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OF THE

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OF

NEW SOUTH WALES

FOR THE YEAR

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(Issued 15th December, 1939.)

CORRIGENDUM.

Paracardiophorus assimilis n. sp., was unfortunately omitted from the table, page 312. Its place therein would be as follows:

8. Hinder pair of maculae round, basal oblong.
   (*a*) Basal maculae wide and oblique .... *fulvosignatus* Cand.
   (*b*) Basal maculae narrow and longitudinal (dumb-bell-like) .... *assimilis*, n. sp.

ANNUAL GENERAL MEETING.

WEDNESDAY, 29th MARCH, 1939.

The Sixty-fourth Annual General Meeting was held in the Society's Rooms, Science House, Gloucester Street, Sydney, on Wednesday, 29th March, 1939.

Mr. T. C. Roughley, B.Sc., F.R.Z.S., President, in the Chair.

The minutes of the preceding Annual General Meeting (30th March, 1938) were read and confirmed.

PRESIDENTIAL ADDRESS.

The concluding part of Volume lxiii of the Society's PROCEEDINGS was issued in December. The complete volume (467 plus lxxx pages, twenty-two plates and 255 text-figures) contains thirty-three papers on a variety of subjects in Natural History.

Exchanges from scientific societies and institutions totalled 1,860 for the session, compared with 2,069, 1,795 and 1,865 for the three preceding years.

Since the last Annual Meeting the names of twelve members have been added to the list, five members and one Corresponding member have been lost by death, the names of five have been removed on account of arrears of subscription and two have resigned.

MARY ELLEN FULLER, who died suddenly at her mother's home in Sydney on 25th September, 1938, had been a member of the Society since 1930. She graduated Bachelor of Science at the University of Sydney in 1929, her final subjects being Botany and Entomology. In January, 1929, she was appointed to the staff of the Division of Economic Entomology of the Council for Scientific and Industrial Research to work at Canberra on the blowfly problem. She continued to work on this problem till her death—first under the late Dr. R. J. Tillyard and later under Dr. I. M. Mackerras. As results of her work on Diptera she published eighteen papers (eleven of them in our PROCEEDINGS) and at the time of her death had completed the material for three more papers.

SARAH HYNES, who died at her home in Randwick on 28th May, 1938, at the age of seventy-eight, was the first woman member of the Society. She became an Associate member in 1892, and in 1909, when women were first admitted to full membership, she became an Ordinary member. Her early education was received in London and Edinburgh, and she was one of the early women graduates at the University of Sydney, where she obtained the degree of Bachelor of Arts in 1891. Her chief scientific interest was botany, and she served for a time on the staff of the Technological Museum and also at the Sydney Botanic Gardens. She was chiefly instrumental in having the Commonwealth Government acquire the collection of paintings of Australian flowers by the late Mrs. Ellis Rowan. She was included in the Honours list in 1934, being made M.B.E.

EDWARD MEYRICK, who died at Marlborough, England, on 31st March, 1938, was born on 24th November, 1854. In December, 1877, he came to Sydney as

Classics Master at Sydney Grammar School. While in Australia he had the opportunity to collect systematically at many localities in New South Wales, and also in Tasmania and Western Australia. He returned to England in 1887 to become Classics Master at Marlborough College, where he remained until he retired in 1914. He was the chief authority on the Microlepidoptera, and bequeathed his collection of about 100,000 specimens to the British Museum of Natural History. He was elected a Fellow of the Royal Society of London in 1904. He had been a Corresponding member of our Society since 1902 and had contributed thirty-two papers to the PROCEEDINGS. Since 1912 he had published privately a journal entitled *Exotic Microlepidoptera*, containing his descriptions of many species of this special group.

LESLIE JOHN WILLIAM NEWMAN, who died at Claremont, Western Australia, on 8th December, 1938, was born in Melbourne in 1878. He had been a member of this Society since 1913. He was appointed an inspector under the Plant Diseases Act in Western Australia in 1904, Assistant Entomologist, Western Australia, in 1908 and Entomologist in 1920, occupying the latter position until his death. He had collected in New South Wales and Victoria as well as in Western Australia, and had published a large number of papers and reports, chiefly in the *Journal of the Department of Agriculture of Western Australia.*

MONTAGU AUSTIN PHILLIPS, who died in England on 11th January, 1939, at the age of fifty-nine years, was a well-known lecturer on Natural History subjects and had for many years been associated with the British Museum of Natural History as a guide-lecturer. He had been a member of this Society since 1921 and was a fellow of a number of the scientific societies in London.

JOHN JAMES WALKER, who died at his home, "Aorangi", Lonsdale Road, Summertown, Oxford, England, on 12th January, 1939, had been a member of the Society since 1900. He paid two visits to Australia, in H.M.S. "*Penguin*" (1890–91), and in H.M.S. "*Ringarooma*" (1900–1904). During these visits he had many opportunities of collecting insects, and has described his experiences in two series of papers in the *Entomologists' Monthly Magazine* (1891–92 and 1905–06).

In May, 1938, the Linnean Society of London celebrated the 150th Anniversary of its foundation, and Professor T. G. B. Osborn represented our Society at the celebrations.

The Australian and New Zealand Association for the Advancement of Science held its jubilee meeting at Canberra in January last, this Society being represented by the President and Mr. H. J. Carter.

In August last, the Australian National Research Council commenced publication of a new journal of general science, the *Australian Journal of Science.* There appears to be some need for such a journal in Australia, and we may offer our best wishes for the success of this new venture.

During the year the Council decided to include each year in its list of nominations of members of Council, the names of two members who have not been members of the Council for the whole of the preceding year. The two members who have retired this year in terms of this resolve are Mr. H. J. Carter and Mr. A. R. Woodhill, and I should like to take this opportunity of expressing our appreciation of Mr. Carter's services to the Society and to the Council over a long period of years. Mr. Woodhill leaves for England shortly for a period of a year and we wish him a pleasant and profitable trip.

The year's work of the Society's research staff may be summarized thus:

Mr. H. L. Jensen, Macleay Bacteriologist to the Society, concluded his work on nitrogen fixation in the wheat soils. Additional soils were tested for content of nitrogen-fixing bacteria, so that the survey is now based on eighty-five soils altogether; five more strains of *Azotobacter* have been tested for nitrogen fixation in pure culture and have, like those previously examined, been found to possess a normal but not outstanding N-fixing capacity; a few other organisms have been tested with a negative result. Further experiments on nitrogen fixation in soil with addition of straw have been conducted over periods of one to three months and have given results in full agreement with those of previous experiments: no nitrogen is fixed unless *Azotobacter* develops abundantly and the decomposition of the organic matter of the straw takes place under conditions of high moisture. It has been shown that with free access of oxygen (i.e. in soil of moderate or low moisture content) only the water-soluble constituents of the straw can serve as food material for *Azotobacter*. Only under conditions that are hardly ever fulfilled in the wheat soils can a gain of about three parts of nitrogen per 1,000 parts of straw be expected. Qualitative tests with a large number of wheat soils have shown that these are practically all too poor in available phosphoric acid to allow a vigorous growth of *Azotobacter*. Certain blue-green algae have again been found capable of fixing elementary nitrogen, but not in quantities that can be considered significant under the conditions obtaining in the wheat fields. A paper giving a full and detailed account of these and the previous experiments on non-symbiotic nitrogen fixation, as well as a discussion of the literature dealing with the importance of this phenomenon under field conditions, has been prepared and submitted to the Society. Preliminary work has been commenced on the isolation of cellulose-decomposing microorganisms in order to test their ability to produce food material for nitrogen-fixing bacteria when growing in association with these.

Miss Elizabeth Pope, Linnean Macleay Fellow of the Society in Zoology, has continued her work on the anatomy of the Port Jackson Shark and has completed a paper on the nervous system. The morphology of the brain and central nervous system have been described in detail and the paths of the main peripheral nerves traced. The organs of special sense were also described, since differences in detail from published accounts were found. Although strictly not part of the nervous system, the histological structure of the pituitary gland was included. Another paper on the blood vascular system is in course of preparation. It should supply the need for an account of this system in the Heterodonti and thus complete the series in which the other groups, namely the Notidani, Scylioidei, Squaliformes and *Raja*, have already been dealt with adequately. The surveys at Long Reef have been continued and as far as possible a list of the larger animals and their habitats and biotic relationships have been recorded. Certain groups of animals will have to be omitted owing to difficulties in determining their names. Some interesting facts have, however, emerged from this work. There are two types of community present on the area. One type is confined to the rocky platform and consists of animals capable of withstanding exposure to all the elements. The other type of community inhabits an area which characteristically consists of small rocks and boulders lying on a substratum of coarse sand. This latter type of community is inhabited by forms which require shelter and which live on the lower surface of the rocks or which burrow in the sand.

Mr. Consett Davis, Linnean Macleay Fellow of the Society in Zoology, has continued work on the Order Embioptera, chiefly on the taxonomic side. Some work has also been done on the bionomics of the Order. One paper on the taxonomy of the genus *Metoligotoma*, and related problems, submitted during the previous year, has been revised and enlarged, and published in the PROCEEDINGS. Further work has been carried out on the ecology of the Five Islands, and the first paper of a series on this subject has been published, with Messrs. M. Day and D. Waterhouse as co-authors. Subsequently, further data have been collected for later papers in this series. By permission of the Council, six weeks were devoted to work on the plant ecology of the Bulli District, the first paper of this series having been published in the PROCEEDINGS in 1936. As a result of this work, concerned mainly with the collection and analysis of soil samples, the data necessary for the compilation of the remaining papers of this series were completed. Mr. Davis was able, by the Council's grant of three months' special leave without pay, to spend some time abroad carrying out research. He worked for some time in the United States and also in England, France and other countries. Research carried out overseas was concerned with a study of the physiology of respiration in aquatic beetles at the University of California, and with the taxonomy of the Order Embioptera from a world standpoint. This latter work consisted chiefly of an examination of the types of inadequately described species, and was carried out chiefly at the Museum of Comparative Zoology, Harvard University; the British Museum of Natural History, London; and the Museum d'Histoire Naturelle, Paris. Type specimens were also obtained from other European museums, and examined at the British Museum, and several collections of unidentified Embioptera were borrowed for further study. In all, some eighty species of exotic Embioptera were examined, mostly from the types.

Mr. A. H. Voisey, Linnean Macleay Fellow of the Society in Geology, continued his geological field work on the Upper Palaeozoic rocks of the North Coast region, particularly in the Upper Clarence and Manning River Districts. A number of reconnaissance trips were carried out. The aim of the work was to describe rocks ranging from Devonian to Tertiary in age and to attempt a correlation between them and other beds in New South Wales and Queensland. Two reports were published which referred to work done in 1937. A third small paper related to rocks in the neighbourhood of Armidale. Four more reports were prepared and are awaiting publication.

Miss Ilma M. Pidgeon, Linnean Macleay Fellow of the Society in Botany, attempted to summarize in one scheme the mosaic of vegetation of the Central Coast of New South Wales, with special reference to the succession of plant communities under various climatic and soil conditions. The succession on sand-dunes has been investigated. One outstanding fact, which has not previously been recorded in the literature, is that the chloride content of dune-soils increases with distance from the sea. This is explained by the fact that the leaching of chlorine ions is minimized by the presence of humus in the soil, and the humus content increases with distance from the sea. Work has been continued on the effects of variation in climate on the structure of forests on sandstone and shale; data for this work are now almost complete. In addition to the ecological work, an investigation was begun on the comparative anatomy and physiology of mature and juvenile leaf-forms of *Eucalyptus globulus*. This problem has proved to be very interesting. The results are briefly summarized: Preliminary anatomical investigations indicate that (i) the two leaf-types differ in internal structure and arrangement of palisade and mesophyll cells; (ii) stomatal index (which is usually constant for a species) is twice as high in the juvenile as in the mature leaves; (iii) stomatal frequency is approximately three times higher in the juvenile leaves. It has been established also that the transpiration rate of mature leaves is greater than that of juvenile leaves. Thus transpiration is not proportional to stomatal frequency. In addition, the ratio of the transpiration rates of the two leaf-types, as measured by potometers, is reversed on the second and third days of the experiment. This indicates that stomatal behaviour is different in the two forms, and this matter is now being investigated. Another interesting fact which has been established, and which hitherto has not been recorded from any leaves, is that there are curious irregularities in the transpiration rate at different places over the surface of individual leaves. Observations of the osmotic pressure of the cell sap, by Barger's method, reveal the fact that the osmotic pressure of the mature leaves is higher than that of the juvenile leaves.

Six applications for Linnean Macleay Fellowships were received in response to the Council's invitation of 28th September, 1938. I have pleasure in reminding you that the Council reappointed Miss Elizabeth C. Pope, Mr. Consett Davis, Mr. A. H. Voisey and Miss Ilma M. Pidgeon to Fellowships in Zoology, Zoology, Geology and Botany respectively for one year from 1st March, 1939. Subsequently Mr. Consett Davis and Mr. A. H. Voisey were appointed to Lectureships in Biology, and Geology and Geography respectively in the New England University College at Armidale, and resigned their Fellowships as from 28th February, 1939. The Council then decided to invite applications for the two vacant Fellowships and three applications were received. I have pleasure in announcing that the Council has appointed Miss D. M. Cumpston, B.Sc., and Miss Valerie May, B.Sc., to Linnean Macleay Fellowships in Entomology and Botany respectively for the period 1st April, 1939, to 29th February, 1940.

Miss Margaret Cumpston graduated in Science in 1938 with First Class Honours in Entomology, and was awarded a Science Research Scholarship in the University of Sydney. For her honours degree she presented a thesis on the biology and larval morphology of the genus *Paropsis*, which added very considerably to our knowledge of the genus, and whilst holding the Research Scholarship she has done similar work on the family Scarabaeidae, her results now having been submitted for the M.Sc. degree.

Miss Valerie May graduated in Science in 1937 with First Class Honours in Botany, having been placed first in Botany in all four years during her University course. She then, for 1937–38, was awarded a Science Research Scholarship, and for 1938–39 a Commonwealth Research Scholarship. She has worked on the Marine Algae of New South Wales, having prepared for publication keys to the Chlorophyceae and Melanophyceae. She has also described an albino form of *Macrozamia spiralis*, and has in preparation papers on the distribution of Mistletoe in New South Wales, and the life-history of *Ectocarpus confervoides*.

During the coming year Miss Pope and Miss Pidgeon will continue the researches already commenced, Miss Cumpston will conduct investigations on species of larval Scarabaeidae, and Miss May will study drought-resistance of plants in New South Wales. We wish all four a very successful tenure of their Fellowships. We also offer our congratulations to Messrs. Consett Davis and Voisey on their appointments to the New England University College, and wish them every success in their new sphere.

A Review of the Scientific Investigation of the Fisheries of New South Wales.

In choosing this subject for my Presidential Address I was guided by the fact that Australia is now embarking on a new era of scientific investigation of the fisheries. At Fisheries Conferences held in Melbourne in 1927 and in Sydney in 1929, at which all States of the Commonwealth were represented, a strong recommendation was made that the Commonwealth Government establish a Department of Fisheries for the purpose of investigating the potentialities of the Australian coast for fisheries development. In 1937 the Commonwealth Government announced that a sum of £80,000 was being set aside for investigation work of this character, and the control of the investigation was placed in the hands of the Council for Scientific and Industrial Research. A boat, the "*Warreen*", suitable for various types of fishing, but more especially for the capture of pelagic fish, was constructed, and Dr. Harold Thompson was brought from Newfoundland to take charge of the investigations.

With a suitable boat, and a staff capable of handling the large-scale investigations which confront our fisheries, we are at the beginning of a period of activity the like of which has never before been known in our history. The time appeared opportune, then, to take stock of the scientific work that has already been accomplished, and I have therefore endeavoured to present in this address a brief outline of the essential features of these investigations.

The volume of this scientific research is singularly small. Much work of a general nature, based on observations that all too frequently cannot be regarded as critical, has been published, but, lacking a strictly scientific foundation, it can scarcely be considered as coming within the range of this discussion. In sorting over the great amount of literature that has appeared on our fisheries, I have been guided in my choice largely, but not solely, by the consideration of whether it has been published in scientific journals. Of course, taxonomic investigation, in which field great activity has been displayed over a long period of years by a number of capable workers, does not fall within the scope of the subject of my address.

Small as is the scientific work on the fisheries of New South Wales, it is far smaller in the other States, and little of importance has been accomplished there. This will be remedied to some extent by the Commonwealth investigations recently inaugurated, for, although the base of operations has been established at Port Hacking, near Sydney, the field will embrace all States. It is probable that the most intensive work will be directed to the waters adjacent to the areas of densest population, for the problem of marketing fish over long distances in a warm climate is one that must be weighed in any plan of economic exploitation.

Trawling Investigations.

Until 1915 the only methods used for the capture of bottom-dwelling fishes offshore, not only in New South Wales, but in all the other States, consisted of hand-lines and long-lines. Now, in the principal fisheries of the northern hemisphere these methods of fishing had been largely replaced by trawlers, which, dragging a large net over the bottom, caught fish in much greater quantities and far more economically. Concerning the economic possibilities of trawlers operating on the Australian coast there had long been a division of opinion, and although several attempts, dating back as far as 1857, had been made to test the offshore waters in various localities, the results obtained were so conflicting, owing to the unsuitability of both vessels and gear, that little information of value was obtained. In 1907, however, the Commonwealth Government decided to make a thorough survey of the possibilities of trawling on the Australian coast by means of an investigation trawler. This trawler, the "*Endeavour*", was constructed at the New South Wales Government dockyards at Newcastle and was placed in commission on the 9th March, 1909, with H. C. Dannevig in charge of the investigations.

The principal objects of the investigation were: (1) by various means of capture to ascertain what marketable food-fishes may be obtained in the ocean waters adjacent to Australia; (2) in what quantity they may be taken; (3) to what extent they migrate, and where; (4) how they may conveniently and economically be captured; and (5) by systematic survey to discover and chart suitable fishing grounds.

The Commonwealth Investigation Trawler carried out this survey from 9th March, 1909, to December, 1914, when she was lost with all hands while returning from a cruise to Macquarie Island. It was discovered that two extensive areas carried fish in payable quantities, one on the south-east coast, the other in the Great Australian Bight. The former was found to extend from near Port Stephens in New South Wales southwards to Gabo Island, and to continue across the eastern slope of Bass Strait, past Flinders Island to Tasmania. It covered approximately 6,000 square miles within easy access to Sydney and Melbourne. The other ground was found to lie along the edge of the continental shelf in the Great Australian Bight and to cover an area of 4,000 square miles, the depth varying from 80 to 300 fathoms, although the greater portion is situated between 100 and 200 fathoms. This ground is about two days' steaming from Adelaide and Albany. Although great hopes had been entertained that the extensive area of bottom in Bass Strait would prove to be a rich trawling ground, the "*Endeavour*" found that only limited portions carried fish in payable quantities.

It was seen that the "*Endeavour's*" catches compared favourably with the average catches obtained in the North Sea by commercial vessels of modern type and working in accordance with long-established experience of the movements of the fish.

The Sydney–Gabo Island section was examined during whole or part of sixteen different cruises at intervals between April, 1909, and August, 1913. During this period the trawl was on the bottom for 228¼ hours, and produced a total of 84,721 lb. of marketable fish, or at the rate of 371 lb. per hour of fishing.

The area south of Gabo Island, including the eastern slope and Flinders Island, was visited during twenty-three cruises over the same period, the actual trawling time occupying 432½ hours, and the total catch of marketable fish amounted to 81,715 lb., or an average of 189 lb. per hour of fishing.

In the Great Australian Bight, five cruises were devoted to an examination of the edge of the continental shelf, two during February and March, 1912, and the other three between February and April, 1913. The net was fishing for 144 hours, and landed 29,232 lb. of marketable fish, the average being 203 lb. per hour of fishing. The deeper section of the Bight was examined during three cruises in May and June, 1913, when the actual fishing time occupied 122 hours, and the catch of marketable fish amounted to 13,939 lb., at an average rate of 118 lb. per hour.

As Dannevig (1913) pointed out, it was to be reasonably expected that a commercial trawler would obtain results which would considerably exceed the catches of the "*Endeavour*", for this vessel had to cover as much ground as possible consistent with systematic work; and frequently she had to leave rich grounds and proceed to others which were either quite unexplored or which previous experience indicated were likely to be inferior. A commercial trawler would, however, remain on a rich ground and revisit it as long as the catches proved to be good.

Thus the "*Endeavour*", under the capable direction of Dannevig, was able to establish beyond doubt that rich trawling grounds existed on at least two areas of the Australian coast, and the New South Wales Government decided to exploit them commercially. Now, the commercial development of trawling scarcely comes within the scope of this address, but in view of the unexpected decline in productiveness of the trawling grounds on the south-eastern Australian coast during recent years, a brief review of the trawling industry seems fairly warranted.

In May, 1915, the New South Wales Government initiated commercial trawling with three modern steam trawlers, and began at once to reap a rich harvest. In 1919 a larger trawler was launched from the Government dockyards at Newcastle; this was intended both for trawling and investigational work, and was shortly afterwards sold to the Queensland Government; but in these northern waters she worked with so little success that in 1922 she was sold and returned to New South Wales. In 1920 four more steel trawlers and a fish-carrier were commissioned from Newcastle. But in spite of the fact that consistently good hauls were obtained and there was a satisfactory demand for the fish, the State Government, facing a loss of £330,000 since the beginning of the industry, decided in 1923 to cease commercial trawling.

The vessels were purchased by private firms and individuals, and under their new management returned a considerable profit to their owners. In 1928 the fleet had increased to nineteen, but, beginning in 1926, the productiveness of those grounds nearest to Sydney fell away alarmingly, forcing the trawlers further afield and increasing their operating costs considerably. It was at first thought that this decline might be only temporary, perhaps a seasonal fluctuation, but unfortunately it has been maintained to the present day, and the number of trawlers operating has been reduced to fifteen. Here we shall leave them for a moment, but we shall have occasion to discuss in greater detail certain features of this decline when reviewing an investigation of the most important fish yielded by them.

The Productivity of the Sea.

In 1929 Professor W. J. Dakin was appointed to the chair of zoology in the University of Sydney, and he at once planned to conduct research into marine biological problems, with special reference to the fisheries.

Up to this time research into the fisheries of New South Wales had, as we have seen, consisted for the most part of observations on the adult fishes, their seasonal migrations, spawning habits, their food as indicated by the contents of their stomachs, and the best methods of catching them. But practically no work had been done on the more fundamental problems, such as why they migrated seasonally, the reason for their fluctuating numbers, their young stages from the egg to the post-larva, their age at various sizes and their rate of growth. With the exception of the last-mentioned, such problems cannot be solved by a study of the adult fishes. For instance, if the catch of a certain species of edible fish suddenly drops to a low level at a period when it may be expected from previous experience to be much more abundant, it will probably be found quite useless to study the conditions that obtain in the waters of its occurrence during the season when the low returns were actually noted; rather must the reason be sought for much earlier. Perhaps certain biological, physical or chemical conditions of the water militated against a heavy spawning, or were so unfavourable during the early stages after hatching that relatively few survived. But we cannot investigate these questions at the time the actual paucity of fish is noticed, at a time, in other words, when they have reached a size which warrants their capture for market; they can be solved only by an investigation when the unfavourable conditions themselves obtained, perhaps four or five years earlier. If, for instance, it is found that there is a lack of sufficient food for the vast population of these young fish, or, perhaps, that one of the many other conditions that influence the rate of survival is adverse at this critical period, the number that can possibly survive will necessarily be restricted, and it will be known long before these fish are taken in the fishermen's nets that the catch will be a poor one. Indeed, as the result of continuous research along these lines in the North Sea, it has been found possible with some species of fish to predict with reasonable certainty the extent of the probable catches for some seasons ahead.

Clearly, therefore, much light has been thrown on the fundamental problems of the productivity of the sea in European waters, and it will help us who face similar problems in the waters of Australia, if we are familiar with the knowledge gained there. On account of its great productivity over a long period and its proximity to scientific marine laboratories, the North Sea and the English Channel have received most study, and I therefore propose to summarize one aspect, probably the most important aspect, of the discoveries that have been made in that region.

We shall have much to say about the plankton, and it is therefore advisable that we understand clearly just what the plankton is. It consists of a great drifting community of plant and animal life, most of it microscopic. The plant life of this community is known as the phytoplankton, and the animal life as the zooplankton.

In the English Channel and the North Sea, during the early months of the year, March and April (spring in Europe), when the strength of the light is increasing, a great change in the plankton occurs. The phytoplankton increases enormously. Now, these microscopic plants form the food of a host of marine animals, and with such an abundant food supply available, these animals in turn multiply greatly; so greatly, indeed, that the supply of plant life cannot long stand up to the strain, and by May or June it is found to have diminished very strikingly. It has not only maintained the animal life that swarms at the surface, but much of it has also fallen to the bottom, where it is consumed by the animal communities that favour that environment. It has served the purpose of developing a great, a new animal plankton which continues to survive during the summer period of diminished plant life by warring amongst itself, the larger forms preying on the smaller.

In the autumn, about October, there is another outburst of plant life, but never so great as in the spring, and then follows, during the winter months, a period when the plankton is at its very lowest, but always with sufficient of all forms surviving to give birth to the great increase characteristic of the spring months.

The abundance of these forms of life in the plankton determines the ultimate productivity of the sea. The phytoplankton provides food for the zooplankton, the smaller forms of which are consumed by the larger, which in turn provide food for the small fishes and other marine creatures adapted to consuming them, and these in their turn fall a prey to the larger fishes that provide a diet for man. If, then, there were no phytoplankton in the sea, there would be no fishes for man to harvest. A knowledge of the seasonal abundance of the plankton is, therefore, a fundamental necessity before the abundance or scarcity of the fishes can be understood.

But we have not yet gone back to the very beginning, for it is necessary that we know the causes of the fluctuations of the plankton and the succession of life in the sea. This problem, too, has received careful study by European scientists during recent years and much light has been thrown on it.

The plant life, which, as we have seen, forms the basis of the food of the animal life of the sea, is dependent for its existence on the nutrient salts contained in sea water, and on the strength of the light which will enable it to use these salts for the storage of nourishment in its tissues. If, therefore, these forms of nourishment in solution are not constant, and if the light varies in its intensity, we should expect to find the plant life of the plankton to vary accordingly. And this is just what has been found to occur.

Of the many constituents of sea water the phosphates and the nitrates have been found to play, more than any others, a determining role in regulating the quantity of plant life that may develop in the sea. In the North Sea these salts are present in greatest quantities during the winter months and up to the beginning of March. It is in March, as we have seen, that the great outburst of plant life occurs; why, then, if the requisite nutrient salts were abundant during the winter, did it not develop then? It is here that the intensity of the light plays its part. During the winter the days in the North Sea are short and the intensity of the light at its poorest, so poor in fact that the plant life in the plankton is unable to avail itself of the salts at its disposal. As the days lengthen and the light increases, more and more of these salts can be absorbed and thus it is that the great outburst occurs in the spring. So great a toll is taken of the available salts that they are quickly used up and within about a month or six weeks little remains, and the further increase of the plant life is inhibited. It does not remain stationary, however, for much of it perishes for lack of further nutriment, and great quantities are consumed by the animal life of the plankton which, too, has developed enormously as the result of the abundant food supply the plant life has provided.

But we still have the increase of plant life in the autumn to account for. The heat of the sun's rays during the summer has caused a rise in temperature of the surface waters, but not in the deeper layers, and while the nutrient salts have been used up at the surface, they have been maintained in the deeper layers by the large quantities of animals that have died at the surface and fallen to the bottom. It is not till the autumn, however, when the surface waters cool down, that the two layers are able to mix, and this is aided considerably by the gales that are common in the North Sea during that season. And so the surface layers are replenished with nitrates and phosphates in sufficient quantities to allow of another marked outburst of plant life.

Plankton Fluctuations in New South Wales Waters.

That, in brief, is the story that has unfolded itself after many years of research by a considerable number of marine biologists and chemists. But how far has our knowledge of these fundamental data progressed in Australia? What is the nature of the plankton in the seas washing our coast? In what way, both in the types to be found here and in their seasonal abundance, does this plankton differ from that of European waters? Is there a great seasonal fluctuation such as has been found to be a characteristic feature of the plankton of the North Sea? Concerning these questions we in Australia knew practically nothing, and it was these and related problems that Dakin set about to investigate, for a knowledge of them will enable us to explain the natural fluctuations of the fish in the sea, and will help us to account for the migrations that many of these fish undertake periodically. But these migrations may be very extensive; they may extend in some cases from the waters of Tasmania, cooled by an antarctic current, to those of Queensland, warmed by a tropical current from the north. A complete understanding of these movements will therefore be gained only if the conditions throughout the range of the migration be understood, and this would involve continuous work at a series of stations from Tasmania to Queensland. Dakin had to limit the sphere of his activities practically to one restricted area, in the vicinity of Sydney; even then it was a giant's task for one investigator to undertake, and it was rendered all the more difficult by the lack of a boat which would allow of the work being carried out in reasonable comfort. Nevertheless, in the comparatively short time of ten years he has succeeded in throwing much light on the problems he set about to solve.

An area, four miles east of North Head, Port Jackson, was chosen for the investigation, and efforts were made to reach this spot at fortnightly intervals, at or about the hour of high water, and at about the same time of day on each occasion. The period of high water was chosen to ensure that the water where the investigations were to be carried out would not be contaminated by the water flowing from Sydney Harbour on the ebb tide.

After two years' work, Dakin (1931) was able to announce that the catches of plankton were very uniform compared with the seasonal variations of those of the North Atlantic. But there were variations, nevertheless, both in quality and quantity, and the regular hauls of plankton over this period at last enabled a comparison to be made with the catches in other waters. For two years two nets had been towed twice a week in the Irish Sea, the average plankton catch being 14 c.c. Two similar nets towed each fortnight in the sea off Sydney Harbour gave an average of only 4 c.c., and Dakin pertinently asks if this is a measure of the relative productivity of the two regions in fish food.

In a conjoint paper published in these PROCEEDINGS, Dakin and Colefax (1933), working in the area previously selected by Dakin, discussed the species of diatoms most prominent in their catches; they found that at this station they consisted of the usual admixture of oceanic and neritic species, which might be expected within the vicinity of a continental shelf and the open ocean, with, as usual, only a few species quantitatively of great significance. All the important species were found to be well-known types, those predominating belonging to the genera *Chaetoceras*, *Asterionella*, and *Thalassiosira*, which have a wide distribution in the seas of the northern hemisphere. With few exceptions, however, they were recorded from Australian waters for the first time. While peculiarly Antarctic species played little part in their catches, there was found to be an admixture of temperate and tropical types.

Quantitatively, these authors confirmed Dakin's previous conclusion that the changes in volume of the diatom catches during the year east of Sydney is nothing like so marked as it is in certain colder seas. Seasonal variations were scarcely obvious from inspections of the nets, and it was not until their enumerations were complete that a picture of diatom change directly comparable with that of northern seas became clear, the net result being a curve representing the rise and fall in the quantity of the plant plankton, with a peak in early spring and another smaller one in late autumn. There is, therefore, a striking similarity with the plankton rhythm of European seas, and this was the first time a rhythm of this kind had been discovered in the southern hemisphere. The abundance of planktonic algae in spring is nothing like so great as in the colder waters about Britain, but it is nevertheless quite marked, though it is relatively earlier than in British seas.

An analysis was also made of the animal plankton, and a clear indication was obtained that the chief constituents of the zooplankton have their maxima just after those of the phytoplankton. Thus the zooplankton presents a maximum in the summer, with peaks in the early summer (November to December) and another in autumn. The zooplankton maxima were found to be due principally to Copepoda and Cladocera.

Fish Eggs in the Plankton.

During these investigations, also, Dakin and Colefax discovered eggs of several species of fish in considerable abundance. Anchovy eggs, distinctive on account of their elliptical shape and characteristically segmented yolk, were found in large numbers in January, 1931, and in November of that year they again began to appear and remained in the catches till January, 1932, although in January they were not found in large numbers. Eggs of two different sizes, but very striking on account of a vitelline membrane with a distinct blue tinge, a relatively large perivitelline space and a segmented yolk, were found in great abundance between June and August, 1931. These were thought to be clupeid eggs, possibly those of *Sardinops neopilchardus*, the common pilchard of New South Wales waters. From January to April, 1932, eggs of several unknown species of fish also occurred in considerable numbers, the peak being reached in March.

In March the following year Dakin and Colefax (1934) were able to state definitely that these "blue" eggs were actually those of the Australian pilchard, for early stages from those newly hatched to young fish up to 28 mm. in length were obtained, and these allowed of a definite determination being made. The eggs were abundant in three successive years during the months of June, July and August. Actually, in 1933 the eggs were first found in the catches late in May. Special efforts were then made to obtain later and later larval stages, and in this great success was attained until, at the beginning of August, they disappeared. The eggs range from 1·27 mm. to 1·5 mm. in diameter, the average being 1·44 mm. The bluish tinge previously noted is purely optical and not due to the presence of pigment; it disappears when the membrane is dissected away from the egg. A single oil globule is present as in the European and Japanese pilchard eggs. In addition to these characters of the egg, the authors describe in detail those of the young fish till it reaches a length of 28 mm.

The number of eggs and larvae captured was at times considerable. For instance, in a net of cheese cloth with a circular mouth three feet in diameter and towed only for ten minutes near the surface, 406 eggs of *S. neopilchardus* were obtained on 18th July, 1931, and over a thousand in a similar haul on 21st June of that year.

This was a very important discovery, for, although it has been known for a long time that pilchards may be found to occur on the eastern Australian and Tasmanian coasts in great quantities, there are very few reliable records of the season of their occurrence, for satisfactory identification of the actual species comprising the shoals has all too frequently not been obtained. If a shoal of small fishes is seen breaking the surface of the water, it is usually assumed that they are pilchards, whereas in many cases a more critical examination of actual specimens might possibly have disclosed that they were sprats, anchovies, maray, or perhaps herrings. There has been a good deal of evidence, however, to show that pilchards do occur on the New South Wales coast during the winter months, and the finding of the eggs and the early stages of the young fish at that period during three successive years is not only a striking confirmation of these observations, but it has the additional importance that in the area of these investigations, from Port Stephens on the north to Port Hacking on the south at least, the fish were spawning at that time.

Further investigations by Dakin (1937) indicated that the spawning of the pilchard on the coast of New South Wales occurs over a much longer period than was indicated previously, for small pilchard larvae varying between 8 and 20 mm. in length were taken in the months from April to November. Large numbers of eggs were obtained at Port Hacking at the beginning of May, and some very large catches were made off Broken Bay in October. Since, however, larvae were obtained in April, it may be assumed that some spawning takes place in February, and Dakin suggests that possibly eggs may be taken in every month of the year. The largest catches made to date, however, were obtained during May, July and October.

In this paper, also, the occurrence of pilchards at the entrance to Broken Bay was recorded for four consecutive weeks in May, 1935, and in the same locality in July, 1937. Shoals of maray were seen and captured at the entrance of Sydney Harbour in August, 1937, and sandy sprats about the same locality in June, while freshwater herring in full roe were marketed from the freshwater reaches of the Clarence River in July, 1937.

Physical and Chemical Conditions of the Sea Water.

In 1935, Dakin and Colefax published some observations on the seasonal changes in temperature, salinity, phosphates, nitrate nitrogen and oxygen of the ocean waters on the continental shelf of New South Wales and their relationship to plankton production. The records were obtained at the same station as previously, about four miles east of North Head, Sydney Harbour.

The total range of temperature variation of the surface water was found to be only about 7° C., the average range at a depth of 30 fathoms being still less. The highest temperatures reached are usually between 22° and 23° C. and occur in February and March. The lowest surface temperatures, 15°–16° C., occur in August and September. During the period that the temperature is at its lowest the water at the surface and the bottom is almost at the same temperature, while from the date in spring when the surface waters begin to rise in temperature the difference between the surface and the bottom becomes more and more pronounced. The condition in summer will therefore hinder any rapid regeneration of nitrate and phosphate supplies if these substances are exhausted in the surface waters by the activity of the plankton, for the pronounced "layering" will tend to prevent supplies passing upwards from the sea bottom. Abnormal weather conditions may, however, on the continental shelf, bring about a temporary destruction of the summer conditions.

At this station the water had an average salinity of approximately 35·5‰, the extremes on the surface in 1933 being 35·80‰ and 35·36‰. No seasonal rhythm was apparent.

The phosphate content was found on the whole to be very stable throughout the year; there are variations, but the average during the summer is not appreciably less than during the winter, and at the surface it varies between about 15 and 25 milligrams of P_2O_5 per cubic metre. On the whole, the coastal water of

New South Wales approximates somewhat to the English Channel conditions, but without the exhaustion of P_2O_5 in the summer. A seasonal cycle is therefore not pronounced. There are, nevertheless, some important variations, but they are usually of brief duration; for instance, the phosphate content was almost down to zero during the whole month of September and the first week of October, 1934. The plankton catches provided a striking confirmation of the theories advanced in Europe to explain the variation in nitrate and phosphate content of the surface waters of the sea during the year, for they showed that the phosphate content never went down to zero without there being an unusual (for this place) development of diatoms.

Notwithstanding the fact, however, that a large outburst of phytoplankton will bring down the phosphate content of our coastal waters to zero, this condition does not continue for the long season noted in British waters. On occasions in 1933, when the phosphate in the surface waters was reduced to a trace, it was again normal ten days or so afterwards. After the spring diatom maximum in September, 1934, the phosphates were down to zero for about three weeks. Regeneration from deeper waters then resulted in the amount rising to 20 mg. per cubic metre, and this figure was maintained during the summer.

While, therefore, the presence of large numbers of diatoms and other phytoplanktonic organisms may reduce the phosphate content of our waters, it cannot be said that the spring or autumn maxima of the phytoplankton are dependent upon the phosphates gradually attaining a maximum. Phosphate has been available in sufficient quantity for two or three months before the spring plankton maximum, and it is also present during the greater part of the summer.

The rapid regeneration of phosphate in the surface waters after the diminution in the speed of plant production may be accounted for by the quantity present in deeper water. On all occasions in 1933 when the surface phosphate was reduced to zero, it was never less than 13 mg. per cubic metre at 50 feet, and was between 20 and 38 mg. per cubic metre at 150 feet.

Dakin and Colefax also found that in New South Wales waters there are fluctuations in the nitrate nitrogen content of the sea which can be correlated quite clearly with fluctuations in the productivity of the sea in plankton. But here, too, it was found that the seasonal changes are not nearly of such amplitude as those of the English Channel. Of special interest, however, is the discovery that the nitrogen content is apparently much more sensitive to the reproduction of the phytoplankton than is the phosphate.

In the spring of both 1933 and 1934 the nitrate nitrogen was reduced to zero, and on both occasions the reduction was accompanied by a great diatom outburst. During 1934 the concentration of the nitrate nitrogen in the surface water remained below 10 mg. per cubic metre for practically the whole of the summer.

Trawled Flathead.

Of all the species of fish marketed in New South Wales the tiger flathead (*Neoplatycephalus macrodon*) taken in the nets of the trawlers is the most abundant; it may also be regarded as the most important. We have seen that commercial trawling was initiated in New South Wales in 1915 when three trawlers began operations. From the beginning the predominant fish caught was the tiger flathead, which rapidly replaced the sea mullet (*Mugil dobula*) as the species marketed in greatest abundance in New South Wales. The trawling grounds exploited in the early years of the industry extended from Newcastle to Cape Howe, although only circumscribed areas of sea bottom were fished. For several years the grounds situated nearest to Sydney, particularly that lying north-east of Sydney Harbour and that extending some distance north and south of Botany Bay, which are usually referred to as the "Home Grounds", were found to yield great quantities of flathead every year between early September and the beginning of December or at times a little later. Then in 1926 these grounds failed to produce their customary supplies and the trawlers were forced further afield during that period. Unfortunately, this proved to be not an isolated experience, for these grounds, so prolific in their yield for about eleven years, have remained poor right to the present day.

During these early days of the industry it was found, also, that the "southern" grounds situated in the Eden–Green Cape area, produced fish in prolific quantities during the period from January to July, but these grounds, too, deteriorated, not only in their production of flathead, but of all other classes of fish, which formerly were found in great abundance. The trawlers were consequently forced still further afield, and in 1929 the grounds discovered by the "*Endeavour*" off Cape Everard in Victoria and east of Flinders Island were explored. These were found to yield rich hauls and an intensive fishery was conducted there, but their subsequent history was little different from that of the grounds previously worked, and in the course of a few years their yield showed a marked decline.

Now, as the trawlers were forced further and further away from their base, the operating costs mounted considerably; the cruises, which originally lasted from three to six days, were now occupying from seven to ten days, involving a much heavier consumption of coal, an increased wages bill and the provision of much greater quantities of ice. Moreover, there has been a considerable decline in the hourly yield of both flathead and other fish.

What has happened? When we come to reflect that the trawling grounds in European waters, such as those of the North Sea, which, although they have shown a decline in productiveness, have withstood a fishery extending over several generations with a far greater number of trawlers operating, the much more rapid decline in the yield of the New South Wales trawling grounds gives much food for thought. It must be realized, however, that the total area of the grounds worked by the New South Wales trawlers embraces about 6,000 square miles, while those of the North Sea embrace about 130,000 square miles. Have our trawlers, confined to a very restricted area, removed fish from our waters at a greater rate than they can withstand? An excellent comparison between the rate of catch here and that of the Irish Sea has been made by Dakin (1931), who stated: "The present New South Wales grounds all added together are only about two-thirds of the Irish Sea—the area of water between Ireland and England—and this from the point of view of steam trawling is nothing more than a huge lake. Discussions are frequent in Europe on the impoverishment of the Irish Sea and North Sea owing to the enormous fishing. Well, we have removed from our coastal area, in one year by trawling alone, four times the catch that the Irish Sea has provided in the same time with its far more boats and men."

Are the fish caught by the New South Wales trawlers more susceptible to overfishing than those of European waters? If so, how can we stay the decline? Can we restore the grounds to the level of their former productiveness? Those are the vital questions facing the trawling industry today, but before we can hope to solve them we must know much more about the natural history of the various fish comprising the catches than we do at present.

On account of the great economic importance of this branch of our fisheries, and because of the fact, too, that we knew practically nothing of the habits of the fish, such as the flathead, that formed the basis of the industry, A. N. Colefax decided in 1930 to devote considerable attention to the study of trawled fish, with particular reference to the flathead, the most important species caught. The results of this investigation were published in this Society's PROCEEDINGS in 1934 when the distribution, supply and length statistics were discussed, and in 1938 when its feeding and breeding habits were described.

Beginning in 1930, Colefax made thirteen cruises in trawlers over a period of twelve months, the length of trip varying from seven to nine days. Practically all of the trawling grounds were visited at least once, and in some cases several visits were made. He found that the decline in the yield of "mixed" fish is one of the most important changes that have occurred during the later years of the industry. The average hourly catch for the year 1930 was found to be 2·97 cwt. only, compared with 4·56 cwt. during 1921 and 4·68 cwt. during 1922. This decline was even greater than the figures indicate, for fishing operations were conducted in 1930 with much increased efficiency, and an improved form of otter trawl (the Vigneron-Dahl) was in use. Reducing the production figures to curves, Colefax found that perhaps the most striking feature of the 1930 curve for all species, flathead included, apart from the general low level of the catches, was its "flatness" when compared with corresponding curves for, say, 1921 or 1922. This was due to the almost entire disappearance of fish from the Botany area, and the considerable decline in the yield of the southern grounds.

Length measurements of the flathead, as they occurred in the hauls, were conducted with several objects in view. Firstly, as Colefax states, it is well known that if taken over a sufficiently long period at different seasons and without artificial selection of the samples, they may present a picture of size classes which may be used for the determination of age. The distribution of size classes can be used for the discovery of migratory movements of the fish, and, finally, comparative treatments of length measurements may give valuable information regarding over-fishing.

In waters where the range of temperature between summer and winter is more marked than it is in New South Wales, the growth-rate during those seasons frequently shows itself in the form of well-defined bands on the scales, and in the uneven development of the otoliths, opercular bones and vertebrae, so that the age of a fish can be readily determined by a study of those parts. In the more equable waters of New South Wales, however, the growth-rate of the fish appears to be much more regular; the secondary indications on the scales are not nearly so clearly delineated, and the age of the fish cannot usually be determined with the same degree of certainty. Recent experiments by Professor Dakin in the grinding down of the otoliths give promise, however, of throwing much light on this question.

Another very valuable method, which not only gives an accurate picture of the growth-rate over a certain period, but also gives an indication of the migration of fish, is that of tagging them when caught and immediately liberating them. This method is scarcely open to an investigator working on board a commercial trawler, for the reason that most of the fish when brought to the surface are dead. It should have practicable application, however, on a boat using a Danish seine net, in which most of the fish are brought up alive, and this should be kept in mind in subsequent investigations of this nature.

The measurements of some 35,000 flathead were taken by Colefax during a series of monthly cruises, the period ranging from March, 1930, to April, 1931, and over an area of coast extending from Port Stephens to Cape Everard. It was found that four age groups were readily distinguishable, the first being represented by fish 24 cm. in length, the second by fish 30–36 cm., with a tendency to predominance at 31–33 cm., the third mainly by fish of 42 cm., the range being 41–44 cm., and the fourth by fish of 54 cm. in length. But a serious discrepancy was found inasmuch as flathead less than 20 cm. were not taken in numbers, so that data regarding the sizes from 1 to 20 cm. are entirely lacking. The intervals between these "peaks" are approximately equal, about 8–10 cm., and it is reasonable to assume that they correspond with four age groups. If, therefore, the period from 1 to 20 cm. be denoted by the symbol "x" years, then the ages of the succeeding groups are x + 1, x + 2, and x + 3 years respeetively.

It was also found that there is a tendency for the flathead of one age group to remain on the same ground for long periods, and for the fish to move about in age groups, while on two occasions the study of the measurements of the fish indicated important migratory movements.

In his investigations of the feeding habits of the tiger flathead, Colefax (1938) found abundant confirmation of the experience of the men engaged in trawling that only on rare occasions can flathead be caught after dark. It has become the custom for the trawlers to fish up till about 7 p.m. and then cease operations until the following morning, though heavy catches of flathead have been taken on occasions during the night, indicating that the fish do not always leave the bottom. This migration from the bottom towards the surface at night is apparently correlated with the feeding habits of the fish, for the contents of the stomachs examined indicated that it preys extensively on the Euphausid, *Nyctiphanes australis*, the stomachs of even the largest individuals being frequently found distended with this small crustacean, while some of the remaining food-types were found to be mid-water or even surface-swimming forms.

Gut samples were taken on each cruise over a period of some fifteen months from practically every fishing ground along the coast. For all sizes of flathead the most common constituent is fish (51·2%), followed by crustaceans (25%). Of the fish, *Apogonops anomalus* is consumed in greatest numbers, comprising 36·4% of the total. This is quite a small fish, seldom exceeding five inches in length, and it must be very abundant on the trawling grounds at times, for considerable quantities are occasionally brought up in the nets, in spite of their wide mesh. The most abundant crustacean found in the flathead's stomach was *Nyctiphanes australis*, which constituted 60% of the whole of the crustaceans consumed. It was found that the flathead tends to change its diet as it becomes larger, the proportion of fish consumed increasing with the size of the flathead.

On account of the great prominence of *Apogonops* in the diet of the flathead, considerable attention was paid to the diet of this small fish, and it was found that the main item consisted of copepods (76%), followed by *Nyctiphanes* larvae (26·3%), *Nyctiphanes* (13·1%), with a smaller percentage of bottom mud and unrecognizable debris. It is in part, therefore, a plankton feeder, and this suggests that the flathead may pursue it into the upper layers of the water.

Colefax also found that the smaller sizes of flathead tend to occur in the shallow water near the coast, while hauls made in deeper water provided individuals of a larger average size, and he found evidence that would appear to indicate that this is largely due to the marked difference in the types of food available in those regions.

Coming now to the breeding habits of the flathead, it was found that the first definite indication of the breeding season occurs in September, although as early as July the ovaries may show signs of development. Breeding extends almost to the end of summer, but the actual breeding grounds were not discovered, for only about a half-dozen really ripe females were seen amongst thousands of fish examined, and spent females were also scarce, this presumably indicating that the flathead were not spawning on the actual fishing grounds. The northern flathead were found to spawn earlier than those on the southern grounds, the spawning period in the north terminating about the middle of December. It was determined also that the tiger flathead produces up to two and a half million eggs in one season.

The smallest flathead examined with partially ripe ovaries measured 30 cm. (11·8 inches) in length. This is interesting in view of the fact that the minimum lawful size for the sale of this fish is 13 inches. The smallest sexually mature male examined was 23 cm. in length, 10 cm. shorter than the smallest female. There appears to be a size dimorphism in the two sexes and a probability that the females mature more slowly.

The Life History of New South Wales Prawns.

The prawn industry of New South Wales is one of considerable economic importance, the value of the yield averaging about £38,000 annually, an unusually high figure being recorded in 1931, when the quantity obtained amounted to 1,537,420 lb., valued at £76,871. Yet, although a good deal was known about the habits of our commercial prawns in the adult stage, practically nothing was known until the last few years about their breeding habits, a knowledge of which is essential before sound measures can be applied towards their conservation.

Actually, there are two principal commercial species in New South Wales waters, one known as the king prawn (*Penaeus plebejus*), the other as the school prawn (*Penaeopsis macleayi*). The habits of the adults of both species are very similar. They are found in estuaries and so-called lakes, which usually have a narrow outlet to the sea, and are caught in greatest abundance as they make a mass migration to the sea during the period after full moon, before the moon actually rises, when the nights are at their darkest.

But why this migration to the sea? Although it was assumed in some quarters that they were making to the sea to spawn, they were rarely found with roe, and most fishermen were firmly of the opinion, without any real evidence, however, to support it, that spawning took place in the estuaries. On account of the importance of the fishery, and in an effort to establish beyond doubt the breeding place of these prawns, Professor Dakin included this investigation in his programme, concentrating his attention on the king prawn.

Dakin (1935) found that in Port Jackson the only time when king prawns were taken with well developed roes was in late summer, and they were always located near the entrance. But always when large king prawns were obtained from the ocean (these were brought up in the trawl nets) the gonads were well developed. Early larval stages of king prawns were obtained in plankton nets at sea, but never in the estuaries and lakes, and this was regarded as reasonable evidence that this prawn, at least, spawns at sea.

Continuing this work, Dakin (1938) was able to obtain sufficient evidence to establish this without any possible doubt. So far he has not located the eggs and the very earliest stage of the newly hatched young, the nauplii, but the capture of an almost complete series beyond those stages has enabled a fairly full picture to be presented.

The evidence from the plankton collections indicates that this prawn breeds over a long period of the year; this will explain the occurrence of prawns of such different sizes as can be obtained in any particular week from different localities on the same river estuary. The captures of larvae in the plankton indicate the deposition of eggs between January and June, and also in August, the largest captures during 1937 being taken in March and April.

It was found that it is during the post-*Mysis* stage and later planktonic stages that the young prawns enter the harbours and estuaries and migrate to the upper waters of these regions. The earliest stage at which the king prawn leaves the plankton and seeks the bottom is that in which eight, nine or ten rostral teeth are present, and when it is approximately 17 mm. in length. The growth of the king prawn, like that of related species overseas, appears to be very rapid, for the evidence obtainable indicates that many large king prawns, leaving the estuaries for the sea in February, entered the estuaries as post-larval stages approximately twelve months before. In some cases it may be even less; in others, where growth has been retarded or the lake has been closed, the age will naturally be greater, and two years may be necessary before maturity is reached. Dakin is also of the opinion that from four to eight months elapse between the time when the prawns make to the sea and when they are ready to spawn; in other words, that it is probably eighteen months at least before the first sexual maturity is attained, the final development of the gonads being accompanied by a very considerable increase in the size of the animal.

Dakin observes, also, that nothing is more certain than the fact that these large prawns never re-enter the estuaries after spawning, for they would be at once recognized by their size, but no evidence has been obtained to show whether the mature prawn dies after one season's reproduction, or whether it remains in the ocean to breed more than once. He inclines towards the former view because no very large specimens with spent gonads have been obtained from the sea.

The Murray Cod.

Although the Murray cod (*Maccullochella macquariensis*) is the most important freshwater edible fish found in New South Wales, scant attention has been given to the study of its habits and life history. Owing to the rather alarming statements that are made from time to time concerning its rapid depletion, Dakin joined forces with G. L. Kesteven, a young scientist until recently on the staff of State Fisheries, in a preliminary investigation of this fish, with particular reference to its life history and its artificial propagation with a view to re-stockng the streams of its occurrence.

Dakin and Kesteven (1938) found that it is possible to hold the Murray cod in cages of relatively small dimensions for considerable periods when suspended in the river; after thirteen weeks' confinement the fish appeared to be quite healthy and became so tame that they fed out of the keeper's hand. In a system of ponds it should therefore be possible to keep them alive indefinitely.

The spawning period appears to vary considerably according to locality, and it is possible to find some fish in full roe from October (and possibly September) to January.

During their experiments on artificial propagation it was found that only when approaching full development of the roe was it possible to distinguish males from females; at this period the female showed a greater swelling of the abdomen and the genital opening became more swollen than that of the male. It was seen, also, that when the female is ripe the eggs come away very easily, but considerable pressure has to be exerted to strip the male. The actual procedure in artificial fertilization consisted of stripping the milt from the male into a flat dish containing a small quantity of river water; the milt was stirred well in the water and then the eggs were stripped into it. The sperm of the Murray cod is immobile until it makes contact with water, and it lives only a few minutes, while the eggs, after fertilization takes place, become adhesive. More than 90 per cent. of the eggs produced larvae, the actual hatching period occupying nine days at a temperature which varied from 62° F. to 74° F., with an average of approximately 68° F. Following the success of their experiments the authors consider that there should be no difficulty in the hatching of the Murray cod on a large scale, though there would appear to be considerable difficulty in obtaining a sufficient number of both females and males in a spawning condition at the same time.

The development of the Murray cod after hatching was found to be rather rapid; the yolk sac had almost disappeared ten days after hatching, and in less than nineteen days the adult form of the fish was well developed. They were kept alive for 32 days and during this time the growth-rate was noted, but a reliable comparison between the growth-rate of young fish kept in an aquarium, as these were, and those in a large body of water can scarcely be made, for apart from the consideration of the most suitable types of food, experience with other fish reared in captivity indicates that the small body of water contained in the aquarium is itself a deterrent to rapid growth.

The Oyster.

As in other branches of the fisheries of New South Wales, scant attention was paid until recent years to the scientific investigation of the oyster. There are several species found on the coast of New South Wales, and in the early days of the Colony two of them were common; one, the present commercial oyster, *Ostrea commercialis* (*cucullata*), was extremely abundant from the Queensland to the Victorian border, the other, *O. angasi*, was prevalent only along the southern half of the coast. Owing principally to the ravages of the mud worm (*Polydora ciliata*), *O. angasi* has been almost exterminated throughout its range on the New South Wales coast, but *O. commercialis*, more valuable on account of its superior edible and keeping qualities, has been cultivated extensively and forms a valuable industry, the average annual production for the years 1928 to 1937 being valued at £75,600.

In 1883 Tenison-Woods stated that the sexes of the common commercial oyster (*O. commercialis*) are distinct, and the eggs are probably discharged into the water where they may easily meet with sperm from the males. By mixing "the male and female fluid" it was found that fertilization of the ova readily occurred. Later, in 1888, Tenison-Woods appears to have altered his views on the discharge of the sexual products into the water, for he stated that the "young oysters are reared in the gill-chambers of the mother, in the case of the Australian oyster, *O. mordax*". It seems probable that Tenison-Woods was confused with his species, for the taxonomy of the New South Wales oysters was at that time very unstable. In the first instance, he was apparently dealing with the oviparous *O. commercialis*, and in the second with the larviparous *O. angasi*, both of which were then plentiful in the neighbourhood of Sydney. Altogether Tenison-Woods's observations were quite confusing and threw little real light on the subject.

The work of Saville-Kent (1890), although it erred in a number of particulars, contained much of value. He stated that in the case of *O. glomerata* (*commercialis*) fertilization takes place in the water, "the young embryos . . . being thrown upon their own resources from the earliest period of their existence", and that the embryos of *O. angasi* are retained within the mantle cavity of the parent.

Saville-Kent described the embryonic development of *O. commercialis* as far as the complete envelopment of the embryo by a shell, but erroneously assumed and actually illustrated their attachment at that stage as spat, stating that the length of larval life occupied, under favourable conditions, four days.

The "Mud Worm".

In the early days of the oyster industry, the bulk of the oysters were obtained for market from beds situated below low-tide level, and, a dredge being necessary to gather them, the grounds on which they were grown came to be known as "dredge" beds. About 1870, however, the oysters growing on the dredge beds of the Hunter River were found to be dying in large numbers, and an examination disclosed that the shells of the oysters were extensively infected with mud worms (*Polydora ciliata*). Until that time there appears to have been no reference to such an infection, and there is no satisfactory evidence as to the cause of the outbreak. Gradually, however, it spread to other rivers and in the course of time rendered the principal dredge beds of the State useless for the cultivation of oysters. With the deterioration of the oyster-bearing grounds situated below low-tide level, oyster growers were forced to confine their cultivation to the inter-tidal zone. The mud worm has therefore had a profound effect on the cultivation of oysters in New South Wales, and it remains to this day the greatest pest the oyster growers have to combat.

Much light was thrown on the attacks of this worm by an investigation carried out by Thomas Whitelegge (1890), a zoologist of the Australian Museum. Whitelegge found that the attacks were most severe on the mud flats about low-water mark. He formed the opinion that the worm in its early larval stage swims into the oyster and fixes itself by its head on the margin of the shell; here it immediately begins to construct a tube and rapidly accumulates a large quantity of mud, which is at once covered over by the oyster with a thin layer of shelly matter; if the oyster is healthy the deposit is laid down quickly, confining the worm with its patch of mud to a very small space. On the other hand, if the oyster is unhealthy and already infected, deposition of the shell material is slower and the worm collects a large patch of mud before the layer is solidified. Hence it is that the size of these accumulations gets larger as the attacks increase and the oyster gets weaker.

Whitelegge studied the life history of the worm and found that for the first six days the larvae swim about vigorously, after which they begin to settle down and are capable of attaching themselves by the head with leech-like tenacity, a faculty which appears to be of great value to the worm for it enables it, when it swims between the gaping valves of the shell of an oyster, to exercise some choice in its place of attachment.

Whitelegge found that if the oysters were removed from the beds, washed free of mud, and then placed where they were sheltered from the sun's rays for a period of about ten days, the worms were killed and the oysters survived.

Winter Mortality of Oysters.

Of recent years the oysters from Port Stephens on the north to the Victorian border on the south have been subject to a mortality during the late winter months; this varies in its intensity from year to year, but usually causes heavy losses to the oyster growers. On account of the mortality making its appearance during the coldest months of the year, it was thought that it was the outcome of the chilling of the oysters, and many oyster growers considered that it was caused by the frost lying on them when bared by the tide. This mortality was investigated by me at the George's River during the winters of 1924 and 1925, and an account was published in these PROCEEDINGS in 1926.

It was found that the mortality was not caused by frost, nor even by the direct action of low temperatures, for experiments carried out during both winters actually showed that those oysters survived which were exposed to the cold air longest, while those submerged during the winter in the more equable temperature of the water died in large numbers. During this investigation it was found that the lowest temperature to which the oysters were exposed was 36° F.; that after packing oysters in ice for 72 hours few of them died when replaced on the beds; and that oysters whose tissues were lightly frozen by a combination of ice and salt survived for a period up to two months afterwards, and even after their tissues had been frozen hard they lived for some weeks.

The food extracted from the oysters' stomachs corresponded, in the types comprising the bulk of it, with that extracted from the stomachs of the oysters at Port Hacking and the Hawkesbury River, where no abnormal winter mortality had been known to occur. The volume of the food obtained by the oysters was found to increase with a rise in the temperature of the water, and on the flood tide as against the ebb. At a temperature of or below 50° F. the shells of the oysters remain closed.

Where a heavy mortality occurred during the winter of 1924 many of the oysters still remaining alive had abscesses, ulcerations or inflammation of the tissues, particularly common on the labial palps, gills and inner surfaces of the mantles, but they also occurred in the gonad, digestive diverticula, stomach and adductor muscle. Where the mortality was greatest ulcerated oysters were most prevalent; in fact, a fairly definite ratio of ulceration to mortality was seen. The cause of the abscesses and ulcerations was not determined, though microscopical examination of the pathological areas indicated that they probably have a bacterial origin. It was found that adverse conditions other than low temperatures, such as lack of aeration, food, and the presence of decomposition products of dead oysters, may also result in the formation of abscesses and ulcers.

Although the actual cause of the mortality was not discovered, the incidence of the disease as determined by experiments conducted during both winters suggests that it might be avoided by raising the oysters on wire-netting racks during the months from June to September inclusive.

The Life History of the New South Wales Oyster.

In 1928 I was able to announce that a sex-change occurs in the common commercial oyster (*O. commercialis*) of New South Wales, which is an oviparous species. Previous to this discovery all oviparous oysters were regarded as unisexual, but subsequently it has been shown that the dominant oviparous species of the Atlantic coast of North America (*O. virginica*), of Japan (*O. gigas*), of India (*O. cucullata*), and of Portugal (*O. angulata*) also undergo a sex-change.

The results of an investigation of the life history of the New South Wales oyster, conducted by me at intervals over a number of years, the field work being carried out at Port Macquarie and the Hawkesbury River, were published in these PROCEEDINGS (1933).

The spawning of the oyster on the coast of New South Wales is very irregular. With the warming of the water during spring the gonads develop rapidly, and may become fully developed by the middle of December. Spawning frequently occurs in such oysters during the high spring tides round about the Christmas period.

These oysters may spawn again in late summer. If, however, owing to an abnormally cool spring, the gonad develops slowly, spawning may occur in January, or even as late as April or May. In other cases there may be several partial spawnings throughout the summer months. Spawning is not confined to the summer months, however, for on rare occasions intermittent light spawnings may occur throughout the winter, as shown by an irregular winter catch of spat. When, as is usual, spawning is completed by the end of summer, the gonad displays great activity during the winter in the storage of glycogen in the vesicular tissue in preparation for the development of ova and sperm in the spring.

This oyster was found to spawn on the ebb tide following a high spring-tide, the temperature of the water being 68° F. and the density 1·020. The rate of development of artificially fertilized eggs decreases as the density of the water is lowered. At a density of 1·005 a large proportion of the eggs remained unfertilized, and in no case did development proceed beyond the morula stage. At a temperature varying from 68° F. to 70° F. and a water density of 1·021, the free-swimming stage was reached in seven hours, and the embryos were completely enveloped in shells in 34 hours. At an average temperature of 78° F. the embryos began to swim as trochophores in six hours, while at an average temperature of 62° F. the same stage was not reached until 22 hours after fertilization.

Although practically all, if not all, young oysters spawn for the first time as males, it was found that the sex-ratio of 3,000 oysters of marketable size from the principal oyster-bearing grounds of New South Wales presented a very different picture, for females always predominated, varying from 54 per cent. to 88 per cent. The average percentage was found to be: females 73, and males 27; in other words, there were 2·7 times as many females as males. The determination of sex in this oyster does not appear to be governed by the amount of food available, as has been suggested for other oviparous oysters.

Fishery Investigations by the Commonwealth Government.

As I stated at the beginning of this address, a new outlook on fishery research is dawning in Australia, for the Commonwealth Government has already begun a large-scale investigation into various branches of our fisheries which should lay a foundation for the sound development of new industries, just as the exploratory work of the Commonwealth Investigation Trawler "*Endeavour*" did for our trawling industry. But these investigations are intended to go much further than did those of the "*Endeavour*", for, in addition to the all-important task of discovering new sources of wealth in our fisheries, the research will be directed towards the determination of the limits beyond which the exploitation of those fisheries may proceed with safety in order that we may avoid the spectacle, already seen here and in most of the fisheries of the world, of the removal of fish from the sea at a greater rate than they can be replenished. When a new fishery is established, it is customary to exploit it to the limit the available markets will stand, without thought of the limit the fishery itself will stand, and all too frequently the production is suddenly found to be subject to a progressive decline, which, if not stayed, leads eventually to the failure of the industry. It is far preferable that the limits of the fishery be realized at the beginning and the extent of the catches so regulated that the fishery is maintained permanently at a fairly uniform level, rather than that a spectacular rise in production occur, to be followed by a similarly depressing fall in the yield. That is to be the constant aim of the Commonwealth fisheries investigations.

The exploratory investigations of the Council for Scientific and Industrial Research, which has been entrusted with the work, have, as stated by Dr. Harold Thompson (1939) in a recent address to the meeting of the Australian and New Zealand Association for the Advancement of Science held at Canberra, been divided into two sections embracing tropical and temperate areas. Of these, the latter will receive first consideration, and the region chosen for immediate exploration extends from about the tropic of Capricorn on the north to Tasmania and South Australia on the south. This is a natural choice, for it embraces the most populous areas of five States.

We have already seen that no great extensions of the trawling industry are likely, and I am convinced that the problems of our estuarine fisheries are for the most part those of conservation rather than exploitation; if, therefore, there is to be any large-scale development of Australian fisheries it would appear that it can come only from our pelagic fishes, such as tunny, Australian salmon, barracouta, pilchards, sprats and anchovies. And it is on these that the Commonwealth investigations are being especially concentrated. We have known for some time that the blue-fin tunny occurs in large shoals on the southern half of the coast of New South Wales during the spring months, September, October and November, and we have found that it cans excellently, but three months (or, perhaps, one should say a maximum of three months) is a rather restricted period for the commercial exploitation of this species with its present somewhat uncertain methods of capture on a large scale. Would it be possible to can fish of other species during the intervening period when tunny are no longer on our coast in large shoals? Now, the Australian salmon, which, incidentally is a very different species from the salmon of the northern hemisphere, is one of the most abundant fish on the south-eastern Australian coast, but unfortunately it is not regarded as a fish of prime edible quality. Would it be possible to improve the quality of this fish when canned? Experiments to determine this were undertaken by me, and it was found that, provided the fish were penned up for several weeks, as is done in Victoria, before they are marketed, the palatableness and texture of the fish improve considerably when canned. A factory was established on the banks of the Wagonga River, on the south coast of New South Wales, and provision has already been made for the disposal in Australia of over four million tins during the next two years. So busy has the factory been in the canning of salmon that the initial plans for the canning of tunny have had to be left in abeyance.

But what becomes of the tunny when they leave the coast of New South Wales? No evidence at all was available on this question until the Council for Scientific and Industrial Research, at the suggestion of one of the officers of its fishery section, S. Fowler, decided to carry out an aerial survey of the waters of south-eastern Australia for the purpose of locating shoals of this and other species of pelagic fish. Fowler (1937) found that during February and March very large shoals of tunny and salmon were lying in an area extending from near Babel Island, east of Bass Strait, to Schouten Island, on the eastern Tasmanian coast, a distance of about 140 miles. The shoals generally were from about five to fifteen miles offshore. This was an important observation and fully justified the survey, for the occurrence of shoals of such magnitude had not been observed by the fishermen operating in that region, possibly because they work usually closer inshore, and it is conceivable that they might have been missed by an investigation vessel, which, with its much more restricted range of observation, might easily have failed to locate them. An interesting point arises as to whether the tunny seen in that area are the same fish as those which earlier were found on the southern New South Wales coast. They may, of course, be a different race, but anglers fishing for them on the south coast of New South Wales have reported that late in the season the tunny appear to make off in a southerly direction.

The great value of the discovery, however, is that the season of the occurrence of this important fish appears now to extend from September to March at the least, although the regularity of its appearance in more southerly waters at the season of these aerial observations has yet to be established. And then, of course, the question arises as to the distance to be travelled to obtain the fish. Actually, this should present no real obstacles, for, when it is realized that California tuna boats travel up to three thousand miles for their fish, the distance to be travelled in Australian waters to secure them is a relatively short one.

During these aerial observations, also, Fowler observed a shoal of salmon lying in the Wagonga River, New South Wales, which he estimated to weigh a thousand tons, while many thousands of tons were lying offshore adjacent to the mouth of the river and in the vicinity of Montague Island. During a later aerial survey (July, 1937) he also saw large concentrations of small fish, which he believed to be pilchards, extending for about twenty miles in the vicinity of Port Stephens, New South Wales, and at various points in the area bounded by Coff's Harbour on the south and Cakora Point on the north. These shoals were from two to eight miles from the coast.

As Thompson states (1939), the outcome to date of this aerial work, which has now been proceeding on and off for two years, is that the general distribution of some of the more prolific pelagic fishes such as the tunny, salmon, pilchard and related species, has been distinguished, and valuable guidance, at least in the preliminary stages, has been given to the movements of the research vessel, which has by her catches confirmed the evidence obtained from the aerial reconnaissance. Naturally, the vessel will at times catch tunny which rise to the lure from deeper water where they cannot be observed from the air, and to this extent the agreement is imperfect, but it has led to the avoidance of much fruitless cruising of the vessel.

In the ten months that the Commonwealth Research Vessel "*Warreen*" has been in commission it has been found possible to maintain touch with the chief tunny shoals in the south-eastern area, from the first onshore manifestation in the Jervis Bay–Eden sector (October–December) to the later appearances (January–May) in Tasmanian and South Australian waters. Blue-fin tunny chiefly, and to a lesser extent striped tunny and long-finned tunny (albacore), have been found to occur in what appear to be sufficient quantity to support a fishery—subject to the development of satisfactory means of capture.

An important commercial species, the yellow-fin tunny, has been located in Queensland waters, but its distribution and numbers remain to be determined.

It is here, perhaps, that a warning should be issued. If great shoals of a valuable species of edible fish are located at a certain season of the year, it must not at once be assumed that their commercial exploitation is warranted, for subsequent investigations may reveal that during the following season they may not appear in that region at all; they may, owing to certain physical and biological conditions, have moved to other grounds. For this reason, therefore, an investigation must extend over a period of at least three years before the regular seasonal appearance of the fish can be assumed with any degree of confidence, and then, as Dr. Thompson points out, if a certain species, of good quality, can be shown to occur in great numbers with a good average size and growth-rate, and if this species is present with a high measure of reliability over a period of several years, there is little danger in stating that a reliable and enduring fishery can be based on it—that is, if it can also be shown that it can be caught with a fair measure of ease, and if safe harbours exist nearby.

The programme of the Commonwealth investigations, therefore, includes continuous investigations of pelagic fishes for at least three years in the south-eastern area; these embrace the study of the regions of their occurrence, movements, biological features such as growth-rate, food, age and size at first maturity, migrations, influence of hydrographic and plankton conditions, and the systematic relationship of species, especially the tunnies, to similar types abroad. Chemical studies are also being undertaken to determine the value of certain species for the production of fish meal, the fluctuations in chemical composition, and the best seasons for such processes as canning and smoking.

The programme is a formidable one but, for the first time in the history of Australia, adequate resources have been made available for the purpose, and we may confidently expect that much light is about to penetrate the darkness that has enveloped our fisheries for a period that has been unreasonably prolonged.

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Dr. G. A. Waterhouse, Honorary Treasurer, presented the balance-sheets for the year ended 28th February, 1939, duly signed by the Auditor, Mr. F. H. Rayment, F.C.A. (Aust.); and he moved that they be received and adopted, which was carried unanimously.

No nominations of other candidates having been received, the Chairman declared the following elections for the ensuing session to be duly made:

President: Professor J. Macdonald Holmes, B.Sc., Ph.D.

Members of Council: C. Anderson, M.A., D.Sc., Professor E. Ashby, D.Sc., Professor J. Macdonald Holmes, B.Sc., Ph.D., A. F. Basset Hull, M.B.E., T. C. Roughley, B.Sc., F.R.Z.S., C. A. Sussmilch, F.G.S., E. Le G. Troughton, C.M.Z.S.

Auditor: F. H. Rayment, F.C.A. (Aust.).

A cordial vote of thanks to the retiring President was carried by acclamation.

Linnean Society of New South Wales.

GENERAL ACCOUNT. Balance Sheet at 28th February, 1939.

LIABILITIES.

	£	s.	d.	£	s.	d.
Capital: Amount received from Sir William Macleay during his lifetime	14,000	0	0			
Further sum bequeathed by his Will	6,000	0	0			
				20,000	0	0
Contingencies Reserve				9,315	16	1
Commercial Banking Co. of Sydney Ltd.				209	12	8
Suspense				0	7	10
				£29,525	16	7

ASSETS.

	£	s.	d.
Society's Freehold	11,000	0	0
Consols	500	0	0
Loans on Mortgage	2,500	0	0
Science House (one-third share)	14,590	0	0
Metrop. W.S. & D. Board Debentures	494	7	6
Rural Loan	386	0	0
Cash in hand	10	0	0
Income Account	45	9	1
	£29,525	16	7

INCOME ACCOUNT. Year Ended 28th February, 1939.

	£	s.	d.	£	s.	d.
To Salaries				1,010	0	0
„ Printing Publications	496	3	3			
„ Illustrations	92	15	5			
				588	18	8
„ Rates and Insurance				187	15	10
„ Library				21	8	0
„ Postage	42	1	1			
„ Petty Cash	12	12	11			
				54	14	0
„ Audit	7	7	0			
„ Printing	14	0	11			
„ Expenses	15	9	3			
„ Attendance and Cleaning	41	18	0			
				78	15	2
„ Bank Expenses				0	12	9
„ Appropriation: Contingencies Reserve				28	7	0
				£1,970	11	5

	£	s.	d.	£	s.	d.
By Balance from 1937/38				26	8	4
„ Subscriptions: 1938/39	153	2	6			
Arrears	10	10	0			
In Advance	8	8	0			
Associate	0	10	0			
				172	10	6
„ Life Subscription				15	15	0
„ Entrance Fees				12	12	0
„ Interest				175	11	0
„ Rent				338	10	0
„ Science House				170	0	0
„ Sales (including 60 copies of PROCEEDINGS purchased by Government of N.S.W.)				214	10	5
„ Fellowships Account (surplus income at 28th February, 1939, transferred)				799	5	1
„ Balance				45	9	1
				£1,970	11	5

Examined and found correct. Securities produced.
F. H. RAYMENT, F.C.A. (Aust.),
Auditor.

6th March, 1939.

G. A. WATERHOUSE,
Hon. Treasurer.

1st March, 1939.

LINNEAN MACLEAY FELLOWSHIPS ACCOUNT.

BALANCE SHEET at 28th February, 1939.

LIABILITIES.	£	s.	d.	ASSETS.	£	s.	d.
Amount bequeathed by Sir William Macleay	35,000	0	0	Consols	10,400	0	0
Surplus Income Capitalized	15,288	11	4	Loans on Mortgage	38,076	11	4
				Rural Loan	477	10	0
				Metropolitan W.S. & D. Board Loan	1,005	0	0
				Commercial Banking Company of Sydney, Ltd.	221	16	1
				Commonwealth Savings Bank	107	13	11
	£50,288	11	4		£50,288	11	4

INCOME ACCOUNT. Year Ended 28th February, 1939.

	£	s.	d.		£	s.	d.
To Salaries of Linnean Macleay Fellows	1,500	0	0	By Interest	2,399	5	1
,, Capital Account	100	0	0				
,, General Account	799	5	1				
	£2,399	5	1		£2,399	5	1

Examined and found correct. Securities produced.
F. H. RAYMENT, F.C.A. (Aust.),
Auditor.

6th March, 1939.

G. A. WATERHOUSE,
Hon. Treasurer.

1st March, 1939.

BACTERIOLOGY ACCOUNT.

BALANCE SHEET at 28th February, 1939.

LIABILITIES.	£	s.	d.	ASSETS.	£	s.	d.	£	s.	d.
Amount bequeathed by Sir William Macleay	12,000	0	0	Consols				15,820	0	0
Accumulated Income Capitalized	3,820	0	0	Cash—						
Income Account at 28th February, 1939	549	17	8	Commercial Banking Company of Sydney Ltd.	309	10	8			
				Commonwealth Savings Bank	234	7	0			
				In hand	6	0	0			
								549	17	8
	£16,369	17	8					£16,369	17	8

INCOME ACCOUNT. Year Ended 28th February, 1939.

	£	s.	d.		£	s.	d.
To Salary	600	0	0	By Balance from 1937–38	536	11	5
,, Expenses	10	5	9	,, Interest	624	17	10
,, Petty Cash	1	5	10				
,, Balance to 1939–40	549	17	8				
	£1,161	9	3		£1,161	9	3

Examined and found correct. Securities produced.
F. H. RAYMENT, F.C.A. (Aust.),
Auditor.
6th March, 1939.

1st March, 1939.

G. A. WATERHOUSE,
Hon. Treasurer.

ABSTRACT OF PROCEEDINGS.

ORDINARY MONTHLY MEETING.

29th March, 1939.

Professor J. Macdonald Holmes, B.Sc., Ph.D., President, in the Chair.

The Donations and Exchanges received since the previous Monthly Meeting (30th November, 1938), amounting to 53 Volumes, 504 Parts or Numbers, 29 Bulletins, 12 Reports and 27 Pamphlets, received from 178 Societies and Institutions and 4 private donors, were laid upon the table.

PAPERS READ.

1. The Ecology of the Upper Williams River and Barrington Tops Districts. iii. The Eucalypt Forests and General Discussion. By Lilian Fraser, D.Sc., and Joyce W. Vickery, M.Sc.

2. Revision of Australian Lepidoptera. Oecophoridae. viii. By A. Jefferis Turner, M.D., F.R.E.S.

ORDINARY MONTHLY MEETING.

26th April, 1939.

Professor J. Macdonald Holmes, B.Sc., Ph.D., President, in the Chair.

Miss Frances M. V. Hackney, Summer Hill, and Mr. G. F. K. Naylor, M.A., M.Sc., Dip.Ed., Sydney, were elected Ordinary Members of the Society.

The Chairman announced that the Council had elected Dr. W. L. Waterhouse, Mr. C. A. Sussmilch, Mr. E. C. Andrews and Mr. T. C. Roughley to be Vice-Presidents for the Session 1939–40.

The Chairman also announced that the Council had elected Dr. G. A. Waterhouse to be Honorary Treasurer for the Session 1939–40.

The Donations and Exchanges received since the previous Monthly Meeting (29th March, 1939), amounting to 17 Volumes, 126 Parts or Numbers, 6 Bulletins, 2 Reports and 40 Pamphlets, received from 71 Societies and Institutions and 2 private donors, were laid upon the table.

PAPERS READ.

1. A Key to the Marine Algae of New South Wales. ii. Melanophyceae (Phaeophyceae). By Valerie May, B.Sc.

2. Miscellaneous Notes on Australian Diptera. v. On Eye-coloration and other Notes. By G. H. Hardy.

3. Papuan Diptera. ii. Description of a New Genus and Two New Species from Papua. Fam. Pyrgotidae (Diptera). By J. R. Malloch. (*Communicated by F. H. Taylor, F.R.E.S., F.Z.S.*)

4. The Diptera of the Territory of New Guinea. Family Phytalmiidae. By J. R. Malloch. (*Communicated by F. H. Taylor, F.R.E.S., F.Z.S.*)

5. The Diptera of the Territory of New Guinea. Family Otitidae (Ortalidae). By J. R. Malloch. (*Communicated by F. H. Taylor, F.R.E.S., F.Z.S.*)

6. The Diptera of the Territory of New Guinea. Dolichopodidae. By l'abbé O. Parent. (*Communicated by F. H. Taylor, F.R.E.S., F.Z.S.*)

7. Trombidiid Larvae in New Guinea (Acarina: Trombidiidae). By Carl E. M. Gunther, M.B., B.S., D.T.M. (*Communicated by F. H. Taylor, F.R.E.S., F.Z.S.*)

8. Taxonomic Notes on the Order Embioptera. i. The Genotype of *Oligotoma* Westwood. By Consett Davis, M.Sc.

NOTES AND EXHIBITS.

Miss J. W. Vickery exhibited a specimen of *Trianthema portulacastrum* L. recently received by the National Herbarium from Mr. W. W. Hardy of Narrabri, who stated that it is exhibiting a vigorous growth in several places in the town. This species has not previously been recorded in New South Wales, though it has been known since about 1917 in Queensland, where it bears the vernacular name of "Giant Pig Weed". It is a common weed of cultivation, roadsides and waste places in tropical regions, such as in the Philippines, Java, India, the West Indies, tropical America and subtropical United States.

In 1917 it had already become a troublesome weed of cultivation at Bowen in Queensland, but it is less likely to be a serious nuisance in New South Wales than it is further north. As stock are said to be fond of it, it may have some value as a fodder plant in pastoral districts.

Mr. E. Cheel exhibited fresh flowering specimens of Dahlia raised by Mr. W. Sharland of Malvern, Victoria, from seed obtained from cultivated Dahlias "single crimson-red" crossed with a "semi double yellow". The new variety raised by Mr. Sharland differs from the commonly cultivated forms in being of an "evergreen perennial duration" whereas the ordinary cultivated varieties are cut down by frosts in winter and new growth is obtained from the tubers in spring. The well-known "Tree Dahlias" (*Dahlia imperialis* and *Dahlia excelsa*) also die down in winter and commence new growth in summer from a perennial root-stock. Mr. Sharland has raised the question of certain hereditary factors being dormant for a long period and now transmitted to the new variety called "Sharlandia". Although the Dahlia was first mentioned by Hernandes in 1651 and by Cervantes in 1789, it was not properly described until 1805, when Cavanilles prepared a formal description from plants cultivated in Madrid. Since that time formal descriptions have been published for *D. coccinea*, *D. variabilis* and *D. frustranea*, which are probably the parents of the cultivated varieties of Dahlia. More recently two species, viz., *D. Popenovii* and *D. Maxonii*, have been collected in Guatemala. The two latter are said to be "Tree Dahlias". Photographic illustrations were also exhibited on behalf of Mr. Sharland.

THE ECOLOGY OF THE UPPER WILLIAMS RIVER AND BARRINGTON TOPS DISTRICTS. III.

THE EUCALYPT FORESTS, AND GENERAL DISCUSSION.

By Lilian Fraser, D.Sc., and Joyce W. Vickery, M.Sc.

(Plates i–iii.)

[Read 29th March, 1939.]

The Eucalypt Forests: Structure and Composition; Conclusions.
General Discussion. General Summary.

The rain-forests of the Williams River and associated valley systems have been described in a previous paper (Fraser and Vickery, 1938). These forests occupy sheltered and moist areas in the valleys and on the slopes above 900 feet altitude. The surrounding country is occupied by a more open type of forest in which species of the genus *Eucalyptus* predominate. This forest forms part of the Eucalypt-forest formation which occurs throughout the coast and adjacent highlands of New South Wales. It extends from the valley floors bordering and below the sub-tropical rain-forest, along the crests and upper parts of spurs and ridges to the Barrington Tops Plateau. It comprises a number of well marked, altitude-delimited communities which grade into each other so that the forest forms a continuous whole. These communities have been grouped, according to their occurrence, into associations which are interpreted as local expressions of large associations widely distributed elsewhere. Each community will be described separately.

The general structure of the forest is similar throughout. Three main strata can be distinguished: (*a*) Tree, (*b*) Shrub, and (*c*) Ground Flora. The tree stratum may be considered to consist of two parts, viz., trees whose foliage forms the canopy, and smaller trees, 30–35 feet in height, which do not reach the canopy. The leaves of the tall trees are leathery, and all of the same form, narrow lanceolate-falcate. As in most species of *Eucalyptus*, the leaves hang almost vertically, so that, though the canopy is more or less continuous, a considerable amount of sunlight reaches the ground.

The tallest forest occurs in the valley floor, and there is a continuous gradation between this and the plateau forest, which is comparatively stunted. The taller trees range from 120 to 180 feet in height, those on the plateau from 30 to 60 feet. The smaller trees are rarely present in sufficient numbers to give a distinctive appearance to the forest, and they never form a continuous stratum. Usually they are far less frequent than the tall trees, but in places on certain slopes may become important. The ground flora forms a more or less continuous stratum in all the communities. It comprises mostly hemicryptophytes and chamaephytes with some geophytes and therophytes. Grasses are conspicuous, becoming more so with increasing altitude. Between the tree and herb or ground strata is the shrub stratum which may be important and continuous, sparse, or even entirely absent over large areas. As in the tree stratum it is possible to distinguish two sections: a tall-shrub layer, attaining a height of 6 to 12 feet, in places forming dense communities, but usually very discontinuous in all associations, and a low-shrub layer 1 to 6 feet in height, which also varies from very dense and continuous to discontinuous and scanty. The members of the tall-shrub layer have moderately large, but sclerophyllous types of leaves; those of the lower stratum have for the most part very small, coriaceous, stiff leaves.

Lianes and epiphytic ferns and angiosperms, which are such a feature of the sub-tropical rain-forest, are, with one exception, absent from the Eucalypt forest. The exception is the epiphytic orchid *Cymbidium suave*, which grows almost exclusively in the dead branch gaps of Eucalypts. It does not extend upwards beyond an altitude of about 2,000 feet as far as could be observed. Occasionally plants of *Davallia pyxidata*, *Platycerium bifurcatum* and *Cyclophorus serpens* may be present on *Casuarina torulosa* and *Trochocarpa laurina* trees along the margins of the sub-tropical rain-forest, but these are obviously intruders from the rain-forest and do not form a natural part of the Eucalypt-forest associations.

Mosses and lichens are very uncommon in the lower parts of the Eucalypt forest, but with increasing altitude their importance increases, especially as the mist zone is approached. Above 4,000 feet any exposed rock surface is densely covered with mosses and lichens. Even at these altitudes their development is not so great in the Eucalypt forest as it is in the adjoining sub-antarctic rain-forest, while nothing in the Eucalypt forest can compare with the development of mosses in the most humid parts of the sub-tropical rain-forest. Mosses and lichens are fewer in the plateau forests, which, being more exposed to the drying action of the westerly wind than the upper slopes of the ranges, are consequently less humid.

The Eucalypt Forests.

Structure and Composition.

(*a*) The Forests of the Valley Floor.

1. The forest of the lower valley, below 900 feet.

The boundary of the Chichester State Forest cuts at right angles across the valley of the Williams River at the lower limit of the sub-tropical rain-forest at an altitude of about 900 feet. Practically all the Eucalypt forest south of this, both in the valley floor and in the adjacent spurs, has been cleared for pastoral purposes. Little remains of the original flora except scattered trees which have been left for shade. A detailed study of this part of the forest has not been attempted. *Eucalyptus tereticornis*, *Casuarina torulosa* and *Angophora subvelutina* are the most important trees, but *Eucalyptus maculata* and *E. hemiphloia* are dominants over large areas, becoming of greater importance further from the rain-forest, at comparatively low altitudes. Species which are widely distributed but not as a rule very numerous are *E. paniculata* and *E. eugenioides*. *E. saligna* and *Syncarpia laurifolia* occur in restricted areas of specially good soil-moisture. They may be regarded as outliers of the main *E. saligna–S. laurifolia* forest which occurs at an altitude of 1,000 to 1,200 feet.

On the flats by the river *Angophora subvelutina* is most common, occasionally attaining a height of more than 100 feet. *Melaleuca linariifolia*, a small tree not exceeding 30 feet, is present in dense communities in damp places in the flat valley-floor. *Casuarina Cunninghamiana* and *Callistemon viminalis* form a narrow fringe along the river bank mingling with species intrusive from the rain-forest, e.g., *Tristania laurina* and *Eugenia* spp. *Angophora subvelutina* extends part of the way up the east-facing slopes of the enclosing mountain ranges, but is absent from the drier parts and from the west-facing slopes. Another tree of importance on the river flats is *Eucalyptus amplifolia*.

The pasture is composed largely of native grasses, of which *Eragrostis leptostachya*, *Sporobolus indicus*, *Microlaena stipoides*, *Bothriochloa decipiens*, *Panicum effusum*, *Entolasia marginata*, *Themeda australis*, *Echinopogon caespitosus*, *Agrostis avenacea*, *Danthonia penicillata*, *Cynodon dactylon* and *Poa caespitosa* are most prominent. Occasional large patches of *Imperata cylindrica* var. *Koenigii*, which is harsh and useless for grazing, and the bracken fern *Pteridium aquilinum* detract from the value of the pastures. Some *Paspalum dilatatum* is present on the river flats, and *Paspalum distichum* in very moist places. On these river flats large, ungrazed clumps of *Carex longifolia* are sometimes present, a relic of the original vegetation which has spread under the new conditions. Ephemerals such as *Aira caespitosa*, *Wahlenbergia gracilis*, *Gnaphalium japonicum*, *Siegesbeckia orientalis*, *Stellaria flaccida* and *Swainsona coronillifolia* are common in the more disturbed areas. *Notholaena Brownii* and *Pteris paradoxa* (which are the only ferns except *Pteridium aquilinum*), *Lomandra longifolia*, *Ranunculus lappaceus* and the common trailing *Hibbertia volubilis* are present and appear to have formed part of the original vegetation.

2. The forest of the valley floor at 900 to 1,400 feet.

The sub-tropical rain-forest at its lower limit occupies a relatively narrow area each side of the river. The remainder of the valley floor and the sheltered lower slopes of the adjacent mountain ranges are occupied by an association in which *Eucalyptus saligna* and *Syncarpia laurifolia* are dominants. These species are also present throughout the sub-tropical rain-forest (see Fraser and Vickery, 1938). The valley floor narrows rather rapidly above the State Forest boundary, and after about one-half mile from the boundary is occupied entirely by rain-forest, so that the Eucalypt forest is restricted to the slopes of the spurs. An approximately complete list of species present in this part of the formation is given in Table 1, column 1. It can be seen that the numbers of herbs and low shrubs are greatly in excess of the numbers of tall shrubs and trees.

The density of the forest varies considerably from place to place. On dry westerly-facing slopes the trees are somewhat shorter, and are slightly less numerous than on the more sheltered slopes and on the valley floor. On an easterly-facing slope of the Williams Range, the average density of the trees in the *Eucalyptus saligna* forest was observed to be 4 per 1,000 square feet.

The *Eucalyptus saligna*—*Syncarpia laurifolia* association extends upwards to an altitude varying with the exposure of the slope. On dry, westerly-facing slopes, the upper margin is only about 200 feet above the valley floor, i.e., at an altitude of 1,200 feet. Along sheltered gullies, especially in the easterly-facing slopes, the association may extend upward to about 2,500 feet, and scattered members of it to 3,000 feet. The tree stratum forms a continuous canopy (Pl. i, figs. 1, 3). Because of this, and because of the physiographic position in which the forest is developed, less light reaches the forest floor here than on the ridges and upper slopes.

Eucalyptus saligna occurs throughout the association and forms pure communities on westerly-facing spurs or sunny, dry, upper parts of northerly-facing slopes. The necessary requirements for the growth of *E. saligna* appear to be a deep, good, rather heavy soil, and abundant moisture. Its light requirements are not restricted. It is able to develop satisfactorily in areas of maximum light intensity, but is also capable of equally good development under conditions of shade which are unsatisfactory for most other species of *Eucalyptus*.

Syncarpia laurifolia is found fairly frequently throughout the lower forest association, but does not extend so far beyond its edge as *Eucalyptus saligna*, particularly on sunny slopes. It is fairly abundant on the valley floor and on moist parts of westerly-facing slopes, but the lower parts of northerly- and southerly-facing slopes which receive least light do not appear to be particularly well suited for its growth, and it may be absent entirely from large areas occupied by *Eucalyptus saligna*.

Eucalyptus amplifolia is found only along the lower edges where the *E. saligna–Syncarpia laurifolia* association abuts on the association of the lower valley, of which *E. amplifolia* is a subordinate species. *E. acmenioides* occurs near the border of the adjoining forest association of which it is a subordinate species, on sheltered but fairly dry slopes.

The height of the *Eucalyptus saligna* and *Syncarpia laurifolia* trees ranges from 180 feet in the valley floor to 100 feet on the upper parts of the slopes. The diameter of mature specimens on the valley floor may commonly reach 6 feet.

The small-tree stratum is very discontinuous, the only species being *Callistemon salignus, Casuarina torulosa* and *Acacia* spp. *Callistemon salignus* forms local, dense communities in damp areas. *Casuarina torulosa* appears to prefer cool slopes, and is often abundant on the north, north-west and south-east sides of ridges. The transition from Eucalypt forest from which it is absent to forest in which it is present is often very marked. *Acacia* spp. are scanty except after fire, when they form dense thickets (see Fraser and Vickery, 1938).

The tall-shrub stratum is absent (Pl. i, figs. 2, 3). The small-shrub stratum is discontinuous, scanty and not widespread. It occurs over small areas in shaded localities only.

The nature of the ground flora varies considerably with aspect. The floor of the valley, which is shaded for a considerable part of the day, is relatively moist at all times and supports the following species: *Brunella vulgaris, Gratiola peruviana, Mentha gracilis, Plectranthus parviflorus, Veronica plebeja, Eranthemum variabile, Hydrocotyle geraniifolia*, and a number of grasses, notably *Microlaena stipoides, Poa caespitosa* and *Panicum pygmaeum*.

The slopes afford several different types of habitats. The sheltered slope near to the creek or valley just above the rain-forest is usually cool and humid. Here *Culcita dubia* forms almost a pure ground community (Pl. ii, fig. 10). Other important species are *Blechnum cartilagineum, Microlaena stipoides, Themeda australis, Poa caespitosa, Pterostylis* spp. and *Viola* spp.

Other slopes which may be sheltered and shaded by virtue of their position on the spurs on the protected sides of ranges are relatively much drier than the valley areas on account of their steepness. These support a less dense flora. The most common species here is *Imperata cylindrica* var. *Koenigii*, which in places forms an almost pure community (Pl. i, fig. 2). Other species are *Desmodium* spp., *Entolasia marginata, Vernonia cinerea, Lagenophora Billardieri* and *Hibbertia volubilis*.

Pockets or flat areas on such slopes, where moisture collects, show the development of a greater amount of grass and finally of ferns. The most rigorous type of habitat of this association occurs on westerly-facing, well-drained spurs. These are comparatively dry and sunny (Pl. i, fig. 2). *Imperata cylindrica* var. *Koenigii* is the dominant species in the ground flora, forming very dense stands; other species are *Botrychium australe, Pteridium aquilinum* and *Hibbertia volubilis*.

In addition to the typical Eucalypt-forest species, a number of species occur around the edge of the rain-forest which are intrusive from it. Of these the tree-fern *Alsophila australis* is one of the most conspicuous, forming communities in advance of the rain-forest in sheltered localities (Pl. ix, fig. 19, in Fraser and Vickery, 1938), associated with *Culcita dubia*.

(*b*) The Forests of the Valley Sides at 1,400–3,000 feet.

At about 1,200 feet on dry slopes and 1,500 feet on sheltered slopes, the *Eucalyptus saligna–Syncarpia laurifolia* forest grades into a forest in which *E. campanulata, E. punctata* and *E. acmenioides* occur. The gradation takes place over a vertical range of about 300 feet or more because of the variability in the range of *E. saligna*. An approximately complete list of the species occurring in this part of the forest is given in Table 1, column 2.

This part of the forest is dominated by *Eucalyptus campanulata* and *E. punctata*. It is of considerable extent, occupying the crests and upper slopes of the lower ranges and extending upwards to an altitude of 3,000 feet. It occupies soil derived at the lower levels from mudstone, and at the upper levels from basalt, but, as far as could be seen, the change of soil type exerted little or no influence on the flora over this area.

The composition of the forest varies from place to place, largely as the result of aspect.

Eucalyptus acmenioides is confined to the lower sheltered parts of slopes, particularly easterly-facing slopes, where it merges into the *E. saligna* association (Pl. i, fig. 4). In places it forms almost a pure community, but at higher altitudes it is associated with *E. campanulata* (Pl. i, fig. 5). It appears to have higher soil-moisture requirements than *E. campanulata*. *E. Wilkinsoniana* also occupies the lower slopes (Pl. i, fig. 5), but is confined to areas of high soil-moisture as well as shelter. On sunny, dry, westerly-facing slopes *E. acmenioides* may be lacking or very scanty, and the *E. saligna* association grades almost directly into the *E. campanulata–E. punctata* association.

E. campanulata is the most abundant species, and is found throughout the association, particularly on westerly-facing or upper slopes (Pl. i, fig. 8), where it occurs in an almost pure state. It does not grow at low altitudes on shaded slopes, but comes down to 1,200 feet on westerly-facing slopes, which are light and well-drained. It is not found around moist, sheltered, shady gullies even as high as 1,800 feet. *E. punctata* prefers sunny, fairly moist localities (Pl. i, fig. 6). It is common on ridges, especially on the Chichester Range (Pl. i, fig. 7), but is absent from the driest parts of the ridge tops (Pl. i, fig. 8). It extends upwards to an altitude of 2,000 feet only.

Of the smaller trees, *Casuarina torulosa* is the only species occurring in this part of the forest. It is more abundant on sheltered northerly- and easterly-facing hillsides in regions of relatively abundant moisture (Pl. i, fig. 5), and is relatively less important on southerly- and westerly-facing slopes. It does not extend upwards beyond an altitude of about 2,000 feet.

The tree stratum forms a closed or nearly closed canopy. The height of the trees varies from 120 feet on the lower slopes to 60 feet on the crests and flat tops of ridges. The lateral spread of each tree may be considerable, especially on ridge tops. The density is much the same as in the *Eucalyptus saligna* forest in the same locality, averaging 4·12 trees per 1,000 square feet, and ranging from 1 to 6 per 1,000 square feet.

Above 2,000 feet the forest consists almost entirely of *Eucalyptus campanulata*, until about 3,000 feet, where it gives place rather abruptly to the next type of forest. The abruptness of this transition is much more marked than the transition between the *E. saligna* and *E. campanulata* forest types.

The tall-shrub stratum is very discontinuous and scanty. *Acacia mollissima* forms local thickets, but these are not of wide extent and may have resulted from burning. *Persoonia linearis* and *Xanthorrhoea resinosa* are present on sheltered slopes.

The low-shrub stratum is also discontinuous and scanty, but is more abundant than the tall-shrub stratum. It is best developed in regions of greatest light, such as on the crests of spurs, where *Leucopogon lanceolatus*, *Oxylobium trilobatum* and other shrubs may form local thickets. A few less xeromorphic species such as *Indigofera australis* and *Desmodium rhytidophyllum* appear to be restricted to shaded, humid slopes.

In the ground stratum *Poa caespitosa* and *Lomandra longifolia* are most important at higher levels. Other grasses, including *Imperata cylindrica* var. *Koenigii*, *Themeda australis* and *Microlaena stipoides*, are dominant, especially at lower levels. These form a continuous ground-cover which is rather thin, especially on well-drained, shaded slopes. Moist areas support a denser cover, the more common species being *Desmodium* spp., *Viola* spp., *Podolepis acuminata* and *Lagenophora Billardieri*, in addition to the above-mentioned grasses. *Culcita dubia* forms dense communities above the rain-forest margin in humid parts.

(*c*) The Forests of the Upper Spurs.

Below 3,000 feet zonation of the Eucalypt species is rather masked by the differential effect of aspect on the various species, but above that level it is most conspicuous. The forest consists of successive zones of different species. The lowest zone is formed by *E. obliqua*, which occupies the crests and upper slopes of the ranges approaching the plateau between 2,800 feet and 3,500 feet. The average tree-height is about 80 feet and diameter 2 to 3 feet. The canopy is fairly thick and continuous or nearly so. Because this forest type occurs mainly on the ridge tops and upper slopes, a considerable amount of light reaches the ground stratum. This region also, since it occurs at high altitudes, probably receives more rain than the lower spurs and ranges. In addition the soil is derived from basalt and has a high water-retaining capacity. These factors of high soil-moisture and strong light intensity lead to an extensive development of the ground flora. This is very dense, much more so than in the lower forests, the average height being 12 to 18 inches.

The transition from the *Eucalyptus campanulata* forest to the *E. obliqua* forest takes place over a vertical range of about 100 feet, and in this zone the two species occur mingled together. The other tree species of the *E. campanulata* zone do not extend upwards to this altitude. *E. saligna*, however, which reaches its maximum development in the valley at 1,000 feet, extends upwards to the *E. obliqua* zone along sheltered creek sides to 3,000 feet (Pl. ii, fig. 10).

At about 3,500 feet *E. obliqua* gives place to *E. viminalis*. The transition zone is fairly wide, taking place over a vertical range of about 250 feet. In the greater part of this zone the two species are present in about equal amounts (Pl. i, fig. 11). The trees are spaced to about the same degree as in the lower forest, and have an average height of about 80 feet and a diameter of 2–2·5 feet. The canopy on the whole is rather thinner than that of the *E. obliqua* forest, but is continuous or nearly so.

The associated shrubs and herbs are similar in both the *Eucalyptus viminalis* and the *E. obliqua* forests. A list of the most prominent species is given in Table 1, column 3. Some of these are of special interest. *Hakea eriantha*, a diffuse shrub attaining a height of about 10 feet, has a sporadic distribution between 3,000 and 3,500 feet. *Acacia melanoxylon* is common throughout both forests in regions of specially high soil-moisture. It attains the dimensions of a small tree, 20 to 25 feet in height with a diameter of 10 inches. This species occurs in the valley below the sub-tropical rain-forest at 800 to 900 feet, chiefly along river banks, but it is absent from the lower Eucalypt associations. *Acacia floribunda* has a very limited vertical range, forming thickets at about 3,000 feet. *Banksia integrifolia*, growing to a tree 30 to 35 feet high, is a conspicuous member of both forests (Pl. ii, fig. 12). It reaches its maximum development in the *Eucalyptus viminalis* forest, but extends upwards beyond its limits, and in places also downwards as far as the *E. campanulata* forest.

The low shrubs, of which *Leucopogon lanceolatus* is the most common, are scanty, forming occasional communities. *Senecio amygdalifolius*, *S. dryadeus* and *Olearia Nernstii*, forming shrubs up to 5 feet in height, are locally common. The ground flora is very dense and continuous. *Poa caespitosa* and *Lomandra longifolia* are co-dominants. Scattered throughout this community are single plants and small groups of *Hibbertia volubilis*, *Dianella coerulea*, *Scutellaria humilis*, *Plectranthus parviflorus*, *Festuca Hookeriana* (?), *Pteridium aquilinum* and *Helichrysum lucidum*. These are specially common on moist slopes where the soil is rather shallow and continual seepage of water takes place; in addition, *Ajuga australis*, *Crassula Sieberiana*, *Luzula campestris*, the ferns *Asplenium flabellifolium*, *Pleopeltis diversifolia*, *Polystichum aculeatum*, and the trailing Angiosperms *Tecoma australis*, *Rubus parvifolius* and *Smilax australis* are frequent.

The large number of ferns in the *Eucalyptus obliqua–E. viminalis* forests can be related to the very moist conditions prevailing there, this region being within the mist belt. Above this, though the conditions are no less moist, the ferns are less frequent, probably because of the colder temperatures. The moist conditions are reflected in the large number of mosses present on exposed rock surfaces and the lower parts of tree trunks.

(*d*) The *Eucalyptus fastigata* Forest.

At an altitude of 4,200–4,500 feet there is a considerable area to the south-east, east and north-east of the highest part of the plateau occupied by a distinctive forest in which *Eucalyptus fastigata* is dominant. *E. viminalis* is present as a sub-dominant species in the lower part of this forest, but does not extend upwards above 4,300 feet. This region is fairly flat for the most part, constituting the tops of the ridges diverging from the plateau whose sides are occupied by sub-antarctic rain-forest and by the *E. obliqua–E. viminalis* forests. The soil is particularly moist and the whole habitat distinctly more sheltered and less cold than the actual plateau. It is chiefly this forest area which is being invaded by the beech forest (see Fraser and Vickery, 1938) (Pl. ii, fig. 14). The transition between it and the *E. viminalis* forest is not abrupt, considerable mixing taking place in the ecotone region. On slopes or areas exposed to the action of the westerly wind this forest type is replaced by communities of *Eucalyptus pauciflora* invading from the plateau forest.

The trees of the *E. fastigata* forest average 60 to 80 feet in height and have a diameter of 2 to 3 feet (Pl. ii, fig. 13). The canopy is nearly closed but not dense. The ground flora is particularly well developed. The important component species are shown in Table 1, column 4. The low-shrub communities are rather more common and better developed than in the lower forests, forming mixed or pure communities over considerable areas. The individual plants are often evenly scattered. The tree-fern *Dicksonia antarctica* is common in damp areas, together with *Polystichum aculeatum* and such herbs as *Stellaria flaccida* and *Veronica calycina*. The herb stratum is dense and continuous. *Poa caespitosa* is perhaps slightly more abundant than *Lomandra longifolia* over most of the area. The bracken fern *Pteridium aquilinum* is fairly widely distributed, but does not form dense stands here. The only small tree is *Banksia integrifolia*, which is widespread and fairly abundant.

Tall shrubs, such as occur in the lower forests, are absent, and their place is taken by a shrub stratum 5 to 8 feet high comprising species which do not occur at lower altitudes, such as *Gaultheria appressa*, *Drimys purpurascens*, and *Olearia* spp., which in places form dense thickets. *Acacia melanoxylon*, *Tieghemopanax sambucifolius* and *Lomatia arborescens* are also part of this layer. The species of this stratum are marked off very distinctly from those of the low-shrub stratum by their larger size and larger leaves. The low-shrub communities are rather more common and better developed than in the lower forests, forming mixed or pure communities of large extent. The component species are small, woody perennials with stiff, small leaves, and rarely exceed 2 feet in height. *Leucopogon Hookeri* and *Omphacomeria acerba* are amongst the most important.

(*e*) The Vegetation of the Plateau.

1. The Eucalypt forest.

The plateau region at an altitude of 4,500 to 5,000 feet is exposed to considerable wind action, and is the only area in this region where snow lies for more than a few days at a time. At 4,500 feet the *E. fastigata* forest gives place to the typical forest of the Barrington Tops Plateau, in which *E. pauciflora* is the dominant species. On northerly, fairly sheltered slopes this species may attain a height of 60 feet and a diameter of 2 feet (Pl. ii, fig. 16). It becomes smaller with increasing exposure, and at 5,000 feet rarely exceeds 40 feet in height (Pl. ii, fig. 15). It is commonly rather gnarled and twisted. Possibly owing to the action of wind and snow and also to the rather brittle nature of the branches, fallen trees and broken limbs are a conspicuous feature of this forest community (Pl. ii, figs. 14, 16, 17), and are the more striking because of their absence or rarity in the lower forests.

The canopy is nearly continuous but very thin, and a considerable amount of light reaches the ground stratum. *Eucalyptus stellulata*, the only other tree occurring in this forest, is not a prominent species. It is most commonly found near water, and forms a community along creek banks and swamp margins.

The species found in this forest are shown in Table 1, column 5. The shrub strata reach their best development on the eastern and northern slopes of the hills. There are two strata, similar to those of the *E. fastigata* forest. The tall-shrub stratum includes such species as *Acacia dealbata*, *A. Clunies-Rossiae*, *A. melanoxylon*, *Hakea microcarpa*, *Persoonia oxycoccoides*, *Drimys lanceolata*, *D. purpurascens*, *Lomatia arborescens*, *Hovea longifolia* and *Olearia* spp. Some of these species, such as *Gaultheria appressa*, *Drimys purpurascens* and *Olearia* spp., appear to be relatively restricted to the south-eastern part of the plateau.

The small-shrub stratum includes small, upright, woody perennials such as *Leucopogon Hookeri*, *Pimelea linifolia* and *Comesperma sylvestre*, and a number of woody, prostrate or decumbent perennials such as *Pultenaea fasciculata*, *Leucopogon collinus*, *Persoonia oxycoccoides* and *Bossiaea neo-anglica*. The prostrate habit is most marked on wind-swept, exposed hillsides or hill tops. On sheltered slopes the same species may grow to the size of small bushes 2 to 3 feet in height.

The ground flora is very dense and consists predominantly of *Poa caespitosa*, which forms a thick, continuous carpet throughout the whole forest (Pl. ii, fig. 16). A number of herbaceous perennial and annual species and geophytic orchids are present between the clumps of *Poa*, the most important being *Candollea serrulata, Ranunculus lappaceus, Lotus corniculatus, Scleranthus biflorus, Prasophyllum* spp., *Lomandra longifolia, Dianella coerulea* and *Pteridium aquilinum*. *Glycine clandestina, Hovea heterophylla, Smilax australis* and *Rubus parvifolius* are trailing woody or semi-woody perennials mostly forming tangled masses on the ground stratum, but rarely ascending to the height of 2 to 3 feet over woody shrubs.

A considerable part of the plateau is composed of grano-dioritic rock and the remainder of basalt. The forest here described is that developed on the basaltic part, and a detailed examination of the granitic part has not been made. As far as could be seen, however, in preliminary surveys, the forest is slightly more open and the development of the shrub strata is not quite so pronounced on the soils derived from the granite. The ground flora is scarcely less luxuriant and appears to have a similar composition.

2. The swamps at the head-waters of the Barrington River.

As previously described (Fraser and Vickery, 1937), the Barrington Tops Plateau consists of rounded hills up to 200 feet high covered by *Eucalyptus pauciflora* forest. The southern part of the plateau is drained by a system of small, permanently running streams which converge to form the upper Barrington River. In the flatter places these streams are bordered by swamps, varying in size from a few square yards to a hundred acres or more (Pl. iii, figs. 21, 22, 23). The largest swamps occur along the main stream. They are not all at the same level. The successive swamps along the upper Barrington River are progressively lower, while those of the tributary streams may be at a much higher level than those of the main stream. The actual depth of the swamps does not appear to be more than 10 feet in any case, and is sometimes not more than 1 to 2 feet in the case of the restricted areas of swamps fringing the smaller streams.

After leaving the swamps the Barrington River plunges into a deep and inaccessible gorge dissecting the plateau edge on the eastern edge. Consequently there has been a slow cutting-back and deepening of the river bed progressively from the top of the gorge along the plateau for several miles. This has resulted in the partial or complete drainage of much land which appears to have been at one time occupied by typical swamp. Entrenchment is very slow and in this partly dissected region the river has deep, still pools alternating with short stretches of rapids (Pl. ii, fig. 18, Pl. iii, fig. 19).

A distinct and very dense river-bank flora composed of shrubs up to 10 feet high occupies the steep sides of the upper gorge below the level of the swamps. The following species are common: *Baeckea Gunniana* var. *latifolia, Leptospermum myrtifolium, Callistemon pallidus, Prostanthera lasianthos, Oxylobium ellipticum* var. *alpinum, Olearia chrysophylla, Phebalium squamulosum* and some *Dicksonia antarctica*. This gives way further down the gorge to beech forest particularly rich in tree-ferns (*Dicksonia antarctica*). A prominent feature of this phase of the river-bank flora is the presence of large and numerous plants of a stocky tree-fern, *Todea barbara*. This does not occur in any other part of the beech forest or sub-tropical rain-forest, and in this area is restricted to siliceous soil.

Undrained swamps occur around the actual head-waters of the Barrington River (Pl. iii, fig. 21). Here the water table is permanently high, much of the vegetation being just above the water level (Pl. iii, fig. 23). The main constituent of the swamps is the moss *Sphagnum*, which forms compact hummocks in places protruding above the water level. These support a large variety of geophytic and hemicryptophytic plants which flourish in the swamp only in these slightly drier areas, such as *Lagenophora Billardieri*, *Prasophyllum* spp., *Asperula conferta*, *Microtis* spp., *Ranunculus lappaceus*, *Euphrasia Brownii* var., *Utricularia dichotoma*, *Scaevola Hookeri*, *Deyeuxia breviglumis*, *Cardamine hirsuta* var. *tenuifolia* and *Plantago* spp. In the partly submerged areas between these hummocks *Carex cernua* var. *lobolepis* and *Scirpus Brownii* form a continuous stratum, with scattered communities of *Restio australis*, *Juncus falcatus*, *J. pallidus*, *Claytonia australasica*, *Euphrasia Brownii* var., and *Utricularia dichotoma*. *Carex Brownii* is especially common along the margins of the streams. *Myriophyllum pedunculatum* is common in the smaller, shallow creeks, where it often forms with *Sphagnum* compact, cushion-like masses at the level of the running water.

A definite border community, comprising small, woody shrubs and a number of herbs, occupies the edges of the swamps and any elevated, dry parts within them (Pl. iii, fig. 21). Around small swamps the border may not exceed a foot or so in width. The constituent species are *Poa caespitosa*, *Epacris* spp., *Hypolaena lateriflora*, *Oreomyrrhis andicola*, *Ajuga australis*, *Erigeron pappochromus*, *Scleranthus biflorus*, *Velleya montana*, *Scaevola Hookeri* and *Plantago* spp. The moss *Polytrichum australe* frequently forms a definite community behind the border herbs and shrubs. In some cases, especially around very large swamps, the border community may be 30 to 40 yards wide, consisting predominantly of *Hypolaena*, with scattered plants of *Epacris* spp. (Pl. iii, fig. 21).

3. The creek-edge communities.

Some of the species found in the swamp edge also form communities along the banks of the slightly swampy creeks which drain the upper parts of the hills (Pl. iii, fig. 19). Here they become taller and more robust than around the margins of the swamps. This is probably largely due to the greater degree of shelter received by them.

A number of species are present in the creek-bank flora which are not usually found bordering the swamps. These are *Billardiera longiflora*, *Leptospermum myrtifolium*, *Prostanthera lasianthos*, *Olearia chrysophylla*, *Baeckea Gunniana* var. *latifolia*, *Coprosma* spp. and *Epacris microphylla* var. *rhombifolia*. These communities rarely extend more than 3 to 6 feet on either side of the creek, and have a maximum height of 6 to 7 feet. They grade into a second type of creek-bank flora which appears to require more shelter. This is found only along fairly large, non-swampy creeks well entrenched between sheltering hills, and enclosed on either side by Eucalypt forest (Pl. ii, fig. 17). This community reaches a maximum height of about 30 feet. It is of mixed origin, in part consisting of elements from the beech forest, and in part of true alpine species not found in the main beech forest. It has been described briefly in a previous paper (Fraser and Vickery, 1938).

The species occurring here are *Nothofagus Moorei*, *Prostanthera lasianthos*, *Elaeocarpus holopetalus*, *Atherosperma moschatum*, *Libertia pulchella*, *Uncinia riparia*, *Hierochloa redolens* and *Polystichum aculeatum*. On the plateau this community is never very dense. As the main beech forest is approached it becomes more and more like it in composition and structure, and finally the plateau species, notably *Prostanthera lasianthos*, disappear entirely or are found only as border communities.

4. The grassland community.

Though the forest extends to the margins of the larger, non-swampy streams draining the hills, it does not extend down to the edges of the swamps, but ceases abruptly at a vertical level of about 20 to 30 feet above them (Pl. iii, figs. 21, 22, 23). The tree level is relatively higher above the larger swamps than above the smaller ones (cf. Pl. iii, figs. 21 and 23). Thus an area of grassland of varying width borders all the swamps.

The grassland is composed of species which form the low-shrub and herb strata in the forest, but not in the same proportions (for comparison see Table 1, columns 5 and 6). The grassland is more compact and lower in habit than the ground stratum in the forest. The principal and dominant species *Poa caespitosa* forms a continuous cover (Pl. iii, fig. 20). In this occur isolated individuals, clumps or societies of other species. The species present are shown in Table 1, column 5. A few species are apparently restricted to the grassland. Of these *Exocarpus nana* is the most noteworthy.

The habit of these species is chiefly very low; only a few exceed one foot in height. The community includes small, prostrate herbs such as *Scleranthus biflorus* and *Scaevola Hookeri*, rosette herbs such as *Ranunculus lappaceus* and *Plantago* spp., and small, woody perennials such as *Exocarpus nana*, *Pultenaea fasciculata*, *Pimelea linifolia* and *Comesperma sylvestre*.

5. Change of swamp to grassland and grassland to forest.

The first stages in swamp reclamation are shown in those swamps along the course of the river just below the undrained swamps. In the main swamps the water level of the draining stream is as high as the water level in the swamp (Pl. iii, fig. 23). The first sign of reclamation is the entrenchment of the stream and the consequent draining of the upper levels of the swamp (Pl. iii, fig. 24). As a result of this action the *Sphagnum* dies out, persisting in the damper depressions till a relatively late stage. *Hypolaena lateriflora*, *Epacris* spp. and *Poa caespitosa* become established over the greater part of the reclaimed area, but *Utricularia dichotoma*, *Claytonia australasica*, *Restio australis* and the sedges disappear. A few species which may have been present in the higher places before draining commenced persist throughout the process, e.g., *Scaevola Hookeri*, *Geranium pilosum* and *Ranunculus lappaceus*.

When the river is more entrenched, to a depth of about 3 to 4 feet, *Hypolaena lateriflora* and *Epacris* spp. disappear, *Poa caespitosa* becomes dominant, and the grassland species, e.g., *Pimelea linifolia*, *Comesperma sylvestre*, *Hakea microcarpa* and *Candollea serrulata* make their appearance. *Eucalyptus stellulata* becomes established along the banks of the streams (Pl. iii, figs. 25, 26).

Drained swamps passing to forest can be seen as wide, flat plains on the side of the river (Pl. iii, fig. 25). At this stage the river is entrenched about 10 to 12 feet, and *Eucalyptus pauciflora* seedlings are becoming established on these grassy flats.

6. River flora.

In the parts of the river draining the upper swamps, the flow of water is fairly swift, and *Myriophyllum pedunculatum* is the only aquatic Angiosperm species. Further down where the stream is slightly entrenched (Pl. iii, fig. 26), large, relatively still pools occur, and in these *Potamogeton tricarinatus* and *Ranunculus rivularis* are also present.

7. The flora of the western part of the plateau.

The Barrington Tops Plateau falls away rapidly on its western side, where it is drained by the upper Hunter River and its tributaries (Pl. xiv, fig. 3, in Fraser and Vickery, 1937). The rainfall on these western slopes is less than that of the eastern, southern and north-eastern slopes, and the evaporation rate is high, as the slopes are exposed to the full action of the westerly winds. This country has been extensively cleared for grazing.

The tree association is different from that found on the other slopes of the plateau, and is definitely related to that found on the central-western parts of the Main Dividing Range. Because of the amount of clearing which has taken place, it is not possible to determine exactly the nature of the original vegetation.

The following species of *Eucalyptus* occur: *E. sideroxylon*, *E. crebra*, *E. melanophloia*, *E. melliodora*, *E. laevopinea* and *E. Stuartiana*. The association appears to have been of the open forest or woodland type, with strong development of grasses, such as *Aristida* spp., *Dichanthium sericeum*, *Bothriochloa decipiens*, *Danthonia* spp. and *Eragrostis* spp. *Poa caespitosa* is absent. *Casuarina Cunninghamiana* occurs along river banks, and *Angophora subvelutina* on river flats.

The *Eucalyptus pauciflora* forest persists to the edge of the plateau, with a characteristic undergrowth of *Poa caespitosa*. *Acacia dealbata* is the most common shrub, which seems to indicate a great degree of disturbance by fire.

(*f*) Regeneration in the Eucalypt Forest.

The Eucalypt forests are, except for the lowest associations, uncleared and relatively undisturbed, except for occasional fires which destroy the undergrowth. The woody species quickly regenerate. Large stands of *Acacia mollissima* result in the lower forest, and of *A. dealbata* in the plateau forest. *Eucalyptus* saplings are not common in the forest between 1,800 and 4,800 feet, but are locally abundant below 1,800 feet in parts of the *E. saligna* forest, where trees have been felled.

In the *Eucalyptus pauciflora* forest, chiefly above 4,800 feet, where the canopy is light, *Eucalyptus* seedlings are quite common. This forest is subject to occasional burns and slight grazing by cattle. These do not seem to have had a modifying influence on the vegetation as a whole, but the burning may be partly responsible for the large numbers of *Eucalyptus* seedlings.

Except for occasional plants of *Erechtites arguta* and *Taraxacum officinale*, and in the upper forests *Picris hieracioides*, no plants not native to the area have become established in the main part of the forest. The plateau forest and the swamps, being subjected to grazing, have a few aliens established, of which the most important are *Trifolium repens* and *Sonchus oleraceus*.

Conclusions.

(*a*) The Eucalypt Forest Associations.

With the possible exception of the association of the western slopes of the plateau, the various types of Eucalypt forest here described all belong to the one formation, as all have a similar structure and appearance, though varying in height and density. The *Eucalyptus pauciflora* forest is the most open, and in places on some granite hillsides approaches in structure the open forest or woodland type.

Owing to the vertical sequence of species, each type of *Eucalyptus* forms a nearly pure consociation over most of its range in the area studied. An attempt has been made to group them into associations compatible with associations elsewhere. Owing to the broken nature of the topography of the east coast and highlands of New South Wales and the variety of climatological and soil habitats, the associations are often fragmentary in their occurrence. It is unlikely that a complete understanding of the associations and the principles underlying their distribution will be reached until ecological surveys of many more areas are available. The associations tentatively recognized in this area are interpreted as being local expressions of widely occurring associations. Elsewhere they rarely occur in vertical sequence in adjoining areas, as they do here, and there are considerable differences in detail, especially in the ground- and shrub-strata. This is probably due to the interaction of the associations and invasion from one to another, but may also be due in part to the fact that the Williams River forests are developed under very favourable soil and water conditions, which stimulate the development of a luxuriant ground flora.

Five main associations have been recognized in this area:

1.—*Eucalyptus pauciflora* and *E. stellulata* form a natural association on the plateau and are widespread in the colder parts of the dividing range from the New England Tableland to Victoria. *Poa caespitosa*, which is the chief element of the ground flora, extends throughout the range of the association as a sub-dominant. This type of association is here classed as forest, but in many parts of New South Wales it approaches the savannah woodland in structure.

2.—*Eucalyptus viminalis* and *E. obliqua* occur here mixed over a considerable area, though to a certain extent they occupy a different height range. They are interpreted as forming part of a large and widespread *E. viminalis–E. obliqua* association characteristic of fairly well watered soils in cool localities from Tasmania, South Australia and Victoria at low elevations, and at increasingly high elevations on the New South Wales Dividing Range to as far north as Dorrigo. Both species occur throughout the whole range of the association. In other localities associated Eucalypts are *E. rubida*, *E. dives* and *E. Blakelyi* towards the drier parts of its range, and *E. radiata* and *E. fastigata* towards the colder parts of its range.

E. fastigata, which in the area under investigation forms an almost pure consociation, is characteristic of well watered soils at high elevations on the southern and central highlands of New South Wales. It is frequently associated with *E. viminalis*, *E. obliqua* and *E. Dalrympleana*, and may perhaps best be regarded as a consociation within the *E. viminalis–E. obliqua* association, occurring only in cool localities which receive a well distributed rainfall.

3.—*Eucalyptus acmenioides*, *E. Wilkinsoniana* and *E. punctata* are part of an association of which *E. acmenioides*, *E. punctata* and *E. carnea* are dominants occurring on fairly heavy, moderately moist soils on the north coast of New South Wales. It is essentially an association of warm climates, and is present here in a depauperated form. To the north *E. propinqua* takes the place of *E. punctata*, and *E. carnea* also occurs. *E. punctata* extends southwards, where it occurs on fairly well watered and well drained sandy soils, on the margins of other associations.

E. campanulata may best be considered as forming part of this association, occurring along the upper limits of its range. It occurs at comparable positions at Comboyne, the upper Hastings River, and other parts of the northern tablelands.

4.—*Eucalyptus saligna* and *Syncarpia laurifolia* are the dominant species of a very well marked association restricted to deep, rich soils in well watered areas, especially on the northern parts of the coast. *E. grandis*, *E. microcorys*, *E. paniculata* and *E. pilularis* also form part of this association in other localities.

5.—*Eucalyptus hemiphloia* and *E. tereticornis* form extensive associations on clay and sandy soil in the drier parts of the coast. *E. maculata* is often associated with these species.

Casuarina Cunninghamiana forms a river-bank community, and *Angophora subvelutina* and *Eucalyptus amplifolia* river-flat communities occurring widely throughout the forest associations of the coast and highlands.

(*b*) Extent of the Associations.

The distribution and extent of the various associations in the Eucalypt-forest formation are governed by the individual requirements of the dominant species. The main factors governing distribution here are altitude and therefore temperature, and soil moisture. Each species has a different optimum temperature and soil-moisture requirement. The area offers a number of types of environment, the plateau being cold, the upper slopes cool and the lower slopes both warmer and drier than the upper. Since in this area good soil-moisture conditions prevail except on the slopes below 2,000 feet, temperature appears to be the main controlling influence, with soil-moisture conditions second in importance. This is evident from the vertical sequence of the forest above that level.

The boundary between the *Eucalyptus saligna* and the *E. campanulata* forest is probably conditioned by soil moisture rather than by temperature, as *E. saligna* occurs sporadically in the better watered parts of the slopes upwards to the lower edges of the *E. obliqua* zone. It appears probable that the upward extent of the *E. campanulata* and *E. saligna* forests is limited by frost, for within their canopies frost does not form at ground level. Within the *E. acmenioides–E. punctata* association distribution is conditioned by aspect, i.e., exposure to evaporation with its consequent effect on soil moisture and transpiration. This is very easily seen as the spurs and hollows provide a number of habitats in close proximity, and the change from one type of community to another, such as a community of *Eucalyptus acmenioides* with *Casuarina torulosa* on a north-eastern slope to a community of *E. campanulata* and *E. punctata* on the crest of a spur or a western slope, is very evident.

The only soil type is clay loam, below 2,000 feet derived from mudstone and alluvium, and above 2,000 feet from basalt. On the northern part of the plateau, outside the area considered in detail in this paper, the soil is a sandy loam derived from grano-diorite. None of the species of *Eucalyptus* here mentioned are restricted to basaltic soils, but many other species which occur elsewhere in association with them are not found on this soil type. Thus while temperature and rainfall are the main factors controlling the distribution of the associations, soil type may exert a considerable influence on the distribution of the species within it. The limited variety of soil types found in this area may therefore account for the fragmentary nature of the associations.

(*c*) Distribution of Shrubs and Ground Flora.

As far as the dominant *Eucalyptus* species are concerned the associations are fairly well defined. This does not apply equally to the undergrowth, as can be seen from a consideration of Table 1.

There appear to be two main types of undergrowth: (*a*) characteristic of low altitudes, and (*b*) characteristic of the sub-alpine forests. The floras of the intervening associations are mixtures, in various proportions, of these, together with a very few additional localized species. It can be seen at once that a fair proportion are limited in upward extent by cold temperature, i.e., by approximately the lowest limit of the formation of snow. A considerable number, however, range from plateau to valley floor. With the exception of *Poa caespitosa* and *Lomandra longifolia*, these are species of minor importance.

It can be seen that a greater number of species is restricted to the higher altitudes than to the lower, and that there is a greater total number of species occurring at the higher levels than at the lower. This is probably due to the greater amount of light and moisture available in the upper forests. The greatest development of shrubs in the lower forest takes place in areas of greatest moisture and shade. The species are quite distinct from those of the upper forest and are much more mesophytic.

The species restricted to the higher altitudes here are for the most part restricted to high altitudes elsewhere in the State, but a few, such as *Sphaerolobium vimineum*, *Candollea serrulata*, *Lotus corniculatus* and *Pimelea linifolia*, are commonly found at low levels along parts of the coast.

(*d*) Swamps.

The swamps of the Barrington Tops Plateau are similar in many respects to those occurring on the Kosciusko Plateau in the extreme southern part of the State, but they lack the diversity of species characteristic of these more alpine regions. The bog moss *Sphagnum* is the main constituent of the wettest parts in both localities. A similar ecotone or margin community is formed by *Hypolaena lateriflora* and *Poa caespitosa*, with *Hypolaena* extending further into the swamps than *Poa*. Such species as *Oreomyrrhis andicola*, *Euphrasia Brownii* var., *Restio australis* and the moss *Polytrichum commune* occur in both areas in this type of habitat. *Epacris serpyllifolia* and *Epacris paludosa*, which are important members of the margin community at Kosciusko, are replaced on the Barrington Tops Plateau by *Epacris breviflora* and *Epacris microphylla* var. *rhombifolia*, and *Plantago stellaris* and *P. Brownii* are replaced by *P. palustris*. A number of margin and swamp species present on the Barrington Tops do not occur at Kosciusko.

(*e*) Species Common to Swamp and Forest.

The species found both in the swamps and in the forests of the Barrington Tops Plateau are shown in Table 2. Some of these, such as *Deyeuxia breviglumis*, *Cardamine hirsuta* var. *tenuifolia*, *Scaevola Hookeri*, *Asperula conferta* and *Prasophyllum* spp. have the same appearance in both habitats. A number, however, are slightly modified. *Halorrhagis micrantha*, *Hydrocotyle hirta*, *Ajuga australis*, *Ranunculus lappaceus*, *Viola hederacea* and *Lagenophora Billardieri* are dwarfed, with smaller leaves and flowers, when growing in the swamp. *Epilobium glabellum* on the other hand produces larger flowers and has a more vigorous growth form in the swamp than in the forest.

The absence of *Eucalyptus pauciflora* from the region immediately surrounding the swamps is probably due to the waterlogging of the soil. This conclusion was also reached by McLuckie and Petrie (1927) in connection with the swamps at Kosciusko. *E. stellulata* appears to be capable of growing under conditions of greater soil moisture than *E. pauciflora*, as it is common along the margins of streams and parts of the swamps.

(*f*) Floristic Relationships.

1. The lower Eucalypt-forest.

The shrubs and herbs of the lower Eucalypt-forest are for the most part widely distributed elsewhere. Except for a few cosmopolitan species, they form, together with the species of *Eucalyptus*, a part of the "Australian Flora" (Maiden, 1914). The distribution of a few species is, however, of special interest.

Acacia elata occurs sparingly around the rain-forest margins at 2,000 feet and below. This is the most northerly occurrence of this species, which elsewhere appears to be restricted to cool, moist, sandy soils from Gosford south to Illawarra, and is specially common on the Blue Mountains.

The distribution of *Banksia integrifolia* is particularly interesting. This species occurs commonly along the coast of New South Wales in positions close to the salt water, and reappears again in the *Eucalyptus viminalis* association at elevations of 3,000 feet and above on the northern tablelands.

Acacia dealbata and *A. melanoxylon* are both southern species, reaching their best development in Tasmania, where they attain the dimensions of trees of 50 feet and 100 feet respectively. *A. dealbata* is characteristic of cold localities of moderate to good rainfall in light forest associations. The distribution of *A. melanoxylon* appears to be limited more by rainfall than by temperature, though it is best developed in cold localities. It is restricted to areas of fairly high rainfall. In the Williams River district it is most abundant in the upper forests. At 4,500 to 5,000 feet it forms a shrub 6 to 8 feet high, and at 3,500 to 4,000 feet a small tree up to 25 feet. It is also present occasionally in the lower sub-tropical rain-forest, where it attains a height of 40 to 50 feet. Its absence from the *Eucalyptus campanulata–E. acmenioides* forest must be attributed to the greater degree of dryness obtaining there.

Tieghemopanax sambucifolius, *Rapanea variabilis*, *Celastrus Cunninghamii* and *Breynia oblongifolia* are found in shady, moist areas throughout the coastal forests. They are especially well developed along creeks. *Tieghemopanax sambucifolius*, which is present sparingly in light places in the lower sub-tropical rain-forest and extends to 4,500 feet, has the greatest range.

Leptospermum flavescens is one of the most common tea-trees along creek banks on the shale and good sandstone soils of the central coast district. In this area it occurs only in a restricted range at 4,500 feet.

Lomatia arborescens has the same distribution and form in this locality as has *Acacia melanoxylon*. In the sub-tropical and sub-antarctic rain-forests it attains the dimensions of a tree, but at higher altitudes, where, on account of the greater rainfall, it is also present in the Eucalypt forest, it is a shrub 6 to 8 feet high. This species is restricted to comparable areas on the northern tablelands, such as at Barrington Tops, the Williams River, Comboyne and Dorrigo, but it is rather closely allied to *L. longifolia*, a river bank species extending to Victoria and best developed in the fern gullies there.

2. The sub-alpine forest and swamps.

The Australian Alps in the southern part of the State support a flora which may be termed sub-alpine to alpine, at 5,000 to 7,000 feet. The tree line there stands at about 6,500 feet, being lower on the western side. The Barrington Tops Plateau reaches an altitude of only 5,000 feet and does not support a truly alpine flora of the same extent and purity, nor does a tree line occur, the forest extending to the highest parts of the plateau.

There appears to be in the herb and shrub communities of the plateau an admixture of three more or less distinct floral assemblages, (*a*) sub-alpine, (*b*) montane, and (*c*) coastal. The distribution of the sub-alpine and montane species is shown in Table 3. The sub-alpine species occurring on the plateau are found exclusively on high mountain areas on the mainland, or in Tasmania, and in many cases Barrington Tops is the most northerly recorded locality (see Fraser and Vickery, 1937*a*). Important species are *Juncus falcatus*, *Scaevola Hookeri*, *Claytonia australasica*, *Exocarpus nana*, *Billardiera longiflora*, *Restio australis*, *Lycopodium clavatum* var. *fastigatum*, *Gentiana diemensis*, *Patersonia glauca*, *Hakea microcarpa*, *Baeckea Gunniana* var. *latifolia*, *Atherosperma moschatum* and *Coprosma* spp. Some of these are present also on the mountains of the central part of the coast, but a number are recorded only at Kosciusko and Barrington Tops, about 300 miles apart in a direct line.

The montane species are found on the New England Tableland or Blue Mountains, and have no special southern or alpine affinities. They include *Bossiaea neo-anglica*, *Persoonia oxycoccoides* and *Comesperma sylvestre*.

The third element in the plateau flora includes *Lotus corniculatus*, *Pimelea linifolia*, *Sphaerolobium vimineum*, *Candollea serrulata* and *Hovea heterophylla*. These species do not occur at lower levels in the Williams River district, but are found in areas of suitable soil moisture along the coast. Their presence on the plateau and absence from the lower forests may be due to the greater amount of water and greater degree of light on the plateau.

A feature of the vegetation of the plateau is the relatively large number of endemic species or varieties. *Drimys purpurascens*, *Plantago palustris*, *Diuris venosa* (Rupp, 1937), *Prasophyllum Rogersii* and possibly the forms of *Gentiana diemensis* and *Acacia Clunies-Rossiae* are restricted to this district.

The plateau is relatively isolated, being connected by lower mountains to the main range, which is itself lower than the plateau, and is surrounded on all other sides by low ground. The eroding action of the Hunter and Manning Rivers must have caused its isolation relatively soon after the conclusion of the uplift which was responsible for the formation of the main dividing range. The plateau is higher than any other large land mass north of the Kosciusko Plateau. The nearest area of similar type is the Ebor district in the New England Tableland, which it resembles in certain respects. Its altitude and high rainfall therefore seem to have permitted the survival of many species which are now gone from the intervening localities.

General Discussion.

Floristic Relationships of the Formations.

Maiden (1914), Herbert (1935) and others have pointed out that there are three main elements contributing to the formation of the flora of Australia as a whole, (*a*) Indo-Malayan, (*b*) Antarctic and (*c*) Australian. The Indo-Malayan species are allied to species occurring in the rain-forests of the Malayan Archipelago, and are regarded as having invaded Australia during the early Tertiary period along the east coast. The extent of the invasion has varied throughout subsequent geological history with changing climatic and physiographic conditions. Since Australia has been separated from the source of this flora since early Pleistocene times, the actual species and genera, though obviously related to the tropical families, are mostly endemic to Australia. Relatively few species are common to Australia and the Malay Archipelago (Merrill, 1923).

While most of the Indo-Malayan species are found only as members of the rain-forests of the coast, a number have become adapted to the more rigorous conditions of the drier Eucalypt forests. Examples of these are *Flindersia maculosa* in New South Wales and southern Queensland, *Atalaya hemiglauca* in western New South Wales, and *Alphitonia excelsa*, *Ficus rubiginosa* and *Alectryon* *subdentatus* on the western slopes of northern New South Wales. Others, which are perhaps intermediate in requirements between the rain-forest and Eucalypt-forest representatives of the Indo-Malayan flora, reach their best development in the more sunny, marginal parts of rain-forests; others again are restricted to river banks.

The Australian Flora is supposed by Andrews (1913, 1914, 1916) to have arisen in Western Australia in the early Tertiary, such families as the Epacridaceae, Proteaceae, sections of the Myrtaceae, Rutaceae and Leguminosae being best represented. Andrews postulates that this flora came to occupy the western and the poorer, drier soils of the eastern part of Australia, while the rain-forest of Indo-Malayan species occupied the better eastern soils.

Within the eastern part of the Australian flora a certain degree of specialization has taken place, a number of species being restricted to such habitats as alpine, desert, river bank, etc. As Herbert (1935) has pointed out, the rain-forests have been augmented by additions from the Australian flora which have become adapted to life under rain-forest conditions, and do not now occur elsewhere. Intermediate in requirements between these and the species of the open forests are certain species which are restricted to localities of good soil and rainfall. They are most common along sheltered water courses and form what Pidgeon (1938) has called the "gully flora" phase of the Eucalypt-forest formation. The gully flora is best developed in the southern parts of the State in localities which are either too cool or too restricted for the development of typical rain-forest. As can be expected, there is often a considerable admixture with rain-forest types, especially those characteristic of the margin communities. In the Williams River rain-forest a number of species are present which are probably representatives of the gully flora. These are *Acacia melanoxylon*, *Lomatia arborescens*, *Pittosporum* spp., *Tristania laurina*, *T. conferta* and *Trochocarpa laurina*. It is often not possible to decide, on the evidence so far available, from what system a species may have originated, e.g., *Callicoma serratifolia* and *Ceratopetalum apetalum*, which are common constituents of the gully flora and rain-forest margin communities, and in places extend into the rain-forest.

The sub-tropical rain-forest margin community is a definite ecological unit, but the component species are of diverse origin. It has a close relationship with the gully flora, which may perhaps be regarded as its southern expression. Margin communities are found bordering rain-forests throughout the coastal districts, and increase in variety of species to the north.

A similar relationship to that shown to the sub-tropical rain-forest by the margin community, is shown to the beech forest by a community comprising *Prostanthera lasianthos*, *Leptospermum flavescens*, *Hedycarya angustifolia*, *Trochocarpa laurina*, and the tree-fern *Dicksonia antarctica*.

Ecological Relationships of the Formations.

So long as a species fits into the general structure of a formation without disturbing the balance between the different life forms, it can be considered ecologically to form part of the formation, whatever its geographical associations may be. If, however, a species occurs in such numbers as to alter the appearance and destroy the typical structure of the formation, it is desirable to consider the resultant as a mixed formation. An example of the latter may be seen in the lower Chichester rain-forest, where *Tristania conferta* and *Eucalyptus saligna* form a type of mixed, open rain-forest with some true Indo-Malayan species.

A complete range of forest types between true rain-forest and Eucalypt forest could be found. In parts of southern Queensland and northern New South Wales communities occur which appear to be more or less stable and transitional between the two forest-types. In the southern and central parts of New South Wales the rain-forests become mixed with addition of margin and gully flora species. At Mt. Wilson (Brough, McLuckie and Petrie, 1924), for example, the formation has the structure of a sub-tropical rain-forest, and floristically is a mixture of Indo-Malayan, Antarctic and Australian elements. The presence of *Alsophila australis* and *Dicksonia antarctica* throughout the Mt. Wilson forest indicates that the canopy is less dense than that of the pure sub-tropical rain-forests in which these species never occur, but form communities around the margins.

Similarly in southern Queensland (Herbert, 1936) the sub-antarctic rain-forest is so mixed with Indo-Malayan species that the structure is greatly modified.

Petrie, Jarrett and Patton (1929) and Patton (1934) have stated that the plant communities of the moist gullies of the Blacks' Spur Region and eastern mountains of Victoria are related structurally and floristically to the Indo-Malayan rain-forests. The chief structural features of the tropical rain-forest are, however, almost completely lacking. The canopy formed by the upper tree stratum is, according to Patton (1934), so broken and discontinuous that a second layer of tall shrubs has been able to form, and it is these which, by producing a continuous canopy, are responsible for the reduction of light to the strata below. This is quite unlike the structure of typical rain-forest. The liane species, whose presence Patton stresses, are only three in number, and of these *Clematis aristata* is a margin or gully flora species. Large lianes such as *Vitis* spp. and *Palmeria scandens* are completely absent. As Herbert (1935) has pointed out, very few of the species are floristically related to the Indo-Malayan flora, the affinities of most lying with the Antarctic and Australian elements of the flora. The presence of the tree-ferns *Alsophila australis* and *Dicksonia antarctica* indicates that this is a less dense community than the true rain-forest. Patton has argued that because some of the component species show features which are considered to be primitive and characteristic of tropical countries, such as woodiness of the Compositae, and large size of the Gramineae, their presence confirms the tropical affinities of the community. The floristic relationships seem doubtful in view of the complete absence of similar species from the rain-forests of New South Wales and Queensland. Even if floristic relationships were stronger, the structure is such that an ecological relationship seems very distant and slight. Using the system of nomenclature followed in this paper, the Victorian fern gully association would be impure sub-antarctic rain-forest, with strong admixture with Eucalypt-forest gully flora species and a very few species, such as *Tieghemopanax sambucifolius*, which may be of Indo-Malayan origin.

Inter-relations of the Formations in the Williams River District.

It can be seen that, given uniform conditions, the rain-forest will advance over the Eucalypt forest, forming its own interior climate as it advances, and this is due to the inability of the Eucalypt-forest species to grow under conditions of low light intensity.

As the advance is relatively slow and the presence of only a few advance species will provide shelter for a second invasion of perhaps less hardy types, it follows that aspect is of secondary importance in deciding the composition of the final forest. Thus, though the advance up one slope may be fast and that up another very slow, the final result will be a mature forest of similar structure, and probably composition.

The sub-tropical rain-forest invades the adjoining formations as a unit. First tree seedlings and hardy epiphytes become established in the adjoining formation. These grow and are supplemented, providing a shade that causes the ground flora of the invaded formation to become weakened. Further shading results in the elimination of many of these species, and the rain-forest shrubs and herbs take their place. Epiphytes and lianes follow, and in time a mature forest of typical structure results. The trees of the invaded formation persist for the length of their usual lifetime, and then the species die out altogether, unless, like *Eucalyptus saligna* and *Syncarpia laurifolia*, they are able to regenerate.

The history of the Williams River rain-forest cannot, of course, be traced, but it is evident that much of the ground now covered by rain-forest previously supported a Eucalypt-forest formation. Fossil evidence from other parts of the State indicates that rain-forests were at one time far more extensive than they are at present (Brough, McLuckie and Petrie, 1924). It is suggested that after the orogenic movements of the late Tertiary, which apparently were the cause of a retrogression of the rain-forests by providing exposed land masses and alteration of precipitation, the rain-forests once more commenced to advance. In some areas their progress was stopped after a while by soil or rainfall conditions, but in other places, such as the Williams River district, it appears that a steady advance has taken place ever since.

Life-Form Spectra of the Formations.

The differences between formations are shown often very clearly by comparisons of life-form spectra, following the method of Raunkiaer (1934).

Table 4 gives the life-form spectra and Pteridophyte quotient of the various associations of the Eucalypt-forest formation, the total Eucalypt forest and the sub-alpine swamps, and also, for comparison, the sub-tropical and sub-antarctic rain-forests. The spectra for the Eucalypt-forest associations are all similar. The most significant features are the importance of the geophytes, mostly orchids, especially in the sub-alpine forests, and the relatively few therophytes. The greater number of nanophytes in the plateau forest is indicative of the greater amount of light reaching the lower strata there. In the lower forests, chamaephytes are in excess of hemicryptophytes. This relationship is reversed in the upper forest, which is to be expected because of the colder conditions obtaining there.

The spectrum for the sub-tropical rain-forest brings out very strongly the importance of the phanerophytes and epiphytes, and the unimportance of the chamaephytes and cryptophytes.

When considering the spectra of the sub-tropical and sub-antarctic rain-forests, the most conspicuous feature is the high Pteridophyte quotient of the latter, though the actual total number of species is very much fewer. The absence or paucity of hemicryptophytes, geophytes and therophytes in both rain-forests is a clear indication of the absence of dry conditions. The greater percentage of chamaephytes in the sub-antarctic rain-forest is a reflection of the greater amount of light reaching the ground there.

Allan (1937) has pointed out some of the weaknesses of a system devised with special reference to the climate of the cold temperate northern hemisphere. His remarks on the difficulty of classification of and diverse nature of the hemicryptophytes and chamaephytes of the New Zealand flora apply equally to the species of the Eucalypt forests here discussed, especially those of the sub-alpine forest, grassland and swamps. The altitudinal distribution of woody chamaephytes is similar to that found by Allan.

When the Eucalypt-forest spectrum is compared with spectra of the flora of arid parts of Australia (Adamson and Osborn, 1922) the most striking differences are seen in the chamaephyte and therophyte classes. At Mt. Lofty, South Australia (Adamson and Osborn, 1924), which has a period of drought during the summer months, there is a greater proportion of hemicryptophytes and fewer chamaephytes than in the Williams River forests.

General Summary.

The area studied includes the upper Williams and Allyn River valleys and adjacent ranges and the southern part of the Barrington Tops Plateau. This plateau is an isolated, elevated area of land of mature topography rising to an altitude of about 5,000 feet and lying at about latitude 32°S. and longitude 151·5°E. It is connected to the main dividing ranges by the Mount Royal Range, of which it is the southern extension. It is drained on its western and southern sides by the tributaries of the Hunter River, and on the eastern and north-eastern sides by the Karuah River and the tributaries of the Manning River. The topography of the upper valleys draining the plateau is very juvenile, the country often being very rough.

From about 1,800 feet to the summit of the plateau, the underlying rock is basaltic, with a large intrusive mass of a dioritic nature. Below this level, in the valleys and sides of the ridges, Carboniferous limestones and mudstones outcrop. The soil appears to be of fairly good quality throughout the area studied, and its water-retaining capacity is high.

The annual rainfall received by the highland mass and the upper parts of the river valleys draining it is high (probably about 8,000 points p.a.). The average annual rainfall decreases to the west, south and east of the plateau region, which is therefore surrounded by a drier zone.

Three plant-formations are present in the area studied: (1) sub-tropical rain-forest; (2) sub-antarctic rain-forest or beech forest; (3) Eucalypt forest.

The sub-tropical rain-forest is a tall, dense forest composed largely of trees belonging to many genera and families. The tree stratum is continuous and the most conspicuous, while the shrub and herb strata are relatively scanty. Lianes and epiphytic ferns, orchids, mosses and lichens are common. The canopy is very dense and prevents all but a small proportion of the light from reaching the ground beneath. The species present show affinities with the species of the flora of the islands of the Malayan Archipelago.

This forest type occurs in sheltered valleys in the upper parts of the rivers draining the southern and eastern parts of the plateau, at an altitude of about 1,000 to 3,000 feet. At the higher altitude it gives place to the sub-antarctic rain-forest.

The sub-tropical rain-forest is not homogeneous in composition, and no species assumes any marked degree of dominance. In one area certain species may be present in large numbers, and in another these species may be absent and different species numerous. This variation is due in some particular cases to variations in the habitat; for example, communities of water-loving species are found only in wet places in the forest. Many other variations, however, are probably due to chance.

The density of the rain-forest varies from 1·9 to 9·15 trees more than 30 feet high per 100 square feet, and from 11·74 to 23·49 total trees and tall shrubs per 100 square feet in the areas analysed. The greatest density is found in the main valley and the least on the slopes at the side of the main valley.

The sub-tropical rain-forest is advancing over the Eucalypt forest except at high altitudes, where its advance is stopped by the low temperature. This advance is possible because the species found in the Eucalypt forest are light-loving forms, and the establishment of rain-forest species and consequent formation of a dense canopy cause them to die out. The rapidity of the advance depends on the position, the most rapid advance taking place on sheltered, moist slopes.

Special features characteristic of the sub-tropical rain-forest, such as lianes, epiphytes, buttressing of tree trunks, and leaf features, are described.

Regeneration of the sub-tropical rain-forest after partial destruction is considered.

A comparison is made with the sub-tropical rain-forests of some of the associated river valleys. The distribution of a number of species is described, and it is concluded that there has been an invasion of the area by rain-forest species from the north-east.

The sub-tropical rain-forest becomes less rich in species with increasing altitude. It ceases at the altitude at which snow forms, and is replaced here by the sub-antarctic rain-forest. The transition from sub-tropical to sub-antarctic rain-forest is described.

The sub-antarctic rain-forest is a tree formation dominated by the antarctic beech *Nothofagus Moorei*. The canopy is moderately dense and very thick. Stratification is less marked in this forest, and relatively few small trees and shrubs are present. In wet areas *Polystichum aculeatum* and the tree-fern *Dicksonia antarctica* are common, but they are scarce in areas of good drainage. This formation occurs on sheltered slopes and along creeks from 3,000 to 5,000 feet.

The density of the sub-antarctic rain-forest is about 2·4 trees and about 4·6 to 7·6 total trees and shrubs per 100 square feet. Lianes are few, and angiospermic epiphytes are almost absent, probably because of the low temperatures. Epiphytic mosses and lichens are abundant.

The sub-antarctic rain-forest is advancing over the adjacent Eucalypt-forest except at its lowest margin, where it is probably stopped by high temperature.

Certain species form definite margin communities round the sub-tropical and sub-antarctic rain-forests.

The Eucalypt-forest formation surrounds the two rain-forest formations, occurring in areas of less shelter and moisture. It comprises a tree stratum consisting of various species of *Eucalyptus* which form a more or less continuous but relatively thin canopy, a discontinuous small-tree stratum, a tall-shrub stratum 6 to 8 feet high, a low-shrub stratum and a ground stratum. The shrub strata are usually discontinuous, but may be continuous over some areas. The ground stratum is usually continuous.

The Eucalypt forest occupies the ridge tops and upper slopes from 1,400 to 5,000 feet, and also the valley floor and slopes below 1,000 feet. The largest trees are found adjacent to the sub-tropical rain-forest in the valley floor and lower slopes at 1,000 to 1,500 feet. The average tree-height decreases from more than 150 feet on the valley floor to less than 40 feet on the more exposed parts of the plateau.

The composition of the forest varies with altitude. The following association groupings have been made:

(1) *Eucalyptus tereticornis–E. maculata–E. hemiphloia* association, characteristic of the rather dry valley floor and slopes below 900 feet.

(2) An association characterized by *E. saligna* and *Syncarpia laurifolia*, which occurs on the lower slopes and valley floors in situations of good soil moisture

and shelter at 900 to 1,400 feet. Trees of this association also occur scattered throughout the sub-tropical rain-forest.

(3) *E. punctata–E. acmenioides* association with *E. campanulata*, *E. Wilkinsoniana* and *Casuarina torulosa*, characteristic of the ridge tops and slopes from 1,400 to 3,000 feet. In the lower part of this association the *Eucalyptus* species occur together, but towards its upper limit it is represented by an almost pure forest of *E. campanulata*.

(4) *E. obliqua–E. viminalis* association with *E. fastigata*, characteristic of upper spurs and ridges from 3,000 to 4,500 feet. *E. obliqua* occupies the lower altitudes, and *E. fastigata* forms an almost pure consociation at the higher altitudes of this association.

(5) *E. pauciflora* and *E. stellulata* association, characteristic of the plateau forest at 4,500 to 5,000 feet.

In this formation the undergrowth does not vary very much with each association. Two main types of undergrowth occur, one characteristic of low altitudes, and another characteristic of high altitudes. The undergrowth at any particular altitude is largely a mixture in various proportions of these. Some species range from the valley floor to the plateau. The most important of these is the "tussock grass" or "snow grass" *Poa caespitosa*. This is present in the herb stratum of the valley floor, becomes increasingly important at higher altitudes, and at 5,000 feet is the most important species in the herb stratum. Shrubs become more important at high altitudes.

The floras of the swamps and creek banks at the head-waters of the Barrington River are described, and the successive stages in the drainage of the swamps are indicated. The swamps are surrounded by a zone of grassland, which separates them from the *E. pauciflora* forest, the development of which is apparently limited by the high water-table around the swamps.

The distribution of the alpine and montane species is discussed. The flora of the plateau appears to have two main constituents, one which is present also in the southern alpine regions of New South Wales and in Tasmania, and another characteristic of high altitudes in the northern parts of New South Wales. As well as these there are a number of species which also occur near sea level on parts of the coastal districts.

Lists of species occurring in the various formations and associations described have been compiled. The life-form spectra of the Eucalypt-forest associations and of the sub-tropical and sub-antarctic rain-forests are discussed.

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EXPLANATION OF PLATES I-III.

Plate i.

1.—A partially cleared area of Eucalypt forest on the valley floor of the Williams River, at an altitude of about 1,000 feet, showing *Eucalyptus saligna* (about 150 feet high) and *Casuarina torulosa.*

2.—*Eucalyptus saligna* forest, with occasional *Syncarpia laurifolia* trees, and a ground flora of *Imperata cylindrica* var. *Koenigii.* Rain-forest along the side of a sheltered creek can be seen on the right. (Altitude about 1,200 feet.)

3.—A pure stand of *Eucalyptus saligna* (about 150 feet high) on a westerly-facing hillside. (Altitude about 1,300 feet.)

4.—The mingling of two associations, *Eucalyptus saligna* with *E. acmenioides* and *E. Wilkinsoniana* on a north-easterly-facing slope of the Williams Range at an altitude of about 1,300 feet. Trees about 160 feet high.

5.—*Eucalyptus campanulata-E. acmenioides* forest (about 120 feet high) with *Casuarina torulosa*, on a north-easterly-facing slope of the Williams Range, at about 1,500 feet.

6.—Mixed *Eucalyptus punctata-E. campanulata* forest at an altitude of about 1,700 feet on the Chichester Range.

7.—*Eucalyptus punctata* on the crest of the Chichester Range at about 1,800 feet. *E. campanulata* and *Casuarina torulosa* occur on the right.

8.—*Eucalyptus campanulata* on the crest of the Williams Range at about 1,800 feet; ground flora of *Imperata cylindrica* var. *Koenigii, Pteridium aquilinum, Lomandra longifolia* and scattered small shrubs in the foreground.

9.—A ground community of *Culcita dubia* in a forest of *Eucalyptus saligna* and *Casuarina torulosa* on a sheltered south-easterly-facing slope, just above the sub-tropical rain-forest association. *Poa caespitosa* and other grasses occur in the foreground.

11.—*Eucalyptus viminalis* (with white trunks) and *E. obliqua* (with stringy-bark); ground flora of *Poa caespitosa*, and *Lomandra longifolia*. (Altitude about 3,800 feet.)

Plate ii.

10.—*Eucalyptus obliqua* forest with *E. saligna* intrusive into it along the margins of a sheltered creek. Rain-forest elements are present in a soakage area in the background. (Altitude about 3,000 feet.)

12.—*Eucalyptus viminalis, E. obliqua* and *Banksia integrifolia*, with a ground flora of *Lomandra longifolia* and *Poa caespitosa*. (Altitude about 4,000 feet.)

13.—*Eucalyptus fastigata* forest with *Banksia integrifolia*, showing the presence of tree-ferns (*Dicksonia antarctica*) in sheltered areas. (Altitude about 4,700 feet.)

14.—On the right, *Nothofagus Moorei* at the head of a creek, facing north; on the left, *Eucalyptus fastigata* forest with a ground flora of *Poa caespitosa, Lomandra longifolia*, and some small plants of *Lomatia arborescens*. (Altitude about 4,800 feet.)

15.—*Eucalyptus pauciflora* trees on the southern edge of the Barrington Tops Plateau, showing their stunted habit. The steep upper slopes of the escarpment can be seen on the extreme right.

16.—*Eucalyptus pauciflora* forest with a ground flora of *Poa caespitosa, Lomandra longifolia* and scattered shrubs on the Barrington Tops Plateau at an altitude of about 4,800 feet.

17.—*Eucalyptus pauciflora* forest (in foreground) in contact with a border community of *Nothofagus Moorei, Atherosperma moschatum, Prostanthera lasianthos*, etc., along a creek on the Barrington Tops Plateau.

18.—*Eucalyptus pauciflora* woodland with a ground flora of grass and scattered shrubs, on the upper Barrington River. (Altitude about 4,500 feet.)

Plate iii.

19.—Grano-diorite country on the Barrington Tops Plateau showing scattered boulders. A small-shrub community occurs near the river, with grassland and *Eucalyptus pauciflora* forest behind. (Altitude about 4,500 feet.)

20.—Grassland community on the Barrington Tops Plateau showing the shrub and grass strata; *Eucalyptus stellulata* trees occur in the background,

21.—Swamp and grassland areas on the Barrington Tops Plateau at an altitude of 4,500-5,000 feet. *Eucalyptus pauciflora* forest covers the hills in the background.

22.—A comparatively small swamp through which the meandering course of the stream fringed by tall sedges can be seen. *Eucalyptus pauciflora* forest occurs in the hillsides, and some trees of *E. stellulata* along the creeks and margins of the swamp. (Altitude about 4,500 feet.)

23.—*Eucalyptus pauciflora* forest, grassland and swamp communities on the Barrington Tops Plateau. *E. stellulata* occurs by the margin of the small creek where it enters the swamp. A community of *Restio australis* can be seen in the foreground beside the stream draining the swamp.

24.—A partly entrenched creek in a swamp on the Barrington Tops Plateau.

25.—The upper Barrington River entrenched below the level of old swamps. *Eucalyptus stellulata* occurs along the river banks.

26.—The upper Barrington River entrenched below the level of ancient swamps (the flat ground in the background) which it has drained. *Eucalyptus stellulata* occurs along the river banks, *Poa caespitosa* in the foreground.

TABLE 1.

List of Plants occurring in the Eucalypt Forest Associations.

Life forms classed according to Raunkiaer's (1934) system.
W, woody ; R, rare ; S, scanty ; F, frequent ; C, common ; LC, locally common ; VC, very common.
Col. 1—*E. saligna-Syncarpia laurifolia* Association.
Col. 2—*E. campanulata-E. acmenioides-E. punctata* Association.
Col. 3—*E. viminalis-E. obliqua* Association.
Col. 4—*E. fastigata* Community.
Col. 5—*E. pauciflora* Association.
Col. 6—Sub-alpine Grassland.
Col. 7—Sub-alpine Swamp.

Species.	Life Form.	1	2	3	4	5	6	7
Pteridophyta.								
Dicksoniaceae.								
Dicksonia antarctica Labill. ..	N				LC	S		
Cyatheaceae.								
Alsophila australis R.Br.	N		S	S				
Polypodiaceae.								
Adiantum aethiopicum L.	H	S	R					
formosum R.Br.	H			S				
Asplenium flabellifolium Cav. ..	H			F				
Blechnum capense Schlecht. ..	H				R			
cartilagineum Sw.	H-Ch	LC	S-R					
penna-marina Kuhn.	H				S	S		
Culcita dubia Maxon.	H	LC	LC-VC	LC				
Cyclophorus serpens C. Chr. ..	E			S				
Davallia pyxidata Cav.	E	R	R					
Doodia aspera R.Br.	Ch	S	S	F				
Histiopteris incisa J.Sm.	H			S				
Lindsaya linearis Sw.	H					S	S	
Pellaea falcata Fée	H			S-F				
paradoxa Hook.	H	R	R					
Pleopeltis diversifolia Melvaine ..	N			S		R	R	
Platycerium bifurcatum C.Chr. ..	E	R	R					
Polystichum aculeatum Schott. ..	H			F	F	S		
Pteridium aquilinum Kuhn. ..	G	F	F	F	F	S		
Gleicheniaceae.								
Gleichenia flagellaris Spreng. ..	H			LC				
Ophioglossaceae.								
Botrychium australe R.Br.. ..	G	S	S					
Lycopodiaceae.								
Lycopodium clavatum L. var. *fastigiatum* Benth.	G					S	LC	
Monocotyledons.								
Potamogetonaceae.								
Potamogeton tricarinatus F.v.M. ..	HH							LC
Gramineae.								
Agropyrum scabrum Beauv. ..	H					S		
Cymbopogon refractus A.Camus ..	H		S					
Danthonia penicillata F.v.M. ..	H			S	S	S		
Deyeuxia breviglumis Benth. ..	H-Th					F	F-C	LC
rudis Roem. & Schult.	Th					S		
Dichelachne micrantha Domin. ..	H		S	S	S	S		
Digitaria parviflora Hughes ..	H		S					
Entolasia marginata Hughes ..	H-Ch	S	S					
stricta Hughes	H-Ch		S					
Festuca Hookeriana F.v.M. ..	H			LC				
Hierochloa redolens R.Br. ..	H					S		
Imperata cylindrica var. *Koenigii* Durand & Schinz.	G	S	LC					

TABLE 1.—*Continued.*

Species.	Life Form.	1	2	3	4	5	6	7
Microlaena stipoides R.Br.	H-Ch	S	S					
Panicum fulgidum Hughes	H	S	S					
pygmaeum R.Br.	Ch	C						
Paspalidium distans Hughes	H	R						
Poa caespitosa G.Forst. (sensu lato)	H	F	C	C	VC	VC	VC	S
Sorghum leiocladum C. E. Hubbard	H		S	S	S	S		
Themeda australis Stapf.	Ch	S	F	S	S	S		
Cyperaceae.								
Carex Brownii Tuck.	H							C
cernua var. *lobolepis* Kükenth.	H							C
Gahnia melanocarpa R.Br.	H			S	S			
Lepidosperma laterale R.Br.	H	R	R					
Schoenus apogon Roem. & Schult.	H					S	F	C
ericetorum R.Br.	H					S	F	C
Scirpus setaceus L.	H					S	F	C
Uncinia riparia R.Br.	H					F		
Restionaceae.								
Hypolaena lateriflora Benth.	H						F	C-VC
Restio australis R.Br.	H							LC
Juncaceae.								
Juncus falcatus E.Mey.	H							LC
pallidus R.Br.	H							LC
pauciflorus R.Br.	H	S			S			
Luzula campestris DC.	H			S		F	F	
Liliaceae.								
Arthropodium paniculatum R.Br.	G	LC	S	LC	LC	C	C	
Dianella coerulea Sims	Ch	S	S	LC	F	F		
Geitonoplesium cymosum A.Cunn.	N			S				
Lomandra longifolia Labill.	H	S	F	C	C	C	R	
Smilax australis R.Br.	N			S-F	S	F		
Xanthorrhoea resinosa Pers.	N		S					
Iridaceae.								
Libertia pulchella Spreng.	Ch					S		
Patersonia glauca R.Br.	H					R		
Orchidaceae.								
Acianthus fornicatus R.Br.	G	S	S					
Adenochilus Nortonii Fitzg.	G							S
Chiloglottis Gunnii Lindl.	G				LC	S		
trapeziformis Fitzg.	G		S					
Corysanthes bicalcarata R.Br.	G	R						
Cymbidium suave R.Br.	E		F					
Diuris venosa Rupp	G						LC	C
Gastrodia sesamoides R.Br.	G					F		
Microtis parviflora R.Br.	G			F	F	F	F	F
porrifolia R.Br.	G	S		F		F	F	F
Prasophyllum brevilabre Hook. f.	G					LC	LC	LC
fimbriatum R.Br.	G		R					
odoratum Rogers	G					LC	LC	LC
Rogersii Rupp	G							LC
Ruppii Rogers	G		R					
Pterostylis acuminata R.Br.	G	S						
coccina Fitzg.	G	LC	LC			S		
cynocephala Fitzg.	G							S
decurva Rogers	G					S		
grandiflora R.Br.	G	S	F					
longifolia R.Br.	G	S	S					
nutans R.Br.	G	LC	LC					
Spiranthes australis Lindl.	G	R						
Thelymitra ixioides Swartz.	G					LC	LC	LC
venosa R.Br.	G							LC

TABLE 1.—*Continued.*

Species.	Life Form.	1	2	3	4	5	6	7
Dicotyledons.								
Casuarineae.								
Casuarina torulosa Ait.	M	S	LC	R				
Proteaceae.								
Banksia integrifolia L.	M		R	LC	LC			
Hakea eriantha R.Br.	N			S				
microcarpa R.Br.	N					LC	LC	
Lomatia arborescens Fraser & Vickery	N-M			S	F	S		
Persoonia linearis Andr.	N-M		S					
oxycoccoides Sieb.	N					F	LC	
Santalaceae.								
Exocarpus nana Hook. f. ..	Ch (W)						S	
Omphacomeria acerba A. DC. ..	N				LC			
Loranthaceae.								
Loranthus Betchei Blakely.. ..	E		S					
Portulacaceae.								
Claytonia australasica Hook. f. ..	Ch							LC
Caryophyllaceae.								
Scleranthus biflorus Hook. f. ..	H-Ch					S	F	F-LC
Stellaria flaccida Hook.	H-Ch			S	S			
pungens Brongn.	H				S	S		
Ranunculaceae.								
Ranunculus lappaceus Sm. ..	H	F	S	S	F	VC	VC	C
rivularis Banks & Sol.	HH							LC
Winteraceae.								
Drimys lanceolata Baill.	N					LC		
purpurascens J.Vickery ..	N				S	LC		
Monimiaceae.								
Hedycarya angustifolia A.Cunn. ..	N			S				
Cruciferae.								
Cardamine hirsuta L. var. *tenuifolia* F.v.M.	Th			S	S	S		F
Crassulaceae.								
Crassula Sieberiana Druce ..	Th			LC				
Pittosporaceae.								
Billardiera longiflora Labill. ..	N					R		
scandens Sm.	N	S						
Citriobatus multiflorus A.Cunn. ..	N			S	R			
Rosaceae.								
Acaena sanguisorba Vahl. ..	Ch	S	R	F				
Rubus parvifolius L.	Ch-N	S	S	S	S	S		
Leguminosae.								
Acacia Clunies-Rossiae Maiden ..	N					S	LC	S
dealbata Link.	N-M					C		
floribunda Sieb.	M			F				
melanoxylon R.Br.	M			LC	LC	F		
mollissima Willd.	M	LC	LC					
Bossiaea neo-anglica F.v.M. ..	Ch (W)					S		
Desmodium brachypodium A.Gray..	Ch-N		S					
rhytidophyllum F.v.M.	Ch-N		S					
varians Endl.	Ch-N	S	S					
Glycine clandestina Wendl. ..	Ch-N	S	S			S		
Hardenbergia monophylla Benth.	Ch-N		F					
Hovea heterophylla A.Cunn. ..	Ch-N					S	S	
longifolia R.Br.	N					S		
Indigofera australis Willd. ..	N	R	LC					
Kennedya rubicunda Vent. ..	Ch-N	S	S	S				
Lotus corniculatus L.	Th					C	C	

TABLE 1.—*Continued.*

Species.	Life Form.	1	2	3	4	5	6	7
Oxylobium ellipticum R.Br. var.								
alpinum Maiden & Betche	N					S		
trilobatum Benth.	N		LC	LC				
Pultenaea fasciculata Benth.	Ch (W)					LC	LC	
Sphaerolobium vimineum Sm.	Ch					S	S	
Trifolium repens L.	H						R	
Zornia diphylla Pers.	Ch	S	R					
Geraniaceae.								
Geranium pilosum Forst.	Th	R	R	S	S	S		S
Rutaceae.								
Phebalium squamulosum Vent.	N					R		
Polygalaceae.								
Comesperma sylvestre Lindl.	N					F	S	
Euphorbiaceae.								
Breynia oblongifolia J.Muell.	N	S						
Poranthera microphylla Brongn.	Ch-Th	S	S					
Celastraceae.								
Celastrus Cunninghamii F.v.M.	N	S						
Dilleniaceae.								
Hibbertia dentata R.Br.	Ch-N	S	S	S				
volubilis Andr.	Ch-N	S	F	F				
Guttiferae.								
Hypericum japonicum Thunb.	Th	S	S					
Violaceae.								
Hymenanthera dentata R.Br.	N			S				
Viola betonicifolia Sm.	H	S	F	LC	LC	S	S	
hederacea Labill.	H-Ch	F	S	S	S	S	S	LC
Thymeliaceae.								
Pimelea ligustrina Labill.	N					S		
linifolia Sm.	N					F	LC	
Myrtaceae.								
Angophora subvelutina F.v.M.	MM	S						
Baeckea Gunniana Schau. var.								
latifolia Benth.	N					F		
Callistemon pallidus DC.	M					S		
salignus DC.	M	LC	S					
Eucalyptus acmenioides Schau.	MM	S	LC					
amplifolia Naudin	MM	S	R					
campanulata R.T.Baker	MM		VC					
fastigiata Deane & Maiden	MM			R	C			
obliqua L'Hér.	MM			C				
pauciflora Sieb.	M				S	VC		
punctata DC.	MM		LC					
saligna Sm.	MM	C	F	R				
stellulata Sieb.	M					LC		
viminalis Labill.	MM			C	S			
Wilkinsoniana R.T.Baker	MM	R	S					
Leptospermum flavescens Sm.	N				S			
myrtifolium Sieb.	N					F		
Myrtus Beckleri F.v.M.	N	S						
Syncarpia laurifolia Ten.	MM	F	R					
Tristania laurina R.Br.	N-M	LC		LC				
Oenotheraceae.								
Epilobium glabellum G.Forst.	H-Ch					S	S	LC
Halorrhagaceae.								
Halorrhagis micrantha R.Br.	Th							LC
tetragyna Hook. f.	Ch	S	S	S				
teucrioides P. DC.	Ch				S	S		
Myriophyllum pedunculatum Hook. f.	HH							LC

TABLE 1.—*Continued.*

Species.	Life Form.	1	2	3	4	5	6	7
Araliaceae.								
Astrotricha floccosa DC.	N			LC				
Tieghemopanax sambucifolius R.Viguier	N	R		LC	LC			
Umbelliferae.								
Apium leptophyllum F.v.M. ..	Th	S	S					
Daucus brachiatus Sieb.	Th		S					
Hydrocotyle geranifolia F.v.M. ..	Ch-H	F	S					
hirta R.Br.	Ch-H	S		S		S	S	LC
Oreomyrrhis andicola Endl. ..	H					S		LC
Ericaceae.								
Gaultheria appressa A.W.Hill ..	N				LC	LC		
Epacridaceae.								
Epacris microphylla R.Br. var. *rhombifolia* Fraser & Vickery	N							LC
breviflora Stapf.	N							LC
Leucopogon collinus R.Br.. ..	Ch (W)					LC	LC	
Hookeri Sond.	Ch (W)				LC	C	C	
lanceolatus R.Br..	N		S	LC	LC			
Myrsinaceae.								
Rapanea variabilis Mez.	N	S						
Primulaceae.								
Lysimachia japonica Thunb. ..	Ch	R						
Oleaceae.								
Notelaea venosa F.v.M.	M			S				
Loganiaceae.								
Mitrasacme serpyllifolia R.Br. ..	H-Ch					LC	F	S
Gentianaceae.								
Gentiana diemensis Griseb. var. ..	Th					S		
Convolvulaceae.								
Dichondra repens R. & G.Forst. ..	H	S						
Borraginaceae.								
Myosotis australis R.Br.	Th							S
Labiatae.								
Ajuga australis R.Br.	H			LC	S	S	F	LC
Brunella vulgaris DC.	H	S						
Mentha gracilis R.Br.	Ch	LC	R					
Plectranthus parviflorus Henck. ..	Ch	S		S				
Scutellaria humilis R.Br. ..	Ch	R		S				
Prostanthera lasianthos Labill. ..	N					LC		
Scrophulariaceae.								
Euphrasia Brownii F.v.M. var. ..	Th-H					S	S	C
Gratiola peruviana L.	Ch	S						
Veronica calycina R.Br.	Ch			S	LC			
plebeja R.Br.	Ch	F	S					
Bignoniaceae.								
Tecoma australis R.Br.	N			S				
Lentibulariaceae.								
Utricularia dichotoma Labill. ..	H							C
Acanthaceae.								
Eranthemum variabile R.Br. ..	H	F	S					
Plantaginaceae.								
Plantago palustris Fraser & Vickery	H							LC
varia R.Br.	H	R				R	S	F
Rubiaceae.								
Asperula conferta Hook. f. ..	Ch							LC
Coprosma Billardieri Hook. f. ..	N				F	F		
hirtella Labill.	N				F	F		
Galium australe DC.	Ch	R						

TABLE 1.—*Continued.*

Species.	Life Form.	1	2	3	4	5	6	7
Campanulaceae.								
Lobelia gibbosa Labill.	Th			F				
pedunculata R.Br.	Ch	S	R	LC	F	F	F	F
Wahlenbergia gracilis A. DC. ..	Th		S	S	S	F	F	
Goodeniaceae.								
Goodenia hederacea Sm.	Ch	R	R					
Scaevola Hookeri F.v.M.	Ch					F	LC	LC
microcarpa Cav.	Ch	S	R					
Velleia montana Hook. f. ..	H							F
Candolleaceae.								
Candollea serrulata Labill. ..	Ch			S	C	VC	C	
Compositae.								
Centipeda orbicularis Lour. ..	Th	S	S					
Cotula australis Hook. f. ..	Th					S		
filicula Thunb.	Ch				S	R		
Craspedia Richea Cass.	Th-H				LC	C	C	
Erechtites arguta DC.	Th-H				R			
Erigeron pappochromus Labill. ..	H					LC		S
Gnaphalium japonicum Thunb. ..	Ch	S	S					
Helichrysum lucidum Henck. ..	Ch			S	S	LC	LC	
elatum A.Cunn.	Ch					LC	C	
ferrugineum Less.	N					S		
scorpoides Labill.	Ch					F		
Lagenophora Billardieri Cass. ..	H-Ch		S			S	S	LC
emphysopus Hook. f.	H-Ch					F	LC	
Olearia chrysophylla Benth. ..	N					LC		
Nernstii F.v.M.	N		S	S	LC	S		
stellulata DC.	N				LC	LC		
Picris hieracioides L.	Th				LC	LC		
Podolepis acuminata R.Br. ..	Ch		LC					
Senecio amygdalifolius F.v.M. ..	N	R	R	LC	S			
dryadeus Sieb.	N			LC				
Siegesbeckia orientalis L.	Th	S	S					
Vernonia cinerea Less.	Ch	S	LC					

TABLE 2.

Species Common to the Sub-alpine Forest or Grassland and the Swamps.

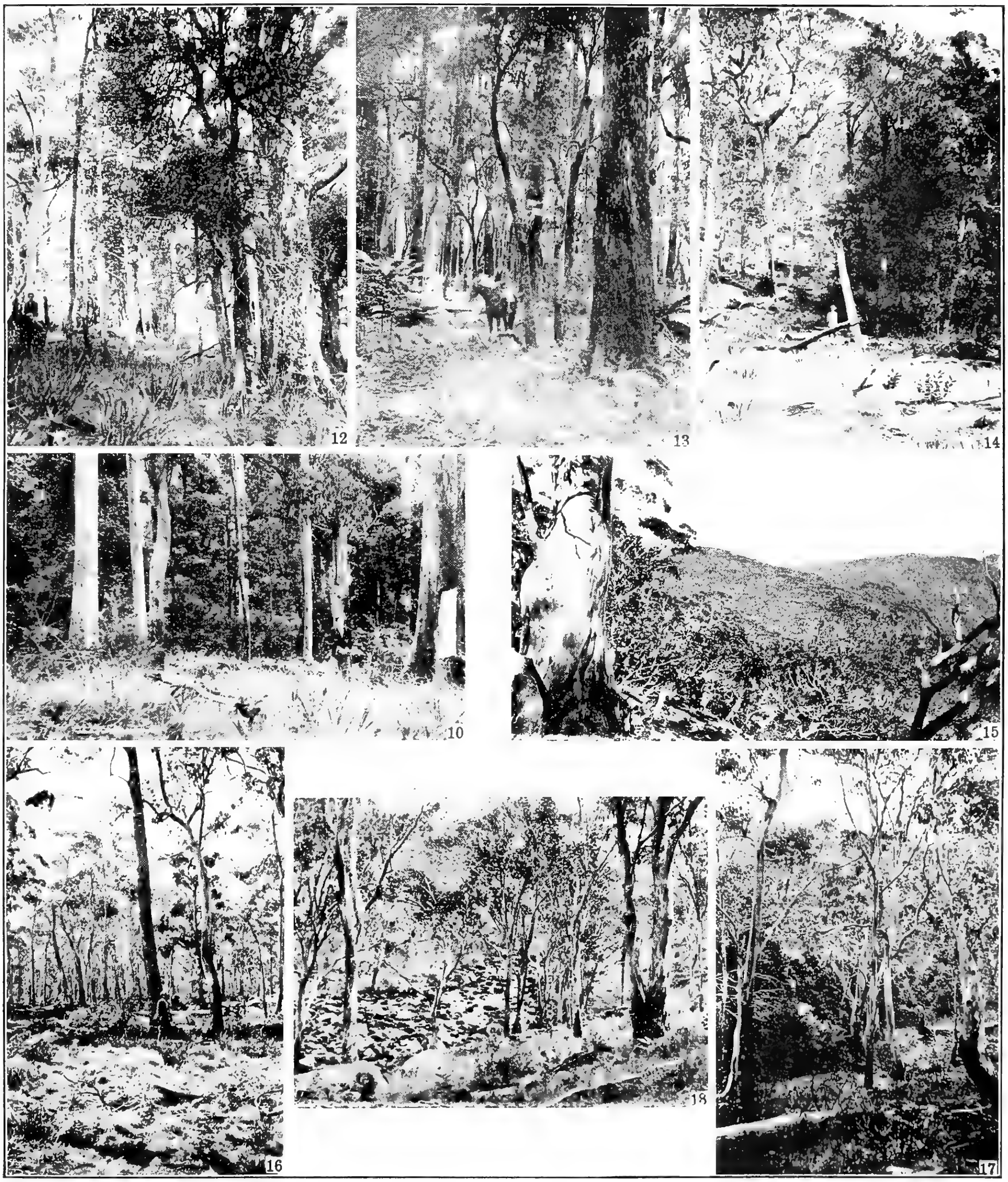
Acacia Clunies-Rossiae.
Ajuga australis.
Asperula conferta
Cardamine hirsuta var. *tenuifolia.*
Deyeuxia breviglumis.
Diuris venosa.
Epilobium glabellum.
Erigeron pappochromus.
Euphrasia Brownii var.
Geranium pilosum.
Halorrhagis micrantha.
Hydrocotyle hirta.
Hypolaena lateriflora.
Lagenophora Billardieri.
Lobelia pedunculata.
Microtis parviflorus.
Microtis porrifolius.
Mitrasacme serpyllifolia.
Oreomyrrhis andicola.
Plantago varia.
Poa caespitosa.
Prasophyllum brevilabre.
Prasophyllum odoratum.
Ranunculus lappaceus.
Scaevola Hookeri.
Schoenus apogon.
Schoenus ericetorum.
Scirpus setaceus.
Scleranthus biflorus.
Thelymitra ixioides.
Viola hederacea.

TABLE 3.

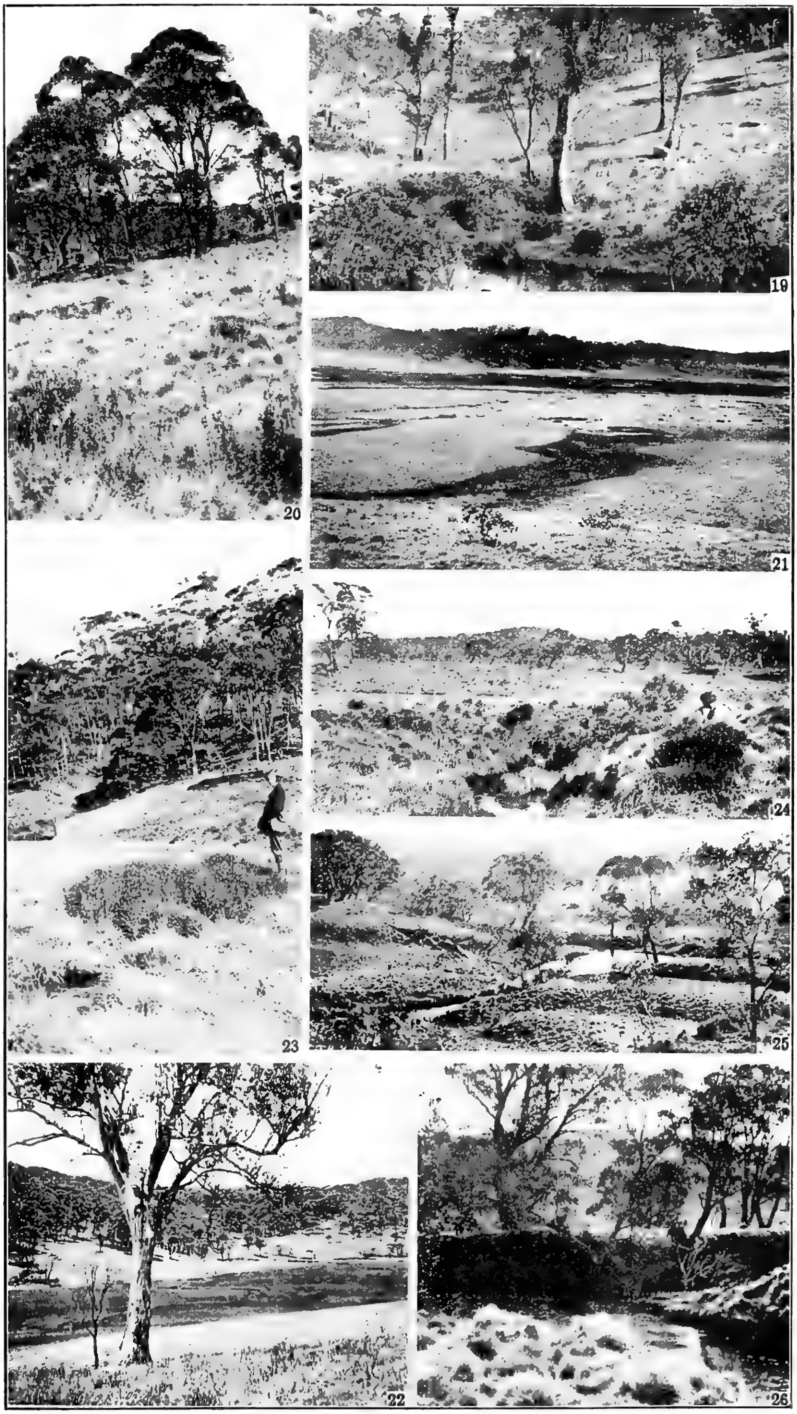
Distribution of the Sub-alpine and Montane Species.

Species.	Tasmania.	Victoria.	Mt. Kosciusko.	Southern Tablelands.	Blue Mountains.	Barrington Tops.	Northern Tablelands.
Adenochilus Nortoni					x	x	
Atherosperma moschatum	x	x			x	x	
Baeckea Gunniana var. *latifolia*			x	x	x	x	
Blechnum penna-marina	x	x	x	x	x	x	
Bossiaea neo-anglica				x		x	x
Callistemon pallidus	x	x		x	x	x	x
Carex cernua var. *lobolepis*						x	x
Chiloglottis Gunnii	x	x	x			x	
Claytonia australasica	x	x	x	x		x	x
Comesperma sylvestre						x	x
Coprosma Billardieri	x	x	x	x	x	x	
hirtella	x	x	x	x	x	x	x
Cotula filicula	x	x	x			x	
Deyeuxia breviglumis			x	x		x	x
Diuris venosa						x	
Drimys lanceolata	x	x	x	x	x	x	
purpurascens						x	
Elaeocarpus holopetalus	x	x		x	x	x	x
Epacris breviflora		x	x	x	x	x	x
microphylla var. *rhombifolia*				x		x	
Erigeron pappochromus	x	x	x			x	
Exocarpus nana	x		x			x	
Festuca Hookeriana (?)		x		x		x	x
Gaultheria appressa		x	x		x	x	
Gentiana diemensis	x		x			x (form)	
Hakea microcarpa	x	x	x	x	x	x	x
Helichrysum ferrugineum	x	x	x	x		x	
Hierochloa redolens	x	x	x			x	
Juncus falcatus	x	x	x			x	
Lagenophora emphysopus	x	x			x	x	x
Leptospermum myrtifolium		x	x	x		x	x
Leucopogon collinus	x	x		x		x	x
Hookeri	x	x	x		x	x	x
Libertia pulchella	x	x			x	x	
Lycopodium clavatum var. *fastigiatum* ..	x	x	x			x	
Mitrasacme serpyllifolia	x	x		x	x	x	
Myriophyllum pedunculatum	x	x	x		x	x	
Olearia chrysophylla						x	x
stellulata	x	x	x			x	
Oreomyrrhis andicola	x	x	x	x	x	x	x
Oxylobium ellipticum var. *alpinum*		x	x	x		x	
Persoonia oxycoccoides				x	x	x	x
Plantago palustris						x	
Prasophyllum Rogersii						x	
Pultenaea fasciculata	x	x	x			x	
Restio australis	x	x	x		x	x	
Scaevola Hookeri	x	x	x	x	x	x	x
Scleranthus biflorus	x	x	x	x	x	x	x
Uncinia riparia	x	x	x			x	
Velleia montana	x	x	x		x	x	

Ecology of Williams River and Barrington Tops District.



Ecology of Williams River and Barrington Tops District.



Ecology of Williams River and Barrington Tops District.

TABLE 4.
Life-Form Spectra.

Life-Form.		Total Number of Species.	MM.	M.	N.	Ch.	H.	G.	Th.	E.	HH.	Pteridophyte Quotient.
Sub-tropical rain-forest ..	Without ferns	155	50·9	21·3	1·9	4·5	8·4	0·6	1·3	19·7	—	3·6
	With ferns ..	192	41·2	17·7	3·6	4·2	18·7	0·5	1·05	11·4	—	
Sub-antarctic rain-forest ..	Without ferns	33	24·2	24·2	15·15	21·2	6·6	—	6·6	3·3	—	5·9
	With ferns ..	46	17·9	17·9	17·9	15·2	46·1	—	4·3	2·2	—	
Eucalyptus saligna - *Syncarpia laurifolia* forest	Without ferns	78	7·6	3·9	11·7	34·6	19·7	12·9	8·9	—	—	1·5
	With ferns ..	86	6·9	3·5	10·5	32·5	22·0	15·1	8·1	—	—	
E. campanulata - *E. punctata* forest	Without ferns	78	8·9	6·4	7·6	34·6	19·7	12·8	8·9	1·3	—	1·7
	With ferns ..	87	8·0	5·7	8·0	32·0	22·0	12·6	8·0	3·4	—	
E. obliqua-*E. viminalis* forest ..	Without ferns	59	6·7	10·1	25·4	23·9	22·6	5·0	6·7	—	—	2·3
	With ferns ..	70	5·7	8·6	21·4	21·4	28·6	7·1	5·7	1·3	—	
E. fastigata forest	Without ferns	51	3·9	5·9	25·5	21·5	29·4	5·9	3·9	—	—	1·8
	With ferns ..	57	3·5	5·2	26·3	19·3	31·5	7·0	7·0	—	—	
E. pauciflora forest	Without ferns	96	—	3·1	28·5	20·4	30·2	10·4	8·3	—	—	1·1
	With ferns ..	103	—	2·9	27·1	19·4	31·1	11·6	7·7	—	—	
Sub-alpine swamps	Without ferns	48	—	—	6·2	14·5	45·8	20·8	6·2	—	6·2	—
Total Eucalypt forest	Without ferns	214	5·6	4·6	21·0	23·3	22·0	12·1	7·9	1·0	1·5	1·4
	With ferns ..	234	5·1	4·2	20·5	22·2	26·1	12·4	7·2	0·8	1·2	
Normal spectrum..			3	12	17	14	39	8	6	1	3	1

MISCELLANEOUS NOTES ON AUSTRALIAN DIPTERA. V.

ON EYE-COLORATION, AND OTHER NOTES.

By G. H. Hardy.

(One Text-figure.)

[Read 26th April, 1939.]

A theory of the Eye-marking.—David Sharp (*Cambridge Natural History*, vi, part 2, 1899, p. 440), referring to eye marks on living flies, states that it is uncertain what use the variegated eye-coloration may have; subsequent authors seem to have limited their interests, in print, to the needs of taxonomy, and they figure markings more effectively than they describe them. There does not seem to be any plan upon which a uniform system of descriptions can be based. Enough, however, has been published to indicate that eye-marking is a phenomenon in the evolutionary process of the insect.

Probably the primitive eye-colour is black; this is common in the Nematocera, but limited to the lowest section in the Brachycera, where black is rarely found. The first advance is indicated by the possession of red eyes, a common feature throughout the Brachycera, with other hues, which may partly or completely cover the eye. The variegated colour pattern so frequently found seems always to be based on a red eye, and is never found on the primitive black eye.

The most advanced eye is normally green, rarely yellow, blue, or some other colour, and it is the change from the red to green that is considered here.

The change takes place in two ways. In some cases the green invades the red uniformly so that there first appears the red eye with green reflections, changing to red and green equally reflected, then green with red reflections, and finally the eye becomes wholly green. The other method is a change through the colour-band development, an account of which is given below. Actually several large genera show a range from a species with red eyes, through species with the red invaded with green to varying degrees, to a species with entirely green eyes. The variegated eyes can be arranged in a series to show how the change proceeded, and this seems to follow a uniform plan for all genera, but varies in the details with each genus.

The consistency of marking retained by each species suggests that some slight change in structure within the eye may take place uniformly with the change in colour; thus there are produced the marked contours that vary very little on any one species, although some variation in actual colour is not unusual.

I make no attempt to explain why colour changes should proceed through the colour-band system, but it seems advisable to point out that perhaps vision given by black eyes is less efficient than that by red eyes, whilst the green may be much superior to both; even a small area of green in a red field may be advantageous. Entirely green eyes occur consistently throughout the Asilidae and are common in many other predaceous Brachycera, whilst blood-sucking forms have both red and green, as well as the variegated eyes. Black eyes occur rarely in Stratiomyiidae, but apparently always in Cyrtidae, and perhaps in most Conopidae. Exotic Leptidae are often recorded with green eyes, but in the Australian species the eyes always seem to be red.

The theory of colour-band development.—By simplifying the complexities seen in colour marks, it becomes apparent that there first develops a green spot which extends laterally across the red field at antennal level, and lying in band formation practically parallel with the central line of the insect from head to abdomen, no matter what this direction may be in relation to the major axis of the eye. The band of green becomes complete when it reaches the anterior and posterior eye-margins. Above and below the green band so formed, the red areas of the eye form two blotches touching respectively the upper and the lower eye-margins and in either or both of these, further green spots form, running to bands parallel to the original one. By this process red bands are isolated; the blotches which still retain contact with the eye-margins above and below become smaller in area, and between them now lie alternating green and red bands.

Complications are introduced by the green having a tendency to spread, upsetting the band formation by invading the red areas in another way. In the lower Brachycera, this takes place largely by the green invading along the eye-margin, and in the higher Brachycera the invasion is strongly marked in the central field of the eye. It is also quite normal to see this spread more pronounced over the lower half of the eye than the upper half. The green thus encroaches over the red areas until the bands and blotches disappear. There is no uniformity in this matter; many species have eye-markings which may be used with conspicuous success in specific determinations, and any large genus may exhibit grades in markings, all being of the one general type.

Eye-coloration and markings may take some other form, as in Syrphidae, where some unusually active *Eristalis* have yellow eyes with minute black spots that survive death, but the chief interest lies in the colour-band type found in the following families: Stratiomyiidae, Tabanidae and Therevidae (colour band range very wide), Syrphidae (colour band at least in genus *Bacchus*), Ortalidae (colour band plentiful, but not studied in detail), and Calliphoridae (colour band limited to Rhiniinae).

A Scheme for Describing Eye-markings.

1. *The primary green band.*—All marks are orientated about that green band which forms the original invasion of the red eye and is situated at antennal level. It is to be noted that the area at antennal level is almost invariably green at least in part. This colour may extend indefinitely above and below, the nature of the band thus becoming lost in the general green field on species with advanced eye marks.

2. *The red bands.*—With the development of additional green bands above and below the primary one, red bands are left between them. Thus one red band lies just above, another just below the primary green band; rarely do either of these red bands lie in a position that can be confused with the antennal level.

3. *The multiplicity of bands.*—Further green bands may develop above and below, leaving red bands between them. This division of the red area may develop until seven green and six red bands are present, these being the maximum numbers of true bands observed in Diptera, although the green may spread along the eye-margins (as in some Rhiniinae), making the remnant of the original red blotch at the upper and lower eye-margins resemble a further band of red.

4. *The blotches.*—With the formation of the primary band, there are left two red areas retaining contact with the upper and lower eye-margins respectively. These two portions of red are the blotches, and they become smaller with every successive increase in the number of bands formed in the red areas. If perchance the green colour isolates the blotch from contact with the eye-margin, then the area of red left becomes a spot and the term blotch will no longer apply.

5. *The spots.*—This may apply either to the red or the green areas that do not touch the eye-margins and that are sufficiently spot-like to warrant the term.

6. *Colour invasion and elimination.*—Together with the tendency to build up the eye-markings to a maximum number of green and red bands, there is also a tendency for the green to invade and eliminate the bands formed and blotches left. This extra invasion by the green mostly takes place along the eye-margin in the lower Brachycera and largely in the central area in the higher Brachycera. In this way there is a trend towards the production of two markedly distinct eye-patterns, both traceable to band formations when analysed. The red colour disappears by suppression and the green increases by invasion and by the fusion of one green area with another. For descriptive purposes, when bands and blotches have been enumerated relative to antennal level, then this further invasion of green, bringing distortions and alterations in the red areas, is described only when marked effects are present.

7. *Abortive band development.*—It sometimes happens that the eye-marks show an abortive development, as in the case of *Wallacea.* Here the band at antennal level does not develop, but remains as a small elongate spot in a field of red, and above it in the same field are two other small elongate spots of green. This has produced an apparent blotch containing markings within, but on analysis with regard to antennal level they are readily interpreted. There are other abnormal markings which need to be interpreted in another way.

8. *Abnormal band development.*—That the simple horizontal band development does not apply in all cases is well illustrated in the case of some exotic Tabanidae, but is not yet known in the Australian fauna. In the genus *Chrysops* studied in the Palaearctic and the two American regions, the band development is vertical and irregular in shape; the blotches lie along the anterior and posterior eye-margins when present. Further invasion by the green takes place along the eye-margins and the red bars give way to spots that retain strong traces of their original irregularity. The genus *Chrysops* has its antennae placed near the eye-centre level, but *Tabanus* has the antennae nearly level with the lower eye-margin, and it is interesting to note the angle in these two cases; the line between the eye-centre and antennae compared with the direction of the eye-bands is about the same.

9. *Variations in colour.*—In the eye-colour the green and the red are not necessarily constant. Blue and purple may develop in their place, or an area may be bordered with these colours, and more rarely the green may give place to yellow. Melanism may appear in the eye, or at least a deepening of the shade resembling black may give this effect, but the actual markings seem nearly always to remain constant for each species.

10. *Irregularities in bands and blotches.*—Bands may disappear by elimination of the red and fusion of the green; they may reach the eye-border or fail to do so; the size of the blotches may depend on the number of bands formed, all lending themselves to description in general terms in conformity with the present discussion. In addition, markings are frequently different in the sexes, but usually

these have their salient points in common and differ in details. The markings may become distorted even to the extent of hiding the band formation, such as forming circular rings, but seldom do marks require special description apart from that outlined here.

STRATIOMYIIDAE.

NEOEXAIRETA SPINIGERA Wiedemann.

In life the eyes are entirely black and the habits are striking when regarded in this light, for the fly is particularly active and wary of movements so as to be not readily caught. It breeds in piles of decayed vegetation in gardens and orchards, where it mostly abounds, and is often abundant around sheds; it rarely enters houses, apparently avoiding dark places. The fly is very rapid in flight and has quick dodging movements.

ACTINA BRISBANENSIS, n. sp.

Actina incisuralis (dark form), Hardy, *Proc. Roy. Soc. Queensland*, xliii, 1932, 53.

The exact identity of *Actina incisuralis* is uncertain; it is regarded as being that form most commonly met with in Sydney, but owing to variations found in collections there would appear to be several forms already discussed by me. This *incisuralis* group, which includes the Tasmanian form as a possible subspecies, becomes difficult to unravel. Possibly more than one species occurs in Tasmania and certainly two occur in Queensland; the one described here is not known to me outside this State with certainty, but is very common at times in Brisbane, where it would seem to be the only species occurring.

The other Queensland species, still regarded as being *incisuralis*, has on the female a red band at one-quarter of the eye-depth from the summit in a green field and stretching from the anterior margin three-quarters of the way towards the posterior margin, which marking differs from the present species considerably.

♂, ♀. Very like *A. incisuralis* Macq., but the black markings on the tergites are invariably broadly black, thus reducing the orange colour, which may be entirely eliminated in the case of the male. The orange colour varies in amount, but never seems to increase in size comparable with that of the other various forms of *incisuralis* seen. The eyes on both sexes have the red and green intermingling with shot effect in more or less equal amounts, and there is no trace of a marking in the eye.

Hab.—A very long series taken in Brisbane over many years, throughout the summer half of the year; it seems quite common in the autumn on the underside of the leaves of the Moreton Bay Fig trees in the Botanical Gardens and University grounds.

LECOMYIA CYANEA White.

At the time of capture (10.10.1923), I made a sketch of the eye-marks on this species, and this shows a blue-green field with a red band above antennal level, strongly angulated near, but not reaching, the posterior margin. This is the effect of a sudden broadening of the band just before terminating; the narrowest part is about the centre. The green band above is thus very irregular in shape and fuses along the posterior eye-border with the green covering the eye below the red band. The upper red blotch reaches about half the length of the frons.

A pair of these rather rare flies recently captured (Sunnybank, October, 1938) shows a normal green field on both sexes and, instead of the upper blotch, a second red band which slopes about 45 degrees upwards from the middle of the frons, petering out to a point before reaching the posterior eye-margin. The latter is perhaps the normal, the former the variation as the ground-colour is abnormal. Also there is a common Brisbane Ortalid in some swamps that shows two forms of eye-marks, a red band being either present or absent, an alternative variation that might suggest how certain abnormal markings occur by suppression of red on certain specific areas, not as a gradual development but rather as an abrupt change. Alternative variations like these seem to be very rare.

Genus Damaromyia Kertesz.

Hardy, *Ann. Mag. Nat. Hist.*, (10) viii, 1931, 120–8.

D. whitei Hardy has the eyes green with a red band just above antennal level, and the band curves upwards posteriorly, but does not reach the posterior eye-margin. *D. clivosa* Hardy has a green band at antennal level between a red band below and a red blotch above; below this the eye is green. A sketch pinned with the specimen shows the blotch has a sinuous lower border, making the green band irregular in depth.

Two new species described below run out at couplet 5 of my key which can be used here by substituting the following new rendering of couplet 5 and adding the couplets 12 and 13:

5. Frons with a median deep depression; frons one-fifth to one-sixth head-width .. 6
   Frons without the depression; scutellum with one marginal depression 12
12. Hair-pits plentiful on frons and with the hairs abnormally long there; body hairs also much more conspicuous than normal. Frons one-quarter the head-width .... *hirsuta* Hardy
   Hair-pits and hairs normal 13
13. Frons one-quarter the head-width .... *neohirsuta*, n. sp.
   Frons one-sixth the head-width .... *similis*, n. sp.

D. neohirsuta is one of the two species recorded by me as near *D. hirsuta*; the other referred to is in the Ferguson collection and from Sydney; no further specimens have come before me. *D. similis* is quite a new form and both sexes are known.

Damaromyia similis, n. sp.

♀. Frons converging towards antennae, median width one-sixth that of the head. The hair-pits are arranged two together each side of the ocellar triangle and increase to three in a diagonal row towards the antennae; these lie mostly in a long slight depression each side of the very narrow grooved carina. The eyes in life are red shot with green and the eye-frons-eye proportions are 15:6:15. The thorax, scutellum and abdomen dorsally are completely covered with punctures uniformly dense and the triangular scutellum, lying in a plane with the thorax, has but one marginal depression. The coxae are black, the remainder of the legs is yellow, usually fuscated centrally on the femora and tibiae.

♂. Body characters very much as in the female, with occasional small areas on which the punctures may be less dense. The eyes are contiguous, with the lower third (antennal level and below) green in life, the remainder red.

Variations from this normal do not seem to occur, and although there is a general depression each side of the carina, this may be due to shrinkage after death and is not to be confused with those deep depressions on the lower section of the frons and seen on other species. Those species having the frons one-sixth the head-width or near are distinguished by the presence of the depression and in additional characters; *confusa* has two marginal scutellar depressions, *tasmanica* has a parallel-sided frons, *whitei* has a distinctive eye-mark when alive, and *trina* is less regularly pitted on the body. The raised scutellum distinguishes *recemipuncta*, the only other species with a narrow frons and also without the deep frontal depression.

Hab.—Queensland: Brisbane, September and October, 1932 to 1937, mostly in the latter year. 10 ♂, 18 ♀ from a persimmon tree and nearby foliage in my garden at Sunnybank. I have no hesitation in relegating the male to this position, as the only other species taken was represented by two females referred to below and apparently were stray visitors, and not breeding in the locality.

DAMAROMYIA NEOHIRSUTA, n. sp.

♀. Very like *D. similis*, but differing by the frons being one-fourth head-width, with coarser punctures more generally distributed, reaching nearer the eyes over most of the length, and there are four punctures in a diagonal line anteriorly. The eyes, when alive, have the lower quarter green, the remainder red. The eye-frons-eye proportions are 9:6:9. The abdomen also differs in the punctures being less dense than on the thorax and scutellum; on the two latter they are as on *D. similis*. The male is not known.

The female is liable to be confused only with *D. hirsuta* because the characters on other known species with a wide frons differ in many ways, but *hirsuta* differs in having a greater density of hair-pits from head to scutellum and very conspicuous hairs; the hair-pits of the frons are too dense for the regular rows to be seen.

Hab.—Queensland: Brisbane, September, 1937, 2 females taken on a persimmon tree in my garden at Sunnybank, and in company with *D. similis*. Another female (now without a head) was taken in September, 1929.

WALLACEA SPLENDENS Hardy.

In both sexes the eyes are green, with a large apparent, rounded, red blotch on the upper third. As the antennae are situated very high on the head, the blotch descends below the antennal level, where, within the blotch, a short green band occurs. This band tapers to its ends, and above it is another band which widens at the ends, but is hardly longer, and again above these is yet a third green band that resembles the first. These green bands and the red blotch are all subject to colour variation, peacock-blue, purple, etc., being substituted. Apparently the species is not uncommon at Sunnybank, as students have collected a series, now in the Queensland University, and I myself have added more to my collection.

OPHIODESMA INNODUS Hardy.

A sketch that I made some years ago shows that the female of this species has a green band at antennal level, bordered above and below with a red-purple band, the upper one being the shorter, but neither reaches the posterior eye-border, nor does the next red band above, which resembles in general proportions the lowest of these three. The two intervening green bands are thus fused with each other along the posterior eye-margin and also with the green broad areas above and below the three central red bands. The lower of these green areas is exceptionally wide and fuses with yet another green band, along the anterior eye-margin this time, that lies between the outer red curved band and the blotch. Similarly these red and green bands are repeated in general shape and contour just below the red blotch at the upper eye-margin. Hence there are, in a green field, three central red bands that fail to reach the posterior eye-margin, whilst above and below these respectively, there is another red band that fails to reach the anterior eye-margin, and also the two blotches. This makes two red blotches and five red bands alternating with six green bands, one of which is very wide. It will be noted that this is only one red and one green band less than the maximum yet noted in Diptera, and possibly a red band has disappeared from the very wide green area in the lower half of the eye. This forms the most complete example of retained eye bands I have yet noted in the Stratiomyiidae, but none of the red bands are complete, nor are any quite regular. The central red band is slightly curved and is the narrowest, the adjacent ones above and below expand towards the rear and only the lower of these two is reasonably straight. The other two bands, adjacent to the blotches, are strongly curved, one upwards, the lower one downwards following the contour of the equal blotches. The symmetry of the markings is very striking.

TABANIDAE.

Genus PELECORRHYNCHUS Macq.

Two species, *P. personatus* Walk. and *P. fergusoni*, n. sp., definitely have entirely red eyes, which character I believe to be consistent throughout the genus.

Pelecorrhynchus fusconiger-group.

In the first part of this series I defined three groups within the genus, of which the present one is the second, containing five described species and several undescribed.

Distribution.—Only one species occurs in Tasmania and this, *fusconiger* Walker, extends as a coastal species at least as far north as Sydney. The more northern coastal species, *fergusoni*, seems to have a very limited range from the Brisbane area and Stradbroke Island and possibly the northern parts of New South Wales. Of these two, only the former reaches the mountain areas where all the other known species occur, some showing a limited range even there. It is to be particularly noted that the group is unknown from the Tasmanian mountains.

Key to species of the fusconiger *group.*

1. Wings with two contrasting colours; black and yellow 2
   Wings unicoloured, more or less hyaline 3
2. Thorax mainly yellow with a thin median black stripe .... *deuqueti* Hardy
   Thorax mainly black with a pair of yellow stripes .... *flavipennis* Ferguson
3. With some dense white pubescence at base of abdomen. Thorax mainly black with a pair of very broad, narrowly separated grey stripes, within each of which occurs a short black stripe near the scutellum. The grey stripe is bordered laterally with a thin whitish line .... *tillyardi* Taylor
   White pubescence at base of abdomen if present sparse and the thorax otherwise marked 4
4. Species with some fiery red hairs on thorax and abdomen ...... *claripennis* Ricardo
   Species without red hairs 5
5. Thorax black with a pair of very thin whitish stripes interrupted just behind the transverse suture, and broadening out to meet along the apical margin. (From Barrington Tops.) .... sp.
   Thorax brown or slate-greyish. The white stripes are complete or incomplete, but do not meet 6
6. Thorax velvet-brown throughout with the whitish stripes conspicuous, at most, before the transverse suture and faintly indicated beyond this; often limited to a spot at the transverse suture. Rarely do black marks appear .... *fusconiger* Walk.
   Thorax more or less strongly slate-grey coloured with a conspicuous pair of whitish stripes complete and partly bordered laterally with thin black marks. There may also be a thin median black stripe .... *fergusoni*, n. sp.

In literature, under the name *fusconiger*, there are records of specimens with red hairs on the body, and these doubtless should all be referred to *claripennis* Ricardo. According to specimens in collections named by Mackerras, there are two species that run to *claripennis*, both before me, the new one having the wings strongly suffused with yellow and with a nebulous median spot; the thorax of the two agrees in markings with that of *fusconiger*.

PELECORRHYNCHUS FERGUSONI, n. sp.

P. fusconiger of authors in part.—Ferguson, *Proc. Roy. Soc. Victoria*, xxxiii, 1921, 2 (Queensland variety only).

Ricardo (1910) refers to *fusconiger* as occurring between Sydney and Moreton Bay, but specimens from the latter locality should be referred here. Taylor (1917) gives Stradbroke Island, and again all those specimens belong here. Ferguson (1921) records differences in the Stradbroke Island specimens, but did not regard the characters as more than a local variety at the time. Subsequently Mackerras has shown (but not published) that specific differences occur in the terminalia, and I have mounts of these made by him. Ferguson's description and the characters given in the key above are ample for the recognition of this species.

Hab.—Brisbane, August to October, 1924 to 1937, at the Sunnybank swamps. Also Stradbroke Is., from which many specimens come, as far as I know, all captured in September.

The flies do not seem to occur on the wing in any year for longer than a fortnight or three weeks, usually about the middle of September, varying with the early and late seasons. During 1937, a drought year, they appeared first in late August, then disappeared, but came again in very late September and early October. Similarly, *P. personatus* Walker, which normally comes in late September, became plentiful on the same swamps in October only. These are the only two species of the genus known to occur in the Brisbane district.

SCAPTIA (DIATOMINEURA) PULCHRA Ricardo.

On the female a red narrow band occurs well above antennal level, about half eye-depth; the area above this is blackish, and below it green. These colour marks are based upon a small series from Mt. Glorious, Brisbane.

SCAPTIA (DIATOMINEURA) AURIFLUA Don.

On the female a blue blotch margined below with red extends from the summit to about two-thirds the distance towards the anterior eye-corners, and below this the eye is mainly green, but the blue extends along the posterior margin and peters out at the lowermost point of the eye. The description is from Brisbane specimens.

ECTINOPSIS VULPECUNA Wied.

In literature two varieties are recorded and the exact determination of them is not clear to me. On the Brisbane form the eyes of the male are green with a thin red band about antennal level, tapering to a point and not reaching the posterior border. This red marking is broader but similar on the female and situated at about level with the anterior eye-corners.

Genus TABANUS Lin.

Except for occasional references to the eyes on a species being green (red on *T. cyaneus* Wied.),* there are no records yet made concerning eye-marks on

* Species of *Tabanus* seen by me show unusually green eyes, or green with slight red reflections, but one unidentified species has red eyes with slight reflections green, thus bridging the gap between *T. cyaneus*, which I have not examined alive, and the more normal forms.

Australian species and I myself have manuscript notes in only two cases. There is a considerable difficulty met with in identifying species, and there is no unanimous opinion concerning the interrelationship between species. Ricardo made a number of groups that failed to hold. The hairy eye, as against the bare eye, is about the last of these characters used. White indicated his ideas by suggesting one hairy-eyed species is allied to a bare-eyed species that also has the very long and narrow frons, and this is the first suggestion that breaks away from the traditional scheme. It is proposed here to follow this lead, as it certainly helps in the natural grouping of species.

Already I have grouped into order those species known from Tasmania, where only hairy-eyed forms occur, and here I extend this section in order to incorporate the mainland forms. Most bare-eyed species seem to conform to one or other of those groups already formed, and some groups previously suggested are now reduced by amalgamation. These main features are to be recognized in the following key, the exceptions being few and perhaps not particularly important if the key be used only as a guide.

Key to sections in genus Tabanus.

1.	Frons very narrow and parallel-sided	Section 1
	Frons normal to very wide	2
2.	Frons diverging towards antennae	Section 2
	Frons parallel-sided	Section 3
	Frons converging towards antennae	Section 4

Section 1.

Tabanus avidus-group.

This new group contains inter-related species, including: *Tabanus alternatus* Ferg. & Hill (with synonyms *limbatinervis* Macq. and *macquarti* Ric., both names preoccupied), *T. avidus* Bigot (with synonyms *fuscipes* Taylor and *taylori* Austen), *T. davidsoni* Taylor, *T. doddi* Taylor (with synonym *abstersus* Taylor, nec Walker), *T. duplonotatus* Ricardo (with synonym *parvicalosus* Tayl., nec Ric.), *T. ochraceo-flavus* Ferg. & Henry, *T. palmensis* Ferg. & Hill (with synonym *nigropicta* Macq. preocc.), *T. sanguineus* Bigot, *T. torresi* Ferguson, *T. victoriensis* Ricardo and var. *heroni* Ferguson, var. *wentworthi* Ferg. & Hill.

The two varieties are regarded as such by Ferguson, who reduced their rank, but the matter is by no means assured yet. All these are without the appendix, and agree in the frons, antennae and general characters. From others that I have seen (unidentified) and from various descriptions, I suspect several more names will fall here.

Nearest to this group, amid the hairy-eyed species, comes the *Tabanus microdonta*-group, of which only one species is known and is limited to Tasmania. It is not possible at present to draw a limit to section 1, so I cannot tell with certainty if this will come here, but White thought it should be included with *T. victoriensis* Ric.

Section 2.

This contains the *gentilis*-group, the *gregarius*-group and the *regisgeorgii*-group, all of which seem likely to maintain their status. All species so far placed in them have hairy eyes.

Section 3.

The *exulans*-group seems to be the hardest to understand and contains the species most confused in literature; the limits are uncertain as they verge towards section 2, but with this paper the hairy-eyed species are now fairly well isolated.

Section 4.

The *Tabanus pallipennis*-group is a new one and is well isolated from the other sections and apparently it is the outskirts of a palaearctic fauna, whilst the other three are apparently limited to the Australian region or almost so. As far as I know, this is the only group in Australia that has banded eyes, all others seem to have entirely green eyes except *T. cyaneus* Wied., which is said to have red eyes.

Key to species of Tabanus *with hairy eyes.*

1. Fourth radial vein without an appendix, frons rather narrow (*microdonta*-group) .... *microdonta* Macq.
   Fourth radial vein with an appendix. Frons not more than four times longer than wide, usually much less 2
2. Frons of female diverging towards antennae, normally becoming there one and a half times wider than at vertex 3
   Frons of the female parallel-sided .... *exulans*-group 5
3. Thorax with well-defined dark stripes, four anteriorly and three posteriorly on a grey ground .... *regisgeorgii*-group
   Thorax with rather ill-defined markings on dorsum, two to five light thin stripes on a dark ground 4
4. Thorax with a median light stripe normal, but sometimes very obscure if not quite obsolete. Wings spotted .... *gentilis*-group
   Thorax never with the median stripe, wings without spots (*gregarius*-group) ... 13

Key to the exulans-*group.*

5. Callus absent .... *adelaidae* Ferguson; *pseudobasilis* Tayl.
   Callus not reaching eyes, being separated by a pulverulent strip 6
   Callus reaching eye-margins 8
6. Body covered with a uniform pulverulent overlay, brownish-yellow (sand colour), usually completely hiding the markings .... *vetustus* Walk.
   Body not so covered, the markings defined 7
7. A somewhat yellowish species from N. S. Wales and Queensland ... *ocultus* Ricardo
   Dark forms .... *neocirrus* Ric. (Tasm.); *dixoni* Ferg. (Vict.); *geraltonensis* Tayl. (Queensl.); and *postponens* Walker (N. S. Wales).
8. Hairs of frons longer than half the width of frons 9
   Hair of frons short, normal 10
9. Fringe on hind tibiae black (Tasmania) .... *edentulus* Macq.
   Fringe on hind tibiae white (S. Austr.) .... *albohirtipes* Ferg.
10. Eyes densely clothed with hairs 11
    Eyes scantily clothed with hairs. Large species with black antennae and dark wings; 15 mm. .... *innotatus* Ferg.
11. Eyes with brownish pubescence; medium to small species .... *exulans* Erich.
    Eyes with white pubescence; large species, 15 mm. 12
12. Abdomen black and brown with only a median line of light spots ... *whitei*, n. name
    Abdomen more variegated and broader; with three lines of spots, the outer ones oblique .... *acutipalpis* Macq.

Key to the gregarius-*group.*

13. Callus separated from the eyes by a pulverulent strip. Face broad, eye-margins at an obtuse angle .... *tasmanicus* Ferg.
    Callus reaching eye-borders 14
14. Costa strongly bordered with fuscous; face broad .... *gregarius* Erichs.
    Costa not so bordered, clear 15
15. Hair on frons and below callus, unusually long and abundant 17
    Hair on frons normal, that below callus short, scanty or absent 16
16. Callus short, not reaching half-way up frons .... *hobartensis* White (Tasm.); *indefinitus* Taylor (N. S. Wales); *moretonensis* F. & H. (Queensl.) and possibly *milsonensis* F. & H. (N. S. Wales)
    Callus reaching beyond half length of frons .... *imperfectus* Walk (Tasm.); *flindersi* Ferg. (Flinders Is.); *cirrus* Ricardo (Queensl.) and *dubiosus* Ric. (Queensl.)

17. Face excessively wide, the eye-margins lying at an obtuse angle one to the other .... *neolatifrons* Ferg.
Face normal, the eye-margins lying at an acute angle one to the other (belongs to the *exulans*-group) .... *edentulus* Macq.

Species not known to me are placed in the above key in accordance with their descriptions, but many species require a closer investigation with a view to improving upon the characters here used.

TABANUS MICRODONTA Macq.

Macquart, 1847; Walker, 1854; White, 1915; Ricardo, 1915; and Hardy, 1934.—*T. wynyardensis* Hardy, 1916 and 1935.

It seems that the form *wynyardensis* is based on unusually small specimens of *microdonta* males. The differences are not apparent and an attempt to find females of the former has yielded, so far, only females of the latter. On this account it is best, I think, to accept the synonymy.

TABANUS ACUTIPALPIS Macquart.

Macquart, 1838; Walker, 1854; Ricardo, 1915; Ferguson, 1921; Hardy, 1934.—*T. circumdatus* var., White, 1915.

The specific interpretation was given by Ferguson, but the synonymy is new.

TABANUS WHITEI, new name.

T. circumdatus White, 1915; Ferguson, 1921; Hardy, 1934.—nec Walker, Ricardo, etc.

White used the name *circumdatus* under circumstances still obscure. Apparently Ricardo had already fixed the name correctly for a mainland species, followed by Ferguson and Henry, and this is the sense in which it is still used for mainland specimens. However, finding *circumdatus* and its supposed synonym *edentulus* were used by White for two species in Tasmania, the other authors tried to divide the *circumdatus* known to them into two, which has proved impossible. Actually White gave no evidence to show that *circumdatus* proper occurs in Tasmania; the form he called *edentulus* should have been given the name. Ferguson has already shown that *edentulus* used by all authors is wrongly applied and that this should be applied to an ally which is otherwise without a valid name, but to which White applied Walker's name *antecedens*. This synonymy is very involved, but its present elucidation has the advantage of bringing back the naming of species to alignment with the point at which confusion arose subsequent to the clearing up of specific identities by Ricardo and Ferguson. The *circumdatus* of White is without a valid name, and it certainly does not correspond with any specimens well known on the mainland as *circumdatus*. For this reason I have found it necessary to give a new name to White's species, which is limited to Tasmania.

TABANUS EDENTULUS Macq.

Macquart, 1845; Walker, 1854; Ricardo, 1915; nec White, 1915.—*T. antecedens* Walker, 1854; White, 1915; Ricardo, 1915; ? Taylor, 1916 and 1918; Ferguson, 1921; nec Walker, 1848.

Walker originally described *antecedens* from mainland specimens, and hence it cannot be the form so called by White, which is limited to Tasmania. Walker's second description from a Tasmanian specimen may apply. Ferguson considered that *edentulus* Macquart applies here and, as it seems the only name valid for the species with strong evidence for its validity, I propose the interpretation should be accepted.

The structure of the frons makes its position in a section rather ambiguous. The frons varying from diverging to parallel does not form an index to its relationship. Other characters show it belongs to the *exulans*-group, but it is placed also under the *gregarius*-group as a convenience for key purposes.

TABANUS EXULANS Erichson.

Erichson, 1842; Walker, 1854; Ricardo, 1915 (*esculans*); Hardy, 1935—*T. hebes* Walker, 1848.—*T. nepos* Walker, 1848.—*T. circumdatus* Walker, 1848; Ricardo, 1915, 1917; Taylor, 1918, 1919; Ferguson and Henry, 1919; Johnston and Bancroft, 1920; Ferguson, 1921; nec White, 1915.—*T. abstersus* Walker, 1850; Schiner, 1868; Austen, 1914.—*T. fraterculus* Macq., 1850.—*T. brevidentatus* Macq., 1855.—*T. edentulus* White, 1915; Ricardo, 1915; Taylor, 1917, 1918; Ferguson and Henry, 1919; Ferguson, 1921; nec Macquart.

The above synonymy incorporates that given for the species by Ricardo, but there is doubt if the species incorporated by the various authors include only the one form.

TABANUS NEOCIRRUS Ricardo.

Ricardo, 1917, 1921; Hardy, 1934; nec Ferguson.—*T. bassii* Ferguson, 1921; Hardy, 1934.

The synonymy is new and the confusion here originates from Ricardo having quoted Tasmania as the type locality, but Ferguson considered she described from two species, the type being that from South Australia. Apparently Ferguson redescribed the species from Victoria, including in it the same species from Tasmania as Ricardo's, if the type locality given by her is to be accepted.

In my earlier paper I attempted to deal with these as two species, a position that cannot be retained. The Tasmanian record of *T. bassii*, which specimen is before me, is only a specimen of *neocirrus* with a very denuded abdomen, and the narrower frons that seemed apparent is only a specific variation; careful study shows it to be of the broad type normal to the species. Doubtless the mainland specimens in Ferguson's small series have the same type of denudation. It has yet to be discovered if the South Australian specimen of *neocirrus* is distinct, and it is pertinent to note that Ferguson regarded the Tasmanian series of *neocirrus* before me as containing two forms.

TABANUS IMPERFECTUS Walker.

Walker, 1848, 1854; White, 1915; Ricardo, 1915; Taylor, 1918; Ferguson, 1921; Hardy, 1934.—*T.* species, near *imperfectus* Ferguson and Henry, 1919.

I have a mainland specimen identified by Ferguson as being *T.* sp., near *imperfectus*, but it differs from the Tasmanian specimens only in the less dense pubescence of the eyes, a specific variation. One Tasmanian specimen has the frons parallel-sided.

Tabanus pallipennis-group.

Section 4, consisting of a large element in the Palaearctic region, seems to be limited in Australia to a single group containing only two species as far as yet known. Of these *T. pallipennis* Macq. was seen by neither Ricardo nor Ferguson, but the latter used the name for a species with spotted wings, which is normally met with in inland districts. The original description makes no mention of the wing spots and hence can be applied quite readily to *rufinotatus* Bigot and may ultimately be found to belong there.

The group is characterized by the converging frons with two calli, the second lying above the normal one and formed into a round spot; the two may join on abraded specimens by a median line. The abdomen has three almost equally broad light stripes more or less interrupted at incisions, and both species have eye-marks.

TABANUS PALLIPENNIS Macquart.

In life the eyes of the female have a green band at antennal level and another above lower callus level. This gives one red band situated at callus level lying between two green bands and two red blotches.

The contiguous eyes of the male have an abnormal marking. The upper blotch is grey-black and below this lies a white band that persists after death, and it touches the anterior eye-corners where the band is broadest, tapering towards the posterior border, ending in a point before reaching there. Below this is a purple band. The lowermost area covering the antennal level is green. That white band is apparently a layer of opaque white at or near the surface, not arising from ordinary eye-pigmentation; it extends across the two eyes as an uninterrupted band.

Hab.—Victoria to Queensland. Widely distributed over the inland sheep areas, recorded from Lake Hatton, reaching to Gogango, about thirty miles west of Rockhampton. The specimens upon which the eye description is based are from Goondiwindi, about four miles north of the township; 5 ♂, 3 ♀, September, 1935.

TABANUS RUFINOTATUS Bigot.

Eye-marks of the female only are known to me. This sex has a green band at antennal level and another just half-way between this and the summit, so that one red band lies at and below callus level between two green bands and two blotches, giving a pattern very similar to that of the previous species. The fly is common in Brisbane.

THEREVIDAE.

Chaetotaxy.—White refers to the bristles of the thorax as being presutural, supraalar, postalar, prescutellar and scutellar, whereas Mann refers to them as prealar, supraalar, postalar, prescutellar and scutellar. Relative to those of the Asilidae, there are notopleural, presutural, intraalar, postalar, postsutural, dorsocentral and scutellar bristles. There are no supraalar bristles and the so-called prealar often combine the notopleural with the presutural one.

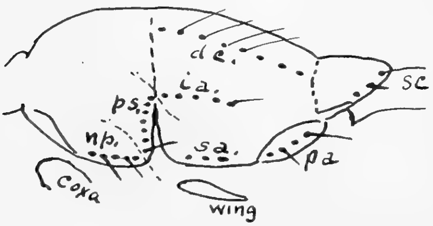


Diagram of chaetotaxy.

This diagram combines the bristles normal on a Therevid with more abundantly represented bristles (dots) on certain Asilidae. *dc*, dorsocentral bristles; *ia*, intraalar bristles; *np*, notopleural bristles; *pa*, postalar bristles; *ps*, presutural bristles; *sa*, supraalar bristles; *sc*, scutellar bristles.

The diagram (Fig. 1) shows rows of dots representing the line of bristles in Asiloidea and the reduced number of bristles represented on Therevidae are drawn in full. The row *np* lying along the notopleural ridge is confluent with the row *ps* that borders the transverse suture, and this again is confluent with the intraalar row *ia*. These rows are normally reduced in regard to number of bristles on most Asilidae and all Therevidae. The dorsocentrals, when present, are usually over the central portion of the postsutural region, less frequently in the immediate prescutellar region on Therevidae.

Ectinorrhynchus variabilis Macq.

On the eyes of both sexes there is only an upper blotch of red; the green at antennal level and below invades this red along the eye-margins, producing a rounded red blotch. This description is based on Brisbane specimens, but an old Tasmanian specimen was used, not very satisfactorily, in an attempt to revive the colours, and this showed traces indicating that the same marking occurs there.

Ectinorrhynchus levis Mann.

The eyes are entirely red on the male, those of the female have not yet been noted.

Taenogera notatithorax Mann.

The eyes of the female are uniformly but obscurely greenish shot with red. The male of this fly is unknown.

Neodialineura striatithorax Mann.

The greenish-yellow eyes of the female have a red complete band just above antennal level, and in addition the lowermost eye-border is margined red. The markings on the male are not yet noted.

Agapophytus ruficaudatus Mann.

The eye on the female has a green band at antennal level with a red band below and a large red blotch above; the rest is green.

Agapophytus albibasis Mann.

The green eye on the female has a green band at antennal level bordered by a red band above and below. The upper red band strongly tends to become thin at anterior margin and the lower one broadens out there; otherwise the bands are fairly uniform in width.

The male is similarly marked, but the upper band is very sinuous and does not reach the posterior eye-margin, whilst the green band is thereby rendered irregular in width.

Agapophytus squamosus Mann.

The red eyes of the female have four green bands all reaching the eye-margins. The uppermost green band is broad and curves upwards at each end. The second and third bands are similarly curved and it is uncertain which is to be regarded as being at antennal level; they fuse together along the posterior eye-margin. The lowermost band lies practically straight and at a level half-way down the face.

Acutipalpa polinosa Mann.

Synonymy.—A. semiflava Mann.

Associated with *A. polinosa* Mann, only recorded on the male, there are invariably found females that correspond with *A. semiflava* Mann, only recorded on the female. These have not yet been taken *in copula*, but field evidence is very strong on the suggestion that they are sexes of the same species. I have a letter from Mr. Mann, in answer to this, saying that he too has suspected the names belong to the one species. This dimorphism is a feature of the genus, so doubtless the synonymy is quite correct.

On the male the eye has a green band at antennal level, but the green invades upwards along the eye-margins, isolating the large red area above into a spot. This large triangular spot has a concave anterior side and a convex posterior side with a moderately straight base. Below the green band is a red one which reaches both eye-margins, and the lowermost border of the eye is margined with red, a remnant of the blotch. Elsewhere the eyes are green.

The female has a very similar design, but the green at antennal level does not extend as far as the summit, so the red triangular area maintains contact with the eye-margin, thus retaining the character of a blotch. This blotch is similar in shape to the spot on the male, but with the top of the triangle cut off by the eye-margin. The red band below does not reach the posterior eye-margin and the whole area below this is green.

Acraspiza obscuripes Mann.

I have only seen the characters of the eye on one male and two females, and my notes were not made with reference to the new species below. From my notes it would appear that the male has a green band at antennal level lying between two red bands; the area above is reddish, and that below is green. The female has a green band at antennal level lying between a red blotch above and a red band below, the band not reaching the posterior eye-border. These remarks are based upon specimens taken at Sunnybank close to where the type pair were taken *in copula.*

Acraspiza similis, n. sp.

Subsequent to the publication of *A. obscuripes*, and taken in the same place, a new species has been discovered that at first was thought from males only to be the same. Recently the discovery of a pair *in copula* has shown very decisively that there are two species standing in collections under the name *obscuripes* male, but this does not affect any of the type series in accordance with information given to me by Mr. Mann.

♂. Very similar to *obscuripes* Mann, but of larger average size. The eyes have a green band at antennal level, between two red bands; the upper red band is turned upwards near the posterior margin, which it does not reach, and the lower red band fails (? not always) to reach the posterior border too. Above this the eye is reddish or at least shot with red, and below it is green. The facets above are strongly contrasting with those at and below antennal level, with a marked line of division, which character is less marked on *A. obscuripes.* The two basal segments of the antennae are equally short. The thorax each side of the median line has 2 notopleural, 3 presutural dorsocentral, 1 intraalar and 1 postalar bristles; and a pair of scutellar marginals. The black abdomen shows brown integuments at the base and at some incisions. The yellow hypopygium and legs (including coxae) are further distinctive characters, as also the wing pattern, which is hardly reduced, but resembles that of the female on both this and *obscuripes.*

♀. A green band at antennal level lies between a red band below and a red blotch above; the latter does not reach the posterior eye-margin; elsewhere green. The frons is fully twice as long as its median width and hence is obviously narrower than that on *obscuripes.* The thorax is quite bright reddish instead of deep reddish-brown, and there are only two dorsocentral bristles. The abdomen has a slight covering of tomentose brown above, otherwise all characters are as on the male.

Hab.—Queensland: Brisbane, the holotype male and allotype female *in copula,* 7 ♂, 8 ♀ paratypes all captured at Sunnybank, April, 1937 and 1938, by sweeping grass. Others in September, October, February, March, and May, 1930, 1933, 1936 and 1937, so doubtless the species is quite common over the summer months.

Note.—The scutellum in this genus is said to be raised to the perpendicular, but actually this is not morphologically comparable with that of any other genera examined where the apex of the scutellum lies considerably higher than the base. In the present case there is the apex with its apical bristles quite normal, but the dorsal surface of the scutellum has a large protuberance rising perpendicularly, giving to the observer the impression of a raised scutellum.

ACRASPIZA TRIFASCIATA Krober.

There is a male before me that evidently belongs to this species, and it bears on its label "Bred from a Scenopinid ? larva" and on another label "Gordonvale, W. C. Dormer, 19.10.23". It may be presumed, I think, that this fly was reared from an Asiloidean larva. All Therevid larvae that I have found have been living free in the soil. Melin has pointed out that Asilid larvae may be reared on a vegetable diet, and, with my own experience, which is limited, I find field observations suggest that the carnivorous habits are not essential for the Asiloidean larvae; it is possible they are omnivorous, feeding in an incidental manner on any other larvae that may be associated with them.

Addendum.

ON EYE-COLORATION.

Whilst writing the above paper I briefly set down some ideas on eye-coloration and sent them to Dr. B. M. Hobby, of the Oxford University. I expected the main theme would interest him and others who are also collecting in the field data concerning insect behaviour. Dr. Hobby forwarded the manuscript to Dr. H. Eltringham, of Stroud, Gloucester, an authority on related matters, and received in reply an encouraging letter which is now before me.

Dr. Eltringham has since then allowed me to quote from his letter and a subsequent one. He informs me it had not occurred to him that there is any connection between the colour of insect eyes and their habits, but it is ". . . an interesting point that might be worth investigation . . ." "Red and black in flies' eyes are due to colour of the pigment surrounding the pseudocones, red being much the commoner." "So far as I have been able to make out, green is always a 'structural' colour caused by iridescence. The fact that there are these green eyes would, however, suggest that there is some difference in the structure. . ."

The letters then discuss Exner's original paper, which goes somewhat elaborately into refraction from the mathematical point of view, and which Dr. Eltringham found to be unusually obscure. In 1933, Dr. C. J. Van der Horst published a paper on the optics of the Eucone eye, purporting to show that the existing theories in relation to this type of eye are untenable. The point was submitted to Mr. T. R. Smith, of the National Physical Laboratory, and in his opinion Van der Horst's conclusions are invalid, since the optical principles invoked are not applicable to the structure in which the elements are in physiological continuity.

Dr. Eltringham, in his first letter, expressed the opinion that if the green colour be a diffraction effect, and due to interference by some structure of smaller dimensions than the average light wave, there seems little hope of detecting it in a micro-section, and he ends on the encouraging note: "At the same time let Hardy carry on. His results should be very interesting, but I should recommend him to get a lot more data before publishing."

It will be many years before my limited opportunities for field work can bring results. The study is, of course, of basic interest and without it insect behaviour cannot be adequately understood. I am indebted, however, to both Dr. Hobby and Dr. Eltringham for having cleared up the exact position relative to the theory of eye-colour in insects. Tentatively my theory stands that green is entirely due to refraction or some allied displacement of light, a structural alteration. This is slowly taking place parallel with alterations in behaviour, giving a new sense to or an improvement to vision in the Diptera. This is, however, only one branch in the study of coloration relative to the insect's welfare, and I have further notes that trend towards showing the development of body-coloration coming more or less under the studies in so-called "mimicry". Parallel developments in body-coloration and form are well known, but hitherto I have seen no data or theories to indicate how these convergences have been brought about. The purpose of the above paper and others in manuscript is to accumulate data rather than to express a theory, data that may clear up an obscure point relative to eye-coloration, namely, whether this has relationship to fly behaviour.

DESCRIPTION OF A NEW GENUS AND TWO NEW SPECIES FROM PAPUA.

FAMILY PYRGOTIDAE (DIPTERA).

By J. R. MALLOCH.
(*Communicated by Frank H. Taylor, F.R.E.S., F.Z.S.*)

(Two Text-figures.)

[Read 26th April, 1939.]

At present I know of but one species of this family recorded from New Guinea, *Campylocera brevicornis* Hendel. I have not seen the species. Before me now there are two Papuan species, neither of them described, and below I present descriptions of them.

In 1929 appeared a posthumus paper on the family in Australia by Dr. M. Bezzi (PROC. LINN. SOC. N.S.W., liv, pp. 1–31) in which there was included a list of the then known species. Keys to the genera and species from Australia were given, so that the paper is helpful in any consideration of the family from this region.

ADAPSILIA Waga.

Ann. Soc. Ent. France, 1 (i), tom. ii, 1842, 279.

Bezzi described a species of this genus from northern Queensland and, though the single damaged female before me does not entirely agree with the generic characters, I tentatively place it in *Adapsilia*.

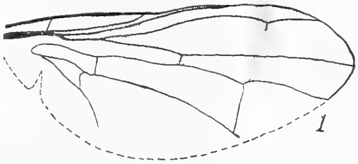
ADAPSILIA AEQUALIS, n. sp.

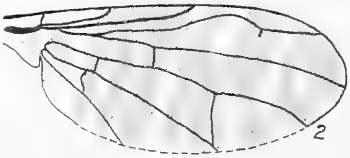
♀. An entirely brownish-yellow species, with the facial foveae and parafacials and genae polished, the latter darkened and with a black mark below eye, the mesonotum slightly shiny. Wing yellowish-hyaline, more noticeably yellow in the costal and base of anterior basal cells and stigma, with a narrow dark cloud on cross-veins at apices of the basal cells, and on inner cross-vein, and a slender fuscous streak over the spur vein near apex of second vein extending to or almost to the outer cross-vein. All hairs and bristles, and the legs, brownish-yellow.

Frons about 1·25 times as long as wide, and about 1·5 times as wide as one eye, protruded in front, with some fine erect hairs in centre and a few on sides above, one of them more pronounced than the others, and four fine bristly hairs on the vertex bent over the elevated vertical edge, the latter not very prominent. Parafacial at base of antenna about half as wide as eye at middle and wider than the third antennal segment, gradually narrowed below, with some microscopic surface hairs, more evident along outer edge; gena about as high as widest part of parafacial, with very fine sparse hairs; face with the foveae fused above, separated below by a raised line that widens at lower extremity. Lower occiput widened, widest part about half as wide as eye. Antennae normal, geniculated at second joint, the first segment about half as long as second, the latter entire, densely short, stiff yellow-haired, on upper or outer edge about two-thirds as long as third segment, the latter slightly tapered to apex where it is moderately broadly rounded; arista bare, slightly flattened, length greater than that of antenna.

Mesonotum with traces of two blackish vittae, most noticeable behind suture. Bristles as follows: Humeral, sometimes two, notopleurals 2, sometimes either or both duplicated, supra-alar 1, postalars 2, dorsocentrals 1 pair; scutellars 4 or more, the brownish-yellow surface hairs long and stiff and quite numerous. One or more mesopleural bristles.

Legs normal, mid femur with an elongate pear-shaped depressed area on the anterior surface extending from close to base to about the apical third, its broad extremity towards base, its surface entirely dull. All femora with some fine ventral bristles and the usual long basal ventral bristle. Wing as Figure 1. Halteres brownish-yellow. Abdomen coloured as thorax, without blackish markings,





1.—*Adapsilia aequalis*, n. sp. 2.—*Epicerina setifemur*, n. sp.

quite densely stiff yellow-haired, the lateral armature on the elongate composite basal tergite bristle-like, quite prominent apically. Genital cone evenly tapered, with numerous yellow bristly hairs, no exceptional features, and more than half as long as remainder of the abdomen. Length, 15 mm.

Type, Papua: Mondo, 5,000 feet, Jan.-Feb., 1934 (L. E. Cheesman), British Museum.

In *Adapsilia illingworthi* Bezzi, the inner cross-vein of the wing is at about one-third from the apex of the discal cell instead of close to the middle of that cell, and there are many other characters to distinguish the two species.

Epicerina, n. gen.

This genus is very similar to *Epicerella* Macquart, but differs in having all the femora, in at least the male, armed with short stout bristles on the apical fourth or less of the anteroventral and posteroventral surfaces, in having no dorsocentral bristles, one or more hind marginal mesopleural bristles, one sternopleural and one pteropleural bristle. For other characters see description of the genotype below.

Epicerina setifemur, n. sp.

♂. General colour brownish-yellow, greater portion of the frons, dorsum of thorax, including the scutellum and the postnotum, and dorsum of abdomen, blackened or dark brown.

Head about 1·5 times as high as long in centre, tapered below in profile; frons about 2·5 times as long as wide, slightly widened in front where it projects about one-fifth of its length beyond the eyes. Ocelli lacking; vertex with a pair of moderately strong bristles; orbitals lacking; interfrontalia with a number of strong hairs anteriorly. Parafacial at base of antenna about as wide as third antennal segment, much narrowed centrally; gena higher than width of parafacial at base. Some fine hairs on the parafacial above. Antenna reaching to almost the lower level of eye, basal segment not half as long as second, the latter entire, quite densely haired, almost as long as the third segment which is tapered slightly to, and narrowly rounded at, apex; arista distinctly pubescent, thickened on basal fifth, thread-like beyond. Palpi moderately thick, parallel-sided, bare. Lower occiput but slightly projecting. Eye narrowed below, the facets larger than usual. Humeral and posterior postalar bristles very fine and short, anterior notopleural, the supra-alar and anterior postalar short but strong; scutellum bare, with a pair of quite closely placed apical bristles.

Wing as Figure 2, greyish-hyaline, with pale brown markings. Third vein bare at base. Legs normal in form, with no exceptional armature except the femoral bristles. Abdomen glossy, largely black, the pregenital segment black except at base. The basal composite segment as long as the next four combined, the latter subequal in length, the sixth with some outstanding bristles laterally at apex; pregenital segment longer than the basal one, with sparse erect fine hairs on dorsum and more noticeable hairs below at apex; genital segment with a prominent stout spike-like apical process. Length, 9 mm.

Type, Papua: Mafulu, 4,000 feet, Dec., 1933 (L. E. Cheesman), British Museum.

A slender species readily recognizable by the femoral armature.

REVISION OF AUSTRALIAN LEPIDOPTERA. OECOPHORIDAE. VIII.

By A. Jefferis Turner, M.D., F.R.E.S.

[Read 29th March, 1939.]

67. Gen. Eulechria Meyr. (continued).

Recent captures at Talwood, Miles, Roma, and especially those made by Mr. W. B. Barnard at Injune, have revealed many obscure autumnal species of this genus, at a season when Oecophoridae are scarce in most localities. It is desirable to describe these here. The species in the genus now number 376.

After these descriptions there follows the first instalment dealing with the numerous genera and huge collection of species terminating with the genus *Philobota.*

892. Eulechria platyphaea, n. sp. (πλατυφαιος, broadly dusky.)

♀. 18 mm. Head ochreous-whitish; back of crown fuscous. Palpi with second joint reaching base of antennae, moderately thickened with appressed scales, terminal joint two-thirds, slender; white, base of second joint fuscous. Antennae fuscous. Thorax white, with large anterior and posterior dark fuscous spots. Abdomen fuscous. Legs fuscous with ochreous-whitish rings; posterior pair ochreous-whitish. Forewings moderately broad, suboval, costa moderately arched, apex rounded, termen obliquely rounded; white with three dark fuscous fasciae; first basal extending from one-sixth costa to one-fourth dorsum; second median, anterior margin extending from one-third costa to mid-dorsum, posterior margin from two-thirds costa to before tornus; third apical, anterior margin from five-sixths costa to tornus; cilia fuscous, apices ochreous-whitish except at tornus. Hindwings grey; cilia grey, beneath apex ochreous-whitish except bases.

Queensland: Injune in April; one specimen received from Mr. W. B. Barnard. This species should follow *E. ombrodes* (No. 552).

893. Eulechria plagiophaea, n. sp. (πλαγιοφαιος, obliquely fuscous.)

♀. 16 mm. Head and thorax white. Palpi with second joint just exceeding base of antennae, terminal joint two-thirds; pale brownish-ochreous. Antennae fuscous. Abdomen ferruginous-brown; apices of segments and tuft ochreous-whitish. Legs whitish-ochreous; anterior pair fuscous. Forewings narrow-oval, costa moderately arched, apex rounded, termen obliquely rounded; white; a dark fuscous spot at two-thirds, connected by an irregular paler fuscous streak with tornus; cilia white. Hindwings and cilia whitish-grey.

In colour and marking this resembles *E. gypsochroa.* but the palpi are much shorter. I place it after *E. eurygramma* (No. 554).

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

894. Eulechria emmeles, n. sp. (ἐμμελης, harmonious.)

♂, ♀. 20–21 mm. Head pale yellow. Palpi with second joint reaching base of antennae, moderately thickened with appressed scales, terminal joint three-fourths, slender; pale yellow, terminal joint fuscous. Antennae fuscous; ciliations in male

1. Thorax fuscous; apices of tegulae and a large posterior spot pale yellow. Abdomen ochreous-grey; tuft ochreous. Legs pale yellow; anterior pair and middle tarsi fuscous. Forewings suboval, rather narrow, costa moderately arched, apex round-pointed, termen obliquely rounded; pale yellow with fuscous markings; base of costal edge fuscous; a narrow fascia from two-fifths costa to mid-dorsum, nearly straight or slightly curved inwards; a large apical blotch, its anterior edge irregularly convex from three-fourths costa to tornus; a terminal series of dots from before apex to above tornus, and between its extremities a slender suffused line more or less developed, both pale yellow; cilia grey. Hindwings dark grey; cilia whitish-ochreous, on apex grey.

Queensland: Injune in March and April; four specimens received from Mr. W. B. Barnard, who has the type. This should follow *E. cosmosticha* (No. 556).

895. Eulechria stenophylla, n. sp. (στενοφυλλος, narrow-winged.)

♀. 20–22 mm. Head and thorax white. Palpi with second joint exceeding base of antennae, terminal joint three-fourths; whitish. Antennae grey; towards base whitish. Abdomen whitish-grey. Legs whitish. Forewings very narrow, costa gently arched, apex pointed, termen oblique; 2 and 3 connate; white faintly ochreous-tinged; cilia white. Hindwings and cilia white.

Australian Capital Territory: Canberra in March; two specimens. I place this before *E. epibosca* (No. 562).

896. Eulechria fumifera, n. sp. (*fumiferus*, smoky.)

♂. 22 mm. Head and thorax fuscous sparsely sprinkled with whitish. Palpi with second joint just reaching base of antennae, rather stout, terminal joint three-fifths; fuscous, extreme apex of second and extreme base of terminal joint white. Antennae grey; ciliations in male 1. Abdomen grey; tuft whitish-ochreous. Legs fuscous with white rings; posterior pair ochreous-grey-whitish. Forewings suboval, costa strongly arched, apex rounded, termen obliquely rounded; fuscous densely sprinkled with whitish, appearing grey; darker at base; markings fuscous; a triangle on costa from one-third to two-thirds; first discal at one-third, plical beneath it, second discal before two-thirds, crescentic, a dot above and between discals forming apex of costal triangle; a suffused line from five-sixths costa inwards, soon bent outwards and then downwards and continued to tornus, more or less interrupted; cilia grey with a broad interrupted dark basal line. Hindwings and cilia grey.

Queensland: Injune in February; one specimen received from Mr. W. B. Barnard. I place this after *E. placophaea* (No. 660).

897. Eulechria acompsa, n. sp. (ἀκομψος, unadorned.)

♂. 20–23 mm. Head and thorax fuscous mixed with whitish. Palpi slender, second joint not reaching base of antennae, terminal joint one-half; fuscous sprinkled with whitish. Antennae grey; ciliations in male 1. Abdomen ferruginous; apices of segments and tuft brown-whitish. Legs fuscous sprinkled with whitish; posterior pair mostly whitish. Forewings narrow, costa gently arched, apex rounded, termen very obliquely rounded; fuscous sprinkled with whitish, more densely so in centre of disc; markings dark fuscous; first discal at one-third, plical slightly beyond, second discal at two-thirds, a dot above and between discals, another beneath and sometimes confluent with second discal; a small fuscous costal triangle, sometimes obsolete, its apex reaching second discal; a fine line inwards from costa before apex, strongly angled outwards beneath costa, thence curved to tornus, sometimes indistinct; a terminal series of dots; cilia whitish with a fuscous submedian line. Hindwings grey; cilia grey-whitish.

Queensland: Injune in March; six specimens received from Mr. W. B. Barnard, who has the type. I place this after *E. capnopleura* (No. 663).

898. Eulechria acerba, n. sp. (*acerbus*, gloomy.)

♂, ♀. 18–20 mm. Head ochreous. Palpi with second joint reaching base of antennae, moderately thickened, smooth, terminal joint three-fourths, slender; fuscous, apex of second and terminal joint except apex whitish. Antennae fuscous; ciliations in male two-thirds. Thorax fuscous. Abdomen grey; apices of segments and tuft ochreous. Legs fuscous; posterior pair whitish-grey. Forewings suboval, costa gently arched, apex rounded, termen obliquely rounded; dark grey with patchy whitish suffusion in disc reaching costa at two-thirds, remainder of costal and terminal area wholly grey; stigmata obscure, fuscous, approximated, first discal at one-third, plical beneath it, second discal before two-thirds, a dot above and between discals nearer first, another beneath second; cilia grey. Hindwings and cilia grey.

Queensland: Injune in March; three specimens received from Mr. W. B. Barnard, who has the type. This may follow *E. synnephes* (No. 678).

899. Eulechria polypenthes, n. sp. (πολυπενθης, very mournful.)

♂. 26–28 mm. Head and thorax fuscous mixed with whitish, appearing grey. Palpi with second joint reaching base of antennae, moderately stout, terminal joint two-fifths, slender; white sprinkled with fuscous. Antennae whitish finely ringed with blackish; ciliations in male two-thirds to one. Abdomen ferruginous-grey; apices of segments and tuft ochreous-whitish. Legs fuscous irrorated, and tarsi annulated, with white. Forewings narrow, not dilated, costa moderately arched, apex rounded, termen oblique; fuscous mixed with whitish, appearing grey; markings dark fuscous; first discal before one-third, plical beneath it, second discal before two-thirds, sometimes double, a dot above and between discals; a line inwards from four-fifths costa, sharply angled outwards beneath costa, thence curved to tornus; cilia pale grey. Hindwings and cilia pale grey.

Queensland: Injune in February and March; two specimens received from Mr. W. B. Barnard, who has the type. This may come after *E. orecta* (No. 708).

900. Eulechria difficilis, n. sp. (*difficilis*, hard to distinguish.)

♂. 18–24 mm. Head and thorax fuscous mixed with whitish. Palpi with second joint slender, not reaching base of antennae, terminal joint one-half; fuscous mixed with whitish. Antennae fuscous; ciliations in male 1 to 1½. Abdomen dark grey; tuft grey-whitish. Legs fuscous mixed with whitish; tibiae and tarsi fuscous with whitish rings. Forewings narrow, costa gently arched, apex rounded, termen obliquely rounded; fuscous finely sprinkled with whitish, sometimes more so in centre of disc; markings dark fuscous; first discal at one-third, plical beyond it, second discal at two-thirds, sometimes forming a short transverse crescent, a dot above and between discals, sometimes a short streak before and beneath second; a line from three-fourths costa at first transverse, sharply angled outwards in disc, then curved inwards to tornus, but usually more or less obsolete; cilia fuscous with some white points. Hindwings and cilia grey.

The few examples before me show considerable variation in size and development of marking. The length of the antennal ciliations also varies more than usual. For their identification I rely mainly on the structure of the palpi, but more material is desirable. Together with the following, it may be placed before *E. phoryntis* Meyr. (No. 745).

Queensland: Injune in March; Roma in April; Miles in May; four specimens.

901. Eulechria maesta, n. sp. (*maestus*, gloomy.)

♂. 16–18 mm. Head and thorax fuscous sprinkled with white. Palpi slender, second joint not reaching base of antennae, terminal joint one-fourth, reaching vertex; fuscous sprinkled with white. Antennae fuscous; ciliations in male 1. Abdomen fuscous. Legs fuscous sprinkled with whitish; posterior pair paler. Forewings narrow, costa gently arched, apex rounded, termen very obliquely rounded; fuscous sprinkled with white; markings dark fuscous; first discal at one-third, plical beneath it, second discal at two-thirds, double or crescentic, a dot above and between discals; a suffused basal spot and another on mid-dorsum; a subterminal line indented beneath costa; cilia grey with a fuscous sub-basal line. Hindwings and cilia fuscous.

Very similar to *E. difficilis*, but the terminal joint of palpi is much shorter.

Queensland: Injune in February and March; nine specimens received from Mr. W. B. Barnard, who has the type.

902. Eulechria clastosticha, n. sp. (κλαστοσιχος, with broken lines.)

♂. 28–32 mm. Head and thorax fuscous. Palpi slender, second joint exceeding base of antennae, terminal joint three-fifths; fuscous with a few whitish scales. Antennae whitish obscurely ringed with fuscous; ciliations in male 1½. Abdomen fuscous; tuft ochreous-grey-whitish. Legs fuscous; posterior pair paler; tibiae and tarsi white-ringed. Forewings elongate, strongly dilated posteriorly, costa slightly arched, apex rounded, termen obliquely rounded; fuscous sprinkled with whitish; markings dark fuscous; a fine subcostal broken line from base to two-thirds, a similar line below middle, bent upwards at its extremity to join subcostal line, both lines partly continuous to a variable extent; a line from four-fifths costa, at first nearly transverse, then bent outwards and continued near and parallel to termen to end at tornus; a terminal series of dots; cilia grey-whitish with a darker median line. Hindwings and cilia pale grey.

Queensland: Injune in May and June; eight specimens received from Mr. W. B. Barnard, who has the type. This may be placed after *E. atrisignis* (No. 764), with which it agrees in shape of forewings.

903. Eulechria dryocoetes, n. sp. (δρυοκοιτης, lurking in the forest.)

♂. 18 mm. Head and thorax whitish-brown. Palpi with second joint much exceeding base of antennae, terminal joint three-fourths; whitish-brown, second joint fuscous externally from base to middle and with a subapical fuscous ring. Antennae whitish-brown annulated with fuscous; ciliations in male 4. Abdomen pale ochreous-brown. Legs whitish-ochreous; anterior tibiae barred with fuscous on outer surface. Forewings suboval, costa moderately arched, apex rounded, termen obliquely rounded; whitish-brown; markings and some scattered scales dark fuscous; a fine streak from base of costa; a dot on base of dorsum; stigmata rather large, first discal at one-third, plical beneath it, second discal before two-thirds; a spot on three-fifths costa; another on costa before apex giving rise to a line of fine dots, indented beneath costa, thence outwardly curved and running along lower half of termen to tornus; cilia whitish-brown with some fuscous points. Hindwings and cilia ochreous-grey-whitish.

North Queensland: Lake Barrine (Atherton Tableland) in September; two specimens. This is not near any other species, but may precede *E. mutabilis*.

904. Eulechria mutabilis, n. sp. (*mutabilis*, inconstant.)

♂, ♀. 16–20 mm. Head whitish. Palpi with second joint reaching base of antennae, slender, smooth, terminal joint three-fifths, slender; white. Antennae grey; ciliations in male 2. Thorax whitish-grey. Abdomen ochreous-whitish. Legs ochreous-whitish; anterior pair pale rosy. Forewings suboval, costa gently arched; apex rounded-rectangular, termen obliquely rounded; white; a small blackish spot at one-third and another at two-thirds; a dark fuscous streak from mid-base along fold, touching first spot, then bent slightly upwards and nearly reaching second spot, but this may be partly or wholly obsolete; cilia white. Hindwings with 5 approximated to 4 at origin; white; sometimes ochreous-tinged; cilia white.

A peculiar species not near any other. I place it before *E. cycnoptera.* The pink forelegs and curvature of vein 5 of hindwings suggest some affinity to *Machimia*, but the antennal pecten is strongly developed.

Queensland: Injune in March and April; three specimens received from Mr. W. B. Barnard, who has the type.

905. EULECHRIA ALBIPALPIS, n. sp. (*albipalpis*, with whitish palpi.)

♂. 18 mm. Head and thorax fuscous. Palpi with second joint reaching base of antennae, terminal joint three-fourths; ochreous-whitish, extreme base of second joint fuscous. Antennae fuscous; ciliations in male 1. Abdomen grey. Legs whitish sprinkled with fuscous; anterior pair wholly fuscous except whitish tarsal rings. Forewings comparatively short and broad, dilated posteriorly, costa strongly arched, apex rounded-rectangular, termen slightly rounded, slightly oblique; fuscous with blackish markings; first discal at one-third, plical beneath it, second discal before two-thirds; a subterminal line of dots; cilia fuscous. Hindwings and cilia grey.

An obscure species, but easily recognized by its broad forewings and whitish rather stout palpi. I place it before *E. thetica* (No. 880).

Macpherson Range (Binna Burra, 2,500 feet) in February; one specimen.

Key to the following Genera.

1.	Palpi with second joint long, rough-haired above and beneath from middle or before to apex	2
	Palpi not so	5
2.	Palpi with long anterior tuft on apex of second joint	3
	Palpi without anterior tuft	4
3.	Forewings with 2 and 3 connate or stalked	*Exarsia*
	Forewings with 2 and 3 separate	*Corethropalpa*
4.	Antennae with basal pecten	*Pleurota*
	Antennae without pecten	*Zacorus*
5.	Palpi with apical inferior tuft	6
	Palpi without apical tuft	10
6.	Hindwings with 4 absent	*Ptochosaris*
	Hindwings with 4 present	7
7.	Forewings with 2 and 3 stalked	*Pararsia*
	Forewings with 2 and 3 separate	8
8.	Antennae without pecten	9
	Antennae with pecten	*Saropla*
9.	Forewings elongate-ovate	*Atheropla*
	Forewings broadly ovate	*Orthiastis*
10.	Palpi with second joint thickened and rough-haired towards apex posteriorly	11
	Palpi not so	12
11.	Palpi with terminal joint less than one-third	*Trachyzancla*
	Palpi with terminal joint one-half or more	*Protomacha*
12.	Palpi with second joint thickened and rough-scaled almost from base	13
	Palpi not so	17
13.	Palpi with second joint not reaching base of antennae	14
	Palpi with second joint reaching base of antennae	16
14.	Forewing cilia with a basal series of broad scales	*Aeolocosma*
	Forewing cilia not so	15
15.	Antennae with basal pecten	*Coeranica*
	Antennae without basal pecten	*Euthictis*
16.	Antennae without basal pecten	*Thalerotricha*
	Antennae with basal pecten	*Trachyxysta*

17.	Palpi with second joint rough-scaled at apex anteriorly	18
	Palpi not so	19
18.	Hindwings lanceolate; 3 and 4 separate	*Acorotricha*
	Hindwings elongate-ovate or broadly ovate; 3 and 4 connate	*Pachybela*
19.	Antennae without basal pecten	*Antiopala*
	Antennae with pecten	20

68. Gen. Pleurota Hb.

Verz., p. 406; Meyr., P.L.S.N.S.W., 1884, p. 747.

Tongue present. Palpi very long, porrect or ascending, not recurved; second joint with rough hairs above and beneath from middle or before middle to apex; terminal joint much shorter than second, ascending, slender, acute. Antennae with basal pecten; ciliations in male moderate or rather long. Forewings with 7 to termen. Hindwings elongate-ovate; neuration normal. Type, *P. bicostella* Clerck from Europe.

This genus is easily recognized by its peculiar palpi which, however, present minor differences in the several species. Its closest allies are all Australian genera, and there can, therefore, be little doubt that it is of Australian origin. It is, therefore, anomalous that about 60 species should occur in the Palaearctic region, while the genus is wholly unrepresented in the Indomalayan. The European species are mostly very similar and may have originated, according to Meyrick, from a single immigrant. The simplest explanation is that some representative spread overland, but the genus became extinct in the intermediate region, or may possibly still survive in high altitudes, which have been insufficiently explored for microlepidoptera. It is noteworthy that species of *Pleurota*, when intratropical, appear to occur only at high altitudes.

Forty-two species.

906. Pleurota semophanes Meyr., P.L.S.N.S.W., 1888, p. 1649; *Gen. Ins.*, Oecophor., Pl. 4, f. 66 (Birchip, Dimboola; W.A.: York, Geraldton).

907. Pleurota callizona Meyr., P.L.S.N.S.W., 1884, p. 753 (Beaconsfield, Fernshaw, Macedon).

908. Pleurota photodotis Meyr., ibid., 1888, p. 1653; = *chrysopepla* Turn., *Tr.R.S.S.Aust.*, 1917, p. 76 (Stanthorpe, Glen Innes, Bathurst).

909. †Pleurota xyphochrysa Low., ibid., 1904, p. 108 (Stawell).

910. Pleurota phormictis Meyr., *Exot. Micro.*, i, p. 121 (Gisborne).

911. Pleurota agastopis, n. sp. (ἀγαστωπις, admirable.)

♂. 20 mm. Head yellow. Palpi with second joint long, porrect, shortly rough-scaled beneath towards apex, and with very long rough hairs above towards apex, terminal joint three-fifths, slender, ascending; yellow, basal two-thirds of second joint and a basal ring on terminal joint fuscous. Antennae fuscous; ciliations in male 1. Thorax and abdomen fuscous. Forewings suboblong, costa rather strongly arched, apex round-pointed, termen strongly oblique; whitish mostly suffused with yellow; markings fuscous; a broad costal streak from base to one-fourth; some suffusion on midcosta connected with a dorsal mark before middle, and with a large circular suffused tornal spot; a row of dots from three-fourths costa, at first outwardly oblique, soon bent parallel to termen and partly confluent, ending on tornus; a terminal series of dots. Hindwings pale grey; cilia pale grey, ochreous-tinged.

North Queensland: Eungella (2,500 feet) in October; one specimen.

912. Pleurota tyrochroa, n. sp. (τυροχροος, cheese-coloured.)

♂, ♀. 15–16 mm. Head and thorax ochreous-yellow. Palpi with second joint very long, short rough hairs on apical two-thirds of upper surface, longer hairs on apical half of lower surface, terminal joint two-fifths; white, basal half of external surface, a subapical ring, and a longitudinal streak below middle on inner surface of second joint, and all terminal joint, fuscous. Antennae grey. Abdomen fuscous; tuft ochreous. Legs ochreous-whitish; anterior pair fuscous. Forewings suboblong, costa slightly arched, apex rounded, termen rounded, slightly oblique; ochreous-yellow; a narrow pale fuscous erect bar from tornus reaching slightly above middle; cilia pale fuscous. Hindwings and cilia grey.

But for the palpi this would be taken for a small yellow species of *Coesyra*.

New South Wales: Sydney in November; three specimens received from Mr. G. M. Goldfinch, who has the type.

913. PLEUROTA THIOPEPLA, n. sp. (θειοπεπλος, clothed in pale yellow.)

♂. 20 mm. Head pale yellow. Palpi with loose spreading hairs near apex of second joint beneath, and on apical third above, terminal joint four-fifths; pale yellowish, basal two-thirds of external surface of second joint, and all terminal joint, fuscous. Antennae grey; ciliations in male 2. Thorax fuscous. Abdomen grey; tuft pale yellow. Legs fuscous; posterior pair yellow. Forewings rather narrow, costa slightly arched, apex pointed, termen oblique; pale yellow; costal edge fuscous towards base; a rather large fuscous tornal spot; cilia pale yellow. Hindwings grey; cilia pale yellow.

Central Australia: Mt. Liebig; one specimen received from Mr. J. D. O. Wilson.

914. PLEUROTA HOPLOPHANES Meyr., P.L.S.N.S.W., 1888, p. 1651 (Caloundra to Sydney).

915. PLEUROTA HIMANTIAS Meyr., *Exot. Micro.*, i, p. 121 (Glen Innes, Armidale, Adaminaby, Gisborne, Grampians).

916. PLEUROTA BREVIVITTELLA Wlk., xxix, p. 802; Meyr., P.L.S.N.S.W., 1884, p. 752; = *pyrosema* Meyr., 1884, p. 754 (Duaringa to Melbourne).

917. PLEUROTA PELOXANTHA Meyr., ibid., 1884, p. 753 (Nambour to Lismore).

918. PLEUROTA PSAMMOXANTHA Meyr., ibid., 1884, p. 755 (Brisbane to Sydney and Mittagong).

919. PLEUROTA LOMOGRAPHA Low., *Tr.R.S.S.Aust.*, 1902, p. 245 (Goolwa, S. Aust.).—Very near *P. psammoxantha*. Differs as follows: a small costal mark at four-fifths; no tornal mark; terminal half of cilia fuscous; antennal ciliations 1½ (in *psammoxantha*, 1).

920. PLEUROTA MACROSCIA Meyr., P.L.S.N.S.W., 1888, p. 1651 (Glen Innes, Armidale, Bathurst, Cooma).

921. PLEUROTA CHLOROCHYTA Meyr., ibid., 1884, p. 757; = *perisema* Low., *Tr.R.S.S.Aust.*, 1905, p. 108 (Guyra to Melbourne, Tasmania, Mt. Lofty).

922. PLEUROTA ENDESMA Meyr., P.L.S.N.S.W., 1884, p. 755 (Macpherson Range, Mt. Kosciusko, Victoria, Tasmania).

923. PLEUROTA STASIASTICA Meyr., P.L.S.N.S.W., 1884, p. 757 (Gosford, Sydney, Bulli, Beaconsfield, Fernshaw, Gisborne).

924. PLEUROTA EPICLINES, n. sp. (ἐπικλινης, oblique.)

♀. 17 mm. Head white. Palpi with loose spreading hairs on upper and lower surface of second joint from near base, terminal joint two-fifths; pale fuscous. Antennae fuscous. Thorax and abdomen fuscous. Legs pale fuscous; posterior pair ochreous-whitish. Forewings narrow, costa strongly arched, apex pointed, termen straight, oblique; white with fuscous markings; a basal costal streak to middle; a moderate oblique fascia from midcosta to mid-dorsum; a second oblique fascia from before apex, narrow on costa, broad in disc, not reaching tornus; a terminal line; cilia fuscous. Hindwings and cilia grey.

Near *P. stasiastica*, but the second fascia is not terminal and does not reach tornus.

New South Wales: Barrington Tops in December; one specimen received from Mr. G. M. Goldfinch, who has the type.

925. PLEUROTA GYPSOSEMA Turn., *Tr.R.S.S.Aust.*, 1917, p. 76 (Nambour to Robertson, N.S.W.).—This species is distinct from *P. epitripta*, of which I have both sexes. It varies; of my ten examples, two from the Macpherson Range have the forewings wholly fuscous except for a broad white dorsal streak from base to two-thirds and a triangular white tornal spot. These are females, but I have received a male (antennal ciliations 1) from Mr. G. M. Goldfinch, taken at Robertson, which corresponds to them nearly.

926. PLEUROTA ARGOPTERA Meyr., P.L.S.N.S.W., 1884, p. 758 (Ebor to Sydney, Mt. Kosciusko, and Melbourne).

927. PLEUROTA LEUCOPHARA Turn., ibid., 1914, p. 558 (Ebor).

928. PLEUROTA HOLOXESTA Meyr., ibid., 1888, p. 1652; = *cathara* Turn., ibid., 1914, p. 559 (Glen Innes, Guyra, Ebor, Mt. Buffalo, Beaconsfield).

929. PLEUROTA GYPSINA Meyr., ibid., 1884, p. 756 (Mt. Wilson, Mittagong, Fernshaw, Beaconsfield).

930. PLEUROTA EPITRIPTA Turn., *Tr.R.S.S.Aust.*, 1917, p. 77 (Nambour and Macpherson Range to Lismore).—The female differs from the male in having the whole dorsal and terminal areas of the forewings suffused with fuscous-brown, and the oblique line from second discal to tornus very distinct.

931. PLEUROTA PROXIMA, n. sp. (*proximus*, very near.)

♂. 16–17 mm. Head and thorax white more or less tinged with grey. Palpi with loose spreading hairs on apical half of lower, and apical three-fourths of upper surface, of second joint, terminal joint two-fifths; fuscous, inner surface and apex of second joint white. Antennae fuscous; ciliations in male 1. Abdomen grey. Legs fuscous; posterior pair whitish. Forewings slightly dilated, costa gently arched, apex acute, termen straight, oblique; white; base of costal edge fuscous; stigmata blackish, first discal at one-third, plical beneath it, second discal before two-thirds; a suffused fuscous dorsal streak, and some minute terminal fuscous dots; cilia white. Hindwings and cilia grey-whitish.

Near *P. gypsina*, but the forewings are white without any ochreous tinge. Also in that species the plical dot precedes the first discal, and the markings are more developed in the female than in the male.

Victoria: Mt. Buffalo (4,500 feet) in January and February; three specimens.

932. PLEUROTA ACRATOPA, n. sp. (ἀκρατωπος, unmarked.)

♀. 16 mm. Head and thorax whitish-ochreous. Palpi with long hairs on upper surface of second joint from one-fourth to apex, shorter hairs on lower surface from middle to apex, terminal joint one-half; whitish-ochreous, external surface of second joint fuscous. Antennae fuscous. Abdomen dark grey. Legs whitish-ochreous; anterior pair fuscous. Forewings with costa strongly arched to middle, thence straight, apex round-pointed, termen oblique; whitish-ochreous; cilia whitish-ochreous. Hindwings and cilia grey.

Queensland: Macpherson Range (Binna Burra, 2,000 feet) in December. N.S.W.: Lismore in October. Two specimens.

933. PLEUROTA PLACINA, n. sp. (πλακινος, wooden.)

♂, ♀. 17–22 mm. Head and thorax brown. Palpi with second joint very long, with long hairs on apical three-fourths of upper and apical half of lower surface, terminal joint two-fifths; pale brown, outer surface except apex and inferior hairs on second joint, and apex of terminal joint, blackish. Antennae grey with blackish annulations; ciliations in male 2. Abdomen fuscous; tuft brownish. Legs brownish; anterior pair fuscous. Forewings somewhat dilated, costa gently arched, apex pointed, termen oblique; pale brown or ocheous, suffusedly darker in dorsal area; cilia pale brown, on tornus narrowly fuscous. Hindwings grey; cilia ochreous-whitish.

Queensland: Bribie I. near Caloundra in August; Crow's Nest near Toowoomba and Milmerran in September; five specimens.

934. Pleurota leucostephes, n. sp. (λευκοστεφης, white-wreathed.)

♂, ♀. 12–13 mm. Head and thorax white. Palpi with second joint long, upper surface with long hairs on apical three-fifths, lower with shorter hairs on apical half, terminal joint two-thirds; white, lower surface of second joint except apex, and all terminal joint, fuscous. Antennae whitish; basal joint fuscous; ciliations in male two-thirds. Abdomen grey; tuft whitish. Legs whitish; anterior pair fuscous. Forewings narrow, costa slightly arched, apex pointed, termen very oblique; white with some patchy fuscous suffusion; markings fuscous; first discal at one-third, minute, plical beyond it, second discal before two-thirds; basal area suffused with fuscous leaving a white line on fold; median and tornal areas mostly white; a small fuscous supratornal blotch resting on termen; a similar blotch above middle between discals, more or less connected with costa; slight fuscous lines on veins in apical area; cilia fuscous, bases white. Hindwings and cilia pale grey.

Very small and inconspicuous.

Queensland: Brisbane in January and February; three specimens.

935. Pleurota tenellula, n. sp. (*tenellulus*, very tender, delicate.)

♂, ♀. 12–13 mm. Head and thorax white. Palpi with second joint very long, rough-haired above in apical two-thirds, beneath in apical half, terminal joint ½; white, terminal joint and base, inferior hairs, and a subapical ring on second joint fuscous. Antennae whitish-grey; ciliations in male 1. Abdomen grey. Legs whitish; anterior pair fuscous. Forewings with costa slightly arched, apex pointed, termen oblique; white; extreme base of costal edge fuscous; stigmata fuscous, minute, first discal beyond one-third, plical beyond it, second discal before two-thirds; cilia pale grey. Hindwings and cilia pale grey.

Small, inconspicuous and easily overlooked.

North Queensland: Cairns in April; Queensland: Brisbane in March and April. Six specimens.

936. Pleurota macrosticha, n. sp. (μακροστιχος, long-streaked.)

♀. 16 mm. Head white. Palpi with second joint rough-haired beneath on apical three-fourths, hairs longer and forming a tuft at apex, shortly rough-haired above on apical half; white, inferior edge brown. Antennae pale grey. Thorax white with sublateral brown stripes. (Abdomen missing.) Legs pale brownish; posterior pair whitish. Forewings narrow, costa gently arched, apex pointed, termen very oblique; white with fuscous-brown markings; a broad streak from base of costa, becoming costal again at three-fourths, and extending to apex, giving off a branch to costa at two-thirds, another broader to termen, and a third to tornus, joining preceding on termen; a broad streak from base of costa along fold, narrowing to a sharp point at one-third; cilia pale grey, on costa and beneath apex fuscous-brown. Hindwings and cilia pale grey.

South Australia: Gawler in November; one specimen received from Mr. G. M. Goldfinch, who has the type.

937. Pleurota protogramma Meyr., P.L.S.N.S.W., 1884, p. 751; = *crassinervis* Meyr., ibid., 1884, p. 752 (Stanthorpe, Sydney, Victoria).—This species is variable:

fine fuscous streaks are often developed on forewings, a subcostal and a dorsal from base, and a series on terminal veins; sometimes the whole disc is traversed by these streaks, obscuring the light ochreous ground-colour. Its palpi are characteristic, the long hairs beneath being of even length throughout.

938. PLEUROTA TEPHRINA Meyr., ibid., 1888, p. 750; = *leucogramma* Turn., *Tr.R.S.S.Aust.*, 1917, p. 76 (Nambour to Mittagong, Tasmania. W.A.: Geraldton).

939. PLEUROTA CNEPHAEA Meyr., ibid., 1888, p. 1650 (W.A.: Albany, Denmark, Geraldton).

940. PLEUROTA THEMEROPIS Meyr., ibid., 1884, p. 749 (Tasmania).

941. PLEUROTA TITANITIS Turn., *P.R.S.Tas.*, 1926, p. 148 (Cradle Mt.).

942. PLEUROTA LACTEOLA, n. sp. (*lacteolus*, milk-white.)

♂. 14–15 mm. Head and thorax white. Palpi with long rough hairs on apical two-thirds of second joint above, on apical half beneath, terminal joint ½; white, base and posterior edge of inferior hairs on second joint, and terminal joint, fuscous. Antennae whitish-grey; ciliations in male 1. Legs whitish; anterior pair fuscous. Forewings with costa moderately arched, apex pointed, termen oblique; white slightly suffused with grey near base; extreme base of costal edge blackish; stigmata blackish, distinct, first discal at one-third, plical slightly beyond; second discal before two-thirds, sometimes a minute dot beneath second discal; a series of minute blackish dots in a line from three-fourths costa, angled before apex, thence parallel to termen; cilia white. Hindwings and cilia white.

Larger than *P. tenellula*, costa of forewings more arched, dots more distinct, a subterminal line present, cilia and hindwings white.

Queensland: Caloundra in October. New South Wales: Brunswick Heads in January. Two specimens.

943. PLEUROTA HOMALOTA Meyr., P.L.S.N.S.W., 1888, p. 1649 (W.A.: Perth, Waroona).

944. PLEUROTA PSEPHENA Meyr., ibid., 1884, p. 751 (Tasmania).

945. PLEUROTA ZALOCOMA Meyr., ibid., 1884, p. 749 (Mt. Wellington).

946. PLEUROTA TRITOSTICTA Turn., *P.R.S.Tas.*, 1926, p. 149 (Lake Fenton, Tas.).

947. PLEUROTA PICEA, n. sp. (*piceus*, pitch-black.)

♀. 18 mm. Head fuscous. Palpi with second joint expanded above and beneath with long rough hairs from middle to apex, terminal joint three-fourths; fuscous. Antennae fuscous. Thorax blackish. Abdomen fuscous; bases of segments dark ferruginous. Legs fuscous. Forewings slightly dilated, costa gently arched, apex pointed, termen oblique; blackish; cilia blackish. Hindwings and cilia grey.

Queensland: Noosa in May; one specimen.

69. Gen. CORETHROPALPA Turn.

Tr.R.S.S.Aust., 1896, p. 27; Meyr., *Gen. Ins.*, Oecophor., p. 104.

Tongue present. Palpi with second joint very long, porrect or ascending, not recurved, with long rough hairs above and beneath, the latter forming a strong projecting terminal tuft; terminal joint much shorter than second, ascending, slender, acute. Forewings with 7 to termen. Hindwings elongate-ovate; neuration normal. Type, *C. melanoneura.*

Nearly allied to *Pleurota*, but differs in the strong anterior tuft on apex of second joint of palpi. Three species.

948. CORETHROPALPA MELANONEURA Meyr., P.L.S.N.S.W., 1884, p. 744; *Gen. Ins.*, Oecophor., Pl. iv, f. 69; = *falcata* Turn., *Tr.R.S.S.Aust.*, 1896, p. 28 (Brisbane, Sydney, Shoalhaven R.).

949. Corethropalpa cinerea Meyr., ibid., 1884, p. 742; = *leuconeura* Turn., ibid., p. 77 (Brisbane to Melbourne, Mt. Lofty).

950. Corethropalpa homophanes, n. sp. (ὁμοφανης, uniform.)

♀. 24 mm. Head and thorax brownish-grey. Palpi with long hairs on lower surface of second joint from one-third, ending in a strong apical tuft, shortly rough-haired above towards apex, terminal joint one-fourth; grey. Antennae and abdomen grey. Legs pale fuscous (posterior pair missing). Forewings elongate, costa slightly arched, apex round-pointed, termen oblique; pale brownish-grey; cilia grey, apices whitish. Hindwings and cilia grey.

North Queensland: Stannary Hills near Herberton; one specimen received from Dr. T. Bancroft.

70. Gen. Exarsia.

Meyr., *Exot. Micro.*, i, p. 269. Type, *E. paracycla*.

Head with appressed scales, side tufts small. Tongue rudimentary. Palpi with second joint moderately long, ascending, with a triangular tuft of hairs from middle to apex above, and a long dense projecting apical tuft beneath; terminal joint as long as second, smooth, slender, acute. Antennae with basal pecten; in male moderately ciliated. Forewings with 2 and 3 connate or stalked, 7 to termen, 11 from before middle. Hindwings with 3 and 4 connate, 5 from middle of cell. Type, *E. paracycla*. Two species.

951. Exarsia poliochra Low., *Tr.R.S.S.Aust.*, 1903, p. 224 (Stawell).

952. Exarsia paracycla Low., P.L.S.N.S.W., 1897, p. 24 (Broken Hill).—Antennal ciliations in male 1. Forewings grey-whitish, sometimes whiter towards costa, lightly sprinkled with fuscous; costa narrowly pale fuscous; stigmata fuscous, first discal at one-third, minute, often obsolete, plical before it, but often obsolete, second discal at two-thirds; usually a series of submarginal fuscous dots close to termen.

71. Gen. Pararsia, n.g.

Head with side tufts large, with loose spreading hairs. Tongue weakly developed. Palpi with second joint very long, ascending, smooth above, with a sharply projecting apical tuft beneath; terminal joint less than half second, smooth, slender, acute. Antennae with basal pecten; ciliations in male long. Forewings with 2 and 3 stalked, 7 to termen, 11 from middle. Hindwings with 3 and 4 connate, 5 from middle of cell. Near *Exarsia*.

953. Pararsia marmorea Low., *Tr.R.S.S.Aust.*, 1897, p. 54.—Lower's type was said to be from Mackay, and I have received an example bearing a printed label "Brisbane" but undated. I know of no Queensland examples, and have some doubt as to the correctness of these localities.

72. Gen. Ptochosaris Meyr. (*Tr.R.S.S.Aust.*, 1906, p. 37.)

Tongue present. Palpi moderately long, slightly curved, subascending; second joint with long projecting tuft of hairs towards apex beneath; terminal joint less than half second, slender, acute. Antennae without basal pecten; ciliations in male moderate. Forewings with 7 to termen. Hindwings lanceolate, cilia 2; 4 absent, 5 approximated to 3.

954. †Ptochosaris horrenda Meyr., ibid., 1906, p. 37 (Katoomba, Mt. Lofty).

73. Gen. Saropla Meyr. (P.L.S.N.S.W., 1884, p. 743.)

Tongue present. Palpi moderately long, ascending, recurved; second joint reaching or exceeding base of antennae, with rough projecting apical tuft beneath;

terminal joint shorter than second, smooth, slender, acute. Antennae with basal pecten; ciliations in male short or moderate. Forewings with 7 to termen. Hindwings lanceolate; neuration normal. Type, *S. caelatella.*

This natural genus shows considerable variation in the length of the terminal joint of the palpi. Meyrick records one species from South Africa. There are ten Australian species.

955. SAROPLA HEMIXANTHA, n. sp. (ἑμιξανθος, half-yellow.)

♂. 15 mm. Head and thorax fuscous. Palpi with second joint not reaching base of antennae, with a strong anterior apical tuft, terminal joint one-third; fuscous. Antennae fuscous; ciliations in male 1. (Abdomen missing.) Legs fuscous. Forewings narrow, posteriorly slightly dilated, costa straight, apex obtusely pointed, termen straight, oblique; fuscous, markings obscurely darker; first discal obsolete, plical present, second discal at two-thirds; a curved line of dots from four-fifths costa to tornus; cilia fuscous. Hindwings orange-yellow; cilia fuscous.

South Australia: Ooldea in August (A. J. Nicholson); type in Coll. Goldfinch.

956. †SAROPLA BRACHYOTA Meyr., P.L.S.N.S.W., 1888, p. 1648 (W.A.: Perth).

957. †SAROPLA PRODOTIS Meyr., *Exot. Micro.*, i, p. 246 (W.A.: York).

958. †SAROPLA AMYDROPIS Meyr., P.L.S.N.S.W., 1888, p. 1648 (W.A.: Geraldton).

959. SAROPLA CLERONOMA Meyr., ibid., 1884, p. 746 (Brisbane, Stanthorpe, Sydney).

960. †SAROPLA ANCISTROTIS Meyr., ibid., 1888, p. 1647 (W.A.: Geraldton).

961. SAROPLA HARPACTIS Meyr., ibid., 1888, p. 1646 (W.A.: Perth, Northampton).

962. SAROPLA PHILOCALA Meyr., ibid., 1884, p. 746 (Noosa to Jervis Bay, Mt. Kosciusko).

963. SAROPLA CAELATELLA Meyr., ibid., 1884, p. 745 (Duaringa to Melbourne, Pt. Lincoln).

964. SAROPLA STENODESMA Low., *Tr.R.S.S.Aust.*, 1894, p. 99 (Mt. Lofty).

74. Gen. ATHEROPLA Meyr. (P.L.S.N.S.W., 1884, p. 758.)

Tongue present. Palpi long, curved, ascending; second joint much exceeding base of antennae, with triangular apical tuft beneath; terminal joint as long as or rather shorter than second, slender, acute. Antennae without basal pecten; ciliations in male long. Forewings with 7 to termen. Hindwings lanceolate or ovate-lanceolate; neuration normal. Type, *A. melichlora.*

The triangular tuft on palpi varies considerably in degree of development. In *A. barytypa* and *A. dysprepes* it is very small. Meyrick records one species from North America. Eleven species.

965. ATHEROPLA TRIPLACA Meyr., *Tr.R.S.S.Aust.*, 1902, p. 141 (Katoomba).

966. †ATHEROPLA SCIOXANTHA Low., ibid., 1902, p. 242 (Stawell, Birchip).

967. ATHEROPLA CHORIAS Meyr., ibid., 1902, p. 140 (Sydney).

968. ATHEROPLA FUMOSA Turn., *P.R.S.Tas.*, 1926, p. 149 (Tasmanian Mts.).

969. ATHEROPLA BARYTYPA, n. sp. (βαρυτυπος, heavily marked.)

♂. 14–16 mm. Head pale yellow. Palpi ochreous-whitish; second joint with a small angular apical inferior projection, fuscous externally on distal half except at apex; apical third of terminal joint fuscous. Antennae pale yellow becoming grey towards apex; ciliations in male extremely long (12). Thorax pale yellow. Abdomen grey, towards base whitish. Legs fuscous with whitish-ochreous rings; posterior pair whitish-ochreous. Forewings dilated, costa strongly arched, apex pointed, termen straight, oblique; pale yellow with fuscous-brown markings; a costal streak, very narrow to one-fourth, thence broader to apex; an oblique narrow fascia from costa about middle to one-third dorsum; a spot in disc at two-thirds, touching a rather broad subterminal fascia, its anterior edge straight, posterior edge sharply dentate; cilia pale yellow, on costa fuscous, on tornus and dorsum grey. Hindwings rather narrowly ovate; apex rounded; whitish suffused with pale grey towards apex; cilia pale grey, on tornus and dorsum whitish.

The slight angular projection, which represents the tuft of the palpi characteristic of the genus, is distinct, but might be easily overlooked.

Queensland: Macpherson Range (low level to 4,000 feet) in November, December and February; seven specimens.

970. ATHEROPLA DYSPREPES, n. sp. (δυσπρεπης, unadorned.)

♂. 13 mm. Head and thorax whitish-ochreous. Palpi with angular thickening at apex of second joint, terminal joint 1; whitish-ochreous, outer surface of second joint except apex fuscous. Antennae whitish-ochreous, towards base fuscous; ciliations in male 8. Abdomen pale grey. Legs fuscous; posterior pair whitish-ochreous. Forewings narrow, costa gently arched, apex rounded, termen obliquely rounded; whitish-ochreous; stigmata blackish, first discal before one-third, plical beyond it, second discal before two-thirds; cilia whitish-ochreous. Hindwings and cilia whitish-grey.

Queensland: Bunya Mts. in November and December; two specimens.

971. ATHEROPLA CROCEA, n. sp. (κροκες, saffron.)

♂, ♀. 12–13 mm. Head and thorax orange. Palpi with a strong anterior triangular tuft on second joint, terminal joint three-fifths; ochreous with a broad fuscous subapical transverse bar on second joint. Antennae ochreous annulated with fuscous; ciliations in male 8. Abdomen and legs fuscous. Forewings dilated posteriorly, costa gently arched, apex pointed, termen oblique; orange with dark fuscous markings; first discal at one-third, plical before it, second discal before two-thirds; a broad subterminal fascia leaving terminal edge orange; cilia orange, on apex and tornus fuscous. Hindwings and cilia grey.

Differs from *A. melichlora* in the deep orange and fuscous forewings and the darker hindwings.

New South Wales: Sydney in September and October; three specimens received from Mr. G. M. Goldfinch, who has the type.

972. ATHEROPLA MELICHLORA Meyr., P.L.S.N.S.W., 1884, p. 759 (Katoomba, Jervis Bay, Gisborne, Beaconsfield).

973. ATHEROPLA PSAMMODES Turn., *Tr.R.S.S.Aust.*, 1898, p. 211 (Brisbane, Macpherson Range, Sydney, Moruya).

974. ATHEROPLA DECASPILA Meyr., P.L.S.N.S.W., 1888, p. 1653 (Bathurst, Gisborne, Beaconsfield).

975. †ATHEROPLA PSILOPIS Meyr., ibid., 1888, p. 1652 (Mt. Kosciusko).

75. Gen. ORTHIASTIS Meyr. (*Exot. Micro.*, i, p. 247).

Tongue present. Palpi very long, ascending, recurved; second joint more than twice length of face, with loose rough hairs before middle, forming a strong apical tuft; terminal joint about half second, slender, acute. Antennae without basal pecten; ciliations in male short. Forewings with 7 to termen. Hindwings elongate-ovate; neuration normal.

976. ORTHIASTIS HYPEROCHA Meyr., P.L.S.N.S.W., 1884, p. 764 (Katoomba, Mt. Kosciusko, Wangaratta, Mt. Erica).

76. Gen. ZACORUS Butl. (*Ann. Mag. Nat. Hist.* (5), ix, 1882, p. 102).

Tongue present. Palpi very long, recurved, ascending; second joint more than twice length of face, shortly rough-haired above at apex and beneath from one-third to apex; terminal joint shorter than second, slender, acute. Antennae without basal pecten; ciliations in male short. Forewings with 7 to termen. Hindwings ovate, broader than forewings; neuration normal. Type, *Z. cara*. I refer only one species to this genus.

977. ZACORUS CARA Butl., *A.M.N.H.* (5), ix, p. 103; Meyr., P.L.S.N.S.W., 1884, p. 740 (Stanthorpe to Katoomba and Bathurst; Victoria; Tasmania).

77. Gen. THALEROTRICHA Meyr. (P.L.S.N.S.W., 1884, p. 741).

Tongue present. Palpi moderately long, recurved; second joint reaching base of antennae, shortly rough-haired beneath from middle to apex, smooth above; terminal joint as long as or shorter than second, slender, acute. Antennae without basal pecten; ciliations in male short or long. Forewings with 7 to termen. Hindwings elongate-ovate; neuration normal. Type, *T. mylicella.* Four species.

978. THALEROTRICHA MYLICELLA Meyr., P.L.S.N.S.W., 1884, p. 741 (Stanthorpe to Melbourne; Tasmania).

979. THALEROTRICHA HEMISPILA Meyr. (P.L.S.N.S.W., 1888, p. 1636; = *cremnopelta* Low., ibid., 1897, p. 269).

♂, ♀. 20 mm. Head and thorax whitish-ochreous. Palpi with second joint expanded at apex to form an angular anterior tuft, terminal joint 1; whitish-ochreous, outer surface of second joint except apex fuscous. Antennae ochreous-grey, towards base fuscous; ciliations in male 6. Abdomen grey; tuft whitish-ochreous. Legs fuscous with whitish-ochreous rings; posterior pair except tarsi whitish-ochreous. Forewings dilated posteriorly, costa almost straight, apex pointed, termen moderately oblique; whitish-ochreous; markings and scanty irroration dark fuscous; first discal at one-third, plical beyond it, second discal before two-thirds; a tornal dot above which is a circular blotch; a series of dots on apical third of costa and termen; cilia whitish-ochreous. Hindwings and cilia whitish.

Described from the types, both of which are in the South Australian Museum.

Victoria: Moe; Hamilton.

980. THALEROTRICHA MONTIVAGA, n. sp. (*montivagus*, roaming the mountain.)

♂. 24–25 mm. Head, thorax, abdomen, and legs grey. Palpi with terminal joint two-thirds; grey. Antennae grey; ciliations in male 1½. Forewings scarcely dilated, costa gently arched, apex obtusely pointed, termen straight, oblique; pale grey; stigmata blackish, first discal at one-third, plical before it, second discal well before two-thirds; cilia whitish-grey. Hindwings and cilia pale grey.

New South Wales: Mt. Kosciusko (5,000 feet) in December; three specimens received from Mr. G. M. Goldfinch, who has the type.

981. THALEROTRICHA MESOPLACA, n. sp. (μεσοπλακος, with median blotch.)

♂. 23 mm. Head white. Palpi with second joint expanded at apex to form a small angular anterior tuft, terminal joint 1; white, second joint except apex, and extreme apex of terminal joint, fuscous. Antennae pale grey; ciliations in male 5. Thorax grey. Abdomen grey mixed with blackish; apices of segments and tuft whitish. Legs grey; anterior pair fuscous. Forewings dilated posteriorly, costa strongly arched, apex acute, termen sinuate, oblique; grey; markings fuscous; a suffused circular blotch on mid-dorsum with some surrounding suffusion; a slender line from midcosta towards midtermen, sharply angled in middle and continued to four-fifths dorsum; an interrupted terminal line; cilia grey, on apex fuscous. Hindwings and cilia pale grey.

Tasmania: Mt. Wellington in January; one specimen.

78. Gen. TRACHYXYSTA Meyr. (*Exot. Micro.*, i, p. 552).

Tongue present. Palpi ascending, recurved; second joint reaching base of antennae, thickened with dense scales roughly projecting beneath throughout; terminal joint less than one-third second. Antennae with basal pecten; in male rather strongly ciliated. Forewings with 7 to termen. Hindwings elongate-ovate; neuration normal.

982. †TRACHYXYSTA ANTICHROMA Meyr., *Tr.R.S.S.Aust.*, 1902, p. 137 (Healesville, V.).

79. Gen. COERANICA Meyr. (P.L.S.N.S.W., 1884, p. 759).

Tongue present. Palpi with second joint not reaching base of antennae, with rough projecting scales beneath from middle to apex; terminal joint less than one-half, slender, acute. Antennae with basal pecten; in male shortly ciliated. Forewings with 7 to termen. Hindwings rather broadly ovate; neuration normal. Type, *C. isabella*. Two species.

983. COERANICA ISABELLA Newm., *Tr.E.S.* (2), iii, 1855, p. 295; Meyr., P.L.S.N.S.W., 1884, p. 760 (Brisbane and Toowoomba to Melbourne and Gisborne).

984. COERANICA ERITIMA Meyr., ibid., 1884, p. 760 (Victoria; South Australia; W.A.: Cunderdin).

80. Gen. TRACHYZANCLA Turn. (*Tr.R.S.S.Aust.*, 1917, p. 79).

Tongue present. Palpi with second joint much exceeding base of antennae, more than twice length of face, rough anteriorly, posteriorly expanded with long hairs at apex; terminal joint one-sixth, slender, acute. Antennae with basal pecten; ciliations in male long. Forewings with 7 to termen, 2 and 3 stalked. Hindwings elongate-ovate; neuration normal.

The affinities of this genus are far from clear.

985. TRACHYZANCLA HISTRICA Turn., *Tr.R.S.S.Aust.*, 1917, p. 80 (W.A.: Cunderdin).

81. Gen. PROTOMACHA Meyr. (P.L.S.N.S.W., 1884, p. 739).

Tongue present. Palpi long, recurved, ascending; second joint exceeding base of antennae, gradually thickened towards apex, with short rough hairs at or towards apex posteriorly and sometimes also anteriorly; terminal joint shorter than second, slender, acute. Antennae with basal pecten; ciliations in male short. Forewings with 7 to termen. Hindwings elongate-ovate; neuration normal. Type, *P. chalchaspis*.

A natural genus, which as here defined shows slight variations in the scaling of the second joint of the palpi. It is probably directly ancestral to *Pleurota*. Meyrick records two species from South Africa. Eight species.

986. PROTOMACHA CHALCHASPIS Meyr., P.L.S.N.S.W., 1884, p. 740 (Tweed Hds. to Melbourne; Hobart; Mt. Lofty).

987. PROTOMACHA CONSUETELLA Wlk., xxix, p. 651; Meyr., ibid., 1884, p. 739 (Sydney, Katoomba, Jervis Bay).

988. PROTOMACHA OCHROCHALCHA Meyr., ibid., 1888, p. 1646 (W.A.: Albany).

989. PROTOMACHA STRAMINEA Turn., *Tr.R.S.S.Aust.*, 1917, p. 78 (Brisbane).

990. PROTOMACHA PARALIA Meyr., *Exot. Micro.*, i, p. 122 (Adelaide).

991. PROTOMACHA ZORODES, n. sp. (ζωρωδης, unmarked.)

♂. 23 mm. Head and thorax whitish-ochreous. Palpi with second joint much exceeding base of antennae, thickened with rough hairs at apex posteriorly, terminal joint one-fifth; anteriorly fuscous, posteriorly whitish-ochreous. Antennae whitish-ochreous; ciliations in male 6. Abdomen ochreous-whitish. Legs ochreous-whitish; anterior pair fuscous. Forewings elongate, costa strongly arched, apex round-pointed, termen obliquely rounded; whitish-ochreous; cilia whitish-ochreous. Hindwings and cilia whitish.

North Queensland: Lake Barrine (Atherton Tableland), in November; one specimen in Coll. Goldfinch.

992. Protomacha phloeomima, n. sp. (φλοιομιμος, imitating bark.)

♂. 18–19 mm. Head and thorax whitish sprinkled with dark fuscous. Palpi whitish, second joint sprinkled with blackish. Antennae grey; ciliations in male 1½. Abdomen grey; bases of segments brown. Legs: anterior pair fuscous; middle pair white sprinkled with fuscous; posterior pair grey. Forewings narrow, costa gently arched, apex round-pointed, termen straight, oblique; white suffused and sprinkled with fuscous, appearing grey; interrupted slender blackish longitudinal streaks, on fold, beneath fold, on upper margin of cell, and several before apex; cilia white with fuscous bars. Hindwings and cilia pale grey.

Queensland: Yeppoon in October; two specimens.

993. Protomacha anthracina Turn., *Tr.R.S.S.Aust.*, 1917, p. 78 (Bundaberg to Sydney).

82. Gen. Aeolocosma Meyr. (P.L.S.N.S.W., 1880, p. 225).

Head smooth. Tongue present. Palpi slender, second joint not reaching base of antennae, rough-scaled beneath; terminal joint one-half, acute. Antennae with basal pecten; ciliations in male short. Forewings with 7 to termen, 1 not furcate at base; cilia with a basal series of broad scales. Hindwings lanceolate; neuration normal. Type, *A. iridozona*. Three species.

994. Aeolocosma cycloxantha Meyr., *Tr.R.S.S.Aust.*, 1906, p. 38 (W.A.: Albany, Perth, Mt. Barker).

995. Aeolocosma iridozona Meyr., P.L.S.N.S.W., 1880, p. 225 (Sydney, Beaconsfield).

996. †Aeolocosma abditella Wlk., xxviii, p. 491 (Queensland).

83. Gen. Euthictis Meyr. (*Exot. Micro.*, i, p. 246).

Head with short erect sidetufts. Tongue present. Palpi with second joint not reaching base of antennae, thickened with rough scales anteriorly; terminal joint short or moderate (one-third to two-thirds), slender, acute. Antennae without basal pecten; ciliations in male long. Forewings with 7 to termen, 1 furcate at base. Hindwings narrowly elongate-ovate; neuration normal. Type, *E. xanthodelta*. Four species.

997. Euthictis plectanthra Meyr., *Exot. Micro.*, i, p. 120 (Cairns).

998. Euthictis xanthodelta Meyr., P.L.S.N.S.W., 1888, p. 1637 (Deloraine, Hobart, Mt. Lofty).

999. Euthictis marmaraspis Meyr., ibid., 1880, p. 225 (Katoomba, Gisborne, Beaconsfield, Tasmania).

1000. Euthictis alampitis, n. sp. (ἀλαμπιτις, gloomy.)

♂, ♀. 14–18 mm. Head, thorax, and abdomen fuscous. Palpi with terminal joint two-thirds; fuscous. Antennae fuscous; ciliations in male 2. Legs fuscous; posterior pair grey-whitish. Forewings narrow, costa in male almost straight, in female slightly arched, apex pointed, termen straight, oblique; pale fuscous; stigmata small, dark fuscous, first discal at one-third, plical slightly beyond it, second discal before two-thirds; median area between stigmata grey-whitish; cilia pale fuscous. Hindwings and cilia fuscous.

South Australia: Mt. Lofty in October; abundant flying near the ground in the late afternoon.

84. Gen. PACHYBELA Turn. (*Tr.R.S.S.Aust.*, 1917, p. 94).

Tongue absent. Palpi with second joint reaching base of antennae, much thickened with loosely appressed scales and greatly expanded with rough scales anteriorly at apex; terminal joint much shorter, rather stout or markedly so, more or less acute. Antennae stout, basal pecten strong; ciliations in male moderate or rather long. Forewings with 7 to termen. Hindwings elongate-ovate; neuration normal. Type, *P. eremica.* Eleven species.

1001. PACHYBELA CREMNODISEMA Low., P.L.S.N.S.W., 1897, p. 19 (Broken Hill; Petersburg, S.A.; Waroona, W.A.).

1002. †PACHYBELA EUADELPHA Low., *Tr.R.S.S.Aust.*, 1901, p. 86 (Broken Hill).

1003. PACHYBELA EREMICA Turn., ibid., 1917, p. 94 (Adavale, Q.; Sea Lake, V.).—Best distinguished from *parisa* by the very stout terminal joint of palpi. In the latter this is comparatively slender.

1004. PACHYBELA PARISA Turn., ibid., 1917, p. 95 (Injune, Adavale).

1005. PACHYBELA PHILOTECHNA, n. sp. (φιλοτεχνος, curious.)

♂. 22–24 mm. Head whitish. Palpi with terminal joint three-fifths, rather stout; whitish, outer surface of second joint sometimes fuscous at base. Antennae grey annulated with fuscous; ciliations in male 1. Thorax fuscous. Abdomen grey. Legs fuscous with ochreous-whitish rings; posterior pair whitish-grey. Forewings rather narrow, slightly dilated, costa slightly arched, apex round-pointed, termen very obliquely rounded; fuscous with whitish irroration; markings pale reddish partly outlined with blackish scales; an irregular submedian streak from base to one-third; three subcostal discal spots in a line, at one-third, two-thirds, and midway between; a terminal area ill-defined anteriorly, posteriorly more or less divided into spots by fine fuscous lines; costal edge whitish from one-fourth to near apex; cilia fuscous, apices sometimes white.

♀. 28 mm. Forewings whitish except for a broad fuscous costal streak from base to three-fifths; submedian streak mostly blackish; discal spots approximated.

Evidently a variable species.

Queensland: Cunnamulla in April; two males and one female.

1006. PACHYBELA PELOMA Low., P.L.S.N.S.W., 1900, p. 42 (Warrego, Broken Hill).

1007. PACHYBELA ARGOCENTRA Low., *Tr.R.S.S.Aust.*, 1901, p. 86; = *mimica* Low., P.L.S.N.S.W., 1915, p. 482 (Broken Hill).

1008. PACHYBELA LEPORINA Meyr., *Exot. Micro.*, i, p. 169 (W.A.: Roeburne).

1009. PACHYBELA TETRASPORA Low., P.L.S.N.S.W., 1900, p. 413 (W.A.: Derby).

1010. PACHYBELA SARCOSMA Low., *Tr.R.S.S.Aust.*, 1896, p. 164; = *erebocosma* Low., P.L.S.N.S.W., 1900, p. 42 (Bourke, Broken Hill, Cockburn).

1011. PACHYBELA EURYPOLIA, n. sp. (εὐρυπολιος, broad grey.)

♂. 31 mm. Head and thorax grey. Palpi with rough apical expansion of second joint large, terminal joint one-half, stout; grey, external surface of second joint fuscous anteriorly. Antennae grey; ciliations in male 1¼. Abdomen pale grey. Legs fuscous with ochreous-whitish rings (posterior pair missing). Forewings broad, costa moderately arched, apex rounded, termen obliquely rounded; minute discal dots at one-third and two-thirds, pale reddish, each with a dark fuscous dot beneath; a series of dark fuscous dots on termen and apical fourth of costa; cilia grey. Hindwings and cilia grey.

Queensland: Cunnamulla in April; one specimen.

85. Gen. Antiopala Meyr. (P.L.S.N.S.W., 1888, p. 1646).

Palpi long, recurved, ascending; second joint reaching and usually much exceeding base of antennae, smooth; terminal joint shorter than or nearly as long as second, slender. Antennae without basal pecten (very rarely two or three scales present). Forewings with 7 to termen. Hindwings with 3 and 4 connate or approximated at origin. Type *A. tephraea.* Ten species.

1012. Antiopala gennaea, n. sp. (γενναιος, noble.)

♂, ♀. 11–12 mm. Head orange. Palpi with second joint exceeding base of antennae, terminal joint four-fifths; orange, in female terminal joint and a subapical ring on second joint blackish. Antennae fuscous; ciliations in male 5. Thorax fuscous. Abdomen orange-ochreous. Legs fuscous; posterior pair ochreous. Forewings with costa gently arched, apex pointed, termen straight, oblique; orange; a dark fuscous basal fascia; a large apical blotch, dark fuscous with purple reflections, anterior edge straight from three-fifths costa to three-fifths dorsum; cilia orange, on tornus fuscous. Hindwings fuscous; cilia fuscous, around apex orange.

North Queensland: Cape York in April and May; three specimens from Mr. W. B. Barnard, who has the type.

1013. Antiopala bathroxantha, n. sp. (βαθροξανθος, yellow at the base.)

♂. 16 mm. Head pale yellow. Palpi with second joint exceeding base of antennae, terminal joint one-fourth; pale yellow. Antennae fuscous; ciliations in male 10. Thorax fuscous with a small pale yellow posterior spot. Abdomen grey. Legs fuscous; posterior pair whitish. Forewings narrow, costa gently arched, apex pointed, termen straight, oblique; fuscous; basal third pale yellow except for a small basal fascia; a darker discal dot at one-third; cilia fuscous. Hindwings and cilia pale grey.

North Queensland: Eungella in September; one specimen in Coll. Goldfinch.

1014. Antiopala flavitincta Turn., *Tr.R.S.S.Aust.*, 1917, p. 93 (Mt. Tambourine, Macpherson Range).

1015. Antiopala niphostola, n. sp. (νιφοστολος, in snow-white clothing.)

♀. 18 mm. Head and thorax white. Palpi with second joint much exceeding base of antennae, terminal joint two-fifths; white. Antennae grey-whitish. Abdomen whitish-grey. Legs whitish. Forewings narrow, costa strongly arched, apex pointed, termen oblique; white; cilia white. Hindwings and cilia white.

Exceptional in the genus by its palpi.

New South Wales: Mt. Kosciusko (5–6,000 feet) in January; two specimens.

1016. Antiopala neurotenes, n. sp. (νευροτένης, with tightened sinews.)

♀. 17 mm. Head whitish. Palpi with second joint exceeding base of antennae, terminal joint 1; fuscous, apex of second joint and terminal joint except apex whitish. Antennae pale grey. Thorax pale grey; tegulae fuscous. Abdomen pale grey. Legs grey; posterior pair ochreous-whitish. Forewings slightly dilated, costa moderately arched, apex pointed, termen straight, oblique; pale grey with dark fuscous streaks; a streak from base along fold nearly to tornus; stigmata represented by short streaks, first discal at one-third, second at three-fifths; fine interrupted streaks on all veins; cilia grey sprinkled with fuscous. Hindwings and cilia whitish.

New South Wales: Mittagong in November; one specimen received from Mr. G. M. Goldfinch, who has the type.

1017. †Antiopala melanocentra Meyr., P.L.S.N.S.W., 1888, p. 1679 (Melbourne).

1018. Antiopala anomodes Meyr., ibid., 1888, p. 1653 (Sydney).

1019. Antiopala tephraea Meyr., ibid., 1888, p. 1647 (Deloraine, Mt. Wellington).

1020. Antiopala ebenospila Turn., *Tr.R.S.S.Aust.*, 1917, p. 79 (Eungella to Lismore).

1021. Antiopala proclivis, n. sp. (*proclivis*, oblique.)

♂, ♀. 14–18 mm. Head and thorax grey. Palpi with second joint just reaching base of antennae, terminal joint two-thirds; whitish sprinkled with fuscous, outer surface of second joint except apex fuscous. Antennae whitish annulated with dark fuscous; ciliations in male 1. Abdomen pale grey. Legs fuscous; with ochreous-whitish rings; posterior pair mostly ochreous-whitish. Forewings with costa gently arched, apex round-pointed, termen obliquely rounded, ochreous-whitish; markings and some irroration dark fuscous; three basal dots, costal, median, and dorsal; costal spots near base and at one-fourth; two oblique fasciae; a broad median fascia tolerably well defined; a more suffused subterminal fascia; stigmata blackish, on margins of first fascia, first discal at one-third, plical before it, second discal before two-thirds; a terminal line; cilia grey, bases obscurely barred with fuscous, extreme apices whitish. Hindwings whitish, apex grey-suffused; cilia pale grey, on tornus and dorsum whitish.

Queensland: National Park (3,000 feet) in October, November, and January; sixteen specimens, including only one female.

TROMBIDIID LARVAE IN NEW GUINEA (ACARINA: TROMBIDIIDAE).

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(*Communicated by Frank H. Taylor, F.R.E.S., F.Z.S.*)

(Forty Text-figures.)

[Read 26th April, 1939.]

Owing to the writer's lack of experience, some confusion has arisen with regard to the nomenclature of these species. Shortly after this article was despatched for publication, a paper discussing the relation of these species to endemic typhus in New Guinea was prepared; it included a list (but no descriptions) of the names originally intended for them. The latter article has already been published (1938), and the original names have therefore become *nomina nuda*. A list of the present names with the corresponding original *nomina nuda* is given below:

Present names.	*Nomina nuda.*
T. hirsti var. *buloloensis.*	*T. hirsti* var. *morobensis.*
T. rioi.	*T. edwardsi.*
N. yeomansi.	*N. jamesi.*
N. kallipygos.	*N. callipygea.*
N. impar.	*N. clauda.*
N. lorius.	*N. jimungi.*
N. edwardsi.	*N. rioi.*
N. retrocincta.	*N. retrocoronata.*
N. backhousei.	*N. fournieri.*
N. dubia.	*N. incerta.*
S. jamesi.	*S. rotunda.*
S. blestowei.	*S. yeomansi.*
W. morobensis.	*W. buloloensis.*
L. australiense.	*H. blestowei.*

General Considerations.

Larval mites are abundant in New Guinea, where they go by the "pidgin" name of *bush-mokka*, and few whites who get off the beaten track escape the irritation of their bites. Natives occasionally complain of their attacks; the Finschhafen tribes call them *pipi*; on the Rai Coast they are called *gugung*. Patton (1931) states that "in New Guinea they are known as *akran*".

The *mokka* is distinctly regional in its habitat. In general, the *kunai* hills (switchback country covered with *kunai* grass and kangaroo grass) are practically free, although the scrub along the water-courses among these hills is fairly heavily infested; the bush is patchy—areas of dense damp jungle in the river basins and smaller valleys are very bad; sago-palm (*sak-sak*) and water-bamboo (*pit-pit*) swamps are reputed to be the most heavily infested spots of all, but the drier, less dense bush on the mountain slopes seems often to be quite free.

The larvae attack the parts of the body where the clothing exerts pressure—around the waistline, beneath the stocking, especially on the dorsum of the foot and under the garter; on the scrotum, and in the groins and armpits. They bury the full length of their cheliceral fangs in the skin; projecting from between the fangs is found a tubule. In colonies composed of newly-hatched larvae, these tubules appear with rounded blind ends, without any adventitia, of varying lengths from a few microns up. The tubule is a remarkable organ; its wall is thin and colourless, and I have seen one 290μ long. It must be possessed of power to cause lysis of the host's tissues at its tip, probably by reason of a salivary secretion. That there is an irritant secretion injected by the larva is proved by the development, at the site of a bite, of an itching papule topped by a blister.

If such be the case, then the obvious adventitious coat surrounding the fine tubular sheath is easily explained as a zone of reaction by the host's tissues against the irritation of the lysing secretion.

Brandis, in 1897, as quoted by Warburton (1928), described "long trumpet-like organs plunged deeply into the tissues". Fantham, Stephens and Theobald (1916) give two illustrations showing the chelicerae, the tubule and the adventitious coat, with the captions: "1. *Leptus autumnalis* with so-called sucking proboscis (enlarged)" and "2. Do. The so-called proboscis is formed around the hypopharynx sunk into the skin." In the text the following passage occurs: "Around the point attacked there arises a wheal about the size of a lentil, and around the inserted hypopharynx a fibrinous secretion, the 'proboscis', which however is a product of the host just as chitinous secretions are provoked by *Trombidia* parasitic on arthropods."

It seems that my "tubular sheath" and the "long trumpet-like organs" of Brandis are identical with the "hypopharynx" of these writers, and I believe that their name is the best one. It is also apparent that my "adventitious coat" is their "fibrinous secretion", and that it is to the description of this structure as a "proboscis" that they object so strongly. Unless this interpretation of their remarks be accepted, they must be credited with applying the term "hypopharynx" to the chelicerae, which is unlikely.

Womersley (1936*a*) gives a sketch of *T. macropus* showing the "rostral tube", which corresponds to the hypopharynx.

Hosts.

The following birds and mammals have been found by me to harbour larval mites of various species:

1. Red bush-fowl, Jungle-fowl (*Megapodius duperreyi*).
   Colonies on neck and legs. Single specimens embedded in the neck, around the eyes, ears and beak, beneath the wings and on the legs, and around the cloaca. Single specimens running free among the feathers. The following species have been found on this bird: *T. hirsti* var. *buloloensis*, *N. yeomansi*, *N. retrocincta*, *S. jamesi*, *T. rioi*, *N. edwardsi*, *N. backhousei*, *S. blestowei.* Found on 86 of 93 examined.
2. Grey bush-turkey (*Talegallus jobiensis*).
   Colonies on comb and wattles. Single specimens as on the bush-fowl. *T. hirsti* var. *buloloensis* was found on 9 of 10 examined.
3. Cassowary, *Muruk* (*Casuarius casuarius*).
   Colonies and single specimens as on the bush-fowl. *T. hirsti* var. *buloloensis* was found on 10 examined; a single specimen of *Leeuwenhoekia australiense* Hirst, 1929, was found on one.

4. Ground-pigeon (*Gallicolumba jobiensis*).
Colonies and single specimens as on the bush-fowl. *T. hirsti* var. *buloloensis* was found on 6 of 7 examined.
5. Swamp-hen, Purple water-hen (*Porphyrio melanotus*).
One specimen of *T. hirsti* var. *buloloensis* embedded near the eye on each of 2 of 4 examined.
6. Rail, Swamp-hen (*Amaurornis moluccanus nigrifrons*).
One specimen of *T. hirsti* var. *morobensis* embedded near the cloaca on 1 of 3 examined.
7. Parrot (*Lorius roratus* subsp.).
One colony containing 12 specimens of *N. lorius* on the neck of 1 female of 6 examined.
8. Brown's rat, Little rat (*Rattus browni*).
Many specimens of *N. kallipygos* embedded around the mammae or in the penis of 6, and running free in the fur of 20; ova containing *N. kallipygos* cemented to the abdominal hairs of many. Four specimens of *W. morobensis* running free in the fur of 2. Found on 22 of 300 examined. Brown's rat readily becomes domesticated; of the 300, at least 250 were taken in and around townships, and only 2 carried mites. The remainder were trapped in the bush.)
9. Brown bush rat, Mottle-tailed rat (*Rattus ringens*).
N. impar in rows like fringes along the free margins of the ears, and single specimens on the penis, scrotum, or mammae. Many specimens of *N. kallipygos* on the penis, abdomen, and hind legs, and running free in the fur. Ova containing *N. kallipygos* cemented to the abdominal hairs. Several specimens of *W. morobensis* embedded in the nose. Found on 13 specimens examined.
10. Arboreal "mouse" (*Melomys* sp.).
Single specimens of *N. kallipygos* running free in the fur of 1 of 2 juveniles examined.
11. Arboreal rat, Monckton's melomys (*Melomys moncktoni*).
N. impar in rows on the free margins of the ears. *N. kallipygos* running free in the fur, and embedded in the penis, legs, and scrotum, on 2 examined.
12. Arboreal rat, Stalker's melomys (*Melomys stalkeri*).
N. impar and *N. kallipygos* as for *M. moncktoni*. Ova containing *N. kallipygos* cemented to the abdominal hairs. Found on 1 only.
13. Arboreal rat, Rufous melomys (*Melomys rubex*).
As for *M. stalkeri*. Found on 1 examined.
14. Bandicoot, *Mumut* (*Echymipera cockerelli*).
Colonies on the scrotum, or around and just inside the lip of the pouch. The following were found on 9 of 10 examined: *T. hirsti* var. *buloloensis*, *N. kallipygos*, *S. jamesi*, *N. edwardsi*, *N. impar*.
15. Bandicoot, *Mumut* (*Peroryctes raffrayana*).
Colonies of *N. impar* and single specimens of *N. kallipygos* on the scrotum of 1 examined.
16. Bush pig, Wild pig (*Sus papuensis*).
Colonies in the groin and around the ear, on 1 juvenile of 54 examined; 80 specimens of *T. hirsti* var. *buloloensis*.
17. Man.
Nineteen specimens of *T. hirsti* var. *buloloensis* from 3 men at Bulolo; 15 specimens of *S. blestowei* from 2 others at Wewak, and 6 specimens of *S. blestowei* from 1 at Bulolo.

The "colonies" referred to occur on areas of skin which are almost bare of fur or feathers. They are formed of groups of up to 50 larvae, packed closely together, heads down, in hollowed-out pits in the skin. Abandoned pits can be found on birds, filled with a waxy yellow scab which can easily be detached, leaving the pit lined by apparently normal epithelium. Sometimes pits are found surrounding the contour-feathers, but I have never found them around the larger feathers. On the bandicoot, the pits are not deep, and when abandoned are covered with an ordinary serous scab. I have not found on rodents here any colonies or single specimens or abandoned pits, either in or around the ears, except for the fringes of *N. impar* along the free margins of the ears of the various species of *Melomys* and the brown bush-rat.

N. kallipygos and *W. morobensis* do not occur in colonies, but they do occur consistently in fairly large numbers in the same sites on their hosts. *T. rioi*, *N. edwardsi*, *N. retrocincta*, *N. backhousei*, *N. dubia*, and *S. jamesi*, have not yet been found in colonies, which suggests that the chief hosts of these species have not yet been located. These may yet be found among the two species of snipe and one of quail, which have not yet been investigated.

The following have been examined without finding any larval mites whatever; the larger numbers are approximate only, but are practically correct; 100 pigeons (3 species); 80 cockatoos; 20 doves (2 species); 10 parrakeets (2 species); 6 kingfishers; 6 owls (3 species); 3 hawks; 3 hornbills; 2 night-herons; 2 quail; 200 miscellaneous small perching birds (about 30 species); 50 snakes and lizards; 40 flying foxes; 10 bats (3 species); 5 opossums; 3 flying squirrels; 6 wallabies.

Reliable natives, however, assure me that larvae sometimes occur in colonies on wallabies; Womersley (1936*a*) records *T. macropus* from a wallaby at Darwin.

It will be seen that larval mites have been found on none of the tree- or bush-frequenting birds except a parrot (No. 7 above; this species has never been observed upon the ground; it nests in hollow branches), but on all the available ground-birds except the quail, which lives in the *kunai* and is hard to come by, and the snipe, no specimens of which have as yet been taken. A similar distinction can be drawn among the mammals: all the species of *melomys*, although they build their nests in bushes, nevertheless spend the night foraging on the ground.

I have not found mites on dogs, cats, or domestic fowls.

Technique and Notes.

When collecting specimens from man, it is necessary to examine the selected sites before the evening bath; it is also necessary as a rule to dig them out of the skin with a needle, and it is difficult to avoid damaging them.

Specimens embedded in the skin of game are best secured by cutting out the section of skin and placing it overnight in a small white pot with a screw-on lid. By morning most of the larvae will have detached themselves, and can easily be lifted with a needle. Unless the lid fits perfectly, it is necessary to smear the thread with vaseline to prevent the larvae escaping.

To secure those running free the host should be held over a large sheet of white paper and wiped lightly all over with a piece of cotton wool moistened with chloroform. The fur is then thoroughly brushed and combed, the debris spread on slides, and systematically examined under the microscope, using the low power; this is necessary as many of the specimens from mammals are not orange or red, but cream or pale dirty yellow, and cannot be picked out easily.

They should be mounted in gum-chloral (on the advice of Mr. Womersley; mine until now have been mounted without preparation in "Euparal").

In freshly-killed specimens which are examined at once the eyes are seen to be underlain by a dense accumulation of ruby-red granules or droplets which outline the ocular shields. Much of the body-colour may also be seen to be due to red droplets lying just beneath the body wall; by screwing down the lens on to the coverslip, this fluid can be made to run about. Most of the body-colour fades and disappears; in about 24 hours that under the ocular shields fades through orange and yellow to a weak fluorescent green, and in many specimens becomes indistinguishable after a few days. The eyes themselves are clear and colourless. In several instances I missed a second eye in older mounts, and I owe it to Mr. Womersley that I am able to report the eyes correctly.

It is an important fact that for any given species the size and shape of the scutum and the relative positions of the scutal setae and the pseudostigmata do not vary; these are the only absolute criteria, since appendages may be missing, various relationships alter with the degree of engorgement, and certain features fade shortly after death. It is granted that these criteria may not suffice for complete identification of a specimen, but they are essential for grouping a series so that a full description may be pieced together.

Various decisions made by Gater (1932) on such points as the spelling of *Trombicula* and the retention of Ewing's amended definitions (1929) of the genera *Schöngastia* and *Neoschöngastia* have been followed in this paper, which is modelled to the best of my ability on Gater's work on the Malayan species.

The species here described have been taken at all seasons during the last five years, from hosts from the main Lower Bulolo River basin, in the Morobe

Fig. 1.—Map of the eastern part of New Guinea, showing localities mentioned in text.

District of New Guinea, at a mean altitude of 2,500 feet; *S. blestowei* was also collected on the Suein River, on the coast near Wewak, in the Sepik District (see Fig. 1).

Type specimens of all species here described are at the School of Public Health and Tropical Medicine, University of Sydney, and paratypes of all except *N. retrocincta* and *N. dubia* are at the Australian Museum, Sydney.

All measurements are average figures from as large a number of specimens as possible, up to 25 in some cases, but usually from 4 to 10. Measurements are as follows:

Length of body: from anterior to posterior margins, not including the cephalothorax.

Width of body: greatest width.

Length of legs: exclusive of coxae and tarsal claws.

Scutum: greatest length and width.

Pseudostigmata: distance between centres.

Eyes and scutum: distance between adjacent margins.

The following abbreviations have been used: L, length; W, width; AM, anteromedian; AL, anterolateral (-s); PL, posterolateral (-s) (AM, AL, and PL refer to the scutal setae).

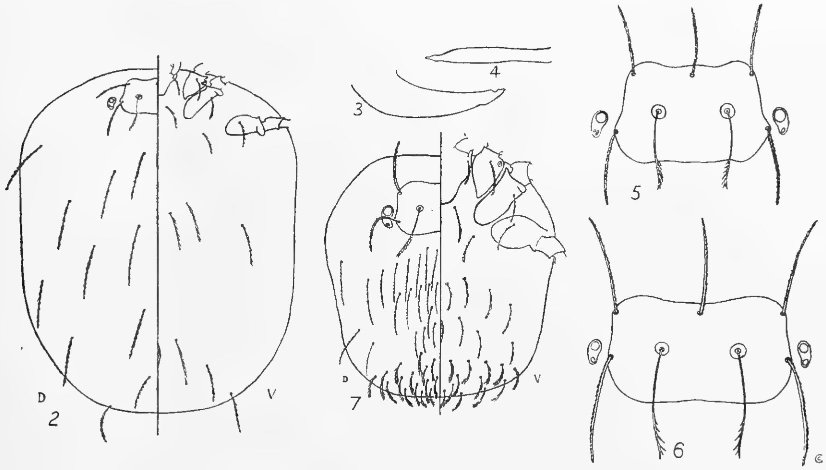
Roman numerals refer either to the segments of the palpi or to the fore-, mid-, and hind-legs, or to the coxae or tarsi of these legs, according to the context.

Photomicrographs were taken with a "Brownie" camera, using a technique described by me elsewhere (1937), and drawings made from these or from freehand sketches direct from the microscope.

Genus TROMBICULA Berlese. (*Redia*, ii, fasc. 2, 1905, 155.)

TROMBICULA HIRSTI var. BULOLOENSIS, n. var. Figs. 2, 3, 5.

Body: Newly-hatched, a short broad oval, flattened at the posterior end; greatest width between coxae ii and iii. Half-grown, ovoid, widest at level of coxa iii, tapering to half that width posteriorly, the posterior pole flattened or incavated. Fully-engorged, a swollen blunt-ended oval, widest at level of coxa iii. Striations strong; pitting on scutum, maxilla and coxae. Colour bright orange, except those from the bandicoot, which are pale orange, and have not the chelicerae and palpal claws so deeply pigmented. All setae, except those on the cheliceral sheaths and the pseudostigmatic organs, are bright orange. Newly-hatched, L, 176μ; W, 147μ; fully-engorged, L, 450μ; W, 364μ; largest seen, 480μ $\times$ 390μ. Maxillary setae single, fine, curved, with long branches on the convex side. Chelicerae stout and slightly curved. Dorsoapical tooth single, small and blunt. Ventral tooth small and sharp. Bases of chelicerae deep orange, even in faded specimens. A long, straight, slender nude seta on each cheliceral sheath. Palpi angular, relatively large, projecting boldly forward. One long curved seta with long fine branches on the convex side, on ii; one straight nude seta on iii; on iv, near the base, one curved seta with fine branches on its convex side, and near the apex, two nude setae, one short and stout, the other long and fine. Appendiculum tapering bluntly, with six setae: two very long, coarse and pigmented, with long branches on all sides over the whole length; four finer, with branches on the distal half of the convex side; and one short, nude, near the base. Palpal claw bifurcate, the ventral element shorter but stouter than the dorsal; both strongly curved, with sharp points, and the central core deeply pigmented. Scutum trapezoidal, half as wide again as long; L, 66μ; W, 102μ. Set well forward on the body. Anterior margin slightly concave in its middle three-fifths, the lateral fifths convex; anterior corners rounded; lateral margins straight or slightly incavated opposite the ocular shields; posterior margin strongly convex, but flattened or smoothly concave in the middle fifth, and curving forward in the lateral fifths to meet the lateral margins; posterior corners about one-fourth of the distance forward, and rounded. Scutal setae 5: stout, tapering bluntly, covered with short spines over the whole surface. The AL set back from the anterior corners and in line with the AM; the PL set well forward in the posterior corners; the four lateral setae set on the edge of the scutum. AM, 47μ; AL, 50μ; PL, 56μ. Pseudostigmata one-third of the way back, behind the midpoint of the line joining the AM and PL setae; 45μ apart. Pseudostigmatic organs filiform, very fine, with about 6 fine branches on the convex side of the distal third; L, 56μ. Ocular shield about 7·5μ from the scutum in the fully-engorged larva; closer in the newly-hatched. Eyes double, the anterior much the larger, opposite the pseudostigmata; the posterior just behind the PL setae. Body setae 38: of two forms—those of the



Figs. 2-7.—2. Composite dorsal and ventral diagram of *Trombicula hirsti* v. *buloloensis*, n. var.; 3. Cheliceral fang of *T. hirsti* v. *buloloensis*; 4. Same of *T. rioi*, n. sp.; 5. Dorsal scutum of *T. hirsti* v. *buloloensis*; 6. Same of *T. rioi*; 7. Composite dorsal and ventral diagram of *T. rioi*.

dorsum and the last two rows of the venter are covered all over with fine short branches; the remainder of those of the venter have closely-set short branches on the convex side only. Dorsum: Setae 22, in rows approximately as follows: 2, 6, 6, 4, 2. Row 2 is set close to the posterior margin of the scutum; row 6 is along the posterior margin of the body. Venter: Setae 16, in rows as follows: 2, 2, 6, 2, /2, 2. Legs relatively long. i, 236μ; ii, 206μ; iii, 241μ. Leg setae stout, with very short branches on the convex side. Coxal setae single, fine, curved, with long fine branches on the convex side. A similar seta, but coarser and pigmented, on each second segment. Base of sixth segment moderately constricted; distal half of sixth segment of i moderately expanded. All tarsi tapering, that of iii very long and slender. A short stout spur on tarsi i and ii, a long nude seta on tarsus iii.

Nineteen specimens from three men; fifty from seven bandicoots (*Echymipera cockerelli*); many hundreds from many bush-fowl (*Megapodius duperreyi*), bush-turkeys (*Talegallus jobiensis*), Cassowaries (*Casuarius casuarius*) and Ground-pigeons (*Gallicolumba jobiensis*); one from a rail (*Amaurornis moluccanus nigrifrons*) and two from a Swamp-hen (*Porphyrio melanotus*); eighty from a Bush-pig (*Sus papuensis*).

T. hirsti var. *buloloensis* corresponds very closely with Sambon's description of *T. hirsti* (1927); the differences are:

T. hirsti.	*T. hirsti* var. *buloloensis.*
Seta on 2nd palpal segment has 3 branches.	Many branches.
2 nude setae on fourth palpal segment.	2 nude, 1 branched.
Appendicular setae, 6 plain, 1 branched.	1 plain, 5 branched.
Dorsal setae 2, 6, 6, 2, 2, 2.	2, 6, 6, 4, 2.
40μ long.	56μ long.
Scutum uniformly smaller.	Larger.

It differs from Hirst's description of *T. akamushi* as quoted by Patton and Evans (1929) as follows:

T. akamushi.	*T. hirsti* var. *buloloensis.*
Anteromedian scutal seta longer than scutum.	Shorter than scutum.
Pseudostigmata nearer posterior margin.	Nearer anterior margin.
Dorsal setae 2, 8, 6, plus a few posterior setae (rarely 2, 6, 8-10, 8).	2, 6, 6, 4, 2.
Seta on 2nd palpal segment plain.	Many branches.
3 palpal claws.	2 palpal claws.
No plain seta on tarsus iii.	Present.

It differs from *T. wichmanni* in the number and arrangement of the body-setae.

It is probably only a local variant, and it seems unnecessary to add another new name to the list, which might also include *T. pseudoakamushi* and *T. deliensis.* Confusion between these closely related species is not only possible, but probable, because it was apparently customary to dismiss them in a few lines until Gater published his detailed descriptions of the Malayan species in 1932. The increasing importance of certain species because of their association with endemic typhus makes more detailed descriptions essential.

Of approximately three thousand mites collected in the Bulolo basin, almost two thousand seven hundred are *T. hirsti* var. *buloloensis.* I have succeeded in hatching out twenty-one nymphs from these larvae, but as yet no adults. Detailed consideration of these does not come within the scope of the present work, but superficially they resemble Hirst's "*Neotrombicula autumnalis*".

TROMBICULA RIOI, n. sp. Figs. 4, 6, 7.

Body a short, wide, blunt oval, widest at the level of coxa iii, smoothly constricted midway. Striations strong; pitting on scutum, maxilla and coxae. Colour light orange. L, 316μ; W, 302μ. Largest seen, 389μ × 375μ. Maxillary setae curved, with long fine branches on the convex side. Chelicerae slender. Dorso-apical tooth single, small, blunt. Ventral tooth a small rounded swelling only. A long nude seta on each cheliceral sheath. Palpi rounded. One coarse straight seta on ii, with long branches on one side; one straight nude seta on iii; on iv, near the base, one long straight seta with fine branches on one side of the distal half, and two nude setae near the apex. Appendiculum small and rounded, with one short pointed nude seta near the base, and three fine setae with fine branches, near the apex. Palpal claw bifurcate, the dorsal element the longer; both elements slender, slightly curved, with sharp points, the central core orange. Scutum trapezoidal, only slightly wider posteriorly; almost twice as wide as long; L, 69μ; W, 120μ. Anterior margin sinuate, the central third straight or slightly concave, the lateral thirds projecting forward; anterior corners rounded; lateral margins slightly concave; posterior margin concave in its middle third, convex in its lateral thirds, curving sharply forward in its lateral fifths to meet the lateral margins; posterior corners rounded, set one-third of the distance forward. Scutal setae 5: with short coarse branches along the whole length of one side. Set in the corners, the three anterior in line. AM, 66μ; AL, 68μ; PL, 75μ. Pseudostigmata half-way back, behind and medial to the mid-point of the line joining the AM and PL setae; 50μ apart. Pseudostigmatic organs filiform, very slender, with a few fine branches on the distal third; L, 75μ. Ocular shield 6μ from the scutum. Eyes double, the anterior much the larger and more refractile, opposite the pseudostigmata; the posterior just behind the PL setae. Body setae 110; the first five rows of the dorsum are slightly curved, with a few short branches on the concave side and many slightly longer branches on the convex side. The first four rows of the venter are slightly curved, with short branches on both sides. The posterior setae, both dorsal and ventral, are more curved, and have longer branches than the others, set over the whole surface. Dorsum: Setae 68, in rows approximately as follows: 2, 14, 12, 4, 6, /8, 10, 8, 4. Venter: Setae 42, in rows approximately as follows: 2, 2, 8, 6, /10, 6, 4, 4. The last four rows of each surface are continuous, forming a series of concentric circles around the posterior pole of the body, composed of 18, 16, 12, and 8 setae respectively. Legs relatively long; i, 300μ; ii, 230μ; iii, 300μ. Leg setae long, slightly curved, with short fine branches on the convex side. Coxal setae single, and a single seta on each second segment. Base of sixth segment of each leg markedly constricted, and the distal part of the sixth segment of i markedly expanded. All tarsi tapering, the first more bluntly than the others. A short fine spur on tarsi i and ii, and a slender, not very conspicuous nude seta on iii. Several fine nude setae at the apex of each tarsus.

Eighteen specimens from 4 bush-fowl (*Megapodius duperreyi*).

Key to the Australian and New Guinea Species of Trombicula.
(Constructed by H. Womersley.)

1. Dorsal setae more than 50 2
   Dorsal setae 42 or fewer 3
2. Dorsal setae arranged 2, 14, 12, 4, 6, 8, 10, 8, 4; the posterior rows set closely, their individual setae thicker and more strongly branched than the others. Scutum with posterior margin convex laterally, concave medially; AW, 118μ; PW, 120μ; L, 69μ .... *T. rioi*, n. sp.
   Dorsal setae 2, 6, 8, and then about five rows of closely-placed setae branched similarly to the others. Scutum with posterior margin evenly convex; AW, 80μ; PW, 86μ; L, 51μ .... *T. macropus* Womersley 1936
3. Dorsal setae 42, arranged 2, 6, 6, 6, 6, 6, 6, 4; 60-75μ long. Scutum with posterior margin evenly convex; AW, 70μ; PW, 70μ; L, 101μ .... *T. novae-hollandiae* Hirst 1929
   Dorsal setae less than 42 4
4. Scutum with posterior margin convex laterally, strongly concave medially. Dorsal setae 24, arranged 2, 6, 6, 6(2), 2(6), 2 .... *T. wichmanni* Oudemans 1905
   Scutum with posterior margin evenly convex 5
5. Dorsal setae 20, 40μ long, arranged 2, 6, 6, 2, 2, 2. Scutum, AW, 76μ; PW, 94μ; L, 56μ; ratio PW/L, 1·68 .... *T. hirsti* Sambon 1927
   Dorsal setae 20, 56μ long, arranged 2, 6, 6, 4, 2. Scutum, AW, 90μ; PW, 110μ; L, 66μ; ratio PW/L, 1·66 .... *T. hirsti* var. *buloloensis*, n. var.

(The abbreviations AW and PW refer to the width of the scutum at the levels of the anterolateral and posterolateral setae respectively.)

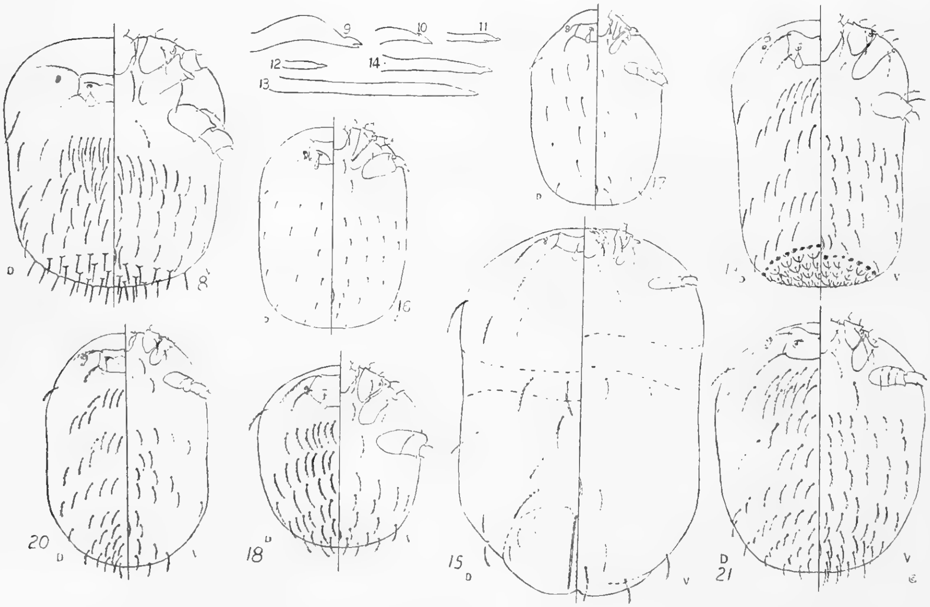
Genus Neoschöngastia Ewing 1929.

Manual External Parasites, 1929, 187.

Neoschöngastia yeomansi, n. sp. Figs. 8, 9, 22.

Body: Newly-hatched, a short broad oval, widest at level of coxa ii, rounded posteriorly; fully-grown, a broad sharply-tapering oval, widest at level of coxa ii.

Striations very fine, absent over the posterior fourth of the body; pitting on scutum, maxilla, and coxae, and over the posterior fourth of the body. Colour orange-red. Newly-hatched, L, 200μ; W, 167μ; largest seen, 333μ × 292μ. Maxillary setae single, long, fine, with long fine branches on each side. Chelicerae stout, narrowed at the base, tapering to a sharp point. Dorsoapical tooth a short sharp barb well back from the apex; ventral tooth long and pointed, nearer to the apex than the dorsoapical. A long fine seta set with short fine spines on one side, on each cheliceral sheath. Palpi rounded. One long fine curved seta set with fine branches on the convex side, on ii; a similar seta on iii; on iv, near the base one seta with many fine branches on all sides, and near the apex one slender nude seta and one short stout seta. Appendiculum pointed, with six setae: one stout with many branches, four slender with fine branches, and one nude, near the base. Palpal claw trifurcate, with sharp points; the middle element the largest, the dorsal and ventral elements short and equal. Scutum oblong, twice as wide as long; L, 56μ; W, 100μ. One-third of the distance back there is a transverse crest composed of four curved ridges, concave posteriorly, the lateral the strongest. Anterior to the crest the pitting is simple; posteriorly the pits are surrounded by circular striations. Anterior margin concave; anterior corners rounded and projecting forward; lateral margins slightly concave; posterior margin straight or slightly concave in the middle three-fifths, the lateral fifths curving forward to meet the lateral margins; posterior corners rounded, projecting slightly laterally. Scutal setae 5: fine, with fine branches over the whole length on all sides. The AM set back from the margin; the AL on the edge of the anterior corners, well in front of the AM; the PL set forward in the posterior corners. AM, 37·5μ;



Figs. 8-21.—8. Composite dorsal and ventral diagram of *Neoschöngastia yeomansi*, n. sp.; 9. Cheliceral fang of *N. yeomansi*, n. sp.; 10. Same of *N. kallipygos*; 11. *N. impar*, n. sp.; 12. *N. lorius*, n. sp.; 13. *N. edwardsi*, n. sp.; 14. *N. backhousei*, n. sp.; 15. Composite ventral and dorsal diagram of *N. kallipygos*; 16. Same of *N. impar*; 17. Same of *N. lorius*; 18. Same of *N. edwardsi*; 19. *N. retrocincta*, n. sp.; 20. *N. backhousei*; 21. *N. dubia*, n. sp.

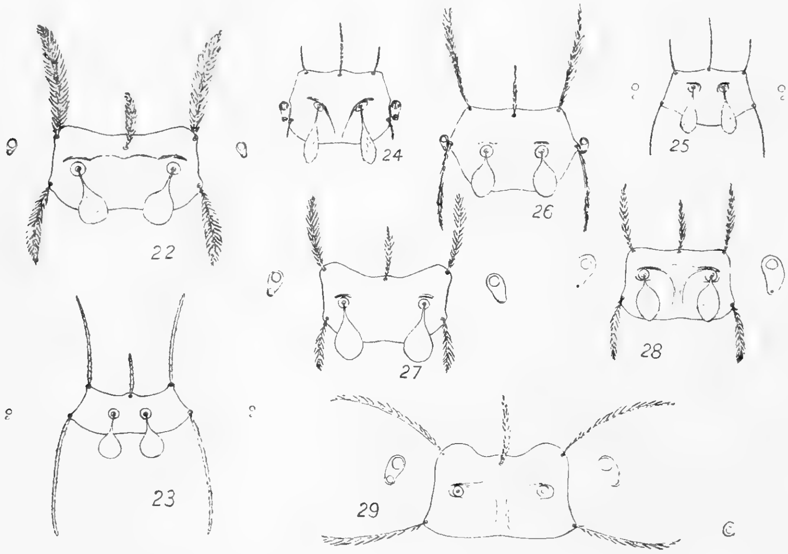
AL, 80μ; PL 60μ. Pseudostigmata half-way back, lateral to the midpoint of the line joining the AM and PL setae; they are in the hollow behind the lateral curves of the crest, like eyes beneath eyebrows; 62·5μ apart. Pseudostigmatic organs capitate, racquet-shaped. L, 37·5μ; stem, 9·5μ; head, 28μ × 19μ. A few fine short setules on the head. Ocular shields 25μ from the scutum. Eyes double, the anterior in line with the AM seta or just in front of it. In the newly-hatched larva they are close to the scutum, and relatively a little further back. Body setae approximately 178, of two forms: those on the anterior part fine, with fine branches; those on the posterior unstriated portion straight, stout and blunt, covered with minute short spines all over, and set on tubercles. The latter type comprise the last five rows on the dorsum, and the last four rows on the venter. Dorsum: setae 100, in rows approximately as follows: 2, 16, 8(10), 12(10), 10(8), 10, 8(10), /12, 6, 6, 6, 4. Venter: setae 78, in rows approximately as follows: 2, 2, 16, 14(12), 12, 6(8), 2, /10(8), 6, 4, 4. Legs relatively long; i, 260μ; ii, 215μ; iii, 270μ. All leg setae fine with fine branches, except for a few on each tarsus which have a very few short branches. Coxal setae single. Sixth segment of each leg not markedly constricted, but that of iii slightly expanded distally. All tarsi tapering. A very slender spur on tarsus i; that on tarsus ii short and fine; a very fine long nude seta on iii.

Fifty specimens from ten bush-fowl (*Megapodius duperreyi*).

NEOSCHÖNGASTIA KALLIPYGOS, n. sp. Figs. 10, 15, 23.

Body a broad oval, widest at level of coxa iii. A slight shallow constriction midway, which marks a fold running obliquely around the body, dorsally at the level of the third row of setae, ventrally just behind coxa iii. A shallow cleft in the centre of the posterior margin, which marks the junction of two dorsal caudal swellings or plates, roughly semicircular in shape. The anus lies in a longitudinal fold on the ventral surface. No striations, but fine pitting over the whole surface, on the scutum, maxilla, and coxae. Colour pale dirty-yellow to pale orange. L, 487μ; W, 323μ. Cephalothorax relatively small, set back on the ventral surface; only the tips of the chelicerae and palpi are visible from the dorsal aspect. Maxillary setae fine, with fine branches on the convex side. Chelicerae short, slightly curved. Dorsoapical tooth single, a comparatively long barb; ventral tooth small. A long stout slightly curved nude seta on each cheliceral sheath. Palpi rounded. One short curved seta on ii, with fine branches on the convex side; a similar seta on iii; two fine long straight setae covered with short spines, on iv. Appendiculum pointed, with five or six setae; four or five very long, curved, and heavily branched on the convex side, set towards the apex; one short and straight, covered with fine spines, set towards the base. Palpal claw trifurcate, the ventral element the shortest, the dorsal the longest. Scutum trapezoidal, about two and one-half times as broad as long; L, 33μ; W, 81μ. Set on the forward slope of the body. Anterior margin concave, sharply recurved around the AM seta; anterior corners projecting forward and laterally around the AL setae; lateral margins slightly concave; posterior margin convex, smoothly indented in the middle; posterior corners projecting backward and laterally around the PL setae. Scutal setae 5; long and stout, constricted at the base, tapering bluntly at the tip, covered with fine short spines over the whole surface. Set well into the projecting corners. AM, 28μ; AL, 63μ; PL, 83μ. Pseudostigmata two-thirds of the way back, behind and medial to the midpoint of the line joining the AM and PL setae, 21μ apart. Pseudostigmatic organs capitate, racquet-shaped, the stem very slender. L, 27·5μ; stem, 12·5μ; head, 15μ × 15μ. Ocular shield absent. (Present in unhatched larva.)

Eyes double, opposite the centre of the scutum, nearer to the lateral margins of the body than to the scutum. (The two eyes are plainly visible in the unhatched larva, but only one can normally be made out with ease in the newly-hatched larva.) Body setae 46 to 50, of two forms: long and stout, narrow at the base, tapering bluntly at the tip, covered with short spines over the whole surface; and short and fine, curved, with fine branches on the convex side. The latter compose row 8 of the dorsum, and rows one to four of the venter. Dorsum: setae 28 (30 or 32) in rows as follows: 2, 6 (2 or 4), 4, 2, 4, 2, /6, /2. Row three varies; it is set on the transverse dorsal constriction; row seven is composed of two very long straight setae (L, 75μ) set close together; row eight is composed actually of two curved rows of three setae running more or less longitudinally along the lateral edges of the dorsal caudal plates; row nine is set on the posterior margin



Figs. 22-29.—Dorsal scutum of, 22. *N. yeomansi*; 23. *N. kallipygos*; 24. *N. impar*; 25. *N. lorius*; 26. *N. edwardsi*; 27. *N. retrocincta*; 28. *N. backhousei*; 29. *N. dubia.*

of the body, often more ventrally than dorsally. Venter: setae 18, in rows as follows: 2, 2, 4, 2, /4, 4. Legs relatively short. i. 180μ; ii, 130μ; iii, 205μ. Leg setae stout, straight, set with fine spines over the whole surface, except as below. Coxae set well in on the ventral surface, and well forward. Coxal setae single, curved, fine with fine branches on the convex side. A similar seta, but longer and coarser, on each second segment. Base of sixth segments not unduly constricted. Tarsus i truncated, the others tapering. Spur on tarsi i and ii short and fine; no spur on iii. Four curved branched setae at the apex of each tarsus. The central tarsal claw very long and fine, usually broken off.

Two specimens from an arboreal "mouse" (*Melomys* sp.), seven from two bandicoots (*Echymipera cockerelli* and *Peroryctes raffrayana*); many from Brown's rat (*Rattus browni*), Monckton's melomys (*Melomys moncktoni*), Stalker's melomys (*Melomys stalkeri*), the Rufous melomys (*Melomys rubex*), and the Brown bush-rat (*Rattus ringens*).

Many ova have been found cemented to the abdominal hairs of *Rattus ringens*, *Rattus browni*, and the various *Melomys*, containing *N. kallipygos* in recognizable stages of development. Detailed consideration of these does not come within the scope of the present work, but the fact throws light on the life-history of this species; it is obvious that adult females must spend at least some time as parasites on these hosts.

So far all attempts to hatch out nymphs with the technique used for *T. hirsti* var. *buloloensis* have failed.

It is probable that this larva should be placed in a separate genus, a subdivision of *Neoschöngastia*, on account of: The constricted body; the caudal plates; the shape of the scutum; the substitution of pitting for striations over the whole body-surface; the dorsal setae; the distinctive features of the tarsi; and the variation from the usual of the life-history.

NEOSCHÖNGASTIA IMPAR, n. sp. Figs. 11, 16, 24.

Body oval, widest at level of coxa iii, with a slight shallow constriction midway. Striations strong and very coarse; pitting on scutum, and finer and weaker on maxilla and coxae. Colour salmon-pink. L, 268μ; W, 196·5μ; largest seen, 333$\mu \times$ 250μ. Maxillary setae long, curved, with long fine branches on the convex side. Chelicerae stout, tapering sharply to a long slender tip. Dorso-apical tooth single, small, blunt. Ventral tooth a small squared tubercle at the end of a ridge. A long straight slender nude seta on each cheliceral sheath. Palpi angular, with a small tubercle at the lateral angle of ii. One short slender nude seta on ii; a slender seta with two fine branches near its tip, on iii; on iv, two nude setae, one slender near the apex, the other short, stout and rod-like near the base. Appendiculum bluntly tapering, with four setae: one stout, with a few fine branches on both sides, three finer, with fine branches on the convex side only. Palpal claw bifurcate, the dorsal element stouter and more curved than, but equal in length to the ventral. Scutum a rounded oblong; L, 48μ; W, 66μ. Anterior margin sinuate, with slight convexities in the middle and at each end; anterior corners rounded; lateral margins straight, but incavated opposite the ocular shields; posterior margin strongly convex, straight in its middle third; posterior corners rounded. Crest represented by two oblique ridges, concave postero-laterally, about one-third of the distance back. Scutal setae 5: short, stout, covered with a few short spines. The three anterior setae in the convexities of the anterior margin, the AM slightly behind the AL; the PL well forward in the posterior corners. AM, 37·5μ; AL, 19μ; PL, 12·5μ. Pseudostigmata half-way back, in the hollows of the crest, medial to the mid-point of the line joining the AM and PL setae; 27μ apart. Pseudostigmatic organs capitate, paddle-shaped, covered with short sharp setules. L, 37·5μ; stem, 7·5μ; head, 30$\mu \times$ 9μ. Ocular shields contiguous with the scutum. Eyes double, the anterior opposite the pseudostigmata. Underlying the anterior eye a group of four pale fluorescent bodies; beneath the posterior eye the number of these bodies varies from 0 to three. The posterior eye opposite the PL setae. Body setae 68 to 72; those of the dorsum short, pointed, with a few short spines; on the venter the first two rows are short, straight, with a few fine branches on one side; the remainder still shorter, with a few short spines. Dorsum: setae 26 to 30, in rows as follows: 2, 6, 6, (2), 6, 4, 2, (2). Rows 4 and 8 vary. Venter: setae 42, arranged in rows as follows: 2, 2, /8, 6, 8, 6, 4, 2, 2, 2. Legs: there are only six segments in the mid and hind legs, due apparently to the fusion of the third and fourth segments; i, 150μ; ii, 130μ; iii, 163μ. On legs i and ii the setae are short, with fine short branches on one side; on iii they are longer, with fine long branches on one side. Coxal setae single. Sixth segment of i and fifth of ii and iii moderately constricted. Tarsus i is truncated, and bears a long nude seta with a tiny claw-like tip in addition to the usual stout spur. The other tarsi are tapered, ii bearing a stout spur, iii a long nude seta.

Sixty specimens from seven bandicoots (six *Echymipera cockerelli* and one *Peroryctes raffrayana*), many from two Monckton's melomys (*Melomys moncktoni*), one Stalker's melomys (*Melomys stalkeri*), one Rufous melomys (*Melomys rubex*) and thirteen Brown bush-rats (*Rattus ringens*).

The lack of a segment in the mid and hind legs, analogous to the similar condition in *Schöngastia oudemansi* Walch, does not warrant erecting a new genus. The fact is taken notice of in the name.

NEOSCHÖNGASTIA LORIUS, n. sp. Figs. 12, 17, 25.

Body a long ellipse, slightly produced anteriorly, with a shallow constriction behind the third coxa. Striations very fine; fine pitting on the scutum, and finer on maxilla and coxae. Colour bright orange-red. L, 259·5μ; W, 173·5μ; largest seen, 278μ × 200μ. Maxillary setae fine, with three long fine branches. Chelicerae slender, sharp, tapering gently. Dorsoapical tooth single, represented by a minute prominence. Ventral tooth a minute tubercle at the end of a ridge. A slender straight nude seta on each cheliceral sheath. Palpi rounded. One plain seta on each segment, that on iii the longest and most slender, that on iv shorter and very stout. Appendiculum short, bluntly tapering, with a rounded tip; bearing four plain setae, one very stout, two longer and more slender, and one stouter still, near the base. Palpal claw bifurcate, blunt, the two elements equal. Scutum roughly hexagonal, almost twice as broad as long; L, 37·5μ; W, 62·5μ. Anterior margin projecting in the centre, the lateral portions slightly concave; anterior corners rounded; lateral margins straight; posterior margin strongly convex, bluntly pointed in the centre; posterior corners rounded. A small semicircular ridge around the anteromedial sides of the pseudostigmata. Scutal setae 5, slender, straight, covered with fine spines. The AM in the apex of the forward projection, in front of the AL, which are set well out in the anterior corners; the PL in the posterior corners. AM, 36μ; AL, 25μ; PL, 37·5μ. Pseudostigmata one-third of the way back, medial to the midpoint of the line joining the AM and PL setae; 20μ apart. Pseudostigmatic organs capitate, a broad paddle shape. L, 30μ; stem, 7μ; head, 23μ × 9·5μ. Covered with fine short setules. Ocular shields apparently missing. Eyes double, about 19μ from the scutum, the anterior opposite the pseudostigmata. Body setae 42, stout, almost straight, covered with fine spines. Dorsum: setae 22, in rows as follows: 2, 6, 6, 4, 2, 2. Venter: setae 20, in rows as follows: 2, 2, 4, 2, 4, 4, 2. Row 1 is close behind the maxilla, anterior to the tips of the first coxae. Legs: i, 134μ; ii, 92μ; iii, 130μ. Leg setae nude except as follows: on the second segment, a prominent seta with a few very short branches along the convex side; the setae on the sixth and seventh segments similar but shorter. Coxal setae single; the first with 3 fine long branches, the others nude. Tarsus ii tapering very bluntly, iii very long and slender. A short blunt spur on tarsi i and ii, a long slender nude seta on iii. The central tarsal claw very long and slender.

Twelve specimens from a parrot (*Lorius roratus* subsp.).

NEOSCHÖNGASTIA EDWARDSI, n. sp. Figs. 13, 18, 26.

Body rounded, widest at level of coxa iii, slightly flattened posteriorly. Striations very coarse and strong; pitting on scutum, maxilla and coxae. Colour orange. Newly-hatched, L, 187·5μ; W, 169μ; half-grown, L, 244μ; W, 213μ; no fully-engorged specimens were taken; largest seen, 278μ × 250μ. Maxillary setae long and fine, with a few fine branches on the convex side of the proximal half. Chelicerae very long, straight and slender. Dorsoapical tooth a small sharp barb. Ventral tooth apparently missing. A long fine straight nude seta on each cheliceral sheath. Palpi slender and curved. A fine seta with many long fine branches on ii; one with short fine branches on iii; on iv one at the base with fine branches, and two nude at the apex. Appendiculum with eight setae: seven with fine branches, and one nude near the base. Palpal claw bifurcate, the ventral element the longer, both slender, blunt and slightly curved. Scutum roughly hexagonal, half as broad again as long; L, 56μ; W, 87·5μ. Anterior margin slightly concave, slightly recurved in the middle; anterior corners angular; lateral margins straight; posterior margin strongly convex, the middle fifth concave; posterior corners sharp and projecting. A slight, gently-curved ridge in front of each pseudostigma. Scutal setae 5: relatively very long, with many long branches on all surfaces. Set well into the angles, the AL just in front of the AM. AM, 37·5μ; AL, 75μ; PL, 60μ. Pseudostigmata half-way back, just behind the PL setae; 36μ apart. Pseudostigmatic organs capitate, leaf-shaped, covered with minute setules. L, 29μ; stem, 6μ; head, 23μ × 15μ. Ocular shield contiguous with the scutum, curved around the posterior corners. Eyes double, the anterior the larger, in front of the PL setae; the posterior behind the PL setae. Body setae 96, with closely-set short branches on the convex side, those of the venter finer than the dorsal. Dorsum: setae 64, in rows as follows: 2, 14, 14, 10, 12, 8, 4. Venter: setae 32, in rows as follows: 2, 2, 8, 4, 6, 6, 4. Row one on one specimen has three setae. Row six sometimes contains eight setae. Legs relatively long. i, 210μ; ii, 200μ; iii, 230μ. Leg setae with fine branches on the convex side; a few straight setae with a few short apical branches on each tarsus. Coxal setae single, slender, with fine branches on the convex side. The sixth segment of each leg is expanded distally, that of leg iii less than the others. Tarsi tapering. A short slender nude seta on tarsus i instead of the usual spur; a short stout spur on ii; a long slender nude seta on iii.

Twenty specimens from five bush-fowl (*Megapodius duperreyi*); one from a bandicoot (*Echymipera cockerelli*).

NEOSCHÖNGASTIA RETROCINCTA, n. sp. Figs. 19, 27.

Body rounded anteriorly, flatly convex posteriorly, slightly convex laterally, widest opposite coxa iii. Striations moderately strong, merging into pitting over the posterior fourth of the body. Pitting also on scutum, maxilla and coxae. A circle of thirty small tubercles, devoid of setae, surrounding the body at the level of the posterior margin of the anus. Within this circle, twenty-two to twenty-five closely-set large tubercles bearing setae. Colour yellow. L, 354μ; W, 236μ. Maxillary setae long, with fine branches on the convex side. Chelicerae missing from both specimens. A short seta, apparently nude, on each cheliceral sheath. Palpi rounded, narrow at the base, widest at the apex of ii. One long seta, with long fine branches on the convex side, on ii; one with short branches on the convex side on iii; on iv one short stout blunt nude seta near the base, and one with short branches on the convex side, near the apex. Palpal claw trifurcate, the middle element the longest, the ventral the shortest. Appendiculum with 5 or 6 branched setae, one stout and prominent. Scutum roughly crescentic; L, 52μ; W, 87μ. Anterior margin strongly concave, recurved in the middle; anterior corners rounded, large, projecting forward; lateral margins slightly concave; posterior margin convex, indented in the middle, not clearly defined, but merging into the body-striations; posterior corners rounded. Short curved ridges in front of the pseudostigmata, and a diffuse longitudinal swelling down the centre. Simple pits in front of the crest; behind it, the pits surrounded by circular striations. Scutal setae 5, long, with long branches over all surfaces; set into the angles, the AM well behind the AL. AM, 37·5μ; AL, 56μ; PL, 47μ. Pseudostigmata half-way back, lateral to the midpoint of the line joining the AM and PL setae; behind the ridges of the crest; 53μ apart. Pseudostigmatic organs capitate, racquet-shaped, with no apparent setules, but striated. L, 37·5μ; stem, 9·5μ; head, 28μ × 19μ. Ocular shield 25μ from scutum. Eyes double, the anterior opposite the AM seta. Body setae 104 (106), plus 22 to 25 caudal setae. Those of the dorsum long, with short branches on the convex side; the first two ventral rows long, with long branches on the convex side, the remainder on the venter similar but shorter; the caudal setae stout, straight, nude. Dorsum: setae 52, in rows as follows: 2, 8(10), 12(10), 6, 8(10), 8, / 8(6), / 17 tubercles, / plus 11(13). Row seven is on the part where the striations have given way to pitting. Venter: setae 52(54), in rows as follows: 2, 2, 10(12), 12(10), 10, 8, / 4(6), 6(2), / 13 tubercles, / plus 11(12). Rows seven and eight are on the pitted part, row seven anterior to, row eight level with the anus. Legs relatively long; i, 245μ; ii, 207μ; iii, 240μ. Leg setae vary; they have branches on the convex side except as follows: on the third to sixth segment of i, third to fifth segment of ii, and on the third segment of iii, they have branches on all sides. Coxal setae very long, with fine branches on the convex side; a single seta on coxae i and ii, but two on iii. The base of the sixth segment is constricted, its distal portion expanded, on each leg. A long fine spur on tarsus i, a shorter fine one on ii, a long nude seta on iii.

Two specimens from a bush-fowl (*Megapodius duperreyi*).

In the absence of chelicerae from both specimens, the justification for placing this species in the genus *Neoschöngastia* rests on the fact that the scutal crest resembles the crests of the other species of *Neoschöngastia* here described. The appearance of circular striations around the pits on the portion of the scutum behind the crest resembles that of *N. yeomansi* and *N. backhousei*; and partly on the evidence of eyes and palpal claws.

Ewing's key (1929) reads, in part,

"4. Chelicerae armed with a row of teeth above; palpal claw usually bifurcate .... *Schöngastia* Oudemans
Chelicerae each with not more than a single dorsal tooth; palpal claw trifurcate .... *Neoschöngastia* (new)"

to which Womersley (1937) adds, for *Neoschöngastia*, "Eyes two"; a previous division of his key indicates that *Schöngastia*, among other genera, is characterized by single eyes.

That is, besides the evidence afforded by the cheliceral teeth, *Schöngastia* has single eyes and usually bifurcate palpal claws; *Neoschöngastia* double eyes and trifurcate claws; the latter is the case in this species.

N. retrocincta is a member of a group, the outstanding example of which is *N. yeomansi*, which contains also *N. backhousei* and *N. dubia*. The features of this group are: Well-defined crest on scutum; typical scutal pitting, with the pits behind the crest surrounded by circular striations; pitting, not striations, on the posterior portion of the body; distinctive setae on the pitted portion. It is possible that this group may be found to constitute a new genus, a second subdivision of *Neoschöngastia*.

N. retrocincta is also linked with *N. dubia*, in that each has multiple setae on the third coxa. *N. mutabilis* Gater, 1932, also shows this feature; the number varies from three to five, and also varies on each side of the same specimen.

NEOSCHÖNGASTIA BACKHOUSEI, n. sp. Figs. 14, 20, 28.

Body oval, widest at level of coxa iii. Striations fine and moderately strong, but weaker over the posterior sixth of the body; pitting on scutum, maxilla and coxae, and over the posterior sixth of the body. Colour orange. L, 312μ; W, 216μ. Maxillary setae single, long, fine, with a few long branches on all sides. Chelicerae straight, slender, tapering to a sharp point. Dorsoapical tooth represented by a minute subterminal tubercle. Ventral tooth a minute pointed swelling. A slender straight nude seta on each cheliceral sheath. Palpi rounded. A long seta with a few long branches on the convex side on ii; a shorter seta with a few long branches on the convex side on iii; on iv, at the base, a short seta with a few long branches on the convex side, and two nude setae at the apex. Palpal claw trifurcate, sharp, the middle element the longest, the dorsal and ventral elements equal in length. Appendiculum rounded, with four or five setae, one nude, the others stout with short branches. Scutum a rounded trapezoid, half as wide again as long, with a crest one-third of the distance back, consisting of two short lateral curves joined by a weaker long central curve, all concave behind; from the centre of the crest a diffuse ridge runs back to the posterior margin. The pits in front of the crest simple; behind the crest they are surrounded by circular striations. Anterior margin sinuate, with three smooth convexities; anterior corners rounded; lateral margins slightly concave; posterior margin convex; posterior corners rounded. L, 47μ; W, 75μ. Scutal setae 5, long, with fine branches on all sides. The three anterior in line, in the anterior convexities; the PL forward in the posterior corners, on the margins of the scutum. AM, 37·5μ; AL, 47μ; PL, 44μ. Pseudostigmata about two-fifths of the way back, behind the lateral curves of the crest, lateral to the midpoint of the line joining the AM and PL setae; 44·5μ apart. Pseudostigmatic organs capitate, a broad leaf-shape, the apex bluntly pointed, the head covered with fine setules. L, 30μ; stem, 6μ; head, 24μ × 15μ. Ocular shield 19μ from the scutum. Eyes double, the anterior just in front of the pseudostigmata. Body setae 116, of three forms: the first four rows of the dorsum with short branches all over; the remainder of the dorsum and the last two rows of the venter with very short branches on the convex side, a few short spines on the concave side; the remainder of the venter with short branches on the convex side only. Dorsum: setae 72, in rows approximately as follows: 2, 14, 14, 10, / 8, 8, 6, 6, 2, 2. Venter: setae 44, in rows approximately as follows: 2, 2, 8, 4, 6, 8, 2, 2, / 6, 4. Legs relatively long; i, 190μ; ii, 125μ; iii, 167μ. Coxal setae single, the first two with short branches all over, the third with branches on the convex side only. On the second to the fourth segments of i and ii the setae have short branches all over; on the last three segments of these legs, and on all the segments of iii, they have branches on the convex side only. Tarsus i has a sharp concave taper dorsally, with the dorsal nude seta very prominent and set on a tubercle, the spur very short and fine. The spur on tarsus ii is short, stout and blunt; there are two prominent setae set with short spines. There is no prominent nude seta on tarsus iii.

Two specimens from two bush-fowl (*Megapodius duperreyi*).

NEOSCHÖNGASTIA DUBIA, n. sp. Figs. 21, 29.

Body a blunt oval, widest at level of coxa iii. Striations fine and strong; pitting on scutum, maxilla and coxae. Colour orange. L, 333μ; W, 278μ. Maxillary setae long, with many branches on the convex side. Chelicerae missing. A short fine seta with three very fine branches on each cheliceral sheath. Palpi stout, rounded. A very long seta with fine branches on the convex side on ii; a long seta with four branches on the convex side on iii; on iv, near the base, a stout seta with fine branches on one side, and near the apex two nude setae, one slender, the other stout. Palpal claw trifurcate, the middle element much the longest, the dorsal and ventral elements equal, all with sharp points. Appendiculum rounded, with six setae: four very long, one of them coarse and heavily branched, the other three finer, with fine branches on the convex side; two nude, one slender, the other stout. Scutum: L, 62·5μ; W, 100μ. Anterior margin strongly concave; anterior corners rounded, projecting well forward; lateral margins straight; posterior margin convex, indented in the middle; posterior corners small, projecting laterally. In front of each pseudostigma a short flatly-curved ridge, about one-third of the distance back. A longitudinal diffuse ridge along the posterior two-thirds of the midline. Pits simple in front of the crest; those behind it surrounded by circular striations. Scutal setae 5, very long, the AM with branches over all surfaces, set well back from the anterior margin; the others with fine branches on the convex side only, the AL on the lateral margins of the anterior corners, the PL in the posterior corners. AM, 47μ; AL, 84·5μ; PL, 75μ. Pseudostigmata half-way back, behind the ridges of the crest, lateral to the mid-point of the line joining the AM and PL setae; 56μ apart. Pseudostigmatic organs missing. Ocular shield 19μ from scutum. Eyes double, the anterior opposite the AM setae. Body setae 196, with branches on the convex side only. On the dorsum the anterior setae are very long; they become successively shorter, with fewer and shorter branches, towards the posterior pole. On the venter, rows one and two are long, row three is very short. They become successively longer towards the posterior pole, with fewer and shorter branches. Dorsum: setae 96, in rows approximately as follows: 2, 14, 10, 12, 6, 14, 14, 12, 8, 4. Venter: setae 100, in rows approximately as follows: 2, 2, /12, 10, 10, 10, 12, 12, 10, 8, 6, 4, 2. Legs relatively long; i, 278μ; ii, 230μ; iii, 292μ. A single seta, with short branches all along one side, on coxae i and ii; three setae with only a few short branches on one side of the distal third, in a row along the anterior margins of coxa iii. On the second segment of each leg a long seta with long branches all over. The other setae have branches on the convex side only, those on the distal segments with fewer and shorter branches. The spurs on tarsi i and ii long and stout, the dorsal nude seta on tarsus i prominent. A very long slender nude seta on tarsus iii.

One specimen, imperfect, from a bush-fowl (*Megapodius duperreyi*).

In the absence of both chelicerae and pseudostigmatic organs, the placing of this species in the genus *Neoschöngastia* is certainly speculative. Nevertheless the scutal crest and scutal pitting resemble those of certain other species of this genus here described, and the evidence of trifurcate palpal claws and double eyes is of value (see discussion on *N. retrocincta*). The presence of three setae on coxa iii is analogous to the similar condition in *N. retrocincta*, and *N. mutabilis* Gater 1932.

Key to the Australian and New Guinea Species of Neoschöngastia.
(After Womersley.)

1. Scutum with a well-defined crest, often in four curves: the pseudostigmata in the posterior walls of the crest. Anterior part of scutum with pits only, posterior part with circular striations surrounding pits. Body striated anteriorly, pitted posteriorly. Dorsal setae 64μ to 100μ .... *yeomansi* group 2

Scutum without definite crest, but with a line round the pseudostigmata; simply pitted, without striations. Body either entirely striated or entirely pitted. Dorsal setae 22 to 64 5

2. Coxa iii with a single seta 3
Coxa iii with more than one seta 4
3. No striations over posterior fourth of body, but pitting over this area. Setae in this area arising from tubercles. Dorsal setae 100, arranged 2, 16, 8(10), 12(10), 10(8), 10, 8(10), 12, 6, 6, 6, 4 .... *N. yeomansi*, n. sp.
Striations weak over posterior sixth of body, with weak pitting over this area. Dorsal setae 72, arranged 2, 14, 14, 10, 8, 8, 6, 6, 2, 2 ...... *N. backhousei*, n. sp.
4. Coxa iii with two setae. Posterior pitted area of body relatively small, bounded anteriorly by a circle of tubercles devoid of setae; setae in this area arising from tubercles. Dorsal setae 64, arranged 2, 8(10), 12(10), 6, 8(10), 8, 8(6), tubercles, 12 .... *N. retrocincta*, n. sp.
Coxa iii with three setae. No pitted area posteriorly on body. Dorsal setae 96, arranged 2, 14, 10, 12, 6, 14, 14, 12, 8, 4 .... *N. dubia*, n. sp.
5. Body pitted all over, not striated; strongly constricted at level of coxa iii; with two semicircular caudal plates, each bearing three fine setae. Dorsal setae 28 to 32 .... *N. kallipygos*, n. sp.
Body striated all over, not pitted; of usual shape, or only slightly constricted at coxa iii. No caudal plates 6
6. Pseudostigmatic organs more or less globular 7
Pseudostigmatic organs definitely clavate 11
7. Posterior margin of scutum convex, so that the postero-lateral setae are much in advance of its midpoint 8
Posterior margin of scutum straight or sinuate, so that the posterolateral setae are hardly, if at all, in advance of its midpoint 10
8. Pseudostigmatic organs a broad leaf-shape. Scutum roughly hexagonal; corners angular; posterior margin strongly convex, its lateral thirds at about 45° from the middle third. Pseudostigmata almost in line with the posterolateral setae. Dorsal setae 64, 26μ long, arranged 2, 14, 14, 10, 12, 8, 4 .... *N. edwardsi*, n. sp.
Pseudostigmatic organs truly globular. Scutum roughly trapezoidal, corners rounded 9
9. Posterior margin of scutum rounded. Dorsal setae 32, 50μ long, arranged 2, 6, 6, 6, 6, 4, 2 .... *N. coorongense* Hirst 1929
Posterior margin of scutum flattened medially. Dorsal setae approximately 64, 40μ long, arranged 2, 6, 6, then about 50 in five or six rows ....
.... *N. petrogale* Womersley 1934
10. Anterior margin of scutum four-fifths of length of posterior margin. Dorsal setae 50, 36μ long, arranged 6, 8, 8, 8, 8, 6, 4, 2 .... *N. antipodianum* Hirst 1929.
11. Scutum three-fourths as long as wide 12
Scutum three-fifths, or less, as long as wide 13
12. Posterior margin of scutum evenly convex. Pseudostigmata in line with postero-lateral setae. Dorsal setae 32, 40μ long, arranged 2, 8, 6, 6, 6, 2, 2 ....
.... *N. dasycerci* Hirst 1929
Posterior margin of scutum flattened in its middle third. Pseudostigmata well in front of posterolateral setae. Only six segments in mid- and hind-legs. Dorsal setae 26 to 30, 26μ long, arranged 2, 6, 6, (2), 6, 4, 2, (2) ...... *N. impar*, n. sp.
13. Scutum three-fifths as long as wide; roughly hexagonal; posterior margin strongly convex, bluntly pointed in the centre; anterior margin projecting in the centre. Pseudostigmata closer to the anterolateral setae than to the posterolaterals. Dorsal setae 22, 30μ long, arranged 2, 6, 6, 4, 2, 2 .... *N. lorius*, n. sp.
Scutum not more than half as long as wide; posterior margin concave. Dorsal setae 34, 79μ long, arranged 2, 8, 6, 6, 6(4), 4(6), 2 ....
.... *N. westraliense* Womersley 1934

Genus SCHÖNGASTIA Oudemans, 1910.

Entomol. Ber., iii, No. 54, 1910, 86.

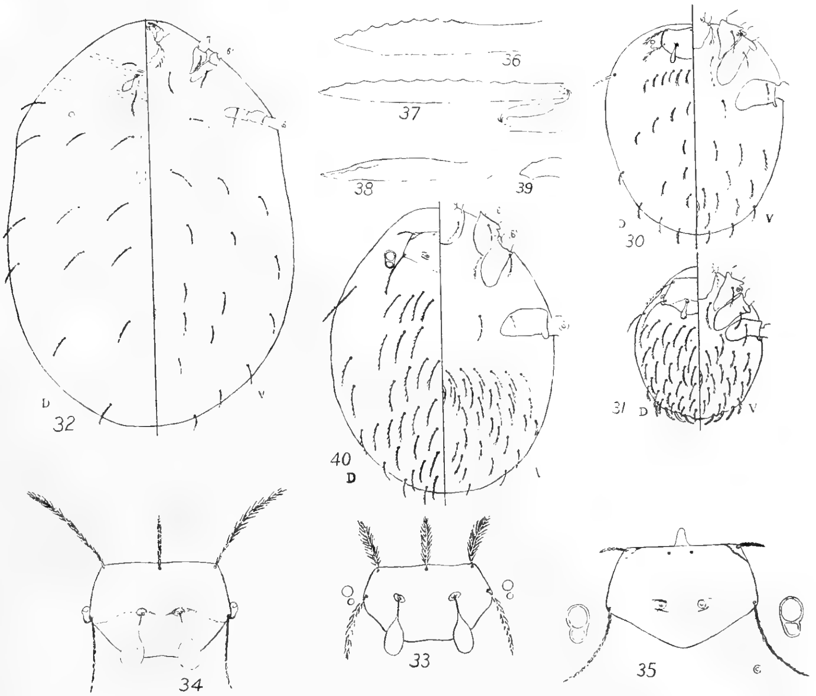
SCHÖNGASTIA JAMESI, n. sp. Figs. 30, 33, 36.

Body a rounded oval, flattened anteriorly, widest at level of coxa iii. Striations coarse and moderately strong; very fine pitting on scutum, maxilla and coxae, and over the anterior third of the venter. Colour bright orange. L, 278μ; W, 232μ. Maxillary setae single, fine, with six long branches on the convex side. Chelicerae very long, straight, slender; a minute sharp dorsoapical barb, with ten small saw-teeth in a row on the distal two-thirds. Ventral tooth represented by a rounded thickening opposite the fourth and fifth teeth. Cheliceral sheaths long, slender, reaching almost to the ends of the chelicerae, and bearing a short nude curved seta on the base of each. Palpi rounded, slender, narrow at the base, widest towards the distal end of ii. A long seta with long branches all over on ii; a short seta with a few long branches on iii; on iv a long seta near the base with six branches on the convex side, two short nude setae near the apex. Palpal claw trifurcate, the dorsal and ventral elements long and sharp, with a shorter, finer lateral element alongside them. Appendiculum with a rounded point, bearing seven setae; one prominent, four finer, all with branches along one side; two nude, the one stout, short and curved, the other fine and straight. Scutum a rounded trapezoid. L, 50μ; W, 85μ. Anterior margin sinuate; anterior corners rounded; lateral margins slightly concave; posterior margin convex; posterior corners rounded. Scutal setae 5, long, with long branches on all sides. The three anterior in line; the PL in the posterior corners on the margins of the scutum. The AM broken off short; AL, 37·5μ; PL, 47μ. Pseudostigmata just behind the PL setae; 37μ apart. Pseudostigmatic organs capitate, leaf-shaped, with apparently no setules on the head. L, 37·5μ; stem, 12·5μ; head, 25μ $\times$ 12·5μ. Ocular shield 7μ from scutum. Eyes double, the anterior just in front of the PL setae. Body setae approximately 68. (The dorsal details cannot be made out easily, as the only available specimens are not well cleared and are all mounted with the dorsum down. The figures are therefore imperfect.) Those of the first dorsal row are stout, straight, blunt, with a few short spines along one side; those of the first two ventral rows are slender, with long branches on one side; the remainder, dorsal and ventral, have short branches on one side. Dorsum: setae approximately 40, in rows as follows: 2, / 12, (8), (4), (6), 4, 2, 2. Venter: setae 28, in rows as follows: 2, 2, / 6, 4, 8, 4, 2. Legs relatively very long. i, 246μ; ii, 209μ; iii, 215μ. Coxal setae single, long, with many branches on the convex side. The leg setae similar, but those on the distal segments have fewer branches, those of iii having shorter and still fewer branches. The bases of the sixth segments are markedly constricted, their distal portions markedly expanded. All tarsi tapering, the third very long. A fine spur on tarsus i; that on ii short and blunt; a fine nude seta, not at all prominent, on iii.

Two specimens from a bush-fowl (*Megapodius duperreyi*); one from a bandicoot (*Echymipera cockerelli*).

SCHÖNGASTIA BLESTOWEI, n. sp. Figs. 31, 34, 37.

Body a short rounded oval, widest at level of coxa iii. Striations moderately coarse, strong and very wavy; pitting on scutum, maxilla and coxae. Colour dull brownish-orange. Newly hatched, L, 167μ; W, 167μ; average, 203μ $\times$ 168μ; largest seen, 223μ $\times$ 207μ. Maxillary setae single, short, stout, with four long branches on the convex side. Maxilla typically square. Chelicerae very long, straight, slender, with sharp points. A minute dorso-apical barb and a row of twelve denticles along the distal three-fifths. Ventral tooth apparently missing. Cheliceral sheaths slender, as long as the chelicerae, with a long nude seta on the base of each. Palpi rounded, projecting boldly forward. A long seta with a few fine branches on the convex side on ii; a similar seta, but shorter on iii; on iv near the base a short seta with a very few fine branches on the convex side, near the apex two nude setae, one very short and stout. Palpal claw trifurcate, the ventral element much the longest and stoutest, the lateral very short and fine, almost vestigial. Appendiculum rounded, with six setae; one stout with a few stout branches, three finer with short fine branches, and two nude, one of them short, sharp and strongly curved. Scutum rounded, straight anteriorly. L, 62·5μ; W, 94μ. Crest a sinuate overhanging ledge, two-thirds of the way back; the posterior portion of the scutum at a much lower level than



Figs. 30-40.—30. Composite dorsal and ventral diagram of *Schöngastia jamesi*, n. sp. 31. Same of *S. blestowei*, n. sp.; 32. *Walchia morobensis*, n. sp.; 33. Dorsal scutum of *S. jamesi*; 34. Same of *S. blestowei*; 35. *Leeuwenhoekia australiense* Hirst; 36. Cheliceral fang of *S. jamesi*; 37. Same of *S. blestowei*; 38. Same of *L. australiense*; 39. Same of *W. morobensis*; 40. Composite dorsal and ventral diagram of *L. australiense*.

the anterior. Crest very faintly marked in some specimens. Anterior margin straight; anterior corners angular, projecting very slightly forward; lateral margins slightly convex; posterior margin strongly convex, with a smooth indentation in the middle; posterior corners about two-thirds of the way back, angular, projecting laterally. Scutal setae 5, the AM 37·5μ, stouter than the others, with short branches on all sides, set well back from the anterior margin, behind the AL; the AL 75μ, slender, with long branches on all sides, well forward in the anterior corners; the PL 50μ, slender, with branches on one side only, in the posterior corners. Pseudostigmata half-way back, directed almost horizontally, lying under the overhang of the crest, just anterior to the PL setae; 25μ apart. Pseudostigmatic organs capitate, racquet-shaped, the heads covered with fine short setules. L, 37μ; stem, 12μ; head, 25μ × 15μ. Ocular shield applied to the scutum from well in front of the pseudostigmata to behind the PL setae. Eyes single, small, the posterior missing; just anterior to the pseudostigmata. Body setae 108, of three forms: those of the last two rows of both dorsum and venter are short, stout, curved, with short spines along the convex side; the remainder of the dorsum stout, with closely-set branches on the convex side; the remainder of the venter slender, with a few branches on the convex side. Dorsum: setae 64, in rows as follows: 2, 10, 8, 10, 8(10), 10(8), / 8, 8. Row eight is on the posterior margin, often more ventral than dorsal. Venter: setae 44, in rows as follows: 2, 2, 10(8), 8(10), 6, 6, / 6, 4. Row six is at the level of the anus. Legs relatively very long; i, 270μ; ii, 209μ; iii, 250μ. Leg setae slender, with a few fine branches on the convex side. Coxal setae single. Sixth segments not unduly constricted or expanded. Tarsi tapering. A short stout spur on tarsus i, the dorsal nude seta prominent, set on a tubercle. The spur on tarsus ii short, finer and sharper. A very fine nude seta on tarsus iii, often broken.

Fifteen specimens collected from two men near the Suein River, Sepik District; eight specimens from abandoned colonies in the ears of two bush-fowl (*Megapodius duperreyi*) from the Bulolo River basin, Morobe District; six specimens from a man at Bulolo.

There is a strong resemblance between this species and *S. vandersandei* Oudemans, 1905. The differences are as follows:

S. vandersandei	*S. blestowei*
Dorsal setae 50.	64.
Ventral setae 42.	44.
Dorsal setae arranged: 2, 10, 10, 10, 10, 8.	2, 10, 8, 10, 8(10), (10)8, 8, 8.
2 palpal claws.	3.
Maxillary setae plain.	With 4 long branches.

Key to the New Guinea Species of Schöngastia.

(Constructed by Mr. H. Womersley.)

1. Dorsal setae more than 50 2
   Dorsal setae 40, arranged 2, 12, (8), (4), (6), 4, 2, 2. 50μ long .... *S. jamesi*, n. sp.
2. Dorsal setae 52, arranged 2, 10, 10, 10, 10, 8(10), 2(10). Ventral setae 42. Maxillary setae plain. Palpal claw bifurcate .... *S. vandersandei* Oudemans 1905
   Dorsal setae 64, arranged 2, 10, 8, 10, 8(10), 10(8), 8, 8. 40μ long. Ventral setae 44. Maxillary setae with four long branches. Palpal claw trifurcate .... *S. blestowei*, n. sp.

Genus Walchia Ewing.

Proc. U.S. Nat. Mus., lxxx, 1931, 10.

Walchia morobensis, n. sp. Figs. 32, 39.

Body a broad oval, widest midway, the anterior fourth with a gradual straight taper to a rounded point. Irregular folds radiating in all directions from behind the pseudostigmata. No striations; pitting all over, not specially marked on scutum, maxilla or coxae. Cephalothorax completely hidden below the anterior point of the body. Colour a dirty cream. L, 425μ; W, 310μ; largest seen, 535μ × 375μ. Maxillary setae single, long, fine, curved, with long fine branches on the convex side. Chelicerae short, stout, almost straight, tapering very sharply. Dorso-apical tooth single, small, sharp. Ventral tooth a small swelling behind a shallow notch. Cheliceral sheaths almost as long as the chelicerae, and relatively stout. Palpi small, strongly curved, ii angular. A long nude seta on ii; a similar one on iii; on iv two short nude setae and a longer one with a few fine short branches. Palpal claw bifurcate, the two elements curved, very long and slender, the ventral slightly longer and stouter than the dorsal. Appendiculum small, rounded, with five setae; two long and stout, with a few fine branches; two long and very fine, with a few fine short branches; and one short, nude, stout and pointed. Scutum not distinguishable in these specimens. Pseudostigmata 53μ back from the anterior margin of the body (74μ in the largest specimen) and 25μ apart (this figure does not vary). An oblique curved ridge lies around the anterior and medial aspects of each pseudostigma. Scutal setae 4: a pair 14μ in front of the pseudostigmata, 18μ long, curved, with two or three fine branches; and a pair 19μ behind the pseudostigmata, 30μ long, curved, with five or six long fine branches. Pseudostigmatic organs capitate, leaf-shaped, the head covered with setules. L, 25μ; stem, 6μ; head, 19μ × 11μ. Ocular shield apparently missing. Eyes single, very indistinct except in freshly-killed specimens; about 75μ lateral to and 30μ behind the corresponding pseudostigma. Body setae 58, those of the dorsum and the first two rows of the venter long, fine, with six to eight long fine branches on the convex side; the remainder of the venter shorter, with fewer branches. Dorsum: setae 26, in rows as follows: 2, 6, 6, 6, 4, 2. Venter: setae 32, in rows as follows: 2, 2, 8, 6, 6, 6, 2. Row five is level with the anus. Legs relatively very short; i, 125μ; ii, 111μ; iii, 165μ. Only six segments in legs ii and iii. Leg setae long, fine, with a few fine branches along the convex side. Coxal setae single. The sixth segment of i and the fifth of ii short and stout; the fifth of iii is of typical shape. Tarsi bluntly tapered, short. The dorsal nude seta on tarsus i prominent, the spur very long, stout and curved; the spur on ii shorter but stouter. No prominent nude seta on iii. On each tarsus two or three setae with only two fine terminal branches.

Four specimens from two Brown's rats (*Rattus browni*); many from the Brown bush-rat (*Rattus ringens*).

Genus Leeuwenhoekia Oudemans, 1911.

's Gravenhage Ber. Ned. Ent. Ver., iii, 1911, 138.

Leeuwenhoekia australiense Hirst. Figs. 35, 38, 40.

Trans. Roy. Soc. Trop. Med. Hyg., xix, 1925, 150.

A single specimen of this species, lacking the pseudostigmatic organs, was taken at Bulolo from a Cassowary (*Casuarius casuarius*). I am indebted to Mr. H. Womersley for its identification.

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THE DIPTERA OF THE TERRITORY OF NEW GUINEA. VII.

FAMILY OTITIDAE (ORTALIDAE).

By John R. Malloch, Arlington, Va.
(*Communicated by Frank H. Taylor, F.R.E.S., F.Z.S.*)

(Plates iv–v.)

[Read 26th April, 1939.]

This family is in many respects similar to the Trypetidae, the only almost invariably dependable character for its separation therefrom consisting of the lack of incurved anterior orbital bristles on the frons. The course of the subcostal vein at its apex is also usually distinctive, the vein in the Otitidae normally gradually approaching the costa and connecting with it at an acute angle, while in the Trypetidae the vein makes an abrupt angular bend forward close to its apex and is usually faint beyond the angle. All the New Guinea Otitidae lack the presutural bristle.

There have been many species recorded from New Guinea and adjacent islands, as the peculiar forms and distinctive colour markings of most of them readily attract collectors. In the Australian region the family is represented almost exclusively by the subfamily Platystominae, though some species of almost cosmopolitan occurrence have been brought in, probably by commerce.

The late Dr. F. Hendel published many papers on the family, the most interesting of them, from an Australian point of view, being that on the Platystominae. This is the predominant subfamily in the Indo-Australian region, more than half of the approximately 500 species occurring in the region, and in 1914 only 45 in North and South America.

I present herein a key to the New Guinea and Australian genera of Platystominae based upon materials available to me and to some extent upon data obtained from Hendel's paper when the genus or species is not available.

In 1924 Enderlein published a paper in which he erected several new genera and described some new species from this region. I have incorporated his work herein.

Material collected in Papua and Dutch New Guinea by Miss L. E. Cheesman has been included in this paper for geographical reasons, thus rendering the paper more valuable.

I have to thank the British Museum (Nat. Hist.) authorities for photographs of the wings of the type-specimens of the species in their material, and Mr. Frank H. Taylor for the other photographs of wings when the types belong to the School of Public Health and Tropical Medicine, University of Sydney.

Subfamily Ulidiinae.

In this collection there is but one species of this subfamily. This is an almost cosmopolitan species which occurs in adjoining islands and Australia.

Pseudeuxesta Hendel. (*Gen. Ins.*, Fasc. 106, 1910, 30.)

Pseudeuxesta prima Osten-Sacken.

Ann. Mus. Civ. Stor. Nat. Genov., xvi, 1881, 470 (*Euxesta*).—*Euxesta semifasciata* Malloch, Insects of Samoa, pt. 6, Diptera, fasc. 5, 1930, 216.

Originally described from Celebes and known from many other localities, including Hawaii.

There is a single specimen in the collection from Wewak, New Guinea (F. H. Taylor).

Subfamily Platystominae.

The genus name *Platystoma* is preoccupied in Mollusca, but up to the present no writer on the group has proposed a new name for the genus.

The group segregated here may be distinguished from others in the family by the presence of short stiff setulae on the upper surface of the first vein, usually extending from near the humeral cross-vein to its apex, the lack of the propleural bristle, and the presence of at most three bristles between the suture and the anterior lateral angle of the scutellum, i.e., one supra-alar and two postalars. Hendel has attempted to separate the group from the Pyrgotidae by the shorter basal two antennal segments and the presence of ocelli, but these characters do not invariably apply, as some Pyrgotidae have ocelli, and short basal segments to the antennae.

Key to the Genera.

1. Eyes quite densely haired; arista long haired; frons with two pairs of fronto-orbital bristles; fifth wing-vein with stiff setulae along the entire extent of the posterior basal cell on upper surface 2
   Eyes not distinctly haired; other characters not as above *in toto* 3
2. Face below antennal foveae with two rounded or oval elevations .. *Lasioxiria* Hendel
   Face without such elevations .... *Dasyortalis* Hendel
3. All femora with some short stout ventral spines 3*a*
   At most one pair of femora with short stout ventral spines 3*b*

3*a*. All femora with anteroventral and posteroventral spines; an extra cross-vein between second and third veins; arista subnude (Samoa) .... *Apactoneura* Malloch
   Only mid and hind femora with biseriate ventral spines, the fore femora with spines on anteroventral surface only; venation normal; arista long-haired (Samoa) .... *Xenognathus* Malloch

3*b*. Suprasquamal ridge with erect hairs near posterior extremity; stem vein of the wing bare at base above; lower squama about twice as large as upper; no fronto-orbital bristles on frons; arista bare or almost so (Australia) .... *Duomyia* Walker
   Suprasquamal ridge bare, or if haired then the stem vein of the wing is haired above at base, or the other characters are not all as above 4

4. Mesopleura, sternopleura and pteropleura with numerous short stout bristles .... *Pseudocleitamia*, n. gen.
   The above sclerites of pleura without short stout bristles 4*a*

4*a*. Elongate slender species, the abdomen slim, not widened at base or at middle and usually quite noticeably laterally compressed; arista never long haired, if noticeably haired at base then bare beyond middle, or extremely long and with dense short white hairs on entire extent that give it the appearance of being thickened; antennal foveae usually long and distinct; sternopleural bristle always lacking; fourth wing-vein never setulose above along posterior basal cell 5
   Stouter species, the thorax sometimes much wider than long, the abdomen either wide at base or centrally, never laterally compressed, if rather slender species the arista is haired to apex; fourth wing-vein sometimes setulose in part above 14

5. Third antennal segment with quite dense decumbent stiff black hairs; face more or less produced above, receding below .... *Conicipithea* Hendel
   Third antennal segment not stiff haired; face not receding below 6

6. Antennae and aristae exceptionally long, the former longer than the face, the aristae still longer and with a thickened appearance because of the presence of dense short white hairs; humeral bristle lacking 7
Antennae usually not longer than the face, the aristae shorter and never with dense short white hairs; humeral bristle present or lacking 8
7. Fourth wing-vein making a wide shallow dip into the discal cell from inner to outer cross-vein and angularly bent up just beyond that vein; cross-veins rather widely separated .... *Philocompus* Osten-Sacken
Fourth wing-vein not dipped down into discal cell from inner to outer cross-vein, and not angularly bent upward just beyond outer cross-vein; cross-veins quite closely placed, sometimes interstitial .... *Antineura* Osten-Sacken
8. First posterior cell of the wing quite noticeably narrowed at apex, the fourth vein either sloping forward from outer cross-vein or with its apex curved appreciably forward 9
First posterior cell of the wing not narrowed at apex, the fourth vein either straight or with its apex slightly downwardly sloped 13
9. Frons deeply or rather closely pitted or punctured; parafacials wrinkled above; facial carina prominent, in profile exposed at least as widely as parafacial, rounded on dorsum; two fine pairs of fronto-orbital bristles generally visible .... *Rhytidortalis* Hendel
Frons not distinctly punctured nor the parafacials wrinkled above, the facial carina not prominent in profile 10
10. Mesonotum as wide as long; frontal orbits with two pairs of bristles; mouth opening very large, male with a beard of long downwardly-directed bristles on posterior portion of jowls .... *Pogonortalis* Hendel
Mesonotum longer than wide; frons with at most one pair of orbital bristles 11
11. Penultimate section of fourth wing-vein about one-fifth as long as ultimate and only as long as the outer cross-vein, the latter as long as ultimate section of fifth vein; frons wrinkled .... *Microepicausta* Hendel
Penultimate section of fourth wing-vein longer, the outer cross-vein much nearer to the apex of fifth vein and tip of wing than in the above; frons smooth 12
12. Inner cross-vein of the wing oblique, upper extremity much nearer to the base of wing than the lower; face with some fine short hairs in centre .... *Plagiostenopterina* Hendel
Inner cross-vein of the wing erect or almost so; face bare in centre .... *Elassogaster* Bigot
13. Frons with two pairs of orbital bristles 13*a*
Frons with but one pair of orbital bristles .... *Pseudepicausta* Hendel
13*a*. Inner cross-vein of wing more than one-third from apex of discal cell .... *Scotinosoma* Loew
Inner cross-vein of wing not more than one-fifth from apex of discal cell .... *Euxestomoea* Hendel
14. Sternopleura with a strong upper marginal bristle 15
Sternopleura without a well-developed bristle 16
15. First posterior cell of the wing narrowed at apex; second vein nearer to third than to costa; head higher than wide in front (Australia) .... *Celetor* Loew
First posterior cell of the wing not noticeably narrowed at apex; second vein nearer to costa than to third vein; head seen from in front as wide as or wider than high .... *Scholastes* Loew
16. Mid femur much stouter and distinctly longer than the hind one, with two series of short strong ventral bristles 17
Mid femur not thicker nor longer than the other pairs, if slightly stouter then with at most fine ventral bristles 18
17. Antennal bases close together, separated by less than the width of the third antennal segment; discal cell of the wing much narrower at base than at apex .... *Brea* Walker
Antennal bases widely separated, distance between them exceeding length of third antennal segment; discal cell of the wing almost as wide at base as at apex .... *Mesoctenia* Enderlein
18. Hind femur much stouter than the other pairs and armed below with short stout black bristles or spines (Pacific Islands, Fiji, Samoa) .. *Pseudorichardia* Hendel
All femora about equally thick, hind pair without stout ventral spines 19

19. Cross-veins of the wing quite close together, the penultimate section of fourth vein not one-fifth as long as the antepenultimate one 20
Cross-veins of the wing not exceptionally close together, the penultimate section of fourth vein not less than one-third as long as the antepenultimate one 23
20. Frons with two pairs of strong orbital bristles; arista with very short hairs; fifth abdominal tergite in the male not long-bristled at apex .... *Euxestomoea* Hendel
Frons without or with but one pair of orbital bristles except in *Loriomyia*; arista rather long haired; fifth abdominal tergite of the male long-bristled at apex; squamae small 21
21. The cross-vein closing the anal cell angled below middle, broken, the cell at apex below forming a short point; two pairs of fronto-orbital bristles .... *Loriomyia* Kertész
The cross-vein closing the anal cell rather angularly curved outward at middle, the cell not pointed below at apex 22
22. Second wing-vein usually much bent forward at apex, unusually close to first near costa, sometimes almost fused with it, its tip much closer to that of first than to tip of third in costa; head of male frequently widened, but never with pedunculate eyes 22*a*
Second and first wing-veins never approaching each other apically; male with the eyes on variably long stalks .... *Laglaisia* Bigot
22*a*. Second wing-vein much closer to third than to first on apical section of latter; one pair of strong orbital bristles present .... *Cleitamia* Macquart
Second wing-vein at least as close to first as to third on apical section of former; no orbital bristle present .... *Cleitamoides*, n. gen.
23. Anal cell closed by an angulate cross-vein, produced into a distinct, sometimes elongate, point or lobe at lower apical angle; frons with only the outer verticals present and one pair of orbitals .... *Neosophira* Hendel*
Anal cell closed by a straight or slightly curved cross-vein at apex, not produced into a point or lobe at lower apical angle 24
24. Extremely short stout species, the thorax broader than long, the mesopleura well exposed when seen from above, the tergites of basal half of abdomen in female usually more or less telescoped so that the abdomen is usually not longer than wide excluding the ovipositor; first posterior cell of the wing almost invariably parallel-sided or widened at apex 25
More elongate species, both the thorax and abdomen longer than wide, the segments of the latter not noticeably telescoped; first posterior cell of wing usually narrowed apically 30
25. Posterior basal cell of the wing longer and larger than the discal cell; wings more or less folded lengthwise and crosswise centrally, usually held close against the abdomen and depressed at apices 26
Posterior basal cell of the wing shorter and smaller than the discal cell; wings not distinctly folded 27
26. Antennal bases rather widely separated; fourth wing-vein ending in the wing-tip; vein closing the anal cell sloping outward posteriorly so that the cell is rather acutely pointed below at apex .... *Asyntona* Osten-Sacken
Antennal bases closer together; fourth wing-vein ending below wing-tip; vein closing anal cell erect or sloping forward anteriorly, the cell transverse at apex .... *Naupoda* Osten-Sacken
27. Frons with a pair of strong orbital and two vertical bristles; antennae short, inserted at middle of eyes in profile; arista plumose; ultimate section of fourth vein slightly curved upward .... *Chaetorivellia* de Meijere
Frons without distinct orbital bristles; antennae inserted below middle of eyes in profile; ultimate section of fourth vein not bent upward 28
28. Bases of antennae close together; discal cell of the wing much narrower at base than at apex 29
Bases of antennae well separated; discal cell of wing nearly as wide at base as at apex .... *Zygaenula* Doleschall
29. Base of stem vein of the wing haired above; clypeus not tumid at lateral angles .... *Pterogenia* Bigot
Base of stem vein of the wing bare above; clypeus tumid at each lateral angle .... *Neohemigaster*, n.n.

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* Hendel included this genus in his key of genera of the Platystominae, but it will be dealt with in a subsequent paper, of this series, on the family Trypetidae.

30. Posterior basal cell of the wing four-fifths as long as the discal cell; fourth vein as in *Rivellia*, distinctly dipped down before inner cross-vein; frons with two pairs of orbital bristles .... *Loxoneuroides* Hendel
Posterior basal cell of the wing about half as long as discal cell 31
31. Fourth wing-vein distinctly dipped down into discal cell just before inner cross-vein; frons with two pairs of orbital bristles .... *Rivellia* Robineau-Desvoidy
Fourth wing-vein not noticeably dipped down in front of inner cross-vein 32
32. Squamae small; arista moderately long haired on entire length; base of R bare above 33
Squamae large, the lower one exceptionally so; if the eyes are protruded laterally the abdomen is not petiolate at the base 34
33. Eyes protruded laterally; abdomen pedunculated; first posterior cell of wing narrowed to apex; wing with or without a dark costal border .... *Achiosoma* Hendel
Eyes not protruded laterally; abdomen elongate-ovate, not pedunculate; first posterior cell of wing not narrowed apically; wing dark brown, with many small hyaline spots in the cells .... *Euthyplatystoma* Hendel
34. Base of the radial, or stem, vein of the wing without setulose hairs or bristles above 35
Base of the stem vein of the wing with stiff hairs or bristles above 38
35. Eyes of male, and to a lesser extent those of female, protruded laterally, the head distinctly wider than the thorax .... *Achias* Fabricius
Eyes in neither sex at all protruded laterally, the head not distinctly wider than the thorax 36
36. Fore femur with several strong ventral bristles .... *Holocnemia* Enderlein
Fore femur without strong ventral bristles 37
37. Scutellum with two stout pointed thorns at apex .... *Ceratopelta* Bigot
Scutellum with two or more normal apical bristles .... *Lamprogaster* Macquart
38. Fore femur with numerous short stout bristles on the central portion of the postero-dorsal surface that are biseriate or triseriate centrally; antennae widely separated at bases, the flat facial carina at this point about half as wide as frons at vertex .... *Notospila* Osten-Sacken
Fore femur with usually a single postero-dorsal series of longer bristles; antennae narrowly separated at bases, the carina at this point not nearly half as wide as frons at vertex .... *Euprosopia* Macquart

N.B.—I have included several genera in the above key that do not belong in the New Guinea list. One or two of these are found in Australia, and are so marked in the key, and they have been dealt with by me in one or more of my papers on the Diptera of Australia that have appeared in these PROCEEDINGS. Two other genera were described by me from Samoa and, with the Australian genera, may be expected to occur in New Guinea. In a few other cases I have included genera that do not occur in New Guinea because I wanted to make clear their distinguishing characters or because the genus is new. Two concepts, *Ceratopelta* Bigot and *Notospila* Osten-Sacken, are also included, though I doubt their claim to generic status and include the first in my treatment of *Lamprogaster*, *Notospila* being considered merely a subgenus of *Euprosopia*.

LASIOXIRIA Hendel.

Abhandl. Zool.-botan. Ges., viii, 1914, 28.

This is the only genus of Hendel's "Trapherina" in the New Guinea region. It is unknown to me and the description and figures suggest a close relationship with *Dasyortalis* Hendel, if not their synonymy.

LASIOXIRIA HIRSUTA Hendel.

Op. cit., viii, 1914, 28.

Described from a male from Sattelberg, Huon Gulf, New Guinea. The only structural details available are shown in Hendel's figures; the description consists of merely colour characters.

Dasyortalis Hendel.

Dasiortalis Hendel, in de Meijere, *Nov. Guin.*, ix, livr. 3, 1913, 378; *Abhandl. Zool.-botan. Ges.*, viii, 1914, 277.

This genus is distinguished from its allies by the presence of dense short erect hairs on the eyes, the two pairs of fronto-orbital bristles, lack of short hairs on the upper surface of the stem vein of the wing at its base, the presence of setulae on the fifth vein along the extent of the posterior basal cell above, and in having the aristae long-haired.

All the known species occur in New Guinea.

Key to the Species.

1. The dark apical costal streak on the wing is distinctly separated by a hyaline interval from the anterior outer extremity of the black fascia over the outer cross-vein; anal cell almost entirely hyaline; frontal and dorsal thoracic bristles and hairs fulvous-yellow in male, usually all these bristles and most of the dorsal hairs black in the female; fore femora normal in male .... *complens* (Walker) 2

   The dark apical costal streak on the wing connected with the anterior outer extremity of the black fascia over the outer cross-vein 4

2. The short dark linear streak on the costa at apex of the first vein not connected with the broad black fascia over the inner cross-vein, stopping at second vein; anal cell slightly browned below; no hyaline spot just beyond apex of anal cell; the yellow margin on upper edge of mesopleura linear .... *complens* var. *separata*, n. var.

   The short dark linear streak on the costa at apex of the first vein connected with the anterior edge of the broad black fascia over the inner cross-vein at third vein; anal cell browned at apex and with the usual brown line along upper edge, not browned along lower margin 3

3. Mesopleura with a very narrow yellow line on upper edge; a hyaline spot just beyond apex of anal cell .... *complens* (Walker)

   Mesopleura with a broad yellow streak on upper edge that is about half as wide as long; no hyaline spot just beyond apex of anal cell .... *complens* var. *fasciata* Curran

4. The short brown streak on the costa at apex of first vein connected with the outer edge of the broad black fascia over the inner cross-vein; seen from in front the head of the male is as high as wide, rounded in aspect, with the genae not angulate; tarsi entirely whitish-yellow .... *angustifrons* Hendel

   The short brown streak at apex of the first vein not connected with the outer edge of the broad black fascia over the inner cross-vein; apices of tarsi dark 5

5. The two basal cells of the wing brown, with a hyaline spot near their apices; male with a clump of downwardly-directed bristles on the genae .... *barbata* Hendel

   Both basal cells of the wing brown; male without genal group of bristles, but the genae angularly produced .... *goniceps* Hendel

Dasyortalis complens (Walker). Pl. iv, figs. 1, 2.

Journ. Proc. Linn. Soc. Lond., iii, 1859, 118 (*Ortalis*).—*Ortalis çontigua* Walker, op. cit., viii, 1865, 123; Hendel, *Abhandl. Zool.-botan. Ges.*, viii, 1914, 277.

The legs are much more extensively lemon-yellow in the male than in the female, the latter having the femora and tibiae largely black. The palpi of the male are also white and almost disc-like, while in the female they are lemon-yellow and club-shaped.

There is some variation in the wing markings (Pl. iv, fig. 1) in a number of the specimens; the hyaline spot beyond the anal cell is sometimes very indistinct, and in one female the short curved brown streak proximad of the apex of the first vein connects with the fascia over the outer cross-vein on the third vein.

Recorded from New Guinea and Aru Islands. A large series from Wewak, New Guinea (F. H. Taylor), and two specimens from Papua: Kokoda, 1,200 feet and 3,000 feet (L. E. Cheesman).

DASYORTALIS COMPLENS VAR. SEPARATA, n. var. Pl. iv, fig. 3.

This variety, which is very similar in all particulars to the typical form, may be distinguished by the failure of the short dark streak near the apex of the first vein to connect with the broad dark fascia over the inner cross-vein, and the pale brown margin of the anal cell along the anal vein (Pl. iv, fig. 3). Length, 4·5 mm.

Type, female, Dutch New Guinea: Cyclops Mts., Sabron, 930 feet, April 1936 (L. E. Cheesman).

DASYORTALIS COMPLENS VAR. FASCIATA Curran.

Proc. Cal. Acad. Sci., xxii, No. 1, 1936, 54 (*Lasiopsila*).

This variety differs from the typical form in having the yellow streak on the upper margin of the mesopleura widened behind, where it is almost half as wide as it is long, instead of uniformly wide and more than four times as long as wide. There is no hyaline spot just beyond the apex of the anal cell. Length, 4 mm.

Kavieng, New Ireland; Makada Is., off New Britain (F. H. Taylor); Solomon Islands (W. W. Froggatt). Type locality, Matema Island.

Curran described this as the type of a new genus, *Lasiopsila*, which he placed in the family Psilidae. His description is lacking in several essential characters and his figure of the wing is slightly inaccurate, but I have no doubt as to the identity of the species.

DASYORTALIS ANGUSTIFRONS Hendel.

Abhandl. Zool.-botan. Ges., viii, 1914, 279.

Hendel states in his description that the hyaline fascia between the cross-veins of the wing does not attain the hind margin. In the well preserved male before me it does.

Described from a single male taken in New Guinea. Papua: Kokoda, August 1933 (L. E. Cheesman).

DASYORTALIS BARBATA Hendel.

Op. cit., viii, 1914, 279.

Described from both sexes from New Guinea. Not known to me.

DASYORTALIS GONICEPS Hendel.

Op. cit., viii, 1914, 281.

I have one male before me that apparently belongs to this species. Hendel makes no mention of an abnormal structure of the fore femur in this sex, but in this specimen the femur is swollen and slightly tumid at the apex, and there furnished with a clump of short erect black bristles.

Described from three males from New Guinea. Wewak, New Guinea (F. H. Taylor).

CONICIPITHEA Hendel.

Abhandl. Zool.-botan. Ges., viii, 1914, 29.

The head in my specimens is not particularly noticeable for its forward production at the base of the antennae, but the stiff short setulae on the outer edge of the third antennal segment are sufficient to identify the genus. These are not mentioned by Hendel in his description.

CONICIPITHEA ADDENS (Walker).

Dacus addens Walker, *Jour. Proc. Linn. Soc. Lond.*, iv, 1860, 149.

Recorded from Celebes, Molucca, and Amboina, not as yet known from New Guinea, though likely to occur there. Introduced here because of that fact and to present the above character.

PHILOCOMPUS Osten-Sacken.

Bull. Ent. Soc. France, x, 1881, 134.

This genus contains three species, none of which is as yet known to occur in New Guinea. One was described from Celebes and may be found in New Guinea.

ANTINEURA Osten-Sacken.

Op. cit., x, 1881, 134.

This genus has been divided into two subgenera as below:

A. Inner cross-vein of the wing directly above the outer one, forming a continuous line .... *Antineura* Osten-Sacken

AA. Inner cross-vein not directly above the outer one, curved and oblique .... *Adantineura* Hendel

N.B.—Neither of the two known species of *Antineura*, s.s., is known to occur in New Guinea; they are Malayan. The species of *Adantineura* are distinguished as below:

1. Wing without a longitudinal black streak from base of third vein to middle of discal cell below fork of radial vein; palpi red .... *biroi* de Meijere
   Wing with a longitudinal black streak from base of third vein to middle of discal cell below fork of radial vein; palpi red, black at bases 2
2. Epistome shining metallic black .... *kerteszi* de Meijere
   Epistome yellow, thickly silvery-white-dusted .... *grandis* Doleschall

ANTINEURA (ADANTINEURA) BIROI de Meijere.

Ann. Mus. Nat. Hung., iv, 1906, 188.

Described from a male from New Guinea. Not since recorded.

ANTINEURA (ADANTINEURA) KERTÉSZI de Meijere. Pl. iv, fig. 4.

Op. cit., iv, 1906, 189.

Described from both sexes from New Guinea. Both sexes, Wewak, New Guinea (F. H. Taylor).

ANTINEURA (ADANTINEURA) GRANDIS (Doleschall).

Natuurk. Tijdschr. v. Nederl.-Ind., xvii, 1858, 126 (*Herina*).

Described from a male taken on Amboina. May yet be taken in New Guinea.

PSEUDOCLEITAMIA, n. gen.

Generic characters.—A remarkable genus in this subfamily, readily distinguished from any other by the very narrow upper portion of the frons, which has three or four pairs of short stout orbital bristles and four verticals. The head is otherwise much as in *Rivellia* and related genera, the face being almost vertical in profile, with shallow foveae on almost the entire height, the parafacials are narrow and have some fine short hairs; antennae as long as the face, the third segment about five times as long as its greatest width, narrowly rounded at apex; aristae bare; upper occiput depressed, lower swollen. Thorax longer than wide, with the following bristles: 1 humeral, 2 notopleurals, 1 supra-alar, 2 postalars, a strong closely-placed pair of dorsocentrals, 1 mesopleural and four subequal scutellars. The unique feature of the thorax lies in the presence on the hind half of the mesopleura, the anterior half of the pteropleura, and the upper margin of the sternopleura of numerous short stout bristles. Wing as in Plate iv, Figure 5, the apices of first and second veins wide apart, inner cross-vein about its own length from outer, first posterior cell not narrowed at apex, vein closing the anal cell bent in middle, first and third veins setulose on upper surface. Squamae rather small, lower one a well developed lobe. Legs normal, rather stout.

Genotype, *Pseudocleitamia setigera*, n. sp.

PSEUDOCLEITAMIA SETIGERA, n. sp. Pl. iv, fig. 5.

♀. Black, rather dull, anterior margin of frons, basal two segments and base of third segment of antennae yellowish-brown, thorax pale-grey-dusted, but the type is damaged so that markings if any are not distinguishable. Wings hyaline, costa narrowly brownish-yellow from humeral cross-vein to apex of first vein, an oblique black fascia from below apex of the subcostal to midway to inner cross-vein over furcation of second and third veins, a narrow black fascia from apex of first vein to fifth enclosing the inner cross-vein, and a large black mark on apical two-fifths of the wing, the anterior outline of which is slightly rounded, touching the outer cross-vein, broken at apex by a wedge-shaped hyaline streak that extends from the tip of fourth vein obliquely to near the apex of second vein that leaves a narrow dark border from the apex of second to beyond the apex of third vein on the costal margin; edge of the anal region slightly brown clouded apically.

Frons at vertex about one-fifth of the head-width, slightly widened to anterior margin, where it is a little less than one-third the head-width and one-third its own length; orbits narrow, whitish-grey-dusted; eyes bare, slightly oblique, about 1·5 times as high as long; gena reddish-yellow, about one-fourth as high as eye. Prelabrum well exposed. The pairs of orbital bristles very close together and strong, though not very long. The type is damaged or rubbed so that their details are uncertain. Mesonotum with quite dense short depressed black hairs; scutellum with one or two fine erect discal hairs. Legs black, femora more brownish apically. Fore tarsi about 1·5 times as long as their tibiae, slightly thicker than usual, metatarsus on all legs longer than the other four segments combined; fore femora with sparse posteroventral bristles; mid tibia with two strong apical ventral bristles; hind tibia with a few inconspicuous central anteroventral setulae. Second wing-vein slightly undulated. Abdomen widest centrally, without long bristles at apex of fifth tergite. Length, 7·5 mm.

Type, Papua: Kokoda, 1,200 feet, May 1933 (L. E. Cheesman).

EUXESTOMOEA Hendel.

Hendel in de Meijere, *Nova-Guinea*, ix, Zool., livr. 3, 1913, 377; *Gen. Ins.*, Fasc., 157, 1914, 91; *Abhandl. Zool.-botan. Ges.*, viii, 1914, 187.

There are three known species of this genus, all recorded from New Guinea. They are rather slender species, though placed by Hendel along with the stouter forms in his generic key. To prevent mistakes in allocation I have inserted the genus in both sections of the key to genera given herein.

The antennae are shorter than in *Scotinosoma* and the inner cross-vein is hardly more than its own length from the outer, the section of fourth vein between the cross-veins being not more than one-fifth as long as the preceding section. In both species I have before me the third antennal segment is distinctly angulate at apex above which is distinctive. There are striking differences in the chaetotaxy of the two species before me that are not mentioned by Hendel. I do not know what are the chaetotactic characters of *discifera*.

Key to the Species.

1. Mid and hind femora orange-yellow, remainder of legs deep black; thorax, scutellum and abdomen glossy metallic-blue, without trace of dusting; no bristles on the mesonotum proximad of the strong acrostichal pair; the 6 scutellar bristles sub-equal in length, all on margin; arista short-haired, the longest hairs about 3 times as long as its basal diameter; the large apical brown mark on the wing narrowly connected with the fascia over the cross-veins on both the costa and hind margin .... *bipunctata* Hendel

   Legs entirely black, or black-brown; thorax with greyish dust; aristae pubescent basally 2

2\. Apical brown mark on the wing entire; mesonotum with a pair of strong bristles proximad of the prescutellar acrostichals and more widely separated than the latter; intermediate pair of scutellar bristles much shorter than the others, and subdorsal in position; no apical palette on arista of the male .... *prompta* (Walker)

Apical brown mark on the wing interrupted by hyaline streaks in the cells; arista of male with an apical palette .... *discifera* de Meijere

EUXESTOMOEA BIPUNCTATA Hendel. Pl. iv, fig. 6.

Abhandl. Zool.-botan. Ges., viii, 1914, 188.

The only specimen before me does not have the brown fascia from the stigma extending entirely to the hind margin of the wing as described by Hendel; it is broken above the fifth vein and the continuation below that vein to its fusion with the second fascia is faint (Pl. iv, fig. 6). The post-vertical pair of bristles is practically undeveloped. Halteres with yellow knobs.

Originally described from New Guinea: Maroka. One female, Papua: Mafulu, 4,000 feet, January 1934 (L. E. Cheesman).

EUXESTOMOEA PROMPTA (Walker).

Jour. Proc. Linn. Soc. Lond., iii, 1859, 118 (*Ortalis*).

A much duller coloured species than the preceding, with better developed post-vertical pair of bristles and brown halteres.

Recorded from New Guinea and Aru. Five specimens, Papua: Mafulu, 4,000 feet, December 1933, and Kokoda, 1,200 feet, December 1933 (L. E. Cheesman).

EUXESTOMOEA DISCIFERA de Meijere.

Nov. Guin., ix, Zool., livr. 3, 1913, 377.

Described from a poorly preserved male from New Guinea. As in *prompta* the bases of the abdominal tergites are whitish-grey-dusted, but in this species the bands are broader, about half the length of the tergites, and in the male there is an apical palette on the arista.

RHYTIDORTALIS Hendel.

Abhandl. Zool.-botan. Ges., viii, 1914, 121.

This genus belongs to the same group as *Pseudepicausta*, having the first posterior cell of the wing not narrowed at the apex, but is separated from its nearest allies by the presence of rather coarse punctures on the frons.

Neither of the two known species occurs, as far as known, in New Guinea, but the Australian *rugifrons* Thomson may yet be found there; the other species is Formosan.

CLEITAMOIDES, n. gen.

Generic characters.—Similar to *Cleitamia* in most particulars, but differing markedly in having the second wing-vein much closer to the first on apical third or more of the latter than it is to third, and the orbits without strong bristles. There is also, in all three known species, a thickened strip on the wing membrane near the apex of the first vein that runs to the third vein. There is a striking uniformity in the wing markings of the included species, all having a basal brown or yellowish mark that extends to level of apex of the subcostal vein and to fourth vein across the field, and beyond this a large rather rounded blackish-brown mark from the costa to the hind margin that covers both the cross-veins.

Genotype, *Cleitamia kerteszi* Hendel.

Key to the Species.

1. No black streak emanating from the costal edge of the large brown mark over the cross-veins .... *liturata* (Walker)
   A black or dark brown streak emanating from the costal edge of the large brown mark over the cross-veins and extending narrowly round the costal margin to apex of the fourth vein 2
2. The basal brown mark on the wing not extending to the costa at apex .... *kerteszi* Hendel
   The basal brown mark extending to the costa on a large part of its apical half .... *latifascia* (Walker)

CLEITAMOIDES LITURATA (Walker).

Jour. Proc. Linn. Soc. Lond., v, 1861, 251 (*Dacus*).

Originally described from Dorey, and subsequently recorded from New Guinea.

CLEITAMOIDES KERTESZI Hendel.

Abhandl. Zool.-botan. Ges., viii, 1914, 130.—*Cleitamia liturata* Osten-Sacken, *Ann. Mus. Civ. Genov.*, xvi, 1881, 468; op. cit., (2) xix (xxxix), 1899, 559.

Described from New Guinea and known only from the original material.

CLEITAMOIDES LATIFASCIA (Walker). Pl. iv, fig. 7.

Jour. Proc. Linn. Soc. Lond., iii, 1859, 114 (*Dacus*); Edwards, *Trans. Zool. Soc. Lond.*, xx, pt. 13, 1915, 415.

Originally described from Aru Islands and subsequently recorded from Dutch New Guinea by Edwards. Papua: Kokoda, 1,200 feet, April, September and October 1933 (L. E. Cheesman). (Pl. iv, fig. 7.)

CLEITAMIA Macquart.

Suites à Buffon, Diptères, ii, 1835, 440.

This genus, the species of which are usually distinguished by the conspicuously black-marked wings with hyaline streaks or spots, is very well represented in New Guinea and below I present a key to the species referable to it, some of which are known to me only from descriptions. Hendel in his paper on Platystominae (*Abhandl. Zool.-botan. Ges.*, viii, 1914, 123) presented a key to 14 species, which list is considerably enlarged herein.

Key to the Species.

1. Scutellum with four marginal bristles, the basal pair sometimes weak and hair-like 2
   Scutellum with six strong marginal bristles; fourth wing-vein beyond the outer cross-vein usually markedly upwardly curved to before middle of apical section, then sloping down to wing-margin 12
2. Wing brownish-black, with three wedge-shaped hyaline streaks on the costa, one before the apex of the subcostal vein that extends over the wing to second vein near its furcation with third, two others between apex of subcostal vein and that of first vein that extend backward over third vein, three hyaline streaks on apical half, the anterior one extending diagonally from below the apex of second vein to apex of the first posterior cell, the central one extending from behind middle of the inner cross-vein to and including most of apical half of second posterior cell, and the third extending from the lower half to inner cross-vein over the discal cell to the hind margin of wing, angulate on fifth vein, and a hyaline streak along the anal margin to apex of fifth vein .... *catharinae* de Meijere*
   Wing not as largely black, and differently marked 3

* In 1915 (*Tijdschr. v. Ent.*, lviii, 129) de Meijere placed this species as a synonym of *tricurvata* Walker, but there does not appear to be a great similarity in the descriptions and I leave the matter as presented in the above key until a comparison of the types is made.

3. Both the cross-veins of the wing enclosed in a large broad black mark or spot .. 4
Both the cross-veins of the wing not enclosed in a single large black mark or spot, or covered by a linear black streak 9
4. The large black spot over the cross-veins extending over the entire width of wing from the costa to the hind margin .... *amabilis* Osten-Sacken
The above black spot or mark not reaching the costal margin or only so as a mere line 5
5. No black streak emanating from the apical border of the large discal spot, the only dark mark beyond it consisting of a narrow costal streak that is not connected with the large spot 6
At least one dark streak emanating from the apical border of the large discal spot 7
6. Pleura fulvous-yellow on hind margin of the mesopleura and all of the sternopleura; mesonotum with a rather broad pale-grey-dusted central vitta from anterior margin to the suture; no hyaline spot in the dark mark over the cross-veins, and a wedge-shaped hyaline mark above apical part of the anal vein .... *similis* Kertész
Pleura entirely metallic violet-blue; no grey-dusted central anterior vitta on the mesonotum; a small hyaline spot behind the lower extremity of the outer cross-vein, and the entire posterior half of the cell in front of the apical section of anal vein whitish-hyaline .... *cheesmanae*, n. sp.
7. Only one arcuate black streak emanating from the apical border of the large discal spot .... *biarcuata* Walker
Two arcuate black streaks emanating from the apical border of the large discal spot 8
8. Frons in both sexes broader than long; basal halves of the femora yellow; anal cell of the wing with a small sub-hyaline spot; lower occiput yellow on sides .... *astrolabei* Boisduval
Frons longer than broad; basal two-thirds of femora yellow; anal cell of the wing with only the upper and apical margins blackened; entire occiput metallic blue-black .... *orthocephala* Hendel
9. First posterior cell of the wing without a dark fascia; third vein beyond the inner cross-vein evenly and but slightly arcuate, almost parallel with the apical section of fourth; a slender curved fascia over the outer cross-vein from costa to hind margin .... *rivelloides* Osten-Sacken
In addition to the dark costal band there is a dark fascia or short streak through the first posterior cell of the wing 10
10. The oblique dark fascia through the first posterior cell is not connected with the dark costal streak, the one over the cross-vein narrow, curved forward in front ... 11
The oblique dark fascia through the first posterior cell is connected with the costal streak; outer cross-vein in a large black mark that occupies a large portion of the second posterior cell .... *tricurvata* Walker
11. The oblique dark streak in the first posterior cell dark brown at apex of fourth vein, becoming gradually paler from there to its anterior extremity, which is pale brown and distinctly widened .... *ostensackeni* Hendel
The oblique dark streak in the first posterior cell entirely deep black, narrow, of uniform width, not widened at anterior extremity .... *cyclops*, n. sp.
12. A large black mark enclosing both the cross-veins of the wing, that does not touch the narrow black costal streak, from the upper edge of which spot emanates a slender curved black streak that extends downward to the apex of the fourth vein 12*a*
Wing not so marked, the spot enclosing the cross-veins either reaching costa or a short brown streak over apex of the fourth vein that is not connected with the dark mark enclosing the cross-veins, the latter mark not entirely black 13
12*a*. The large black mark enclosing the cross-veins extending to the costa, connected with the narrow costal stripe that extends to apex of third vein, but not with the one that runs obliquely over apex of fourth vein (Pl. iv, fig. 12) .... *delandi*, n. sp.
The large black mark enclosing the cross-veins not extending to the costa, and connected with the narrow black stripe that ends on apex of fourth vein .... *excepta*, n. sp.

13. Basal and discal cells brown, partly yellowish apically; the costal margin of wing with three hyaline spots that do not extend over the second vein .... *gestroi* Kertész
Basal and discal cells not entirely brown; an oblique hyaline fascia from costa or near it to the fifth vein beyond middle of the discal cell; costal margin with but one hyaline mark on or near costa on its basal half 14
14. A wedge-shaped hyaline mark on the costa before middle of wing that extends to third vein; the hyaline central fascia attaining the costal margin .... *roederi* Kertész
Only a small hyaline spot between first and second veins before middle of wing; the hyaline central fascia not attaining the costal margin ... *insignis* de Meijere

CLEITAMIA AMABILIS Osten-Sacken.

Ann. Mus. Civ. Stor. Nat. Gen., xvi, 1881, 468.

Described from New Guinea.

The large oval dark mark over the cross-veins extends from the costa to the hind margin and has a single slender apical costal marginal streak extending from its costal edge to midway between the apices of third and fourth veins. There is a complete hyaline fascia in front of the large oval mark. There are two hyaline costal marks in the basal half of the wing.

CLEITAMIA ASTROLABEI Boisduval. Pl. iv, fig. 8.

Voy. l'Astrolabe, pt. 2, 1835, 668 (*Ortalis*).—*Poticara triarcuata* Walker, *Jour. Proc. Linn. Soc. Lond.*, v, 1861, 249.

This species has been recorded from several localities in New Guinea. The head of the male varies considerably in width and is always distinctly wider than that of the female, noticeably exceeding in width the widest part of the thorax.

New Guinea: Bulolo (F. H. Taylor), Marprik (C. M. Deland and J. R. Rigby); Papua: Kokoda, 1,200 feet, July 1933 (L. E. Cheesman), Koitaki (E. O. Pockley); Dutch New Guinea: Cyclops Mts., 930 feet, Sabron, April 1936, Lake Sentani, August 1936, 58 specimens (L. E. Cheesman).

CLEITAMIA ORTHOCEPHALA Hendel.

Abhandl. Zool.-botan. Ges., viii, 1914, 126.

Very closely allied to *astrolabei*, differing essentially from the latter as noted in the foregoing key. Unknown to me except from the description and known only from New Guinea.

CLEITAMIA SIMILIS Kertész.

Ann. Mus. Civ. Stor. Nat. Gen., (2) xix (xxxix), 1899, 562.

Described from New Guinea. Papua: Mafulu, 4,000 feet, January 1934 (L. E. Cheesman).

CLEITAMIA OSTENSACKENI Kertész.

Term. Füzet., xxi, 1898, 494.

Type locality, Madang (Frederich Wilhelm Hafen), New Guinea.

CLEITAMIA TRICURVATA (Walker).

Jour. Proc. Linn. Soc. Lond., vii, 1864, 227 (*Poticara*).

Described from Waigou Island, New Guinea. Recorded from New Guinea by Enderlein in 1924.

CLEITAMIA GESTROI Kertész.

Ann. Mus. Civ. Stor. Nat. Gen., (2) xix (xxxix), 1899, 566.

In this species and *roederi* the fourth wing-vein is highly arched beyond the outer cross-vein.

Originally described from New Guinea.

CLEITAMIA ROEDERI Kertész.

Op. cit., (2) xix (xxxix), 1899, 565.

Described from New Guinea.

CLEITAMIA INSIGNIS de Meijere.

Tijdschr. v. Ent., lviii, 1915, 128.

A large, robust species, with a peculiar wing-pattern, the small quadrate hyaline spot near the middle of the marginal cell, the central hyaline fascia which does not attain either the costa or the hind margin and lies near the apex of the discal cell, and the broad costal streak from the large dark mark enclosing the cross-veins extending well over the third vein, its lower edge being at middle of the tip of first posterior cell, are distinctive. The third wing-vein is conspicuously humped up just beyond the outer cross-vein.

Described from North New Guinea. One pair, West New Guinea; Njau-limon, south of Mt. Bougainville, 300 feet, February 1936 (L. E. Cheesman).

CLEITAMIA BIARCUATA (Walker).

Jour. Proc. Linn. Soc. Lond., viii, 1865, 133 (*Poticara*).

This species is readily distinguished from *astrolabei* and its allies by the character of the wing markings as noted in the foregoing key to the species.

Originally described from the island of Salawati and subsequently recorded from New Guinea by Hendel.

CLEITAMIA RIVELLOIDES Osten-Sacken.

Ann. Mus. Civ. Stor. Nat. Gen., xvi, 1881, 469.

Originally described from New Guinea, the female type being in Genoa. Not subsequently recorded.

CLEITAMIA CYCLOPS, n. sp. Pl. iv, fig. 9.

♀. Similar to *ostensackeni* in general colour and markings, differing as follows: Frons brownish-black to black, with a velvety mark on each side in front, sometimes red in centre; third antennal segment dark brown; palpi dark at bases; face violet-black; mesonotum blue-black, slightly grey-dusted on disc, with three rather faint broad brownish vittae, the sublaterals obsolete before suture; abdomen entirely violet-black, with rather dense, very short, yellowish pile; the black fasciae on the wing much narrower, almost linear, the one over the cross-veins hardly widened behind, and the one in the first posterior cell as described in the foregoing key to the species (Pl. iv, fig. 9).

All four vertical bristles and the pair of orbital bristles strong. Scutellars four. Fore femora almost entirely black. Cross-veins of the wing almost interstitial. Halteres black. Length, 8–10 mm.

Type and 2 paratypes, Dutch New Guinea: Cyclops Mts., 3,500 feet, March 1936 (L. E. Cheesman).

CLEITAMIA CHEESMANAE, n. sp. Pl. iv, fig. 10.

♀. Similar to *similis*, differing as stated in the foregoing key to the species, and as follows: The frons is narrower and not so noticeably widened in front, the undusted lower half of the face is not green but is purple in colour, and the wing has but one hyaline wedge-shaped costal mark in front of the semi-circular hyaline fascia (Pl. iv, fig. 10).

The type-specimen has 5 scutellar bristles, but I assume that the normal number will be found to be 4, as the similarity to *similis* is very striking and the two are closely allied. Length, 9 mm.

Type, Dutch New Guinea: Cyclops Mts., 3,500 feet, March 1936 (L. E. Cheesman). Named in honour of the collector.

CLEITAMIA EXCEPTA, n. sp. Pl. iv, fig. 11.

♀. This species resembles *astrolabei* in general colour and markings, but has 6 scutellar bristles. The head is narrower than in that species, with the frons about 1·5 times as long as wide, red in colour, with the upper orbits and the ocellar triangle blue-green, the narrow eyes in front white-dusted, and the anterior margin hardly darkened. The mesonotum is greenish or bluish-black, with slight grey dusting and traces of brown discal vittae, but no transverse black band at the suture. Pleura largely yellowish-brown. Legs with the femora more extensively yellow. Wing with the same large broad black mark enclosing the cross-veins and the narrow black costal margin beyond it, but there is only one slender curved streak emanating from upper apical margin of the large mark, ending on apex of fourth vein, and but one hyaline wedge-shaped mark on the costa before middle; the anal cell is almost entirely hyaline, and the posterior edge of the black mark beyond the anal cell is not as markedly dentate. Length, 8–9 mm.

Type and 9 paratypes, West New Guinea: 7 from Njau-limon, 300 feet, and 2 from Mt. Nomo, 700 feet, February 1936 (L. E. Cheesman).

Types of all three new species in the collection of the British Museum (Nat. Hist.), London.

CLEITAMIA DELANDI, n. sp. Pl. iv, fig. 12.

♀. Head black, frons almost imperceptibly brownish above, much darker than in *excepta*, the upper orbits glossy blue-black, the lateral edges narrowly silvery in front; vertex with four bristles, one pair of orbitals rather strong. Frons about 1·5 times as long as wide. Face vertical, dull red, edges of foveae and parafacials glossy-black, foveae white-dusted. Genae a little higher than width of third antennal segment, the latter extending to a little below middle of face. Antennae red; longest hairs on aristae about as long as width of third antennal segment; palpi slender, brownish-red.

Thorax black, rather brown at sutures, mesonotum dull centrally, metallic blue-black on sides, the scutellum and pleura blue-black or metallic-blue. Some whitish dust at the humeri and at suture laterally, most evident from behind, no trace of markings. Scutellum with six bristles, the disc microscopically fine-haired. Legs brownish-yellow, tibiae darkened apically, tarsi black. Wing black-brown, paler brown in the costal and subcostal cells, with the following parts whitish hyaline: Two wedge-shaped marks beyond the apex of the subcostal vein, the first one extending to almost the fourth vein, an inverted V-shaped mark at apex, its base near costa, its outer arm ending in apex of first posterior cell, its inner in upper half of second posterior cell, a short streak beyond middle of the discal cell extending from near anterior edge of latter to hind margin of the wing, and a broad stripe along the anal angle that extends almost across the anal cell (Pl. iv, fig. 12). Halteres dark brown. Abdomen metallic-blue, without the usual apical bristles in type. Length, 11 mm.

Type, New Guinea: Marprik (J. R. Rigby and C. M. Deland). Type in the collection of the School of Public Health and Tropical Medicine, University of Sydney.

CLEITAMIA TRIGONALIS de Meijere.

Nov. Guin., ix, Zool., livr. 3, 1913, 375.

This species which was described from New Guinea is entirely unknown to me. It is similar to *liturata*, but has entirely yellow femora and different wing markings.

LAGLAISIA Bigot.

Ann. Soc. Ent. France, (5) x, 1880, 92.

The males of this genus have the head much widened, the eyes being usually on very long stalks, the width sometimes exceeding the entire length of the insect, but in the females the head is not markedly wider than the thorax. The anal cell is closed by a centrally outwardly-bent cross-vein, and the apex of the abdomen in the males has a few quite long bristles much as in *Cleitamia*.

Hendel published, in his 1914 paper, a key to the then known species which I reproduce below for the convenience of students of the group.

Key to the Species.

1. Body entirely reddish-brown 2
   Metallic coloured species, at least the postnotum and the abdomen blackish-green .. 3
2. Inner cross-vein not longer than the section of the fourth vein between the cross-veins; the outer cross-vein only enclosed within a brown mark that extends narrowly along the hind margin of the wing from near the anal angle in a curve to the middle of the submarginal cell at wing tip, widening apically .... *kochi* de Meijere
   Inner cross-vein longer than the section of the fourth vein between the cross-veins; wings brownish, a transverse whitish-hyaline streak from behind the fifth vein to the third vein just proximad of the cross-veins in front of a large dark brown mark over both cross-veins that encloses a small hyaline central spot, the wing tip hyaline .... *caloptera* Bigot
3. Thorax and scutellum blue-black, metallic; first and second posterior cells of wing with a brown cross-band; wing with two narrow white cross-bands in the middle .... *fascipennis* de Meijere
   Thorax and scutellum reddish-brown, mesonotum with metallic-blue discal mark, the scutellum with a violet sheen; first and second posterior cells of the wing without a brown cross-band; wing with but one wedge-shaped hyaline cross-band in the middle that extends from the costa to fifth vein just proximad of the cross-veins, a narrow brown cross-band over the latter and a continuation of same on the apical margin of the costa to the middle of first posterior cell .... *biroi* Hendel

LAGLAISIA CALOPTERA Bigot.

Ann. Soc. Ent. France, (5) x, 1880, 92.

Described from New Guinea.

LAGLAISIA KOCHI de Meijere.

Tijdschr. v. Ent., li, 1908, 120.

Described from New Guinea.

LAGLAISIA BIROI Hendel.

Abhandl. Zool.-botan. Ges., viii, 1914, 136.

Described from New Guinea.

LAGLAISIA FASCIPENNIS de Meijere.

Hendel, *Abhandl. Zool.-botan. Ges.*, viii, 1914, 134; de Meijere, *Tijds. v. Ent.*, lviii, 1915, 134.

It is rather difficult to determine who should be credited with this species. Hendel included it in his key to the species as *fascipennis* de Meij. in litt., but he did not state whether the data given by him were to be credited to de Meijere, whose description of the species did not appear until about a year later. Hendel had not seen the species apparently and simply included it to make his paper complete to date. I therefore credit the species to de Meijere.

Northern New Guinea.

LAGLAISIA STYLOPS Enderlein.

Mitt. Zool. Mus. Berl., xi, 1923, 116.

This species apparently belongs in the group in which the thorax and abdomen are reddish-brown, but the posterior notopleural elevation is described as greenish-metallic. The wing is compared by Enderlein with that of *biroi* with the distinctions that there is no hyaline spot in the cell R, the wedge-shaped hyaline fascia from the costa near middle is narrower and does not reach Cu_1, and the hyaline band at the wing tip does not penetrate the cell R_{2+3}, but ends in R_{4+5}.

North-east New Guinea.

LAGLAISIA TELESCOPICA Enderlein.

Op. cit., xi, 1923, 116.

Another closely allied species of the same colour group, differing from all the others in the markings of the wings.

North-east New Guinea.

LORIOMYIA Kertész.

Ann. Mus. Civ. Stor. Nat. Gen., (2) xix (xxxix), 1899, 567.

LORIOMYIA GUTTIPENNIS Kertész.

Op. cit., (2) xix (xxxix), 1899, 567.

This is the only species of the genus and was described from New Guinea. It is unknown to me.

PLAGIOSTENOPTERINA Hendel.

Abhandl. Zool.-botan. Ges., viii, 1914, 52; Malloch, *Proc. U.S. Nat. Mus.*, lxxviii, art. 15, 1931, 12.

In the paper cited above I redefined this genus, segregating four subgenera, and using new characters for its separation from *Elassogaster*. There are none of the previously described subgenera except the typical one in the New Guinea material before me, so I have used only the characters of it in my synoptic key to the genera herein.

In all the species of this subgenus and in the new one dealt with below, there are some fine hairs on the face visible with a magnification of 32 diameters.

I present below a key to the species in the present collection and include one other not represented in it.

Key to the Species.

1. Scutellum with many piliferous punctures on the entire dorsal surface besides the four marginal bristles 2
   Scutellum without piliferous punctures on dorsum, with only the four marginal bristles 3
2. Male with an apical palette on the arista; fourth (third visible) abdominal tergite about 1·5 times as long as fifth in male; ocellar triangle rather elongate and narrow, quite distinctly grey-dusted or tomentose; outer cross-vein of the wing very narrowly and faintly brown-clouded .... *aenea* Wiedemann
   Male without an apical palette on the arista; fourth abdominal tergite of male shorter than fifth; ocellar triangle wider and not distinctly grey-dusted in front of the ocelli; outer cross-vein not at all brown-clouded .... *enderleini* Hendel

3. Humeral bristle weak or lacking; legs black; outer cross-vein of the wing not noticeably brown-clouded .... *parva* Malloch
Humeral bristle long and strong; legs largely orange-yellow; outer cross-vein of the wing broadly clouded with dark brown .... *orbitalis*, n. sp.

PLAGIOSTENOPTERINA (PLAGIOSTENOPTERINA) AENEA Wiedemann.

Pl. iv, fig. 13.

Zool. Mag., i (3), 1819, 29 (*Dacus*).

A common species of quite wide distribution, occurring throughout the Malayan region and southward to New Guinea and Australia.

The female is difficult to distinguish from that of *enderleini*, but the male is readily separated by the apical aristal palette.

A series of specimens from Wewak, New Guinea (F. H. Taylor), Keravat, Rabaul, New Britain (F. H. Taylor), and another from Dutch New Guinea: Cyclops Mts., Sabron, 900 feet, May 1936 (L. E. Cheesman).

PLAGIOSTENOPTERINA (PLAGIOSTENOPTERINA) ENDERLEINI Hendel.

Pl. iv, fig. 14.

Abhandl. Zool.-botan. Ges., viii, 1914, 56.—*Stenopterina aenea* Enderlein, *Zool. Jahrb.*, 1912, 356.

Apparently not as common as the genotype. Occurs in the Malayan region. There are 2 specimens from Bulolo, 2 from Bulowat (F. H. Taylor), and one specimen from Marprik (J. R. Rigby and C. M. Deland), New Guinea, and 3 from Papua: Kokoda, 1,200 feet, April and August 1933 (L. E. Cheesman), in this collection.

PLAGIOSTENOPTERINA (PLAGIOSTENOPTERINA) PARVA Malloch.

Proc. U.S. Nat. Mus., lxxviii, art. 15, 1931, 15.

I have seen only the type specimen, from north-east New Guinea (Kaiser Wilhelmsland), which is in the collection of the Deutsches Entomologisches Institut, Berlin-Dahlem.

PLAGIOSTENOPTERINA (STENOPTEROSOMA) ORBITALIS, n. sp. Pl. iv, fig. 15.

This new subgenus is distinguished from its allies by the presence of two pairs of very small fine upper orbital bristles on the frons, a fine short pair of divergent ocellars, and the lack of any hairs on the lower part of the sides of the postnotum.

♂, ♀. Head black, lower portion of face laterally yellowish-brown, frons shiny, glossy on ocellar region, vertex and upper orbits, with a narrow silvery-white-dusted line on each side to orbits; face white-dusted on upper half, and in the foveae, the parafacials also white-dusted; antennae fulvous-yellow, third segment dark on upper edge; aristae fuscous. Frons parallel-sided, fully 1·5 times as long as wide and a little more than one-third of the head-width, slightly bulged up in centre in front, and with many short pale fine surface hairs; all four vertical bristles long and strong; postvertical bristles lacking; postocular bristle moderately long. Face concave in profile, the epistome slightly projecting, gena about one-seventh as high as the eye, genal bristle strong. Facial foveae deep, edges of the central carina rounded. Antennae not extending fully to lower level of eyes, third segment four times as wide as long, the upper apex slightly angulate, lower one rounded; aristae short-haired on less than the basal half, that of male without an apical palette; palpi moderately wide.

Thorax shiny black, with a bluish or bronzy tinge, most noticeable on mesonotum, with grey or yellowish dust, palest on lateral edges of mesonotum and on pleura, that on the former forming a wide central vitta, narrowed in front where it is also palest, pleura most densely dusted below anterior spiracle, on a wide central fascia, and on the pleurotergite. Hairs dark, bristles black. Bristles as follows: 1 humeral, 2 notopleurals, 2 postalars, one supra-alar, and a weaker pair of dorsocentrals; mesopleural bristle strong. Scutellum as mesonotum, slightly granulose, with four strong marginal bristles and no hairs except one in front of each of the anterior bristles. Legs black, fore femora almost entirely, and mid and hind femora except their apical third or less, fulvous-yellow. Fore femur with a series of posteroventral bristles, mid tibia with a long apical ventral bristle, hind tibia with a series of short setulae on the central portion of the anteroventral surface.

Wings greyish-hyaline, brown on costal margin from apex of the subcostal vein to apex of fourth or slightly beyond it, darkest in the subcostal cell and widest at apex, the costal cell and a stripe along the hind margin of the apical half of the dark border yellow; a brown streak fills the entire anterior basal cell, extends along the fourth vein to outer cross-vein and expands broadly but less intensely backward to enclose the outer cross-vein. Inner cross-vein a little beyond middle of discal cell, veins 3 and 4 slightly convergent at apices. Halteres yellow. Abdomen coloured as thorax but more distinctly blue and without dusting, the sides at apex of the composite tergite yellowish. Length: 5–6 mm.

Type, male, allotype, and 5 paratypes, Papua: Kokoda, 1,200 feet, April, May and Sept.-Oct. 1933 (L. E. Cheesman).

ELASSOGASTER Bigot.

Ann. Soc. Ent. France, 1859, 546.

Very similar to *Plagiostenopterina*, differing in the lack of hairs on the face, the more nearly erect inner cross-vein of the wing, and the almost straight apical section of third wing-vein.

Of the 18 known species, only 3 are reliably reported from New Guinea.

Key to the New Guinea Species.

1. Wing without dark cloud on either or both cross-veins 2
   Wing with a dark cloud on either or both cross-veins 3
2. No white-dusted vitta on the mesonotum; scutellum convex, with rounded outline and four strong bristles, the disc with numerous decumbent fine hairs .... *evitta*, n. sp.
   A white-dusted vitta on centre of the mesonotum; scutellum slightly flattened, not regularly rounded in outline, with a pair of short hairs near base, a moderate-sized pair of bristles at middle of sides, and a long pair at apex, the surface otherwise bare 4
3. Wing with a narrow dark costal streak at apex beyond the tip of second vein that is diffuse posteriorly; legs honey-yellow, the fore tibiae and tarsi deep black .... *terraereginae* Malloch
   Wing with a large black spot at apex extending back from a little beyond the apex of the second vein to the fourth vein and filling apices of submarginal and first posterior cells; legs largely black, rather variable, but the fore tibiae and tarsi and the mid and hind femora and tibiae always black ...... *sepsoides* (Walker)
4. Both the cross-veins of the wing with very large round brown spots; posterior basal cell only one-third as long as the discal cell .... *didymus* Osten-Sacken
   Both the cross-veins of the wing merely broadly brown-clouded; posterior basal cell of the wing half as long as the discal cell .... *didymoides* Osten-Sacken

ELASSOGASTER SEPSOIDES (Walker).

Jour. Proc. Linn. Soc. Lond., vol. 5, 1861, 163 (*Dacus*).—*Cephalia bicolor* Bigot, *Ann. Soc. Ent. France*, 1886, 385.—**Stenopterina unimaculata* Kertész, *Term. Füz.*, xxii, 1899, 185.

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* Cited as *S. immaculatus* by Hendel, *Abhandl. Zool.-botan. Ges.*, viii, 1914, 82.

A common species throughout the Malayan region, extending southward to Australia. Wewak and Bulwa, New Guinea (F. H. Taylor); Rabaul, New Britain (F. H. Taylor).

ELASSOGASTER EVITTA, n. sp. Pl. iv, fig. 16.

♂, ♀. A metallic blue-black species, with slight dusting on the sides, but no central white-dusted vitta on the mesonotum.

Head black, jowls behind and the vibrissal angles brownish-yellow, face brown, lateral edges of frons with a silvery-white-dusted line, the frons shiny. Antennae reddish-yellow, palpi brown. Frons almost parallel-sided, about 1·5 times as long as wide and one-third as wide as head, short-haired, all four vertical bristles long and strong, each orbit with a microscopic pair of upper setulae and a pair of similar ocellars present. Aristae subnude, third antennal segment about 3·5 times as long as its basal width, narrowly rounded at apex. Face concave in profile, the foveae deep.

Thorax with the dorsum closely and finely piliferous punctate, the pile and bristles black. Bristles as follows: 1 humeral, 2 notopleurals, 1 supra-alar, 2 postalars, and a pair of strong dorsocentrals, the mesopleural strong. Scutellum convex and evenly rounded in outline, the disc with many decumbent black hairs, the surface not as noticeably punctate as the mesonotum; four strong marginal bristles. Legs brownish-black, tibiae and fore tarsi darker, bases of fore and hind femora, and bases of mid and hind tarsi reddish-yellow. Fore femora with posteroventral series of bristles; mid tibia with one strong apical ventral spur. Wings greyish-hyaline, stigma blackish-brown, and a diffuse brown mark at apex beyond tip of second vein and extending to tip of fourth, darkest over the apex of the third vein. Stigma as long as the next two costal sections combined, the latter subequal in length; inner cross-vein close to middle of the discal cell and almost erect; apex of second vein rounded forward to the costal vein, that of third vein slightly downwardly sloped. Halteres yellow.

Abdomen elongate, almost parallel-sided in the male and in that sex noticeably compressed, the abdomen of female more ovate. Fifth tergite of male as long as or longer than third and fourth combined. Length, 5–6 mm.

Type, male, and allotype, Makada Is., off New Britain (F. H. Taylor).

ELASSOGASTER TERRAEREGINAE Malloch.

PROC. LINN. SOC. N.S.W., liii, 1928, 352.

This Australian species may yet be found in New Guinea.

ELASSOGASTER DIDYMUS (Osten-Sacken).

Stenopterina didyma Osten-Sacken, *Ann. Mus. Civ. Stor. Nat. Genov.*, xvi, 1881, 465; Hendel, *Abhandl. Zool.-botan. Ges.*, viii, 1914, 75.

I am free to confess that I am slightly doubtful about the status of this and the next species, though this may be due to my not having specimens of the latter. The specimens before me do not exactly agree with Osten-Sacken's description and figure in that the femora are almost entirely greenish-black, only the extreme apices being reddish, and the second wing-vein does not bend as abruptly forward at its tip. The posterior basal cell of the wing is however a little more than one-third as long as the discal cell and not half as long as it is called for by Hendel's description of his species. I accept the specimens before me as *didymus*.

Originally described from New Guinea. Papua: 1 specimen, Mafulu, 4,000 feet, January 1934; 4 specimens, Mondo, 5,000 feet, February 1934 (L. E. Cheesman); 1 specimen, New Guinea: Marprik (J. R. Rigby and C. M. Deland).

Elassogaster didymoides Hendel.

Op. cit., viii, 1914, 76.

Originally described from Madang (Frederich-Wilhelmshafen), New Guinea, and not known to me nor since recorded. See remarks above.

Scotinosoma Loew.

Mon. N. Amer. Dipt., iii, 1873, 45.

This genus is very closely related to *Pseudepicausta* Hendel and I have had to redefine it on the basis of the characters of the genotype. I find that in the two Australian species I previously described as belonging to *Pseudepicausta* and in the genotype there are two pairs of fronto-orbital bristles present, which is not the case in that genus, or at least in the genotype, and in the latter the mid tibia has three almost equally long and strong apical spurs, while in *Scotinosoma* there are but one long and two very short apical spurs. None of the species here included have conspicuous dark markings on the wing except along the costa. There are usually a number of short serially arranged setulae on the central portion of the anteroventral surface of the hind tibia.

Key to the Species.

1. No distinct dark costal streak on the wing, the marginal cell (stigma) yellowish, and the costal vein beyond it to apex dark brown, the brown colour not extending on to membrane except faintly from apex of second to beyond apex of third vein; the cross-veins at base of discal cell and the inner cross-vein rather distinctly dark-clouded, the outer cross-vein very faintly so; no apical palette on arista of male; posterior notopleural bristle not duplicated, short in female .... *erasa*, n. sp.
   A dark brown costal streak from base to apex of the wing that extends on to membrane on at least a part of its extent; other characters not as above *in toto* 2
2. Scutellum with 4 strong bristles; costal margin of wing uniformly black-brown from base to apex, the dark colour not extending over the second vein except at its tip; posterior notopleural bristle duplicated .... *completa* (Malloch)
   Scutellum with 6 well-developed bristles, the apical pair the longest; costa with a brown streak from base to apex, darkest in the stigma and apically, yellowish along the inner edge of the second vein and in the costal cell 3
3. The brown costal streak not extending over the second vein except at its apex; posterior notopleural bristle duplicated .... *attenuata* (Malloch)
   The brown costal streak extending spot-like over the second vein a little before its apex; posterior notopleural bristle not duplicated; male with an apical palette on the arista .... *bistrigata* Hendel

Scotinosoma bistrigata Hendel.

Abhandl. Zool.-botan. Ges., viii, 1914, 120.

Described from both sexes taken at Cape York, Queensland. I have 2 males from Northern Queensland. It ought to occur in New Guinea.

Scotinosoma completa (Malloch).

Proc. U.S. Nat. Mus., lxxviii, art. 15, 1931, 27 (*Pseudepicausta*).

Cairns, Queensland. Ought to occur in New Guinea.

Scotinosoma attenuata (Malloch).

Op. cit., lxxviii, art. 15, 1931, 27 (*Pseudepicausta*).

Same locality as above.

Scotinosoma erasa, n. sp.

♂, ♀. Head brownish-yellow, frons brown, ocellar triangle, upper orbits, and upper occiput, shiny brownish-black, frontal, facial, and postocular orbits white-dusted. Frontal hairs yellow, the bristles black. All four vertical bristles strong, the orbitals rather weak, and the divergent ocellars distinct though not very long. Aristae bare, without apical palette in male, third antennal segment in that sex much wider than in female and about four times as wide as the almost linear parafacial. Postocular bristle indistinguishable from the setulose hairs.

Thorax shiny black, with distinct blue tinge, the mesonotum with dense white dust on a broad central vitta and a similar vitta on each side, the intervening glossy stripes much widened in front of the suture; pleura with a white-dusted vitta from base of fore coxa to base of haltere; scutellum but slightly dusted. Hairs mostly yellow, the bristles black. Legs brownish-black, fore coxae, fore femora, all trochanters, and apices of mid and hind femora, tawny-yellow. Posteroventral bristles on fore femora rather long and fine; hind femora with several bristles near apices on the anterodorsal surface. Wings yellowish-hyaline, veins pale brown, darkest apically, the markings as described in the foregoing key to the species. Inner cross-vein long, sloped outward at lower extremity, the latter at two-fifths from the apex of discal cell; first posterior cell not widened at apex. Abdomen metallic-blue, with a brownish patch on each side near base in the male. Squamae and halteres yellow. Length, 6–7 mm.

Type, male, and allotype, Stradbroke Is., Queensland. May occur in New Guinea.

Pseudepicausta Hendel.

Abhandl. Zool.-botan. Ges., viii, 1914, 112.

The genotype, *chalybea* Doleschall, has no fronto-orbital bristles and the mid tibia with three equally strong apical spurs. Whether the other four species included below have these characters in common I do not know.

Key to the Species.

1. The entire wing beyond the outer cross-vein black-brown, with an oblique curved white fascia before the apex; fore femur of male with a series of lanceolate posteroventral bristles .... *lagarosia* Hendel
   Wing not marked as above; fore femur of male without lanceolate bristles 2
2. Vertex with only the outer divergent pair of bristles; both cross-veins of the wing dark clouded .... *chalybea* (Doleschall)
   Vertex with 4 strong bristles, the inner pair incurved 3
3. Species brown in colour, with grey dust; both cross-veins brown clouded, the marks separated .... *multilloides* (Walker)
   Species more or less metallic, generally blue or greenish-blue in colour 4
4. Inner cross-vein not clouded, outer one only faintly so .... *apicalis*, n. sp.
   Both cross-veins dark clouded, the marks connected in discal cell 5
5. The broad brown zigzag cross-band on the wing extends to the costa .... *angulata* Hendel
   The zigzag cross-band is interrupted above the inner cross-vein ... *wallacei* Hendel

Pseudepicausta chalybea (Doleschall).

Natuurk. Tijdschr. v. Ned.-Ind., xvii, 1858, 125 (*Herina*).

Apparently a widely distributed species, recorded from New Guinea northward to the Philippine Islands. I have seen it from Aitape and Wewak (F. H. Taylor), Aitape, New Guinea (L. E. Cheesman), Makada Is., near New Britain (F. H. Taylor).

Pseudepicausta lagarosia Hendel.

Abhandl. Zool.-botan. Ges., viii, 1914, 118.—? *Dacus pompiloides* Walker, *Jour. Proc. Linn. Soc. Lond.*, iii, 1859, 116.

Described from a male from New Guinea. Hendel suggested the above synonymy. The Walker species is from the Aru Islands.

Pseudepicausta multilloides (Walker).

Jour. Proc. Linn. Soc. Lond., iii, 1859, 115 (*Dacus*).

New Guinea. Not recorded since its original description.

Pseudepicausta angulata Hendel.

Abhandl. Zool.-botan. Ges., viii, 1914, 118.

Celebes. I have seen this species from the Federated Malay States; it may be expected to occur in New Guinea.

Pseudepicausta wallacei Hendel.

Op. cit., viii, 1914, 117.

Described from a female from New Guinea.

The scutellum in this species has fine hairs in addition to the strong marginal bristles.

Pseudepicausta apicalis, n. sp. Pl. iv, fig. 17.

♀. Similar in general colour to *chalybea*, but the mesonotum is largely brown-dusted, which feature is best seen from the side, the disc of the scutellum is also brownish-dusted. The mesonotal hairs are dark brown. The wing (Pl. iv, fig. 17) has the stigma dark brown, with a yellowish suffusion in the marginal cell, there is a rather faint fuscous cloud on the outer cross-vein, and the apex of the wing is fuscous from a little beyond the outer cross-vein to the tip. Legs blackish-brown, fore femora and coxae and apical third or more of mid femora brownish-yellow, mid metatarsus and most of hind one orange-yellow. Squamae dark brown, knobs of halteres pale yellow. Vertex with 6 bristles, one small orbital present, scutellum with 4 bristles. Other bristling as in *chalybea*. Length, 8 mm.

Type, Papua: Mafulu, 4,000 feet, Jan. 1934 (L. E. Cheesman).

The antennae are broken off in the type.

Pogonortalis Hendel.

Hendel, in de Meijere, *Tijdschr. v. Ent.*, liv, 1911, 370; *Abhandl. Zool.-botan. Ges.*, viii, 1914, 143.

This genus was first described in a footnote to a paper by de Meijere as above listed and subsequently in the second paper referred to above as a new genus. As there is no question that Hendel supplied the data published by de Meijere, the genus is credited to Hendel.

In the two species that I have seen there are a few setulae on the base of the second vein on its underside, and there is a sharp raised edge on the anteroventral margin of the hind femur about one-third from its apex in both sexes. Sometimes there is a marked expansion of the jowls in the male and the bristles of the beard are much shorter than in *doclea*, the genotype. The frons has two pairs of short orbital bristles, the ocellars are minute, and the postocular bristle is of moderate length.

Key to the Species.

1. Costal margin without a black or dark brown mark at apex of the stigma; body bronzy or brassy-green .... *similis* Hendel
   Costal margin with a conspicuous black or dark brown mark at the apex of the stigma that extends backward to or beyond the third vein; body blackish-brown 2
2. The black-brown apical spot on the wing does not extend basally to the apex of the second vein .... *doclea* (Walker)
   The black-brown apical spot on the wing extends basally to the apex of second vein (Netherland Indies) .... *uncinata* de Meijere

Pogonortalis doclea (Walker).

List Dipt. Ins. Brit. Mus., pt. iv, 1849, 1035 (*Trypeta*).—*Pogonortalis barbifera* Hendel, *Abhandl. Zool.-botan. Ges.*, viii, 1914, 144.

An Australian species that very probably will be found in New Guinea. Walker's description unmistakably applies to Hendel's genotype.

Pogonortalis similis Hendel.

Op. cit., viii, 1914, 145.

Described from New Guinea.

Rivellia Robineau-Desvoidy.

Mém. Acad. Roy. Sci. Inst. de France, ii, Essai Myod., 1830, 729.

A large genus of almost cosmopolitan distribution, keys to the species of which from the different faunal regions have been published by Hendel in his paper on the subfamily. I present below a key to the recorded species from New Guinea with the description of one new species.

Key to the Species.

1. Wing with only the subcostal cell and a spot at the apex dark brown .... *connata* Thomson
   Wing with several dark fasciae 2
2. The oblique dark fasciae over the cross-veins more or less distinctly connected at or near the hind margin of the wing; aristae usually distinctly pubescent or short-haired 6
   The oblique dark fasciae over the cross-veins of the wing not connected behind, the one over the inner cross-vein ending at the fifth vein; aristae bare, or pubescent (*fusca*); posterior basal cell of the wing hyaline 3
3. The black fascia over the inner cross-vein connected in part with the black basal mark .... *affinis* Hendel
   The black fascia over the inner cross-vein separated from the basal black mark by a hyaline stripe about as wide as the fascia 4
4. Costal cell of the wing hyaline except at its base; the short black fascia over the fuscation of second and third veins and apex of the subcostal vein not fused with the dark cloud in the anterior basal cell .... *fusca* Thomson
   Costal cell of the wing brown or black; the short black fascia over the fork of second and third veins and apex of the subcostal vein fused with the black colour of the wing base 5
5. Thorax greenish-black; abdomen red at base or entirely so; legs brownish-black, bases of mid and hind tarsi yellow .... *rufibasis*, n. sp.
   Thorax, abdomen, and legs, red, tibiae and tarsi brownish ...... *ferruginea* Hendel
6. Posterior basal cell of the wing and a streak along the fifth vein in basal half of the discal cell hyaline; fusion of the fasciae over the cross-veins faint behind the fifth vein .... *dimidiata* de Meijere
   Posterior basal cell of the wing and basal half of the discal cell black-brown; fusion of the fasciae over the cross-veins at or behind fifth vein very distinct, dark brown 7
7. The dark marks on the wing not extending to the anal vein on the basal half; the fusion of the fasciae over inner and outer cross-veins broad, unbroken behind the fifth vein, but not attaining the hind margin of the wing except directly below the outer cross-vein; mesonotum more or less reddish in front; head, including the antennae and palpi, fulvous-yellow or red .... *connexa* Hendel
   The dark marks on the wing extending to the anal vein on almost its entire extent; the fusion of the fasciae over inner and outer cross-veins evident at only the hind margin of the wing; mesonotum blue-black; head, including the antennae and palpi, black, the latter slightly whitened at apices .... *radiata* Hendel

Rivellia connata (Thomson).

Eug. Resa, Zool. 1, 1868, 575 (*Hernia*).

This species is common in Australia and has been recorded from Fiji, so that it may yet be found in New Guinea.

RIVELLIA FERRUGINEA Hendel.

Abhandl. Zool.-botan. Ges., viii, 1914, 159.

The entire insect is usually reddish-yellow in colour, with the dorsum of the thorax sometimes slightly darkened and the tibiae and tarsi brownish.

Described from New Guinea, but not in the present collection.

RIVELLIA RUFIBASIS, n. sp. Pl. iv, fig. 18.

♂, ♀. Differs from *ferruginea* in having the thorax except the prothoracic region greenish-black, the mesonotum with grey dust, the abdomen infuscated apically in the male, brownish-red in the female, the legs except the bases of the mid and hind tarsi brownish-black, and the wing markings darker and broader, the brown streak along the apex of the costa in particular being much wider. The third antennal segment is not angulate at the apex above, and the arista is bare. Length, 5 mm.

Type, male, allotype and 2 paratypes, Wewak, New Guinea (F. H. Taylor); one paratype, Aitape, New Guinea, Oct.-Nov. 1936 (L. E. Cheesman).

RIVELLIA FUSCA (Thomson).

Eug. Resa, Zool. 1, 1868, 575 (*Hernia*); Osten-Sacken, *Berl. Ent. Zeitschr.*, xxvi, 1882, 211.

A small blue-black or greenish-black species, with the black fasciae on the wing very slender.

Recorded from Java, the Philippines, Formosa, and the Solomon Islands. New Guinea: Aitape, Oct.-Nov. 1936 (L. E. Cheesman).

RIVELLIA AFFINIS Hendel.

Abhandl. Zool.-botan. Ges., viii, 1914, 161.

Described from New Guinea and not in this collection.

RIVELLIA DIMIDIATA de Meijere. Pl. iv, fig. 19.

Tijdschr. v. Ent., li, 1908, 122.

This species was described without locality record by de Meijere, Hendel listing it as probably from Java, but de Meijere subsequently gave the type locality as New Guinea.

Three specimens, Dutch New Guinea: Lake Sentani Iffar, August 1936 (L. E. Cheesman).

RIVELLIA CONNEXA Hendel.

Abhandl. Zool.-botan. Ges., viii, 1914, 163.

A smaller and more intensely black marked species.

Originally described from Astrolabe Bay, New Guinea, from females only. I have before me 3 specimens from Wewak, New Guinea, and 5 from Kavieng, New Ireland, one pair of the latter taken *in copula* (F. H. Taylor), Makada Is., near New Britain (F. H. Taylor); Papua: Mediri (Fly River), one specimen 12.xii.22 (A. R. McCulloch).

RIVELLIA RADIATA Hendel.

Op. cit., viii, 1914, 161.

Described from New Guinea. One specimen, Wewak, New Guinea (F. H. Taylor).

ASYNTONA Osten-Sacken.

Bull. Ent. Soc. France, 1881, 135.

A peculiar genus, readily distinguished by the wide head, especially in the male, and the downwardly-flexed wings that generally adhere quite closely to the body and appear wrinkled or broken. This flexure is caused by a diagonal weak line at or near the middle of the wing with corresponding weak parts of the veins extending apically, and a crease extending from near the base to apex along the centre of the wing. The posterior basal cell of the wing is much longer than the discal cell, and the fourth vein ends in the wing tip. The third vein is not raised above the level of the membrane on the upper side and usually the setulae there are very sparse or even lacking. A striking feature of both sexes before me is the presence of 6 evenly-spaced bristles along the edge of the vertex in the genotype. But in one specimen of *flaviceps* the second bristle from each eye is placed well forward of the others, indicating that it is really the upper fronto-orbital and not an extra vertical bristle. There is also frequently a very weak additional orbital on each side rather high on the frons.

Asyntona tetyroides (Walker). Pl. iv, fig. 20.

Jour. Proc. Linn. Soc. Lond., iii, 1859, 112 (*Lamprogaster*).—*Asyntona doleschalli* Osten-Sacken, *Berl. Ent. Zeitschr.*, xxvi, 1882, 224.

A deep metallic-blue coloured species, with dark wings marked with a few small sub-hyaline dots, the head with a yellow postocellar streak and the tarsi except the apical two segments yellow. Eyes in male produced into a point on outer side, rounded in female. Frons wider than long, narrowed in front; lateral edges of frons, especially in the male, beaded.

Wewak, New Guinea. Recorded from New Guinea, and the Philippine Islands. Both sexes are represented in Mr. Taylor's material, attracted to light.

Asyntona flaviceps Hendel.

Abhandl. Zool.-botan. Ges., viii, 1914, 291.

Similar to the genotype, distinguished from it by the entirely yellow head, tibiae, and tarsi. The frons in both sexes is longer than wide, parallel-sided, and not beaded on lateral edges in either sex. Eyes in both sexes rounded.

Wewak, New Guinea, both sexes (F. H. Taylor) attracted to light; Solomon Islands. Described from one female, Cretin Is., New Guinea.

Naupoda Osten-Sacken.

Bull. Soc. Ent. France, 1881, 135.

Quite similar to *Asyntona*, distinguished by the wing venation as stated in the generic key given above. The genotype has no orbital bristles, but most of the other species have at least one distinct pair. Hendel did not see the genotype, and merely copied Osten-Sacken's original description.

Naupoda regina Hendel.

Abhandl. Zool.-botan. Ges., viii, 1914, 298.

This species was described from New Guinea and North Queensland. I have it from Cairns, Queensland, and a large series from Wewak, New Guinea (F. H. Taylor).

A Fijian species, *simmondsi* Bezzi, may yet be found in New Guinea. It differs from other species of the genus in having the aristae long-haired, and from *regina* in having the wing black from the base to the middle, the apical half or less and the hind margin hyaline.

None of the other species of the genus are likely to occur in New Guinea.

ZYGAENULA Doleschall.

Natuurk. Tijdschr. Ned.-Ind., xvii, 1858, 117.

The genotype, *paradoxa* Doleschall, is unknown to me and is not known to occur in New Guinea. Hendel in his "Revision of the Platystominae", p. 292, gives only Gerstaeker's description, which does not include details of the structure or armature of the mid femur. It is thus impossible to determine the validity of *Mesoctenia*, though its author, Enderlein, had apparently both sexes of *paradoxa* from Amboina before him when he erected his new genus.

MESOCTENIA Enderlein.

Mitt. Zool. Mus. Berl., xi, 1924, 130.

This genus was erected for the reception of a species, *ralumensis*, assumed to be new to science, but which I consider is without doubt a synonym of *Zygaenula coalescens* Hendel. I distinguish the genus from *Brea* Walker, in the foregoing generic key. It is hard to understand why Hendel did not couple his *coalescens* with the species of *Brea* in his generic key as the mid femoral characters are similar in both. *Mesoctenia* may be a synonym of *Zygaenula*; the genotype of the latter is unknown to me.

Key to the Species.

1. Legs yellow, femora black; mesopleura with a bright yellow upper margin .... *hilaris* (Hendel)
   Legs entirely yellow; mesopleura black 2
2. Wing with three pale slender dark fasciae beyond middle ...... *coalescens* (Hendel)
   Wing with four dark fasciae .... *celyphoides* (Walker)

MESOCTENIA COALESCENS (Hendel).

Abhandl. Zool.-botan. Ges., viii, 1914, 293 (*Zygaenula*).—*Mesoctenia ralumensis*, Enderlein, *Mitt. Zool. Mus. Berl.*, xi, 1924, 131.

Described from two males from New Britain, redescribed from the same locality by Enderlein, and represented by a male now before me from apparently the same lot.

Besides the three slender dark fasciae, the wing is pale brownish basally as far out as the apex of the posterior basal cell.

MESOCTENIA HILARIS (Hendel).

Abhandl. Zool.-botan. Ges., viii, 1914, 294 (*Zygaenula*).

Described from a female specimen taken at Maroka, New Guinea. I have before me a fine female specimen which shows the same wing markings as *coalescens* and in addition a small dark spot at the apex of the fourth vein.

Papua: Kokoda, 1,200 feet, August 1933 (L. E. Cheesman).

MESOCTENIA CELYPHOIDES (Walker).

Jour. Proc. Linn. Soc. Lond., iii, 1859, 112 (*Lamprogaster*).

Known from the original description. Generic position in question.

BREA Walker.

Jour. Proc. Linn. Soc. Lond., iii, 1859, 117.

This genus is readily distinguished from its nearest relatives by the very much stouter mid than hind femur with its two series of stout spines on the ventral surface, the curved mid tibia which fits between the two series of femoral spines, and the short hairs on the upper surface of the aristae, the hairs being present only at base below.

Hendel gave a key to six species in his paper on the subfamily, all except one being known to him and described from New Guinea. In 1924 Enderlein described two additional species, one from New Guinea. Only two of the species are known to me, but I present below an adaptation of Hendel's key to aid in the identification of the species.

Key to the Species.

1. The large black mark over the inner cross-vein of the wing enclosing a hyaline spot in the marginal cell 2
   The large black mark over the inner cross-vein without a hyaline spot in the marginal cell 3
2. Legs yellow, only the fore femora at apices and the fore tibiae at bases blackened; mesonotum black, with a broad grey central vitta .... *discalis* Walker
   Legs yellow, all the tibiae black, femoral bases brown; mesonotum dull olive-green, with two broad coffee-brown vittae .... *discifera* Hendel
3. The dark fascia over the outer cross-vein is much broader than the hyaline strip separating it from the fascia over the inner cross-vein, being about equal in width to the length of the outer cross-vein, and connected with the anterior fascia in the discal cell; mid and hind femora yellow .... *flavipes* de Meijere
   Only a slender dark fascia over the outer cross-vein that is not connected with the broad mark over the inner cross-vein 4
4. Head largely, and fore femora entirely, black; male without an apical palette on the arista .... *nouhuysi* de Meijere
   Head and all, or almost all, of the fore femora orange-yellow; male with an apical lanceolate palette on the arista 5
5. Mid and hind femora and all tibiae black; the black mark over the inner cross-vein not filling all of basal half of the discal cell, nor extending over the fifth vein; humeri white-dusted on upper edges .... *contraria* Walker
   Mid femora more or less blackened, more extensively so in the female, hind femora entirely orange-yellow, bases of all tibiae blackened; the black mark over the inner cross-vein filling the entire basal half of the discal cell and extending well over the fifth vein .... *magnifica* Hendel

BREA DISCALIS Walker.

Jour. Proc. Linn. Soc. Lond., iii, 1859, 117.

Described from Aru Islands and not subsequently reported.

BREA DISCIFERA Hendel.

Abhandl. Zool.-botan. Ges., viii, 1914, 270.

Described from Key Island from a single female.

Most nearly like *magnifica*, differing as noted in the key to species.

BREA FLAVIPES de Meijere.

Nov. Guin., ix, Zool., livr. 3, 1913, 371; Hendel, *Abhandl. Zool.-botan. Ges.*, viii, 1914, 272.

Described from one female from Biwak Island, New Guinea.

Similar to *magnifica* in most respects, differing as noted in the key and in having the tibiae dark brown except their apices and the apical half of the fore femora also dark brown.

Hendel suggests the possibility that this is *discalis*, though Walker says that there is a 'blackish line' over the outer cross-vein, which would hardly equal the broad black fascia present in *flavipes*.

BREA CONTRARIA Walker. Pl. iv, fig. 21.

Jour. Proc. Linn. Soc. Lond., iii, 1859, 117.—*Maria caeruleiventris* Bigot, *Rev. et Mag. de Zool.*, 1859, 311.

This species was originally described from New Guinea and recorded from Aru Is. It has the legs more extensively black than any of the other species and is readily distinguished from any of them by the wing markings. Halteres black-brown.

A large series of both sexes, Wewak, New Guinea (F. H. Taylor).

BREA MAGNIFICA Hendel. Pl. v, fig. 22.

Abhandl. Zool.-botan. Ges., viii, 1914, 271.

Originally described from a single male taken in New Guinea.

Hendel states in his key that the "four hind legs" are entirely yellow, but in his description he gives the bases of all tibiae as black-brown. The latter statement is correct for most specimens of the male sex, but the apices of the mid femora are in all females more or less distinctly blackened, and in a few specimens the greater part of the mid femora is black. The different wing markings are sufficient to distinguish it from any other species of the genus. The costal edge between the apices of the third and fourth veins is narrowly browned, which is not the case in *contraria*.

A large series of both sexes, Wewak, New Guinea (F. H. Taylor).

BREA RALUMENSIS Enderlein.

Mitt. Zool. Mus. Berl., xi, 1924, 129.

This species was described from a single female from Ralum, New Britain. It was merely distinguished from *contraria* by a few characters, of which the following appear to be the most important: Mesonotum with three slender vittae of yellowish-brown tomentum (white in *contraria*), fore coxae and fore femora brown (yellow in *contraria*); of the brown basal fascia there is only a small spot on the fork of the radius.

It may be a variety of *contraria*, but I have seen no specimen that appears to agree with it from New Guinea.

BREA BASILIS Enderlein.

Op. cit., xi, 1924, 129.

This species apparently falls with *discalis* and *discifera* in the foregoing key. It differs from both in having the mesonotum black, with thick yellowish-grey tomentum; there is no mention of vittae in the description. The legs are ochre-yellow, mid and hind tibiae brown, and the fore tibiae somewhat brownish. Length, 7·5 mm.

North-east New Guinea.

I have seen no species that agrees with this one.

PTEROGENIA Bigot.

Rev. et Magas. de Zool., (2) xi, 1859, 312.

Species of this genus have been recorded from the Straits Settlements, Sarawak, Borneo, Batchian, Molucca, Aru, Java, Formosa, Ceylon, the Philippine Islands, New Guinea, and Australia. Hendel keyed 14 species and included 13 additional species described by Walker that he tentatively assigned to the genus in his large paper on the Platystominae. The New Guinea and Australian species may be distinguished as in the key given below.

A striking character of the species before me is the presence of short stiff hairs on the upper side of the stem vein of the wing at its base as in *Euprosopia*.

Key to the Species of New Guinea and Australia.

1. Scutellum black, with the margin pale yellow 2
   Scutellum entirely black or dark brown 3

2. The preapical dark fascia on the wing meeting the dark cloud over the outer cross-vein; the small hyaline costal spot through stigma extending to third vein; palpi brown at apices .... *pectoralis* Hendel
   Preapical dark fascia on the wing not meeting the dark cloud over the outer cross-vein; the small hyaline costal spot through stigma not extending over second vein; palpi entirely yellow .... *similis*, n. sp.
3. Thorax entirely shiny black; aristae with very long hairs; palpi blackish-brown .... *fuliginosa* Hendel
   Thorax partly red or yellow; aristae moderately long-haired; palpi red, apices darkened 4
4. Frons and mesonotum black-haired; face and lower occiput blackish-brown .... *nubecula* Hendel
   Frons and mesonotum golden-haired; face and lower occiput red .. *latericia* Hendel

PTEROGENIA PECTORALIS Hendel.

Abhandl. Zool.-botan. Ges., viii, 1914, 316.

Described from Bogadjim (Stephansort), New Guinea. I have seen one specimen from North-east New Guinea (Kaiser Wilhelmsland), and one, Papua: Kokoda, 1,200 feet, August 1933 (L. E. Cheesman).

PTEROGENIA SIMILIS, n. sp.

♂, ♀. Similar to *pectoralis*, but the wing pattern is different, the frons narrower, the legs preponderantly yellow as in the variety of *pectoralis* described by Hendel (*Abhandl. Zool.-botan. Ges.*, viii, 1914, 316).

Type, male, Kuranda, Queensland (Dodd).

PTEROGENIA FULIGINOSA Hendel.

Abhandl. Zool.-botan. Ges., viii, 1914, 309.

This New Guinea species is not known to me except from the description.

Described from Maroka, New Guinea.

PTEROGENIA NUBECULA Hendel.

Op. cit., viii, 1914, 314.

Described from Burpengary, Queensland, and New South Wales.

I have two specimens from Kuranda, Queensland, sent to me by Mr. F. H. Taylor. It may occur in New Guinea.

PTEROGENIA LATERICIA Hendel.

Op. cit., viii, 1914, 312.

This form was considered doubtfully distinct from *nubecula* by its describer. I have seen no specimen that has golden hairs on the mesonotum, but occasionally in this and related genera teneral specimens have the hairs yellowish instead of black as in the mature individuals of the same species.

Queensland.

NEOHEMIGASTER, n. n.

Hemigaster Rondani (*nec* Brullé), *Ann. Mus. Civ. Stor. Nat. Gen.*, vii, 1875, 431.

This genus is distinguished from *Pterogenia* by the following characters: Base of the stem-vein of the wing bare above, lateral angles of the clypeus more or less produced downward and with a small rounded elevation on the dorsum, vertex with four strong bristles, humeral bristle present. The humeral bristle is not always present in *Pterogenia*, and while the antepenultimate section of the fifth vein is either bare or setulose in that genus, in all species of *Neohemigaster* it is setulose. The apex of the second abdominal tergite and usually to a lesser extent the base of the third in all species of the latter is compressed in centre and furnished with a sharp keel-like elevation.

This last character is met with also in *Tropidogastrella* Hendel, but in the latter the third antennal segment is much longer, reaching to or beyond the epistome, and the structure of the face and prelabrum is different. Despite the removal of this genus so far from *Pterogenia* in Hendel's key to the genera, it is closely related to both the genera now under discussion.

I have proposed the new name *Neohemigaster* for Rondani's concept, with the same genotype.

NEOHEMIGASTER ALBOVITTATA Rondani.

Op. cit., vii, 1875, 431.

I identify as this species a male from Sandakan, Borneo, sent me some years ago by the late C. F. Baker.

Although no species known to me from New Guinea is referable to this genus, there may be such that are as yet unknown to me, and the acceptance of the genus contrary to Hendel's action, who placed the genotype in *Pterogenia*, appears to justify the inclusion of the above data in this paper.

I have seen two additional species of the genus from Sibuyan Island.

CHAETORIVELLIA de Meijere.

Nov. Guin., ix, Zool., livr. 3, 1913, 376.

A monobasic genus, distinguished from its allies by the single pair of strong orbital and vertical bristles, the very short antennae which are not half as long as the face and inserted at the middle of the eye in profile, the plumose aristae, lack of humeral, anterior notopleural, supra-alar, and prescutellar acrostichal bristles. Scutellum haired, with four marginal bristles.

CHAETORIVELLIA TRIFASCIATA (Doleschall).

Natuurk. Tijdschr. v. Nederl. Ind., xvii, 1858, 121 (*Ortalis*).—*Ortalis punctifascia* Walker, *Jour. Proc. Linn. Soc. Lond.*, vi, 1862, 15.

A small glossy blue-black species, with black head on which there is a silvery-white stripe round the eye-margins; antennae and palpi and lower half of face brown. Pleura with a silvery central vitta. Basal two segments of all tarsi orange-yellow. Wings whitish-hyaline, with three dark brown fasciae as follows: a short one from the humeral cross-vein to the anal cell, a broad complete one filling the area between the apices of the subcostal and first veins that encloses a small hyaline spot on the costa at the middle of the stigma, and a third one much narrower from the costa between the apices of first and second veins to fifth vein and enclosing the outer cross-vein which sends an equally wide streak along the costa to the apex of the fourth vein.

Recorded from New Guinea, Djilolo, Molucca, and Amboina (type locality). One female, Papua: Kokoda, 1,200 feet, August 1933 (L. E. Cheesman).

SCHOLASTES Loew.

Mon. N. Amer. Dipt., iii, 1873, 38; Hendel, *Abhandl. Zool.-botan. Ges.*, viii, 1914, 248; Curran, *Proc. Cal. Acad. Sci.*, xxii, ser. 4, no. 1, 1936, 23.

The robust habitus, haired aristae, strong orbital and sternopleural bristles, the subtriangular, quite densely short-haired scutellum with its six marginal bristles, and the almost invariable yellow sublateral lines on the mesonotum and marginal yellow line on the scutellum readily distinguish this genus from others in the family.

Hendel recognized 6 species, and in 1936 Curran described 3 additional species. I give below a key to those species known to me, and notes on some others under those that they are apparently most closely related to.

Key to the Species.

1. Supra-alar bristle lacking; mesonotum with almost invariably four pairs of dorsocentral bristles, the anterior one at or slightly in front of the suture; arista of male with, that of female without, an apical palette; first wing-vein setulose on a part of its basal half below .... *cinctus* Guérin
   Supra-alar bristle present; mesonotum with 3 or 2 pairs of short dorsocentrals, all postsutural 2
2. The prescutellar pair of acrostichal bristles lacking; dorsocentrals 0 + 1 or 0 + 2; sublateral pale line on mesonotum and pale line on margin of the scutellum inconspicuous, the ground colour yellowish-brown; first wing-vein bare below; neither sex with an apical palette on arista .... *aitapensis*, n. sp.
   Prescutellar pair of acrostichal bristles quite strong; dorsocentrals 0 + 2 or 0 + 3; yellow sublateral lines on mesonotum and the yellow marginal line on the scutellum quite conspicuous 3
3. Arista with a lanceolate preapical palette in both sexes; dorsocentral bristles 0 + 2 ... . *lonchifera* Hendel
   Arista without a preapical palette in either sex 4
4. Dorsocentral bristles 0 + 3; general colour black, the thoracic lines whitish-yellow; wing with two narrow complete, or almost complete, black fasciae, one over the inner cross-vein and the other over the outer cross-vein .... *taylori*, n. sp.
   Dorsocentral bristles 0 + 2; general colour dark brown, the pale lines on the thorax not very conspicuous; wing speckled with pale brown, two darker outstanding subquadrate marks on the costa, one at the stigma and the other before apex of second vein .... *bimaculatus* Hendel

SCHOLASTES CINCTUS (Guérin). Pl. v, fig. 23.

Voy. de la Coquille, Zool., ii, 1830, 299 (*Platystoma*).

This widely distributed species occurs from the Malayan region to and including Australia.

It must be noted that I distinguish the supra-alar from the postalar bristles, contrary to the system used by Bezzi and Hendel. In *cinctus* there are two strong postalar bristles and no supra-alar. No writer on the group has mentioned this character heretofore, and I am unable to determine whether or not *whitneyi* Curran has the supra-alar bristle. The latter species is described as having three pairs of dorsocentrals, and though the characteristic ring-like mark over the outer cross-vein of the species is similar to that seen in *cinctus*, the markings are more fasciform, and the tip of the wing is shown as having a blackish spot, whereas in *cinctus* the extreme tip is clear.

A series of specimens from Makada Is., Pondo, New Britain (F. H. Taylor); New Guinea: Aitape, Vanimo, Wewak (F. H. Taylor), Marprik (J. R. Rigby and C. M. Deland); and another from Dutch New Guinea: Humboldt Bay, Lake Sentani; Papua: Kokoda (L. E. Cheesman); Mt. Lamington (Northern Division) (C. T. McNamara).

SCHOLASTES AITAPENSIS, n. sp. Pl. v, fig. 24.

♂, ♀. Head brownish-yellow, frons with a broad brown transverse band on upper half leaving only a yellow line on vertex, and a blackish-brown transverse band on anterior half that is darkest on the anterior carina; face without a dark mark; antennae and palpi orange-yellow. Frons a little longer than wide, slightly widened in front, with a marked transverse carina above the lunule, the latter broadly arched. All four vertical and the single pair of orbital bristles strong. Aristae moderately long-haired to beyond the middle, without apical palette. Genal bristle strong. Thorax brownish-yellow, darker on the mesonotum, the sublateral pale lines quite distinct, but the pale edges of the scutellum not as noticeable; pleura with a pale line above. Supra-alar bristle strong, presutural acrostichals lacking, dorsocentrals usually two pairs, the anterior pair small and weak. Legs yellow, apical two segments of all tarsi infuscated, metatarsi paler than the remainder of legs.

Wings greyish-hyaline, with dark brown markings (Pl. v, fig. 24), the most conspicuous being a short fascia from the costa at base of the stigma that extends backwards to the fourth vein, two similar marks at apex of the second vein, and a larger spot in the wing tip that is very narrowly separated from the margin, and in addition to these there are two short streaks from costa to fourth vein between the two first-mentioned costal marks, the outermost one sometimes connecting with a mark on the outer cross-vein, four in the first posterior cell, two in the second posterior cell, a streak from middle of the discal cell to near hind margin, and a curved streak basad of the latter. Halteres yellow. Abdomen coloured as thorax, but the tergites are more or less extensively violet-blue; hypopygium of male yellow, genital cone of female black. Length, 6–7 mm.

Type, male, allotype and 6 paratypes, Aitape, New Guinea, 1 paratype, Madang, New Guinea (F. H. Taylor); one, Solomon Is., Shortland Is., Korovo, 23.iv.1934 (H. T. Padgen, Brit. Mus.).

SCHOLASTES LONCHIFERA Hendel.

Abhandl. Zool.-botan. Ges., viii, 1914, 253.

Described from Cook Islands. I have examined the type specimen in the United States National Museum. It is a common species in the Society Islands and probably will yet be found in New Guinea.

SCHOLASTES BIMACULATUS Hendel.

Abhandl. Zool.-botan. Ges., viii, 1914, 252.

Makada Is., off New Britain (F. H. Taylor).

SCHOLASTES TAYLORI, n. sp. Pl. v, fig. 25.

♂, ♀. Head testaceous-yellow, occiput largely black above, frons with two broad black bands, one just in front of the vertex and the other on anterior margin, the latter separated from eyes by a narrow yellow line. Upper half of face except lunule black. Antennae and palpi brownish-yellow. Frons about 1·25 times as long as wide, slightly widest at middle, upper orbits glossy; four vertical and two orbital bristles strong. Arista moderately long-haired to near apex, without apical palette. Genal bristle strong. Thorax black, with a sharply contrasted pale yellow submarginal line on mesonotum that is broken at the suture and connected with the pale yellow marginal line on the scutellum; humeri pale yellow; pleura yellow on upper margin and with a less conspicuous yellow central vitta, the lower part of sternopleura yellowish-brown. Supra-alar and prescutellar acrostichal bristles present, dorsocentrals usually 3 pairs. Legs pitchy-black, mid and hind tibiae except their apices yellowish-brown, basal two tarsal segments pale yellow.

Wings hyaline, with brownish-black transverse streaks (Pl. v, fig. 25); the most conspicuous being a fascia from stigma to hind margin, and another from apex of first vein to hind margin that covers the bend in second vein and encloses the outer cross-vein, at which latter point there is a hyaline central spot; in addition to these there is a narrow streak between them from the stigma to the inner cross-vein, 3 or 4 streaks in the apical third, and a number of paler spots in basal third of the wing. Squamae white, with parts of edge blackened. Abdomen blue-black in female, each tergite in male with a pale yellow apical margin. Length, 6·5–7·5 mm.

Type, male, allotype and 5 paratypes, Wewak, New Guinea (F. H. Taylor).

This species closely resembles *distigma* Hendel, but lacks the two black spots in the lower extremities of the facial foveae that distinguish the Javanese species.

ACHIOSOMA Hendel.

Gen. Insectorum, Fasc. 157, 1914, 15th April, 100; *Abhandl. Zool.-botan. Ges.*, viii, 1914, 15th June, 200.

This genus resembles *Achias* superficially, but the squamae are very much smaller, and the general structure much less robust. Hendel accepted both of Walker's species as valid, though Osten-Sacken considered there was but one species.

ACHIOSOMA DACOIDES (Walker).

Jour. Proc. Linn. Soc. Lond., viii, 1865, 133 (*Achias*).—*Zygothrica robusta* Bigot, *Ann. Soc. Ent. France*, x, ser. 5, 1880, 93.—*Achias gracilis* de Meijere, *Nov. Guin.*, ix, Zool. livr. 3, 1913, 373.

I have been unable to see a specimen of this species, or at least a specimen that agrees with the description of Walker or with that of Hendel in 1914. Unless there is very considerable variation in the markings of the head, and to a lesser extent in the colours of the legs and thorax, it appears to me possible that Hendel did not have his specimen correctly identified. He states that there is a black cross-band on the anterior margin of the frons that sends a branch down each antennal fovea widening below and ending at the epistome, and that there is another parallel-margined black stripe on the gena from the eye to the genal margin. The vertex has no black fascia. Walker states that there are two black "vertical" bands by which he means frontal bands, so that I interpret this to include a vertical and an anterior frontal band. Both the descriptions give the legs as preponderantly black, though Hendel gives a small portion of the femora blackened at apices, while Walker gives them with a small portion black at bases. I believe Walker to have made an error here and that Hendel is correct. Walker gives the halteres as having black knobs, which may or may not be correct. He also gives the mesonotum as having three black stripes.

Type locality, Salwatty Island. Recorded from New Guinea.

ACHIOSOMA ASPICIENS (Walker).

Jour. Proc. Linn. Soc. Lond., vii, 1864, 229 (*Achias*).

This species is rather similar to the genotype, but in addition to having the costa with a black border extending back to the third vein on its entire length and slightly over that vein at apex, it has a large brown cloud over the outer cross-vein. The mid and hind femora are also entirely yellow.

Type locality Waigou Island, North-west Dutch New Guinea.

ACHIOSOMA COSTALIS, n. sp.

♀. A brownish-yellow species, but slightly shiny.

Frons with a narrow dark brown band on vertex from eye to eye, enclosing ocelli, a fainter subquadrate brown patch in centre of front, and on each side in front below level of the brown mark an oblique black streak from eye to level of base of third antennal segment, widened inwardly, and continued downward as a line on each parafacial edge, the foveae yellow, and each side of the facial carina with a brown streak that is linear above and widened below; gena with a black stripe from eye to lower margin, narrowed below. Head about 1·25 times as wide as thorax, frons about four times as wide as one eye, much depressed centrally, without bristles. Gena nearly twice as high as eye; width of head at epistome less than half that across eyes; face slightly depressed above epistome in profile. Arista moderately long-haired.

Thorax with dense yellow dusting on mesonotum, most noticeable posteriorly, and with faint traces of narrow vittae in front, the pleura whitish-grey-dusted, most densely so centrally, scutellum tawny-yellow, basal half of disc with many microscopic black dots. The only well-developed bristles are the posterior notopleurals and the apical pair of scutellars, the anterior notopleural and the other four scutellars reduced to fine short hairs; disc of scutellum bare.

Wings glassy, veins brown, costa with a dark brown streak from base to apex that extends backward to the third vein on its entire extent and narrowly over that vein at its apex, the tip of the dark colour reaching tip of fourth vein. First posterior cell narrowed at apex; inner cross-vein slightly oblique; penultimate section of fourth vein about three-fourths as long as ultimate; discal cell from base to inner cross-vein much narrower than anterior basal cell. Squamae brownish-yellow. Halteres yellow. Legs tawny-yellow, bases of all tibiae rather broadly dark brown, entire fore tarsi black-brown. All femora with some short strong erect spines on the apical fourth or less below. Abdomen yellow, with the sides of each tergite brown, the central pale part with glistening yellow pile. Basal composite tergite subpetiolate. Length, 12 mm.

Type, Western New Guinea: Mt. Nomo, south of Mt. Bougainville, 700 feet, February 1936 (L. E. Cheesman). British Museum.

Apparently the members of this genus are rare, but few having been recorded, and a careful examination of a series of specimens from the same locality may show that what I am considering to be valid species are merely variants of a single species.

ACHIOSOMA NIGRIFACIES, n. sp. Pl. v, fig. 26.

♀. Differs from the three already described species in having the head except a centrally interrupted yellow fascia at middle of the frons dull black, and in having the wing with the inner cross-vein broadly dark brown, the dark colour connected with the dark costal stripe, and a large dark brown apical mark that begins well before the outer cross-vein, and extends to tip, is darkest on the costa, fading out along the hind margin (Pl. v, fig. 26).

Head rather dull black, the frons slightly shiny with a white-dusted line on each side that extends down over the parafacial edges, the facial foveae white-dusted. Antennae dark brown; palpi brownish-yellow. Frons almost half the head-width, wider than long, depressed across centre at the yellow mark, the head a little wider than thorax at bases of the wings, vertex with only the outer vertical showing, this short, but the head is pressed against the thorax so that it is impossible to determine if all four verticals have been present; ocelli very close together and well in front of the vertex. Facial foveae deep, extending to lower third of face, antennae lying within the foveae, third segment about five times as long as wide; aristae plumose; palpi wider than antennae; prelabrum exposed. Gena nearly as high as eye, and twice as high as width of parafacial, with a deep broad oblique posterior depression above.

Mesonotum dull black, with three golden tomentose vittae, the central one straight to near posterior extremity where it widens out and connects narrowly on the hind border with the laterals, the latter not covering the humeri, spreading inward at the suture, and widening on the posterior calli. The humeral bristle is lacking, as are also the dorsocentrals, supra-alar, mesopleural, sternopleural, and pteropleural, the anterior notopleural is short and fine, the posterior one strong, the anterior postalar is present but the other is not; pleura almost uniformly white tomentose; scutellum with ten marginal bristles that become stronger to the apical pair, all situated on small elevated bases or warts, the disc bare, microscopically granulose.

Legs black, fore femora brown, mid and hind femora yellow on basal two-thirds, mid and hind tarsi brownish-yellow. Fore femora with three or four short spines on apical third of the posteroventral surface, mid and hind pair with the same armature but a little weaker and on the anteroventral surface. Dark parts of the wing densely short brown-haired, third posterior cell with less dense but still distinct hairing, the other cells glassy and apparently bare. Inner cross-vein much nearer to apex of discal cell than in the other species. Halteres with fuscous knobs. Abdomen shiny brownish-black, with grey dust at constriction of the composite basal tergite, and large patches of dust on sides of the other tergites, grey on the third, and yellow on the fourth and fifth. Hairs pale on basal half, dark on apical half. Length, 11 mm.

Type, Papua: Mt. Lamington District, Northern Division, Jan.–Feb. 1929 (C. T. McNamara), in Australian Museum. One paratype, topotypical, by same collector, July 1927, retained by the author.

The presence of warts at bases of the scutellar bristles is unique in this species, as is also the number of scutellar bristles, the others as far as I know having but six such bristles. While the character may not invariably hold it appears worth mentioning that there are no fine pale hairs on the ridge above the base of the lower squama in this genus and that such hairs do occur in the species of *Achias* that I have examined.

ACHIAS Fabricius.

Syst. Antliat., 1805, 247 (Diptera).

This genus is readily separated from *Achiosoma* by the much larger lower squama, and the more numerous thoracic bristles.

There are 13 species recorded from New Guinea. Hendel's key is the only one that incorporates all the species and I present a modification of it herein in the hope that it may prove of value in the identification of the species.

The genotype, *oculatus* Fabricius, is not definitely known, the only data on it available being in the older descriptions. It was recorded originally from Java, but if this is correct it is the only species of the genus known from outside the Australian and New Guinea regions. Hendel suggested that his *platychirus* was the same species.

Key to the Species.

1. Wings with no dark costal streak, with at most a slight yellowish shade or some small pale brown marks near base or very faint marks on the edge 2
   Wing with the costal border dark brown or black, sometimes more or less broken by yellowish or reddish patches 6
2. Thorax, tibiae, and frons yellow, the last with a round black spot; outer cross-vein clouded with brown .... *venustulus* Walker
   Thorax and tibiae black 3
3. Ground-colour of thorax and scutellum deep metallic black-blue, with slight violet tinge, the mesonotum with surface shagreened and with dark vittae, scutellum almost dull, bare, with 6 marginal bristles; head rusty-red, anterior margin of frons with a dark mark, antennal foveae and sides of epistome with dark

marks, no dark stripe on the genae; basal half of the costal cell, marginal cell with the exception of the middle and extreme apex, reddish-yellow to brown, and the inner cross-vein dark-clouded .... *fulviceps* de Meijere

Ground-colour of thorax and scutellum black-brown; frons and centre of face largely black 4

4. Scutellum bare; fore tarsi of male exceptionally widened; apical three tergites of abdomen in male almost equally long, third a little shorter than either of the others; centre of face black, with only two or four small indistinct spots, centrally reddish .... *platychirus* Hendel

Disc of the scutellum haired; fore tarsi in neither sex much widened; fifth abdominal tergite of male as long as third and fourth combined; other characters not as above 5

5. Disc of the scutellum densely golden-yellow haired; bases of fore femora in male yellow .... *strigatus* de Meijere

Disc of the scutellum with extremely short inconspicuous pale yellow hairs; fore femora of male black ....*subnudus*, n. sp.

6. Scutellum rusty-yellow; frons and genae without black-brown stripes, only the sides of the face black-brown in both sexes; scutellum bare ..... *amplividens* Walker

Scutellum black or dark blue to bronzy coloured 7

7. Abdomen testaceous, but faintly greenish, apices of the tergites piceous; no dark central stripe on face; inner cross-vein quite broadly clouded with black, outer cross-vein not clouded except faintly below; tibiae and tarsi black .... *brachyophthalmus* Walker

Abdomen entirely or in large part metallic blue or blue-green; other characters not as above 8

8. Costal streak uniformly brown, emitting two broad fasciae over the cross-veins that are narrowly divided by a hyaline stripe from the second to the fourth vein on field of the wing; scutellum haired on apex and sides .... *furcatus* Hendel

Wing without such dark markings, when there is a dark fascia over the inner cross-vein it is much narrower and shorter, and when there is a cloud on the outer cross-vein it is not distinctly connected with the costal streak 9

9. Mesonotum not vittate, uniformly covered with dense ochreous dust; scutellum bare .... *thoracalis* Hendel

Mesonotum dusted, but with more or less conspicuous dark vittae 10

10. Genae with a distinct dark brown or black vertical stripe 12

Genae without a dark vertical stripe; costal margin of the wing black-brown from base to apex and a streak from this over the inner cross-vein 11

11. Scutellum with fine pale hairs; no pale parts in the dark costal stripe; head with a slender black stripe down each facial fovea and with no central facial nor genal black stripes .... *diversifrons* de Meijere

Scutellum bare; a pale patch in the costal stripe each side of the fascia over the inner cross-vein; genae, face, and frons with many brown dots .... *punctulatus* de Meijere

12. Mesonotum with distinct metallic sheen that is not entirely obliterated by the yellowish dusting 13

Mesonotum not shining, entirely dull 15

13. Legs pitchy-brown, only the femora at bases yellow, tibiae entirely pitchy-brown; black stripes on facial foveae and genae .... *longividens* Walker

Femora yellow, black only at apices below, tibiae yellow, with black extremities and a black dorsal stripe 14

14. Eye-stalks reddish-yellow below; clypeus yellow; the dark genal stripe separated from the dark epistomal mark; fore metatarsus noticeably longer than the remaining segments of fore tarsus combined (male); scutellum bare .... *rothschildi* Austen

Eye-stalks blackish; clypeus with a black-brown central vitta; the dark genal stripe united with the dark epistomal mark; fore metatarsus as long as the other segments combined in both sexes; scutellum bare .... *latividens* Walker

Eye-stalks yellowish below; clypeus with a black central vitta; genal black stripe separated from the dark epistomal stripe; fore metatarsus shorter than remaining segments combined .... *australis*, n. sp.

15. Genae yellow, black in front; fifth abdominal tergite of male as long as third and fourth combined; eyes of male long stalked; outer cross-vein of the wing not dark-clouded; scutellum haired at apex .... *albertisi* Osten-Sacken

Gena with a dark stripe; fifth abdominal tergite of male longer than third and fourth tergites combined; eyes of male not stalked; outer cross-vein of wing distinctly brown-clouded; scutellum haired on disc .... *microcephalus* Hendel

Achias venustulus Walker.

Jour. Proc. Linn. Soc. Lond., viii, 1865, 119.

This is the only species without a dark costal stripe that has the outer cross-vein of the wing dark-clouded, and if the description is accurate the only one in that group that has the femora and tibiae yellow.

Originally described from New Guinea and not subsequently recorded.

Achias platychirus Hendel.

Abhandl. Zool.-botan. Ges., viii, 1914, 204.—? *Achias oculatus* Fabricius, *Syst. Antl.*, 1805, 247 (Diptera).

Hendel suggests the possibility that this may be *oculatus*, and if so then it appears certain that the original citation of Java as the type-locality is erroneous.

The tarsi of all the legs are widened in the male, the fore pair most conspicuously so; the apices of the fore tibiae are also widened. The femora are armed on the apical half below with short bristles or thorns. This last character suggests an affinity with *Achiosoma*, the only specimen I have seen of that genus having similar femoral spines.

Described from a male taken in New Guinea.

Achias fulviceps de Meijere.

Nov. Guin., ix, Zool. livr. 3, 1913, 373.

This species also has short bristly thorns on the apical portion of the ventral surface of the femora, longest on the posteroventral surface of the fore pair. The wing tip from before the outer cross-vein is greyish, the basal half of the costal cell, the marginal cell with the exception of the middle and an apical suffusion, reddish-yellow to brown, the inner cross-vein dark-clouded.

Described from a female from New Guinea and not since recorded.

Achias strigatus de Meijere.

Op. cit., ix, Zool. livr. 3, 1913, 372.

Known only from a teneral male specimen. The facial carina is black below, yellow on upper half, the fore femora are yellow on their basal halves. The scutellum is thickly golden-yellow-haired, the ventral femoral setulae are short and weak.

Described from New Guinea and not subsequently recorded.

Achias subnudus, n. sp.

♂, ♀. This species is apparently very closely related to *strigatus*, differing markedly in having the fore femora entirely black, and the shiny black scutellum with extremely short fine pale hairs, noticeable only with a strong lens. There are no ventral setulae on any of the femora in the specimens before me.

♂. Head more than 1·5 times as wide as thorax, the eye-stalks thick, vertex with 4 bristles, the outer ones about midway between inner one and eye. Frons black to level of bases of antennae, the yellow colour of upper occiput projecting in a short wedge each side of ocelli. Face with a large black-brown spot extending from above middle of facial carina to epistome and laterally to about midway from outer edge of foveae to middle of genae; remainder fulvous-yellow except a narrow pale yellow streak along the lower edge of the black frontal fascia. Basal two antennal segments pale brown, third and palpi black. Thorax brown-black, only the scutellum distinctly shiny, not metallic, pleura slightly, mesonotum densely, greyish-yellow-dusted, the latter with 4 complete black vittae and the lateral margins black; scutellum without dust; mesonotal hairs short and pale, those on the scutellum very inconspicuous. Bristles as follows: 1 humeral, 2 notopleurals, 1 supra-alar, 2 postalars, 1 pair of dorsocentrals, and 1 pair of prescutellar acrostichals; no mesopleural; scutellars 6, the apical pair the longest and strongest. Legs black, mid and hind femora fulvous-yellow on basal halves, tarsi normal, no evident ventral femoral spines, only some hairs present.

Wings glassy, seen against a white background the apex from before the outer cross-vein appears stained or greyish, much as I assume those of *fulviceps* must be, judging from the description, costa brownish to a little beyond the humeral cross-vein and in stigma, the margin infuscated above fork of second vein, and from there to level of apex of the stigma slightly yellow; fork of second vein and inner cross-vein narrowly darkened. Ultimate section of fourth vein slightly biarcuate, the tip slightly upcurved. Abdomen glossy brownish-black, yellowish at base of composite tergite, with a slight aeneous tinge apically, the hairs yellow except on fifth tergite, long on sides of basal one, the fifth with a series of fine black bristles on apical edge.

♀. Similar to the male, differing in having the head very little wider than the thorax, the outer vertical bristles close to the eyes, the frontal fascia less sharply defined, with no pale yellow streak along its anterior edge, and a black streak from each eye downward on the gena that is sometimes connected with the large black facial mark by a series of minute black dots. The fore femora are usually fulvous-yellow at bases, and all the tibiae are of that colour centrally, the fore pair least distinctly so. Length, 9–12 mm.

Type male, allotype, and 9 paratypes, Papua: Mt. Tafa, 8,500 feet, March 1934 (L. E. Cheesman).

This may be *strigatus*, but there are so many points in which it differs from the description of that species that I prefer to describe it tentatively as new.

Achias amplividens Walker.

Jour. Proc. Linn. Soc. Lond., iii, 1859, 122; Hendel, *Abhandl. Zool.-botan. Ges.*, viii, 1914, 212.

The female only was described by Walker, but Hendel described the male. This latter has the eyes on long stalks, in the one described by Hendel the width of the head (17 mm.) greatly exceeded the length of the insect (12 mm.). The scutellum is bare.

Aru Islands (Walker), New Guinea (Hendel).

Achias brachyophthalmus Walker. Pl. v, fig. 27.

Jour. Proc. Linn. Soc. Lond., viii, 1865, 119.

A smaller species than most of the others in the genus, with the eye-stalks shorter than usual in the male, the head being 7·5 mm. wide and the length of the insect 10 mm. in the male specimen with the widest head before me. The head in the male has a black-brown stripe covering each antennal fossa and extending to lower margin of face, while the female has, in addition to these, a short black streak on each gena from edge of eye to near middle, tapered to a point below. The frons is black speckled in both sexes, in male dark brown on each side against tips.

Mesonotum densely yellowish-grey-dusted with 4 uniformly wide shiny brown vittae, neither pair extending to the posterior margin, the central pair shortest. Scutellum shiny black, with 6 black bristles, and some microscopic pale hairs on sides of disc. Legs black, femora tawny-yellow except their apices. All femora with short black apical bristles on the posteroventral surfaces of fore and mid pairs and on anteroventral of hind pair. Hind coxae densely brown-haired in male. Wing as Plate v, figure 27. Abdomen sometimes with a marked green tinge. Fifth tergite of male about as long as third and fourth combined. Length, 7–11 mm.

A series of about 50 specimens, both sexes, from Kuranda, N. Queensland (F. P. Dodd).

Originally described from a female taken in New Guinea. Not known to Hendel.

ACHIAS FURCATUS Hendel.

Gen. Ins., Fasc. 157, 1914, April, 103, Taf. 10, fig. 177; *Abhandl. Zool-botan. Ges.*, viii, 1914, June, 216.

Both sexes of this species were described. The scutellum is partly haired above. The short biseriate bristles on the apical portion of the ventral surface of the femora are stated to be quite strong. The entire brown costal streak with the emitted fasciae over both cross-veins should readily distinguish this species from its congeners.

Mafor and Roon.

ACHIAS THORACALIS Hendel.

Abhandl. Zool.-botan. Ges., viii, 1914, 213.

Described from two females. The mesonotum is densely ochreous-brown-dusted, without evident dark vittae, and with black hairs. This lack of vittae is unique in the genus as far as we know. The scutellum is bare. Coxae and femora reddish-yellow, tibiae and tarsi black.

Dutch New Guinea.

ACHIAS DIVERSIFRONS de Meijere.

Nov. Guin., ix, Zool. livr. 3, 1913, 371.

The only male before me has the head, including the eye-stalks, 14 mm. in width, the stalks black except at extreme bases below, the frons with black specks that are mostly fused, so that only an irregular mark in centre is reddish-yellow, remainder of head testaceous except a narrow black stripe on each antennal fovea from base of antenna to epistome, and a fuscous transverse stripe on occiput below vertex. Vertex with 4 bristles as usual. Mesonotum with yellowish dust and 4 dark uniform vittae, the sublaterals reddish behind suture; scutellum black, with fine pale hairs and 6 marginal bristles. Legs black, basal half or more of all femora yellow, hind tibiae brownish centrally. Fore tarsi of male slightly flattened.

Wing with a black-brown costal stripe from base to apex that sends a spur over the inner cross-vein, is narrowest for a short stretch just beyond this and faintest in the apex of the first posterior cell. Abdomen metallic-blue, with a reddish shade showing below in parts, hypopygium orange-yellow.

Described from New Guinea, Papua (British New Guinea): Aroa R., Central Division (west of Port Moresby), presented to the British Museum by the Hon. L. W. Rothschild. One male.

Achias punctulatus de Meijere.

Op. cit., ix, Zool. livr. 3, 1913, 372; Edwards, *Trans. Zool. Soc. London*, xx, pt. 13, 1915, 416.

Scutellum bare.

Described from a female taken in New Guinea and subsequently recorded from Setakwa River, Dutch New Guinea, by Edwards.

Achias longividens Walker.

Jour. Proc. Linn. Soc. Lond., iii, 1859, 121.

Walker described both sexes. The head is described as having two black bands on the vertex and 4 black stripes in front. There appears thus to be a genal stripe.

Aru Islands.

Achias rothschildi Austen.

Nov. Zool., xvii, 1910, 459.

Closely related to *latividens*, the outstanding differences between the species being noted in the foregoing key to species.

New Guinea: Bogadjim (Stephansort); Papua: Milne Bay.

Achias latividens Walker.

Jour. Proc. Linn. Soc. Lond., iii, 1895, 121.

I have before me two males that apparently belong here. The outer cross-vein of the wing is very narrowly and faintly pale brown-clouded and the centre of the face has an entire black stripe. The genal black stripe connects with the short one below the antennal fovea, while the latter does not extend over the fovea, the bottom of the latter being yellow. There are no fine hairs on the scutellum. Fore femur with some irregular short strong posteroventral bristles apically.

One of the specimens is from Milne Bay, from which locality Hendel also had the species; the other is from Ferguson Island, S.E. Papua (A. S. Meek). One male, Fly River, N.G. This specimen is in good condition and shows the long strong yellow hairs on the inner side of the hind coxae very clearly.

Recorded from New Guinea, Aru Island, and Waigou.

Achias albertisi Osten-Sacken.

Ann. Mus. Civ. Stor. Nat. Gen., xvi, 1881, 473.

Described from New Guinea and not since recorded.

Achias microcephalus Hendel.

Abhandl. Zool.-botan. Ges., viii, 1914, 215.

Described from New Guinea.

Achias australis, n. sp. Pl. v, fig. 28.

♂, ♀. Head testaceous-yellow, slightly shiny, frons with a broad transverse anterior marginal black band that covers all the eye-stalks except a line on the upper anterior edge and descends on face to almost the level of apex of the third antennal segment, and another similar band on the vertex that is more or less punctiform centrally and on a transverse line behind; a narrower black stripe covers each of the facial foveae and connects with a similar band on the epistomal margin; a third stripe extends from the latter upward on centre of face to between bases of antennae, widening above and below; from the lower edge of the black eye-stalks there extends downward another black stripe that tapers below and is there somewhat punctiform. Antennae dark brown; palpi black; prelabrum brown; inner mouth margin black. Eyes of male on variably long slender stalks, the entire head at times as long as or longer than the insect, in the female the eye-stalks are much shorter, being at most as long as the thorax and scutellum. Verticals 4, genal weak but evident; face bulging out on its upper half, concave in profile below middle, with the epistome slightly projecting.

Thorax brown, slightly shiny, with grey dust, the mesonotum with slight metallic tinge on dorsum posteriorly, most evident on posterior extremities of the four dark vittae, a fifth vitta evident at posterior extremity between the submedian pair; scutellum glossy dark brown to blue-black, with a grey-dusted transverse mark at base, the disc bare, the margin with 6 bristles on minute raised bases. Mesonotum with the usual bristles: 1 humeral, 2 notopleurals, 1 supra-alar, 2 postalars, 1 intra-alar, a pair of prescutellar acrostichals, and no pleurals; hairs on mesonotum mainly dark except posteriorly and laterally, those on pleura pale.

Legs tawny-yellow, apical half of all femora blackened, bases and apices of all tibiae and a dorsal line black, tarsi black. Fore femora with six or seven short black bristles on the apical third of the posteroventral surface; fore metatarsus not as long as remainder of segments of that tarsus.

Wing (Pl. v, fig. 28) brownish-hyaline, with a dark brown costal stripe that is paler but not obsolescent on a short portion beyond the inner cross-vein, sends a narrow spur on the latter, and ends on apex of fourth vein; outer cross-vein with a slight broad brown suffusion. Halteres brown. Squamae greyish-white, edge of upper one brown. Abdomen brown, semipellucid, with distinct green sheen, most conspicuous apically. Fifth abdominal tergite of male not as long as third and fourth together. Length, 12–14 mm.

Type, male, allotype, and 4 paratypes, Kuranda, Queensland (F. P. Dodd); 1 paratype, Cairns, Queensland, from the Lichtwardt collection. Two of the Kuranda specimens are also from the Lichtwardt collection in the Deutsches Entomologisches Institut; the type and allotype are being returned to Mr. F. H. Taylor.

LAMPROGASTER Macquart.

Dipt. Exot., ii, pt. 3, 1843, 211.—*Ceratopelta* Bigot, *Bull. Soc. Ent. France*, viii, ser. 5, 1878, 34.—*Liolamprogaster* Enderlein, *Mitt. Zool. Mus. Berl.*, xi, 1924, 128.—*Holocnemia* Enderlein, op. cit., xi, 1924, 128.

There are probably 50 species of this genus occurring from the Philippines southward to and including Australia. Enderlein in 1924 accepted one of Bigot's genera, *Ceratopelta*, and erected two others for the reception in one case (*Holocnemia*) of a single species, and in the other (*Liolamprogaster*) of three species. *Ceratopelta* is distinguished from *Lamprogaster* by the presence of two stout spines or tubercles on the disc of the scutellum close to the apex, and I have included it in my key to the genera in this paper, though I hardly care to admit the validity of the concept. *Holocnemia* is distinguished from *Lamprogaster* by the presence of stout spines on the ventral surface of the fore femur and long fine hairs on the ventral surfaces of the other femora. The genotype, *apicalis* Walker, is from Western Australia, so that it does not concern us at the present time. *Liolamprogaster* is discussed in the following text.

Lacking as I do a number of the New Guinea species, I have been compelled to adhere quite closely to Hendel's synopsis in the following key to the species, but I have endeavoured to clarify specific distinctions where the species are in the collection by giving notes on the more outstanding characters under the species.

Key to the Species.

1. Scutellum with a pair of short stout pointed processes or tubercles near apex of disc, the margin below these with a number of bristles and setulose hairs .... (*Ceratopelta*) *patula* Walker
   Scutellum with no apical discal tubercles, with a few marginal bristles 2
2. Wing hyaline or slightly yellowish, usually more noticeably so along the costa, but with no brown or black marks or spots 3
   Wing with either brown base, more or less complete dark costal streak, or black or brown spots or markings, or at least a dark streak over the inner cross-vein that extends to or almost to the costa 9
3. Mesonotum almost bare on the disc, the microscopic fine hairs confined to series on the acrostichal and dorsocentral lines; abdomen with the composite basal tergite finely haired, the other tergites practically bare; supra-alar bristle lacking; inner cross-vein of the wing at middle of the discal cell; upper occiput more protruded than usual, rather broadly exposed in profile; species orange-yellow, with or without a slight bluish sheen on dorsum .... *gracilis* Hendel
   Mesonotum rather uniformly and closely haired on the entire surface; all the abdominal tergites quite closely haired; supra-alar bristle present, or absent (*grossa*); inner cross-vein beyond middle of discal cell of the wing 4
4. Prescutellar acrostichal bristles present; fourth wing-vein straight on its apical section, not arched upward just beyond the outer cross-vein; humeral bristle present; thorax and abdomen reddish, with marked blue tinge (Queensland) .... *pseudoelongata* Malloch
   Prescutellar acrostichals lacking; fourth wing-vein usually arched just beyond the outer cross-vein and slightly curved upward at apex 5
5. Humeral bristle lacking; fourth wing-vein sinuous proximad of the inner cross-vein; thorax and abdomen brownish-yellow, sometimes with slight bluish sheen on dorsum, the hairs and bristles luteous or yellow 6
   Humeral bristle present; fourth vein arched or straight proximad of the inner cross-vein; thorax and abdomen either metallic blue or greenish, if brownish-yellow the hairs and bristles black 7
6. Distance between the cross-veins of the wing about equal to the length of the outer one; supra-alar bristle lacking .... *zelotypa* Hendel
   Distance between the cross-veins of the wing about 1·5 times as long as the outer cross-vein; supra-alar bristle present .... *zelotypa* Hendel, var.?
7. Stout yellowish-brown species; gena about half as high as the eye; supra-alar bristle lacking; legs tawny-yellow, each tibia with a brown dorsal line from base to apex .... *grossa*, n. sp.
   More slender species, preponderantly metallic blue or green in colour; gena not more than one-fourth as high as eye; supra-alar bristle present; legs fulvous-yellow, with no dark dorsal line on the tibiae 8
8. Epistome with two dark brown stripes in the lower portions of the facial foveae; squamae with red margins .... *austeni* Sharp
   Epistome without the above-mentioned black stripes, slightly browned at sides; squamae blackish margined .... *elongata* van der Wulp
9. Entire costal margin of the wings broadly brown, sometimes yellow beyond inner cross-vein 10
   Wings without entire dark costal margin 11
10. Outer cross-vein of the wing broadly clouded with brown .... *stenoparia* Hendel
    Outer cross-vein of the wing not brown-clouded .... *basalis* Walker
11. Wing without a dark apical spot 12
    Wing with a dark apical spot or mark 17
12. Wing with only a large reddish-brown mark at base between the costal and cubital veins 12*a*
    Wing never with such large basal mark, but with two or three smaller dark spots on the cross-veins and radius 13

12*a*. Preponderantly metallic-blue species; scutellum with 6 bristles; inner cross-vein near middle of discal cell .... *basalis* Walker
    Brownish-yellow species; scutellum with 2 bristles; inner cross-vein less than one-third from apex of discal cell .... *decolor*, n. sp.

13. Both the cross-veins brown-clouded; thorax and abdomen metallic-green, shagreened and with fine yellow hairs; fore femora green, fore tarsi black .... *laeta* Walker
Outer cross-vein not dark-clouded 14
14. Wing with a dark brown costal spot above the level of the outer cross-vein and two others proximad of it on the costa; squamae dark brown 15
Wing without a dark costal spot above level of the outer cross-vein, with only two dark costal spots; squamae pale 16
15. Only the inner cross-vein dark clouded; legs entirely reddish-yellow 15*a*
A short dark streak from the costa to and enclosing the inner cross-vein; bases of fore femora and the tarsi black .... *maculipennis* Macquart
15*a*. Gena one-third as high as eye; prelabrum very exposed; scutellum bare except for the marginal bristles .... *macrocephala* Hendel
Gena not more than one-fourth as high as eye; prelabrum quite prominently exposed; scutellum strongly haired and with six marginal bristles .... *fulvipes*, n. sp.
16. Dorsum of thorax, scutellum, and abdomen, glossy, bare, reddish-brown; pleura yellow .... *costalis* Walker
Thorax and scutellum black, shiny, abdomen greenish-black .... *trisignata* van der Wulp
17. Wing with three dark brown costal marks; legs entirely yellow; scutellum bare .... *rufipes* Hendel
Wing with four dark marks on the costa; tarsi more or less blackened 18
18. Outer cross-vein dark-clouded 19
Outer cross-vein not dark-clouded; basal dark wing-spot not extending to costa; thorax and abdomen blue-black; legs yellow .... *pumicata* van der Wulp
19. Frons, pleura, and legs reddish-yellow 20
Frons dark brown to black; mesonotum steel-blue, with a short yellowish-white-dusted vitta over the upper half of each humerus extending to suture, and a similar one along the upper edge of each pleuron; abdomen violet-black .... *quadrilinea* Walker
20. Apical and basal dark spots on the wing very large, the latter extending from subcosta to the anal vein .... *severa* Hendel
Basal spot on the wing small, extending from posterior basal cell to inner cross-vein; apical spot slender, diffuse .... *taeniata* van der Wulp

LAMPROGASTER (CERATOPELTA) PATULA Walker.

Jour. Proc. Linn. Soc. Lond., v, 1861, 247.—*L. bispinosa* Walker, op. cit., viii, 1865, 118.—*Ceratopelta tricolor* Bigot, *Bull. Soc. Ent. Fr.*, viii, ser. 5, 1878, 35.

A reddish-yellow species with entirely pale legs and yellowish-hyaline wings, the costal margin deeper yellow, the dorsum of abdomen usually largely steel-blue. The frons, genae, mesonotum, scutellum, and pleura, generally with microscopic black dots on parts of their surfaces. Antennae not extending to lower level of eyes; arista short-haired to beyond the middle; vertex with four bristles. Mesonotum black-haired, pleura largely yellow-haired, the hairs rather long and dense. Bristles as follows: 1 humeral, 2 notopleurals, 2 postalars, 1 pair of dorsocentrals and one mesopleural; the prescutellar acrostichals undeveloped. Scutellum stout, convex, the two tubercles with minute black apices; some of the marginal black bristles on small elevated bases; disc rather long-haired. First posterior cell of the wing narrowed at apex; inner cross-vein slightly dark-clouded. Abdomen broadly ovate, convex on dorsum, fifth tergite of male nearly twice as long as fourth, and with rather long stiff hairs. Length, 12–14 mm.

Dutch New Guinea: Lake Sentani, August 1936, one male (L. E. Cheesman). Originally described from New Guinea. Enderlein recorded it from Dutch New Guinea and accepted the genus as valid. I incline to accept *Ceratopelta* as a subgenus and so treat it here.

LAMPROGASTER (LIOLAMPROGASTER) GRACILIS Hendel.

Abhandl. Zool.-botan. Ges., viii, 1914, 225.

This species, *costalis* Walker, and *angusta* Enderlein were placed in a new generic concept by Enderlein, the characters used for the segregation being the lack of hairs on the dorsum of the thorax and abdomen, and the slender form, especially of the abdomen. The designated genotype is *angusta*. This species is unknown to me, was very briefly described, and the type locality is Ternate, so we may ignore it here.

I have a male and female that I refer to *gracilis*. The female is considerably darker than the male. In the latter the humeri, lateral margins of the mesonotum, the scutellum and most of the pleura are tawny-yellow, with many microscopic black dots, while in the female these parts are almost entirely blackish-blue. The mesonotum is not entirely bare in the disc, but has a double series of microscopic fine hairs down the centre, and there are some hairs on the sides. The face and prelabrum are fulvous-yellow and speckled with black in both sexes.

As stated by Hendel, the occiput projects behind the eyes in profile more than in the other species of the genus, being as wide above as the parafacial, but whether this character is maintained in the other two species I am unable to state.

The wings are yellowish-hyaline, with a more distinct yellow tinge along the costa as far back as the third vein to its apex. The first posterior cell is not narrowed at its apex.

Papua: Kokoda, 1,200 feet, May, Sept.–Oct. 1933 (L. E. Cheesman). Originally described from Astrolabe Bay, New Guinea.

Both my specimens lack the humeral and mesopleural bristles, and I can detect only one pair of verticals.

LAMPROGASTER (LIOLAMPROGASTER) COSTALIS Walker.

Jour. Proc. Linn. Soc. Lond., v, 1861, 247; Osten-Sacken, *Ann. Mus. Civ. Stor. Nat. Gen.*, xvi, 1881, 472; Hendel, *Abhandl. Zool.-botan. Ges.*, viii, 1914, 231.

Osten-Sacken states that Walker's description is "recognizable", but considers that the species seems to be closely allied to *superna* Walker and *quadrilinea* van der Wulp, the former of which was unknown to Hendel. I have not seen either of those species.

Hendel states that the dorsa of the thorax and abdomen are bare and, as Enderlein had apparently seen neither *angusta* Hendel nor *costalis*, it may be assumed that he placed them in his new genus *Liolamprogaster* on the basis of Hendel's statement to that effect. Hendel makes no mention of the occiput being convex and it may be assumed to be as in typical species of *Lamprogaster*. The wing has three short brown streaks on the costa, the outermost one being above the level of the outer cross-vein.

Hendel described a variety *nuda* which differs from the typical form in lacking the two grey-dusted pleural vittae, in having the apex of the scutellum almost transverse, and a slight dark cloud on the outer cross-vein.

Described from New Guinea. Recorded from Dorey (O.S.), and Huon Gulf (Hendel).

LAMPROGASTER (LAMPROGASTER) ZELOTYPA Hendel.

Op. cit., viii, 1914, 226.—*L. ventralis* Walker, *Jour. Proc. Linn. Soc. Lond.*, v, 1861, 248.

I give the above citation from Hendel's paper on the group without comment.

A glossy fulvous-yellow species, with yellow or fulvous hairs and bristles, and yellowish-hyaline wings, with a less markedly intense yellow costal border than in *gracilis*, the yellow colour not extending very noticeably over the second vein. There are no microscopic black specks on the head and thorax as in *gracilis*. The upper occiput is much narrower in profile, the vertex has four fine dark bristles, the mesonotum and scutellum are quite densely short-haired, the latter has 4 marginal bristles, the humeral is lacking, but the mesopleural is present. Dorsum of the abdomen rather densely short-haired.

Papua: Kokoda, 1,200 feet, August 1933 (L. E. Cheesman). Recorded previously from Dorey, New Guinea, and Australia.

The variety of this species listed in the key is from Cairns, Queensland.

LAMPROGASTER (LAMPROGASTER) GROSSA, n. sp.

♂. A large robust species of a general yellowish-brown colour, with fuscous frons, the thorax appearing darker brown because of the presence of many minute black dots visible only under a strong lens, the abdomen infuscated, especially apically, and no trace of any metallic sheen. Wings yellowish-tinged, darker basally, the inner cross-vein and the stigma brown-clouded.

Frons at vertex about two-fifths the head-width, almost parallel-sided and about 1·25 times as long as wide, with many short pale surface hairs, the orbits narrow, densely yellowish-grey tomentose, which tomentum is carried down on the parafacials, narrowing below; vertex in type specimen with 6 fine black bristles, the inner pair duplicated. Antennae hardly more than half the length of face, third segment fully three times as long as wide; arista pubescent on basal half, simple at apex; palpi longer than antennae, slender. Facial carina with sharp edges, the foveae deep; prelabrum poorly developed, not heavily chitinous. Gena about half as high as eye. Face and genae black dotted, the latter with blackish marginal line; occiput narrowly visible above in profile; parafacial in profile wider than third antennal segment.

Mesonotum in type specimen with the black dots lacking on four wide contiguous vittae, the central pair not attaining posterior margin, rounded at extremities; surface quite densely covered with short decumbent black hairs; bristles as follows: 1 humeral, 2 notopleurals, 2 postalars, and 1 pair of dorsocentrals. Scutellum slightly convex above and rounded in outline, with many short black discal hairs and six marginal bristles. Pleura partly black dotted, pale haired; mesopleural bristle of moderate length.

Wings large, veins brown, yellow clouds in cells of basal half. Fourth vein near base of discal cell slightly angulate and with a short spur vein on its anterior edge; inner cross-vein a little beyond middle of the discal cell; fourth vein very slightly bent up beyond outer cross-vein. Squamae and halterés pale brown. Legs rather stout, brownish-yellow, all the tibiae with a brown dorsal line. Fore femora without posteroventral bristles. Abdomen short ovate, blackened apically. Fifth tergite about as long as the third and fourth combined. Length, 13 mm.

Type, Dutch New Guinea: Cyclops Mts., Mt. Lina, 3,500 feet, March 1936 (L. E. Cheesman).

LAMPROGASTER (LAMPROGASTER) QUADRILINEA Walker. Pl. v. fig. 29.

Jour. Proc. Linn. Soc. Lond., iii, 1859, 111.—*L. sepsoides* Walker, op. cit., vii, 1864, 220; Hendel, *Abhandl. Zool.-botan. Ges.*, viii, 1914, 242.

A metallic black-blue species, with three narrow black costal streaks, the basal one not extending to costa, the middle one at the stigma and enclosing the inner cross-vein, and the outer one above level of the outer cross-vein, a narrow black edge from midway between apices of second and third veins to apex of fourth, a narrow cloud over the outer cross-vein, and a spot on cross-veins at base of discal cell that connects with a basally directed streak in basal half of anterior basal cell. The mesonotum is closely piliferous-punctate, the very short depressed pile black, and has a yellowish-white-dusted vitta over the upper half of each humerus extending to the suture, and one on upper edge of the pleura; scutellum slightly alutaceous, not punctate, bare on disc, with a few fine hairs and four or six weak bristles on sides, the apex truncate. Mesopleural and humeral bristles lacking. Legs black, mid and hind tibiae and tarsi largely brownish-yellow, fore femora sometimes brownish at bases.

New Guinea: Wewak (F. H. Taylor). Thirteen specimens; two pairs taken *in copula*. Western New Guinea: Njau-limon, south of Mt. Bougainville, 300 feet, February 1936; Eastern Dutch New Guinea: Jutefa Bay, sea level, 100 feet, February 1936, four specimens (L. E. Cheesman).

Originally described from Aru Island, and recorded from Mysol, Waigou, and New Guinea.

LAMPROGASTER (LAMPROGASTER) SEVERA Hendel.

Op. cit., viii, 1914, 240.

Originally described from New Guinea and not since recorded.

Scutellum bare.

LAMPROGASTER (LAMPROGASTER) MACULIPENNIS Macquart.

Dipt. Exot., Suppl. ii, 1847, 89.

This Australian species may be found in New Guinea.

LAMPROGASTER (LAMPROGASTER) TRISIGNATA van der Wulp.

Tijdschr. v. Ent., xxviii, 1885, 231.

Described from New Guinea and not seen by Hendel. Unknown to me.

LAMPROGASTER (LAMPROGASTER) AUSTENI Sharp.

Zool. Res. on material from New Britain, etc., Cambridge, Arthur Willey, pt. iv, 1900, 391.—*Lamprogaster xanthoptera* Hendel, *Abhandl. Zool.-botan. Ges.*, viii, 1914, 225.

I have arrived at the above synonymy after a careful examination of a long series of specimens from the Solomon Islands submitted to me by Sir Guy A. K. Marshall of the Imperial Institute of Entomology and a comparison with a specimen from New Britain, the type-locality.

There can be no doubt as to the correctness of the determination, though it is in only a few cases possible to see the large sack-like abdominal expansions of the abdomen described and figured by Sharp in his paper. In one female, however, these are widely exposed and agree well with Sharp's figure.

LAMPROGASTER (LAMPROGASTER) RUFIPES Hendel.

Abhandl. Zool.-botan. Ges., viii, 1914, 233.

Scutellum bare.

Described from New Guinea, Key Island.

LAMPROGASTER (LAMPROGASTER) PUMICATA van der Wulp.

Tijdschr. v. Ent., xxviii, 1885, 230.

Described from New Caledonia. Unknown to Hendel and myself. May occur in New Guinea.

LAMPROGASTER (LAMPROGASTER) BASALIS Walker.

Jour. Proc. Linn. Soc. Lond., v, 1861, 248.—*L. limbata* van der Wulp, *Tijdschr. v. Ent.*, xxviii, 1885, 228.

I have before me two specimens that agree very well with the description of this species, though they have not the mesonotum, scutellum, and abdomen particularly long black-haired as stated by Hendel.

The mark on the anterior half of the base of the wing up to and including the inner cross-vein is quite dark brown, and beyond that point on the costal margin back as far on to the field of the wing as the third vein and to the apex of the latter there is a distinct yellow streak. The thorax and abdomen, except the apex of the latter and the pleural sutures, are glossy metallic-blue. In the female before me the legs, except the mid and hind coxae, are orange-yellow, while in the male the femora all have a blackish streak on their basal half or less on ventral surface.

The vertex has 4 strong bristles; the humeral and supra-alar bristles are lacking; the scutellum has six marginal bristles and, like the mesonotum, is rather long black-haired on the disc. Inner cross-vein a little beyond middle of the discal cell, the outer one twice its own length from inner one; fourth vein undulated proximad of the inner cross-vein, highly arched just beyond outer one, then almost parallel with third to its apex.

Known only from New Guinea. East Dutch New Guinea, Jutefa Bay, Pim, sea-level to 100 feet, February 1936 (L. E. Cheesman).

I have no doubt about the synonymy given above, though Hendel kept the species separate. He did not have *limbata* before him and merely quoted van der Wulp's description.

LAMPROGASTER (LAMPROGASTER) DECOLOR, n. sp. Pl. v, fig. 30.

♀. Very similar to *zelotypa* in general colour, the blue metallic sheen not very conspicuous on the fulvous-yellow ground-colour, most evident on the pleura. The main differences between the two lie in the presence of a brown cloud over the base of the wing from costal margin to anal vein and extending to apices of first posterior and anal cells, most noticeable on the cross-veins at the apices of these cells, a faint brown cloud over inner cross-vein, the more approximated cross-veins, which are usually separated by less than the length of the outer cross-vein. The genae are also much darkened, usually dark brown. The vertex has four bristles in both species, very small and fine in *decolor*, and in the latter there are but two marginal bristles on the scutellum. The thoracic bristles are also darker than in *zelotypa* though not black. Length, 7–11 mm.

Type and 7 paratypes, Wewak, New Guinea (F. H. Taylor).

LAMPROGASTER (LAMPROGASTER) STENOPARIA Hendel.

Abhandl. Zool.-botan. Ges., viii, 1914, 227.

This species has much in common with *basalis* Walker, but the wing markings to the apex of the costal streak, including a conspicuous cloud over the outer cross-vein, are dark brown.

Originally described from North Queensland and very possibly will yet be found in New Guinea.

LAMPROGASTER (LAMPROGASTER) ELONGATA van der Wulp.

Tijds. v. Ent., xxviii, 1885, 228.

A common species in New Guinea though not in this collection. Recorded also from Key Island and Molucca. Papua: Itikinumu Plantation (F. P. Dodd).

Lamprogaster (Lamprogaster) macrocephala Hendel.

Abhandl. Zool.-botan. Ges., viii, 1914, 230.

This species is described by Hendel as the most robust species known to him, with an exceptionally large head. It must resemble *grossa* described herein, but the parafacial is wider, about twice as wide as the third antennal segment, and the gena is more than half as high as the eye. In addition to these differences the scutellum is bare on disc, and the wing has a large black-brown mark on the base and the inner cross-vein blackened.

Described from New Guinea and not known to me except from the description.

Lamprogaster fulvipes, n. sp. Pl. v, fig. 31.

♂. Head brown, frons pitchy-black, shiny, with yellowish-dusted line on each side widened in front and carried down over the parafacials, the latter and the genae dark brown, the parafacials glossy on anterior edges. Frons subquadrate, almost half as wide as head; vertex with four moderately strong bristles, the short glossy upper orbits with a bristle; surface hairs short and dark. Face produced slightly below, concave centrally in profile, with irregular transverse striae on upper half. Antennae extending to below middle of face; aristae short-haired to near middle; palpi reddish-yellow, slightly club-shaped, with some fine black bristles on sides. Thorax metallic-blue, without vittae or dust on mesonotum, the pleura slightly brown-dusted. Mesonotum and scutellum with quite dense depressed stiff black hairs, longer on the sides. Humeral, both noto-pleurals, the supra-alar and postalar bristles present, mesopleural fine but distinct; scutellum short, thick, rounded in outline, convex on disc. Legs fulvous-yellow, without exceptional structure or armature.

Wings yellowish, as usual more distinctly so costally, with a rather faint blackish streak from over inner cross-vein extending towards costa, most marked on the former, and a small dark brown mark on fork of second and third veins; stigma brownish-yellow. Inner cross-vein close to middle of the discal cell; venation as in *pseudoelongata* Malloch, second vein in type specimen with a few setulae on upper side on basal half (Pl. v, fig. 31). Squamae and halteres brownish-yellow. Abdomen deep metallic-blue, glossy, with rather long black hairs. Length 7·5 mm.

Type, New Guinea: Marprik (J. R. Rigby and C. M. Deland). Type in the collection of the School of Public Health and Tropical Medicine, University of Sydney.

Lamprogaster laeta Walker.

List Dipt. Ins. Brit. Mus., pt. iv, 1849, 805 (*Chromatomyia*).

Hendel placed this species in his key to the species of this genus, but stated that he believed it belongs to *Duomyia*. It is an Australian species and he is probably correct in his conclusion, though I have not seen the insect.

Lamprogaster (Lamprogaster) taeniata van der Wulp.

Tijds. v. Ent., xxviii, 1885, 229.

Described from Molucca and not known to Hendel or myself, except from description.

Euprosopia Macquart.

Dipt. Exot., Suppl. ii, 1847, 89.

In 1881 Osten-Sacken proposed the generic name *Notopsila* to supplant *Pachycephala* Doleschall, the latter name being preoccupied, the genotype named being *mohnikei* Doleschall. In 1924 Enderlein proposed for this same concept the name *Oncoscelia*, again as a substitute for *Pachycephala*, apparently having overlooked Osten-Sacken's previous action. In 1931 I dealt with this matter briefly and, in addition, singled out certain segregates of *Euprosopia* without proposing the use of distinguishing names for any of them. Enderlein went farther than Osten-Sacken and erected the genus *Lepidocompsia* for the reception of two New Guinea species, *impingens* Walker and *fusifacies* Walker. The characters used to distinguish this concept consisted of the presence of broad spindle-like scales on the abdomen, and of long hairs on the entire extent of the aristae. He also proposed a new genus, *Tetrachaetina*, for a new species, *burgersiana*, and *E. brevicornis* Hendel, the distinguishing character being the 4-bristled scutellum. His new species was from New Guinea (see under *innocua*, n. sp.).

It must be obvious that the proposal of new genera, on the basis of characters such as those listed and used by Enderlein for his new concepts in a genus that contains such a large number of species with all sorts of combinations of these and similar characters, places no limit upon the number of genera that may be suggested except the number of species involved. The application of such criteria necessarily renders valueless such generic concepts insofar as indices to relationships are concerned. I therefore do not make use of Enderlein's genera herein.

Below I present a key to the species of *Euprosopia* from New Guinea.

Key to the Species.

1. Thorax dull brownish-black, with five golden-yellow vittae, three on the mesonotum and one on each pleuron; the abdomen brownish-black, with a dorsocentral parallel-sided bright yellow vitta 2

Thorax and abdomen not vittate with bright yellow 3

2. Wing greyish-hyaline with three narrowly separated black or brown fasciae on the apical half that are fainter and slightly attenuated behind, the basal one connected near the costa with a streak from base of wing in the subcostal cell and the preapical one connected with an apical blackish spot; aristae of the male slightly widened at apices; vertex with two bristles .. *tigrina* Osten-Sacken

Wing with numerous small fuscous spots basally, becoming more numerous to middle, and from there to apex the membrane dark brown, with a few transverse linear hyaline streaks in the field, two series of the latter forming slightly interrupted fasciae between the outer cross-vein and the tip; aristae of male hair-like at apices; vertex with two bristles and two short fine hairs .... *aureovitta*, n. sp.

3. Scutellum more or less distinctly emarginate or concave at apex; abdomen yellowish-red in ground-colour, with ochre-yellow dusting; inner vertical bristles lacking, outer pair very small; aristae haired, not spatulate at apices in male; scutellum with 6 marginal bristles .... *rufiventris* Hendel

Scutellum regularly rounded at apex; abdomen black or blackish-brown 4

4. Wings dark brown, with many small hyaline or yellowish transverse marks in the cells extending in most cases entirely across the cell, sometimes almost or entirely divided centrally and then forming two series of small spots against the veins; small species usually much less than 7 mm. in length 4*a*

Wings either hyaline with entire or broken dark fasciae, or with brown or black spots; species normally much more than 7 mm. in length 7

4*a*. Only 3 or 4 hyaline marks in first posterior cell, which extend entirely across the cell; fore femur (♀) with 2 or 3 short stout preapical bristles on the posteroventral surface; fifth vein bare above; prescutellar acrostichals lacking; pleura without yellow-dusted vittae .... *minuta*, n. sp.

More numerous hyaline marks in first posterior cell, mainly consisting of small paired spots opposite each other against the veins; fore femur with some fine bristles on the apical half or more of the posteroventral surface; prescutellar acrostichals present; pleura with one or more golden-yellow-dusted vittae ... 5

5. Fifth wing-vein closely setulose on the entire extent of posterior basal and discal cells above; pleura with a short golden-yellow vitta on upper margin and a complete similarly coloured vitta on lower margin of mesopleura; vertex with four bristles, the inner pair the shorter .... *setinervis,* n. sp.
Fifth vein not setulose above on entire extent of posterior basal and discal cells: pleura with a complete golden-yellow central vitta and a short one on upper margin and a third one on upper edge of the sternopleura 6
6. Vertex with four strong bristles .... *miliaria* Hendel
Vertex with but two strong bristles .... *dubitalis,* n. sp.
7. Face with a black or dark brown streak on each side, at least from the antennal fovea to the epistome 8
Face yellow or grey, without a black streak on each side from antennal fovea to the epistome 10
8. No dark vitta over the middle of the discal cell of the wing; palpi black; scutellum with 4 marginal bristles; abdomen of the male without yellow lanceolate scales; wing with two outstanding dark fasciae among the other markings, the inner one wide on the costa and falling over the outer cross-vein, the outer one narrower and not extending to the hind margin, the apex with a rounded black spot, the basal half with numerous small dark spots in the cells .... *bilineata* de Meijere
A dark vitta extending over the inner cross-vein and the middle of the discal cell of the wing, other characters of markings not as above 9
9. The dark fascia over the outer cross-vein connected with the preapical one before attaining the hind margin of the wing; inner vertical pair of bristles lacking; aristae of the male without an apical palette .... *impingens* Walker
The two dark fasciae above referred to not connected behind; inner vertical pair of bristles present; aristae of male with a lanceolate apical palette .... *fusifacies* Walker
10. Tarsi entirely black, or at most only the base of the mid metatarsus brownish 11
At least all the metatarsi except their extreme tips yellow 13
11. The dark fascia over the outer cross-vein of the wing broken into small spots costally; legs except the tarsi yellow, the femora brownish marked on both sides below at apices; mid metatarsi reddish-brown at bases; fore tibiae of male with a small brush of short thick setulae at apex on the posteroventral surface .... *penicillata* Hendel.
The dark fascia over the outer cross-vein of the wing as in *penicillata,* but the femora almost entirely black .... *innocua,* n. sp.
The dark fascia over the outer cross-vein of the wing complete 12
12. Mesonotum whitish-grey-dusted, with two broad blackish vittae .... *albolineata* de Meijere
Mesonotum olive-grey-dusted, with seven narrow indistinct dark vittae .... *protensa* Walker
13. Abdominal tergites with pale brown preapical or central fascia; hind femora slightly emarginate or concave below centrally .... *potens* Walker
Abdominal tergites with four brown discal spots; hind femora slightly thickened, not emarginate or concave below centrally .... *ventralis* Walker

N.B.—There are several species that occur in Australia and in some of the adjacent islands that may yet be found in New Guinea. It will thus be necessary to take these into consideration in making identifications in the genus. One such species that is closely similar to *impingens* occurs in the Solomon Islands and may occur also in the territory now under consideration.

EUPROSOPIA TIGRINA Osten-Sacken.

Ann. Mus. Civ. Stor. Nat. Genov., xvi, 1881, 473.

The golden-yellow vittate thorax is not unique for this species in this genus, there being several others with that character known to me, but, taken in conjunction with the dark vittate wing, the characters readily separate it from any other now before me.

Known only from New Guinea. I have seen specimens, but have none before me at this time.

EUPROSOPIA RUFIVENTRIS Hendel.

Abhandl. Zool.-botan. Ges., viii, 1914, 334.

This is the only species of the group with emarginate apex to the scutellum known from New Guinea. I have seen one of the group from the Solomon Islands and several from Malaya.

Described from New Guinea and not subsequently recorded.

EUPROSOPIA MINUTA, n. sp. Pl. v, fig. 32.

♀. The smallest species of the genus known to me, distinguished from all the others by the blackish-brown wings with their transverse hyaline markings in the cells (Pl. v, fig. 32).

Head brownish-yellow, occiput fuscous, with grey dust, frons red on each side of central stripe except in front, the orbits and triangle grey-dusted; antennae yellowish-brown; face with a small dark spot on epistome below and slightly mesad of each fovea, the prelabrum with a similar spot on each side; palpi orange, with dark tips. Frons at vertex not depressed, about one-third of the head-width, a little more than that in front, and about 1·25 times as long as its anterior width; vertex with four bristles. Antennae about two-thirds as long as face, third segment about three times as long as wide; arista very short haired on basal fourth or less. Edges of facial carina not sharp. Gena about one-sixth as high as eye.

Thorax dull black, quite densely grey-dusted, mesonotum with five dark brown irregular vittae, submedian pair broken at suture and notched on inner edge behind suture, the sublateral pair broken at suture. Pleura pale-grey-dusted, dull black above; scutellum with a large dark brown discal spot. Hairs black, rather strong on pleura. Bristles as follows: 1 humeral, 2 notopleurals (and some long setulae at base of the posterior one), 2 post-alars, and a pair of dorsocentrals; scutellum convex on disc, rounded in outline, with numerous dark discal hairs and 4 marginal bristles. Legs black, hind tibiae centrally sometimes brownish, all metatarsi except the extreme apices whitish-yellow.

Wings brownish-black, marked as in Plate v, figure 32. Stigma entirely brown, nearly as long as the third section of the costa; fourth vein almost straight on apical section, its tip almost imperceptibly turned up; inner cross-vein at about one-third from base of discal cell; fifth vein bare above. Squamae brown. Halteres yellow. Abdomen black, dull, grey-dusted at bases of the tergites. Genital cone very broadly leaf-like. Length, 4 mm.

Type and 1 paratype, Papua: Kokoda, 1,200 feet, August 1933 (L. E. Cheesman).

EUPROSOPIA MILIARIA Hendel.

Abhandl. Zool.-botan. Ges., viii, 1914, 353.—*Platystoma pectorale* Walker, *Jour. Proc. Linn. Soc. Lond.*, vi, 1862, 13.—*Euprosopia diminutiva* de Meijere, *Nov. Guin.*, ix, Zool. livr. 3, 1913, 368.

The above synonymy is that given by Hendel in his work on the Platystominae, but I have some doubts as to the correctness of his deductions. Until I had the opportunity of examining the present collection I considered there was but one small species with the peculiar type of wing markings shown for *miliaria* by Hendel (Pl. 2, fig. 41). Now I have four very similar species, three of which are dealt with herein.

Hendel's species I have been able to determine from his photograph of the wing and his statement that there are four strong vertical bristles and three golden-yellow-dusted vittae on the pleura. One specimen agreeing with these characters, a male, is before me. It has a lanceolate apical aristal palette, and there are some very short hairs or pubescence on the basal fifth of the upperside of the aristae. Hendel gives the aristae as bare. The fifth ventral segment of the abdomen is furnished with a clump of about 8 downwardly-directed black bristles on each side at apex, a character found in two of the other closely allied species of which I have males. The hairs on the underside of the basal section of the stem vein of the wing are indistinguishable in *miliaria*, and there are no setulae on the upperside of the fifth vein along the discal cell, but the latter may have been rubbed off. The extreme apex of the first posterior cell is dark brown.

Originally described from Isle of Lakes in the Papuan region. One male. New Britain (Dr. Heydon).

Euprosopia dubitalis, n. sp. Pl. v, fig. 33.

♂, ♀. Very similar to *miliaria* as above accepted, differing essentially as follows: Vertex with but the two outer bristles present; basal section of stem vein of the wing with short fine hairs below. Both species have a transverse series of bristles on the hind margin of the mesonotum, the outer one on each side being the posterior postalar, the others the dorsocentrals and prescutellar acrostichals. Length, 5–6·5 mm.

Type, male, Aitape, Oct.–Nov. 1936 (L. E. Cheesman), allotype, Vanimo (F. H. Taylor), New Guinea.

Euprosopia setinervis, n. sp. Pl. v, fig. 34.

A smaller and darker species than either of the other two, with wing markings more distinctive (Pl. v, fig. 34), and only two golden-dusted pleural vittae.

♀. Face largely blackened, and the third antennal segment darkened above. The latter is shorter than in the other two species and the arista is much more distinctly haired, the longest hairs on the basal fifth being about half as long as the width of the third antennal segment. Vertex with four bristles, the inner pair the shorter. Gena about one-tenth as high as the eye. Mesonotum much darker than in the other two species, the yellowish-grey-dusting less dense and the seven dark vittae inconspicuous. Bristling as in *miliaria*, the hairs on disc of mesonotum and on most of the pleura dark, those on the pteropleura and the margins of the mesonotum and scutellum yellow. Legs black, basal two-thirds of all tibiae fulvous-yellow, all metatarsi except their extreme apices whitish-yellow.

Wings dark brown, with many small hyaline spots, becoming short transverse streaks in the cells apically (Pl. v, fig. 34). First, third and fifth veins closely setulose above, the fifth on the entire extent of posterior basal and discal cells, third more widely setulose below almost to its apex; first posterior cell slightly narrowed at apex. Halteres yellow. Abdomen shiny black, with less dense grey-dusting than in the other two species, the dust most distinct across bases of the tergites, each tergite with a large poorly-defined black mark on each side, hairs and bristles black. Length, 5 mm.

Type, West New Guinea: Mt. Nomo, south of Mt. Bougainville, 700 feet, February 1936 (L. E. Cheesman).

This is the only species known to me in this genus in which the fifth vein is setulose on the extent of the posterior basal and discal cells.

Euprosopia bilineata de Meijere. Pl. v, fig. 35.

Nov. Guin., v, Zool. livr. 1, 1906, 92; op. cit., ix, 1913, 367.

Originally described from New Guinea and not since recorded. One male which I refer here agrees with the rather brief description. The frons has a narrow brown central vitta, the face has a rather broad dark brown streak in the lower half of each fovea that extends over the sides of the prelabrum. The antennae descend to lower level of the eye, and the aristae are long-haired on their basal halves. There are but two vertical bristles. Thorax quite densely whitish-grey-dusted, the mesonotum with two uniformly wide black vittae that extend over the sides of the scutellum, pleura entirely grey-dusted. Scutellum with two short and two long apical bristles. Abdomen entirely pale-grey-dusted, quite densely covered with moderately long whitish-yellow hairs and without scales. Legs with the exception of the yellowish basal halves of the tibiae entirely black. Wings as in *fusifacies*, but the fascia proximad of the one over the outer cross-vein is broken into numerous spots and the apical spot is but narrowly or not at all connected with the preapical fascia; the markings are also paler than in *fusifacies* and *impingens*.

Dutch New Guinea: Cyclops Mts., Sabron, 930 feet, April 1936 (L. E. Cheesman); New Guinea: Marprik (C. M. Deland and J. R. Rigby) one female; Papua: Mt. Lamington (Northern Division) one specimen, July 1927 (C. T. McNamara).

EUPROSOPIA PROTENSA (Walker). Pl. v, fig. 36.

Jour. Proc. Linn. Soc. London, vii, 1864, 228 (*Platystoma*).

New Guinea: Vanimo, Wewak (F. H. Taylor).

EUPROSOPIA POTENS (Walker). Pl. v, fig. 37.

Op. cit., vi, 1862, 12 (*Platystoma*).

This species has the face yellow, the thoracic dorsum olive-grey-dusted, with three, five, or seven, narrow dark vittae, and the abdomen with a pale brown fascia near the apex of each tergite, usually quite indistinct. The wings are hyaline, with a slight yellowish tinge, and numerous almost evenly distributed pale brown spots. There is no noticeable anterior prolongation of the tegulae, the scutellum has six bristles, the anterior pair rather high-placed. There are no scales on the dorsum of the abdomen in either sex.

New Guinea, Key Is., Ternate, Gilolo, and Molucca. A long series from Wewak, New Guinea (F. H. Taylor); four specimens, Dutch New Guinea, Cyclops Mts., Sabron, 930 feet, April–June 1936 (L. E. Cheesman).

EUPROSOPIA VENTRALIS (Walker). Pl. v, fig. 38, 39.

Op. cit., iii, 1859, 131 (*Lamprogaster*).

I have a female that I refer here, though the character of the maculation of the dorsum of the abdomen is not distinguishable owing to its being crushed. However, from the citation of other characters by Hendel, I am certain that my identification of the species as the one he accepted as *ventralis* is correct. The thorax and abdomen are darker in ground-colour, with the black interrupted vittae on the former much more developed. The small black spot at the apex of the subcostal vein is larger and more intense than in *potens*, and there is a short blackish streak over the inner cross-vein that is not present in that species, there being only a short transverse line through the vein. The preapical blackish fascia on the wing in *ventralis* is also entire, the one over the outer cross-vein is almost so and both are darker and more definitely fasciform than are the rather broken markings in *potens*. In neither sex is the hind femur concave below, and the mid and hind pairs are more noticeably browned apically than in *potens*. Though it may not be constant, I may mention that in my specimen of this species the inner pair of vertical bristles is much smaller and more incurved than in the females of *potens* before me.

Originally described from Key Island, and subsequently recorded from New Guinea by Hendel. One female, Dutch New Guinea; Cyclops Mts., Sabron, Camp 2, 2,000 feet, May 1936 (L. E. Cheesman).

EUPROSOPIA IMPINGENS (Walker). Pl. v, fig. 40.

Op. cit., viii, 1865, 134 (*Platystoma*).—*Euprosopia fusifacies* de Meijere, *Nov. Guin.*, v, Zool. livr. 1, 1906, 92; op. cit., ix, Zool. livr. 3, 1913, 367; Edwards, *Trans. Zool. Soc. Lond.*, xx, pt. 13, 1915, 416.

The black mark on either side of the lower edge of the face, and the conspicuous V-shaped black mark on the apical third of the wing, which has both extremities widened, readily distinguishes this species from its nearest allies. The tegulae are not at all produced forward and the aristae are long-haired on their basal two-thirds. Abdomen with many yellow lanceolate scales on the dorsum.

Described from New Guinea. Two females, Kavieng, and Put Put, New Ireland (F. H. Taylor), and four from Dutch New Guinea: Cyclops Mts., Sabron, 930 feet, May–June 1936 (L. E. Cheesman).

EUPROSOPIA FUSIFACIES (Walker). Pl. v, fig. 41.

Op. cit., iii, 1859, 113 (*Platystoma*); Osten-Sacken, *Ann. Mus. Civ. Stor. Nat. Gen.*, xvi, 1881, 473.—*Euprosopia squamifera* de Meijere, *Nov. Guin.*, ix, Zool. livr. 3, 1913, 368.

This species is very similar to the preceding, but differs in having the fasciae of the wings as stated in the foregoing key to the species. Both sexes have lanceolate scales on the dorsum of the abdomen.

Originally described from Aru Islands and subsequently from New Guinea. A pair, Papua: Kokoda, 1,200 feet, April 1933 (L. E. Cheesman); Mt. Lamington (Northern Division), five specimens (C. T. McNamara).

EUPROSOPIA PENICILLATA Hendel.

Abhandl. Zool.-botan. Ges., viii, 1914, 343; Edwards, *Trans. Zool. Soc. London*, xx, pt. 13, 1915, 416.

Very like *potens* Walker, differing as specified in the foregoing key to species.

Described from New Guinea: Huon Gulf; Dutch New Guinea: Wataikwa River. Unknown to me except from the description.

EUPROSOPIA AUREOVITTA, n. sp. Pl. v, fig. 42.

♂, ♀. Readily distinguished from any other species of the genus by the dull brownish-black thorax with the three broad densely yellow-dusted mesonotal vittae, the central one continued over the scutellum and the others sublateral and continued down over the postalar declivities, and the single similarly-dusted vitta on the pleura from below the anterior spiracle to the posterior margin of the pteropleura. Wing dark brown, with hyaline spots in the cells, becoming sparser and smaller apically (Pl. v, fig. 42).

Head brownish-yellow, with a yellowish-white-dusted line round the entire eye-margins, centre of frons reddish-brown, face with a brown line from lower part of each antennal fovea to epistome, occiput largely grey; third antennal segment brown above; palpi brown at tips. Antennae extending about two-thirds of the distance to epistome; aristae short-haired on basal fifth or less, without an apical palette in either sex. Outer pair of vertical bristles strong, inner pair short and fine. Height of head barely greater than its greatest width in front; frons slightly narrowed and a little depressed above, about 1·5 as long as wide; gena about one-eighth as high as eye.

Thorax of male with the following bristles: 1 humeral, 2 notopleurals, 1 supra-alar, 2 postalar, and 1 pair of dorsocentrals, the prescutellar acrostichals lacking; scutellum with 4 bristles, the outer pair well in front of the apicals and rather highly placed. In the female the humeral is minute and the notopleurals are hardly larger, the posterior one being directed forward and upward. Tegulae of male normal, those of the female rather noticeably produced forward. Hairs black, yellow on central yellow vitta and on the pteropleura. Legs black, femora grey-dusted, fore coxae and basal two-thirds or more of all tibiae brownish-yellow, all metatarsi whitish-yellow except their apical fifth. Fore femur with a series of posterodorsal bristles and a few finer bristles on the apical half of the postero-ventral surface.

Wings as in Plate v, figure 42. No costal bristle at the break basad of the humeral cross-vein, nor hairs on the underside of the stem vein on its basal section; fourth vein slightly forwardly bent at apex, inner cross-vein oblique. Halteres yellow. Squamae brownish-yellow, edge of the upper one with narrow black line. Abdomen blackish-brown, dull, with a broad, complete dorsocentral vitta of yellow dust, the hairs on latter yellow, on sides black. Length, 7 mm.

Type male, and allotype, Papua: Mafulu, 4,000 feet, December 1933 (L. E. Cheesman).

EUPROSOPIA INNOCUA, n. sp. Pl. v, fig. 43.

♂, ♀. This species belongs to that group in which the aristae are pubescent on their basal fifth or less, the scutellum has four bristles, and there are no lanceolate scales on the dorsum of the abdomen in either sex. The entirely black tarsi are distinctive.

Head brownish-yellow, the usual grey-dusted line against the eye-margins, face sometimes brownish centrally. Antennae ferruginous, with the third segment brown above; the palpi darkened at apices. Frons narrowed above, about 1·25 times as long as its greatest width, the latter exceeding one-third of the head width. Vertex with 4 strong bristles. Arista of the male with a small broad apical palette. Gena about one-fourth the eye-height.

Thorax brownish-black, pleura paler, mesonotum with greyish-brown dust and 7 inconspicuous dark vittae, the central one entire and most evident, the next pair broken between suture and hind margin, the outer pair obsolete before suture; mesopleura with a brown central mark. Hairs black. Bristles as follows: 1 humeral, 2 notopleurals, 1 supra-alar, 2 postalars (the outer one sometimes duplicated in the female), 1 pair of dorsocentrals, and 1 pair of prescutellar acrostichals. Scutellum with 4 bristles as in the preceding species. Suprasquamal ridge haired in centre. Legs black, mid and hind femora usually reddish-brown in part, at least the mid and hind tibiae reddish-brown except apically. Fore tibia of male with a yellow subnude stripe on the anteroventral surface except at base and apex, the posteroventral surface with dense short slightly lanceolate black bristles on apical sixth. Posteroventral bristles on fore femora of female stronger than in the male. Tarsi black.

Wings greyish-hyaline, with numerous brownish-black spots (Pl. v, fig. 43). Stem vein with some fine hairs below on basal section, costa with a fine bristle below at basal break; fourth vein bent forward at apex; inner cross-vein oblique;

outer cross-vein enclosed in a dark spot. Halteres yellow. Squamae brown, edge of upper one fuscous. Abdomen black, densely olive-grey-dusted, usually with a faint narrow dark apex to tergites 3 and 4 and a brownish central fascia on fifth tergite. The hairs dense, short, and black, longer and yellow on centre and sides of the basal composite tergite. Length, 11–13 mm.

Type, male, allotype, and 7 paratypes, Dutch New Guinea: Cyclops Mts., Sabron, 930 feet, May 1936 (L. E. Cheesman).

It is possible that this is *Tetrachaetina burgersiana* Enderlein, described from the same colony, but there are so many important characters lacking in the brief description of the species, and such probabilities that there are many closely related forms in New Guinea that I have felt compelled to describe this species as new and leave the question of the identity of Enderlein's species to the future. His genus in any event is not tenable, in my opinion.

Another species that should be considered in connection with this one is *penicillata* Hendel. The very brief description given by Hendel states that the scutellum and pleura are distinctly reddish, and the legs are reddish-yellow, with the femora at apices below on both sides brownish-striped, and the tarsi black, only the base of the mid metatarsus brownish. The fifth tergite of the male is only a little longer than the fourth or third. His comparison is with *potens* Walker, which his new species resembles very strongly. In the type male of *innocua* the fifth tergite is about as long as the third and fourth together. The dense short bristles on the posteroventral surface at tip of the fore tibia of the male of the latter could hardly be termed as "Burste" as in *penicillata.*

Euthyplatystoma Hendel.

Abhandl. Zool.-botan. Ges., viii, 1914, 398.

Euthyplatystoma rigidum (Walker).

Jour. Proc. Linn. Soc. Lond., i, 1857, 32 (*Platystoma*).—*Platystoma stellatum* Walker, op. cit., i, 1857, 32.—*Platystoma punctiplenum* Walker, op. cit., v, 1861, 268.—*Platystoma parvulum* Schiner, *Reise Novara*, Zool., ii, 1, Dipt., 1868, 286.

I have seen no specimens of this species from New Guinea, having only one from Celebes, the type locality, and another from Singapore, the last sent me by C. F. Baker.

It may yet be found in New Guinea.

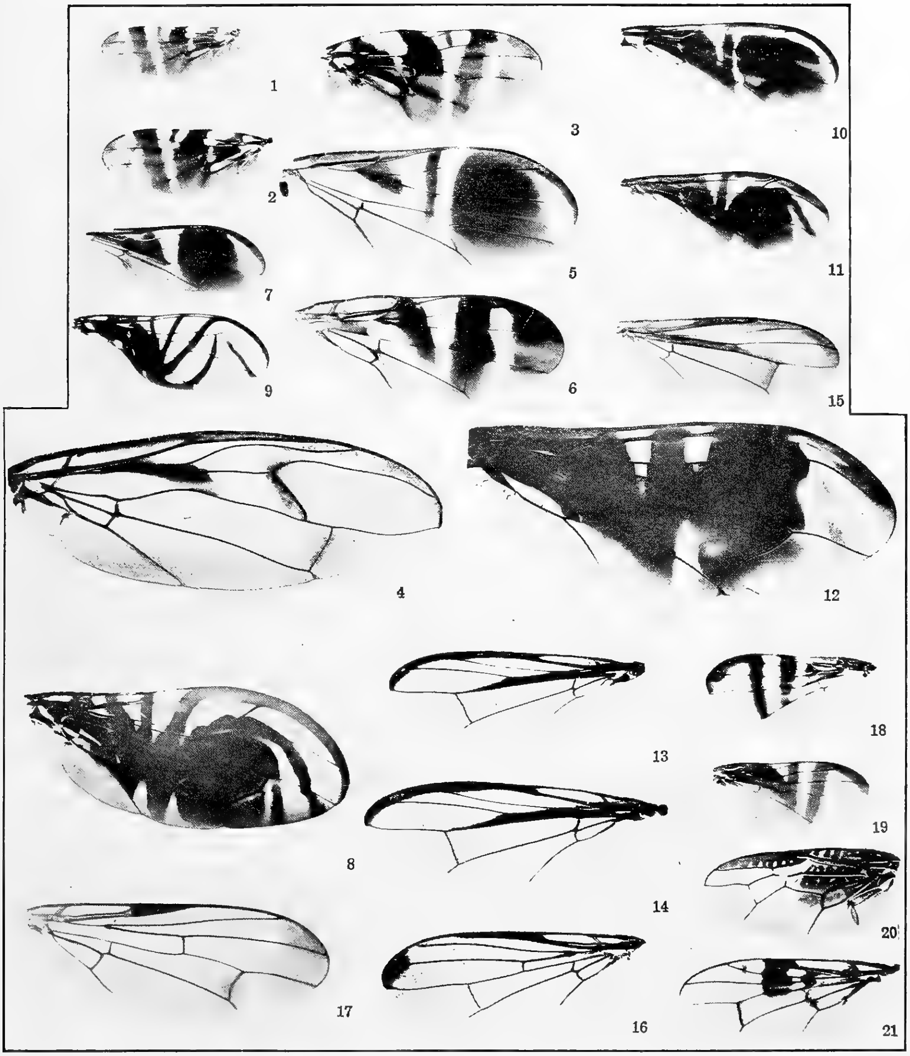
EXPLANATION OF PLATES IV-V.

Plate iv.

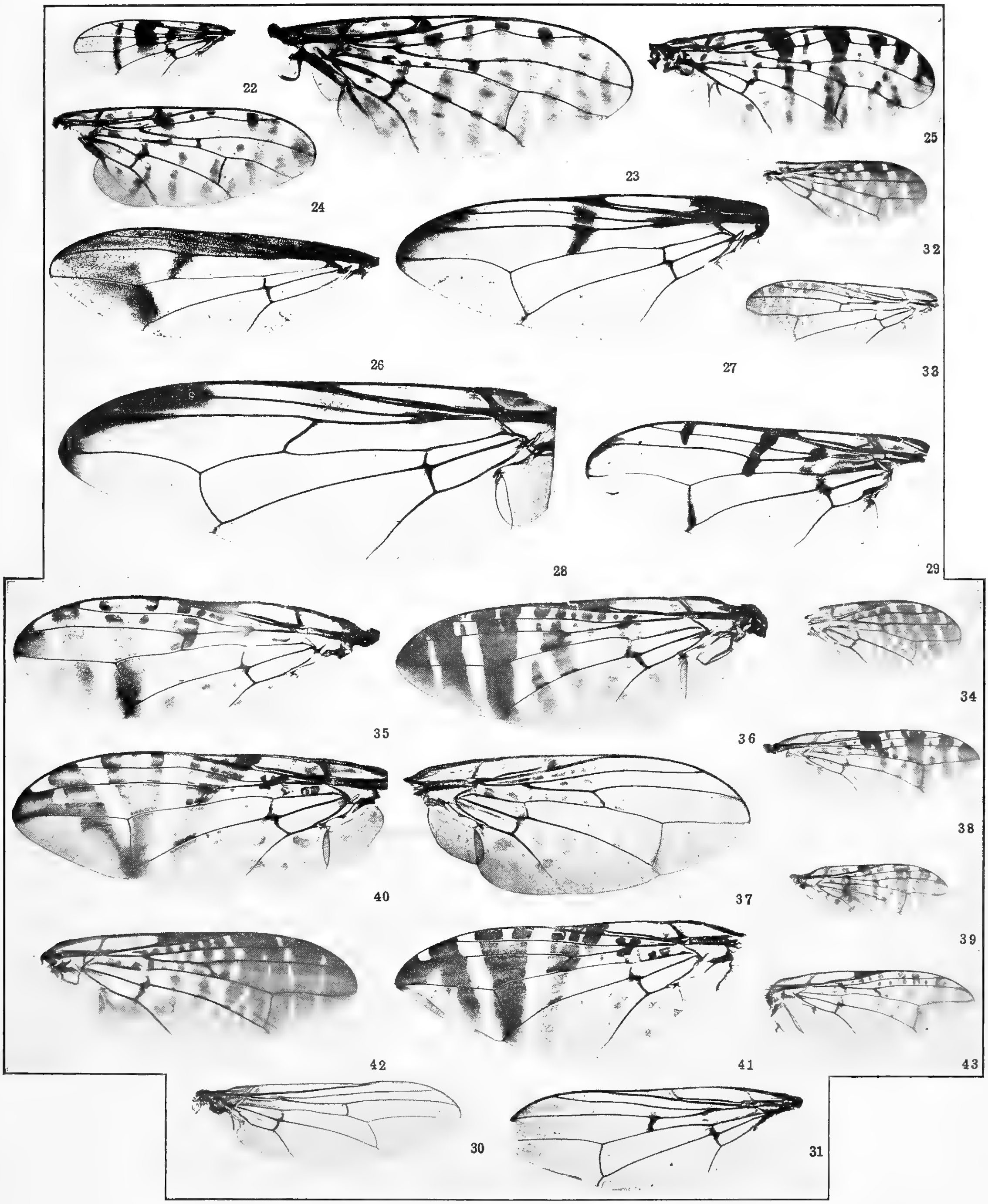
1.—*Dasyortalis complens* (Walker) ♂ co-type. ×12.
2.—*Dasyortalis complens* (Walker). ♀ co-type. ×12.
3.—*Dasyortalis complens* var. *separata*, n. var. type. ×12.
4.—*Antineura* (*Adantineura*) *kerteszi* de Meijere. ×6.
5.—*Pseudocleitamia setigera*, n. sp. type. ×12.
6.—*Euxestomoea bipunctata* Hendel. ×12.
7.—*Cleitamoides latifascia* (Walker) type. ×3.
8.—*Cleitamia astrolabei* Boisd. ×6.
9.—*Cleitamia cyclops*, n. sp. type. ×3.
10.—*Cleitamia cheesmanae*, n. sp. type. ×3.
11.—*Cleitamia excepta*, n. sp. type. ×3.
12.—*Cleitamia delandi*, n. sp. type. ×6.
13.—*Plagiostenopterina* (*Plagiostenopterina*) *aenea* Wied. ×6 app.
14.—*Plagiostenopterina* (*Plagiostenopterina*) *enderleini* Hendel. ×6.
15.—*Plagiostenopterina* (*Stenopterosoma*) *orbitalis*, n. sp. type. ×12.
16.—*Elassogaster evitta*, n. sp. type. ×6.
17.—*Pseudepicausta apicalis*, n. sp. type. ×12.
18.—*Rivellia rufibasis*, n. sp. allotype. ×6.
19.—*Rivellia dimidiata* de Meijere. ×12.
20.—*Asyntona tetyroides* (Walker). ×6.
21.—*Brea contraria* Walker. ×6.

Plate v.

22.—*Brea magnifica* Hendel. × 6.
23.—*Scholastes cinctus* (Guérin). × 6.
24.—*Scholastes aitapensis*, n. sp. paratype. × 6.
25.—*Scholastes taylori*, n. sp. paratype. × 6.
26.—*Achiosoma nigrifacies*, n. sp. type. × 6.
27.—*Achias brachyophthalmus* Walker. × 6.
28.—*Achias australis*, n. sp. type.
29.—*Lamprogaster quadrilinea* Walker. × 6.
30.—*Lamprogaster decolor*, n. sp. paratype. × 6.
31.—*Lamprogaster fulvipes*, n. sp. type. × 6.
32.—*Euprosopia minuta*, n. sp. type. × 12.
33.—*Euprosopia dubitalis*, n. sp. allotype. × 6.
34.—*Euprosopia setinervis*, n. sp. type. × 12.
35.—*Euprosopia bilineata* de Meijere. × 6.
36.—*Euprosopia protensa* (Walker). × 6.
37.—*Euprosopia potens* (Walker). × 6.
38.—*Euprosopia ventralis* (Walker) type. × 3.
39.—*Euprosopia ventralis* (Walker). A small specimen identified by J. R. Malloch. × 3.
40.—*Euprosopia impingens* (Walker). × 6.
41.—*Euprosopia fusifacies* (Walker). × 6.
42.—*Euprosopia aureovitta*, n. sp. type. × 12.
43.—*Euprosopia innocua*, n. sp. type. × 3.



Otitidae from New Guinea.



Otitidae from New Guinea.

THE DIPTERA OF THE TERRITORY OF NEW GUINEA. VIII.

DOLICHOPODIDAE.

Par l'abbé O. PARENT, Ambleteuse.

(*Communicated by Frank H. Taylor, F.R.E.S., F.Z.S.*)

(Thirty-one Text-figures.)

[Read 26th April, 1939.]

I. CAMPSICNEMINAE.

SYMPYCNUS Loew.

Neue Beitr., v, 1857, 42; *Smiths. Misc. Coll.* 171 (Mon. Dipt. North Amer.), Gen. xxxii, 1864, 185.

S. PLUMIPES, n. sp. Fig. 1–3.

♂. Front bleu d'acier brillant. Face à épais satiné blanc, moins large que l'article 3 des antennes. Cils postoculaires inférieurs pâles. Antennes noires, l'article 3 triangulaire arrondi, pas plus long que large, soie glabre, insérée au milieu du bord dorsal. Mesonotum vert brillant, varié de cuivreux, 2 séries mal distinctes de soies acrosticales réduites, 6 d.c., 2 scutellaires, 1 prothoracique noir. Abdomen vert sombre métallique, segment 2 jaune rouge translucide sur la moitié basilaire. Hypopyge noir à appendices peu saillants. Hanches jaunes, II noires, toutes à vestiture noire. Pattes jaune rouge, tarses noirs, II à partir du milieu du protarse. Patte I: tibia, face dorsale, un chète postérieur long, tarse (fig. 1) 1 fois ½ aussi long que le tibia, les articles 1 et 2 filiformes, le protarse un peu plus long que le reste, 2 un peu plus long que les 3 suivants réunis, ceux-ci aplatis dorso-ventralement, et un peu élargis; aux bords antérieur et postérieur avec une plumosité noire. Patte II: femur, un préapical. Tibia, face dorsale, 3 antérieurs, 2 postérieurs; face ventrale, 2 antérieurs. Tarse simple, un peu plus long que le tibia, protarse un peu plus court que le reste. Patte III: femur, un préapical; tarse plus court que le tibia, les articles 1 et 2 courts, 3 le plus long, un peu plus long que les 2 suivants réunis; protarse (fig. 2), face ventrale, avec 2–3 longs cils, 2 avec un appendice vermiforme à l'apex. Ailes (fig. 3) teintées de brun, nervures noires, 3 et 4 à peine convergentes à l'apex; transverse postérieure légèrement plus longue que la section apicale de la 5e. Balanciers jaunes. Cuillerons jaunes à cils noirs. Long: 5 mm.

Femelle inconnue.

N. Guinea: Edie Creek (F. H. Taylor).

II. CHRYSOSOMATINAE.

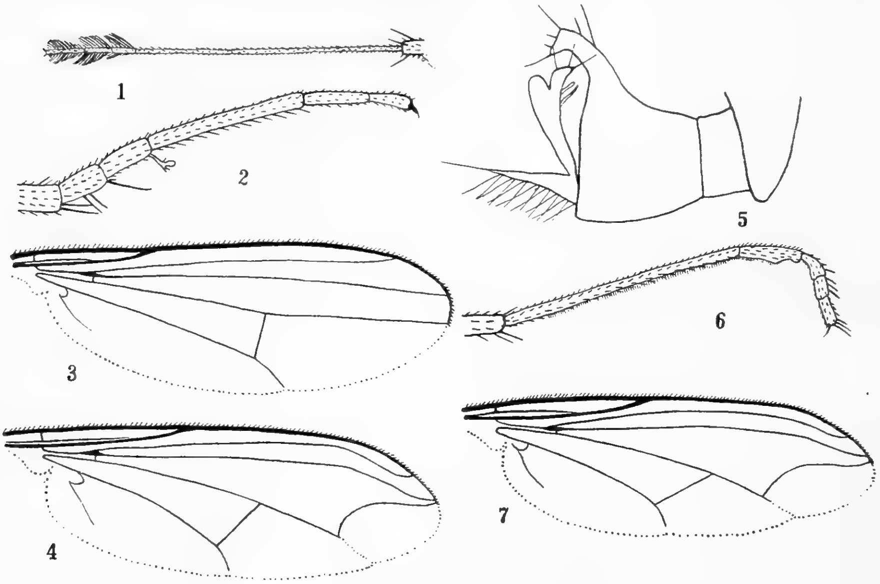
CHRYSOSOMA Guérin.

Voy. Coquille Atlas, vii, 1831, 25.

1. C. ABRUPTUM Walker, *Jour. Proc. Linn. Soc. London*, iv, 1860, 115 (*Psilopus*); *muticus* Thomson, *Eugenies Resa*, Zool., i, Diptera, 1868, 509.
New Britain: Rabaul (F. H. Taylor).

2. C. ATROPURPUREUM, n. sp. Fig. 4.

♀. Front vert bleu brillant, une soie orbitaire. Face à satiné blanc à côtés parallèles, étroite, large comme un tiers de travers d'oeil. Favoris blancs avec 3 chètes noirs près de la bouche. Antennes noires, l'article 3 rouge brique, noir au bord dorsal; soie ventrale de l'article 2 presque aussi longue que l'article 3; celui-ci 1 fois $\frac{1}{2}$ aussi long que large; soie apicale longue comme tête, thorax et écusson



Figs. 1-7.—1-3. *Sympycnus plumipes* ♂, 1, tarse i; 2, tarse iii; 3, aile.—4. *Chrysosoma atropurpureum* ♀, aile.—5-7. *C. barbescens* ♂, 5, hypopyge; 6, tarse i; 7, aile.

réunis. Mesonotum vert brillant, 3 acrosticales longues, 5 d.c., 2 scutellaires. Abdomen très brillant, à part le bord postérieur du segment 2 noir violacé; une seule série transverse de soies. Hanches noires à givré blanc, I à pilosité blanche; au bord externe avec un peigne de 6 épines noires; III avec un chète externe noir, robuste. Trochanters noirs. Femurs noirs, I et II étroitement jaunes à l'apex. Tibia I jaune, II and III noirs. Tarses noirs. Patte I: tibia, face dorsale, 1 chète antérieur près de la racine; tarse un peu plus long que le tibia, protarse presque aussi long que le reste. Patte II: tibia, face dorsale, 2 antérieurs, 2 postérieurs, 3 chètes ventraux, tarse 1 fois $\frac{1}{3}$ aussi long que le tibia, protarse égal au reste. Patte III: tarse un peu plus court que le tibia, protarse égal aux articles 2 et 3 réunis. Ailes (fig. 4) sans tache; transverse apicale naissant à angle droit; transverse postérieure droite. Balanciers jaunes. Cuillerons à cils pâles. Long: 5 mm.

Mâle inconnu.

N. Guinea: Wewak (F. H. Taylor). N. Britain (Dr. Hosking).

3. C. BARBESCENS, n. sp. Figs. 5-7.

♂. Front vert métallique brillant, avec, au coin postérieur, une plage de soies folles noires, s'étendant jusqu'à l'avant. Face violacée brillante, sans poudré, renflée, de largeur moyenne égale aux $\frac{2}{3}$ d'un travers d'oeil. Palpes noirs à pilosité dense, jaune blanc. Favoris longs, jaune blanc. Antennes noires, l'article 2 à chètes dorsaux et ventraux 1 fois ½ aussi longs que l'article 3, celui-ci légèrement plus long que large, ovale, tronqué à l'apex; soie apicale mais insérée au coin dorsal, simple, pas plus longue que tête et mésonotum réunis. Mesonotum vert brillant, 3 acrosticales longues, 2 d. c. à l'arrière, 2 scutellaires. Abdomen vert doré brillant, les segments 3, 4 et 5 avec, à la base, une étroite bande noir mat, une seule série transversale de chètes. Hypopyge (fig. 5) et ses appendices noirs, les externes fourchus, à branche ventrale bilobée à l'apex. Hanches noires, à vestiture blanche. Trochanters et femurs noirs, tibias jaunes, tarses I et II jaunes, noirs à partir de l'apex du protarse, III entièrement noir, le protarse cependant un peu rougeâtre. Tous les femurs, face ventrale, à pilosité blanche, longue comme le travers. Patte I: tibia, face dorsale, 2 chètes minuscules, tarse (fig. 6) un peu plus long que le tibia, protarse plus long que le reste, un peu élargi; à la face ventrale aplati et pelucheux, les autres articles aplatis latéralement, 2 épaissi, échancré ventralement peu avant l'apex. Tarse II à peine plus long que le tibia, protarse plus long que le reste. Patte III: tibia grêle, tarse sensiblement égal au tibia, protarse sensiblement égal au reste. Ailes (fig. 7) sans tache, transverse apicale formant arcature régulière, transverse postérieure pratiquement droite. Balanciers brun noir. Cuillerons blancs à large bordure noire et cils blancs. Long: 5 mm.

Femelle inconnue.

N. Guinea: Aitape (F. H. Taylor).

4. C. COMPRESSIPES, n. sp. Fig. 8, 9.

♂. Front vert métallique, brillant, une touffe dense de longues soies folles noires au coin postérieur. Face à satiné blanc, à côtés convergents vers l'apex, de largeur moyenne égale aux ⅔ d'un travers d'oeil. Favoris blancs. Antennes entièrement noires, les soies de l'article 2 plus courtes que l'article 3, celui-ci triangulaire, un peu plus long que large; soie simple, longue comme tête, thorax et écusson réunis. Mesonotum vert sombre brillant, 3 acrosticales longues, 5 d.c. dont les deux postérieures seules développées, 2 scutellaires. Abdomen vert sombre, brillant, les segments noir mat, dans leur moitié basilaire, pilosité noire assez longue, une seule série transversale de chètes. Hypopyge (fig. 8) et ses appendices noirs, les externes fourchus. Hanches noires, I à pilosité blanche longue, 3 soies apicales noires, III à pilosité blanche, une soie externe noire, robuste. Trochanters jaune brun. Femurs noirs, tibia I jaune rouge, II jaune brun, III noir, tarses noirs. Patte I: femur, face ventrale, deux séries divergentes de soies blanches, de longueur décroissante vers l'apex, les basilaires au plus aussi longues que le travers. Tibia inerme. Tarse un peu plus long que le tibia, protarse égal au reste, face ventrale, avec une série de chétules courts, les 4 articles suivants aplatis latéralement et élargis, les articles 2, 3 et 4 d'égale longueur. Patte II: femur, face ventrale, ligne médiane, sur les ⅔ basilaires, une série dense de soies fines, blanches, rigides, aussi longues que le travers; ligne antérieure et postérieure, sur la moitié apicale, une série de soies rigides, noires, au moins aussi longues que le travers, les postérieures moins développées. Tibia, face dorsale, 2 chétules antérieurs, 1 postérieur. Tarse un peu plus long que le tibia; protarse plus long que le reste. Patte III: femur, face ventrale, une série de soies blanches peu remarquables. Tarse plus court que le tibia, protarse un peu plus court que le reste. Ailes (fig. 9) (les deux exemplaires sont immatures) brunies au bord antérieur, les transverses apicale et postérieure nimbées de brun. Costa non ciliée; transverse apicale naissant à angle légèrement obtus; transverse postérieure légèrement sigmatiforme. Balanciers noirs. Cuillerons noirs à cils noirs. Long: 6 mm.

Femelle inconnue.

N. Guinea: Vanimo (F. H. Taylor).

5. C. FASCIATUM Guérin, *Voy. Coquille*, Zool. ii (2) i, 1838, 293 (*Agonosoma*).
New Guinea: Wewak, Aitape (F. H. Taylor).

6. C. FISSILAMELLATUM, n. sp. Fig. 10, 11.

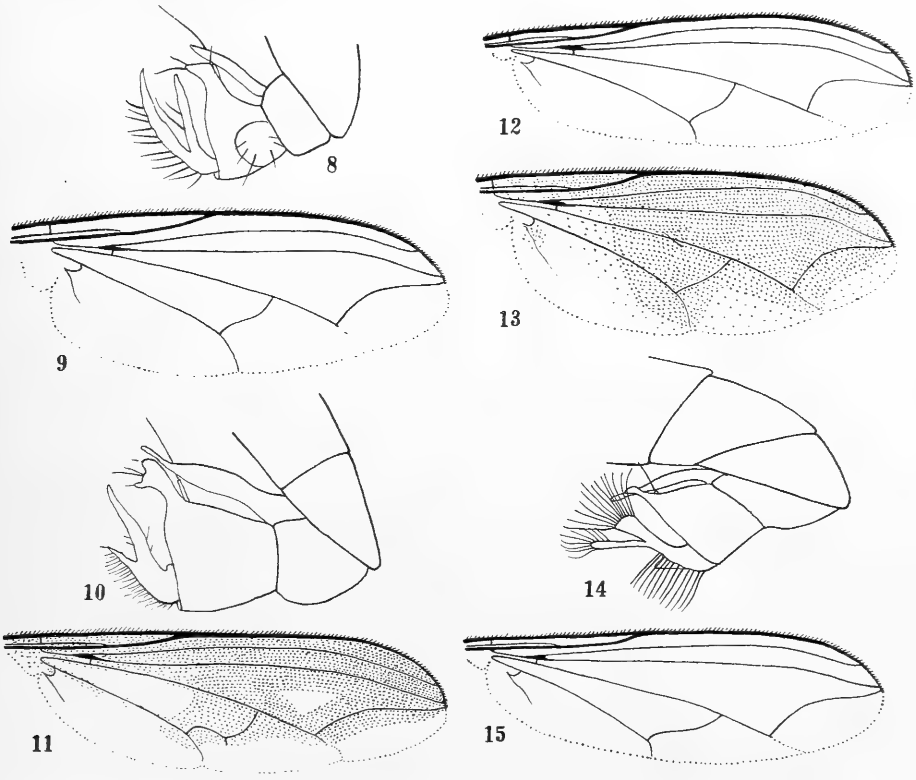
♂. Front violacé brillant, une soie orbitaire minuscule, arquée. Face verte, à satiné blanc, de largeur moyenne égale aux $\frac{2}{3}$ d'un travers d'oeil. Favoris blancs. Antennes noires, article 2 à soie ventrale, un peu plus longue que l'article 3, celui–ci 1 fois $\frac{1}{2}$ aussi long que large; soie apicale simple, longue comme thorax et écusson réunis. Mesonotum assez brillant, noir pourpre; flanquant extérieurement les soies d.c. une bande longitudinale vert bleu; 4 acrosticales longues, 2 d.c. à l'arrière, 2 scutellaires. Abdomen plutôt terne, vert, les segments noir mat sur la moitié basilaire, une seule série transverse de chètes, pilosité courte, dressée. Hypopyge (fig. 10) et appendices noirs, les externes fourchus, la branche ventrale plus longue que l'autre. Pattes entièrement noires. Hanche I à pilosité blanche; trois soies apicales noires, III avec plusieurs soies externes dont une noire. Patte I: femur, face ventrale, sur le tiers basilaire, 4–5 soies noires rigides, longues 2 fois comme le travers, disposées en deux séries irrégulières; au delà, deux séries divergentes de soies blanches plus longues que le travers. Tibia: 3 chètes postérieurs remarquables, 2 chètes dorsaux, quelques chétules ventraux. Tarse 1 fois $\frac{2}{3}$ aussi long que le tibia, protarse presque aussi long que le tibia, un peu plus long que le reste. Patte II: femur, face ventrale, à villosité blanche, un peu plus longue que le travers. Tibia, face dorsale, une ciliation fine, droite, aussi longue que le travers, se continuant sur tout le tarse; un chète antérieur près de la racine, 2 chètes postérieurs, 2 chètes ventraux. Tarse 1 fois $\frac{1}{3}$ aussi long que le tibia, protarse plus long que le reste; face ventrale, avec une série de chétules épais, espacés. Patte III: femur, face ventrale, une pilosité blanche plus longue que le travers. Tibia à nombreux chètes dorsaux. Tarse égal au tibia, protarse plus long que le reste. Ailes (fig. 11) presque entièrement noires, une tache fenêtre dans la première cellule postérieure; une étroite bande blanche au bord postérieur. Costa non ciliée. Transverse apicale naissant à angle obtus, transverse postérieure fortement S-forme. Balanciers noirs. Cuillerons à cils noirs. Long: 7 mm.

Femelle semblable au mâle.

N. Guinea: Edie Creek (F. H. Taylor).

7. C. FUTILE, n. sp. Fig. 12.

♀. Front vert métallique brillant. Face à satiné blanc, plane, à côtés parallèles, large comme les $\frac{3}{4}$ d'un travers d'oeil. Palpes et trompe jaunes. Favoris blancs. Antennes noires, chète dorsal de l'article 2 long comme l'article 3, celui-ci 1 fois $\frac{1}{2}$ aussi long que large; soie longue comme thorax et écusson réunis. Mesonotum vert métallique brillant, 3 acrosticales grandes, 2 d.c. à l'arrière, 2 scutellaires. Abdomen vert métallique brillant, sans bandes noires; une seule série transverse de chètes, pilosité courte et rare. Hanche I jaune à pilosité jaune, 2 soies noires à l'apex, II et III noires, III avec un vrai chète externe noir. Trochanter I jaune, II et III noirs. Pattes jaunes, femur III noir à l'apex, les tibias confusément noirs à l'apex, III plus largement, tarses I et II noirs à partir de l'apex du protarse, III entièrement. Patte I: femur, face ventrale, sur le quart basilaire, 2 soies chétiformes noires, 1 fois $\frac{1}{2}$ aussi longues que le travers. Tibia, face dorsale, 1 antérieur, 2 postérieurs; face ventrale, 1 antérieur, 1 postérieur. Tarse 1 fois $\frac{2}{3}$ aussi long que le tibia, protarse sensiblement égal au reste. Patte II: tibia face dorsale, 2 postérieurs, 1 antérieur plus développé. Tarse un peu plus long que le tibia, protarse plus long que le reste. Patte III: tarse sensiblement



Figs. 8-15.—8-9. *Chrysosoma compressipes* ♂, 8, hypopyge; 9, aile.—10-11. *C. fissilamellatum* ♂, 10, hypopyge; 11, aile.—12. *C. futile* Par. ♀, aile.—13. *C. latemaculatum* ♀, aile.—14-15. *C. nigrohalteratum* ♂, 14, hypopyge; 15, aile.

égal au tibia, protarse égal au reste. Aile (fig. 12) sans tache, transverse apicale naissant à angle droit et formant une arcature régulière, transverse postérieure légèrement S-forme. Balanciers noirs. Cuillerons à cils blancs. Long: 5 mm.

Mâle inconnu.

N. Guinea: Edie Creek (F. H. Taylor).

8. C. IMPRESSUM Becker, *Capita Zool.*, i, afl. 4, 1922, 173, fig. 138.
New Guinea: Wewak (F. H. Taylor).

9. C. INSULANUM, n. sp.

♀. Front vert métallique brillant, une soie orbitaire. Face à satiné blanc argent, à côtés parallèles, large comme les $\frac{2}{3}$ d'un travers d'oeil. Favoris pâles. Antennes noires, soie dorsale de l'article 2 aussi longue que l'article 3, celui-ci triangulaire un peu plus long que large, soie apicale longue comme le thorax.

Mesonotum vert brillant, 3 acrosticales grandes, 5 d.c., 2 scutellaires. Abdomen vert métallique; une bande noir mat à cheval sur les incisions, une seule série transversale de chètes. Hanche I jaune, à soies terminales noires, II et III noires. Trochanter I jaune, II et III noirs. Pattes jaunes, tarses I et II noirs à partir de l'apex du protarse, III entièrement. Patte I: femur, face ventrale, une série de 5 soies jaunes, de longueur décroissante vers l'apex, les basilaires plus longues que la demi-longueur du femur. Tibia face dorsale, moitié basilaire, 3 longues soies noires, égales. Tarse presque 1 fois ½ aussi long que le tibia, protarse au moins aussi long que le reste, muni de 2 chètes dorsaux antérieurs. Patte II: tibia face dorsale, 2 chètes postérieurs minuscules, 3 antérieurs longs et robustes, face ventrale, 3 chètes dont le proximal long et robuste. Tarse plus long que le tibia, protarse 1 fois ⅓ aussi long que le reste, avec, à la face dorsale, un chète court au tiers apical et, face ventrale, des chétules remarquables. Patte III: tibia face dorsale, 2 chètes antérieurs assez longs. Tarse égal au tibia; protarse égal au reste, muni après le milieu d'un chétule dorsal remarquable, les autres articles comprimés et légèrement dilatés. Aile sans tache; transverse postérieure légèrement S-forme. Balanciers jaunes. Cuillerons à cils jaunes. Long: 4 mm.

Mâle inconnu.

Duke of York Island, off New Britain (Dr. Hosking).

10. C. LATEMACULATUM, n. sp. Fig. 13.

♀. Front vert métallique brillant, une soie orbitaire robuste. Face à côtés parallèles, verte, à satiné blanc, large au plus comme le demi-travers de l'oeil. Trompe noire. Favoris blancs. Antennes noires, soie dorsale de l'article 2 plus courte que l'article 3, celui-ci triangulaire un peu plus long que large; soie un peu plus longue que le mesonotum. Celui-ci vert brillant, 3 acrosticales longues, 5 d.c., les deux dernières plus développées, 2 scutellaires. Abdomen vert métallique, les segments noir mat sur la moitié basilaire, une seule série transversale de chètes peu développés. Hanches noires, I à pilosité blanche, et 3 soies apicales noires, III avec un chète externe noir, robuste. Trochanters et femurs noirs, tibia I jaune rouge, II et III noirs, tarses noirs. Patte I: femur, face ventrale, à courte pilosité blanche, tibia, face dorsale, un chétule minuscule près de la racine. Tarse un peu plus long que le tibia, protarse inerme, égal au reste. Patte II: tibia, face dorsale, 2 chètes antérieurs bien développés, 2 postérieurs, protarse plus long que le reste. Patte III: protarse aussi long que le reste. Ailes (fig. 13) presque entièrement noires, les nervures longitudinales 2 et 3 sinueuses à l'extrémité; transverse apicale naissant à angle droit; transverse postérieure faiblement S-forme. Balanciers noirs. Cuillerons noirs à cils noirs. Long: 6,5 mm.

Mâle inconnu.

N. Guinea: Vanimo (F. H. Taylor).

Remarque.—Cette espèce ne peut se comparer qu'à *nigrilimbatum* Meij. (N. Guinea), *marginale* Walk. = *anthracinum* Beck. (N. Guinea et Kaiser Wilhelmsland) et *latefuscatum* Par. (I. Samoa).

Elle se distingue: (i) de *nigrilimbatum* Meij. dont la femelle seule est connue 1, par la pilosité blanche des hanches I et de la face ventrale du femur I; 2, par le tibia I présentant un seul chétule et non 3; 3, par le contour de la tache alaire. (ii) de *marginale* Walk. 1, par la couleur des cils des cuillerons franchement noirs et non brun clair; 2, par la forme triangulaire de l'article 3 des antennes; 3, par la couleur des tibias; 4, par l'absence de chètes apicaux à la hanche I. (iii) de *latefuscatum* Par. 1, par la couleur des tibias dont seul l'antérieur est jaune; 2, par la transverse postérieure égale au manche de la furca; 3, par la tache de l'aile s'étendant jusqu'à l'apex.

11. C. LUCIGENA Walker, *Jour. Proc. Linn. Soc. London*, iii, 1859, 91 (*Psilopus*). New Guinea: Salamaua (F. H. Taylor).

12. C. NIGROHALTERATUM, n. sp. Fig. 14, 15.

♂. Front vert métallique brillant, une soie orbitaire folle. Face de largeur moyenne égale aux $\frac{2}{3}$ d'un travers d'oeil, épistome renflé, vert doré brillant, clypeus à satiné gris jaunâtre. Favoris jaunes. Antennes noires, article 2 à chète dorsal égal à l'article 3, celui-ci conique, 1 fois $\frac{1}{2}$ aussi long que large; soie apicale, simple, longue comme tête, thorax et écusson réunis. Mesonotum vert terne, 3 acrosticales grandes, précédées de 3–4 minuscules. 2 d.c. postérieures, 2 scutellaires. Abdomen vert doré, une bande noir mat sur les incisions, pilosité courte, une seule série transverse de chètes. Hypopyge (fig. 14) noir, appendices noirs, les externes fourchus à pilosité claire. Hanches noires à vestiture claire, I face antérieure avec une série externe de soies plus robustes à l'apex. Trochanters et femurs noirs; tibias jaune rouge, III progressivement brunis vers l'apex; tarse brun noir, les protarses I et II plus ou moins rougeâtres à la racine. Patte I: femur, face ventrale, une série de soies jaunes, de longueur décroissante vers l'apex, les deux basilaires plus longues, longues comme les $\frac{3}{4}$ de la longueur du femur. Tibia face dorsale, 3 longues soies chétiformes; face ventrale, 1 soie chétiforme vers le milieu. Tarse 1 fois $\frac{2}{3}$ aussi long que le tibia, protarse égal au tibia; sur le tiers basilaire légèrement élargi, aplati ventralement et pelucheux. Patte II: femur, face ventrale, une série de soies fines, rigides, pales, longues 1 fois $\frac{1}{2}$ comme le travers. Tibia, face dorsale, ligne antérieure, 3 soies chétiformes; face ventrale, 1 soie chétiforme longue, au quart basilaire, une courte vers le milieu. Tarse 1 fois $\frac{1}{3}$ aussi long que le tibia, protarse un peu plus long que le reste. Patte III: femur, face ventrale, une ciliation claire comme au femur II, mais un peu plus courte. Tibia, un chète dorsal long au quart basilaire. Tarse un peu plus court que le tibia, protarse égal au reste. Ailes (fig. 15) brunes plus intensément au bord antérieur, sans taches nettes et bien délimitées; transverse apicale plutôt anguleuse, transverse postérieure modérément S-forme. Balanciers noirs. Cuillerons noirs à cils pâles. Long: 6 mm.

Femelle semblable au mâle, l'article 3 des antennes plus développé, presque 2 fois aussi long que large.

N. Guinea: Wewak (F. H. Taylor).

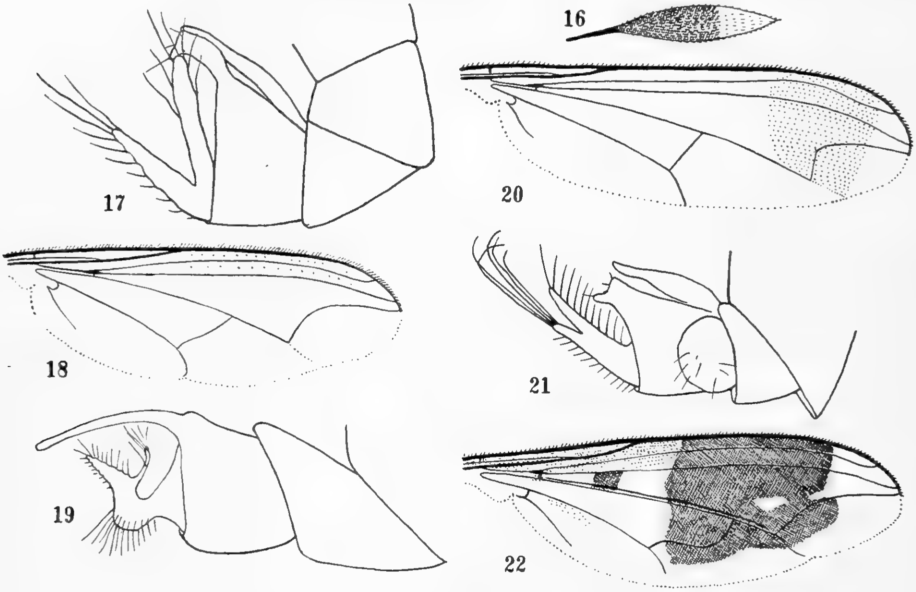
13. C. PAPUASINUM Bigot, *Ann. Soc. Ent. France*, Sér. 6, x, 1890, 283 (*Spathiopsilopus*).

New Guinea: Vanimo, Aitape; New Britain: Rabaul (F. H. Taylor).

14. C. PEXOIDES, n. sp. Fig. 16–18.

♂. Front vert métallique, une soie orbitaire noire, arquée, minuscule. Face verte au fond, à satiné gris blanc, à côtés convergents vers l'apex, de largeur moyenne égale aux $\frac{3}{4}$ d'un travers d'oeil. Trompe jaune. Favoris blancs. Antennes noires, article 2 à soie ventrale 1 fois $\frac{1}{2}$ aussi longue que l'article 3, celui-ci pas plus long que large, triangulaire; soie presque aussi longue que le corps entier, terminée par une palette (fig. 16) fusiforme, 3 fois aussi longue que large, noire sur ses $\frac{2}{3}$ basilaires, blanche au delà. Mesonotum vert bleu brillant, 3 acrosticales grandes, 2 d.c. à l'arrière, 2 scutellaires. Abdomen brillant, cuivreux doré, la moitié basilaire des segments noir mat, le segment 1 bordé de blanc à la marge postérieure; une seule série transverse de chètes. Hypopyge (fig. 17) et ses appendices noirs, les externes fourchus. Hanches I jaunes presque glabres, les soies apicales jaunes; II et III noires, à vestiture pale. Trochanter I jaune, II et

III brun noir. Pattes jaunes, femur III noir sur le huitième apical, tarses I et II noircis à partir de l'apex du protarse, III entièrement noir. Patte I: femur, face ventrale, tout au long, avec une double ciliation rigide noire, le chète basilaire de chaque série remarquablement long, au moins double du travers, le chète suivant au plus aussi long que le travers du femur, les autres de longueur progressivement décroissante vers l'apex. Tibia: un chète dorsal très réduit près de la racine. Tarse presque 1 fois ½ aussi long que le tibia; protarse égal aux 2 articles suivants



Figs. 16-22.—16-18. *Chrysosoma pexoides* ♂, 16, palette antennaire; 17, hypopyge; 18, aile.—19-20. *C. pulverulentum* ♂, 19, hypopyge; 20, aile.—21-22. *C. trichromatum* ♂, 21, hypopyge; 22, aile.

réunis. Patte II: tarse un peu plus court que le tibia, protarse égal au reste. Patte III: tarse plus court que le tibia, protarse un peu plus court que le reste. Ailes (fig. 18) teintées de rouille, plus intensément au bord antérieur. Costa ciliée, transverse apicale naissant à angle droit, transverse postérieure légèrement sigmatiforme. Balanciers jaune pâle. Cuillerons à cils pâles. Long: 6 mm.

Femelle inconnue.

N. Guinea: Wau (F. H. Taylor).

Remarque.—Cette espèce est extrêmement voisine de *pexum* Beck. décrite de N. Guinée et lui est peut-être synonyme. Cependant, si la description de Becker est exacte, elle s'en sépare: (1) par la longueur de la soie antennaire ici presque égale au corps entier, chez *pexum* à peine plus longue que tête et thorax réunis, (2) par la couleur du tibia III jaune et non brun noir, (3) par la forme de l'hypopyge, (4) par la ciliation ventrale du femur I. Ici le chète basilaire de chaque série tranche vigoureusement par sa longueur sur les suivants, chez *pexum* il semble que la décroissance de longueur soit progressive.

15. C. PULVERULENTUM, n. sp. Fig. 19, 20.

♂. Front vert métallique terni par un poudré jaunâtre; une soie orbitaire minuscule. Face verte, à satiné jaune. Trompe jaune. Favoris pâles. Antennes jaune orange, l'article 2 avec une soie dorsale un peu plus longue que 3, celui-ci pas plus long que large; soie apicale, noire, simple, longue comme tête et thorax réunis. Mesonotum bleu métallique terni par un poudré jaune, 3 acrosticales longues, 2 d.c. à l'arrière, 2 scutellaires. Métaépimère jaune. Abdomen partie vert, partie jaune, segment 1 entièrement métallique, 2, 3 et 4 largement tachés de jaune sur les flancs; 5 presque entièrement métallique, le reste entièrement. Hypopyge (fig. 19) vert, à appendices jaunes, les cornes de la capsule très longues, jaunes. Hanches jaunes, II et III tachées de noir à la face externe, toutes à vestiture pale. Trochanters et pattes jaunes, tarse I progressivement noirci, II et III avec les 4 derniers articles noirs. Femurs pratiquement glabres à la face ventrale. Patte I: tibia aplati dorso-ventralement; face postérieure peu avant l'apex, une soie fine, remarquable. Tarse extrêmement grêle, 2 fois $\frac{1}{3}$ aussi long que le tibia, protarse presque 2 fois aussi long que le reste, l'article 5 déprimé, un peu élargi. Patte II: tarse presque 2 fois aussi long que le tibia, protarse 1 fois $\frac{1}{2}$ aussi long que le reste. Patte III: tarse plus court que le tibia, protarse un peu plus long que le reste. Ailes (fig. 20) à nervures noires; costa non ciliée. Transverse apicale naissant à angle un peu aigu, transverse postérieure droite; à l'extrémité de l'aile une tache brune, presque carrée, allant de la costa à la 4e longitudinale et respectant l'apex de l'aile. Balanciers jaunes. Cuillerons jaunes à cils pâles. Long: 5 mm.

♀. Semblable au mâle. En particulier pour le tarse I. Cependant la soie orbitaire est robuste, le protarse III est sensiblement égal au reste du tarse, la tache alaire est à peine indiquée.

N. Guinea: Edie Creek (F. H. Taylor).

16. C. TRICHROMATUM, n. sp. Fig. 21, 22.

♂. Front vert métallique brillant; au coin postérieur un large buisson de soies folles jaunes. Face vert métallique au fond, à satiné gris jaune, de largeur moyenne égale presque aux $\frac{2}{3}$ d'un travers d'oeil. Favoris clairs. Antennes jaune orange, l'article 3 brun au bord dorsal, l'article 2 à soies très courtes, 3 conique, à peine aussi long que large; soie apicale noire, simple, longue comme tête, thorax et écusson réunis. Mesonotum vert métallique assez brillant, une fascie médiane entière, bien délimitée, noir purpurescent; sur les flancs une fascie de même couleur, fragmentée, 4 acrosticales grandes, 6 d.c. dont les 2 dernières seules bien développées, 2 scutellaires. Flancs sombres, à satiné gris blanc. Abdomen cuivreux doré, avec une large bande noire sur les incisions, une seule série transverse de chètes. Hypopyge (fig. 21) noir à appendices noirs, les externes fourchus. Hanches I jaunes, à pilosité jaune, et 3 chètes apicaux noirs, II et III noires, à pilosité pâle, III avec un chète externe noir. Trochanters et pattes jaunes; tibia III brun noir, à part le sixième basilaire; tarses I et II brun noir à partir de l'apex du protarse, III entièrement noir. Tous les femurs, face ventrale, tout au long, avec une pilosité pâle, fine, érigée, longue comme le travers. Patte I: tibia, face dorsale, 2 chètes antérieurs, 3 postérieurs, 2 ventraux. Tarse 1 fois $\frac{1}{3}$ aussi long que le tibia; protarse un peu plus long que le reste. Patte I: tibia, face dorsale, 3 antérieurs, 3 postérieurs, 2 ventraux; tarse sensiblement aussi long que le tibia; protarse presque 2 fois aussi long que le reste. Tarse III un peu plus court que le tibia, protarse sensiblement égal au reste. Ailes (fig. 22) blanches au fond, une grande tache brun noir dans la moitié apicale, une autre beaucoup plus petite au niveau de l'embouchure de la 1e longitudinale. Bord antérieur de l'aile moitié basilaire, jaune rouille. Transverse apicale formant arcature régulière, transverse postérieure fortement S-forme. Balanciers jaunes clair. Cuillerons jaunes, noirs à l'apex, à cils blancs. Long: 8 mm.

Femelle semblable au mâle, cependant tous les tarses brun noir, l'apex du tibia II noirci.

Makada Is., off N. Britain (F. H. Taylor).

MEGISTOSTYLUS Bigot.

Ann. Soc. Ent. France, vii, 1859, 215.

M. LONGICORNIS Fabr. var. LONGISETOSUS Wulp, *Tijds. v. Ent.*, xxv, 1882, 120, Tab. x, fig. 7 (*Psilopus*).

New Britain: Rabaul (F. H. Taylor), Laup (Dr. H. C. Hosking).

SCIOPUS Zeller.

Isis, 1842, 831.

1. S. BASISTYLATUS, n. sp. Fig. 23, 24.

♂. Front vert métallique brillant. Face couverte d'un satiné blanc. Trompe jaune. Favoris blancs. Antennes (fig. 23) jaunes, les articles 1 et 2 largement noirs au bord dorsal, 3 au point d'insertion de la soie; article 3, 1 fois ½ aussi long que large, piriforme; soie simple, insérée à la base du bord dorsal. Mesonotum vert brillant, 2–3? acrosticales longues, 2 d.c. à l'arrière, précédées de soies fines et courtes, 2 scutellaires. Abdomen vert brillant, une large bande noir mat à la base des segments, une seule série transverse de chètes. Hypopyge noir (en mauvais état). Hanches I jaunes, II et III noires, toutes à vestiture pâle. Trochanters et pattes jaunes, au tarse I, article 4 noir, 5 blanc; aux tarses II et III les 4 derniers articles noirs. Tous les femurs pratiquement glabres à la face ventrale. Patte I (fig. 24): tibia, face dorsale, un chète à la racine. Tarse très grêle, 2 fois ⅓ aussi long que le tibia, protarse un peu plus long que le tibia, égal au reste, 2 fois aussi long que l'article suivant; celui-ci un peu plus long que 3, lequel est plus long que 4 et 5 réunis; ces derniers aplatis dorso-ventralement, et élargis; 4 une fois ½ plus long que 5, à plumosité noire ce qui lui donne un contour ovalaire, 5 blanc argent. Patte II: tibia face dorsale, 2 chètes antérieurs dans la moitié basilaire, 1 postérieur près de la racine. Tarse un peu plus long que le tibia, protarse légèrement plus long que le reste. Patte III: tarse nettement plus court que le tibia, protarse légèrement plus long que l'article suivant, les articles 4 et 5 très courts. Ailes sans tache, à nervures noires. Costa non ciliée; transverse apicale naissant à angle droit; transverse postérieure droite, fortement oblique. Balanciers jaunes. Cuillerons noirs à cils jaunes. Long: 5 mm.

Femelle inconnue.

N. Guinea: Sauri, Wewak (F. H. Taylor).

Remarque.—Cette espèce par l'insertion basilaire de la soie antennaire est à rapprocher de l'espèce australienne décrite par Becker sous le nom de *S. anomalicornis.* Elle s'en distingue par de nombreux caractères: couleur des antennes, forme et dimensions relatives de l'article 3 des antennes, les soies acrosticales robustes, les deux derniers articles du tarse I de forme et de couleur différentes.

2. S. OCCULTUS Par., *Encycl. Entom.*, Diptera, vii, 1934, 124; op. cit., viii, 1935, 75.
New Britain: Rabaul (F. H. Taylor). Décrit des Iles Salomon.

3. S. RECTUS Wied., *Ausser. Zweifl. Ins.*, ii, 1830, 225 (*Psilopus*).
New Guinea: Edie Creek (F. H. Taylor).

III. Diaphorinae.

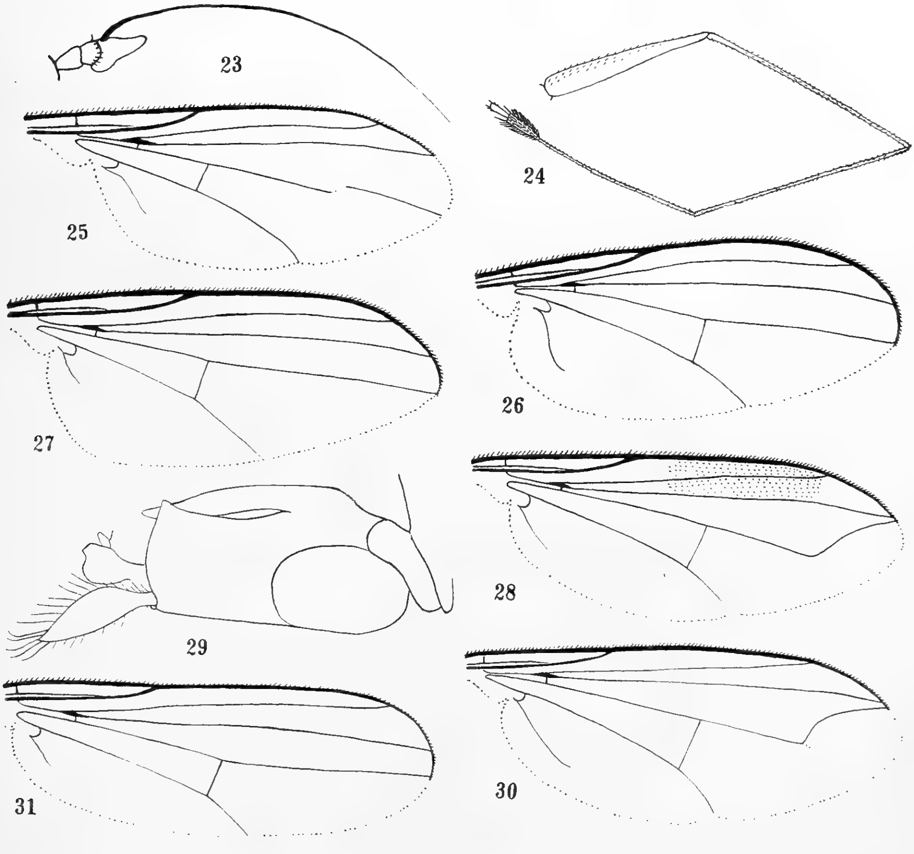
Asyndetus Loew.

Berlin Ent. Zeitschr., xiii, 1869, 35.

1. A. latitarsatus Beck., *Capita Zool.*, i, afl. 4, 1922, 83.
   New Guinea: Wewak (F. H. Taylor).

2. A. porrectus, n. sp. Fig. 25.

♂. Front entièrement terni par un satiné gris blanc; 1 soie orbitaire. Face vue de face, vert métallique, tangentiellement à satiné blanc. Palpes noir profond, porrigés; vers l'apex, élargis en spatule, à pilosité noire, rude et chètes terminaux noirs. Favoris blancs. Antennes noires, l'article 3 nettement triangulaire, presque aigu à l'apex; soie presque basilaire nue. Mesonotum vert clair à givré blanc; acrosticales petites, bisériées, 5 d.c. dont la médiane faible. Abdomen brillant, cuivreux, à givré blanc sur les flancs, 4 macrochètes anaux. Hanches noires, toutes à vestiture noire; III: 1 chète externe noir. Trochanters et femurs noirs,



Figs. 23-31.—23-24. *Sciopus basistylatus* ♂, 23, antenne; 24, patte i.—25. *Asyndetus porrectus* ♂, aile.—26. *Diaphorus fulvifrons*, aile.—27. *D. lateniger*, aile.—28. *Paraclius maculifer* ♀, aile.—29-30. *P. strictifacies* ♂, 29, hypopyge; 30, aile.—31. *Thinophilus taylori* ♂, aile.

tibias I et II jaune rouge, III noir, tarses noirs. Patte I: tibia, 4 chètes dorsaux en une série; tarse à pelotes un peu hypertrophiées; pas de griffes. Patte II: tibia face dorsale, 4 postérieurs, 3 antérieurs, tous robustes; pas de ventral. Tarse: protarse un peu plus long que l'article suivant; pelotes normales, pas de griffes. Patte III: tibia, face dorsale, 4 antérieurs, 4 postérieurs, tous robustes, pas de ventral; protarse un peu plus long que l'article suivant, pelotes normales, pas de griffes. Ailes (fig. 25) grises, nervures noires; la 4e simplement coudée. Transverse postérieure en face de l'embouchure de la 1e. Balanciers jaunes. Cuillerons à cils blancs. Long: 3,5–4 mm.

Femelle semblable au mâle.

N. Guinea: Vanimo (F. H. Taylor).

DIAPHORUS Meigen.

Syst. Beschr. Zweifl. Insekt., iv, 1824, 32.

1. D. ALLIGATUS Walker, *Jour. Proc. Linn. Soc. Lond.*, i, 1857, 121.—Bulolo, N. Guinea (F. H. Taylor).

2. D. FULVIFRONS, n. sp. Fig. 26.

♂. Front à satiné fauve, large comme le tubercule ocellaire. Face à satiné gris jaunâtre. Favoris pâles. Antennes noires, l'article 3 en demi cercle surbaissé; soie à peine pubescente. Mesonotum brillant, vert bleu sombre, 5 d.c., acrosticales bisériées, peu développées. Abdomen brillant, noir bronzé, 4 macrochètes anaux. Appendices hypopygiaux externes noirs. Hanche I noire sur la moitié basilaire, à vestiture noire, II et III noires, III avec un seul chète externe. Trochanters jaunes. Femur I jaune, II noir sur les $\frac{2}{3}$ basilaires, III jaune, noirci sur la moitié apicale, à part l'apex; tibias jaunes; tarses noirs à partir de l'apex du protarse. Femurs sans vestiture remarquable. Patte I: tibia avec 2 chètes dorsaux. Pelotes hypertrophiées, pas de griffes. Patte II: tibia, face dorsale, 2 antérieurs, 2 postérieurs, 1 seul ventral. Pelotes normales, des griffes. Patte III: tibia, face dorsale, 2 antérieure, 4 postérieurs. Protarse à peine plus long que l'article suivant. Pelotes normales, des griffes. Ailes (fig. 26) teintées de rouille; nervures noires. Balanciers jaunes. Cuillerons à longs cils noirs. Long: 5 mm.

Femelle inconnue.

N. Guinea: Edie Creek (F. H. Taylor).

3. D. LATENIGER, n. sp. Fig. 27.

♂. Front gris, en son milieu complètement oblitéré par la coalescence des yeux. Face noire, à satiné gris blanc. Favoris jaunes. Antennes noires, l'article 3 demi-circulaire, soie simple. Mesonotum vert bleu, assez brillant, malgré un léger givré gris blanc; acrosticaux bisériés, bien développés; 5 d.c. Abdomen noir bronzé, le segment 2 entièrement jaune, à vestiture noire, 4 macrochètes anaux bien développés. Hanche I jaune, II et III noires, toutes à vestiture noire; III avec un chète externe noir. Trochanters et pattes jaunes, femur III noir sur sa moitié apicale; tarses I et II légèrement brunis à l'apex, III tombé. Patte I: femur, face ventrale, une double série de soies presque aussi longues que le travers; tibia, face dorsale, un chète postérieur; face postérieure, une ciliation presque aussi longue que le travers. Pelotes hypertrophiées, griffes absentes. Patte II: tibia, face dorsale, 2 antérieurs, 2 postérieurs; face ventrale, un seul chète. Pelotes normales, des griffes. Ailes (fig. 27) de la forme ordinaire au genre. Balanciers jaunes. Cuillerons jaunes à cils noirs. Long: 3, 5 mm.

Femelle inconnue.

N. Guinea: Aitape (F. H. Taylor).

4. D. MAURUS O.-S., *Berl. Ent. Zeit.*, xxvi, 1882, 114.
New Guinea: Wewak (F. H. Taylor).

5. D. SERENUS Beck., *Capita Zool.*, i, afl. 4, 1922, 72.
Makada Is., off New Britain (F. H. Taylor).

IV. DOLICHOPODINAE.

DOLICHOPUS Latr.

Precis Caract. Ins., 1796, 159.

D. ZICZAC Wied., *Analecta* Ent., 1824, 40; *Ausser Zweifl. Ins.*, 1830, 232.
Admiralty Is.: Lombrum (F. H. Taylor).

PARACLIUS Bigot.

Ann. Soc. Ent. France, (3) vii, 1859, 215 and 227 (*Paracleius*).

1. P. MACULIFER, n. sp. Fig. 28.

♀. Front vert bleu métallique brillant. Face à côtés parallèles, à épais satiné blanc, large comme un tiers de travers d'oeil. Cils postoculaires inférieurs blancs. Antennes jaune rouge, l'article 3 noir sur la moitié apicale. Mesonotum vert bleu, peu brillant; fossettes notopleurales noirâtres, précédées d'une bande transversale blanc de neige, interrompue au milieu; 6 chètes scutellaires, les moyens très robustes, les externes de moitié plus courts, les internes croisés. Abdomen vert sombre brillant, les segments noirs à la base, et sur les flancs à givré blanc argent. Hanche I jaune, II et III noires, toutes à vestiture noire. Pattes jaunes, femur III avec un point noir à l'apex, face antérieure; les tarses I entièrement jaunes, II avec les derniers articles noircis, III entièrement noirs. Patte I: tibia, face dorsale, 3 antérieurs robustes, 3 postérieurs faibles. Tarse à peine aussi long que le tibia. Patte II: femur, 1 préapical. Tibia, face dorsale, 3 antérieurs, 3 postérieurs, face ventrale, un antérieur. Patte III: femur, épais, 1 préapical. Tibia, face dorsale, 3 antérieurs, 4 postérieurs; face ventrale, tout au long, une série dense de chètes fins. Protarse égal aux $\frac{4}{5}$ de l'article suivant. Ailes (fig. 28) grises, à nervures noires, une tache brune allant de la costa à la 3e longitudinale, commencant peu après l'embouchure de la 1e et finissant à l'apex de la 2e. Quatrième longitudinale coudée au tiers apical, sa section apicale arquée convexe vers l'avant. Balanciers jaunes. Cuillerons jaunes, à longs cils noirs. Long: 6 mm.

Mâle inconnu.

N. Guinea: Wewak (F. H. Taylor).

2. P. STRICTIFACIES, n. sp. Fig. 29, 30.

♂. Front vert métallique. Face blanche très étroite; en son milieu, réduite à un filet à peine perceptible. Cils postoculaires inférieurs noirs. Antennes noires, l'article 3 pas plus long que large; soie insérée au milieu du bord dorsal. Mesonotum bleu vert métallique, brillant; une tache blanche peu marquée à l'avant des fossettes notopleurales. Abdomen noir, les segments à leur base, à taches latérales rectangulaires blanc argent. Hypopyge (fig. 29) noir, bien développé, à appendices noirs. Hanches noires à vestiture noire. Trochanters I et II jaunes, III noir. Femurs noirs, tibias jaunes, III noir aux deux extrémités; tarses I et II noirs à partir de l'apex du protarse; III entièrement. Patte I: tibia, face dorsale, 4 antérieurs robustes, 3 postérieurs faibles; face ventrale un postérieur, tarse un peu plus court que le tibia. Patte II: femur, 3 préapicaux. Tibia, face dorsale, 4 postérieurs, 3 antérieurs, 1 proprement dorsal près de la racine; face ventrale, 1 antérieur. Patte III: femur 3 préapicaux. Tibia, face dorsale, 4 antérieurs, 4 postérieurs, 1 proprement dorsal formant groupe avec les premiers de chaque série; pas de chètes ventraux. Protarse à peine plus court que l'article suivant. Ailes (fig. 30) hyalines à nervures noires. Segment apical de la 4e un peu avant le tiers apical brusquement coudé à angle droit, la transverse apicale ainsi formée, arquée convexe vers l'avant; la 4e longitudinale au delà du coude se prolongeant en courte spuria comme chez les Chrysosomatinae. Balanciers jaunes. Cuillerons jaunes à cils noirs. Long: 5 mm.

Femelle semblable au mâle.

N. Ireland: Put-Put; Kavieng (F. H. Taylor).

Remarque.—Cette espèce se place à côté de *P. neglectus* Beck. décrit de Palmerston, N. Australia. Elle s'en distingue comme suit:

Article 3 des antennes brun rouge. Yeux non contigus au milieu de la face. Tibia III entièrement jaune. Femurs II et III avec un seul préapical. Quatrième longitudinale non fourchue .... *neglectus* Beck.

Antennes entièrement noires. Yeux pratiquement contigus au milieu de la face. Tibia III noir aux deux extrémités. Femurs II et III avec 2-3 chètes préapicaux. Quatrième longitudinale fourchue comme chez les Chrysosomatinae .... *strictifacies*, n. sp.

V. Hydrophorinae.

Thinophilus Wahl.

Öfvers Kongl. Vet. Akad. Forhandl., i, 1844, 37.

T. taylori, n. sp. Fig. 31.

♂. Front vert métallique assez brillant. Face guère plus large qu'un tiers de travers d'oeil, vert métallique; le clypeus brun fauve. Palpes jaunes à pilosité noire. Favoris jaunes. Antennes noires, l'article 3 brun rouge à la base ventrale, pas plus long que large; soie pratiquement glabre. Mesonotum vert brillant, deux stries bronzées flanquant intérieurement les 2 séries de soies d.c., pas d'acrosticales, 5–6 soies d.c. dont la dernière seule bien développée, 2 scutellaires, pas de prothoraciques. Abdomen brillant, entièrement bleu d'acier; lamelles hypopygiales externes brunes. Hanche I noire, jaune à la face interne, à vestiture noire; II et III noires. Pattes jaune rouge, les tarses noircis à partir de l'apex du protarse. Tarse I un peu plus long que le tibia. Patte II: femur, face ventrale, moitié apicale avec 2 séries divergentes de chètes noirs rigides, 2 fois aussi longs que le travers. Tibia, face dorsale, 2 chètes antérieurs, 2 postérieurs, ceux-ci plus réduits. Patte III: protarse à peine plus long que l'article suivant. Ailes (fig. 31) teintées de rouille, à nervures noires. Balanciers jaunes. Cuillerons à cils pales. Long: 3 mm.

Femelle inconnue.

N. Ireland: Kavieng (F. H. Taylor).

THE DIPTERA OF THE TERRITORY OF NEW GUINEA. IX.

FAMILY PHYTALMIIDAE.

By John R. Malloch.

(*Communicated by Frank H. Taylor, F.R.E.S., F.Z.S.*)

(Thirteen Text-figures.)

[Read 26th April, 1939.]

This group was accorded family rank by Hendel, but it appears to me to be composite in nature, the group containing *Angitula* Walker, *Angituloides* Hendel, and *Giraffomyia* Sharp, being probably derived from a different stem from *Phytalmia* Gerstaecker and *Diplochorda* Osten-Sacken. However, this is not the place to deal exhaustively with the matter, there being three other genera referred to the family, only one of which I am able to examine at this time, and none of them belonging to the faunal region now under consideration. Below I present a key to the genera covered by this paper, and keys to the species of those genera that are known to occur in New Guinea.

Material collected in Papua by Miss L. E. Cheesman has been included in this paper for geographical reasons, thus rendering the paper more valuable.

Key to the Genera.

1. Scutellum with a pair of long, divergent, apical, finger-like processes, at the apex of each of which there is a fine bristle; suture at hind margin of the mesopleura extending downward beyond the level of upper edge of the sternopleura and appearing to cut into the former proximad of the middle; frons without an anterior incurved pair of fronto-orbital bristles ...... Subfamily Angitulinae, 2

   Scutellum without finger-like processes, with at most two fine divergent bristles at apex; suture at hind margin of the mesopleura not extending downward into the sternopleura; frons usually with a pair of fine incurved anterior orbital hairs or bristles .... Subfamily Phytalmiinae, 4
2. Anterior margin of the pronotum with three moderately long forwardly-directed processes, the central one with two fine apical bristles .... *Angituloides* Hendel

   Anterior margin of pronotum without three processes as above 3
3. Vertex with two quite strong bristles; inner cross-vein of the wing much beyond the middle of the discal cell .... *Giraffomyia* Sharp

   Vertex without distinct bristles; inner cross-vein at, or a little before, middle of the discal cell .... *Angitula* Walker
4. First, second, and third wing-veins closely placed, distance from costal to third vein opposite the inner cross-vein rarely more than half as great as length of the cross-vein; first vein ending in the costa much closer to apex of second vein than to that of subcosta, and far beyond level of inner cross-vein; costa of male thickened and elevated beyond middle .... *Diplochorda* Osten-Sacken

   First, second, and third wing-veins normally placed, the distance from the costal to the third vein opposite the inner cross-vein distinctly greater than the length of the latter; first vein ending in the costa about midway between apices of subcostal and second veins, and almost directly above the inner cross-vein; costa in male not thickened .... *Phytalmia* Gerstaecker

Subfamily Angitulinae.

There is but one of the three known genera of this subfamily as yet reported to occur in New Guinea, the others being known from New Britain and the Solomons. No species of the other two genera are as yet known from New Guinea. A more extensive consideration of the extralimital species is included in a report on the species of Phytalmiidae from the Solomon Islands now ready for the press.

Angitula Walker.

Jour. Proc. Linn. Soc. Lond., iii, 1859, 123; *Elaphomyia* pt., Saunders, *Trans. Ent. Soc. Lond.*, v, ser. 2, 1861, 416; Edwards, F. W., *Trans. Zool. Soc. Lond.*, xx, Pt. 13, 1915, 417.

There are two species of the genus known, but one of them being in material now before me. Edwards has given the following distinguishing characters:

Head dark bluish, submetallic, rarely with any reddish tinge except on front and face; antennae almost entirely dark brown; a small, but sharply-defined dark brown spot at the tip of the wing .... *longicollis* Walker

Head bright reddish, with two narrow dark lines on the nape; antennae yellowish except for the tip of the third joint which is dark brown; wings with a somewhat larger but much fainter and ill-defined brown patch at the tip .... *cyanea* Guérin

Angitula longicollis Walker.

Jour. Proc. Linn. Soc. London, iii, 1859, 123; *Elaphomyia polita* Saunders, *Trans. Ent. Soc. London*, v, ser. 2, 1861, 416; Osten-Sacken, *Ann. Mus. Civ. Stor. Nat. Genova*, xvi, 1881, 481; Edwards, *Trans. Zool. Soc. London*, xx, pt. 13, 1915, 417.

A glossy-black species with the fore coxae and basal fourth or less of all femora whitish-yellow. The face, lower part of occiput, and the genae, yellowish in male, less noticeably so in the female; third antennal segment sometimes yellowish basally in male but usually black in female. Basal half of the costal margin of wing narrowly black, and a narrow black margin along the costa between apices of second and fourth veins (Fig. 1). Halteres black. Basal composite tergite of abdomen about as long as the others combined, with a pair of short, sharp, upwardly-directed tubercles at basal angles and a more or less conspicuous somewhat centrally divided elevation or hump a little proximad of middle.

Female, Sauri, Wewak District (F. H. Taylor), Marprik (J. R. Rigby and C. M. Deland), Territory of New Guinea; both sexes, Papua: Kokoda, 1,200 feet, April, June, August to October, 1933; Dutch New Guinea: Cyclops Mts., Sabron, 930 feet, May, 1936; Western New Guinea: Njau-limon, south of Mt. Bougainville, 300 feet, February, 1936 (L. E. Cheesman). Seventeen specimens. Previously recorded from Aru, Dorey, and New Guinea.

Angitula cyanea (Guérin).

Voy. de la *Coquille*, Zool. ii (2), 1838, 301, Pl. 21, fig. 11 (*Nerius*).

This species is not known to me. Described from New Guinea.

Phytalmia Gerstaecker.

Stett. Ent. Zeit., xxi, 1860, 169; *Elaphomyia* Saunders, *Trans. Ent. Soc. Lond.*, v, ser. 2, 1861, 413.

In the key presented below I have included all species known to me but have not included *wollastoni* Edwards, of which I have seen only the description and figure. It differs from all the others in the genus in having the anterior notopleural bristle well developed, and the aristae with the hairs almost as long below as above and carried to, or almost to, the apices. The wing has a very narrow dark brown costal streak from the apex of the subcostal vein to the tip. Originally described from New Guinea, in the paper by Edwards cited under *Angitula.*

Key to the Species.

1. Brownish-yellow species, with all the femora of that colour, the hind tibiae largely dark brown; both sexes with a short stout upwardly-directed and slightly backwardly-curved tubercle in centre of the anterior edge of the pronotum, the lateral portions of collar low; a pair of small tubercles on the posterior margin of the head below in male and female; male with a pair of stout black anteriorly-directed thorns at the middle of the anteroventral surface of the fore femur, and a series of microscopic decumbent black setulae from near them to apex on same surface, the posteroventral surface with one or two decumbent forwardly-directed short black bristles nearly opposite the two strong thorns, and some microscopic black setulae in a series from them to apex; the long apical ventral spur of mid tibia knobbed and slightly warped at apex in male, simple and acute at apex in female; frons with a pair of hair-like incurved anterior orbitals, and a very fine pair of slightly recurved orbitals well above middle; genal process of male when fully developed about two-thirds as long as entire insect, very slender; with a short preapical branch, black or dark brown, with white tips .... *cervicornis* Gerstaecker

   Black or pitchy-brown coloured species, with pale yellow scutellum and sometimes yellow thoracic markings, the greater portion of the legs blackened or browned; one species with a central tubercle on anterior margin of the pronotum, but the lateral portions of the collar are more or less elevated and not forwardly produced; neither sex with a pair of tubercles below on posterior margin of the head; fore femur of male if armed with strong central bristles has them either on the posteroventral surface, or the bristles on the anteroventral surface are close to the base; the long apical ventral spur in both sexes simple, acute at apex 2

2. Anterior margin of the pronotum with a short central wart-like tubercle; fore femur of male with a series of three or four strong closely-placed bristles beginning just beyond middle of the posteroventral surface; femora brownish-black; mid and hind pairs narrowly yellowish-white at bases; pleura without pale yellow markings; epistome quite prominently protruded; genal processes of male about as long as thorax, almost equally wide from base to beyond middle, from there tapered to a point at apices; scutellum with the pair of apical bristles fine and short .... *wallacei* (Saunders)

   Anterior margin of the pronotum emarginate in centre, without a central tubercle, at most with a low transverse ridge centrally; fore femur with at least six posteroventral bristles; pleura with yellow markings; epistome not protruded, or but slightly so 3

3. Fore tibia of male with dense short stout spinules from near base to near apex on the ventral surface, the fore femur stoutest at base, with strong bristles on both the anteroventral and posteroventral surfaces, basally only on the latter, on almost the entire extent of the anteroventral surface; genal processes of male about as long as the thorax, moderately stout, with a thumb-like projection on the posterior side near middle; scutellar bristles as long and strong as the posterior notopleural .... *biarmata*, n. sp.

   Fore tibia with only fine appressed hairs on the ventral surface in both sexes; fore femur of male stoutest at middle, with six closely-placed bristles in a series beginning just beyond middle; genal processes of male longer than the thorax, expanded fan-like near base, and with a rather slender lobe from posterior apical angle that is as long as the expanded portion; scutellar bristles represented by fine short hairs, not nearly as long as the posterior notopleural bristle .... *alcicornis* (Saunders)

PHYTALMIA CERVICORNIS Gerstaecker.

Stett. Ent. Zeit., xxi, 1860, 173, Pl. 11, fig. 4; *Elaphomyia cervicornis* Saunders, *Trans. Ent. Soc. Lond.*, v, ser. 2, 1861, 414.

By a strange coincidence Saunders chose the same specific name for this species as had Gerstaecker before him.

The males before me have the head black, with an oval yellowish spot in front of the ocelli, and a pear-shaped yellow spot on each side of the face close to the lower margin, the tapered end of each close to the parafacials. The propleura and basal half or more of the fore coxae are blackened. The genal thorns (Fig. 2) are very long and slender, deep black, with the apices of the two branches white. I have three typical males before me. Wing as in Figure 3. Length, 15 mm.

Papua: Kokoda, 1,200 feet, August, September, October, 1933 (L. E. Cheesman), six specimens; Mt. Lamington (Northern Division), three specimens (C. T. McNamara). The females are not as long as the males except the ovipositor is included in the measurement. One female, New Guinea: Marprik (J. R. Rigby and C. M. Deland). Recorded from New Guinea and Dorey.

PHYTALMIA PRISCA Enderlein.

Arb. morph. taxon. Entom. Berlin., iii, No. 3, 1936, 230 (*Archiphytalmia*).

Papua: Kokoda, 1,200 ft., June, 1933 (L. E. Cheesman), British Museum (Nat. Hist.).

PHYTALMIA WALLACEI Saunders.

Trans. Ent. Soc. Lond., v, ser. 2, 1861, 414 (*Elaphomyia*).

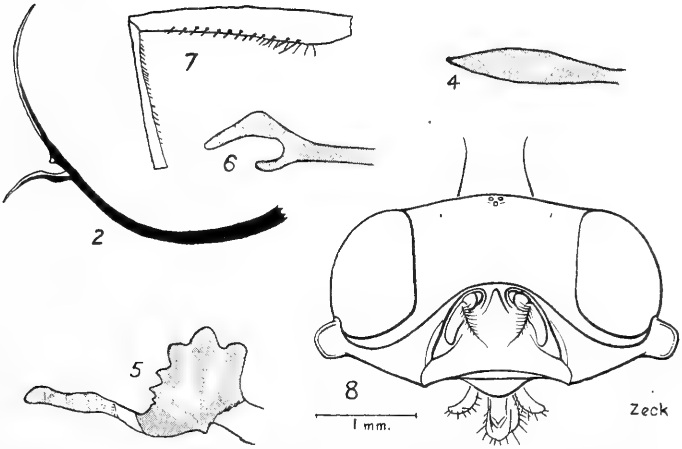
♂. A much darker species than *cervicornis*, general colour black, part of the frons, most of the genal processes, and the face yellow or yellowish-brown, scutellum and thoracic sutures also of that colour. A yellow spot near the apex of abdominal petiole, and the apices of tergites slightly paler than remainder of tergites. Legs dark brown, bases of mid and hind femora and bases of all tarsi yellow. Stigma brown, apex of wing faintly browned. Genal processes (Fig. 4) much longer than in *prisca*, about as long as the thorax, flattened, width less than that of frons, tapered on apical third, ending in a point. Anterior dorsal marginal process of thorax much shorter than in *cervicornis*. Fore femur with postero-ventral armature only, consisting of about three short curved bristles close to middle. Longer mid-tibial spur sharp at apex. First posterior cell of wing not noticeably widened at apex. Length, 12 mm.

Papua: Kokoda, 1,200 feet, June and August, 1933 (L. E. Cheesman). Originally described from the island of Dorey, Mt. Lamington (Northern Division), two specimens (C. T. McNamara).

PHYTALMIA ALCICORNIS (Saunders).

Trans. Ent. Soc. London, v, ser. 2, 1861, 415.

A larger species than *wallacei*, with a greater amount of yellow on the head and thorax, there being a broad hind marginal streak on the mesopleura, another behind the wing base that extends to the lower margin of the metapleura, and a number of marks on the mesonotum, as well as a streak in centre of the chitinous rounded sclerite between the base of the abdomen and bases of the hind coxae. The apices of the abdominal tergites are also quite noticeably yellow. The genal processes of the male (Fig. 5) are longer than the thorax, much expanded, fan-like on the basal half, with a slender lobe extending outward from the apical posterior angle of the "fan" that is a little longer than the latter. These processes are pale stramineous in colour, with reddish-brown streaks, the extreme tip of the slender lobe black. Pronotum in both sexes emarginate in centre, behind the emargination there is a slightly-raised transverse rounded ridge, and the collar on each side of the emargination is in the form of a rounded ridge extending forward. Scutellum with two hair-like apical bristles that are distinctly shorter and finer than the posterior notopleural bristle. Fore femur in both sexes thickest centrally, much



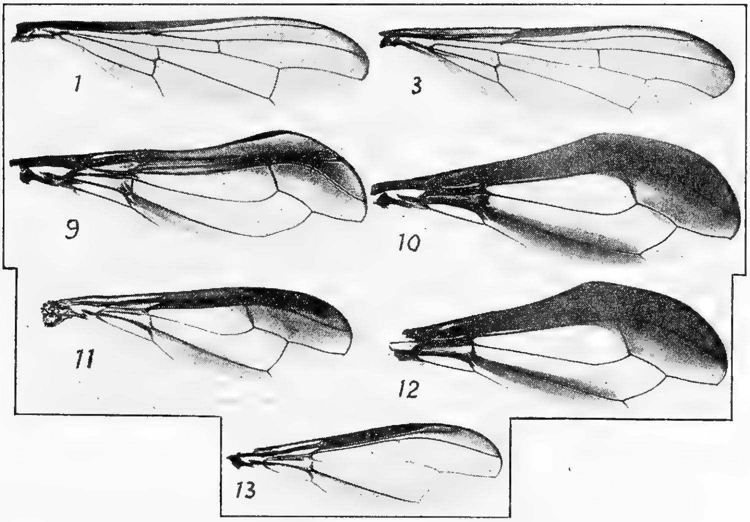


Fig. 1.—*Angitula longicollis* Walker, wing of female.
Fig. 2.—*Phytalmia cervicornis* Gerstaecker, left genal process of male from the side.
Fig. 3.—*Phytalmia cervicornis* Gerstaecker, wing of female.
Fig. 4.—*Phytalmia wallacei* Saunders, left genal process of male from above.
Fig. 5.—*Phytalmia alcicornis* (Saunders), left genal process of male from above.
Fig. 6.—*Phytalmia biarmata*, n. sp., left genal process of male from above.
Fig. 7.—*Phytalmia biarmata*, n. sp., right fore femur and tibia, anterior view.
Fig. 8.—*Diplochorda aneura*, n. sp., head of male from in front.
Fig. 9.—*Diplochorda aneura*, n. sp., wing of male type.
Fig. 10.—*Diplochorda myrmex* O.S., wing of male.
Fig. 11.—*Diplochorda myrmex* O.S., wing of female.
Fig. 12.—*Diplochorda trilineata* de Meij., wing of male.
Fig. 13.—*Diplochorda minor*, n. sp., wing of female type.

thicker in male than in female, and in the former with a series of about six very closely placed slightly curved and forwardly-directed black bristles, the basal one almost exactly at middle of the posteroventral surface. Mid-tibial spur simple in both sexes. Length, 13–16 mm.

Papua: Kokoda, 1,200 feet, June and August, 1933 (L. E. Cheesman). Ten specimens, both sexes. Original locality, island of Dorey.

Four males identified as this species by Dr. Smart were sent to me by him, and without these I should have had some doubt as to the identity of the specimens before me, because no long apical lobe is shown in Saunders' figure of the genal process. In some specimens in hand this apical lobe is bent back against the "fan" and it may sometimes be broken off.

PHYTALMIA BIARMATA, n. sp.

♂, ♀. Similar in general colour and markings to *alcicornis*, but the yellow vertical mark on the metapleura is not nearly as distinct and does not attain the lower edge.

Structurally the main distinctions lie in the form of the genal processes of the male (Fig. 6), in the shape and ventral armature of the fore femur of the same sex, there being bristles on both the anteroventral and posteroventral surfaces (Fig. 7), and in the much stronger apical pair of scutellar bristles in both sexes. In other characters the species is much as in *alcicornis*, the mid tibia having the apical ventral spur simple, acute at apex, in both sexes. The frons has the anterior incurved orbital bristles well developed, usually stronger than in most of the allied species, but the upper reclinate pair is not evident in any of the seven specimens before me. Wing coloured as in the other species, with the stigma dark brown and the tip more or less suffused with pale brown. In teneral specimens the apical clouding is usually very indistinct or lacking. Length, 12–15 mm.

Type, male, allotype, and five paratypes, Papua: Mondo, 5,000 feet, February, 1934 (L. E. Cheesman).

DIPLOCHORDA Osten-Sacken.

Ann. Mus. Civ. Stor. Nat. Genova, xvi, 1881, 484; Hendel, *Gen. Insectorum*, Pyrgotinae, fasc. 79, 1908, 4.

Bezzi did not recognize this genus when he published his paper in 1924 (*Rev. Zool. Afric.*, xii, fasc. 2, p. 225), so that it is not found in his key to the genera included in the paper. He also omitted *Angituloides* Hendel, though in the copy of the paper sent to me by Bezzi he pencilled it in the margin.

Key to the Species.

1. The dark brown costal stripe on the wing extending on the field to over the third vein a little proximad of the inner cross-vein, running obliquely back to near middle of that vein and entirely filling the first posterior cell, even spreading into the second 2

   The dark brown stripe on the costal border of the wing not extending over the third vein, or if it does then only at a point well beyond the inner cross-vein, and never entirely filling the first posterior cell 4

2. Posterior basal cell of the wing hyaline, narrowly dark brown at apex; the hind marginal brown streak not or very faintly extending over the fifth vein into the discal cell; scutellum dark brown; mesonotal black fasciae fused before suture; frons without incurved anterior and upper reclinate orbital bristles; gena with a short thin elevated apically-rounded process; fore femur with a short stout spine at about one-third from apex on the posteroventral surface .... *aneura*, n. sp.

Posterior basal cell of the wing pale brown, darker on edges; hind marginal streak extending rather broadly over the fifth vein into the discal cell; scutellum partly yellow; mesonotal vittae separated on their entire extent; frons with a pair of anterior incurved and a pair of very short reclinate upper orbital bristles 3

3. Fore femur in both sexes with a preapical posteroventral bristle .... *myrmex* Osten-Sacken.

Fore femur in neither sex with a preapical posteroventral bristle .... *trilineata* de Meijere

4. The brown costal border extends widely over the third vein from a little beyond the inner cross-vein to its apex, sometimes faintly to apical section of fourth vein; posterior basal cell and a broad streak covering the fifth vein and extending narrowly into the discal cell and filling the entire third posterior cell dark brown 5

The brown costal border does not extend over the third wing-vein, or if so then only very faintly so at its extreme apex 6

5. Genae with short stout process; mesonotal vittae not distinctly divided by yellow interspaces .... *brevicornis* (Saunders)

Genae without distinct processes, with at most a slightly elevated ridge; mesonotal black vittae distinctly divided by yellow interspaces .... *concisa* (Walker)

6. Posterior basal cell of the wing pale brown, and a faint pale-brown cloud over the fifth vein that does not extend distinctly into the discal cell, and fills the third posterior cell; face with a brown transverse band below middle; the yellow mark on the basal (composite) abdominal tergite small, separated from the hind margin by about its own length; no well developed bristle outside of and below level of the strong vertical pair .... *minor*, n. sp.

Posterior basal cell of the wing hyaline, and no brown cloud over the fifth vein; face yellow; the yellow mark on the basal (composite) abdominal tergite large, separated from the hind margin by less than half its own length; an outwardly-curved bristle on each side of back of head outside of and below level of the strong verticals that are about half as long as them .... *unistriata*, n. sp.

Diplochorda aneura, n. sp.

♂. A very dark species with the head and thorax much as in *brevicornis*, but the wing as in *myrmex*.

Head pale testaceous yellow, with numerous black marks as follows: Ocellar spot, a mark on each side of latter, a large mark on centre of frons and a small one on each side in front, a small spot between each antenna and eye, another in lower extremity of each facial fovea, a transverse band above epistome, the genae including the processes, and most of the occiput except the margins. Antennae fuscous, apex of the second and base of third segment yellowish-brown; palpi black, testaceous at apices. Head a little wider than widest part of thorax, frons almost one-third of head-width and more than 1·5 times as wide as long, slightly flattened; no orbital bristles present; verticals strong, separated from each other by about as great a distance as either is from eye-margin. Epistome slightly protruded; foveae distinct. Genal process short, seen from in front as Figure 8. Hairs on upper side of aristae long at base, a few moderately long hairs at base below.

Thorax black, slightly shiny, a yellow vitta on each side of disc of mesonotum behind the suture that expands behind over the postalar callosity, and a large yellow mark on the posterior notopleural callosity that connects with a vertical streak of the same colour on the hind margin of the mesopleura; a large yellow mark on each pleurotergite and a smaller one above it on the side of the postnotum, the latter without a yellow central streak; postscutellum yellowish. Bristles as follows: 1 notopleural, 1 supra-alar, and 1 postalar; mesopleural hair-like; scutellum with two quite strong apical marginal bristles. Legs pitchy-black, apices of fore and mid femora brownish, bases of mid and hind pairs yellow, basal two segments of mid and hind tarsi brownish-yellow. Fore femur with a short stout bristle at about the apical third of the posteroventral surface; mid tibia with the apical ventral long spur sharp at tip. Wing as in Figure 9, the dark part chocolate brown; fifth vein not present beyond outer cross-vein. Halteres brownish-yellow. Abdomen shiny black, a narrow yellow band near the apex of the basal composite tergite. Length, 11 mm.

Type, Wewak, New Guinea (F. H. Taylor) .

This species agrees with *brevicornis* very closely in the structure of the head, but in addition to the differences in the wing markings the thorax is also differently marked.

Diplochorda myrmex Osten-Sacken.

Ann. Mus. Civ. Stor. Nat. Genova, xvi, 1881, 488.

This species was originally described from a female. I have both sexes of a species that I accept as that described by Osten-Sacken, though the female does not entirely agree with his description.

The head is yellow, with five black marks on the occiput, three across the upper half and an elongate one on each side below, the frons has a small ocellar spot, a more or less divided larger central spot, and a small one on each side at base of the upper orbital bristle; the face is largely black on the lower half in the male, but in the female there are only two black spots at apices of the foveae. Both pairs of orbitals are present. Head almost normal in the male, the genae with slight central carina only, the eye not sharply notched, merely slightly emarginate at ridge.

Mesonotum in male black, with two entire yellow discal vittae that expand to cover the postalar callosities, and a yellow lateral vitta covering humerus and posterior notopleural callosity leaving a small black mark at middle against the suture, the vitta connects with a yellow stripe that extends along the hind margin of the mesopleura and across the sternopleura to the venter. A broad yellow stripe from below the squamae to venter enclosing the posterior spiracle, and a similar stripe over centre of the postnotum and postscutellum, both widest above. Scutellum with a yellow elongate mark on each side. These yellow markings are wider in the female, and there is an additional yellow mark on the propleura. Bristles as in *aneura*, but the mesopleural one is quite strong, though not very long. Legs dark brown, fore femora in female browned only centrally, in male dark brown basally, paler apically; mid and hind femora more broadly yellow at bases than in the preceding species. Male with a posteroventral bristle beyond middle of the fore femur, female occasionally with a similar but smaller bristle.

Wing as Figure 10 in male, as Figure 11 in female, the costa less elevated beyond middle in the female. Halteres yellow. Abdomen shiny black, composite basal tergite with a yellow patch beyond middle in both sexes, in the female the fifth tergite at apex and most of the sixth are orange-yellow. Basal tergite longer and more slender in male than in female. Length 10–12 mm.

New Guinea: Wewak (F. H. Taylor), Marprik (C. M. Deland and J. R. Rigby). Originally described from Katau, New Guinea.

Diplochorda trilineata de Meijere.

Tijdschr. v. Ent., lviii, 1915, 124.

This species was described from Northern New Guinea. Its describer compared it briefly with *myrmex*, which latter he accepted as having the black mesonotal vittae interrupted at the suture, and the scutellum reddish-yellow. Neither of these characters holds good for the species if I am correct in my identification, but the lack of yellow colour on the abdomen except on the basal tergite leads me to accept three specimens now before me as de Meijere's species. Unfortunately that author did not state whether the type was a male or a female, nor did he state whether the fore femur had or had not a posteroventral bristle. His description of the wing (Figure 12) leads me to infer that his type was a male. The specimens accepted by me as this species have no trace of yellow on the fifth and sixth abdominal tergites, and lack the posteroventral bristle on the fore femur.

One ♂, Wewak, New Guinea (F. H. Taylor); two ♀, Dutch New Guinea: Lake Sentani, Aug., 1936, and Cyclops Mts., Sabron, 900 feet, May, 1936 (L. E. Cheesman).

Diplochorda ophion Osten-Sacken.

Ann. Mus. Civ. Stor. Nat., Genova, xvi, 1881, 488.

I have not seen any specimen that I can accept as this species, and to make the present paper as complete as possible for the genus I include below some details from the original description.

Head, antennae, and palpi yellow; a double brown spot on the frons about midway between antennae and ocelli. Thorax yellow, a narrow brown line on middle of dorsum, interrupted anteriorly before the collar; the suture on each side tinged with brown, which colour expands into a larger spot about midway between the base of the wing and the humerus; an oblique brown streak on middle of the pleura, and a brown shade above the hind coxae. Abdomen black as far as the middle of the first tergite, yellow beyond, with two large osculant black spots occupying, one on each side, the end of the first and the sides of the second and third segments. Ovipositor ferruginous-yellow. Legs yellow, femora with faint vestiges of a brownish ring; fore coxae brownish; tarsi brownish, hind metatarsus yellowish. Wing subhyaline, costal border inside the third vein brown, near the apex this colour crosses that vein, encroaching a little on the first posterior cell; an irregular brown cloud along the fifth vein inside the third posterior cell that is connected across the cross-veins, closing the basal cells with the brown costal border. Length, 6–7 mm.

Hatam, New Guinea.

Diplochorda concisa (Walker).

Dacus concisus Walker, *Jour. Proc. Linn. Soc. Lond.*, v, 1861, 252.—*Dacus turgidus* Walker, op. cit., viii, 1865, 134.—*Elaphomyia brevicornis* Saunders, pt., *Trans. Ent. Soc. Lond.*, v, ser. 2, 1861, 415.—Osten-Sacken, *Ann. Mus. Civ. Stor. Nat. Genova*, xvi, 1881, 487.

The above synonymy is given on the statement of Osten-Sacken, who examined the type specimens in the British Museum, but I have used the name *concisa* instead of *turgida* contrary to the course adopted by that author.

The species is, if my identification is correct, apparently a common one in some sections of New Guinea, as there is a large number of specimens in this collection.

A black slightly shiny species with much the same markings as *myrmex*, but readily distinguished from it by the difference in the form of the dark brown costal border of the wing. Here this border does not extend over the third vein until it reaches the basal third of the ultimate section of that vein and it spreads over only the anterior or costal half of the first posterior cell, though there sometimes is a slight brownish suffusion to almost the fourth vein in the cell. The posterior basal cell is dark brown and the brown cloud on the fifth vein extends well over the vein into the discal cell. The male has a slight genal ridge, both sexes have two pairs of orbital bristles, a distinct mesopleural bristle, and the apical pair of scutellar bristles rather strong. The thoracic markings are as in *myrmex*. Femora broadly yellow at bases, the fore pair almost entirely yellow, without posteroventral bristle in both sexes. Abdomen black, with a yellow mark on the composite basal tergite near its middle.

Papua: Kokoda, 1,200 feet, Apr. and May, 1933 (L. E. Cheesman), thirty-one specimens; Mt. Lamington (Northern Division), four specimens (C. T. McNamara).

DIPLOCHORDA BREVICORNIS (Saunders).

Elaphomyia brevicornis Saunders, *Trans. Ent. Soc. London*, v, ser. 2, 1861, 415.

I have not seen this species, but from the description and figures by Saunders and a drawing of the apical part of the wing of the type sent me by Dr. Smart I have been able to include it in my key to the species and, I believe, reliably differentiate it from other species of the genus.

It is the only species with the costal border falling short of the inner cross-vein in which the male has a well-developed genal process. This is apparently very similar to that of *aneura*, but in the latter the dark brown costal border is much wider apically, encroaching on the inner cross-vein and, in fact, spreading into the cell in front of the latter on its anterior portion. Saunders shows a bristle on the fore femur, but unless the drawing is incorrect it appears to be situated on the anteroventral instead of on the posteroventral surface.

Locality, Dorey.

The specimen figured as the female of this was correctly stated by Osten-Sacken to be a male, and was referred by him to *turgida* Walker. I have followed the same course in this paper.

DIPLOCHORDA MINOR, n. sp.

♀. Head pale yellow, with a black dot on ocelli, a bifid central black mark on frons, and a small black spot at base of each upper orbital bristle; face with a small black mark at lower extremity of each fovea; occiput with a large black subquadrate central mark behind vertex, a small spot on each side of it, and below the latter an elongate black mark on each side. Antennae and palpi yellow, bases of the latter browned. Both pairs of orbitals present, verticals strong, frons a little wider than long; gena about one-fourth as high as eye, with a slight central carina and brown line. Mesonotum yellow, with three black vittae, central one attenuated and broken at suture; pleura black, a yellow mark above fore coxae, a yellow stripe from posterior notopleural callosity to venter, a similar one over the pleurotergite to venter, and another on centre of the postnotum and post-scutellum. Bristles as in *myrmex*. Legs yellow, coxae and trochanters black, fore femora slightly browned centrally, mid and hind pairs broadly dark brown centrally, fore and hind tibiae almost entirely dark brown, mid pair yellowish apically, fore tarsi brown, mid and hind pairs with the basal two segments yellowish, the others brown. Fore femur without posteroventral preapical bristle.

Wing (Fig. 13) hyaline, browned along costal margin, subhyaline in costal cell, dark brown beyond it, the dark colour not extending backward over the third vein except a very faint shade apically; posterior basal cell and entire third posterior cell rather pale brown, the colour not extending into the discal cell. Halteres yellow. Abdomen elongate-ovate, petiole much widened at apex, general colour pitchy-black, more brownish apically, yellowish on disc of fifth and sixth tergites, the composite basal tergite with a yellow mark at about its own length from apex. Length, including the ovipositor, 7·5 mm.

Type and one defective paratype, Bulolo, New Guinea (F. H. Taylor).

DIPLOCHORDA UNISTRIATA, n. sp.

♂, ♀. Rather similar to *minor*, differing as follows: Face yellow, frons a little longer than wide, gena less evidently carinate centrally. Mesonotum with three entire black vittae; pleura predominantly yellow, with a curved black stripe from prothoracic spiracle back over upper part of the mesopleura, then downward over middle of latter and sternopleura, ceasing well above lower edge of latter; a black streak from below wing base to venter over mid and hind coxae, and a narrower black streak on postnotum below each lateral angle of the scutellum, the latter dark brown. Bristling as in *minor*. Legs and wings as in *minor*, but the brown streak over the fifth vein is lacking. Abdomen similar to that of *minor*, rather broad and short petiolate for this genus, and the yellow mark on the petiole larger and much closer to the hind margin than in that species. Length, 7·5–9·5 mm.

Type, male, allotype, and 11 paratypes, Papua: Mondo, 5,000 feet, Jan.-Feb., 1934 (L. E. Cheesman).

Addendum.

In 1936 (*Arb. u. morph. taxon. Ent. Berl.-Dahlem*, Bd. 3, No. 3, 225) Enderlein published a review of the family Phytalmiidae in which he proposed three new genera, two of them based on new species.

It appears to me to be unwise to erect so many monobasic genera in a family containing so few species, especially on the basis of such apparently trivial characters as are made use of by Enderlein. My conclusions as to the status of his genera and species are given below.

GIRAFFOMYIA Sharp.

Records of the genotype, *willeyi* Sharp, are given from Ralum and Alovon, New Britain, Bismarck Archipelago.

ANGITULA Walker.

Enderlein's identification of *cyanea* is apparently correct, but his placing of *longicollis* Walker as a synonym is incorrect according to specimens sent me from the British Museum.

I consider *polita* Saunders, which Enderlein designated as genotype of his new genus *Angitulina*, and *nigra*, n. sp., the genotype of Enderlein's new genus *Hammatopelma*, as synonyms of *longicollis*, and these genera as synonyms of *Angitula*.

MEACHINA Enderlein.

Op. cit., Bd. 3, No. 4, 1936, 241.

I have in the press the description of a species very similar to the genotype of this, but I consider it belongs to *Giraffomyia*. Whether Enderlein's species belongs to the same concept I am unable to say without an examination of his species. The species, *violacea*, may be distinguished from any recorded in this paper by the strongly violaceous or blue tinge on the thorax and abdomen. It is rather similar to *Angitula cyanea* Guérin in most respects.

Dutch New Guinea: Dorey.

Phytalmia Gerstaecker.

Enderlein restricts this genus to the genotype, *cervicornis*.

Archiphytalmia Enderlein is inseparable from the above. His species, *prisca*, is from Sattelberg, Huon Gulf, New Guinea.

Atopognathus Bigot.

Ann. Soc. Ent. France (6) 1, 1881, 24.

The genotype, *platypalpus* Bigot, is unknown to me, as it was also to Enderlein. Locality, Ternate.

Elaphomyia Saunders.

Enderlein used this generic name for a group containing *alcicornis* Saunders, which he designated as genotype, *megalotis* Gerstaecker, and *wallacei* Saunders.

He had apparently not seen any of these species and in using the presence or absence of the pair of small incurved infraorbital bristles for separating the genera he erred. This pair of bristles is present in both his concepts.

Diplochorda Osten-Sacken.

Enderlein did not list this genus in his paper, though he did include *Phytalmodes* Bezzi, an African genus, and a so-called subfamily, Terastiomyiinae, which is South American and considered by Hendel and others as belonging to the Pyrgotidae.

TAXONOMIC NOTES ON THE ORDER EMBIOPTERA.

I. THE GENOTYPE OF OLIGOTOMA WESTWOOD.

By Consett Davis, M.Sc., Lecturer in Biology, New England University College, Armidale.*

(Five Text-figures.)

[Read 26th April, 1939.]

Much of the material for this and subsequent papers was gathered overseas, when the types of many species were examined in the United States, England and France, and those of other species were obtained on loan from several European museums. Sufficient data were obtained to justify a detailed consideration of the taxonomy of the Order as a whole, in a series of papers of which this is the first. This paper is presented first to enable other workers to use the facts contained herein. The two species here considered have long been known by incorrect names, and, in addition to the fact that one is the genotype of *Oligotoma*, there is the consideration that both are exceedingly common in nearly all the warmer countries of the world.

Genus Oligotoma, 1837.

Trans. Linn. Soc. Lond. (Zool.), xvii, p. 373 (as subgenus of *Embia* Latr.); genotype *O. saundersii* Westw., l.c. Raised to generic rank by Burmeister (1839).

Oligotoma saundersii Westwood, 1837, l.c.

Westwood's type is in the Hope Department of Entomology, Oxford University. It is a carded specimen in fair condition, with the mandibles dissected out and mounted on a separate card. The labels below this specimen are: (1) 'Embia (Oligotoma) saundersii West. in Trans. Linn. Soc.'; (2) 'W. S. Saunders. East Ind.'; and (3) a blue rhomboidal label with the letter 'W', Westwood's equivalent to a type label.

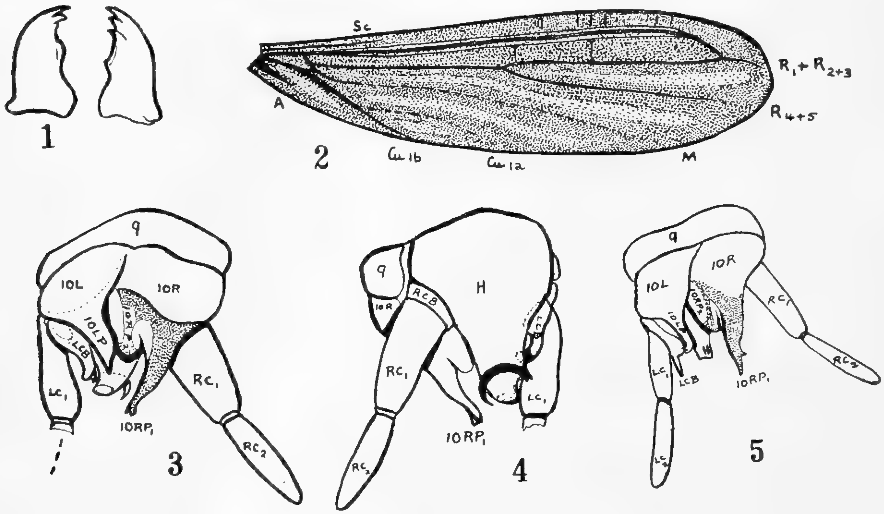
Preparation of the terminalia of this specimen immediately revealed that the species known to Krauss (1911), Enderlein (1912) and subsequent workers as *Oligotoma saundersii* (misspelt *saundersi* in some cases) is not conspecific with Westwood's type. Westwood's specimen is conspecific with examples determined by Enderlein (l.c.) as *Oligotoma latreillei* (recte *latreillii*) (Rambur, 1842). The name *latreillii* (Ramb.) must be added to the synonymy of *Oligotoma saundersii* Westw., both referring to the series so long referred incorrectly to *O. latreillii* (Ramb.).

The species known to Enderlein (l.c.) and other workers as *Oligotoma saundersi* must now be called by the next valid name, *Oligotoma humbertiana*

* Most of the work embodied in this paper was carried out when the writer held a Linnean Macleay Fellowship in Zoology.

(de Saussure, 1896). The following description of *O. saundersii* is from Westwood's type (♂).

Dimensions: Length of body 7 mm.; forewing 5 mm. × 1·4 mm.; hindwing 4 mm. × 1·4 mm. General colour pale chocolate brown; bands bordering wing-veins or their traces pale brown; veins darker brown. Dimensions and form of head not discernible, on account of dissection. Mandibles (fig. 1) rather slender, incurved distally, with a terminal acute tooth, the left with two subterminal teeth, the right with one; each mandible with a blunt projection midway along the inner margin, representing the basal end of the cutting edge. Body sclerites, except the terminalia, normal for winged specimens of the Order. Wings with subcosta reaching to one-quarter the length of the wing; R_1 strong, bordered by fine dark lines, confluent subterminally with R_{2+3}, the fused vein reaching the termen.



Figs. 1-4.—*Oligotoma saundersii* Westwood, holotype ♂.—1. Mandibles, ventral view, × 33.—2. Right forewing, × 13, conventional lettering for venation.—3. Terminalia from above, × 33.—4. Terminalia from below, × 33 (9, ninth abdominal tergite; 10L, 10R, left and right hemitergites of tenth abdominal segment; $10RP_1$, $10RP_2$, outer and inner processes of 10R; 10LP, process of 10L; H, hypandrium (ninth abdominal sternite); LCB, RCB, left and right cercus-basipodites; LC_1, first segment of left cercus; RC_1, RC_2, first and second segments of right cercus).

Fig. 5.—*Oligotoma humbertiana* (Sauss.) ♂, Mt. Makilling, Luzon, Philippine Isds., terminalia from above, × 30. Lettering as in figs. 3-4; LC_2, second segment of left cercus. (All figures based on camera lucida outlines; all setae omitted.)

R_s forking to R_{2+3} and R_{4+5} midway along the wing; R_{4+5} simple, becoming obsolete before the margin. M represented only by a row of hairs and by the pigment-band normally bordering each vein or its trace in this Order. Main stem of Cu_1 strong, reaching the margin; its anterior branch (Cu_{1a}) no stronger than M. Anal vein short but distinct. Some five weak cross-veins between C and R_1, and two stronger between R_1 and R_{2+3}. All veins, or (if obsolescent) their traces, with broad pigment-bands, the hyaline areas between being narrow longitudinal streaks (fig. 2).

Terminalia (figs. 3, 4) with tenth tergite divided to left (10L) and right (10R) hemitergites, the suture between which tends to become obsolete proximally. Right hemitergite with its outer margin produced backwards and inwards to a slender sinuous process ($10RP_1$), ending in two teeth, the outer blunter and more dorsally placed, the inner sharper and more ventral. The inner part of $10RP_1$ basally overlies another flap-like process ($10RP_2$), the medial chitinization of which is a continuation of the chitinization of $10RP_1$. Left hemitergite produced backwards to a cultriform process (10LP), acutely tapered. Right cercus of two subequal subcylindrical segments, the first (RC_1) somewhat thicker. Left cercus of similar form, the first segment (LC_1) very slightly clavate, the second broken. Rudimentary subannular cercus-basipodite (RCB) ventrally at base of right cercus; left cercus-basipodite (LCB) well developed, tapered, curved outwards, ending obtusely. Ninth sternite (H) tapered, curved to the left, truncate distally, with a trace of a tubular structure dorsally. A slender, heavily-chitinized spine arises subterminally from the left margin of the ninth sternite, with two minute teeth at its point of origin; the spine curves to the right under the end of the sternite, projecting upwards and backwards terminally.

The above description and figures are based on an old specimen which, being the type, could not be fully dissected; it cannot therefore be as full as many other descriptions which have been based on well-preserved series, and published from time to time under the name *Oligotoma latreillei*. It is given in detail to obviate any criticism of the identity of Westwood's type. Fuller descriptions, under the name *O. latreillei*, have been given by Enderlein (1912), Okajima (1926), Menon and George (1936) and Davis (1936), and by Krauss (1911) under the name *O. hova* (Sauss.). Additional morphological points, not included in the description of the type, are that only one bladder is present on the first tarsal segment of the hind legs, and that the first abdominal sternite is much reduced. The second segment of the left cercus is subequal to that of the right in most examples.

The following species may now be listed as synonyms of *O. saundersii* Westw.:

O. latreillii (Rambur).—*Embia latreillii* Rambur, *Hist. nat. Névroptères*, 1842, p. 312. Enderlein's description and figures of *O. latreillii* (l.c.) are not from the type; he had, however, examined Rambur's type in the de Selys collection, so that the synonymy may be taken as established.

O. insularis M'Lachlan, 1883, *Ann. Mag. Nat. Hist.* (5), vol. 12, p. 227.—The identity of M'Lachlan's species with that previously known as *O. latreillei* has been suggested by several authors (e.g. Enderlein, 1912; Navás, 1918*a*; Friederichs, 1934, 1935), without examination of the types. In the M'Lachlan collection (British Museum of Natural History) are M'Lachlan's three original types, each labelled 'Oligotoma insularis M'Lach.'; 'Type'. Preparation of the terminalia of one of these, and examination without preparation of the others, left no doubt that *O. insularis* is an absolute synonym of *O. saundersii* as defined above.

Oligotoma cubana Hagen, 1885, *Canad. Entomologist*, vol. 17, p. 141. (Used as a nomen nudum, Hagen, 1866, p. 221 (*Olyntha cubana*) and by M'Lachlan, 1877, p. 381.) Hagen's type is in the Museum of Comparative Zoology, Harvard University. Preparation and examination of its terminalia showed it to be a normal specimen of *O. saundersii* Westw. The synonymy has not previously been proved by reference to the type.

Oligotoma hova (de Saussure).—*Embia hova* de Saussure, 1896, *Mitt. Schweiz. Entomol. Ges.*, ix, p. 354.

We are indebted to Krauss (1911) for the definite information that *O. hova* refers to the insect under discussion here. Krauss saw de Saussure's type in the Muséum d'Histoire naturelle, Geneva, and although his figures (e.g. Pl. ii, figs. 9A, 9B) are not from de Saussure's type, there can be no doubt that de Saussure's name refers to this series.

Krauss (l.c.) used the name *O. hova* for this series, believing that *O. saundersii* and *O. latreillii* both stood for the species known to Enderlein by the former name, and now rightly to be known as *O. humbertiana* (Sauss.). It is evident from a later paper (1917) that Krauss then followed Enderlein in applying the name *O. latreillii* to the insect now under discussion, and using *O. saundersii* in Enderlein's sense.

Oligotoma bramina (de Saussure)—*Embia bramina* de Saussure, l.c., p. 352.—Krauss (1911, Pl. i, figs. 6, 6A) has figured the type (Mus. Geneva), and allows it as a different species from *O. hova.* Although de Saussure and Krauss, with the specimens before them, recognized *O. hova* and *O. bramina* as distinct, I believe that they are to be considered conspecific, the type of *O. bramina* being perhaps individually aberrant. The locality is Bombay, India, where *O. saundersii* (= *O. hova*) occurs; and there are no existing descriptions of insects from this region to support the belief that *O. bramina* exists as a distinct species, although quite a number of other records of the genus for India have been published. Krauss's figure of the type of *O. bramina* shows the termination of the outer process of the right hemitergite as slightly different in form from the normal for *O. saundersii* (*O. hova*), and no process at all is shown from the left hemitergite, although actually such a process is present in all species of the genus; the omission may be due to breakage, or to failure to distinguish the structure in the unprepared terminalia. The ventral structures shown in the figure may well represent the tubular ninth sternite, curved to the left, and its associated spine, somewhat distorted. As Krauss's figure is from a dried specimen, the differences noted may not represent actual structural differences, but merely a variation in configuration associated with the state of preservation. A careful examination of the type of *O. bramina* alone can establish or reject this synonymy.

Oligotoma rochai Navás, 1917, *Ent. Mitteilungen*, vi, nos. 7–9, p. 281.—There can be little doubt that Krauss (1917) is correct in referring this species to *O. latreillii* (recte *O. saundersii*), though Navás's figure (fig. 17) differs appreciably from his own verbal description and from the true structure of *O. saundersii.* This is of no significance, as a comparison of many of Navás's figures with the specimens from which they were made (e.g. *Oligotoma albertisi*, Museo Civico di Storia Naturale, Genoa; *Dihybocercus spinosus*, Musée du Congo belge, Tervueren) indicates that little importance can be attached to any of his figures.

Oligotoma inaequalis Banks, 1924, *Bull. Mus. Comp. Zool. Harvard*, vol. 65, no. 12, p. 421.—The type, in the Museum of Comparative Zoology, Harvard University, proved on examination to be a normal specimen of *O. saundersii.* Banks (l.c.) writes: 'The genitalia are similar to *O. insularis*, but the second joint of the left cercus is much longer than this joint in the right cercus. Length of body 7·5 mm., of forewing 6 mm. Larger and darker than *O. cubana*, and with an extra pale line in the wings.' Minor variations in the lengths of the segments of the cerci frequently occur as individual aberrations, and variations of considerable degree sometimes occur, such as in a specimen figured by Krauss (1911, Pl. ii, fig. 9E; the author has seen a similar aberration in a specimen from Honolulu). The type of *O. inaequalis* shows relatively only very slight asymmetry in this respect, and this cannot be considered of taxonomic importance. In colour and size the specimen falls well within the normal range for *O. saundersii* (syn. *O. cubana*), and there is in fact no extra pale line in the wings.

Localities of Oligotoma saundersii.

Below is a summary of the distributional records of this species under its various pseudonyms. Only those based on mature males have been allowed, as other records can have no significance. Except for specimens re-examined by later workers, only records since the monograph of Krauss (1911) are listed, as the determinations of earlier workers cannot be evaluated.

Westwood's type: East India.

As *O. latreillii* (or *latreillei*): Bombay; Madagascar (the types of Rambur, 1842).—Davis (1936): Queensland: Brisbane; Townsville. New Caledonia: Noumea.—Enderlein (1910): Aldabra Isd.—Enderlein (1912): South Formosa; Madagascar; East Africa: West Pemba Id.; Dar-es-salam. South Brazil: State of Santa Catharina; Colombia: St. Jean; Cuba.—Friederichs (1923): Madagascar: Ilôt Prune; Tamatave; Fort Duchesne.—Friederichs (1934): Brazil: State of Sta. Catharina, Humboldt District. British East Africa: Chiromo (Nyasaland).—Menon and George (1936): India: Salsette Isd.; Ernakulam, Cochin State.—Mukerji (1935): India: Bombay Presidency; Central Provinces. Ceylon: Peradeniya.—Navás (1918*a*): Cuba; Brazil; Colombia (probably not original references).—Navás (1922): Brazil: Bahia.—Navás (1923*b*): Singapore; Mascate (? Muscat); New Caledonia: Noumea: Mozambique; Vallée du Pungoné (? R. Pungwe); French Guinea: Îles de Los; Tonquin: Cho-gahn.—Navás (1928): Sumatra: Padang.—Navás (1929): Congo: Panga, Aruwimi; Luebo; Djamba, Bas Uelé; Kimbou, Kwango.—Okajima (1926): Southern Japan.—Rimsky-Korsakov (1914): Formosa: Anping; Alikang.

As *O. insularis*: Hawaiian Isds. (the types of M'Lachlan, 1883).—Perkins (1913): Hawaiian Isds.: Kauai; Oahu; Molokai; Maui; Hawaii.

As *O. cubana*: Cuba (the type of Hagen, 1885).

As *O. hova*: Madagascar (the type of de Saussure, 1896).—Krauss (1911): South Madagascar; French Guyana: St. Jean.

As *O. bramina*: Bombay, India (the type of de Saussure, 1896).

As *O. rochai*: Brazil: Ceará (the type of Navás, 1917).

As *O. inaequalis*: St. Croix, West Indies (the type of Banks, 1924).

New Records: In addition to types discussed in the synonymy, mature males of *O. saundersii* from the following localities have been examined by the author: *Californian Academy of Sciences, San Francisco*: Honolulu.—*Museum of Comparative Zoology, Harvard University*: St. Augustine, Trinidad, 10.5.35, N. A. Weber; Wiecsdale, Florida, 24.4.—, C. H. Paige.—*British Museum of Natural History*: Aldabra Isd., '08–9, J. C. Fryer; Ascension; Caia, Zambesi, 29.7.11, H. Swale; Ceylon, coll. Thwaites; Kaunakakai, Molokai, Perkins; Mts. Waimea, Kauai, Perkins; Zomba, Nyasaland, H. S. Stannus.—*Museo Civico di Storia Naturale, Genoa*: Bambili, Congo, 1907, coll. Ribotti.—*Museum d'Histoire naturelle, Paris*: Békily, S. Madagascar, A. Seyrig.—*Colombo Museum, Ceylon*: Warahamankada, Southern Province, 14.3.35.—*Macleay Museum, Sydney University*: Rockhampton, Queensland, and environs; numerous records, specimens collected by and received from Mr. W. J. S. Sloan.

Variability of Oligotoma saundersii.

The species as herein recognized is subject to variability in the taxonomically unimportant characters of size and colour, and in minor structural details. Total lengths of mature males range from 5 mm. to nearly 9 mm., and the general body colour from pale yellowish-brown to chocolate-brown. The specimen listed from Warahamankada, Ceylon, was exceptionally dark brown. The number of cross-veins in the wings is variable, and the structure of the tip of the outer process of the right hemitergite is subject to minute variations. Individual variations in the relative lengths of the segments of the cerci also occur.

It would serve no purpose to recognize any variations such as the above under varietal or subspecific names. Members of the species have undoubtedly been much spread over the face of the globe by man, and a detailed study of variation could not therefore be anticipated to yield geographic data of any value.

The female (v., e.g., Davis, 1936, 1938) possesses no characters of taxonomic importance.

OLIGOTOMA HUMBERTIANA (de Saussure, 1896).

Embia humbertiana de Saussure, 1896, *Mitt. Schweiz. Entomol. Ges.*, ix, p. 353. Ceylon.

Krauss (1911, Pl. i, fig. 7C) has figured de Saussure's type (Geneva Mus.). It belongs to the species incorrectly known to Krauss (l.c.) and Enderlein (1912) as *O. saundersii* (or *saundersi*). Under this name it has been well figured by other workers in addition to the above, e.g. Rimsky-Korsakov (1914), Okajima (1926), Shao Wen Ling (1934) and Menon and George (1936). A detailed description is therefore unnecessary here. The figure of the terminalia (fig. 5) is from a specimen in the Museum of Comparative Zoology, from Mt. Makilling, Luzon, Philippine Isds. The species is immediately recognizable by the external subterminal tooth on the outer process of the right hemitergite ($10RP_1$). The process of the left hemitergite (10LP) ends typically in a small bifid claw directed outwards, although variations in this structure may occur (v., e.g., Menon and George, 1936, p. 90). The breadth of $10RP_1$ and the size and position of its subterminal tooth are somewhat variable; in this respect Krauss's figure of the type differs slightly from his figure of a specimen from Java (l.c., fig. 7), and from the figures of authors quoted above. The taxonomic recognition of such variations would serve no useful purpose, for the reasons noted under *O. saundersii.*

Specimens of *O. humbertiana* from Ceylon do not in general agree with Krauss's figure of de Saussure's type, as opposed to published figures of specimens from other countries, in the breadth of $10RP_1$. In the Colombo Museum there are specimens from various localities in Ceylon agreeing more closely with Krauss's figure 7 than with his figure 7C (the type).

It is unlikely that *Embia klugi* Rambur (1842, p. 313) refers to the insect under discussion here. It is given (with a query) in the synonymy of '*O. saundersi*' by Enderlein (1912). This synonymy is copied by Navás (1918*a*), without query. Both authors were referring to the insect now known to be *O. humbertiana.* Rambur's type, from Brazil, is stated by Hagen (1885, p. 197) to belong 'to the Museum in the Jardin des Plantes, in Paris', and Krauss (1911, p. 30) states that it is in 'Mus. Paris'. It is not now there, nor (fide Enderlein) in the de Selys collection, where others of Rambur's types are to be found.

Rambur does not describe the wings, so that it cannot be decided whether the venation was Oligotomoid. As the type is apparently lost, and the original description and lack of detailed locality give no hope of identification, the species should be listed as permanently unrecognizable. It may be noted that Rambur's description of the appendages (cerci) is suggestive rather of a member of the series to which belongs *Olyntha brasiliensis* Griffith and Pidgeon (1831–2, ex Gray MS.). This series is certainly not related to *Oligotoma*, having R_{4+5} forked, and a new generic name is in fact required to replace *Olyntha*, which is a homonym of the earlier *Olynthus* Hübner (Coleoptera). This series includes *Olyntha ruficapilla* Burmeister, with which Hagen synonymized *Embia klugi*; it is not congeneric with *Embia* Latreille, as stated by Enderlein (1912).

Navás (1922) refers a series from La Paz, Lower California (Mexico) to *O. californica* (Banks, 1906). The series (in the Paris Museum) proved on examination to be *O. humbertiana*. The locality is a considerable distance from Banks's type locality (Los Angeles, California). The actual identity of *O. californica* will be dealt with shortly in a paper by Mr. E. S. Ross, of the University of California.

De Saussure's type locality is merely 'Ceylon'. The following records, based on mature males, exist under the name *O. saundersii* (or *saundersi*): Enderlein (1912): East Africa; Formosa; South Brazil; Ceylon; Singapore.—Friederichs (1923): Manila, Philippine Isds.—Friederichs (1934): Kagoshima, Japan; Dutch East Indies: Buitenzorg; Malang; Padang.—Krauss (1911): Singapore; Java.—Menon and George (1936): India: Bombay; Salsette Isd.; Ernakulam, Cochin State.—Mukerji (1935): Ross Isd., Andamans; India: Barkuda Isd., Madras Presidency; Burhanpur, Central Prov.; Calcutta; Medha, Satara District, Bombay Presidency; Rutnagiri District; Saugor, Central Prov.—Navás (1918*b*, 1923*a*): Manila, Philippine Isds.—Navás (1923*b*): India: Pondicherry; Malabar Coast. Seychelles: Mahé. Coroman de Gengi.—Navás (1928): Rio Cassine, Portuguese Guinea; Minhla, Birmania (Burma?).—Okajima (1926): Southern Japan.—Rimsky-Korsakov (1914): Anping, Formosa.—Shao Wen Ling (1934, 1935): Amoy University, China.

The following are the localities of mature males of *O. humbertiana* seen by the author: *Zoological Museum, Buitenzorg*: Java: Buitenzorg (several records).—*Museum of Comparative Zoology, Harvard University*: Philippine Isds.: Mt. Makilling, Luzon, coll. Baker; La Carloto Central, Occ. Negros, L. E. Uichanco, 3–1930; Manila, Banks.—*Museum d'Histoire naturelle, Paris*: La Paz, Lower California, 1914, L. Diquet.—*Colombo Museum*: Ceylon: Bintenne, 10.28; Horowupotana, 9.10.24; Katagamuwa, Southern Province, 7–11.2.36; Marai Villu, N.W. Province, 24.3.33; Pulmoddai, Trincomali District.

The series from Borneo, from which Hagen (1885) redescribed *O. saundersii*, is in the Museum of Comparative Zoology, Harvard University. Hagen (l.c.) suggested the use of the name *O. borneensis* for this series, but in the same place decided to refer it to *O. saundersii*. It is not conspecific with either of the species here under consideration, but is the same as that now known as *O. vosseleri* (Krauss, 1911). This series will be considered in a later paper.

Variability of Oligotoma humbertiana.

The general colour of mature males of this species varies between pale and dark ferruginous; the total length from 5·5 mm. to 8 mm. The number of cross-veins in the wings is variable. Minor variations in the processes of the hemitergites have been mentioned above.

Discussion.

The tropicopolitan distribution of *O. saundersii* and *O. humbertiana* is evident from the facts listed above. A third species, *O. nigra* Hagen, 1885 (syn. *O. mesopotamica* Esben-Petersen, 1929), is also very widespread; its distribution will shortly be dealt with in a paper by Mr. E. S. Ross. All three species probably owe their wide distribution in part to human transport. Apart from these species, the range of the genus *Oligotoma* (including *Aposthonia* Krauss, 1911; v. Davis, 1936) extends from East Africa through India and China to Southern Japan, the Philippines, the East Indies, New Guinea, Australia and Tasmania, and some islands in the Indian Ocean. This distribution is in contrast to previous concepts, as the genus was believed to be indigenous in all warm countries.

Certain species have been incorrectly referred to *Oligotoma*; the following require new generic names, being actually not directly related to *Oligotoma*: *O. hospes* Myers, 1928, Cuba; *O. hubbardi* Hagen, 1885, Florida; *O. ruficollis* de Saussure, 1896, Central America; *O. sulcata* Navás, 1923*b*, Galla Annia, Africa; *O. venosa* Banks, 1924, Cuba.

These will be dealt with in later papers, except *O. hospes* Myers, which is being dealt with by Mr. E. S. Ross.

The genus is exceedingly compact, showing few affinities to other members of the Order. The general form of the right hemitergite in the male, especially the structure marked on the accompanying figures as $10RP_2$, and the distribution of the main veins of the wings, remain constant throughout the component species. The family which the genus forms, the Oligotomidae, must temporarily be considered to contain no other genus. *Notoligotoma* Davis, 1936, and *Anisembia* Krauss, 1911, possess structural (venational) resemblances, but these can be regarded only as convergent. *Notoligotoma* belongs rather to a series of genera including *Burmitembia* Cockerell, 1919, *Embonycha* Navás, 1917*a*, *Metoligotoma* Davis, 1936, and *Ptilocerembia* Friederichs, 1923 (cf. Davis, 1938, p. 267, footnote 2); *Anisembia* rather to a series including '*Oligotoma*' *hospes* Myers. Whether, as Krauss (1911) considers, *Haploembia* is referable to the family Oligotomidae is very problematical. It certainly possesses a long outer process to the right hemitergite, but the remainder of this hemitergite is not otherwise very close in structure to its homologue in *Oligotoma*. Another point of similarity lies in the left cercus, whose first segment always lacks nodules. Those species referred to *Haploembia*, which have nodules on this segment (e.g. *H. capensis* Esben-Petersen, 1920) are rightly referable to *Dictyoploca* Krauss, 1911 (sensu Rimsky-Korsakov, 1927) rather than to *Haploembia*. In its other characters, e.g. tarsal bladders, *Haploembia* differs markedly from *Oligotoma*, and as *Haploembia* is entirely wingless it is impossible to decide its affinities to *Oligotoma* on the important character of venation.

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Addendum.

P. 185, line 15, *after* Dar-es-salam, *add* Lindi, Morogoro. Cameroons: Garua; Rei Buba.

P. 187, line 34, *after* Banks, *add* Surigao, Mindanao, coll. Baker. Formosa: Rokki, 15.6.32, coll. L. Gressitt. India: Bhadravate, Mysore, coll. P. S. Nathan.

A KEY TO THE MARINE ALGAE OF NEW SOUTH WALES.*

Part 2. MELANOPHYCEAE (Phaeophyceae).

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[Read 26th April, 1939.]

In 1909 Lucas recorded 43 species of brown algae from the east coast of Australia; since that date the number of species recorded for New South Wales has been increased to 83, the number in this key.

Setchell and Gardner's scheme of classification (1925) has been followed almost exactly. In addition, the works of Newton (1931) and Tilden (1935) have been consulted repeatedly. J. Agardh's *Species Sargassorum Australiae* (1888) has been followed for the *Sargassum* species in this key. Lucas's 'Seaweeds of South Australia' (1936) has been used especially in connection with the Dictyotaceae.

The abbreviations used as sub-headings under localities are as follows:
Bailey: Bailey, F. M. (1895).
C.S. & I.R.: Lucas Collection, Council for Scientific and Industrial Research, Canberra.
D.T.: De Toni, G. B. (1895).
Harv. Aus.: Harvey, W. H. (1858-63).
Herb. Notes: Notes or lists of collections found at the National Herbarium, Sydney.
J. Ag.: Agardh, J. (1888).
Laing: Laing, R. M. (1900).
Lucas (1913): Lucas, A. H. S. (1913).
Lucas (1935): Lucas, A. H. S. (1935).
Lucas (1936): Lucas, A. H. S. (1936).
Lucas, C. S. & I. R. Notes: Herbarium Notes from the Lucas collection, Canberra.
Muell.: Sonder, W. (1880).
Nat. Herb.: The algal section, National Herbarium, Sydney.
Okamura: Okamura, K. (1904).
Sonder: Sonder, W. (1871).
Tilden & Fess.: Tilden, J. E., and Fessenden, A. P. (1931).
University: The algal herbarium, University of Sydney.

The system of classification used in the present key is as follows:

MELANOPHYCEAE.

Phaeosporeae.

Sphacelariales: Sphacelariaceae (*Sphacelaria*); Cladostephaceae (*Cladostephus*); Stypocaulaceae (*Stypocaulon*).

Ectocarpales: Elachisteaceae; Myrionemataceae; Ralfsiaceae; Leathesiaceae (*Leathesia*); Asperococcaceae (*Asperococcus*); Punctariaceae; Scytosiphonaceae (*Ilea*; *Scytosiphon*; *Colpomenia*); Ectocarpaceae (*Ectocarpus*; *Pylaiella*); Striariaceae; Aegiraceae (*Bactrophora*); Chnoosporaceae (*Chnoospora*); Heterochordariaceae.

Cutleriales.

* Continued from Vol. lxiii, 1938, p. 218.

Sporochnales: Sporochnaceae (*Sporochnus*; *Carpomitra*).
Desmarestiales: Desmarestiaceae; Myriogloiaceae (*Myriogloia*).
Chordariales: Chordariaceae; Coilodesmaceae; Scytothamnaceae (*Scytothamnus*).
Dictyosiphonales: Dictyosiphonaceae; Spermatochnaceae (*Spermatochnus*).
Laminariales: Chordaceae; Laminariaceae; Lessoniaceae (*Macrocystis*); Alariaceae (*Ecklonia*).

Aplanosporeae.
Tilopteridales.
Dictyotales: Dictyotaceae (*Gymnosorus*; *Zonaria*; *Homoeostrichus*; *Padina*; *Spathoglossum*; *Neurocarpus*; *Dictyota*; *Dilophus*; *Lobospira*).

Cyclosporeae.
Fucales: Sargassaceae (*Sargassum*; *Carpophyllum*; *Blossevillea*; *Cystophyllum*; *Scaberia*; *Phyllospora*); Fucaceae (*Hormosira*); Durvillaeaceae (*Sarcophycus*; *Notheia*); Splachnidiaceae (*Splachnidium*).

MELANOPHYCEAE Stiz.

Reproduction sexual only.
Thallus at maturity never unicellular or monosiphonous, but composed of differentiated and complex tissues; growth terminal; reproductive structures located within the thallus in conceptacles and associated with branched paraphyses; female gamete non-motile; male gamete motile by means of two laterally-placed cilia of unequal length; fertilization effected when both gametes have escaped into the water .... Tribe CYCLOSPOREAE Aresch.

Reproduction sexual and non-sexual.
Aplanospores present.
Fronds filamentous or complanate; reproductive organs on the surface of the thallus; non-motile, non-sexual spores occur singly or in groups of four; bi-ciliated zoospores sometimes present also .... Tribe APLANOSPOREAE S. & G.
Aplanospores absent.
Non-sexual reproduction (where known) by zoospores with two lateral cilia; male gametes motile, biciliated; female as above or non-motile; typical members possess unilocular zoosporangia and plurilocular gametangia and have the gametophyte and sporophyte of very closely similar size and structure ...... Tribe PHAEOSPOREAE Thur.

Tribe PHAEOSPOREAE Thur.

Gametangia present on macroscopic plants (zoosporangia known or unknown).
A terminal cell present and conspicuous; plants usually tufted; thallus filamentous, monosiphonous near or at the tips, usually becoming polysiphonous below through longitudinal walls—also there may be cortication due to descending filaments; whole attached by filaments or discs; branching, where present, very regular; unilocular and plurilocular reproductive structures on the same or similar plants and consisting of transformed apical portions of usually short branchlets. The cell wall differs in composition or constitution from that of any of the Ectocarpales in that, when older, it darkens if treated with eau-de-javelle, turning black in mature cells .... I. Order SPHACELARIALES Oltmanns.
The terminal cell, if present, at least not conspicuous. This includes Cutleriales Oltmanns. Gametes nearly or quite equal; growth in length strictly subapical, often trichothallic; thallus variable; unilocular and plurilocular reproductive structures on the same or similar plants .... II. Order ECTOCARPALES S. & G.

Only unilocular zoosporangia present on macroscopic plants (gametangia known, or suspected of being, on macroscopic plants).
Thallus built up by means of branching cell filaments, which adhere more or less strongly to one another.
Specialized sori of sporangia encircle the thallus or occur at the apices of the branchlets .... III. Order SPOROCHNALES Sauvageau.
Zoosporangia immersed in the cortical filaments.
Growth sub-apical from apical filaments, not trichothallic; colourless hairs generally present; thallus of three layers, an inner layer of slender filaments (which may disappear), an intermediate layer of cells which are longer than broad or thick, and a cortical layer of short anticlinal, assimilatory filaments—the whole enclosed in jelly .... V. Order CHORDARIALES S. & G. (part.)

Terminal growth conspicuously trichothallic; frond clothed, where young, with densely crowded, exserted, simple or branched, coloured, monosiphonous hairs .... IV. Order DESMARESTIALES S. & G.

Intercalary longitudinal division occurs, as a result of which true parenchymatous tissue is formed.

Growth apical or sub-apical.

Growth sub-apical from apical filaments; thallus of three layers, an inner layer of slender filaments (which may disappear), an intermediate layer of cells which are longer than broad or thick, and a cortical layer of assimilatory filaments combined into a tissue; zoosporangia immersed in the cortical tissue........................ .... V. Order CHORDARIALES S. & G. (part.)

Growth in length apical; cylindrical thallus much branched and composed of two, or sometimes three tissues, the inner tissue of elongated cells, the outer of shorter, nearly iso-diametric or somewhat flattened cells; hairs scattered singly over the frond and soon deciduous .... VI. Order DICTYOSIPHONALES S. & G.[1]

Growth never apical, increase in length being caused by the tissue between the blade and stipe or (in the Chordaceae Dumont.) that just above the holdfast; plants large and complex in structure and usually consisting of base, stipe and blade; tissue usually differentiated into central 'hyphal' cells (some with trumpet cells), intermediate tissue and a cortical tissue of small cells; unilocular zoosporangia of the macroscopic plant associated with unicellular paraphyses and forming extensive sori .... VII. Order LAMINARIALES Oltmanns.

I. Order SPHACELARIALES Oltmanns.

Branches formed from initial cells below the apical cell, although hairs may arise by direct division of the apical cells; unilocular and plurilocular reproductive structures stipitate.

Unilocular and plurilocular reproductive structures borne on the ordinary branches .... Sphacelariaceae Reinke (emend. Oltmanns).

The external layer of rectangular cells arranged in a regular transverse band; lower portion of the plant often provided with a false cortex. Only genus recorded for New South Wales .... 1. *Sphacelaria* Lyngb.

Secondary branchlets whorled; unilocular and plurilocular reproductive structures borne on special branches growing near the apex, these special branches inserted between the ordinary whorls .... Cladostephaceae Oltmanns.

Main axis densely corticate by the growth of rhizoidal filaments; secondary branches ecorticate; hairs in tufts just below the apices of the branches. Only genus recorded for New South Wales .... 2. *Cladostephus* Ag.

Branches formed by the direct division of the apical cell in a manner similar to the formation of the hairs of *Sphacelaria* and *Cladostephus* .... Stypocaulaceae Oltmanns.

Frond pinnate; central axis consists of a number of cuboidal cells surrounded by a wide band of corticating cells; fertile branches bear numerous sporangia in groups in the axils. Only genus recorded for New South Wales .... 3. *Stypocaulon* Kuetz.

II. Order ECTOCARPALES S. & G.

Punctariaceae Kjellm., Striariaceae Kjellm., Heterochordariaceae S. & G., Elachisteaceae Kjellm., Myrionemataceae Foslie (orthog. mut.) and Ralfsiaceae Kjellm. do not occur here. Fronds are usually erect, membranaceous or filamentous; when globular or prostrate they are either hollow or carnose (not so in Elachisteaceae Kjellm., Myrionemataceae Foslie (orthog. mut.) and Ralfsiaceae Kjellm.).

Fronds irregularly globular and hollow, or flattened and solid carnose, thick; inner tissue of large colourless cells and loosely parenchymatous of di- or trichotomous filaments, outer cells coloured and in anticlinal rows, held together, at least loosely, by the surrounding jelly; zoosporangia and gametangia, with loculi uniseriate or nearly so, immersed in the external, anticlinal rows and borne on the same or similar plants; plant arises from a primitive basal disc and is epiphytic or saxicolous .... Leathesiaceae S. & G.

Zoosporangia pyriform to ellipsoidal, attached at the base. Only genus recorded for New South Wales .... 4. *Leathesia* Gray.

Fronds elongated, erect when globular, not carnose.

Fronds membranaceous or flattened, at times hollow (this includes Punctariaceae Kjellm.).

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[1] See footnote on page 195.

Sori definite, entirely projecting and scattered over most of the frond; fronds ligulate or saccate, simple, differentiated into an inner tissue of nearly colourless cells and an outer, coloured, cortical layer; growth trichothallic at first, later intercalary; hairs present .... Asperococcaceae Foslie.

Paraphyses present. Only genus recorded for New South Wales .... 5. *Asperococcus* Lamour.

Sori usually indefinite, superficial (not projecting beyond the surface); gametangia very closely packed; fronds cylindrical or hollow, flattened and solid or more or less globular and hollow; main growth in length at first trichothallic, later intercalary; frond of two or three layers of tissues, the outer being of smaller assimilating cells; hairs, when present, occur in groups .... Scytosiphonaceae[2] Foslie.

Frond cylindrical, not membranaceous.

Frond monosiphonous, occasionally polysiphonous; branching various; filaments arise from superficial (occasionally penetrating) filaments, or from a small superficial disc; cells uni-nucleate with parietal chromatophore(s); unilocular and plurilocular reproductive structures arise from branchlets transformed wholly or in part, or are intercalary .... Ectocarpaceae[2] Harv.

Fronds more complex (this includes Striariaceae Kjellm. and Heterochordariaceae S. & G.).

Growth trichothallic; no distinct sori occur; sporangia and gametangia neither superficial nor projecting, but scattered in assimilating filaments; fronds erect, branched, gelatinous, and of two or three tissues; the central tissue of larger and longer, colourless filaments, and the cortical of distinct, anticlinal filaments (there may be an intermediate zone) .... Aegiraceae S. & G.

Frond often hollow, central portion composed of anastomosing filaments with two other layers to the outside. Only genus recorded for New South Wales .... 11. *Bactrophora*[3] J. Ag.

Growth sub-terminal, not distinctly trichothallic; fronds elongated, solid, slender, more or less compressed, more or less dichotomous or proliferous from the margins, of two sets of tissues, an inner of large cells, an outer of one or more layers of small, coloured cells in short, anticlinal rows; cryptostomata occur; gametangia uniseriate, arising from clusters of hairs and spreading over the surface, at times into confluent sori .... Chnoosporaceae S. & G.

Only genus .... 12. *Chnoospora* J. Ag.

Scytosiphonaceae Foslie.

Frond solid (or very nearly so) and strap-shaped, flaccid, tapering to a small solid stipe at base; gametangia with uniseriate loculi; gametes freed by complete dissolution of the entire wall .... 6. *Ilea* Fries.[4]

Frond hollow and cylindrical, flattened, globose or difform.

Frond cylindrical or flattened, unbranched; inner layer of cells thick-walled, vertically elongated and colourless, the outer of small, rounded, cuboidal, assimilating cells; growth intercalary near the base .... 7. *Scytosiphon* Ag. (emend. Thur.)

Frond globose or difform (solid in very juvenile form); membrane rather thin and membranaceous, entire (though it may be lacerated in age); inner tissue of large, rounded, nearly colourless, thin-walled cells, outer of small, cuboidal, assimilatory cells; gametangia early developed around groups of hair-filaments, later spreading over the entire frond surface .... 8. *Colpomenia* Derb. & Sol.

Ectocarpaceae Harv.

Creeping portion of the vegetative filaments superficial or penetrating the host merely by rhizoids; zoosporangia and gametangia transformed branchlets or tips of branches or branchlets, and so strictly terminal .... 9. *Ectocarpus* Lyngb.

Creeping filaments not penetrating the uninjured host; zoosporangia and gametangia catenate, intercalary; zooid liberation via lateral pores .... 10. *Pylaiella* Bory.

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[2] For greater clarity the key to the genera of this family is placed at the end of the Order Ectocarpales.

[3] If the growth be sub-apical, not trichothallic, and if the plurilocular reproductive structures occur only on macroscopic plants, this genus will need to be placed in the Chordariaceae Reichenb. (in part). Both the above mentioned points of classification are as yet unsettled in this genus, but plurilocular reproductive structures have been reported on macroscopic plants.

[4] Setchell & Gardner (1925) support priority of the generic name of *Ilea* Fries over that of *Phyllitis* Kuetz.

III. Order SPOROCHNALES Sauvageau.

Unilocular and plurilocular reproductive structures on or among articulated ramuli, on receptacles .... Sporochnaceae (Reichenb.) Decne.

Sporangiferous regions, i.e., receptacles, cylindrical, globose or club-shaped beneath pencils of deciduous hairs .... 13. *Sporochnus* Ag.

Sporangiferous regions, i.e., receptacles, shortly conoid or mitriform; no pencils of plumes .... 14. *Carpomitra* Kuetz.

IV. Order DESMARESTIALES S. & G.

Desmarestiaceae Kjellm. does not occur here.

Cortical filaments free; fronds filamentous, erect, cylindrical, solid (always in Australian types) or later tubulose; central strands of large, colourless cells, the peripheral of two sorts, (1) free, short, cortical filaments with rounded terminal cells, and (2) exserted, monosiphonous filaments with basal, meristematic cells and outer cells provided with phaeoplasts and consequently coloured; colourless hairs absent .. Myriogloiaceae Kuckuck.

Axis of frond polysiphonous or hollow below (Australian types polysiphonous always). Only genus recorded from New South Wales .... 15. *Myriogloia* Kuckuck.

V. Order CHORDARIALES S. & G.

Chordariaceae (Reichenb.) in part, and Coilodesmaceae S. & G. do not occur here.

No distinct cortical, anticlinal filaments occur .... Scytothamnaceae S. & G.

Frond filiform, repeatedly and unequally branched; the anastomosing mass of filaments, both elongated axial and radiating peripheral, held in a jelly-like substance, reticulum more dense in the cortical region; sporangia elongated and immersed in the peripheral filaments. Only genus recorded from New South Wales ..... 16. *Scytothamnus* H. & H.

VI. Order DICTYOSIPHONALES[6] S. & G.

Dictyosiphonaceae D.T. does not occur here.

Sporangia borne at the base of more or less clavate paraphyses, or intercalary .... Spermatochnaceae Kjellm. (lim. mut.)

Frond filiform, elongated and regularly branched; central axis consists of a central cell and a band of corticating cells from which arise elongated, assimilatory filaments and hairs; sporangia borne at the base of clavate paraphyses. Only genus recorded from New South Wales .... 17. *Spermatochnus* Reinke.

VII. Order LAMINARIALES Oltmanns.

Chordaceae Dumont. and Laminariaceae Reichenb. do not occur here.

The stipe is distinct, at least when young, and paraphyses bear hyaline appendages in the types so far recorded from New South Wales.

Splitting arises at the transition place or within its influence; fronds composed of hold-fast, branching stipe and a few to numerous blades; no cryptostomata or tufts of hair; paraphyses unicellular. No outgrowths develop as in Alariaceae except in *Lessoniopsis* Reinke. .... Lessoniaceae S. & G.

Sori on the ordinary blades; stipe scorpioid-sympodial. This is the only section recorded for New South Wales .... Macrocysteae Kuetz. (lim. mut.)

Stipe solid. Only genus recorded from New South Wales .... 18. *Macrocystis* Ag.

Outgrowths arise at the transition place or within its influence ...... Alariaceae S. & G.

Mature outgrowths confined to the blade. This is the only section recorded for New South Wales .... Ecklonieae Setchell.

Lamina pinnatifid, ribless and broad. Only genus recorded from New South Wales .... 19. *Ecklonia* Hornemann.

1. SPHACELARIA Lyngb.

Branching pinnate; pinnae frequently opposite, irregular in length, but becoming shorter near the tips of branches; articulations about equal in length and breadth .... 1. *S. cirrhosa* (Roth.) Ag.

Locality.—Harv. Aus.: Port Jackson.

Branching not pinnate; articulations longer than broad ...... 2. *S. tribuloides* Menegh.

Locality.—Nat. Herb.: Tuggerah Lakes. Harv. Aus.: Port Jackson, Kiama (also Victoria).

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[6] The Order Dictyosiphonales S. & G. is here regarded as extended to include those members of the Spermatochnaceae with growth from a distinct apical cell. This extension is suggested by Setchell and Gardner (1925, p. 587).

2. CLADOSTEPHUS Ag.[6]

Whorls of ramuli very close together and difficult to differentiate; joints of the ramuli shorter than broad .... 3. *C. spongiosus* (Lightft.) Ag.

Locality.—Nat. Herb.: Tuggerah Lakes (also Victoria). C.S. & I.R.: Narrabeen. Herb. Notes: Lake Macquarie.

Whorls of ramuli close but distinct; joints about as long as broad .... 4. *C. verticillatus* (Lightft.) Ag.

Locality.—Nat. Herb.: Narrabeen (also Victoria).

3. STYPOCAULON Kuetz.

Frond notably stupose, to 20 cm. or more high and harsh and stiff; fruits occur 3 or 4 aggregated in the axils .... 5. *S. paniculatum* (Suhr.) Kuetz.[7]

Locality.—Nat. Herb.: Kiama, Narrabeen, Newcastle (also Victoria). University: Broken Bay. C.S. & I.R.: Bondi or Long Bay—cast up.

4. LEATHESIA Gray.

Thallus of metallic-green, shining, irregularly globose, hollow sacs of up to 5 cm. diameter; paraphyses clavate, gradually and uniformly enlarging upwards .... 6. *L. difformis* (Linn.) Aresch.

Locality.—Nat. Herb.: (also Victoria). C.S. & I.R.: Eden.

5. ASPEROCOCCUS Lamour.

Fronds attenuated at the base, swelling into elongated sacs, which may be constricted into segments; sori dotted over the surface; paraphyses numerous .. 7. *A. bullosus* Lamour.

Locality.—Nat. Herb.: Eden, Twofold Bay, Botany Bay.

6. ILEA Fries.

There is a disc-like attachment organ; frond oval or cuneiform; no hairs or paraphyses occur; plant very variable .... 8. *I. fascia* (Muell.) Fries.

Locality.—Nat. Herb.: Plant as *Phyllitis fascia* (Muell.) Kuetz. Farm Cove, Sydney, Woolloomooloo Bay, Sydney. C.S. & I. R.: Plant as *Phyllitis fascia* (Muell.) Kuetz. Sydney district, Maroubra, Wollongong, Kurnell, Manly, Bondi.

7. SCYTOSIPHON Ag. (emend. Thur.).

Unbranched frond is intestiniform, sometimes articulately constricted; attachment by a small disc; sporangia associated with paraphyses .... 9. *S. lomentaria* (Lyngb.) J. Ag.

Locality.—Nat. Herb.: Huskisson, Jervis Bay. Lucas (1936): 'North as far as Sydney'.

8. COLPOMENIA Derb. & Sol.

Thallus consists of pale brown bladders without stipes—attachment being by a broad base; the cortical layer consists of 1 or 2 rows of cuboidal cells—the inner layer of larger, rounded cells .... 10. *C. sinuosa* (Roth.) Derb. & Sol.

Locality.—Nat. Herb.: Middle Harbour, Sydney, Newcastle (also Victoria). University: Watson's Bay. C.S. & I.R.: Botany Bay, Port Jackson (also Queensland and Lord Howe Island). Muell.: Plant as *Asperococcus sinuosus* Bory., Tilba Tilba.

9. ECTOCARPUS[8] Lyngb.

Plant tufted, usually about 30 mm. high and rarely, if ever, exceeding 1 cm.; usually epiphytic; branching diffuse; articulations at the base half as long as broad, and in the other parts four or more times longer than their breadth; plurilocular reproductive structures egg-shaped or elongated, sessile or shortly stipitate; unilocular reproductive structures egg-shaped and sessile .... 11. *E. simpliciusculus* Ag.

Locality.—C.S. & I.R.: Manly. D.T.: (also Queensland).

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[6] Notes in the Algal Section of the National Herbarium, Sydney, indicate that there are intermediate forms between the two species listed below.

[7] Sonder (1880) lists *Sphacelaria paniculata* Lgb. as from Tilba Tilba. This species is not mentioned by De Toni (1895). *Sphacelaria paniculata* Suhr. is a synonym of *Stypocaulon paniculatum* Kuetz.

[8] S. & G. (1925) use chromatophore form-discoid or band-shaped, as a means of distinguishing species of *Ectocarpus*. The writer has found both forms present in a single filament of *E. confervoides*.

Plant tufted; when mature usually exceeds 2 cm. in height, and may be more than 30 cm. long; branching alternate or secund, not opposite; plurilocular reproductive structures very variable, but not cylindrical or obtuse-conical at maturity .... 12. *E. confervoides*[9] (Roth.) Le Jol.

Some workers divide this species further as:

Plant always fixed; never possessing a terminal hair on the plurilocular reproductive structure .... *E. confervoides* (Roth.) Le Jol.

Plant often free-floating and usually possessing a terminal hair on the plurilocular reproductive structure .... *E. siliculosus* (Dillw.) Lyngb.

Locality.—Nat. Herb.: Plant as *E. confervoides* (Roth.) Le Jol., Port Stephens; Plant as *E. siliculosus* (Dill.) Lyngb., Wollongong, Port Hacking. C.S. & I.R.: Plant as *E. confervoides* (Roth.) Le Jol., (also Queensland and Lord Howe Island). Bailey: Plant as *E. siliculosus* (Dill.) Lyngb. (also Queensland).

10. Pylaiella Bory.

Branches usually opposite, and given off at wide angles; articulations once or twice longer than broad; plant gelatinous, adhering to paper .. 13. *P. littoralis* (Linn.) Kjellm.

Locality.—C.S. & I.R.: South Head, Port Jackson.

11. Bactrophora J.Ag.

Lower branches pinnately branched, becoming simple and somewhat attenuate on ascending; fertile filaments occur near the apices .... 14. *B. nigrescens* (Harv.) J. Ag.

Locality.—Nat. Herb.: (also Victoria). C.S. & I.R.: Eden.

Branching absent or simple, never pinnate.

Distinct stipe present; branching alternate and rare or absent; apices attenuated .... 15. *B. filum* (Harv.) J. Ag.

Locality.—Nat. Herb.: Twofold Bay (also Victoria).

No distinct stipe present; branching irregular and frequent; apices blunt .... 16. *B. irregularis* Tilden & Fess.

Locality.—Tilden & Fess.: Kiama.

12. Chnoospora J. Ag.

Fronds densely caespitose, of the same diameter throughout, except at the slightly attenuated apices; branches forming acute angles .... 17. *C. pacifica* J. Ag.[10]

Locality.—Muell.: Plant as *C. fastigiata* J. Ag., N.S.W.

13. Sporochnus Ag.

Receptacles borne on pedicels which are at least longer than the receptacle.

Receptacles linear-cylindrical, obtuse at each end; frond very lax and slender .... 18. *S. Moorei* Harv.

Locality.—Nat. Herb.: Parramatta River, Port Jackson, (also Victoria).

Receptacles spherical or ovoid; frond terete .... 19. *S. radiciformis* (R. Br.) Ag.

Locality.—Nat. Herb.: Botany Bay, Eden. Muell.: Tilba Tilba.

Receptacles borne on pedicels which are shorter than the receptacles; fronds cylindrical; branching repeatedly decompound .... 20. *S. comosus* Ag.

Locality.—Nat. Herb.: Botany Bay (label not attached), (also Victoria).

14. Carpomitra Kuetz.

Plant much branched and irregularly dichotomous; thallus compressed; branches erect with acute axils, attenuated at the base and obtuse at the apex; receptacles occur at the thickened apices of the branch midrib .... 21. *C. costata* Batt.

Locality.—Nat. Herb.: Plant as *C. Cabrerae* Kuetz., (also Victoria). C.S. & I.R.: Plant as *C. Cabrerae* Kuetz., Eden. Harv. Aus.: Plant as *C. Cabrerae* Kuetz., Kiama.

15. Myriogloia Kuckuck.

Branching alternate or irregular; every portion of the frond thickly clothed with long, free, villous, hair-like, articulate filaments, which are branched at the base .... 22. *M. Scurius* (Harv.) Kuckuck.

Locality.—Nat. Herb.: Plant as *Myriocladia Scurius* Harv., (also Victoria). Harv. Aus.: Plant as *Myriocladia Scurius* Harv., Newcastle.

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[9] As the result of unpublished work on the variation of this species found near Sydney, the writer considers *E. siliculosus* (Dillw.) Lyngb. should be included as a variety.

[10] Under the name *C. fastigiata*, J. Agardh included his *C. pacifica* and *C. atlantica*. By rules of priority, *C. pacifica* must be accepted for our species.

16. Scytothamnus H. & H.

Frond somewhat compressed or terete, the median part vaguely ramose, the ultimate ramuli thin, rigid and acuminate .... 23. *S. australis* (J. Ag.) H. & H.
Locality.—Nat. Herb.: Manly, Bondi, (also Lord Howe Island).

17. Spermatochnus Reinke.

Apices of the filaments without peripheral filaments; branching dichotomous; branches elongated; secondary branches few, the apices attenuate; sori not sharply differentiated .... 24. *S. Lejolisii* (Thur.) Reinke.
Locality.—Nat. Herb.: Plant as *S. Lejolisii* (Thur.) D.T., Port Stephens.

18. Macrocystis Ag.

Main stipes bear at their summits the young differentiating blades and along the greater part of their length, at regular intervals, the mature, lateral blades, each with a pyriform bladder at its base, which in turn is supported by a short, cylindrical stipe; blades rigid, coarsely rugose and with spinulose margins .... 25. *M. pyrifera* (Linn.) Ag.
Locality.—Nat. Herb.: Plant as *M. pyrifera* (Turn.) Ag., Long Bay, (also Victoria and Lord Howe Island). C.S. & I.R.: Plant as *M. pyrifera* (Turn.) Ag., Bondi. Muell.: Tilba Tilba.

19. Ecklonia Hornemann.

Pinnae linear; triangular spines occur at the frond margins, and sometimes cover the whole surface; stipes thick .... 26. *E. radiata* (Turn.) J. Ag.
Locality.—Nat. Herb.: Between Harrington and Farquhar Inlets, Tweed River, Richmond River, Woy Woy, Urunga, Farm Cove, Clifton Gardens, Long Bay, Bermagui, Jervis Bay (cast up), (also Lord Howe Island). C.S. & I.R.: Botany Bay to Long Reef. Herb. Notes: Clarence River, Port Macquarie, Manning River, Forster, Port Stephens, Newcastle, Tuggerah, Hawkesbury River, Port Hacking, Lake Illawarra, Nowra, Bateman's Bay, Pambula. D.T.: (also Victoria). Sonder: Plant as *E. radiata* Harv., (also Queensland). (As Harvey treated *E. lanciloba* as merely a variety of the plant under discussion, this record for Queensland cannot be accepted as definite.) Muell.: Tilba Tilba.
Pinnae linear-lanceolate, with spinose dentate margins; stipes slender .... 27. *E. lanciloba* Sond.
Locality.—C.S. & I.R.: Port Stephens, (also Victoria).

Tribe Aplanosporeae S. & G.

The Tilopteridales Kylin do not occur here (the aplanospores of these occur singly, and unilocular zoosporangia giving rise to bi-ciliated zoospores are sometimes produced).
Fronds of moderate size, complanate; plants usually attached by a stupose base; growth apical; reproductive structures formed from superficial cells and projecting beyond the surface; aplanospores in groups of, usually, four, produced from a single mother cell; no zoospores produced; gametangia usually in dense sori; distinct oogamy occurs; male gametes with a single cilium .... VIII. Order Dictyotales Kjellm.
Only family .... Dictyotaceae Harv. (lim. mut.)
Fronds flabellate, zoned with conspicuous lines of innovation; growth in length by the division of many marginal cells; thallus ecostate.
No independent tufts of paranemata on the frond; frond composed of several layers of cells (distromatic in *Chlanidote* J. Ag.); reproductive organs may occur on both sides of the thallus; sori entirely superficial at maturity.
Striae of cortical cells radiate fan-wise in pairs, as if twinned.
Sori naked and on the upper surface; sub-zonate; frond flat, fan-shaped and with lobes .... 20. *Gymnosorus* J. Ag.
Sori protected by a hyaline indusium; paraphyses present; frond stipitate .... 21. *Zonaria* (Ag.) J. Ag.
Striae of cortical cells radiate fan-wise, singly; ultimate divisions of the frond fan-shaped; thallus pleiostromatic; sori prominent; paraphyses present; indusium absent .... 22. *Homoeostrichus* J. Ag.
Independent tufts of paranemata on the fronds; thallus ecostate and flat; fronds reniform and orbiculate, the edges involute or scrolled; lamina sometimes split into lobes; thallus of two or more layers of parallelepipedal cells covered by a single layer of coloured cells; reproductive structures formed in transverse zones; hairs and reproductive structures on one side of frond only .... 23. *Padina* Adanson.

Fronds erect, nowhere zoned with lines of innovation.
Terminal cells of the frond numerous and radiating fan-wise.
Fronds ecostate, sub-palmate, dichotomous; spores single or twinned, and evolved on both faces of the frond; thallus of inner, empty angular cells in several layers, and an outer zone of cubical cells scarcely smaller, but coloured .... 24. *Spathoglossum* Kuetz.
Frond prominently costate and dichotomous; thallus of an inner zone of rectangular, empty, colourless cells, and an outer (cortical) of cubical and densely coloured cells (monostromatic layer); reproductive structures on each face of frond; tetraspores collected in naked sori; paranemata occur apart from the sori, in clumps .... 25. *Neurocarpus* Webb. & Mohr.[11]
Terminal cells of frond converging towards a central, apical, initial cell.
Frond ecostate; reproductive cells borne on frond proper (but on proliferations in *Glossophora* J. Ag.).
Frond flat, dichotomous and composed of a median, monostromatic layer of large, colourless cells covered on each face by a cortical layer of small, coloured cells; hairs occur in groups on both surfaces .... 26. *Dictyota* Lamour.
Fronds as above, but the central layer di- or polystromatic .... 27. *Dilophus* J. Ag.
Holdfast much and diffusely branched; frond erect; stem cylindrical or compressed, especially in the upper part; cartilaginous and closely set throughout with patent lateral branches; branches slender, flat, furnished with a midrib in the lower half; ultimate divisions linear, spirally-twisted, alternately pinnate and bi-cuspidate; reproductive structures on both surfaces, in diffuse sori, on the pinnules .... 28. *Lobospira* Aresch.

20. Gymnosorus J. Ag.

Plant variegately pale brown .... 28. *G. variegatus* (Lamour.) J. Ag.
Locality.—Nat. Herb.: Long Bay. C.S. & I.R.: (also Victoria and Queensland). Herb. Notes: Tuggerah. Muell.: Plant as *Zonaria variegata* Mert., Port Jackson.
Plant very dark, turning black on being exposed or dried .... 29. *G. nigrescens* (Sond.) J. Ag.
Locality.—Nat. Herb.: Cronulla, Long Bay, Narrabeen, Tuggerah, Port Stephens (also Lord Howe Island). C.S. & I.R.: (also Queensland). Sonder: Richmond River, Ballina.

21. Zonaria (Ag.) J. Ag.

Stem terete or winged; thallus much divided, in general outline being flabellate; branches end in deeply parted, basally woolly laciniae, whose segments are narrow-linear, truncate, sparingly toothed or incised; no paraphyses occur in the sori .... 30. *Z. Turneriana* J. Ag.
Locality.—Nat. Herb.: Eden, (also Victoria).
Frond (where unbranched) or branches cuneate-flabellate.
Frond stupose on under-surface; colour variegately pale brown .... 31. *Z. Diesingiana* J. Ag.
Locality.—Muell.: N.S.W. Laing: (also Norfolk Island).
Frond rather erect, branching; margins coarsely crenate .... 32. *Z. crenata* J. Ag.
Locality.—Nat. Herb.: (also Victoria). C.S. & I.R.: Port Jackson, Maroubra, Bondi, Port Stephens, (also Queensland).

22. Homoeostrichus J. Ag.

Stem terete, stupose, much branched; branches end in narrow wedge-shaped, flat segments, which are free from stupa (wool) .... 33. *H. Sinclairii* (H. & H.) J. Ag.
Locality.—Nat. Herb.: Bulli, Kiama, Narrabeen, Tuggerah, Bondi, Newcastle, (also Victoria). Herb. Notes: Lake Macquarie.

23. Padina Adanson.[12]

Tissue subcoriaceous; frond fan-shaped and split many times, the base stupose .... 34. *P. Fraseri* (Grev.) J. Ag.
Locality.—Nat. Herb.: Kiama, (also Victoria, Queensland, Lord Howe Island and Norfolk Island). C.S. & I.R.: Eden, Maroubra. Lucas (1936): 'Generally around Australia'. Muell.: Tilba Tilba.

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[11] Setchell & Gardner (1925) give the reasons for the adoption of the generic name *Neurocarpus* Webb. & Mohr. in preference to the more customary *Haliseris* Targ. Tozz.

[12] Lucas (1935) says he is 'inclined to follow Harvey in referring' Australian species of *Padina* 'all to *Pavonia*'. Until definite proof of synonymy is forthcoming, it is perhaps wiser to leave the species as they are labelled in the herbaria consulted.

Tissue thick, subcoriaceous below, delicately membranaceous above, highly reticulate; plant attenuated at the base; the broad, fan-shaped upper part simple or cleft, the frond or lobes being curled into funnel-shaped cups while growing; on the upper surface deciduous, orange filaments fringe the concentric bands, these replaced by white, chalky powder on the lower surface .... 35. ***P. pavonia*** (Linn.) Lamour.
Locality.—Nat. Herb.: Port Jackson, Forster, (also Queensland, Norfolk Island, and Lord Howe Island). C.S. & I.R.: Long Bay. Herb. Notes: Tuggerah.

24. SPATHOGLOSSUM Kuetz.

Apices squared and sinuses conspicuously rounded; plant much branched .... 36. *S. cornigerum* J. Ag.
Locality.—Nat. Herb.: Port Jackson, Port Stephens. C.S. & I.R.: Botany Bay.

25. NEUROCARPUS Webb. & Mohr.[13]

There are no veins running from midrib to margins in the New South Wales species.
Spores form a linear band on either side of the midrib, leaving wide sterile margins; muciferous glands arranged in recurved arches from midrib to margin; the tufts of paranemata larger than in *N. Muelleri* ...... 37. *N. acrostichoides* (J. Ag.), nov. comb.
Locality.—Nat. Herb.: Plant as *Haliseris acrostichoides* J. Ag., Port Jackson, Port Stephens, (also Queensland and Victoria).
Spores do not form a linear band on either side of the midrib.
Spores form a cloud-like patch, continuous from midrib to margin; muciferous glands and tufts of paranemata scattered over the surface; axils rounded and margins entire .... 38. *N. Muelleri* (Sond.), nov. comb.
Locality.—Nat. Herb.: Plant as *Haliseris Muelleri* Sond., (also Victoria). Harv. Aus.: Plant as *Haliseris Muelleri* Sond., Port Jackson.
Spores scattered over the frond.
Segments denticulate .... 39. *N. Woodwardia* (R. Br.), nov. comb.
Locality.—Lucas (1913): Plant as *Haliseris Woodwardia* (R. Br.) J. Ag., Ballina, (also Queensland).
Segments entire .... 40. *N. polypodioides* (Desf.), nov. comb.
Locality.—Sonder: Plant as *Haliseris polypodioides* Ag., Ballina, (also Queensland). (As Sonder treated *N. Woodwardia* as merely a variety of the plant under discussion, this record for New South Wales cannot be accepted as definite.)

26. DICTYOTA Lamour.

Base of the plant not stupose or woolly, the attachment being by means of many long, simple, thread-like fibres arising from the base of the frond and from the lower parts of the principal rachides; apices of the much-elongated segments of the frond are blunt.
Plant dark olive-green, the tips of the dichotomies lighter and flabellately expanded; the branches of each dichotomy slightly diverge above a rotundate sinus; segments often narrower near the base; margins of thallus have the internal stratum thicker than the usual monostromatic; surface of the thallus (apices and margins excepted) covered with small, dense and crowded hairs .... 41. *D. prolificans* A. & E. S. Gepp.
Locality.—Nat. Herb.: Long Bay, Tuggerah, (also Queensland and Lord Howe Island). Lucas (1935): Narrabeen, Newcastle.
Membrane rather translucent, lighter in colour towards the extremities; segments of the irregularly dichotomous frond linear-cuneate, much attenuated at the base, and quite entire; frond width variable .... 42. *D. radicans* Harv.
Locality.—University: Port Stephens. Sonder: (also Queensland). Harv. Aus.: (also Victoria).
Base of the plant stupose or woolly.
Apices of segments forked and furcate or rather rounded-obtuse; frond delicately membranaceous, cuneate at the base, afterwards nearly linear; much and regularly divided dichotomously, the segments being elongate-cuneate; ultimate branches approximately equal in length; frond width variable, if narrow, segments may twist spirally and entangle; no proliferations occur on the surface; spores scattered over the disc of the frond, leaving a clear border on the margins; cells elongated .... 43. *D. dichotoma* (Huds.) Lamour.
Locality.—Nat. Herb.: Botany Bay, Kirribilli Point, Port Jackson, Port Stephens, (also Victoria and Queensland).

[13] See footnote on page 199.

Frond decompound-dichotomous, densely striate—especially in the older portions; cortical cells rectangular.

Fertile cells occur over the central area in almost linear, longitudinal, parallel lines, which may be broken .... 44. *D. robusta* J. Ag.

Locality.—Nat. Herb.: Botany Bay.

Fertile cells occur scattered irregularly over the central area .... 45. *D. linearis* (Ag.) Grev.

Locality.—Muell.: Clarence River.

27. Dilophus J. Ag.

Frond caespitose, attached by radicles, decompound-dichotomous, with linear, erect segments; adult fronds marked with conspicuous, transverse wrinkles; margins thickened, the inner stratum of the lamina there consisting of four layers; sori occur in broken, median series .... 46. *D. marginatus* J. Ag.

Locality.—Nat. Herb.: Long Bay, Tuggerah, (also Victoria).

28. Lobospira Aresch.

Thallus wiry and spirally much twisted, the lower portion being fibrous; the quadrate cells of the thallus surface converge towards the apices of each terminal tooth of the pinnule .... 47. *L. bicuspidata* Aresch.

Locality.—Nat. Herb.: Eden, (also Victoria).

Tribe Cyclosporeae Aresch.

IX. Order Fucales Kylin is the only order.

Frond differentiated into axial and lateral members, and consisting of holdfast, stem, branches and leaf-like organs; vesicles and specialized receptacles may also be present; oogonia monosporous; growing region at the apex of the rachis, being somewhat obscure .... Sargassaceae[14] (Decne.) D.T.

No differentiation of frond into axial and lateral members.

Frond not homogeneous; 2 to 8 oospores (4 in Australian species) produced per oogonium; holdfast disc-shaped .... Fucaceae (Lamour.) Kjellm.

Frond moniliform and branching; internodes inflated and carrying the conceptacles; paranemata simple. Only genus recorded from New South Wales .... 35. *Hormosira* Endl.

Frond homogeneous; no special organs developed; conceptacles scattered over the whole frond.

Frond solid .... Durvillaeaceae[14] Oltmanns (lim. mut.)

Frond hollow, cylindrical, containing fluid within, pinnately branched on all sides; thallus of two layers of cubical, epidermal cells and three layers of polygonal to ovate cortical cells, within these are long filaments bordering on the central, mucilaginous mass .... Splachnidiaceae Mitchell & Whitting.

Plant pale green to brown when mature; disc holdfast. Only genus .... 38. *Splachnidium* Grev.

Sargassaceae (Decne.) D.T.

Receptacles specialized from the frond segments.

Receptacles, or groups of receptacles, arise from the transformation of the upper part of proper branches.

Stem abbreviated, not vesicular, giving off long branches; leaves flat modified branches .... 29. *Sargassum* Ag.

Stem elongated, exceeding the branches in height; leaves flat, marginal .... 30. *Carpophyllum* Grev.

Receptacles marginal, single, arising from the transformation of an entire ramulus or proliferation.

Vesicles distinct from other organs and stipitate; leaves unspecialized, ramuli-form and not passing into branches, i.e., leaves not mid-ribbed .... 31. *Blossevillea*[15] Decne. (orthog. mut.)

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[14] For greater clarity the key to the genera of this family is placed at the end of the Order Fucales.

[15] Gardner (1913) gives reasons for the adoption of the generic name *Blossevillea* Decne. (orthog. mut.) in preference to the more customary *Cystophora* J. Ag.

Vesicles not distinct from other organs, but are inflations in the terminal leaves; leaves alternate, mid-ribbed and with cryptostomata .... 32. *Cystophyllum* J. Ag.

Receptacles not specialized from the frond segment.

Leaves peltate, fleshy, warted externally and spirally inserted round the stem; vesicles are modified leaves .... 33. *Scaberia* Grev.

Leaves take form of a flattened stem; cauline vesicles present; leaves intermixed with small ciliary processes that may develop into leaves .... 34. *Phyllospora* Ag.

DURVILLAEACEAE Oltmanns (lim. mut.).

Frond stipitate, flat, pinnatifid or subdigitate .... 36. *Sarcophycus* Kuetz.

Frond terete, vaguely branched and parasitic on other algae .. 37. *Notheia* Bail. & Harv.

29. SARGASSUM Ag.[16]

Leaves pinnatifid, the lower segments being broader, the upper narrower, often ramelliform; frond formed by the evolution and repeated division of a primordial, pinnate, leaf-like axis, the parts of which, by transformation, bear proper leaves, vesicles and receptacles; vesicles either minute, ellipsoidal swellings in the lamella and beaked (aristate), or larger, terminal, rounded and unbeaked (mutic); receptacles terminal, smooth, at length racemose on a ramulus .... This is the subgenus *Phyllotricha* (Aresch.) J. Ag.

Vesicles minute, ellipsoidal, aristate; common caulis compressed and rugged or nodose; lower leaves pinnatifid, upper simple, sub-linear ...... 48. *S. linearifolium* (Turn.) Ag.

Locality.—Nat. Herb.: Richmond River (questioned by Lucas). Sonder: Ballina, (also Victoria).

Vesicles spherical, mutic, large and numerous; leaves much divided, compound, at first trichotomous, then more vaguely dichotomous-pinnate, all the segments (laciniae) being filiform; primary caulis rounded, rachides of branches being angulate-rounded; petiole bases persist as spines on the branches; laciniae warted (verruculose) from the presence of cryptostomata .... 49. *S. verruculosum* (Mert.) Ag.

Locality.—Nat. Herb.: (also Victoria). C.S. & I.R.: Maroubra.

Leaves entire or dentate-serrate, but not pinnatifid or pinnate; fronds not formed as described above.

Frond an elongated, branching axis bearing simple leaves without cryptostomata; vesicles crowned by a mucro or leaflet, unarmed or dentate (this is subgenus *Arthrophycus* J. Ag.); branches conspicuously angular; ramuli retrofract; leaves which act as bracts often differ conspicuously from the others.

Receptacles terete, unarmed by teeth; midrib obvious in the lower leaves, but absent in the upper ones; vesicles almost spherical.

Lower leaves very large, oblong-lanceolate, denticulate and crowded at the base .... 50. *S. paradoxum* (R. Br.) Harv.

Locality.—Nat. Herb.: Eden, (also Victoria).

Lower leaves flat, somewhat membranaceous and almost entire (without teeth on the margins).

Leaves elongate-linear .... 51. *S. fallax* Sond.

Locality.—Nat. Herb.: Clarence River. C.S. & I.R.: Bondi, Tuggerah Lakes. Sonder: Richmond River, Ballina.

Leaves shorter, lanceolate .... 52. *S. laevigatum* J. Ag.

Locality.—D.T.: New South Wales.

Receptacles acutely angled and dentate.

Receptacles terete, angulate or two-edged, and beset with small scattered teeth; lower leaves flat, coriaceous, obovate-obtuse and almost entire .... 53. *S. globulariaefolium* J. Ag.

Locality.—J. Ag.: Illawarra, Port Jackson.

Receptacles triquetro-prismatic with prominent acute-angled edges.

Receptacles without teeth; lower leaves obovate-lanceolate, flat, coriaceous, whole or slightly or distantly dentate, upper leaves lanceolate-serrate .. 54. *S. erosum* J. Ag.

Locality.—Nat. Herb.: Tuggerah Lakes, Port Jackson. C.S. & I.R.: Manly. J. Ag.: Port Stephens.

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[16] Sonder (1880) lists *S. Muelleri* Sond. as from New South Wales. The writer has been unable to trace this species; it is not mentioned by J. Agardh (1888) nor by De Toni (1895).

Receptacles toothed; stem branches quadrate with branches arising from the flat sides; leaves membranaceous, the lower being very large, oblong, lanceolate, deeply serrate and crowded at the base, the upper very narrow, linear and sharply serrated; vesicles near-spherical, possessing a wing-like border and tipped with a nerved and serrated leaf .... 55. *S. lacerifolium* (Turn.) Ag.

Locality.—Nat. Herb.: Ulladulla.

A short, common caulis bears several elongated, branching fronds; leaves simple and usually bearing conspicuous cryptostomata; vesicles spherical, usually mutic and petiolate. This is subgenus *Eusargassum* J. Ag.

Mature, fertile branches bearing receptacles associated with and united to the petiolate, vesicular leaves in the axils of the ordinary leaves; leaves usually serrate and costate.

Leaves narrow-linear .... 56. *S. angustifolium* (Turn.) Ag.

Locality.—C.S. & I.R.: Port Jackson. J. Ag.: (also Queensland).

Leaves lanceolate-linear, acuminate .... 57. *S. carpophyllum* J. Ag.

Locality.—Nat. Herb.: Botany Bay. C.S. & I.R.: Lake Macquarie, (also Queensland).

Mature fertile branches bearing receptacles not associated with or united to the vesicular leaves.

Receptacles compressed, obovoid-oblong, slightly curved, the apex and outer margins serrate or dentate; lower leaves oblong-elliptical, with slightly developed midribs, coriaceous and somewhat serrate, the upper subcuneate falcate, the inner margin entire, the outer very dentate, midrib not developed .... 58. *S. lophocarpum* J. Ag.

Locality.—Nat. Herb.: Wollongong, (also Lord Howe Island). C.S. & I.R.: Narrabeen, Manly. Okamura: Bondi, Sydney.

Receptacles not serrate or dentate.

Receptacles completely confluent with the branching system which bears them .... 59. *S. aquifolium* (Turn.) Ag.

Locality.—Sonder: Plant as *S. obovatum* Grev., Ballina.

Receptacles racemose and each with a distinct pedicel.

Receptacles verrucose and cylindrical; lower leaves lanceolate, costate with serrated margins, the upper cuneate-obovate and dentate .... 60. *S. fragile* J. Ag.

Locality.—C.S. & I.R.: Hawkesbury River, (also Queensland). D.T.: Port Stephens.

Receptacles lanceolate-conoid.

Cryptostomata almost or quite absent: leaves with a prominent, percurrent midrib, lower leaves broad lanceolate, the upper narrow-linear and entire .... 61. *S. neurophorum* J. Ag.

Locality.—Nat. Herb.: Wollongong, Thirroul, Twofold Bay, (also Lord Howe Island). C.S. & I.R.: Narrabeen, (also Queensland). University: Nelson's Bay, Port Stephens.

Cryptostomata inconspicuous or arranged in a series on either side of the midrib.

Mature vesicles ellipsoid-spherical, often apiculate and on petioles longer than the vesicles; leaves serrate-dentate, lower broad-lanceolate, the upper narrow-linear; cryptostomata arranged in a series on either side of the midrib .... 62. *S. leptopodum* J. Ag.

Locality.—Nat. Herb.: (also Queensland). C.S. & I.R.: Coogee, Bondi, Port Jackson, Jervis Bay, (also Lord Howe Island and Victoria). Herb. Notes: Bermagui, Port Hacking, Woy Woy, Forster, Urunga.

Vesicles spherical and petiole often shorter than the vesicle it bears.

Leaf serrations never acute.

Upper leaves lanceolate, serrate-dentate or uneven at the margins, with a series of cryptostomata arranged on each side of the midrib; lower leaves broader and with but few cryptostomata .... 63. *S. spinuligerum* Sond.

Locality.—Harv. Aus.: Sydney, (also Victoria). Sonder: (also Queensland). Lucas (1936): 'On all the coasts of Australia except the North.' Muell.: Ballina.

Upper leaves small, entire or obsoletely dentate, obtuse, with two rows of small glands; mid-rib conspicuous; lower leaves large, sessile, obtuse and whole (rarely bifid) .... 64. *S. Godeffroyi* Grun.

Locality.—Muell.: Richmond River. Nat. Herb.: (also Norfolk Island). D.T.: (also Queensland).

Cryptostomata often completely obsolete; leaves lanceolate-linear, the cauline whole, the upper sharply acute and unequally serrate-dentate, the teeth often being prolonged into spines; midribs smooth, percurrent .... 65. *S. polyacanthum* J. Ag.

Locality.—Nat. Herb.: Bondi, Little Coogee, Long Bay. C.S. & I.R.: Maroubra, Jervis Bay, Port Jackson, Wollongong. J. Ag.: 'Port Jackson et alius locis New South Wales.'

30. Carpophyllum Grev.

Lower vesicles spherical-ellipsoid, terminated by a leaf or mucro; the upper piriform-ellipsoid, mucronate; lower leaves of the young plant much pinnatifid and with uneven margins .... 66. *C. phyllanthus* (Turn.) H. & H.

Locality.—Muell.: Plant as *C. Phyllanthus* Grev., Sydney.

31. Blossevillea Decne. (orthog. mut.).[17]

Vesicles spring direct from the stem or primary branches.

Vesicles spherical, mutic .... 67. *B. uvifera* (Ag.) Harv.

Locality.—Nat. Herb.: Plant as *Cystophora uvifera* (Ag.) J. Ag., Long Bay, Jervis Bay (cast up), Eden, (also Victoria and Norfolk Island). C.S. & I.R.: Plant as *Cystophora uvifera* (Ag.) J. Ag., Bondi.

Vesicles cylindro-elliptical, apiculate; stem filiform, the lower part being warted or muricated with the remains of old branches .... 68. *B. Cephalornithos* (Labill.) Kuetz.

Locality.—Nat. Herb.: Plant as *Cystophora Cephalornithos* (Labill.) J. Ag., (also Victoria). Lucas (1936): Plant as *Cystophora Cephalornithos* (Labill.) J. Ag., 'Victoria to Twofold Bay'.

Vesicles spring from ramuli of the last order.

Conceptacles occur in two linear series; vesicles, if present, mutic.

The whole plant sub-distichously pinnate, the pinnae being flattened, pinnatifid; stem and branches flattened, pinnate along the edges; ultimate pinnules pedicellate, lanceolate, passing into broad, flat receptacles; vesicles spherical .... 69. *B. platylobium* (Mert.), nov. comb.

Locality.—Nat. Herb.: Plant as *Cystophora platylobium* (Mert.) J. Ag., (also Victoria). C.S. & I.R.: Plant as *Cystophora platylobium* (Mert.) J. Ag., Bondi.

Frond pinnately divided, the branches emerging from the flat faces of the rachis and generally bent back near the base (retrofract); ramuli terete, not conspicuously compressed.

Vesicles usually numerous, but occasionally absent; plant very variable; axils sub-rounded; receptacles compressed and somewhat less torulose than usual for the genus .... 70. *B. retroflexa* (Labill.), nov. comb.

Locality.—Nat. Herb.: Plant as *Cystophora retroflexa* (Labill.) J. Ag., Eden, Kiama, (also Victoria). C.S. & I.R.: Plant as *Cystophora retroflexa* (Labill.) J. Ag., Bondi, Thirroul. Muell.: Plant as *Cystophora retroflexa* (Lab.) Ag., Tilba Tilba, Sydney.

No vesicles occur; stem quadrate and robust (much thicker than in *B. retroflexa*); pinnate rachides not as flat as in the above-mentioned species; bases of the pinnules persist as small conical protuberances; receptacles elongated and slightly compressed .... 71. *B. siliquosa* (J. Ag.), nov. comb.

Locality.—Nat. Herb.: Plant as *Cystophora siliquosa* J. Ag., Jervis Bay, (also Victoria).

Conceptacles scattered, i.e., not confined to two linear series.

Stem flattened, the rachis being dorso-ventrally compressed and giving off pinnate, much divided branches from the sharp edges of the rachis, these plano-compressed like the stem; pinnules warted at the base, thence to the apex closely set with alternate filiform, setaceous, irregularly dichotomous ramuli; receptacles long, cylindrical, pointed, warted and constricted at short intervals, i.e., nodoso-filiform; vesicles absent .... 72. *B. spartioides* (Turn.) Decne.

Locality.—Nat. Herb.: Plant as *Cystophora spartioides* (Turn.) J. Ag., Bermagui River, Long Bay, Sydney district, Coogee, Kiama, Thirroul, (also Victoria and Lord Howe Island). University: Plant as *Cystophora spartioides* (Turn.) J. Ag., Port Stephens. Herb. Notes: Plant as *Cystophora spartioides* (Turn.) J. Ag., Illawarra.

Stem usually flattened laterally and, if so, the pinnae emerging from the plane faces.

Stem terete, bearing pinnae and pinnules, etc., from all sides; secondary stems retrofract (bend downwards at point of insertion); tertiary branches bare on their lower half, and densely beset above with tertiary ramuli, these latter closely covered with filiform, setaceous, ultimate ramuli, especially towards the summits; vesicles not known; receptacles nodose .... 73. *B. paniculata* (Turn.) Decne.

Locality.—Nat. Herb.: Plant as *Cystophora paniculata* (Turn.) J. Ag., Long Bay, Kiama, Jervis Bay (cast up), (also Victoria). C.S. & I.R.: Plant as *Cystophora*

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[17] See footnote on page 201.

paniculata (Turn.) J. Ag., Long Bay. University: Plant as *Cystophora paniculata* (Turn.) J. Ag., Bondi, Port Stephens. Lucas (1936): Plant as *Cystophora paniculata* (Turn.) J. Ag., 'As far up as Sydney'. Herb. Notes: Plant as *Cystophora paniculata* (Turn.) J. Ag., Illawarra, Tuggerah, Newcastle. Muell.: Plant as *Acrocarpia paniculata* Aresch., Tilba Tilba.

Stem definitely flattened laterally, with branches arising from the plane faces; pinnae retrofract; vesicles present usually.

Vesicles elongate-ellipsoid, acute at both ends, occasionally absent; pinnules slender, dichotomo-pinnate, the ultimate segments being filiform; receptacles filiform, distantly tortulose and ending in sterile beaks .. 74. *B. polycystidea* Aresch.

Locality.—Nat. Herb.: Plant as *Cystophora polycystidea* Aresch., Jervis Bay (cast up), Long Bay (cast up), (also Victoria). Herb. Notes: Plant as *Cystophora polycystidea* Aresch., Bateman's Bay.

Vesicles spherical mutic; primary branches pinnated at intervals of about an inch with closely-branched and decompound pinnae, these usually bare at the base except for scars of broken, alternate branchlets; ultimate pinnules dichotomo-pinnate, slender and almost setaceous; receptacles constricted and so appearing bead-like, usually each terminated by a setaceous point .... 75. *B. monilifera* (J. Ag.), nov. comb.

Locality.—Nat. Herb.: Plant as *Cystophora monilifera* J. Ag., Long Bay, Jervis Bay, (also Victoria and Lord Howe Island). C.S. & I.R.: Plant as *Cystophora monilifera* J. Ag., Bondi (cast up). Lucas C.S. & I.R. Notes: Plant as *Cystophora monilifera* J. Ag., Illawarra, Sydney. Herb. Notes: Plant as *Cystophora monilifera* J. Ag., Bateman's Bay.

32. Cystophyllum J. Ag.

Rachides densely muricated; lower leaves linear, entire, pointed and with a row of cryptostomata on each side of the midrib; upper leaves filiform, with ovoid vesicle swellings, like beads on a thread, the leaf continuing beyond the vesicle; receptacles on the interior side of the terminal leaves, racemose, and each stipitate, cylindrical-lancoid; plant frequents harbours .... 76. *C. muricatum* (Turn.) J. Ag.

Locality.—Nat. Herb.: Port Stephens, Port Hacking, Port Jackson, Lake Macquarie, (also Queensland and Lord Howe Island). C.S. & I.R.: Botany Bay, Wallis Lake, (also Victoria). Lucas (1913): Clarence River. Lucas (1936): 'All round Australia'.

33. Scaberia Grev.

Frond a dark colour and much branched, branching being irregular or alternate; lower part of the stem and older branches denuded of leaves, smooth, filiform and flexuous, the upper portion and all younger branches closely imbricated with small, vertically-compressed leaves, which are smooth on the lower side and densely warted on the upper side; the petioles of these are spirally inserted round the stem; vesicles spherical, sessile and warted .... 77. *S. Agardhii* Grev.

Locality.—Nat. Herb.: (also Victoria). C.S. & I.R.: Bondi (cast up). D.T.: (also Lord Howe Island).

34. Phyllospora Ag.

Attachment consists of a central, concave, margined disc, radiating from which are numerous short, robust, simple, closely imbricating, obtuse fibres; the solitary stem arises from the centre of the disc; branching pinnately decompound; stem and branches strap-shaped, of approximately the same width throughout, plano-compressed, two-edged, somewhat thicker in the middle, and densely beset throughout with irregular, marginal leaves, which taper to each end and are toothed or more or less entire; whole plant very tough and leathery .... 78. *P. comosa* (Labill.) Ag.

Locality.—Nat. Herb.: Woy Woy, Long Bay, Sydney, (also Victoria and Lord Howe Island). C.S. & I.R.: Bondi. Herb. Notes: Pambula, Bermagui, Bateman's Bay, Nowra, Illawarra, Port Hacking, Botany Bay, Hawkesbury River, Woy Woy, Tuggerah, Lake Macquarie, Newcastle, Port Stephens, Manning River, Port Macquarie. Muell.: Tilba Tilba.

35. Hormosira Endl.

Stem triquetrous with interrupted wing expansions, which are more or less dentate; nodes approximately as long as the vesicated internodes .... 79. *H. ? articulata* (Forsk.) Zan.

Locality.—Nat. Herb.: Port Stephens, (also Queensland).

Frond dichotomously or irregularly branched, and consisting of a series of inflated, vesicated internodes and filiform nodes; internodes act as vesicles and receptacles, they vary greatly in size and shape according to the habitat, and this accounts for the synonyms; attachment by means of a minute disc; thallus coriaceous .... 80. *H. Banksii* (Turn.) Decne.

Locality.—Nat. Herb.: Botany Bay, Lake Macquarie, Long Bay, Eden, (also Victoria). C.S. & I.R.: (also Lord Howe Island). University: Bondi. Herb. Notes: Bermagui, Lake Illawarra, Forster, Port Macquarie. Lucas (1936): 'As far north as Pt. Macquarie'. Laing: (also Norfolk Island).

36. Sarcophycus Kuetz.

Holdfast a large disc; stem sub-terete at base, soon compressed, widening and flattening and so becoming lost in the base of the lamina; lamina thick, simple, or once or twice forked, the segments being strap-shaped and more or less copiously furnished with lateral, lanceolate lobes or pinnate, which sometimes are again lobulate or forked as the lamina, these taper to both ends and possess undulate margins; plant very large, tough and leathery .... 81. *S. potatorum* (Labill.) Kuetz.

Locality.—Nat. Herb.: Eden, Pambula. C.S. & I.R.: (also Victoria).

37. Notheia Bail. & Harv.

Cylindrical base of the plant inserted in a conceptacle of the host plant, *Hormosira Banksii* (Turn.) Decne.; branches linear-fusiform, much attenuated at their insertion, and tapering towards the apex, they arise from spore cavities of older branches; axis composed of long, interwoven filaments, the periphery being of sub-horizontal, parallel, radiating, slender, coloured filaments .... 82. *N. anomala* Bail. & Harv.

Locality.—Nat. Herb.: Port Stephens, Crookhaven Heads, Newcastle, (also Victoria). University: Long Reef. Lucas (1913): Twofold Bay.

38. Splachnidium Grev.

Main frond quite simple, linear-club-shaped, cylindrical, tapering to the base, truncate at the apex; lateral branches similar to the primary, and spring proliferously from its sides; there may be tertiary similar ramuli; whole plant very mucilaginous; attachment by means of a conical disc .... 83. *S. rugosum* (Linn.) Grev.

Locality.—Nat. Herb.: Ocean coasts about Sydney, Crookhaven Heads, Newcastle, (also Victoria). C.S. & I.R.: Middle Harbour, Narrabeen, Bondi, Long Bay. Lucas (1936): 'As far north as Newcastle.' Muell.: Tilba Tilba.

Synonyms.

Under the name of each accepted species are listed those synonyms which various workers have attributed to it. In each case a bracketed number then follows. This number indicates the authority quoted for the acceptance of the synonymy. The numbers and their corresponding references are: (1) De Toni, G. B. (1895); (2) Harvey, W. H. (1858–63); (3) Harvey, W. H. (1846–51); (4) Agardh, J. (1888); (5) Laing, R. M. (1900); (6) Laing, R. M. (1906); (7) Lucas, A. H. S. (1909); (8) Herbarium Notes from the Lucas Collection, C.S. & I.R., Canberra; (9) Newton, Lily (1931); (10) Lucas, A. H. S. (1913); (11) Setchell, W. A., and Gardner, N. L. (1925); (12) Sonder, W. (1871); (13) The generic name has been changed by the writer in the present paper; (14) Grunow, A. (1874); (15) Sonder, W. (1880); (16) Kuckuck (1930).

1. Sphacelaria cirrhosa (Roth.) Ag.
Sphacelaria cervicornis Ag. (1)
cirrosa var. *cervicornis* Ardiss. (1)
fusca Ag. (1)
irregularis Kuetz. (ex parte) (1)
japonica Martens (1)
pennata Lyngb. (1)
pennata Lyngb. (excl. var. B). (3)
racemosa Reinsch. (1)
rhizophora Kuetz. (1)
Conferva cirrhosa Roth. (1), (3)
Conferva cirrhosa Dillw. (3)
fusca Huds. (1)
intertexta Roth. (3)
marina Dillw. (3)
pennata Huds. (1), (3)
prebrevis Dillw. (3)
villosa Dillw. (3)
Stypocaulon bipinnatum Kuetz. (1)
Ceramium cirrhosum Hook. (3)
cirrhosum Ag. (1)
pennatum Roth. (1)

Varieties include:
Sphacelaria fusca Harv. (9)

2. SPHACELARIA TRIBULOIDES Menegh.

Sphacelaria brachygonia Mont. (1)
  caespitula Kjellm., non Lyngb. (1)
  capensis Kuetz.? (1)
  cervicornis Decne.? (1)
  fulva Kuetz. (1)
  Novae-Hollandiae Sond. (1)
  rigida Hering. (1)
Ceramium fulvum Bertol. (1)

3. CLADOSTEPHUS SPONGIOSUS (Lightft.) Ag.

Cladostephus laxus Fl. Dan. (?) excl. syn. (1), (3)
  setaceus Suhr.? (1)
  verticillatus var. *spongiosus* Farl. (1)
Ceramium spongiosum DC. (1)
Fucus hirsutus Linn. (non Wulf.) (1), (3)
Conferva spongiosa Huds. (3)
  spongiosa Lightft. (1)

4. CLADOSTEPHUS VERTICILLATUS (Lightft.) Ag.

Cladostephus australis var. *ponticus* Sperk. (1)
  hedwigioides Bory ? (1)
  Myriophyllum Ag. (1), (3)
  spongiosus Kuetz., non Ag. (1)
  tomentosus Kuetz. (1)
Fucus hirsutus Wulf., non Linn. (1)
  verticillatus Wulf. (1), (3)
Conferva ceratophyllum Roth. (?1), (3)
  Myriophyllum Roth. (1), (3)
  verticillata Lightft. (1), (3)
Ceramium verticillatum DC. (1), (3)

5. STYPOCAULON PANICULATUM (Suhr.) Kuetz.

Stypocaulon filare Kuetz. (1)
  gracilescens Kuetz. (1)
  hordeaceum Kuetz. (1)
  virgatum Kuetz. (1)
Sphacelaria filaris Sond. (1)
  gracilescens Dies. et J. Ag. (1)
  hordeacea Harv. (1), (2)
  Muelleri Sond. (2)
  paniculata Suhr., non Hering. (1), (7)
  scoparia Sond. (2)
  (*Stypocaulon*) *spicigera* Aresch. (1)
  virgata H. & H. (1)

6. LEATHESIA DIFFORMIS (Linn.) Aresch.

Leathesia marina J. Ag. (1)
  marina Endl. (3)
  tuberiformis S. F. Gray (1), (3), (9)
Chaetophora marina Lyngb. (1), (3)
Nostoc marinum Ag. (1), (3)
  mesentericum Ag. (1)
Clavatella Nostoc Bory. (1)
Rivularia tuberiformis Engl. Bot. (1), (3)
Corynephora baltica Kuetz.? (1)
  marina Ag. (1), (3)
Ulva mesenterica Bonn. (1)
Corynophloea baltica Kuetz. (1)
Tremella difformis Linn. (1), (3), (11)

7. ASPEROCOCCUS BULLOSUS Lamour.

Asperococcus rugosus B. bullosus Duby. (1), (3)
  tenuis Zan. (1)
  Turneri Hook. (1), (3), (7)
  utricularis D'Urv. (1)
Encoelium bullosum Ag. (1), (3)
  Mac-Gregoryi Suhr. (1)
  tenue Kuetz. (1)
  utriculare Kuetz. (1)
Gastridium Opuntia Lyngb. (1), (3)
Ulva Turneri Dillw. (1), (3)

8. ILEA FASCIA (Muell.) Fries.

Phyllitis caespitosa Le Jol. (1)
  fascia Kuetz., non Le Jol. (1), (11)
Phycolapathum cuneatum Kuetz. (1)
Laminaria caespitosa J. Ag. (1)
  cuneata Suhr. (1), (3), (6)
  debilis Ag. (3)
  fascia Ag. (1)
  fascia Muell. (6)
  papyrina Bory (3)
Fucus fascia Muell. (1), (11)
  fascia Fl. Dan. (3)
Ulva fascia Lyngb. (6)
Petalonia fascia Kuntze (11)
Varieties include:
Phyllitis debilis Kuetz. (1)
  filiformis Batt. (11)
  Zosterifolia Reinke (11)
Petalonia debilis Derb. & Sol. (1)
Fucus Phyllitis var. *subsessilis* Clem. (1)
Laminaria caespitosa J. Ag. (11)
  debilis Ag. (1), (11)
  papyrina Bory? (1)
  Phyllitis Delle Chiaje Hydrophyt. (1)

9. SCYTOSIPHON LOMENTARIA (Lyngb.) J. Ag.

Scytosiphon filum var. *fistulosus* Ag. (1)
  filum var. *lomentarius* Ag. (1)
  filum var. γ Ag. (3)
  fistulosus Ag. (1)
  lomentaria Endl. (3)
Chorda filum var. *fistulosa* Kuetz. (1)
  filum var. *lomentaria* Kuetz. (1)
  fistulosa Zan. (1), (3)
  lomentaria Lyngb. (1), (11)
Ulva fistulosa Good. & Woodw. (1)
  simplicissima Clem. (1)
Conferva fistula Roth. (1)
Solenia fuscata Bory (1), (3)
Asperococcus castaneus Carm. (1), (3)
Chlorosiphon Shuttleworthianus Kuetz. (3)

10. COLPOMENIA SINUOSA (Roth.) Derb. & Sol.

Asperococcus sinuosus Bory. (1), (7)
Ulva cavernosa Forsk. (?) (1)
  sinuosa Roth. (1), (11)
Encoelium sinuosum Ag. (1)
  sinuosum Kuetz. (12)
  vesicatum Kuetz. (1)
Hydroclathrus sinuosus Zan. (1)
Stilophora sinuosa Ag. (1)
  vesicata Harv. (1)

Nostoc mesentericum Delle Chiaje Hydrophyt. Neap. (1)
Tremella cerina Clem. (1)
rugulosa Clem. (1)
Zonaria sinuosa Ag.
Varieties include:
Colpomenia tuberculata Saund. (11)
Scytosiphon bullosus Saund. (11)

11. ECTOCARPUS SIMPLICIUSCULUS Ag.

Ectocarpus irregularis Kuetz. (1)

12. ECTOCARPUS CONFERVOIDES (Roth.) Le Jol.

Ectocarpus amphibius Harv. (1 a')[18]
confervoides var. *siliculosus* Auct. (1 a')
corymbosus Kuetz. (1 a')
gracillimus Kuetz. (1 a')
siliculosus Harv. (9)
siliculosus Lyngb. ex parte (1), (11)
spalatinus Kuetz. (1 a')
viridus Harv. (1 a')
Ceramium confervoides Roth. (1), (3 a'), (11)
confervoideum Roth. (1 a')
siliculosum var. *atrovirens* Ag. (1)
siliculosum Ag. (1 a'), (3 a')
Conferva siliculosa Dillw. (1 a'), (3 a')
siliculosa Dillw. (excl. synonyms) (11 a')
Varieties include:
Ectocarpus amphibius Harv. (11 a')
approximatus Kuetz. (1)
arachnoideus Zan. (1)
arctus Kuetz. (1 a')
bombycinus Kuetz. (1)
ceratoides Kuetz. (1)
confervoides f. *arcta* Kjellm. (1 a')
var. *hiemalis* Kjellm. (1 a')
B. *subulatus* Hauck. (excl. synonyms) (11 a')
f. *subulatus* Collins, Holden & Setchell (11 a')
draparnaldioides Kuetz. (1 a')
draparnaldiaeformis Kuetz. (1)
fasciculatus Kuetz., non Harv. (1)
flagelliformis Kuetz. (1)
flavescens Kuetz. (1)
fuscatus Zan. (1 a')
hiemalis Crouan (1 a')
intermedius Kuetz. (1 a')
Kochianus Kuetz. (1)
leptocarpus Kuetz. (1)
macroceras Kuetz. (1)
nebulosus Zan.? (1)
nitens De Not. (1)
ochroleucus Kuetz. (1 a')
patens Kuetz. (1)
polycarpus Zan. (1 a')
pseudosiliculosus Crouan (1 a')
pygmaeus Aresch. (1), (11)
rigidus Kuetz. (1 a')
rufulus Kuetz. (1 a')
Ectocarpus siliculosus nebulosus Ag. (1)
parvis Saunders (11)
spinosus Kuetz. (1 a')
subulatus Kuetz. (1), (11 a')
terminales Collins, Holden & Setchell (11)
venetus Kuetz. (1)
vermicelliferus De Not. (1)
verminosus Kuetz. (1 a')
Corticularia arcta Kuetz. (1 a')
fuscata Kuetz. (1 a')
Naegeliana Kuetz. (1)
verminosa Kuetz. (1 a')

13. PYLAIELLA LITTORALIS (Linn.) Kjellm.

Pylaiella flexilis Rupr. (1)
nordlandica Rupr. (1)
pyrrhogon Rupr. (1)
saxatilis Rupr. (1)
Ectocarpus compactus Ag. (1), (3)
crinitus Croall ? (1)
ferrugineus Ag. (3)
firmus Aresch. (f. *vernalis* Aresch. et var. *rupincola* Aresch.). (1)
littoralis Ag. (1)
f. *protensus* Lyngb. (11)
ochraceus Zell. Zweite Polarfahrt., non Kuetz. (1)
Conferva littoralis Linn. (1), (3)
littoralis Linn. (in part). (11)
Varieties include:
Pylaiella littoralis Kjellm. ex parte (1)
f. *compacta* (Linn.) Kjellm. (1)
macrocarpa Foslie (1)
varia Kjellm. (1)
Ectocarpus brachiatus Ag. (1)
compactus Ag. ex parte (1)
firmus J. Ag. (1)
var. *rupincola* Aresch. (1)
f. *vernalis* Aresch. (1)
fluviatilis Kuetz. (1)
Landsburgii Dick. (1)
littoralis Wyatt (1)
var. *brachiatus* J. Ag. (1)
f. *brachiatus* Aresch. (1)
f. *vernalis* Kjellm. (1)
var. γ *compactus* J. Ag. (1)
ramellosus Kuetz. ex parte (1)
siliculosus γ *firmus* Ag. (1)
subverticillatus Kuetz. (1)
Vidovichii in Heugl. Reise non Menagh. (1)
Spongomorpha castanea Kuetz. (1)
Ceramium compactum Roth. ex parte (1)
Spongonema castaneum Kuetz. (1)

14. BACTROPHORA NIGRESCENS (Harv.) J. Ag.

Cladosiphon nigrescens Harv. (1)
nigricans Harv. (1), (7)

15. BACTROPHORA FILUM (Harv.) J. Ag.

Mesogloia filum Harv. (1)

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[18] The "a'" within the number bracket indicates that this is claimed by the authority quoted as a synonym of *E. siliculosus* (Dill.) Lyngb., which species he regards as distinct from *E. confervoides* (Roth.) Le Jol.

17. CHNOOSPORA PACIFICA J. Ag.
Chnoospora fastigiata var. *pacifica* J. Ag. (11)
Sargassum piluliferum Collins, Holden & Setchell (11)
19. SPOROCHNUS RADICIFORMIS (R. Br.) Ag.
Fucus radiciformis R. Br. (1), (2)
21. CARPOMITRA COSTATA Batt.
Carpomitra Cabrerae Kuetz. (9)
Fucus Cabrerae Clem. (1), (3)
costatus Stackh. (9)
Sporochnus Cabrerae Ag. (1), (3)
Cabrera gaditana Schousb. (1)
22. MYRIOGLOIA SCURIUS (Harv.) Kuckuck
Myriocladia scurius Harv. (11), (16)
23. SCYTOTHAMNUS AUSTRALIS (J. Ag.) H. & H.
Chordaria australis J. Ag. (1)
24. SPERMATOCHNUS LEJOLISII (Thur.) Reinke.
Spermatochnus microspermus Kuetz.? (1)
Stilophora Lejolisii Thur. (1), (9)
25. MACROCYSTIS PYRIFERA (Linn.) Ag.
Macrocystis angustifolia var. *oocysta* Ag. (1)
communis Bory (1)
Dubenii Aresch. (1)
Humboldtii Ag. (1)
latifolia Bory (*M. latifolius*) (1)
latifrons Bory ? (1)
orbignyana Mont. (1)
pelagica Aresch. (1)
planicaulis Ag. (1)
pomifera Bory (1)
tenuifolia Post. & Rupr. (1)
Laminaria pomifera Lamour. (1)
Fucus hirtus Humb. et Bonpl. (1)
Humboldtii Bonpl. (1)
piriferus Linn. (excl. syn. Esper) (1)
piriferus Linn. (11)
Lessonia armata J. Ag. (1)
ciliata Post. et Rupr. (1)
Varieties include:
Macrocystis Dubenii Aresch. (2)
26. ECKLONIA RADIATA (Turn.) J. Ag.
Fucus radiatus Turn. (1)
Laminaria radiata Ag. (1)
Capea radiata Endl. (1)
Varieties include:
Ecklonia exasperata (Turn.) J. Ag. (1), (2)
flagelliformis J. Ag. (1)
lanciloba[19] Sond. (2)
Richardiana J. Ag. (1), (2)
Fucus radiatus var. *exasperatus* Turn. (1)
Laminaria biruncinata Bory (1)
Cunninghamii Grev. (1)
flagelliformis A. Rich. (1)
Prieurii Bory (1)
radiata var. *exasperata* Ag. (1)
Capea biruncinata Mont. (1)
exasperata Mont. (1)
flabelliformis H. & H. (1)
Pinnaria fastigiata Endl. & Dies. ? (1)
27. ECKLONIA LANCILOBA Sond.
Capea biruncinata γ *elongata* Sond. (1)
28. GYMNOSORUS VARIEGATUS (Lamour.) J. Ag.
Zonaria variegata Mert. (1)
Dictyota variegata Lamour. (1)
Spatoglossum variegatum Kuetz. (1)
Padina lobata Mont. ? (1)
variegata Gaill. (1)
variegata Mont. (1)
Orthosorus variegatus Trev. (1)
Stypopodium fissum Kuetz. (1)
laciniatum Kuetz. (1)
29. GYMNOSORUS NIGRESCENS (Sond.) J. Ag.
Zonaria nigrescens Sond. (1)
Orthosorus nigrescens Trev. (1)
Spatoglossum nigrescens Kuetz. (1), (12)
30. ZONARIA TURNERIANA J. Ag.
Zonaria interrupta Ag. (1)
Phycopteris angustata Kuetz., non *Dictyota interrupta* Lamour. (1)
interrupta Kuetz. ex parte (1)
Fucus interruptus Turn. (1)
32. ZONARIA CRENATA J. Ag.
Zonaria flava Harv., non Ag. (1)
var. *tenuior* Sond. (1)
3. HOMOEOSTRICHUS SINCLAIRII (H. & H.) J. Ag.
Zonaria Sinclairii H. & H. (1)
Phycopteris Sinclairii Kuetz. (1)
Stypopodium Sinclairii Kuetz. (1), (2)
34. PADINA FRASERI (Grev.) J. Ag.
Zonaria Fraseri Grev. (1)
Pavonia var. *fuscescens* Ag. (1)
35. PADINA PAVONIA (Linn.) Lamour.
Padina anglica Kuetz. (1)
Commersoni Auct. (2)
D'Urvillaei Auct. (2)
D'Urvillaei Bory ? (5)
Fraseri[20] Grev. (2)
gymnospora Kg. (5)
Mediterranea Bory' (1), (3)
Neapolitana Kuetz. (1)
Oceanica Bory (1)
Dictyota Pavonia Lamour. (1), (3)
Ulva cucullata Cav. (1), (3)
Pavonia Linn. (1), (3)
Flabellaria Pavonia Lamarck (1)
Zonaria gymnospora Kuetz. (14)
Pavonia Ag. (3)
Pavonia Draparn. (1)
tenuis Kuetz. (excl. var.), non *Z. Pavonia* var. *tenuis* Ag. (1)
Fucus Pavonicus Gmel. (1)
Pavonius Linn. (1), (3)

[19] Following De Toni, this synonym has not been accepted.

[20] This synonym has not been accepted by the writer. See footnote to genus *Padina* in the key.

Varieties include:
Spatoglossum versicolor K. (15)
37. NEUROCARPUS ACROSTICHOIDES (J. Ag.), nov. comb.
Haliseris acrostichoides J. Ag. (13)
Muelleri Harv. (partim) (1)
38. NEUROCARPUS MUELLERI (Sond.), nov. comb.
Haliseris Muelleri Sond. (13)
polypodioides Harv. (1)
polypodioides Harv. (excl. syn.) (2)
39. NEUROCARPUS WOODWARDIA (R. Br.), nov. comb.
Haliseris Woodwardia (R. Br.) J. Ag. (13)
polypodioides var. *denticulata* Sond. (10)
Fucus Woodwardia Brown. (1)
Woodwardia Turner Hist. (12)
40. NEUROCARPUS POLYPODIOIDES (Desf.), nov. comb.
Haliseris polypodioides (Desf.) Ag. (13)
Fucus ambiguus Clem. ? (1)
membranaceous Stackh. (1)
polypodioides Desf. (1)
Ulva polypodioides DC. (1)
Dictyopteris elongata Lamour. (1)
polypodioides Lamour. (1)
42. DICTYOTA RADICANS Harv.
Dictyota intermedia Zan. ? (1)
zonata J. Ag. (1)
43. DICTYOTA DICHOTOMA (Huds.) Lamour.
Dictyota acuta Kuetz. (1)
attenuata Kuetz. (1)
(*Dictyopteris* ?) *areolata* Schousb. (1)
(*Dictyopteris* ?) *complanata* Schousb. (1)
dichotoma volubilis Lenorm. (1)
elongata Kuetz. (1)
implexa Lamour. (1)
intricata Kuetz. (14)
latifolia Kuetz. (1)
ornata Zan. (1)
? *setosa* Duby. ? (1)
sibenicensis Zan. (1)
spiralis Mont. ? (1)
volubilis Kuetz. (1)
vulgaris Kuetz. (1)
Neurocarpus annularis Schousb. (1)
areolatus Schousb. (1)
Fucus dichotomus Bertol. (1)
Ulva dichotoma Huds. (1), (3)
Dichophyllium dichotomium Kuetz. (1), (3)
vulgare Kuetz. (1), (3)
Zonaria dichotoma Ag. (1), (3)
Haliseris dichotoma Spreng. (3)
Varieties include:
Dictyota implexa Lamour. (3)
Dichophyllium implexum Kuetz. (3)
45. DICTYOTA LINEARIS (Ag.) Grev.
Dictyota aequilis Kuetz. ?? (1)
angustissima Sond. (1)
ceylanica Kuetz. ? (1)
divaricata Kuetz. (1)
fibrosa Kuetz. (1)
Zonaria linearis Ag. (excl. synon.) (1)
47. LOBOSPIRA BICUSPIDATA Aresch.
Metachroma thuyoides Harv. (1), (2)
48. SARGASSUM LINEARIFOLIUM (Turn.) Ag.
Fucus linearifolius Turn. (1), (4), (12)
49. SARGASSUM VERRUCULOSUM (Mert.) Ag.
Sargassum adenophyllium Harv. (1), (4)
capillaceum H. & H. (1), (4)
Raoulii H. & H. (1), (4)
Cystophora flaccida J. Ag. (1)
verruculosa J. Ag. (1), (4)
Fucus flaccidus Labill. (1), (4)
verruculosus Mert. (1), (4)
50. SARGASSUM PARADOXUM (R. Br.) Harv.
Sargassum paradoxum J. Ag. (4)
Fucus paradoxus R. Br. (1), (4)
Cystoseira paradoxa Ag. (1)
Blossevillea paradoxa[21] Kuetz. ? (4)
51. SARGASSUM FALLAX Sond.
Blossevillea fallax Kuetz. (1), (4)
55. SARGASSUM LACERIFOLIUM (Turn.) Ag.
Fucus lacerifolius Turn. (1), (2)
Carpacanthus lacerifolius Kuetz. (1), (2), (4)
56. SARGASSUM ANGUSTIFOLIUM (Turn.) Ag.
Sargassum angustifolium (Ag.) J. Ag. (4)
flexile Grev. (1), (4)
Fucus angustifolius Turn. (1)
filiformis Klein. (1)
leptocystus Mert. (1)
trichophyllus Klein. (1)
58. SARGASSUM LOPHOCARPUM J. Ag.
Sargassum obovatum Sond. ?, non Harv. nec. Grev. (1), (4)
59. SARGASSUM AQUIFOLIUM (Turn.) Ag.
Sargassum densifolium var. *subcompressa* Grun. (1), (4)
herbaceum Kuetz. (1), (4)
obovatum Grev. (1), (4)
virescens Fig. et De Not. (1), (4)
Fucus aquifolius Turn. (1)
66. CARPOPHYLLUM PHYLLANTHUS (Turn.) H. & H.
Carpophyllum flexuosum Grev. (1)
macrophyllum Mont. (1)
Fucus flexuosus Esp. (1)
Phyllanthus Turn. (1)
Sargassum Phyllanthus Ag. (1)
67. BLOSSEVILLEA UVIFERA (Ag.) Harv.
Cystophora uvifera (Ag.) J. Ag. (1), (2)
Sargassum uviferum Ag. (1), (2)
Caulocystis uvifera Aresch. (1)
68. BLOSSEVILLEA CEPHALORNITHOS (Labill.) Kuetz.
Cystophora Cephalornithos (Labill.) J. Ag. (1)
Cystoseira Cephalornithos Ag. (1), (2)
Fucus cephalornithos Labill. (1), (2)
Caulocystis Cephalornithos Aresch. (1)
69. BLOSSEVILLEA PLATYLOBIUM (Mert.), nov. comb.
Cystophora Lyalli H. & H. (1), (2)
platylobium (Mert.) J. Ag. (13)

[21] De Toni considers this is more probably *Sargassum grande*.

Fucus platylobium Mert. (1)
Cystoseira platylobium Ag. (1)
Platylobium Mertensii Kuetz. (1)
70. BLOSSEVILLEA RETROFLEXA (Labill.), nov. comb.
Blossevillea campylocoma Kuetz. (1)
caudata Harv. (1)
Cystophora retroflexa (Labill.) J. Ag. (13)
Fucus caudatus Lamour. (1)
retroflexus Labill. (1)
Cystoseira retroflexa Ag. (1)
71. BLOSSEVILLEA SILIQUOSA (J. Ag.), nov. comb.
Cystophora siliquosa J. Ag. (13)
72. BLOSSEVILLEA SPARTIOIDES (Turn.) Decne.
Blossevillea intermedia Kuetz. (1)
penicillifera Kuetz. (1)
Cystophora spartioides (Turn.) J. Ag. (1), (2)
Fucus spartioides Turn. (1), (2)
Phyllotricha spartioides Aresch. (1), (2)
Cystoseira spartioides Ag. (1), (2)
73. BLOSSEVILLEA PANICULATA (Turn.) Decne.
Cystophora paniculata (Turn.) J. Ag. (1), (2)
Fucus paniculatus Turn. (1), (2)
Cystoseira paniculata Ag. (1), (2)
Acrocarpia paniculata Aresch. (1)
74. BLOSSEVILLEA POLYCYSTIDEA Aresch.
Blossevillea expansa Aresch. (1)
Cystophora polycystidea Aresch. (1)
75. BLOSSEVILLEA MONILIFERA (J. Ag.), nov. comb.
Blossevillea retroflexa Kuetz. (1)
retroflexa Decne. (2)
Cystophora monilifera J. Ag. (13)
Fucus retroflexus Turn. (non Labill.) (1), (2)
Cystoseira retroflexa Rich. (1), (2)
76. CYSTOPHYLLUM MURICATUM (Turn.) J. Ag.
Cystophyllum muricatum Harv. (12)
trinode J. Ag. (12)
Fucus muricatus Turn. (1), (2)
Cystoseira muricata Ag. (2)
trinodis Ag. (1), (2)
Sirophysalis binodis Kuetz. (12)
muricata Kuetz. (1), (2), (12)
trinodis Kuetz. (12)
Varieties include:
Cystoseira virgata Endl. et Dies. (1)
Sirophysalis binodis Kuetz. (1)
virgata Kuetz. (1)
77. SCABERIA AGARDHII Grev.
Castraltia salicornoides Rich. (non Martens) (1), (2)
78. PHYLLOSPORA COMOSA (Labill.) Ag.
Fucus comosus Labill. (1), (2)
Macrocystis comosa Ag. (1), (2)
79. HORMOSIRA ? ARTICULATA (Forsk.) Zan.
Hormosira triquetra Decne. (1)
Fucus articulatus Forsk. (1)
triqueter Delile (1)
Cystoseira articulata J. Ag. (1), (7)
triquetra Mont. (1)
Moniliformia triquetra Decne. (1)
80. HORMOSIRA BANKSII (Turn.) Decne.
Fucus Banksii Turn. (1)
Cystoseira Banksii Ag. (excl. synon.) (1)
Moniliformia Banksii Bory (1)
Varieties include:
Hormosira Billardieri Mont. (2)
gracilis Kuetz. (2)
obconica Kuetz. (2)
Sieberi Decne. (2)
Fucus Banksii Turn. (2)
moniliformis Labill. (2)
Cystoseira Banksii Ag. (2)
Moniliformia Labillardieri Bory (2)
Banksii Bory (2)
Sieberi Bory (2)
81. SARCOPHYCUS POTATORUM (Labill.) Kuetz.
Fucus potatorum Labill. (1), (2)
Laminaria potatorum Lamour. (1), (2)
D'Urvillaea potatorum Aresch. (1), (2)
83. SPLACHNIDIUM RUGOSUM (Linn.) Grev.
Ulva rugosa Linn. (1)
Fucus rugosus Turn. (1)
rugosus Linn. (2)
Dumontia auriculata Suhr. (1)
rugosa Suhr. (1), (2)

An alphabetical list of the synonyms attributed to the whole, or to part of, species mentioned in the key has been prepared. Opposite each name is the number of the accepted species as listed in the key, e.g., *Acrocarpia paniculata* Aresch. ...... 73, indicates *Blossevillea paniculata* (Turn.) Decne.

Acrocarpia paniculata Aresch. 73
Asperococcus castaneus Carm. 9
rugosus B. *bullosus* Duby. 7
sinuosus Bory 10
tenuis Zan. 7
Turneri Hook. 7
utricularis D'Urv. 7
Blossevillea campylocoma Kuetz. 70
caudata Harv. 70
Blossevillea expansa Aresch. 74
fallax Kuetz. 51
intermedia Kuetz. 72
paradoxa Kuetz. ? 50
penicillifera Kuetz. 72
retroflexa Decne. 75
retroflexa Kuetz. 75
Cabrera gaditana Schousb... 21
Capea biruncinata γ *elongata* Sond. 27
Capea biruncinata Mont. .. 26
exasperata Mont. 26
flabelliformis H. & H. .. 26
radiata Endl. 26
Carpacanthus lacerifolius Kuetz. 55
Carpomitra Cabrerae Kuetz. 21
Carpophyllum flexuosum Grev. 66
macrophyllum Mont. .. 66

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TAXONOMIC NOTES ON THE ORDER EMBIOPTERA. II.

A NEW NEOTROPICAL GENUS OF EMBIOPTERA.

By CONSETT DAVIS, M.Sc., Lecturer in Biology, New England University College.*

(Twenty-one Text-figures.)

[Read 31st May, 1939.]

OLIGEMBIA, n. gen.

Genotype: *Oligotoma hubbardi* Hagen, 1885, *Canadian Entomologist*, vol. 17, p. 142.

Very small Embioptera, the males with the following characters: Winged, the main veins greatly reduced in their development without reduction in number. R_1 and main stem of Cu_1 strong; R_{2+3} weak; remaining veins represented only by their bordering pigment-bands and by rows of macrotrichia, sparse and little obvious. These remnants of the main veins follow the course of those of the genus *Embia*, R_{4+5} being clearly forked, the fork longer than the stem; M simple; anterior branch of cubitus (Cu_{1a}) simple, very weak. Mandibles slender, terminally incurved and acute. Hind legs with first tarsal segment devoid of bladders. Terminalia with tenth abdominal tergite divided by a longitudinal suture, obsolete proximally; right hemitergite with a long thin process directed backwards; process of left hemitergite complex; left cercus-basipodite well-developed, associated closely with base of left cercus; no nodules on any of the segments of the cerci.

♀ unknown.

Southern parts of the United States to South America.

The genus is closely allied to *Diradius* Friederichs 1934 (genotype *D. pusillus* Friederichs 1934), from Brazil, in which, however, the process of the left hemitergite is simply tapered, and the left cercus-basipodite of different form. The species are superficially similar to those of *Oligotoma*; the forking of the trace representing R_{4+5} immediately differentiates them, and seems to rule out descent from *Oligotoma*, just as the more complex terminalia and more complete reduction in strength of the veins rules out the descent of *Oligotoma* from *Oligembia*. To some extent the mandibles, hind tarsi, left cercus-basipodite, elongate process of the right hemitergite and incomplete fission of the last abdominal tergite, suggest some relationship to *Oligotoma*, but whether this is due to common descent from a type possessing some or all of these characters, or merely to convergence, is at present problematical.

Although one of the South American species referred by Enderlein to *Rhagadochir* Enderlein 1912 is herein referred to *Oligembia*, the others do not seem to be closely related. The genotype of *Rhagadochir* (*Rh. vosseleri* End.) is African, and no South American species is actually congeneric with it; a new generic name

* A considerable part of the work embodied in this paper was performed when the writer held a Linnean Macleay Fellowship in Zoology.

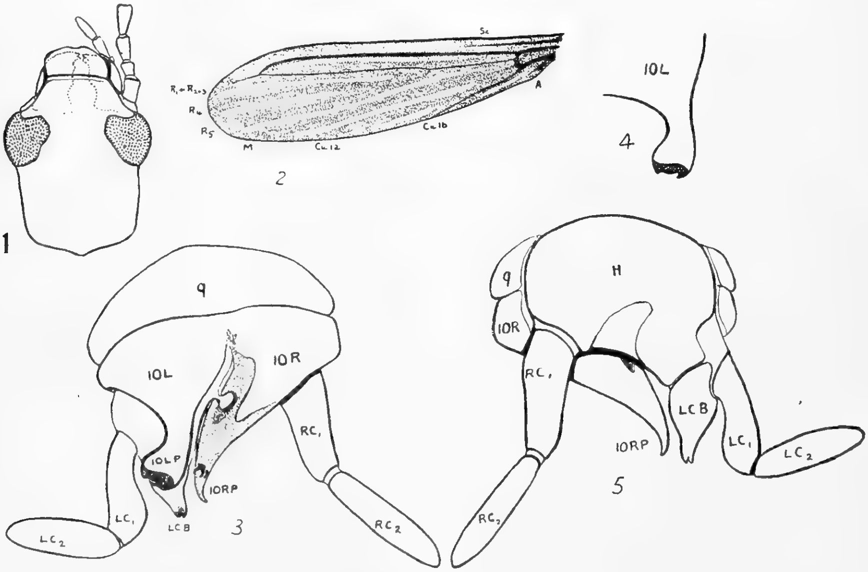
is required for this South American series, of which *Embia trinitatis* de Saussure 1896 is a typical example. This series agrees with *Oligembia* in having the process of the left hemitergite complex, but differs in the complete fission of the last abdominal tergite, number of hind tarsal bladders, and in having the first segment of the left cercus echinulate, the veins R_{4+5} and M more strongly developed, etc.

OLIGEMBIA HUBBARDI (Hagen, 1885). Figs. 1–5.

Oligotoma hubbardi Hagen, 1885, *Canad. Entomologist*, vol. 17, p. 142.

♂. Length 4 mm.; forewing 3·7 mm. × 1·0 mm. (dimensions of the type).

General colour pale yellowish-brown, head somewhat darker, eyes black, wings very pale brown with hyaline streaks between veins or their traces. Head (fig. 1) slender, eyes relatively large; sides of head behind eyes relatively straight, scarcely converging. Mandibles slender, incurved distally, acute, the apex weakly bifid. Antennae incomplete. Body sclerites, except the terminalia, as in *Oligotoma.* Wings (fig. 2) with Sc reaching to one-quarter the length of the wing; R_1 strong, confluent subterminally with R_{2+3}, the fused vein not quite reaching the termen. R_{4+5}, M and Cu_{1a} represented only by pigment-bands and weak rows of macrotrichia; R_{4+5} with fork twice length of stem; M simple; Cu_{1a} very weak; A short but distinct. No cross-veins apparent. Terminalia (figs. 3, 4, 5) with tenth tergite divided incompletely by a submedian suture, obsolete proximally; right lobe (10R) produced backwards and inwards to a slender evenly-tapered process (10RP), curved outwards terminally. Three minute claw-like hooks placed dorsally on 10RP a little before the apex. 10RP more heavily pigmented and sclerotized than remainder of 10R, and with a circular slot half-way along inner margin. Left



Figs. 1-5.—*Oligembia hubbardi* (Hagen), ♂. 1, Head, × 28; 2, Left forewing, × 13; 3, Terminalia from above, × 64; 4, Process of left hemitergite of tenth abdominal segment, × 64; 5, Terminalia from below, × 64.

(9, ninth abdominal tergite; 10L, 10LP, left hemitergite of tenth abdominal segment and its process; 10R, 10RP, right hemitergite and its process; LC_1, LC_2, first and second segments of left cercus; RC_1, RC_2, segments of right cercus; LCB, left cercus-basipodite; H, ninth abdominal sternite (hypandrium).)

lobe (10L) (fig. 4) tapered backwards to a process (10LP), expanding terminally, distal face concave. Right cercus of two subcylindrical segments (RC_1, RC_2), the first somewhat thicker. Left cercus of two subequal segments (LC_1, LC_2), the first slightly dilated distally on the inner side, but without nodules. Ninth sternite (H) with a more membraneous concavity on the right side of the posterior margin, and to the left of this a subquadrate lobe directed towards the base of the left cercus. Left cercus-basipodite (LCB) tapered, directed backwards, bifid at apex, basally apparently distinct from left cercus and not fused thereto as in other species.

♀ unknown.

Hagen's type, from Enterprise, Florida (Museum of Comparative Zoology, Harvard University) is in a very battered condition, as it was, indeed, when he received and described it. The head is moderately well-preserved; the left forewing is the only wing complete, the rest being much abraded. The abdomen, broken off, was embedded in gum on a card, the terminalia almost entirely destroyed. Preparation of the remains of the terminalia revealed the structure of 10RP, with its associated claw-like processes, and the tip of 10LP. These characters, and the head and left forewing, were sufficient to identify the specimen with certainty with another series in the Museum of Comparative Zoology, three males (one much damaged) from Royal Palm Park, Florida (coll. Blatchley). One of these was accordingly labelled plesiotype, and the figures (except fig. 2) and much of the above description are from this specimen. In colour and dimensions this series agrees with the type.

OLIGEMBIA ROSSI, n. sp. Figs. 6–12.

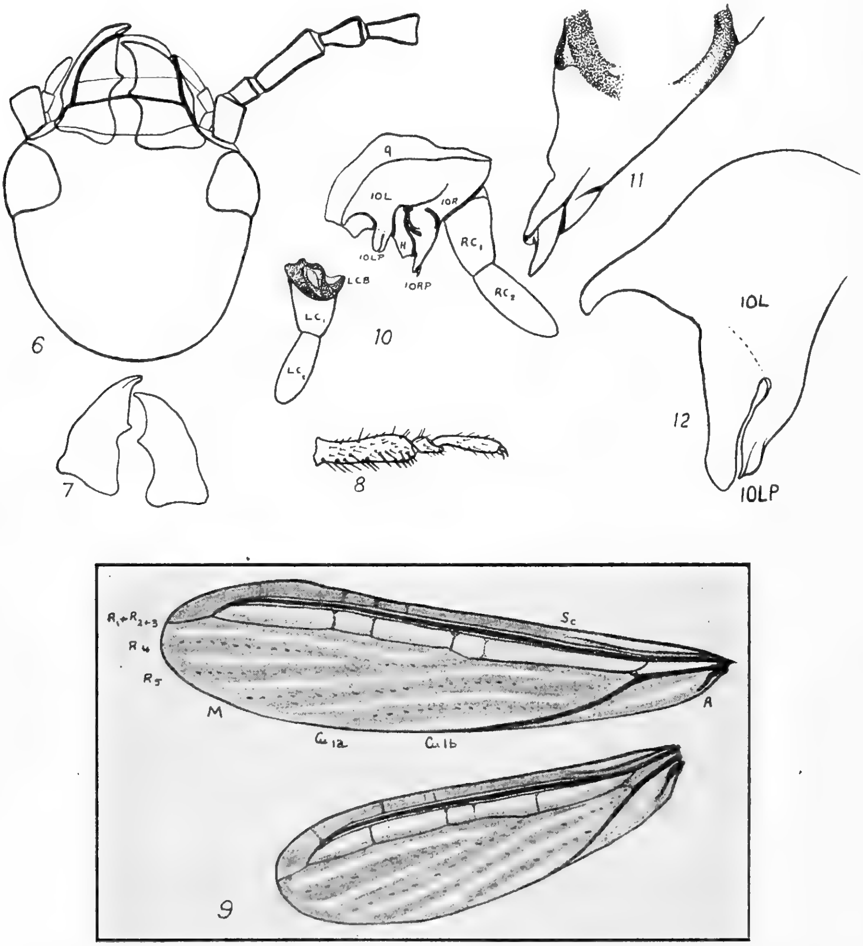
♂. Length 3 mm.; head, length 0·8 mm., breadth 0·6 mm.; forewing 3·1 mm. × 0·7 mm.; hindwing 2·3 mm. × 0·7 mm.

General colour pale ferruginous, head a little darker, eyes black. R_1, R_{2+3} and stem of Cu pale brown; bands bordering veins or their traces very pale yellowish-brown; thin lines bordering R_1 (Radiusnebenlinien or pseudo-radial lines) rose. Head (fig. 6) relatively broader and more rounded than in *O. hubbardi*. Right antenna with 14 segments, length 1·9 mm., probably complete; left broken. Mandibles (fig. 7) slender, terminally incurved and acute, the tip of the left with a weak longitudinal division; inner margin behind apex concave, with a tooth half-way from apex. First segment of hind tarsi (fig. 8) without even the terminal ventral bladder found in *Oligotoma*. Wings (fig. 9) much as in *O. hubbardi*, but with a few weak cross-veins between costa and radius, and between radius and sector. In the left hindwing the pigment-band representing R_4 is disconnected basally from the stem R_{4+5}. Terminalia (figs. 10–12) with tenth abdominal tergite divided by an oblique suture, obsolete proximally. Right hemitergite (10R) produced backwards to a tapered process (10RP) ending in two teeth (fig. 11), the outer acute, the inner obtuse, shorter, and more dorsal. Base of 10RP with more heavily-sclerotized areas in the form of two half-rings. Left hemitergite (10L) produced backwards to a massive process (10LP; fig. 12), bifid, the inner or right lobe slender, irregularly tapered, heavily sclerotized, the outer or left lobe obtuse, membraneous, and placed somewhat dorsad. Right cercus of two subcylindrical segments (RC_1, RC_2), the first somewhat thicker. Segments of left cercus (LC_1, LC_2) similar to those of right, the first with the left cercus-basipodite (LCB) fused to its base as a heavily-chitinized ring, produced inwards to a tapered horn curving forwards. Hypandrium (H) tapered, truncate distally.

♀ unknown.

Locality.—Barro Colorado Isd., Panama Canal Zone, coll. Dr. W. M. Wheeler; in fungus.

This species is described from a single specimen in the British Museum of Natural History, which I received mounted on two slides, one carrying the terminalia, somewhat distorted, and one the other parts of the insect. The exactitude of the locality and clarity of the taxonomic characters justify its description, especially considering the morphological and geographic interest of the record. The species is named after Mr. E. S. Ross, of the University of California.

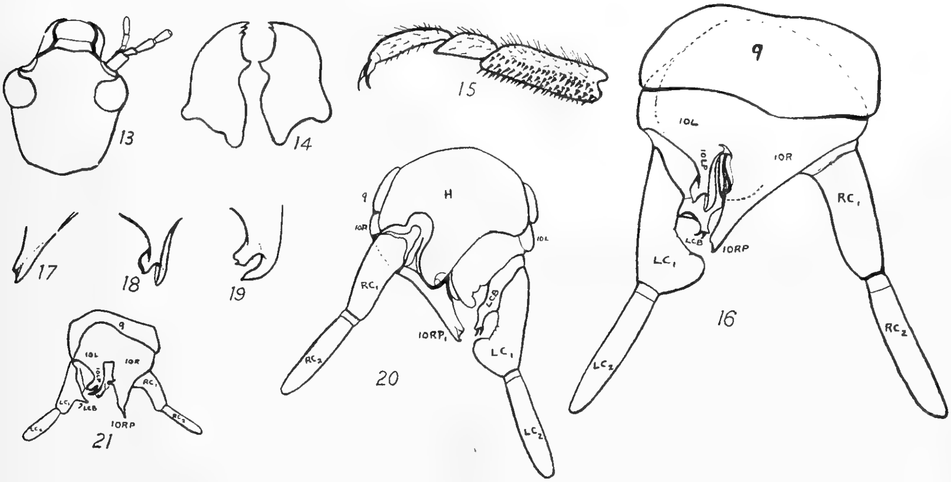


Figs. 6-12.—*Oligembia rossi*, n. sp., ♂. 6, Head, × 60; 7, Mandibles from above, × 60; 8, Tarsus of right hind leg, viewed laterally, × 60; 9, Left fore- and hind-wing, × 20; 10, Terminalia from above, × 56; 11, Process of right hemitergite of tenth abdominal segment, × 280; 12, Process of left hemitergite, × 280.

Oligembia banksi, n. sp. Figs. 13–20.

♂. Length 4·8–6·2 mm.; head, length 0·8–1·1 mm., breadth 0·6–0·9 mm. Forewing, length 3·8–4·6 mm., breadth 1·0–1·2 mm.; hindwing, length 3·0–3·8 mm., breadth 1·0–1·2 mm.

General colour pale golden-brown, head darker, eyes black; wings very pale brown with hyaline streaks. Head (fig. 13) relatively broader than in *O. hubbardi*, the sides converging markedly behind the eyes. Greatest number of antennal segments observed 15 (incomplete); greatest antennal length 2 mm. Mandibles (fig. 14) similar to those of *O. rossi*, but with three terminal teeth on the left, two on the right. Wings as in *O. rossi*, without anomalies. Hind tarsi (fig. 15) similar to *O. rossi*. Terminalia (figs. 16–20) with longitudinal fission of tenth abdominal tergite very incomplete; right lobe (10R) produced backwards and inwards to a thin, flat tapered process (10RP), truncate distally, but apparently smoothly tapered and acute from some aspects; inner margin of 10RP somewhat



Figs. 13-20.—*Oligembia banksi*, n. sp., ♂. 13, Head, × 20; 14, Mandibles from above, × 40; 15, Hind tarsus, viewed laterally, × 60; 16, Terminalia from above, × 56; 17, Process of right hemitergite from above, × 56; 18, Process of left hemitergite from above, × 56; 19, The same, from another specimen, viewed from a different angle, × 56; 20, Terminalia from below, × 40.

Fig. 21.—*Oligembia oligotomoides* (Enderlein), ♂ terminalia from above, × 13 (after Enderlein, 1912).

corrugated, basally overlying an obtuse flap, similar to the structure present in *Oligotoma*. Left lobe (10L) produced backwards to a bifid process (10LP), the right lobe of which is flattened in a vertical plane, terminally subacute, but obtuse from some aspects, curved to the left; left lobe of 10LP dorsiventral, spathulate. Right cercus of two subcylindrical segments (RC_1, RC_2); first segment of left cercus (LC_1) clavate, inner margin lobed distally; basal part of inner margin a little roughened by transverse furrows or creases, but without nodules. Second segment (LC_2) subcylindrical. Ninth sternite (H) produced backwards and to the right in a blunt lobe, between which and the base of the left cercus are two structures, one blunt, terminally outcurved, on the right, the other (LCB), probably the true cercus-basipodite, on the left, i.e., at the base of the left cercus, and fused thereto; LCB curved upwards, ending in two small claws. Right cercus-basipodite rudimentary.

♀ unknown.

Locality.—Villarica, Paraguay, coll. F. Schade. Holotype ♂ and series of paratype ♂♂, Museum of Comparative Zoology, Harvard University; paratype ♂ in the Macleay Museum, University of Sydney. Named after Mr. Nathan Banks, Curator in Entomology, Museum of Comparative Zoology, Harvard.

OLIGEMBIA OLIGOTOMOIDES (Enderlein 1912).

Rhagadochir oligotomoides Enderlein, 1912, Embiidinen, in Coll. de Selys-Longchamps, p. 61.

Enderlein described this species from two males, the locality being given as South America. I have not seen the types (in the Berlin and Stettin Museums), but there seems little doubt from Enderlein's description and figures that the species should be referred to *Oligembia.*

Enderlein's description may be summarized as follows: ♂. Pale ferruginous-yellow, head somewhat darker, eyes black, wings greyish-white. Length 4¼–4¾ mm., forewing length 3·6 mm., hindwing 3·1 mm. Venation as in *O. hubbardi* and *O. rossi*, but with R_1 apparently not confluent with R_{2+3}; cross-veins apparently stronger; R_{4+5} simple in left forewing of the smaller example. Terminalia as in figure 21 (after Enderlein); the projection from the base of the left cercus probably represents the left cercus-basipodite fused to the cercus, as in *O. rossi*, *O. banksi* and the undescribed species mentioned below.

Discussion.

The possible affinities of *Oligembia* have been suggested in the generic description. Other American genera which may have some obscure relationship to *Oligembia* are *Teratembia* Krauss 1911, from the Argentine, and the genus to be formed for *Embia ruficollis* de Saussure 1896, from Central America, which is referable neither to *Embia* nor, as some authors have stated, to *Oligotoma* (cf., e.g., Friederichs, 1934). Both, however, are further removed structurally than is *Diradius*, or even *Oligotoma.*

I have received details of two interesting species referable to *Oligembia* from Mr. E. S. Ross. One is from Guatemala, the other from Tres Marias Isds., off the west coast of Mexico; the latter is structurally similar to *O. banksi.* These species will be described shortly by Mr. Ross, and the preparation of a key to the species of the genus must await these descriptions.

It is probable that further collecting in the countries adjacent to Central America will bring to light a number of further species of the genus *Oligembia.*

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A NEW SPECIES OF CHALCID (GENUS *EURYTOMA*) ASSOCIATED WITH *TEPPERELLA TRILINEATA* CAM., A WASP CAUSING GALLING OF THE FLOWER BUDS OF *ACACIA DECURRENS*.*

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(Twelve Text-figures.)

[Read 31st May, 1939.]

A detailed account of the life history of *Tepperella trilineata*, a wasp which causes galling of the flower buds of *Acacia decurrens* var. *pauciglandulosa* in the vicinity of Sydney, New South Wales, has already been published by the writer (1938).

At that time it was pointed out that the species of *Eurytoma* under discussion, hitherto undescribed, occurred so abundantly in these galls that it outnumbered *T. trilineata*, the primary gall-former.

The unusual behaviour of the larva of a species of *Eurytoma* was commented upon, and in the present paper the life history of this species is set out in detail.

The writer (1936) has already discussed the genus *Eurytoma*, and both phytophagous and parasitic species in this genus are present in Australia. The larva of *E. gahani* is first phytophagous, but later becomes a predator.

Morphology.

Specimens of this species were submitted to Dr. A. B. Gahan, Senior Entomologist of the United States Department of Agriculture, and in a letter dated 29th May, 1937, he informed the writer that it differed from any of the species in the collections at the United States National Museum. He stated that it ran close to *Eurytoma mazzinii* and also *E. acaciae*, two Australian species, but was neither of these two. He concluded that the species was possibly new. The writer has since compared specimens with all the available descriptions of Australian species of this genus and has come to the conclusion that it is undescribed, and a description of this species is included in the present paper.

Eurytoma gahani, n. sp.

The Adult.

♀ (fig. 1): Length: Average, 2·6 mm.; maximum, 3·0 mm.; minimum, 2·3 mm.

Head black, evenly and coarsely reticulate and bearing short white setae. Eyes red, this colour sometimes fading completely in mounted specimens. Mandible (fig. 2C) brown. Antenna (fig. 2B) very dark brown, except the ring joint and the base of the scape which is light brown. The scape extends a little beyond the antennal groove, terminating level with the median ocellus.

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* This contribution is one of ten papers on Australian Chalcidoidea submitted to the University of Sydney in fulfilment of the requirements for the degree of Doctor of Science in Agriculture.

Each segment of the funicle is very slightly wider than that preceding it. The first segment of the funicle is a little longer than wide. The second segment is a little shorter than the first and is exactly as wide as long. The third segment of the funicle is slightly longer than the second and is very slightly longer than it is wide. The fourth segment is approximately the same length as the third and is very slightly wider than long. The fifth segment is slightly shorter than the fourth and is slightly wider than long. The club, which is approximately twice as long as wide, is only very slightly wider than the last segment of the funicle.

Thorax black and, like the head, evenly and coarsely reticulate and bearing short white setae. Wings hyaline; venation light brown, the postmarginal vein is only slightly longer than the marginal vein, both being a little longer than the stigmal vein (fig. 2D).

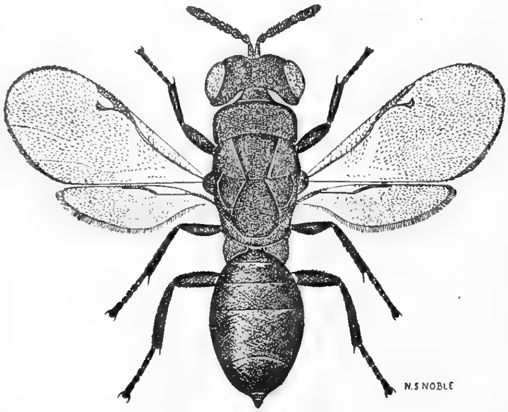


Fig. 1.—*Eurytoma gahani,* adult female (× 15).

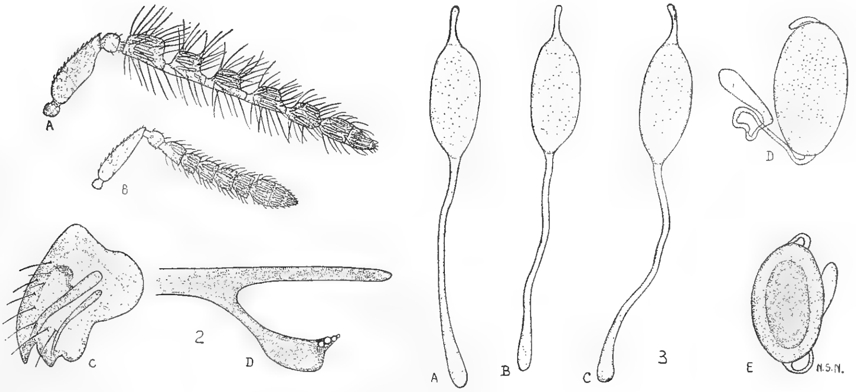
Coxae and trochanters of all legs black. Coxae reticulate, more coarsely so on the hind leg. Outer side of coxae of hind leg conspicuously grooved distally, and in some mounted specimens the trochanter and base of the femur lie in this groove. Femur of front and middle leg dark brown except distally, where it fades to amber, tibia and tarsus amber. Femur of hind leg black except distally, where it fades to amber, tibia and tarsus amber.

Abdomen black, rounded, not laterally compressed as is the case in many species of *Eurytoma* reared from Australian plant galls. First five abdominal segments smooth and shining, but at high magnifications fine reticulations can be distinguished on these segments. Remainder of abdomen reticulate and dull, and bearing a number of scattered white setae. No setae are present on the first and second abdominal segments. A few short lateral setae borne in a median position on the third segment. Setae on the fourth segment a little longer and in a median single row laterally, but extending a little further up on to the dorsal surface than in the third segment. Setae more numerous on the fifth segment, being scattered irregularly over the distal half of the segment.

♂: Length: Average, 2·5 mm.; maximum, 2·8 mm.; minimum, 2·2 mm. In general resembles the female, but is less robust. The abdomen is small and globular, with a distinct petiole. The antenna of the male (fig. 2A) is conspicuously larger than that of the female. The longest setae of the antenna are approximately the length of the segments bearing them.

The type, allotype and numerous paratypes were bred by the writer from galls caused by *Tepperella trilineata* on the flower buds of *Acacia decurrens* at Lindfield, Sydney, New South Wales, in November, 1936.

The type, allotype and five paratypes of both sexes have been forwarded to the British Museum of Natural History, South Kensington, London, and six paratypes of both sexes have also been forwarded to the United States National Museum, Washington, U.S.A.



Figs. 2, 3.—*Eurytoma gahani.* 2: A, Antenna of male (× 36); B, Antenna of female (× 36); C, Mandible of female (× 103); D, Stigmal knob of female (× 103). 3: A, B, C, Ovarian eggs; D, E, Eggs after deposition (all × 103).

The Egg.

The ovarian egg (figs. 3, A–C) is just visible to the unaided eye. It is white in colour and consists of an oval body bearing anteriorly a short pedicel with a rounded end and posteriorly a very long slender pedicel which widens out distally. The dimensions of the various parts of the egg are set out in Table 1. In general features it bears a marked resemblance to the egg of *Eurytoma fellis*, a species which has been studied by the writer (1936).

TABLE 1.—*Dimensions of Egg of* Eurytoma gahani (*in millimetres*).

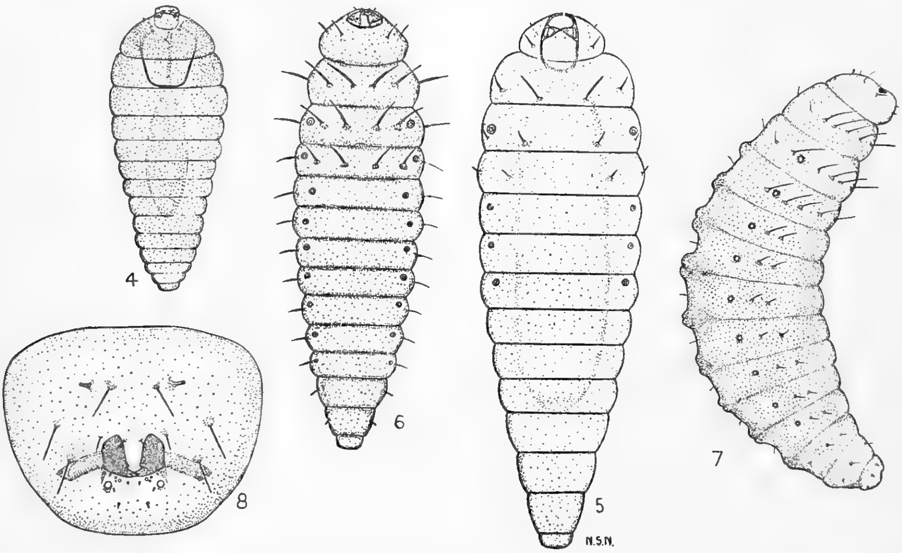
	Total Length.	Ovarian Egg.						Newly Deposited Egg.	
		Body of Egg.		Anterior Pedicel.		Posterior Pedicel.		Body.	
		Length.	Width.	Length.	Width.	Length.	Width.	Length.	Width.
Average	0·447	0·137	0·062	0·044	0·007	0·266	0·017	0·158	0·091
Maximum	0·492	0·142	0·066	0·050	0·007	0·310	0·020	0·172	0·096
Minimum	0·393	0·125	0·053	0·040	0·007	0·218	0·016	0·149	0·089

After deposition (figs. 3, D and E) both the long and the short pedicels may become flaccid and twisted.

The Larva.

Based on mandible size and shape and the distribution of setae, five larval stages are recognizable, there being one more stage than in *Eurytoma fellis*.

Stage I.—The first stage or primary larva (fig. 4) soon after hatching is clear and translucent, but after feeding the region of the alimentary tract becomes green. The smallest larva measured was 0·12 mm. in length and 0·06 mm. in width, being almost invisible to the unaided eye. It consists of a rather prominent head and thirteen clearly defined segments, the head being somewhat chitinized and pale amber in colour. The larva is slightly dorso-ventrally flattened, and when seen in side view is only very slightly arched. The head is slightly narrower than the thoracic segments, the second segment being widest, the larva then tapering gradually to the last segment.



Figs. 4-8.—*Eurytoma gahani*. 4, Ventral view of first-stage larva (× 180). 5, Ventral view of second-stage larva (× 103). 6, Ventral view of third-stage larva (× 55). 7, Lateral view of mature larva (× 20). 8, Front view of head of mature larva (× 55).

When viewed from beneath, the head is semi-circular in outline. The mouth is ventral and is surrounded by a short rounded tubular structure formed from the integument. In this respect it resembles closely the first stage larva of *Habrocytus cerealellae* which has been studied by the writer (1932) and, as in this larva, this tubular outgrowth is most conspicuous when the larva elevates the head when moving. The mandibles (fig. 9A) are triangular in outline, unidentate, lightly chitinized and pale golden in colour, slightly curved and have the tips overlapping, their average length being 0·007 mm.

Dorsally the head bears a pair of very minute truncate antennae, while ventrally and a little to each side of the mouth one pair of minute setae are present. There are no setae or papillae on any of the abdominal segments.

Towards the close of the first larval stage the development of lateral tracheal trunks, united anteriorly and disappearing posteriorly, gives the first indication of the respiratory system.

Stage II.—In general appearance the second-stage larva (fig. 5) resembles the first stage fairly closely, being still more or less translucent with the alimentary tract imparting a dark green colour to that region of the larva. It consists of a head and thirteen segments, the head now being somewhat smaller in proportion to the body segments, and being now no longer more heavily chitinized than the latter. The smallest larva measured was 0·37 mm. in length and 0·13 mm. in width.

The mandibles (fig. 9B), which are pale amber in colour, are unidentate, very slightly curved and triangular in outline, their average length being 0·021 mm., the maximum being 0·023 mm., and the minimum 0·018 mm.

On the dorsal surface of the head there is a pair of truncate antennae, and on the ventral surface there is a pair of large setae, there being a shorter pair of setae on the front border of the head. Setae are present only on the three thoracic segments. On the first segment there is a pair of very large ventral setae and a smaller lateral pair, while on the second and third segments there is a pair of smaller ventral setae and also a pair of lateral setae about the same length.

The respiratory system is now an open one. It consists of the two main tracheal trunks, one extending along each side of the body, being united anteriorly and posteriorly by transverse commissures. From the main trunks four pairs of spiracular trunks pass out to open spiracles, one pair being situated on segments two, four, five and six, the spiracles on segment two being much the largest. A limited number of tracheae pass to the various organs.

Stage III.—The third-stage larva (fig. 6) differs little in general appearance from the second stage. It is now more white in colour and the contents of the alimentary tract are dark green to almost black. The larva is very slightly dorso-ventrally flattened and in side view is very slightly arched. The smallest larva measured was 0·50 mm. in length and 0·19 mm. in width. The mandibles (fig. 9C) are unidentate, triangular in outline, amber in colour, with the tips conspicuously curved and overlapping. They average 0·035 mm. in length, the maximum being 0·040 mm. and the minimum 0·033 mm.

On the dorsal surface of the head is a fairly prominent pair of antennae, which are more or less cylindrical with rounded ends, and pale amber in colour. Between the antennae on the dorsal surface is a pair of fine setae, a second pair also being dorsal and further back and more to the sides of the head. On the front margin of the head and in front of and a little to the sides of the head, there is another pair of setae, and ventrally just above the mandibles there is also a very short pair of setae, while by far the largest on the head is a pair of ventral setae situated below and to the sides of the mouth. There are thus five pairs of setae of various sizes situated on the head.

Below the mandibles there is a large number of rounded sensory papillae of various sizes, a more limited number being situated above the mandibles.

On the first three abdominal segments there are eight setae. One extremely minute pair are dorsal and two large pairs are ventral and one pair are lateral. From segment four to segment twelve, inclusive, there are two pairs of setae, one minute pair being dorsal and a larger pair being lateral. On the thirteenth segment the lateral setae are always wanting and only in some larvae examined can the minute dorsal setae be distinguished.

During the later period of the second stage, further spiracles develop, and in the third stage there are nine pairs of open spiracles situated on segments two to ten inclusive and there is now a very well developed respiratory system. The first pair of spiracles are much larger than the succeeding ones.

Stage IV.—The fourth-stage larva is white in colour, cylindrical and arched, and tapering gently towards both ends. The smallest larva measured was 0·96 mm. in length and 0·32 mm. in width.

The mandibles (fig. 9D) are triangular in outline, still only lightly chitinized and amber in colour, slightly curved and average 0·064 mm. in length, the maximum being 0·069 mm. and the minimum 0·059 mm. The antennae, apart from size, are very similar to those of the third-stage larva, and the number and distribution of the setae on the head is the same in the two stages. The distribution and number of setae on the abdomen is, however, different. In the fourth stage there are eight elongate amber setae on the ventral and lateral surface of the first three segments, there being two small setae on each side of the dorsal surface of these three segments.

On the remaining segments there are two pairs of large lateral setae and one pair of minute dorsal setae on each segment. These setae become smaller on each succeeding segment, those on the last segment being very minute. A well developed open tracheal system, as in the third stage, is present.

Stage V.—The fifth and last larval stage (fig. 7) is cylindrical and arched, and tapers towards both ends, much more conspicuously than do any of the preceding stages. The colour varies from white to light grey. The alimentary tract is black, but this, being mainly masked by fat body, imparts a darker grey appearance to this region of the larva.

It consists of a head and thirteen segments. The average length of the mature larva is 3·32 mm., the maximum being 3·54 mm. and the minimum 2·97 mm. The average width of the mature larva is 1·07 mm., the maximum being 1·15 mm. and the minimum 0·94 mm.

The head (fig. 8) is of the typical generalized chalcidoid type, being more or less hemispherical in outline. The mandibles (fig. 9E) are now much more heavily chitinized, being brown in colour, somewhat triangular with a very broad base, bidentate, with one very much longer curved and more heavily chitinized tooth. The average length of the mandibles is 0·106 mm., the maximum being 0·116 mm. and the minimum 0·092 mm.

The head, as in preceding stages, bears a dorsal pair of cylindrical antennae (fig. 9F) and five pairs of setae of various sizes, their distribution being as in the third and fourth larval stages. Below the mandibles there are also four pairs of minute sensory setae and four pairs of minute papillae, their distribution being shown in figure 8.

The number and distribution of the setae on the abdomen is the same as in the fourth stage, i.e. there are ten large lateral and ventral setae (figs. 9, G, H, and I) and two pairs of smaller dorsal setae on the first three segments, while on the remaining segments there are two pairs of lateral and one pair of dorsal and smaller setae. With the decrease in size of the posterior segments all these setae are brought closer together and more or less form a median circlet.

A very profusely branching open tracheal system is present with nine pairs of open spiracles, one pair on each of segments two to ten inclusive.

Intermediate measurements of the various larval stages of *Eurytoma gahani* are given in Table 2.

TABLE 2.—*Dimensions (in millimetres) of the various Larval Stages of* Eurytoma gahani.

Stage of Larva.		Length.	Width.	Average Width of Head.
Stage 1 ..	.. Largest	0·30	0·11	0·063
	Smallest	0·12	0·06	
Stage 2 ..	.. Largest	0·51	0·18	0·098
	Smallest	0·37	0·13	
Stage 3 ..	.. Largest	1·04	0·32	0·180
	Smallest	0·50	0·19	
Stage 4 ..	.. Largest	1·66	0·50	0·304
	Smallest	0·96	0·32	
Stage 5 ..	.. Largest	3·54	1·15	0·443
	Smallest	1·68	0·64	

BIOLOGY.

Length of Life of Adults.

Newly-emerged adults of both sexes of *E. gahani* were placed in glass tubes six inches in length and one inch in diameter. One end of the tube was covered with cheese cloth and the other was plugged with cotton wool which was kept moistened with sugar and water solution. These were held in the laboratory until death; the length of life under these conditions is set out in Table 3.

TABLE 3.—*Length of Life of* Eurytoma gahani *in the Laboratory.*

Length of Life in Days.	Number of Males.	Number of Females.	Length of Life in Days.	Number of Males.	Number of Females.
1	4	3	15	2	2
2	21	4	16	1	3
3	19	26	17	—	—
4	29	16	18	2	—
5	21	18	19	2	—
6	31	10	20	—	1
7	27	25	21	1	1
8	38	24	22	1	1
9	18	44	23	—	—
10	12	20	24	—	—
11	4	17	25	—	1
12	10	13	26	—	1
13	5	7	27	—	2
14	2	1			
			Total ..	250	240

Average length of life of male wasps, 6·82 days; female wasps, 8·17 days.
Maximum „ „ „ „ „ „ 22 „ „ „ 27 „
Minimum „ „ „ „ „ „ 1 day; „ „ 1 day.

Under these conditions the average length of life was comparatively short, but limited numbers of adults lived for more than two weeks, and a few females lived for a period of three weeks or more, which is considerably longer than the adults of the primary gall-former, *Tepperella trilineata*, lived under similar conditions.

Habits of Adults.

Adults are comparatively sluggish and do not fly readily, it being possible to pick buds on which females are resting without disturbing them. However, they can fly quite well, and during November and December, 1936, on bright sunny days, large numbers were to be seen flying around the galled tree, individuals remaining on the wing for some minutes.

When confined in tubes in the laboratory, this species fed much more readily on sugar solution than did the adults of *Tepperella trilineata.*

Percentage of Sexes.

Of a total of 1,605 adults which emerged from galls in 1936, 1,028 or 64·05 per cent. were females, and 577 or 35·95 per cent. were males. It will be seen that females outnumbered males in a ratio of almost 2 to 1. It is worthy of note that in *Eurytoma fellis*, the citrus gall wasp, studied by the writer (1936), of 4,889 adults, 3,122 or 63·86 per cent. were females, a percentage which is remarkably close to that recorded for *Eurytoma gahani.*

Mating.

This species mated much more readily in the laboratory than did any of the other species from the galls on *Acacia decurrens.* There is nothing unusual in the procedure. The male spends a few moments on the dorsum of the female vibrating the antennae in front of those of the latter, and fertilization follows, the male invariably returning to the back of the female after coupling, but a second contact was never observed. The time occupied ranged from 7 to 20 seconds, the average being 11 seconds. Adults were frequently observed mating a few minutes after emerging from the galls.

Oviposition.

Unlike *Tepperella trilineata*, the female of *Eurytoma gahani* at the time of emergence from the galls has comparatively few eggs ready for deposition, and even after being kept in tubes in the laboratory and fed for some days, the number of well-developed eggs is still limited. Adults of *Eurytoma gahani* live longer and are more vigorous than the adults of *T. trilineata*, and it is probable that oviposition in the former species is a much more gradual process and extends over a longer period.

At the time the first adults of *Eurytoma gahani* emerge all the flower buds are very well developed, but it is several weeks before the tree blossoms, so that these early emergents oviposit in advanced flower buds. During the greater part of the emergence period of this species, however, the tree is in flower. It has been pointed out that in globular flower-heads in which *Tepperella trilineata* has oviposited only the upper flowers open, and many females of *Eurytoma gahani* oviposit in the fleshy green base of the unopened portion of the flower heads.

At the time the later adults of *Eurytoma gahani* emerge, viz. the last half of December and early January, the tree has completed flowering, the normal flowers have died and fallen, and the flower heads in which *T. trilineata* has oviposited are now present as very minute galls, and in these *Eurytoma gahani* oviposits.

The tips of the antennae are held just above the surface of the plant tissues to locate a suitable oviposition site. The abdomen is then brought down at right angles to the normal position, the ovipositor is exposed and worked into the gall until some stage of *T. trilineata* is located, and then a single egg is deposited, the process of oviposition being rather protracted. At the time the first adults of *Eurytoma gahani* emerge, a limited number of eggs of *Tepperella trilineata* are present in the buds, and the egg of *E. gahani* in such instances is deposited alongside the egg of *T. trilineata*.

During the greater part of the emergence period of *Eurytoma gahani*, *T. trilineata* is present in the first larval stage, and in large numbers of dissections during December 1936, a single egg of *Eurytoma gahani* was found adhering to the integument of a first-stage larva of *T. trilineata*, and in two instances two eggs of *E. gahani* were found adhering to the integument of a second-stage larva of *T. trilineata*.

It is evident that the egg of *E. gahani* is always deposited alongside some stage of *T. trilineata*, the exact stage of development of the latter species, at the time of oviposition, apparently being of little significance.

Superparasitism.

In four instances it was evident that at least two eggs of *Eurytoma gahani* had been laid in the cell occupied by *Tepperella trilineata*.

On 14th December, 1936, and again on 15th February, 1937, two eggs of *Eurytoma gahani* were found adhering to the integument of a second-stage larva of *T. trilineata*. In both cases the eggs were at distinctly different stages of development.

On 17th July, 1936, two larvae of *Eurytoma gahani*, both in the fourth stage, were found in a cell with a maturing larva of *T. trilineata*. Both these larvae were normal and active, but the larva of *T. trilineata* was very unhealthy in appearance.

Again on 1st September, 1936, two fifth-stage larvae of *Eurytoma gahani* were found in the one cell accompanied by the dead remains of a fifth-stage larva of *T. trilineata*.

Never more than one adult, however, was ever observed to emerge from a single gall cell.

Larval Development.

The stages of *Eurytoma gahani* and *Tepperella trilineata* found in association during a period of 16 months during 1936 and 1937 are set out in Table 4. It must be remembered that as early as 16th May, 1936, gall cells were dissected in which *Eurytoma gahani* had already devoured the larva of *T. trilineata* and was in the last larval stage, and the number of such cells increased with each succeeding dissection date. The figures indicated in Table 4 apply only to dissections in which both species were still present in the cell, and this table does not give any indication of the relative abundance of the two species.

Table 4 should be consulted in conjunction with Table 5, when considering dissections during the second half of 1936, as the latter table indicates clearly at the different dissection dates just what numbers of *Tepperella trilineata* still remained in association with the larvae of *Eurytoma gahani*, the numbers of mature larvae of the latter species present indicating the numbers of *Tepperella trilineata* which had been devoured.

Though the eggs of the two species may be found in association, it was much more usual to find the egg of *Eurytoma gahani* in the gall cell with the first-stage larva of *T. trilineata.*

TABLE 4.—*Stages of* Tepperella trilineata *and* Eurytoma gahani *found associated in Gall Cells on* Acacia decurrens *during a period of Sixteen Months.*

Date of Dissection.	Number of Gall Cells Examined.	Stage of Larvae of *Tepperella trilineata* in Cell.	Stage of Larvae of *Eurytoma gahani* in the same Cell.
		1935–36 Galls.	
11/5/36	4	4 fourth.	1 second, 3 third.
	1	1 fourth.	1 third.
16/5/36	3	3 fifth.	2 third, 1 fifth,
	1	1 fourth.	1 third.
27/5/36	1	1 fifth.	1 third.
5/6/36	1	1 fifth.	1 third.
11/7/36	1	1 third.	1 second.
16/7/36	1	1 third.	1 second.
	4	4 fifth.	3 fourth, 1 fifth.
9/8/36	9	9 fifth.	1 third, 8 fourth.
12/8/36	7	7 fifth.	7 fourth.
	3	3 fourth.	2 second, 1 third.
6/9/36	1	1 fourth.	1 third.
		1936–37 Galls.	
31/10/36	1	1 egg.	1 egg.
29/11/36	1	1 first.	1 egg.
13/12/36	1	1 first.	1 egg.
14/12/36	1	1 second.	2 eggs.
16/1/37	1	1 first.	1 first.
	1	1 second.	1 first.
30/1/37	3	3 first.	3 first.
1/2/37	2	2 first.	2 first.
	2	2 first.	2 eggs.
15/2/37	1	1 second.	1 first.
9/3/37	4	4 second.	4 first.
	1	1 third.	1 third.
	1	1 fifth.	1 fourth.
2/4/37	1	1 second.	1 first.
	4	4 third.	2 first, 2 second.
20/4/37	9	9 third.	9 second.
7/5/37	1	1 second.	1 second.
	8	8 third.	8 second.
	7	7 fourth.	6 second, 1 third.
1/6/37	1	1 third.	1 second.
	5	5 fourth.	5 third.
29/6/37	1	1 third.	1 second.
	2	2 fourth.	2 third.
	6	6 fifth.	5 third, 1 fourth.
15/7/37	13	13 fifth.	13 third.
6/8/37	14	14 fifth.	14 fourth.
13/8/37	18	18 fifth.	2 third, 16 fourth.
30/8/37	6	6 fifth.	6 fourth.
	1	1 third.	1 second.

In January and the beginning of February, 1937, the first-stage larvae of the two species were sometimes found in association, but for the greater part of the year the larvae of *T. trilineata* were one stage, and occasionally two stages, ahead of the larvae of *Eurytoma gahani* with which they were associated, and the size of the larvae of the former was always greatly in excess of the size of those of the latter species.

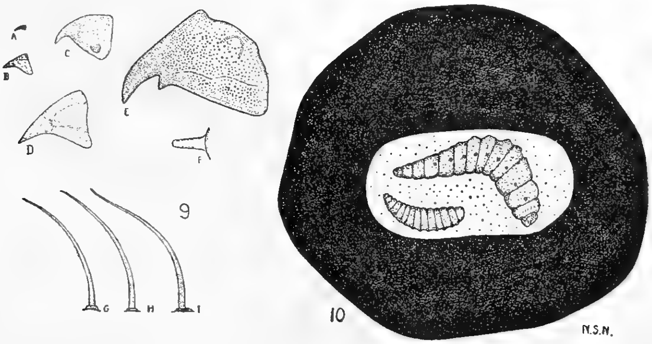


Fig. 9.—*Eurytoma gahani*: A, Mandible of first-stage larva; B, Mandible of second-stage larva; C, Mandible of third-stage larva; D, Mandible of fourth-stage larva; E, Mandible of fifth-stage larva; F, Antenna of fifth-stage larva. (× 180.) G, H, I, Setae from first segment of mature larva (× 103).

Fig. 10.—Cross section of a fully-developed unilocular gall showing a maturing larva of *Tepperella trilineata* in the cell together with a fourth-stage larva of *Eurytoma gahani*, the latter larva being the smaller (× 7). Sectioned 14th August, 1936.

During the earlier part of the larval life the plant tissues fit closely up against the integument of the larvae, and there is no room for movement. As the two larvae feed upon the contents of the surrounding nutrient layer, their alimentary tracts, which are blind sacs, become green in colour, and gradually as the nutrient layer is devoured and the galls increase in size, the two larvae are to be found in fairly large gall chambers in which there is room for movement, and while it is more usual to find the small larva of *E. gahani* touching the larva of *T. trilineata*, the two larvae are sometimes found at opposite ends of the chamber (fig. 10).

All stages of *Eurytoma gahani*, except the last larval stage, possess some powers of locomotion, the second and third larval stages in particular being able to crawl along quite actively. With the increased space in the gall chambers is correlated the further development of the respiratory systems in the two species of larvae. This has been referred to when discussing the morphology of these species.

The two species of larvae continue to develop normally together until the late winter, when it is found that the majority of the larvae of *T. trilineata* have reached the last larval stage. At this time the galls have also reached their full size. However, larvae of *T. trilineata*, which are present in cells with the larvae of *E. gahani*, are never able to pupate, and by the time the larvae of the latter species reach the fifth or last larval stage, the larvae of *T. trilineata* have an unhealthy appearance, and are sluggish and abnormal. Eventually the cells are found to contain maturing larvae of *Eurytoma gahani* and the dead remains of the larvae of *T. trilineata*, and finally all traces of the latter disappear, having been devoured by the last-stage larvae of *Eurytoma gahani*, which reach maturity and subsequently pupate in the cell formerly occupied by the two species. Factors which bring about the destruction of the larvae of *T. trilineata* are not clear.

It is possible that the exhaustion of the food supply may play an important part, as examination of cells in which the larva of *T. trilineata* are dead shows that the inner wall is hard and dry, the nutrient layer having completely disappeared, this exhaustion of the food supply possibly being due to the extra demands made upon it owing to the presence of two larvae. This exhaustion of the food may cause the larva of *T. trilineata* to become weak or even to die, and hunger may be the factor which causes the larva of *Eurytoma gahani* to become predaceous and devour the larva with which it formerly lived in harmony. On the other hand, it is possible that the parasitic or predatory habit may develop normally in the larva of *Eurytoma gahani* once it reaches the fifth stage, and it may attack and destroy the larva of *T. trilineata* regardless of the state of the food supply.

Many larvae of *T. trilineata* which had recently died, but in which the stomach contents were still quite fluid, were mounted on slides and cover slips were superimposed and light pressure was applied. The integument became distended, but there was no evidence of any break in the integument, which would be present had the larva of *Eurytoma gahani* made a direct attack upon it. Continued pressure of the cover glass usually forced the stomach contents out through the anus. In more shrivelled specimens of dead larvae of *T. trilineata* gaping ruptures were present in the integument. These must have been made by the larva of *Eurytoma gahani*, but it seems much more likely that these ruptures were made after the death of *T. trilineata*, as otherwise such ruptures should be present in all the dead larvae.

In any case *Eurytoma gahani* behaves as a predator rather than a parasite, and though many hundreds of cells were examined in 1936 in which both species of larvae were present, it was only on very rare occasions that the larva of *Eurytoma gahani* was actually observed feeding on the larva of *T. trilineata*.

Though the great majority of the larvae of *T. trilineata* were devoured during August, 1936, at each weekly examination of galls from May onwards occasional maturing larvae of *Eurytoma gahani* were found in cells with dead *T. trilineata* larvae of the last stage. Though at any particular period of the year the majority of the larvae of *Eurytoma gahani* are at the same stage, a few cells may be found in which the larvae of this species are more advanced.

In Table 5 are set out the results of a series of gall dissections during the last six months of 1936 and also in August and September, 1937, and which indicate the various stages of both *Tepperella trilineata* and *Eurytoma gahani* present. Some maturing larvae of *Eurytoma gahani* were found as early as 16th May, 1936, but it will be seen from Table 5 that in the dissections of galls on 3rd August and 9th August only six larvae of *Eurytoma gahani* were found alone, while the larvae of the two species were still together in 90 cells.

On 22nd August, 1936, however, in 52 out of a total of 58 cells examined it was found that the larvae of *Eurytoma gahani* had devoured those of *T. trilineata*, and in 1936 and 1937 it was mainly during the last half of August and the first half of September that the majority of the larvae of *E. gahani* devoured those of *T. trilineata* and reached maturity. A remarkable increase in the size of the larvae of *Eurytoma gahani* occurs during this time, larvae of this species which have devoured the larvae of *T. trilineata* increasing to twice the size

TABLE 5.—*Results of Dissection of Galls on* Acacia decurrens *showing Stages of* Tepperella trilineata *and* Eurytoma gahani *present during the last half of* 1936 *and in the spring of 1937.*

Date of dissection.	No. of Cells Examined.	No. of Emergence Holes.	Cells containing both *T. trilineata* and *Eurytoma gahani.*	*Tepperella trilineata.*			*Eurytoma gahani.*			Cells occupied by other Species.
				Larvae.	Pupae.	Adults.	Stage V Larvae.	Pupae.	Adults.	
				1936 Galls.						
8-16/6/36	545	—	278	262	—	—	5	—	—	—
26/7/36	36	—	20	15	—	—	1	—	—	—
28/7/36	30	—	13	16	1	—	—	—	—	—
3/8/36	75	—	49	8	13	—	5	—	—	—
9/8/36	68	—	41	20	6	—	1	—	—	—
18/8/36	82	—	26	—	21	—	35	—	—	—
22/8/36	85	—	6	8	19	—	52	—	—	—
30/8/36	136	—	13	9	30	1	83	—	—	—
6/9/36	253	—	14	2	40	3	144	—	—	50
9/9/36	77	—	5	—	12	1	45	—	—	14
13/9/36	98	1	1	—	14	9	44	—	—	29
20/9/36	151	35	—	—	2	10	69	—	—	35
27/9/36	222	42	1	—	1	11	142	—	—	25
4/10/36	177	34	2	—	4	4	103	1	—	29
11/10/36	113	18	—	—	—	—	63	7	—	25
18/10/36	153	54	—	—	—	—	67	11	—	21
25/10/36	102	28	—	—	—	—	39	31	—	4
1/11/36	114	48	—	—	—	—	27	37	—	2
8/11/36	109	46	—	—	—	—	15	44	4	—
15/11/36	35	15	—	—	—	—	1	17	2	—
22/11/36	44	25	—	—	—	—	—	14	5	—
				1937 Galls.						
6/8/37	20	—	17	3	—	—	—	—	—	—
13/8/37	43	—	23	10	4	—	4	—	—	2
30/8/37	57	—	23	5	15	—	6	—	—	8
13-16/9/37	516	—	11	—	84	8	322	—	—	91

First adult of *Tepperella trilineata* emerged on 7th September, 1936.
Last ,, ,, ,, ,, ,, ,, 12th October, 1936.
First ,, ,, *Eurytoma gahani* ,, ,, 30th October, 1936.
Last ,, ,, ,, ,, ,, ,, 5th January, 1937.
The first adult of *T. trilineata* of the following generation emerged on 19th September, 1937.

of larvae of the same stage which are still accompanied by the normal larvae of *T. trilineata.* This great increase takes place in a very short space of time, and it is evident that at this period the larva of *T. trilineata* provides an abundant source of highly nutritious food.

All the available evidence points to the fact that after the larva of *Eurytoma gahani* devours the larva of *T. trilineata* it partakes of no further food, but it is evident that this species remains in the mature larval stage within the galls for several months prior to pupation.

A number of larvae of *Eurytoma gahani* were taken from cells in August after devouring the larvae of *T. trilineata* and were measured, and they were just as large as larvae of the same species removed from the galls several months later. Moreover, it has already been pointed out that at the time the larva becomes predaceous the inner wall of the gall cell or chamber is hard and dry.

Many larvae of *Eurytoma gahani* which were removed from galls on 2nd August, 1936, and placed on cotton wool in petri dishes remained alive for periods of two and three months and finally voided waste matter and pupated normally.

The smallest and the largest larvae of the various stages of *Eurytoma gahani* measured are set out in Table 2. It will be seen that the growth in the various stages is fairly regular, there being comparatively little overlapping in size in the various stages, and that the larva almost doubles its size during the last larval stage.

Dissection of the larvae of *Tepperella trilineata* which are in cells with *Eurytoma gahani* shows that numbers of them contain also larvae of a parasite, *Megastigmus* sp. As *Eurytoma gahani* devours the larvae of *T. trilineata* it accidentally also becomes a predator of the larvae of *Megastigmus* sp. in those cells.

During 1936 and before any of the larvae of *Tepperella trilineata* had been devoured, six twigs of galls were taken and every cell examined and the species present recorded. Cells containing strange larvae were discarded, and the number of cells in which *T. trilineata* occurred alone and with *Eurytoma gahani* were recorded, and then all the larvae of *T. trilineata* were dissected in order to determine whether *Megastigmus* sp. was present. The results of these dissections are set out in Table 6.

TABLE 6.—*Numbers of Larvae of* Tepperella trilineata, Megastigmus sp. *and* Eurytoma gahani *present in Galls on* Acacia decurrens *at Lindfield, Sydney, in 1936.*

Twig No.	Total Gall Cells.	Total Cells containing Larvae of *T. trilineata*.	Total Cells containing Larvae of *Megastigmus* sp.	Cells containing Larvae of *Eurytoma gahani*.	Cells containing only Larvae of *T. trilineata*.	Cells containing Larvae of *Megastigmus* sp. within Larvae of *T. trilineata*. Larvae of *E. gahani* absent.
1	54	54	15	25	21	8
2	63	63	27	29	19	15
3	54	54	27	26	15	13
4	136	136	50	78	36	22
5	116	116	40	68	35	13
6	122	122	52	67	29	26
Total ..	545	545	211	293	155	97

Knowing the habits of these three species, it is evident that though there were originally 545 cells containing larvae of *T. trilineata*, only 155 or 28·44 per cent. of this species could have emerged as adults, while from the same galls, though 211 larvae of *Megastigmus* sp. were present, only 97 or 17·80 per cent. could have emerged as adults, while of the 293 larvae of *Eurytoma gahani* present and which occupied 53·76 per cent. of the cells, all would have emerged as adults, no larvae of this species ever having been found parasitized, though many hundreds have been examined. In the spring of 1937 examination of a further series of 545 gall cells from the same tree showed that 362 or 66·42 per cent. would have yielded adults of *Eurytoma gahani*, this remarkably successful species having increased in numbers at the expense of *Tepperella trilineata* and *Megastigmus* sp. as compared with 1936.

The preceding figures give an excellent idea of the relative abundance of the three species of Chalcids in the galls. It is of interest to note that until the larvae of *T. trilineata* and *Eurytoma gahani* reach the last stage, the development of *T. trilineata* when associated with *E. gahani* was just as rapid as that of larvae which were in cells alone, indicating that during this period the presence of the larva of *Eurytoma gahani* has no visible adverse effect upon the larva of *T. trilineata*. This is further borne out by the fact that development of galls in which the two larvae are associated in the cells is just as rapid and normal as in galls in which the cells were occupied by the larvae of *T. trilineata* alone.

The association of these two species of larvae in the one gall chamber is a remarkable and unusual one.

Kinsey (1920), who has made an exhaustive study of cynipid wasps, which are the main gall-formers of the United States, in discussing inquilines in the galls, pointed out that no struggle existed between these and the primary gall-formers, that the larvae of the two species lived in closely identical environments, but that they did not come in contact with one another or interfere with one another in any way. Judged on this basis, *Eurytoma gahani* could not at any stage be classed as an inquiline. In some respects during its early larval stages its behaviour resembles that of an inquiline, but it is always a competitor and becomes a predator in its last larval stage.

Triggerson (1914) recorded an unusual phenomenon in the case of a Cynipid gall wasp, *Dryophanta erinacei*, in America. A second species of Cynipid, *Synergus erinacei*, destroyed the larva of *D. erinacei*, and then tunnelled through the galls to the various cavities and fed upon the occupants.

The occurrence of the parasitic and phytophagous habit in a single chalcid species has been observed by a number of workers, but the behaviour of *Eurytoma gahani*, in a number of respects, is unusual. It is the intention of the writer to discuss phytophagy and parasitism in the Chalcidoidea in a later paper.

Pupation and the Pupal Period.

As with the other species studied in this gall complex, no waste matter is voided during larval life, but some days prior to pupation the larva voids from the anus a quantity of black and fairly solid waste matter. In the gall cells this waste matter usually becomes broken to fine black particles which adhere to the larva and later the pupa, but sometimes it remains as one long twisted black strand adhering to the tip of the pupa. The quantity of waste matter voided by the mature larva is considerable and much more than in any chalcid larvae previously studied by the writer.

On first passing to the pupal stage, the pupa is a uniform white in colour, but within twenty-four hours the head, thorax and wing buds become amber and the pupae remain thus for approximately two weeks, when they gradually commence to turn black, and some days before emergence the pupae are a uniform black. The average length of the pupa of *Eurytoma gahani* is 2·46 mm., the maximum being 2·66 mm., and the minimum 2·19 mm.

From August until November, 1936, large numbers of mature larvae were dissected from galls and placed on either blotting paper or cotton wool in petri dishes, and fifty-eight of these pupated in a normal manner and eventually emerged as adults. The pupal period under these conditions is set out in Table 7. It will be seen that the pupal period ranged from 25 to 36 days, the average for male wasps being 32·84 days and for female wasps 33·13 days. The first pupa was found in a gall on 4th October, 1936, and the first adult of *Eurytoma gahani* emerged on 30th October, 1936.

TABLE 7.—*Pupal period of* Eurytoma gahani *in the Laboratory, 1936.*

Pupal Period in Days.	Number of Males.	Number of Females.
25	—	1
26	1	—
27	—	—
28	1	1
29	1	2
30	1	1
31	1	1
32	4	1
33	7	6
34	5	8
35	3	7
36	3	3
Total ..	27	31

Average pupal period of male wasps, 32·84 days ; female wasps, 33·13 days.
Maximum ,, ,, ,, ,, ,, 36 ,, ,, ,, 36 ,,
Minimum ,, ,, ,, ,, ,, 26 ,, ,, ,, 25 ,,

Emergence of Adults.

Adult wasps emerge by eating a cylindrical channel out to the exterior of the gall. In figure 11 is shown graphically the daily emergence of 2,779 adults of *Eurytoma gahani* from galls on *Acacia decurrens* in 1936.

It will be seen that emergence commenced on 30th October, 1936, and continued until 5th January, 1937. Though the emergence period extended over 68 days, it will be seen that by far the greatest numbers emerged during the second half of November and the first half of December. This emergence period was approximately twice as long as that of *T. trilineata* from the same tree.

In figure 11 is also shown graphically the emergence of 1,058 adults of *T. trilineata* and 1,559 adults of *Megastigmus* sp., an internal larval parasite of *Tepperella trilineata*. While figure 11 indicates the emergence periods of the three species, it does not represent their relative abundance, as it was not always possible to obtain emergence records of the three species from the same galls, the total period being so extensive that galls used in the early part of the emergence period became so hard and dry that they were unsuitable for later emergence

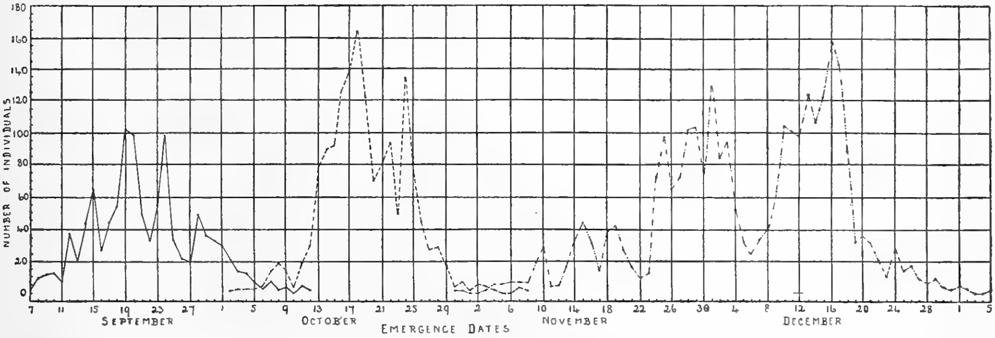


Fig. 11.—Graph showing daily emergence of *Tepperella trilineata*, *Megastigmus* sp. and *Eurytoma gahani* in 1936-37, from galls on *Acacia decurrens*.

(1058) *T. trilineata* ————

(1559) *Megastigmus* sp. - - - - - - - - - - - -

(2779) *E. gahani* —··—··—··—

records. It will be seen that the first adult of *Eurytoma gahani* did not emerge until eighteen days after the last adult of *T. trilineata* emerged and only six days before the last adult of *Megastigmus* sp. emerged.

In figure 12 is shown graphically the emergence of 1,605 adults of *Eurytoma gahani*, representing the total emergence of this species from one batch of galls

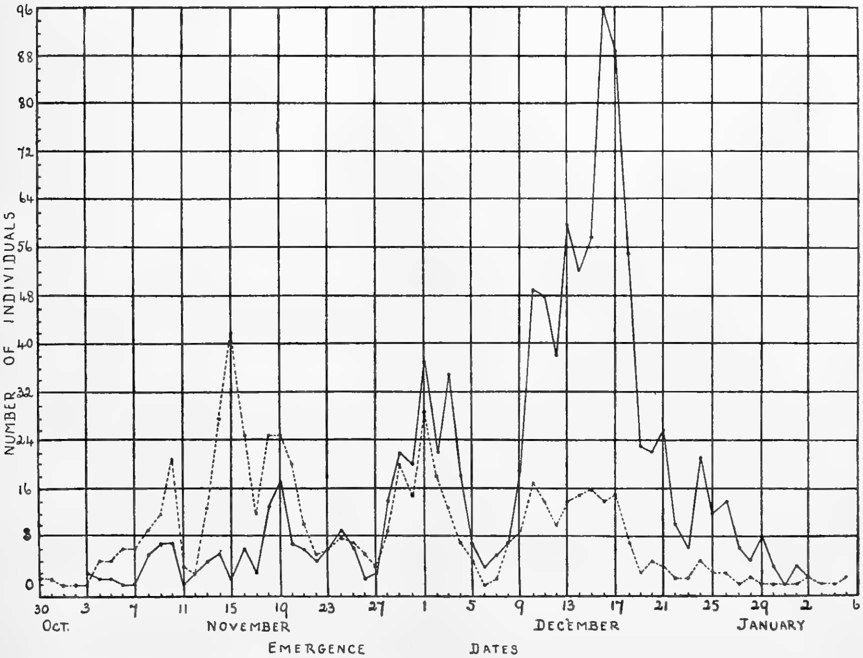


Fig. 12.—Graph showing daily emergence of 1028 females and 577 males of *Eurytoma gahani* from galls on *Acacia decurrens* in 1936-37.

(1028) females ————

(577) males - - - - - - - - - - - -

in 1936, the emergence of the two sexes being shown separately. It will be seen that while the two sexes emerged over approximately the same period, in the early part of the emergence period males predominated, while later the females were greatly in excess of the males.

During the later part of the emergence period, the galls shrivel, become black and extremely hard, and fall from the tree, but it was found that adults of *Eurytoma gahani* emerged from these fallen woody galls in a normal manner.

Summary.

The morphology and biology of *Eurytoma gahani*, a new species, which occurs in the galls on the flower buds of *Acacia decurrens* caused by *Tepperella trilineata*, is described.

Like that of the primary gall-former, *T. trilineata*, the life cycle of *Eurytoma gahani* is annual.

The adults of *E. gahani* emerge from the galls mainly during November and December, some time after all the adults of *T. trilineata* have emerged.

Of 1,605 adults of *Eurytoma gahani* which emerged in 1936, 1,028 or 64·05 per cent. were females and 577 or 35·95 per cent. were males. The average length of life of male wasps was 6·82 days, and of female wasps 8·17 days, but the maximum length of life of male wasps was 22 days and of female wasps 27 days.

The egg of *Eurytoma gahani* is deposited alongside the egg, or more commonly the first-stage larva, of *T. trilineata* within the minute acacia flower-buds or aborted flower-heads.

The larva of *E. gahani*, on hatching, lives with the larva of *Tepperella trilineata* in the one cell, the development of the latter usually being at least one stage more advanced than the larva of *Eurytoma gahani*.

Five larval stages occur, and these are described in detail.

The two species of larvae live phytophagously on the plant tissues, and the larva of *T. trilineata* reaches the fifth or last larval stage, but when the larva of *Eurytoma gahani* is also present, the larva of *T. trilineata* never pupates.

By the time the larva of *E. gahani* reaches the fifth stage, the larva of *T. trilineata* is unhealthy in appearance and is eventually devoured by the larva of *E. gahani*.

Possible factors concerned in the change from a phytophagous to a predatory habit in the fifth larval stage of *E. gahani* are discussed.

Having devoured the larva of *T. trilineata*, the larva of *Eurytoma gahani* is fully-fed and may remain in the gall cells for several months before pupating. The pupal period is approximately four weeks.

Of 545 gall cells examined in 1936, 293 or 53·76 per cent. were occupied by the larvae of *Eurytoma gahani* and *T. trilineata* together, and within 114 of the larvae of the latter species there were also larvae of *Megastigmus* sp., an internal parasite, and all of these latter larvae would have been devoured when the larvae of *T. trilineata* were eaten by those of *Eurytoma gahani*.

In the spring of 1937, examination of a further 545 gall cells from the same tree showed that 362 or 66·42 per cent. were occupied by *Eurytoma gahani*.

Though several thousand cells were examined, no larvae of *E. gahani* were ever found to be parasitized.

The presence of the larva of *E. gahani* does not affect the development of the galls.

Acknowledgement.

The writer wishes to acknowledge his indebtedness to Dr. A. B. Gahan, Senior Entomologist of the United States Department of Agriculture, for his critical opinion on the species under discussion.

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THE UPPER PALAEOZOIC ROCKS BETWEEN MOUNT GEORGE AND WINGHAM, N. S. WALES.

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(One Map; three Text-figures.)

[Read 31st May, 1939.]

The area examined lies on both sides of the Manning River between Mount George and Wingham and adjoins the Taree District which was described in a previous paper (Voisey, 1938).

Geological field-work was commenced in May 1937, following the receipt at the University of Sydney of some excellent specimens of *Linoproductus springsurensis* forwarded by Mr. R. T. Cox of "Colraine", Kimbriki. The occurrence of fossils at Kimbriki has not been recorded previously, although their presence has been known to local residents for many years.

The only references which have been found relating to the geology of this locality are those by Benson (1916) and Woolnough (1911). The former recorded Devonian rocks, serpentine and Permo-Carboniferous fossils from the vicinity of Mount George, and the latter noted the presence of fossils in a railway cutting at Killawarra. On Professor Sir T. W. E. David's map of the Commonwealth of Australia (1932) the area covered by the accompanying map was marked as Lower Carboniferous, with the exception of the north-western corner, which was shown as Devonian.

Except where noted otherwise, the fossils mentioned in this paper have been identified by Mr. H. O. Fletcher, Palaeontologist at the Australian Museum, Sydney. They have been included in the Museum's palaeontological collection. No microscopical examinations of the rocks have been made so far, but it is hoped that this work will be carried out in the near future.

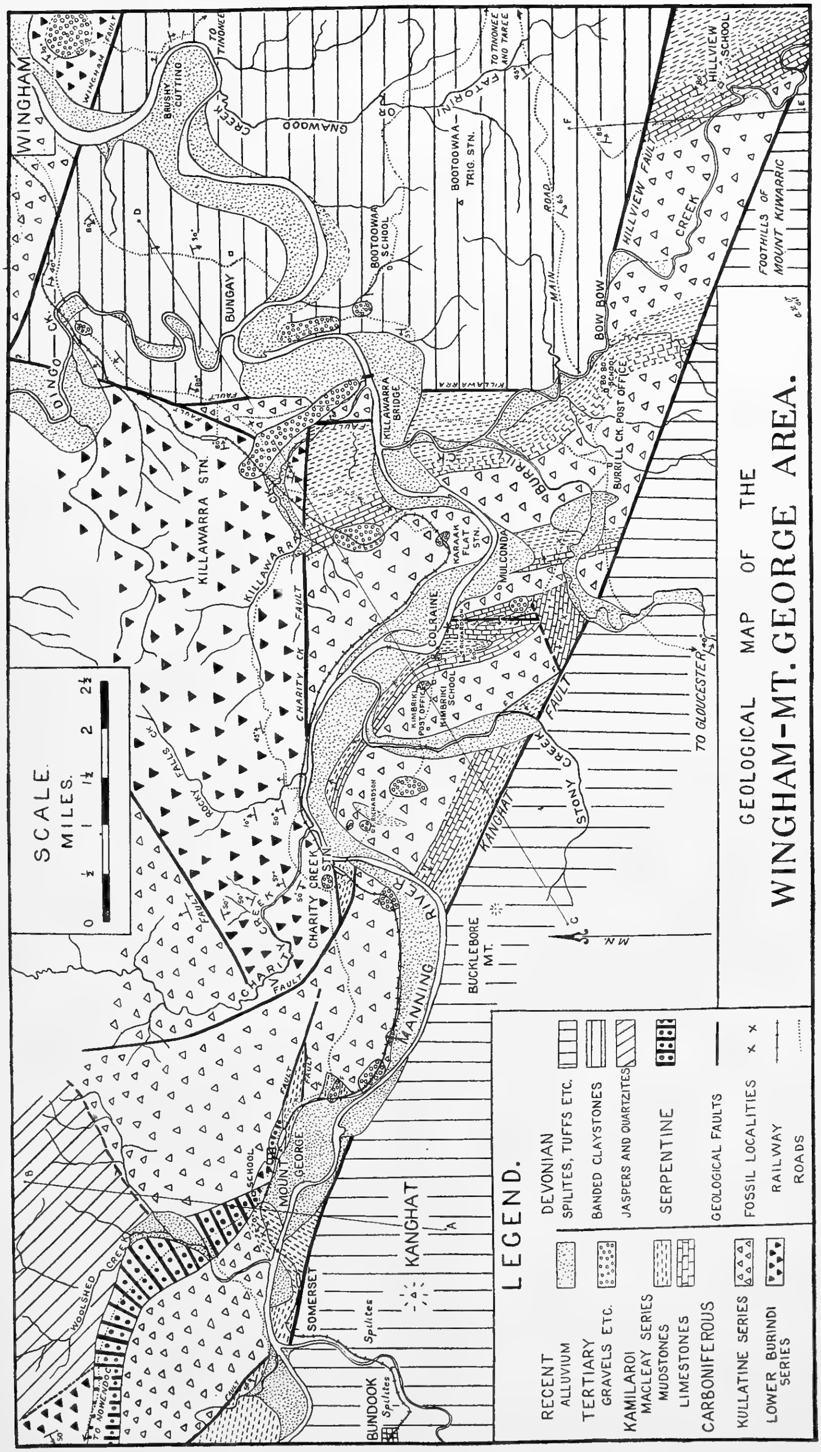
Map 1 indicates the distribution of the principal rock types and the positions of the major faults. Parish maps were used in connection with geological mapping, and the place names have been taken from these maps. Certain differences in spelling are worthy of comment. Burrell Creek Post Office is situated near Burrill Creek and the school near Bow Bow Creek is called "Bo Bo School".

Stratigraphy.

Devonian.

Three areas of Devonian rocks are shown on the map and each of these consists of a different association of rock-types.

* This paper was completed while the author was Linnean Macleay Fellow of the Society in Geology.


GEOLOGICAL MAP OF THE
WINGHAM-MT. GEORGE AREA.
SCALE.
MILES.
0 ½ 1 1½ 2 2½
LEGEND.
RECENT ALLUVIUM
TERTIARY GRAVELS ETC.
KAMILAROI MACLEAY SERIES MUDSTONES LIMESTONES
CARBONIFEROUS
KULLATINE SERIES
LOWER BURINDI SERIES
DEVONIAN
SPILITES, TUFFS ETC.
BANDED CLAYSTONES
JASPERS AND QUARTZITES
SERPENTINE
GEOLOGICAL FAULTS
FOSSIL LOCALITIES
RAILWAY
ROADS
WINGHAM
BRUSHY CUTTING
BUNGAY
BOOTOOWAA SCHOOL
BOOTOOWAA TRIG. STN.
KILLAWARRA STN.
KILLAWARRA BRIDGE
CHARITY CREEK STN.
COLRAINE
MULCONDA
KIMBRIKI POST OFFICE
KIMBRIKI SCHOOL
BURRILL CK. POST OFFICE
HILLVIEW SCHOOL
HILLVIEW FAULT
FOOTHILLS OF MOUNT KIWARRIC
TO GLOUCESTER
KANGHAT FAULT
MANNING RIVER
BUCKLEBORE MT.
MOUNT GEORGE
SOMERSET
KANGHAT
BUNDOOK
Spilites
WOOLSHED CREEK
TO NOWENDOC
STONY CREEK
ROCKY FALLS CK.
CHARITY CK FAULT
DINGO CK.
GNAWOOD CREEK
TO TINONEE
TO TINONEE AND TAREE
MAIN ROAD
BOW BOW
M.N.

Map 1.

1. *Jaspers and Quartzites.*

Jaspers and quartzites outcrop around the head-waters of Woolshed Creek and continue to the north and north-east beyond the limits of the map to Wherrol Flat, where they are cut off by a belt of serpentine presumably injected along a major fault-plane. They give rise to very rugged topography, the high land culminating in Johnston's Peak near Wherrol Flat.

The siliceous rocks range in colour from the reds and reddish-browns of the jaspers to the pale greens and yellows of the quartzites. The last-named, however, are more often white and translucent. The beds are riddled with quartz veins and are very hard. They are extensively jointed and cracked.

Stratification is indicated by colour differences and slight variations in the physical characteristics of the units. Most traces of original sedimentary characteristics have been obscured by the silicification.

It is proposed tentatively to correlate the jaspers and quartzites with the Woolomin Series of Benson (1913) on account of their similarity to some of the beds of that series in the Tamworth District. The micaceous phyllites, purple schistose tuffs, and altered spilites which are associated with the siliceous rocks in that region, however, have not been found so far in the area now being described.

The correlation suggested is open to question and the writer has recently assigned similar beds in the Armidale District to the Carboniferous system, but here again no definite evidence was available (Voisey, 1938*b*).

2. *Banded Claystones, Cherts and Tuffs.*

Portion of a large block of Devonian rocks is shown to the east of Bow Bow Creek and Killawarra. This block is bounded by heavy faults on its northern, southern and western sides, so that the beds are brought into contact with those of the Carboniferous and Kamilaroi Systems.

Outcrops are poor as the rocks have been reduced by erosion to comparatively low hills covered by a fair soil. Much of the country has been cleared and is now well grassed.

The beds are exposed by cuttings along the main Gloucester–Taree road between Bow Bow Creek and Tinonee and also along the roads from Killawarra Bridge to Bootoowaa, and from Wingham to Tinonee. Isolated outcrops are seen in gullies and quarries. There are insufficient data to permit the elucidation of the structures in detail, since the variations in the direction of strike, together with the complicated faulting and folding observed in the limited exposures, point to the presence of numerous fractured folds of small amplitude and on different axes.

The rock types are similar to those described by Benson (1913*a*) from the Tamworth Series. Banded claystones and cherts comprise most of the sequence. The bands vary from a fraction of an inch to several inches in width. In the fresh rock they are alternately light bluish-grey and dark bluish-grey, but, on weathering, they become white, yellow or light grey. The dark grey bands are usually the wider ones. The rock is quite hard and splintery. It exhibits a conchoidal fracture in places. Excessive jointing has broken the beds into small blocks, and it is difficult to obtain unweathered material. Radiolaria have been recorded from these rocks immediately to the south (Benson, 1916; Sussmilch, 1921, p. 239).

A characteristic variant of the claystone described above weathers to a dark or light green colour and is useful in the identification of the series.

Interbedded with the claystones and cherts are thick beds of tuff which appear in places to be intrusive into them. The tuffs are generally dark grey or dark green in colour. They vary in texture, composition and appearance, but are generally hard, massive, and weather to a brown colour. Some of them could be confused with the Carboniferous tuffs, but their association with banded claystones and cherts is sufficient to distinguish them.

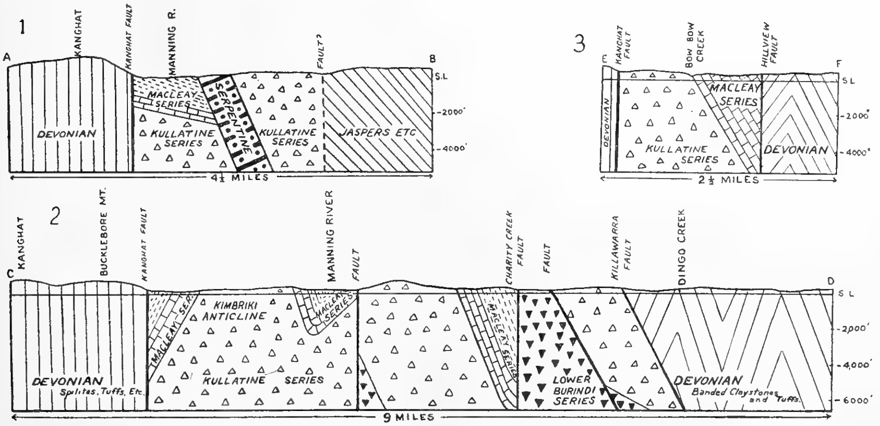


Fig. 1.—Section along line A-B (Map 1). V/H = 1/1.
Fig. 2.—Section along line C-D (Map 1). V/H = 1/1.
Fig. 3.—Section along line E-F (Map 1). V/H = 1/1.

3. *Spilites, Tuffs and Cherts.*

A thick series of tuffs, cherts and spilites forms the Kanghat Range and its foothills. These beds are bounded on the north by the Kanghat Fault which runs from the west of Mount George to Hillview and beyond. Southward the series has not been thoroughly investigated, but its continuity is interrupted by faults before Kramback is reached.

In marked contrast with the claystones and tuffs described above, these beds give rise to rugged topography as evidenced by Mount Kiwarric and the Kanghat Range, which attain heights of 2,000 feet. Steep slopes covered with talus and dense vegetation seriously interfered with geological work in this area. Moreover, elucidation of the sequence was rendered impracticable by the presence of strong faults. Spilites, so wonderfully developed at the western end of Kanghat Range, do not appear to intersect Burrill Creek which separates the Kanghat Range from Mount Kiwarric. Strikes are extraordinarily variable.

Pillow lavas were described from between Gloucester and Mount George by Benson (1916). He stated that very dense, hard, fresh-looking subvariolitic spilites with well-preserved pyroxenes but albitic felspars were exposed in railway cuttings east of Bundook. These greenish rocks contain quartz and epidote which fill numerous cracks and vesicles.

The north-western extremity of Kanghat Range is an impressive feature composed largely of spilites.

The northern slope of Bucklebore Mountain, which is a smaller range branching east from the northern front of Kanghat, is a fault scarp which is strewn with talus consisting of a great variety of tuffs. The most spectacular of these is a green volcanic agglomerate containing irregular fragments up to several inches across. This rock is associated with breccias and finer grained tuffs, some grey and others green and blue in colour. These outcrop in the bed of Stony Creek near Bucklebore Mountain and also on the adjacent slopes. The brecciated character of some of the varieties is seen best on the weathered surfaces, the rock becoming brown and greenish-brown on decomposition.

In the foothills of Mount Kiwarric in the south-east corner of the area fine-grained dark blue cherts are interbedded with tuffs, breccias and spilites.

CARBONIFEROUS.

With the exception of the Upper Burindi Series, which has not been identified, the same series are developed in this area as in the adjacent Taree District (Voisey, 1938*a*). The Lower Burindi Series consists essentially of olive-green mudstones and tuffs and the Kullatine Series principally of tillite and tuff. These two series bear faulted relationships to one another and to the Devonian beds.

1. *Lower Burindi Series.*

The Lower Burindi beds outcrop between Charity Creek and Dingo Creek and are excellently exposed by road cuttings between Mount George and Killawarra. Rocky Falls Creek has revealed a thickness of more than 1,000 feet of sediment. The northerly dip changes from 60 degrees to 10 degrees going up the creek, and in places the strata are practically horizontal. Variable strikes along the course of Charity Creek and its tributaries indicate faulting and perhaps folding in that locality. Owing to scanty outcrops away from the creeks and the absence of any marker beds, details of the structures could not be obtained.

Tuffs and tuffaceous sandstones interbedded with mudstones make up the sequence. The tuffs range from dark grey to light bluish-grey in colour and vary considerably in texture. Fine-grained conglomerate bands containing pebbles up to the size of a pea occur in places, but the most common rock is a gritty water-sorted tuff containing fragments of felspar reaching a millimetre or more in diameter. Fine-grained tuffs, dark bluish-grey but weathering to brown, occur, generally in bands a few feet in thickness separated by thin beds of mudstone.

The mudstones range in thickness from a few inches to ten feet. They are olive-green or black in colour and are rarely laminated. They contain numerous unidentifiable plant remains. These do not necessarily indicate a fresh-water origin since they are associated with marine fossil beds elsewhere in the Manning District. They have been recorded from the Burindi Series in the Hunter Valley (Osborne, 1922, p. 164).

The mudstones decompose readily on exposure to weathering agencies and are generally found as buff or light brown crumbling material from which fresh specimens are difficult to obtain.

Dr. Woolnough (1911) recorded tuffs containing a lamellibranch, identified tentatively by W. S. Dun as a *Pachydomus* of Permo-Carboniferous age from a railway cutting west of Killawarra Station. There is little doubt, however, that the beds belong to the Lower Burindi suite. Of the 200 feet of mudstones and tuffs exposed by the cutting the most important unit is a greenish-grey tuff fifty feet in thickness. An attribute peculiar to this rock and perhaps to several other massive tuffs in the sequence is the weathering out of spheres of the rock a little smaller than cricket balls. These cannot be satisfactorily explained in a similar manner to ordinary spheroidal weathering since the spheres are surrounded by the unfractured rock separated only by a small thickness of brown decomposed material. No suitable explanation of the phenomenon can be offered. Woolnough regarded the bed as the equivalent of his "Pachydomus" horizon, but no fossils were found during the recent survey.

As the continuity of the sequence both upward and downward has been interrupted by faulting, it is not possible to estimate the maximum thickness of the series. There is evidence, however, of at least 2,000 feet.

2. *Kullatine Series.*

The Kullatine beds consist almost entirely of tillite. Tuff and mudstone bands probably make up less than a quarter of the whole thickness of several thousand feet.

The tillite is a massive hard bluish-grey mudstone containing scattered fragments of a variety of rock types including granites, porphyries, felsites, andesites, tuffs, sandstones, cherts and quartzites. The included pebbles up to half an inch in diameter are nearly all angular, but those above that size are more or less rounded. While most of the rock fragments are less than two inches in diameter, occasional larger ones reaching a foot across have been found. A most abundant and ubiquitous pebble is a purple andesitic rock which is similar in appearance to types found in the tillites and fluvio-glacial conglomerates in the Upper beds of the Kullatine Series of the Macleay District.

The tillite outcrops as hard rounded boulders on the hillsides or, when more extensively weathered, in cuttings when it has changed to a buff or yellow colour and resembles a decomposed mudstone. The weathered rock is easily recognized, however, by virtue of the small fragments of felspar and other minerals and rocks which give it a speckled appearance. It is rarely that the tillite is free from the smaller angular pebbles. The larger ones are more sporadic in their distribution, but when present they constitute a more conclusive test.

Occasional bands of dark grey tuff of slightly variable texture break the continuity of the tillite in places, as on F. Richardson's property about half a mile south-east of Charity Creek Railway Station. Two hundred feet of them are developed at the top of the sequence below the Kamilaroi strata.

Fine-grained rocks resembling mudstones may be variants, but no definite banding was observed.

The tillite and its associates occupy a large proportion of the area mapped. Excellent exposures are found in the railway cuttings between Mount George and Karaak Flat. Since the beds are dipping at a fairly high angle in most places where measurement is possible, the immense development of tillite is apparent.

An interesting occurrence is that on the first hill on the Mount George road past its junction with the Wingham–Gloucester road at Killawarra. A band of sediment 3 inches to 6 inches thick embedded in tillite was found to contain crinoid stems. This band is exposed in a gutter on the south side of the road about half-way up the hill. Exposures being continuous for some distance, there does not appear to be any escape from the conclusion that the tillites here, at any rate, were laid down under marine conditions. No other fossils were found in the series.

The tillite is indistinguishable lithologically from that occurring at the top of the Kullatine Series in the Macleay District (Voisey, 1934). It also resembles closely the tillites of Currabubula and Limeburner's Creek. It is probable, therefore, that the glacial beds were contemporaneous with part of the glacial stage of the Kuttung Series.

KAMILAROI*: MACLEAY SERIES.

The Kamilaroi sediments overlie the Kullatine Series without any apparent unconformity. Indeed, there appears to be a transition from the tuffs overlying

* See David, 1932.—Terminology used here in order to avoid confusion, but regarded by the writer as synonymous with "Permian".

the tillite into banded mudstones which have been taken as the basal unit of the younger series. Since the tuffs bear a marked resemblance to those lower in the Carboniferous sequence they must be retained in it.

Continuous exposures of the junction between the Carboniferous and Kamilaroi strata are found in the following places: (1), a creek just behind Kimbriki Public School; (2), along the south bank of the Manning River immediately west of "Colraine"; (3), along the south bank of the Manning River south of Charity Creek Railway Station.

In each of the above localities a good section of the sequence of the Macleay Series was obtained. The variations in the thickness and nature of the sediments are expressed by these sections, which are representative of the series in the district.

1. Creek behind Kimbriki School.

	Thickness in feet.
D. Mudstones	100
C. Limestones, banded mudstones and tuffs	60
B. Tuff containing sponge spicules	110
A. Banded mudstones	220
Total thickness	490

Beneath the Kamilaroi beds 200 feet of tuff were measured and then an indeterminate thickness of tillite was found.

2. Along the Manning River in the neighbourhood of "Colraine".

	Thickness in feet.
F. Micaceous mudstone	200
E. *Linoproductus* horizon	8
D. Mudstones, sandstones and tuffs	200
C. Limestone with marine fossils } B. Tuff containing sponge spicules }	120
A. Banded mudstones	500
Total thickness	1,028

3. Along the south bank of the Manning River south of Charity Creek Railway Station.

	Thickness in feet.
F. Micaceous mudstones	720
D and E. Tuffs and sandy mudstones with marine fossils	900
C and B. Marine fossiliferous limestones, argillaceous in part interbedded with banded mudstones and sandstones	560
A. Dark-grey mudstones	240
Total thickness	2,420

The various units grade into one another as, for example, in the last-mentioned section, where the banded mudstones, tuffs with sponge spicules, and limestones are interbedded. It is convenient to discuss the beds in the order in which they occur near "Colraine". This may be regarded as the type-section.

A. The Banded Mudstones.

These are banded, dark and light-grey rocks weathering to grey, brownish-grey, light brown and white. They possess a well-marked rhythm throughout and lamination is particularly noticeable. A major rhythm of from two to six inches occurs. Some of the bands are crumbly, dark grey mudstones and others are lighter in colour.

Lamination is more noticeable in the light sandy layers—that in the grey mudstones is more obscure. A parting is present parallel to the lamination. In many cases the banding is spectacular and the rock resembles the banded mudstones of the Tamworth Series, there being a definite contrast between the light and dark bands. The widths of these bands vary from less than a millimetre to several centimetres.

B. Sponge Spicule Tuff.

This rock is closely associated with both the mudstones and the limestones and forms a link between the two. Behind Kimbriki School beds of the tuff share in the rhythm of the banded mudstones and grade into them. In the same section bands of it alternate with limestone. The rock is composed of what appear to be felspar fragments embedded in argillaceous material and is in all probability a water-sorted tuff. It contains abundant sponge spicules. These serve a useful purpose, as the rock is very easily recognized by their presence.

On the road from "Colraine" to the cultivation the tuff beds are several feet in thickness and pass upward into grey impure limestones which consist almost entirely of the remains of crinoids, bryozoans and brachiopods in a matrix of tuffaceous material in places and elsewhere of mudstone.

C. Limestones.

Nearly six hundred feet of calcareous sediments, about half of which might be called limestone, are represented in the section south of Charity Creek. They pass into the banded mudstones along the strike and these assume more importance to the east. At "Colraine" and near Kimbriki School the limestone is subordinate to the argillaceous sediments. Mudstones, tuffs and sandstones are interbedded with the limestones.

Among the thicker calcareous beds in the Charity Creek section is an interesting bed of the banded mudstone about two feet in width and showing the rhythms quite as clearly as the better-developed horizons around Kimbriki. This establishes beyond any doubt the intimate relationship between the mudstones and limestones and is in opposition to the otherwise plausible suggestion that the former might be varves belonging to the Carboniferous glacial suite.

The limestones are generally dark grey in colour but weather to a yellow spongy rock consisting of insoluble material with which the calcite composing the fossils was mixed. Some of the limestone is coarsely crystalline resembling to some extent the Cedar Party Limestone (Voisey, 1938*a*) with which it may be correlated with confidence. Most of it, however, is finer in texture, more argillaceous and darker in colour.

D. Mudstones, Sandstones and Tuffs.

The limestones gradually pass upward into mudstones, tuffs and sandstones. These are all dark grey in colour; the coarser beds are quite hard but the fine-grained mudstones are easily weathered. Fossils are rare except in the Charity Creek section, where several bands of marine forms have been found.

The beds grade into the overlying micaceous mudstones but are separated from the main portion of them at "Colraine" and possibly in other places by a very rich band of marine fossils called the *Linoproductus* horizon.

E. Linoproductus Horizon.

The horizon is beautifully developed in the neighbourhood of "Colraine" homestead and has been exposed by the Manning River which has cut into its southern bank, revealing the folded bed. The fossils may be collected from the horizon on either limb of an asymmetrical syncline of small amplitude.

The rock containing the shells is micaceous mudstone, the fossils being internal and external moulds coloured by limonite. The actual shelly material is also present, but well-preserved specimens of the forms are difficult to obtain.

Linoproductus springsurensis is particularly abundant, but the suite of fossils collected is as follows:

Fenestella fossula Lonsdale
Fenestella spp.
Protoretepora ampla Lonsdale
Stenopora (small dendroid form)
Zaphrentis cf. *gregoriana* De Koninck
Trachypora wilkinsoni Eth.
Monilopora nicholsoni Eth.
Crinoid stems (large form)
Martiniopsis subradiata cf. var. *branxtonensis* Eth.
Terrakea brachythaera (Sowerby)
Spirifer tasmaniensis Morris
Spirifer stokesi Konig.
Strophalosia gerardi King
Strophalosia jukesi Eth.
Terrakea fragile Dana sp.
Linoproductus springsurensis Booker.
Linoproductus cf. *cancriniformis* Tschern.
Aviculopecten squamuliferus (Morris)
Aviculopecten multicostatus Fletcher
Aviculopecten sprenti Johnston
Aviculopecten parkesi Fletcher
Conocardium sp. (large form)
Merismopteria macroptera (Morris)
Stutchburia costata Morris
Stutchburia obliqua Eth.
Pleurophorus sp.
Myonia sp. (? small new sp.)
Nuculana sp.
Nuculana, sp. nov.
Nuculana waterhousei Eth.
Pleurotomaria morrisiana McCoy.

(Specimens F 37896–F 38012, Aust. Museum Collection.)

F. Micaceous Mudstone.

This rock is light to dark grey in colour, soft and easily weathered. It contains a large proportion of mica, which is very useful for identification purposes, especially since the mudstone makes very poor outcrops but yields a light grey micaceous soil. Joints are excessively numerous, resulting in spheroidal weathering, which is particularly well developed in cliff sections beside the river at "Colraine". Calcareous nodules or concretions are common.

The mudstone is almost massive in its occurrence, only rare narrow sandstone bands breaking its continuity. The maximum thickness measured was 720 feet south of Charity Creek Station, and here the section was interrupted by a fault. It is probable that the total thickness is far greater than this.

Distribution, etc.

Owing to the intense folding and faulting which has taken place, the Kamilaroi rocks have been infolded and infaulted into Carboniferous tillite. They outcrop largely as isolated blocks between Bundook and Hillview, except in the Kimbriki area, where they form the limbs of an anticline.

West of Woolshed Creek the micaceous mudstones are in contact with tillite, the lower beds of the sequence having been removed by faulting. Similar beds containing marine fossils were recorded by Benson (1916) from Somerset, where they are faulted against Devonian spilites.

Another small area of mudstone occurs between Woolshed Creek and Mount George. Marine fossils were found by Benson (1916) and Sussmilch in a railway cutting which passes through these beds. They are principally in a band of breccia several feet in width.

Numerous specimens of *Taeniothaerus subquadratus* were found in the mudstones about half-way along the cutting which is the first one east of the railway bridge across the Manning River. Benson (1916) listed the following forms: *Deltopecten illawarrensis*, *Spirifer* sp., *Martiniopsis subradiata*, *Polypora*?, to which the writer adds: *Spirifer* cf. *tasmaniensis* Morris, *Spirifer duodecimcostata* McCoy, *Taeniothaerus subquadratus* Morris (plentiful), *Linoproductus springsurensis* Booker, *Aviculopecten sprenti* Johnston, *Aviculopecten mitchelli* Eth. and Dun, *Eurydesma cordatum* Morris (fairly common), *Platyschisma* sp. indet. (Specimens F37671–77, Australian Museum Collection.)

Two more outcrops of the micaceous mudstone, one of which was noted by Benson (1916), occur between Mount George and Charity Creek. The first is an infaulted block containing *Linoproductus* and bryozoa, at the bend of the road about ¼ mile on the Wingham side of Mount George station. A road-material quarry on the north of the road exposes the beds. The second is revealed by railway cuttings a short distance to the south of the first-named outcrop.

The mudstones are seen in cuttings at Charity Creek Station and are bounded by faults which bring them into contact with Carboniferous rocks.

More complete sequences are found on the north and south sides of the tillite which forms the core of the Kimbriki anticline, and are terminated by faults on all sides. Between Kimbriki and Burrill Creek the tightly infolded Kamilaroi beds alternate with tillite. Marine fossils occur in a number of places.

Although outcrops are very poor indeed, they indicate that a belt of rocks of the Macleay Series runs along the courses of Bow Bow and Burrill Creeks east of Burrell Creek Post Office, and continues northwards across the Manning River to the railway line between Karaak Flat and Killawarra. The mudstones and limestones with the usual marine fossils are seen in cuttings along the Karaak Flat road. Kamilaroi limestones and their associates outcrop on the hill just before Hillview School is reached.

The rock types belonging to the Kamilaroi suite are so distinct from any others in the district that they are readily recognized whenever they are exposed. The fact that they are easily weathered somewhat restricts outcrops, but at the same time this property provides a useful clue in the location of the series as a whole. The underlying Carboniferous beds are so hard that differential erosion along the junction serves to separate the two series.

Since the beds are lithologically and palaeontologically related to those around Yessabah on the Macleay River, they are included in the Macleay Series (Voisey, 1934).

PLEISTOCENE TO RECENT.

The high-level river-gravels and recent alluvial deposits are shown on the map, but will be discussed in connection with the physiography in a subsequent publication.

IGNEOUS ROCKS.

Serpentine.

A belt of serpentine running north-west and south-east outcrops alongside the Nowendoc road between its junction with the Bundook road and the village of Mount George. It narrows near Mount George and disappears just east of the railway station. The fault which it partly occupies continues eastward, separating Carboniferous tillite on the north from Kamilaroi micaceous mudstone on the south.

Further to the west, beyond the limits of the map, the serpentine lies between Lower Burindi tuffs and mudstones and the Kullatine tillite. Both series of rocks are slightly metamorphosed by the intrusion.

A possible contact between Kamilaroi beds and serpentine near Mount George school is obscured by alluvium. This occurrence of serpentine intruding Carboniferous tillite is the first direct evidence produced that it was injected at a period later than the Drummond Movement at the close of Upper Burindi times. It is of little consequence, then, that a well-exposed contact with Kamilaroi beds has not been found, since no orogeny is known in eastern Australia at the close of Upper Kuttung time. The Lochinvar Movement (Carey and Browne, 1938) was not characterized by extensive faulting.

A stronger argument for a late Kamilaroi age is the fact that the serpentine fault transgresses the trends of the rocks and earlier faults which must be referred to the Hunter-Bowen orogeny. Evidence that the serpentine is pre-Jurassic was produced by Benson (1913, p. 493). It will be shown in a subsequent publication that it is overlain by Triassic beds near Broken Bago, in the vicinity of Wauchope, N.S.W.

Carey and Browne (1938) referred the Peel Thrust and serpentine to the Drummond Movement and suggested that there was a renewal of movement along the thrust during the Hunter-Bowen Movement. On the other hand, they recognized the alternative of assigning both thrust and serpentine to the Hunter-Bowen Movement, and such a course was favoured by Carey (p. 605).

Following the evidence available in the field at Mount George it seems now that there cannot be any reasonable doubt that the serpentine at Mount George, and possibly in other areas, belongs to the Hunter-Bowen Movement of late Kamilaroi times.

The physical characteristics of the serpentine are similar to those of the basic rocks described in detail by Benson (1913*a*, pp. 669–693).

Structural Geology.

The geological structures are indicated on Map 1 and in the sections (Text-figs. 1, 2). The principal points worthy of notice may be considered as follows:

1. *Folds and Faults in Devonian Rocks.*

The structures in Devonian rocks were not studied in detail. Little can be written of the beds south of the Kanghat Fault except that they dip generally north or south at high angles. Silicification has obscured most of the structures in jasper and quartzite areas.

The banded claystones and tuffs have been tightly folded and most folds have been extensively fractured. Owing to their incompetence the claystones have suffered much more deformation than the more resistant spilites, agglomerates and tuffs. As the soft Kamilaroi beds are affected to a comparable degree there is no definite evidence to demonstrate that there was any folding of the Devonian beds prior to the deposition of the Carboniferous rocks which, on account of their resistance, are folded and faulted to a lesser extent.

2. *The Kimbriki Anticline and Associated Folds.*

This is the best developed folded structure in the area. It strikes in a west-north-west–east-south-east direction and appears to pitch to the east-south-east. The limbs dip at approximately 45 degrees and consist of Kamilaroi limestones and mudstones, while the core is of Carboniferous tillites and tuffs. Near the nose of the anticline in the vicinity of "Colraine" several folds of small amplitude occur. These strike generally north and south and pitch gently to the north. A syncline and an anticline are exposed by cliff sections on the south bank of the Manning River. These are asymmetrical and the axial plane is tilted to the west. Overturning accompanied by extensive faulting has taken place about a mile to the south. Faults have broken the folds and tillite reappears near "Mulconda".

3. *The Kanghat Fault.*

The Kanghat Fault runs right across the area shown on the map from west-north-west to east-south-east for a distance of about sixteen miles, and has been traced much further to the west and to the east. It is particularly important and has very well marked physiographical expression in the Kanghat Range and Mount Kiwarric. These features, consisting mainly of hard Devonian rocks, rise to approximately 2,000 feet in height and present steep escarpments towards the north.

The fault brings Devonian spilites, agglomerates, tuffs and cherts into contact with Kamilaroi rocks at Somerset (Benson, 1916), Kimbriki and Mount George and elsewhere with Carboniferous tillite. Therefore, it must have a throw which exceeds a mile in amount, but no more exact measurement of this could be made.

4. *The Hillview Fault.*

This fault forms the northern boundary of the downthrown block which is responsible for the valley through which Bow Bow Creek flows. It runs at a slight angle to the Kanghat Fault and separates Devonian banded claystones and tuffs on the north from the Carboniferous and Kamilaroi beds on the south.

5. *The Killawarra Fault.*

The Killawarra Fault runs in a north-south direction parallel to Bow Bow Creek and passes just west of Killawarra Bridge. Owing to poor outcrops, its position as indicated on the map is approximate only, but its presence is amply demonstrated because it separates Devonian claystones and tuffs on the east from Kamilaroi rocks on the west. It is probable that a number of smaller faults are present in the neighbourhood of Killawarra Bridge.

6. *The Charity Creek Fault.*

This fault separates Lower Burindi from Kullatine beds north of Donkin's Mountain near Karaak Flat, and Lower Burindi from Kamilaroi beds near Charity Creek station. It may continue westwards to Mount George, but as, in such a case, it would bring tillite into contact with tillite, it would be difficult to detect. Strike measurements can be made only rarely in tillite areas.

7. *Other Faults.*

Faulted relationships between Lower Burindi and Kullatine strata are indicated north of Charity Creek, and two major faults are shown. There is no doubt, judging from minor anomalies in strike and dip measurements, that faults are excessively numerous throughout the whole area, and even the number of faults shown on the map gives little indication of the shattering to which the rocks have been subjected.

Age Relations of the Folding and Faulting.

The oldest group of faults are those which are genetically related to the folding of the Devonian, Carboniferous and Kamilaroi beds. Especially in the

Devonian claystones are the faults in anticlines and synclines obvious results of the extreme compression to which the beds were subjected. Numerous other faults involving the incorporation of blocks of Kamilaroi strata in Carboniferous areas almost certainly belong to the folding period.

The fault which is occupied by serpentine at Mount George cuts across the folded rocks and faults associated with such folding and is therefore of later occurrence. Its relation to the Kanghat Fault is not demonstrated in the area.

The group of very large faults, Kanghat, Hillview, Killawarra and Wingham, also cut across earlier trends and are distinctly of later occurrence than the first period of folding and faulting. They may be referred, tentatively, to the Hunter-Bowen Movement, but there is not any evidence available to prove that they were not of much later occurrence.

Acknowledgement.

I desire to thank Mr. R. T. Cox, of "Colraine", Kimbriki, for his hospitality extending over a period of several months. It was he who was instrumental in drawing attention to the important fossil beds at Kimbriki, and his careful observations and local knowledge of the rocks have been very helpful.

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THE LORNE TRIASSIC BASIN AND ASSOCIATED ROCKS.

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(1 Map; two Text-figures.)

[Read 31st May, 1939.]

The first record of Triassic rocks in the neighbourhood of the Camden Haven River appears to be that contained in a report by J. E. Carne in 1897. Carne found well preserved plant-remains in clay-shales underlying a massive bed of conglomerate at Perpendicular Point, a short distance south of the entrance of the Camden Haven River. He located similar beds at Grant's Head and Diamond Head and erroneously correlated them with the deposits at Crowdy Head. The rocks at the last-named locality are Carboniferous. Carne viewed the Broken Bago Range from Wauchope and suggested that it was composed of Mesozoic rocks underlain by Permo-Carboniferous coal measures as in the Sydney District.

Carne also referred to the Triassic beds in his paper on the Western Coalfield (1908); Benson (1918) showed a large area of Triassic rocks south of Port Macquarie on his sketch-map, and Osborne (1929, p. 449) remarked on Triassic rocks in the Kempsey district. However, the suggested Mesozoic area south of Wauchope was not shown on other maps and only the coastal headlands and Oxley Island were marked as Triassic. The alleged occurrence at the last-named locality will be discussed later.

The writer, in the course of his investigations, independently came upon Carne's fossil locality at Perpendicular Point and collected a number of well preserved specimens which were exhibited at a meeting of the Linnean Society in September 1937. Since then the Triassic rocks have been examined in a number of localities and portions of the boundary have been mapped.

It has been decided to call the geological structure which the beds constitute, the Lorne Triassic Basin. The rocks themselves will be discussed under the name of Camden Haven Series after the river which drains the Basin.

The igneous rocks which intrude the Triassic strata, the Palaeozoic sediments and the serpentine with which they are associated will receive brief mention. However, the boundaries between these units have not been mapped in detail and most of those shown on the map (Map 1) are approximations only.

Stratigraphy.

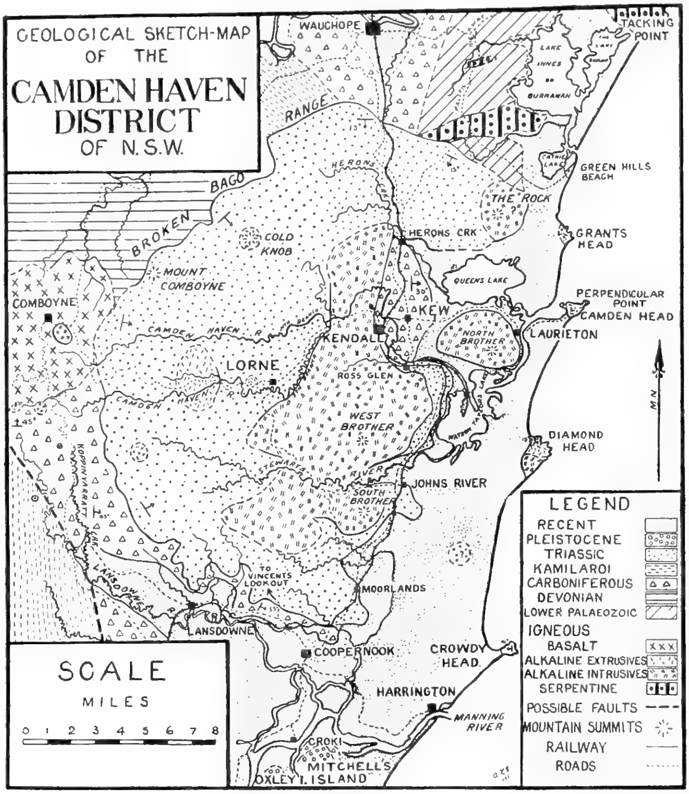
Triassic: Camden Haven Series.

Distribution.

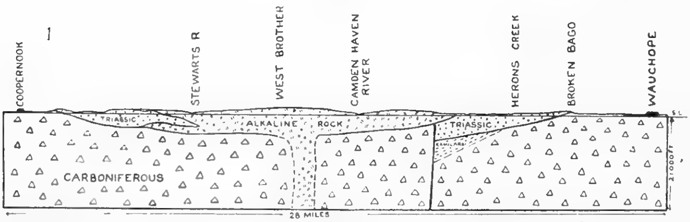
The Camden Haven Series, as mentioned above, forms the headlands of Perpendicular Point and Camden Head, Grant's Head, and portion of Diamond Head. These occurrences are separated from one another by low swampy coastal

* This paper was completed while the author was Linnean Macleay Fellow of the Society in Geology.

flats so that it is impossible to trace the beds from one headland to the other or towards the principal basin structure further inland.



Map 1.



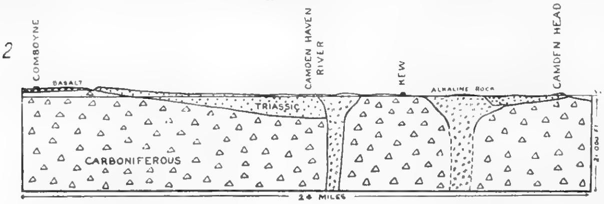


Fig. 1.—Sketch Section from Coopernook to Wauchope. V/H = 1/1.
Fig. 2.—Sketch Section from Comboyne to Camden Head. V/H = 1/1.

Conglomerates, sandstones and grits constituting the basal beds of the series may be traced from Broken Bago, just south of the town of Wauchope, westward towards the Comboyne Plateau. They then swing southward, running east of the Comboyne to curve easterly just north of Upper Lansdowne. Thence the beds swing to the north-east to the neighbourhood of Coopernook. Along the easterly rim of the basin large intrusions of alkaline rock have interrupted the continuity of the beds and have made alterations in the direction of dip. However, the Triassic beds are exposed by cuttings alongside the Pacific Highway between John's River and Ross Glen.

Within the basin outcrops are poor, on account of the ease with which the soft clay-shales and sandstones, which overlie the more resistant beds of the basal stage, are weathered. Road cuttings between Kendall and Lorne expose the beds, which, in places, are overlain by Tertiary lavas.

Lithology.

The basal beds of the Camden Haven Series may be seen to advantage almost anywhere around the rim of the Lorne Basin. To the north-west of Lansdowne they consist of massive conglomerates, the basal bed being upwards of fifty feet in thickness and forming a frowning escarpment. The rock is made up of boulders and pebbles of quartzites, jaspers, cherts, quartz, and other resistant rock-types. Some of the boulders attain a diameter of two feet, but for the most part, they are only a few inches across.

The conglomerate in this region, the southern rim of the Basin, is overlain by coarse sandstones and grits which are stained reddish-brown and purple by iron-oxides. These may be examined at various points along the road between Coopernook and Vincent's Lookout. The sandstones pass upwards into grey shales containing plant remains, and reddish and purple clay-shales which resemble those of the Narrabeen Series further south. A good section of these beds is to be seen in the cuttings along the Vincent's Lookout road shortly after the railway line is crossed near Coopernook Station. An estimated thickness of about three hundred feet of sediment occurs here, but outcrops of the clay-shales are so poor, and dips so slight, that no information regarding higher beds in the series could be obtained.

In the road cuttings along the Pacific Highway just south of Ross Glen the grey and purple clay-shales associated with bands of sandstone are well exposed. Plant remains are said to have been found in them. It is probable that these beds correspond with those on the Vincent's Lookout road, but this is uncertain.

Probably the best section which has been examined is that shown by the cuttings alongside the road to Wauchope which leaves the Pacific Highway near Heron's Creek.

Where this road descends to a creek near the railway tunnel through Broken Bago, four miles by road from Wauchope, a thickness of approximately two hundred feet of coarse grits and fine quartz-pebble conglomerates, interstratified with purple and grey shales and sandstones, was measured. The coarse beds are each several feet in thickness and constitute the bulk of the section. The heavy conglomerate underlies the grits, but varies somewhat in its development from place to place. The clay-shales and sandstones which overlie the more resistant basal beds again give rise to very poor outcrops.

The Pacific Highway crosses the Camden Haven Series between Heron's Creek and the turn-off to Green Hills beach. Outcrops are scarce all the way, but conglomerates and sandstones, probably belonging to the basal stage, are exposed by a road-material quarry about 13 miles south of Port Macquarie near the Green Hills Beach turn-off. Between this point and Broken Bago the Triassic beds cross and overlie the serpentine which is so well developed in this district.

The highest known beds of the series outcrop in the neighbourhood of Lorne and are exposed in road cuttings. These are clay-shales, generally grey in colour, containing plant remains, and associated with sandstone bands. The exact position of these beds in the sequence could not be determined on account of the low dip and lack of continuous outcrops.

The Camden Head or Perpendicular Point occurrence, which is important because it was the first outcrop of the Triassic rocks found, is somewhat anomalous when studied in relation to the rest of the beds in the sequence. As described by Carne, a massive conglomerate overlies purple and grey clay-shales containing plant remains. This is the reverse of the sequence of beds elsewhere in the area.

The section as exposed in the cliff face at Perpendicular Point is as follows:

	Thickness in feet.
Conglomerate	40
Purple clay-shale	10
Purple sandstone	2
Purple clay-shale	15
Grey clay-shales with plant-remains	5
Purple clay-shale	10+
	82+

The clay-shales are lithologically identical with those of the Narrabeen Series with which they may be correlated with confidence. This suggests a Hawkesbury age for the overlying conglomerate.

The conglomerate contains rounded pebbles of chalcedonic quartz, jasper, yellow quartzite, red quartzites and hard sandstones, some of which attain a diameter of six inches. The matrix consists of fine sand-grains and clay cemented with iron-oxide. Lenticular narrow bands of purple sandstone are included in the conglomerate bed and suggest an estuarine origin for the deposit. It would appear that the conglomerate is overlain by more clay-shales and sandstones outcropping to the north near the entrance of the Camden Haven River.

At Diamond Head, on the northern side of the headland, sandy shales contain plant remains and overlie grey shales. The beds dip in a direction 335 degrees at 15 degrees. They are harder here than elsewhere in the area since they are intruded by alkaline rocks and are overlain by felsite.

Coal has been found in the Triassic beds in a number of localities, but so far no deposits of economic importance have been located. Small quantities are seen in streaks in the Perpendicular Point section and traces are found in the railway cuttings between Heron's Creek and Wauchope. These are associated with sandstones and clayshales.

The writer has spent some time searching for the alleged Triassic beds on Oxley and Mitchell's Islands, but has not been able to find any. The hills on these two islands are covered with gravel which may have been derived from Triassic conglomerates, but, wherever quarries have been observed in these gravels, the beds appear to be loosely consolidated sands and clays with occasional concretions yielding harder material. They resemble the high level gravels so abundant in the river valleys along the coast.

At Oxley Island, near the cemetery, tilted tuffs and mudstones, probably Lower Carboniferous in age, outcrop. These could not be Triassic.

The writer has not seen any written record of Triassic rocks on Oxley Island, but on most geological maps of New South Wales and on Professor T. W. E. David's Map of the Commonwealth of Australia (1932) this island is so coloured.

It is tentatively suggested that earlier observers were misled by the occurrence of sandstone alongside the Manning River and used in punt approaches. This is almost certainly Hawkesbury Sandstone which was used as ballast and carried to its present location by coastal vessels many years ago.

Palaeontology.

The fossils collected by Carne from Perpendicular Point were identified by W. S. Dun (Carne, 1897) as: *Thinnfeldia odontopteroides* Morris, *Alethopteris Lindleyana* Royle, *Equisetum*, Cycad (probably *Ptilophyllum oligoneurum* Ten.-Woods), *Gleichenites?*, *Cardiocarpum*, *Phyllotheca* sp.

Specimens collected by the writer include Equisetaceous stems, *Thinnfeldia Feistmanteli* Johnston, *Cladophlebis* sp., and a seed. These were determined by Dr. A. B. Walkom, who suggests that the *Thinnfeldia odontopteroides* determined by Mr. Dun was probably the species now known as *T. Feistmanteli.*

Correlations.

The presence of plant fossils and the purple shales characteristic of the Narrabeen Series of the Sydney District are strong points in favour of a correlation between part, at least, of the Camden Haven Series and the Narrabeen Series.

That the best development of the purple shales has been observed in the isolated headland of Perpendicular Point is unfortunate, since there is some doubt about the correlation of these beds with those of the principal Triassic area of the Lorne Basin.

It is uncertain whether representatives of the Hawkesbury Series are present. The conglomerate at Perpendicular Point suggests a stratigraphical break and, as it overlies the purple shales, it may make the base of this Series. As the only conglomerates found in the Lorne Basin up to the present are those at the base, it is a matter of some difficulty to determine the horizon of the Perpendicular Point occurrence. In the case of a correlation being made with the basal conglomerate an overlapping of the purple shales is inferred. Such a suggestion implies that the Triassic beds of the main part of the Camden Haven Series correspond to the Hawkesbury Series and that the only beds of Narrabeen Series are those at Perpendicular Point. This idea is not favoured on account of the abundance of purple shale in the sequence. Hence a high horizon for the Perpendicular Point conglomerate is indicated. The absence of the conglomerate to the west may be accounted for by suggesting that it passes laterally into softer beds which have not been identified with it.

It is not believed that any big development of the Hawkesbury Series occurs in the area but rather that most of the beds are Narrabeen in age.

KAMILAROI:* MACLEAY SERIES.

Limestones and mudstones belonging to the Macleay Series and identical in lithology and fossil content with those described from the Macleay and Manning Rivers (Voisey, 1934, 1936, 1938) outcrop in the neighbourhood of Wauchope.

Limestone is being mined at the present time on M.L.2. parish of Koree. Carne and Jones (1919) recorded it and noted that the strata dipped in a direction S. 20° E. at 38°. The limestone is composed almost entirely of the remains of

* See David (1932). Terminology used here to avoid ambiguity, but regarded by the writer as synonymous with "Permian".

organisms, principally crinoids and lamellibranchs. It is a *Eurydesma cordatum* horizon and contains numerous well-preserved specimens of this genus and pectens. Mr. Fletcher has identified the following forms: *Deltopecten limaeformis* (Morris), *Eurydesma cordatum* Morris, *Eurydesma hobartense* Johnston (Specimens F38013–15, Australian Museum Collection).

The limestone is lighter in colour than that found in the Yessabah District (Voisey, 1934, 1936), and is generally light grey. It has been recrystallized, but this has not deformed the contained fossils. Outcrops of the limestone are very scarce, and the country surrounding the quarry on M.L.2 is not promising for further geological investigations.

Associated with the limestone, and almost certainly underlying it, are mudstones weathering brown and containing abundant fossils, including: *Fenestella fossula* Lonsdale, *Fenestella* spp. (abundant), *Protoretepora ampla* Lonsdale, *Stenopora* (small dendroid form), Crinoid stems, *Chonetes* sp., *Martiniopsis* sp. indet., *Linoproductus cora* var. *farleyensis* Eth. and Dun, *Aviculopecten sprenti* Johnston, *Aviculopecten englehardti* Eth. and Dun, *Aviculopecten* (small form) sp. indet. (Specimens F38016–24, Australian Museum Collection).

Fletcher writes: "*Linoproductus cora* var. *farleyensis* Eth. and Dun appears to be abundant and several specimens were nicely preserved. This species was described from the ferruginous sandstone of the Farley Stage. It has the general outward appearance of *Terrakea brachythaera* (Sowerby), but is considered more nearly allied to *Productus cora* because of the costation, the auricle-wrinkles which pass into indefinite body corrugations and the few spines along each lateral portion of the cardinal margin."

No definite Kamilaroi outcrops were found in the neighbourhood of Wauchope, except around the quarry mentioned above, and this is about three miles south-west of the town.

CARBONIFEROUS: KULLATINE SERIES.

(*a*) *Glacial Beds.*

Conglomerates and tuffs similar to those underlying the Macleay Series at Yessabah (Voisey, 1936) are met alongside the track leading from the Oxley Highway to the limestone quarry near Wauchope.

Tillite, similar to that of the Kullatine Series elsewhere, outcrops on the slopes of Broken Bago and is exposed in cuttings beside the Bago road from Wauchope to the Pacific Highway. This occurrence was noted first by Professor W. R. Browne in the company of the writer in 1937.

Numerous outcrops of tuff and conglomerate indicate the presence of Carboniferous rocks over quite a large area, but the geological mapping of this district has not been completed and further details cannot be given at present.

(*b*) *Plant Beds.*

Excellent exposures of plant-bearing Carboniferous rocks occur between Heron's Creek and Ross Glen. The prevailing strike is north and south, and the dip easterly. The highest bed examined was a conglomerate. This runs from Heron's Creek to Kew, keeping to the east of the Pacific Highway. Just below it are thinly bedded mudstones and cherts containing plant remains. In the road-cutting immediately opposite Kew School a chert bed about eight inches thick contains numbers of beautifully preserved fronds of *Rhacopteris*.

Tuffs, mudstones and sandstones are seen in road and railway cuttings around Kendall.

A coal seam is exposed alongside the road opposite the sawmill in the township.

Lower Burindi Series.

These rocks outcrop to the south of the Triassic basin in the neighbourhood of Lansdowne. They consist principally of mudstones and tuffs similar to those described in the Taree District (Voisey, 1938).

DEVONIAN.

In 1933 Dr. G. D. Osborne showed the writer spilites, tuffs and other rocks of Devonian age along the Wauchope road to the Comboyne where the ascent is made up to the plateau. In 1937, in the company of Professor W. R. Browne, an interesting exposure of conglomerates and agglomerate associated with mudstones and tuffs was examined in Bulli Creek. These closely resemble the Baldwin Agglomerates of Benson (1913). Patches of angular fragments of mudstone are set in a dark grey matrix probably tuffaceous. Elsewhere rounded pebbles are prevalent.

No detailed mapping was carried out in this region and relationships between Devonian and Carboniferous strata were not ascertained.

LOWER PALAEOZOIC.

An interesting suite of rocks outcrops between Port Macquarie and the turn-off from the Pacific Highway to Green Hills Beach. It is probable that beds of several ages occur. The metamorphism which the strata have undergone is indicative here of a Lower Palaeozoic sequence. Green tuffaceous rocks interbedded with dark grey or greenish-grey mudstones outcrop in road cuttings along the Pacific Highway between the points mentioned above. In places phyllite bands showing puckering and contortion are interbedded with the harder tuffs.

Along the Green Hills Beach track conglomerates and tuffs, differing somewhat from the types mentioned above, but dark grey in colour and resembling those of the Kullatine Series, were examined near their contact with serpentine which intrudes them. It is said locally that fossil shells have been found in this neighbourhood, but the observation has not been confirmed.

On the property of Mr. J. Kenny and in that neighbourhood alongside the Port Macquarie–Wauchope road, about five miles from the first-named town, a band of silicified conglomerate is interbedded with phyllites. The conglomerate consists principally of quartz pebbles. Silicification has produced a very hard compact rock. The phyllites are soft and make poor outcrops except where they have been cemented by iron oxides. Quartz reefs containing small quantities of gold are present. Hard, dark grey, slaty rocks are subordinate to the phyllites.

Dyke-like intrusions of basic rock are not uncommon in this area, but their age and origin have not been determined.

IGNEOUS ROCKS.

Basalt.

The Comboyne Plateau is capped by basalt which must be several hundred feet in thickness. Good sections of the flows are seen on the ascent from the northern side. The rock has been leached and has given rise to a white decomposition product which is termed "trap".

The igneous rock was poured out during the Tertiary Era and is referable probably to the Newer Basic Lava group (Browne, 1933).

Alkaline Intrusives.

The first record of intrusions of alkaline rock in the area under discussion appears to be that given by J. E. Carne (1897), who noted diorite, quartz-felsite and rhyolite at Diamond Head.

The volcanic plugs in the neighbourhood of Upper Lansdowne have received slight mention in literature. C. A. Sussmilch (1932), W. R. Browne (1933) and R. O. Chalmers (1934) made brief references to them. Browne stated (1933, p. 48) that it was possible to recognize among these rocks "comendites, arfvedsonite-anorthoclase trachyte, bostonite and a perlitic glass, probably trachytic with microlites of potash felspar". Chalmers (1934, p. 173) gives a panoramic view from the Comboyne showing the volcanic ridge, Camelback, and the small volcanic peaks Oliver and Kennedy, and "the large volcanic peaks Baldy, Coxcomb and Goonook".

The alkaline rocks are intrusive into Carboniferous and Kamilaroi rocks in the Lansdowne area, but looking northward from the Manning River Valley other peaks may be seen inside the rim of the Triassic Basin.

Associated with the Lansdowne plugs are several dyke-like intrusions where the magma has welled up through a fissure in the rocks. The plugs themselves are mainly small, simple structures which give rise to steep-sided hills, some of which jut abruptly from the valley floor to heights of several hundreds of feet.

There has been little reference made in literature to a group of intrusions much larger than those at Lansdowne and having much more physiographical expression. These constitute the Three Brothers which were mentioned by Oxley in his "Journal of Two Expeditions", etc., in 1817–1818. The North Brother is situated between Laurieton and Kew, the Middle or West Brother rises to the south-west of Kendall, and the South Brother is a short distance to the west of John's River. Each of the three far exceeds a thousand feet in height.

Another large body of igneous rock occurs just west of the South Brother and, judging from the size and shape of the hills in the neighbourhood of the Rock, these also are of similar composition.

Specimens of the alkaline rocks may be obtained by making short excursions off the Pacific Highway between Moorlands and Kew. A variety of rock-types from the South Brother and associated bodies may be collected along the road to Hannam Vale and the branch road from it to Lorne. A mile and a half from the Pacific Highway near Moorlands towards Hannam Vale is a small road-material quarry behind a house on a slight rise. Fresh specimens of a fine-grained blue trachytic rock and of a glassy phase of the intrusion are obtainable. The last-named is in contact with the Palaeozoic(?) sedimentary beds into which it was thrust and is evidently on the margin of a larger body. It is a black translucent rock through which are scattered idiomorphic crystals of felspar.

It is evident from the relationships of the intrusions to the country rock that they are somewhat irregular in shape and transgressive in part. The igneous rock has spread out along the surface of Palaeozoic beds and has intruded and lifted the Triassic strata. Some of the magma reached the surface, as evidenced by the lava flows in the Lorne District and the felsite and rhyolite at Diamond Head.

The hypabyssal portion of the intrusion would appear to form a more or less continuous sill-like body which was fed by magma rising up along fault planes. The high peaks of the Brothers are due to the thickening of the sheet at these points, probably near the sites of the principal feeders to the mass. Such indication of the presence of pipes suggests that the igneous mass is a complex laccolite or number of laccolites connected to one another by sills.

It may be of some significance that the laccolitic and sill-like intrusions are confined to the area occupied by Triassic sediments. The bodies outside the Lorne Basin are plugs or dykes in Palaeozoic sediments. It is possible that these were the feeders of sills which have been eroded. What is more likely, however, is that they were more or less simple cores of old volcanoes.

The lavas, which may be related to the alkaline intrusions, outcrop in a number of places west of Lorne. Beautifully-banded rhyolites occur at the saw-mill on the track from Lorne to the Comboyne.

Felsites at Diamond Head overlie Triassic strata in the northern part of the headland, while intrusive rock occurs to the south (Carne, 1897).

It may be deduced from the description of the field occurrence of the alkaline rocks given above that they are post-Triassic in age. Moreover, they appear to have welled up a fault-plane which separated Triassic and Carboniferous beds in the neighbourhood of Kendall. At any rate, they do not appear to have been dislocated by it. Hence, they are later than the folding and faulting which affected the Triassic beds.

No conclusive evidence was obtained regarding the relationship existing between the alkaline rocks and the basalts of the Comboyne Plateau. The former certainly occupy higher ground in places, but it is suggested that there was a great deal of erosion of the beds which the igneous rocks had invaded before the basalts were laid down. W. R. Browne (1933, p. 41) would place the Lansdowne intrusions, and, presumably, those of the Three Brothers, in his "Middle Series" of Tertiary igneous rocks, together with the allied intrusions of the Canoblas, Warrumbungle and Nandewar Mountains.

Serpentine.

Two belts of serpentine striking in a general east–west direction intersect the Lower Palaeozoic (?) rocks. They are crossed by the Pacific Highway between the Green Hills Beach turn-off and the Wauchope road.

The green rock is seen to best advantage at Port Macquarie.

The Kamilaroi age of the serpentine has been proved beyond reasonable doubt on account of its intrusive relationships to tillite of the Kullatine Series and probably to the Macleay Series (Voisey, 1939). It is overlain by the Camden Haven Series near Broken Bago and, hence, must have antedated the deposition of the Triassic rocks.

Structural Geology.

The accompanying sections (Text-figs. 1, 2) indicate the relationships existing between the rocks which occur in the region under consideration. The structures may be considered in three divisions: Palaeozoic, Mesozoic, and Cainozoic.

Palaeozoic.

The Palaeozoic beds have been folded along a meridional axis. The strikes of the beds vary in accordance with the folding and the extensive faulting which have taken place. Structures in these rocks will be dealt with in connection with the examination of the geology of the Hastings River district. It is hoped that this work will be carried out in the near future.

The deformation of the Palaeozoic strata took place prior to the deposition of the Mesozoic sediments and may be referred to the Hunter–Bowen Movement at the close of Kamilaroi times.

Mesozoic.

The Mesozoic rocks lie with a violent unconformity on the steeply-dipping Palaeozoic beds. They are in the form of a basin structure which has been broken on the eastern margin by intrusions of alkaline rocks taking the form of irregular sills and laccolites.

The dip of the strata at Broken Bago is south at angles ranging from 10 degrees to 15 degrees. This swings south-east, then east going towards the Comboyne Plateau. From the hills on the plateau itself cuestas of the basal beds swinging round the basin are seen to good advantage. At Lansdowne they are dipping northward; further east they turn north-west. In the neighbourhood of Ross Glen the Triassic strata are tilted by the intrusive rocks and thus the dips there do not conform to the basin structure. Around Lorne the clay-shales are practically horizontal, but in places show a tendency to dip to the east.

There has been a considerable amount of faulting since the formation of the Camden Haven Series. One important example is the Heron's Creek Fault which has brought Carboniferous rocks belonging to the Kullatine Series into contact with the Triassic beds. The fault has been taken advantage of by Heron's Creek, which follows it at the point where the stream is crossed by the Pacific Highway. In the railway cutting behind Heron's Creek School the Triassic sandstones and shales are seen in vertical positions and are also twisted and fractured. Since the Camden Haven Series should be at least 200 feet thick below the beds examined, the movement along the fault must exceed this amount and almost certainly does so with a considerable margin.

Alkaline intrusives intervene between similar Carboniferous and Triassic beds in the vicinity of Kendall, as shown on the accompanying map. It may well be that these were injected along a fissure similar to that at Heron's Creek.

The anomalous dip of the strata at Perpendicular Point (northerly at about 20 degrees) suggests further faulting, but the swampy coastal flats make investigation of them quite impossible. The beds at Grant's Head dip at 7 degrees to the south-west (Carne, 1897) and are consistent with the basin structure.

It seems that the main folding movements producing the basin preceded the introduction of the alkaline rocks, since these do not appear to have been affected. Moreover, the intrusions almost certainly followed fractures which were formed either during, or at some time after, the formation of the basin. This will be realized after an examination is made of the map and sections.

Whether the Heron's Creek and similar faults are genetically related to the basin folding is an interesting point. If they are not, and may be referred to Tertiary times, there is some further evidence in favour of the contention of C. A. Sussmilch (1932) that the alkaline rocks are related to late Tertiary tectonic lines. Sussmilch did not mention the intrusions of the Three Brothers in his paper, but refers to those in the neighbourhood of Lansdowne.

Cainozoic.

Apart from the question of the age of the Heron's Creek fault, there is ample evidence of elevation of portions of the area during Tertiary times. The basalt-covered Comboyne Plateau stands at well over 2,000 feet above sea-level. No definite fault scarps were proved, but it would appear that there has been warping and perhaps monoclinal folding (Sussmilch, 1932, p. 401). The elevated position of the basal conglomerates and sandstones of the Camden Haven Series to over a thousand feet in the vicinity of the Comboyne suggests that the whole basin has received an eastward tilt (W. R. Browne, verbal communication). Such tilting is indicated by the easterly dip of some lava flows which overlie the Triassic beds near Lorne. If this evidence is to be relied upon, the tilting must have taken place after the volcanic eruptions which produced the lavas.

By comparison with other areas it may be taken that the uplift of the Comboyne Plateau and the associated movements occurred towards the close of Tertiary times.

Conclusion.

The principal aim of the writer has been to draw attention to a basin of Triassic rocks and a fine suite of alkaline intrusives occurring in the Camden Haven district. Both were known only to a few geologists and there has been very little mention of them in literature.

It is hoped that the reconnaissance work carried out will be followed by a more detailed treatment of the rocks.

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A NEW SPECIES OF *MEGASTIGMUS* PARASITIC ON *TEPPERELLA TRILINEATA* CAM., A WASP CAUSING GALLING OF THE FLOWER BUDS OF *ACACIA DECURRENS*.

By N. S. Noble,* D.Sc.Agr., M.Sc., D.I.C.

(Ten Text-figures.)

[Read 28th June, 1939.]

An account of investigations into the complex of insects associated with the galling of flower buds on *Acacia decurrens* var. *pauciglandulosa* in the vicinity of Sydney has already been published by the writer (1938*b*), and the life history of *Tepperella trilineata* Cam., the primary gall-former, was set out in detail.

At that time it was pointed out that a new species of *Megastigmus* was a common internal parasite of the larva of *T. trilineata* and that the life cycles of the two species were annual. The life history of this species of *Megastigmus* has been studied, and will be set out in the present paper.

The writer in a previous paper (1938*a*) set out in detail the life history of *Epimegastigmus* (*Megastigmus*) *brevivalvus*, which is an internal parasite of the larva of *Eurytoma fellis*, a wasp causing galling of the stems of citrus, and in its morphology and biology this species of *Megastigmus* resembles very closely *Epimegastigmus brevivalvus*. The writer (1938*a*) has already discussed the habits of the members of the genus *Megastigmus* throughout the world, and it has been pointed out that the majority of these are phytophagous, living in the seeds of various plants.

Specimens of the species under discussion were submitted to Dr. A. B. Gahan, Senior Entomologist of the United States Department of Agriculture, who subsequently, in a letter to the writer dated 29th May, 1937, stated: "This species appears to be close to *Epimegastigmus brevivalvus* but is not that species, nor does it agree with any of the descriptions of other species so far as I can tell. It is probably undescribed."

The writer has studied all the available descriptions of species of the genus *Megastigmus* described from Australia, and has decided that the species is new.

Morphology.

Megastigmus acaciae, n. sp.

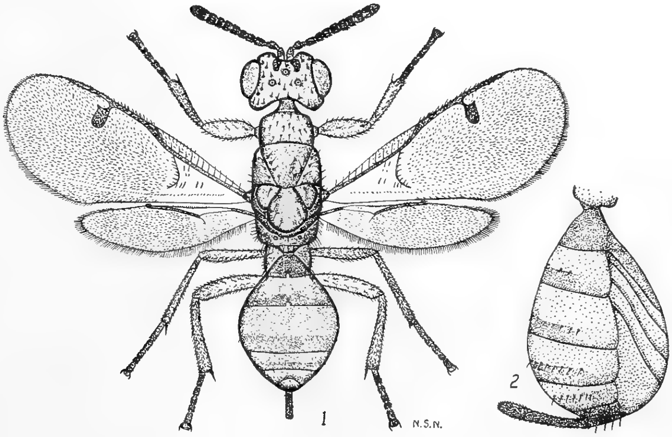
The Adult.

♀ (Fig. 1). Length: average 2·68 mm.; maximum 3·07 mm.; minimum 2·08 mm. Length of ovipositor: average 0·47 mm.; maximum 0·52 mm.; minimum 0·39 mm.

Head pale castaneous, with two small irregular oval black spots below and more or less in line with the lateral ocelli. Eyes dull red; antennae brown. Surface of head aciculate. Thorax pale castaneous; variable amount of base of

* This contribution is one of ten papers on Australian Chalcidoidea submitted to the University of Sydney in fulfilment of the requirements for the degree of Doctor of Science in Agriculture.

propodeum dark brown to black. Surface rugose; rugae finest on pronotum; rugae mainly transverse on the pronotum, scutum, and parapsides, more curved and longitudinal on the axillae, and irregular on the scutellum and reticulate on the propodeum. The legs are pale castaneous apart from the bases of the fore-coxae which are dark brown to black. Stigmal knob as in figure 3*c*. Abdomen pale castaneous, slightly paler than thorax, with slightly darker bands on the distal portion of each segment. Surface smooth. Ovipositor dark brown, curved conspicuously upwards, its tip being almost in line with the dorsal surface of the abdomen (fig. 2).



Figs 1-2.—*Megastigmus acaciae*.
1, Adult female (× 15).—2, Lateral view of abdomen of female (× 21).

Black setae are borne on the surface of the head and thorax as far back as the propodeum which carries a series of white hairs. On the third and succeeding segments of the abdomen there is a single band of black setae.

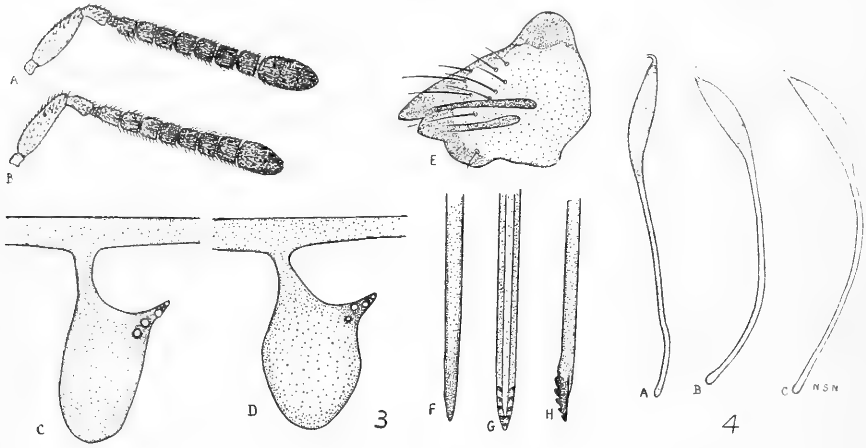
In many instances specimens examined two years after either mounting or preservation in alcohol had become somewhat paler, the oval black patches on the head and the black on base of the propodeum having disappeared.

The tip of the ovipositor stylet (fig. 3F) and sheath (figs. 3G, 3H), the mandible (fig. 3E), the stigmal knob (fig. 3C), and the antenna (fig. 3B) of the female are illustrated.

In colour and structure the female resembles the female of *Epimegastigmus brevivalvus* very closely. The latter species is in general a shade darker and the sculpture of the thorax is less distinct, but the two species can be readily separated on the difference in shape of their stigmal knobs and the absence of the oval black spots below the ocelli in *Epimegastigmus brevivalvus*.

♂. Length: average 2·54 mm., maximum 3·02 mm.; minimum 2·24 mm. It is slightly shorter and is less robust than the female. Sculpture much as in the female. Dorsal surface of head, thorax and abdomen mainly black, the ventral surface including the legs being pale castaneous as in the female. The black markings are very regular. On the head there is a more or less rectangular black patch which surrounds the ocelli. On the pronotum there is a somewhat triangular black patch which fades towards the distal margin. The scutum, apart from the lateral edges, is black. A median line on the scutellum and the greater part of the propodeum are black. The antenna (fig. 3A) and the stigmal knob of the male (fig. 3D) are illustrated.

The type, allotype, and numerous paratypes, were bred by the writer from galls caused by *Tepperella trilineata* on the flower buds of *Acacia decurrens* at Lindfield, Sydney, New South Wales in October, 1936.



Figs. 3-4.—*Megastigmus acaciae.*

3.—A, Antenna of male (× 36) ; B, Antenna of female (× 36) ; C, Stigmal knob of female (× 105) ; D, Stigmal knob of male (× 105) ; E, Mandible of female (× 105) ; F, Lateral view of ovipositor stylet (× 180) ; G, Ventral view of ovipositor sheath (× 180) ; H, Lateral view of ovipositor sheath (× 180).

4.—A, B, C, Ovarian eggs (× 105).

The type, allotype, and 5 paratypes of both sexes have been forwarded to the British Museum of Natural History, South Kensington, London, and 6 paratypes of both sexes have also been forwarded to the United States National Museum, Washington, U.S.A.

The Egg.

The ovarian egg, just prior to deposition, is barely visible to the unaided eye. It consists of a minute white oval body, bearing at its anterior end a short pointed pedicel and at its posterior end a very long slender pedicel (fig. 4, A–C), which widens out slightly posteriorly. The dimensions are set out in Table 1.

TABLE 1.—*Dimensions of Ovarian Egg of* Megastigmus acaciae (*in millimetres*).

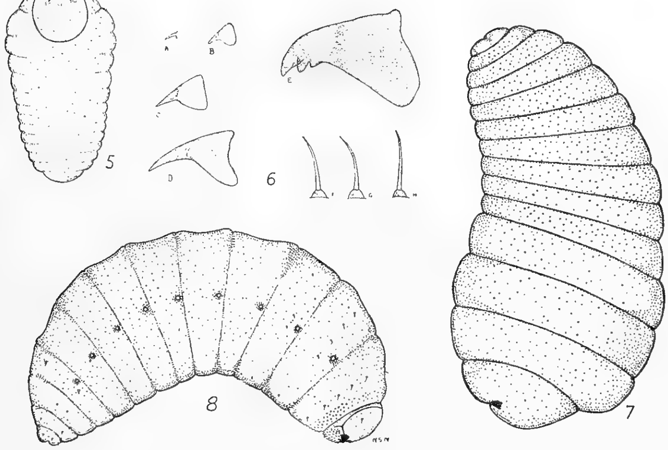
	Total Length.	Body of Egg.		Long Pedicel.		Length of Short Pedicel.
		Length.	Width.	Length.	Width.	
Average ..	0·438	0·133	0·024	0·297	0·006	0·013
Maximum ..	0·459	0·139	0·025	0·314	0·007	0·010
Minimum ..	0·409	0·125	0·022	0·287	0·005	0·017

In general features the egg resembles very closely the egg of *Epimegastigmus brevivalvus* (Noble, 1938*a*).

The Larva.

Based on mandible size and shape and the integumentary setae, five larval stages are recognizable. Five larval stages were also found in *Epimegastigmus brevivalvus*, and the various larval stages in the two species are remarkably similar.

Stage 1.—The first-stage larva (fig. 5) is so minute that it is invisible to the naked eye. Under the microscope it is seen to be translucent, and in side view is slightly arched, and consists of a head and thirteen segments. The head is more or less hemispherical in outline, and somewhat narrower than the first abdominal segment, which is the widest portion of the larva. Each succeeding segment becomes narrower. The smallest larva measured was 0·16 mm. in length and 0·08 mm. in width. The integument is free of ornamentation and there is no evidence of any respiratory system. The mouth is ventral and the mandibles (fig. 6A), which are pale golden, are very lightly chitinized, extremely fine pointed, and slightly curved, with the tips overlapping. Their average length is 0·009 mm., the maximum being 0·012 mm. and the minimum 0·007 mm.



Figs. 5-8.—*Megastigmus acaciae.*

5.—Ventral view of first-stage larva (× 180).

6.—A, Mandible of first-stage larva; B, Mandible of second-stage larva; C, Mandible of third-stage larva; D, Mandible of fourth-stage larva; E, Mandible of fifth-stage larva; F, G, H, setae of first segment of mature larva (all × 180).

7.—Lateral view of second-stage larva (× 180).

8.—Lateral view of mature larva (× 20).

Stage 2.—The second-stage larva (fig. 7) resembles the first very closely in general appearance. It is translucent except for a narrow central zone in the abdomen, the contents of which are bright green. It consists of a hemispherical head and thirteen clearly defined segments. The larva is slightly arched. The first and second segments are widest and the larva narrows gently to the last segment. The dimensions of the smallest and largest larvae measured are set out in Table 4. The head is slightly more than the width of the widest segment, and the latter is approximately half the total length of the larva. There is no evidence of integumentary setae or of any respiratory system. The mouth is ventral and the mandibles (fig. 6B), which are triangular in outline, are unidentate with the tips slightly curved and overlapping. At the base the mandibles are almost colourless, the tips being golden. Their average length is 0·018 mm., the maximum being 0·020 mm. and the minimum 0·015 mm.

Stage 3.—The third-stage larva is somewhat more arched than the two preceding stages and it tapers towards both ends. It is translucent to green in colour, the region of the alimentary tract being a darker green. Superficially it resembles the second stage. Dimensions of the largest and smallest larvae are given in Table 4. The mandibles (fig. 6C) are triangular in outline, with the tips curved and overlapping. The bases are pale amber, with the tips more heavily chitinized and overlapping. Their average length is 0·044 mm., the maximum being 0·050 mm. and the minimum 0·033 mm. In the third larval stage, as is the case with *Epimegastigmus brevivalvus*, the first signs of the developing respiratory system are to be seen. In the more advanced larvae of this stage there are developing longitudinal tracheal trunks united anteriorly, but disappearing posteriorly. A limited number of short tracheal branches can also be seen in process of development, but there is no evidence of any spiracular formation.

Stage 4.—The fourth stage is pale green in colour, cylindrical and arched, and tapering towards both ends. It resembles the third stage in all general respects and the dimensions of larvae of this stage are set out in Table 4. A depression in the last abdominal segment marks the position of the developing anus. The mandibles (fig. 6D) are still triangular in outline, unidentate and curved, with the tips overlapping. The basal half of the mandibles is pale, but the distal half is amber in colour. The average length of the mandibles is 0·066 mm., the maximum being 0·076 mm. and the minimum 0·059 mm. A number of rounded sensillae are to be seen above and below the mandibles. There is further marked development of the respiratory system during this stage. Well-developed tracheal trunks are present, united anteriorly and posteriorly, and profusely branching tracheae can be seen passing out to the various body organs. In more advanced larvae of this stage the developing spiracles and spiracular trunks are to be seen.

Stage 5.—The last-stage larva (fig. 8), which varies from white to dark grey in colour, is cylindrical and arched, and tapering towards the head and the anus. The contents of the alimentary tract are sometimes dark grey and may give the larva a grey appearance, but this is always masked by fat body which at times completely obscures the grey, and the larva then appears quite white. It consists of a head and thirteen segments, the head being conspicuously narrower than the first abdominal segment. The average length of the mature larva is 2·63 mm., the maximum being 2·81 mm. and the minimum 2·45 mm.; the average width is 0·91 mm., with a maximum of 1·04 mm. and a minimum of 0·83 mm. On the ventral surface of the head and surrounding the anterior border of the first segment there is a series of short papillae. A median circlet of short setae is present on the first segment (fig. 6F, G, H), a limited and decreasing number of smaller setae being present on the second and third segments. No setae are present on the fourth to eighth segments inclusive, while a limited and variable number of short setae are borne laterally on segments nine to twelve inclusive, there being a circlet of minute spines on the last segment. A well defined depression in the last segment marks the anus. The head is hemispherical in outline. The mouth is ventral. The mandibles, which are more heavily chitinized than in the preceding stage, are somewhat triangular in outline and are four-toothed (fig. 6E). They are brown in colour and average 0·10 mm. in length, the maximum being 0·11 mm. and the minimum 0·09 mm. Development of the respiratory system continues during the fifth stage, and at maturity the larva possesses nine pairs of open spiracles, one pair being present on each segment from two to ten inclusive. Profusely branching tracheae pass out from the two main longitudinal trunks to the various body organs. The dimensions of the smallest and longest larvae of the various stages measured are set out in Table 4.

Biology.

Length of Life of Adults.

Newly-emerged adults were placed in glass tubes six inches in length and one inch in diameter. One end of the tube was covered with cheese-cloth and the other was plugged with cotton-wool which was kept moistened with sugar solution. These were retained in the laboratory and dead wasps were removed daily; the length of life of 500 individuals is set out in Table 2.

Table 2.—*Length of Life of* Megastigmus acaciae *in the Laboratory.*

Length of Life in Days.	Number of Males.	Number of Females.	Length of Life in Days.	Number of Males.	Number of Females.
1	13	6	8	20	12
2	18	14	9	12	5
3	10	22	10	4	2
4	34	39	11	5	1
5	56	61	12	—	1
6	46	62	13	1	—
7	31	25			
			Total ..	250	250

Average length of life of male wasps, 5·46 days; female wasps, 5·17 days.
Maximum length of life of male wasps, 13 days; female wasps, 12 days.
Minimum length of life of male wasps, 1 day; female wasps, 1 day.

It will be seen that the length of life is comparatively short, the average for male wasps under these conditions being 5·46 days, and for female wasps 5·17 days.

Percentage of Sexes.

Of a total of 1,559 adults of *Megastigmus acaciae* which emerged in 1936, 1,013 or 64·98 per cent. were males and 546 or 35·02 per cent. were females. Thus males outnumbered females almost in a ratio of 2 to 1, which the writer found to be the case in *Epimegastigmus brevivalvus*, *E. trisulcus* and *Epibootania nonvitta*, Megastigmines which are parasites of the citrus gall wasp, *Eurytoma fellis*, and it seems that this is a characteristic of the parasitic Megastigmines, which is in direct contrast to the species of *Eurytoma* studied by the writer, females in this genus outnumbering the males in the ratio of 2 to 1.

Mating.

Mating was observed on a number of occasions in tubes in the laboratory, and the behaviour of the two sexes is typical of other Chalcids studied by the writer. The male mounts the back of the female, strikes the antennae in front of those of the female for a few moments and then moves back and fertilizes her. In the case of two couples under observation the contact lasted 17 and 21 seconds respectively. The male, as is usual, returned to the back of the female, but a further contact was not established.

Oviposition.

In ovipositing, the female uses the antennae tips to locate flower buds in which *Tepperella trilineata* has already oviposited. The abdomen is brought down at right angles to the thorax, the ovipositor is exposed, and worked down into the acacia bud and an egg is deposited. After each oviposition females under observation withdrew the ovipositor and flew away, usually alighting on numbers of buds before finding a suitable one in which to oviposit.

In 1936, emergence of adults of *M. acaciae* extended from 2nd October to 8th November. The first flower was observed on this tree on 12th November that year, i.e., 4 days after the last emergence of adults of this parasite. Thus during the greater part of the oviposition period of *M. acaciae*, flower buds only are present and it is not until some months later that any external evidence of gall development is visible.

Dissection of buds in which *Megastigmus acaciae* had been observed ovipositing invariably revealed the presence of either eggs or first-stage larvae of *Tepperella trilineata*, and on two occasions during November 1936 the eggs of *Megastigmus acaciae* were dissected from the first-stage larvae of *T. trilineata.*

In the case of *Epimegastigmus brevivalvus* (Noble, 1938*a*) the eggs are deposited within the eggs of *E. fellis*, but do not hatch until the host has passed to the first larval stage.

It is possible that *Megastimus acaciae* has the same method of oviposition and that the eggs found in first-stage larvae were deposited originally in the host eggs. In the case of *M. acaciae*, however, in 1936, the first adults did not emerge until twenty-five days after the first *Tepperella trilineata* adults emerged. During the greater part of the emergence period of *M. acaciae*, both eggs and first-stage larvae of its host are present, and towards the end of the emergence period of *M. acaciae* first-stage larvae of *T. trilineata* predominate, and it is possible that *M. acaciae* oviposits in both the egg and the first-stage larva of *T. trilineata.*

Superparasitism.

On 16th January, 1937, a second-stage larva of *T. trilineata* was dissected and found to contain two first-stage larvae of *M. acaciae.* On the same day two first-stage larvae of *M. acaciae* were dissected from a first-stage larva of *T. trilineata.* On 2nd September, 1936, a fifth-stage larva of *T. trilineata* was dissected and found to contain both a third- and a fourth-stage larva of *M. acaciae.*

In all cases the larvae appeared normal and active, but more than one larva was never observed to reach maturity within a single host larva.

Larval Development.

First-stage larvae of *M. acaciae* are to be found in first-stage larvae of *T. trilineata* and it has been pointed out, when discussing the morphology, that there are five larval stages. When the first-stage larva of *M. acaciae* hatches, the head is quite conspicuous but, as feeding takes place, the abdominal segments increase considerably in size so that the head becomes smaller in proportion. The five larval stages of *M. acaciae* are spent within the larva of *T. trilineata.*

M. acaciae spends the summer, autumn and winter in the larval stage within the larva of *T. trilineata* and the green of the contents of the midintestine of the parasite larva can frequently be seen showing through the integument of the host

TABLE 3.—*Results of the Dissection of Galls on* Acacia decurrens *during a period of Sixteen Months showing the Stages of* Tepperella trilineata *and* Megastigmus acaciae *Present.*

Date of Dissection.	*Tepperella trilineata* larvae parasitized.		Numbers and Stages of larvae of *Megastigmus acaciae* within larvae of *T. trilineata*.
	Number.	Stages.	
		1935-36 Galls.	
11/5/36	2	Fourth.	2 first.
16/5/36	2	Fifth.	2 third.
18/5/36	1	Fourth.	1 first.
27/5/36	17	Fourth.	15 first, 2 second.
5/6/36	6	Fifth.	1 first, 2 second, 1 third, 2 fourth.
12/6/36	9	Fifth.	8 first, 1 second.
11/7/36	4	Fifth.	1 first, 3 second.
16/7/36	1	Second.	1 first.
	1	Third.	1 first.
	1	Fifth.	1 first.
17/7/36	9	Fifth.	6 second, 1 third, 2 fourth.
28/7/36	13	Fifth.	2 second, 11 third.
9/8/36	14	Fifth.	2 second, 9 third, 3 fourth.
12/8/36	2	Fifth.	2 fourth.
14/8/36	13	Fifth.	9 third, 3 fourth, 1 fifth.
18/8/36	8	Fifth.	5 fourth, 3 fifth.
2/9/36	4	Fifth.	3 fourth, 1 fifth.
6/9/36	1	Fifth.	1 third.
		1936-37 Galls.	
9/1/37	3	First.	3 first.
16/1/37	4	First.	4 first.
	1	Second.	1 first.
1/2/37	1	First.	1 first.
15/2/37	3	Second.	3 first.
9/3/37	3	Second.	3 first.
	1	Fourth.	1 second.
	1	Fifth.	1 second.
2/4/37	2	Third.	2 first.
20/4/37	6	Third.	6 first.
	1	Fourth.	1 first.
7/5/37	5	Third.	5 first.
	5	Fourth.	5 first.
1/6/37	1	Third.	1 first.
	5	Fourth.	1 first, 4 second.
29/6/37	1	Fifth.	1 second.
15/7/37	2	Fifth.	2 second.
6/8/37	3	Fifth.	2 third, 1 fourth.
13/8/37	3	Fifth.	1 second, 1 third, 1 fifth.
30/8/37	3	Fifth.	3 fifth.
13/9/37	2	Fifth.	1 fourth, 1 fifth.

In 1936 some larvae of *Megastigmus acaciae* had already eaten their way out of their hosts on 22nd August and in 1937 a number of mature larvae of *M. acaciae* were also present on 30th August.

On subsequent dissection dates shown in Table 3, mature larvae, prepupae and pupae of *M. acaciae* were present in the galls.

1936.—Date of first emergence of adults of *M. acaciae*, 2nd Oct.

1937.—Date of first emergence of adults of *M. acaciae*, 3rd Oct.

larva. During the greater part of the time it lies in the haemocoele and apparently feeds upon the blood of the host larva and, remaining comparatively small, does not appear to have any marked adverse effect upon the host larva. Thus, though parasitized, the larva of *T. trilineata* is able to reach the last larval stage, but is never able to pupate, for at this time the larva of *Megastigmus acaciae* begins a period of rapid development, undergoes a series of moults, reaches the last larval stage, and devours the greater part of the internal contents of the larva of *T. trilineata*.

The larva of *M. acaciae*, on reaching maturity, tears an opening in the integument of the host larva and gradually works its way out. The host larval integument appears for a short time as a small crumpled mass near the tip of the abdomen of the parasite larva. Prior to pupation the larva of *M. acaciae* reduces the host-remains to minute particles and, as a result of this final feeding, increases in size slightly, and the particles are often to be seen adhering to the integument of the parasite larva. The latter then voids a quantity of dark waste matter, and becomes white in colour. Within a few days it pupates in the gall cell formerly occupied by its host.

In Table 3 are set out the results of the dissections of galls on *Acacia decurrens*, during a sixteen-months period, showing the stages of both *Tepperella trilineata* and *M. acaciae* present. It will be seen that the larvae of the latter species were usually several stages less advanced than the host larvae from which they were dissected. At the time most of the larvae of *M. acaciae* reach maturity, the larvae of *Tepperella trilineata* have pupated and some have already commenced to emerge as adults. The dimensions of the smallest and largest larvae of the various stages of *M. acaciae* measured are set out in Table 4.

TABLE 4.—*Dimensions (in millimetres) of various Larval Stages of* Megastigmus acaciae.

Stage of Larva.		Length.	Width.
Stage 1	Largest	0·40	0·18
	Smallest	0·16	0·08
Stage 2	Largest	0·58	0·29
	Smallest	0·30	0·13
Stage 3	Largest	0·88	0·35
	Smallest	0·51	0·22
Stage 4	Largest	1·10	0·43
	Smallest	0·96	0·35
Stage 5	Largest	2·81	1·04
	Smallest	1·36	0·56

The Pupa.

The pupa is at first white; later the eyes turn red, and the body gradually becomes pigmented and all the colours of the adult are showing some days before emergence.

The average length of female pupae is 2·33 mm., the maximum being 2·50 mm. and the minimum 2·08 mm. The average length of male pupae is 2·11 mm., the maximum being 2·23 mm. and the minimum being 1·93 mm. The first pupa was dissected from galls on 6th September, 1936, and the first adult of *M. acaciae* emerged on 2nd October, 1936.

Emergence of Adults.

In Figure 9 is shown graphically the emergence of 1,559 adults of *Megastigmus acaciae* from galls on *Acacia decurrens* in the spring of 1936. Emergence commenced on 2nd October and continued until 8th November, a period of 38 days, which is only two days longer than the emergence period of its host *Tepperella trilineata*. The main emergence occurred during the last half of October. During the early part of the emergence period males predominated, but later the females outnumbered the males.

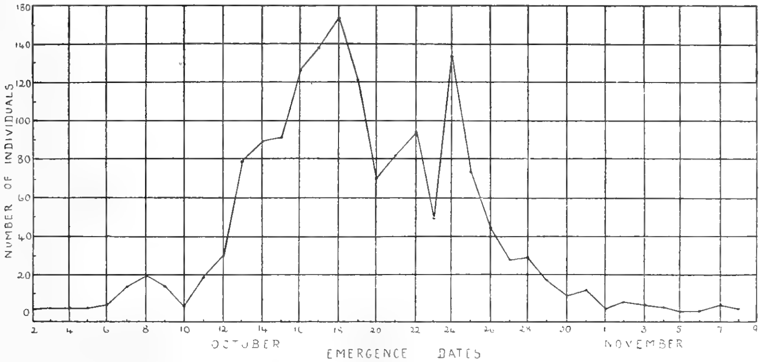


Fig. 9.—Graph showing emergence of 1,559 adults of *Megastigmus acaciae* from flower-bud galls on *Acacia decurrens* in the spring of 1936.

In Figure 10 is shown graphically the daily emergence in 1936 of 1,058 adults of *T. trilineata* and of 703 adults of *M. acaciae*, this representing the total emergence of the two species from this series of galls. In this instance the first adult of *M. acaciae* emerged eleven days before the last adult of *T. trilineata*. The total emergence period of *T. trilineata* from these galls was thirty-six days, while the total emergence period of *M. acaciae* from this same batch of galls was thirty-four days.

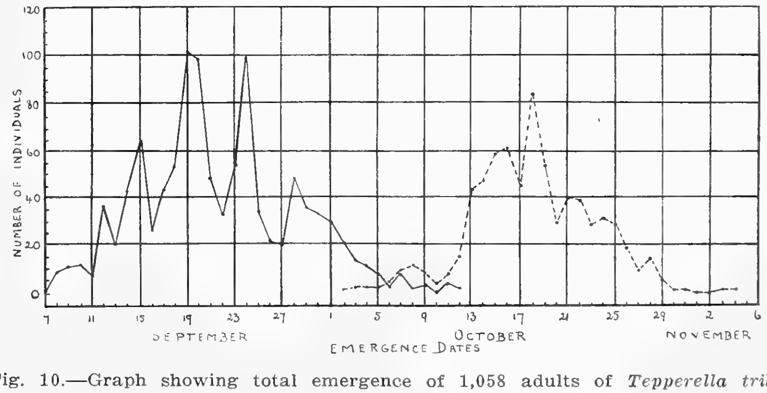


Fig. 10.—Graph showing total emergence of 1,058 adults of *Tepperella trilineata* and 703 adults of *Megastigmus acaciae* from one series of galls on *Acacia decurrens* in the spring of 1936.

Tepperella trilineata ————————

Megastigmus acaciae - - - - - - - - - - -

Galls were collected on 17th October, 1935, from the same tree, and adults of *M. acaciae* were then emerging in numbers. On 28th October, 1921, galls were collected from *Acacia decurrens* at Wyong, and at this time adults of *M. acaciae* were emerging freely.

In Table 5 are set out the results of the periodical dissection of galls in the spring of 1936, showing only the various stages of *M. acaciae* present, after the larvae of this species have eaten their way out of the larvae of *Tepperella trilineata*.

Pupae were present on 6th September, 1936, and the last pupa was found on 18th October, 1936. The first mature larvae were found on 22nd August, but mature larvae were found up to 4th October, which was slightly more than one month before the last adult emerged.

In the spring of 1937, in dissections made from 13th September to 16th September inclusive, 55 mature larvae, three prepupae, and 5 pupae of *M. acaciae* were found in the galls from the same tree. The first mature larva of *M. acaciae* was found on 30th August, 1937, the first pupa was found on 4th September, 1937, and the first adults of *M. acaciae* emerged on 3rd October, 1937, only one day later than the first emergence of this species in the preceding year, though the emergence of its host *Tepperella trilineata* was twelve days later in 1937 than in 1936.

TABLE 5.—*Results of Dissections of Galls from* A. decurrens *in the Spring of 1936 showing the Progressive Development of* M. acaciae *after leaving the larvae of* Tepperella trilineata.

Date of Dissection.	Number of Cells Vacated or Occupied by other Species.	Stage of *M. acaciae* present.			Remarks.
		Mature Larvae.	Pupae.	Adults.	
22/8/36 ..	80	5	—	—	Many *M. acaciae* larvae still within host larvae.
30/8/36 ..	132	4	—	—	
6/9/36 ..	203	31	19	—	
9/9/36 ..	63	8	6	—	
13/9/36 ..	69	23	6	—	
20/9/36 ..	116	23	12	—	
27/9/36 ..	197	1	24	—	
4/10/36 ..	148	1	25	3	Some of the vacated cells during this period must have once been occupied by *M. acaciae*.
11/10/36 ..	81	—	21	4	
18/10/36 ..	132	—	13	8	
25/10/36 ..	98	—	—	4	
1/11/36 ..	112	—	—	2	
8/11/36 ..	109	—	—	—	

First adult of *M. acaciae* emerged 2nd October, 1936.
Last adult of *M. acaciae* emerged 8th November, 1936.

Percentage of Parasitism.

In May and June 1936, 545 larvae of *Tepperella trilineata* were dissected, and 211 or 38·71 per cent. were found to contain larvae of *Megastigmus acaciae.*

In a previous paper (1939) the writer discussed the biology of *Eurytoma gahani* Noble, another species of Chalcid which is present in these galls on *Acacia decurrens.* The larvae of this species are to be found in the same gall cells as larvae of the primary gall-former, *Tepperella trilineata*, and ultimately the larvae of *E. gahani* devour the larvae of *T. trilineata* with which they are associated, and destroy at the same time any larvae of *M. acaciae* which happen to be present in these cells.

In the 545 cells mentioned above, though 211 larvae of *M. acaciae* were present, all but 97 were also accompanied by the larvae of *E. gahani* and would later have been destroyed; thus out of the 545 cells examined, adults of *Megastigmus acaciae* would only have emerged from 97 or 17·80 per cent. of them.

In the spring of 1937 a further 545 gall cells from the same tree were examined, the larvae of *Eurytoma gahani* at the time of examination having already devoured the other occupants of the gall cells. It was found that *Megastigmus acaciae* would have emerged as adults from only 71 or 13·03 per cent. of the gall cells, a decrease of more than 4 per cent. as compared with 1936.

Effect of Parasitism on the Host and on Gall Development.

At times during the course of these investigations, minute galls were observed, which were much less advanced than the majority of the galls on the tree, and dissection of these frequently revealed minute host larvae, which were parasitized, and which were much less advanced than unparasitized larvae of this species in other galls. However, such minute galls were also found, in which very backward larvae of *T. trilineata* were present, and were unparasitized.

On the other hand, maturing larvae of *T. trilineata* have been examined in which well-developed larvae of *M. acaciae* were present, without having any apparent effect on the host larva.

At various times unilocular galls were found in which mature larvae or pupae of *M. acaciae* alone were present, and these galls were just as large and normal as galls in which the primary gall-former, *T. trilineata*, was present alone. Froggatt (1892), in the case of *Trichilogaster acaciae-discoloris*, causing galls on *Acacia discolor*, stated that, as a result of infestation by a small black chalcid, the galls are changed to a shapeless, fleshy mass. In the case of *T. trilineata* it would appear that, provided the larvae are permitted by the parasite to reach maturity, the presence of the latter does not affect the size or shape of the gall.

Summary.

The external morphology and biology of *Megastigmus acaciae*, a new species, are set out.

M. acaciae is an internal parasite of the larva of *Tepperella trilineata*, a species which causes galling of the flower buds of *Acacia decurrens* and, like its host, the life cycle of *M. acaciae* is annual.

Emergence of both species commences in the spring each year. Emergence of adults of *M. acaciae* commences after most of the host adults have emerged, the main emergence taking place in October. Of a total of 1,559 adults which emerged in 1936, 1,013 or 64·98 per cent. were males and 546 or 35·02 per cent. were females.

Adults of *M. acaciae* are short lived, the average length of life of male wasps in the laboratory being 5·46 days, and of female wasps 5·17 days.

Eggs of *M. acaciae* are found in first-stage larvae of *T. trilineata*, but it is possible that they may be deposited in the eggs of the latter species and remain unhatched until after the eggs of *T. trilineata* had done so, this being the known habit of *Epimegastigmus brevivalvus*, an allied species studied by the writer.

The entire larval period of *M. acaciae* is spent within the haemocoele of the host larva. For the greater part of the larval period, the development of the parasite larva is very slow, the latter still being comparatively small and some being only in the first stage, when the last host-larval stage has been reached. A

period of rapid development then follows and, before the larva of *T. trilineata* can pupate, the larva of *M. acaciae* devours all of its internal contents, eats its way out of the larval skin of the host, and later pupates in the cell formerly occupied by the host larva.

There are five larval stages, all of which are described.

Of 545 larvae of *T. trilineata* dissected in 1936, 211 or 38·71 per cent. were parasitized by *M. acaciae*.

Acknowledgement.

The writer wishes to acknowledge his indebtedness to Dr. A. B. Gahan, Senior Entomologist of the United States Department of Agriculture, for his valuable observations on the species under discussion.

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A RECONNAISSANCE SURVEY OF THE VEGETATION OF THE MYALL LAKES.

By T. G. B. Osborn[1] and R. N. Robertson.[2]

(Plates vi–vii; three Text-figures.)

[Read 28th June, 1939.]

The coastal dune and swamp sequences of New South Wales have been so much disturbed in the neighbourhood of Sydney, and for many miles to the north and south of it, that particular interest is to be found in the Myall Lakes district. There the coastal vegetation has been very little disturbed and the series of plant communities that it shows can be examined in an almost primitive state. The same area also offers some interesting comparisons between the Eucalyptus forest developed on recent sands and on hills of palaeozoic rocks. The junction between Eucalyptus forest and sub-tropical rain-forest—locally called 'brush'—can also be studied. These features of ecological interest appear to justify our placing on record the notes made on three reconnaissance visits to the area. Circumstances will prevent our continuing the joint work.

Visits were made to the area in September 1934, June and September 1935. The first two were with the Sydney University Rover Scouts. We are indebted to all who took part in these camps for assistance in various ways which made possible work in an otherwise sparsely inhabited district. We also desire to express our thanks to certain members of the camps for technical help; to S. W. Carey and H. Maze for access to their field-notes on the geology and physiography of the area; to N. A. Kelly and N. C. W. Beadle for help in collecting, and to O. D. Evans, of the Botany School, University of Sydney, for assistance in determining some of the plants.

The Myall Lakes are an extensive series of coastal lagoons situated 32° 30′ S. Lat., and 152° 25′ E. Long., about 50 miles north-east from Newcastle. At the present day they communicate with the sea only indirectly, by means of the Lower Myall River. This is a slow-moving, narrow, tortuous stream which extends from the southern end of the Lakes to Tea Gardens on Port Stephens, eleven miles away. Between the lakes and the Southern Pacific Ocean lies a belt of sand-dunes, low heaths and swamps, varying in width from a few hundred yards at Mungo to three miles or more at its northern end. From this there rise at infrequent intervals low rounded hills of tuffaceous rock. To the west of the lakes the country consists of broken hills and valleys—also of tuffaceous rock—with, however, considerable swamp and heath areas.

Though the area has been inhabited by white men for over a century, much of it, especially the dunes, heaths and swamps, is still in a primitive state. Much

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of the forest has been influenced by timber-getting,[3] or has been partially cleared for grazing, but sufficient remains to reconstruct the essential parts of the story.

Physiography.

During the Tertiary Period the area now occupied by the Myall Lakes, like the rest of the East Coast of Australia, was subjected to the uplift which resulted in the formation of the coastal tablelands. In this region the uplift probably amounted to about 1,300 feet. The plateau of palaeozoic tuffs thus formed was

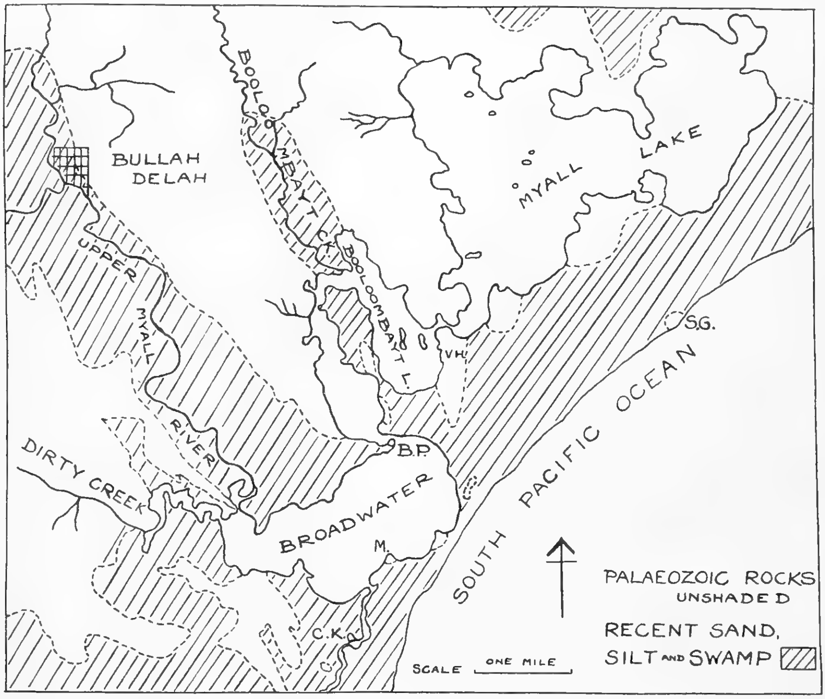


Fig. 1.—Sketch Map of the Area. C.K. = Chinaman's Knob on the Lower Myall River; M = Mungo; B.P. = Bombah Point; V.H. = Violet Hill; S.G. = South Gibber.

rapidly attacked by streams which carved deep valleys into its surface. In a subsequent general subsidence of some 400 feet, these valleys were drowned by the sea and a typical rias coast was formed. The coast then presented a rugged appearance with numerous off-shore islands. At that time landmarks like Mungo, Violet Hill, Bombah Point and Chinaman's Knob were all islands. The combined action of coastal currents, waves and tides resulted in the formation of sandspits. Under the influence of currents, these sandspits would develop on the south-western side of the islands and, gradually extending southwards, link up with each other. Thus there would be formed a continuous sandspit running from

[3] R. Dowson, who founded the Australian Agricultural Company's Settlement at Port Stephens, records that he ascended the Myall River in 1825 to visit a timber-camp, and that "Cedar" (*Cedrela Toona*) getters had been operating in the district, under licence, for some time previously. "Present State of Australia, etc.", Edition II, pp. 41-76, London, 1835.

island to island for twenty miles parallel to the coast. This cut off the Myall Lakes as a large coastal lagoon studded with islands. With their appearance above water, the sandspits became subject to the direct action of wind which caused the sand to accumulate in dunes and to advance landwards across the sandspits. Since the prevailing wind was an easterly, and since the coast-line ran approximately NE–SW, the sand-dunes, advancing before the wind, did not advance parallel to the coast, but developed en échelon.

Meantime, land was, and is still, being reclaimed from the lakes. The accumulation of blown sand has caused a gradual shallowing. Sand-bars made their appearance and, assisted by the water-weeds, were built above the water. There are no recently-formed sand-islands in the lakes, but the extensive sand-bar in the lower part of the Booloombayt Lake approaches within a foot of the surface. In certain parts of the area—particularly on the Broadwater—the waves of the lake themselves have caused an accumulation of sand to form sloping beaches. The sand thus raised above the water has come under the influence of the wind and has formed dunes of varying sizes on the inland shore of the lakes.

Certain areas, known locally as 'moors', extend for some miles without any elevation whatever. Though known as 'moors' there is no accumulation of peat on them, and they will be termed 'heaths' in this account. Their level nature and the fact that they are bounded by fixed sand-dunes point to their being old lake beds which, having been raised above the water-level, have gradually drained. (Possibly the relatively recent 15-foot uplift recorded in places along the New South Wales Coast may account for some of these heaths.)

While the chief reclamation of the lakes, particularly on the coastal side, has been by sand, silt deposition has been important in some areas. Three main rivers drain into the lakes, the Upper Myall River and Dirty Creek into Broadwater at the south, and the Booloombayt Creek into the small lake of that name in the centre. These streams have built silt flats of considerable areas. Silt deposition is at present active at the outlet (on the Broadwater) of the Lower Myall River and particularly so at the mouth of Booloombayt Creek.

Beyond the entrance of the Lower Myall into Broadwater, tide has very little effect, and in the channel at Bombah Point which connects Broadwater and Booloombayt, the effect of daily tides cannot be noticed. The mangrove, *Aegiceras majus*, which tolerates a considerable amount of freshwater, grows with *Casuarina glauca* in the upper reaches of the Lower Myall, but does not enter the lakes.

Floods are very important. The Myall Lakes present the interesting example of a lake system which is drained at one end and filled in the centre. That is to say, they are drained by the Lower Myall River in the south, and filled by the Upper Myall River, Dirty Creek and Booloombayt Creek, but the largest lake—Myall Lake proper—receives no streams of importance. During flood times the rivers filling the lakes do so at a much greater rate than the small Lower Myall River can drain them. Consequently, they may rise quite rapidly. The rising waters of the Booloombayt meet the rising waters of the Broadwater and, being unable to escape, are pushed away from the outlet into the Myall Lake. Thus the lakes which drain Myall Lakes are also the lakes which flood it. If the floods in the filling streams are also accompanied by spring tides on the Lower Myall River, the northward flow of the water may be quite rapid, and a strong current may run in the channel at Bombah Point. This channel is the only place in the lakes which shows evidence of stream scour.

The salinity of the lakes varies periodically. Generally speaking, the water is brackish, but following heavy rain in the surrounding ranges, it may be almost fresh. The salinity increases greatly after periods of dry weather, especially if such periods are accompanied by high tides in the Lower Myall.

Climate.

The Myall Lakes lie in the coastal belt of New South Wales, just within the region having a maximum summer rainfall. The two nearest stations on the coast for which rainfall figures are available are Manning Heads and Newcastle. Manning Heads is about as far north of the area as Newcastle is to the south. The average annual rainfall at these two stations is 139·7 cm. (5,505 points) and 116·1 cm. (4,571 points) respectively. The rainfall in the Myall Lakes area may, therefore, be taken as about 127 cm. (50 inches) per annum. The average monthly falls at Manning Heads and Newcastle are set out in the following table:

Average Annual Rainfall in Millimetres.

	Jan.	Feb.	Mar.	April.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Year.
Manning Heads	123	156	146	142	137	123	112	87	84	80	94	113	1397
Newcastle	88	103	122	119	126	99	119	78	78	58	66	87	1161

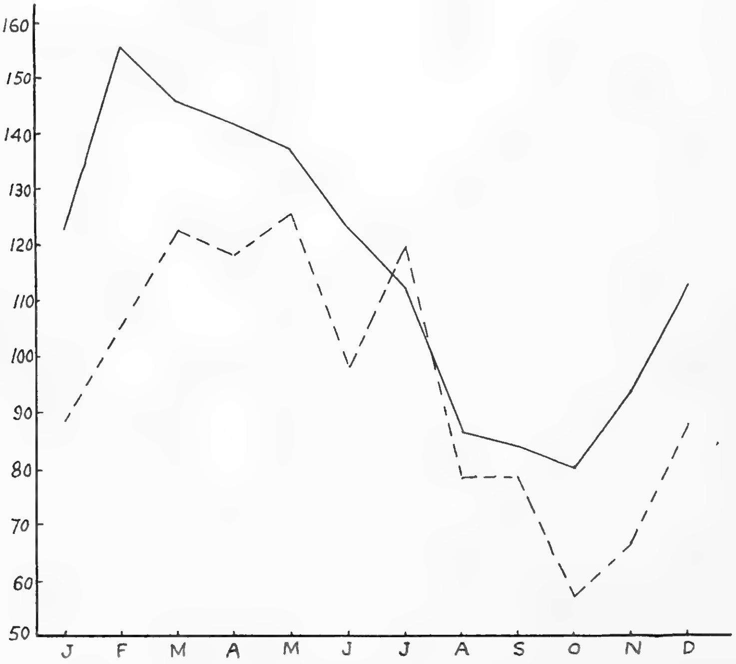


Fig. 2.—Curves showing mean annual rainfall in millimetres at Manning Heads (continuous line) and at Newcastle (broken line). Data from *C.S. & I.R. pamphlet* 42, 1933.

Occasionally very heavy falls of rain accompanied by severe flooding are features of the summer months. Thus, in Newcastle, there are records of 25·4 or 27·94 cm. (10 or 11 inches) of rain falling within 24 hours. It will be noticed (Fig. 2) that the late summer months, February–March, are the wettest months, and that the spring, September–October, are the driest. The main flowering period of the sclerophyllous shrubs is in the months August–September.

At Manning Heads the average annual humidity is 77%, the extremes being 83% in April and 71% in October. An effect of the high humidity is to be noticed in the abundance of the epiphytic *Dendrobium teretifolium* on Casuarinas fringing the slow-moving rivers. Epiphytes do not usually develop on Eucalypts, but a young tree of *Ficus rubiginosa* was observed in a fork of a large *Eucalyptus tereticornis* near the entrance to Booloombayt Lake, opposite to Bombah Point.

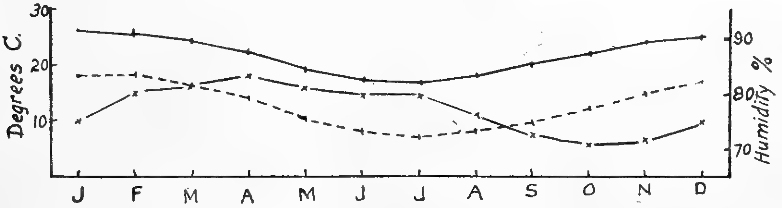


Fig. 3.—Curves showing mean monthly maximum (continuous line) and minimum (broken line) temperatures at Manning Heads in °C., also mean relative humidity (as per cent.). Data from *C.S. & I.R. pamphlet* 42, 1933.

The mean maximum and minimum temperatures at Manning Heads are given below:

Mean Temperature at Manning Heads in Degrees C.

	Jan.	Feb.	Mar.	April.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Year.
Maximum	26·2	25·9	24·7	22·5	19·7	17·7	17·0	18·1	20·5	22·4	24·3	25·3	22·0
Minimum	17·7	17·9	16·8	14·1	10·8	8·7	7·4	8·1	10·0	12·9	15·1	17·2	13·1

Night frosts are not unknown between June and August in the valley bottoms. They may have an effect on the stunted vegetation of the large open heaths.

The Psammosere.

The vegetation of the sand-dunes shows all stages from that of the first colonists of bare beach to climax forest on fixed dunes. The climax is an association in which *Eucalyptus pilularis* (the black-butt) is found with *E. gummifera*, *Angophora lanceolata*, and one or other of the Banksias, *B. integrifolia* or *B. serrata*. The sere is complicated by an admixture of certain lower-growing but broader-leaved species, e.g., *Cupaniopsis anacardioides*, *Clerodendron tomentosum*, in more favourable locations near the sea. It is part of an Indo-Malayan element in the flora which, however, does not enter into the Climax. There are some extensive blow-outs and white dunes to the south of the area, inland from Broughton Island.

Strand Plants.

The strand consists of a clear white sand derived from the wastage of the tuff rocks. Unlike the sands of the southern Australian coast, it has not a high lime content. *Cakile maritima*, a doubtfully indigenous species, is the only true strand plant.

Fore-Dune.

Dune building is begun by *Festuca littoralis*, a tussock grass, mingled with which low mats of *Senecio spathulatus* may also occur. *Spinifex hirsutus*, which also occurs, is not so important in dune formation as it is further south on the Australian coast.

Fixed Dunes.

These are remarkable for the important role of such mat plants as *Mesembryanthemum aequilaterale*, *Scaevola suaveolens* and *Stackhousia spathulata*, also for the early appearance of woody plants such as *Correa alba* and *Leucopogon Richei*. The mat plants may persist, binding the sand into rounded hummocks a metre or more in height, long after wind erosion has removed the low dune on which they had been growing.

The following is a composite list from the dune face and the crest of the first line of dunes:

Festuca littoralis	*Apium prostratum*
Spinifex hirsutus	*Leptospermum laevigatum*
Scirpus nodosus	*Leucopogon Richei*
Dianella caerulea	*Stackhousia spathulata*
Lomandra longifolia	*Monotoca elliptica*
Pelargonium australe	*Convolvulus Soldanella*
Oxalis corniculata	*Cupaniopsis anacardioides*
Mesembryanthemum aequilaterale	*Pomax umbellata*
Correa alba	*Scaevola suaveolens*
Acacia longifolia	*Senecio spathulatus*
Kennedya rubicunda	*S. lautus*
Euphorbia Sparmanni	*Sonchus maritimus*

The height to which the taller of these plants will grow is dependent on exposure. Thus *Cupaniopsis*, normally a small tree about 3 m. high, has been observed growing in extensive mats, not more than 30 cm. high, on the edge of a stable dune. The density of the vegetation appears to be dependent upon its freedom from fire, rather than on actual exposure to wind-shearing. Dense impenetrable thickets of shrubs and low trees occur on exposed faces of settled dunes, pruned neatly to an angle of 25° with the horizontal. Such a thicket may have the following composition:

Banksia integrifolia	*Leptospermum laevigatum*
B. serrata	*Angophora lanceolata*
Breynia oblongifolia	*Monotoca elliptica*
Dodonaea triquetra	*Myrsine variabilis*
Eugenia Smithii	*Notelaea longifolia*
Clerodendron tomentosum	

The lianes, *Kennedya rubicunda*, *Hibbertia volubilis* and *Tecoma australis* are found intertwined with the woody plants. In such a dense thicket there is very little ground flora. Occasional plants of *Pomax umbellata* and *Commelina cyanea* occur, but are not important.

Fixed Dune Woodland.

Banksia-Angophora Forest.

Given sufficient shelter from the wind, the tree species quickly assume dominance and a more open woodland community results. The dominants here are *Angophora lanceolata* and one or other of the Banksia species. In some places the twisted limbs and frequent branching of the Angophora give evidence of its development under scrub conditions (Pl. vi, fig. 3). In such a woodland the trees may be no more than 5 m. high. Under more favourable conditions the dominants may be 20 m. or more.

With the dominance of the trees, two changes are to be noted. First, the broad-leaved species of sub-tropical affinities disappear. This 'brush' element, which is a characteristic feature of the dense dune scrub, is not conspicuous or is wholly absent in the dune forest. Secondly, most of the shrub species associated with the earlier phases are lost. Other shrubs come in, also *Pteridium*, *Macrozamia* and various Cyperaceae. Grass is not a feature of the dune forests. This Angophora-Banksia forest is a very characteristic community of the settled dunes and intervening dune flats. It exists in all grades between a forest with close, but not dense, canopy and very little undergrowth, to open scrub woodland with a considerable undergrowth of shrubs. Finally, as a result of burning, there may be extensive areas of scrub in which the Angophora is absent and the Banksias only present in the shrub layer.

The following are some of the more important constituents of the undergrowth in the Angophora-Banksia forest:

Pteridium aquilinum
Macrozamia spiralis
Imperata cylindrica, var. *Koenigii*
Schoenus ericetorum
S. imberbis
Xanthorrhoea hastilis
Lomandra longifolia
Persoonia lanceolata
P. salicina
Leptomeria acida
Eriostemon lanceolatus
Gompholobium latifolium
Goodia lotifolia
Leptospermum laevigatum
Halorrhagis tetragyna
H. teucrioides
Monotoca elliptica
Styphelia viridis
Pomax umbellata
Opercularia varia

With the destruction of the dominants a great wealth of shrubs comes in, chiefly nanophyllous or microphyllous forms belonging to the Proteaceae, Leguminosae, Myrtaceae or Epacridaceae. These are given at some length in Appendix I.

Dune Eucalyptus Forest.

On deep stable sands, whether of fixed dunes or inter-dune flats, a forest of Eucalypts develops. *Eucalyptus pilularis* is the dominant and often occurs pure, though there is commonly present *E. gummifera*. Occasional trees of *Angophora lanceolata* persist, and *Banksia serrata* is generally present in the second tree-layer. This forest has a rather open canopy, but the amount of shade, and consequently the scarcity or density of the undergrowth, appear to depend largely on the time which has elapsed since the last forest-fire. The dominants are generally about 15 m. in height, with a secondary tree-layer—largely *Banksia serrata*—up to half that height. When the forest is open, an upper shrub layer may reach 2–3 m. It contains such species as *Leptospermum stellatum*, *Calycothrix tetragona*, *Leptomeria acida*, *Persoonia salicina* and *Banksia aemula*. Such a height is exceptional; most of the undershrubs do not reach more than a metre. Such plants are *Banksia spinulosa*, *Isopogon anemonifolius*, *Persoonia lanceolata*, *Conospermum taxifolium*, *Acacia suaveolens*, *A. discolor*, *Hibbertia linearis*, *Eriostemum Crowei*, *Bossiaea heterophylla*, *B. scolopendria*, *Gompholobium latifolium*, *Dillwynia ericifolia*, *Hardenbergia monophylla*, *Trachymene linearis*, *Xanthosia pilosa*, *Leucopogon ericoides*, *L. virgatus*, *Epacris pulchella*, *Styphelia viridis*. *Pteridium aquilinum*, occasional plants of *Macrozamia* and various Cyperaceous species occur, but grasses are scarce or absent.

A variant of this type of forest is to be found under conditions that are presumably less favourable. In it the height-growth of the trees is only about 8 m. and the canopy is more open. The conditions of the reconnaissance did not permit the taking of many soil samples. Superficially, the soils were similar; stable sands with some humus development in the upper layers. Here *Eucalyptus pilularis* is less abundant to absent. *E. gummifera* is more abundant and *E. micrantha* is present in sufficient quantities for its white trunk and limbs to give character to the forest. These last two species are characteristic of tree-scrub and low scrub-forest on the Hawkesbury Sandstone near Sydney, and are the hardiest Eucalyptus species in that area.

Apart from a change of the dominants, the vegetation appears to be essentially similar. Trees of *Angophora lanceolata* and *Banksia serrata* are present and *Pteridium* is an important constituent of the undergrowth. In one instance, this forest community was traversed by a water-course. These, of course, are noticeably absent on the deep sandy soils. The water-course, which was scarcely lower than the surrounding area, was marked by a pure stand of *Melaleuca linariifolia* trees 3–4 m. high with twisted trunks and canopy tops. The soil beneath, which was superficially sandy, had much *Selaginella uliginosa.*

Where the deep sands abut on hills of tuff rock, an ecotone forest develops. This will be considered in connection with the vegetation of the hills. The water-relations of such boundaries are presumably better than either the sands—where the water-table must lie at some depth—or the hills themselves, which have a shallow soil. On the other hand, the Eucalypt forests mentioned above appear to be unfavourably influenced by a permanently high water-table. They do not extend into the various swamps and heaths to be described below.

The Hydrosere.

The communities to be considered here are of interest because a very full series is available for study, extending from open water to a swamp forest of *Eucalyptus robusta.* With silt deposition, the series can be traced to a high eucalypt forest, though only vestiges of this remain.

The open water of the lake is fringed by a reed swamp, except where white sand reaches the water's edge, or where the shore is stony owing to tuff hills rising directly from the lake. The water of the lake is brackish and has a pH of 7–7·5[4] but all swamp soils tested are acid.

Submerged Phase.

So far as could be ascertained, the bottom of Booloombayt and Broadwater Lakes is covered with submerged vegetation. The most abundant species is *Najas marina,* which has been found to a depth of 10 feet. This extends towards the shore to depths of about 2 feet. With it is associated *Potamogeton tricarinatus, Vallisneria spiralis, Myriophyllum* sp., *Ruppia maritima.* Both *Potamogeton* and *Myriophyllum* are very abundant locally at shallower depths, but we have had no opportunity of considering the factors which influence their relative distribution. In places outside the recognized channels, progress, even in a rowing-boat, is difficult. On sandy bottoms in shallow water *Chara* sp. may be found growing in water 1 foot, or less, in depth, to the complete exclusion of other species. This has been observed on sandbanks at a hundred yards or more from the shore, as well as near to the shore line.

[4] Field determination made by B.D.H. Universal Indicator. The other pH determinations were made with a quinhydrone electrode in Sydney. We are indebted to N. C. W. Beadle for these and other analyses of the swamp soils, made after his visit in June, 1935.

Succession with Silt Accumulation.

Amphibious Phase.

The reeds extend from a depth of 4–5 feet—where they are scattered—to the water's edge. The width of this zone is variable, but it is widest where there are long stretches of shallow water. The pioneer plant is *Scirpus lacustris*, which establishes itself on the lake bottom, spreading out from the shore, in places for as much as 25 yards. Nearer inshore, in 1–2 feet of water, there is usually a continuous densely-growing zone. On its landward side *Scirpus* becomes mingled with *Phragmites communis*, which gradually assumes dominance. In the Booloombayt Lake the reed swamp may be 10 feet in width, and it is still wider in the lower part of Broadwater. Other plants in the amphibious phase are *Typha angustifolia*, which often forms characteristic socies in the shallower water; *Cladium articulatum*, *C. Mariscus* and *Juncus maritimus*. *Triglochin procera* occurs in open patches of water in the shelter of the reed swamp, and *Gratiola pedunculata* may form extensive submerged colonies as well as being present in the emerged flora near the margin. It is in the Phragmites zone that both *Casuarina glauca* and *Melaleuca Leucadendron* first make their appearance. These are invariably small trees (up to 5 m.) generally with a leaning trunk and abundant branches. They differ markedly in habit from the upright and taller trees which form the next two zones in the Swamp Forest.

Swamp Forest Phase.

From the edge of the reed swamp to the junction with the stable sand or silt flats there extends a characteristic swamp forest with a dense undergrowth of sedges. This can be divided into two consocies in which *Casuarina glauca* and *Melaleuca Leucadendron* are respectively dominant. The former lies nearer to the lake.

Casuarina glauca *Fringing Forest.*

A closed forest of *Casuarina glauca* immediately succeeds the reed swamp. The trees, unlike those near the water's edge, grow erect to a height of about 15 m. The ground beneath is covered with the litter of their fallen branches, and a dense undergrowth of tussocks of *Cladium junceum*, the wiry stems of which stand about 40–50 cm. high. The water-table in this forest is high. Occasional openings in the ground-cover support colonies of *Cladium articulatum*, with which *Cotula reptans* and *C. coronopifolia* occur. Other plants are *Schoenus brevifolius* and *Lepyrodia mucronata*, the latter locally abundant. Many of the trees have a considerable growth of the epiphytic *Dendrobium teretifolium*, but the epiphytic fern *Platycerium alcicorne*, which is a feature of similar forests to the south of Sydney, was not observed. The soil here consists largely of decomposing plant remains. The loss on ignition is high, 68–69%; the pH is 5·3 to 5·6.

Melaleuca Leucadendron *Forest.*

This characteristic forest succeeds that dominated by *Casuarina glauca*, on the inland side, and may occupy a much wider zone. Occasional trees, scattered in the *Casuarina* zone, link the *Melaleuca* forest with the low-growing trees at the water's edge. An important factor seems to be a decrease in the humus content, with a corresponding relative increase in the mineral matter. *Melaleuca Leucadendron* can maintain itself on silt flats which have been cleared for poor grazing land. There it regenerates freely from seed and the seedlings have to be cut every two or three years to prevent the land reverting to forest. The undergrowth beneath the Melaleucas is very similar to that beneath *Casuarina glauca*; *Cladium junceum* is the chief ground cover. The Melaleuca trees in this forest, unlike those of the lake margin, are stout and upright. About 15 metres is an average height, but trees of 20 m. and more are not unusual, with a diameter of more than a metre at breast height. With their papery white bark, showing black streaks caused by fires, and olive green-brown foliage, they are striking and handsome trees. Occasional trees of *Endiandra Sieberi* occur, but otherwise, except for some *Casuarina glauca* or *Eucalyptus robusta* at the margins, the Melaleuca forests are a very pure community.

Eucalyptus robusta *Forest.*

On the landward side, where the Melaleuca forest approaches the stable sand or tuff rocks, there is developed a forest of *Eucalyptus robusta,* the swamp mahogany. Well-grown trees may be more than 20 m. high, with a rough fibrous reddish bark and—for a eucalypt—broad, glossy green leaves. The soil here is often very wet, with pools of standing water due to seepage and run-off from the inland parts. Here, too, the soil commonly has a considerable admixture of sand, washed down or blown on to the area from behind. The acidity may be high—pH 4. The undergrowth is typically *Blechnum serrulatum,* either as a carpet or rising in clumps from pools of standing water. Large tussocks of *Gahnia psittacorum* occur with the *Blechnum.* The junction between the *Eucalyptus robusta–Blechnum* swamp and stable sand is often marked by a pure ribbon-community of *Restio tetraphyllus.* Many variants of this forest exist, but it appears to be a very stable community, progression beyond which depends rather on allogenic than on autogenic causes.

Where there is any considerable admixture of sand—e.g. where a stable dune abuts on a *Eucalyptus robusta* forest—the trees can survive for a time, though the undergrowth changes. *Pteridium* and *Imperata* replace the *Blechnum.* It is probable that the Eucalypt is rooted in swamp conditions, only the upper layer of the soil being changed. *Eucalyptus robusta* does not occur on deep stable sand, though it may be found at the margins of small swamps which occasionally occur as outliers in the stable dunes. Stunted trees also occur on some of the wet sand heaths described below.

Eucalyptus Forest on Silt Flats.

Behind the swamp forest zones on either side of the Booloombayt Creek and the Upper Myall River are extensive silt flats caused by the flooding of these rivers and wash from the neighbouring hills. These flats have been largely cleared of timber or the standing trees ring-barked and burnt. Occasional trees of *Eucalyptus saligna* var. *pallidivalvis* (*E. grandis*) are left as indicators of what must have been a magnificent forest. Some of the standing trees here are 36–40 m. high, rising 18 m. to the first branch. The sward now consists largely of *Paspalum distichum*; occasional patches of *Cladium junceum* or pools with *Ranunculus aquatilis* indicate the wetness of the soil.

Swamp Forest with Palms.

In the vicinity of Mungo there is an extensive area in which the palm, *Livistona australis,* grows abundantly and regenerates freely in a mixed swamp forest of both *Melaleuca Leucadendron* and *Eucalyptus robusta.* The soil conditions are a very confused mixture of silt banks, humus masses and standing water. The palm has a similar occurrence in patches of swamp forest along the Hawkesbury Estuary nearer Sydney. It is an important constituent of the subtropical rain-forest on the tuff hill at Mungo, described below.

Succession on Sandy Shores.

The sandy shores at the northern end of Broadwater show lines of *Melaleuca Leucadendron* growing as regularly as if they had been planted. Apparently these result from abundant germination of *Melaleuca* seeds from time to time in the flotsam and jetsam cast up on the sand (Pl. vii, fig. 9). Most of these crops of seedlings fail to establish themselves, but, occasionally, they have survived. When this happens and the sand builds up towards the lake, there is left a regular row of young trees parallel with the shore. Except for these trees, the sandy shore bears only occasional clumps of *Juncus maritimus* or *Leptocarpus tenax.*

Rocky Shores.

Plants of the reed-swamp communities usually fail to establish themselves on shores where the tuff hills come directly to the waterside. *Scirpus lacustris* may be found in the water, but the succession does not advance. On the shore itself there is an open community of *Casuarina glauca*, behind which the land rises with the forest vegetation of the hills, or its modifications.

Heaths and Swamps.

The foregoing account of the psammosere and hydrosere has only incidentally mentioned the heaths and swamps which are such a feature of the Myall Lakes area. These are not directly connected with either of the two major seres, though in some cases they may represent deflections of the successions.

The origin of the extensive level sandy plains, locally called 'moors', but which we have termed heaths, is difficult to explain, except as the sandy bottoms of former lake beds. Any method of gradual reclamation by vegetation does not meet the facts, for the heaths are sandy plains; their surface soil has no peat and but little organic matter. An extensive heath, four or five miles long and as much as half a mile wide, lies between the coastal dunes and the tuff hills south-east of Booloombayt and Myall Lakes.

A soil profile in this is as follows:

Depth.	Description.	Loss on Ignition.	Water-holding capacity.	pH.
0–3 inches ..	Sand, discoloured dark brown to black with organic matter.	9·1%	57·5	4·4
3–15 ,,	Yellow sandy loam.	4·05 to 3·53%	33·3 to 25·0	4·0 to 4·2
15 ,,	Clean white sand saturated with water at 16–17 inches.	0·13%	20·5	4·4

The heath vegetation consists of a considerable number of shrubs and herbs. Our lists, inevitably incomplete, include more than sixty species. Most of the shrubs are leptophylls or nanophylls and few of them exceed 60 cm. in height. There is also considerable local variation. That portion of the heath shown in Plate vii, Figure 10, shows numerous scattered bushes of *Banksia latifolia.* With it occur such plants as *Conospermum taxifolium, Dillwynia ericifolia, Aotus villosa, Melaleuca nodosa, Epacris obtusifolia, E. microphylla, Sprengelia incarnata* and various Cyperaceae and Restionaceae.

Dry Heath.

In contrast, other heaths are still drier, the surface soil is lighter in colour and the vegetation resembles that of scrub on the inter-dune flats, but, as is usual on the heaths, the individuals are all stunted in their growth. Throughout the heaths as a whole there are to be found pure societies of this or that species which—for no apparent reason—assumes local dominance. An extensive society of *Hakea pugioniformis* was observed growing so thickly as to be almost impenetrable, although it was less than a metre in height. A fire had burnt out a part of the community, and the regenerating area was quite different floristically. After such fires rhizomic plants, such as *Hypolaena lateriflora*, *Leptocarpus tenax*, *Caustis flexuosa*, and *Schoenus ericetorum* have an obvious advantage which they share with *Xanthorrhoea hastilis* and *X. minor*.

Wet Heath.

Certain of the heaths may be classified as wet. This is a mere matter of convenience, and all gradations exist between the two ends of the scale. In the wet heath there is a greater frequency of Cyperaceae and Restionaceae, *Xanthorrhoea minor* is more abundant, and *Sprengelia incarnata* tends to be replaced by *S. Ponceletia*. A comparison of the two floras can be made from the list in Appendix II.

With increasing wetness there is an accumulation of humus which, if the high permanent water-level be maintained for long, results in the formation of peat. Eventually, a peat-swamp may be formed.

Peat Swamps.

Just as all gradations may exist between dry and wet heaths, so the distinction between some wet heaths and swamps with a shallow peat layer is not easily drawn. In extreme cases there is no difficulty. One swamp was found to have a depth of more than five feet of dark brown, wet peat. The pH was about 4—field test with B.D.H. Indicator. Scattered and stunted *Eucalyptus robusta* occurred over the area, but they could not be termed dominant. The dominant was *Leptospermum Liversidgei*, which grew as a slender bush to 2 m. The ground cover was largely tussocks of *Blechnum serrulatum*, *Hypolaena lateriflora* was very common, *Restio tetraphyllus* and *Blandfordia* sp. were both frequent. A feature of this swamp was the sheets of *Sphagnum* between the tussocks of *Blechnum*.

As the depth of peat decreased, so did the height of the *Leptospermum*, and *Blechnum* almost disappeared. The shrubs *Epacris pulchella* and *Sprengelia Ponceletia* appeared, with dense masses of *Hypolaena fastigiata*. Local societies of *Gleichenia dicarpa* were almost impenetrable.

There remains to mention one swamp. This was almost surrounded by stable dunes with typical *Eucalyptus pilularis–Angophora* woodland. It was a pure society of *Blechnum serrulatum*, bounded at the margin by a belt of *Restio tetraphyllus*. The soil here had a loss on ignition of 89·7% and the pH was 3·7.

Vegetation of the Tuff Hills.

The vegetation of the hills composed of Carboniferous rocks differs markedly from that of even the most settled dunes and sand flats. The local resident will aptly refer to the 'old' country and the 'new'. The former is of value for its timber and as potential grazing-land after the forest has been cleared; the latter is almost worthless. Extensive masses of tuff rock occur as islands in the lakes, form occasional promontories by their shores, or rounded hills rising from the surrounding sandy or swampy soil. In all cases there is a sharp break in the floristic composition, and often in the actual vegetation type. To the west of the lakes the 'old' rocks form part of the foothills to the coastal plateau. The hills here are often steeper and more broken, but the forest types, so far as we have seen, are essentially similar.

Two distinct and unrelated forest types are developed: the one a mixed Eucalyptus forest; the other sub-tropical rain-forest. This is composed largely of species with Indo-Malayan affinities, from which eucalypts are absent, except for the one species —*Eucalyptus saligna*—present at the margin. The evidence available shows that sub-tropical rain-forest develops only in sheltered areas where the micro-climate is favourable and the soil-water relations are good. On one occasion, helped by a party, a traverse was made along a rain-forest–eucalypt-forest junction. The result showed clearly that the sub-tropical rain-forest, which grew thickly along the south- and east-facing slopes of certain steep-sided valleys, hardly rose much above the valley floor on the north- and west-facing slopes. Moreover, even with a favourable aspect, it was absent from the ridges, for they are exposed to the drying northerly and westerly winds. A more difficult problem in the distribution of the rain-forest is to account for its presence on certain of the rock outcrops near the lakes, and its absence from others.

The 'Brush' at Mungo, though only a few acres in extent, covers the low hill in a distinctive sub-tropical rain-forest (Appendix III). In a depauperate form it exists at Chinaman's Knob and Bombah Point, but it is absent from an outcrop of tuff rock about a mile north of Mungo and from the hills to the east of Booloombayt Lake. The rocks are all tuffs of the Burindi Series, of essentially the same composition. Under eucalypt forest they tend to develop a podsol; in the Brush the soils are loamy with a considerable amount of humus. Determinations of the water-holding capacities of the eucalypt forest soil averaged about 40%, that of the rain-forest about 70%.

Eucalyptus Forest.

The forests consist of a number of species growing to about 20 m. with clean, straight boles. The canopy is generally closed, though the shade cast is light. The more important species are *Eucalyptus maculata*, *E. propinqua*, *E. punctata*, *E. umbra*, *E. acmenioides*, *E. microcorys* and *E. siderophloia*. With these, growing to a lesser height are scattered *Casuarina torulosa*, *Exocarpus cupressiformis*, *Acacia decurrens* and *Brachychiton populneus*. Undergrowth is sparse, but the following shrubs were noted: *Persoonia linearis*, *Acacia floribunda*, *A. Maideni*, *Dillwynia floribunda*, *Pomaderris ellipticum* and *Monotoca elliptica*. Much of the soil is bare or covered with low perennial herbs or grasses and sedges.

The following list serves as an indication of the plants present; grasses, unfortunately, have not been prominent at the seasons of our visits.

Carex paniculata	*Lomandra longifolia*
Schoenus imberbis	*L. filiformis*
Lepidosperma laterale	*Dianella caerulea*
Imperata cylindrica, var. *Koenigii*	*Pomax umbellata*
Andropogon sp.	*Opercularia varia*
Poa caespitosa	*Helichrysum elatum*

At the head waters of small streams or other wet places, there are indications of an invasion by Indo-Malayan types. Thus, the following were noted in one such place: *Trema aspera*, *Ficus aspera*, *Callicoma serratifolia*, *Melaleuca styphelioides*, *Eugenia Smithii*, *Breynia oblongifolia*. These were growing with large tussocks of *Gahnia psittacorum* and amongst them *Dioscorea transversa* was climbing. We regard these plants as rain-forest indicators. Some are mesophyllous forms with a leaf type quite unlike the microphyllous sclerophylls around them. The presence of the liane, *Dioscorea,* is also significant. Lianes are not a feature of the eucalypt forest, but they are abundant in the sub-tropical rain-forest.

Probably, all these forests have been modified by fire and by felling. Under such conditions the more exacting 'Brush' plants would disappear.

Many of the hills formerly covered by eucalypt forest have been cleared, or had the timber ring-barked to encourage a growth of grass, but the results can hardly be satisfactory (Pl. vii, fig. 13). The majority of the tussocks seen in this figure are *Carex paniculata* or other sedges. In places *Pteridium* and *Imperata* are abundant. The trees regenerate freely (Pl. vii, fig. 15) when they escape from fires.

Marginal Forest.

Around the bases of the tuff hills where there is a junction of rock and sand, there is some mingling of eucalypts characteristic of the 'old' country with trees of the deep sands. Both types find better water-relations and grow to a great size. Certain species of eucalypt—e.g. *Eucalyptus paniculata* and *E. resinifera*—seem limited to these areas. We have also noticed *E. punctata*, *E. umbra*, *E. microcorys* of the tuff forests and *E. pilularis* and *Angophora lanceolata* of the sands. Many of these trees were 30 m. in height, rising with massive trunks for 12 m. to the first branch. *Casuarina torulosa* was common at such junctions and *Angophora subvelutina* also occurred. The undergrowth consisted of tall-growing *Pteridium* with *Imperata.* Such shrubs as *Dillwynia floribunda*, *Gompholobium latifolium* and *Dodonaea triquetra* were present.

Sub-tropical Rain-Forest.

These forests are strikingly different from the mixed eucalypt forests. They grow with a close canopy of dark green foliage, the leaves often having a polished or glossy upper surface which contrasts markedly with the dull, grey olive-green of the eucalypt. Most of the species have mesophyllous or even macrophyllous foliage which casts a dense shade upon the forest floor. There is a high percentage of lianes and ferns in the flora. Palm species, though few in number, are a characteristic element.

Consideration of the list of plants compiled in the different 'Brushes' shows that the forests are by no means of uniform composition. It is obvious that they can be divided into two groups: (1) those in which *Tristania conferta* is a characteristic tree, sometimes dominant; (2) those in which *Tristania* is absent.

The first type is represented in the valleys of the hills, the second by the 'Brushes' at lake level at Mungo and Chinaman's Knob.

Sub-tropical Rain-Forest—with Tristania.

The rain-forests in the hills have probably all been exploited for timber for many years. At the time of our visit the brush-box trees (*Tristania conferta*) were being felled. Relicts, such as strangling figs or tall trees on less accessible slopes, show that the general height growth of the trees was much greater than at Mungo. The palm, *Archontophoenix Cunninghamiana*, formed definite societies in the valley bottom. *Livistona* was less prominent than it was nearer the coast.

It is not proposed to describe the forest further here. The most interesting point brought out by this reconnaissance was the clear evidence that the development of rain-forest depends on local micro-climate rather than the underlying rock. A second point is that, given the appropriate soil and water relations, rain-forest is increasing its present areas. But the danger of fire is much more serious to the isolated rain-forest community than it is to the eucalyptus forest. There is no rapid regeneration of the grown tree from epicormic shoots.

Sub-tropical Rain-Forest at Sea-level.

In Appendix III is a list of species found in the small patch of rain-forest at Mungo. It is limited to a low rounded hill of tuff which, so far as our comparison with rock specimens collected elsewhere goes, does not differ significantly from other tuffs that are not covered with rain-forest. This hill must have been an island quite recently. It is so marked on some charts; and a belt of *Eucalyptus robusta* swamp-forest fringes its southern and eastern sides. This isolation may have preserved it from fire, and it appears to have been immune from timber-getters. None of the trees are of any great height—20 to 25 m. The tallest of them is out-topped by a number of gigantic *Livistona australis* which project 5 m. or more above the general level of the trees like huge mops. Of the 78 species included in the list, 27 are trees, all of which at some place or other rise to the canopy. No dominant species can be recognized. Inside the forest the light is subdued. The ground flora is chiefly ferns which grow amongst the cable-like basal portions of the lianes. This life-form comprises 16% of the species recorded. The better light-relations at the margins probably account for the greater frequency of nanophanerophytes which occurs there.

The little patch of rain-forest on Chinaman's Knob is much more open than that of Mungo. The list is shorter, and the few species growing there which do not also occur at Mungo are plants of the rain-forest margin, not of the established community.

Appendix I.

Plants of the Dune Scrub.

Ophioglossum coriaceum
Pteridium aquilinum
Imperata cylindrica, var. *Koenigii*
Festuca bromoides
Themeda Forskalii
Caustis flexuosa
Lepidosperma laterale
Schoenus ericetorum
S. imberbis
Leptocarpus tenax
Dianella caerulea
Lomandra longifolia
L. filiforme
Xanthorrhoea hastilis
Acianthus exsertus
Caladenia carnea
Glossodia major
Pterostylis sp.
Casuarina suberosa
C. stricta
Banksia serrata
B. integrifolia
B. aemula
Isopogon anemonifolius
Persoonia lanceolata
P. salicina
Leptomeria acida
Olax stricta
Drosera auriculata
Boronia ledifolia
B. pinnata
Correa speciosa
Eriostemon lanceolatus
E. Crowei
Zieria laevigata
Tetratheca thymifolia
T. ericifolia
Billardiera scandens
Acacia longifolia
A. suaveolens
Aotus villosa
Bossiaea heterophylla
B. ensata
B. scolopendria
Dillwynia ericifolia
D. floribunda
Indigofera australis
Hardenbergia monophylla
Kennedya rubicunda
Platylobium formosum
Phyllota phylicoides
Ricinocarpus pinifolius
Dodonaea triquetra
Elaeocarpus cyaneus
Hibbertia fascicularis
H. linearis
Leptospermum flavescens
L. laevigatum
Xanthosia pilosa
Trachymene linearis
Actinotus helianthi
Astroloma pinifolia
Brachyloma daphnoides
Epacris pulchella
E. microphylla
Leucopogon Richei
L. ericoides
L. virgatus
L. lanceolatus
Styphelia viridis
Monotoca elliptica
Tecoma australis
Asperula oligantha
Opercularia varia
Pomax umbellata
Wahlenbergia gracilis
Dampiera stricta
Cassinia aculeata

Appendix II.

Plants of the Heaths.

	Dry.	Wet.
Selaginella uliginosa		X
Blechnum serrulatum		X
Gleichenia dicarpa		X
Schizaea bifida	X	
Caustis flexuosa	X	
Schoenus ericetorum	X	
Costularia paludosa		X
Restio complanatus		
R. gracilis		
R. tetraphyllus	X	X
Hypolaena lateriflora		X
H. fastigiata	X	X
Leptocarpus tenax	X	X
Xyris operculata		X
Blandfordia sp.		X
Lomandra longifolia	X	
Xanthorrhoea hastilis	X	
X. minor		X
Haemodorum sp.	X	
Casuarina suberosa	X	
Banksia latifolia		X
B. serrata	X	
Conospermum latifolium	X	
C. ericinum	X	
Isopogon anemonifolius	X	
Persoonia lanceolata	X	
P. salicina	X	
Hakea pugioniformis		X
Symphyonema paludosum		X
Leptomeria acida	X	
Olax stricta	X	
Drosera spathulata	X	X
Boronia parviflora	X	
Eriostemum Crowei	X	
Acacia longifolia	X	
A. suaveolens	X	
A. juniperina		X
Aotus villosa	X	
Dillwynia floribunda	X	X
D. ericifolia	X	
Platylobium formosum	X	X
Sphaerolobium vimineum		X
Bossiaea heterophylla		X
Phyllota phylicoides	X	
Pultenea incurvata		X
Viminaria denudata		X
Ricinocarpus pinifolius	X	
Pimelea latifolia	X	X
Callistemon lanceolatus		X
Melaleuca nodosa	X	X
M. thymifolia		X
Leptospermum flavescens	X	
L. laevigatum	X	
L. scoparium var.		X
L. Liversidgei		X
Trachymene Billardieri	X	
Epacris obtusifolia	X	X
E. microphylla	X	X
E. paludosa		X
Brachyloma daphnoides	X	
Leucopogon Richei	X	
L. ericoides	X	
L. virgatus	X	
Styphelia viridis	X	
Sprengelia incarnata		X
S. Ponceletia		X
Mitrasacme polymorpha	X	
Villarsia reniformis		X

Appendix III.

Floristic Composition of the Brush at Mungo.

	Mungo.	Chinaman's Knob.
Aspidium decompositum	X	
Woodwardia aspera	X	X
Pellaea falcata	X	
Adiantum hispidulum	X	X
Pteris tremula	X	X
Polypodium confluens	X	X
P. tenellum	X	
Platycerium bifurcatum	X	
Botrychium australe	X	
Podocarpus elatus	X	
Gymnostachys anceps	X	
Oplismenus compositus	X	X
Cyperus sp.	X	
Gahnia aspera	X	
Livistona australis	X	
Flagellaria indica	X	
Commelina cyanea	X	
Juncus pauciflorus	X	
Drymophila cyanocarpa	X	
Rhipogonum sp.	X	
Smilax australis	X	
Dioscorea transversa	X	X

APPENDIX III.—Continued.

Floristic Composition of the Brush at Mungo.

	Mungo.	Chinaman's Knob.		Mungo.	Chinaman's Knob.
Alpinia caerulea	X		*Cupaniopsis anacardioides* ..	X	X
Peperomia leptostachya ..	X		*Nephelium leiocarpum* ..		X
Trema aspera	X	X	*Nephelium* sp.	X	
Laportea photiniphylla ..	X		*Alphitonia excelsa*	X	X
Cudrania javanensis	X		*Vitis clematidea*	X	X
Ficus sp.	X		*V. antarctica*	X	X
F. rubiginosa	X		*V. nitens*	X	
Sarcopetalum Harveyanum ..	X		*V. hypoglauca*	X	
Stephania hernandifolia ..	X		*Elaeocarpus cyaneus*	X	
Cocculus Moorei	X		*E. obovatus*	X	
Mollinedia macrophylla ..	X	X	*Viola hederacea*	X	X
Cryptocarya microneura ..	X		*Scolopia Brownii*	X	
Clematis glycinoides	X		*Passiflora edule*	X	
Citriobatus multiflorus ..	X		*P. Herbertiana*		X
Pittosporum undulatum ..	X		*Eugenia* sp.	X	
P. revolutum	X		*Rhodomyrtus psidioides* ..	X	
Acacia implexa	X	X	*Panax* sp.	X	X
A. decurrens var.	X		*Myrsine variabilis*	X	X
A. floribunda		X	*Sideroxylon australe*	X	X
Pultenea flexilis	X		*Cargillea australis*	X	
Acronychia laevis	X		*Notelaea longifolia*	X	X
A. Baueri	X		*Lyonsia reticulata*	X	
Zieria Smithii	X		*Marsdenia rostrata*	X	
Dysoxylum Fraseranum ..	X		*Solanum pseudocapsicum* ..	X	
Breynia oblongifolia	X	X	*S. stelligerum*	X	X
Croton Verreauxii	X		*S. verbascifolium*	X	
Omalanthus populifolius ..		X	*Clerodendron tomentosum* ..	X	
Poranthera microphylla ..		X	*Myoporum tenuifolium* ..	X	
Phyllanthus Ferdinandi ..	X		*Morinda jasminoides*	X	
Elaeodendron australe ..	X		*Asperula oligantha*		X
Cupania semiglauca	X	X	*Siegesbeckia orientalis*		X

EXPLANATION OF PLATES VI-VII.

Plate vi.

1.—Fore dune vegetation of *Festuca littoralis* and *Senecio spathulatus.* Near South Gibber.

2.—*Melaleuca Leucadendron* swamp forest at margin of lake, looking towards the water. Dense ground flora of *Cladium junceum.* Shores of Booloombayt Lake.

3.—Low forest of *Angophora lanceolata* on stable dune near sea; note distorted limbs. *Macrozamia spiralis* at foot of trees to left. Undergrowth of *Pteridium, Xanthorrhoea* and *Lomandra.* Near South Gibber.

4.—*Eucalyptus pilularis-E. gummifera* forest on deep stable sand. *Banksia serrata* in second storey (right foreground) and tall, shrubby undergrowth of *Leptospermum stellatum, Calythrix,* etc. About one-fourth mile inland from landing opposite Bombah Point.

5.—*Livistona australis* in swamp forest of *Eucalyptus robusta,* near to Mungo. Note the palms are flowering and there is active regeneration beyond the figure. South of Mungo.

6.—Mixed eucalypt forest on tuff hill. *Xanthorrhoea arborea* in centre, ground cover of tussock grasses and Cyperaceae. Near 'Cutler's', west of Booloombayt Lake.

7.—Sub-tropical rain-forest in steep-sided valley of tuff hills. A society of *Archontophoenix* in centre. Sheltered valley to north-east of Booloombayt Creek.

Plate vii.

8.—Remains of *Eucalyptus saligna*, v. *pallidivalvis* on silt flat by Booloombayt Creek. To the left is a swamp forest of *E. robusta*. Near northern extremity of Booloombayt Lake.

9.—Sandy shore at north end of Broadwater, east of Bombah Point. There is a dense fringe of young *Melaleuca Leucadendron* in the middle distance; other small trees occur between clumps of *Juncus maritimus* in the foreground. Tall *M. Leucadendron* behind.

10.—Heath with scattered *Banksia latifolia* among leptophyllous shrubs and sedge-like plants. Behind is a fringe of *Melaleuca Leucadendron* beyond which rises *Eucalyptus pilularis-Angophora lanceolata* forest on a stable dune. About 2 miles south-east of South Gibber.

11.—Peat Swamp, *Leptospermum Liversidgei* dominant, with occasional stunted *Eucalyptus robusta*. Eucalypt-Angophora forest on stable dunes behind. About 1 mile east of Bombah Point.

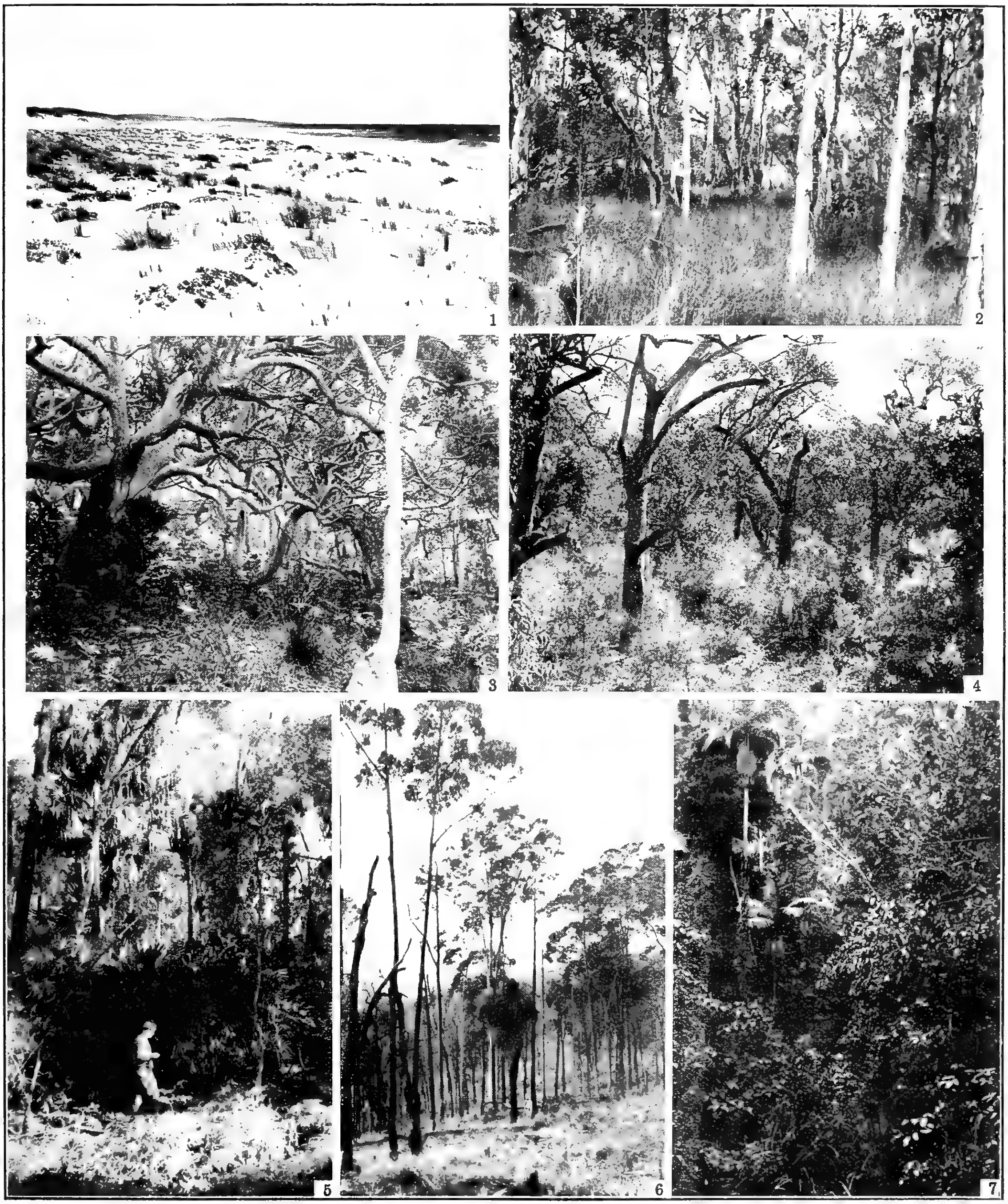
12.—Peaty Swamp with *Blechnum serrulatum*; to the left and behind are stable dunes with *Eucalyptus pilularis-Angophora lanceolata* forest. About 1 mile east of Bombah Point.

13.—Poor grass-land with tussocks of *Carex paniculata* on tuff hill, forming part of the peninsula in Booloombayt Lake.

14.—Mixed eucalypt forest on tuff hill; the trees shown include *E. maculata, E. umbra* and *E. microcorys*. North-east of Booloombayt Lake.

15.—Natural regeneration of mixed eucalypt forest on tuff hill; poor grazing land with tussocks of *Carex paniculata*. Near the northern extremity of Booloombayt lake.

Postscript, 14 July, 1939.—There exists some doubt about the correct specific name of the *Melaleuca* referred to in this paper as *M. Leucadendron*. R. T. Baker (*Journ. Roy. Soc. N.S.W.*, 1913, and Proc. Linn. Soc. N.S.W., 1913), after comparison of the local plants with the Linnean type specimen, came to the conclusion that they were so different as to warrant the description of two new species, *M. Smithii* and *M. Maideni*. He questioned whether *M. Leucadendron* really occurred in Australia. Nevertheless the *Census of N.S.W. Plants* (1916) retains the three specific names—*Leucadendron, Smithii* and *Maideni*. In view of the fact that there exists doubt as to the real specific designation, the name *Leucadendron* which is widely used by local botanists for this plant has been retained in this paper, though it is recognized that revision of the species may be necessary.



Vegetation of Myall Lakes district.

Vegetation of Myall Lakes district.

AUSTRALIAN COLEOPTERA.

NOTES AND NEW SPECIES. NO. XI. [Mostly Elateridae.]

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

(Plates viii–ix; one Text-figure.)

[Read 26th July, 1939.]

Colydiidae.

In examining what seemed to be a new species of *Byrsax*, Mr. Zeck found that its tarsal formula was 4–4–4. From the similarity of form, the other members of this genus were then examined, with the result that *Byrsax saccharatus* Pasc. and *B. egenus* Pasc. (= *coxi* Cart.) are seen to be similarly furnished. Both of these are thus true Colydiidae, near the New Zealand genus *Tarphiomimus*. So close must be this relation that for the present I would call them (?) *Tarphiomimus* (*Byrsax*) *egenus* Pasc. and (?) *Tarphiomimus* (*Byrsax*) *saccharatus* Pasc. The remaining members recorded under the genus, *B. macleayi* Pasc. and *B. pinnaticollis* Cart., have heteromerous tarsi.

The following is the new species mentioned above.

Tarphiomimus (?) zig-zag, n. sp.

Convex, oblong; pale brown above, reddish beneath.

Head wide, trilobate, each lobe subtruncate in front, exterior angles subdentate: near base of outside lobes, in one example, can be seen a small conical protuberance. Antennae short, stout, the three apical segments strongly clavate. *Prothorax* widely, arcuately, foliate; externally fringed with about five wide crenulations, the foremost almost level with apical lobe of head; posterior third abruptly excised and narrowed; disk strongly raised, medial area concave, bounded on each side by a pustulose ridge; the outline somewhat variable in the three examples, the most conspicuous features being two subconical pustules overhanging head and two rounded ones at basal third. *Elytra* of same width as prothorax, and of almost equal width for the greater part; widely (subtruncate) rounded behind, with wide lateral foliation, fringed by deep, blunt, crenulations; discal regions with shoulders prominent and widely ridged, with a variable number of conical pustules along sides; medial area with two strongly-raised ridges, forming straight lines at base and on apical declivity, the middle parts forming two wide zig-zags, the intervening area foveate-punctate, with squamose derm; underside squamose-rugulose. *Dim.* $3 \times 1\frac{1}{2}$—4×2 mm.

Hab.—N. Queensland: Mulgrave R. (H. Hacker).

One of Mr. Hacker's many discoveries. The species is near *T.* (?) *saccharatus* Pasc., but, besides being less than half its size, has the following distinctions: (*a*) All ridges less spinose-pustulose, (*b*) Fewer crenulations to pronotal foliation, (*c*) Elytral spinose ridges replaced by zig-zag elevations. The only evident sexual character lies in the frontal tubercles noted in one example. Holotype in the National Museum.

Buprestidae.

Bubastes subnigricollis, n. sp.

Conico-cylindric, nitid. Head dark blue, prothorax, underside and legs blue-black, tarsi coppery, elytra brilliant coppery, its suture narrowly more brightly metallic, scutellum peacock-blue.

Head very lightly concave, with narrow frontal sulcus, uniformly, closely punctate; eyes large, not prominent, width of head less than that of prothorax at apex. *Prothorax* (3½ × 5 mm.) very convex, widest near front, sides lightly arcuate, apex subtruncate, front angles wide, base lightly bisinuate, hind angles less than 90°; disk closely and finely punctate, slightly flattened on basal half at middle, with a well impressed medial sulcus, just traceable on apical half. *Scutellum* small, with longitudinal depression. *Elytra* of same width as prothorax at base, lightly narrowed to apex; apices each finely bidentate, with small lunation between teeth; striate-punctate, the seriate punctures distinct on basal half and at sides, elsewhere indistinct; intervals lightly raised and nitid, their interspaces transversely hatched and rugose. *Prosternum* with large, alveolate punctures, *metasternum* and abdomen with finer and more distant punctures. *Dim.* 17 × 5 mm.

Hab.—Western Australia: Wurarga (A. Goerling).

A single example sent by this observant naturalist is remarkable for its nitid and bicolorous surface. While the general colour scheme somewhat follows that of *B. vagans* Blkb., it differs greatly in (1) the colours more strongly contrasted—nitid blue-black thorax and brilliant coppery elytra, (2) the strong transverse ridges of the interspaces between the raised intervals of elytra. Holotype presented to the Australian Museum.

Melobasis impressa Cart.—Further material of this, also of *M. abnormis* Cart. sent by Mr. A. Goerling, together with a helpful field note, enables me to correct an erroneous synonymy (*Trans. Roy. Soc. S. Aust.*, 1937, p. 125). He writes: "I find these" (*impressa* and *abnormis*) "always separate in places about 2½ miles apart—never together, and this is my experience for the last 3 years." An examination of four examples of each gives constant differences as follows:

abnormis (1923)	*impressa* (1936)
Average dimensions, 12¾ × 5 mm.	15¾ × 6¼ mm.
Upper surface subopaque, strongly pubescent.	nitid, almost glabrous.
Pronotum sulcate.	often (in 3 of 4 examples) carinate.[1]
Elytra: costae more, punctures less defined.	vice versa.
impressions subobsolete.	well defined (as in description).

Melobasis bellula, n. sp.

Elongate-ovate; head coppery with greenish tinge, prothorax variably violet-bronze (each predominating in different examples); elytra blue, with golden markings, as follows: a wide basal band, having similarly wide, trilobed, extensions, namely two lateral, extending half the total length, and a sutural of about half the length of the lateral, and two triangular, subapical markings. Underside purple, often bluish in part, legs and antennae blue.

Head glabrous, densely, finely punctate, eyes not protruding laterally beyond thorax. *Prothorax* widest at base, thence gently, arcuately narrowed to apex, lightly produced in front at middle, base lightly bisinuate, all angles rather wide, the posterior subrectangular; disk with fine, not close, punctures and a smooth medial line. *Scutellum* small, subcircular. *Elytra* lightly widened at shoulders and compressed behind them, narrowly and separately rounded at apex, marginal

[1] Very unusual in the genus.

serrulation evident to apical third. Disk with well-marked subsutural concavity, and a few punctate striae near this, otherwise seriate punctures confused with close general punctures, these dense near base. Underside glabrous, sternal area with round, abdomen with finer, shallow, oval punctures, rather widely spaced; apical segment of ♂ truncate between two spines, of ♀ with oval excision between spines. *Dim.* 6–7 × 2 mm.

Hab.—Western Australia: Wurarga (A. Goerling).

A lovely little species, of which 14 examples were received from the keen naturalist squatter in a prolific Buprestid region, showing little variation in size and markings. Holotype presented to the Australian Museum.

MELOBASIS SPINOSA, n. sp.

Narrowly ovate; very nitid greenish coppery-bronze, head green, pronotum with green and coppery sheen; elytra greenish-bronze, purplish near apex; sternal regions, legs and antennae green, abdomen coppery.

Head rather flat, densely and finely punctate, width at eyes wider than that of prothorax at apex. *Prothorax*: apex and base bisinuate, all angles subacute, sides lightly narrowed in a feeble arch from base to apex, disk finely punctate, punctures sparse and distant on basal half, closer (but clearly separate) at sides and apex; medial fovea at base, no medial line. *Scutellum* small, subcircular. *Elytra* of same width as prothorax at base; basal half subcylindric, thence finely tapering to a spinose apex, each elytron terminated by a triangular tooth, the margin between tooth and suture with two small spicules; subapical margins strongly serrate; disk finely seriate-punctate, intervals flat and impunctate. Prosternum densely punctate, rest of underside more sparsely so; apical segment of abdomen strongly bispinose. *Dim.* 8 × 3 mm.

Hab.—Queensland: S. Johnstone River (H. W. Brown).

Two examples, both, I think, male, given me by Mr. Brown some time back, are unlike anything in the genus in the apical structure. Under the Zeiss binocular, each apex appears trispinose. The elytral seriate punctures are regular and clear, almost (but not) striate-punctate. Holotype presented to the Australian Museum.

MELOBASIS VIRIDISTERNA, n. sp.

♂. Elongate-ovate; nitid bronze and glabrous above (save for a fine frontal pubescence); prosternum, tibiae, tarsi, antennae and parts of head metallic green, rest of underside coppery and glabrous.

Head densely, very minutely punctate, width less than that of prothorax at apex. *Prothorax*: apex bisinuate, anterior angles acute; base subtruncate, posterior angles obtuse, sides nearly straight, lightly narrowed from base to apex; disk finely transversely strigose, only at sides very densely and minutely punctate, without medial line or fovea. *Elytra* slightly wider than prothorax at base, feebly widening behind middle, thence tapering to apex; subapical margins strongly serrate, the serration continuous to extreme tip; very finely seriate-punctate, the intervals almost flat, with subuniform punctures, especially on apical half, and some transverse strigae. Prosternum forming a rectangular plate, with small triangular process fitting into mesosternum; densely punctate, rest of underside irregularly punctate, abdomen strongly bispinose at apex.

♀. Green colour apparently limited to antennae, tibiae and tarsi. *Dim.* 11–12 × 4 mm.

Hab.—N.S.W.: Cooma (W. Duboulay), 4 examples. Victoria: Kiata, 2 examples.

A species with an unusually fine surface sculpture, the pronotal consisting chiefly of fine strigae, the elytral suggestive of *uniformis* Cart. which, however, is more convex, with a strongly pilose underside. *M. viridiceps* has a much more strongly punctate pronotum. The flat prosternal plate is a well marked character. Holotype presented to the Australian Museum.

Since the publication of my Revision of the Australian species of the genus *Melobasis*[2] I have added 14 names for new species, tabulated below. Of these 9 appear to be peculiar to Western Australia, three to Queensland and two to New South Wales. Thus Western Australia records 39 out of a total of 81 species, nearly 50% of the Australian species. The genus also occurs in New Guinea, New Caledonia, Fiji, Sumatra, Java, Timor, Borneo and Penang. In Australia it frequents various Leguminous plants, especially the numerous and widely distributed Acacias, while individual species are associated with Cassias, *Daviesia*. *Dillwynia* and *Viminaria*.

Table of Australian Melobasis *described since 1923.*

1.	Elytra with prominent costae	2
	Elytra without prominent costae	4
2.	Elytra unicolorous	*impressa* Cart.
	Elytra patterned	3
3.	Elytra purplish, lateral vittae and sutural mark golden	*aurocincta* Cart.
	Elytra with defined areas of light and dark bronze	*browni* Cart.
4.	Elytra unicolorous bronze	5
	Elytra metallic coppery, green, or purple	6
	Elytra patterned	11
5.	Pronotum punctate, underside bronze. (Sculpture finer than in *igniceps* Saund.)	*marlooensis* Cart.
	Pronotum finely strigose, except near sides, prosternum green in ♂	*viridisterna* Cart.
6.	Elytral apices spinose	*spinosa* Cart.
	Elytral apices normal	7
7.	Elytra striate-punctate	*wannerua* Cart.
	Elytra irregularly punctate	8
8.	Upper surface blue, elytra sulcate-punctate	*pavo* Cart.
	Upper surface otherwise	9
9.	Upper and lower surface green (6-7 mm. long.)	*pusilla* Cart.
	Elytra violaceous or purple	10
10.	Pronotum and underside blue-bronze (12 mm. long)	*myallae* Cart.
	Pronotum and underside green (6 mm. long)	*parvula* Cart.
11.	Elytra striate-punctate (blue with gold vittae)	*aurocyanea* Cart.
	Elytra not, or scarcely, striate-punctate	12
12.	Elytra green with golden vittae	*radiola* Cart.
	Elytra blue, with trilobed basal and preapical mark gold	*bellula* Cart.

STIGMODERA (CASTIARINA) PUTEOLATA, n. sp.

Ovate, subconic. Head, prothorax, underside and appendages nitid bronze, the last brassy, elytra dull brick-red with black markings as follows: an irregular medial fascia, widened at suture, extending obliquely to sides, this connected along suture with a wide, sagittate, preapical mark (in two examples narrowly produced to extreme apex) and three small spots—the middle one behind the others—halfway between the fascia and base.

Head widely excavate-canaliculate, with brassy reflections. *Prothorax* convex, apex subtruncate, base bisinuate, sides nearly straight on basal two-thirds, thence narrowed to apex, base without excisions; disk with exceptionally coarse punctures, widely separated on basal half, closer and finer near front, rather strongly pubescent on sides; medial channel wide and deeply impressed throughout. *Elytra* convex, subconical to apex, sides entire throughout, apices rounded; striate-

[2] *Trans. Ent. Soc. Lond.*, 1923, pp. 64-104, with two plates.

punctate, the strial punctures large, crenulating sides of intervals, these sharply convex—the 2nd, 3rd and 5th more strongly so on apical half, each interval with a line of well marked punctures. Underside glabrous, almost impunctate, very nitid. *Dim.* 10·5–12 × 3·5–4·5 mm.

Hab.—Western Australia: Lake Ningham (H. W. Brown).

Three examples examined, two given me by this enthusiastic collector, show a species somewhat like *S. convexa* Cart. in colour and in the entire margins and rounded apex of elytra. It differs strongly in its subcylindric, coarsely punctate prothorax and the more sharply convex elytral intervals and more conical form. Holotype in the Australian Museum.

Stigmodera brevifasciata Cart. = *bifasciata* Saund.—Mr. F. E. Wilson has called my attention to the tarsal claws of this species, which are characteristically those of *Themognatha*. I find the same in its close ally, *S. secularis* Thoms. Both species should thus be removed from the subgenus *Castiarina* to that of *Themognatha*.

ELATERIDAE.

This family has received somewhat piecemeal attention from Australian authors, Elston alone venturing to deal seriously with the larger groups. The chief difficulties attending its study are (1) the absence from Australia of well-named collections, (2) the sketchy descriptions of many of our species by Candèze the great specialist in the family, and (3) the slight and elusive characters that separate species and, sometimes, genera. The purchase of the Elston collection by the Australian Museum, with the helpful and industrious work of this author in putting together and translating the descriptions of our species, was the inducement to the undertaking of the present paper. The large amount of new material available here indicates the need for further revisional work in this family. My thanks are due to Mr. K. C. McKeown of the Australian Museum, Mr. Womersley of the Adelaide Museum, Mr. E. W. Salter of the Macleay Museum, Mr. Clark of the Melbourne Museum, Mr. H. Hacker of the Queensland Museum, Mr. Campbell of the Canberra Museum, as also to Messrs. F. E. Wilson, J. E. Dixon and J. C. Goudie for the loan or gift of material. I would here wish to express my appreciation of the generosity of Mr. H. W. Brown and of Mr. Gurney, of the Department of Agriculture, for their presentation of holotypes to the Australian Museum.

LACON BULLATUS, n. sp.

Wide, oblong; opaque reddish-brown, with short pubescence, antennae and legs red.

Head concave, punctate, widened to the front, here rounded on each side; antennae short. *Prothorax* subquadrate, length and breadth subequal, convex, scarcely gibbous; apex emarginate, front angles wide; sides nearly straight for the greater part, rather abruptly narrowed in front, sinuately widened at the posterior angles, lateral border coarsely crenulate, irregularly bicarinate, the exterior carina sometimes reduced to a row of nodules, the two carinae forming the lateral outline of the truncate, divaricate hind angles; disk coarsely alveolate-punctate; an ill-defined medial depression, and, in two examples (of four), bi-impressed. *Scutellum* transversely oval. *Elytra* as wide as prothorax at base, and less than twice as long (9:5); lightly convex, very lightly enlarged behind middle; sutural region, in two examples, depressed; striate-punctate, the striae wide and deep, seriate punctures large and close; intervals flat, except near base, 1st with a single row of punctures, 2nd and 3rd with a double row of punctures and transverse ridges, those exterior to 3rd studded with rows of rounded nodules. Underside finely punctate; prosternum with a transverse ridge, tarsal sulci absent. *Dim.* 17–20 × 7–8 mm.

Hab.—Western Australia: Lake Austin (H. W. Brown).

Four examples taken by Mr. Brown, who has generously given the type to the Australian Museum. It is characterized by its unusual size and width and the coarsely nodulose exterior elytral intervals. Holotype in the Australian Museum.

Myrmodes (?) elongatus, n. sp.

Elongate; subparallel; above, beneath and appendages brownish-red, sparsely pilose.

Head quadrate, somewhat rounded in front, briefly narrowed at hind angles, coarsely setose-punctate; antennae short, segment 1 very large, twice as long as wide, 2–3 short and oval, 4–8 bluntly dentate, 9–10 oval, 11 elongate-oval, narrower than 10. *Prothorax* convex, as wide as long (4½ mm.), widest at apical third, apex arcuate, front angles defined but wide, base subarcuate, sides entire, widely sinuate behind, posterior angles acute, obliquely pointing outwards, without carinae, the discal sculpture continuous to margins, without lateral sulcus; rather coarsely punctate in middle, more finely at sides and base. *Scutellum* large, oval. *Elytra* closely adapted to, but wider than, prothorax, shoulders obliquely truncate, sides subparallel; striate-punctate, with large square punctures in deep, clear-cut striae; intervals flat, closely punctate towards base, elsewhere with transverse, sometimes undulate, rugae, with recumbent pile near sides and apex. *Prosternum* coarsely and closely punctate, without sign of tarsal sulci; the rest of underside densely covered with small punctures: tarsi rather slender, clothed beneath with tufts of hair, post tarsi nearly as long as tibiae; segment 1 as long as 2–3 together, 2, 3, 4 successively shorter. *Dim.* 13–15 × 4½ mm.

Hab.—Queensland: Clermont (Peak Downs) (Dr. K. K. Spence).

Three examples given me by their captor can only be referred to *Trieres* or *Myrmodes*, to the former of which it is similar, so far as may be judged by the figure in the Genera Insectorum, but the narrow tarsi forbid its inclusion here. While differing from the monotypic *M. akidiformis* Cand. in its elongate elytra, it may provisionally be placed here. Holotype in the Australian Museum.

Glypheus cruciger, n. sp.

Elongate, oblong. Head, metasternum, abdomen, and elytral markings black, clypeus, prothorax (above and beneath), legs and ground colour of elytra orange-red; elytra bearing a postmedial cross, with diamond-shaped widening at suture, the seriate punctures and the apex, also antennae, black.

Head with usual concave clypeus and narrow border; antennae sublinear, extending slightly beyond base of prothorax; basal segments yellow. *Prothorax* subquadrate, apex arcuate, the acute anterior angles embracing the head to the eyes; sides feebly, arcuately, widening from the apex, sinuate before the long, divaricate hind angles; these with a strong, central carina. Disk very nitid, almost impunctate; a few white hairs at side. *Elytra* as wide as prothorax across the hind angles and more than twice as long; striate-punctate, the round strial punctures emphasized by dark colour; intervals convex and impunctate. *Dim.* 7–8 × 2·2 mm.

Hab.—New South Wales: Dorrigo (W. Heron).

Three examples, alike in colour, differ slightly in size. One example sent to Mons. E. Fleutiaux, others given, some time back, to Mr. A. M. Lea. It differs clearly in pattern from recorded species while approaching *G. alpinus* Blkb. in size. Holotype presented to the Australian Museum.

Glypheus militaris, n. sp.

Elongate, oblong. Head, underside (except prosternum), antennae and legs (including tarsi) black; prothorax above and below sanguineous, with apical border and hind angles black; elytra black with the following markings sanguineous: an arcuate patch at each side on basal third, covering 3rd and 4th intervals, widened and produced to sides, this narrowly connected with wide preapical fascia, interrupted at the suture. Whole upper surface with long, upright, black hairs. Underside glabrous, sparsely and minutely punctate.

Head less rounded in front than usual, with well-raised border and excavate within; antennae short, segment 3 slightly longer than the rest, 4–10 subequal. *Prothorax* feebly widened behind middle, scarcely sinuate anteriorly, front angles rounded off, sides more strongly sinuate before the long, acute, strongly divaricate and carinate hind angles; disk with fine, sparse setae and long, upright hairs at sides; a fine medial sulcus traceable for the greater part, except near apex. *Elytra* about as wide as prothorax, sides nearly straight, lightly rounded at apex; striate-punctate, the seriate punctures large, black, intervals nearly flat except at base, impunctate save for setae towards margins bearing long upright hairs. *Dim.* 12 × 5 (+) mm.

Hab.—New South Wales: Lithgow district (H. E. F. Bracey).

A unique example is a striking species of a similar colour to *G. sanguineus* Elst., but differs in its red pronotum with black hind angles, different elytral pattern, narrower form and finer sculpture, especially of underside. In some respects it must be near *G. decoratus* Cand., a species with black prothorax and different elytral pattern. Holotype in the Australian Museum (K.58776).

A second example in the S. Australian Museum, taken by the late A. M. Lea, at Wilmot, Tasmania, is probably the other sex. It is smaller (10 × 3 mm.) with the lateral red patch smaller and disconnected from the preapical fascia, but is otherwise like the Lithgow insect. There are many instances of this faunal distribution (Tasmania and alpine New South Wales).

Pseudaeolus[3] bimaculatus, n. sp.

Opaque black above and beneath, including appendages; hind angles of prothorax, tarsi, two ill-defined plagia on apical third of elytra, and the apical regions, vaguely, red.

Head rounded in front, strongly pubescent; antennae, with segment 1 long and curved, 2 and 3 small, equal, 4 longer than 5, 5–10 equal, subtriangular, 11 lineate oval. *Prothorax* sparsely pubescent, subcylindric, lightly narrowed in front and subsinuate behind, hind angles directed slightly outward, bicarinate. *Elytra* of same width as prothorax, apices diverging, each truncate; striate-punctate, the striae fine and clearly cut, the punctures scarcely discernible, intervals flat and silky, pubescent at sides and apex. *Dim.* 7–8 × 2 (+) mm.

Hab.—New South Wales: Rockley (H. J. Carter); Queensland: Cairns (H. W. Brown).

Four examples, two from each locality, differ from *Ae. australis* Cand. and *Ae. waggae* Cand. in the non-fasciate elytra. If considered only as a variety of *P. australis* Cand. it deserves a name. Holotype in the Australian Museum.

[3] Candèze considered that the Australian species of *Aeolus* should be placed under a separate subgenus *Pseudaeolus* (Cat. Elat., 1891, p. 77).

N.B.—*Ae. waggae* Cand. is stated to differ from *Ae. australis* Cand. in having the hind angles unicarinate. Examples from the Bogan River correspond with description, and are smaller, paler and more pubescent than examples determined as *Ae. australis* (4 examples from Mundaring, W.A. (Carter), 4 from Cue, W.A. (H. W. Brown)); Candèze's locality is Sydney. The species seem to have a wide distribution.

Pseudaeolus zig-zag, n. sp.

Opaque, castaneous, mottled with black; head black, pronotum with medial and apical regions black; elytra castaneous with ill defined postscutellary mark, a zig-zag fascia at apical third and the apex black; underside subfuscous red, abdomen darker; antennae, palpi and legs testaceous. A short, pale, pubescence, thickest on the elytra.

Head: clypeus rounded, frontal sculpture obscured by pubescence, antennae, segment 1 stout, 2 shorter than 3, 3 than 4, 4 longer than 5, 8–11 wanting. *Prothorax* longer than wide, laterally convex, sides very lightly converging to the front, feebly sinuate behind, hind angles scarcely divergent, unicarinate, disk without medial sulcus. *Scutellum* elongate-ovate. *Elytra* elongate-ovate, as wide as prothorax and nearly twice as long; striate-punctate, the striae fine, and, except near base and sides, obscured by the dense pubescence, as also the dark markings, intervals flat. *Dim.* 7 × 2 mm.

Hab.—N. Queensland: Cairns.

A single example in the Elston Collection is clearly distinct from recorded species. Holotype in the Australian Museum. I find a second example amongst some unlabelled Elateridae—probably from Queensland.

Pseudaeolus vagefasciatus, n. sp.

Elongate, parallel; upper surface varicoloured, with varied amount of red, subopaque, with short, pale pubescence; in general head and prothorax dark brown, the hind angles and basal area of the latter red, the elytra chiefly dark, with ill-defined postmedial fascia and the apex red. Underside castaneous, legs and antennae yellow.

Head minutely, densely punctate; clypeus rounded, antennae extending well beyond the prothorax in ♂, scarcely beyond the base of prothorax in the ♀, segment 1 curved, 2 and 3 short, 3 longer than 2, 4–7 subconic, 8–11 successively narrowed, 4–10 subequal in length, 11 lineate. *Prothorax* longer than wide (4 × 3 mm.), lightly convex; apex arcuate, front angles rounded off, sides nearly straight, hind angles well developed, lightly divaricate, with a long carina parallel to and near the external border. *Elytra* of same width as prothorax and twice as long; sides parallel for the greater part; finely striate-punctate, the punctures more evident in external half of elytra, intervals flat, finely transversely striolate, apices subtruncate. Underside densely, minutely punctate. *Dim.* 10–12 × 3 mm.

Hab.—New South Wales: Comboyne (H. J. Carter); Kurrajong and Epping (Dr. K. K. Spence); N.S.W. (H. W. Brown).

One ♂, 3 ♀ before me, the ♂ with longer antennae and the red colour more extended over the upper surface. It is the largest species of the genus recorded. Holotype presented to the Australian Museum.

An examination of the types in the Macleay Museum shows the following synonymy:

Melanoxanthus (*Cardiophorus*) *froggatti* Macl. ♂ = *M.* (*Cardiophorus*) *fasciolatus* Macl. ♀.—I think these are the sexes of the same species. I have noted this sexual colour difference in other species.

Elatichrosis (*Chrosis*) *angusticollis* Blkb. = *E. trisulcata* Er.—Blackburn's description exactly fits Victorian examples that cannot be separated from Erichson's species.

MELANOXANTHUS.

This genus appears to be common in tropical Australia, though undetermined in our collections. In form subconic or navicular, elytra short in proportion to the prothorax, the hind angles of the latter strongly developed, divaricate and carinate, the sculpture often coarse, the antennae serrate, sometimes widely so, often ornately coloured, they are strikingly different from the Cardiophorinae. In *Mem. Soc. Roy. Liége*, 1882, Candèze states "la distinction entre les deux genres" (*Megapenthes* et *Melanoxanthus*) "est devenue absolument impossible". Yet I prefer to separate the Australian species of these genera known to me by the different antennae. As with other of our northern species of Coleoptera, many occur on both sides of Torres Straits. Thus I have identified *Melanoxanthus angularis* Cand., *M. ruficollis* Cand. and (?) *M. abdominalis* Cand., described from New Guinea, amongst Elateridae labelled as from Cairns district by the late F. P. Dodd. The following are, I believe, undescribed.

MELANOXANTHUS JUCUNDUS, n. sp. Pl. viii, fig. 2.

Head, antennae, underside and legs black, prothorax and tarsi red; elytra black, with two white rectangular markings, forming a medial fascia, interrupted at sides and suture, each sloping backward from suture to sides: sparsely pubescent.

Head short, punctate, antennae not reaching base of prothorax, rather wide, segment 1 tumid, 2, 3 small, 4–10 triangularly dentate, 5–10 subequal, 4 smaller than 5, 11 oval. *Prothorax* about as long as wide, arcuately narrowed in front, subsinuately widened at the acute, carinate, posterior angles. Disk moderately convex, coarsely and evenly alveolate-punctate, short bristly hair showing laterally. *Scutellum* large, triangular. *Elytra* subconic, navicular, at base as wide as prothorax at hind angles, thence narrowing to apex, here not quite covering abdomen; striate-punctate, striae close, seriate punctures large and close, intervals asperate and nodulose on basal half. Prosternum coarsely, metasternum more finely punctate. Hind coxae angulately widened within, narrowed externally. *Dim.* $4 \times 1\frac{1}{2}$ mm.

Hab.—North Queensland: Townsville (Elston Coll.), Port Denison (Macleay Museum), Wide Bay (Australian Mus.).

Four examples examined of this pretty little species. Holotype in the Australian Museum.

VAR.—Two of the examples have the apical area of the pronotum black.

MELANOXANTHUS BIARCTUS, n. sp. Pl. viii, fig. 4.

Of the same size and form as *H. jucundus*. Nitid black with dark pubescence, elytra with two elongate-oval markings testaceous extending from behind the shoulders to the apical fourth, near, but not touching, sides; legs black, tarsi red, antennae with reddish tinge.

Head strongly punctate, clypeus rounded, antennae very similar to that of *jucundus*, but 4–10 less widely dentate, more closely adjusted, 11 wider. *Prothorax*: length and breadth subequal, arcuately narrowed in front, hind angles long, acute, slightly divergent and carinate, sides feebly widened near middle; disk moderately convex, with large, round punctures, alveolate in middle, separate towards sides, a linear depression behind each hind angle, basal declivity steep. *Elytra* at base as wide as prothorax at hind angles, thence navicular to apex, not quite covering abdomen; striate-punctate, with series of large round punctures between narrowly raised intervals, underside with dense silvery pubescence. *Dim.* 3½–4 × 1½ mm.

Hab.—North Queensland: Cairns (Macleay Museum); Coen R. (C. York) (Hacker).

Five examples; two on a card include the holotype, a third in the South Australian Museum, and two in the National Museum, Melbourne, from Cape York.

Melanoxanthus columbinus, n. sp. Pl. viii, fig. 3.

Narrowly ovoid, with short, rather thick pubescence. Head black, prothorax above and below red, with a black patch at apex, narrowing to a point near the middle; elytra nitid black, with two curved yellow maculae at middle, formed like the wings of a bird at rest; these nearly meeting at suture and extending along, but not reaching, sides for about one-third of their length; underside (except prosternum) black, legs reddish, antennae dark red.

Head: clypeus rounded, forehead coarsely punctate, antennae not reaching base of prothorax, wide, very much as in *M. biarctus*, 4–10 strongly dentate, 11 oval. *Prothorax* rather wider than long, arcuately narrowed in front, sides nowhere widened, hind angles lightly divergent, bi-carinate and acute, embracing the shoulders of elytra; disk moderately convex, closely, not contiguously, punctate, the punctures large, round and umbilicate. *Scutellum* large, triangular. *Elytra* slightly narrower than prothorax at the hind angles, thence converging to apex; striate-punctate, the striae wide, intervals flat (except near base), seriate punctures large and close with rugose edges, giving the basal half an asperate, though nitid surface; underside rather densely clad with silvery pubescence. *Dim.* 4½ × 1½ mm.

Hab.—North Queensland: Cairns. (Macleay Museum.)

Another interesting novelty from this rich collection. The elytral pattern suggests a dove's wing. Hence the name. Two examples on a card include the holotype, marked with an arrow. A third is in the South Australian Museum and a fourth, from Wyreema, Q., is in the Queensland Museum. Examples in the South Australian Museum from Cairns differ in having the prothorax wholly black. These are ♀ and, like *froggatti* Macl., show a sexual coloration.

Melanoxanthus flavosignatus, n. sp. Pl. viii, fig. 1.

Ovate; nitid black, hind angles of prothorax and wide medial, interrupted fascia on elytra yellow, legs reddish, antennae reddish-brown.

Head short, punctate and pubescent, antennae short, 4–10 strongly dentate. *Prothorax* gently narrowed from base to apex, a little sinuate before the extreme point of hind angles—these lightly divaricate and embracing elytral shoulders. Disk moderately convex, densely covered with subcontiguous, umbilicate punctures and with short, bristly dark hairs. *Scutellum* large, oval. *Elytra* slightly narrower than prothorax at hind angles, gently narrowed from base to apex, the wide yellow fascia extending to the sutural interval, not quite reaching sides; striate-punctate, strial punctures small, intervals flat, except on basal half—here strongly asperate with fine nodules and transverse wrinkles. *Dim.* 4 (vix) × 1½ mm.

Hab.—Queensland: Wide Bay (Macleay Museum.) Holotype in the Macleay Museum.

Var.—Two examples in the Australian Museum, from the same locality, are clearly conspecific, but have the hind angles of the prothorax black.

MELANOXANTHUS INSOLITUS, n. sp. Pl. viii, fig. 6.

♂. Elongate-oval. Head black, prothorax red, elytra black with yellow markings as follows: a small round spot on each side at extreme base, an arcuate diagonal macula on each, extending from behind shoulder to the 2nd elytral interval, forming an interrupted fascia, a straight subrectangular macula at apical third, forming a second interrupted fascia; prosternum red, strongly pubescent, rest of underside black.

Head rather longer, but of similar structure to that of *H. jucundus*, antennae 4–10 dentate, 11 oval. *Prothorax* arcuately narrowed in front, sides nearly straight on basal two-thirds, posterior angles feebly divergent, acute and strongly carinate; disk rather closely punctate, the punctures much smaller than in the other species described here, sparsely clad at sides with pale pubescence. *Scutellum* large, oval. *Elytra* at base as wide as prothorax and more than twice as long, sides nearly straight, more widely rounded at apex than usual; striate-punctate, striae narrow, seriate punctures moderately large and very distinct, intervals—especially on dark areas—cancellately divided by transverse wrinkles, the basal area asperate and subnodulose.

♀. Of two examples on a card, what I take to be the other sex has the pronotum dark brown, with the hind angles red, the yellow subhumeral mark connected with the basal spot, and the two subapical marks oval. There is little doubt of the two being conspecific. *Dim.* 5 × 2 mm.

Hab.—Cape York. (Macleay and the Queensland Museums.)

Less conical in form than usual, otherwise typical of the genus. A dual carina at sides of pronotum—somewhat as in *Cisseis* (Buprestidae). Holotype and allotype in the Macleay Museum.

MELANOXANTHUS LATIVITTIS, n. sp. Pl. viii, fig. 7.

Elongate, subconic; very sparsely pubescent. Head, prothorax and underside dull brownish-black, the prothorax with apical band and hind angles, also antennae and legs, red; elytra with base brightly luteous, a wide vitta extending throughout, gradually narrowing to apex, yellow, leaving the suture narrowly, the sides more widely, brown.

Head deeply enclosed in prothorax, antennae with segments 2 and 3 small, 4–10 moderately serrate. *Prothorax* gently narrowed from base to apex, sides feebly sinuate behind, hind angles unicarinate, closely adapted to elytral humeri, disk rather finely alveolate-punctate. *Elytra* elongate, subconic, more than thrice as long as prothorax; striate-punctate, strial punctures rather small, intervals lightly convex, except near base; those on dark areas rugosely wrinkled. *Underside* subglabrous, finely and closely punctate, *epipleurae* with larger punctures. *Dim.* 4·5 × 1 (+) mm.

Hab.—Queensland: Wide Bay.

Two examples in the Macleay Museum show a species more elongate and narrow than usual. Type series in the Macleay Museum.

MELANOXANTHUS SEMIRUBER, n. sp. Pl. viii, fig. 5.

Subconic. Head and antennae, prothorax and underside dull black, the hind angles of prothorax, basal segments of antennae and legs red, elytra with basal half chiefly red, this colour with undefined limits at base, the base, suture and apical half black; upper surface with short pubescence.

Head convex, antennae rather stout, submoniliform, 2–3 short, 8–10 tending to triangular, 11 oval. *Prothorax* slightly longer than wide, sides nearly straight, lightly narrowed in front, hind angles acute, slightly divaricate and strongly carinate; disk uniformly alveolate-punctate. *Scutellum* large, oval. *Elytra* of same width as prothorax and about twice as long, sides narrowed from base to apex; striate-punctate, strial punctures fairly large and close, setigerous; apical half finely rugose. *Dim.* $4\frac{1}{2} \times 1\frac{1}{2}$ mm.

Hab.—North Queensland: Cairns (Macleay and the South Australian Museums).

Of like form to *H. biarctus* and *H. flavosignatus.* Holotype in the Macleay Museum.

MELANOXANTHUS RUFONIGER, n. sp. Pl. viii, fig. 11.

♂. Base of head, antennae (except basal segments), a wide median vitta on pronotum, apical three-quarters of elytra subnitid black, rest of surface, above and below, red or yellow; dull red on head and pronotum, base of elytra, underside and legs pale yellow, with rather dense pubescence at sides of pronotum and elytra.

Head closely punctate, antennae not quite reaching base of prothorax, segments rather widely triangular to scutate. *Prothorax*: sides converging from base to apex, hind angles acute, unicarinate, and feebly divaricate, closely embracing shoulders of elytra; disk closely punctate, the punctures tending to coalesce in lines, becoming finer towards sides. *Elytra* twice as long as prothorax, cuneiform; clearly striate-punctate, intervals nearly flat and finely granulate.

♀. Whole of head and greater part of elytra orange-red, the latter paler near base, the sides only black, elsewhere very faintly clouded.

Dim. ♂, $3\frac{3}{4}$ mm.; ♀, 4 mm. long.

Hab.—Queensland: Tambourine Mountain (A. M. Lea).

A pair, the sexes, in the South Australian Museum, give evidence of the thorough field-work of my old friend. The name *vitticollis* is barred by the triple use of this name in the genus. The elytra are evidently liable to colour variation. Holotype in the South Australian Museum.

Australian species of Melanoxanthus *known to me.*

1.	Prothorax black, or chiefly so	2
	Prothorax red, or chiefly so	8
	Prothorax trivittate, medial area black, sides yellow	*rufoniger*, n. sp.
2.	Prothorax wholly black	3
	Prothorax with hind angles red or yellow	5
3.	Elytral markings longitudinal	*biarctus*, n. sp.
	Elytral markings more or less fasciate	4
4.	Fascia narrow	*fasciolatus* Macl.; ? ♀ *froggatti* Macl.
	Fascia alatiform	♀ *columbinus*, n. sp.
5.	Elytra black	*angularis* Cand.
	Elytra variegated	6
6.	Elytral markings more or less fasciate	*flavosignatus*, n. sp.
	Elytral markings longitudinal	7
7.	Apex of prothorax red	*lativittis*, n. sp.
	Apex of prothorax black	*semiruber*, n. sp.
8.	Prothorax wholly red	9
	Prothorax red with black markings	11
9.	Elytra with one pair of pale maculae	10
	Elytra with two pairs of pale maculae	*insolitus*, n. sp.
10.	Pale maculae at right angles to suture	*froggatti* Macl.
	Pale maculae sloping backwards from suture	*jucundus*, n. sp.
11.	Prothorax with black apical patch	♂ *columbinus*, n. sp.
	Prothorax with hind angles black	*ruficollis* Cand.

HYPNOIDUS FLAVOPICTUS, n. sp. Pl. viii, fig. 9.

Obovate; nitid black with silvery pubescence, hind angles of prothorax, antennae, tibiae, tarsi and elytral markings pale yellow, the last as follows: basal mark extending and widened laterally on basal fourth, medial oval mark on each side of suture and a wide, irregular, preapical fascia, produced along suture to apex.

Head closely pubescent, antennae mutilated, the few remaining segments subtriangular. *Prothorax* convex, ovate, widest near middle, more narrowed behind than in front, subsinuate near hind angles, these non-carinate, acute, triangular, directed slightly outward; disk mirror-like and minutely punctate, a short basal sulcus, bordered by carina, parallel to sides. *Elytra* ovate, wider than prothorax; striate-punctate, the strial punctures large, intervals roundly convex throughout with light transverse wrinkles. *Underside* and *femora* black, nitid. *Dim.* 4–5 × 1½ mm.

Hab.—New South Wales (Macleay Museum).

Two examples with incomplete antennae and legs are very distinct from described species. Type series on card in the Macleay Museum.

H. (*Cryptohypnus*) *dimidiatus* Macl. = *H.* (*Cryptohypnus*) *semifasciatus* Macl.—An examination of the types makes this evident: a slight colour difference only between the types.

Subfamily CARDIOPHORINAE.

Three generic names, *Cardiophorus*, *Paracardiophorus* and *Horistonotus*, have been applied to Australian species. Of these, *Horistonotus* appears to be a purely American genus, separated from *Paracardiophorus* by the narrow front of head and the more strongly developed hind angles of the prothorax and generally flatter form. *Cardiophorus* is limited, fide Schwartz (*Gen. Ins.*, p. 46*b*; also *Deutsch. Ent. Zeit.*, 1895, p. 40), to species having the lateral carina either absent, or, when present, only on the underside.

I have examined examples of *C. cinereus* Hbst. (Europe), *C. ophidius* Cand. (India) and *C. ruficollis* L. (Europe), kindly sent from the British Museum. The Australian species standing under *Cardiophorus* in the Junk catalogue are clearly not congeneric with these; in no instance is the lateral carina either absent or bent downward from the hind angles, as in the above three. Omitting the four species recorded from New Guinea, Celebes and Ternate as unknown to me, five Australian species remain in this list as follows:

fasciolatus Macl. ♀ and *froggatti* Macl. ♂ are, I consider, the sexes of the same species, differing only in the colour of the prothorax. They belong to the genus *Melanoxanthus*.

macleayi Schw. = *quadrimaculatus* Macl. is a typical *Paracardiophorus*, the lateral carina being continuous along the basal two-thirds of margin.

tumidithorax Schw. (*tumidicollis* Schw.)—Unknown to me. The description strongly suggests a *Paracardiophorus*, structurally similar to *C. venustus* Cand.

venustus Cand.—A common species in South and Western Australia, of which many examples are before me. The lateral carina is very short, extending little beyond the basal fourth of the margin; here abruptly terminated, not bent to the underside. According to the tabulation of Schwartz, this short carina would bring it under *Horistonotus*. But the structure of head, prothorax and elytra is that of a typical *Paracardiophorus*, congeneric with *P. australis* Cand. and others. Moreover, the distinction given by Schwartz for *Horistonotus*—"Die seiten des Prothorax sind höchstens bis zu Mitte gerandet"—fails in two species sent me for examination, *H. exoletus* Er. (Mexico) and *H. flavipes* Champ. (Costa Rica), in both of which the lateral carina extends along two-thirds of the margin.

Rather than give new generic names to the few species having this short lateral carina, it seems advisable to include all the known Australian Cardiophorinae under the single genus *Paracardiophorus.* Further, in the tabulation of Schwartz this genus is thus characterized: "Die Seiten des Prothorax sind gewöhnlich bis zur den Vorderecken gerandet"; but in no single instance, of the hundreds examined, have I seen this lateral border continued to the front angle, though it is generally traceable beyond the middle.

A single species of *Cardiotarsus*, described below, adds this genus to the Australian Elaterid fauna.

Paracardiophorus attenuatus Elst.—This species is doubtfully fitted to its present position. The lightly convex, little widened, prothorax, with divaricate, rather wide hind angles, prosternal sutures well developed, hind coxae not produced laterally, antennae with wide, subdentate, segments, present features inconsistent with its status in the subfamily.

The greater number of the genus are found under the bark of Eucalyptus trees.

Horistonotus bicolor Rainb. (*Rec. Aust. Mus.*, 1904) has been omitted by Schenkling from the Junk Catalogue. An examination of the type shows it to be a *Paracardiophorus*—one of the common varieties of *P. australis* Cand. in which the pale maculae are connected to form vittae.

P. despectus Cand. = *P. antennalis* Schw.?—This synonymy is extremely probable. The descriptions are almost identical. The query is a concession to my inability to compare the types.

I have omitted certain of the more or less concolorous species from my table, since it has been difficult to identify these with certainty; though most have been 'hypothetically' labelled. A few notes on these may be helpful.

Of the four black species, *compactus* Cand., *consobrinus* Cand., *dissimilis* Schw., and *tumidithorax* Schw., *dissimilis* is readily distinguished by its black legs. It is common in Western Australia, and, as noted by the author, the ♀ has, sometimes, a red shoulder-mark. As this colour variation may apply to others, it is possible that the three *lenis* Cand., *moseri* Schw., and *xanthomus* Cand. may be forms of concolorous species. Careful field notes only can establish this.

P. tumidithorax Schw. should be easily determined by its large size (10 mm. long), and opaque surface. I have not seen it.

P. compactus Cand. has been hypothetically separated from *consobrinus* Cand. by locality (Victoria and Queensland respectively) and the dark antennae of the former. My examples of (?) *compactus* are from Beaumaris, Vict., and Mulwala (Murray R.); of (?) *consobrinus* from Cairns, Stewart R. (N.Q.), Cape York and Brisbane.

P. lenis Cand. is said to be distinguished from *xanthomus* Cand. by basal spot and apex red. My examples of the former are from Benalla, and of the latter from Wattle Glen, Heathcote Junction and L. Hattah, Vict.

P. moseri Schw. I think I know by its larger shoulder-spot and dark antennae. Examples from Frankston and other Victorian localities.

Six species are described as brown. Of these *despectus* Cand. (= *antennalis* Schw.) has a wide distribution in New South Wales and Victoria and beyond. My examples are from Sydney district, Jenolan, Morgan (S.A.) and one example (det. by M. Fleutiaux) from Queensland.

P. consputus Cand., from Victoria, must be very close to *vagus* Schw. from New South Wales. Examples (?) of the former are from L. Hattah, Wood Wood, Vict., and of the latter from Illawarra and Cotter R. (N.S.W.).

P. humilis Er. and *jugulus* Elst. are included in my table.

Of the five species described as castaneous, red or yellow, *mjöbergi* Elst. is tabulated below; *victoriensis* Blckb. and *flavipennis* Cand. (a minute species from W.A.) are unknown to me; *pallidipennis* Cand. is determined with a ? from Cheltenham (Vict.), Albury and Mulwala, and *longicornis* Cand. from Kuranda and Cairns. The 14 other recorded species, together with 19 new species, are tabulated below.

N.B.—Since writing the above, I have received from M. Fleutiaux some notes on examples sent, as identified with a (?) by me. Of *compactus* Cand., *consobrinus* Cand., *despectus* Cand. and *pallidipennis* Cand., he writes: "Ils paraissent appartenir à la même espèce! Mais laquelle?" Of each Schwartz species, *vagus*, *moseri* and *longicornis*, he writes: "M'est inconnu"! which explains my difficulties in this group.

Table of Australian species of Paracardiophorus.

Section A.—Species with elytra concolorous or with defined areas of dark and pale colours.

1.	Elytra unicolorous	2
	Elytra bicolorous	4
2.	Prothorax red, head and elytra black	*bicolor* Cand.
	Upper surface testaceous	*mjöbergi* Elst.
	Upper surface fuscous or black	3
3.	Black, or nearly so, post angles of prothorax red	*humilis* Er.
	Brown, anterior angles of prothorax red	*jugulus* Elst.
4.	Elytra black or brown, with defined red or yellow areas	5
	Elytra variegated, colours vaguely defined	8
5.	Size normal, 5-6½ mm. long	6
	Size small, 4-4½ mm. long	7
6.	Basal half of elytra red or yellow	*dimidiatus* Schw.
	Basal two-thirds of elytra yellow, with black humeral spot	*divisus* Cand.
	Base, with lateral extension, red or yellow	*elisus* Cand.
7.	Brown, shoulder spot paler	*octavus* Cand.
	Black, shoulder spot red	*eucalypti* Blkb.
8.	Prothorax concolorous (castaneous)	9
	Prothorax variegated	*variegatus* Schw.
9.	Elytra with pale and dark areas ill defined	10
	Elytra red, the dark areas more or less fasciate	11
10.	Elytra testaceous, variably suffused with fuscous	*litoralis*, n. sp.
	Elytra nitid castaneous, suture and variable area black	*cooki*, n. sp.
	Elytra dull red, apical half variously infuscate	*varians*, n. sp.
11.	Elytral fascia well defined, underside red	*subfasciatus*, n. sp.
	Elytral fascia vaguely defined, underside black	*nigrosuffusus*, n. sp.

Section B.—Elytra with markings in a symmetrical pattern.

1.	Elytral colours longitudinally arranged	2
	Elytra maculate	4
2.	Prothorax black, post angles red, elytra with black and pale vittae	*vittipennis*, n. sp.
	Prothorax variegated	3
3.	Elytra with orange shoulder-spot, extended on sides, and disconnected red streaks	*rufopictus*, n. sp.
	Elytra with dark and pale yellow vittae	*alternatus*, n. sp.
4.	Elytra yellow, with 4 spots and apex black	*atronotatus*, n. sp.
	Elytra with 4 pale spots on dark ground	5
	Elytra otherwise	14
5.	Prothorax red	*venustus* Cand.
	Prothorax black	6

6. Size 5-6 mm. long 7
 Size 3-4 mm. long 11
7. Maculae yellow 8
 Maculae orange or red 10
8. Hinder pair of maculae round, basal oblong .... *fulvosignatus* Cand.
 Hinder pair of maculae subfasciate 9
9. Basal maculae oblique from shoulder .... *australis* Cand.
 Basal maculae forming an elongate S .... *hamatus* Cand.
10. Hinder pair of maculae oval .... *dulcis*, n. sp.
 Hinder pair of maculae elongate and wide .... *occidentalis*, n. sp.
11. Maculae yellow 12
 Maculae orange or red 13
12. Basal maculae lunate, hinder fasciate .... *minimus* Cand.
 Maculae subdiagonal, cruciform .... *subcruciatus*, n. sp.
13. Basal maculae large and round, hinder oblong .... *macleayi* Schw.
 Elytral maculae small and round .... *quadristellatus*, n. sp.
14. Size $4\frac{1}{2}$-$5\frac{1}{2}$ mm. long 15
 Size 3 mm. long. Elytra with 4 maculae and postmedial fascia .. *carissimus*, n. sp.
15. Elytra with basal area widely red 16
 Elytra not so 17
16. Elytral basal half red, apical black with white fascia .... *amabilis*, n. sp.
 Elytral basal third red, apical two-thirds black with two yellow spots .... *stellatus*, n. sp.
17. Prothorax black, elytra with six maculae .... *sexnotatus*, n. sp.
 Prothorax with 2 orange spots, elytra with 6 maculae .... *octosignatus*, n. sp.

The new species are described below.

Paracardiophorus alternatus, n. sp. Pl. ix, fig. 10.

Nitid red, head and prothorax a dark castaneous, the latter mottled with pale red; elytra with alternate intervals dark and pale yellow, appendages red; underside densely pubescent with pale, recumbent hair.

Head strongly punctate and finely pubescent, antennae extending well beyond base of prothorax, rather stout, segments 2 and 3 short, 4–10 elongate conic. *Prothorax* tumid, moderately widened in front of middle, sinuate before hind angles; lateral border abruptly terminated before half-way; disk finely and rather closely punctate, a short sulcus near hind angles. *Scutellum* cordate. *Elytra* wider than prothorax at base, sides nearly straight on basal half, thence lightly narrowed behind; striate-punctate, the striae deep, strial punctures indistinct; intervals rather strongly convex and punctate, pubescence thick at sides and apex. *Dim.* $4\frac{1}{2} \times 1\frac{1}{3}$ mm.

Hab.—Western Australia: Geraldton (J. Clark).

A unique example in the Elston Collection is unlike any recorded species. Holotype in the Australian Museum.

Paracardiophorus amabilis, n. sp. Pl. ix, fig. 6.

Head, prothorax, abdomen and parts of elytra nitid black, hind angles of prothorax rufescent; elytra with basal half red, apical half black, except for a transverse oval macula white (or nearly so) forming an incomplete fascia at middle of black area; metasternum and basal margin of prosternum red; hind femora dark, legs otherwise red; antennae with basal segments dark red, the rest more or less infuscate.

Head lightly convex, rather densely clad with silvery hair; antennae slender, segments 3–10 subequal, lineate-obconic. *Prothorax* tumid, widely rounded, widest in front of middle, sides contracting roundly in front, a little sinuate before the well defined, dentate hind angles, the narrow raised border evident only at posterior fourth; disk closely, unevenly punctate, the larger punctures at base and sides, a feebly depressed medial line near base. *Elytra* lightly enlarged at shoulders, subparallel for the greater part; striate-punctate, with large punctures set in deeply impressed striae, intervals convex and clearly punctate. Underside with dense, grey, recumbent hair. *Dim.* $5\frac{1}{2} \times 2$ mm.

Hab.—N.W. Victoria: Sea Lake (J. C. Goudie), Lake Hattah (J. E. Dixon). S. Australia: Port Lincoln (Blackburn).

Six examples examined. It and *C. venustus* Cand. are the prettiest of the Australian species. I am indebted to Mr. Dixon for one example; two others, including the holotype, are in the Elston Collection in the Australian Museum. Three more are in the South Australian Museum.

PARACARDIOPHORUS ASSIMILIS, n. sp. Pl. ix, fig. 3.

Nitid black; elytra with four yellow maculae: two narrow, elongate, from base along the 4th interval, rounded and enlarged at base; two small, round spots at apical third; antennae and femora black, tarsi and basal segments of antennae yellow, tibiae variably suffused with yellow; head strongly, elsewhere sparsely, pubescent.

Head punctate, pubescent, antennae long and slender, extending beyond base of prothorax. *Prothorax* convex, ovate, well rounded anteriorly, widest in front of middle, sinuately and strongly narrowed behind, narrow lateral border terminated abruptly about apical fourth; disk finely duplo-punctate, hind angles small and subtruncate. *Scutellum* large, triangular. *Elytra* narrowly ovate, widest behind middle; striate-punctate, intervals convex near base, elsewhere nearly flat and transversely wrinkled; underside lightly pubescent, minutely punctate. *Dim.* $5 \times 1{\cdot}5$ mm.

Hab.—Australian Capital Territory: Black Mountain (A. Tonnoir and F. Graham); New South Wales: Tallong (F. H. Taylor); Queensland: Bribie Island (A. M. Lea, H. Hacker).

Nine examples before me have been confused with *C. australis* Cand., but the following comparison will distinguish them:

	australis Cand.	*assimilis*, n. sp.
Elytral marks:	Two wide, oblique from behind shoulders; two postmedial, subfasciate.	Two narrow, longitudinal, from mid-base, forming round, luteous spot at base; two postmedial small and round.
Tibiae	yellow	in general dark above except at knees.

In form *assimilis* is more biovate, with more strongly punctate prothorax. Holotype in the Canberra Museum.

PARACARDIOPHORUS ATRONOTATUS, n. sp. Pl. viii, fig. 10.

Biovate; head, prothorax (except hind angles, yellow), underside and elytral markings black; elytra yellow, with two small, elongate spots near base, on the 4th interval, two oval maculae at middle of sides and the apical fourth black; antennae black with the three basal segments yellow, legs yellow.

Head with pale pubescence, antennae not reaching the base of prothorax, segment 1 very tumid, 2 and 3 subequal, each shorter than 4, 4–10 subequal. *Prothorax* very nitid black, widest and well rounded in front of middle, lightly narrowed and scarcely sinuate behind; disk clearly, finely, but distinctly punctate, the punctures evenly spaced; lateral carina on basal half only. *Scutellum* cordate. *Elytra* narrowly ovate; striate-punctate, striae and punctures clearly impressed, intervals convex only near base and minutely setose. *Dim.* $4 \times 1{\cdot}3$ mm.

Hab.—New South Wales: Craven (T. G. Sloane).

A single example was given me by my old friend. It has a distinct pattern unlike any other, while belonging to the section that includes *octavus* Cand., *macleayi* Schw., *subcruciatus* Cart. Holotype in the National Museum, Melbourne.

PARACARDIOPHORUS CARISSIMUS, n. sp. Pl. ix, fig. 2.

Narrow, elongate; head, prothorax and underside nitid brownish-black, almost glabrous, elytra reddish-brown, with testaceous pattern as follows: humeral comma-shaped mark, covering shoulders and continued laterally backward, two premedial, elongate-oval marks, and a wide, oblique, postmedial fascia, rather widely interrupted at suture, its interior hind corners connected with a sutural extension almost to apex, posterior angles of prothorax testaceous, antennae and femora dark, tibiae and tarsi red.

Head of typical form, antennae obscured by gum. *Prothorax* moderately convex, ovately widened, equally narrowed each way, slightly wider in front than behind the middle, without posterior sinuation; disk very minutely punctate and mirror-like, lateral border continued for three-quarters of length from base. *Elytra* elongate-ovate, more convex than usual, widest at middle; striate-punctate, the round punctures well defined on light areas, intervals a little convex towards base, nearly flat elsewhere. *Dim.* 3 × 1 mm.

Hab.—Western Australia: King George's Sound.

Four examples, two in the Australian Museum, badly gummed, and two in the National Museum, are amongst the most ornate and distinct of the genus and one of the smallest. Holotype in the Australian Museum.

PARACARDIOPHORUS COOKI, n. sp. Pl. viii, fig. 14.

Elongate-ovate; head and pronotum nitid castaneous, scutellum, suture and a large, variable area of elytra black; underside red, appendages testaceous.

Head pubescent, clothing little paler than surface; antennae extending to base of prothorax, segments subtriangular. *Prothorax* moderately convex, little contracted in front or behind, hind angles shortly triangular, blunted at extremity, with black margin; disk with dual system of punctures, the larger evenly spaced some distance apart, ground punctures minute and close; very lightly pubescent; lateral carina not extending half-way to front. *Scutellum* cordate, dull black. *Elytra* narrowly ovate, striate-punctate, striae well impressed, serial punctures large, regular, crenulating sides of intervals, these lightly convex and transversely wrinkled; pubescent at sides and apex; underside lightly pubescent. *Dim.* 4–5 × 1¼ mm.

Hab.—North Queensland: Endeavour River.

Three examples examined are somewhat like *P. nigrosuffusus* and some forms of *P. varians*. From the former it is separated by smaller size, different colour, especially of underside, and shorter lateral carina; from *varians* it is readily separated by its nitid and far less hirsute surface, wider prothorax and different sculpture. The name will indicate its habitat. Holotype in the South Australian Museum.

PARACARDIOPHORUS DULCIS, n. sp. Pl. ix, fig. 7.

Nitid black above and beneath, strongly pilose with silvery hair, elytra with four large orange maculae: two, longitudinal at base, of variable size, in general covering 3 intervals, two preapical; metasternal epipleurae red, 1st abdominal segment with pale spot at side, antennae and legs infuscate, the basal segment of the former and the tarsi flavous.

Head rounded, with raised border in front, antennae sublinear, extending just beyond base of prothorax; segment 1 stout, 2 shorter than 3, 3 than 4, thence subequal. *Prothorax* very tumid, arcuately narrowed on frontal half, less strongly and subsinuately behind, widest about middle, with small truncate hind angles, directed backward; the narrow lateral border quite obliterated about half-way to the front; disk rather closely punctate, the punctures larger near sides, these bearing white hairs, a short, well-marked sulcus near hind angles, parallel to sides. *Scutellum* subcordate. *Elytra* as wide as prothorax, feebly widened behind middle, striate-punctate, punctures large in well-marked striae, intervals convex and punctate-setose. Underside with dense, recumbent hair. *Dim.* 5–5½ × 1½–2 mm.

Hab.—N.W. Victoria: Lake Hattah (J. E. Dixon and C. G. Oke), Murray River (H. S. Cope); South Australia (Macleay Museum).

Six examples before me are easily distinguished from *P. australis* Cand. by the basal markings extending longitudinally from border and of orange colour (in *australis* these are oblique from shoulder and testaceous). Holotype in Australian Museum.

PARACARDIOPHORUS LITORALIS, n. sp. Pl. viii, fig. 8.

Short, bi-ovate; head and prothorax nitid reddish, varying from red to brown or nearly black; elytra testaceous, variably suffused with fuscous, underside red, legs and antennae testaceous.

Head lightly pubescent, antennae unusually long and slender, extending well beyond base of prothorax, segments linear. *Prothorax* convex, ovate, sides well narrowed in front, subsinuate behind; disk microscopically punctate, raised lateral border terminated about two-thirds of the way from base. *Scutellum* cordate. *Elytra* ovate, of same width as prothorax at base, widest near middle; striate-punctate, strial punctures large, crenulating sides of intervals, these with a single line of punctures. *Dim.* 3–4½ × 1–1½ mm.

Hab.—South Australia: Adelaide (sea-beach, A. M. Lea); Western Australia: Geraldton (J. Clark); Tasmania: Kelso (beach, A. M. Lea and A. Simson); Queensland: Brisbane (Tiegs).

Sixteen examples show a little species, variable in size and colour. The five from Tasmania show a tendency to vittate arrangement of the dark colour on elytra, but cannot otherwise be separated from those from Adelaide and Geraldton. As with *P. nigrosuffusus*, the pronotum varies in colour from pale red to brown (or black in one example). Type series in the South Australian Museum.

VAR.—An example from Brisbane, in the Queensland Museum, has the pronotum and the apex of elytra black. This form is apparently near *flavipennis* Cand., described from the Swan River; but apart from the widely separated locality, none of the long series before me tally with Candèze's description.

PARACARDIOPHORUS NIGROSUFFUSUS, n. sp. Pl. ix, fig. 12.

Oblong; subnitid red, sparsely pubescent above, brownish-black beneath, elytra with a wide, variable, ill-defined black, postmedial fascia; legs and antennae flavous.

Head feebly pubescent, antennae short and extremely slender, not extending to base of prothorax; segments linear, 2 and 3 shorter than succeeding. *Prothorax* convex, subquadrangular, length and breadth subequal, sides nearly straight, the short, blunt hind angles continuous with lateral margin, the raised border terminated two-thirds of the distance from base; disk strongly, sparsely punctate, with short, indistinct basal sulcus. *Scutellum* subcordiform. *Elytra* wider than prothorax, narrowly oval; striate-punctate, striae deep, the strial punctures distinct, intervals wide and flat, except at base, apparently impunctate, with recumbent pale hair; underside with fine scattered punctures on sternal areas, abdomen feebly pubescent. *Dim.* 5–6 × 2 mm.

Hab.—Inland N.S.W., Victoria and South Australia, ? N.W. Aust.—Bogan River (J. Armstrong), Sea Lake (J. C. Goudie), Leigh's Creek (Blackburn Coll.).

Thirteen examples are before me that vary in size and colour. The dark colour sometimes extends to the pronotum. Two examples in the South Australian Museum from the Fortescue River, N.W.A. (W. D. Dodd), have the prothorax wholly dark brown, but may be considered as a variety of this species. Type series in Coll. Carter (presented to the Australian Museum).

PARACARDIOPHORUS OCCIDENTALIS, n. sp. Pl. ix, fig. 9.

Ovate; head, prothorax, underside and legs black, the prothorax nitid, with short pubescence, the last two opaque from the dense, recumbent, whitish pubescence; elytra black, with four red markings, two comma-shaped at shoulders, narrow at base, thickened and incurved to 3rd interval, two elongate, preapical; tarsi and basal segments of antennae red, in some examples a small red spot at anterior angles of prothorax.

Head strongly pubescent, antennae not reaching base of prothorax, segments 2 and 3 short, 4–10 narrowly subconic. *Prothorax* convex, ovate, widely rounded, strongly narrowed in front and behind, subsinuate at the latter; hind angles short, truncate and feebly divaricate, lateral border terminated at apical third, disk finely, irregularly, punctate. *Elytra* ovate, wider than prothorax at base and nearly thrice as long; striate-punctate, striae deep, intervals strongly convex on basal half, somewhat flattened on middle area, clearly punctate, also setose at sides. *Dim.* 6 × 2 (vix) mm.

Hab.—Western Australia: Warren River (W. B. Dodd).

Four examples are marked somewhat like the eastern *P. dulcis* Cart., but differ as follows: Size larger, the hinder pair of maculae elongate on intervals 6, 7, 8 (oval in *dulcis*). Holotype in South Australian Museum.

PARACARDIOPHORUS OCTOSIGNATUS, n. sp. Pl. ix, fig. 4.

Biovate; nitid black, with short silvery pubescence; upper surface with 8 orange maculae, placed as follows: one near each front angle of pronotum, six on elytra, of which two are small, basal, two oval, premedial, and two preapical, forming a fascia interrupted at suture but extending to sides; the hind angle of prothorax also inclined to reddish; legs and antennae black, tarsi and basal segments of the latter red.

Head rounded and narrowly bordered in front, strongly pubescent and subopaque, antennae long and narrow, extending beyond base of prothorax, segment 1 stout, 2 very small, 3 shorter than 4, 4 and 5 equal, 6–10 longer and wider than preceding, 11 lanceolate. *Prothorax* convex, widest at middle, sides arcuately narrowed in front, and sinuately so behind; narrow lateral border obliterated about half-way to the front, hind angles small, directed backward, non-carinate, a short sulcus near each; disk closely and indistinctly punctate-setose. *Scutellum* cordate. *Elytra* wider than prothorax, sides subparallel; striate-punctate, with rather large punctures in deeply impressed striae; intervals wide, moderately convex, on dark areas transversely rugose. *Underside* strongly pubescent. *Dim.* 4½–5 × 1½ mm.

Hab.—South Australia (Macleay Museum).

Two examples on a card are easily distinguished by pattern from all described species. Holotype in the Macleay Museum.

PARACARDIOPHORUS QUADRISTELLATUS, n. sp. Pl. ix, fig. 1.

Oblong-ovate; subnitid black above, beneath and appendages, except tarsi; elytra with four small orange spots, two premedial, two postmedial on the 6th and 7th intervals; tarsi red.

Head with short silvery pubescence, antennae long and stout, dull black, extending beyond the base of prothorax, the segments rather widely triangular, 1 stout but shorter than usual, 2 very small, 3 smaller than 4, 3–10 subtriangular, 11 elongate-oval. *Prothorax*: length and breadth subequal, moderately convex, less widened than usual, sides gently arcuate, not sinuate behind, posterior angles acute, subtriangular, directed backward; lateral border abruptly terminated about three-fourths from base; disk with a double system of punctures, the larger punctures distinct and rather close, sparse pubescence at sides. *Scutellum* pentagonal. *Elytra* at shoulders slightly wider than prothorax, sides sub-parallel; striate-punctate, the striae wide and deep; intervals convex and rugose. *Dim.* 4 × 1 mm. (approx.).

Hab.—N. Territory: Port Darwin (W. K. Hunt).

Two examples in the South Australian Museum are unlike anything in the genus, with slight difference of structure (less widely ovate prothorax, sharper hind angles), but with incomplete lateral border, as in others. Type series in the South Australian Museum.

PARACARDIOPHORUS RUFOPICTUS, n. sp. Pl. viii, fig. 12.

Biovate, convex; upper surface brownish-black, variegated with red, underside brownish-black, abdomen with medial stripe yellow; appendages testaceous. The whole with pale pubescence.

Head densely pubescent, apical half reddish; antennae long and slender, segment 1 tumid, 2 and 3 each shorter than 4, 4–10 subequal and subconic, 11 lineate-ovate. *Prothorax* in ♂ confusedly variegated, in (?) ♀ the red is confined to a marginal band at apex. Ovate, widest in front of middle, sides feebly sinuate behind, the hind angles briefly triangular; disk pubescent, with moderately strong punctures, lateral carina continuous beyond middle. *Scutellum* cordate. *Elytra* convex, ovate; striate-punctate, the seriate punctures large, placed in deep striae; intervals wide and convex, pubescent, especially at sides and apex. An orange patch covering shoulders, produced along sides and some disconnected red patches, in longitudinal streaks. Underside black, abdomen with medial area yellow. *Dim.* 4 × 1 (+) mm.

Hab.—Western Australia (Duboulay, in British Museum).

Two examples sent by Dr. Blair, amongst others, show a pretty and distinct little species. Holotype in the British Museum.

PARACARDIOPHORUS SEXNOTATUS, n. sp.

Ovate; nitid black above and beneath, vaguely pubescent, elytra each with three red maculae, one round at base, a second near sides at basal third, a third, the largest, oblong, on apical third, behind the second; underside glabrous, appendages red.

Head lightly pubescent, antennae mutilated. *Prothorax* robust, convex, widest at middle, sides well rounded, narrowed on front half, lightly sinuate behind; hind angles short and wide, in one example pubescent at apex; lateral carina extending half-way to front; disk uniformly covered with a dual system of punctures, the larger very distinct. *Scutellum* cordiform. *Elytra* slightly wider than prothorax at base and more than twice as long; sulcate-punctate, the sulci wide and deep, intervals very convex and strongly punctate. *Dim.* 5 × 2 (vix) mm.

Hab.—Queensland: Cape York.

Four examples, two in the Queensland Museum, and two in the National Museum, Melbourne, are easily recognizable by the strong sculpture of the elytra, besides the distinct pattern. Holotype in the Queensland Museum.

PARACARDIOPHORUS STELLATUS, n. sp. Pl. ix, fig. 5.

Ovate; nitid black above and beneath; elytra with basal third red, the rest black, with two round testaceous spots, one on each, at apical third. Upper surface rather densely griseo-pubescent; elytra with long upright hair; palpi and tarsi red, basal segments of antennae partly red.

Antennae slender, extending slightly beyond the base of prothorax, segment 1 stout, as long as 2 and 3 together, 4–10 subtriangular successively slenderer, 11 oval. *Prothorax* convex, ovate, widest near middle, sides subsinuate behind the short, subtruncate hind angles directed backward, the narrow raised border terminating abruptly at three-fourths length from base, a short indistinct basal sulcus; disk distinctly, rather closely, punctate. *Elytra* elongate-ovate, wider than prothorax at base; striate-punctate, striae well marked, strial punctures large, elongate; intervals flat except at extreme base, the 6th here strongly convex; intervals finely setose. *Dim.* 4–4½ × 1½ mm.

Hab.—New South Wales: Tamworth (A. M. Lea, in Department of Agriculture).

Two examples taken by my old friend are, in colour, nearest *P. dimidiatus* Schw., but smaller, more pilose, with the basal red mark shorter and the two testaceous spots in addition on the elytra, the antennae more slender, their segments shorter. A third example is in the South Australian Museum. Holotype series presented to the Australian Museum.

PARACARDIOPHORUS SUBCRUCIATUS, n. sp. Pl. ix, fig. 8.

Narrow, elongate; nitid black above and beneath; feebly pubescent, elytra with four testaceous maculae, arranged in a somewhat cruciform manner—two starting from sides at shoulder, obliquely narrowing to a point on 4th interval at basal third, two wider, subrhomboidal, extending from the 2nd interval, post-median, and extending backward to sides; hind angles of prothorax variably testaceous, legs testaceous, antennae infuscate with basal segments yellow.

Head finely punctate, lightly pubescent, antennae extending to base of prothorax, segment 1 strongly tumid, 2 smaller but tumid, 3 narrowly lineate, 4–10 narrowly oval, 11 lineate. *Prothorax* narrower than usual, convex, widest in front of middle, lightly narrowed in front, a longer convergence behind, without sinuation; lateral border extending three-quarters of the distance to the front margin, hind angles small, acute, an obscure neighbouring sulcus; sparsely and minutely punctate. *Scutellum* cordate. *Elytra* little wider than prothorax at shoulders, sides subparallel; striate-punctate, strial punctures close, well defined except near suture, intervals convex, cross-wrinkled on the dark areas. Underside subglabrous, almost impunctate. *Dim.* 3–3½ × 1 mm.

Hab.—South Queensland: Tambourine Mountain (A. M. Lea and A. Musgrave), Wide Bay (Australian Museum).

Four examples of this pretty little species are before me. In two examples the apices of elytra are reddish. Holotype in the Australian Museum.

VAR.—Examples from the Richmond River, in the N.S.W. Department of Agriculture, taken by the late W. W. Froggatt, have the maculae so connected as to form two curved vittae, but there is little doubt of these being conspecific.

PARACARDIOPHORUS SUBFASCIATUS, n. sp. Pl. ix, fig. 13.

Whole surface, above and beneath, more or less red, sparsely pubescent, pronotum darker than elytra, the latter with wide postmedial fascia dark brown; legs and antennae yellow.

Head punctate, pubescent, antennae very slender, lineate, extending to base of prothorax, 2–3 subequal and short, 4–10 subequal, 11 needle-like. *Prothorax* tumid, length and breadth subequal, sides nearly straight, slightly widened to anterior third, thence arcuately converging to front, feebly narrowed behind, without sinuation; lateral border very short, only apparent to posterior fourth; disk closely and finely punctate, with short, bristly hair at sides and apex. *Scutellum* cordate with medial depression. *Elytra* of same width as prothorax, sides subparallel; striate-punctate, with coarse, close punctures set in well-defined striae, intervals convex, subrugose on apical half. Underside and legs strongly pubescent. *Dim.* $5\frac{1}{2} \times 1\frac{1}{2}$ mm.

Hab.—N.W. Victoria: Sea Lake (J. C. Goudie), Ouyen (J. E. Dixon.).

One each taken by my old brother coleopterists, include the sexes, the smaller, from Ouyen, being a ♂. Holotype in the Australian Museum.

PARACARDIOPHORUS VARIANS, n. sp. Pl. viii, fig. 13.

♂. Oblong; densely pubescent, whole surface more or less dull red, the elytra with apical half variably infuscate; appendages stramineous.

Head punctate and pubescent, antennae not quite reaching base of prothorax, segments 2 and 3 shorter than 4, 4–10 subtriangular. *Prothorax* convex, narrower than usual, length and breadth subequal, widest near middle, lightly contracted in front, more strongly and subsinuately behind, hind angles briefly triangular, with blunt apex, disk closely punctate, asperate, and pubescent. Lateral carina extending less than half-way to front. *Elytra* elongate-ovate, sides nearly straight; striate-punctate, the striae narrow, the serial punctures irregular and ill defined, intervals nearly flat, feebly raised at extremities, densely pubescent, as also the underside. *Dim.* $4–5 \times 1\frac{1}{4}$ mm.

Hab.—Minnie Downs, N.E. Corner of South Australia (L. Reese), also Charters Towers and Rockhampton, Queensland (A. M. Lea).

VAR., or ♀, differing only in having the pronotum black, sometimes with front corners red, and the elytra with apical half more or less black and the humeral region brick-red. (The Queensland examples are amongst these.)

Fifty-three examples are amongst the material sent from the South Australian Museum, of which 44 are from Minnie Downs, that I consider conspecific, though showing great colour variation. Twenty-nine have the red, 24 the black pronotum, the underside being red in both series. The majority, at least, of the former are ♂, of the latter ♀, a colour sexual difference noted in other species of the genus. It is not *P. mjöbergi* Elst.—a paler and more nitid species. Type series in the South Australian Museum.

Paracardiophorus vittipennis, n. sp. Pl. ix, fig. 11.

Head, prothorax and underside nitid black, the prothorax with all its angles widely red, elytra with alternate intervals black and testaceous, antennae and legs red.

Head pubescent, not, apparently, punctate, antennae scarcely extending to base of prothorax, segments 2 and 3 smaller than rest, 4–10 shortly triangular, 11 oval. *Prothorax* convex, wider than long, widest near middle, sides with long arcuation to front and shorter, sinuate, convergence behind, lateral border terminated abruptly rather behind middle; disk uniformly very densely and finely punctate, a fine, short, basal sulcus. *Scutellum* cordate. *Elytra* as wide as prothorax, subovate, longitudinally arched; striate-punctate, striae well impressed, strial punctures small, intervals convex, lightly cross-wrinkled on apical half. *Dim.* 5 (vix) × 1½ mm.

Hab.—Victoria: Lakes Entrance (F. E. Wilson).

A distinct species, differing from *alternatus* by colour and very different sculpture of the pronotum, in which it is unlike any other seen by me, the tiny punctures being densely packed, yet separate. There is a round patch at the front angles, the red at the hind angles extending to the sulcus. Holotype in Coll. Wilson.

Var.—Another example sent by Mr. Wilson has the hind angles of prothorax black, apex of pronotum red and the elytral vittae less regular, but it is clearly conspecific. National Park, Victoria (R. Blackwood).

Cardiotarsus mjöbergi, n. sp.

Oblong-oval; castaneous above and beneath, with pale recumbent pubescence; antennae and legs pale red.

Head: clypeus oval, its margin raised; forehead punctate and pubescent; antennae extending to base of prothorax, segments stout, elongate subtriangular, 1st tumid, 2nd and 3rd equal and together as long as the 4th, 4–10 subequal. *Prothorax* longer than wide, sides slightly widened near middle, lightly narrowed each way, sides nearly straight behind to the short, backwardly-directed hind angles; disk finely, not closely, punctate, without sign of middle line; lateral carina as in *Paracardiophorus*, ending abruptly two-thirds of the distance from base. *Scutellum* subcordate, depressed in middle. *Elytra* as wide as prothorax and more than twice as long, narrowing gradually to apex; at base angulate on each side of the scutellum: striate-punctate, the rather indistinct punctures set in deep striae, intervals convex and punctate-setose; sides and apical half strongly pubescent. Underside scarcely punctate, prosternum with a well-developed mentonière, the sutures narrow, but more sulcate than in most Paracardiophori. *Dim.* 7 × 2 mm.

Hab.—Tambourine Mountain, Queensland (Mjöberg).

A single example in the Elston collection, Australian Museum, is described as the first recorded Australian species of this genus. Its facies is that of an elongate *Paracardiophorus* with a longer, less convex prothorax and the characteristic cordate 4th tarsi. I am indebted to M. Fleutiaux for indicating its generic status. Holotype in the Australian Museum.

Limonius.

The species of this genus have been generally confused with the Cardiophori (from which they are readily separated by the acute, outwardly directed hind angles of prothorax) in Australian collections. I have nowhere seen it identified;

yet *L. collaris* Cand., the only described Australian species, is one of the commonest of our Elateridae. Seventy-two examples are before from Sydney district (10), Blue Mts. (12), Mittagong (7), Dorrigo (5), Barrington Tops (3), Queensland, chiefly Cairns district (28), Victoria (5). These vary in size from 3½ to 6 mm. long, and considerably in colour as follows: Pronotum with varying amount of red, from the typical "margine antico angulisque posticis rufis" to cases where the whole is red except for a discal spot. The prosternum may be either "aeneo-niger" or red. The head, usually black, is, in a few cases, red, the antennae, usually black with basal segments red, are sometimes wholly red. The word 'serrate' scarcely applies to the segments, which are subtriangular, gradually increasing in width outward. The pubescence also varies in density. The affinity of the genus is apparently with *Poemnites* rather than with *Paracardiophorus*, some examples closely resembling a small *Poemnites litura* Cand. The following appear to be distinct species or, if extreme varieties of *L. collaris* Cand., deserve a name.

LIMONIUS PUBESCENS, n. sp. or var.

Head, pronotum, prosternum and sometimes *abdomen* yellow or red; appendages yellow, apical half of antennae sometimes fuscous; upper surface with dense yellow pubescence, elytra so densely clothed that the darker ground-colour is greatly modified by it. *Dim.* 4–5 mm. long.

Hab.—N. S. Wales: Tweed and Clarence Rivers; Queensland: Tambourine Mountain (A. Musgrave and C. Geissmann).

Eight examples are before me, the pronotum sometimes a little clouded. Holotype in the Australian Museum.

LIMONIUS NIGER, n. sp. or var.

Whole surface, above and below, nitid bronze-black; basal segments of antennae, tarsi and underside of legs (partly) red; sparsely pubescent, with fine whitish hair.

Head more pubescent than the rest; *pronotum* distinctly but finely punctate. Elytral intervals flat, except near base, and more coarsely punctate than pronotum. *Dim.* 4–5 mm. long.

Hab.—N. S. Wales: Barrington Tops (Sydney University Exped.), Ebor (F. E. Wilson).

Eight examples, similar in form to the others, but differing in the almost total absence of colour and slight pubescence. Holotype in the Australian Museum.

LIMONIUS ANGULATUS, n. sp. or var.

Whole surface, above and below, except hind angles of prothorax, black, the angles yellow; legs red; antennae red or with apical half fuscous.

Very similar to the preceding, but upper surface strongly punctate. *Dim.* 4–6 mm. long.

Hab.—Victoria: Woori Yallock; N. S. Wales: Barrington Tops; Queensland: Tambourine Mountain and Cairns district (28 examples). In all, 49 examples, differing from *niger* in its yellow hind angles to prothorax. Holotype in the Australian Museum.

The antennae in all examples of *Limonius* above, extend beyond the base of prothorax, their segments subconic or subtriangular, not serrulate. Segment 1 tumid, 2 and 3 short, 4–10 successively longer and wider at apex, 11 oval.

LIMONIUS PALLIDUS, n. sp.

Head and prothorax (except hind angles) dark red; hind angles and basal margins of prothorax, antennae and legs pale red, upper surface with pale pubescence; underside black, except prosternal process, this red.

Head pubescent and closely punctate, antennae extending to base of prothorax, segment 1 tumid, 2 shorter than 3, 3–10 subequal, lineate-triangular, 11 ovate-lanceolate. *Prothorax* slightly longer than wide, sides lightly widened at middle and sinuate before the divaricate hind angles, these with an inconspicuous carina near and parallel to margins; disk strongly punctate with a well-marked medial channel. *Scutellum* elongate-ovate. *Elytra* as wide as prothorax and nearly thrice as long; striate-punctate, intervals flat except near base and transversely rugose; underside very nitid with sparse pubescence. *Dim.* $6\frac{1}{2} \times 1\frac{1}{2}$ mm.

Hab.—Victoria: Apollo Bay (in National Museum).

VAR.—Upper surface reddish-brown, hind angles of prothorax and adjacent region red.

Five examples before me are clearly distinct from the common *L. collaris* Cand. not only in colour but in larger size, channelled pronotum and coarser sculpture. Three have the elytra more or less pale, in two the darker colour prevails. Holotype in National Museum, Melbourne.

LIMONIUS PYGMAEUS, n. sp.

Narrowly oblong; head and prothorax dark red, elytra yellow, with the sides. suture and apex reddish-brown; underside red, appendages yellow.

Head pubescent, antennae long, extending well beyond base of prothorax, segments subtriangular, successively diminishing in width from 6th to the 10th, 3rd small. *Prothorax* lightly convex, widest at middle, sinuate behind, hind angles well developed, acute, directed a little outwards; disk minutely punctate. *Elytra* slightly wider than prothorax at base; striate-punctate, with rather large seriate punctures, in shallow striae; intervals flat, except near base. *Dim.* 3 mm. long.

Hab.—South Australia (in Macleay Museum).

Two examples seem to belong to this genus. It is smaller and narrower than *L. collaris* Cand. with longer and finer antennae. Type series in the Macleay Museum.

DICTENIOPHORUS BIFOVEATUS, n. sp.

Elongate, oblong; head, prothorax and underside subnitid red, elytra stramineous; antennae and legs black; subglabrous, elytra only with short, light pubescence at sides.

Head: mandibles evident, antennae strongly dentate-serrate, extending considerably beyond base of prothorax. *Prothorax* longer than wide, sides gently narrowed for the greater part, more abruptly at extreme front, hind angles strongly divaricate, acute and carinate; disk with dense, shallow punctures, a fine medial sulcus, obsolescent at apical fourth, and two foveae at apical third. *Scutellum* elongate-ovate. *Elytra* wider than prothorax at base, sides almost parallel, separately and narrowly rounded at apices; striate-punctate, the seriate punctures round and regular, striae well marked, intervals nearly flat, finely punctate and rugulose; underside nearly impunctate, prosternum very minutely so. Legs rather long, tarsi slender. *Dim.* $18 \times 4\frac{1}{2}$ mm.

Hab.—N. S. Wales: Ellenborough, Hastings River district (R. Paxton).

Two examples sent me by their captor, both ♂, differ from *D. ramifer* Cand. not only in colour, but in narrower form and much finer sculpture of the pronotum, and dentate, not pectinate, antennae. Holotype presented to the Australian Museum.

DICTENIOPHORUS ELEGANS, n. sp.

Elongate, navicular; subnitid pale red; pronotum with medial vitta and hind angles, elytra with suture and lateral margins black. In one example (of 8) the elytra concolorous red. Antennae somewhat infuscate. Body with short, sparse, pubescence. Underside and legs red.

Head subrectangular, with clypeus arcuate, antennae extending to half the length of body, pectinate in ♂, the rami long and slender, emanating from near middle of segments 4–10; strongly serrate in ♀, segment 2 very small. *Prothorax* longer than wide, sides very gradually narrowing to apex, hind angles long, acute, divaricate and carinate; disk densely punctate, sulcate only near base. *Scutellum* elongate, dark red. *Elytra* as wide as prothorax across hind angles and 2½ times as long, gently narrowing to apex; striate-punctate, strial punctures small and regular; intervals nearly flat, closely and finely punctate, with short, thick pubescence at sides. Legs long; hind tarsi, 1 longest, 2, 3, 4 successively shorter, 5 nearly as long as 1. *Dim.* ♂ 11 × 2½ mm., ♀ 14 × 3 mm.

Hab.—Queensland: National Park, Macpherson Range (H. J. Carter), Tambourine Mountain (A. Musgrave and C. Geissmann); N. S. Wales: Macleay River (H. J. Carter).

I took two of each sex in January, 1928, and there are 4 ♀ in the Australian Museum. In the male the prothorax is slightly shorter than in the female examples. Holotype and allotype in the Australian Museum.

In general facies it must be near *Stichotomus fusiformis* Schw., but two characters are inconsistent with their identity: (*a*) The antennal rami *not* springing from the base of segments; (*b*) the hind angles of prothorax clearly carinate.

DICTENIOPHORUS HIRTICORNIS, n. sp.

Elongate-ovate; subnitid pale red above and beneath; head red or black, antennae black, legs fuscous, upper surface with recumbent red clothing.

♂. *Head*: clypeal region red, basal area infuscate, antennae extending nearly to the base of prothorax, segments 4–10 strongly dentate-serrate, the margin fringed with upright red hairs, the prominent teeth each with a tuft of longer hair. *Prothorax*: length and breadth equal, sides nearly straight for the greater part, arcuately narrowed near front, non-sinuate behind, hind angles acute, carinate and directed backwards (the exterior margin, at least, in line with rest of lateral border); disk minutely and densely punctate, a short medial sulcus on basal half only. *Scutellum* elongate-oval. *Elytra* of same width as prothorax at base, and 2·6 times longer; striate, striae well marked, seriate punctures obsolete or vague, intervals narrow, equal and lightly convex, rather thickly pubescent at sides and apex. *Dim.* 19 × 5½ mm.

Hab.—Queensland: Johnstone River (H. W. Brown).

Two examples, both male, in the collection of Mr. Brown, show a robust species of bright colour, with unusual antennal characters. There is a tendency to infuscation at the scutellum and the junction of prothorax with the elytra. Holotype generously presented to the Australian Museum.

DICTENIOPHORUS RUFOLINEATUS, n. sp.

♀. Elongate-oblong; head, prothorax, above and below, brownish-black, elytra black, with a wide red vitta on each, in general covering intervals 3–4, extending from base almost to apex, and widening on basal area; abdomen and legs red, tarsi yellow, antennae black, the basal segments red; a dark pubescence at sides and pale recumbent pile beneath.

Head with strong, close, punctures, mandibles prominent, front lightly convex, antennae reaching base of prothorax, strongly serrate from 4–10, 2 very short. *Prothorax* transversely convex, length and width subequal, arcuately narrowed from base to apex, hind angles robust, feebly divergent, strongly carinate; disk with faint indications of medial sulcus on basal half, elsewhere densely, uniformly punctate. *Scutellum* elongate-ovate. *Elytra* lightly obovate, widest behind middle, here wider than prothorax; striate-punctate, the striae fine but clearly cut, the seriate punctures obscure, intervals flat and strongly punctate. *Prosternum* densely, rather strongly punctate, rest of underside minutely so. *Dim.* 15 × 4½ mm.

Hab.—N. Queensland: Cairns (H. Hacker).

A single female example in the Department of Agriculture, Sydney, bears a label in the handwriting of the late W. W. Froggatt. Its elytral markings should render it easy to identify. Holotype presented to the Australian Museum.

♂ latet.

Dicteniophorus quadrifoveatus, n. sp.

Oblong; nitid reddish-brown above, antennae, legs and underside red; finely pubescent.

♂. *Head* subquadrate, mandibles prominent; antennae pectinate, with long, linear rami, emanating from near apex of segments 4–10. *Prothorax*: length and breadth equal; sides almost straightly narrowed to front, hind angles acute, moderately divaricate and carinate; disk finely and densely punctate; a thin medial sulcus not extending to apex and four foveae, two round and deep in front of middle, two smaller at basal third, nearer the sides than front two. *Scutellum* elongate, oval. *Elytra* as wide as prothorax across apices of hind angles and more than thrice as long; striate, seriate punctures subobsolete, intervals widely convex and transversely rugulose; underside glabrous, impunctate. *Dim.* 20–22 × 5½–6 mm.

Hab.—N. S. Wales: Tweed River.

♀ wanting.

Four male examples in the collection of Mr. H. W. Brown, possibly near *D. badiipennis* Cand., described from a single ♂, but Candèze distinguishes his species by the absence of pronotal sulcus and briefly pectinate antennae, neither of which characters applies to the above, in which the rami are unusually long. Holotype presented to the Australian Museum.

Crepidomenus cervus, n. sp.

♂. Narrowly subcylindric-navicular; nitid light fawn colour above and beneath, the apical region, above and beneath, a little clouded and darker; appendages red; a short, sparse pubescence on head and elytra.

Head clearly punctate, two light grooves representing the usual depression, antennae not reaching base of prothorax, 1 tumid, 2 shorter than 3, 3–10 subequal, lineate-triangular. *Prothorax* longer than wide, widest at base, sides very slightly converging to apex, feebly sinuate before the strongly developed hind angles, these very lightly divaricate and strongly carinate; disk with fine, sparse punctures, medial channel fine but distinct on basal two-thirds. *Elytra* of same width as prothorax and almost exactly twice as long, finely tapering to apex; striate-punctate, suture subcarinate, this emphasized by a subsutural sulcus on each side, extending from just behind scutellum to apical third; the striae and strial punctures very fine, intervals almost flat, with small, distinct punctures, more evident on apical half, obsolescent towards base. Underside subglabrous, minutely punctate.

♀ much larger and wider, antennae shorter, their segments more widely triangular; legs and tarsi wider; prothorax with a deeper and wider medial sulcus; elytral striae and intervals wider, the latter clearly convex on basal region. *Dim.* ♂ 13–14 × 3 mm.; ♀ 19 × 5 mm.

Hab.—Queensland National Park, MacPherson Range (H. J. Carter).

Four ♂, one ♀ before me. The narrow form, almost concolorous surface, reddish-fawn colour, and fine sculpture distinguish it. Holotype and allotype in the Australian Museum.

An example of *C. queenslandicus* Blkb., compared with type by Dr. Blair, differs from the above by smaller size, duller and more roughly punctate surface.

Crepidomenus divaricatus, n. sp.

Above and beneath nitid, reddish-brown, with short, pale pubescence, legs and antennae reddish, tarsi pale red.

Head: anterior margin semicircular, front rather flat, with shallow triangular impression; antennae extending slightly beyond base of prothorax, slender, segment 2 short, 3–10 subequal in length, successively narrowed. *Prothorax* very slightly longer than wide, excluding hind angles, widest behind middle, thence lightly narrowed to front, and sinuate behind, post angles long, divaricate, acute, with a narrow carina near and parallel to the exterior border; disk very nitid, with sparse, fine punctures and a deep, clearly-cut medial sulcus. *Scutellum* elongate-oval. *Elytra* rather wider than prothorax and 2¼ times as long, tapering rather narrowly to apex; striate-punctate, the striae well defined, the strial punctures subobsolete near suture, large and oblong near sides, intervals convex at base and sides, elsewhere nearly flat and minutely punctate; underside glabrous. *Dim.* 15 × 4 mm.

Hab.—Queensland National Park, MacPherson Range (H. J. Carter).

I took three examples in January, 1928. Somewhat of the form of *C. metallescens* Cand., but with longer, more divaricate hind angles. The concolorous mahogany-brown surface is distinctive. Holotype presented to the Australian Museum.

Crepidomenus montanus, n. sp.

Above and beneath blue or greenish-black, with short white pubescence, mandibles, also tip of prosternal process, red, antennae black, legs above more or less concolorous with body, their underside and tarsi reddish.

Head punctate and pubescent; antennae, segment 1 very tumid, 2 shorter than 3, 4–10 successively narrowed. *Prothorax* robust, convex, slightly wider than long, widest behind middle, thence lightly arcuately narrowed to front, a wide, feeble sinuation before the divaricate, strongly carinate hind angles; disk moderately, not closely, punctate, medial sulcus deeply impressed. *Elytra* slightly wider than and 2½ times longer than prothorax; striate-punctate, the striae deep, the intervals subcostate, strial punctures irregular and somewhat confused, with lines of small punctures on sides of intervals. Prosternum and metasternum densely, finely punctate, abdomen sparsely so. *Dim.* 11–16 × 4–5 mm.

Hab.—New South Wales: Mt. Kosciusko (T. G. Sloane, A. Musgrave and H. A. Fletcher), Kiandra (D. G. Stead); Victoria: Bogong Plains (F. E. Wilson).

Twelve examples before me vary in size, and, to some extent, in density of puncturation, the larger examples being female. The dark blue-green colour is more pronounced in some, and more so on the upper than on the under surface. Holotype in the Australian Museum.

Crepidomenus navicularis, n. sp.

Above and beneath nitid, dark castaneous, head, antennae and legs black or nearly so, with sparse, whitish pubescence. Elytra with basal margins and apices darkened.

Head with coarse, sparse punctures, front with wide, subtriangular impression, antennae not extending to base of prothorax, segments lineate, 2 shorter than 3, 3–10 successively finer and shorter. *Prothorax* clearly longer than wide, widest near base, thence lightly narrowed to front, hind angles scarcely, or feebly divergent, rather thick with long carina not very close to lateral margin; disk coarsely and rather irregularly punctate, with some smooth spaces, the punctures more closely clustered near sides; medial sulcus wide and deep. *Elytra* of same width as prothorax and 2½ times as long, tapering finely to apex; striate-punctate, the suture a little raised and bordered by subsutural sulci; striae indistinct on apical third, seriate punctures round and distinct; intervals narrow, convex at base and strongly punctate. Flanks of prosternum minutely punctate, the rest of underside impunctate. *Dim.* 16 × 4 mm.

Hab.—New South Wales: Richmond River (W. W. Froggatt).

Two examples before me combine dark-red colour, navicular form with coarsely punctate surface. Holotype in the Australian Museum.

(?) *Crepidomenus luteipes* Boh. = *C. cyanescens* Cand.—A probable synonymy from close similarity of description.

Acroniopus pallidus Blkb. (Elston Coll.) = *A. rufipennis* Macl., if Elston's determination be correct.

Tenebrionidae.

Gonocephalum hispidocostatum Fairm. = *G. costipenne* Cart.—This synonymy has not been published, though my suspicions of it were endorsed some time ago by Dr. K. G. Blair. It is one of the many species found on both sides of Torres Strait.

The following is a list of Australian Tenebrionidae known to occur beyond Australia, excluding cosmopolitan species.

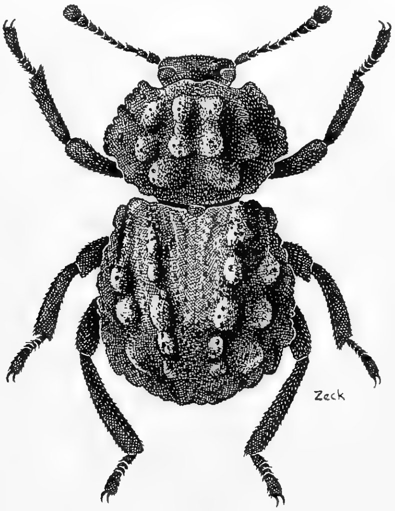
Amarygmus jodicollis Guér.
A. morio F.
Bradymerus crenatus Pasc. (= *B. granaticollis* Fairm.)
B. nigerrimus Geb.
B. raucipennis Blkb.
Byrsax pinnaticollis Cart.
Ceropria immaculata Geb.
C. maculata Geb.
C. peregrina Pasc.
Chalcopterus bellus Blkb.
C. cyanopterus Hope.
C. modestus Blkb.
Chariotheca planicollis Fairm.
Dioclina nitida Cart.
Diphyrrhyncus nicobaricus Redt. (= *D. apicalis* Champ.)
Doliema spinicollis Fairm.
Encyalesthus atroviridis Macl.
Espites basalis Pasc.
Gonocephalum arenarium F.
G. hispidocostatum Fairm.
G. planatum Walk.
Hypophloeus analis Geb.
Leichenum seriehispidum Mars.
Leiochrodes suturalis Westw.
Lyprops atronitens Fairm.
Mesomorphus viliger Blanch.
Microcrypticus scriptipennis Fairm.
Notostrongylium rugosicolle Cart.

Palorus austrinus Champ.
P. pygmaeus Cart.
Platolenes hydrophiloides Fairm.
Platydema detersum Walk. (= *P. valga* Pasc., etc.)
P. striatum Montr.
Scotoderus aphodioides Pasc.
Setenis sulcigera Boisd.
Toxicum punctipenne Pasc.
Zophophilus curticornis Fairm.

MYCHESTES LATICOLLIS, n. sp. Text-fig. 1.

Widely ovate; opaque fawn colour.

Head vertical, unseen from above, epistoma rounded, antennal orbits ear-like and raised; antennae stout, biclavate, apical segment subspherical, the preceding (9th) cup-shaped. *Prothorax* very wide ($2\frac{1}{2} \times 4$ mm.) and convex, apical third subvertical, largely overhanging head; foliate margins thick and forming a widely



Text-fig. 1.—*Mychestes laticollis*, n. sp.

rounded wing, at basal third excised and obliquely narrowed to base, extreme edge irregularly crenulate; discal area with medial concavity bounded by longitudinal ridges, each formed by two large, oblong tubercles, not quite connected and small tubercles behind these, two large and some smaller tubercles forming the lateral edge of disk. *Elytra* of same width as prothorax at their immediate junction, widely ovate behind this and very convex, without evident lateral foliation, as seen from above; surface with sparse tubercles of unequal size, subseriately placed, more or less, in four rows, and becoming smaller towards apex, apical margins finely crenulate; the larger tubercles, both on prothorax and elytra, dotted with small black pustules. Underside squamose, abdomen more or less glabrous. *Dim.* 7×4 mm.

Hab.—N. Queensland: Mulgrave River (H. Hacker).

A single example sent by Mr. Clark is quite distinct from the species tabulated by me (*Trans. Roy. Soc. S. Aust.*, 1937, p. 129) though nearest in sculpture to *M. ordinatus* Cart., from which it is separated by (*a*) smaller size and unusual relative width, (*b*) abbreviated form, its prothorax and elytra forming two wide ovals, (*c*) the larger tubercles dotted with small pustules (a feature only seen in *M. pascoei* Macl. of other Australian species). Holotype in the National Museum, Melbourne.

PTEROHELAEUS LATIFOLIUS, n. sp.

Oblong; nitid dark brown with a reddish tinge, foliate margins red, underside and appendages, including tarsi, dark.

Head almost impunctate; epistoma truncate and flat in front, oblique and raised at sides, making a wide angle with the well-raised, rounded antennal orbits; eyes large, separated by a space less than the diameter of one; antennae: segment 3 not as long as 4–5 together, 8–11 transverse, oval. *Prothorax* (3 × 10 mm., length in middle): subhorizontal foliation occupying half total width; widest at base, thence arcuately narrowed to apex, anterior angles well advanced and rounded, posterior acute and lightly falcate; extreme border thinly reflexed; disk rather flat, very minutely and sparsely punctate, medial line faintly indicated by shallow depression and feeble basal fovea. *Scutellum* semicircular. *Elytra* (14 × 11 mm.): foliation wide and lightly concave throughout, narrowed only at extreme apex; humeral angle sharply rectangular, sides nearly straight; striate-punctate, intervals narrow and subplanate, with faint signs of smooth strigae towards apex. Underside of head with deep transverse strigae on neck, prosternum more finely striolate, as also abdomen, otherwise surface nitid and glabrous. *Dim.* 20 × 13 mm.

Hab.—Victoria: Bendoc, East Gippsland (F. E. Wilson).

A fine species of Macleay's Sect. ii, Subsect. i, but differing from the majority of these by its almost flat elytral intervals. Its colour is that of *rubescens* Cart., sculpture nearest *planior* Cart. While diffident in adding to the long list of this genus, I consider a species so distinct deserves a name. Holotype in Coll. Wilson.

EUTHERAMA COERULEUM, n. sp.

Obovate, rather strongly convex; above nitid dark blue, beneath and greater part of femora reddish, base of femora, tibiae, tarsi and antennae blue.

Head: epistoma slightly rounded and finely punctate, forehead more coarsely so; antennal orbits raised and rounded, antennae very long, segment 1 stout, 2 half as long as 1, oval, 3–6 sublineate, 3 longer than 4, 8–10 subconic and subequal, much wider than preceding, 11 ovoid, of same size as 10. *Prothorax*: apex subcordiform, widest at middle, anterior angles rounded off, sides rounded and lightly bordered, posterior angles obtuse, base truncate; disk irregularly and rather coarsely punctate, the punctures more sparse in middle, without sign of medial line, a biarcuate, transverse sulcus near base connecting basal foveae. *Scutellum* triangular, punctate. *Elytra* closely applied to prothorax and of same width at junction, widest and greatest convexity behind middle; sulcate punctate, each elytron with 9 sulci, besides a short scutellary one, containing close-set punctures, the convex intervals themselves finely punctate; sternal regions rugose-punctate, abdomen finely punctate. *Dim.* 8 × 3 mm.

Hab.—N. Qland: Wolfram (S. H. Parlett).

A single example in the collection of Mr. F. E. Wilson is clearly a close ally to *E. cyaneum* Cart., the only other species of the genus from which it differs in colour (whole upper surface blue), the wider and non-sulcate prothorax,* and the coarser punctures of the prothorax and elytra. Holotype in Coll. Wilson.

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* In *E. cyaneum* Cart. the prothorax has a distinct medial sulcus which was not mentioned in its description.

N.B.—The dimensions are wrongly given in the original description of *E. cyaneum*. The correct dimensions of the type are 7 × 2¾ mm. Other examples in the South Australian Museum measure 6½ × 2½, 6¼ × 2¼, and 7 × 2½ mm. respectively.

DYSTALICA GRACILIS, n. sp.

Elongate-oblong; subopaque black, antennae and tarsi reddish, clothed above with short bristly hair.

Head subtriangular, granulose punctate and pubescent, maxillary palpi long, their basal segments red, apical securiform, antennae extending beyond base of prothorax, segments 1 and 2 short, 3 as long as 4–5 together, 4–8 submoniliform (rather longer than wide), 9–10 rounder, wider than preceding, 11 oval, large. *Prothorax* wider than long, apex arcuate, anterior angles about 60°, sides lightly widened near middle, narrowed each way, without sinuation; base with medial area extended to form a narrow rectangular lobe, hind angles obtuse, lateral margins fringed with bristly hair; disk almost uniformly covered with alveolate, umbilicate punctures. *Scutellum* transversely oval. *Elytra* wider than prothorax at base and about 2½ times as long; sides parallel; striate-punctate, with large close punctures set in deep striae, intervals convex, cancellate, with fine punctures and pustules along their whole length. Prosternum transversely rugose, metasternum and abdomen densely and coarsely punctate, the latter alveolate, tarsi pilose. *Dim.* 8 × 2½ mm.

Hab.—New South Wales: Warialda.

A single example sent by Mr. J. G. Brooks is an ally of *D. angusta* Cart., but a still narrower insect, with a general facies of an elongate *Cestrinus* and, like its congeners, distinguished by its asperate surface. The elytral intervals, under a strong lens, have a somewhat zig-zag outline, due to the impinging of the large punctures on their sides. Holotype in the Australian Museum.

CURCULIONIDAE.

TALAURINUS SUTTONI, n. sp.

Elongate-ovate; black or brownish, depressed areas (in one example) densely clothed with greyish scales, forming three vittae on the prothorax and more irregular depressions on elytra. Beneath black with some small irregular patches of grey scales on the medial regions.

Head: rostrum deeply excavate, external ridges very slightly divergent, sparsely punctate, continuous almost to extreme base of head, in front fasciculate, the fascicles meeting in front; internal ridges little prominent, meeting behind; scrobes open behind. *Prothorax* (6 × 7 mm.): sides lightly rounded, widest in front of middle, base not sinuate, with four irregular, compound rows of large, rounded tubercles, the lateral rows crenulating sides, the internal rows more irregularly clustered and less flattened than in *T. fergusoni* Cart. *Elytra* (18 × 10 mm.) ovate, apex shortly and bluntly mucronate; base arcuate, humeral angles prominently tuberculiform; sculpture consisting of three rows of large, oval or round tubercles and more closely set rows of small tubercles; of the large tubercles, rows 1 and 2 contain from 4 to 6, the 1st in row 1, at some distance from base, the last on apical declivity; in row 2, the 1st is at base, the last near apex; the 3rd row (sublateral) contains 10 or more; beyond the 3rd the tubercles scarcely seriate. Of the small tubercles, two rows form the sutural edges, towards scutellum becoming joined to form a furcate carina, continued along base to 1st row of large tubercles, a 2nd geminate series between the 2nd and 3rd rows of large tubercles; others irregularly scattered over depressed areas. Abdominal segments depressed in middle, the apical more notably so and notched at apex. *Dim.* 25–28 × 9–10 mm.

Hab.—South Queensland: Wyberba (E. Sutton).

Two examples, both (?) ♀, from this prolific region have been sent by their captor. It is nearest to *T. subvittatus* Ferg. and *T. fergusoni* Cart., but is readily distinguished from the former by larger size, longer rostrum, surface tubercles larger and differently placed. From the latter it is further separated by its less wide prothorax, less flattened tubercles thereon, and the presence of a system of smaller tubercles on elytra. Holotype in the Australian Museum.

A third example received since the above description was written is, I think, ♂.

MYTHITES VARIABILIS, n. sp.

Rather dull black, ovate, elytra flattened or depressed in middle. ♂ with patches of black tomentum in middle of abdomen, with grey scales elsewhere.

Head deeply excavate in middle, rostrum not separated from head by transverse sulcus, with two subparallel ridges on each side, each feebly converging behind, forehead convex, sometimes widely subcarinate, sparsely punctate, scrobes open behind. *Prothorax*: length and breadth equal (4 mm.), widest in front of middle, sides lightly rounded and crenulated by large tubercles, apex and base arcuate, disk vermiculate-tuberculate, medial sulcus distinct, bordered by vermiculate tubercles; exterior to these with irregular, discrete tubercles, with some more or less elongate depressions clothed with grey scales. *Elytra* obovate (9 × 11 mm.), considerably wider than prothorax, shoulders with prominent tubercles embracing the rounded hind angles of prothorax, widest behind middle; with rows of very large foveae, the two interior rows compound, each of two rows confusedly combined between wide undulate costae, 3rd row (lateral) of single foveae, the sutural area, including the first double row, depressed between undulate costae. ♀ larger, abdomen sublaevigate, more or less convex. *Dim.* ♂ 14–17 × 6–7½ mm.; ♀ 18–20 × 7½–9 mm.

Hab.—South Queensland: Wyberba, Fletcher (E. Sutton), Stanthorpe (Von Wieldt).

Eleven examples before me differ greatly in size and sculpture, but I cannot separate them by any definite character. The smooth, wide carina on head in some examples, shows only slightly in others, or is wanting. In 3 examples there is a small mucro at apex.

The variations of sculpture consist of irregularity in size and number of foveae, and of the undulate costae, the first generally continuous throughout, the 2nd and 3rd varyingly discontinuous. The suture is bounded by fine carinae which in some of the larger examples are more or less granulate. Holotype and allotype presented to the Australian Museum.

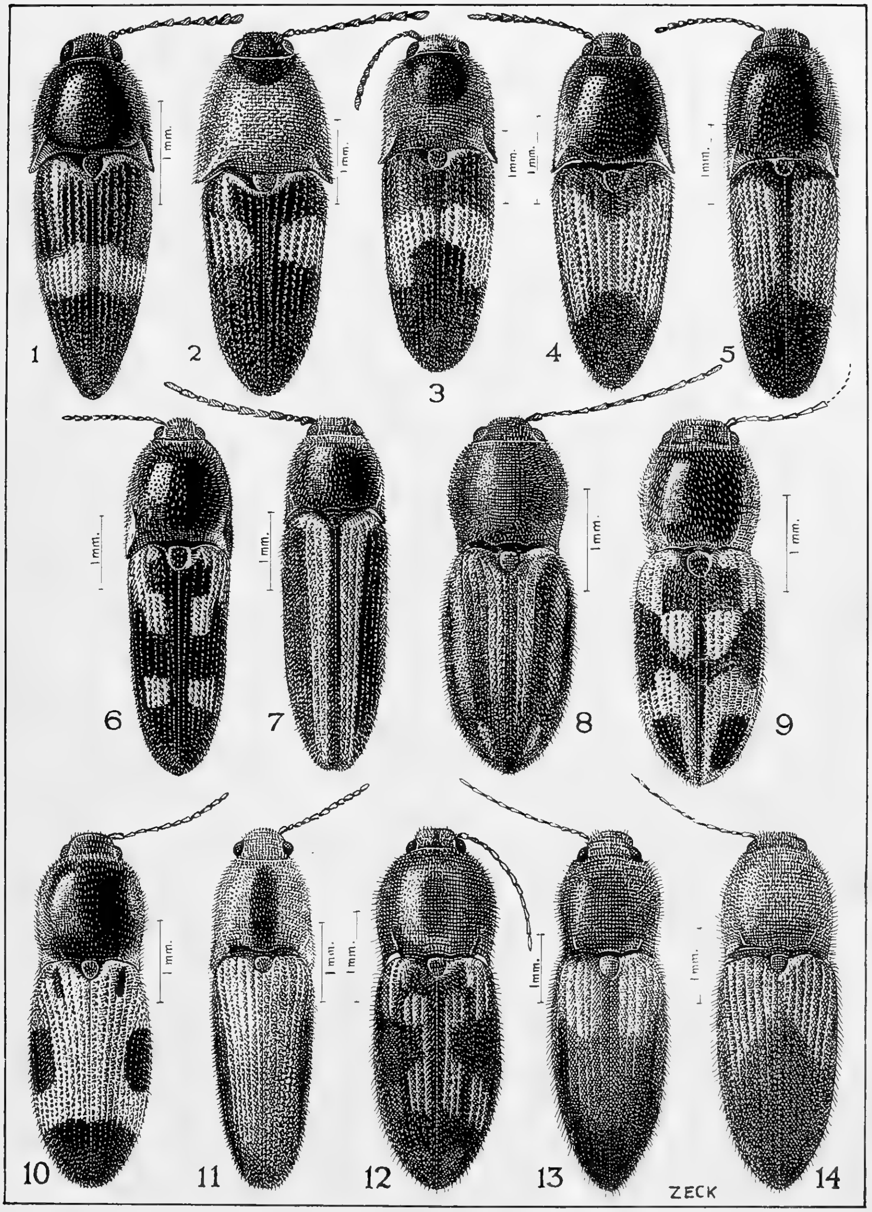
DESCRIPTION OF PLATES VIII-IX.

Plate viii.

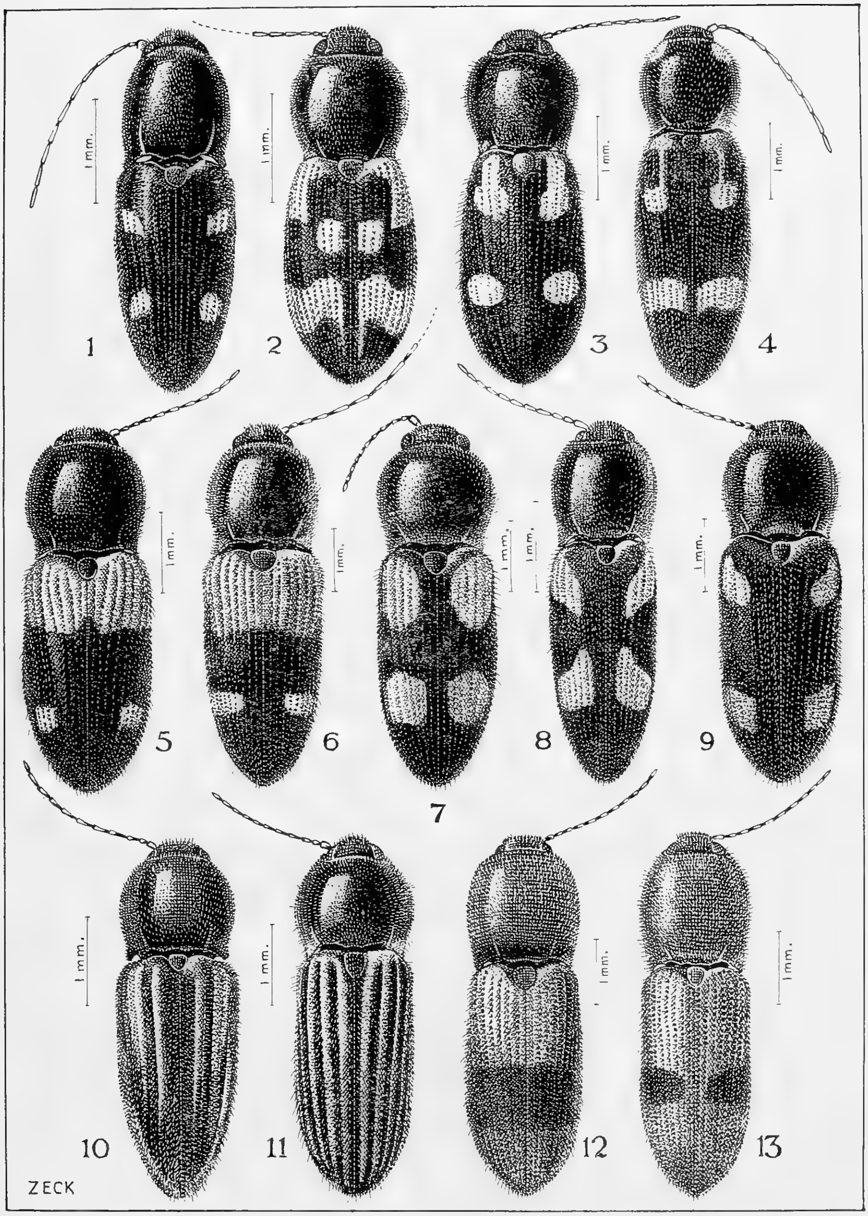
1.—*Melanoxanthus flavosignatus*, n. sp.
2.—*M. jucundus*, n. sp.
3.—*M. columbinus*, n. sp.
4.—*M. biarctus*, n. sp.
5.—*M. semiruber*, n. sp.
6.—*M. insolitus*, n. sp.
7.—*M. lativittis*, n. sp.
8.—*Paracardiophorus litoralis*, n. sp.
9.—*Hypnoidus flavopictus*, n. sp.
10.—*Paracardiophorus atronotatus*, n. sp.
11.—*Melanoxanthus rufoniger*, n. sp.
12.—*Paracardiophorus rufopictus*, n. sp.
13.—*P. varians*, n. sp.
14.—*P. cooki*, n. sp.

Plate ix.

1.—*Paracardiophorus quadristellatus*, n. sp.
2.—*P. carissimus*, n. sp.
3.—*P. assimilis*, n. sp.
4.—*P. octosignatus*, n. sp.
5.—*P. stellatus*, n. sp.
6.—*P. amabilis*, n. sp.
7.—*P. dulcis*, n. sp.
8.—*P. subcruciatus*, n. sp.
9.—*P. occidentalis*, n. sp.
10.—*P. alternatus*, n. sp.
11.—*P. vittipennis*, n. sp.
12.—*P. nigrosuffusus*, n. sp.
13.—*P. subfasciatus*, n. sp.



Australian Elateridae.



Australian Elateridae.

THE GENUS *ADRAMA*, WITH DESCRIPTIONS OF THREE NEW SPECIES (DIPTERA, TRYPETIDAE).

By John R. Malloch.
(*Communicated by Frank H. Taylor, F.R.E.S., F.Z.S.*)

(Two Text-figures.)

[Read 28th June, 1939.]

This short paper includes a review of the species of the genus *Adrama* known to the writer, with descriptions of two new species, only one of them being as yet known to occur in New Guinea.

The genus belongs to the Adraminii, which contains very few species and is distinguished from most of the members of the family by the lack of the presutural thoracic bristle, the paucity of orbital bristles, which usually consist of two or three incurved anterior and one reclinate posterior pair of weak bristles. There are no well developed ocellar or postvertical bristles, the humeral is not present, and there is no pteropleural bristle in any species. Not all the species of the Tribe have the femora spinose, but all have the first vein and part of the third setulose on the upper surface.

It is possible that the Australian species described below will yet be found in New Guinea.

The types of two of the new species are being returned to Mr. Frank H. Taylor, the paratypes to the British Museum. The type of the third species and identified specimens of the two already-known species are at present in the writer's collection.

Adrama Walker.

Walker, *Jour. Proc. Linn. Soc. Lond.*, iii, 1859, 117.

In this genus the sides of the postnotum including the lower part of the convexity have fine erect hairs; usually all the femora with some short stout black ventral spines on the apical portion, rarely the fore femora unspined.

Below I present a key to the species available to me:

1. Scutellum with but two bristles, the basal pair absent; fifth (apical) abdominal tergite of male with some short stout black bristles at each apical lateral angle; mesonotum with an entire yellow central vitta; centre of postnotum black, the dark colour not extending to the metapleural convexity, and no black mark on pleura in front of the latter which is not conspicuously ivory-white; no black spot in front of frons .... *biseta*, n. sp.

   Scutellum with four strong bristles, two close to base, the others rather close together at apex; fifth abdominal tergite of male not strongly bristled at each lateral apical angle; mesonotum with the yellow central vitta present at most postsuturally; postnotum either without black central vitta, or with the black colour extending to the metapleural convexity, and the pleura black in front of the latter, which is pale ivory-white; a black spot near anterior margin of frons 2

2. Postnotum, pleura, and scutellum yellowish-red, without distinct black markings; wing with the apex slightly infuscated, the anterior edge of the infuscated area, across the outer cross-vein blackish-brown, the dark streak extending to third vein above the outer cross-vein .... *papuaensis*, n. sp.

Postnotum black up to, and the pleura broadly black in front of, the metapleural convexity, the front half of the mesopleura and dorsum of the scutellum except narrowly along the edges also black; wing rather uniformly dark brown from outer cross-vein to tip 3

3. Fore tarsi entirely reddish-yellow; frons except the narrow orbits black in front, fading into reddish-yellow above middle; supra-alar bristle lacking .... *flavimana*, n. sp.

Fore tarsi entirely black or blackish-brown; frons with a small round black mark or spot on anterior margin; supra-alar bristle present and strong 4

4. The glossy-black marks on the metapleura and mesopleura meeting below, epistomal black spots fused .... *determinata* Walker

The glossy-black marks on the metapleura and mesopleura not meeting on venter, lower half of sternopleura and the area of thorax below base of abdomen and above hind coxae reddish-yellow; epistomal black spots small, separated .... *selecta* Walker

Adrama biseta, n. sp.

This species agrees with the genotype in general colour, markings, and structure. The principal distinctions are pointed out in the above key to the species. The type specimen is from northern Queensland.

♂.—Head orange-yellow, the face paler and with a large black spot on centre of the epistome, the frons without black anterior markings, with narrow black edge round the ocelli. Antennae entirely orange-yellow; palpi brownish in type, but the mouth parts are greasy so that colour may be abnormal. Frons fully twice as long as its central width, slightly widened in front, with the usual two long inner vertical bristles, outside of these a short outer vertical, one pair of upper reclinate, and two pairs of weaker incurved anterior orbitals, the surface with some microscopic yellow hairs and faint white-dusting. Face concave in centre in profile, the epistome slightly projecting, parafacial at base of antenna not as wide as third antennal segment, centrally invisible in profile. Antenna not attaining epistome, third segment 3·5 times as long as wide, slightly narrowed to apex where it is rounded; aristae short-haired on entire extent, the longest hairs about half as long as width of third antennal segment. Eye about 1·5 times as high as long, narrowed below; gena one-seventh as high as eye and about equal to width of third antennal segment.

Thorax a little darker than head, brownish-orange or red, the mesonotum with two broad black shiny vittae that are interrupted or almost so at the suture, the anterior portion carried laterally to margin in front of wing base; scutellum with a broad black triangle, only the lateral margins and apex red; pleura entirely red, postnotum and postscutellum shiny black. Bristles as follows: notopleurals 2, supra-alar 1, post-alars 2, a weak mesopleural, and a short hair-like pair of dorsocentrals near the posterior margin. Scutellum flattened, triangular, with a pair of rather closely placed strong apical bristles, both sclerites with quite close short decumbent yellow hairs, those on black vittae of mesonotum dark.

Wing (Figure 1): Stigma yellow, the preapical and apical marks brown. First vein setulose from extreme base to apex above, third from fork to beyond inner cross-vein. Halteres and squamae brownish-yellow or red. Legs orange-yellow, fore tibiae from near bases and entire fore tarsi, and hind tibiae to near apices, dark brown. Fore femur with a short stout bristle near apical third of posteroventral surface; mid femur thicker than the others, thinner on apical half where there are two series of short stout spines, one on the anteroventral and the other on the posteroventral surface, hind femur with three or four anteroventral and two posteroventral spines, all the spines black; mid tibia with a strong apical ventral spur. Abdomen red, more or less discoloured in type, with short decumbent black hairs that are inserted in very minute punctures, the four or five bristles on the apical lateral angles on fifth tergite black. Basal composite tergite about as long as the next two combined, fifth about 1·5 times as long as fourth. Length, 11 mm.

Type, N. Queensland: Cairns (Illingworth). In the collection of the School of Public Health and Tropical Medicine, University of Sydney.

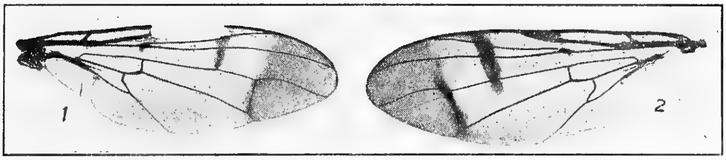


Fig. 1.—*Adrama biseta*, n. sp. Wing.
Fig. 2.—*Adrama papuaensis*, n. sp. Wing.

Adrama papuaensis, n. sp.

♂, ♀.—Similar to the above species in general colour, differing in having the frons darkened above and with a large anterior central dark brown mark, the face with a pair of well-separated black epistomal spots, the mesonotum entirely black with the exception of the ivory-yellow humeri presuturally while behind the suture the black vittae do not attain the posterior margin and are separated on the anterior two-thirds from suture to posterior margin by a bright lemon-yellow central stripe; the scutellum is entirely red, as are also the postnotum and post-scutellum. There are two bright lemon-yellow or ivory-white marks on the pleura, one, subtriangular, on the posterior margin of the mesopleura, and the other covering the supraspiracular convexity of the metapleura; these are indistinct in the preceding species. The wing is also different in the dark markings as shown in Figure 2. Frons a little wider than in *biseta*, gena distinctly narrower. I can detect no outer vertical bristles in this species; all the other bristles present. Thorax with the same bristles and hairs as in the preceding species, except in having two pairs of scutellar bristles, the additional pair close to base. Legs as in *biseta*, but there is no bristle below on the fore femur in any of the specimens before me.

Wing (Figure 2) with the same markings as in the above species, but here the apical costal mark is darkest along the anterior edge. Veins setulose as in *biseta*. Abdomen as in *biseta*, but there are no well developed bristles as a rule on the posterior lateral angles of the fifth tergite. Length, 10–13 mm.

Type, male, allotype, and 1 paratype, New Guinea: Wewak (F. H. Taylor); 3 paratypes, Papua: Kokoda, 1,200 feet, Sep.–Oct., 1933 (L. E. Cheesman). The last-mentioned three paratypes in the collection of the British Museum. Types in the collection of the School of Public Health and Tropical Medicine, University of Sydney.

Adrama flavimana, n. sp.

♂.—This species has the frons brownish-black except on the upper fourth, the two black epistomal spots large, almost or quite fused centrally, the mesonotum black, marked much as in *papuaensis*, but the postsutural black vittae reach the posterior margin, there are two large glossy-black pleural marks, one on the anterior half of the mesopleura from upper edge behind the spiracle downward to below lower margin of the mesopleura, and the other on the pteropleura except its upper edge that extends backward below the ivory-yellow metapleural convexity and posterior spiracle; the postnotum and postscutellum broadly black; scutellum dark brown on disc, only the edges red.

Head as in the two preceding species, the genae as narrow as in *papuaensis*, but the three pairs of orbital bristles are much weaker than in that species. The antennae are both broken off in the type specimen. I can detect neither the mesopleural nor the supra-alar bristle in the type, but all the other bristles, with the possible exception of the weak dorsocentrals, are present, and there are two pairs of strong scutellars. Legs almost as in *biseta*, no ventral bristle on fore femur, but the fore tarsi are reddish-yellow, not blackish-brown.

Wing as in the two preceding species, but the short brown streak at inner cross-vein descends a little more evidently below that vein, and the apical brown mark is almost uniform in depth of colour. Veins setulose as in *biseta*. Abdomen red. Fifth tergite with a few setulose hairs on lateral apical angles. Length, 9 mm.

Type, Borneo: Sandakan (C. F. Baker). Sent to me a number of years ago by the collector.

Adrama selecta Walker.

Jour. Proc. Linn. Soc. London, iii, 1859, 118.

I have before me one specimen received from Dr. Baker that appears to agree in all particulars with Walker's species. Dr. Smart has sent me a sketch of the thoracic markings of Walker's type and my specimen agrees well with this, though I am rather doubtful of the propriety of accepting the identification without a careful comparison of material with the types.

Originally described from Aru Islands, but recorded from the Malayan region. My specimen is from the Philippines.

Adrama determinata Walker.

Dacus determinata Walker, *Jour. Proc. Linn. Soc. Lond.*, i, 1857, 133.

I have this also from Dr. Baker, taken in the Philippines. Originally described from Borneo.

A NEW FAMILY OF LEPIDOPTERA.

By A. Jefferis Turner, M.D., F.R.E.S.

[Read 28th June, 1939.]

In his revision of the Australian Gelechiadae (these Proceedings, 1904, p. 435) Meyrick described the genus *Thalamarchis* at the end of that family, but had apparently some doubt as to the correctness of its position there. He wrote: "this genus appears to stand quite isolated, and I am unable to see that it bears any near relationship to any form known to me. In its large size and conspicuous colouring it resembles an Oecophorid of the *Philobota* and *Hypercallia* groups, and since the palpi and neuration also agree, it might be thought to be really akin to them, but the hindwings considerably exceed the forewings in breadth, and the antennae of male are quite without ciliations; the combination of these two prohibitive characters seems to me conclusive. The structure of vein 2 of the forewings, which is not widely remote from 3, removes the species from the Xyloryctid group. It accords well with the family characters of the Gelechiadae, but is discordant in every group of that family, and I am compelled to regard it as representing an early unspecialised branch; perhaps other allied forms may be discovered in West Australia."

The genus does not appear in his revisions in the Genera Insectorum of the Oecophoridae (1922) and of the Gelechiadae (1925), and *Thalamarchis* appears to be now an unassigned genus. I propose to make it the type of a new family, and to associate with it three hitherto unnamed genera. This small family is known only from Western Australia. It is probably related to some early forms of Oecophoridae, and less closely with the Gelechiadae, as a side-branch, which has not developed much, and may have become largely extinct.

Fam. Thalamarchidae, nov.

Head smooth-scaled with moderate erect side-tufts. Tongue developed. Labial palpi long, ascending, recurved, acute. Maxillary palpi minute. Antennae without basal pecten; in male simple. Forewings with 7 and 8 stalked, 7 to termen. Hindwings much broader than forewings (1½–2); 3 and 4 connate, 5 from below middle of cell, 6 and 7 widely separated at origin, parallel or diverging, 12 more or less approximated to cell for some distance.

Gen. Thalamarchis.

Meyr., P.L.S.N.S.W., 1904, p. 435.

Antennae about three-fourths. Palpi very long; second joint much exceeding vertex, moderately thickened with smoothly appressed scales; terminal joint four-fifths, slender. Posterior tibiae densely clothed with long hairs. Forewings with 2 from shortly before angle, 3 and 4 approximated from angle. Hindwings with 12 closely approximated to cell to about middle, 5 from about middle.

THALAMARCHIS ALVEOLA.

Cryptolechia alveola Feld., *Reis. Nov.*, Pl. 140, f. 35.—*Thalamarchis alveola* Meyr., P.L.S.N.S.W., l.c., p. 436.

Western Australia: Albany, Margaret River, Waroona, Perth, York, Yanchep, Mogumber, Geraldton, Cunderdin.

Gen. PSILOSCELES, nov. (ψιλοσκελης, with smooth tibiae.)

Antennae about four-fifths. Palpi very long; second joint about 3 times length of face, slender; terminal joint as long as second. Posterior tibiae smooth with a few hairs on dorsum at apex. Forewings with 2 very oblique from about three-fourths, 3 and 4 approximated from angle. Hindwings with 5 from below middle, 6 and 7 widely separated at origin, thence diverging, 12 closely approximated to cell to about middle.

Rather closely allied to *Thalamarchis*; the points of difference being of minor importance, with the exception of the origin of 2 in the forewings, which suggests some relation, probably distant, to the *Xyloryctidae*.

PSILOSCELES DICHOCHROA, n. sp. (διχοχροος, double-coloured.)

♂, ♀. 18–20 mm. Head and thorax dark fuscous. Palpi dark fuscous with two slender whitish side lines on anterior surface of second joint. Antennae fuscous. Abdomen fuscous with lateral ochreous streaks. Legs fuscous; anterior coxae, middle and posterior femora, and posterior tibiae except at apex ochreous-whitish. Forewings dilated before middle, costa strongly arched, apex subrectangular, termen obliquely rounded, dark fuscous; in male a slender whitish line on fold from base to near above tornus; in female this is obsolete, being represented by a few whitish scales only; cilia dark fuscous. Hindwings broadly ovate, termen sinuate; deep ochreous-yellow; cilia grey; bases dark fuscous.

Western Australia: Coorow in October; two specimens.

Gen. PHILETES, nov. (φιλετης, deceitful.)

Antennae about two-thirds.

Palpi with second joint reaching base of antennae, thickened with rough scales and expanded towards apex; terminal joint as long as second, slender. Thorax with a posterior crest. Posterior tibiae clothed with long hairs. Forewings with 2 and 3 connate from angle, 4 from well above angle. Hindwings with 5 from below middle, 6 and 7 separate, diverging, 12 approximated to cell, but not closely, to middle, gradually diverging.

The type species shows no resemblance to the two preceding, and might easily be mistaken for one of the Xyloryctidae, but for the neuration.

PHILETES MEGALOSPILA, n. sp. (μεγαλοσπιλος, with large spot.)

♂. 24–30 mm. Head grey; side-tufts whitish. Palpi fuscous sprinkled with whitish. Antennae fuscous. Thorax fuscous-grey. Abdomen pale grey; tuft grey-whitish. Legs dark grey sprinkled with whitish and faintly tinged pink; posterior pair grey-whitish. Forewings elongate-oval, costa moderately arched, apex rounded, termen oblique; grey; a fine fuscous subcostal line from base to one-third, interrupted by whitish; a large oblong fuscous white-edged median spot with a short transverse fuscous mark just beyond; median third of costal edge pinkish; a suffused outwardly curved whitish line at two-thirds, cut by fine fuscous lines interrupted by whitish running into termen; cilia grey. Hindwings with termen rounded; dark grey; cilia grey.

Western Australia: Waroona in October; Perth in November; two specimens.

Gen. Blacophanes nov. (βλακοφανης, of sluggish appearance.)

Antennae about two-thirds. Tongue present but weakly developed. Palpi with second joint reaching base of antennae, thickened with smoothly appressed scales; terminal joint as long as second. Posterior tibiae hairy on dorsum. Forewings with 2 from angle approximated to 3, 7 to termen. Hindwings with 5 from below middle, 6 and 7 approximated at origin, gradually diverging, 12 moderately approximated to near end of cell.

Blacophanes pallida n. sp. (*pallidus*, pale.)

♀. 35–38 mm. Head and thorax whitish. Palpi whitish sprinkled with pale grey. Antennae whitish. Abdomen whitish; apex and underside fuscous. Legs grey; posterior pair paler. Forewings suboblong, costa straight, apex rounded-rectangular, termen slightly rounded, slightly oblique; whitish sprinkled with grey; a discal spot at two-thirds and a terminal series of dots grey; cilia whitish. Hindwings and cilia whitish.

Western Australia: Perth (L. J. Newman); two specimens.

HYMENOPTEROUS PARASITES OF EMBIOPTERA.

By Alan P. Dodd.

[Read 26th July, 1939.]

Family Bethylidae.

Subfamily Sclerogibbinae.

This small subfamily is distinguished by the fact that the antennae contain from 22 to as many as 40 joints, compared with 12 to 13 joints in the large subfamily Bethylinae. In his 1914 monograph of the Bethylidae (*Das Tierreich*, 41, Berlin), Kieffer lists six described and two undescribed species of Sclerogibbinae, which are divided between six genera; four of the genera are based on females, and two are erected for undescribed males. Of the eight species, four are from Africa, two from Europe, and one each from Asia and North America. The known females are wingless; the males are fully winged. They appear to be rare insects; in no case have both sexes of the one species been recognized.

While the discovery of the subfamily in Australia is of interest, the record of the species as an ectoparasite of an Embiid deserves particular notice, since nothing seems to have been known previously concerning the host relations of these insects.

The single Australian example is a female. It disagrees with the characters given for the four genera based on this sex, viz., *Sclerogibba* Riggio and T. Stefani, *Tanynotus* Cameron, *Mystrocnemis* Kieffer and *Prosclerogibba* Kieffer, in the possession of ocelli. However, in view of the small amount of knowledge of the group and of the limited number of species, I have preferred to place the insect in the type genus rather than to erect a new genus for its reception.

Sclerogibba embiopterae, n. sp.

♀. Length 4 mm. Body black, except as follows: the produced anterior margin of the head between the antennae is clear testaceous, to agree with the colour of the antennae; the declivous anterior shoulders of the pronotum are pale ferruginous; there is a similar pale area across the posterior margin of the pronotum; posteriorly on the propodeum against the base of the abdomen is a ferruginous spot. Antennae clear testaceous for basal two-thirds, the apical third brown. Coxae black, the intermediate and posterior pair with a pale spot at apex; anterior femora black, the other femora blackish; tibiae dusky-brown; tarsi ferruginous.

Head flattened; from dorsal aspect slightly longer than its greatest width, which is at one-third its length from the posterior margin, somewhat narrowed anteriorly where it is produced in the form of a broad, very transverse 'beak', the anterior margin of which is straight; posterior margin of head gently but definitely concave, not margined but sharp, since the occiput falls away very precipitously; mouth parts and antennal insertions on the underside, the mouth parts just beyond the middle, the antennae near the anterior margin; eyes very wide apart, moderately large, rather narrow, extending for two-thirds the length of the head almost to the posterior margin, with a pubescence of very short fine hairs; ocelli present, small, in a triangle, the posterior pair close to the occipital margin, separated from the eyes by almost their own distance apart; dorsal surface of head with fine close polygonal reticulation and very fine short dense pubescence, and with a scattered pubescence of moderately long hairs arising from indefinite punctures. Antennae 26-jointed; scape moderately stout, 2½ times as long as wide, excavated for its dorsal third where it fits underneath the head, the margin of the excavation armed with several stout hairs or bristles; pedicel short, transverse, half hidden in the scape; flagellum curved, very gradually tapering to apex; joint 1 as long as wide; 2 and the following joints distinctly wider than long, but the several apical joints are as long as wide, and the ultimate joint is almost twice as long as its basal width. Thorax distinctly narrower than the head and abdomen, four times as long as its width, almost parallel-sided, the dorsal surface of pronotum and propodeum flat; pronotum twice as long as wide, narrowly impressed at the median line, rounded anteriorly, not margined laterally, the posterior border rather deeply concave; mesoscutum small, shorter than its width; scutellum convex, twice as long as the scutum, fully as long as its greatest width, which is at two-thirds its length; propodeum without carinae or carinated margins, its surface flat, scarcely as long as the pronotum, widening gradually toward the posterior margin, thence narrowing very sharply; sculpture of thorax of fine close reticulation and fine short dense pubescence, but without the long hairs and indefinite punctures of the head. Front femora very greatly swollen; middle and posterior tibiae as long as their femora, each with a stout apical spur; posterior tarsi longer than their tibiae, with two tarsal claws, one of which has a short broad inner tooth. Abdomen somewhat shorter than the thorax, with the same fine sculpture and pubescence; convex dorsally, pointed at apex; segments 1 and 2 together occupying fully one-half the length; 1 somewhat longer than 2; 3 transverse, one-half as long as 2; 4 narrower and a little longer than 3; 5 narrower and shorter than 4; 6 triangular, somewhat longer than 5 or than its basal width.

One female reared by Mr. B. A. Smith on 8th October, 1935, at Chinchilla, Queensland, from a larva of *Oligotoma gurneyi gurneyi* Frogg., var., as determined by Consett Davis. Mr. Smith has supplied the following notes on this insect: "The legless larva, which was nearly full-grown when found, was attached between the prothorax and mesothorax dorsally of the Embid larva which was in the last instar and was quite active. The parasite spun a cocoon, after the manner of other Bethylids."

Holotype in the Queensland Museum.

It is of interest to record that a Hymenopterous larva attached to a female of *Oligotoma gurneyi gurneyi* Frogg., was collected by Consett Davis at Bagdad Valley, Tasmania, 31.1.37.

Family Scelionidae.

Subfamily Scelioninae.

Embidobia Ashmead.

This genus was erected by Ashmead in 1895 (*Journ. Trinidad Club*, Vol. 2, No. 11, pp. 264–266) with the type species, *E. urichi* Ashmead, which had been reared from Embiid eggs in the island of Trinidad, West Indies. No other members of the genus have been described. However, Imms (1913) has recorded the existence of a species attacking the eggs of *Embia major* Imms in the Himalayas, India.

The discovery of these interesting egg-parasites in Australia is associated with the recent investigations of our Embioptera by Consett Davis, to whom I am indebted for the opportunity to study and describe the parasite material, which contains three species.

In addition to the Australian species, Consett Davis has submitted a female of another species, collected by himself at Colombo, Ceylon, in a nest of *Oligotoma greeniana* End., in bark, 7.1.39.

Ashmead's diagnosis of the characters of *Embidobia* gives the female antennae as 12-jointed. He states: "Antennae inserted just above the clypeus, 12-jointed, in the female terminating in a 4-jointed club, the funicular joints all very minute, except the first, transverse; pedicel obconical, stouter and longer than the first three or four funicular joints united." In the four species I have examined, the female antennae are 11-jointed; the funicle is either 5- or 6-jointed and the club 3- or 4-jointed, depending upon the eighth antennal joint being counted as a funicle or club joint; this joint is wider than the seventh joint, but is much smaller than the ninth; however, in this paper, it is considered as the small first segment of a 4-jointed club.

Whether *E. urichi* has 11- or 12-jointed antennae in the female cannot be determined without an examination of the type material. Ashmead's description may be correct. On the other hand, it would have been a simple mistake to have miscounted the small funicle joints.

Despite the 11-jointed female antennae, which might suggest the subfamily Telenominae, the flanged or carinate lateral margins of the abdomen are typical of the Scelioninae.

The four species recognized in this paper can be distinguished by the following key:

1. Segment 2 of abdomen finely reticulate, without striae; metanotum hidden by the raised posterior margin of the scutellum .... *orientalis*
   Segment 2 striate for the greater part; metanotum short, but not hidden under the posterior margin of the scutellum 2
2. Abdomen narrower at base, especially in the female; wings extending well beyond apex of abdomen in both sexes .... *longipennis*
   Abdomen more broadly sessile at base, especially in the female; wings not reaching beyond apex of abdomen in the female, and very little beyond abdomen in the male 3
3. Postmarginal vein long, much longer than the stigmal vein; frons without longitudinal rugae and striae .... *australica*
   Postmarginal vein short, scarcely longer than the stigmal vein; frons with longitudinal rugae and striae .... *metoligotomae*

EMBIDOBIA AUSTRALICA, n. sp.

♀. Length 0·95 mm. Head, mesoscutum and scutellum, and the greater part of the abdomen, dull-black or blackish; thorax, except scutum and scutellum; deep red-brown; first segment, base of second segment, margin between second and third segments, and lateral margins ventrally, of abdomen red-brown; antennal scape yellow, the pedicel and funicle joints brown, the club dusky; coxae red-brown, the femora rather dusky-brown, the tibiae and tarsi testaceous.

Head, from dorsal aspect, transverse, no wider than the thorax, the occiput gently concave and with a complete occipital carina; from lateral aspect, the vertex and frons are regularly convex, the cheeks are moderately broad and slope sharply ventro-posteriorly; from frontal aspect, the head is regular in outline, and is one-half wider than deep; frontal impression absent, but a carina extends above the antennal prominence and the face is depressed on either side of the carina; eyes moderately large, wide apart, densely pubescent; ocelli moderately small, very wide apart, the lateral pair separated by their own diameter from the eye margins; head with fine pubescence and with fine dense reticulate or rugose sculpture. Antennae 11-jointed; scape moderately long; pedicel almost twice as long as its greatest width; funicle joints small, much narrower than the pedicel, 1 a little longer than wide, 2 quadrate, 4 and 5 much wider than long; club compact, 4-jointed, joint 1 rather small, 2 and 3 each a little wider than long, the terminal joint as long as its basal width. Thorax short, no longer than its greatest width or height; pronotum declivous, scarcely visible from above; scutum very broadly rounded anteriorly, the parapsidal furrows absent; scutellum semicircular, margined posteriorly; scutum and scutellum with fine dense pubescence and fine raised scaly reticulation; metanotum very short, unarmed; propodeum very short, visible laterally only. Forewings rather short, failing to reach apex of abdomen; moderately narrow, rounded at apex; distinctly brownish but paler toward base; marginal cilia moderately long; discal cilia fine and dense; venation deep brown, thick, very distinct; submarginal vein joining the costa at one-half the wing length; marginal vein one-half as long as the stigmal vein, which is moderately oblique, straight, with a distinct terminal knob; postmarginal vein long, three times as long as the stigmal vein and fully one-half as long as the submarginal. Fore and middle legs short, the posterior pair longer; tarsi 5-jointed, the posterior tarsi no longer than their tibiae. Abdomen as long as the head and thorax united, one-half longer than its greatest width, which is somewhat greater than that of the thorax; broadly sessile at base, its lateral margins gently convex; segment 1 transverse, less than one-half as long as its basal width, transversely impressed at one-half its length so that the base is broadly and shortly raised; 2 two-thirds longer than 1, with a foveate transverse line at base; 3 the longest, one-third longer than 1 but much wider than long; 4–6 each transverse, together two-thirds as long as wide; 1 strongly striate; 2 more finely striate but smooth toward posterior margin, while laterally the striae fail and are replaced by fine reticulation and pubescence; 3–5 with fine impressed polygonal reticulation and fine pubescence, the sculpture stronger and the pubescence less pronounced medially on 3.

♂. Agrees very closely with the female, except in sexual characters. The forewings are longer, extending for a short distance beyond the abdomen, and are wider, with the apex more broadly rounded. Antennae 12-jointed, the scape yellow, the pedicel dusky yellow or brown, the flagellum black; scape moderately long; pedicel slender, nearly twice as long as its greatest width; flagellar joints moniliform; 1 somewhat shorter than the pedicel, one-half longer than wide; 2 and 3 slightly shorter than 1; 4–9 quadrate or slightly wider than long, their basal and posterior margins truncate; apical joint about twice as long as the penultimate.

A large series included with *E. metoligotomae* and labelled "From nests of *Metoligotoma ingens* Davis, Black Mountain, Canberra, F.C.T., 25.1.35, R. V. Fyfe". Two females labelled "From eggs of *Metoligotoma illawarrae illawarrae* Davis, Austinmer, N. S. Wales, C. Davis; eggs collected 1.3.36, parasites emerged 27.3.36". The holotype and allotype have been selected from the Canberra series.

Holotype female and allotype male in the Queensland Museum. Paratypes retained by the author and returned to Consett Davis.

EMBIDOBIA METOLIGOTOMAE, n. sp.

♀. Length 0·90 mm. Head, thorax and abdomen wholly black, except that the lateral line or flange of the abdomen ventrally is reddish; coxae dusky black, the femora dusky brown, the tibiae and tarsi clear testaceous; antennae brownish-yellow, the club dark fuscous.

Frons rather less convex than in *australica*, its median carina stronger and extending to the frontal ocellus; sculpture of vertex definitely but finely rugose in irregular raised lines; upper half of frons irregularly longitudinally rugose, the lower half regularly longitudinally striate. Antennae as in *australica*. Mesoscutum with fine scaly reticulation and fine pubescence; scutellum shining, with the sculpture weak and indefinite. Forewings just reaching or failing by a little to reach apex of abdomen; broader than in *australica*, the apex more broadly rounded; lightly stained brownish, not appreciably paler toward base; venation very distinct, marginal vein one-third as long as the stigmal, the postmarginal short, very little longer than the stigmal. Abdomen one-half longer than its greatest width, broadly sessile at base; segment 1 one-half as long as its basal width; strongly striate, but medially at base irregularly rugose; 2 very narrowly smooth at base, followed by the foveate line, the striate sculpture stronger than in *australica* but giving way to reticulate sculpture latero-posteriorly, smooth along posterior margin; 3 very slightly longer than 2, medially with a close polygonal reticulation and without pubescence; 4 and 5, 3 laterally, and lateral margin of 2 with fine pubescence and fine indefinite reticulation.

♂. Abdomen rather more slender and narrower at base than in the female, almost twice as long as its greatest width; segment 1 almost as long as its basal width, strongly striate but not rugose medially at base. Forewings a little broader and longer, extending a short distance beyond apex of abdomen. Antennae black, the scape and pedicel dusky-brown; pedicel one-half longer than wide; flagellar joint 1 subquadrate or slightly longer than wide; 2–9 each somewhat wider than long, their basal and apical margins sharply truncate.

At once differing from *australica* in the short postmarginal vein, and in the sculpture of the head; the frons and vertex in *australica* are finely reticulate-rugose, without the longitudinal striae or rugae on the frons; the scutellum is definitely sculptured like the scutum in *australica*, whereas in *metoligotomae* it is shining and the sculpture is indefinite.

A series included with *E. australica* and labelled "From nests of *Metoligotoma ingens* Davis, Black Mountain, Canberra, F.C.T., 25.1.35, R. V. Fyfe". A small series bred from eggs of *Metoligotoma intermedia* Davis, Nowra, N. S. Wales, Consett Davis; eggs collected 8.10.37, parasites emerged 31.12.37. Three females bred from eggs of *Metoligotoma extorris* Davis, Brush Island, near Ulladulla, N. S. Wales, 6.9.36, Consett Davis. One female in nests of *Metoligotoma pentanesiana* Davis, Five Islands, N. S. Wales, 12.3.36, Consett Davis. The holotype and allotype have been selected from the Canberra series.

Holotype female and allotype male in the Queensland Museum. Paratypes retained by the author and returned to Consett Davis.

A female from Lady Barron, Flinders Island, Bass Strait, collected by Consett Davis in a web of *Metoligotoma tasmanica* Davis, subspecies ?, 9.1.38, should be referred to this species, although it differs in minor particulars. The legs are darker, with the tibiae and tarsi brownish-yellow, not clear yellow. The antennae are darker, the scape being fuscous like the club, and the pedicel and funicle joints dusky-brown. Segment 2 of the abdomen is not narrowly smooth at base; the striation is not so strong, and on the posterior half there is polygonal reticulation between the striae.

Embidobia longipennis, n. sp.

♀. Length 0·95 mm. Black, the base of the abdomen dull reddish; antennae dark, the joints, except the club, somewhat brownish; coxae and femora dusky-black, the tibiae and tarsi dusky ferruginous.

Frons rather less convex than in *australica*; the median carina extending to the anterior ocellus; sculpture much as in *metoligotomae*, the lower half of frons regularly longitudinally striate, the upper frons irregularly longitudinally rugose, the vertex irregularly transversely rugose. Antennae as in *australica*. Mesoscutum with fine pubescence and fine raised reticulation; scutellum shining, without sculpture, with scattered pubescence. Forewings extending well beyond apex of abdomen, moderately broad, the apex rather broadly rounded; lightly and uniformly stained brownish; venation light brown, moderately distinct; marginal vein one-half as long as the stigmal vein, the postmarginal twice as long as the stigmal. Abdomen not wider than the thorax, almost twice as long as its greatest width; segment 1 much more narrowed at base than in *australica* and *metoligotomae*, as long as its basal width, very definitely raised and convex at base medially; 1 rather strongly striate; 2 rather strongly striate, the striae becoming finer posteriorly, smooth posteriorly, laterally with fine sculpture and pubescence; 3 for the greater part with raised polygonal reticulation and scattered hairs, the sculpture finer and the pubescence denser laterally, smooth along the posterior margin; 4 and 5 with fine sculpture and pubescence.

♂. Forewings very long, extending beyond the abdomen for almost the length of the latter. Antennae black, the scape and pedicel dusky brown; flagellar joint 1 as long as the pedicel, twice as long as wide, 2 and 3 somewhat longer than wide, 4–9 each slightly longer than wide; flagellar joints not so compact, and less quadrate in outline than in the other two species, gradually narrowing at base and apex.

This species differs from the two preceding forms in the longer wings and the narrower base of the abdomen; both of these differences are more pronounced in the females. The flagellar joints of the male antennae are longer and taper somewhat to the ends, so that the basal and apical margins are not truncate, thus giving the flagellum a less compact appearance than in *australica* and *metoligotomae*.

One female (holotype) and one male (allotype) labelled "In webs of *Oligotoma gurneyi gurneyi* Frogg., Hobart, Tasmania, 29.1.37, G. and C. Davis". One female in web of *Notoligotoma nitens* Davis, Sylvania, George's River, New South Wales, C. Davis, 11.8.35.

Holotype and allotype in the Queensland Museum. Paratype in the author's collection.

EMBIDOBIA ORIENTALIS, n. sp.

♀. Length 0·85 mm. Head and thorax black; abdomen dusky black, the basal segment clear testaceous; antennal scape yellow, the remaining joints dusky brown; legs clear yellow, the anterior coxae fuscous.

Head, from lateral aspect, distinctly convex; lower half of frons rather deeply impressed, the median carina not extending for more than one-half the distance to the anterior ocellus; occipital border of the vertex not margined or carinate; frons and vertex with close scaly reticulation and with a pubescence of rather long fine hairs; mandibles rather long, bidentate. Funicle joints very small, 1 as long as wide, the others wider than long; 1st club joint small, not much wider than the funicle, very transverse, 2 quadrate, 3 somewhat wider than long. Scutum and scutellum with similar reticulation and the rather long pubescence of the head; scutellum semicircular, but rather longer than in the Australian species, somewhat raised posteriorly and from dorsal aspect completely hiding the short metanotum. Forewings just reaching apex of abdomen; rather narrow, the apex rather sharply rounded; lightly stained brownish, the infuscation deepest at one-half the length; marginal vein two-thirds as long as the stigmal, which is rather short and very oblique; postmarginal long, almost as long as the submarginal, fully three times as long as the stigmal. Abdomen two-thirds longer than its greatest width; very broadly sessile, its base as wide as the posterior margin of the thorax; segment 1 very little wider posteriorly than across the base, one-third as long as its basal width, faintly raised at base medially; 2 one-half longer than 1, more than twice as wide as long, without a foveate line at base; 3 slightly shorter than 2; 1 with fine close striae; 2–4 with a network of fine impressed reticulation; 4 and 5, and 2 and 3 laterally, with numerous hairs forming a rather scattered pubescence.

♂. Unknown.

This species differs from the three Australian forms in the following characters: the absence of striae on the second abdominal segment; the raised posterior margin of the scutellum hiding the metanotum; the non-carinate occipital border of the vertex. The abdomen is even wider at its base in *orientalis* than in *australica* and *metoligotomae.*

One female labelled "Colombo, Ceylon; in nest of *Oligotoma greeniana* End., in bark; 7.1.39, Consett Davis".

Holotype in the Queensland Museum.

MISCELLANEOUS NOTES ON AUSTRALIAN DIPTERA. VI.

DOLICHOPODINAE.

By G. H. Hardy.

[Read 26th July, 1939.]

The Australian species of Dolichopodidae are referred to eight subfamilies, of which one, the Chrysosomatinae (these Proceedings, lx, 1935, 248), has been dealt with in this series. There may be some doubt as regards the subfamily designation of the genus *Mesorhaga*, known to me only from the female; but the rest of the Chrysosomatinae are clearly differentiated from the Dolichopodinae, with which may be merged the Neurogoninae and Medeterinae. The following should now be added to my key by inserting the figure "8" (Hardy, 1935, 248) in the place of "other subfamilies".

8. Hypopygium exposed, large or very large, normally reflexed so as to be carried under the abdomen, or, if placed apically, opening downwards; frequently highly ornamented. Postocular vestiture usually limited to a single row of bristles and the summit is usually slightly depressed and apparently the antennae are always situated very high on the head, with the third segment always short and the arista dorsally placed. Although the venation is variable, this subfamily incorporates all forms outside Chrysosomatinae that have the median vein much upcurved, including those with this vein less strongly tending towards the radial, and all that have an appendix on this vein. The acrostichal bristles are always biserial as far as yet known .... DOLICHOPODINAE. 9
   Hypopygium small, hardly noticeable or concealed. Acrostichals biserial, uniserial or absent. Summit never depressed between the eyes, no appendix to the median vein which is never bent to a marked degree .... *Other subfamilies*
9. Thorax with a large depressed area adjacent to the scutellum 11
   Thorax without such a depression (Dolichopodinae of authors) 10
10. Posterior metatarsus with upstanding dorsal bristles. The upper median vein formed with two sharp bends close together, each at right angles and each with an appendix. Hypopygium long, the lateral view excluding lamellae being one and a half times longer than broad. (Wing character applies to the Australian species and is not general) .... *Dolichopus*
   Posterior metatarsus without upstanding dorsal bristles. The upper median vein bent to a variable degree, and directed to lie converging towards the radial, reaching the margin usually before the wing apex .... *Paraclius*
11. Legs elongate; abdomen gently tapering, rather large species (Neurogoninae of authors) 12
   Legs of normal length, abdomen short and strongly conical, not exceeding the length of thorax. Small species (Medeterinae of authors) 13
12. Upper median vein strongly upturned and reaching margin before wing apex. Hypopygium reflexed .... *Neurogona*
   Upper median vein only slightly curved and reaching margin beyond wing apex. Hypopygium not reflexed .... *Arachnomyia*
13. Anal vein present .... *Medetera*
   Anal vein absent .... *Thypticus*

Genus Dolichopus Latr.

Only one species is known from Australia; it has venation like that of *D. zickzack* Wied., and is represented in the collection before me by a male from

Southport and a female from Brisbane, labelled with a query as being this species, which reaches from Java to the Mandated Territory of New Guinea. The specimens differ, however, by the larger size (5 mm.) and by the venation which is more complete than that noted by Becker, who indicates that the fifth vein is short and the second sinuous, whereas these veins are complete and practically straight respectively on the present specimens. Other small differences occur, but are hardly enough to show with certainty that the Queensland specimens are more than a variation.

Genus Paraclius Bigot.

Six species, perhaps seven, are before me. Some correspond rather well with described forms, but three are certainly undescribed. One species is so different in head characters that I place it here until its true valuation becomes known, there being no genus yet proposed suitable for its reception.

Key to species of Paraclius.

1. Face of male very narrow, narrowest in centre and entirely white. Face of female broader, slightly converging to oral margin or practically parallel, with a pulverulent white covering usually dense. Posterior metatarsus not quite as long as second segment, usually much shorter. Hypopygium normal 2
   Face on both sexes equally broad and bottle-shaped, yellowish. Posterior metatarsus as long as second segment. Upper median vein gently curved. Hypopygium more swollen than normal .... *latifacies*, n. sp.
2. Legs mainly black. Upper median vein bent to a rectangle. Posterior metatarsus two-thirds as long as second segment on male, nearly equal on female .... *neglectus* Becker
   Legs mainly yellow 3
3. All coxae black. Median vein gently curved. Posterior metatarsus on female not quite equal to the second segment (♀) .... *australiensis* Parent
   Anterior coxae yellow or mainly so 4
4. Upper median vein sharply bent, approaching rectangular. Posterior metatarsus two-thirds length of second tarsal segment, or longer when stated as such below 5
   Upper median vein gently bent. Posterior metatarsus half length of second (♂) .... *cilipes*, n. sp.
5. Intermediate tibiae with two anterior and four posterior dorsal bristles .... *darwini* Parent
   Intermediate tibiae with three anterior and two posterior dorsal bristles .... *obtusus*, n. sp.
   Intermediate tibiae with three anterior and four posterior dorsal bristles. Posterior metatarsus only slightly shorter than second segment (♀) .... *trisetosus* Parent

The characters of *P. australiensis* and *P. darwini* are taken from published descriptions. *P. trisetosus* Parent (♀) before me approaches *obtusus*, n. sp., and has the median vein similarly bent, a little more so than shown by Parent. In the key the character "median vein gently bent" refers to change in direction of less than 45 degrees as shown in Parent's figure 19; those "approaching rectangular" are as in his figures 20 and 21.

It is worth noting that on *P. neglectus* Becker the proportional length of the posterior metatarsus differs in the sexes, a character likely to be repeated on *australiensis* and *trisetosus*, which are known only from the female. The two latter species are likely to be closely related, but I am still uncertain if the *trisetosus* (from Gordonvale and Palm Island) before me is correctly identified; there are minor differences suggesting an allied species, and the males are needed to ascertain this. Parent's species are described in *Ann. Soc. Sci. Bruxelles* (B), liii, 1933, pp. 184–5, figs. 19–22.

Paraclius neglectus Becker.

Becker, *Cap. Zool.*, i, 1922, 16; Hardy, *Austr. Zool.*, vi, 1930, 134; Parent, *Ann. Soc. Sci. Bruxelles* (B), lii, 1932, 57.

Becker's description is very short, is based upon a specimen from Darwin (Palmerston is the older name) and agrees rather well with Brisbane specimens before me. These have, on the anterior tibiae, three anterior and two posterior strong bristles on the dorsal side and one posterior on the ventral side. The intermediate tibiae have four anterior and four posterior strong bristles dorsally and one ventrally. The posterior tibiae have four very strong bristles alternating with less strong ones, making seven in all anteriorly and four posteriorly on the dorsal side and two ventrally. The bristles mentioned are liable to variation and exclude subbasal bristles that may appear strong but do not reach the size of those counted, and the apical bristles are also excluded; Becker makes no mention of these.

Hab.—Northern Territory; Queensland: Brisbane, 3 ♂, 3 ♀, September and October, 1928 and 1930.

Paraclius obtusus, n. sp.

♂. Frons metallic-green, very slightly covered with a pulverulent white. Antennae yellowish, third segment and arista mainly blackish. Postocular bristles mainly white. Thorax metallic-green with red reflections mainly between the acrostichals; there is a limited covering of pulverulent white and a strong black colour shows on the area adjacent to the head, above the wings and at sides of scutellum. Abdomen also green with black margins to each segment, anteriorly and posteriorly, and a strong trend towards an interrupted black median stripe. The blackish hypopygium has its lamella rather heart-shaped when seen laterally. The legs are almost entirely yellow, the basal two-thirds of the intermediate and posterior coxae only being black. The anterior legs have the normal row of apical bristles on the coxae, one small subapical on the femora and on the tibiae with three rows of dorsal, three bristles to each row, besides the two apical ones, but all these are rather small; the metatarsus is about as long as the combined and equal following segments, whilst all these tarsal segments combined equal the length of the tibiae. The intermediate legs have many bristles on the coxae, one on the anterior surface of the trochanters, a row of very thin ventral bristles and a stout one on the anterior surface of the femora, the latter placed subapically; the tibiae have, besides a pair of small subbasal bristles, three anterior and two posterior long bristles on the dorsal surface, and five subapical bristles; the metatarsus is longer than the second tarsal segment and all segments combined are a little longer than the tibiae. The hind legs have a single bristle on the coxae, another on the trochanters, a ventral row and an anterior dorsal bristle on the femora; the tibiae have two small subbasal bristles, three anterior, four posterior and one subapical bristle; the metatarsus is two-thirds the length of the second segment which itself equals the combined length of the remaining segments, and all together are a little longer than the tibiae. The upper median vein is bent to a sharp angle, not quite a rectangle. Length about 5 mm.

♀. Similar, with the normal wide face parallel-sided.

Hab.—Queensland: Brisbane, 3 ♂, 5 ♀, August to November, 1928, 1929 and 1931.

Closely related to *P. darwini* Parent, according to description, but that species has a somewhat triangular lamella fringed on one side by long hairs, whereas on the present species the lamellae are somewhat heart-shaped, attached broadly at the base and the hairs are uniformly short throughout. That process, with three diverging hairs at the apex, is shown by Parent to be large, but is small on the present form, which is distinguished also by the bristles of the tibiae as given in the key. Characters mentioned by Parent, and not included above, are the same in both species.

PARACLIUS LATIFACIES, n. sp.

♂. Frons and postocular region metallic-green with a slight covering of pulverulent yellow. Face as broad as that on the female, completely covered with a yellow pulverulent overlay including the clypeus. The eye-margins converge from the frons to the upper part of the face, then diverge towards the oral margin, where they again converge, giving the face a somewhat bottle-shaped outline. The reddish-yellow antennae have the third segment and the arista black; the proboscis, palpi and upper bristles of the head are black, the lower bristles are white.

Thorax metallic-green with a large dorsal area coppery and the acrostichal bristles extend further than is normal with the genus. There are six dorsal central bristles and two large widely separated scutellar bristles, and a small bristle outside these making a second pair. Other bristles seem normal. The metallic-green abdomen has coppery reflections showing on its apical area, and along the apical margins of each segment. A white pulverulent overlay covers almost the whole abdomen, but becomes strong laterally. The swollen black hypopygium seems not quite normal to the genus and the lamellae are oblong, leaf-like, attached by a slender stalk to one corner. All the coxae are dark (greenish covered with a pulverulent white) and with normal chaetotaxy; this colour extends onto the posterior trochanters, but otherwise the legs are yellow. Omitting the small dorsal subbasal bristles and the apical, there are, on the anterior tibiae, three anterior, two posterior dorsal bristles and two ventrals; on the intermediate tibiae there are four each anterior and posterior dorsals, and four each anterior and posterior ventrals; on the posterior tibiae four each anterior and posterior dorsals and five or six, mostly small, white ventrals. The anterior tarsi are but slightly longer than the tibiae, with the metatarsus as long as the four following segments. The intermediate tarsi are longer than the tibiae, with the metatarsus about equal to the two following segments. The posterior tarsi are again longer than the tibiae, with the metatarsus equal in length with the next segment. The wings have the upper median vein gently curved and, although the curve is slight and the vein straightens, yet the vein ends before the wing apex as in *darwini* and *obtusus*.

♀. Similar to the male.

Hab.—Queensland: Brisbane, 2 ♂, 5 ♀, August and September, 1928.

With the multiplicity of bristles on the tibiae, there is a tendency to add or miss a bristle here and there, but in the main the character shows little variation. If a bristle be suppressed, a hair each side may increase in size, making two apparent bristles where one is normal. Such fortuitous bristles are liable to mislead and need to be guarded against.

PARACLIUS CILIPES, n. sp.

♂. Frons and face completely covered with pulverulent white, the latter narrow and normal. Antennae and arista blackish-brown, the latter subapically placed. Postocular bristles black. Thorax green with some reddish reflections and hardly any pulverulent overlay. Thoracic bristles include six dorsocentral and two widely separated scutellar bristles. Abdomen green with black border on the base and apex of each segment, and a pulverulent white spot laterally. Hypopygium only as long as wide (lateral view), ending in a pair of broad lamellae, somewhat square in outline. Anterior coxae yellow, the others darker, at least on the basal two-thirds, otherwise the legs are almost completely yellow. The intermediate and posterior coxae have one outstanding bristle apart from the normal marginal bristles and the hairs; the trochanters are without observed bristles. Posterior femora with one bristle situated antero-dorsally at three-quarters the length; otherwise only apical bristles are occasionally present. Anterior tibiae with three pairs of bristles on the dorsal side, varying to include a fourth. Tarsi very attenuated, with the apical segment ornamented; metatarsus one and a half times the length of second segment and about as long as the third and fifth, the fourth very slender, about as long as the first three together, and the fifth unusually long with six cilia on the anterior edge, tapering towards the apex, white on the apical half and claws hardly visible; the total tarsal length is about equal to that of the femora and tibiae combined. The intermediate tibiae have four anterior and four posterior bristles on the dorsal side besides a pair of subbasal bristles and a complete complement of apical ones; there are also four ventral bristles, but all these are apparently subject to variation; the tarsi are subequal, with the segments combined a little longer than the tibiae. The posterior tibiae seem to have normally a pair of small subbasal bristles followed by three anterior and four posterior on the dorsal side and no ventrals, but a set of apicals is present; the metatarsus is about half the length of the second segment and the others normal; the second to fifth segments equal the length of the tibiae. The upper median vein is gently bent, running thence rather straight towards the median, meeting the margin a little before the wing apex. Length about 5 mm.

Hab.—Queensland: Brisbane, May, 1935, 3 ♂.

From the description of *P. australiensis* Par., described from the female only, the present form is distinguished by its yellow anterior coxae, the straight section of the median vein, and other differences which might be sexual, but with the different chaetotaxy as described above, and the posterior metatarsus being shorter than the second segment (not almost equal to it), it seems unlikely that the two are conspecific. There is, however, a close ally, *P. ornatipes* Parent (*Treubia*, vii, suppl., 1932, 315, figs. 6 and 7), of which both sexes are known, and Parent's description of it and that given above are the same in essential points, whilst his Figure 6 applies to both; the differences here lie in the posterior metatarsus and the curvature of the upper median vein; Parent's species is from Buru.

Genus Neurogona Rond.

Rond., *Dipt. Ital. Prod.*, i, 1856, 142; Becker, *Cap. Zool.*, i, 1922, 61; Hardy, *Austr. Zool.*, vi, 1930, 134; Parent, *Ann. Soc. Sci. Bruxelles* (B), lii, 1932, 163, 174.

Becker described a species of *Neurogona* from Formosa, recording it also from India, Ceylon and Assam; in addition, he quotes a pair from Queensland (Kuranda), all under the name *denudata*. To this Parent has added a species, male only, from Eidsvold in which he contrasts five characters differing from Becker's species. A species before me is from Brisbane and the Queensland National Park, agreeing with Parent's form, but differing in certain respects mentioned in the key; I do not know if it be truly distinct.

Key to species of Neurogona.

1. Ten pairs of dorsocentral bristles, with hairs between these and the acrostichals. The prescutellar depression is unmarked. Frons covered with pulverulent white. Hypopygium figured by Becker (fig. 44) .... *denudata* Beck.
   Five pairs of dorsocentral bristles, the remainder reduced to hairs not distinguishable from those adjacent to the acrostichals. Prescutellar depression and disc of the scutellum blackish. Frons covered with pulverulent yellow. Hypopygium of the general form figured by Parent (fig. 77) 2
2. The lateral edge of the fifth tergite on male produced laterally, triangular. Hypopygium with an upstanding elongate slender process in accordance with Parent's description .... *signata* Parent
   The lateral edge of the fifth tergite on male normal. Hypopygium without process. .... sp.

Genus Arachnomyia White.

Proc. Roy. Soc. Tasmania, 1916, 252; Hardy, *Austr. Zool.*, vi, 1930, 134; Parent, *Ann. Soc. Sci. Bruxelles* (B), lii, 1932, 107 (in key).—*Pleuropygius* Parent, *Ann. Soc. Sci. Bruxelles* (B), liii, 1933, 186.

The synonymy is new. In his key, Parent gave characters for *Arachnomyia*, evidently based on White's description, which omits the prescutellar depression; he was thus misled, renaming the genus and giving characters that are identical with White's genotype, except for minor differences. There are three species before me.

Key to species of Arachnomyia.

1. Lamellae highly developed and highly ornamented 2
   Lamellae quite small, normal, with hairs, or at most with a furry covering 3
2. Posterior metatarsus half the length of the second tarsal segment .. *arborum* White
   Posterior metatarsus two-thirds the length of the second tarsal segment .... *longipes* Parent
3. Posterior metatarsus half the length of the second tarsal segment. Anterior tarsi with the three apical segments flattened and ornamented ...... *ornatipes*, n. sp.
   Posterior metatarsus two-thirds the length of the second tarsal segment and only the two apical segments of the anterior tarsi are flattened, and otherwise not ornamented .... sp.

Arachnomyia arborum White.

♂. Frons green with a strong covering of pulverulent white. Face white; the eyes practically meet at the narrowest point. Proboscis and palpi yellow. Postocular bristles white, antennae yellow, third segment missing. Thorax dorsally metallic-bronze with a green median stripe along the acrostichals. Four pairs of dorsocentral bristles anteriorly and a pair of large ones adjacent to the depressed area, which is white-covered. A row of strong prothoracic bristles, one humeral, one propleural, two notopleural and three others between the last and the dorsocentrals. Scutellum with a pair of widely separated marginal bristles. Anterior coxae yellow, the others blackish, the posterior ones with a lateral bristle, otherwise bristles are not prominent on such parts of the legs as are present on the specimen. Only one anterior leg is complete, showing femora and tibiae about equal in length, the metatarsus very long and, together with the second segment, about equal in length with the tibiae; subsequent segments decreasing in size and together slightly longer than the second segment.

The abdomen has four normal segments and the hypopygium is of the same form as on *longipes*, but there is no long bristle as shown in Parent's figure, whilst the lamellae, though laterally fringed, also apparently differ. The general design of this is reminiscent of the tail of a lyre-bird (*Menura victoriae*) owing to it being feathery and of a general lyre-shape. The fifth abdominal segment is evidently present but retracted.

♀. Similar to the male, face uniformly narrow, and up to six dorsocentral bristles are present. Third antennal segment as long as wide, with the arista placed in the median position. Five abdominal segments present and two more incorporated in the telescopic ovipositor, all strongly tapering to a point. The anterior legs are similar to those of the male and the intermediate tibiae and tarsi are longer than the anterior ones, with four widely separated short ventral bristles on the metatarsus, which equals the length of the tibiae, and the second tarsal segment is longer than the two apical ones combined. The posterior metatarsus is half the length of the elongated second and the median tibial bristle is present.

Hab.—Tasmania. 1 ♂, slightly damaged, and 2 ♀, the allotype and a paratype; from Hobart and Dunalley, February and March, 1915, 1917 and 1918.

Arachnomyia ornatipes, n. sp.

♂. Conforming very closely to the genotype, this species differs remarkably in the hypopygium which is rather small and has the lamellae small with a fur-like covering. It differs also in the last three segments of the anterior tarsi being highly ornamented, the intermediate tibiae with four widely separated bristles on the anterior side and a bristle each on the trochanters and coxae; otherwise the legs conform to those of the genotype. The anterior tarsal segments have the last three flattened, with a fringe of long curly hairs on the edge of one, and short straight hairs on the edge of the two apical ones.

Hab.—Queensland: National Park, February, 1921, 1 ♂ only.

Genus Medetera Fisch.

Key to species of Medetera.

1. Upper median vein parallel with the radial 2
   Upper median vein strongly converging towards the radial 3
2. Thoracic bristles white; only two scutellar bristles .... *extranea* Becker
   Thoracic bristles black; four scutellar bristles .... sp.
3. Posterior metatarsus three-fifths the length of the second tarsal segment .... *nigrohalterata* Par.
   Posterior metatarsus one-half the length of the second tarsal segment .. *palmae,* n. sp.
   Posterior metatarsus one-third the length of the second tarsal segment .. *comes,* n. sp.

Medetera palmae, n. sp.

♂. Frons, face, clypeus and palpi greenish-black; occiput, thorax and coxae similarly coloured but tending to shine more, except on the depressed area adjacent to the scutellum, which retains a dense amount of the whitish pulverulent overlay that covers these parts; the abdomen is also similarly covered but quite shining. Antennae varying to black, but normally the two basal segments are reddish and the arista is apically placed. The proboscis, all bristles except the white postoculars, the femora except apex, and the hypopygium mainly, are black. The anterior tibiae are normally stained with black, but otherwise the legs are yellow with occasional black apices to segments. The halteres, the squama with its fringe, and the wing veins are yellow.

Four apical dorsocentral bristles are large, the others are of equal size with the acrostichals. Two widely separated large scutellar bristles occur, each with a smaller bristle situated on the outer side along the scutellar margin. The intermediate tibiae have a well developed anterior bristle, blackish-yellow, at one-third its length, and a smaller one nearby on the dorsal side. The posterior tibiae have a light dorsal subapical bristle usually visible. The anterior tarsi are subequal, the intermediate metatarsus is equal to the length of the remaining segments combined. The posterior metatarsus is half the length of the second segment, as also is the third. Wings, as in *nigrohalterata*, have the upper median vein first bending towards the radial, thence concave, but becoming convex beyond, making it slightly sinuous.

♀. Similar to the male.

Hab.—Queensland: Brisbane, 10 ♂, 7 ♀ mainly collected from the trunk of a palm tree in my Sunnybank garden. I have known the presence of *Medetera* on this palm tree for many years, but on close inspection I find there are two species with the habit, the companion being described below. Besides the characters quoted, the species differ from each other in the male terminalia, the present one being large and swollen at its base, the other similar in length but not swollen. The two descriptions are based on material collected during August and September, 1937, after which month they become scarce.

MEDETERA COMES, n. sp.

♂. Face, clypeus and palpi metallic-green varying to blue and purple. Antennae black, occiput, the thorax dorsally, and to a certain extent the abdomen above are all coppery, elsewhere green. The whitish pulverulent overlay is dense between the acrostichals, forming a stripe there which dilates over the depressed area near the scutellum. The legs are black with traces of yellow on trochanters, knees, and sometimes elsewhere. Dorsocentrals with only the two last bristles strong. The anterior tarsi have the second segment slightly longer than the metatarsus, the intermediate tibiae have one bristle on the anterior surface at about one-third its length, none above, and the tarsi have the first two segments equal. The posterior tibiae are apparently without the subapical bristle and the posterior metatarsus is one-third the length of the second segment, the third segment a little in excess of half the second. Wings like those of *nigrohalterata*, except that the upper median vein is uniformly convex throughout its length. In other characters the species agrees with *palmae*.

♀. Similar to the male.

Hab.—Queensland: Brisbane, 2 ♂, 5 ♀, September to October, 1937, in my garden at Sunnybank.

OBSERVATIONS ON THE BIONOMICS AND MORPHOLOGY OF SEVEN SPECIES OF THE TRIBE PAROPSINI. [CHRYSOMELIDAE.]

By D. MARGARET CUMPSTON, M.Sc., Linnean Macleay Fellow of the Society in Zoology.

(Plate x; twenty-two Text-figures.)

[Read 26th July, 1939.]

Although considerable work has been carried out on the systematics of adult *Paropsis* species, the only previous bionomical worker was Clark, who published a short paper on *Paropsis dilatata*, a pest species in New Zealand (1930). This species was introduced from Australia, and first mentioned for New Zealand in 1922.

Paropsis species are recorded from all parts of Australia, from Tasmania, and from New Guinea. Some species are common throughout Australia (e.g., *Paropsis octomaculata*). Eucalypt species are attacked chiefly, but *Paropsis immaculata* on wattles, and *Paropsis pictipennis* and *P. orphana* on *Leptospermum*, are also quite common. Tillyard (1926) records occasional considerable damage by both larvae and adults to young eucalypts and wattles.

Five species of *Paropsis*, one of *Chrysophtharta*, and one of *Paropsisterna* are considered in this paper. The adults were identified by Mr. Bryant of the British Museum. Two other species of *Paropsis* have also been studied, but are new species which have not yet been named. Mr. Bryant is in possession of series of adults of these species, and descriptions are shortly to be published. Since the classification published by Blackburn in his series of papers (1894, 1896–1901), the genus *Paropsis* has been divided into nine genera. Tribe IV of the family Chrysomelidae, subfamily Chrysomelinae, the Dicranosternini, contains *Dicranosterna, Sterromela,* and *Trochalodes*; Tribe V, the Paropsini, contains *Paropsis, Procris, Paropsisterna, Chrysophtharta, Trachymela,* and *Pyrgo*. *Paropsis*, *Chrysophtharta* and *Paropsisterna* are therefore closely allied: this is further apparent in a bionomical study.

Material and Methods.

Field observations and collection were carried out in Canberra, and in the Sydney district, the species studied being found in quantity in both places. Larval groups were studied both under natural conditions and in the laboratory; a satisfactory breeding technique was evolved. Adults collected from the trees readily mated and laid eggs in captivity. It was found that the adults, if not overcrowded, could be kept readily and conveniently in Agee jars with screw-top lids, in which were wire-gauze inlets. Fresh leaves must be provided daily. Not more than ten beetles should be kept in each jar. Mating and oviposition took place normally. The use of the Agee jar is a good method for obtaining records of egg batches from individual females.

Both eggs collected in the field and eggs laid in captivity were bred through. As long as the larvae have a sufficiency of fresh leaves they do not wander until ready to pupate. The most convenient containers for the twigs are straight glass tubes about 4″ long. Fresh leaves are necessary daily. Differences in the length of the various stages, and in the larval behaviour, under natural and under laboratory conditions, were small.

Both Hymenopterous (Chalcidoid) egg parasites and Dipterous (Tachinid) larval parasites were bred out. Cocoons of some Hymenopterous larval parasites were obtained, but the wasps did not emerge. The egg parasites were bred in test tubes, and fed upon cut raisin. They oviposited readily. The slight amount of work done on the egg parasites indicates ease of handling, and ready breeding under laboratory conditions. It is always possible to obtain fresh *Paropsis* eggs by keeping adults in cages with suitable food, and thus the supply of eggs for the parasitic wasp larvae can be maintained. To obtain the Tachinids collected final-instar larval material was placed in cages within which were galvanized iron trays containing earth: the larvae pupated in this, and were left undisturbed until either the beetles or the parasites emerged.

A similar procedure to that just described was followed with laboratory bred material, the larvae dropping into the earth when ready to pupate.

Damage.

As previously mentioned, the damage to the leaves is caused by both larvae and adults. The adult feeding on Eucalyptus leaves cuts the tissues in strips from the edge of the leaf into the midrib, so that there results a concavity in the leaf. The end result is a more or less regular series of notches, and, if the beetles are numerous, the whole tree appears ragged (Pl. x, fig. 1). The adults feed alone, never aggregated. On the other hand, the larvae feed in groups, destroying one leaf before moving to the next. They strip the tree of its young leaves and shoots, both apically and laterally, leaving only bare twigs (Pl. x, fig. 1). Thus the damage caused by the adult, and that due to the larvae, are quite different in appearance, so that it is possible, on examining a tree, to decide whether it has been attacked by the immature, or by the mature, form.

Bionomics.

The eggs are laid on the leaves or stems of the young upper and lateral shoots of the trees. When the egg is ready to hatch, pressure is concentrated in the thorax, so that the hatching spines on each side of the body (Fig. 1) pierce the chorion. By vermiform movement the spines are repeatedly drawn longitudinally down the egg, functioning only on the backward stroke, i.e., from head to anus. Finally two slits are cut. The larva presses on one slit to widen it, and forces its way out. Its thorax emerges first, then its head and legs, and by clinging to the nearest object it is able to draw out the abdomen. In about half an hour the pigmented areas of the body have darkened. The larva then begins to feed on the eggshells (Pl. x, fig. 2). All larvae in an egg cluster hatch out at about the same time, and remain feeding until the empty shells have been completely eaten. They may remain up to two days with the egg-mass, usually less, before moving in search of green food. The larvae are very active and capable of moving long distances.

First-instar larvae are very gregarious (Pl. x, fig. 3). In all instars feeding takes place generally at night, in aggregations on one leaf, the larvae remaining quiescent during the day. Final-instar larvae feed voraciously and move about more frequently; they are responsible for a large part of the total damage. When fully fed, they either move downwards or else drop straight from the leaf to the ground, and wander about on the soil till a suitable point of entry is found. Before pupation they enter upon a motionless "prepupal" stage, assuming a curled position in the pupal cell (Pl. x, fig. 4), which is formed at a depth of 2″–8″. It consists of earth particles cemented together by a dark brown and very sticky exudation from the anus. The pupal cell is spherical and very fragile, completely enclosing the prepupa. When the adult emerges there are left behind in the broken cell the cast larval and pupal skins.

TABLE 1.

Species.	Number of eggs per batch.
Paropsis reticulata	40-100; usually 60-80.
Chrysophtharta varicollis	About 40.
Paropsis maculata	May be up to 24; usually 6.
Paropsis beata	20-30.
Paropsisterna liturata	About 12.
Paropsis obsoleta	Varies from 1-10; usually 6.
Paropsis aegrota	8 (one batch only).

Species.	Incubation.	Instar. 1	2	3	4	Prepupa.	Pupa.	Total developmental period.
P. reticulata	10-14 days	6-7	4-5	5-7	5-7	5-6	8-12	6-7 weeks
C. varicollis	5-6 days	5-6	4-5	3-4	5-6	4-6	7	4-5 weeks
P. maculata	4-6 days	3-5	3-5	3-4	4-5	12-14		About 5 weeks
P. beata	Not known	4	3-5	4-5	4	7	10	5-6 weeks
P. liturata	Developmental cycle occupies approximately the same time as *P. beata*.							
P. obsoleta	4	3-4	3-4	2-3	2-3	3-5	9-10	4-5 weeks
P. aegrota	Total developmental period from egg to adult, about 4½ weeks.							

The total developmental periods cannot be compared, since the observations were made at different periods of the year, some at Canberra, and some in Sydney.

A defence mechanism is present in the larvae of the species studied. The only previous records in Chrysomelidae of defensive structures of the kind found in these larvae are those of Miller (1925) and Clark (1930) for *Paropsis* species in New Zealand, and Gahan (*Phytodecta viminalis*—London, 1922). The actual mechanism was not described. This defensive mechanism is present in all instars of all species examined, but in those species (e.g. *P. beata*) which carry a heavy covering of bristles it is not so well developed, nor is it as readily protruded, as in those larvae which have no protective hairs. It consists of a pair of integumental invaginations capable of being everted by localized pressure of body fluids between the 7th and 8th abdominal tergites (Fig. 2). A repellent secretion is carried at the tip of the evaginated horn. Detailed anatomical and histological descriptions will be published later.

The adults are negatively geotropic on emergence from the pupal cell. They fly readily, making short abrupt flights from one part of the tree to another. Spread of the insect takes place by migratory flights, which, according to Clark (1930), occur in the heat of the day. It was found, however, that adults are most active before midday and in the late afternoon. Copulation and oviposition take place at these times. When quiescent the beetles usually remain on the undersurface of a leaf. If disturbed, they drop to the ground with their legs and antennae folded flat on the undersurface of the body; it is difficult then to distinguish them from the background of dead leaves and twigs. When actually handled on the leaf or stem, the beetle clings tenaciously, and is hard to dislodge. The adult feeds both during the day and at night.

On any given tree throughout the season (November–March) the larval damage is much more noticeable than that of the adults, which are more scattered, dispersing by migratory flights. The last generation of imagines, after emergence, congregates in large numbers on the host trees, and it is at this time, after the larvae have ceased feeding, that the damage done by the adults becomes most conspicuous (Pl. x, fig. 1). During this period of intensive feeding masses of fat-body are collected. *Paropsis* species overwinter in the adult stage, sheltering in crevices of bark, or under stones and leaves on the ground. It is possible that it may also overwinter as pupae or prepupae, but no field evidence in support of this was obtained. Feeding adults were collected in Canberra as late as the middle of May, although the larvae had disappeared finally from the field about the beginning of April. All recent damage seen at this time was due to adults, which were present in swarms on the trees; little migration took place. The beetles are not gregarious, and do not overwinter in groups. Probably the final generation of larvae enter the prepupal stage about the first week of April, and emerge at the beginning of May. They then feed until they have accumulated enough fat-body to last through the winter.

Adults of *Paropsis obsoleta* kept indoors through the winter continued to feed; they emerged in May and laid several egg batches at the end of July. In the field the adults were on the wing by early October; by mid-October eggs and first and second instar larvae of *Paropsis reticulata* were to be found at Narrabeen, Sydney. *Paropsis* species have therefore an extended season, and are absent from the field for a few months only each year. The life-cycle ranges between four and seven weeks (see Table ii), so that there are several generations every year; the adults are fairly long-lived, and oviposition starts within a week to a fortnight after emergence. Considerable overlapping of generations occurs, since each female lays several egg-batches.

Larval Associations.

A most interesting feature exhibited by these larvae is the manner in which they group themselves upon the leaves. This has been found to be so invariable in certain species that it is a reliable diagnostic feature, maintained normally in all instars, although it may be lost to a certain degree in the last. Some of the species studied are definitely gregarious, and remain so throughout larval life, others show loose association only, and the rest are solitary. In the first category fall *Paropsis reticulata* and *Chrysophtharta varicollis*, the larvae of which have distinctive and invariable types of association. *Paropsis maculata*, *P. aegrota* and *P. obsoleta* have a less well-defined type of association; while *Paropsis beata* and *Paropsisterna liturata* are almost solitary in habit.

The larval grouping in *P. reticulata* consists of a more or less compact series of overlapping rows, resting longitudinally on the leaf, the heads of the larvae in each row touching the ventral thoracic regions of the next anterior larvae. This arrangement gives the maximum amount of mutual protection; it is broken while feeding, but resumed during the daytime. This larval association is valuable for macroscopic diagnosis of the species during the first three instars. The grouping shown in Plate x, figure 3, is not quite typical.

The larvae of *Chrysophtharta varicollis* arrange themselves on the leaf in circular fashion, overlapping when numerous, with their heads all pointing toward a central focal point: the larvae lie along the radii of the circle. In this species a group containing larvae of all instars has been seen, indicating that the members hatched from more than one egg-mass.

In *Paropsis maculata*, *P. aegrota* and *P. obsoleta* the larval association is in pairs or more, up to many. They always form a single row, with the tip of the abdomen of the foremost larva resting on the body (usually the thorax) of the next following larva. When not feeding they are always found in the angle formed by the junction of a lateral shoot with the main stem of a twig. They are solitary in feeding habits (compare with *P. reticulata* and *Chrysophtharta varicollis*, in which the larvae feed gregariously and when resting do not migrate from the leaf they are attacking).

The larvae of *Paropsis beata* and *Paropsisterna liturata* are not gregarious, and any accidental association is in pairs or in loose groups of 3 or 4. They are more inclined to wander than the other species, particularly in the last instar, when they are easily disturbed.

In all species, the groups frequently move from place to place, and break up while so doing, but they always reassemble in the original formation. This larval association is flexible enough, however, to allow grouping not only of different instars of the same species, but of the same and different instars of different species. This complex type of combination is only found on very small trees where the larvae are extremely numerous.

General Morphology.

The egg is elongate-oval in shape, 1·5–3·0 mm. long and 0·6–0·8 mm. wide. The most striking eggs are those of *Paropsis reticulata*, which alone have an external ornamentation separate from the egg itself (Fig. 3): the other species investigated have either a tuberculate shell (Pl. x, fig. 8), a slightly reticulate, or a smooth and shining one (Pl. x, fig. 11). For detailed descriptions see below. It is worth noting here the great differences in the placing of the eggs at oviposition by the females of the various species (see egg key). About 24 hours prior to hatching various dark structures are visible through the chorion (Fig. 1)—ocelli, spiracles, mandibles and tarsal claws, hairs if present (partially obscured in tuberculate eggs), and hatching spines. Of these structures the most conspicuous is the row of hatching spines on each side of the body.

The larvae are elongate; the abdomen is slightly curved at the posterior end. In all species, upon hatching, the larva is colourless or pink, except for those structures already mentioned, but darkening occurs on exposure to air; the head capsule, prothoracic shield, legs, sclerotic areas of the 7th, 8th, and 9th abdominal segments, and the body tubercles, all turn black. The first instar is readily distinguished because of the paired hatching spines present on the meso- and metathorax and first abdominal segment respectively. These are plate-like sclerotic areas (modified body tubercles) carrying heavy protuberances with sharp cutting edges, in species with tough-shelled eggs, or with points, in species with thin-shelled eggs. Similar egg-hatching mechanisms occur quite commonly in other genera (see Sikes and Wigglesworth, 1931; Van Emden, 1925; Ritterschaus, 1925). The hatching spines are lost at the first ecdysis. The final (the fourth) instar is the most conspicuous and striking in coloration, as a rule.

"Body tubercles" are the pigmented, round or square seta-bearing areas which present a regular arrangement repeated on each segment, an arrangement most apparent in the first six abdominal segments. They are not invariably present in every instar. In addition, one species has been collected in which they are absent from the larva at any stage. The sclerotic areas of the three terminal abdominal segments are an outstanding feature of the larvae. They are present in all instars of all species studied. They represent enlarged and fused tubercles analogous with those of preceding body-segments. In general, the first two sclerotic areas are double, that of the 9th segment single (Fig. 4). The body tubercles occur in two distinct arrangements, the larvae of all species studied conforming with one or other. In two species, *Paropsis beata* and *Paropsisterna liturata*, the setae become elongated into large and conspicuous bristles. The 9th segment always carries a pubescence. The meso- and metathorax are frequently

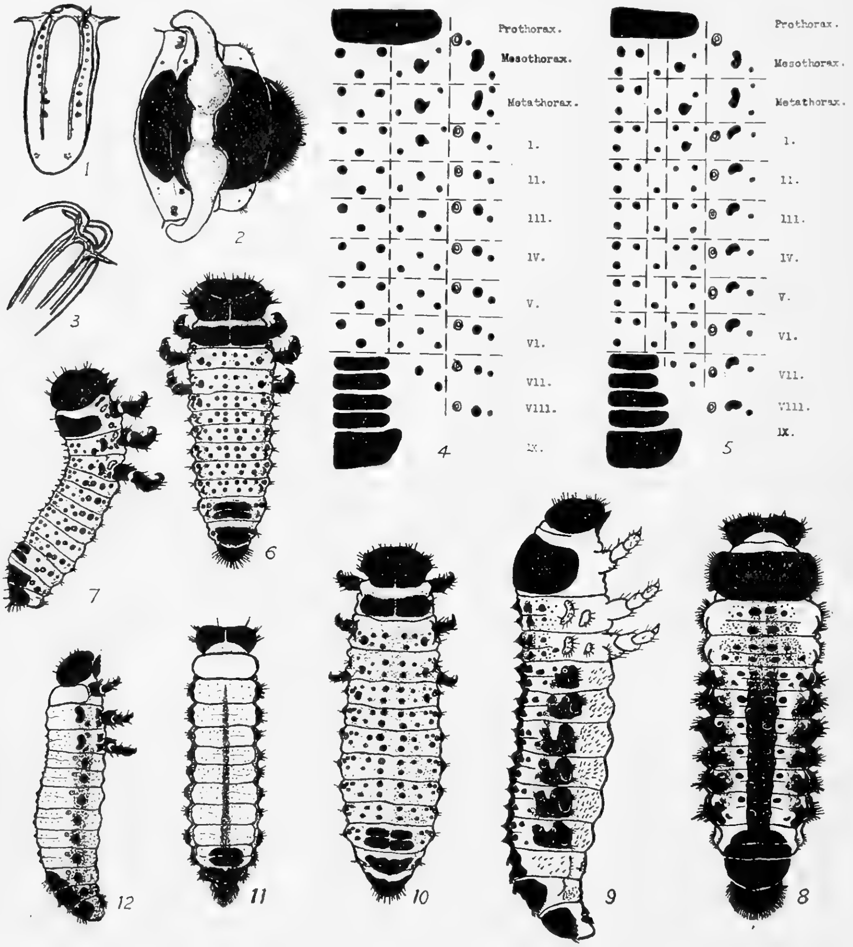


Fig. 1.—Egg of *Paropsis reticulata*; hatching spines visible through chorion. × 12.

Fig. 2.—*Paropsis reticulata*, final instar, showing horns of defence mechanism fully extended. × 10.

Fig. 3.—*Paropsis reticulata* egg, showing external ornamentation. × 12.

Fig. 4.—Diagrammatic representation of tubercle pattern of *Paropsis reticulata* larvae (right half of the body only).

Fig. 5.—Diagrammatic representation of the tubercle pattern of *Chrysophtharta varicollis* larvae (right half of the body only).

Figs. 6, 7.—First-instar larvae of *Paropsis reticulata*. × 12. Note hatching spines.

Figs. 8, 9.—Final-instar larvae of *Paropsis reticulata*. × 4.

Fig. 10.—First-instar larva of *Chrysophtharta varicollis*. × 12.

Figs. 11, 12.—Final-instar larvae of *Chrysophtharta varicollis*. × 4.

characterized by the presence of 2 large lateral kidney-shaped tubercles, and the prothorax by a pigmented prothoracic shield.

The first type of tubercle arrangement is that seen in *Paropsis reticulata* (Fig. 4). The pattern on the body of the larva is divided by the rows of spiracles into a dorsal supraspiracular and lateral subspiracular parts. The latter has two pairs of tubercles to each segment, except the prothorax, which has one pair, and the metathorax which has three pairs. The supraspiracular region is the distinctive part of the pattern. In the mesothorax, metathorax and first six abdominal segments there are two transverse rows of six tubercles each on each segment, which fall into two groups of three on each side of the median longitudinal line. The sclerotic area of abdominal segment 7 includes all tubercles except the outermost two of the second group of three: the sclerotic area of abdominal segment 8 is extended to include all the tubercles of the supraspiracular arrangement seen in the other segments. Segment 9 is completely pigmented.

Paropsis beata, *P. obsoleta* and *Paropsisterna liturata* possess a tubercle pattern corresponding with that of *P. reticulata.*

The second type of arrangement of tubercles is seen in *Chrysophtharta varicollis* (Fig. 5). Again, it is divided into a supraspiracular and a subspiracular part. In the latter, there are two pairs to each segment, except the prothorax, which has none, and the metathorax, which has three. The supraspiracular tubercles of the meso- and metathorax are arranged in two transverse rows of six, but on abdominal segments 1–6 the arrangement is quite distinct from that seen in *P. reticulata* larvae. The supraspiracular pattern in these segments consists of two transverse rows of eight and six respectively, and these are grouped on each side into two sets of three separated by a single tubercle lying in the lower row—contrast this with the arrangement in *P. reticulata.* Abdominal segment 7 carries three tubercles on each side of the sclerotic area. In spite of the close superficial resemblance of these larvae, they can be readily distinguished by examination of the 7th abdominal segment, which in *P. reticulata* has two pairs of free tubercles, while in *Chrysophtharta varicollis* it has three pairs.

Paropsis maculata corresponds with *Chrysophtharta varicollis.*

Two other species of *Paropsis* have been studied in the immature stages, one of which has a tubercle pattern identical with that of *Chrysophtharta varicollis.* The second species possesses no body tubercles, only the sclerotic areas of the last three abdominal segments. Unfortunately the tubercle pattern in *Paropsis aegrota* was not studied, but this species resembles closely *Paropsis maculata* in general appearance and habits.

Specific Morphology of Immature Stages.

1.—*Paropsis reticulata* Marsh.

The eggs are deposited upright around the stem of a young shoot, forming a compact ringed cluster, the members of which project radially, and adhere to one another (Pl. x, figs. 5, 6). The eggs are also at times laid with the same formation round the tip of a leaf. They are the only eggs (of the species studied) carrying an external ornamentation, which is moulded by the ovipositor during passage to the exterior. This ornamentation comprises four projecting horns and four longitudinal stripes (Fig. 3). The colour of the egg varies from almost white to mauve, the usual colour being pink, while the translucent horns and stripes vary correspondingly from golden to purple. The latter are eaten away by the newly-hatched larvae before the rest of the egg, and therefore may represent a special food. The chorion is reticulated, thick and tough, and the hatching spines of the larva are heavy and knife-like.

Outstanding features of the first-instar larvae (Figs. 6, 7) are the large kidney-shaped tubercles on the mesothorax and metathorax. The tubercle pattern has already been described. The setae of the body tubercles are short and only evident microscopically, so that the larva has a smooth appearance; the general body colour is a shiny yellow, with contrasting black pigmented areas.

The pigmentation of the body tubercles and prothoracic shield is lost during the 2nd and 3rd instar, so that the body is a bright glistening yellow with head capsule and terminal abdominal segments shining black, and legs and spiracles brown. These larvae can be differentiated from those of *Chrysophtharta varicollis*, which they resemble closely, during these instars, by the bright and glistening colour and the brown spiracles (*Chrysophtharta varicollis* is dull cream in colour, with black spiracles), and by the characteristic attitude assumed in grouping (see above, p. 356). The body tubercles are rounded, not square as in *Paropsis beata*.

The final-instar larva is unmistakable (Figs. 8, 9). The pigmented areas of the body are greatly increased, and stand out sharply against the general yellow or cream of the body. The prothoracic shield is black, but the legs are brown. There is a median longitudinal black line extending from the prothorax to the 7th abdominal segment, and including four tubercles in each segment. There also are large lateral black areas on abdominal segments 1–6, each partially enclosing a white spot. The lateral tubercles enclosed in these areas are extremely prominent and bear numerous setae. This heavy pigmentation is not unusual in final-instar larvae—melanin formation is supposed to provide an excretory mechanism for disposing of various toxic phenols arising in metabolism. The typical tubercle arrangement is present: those dorsal tubercles free from the general pigmentation stand out sharply. These larvae cannot be mistaken for those of any other species, and are well known to collectors, since they are so conspicuous on the tree. *Paropsis reticulata* is one of the commonest species found in New South Wales. Larval association is not important as a diagnostic feature in this instar, and may be lost to some extent.

The pupa is pale to bright yellow, with light-brown pubescence and bristles. The terminal portion carries a ventral bilobed dark-brown shield and two rows of small brown tubercles. The wing sheaths and legs are pallid and translucent. The hindwings show black, and the elytra pink just prior to emergence. The adult does not show the full pigmentation for a few days after emergence.

2.—*Chrysophtharta varicollis* Chap.

The eggs are deposited in longitudinal, overlapping rows on the dorsal surface of leaves at the extreme tip of the young shoots; the arrangement may be very regular or rather irregular (Pl. x, figs. 7, 8). Each egg is attached at one end. The colour is white to creamy-yellow; the tuberculate chorion is very thin and readily cut at hatching. The hatching spines of the first-instar larva are slender and hooked.

The first-instar larva (Fig. 10) has head capsule, prothoracic shield, body tubercles (including sclerotic areas), and legs of dull black. The general body colour is yellowish or creamy. The second and third instars lose the pigment of the prothoracic shield and of the body tubercles, retaining that of the head capsule, terminal sclerotic areas and legs. The lateral tubercles of the 8th abdominal segment, however, remain black and conspicuous in the second instar, and in the third instar the lateral tubercles of the 7th segment are pigmented in addition; also the ventral surface of the last three abdominal segments becomes quite black.

The final instar is distinctive (Figs. 11, 12), with a heavy black line running medianly down the dorsal surface, from the mesothorax or metathorax to the 7th abdominal segment. The head capsule and legs are black; the terminal areas of the abdomen form an almost complete black area, enclosing the lateral tubercles of the 8th segment. The subspiracular tubercles on each side of the body are black and conspicuous, and surrounded by pigmented areas, which form two longitudinal black lines laterally. The terminal ventral part of the abdomen is heavily pigmented.

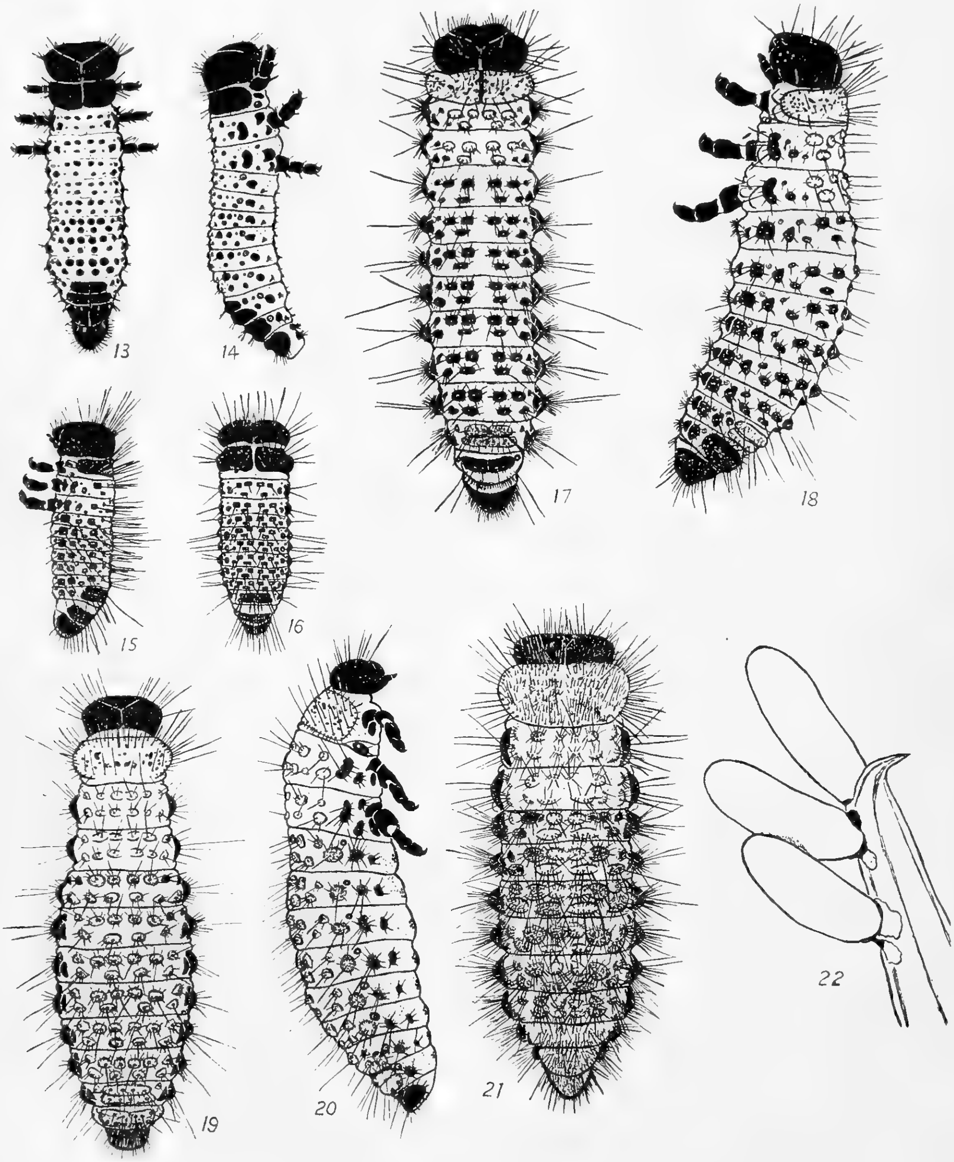
The pupa resembles that of *Paropsis reticulata.*

3.—*Paropsis maculata* Marsh.

The eggs are laid upright on the edge of a leaf (Pl. x, fig. 9) or on a stem (Pl. x, fig. 10), always evenly spaced from each other, and fixed by a light-coloured cement. They are generally so arranged that they are alternate and opposite, placed at an angle of almost 180° to each other. The colour is purplish to bright brown, sometimes dull green; the chorion is tough and reticulated. In this case the body tubercles can be seen through the chorion before hatching, and also short stout bristles.

First-instar larvae are thin and elongate (Figs. 13, 14). They are brown in colour. The tubercles, which become noticeably larger towards the end of the body, are black and rough, and carry short black bristles. The lateral kidney-shaped areas of the meso- and metathorax are conspicuous. The head capsule, legs, prothoracic shield, and sclerotic areas, as well as the tubercles, are black. In the second instar the general body colour is greenish-brown to brown, and the prothorax is greenish-black. There are a number of small tubercles scattered over the body, distinct from the main pattern. The only difference in the third instar, apart from the increase in size, is a further increase in roughness and conspicuous appearance of the body tubercles, which are now clearly visible to the naked eye. The terminal sclerotic areas are very rough and almost fused into a complete shield; the dorsal tubercles of abdominal segments 4, 5 and 6 are extremely large, and the lateral subspiracular tubercles have nearly merged into one another. The abdomen, viewed dorsally, is much wider than the thorax, curved (almost humped) and tapering abruptly posteriorly.

In the final instar the head capsule and legs are black, the prothoracic shield partially black only, its lateral yellow areas flecked with black specks. Below the level of the spiracles on each side there is a broad and rough black ridge extending from the mesothorax to the 8th abdominal segment, and including on each segment two large black tubercles carrying numerous setae. The colour of the meso- and metathorax and first three abdominal segments is yellowish-green, with small but conspicuous black tubercles. Abdominal segments 4, 5 and 6 are much enlarged, with white areas in each segment surrounding the first three tubercles on either side of the median line; the lateral regions are black. The terminal sclerotic areas are fused, forming a large shield. As the larva approaches the end of the instar, the colour changes, and whole body becomes pinkish. The meso- and metathorax and two first abdominal segments are greenish-pink; 3, 4, 5 and 6 are deeper pink, almost red laterally, with the white areas standing out on the dorsal surface. The colour again changes to a uniform pink which includes the white areas, and the body tubercles become sunken and less noticeable, in the general swelling of the body. The broad lateral bands remain black throughout.



Figs. 13, 14.—First-instar larvae of *Paropsis maculata*. × 10.
Figs. 15, 16.—First-instar larvae of ***Paropsis beata***. × 10.
Figs. 17, 18.—Second-instar larvae of ***Paropsis beata***. × 10.
Figs. 19, 20.—Third-instar larvae of ***Paropsis beata***. × 6.
Fig. 21.—Final-instar of ***Paropsis beata***. × 4.
Fig. 22.—Eggs of ***Paropsis obsoleta***. × 10.

The pupa is salmon-pink in colour, with light-coloured pubescence on prothorax and abdominal segments. The usual chitinized structure at the end of the abdomen, and two rows of small brown tubercles, are present.

4.—*Paropsis beata* Newm.

The dark-brown eggs are deposited in two flat rows on the dorsal surface of the leaf, adhering by their sticky coating (Pl. x, fig. 11). The eggs are smooth and shining, the chorion is thin and tough. The egg has a peculiar feature in the presence of a small raised circular area with a distinct rim at the upper end of each egg; the chorion is slightly wrinkled round the rim of this thinner area. Through the chorion may be seen numbers of long hairs.

The larvae when just hatched are pinkish in colour, with long black bristles (Figs. 15, 16). Later in the instar the thorax becomes green, and the abdomen brown. The head capsule, legs, prothoracic shield, body tubercles and terminal sclerotic areas are black. The body tubercles are square. The same colouring is retained through the succeeding instars; with increase in length the differentiation of thorax as clear yellow-green and abdomen as reddish-brown is more striking. The developing larva is characterized in each instar by reduction of pigmentation (instead of increase, which occurs in most cases) in the terminal sclerotic areas of the 7th, 8th and 9th abdominal segments. The thoracic tubercles become less conspicuous, and the dorsal abdominal tubercles become relatively larger and more protuberant, but less pigmented. In the final instar they are almost continuous across the body surface. The innermost tubercles in each segment are light brown, the outer black. The prothoracic pigmentation also decreases in the second and third instars (Figs. 17 and 18, 19 and 20). The lateral tubercles remain black and prominent, and are very heavy and conspicuous in the final instar (Fig. 21). The head capsule is black, and the legs are brown, in this instar.

In addition to the long bristles present in all instars, there is a pubescence of fine silvery hairs arising from the tubercles, and evident even to the naked eye (part of this pubescence has been left out of the drawings, owing to difficulty of adequate representation). It is most conspicuous in the second and third instars. It is of interest to note that the coloration of these larvae corresponds quite closely with that of the Eucalypts on which they were found, and which had reddish stems and green leaves. Protection is apparently afforded by this coloration and by the numerous bristles, for the usual defence mechanism of the larva, though present, is reduced in size and is not often used. In this species there is ready regurgitation of food material from the mouth when the larva is stimulated.

The upper half of the pupa is pinkish-yellow, with pale bristles arising from the prothorax. The abdominal portion is bright pink with a light-coloured sparse pubescence of long hairs arising from the lateral tubercles, the last three segments carrying coarse light-brown bristles. The tip of the abdomen is dark brown. The adult does not attain its black and red colours until a day after emergence.

5.—*Paropsisterna liturata* Marsh.

The arrangement and general appearance of the eggs is very similar to that of *P. beata.* A similar raised area is present. The eggs of this species are grey in colour with a pink tinge at the end. They are smooth and shining, with a sticky coating, and the chorion is thin and tough. The larvae in all instars are very similar in appearance to those of *P. beata* (Pl. x, fig. 12). Their coloration, the shape and arrangement of the tubercles, presence of long bristles and silvery pubescence, and degree of larval association all correspond in the two species, except that in the final instar none of the abdominal tubercles are black. The pigment is completely lost in *P. liturata*. The pupae resemble those of *P. beata*.

6.—*Paropsis obsoleta* Oliv.

Eggs are usually laid upright in a single evenly-spaced row along the upper surface of a leaf (Pl. x, fig. 13), sometimes on the edge (Fig. 22). The colour of the egg is a deep livid brown, and the cement is a purplish colour. The chorion is tough, with a slight reticulation but a general smooth appearance, and short bristles are visible, as in *Paropsis maculata*.

The short stout larvae are dark brown in colour. Head capsule, legs, prothoracic shield, sclerotic areas of the abdomen, and body tubercles are black. The head capsule has conspicuous and comparatively long bristles; short stout bristles project from each tubercle, while those of the terminal sclerotic areas are long and coarse. There is nothing very distinctive in the appearance of the larva, and it changes little in the next three instars. It is exceptional in that the final instar is not conspicuous or different from the others in general colour or markings; even in *P. beata* and *P. liturata*, the tubercles of the final instar are very greatly enlarged and render this stage easily distinguishable.

7.—*Paropsis aegrota* Boisd.

Only one batch of these has been seen. The eggs are bright yellow and slightly tuberculate, laid upright and circularly at the tip of a leaf (Pl. x, fig. 14).

The first-instar larvae are similar in appearance, and type of association, to those of *P. maculata*. In the second and third instars a black central longitudinal line is present, the sides of the body are black and the general body-colour is orange. The dorsal tubercles are yellowish. Head, prothoracic shield, legs and terminal sclerotic areas are black. In the fourth instar the prothoracic shield is black centrally and orange laterally; there is one pair of lateral orange spots on each of the first seven abdominal segments. The general body-colour is a dull orange with a black central line running from the prothorax to the 7th abdominal segment. The tubercles are black, and become increasingly prominent towards the end of the body. The abdomen is much broader than the head, and tapers to a point.

In the pupa the upper half of the body is brownish-black, and the abdomen pink. The prothoracic bristles are brownish and the pubescence of the abdomen fine and silvery.

Tentative Keys to Eggs and Larvae.

1. *Larval key.*

With many of the species the final instar is so distinctive that it cannot be mistaken for that of any other species; descriptions have already been given. The second and third instars might be confused in one or two species, but they generally resemble the first instar. The first instar is easily recognizable because of the presence of the hatching spines, and this key is based on larvae of this instar. The key is tentative only, but the tubercle arrangement on which it is based seems to be a constant character, and its value may be substantiated by further study.

1. Tubercles of abdominal segments 2-6 inclusive, dorsal to the line of spiracles, 12 in number 2
   These tubercles 14 in number 4
2. Tubercles round or oval, bristles short 3
   Tubercles square, with long bristles ...... *Paropsis beata* and *Paropsisterna liturata*.
   Final-instar larvae in which none of the abdominal tubercles are black. Egg batches with 12 eggs, colour of eggs grey .... *Paropsisterna liturata*.

Final-instar larvae in which the lateral supraspiracular tubercles are black. Egg batches with 20-30 eggs, colour of eggs dark-brown .... *Paropsis beata.*
3. Larvae yellow, definite and characteristic larval association .... *Paropsis reticulata.*
Larvae deep brown. Larval association loose .... *Paropsis obsoleta.*
4. Larvae thin and elongate, tubercles of abdominal segments 4, 5 and 6 very much larger and more conspicuous than those of other segments. General body-colour brown .... *Paropsis maculata.*
Tubercles of those segments of the same size as the remainder. General body-colour yellow .... *Chrysophtharta varicollis*

2.—*Key to eggs.*

1. Eggs placed upright, non-tuberculate chorion 2
Eggs laid flat 5
2. Eggs grouped in clusters and touching 3
Eggs spaced from each other, not touching 4
3. Eggs with external ornamentation, forming a compact group. Colour generally pink, may be white to mauve .... *Paropsis reticulata.*
Eggs without ornamentation, group not so compact. Colour yellow .. *Paropsis aegrota.*
4. Arrangement in a linear row .... *Paropsis obsoleta.*
Arrangement with eggs alternating, at 180° to each other .... *Paropsis maculata.*
5. Eggs with tuberculate chorion .... *Chrysophtharta varicollis.*
Eggs with chorion smooth, shiny and sticky. Colour deep brown .... *Paropsis beata.*
Colour grey .... *Paropsisterna liturata.*

Parasites.

1.—*Egg parasites.*

Two egg parasites were bred out (Chalcidoid, Hymenoptera). The commonest is *Neopolycystus insectifurax* Gir. (Pteromalidae), of which the male only has been described; it was bred by the writer from *P. reticulata* eggs. *Baoanusia albifunicle* Gir. was also obtained from *P. reticulata* eggs. *Neopolycystus insectifurax* was bred in large numbers in the laboratory. From one original batch bred from field material, three generations were bred through, with an average cycle from egg to adult of 12 days. The wasps oviposit readily in the fresh egg batches supplied to them. They did not oviposit in egg batches of *Chrysophtharta varicollis.*

2.—*Larval parasites.*

The host larva is not killed by the Tachinid parasite until the fourth instar, or even until the prepupal stage has been reached—parasite larvae have emerged from the host eight days after the latter has ceased feeding. A parasitized larva can be diagnosed by the presence of a discoloured patch (caused by the "sheath" of the parasite) on the pro- or mesothorax, usually just above the leg. In the centre of the patch is the small hole used for air supply by the parasite. Also the host larva appears oily and brownish in colour when the parasite larva is nearly mature. The internal organs are completely demolished, and the parasite leaves the empty integument by a hole cut in the thoracic ventral surface. Sometimes pupation takes place inside the host. There may be more than one parasite per host, but only one comes to maturity. It always lies with the anterior end directed posteriorly in the host, respiring by means of the anal stigmata through the thoracic aperture, and when fully grown occupies the whole body-cavity.

All attempts at obtaining parasitism of the larvae in captivity were unsuccessful. The Tachinid adults bred out have not yet been identified.

Summary.

The morphology and bionomics of five species of *Paropsis* have been considered. These species are *Paropsis reticulata*, *P. maculata*, *P. aegrota*, *P. beata*, and *P. obsoleta*. Two other species, closely allied to *Paropsis* species, have also been considered. These are *Chrysophtharta varicollis* and *Paropsisterna liturata*.

Two interesting features noted in this study are the various kinds of larval association, and the different arrangements of the egg clusters. Drawings and descriptions of eggs, larvae and pupae have been made, and tentative keys for the larvae and for the eggs have been included.

Acknowledgements.

My thanks are due to Dr. A. J. Nicholson for permission to work at the laboratories of the Division of Economic Entomology, Council for Scientific and Industrial Research, Canberra, and for the use of apparatus there; and to Mr. A. R. Woodhill and to Mr. A. L. Tonnoir for their interest and helpful advice. Mr. Bryant of the British Museum kindly identified series of adults. Some of the photographs were taken by Mr. James, photographer of the Council for Scientific and Industrial Research, and some by Miss Burns of the Zoology Department, University of Sydney. I am indebted to the C.S.I.R. for photographs 3, 4, 6, 8, 9, 13 and 14; and to the Zoology Department for photographs 2, 11, and 12. I should also like to express my thanks to Mr. F. H. Taylor, who sent the material to the British Museum for identification.

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DESCRIPTION OF PLATE X.

Fig. 1.—A branch damaged both by larvae and by adults. Larval damage can be seen at the ends of the twigs, from which the young leaves have been completely stripped.

Fig. 2.—Larvae of *Paropsis beata*, just after hatching.

Fig. 3.—First-instar larvae of *P. reticulata*, showing grouping. It also shows larval method of feeding for this species.

Fig. 4.—*Paropsis reticulata.* "Prepupa" in cell, which is partly broken.

Figs. 5, 6.—Egg clusters of *Paropsis reticulata.*

Figs. 7, 8.—Eggs of *Chrysophtharta varicollis.* Note tuberculate chorion in figure 8.

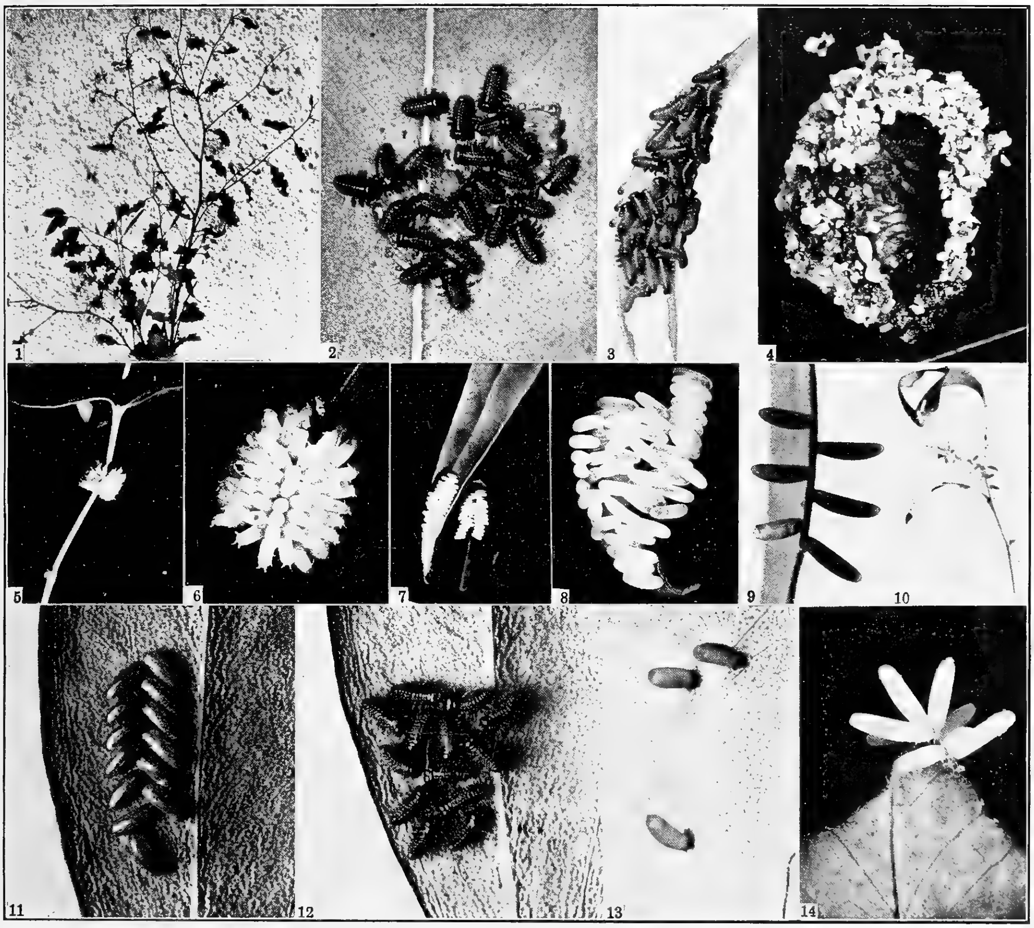
Figs. 9, 10.—Eggs of *Paropsis maculata.*

Fig. 11.—Eggs of *Paropsis beata.*

Fig. 12.—*Paropsisterna liturata* larvae just after hatching.

Fig. 13.—Eggs of *Paropsis obsoleta.*

Fig. 14.—Eggs of *Paropsis aegrota.*



Larvae and eggs of species of tribe Paropsini.

THE DIPTERA OF THE TERRITORY OF NEW GUINEA. X.

FAMILY CERATOPOGONIDAE.

By J. W. S. Macfie, M.A., D.Sc., F.R.E.S.
(*Communicated by Frank H. Taylor, F.R.E.S., F.Z.S.*)

(Two Text-figures.)

[Read 30th August, 1939.]

Styloconops albiventris (de Meij.).

Tijdschr. voor Entomol., lviii, 1915, 98.

New Guinea: Aitape, June 1938, 68 ♀ (S. H. Christian). New Britain: Rabaul, no other data, 11 ♀ (F. H. Taylor).

Forcipomyia punctum-album Kieffer.

Ann. Mus. Nat. Hung., xv, 1917, 178.

New Britain: Rabaul, no other data, 1 ♂, 1 ♀ (damaged), (F. H. Taylor).

These insects probably belong to the same species as those described by Kieffer (1917) for which he proposed the name *F. punctum-album*. The details which should be added to his description I should prefer to defer until further material is available for study, because the female in this collection is fragmentary. It may be stated at once, however, that there are no definite scales, no modified tibial spines, that the T.R. is about 0·7, and that the harpes of the male are long, slender rods with filiform ends.

Culicoides sp. near mollis Edw.

New Britain: Rabaul, no other data, 2 ♀ (F. H. Taylor).

These insects are probably the same as *C. mollis*, a species taken in Samoa, and described by Edwards (1928). They differ, however, from the specimens examined by Edwards, and from others which I have assigned to the same species on previous occasions, in having paler, almost uniformly pale brown, legs.

Culicoides rabauli, n. sp. Fig. 1.

A dark brown species with the wings densely clothed with macrotrichia and characteristically adorned.

♀. Length of wing about 1·4 mm., greatest breadth 0·6 mm.

Head very dark brown. Palpi dark brown, third segment much inflated about middle, with large but relatively shallow pit; lengths of last three segments about 28, 10, and 11 units* respectively. Antennae uniformly darkish brown; segments 4–10 oval, ranging from about 10 by 9 to 9 by 7 units; 11–14 more elongate, sub-cylindrical, sub-equal, averaging about 22 by 7 units; 15 about 31 by 7 units, without stylet. The combined lengths of segments 4–10 and 11–15 about 65 and 118 units respectively. *Thorax* dark brown, the adornment consisting of large patches, not small spots. Scutellum very dark brown, bearing 4 bristles, and several small hairs. *Wings* (Fig. 1) densely clothed with macrotrichia (not shown

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* The unit used is approximately 3·6 μ.

in diagram) which cover almost whole surface excepting radial areas, extend practically to base between M and Cu, and are very numerous in anal cell. Adornment characteristic, as shown in diagram, the markings in the region of the fork of Cu being particularly notable. Halteres with white or creamy knobs. *Legs* rather dark, femora and tibiae almost entirely dark brown, with only faint traces of narrow paler bands on each side of the dark knees. T.R. about 2·2. Form of segments and claws normal. *Abdomen* dark brown with a greenish tint. Spermathecae two, well chitinized, obovate, sub-equal, partially collapsed in the unique specimen but total length probably about 55 μ, and greatest breadth 42 μ.

New Britain: Rabaul, no other data, 1 ♀ (F. H. Taylor).

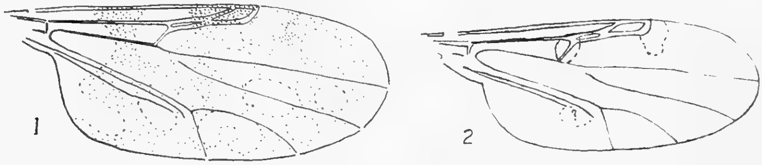

Fig. 1.—*Culicoides rabauli,* n. sp. Diagram to show adornment of wing of female.
Fig. 2.—*Culicoides melanesiae,* n. sp. Diagram to show adornment of wing of female.

CULICOIDES MELANESIAE, n. sp. Fig. 2.

A dark brown species with the wings densely clothed with macrotrichia and adorned with only two distinct pale spots.

♀. Length of wing about 1·2 mm., greatest breadth 0·5 mm.

Head very dark brown. Palpi dark brown, third segment without pit; lengths of last three segments about 18, 10, and 10 units respectively. Antennae uniformly dark brown; segments 4–10 oval to vasiform, ranging from about 10 by 7 to 12 by 6 units; 11–14 more elongate, sub-cylindrical, averaging about 17 by 5–6 units; 15 about 22 by 5–6 units, without stylet. The combined lengths of segments 4–10 and 11–15 about 85 and 89 units respectively. *Thorax* very dark brown, the adornment indistinct but not composed of small spots. Scutellum very dark brown, bearing 4 bristles, and several small hairs. *Wings* (Fig. 2) densely clothed with macrotrichia (not shown in diagram) which cover almost whole surface with exception of radial areas, extend practically to base between branches of M and Cu, and are very numerous in anal cell. Adornment as shown in diagram, consisting of two small, clearly defined, pale spots, the one just beyond end of costa, the other covering cross-vein. The latter spot does not extend anteriorly as far as the margin of the wing, and covers only a small part of first radial cell. There is, too, a suggestion of a pale spot in the anal cell at the end of the anal vein. Halteres with pale brownish knobs. *Legs* rather dark brown, with dark knees, but tibiae of hind legs with a distinct narrow, yellowish, band at both base and apex. T.R. about 2·2. Form of segments and claws normal; fourth tarsal segments cylindrical, about same length as fifth. *Abdomen* very dark brown. Spermathecae two, well chitinized, obovate, sub-equal, total length about 78 μ, and greatest breadth 57 μ.

New Britain: Rabaul, no other data, 1 ♀ (F. H. Taylor).

This insect resembles in some respects *C. flumineus* Macfie, a species taken in Malaya, but the wings are without the indistinct pale spots at the periphery present in that species. In *C. flumineus,* too, the third palpal segment is furnished with a large, shallow pit.

TAXONOMIC NOTES ON THE ORDER EMBIOPTERA. III.

THE GENUS BURMITEMBIA COCKERELL.

By CONSETT DAVIS, M.Sc., Lecturer in Biology, New England University College, Armidale.*

(Six Text-figures.)

[Read 30th August, 1939.]

Genus BURMITEMBIA Cockerell, 1919.

The Entomologist (London), Vol. 52, No. 676, p. 194. Genotype, *Burmitembia venosa* Cockerell, 1919, l.c., p. 195, figs. 2-3.

Cockerell's type, in Burmese Amber (? Miocene), is in the British Museum of Natural History (Geology Department). By the courtesy of the authorities I was enabled to have the amber block ground down, so as to remove overlying flaws and to reveal the structure of the insect more clearly. It is thus possible to add certain details of the terminalia to the existing description, and to gain a truer perspective of the morphological and evolutionary position of this very interesting specimen. The revised generic description is as follows: Fossil Embioptera, probably Miocene, the males winged, veins strong, R_{4+5} simple, M simple, Cu with two branches; several strong oblique cross-veins, and traces of numerous obsolescent cross-veins. Hind legs with apparently two ventral bladders on metatarsus.† Left cercus one-segmented.

BURMITEMBIA VENOSA Cockerell 1919, l.c. Figs. 1–6.

♂. Length 4·4 mm.; length from front of eyes to back of head, 1·0 mm.; breadth of head at eyes approximately 1 mm.; forewing 4·3 mm. × 1·3 mm.; hindwing 3·5 mm. (approx.) × 1·0 mm. Original colour probably pale brown, eyes black. Head damaged, one half behind and including eye preserved; eye relatively large and prominent, side of head behind eye sinuous, rounded behind; posterior border of head sinuous, with a medial swelling. Tip of maxillary palp visible, with three subcylindrical segments, basal segments destroyed. Right mandible (Fig. 3) with sinuous inner margin, and with a single distal incurved tooth, acute. Left mandible not present. Base of antennae destroyed; distalia (Fig. 4) cylindrical, slightly dilated distally. Pronotum (Fig. 1) as in recent Embioptera, with an anterior transverse furrow dividing the notum into a small prozona and a

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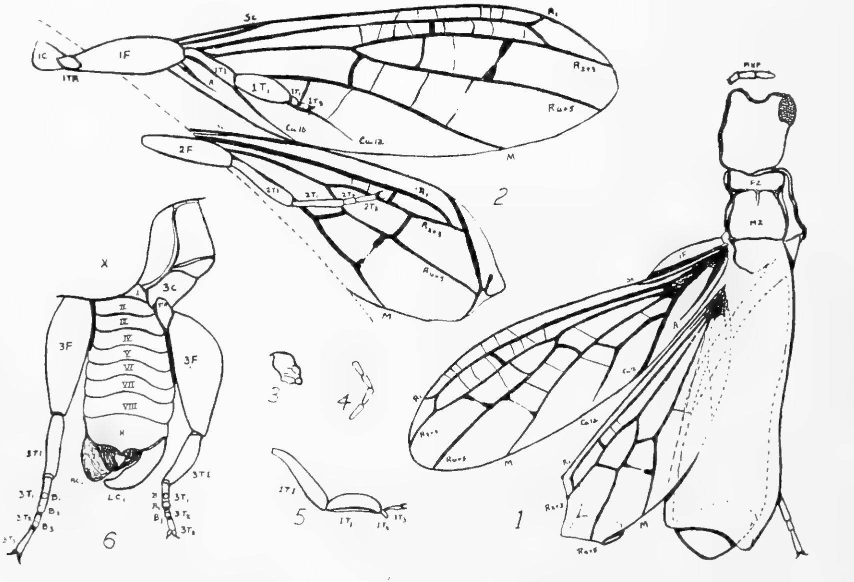
* Part of the work embodied in this paper was carried out when the writer held a Linnean Macleay Fellowship in Zoology.

† Metatarsus is used throughout this series to indicate the first segment of the tarsus, regardless of which pair of legs is considered. It does *not* mean "tarsus of metathoracic legs". The present usage is in accord with that previously adopted in this Order, especially by the German workers; it is equivalent to the more modern term "basitarsus".

subquadrate metazona, the latter with a trace of a longitudinal suture anteriorly. Mesonotum apparently subtriangular. Wings (Figs. 1, 2) with main veins strong, subcosta short, terminally curved upwards; R_1 terminally fused with R_{2+3}, in the forewing sending an additional branch to the costa; R_{4+5} simple, reaching margin; M simple, also reaching margin; cubitus with a strong anterior branch, not quite reaching margin; main stem reaching margin; anal strong, longer than in most recent Embioptera. A few strong cross-veins, and traces of others, indistinct, fairly numerous. Venation of right wings obscured; in left forewing, strong cross-veins from R_1 to R_{2+3} (1), R_{2+3} to R_{4+5} (2), R_{4+5} to M (1), M to Cu_{1a} (1, oblique); in left hindwing, strong cross-veins from R_1 to R_{2+3} (1), R_{2+3} to R_{4+5} (1), R_{4+5} to M (2, the basal one oblique), cubital and anal areas obscured. Legs as in recent Embioptera, the forelegs (Fig. 5) with the femur strong, the tibia weak, the first tarsal segment dilated, ovoid, the plantar surface flattened, the second segment small, partly embedded in the first, the third slender, dilated distally, with two strong claws. Second legs slender, with three unmodified tarsal segments. Hind femora (Fig. 6) incrassate; hind tarsi with two ventral bladders on first segment (to judge by surface view; lateral view unobtainable), one on second. First abdominal sternite partly obscured, apparently triangular, not very much reduced; sternites II–VIII transverse, distal margins with shallow medial concavity. Ninth sternite large, somewhat obscured, but apparently with a triangular distal process.



Burmitembia venosa Cockerell, holotype ♂.—1. Dorsal view, × 12. 2. Ventral view of right wings and first two legs, × 16. 3. Right mandible, viewed obliquely (from above, inside and basad), × 16. 4. Four of distalia, × 16. 5. Tibia and tarsus of right foreleg, viewed laterally, × 16. 6. Hind legs and abdomen from below, × 12. Figures based on camera lucida outlines. All setae omitted.

(Conventional lettering for venation.—MXP, three distal segments of maxillary palp; PZ, MZ, prozona and metazona of pronotum; 1C, coxa, 1TR, trochanter, 1F, femur, 1TI, tibia, $1T_1$, $1T_2$, $1T_3$, three tarsal segments of first leg; prefixes 2 and 3 for second and third legs; B_1, B_2, ventral bladders of first segment of hind tarsi; B_3, ventral bladder of second segment; I-VIII, abdominal sternites; H, ninth abdominal sternite; LC_1, one-segmented left cercus; RC_1, structure probably representing first segment of right cercus; X, area obscured by flaw in amber.)

Left cercus one-segmented, as in *Metoligotoma*, incurved, obtusely tapered, inner margin with a slight medial swelling; apparently no nodules. Right cercus partly obscured, but apparently with first segment massive, broader than long, as in *Metoligotoma*, second segment wanting.

It is possible that careful examination of the terminalia, with efficient lighting and a high-powered binocular, would reveal the structure even more fully. The dorsal view is obscured by the right wings, but the absence of any projecting dorsal structure in ventral view suggests that there is no elongate process to the right hemitergite, such as is present, and visible in ventral view, in genera such as *Oligotoma*, *Oligembia*, and *Haploembia*.

Discussion.

Although the exact horizon and locality of the so-called Burmese Amber is not known, *Burmitembia* is of considerable evolutionary interest. It may be assumed to be approximately Miocene in age, and to belong, broadly, to the Indo-Malayan region. It seems to be related anatomically and geographically to a series of recent genera comprising *Embonycha* Navás 1917, from Indo-China; *Ptilocerembia* Friederichs 1923, from Sumatra and islands adjacent thereto; *Notoligotoma* Davis 1936, and *Metoligotoma* Davis 1936, from Australia. None of these genera seems to be directly related to *Oligotoma*, although *Burmitembia* and *Notoligotoma* have R_{4+5} simple; this resemblance to *Oligotoma* may be regarded as convergent.

The five genera, Indo-Malayan to Australian in range, are characterized to a greater or less extent by the fusion of the two segments of the left cercus in the adult male. *Embonycha* is stated by Navás (1917) to have R_{4+5} forked, and the tenth tergite undivided. While the former may be true, the entirety of the tenth tergite must be very much doubted. Navás's figure (l.c., fig. 11) shows it as entire, but as this figure also omits the sutures between the tenth tergite and both of the cerci, it cannot be regarded with much confidence. The number of hind metatarsal bladders is not given. *Ptilocerembia* is closely related to *Notoligotoma*, as suggested previously (Davis, 1938, p. 267, footnote 2), but has R_{4+5} forked; the number of tarsal bladders is not known. The derivation of *Notoligotoma* from *Ptilocerembia* seems to be concerned mainly with the loss of R_5. The derivation of *Metoligotoma* from *Burmitembia* could be accomplished by little more than the loss of the wings; the structure of the hemitergites in *Burmitembia* is not known, but they appear to be without long appendages (cf. above), as they are in *Metoligotoma*. On the other hand, *Ptilocerembia* and *Embonycha* appear to be derived from an ancestor more generalized than *Burmitembia*, with R_{4+5} forked.

The possibly direct ancestral relationship of *Burmitembia* to *Metoligotoma* further strengthens the idea that *Metoligotoma* or its ancestors reached Australia from the Indo-Malayan region, and agrees with the modern concept of this element of the Australian fauna and flora having reached Australia from the north and west when the Australian and Oriental massifs made contact in Miocene times. The discovery of an undescribed recent species of *Metoligotoma* from North Queensland (Townsville), with the left cercus very similar to that of *Burmitembia*, is in line with this concept. *Burmitembia* seems to be the only known Tertiary fossil from the Indo-Malayan region which can reasonably be regarded as directly ancestral to a recent type apparently confined to the Australian region.

The structure of *Burmitembia*, and especially of its left cercus, strengthens the modern concept that insects were much more highly evolved at any one period of geological time than has been supposed or allowed in the past. It also argues against the supposed recency of *Metoligotoma* (Davis, 1938).

Acknowledgements.

I am particularly indebted to the Keeper, Geology Department, British Museum of Natural History, for permission to prepare and examine the type, and to Mr. R. H. Spires, of the same department, who performed the delicate operation of grinding down the amber block in which it is embedded, in such a way as to reveal the more important details of its structure.

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TAXONOMIC NOTES ON THE ORDER EMBIOPTERA. IV.

THE GENUS CLOTHODA ENDERLEIN.

By CONSETT DAVIS, M.Sc., Lecturer in Biology, New England University College, Armidale.*

(Twenty-five Text-figures.)

[Read 30th August, 1939.]

Genus CLOTHODA Enderlein 1909.

Zool. Anz., 35, p. 176. Genotype, *Embia nobilis* Gerstaecker, 1888, *Mitt. naturw Ver. Neuvorpommern und Rügen*, xx, p. 1.

Enderlein's generic concept is based on specimens from Fonteboa, Brazil, and from an unspecified locality in Brazil, which he referred to Gerstaecker's species. The generic concept is clear, but some doubt might have been expressed as to the specific identity of Enderlein's specimens with Gerstaecker's name; Gerstaecker's description can hardly be termed specifically recognizable, and his type locality (Itaituba, Brazil) is nearly a thousand miles from Fonteboa.

In the M'Lachlan Collection (British Museum of Natural History) there is a dried male carrying the following old manuscript labels: 'Itaituba'; 'Embia nobilis Gerst.'. It probably belongs to the series from which Gerstaecker's description was made. The slight differences between Enderlein's figures and this specimen may be attributed to individual variation and to the personal equation in the method of figuring, so that Enderlein's specimens appear to be rightly referable to Gerstaecker's name.

The generic concept is enlarged to include *Antipaluria* Enderlein 1912 (genotype, *A. aequicercata* Enderlein 1912), as forms linking the two genera militate against the retention of both. The genus may be re-defined as follows:

Medium to large Neotropical Embioptera, the males with the following characters: Winged, R_{4+5} forked (rarely simple as an individual venational aberration), M simple, cubitus with 2–4 branches; hind tarsi with two ventral bladders on first segment, one on second. Tenth abdominal tergite entire or divided; if divided, processes of hemitergites little prominent. Cerci symmetrical, each with two subcylindrical segments, without nodules.

The belief of Krauss (1911) that *Olyntha brasiliensis* Griffith and Pidgeon, 1832 (ex Gray MS.), is congeneric with this series, is shown to be incorrect by examination of the type, which has the first segment of the left cercus clavate and nodulose, and the processes of the hemitergites free and prominent.

CLOTHODA NOBILIS (Gerstaecker 1888). Figs. 1–7.

Embia nobilis Gerstaecker, 1888, l.c.—*Clothoda nobilis* (Gerstaecker), Enderlein, 1909, l.c.

* Part of the work embodied in this paper was carried out when the writer held a Linnean Macleay Fellowship in Zoology.

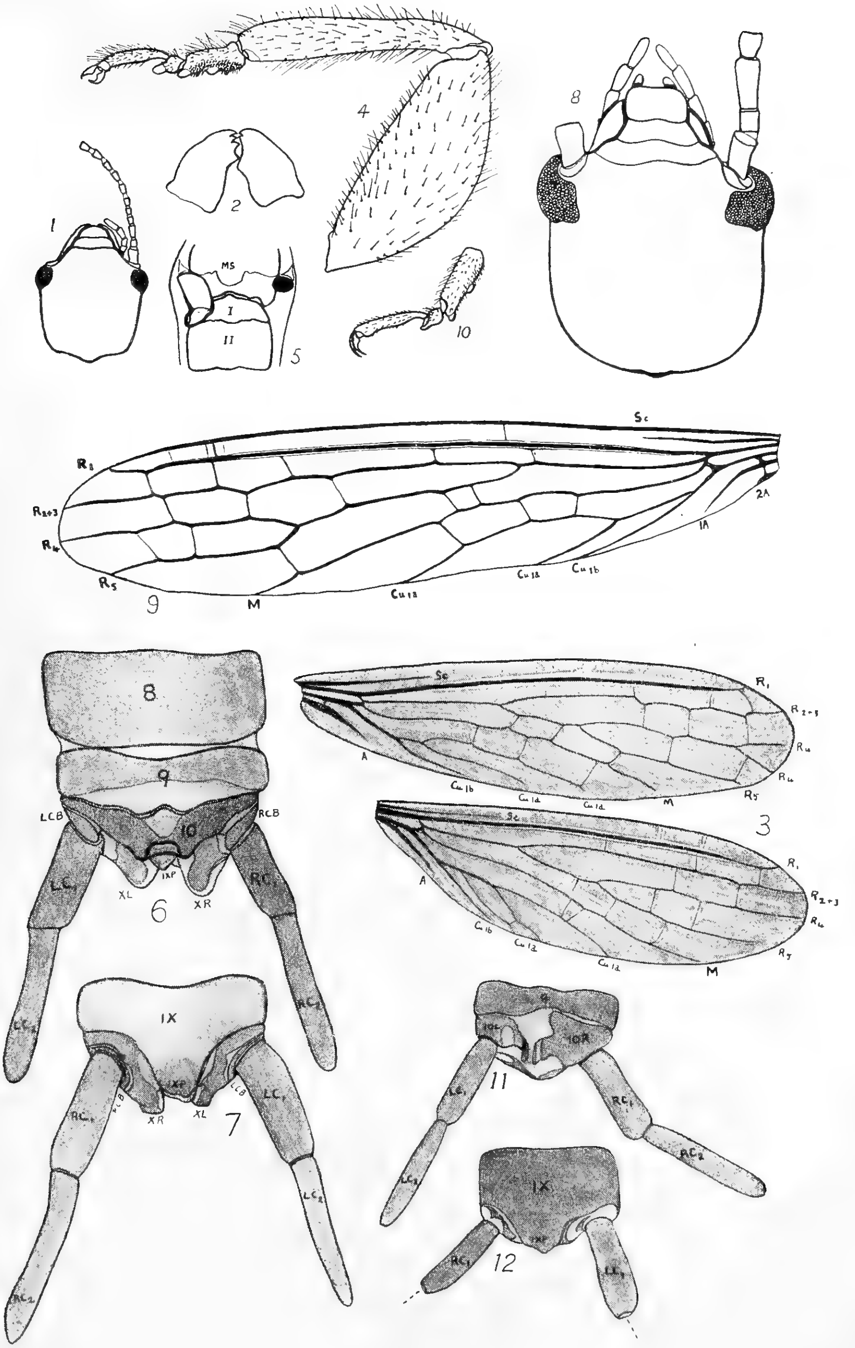
♂ (Itaituba, Brazil; M'Lachlan Collection, British Museum): Length (relaxed) 17 mm.; head, length 3·1 mm., breadth 2·5 mm.; forewing 11·2 mm. × 3·1 mm.; hindwing 10·0 mm. × 3·1 mm. Colour (dry) very dark brown, wings dark smoky brown, with hyaline longitudinal striae and hyaline areas at cross-veins; venation dark brown; eyes black. Head (Fig. 1) large, eyes of medium size, prominent, sides behind eyes converging slightly, hind margin with median swelling. Antennae incomplete, the longer (the left) with 11 segments. Mandibles (Fig. 2) massive, a blunt tooth on inner margin nearer to apex than to base, the left with three, the right with two subacute incurved teeth terminally. Wings (Fig. 3) with Sc reaching to nearly one-third the length of the wing; R_1 strong, not confluent with R_{2+3}; R_{4+5} forked, fork longer than stem; in the right forewing R_4 is shortly forked terminally, in the left forewing the fork of R_{4+5} coalesces again, the stem, separated portion, and recoalesced portion being all subequal in length. M simple. Cubitus with anterior branch (Cu_{1a}) giving off one posterior branch, except in the right hindwing, where two such branches are given off pectinately. One anal vein, relatively long. Cross-veins fairly numerous. Hind legs (Fig. 4) with femora somewhat swollen, first tarsal segment with two ventral bladders, one medial, one terminal; second segment with one terminal bladder. Claws long, curved. First abdominal sternite (Fig. 5) subtriangular, relatively large. Terminalia (Figs. 6, 7) with ninth tergite (9) transverse, anterior part more heavily sclerotized; tenth tergite (10) transverse, with a more membraneous medial area anteriorly; posteriorly, obtuse, curved upwards and forwards, distally bearing a more or less membraneous epiproct. Cerci symmetrical, each with two subcylindrical segments, the first thicker and shorter.

The homologies of the ventral structures (Fig. 7) can be understood only by consideration of the larval structure, as found throughout the Order, and also retained in the adult female (cf. Fig. 16). In the immature stages, the ninth sternite is subrectangular, the tenth divided by a longitudinal suture to two hemisternites (XL, XR). The cerci are separated from the hemisternites by annular cercus-basipodites, which may be vestiges of the eleventh abdominal segment, or basal segments of truly three-segmented cerci.

Although the ontogenetic stages in *Clothoda* have not been followed, it would appear that the adult structure is attained by the outgrowth of the ninth sternite (IX) to a process (IXP), on the dorsal side of which is situated the genital aperture. The hemisternites of segment 10 are forced to the sides by this outgrowth, and in *Clothoda* remain as distinct structures (XL, XR), the cercus-basipodites also remaining distinct (LCB, RCB). In other genera the hemisternites and cercus-basipodites appear to form a composite structure, different on the two sides, and in common referred to as the cercus-basipodites of the adult. The ontogenetic process has been followed in the Australian genera (unpublished). It seems convenient to retain the term cercus-basipodite in genera other than *Clothoda*, remembering that the term covers a composite structure, including, perhaps in some cases as its most prominent part, the hemisternite of the tenth abdominal segment.

It is clear that, in the above interpretation, the genital aperture occupies its characteristic Hexapod position, immediately posterior to the ninth sternite, in the male. The tenth, and possibly the eleventh, sternites having moved laterad, and somewhat forwards, without becoming morphologically anterior to the genital aperture.

In *C. nobilis* the process of the ninth sternite (IXP) is almost symmetrical (possibly entirely symmetrical, as figured by Enderlein (1912, fig. 6), and distorted



Figs. 1-7.—*Clothoda nobilis* (Gerstaecker), Itaituba, Brazil, ♂.

1. **Head from above, × 6. 2. Mandibles from above, × 11. 3. Right fore- and hind-wing, × 6. 4. Right hind-leg from the side, × 11. 5. First two abdominal sternites and adjacent structures, × 6. 6. Terminalia from above, × 15. 7. Terminalia from below, × 15.**

Figs. 8-12.—*Clothoda intermedia*, n. sp., holotype ♂, Carácas, Venezuela.

8. **Head from above, × 15. 9. Left forewing, × 8. 10. Hind tarsus viewed laterally, × 15. 11. Terminalia from above, × 15. 12. Terminalia from below, × 15.**

in the specimen shown herein in Fig. 7). The process is obtuse, weakly bilobed. The hemisternites (XL, XR) are massive, obtuse, and partly membraneous, the cercus-basipodites (LCB, RCB) small and distinct, annular. The structures referred to as hemisternites under the above interpretation are labelled cercus-basipodites by Enderlein (l.c., figs. 5, 6).

Gerstaecker's dimensions for the male are: Length 13–14 mm.; forewing 10–12 mm. Enderlein's specimens were of the following dimensions: Length 13–14 mm.; forewing $10\frac{1}{2}$–$11\frac{1}{2}$ × $2\frac{1}{2}$–$2\frac{3}{4}$ mm.; hindwing 9–10 × 3 mm. (approx.). Enderlein (l.c., fig. 4) figures the cubitus as 4-branched in the right forewing, 3-branched in the right hindwing, the same range of variation noted above.

♀. See Gerstaecker (1888) and Enderlein (1912). Not important taxonomically.

CLOTHODA INTERMEDIA, n. sp. Figs. 8–16.

♂. Length (dry) 16 mm.; head, length 2·6 mm., breadth 2·1 mm.; forewing 12·0 mm. × 2·8 mm.; hindwing 10·5 mm. × 2·8 mm. Colour as in *C. nobilis*, a little paler. Head (Fig. 8) as in *C. nobilis*, more smoothly rounded behind. Antennae incomplete. Wings (Fig. 9) with venation similar in general distribution to *C. nobilis*; R_1 confluent with R_{2+3} in right forewing only; R_{4+5} forked, without anomalies, fork longer than stem; M simple. Anterior branch of cubitus (Cu_{1a}) forked only once (i.e., cubitus 3-branched). In the left forewing a second anal vein is present, very small, connected to first anal vein by a cross-vein. Hind tarsi (Fig. 10) as in *C. nobilis*. Terminalia (Figs. 11–12) with tenth tergite divided, hemitergites separated by more membraneous areas; right hemitergite (10R) produced inwards in a flat process, free distally; left hemitergite (10L) produced backwards and inwards to a blunt process (10LP), longer than thick, termination free, curved. Cerci as in *C. nobilis*; tenth hemisternites and cercus-basipodites more reduced than in *C. nobilis*, apparently slightly asymmetrical, left hemisternite larger than right. Process of ninth sternite (IXP) obtuse, not bilobed.

Locality: Carácas, Venezuela.

The above description is from a single dried male, the holotype, in the British Museum (coll. Dr. Ernst). In the same museum are three alcoholic specimens, 1 ♂, 2 ♀, which appear to be referable to the same species. Unfortunately they bear no data of locality, etc., and cannot therefore be used as types. On account of their better preservation, and the presence of females, full details are given.

♂. Length 17 mm.; head 2·8 mm. × 2·2 mm.; forewing 12·0 mm. × 2·8 mm. hindwing 10·5 mm. × 2·8 mm. Colour, head, legs and wings as in the type, R_{4+5} similarly forked, cubitus variable; in the forewings, its anterior branch (Cu_{1a}) has two posterior pectinate branches, i.e., the system is 4-branched; in the right hindwing, Cu_{1a} has one posterior branch, and is itself shortly bifid terminally, the system being 4-branched; in the left hindwing, Cu_{1a} has only one posterior branch, which is itself bifid, the system being again 4-branched. First abdominal sternite (Fig. 13) similar to that of *C. nobilis*. Structure of terminalia (Figs. 14–15) more clearly visible than in the type, due to method of preservation, but apparently of the same original structure.

♀. Length 19–20 mm.; head, length 2·8 mm., breadth 2·6 mm. Legs and first abdominal sternite as in the male. Colour a little paler than the male. Terminalia (Fig. 16) as in all female Embioptera, symmetrical, the tenth sternite cleft longitudinally to two subtriangular hemisternites (XL, XR); the tenth tergite (10) entire, subtriangular, obtuse posteriorly; the cercus-basipodites annular, produced a little postero-dorsally in flat plates.

CLOTHODA URICHI (de Saussure 1896). Figs. 17–25.

Embia urichi de Saussure, *J. Trinidad Club*, 2, No. 12 (Feb. 1896); *E. uhrichi* de Saussure, *Mitt. Schweiz. entomol. Ges.*, Bd. 9, Hft. 8 (July 1896); *Antipaluria urichi* (de Saussure), Enderlein, 1912, *Coll. de Selys-Longchamps*, fasc. 3, p. 64.

(The species was named after Mr. F. W. Urich, and the correct spelling, 'urichi', which, in fact, appeared first, must be retained. De Saussure apparently wrote the name 'uhrichi' in error (as it is written on the type labels), and Urich, then Secretary of the Trinidad Club, probably corrected the manuscript.)

The following description is from one of de Saussure's co-types, from the Muséum d'Histoire naturelle, Geneva:

♂. Length 11 mm.; head, length 2·0 mm., breadth 1·5 mm.; forewing 8 mm. × 2·3 mm.; hindwing 8 mm. × 2·5 mm. General colour as in the two preceding species. Head (Fig. 17) as in *C. intermedia*, sides converging more behind. Mandibles as in *C. nobilis*, but more slender. Antennae: left with 19, right with 20 segments, last four cream in each case. Wings (Fig. 18) with Sc short, R_1 not confluent with R_{2+3}, R_{4+5} simple, except in the left forewing (figured) where it is shortly forked. M simple; cubitus with only two branches (i.e., Cu_{1a} simple), anal short. Hind tarsi (Fig. 19) as in two preceding species. Terminalia (Figs. 20, 21) with dorsal structures much as in *C. intermedia*, the ventral structures more symmetrical, the hemisternites fused to the sides of the ninth sternite and its process, the cercus-basipodites annular, each with a posterior tapered process embedded in membrane.

♀. See de Saussure (1896*a*, *b*).

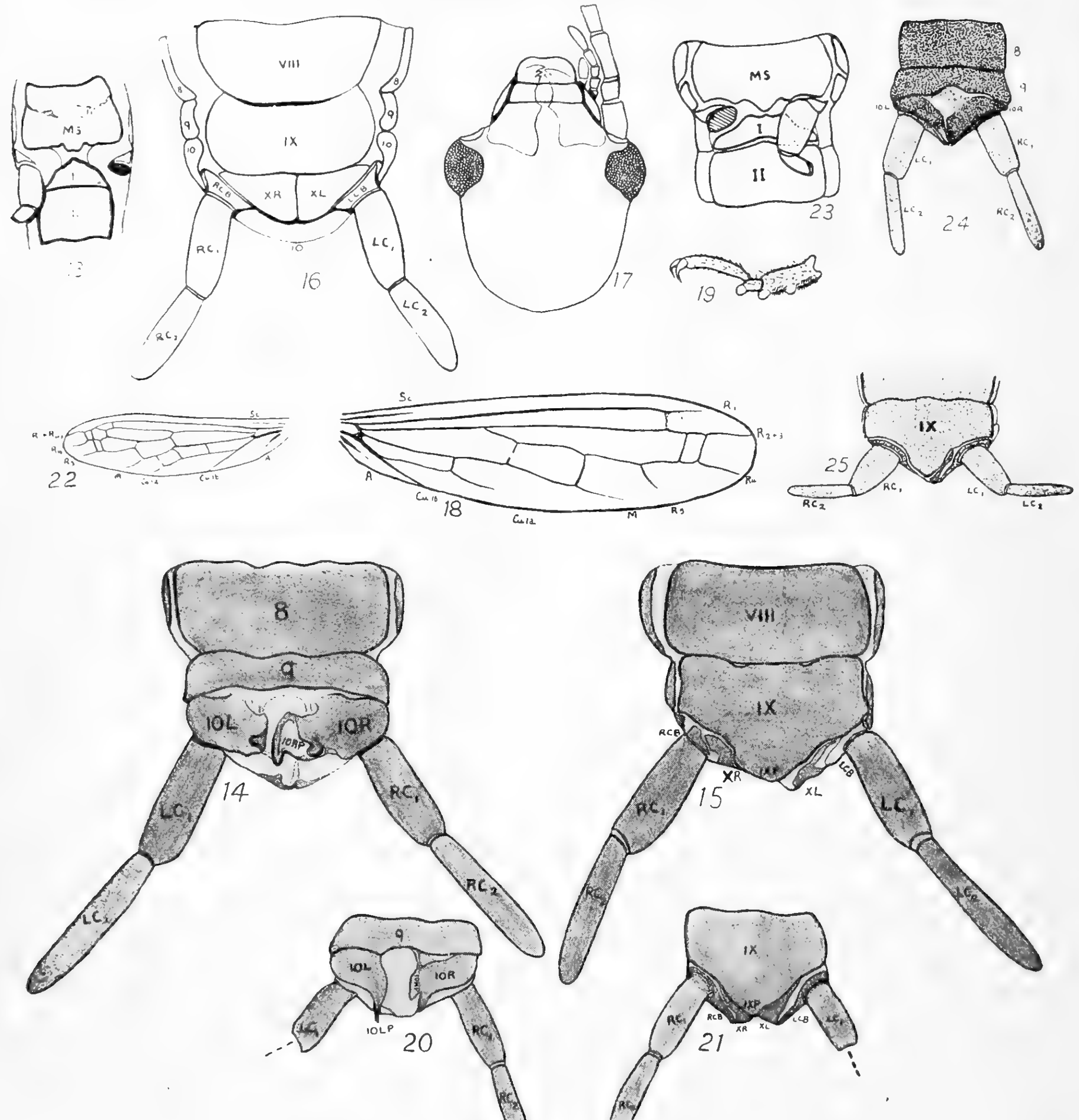
The simplicity of R_{4+5} in the co-type seen by me appears to be an individual aberration. De Saussure's description and figure show it clearly forked (cf. Fig. 22), a condition which may be taken as the normal for his series. In the specimen described below it is also clearly forked in all wings.

De Saussure gives the length of the forewing as 10 mm. His statement (1896*b*) that the cross-veins are not white-bordered appears to be incorrect; it may have been due to the incidence of the light when the specimen was examined.

In the Museum of Comparative Zoology (Harvard University) there is a male labelled 'Port of Spain, Trinidad', and three females labelled 'Port of Spain, Trinidad, July 8/20, Wheeler'. These are referable to *C. urichi*. Port of Spain may be taken as the type locality of *C. urichi*, as Urich, who collected the types, was stationed there at the time.

As these specimens were preserved in alcohol, extra details were obtainable which could not be determined from de Saussure's dried types. The male (Figs. 23–25) was dark brown, the head and thoracic nota a little paler (golden-brown); length 12 mm.; forewing, length 10 mm.; head, length 2·1 mm., breadth 1·8 mm. R_{4+5} forked in all wings. First abdominal sternite (Fig. 23) subtriangular, relatively large. Otherwise as in the co-type described above, except that the right hemisternite of the tenth abdominal segment seems to be much reduced or aborted; these structures may be slightly variable intraspecifically in this genus. The first abdominal sternite in the females is of the same structure as in the male.

It is clear that in de Saussure's figure (1896*b*, fig. 11) of the male terminalia, the structure marked as the ninth tergite is actually the eighth, and that labelled the tenth is in fact the ninth tergite plus the hemitergites of the tenth segment, with the sutures omitted. De Saussure's description appears to have been made from the dry material in an unprepared state.



Figs. 13-16.—*Clothoda intermedia*, n. sp., locality unknown, 13-15, ♂.

13. First two abdominal sternites and adjacent structures, × 7. 14. Terminalia from above, × 17·5. 15. Terminalia from below, × 17·5. 16. ♀ of above: Terminalia from below, × 17·5.

Figs. 17-21.—*Clothoda urichi* (de Saussure), co-type ♂, Trinidad.

17. Head from above, × 17·5. 18. Right forewing, × 7 (three other wings have R_{4+5} entirely simple). 19. Hind tarsus viewed laterally, × 17·5. 20. Terminalia from above, × 17·5. 21. Terminalia from below, × 17·5.

Fig. 22.—*Clothoda urichi* (de Saussure), ♂, left forewing after de Saussure (1896*b*), × 3.

Figs. 23-25.—*Clothoda urichi* (de Saussure), ♂, Port of Spain, Trinidad (specimen in the Museum of Comparative Zoology, Harvard University).

CLOTHODA FLORISSANTENSIS (Cockerell 1908).

Embia florissantensis Cockerell, *Amer. Journ. Science,* Series 4, 25, p. 230 (fig. 4), p. 231 (description).

Cockerell's specimens are from the Miocene of Florissant, Colorado, U.S.A. Until the types can be re-examined, little can be said of this species except concerning its size and venation.

♂. Length 12½ mm.; head, length c. 2 mm.; forewing 11 mm. × 3¾ mm.; hindwing 9 mm. × 3¾ mm. Venation as in *Clothoda urichi*, R_{4+5} forked.

Cockerell referred his species to *Embia*, believing that it was a tropicopolitan recent genus. Actually it is a genus with a Mediterranean distribution, ranging to South Africa; species from the New World, which have been referred to *Embia*, are not actually congeneric with the genotype, *E. savignyi* Westwood. It would therefore be misleading to retain Cockerell's species in *Embia*, although its structure is not sufficiently well known to be certain to which recent Neotropical genus it belongs, if to any. I have provisionally selected *Clothoda* as being the most primitive, and thus more likely to resemble a Miocene fossil, and also because of Cockerell's reference to de Saussure's species.

There is no justification for Krauss's reference (1911) of Cockerell's species to *Oligotoma*; it has R_{4+5} clearly forked in the latter's figure (l.c.).*

Note.—*Embia kotzbaueri* Navás (1925) may possibly be referable to *Clothoda*; it is certainly not referable to *Embia* Latreille, which does not occur in America. Navás's description does not allow any certain decision on the subject, and his figures are notoriously inaccurate. The type (♂) is recorded as in the Navás Collection, presumably in Spain, and may therefore be no longer extant. The species may be listed as a species inquirenda, and if the type is lost, it must be deleted as unrecognizable; it is unlikely that further material from the type locality (Nictheroy, near Rio Janeiro, Brazil) would establish it, as it is probable that several species (of various genera) occupy this territory, as is the case in other parts of South America.

Discussion.

Enderlein (1912, p. 63) erected the genus *Antipaluria*, genotype *A. aequicercata* Enderlein (l.c.), from Colombia; he referred *Embia urichi* to *Antipaluria*, his knowledge of this species being based on de Saussure's meagre description.

* Since the completion of this paper, I have received details of the type (Univ. Colorado) from Mr. E. S. Ross, of the University of California. He writes: "The details of the terminalia are absolutely impossible to make out. . . . Furthermore, it appears that someone has tampered with the specimen, in that a chip has been removed from just behind the expanded pair of wings, and may have thus removed the terminalia. . . . Cockerell's photograph (*Amer. Journ. Sci.*, (4), 25, 230) cannot be improved." Mr. Ross enclosed a sketch of the wing, showing R_{4+5} clearly forked (a condition he notes as common to fore- and hindwing). Cu_{1a} appears to be simple.

It is advisable to retain the species in *Clothoda*, as discussed above.

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23. First two abdominal sternites and adjacent structures, × 11·5. 24. Terminalia from above, × 11·5. 25. Terminalia from below, × 11·5.

All figures, except Fig. 22, based on camera lucida outlines. Setae omitted except in Figs. 4, 10 and 19. Conventional lettering for venation.

MS, metasternum; I, II, first two abdominal sternites; 8, 9, abdominal tergites; 10, undivided tenth abdominal tergite; 10L, 10R, left and right hemitergites of tenth abdominal segment; 10LP, 10RP, processes of same; IX, ninth abdominal sternite; IXP, process of same; XL, XR, left and right hemisternites of tenth abdominal segment; LCB, RCB, left and right cercus-basipodites; LC_1, LC_2, RC_1, RC_2, first and second segments of left and right cerci respectively.

A. aequicercata was based on a single male (Mus. Berlin), which had the terminalia missing, except apparently the left cercus, which was as in *A. urichi* (*Clothoda urichi*). Enderlein differentiated *A. aequicercata* from *A. urichi* because it had white-bordered cross-veins, de Saussure having wrongly stated this to be inapplicable to his species.

On the existing description, there is nothing to lead us to suppose that Enderlein's species differs from de Saussure's. In view of the different locality, I list *Clothoda aequicercata* as a species inquirenda; the examination of complete specimens of this generic series from Colombia may establish the species, or may synonymize it with *C. urichi*. Such a damaged specimen should never have been described, let alone as genotype of a new genus.

I have no hesitation in referring de Saussure's species to *Clothoda*, i.e., in synonymizing *Antipaluria* with *Clothoda*. The Venezuelan species *C. intermedia* forms a perfect link between *C. nobilis*, from Brazil, and *C. urichi*, from Trinidad. *C. intermedia* has the robust build, and 3–4-branched cubitus, of *C. nobilis*, but the divided tenth tergite and slightly asymmetrical terminalia of *C. urichi*. The division of the tenth tergite in *C. intermedia* and *C. urichi* is not as marked as in other genera, the central part of the tergite being somewhat membraneous (as noted incipiently in *C. nobilis*), the sclerotized hemitergites being largely, with their processes, embedded in this membrane, or merely a continuation of the membrane somewhat differentiated. The cerci and ventral structures agree sufficiently closely throughout the genus, and are far removed from these structures in other genera.

It is difficult to understand why Enderlein referred *Antipaluria* to his subfamily Embiinae, rather than to the Clothodinae, with which it agrees far more closely in his key to the subfamilies.

Key to the Species of Clothoda (♂).

1. Miocene. Colorado . . . . *florissantensis* (Ckll.)
   Recent. South America 2
2. Cubitus 2-branched; R_{4+5} forked, occasionally simple; length 12 mm. or less. Trinidad . . . . *urichi* (Sauss.)
   Cubitus 3–4-branched; R_{4+5} clearly forked; length 13 mm.–17 mm. 3
3. Tenth tergite divided, the hemitergites separated by membraneous areas. Venezuela . . . . *intermedia*, n. sp.
   Tenth tergite entire, sclerotization continuous from side to side. Brazil . . . . *nobilis* (Gerst.).

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TAXONOMIC NOTES ON THE ORDER EMBIOPTERA. V.

THE GENUS DONACONETHIS ENDERLEIN.

By Consett Davis, M.Sc., Lecturer in Biology, New England University College, Armidale.*

(Five Text-figures.)

[Read 30th August, 1939.]

Donaconethis Enderlein 1909.

Zool. Anz., 35, p. 176. Genotype, *Donaconethis abyssinica* Enderlein, 1909, l.c., p. 177.

Enderlein's generic concept depends on the forking of the media. Since venational aberrations are moderately frequent in the Order Embioptera, specimens rightly referable to *Donaconethis* may occur with M simple, as a venational anomaly, and specimens of other genera may likewise, in exceptional cases, have M forked (cf. Navás 1923, concerning *Embia ramosa*). It is consequently desirable to establish the genus on the more reliable characters of the terminalia, and at the same time to give a more complete description of the genotype.

The following description is based on a specimen (♂) in the Museo Civico di Storia Naturale, Genoa, labelled 'Bogos, Keren; 1870, Dr. Beccari'. It had been identified as *Donaconethis abyssinica* by Navás, who (1928) has given a brief and inaccurate description of the venational anomalies, without detailing the structure of the terminalia. Examination of the terminalia showed the species to agree with Enderlein's description of the type (Berlin Zool. Museum), which is from Asmara, Eritrea, only some 50 miles from Keren. The genus may therefore be re-defined as follows:

Robust Embioptera, the males with the following characters: Winged, with R_{4+5} forked, M with a tendency to fork, not always manifest. Hind tarsi with one metatarsal bladder. Terminalia with tenth tergite completely cleft longitudinally; right hemitergite massive, with a posterior tapered process directed downwards, and an internal flap-like process. Process of left hemitergite bifid. First segment of left cercus with inner margin produced into two marked lobes, each with 3–5 very large spiniform toothlets directed forwards.

The genus is differentiated from *Embia* and *Rhagadochir*, apart from the variable character of venation, by the structure of the first segment of the left cercus, with its two lobes bearing few but very large toothlets. It is different from *Embia*, but similar to *Rhagadochir* (probably by convergence), in having the process of the left hemitergite forked. It agrees with *Dihybocercus severini* Enderlein (1912), the genotype of *Dihybocercus* Enderlein, from the Congo, in the two lobes of the first segment of the left cercus, which, however, according to

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* Part of the work embodied in this paper was carried out when the writer held a Linnean Macleay Fellowship in Zoology.

Enderlein's figure, carry numerous small teeth in this species. *Dihybocercus spinosus* Navás 1931, also from the Congo, is more closely related to *Donaconethis* than is *Dihybocercus severini.* The structure and dentition of the first segment of the left cercus in *Dihybocercus spinosus* are strongly reminiscent of *Donaconethis*, and other parts of the terminalia (process of left hemitergite; posterior process of right hemitergite; hypandrium; left cercus-basipodite) also show general resemblance. The two hind metatarsal bladders, simple media (in the unique specimen), and right cercus-basipodite of *Dihybocercus spinosus* suggest that it should be placed in a new genus, as they differentiate it from *Donaconethis* (in the present sense) just as the dentition of the left cercus differentiates it from *Dihybocercus.*

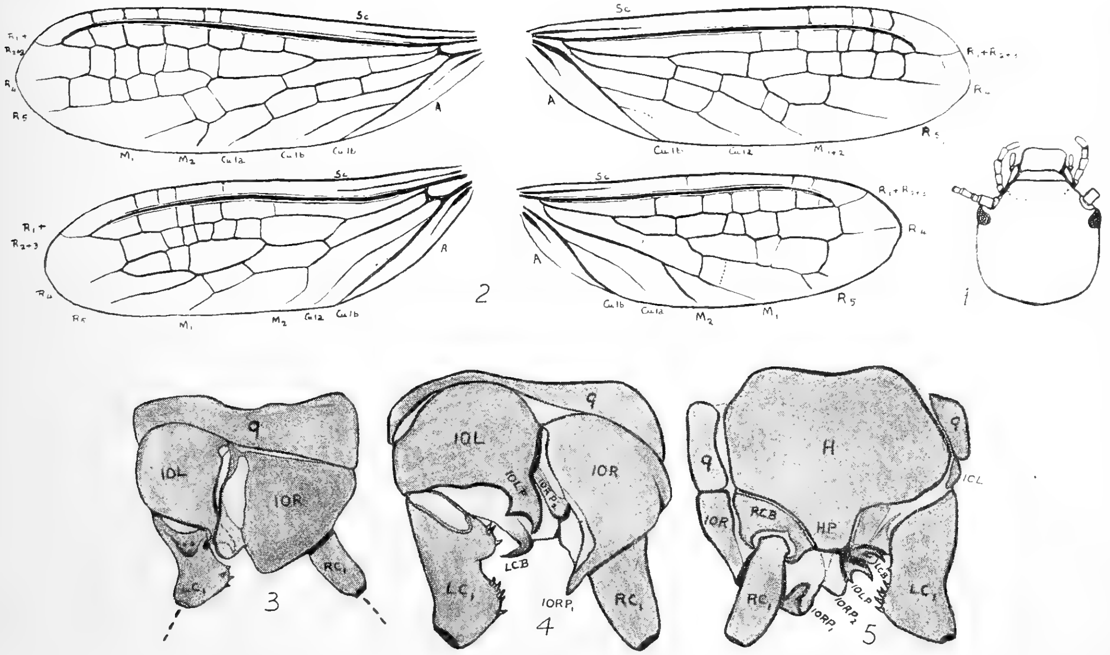
Dihybocercus berlandi Navás 1922, and *D. gromieri* Navás 1934, together with another undescribed species from West Africa congeneric with the above, are related neither to *Dihybocercus* nor to *Donaconethis.* A new generic name is required here also.

DONACONETHIS ABYSSINICA Enderlein, 1909, l.c. Figs. 1–5.

♂ (Keren, Eritrea; Genoa Museum). Length 10·9 mm.; head, length 3·1 mm., breadth 2·5 mm.; forewing 9 mm. × 3 mm.; hindwing 8 mm. × 3 mm. General colour very dark brown. Head (Fig. 1) large, eyes small, sides of head behind eyes at first slightly divergent, rounded behind. Antennae incomplete. Wings (Fig. 2) with numerous cross-veins; Sc reaching to one-quarter the length of the wing; R_1 confluent distally with R_{2+3}; R_{4+5} forked, fork longer than stem; R_5 again forked in left hindwing (the anterior branchlet fusing distally with R_4), and very shortly forked in right hindwing. M simple in right forewing, shortly forked in left forewing and right hindwing, more clearly forked in left hindwing. Cubitus two-branched, with a vestige of a third branch in left hindwing and right forewing (cf. Enderlein's figure, 1912, fig. 7, of the right forewing of the type), and a prominent third branch in the left forewing. Metatarsus of hind legs with only the terminal ventral bladder, as in the African species of *Embia.* Terminalia (Figs. 3–5) with tenth tergite completely cleft, right hemitergite (10R) posteriorly produced downwards and inwards to a tapered process ($10RP_1$), the parts internal and anterior to which are more membraneous. Inner margin of 10R with a sclerotized flap ($10RP_2$), as in *Embia*, separated from 10R except posteriorly by membrane; free edge of $10RP_2$ roughened posteriorly. Left hemitergite (10L) massive, inner margin produced backwards to a broad flat process (10LP), terminally curved out and acute, roughened on internal edge, with a subterminal broad, flat, acutely-ending process latero-dorsally to the left. In this detail, the specimen differs from Enderlein's figure and description of the type, which indicate no lateral lobe for 10LP; it is probable that it has been broken or overlooked in the type. Second segments of both cerci broken; first segment of left cercus (LC_1) very characteristic, inner margin dilated subterminally in a rounded lobe, with 4–5 relatively large teeth curved slightly forwards, acute; LC_1 with a more dorsal basal lobe, rounded, with 3–4 similar teeth. First segment of right cercus (RC_1) subcylindrical. Ninth sternite (H) produced backwards from the right-hand side to an obtuse process (HP); space between HP and base of LC_1 occupied by left cercus-basipodite (LCB), which has a long curved acute process directed downwards and outwards.

Enderlein's dimensions of the type male are: Length 11 mm., forewing 8 mm. His description and figures (1909, 1912) tally with the above except for the structure of the process of the left hemitergite.

♀. v. Enderlein, l.c. Not of taxonomic importance.



Donaconethis abyssinica, ♂, Keren, Eritrea.

1. Head, × 7. 2. Wings, × 7 (conventional lettering for venation). 3. Terminalia from above, × 15. 4. Terminalia from above, and slightly to the left and behind, × 15. 5. Terminalia from below, × 15.

9, ninth abdominal tergite; 10L, 10R, left and right hemitergites of tenth abdominal segment; 10LP, process of 10L; 10RP$_1$, 10RP$_2$, posterior and inner processes of 10R; LC$_1$, RC$_1$, first segments of left and right cerci (second segments missing); LCB, RCB, left and right cercus-basipodites; H, HP, ninth sternite and its process.

All figures based on camera lucida outlines.

Note.—The genus *Donaconethis* must at present be considered monotypic. Krauss (1911) rightly classes *D. ehrenbergi* Enderlein 1909 (*Zool. Anz.*, 35, p. 178) as a doubtful species. The type male (Berlin Zool. Museum), from Egypt, has the terminalia missing. Its exact locality is not known. The species is likely to remain unrecognizable; it should never have been described. It may represent a specimen of some species of *Embia* with a venational aberration; its size, colour, and the form of the head, suggest *E. savignyi* Westwood. There is no evidence that it is referable to *Donaconethis* in the present sense. Enderlein, in his 'Nachtrag' (1912, pp. 107–108, fig. 70) describes terminalia which may belong to his type; according to his figure, these terminalia are exactly similar to those of *Embia savignyi* Westw.

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THE GEOLOGY OF THE COUNTY OF BULLER, N.S.W.

By A. H. Voisey,* M.Sc., Lecturer in Geology and Geography, New England University College.

(One map; two Text-figures.)

[Read 30th August, 1939.]

The County of Buller lies in the Far North Coast District of New South Wales and is limited on the north and west by the Main Divide which marks the boundary between New South Wales and Queensland. The Richmond Range forms a natural boundary on the east, but the southern boundary, though following creek divides, is less clearly defined. The area is drained by the Clarence River and its tributaries, the most important of which are the Maryland, Cataract and Boonoo Boonoo rivers and Koreelah, Tooloom, Duck and Peacock creeks.

Woodenbong, Urbenville and Bonalbo are the principal towns in the County, but other small centres are Legume, Liston, Amosfield, Wilson's Downfall, Boonoo Boonoo, Acacia Creek, Capeen, Koreelah and Tooloom. Drake, Tabulam and Mallanganee lie just outside the southern border of the County on the road between Tenterfield and Casino.

Most of the data used in the compilation of this report were collected during the early part of 1938 and during a trip to Rivertree in February 1934.

It is unfortunate that several problems raised by the writer in his report on Boorook and Drake (Voisey, 1936) still remain unsolved. The most important of these refers to the basal beds of the Drake Series and their relationship to the Emu Creek Series. A thick soil cover prevents a close examination of the meeting place of the two series in the neighbourhood of the Lunatic Gold-Field, but examination of the structures in the adjoining areas suggests that the junction is a faulted one. The continuation of the boundary of the Emu Creek Series is believed to run through thickly wooded and rugged country which is difficult of access. An attempt to map it in May 1938 was frustrated by heavy rains leading to a flooding of the streams.

The purpose of this paper is to bring together a number of somewhat scattered observations made by previous workers and the writer. The outcrops of the various rock types are shown on the accompanying map.

Previous Literature.

Most of the earlier observations made in the County of Buller are mentioned in the reports of E. C. Andrews (1900, 1901, 1902, 1903, 1908). E. F. Pittman (1908) referred to the trachyte of the South Obelisk near Tooloom, and L. F. Harper (1929) gave a short account of the general geology of the northern and eastern parts of the county. The writer (1936) in connection with investigations

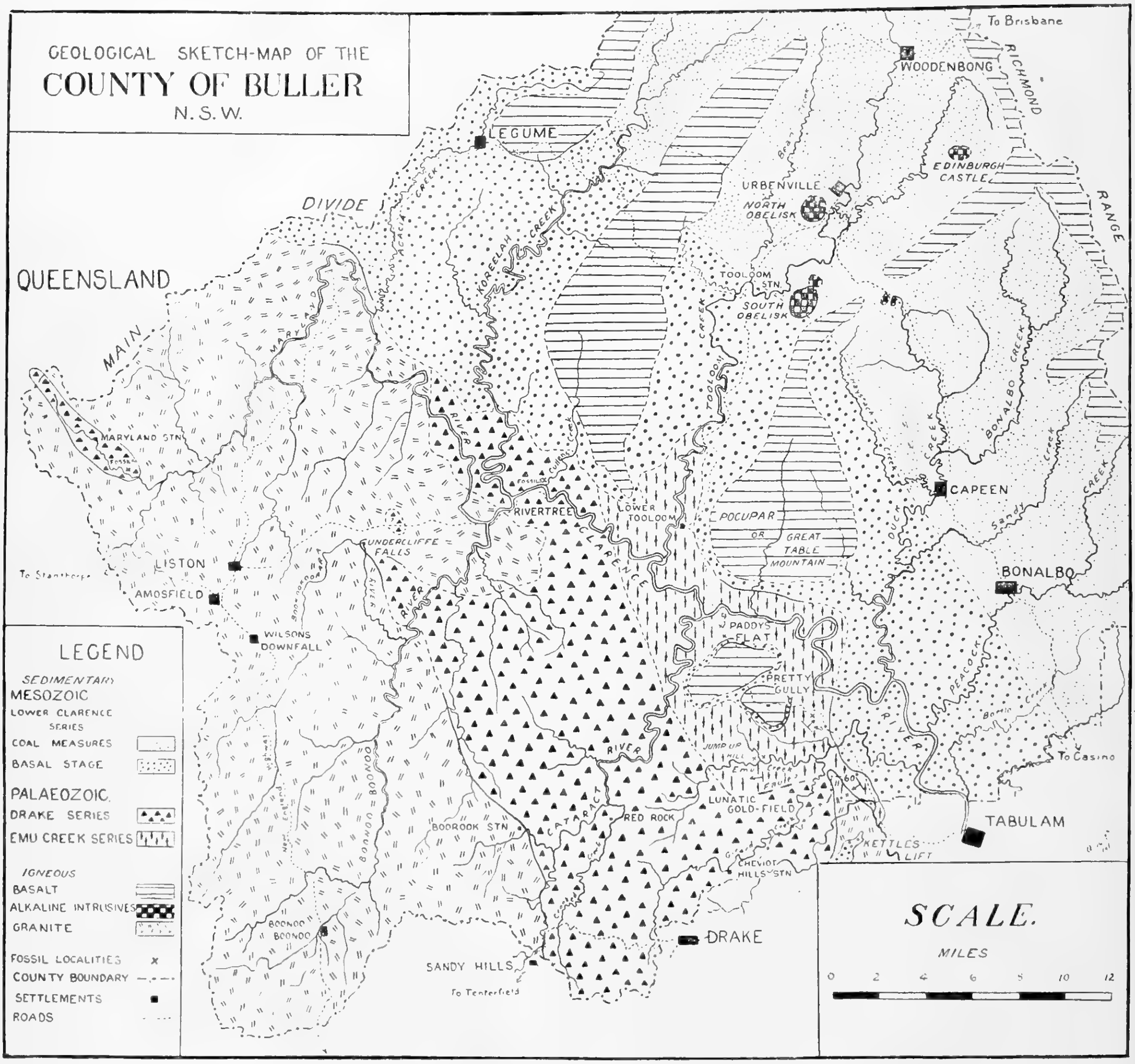
* This paper was completed while the author was Linnean Macleay Fellow of the Society in Geology.

on the rocks in the neighbourhood of Boorook and Drake, reported on the stratigraphy and palaeontology of the southern part of the area and submitted a map.

General Geology.

Summary.

The oldest rocks found in the area belong to the Emu Creek Series and are believed to be Upper Carboniferous in age. They outcrop principally between Emu Creek and the Clarence River.



Map 1.

The Drake Series, comprising more than 5,000 feet of volcanic rocks, passing upwards into several thousand feet of marine sediments, belongs to the Kamilaroi (Permian) System. It continues northwards from the neighbourhood of Drake to Rivertree and beyond.

Nearly half of the County of Buller is covered by sediments of Jurassic age belonging to the Clarence Series. These in places are overlain by Tertiary basalts and are intruded by sills, plugs, and, perhaps, laccolites of alkaline rocks also of Tertiary age.

Granite in Late Palaeozoic times invaded the Drake and Emu Creek Series, but is unconformably overlain by the sediments of the Clarence Series.

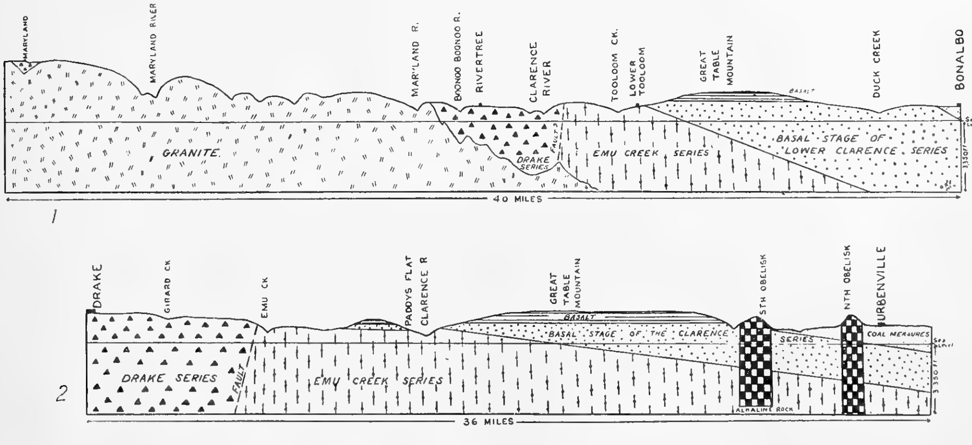
Carboniferous.

The Emu Creek Series.

Mudstones and tuffs containing an abundant marine fossil fauna and outcropping at Jump-up Hill and along Emu Creek have been described previously (Voisey, 1936). They were traced northward to Pretty Gully by Andrews (1908) and have been found to continue to Paddy's Flat and beyond.

The beds are overlain unconformably by conglomerates and sandstones of the Clarence Series and by Tertiary basalt between Pretty Gully store and Paddy's Flat.

The prolific Fenestellidae beds outcrop in cuttings along the Paddy's Flat road 10 miles from Tabulam. At least 30 feet of strata are crammed with polyzoan remains. Several small spirifers were found also. The matrix is olive-green mudstone which weathers to a buff colour. Associated with the mudstones are hard tuffs and tuffaceous sandstones. The beds dip in a north-easterly direction at 45 degrees. They disappear beneath the Clarence Series about a mile from Pretty Gully store but make their appearance beside the road again where the descent is made to the Clarence River at Paddy's Flat. The highest beds are principally tuffs, tuffaceous sandstones and mudstones, but occasional bands of conglomerate are present. The mudstones contain Fenestellidae horizons with subordinate coarser bands of sediment. They underlie the tuffaceous group and



1.—Section from Maryland to Bonalbo. V/H = 5/1.
2.—Section from Drake to Urbenville. V/H = 5/1.

comprise several hundred feet of the total of approximately 1,000 feet of rocks exposed. The dip is generally to the south-east at 40 degrees.

The Emu Creek Series is overlain by the Lower Clarence Series in the northern part of the County but reappears in the vicinity of Mount Barney just over the Queensland border (Richards, Bryan and Whitehouse, 1932).

In his previous paper the writer (Voisey, 1936) discussed limestones, cherts, etc., occurring near the junction of the Paddy's Flat road with the main road from Tabulam to Drake under the name of Plumbago Creek Series. It was suggested that the beds might be related to the Drake Series. However, they seem to pass northwards into the Emu Creek Series and hereafter will be considered part of that series. Some of the sediments have been contact metamorphosed by the adjacent granite. They are indurated black rocks, some possessing a rough parting parallel to the lamination. The name slate, loosely applied to them, is somewhat misleading since there is no evidence of any dynamic metamorphism.

KAMILAROI.

Since the limits of the Permian System are still in dispute and the use of the term "Permian" admits of a number of interpretations it has been decided to follow the nomenclature suggested by the late Professor Sir T. W. E. David (1932). In an earlier paper (Voisey, 1936), the Drake Series was considered as Permian in age, but, until the controversy is settled, the better-defined name "Kamilaroi" will be used. The writer regards "Kamilaroi", "Permian" and "Permo-Carboniferous" as synonyms and is opposed to the division of the first-named into Permian and Carboniferous sections.

Drake Series.

The Upper and Lower Divisions of the Drake Series continue north and north-east of Boorook and are folded into anticlines and synclines along a meridional axis. In the neighbourhood of Boorook beds of the Upper Division occupy a synclinal structure which pitches gently in a northerly direction. The beds continue northwards towards Undercliffe and Rivertree.

Andrews (1901) noted the presence of graphite produced by the intrusive granite from dirty coal seams at a point eleven miles east of Wilson's Downfall. These coal seams occur with tuffs and contact-altered sediments, probably belonging to the Upper Division of the Drake Series.

Altered tuffs and mudstones outcrop at Undercliffe Falls in contact with granite. Andrews (1902) recorded "Permo-Carboniferous" fossils from this locality and also from Cullen's Creek at Rivertree (1908). The present writer in 1934 found a number of marine fossils in indurated mudstones near the old silver mines at Rivertree. Owing to the lack of detailed mapping between here and Boorook the stratigraphical position of the beds has not been determined. The irregular boundary of the granite and the contact alteration of the sediments which it has produced add to the difficulty of mapping this rugged, well-wooded country.

North of Rivertree the Kamilaroi rocks are overlain by the Clarence Series and Tertiary basalt.

Near the Queensland border, at Maryland Station, and running in a north-westerly direction through the parish of Maryland, is a mass of sedimentary rock about seven miles long and averaging about a mile wide. It is surrounded on all sides by granite and has suffered intense contact metamorphism. The rocks are principally indurated mudstones, sandstones and tuffs which contain numerous Kamilaroi marine fossils including *Linoproductus springsurensis* and Fenestellidae, The fossil beds are located on the properties of Messrs. C. Bonner and W. E. Barnard on portions 266, 37, 446 and 23, parish of Maryland, and portion 73, parish of Ruby.

Good exposures occur along Maryland Creek in the portions named. So far as the author is aware, this is the first record of the discovery. Mr. H. W. Scott, Manager of the Stanthorpe branch of the Commercial Banking Company of Sydney, drew the writer's attention to the beds after having been shown the fossils by Mr. C. Barnard some years ago.

Associated with the altered sediments are several bands of what appears to be volcanic rock. This contains well developed phenocrysts of felspar and resembles some of the lavas of the Drake Series. Microscopical examination will be necessary to prove the suggested correlation.

The fossil beds dip in a south-easterly direction at high angles, reaching 80 degrees in places. Felsite (?) half a mile south of Maryland Station strikes 140° and appears to be vertical. At Cundumbul andesite (?) strikes 120° and again the dip is very steep. The general strike of the beds within the sedimentary area is north-west—south-east, but, as in the case of the fossil beds, there are local variations.

Other blocks of sedimentary rock surrounded by granite occur in the neighbourhood of Maryland, one such being found about 7 miles from Liston on the Rivertree road and another is exposed by a railway cutting just north of Dalveen (Queensland). The last-named may consist of members of the Silverwood Series of Devonian age (Richards and Bryan, 1924). The Maryland and Rivertree road beds may be referred to the Drake Series and, geographically, are situated between known outcrops of these rocks and those of the Fault Block Series (Richards and Bryan, 1924).

The writer visited the Silverwood area and examined the members of the Fault-Block Series before he was acquainted with the Drake sequence and for various reasons disagreed from the arrangement of the succession tentatively put forward by Richards and Bryan (1924). This paper (Voisey, 1934) was discussed at a meeting of the Royal Society of Queensland and a number of other arrangements and correlations were suggested (A.N.Z.A.A.S., 1935).

The most satisfactory method of dealing with the isolated occurrences appeared to be by correlating the units with horizons in an adjacent area where the sequence was known. Therefore, field-work was carried out around Drake and Boorook (Voisey, 1936) with the result that such a sequence was obtained at a distance of less than forty miles from Silverwood. On the evidence furnished by these beds the writer had no alternative but to alter the arrangement which he had put forward previously.

There appears to be little doubt that the lavas, tuffs, conglomerates and grits of the Tunnel, Rhyolite Range and Eight Mile blocks belong to the Lower Division of the Drake Series. Detailed petrological work on these beds is of the utmost importance and will settle the correlation question.

The tuffs and mudstones of the Condamine Block suggested by Richards and Bryan (1924, p. 65) to be contemporaneous with the volcanic beds discussed above were regarded by Reid (1930), the writer (Voisey, 1934) and others to have preceded them. However, at Boorook, similar beds also containing abundant *Trachypora wilkinsoni* and *Monilopora nicholsoni* occur with other marine strata above the lavas and tuffs of the volcanic suite. Beneath the *Trachypora–Monilopora* zone at Boorook are richly fossiliferous sediments with some bands composed almost entirely of the remains of *Strophalosia* and others of Fenestellidae or lamellibranchs. The stage is suggestive of that composing part of the Wallaby Block at Silverwood.

Although a close correlation between the individual units of the Silverwood and Boorook–Drake areas cannot be made at the moment, it would appear from the presence of abundant specimens of *Trachypora*, *Monilopora*, *Fenestella*, *Strophalosia* and certain lamellibranchs occurring in zones in both areas that correlation in a broad way is indicated. It seems, therefore, that the Condamine and Wallaby beds are the equivalents at Silverwood of part of the Upper Division of the Drake Series.

The position of the strata of the Eurydesma Block is still in doubt. The writer (1934) attempted to show that they overlay the strata of the Condamine Block, using as evidence certain similarities in lithology and the presence of *Monilopora* in each block. If the rocks are so related the Eurydesma beds must belong to the Upper Division of the Drake Series, possibly occurring immediately below the main *Trachypora–Monilopora* zone. In such a case the somewhat forced palaeontological arguments indicating that the beds underlay the volcanic suite must be disregarded. On the other hand, the horizon of abundant *Eurydesma cordatum* is still regarded by most Australian geologists as indicating a position low down in the Kamilaroi sequence, even though the genus has been found scattered throughout the whole system. If we regard this horizon as occurring high up in the Upper Division of the Drake Series it is somewhat surprising to find such a big thickness of sediments and lavas between it and the base of the Kamilaroi system. The lavas and tuffs of the volcanic suite cannot be placed in the Carboniferous System since Andrews (1908) records several occurrences of definite Kamilaroi fossils interbedded with them. The writer has seen similar fossils in the Lower Division of the Drake Series beside Girard Creek (Voisey, 1936).

No beds directly underlying the lavas have been found in the Boorook–Drake area. Neither *Glossopteris* nor *Gangamopteris* has been collected. The presence of dirty coal seams at Undercliffe (Andrews, 1901) is indicative, however, of some fresh-water deposits.

JURASSIC.

Clarence Series.

Sediments belonging to the Clarence Series occupy most of the north-eastern part of the County of Buller, their boundary running diagonally across it from the neighbourhood of Legume to Tabulam. Outliers occur to the west of this at Kettle's Lift, Pretty Gully and elsewhere.

Warping and faulting which took place, probably in Tertiary times, have been responsible for the elevation of the sediments, the base of which rises gradually from Tabulam at 400 feet towards Legume and to Warwick in Queensland where it is at approximately 1,500 feet. Outliers in the vicinity of Silverwood attain a height of over 2,000 feet. The base of the Pretty Gully outlier lies at about 1,100 feet.

Only the Lower Clarence Series is represented in the County and it may be divided conveniently into two stages, the Basal Stage and the Coal Measures.

Basal Stage.

The lowest beds of the Clarence Series consist principally of conglomerates made up of a great variety of well-rounded pebbles. Sandstones separate the conglomerates and merge into them. Smaller lenticular sandstone bands occur within the main conglomerate horizons which are usually about ten feet in thickness. Fine-grained sediments are rare in the Basal Stage.

Large tree trunks and numerous pieces of fossil wood are a distinctive feature of the beds. They are seen to advantage in road cuttings just east of Tabulam and alongside creeks in that locality. Magnificent examples have been found at Warwick in Queensland just beyond the limits of the accompanying map.

The constitution of the outlier at Kettle's Lift is noteworthy since it is a remarkably good example of a consolidated soil or rubble which had covered the land surface before inundation. The rock consists of granite soil in which are set large rounded granite boulders which give the impression that they are intrusive into the bed in which they lie. Similar rocks characterize the basal beds of the Jurassic System in parts of the Northern Territory, notably at Buldiva (Voisey, 1938).

Coal Measures.

The Coal Measures overlie the Basal Stage. In the County of Buller coal seams were met at intervals from a point near the junction of the Bonalbo road with the Tabulam–Mallanganee road to Urbenville. They are then hidden by basalt but reappear near the junction of the Urbenville road and the New England Highway and continue northwards into Queensland. Owing to the very gentle dip in the north the coal measures outcrop over a much larger area than in the south of the Clarence Basin near Coramba.

The beds consist of soft mudstones with subordinate sandstone and a number of coal seams. Details of the properties and value of the coal in the region are given by Pittman (1908). He recorded a workable seam nearly three feet wide near Killarney in Queensland. Most of the seams, however, are of poor quality and less than 2 feet in thickness. *Alethopteris* was found by Pittman near Killarney.

Age of the Clarence Series.

A. B. Walkom (1918) discussed in some detail the relationship between the Clarence Series and the Mesozoic rocks of Queensland. There seems to be little doubt that the Coal Measures of the Lower Clarence Series can be correlated with the lower part of the Walloon Series of Queensland. They are, therefore, Lower Jurassic in age. The Basal Stage bears some lithological resemblances to the Bundamba Series which consists also of massive sandstones, grits and conglomerates. The age of this series is still in doubt since no recognizable fossils have been found in it. Fossil wood, however, is extremely abundant in the Basal Stage of the Lower Clarence Series and may give some clue which will lead to the solution of the problem.

As there does not seem to be any evidence to the contrary, both the Basal Stage and the Coal Measures are regarded as Jurassic in this paper.

PLEISTOCENE.

High-level river gravels occur alongside the Clarence River and are similar to those of the Macleay, Manning and other rivers along the coast. On the hills just west of Tabulam bridge they are about 70 feet above the river.

RECENT.

Beautifully terraced alluvial flats are prevalent beside the Clarence River and are developed to a lesser extent beside some of its tributaries. The terraces in the neighbourhood of Tabulam are particularly fine examples.

Igneous Rocks.

Granite.

E. C. Andrews (1903, 1905, 1908) has dealt adequately with the granitic rocks of New England and part of the County of Buller and little can be added here.

The granite occupies a large area to the west of the County, its eastern boundary running irregularly through Boorook, Undercliffe and Rivertree to pass under the Clarence Series and basalt.

Professor Skeats (1930–32) suggested that the age of some of the granites might be Mesozoic following verbal communications from Professor Richards, Dr. Bryan and Dr. Whitehouse. There appears to be general agreement, however, that the evidence upon which the suggestion was based admits of another interpretation. It is highly improbable, therefore, that any of the granite in the area being described is intrusive into Mesozoic rocks. Its age may be regarded as late Palaeozoic.

Alkaline Intrusives.

A number of alkaline plugs, laccolites and sills occur in the north-eastern portion of the County. They comprise the prominent hills North Obelisk, South Obelisk, Edinburgh Castle and others. These were mentioned by Andrews (1903) in his report on New England. Pittman recorded the presence of the alkaline rock at the North Obelisk in 1908 (Pittman, 1908). He regarded its occurrence as being that of a laccolite.

Sills of fine-grained trachytic rock intrusive into the Coal Measures of the Clarence Series are exposed by cuttings on the Bonalbo road about 9 miles south of Urbenville near the bridge over Lemon Tree creek. The sills, which attain thicknesses up to ten feet in places, have slightly metamorphosed the sedimentary rocks and, where they have followed the coal seams, have affected them considerably. They are particularly well developed in close proximity to the coal, evidently having found progress more easy in the softer rocks.

Basalt.

Sheets of basalt cap most of the ridges in the north and east of the area, notably Pocupar or the Great Table Mountain, the Richmond, Tooloom and MacPherson Ranges. Its base lies generally at a height of about 1,000 to 1,200 feet above sea-level, but this height varies considerably from place to place.

The basalt is post-Jurassic in age since it overlies the Coal Measures. It may be assigned confidently to the Tertiary Era.

Structural Geology.

The Emu Creek Series has been folded on a general meridional axis and has been extensively faulted. Details of the individual folds have not been ascertained.

The Drake Series is gently folded into anticlines and synclines at Boorook and Red Rock, the axis of the folding being generally north and south. Further east the folding has become more intense and, in places, the beds have assumed vertical positions.

A faulted junction between the Emu Creek Series and the Drake Series is indicated on the map and has been deduced from a study of the strikes in that region. Outcrops there are very poor. The relationship between the two series between Rivertree and Emu Creek is in doubt since the country is difficult of access and recent investigations were hampered by floods.

The Jurassic rocks have a general easterly dip in the south-eastern part of the county. They flatten somewhat and turn slightly northward in the north-west region. These sediments unconformably overlie the Upper Palaeozoic rocks and the granites.

Physiography.

The County of Buller comprises the basin of the Upper Clarence River, being bounded by divides on the east, north and west, respectively the Richmond Range, MacPherson Range and the Main Divide.

Basalt forms a capping on most of the ridges and was apparently poured out over a surface which now stands at heights of between 1,000 and 1,200 feet above sea-level. This surface tilts upwards to the west.

Deep gorges characterize the Cataract and Maryland rivers and many of their tributaries which are working in the Palaeozoic rocks and the granites. The Clarence Series has responded much more readily to erosion and the region which it occupies is more or less undulating.

The alkaline intrusions around Urbenville are conspicuous features rising steeply from the more open country.

Acknowledgements.

I desire to thank Mr. H. W. Scott of Stanthorpe for his hospitality and help which have been given freely over a number of years.

Messrs. C. Bonner of Cundumbul Station and W. E. Barnard of the Summit guided me to the Maryland fossil beds and gave me much useful information, and to them also my thanks are due.

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THE GEOLOGY OF THE LOWER MANNING DISTRICT OF NEW SOUTH WALES.

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(One map; one Text-figure.)

[Read 30th August, 1939.]

This paper deals with the general geology of the Lower Manning River District. The accompanying map embraces parts of the counties of Macquarie and Gloucester which lie respectively to the north and south of the Manning River. The area is drained by the Manning and its tributaries, Lansdowne and Dawson rivers and Cedar Party, Dingo and Burrill creeks.

The principal towns are Taree, Wingham, Coopernook, Cundletown, Mount George, Croki, Harrington and Kramback.

Previous Literature.

No detailed account of the geology of the region has been published, but there are a number of references to some of the occurrences of rocks within it.

J. E. Carne (1896) described the rocks of the principal coastal headlands, mentioning particularly Diamond Head, Halliday Point (Black Head) and Wallaby Point. He regarded the last two as Carboniferous in age, but they are placed more satisfactorily now as Devonian.

W. G. Woolnough in 1911 described the Cedar Party Limestone and underlying beds, suggesting a glacial origin for some conglomeratic material. His tentative correlations with the sequence on the Macleay River are not likely to be challenged.

Devonian and Kamilaroi beds were discussed by W. N. Benson (1916, 1918) and the occurrence of serpentine in the neighbourhood of Mount George was recorded.

References to the alkaline intrusions in the neighbourhood of Lansdowne have been made by C. A. Sussmilch (1932), W. R. Browne (1933), R. O. Chalmers (1934) and others.

The writer has described portions of the area more recently (Voisey, 1938, 1939*a*, 1939*b*).

Stratigraphy.

Devonian.

All the rocks of undoubted Devonian age in the Lower Manning District are found south of a group of faults which will be referred to as the Manning River Fault System. These faults separate Devonian from the Carboniferous and Kamilaroi rocks which occupy the country to the north of the Manning River.

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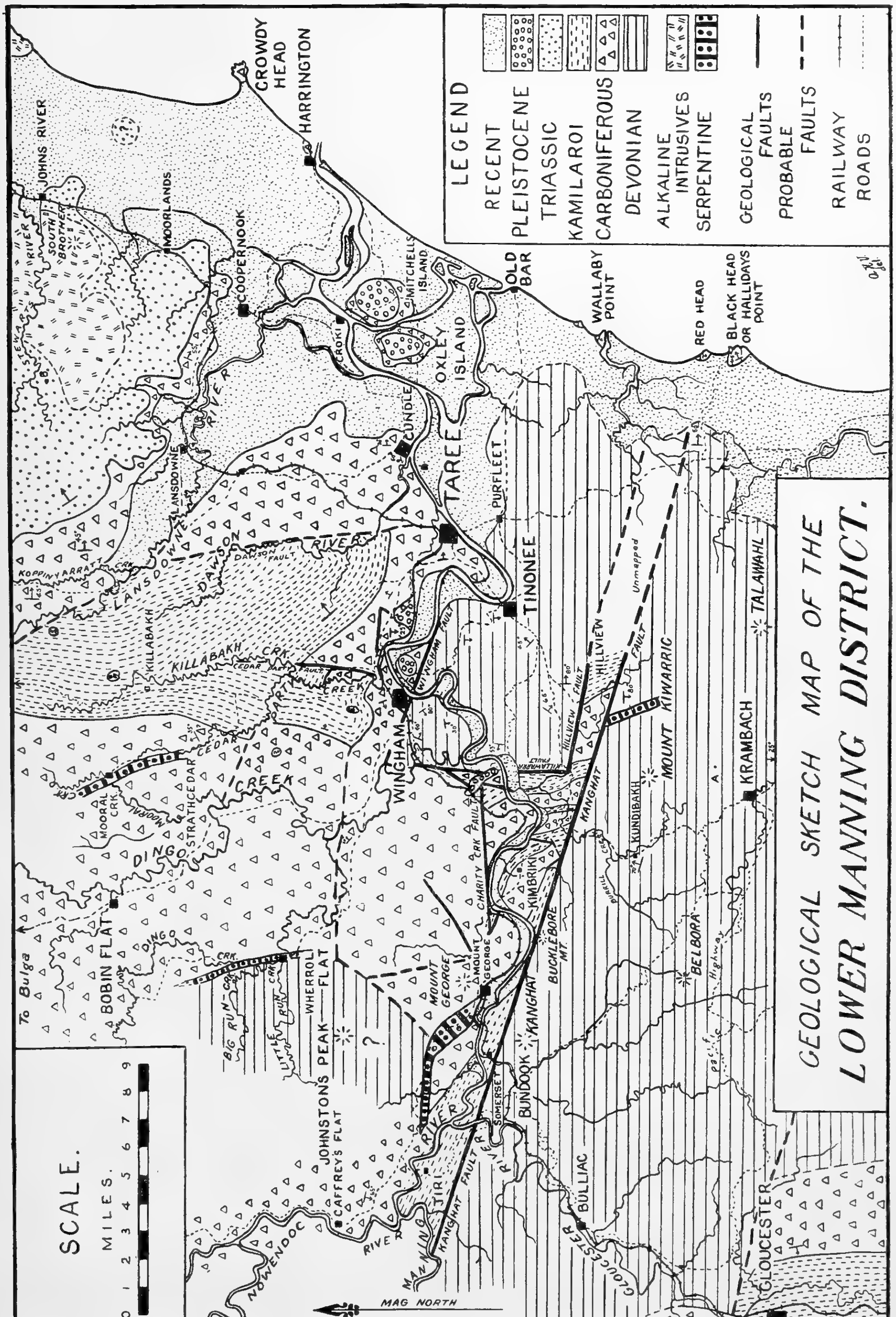
* This paper was completed while the author was Linnean Macleay Fellow of the Society in Geology.


GEOLOGICAL SKETCH MAP OF THE
LOWER MANNING DISTRICT.
LEGEND
RECENT
PLEISTOCENE
TRIASSIC
KAMILAROI
CARBONIFEROUS
DEVONIAN
ALKALINE INTRUSIVES
SERPENTINE
GEOLOGICAL FAULTS
PROBABLE FAULTS
RAILWAY
ROADS
SCALE.
MILES.
0 1 2 3 4 5 6 7 8 9
MAG NORTH
CROWDY HEAD
HARRINGTON
JOHNS RIVER
MOORLANDS
COOPERNOOK
MITCHELLS ISLAND
OLD BAR
OXLEY ISLAND
CROKI
CUNDLE
TAREE
PURFLEET
WALLABY POINT
RED HEAD
BLACK HEAD OR HALLIDAYS POINT
TINONEE
WINGHAM
HILLVIEW
HILLVIEW FAULT
KILLAWARRA FAULT
WINGHAM FAULT
KIWARRIC
MOUNT KIWARRIC
TALAWAHL
KRAMBACH
KANGHAT
KANGHAT FAULT
KUNDIBAKH
KIMBRIKI
BUCKLEBORE MT.
BELBORA
MOUNT GEORGE
BUNDOOK
SOMERSET
BULLIAC
GLOUCESTER
TIRI
MANNING
RIVER
NOWENDOC
CAFFREY'S FLAT
JOHNSTONS PEAK
WHERROL FLAT
BIG RUN CRK.
LITTLE RUN CRK.
BOBIN FLAT
To Bulga
DINGO CRK.
MOORAL CRK.
STRATHCEDAR
CEDAR PARTY CREEK
KILLABAKH
KILLABAKH CRK.
DAWSON RIVER
DAWSON FAULT
LANSDOWNE
KOPPIN YARRATT CRK.
STEWARTS RIVER
SOUTH BROTHER
CHARITY CRK FAULT
Unmapped

Map 1.

The complete Devonian sequence was not elucidated owing, in a large measure, to the complexity of the structures and the lack of sufficient outcrops. It may be possible to sort out the Devonian succession after a detailed geological survey of the area, but as the Carboniferous and Kamilaroi rocks were the chief concern of the present writer it was not found practicable to devote the necessarily large amount of time to this project.

Benson (1916, 1918) and Sussmilch (1921) were in agreement that the Devonian sequence closely resembles that of the type-area in the Tamworth District. The suite in each case consists of characteristic banded claystones, tuffs, spilites, agglomerates and breccias.

The beds will be discussed under the headings of the principal localities where they were examined.

Bundook.

Fresh-looking, dense, pale green spilites containing well-preserved pyroxenes and albitic felspars are beautifully exposed by railway cuttings all the way from Bundook to Somerset (Benson, 1916). They continue eastwards to the Kanghat Range, where they are responsible for this imposing feature which rises to over 2,000 feet. The spilites continue in a westerly direction beyond the limits of the map.

Between Bundook and Gloucester, railway cuttings reveal banded mudstones, tuffs, cherts and breccias of Devonian age. Quite close to Gloucester they give way to the Carboniferous suite (Sussmilch, 1921).

Kundibakh.

Two miles south of Burrell Creek Post Office, along the Gloucester road, mudstones and sandstones associated with hard bluish tuffs outcrop. They contain fragmental plant remains. Although these beds resemble those of the Burindi Series to some extent, they are included with the Devonian on account of their association with definite Devonian rocks south of the Kanghat Fault. They dip in a south-easterly direction at 40 degrees.

Two and a half miles south of this occurrence in the Kramback Cutting are coarse tuffs dipping steeply in a direction 30 degrees. They are very like those at Tiri and contain the same kind of large angular shaly fragments. Associated with them are greenish-grey mudstones and other fine-grained blue tuffs.

Banded mudstones and tuffs may be followed in road cuttings along the Pacific Highway to the neighbourhood of Mongrani Cutting near Gloucester.

Bucklebore Mountain.

This spur from the main Kanghat Range is composed largely of coarse tuffs associated with spectacular volcanic agglomerates or tuff-breccias. Fragments of green tuffs up to several inches across are cemented into a very hard and beautiful rock. Fresh specimens of this may be obtained from large blocks in the scree on the south bank of the Manning River at the bend about a mile south of Charity Creek Railway Siding.

Mount Kiwarric.

The north-eastern slopes of Mount Kiwarric are composed of hard blue tuffs and grey cherts with some interbedded igneous rocks, probably spilites. These beds dip in a southerly direction at about 70 degrees near the head of Stoney Creek, a tributary of Bow Bow Creek. In this locality they are intruded by serpentine.

Tinonee.

Typical Devonian banded claystones with interbedded coarse tuffs are exposed by cuttings along the Taree–Gloucester road between Tinonee and Bow Bow Creek.

At Tinonee punt approach they dip in a direction 320° at 47°. A quarry about a quarter of a mile from Tinonee on the Old Bar road reveals a good section of the claystones which here dip in a direction 175° at 35°.

Dips are so variable in this region that it has not been possible to determine the details of the structures even after numerous measurements have been taken. Examination of the sections revealed by the Brushy Cutting and railway cuttings near Wingham shows how futile it would be to attempt to map the folds and faults with a limited number of measurements. The soft beds appear to have been folded and crumbled along a number of different axes.

The banded claystones and tuffs extend eastward from Wingham to the coast.

Black Head.

Rock Platforms at Black Head expose a splendid variety of green tuffs interbedded with banded claystones. The suite is similar to that met around Tinonee and is undoubtedly Devonian in age. The strata vary in strike but generally dip in a north-easterly direction at about 45 degrees. Numbers of small faults displace the individual beds and are seen to great advantage on the rock platforms. The tuffs have been twisted about in places and are partly silicified, containing numerous veins of quartz.

Red Head.

One of the best places to examine the banded claystones is at Red Head, about a mile north of Black Head. Wave action has cleared away weathered material and polished the rocks so that the banding is particularly well displayed in dark and light grey shades. The strata here dip south at 55 degrees.

Wallaby Point.

Carne (1896) placed the Black Head (Halliday Point), and Wallaby Point rocks in the Carboniferous system, comparing them with the beds at Cape Hawke where he found Carboniferous marine fossils. However, they correspond more closely with the known Devonian rocks and are included now in that system.

Interesting intraformational structures occur in some bands of sandy mudstone interbedded with tuffs. Before consolidation of the laminated mudstones they were puckered and folded.

Fragmental plant remains are abundant in the tuffs but no identifiable material was found. According to Carne (1896) grits and conglomerates are present. He was impressed by the "concretionary weathering of some of the sandstones".

Doubtful Occurrences of Devonian Rocks.

Johnston's Peak.

Jaspers and quartzites are exposed by Little Run Creek west of the serpentine belt at Wherrol Flat and are responsible for the presence of an elevated block of country which rises to a sharp, peculiarly-shaped summit called Johnston's Peak. The higher portions of this rugged region were not examined, but it is assumed that the siliceous rocks are continuous from Wherrol Flat to the neighbourhood of Mount George (Voisey, 1939*a*).

No evidence was found to indicate the stratigraphical position or age of these beds. Abutting serpentine at Wherrol Flat and Mount George, they are believed to be related to it as the Woolomin Series of Benson (1913*b*) is related to the basic intrusives of the Nundle District.

Strathcedar.

On the road to Mooral Creek, about 2½ miles from its junction with the Wingham–Comboyne Road, occur some rocks which bear a strong lithological resemblance to those of the Devonian suite. They are included on the map with the Carboniferous beds since they are surrounded by sediments of that age and are some miles from any other known Devonian occurrence.

They outcrop alongside the road for less than a mile but, as exposures are poor, their extent was not determined nor was their relationship to the adjacent Carboniferous glacial beds ascertained. The rocks consist of cherts and tuffs having, in part, a light green colour which is especially typical of the Devonian beds near Bungay (two miles south of Wingham) and in railway cuttings east of Wingham. Banded claystones are also present.

If the age of the rocks really is Devonian, this anomalous occurrence can be explained only by very strong faulting.

Coopernook.

Alongside the road between Langley Vale and Coopernook Railway Station, road-material quarries expose tuffs and banded claystones which resemble Devonian rock-types. As in the case of the Strathcedar beds, the locality is so far removed from other Devonian areas that doubt is thrown upon lithological correlations and a Carboniferous age is preferred. The strata dip in a direction 98° at 55°.

Correlations.

Although the Devonian sequence has not been worked out on the merits of the outcrops in the area under discussion, the rock types may be correlated, more or less, with those of the Tamworth and Nundle districts (Benson 1913*a*, 1913*b*). Benson (1916, 1918) and Sussmilch (1921) were agreed on this point after examining the sections from Mount George to Gloucester.

Woolomin Series.

The jaspers and quartzites occurring between Mount George and Wherrol Flat are correlated tentatively with the Woolomin Series (Benson 1913*a*). No tuffs, slates or phyllites, however, were found to correspond with those in the Nundle District. Since the siliceous rocks appear to be related to the intrusion of serpentine, it is unsafe to place them on any fixed stratigraphical horizon.

Tamworth Series.

Benson (1918) assigned the spilites of Kanghat Mountain to the Middle Devonian. The tuff-breccias and agglomerates of Bucklebore Mountain suggest a position in the sequence analogous to the Upper Breccias of the Bowling Alley (= Tamworth) Series at Nundle. Here the association of such breccias and spilites was remarked upon by Benson (1913*b*).

By far the most widespread rocks of Devonian age are the banded claystones, possibly containing radiolaria. They are referable to the Tamworth Series, some of them belonging probably to the upper, banded, radiolarian claystones (Benson 1916), but their relationship to the spilites and tuff-breccias could not be ascertained.

Baldwin Agglomerates.

The Kundibakh tuffaceous deposits could belong to the Baldwin Agglomerates. Benson, however, recorded beds of this type from the Tamworth Series, and they resemble some Carboniferous types, so that again correlation is doubtful.

Barraba Series.

Beds referred to the Barraba Series by Sussmilch (1921) occur in the Gloucester District and might be expected to outcrop to the east and north-east. What appear to be members of this series are exposed by road cuttings between Kramback and Nabiac, immediately to the south of the area shown on the map.

Palaeontology.

Numerous fragmental plant remains were found in the Devonian rocks, but none were sufficiently well preserved to allow identification.

Mr. Les. Weller of Nabiac brought in several well-preserved specimens of *Lepidodendron australe* from the neighbourhood of Wang Wauk, several miles south of the area mapped. It was in this locality that the writer was shown the same fossil by Dr. G. D. Osborne in 1933.

CARBONIFEROUS.

The Carboniferous beds have been divided into three series. These, with approximate thicknesses, are as follows (in descending order):

	Feet.
Kullatine Series	2,000 +
Upper Burindi Series	1,000
Lower Burindi Series	4,000 +

The Kullatine Series is very variable in thickness and probably exceeds the amount given above in some localities. The fact that it consists largely of tillite in which bedding is poorly developed renders elucidation of structures very difficult, and the presence of numerous faults has further interfered with stratigraphical work.

The Upper Burindi Series has been examined only in the neighbourhood of Taree (Voisey, 1938) and has not been located anywhere else, although it may well occur in a number of other places.

The Lower Burindi Series is very well developed throughout the area. Its downward limit has not been found, since faults intervene between the series and the Devonian beds. The estimate of 4,000 feet is very conservative since sections of strata which do not correspond with the measured thickness of about 2,500 feet (Voisey, 1938) are known.

The Carboniferous beds are not differentiated on the accompanying map on account of its small scale.

Lower Burindi Series.

Everywhere that Devonian and Carboniferous strata have been found in contact in the area, faults have separated them. This would appear to be the case also to the west of Gloucester, in the Copeland District, where C. A. Sussmilch (1921) has reported a contact between Devonian and Carboniferous rocks.

The beds consist, for the most part, of mudstones and tuffs, the last-named being very variable in character.

Along the Nowendoc Road between Mount George and Caffrey's Flat, notably beside the Nowendoc River, there are good exposures of the series together with the tillites of the Kullatine Series. Beds of tuffs several feet thick are separated by olive-green mudstones containing plant remains. The general dip is in a direction 190° at 65°. Between Wingham and Wherrol Flat similar rocks are exposed in road cuttings. Some of the hard, massive tuff bands may be traced across the country for short distances, usually being cut off by faults.

Members of the Lower Burindi Series occupy most of the country between the Manning River and Wherrol Flat.

At Tiri, where the road from Mount George to Bundook crosses the Manning River, there is a light bluish-grey tuff, very hard and splintery, consisting of rock fragments up to several inches in diameter set in a tuffaceous groundmass. Occasional angular inclusions of grey shale up to two or three inches across are found scattered through the beds. With them are quite large plant stems. These are particularly abundant in the road cuttings on the northern side of the bridge. None of those collected were sufficiently complete to allow identification.

Associated with the Kullatine Series, Lower Burindi beds cover a large area in the watersheds of Dingo Creek and its tributaries, and continue for an undetermined distance to the west.

Mention has been made already of the sequence in the Taree and Wingham–Mount George districts (Voisey, 1938 and 1939*a*).

At Cundletown banded olive-green mudstones dipping in an easterly direction at about 30° outcrop in road cuttings. Further east, tuffs, sandstones and mudstones occur on Oxley Island.

Woolnough (1911) recorded *Knorria* from Carboniferous tuffs and mudstones at Crowdy Head. These rocks have been quarried and brought south to Harrington and used in the construction of the breakwater at the entrance to the Manning River. During the quarrying operations a specimen of a fossil fish was found and forwarded to the Government Geologist, who submitted it to A. Smith Woodward for identification (Smith Woodward, 1900–1904). Having been led to the belief that the beds in which the remains were found were Mesozoic, Woodward referred the imperfectly preserved specimen to the genus *Atherstonia.* He named it tentatively *Atherstonia australis* and suggested that the rocks in which it occurred belonged to the Hawkesbury Series. The matrix in which the fish is preserved is identical with the Crowdy Head tuffs and other Carboniferous types and there is no chance of it belonging to the Triassic suite. Another fossil fish has been presented to the Australian Museum recently. It is set in a similar matrix and comes from the same locality as the supposed *Atherstonia.* The fish may belong to the Crossopterygii, a Palaeozoic group.

A small area of mudstones and tuffs which are similar to the Crowdy Head types occurs at Harrington. The beds are practically horizontal, a most unusual disposition for Palaeozoic strata in this region.

Upper Burindi Series.

The Upper Burindi Series consists of mudstones, sandstones and the Taree Limestone which contains *Aphrophyllum hallense* Smith, *Lithostrotion stanvellense* Eth. fil., and *Lithostrotion columnare* Eth. fil.

The only part of the area in which the series is known to be developed has been described previously (Voisey, 1938).

Kullatine Series.

The Kullatine Series has a wide distribution throughout the Lower Manning District. Together with the Macleay Series it occurs in a number of places alongside the Manning River between Tiri and Hillview. Its occurrence here has been described already (Voisey, 1939*a*).

Tillites and tuffs outcrop in association with the Lower Burindi Series beside the Nowendoc River in the neighbourhood of Caffrey's Flat. In this region the Kullatine Series appears to pass conformably downward into the Lower Burindi Series without any intervening Upper Burindi Series.

Beautiful examples of the glacial beds occur alongside the road which follows the western branch of Dingo Creek north of Wherrol Flat. The fluvio-glacial character of massive conglomerates constituting part of the glacial stage is demonstrated by the presence of numerous rounded boulders of igneous rocks cemented together by material identical with the matrix of the typical tillite.

Further outcrops of tillite are exposed by the Bulga road which follows the eastern branch of Dingo Creek. The rocks are seen to advantage on the ascent to the Bulga Plateau from Bobin Flat. They were shown the writer at Ellenborough Falls by Dr. G. D. Osborne in 1938, and were mentioned by R. O. Chalmers (1934, p. 175).

In the neighbourhood of Strathcedar tillites are intruded by serpentine.

A high ridge composed principally of glacial beds of the Kullatine Series runs northwards from Khatabunda near Wingham to the Comboyne. The beds dip under the Macleay Series which lies to the east.

It would appear that the glacial beds become thinner going from the west of the area to the east. They exceed 2,000 feet in thickness in the neighbourhood of Kimbriki and are no more than 500 feet at Taree. The light-coloured tuffs underlying the glacial stage near Taree have not been found west of Wingham (Voisey, 1938). They may have passed into darker tuffs resembling those of the Lower Burindi Series, but this point has not been established.

Carboniferous lavas and tuffs have been described from the Gloucester District by C. A. Sussmilch (1921). They have been correlated with the Kuttung Series of the Hunter River. These rocks are shown on the map to the east of Gloucester, forming the eastern limb of the Gloucester Syncline or Trough.

KAMILAROI: *Macleay Series.*

The only Kamilaroi beds which have been found outside the areas dealt with previously (Voisey, 1938, 1939*a*) occur just south of the Comboyne Plateau and in the neighbourhood of Tiri.

In the first case they overlie the Kullatine Series which occupies the ridge west of the Wingham–Comboyne road and dip away in an easterly direction.

A road cutting near the last bridge over Killabakh Creek before the ascent to the Comboyne Plateau (portion 32, parish of Marsh) reveals purple shales containing angular pebbles. These shales closely resemble the Tait's Creek Glacial beds (Woolnough, 1911) which have been compared with the Lochinvar shales in the Hunter Valley sequence.

About two miles south of the above-mentioned locality near Killabakh School (portion 32, parish of Marsh) a road cutting exposes impure limestones. The spongy weathered material derived therefrom yields well-preserved Kamilaroi marine fossils. Those collected were identified by Mr. H. O. Fletcher as: *Fenestella* spp., Crinoid stems, *Spirifer* sp. indet., *Linoproductus springsurensis* Booker, *Aviculopecten sprenti* Johnston, *Pleurotomaria* cf. *morrisiana* McCoy (abundant), and *Phillipsia* sp. (Specimens 38133–4 Australian Museum Collection.)

These limestones overlie the purple shales and tuffaceous rocks and are followed by light grey micaceous mudstones.

Along the road from Mount George to Bundook, south of the bridge across the Manning River at Tiri, road cuttings reveal micaceous mudstones, sponge-spicule tuffs and other members of the Macleay Series. Marine fossils similar to those at Kimbriki were found (Voisey, 1939*a*). The beds were associated with tillites belonging to the Kullatine Series.

TRIASSIC: *Camden Haven Series.*

Conglomerates, sandstones and shales comprising the lower beds of the Camden Haven Series outcrop to the north of the Lansdowne River. These

Triassic rocks form the southern margin of the Lorne Triassic Basin which was described in an earlier publication (Voisey, 1939*b*).

PLEISTOCENE TO RECENT.

Raised river gravels occur at varying heights above the Manning River. They may be referred to the Pleistocene period.

A large area of country has been reclaimed from the sea. This extends from Taree to the coast, with the exception of some hills of older rock which rise above the plain of recent accumulation. The lower beds are marine or estuarine sands and muds with bands of shells. They pass up into river alluvium or swamp deposits.

IGNEOUS ROCKS.

Serpentine.

Serpentine has been located in four places in the area: (1) Mooral Creek, (2) Wherrol Flat, (3) Mount Kiwarric and (4) Mount George.

1. *Mooral Creek.*—Serpentine is seen from the Wingham–Mooral Creek road and may be traced for several miles in a north-easterly direction from Strathcedar Public School to the small village of Mooral Creek. It is intrusive into tillites belonging to the Kullatine Series. One block of tillite was found caught up in the basic rock near the Strathcedar School.

2. *Wherrol Flat.*—A belt of serpentine crosses Dingo Creek south of Wherrol Flat Hall and, passing through the settlement, continues for some distance to the north. Contact altered Carboniferous tuffs were found beside the intrusion.

3. *Mount Kiwarric.*—Serpentine occurs on the north-eastern slopes of Mount Kiwarric at the head of Stoney Creek, a tributary of Bow Bow Creek. It is intrusive into Devonian rocks. This occurrence and that at Wherrol Flat (Glen Lewis) were referred to by Benson (1918).

4. *Mount George.*—This belt of basic rock has been mentioned previously by Benson (1916, 1918) and mapped by the writer (Voisey, 1939). Tillites of the Kullatine Series, tuffs of the Lower Burindi Series and Kamilaroi mudstones appear to be the contact rocks.

The Age of the Serpentine.

The age of the serpentine has been discussed in a previous publication (Voisey, 1939*a*) and will be dealt with also under the heading Structural Geology.

As has been pointed out, it is intrusive into Devonian, Carboniferous, and probably Kamilaroi rocks and cannot be pre-Kamilaroi in age. The only evidence previously brought forward to suggest that the rock is older, consists of a pebble of serpentine in Kamilaroi beds and the presence of "Permo-Carboniferous" rocks apparently overlying the Peel Thrust (Benson, 1913, p. 511). With reference to the pebble, such evidence cannot be regarded as definite proof of a pre-Kamilaroi age for the rocks of the Great Serpentine Belt since it may have come from quite another locality. In the second case Benson admits that the beds are not clearly exposed and direct proof is impossible. S. W. Carey (verbal communication) suggests that the beds may be infaulted, and with this view the writer agrees.

That the serpentine is of late Kamilaroi age may be taken now as established beyond reasonable doubt.

Alkaline Intrusives.

A large number of plugs of alkaline rock, including comendites, arfvedsonite-anorthoclase-trachyte, bostonite, etc. (Browne, 1933), occur principally about the headwaters of Killabakh Creek and the Lansdowne River along the southern margin of the Comboyne Plateau (Sussmilch, 1932; Chalmers, 1934; Voisey, 1939*b*).

Structural Geology.

The structural features of the district may be considered in six sections:

1.—The Lorne Triassic Basin and Associated Intrusives.

2.—Folded Carboniferous and Kamilaroi rocks north of the Manning River Fault System.

3.—Tightly folded Devonian rocks south of the Manning River Fault System.

4.—The Gloucester Syncline.

5.—The Manning River Fault System.

6.—Serpentine Faults.

1.—Triassic sediments lie with a violent unconformity on the Palaeozoic beds. The unconformable junction may be followed with ease from the neighbourhood of the Comboyne Plateau to Coopernook. Basal conglomerates and sandstones present a line of vertical cliffs which resemble, in a small way, those of the Hawkesbury Sandstone in the Blue Mountains.

The strata dip at a low angle towards the centre of the Basin which lies to the north of the area embraced by the map. West of John's River, intrusions of alkaline rock have lifted the beds and have the form of sills and laccolitic bodies (Voisey, 1939*b*).

2.—South and west of the Triassic basin are Carboniferous and Kamilaroi sediments which have been folded on a general meridional axis. These folds have been broken extensively by faults (Voisey, 1938, 1939*a*).

Yielding Kamilaroi beds have been overfolded near Kimbriki, but the more resistant Carboniferous beds have been extensively fractured and, in places, such as Cedar Party, thrust over the Kamilaroi strata.

Two synclines and an anticline were mapped north of Wingham and Taree. The anticline has given way along the Cedar Party Fault and the syncline on its eastern side along the Dawson Fault. In each case the overthrusting has been from east to west and Carboniferous beds have been pushed over those of the Kamilaroi.

The exact position of the Dawson Fault has not been determined on account of the exceedingly poor outcrops of Kamilaroi micaceous mudstones on the west and Burindi mudstones and tuffs on the east. Similarly its probable continuation along the course of the Lansdowne River has been inferred from the presence of Burindi beds along the Koppinyarratt road to the Comboyne and the presence of Kamilaroi sediments along the Killabakh Creek road. In most of the intervening area Kamilaroi mudstones are suspected on account of the low ground, grey soil, and lack of outcrops. The duplication of the Taree Limestone in the Upper Burindi Series in and near the limestone quarries at Taree and the disturbed disposition of the beds are evidence of the presence of the fault in that locality.

Between Wingham and Wherrol Flat, strikes are exceedingly variable and indicate extensive faulting. One fault running east and west is shown on the map. This is suggested by a change in the general direction of strike from north-west—south-east to north—south. Again, however, there are many departures from these general directions, and details of the faulting were not obtained.

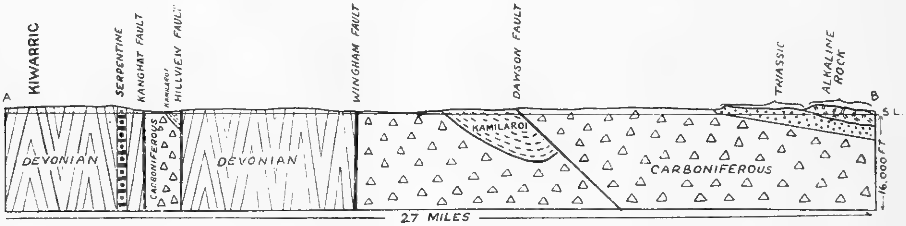
The Kimbriki Anticline (Voisey, 1939*a*) is the most important of the folds in the western part of the area. Along its nose the Kamilaroi beds are folded into asymmetrical anticlines and synclines on a meridional axis. The tilt of the axial plane of the syncline nearest to "Colraine" is towards the west.

3.—The resistant spilites, agglomerates and tuffs of Devonian age constituting the Kanghat and Kiwarric ranges have been folded, for the most part, on an east-west axis. The less-resistant banded claystones and tuffs have been very tightly folded into anticlines and synclines. The amplitude of these folds is small and they have been broken at the crests so that many beds are vertical in disposition.

Splendid examples of the folding are to be seen in railway cuttings west of Wingham and at the Brushy Cutting on the Wingham–Tinonee road. Examination of these has been sufficient to convince the writer that any detailed interpretation of structures, which might be based on the limited outcrops available elsewhere, is likely to be quite unreliable.

4.—The Gloucester Syncline has been described by C. A. Sussmilch (1921) and is shown on this map in order to demonstrate its proximity to the beds of the Lower Manning District. South and east of the syncline are regions where meridional strikes predominate.

The geological structures between this syncline and the well worked out areas of the Hunter Valley have been discussed by G. D. Osborne (1938).



Section along line A-B on Map 1. V/H = 1/1.

5.—The most important structural feature in the Lower Manning District is the Manning River Fault System, which must rank among the largest fault systems in the State. It comprises the Kanghat, Hillview, Killawarra, Wingham and probably the Charity Creek faults. The principal fault in the group, the Kanghat Fault, runs from the coast near Black Head for a distance of at least 30 miles to the west-north-west. At Tiri it is still very powerful, since Devonian and Kamilaroi rocks are in contact with one another. It is to be expected, therefore, that it continues westward for many miles into the Upper Manning District. The displacement of the beds must have been very great indeed, since 7,000 feet, at least, of Carboniferous beds have been faulted out, as well as quite that amount of Devonian beds. In addition, the Kanghat Range is 2,000 feet higher than the Kamilaroi beds beside the Manning River. Thus an estimate of a minimum displacement of three miles is suggested. Lateral as well as vertical components are involved and it is more than likely that the amount of movement was considerably greater than the minimum calculated above.

The Kanghat Fault cuts across the strike of the spilites which were not found along the Pacific Highway which follows Burrill Creek through the Kanghat–Kiwarric ranges. The accompanying map (p. 395) shows how clearly the fault transgresses the strikes of the Kamilaroi and Carboniferous rocks.

Lying to the north of the Kanghat Fault is an area of Devonian strata bounded by the Hillview, Killawarra and Wingham faults. Between the Kanghat and Hillview faults is a sunken block through which portion of Upper Bow Bow Creek flows.

The Wingham Fault separates Lower Burindi and Kullatine beds from Devonian claystones in the neighbourhood of Wingham. It is obscured by alluvium south-east of Kolodong, but there cannot be any reasonable doubt that it continues for some distance to the east, since Carboniferous rocks lie north of the river and Devonian rocks to the south. The displacements along this fault and Killawarra fault are comparable in amount to that of the Kanghat Fault since they separate Devonian from Carboniferous and Kamilaroi beds.

The Charity Creek Fault is probably part of the Manning River Fault System but its throw is not so great as that of the other members mentioned above. It separates Kullatine from Lower Burindi Rocks and runs from Charity Creek railway siding to the neighbourhood of Killawarra siding.

6.—It is assumed by analogy with the Great Serpentine Belt of N.S.W. (Benson, 1913, etc.) that the serpentine in the Lower Manning District was introduced along fault planes.

The serpentine near Mount George appears to follow a fault which separates, in places, Carboniferous tillites from Kamilaroi micaceous mudstones. It cuts across the strike of the Kamilaroi strata and apparently of smaller faults which bring them into contact with tillites (Voisey, 1939*a*).

Actual contacts between serpentine and Kamilaroi beds are obscured and, hence, there must remain a slight doubt as to whether the latter are intruded. It does not seem to be possible, however, to reconcile the observed facts with the supposition that the serpentine was faulted into its present position after being injected prior to the deposition and folding of the Kamilaroi and Carboniferous sediments.

At Wherrol Flat the serpentine fault separates jaspers and quartzites from Carboniferous tuffs, etc. Owing to doubt as to the age and origin of the material from which the siliceous rock was derived no estimate can be made of the order of magnitude of its throw.

The serpentine at Mount Kiwarric is in Devonian beds but is cut off by the Kanghat Fault. It is probable, therefore, that the basic rock was injected before the Manning River Fault System dislocated the strata.

Age Relations of the Folding and Faulting.

In the Gloucester District Sussmilch (1921) described an interesting sequence from Devonian into Carboniferous beds. An examination of some of the country between Gloucester and Copeland did not yield any evidence of a major orogenic movement between the two sequences.

On account of the intensity of the pressure which affected the Kamilaroi sediments, in a manner comparable to the crumpled condition of Devonian claystones in the Lower Manning District, it has not been found possible so far to distinguish any orogenic movement between the deposition of these two formations. The less distorted, but faulted, intervening sequence of the Carboniferous System owes much to its massive and competent units.

Wherever met in the field in the area shown on the map, the boundary between Carboniferous and Devonian strata was found to be a faulted one.

Genetically related to the folds in the Palaeozoic beds are the faults in the crests and the troughs of such folds, e.g., the Cedar Party Fault and the Dawson Fault. Many smaller related faults observed from time to time in the field have not been mapped, but may be referred to this first group of movements.

The available evidence indicates that the faults containing the serpentine cut across the folds and faults mentioned above. In turn, however, these are truncated by the Manning River Fault System.

Since Triassic sediments overlie both folded Palaeozoic beds and serpentine (Voisey, 1939*b*) there can be no doubt that the folding and intrusions may be assigned to the late Palaeozoic orogeny. In order to limit the possible age of the Manning River Fault System it is necessary to consider similar structures in other areas.

The Manning River Fault System may be compared in certain respects with the Hunter Overthrust (Osborne, 1929), Mooki Thrust System (Carey, 1934) and Peel Thrust (Carey and Browne, 1938). In each case doubts have arisen regarding the ages of the movements. The question has been discussed by Osborne (1929, p. 449), Raggatt (1929, p. 278) and Carey (1934, p. 373). No direct evidence was available to these workers to determine whether the diastrophism affecting the regions which they discussed was pre- or post-Triassic. Carey (1934, p. 373), however, showed that the Mooki Thrusts, which were continuous with the Hunter Overthrust, were parallel to the fold axes and in all probability belonged to the same movement. Carey and Browne (1938) further developed this theme and included with the Hunter–Mooki thrusts most other structures developed in the Palaeozoic rocks and referred them to the late Palaeozoic orogeny, the Hunter–Bowen Movement.

Now that the serpentine associated with the Peel Thrust has been shown to intrude Upper Carboniferous and probably Kamilaroi rocks there is little doubt that the writers mentioned above will welcome the opportunity to include not only the Peel Thrust, but the Manning River Fault System in their well developed scheme.

Further, if it is agreed that the serpentine belongs to the same orogeny, the fact that this rock is overlain by Triassic sediments (Voisey, 1939*b*) must be admitted as evidence of a pre-Triassic age for the Hunter–Bowen Movement.

Summary of Structural Geology.

1.—Devonian, Carboniferous and Kamilaroi rocks were folded on a general meridional axis. All the observed folds were fractured generally at the crests and troughs.

2.—Closely following on this folding fractures developed and serpentine was injected into them.

3.—The Manning River Fault System displaced the rocks and all previously developed structures for distances of the order of several miles.

4.—After extensive erosion, Triassic sediments were laid down upon the upturned edges of the Palaeozoic strata and serpentine.

5.—The Triassic sediments were folded, faulted, and, later, intruded by alkaline rocks in the form of laccolites and sills.

Conclusion.

An outline has been given of the stratigraphy of the Lower Manning District. Certain structural features have been described, among them the Manning River Fault System consisting of a group of large and important faults.

It has been suggested that the age of the serpentine is late-Kamilaroi, and evidence produced in favour of this alteration in the accepted views.

The stratigraphical position of the alleged *Atherstonia australis* has been changed from Triassic to Carboniferous.

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A NOTE ON THE SYNONYMY OF *LEPTOPS* (COLEOPTERA: CURCULIONIDAE).

By KEITH C. MCKEOWN, Assistant Entomologist, Australian Museum.
(*Contribution from the Australian Museum.*)

[Read 30th August, 1939.]

Family CURCULIONIDAE.

Subfamily ENTIMINAE (= Leptopinae).

Tribe STENOCORYNINI (= Leptopini).

BARYOPADUS Pascoe (= *Leptops* Schoenherr, nom. praeoc.).

The above are changes in subfamily, tribe, and generic names rendered necessary by the fact that the name *Leptops* Schoenherr for the well-known genus of Australian weevils is preoccupied by *Leptops* Rafinesque, a subgenus of Cat-fish. It is unfortunate that a name so familiar to entomological workers should be displaced but, by the law of priority, there appears to be no alternative.

The genus *Leptops* was founded by Rafinesque in 1820 (*Ichthyol. Ohiensis*, [Dec.] 1820, p. 64); the coleopterous genus, by Schoenherr, founded on the genotype *robustus* Olivier, 1807 (*Curculio*), in 1834 (*Genera et species Curculionidum*, ii (1), 1834, p. 297).

The genus *Leptops* must now be known as *Baryopadus* Pascoe (*Trans. Ent. Soc. Lond.*, 1870, p. 186), a genus erected for the reception of *B. corrugatus*, a species which Lea (*Ann. Soc. Ent. Belg.*, 1906, p. 318) proved conclusively to be a *Leptops*, on these grounds: "This species, an unusually short, robust insect which certainly looks somewhat aberrant for *Leptops*, was described as the type of a new genus *Baryopadus*; but I am convinced that it belongs to *Leptops*. Pascoe briefly defined the genus, stating that its most peculiar feature was the tarsi, but these are exactly as in *superciliaris* and other species of *Leptops*. Its antennae, rostrum and tarsi are almost exactly as in *superciliaris*, the sculpture of the elytra of the same character, and certainly the two belong to but one genus; just as certainly as *superciliaris* and *squamosus* are congeneric, and the latter is quite a normal *Leptops*." I consider that Lea's contentions are sound.

Baryopadus is listed separately by Shenkling and Marshall in Junk's Catalogus Coleopterorum, pars 114, and reference to Lea's paper has been omitted.

I am indebted to Mr. F. H. Taylor, School of Public Health and Tropical Medicine, University of Sydney, for drawing my attention to the fact that *Leptops* could not stand, and to Dr. E. J. White, of the British Museum of Natural History, for supplying certain references.

THE DIPTERA OF THE TERRITORY OF NEW GUINEA. XI.

FAMILY TRYPETIDAE.

By John R. Malloch, Arlington, Va.

(*Communicated by Frank H. Taylor, F.R.E.S., F.Z.S.*)

(Plate xi; fifteen Text-figures.)

[Read 30th August, 1939.]

In this paper I present a review of this family on the basis of materials in hand, the Australian species available to me, and the rather sparse literature of the New Guinea region. I make no attempt to deal with the many Australian species of the genus *Dacus*, sens. lat., but I present records of the few species of the group now before me.

Below I give a synopsis of the various groups reviewed in the paper. While in the main this will apply to the family in other faunal regions, there are several segregates not represented in this region, and in its circumscribed form a strict application of the synopsis will undoubtedly result in misleading associations of some extralimital genera or species if applied to the latter. I have included certain extralimital genera in my keys merely for comparative purposes or because it appears to me that they may yet be found in this region.

I have to thank Mr. Frank H. Taylor for his kindness in supplying me with most of the materials dealt with and for undertaking the final preparation of the manuscript and making most of the figures to illustrate the paper. A few species I have had the opportunity of examining in the collection of the United States National Museum, the wing of one type-specimen being figured for me by Mr. C. T. Greene of that Institution. Some of the specimens belong to me; I have also had the opportunity of including in this report data derived from a study of specimens, belonging to the Imperial Institute of Entomology, taken in the Solomon Islands, these latter forming the basis for a separate paper.

Key to the Subfamilies.

1. Ocellar and postvertical bristles almost invariably lacking, rarely represented by microscopic hairs, the postocular cilia short, almost undeveloped; thorax without the presutural, dorsocentral, and sternopleural bristles, humeral present in only one or two species; antennae slender, the third segment rarely less than three times as long as wide .... Dacinae

   Some or all of the above bristles present on head and thorax, postocular cilia always distinct; third antennal segment usually distinctly less than three times as long as wide 2

2. Costa of the wing with a deep cleft at apex of the subcostal vein, the costa with a definite angle at anterior side of the cleft and at tip of the angle with a pair of well-developed bristles; genus from this region with a pair of long strong erect bristles in front of the ocelli on the interfrontalia .... Schistopterinae

   Costa of the wing with no, or a hardly perceptible, break at apex of the subcostal vein, with or without a pair of bristles at that point; no genus with a pair of long strong erect bristles in front of the ocelli on the interfrontalia 3

3. Postocular cilia black or dark brown, fine at tips; scutellum with from two to ten marginal bristles; sixth abdominal tergite of the female usually distinctly shorter or at least not longer than the fifth .... Trypetinae
   Postocular cilia yellow or yellowish-white, stout and rather blunt at apices; scutellum with two or four bristles on margin; sixth abdominal tergite of female usually longer than fifth .... Tephritinae

Subfamily Dacinae.

I include two tribes in this subfamily, but Adraminii has sometimes been given subfamily rank. The two tribes may be distinguished as below.

A. Posterior basal cell of the wing much wider than the anal cell, the vein on its anterior side much curved up at its base so that the cell is almost as wide at its base as at its apex; lobe of the anal cell usually longer than the free part of the anal vein; pleurotergite without fine erect hairs .... Dacinii

AA. Posterior basal cell of the wing not, or very little, wider than the anal cell, the vein on its anterior side not noticeably curved forward at its base; lobe of the anal cell not nearly as long as the free part of the anal vein; pleurotergite almost invariably with erect hairs on part of its surface .... Adraminii

Tribe Dacinii.

I am not dealing in a complete manner with this tribe as there are so few species in the New Guinea material before me. The few that are in the collection include representatives of four subgenera: *Callantra* Walker, *Chaetodacus* Bezzi, *Zeugodacus* Shiraki, and *Bactrocera* Guérin. Of these the first listed has been considered as a genus by Hendel, but an intensive study of all the species from all the faunal regions where the genus *Dacus*, sens. lat., occurs is essential to a definite conclusion on the matter of generic and subgeneric segregations and this I am not prepared to make at this time. I present below a key to the species now available, with a full realization of the fact that there must be many more species in New Guinea that are unrepresented in this collection.

Key to the New Guinea Species.

1. Abdomen elongated, with a slender basal petiole which has a short pointed tubercle on each lateral basal angle, the apical bulbous portion of the abdomen in the female prominently convex; wing with a broad dark-brown costal border that extends to, or almost to, the fourth vein on its entire extent; scutellum short, broadly rounded in outline, with two bristles (*Callantra* Walker) .... *smieroides* Walker
   Abdomen not elongate, more or less ovate, not petiolate, without distinct tubercles at lateral basal angles on composite basal tergite, and only moderately convex on apical half in both sexes; wing with a much narrower costal brown stripe, or, if with a broad stripe, then with two or three brown fasciae on the disc; scutellum more elongate and not evenly rounded in outline 2
2. Scutellum with four marginal bristles (*Zeugodacus* Shiraki) 3
   Scutellum with but two marginal bristles 4
3. Prescutellar acrostichal and supra-alar bristles lacking .... *cucumis* French
   Prescutellar acrostichal and supra-alar bristles present .... *papuaensis*, n. sp.
4. Wing with a broad dark-brown costal stripe that extends to third vein and from which emanate three dark-brown fasciae, the basal one connecting with the anal stripe, the second covering the cross-veins, and the third, which is usually incomplete behind, lying between the outer cross-vein and the wing tip; prescutellar acrostichals present; humeri and posterior notopleural calli orange-yellow (*Bactrocera* Guérin) .... *umbrosus* (Fabricius)
   Wing with a narrow dark brown stripe on the costal margin that does not extend to third vein, and the field of the wing without dark fasciae beyond the anal stripe (*Chaetodacus* Bezzi) 5
5. Prescutellar acrostichal bristles present; humeri and posterior notopleural calli orange-yellow; outer cross-vein not clouded with brown .... *froggatti* Bezzi
   Prescutellar acrostichals lacking; lateral margins of the mesonotum from anterior margin of humeri to wing bases ivory-white; outer cross-vein of the wing narrowly clouded with brown .... *albolateralis*, n. sp.

DACUS (CALLANTRA) SMIEROIDES (Walker).

Jour. Proc. Linn. Soc. Lond., iv, 1860, 154.

The genus *Callantra* was erected by Walker for the reception of this species. Hendel has since placed in it another species, from New Britain, which I have not seen. *Dacus aequalis* Coquillett, from Australia, also belongs to the group. The Australian species *Dacus bryoniae* Tryon may belong here also, but the petiole of the abdomen is not so long, and the dark-brown costal stripe is narrower than in the other species.

Head brownish-yellow, the face with an elongate black spot in lower third of each antennal fovea; third antennal segment almost entirely brownish-black. Frons subquadrate, a little more than one-third of the head-width, with two pairs of incurved infraorbital and one pair of stronger reclinate supraorbital bristles; verticals four, strong. Antennae long, geniculated at apex of first segment, the apical two segments pendulous, basal segment slightly shorter than second, the latter about one-third as long as third; arista bare, a little longer than third antennal segment. Gena narrow.

Thorax brownish-black, nearly all parts closely and minutely piliferous punctate, but slightly shiny, humeri yellowish, a yellow streak on hind margin of each mesopleuron that extends along the transverse suture on the mesonotum, but they do not entirely meet in centre; another elongate yellow spot on the pleurotergite, and the apical two-thirds of the scutellum yellow. The bristles all weak, as follows: 2 notopleurals, 1 supra-alar, 2 postalars, 1 mesopleural, one very fine short pteropleural, and 2 stronger scutellars. Mesonotal hairs short and mainly yellow, those on scutellum similar.

Legs blackish-brown, tarsi yellow, apices of femora paler brown.

Wing greyish-hyaline, with a broad dark-brown costal stripe that extends over the third vein on its entire extent but does not reach fourth except in basal third of the anterior basal cell, fading out about middle of that cell apically and the middle of the first posterior cell; anal streak paler brown, entire. Inner cross-vein about one-third from apex of the discal cell; outer cross-vein slightly curved. sloping outward above; lobe of anal cell almost twice as long as free part of anal vein. Halteres yellow.

Abdomen coloured as thorax, with a central transverse yellow line at middle and another at apex of the composite basal tergite or petiole, the latter not extending to apical lateral angles, no yellow colour on sides; surface of the remaining tergites in poor shape in the specimen before me because of dust, but apparently there is a large yellowish mark in centre of apex of the penultimate tergite, on which mark the hairs are orange-yellow, and the large oval depression on each side of the ultimate tergite is greyish-dusted. The composite basal tergite is narrower on basal half than in *aequalis*, more distinctly constricted at middle where the yellow transverse line is, and the apical half forms the base of the large, oval, prominently convex remainder of the abdomen, which is pear-shaped when seen from above, and straight on ventral edge when seen in profile; sheath of ovipositor narrowly conical, not at all depressed, with more and longer hairs than in *aequalis*, and these black and not yellowish in colour.

Length, 9 mm.

Originally described from Celebes. The specimen before me is from Dutch New Guinea, Lake Sentani, Iffar, August 1936 (L. E. Cheesman). In British Museum.

I have compared the specimen with the type-specimen of *Dacus aequalis* Coquillett in the United States National Museum to obtain the above comparative data. In a paper on the Trypetidae of the Solomon Islands now in the press I have included a key to all the species of this subgenus.

Dacus (Bactrocera) umbrosus Fabricius.

Syst. Antliat., 1805, 274.

This species and several others closely related to it have been placed in the subgenus *Bactrocera* Guérin, but there are no outstanding characters beyond the two or more oblique dark-brown fasciae on the field of the wing to separate it from *Dacus*, sens. lat.

This species extends in range from the Malayan region to Australia. I have before me specimens taken by Mr. Taylor at Wewak, New Guinea, Rabaul, and Lindenhafen, New Britain.

Dacus (Zeugodacus) cucumis French.

Dacus tryoni var. *cucumis* French, *Jour. Dept. Agric. Vict.*, v, 1907, 307.—*D. cucumis* French, Tryon, *Proc. Roy. Soc. Qsld.*, xxxviii, 1927, 207.

One female, Papua: Mondo, 5,000 feet, i–ii, 1934 (L. E. Cheesman). British Museum. Previously recorded from New South Wales and Queensland.

Dacus (Zeugodacus) papuaensis, n. sp.

♂, ♀. A rather small orange-yellow species, with the usual two black spots on the face, the thoracic dorsum not blackened, with three ivory-white vittae behind the suture, and the abdomen without black markings though the base of the composite basal tergite is browned. Wing with a very narrow dark-brown costal stripe to apex of third vein or slightly beyond that, the costal cells hyaline; anal streak present.

Frons in male a little more than twice as long as wide, with three pairs of incurved infraorbital and one pair of supraorbital bristles, in female wider and with two or three pairs of infraorbitals; both sexes with four strong verticals. Third antennal segment about three times as long as second.

Thorax with mesonotum slightly browned along inner edges of the postsutural yellow vittae, the following parts lemon-yellow: Humeri, posterior notopleural calli, three postsutural vittae, the central one not attaining posterior margin, the entire scutellum, posterior half of the mesopleura, but little narrowed below, a large double spot on the pleurotergite; postnotum black-brown. Scapular bristles quite strong; in the male there is a dark hair-like setula or bristle near the hind edge of each humerus, but in the female this is not distinctly evident. Supra-alar and prescutellar acrostichal bristles present; scutellars four.

Legs yellow.

Wing as Plate xi, figure 1, the costal cells hyaline, and the dark-brown costal streak ending just beyond the apex of third vein. First and third veins setulose as usual, the fifth vein bare; free part of anal vein in both sexes nearly as long as the lobe. Anal streak broad to near apex of lobe of anal cell, faint beyond it.

Abdomen ovate, no visible erect fringe of third abdominal tergite of the male, the depressions on fifth tergite of that sex poorly developed, the fifth tergite of female very distinctly depressed centrally on each side. Hairs pale brown.

Length, 7–8 mm.

Type, male, Bulolo, New Guinea (F. H. Taylor). Allotype, Wewak, New Guinea (J. R. Rigby).

DACUS (CHAETODACUS) FROGGATTI Bezzi.

Dacus zonatus Froggatt, *nec* Saunders, PROC. LINN. SOC. N.S.W., xxxv, 1910, 868.—*D. froggatti* Bezzi, n.n., Dipt. of Fiji, 1928, 101.

One male, Lindenhafen, New Britain (F. H. Taylor). Originally described from Russell Island.

DACUS (CHAETODACUS) ALBOLATERALIS, n. sp.

♂, ♀. A brownish-yellow species, much like *papuaensis* in general colour and markings, the mesonotum with three ivory-white postsutural vittae; along the inner edge of the sublateral pair there is a blackish line. The mesonotum differs from that of any of the other species listed in this paper in having the entire lateral edges in front of the wing bases ivory-white, and in having also a pair of yellowish-grey-dusted vittae extending from the anterior margin to near the posterior margin between the postsutural vittae.

Head brownish-yellow, paler in front, the face with the usual pair of glossy black spots in the foveae. Third antennal segment about 2·5 times as long as second. Frons with two pairs of incurved infraorbital and one pair of reclinate supraorbital bristles, and four strong verticals; ocellar spot black.

Legs yellow, normal in structure and armature.

Wing as Plate xi, figure 2, the costal streak dark brown, not extending over second vein on to the field, ending near middle of apex of the first posterior cell; inner cross-vein not clouded, outer cross-vein distinctly but narrowly clouded with brown. First and third veins setulose as usual, fifth vein bare.

Abdomen elongate-ovate, brownish-yellow, with rather dense concolorous hairs, the apical lateral erect fringe on third tergite of male dark brown. Male with a central apical dark mark on the fourth and fifth tergites.

Length, 7–7·5 mm.

Type, female, Upper Watut, New Guinea (F. H. Taylor). Allotype, Papua: Mondo, 5,000 feet, i–ii, 1934 (L. E. Cheesman). Type returned to Mr. Taylor, allotype in collection of British Museum.

Tribe ADRAMINII.

I have some doubts about the propriety of segregating this group on the basis of the cited characters, as there appears to me to be a great similarity between them and those genera most closely allied to *Euphranta* Loew. This latter group has consistently been well removed from *Adrama* and its allies by specialists on the Trypetidae, but by making use of other characters than have been used for group segregations it might be possible to bring these two groups together.

The haired pleurotergite is present in *Adrama* and in *Euphranta*, as well as in a number of related genera, and there is a great similarity in the general habitus as well as in the wing-markings of most of the genera involved. The lack of the presutural bristle is to my mind rather an important character that links all of them together, and it appears to me to be of more significance than the previously used character of the spinose femora, there being other genera in which this last-mentioned character occurs that are not at all closely related to *Adrama*.

As this is purely a faunal paper and not intended as a revisional one, I prefer to leave some matters, such as this, in abeyance meanwhile, or to other and better informed workers on the family.

Below I present a key to the genera of this group known to me, though one of them is so known from the descriptions and figures only. Two of the genera are not known to occur in New Guinea, but *Neosophira* does occur in Celebes and it may yet be found there.

Key to the Genera.

1. At least the mid and hind femora with short stout ventral spines apically, usually in two series; marginal cell of the wing just beyond the apex of the first vein at least twice as wide as the submarginal cell at the same point; subcostal vein rectangularly bent forward near tip, obsolescent beyond the angle; stigma not half as long as the costal division in front of it; stem vein of the wing with short stiff setulae above to near its extreme base .... *Adrama* Walker

   None of the femora spinose on their ventral surfaces; marginal and submarginal cells of the wing just beyond apex of first vein subequal in width; subcostal vein sloping forward at apex, rather faint beyond the curve; stigma much more than half as long as the division of costa before it; none, or very few, setulae on the upperside of the stem-vein of the wing basad of the level of the humeral cross-vein 2

2. Apical section of the fourth wing-vein more or less undulated and bent forward at apex so that the first posterior cell is narrowed apically .... *Neosophira* Hendel

   Apical section of the fourth wing-vein straight or almost so, the first posterior cell not at all narrowed apically 3

3. A pair of fine erect bristles in centre of anterior margin of the mesonotum (central scapular pair) the apices of which are fine and slightly curled; second wing-vein undulated; section of fifth vein basad of the base of the discal cell not longer than the cross-vein closing the latter; vein closing the anal cell slightly angled below the middle, posterior lower angle of that cell hardly produced, the cell much longer than the free part of the anal vein; pleurotergite bare .... *Pseudosophira*, n. gen.

   No fine erect bristles in centre of anterior margin of the mesonotum; second wing-vein straight; section of the fifth vein basad of the discal cell about twice as long as the cross-vein closing base of latter; vein closing anal cell much angulated at or above middle, the cell with a slender subtriangular lobe at lower posterior angle, not nearly as long as the free part of the anal vein; pleurotergite haired .... *Cyclopsia*, n. gen.*

Neosophira Hendel.

Abhandl. Zool.-Bot. Ges. Wien., viii, 1914, 138; *Wien. Ent. Zeitg.*, xxxiii, 1914, 73.

Originally Hendel placed this genus in the family Otitidae (Ortalidae), subfamily Platystominae, but in the same year, as cited above, he included it in his key to the genera of the family Trypetidae. I have not seen either of the two species he placed in the genus, but there can be no doubt about the correctness of his later decision.

From Hendel's description and figures of the genotype, *distorta* Walker, I draw the following data: The frons has one upper reclinate pair of orbitals and a very weak incurved pair of infraorbitals, and one strong pair of verticals; the arista is moderately long haired; mesonotum with 2 notopleural and 2 supra-alar (postalar?) bristles, the other bristles lacking; scutellum with four marginal bristles. Stigma of wing as long as the costal division before it and much longer than the one between it and the apex of second vein; inner cross-vein beyond middle of discal cell.

Neosophira distorta (Walker).

Trans. Ent. Soc. Lond., iv, n.s., 1857, 230 (*Sophira*). Originally described from Celebes. May be found in New Guinea.

Pseudosophira, n. gen.

The essential characters of this genus may be derived from the features given in the foregoing keys to tribes and genera. As the genus is extralimital, all the known species being from the Philippines, it appears essential to describe only the genotype in order to establish the validity of the genus. This I take the opportunity of doing herein.

* See under Trypetinae, Group III.

PSEUDOSOPHIRA BAKERI, n. sp.

♂. General colour orange-yellow to ferruginous, shiny, frons dull, upper orbits and vertex glossy. Frons with a large pear-shaped black mark, the narrow end of which is on vertex, the other at anterior third of the interfrontalia; face black centrally, the mark widened from between antennae to epistome. Second antennal segment largely black, third bright orange-yellow, barely twice as long as wide, rounded at apex; arista with the longest upper hairs longer than the width of third antennal segment; palpi yellow. Head slightly wider than thorax, frons one-third of the head-width and about 1·25 times as long as wide, parallel-sided; upper orbits well defined, extending to middle, with a short fine yellow bristle at lower extremity, one pair of fine erect infraorbitals only and these near anterior margin; only the inner verticals present, strong and straight. Eye higher than long, more narrowed below than above; gena narrow.

Thorax with three deep black spots on each lateral margin of the mesonotum as follows: One above humerus, one behind humerus, and a very small one against the hind side of the suture; pleura with a large glossy black spot on upper posterior angle; postnotum immaculate. The single, central, pair of scapulars long, luteous; anterior notopleural lacking, posterior one strong; posterior postalar much shorter than the anterior, which latter is equal to the supra-alar; prescutellar acrostichals minute; scutellum with four strong bristles and many short stiff hairs; pleura without bristles; pleurotergite without erect hairs.

Legs orange-yellow, hind tibiae browned centrally. Fore femur with a series of fine yellow bristles that begins at base rather long and runs out about middle with very short hairs. Mid tibia with a strong black apical ventral spur.

Wing (Pl. xi, fig. 3)* as in *Colobostrella ruficauda* Hendel, but the hyaline streak between the cross-veins attains the costa, there is a hyaline marginal streak from the apex of the second to beyond the apex of fourth vein, and the hyaline spot is in the second posterior cell, not near the apex of first.

Abdomen glossy ferruginous yellow, the hairs concolorous.

Length, 8·5 mm.

Type, Kolambugan, Mindanao, Philippine Islands. Sent to me a number of years ago by C. F. Baker when I planned a review of the Trypetidae of the Philippines.

Subfamily TRYPETINAE.

Key to the Groups.

1. Arista plumose, or long-haired, the longest hairs rarely (*Acanthoneura*) less than half as long as the width of third antennal segment; scutellum with six marginal bristles, the intermediate pair sometimes very short .... Group I
   Arista much shorter haired; if plumose then the scutellum has but four marginal bristles 2
2. Scutellum flattened, coarsely haired on its entire surface, and with eight or more strong but unequal marginal bristles; hairs on upperside of the first wing-vein carried almost to the base .... Group II
   Scutellum with but four marginal bristles, rarely with two .... Group III

GROUP I.

In this group there are three genera, in which the dorsocentral pair of bristles are almost in line with, or even in front of, the transverse line between the supra-alar pair. Of these but one, *Diarrhegmoides*, is in the present collection. The others are Malayan, but may yet be found in New Guinea or adjacent island groups.

* The tiny spots all over the wing are dirt adhering to the wing membrane.—F.H.T.

Key to the Genera.

1. Second wing-vein conspicuously undulated beyond level of apex of first vein; petiole of second and third wing-veins sometimes setulose above; dorsocentral pair of bristles well behind the supra-alar line; anterior supraorbital sometimes near anterior fourth of frons 2

Second wing-vein at most but slightly bent beyond level of apex of first vein; if it is so, then the fifth vein and the petiole of second and third veins are bare above, the face is noticeably convex, the anterior supraorbital is above middle of frons; or the dorsocentral pair of bristles is close to, or in front of, the supra-alar line 6

2. Second wing-vein with several short spur-veins at right angles to it on each side that frequently connect with the first or third veins; fourth vein conspicuously bent forward beyond middle of its apical section so that the first posterior cell is very much narrowed in apex of wing .... *Polyara* Walker

Second wing-vein without any, or but one, short spur-vein; if the latter it is near apex on the posterior side and it does not connect with the third vein 3

3. Fourth wing-vein bent forward at its apex so that the first posterior cell is narrowed in the wing tip; only one pair of infraorbital bristles present .... *Colobostroter* Enderlein*

Fourth wing-vein not noticeably bent forward at its apex 4

4. Face in profile strongly convex, receding below; antennae not half as long as face; anterior pair of supraorbital bristles very strong, situated at about the anterior fourth of frons; two supra-alar, two postalar, and six equally strong scutellar bristles present; fifth wing-vein bare above; undulation of second wing-vein not very marked .... *Themaroides* Hendel

Face not at all convex in profile; anterior pair of supraorbital bristles at or above middle of frons 5

5. Second wing-vein with a deep downward loop below apex of first; gena about three-fourths as high as eye (Fiji) .... *Enicopterina* Malloch

Second wing-vein merely undulated, not looped; gena not more than one-fourth as high as eye 5*a*

5*a*. Face vertical, epistome not projecting; antennae not half as long as face; ocellars about as long as the postverticals; petiole of second and third wing-veins not setulose above .... *Pseudacanthoneura*, n. gen.

Face slightly concave centrally in profile, the epistome slightly projecting; antennae descending to distinctly below middle of face in profile; ocellar bristles represented by microscopic hairs 5*b*

5*b*. One pair of infraorbital bristles present; intermediate pair of scutellar bristles very short; petiole of second and third veins bare (Malayan) .... *Themara* Walker

At least two pairs of infraorbital bristles present; all three pairs of scutellars long and strong; petiole of second and third veins setulose above .... *Neothemara* Malloch

6. First, third, and fifth veins setulose on at least a part of their upperside 7

Only the first and third wing-veins partly setulose above 11

7. First wing-vein exceptionally long, ending in the costal vein above level of upper extremity of the outer cross-vein, the distance between its apex and that of the subcostal vein more than twice as great as that between latter and the humeral cross-vein; face with a central vertical rounded keel, narrowed above and not continued between bases of the antennae; genae and lower occiput with numerous rather long black bristly hairs; sternopleural bristle lacking .... *Cheesmanomyia*, n. gen.

First wing-vein not exceptionally long, ending in the costal vein well before level of upper extremity of the outer cross-vein, the distance between its apex and that of the subcostal vein not greater than that between the latter and the humeral cross-vein; face not markedly keeled; gena with a few bristly hairs; sternopleural bristle present 8

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* This genus has but four marginal scutellar bristles, though Enderlein states that it has six. I include it in Groups I and II.

8. Face quite prominently convex in profile, highest at centre, and from there receding to epistome; vertex sharply carinate, the carina projecting behind; antennae about half as long as face; mid tibia with no ventral submedian bristles and with two equally long and strong apical ventral spurs; scutellum bare on disc .... *Rabaulia* Malloch

Face either almost flat and vertical, or, if slightly convex, not receding from middle to epistome; vertex not sharply carinate; mid tibia either with one long and one or more much shorter apical spurs or with a submedian ventral bristle .. 9

9. Antennae not half as long as face, the latter convex and more or less receding below; anterior orbitals very strong, curved backward; hind tibia with two or three submedian anteroventral bristles and the usual series of short anterodorsal setulae; pteropleural bristle present; scutellum with the entire disc covered with stiff hairs .... *Themarohystrix* Hendel

Antennae more than half as long as face; anterior two pairs of orbital bristles proclinate and incurved; mid and hind tibiae without exceptional armature; pteropleural bristle lacking 10

10. Mid tibia with two long apical ventral spurs .... *Trypanocentra* Hendel

Mid tibia with one long and one much shorter apical ventral spur .... *Clusiosoma* Malloch

11. Mesopleura with an outstanding bristle near lower edge centrally; infraorbitals very close together, the anterior pair incurved, the upper pair backwardly directed .... *Hexacinia* Hendel

Mesopleura without an outstanding bristle near lower edge centrally; frontal bristling not as above 12

12. Wing brown or black, with some hyaline incisions in the margin and three or more small hyaline discal spots 13

Wing hyaline or yellowish, with brown longitudinal streaks on costa and veins .. 17

13. Dorsocentral pair of bristles almost in line with the supra-alar bristles 14

Dorsocentral pair of bristles much behind the line of supra-alar bristles 15

14. Second wing-vein straight; fourth vein slightly arcuate on apical section; dorsocentral bristles slightly behind the transverse supra-alar line (Malayan) .... *Diarrhegma* Bezzi

Second wing-vein slightly undulated; fourth vein conspicuously arcuate on apical section; dorsocentral bristles slightly proximad of the transverse line of supra-alar bristles .... *Diarrhegmoides*, n. gen.

15. Setulae on the first wing-vein extending the entire length of the node above .... *Rioxaptilona* Hendel

Setulae on first wing-vein not extending over node above 16

16. One pair of supraorbital bristles present, and usually only one pair of finer infraorbitals; mesonotum narrow, much longer than its greatest width; scutellum with a few minute hairs on each side of disc; arista long haired .... *Termitorioxa* Hendel

Two pairs of supraorbital and two pairs of infraorbital bristles; mesonotum broad, not much longer than its greatest width; scutellum bare; arista long haired .... *Rioxa* Walker

One pair of infraorbitals and two pairs of supraorbitals; arista short haired .... *Acanthoneura* Macquart

17. Inner cross-vein of wing at middle of the discal cell; presutural bristle lacking (Ceylon) .... *Sophiroides* Hendel

Inner cross-vein before or beyond middle of the discal cell; presutural bristle present .... *Sophira* Walker

POLYARA Walker.

Jour. Proc. Linn. Soc. Lond., iii, 1859, 122.

This genus was erected for the reception of a single species, described from the Aru Islands.

The head is broader than the thorax in the male, with the frons broader than long, about two-fifths of the head-width, inner verticals much longer than the outer, postverticals and ocellars short, anterior orbitals two pairs, incurved, anterior pair very short and close to the second pair, two reclinate upper pairs, the anterior pair the longer; face slightly convex, with deep lateral infra-antennal foveae; eye a little higher than long; antennae more than half as long as face; aristae long-haired. Thorax with the following bristles: 1 humeral, 1 presutural, 2 notopleurals, 1 supra-alar, 3 postalars, 1 pair of dorsocentrals a little behind the level of the supra-alars, a pair of strong prescutellar acrostichals, 2 or 3 mesopleurals, 1 sternopleural, 1 pteropleural, and 6 strong scutellars, the disc of scutellum bare. Abdomen slender, with four evident tergites, first (composite) and fourth longer than the others, all with lateral bristles, strongest on fourth and on apex of fifth sternite. Mid and hind tibiae with a few anterodorsal and posterodorsal bristles. Wing with some spur-veins on both sides of the second vein, sometimes extending entirely across the cells, the vein slightly angulate at bases of these spur veins; cross-veins separated by less than the length of the inner, fourth vein much curved forward about apical third; anal cell with a long apical lobe; first and third veins setulose above and below.

Polyara insolita Walker.

Op. cit., iii, 1859, 123.

Head orange-yellow, with a black spot between bases of antennae and another between each antenna and eye; facial foveae white-dusted. Thorax testaceous yellow, with grey dust, mesonotum with four rather obscure black vittae, pleura largely black, with dense grey dust, the postnotum black. Legs tawny yellow.

Wings (Pl. xi, fig. 4) greyish-hyaline, with dark brown costal stripe and paler markings in some of the cells and on the outer cross-vein. Halteres yellow.

Abdomen black, densely grey-dusted, with a testaceous-yellow dorsocentral vitta on its entire extent that tapers behind.

Length, 7·5 mm.

Bulolo, Wau, New Guinea, three specimens (Dr. C. E. M. Gunther, F. H. Taylor). Walker later recorded the species from Mysol, and Osten-Sacken in 1881 listed it from Ramoi and Dorey, New Guinea.

Colobostroter Enderlein.

Zool. Jahrb., Abt. für Syst. Geog. und Biologie, xxxi, 1911, 445.

This is a rather exceptional genus and, though it is not known to occur in New Guinea, and may never be found there, it appears necessary to present a few notes on the genotype.

Colobostroter pulchralis Enderlein.

Op. cit., xxxi, 1911, 445.

Has much the appearance of an Otitid, the posterior basal and anal cells of the wing being much longer than usual in the Trypetidae, the anal cell having but a short angular extension at lower apical angle; the frons has but one infraorbital and one supraorbital pair of bristles, and one pair of verticals, the inner. Specimens that I have seen have but four scutellar bristles despite Enderlein's statement that there are six; this difference from the description has already been noted by de Meijere. A peculiar feature of the wing is the presence of a short spur-vein on the posterior side of the second vein above the outer cross-vein. The forward curve of the apical section of the fourth vein is not very marked, but the apical section of the vein is biundulate, making the upward inflection of the tip more apparent. The wing has three blackish fasciae, the first over the inner cross-vein that does not extend beyond the fifth vein and has a backward extension to almost the fork of second and third veins, the second one extends over apex of second vein and encloses the outer cross-vein, over which it connects with the third fascia on the apical margin of the wing.

Sumatra. I have seen it from the Philippine Islands.

THEMAROIDES Hendel.

Wien. Ent. Zeitg., xxxiii, 1914, 77.

This monobasic genus was erected for the reception of an old species placed by Walker in *Helomyza*. I have not seen the species, which must have been known to Hendel, as the characters used by him for the segregation of the genus are not given by Walker in the original description. Differs from *Rabaulia* in bristling of frons, etc.

THEMAROIDES QUADRIFERA (Walker).

Jour. Proc. Linn. Soc. Lond., v, 1861, 246 (*Helomyza*).

Described from a female that is testaceous in colour, with the apical half of the abdomen black, the black colour most extended on sides, the wings black, limpid at the base and along the hind border, with a white subquadrate costal spot opposite to which the black extends nearly to the hind border, veins black, testaceous in the limpid part, discal transverse vein straight, parted by less than half its length from the border, and by about its length from the prebrachial (inner) transverse vein. Length 11 mm.

Dorey, New Guinea.

THEMARA Walker.

Op. cit., i, 1857, 33.

I have seen several species of this genus, but none from New Guinea.

The undulated second wing-vein, presence of setulae on the first, third, and fifth wing-veins above and on the second and fourth below, the very small intermediate pair of scutellar bristles, and the wing markings distinguish the genus from most of its allies.

Enderlein held that this and *Ptiolina* van der Wulp were synonyms of *Acanthoneura* Macquart, but Hendel did not accept his conclusions.

CHEESMANOMYIA, n. gen.

Generic characters.—Belongs to the same group as *Themarohystrix* Hendel, but is distinguished from it and other closely related genera by the exceptionally long first vein (Fig. A). As in other genera of this group the wings are largely black or very dark brown, without pale spots, though there are pale longitudinal streaks in some of the cells. The frons is much longer than wide, with the upper orbits glossy, the bristles consisting of two anterior incurved and two posterior reclinate pairs of orbitals, the outer verticals and the incurved postverticals about half as long as the inner verticals. Face convex, highest at middle (Fig. B), antennae extending to a little below middle of face, gena and lower jowls with numerous fine black bristles (Fig. B). Thorax much as in *Themarohystrix*, but there is neither a pteropleural nor a sternopleural present and the dorsocentrals are well behind the transverse level of the supra-alars. Mid tibia with one long and one short apical ventral spur and no submedian ventral bristle. First and third wing-veins setulose on almost their entire extent above, less extensively and more sparsely so below, fifth setulose basally above, and fourth with a few widely separated setulae centrally above and below.

Genotype, *Cheesmanomyia unica*.

CHEESMANOMYIA UNICA, n. sp.

♀. Head tawny-yellow, frons, antennae, and palpi brighter yellow, vertical edge and upper occiput brown. Length of frons about 1·75 times its central width, vertex rounded. The four pairs of orbitals about equally spaced, upper anterior and lower posterior bristles longer than the others, the anterior two pairs incurved, upper pairs reclinate, the upper one of latter a little shorter than outer vertical, the latter about half as long as the inner, ocellars minute; postocular cilia fine and black.

Thorax glossy brownish-black, the humeri and a line along upper edge of pleura to base of wing bright yellow, mesonotum in type slightly shrunken because of the teneral nature of the specimen, showing traces of a yellowish central anterior marginal mark. Scutellum with the usual six bristles, the intermediate pair shorter than the others.

Legs yellow, the coxae, femora except their extremities, and basal half of hind tibiae brownish-black.

Wing (Fig. A) dark brown, paler at base, in costal cell, along hind margin, and with pale streaks in centre of discal, first and second posterior, marginal and submarginal cells. Halteres yellow.

Abdomen coloured as thorax, with numerous black hairs and some fine apical and lateral bristles on the tergites.

Length, 8 mm.

Type, East Dutch New Guinea, Jutefa Bay Pim., sea-level to 100 feet, February 1934 (L. E. Cheesman). Type in British Museum.

Genus dedicated to the collector in recognition of the fine collection before me.

I place in this genus also the species described by de Meijere, notes on which are presented below.

CHEESMANOMYIA NIGRA (de Meijere).

Nov. Guin., v, Zool., 1906, 95 (*Rioxa*).

Similar in almost all respects to *unica*, differing in having the costal margin of the wing more rounded at middle, the costal cell yellow, the central portion of the wing including the posterior basal cell, the posterior half or more of the discal cell yellowish-hyaline, the dark colour fading out over the outer cross-vein, and no subhyaline elongate streaks in the cells of the apical half. There are also some minor differences in the leg colour-markings, but the type of *unica* is teneral and has been attacked by mites or dermestid larvae so that minute distinctions are difficult to draw between it and de Meijere's description of his species.

Length, 6–7 mm.

New Guinea.

RABAULIA Malloch.

Ann. Mag. Nat. Hist., (11) iv, 1939, 257.

Generic characters.—Similar to *Themarohystrix* in structure, differing markedly in the structure of the head (Fig. C), the face being quite prominently conically produced, with the highest point a little below the middle in profile and from that point roundly receding to the mouth margin which is not produced. Antennae extending to middle of face. Eye higher than long, about six times as high as gena. Intermediate pair of scutellar bristles shortest, the disc bare. First,

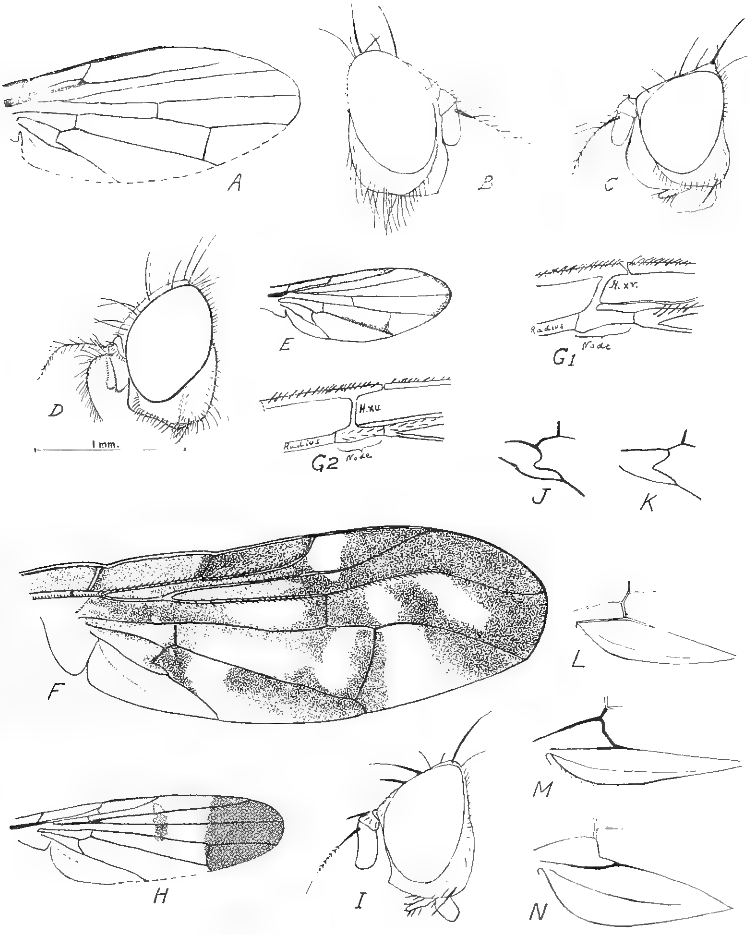

Fig. A.—*Cheesmanomyia unica*, n. sp. Wing.
Fig. B.—*Cheesmanomyia unica*, n. sp. Head in profile.
Fig. C.—*Rabaulia fascifacies* Malloch. Head in profile.
Fig. D.—*Clusiosoma puncticeps*, n. sp. Head in profile.
Fig. E.—*Sophira flava* (Edwards). Wing.
Fig. F.—*Acanthoneura acidiomorpha* Hendel. Wing.
Fig. G.—Types of armature of node of stem vein of wing: 1. *Pseudacanthoneura*. 2. *Chrysotrypanea*.
Fig. H.—*Cyclopsia inaequalis*, n. sp. Wing.
Fig. I.—*Pseudina buloloae*, n. sp. Head in profile.
Fig. J.—*Ceratitis capitata* (Wied.). Anal cell of wing.
Fig. K.—*Ceratitella loranthi* (Froggatt). Anal cell of wing.
Fig. L.—*Tephrella sexincisa* Malloch. Anal angle of wing.
Fig. M.—*Spathulina acroleuca* (Schiner). Anal angle of wing.
Fig. N.—*Sphenella marginata* Fallen. Anal angle of wing.

third, and fifth veins setulose above, both sections of last setulose, first vein not exceptionally long. Mid tibia with two long and two short apical ventral spurs.

Genotype, *Rabaulia fascifacies* Malloch.

RABAULIA FASCIFACIES Malloch.

Op. cit., (11) iv, 1939, 258, Pl. xi, fig. 18.

A small shiny-black species, with black wings, the head largely yellow, the face with a black central narrow fascia.

Rabaul, New Britain.

THEMAROHYSTRIX Hendel.

Wien. Ent. Zeitung, xxxiii, 1914, 78; *Ann. Mus. Nat. Hung.*, xiii, 1915, 432.

This genus was erected for the reception of a species from the Indian Archipelago, but without more definite locality given. The generic description is quite full, but the description of the genotype is very short and rather inadequate for accurate identification. The type species is unrepresented in the material before me. Curran erroneously referred a species taken by the Whitney Expedition on Mouo Island to this genus; I deal with this species under another genus in the following text. Below I present a key for the identification of the species known to me at this time.

Key to the Species.

1. Face with a black central mark; wings blackish-brown, without hyaline markings and the anal angle hardly paler than the disc .... *suttoni*, n. sp.
   Face and frons entirely yellow; wings dark brown, broadly subhyaline on anal angle 2
2. Mesonotum with four black vittae .... *erinaceus* Hendel
   Mesonotum with five black vittae .... *flaviceps*, n. sp.

THEMAROHYSTRIX ERINACEUS Hendel.

Op. cit., xiii, 1915, 433.

Hendel describes this species as having four black mesonotal vittae, the submedian pair continued along the sides of the scutellum, the others along the notopleural suture, and two similar vittae on each pleuron. The abdomen is described as: "Seitenrand der Tergite Schwarzbraun, die Spitze im allgemeinen etwas verdunkelt." The wings are similar to those of *flaviceps*. Length, 9 mm.

In the original description Hendel states that the base of the second vein and the fourth vein to about the middle are setulose. This character holds in both the species before me, and in addition it may be well to add that the second vein has the underside, except at apex, closely setulose and that there are setulae on the underside of the fourth vein to beyond its middle. No doubt these features ought to be taken as of generic import.

Indian Archipelago. Described from a female specimen.

THEMAROHYSTRIX FLAVICEPS, n. sp.

♀. Wing (Pl. xi, fig. 5): In this species the first, third, a part of fourth centrally, and all of the fifth vein are setulose above, and the second on its entire extent from its furcation with third, and a large part of third and fourth, are setulose below. The apical pair of scutellar bristles is a little shorter than either of the other two pairs. The head, thorax, and abdomen are pale testaceous-yellow. The only dark marks on the head consist of a small ocellar spot and a small spot below each eye; antennae and palpi yellow, the third segment of former slightly darkened above. The thorax has five narrow black vittae on the mesonotum, the submedian pair continued over the sides of the scutellum, the pleura each have two similar vittae, one at middle of the mesopleura that extends to hind margin of that sclerite, the other on the upper margin of the sternopleura that does not extend as far back, and a black spot on the lower margin of the pteropleura. Postscutellum with an irregular black transverse line; postnotum yellow. Abdomen with a black central spot on each of the basal three segments and a black basal fascia on each of the others, sometimes broken; genital cone black. Fore and mid tibiae largely black. Fore femur in female with a posteroventral series of long strong bristles and two series of much shorter bristles on the posterodorsal surface; mid femur with two anterior series of bristles, the lower one the least extensive and the stronger; hind femur with one or two strong bristles beyond the middle on the anteroventral surface. Mid tibia with one or two anteroventral bristles and a series of posterior setulae; hind tibia with two or three rather strong anteroventral bristles and a series of anterodorsal setulae. Knobs of halteres dark brown.

Length, 8–10 mm.

Type and 3 paratypes, Bulolo, New Guinea (F. H. Taylor).

THEMAROHYSTRIX SUTTONI, n. sp.

♂, ♀. This species is very similar to *flaviceps*, but differs in having a vertical black stripe on the face that extends over the prelabrum, the mesopleural vitta very rarely extends over the spiracle, there is no black spot on the pteropleura, there usually is a central dark spot on the sternopleura, and the postscutellum is entirely yellow. The wings (Pl. xi, fig. 6) are hardly paler on the anal angle than on the disc. The mid and hind femora are preponderantly black, instead of very narrowly browned at bases as in *flaviceps*. Abdomen with a narrow black dorsocentral vitta on the basal three tergites, the other tergites usually entirely black.

Structurally as *flaviceps*. Length, 6–8 mm.

Type, male, allotype, and 11 paratypes, Wewak, New Guinea (F. H. Taylor). Occasionally the central dark spot on the sternopleura is lacking.

It appears worthy of note that in *Themarohystrix* and *Neothemara* the scapular bristles are distinct, though rather weak and fine, while in *Clusiosoma*, *Trypanocentra*, and *Cheesmanomyia* these bristles are undeveloped. This lack of scapulars in the last-mentioned group of genera is associated with a slight but evident concavity of the occiput which allows the head to fit more closely against the thorax than it does in the other group, and sometimes this concavity is emphasized by a backward extension of the vertex forming a slight flange, most pronounced in *Rabaulia*. I do not make use of this cephalic character in my generic key, though it may be of even more phylogenetic significance than those I have used.

CLUSIOSOMA Malloch.

PROC. LINN. SOC. N.S.W., li, 1926, 547.

This genus was described from Australia. I have several species before me that I refer here and deal with them below though they do not all occur in New Guinea. The genus is similar in general habitus and characters to *Themarohystrix*, but it is readily separated therefrom on the characters of the frontal and scutellar bristling. The upper pair of reclinate orbitals is much shorter than the second pair, the infraorbitals are not very closely placed, they are equally long, very distinctly shorter than the anterior supraorbital pair, and both are sloped forward and slightly inward; the ocellars are minute, and the postverticals are much more widely separated than in *Themarohystrix*. The preapical pair of scutellar bristles is much shorter than either of the other two pairs, and there is no distinct pteropleural bristle. The fore femur in the male is thicker than the other pairs, and sometimes very strongly spined or bristled on the central part of the postero-ventral surface and usually furnished with some short bristles on the anteroventral surface. In the known males either the fore tibia or fore tarsus is modified. There are no long strong bristles on the anteroventral surface of the hind femur beyond the middle in any species as yet known to me.

Key to the Species.

1. Face with a brown spot on each side near lower margin; male with no modification of apex of the fore tibia, but with a stout process at the apex of the metatarsus that projects along the anterior side of the second segment and is covered with minute black spines at its apex; wings greyish-hyaline, with a brown border on the costa, on second vein, on third vein beyond the inner cross-vein, on fifth vein along the discal cell, and on fourth vein from before outer cross-vein to its apex .... *puncticeps*, n. sp.
   Face yellow; fore tibia of male with a spongy swelling at apex on posterior side, and the fore tarsus normal; wings quite evenly blackish-brown apically, usually hyaline on basal half 2
2. Males 3
   Females 7
3. Mesonotum with a broad black central vitta on entire extent that extends laterad of the line of the dorsocentrals and is frequently divided by a yellow central longitudinal line; sides of scutellum narrowly yellow 4
   Mesonotum orange-yellow, with a large subquadrate black mark on each side of anterior margin along inner edges of the humeri that may emit a paler linear streak behind, and postsuturally with four short black vittae, the central pair falling much short of the hind margin, the pair outside the dorsocentral lines not nearly attaining the suture; scutellum broadly yellow on margin 6
4. The dark colour on the wing ceasing abruptly at apex of the entirely whitish-hyaline costal cell, very dark in stigma and beyond it; fore femur with a series of about 8 strong black bristles on the greater portion of the anteroventral surface, most of them distinctly longer than the diameter of the fore tibia .... *biseriata*, n. sp.
   The dark colour on the wing encroaching more or less distinctly on the apical portion of the costal cell, the latter subhyaline; fore femur with at most some fine setulae on the anteroventral surface, the longest of which are much shorter than the diameter of the fore tibia 5
5. Costal cell of the wing subhyaline, dark brown on edges apically; pleural black vittae broad, the one above occupying about three-fourths of the mesopleural width .... *centralis*, n. sp.
   Costal cell distinctly browned, the dark colour fading out near basal fourth; the pleural dark vittae narrow, the upper one about one-third as wide as the meso-pleura .... *pleuralis* Malloch
6. Discal cell of the wing hyaline from base to beyond middle ...... *semifusca* Malloch
   Discal cell subhyaline at base only .... *partita*, n. sp.
7. Mesonotum with either a broad central black vitta or with two complete black vittae that are narrowly separated by a yellow stripe 8
   Mesonotum with a pair of black marks on anterior margin above the humeri and usually with four short blackish discal vittae 10
8. The dark colour of the wing ceasing abruptly at the apex of the entirely whitish hyaline costal cell .... *biseriata*, n. sp.
   The dark colour on the wing encroaching on the apical portion of the costal cell, the latter subhyaline 9
9. Costal cell dark brown on only the edges apically; black vittae on pleura broad; mid and hind femora and hind tibiae blackened .... *centralis*, n. sp.
   Costal cell browned to near base; pleural vittae narrow; legs entirely yellow .... *pleuralis* Malloch
10. Discal cell of wing hyaline on basal half or more .... *semifusca* Malloch
    Discal cell subhyaline at base only .... *partita*, n. sp.

Clusiosoma semifusca Malloch.

Proc. Linn. Soc. N.S.W., li, 1926, 548.

A shiny fulvous-yellow species, with the centre of frons and the basal two antennal segments dark brown, face pale yellow, occiput with a V-shaped black mark. Frons about 2·5 times as long as wide, the lower supraorbital longest and strongest of the orbitals, upper pair not more than one-third as long, and much shorter and finer than the postvertical and outer vertical pairs. Antennal bases touching; third antennal segment about 2·5 times as long as wide, rounded at apex, extending to about lower fourth of face. Antennae inserted below middle of head in profile; height of face not two-thirds the length of frons; eye higher than long; gena about one-eighth as high as eye; face convex, with a shallow transverse depression at lower fourth. Proboscis stout; palpi spatulate. Longest hairs on aristae above longer than width of third antennal segment.

Mesonotum with a black mark on each side of anterior margin clear of the paler yellow humeri from which there is a trace of a blackish streak obliquely back to the posterior notopleural callus, and four short postsutural blackish vittae, the inner pair from suture or shortly before it to midway to posterior margin, the outer pair just laterad of the dorsocentrals extending from close to these bristles to near the hind-margin; pleura with a slender black vitta from prothoracic spiracle to the pteropleura; disc of scutellum dark brown. Intermediate scutellars about one-fourth as long as the other pairs; dorsocentrals very little behind the supra-alars. Postnotum largely black.

Legs paler than thorax. Fore femora much thicker basally than the other pairs, with a number of strong black bristles on posteroventral and ventral surfaces in two or more series, longest and strongest centrally, the longest exceeding thickness of femora; the anteroventral surface with a series of rather irregular short black setulae, most numerous opposite apex of tibia; fore tibia with a protuberant plate or flange at apex on posterior side that is densely yellowish-white pilose on apical surface and has some fine short black hairs on outer edge; fore tarsus simple. Hind tibia with one or two median anteroventral setulae, and a series of short black anterodorsal setulae centrally.

Wings yellowish-hyaline, distinctly browned on apical portion beyond an irregular line from stigma obliquely across disc basad of inner cross-vein to near outer cross-vein, darkest in stigma and along costa; costal cell entirely hyaline. Inner cross-vein at about two-fifths from apex of discal cell; first vein setulose from apex of node to tip above and at apex below, third vein setulose both above and below on most of its extent, fifth vein setulose above on extent of anal and discal cells, fourth with a few setulae above at middle. Halteres yellow.

Abdomen almost entirely black-brown above, fifth tergite longer than third and fourth combined in male, rounded at apex, with some quite long marginal bristles.

Length, 5–6 mm.

Mt. Molloy, Queensland (F. H. Taylor). Originally described from Cairns, Queensland.

Clusiosoma partita, n. sp.

♂. Very similar to *semifusca*, differing in having the black mark on the anterior margin of the mesonotum not connected with a dark posterior line, the pleural vitta broader in front, the fore femur in the male with only three or four long, and about the same number of short posteroventral bristles and practically no black anteroventral setulae, and the wing browned from base of discal cell to apex, only the costal cell, base of anterior, and all of posterior basal cell, the anal cell, and anal angle of wing, subhyaline. Inner cross-vein near middle of discal cell.

Length, 4·5–5 mm.

Type and one paratype, Vanimo; two paratypes, Wewak, New Guinea (F. H. Taylor).

Clusiosoma biseriata, n. sp.

♂, ♀. Head as in *semifusca*, the male usually with the interfrontalia infuscated except in front, the female with the frons entirely yellow.

Thorax yellow, mesonotum with a broad black central vitta that covers all the area between the dorsocentrals and sends a narrow streak angularly from anterior margin above the humeri to each wing base, centrally sometimes with a yellow streak of the ground colour; scutellum black except on sides; pleura with a narrow black vitta from propleura to centre of pteropleura; sternopleura black on anterior third below; postnotum black. Bristles and hairs black, as in the genotype.

Legs yellow. Fore femur much thickened at base, tapered to apex, with two or three series of strong black bristles on the posteroventral surface, the outer series with three to five bristles that are much longer and stronger than the others, at the base of the series many short erect fine bristles quite closely placed, the anteroventral surface with a series of six to eight rather strong black bristles, the longest distinctly longer than the diameter of the tibia. Fore tibia with the pad-like expansion of the posterior apex as in *semifusca*, the entire ventral surface of the tibia with dense short erect black hairs. Other characters as in *semifusca*.

Wings subhyaline at bases (Pl. xi, fig. 7), the costal cells hyaline, remainder dark brown beyond a diagonal line from below base of the subcostal vein to apex of fifth vein. Armature of veins as in *semifusca*. Halteres pale yellow.

Abdomen glossy-black, yellow in varying extent basally, more extensively yellow on dorsum in female, sheath of ovipositor black. Fifth tergite of male as long as third and fourth combined, broadly rounded at apex and with some quite strong apical and lateral bristles; sixth tergite of female a little shorter than fifth, both with a series of apical and lateral bristles not as strong as in male.

Length, 4–5 mm.

Type, male, allotype, and 14 paratypes, Wewak; Vanimo, 6 paratypes (F. H. Taylor); Minjemfluss (R. Schlechter), New Guinea.

The last listed specimen in poor condition, from the Lichtwardt collection in the Deutsches Entomologisches Institut, Berlin-Dahlem.

Clusiosoma centralis, n. sp.

♂, ♀. Similar to *biseriata*, differing as follows: The mesonotum shows less yellow, the pleural vittae are much broader, the upper one covering almost all the mesopleura and the lower covering almost the upper half of the sternopleura on the entire length; fore femur of male with a larger number of much shorter setulae on the anteroventral surface, instead of moderately long bristles; the costal cell of the wing is narrowly dark brown at apex, and the anterior basal cell is almost entirely hyaline. In the female the mid and hind femora and the basal half or more of the hind tibiae are blackened, not entirely yellow.

Length, 4·5–5·5 mm.

Type, male, allotype, and 8 paratypes, Wewak, New Guinea (F. H. Taylor).

Clusiosoma (Clusiosomina) puncticeps, n. sp.

♂, ♀. This species is an aberrant one and may be considered as entitled to subgeneric segregation from typical *Clusiosoma* on the basis of the structure of the fore tarsus of the male, the closely short-haired anterior basal portion of the fore coxae in both sexes, and the lack of setulae on the fourth vein.

General colour stramineous, shiny, the face with a pair of black spots near the lower margin; interocellar spot black; mesonotum with four dark-brown vittae, the outer pair from above humeri diagonally to bases of wings, the submedian pair on the dorsocentral lines and continued along the sides of the scutellum, with a short forwardly-directed branch on outer side of each on posterior extremity at hind margin of mesonotum; a narrow brown vitta from propleura to centre of pteropleura, and a large brown mark on each side of postnotum. Abdomen broadly dark brown on each side of dorsum. Wing as Plate xi, figure 8, greyish-hyaline, with dark brown clouds on the veins except the inner cross-vein, fourth vein from base to beyond inner cross-vein, and the anal vein.

Head as Figure D, the upper supraorbital bristles longer and the gena behind higher than in *Clusiosoma.*

Thorax as in *Clusiosoma*, the scapulars undeveloped, and the pteropleural lacking but the intermediate pair of scutellars is stronger, usually at least half as long as the basal pair.

Legs entirely pale yellow. Fore femur in male thicker than other pairs, but thickest at middle instead of at bases, the bristles on the basal fourth in several series and very short, beyond that in a single series of moderate length, the anteroventral surface without bristles; in female the femur has five or more moderately strong posteroventral bristles on apical two-thirds. Fore coxae in both sexes with quite dense short black hairs on basal half in front, at apex in male with a fringe of short black hairs, and in female with two short bristles. Fore tibia of male rather thick, with a shallow groove on the entire anterodorsal surface, about six fine erect bristles on the basal half of the anterior surface, and some microscopic erect dark hairs on central part of the ventral surface.

Wing venation as in *Clusiosoma*, and the same single short black costal bristle at apex of the subcostal vein.

Abdomen as in *Clusiosoma*; sixth tergite of female much shorter than fifth.

Length, 4 mm.

Type, male, allotype, and two paratypes, New South Wales: Gosford, in wild fig, 1909.

Clusiosoma pleuralis Malloch.

Ann. Mag. Nat. Hist., (11) iv, 1939 (1st August).

This species was described from the Solomon Islands and is not amongst those collected in New Guinea, though it may yet be found there.

Type series in the British Museum, Imperial Institute of Entomology.

Trypanocentra Hendel.

Wien. Ent. Zeitg., xxxiii, 1914, 77; *Ann. Mus. Nat. Hung.*, xiii, 1915, 433.

I have experienced some difficulty in arriving at a decision on the identity of this genus, but believe that two species now in hand belong here and accept them as congeneric with Hendel's genotype.

In the generic description Hendel merely separated *Trypanocentra* from *Themarohystrix* on the basis of a few characters such as the narrower frons, with a central hair on each orbit below which there are two forwardly and inwardly directed pairs of infraorbital bristles and above it two strong pairs of reclinate supraorbitals. He also stated that the pteropleural bristle is absent, which is the case in both the species in hand, but there are, as in the other genus, five so-called supra-alar bristles instead of only three as called for in Hendel's description. One might assume that the scutellum should be covered with stiff hairs, as Hendel says that apart from the characters he lists the two genera are similar, but in neither species I have are there any discal hairs on the scutellum. His further statement that the second and fourth wing-veins are bare does not hold in one of the species that I have, and the one that agrees best with the genotype, there being closely-placed setulae on the entire underside of the second vein and one or two on the central part of the upperside of the fourth vein.

It is possible that Hendel had a different species from either of mine and I present below a key that will aid in distinguishing them.

Key to the Species.

1. Thorax glossy orange-yellow, mesonotum with six black vittae, the central and lateral pairs entire, the sublateral pair postsutural, lateral vittae above and clear of the humeral calli, the pleura with two broad black vittae that are incomplete behind; scutellum black, yellow below level of the bristles; prelabrum yellow; second wing-vein bare below; first vein ending in the costa distinctly beyond level of inner cross-vein .... *vittithorax*, n. sp.
   Thorax glossy-black, with the humeri and a line along the upper edge of the pleura bright yellow, the underside of the scutellum duller yellow; prelabrum black or dark brown; first vein ending in the costa almost directly above the inner cross-vein 2
2. Third antennal segment infuscated at apex; abdomen black .... *nigripennis* Hendel
   Antennae entirely pale orange-yellow; sides of the abdomen on basal third distinctly yellow .... *nigrithorax*, n. sp.

TRYPANOCENTRA NIGRIPENNIS Hendel.

Ann. Mus. Nat. Hung., xiii, 1915, 434.

As already stated herein, Hendel says that the second and fourth wing-veins are bare, though he may have omitted taking note of the underside of the second vein, but he did note that there are no setulae on the upperside of the fourth vein. The yellow lateral marginal stripe on the thorax is mentioned, but there is no mention of yellow colour on the sides of the basal third of the abdomen.

Length with ovipositor, more than 5 mm.

One female from the Indian Archipelago.

TRYPANOCENTRA NIGRITHORAX, n. sp.

♀. A glossy-black species, with the head orange-yellow, the antennae entirely yellow, the prelabrum brownish-black, and the upper half of occiput glossy-black; palpi yellow. Legs yellow, mid and hind coxae, the greater part of all femora black, fore coxae and basal two-thirds of mid and hind tibiae except extreme bases dark brown. Halteres yellow. Wings blackish-brown, fading into paler brown on anal angle and in the costal cell.

Frons at middle about half as wide as one eye and about 2·5 times as long as wide, widened in front, darkened above, upper orbits glossy-black, vertex laterally black, centrally yellow, slightly raised. Central orbital setulose hair quite long, infraorbitals not as long or as strong as the anterior supraorbital, the latter about twice as long as the upper one which is subequal to the outer vertical and post-vertical bristles, the inner vertical the longest and strongest of the frontals; ocellars microscopic, proclinate and divergent. Face evenly convex, without transverse depression, epistome almost transverse; foveae glossy, moderately deep, extending to lower third of face; antennae descending to ends of foveae, third segment about 2·5 times as long as wide at base, tapered slightly to the rounded apex; longest hairs on the arista about twice as long as width of third antennal segment. Eye higher than long; genal bristle moderately strong. Proboscis short and stout; palpi club-shaped. Postocular cilia black, bristle-like, much shorter than in *Themarohystrix*.

Thorax with mesonotum convex in front, slightly flattened behind, the surface with numerous short decumbent coarse black hairs; scutellum subtriangular, flattened and bare on disc, like the mesonotum slightly hoary in certain lights. Intermediate scutellars not as strong as the other pairs.

Legs quite stout, fore femur with some strong posteroventral bristles, the other pairs with no ventral bristles; fore tarsus as long as its tibia; outer apical spur on mid tibia about half as long as the central one, a few black setulae about middle of the posterodorsal surface; hind tibia with one anteroventral bristle and a series of anterodorsal setulae to beyond the middle.

Wings brownish-black, paler in costal cell and on the part basad of the inner cross-vein including the entire third posterior and axillary cells. Inner cross-vein at middle of the discal cell, third and fourth veins divergent at apices, second vein closely setulose on entire extent below, fourth with one or two setulae at middle on upperside and with short closely-placed setulae on about the central third below. Squamae and halteres yellow.

Abdomen glossy-black, sides of composite and second tergites yellowish.

Length, including ovipositor, 6 mm.

Type, Wewak, New Guinea (F. H. Taylor).

TRYPANOCENTRA VITTITHORAX, n. sp.

♀. Differs from the species described above in having the head except a small black spot on ocelli entirely yellow. Thorax orange-yellow, glossy, the mesonotum with six black vittae, the central and lateral marginal pairs entire, the submedian pair extending from the suture to posterior margin; pleura with the two rather broad black vittae that do not extend completely to hind margin; scutellum black, yellow below the level of the marginal bristles. Abdomen glossy-black. Legs entirely yellow. Wings more uniformly black than in the other two species.

Structurally similar to *nigrithorax*, differing in having the frons a little wider, the fore tibia shorter than its tarsus, the anterodorsal setulae on the hind tibiae longer than in the other species and the same tibia with two anteroventral bristles instead of only one, the first wing-vein longer, ending quite distinctly beyond the level of the inner cross-vein which latter is a little beyond the middle of the discal cell, and no setulae on either the second or fourth wing-veins.

Length, 6·5 mm.

Type, Papua, Mondo, 5,000 feet, February 1934 (L. E. Cheesman). In British Museum.

Despite the difference in the armature of the wing-veins, I place the three species in the same genus because of their similarity in other structural features.

TRYPANOCENTRA NIGRIPENNIS de Meijere.

Nov. Guin., ix, Zool., livr. iii, 1913, 366. (*Acanthoneura*).

If de Meijere is correct in stating that the presutural bristle is lacking, this species does not belong here, but I suspect that he erred. Should I be correct in placing the species in *Trypanocentra*, then Hendel's species will require to be renamed. There can be no doubt as to the close relationship of this species to those already placed in this genus. The description calls for a species with similar characters to *nigrithorax*, the antennae being entirely yellow and the abdomen brownish-yellow, but the legs are entirely yellow and the upper and under portions of the mesopleura are yellow, in both of which characters it deviates from *nigrithorax*.

Length, 6 mm.

Dutch New Guinea: Alkmaar.

Should my action be correct in the above placement, I propose the new name *atripennis* for *nigripennis* Hendel.

Sophira Walker.

Jour. Proc. Linn. Soc. Lond., i, 1857, 34.

Sophira flava (Edwards).

Trans. Zool. Soc. Lond., xx, part 13, 1915, 421 (*Rioxa*).

♀. Entirely fulvous-yellow, rather shiny, species, with the exception of a small round deep-black spot on each side anteriorly of the fifth abdominal tergite; all hairs and bristles concolorous with body; wings hyaline, stigma yellow, the apical half fuscous, a narrow dark-brown border on the costa from slightly before apex of second to just beyond apex of fourth vein, a more diffuse brown streak along the fifth vein from near base of discal cell to its apex, and a small pale-brown spot near the middle of inner cross-vein.

Frons a little more than one-third of the head-width and a little longer than wide, each orbit with two anterior incurved and two posterior reclinate bristles, the lower one of the latter the longest; outer pair of verticals much shorter than the inner, postvertical pair about as long as the former, parallel, ocellars lacking. Eye slightly oblique, a little higher than long; gena not more than one-twelfth as high as eye; face concave below middle, epistome slightly protruded, tumid on sides, height of face less than length of frons. Third antennal segment not more than twice as long as wide, rounded at apex; longest hairs on aristae fully as long as width of third antennal segment; palpi wider than third antennal segment. Postocular cilia yellow and slender.

Thorax with the mesonotum longer than wide, slightly flattened, surface with many depressed short hairs and the following bristles: 1 humeral, 2 notopleurals, 1 presutural, 1 supra-alar, 2 postalars, 1 pair of prescutellar acrostichals and 1 much longer pair of dorsocentrals between these and the supra-alar; mesopleura with 1 bristle, the pteropleura with one setula above longer than the surrounding hairs; scutellum subtriangular, disc flattened and bare, the margin with six bristles, the intermediate pair the shortest.

Legs normal in structure, fore femur with an irregular posteroventral series of bristles; mid tibia with a long apical ventral spur; hind femur with one or two fine ventral bristles on basal half.

Wing as Figure E, stigma longer than the preceding costal section, first vein ending almost directly above outer cross-vein, third costal section about half as long as stigma and slightly shorter than fourth, the second vein slightly curved forward apically, inner cross-vein at about one-third from base of discal cell; first posterior cell slightly widened apically.

Abdomen widest at basal third, sixth tergite short, genital organ slender.

Length, 7 mm.

Originally described from one female taken at Utakwa River, Dutch New Guinea. Four females, Papua: Kokoda, 1,200 feet, Sept.–Oct., 1933 (L. E. Cheesman).

This species is readily distinguished from any yet described by the markings of the wings, there being usually in the other species more than the fifth vein dark bordered, and none having the costal markings as here. There is also no species that is described as having a pair of deep-black abdominal spots as here.

It appears worthy of note that the undescribed male of *Sophira limbata* Enderlein has a prominent conical protuberance on each gena that is armed with numerous curled black bristles at the apex. There is also a colour distinction in the legs, the tibiae being dark brown in the female and yellow in the male. There is some difference also in the bristling of the legs. The inner cross-vein is well beyond the middle of the discal cell of the wing, which is not the case in the species redescribed above. I have both sexes of *limbata* from Borneo, sent to me a number of years ago by the late C. F. Baker. Enderlein described the species from Sumatra. One other species he described from Sumatra, *appendiculata*, agrees with *flava* in having the stigma dark, and a dark cloud along the fifth vein, but it has no dark-brown apical costal margin, and has a rather large dark cloud on the fourth vein from a little before the inner cross-vein to, or beyond, the outer cross-vein that extends into the discal cell and the first posterior cell. Both these species have black thoracic markings.

Sophira quadripunctata Malloch.

Ann. Mag. Nat. Hist., (11) iv, 1939 (1st August).

This species differs from *flava* in having the stigma entirely yellow, the inner cross-vein at about one-third from the apex of the discal cell, and a pair of elongate black marks on the fifth and another on the sixth abdominal tergite.

Solomon Islands.

Acanthoneura Macquart.

Dipt. Exot., iii, Pt. 3, 1843, 220; Enderlein, *Zool. Jahrb. Abtl. Syst. Geog. und Biologie*, xxxi, 1911, 414; Hendel, *Wien. Ent. Zeitg.*, xxxiii, 1914, 82; *Flieg. Pal. Reg.* in Lindner, xlix, Trypet., 1927, 16; *Ent. Mitt.*, xvii, 1928, 354.

Hendel in 1914 placed this genus in his key in a section that has the arista short haired, and distinguished the concept by the bare fifth vein, fringed costa, undulated second vein, and the broad head of the male. Some of these characters apply to only the genotype, *fuscipennis* Macquart. Endlerlein in 1911 placed along with *fuscipennis*, in *Acanthoneura*, the genera *Themara* Walker, and *Ptiolina* van der Wulp, but I consider his action unjustified and accept both concepts as valid genera, distinguished from *Acanthoneura* as shown in the foregoing key to the genera. Hendel in 1927 changed his opinions somewhat and accepted as Acanthoneurae two species in which the arista is moderately long-haired. He then introduced as a distinguishing character the single pair of infraorbital bristles. Later, in 1928, the same author further discussed the genus and some closely related thereto and presented a short generic key. In the same paper, pages 359 and 360, he described two Australian species.

I am accepting as a member of the genus a species from Australia that differs from the two described by Hendel as shown in the key presented below.

Key to the Australian Species.

1. Thorax yellowish-brown, mesonotum without black markings; scutellum yellow in the middle, blackish-brown on the sides; abdomen entirely black; wing as Plate xi, figure 9 .... *nigriventris*, n. sp.

Thorax yellow, mesonotum with black lateral marginal streak and black spot on hind margin; abdomen black, with central subquadrate or triangular mark on each tergite 2

2. Wing with two hyaline incisions on costa beyond apex of first vein; inner cross-vein near middle of the discal cell .... *australina* Hendel

Wing with but one hyaline mark or incision on costa beyond apex of first vein; inner cross-vein much beyond middle of the discal cell .... *acidiomorpha* Hendel

Acanthoneura australina Hendel.

Ent. Mitt., xvii, 1928, 359.

Thorax yellow, with a black lateral stripe and a large posterior black spot on mesonotum. Wings dark coffee-brown, with the following hyaline marks: tip of first and a large part of middle of second costal cell, almost the basal half of subcostal cell, a spot in front of the inner cross-vein almost as wide as the cell and one a little larger beyond the inner cross-vein in the first posterior cell about one-third the width of the cell and twice as far from the cross-vein as the one in front of the latter, a keel-like marginal incision in the second posterior cell that covers three-fourths of the margin, in the discal cell a large round isolated spot in front of the outer cross-vein, and obliquely behind it and more basally a small hyaline spot, larger than both together is a not entirely hyaline spot near the wing-margin, and the third posterior cell has in front of the fold a quadrate white mark that margins on the discal cell. Especially characteristic of the species are the two white costal incisions in the marginal cell, the first, before the tip, of which cuts into the submarginal cell. Inner cross-vein at middle of the discal cell. Second vein weakly undulated.

Cairns, N. Queensland. Type in Berlin-Dahlem.

Acanthoneura acidiomorpha Hendel.

Op. cit., xvii, 1928, 360.

The inner cross-vein is separated by about half the length of the outer from latter, the third costal section is not longer than the first. Wing markings as Figure F, the sketch being from the type-specimen in the United States National Museum.

New South Wales.

Acanthoneura nigriventris, n. sp.

♀. Head a little wider than thorax, dull brownish-yellow, face paler, with pale-grey dust, the interocellar spot black; hairs and bristles black. Frons a little longer than wide, slightly narrowed to vertex, and fully one-third of the head-width, the surface with some short erect hairs except on upper third, the single pair of incurved infraorbitals rather short, near anterior margin, the anterior pair of supraorbitals well above middle of frons and nearly twice as large as the upper pair, the latter subequal to the postverticals and about half as long as the outer verticals, the inner verticals the longest of the cephalic bristles. Face convex in centre, the foveae quite deep; gena higher than width of third antennal segment, the latter fully twice as long as wide, tapered to the narrowly rounded apex; longest hairs on arista about one-third as long as width of third antennal segment; palpi spatulate.

Thorax concolorous with head, darker on sides of mesonotum and centre of the mesopleura, quite dull, only the scutellum distinctly shiny, the latter with the sides blackened, postnotum blackened; all hairs and bristles black, the mesonotal hairs very short, quite dense and depressed. Scapular bristles fine, presutural bristle lacking, all other bristles strong, the dorsocentral pair nearer to the acrostichals than to the supra-alar line; scutellum distinctly convex, rounded in outline, with the discal hairs longer and finer than those on the mesonotum, the intermediate pair of bristles almost as long as the other pairs. Metasternum haired.

Legs normal, entirely brownish-yellow. Fore femur with a series of black posteroventral bristles; mid tibia with some central posterior setulae and one strong black apical ventral spur; hind tibia with the anterodorsal series of setulae short.

Wing dark brown, the pale markings whitish-hyaline (Pl. xi, fig. 9). First vein with the setulae extending from node to tip above, bare below; third vein setulose from base to a little beyond inner cross-vein both above and below; fifth vein bare; lobe of anal cell quite long and narrow; inner cross-vein less than one-third from apex of discal cell.

Abdomen broadly ovate, the dorsum brownish-black, slightly shiny, the sides of the composite basal tergite brownish-yellow, all hairs and bristles black. Sixth tergite a little shorter than fifth, with a less regular series of moderately long apical bristles than fifth. Sheath of the ovipositor flattened, conical, black.

Length, 7·5 mm.

Type, New South Wales: Wattle Flat (W. W. Froggatt).

NEOTHEMARA Malloch.

Ann. Mag. Nat. Hist., (11) iv, 1939, 253.

Generic characters.—Similar to *Themara* in most wing characters, but the second vein is not as markedly undulated, and the head in the male is not noticeably widened. The possession of setulae on the upper and under sides of the stem of the second and third veins is distinctive for both genera. In *Neothemara* there are at least two pairs of strong infraorbital bristles, while in *Themara* there is but one pair; in the latter the lower supraorbital pair of bristles is in front of the middle while in *Neothemara* it is at or above the middle. The mesopleural hairs are much stronger in *Neothemara* than in *Themara* and related genera, though there is no one outstanding bristle near the lower central portion such as characterizes *Hexacinia*. The presence of setulae on the fifth wing-vein in *exul* is not sufficient ground for its separation generically from the other two included in this genus.

Key to the Species.

1. Fifth vein setulose along most of the extent of the anal cell above; wings dark brown, with yellow markings, the most conspicuous being a V-shaped mark that has its apex on the third vein beyond the level of the outer cross-vein, its upper arm lying along the third vein to base, and its lower arm running obliquely through the discal cell beyond its middle, terminating over the apex of the anal vein (Solomon Islands) .... *exul* (Curran)
   Fifth wing-vein bare above; wing markings not as above 2
2. Scutellum without evident discal hairs; wing dark brown, with subhyaline markings, the most conspicuous being an irregular streak that stretches from apex of anal vein forward through the apical portion of the discal cell to middle of the outer cross-vein and is divided in second posterior cell (Solomon Islands) .... *formosa* Malloch
   Scutellum with many short stiff blackish discal hairs; wing dark chocolate-brown, with about 10 small yellowish-hyaline marks and the base pale (Pl. xi, fig. 10) .... *formosipennis* (Walker)

NEOTHEMARA FORMOSIPENNIS (Walker).

Jour. Proc. Linn. Soc. Lond., v, 1861, 252 (*Rioxa*).

This is the only species of the genus as yet known to me from New Guinea. The wing markings are quite different from those of the other two species (Pl. xi, fig. 10).

Wewak, New Guinea (F. H. Taylor).

PSEUDACANTHONEURA, n. gen.

Generic characters.—This genus has many of the characters of *Neothemara*, but differs from it in having the petiole of the second and third wing-veins bare, and the ocellar bristles long and strong. Frons at vertex not one-third of the head-width, the two pairs of infraorbitals rather closely placed, incurved and slightly forwardly directed, anterior reclinate supraorbitals at or a little in front of middle of frons, much stronger than the other orbitals, posterior supraorbitals reclinate; postocular cilia black, bristle-like. Eyes oval, erect, much higher than long; antennae inserted above middle of eye in profile; third antennal segment not twice as long as wide, rounded at apex, not extending to middle of face; the latter vertical, with the foveae deep, extending to a little below middle; gena about one-sixth as high as eye; arista with the longest hairs longer than width of the third antennal segment. Thoracic bristling complete; mesopleurals 2; scutellum with six strong marginal bristles and a few microscopic hairs on lateral edges. Fore femur with a series of strong posteroventral bristles; mid tibia with two or three strong black posterior bristles and two strong black apical spurs, one longer than the other; hind tibia with two anteroventral bristles and a series of strong antero-dorsal setulae. First wing-vein setulose from apex of node to tip above (Fig. G1); second vein undulated; third vein setulose above and below from base to well beyond the inner cross-vein, undulated apically; fifth vein setulose above on apical part of posterior basal cell; the cross-vein closing anal cell rectangularly bent, the short lobe of the cell subtriangular.

Genotype, *Pseudacanthoneura septemnotata*, n. sp.

PSEUDACANTHONEURA SEPTEMNOTATA, n. sp.

♂. A large bright orange-yellow-coloured species, but slightly shiny, with four small deep-black spots on each side of the mesonotum and three on each pleuron, the abdomen more or less browned on bases of the tergites, and the wings yellowish-brown, with some small yellowish-hyaline marks in the cells and some large hyaline marks along the hind margin (Pl. xi, fig. 11).

Head higher than long, uniformly orange-yellow except the small interocellar spot which is black; bristles black, the hairs yellow. Frons about twice as long as its width at vertex; ocellar bristles close together at bases and behind the anterior ocellus. Palpi short and broad.

Thorax rather dull, the mesonotum with quite dense depressed short hairs that are yellow except on the lateral margins, the mesopleural hairs strong and, like all the bristles, black. The four small deep-black spots on the lateral margins of the mesonotum are arranged as follows: above the humerus, above the presutural bristle, behind the posterior notopleural bristle, and on the extreme anterior extremity of the postalar declivity; pleural spots as follows: above the anterior spiracle, near the upper posterior angle of the mesopleura, and on centre of the pteropleura; postnotum with a black streak on each side. The few hairs on the lateral portions of the scutellum are black.

Legs entirely yellow and yellow-haired, bristles dark brown. Fore tarsus slender, longer than fore tibia, basal segment as long as the other segments combined.

Wing as Plate xi, figure 11, the veins brown. Inner cross-vein at about one-third from apex of the discal cell. Only one strong bristle at apex of the subcostal vein. Halteres yellow.

Abdomen broadly ovate, with quite strong bristles at apices and on lateral margins of tergites. Hypopygium yellow.

Length, 8 mm.

Type, Vanimo, New Guinea (F. H. Taylor). Paratype, Gordonvale, North Queensland (E. Jarvis).

Acanthoneura insignis de Meijere, from New Guinea, is very like this species in many respects, but has the mesonotum black vittate. It may belong to this genus.

Rioxa Walker.

Jour. Proc. Linn. Soc. Lond., i, 1857, 35.

Hendel in 1928 (*Ent. Mitt.*, xvii, 5, p. 350) dealt with the characters of this genus and *Rioxoptilona* Hendel, maintaining, contrary to Bezzi's expressed opinion, that the two are valid genera. His position in the discussion is that the difference in the comparative lengths and widths of the mesonotum, and the shape of the scutellum in the two genotypes justifies his action in making the separation. I have not either genotype before me, but Hendel's course is adopted in this paper.

Rioxoptilona does not occur in New Guinea and Australia, and typical *Rioxa* also is lacking there. The species usually placed in *Rioxa* from Australia have been put by Hendel in two subgenera, *Termitorioxa* Hendel and *Dirioxa* Hendel. I accept the first as a valid genus and, though I still retain *Rioxa* for *pornia* and two other species dealt with below, I incline to the opinion that *Dirioxa* may yet be accorded full generic status.

There are apparently three species of the genus in Australia as noted below. I do not consider *Rioxa araucariae* Tryon or *R. jarvisi* Tryon as referable here.

Rioxa (Dirioxa) pornia (Walker).

List Dipt. Ins. Brit. Mus., iv, 1849, 1039 (*Trypeta*).—*Trypeta musae* Froggatt, *Agric. Gaz. N.S.W.*, x, 1899, 501; *Repr. Misc. Public. Dept. Agric. N.S.W.*, No. 303, 1899; *Rep. Par. and Inj. Ins.* (1907-8), pt. 3, 1909, 113.—*Rioxa musae* Tryon, *Proc. Roy. Soc. Qsld.*, xxxviii, 1927, 216; Wright, *Agric. Gaz. N.S.W.*, xlviii, 1937, 28.

There has been considerable difference of opinion both as to the correct name for this species and as to its distribution. Hendel erred in stating that the "dornten Schenkel" was part of the original description and that on this account it could not be a Trypetid. Walker referred to the apical ventral spines on the "shanks" or tibiae and not to thorns on the femora. Without a doubt the description applies to what has been most commonly called *musae*, although Walker's description of the wing markings is rather involved.

The species has the round hyaline spot over the outer cross-vein of the wing almost the width of the first posterior cell, but always separated from the wedge-shaped hyaline mark in the second posterior cell by a brown line along the fourth vein, and the hyaline mark in the apex of the discal cell is carried over the fifth vein to the wing-margin. The third wing-vein is bristled above and below to over the outer cross-vein.

Queensland and New South Wales. Type locality of *pornia*, Port Stephens, N.S.W.

Rioxa (Dirioxa) testacea Hendel.

Ent. Mitt., xvii, 1928, 352.

This species has the hyaline spot in the first posterior cell near the outer cross-vein smaller than in *pornia* and connected with the large wedge-shaped hyaline mark in the second posterior cell, and the hyaline mark in the apex of the discal cell not extending entirely across the cell so that the apex of the third posterior cell is dark brown.

North Queensland. Type in Deutsches Entomologisches Institut, Berlin-Dahlem.

RIOXA (DIRIOXA) BICOLOR (Macquart).

Dipt. Exot., Suppl. v, 1855, 124, Pl. 7, fig. 7 (*Urophora*); Hendel, *Ent. Mitt.*, 1928, 353.

The figure of the wing of this species shows the triangular hyaline mark in the second posterior cell separated from the hyaline spot in the first posterior cell, the latter smaller than in *pornia*, the third posterior cell brown, with a narrow stripe-like hyaline mark near the apex of the discal cell carried to the wing-margin over the fifth vein, and a small hyaline dot near basal third of the third posterior cell.

It may be noted that many of Macquart's figures are rather inaccurate in detail and that he may really have figured *pornia*, but if his type is still in existence, or specimens agreeing with his figure are found, the matter will be settled.

The given type-locality, Tasmania, is undoubtedly erroneous as usual.

TERMITORIOXA Hendel.

Ent. Mitt., xvii, 1928, 351.

This concept was proposed as a subgenus, but I accept it as a genus. The distinguishing characters lie in the presence of but one pair of reclinate supra-orbital bristles and either one or two pairs of much weaker incurved infraorbitals, two, instead of but one, strong apical ventral spurs on the mid tibia and the more widely separated and less extensive setulae on the third wing-vein. These characters may not all be the same in other species than *pornia*, as I have not seen the other two referred to *Rioxa*. In *pornia* the scutellum has no short discal hairs, while in the present genus there are a number of short black hairs on each side above the level of the bristles.

TERMITORIOXA TERMITOXENA (Bezzi).

Bull. Ent. Res., x, 1919, 2 (*Rioxa*).

I have seen two female examples from the original type series from Darwin, N.T., and one male labelled Palmerston, N. Australia, xi, 1908, from the Oldenberg collection in the Deutsches Entomologisches Institut, Berlin-Dahlem.

The type material is slightly teneral and has very evident pale streaks in the centre of some of the cells that are not present in the matured male before me, and the base of the wing is also hyaline and not yellowish as in the latter. There are no black spots on the hind margin of the mesonotum as described by Bezzi, but only two rather indistinct brown marks and in line with these, on each lateral angle of the scutellum, two small subtriangular brownish marks. In *pornia* the hind tibia has an extensive anterodorsal and a shorter anteroventral series of short setulae, while in *termitoxena* there is only the anterodorsal series present.

RIOXOPTILONA Hendel.

Wien. Ent. Zeitg., xxxiii, 1914, 78.

I am accepting as belonging to this genus an East Indian species that has the setulae on the upperside of the first vein extending the entire length of the node. The general appearance is similar to that of *Acanthoneura*, the wings being similarly marked. The intermediate pair of scutellars are short, and there are no discal hairs. In both sexes there are some long anteroventral bristles on the hind femur, and in the male the fore femur has several series of closely-placed ventral bristles and the fore tibia is densely short stiff haired on the entire ventral surface.

Not known to occur in New Guinea.

DIARRHEGMOIDES, n. gen.

Generic characters.—Frons longer than wide, inner verticals much longer than the other cephalic bristles, outer pair very short, not longer than the parallel postverticals, ocellars minute, two fine reclinate supraorbitals, the upper a little the shorter, and two incurved infraorbitals, the lower the shorter. Eyes about 1·5 times as high as long, gena very narrow. Antennae pendulous, third segment about twice as long as wide, broadly rounded at apex, downy; arista with hairs above, about 6 of them long. Thorax convex on dorsum, mesonotum a little longer than wide, with the following bristles: 1 humeral, 2 notopleurals, 1 presutural, 1 supra-alar, 2 postalars, 1 pair of long dorsocentrals slightly proximad of the supra-alar line, 1 pair of prescutellar acrostichals; the mesopleural, sternopleural, and pteropleural bristles present; scutellum with 6 bristles, basal pair much the longest, intermediate pair not half as long as the apical. Second wing-vein very slightly bent at the hyaline mark, third much arched beyond the inner cross-vein; first and third setulose to almost their apices, third with a few setulae at base below. Legs normal, mid tibia with an apical ventral bristle.

Genotype, *Diarrhegmoides hastata*, n. sp.

DIARRHEGMOIDES HASTATA, n. sp.

♂, ♀. Head dull yellowish-white, frons except the orbits yellowish-brown to fuscous, ocellar spot black, genae and sides of the prelabrum dark brown, occiput except narrowly on edges shiny-black; palpi and basal two segments of antennae and base of third segment yellow, remainder of third segment brownish-black. Frons at vertex fully one-third of the head-width, slightly widened to anterior margin, and nearly twice as long as wide at vertex, the orbits not sharply defined. Eye higher than long, more narrowed below than above, anterior facets enlarged; frons slightly protruded in front; face receding a little below, the foveae shallow; gena about half as high as width of third antennal segment, the bristle far back and short and fine. Antennae inserted at middle of eye in profile, third segment less than twice as long as wide, broadly rounded at apex, downy; arista sparsely haired, the longest upper hairs fully half as long as width of third antennal segment.

Thorax shiny-black, with pale-grey dust, mesonotum with a faint brownish central vitta on which the dust is quite distinct and somewhat silvery, humeri white, and a white vitta from each extending back clear of the lateral margins to the posterior postalar bristle; a broad white vitta on pleura from base of fore coxae to bases of wings below the mesopleural bristle; scutellum yellowish-white, base broadly brown. All hairs and bristles black. All thoracic bristles except the intermediate scutellar pair long, the posterior notopleural shorter than the anterior one.

Legs yellow, mid and hind femora of female slightly browned.

Wing as Plate xi, figure 12, the general colour brownish-black, the markings whitish-hyaline, the veins dark brown. A single quite long costal bristle at apex of the subcostal vein, setulae on first vein from apex of node. Halteres pale yellow.

Abdomen entirely glossy-black, with black hairs and bristles, elongate-oval, the bristles at apices of tergites fine, fifth tergite of male more densely and shorter haired than the other tergites, slightly tapered at apex, longer than fourth; sixth tergite of female distinctly shorter than fifth; sheath of ovipositor elongate-conical, flattened.

Length, 3·5–4 mm.

Type, male, allotype, and one male paratype, Edie Creek, New Guinea, February 1935 (F. H. Taylor).

DIARRHEGMOIDES ARAUCARIAE (Tryon).

Proc. Roy. Soc. Qsld., xxxviii, 1927, 219 (*Rioxa*).

This species is apparently referable to this genus. It is very similar to the genotype, but differs in the wing markings, in having a black mark extending in centre to apex of the scutellum, and in having the abdomen shiny-black with a white fascia on the apex of each tergite from second to fourth inclusive. The legs are also largely infuscated. The length is much greater, 7–7·5 mm.

South Queensland.

The species is known to me only from the description.

HEXACINIA Hendel.

Wien. Ent. Zeitg., xxxiii, 1914, 82.

This genus was erected for the reception of *Acinia stellata* Macquart, but this name was preoccupied and Rondani's specific name for the same species must be used.

The genus is readily recognized by the strong bristle near the middle of the lower edge of the mesopleura, and the presence of several fine upcurved bristles on the lower margin of the gena in front of the usual genal bristle.

There are three accepted species of the genus, all occurring in southern Asia or the East Indies. A fourth species is described below.

Key to the Species.

1. Mesonotum with 6 dark-brown vittae; wing with no hyaline mark at apex of the first posterior cell, and with four hyaline dots in the second posterior cell, two of them in the disc (Formosa) .... *palposa* Hendel
   Mesonotum not vittate, sometimes with dark dots laterally; a hyaline or subhyaline mark at the apex of first posterior cell; two spots in second posterior cell, both in the margin 2
2. The hyaline spot at apex of first posterior cell not extending entirely across the cell, subquadrate (East Indies) .... *radiosa* Rondani (*stellata* Macquart)
   The hyaline or subhyaline mark at apex of the first posterior cell extending across the entire apex, not subquadrate, usually lunate in shape 3
3. Only two hyaline marks between the apex of first and second veins, the basal one touching the tip of first vein; apical pale mark in first posterior cell conspicuous; pleura unspotted or with only one or two faint brownish dots (Philippine Islands) .... *stigmatoptera* Hendel
   Three hyaline marks between the apices of first and second veins on the costa, the basal one on tip of first vein; apical pale mark in first posterior cell indistinct, brownish-hyaline; pleura with 10-12 black-brown dots .... *multipunctata*, n. sp.

N.B.—I have examined two of the already known species in the collection of the United States National Museum.

HEXACINIA MULTIPUNCTATA, n. sp.

♂, ♀. Similar to the other species in having the head, thorax, and abdomen pale orange-yellow, and the wings dark brown, with numerous hyaline dots or short streaks across some of the cells, the hairs on the pale marks glistening white, on other parts of the wing dark brown.

Face with a small dark mark on each side of epistome, prelabrum with a similar mark on each side, dots at bases of the bristles very inconspicuous, ocellar spot dark, occiput with a black mark on each side above neck. Frontal bristling as in the genotype, yellowish-brown in colour, infraorbitals close together, the lower one incurved, upper one longer than lower, incurved and slightly reclinate, supraorbitals reclinate, the upper not half as long as the lower; ocellars minute; outer verticals brown, about half as long as inner and equal to the postverticals; postocular cilia dark brown, pointed; frons about 1·25 times as long as its vertical width, narrowed in front, with some short dark hairs centrally. Face convex centrally, concave in profile, foveae shallow. Eye much higher than long, gena about as high as width of third antennal segment. Longest hairs on arista about as long as width of third antennal segment, the latter about 2·5 times as long as wide, rounded at apex; palpi spatulate, not segmented.

Mesonotum with the insertions of bristles black, and a number of black-brown dots as follows: above each humerus, behind each notopleural bristle, the supra-alar, and base of wing, mesad of the presutural bristle, between the supra-alar and dorsocentral, and between the postalar and acrostichals; pleura with 6 black dots in a line between the anterior and posterior spiracles, evidently rudiments of a black vitta, and about 6 black dots on lower half; scutellum with a black dot at base of each bristle, smallest at the intermediate pair; postscutellum with a blackish spot on each side. Dorsocentral bristles slightly behind the supra-alars. All the usual bristles present in addition to the lower central one on the mesopleura, the mesopleura with two posterior bristles.

Legs entirely yellow except a small black spot beyond middle of ventral surface of mid and hind femora. Fore femur with a series of strong posteroventral bristles; the other femora without ventral bristles; mid tibia with a strong apical ventral spur, and the posterodorsal series of setulae shorter than that on anterodorsal surface of the hind tibia, the anteroventral bristles on hind tibia longer than the setulae; tarsi normal.

Wing dark brown, the pale markings subhyaline (Pl. xi, fig. 13). First vein setulose on entire extent from apex of node to tip above, bare below, third vein setulose on most of its extent above and on basal half below; fifth vein bare. Halteres yellow.

Abdomen with the usual quadriseriate brownish-black spots on dorsum, genital cone in female yellow, all hairs and bristles black, the apical bristles on tergites quite strong.

Length, 6–7 mm.

Type, male, allotype, and 4 paratypes, Wewak, New Guinea; one paratype, Rabaul, New Britain (F. H. Taylor).

ENICOPTERINA Malloch.

Proc. R. Ent. Soc. London, 1939 (in press).

I recently described this monobasic genus from Fiji. It may yet be found in New Guinea.

GROUP II.

This Group is merely an arbitrary one and contains but one genus, with apparently three species, two of them known to me.

Possibly more species may yet be found in this region and, should such be the case, the data presented below will enable students to determine them.

Xarnuta Walker.

Jour. Proc. Linn. Soc. Lond., i, 1857, 28.

This genus is readily distinguished from its allies by the flattened and coarsely-haired scutellum which has 8 or more marginal bristles. The hairs on the aristae are about one-third as long as the width of the third antennal segment, though Walker's figure shows them comparatively longer. The presence of short black setulae on the upper surface of the first vein of the wing to near its base is an exceptional character in this section of the family. The presutural and dorsocentral bristles are present, the latter far behind the transverse line of the supra-alars, and the pteropleural, sternopleural, and two upper mesopleural bristles are all strong. First and third veins setulose, fifth vein bare.

Genotype, *Xarnuta leucoteles* Walker.

The two species before me are distinguished as below.

A. Wing dark brown, broadly subhyaline on anal angle and whitish-hyaline across apex of first posterior cell, inner cross-vein paler than other veins .... *leucoteles* Walker

AA. Wing yellowish-brown, dark brown at stigma, on a patch below stigma, a narrow angulate fascia over the outer cross-vein and a large patch in apex except the tip of first posterior cell which is whitish hyaline; anal angle and hind margin broadly subhyaline; inner cross-vein not paler than the other veins .... *confusa* Malloch

Xarnuta leucoteles Walker.

Op. cit., i, 1857, 28.

This species was originally described from Singapore. I have seen it from Aru Islands; it may be quite generally distributed in this region.

Xarnuta confusa Malloch.

Ann. Mag. Nat. Hist., (11) iv, 1939.

A recently described species from the Solomon Islands.

Xarnuta morosa de Meijere.

Tijdschr. v. Ent., lvii, 1914, 198.

This species is known to me only from the description. The wing is dark brown, with three hyaline marks in the submarginal cell, one just beyond the inner cross-vein, the second before apex of second vein, and the third a little beyond the latter in the upper part of the apex of the cell, a narrow hyaline fascia from third to fifth vein between the cross-veins, two hyaline marks beyond it in the first posterior cell, the apical one a streak along fourth vein at its apex, a large hyaline mark in apex of the first posterior cell, and some fainter hyaline markings in the third posterior cell and in anal angle.

Batavia.

Group III.

This group contains species all of which, except *Oedaspoides*, have the postocular cilia black and bristle-like, and most of them have the wing-markings fasciform, though a few have the wings black or dark brown with a number of hyaline spots or marginal markings and a few discal dots or spots. None have the wings with a large number of small hyaline spots on dark fasciae, nor have any species the wings hyaline with stellate apical dark mark. In only one genus included in this Group are the postvertical and another pair of more widely spaced bristles just below their level yellowish-white and stubble-like as in the Tephritinae. The first wing-vein in the latter group is always setulose on the upper side of the node, while in most species of Group III the node is bare, though sometimes it is setulose and even the section of the vein proximad of the node is at least partly setulose. Possibly a strict application of the type of armature of this vein will result in a different alignment of the genera. I figure the two main types of armature to make clear this previously unused character (Figs. G1, G2).

Key to the Genera.

1. Mid and hind femora with short closely-placed stout spines on apical halves of the anteroventral and posteroventral surfaces .... *Callistomyia* Bezzi
   Mid and hind femora without short stout spines on the apical halves of the anteroventral and posteroventral surfaces 2
2. Pleurotergite (i.e., that section of the thorax above the impressed line over the posterior spiracle) with some erect fine or stiff hairs on a portion of its surface; presutural bristle lacking; dorsocentral bristles lacking, or but one postsutural discal pair of bristles present; metasternum haired or setulose 3
   Pleurotergite bare, rarely with one or two fine erect hairs, if there are any hairs present the presutural bristle is present; dorsocentral bristles present (ex. *Colobostrella*) 6
3. Frons with but one pair of orbital bristles, which are situated close to the anterior margin and directed inward; prescutellar acrostichal bristles very short; first wing-vein setulose from well proximad of base of node to tip (Nederland Indies) .... *Dimeringophrys* Enderlein
   Frons with at least two pairs of orbital bristles 4
4. Sternopleural bristle lacking 4*a*
   Sternopleural bristle present and quite strong 5

4*a*. Stigma much shorter than costal cell; second vein straight .. *Xanthotrypeta* Malloch
   Stigma subequal to the costal cell measured along the costal vein; second vein very noticeably undulated .... *Colobostrella* Hendel

5. Frons with one pair of incurved infraorbital and one pair of reclinate supraorbital bristles, very closely placed, the latter near anterior third .... *Ptiolina* van der Wulp
   Frons with two pairs of infraorbital and one pair of supraorbital bristles, the latter well above middle of frons 5*a*

5*a*. Infraorbitals strong, upper near the supraorbital pair .... *Euphranta* Loew
   Both infraorbital pairs weak, on anterior third, the upper far in front of supraorbital pair which is near upper third .... *Cyclopsia*, n. gen.

6. Second wing-vein with a short spur-vein near its apex on posterior side; fourth vein bent forward at apex (Nederland Indies) .... *Colobostroter* Enderlein
   Second wing-vein without a preapical spur-vein on posterior side; fourth vein not noticeably bent forward at apex 7
7. Second wing-vein looped or sharply curved forward above inner cross-vein, fused with first for a short stretch, then bending down and continuing to the costa; first vein setulose from near base to apex above; first posterior cell not narrowed at apex; gena nearly as high as eye (Malayan) .... *Enicoptera* Macquart
   Second wing-vein not looped, straight or almost so, well removed from first above inner cross-vein; gena not more than one-third as high as eye 8
8. Only two pairs of orbital bristles present; humeral bristle lacking .... *Ortaloptera* Edwards*
   More than two pairs of orbitals, or the humeral present 9
9. Scutellum with but two bristles (East Indies) .... *Ichneumonosoma* de Meijere
   Scutellum with four bristles 10
10. Sternopleural bristle lacking .... *Colobostrella* Hendel†
    Sternopleural bristle present 11

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* This genus is unknown to me except from the description. It may have pleurotergal hairs and belong near *Euphranta*.

† This genus is introduced here merely for comparison. Hendel gives as a synonym *Kambangania* de Meijere, which in the male has a deep excavation near the base of the underside of the mid metatarsus, and it also has four pairs of orbital bristles. It appears probable to me that the genus belongs to the *Euphranta* group but, not having seen specimens, I am unable to say if the pleurotergite is haired, so place it in both sections in the key. See text of this paper.

11. Six or more pairs of incurved infraorbital bristles present .. *Carpophthorella* Hendel
Not more than three pairs of infraorbital bristles present 12
12. Arista with the longest hairs at least as long as the width of the third antennal segment; scutellum with numerous hairs on the disc and sides; metasternum haired; lobe of the anal cell long and narrow, parallel-sided to near its apex, about four times as long as its basal width (East Indies) .... *Gastrozona* Bezzi
Arista pubescent or with its longest hairs not nearly half as long as the width of third antennal segment 13
13. Frons with no bristles on anterior two-fifths, the upper three-fifths with four pairs of bristles, the anterior two pairs apparently representing the infraorbitals, the second one much stronger than the first, both erect and sloping forward, the supraorbitals extremely short, only the upper pair reclinate, the posterior pair of infraorbitals above middle of frons .... *Pseudina*, n. gen.
Frons with bristles on anterior two-fifths of its extent, not arranged as above .. 14
14. Frons with three pairs of incurved infraorbitals and one pair of reclinate supraorbitals, the upper pair of the latter and the outer vertical pair lacking; ocellars and postverticals represented by microscopic hairs; lobe of the anal cell elongate, narrowed from base to apex, at base a little less than half as wide as its length .... *Cristobalia* Malloch
Frons with two or three pairs of infraorbital and two pairs of supraorbital bristles, the posterior pair of latter sometimes very short; outer verticals present; other characters not as above 15
15. The postvertical and a pair of equally long bristles slightly below their level and more widely spaced, yellowish-white and stubble-like; lobe of the anal cell sinuous; node of first vein setulose above .... *Ceratitis* McLeay*
Postvertical and the outer lower pair of bristles near them black and fine, the lower pair usually much shorter and weaker than the postverticals; lobe of anal cell not sinuous 16
16. Fourth wing-vein bent or dipped down into the discal cell proximad of the inner cross-vein; first vein almost rectangularly bent forward to costal vein, the stigma not half as long on costa as the costal cell .... *Anomoea* Walker
Fourth wing-vein straight proximad of the inner cross-vein 17
17. Wing dark brown on the costal half or more, with or without a hyaline or subhyaline mark on the costa beyond the apex of first vein and with the hind margin more or less broadly hyaline, the posterior edge of the dark portion usually irregular; lobe of the anal cell rather short, tapered to apex .... *Hemilea* Loew
Wing either black with hyaline marginal and discal markings, or almost equally black and hyaline, the black markings not confined to costal half 18
18. Frons not less than twice as long as wide, the ocellar bristles quite short and fine, not longer or stronger than the posterior supraorbitals; anal cell with long narrow lobe .... *Pseudospheniscus* Hendel
Frons much less than twice as long as wide, the ocellar bristles long and strong, distinctly longer and stronger than the posterior supraorbital pair 19
19. Postocular cilia yellowish-white; scutellum yellow, with black spots at bases of the bristles; third antennal segment sharply angulate at apex above .... *Oedaspoides* Bezzi
Postocular cilia and all other cephalic bristles black 20
20. Scutellum black and yellow; anal cell with an elongate apical lower lobe (fig. K) .... *Ceratitella*, n. gen.†
Scutellum black; anal cell with a very short angular lower apical lobe .... *Spheniscomyia* Bezzi

N.B.—It should be noted here that where I have given in parentheses ( ) the locality of a genus listed in the above key it is not treated in the following text, though there may be, in one or two cases, some reference to such a genus under one of those that occur in New Guinea or Australia. There is a possibility that some of these genera may yet be found in the region covered by this report.

EUPHRANTA Loew.

Mon. Europ. Bohrfl., 1862, 28.—*Lagarosia* van der Wulp, *Tijdschr. v. Ent.*, xxxiv, 1891, 210.

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* The characters cited for the segregation of this genus will suffice for use in this region only.

† See note, p. 465.

I am synonymizing the above two generic names after a careful comparison of the type-species of each. Hendel, in his key to the genera in 1914, presents no better character for the segregation of *Lagarosia* from its allies than the type of wing markings, and a classification based upon this character is unreliable.

My examination of the genotypes discloses the fact that they are closely related, having the same cephalic characters as well as the same thoracic bristling, the presutural bristle being absent in both, while the wing venation and bristling are the same. One important character, not mentioned by any writer on the family except Hendel, that links both and segregates them from most related genera known to me, is the presence of many erect fine hairs on the metapleura above the central furrow. I consider therefore that the above cited synonymy is warranted.

The long-haired aristae, four scutellar bristles, 2–3 infraorbital and 1 supra-orbital, lack of the presutural bristle, very small ocellars, the setulose third wing-vein, and metapleural hairs, will separate this genus from any other in the Australian region.

But one species is as yet reported from Australia.

Euphranta minor Hendel.

Ent. Mitt., xvii, No. 5, 1928, 362.

A small species, 4 mm. in length without ovipositor. Head yellow, frons shiny, as wide as one eye and 1·5 times as long as wide; two infraorbitals. Longest hairs on aristae about two-thirds as long as width of third antennal segment. Thorax reddish-brown, whitish-dusted, shiny, hind margin of mesonotum and the scutellum bare, the latter paler yellow, flattened on disc. Mesophragma (= pleurotergite) white-haired. Halteres yellow. Legs including the coxae yellow. Abdomen rusty-coloured, shiny, yellowish-haired, the apical two tergites with black marginal bristles. Venation and markings of the wings as in *Staurella crux* Bezzi. The brown basal cross-band lacking, the one over the inner cross-vein as in *crux*. There are some additional dark markings, including a straight fascia over the outer cross-vein to the costa, but the tip of the wing has a white mark that extends over the tips of third and fourth veins and is convex inwardly; the posterior basal cell is brown, with only a small hyaline mark on the hind margin; base of wing hyaline, the veins yellow.

Darwin (Palmerston), N. Territory, Australia. Type in collection of Deutsches Entmologisches Institut.

Euphranta scutellata Malloch.

Ann. Mag. Nat. Hist., (11) iv, 1939.

A larger species than *minor*, averaging 8 mm. in length, with thorax black except on each side just behind suture, two large spots in centre of postsutural area, and the apical two-thirds of the scutellum which are yellow. Legs preponderantly black. Wing with a large black-brown mark from base of stigma to apex that extends back to middle of the discal cell, a large spot on costa just beyond apex of first vein and the extreme apex whitish-yellow.

Solomon Islands.

Xanthotrypeta Malloch.

Op. cit., (11) iv, 1939, 250.

Generic characters.—This genus is similar to *Euphranta* in all characters, but lacks the sternopleural bristle. The frons has two pairs of inwardly-directed infraorbitals, the upper one twice as far from the lower as it is from the single pair of reclinate supraorbitals, ocellars microscopic, the postverticals mere hairs, outer verticals about half as long as inner pair, surface of frons shiny. Longest hairs on arista about as long as width of third antennal segment, the latter three times as long as wide, slightly tapered to the narrowly rounded apex; face concave in profile, parafacials invisible centrally in profile, gena narrow. Central pair of scapular bristles lacking, lateral pair distinct, presutural, acrostichal, sternopleural, and pteropleural bristles lacking, scutellum flat above, with four strong bristles and the disc closely short-haired, metapleural (pleurotergite) with the upper half above the impressed line furnished with numerous fine erect hairs. First wing-vein setulose from well before node to apex above and at apex below, third setulose to about midway from base to inner cross-vein above and at base below; first posterior cell not narrowed at apex; anal cell with a subtriangular apical lower angle or lobe.

Genotype, *Xanthotrypeta bimaculata* Malloch.

XANTHOTRYPETA BIMACULATA Malloch.

Ann. Mag. Nat. Hist., (11) iv, 1939, 250, Pl. x, fig. 13.

A reddish-yellow species, with an elongate shiny-black mark on each side of anterior margin of mesonotum above the humeri, the frons darkened centrally, legs yellow, the mid and hind tibiae largely browned, the wings yellowish, more distinctly so in front, with a fuscous fascia from stigma to over the inner cross-vein that is carried forward to connect with the large apical black-brown mark beginning midway between the cross-veins and filling the apical third or more of the wing except the hind margin as far in as the middle of the discal cell, a small mark in margin of the second posterior cell near lower extremity of the outer cross-vein, and a narrow lunate mark across the apex of the first posterior cell, these excepted portions whitish-hyaline.

Length, 8 mm.

Solomon Islands. Type in Imperial Institute of Entomology.

CYCLOPSIA, n. gen.

Generic characters.—Frons depressed down centre, with two pairs of rather closely placed weak incurved infraorbital bristles on anterior fourth, and one pair of stronger reclinate supraorbital bristles near upper third, only the inner verticals present; ocelli extremely close together. Antennae extending to lower fourth of face, third segment fully three times as long as second and its own width, slightly tapered to the rounded apex; arista with the longest hairs not more than half as long as width of third antennal segment. Face slightly receding below, foveae rather deep, epistome not projecting; eye higher than long, more narrowed below than above; gena narrow, the bristle weak. Thorax with the following bristles: outer pair of scapulars, 2 notopleurals, 1 supra-alar, 2 postalars, 4 scutellars, the prescutellar pair of acrostichals widely separated, the mesopleural, pteropleural, and sternopleural bristles rather weak, the acrostichal pair reduced to short fine hairs. Scutellum flattened, subtriangular, disc minutely haired. Legs normal, femora not spinose; mid tibia with a strong apical ventral spur. Wings narrow, much as in *Adrama*, but the second vein is straight, about as far from costa as from third vein just beyond apex of first, and the stigma is equal in length to the costal cell. Abdomen elongate-ovate, basal composite tergite nearly as long as the next two tergites combined, fifth tergite longer than fourth, tapered to apex.

Genotype, *Cyclopsia inaequalis*, n. sp.

CYCLOPSIA INAEQUALIS, n. sp.

♂. Head orange-yellow, dull on face, genae, and lower occiput, shiny from near anterior margin of frons and becoming glossy behind and on upper occiput, the frons with a large brownish-black mark from near anterior margin to ocelli that is narrow in front and widens to fill entire width at ocelli, the vertex reddish-yellow, upper occiput glossy-black except in centre; third antennal segment brownish-black except extreme base; palpi yellow. Frons nearly twice as long as wide; surface hairs microscopic, yellow.

Thorax brownish-yellow, distinctly shiny, the humeri and a broad streak down the posterior third of the mesopleura to middle coxae lemon-yellow, the posterior notopleural calli and scutellum pale-yellow; mesonotum with two broad brown vittae along the inner edges of the humeri traceable on entire extent, darkest in front and paler behind the suture, the intervening area grey-dusted and with quite dense pale hairs; pleura blackened in front of the yellow central stripe except on the propleura, and entirely black behind it, including the postnotum, the latter slightly grey-dusted. All the bristles black; hairs largely pale, the scutellar hairs black. Scutellars four.

Legs orange-yellow, mid and hind tibiae dark brown; fore legs missing. Mid tibia with a series of very short posterodorsal setulae; no setulae evident on the hind tibia, tarsi incomplete, the metatarsi long and slender.

Wing as Figure H, hyaline, yellow along the costa from the fork of second and third veins, with a small deep brown transverse mark on the inner cross-vein that does not extend to costa, and the entire apex dark brown from slightly before the outer cross-vein and well before the apex of second vein, the inner edge of the mark almost straight. First vein setulose from a little before node to apex above, bare below; third vein setulose from base one-third of the distance to inner cross-vein above and at extreme base below; lobe of anal cell elongate triangular. Halteres yellow.

Abdomen glossy reddish-yellow, blackened from apex of composite tergite to tip, with a subtriangular grey-dusted mark in centre of apices of third and fourth tergites. Hairs quite dense, short, decumbent, and black; no bristles present.

Length, 8 mm.

Type, Dutch New Guinea, Cyclops Mts., Sabron, Camp 2, 2,000 feet, May 1936 (L. E. Cheesman). Type damaged in shipping, the head mounted on same card, fore legs missing.

This genus connects the Adraminii with the *Euphranta* group rather distinctly.

COLOBOSTRELLA Hendel.

Wien. Ent. Zeitg., xxxiii, 1914, 79; *Ann. Mus. Nat. Hung.*, xiii, 1915, 428.

This genus probably belongs to the group with haired pleurotergite, but I have not seen the genotype, which is described from Celebes. It may occur in New Guinea.

In Hendel's description the following bristles are given as lacking or rudimentary: ocellar, postvertical, presutural, dorsocentral, and sternopleural. He also lists the "Schietelborsten", but I am uncertain just what bristle he refers to by this name. In his 1914 key he states that there is but one infraorbital bristle, and in 1915 he states that there is an infraorbital and a supraorbital pair. If *Kambangania* de Meijere is a synonym then there is a difference in the frontal bristling, as de Meijere says that in his genotype there are four pairs of orbitals, the anterior and posterior pairs being weak and hair-like. In both the genotypes the second wing-vein is distinctly undulated, and the first vein enters the costa much farther from the apex of the subcostal vein than the latter is from the humeral cross-vein. In *Xanthotrypeta* the stigma and the costal cells are subequal on the costal edges, and the second vein is straight. In *Xanthotrypeta* the inner cross-vein is at or slightly before the middle of the discal cell, while in the other two species it is about the apical third of that cell.

COLOBOSTRELLA RUFICAUDA Hendel.

Op. cit., xiii, 1915, 429.

A shiny reddish-yellow species. Mesonotum with a large glossy-black rounded mark on each side between the humeri and the suture and two similar elongate marks behind the suture that widen behind; pleura with two black spots, one at the prothoracic spiracle and one before the mesopleural suture; postnotum with two black stripes. Abdomen with a black mark on each side of each tergite. Wing yellowish-hyaline, with a narrow black fascia from middle of stigma to over second vein, a broader slightly-curved fascia from costa to middle of discal cell just beyond the inner cross-vein that is narrowly connected on the costa with the large apical black mark, the latter with a hyaline spot near apex of the first posterior cell.

Celebes.

Possibly a synonym of *Sophira bistriga* Walker, described from Celebes.

PSEUDINA, n. gen.

Generic characters.—Frontal bristling different from that of any allied genus, the orbitals consisting of four pairs, the upper two pairs very small and evidently the supraorbitals, the upper infraorbital pair at upper third of orbits and twice as long as the anterior pair, both pairs slightly proclinate and incurved; ocellars minute, shorter than the incurved postverticals; outer verticals much shorter than the inner pair; face slightly carinate in centre, epistome not projecting; post-ocular cilia dark and bristle-like; antennae normal; aristae pubescent. Thorax with all bristles present, the four scapulars fine, dorsocentral pair distinctly behind the supra-alars, prescutellar acrostichals strong; mesopleurals 2; scutellum with one or two luteous hairs and four strong black marginal bristles. Wings marked much as in *Rioxa*, the first vein setulose from near apex of node to tip above, bare below, third vein setulose from base to near level of outer cross-vein above and below, fifth vein bare; inner cross-vein about one-fifth from apex of discal cell. Legs normal, fore femur with posteroventral bristles, mid tibia with no central setulae, and a strong apical ventral bristle, hind femur without ventral bristles, hind tibia with a regular series of short closely-placed anterodorsal dark setulae.

Genotype, *Pseudina buloloae*, n. sp.

PSEUDINA BULOLOAE, n. sp.

♂. Glossy brownish-yellow, face a little paler, small ocellar spot black; mesonotum without dust or vittae; humeri, scutellum, and a streak along upper edge of pleura lemon-yellow; abdomen with black mark on each side of each tergite at curve; legs yellow; wings dark brown, with hyaline and yellowish markings (Pl. xi, fig. 14).

Frons shiny, depressed centrally, a little longer than wide and slightly narrowed in front, with a few microscopic pale hairs; profile as Figure I.

Mesonotal hairs short, dark, depressed and numerous. Scutellum short, flattened above. Legs normal.

Wing-veins dark brown. Lobe of anal cell elongate; first posterior cell parallel-sided at apex; stigma short, black-brown except a hyaline line across base. Halteres yellow. Squamae brown, the fringe dark brown.

Abdomen broadly ovate, convex above, with blackish hairs and black bristles. Fifth tergite longer than fourth, rounded at apex, with some quite strong apical and lateral bristles.

Length, 6 mm.

Type, Bulolo, New Guinea (F. H. Taylor).

This species reminds one of the species of the *Rioxa* group, but there are only four scutellar bristles, though a bristly hair on one side in the type-specimen is in the position that the intermediate pair of bristles occupies and may represent that pair, and the arista a merely short pubescent.

Hemilea Loew.

Mon. Eur. Bohrfl., 1862, 32.—*Ocnerus* Costa, *Atti Acad. Sci. Napoli*, v (2), 1844, 102.

This genus is unrepresented in the New Guinea collection before me, but it may yet be found here as there are species occurring as close as the Solomon Islands and Fiji.

In a paper now in the press dealing with the Solomon Islands species I present data on the species from this region so that it may be possible to identify any such that occur in New Guinea if already described.

The genus extends from Europe to Japan and southward to the Solomons with some closely-related species that have been removed to other genera in Africa. All the known species have the costal half or more of the wing dark brown, and the posterior half hyaline, the costa sometimes having a hyaline mark close to the apex of first vein, and the hind edge of the dark portion being more or less irregular in most species.

Callistomyia Bezzi.

Mem. Ind. Mus., iii, 1913, 124.

This genus contains four species, only one of which is known to occur in the region under consideration. The genotype, *pavonina* Bezzi, occurs in India and Formosa. I have examined specimens. The outstanding character of the genus consists of the small stout spines on the apical halves or more of the anteroventral and posteroventral surfaces of the mid and hind femora. The genotype has the following bristles on the head and thorax: 2 supraorbitals, 3 infraorbitals, inner verticals long, outer pair short, postverticals short; 1 humeral, 1 presutural, 2 notopleurals, 2 postalars, a pair of dorsocentrals almost in line with the acrostichals, 4 scutellars, 1 mesopleural, 1 pteropleural, 1 sternopleural, and a fine propleural just below the humerus. Ocellars lacking. Scutellum flat, subtriangular. First and third wing-veins setulose, those on first vein carried to base of the node. Venation closely similar to that of *Sophira*. Sixth tergite of abdomen in female shorter than the fifth.

Callistomyia horni Hendel.

Ent. Mitt., xvii, 1928, 361.

Similar to the other species of the genus in general coloration, agreeing with *pavonina* Bezzi in having a black spot on the lower central portion of the face, and differing from it in the lack of a black fascia on the bases of the abdominal tergites. Thorax brownish-yellow, the humeri and a vitta below the notopleural suture lemon-yellow, the latter continued to base of the wing, scutellum lemon-yellow, mesonotum with five black vittae posteriorly.

Darwin (Palmerston), N. Territory, Australia. Type in the collection of the Deutsches Entomologisches Institut, Berlin-Dahlem, Germany.

Carpophthorella Hendel.

Wien. Ent. Zeitg., xxxiii, 1914, 80; *Ann. Mus. Nat. Hung.*, xiii, 1915, 448.

This genus was erected for the reception of a new species, *magnifica*, from Formosa. It is the only species as yet assigned to the genus. The very striking character of the 6 to 10 pairs of strong incurved equal infraorbital bristles distinguishes the genus from its nearest allies. The species bear a superficial resemblance to those of *Gastrozona* Bezzi and *Callistomyia* Bezzi.

There are two known species that may be separated as below.

A. Frons with 6-7 pairs of infraorbital bristles; wing with a subhyaline mark on costa just beyond apex of first vein; mid and hind tibiae browned apically (Formosa) .... *magnifica* Hendel

AA. Frons with 10 pairs of infraorbital bristles; wing without a subhyaline mark on the costa just beyond apex of first vein; legs entirely orange-yellow (Solomon Islands) .... *setifrons* Malloch

It is possible that *setifrons* will be found in some of the other island groups in the same region.

Carpophthorella setifrons Malloch.

Ann. Mag. Nat. Hist., (11) iv, 1939.

The large number of closely-placed pairs of incurved infraorbital bristles in this species will at once distinguish it from any other in this region.

Solomon Islands.

Cristobalia Malloch.

Ann. Mag. Nat. Hist., (11) iv, 1939.

Generic characters.—Frons at vertex less than one-third of the head-width, narrowed to anterior margin and more than twice as long as wide, with three pairs of infraorbital and one pair of supraorbital bristles, the ocellar and outer vertical pairs undeveloped; aristae very short haired, longest hairs about twice as long as width of arista at base. Thoracic bristling complete, scutellars four. First and third wing-veins setulose; inner cross-vein at middle of the discal cell.

Cristobalia lutea Malloch.

Op. cit., (11) iv, 1939, 265, Pl. xi, fig. 22.

Described from the Solomon Islands.

Anomoea Walker.

Ent. Mag., iii (1), 1835, 80.—*Phagocarpus* Rondani, *Bull. Soc. Ent. Ital.*, iii, 1871, 171.

Most recent writers on the family have used Rondani's name for this genus under the belief that Chevrolat's similar name had priority over that of Walker. It has been conclusively proven that the part of Chevrolat's Catalogue containing the name *Anomoea* did not appear until 1837. Thus Walker's name must be used for the Trypetid genus.

The genus has been generally misinterpreted by writers on the family and a number of species have been placed in it that do not properly belong to it, while at least one species that belongs here has been placed in another genus.

The most striking character for the recognition of the genus is the downwardly bent antepenultimate section of the fourth wing-vein, a character met with in the Otitid genus *Rivellia* Robineau-Desvoidy. The anal cell has a long narrow apical lower lobe that is sometimes as long as the free part of the anal vein, and the third antennal segment is about twice as long as wide, nearly attaining the epistomal edge.

There are four species of the genus, as I interpret it, known to me; they may be distinguished as in the key given below. All except the genotype, *permunda*, may yet be found in New Guinea or on islands close to it.

Key to the Species.

1. Halteres bright yellow 2
   Halteres with dark-brown or black knobs 3
2. Thorax largely, and the legs entirely yellow (Palaearctic, Formosa) .. *permunda* Harris
   Thorax entirely, and the legs largely black .... *nigrithorax*, n. sp.
3. The small hyaline mark in the costal cell of the wing quadrate, extending to the costal vein, the latter yellow along the edge of the mark (Solomon Islands) .... *quadrata* Malloch
   The small hyaline mark in the costal cell of the wing elongate, not attaining the costal vein, the latter black along the edge of the mark (Fiji Islands) .... *curvinervis* (Bezzi)

ANOMOEA NIGRITHORAX, n. sp.

♀. Head black, frons dull brown, with whitish-grey dusting, most evident on the orbits, face brown, shiny below, with rather dense whitish-grey dust, gena brown, occiput shiny black; antennae and palpi red. Frons at vertex fully one-fourth of the head-width, slightly narrowed to anterior margin, and fully twice as long as its central width; uppermost of the three pairs of incurved infraorbital bristles at about two-fifths from upper margin, not much in front of and distinctly laterad of the anterior pair of supraorbitals, the latter much longer than the posterior pair; outer verticals about half as long as the inner pair; surface hairs centrally rather numerous, short, erect and dark. Antennae elongate, nearly attaining the epistome, third segment about three times as long as wide, rounded at apex; arista pubescent. Gena not higher than width of third antennal segment, with numerous short stiff black hairs, vibrissal angle more produced than in the other species.

Thorax black, glossy, the mesonotum rather densely grey-dusted on disc, with three black vittae on anterior half. Dorsocentral bristles slightly in front of the transverse supra-alar line; scutellars subequal, the hairs on sides of scutellum very minute.

Legs black, fore femora brownish on anterior surface, fore tibiae, mid tibiae except their bases, and apices of hind tibiae, and all the tarsi orange-yellow.

Wing hyaline, with black markings as Plate xi, figure 15, the small hyaline mark in the costal cell quadrate, extending entirely across the cell, the vein in front of it black. Second vein not running for any distance closely alongside the costal vein at its apex as in some of the other species, third vein with a distinct arch beyond the black preapical fascia, inner cross-vein at about its own length from outer; setulae on third vein extending to or slightly beyond the inner cross-vein above. Halteres yellow.

Abdomen glossy-black, with narrow grey-dusted apical fascia on second and third tergites. General shape broadly ovate, ovipositor sheath flattened, short and broad.

Length, 4·5 mm.

Type, Edie Creek, New Guinea (F. H. Taylor).

Sphensicomyia Bezzi.

Mem. Ind. Mus., iii, 1913, 146.

This genus is very similar to *Tephrella* Bezzi, differing essentially in having all the cephalic bristles including the postocular cilia black, the latter short and fine, and the scutellum with four strong bristles. There is a slight angular production of the lower apex of the anal cell that is sometimes not evident in *Tephrella*.

Spheniscomyia sexmaculata (Macquart).

Dipt. Exot., ii, Pt. 3, 1843, 222 (*Urophora*).

There is some question as to the distinctness of this species from *atilia* Walker. The entirely yellow hind tibiae have been cited as a distinguishing character for the latter. In both the specimens I have from this region the hind tibiae are infuscated on their basal halves or more, and in the specimen in which the antennae are present they are largely darkened.

Admiralty Island; Papua. Recorded by Hendel from Australia in 1928 (*Ent. Mitt.*, xvii, 364).

Pseudospheniscus Hendel.

Suppl. Ent., ii, 1913, 82.

This genus contains species that rather closely resemble those of *Anomoea*, but the fourth wing-vein is straight before the inner cross-vein. The frons is usually about two or more times as long as its central width, and the ocellar bristles are quite weak, contrasting markedly with those of *Spheniscomyia*. I have not enough material to justify definite conclusions on the status of the genus or the various species referred here, but it appears possible that some future worker may subdivide the present concept. In the only New Guinea species I have the frons is a little less noticeably narrowed than in some of the other species, and the antennae are a little shorter than in such species as *fossata* Fabricius, to which it is rather closely similar in most other features.

I present below a key to the three species from this region that are known to me at this time.

Key to the Species.

1. The entire costal margin of wing from base to middle of apex of first posterior cell black, the black pattern sending three branches to or almost to hind margin, the first on the anal cell that is narrow and does not reach the apex of sixth vein, the second very broad, tapered behind and covering the basal two-thirds of the discal cell, the third in the form of an inverted V, with its inner arm over the outer cross-vein and enclosing it and the outer arm ending near apex of the fourth vein (Fiji) .... *bifidus* Bezzi
   Costal border not entirely black, the costal cell partly whitish-hyaline, and another break in the dark mark beyond apex of first vein, the pattern not as above .. 2
2. Costal cell with two subquadrate whitish-hyaline marks; mesopleura except its anterior margin lemon-yellow (Fiji) .... *mesopleuralis* Malloch
   Costal cell hyaline, dark brown along the anterior and apical edges; mesopleura entirely black .... *taylori*, n. sp.

Pseudospheniscus taylori, n. sp.

♂, ♀. Head entirely orange-yellow, the ocellar spot only dark. Frons at vertex one-fourth of the head-width, hardly narrowed in front, and twice as long as wide; with the usual bristles, the ocellars about as long as the posterior supraorbitals. Antennae extending to lower third of face.

Thorax shiny black, humeri and propleura brownish-yellow, mesonotum rather densely brownish-grey-dusted, with three faint linear dark vittae, the outer pair most evident and along the lines of dorsocentrals. Apical scutellar bristles much shorter than the basal pair, most markedly so in the male.

Legs orange-yellow, mid and hind coxae and femora and basal halves of hind tibiae blackened. Posteroventral bristles on fore femora quite strong; apical ventral spur on mid tibia strong; hind tibia with a series of weak anterodorsal setulae.

Wing whitish hyaline, with black markings as Plate xi, figure 16. Inner cross-vein at a little more than its own length from outer; third vein setulose to inner cross-vein above; first vein setulose from just before apex of node to tip above, and at apex below. Halteres black.

Abdomen broadly ovate, glossy-black, with black hairs and bristles.

Length, 3–4 mm.

Type, male, Bulolo, New Guinea (F. H. Taylor); allotype, Papua: Ishurava, 3,000 feet, July 1933 (L. E. Cheesman); paratype, in poor condition, Wewak, New Guinea (F. H. Taylor).

CERATITIS McLeay.

Zool. Journ., iv, 1829, 475.

This genus is represented by but one species in this region, the widely distributed Mediterranean Fruit Fly. It may be readily distinguished from all other genera of the family by the characteristic diamond-shaped apical palette on the anterior pair of supraorbital bristles of the male, the small black spots or short streaks in the centre of the cells of the basal half of the wing, and the dense stubble-like yellow bristles on the posteroventral and apical portion of the anteroventral surfaces of the fore femora of the male. The characters cited in the foregoing key to the genera will distinguish both sexes from other genera in this region, though they cannot invariably be successfully applied for the distinction of the genus in other regions.

CERATITIS CAPITATA (Wiedemann).

Anal. Entomology, 1824, 55 (*Trypeta*).

This species is distributed from Southern Europe through tropical portions of Africa and Asia as well as in the Hawaiian Islands, and tropical portions of Australia. It has been introduced in commerce in some other sections of the world, but has failed to establish itself permanently, notably in Florida. The lack of continuous supply of suitable fruits for the larvae prevents its being more than a passing menace except in strictly tropical countries.

In addition to the characters mentioned above, it may be worthy of note that the stubble-like postvertical and lateral bristles on the head and the setulose node of the first vein of the wing should be carefully considered as possible indices to a closer affinity with the Tephritinae than with the Trypetinae.

I have seen no specimens from this region.

I figure the characteristic anal cell of this species (Fig. J).

OEDASPOIDES Hendel.

Wien. Ent. Zeitg., xliv, 1927, 63.

This genus is unknown to me, so that I have to depend upon Hendel's description for distinguishing data.

Despite the suggestive generic name the genus is apparently not very closely related to *Oedaspis* Loew, the frons in the latter being much broader and more convex, and the scutellum markedly convex and highly polished.

In his comparative data Hendel states that the third antennal segment is sharply angled at the upper apical corner, the sixth abdominal tergite of the female is shorter than the fifth, and the postocular cilia yellow and pointed. The wings have several dark fasciae as in *Oedaspis* and *Rhagoletis* Loew. In some respects the genus must resemble *Chrysotrypanea* described herein, but in the latter the third antennal segment is rounded at apex, and the orbitals are 3 + 2 instead of 2 + 2, and the postocular cilia stubble-like and pale yellow.

There are two species that Hendel places in *Oedaspoides*.

OEDASPOIDES ESCHERI (Bezzi).

Boll. Lab. Zool. Portici, v, 1911, 21 (*Oedaspis*).

Described from Sydney, N.S.W.

OEDASPOIDES ACUTICORNIS Hendel.

Wien. Ent. Zeitg., xlīv, 1927, 63.

Head pale yellow, with whitish dust on orbits, triangle, and face; bristles reddish-yellow, behind pale-yellow. Thorax black, humeri, suture, pleura over the fore coxae and in front of wing bases ochre-yellow, densely grey-dusted. Hairs pale yellow, the bristles reddish. Scutellum yellow, undusted, and at the bases of the two apical bristles black. Postnotum grey-dusted. Abdomen ochre-yellow, the bases of the tergites with dark fasciae, broader laterally, centrally interrupted on tergites 2 to 4. Genital cone as long as tergites 5 and 6 combined, glossy-black, with dark hairs, other abdominal hairs whitish-yellow. Legs and halteres yellow. Wings as in *escheri;* the hyaline fasciae are all narrower, not wider, than the brown ones, and there is no hyaline dot at apex of first vein.

Sydney, N.S.W.

CERATITELLA, n. gen.

Generic characters.—Quite similar in general appearance to *Ceratitis capitata*, but all the cephalic bristles and the postocular cilia are black, the anterior supra-orbital bristles in the male are simple, the fore femora in the same sex have only the normal bristles, the wings are not as wide at the anal angle, though the markings are quite similar, especially in the basal cells, the lobe of the anal cell is much as in the other genus but not as markedly sinuate, there is no outstanding costal bristle at the apex of the subcostal vein, and the third antennal segment is rather noticeably sharpened at the upper apex. In this last character the genus appears to resemble *Oedaspoides*, as well as in the swollen and black and yellow scutellum, but the black postocular cilia and the black dotted and streaked basal portion of the wing are different from that of Hendel's genus.

Genotype, *Ceratitella loranthi* (Froggatt).

CERATITELLA LORANTHI (Froggatt).

PROC. LINN. SOC. N.S.W., xxxv, 1911, 863 (*Ceratitis*).

♂. Head orange to brownish-yellow, with a lemon-yellow band across anterior fourth of frons, the face and anterior portion of genae yellowish-white, glossy, ocellar black spot small; antennae, aristae, palpi, and proboscis orange-yellow. All bristles, including the genal one, black, central minute hairs on frons and genal margins black, those on lower portion of back of head yellow. Orbitals 2 + 2, the upper reclinate pair much shorter than the lower and not longer than the moderately long ocellar pair; post-verticals shorter and finer than the latter, outer verticals about half as long as the inner pair. Width of frons at vertex about two-thirds its length and two-fifths width of head, slightly widened in front. Face slightly concave in profile, epistome not protruded, centre flat, a slender fovea on each side most evident below, lower margin transverse; eye vertical, about 1·25 times as high as long, longest at middle opposite antennal insertion, and about seven times as high as gena. Antennae extending to lower fifth of face, with noticeable apical upper point; arista subnude. Postocular cilia very short and setulose. Palpi spatulate; proboscis short and stout.

Thorax glossy black, the humeri, a large spot on each basal lateral angle of the scutellum, the posterior portion of the mesopleura above a line from near the spiracle to near the lower posterior angle, and most of the pleurotergite, lemon-yellow; disc of the mesonotum with dense yellowish-grey dust on two vittae from near anterior to near posterior margin, fused in front and behind, with a short lateral spur on anterior edge of the suture, and a short vitta laterad of the outer one behind the suture; hairs on the yellow parts and on dorsal vittae yellow, on other parts mainly black, all the bristles black. All bristles present, the dorsocentral and acrostichal pairs equally long, the former in line with the supra-alar pair; scutellum convex and thick, with four strong bristles, the basal pair in the yellow marks, the hairs fine and dark.

Legs entirely tawny-yellow. Fore femora with a series of black posteroventral bristles; hind tibia with a series of short anterodorsal black setulae on basal two-thirds or more.

Wing as Plate xi, figure 17, with black dots and streaks in cells on basal third and the veins blackened, a broad brownish-black fascia from the stigma to hind margin just in front of apex of anal vein, this connected on costa with a broad costal band of the same colour that extends to wing-tip, filling apex of first posterior cell, and very slightly notched below before apex and narrowly separated from the costal vein along parts of its extent, and a third dark fascia that emanates from the junction of the other two and extends obliquely to wing-margin over both cross-veins. Costal spine very inconspicuous; first vein setulose above from base of node to apex, and at apex below, third vein setulose from base to beyond inner cross-vein above and below, fifth vein bare. Two streaks from second vein to costa more intensely black than the other portions of the cell, may sometimes contain vestigial spur-veins. Anal cell as Figure K. Squamae white. Halteres yellow.

Abdomen shiny-tawny to orange-yellow, with black lateral marks on third and fifth tergites and the apices of second and fourth narrowly whitish-grey-dusted, hairs pale on the pale-dusted parts and base of second tergite, mainly black on other parts. Fifth tergite with an apical series of fine black bristles.

Length, 4 mm.

Sydney, N.S.W., bred from *Loranthus* sp., Dec. 1938 (L. R. Clark).

ORTALOPTERA Edwards.

Trans. Zool. Soc. Lond., xx, Pt. 13, 1915, 419.

This genus is a peculiar one, with characters that make it difficult to associate it with either Trypetidae or Phytalmiidae, though the cephalic and wing characters strongly suggest the latter relationship. There are two pairs of orbitals, the supra-orbital pair strong and reflexed, the infraorbital pair short, weak, and incurved. The arista is long haired. The thorax lacks the humeral, presutural, prescutellar, and propleural bristles, and has the scapular, notopleural, supra-alar, and meso-pleural bristles strong, and the pteropleural and sternopleural bristles weak but distinct. Scutellars four. Edwards states that the genotype has a preapical bristle on the mid tibia, a character he states, erroneously, occurs also in *Rioxa formosipennis* Walker. I have never seen a species of Trypetidae with a preapical dorsal bristle on any tibia. The wing-veins are bare, another very exceptional character, the second vein is undulated, and the anal cell is longer than the free part of the anal vein, without an apical lobe, though longest on its lower edge, the vein closing the cell slightly arcuate, and the inner cross-vein is far before the middle of the discal cell.

ORTALOPTERA CLEITAMINA Edwards.

Op. cit., xx, Pt. 13, 1915, 420.

This species is quite similar to certain species of the genus *Cleitamia*, notably in the wing markings. General colour uniformly dull-black, the head dull light-ochreous-brown, with some darker mottling on the vertex, antennae and palpi ochreous, third segment of former darker at apex. Legs blackish-brown, fore femora, apices of mid tibiae, and the greater part of mid and hind tarsi more reddish-brown. Wings dark brown, hyaline in costal, subcostal, posterior basal, and anal cells, on a narrow fascia at middle that runs straight to fifth vein and then curves apically, ending in hind margin below the outer cross-vein, a broadly arched streak as wide as the fascia that is separated by a brown interspace about its own width from the fascia, extending forward from fifth vein to second vein, then running along the hind side of that vein and ending in the apex of the first posterior cell, the anal angle also hyaline. Length, 10 mm.

Dutch New Guinea, Mimika River.

Subfamily TEPHRITINAE.

This group is usually distinguished from Trypetinae by the longer sixth abdominal tergite of the female, the yellow stubble-like postocular cilia, yellow postvertical, upper supraorbital, and outer vertical bristles, and the speckled wings, on which the setulae of the first vein commence at the base of the node on its upper surface. Frequently the pteropleural and posterior notopleural bristles are yellow, and usually the surface of the thoracic dorsum has flattened yellow scale-like bristles instead of fine hairs. The scutellum has never more than four bristles and often has but two, the apical pair being absent or much shorter than the basal pair. The dorsocentral pair of bristles are in most cases close to the suture, the arista is pubescent or bare, and the fifth vein is bare, while the third is rarely setulose to beyond the inner cross-vein above. In one or two genera I have included, the sixth abdominal tergite is not longer than the fifth. I include *Tephrella* and *Platensina* here though they are generally placed in Trypetinae.

Key to the Genera.

1. Head on lower margin in profile much longer than at bases of antennae; proboscis slender, chitinous, and geniculated at middle, without fleshy labellae, the apical section as long as head on lower margin .... *Paroxyna* Hendel

   Head not or very little longer on lower margin than at base of antennae in profile; proboscis stout, with fleshy apical labella 2

2. Wing exceptionally broad, less than twice as long as wide, the widest point at outer cross-vein, the anal angle undeveloped (Pl. xi, fig. 21), ground colour brownish-black, with some small hyaline wedge-shaped marginal incisions, the extreme apex white, and sometimes some small hyaline dots in the field .... *Platensina* Enderlein

   Wing either normal in width or slender, not less than twice as long as wide, widest point usually near middle of discal cell, the anal angle usually well developed, and not coloured and marked as above, or if but little more than twice as long as wide and the markings and ground colour as above, then there is no hyaline mark at the extreme tip 3

3. Wing black or brownish-black, with whitish-hyaline incisions in the margin and at most four small hyaline dots in the field 4
   Wing hyaline, with black or brown marks, sometimes fasciate markings broken by numerous small hyaline dots, or yellowish-brown, with hyaline fasciae 5
4. Wing more than 2·5 times as long as wide, the anal angle well developed; sixth abdominal tergite of female about 1·25 times as long as fifth; apex of wing with a white transverse streak .... *Spathulina* Rondani
   Wing not or very little more than twice as long as wide, without white mark at extreme tip; sixth abdominal tergite of female not longer than fifth .... *Tephrella* Bezzi
5. Wing yellowish-brown, with hyaline markings, those on the disc consisting of three fasciae from hind margin to near the second vein, converging in front; inner cross-vein at or very close to middle of the discal cell; apical ventral spur on mid tibia not longer than apical diameter of the tibia .... *Chrysotrypanea*, n. gen.
   Wing not marked as above; inner cross-vein much beyond middle of the discal cell; apical ventral spur of mid tibia much longer than apical diameter of the tibia 6
6. Wing brown or brownish-black, with many small hyaline spots on entire area, the base largely hyaline, with a black spot at base of the anterior basal cell that extends over the fourth vein into the posterior basal cell; fore femur of male thicker than the other femora; genital cone of female circular in cross section; third antennal segment more than twice as long as wide, distinctly angulate at upper apical corner .... *Camaromyia* Hendel
   Wing brown, with hyaline spots or with an apical star-like dark mark, or marked with black along the costa and a black fascia from costa to hind margin over the cross-veins, never with a black spot at base of the anterior basal cell that extends over fourth vein into the posterior basal cell; fore femur in neither sex much thicker than others; genital cone of female usually flattened, oval in cross section; third antennal segment, if twice as long as wide, without upper apical angle 7
7. Wing markings consisting of a large star-like mark on apical half or less from which emanate a few dark rays; scutellar bristles 2; infraorbitals 3 pairs .... *Trypanea* Schrank
   Wing markings not as above, not confined to apical half nor star-like; scutellar bristles 4, the apical pair sometimes short; infraorbitals 2 pairs 8
8. Wing hyaline, with some brownish-black markings along the costa, a large mark at apex which usually encloses one or two hyaline dots, and a similarly coloured fascia from the costa to hind margin that encloses both the closely placed cross-veins .... *Sphenella* Robineau-Desvoidy
   Wing dark brown, with many indiscriminately arranged variably-sized hyaline spots on the entire area .... *Tephritis* Latreille

TEPHRELLA Bezzi.

Mem. Ind. Mus., iii, 1913, 151.

This genus superficially resembles *Spheniscomyia* Bezzi in structure, colour, and wing markings, but may at once be distinguished from it by the presence of but two scutellar bristles, the yellow postvertical and outer vertical bristles and postocular cilia, the latter being stout, and stubble-like; the cross-vein closing the anal cell is either straight or very slightly angled at centre so that the lower posterior corner of the anal cell is not produced into a lobe.

I have recently described a species of this genus from the Solomon Islands, and have another from Western Australia that I provisionally refer here. They may be distinguished as below.

A. Wing (Fig. L) black, the costal cell with three whitish-hyaline marks, one against the humeral cross-vein, a larger one before middle, and a narrower one near apex, three pairs of whitish-hyaline marginal incisions, one just beyond the apex of first vein, one in the second posterior cell, and one in the third posterior cell below middle of the discal cell, and three small hyaline discal spots, one in the first posterior cell beyond the outer cross-vein, one near apex, and another before middle of the discal cell; pleura and lateral margins of mesonotum and scutellum brownish-yellow, remainder of thorax black; cross-vein closing the anal cell straight .... *sexincisa* Malloch

AA. Wing black, costal cell whitish-hyaline on basal half, the six whitish-hyaline incisions in the wing margin larger and longer than in *sexincisa*, the outer one in the second posterior cell curved and extending forward to a little over the third vein, the inner one to anterior extremity of the outer cross-vein, the pair in third posterior cell widely separated, the basal one extending across the discal cell near base, the other extending to fifth vein just before outer cross-vein; thorax black, propleura brownish-yellow; vein closing the anal cell slightly angled at middle .... *australis*, n. sp.

Tephrella australis, n. sp.

♀. Head testaceous-yellow, slightly yellowish-grey-dusted, the ocellar spot hardly darkened. Outer vertical, ocellar, and orbital bristles except the posterior supraorbital, dark brown. Frons slightly more than one-third of the head-width and about 1·25 times as long as wide, with three pairs of strong incurved infra-orbitals and two pairs of supraorbitals, the posterior the shorter, the anterior close to middle of frons; ocellars slightly behind the level of posterior edge of anterior ocellus. Antennae short, extending to lower third of face, third segment about twice as long as wide; arista pubescent. Gena not as high as width of third antennal segment.

Thorax shiny-black, grey-dusted, pleura more distinctly so, the propleura brownish-yellow, bristles brown, the scale-like mesonotal hairs pale yellow.

Legs yellow. Fore coxae each with a brown bristle near apex on anterior side; fore femur with a series of brown posteroventral bristles; mid tibia with an apical ventral brown bristle.

Wing brownish-black, whitish-hyaline at base to middle of costal cell and on basal half of edge in front of the anal vein, the other whitish-hyaline markings as in Plate xi, figure 18. Inner cross-vein at about its own length from apex of discal cell; second vein slightly bent in the dark part between the costal hyaline marks. Halteres yellow.

Abdomen glossy-black, abraded in type-specimen. Sixth tergite subequal to fifth; sheath of the ovipositor elongate-conical, the ovipositor slender, spine-like, yellow.

Length, 4 mm.

Type, Western Australia.

Spathulina Rondani.

Dipt. Ital. Prodr., i, 1856, 113.

This genus is distinguished from its allies by the black wings with whitish-hyaline marks, one at the tip distinguishing it from *Tephrella* (Fig. M; Pl. xi, fig. 19). The pair of dorsocentral bristles are at the suture quite noticeably in front of the supra-alar line. Scutellars two.

Spathulina acroleuca (Schiner).

Reise Novara, Zool., ii, i abt., B. Diptera, 1868, 268 (*Tephritis*).

This species is rather variable in wing markings and has been described under several specific names. The distribution is very wide, from Africa through Asia to Australia, including Guam, Fiji, etc.

Efflatoun records *parceguttata* Becker, which is accepted as a synonym of this species, as having been reared from larvae feeding on *Ceruana pratensis* in Egypt, and states that the larvae are known to live on Composites in South Africa.

Shiraki, who records this species from Formosa, states that Schiner's type-specimen could not be found in his collection in Vienna, but there can be no doubt that his species is the one dealt with above, regardless of whether there may be some confusion in the matter of the relationship of forms described under different names from other regions.

I have specimens before me from Townsville, Queensland; Canberra, A.C.T. (F. H. Taylor).

The Canberra specimen has a hyaline dot near the apex of the discal cell of the wing.

CHRYSOTRYPANEA, n. gen.

Generic characters.—This genus is an aberrant one in this subfamily, the fasciate wings being like those of certain Trypetinae, though the yellow post-vertical, outer vertical, and posterior supraorbital bristles, and thick yellow postocular cilia clearly link it with the Tephritinae. Head higher than long, face slightly produced below; frons more than one-third of the head-width, and longer than wide, with hardly any central hairing, the orbitals 3 + 2, ocellars long, in line with the posterior edge of the anterior ocellus. Proboscis stout and short. Thorax with the normal bristles, the posterior notopleural yellowish-white and pteropleural stout and white, the other bristles black; basal scutellars long, apical pair microscopic. Legs rather stout, apical ventral bristle on mid tibia not longer than apical diameter of the tibia. Wing normal in shape, inner cross-vein at middle of discal cell, anal cell with triangular apical lower lobe; first vein setulose from base of node to tip above and at apex below (Fig. G2); third vein bare. Sixth abdominal tergite of female slightly shorter than fifth; sheath of ovipositor conical, circular in cross-section.

Genotype, *Chrysotrypanea trifasciata*, n. sp.

CHRYSOTRYPANEA TRIFASCIATA, n. sp.

♀. Head dull orange-yellow, frontal orbits grey-dusted. Antennae extending to lower third of face, third segment about 1·5 times as long as wide, rounded at apex, hairs on basal segment yellow, on second black; arista subnude. The three pairs of incurved infraorbital bristles equal in length, upper pair near middle, well in front of the anterior pair of supraorbitals, the latter close to upper third and about one-third longer than posterior pair. Gena about as high as width of third antennal segment.

Thorax brownish-yellow, mesonotum except narrowly on lateral margins, and the entire scutellum, glossy-black, lower part of pteropleura and the postnotum black, greyish-dusted. Mesonotum thickly covered with depressed yellow scale-like bristles. Metasternum bare.

Legs entirely yellow, hairs and bristles black, fore coxal bristles yellow. Fore femur with a complete posteroventral series of bristles; no hind tibial setulae.

Wings (Plate xi, fig. 20) yellowish-brown, with a rather faint broad subhyaline fascia from middle of costal cell to near hind margin and three narrow anteriorly convergent hyaline fasciae beyond it from hind margin to near second vein, the first from near apex of anal vein, ending in front of inner cross-vein, second between the cross-veins, the third from near upper apex of second posterior cell ending in submarginal cell above level of outer cross-vein; ground colour darker along the edges of the hyaline fasciae. Halteres yellow.

Abdomen glossy-black above, including the sheath of ovipositor, yellow below, the dorsum with similar yellow scale-like armature to the mesonotum. Bristles yellow.

Length, 3·5 mm.

Type, Seaford, Victoria, from gall on Dogwood.

PLATENSINA Enderlein.

Zool. Jahrb., xxxi, Abtl. Syst. Geog. und Biologie, 1911, 453; Hendel, *Ann. Mus. Nat. Hung.*, xiii, 1915, 461; Curran, *Proc. Cal. Acad. Sci.*, xxii, No. 1, 1936, 29.

This genus was originally erected for the reception of a new species, *sumbana* Enderlein. Subsequently Hendel included six old and two additional new species in the genus. Whether these are all distinct species is a matter of considerable doubt as the general features of several of them are extremely similar. A comparison of the figures of the wings of the genotype, *platyptera* Hendel, and *malaita* Curran shows a remarkable resemblance in the shape and the markings, and examination of a series of specimens may reveal whether they are valid species or not. Each of the three species was described from a single female example.

The genus is distinguished from its allies by the broad wing, with the peculiar type of markings, and the two bristles at the apex of the subcostal vein.

There are two specimens in my present material, one of them a female very like *malaita* Curran, the other a male and quite distinct from that species in wing markings.

PLATENSINA PARVIPUNCTA, n. sp.

♂. Type specimen greasy, but apparently pale yellowish-brown or ferruginous in general colour, the mesonotum darker except on lateral margins, the abdomen glossy-black, yellowish at base; legs entirely brownish-yellow; wings dark brown, with the following hyaline marks: the cell basad of the humeral cross-vein, extreme base and a mark before middle of the costal cell, a narrow irregular streak from below the latter to apex of the anal cell, a transverse mark from the costa to second vein just beyond apex of first vein, two small triangles on hind margin, the basal one close to the tip of anal vein, and a narrow apical margin from just before apex of third to beyond apex of fourth vein. There is in the type specimen a slight short narrow hyaline mark along the edge of the second posterior cell just above the apex of the fifth vein.

Head in profile subquadrate, slightly higher behind, the frons a little longer than wide, three pairs of incurved infraorbital and two pairs of reclinate supra-orbital bristles, the upper one of the latter white and much shorter than the lower, inner verticals as usual much the longest on head, luteous, postverticals short, parallel and, like the postocular cilia, white, ocellars moderately long, brown. Face vertical, not visible in profile except at epistome, with slight antennal foveae separated by a raised line. Antennae a little more than half the length of face, third segment not twice as long as wide, rounded at apex, downy; arista very short haired; eye higher than long; gena about half as high as width of third antennal segment. Proboscis short and thick; palpi moderately wide.

Thoracic bristles, yellowish, as follows: 1 humeral, 2 notopleurals, 1 pair of dorsocentrals in line with the supra-alars, 1 pair of prescutellar acrostichals, 1 presutural, 2 mesopleurals, 1 pteropleural, 1 sternopleural, 2 long basal and 2 short apical scutellars. There are about four quite strong erect setulae or bristles in a series on the propleura.

Legs slender, fore femur with a few rather long bristles on the postero-ventral surface, mid tibia with one long apical ventral spur.

Wing as in Plate xi, figure 21. The usual two bristles at the apex of the subcostal vein, first vein setulose to apex, third with a few microscopic hairs at base above and below.

Abdomen narrowly ovate, fifth tergite longer than fourth, with a few bristles apically on sides. Hypopygium small.

Length, 5 mm.

Type, Cairns, N. Queensland (Illingworth).

PLATENSINA DUBIA, n. sp.

♀. Very similar to *malaita* Curran, the bristling of the frons as in *parvipuncta*; there is a small dark-brown mark between each antenna and eye not mentioned by Curran in his description, and the third antennal segment is quite broadly rounded at apex. Thorax brownish-yellow, mesonotum black except on lateral margins and densely grey-dusted. Bristles as in *parvipuncta*, the apical scutellars about half as long as the basal pair. Legs as in *parvipuncta*. Wing: Costal cell with a hyaline spot before middle and another near apex as in *malaita*, but the stigma has a much narrower hyaline mark at base than in that species, and the hyaline spot near the base of the first posterior cell is much smaller than in *malaita* or *sumbana*. Abdomen glossy-black, without grey-dusting on any part of the dorsum, genital cone as long as the three preceding tergites combined.

Length, 5 mm.

Type, Gordonvale, N. Queensland, in scrub (Illingworth).

One wing of the type-specimen is much damaged.

I take this opportunity to draw attention to the similarity between the genera *Platensina* and *Protephritis* Shiraki. The author of the latter separated them in his key by a very slight difference in the position of the dorsocentral bristles. This difference is largely imaginary, and in fact it is my opinion that the character has been to some extent overemphasized in the classification of the family. In any event, both the genera, so far as my material shows, would fall in the same section of Shiraki's key. A very careful examination of the genotype of *Protephritis* (*Tephritis sauteri* Enderlein) reveals that the only character that might be utilized for its separation from typical *Platensina* is the narrower wing with, peculiarly enough, its wider anal region. The first vein is setulose at apex below, but it is so in *dubia* also, though not in *parvipuncta*, and though there are some setulae on the third vein below almost to the inner cross-vein there are traces of similar setulae on the third vein in *dubia* both above and below though the dark colour of the vein and membrane as well as the setulae makes them difficult to see. It requires no vivid imagination to discern, from the similarity of the wing markings, that both these generic concepts have had a common origin, and one may be pardoned for accepting them as but subgenera. Of course the same attitude may be adopted with regard to several other concepts in the same subfamily, many of them being founded upon quite nebulous characters.

SPHENELLA Robineau-Desvoidy.

Mém. présentés Ac. Roy. Sci. Inst. France, ii, 1830, 773, Essai Myodaires.

This genus contains three palaearctic species, and one is recorded from Formosa. Three species occur in Africa, one of them the genotype, which I have also from Australia.

SPHENELLA MARGINATA (Fallen).

Ortalides Sueciae (1) 1820, 7 (*Tephritis*).—*Trypeta heterura* Thomson, *Eug. Resa*, ii, Zool. i. Insecta, 1868, 584.

A small dark species with dense grey-dusting on the thorax and abdomen, the legs tawny-yellow, the wings (Pl. xi, fig. 22) hyaline, with some marks along costal margin up to the apex of the stigma brownish, the stigma darkest, a rather narrow fascia from the costa to the hind margin enclosing both the cross-veins, and an irregular marginal band from before apex of second vein round the wing margin to beyond apex of fourth vein, black; there are also two faint dark spots on the fifth vein about middle of the discal cell and one about middle of the anal vein (Fig. N). The arista is almost bare, the third antennal segment reaches almost to the slightly produced epistome and is slightly angulate at apex above, the frons has two pairs of incurved infraorbitals and two pairs of reclinate supraorbitals, the uppermost one of the latter short and pale yellow, the ocellars are long and dark, the inner verticals are the longest bristles on the head and are dark while the much shorter outer verticals, the parallel postverticals, and the postocular cilia are yellowish-white. The dorsocentral bristles are almost in transverse line with the supra-alar bristles, the presutural is present, as are also one mesopleural and one sternopleural; the pteropleura has one or two long stiff outstanding setulae; scutellum more or less yellowish and with four subequal black bristles. The cross-veins of the wing are rather closely placed, separated by about the length of the inner one.

Length, 3–4 mm.

Tallong and Scone, N.S.W.; Canberra, A.C.T. (F. H. Taylor). This European species occurs also in Africa and the Canary Islands. I have seen one specimen that is evidently this species from Tonga.

The larvae feed on various species of *Senecio*, *Centaurea*, and *Picris*.

I believe this is *Urophora ruficeps* Mcq., *Dipt. Exot.*, Suppl. 4, 1850, p. 288.

CAMAROMYIA Hendel.

Wien. Ent. Zeitg., xxxiii, 1914, 95.—Malloch, *Dipt. Patag. and S. Chile*, Pt. vi, fasc. 4, 1933, 273.

This genus was erected for the reception of a widely distributed species, *bullans* Wiedemann, but several additional species from Africa and South America have since been placed in it.

CAMAROMYIA BULLANS (Wiedemann).

Trypeta bullans Wiedemann, *Aussereur. Zweifl. Ins.*, ii, 1830, 506.—*Tephritis tenera* Loew, *Zeitschr. ges. Naturw.*, 1869, 8.—*Acinia rufa* Macquart, *Dipt. Exot.*, ii, Pt. 3, 1843, 228.—*Tephritis meleagris* Schiner, *Reise Novara*, Zool. ii, i abt., B. Diptera, 1868, 272.—*Tephritis adspersa* Coquillett, Invert. Pac., p. 30 (1904).—*Camaromyia bullans* Hendel, *Wien. Ent. Zeit.*, xxxiii, 1914, 95; *Abh. Ber. K. Zool. Mus. Dresden*, xiv, 1914, 63.—*Tephritis wolffi* Cresson, *Ent. News*, xlii, 1931, 5.

In this species the scutellum has the apical pair of bristles about half as long as the basal pair, the antennae of the male are dark brown to fuscous in colour, with the apex of the second segment and base of the third yellow, and in the female they are entirely yellow, with the aristae in both sexes thickened to near the middle, yellow at extreme base, white to near middle, the apical portion dark brown. The genital cone in the female is glossy-black, cylindrical, and tapered to apex. Rarely in teneral specimens or in those that have been damaged this cone may be flattened through pressure, so that care should be exercised to determine on the basis of other characters where such specimens fall in the generic key. The wing is marked as shown in Plate xi, figure 23.

Illawarra and Botany Bay, N.S.W.; Brisbane, Queensland. The distribution in the New World extends from the southern United States to Patagonia, and in the Old World throughout most of the Palaearctic Region except Japan, and in Australia. Possibly it may yet be found in intermediate points in the latter.

TEPHRITIS Latreille.

Nouv. Dict. Hist. Nat., xxiv (Tab.), 1804, 196.

This genus, as accepted here, has the wings brown, with many small hyaline marks or spots indiscriminately arranged in the cells on almost the entire field, the frons with but two pairs of infraorbital bristles, and the proboscis quite thick and short.

There is but one species before me from this region which I re-describe below.*

TEPHRITIS PELIA Schiner.

Reise Novara, Zool., ii, i abt., B. Diptera, 1868, 271.

♂, ♀. Very similar to *plebeia* Malloch from New Zealand, with two hyaline dots in the dark-brown stigma, and a hyaline spot at the apex of the first posterior cell of the wing, but the genae are much narrower, not more than one-sixth of the eye-height as against one-third in *plebeia*, there is no small hyaline spot in the dark patch in the marginal cell below the stigma, there is a yellowish patch on each side of the composite basal segment of the abdomen in the male that is not present in *plebeia*, and the genital cone of the female is bright orange or fulvous-yellow with a black tip, not entirely glossy-black.

Head testaceous-yellow, with greyish-white dust, most evident on the ocellar triangle, the frontal orbits and parafacials, occiput broadly black centrally, with grey dust; antennae, aristae and palpi yellow, the palpi brownish apically; infraorbital, anterior supraorbital, ocellar, and inner vertical bristles black, all others and the short hairs yellowish-white. Gena about one-sixth as high as eye, eye slightly oblique, higher than long; head in front about three-fourths as high as at occiput; epistome projecting. Frons about 1·25 times as long as wide, parallel-sided, and more than one-third of the head-width, all black bristles long and strong. Third antennal segment about 1·5 times as long as wide, angulate at upper apex; arista pubescent; palpi rather long and strap-like.

Thorax black, densely brownish-grey-dusted on dorsum and upper part of pleura, grey-dusted below, the humeri, posterior notopleural callosities, and scutellum more or less yellowish, a dark brown spot at insertion of each of the acrostichal and basal scutellar bristles, all the bristles except the pteropleural and scapulars black. Bristling complete, the apical pair of scutellars about half as long as the basal pair. Surface hairs pale yellow and decumbent.

Legs tawny-yellow. Fore tarsi longer than their tibiae, mid and hind pairs shorter; fore femur with the posteroventral series of bristles complete, hind pair with no anteroventral bristles.

Wings greyish-hyaline, with dark-brown markings (Pl. xi, fig. 24), the most distinctive being the bipunctate stigma, and the peculiar hyaline spot at the apices of the submarginal and first posterior cells. First vein setulose from base of node below the humeral cross-vein to apex and below on apical third, third vein with a few setulae at base above and sparsely setulose between base and inner cross-vein below. Halteres yellow.

Abdomen coloured as thorax, densely dark-grey-dusted, with faint traces of a pair of brown discal spots on tergites 3 to 5 inclusive, sides of composite basal tergite of male usually yellowish, hypopygium of that sex fulvous-yellow, the

* I have been unable to find a species agreeing with the description of *Tephritis 11-guttata* Thomson.

genital cone of the female flattened, glossy-orange or fulvous-yellow, with black apex, broadest above. Hairs yellowish-white, bristles at apex of fifth tergite in male and sixth in female quite strong and black.

Length, 3·5–4 mm.

I am accepting as this species, which was originally described from Sydney, a number of specimens from Illawarra and Botany Bay (Peterson); Tallong, N. S. Wales; Canberra, A.C.T. (Taylor). This may be the species recorded by Macquart as *leontodontis* De Geer.

TRYPANEA Schrank.

Briefe Donaumoor, 1795, 147.—*Urellia* Robineau-Desvoidy, *Mém. présentés Ac. Roy. Sci. Inst. France*, ii, 1830, 775, Essai Myodaires.

This generic concept is a difficult one to maintain in cases where many species are available, as I have shown in my paper on the Patagonian Trypetidae. I am, however, segregating the single species now before me from Australia in *Trypanea* as an index to its closest affinities in the Old World fauna. The stellate dark apical wing-mark is quite characteristic in this species and is distinctive enough to warrant this procedure tentatively, though there is little in the line of structural features to justify the perpetuation of the segregation.

TRYPANEA GLAUCA (Thomson).

Eugen. Resa, ii, Zool. i. Insecta, 1868, 581 (*Trypeta*).

♂. Very similar in wing markings to *neodaphne* var. *gamma* Malloch from Patagonia, differing in the three incomplete branches of the brown mark over the first and second posterior cells of the wing (Pl. xi, fig. 25).*

Head testaceous-yellow, with pale-grey dust, centre of occiput broadly black; antennae, aristae, palpi, and proboscis yellow, second antennal segment with a small dark mark above. Head a little wider than thorax, in profile with the face almost vertical, epistome slightly protruded and about two-thirds as high as at occiput; eye oblique, at middle about two-thirds as high as its extreme length; gena fully half as high as width of third antennal segment, the latter about 1·5 times as long as wide, its upper apex angulate; aristae subnude. Frons flat, about 1·25 times as long as wide, and almost parallel-sided, with three pairs of short fine yellowish infraorbitals, the other bristles rubbed off, but scars of four verticals and one pair of supraorbitals distinct.

Thorax black, densely whitish-grey-dusted, humeri and a spot below wing base yellowish. Most of the bristles rubbed off, but those remaining and the short hairs are yellow. Bristles as follows: 1 humeral, 2 notopleurals, 1 presutural, 1 supra-alar, 1 pair of dorsocentrals close to the suture, 1 pair of acrostichals, 2 postalars, 1 mesopleural, 1 sternopleural, 1 pteropleural, and a pair of scutellars near base.

Legs yellow. Fore tarsus shorter than its tibia, basal segment rather stout, in dorsal view about four times as long as wide, all the segments except fifth with a few long pale hairs on anterior edge, longest on basal segment; mid and hind tarsi slender, longer than their tibiae, basal segment much more than four times as long as wide.

Wing milky, veins yellow, dark brown in the dark markings. First vein setulose from base of node to apex above and on apical half below, third vein with a few setulae at base above and below. Halteres yellow.

* The tiny dots on the photograph are dirt, the three irregular patches on the fifth vein are pieces of wing membrane.—F.H.T.

Abdomen coloured as thorax, immaculate, with yellow bristles and hairs. Tergites subequal in length, with some lateral bristles on fifth.

Length, 3 mm.

Waterfall, N.S.W. (H. Peterson). This and other specimens from the same collector sent me by the late C. F. Baker in general sweepings. Type locality, Sydney.

PAROXYNA Hendel.

Flieg. Palear. Reg., in Lindner, xlix, Trypetidae, 1927, 146.

There are a large number of Old World species of this genus, but there is only one known to me from the Australian region.

PAROXYNA SORORCULA (Wiedemann).

Aussereur. Zweifl. Ins., ii, 1830, 509 (*Trypeta*).

A very small species characterized by the long head, slender geniculated proboscis, and slender hyaline wings with numerous small fuscous marks (Pl. xi, fig. 26).

It is recorded from many tropical and subtropical countries in the Eastern and Western Hemispheres, extending in the latter into the Patagonian region, though in the Old World confined to the warmer section. It has been described under several specific names in three genera.

I have four specimens from Tambourine Mt., Queensland (C. Deane).

Recorded from Fiji by Bezzi, and possibly occurs rather generally throughout this region, though its small size may be responsible for its being overlooked by most collectors.

Shiraki, in dealing with the Formosan Trypetidae, retained the species in the genus *Ensina* Robineau-Desvoidy despite Hendel's having placed it in *Paroxyna*.

Subfamily SCHISTOPTERINAE.

This subfamily, as I accept it, contains five genera, only one of them occurring in the region now under consideration, the others being African.

The distinguishing character consists of a deep cleft in the costal margin of the wing at the apex of the subcostal vein, the apex of the section of the costa in front of the cleft sharply angulate and with a pair of bristles that are usually quite strong and conspicuous.

Bezzi distinguished two subfamilies in the group, segregating Schistopterinae from Rhabdochaetinae by the fact that in the former there are no strong bristles on the interfrontalia in front of the ocelli, while in the other group, to which the sole representative we have to consider belongs, there are at least two strong erect bristles in front of the ocelli, usually convergent and slightly forwardly directed at their apices.

This same combination of cleft costa and interfrontal bristles is met with in some other families, notably in the Milichiidae.

RHABDOCHAETA de Meijere.

Bijd. Dierk., 17–18 Afl., 1904, 109.

There are seven described species of this genus known to me, but only one is from this region.

RHABDOCHAETA CROCKERI Curran.

Proc. Cal. Acad. Sci., xxii, No. 1, 1936, 28.

Described from the Solomon Islands and not known from elsewhere, though it may be expected to occur on adjacent island groups.

Unidentified Species from New Guinea.

Ptilona bischofi Kertész, *Term. Fuzet.*, xxiv, 1901, 427.—Bezzi says this is not a *Ptilona*.

Sophira bistriga Walker, *Jour. Proc. Linn. Soc. London*, iv, 1860, 160.—See under *Colobostrella ruficauda* Hendel, in text.

Trypeta brevivitta Walker, op. cit., viii, 1865, 124.—Genus doubtful.

Ptilona lateralis Kertész, *Term. Fuzet.*, xxiv, 1901, 428.—A *Rioxa* according to Bezzi.

Trypeta indistincta de Meijere, *Nor. Guin.*, ix, Zool. livr. iii, 1913, 364.—Genus ?.

Acanthoneura sexguttata de Meijere, *Nor. Guin.*, ix, Zool. livr. iii, 1913, 364.

Acanthoneura debeauforti de Meijere, op. cit., v, 1906, 94 (*Rioxa*).

Acanthoneura insignis de Meijere, op. cit., ix, Zool. livr. iii, 1913, 366.—See under *Pseudacanthoneura septemnotata*, n. sp. in text.

Rioxa (?) *nivistriga* Walker, *Journ. Proc. Linn. Soc. Lond.*, v, 1861, 246 (*Helomyza*).

Themaroides (?) *optatura* Walker, op. cit., viii, 1865, 116 (*Helomyza*).—Czerny has said this is the female of *quadrifera* Walker.

"*Helomyza*" *ortalioides* Walker, op. cit., viii, 1865, 116.—A Trypetid.

Dacus speculifera Walker, op. cit., viii, 1865, 122.—A *Callistomyia* ? according to Bezzi.

Ptilona variabilis Kertész, *Term. Fuzet.*, xxiv, 1901, 426.—Not a *Ptilona* according to Bezzi.

Dacus biarcuatus Walker, *Jour. Proc. Linn. Soc. London*, viii, 1865, 122.—Allied to *Callistomyia* according to Bezzi.

Addendum, by F. H. Taylor.

It has been suggested to me that a few remarks on the method adopted to make the photographs of the wings would be of service.

First of all the wing is taken off the fly with a sharp pointed pair of forceps and placed in absolute alcohol. It is then mounted direct into Euparal and weighted down with a small bottle of mercury, a half-dram vial serves the purpose, until the Euparal has set.

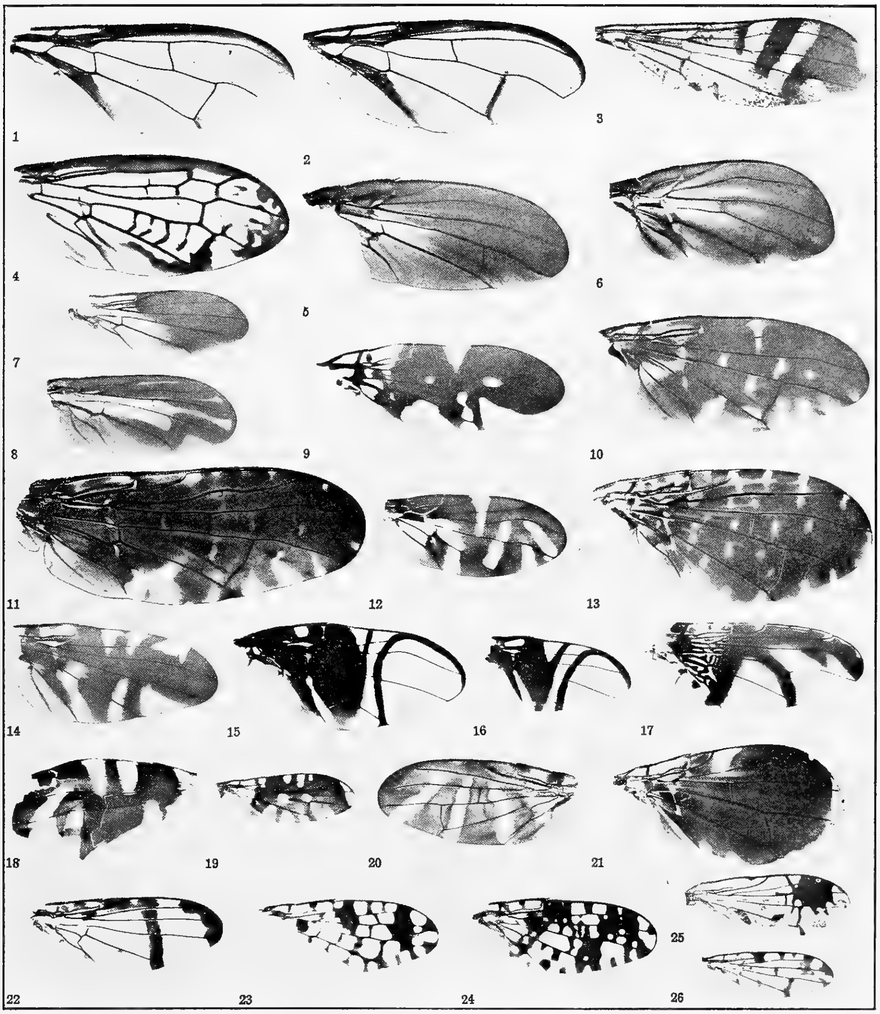
Any good type of projection lamp will serve as the illuminant for the camera. The lens should be of 3·5 cm. focal length; no eye-piece is used. The plate or cut film is "Process". It is a great mistake to use any other type of plate or film as it is essential to have complete control over the negative during development. The developer used is the "Kodak" process formula, Hydroquinone-Caustic Potash. The negative must not be overdeveloped.

Wings showing a lot of "pattern" are comparatively easy to photograph, requiring from two to five seconds' exposure at f. 6·3. Wings which have very little or no "pattern" should have not more than one second exposure at the above lens stop, should be slightly underdeveloped and then intensified. The mercury-ammonia intensifier serves the purpose.

When the negatives are dry the background must be completely blocked out with "Opaque", using a fine sable-hair brush to go round the wing. A hand lens should be used to see that the "Opaque" does not encroach on the wing.

Any slow gaslight paper with a glossy surface will give excellent prints from negatives produced by the above means.

There is no necessity to retouch the wings in any way, as the veins stand out quite well.



New Guinea Trypetidae.

EXPLANATION OF PLATE XI.

Fig. 1.—*Dacus papuaensis,* n. sp. Wing, type. × 6·5.
Fig. 2.—*Dacus albolateralis,* n. sp. Wing, type. × 6·5.
Fig. 3.—*Pseudosophira bakeri,* n. sp. Wing, type. × 5.
Fig. 4.—*Polyara insolita* Walker. Wing. × 5.
Fig. 5.—*Themarohystrix flaviceps,* n. sp. Wing, paratype. × 5.
Fig. 6.—*Themarohystrix suttoni,* n. sp. Wing, paratype. × 6·5.
Fig. 7.—*Clusiosoma biseriata,* n. sp. Wing, paratype. × 6·5.
Fig. 8.—*Clusiosoma puncticeps,* n. sp. Wing, type. × 6·5.
Fig. 9.—*Acanthoneura nigriventris,* n. sp. Wing, type. × 5.
Fig. 10.—*Neothemara formosipennis* Walker. Wing. × 5.
Fig. 11.—*Pseudacanthoneura septemnotata,* n. sp. Wing, type. × 5.
Fig. 12.—*Diarrhegmoides hastata,* n. sp. Wing, allotype. × 6·5.
Fig. 13.—*Hexacinia multipunctata,* n. sp. Wing, paratype. × 6·5.
Fig. 14.—*Pseudina buloloae,* n. sp. Wing, type. × 6·5.
Fig. 15.—*Anomoea nigrithorax,* n. sp. Wing, type. × 6·5.
Fig. 16.—*Pseudospheniscus taylori,* n. sp. Wing, type. × 6·5.
Fig. 17.—*Ceratitella loranthi* (Froggatt). Wing. × 6·5.
Fig. 18.—*Tephrella australis,* n. sp. Wing, type. × 6·5.
Fig. 19.—*Spathulina acroleuca* (Schiner). Wing. × 6·5.
Fig. 20.—*Chrysotrypanea trifasciata,* n. sp. Wing, type. × 6·5.
Fig. 21.—*Platensina parvipuncta,* n. sp. Wing, type. × 6·5.
Fig. 22.—*Sphenella marginata* Fallen. Wing. × 6·5.
Fig. 23.—*Camaromyia bullans* Wied. Wing. × 6·5.
Fig. 24.—*Tephritis pelia* Schiner. Wing. × 6·5.
Fig. 25.—*Trypanea glauca* Thoms. Wing. × 6·5.
Fig. 26.—*Paroxyna sororcula* Wied. Wing. × 6·5.

Note re *Ceratitella* (pp. 442, 452 supra), added 6 September, 1939.—The Formosan genus *Paratrirhithrum* Shiraki (*Mem. Fac. Sci. and Agric., Taihoku Imp. Univ., Formosa,* viii, 1933, Ent. No. 2, 137) differs in having the third antennal segment tapered to the narrowly rounded apex, the apex of the subcostal vein farther from the apex of the first and the latter running into the costal vein at a much more acute angle, not almost rectangularly bent forward to join that vein, while the third vein is much more arched on its apical portion, the apex being distinctly more deflected. The scutellum is also entirely black, though this is hardly a generic character.

THE ASSOCIATION BETWEEN THE LARVA DESCRIBED AS *TROMBICULA HIRSTI* VAR. *BULOLOENSIS* GUNTHER 1939, AND *TROMBICULA MINOR* BERLESE 1904. (ACARINA: TROMBIDIIDAE.)

By CARL E. M. GUNTHER, M.B., B.S., D.T.M. (Sydney), Field Medical Officer, Bulolo Gold Dredging Limited, Bulolo, Territory of New Guinea.

(Three Text-figures.)

[Read 27th September, 1939.]

Previous work on Trombidiid Nymphs and Adults.

Apart from Hirst's paper on the nymphal form of the "Harvest bug" (1926), I have not had access to the original articles on the subject, but am indebted to a paper by Warburton (1928) for the following information.

Brandis first, in 1897, bred nymphs from the European Harvest Bug, *Leptus autumnalis* Shaw, in sterile earth; these were of the general *Trombicula* form, and suggested *T. holosericeum.*

Then, in 1906, Miyajima obtained nymphs of *Microtrombidium akamushi*; and, in 1916, he and Okumara bred adults and established this larva as belonging to the genus *Trombicula.*

Ewing is mentioned as stating that *Leptus irritans* has been bred to the adult, and that the latter belongs to the genus *Trombicula* also.

Meanwhile Bruyant obtained one nymph from *Leptus autumnalis* in 1910, but there is some doubt about its identification with the adult *Microtrombidium pusillum* Hermann, to which it was at first assigned.

Finally, in 1925, Hirst bred out a single female nymph from the harvest bug, and definitely established it as belonging to the genus *Trombicula.*

Apart from these, no other larval species has so far been linked up with its corresponding adult, although both larvae and adults, separately, have been thoroughly worked out.

TROMBICULA MINOR Berlese.

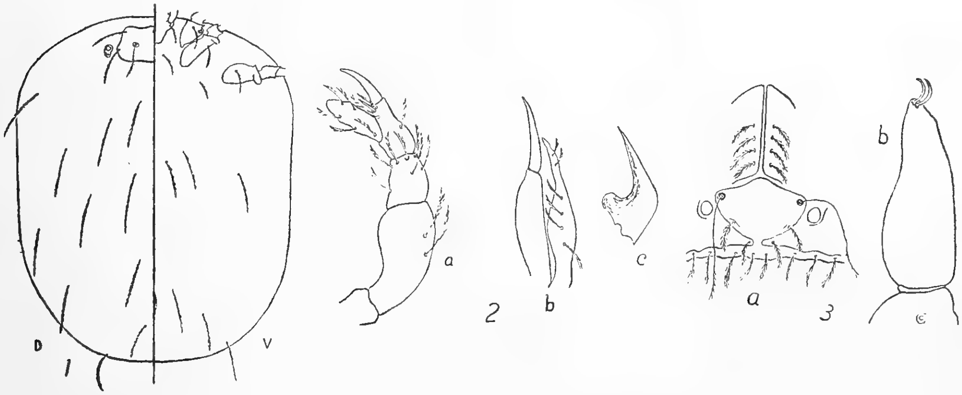
Redia, ii, fasc. 2, 1904 (1905), 155.—*T. hirsti* var. *morobensis* Gunther 1938, 202, nom. nud.—*T. hirsti* var. *buloloensis* Gunther 1939, 78.

This larva occurs in great numbers in the Morobe District on the mainland of New Guinea. Of approximately 3,000 larval mites taken in four years, it numbered about 2,700; the remainder were distributed over 13 other species. It has been found on nine hosts: Man, Bush pig (*Sus papuensis*), Bandicoot (*Echymipera cockerelli*), Bush turkey (*Talegallus jobiensis*), Bush fowl (*Megapodius duperreyi*), Ground pigeon (*Gallicolumba jobiensis*), Cassowary (*Casuarius casuarius*), Rail (*Amaurornis moluccanus nigrifrons*), and Rail (*Porphyrio melanotus*).

The larva is shown in Figure 1, which is from my detailed description of the species (1939). The probable association of this larva with endemic typhus in New Guinea has been discussed (1938).

While investigating this larva, I was so fortunate as to breed out 23 nymphs, and to obtain four specimens in intermediate stages. It was, however, Mr. H. Womersley who, after checking my material, pointed out that, as far as can be determined, these nymphs are identical with *Trombicula minor* Berlese 1904, which I had not recognized. The credit, therefore, belongs to him for this discovery.

Preparation of breeding jars.—A wide-mouthed clear-glass jar with a ground-glass stopper, of 4 ounces capacity, was used. Dry soil was finely crumbled and placed in the jar to a depth of one-quarter of an inch. The open jar and its stopper were then sterilized in an autoclave. When cool, sterile water was added drop by drop until, by stirring with a glass rod, the soil was evenly moistened, care being taken not to add enough water to cause caking of the soil or the formation of mud. The stopper was smeared with a little sterile soft paraffin.



Figs. 1-3. *Trombicula minor.*

Fig. 1.—Composite dorsal and ventral diagram, *T. minor*, larva.

Fig. 2.—*T. minor*, nymph. *a*, Dorsal view of palp. *b*, Dorsal view of chelicera and cheliceral sheath. *c*, Lateral view of chelicera.

Fig. 3.—*T. minor*, nymph. *a*, Crista. *b*, First tarsus.

Obtaining and checking larvae.—A freshly-shot bush fowl or other host was examined with a hand-lens and all sections of skin bearing large larvae were cut out and placed in white china pots with screw-on lids. These were allowed to stand all night; by morning most of the larvae had detached themselves. The largest were placed one at a time in a hollow-ground slide, covered with a cover-slip, and examined with the low power. Once one is accustomed to the salient characteristics of the species, only a few seconds are needed to identify each larva and to determine whether it is sufficiently engorged to be worth trying out.

When checked they were dropped into the jar. By selecting a number of very large larvae there is some chance of obtaining a few which are sufficiently engorged to go on to the nymphal stage without seeking a fresh host for a further feed. Some of the largest were often found hidden beneath the sections of skin; this I believe to be an indication that they are ready to bury themselves and prepare for metamorphosis.

Too large a number in one jar makes subsequent checking too complicated. It was finally found that from 10 to 15 was a convenient number.

Only vigorous and active larvae were selected. It was found too tedious inducing them to climb onto a needle-point and to hold on while being transferred from the pots; a convenient method is to lay the pot on its side, chase a larva out with a needle, and induce it to climb on to a rectangular coverslip held in its path.

When the desired number had been tallied into the jar, the stopper was inserted and the jar placed on a window-ledge where it would get as much direct sunlight as possible. It was found that in jars kept in the shade, moulds covered the soil in a few days. The heat of the sun, however, causes water from the soil to condense on the shady side of the jar; if too little water has been added originally, the soil becomes dry and caked, and more sterile water has to be dropped in.

Behaviour of larvae.—Some of the larvae bury themselves in the soil immediately; others climb the sides of the jar, usually becoming imprisoned in the drops of water on its sides. At first the plan of freeing these latter with a bent wire and dropping them back on the soil was followed, but as they invariably set out to climb up the sides again, it was decided that they were probably in search of another host. It was thought simpler to remove all such larvae on the second and subsequent days. All larvae so removed were checked again under the microscope.

It was found that even after being held in a drop of water for several days most larvae would begin to walk about within a few seconds of being placed on a piece of filter-paper to dry. The longest period noted was 20 days, mostly spent in water; 4 such larvae, when dried and examined, although unable to move about, or even to turn themselves over, still made feeble movements with their legs.

Some of the earlier batches had in their jars slices of apple, banana, paw-paw, liver, or steak, transfixed with a toothpick and placed upright. Moulds grew rapidly and made it impossible to breed out any nymphs, but it was noted that even newly-hatched larvae were not particularly attracted to any of these substances, and none gave any appearance of feeding on them. The method was abandoned.

Breeding-time.—From four batches a total of 23, comprising 7 living nymphs and 16 dead nymphs, was collected; the periods ranged from 17 to 20 days from the time they were placed in the jars. From two batches transitional forms were obtained. From nine batches there was no result.

Assuming that the larvae, when they were put into the jars, were so nearly engorged as to make no difference, this fixes the time for emergence of the nymph under these conditions at from 17 to 20 days. Most of the dead ones were found on the 19th and 20th days, and most of the living ones on the 18th day, which makes me inclined to fix the average time at from 17 to 18 days.

There is, of course, no means of telling whether this is the usual time under natural conditions—it is possible that the temperature and humidity inside the jar are higher than is usually found in nature, and that they may therefore have forced earlier development. It is unlikely that these conditions could have retarded development. Hirst's nymph took 33 days to emerge, but it had its habitat in a much colder climate, and its hatching-time would reasonably be expected to be longer.

When they first emerge, the nymphs are extremely soft and fragile, and easily break up with even the most careful handling. They harden after several hours, but in these breeding-jars they apparently do not live long. Once dead, they shrivel rapidly. For these reasons, most of the present specimens were of no use for detailed study when mounted.

Transitional stage.—In one jar which had too little moisture, the soil became absolutely dry. On the 24th day, since no nymphs had emerged, the soil was gently crumbled and searched. One apparently dead larva was found, but on examination it proved to be an intact larval skin, colourless and transparent, the legs and palpi empty, but containing within the body a pupa-like mass. This mass was orange in colour; its posterior margin had the shape of the posterior pole of a nymph, and bore typical setae; anteriorly there was no projection of any cephalothorax; but ventrally, outlines suggestive of immature folded legs were quite distinctly visible.

From another batch three living nymphs and three specimens in transitional stages were obtained. One of the latter group was much further advanced than the one described above, and one had partly cast its larval skin. These specimens leave no doubt that the larva, when ready for metamorphosis, withdraws inside its own skin and there goes through the nymphochrysalis stage.

The Nymphs.—Berlese's description (1904) is from damaged specimens, and is therefore incomplete. However, my specimens agree with every point in Berlese's description, except that the fore-tarsus is slightly longer and wider; but the ratio of the length to the width of the fore-tarsus (2·5:1) as laid down by Berlese is retained. Berlese's description, however, makes no mention of the number of genital suckers, so the specimens cannot be definitely stated to be adults; that they were not bred out, but were taken running free, makes the assumption that they are adults rather than nymphs possible. This, however, does not affect the validity of the comparison between my specimens and his, and his name should therefore be used.

Description of the Nymph (Figs. 2, 3).—Colour, bright orange-red. Body oval, widest at level of coxa iii, without any marked constrictions; covered with closely-set fine setae bearing long fine branches on all sides. Total length, including chelicerae, 680μ; abdomen, length 500μ, width 325μ. Coxae i and ii set close together at front of body, projecting partly beyond the margin; coxa iii two-fifths of the distance back, and coxa iv half-way back, well in from the margin. Cephalothorax projecting boldly forward. Chelicerae stout, long, sharply curved. No cheliceral teeth. Cheliceral sheaths reaching almost half-way along the chelicerae; bulbous in the middle third, which bears about five fine setae with a few branches; two fine nude setae towards the apex. Palpi long, curved, widest at the distal part of segment ii. A few fine setae with a few fine short branches on ii; on iii and iv, more similar setae. Palpal claw single, long, stout, curved, and sharp. Two accessory bristles near its base. Appendiculum long, rounded, bearing about 6 to 8 fine setae with fine branches. Crista of typical shape, as in diagram; bearing a seta 28μ long, with fine branches on all sides, at the centre of each lateral margin. Greatest width 50μ. Pseudostigmata at the anterolateral angles, 37·5μ apart. Pseudostigmatic organs filiform, 85μ long, with 4 or 5 short widely-spaced branches on the distal fourth. Eyes single, close to the crista, just lateral and posterior to the pseudostigmata. Legs each with seven segments, covered with closely-set branched setae. Two curved claws on each tarsus. Tarsus i typically long and expanded. Lengths, excluding coxae, as follows: i, 416μ; ii, 223μ; iii, 250μ; iv, 292μ. Genital opening with its anterior end opposite the posterior ends of coxa iv. Furnished with two pairs of large, roughly circular suckers. Setae: the general body-setae almost straight, with many relatively long, fine branches on all sides. On the cephalothorax the setae are of similar type, but are shorter, finer, and slightly curved. On the palpi and legs the setae are thicker, very slightly curved, and bear a few branches along the convex side only.

Acknowledgements.

My thanks are due to Mr. H. Womersley, A.L.S., F.R.E.S., of the South Australian Museum, not only for his discovery mentioned above, but also for his kindness in obtaining copies of references for me, and in checking this paper.

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OBSERVATIONS ON THE LIFE HISTORY OF *NEOSCHÖNGASTIA KALLIPYGOS* GUNTHER 1939. (ACARINA: TROMBIDIIDAE.)

By Carl E. M. Gunther, M.B., B.S., D.T.M. (Sydney), Field Medical Officer, Bulolo Gold Dredging Limited, Bulolo, Territory of New Guinea.

(Two Text-figures.)

[Read 27th September, 1939.]

Neoschöngastia bipygalis, nom. nov.

N. kallipygos Gunther, Proc. Linn. Soc. N. S. Wales, lxiv, 1939, 83.

Owing to the regrettable use of the specific name *kallipygos* by Derrick, Smith, Brown and Freeman (1939), before the species was described, a change of name becomes necessary.

Life History.—As far as is known the life history of the trombidiid mites is as follows:

According to Patton and Evans (1929) it is likely that the eggs are laid singly in the ground.

The larvae are mostly parasitic on birds and mammals—the genus *Hannemania* is confined to frogs. When ready for metamorphosis the larvae bury themselves in the ground (this has been observed for *Trombicula akamushi*, *Leptus autumnalis*, and *Trombicula minor*).

The nymph is reported to be parasitic on other arthropods, although there is a possibility that it is a vegetable feeder.

The adult is supposed to live in decaying vegetable matter on the forest floor, or in the sand and silt left by floods, and by assumption (Hirst, 1926), in the nests of field mice.

Nowhere is there any mention of the adult or nymph being parasitic on either birds or mammals, nor is there any record of ova being found cemented to fur or feathers in the manner of louse ova.

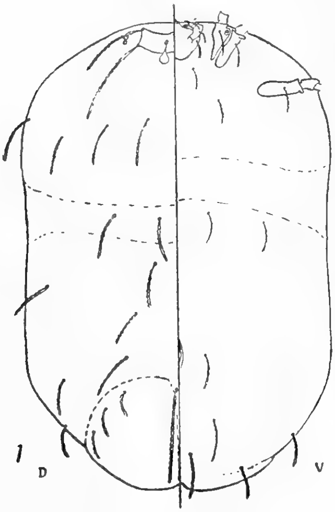
The larvae of *Neoschöngastia bipygalis* occur in New Guinea as parasites on the following hosts: The brown bush rat (*Rattus ringens*), Brown's rat (*Rattus browni*), Monckton's melomys (*Melomys moncktoni*), Stalker's melomys (*Melomys stalkeri*), the rufous melomys (*Melomys rubex*), an arboreal "mouse" (*Melomys* sp.), Bandicoot (*Echymipera cockerelli*), and Bandicoot (*Peroryctes raffrayana*).

On the first five of these it can be found in large numbers embedded around the mammae, or in the penis, and on the bare parts of the hind legs; specimens have also been taken running free in the fur. From the other three hosts only a few specimens have been taken. It seems likely that the rats are the principal hosts, the others being only casual hosts.

On each of the five principal hosts are to be found many ova cemented to the abdominal hairs. Some are undifferentiated, but in those in late stages of development the details of the contained larvae can clearly be seen through the shell.

They show the characteristic scutum, first tarsi, dorsal setae, chelicerae, and caudal plates of the normal larva, *Neoschöngastia bipygalis* (Fig. 1, which is the illustration of this larva from my detailed description, and Fig. 2*b*).

There is no possibility that these ova may have been laid in the nests of the rats, and have become entangled in their fur, for they are definitely cemented to bundles of 5 to 10 hairs at their bases, and the larva lies always in the same relative position in the ovum.



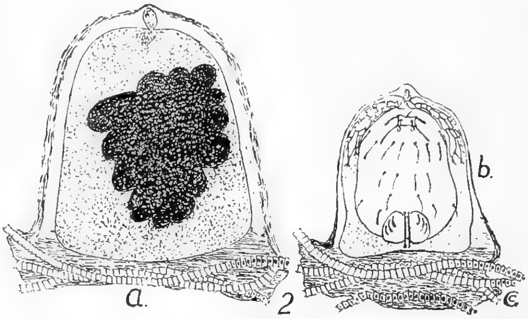


Fig. 1.—Larva of *N. bipygalis.*
Fig. 2.—*a,* Undifferentiated ovum; *b,* Ovum in late stage, showing contained larva.

The adult female must certainly be a parasite of these hosts for as long as it takes her to deposit her eggs. Nothing further can be assumed positively, but the possibilities are:

1. That the adults live in the nests of these rats, and that the ovigerous females deposit their eggs while the rats are sleeping. If this be so, then investigation of nests should result in specimens of adults being taken.

2. That the ovigerous female is a normal parasite of the rats—which would demand that it resembles, for instance, one or other of the two suborders of lice—and that it lives either by sucking or by biting. In this case, adults should be found on the rats.

In view of the fact that nobody knows what the adults of the larval genus *Neoschöngastia* look like, the question is not likely to be settled until the nymph at least can be bred, although the finding of an ovigerous female bearing an ovum of the typical shape and size would be conclusive.

I have tried with ten larvae to breed nymphs, using the technique which was successful with *Trombicula minor*, but the larvae neither buried themselves in the soil nor made any considerable efforts to crawl around; they just died.

So far I have been unable to obtain any rats' nests, nor have I found any promising adults on rats. For the present, therefore, all that can be done is to describe the ova, and point out that their presence on the abdominal hairs of various rats indicates for this species a radical variation from what we know of the normal life history of the Trombidiidae.

OVUM (Figures 2*a*, *b*).

Location: Found cemented to the abdominal hairs of various New Guinea rats: *Rattus ringens*, *R. browni*, *Melomys moncktoni*, *M. stalkeri*, and *M. rubex*. Colour a dirty yellow to light brown. Bell-shaped, cemented to the hairs at its base. The walls consisting of a lining layer, a clear centre, and an outer laminated layer. The apex produced into a small conical tubercle. The larva lying with its head away from the base, its chelicerae projecting into the conical tubercle. The undifferentiated ovum is larger, with thick walls. As the larva matures the shell shrinks and becomes thinner, the latter mainly due to shedding of the outer laminated layer. Average measurements: Height, early, 541μ; mature, 380μ. Width at base: early, 508μ; mature, 370μ. Width across equator: early, 412μ; mature, 270μ. Thickness of shell: early, 141μ; mature, 70μ.

Acknowledgement.

Mr. H. Womersley, A.L.S., F.R.E.S., has been so kind as to check this paper for me.

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TAXONOMIC NOTES ON THE ORDER EMBIOPTERA. VI–X.

By Consett Davis, M.Sc., Lecturer in Biology, New England University College, Armidale.*

(Eighty-three Text-figures.)

[Read 27th September, 1939.]

PART VI. THREE NEW ASIATIC GENERA RELATED TO *EMBIA* LATREILLE.

(Thirty-two Text-figures.)

Genus Metembia, n. gen.

Genotype, *Metembia ferox*, n. sp.

Indian Embioptera closely related to *Embia* Latreille (s. str.), but with two ventral bladders on the first segment of the hind tarsi.

♂. Wings as in *Embia*, with R_{4+5} clearly forked, M simple, and Cu two-branched, except for individual anomalies; terminalia with tenth abdominal tergite completely cleft, right hemitergite as in *Embia*, with a short posterior process directed inwards and downwards, and an inner flap-like process separated from the remainder of the hemitergite, except posteriorly, by a membraneous area. Process of left hemitergite simple, acute. First segment of left cercus with two internal lobes, armed with large sharp teeth.

Metembia ferox, n. sp. Figs. 1–3.

♂. Length 6·5–8·5 mm.; head 1·2–1·5 mm. × 0·9–1·1 mm. Forewing 4·4–6·0 mm. × 1·0–1·2 mm.; hindwing 4·0–5·0 mm. × 1·0–1·2 mm. Antennae incomplete. General colour very dark brown, eyes black, longitudinal bands on wings smoky-brown. Head (Fig. 1) with eyes small, sides behind eyes scarcely converging, smoothly rounded behind. Wings as in generic description, fork of R_{4+5} subequal to stem, all veins well-developed; cross-veins variable, fairly numerous. Hind tarsi with two well-developed ventral bladders on first segment, one on second. Terminalia (Figs. 2–3) with ninth abdominal tergite (9) very short, slightly asymmetrical; tenth tergite completely cleft longitudinally, right hemitergite (10R) produced downward and inward to a tapered, acute process ($10RP_1$); inner margin of 10R with an elongate flap-like process ($10RP_2$), separated from 10R by membrane except at posterior end. Left hemitergite (10L) produced backward from its inner margin to a slender process (10LP), acutely tapered, curving outward very slightly. Right cercus composed of two subequal subcylindrical segments (RC_1, RC_2), arising from a well-developed pad-like cercus-basipodite (RCB). First segment of left cercus (LC_1) with inner margin produced to two rounded lobes, the basal one more dorsal, the distal more ventral in position; both lobes furnished with a number of sharp, prominent teeth. Second segment (LC_2) subcylindrical. Ninth sternite (H) produced backwards to a short blunt lobe (HP), between which and the base of LC_1 is the left cercus-basipodite (LCB), acute, curved outwards.

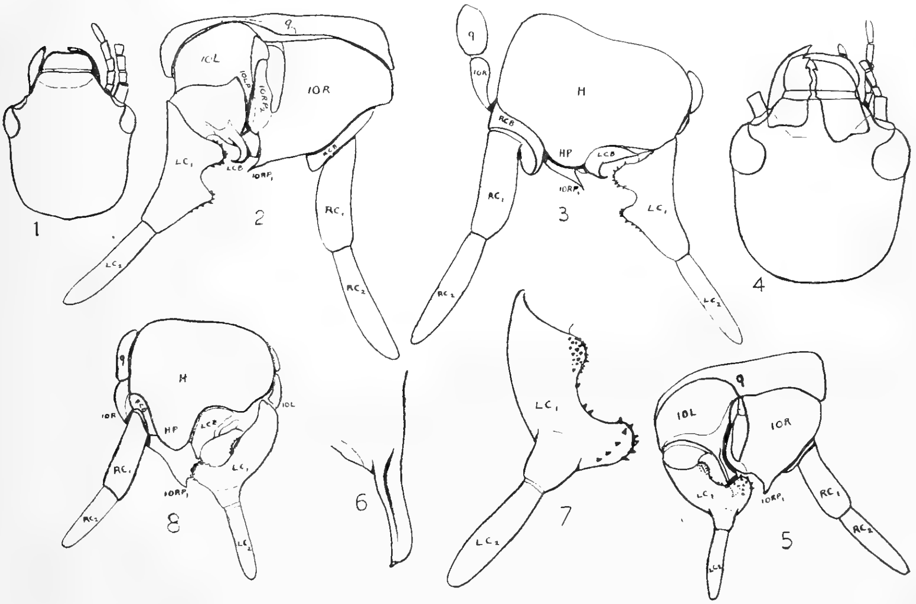
* Part of the work embodied in this paper was carried out when the writer held a Linnean Macleay Fellowship in Zoology.

♀. Eight females, from the same locality as the males, are probably referable to this species. They are not of taxonomic importance.

Locality.—Nedungadu, Southern India, coll. P. S. Nathan, 13 males, and 8 females probably conspecific. Holotype male, 11 paratype males, and females, Museum of Comparative Zoology, Harvard University; one paratype male in the Macleay Museum, Sydney University.

Metembia immsi, n. sp. Figs. 4–8.

♂. Length 14 mm.; head 2·0 mm. × 1·8 mm.; forewing 8 mm. × 1·8 mm.; hindwing, length and breadth as forewing. Antennae incomplete. General colour mid-brown, head darker, eyes black. Wing-veins dark brown, bordered by pale smoky-brown bands. Head (Fig. 4) as in the preceding species, but relatively broader, the eyes relatively larger; left mandible with three acute teeth, right with two, on inner face. Wings as in the preceding species, R_{4+5} simple in the right forewing of the type; cross-veins numerous, 2–4 from costa to R_1, 4–6 from R_1 to R_{2+3}, 1–2 from R_{2+3} to R_{4+5}, 0–1 from R_4 to R_5, 2–3 from sector to media, 0–1 from media to Cu_{1a}. R_1 dichotomizes terminally, one branch going to the costa, the other to R_{2+3}. Hind tarsi as in the preceding species. Terminalia (Figs. 5–8)



Figs. 1-3.—*Metembia ferrox*, n. sp., holotype ♂. 1. Head from above, × 15. 2. Terminalia from above, × 30. 3. Terminalia from below, × 30.

Figs. 4-8.—*Metembia immsi*, n. sp., holotype ♂. 4. Head from above, showing outline of mandibles, × 15. 5. Terminalia from above, × 15. 6. Process of left hemitergite from above, × 30. 7. Left cercus from above, × 30. 8. Terminalia from below, × 15.

All original figures based on camera-lucida outlines, except figures 26-27, which were prepared with constant reference to an ocular micrometer.

Conventional lettering for text-figures:

9, ninth abdominal tergite; 10L, 10R, left and right hemitergites of tenth abdominal segment; 10LP, 10RP, processes of 10L, 10R; LC_1, LC_2, RC_1, RC_2, first and second segments of left and right cerci; LCB, RCB, left and right cercus-basipodites; H, ninth abdominal sternite; HP, process of H.

similar in general arrangement to the preceding species; $10RP_1$ subobtuse; $10RP_2$ more slender; 10LP broader, with a slight dorsal flange longitudinally (Fig. 6); RCB smaller. First segment of left cercus (LC_1) very characteristic; basal lobe smaller, distal lobe strongly incurved, with stronger teeth; outer margin of LC_1 convex. Left cercus-basipodite (LCB) subobtuse, directed backwards.

♀. Unknown.

Locality.—Shimoga, Mysore, India: River Tunga, 1,865 ft., coll. P. S. Nathan, 1.vii.—. A single male, well preserved, in the Museum of Comparative Zoology, Harvard University (holotype). Named after Dr. A. D. Imms, to whom much of our knowledge of Indian Embioptera is due.

Key to the Species of Metembia (♂).

1. First segment of left cercus incurved, external margin convex .... *immsi*, n. sp.
First segment of left cercus not incurved, external margin concave ...... *ferox*, n. sp.

Genus PSEUDEMBIA, n. gen.

Genotype, *Pseudembia paradoxa*, n. sp.

Indian Embioptera related to *Metembia*, but differentiated by the following characters of the male terminalia: Left hemitergite with a simple posterior process, acute or truncate, and with a dorsal lobe, short and obtuse, arising from the hemitergite laterodorsally on the right of the insertion of the posterior process. First segment of left cercus with two internal lobes, the basal one small, the distal one large, both covered wholly or partly with numerous small teeth.

PSEUDEMBIA PARADOXA, n. sp. Figs. 9–14.

♂. Length 11–12 mm.; head 1·8–2·2 mm. × 1·4–1·5 mm.; forewing 9·0–9·5 mm. × 1·8–2·0 mm.; hindwing 8·0–8·5 mm. × 1·8–2·0 mm. General colour (in alcohol) mid- to pale ferruginous, eyes black, wing-veins golden-brown bordered by pale-brown bands, with rather broad hyaline inter-venal lines. Head (Fig. 9) broad, eyes rather large, sides behind eyes converging markedly. Antennae with up to 22 segments, all except first very slender; total length up to 5 mm. Wings as in *Embia*, the holotype with anomalies as follows: In both forewings, R_4 is forked terminally; in the right hindwing there is an additional pigment-band, but no vein, between Cu_{1a} and the cubital stem (Cu_{1b}). First segment of hind tarsi with two large ventral bladders. Terminalia (Figs. 10–14) with right hemitergite (10R) as in *Embia*, the posterior process ($10RP_1$) short, acute, the inner process ($10RP_2$) elongate, slenderly tapered in front. Left hemitergite (10L) complex, with a large laterodorsal lobe directed to the right, short and obtuse, and an elongate posterior process (10LP), curving downwards terminally, irregularly tapered, acute (Figs. 11, 12). Right cercus with two subcylindrical segments (RC_1; RC_2), with a basal annular cercus-basipodite (RCB). First segment of left cercus (LC_1) complex, outer margin convex, inner margin with a small basal lobe dorsally, furnished with small teeth; inner margin distally dilated inwards, dilation with a large concavity for the accommodation of the basal lobe of the left hemitergite; small teeth present on a blunt lobe dorsad to the concavity; ventral parts of distal lobe smooth (Fig. 13). Hypandrium (H) produced to an obtuse process (HP) to the right of the mid-line; left cercus-basipodite (LCB), between HP and base of LC_1, with a short blunt median process.

♀. Unknown.

Locality.—India: Namkum, Ranchi, Bihar, coll. W. B. R. Laidlaw, 1928 (holotype ♂ and paratype ♂ in the British Museum).

PSEUDEMBIA TRUNCATA, n. sp. Figs. 15–19.

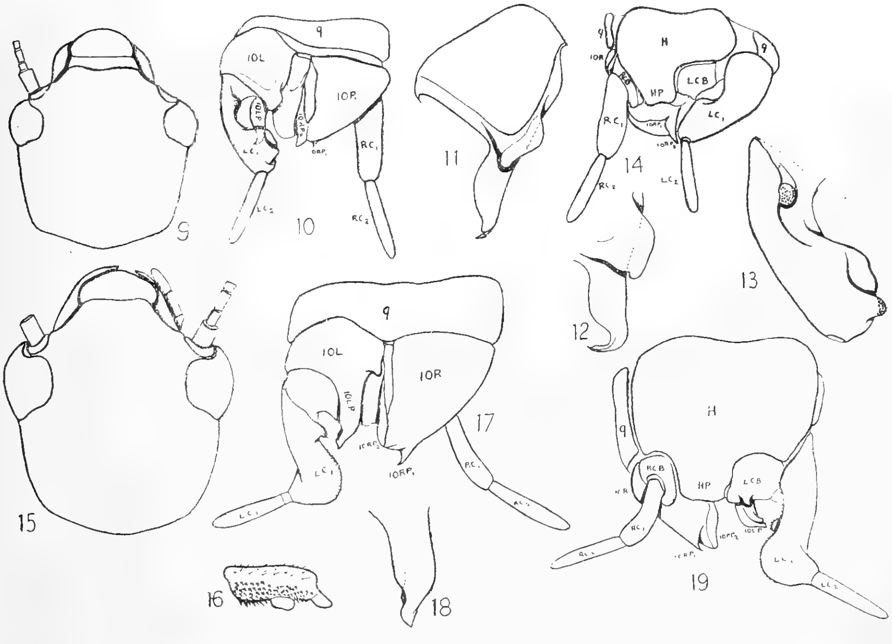
♂. Length 14 mm.; head 2·4 mm. × 2·0 mm.; forewing 12 mm. × 1·9 mm.; hindwing 11 mm. × 1·9 mm. Antennae incomplete. General colour as in *Ps. paradoxa*, darker, probably due to dry state of specimen. Head (Fig. 15), wings, and hind tarsi (Fig. 16) as in *Ps. paradoxa*, wings without venational anomalies. Terminalia (Fig. 17–19) resembling *Ps. paradoxa*, but with the distal part of the inner margin of the first segment of the left cercus (LC_1) smoothly dilated, without any concavity, and evenly furnished with small teeth; basal lobe of left hemitergite correspondingly smaller. Process of left hemitergite (10LP) obliquely truncate terminally (Fig. 18).

♀. Unknown.

Locality.—Shimoga, Mysore, R. Tunga, 1,865 ft.; coll. P. S. Nathan, 13.iv.—(holotype ♂ in the Museum of Comparative Zoology, Harvard University).

Key to the Species of Pseudembia (♂).

1. Distal part of inner face of first segment of left cercus with a large concavity; left hemitergite with a large obtuse basal lobe .... *paradoxa*, n. sp.
   Distal part of inner face of first segment of left cercus smoothly dilated; basal lobe of left hemitergite small .... *truncata*, n. sp.



Figs. 9-14.—*Pseudembia paradoxa*, n. sp., holotype ♂. 9. Head from above, × 15. 10. Terminalia from above, × 15. 11. Left hemitergite from above, × 30. 12. Distal part of left hemitergite viewed laterodorsally from the left, × 30. 13. First segment of left cercus from above and slightly to the right. × 30. 14. Terminalia from below, × 15.

Figs. 15-19.—*Pseudembia truncata*, n. sp., holotype ♂. 15. Head from above, × 15. 16. First segment of hind tarsus viewed laterally, × 30. 17. Terminalia from above, × 15. 18. Process of left hemitergite from above, × 30. 19. Terminalia from below, × 15.

Genus PAREMBIA, n. gen.

Genotype, *Oligotoma valida* Hagen, 1885, *Canad. Entomologist*, 17, p. 150.

Embioptera closely related to *Embia* Latreille, but with two relatively large ventral bladders on the first segment of the hind tarsi. Venation and terminalia not generically distinguishable from *Embia*.

Metembia differs from *Parembia* in the bilobed, strongly-toothed first segment of the left cercus; *Pseudembia* differs in the complex form of the left hemitergite; its left cercus has the first segment bilobed, as in *Metembia*, but the teeth are small, as in *Parembia*.

PAREMBIA VALIDA (Hagen, 1885). Figs. 20–24.

Oligotoma valida Hagen, 1885, l.c.—*Embia major* Imms, 1913, *Trans. Linn. Soc. London*, Zool., xi, p. 1.

Under *Oligotoma michaeli* M'Lachlan, Hagen (l.c.) described a female from Amballa, Kumaon Himalayas, introducing the name *Oligotoma valida*, and thereafter considering the specimen as *O. michaeli*. This female is in the Museum of Comparative Zoology, Harvard University, with the label 'O. valida Hagen*; fem. of O. michaeli; Mon. Emb. 150' in Hagen's writing. The asterisk is Hagen's characteristic type designation. The specimen is conspecific with the species well described from both sexes by Imms (l.c.) as *Embia major*. It is regrettable that Hagen's name must displace that of Imms, by priority; knowledge of the species will, however, be due to Imms's excellent description, although the name is displaced.

Hagen's specimen agrees in colour and size (18 mm.) with Imms's series, and has the characteristic number of hind metatarsal bladders (two). It is, of course, no relation to *Oligotoma michaeli*; the male described from Amballa by Hagen (l.c.) is not *O. michaeli* either, but is, in fact, a large, dark specimen of *O. nigra* Hagen, the type series of which, smaller and paler, is from Egypt (Museum of Comparative Zoology).

In view of the close proximity of Amballa to Imms's localities, and of the knowledge that the species is unlikely to show variation in such a short range, since series from as far away as Mesopotamia and Bihar are scarcely more than subspecifically distinct, there seems to be no alternative but to reject the name *major*, even though Hagen's type, being a female, has no taxonomic features apart from the tarsal bladders and the exceptional size.

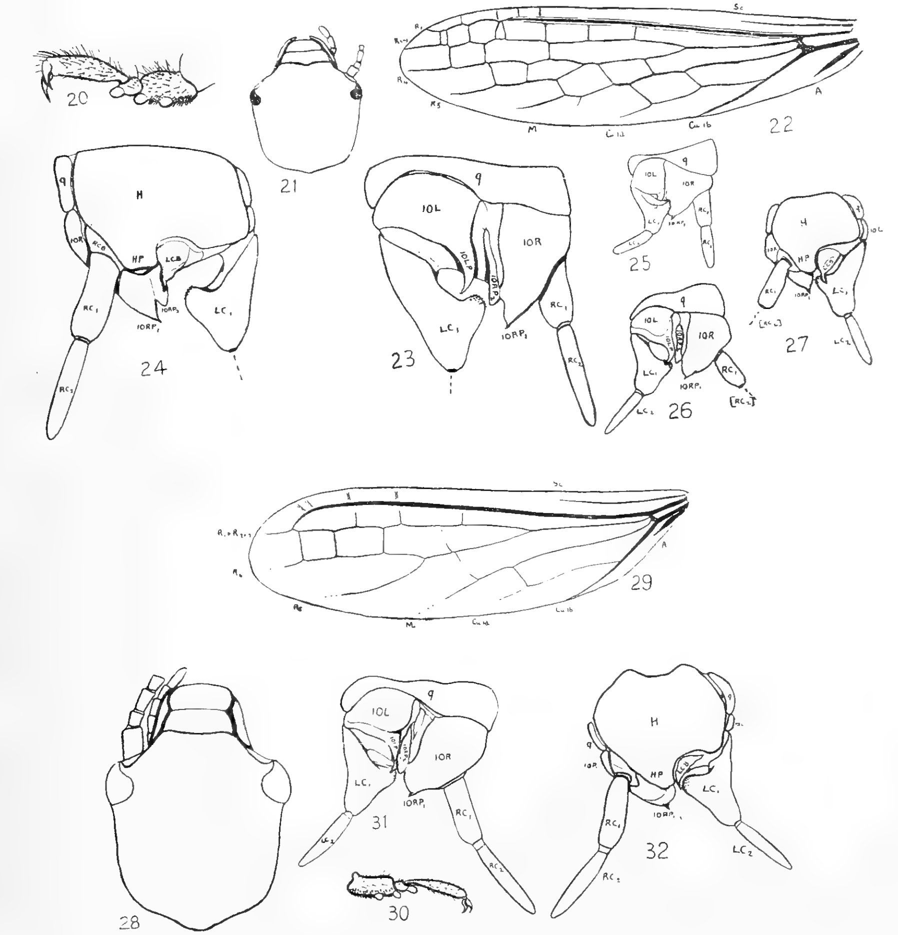
In the British Museum of Natural History there are two well-preserved specimens (♂, ♀), labelled 'Embia major Imms. Bhowali, Kumaon Himalaya, July 1912, A. D. Imms'. These are presumably intended as types, though not so labelled. I name the ♂ allotype of *Parembia valida* (Hagen).

Full details of the morphology of the species, and of individual variation, are given by Imms (l.c.). The accompanying figures (20–24) are from the specimens mentioned above (British Museum), figure 20 from the female, the rest from the male allotype. The occasional forking of the media, noted by Imms, is demonstrated in Figure 22.

PAREMBIA MINOR (Mukerji, 1927). Fig. 25.

Embia minor Mukerji, 1927, *Rec. Ind. Museum*, xxix, p. 253.

Full details have been given by Mukerji (l.c.). The differences from *P. valida* (*E. major*), as tabulated by Mukerji (l.c., p. 265) scarcely warrant more than subspecific rank, but, as I have not seen the specimens, I am unwilling to reduce the status. The size differences are significant, subspecifically at least, but the structural differences listed seem to be based on a misapprehension. Mukerji appears to base his comparison on Imms's description, not on actual specimens, of *P. valida*, and the differences noted in the compression of the ninth tergite and curvature of the process of the left hemitergite seem likely to represent merely a variation in method of preparation and in disposition of the structures when figured. The smoothness of the tarsal bladders appears to be concerned, not



Figs. 20-24.—***Parembia valida*** (Hagen) (= ***Embia major*** Imms). 20. ♀, hind tarsus viewed laterally, × 15. 21-24, allotype ♂. 21. Head from above, × 6. 22. Left forewing, × 6. 23. Terminalia from above, × 15. 24. Terminalia from below, × 15.

Fig. 25.—***Parembia minor*** (Mukerji), ♂, terminalia from above (after Mukerji, 1927, fig. 5B).

Figs. 26-27.—***Parembia persica*** (M'Lachlan), ♂ from Persia. 26. Terminalia from above, × 11·5. 27. Terminalia from below, × 11·5.

Figs. 28-32.—***Parembia persica*** (M'Lachlan), ♂ from Baghdad. 28. Head from above, × 15. 29. Left forewing, × 8. 30. Hind tarsus viewed laterally, × 15. 31. Terminalia from above, × 15. 32. Terminalia from below, × 15.

with structural difference, but with the power of the microscope used. The inner surface of the concavity of the first segment of the left cercus is not denticulate in the specimen of *P. valida* (*E. major*) here figured (Figs. 23, 24), and the 'ventral process' (left cercus-basipodite of this paper) agrees in this specimen with Mukerji's description of *P. minor*. The number of antennal segments is an unreliable criterion, being subject to individual variation and to breakage. All the structural differences noted by Mukerji seem, therefore, to be open to question.

Figure 25, after Mukerji (l.c., Fig. 5B), represents a dorsal view of the male terminalia of *Parembia minor*.

PAREMBIA PERSICA (M'Lachlan 1877). Figs. 26–32.

Embia persica M'Lachlan, 1877, *J. Linn. Soc. London*, Zool., xiii, 70, p. 382.

The type, from Shahrud, North Persia, is not in the M'Lachlan Collection (British Museum), where all M'Lachlan's other types of this Order are preserved. It may therefore be assumed to be irretrievably lost. The following description is from two males in the Paris Museum, from Bender-Bouchir, Persia (coll. Dr. Bussières, 1905). These had been identified by Navás as *Embia tartara* de Saussure 1896, which is probably a synonym of *P. persica* (M'Lachlan) (v. infra). Navás (1923, p. 9, fig. 1) has described these specimens, but his figures are inaccurate.

♂. Length 9·5 mm.; length of forewing 8 mm., of hindwing 7 mm. General colour rather pale brown, eyes black, wings mid-brown with hyaline intervenal lines (M'Lachlan's data are: Black, rather shiny; length 9·5–10·5 mm.). Venation, tarsi, and terminalia as in *P. valida* (no venational anomalies); the first segment of the left cercus (LC_1) is slightly different in form, the longitudinal channelling of the inner face, basad to the internal lobe, being less marked.

♀ (of this series) unknown (cf., however, Silvestri, 1923).

Several series from Mesopotamia (Baghdad, coll. H. Scott; Amara, Basra, coll. P. A. Buxton) are in the British Museum; they have been described by Esben-Petersen (1929*a*) and Silvestri (1923), and the terminalia adequately figured; the number of tarsal bladders has been overlooked, and Esben-Petersen gives the colour as blackish-brown (apparently following M'Lachlan), whereas, in members of the same series seen by me, it was mid- to rather pale brown.

The males agree with the above description of *P. persica*, and there seems no need to introduce the alternative name *scotti* (Esben-Petersen), unless specimens from M'Lachlan's type locality should prove different from the present specific concept.

Silvestri (l.c.) considers these specimens to be probably a subspecies of *Embia savignyi* Westwood; Esben-Petersen (1929*b*) denies this. In view of the difference in the tarsi, considered here as generic, Silvestri's view cannot be followed.

Embia tartara de Saussure 1896 (*Mitt. Schweiz. entomol. Ges.*, Bd. 9, Hft. 8, p. 352), from Turkestan, is probably synonymous with *P. persica* in the present sense. We owe our knowledge of the type of *E. tartara* to Krauss (1911, p. 67, Pl. v, figs. 22, 22A), who studied it in the Geneva Museum. He notes that the second segment of the left cercus is broken, its former attachment being evident; de Saussure considered it as unbroken and originally one-segmented. Krauss's figures of the terminalia are from the dry, unprepared specimen, and show the hemitergites as not quite tallying with the present figures (of *P. persica*); the left cercus and cercus-basipodite, however, agree closely with the present figures. The locality is probably closer to M'Lachlan's type locality than any of those listed here (Baghdad, Amara, Basra, Bender-Bouchir).

Key to the Species of Parembia (♂).

1. Inner face of first segment of left cercus, basad to echinulate lobe, not markedly channelled longitudinally. Pale to mid-brown. Mesopotamia, Persia, Turkestan .... *persica* (M'Lachlan) = *tartara* (Sauss.), = *scotti* (Esb.-Petersen)

   Inner face of first segment of left cercus markedly channelled longitudinally basad to echinulate lobe. Dark brown to black. India 2
2. Length 9·5-12·5 mm.; Bihar .... *minor* (Mukerji)

   Length 12·75-18 mm.; Kumaon Himalayas .... *valida* (Hagen) = *major* (Imms)

Note.—The above may represent three subspecies, in which case *P. persica* should be selected as type subspecies, by priority. *Embia rabaulti* Navás 1934 (*Mem. Pont. Accad. Nuovi Lincei*, Series iii, Vol. i, p. 224, fig. 101) may belong to *Parembia*, and may be synonymous with one of the above. The poor description does not allow any definite conclusion; the type (♂; Mus. Berlin) requires re-examination.

Discussion.

Apart from the hind tarsi, *Parembia* is generically inseparable from *Embia* Latreille. Its separation on this character seems to be justified geographically, and it facilitates the drawing up of a generic concept for *Embia*, and the consideration of the relationships of the more advanced *Metembia* and *Pseudembia*.

It is not possible to state whether the number of hind metatarsal bladders of *Embia* (one) or *Parembia* (two) is the more primitive condition. The Neotropical genus *Clothoda*, the most generalized recent Embiopteron in other characters, agrees with *Parembia* in this respect, but this cannot be used as a safe argument for the primitive nature of two hind metatarsal bladders on an altogether different line of descent. For instance, *Embia* and *Parembia* might possibly be derived from an extinct Old World genus with only one hind metatarsal bladder, and with generalized terminalia as in *Clothoda*.

The differentiation of *Metembia* and *Pseudembia* from *Parembia* has proceeded along two rather divergent courses, and this prevents the use of less than three generic concepts; it is impossible to consider the species of *Pseudembia* congeneric with those of *Metembia*, but not with *Parembia*, while an attempt to group the three as a single genus overlooks the close relation of *Parembia* to *Embia*, and would include three series, two of which would be more divergent from the third than the third would be from *Embia*.

Metembia has been derived from *Parembia* chiefly by modification of the first segment of the left cercus, which is parallel to that found in *Dihybocercus* or, perhaps more closely, considering the dentition, *Donaconethis*. *Pseudembia* has the first segment of the left cercus also bilobed, as in *Metembia*, but with small teeth, as in *Parembia*; its left hemitergite has been considerably modified from the simple form common to *Parembia* and *Metembia*.

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PART VII. THE GENUS *DICTYOPLOCA* KRAUSS.

(Ten Text-figures.)

Genus DICTYOPLOCA Krauss 1911.

Zoologica, Hft. 60, Bd. 23, p. 54.—Genotype, *Dictyoploca cercocyrta* Krauss, l.c.

African Embioptera, the males with the following characters: Wingless; first segment of hind tarsus with two ventral bladders; first segment of left cercus echinulate, second segment distinct, subcylindrical.

This definition of the genus (sensu Rimsky-Korsakov, 1927) separates it from *Haploembia* Verhoeff, which has the first segment of the left cercus smooth (cf. Krauss, 1911, figs. 16A, 17B). It differs from the wingless species of *Embia* Latr. (wrongly divided off as Monotylota) in the presence of an extra tarsal bladder, and in the lack of an inner flap-like process to the right hemitergite of the tenth abdominal segment.

The Australian genera *Notoligotoma* Davis and *Metoligotoma* Davis would agree structurally with the above diagnosis (the former having the males winged as well as wingless), except that they have the second segment of the left cercus reduced or absent.

DICTYOPLOCA CERCOCYRTA Krauss 1911 (l.c.). Figs. 1, 2.

♂ (after Krauss). Length 9 mm. General colour dark yellowish-brown. Head large, elliptical, evenly narrowed behind eyes. First segment of hind tarsi with two ventral bladders, the proximal one very large. Terminalia (Figs. 1–2) with tenth abdominal tergite completely cleft; right hemitergite produced back to a blunt hook-like process (10RP), directed inward and downward; process of left hemitergite (10LP) obtuse, ending spathulately. First segment of left cercus (LC_1) incurved, internally truncate and echinulate. Second segment of left cercus (LC_2), and both segments of right cercus (RC_1, RC_2), subcylindrical. Process of ninth sternite (HP) small, obtuse, directed to the left. Left cercus-basipodite small. ♀ unknown.

Locality.—Port Elizabeth, South Africa; type in Hamburg Museum.

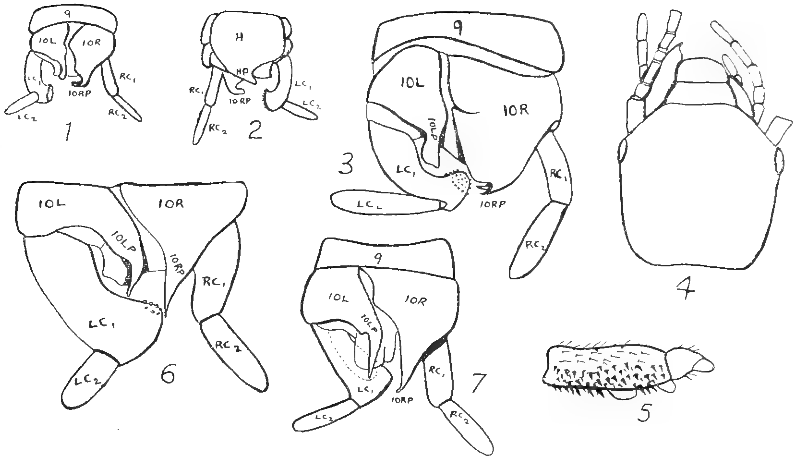
DICTYOPLOCA CAPENSIS (Esben-Petersen 1920). Fig. 3.

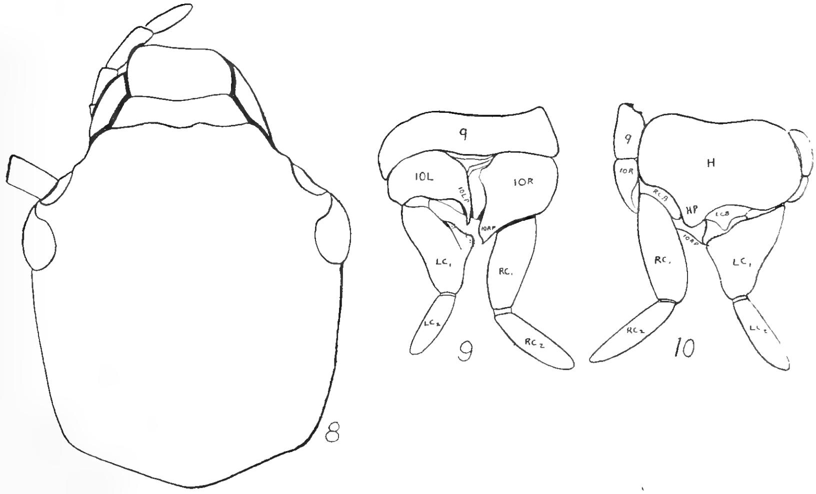
Haploembia capensis Esben-Petersen, 1920, *Ann. S. Afr. Museum*, xvii, 6, p. 503.

♂ (after Esben-Petersen). Length 10–11 mm. General colour dark brown. Head somewhat narrowed behind, with almost straight lateral margins and rounded hind angles. Hind tarsi as in preceding species. Terminalia (Fig. 3) with process of right hemitergite (10RP) bifid, directed inward; process of left hemitergite (10LP) essentially similar to the preceding species. Echinulate process of first segment of left cercus (LC_1) rounded, not truncate as in *D. cercocyrta*.

♀. Length 17 mm. Colour, and hind tarsi, as in the male.

Locality.—Dunbrody, Cape Province. Location of types not stated.





Figs. 1-2.—*Dictyoploca cercocyrta* Krauss. ♂ terminalia from above and below (after Krauss, 1911).

Fig. 3.—*Dictyoploca capensis* (Esb.-Pet.). ♂ terminalia from above (after Esben-Petersen, 1920).

Figs. 4-6.—*Dictyoploca burensis* R.-Korsakov. ♂: 4. Head from above. 5. First two segments of hind tarsus, viewed laterally. 6. Terminalia from above (after Rimsky-Korsakov, 1927).

Fig. 7.—*Dictyoploca sjöstedti* (Silvestri). ♂ terminalia from above (from Enderlein, 1912, after Silvestri, 1910).

Figs. 8-10.—*Dictyoploca rimskyi*, n. sp. Holotype ♂. 8. Head from above, × 15. 9. Terminalia from above, × 15. 10. Terminalia from below, × 15.

Magnifications for Figures 1-7 not given by respective authors. Figures 8-10 based on camera lucida outlines. Setae omitted.

DICTYOPLOCA BURENSIS Rimsky-Korsakov 1927. Figs. 4–6.

Revue russe d'Entomologie, xxi, 3-4, p. 145.

♂ (after Rimsky-Korsakov). Length 10 mm. General colour brown to black. Head as in Figure 4; hind tarsi as in Figure 5. Terminalia (Fig. 6) with process of right hemitergite (10RP) slender, acute, directed backward; process of left hemitergite (10LP) tapered, acute, margins sinuous. First segment of left cercus (LC_1) incurved, inner margin rounded and echinulate distally. ♀ unknown.

Locality.—Bura Mountains, British East Africa. Location of type not stated.

DICTYOPLOCA SJÖSTEDTI (Silvestri 1910). Fig. 7.

Embia sjöstedti Silvestri, 1910, Sjöstedt's Kilimandjaro-Meru Exped., Bd. 3, p. 41 (Stockholm).—*Haploembia sjöstedti* (Silvestri), Enderlein, 1912, Coll. de Selys-Longchamps, fasc. 3, p. 69, fig. 40.

♂ (from Enderlein, after Silvestri). Length 15 mm. General colour black, legs and cerci brownish. Head little longer than broad, posterior angles rounded. Hind tarsi as in preceding species (cf. Silvestri, l.c., Fig. 7). Terminalia (Fig. 7) with only very slight differences from *D. burensis*, e.g. the first segment of the left cercus (LC_1) less incurved, the process of the right hemitergite (10RP) curved inward terminally, and the process of the left hemitergite (10LP) straighter.

♀. Length 15·6 mm.; general colour brownish-red.

Locality.—Ngare-na-nyuki, Lower Meru, Tanganyika. Location of types not stated.

Enderlein's copy of Silvestri's figure shows the first segment of the left cercus of the male smooth. It may be assumed to be echinulate, since the species bears very great resemblance on other characters to *D. burensis*. The differences, noted above, may be due to the disposition of the parts when figured, and not to structural difference; if this were so, *D. burensis* would fall as a synonym. The two species are best considered as distinct pending further information.

DICTYOPLOCA RIMSKYI, n. sp. Figs. 8–10.

♂. Length (dry) 13 mm.; head 3·8 mm. × 2·9 mm. General colour very dark brown to black. Head (Fig. 8) similar in general form to *D. burensis*, relatively longer. Antennae very long (10 mm.), the left with 31 segments, the right with 30. Hind tarsi missing; presumably with two metatarsal bladders, as the species is in its other characters closely related to the preceding. Terminalia (Figs. 9–10) with the right hemitergite (10R) produced inward and downward to a short acute process (10RP), inner margin sinuous. Left hemitergite (10L) produced backward from its inner margin to a slender process (10LP), tapered, subacute. Right cercus composed of two subcylindrical segments (RC_1, RC_2), arising from a pad-like basipodite (RCB). First segment of left cercus (LC_1) clavate, echinulate at middle of inner face, where it is produced into a weakly-bilobed process, flattened dorsiventrally. Second segment (LC_2) subcylindrical. Process of ninth sternite (HP) obtuse, placed to the right of the mid-line; left cercus-basipodite (LCB) obtuse. ♀ unknown.

Locality.—Athi River, British East Africa, May 8–19, 1899, C. S. Betton; holotype ♂ in the British Museum of Natural History. Dedicated to Dr. M. Rimsky-Korsakov.

Key to the Species of Dictyoploca (♂).

1. First segment of left cercus incurved, truncate .... *cercocyrta* Krauss
   First segment of left cercus rounded internally 2
2. Process of left hemitergite obtuse .... *capensis* (Esb.-Pet.)
   Process of left hemitergite subacute 3

3. Process of right hemitergite short, directed inward .... *rimskyi*, n. sp.
   Process of right hemitergite long, directed backward 4
4. Inner margin of first segment of left cercus almost straight .... *sjöstedti* (Silvestri)
   Inner margin of first segment of left cercus markedly concave .. *burensis* R.-Korsakov

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KRAUSS, H. A., 1911.—Monographie der Embien. *Zoologica*, Hft. 60, Bd. 23 (Stuttgart).

RIMSKY-KORSAKOV, M., 1927.—A New Species of Embia from British East Africa. *Rev. russe d'Entomologie*, xxi, 3-4.

SILVESTRI, F., 1910.—Embiidae, in Sjöstedt's Kilimandjaro-Meru Exped. (Stockholm). (Not seen in the original.)

PART VIII. THE GENUS *DIHYBOCERCUS* ENDERLEIN, AND A NEW AFRICAN GENUS RELATED TO IT.

(Twenty-five Text-figures.)

Genus DIHYBOCERCUS Enderlein 1912.

Coll. zool. de Selys-Longchamps, fasc. 3, p. 109 (as subgenus of *Embia* Latr.).

Genotype, *Embia* (*Dihybocercus*) *severini* Enderlein, 1912, l.c.—Raised to generic rank, Navás, 1931, *Rev. Zool. Bot. africaines* (*Tervueren*), Vol. 21, fasc. 2, p. 134.

African Embioptera, the males with the following characters: Winged, R_{4+5} forked, M simple, cubitus 3-branched, the two lateral branches arising anteriorly from the stem, pectinate. First segment of hind tarsi with two large ventral bladders. Tenth abdominal tergite completely cleft; process of left hemitergite complex, with a flat latero-dorsal lobe. First segment of left cercus with inner margin produced in two lobes, both bearing numerous small teeth.

Three species: Uganda, Congo and Rhodesia.

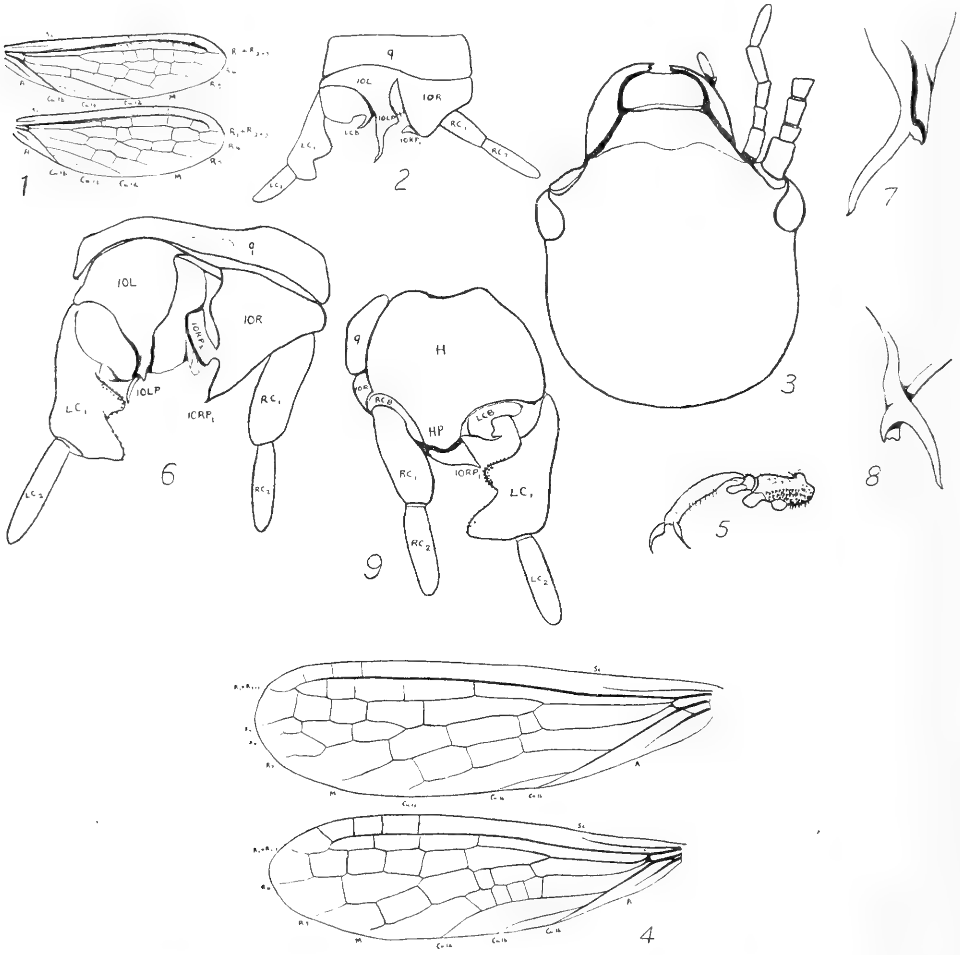
Enderlein's generic diagnosis depends on the lobes of the first segment of the left cercus, a character found in unrelated genera also (*Donaconethis* End., *Pseudembia* Davis, *Metembia* Davis, and others). The above diagnosis delimits the genus from these parallel genera. Additional points not recorded by Enderlein in the genotype (e.g. number of tarsal bladders) are deduced from the structure of a new Rhodesian species, very closely related to *D. severini*, described below.

The genus as here recognized differs from *Donaconethis* End. (sensu Davis 1939) in the number of tarsal bladders, dentition of the left cercus, and in the simplicity of the media, which tends to fork in *Donaconethis*. *Dihybocercus* appears to stand closest to *Rhagadochir* End. (s.str., i.e. congeneric, in a narrower sense than Enderlein's, with *Rh. vosseleri* End.). It is differentiated chiefly by the form of the first segment of the left cercus, which has only one echinulate internal lobe in *Rhagadochir*.

DIHYBOCERCUS SEVERINI Enderlein 1912. Figs. 1–2.

Embia (*Dihybocercus*) *severini* Enderlein, 1912, l.c.—*Dihybocercus severini* Enderlein, Navás, 1931, l.c.

♂ (after Enderlein). Length 12 mm.; forewing 9¾–11 mm. × 2·6–3·2 mm.; hindwing 9–10 mm. × 2·8–3·4 mm.; head 2¼ mm. × 1·8 mm. General colour rust-red, front of head and terminalia dark brown, legs brownish, wings brown with dark-brown veins and hyaline streaks. Head relatively broad, flattened, sides behind eyes somewhat rounded, weakly converging, hind angles rounded. Eyes prominent, fairly large. Wings (Fig. 1) as in generic description. Details of hind tarsi not given by Enderlein, but presumably with two metatarsal bladders, as in the other species. Terminalia (Fig. 2) with right hemitergite (10R) produced downwards and inwards in a short, slender, subobtuse process ($10RP_1$); inner process of 10R not detailed by Enderlein. Process of left hemitergite (10LP) long, sinuously tapered terminally, with a flat basal lobe directed upwards and to the right. First segment of left cercus (LC_1) with two rounded echinulate lobes internally; other segments of cerci (LC_2, RC_1, RC_2) subcylindrical. Left cercus-basipodite (LCB) produced outwards, ending acutely.



Figs. 1-2.—*Dihybocercus severini* End., ♂. 1. Right fore- and hindwing, × 3. 2. Terminalia from above, × 14. (After Enderlein, 1912, Figs. 72, 71.)

Figs. 3-9.—*Dihybocercus rhodesiae*, n. sp., holotype ♂. 3. Head from above, × 20. 4. Left fore- and hindwing, × 8. 5. Hind tarsus viewed laterally, × 20. 6. Terminalia from above, × 20. 7. Process of left hemitergite from above, × 40. 8. The same from below, × 40. 9. Terminalia from below, × 20.

♀ unknown.

Locality.—Belgian Congo: 311 km. from Kindia. Types (♂) in Coll. de Selys-Longchamps, Stettin Museum, and Musée du Congo, Tervueren; not seen by the author.

DIHYBOCERCUS RHODESIAE, n. sp. Figs. 3–9.

♂. Length 12–15 mm.; head 2·1 mm. × 1·8 mm.; forewing 7·6 mm. × 2·2 mm.; hindwing 6·8 mm. × 2·1 mm. General colour very dark brown, wings with dark smoky-brown bands bordering dark-brown veins, with hyaline streaks between. Head (Fig. 3) relatively broad, eyes rather small, sides behind eyes at first diverging, then smoothly rounded. Antennae incomplete. Wings (Fig. 4) as in the generic diagnosis, but with R_4 or R_5 tending to branch terminally in one or more wings: in the holotype, R_5 is simple, but R_4 is shortly bifid in both forewings. Hind tarsi (Fig. 5) with two well-developed bladders on first segment, one on second. Terminalia (Figs. 6–9) with tenth tergite completely cleft; right hemitergite (10R) triangular, posteriorly ending in an acute process ($10RP_1$), directed inward and downward. 10R with an inner subrectangular flap ($10RP_2$), connected posteriorly to 10R, anteriorly separated by membrane. Ventral to $10RP_2$ is a triangular membraneous lobe, partly concealed, chitinized only medially. Left hemitergite (10L) with a long process (10LP), terminally acute, sinuously tapered, with an irregular basal lobe dorsally and to the right (Figs. 7–8). First segment of left cercus (LC_1) similar to *D. severini*, the basal lobe placed more ventrally than the distal lobe. Ninth sternite (H) produced backward, slightly to the right of the mid-line, to an obtuse process (HP). Left cercus-basipodite (LCB) situated between HP and base of LC_1, directed outward, acutely tapered. Right cercus-basipodite (RCB) small, subannular. ♀ unknown.

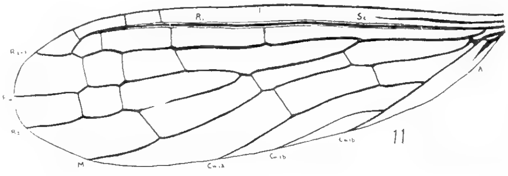
Locality.—Rhodesia (Marshall Collection; British Museum of Natural History): holotype ♂ and paratypes (♂).

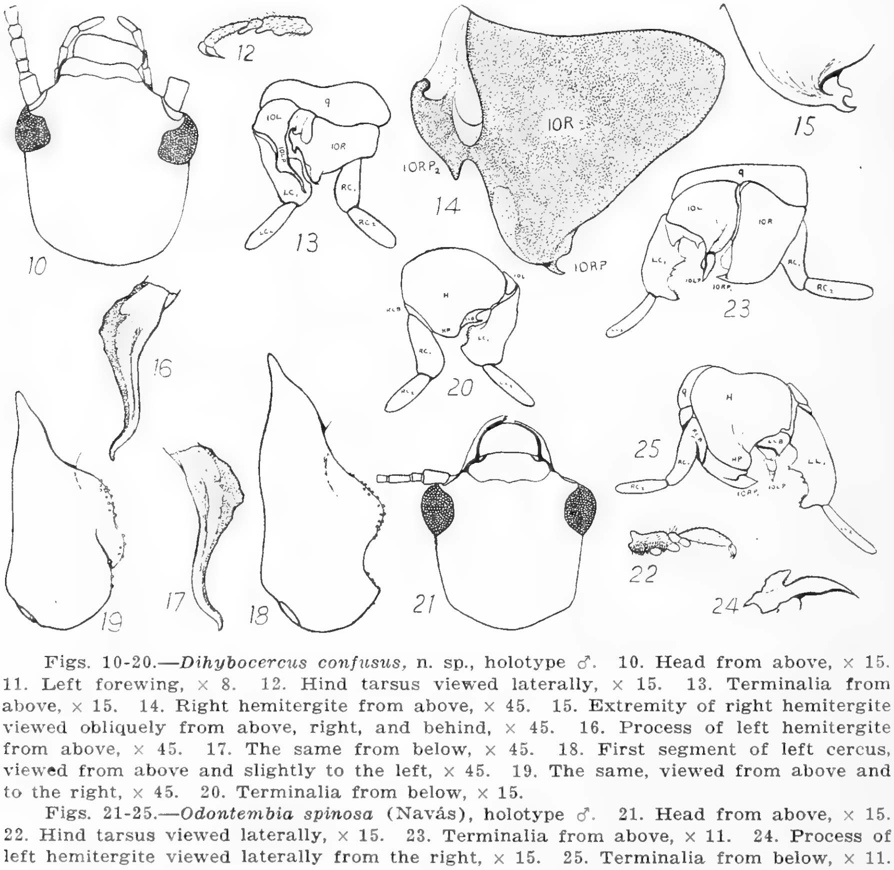
Closely related to *D. severini*. It is therefore admissible to assume similarity in the hind tarsi, ninth sternite, and inner process of right hemitergite. It differs from Enderlein's description of *D. severini* in the narrower process of the left hemitergite. In view of the possibility that this process may be viewed obliquely in Enderlein's figure, or inaccurately figured, it may be that it should be regarded as a subspecies only; the possibility of absolute synonymy cannot be discarded entirely. The present course seems the simplest way in which to place the additional generic facts on record.

DIHYBOCERCUS CONFUSUS, n. sp. Figs. 10–20.

A pinned male in the British Museum of Natural History carries the following labels: 'Gulu, W. Madi, Uganda, 5,000 ft., V-1926, G. D. Hale Carpenter'; 'Rhagadochir vosseleri End., det. Friederichs 1936'. The terminalia of the dried specimen had not been prepared; preparation showed the determination to be incorrect, and the specimen is therefore described as a new species, in the genus *Dihybocercus*.

♂. Length 9 mm.; head, length 2·0 mm., breadth 1·6 mm. Forewing 8 mm. × 2·4 mm. General colour smoky-brown, prothorax and legs (especially femora) more orange-brown, eyes black. Wing-veins dark brown, bands bordering veins smoky-brown, lines between bands hyaline. Head (Fig. 10) with eyes large, prominent, sides behind eyes slightly and smoothly converging, rounded behind. Antennae incomplete. Wings (Fig. 11) with all veins strong, cross-veins numerous, fork of R_{4+5} nearly twice length of stem. Stem of cubitus with two anterior branches pectinately. Hind tarsi (Fig. 12) with two ventral bladders on first segment, one terminal, one medial; second segment short, with a terminal bladder ventrally. Terminalia (Figs. 13–20) with tenth abdominal tergite completely divided by a longitudinal cleft; right hemitergite (10R) posteriorly curving downwards to a short spiniform process ($10RP_1$), directed outwards (Figs. 14–15), with a small concavity and then a blunt projection outside the spine. Inner margin of right hemitergite with a flat process ($10RP_2$) separated from the body of the hemitergite, except posteriorly, by membraneous areas (Fig. 14); process curving inwards anteriorly. Left hemitergite (10L) produced backwards to a slender process





Figs. 10-20.—*Dihybocercus confusus*, n. sp., holotype ♂. 10. Head from above, × 15. 11. Left forewing, × 8. 12. Hind tarsus viewed laterally, × 15. 13. Terminalia from above, × 15. 14. Right hemitergite from above, × 45. 15. Extremity of right hemitergite viewed obliquely from above, right, and behind, × 45. 16. Process of left hemitergite from above, × 45. 17. The same from below, × 45. 18. First segment of left cercus, viewed from above and slightly to the left, × 45. 19. The same, viewed from above and to the right, × 45. 20. Terminalia from below, × 15.

Figs. 21-25.—*Odontembia spinosa* (Navás), holotype ♂. 21. Head from above, × 15. 22. Hind tarsus viewed laterally, × 15. 23. Terminalia from above, × 11. 24. Process of left hemitergite viewed laterally from the right, × 15. 25. Terminalia from below, × 11.

All original figures based on camera lucida outlines.

(10LP), sinuously acute at apex, with a blunt irregular flap-like process latero-dorsally to the left (Figs. 16–17). First segment of left cercus (LC_1; Figs. 18–19) with inner margin produced into lobes, one subapical, the other median, the latter again subdivided by a shallow depression into two blunt lobes; all lobes echinulate. Second segment (LC_2) subcylindrical. Right cercus with first segment (RC_1) slightly dilated distally, second (RC_2) thinner, subcylindrical. Ninth sternite (H, Fig. 20) produced back to an obtuse process (HP) somewhat to the right of the mid-line; to the left of this is a concavity, filled by the left cercus-basipodite (LCB), which gives off an acute process towards the left. Right cercus-basipodite (RCB) subannular, small.

Locality.—Gulu, Uganda. Holotype ♂ in the British Museum.

Key to the Species of Dihybocercus (♂).

1. Posterior process of right hemitergite bifid .... *confusus*, n. sp.
   Posterior process of right hemitergite simply tapered 2
2. Process of left hemitergite broad .... *severini* Enderlein
   Process of left hemitergite narrower .... *rhodesiae*, n. sp.

Genus Odontembia, n. gen.

Genotype, *Dihybocercus spinosus* Navás, 1931, *Rev. Zool. Bot. africaines* (*Tervueren*), Vol. xxi, fasc. 2, p. 134.

African Embioptera closely related to *Dihybocercus*, but with the two internal lobes of the first segment of the left cercus each armed with 4–5 large, sharp teeth, and the right cercus-basipodite produced backward, in the male. Other characters as in *Dihybocercus*.

The structure and dentition of the left cercus are strongly reminiscent of *Donaconethis* (sensu Davis 1939). The remaining characters agree most closely with *Dihybocercus*, the venation and tarsal bladders separating these two genera from *Donaconethis*. The right cercus-basipodite, small and subannular in *Dihybocercus* and *Donaconethis*, appears to be partly fused to the first segment of the right cercus in *Odontembia*, and is produced back to a free obtuse lobe.

The genus probably represents a direct specialization of *Dihybocercus*, notably in the modification of the left cercus convergent to *Donaconethis*. One species: Congo.

Odontembia spinosa (Navás 1931). Figs. 21–25.

Dihybocercus spinosus Navás, 1931, l.c.

The following re-description is from Navás's unique type (Musée du Congo, Tervueren, Belgium):

♂. Length* 10 mm.; forewing 7·5 mm. × 1·8 mm.; hindwing 6·5 mm. × 1·8 mm.; head 1·8 mm. × 1·5 mm. General colour orange-brown, eyes black, wing-veins dark brown, bordered by mid-brown bands. Head (Fig. 21) broad, eyes large, prominent, sides behind eyes converging posteriorly. Venation as in the previous genus. Hind tarsi (Fig. 22) with two large ventral bladders on the first segment, one on second. Terminalia (Figs. 23–25) very characteristic; tenth tergite completely cleft, right hemitergite (10R) produced posteriorly to an acute process ($10RP_1$), directed downward and inward. Inner margin of 10R with only a trace of a flap-like process. Process of left hemitergite (10LP; Fig. 24) very complex, irregularly tapered distally, flattened in a vertical plane, somewhat twisted, with a median dorsal lobe directed forward. This lobe, the dorsal face of 10LP basad to it, and the left face distad to it, are minutely nodulose. Right cercus with two sub-

* These dimensions do not agree with those given by Navás (l.c.) for the same specimen.

cylindrical segments (RC_1, RC_2); base of RC_1 partly fused to right cercus-basipodite (RCB), the inner part of which is produced backward in an obtuse lobe. First segment of left cercus (LC_1) highly characteristic (the figure of Navás, l.c., Fig. 70, is inaccurate), inner margin produced into two rather slender lobes, the basal one placed more ventrally than the terminal one; basal lobe with two very large, sharp teeth at apex, and two on distal face; terminal lobe with five such teeth on anterior face. Second segment (LC_2) subcylindrical. Ninth sternite (H) produced to a blunt process (HP), curved to the left. Left cercus-basipodite (LCB) produced backward, termination acute. ♀ unknown.

Locality.—Lulua, Belgian Congo, 1929, Dr. Walker; holotype ♂ in Mus. Congo, Tervueren.

List of References.

Davis, C., 1939.—Taxonomic Notes on the Order Embioptera. v. The Genus *Donaconethis* Enderlein. Proc. Linn. Soc. N.S.W., lxiv, 3-4.

Enderlein, G., 1912.—Embiidinen, in Coll. zool. de Selys-Longchamps, fasc. 3.

Navás, L., 1931.—Insectes du Congo Belge (Série VI). *Rev. Bot. Zool. africaines*, Vol. xxi, fasc. 2 (Tervueren).

PART IX. THE GENUS *ENVEJA* NAVÁS.

(Six Text-Figures.)

Genus Enveja Navás 1916.

Mem. R. Acad. cienc. y artes de Barcelona, Vol. 12, No. 13, p. 23. Genotype, *Enveja bequaerti* Navás, l.c.

Robust Embioptera, the males with the following characters: Mandibles huge, projecting inwards, distally overlying labrum. Winged, with R_{4-5} forked, the fork exceeding the stem; M simple; cubitus two-branched. All veins strong, cross-veins rather numerous. First segment of hind tarsi with two very large ventral bladders. Tenth abdominal tergite completely cleft by a longitudinal division placed to the left of the mid-line; right hemitergite with a long posterior process; process of left hemitergite complex. First segment of left cercus with a basal echinulate internal lobe, otherwise smooth. Second segment of left cercus, and both segments of right cercus, subcylindrical.

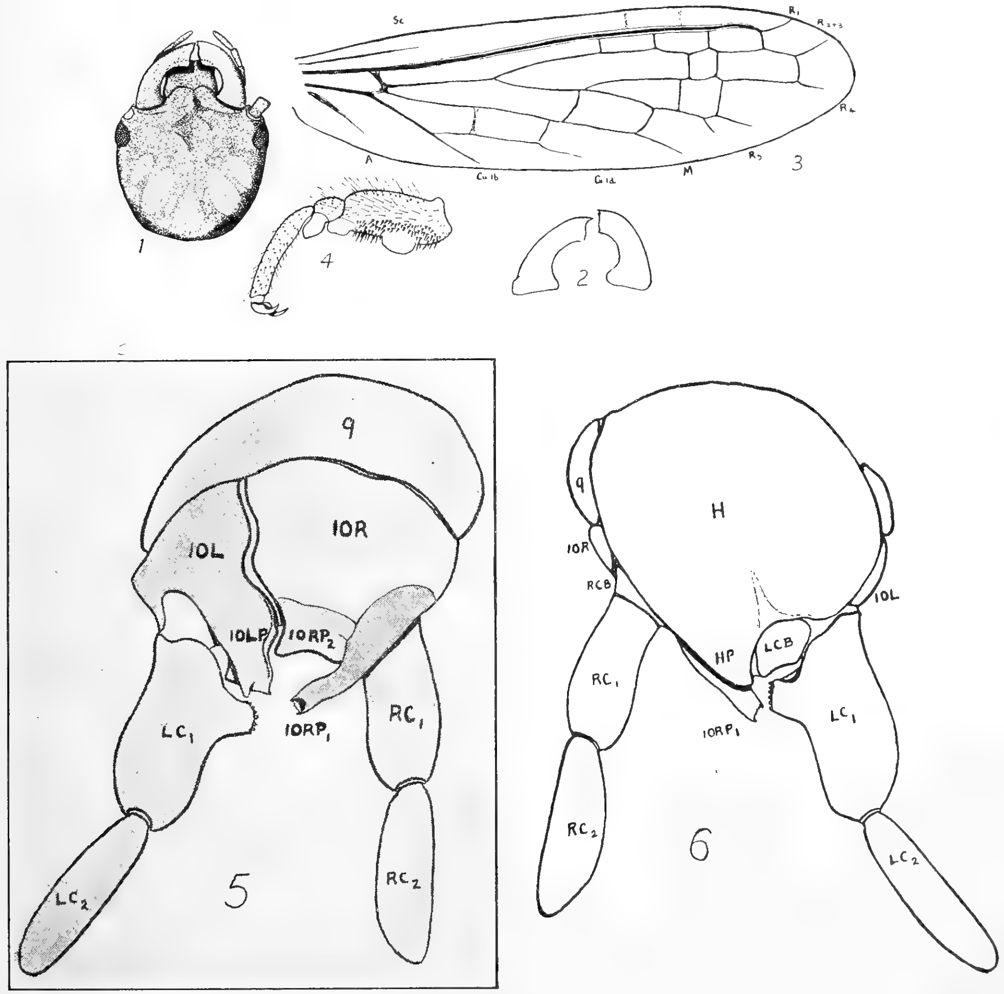
One species: Congo.

This remarkable genus has no close allies. It is perhaps most closely related to *Dihybocercus*, from the same general region. It is immediately differentiated from *Dihybocercus* by the extraordinary mandibles, and by the first segment of the left cercus (with only one lobe); additional but less important differences are found in the right hemitergite and the two-branched cubitus. *Enveja* is not at all closely related to *Embia* Latreille, as stated by Navás (l.c.).

Enveja bequaerti Navás 1916 (l.c.). Figs. 1–6.

The following description is based on two specimens (♂) (Mus. Congo, Tervueren), each labelled: 'Enveja Bequaerti Nav.'; 'Musée du Congo. Mufungwa Sampwe, 1/16–xii–1911, Dr. Bequaert'; 'Enveja Bequaerti Nav.; Navás S.J. det.'. They may be regarded as cotypes (A and B); cotype B also bears Navás's pink manuscript label 'Typus', but there seems no need to distinguish it as holotype or lectotype, as the two specimens are conspecific, and probably collected at exactly the same time.

♂. Length 17·5 mm. (A), 17 mm. (B); forewing 10·5 mm. × 2·5 mm. (A), 11 mm. × 3 mm. (B); hindwing 9 mm. × 2·5 mm. (A), 9 mm. × 3 mm. (B). Head (B) 4·5 × 3·4 mm. General colour dark brown, head with ferruginous areas (as in other members of the Order, but slightly different in position, probably due to changes in the structure of the head associated with the development of the mandibles; compare Figure 1 with that given by Davis, 1936, Fig. 42). Prothorax orange-brown; wings with dark brown veins bordered by pale-brown bands, with hyaline streaks between; margins of wings pale, tawny. Head (Fig. 1) relatively very large, with a median anterior projection behind the clypeus, angular, and a rhomboidal depression behind this projection; whole of head minutely granulate. Eyes relatively small. Mandibles (Fig. 2) huge, incurved, each in the form of a quadrant of a ring, distally truncate, roughened, overlying labrum. Maximum



Figs. 1-6.—*Enveja bequaerti* Navás, ♂. 1. Head from above, × 6. 2. Mandibles from above, × 6. 3. Right forewing, × 6. 4. Hind tarsus viewed laterally, × 15. 5. Terminalia from above, × 25. 6. Terminalia from below, × 25.

Figures 1 and 3 from cotype B, other figures from cotype A. All figures based on camera lucida outlines. Setae omitted except in Figure 4.

antennal length 8 mm., with 18 segments. Wings (Fig. 3) with R_{4+5} forked, fork nearly twice as long as stem; M and Cu_{1a} simple. R_1 confluent subterminally with R_{2+3}. The following venational anomalies occur: In both cotypes, R_5 is terminally forked in the right forewing. In the left forewing of cotype A, R_5 and M become confluent, and almost immediately separate again. The cross-veins are variable, as shown in the following table:

	$C–R_1$.	$R_1–R_{2+3}$.*	$R_{2+3}–R_4$.	$R_4–R_5$.	$R_{4+5}–M$.	$R_5–M$.	$M–Cu_{1a}$.
Cotype A—							
Right forewing	—	—	—	1	—	1	—
Left forewing	—	—	—	—	—	confluent	—
Right hindwing	—	1	2	1	—	2	1
Left hindwing	—	1	3	1	—	1	1
Cotype B—							
Right forewing	2	3	3	2	1	1	2
Left forewing	1	3	3	2	1	2	2
Right hindwing	2	4	2	2	1	1	2
Left hindwing	2	4	2	1	1	1	2

* In addition to terminal confluence.

This extreme variability is characteristic of the Embioptera, and justifies the usual omission of details of position of the cross-veins. The above table shows how small is the significance even of the relative frequency of the cross-veins, as a great difference occurs between the two cotypes, which are structurally indistinguishable on other characters, and obviously conspecific.

Hind tarsi (Fig. 4) with ventral bladders very large, especially the more basal bladder of the metatarsus. Terminalia (Figs. 5–6) with longitudinal division of tenth abdominal tergite complete, placed to the left of the mid-line; right hemitergite (10R) with outer margin produced backward and inward as a heavily-sclerotized process ($10RP_1$), slender, distally truncate, upper part of distal margin concave, lower part furnished with minute teeth. Inner part of posterior margin of 10R heavily sclerotized as a subrectangular plate ($10RP_2$). Left hemitergite (10L) produced backward from its right-hand part to a broad process (10LP), sharply truncate distally, inner margin sinuous; 10LP with a subobtuse dorsal lobe, as a continuation of its outer margin, directed backwards and a little to the right, exceeding the main part in length. Right cercus with two subcylindrical segments (RC_1, RC_2), arising from a small ventral subannular cercus-basipodite (RCB). First segment of left cercus (LC_1) subcylindrical, inner margin produced near base to a blunt lobe, armed apically with small nodules; second segment (LC_2) subcylindrical. Ninth sternite (H) tapered back to an obtuse process (HP), directed somewhat to the left; left cercus-basipodite (LCB) a flat plate between HP and LC_1, terminally obtuse. ♀ unknown.

Locality.—Mufungwa Sampwe, Belgian Congo; types in Musée du Congo, Tervueren.

List of References.

Davis, C., 1936.—Studies in Australian Embioptera. Part i. Proc. Linn. Soc. N.S.W., lxi, 5-6.

Navás, L., 1916.—Neurópteros Nuevos o Poco Conocidos, Séptima Série. *Mem. R. Acad. cienc. y artes de Barcelona*, Vol. 12, No. 13.

PART X. THE GENUS *LEPTEMBIA* KRAUSS.

(Ten Text-figures.)

Genus Leptembia Krauss 1911.

Zoologica, Hft. 60, Bd. 23, p. 71. Genotype, *Leptembia hamifera* Krauss, 1911, l.c.

Robust Embioptera, the males with the following characters: Winged, R_1 not confluent with R_{2+3}; R_{4+5} forked, the fork longer than the stem; M simple; cubitus three-branched, i.e. its anterior branch bifid. Tenth abdominal tergite completely cleft longitudinally; right hemitergite massive, convex; process of left hemitergite simple. First segment of left cercus with an internal echinulate forwardly-directed process, longer than thick.

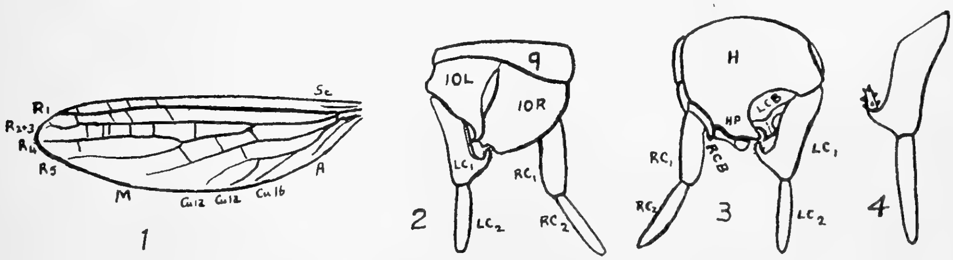
Two species: East Africa (Sudan; Zambesia).

I do not agree with Enderlein (1912), who includes this genus in *Embia* Latreille. The left cercus immediately differentiates it. The right hemitergite has not the characteristic form of *Embia* (s.str.), and the venational differences appear to be significant: R_1 and R_{2+3} are nearly always confluent in *Embia*, and the cubitus is two-branched in most cases.

Krauss does not state the number of hind metatarsal bladders in the genotype. There are two in *L. surcoufi* (Navás), which I consider to be congeneric; this probably applies to *L. hamifera* also, and offers a further point of difference from *Embia* (s. str.).

Leptembia hamifera Krauss 1911 (l.c.). Figs. 1–4.

♂ (after Krauss). Length 15 mm.; forewing 10 mm. × 2·7 mm.; head 2·3 mm. × 1·8 mm. General colour pale ochreous, head darker, eyes black; wings hyaline, with ochreous veins and narrow bordering lines; radius brown. Head with sides behind eyes convergent, rounded behind. Antennae incomplete; eyes small, reniform. Wings (Fig. 1) as in the generic description. Terminalia (Figs. 2–4) with tenth tergite completely divided, right hemitergite (10R) massive, swollen, with a rather short blunt process on the posterior inner angle. Process of left hemitergite (10LP) acute, directed backward and curving to the left. Right cercus with two subcylindrical segments (RC_1, RC_2); first segment of left cercus (LC_1) subcylindrical, inner margin subterminally produced to a slender forwardly-directed hook, armed with sharp teeth (Fig. 4). Inner surface of LC_1, anterior to this hook, longitudinally channelled, with small teeth on the upper part. Second segment (LC_2) subcylindrical, more slender. Ninth sternite (H)



Figs. 1-4.—*Leptembia hamifera* Krauss, ♂, after Krauss, 1911, Pl. v, figs. 23A-D. 1. Left forewing. 2. Terminalia from above. 3. Terminalia from below. 4. Left cercus from below. (Krauss does not state the magnifications, but from his dimensions given in the text they are here approximately × 4, × 12, × 12, and × 16 respectively.)

produced backward to an obtusely-tapered process (HP), curving to the left; left cercus-basipodite (LCB) simple, apparently truncate; right cercus-basipodite (RCB) small, with a peg-like extension posteriorly on the inner side. ♀ unknown.

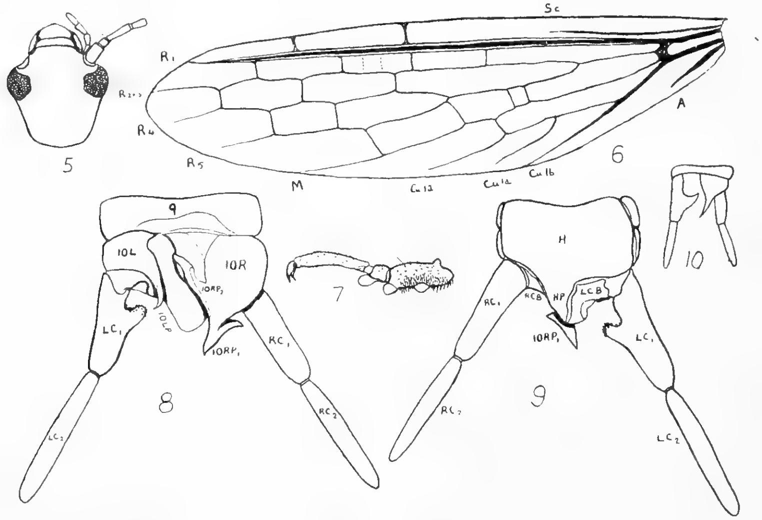
Locality.—Sudan; type in the Vienna Museum (not seen by the author).

Leptembia surcoufi (Navás 1933). Figs. 5–10.

Embia surcoufi Navás, 1933, *Broteria*, Serie trimestral, Vol. 2, fasc. 1.

Navás (l.c.) has noted the similarity to the genotype of *Leptembia*, without accepting Krauss's genus. The following description is from Navás's unique type (Muséum d'Histoire naturelle, Paris):

♂. Length 14·5 mm.; head 2·3 mm. × 1·9 mm.; forewing 11·5 mm. × 3·0 mm.; hindwing 10·5 mm. × 3·4 mm. Body and legs pale orange-brown, head black, abdomen darker posteriorly; wing-veins dark brown, bordered by smoky-brown bands. Eyes black, antennae dark brown. Head (Fig. 5) with eyes large, prominent; sides behind eyes straight, converging strongly. Antennae incomplete. Wings (Fig. 6) as in *L. hamifera.* Hind tarsi (Fig. 7) with two large ventral bladders on first segment, one on second. Terminalia (Figs. 8–9) with tenth abdominal tergite completely divided; right hemitergite (10R) large, convex, with



Figs. 5-10.—*Leptembia surcoufi* (Navás), holotype ♂. 5. Head from above, × 7. 6. Left forewing, × 7. 7. Hind tarsus viewed laterally, × 13. 8. Terminalia from above, × 13. 9. Terminalia from below, × 13. 10. Terminalia from above after Navás, 1933, Fig. 90.

Figures 5-9 prepared with constant reference to an ocular micrometer. Setae omitted except in Figures 7 and 10.

a large oblique postero-ventral process ($10RP_1$), the two ends of which are acute, with a shallow distal concavity between. Inner margin of 10R produced forwards to a process ($10RP_2$), anteriorly separated from 10R by membraneous areas. Left hemitergite (10L) smaller, inner margin produced back to a slender tapered process (10LP), acute, curving outward distally. Right cercus composed of two subcylindrical segments (RC_1, RC_2); cercus-basipodite (RCB) small. First segment of left cercus (LC_1) subcylindrical; inner margin produced near base to a forwardly-directed echinulate lobe, broader than in *L. hamifera*. Second segment (LC_2) elongate-subcylindrical. Ninth sternite (H) produced backwards to a tapered process (HP), between which and the base of LC_1 is the left cercus-basipodite (LCB), embedded in membrane; LCB with a blunt flap directed upward near the base of LC_1, and with a terminal truncate portion adjacent to HP.

I publish without comment a tracing of the figure of Navás (l.c., Fig. 90), a dorsal view of the terminalia of this specimen. ♀ unknown.

Locality.—Zambesia: Chemba, coll. I. Surcouf, Nov. 1928 (Mus. Paris).

Key to the Species of Leptembia (♂).

1. Echinulate lobe of first segment of left cercus subterminal .... *hamifera* Krauss
   Echinulate lobe of first segment of left cercus basal .... *surcoufi* (Navás)

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ELEMENTARY HYDROGRAPHY OF SOUTH-EASTERN AUSTRALIA.

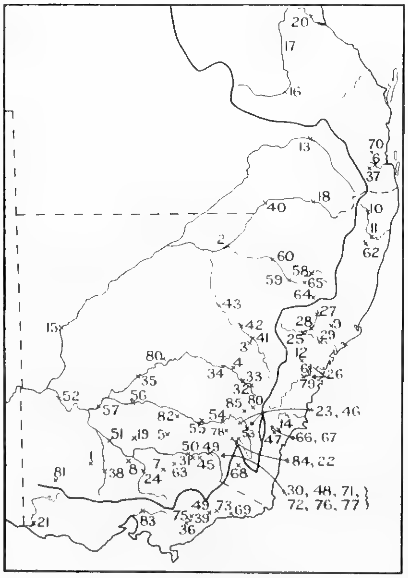
By Frank A. Craft, B.Sc.*

(Ten Text-figures.)

[Read 25th October, 1939.]

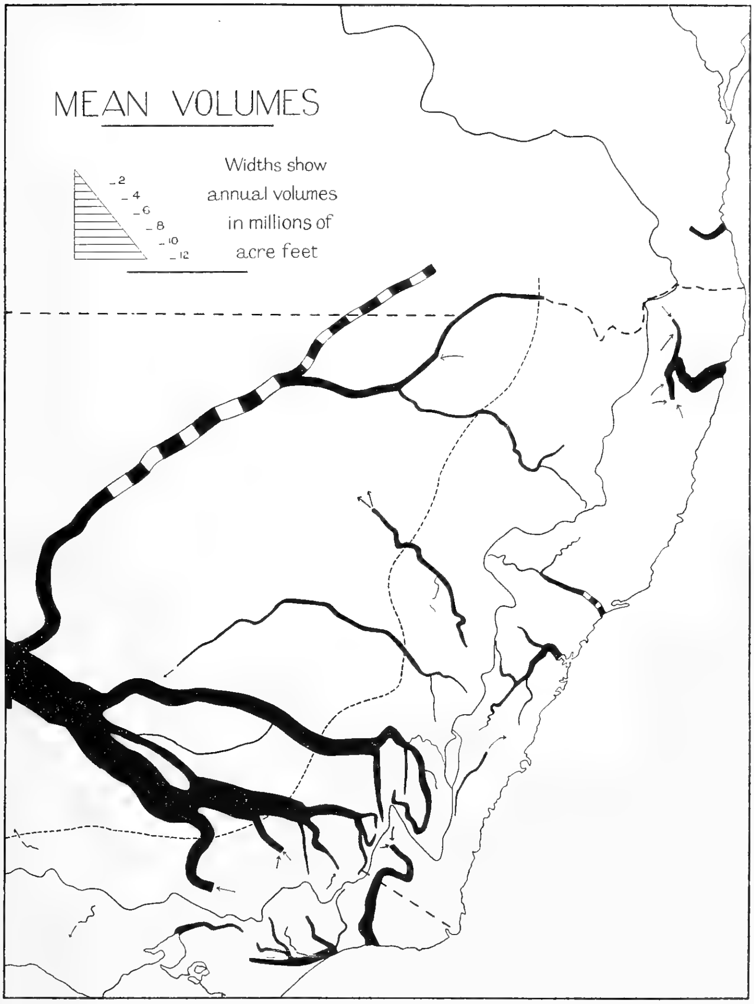
Introduction and Acknowledgements.—This paper is a preliminary attempt to collect and evaluate some of the geographical facts disclosed by stream gauging in south-eastern Australia. Statistics cover many of the largest rivers of the region, and it is not anticipated that future information will affect the general tenor of the conclusions reached herein.

The statistics employed were made available by the Hydrographic Branch of the N.S.W. Water Conservation and Irrigation Commission. The writer's thanks are tendered to many of the officers of that service, including Messrs. H. H. Dare and G. Evatt (Commissioners), the late Mr. A. Morrison, and Messrs. V. T. England and G. E. Robinson. The essentials of the paper were prepared in the University of Sydney Department of Geography, which is under the direction of Professor J. Macdonald Holmes.



Text-fig. 1.—Locality map, with key to stations enumerated in Table 1. A number of stations have been omitted because of shortness of record, lack of continuity of record, or lack of significance by comparison with longer-established or higher-class stations recording flows of similar magnitude on the same river.

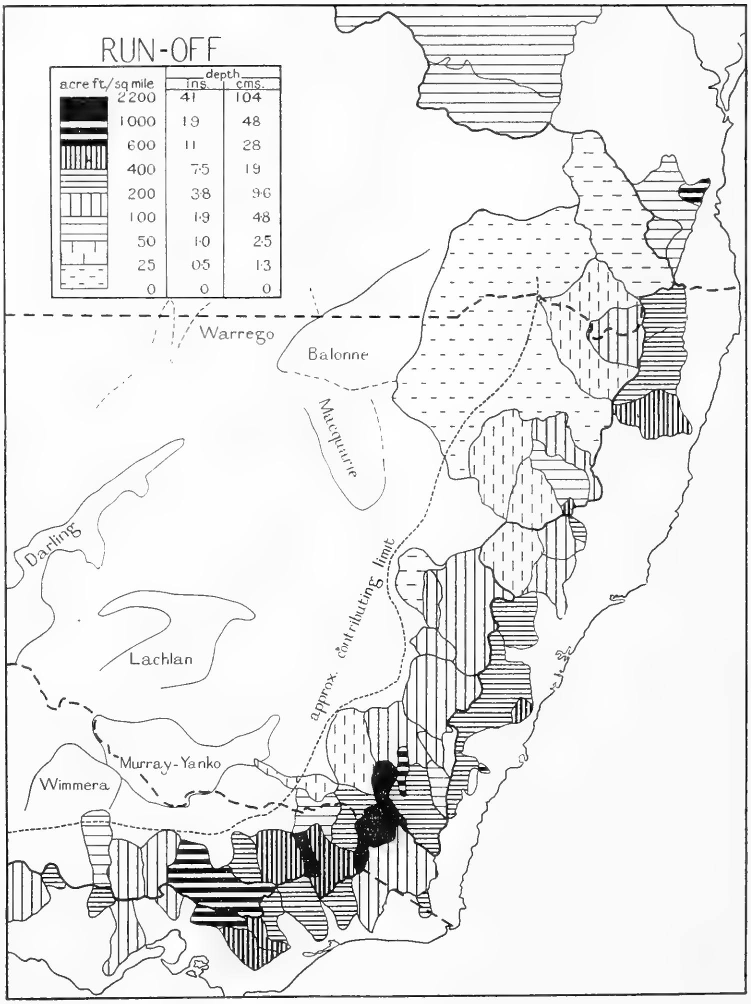
* This research was undertaken whilst the writer held a Linnean Macleay Fellowship of the Society in Geography.



Text-fig. 2.—Map to show volumes discharged by the principal gauged streams. Notice that many of the coastal streams have no significant gaugings, and are thus represented by blank spaces.

Distribution of Flows and Catchments.

The principal facts are set out in Tables 1 and 2, and Text-figs. 2 and 3. There is an apparent predominance of the south-eastern group of streams, especially those flowing to the Murray. This is partly offset by the coastal rivers Clarence and Fitzroy, and by the Macleay, Burdekin, Mary, and Burnet. Of the latter group, the Macleay and Burdekin have not been gauged at all in their main channels, and the others have only short records. However, all except the Burdekin are probably smaller, in average discharge, than those set out below (Table 2). Attention is particularly drawn to the tremendous variations between maximum



Text-fig. 3.—Map to show the distribution of the principal stream catchments, so far as they are known. The inland limit of productive catchments is shown, whilst the names inserted within this limit (Warrego, Balonne, etc.), with their enclosing lines, show the approximate distribution of the main billabong and distributary areas.

and minimum annual totals, and the caution that must be used when discussing matters on the basis of average values.

Although the greatest streams attain a fair average volume, this is mainly due to the run-off from limited areas of headwater country. Many of the rivers are only gauged low down on their courses, outside the main plateau zone, but in every case where tributaries from the highlands are measured separately, they are found to contribute a volume quite out of proportion to the ratio between their catchment areas and those of the main streams. A few of the outstanding examples are given (Table 3).

In other words, we envisage a typical catchment of south-eastern Australia, whether belonging to the coastal or Murray-Darling system, as consisting of a limited area of headwater country with a high run-off, and a great area with a low run-off. The catchments on which this paper is based cover rather more than 400,000 square miles, exclusive of the areic plains of the lower Darling. Of this area, 12,600 square miles, or 3·4% of the total, have a run-off greater than an equivalent depth of 10 inches (25·4 cm.) per annum, and the proportion might be considerably reduced if the upper Goulburn (Vic.), the Ovens and the Mitta basins, aggregating 8,000 square miles, did not have to be included *en bloc.* The portion with an equivalent annual depth of run-off greater than 3 inches is only 12·5% of the total considered.

In order to find why a few limited districts are so productive of water we may consider the highest points in Australia, about Mt. Kosciusko, where the Tooma and Swampy Plain (Murray system), and the Snowy and Tumut Rivers rise. It has already been indicated that the district has a notable orographical rainfall much in excess of that of the nearby valleys to the west, and of those highlands slightly on the eastern or leeward side (Craft, 1934). It is also likely that their summer evaporation is low, not only on account of altitude and lower temperature, but also because of the daily formation of cloud due to local convection. In the summer months, particularly on the hotter days, cumulus gathers from 10 a.m. onwards, and by early afternoon it has covered 50% to 80% of the sky, with a boundary sharply defined by the edge of the higher plateau (4,500 feet plus). Apart from thunderstorms, which help to keep the catchments moist, this cloud has an obvious blanketing effect.

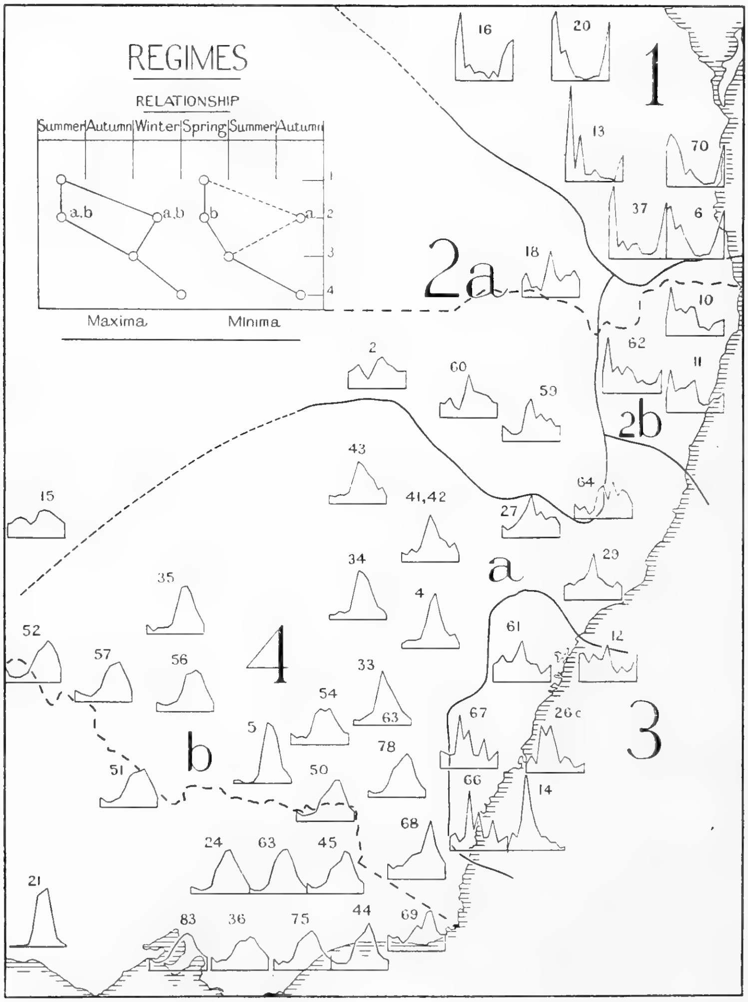
Similar conditions also apply to the Victorian heights at the heads of the Mitta, Goulburn and Latrobe Rivers, and with other streams, such as the eastern tributaries of the Shoalhaven, Wollondilly and Nepean Rivers, there is an almost daily indraught of air in the warmer season. This affects the country to a distance of 50 miles inland, and gives coolness, moisture, frequent mists on the higher points, and much cloud.

Other convection centres occur at Gangerang (Blue Mountains), Moonbi Ranges, Barrington Tops (Namoi-Hunter-Manning focus), and the Macleay-Dorrigo and Nymboida scarps facing respectively eastward and northward on the north-eastern coast of New South Wales. The phenomenon is, of course, well known in tropical regions.

The foregoing are some of the more notable cases observed in the field, and it is worthy of notice that all have considerable areas of swamp land, especially those in the south-eastern highlands of the continent. In the more northerly plateaus of New England and of eastern Queensland, the swamps tend to dry up in their respective dry seasons, whilst in the isolated areas of higher run-off, like the Nymboida (Clarence) and upper Brisbane valleys, the moist areas are mostly in the rain-forests of slopes or scarps. Generally speaking, these latter cases appear to be much less influenced by swamp or moist soil areas than those of the cooler regions.

It is certain, from rain and stream records, that rainfall on the select areas is higher than usual (cf. Text-fig. 3). This would probably be emphasized if rainfall stations were not located consistently in valley settlements, to the exclusion of the top country. It is also reasonable to suppose, as we have indicated, that there is a lower evaporation in these major contributing places, giving an additional reason for the existence of the swamps, and the effectiveness of the districts concerned for both high- and low-water run-off. The very presence of the swamps must further tend to check evaporation and to conserve water.

Whilst we have definite information of the gathering grounds of the stream water, the extent and nature of losses are very uncertain. Thus Balonne River—the Queensland trunk stream of the Darling—appears to lose much of its water by evaporation from swamps and distributaries before its "through" channel, the Culgoa, joins the Barwon to form the name stream, Darling River. The Macquarie and Lachlan both degenerate into many distributaries; 37% of the original volume of the Lachlan passes Booligal, and only a portion of this finds its way to the



Text-fig. 4.—Regimes for the principal rivers of the region. Station numbers are shown. Each polygon contains 13 ordinates, from January to January. The ordinates are percentages of yearly averages. The inset gives a summary of the types; for instance, 2*a* has summer and winter maxima, autumn minimum.

Murray. The position is so well recognized that Lachlan water is excluded, as inconsiderable, from River Murray agreements between the States and the Commonwealth.

The main stream, Murray, appears to lose 20% of the water originally contributed to it, the loss being estimated between the tributary gauges and the confluence with the Darling. Streams like Wimmera, Paroo and Warrego, flowing on the arid borderlands, do not contribute to the main rivers.

Stream Characteristics.

Regimes and their Classification.—The regimes disclose four principal stream types, namely:

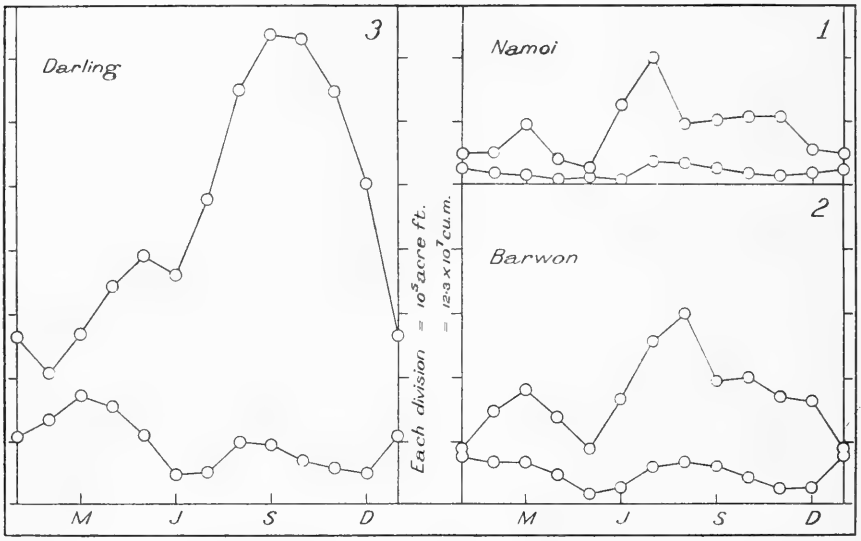
1. *Queensland Type.*—Summer maximum, low at other seasons, with spring minimum.
2. *Transition Type.*—*a.* Barwon Subdivision; summer and winter maxima, autumn minimum. *b.* Clarence Subdivision; summer and winter maxima, spring minimum.
3. *Sydney Coastal Type.*—Autumn or winter maximum, spring or early summer minimum.
4. *Victorian Type.*—Winter or spring maximum, minimum in late summer or autumn.

The letters "*a*" and "*b*" (Text-fig. 4) show the earlier and later incidence, respectively, of phases in the northern and southern streams of the type.

This classification is brought out by the map (Text-fig. 4). The incidence of maxima and minima for individual stations of types 1 and 4 is reasonably constant. Thus the maximum flow of a river like the Murray is always found within the range of the cooler season (Jun.–Nov.), with most occurrences in September–October. Similarly, the maximum of a river like the Fitzroy always occurs in summer. In contrast, the coastal streams of type 3 are likely to have a maximum for a given year in almost any month. The Nepean and Shoalhaven are characteristic: the regime laid down on averages is much less realistic than with the other types, and is really a summation of chance storms.

The combination of summer and winter influences in the Transition type, 2, is well shown by the Darling system, but it is not a constant factor (Text-fig. 5). The Barwon at Walgett is dominated by winter flow in years above the average, but summer flow is a little greater than winter in minimal years. With the Namoi, the winter flow is the greater under all conditions, but the two rivers have this much in common—summer flow varies much less than winter flow. In this area of approximately equal average rainfall at all seasons, the winter rain for run-off comes mainly in 37% to 38% of the seasons. Summer run-off is, however, more widely distributed in time.

In general, the only notable difference between the incidence of a rainy season, on one hand, and major flow, on the other, is found in the south. Here a prolongation of the winter rains into September and October gives a later maximum flow than is shown elsewhere in the Victorian type. The effect of melting snow from the hills over 5,000 feet is a minor factor, and it does not give the double maximum usually found under such conditions of climate. This will be readily understood when the small area of appreciable snow storage is remembered; this amounts to something of the order of 500 square miles, at most, for the whole of south-eastern Australia, split up amongst a number of rivers. This estimate excludes the forest country intermittently covered with snow



Text-fig. 5.—Partial regimes for the transition rivers. In each case, the upper curve is the regime for years above their *annual* average; the lower curve represents the balance. Summer flows tend to predominate in a majority of years, but strong winter influences in a minority of years give the observed higher winter maximum. Periods: 1.—above average, 15 years; below average, 26 years; 2.—above, 17 years; below, 28 years: 3.—above, 14 years; below, 35 years. Stations are: Barwon, 2; Darling, 15; Namoi, 60 on key.

in winter to a depth of a foot or more, liable to complete melting and replacement within the winter itself. (See also Craft, 1934, 316, 317, 324).

In the warmer regions of more inconstant flow, the streams depend on the greater rainstorms for their volume. Failure of these storms, even without temporarily arid or drought conditions, will give a season of minimal flows. This is very marked on the Queensland coast, where the large drainage areas give enhanced flows. The Fitzroy has already been quoted in this regard, and a comparison of its greatest and least flows with those of the Murray is instructive (Table 2).

All told, the averages and diagrams based on them give a fair indication of discharges and regimes for the south-eastern streams, but they should not be relied on beyond a certain point for northern New South Wales, and for the whole of Queensland.

Variability of Flow.

The tables of figures give some idea of the differences met in the annual totals of the various stations, and they lead to the consideration of the relative importance of extremely low and high flows in stream economy. Some consideration of seasonal and annual variability may be added.

Extremes of Flow.—Flows of exceptionally great magnitude were examined on a monthly basis, the figure of 200% of the monthly mean being chosen rather arbitrarily as the lower limit. That is, if the mean for a given month at a given station were 100 units, and an individual record for that month was 205 units, the whole 205 would be credited as an exceptional flow for that month. This was done because the size of each average is largely determined by the greater flows, which are few in actual number, and are usually well above the 200% limit. On the other hand, the usual totals were considerably below the average. Quartile and octile groupings were tried before the arbitrary figure was adopted, but without success.

Having obtained all the exceptional flows for one month, the next month was treated in a similar manner, and finally the twelve monthly totals were added together. The gross figure thus obtained was expressed as the percentage of the total flow of water recorded at the station for the whole period of gauging. Thus a figure of 58% for the Warragamba indicates that 58% of the total water recorded as passing that station did so in months 100% or more above their respective monthly averages.

It was found that stations located at different points on the same river gave very similar results, and that three distinct groupings appeared, namely: *a*,—Streams of the south-eastern highlands, which owe a comparatively small proportion of their totals to exceptional flows, the Murrumbidgee being the northern limit of the type; *b*,—Streams of the central coastal region, between Brisbane and Sydney, owe more than half their volumes to exceptional flows; *c*,—Streams rising in the lower and drier highlands, or in the cyclonic storm areas of the eastern coast of Queensland, owe the greater part of their flow to exceptional months. The outstanding records are as follows (see also Text-fig. 6):

Percentages of Total Volumes due to months of Excessive Flow (more than 200% of monthly means).

Group 1—less than 50%.—Latrobe 8; Yarra 12; Snowy (Jindabyne) 18; Murray (Albury) 20; Tumut 22; Mitchell, Ovens, ea. 25; Murrumbidgee (Gundagai) 32; Glenelg (Sandford) 40.

Group 2—50% to 60%.—Clarence (Newbold-Gorge) 53; Brisbane (Lowood) 57; Yass 57; Warragamba 58; Hunter (Singleton) 59.

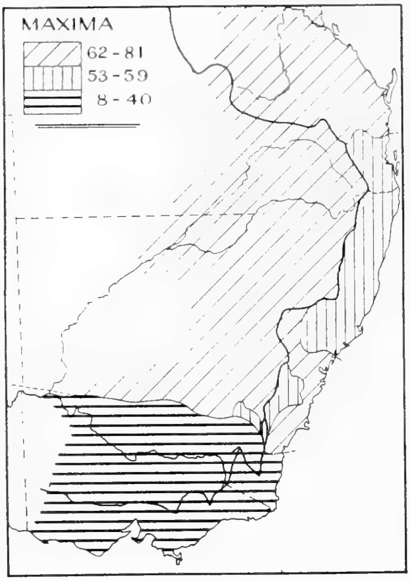
Group 3—more than 60%.—Namoi (Narrabri) 62; Shoalhaven (Welcome Reefs) 62; Lachlan (Cowra) 63; Nepean (Penrith) 63; Macquarie (Dubbo) 64; Barwon (Walgett) 65; Peel (Bowling Alley) 66; Darling (Menindie) 67; Fitzroy (Wattlebank) 70; Colo 71; Lockyer Creek 76; Dawson (Taroom) 81.

A calculation was also made for exceptionally low recordings. In this case, the amount of water passing does not have a great effect on the total, but the number of months subject to minimal flow is of great importance, especially from the economic standpoint. It was found that groups of very low recordings occur at many stations, and the actual number less than 20% of their respective monthly means was determined, and expressed as a percentage of the total number of months for which readings have actually been made. Thus a figure of 10% for the Mitchell indicates that 10% of months have recordings less than 20% of their respective monthly averages. (Text-fig. 7.)

Percentages of Months of Exceptionally Low Flow (less than 20% of means).

Group 1—less than 10%.—Latrobe 0; Yarra 0; Snowy (Jindabyne) 1; Murray (Albury) 1; Tumut 3; Ovens 8; Murrumbidgee (Gundagai) 8; Mitchell 10.

Group 2—20% to 40%.—Clarence 22; Hunter (Singleton) 27; Shoalhaven (Welcome Reefs) 28; Brisbane (Lowood) 30; Warragamba 30; Glenelg (Sandford) 31; Namoi (Narrabri) 33; Lockyer Creek 33; Barwon (Walgett) 34; Nepean (Penrith) 36.



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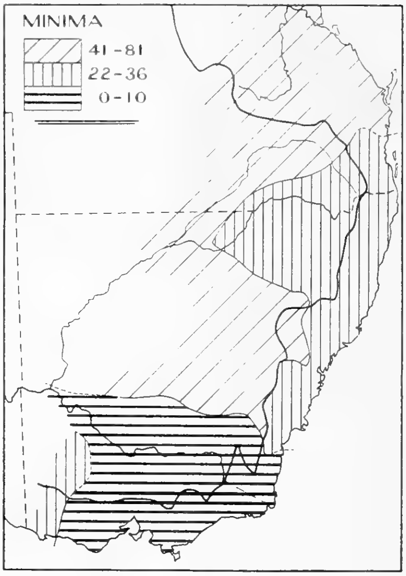

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Text-fig. 6.—Dependence of streams for volume on maximum flows. All flows over 200% of their monthly means were totalled, and the complete total thus obtained was expressed as a percentage of the gross volume measured for the stream in the whole of its record. In the first group, 62% to 81% of the gross flow was due to these individual exceptional flows; in the second, 53% to 59%; in the third, 40% down to 8%.

Text-fig. 7.—Percentages of months with flows less than 20% of their respective means. A figure of "10" shows that only 1 month out of 10 (= 10%) fell below the mean for the month of record. Notice the close correspondence with Text-fig. 6. The south-eastern rivers have few exceptionally low months; the inland and north-western have many—up to four-fifths of the total number of months recorded.

Group 3—more than 40%.—Lachlan (Cowra) 41; Macquarie (Dubbo) 41; Peel (Bowling Alley) 42; Colo 44; Darling (Menindie) 44; Fitzroy (Wattlebank) 70; Dawson (Taroom) 81.

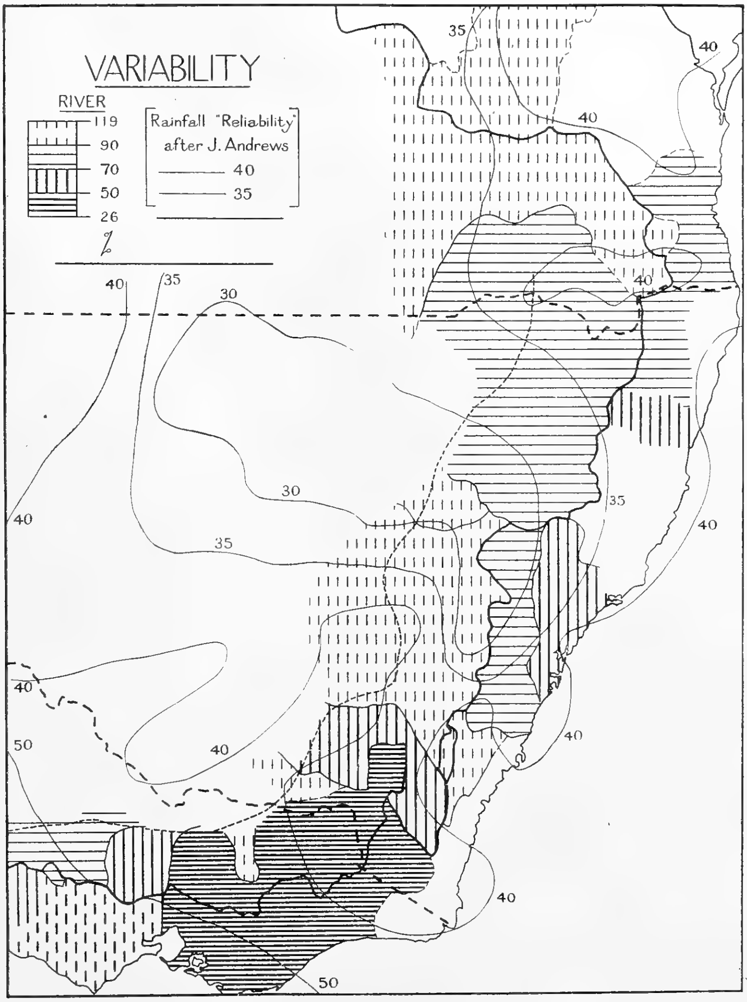
These figures show conclusively that streams which rely on exceptional flows to build up their monthly averages also have a large number of months which contribute little to the discharge volume. There is a clear difference, on both counts, between the south-eastern group and the remainder. Of that balance, the rivers in the warmer northern section have the greatest number of months of exceptionally low flows, and a high percentage of water derived from those of the greatest magnitude.

In all this discussion the topographical factor should not be forgotten. Group 1, in each of the above sets of figures, is associated with the highest of the plateau country, but others of the higher and more abrupt plateaus also have a favourable influence on stream discharges. This is brought out by the map of annual variability.

Annual Variability (Text-fig. 8).—This was calculated as percentage of variation, according to the formula: $\text{Coefficient of Variation} = \frac{\text{Standard Deviation}}{\text{Mean}} \times 100\%.$

When the probable error in calculating S.D. was greater than 15% of the S.D., the result was discarded. In general, a 12-year record was the minimum necessary to give a figure within the limit imposed. The accepted values are given in Table 1.

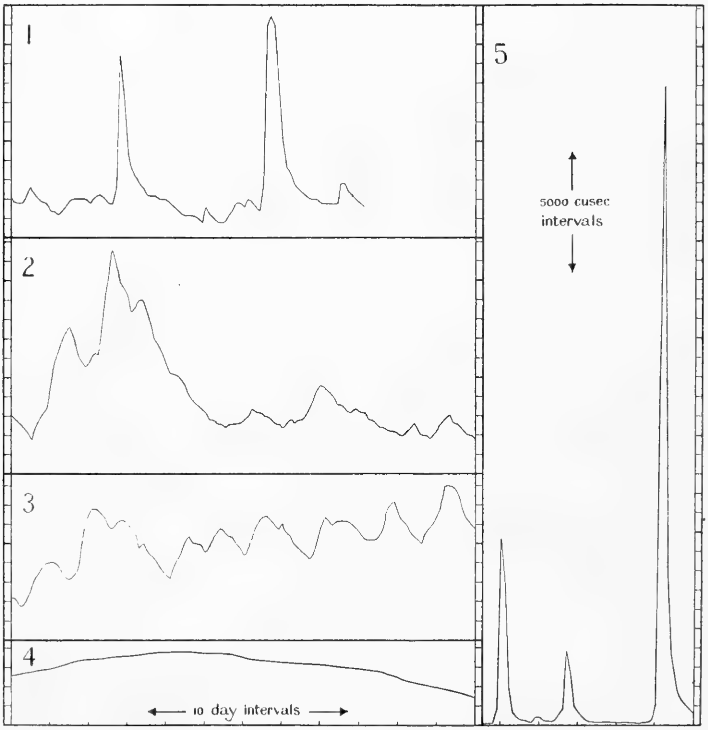
In broad outlines, the map corresponds with the facts obtained by the study of exceptional flows. The south-eastern rivers are the least variable, and are followed by some members of the east coastal group, in country easily penetrated by the inward drift of moist air from the eastern coast.



Text-fig. 8.—Coefficients of variation for recorded catchments. The lowest figures indicate the *least* variability, and the highest show the *greatest* variability. The value of average figures varies accordingly, being greatest when variability is least. For rainfall, the higher the figure attached to the isolines, the greater the "reliability" of rainfall. In the south, there is a general correspondence between variations of rain and river: in the north, it is probable that rivers depend more on concentration than on crude amount of rainfall.

A zone of high variability extends along a NW–SE line from the Lachlan valley to the Shoalhaven, recalling, in a shadowy manner, the southern Andes (de Martonne, 1927). This feature is probably due, in part, to the occurrence of lower and gentler topography here, associated with the northern limit of the most constant and effective winter rains. At the same time, the south-eastern highlands have a screening effect in winter, and there is a considerable flow of descending air from the south-west. Towards the north, also, a similar feature is repeated in the Queensland border country, to the north of New England Plateau. In that case, the streams involved are Condamine River and Lockyer Creek.

It is interesting to compare stream variability with rainfall "reliability". Using modal values, which exclude exceptionally low and high records, Andrews (1932) obtained a map of which some details have been reproduced here (Text-fig. 8). It will be realized, of course, that the river stations represent flows from



Text-fig. 9.—Types of flood curves, drawn from daily discharges. 1 (Station 54, Murrumbidgee, Aug.-Oct., 1916) shows two "flash" floods due to separate periods of concentrated rainfall. 2 (Station 50, Murray, June-Oct., 1931) shows the most severe flood phase recorded for that station; one major period of rain was experienced to give a symmetrical curve. 3 (Station 50, July-Oct., 1917) gives a saw-toothed curve due to heavy rainfall experienced at repeated intervals, and giving the greatest *seasonal* flow recorded for the station. 4 (Station 15, Darling, Sept.-Dec., 1931) demonstrates the slow rise and fall of a river of low gradient, derived from vast areas of country, with natural equalizers in the form of distributary "deltas". 5 (Station 79, Warragamba, May-June, 1930) shows "flash" floods, one of extreme type, derived from a compact, relatively small catchment in a period of heavy general rainfall.

the higher, more rugged, and less settled country rather than the lower lands, whilst the rainfall stations are located in valleys or on plains. For this reason, the writer believes that rainfall "reliability" isolines for the south-eastern highlands cannot be accurately drawn. A similar condition of affairs might well prevail for much of the Main Divide highlands.

On the whole, however, there are marked correspondences between the two sets of values. Both show less variable conditions in the south-east than elsewhere; both emphasize the NW–SE area of greater variability which has been described above, with differentiation along the line of the highlands proceeding northwards. In this respect they vary from Taylor's earlier map of rainfall "reliability", based on departures from the average, which gives isolines concentric about the centre of the continent. On the basis of what has been disclosed above, respecting the distribution of exceptionally low and high flows, it will be agreed that Andrews' map, empirical though it is, gives a more realistic picture than Taylor's (1920).

Variation of Streams with Rainfall.—The "station profiles" are continuous curves showing the height of the river at a particular station for each day. If translated into terms of volume by reference to station rating curves, the quick rise and fall which they show become still more apparent (Text-fig. 9). The small portions published give some idea of conditions met.

With regard to the seasonal aspect, the writer made an investigation of conditions on the upper Murray which, as we have seen, is one of the most constant of the rivers, as well as one of the largest. For the Jingellic and Albury gauging stations, there was a positive correlation between winter (May–October) rainfall and winter flow (June–November), taking the actual totals of precipitation and rainfall in each case. This correlation varied from 0·78 to 0·86, ± 0·03 to 0·04, with a period of 42 years for Jingellic and 55 years for Albury (1935, 131). (See also Text-fig. 10.)

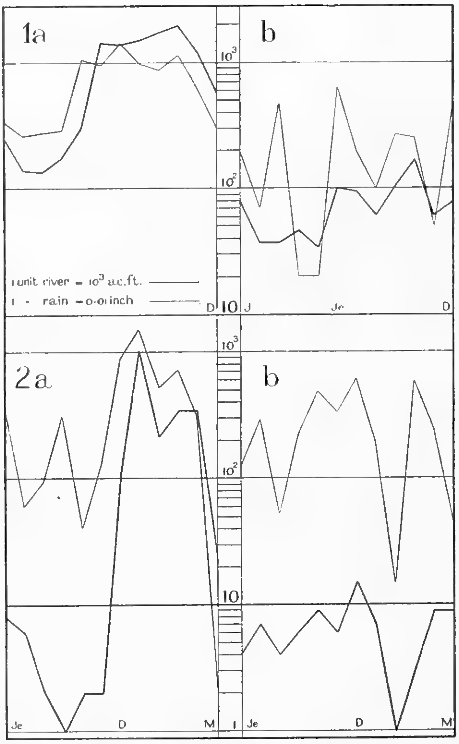
For the upper Murray catchments, then, the volume of rainfall is the main factor determining winter flow. It must be borne in mind that the greatest run-off takes place from alpine or forested areas, and that conditions are as normal as they can be in the region. For the storage of snow, it corrects itself within the season, thus causing no error of any consequence in the correlation.

In fact, there can be little delayed run-off, or carry-over from winter to summer, and if such a conclusion is reached for a river like the upper Murray, it can hardly be departed from in the cases of the less constant rivers with lesser facilities for water storage in the shape of swamp, marsh, or other moist soil areas.

It should also be remarked that the station profiles establish this conclusion independently. The quick rise to a crest, and the rapid fall from it for individual rises or "freshes" show that there is little delayed run-off. In the cooler lands, the seasons with monthly totals above the average (and, indeed, those below the average, too) owe these to a whole series of "freshes", separated by phases of lower levels and smaller flows. The only divergences from this rule occur at those rare times when there are closely-spaced rainstorms extending over a period of weeks, or even months. In this respect, the major floods and inundations of the River Murray are worthy of special notice. Relatively high levels have been maintained at such times by exceptional incidence of rain. (Text-fig. 9, 3.)

In this cooler region, with its greater "reliability" of rainfall, exceptionally humid periods are long, extending over a number of seasons: the group of years 1916 to 1918 is a case in point. On the other hand, invasions of semi-arid conditions are rare, but they may persist even through the winter season, as in 1902.

In the warmer regions, the exceptionally high flows are produced by severe storms of limited duration, and the succeeding periods of low water are more emphatic and prolonged than those in the more constant south. For example, the first three months of 1917 showed the Fitzroy discharging 5,623; 2,558; and 3,560 units ($\times 10^3$ acre feet) respectively. The discharge for April was only 81 units, and the next four months were also below their respective averages.



Text-fig. 10.—1*a* shows the Murray at Albury in 1917, and rainfall at Batlow in the same year; 1*b* treats the same group in 1902. 2*a* shows the Brisbane River at Lowood, and Esk rainfall station, in the middle valley of the river, for 1926-27; 2*b* is for the same group in 1922-23. Note the logarithmic scale of the ordinates. There is a general similarity between rainfall and river curves, which appear to keep closer together in the south. This is a suggestion pointing to future research.

The variations of flow in this warm country produced by varying intensities of rainfall are suggested by Text-fig. 10, parts 2*a*, *b*. The rainfall station chosen—Esk—in the middle Brisbane valley, has a record similar to those of other rain-recording points of the catchment, and might be expected to be representative. The periods of maximum and minimum river flow recorded were chosen, and the corresponding rainfall curves drawn to match them. With (*a*), a rainfall of 49 inches was enough to give a river flow of 2,085,000 acre feet; with (*b*), a rainfall of 32 inches gave a mere 80,000 acre feet, or 3·8% of the other. Such differences might appear fantastic if they were not discernible in all the rain and river statistics of the summer rainfall type.

The portion of the run-off which is delayed by storage in the catchments is used to supply the drought flow of streams, and is thus economically important, even although it is small. There is no indication that it forms a considerable fraction of the normal low-water flow—that is, in times when there is the usual rainfall. It has been indicated that this is the case even in the cooler and higher districts.

As an example, the Snowy at Jindabyne shows a tendency to decrease to a volume of 5,000 to 6,000 acre-feet per month after two consecutive drought months (rainfall less than 0·5 inch per month as shown by *each* of the three nearest rainfall stations). This flow represents a depth of 0·13 to 0·16 inch for the catchment involved, so that delayed run-off from this productive catchment is by no means great. It must be noted that two successive drought months are a rarity here, there is much cloud, and there are considerable areas of swamp and moist soil.

A sound conclusion appears to be that very little of the water which finds its way into streams is delayed for any considerable time in the catchments—say, for a period of a month or more.

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TABLE 1.

Principal statistical details for the rivers of south-eastern Australia, showing lengths of records, areas of catchments, run-off in acre feet per sq. mile (see also table on text-fig. 3), mean run-off, and coefficient of variation, omitting doubtful cases.

Notes.—x1, ana-branch of Murray, which rejoins the main river ; x2, excluding 1918, a year of high flow ; x3, too low, cf. No. 61 ; x4, minor regulation by water supply dams, which now intercept a greater proportion of flow ; x5, for comparison of flow and variability ; x6, principal Lachlan distributary ; x7, cross stream, Murrumbidgee to Murray.

No.	River and Station.	Record.		Catchment. Sq. miles.	Flow.		Var. %
		Start.	Years.		Acre feet.	Per sq. m.	
1	Avoca, Coonooer	1890	35	1,029	63,000	61	80
2	Barwon, Walgett	1886	45	53,500	1,122,000	21	78
3	Bell, Wellington	1913	21	710	72,000	101	100
4	Belubula, Canowindra	1909	25	816	112,000	137	95
5	Billabong, Cocketgedong	1916	15	—	54,500	—	112
6	Brisbane, Lowood	1910	22	3,950	655,000	166	81
7	Broken, Goorambat	1887	47	730	223,000	306	95
8	Campaspe, Rochester	1886	48	1,350	208,000	154	—
9	Chichester, Dam	1913	14	76	130,000	1,710	—
10	Clarence, Tabulam	1917	16	1,724	526,000	305	89
11	,, Gorge-Newbold	1917	16	6,674	2,143,000	321	77
12	Colo, Upper Colo	1910	23	1,680	338,000	202	79
13	Condamine, Chinchilla	1925	7	7,366	177,000	24	—
14	Corang, Hockey's	1925	9	—	42,000	—	—

TABLE 1.—*Continued.*

No.	River and Station.	Record.		Catchment. Sq. miles.	Flow.		Var. %
		Start.	Years.		Acre feet.	Per sq. m.	
15	Darling, Menindie	1885	49	221,675	2,386,000	23	107
16	Dawson, Taroom	1911	21	6,100	328,000	54	92
17	,, Glebe	1924	8	8,500	540,000	64	—
18	Dumaresq, Riverton	1920	13	2,000	215,000	108	70
19	Edward, Deniliquin x1 ..	1898	36	—	1,570,000	—	125
20	Fitzroy, Wattlebank x2 ..	1915	16	53,286	3,450,000	65	112
21	Glenelg, Sandford	1900	20	3,300	599,000	180	67
22	Goodradigbee, Brindabella ..	1919	12	—	116,000	—	—
23	,, Wee Jasper ..	1915	19	443	315,000	712	41
24	Goulburn, Murchison (Vic.) ..	1882	52	3,966	2,384,000	602	45
25	Goulburn, Rosemount (N.S.W.)	1907	12	3,100	134,000	43	90
26	Hawkesbury and Tributaries—Short Records—						
a	Hawkesbury, Richmond x3 ..	1926	5	4,600	925,000	201	—
b	Cox, Cedar Vale	1927	6	1,040	314,000	302	—
c	Nepean, Pheasant's Nest ..	1924	10	274	154,000	525	—
d	,, Wallacia x4	1924	10	—	219,000	—	—
e	Wollondilly, Burragorang ..	1926	7	1,813	320,000	176	—
27	Hunter, Moonan Flat	1912	22	290	92,000	318	100
28	,, Muswellbrook	1907	27	1,630	310,000	190	66
29	,, Singleton	1898	36	6,580	685,000	104	67
30	Indi, Bringenbrong	1908	13	493	442,000	896	—
31	Kiewa, Kiewa	1886	48	434	554,000	1,275	48
32	Lachlan, Wyangala	1920	14	3,200	519,000	162	73
33	,, Cowra	1893	41	4,470	540,000	121	109
34	,, Forbes	1893	41	7,550	577,000	77	101
35	,, Booligal	1909	25	—	215,000	—	—
36	Latrobe, Rosedale	1901	19	1,475	693,000	470	26
37	Lockyer, Tarampa	1910	22	965	66,000	68	111
38	Loddon, Bridgewater	1882	52	1,856	201,000	108	63
39	Macalister, Maffra	1901	9	850	292,000	343	39
40	Macintyre, Boggabilla ..	1925	8	9,050	474,000	52	—
41	Macquarie, Wellington ..	1909	25	5,482	605,000	110	101
42	,, Dubbo	1886	48	7,690	710,000	92	99
43	,, Warren	1902	31	—	574,000	—	105
44	Mitchell, Bairnsdale	1890	32	1,770	686,000	388	37
45	Mitta, Tallangatta	1886	48	1,990	1,079,000	542	50
46	Molonglo, Yarralumla	1927	7	700	51,000	73	—
47	Mongarlowe, Charleyong ..	1925	8	—	81,000	—	—
48	Murray, Bringenbrong	1906	15	820	1,140,000	1,390	40
49	,, Jingellic	1891	42	2,520	1,897,000	752	38
50	,, Albury	1877	57	6,500	3,657,000	563	48
51	,, Barham..	1905	29	—	4,126,000	—	31
52	,, Mildura	1877	56	92,000	8,095,000	88	54
53	Murrumbidgee, Cotter Junction	1927	7	2,660	486,000	183	—
54	,, Gundagai ..	1887	46	8,400	2,723,000	324	54
55	,, Wagga ..	1885	49	10,700	2,830,000	264	63
56	,, Hay	1887	47	17,520	2,239,000	128	60
57	,, Balranald ..	1887	47	—	2,133,000	—	60
58	Namoi, Old Cuerindi	1916	17	940	182,000	194	77
59	,, Gunnedah	1912	21	6,600	431,000	65	79
60	,, Narrabri	1892	41	9,800	517,000	53	87
61	Nepean, Penrith	1892	42	4,240	958,000	226	74
62	Nymboida, Buccarumbi ..	1922	11	1,888	969,000	513	—
63	Ovens, Wangaratta	1887	47	2,090	1,191,000	570	55
64	Peel, Bowling Alley	1916	17	130	66,000	507	79

TABLE 1.—*Continued.*

No.	River and Station.	Record. Start.	Record. Years.	Catchment. Sq. miles.	Flow. Acre feet.	Flow. Per Sq. m.	Var. %
65	Peel, Carroll Gap	1924	8	1,800	116,000	64	—
66	Shoalhaven, Warri	1915	17	572	192,000	335	119
67	,, Welcome Reefs ..	1910	22	1,066	352,000	330	106
68	Snowy, Jindabyne	1903	31	716	951,000	1,330	32
69	,, Orbost	1907	18	5,210	1,749,000	336	36
70	Stanley, Silverton	1916	16	515	465,000	902	80
71	Swampy Plain, Indi	1906	8	320	616,000	1,926	—
72	,, ,, Khancoban ..	1927	7	228	436,000	1,912	—
73	Tambo, Bruthen	1906	19	1,040	212,000	204	62
74	Thames (England) x5 ..	1904	28	—	2,120,000	—	29
75	Thomson, Heyfield	1901	21	550	323,000	587	34
76	Tooma, Warbrook	1910	11	713	634,000	888	—
77	,, Possum Point	1927	7	189	415,000	2,200	—
78	Tumut, Tumut	1905	29	980	1,017,000	1,036	46
79	Warragamba, Nepean J. ..	1904	30	3,383	590,000	174	58
80	Willandra, Tocabil x6	1921	13	—	113,000	—	—
81	Wimmera, Horsham	1889	36	1,530	144,000	94	88
82	Yanko Ck., Offtake x7 ..	1902	26	—	205,000	—	89
83	Yarra, Warrandyte	1892	33	972	740,000	770	31
84	Yarrangobilly, Caves	1911	20	—	51,000	—	49
85	Yass, Yass	1916	17	500	67,000	134	—

TABLE 2.

Largest streams gauged in Australia. Compare Text-fig. 2.

Station No.	River.	Catchment (Sq. mls.)	Record Years.	Annual Flows. Acre feet × 10^3. Mean.	Max.	Min.
52	Murray	92,000	56	8,095	24,452	1,320
20	Fitzroy	53,286	16	3,450	13,301	137
55	Murrumbidgee	10,700	49	2,830	7,712	384
15	Darling	221,675	49	2,386	11,107	1
24	Goulburn	3,966	52	2,384	6,202	567
11	Clarence	6,674	16	2,143	6,066	532
69	Snowy	5,210	18	1,749	2,972	776
63	Ovens	2,090	47	1,191	4,023	141
2	Barwon	53,500	45	1,122	3,866	16
45	Mitta	1,990	48	1,079	3,370	238
78	Tumut	980	29	1,017	2,387	283
61	Nepean	4,240	42	958	2,947	67

TABLE 3.

Comparison of certain main stream catchments (including all headwaters) with gauged headwaters. Note the especial productiveness of limited areas of the highlands.

Station No.	River.	Area. (Sq. miles.)	Depth of Run-off.	
			Inches.	Cm.
50	Murray	6,500	10·5	26·7
30	Indi	493	16·8	42·6
31	Kiewa	434	23·9	60·7
72	Swampy Plain	228	35·8	91·0
77	Tooma	189	41·0	104·2
54	Murrumbidgee	8,400	6·1	15·5
23	Goodradigbee	443	13·3	33·8
78	Tumut	980	19·3	49·0
69	Snowy	5,210	6·3	16·0
68	Snowy	716	24·9	63·3
29	Hunter	6,580	1·9	4·8
27	Hunter	290	6·0	15·2
59	Namoi	6,600	1·2	3·1
64	Peel	130	9·5	24·1

STRONGYLATE NEMATODES FROM MARSUPIALS IN NEW SOUTH WALES.

By T. Harvey Johnston and Patricia M. Mawson, University of Adelaide.

(Sixty-six Text-figures.)

[Read 25th October, 1939.]

The present communication is the fifth of a series dealing with the nematode parasites of Australian marsupials, the earlier papers giving accounts based largely on material from Queensland and Central Australia.

Twenty-five species are proposed as new and are distributed amongst eleven genera, three of which (*Cyclostrongylus*, *Parazoniolaimus*, and *Maplestonema*) are new.

Types of new species described in this report are deposited in the South Australian Museum, Adelaide.

This investigation has been made possible by the Commonwealth Research Grant to the University of Adelaide. We desire to acknowledge assistance in regard to material from Professor J. B. Cleland; Messrs. L. Gallard, Narara; A. S. Le Souef, Director, Sydney Zoological Gardens; and W. L. Rait, Adelaide. Much of the material was collected by the senior author between 1908 and 1911 during his residence in New South Wales. The locality quoted as Lower Hawkesbury is in the vicinity of Milson Island and the township of Hawkesbury River.

List of Hosts and Parasites dealt with in this Paper.

Macropus rufus Desm.: *Pharyngostrongylus alpha* J. & M.; *Zoniolaimus longispicularis* (Wood); *Cloacina magnipapillata*, n. sp.; *C. longispiculata* J. & M.

Macropus major Shaw: *Pharyngostrongylus alpha* J. & M.; *P. beta* J. & M.; *Zoniolaimus longispicularis* (Wood); *Zoniolaimus* sp.; *Cloacina obtusa*, n. sp.; *C. expansa*, n. sp.; *C. magnipapillata*, n. sp.; *Cyclostrongylus clelandi*, n. gen., n. sp.

Macropus robustus Gould: *Pharyngostrongylus alpha* J. & M.

Macropus ualabatus Less. & Garn.: *Pharyngostrongylus alpha* J. & M.: *P. beta* J. & M.; *P. epsilon* J. & M.; *Zoniolaimus ualabatus*, n. sp.; *Z. clelandi*, n. sp.; *Z. setifer* Cobb; *Z. brevicaudatus* Cobb; *Parazoniolaimus collaris*, n. gen., n. sp.; *Cloacina macropodis* J. & M.; *C. wallabiae*, n. sp.; *Cloacina* sp.; *Macropostrongylus dissimilis*, n. sp.; *Cyclostrongylus wallabiae*, n. gen., n. sp.; *Cyclostrongylus dissimilis*, n. gen., n. sp.; *Maplestonema typicum*, n. gen., n. sp.

Macropus ruficollis Desm.: *Pharyngostrongylus alpha* J. & M.; *P. beta* J. & M.; *P. delta* J. & M.; *P. epsilon* J. & M.; *P. zeta* J. & M.; *P. eta* J. & M.; *P. brevis* Canavan; *P. iota*, n. sp.; *P. macropodis* Y. & M.; *Macropostrongylus lesouefi*, n. sp.; *M. wallabiae*, n. sp.; *Zoniolaimus communis* J. & M.; *Z. onychogale* J. & M.; *Zoniolaimus* sp.; *Buccostrongylus australis* J. & M.; *Buccostrongylus setifer*, n. sp.; *B. labiatus*, n. sp.; *Cyclostrongylus gallardi*, n. gen., n. sp.; *Austrostrongylus wallabiae*, n. sp.

Macropus parma Waterhouse: *Pharyngostrongylus epsilon* J. & M.; *P. parma*, n. sp.

MACROPUS THETIDIS Lesson: *Pharyngostrongylus alpha* J. & M.; *P. delta* J. & M.; *P. epsilon* J. & M.; *P. zeta* J. & M.; *P. theta*, n. sp.; *Zoniolaimus* sp.; *Cloacina bancroftorum* J. & M.; *C. similis* J. & M.; *C. thetidis*, n. sp.; *Cloacina* sp.; *Buccostrongylus buccalis* J. & M.; *Globocephaloides thetidis*, n. sp.; *Hypodontus thetidis*, n. sp.

TRICHOSURUS CANINUS Ogilby: *Asymmetricostrongylus trichosuri*, n. sp.

PHARYNGOSTRONGYLUS Yorke & Maplestone.

The original species, *P. macropodis*, was described by Yorke and Maplestone in 1926. Mönnig in the same year described *australis*, attributing it to a preoccupied genus *Spirostrongylus*, but transferred it in 1927 to *Rugopharynx* which was shown by Wood (1929) to be a synonym of *Pharyngostrongylus*. This latter author described *P. woodwardi* in 1930. Canavan in 1931 added *P. brevis*. We described two others in 1938 and recently added four more (1939). In the present report three others are described and host records relating to nine of the known species are mentioned.

PHARYNGOSTRONGYLUS THETA, n. sp. Figs. 1–2.

From stomach, *Macropus thetidis*, New England.

Male 4·8; female 4·5 mm. Head with six small papillae; buccal cavity 9μ long; followed by transversely striated chitinized vestibule 0·04 mm. long, 8μ internal and 14μ external diameter, with wall becoming narrowed suddenly just before joining oesophagus. Oesophagus 0·56 mm. long, anterior part 0·37 mm., followed by a narrower portion around beginning of which is nerve ring, posterior region widening into bulb before joining intestine. Cervical papillae not observed. Excretory pore at level of nerve ring.

Male: Bursa with ventral lobes very small and separated from each other as well as from lateral lobes; lateral and dorsal lobes continuous, dorsal longer. Ventral rays parallel, cleft nearly to base; not reaching edge of bursa; externo-lateral shorter than, and slightly divergent from, laterals; laterals reaching edge of bursa, cleft three-quarters of their length; externo-dorsal long, thin, arising from same root as laterals, diverging from them, not reaching edge of bursa; externo-lateral, laterals and externo-dorsal each elevate bursa into slight papilla at their termination. Dorsal ray long, bifurcating just before its mid-length, each of the two slender branches reaching bursal edge and giving off a very short lateral ray at about mid-length. Spicules 1·9 mm. long, half of body length, stout, with striated alae extending nearly to tips. Gubernaculum present, 40μ long; with a pair of less chitinized leaf-like alae extending alongside the spicules.

Female: Body tapering suddenly behind vulva and again behind anus; tail pointed, 0·2 mm. long, ventrally directed; vagina muscular, 0·35 mm. long; vulva 0·13 mm. in front of anus; ripe eggs not seen.

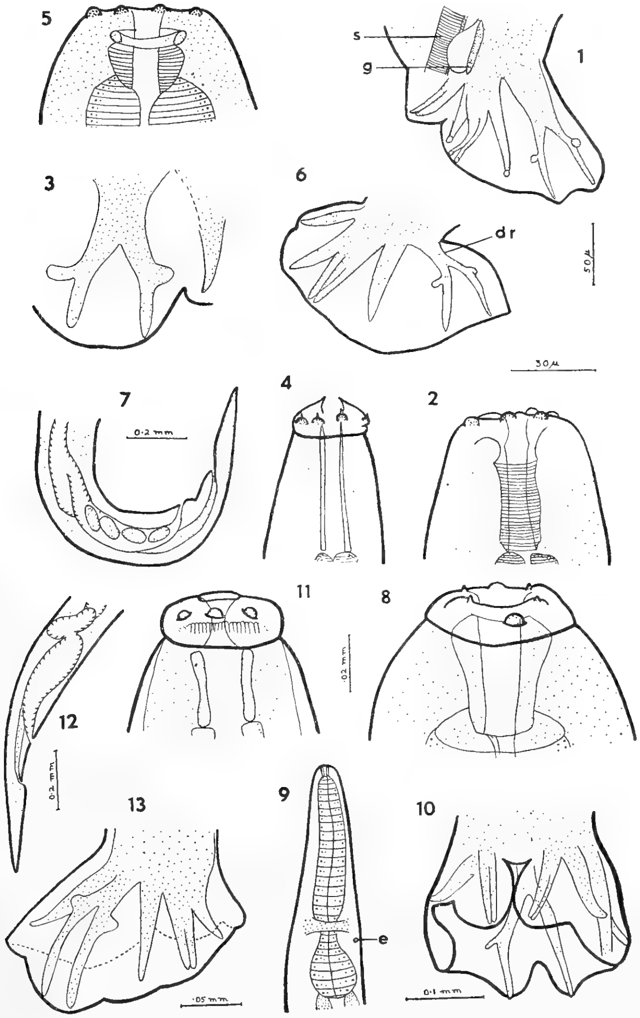
The species differs from *P. australis* in its shorter length, the form of the vestibule, length of the externo-dorsal ray, width of the dorsal ray, absence of median dorsal thickening of the bursa, relatively longer spicules, and the absence of papillae on the bursa. It differs from *P. brevis* in its shorter length, absence of leaf crown and cervical papillae, relatively shorter spicules, and in the relatively larger narrower vestibule. It can be distinguished from *P. alpha* and *P. beta* by the different dorsal ray, the form of the bursa (which is not deeply subdivided), and the absence of bursal papillae.

PHARYNGOSTRONGYLUS IOTA, n. sp. Figs. 3–4.

From *Macropus ruficollis*, Ourimbah, Gosford district (L. Gallard).

About 9 mm. long. Head with external leaf-crown similar to that of *P. gamma*, *P. macropodis*, and *P. eta*; with six similar papillae. Vestibule 1 mm. long, 0·2 mm. wide; without striations. Posterior end of very narrow oesophagus obscured by granular material, hence length not determined.

Male: Spicules 2·9 mm. long, one-third of body length. Bursa deeply lobed, papillated. Ventral rays cleft, not quite reaching edge of bursa; externo-lateral divergent from laterals near tip and shorter than laterals; laterals extending nearly



Figs. 1-2, *Pharyngostrongylus theta*. 1. bursa of male; 2. head.
Figs. 3-4, *P. iota*. 3. dorsal ray of bursa; 4. anterior end.
Figs. 5-7, *P. parma*. 5. head; 6. bursa; 7. posterior end of female.
Figs. 2 and 5 to same scale; figs. 1, 3, 4, and 6.
Figs. 8-10, *Cyclostrongylus wallabiae*. 8. head; 9. anterior end; 10. bursa.
Figs. 11-13, *C. gallardi*. 11. head, lateral view; 12. posterior end of female; 13. bursa.
Figs. 8 and 11 to same scale; figs. 9 and 12.

to edge; externo-dorsal stout, arising separately, not reaching bursal edge. Dorsal ray bifurcating at half-length and its branches not quite reaching edge, each branch giving off a short lateral ray at about mid-length.

Female: Vagina exceedingly long (1·4 mm.), wide, with very small eggs (0·07 mm. by 0·04 mm.); vulva 0·85 mm. and anus 0·63 mm. from tip of tail; tail long, tapering.

This form is very like *P. macropodis*, *P. gamma* and *P. eta*, differing from them in the absence of striations on the vestibule and in general measurements. It most closely resembles *P. gamma*, differing in having a relatively narrower vestibule, a much longer vagina and a stouter dorsal ray whose lateral rays are more robust and relatively shorter, and whose terminal branches are longer.

PHARYNGOSTRONGYLUS PARMA, n. sp. Figs. 5–7.

From oesophagus, *Macropus parma*, Narara, Gosford district (L. Gallard).

Filiform worms, tightly rolled; male 7·3 mm. long; females 6·7–7·5 mm. Body ending abruptly at anterior end and surmounted by six small papillae. Mouth opening 10μ in diameter; continuous with, and of same width as, buccal cavity (14μ deep) and vestibule. Posterior part of buccal cavity surrounded by thick chitinous ring about 4μ long; followed by vestibule 15μ long, and with stout chitinous walls 9μ thick at anterior end, narrowing posteriorly and marked with radial striations. Oesophagus 0·54 mm. long, of uniform width until suddenly constricted near its posterior end and then widening into a terminal elongated bulb; nerve ring surrounding it at level of constriction, 0·4 mm. from anterior end; excretory pore near base of oesophagus.

Male: Bursa large, lobes not divided from one another. Owing to the closeness of the helix it is very difficult to roll the bursa into a position allowing the dorsal ray to be seen in dorsal view. Ventral rays reaching edge of bursa; externo-lateral ray stout, tapering at tip, not reaching edge; laterals cleft for half their length, reaching edge of bursa; externo-dorsal arising separately, stout, tapering, shorter than externo-lateral. Dorsal ray dividing near its base into two long narrow branches reaching nearly to edge of bursa and each giving off near its origin a short stout lateral branch. Spicules 0·96 mm. long, 1:7·6 of body length; narrow, with striated alae; tips curved, bluntly pointed.

Female: Posterior end tapering; tail bluntly pointed, 0·3 mm. long; vulva 0·15 mm. in front of anus; vagina fairly long, wide. Eggs in vagina 0·1 × 0·04 mm.

This species differs from other members of the genus *Pharyngostrongylus* chiefly in its attenuate form and coiled habit, and in the structure of the vestibule.

PHARYNGOSTRONGYLUS ALPHA Johnston & Mawson 1938.

This parasite has been identified amongst collections taken from the following hosts: *Macropus rufus*, from Wentworth (coll. W. L. Rait); *M. major*, Coonamble; *M. ualabatus*, Lower Hawkesbury (coll. J. B. Cleland); *M. ruficollis*, Bathurst district; *M. thetidis*, New England; and *M. robustus* (*robustus*), N.S.W. (coll. A. S. Le Souef, Sydney Zoological Gardens).

PHARYNGOSTRONGYLUS BETA Johnston & Mawson 1938.

From *Macropus ualabatus*, Lower Hawkesbury (coll. J. B. Cleland); *M. ruficollis* from Bathurst district, Ourimbah (Gosford district), and Sydney Zoological Gardens; and *M. major*, Coonamble.

PHARYNGOSTRONGYLUS GAMMA Johnston & Mawson 1938.

From *Macropus ruficollis*, Bathurst district.

PHARYNGOSTRONGYLUS DELTA Johnston & Mawson 1938.

From *Macropus ruficollis*, Bathurst district, and from Sydney Zoological Gardens; *M. major*, Narrabri; and *M. thetidis*, New England.

PHARYNGOSTRONGYLUS EPSILON Johnston & Mawson 1938.

From *Macropus ualabatus*, Lower Hawkesbury River; *M. parma*, Gosford district; *M. thetidis*, New England; and *M. ruficollis*, Bathurst district.

PHARYNGOSTRONGYLUS ZETA Johnston & Mawson 1938.

From *Macropus ruficollis*, Bathurst district; and *M. thetidis*, New England.

PHARYNGOSTRONGYLUS ETA Johnston & Mawson 1938.

From *Macropus ruficollis*, Bathurst district.

PHARYNGOSTRONGYLUS BREVIS Canavan 1931.

From *Macropus ruficollis*, Bathurst district; and *M. ualabatus*, Lower Hawkesbury district.

PHARYNGOSTRONGYLUS MACROPODIS Yorke & Maplestone 1926.

Specimens, probably belonging to this species, were taken from *Macropus ruficollis* from Bathurst district.

CYCLOSTRONGYLUS, n. gen.

Trichoneminae; with long buccal capsule, thick cuticular collar around mouth, the inner surface of which is marked with parallel longitudinal striations extending into the buccal cavity and resembling at first sight a leaf crown of many narrow elements; arising from this collar are four submedian and two lateral papillae. Oesophagus varies in form in different species. Main stem of dorsal ray soon bifurcates, each branch giving off a short lateral ray. Posterior end of female resembles that in *Cloacina*. From stomach of marsupials. Type, *C. wallabiae*, n. sp., from *Macropus ualabatus*.

The generic name is applied because of the circumoral cuticular ring or collar. The genus differs from *Coronostrongylus* in the absence of a leaf crown; and from *Pharyngostrongylus* in the shape of the bursa and in the absence of a vestibule. We have assigned to this genus, in addition to the type, two species *C. clelandi* and *C. gallardi*. A fourth species, *C. dissimilis*, has been placed here provisionally, but it probably belongs elsewhere, its state of preservation preventing us from giving a sufficiently detailed account of it.

CYCLOSTRONGYLUS WALLABIAE, n. sp. Figs. 8–10.

From *Macropus ualabatus*, Lower Hawkesbury (coll. J. B. Cleland).

Worms of moderate size; male 8·5 mm. long; female 5·1 mm.; somewhat coiled. Anterior end rounded, surmounted by wide thick mouth-collar, bearing four small submedian papillae and a pair of small rounded laterals. Mouth opening round, large, leading into a long cylindrical buccal chamber 0·04 mm. long, 0·15 mm. internal diameter, with the walls about 7μ thick anteriorly but diminishing posteriorly; walls marked with transverse striations. At base of buccal cavity a rather disc-like wider ring of chitin lying against anterior end of oesophagus. Latter 0·07 mm. long in male, 1:11 of body length; wider than buccal capsule; and consisting of two parts—the anterior portion longer and narrowing suddenly at level of nerve ring, 0·55 mm. from head end of worm; the posterior part widening to form a bulb. Excretory pore at 0·56 mm., just behind nerve ring; cervical papillae not seen.

Male: Spicules short; 0·7 mm. long, 1:12 of body length; with very narrow striated alae. Gubernaculum not observed. Ventral lobes of bursa short, separate from one another; dorsal lobe with wide median cleft. Ventral rays long, cleft nearly to base: externo-lateral, short, lifting wall of bursa; laterals cleft nearly to base, reaching edge of bursa; externo-dorsal arising separately, nearly reaching bursal edge. Dorsal ray long, bifurcating soon after origin; each branch tapering and forming projection on edge of dorsal lobe, and giving off short lateral ray at about mid-length.

Female: The only available specimen is rather unsatisfactory. Body tapering suddenly behind region of vagina to end in long bluntly-pointed tail. Uteri parallel; vagina short; vulva at 0·25 mm., and anus at 0·2 mm. from tip of tail. Egg in vagina 0·041 × 0·025 mm.

CYCLOSTRONGYLUS GALLARDI, n. sp. Figs. 11–13.

From *Macropus ruficollis*, Ourimbah, Gosford district (L. Gallard).

Male 4–5 mm. long; female 5–6 mm. Head with characteristic cuticular collar round anterior end, through which the hypodermis projects in six small rounded papillae. Mouth small, circular, 10μ diameter, leading to narrow buccal cavity, 17μ long, followed by wide buccal capsule 30μ long, 12μ wide internally, 19μ wide externally. Striations of hypodermis (resembling a leaf crown) 7μ deep and not reaching top of buccal cavity. Oesophagus 0·53 mm. long, 1:8–11 of body length; longer anterior region of uniform width, becoming constricted suddenly, then widening into large spherical bulb before joining intestine. Nerve ring around oesophageal constriction, 0·48 mm. from anterior end of worm; excretory pore just in front of nerve ring; cervical papillae not observed.

Male: Spicules 1·9–2 mm., 1:2·4 of body length; slender; with wide striated alae and blunt tips. Gubernaculum small. Bursa large, ventral part shorter than dorsal; lobes all joined but marked off by shallow indentations. Ventral rays cleft nearly all their length, reaching bursal margin; externo-lateral divergent from laterals, extending nearly to edge; medio- and postero-lateral cleft for half their length, a little shorter than externo-lateral; externo-dorsal arising separately and not reaching edge of bursa. Dorsal ray bifurcating after about one-third to one-quarter its length, each branch almost immediately giving off a very short lateral ray before extending nearly to edge of dorsal lobe; these branches relatively long and parallel.

Female: Body tapering gradually to posterior end; tail bluntly pointed, straight, 0·3 mm. long. Vagina muscular, 0·4 mm. long; vulva 0·13 mm. in front of anus. Eggs in vagina 0·08 × 0·04 mm.

This species differs from *C. wallabiae* in the different form of the buccal capsule, papillae and dorsal ray of the bursa; from *C. clelandi* in regard to the lips, bursal rays and the characters of the buccal capsule; and from *C. dissimilis* in the form of the oesophagus and the dorsal ray.

CYCLOSTRONGYLUS CLELANDI, n. sp. Figs. 14–15.

From *Macropus major*, Coonamble (coll. A. S. Le Souef).

Slender worms, 10–11 mm. long, widest in anterior third, with fine annulate cuticular striations. Head surrounded by large cuticular mouth collar through which project four short cylindrical submedian and two very short lateral papillae. Mouth large, circular; buccal cavity 0·065 mm. long, 0·05 mm. wide; with walls marked by numerous longitudinal lines, at first sight suggesting a leaf crown of numerous elements. Oesophageal region packed with granular material in all but one specimen examined; oesophagus 1·7 mm. long in female, 1:6 of body length;

narrow; with small posterior bulb. Nerve ring, cervical papillae and excretory pore not recognized.

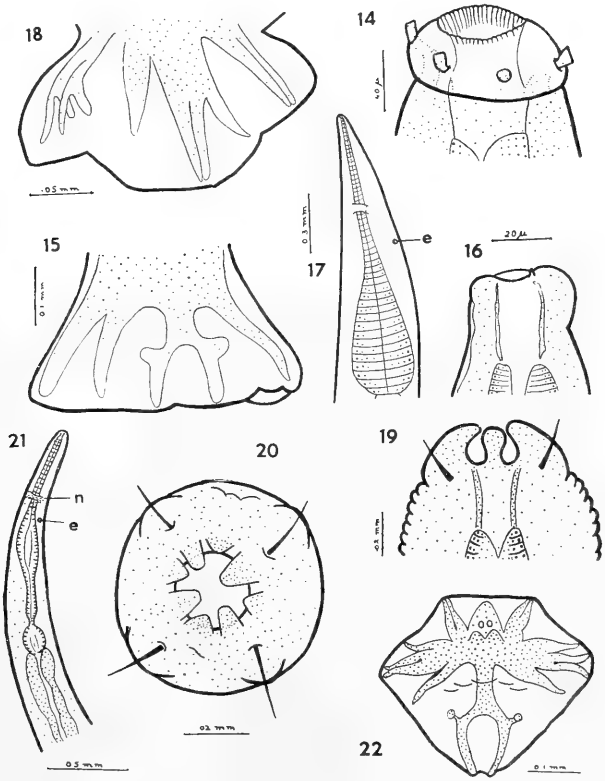
Male: Spicules 1·7 mm. long, 1:6 of body length, stout, with wide striated alae. Bursa large; ventral lobes joined, laterals separated from ventral and dorsal by shallow indentations. Ventral rays long, parallel; externo-lateral long, only slightly divergent from medio- and postero-laterals, all three of same length and nearly reaching edge of bursa; externo-dorsal arising separately, long, thin. Dorsal ray dividing before one-third length into two divergent branches, each giving off a very short lateral ray just before its middle. Genital cone short; accessory cone present.

Female: Body narrowing behind vulva to end in tapering pointed tail; vagina short; vulva at 6·8 mm., anus at 3·8 mm. from tip of tail. No eggs were seen in the only female found, which was immature, and about 11 mm. long.

CYCLOSTRONGYLUS DISSIMILIS, n. sp. Figs. 16–18.

From *Macropus ualabatus*, Milson Island, Lower Hawkesbury (J. B. Cleland).

Only one specimen, a damaged male, was found, but the unusual shape of the oesophagus warrants the inclusion of a description of the worm which was 13·9 mm.



Figs. 14-15, *Cyclostrongylus clelandi*. 14. head; 15. bursa.

Figs. 16-18, *C. dissimilis*. 16. head; 17. oesophageal region; 18. bursa.

Figs. 19-22, *Zoniolaimus setifer*, enlarged from Cobb (1898, fig. 30). 19. lateral view of head; 20. anterior view of head; 21. lateral view of anterior end; 22. posterior view of bursa.

in length. Head very indistinct, with cuticle so swollen that it appears asymmetrical. Only two short conical papillae observed. Mouth leads into a thin-walled cylindrical buccal capsule, 0·015 by 0·02 mm., opening into oesophagus. Latter 1 mm. long; 1:14 of body length; anterior half narrow and surrounded near its posterior end by nerve ring, posterior half increasing in diameter so that it has the form of a cone, with the base near the intestine. Excretory pore in vicinity of junction of the two oesophageal regions.

Spicules 2·5 mm. long, 1:5·6 of body length, with striated alae. Gubernaculum not seen. Bursa large; lobes well marked, distinct from one another. Ventral ray long, thin, nearly reaching bursal edge, cleft for entire length; externo-lateral arising with lateral but divergent from it after half length, and nearly reaching edge of bursa; lateral cleft for half length, nearly reaching edge; externo-dorsal short, stout, arising from base of laterals. Dorsal ray stout, short, bifurcating about half length, each branch dividing beyond mid-length into two rays, the inner being slightly longer and thinner.

As already stated, this species has been placed under the genus only provisionally, since the condition of the solitary specimen has prevented a more detailed account being given and a satisfactory assignment being made.

Zoniolaimus Cobb 1898.

In a recent paper (1939) we rehabilitated Cobb's genus, giving a diagnosis and describing some new species. *Labiostrongylus* Yorke and Maplestone was placed as a synonym and the numerous species described under that genus were transferred to *Zoniolaimus*. Since the two species named by Cobb came from New South Wales material, an attempt has been made to interpret his formula and figures relating to them. In addition to describing two new species in this paper, we give host and locality records for three already known.

Zoniolaimus setifer Cobb 1898. Figs. 19–22.

From the "brush wallaby", Moss Vale. We have already indicated that *Macropus ualabatus* is the species referred to. The following description is based on the figures and formula given by Cobb (1898, fig. 30).

Length of male, 7·75 mm. Head with eight lips, the four submedian larger than laterals, dorsal and ventral, and bearing each a long bristle (0·02 mm.) near the bases. Buccal capsule cylindrical, about 0·02 mm. wide, with base 0·04 mm. from top of lips. Oesophagus 1·23 mm. long, widening at about half its length into an elongate bulbous portion, then narrowing into a constricted region followed by a spherical bulb. Nerve ring at 0·4 mm. from head end and surrounding oesophagus at about two-thirds its length; excretory pore near beginning of median swollen portion of oesophagus, and about 0·52 mm. from anterior end of worm.

Male: Spicules thin, apparently 1·6 mm. long (i.e. 1:4·8 of body length). Bursa large, all rays except externo-dorsal reaching edge. Ventrals parallel, cleft half their length; externo-laterals arising with laterals, diverging from them near tip; laterals cleft half their length; externo-dorsal thin, arising from base of laterals but divergent from them. Dorsal ray bifurcating between one-third and one-half its length, each branch giving off short lateral ray soon after its origin. Genital cone present; accessory cone of two small bodies. The breadth of body of the male at base of buccal capsule, 0·069 mm.; at nerve ring, 0·13 mm.; at posterior end of oesophagus, 0·22 mm.; maximum width 0·28 mm.; width near bursa, 0·08 mm.

No particulars are given of the female, except a drawing of the anterior end.

The measurements given for the *Z. setifer* (*setiferus* in Cobb) agree with the sizes indicated in the diagrams. This worm then is much smaller than most species of the genus. We have not been able to identify it amongst our material.

ZONIOLAIMUS BREVICAUDATUS Cobb 1898.

Host not mentioned, but presumably from a "brush wallaby" (i.e. *Macropus ualabatus*) from Moss Vale, where Cobb was for a time engaged in official parasitological work.

The only information relating to this species is embodied in two figures, one of the female genitalia and one of male apparatus, together with the formula for a female worm. The diagrams are of little use in identification, as also are the measurements of the female. In no specimen of *Zoniolaimus* examined by us, however, are the spicules so short in relation to other parts of the male. They are apparently 1·5 mm. long. The measurements of a female, according to Cobb's formula, are: length of body 7·5 mm.; length of buccal capsule 0·06 mm.; anterior end to nerve ring 0·33 mm.; oesophagus 1·07 mm. (i.e. 1:7 of body length); vulva from tip of tail 0·38 mm.; anus from tip of tail 0·23 mm.; maximum width of body 0·32 mm. The figures in Cobb's paper (figs. 102 and 103) are said to be natural size; the length of the female is given as 7·5 mm., but the length of the sexual organs (as figured) is 30 mm. We suggest, therefore, that an error has occurred either in reduction of the original figures, or perhaps of a decimal place in the stated length of the worm. On the other hand, no such error has been detected in the case of *Z. setifer* (Cobb 1898, fig. 30), where the measurements given agree very well with the figures.

The spicules of *Z. brevicaudatus* as indicated in a diagram (which is stated to be natural size) are of the same length as those of *Z. setifer*, but a comparison of the figures given for the two species shows them to be much shorter than those of the latter in relation to other parts of the male system.

ZONIOLAIMUS CLELANDI, n. sp. Figs. 23–25.

From the stomach of *Macropus ualabatus*, Lower Hawkesbury (coll. J. B. Cleland).

Male 21 mm.; female 30 mm. long. Lateral lips very prominent, with a median terminal papilla; submedian lips rounded, each with a long seta. Buccal capsule 0·1 mm. wide, 0·07 mm. long; base 0·15 mm. from tip of submedian lips. Oesophagus 4 mm. long; 1:5 of body length.

Male: Dorsal lobe of bursa long. Dorsal ray long, giving off a fairly long branch on each side, the main stem continuing for a distance somewhat greater than the length of each branch, and then bifurcating into two rather broad terminal rays reaching the edge of the bursa. Spicules 7·2 mm., 1:3 of body length.

Female: Tail long, tapering; vulva at 1·7 and anus at 0·9 mm. from tip of tail; vagina narrow, twisted, 1·5 mm. long; eggs (in vagina) 0·12 by 0·07 mm.

The species resembles *Z. longispicularis* and *Z. communis*. It differs from the former in the form of the lateral and submedian lips and in the presence of setae on the lips, the thinner dorsal ray and the different form and position of the branches of that ray. It differs from *Z. communis* in the form of the dorsal ray, relative sizes of the lateral and submedian lips, length of setae on the lips, and in the rather shorter spicules.

ZONIOLAIMUS UALABATUS, n. sp. Fig. 26.

From stomach, *Macropus ualabatus*, Lower Hawkesbury (coll. J. B. Cleland).

Only immature females found; short, stout; 6·4–7 mm. long; 0·3 mm. maximum breadth; body with fine longitudinal striations. Head differs from that of any other known member of the genus in having the four submedian lips smaller than the laterals. Submedians conical, each with short seta; laterals tall, wider distally where they bear each a small median rounded papilla; a dorsal and a ventral lip present, conical, as large as lateral lips. Buccal capsule 0·045 mm. wide; 0·051 long from top of lips. Oesophagus 1·1–1·4 mm. long; 1:6–7 of body length; base surrounded by a pair of sheath-like prolongations of intestinal wall. Nerve cord at 0·35–0·4 mm. from head end; excretory pore just behind nerve ring; cervical papillae not observed.

Body narrows suddenly behind vulva, and again behind anus to end in narrow pointed tail, 0·3 mm. long. Anus 0·17 mm. behind vulva. Since the above account was written two adult females, 20 mm. long, were found amongst the material from the same host, the organs in these worms presenting the same proportions as in the younger specimens.

Zoniolaimus longispicularis (Wood 1929).

This large species, originally described as a *Labiostrongylus*, has been identified amongst material collected from *M. rufus*, Wentworth, South-Western New South Wales, and from Balranald; and *M. major*, from Narrandera and Narrabri.

Zoniolaimus communis Johnston & Mawson 1939.

From *Macropus ruficollis*, Bathurst district.

Zoniolaimus onychogale Johnston & Mawson 1939.

From *Macropus ruficollis*, Bathurst district.

Zoniolaimus sp.

Immature specimens and females, not identifiable specifically, were found in *Macropus thetidis*, New England; *M. major*, Coonamble; *M. ualabatus*, Lower Hawkesbury; and *M. ruficollis*, Ourimbah, Gosford district.

Parazoniolaimus, n. gen.

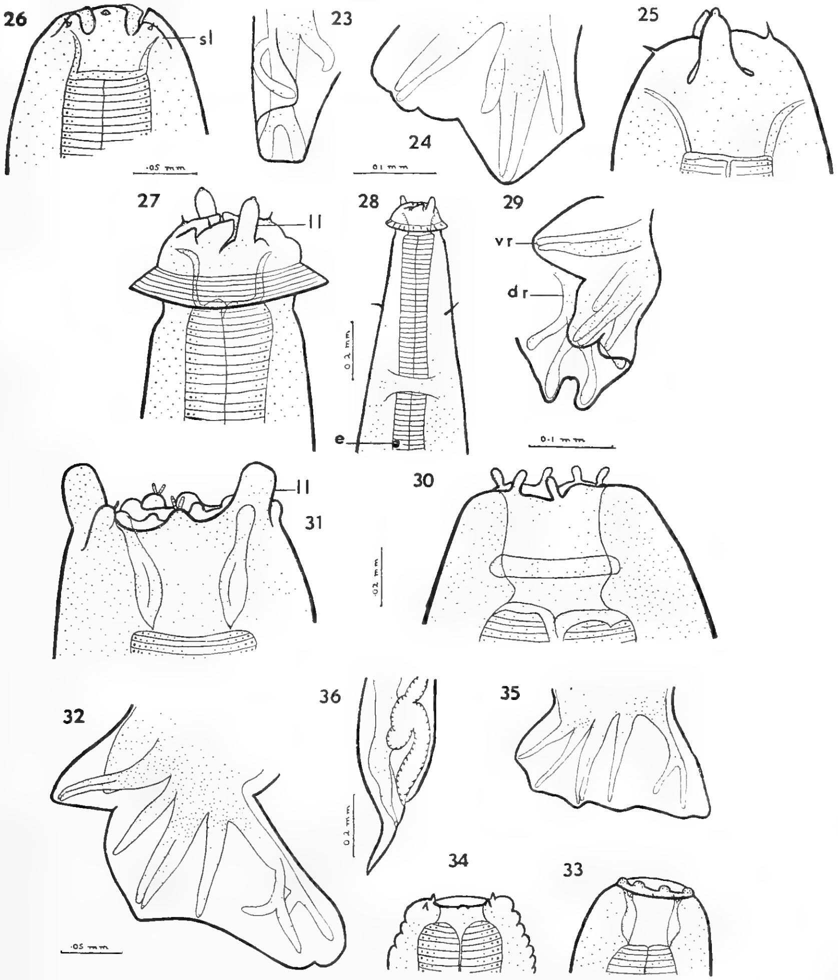
Trichoneminae: Lips prominent, laterals largest, dorsal and ventral smallest. Short cuticular projecting frill around head region just behind lips, followed by slight constriction. Bursa large; ventral lobes separate; dorsal ray giving off a pair of lateral branches and then bifurcating. Female with tapering pointed tail; vulva a short distance in front of anus. From stomach of marsupials. Type, *P. collaris*, n. sp., from *Macropus ualabatus*.

This genus is close to *Zoniolaimus* from which it differs in the possession of a cuticular frill surrounding the head.

Parazoniolaimus collaris, n. sp. Figs. 27–29.

From stomach, *Macropus ualabatus*, Lower Hawkesbury (J. B. Cleland).

Body long, stout; male 15–16·5 mm. long; adult female 20–30 mm.; young females (devoid of eggs) from 11 mm. long. Anterior end with eight lips; two laterals, long, upright, each with small round terminal papilla; four submedian shorter, stout, bent inwards, each bearing rounded papilla with upwardly-directed bristle, the tip of which divides into two; distal end of each submedian lip dividing into two short laterally-directed processes; ventral and dorsal lips short, conical. Behind origin of lips arises a cuticular frill, with free outer edge, 0·03 mm. wide, marked with circular concentric striations, parallel to its edge. Head in this region 0·18 mm. diameter, and followed by somewhat constricted neck region widening after 0·06 mm. to form body proper. Buccal cavity 0·07 mm. in diameter; squarish in side view; lined by thick chitin; base 0·1 mm. from anterior end of submedian lips. Oesophagus about 1:4·2 (or less) of body length; widening towards its posterior end, to become surrounded by sheath-like granular prolongation of intestinal wall. Nerve ring surrounding oesophagus about 0·6 mm. from



Figs. 23-25, *Zoniolaimus clelandi.* 23. dorsal lobe of bursa; 24. ventral and lateral lobes of bursa; 25. head.

Fig. 26. *Z. ualabatus*, head.

Figs. 23, 24, and 25 to same scale.

Figs. 27-29, *Parazoniolaimus collaris.* 27. head; 28. anterior end; 29. half of bursa, ventral and lateral lobes folded over dorsal lobe. All figures to same scale.

Fig. 30, *Maplestonema typicum*, head.

Figs. 31-32, *Macropostrongylus lesouefi.* 31. head, sublateral view; 32. bursa.

Fig. 33, *M. wallabiae*, head.

Figs. 34-36, *M. dissimilis.* 34. head; 35. bursa; 36. posterior end of female.

Figs. 30, 31, and 34 to same scale; figs. 32, 33 and 35.

anterior end of body; cervical papillae long, threadlike, about half-way between nerve ring and frill; excretory pore about 0·2 mm. behind nerve ring.

Male: Bursa large, ventral lobes separate from one another, joined to lateral lobes; dorsal lobe prolonged with rather large median indentation. Ventral rays long, parallel, cleft nearly all their length. Externo-lateral ray short, about half length of laterals; externo-dorsal two-thirds length of laterals with which it arises. Laterals long, parallel, cleft nearly all their length. Dorsal ray very broad at base; giving off at about mid-length a pair of lateral club-shaped branches, and soon afterwards dividing into two club-shaped rays forming an arch reaching into prolongations of the dorsal lobe. Genital cone with small button-like structure on its tip. Spicules 4·05 mm. long in a male 16 mm. long, 1:4 of body length; with striated alae extending nearly all their length, widening near distal ends. Spicules difficult to trace in whole specimens, and have to be dissected out. Gubernaculum 0·08 mm. long, canoe-shaped.

Female: Body tapering to a pointed tail; intestine narrowing suddenly about 0·3 mm. from anus and surrounded by narrow band of tissue (glandular?) before passing to anus; latter 0·7 mm. from tip of tail. Vagina thin, long; vulva about 0·35 mm. in front of anus; eggs 0·09 mm. by 0·07 mm.

MAPLESTONEMA, n. gen.

Since males have not been found, we cannot give a complete diagnosis.

Trichoneminae. Anterior end rounded; no mouth collar; six equal elongate papillae around mouth; deep buccal cavity supported only by narrow ring of chitinous substance near its base; oesophagus of uniform width. Male unknown. Female with tail tapering to a point; vulva just in front of anus. From stomach of marsupials. Type *M. typicum*, n. sp., from *Macropus ualabatus*, Lower Hawkesbury.

This genus differs from its nearest relatives *Macropostrongylus* and *Cloacina* in the absence of a leaf crown, and in the possession of six equal oral papillae. It differs from *Buccostrongylus* in the structure of the buccal capsule; and from *Spirostrongylus* Y. & M. in the absence of the leaf crown and in the characters of the buccal capsule. The generic name is proposed in recognition of Dr. Maplestone's contributions to Australian helminthology.

MAPLESTONEMA TYPICUM, n. sp. Fig. 30.

From *Macropus ualabatus*, Lower Hawkesbury.

We have examined only two immature female specimens. They are small and coiled; about 6·1 mm. in length. Flattened anterior end with six short thin digitate papillae surrounding wide mouth; latter leading into large cavity, 40μ long, 35μ in diameter. This cavity, at about three-fourths length, is surrounded by ring of chitin 8μ long, 5μ thick. No leaf crown. Oesophagus 0·95 mm. long, rather wide, slightly enlarged towards posterior end; surrounded by nerve ring at about end of its anterior half (0·4 mm. from head); excretory pore just behind this level, 0·47 mm. from head end. Body tapering gradually at posterior end, tail pointed, tip curved dorsally. The vulva can just be distinguished, 0·25 mm. in front of the anus. The latter is equidistant from the vulva and the tip of the tail.

MACROPOSTRONGYLUS Yorke & Maplestone 1926.

This genus was based on *M. macropostrongylus* Y. & M. (type) and *M. australis* Y. & M. from *Macropus* sp. from North Queensland. Baylis (1927) added a third species, *M. yorkei*, from the same region. Wood in 1930 described *M. baylisi* from *Macropus robustus woodwardi*. *M. macropostrongylus* and *M. yorkei* were recorded by us from Queensland wallabies (1939). We now add two new species from the red-necked wallaby and one from *M. ualabatus* in New South Wales.

MACROPOSTRONGYLUS LESOUEFI, n. sp. Figs. 31–32.

From stomach of *Macropus ruficollis*, Sydney Zoological Gardens.

Short worms tapering more towards anterior end. Male 6·2–8·4 mm.; female about 10·7 mm. Anterior end with two large prominent lateral papillae, and four small submedian papillae, the latter each with two short bristles. Buccal capsule about 0·04 mm. long and 0·02 mm. in diameter in male; wall not regularly chitinized but middle part (i.e. middle longitudinal layer) most strengthened; wall ending anteriorly in six (perhaps eight) rounded knobs, presumably corresponding to a leaf crown. Oesophagus about 0·95 mm. long (in male); comprising two parts, a longer anterior, about the middle of which is the nerve ring, and a shorter posterior portion, narrow at the beginning but widening to a bulb. Excretory pore not detected; cervical papillae long, hair-like, at 0·25 mm. from anterior end of worm.

Male: Spicules seem to vary in length in specimens otherwise identical, but they are always short, 0·36–0·7 mm.; stout; ends tapering, rounded; wide striated alae extending nearly to tip. Bursa large; dorsal lobe longest; ventral lobes short, joined ventrally. Ventral rays long, thin, cleft nearly all their length; laterals and externo-dorsals arising from same root, long, thin; medio- and postero-laterals longest, cleft half their length. Dorsal ray bifurcating after half its length, each branch giving off stout lateral ray from its mid-length. Genital cone very small.

Female: Uteri parallel; ovejectors 0·15 mm. long; vagina about 0·25 mm. long; vulva about 0·9 mm. and anus at 0·6 mm. from tip of tail.

This species closely resembles *M. macropostrongylus* but differs from it in the length of the spicules and oesophagus as well as in the shape of the female tail and in the characters of the head.

It is named for Mr. A. S. Le Souef, Director of the Sydney Zoological Gardens and author of important works dealing with Australian vertebrates.

MACROPOSTRONGYLUS WALLABIAE, n. sp. Fig. 33.

From stomach, *Macropus ruficollis*, Bathurst district.

Male 8·4 mm., female 11·4 mm. long; cuticle marked with fine striations. Anterior end blunt; mouth collar with six small rounded papillae. Buccal capsule 0·045 mm. deep and 0·025 mm. wide (internal measurement) except at anterior end where walls bend outwards; walls much thicker in posterior half than in anterior. Short leaf crown probably present, arising from anterior end of capsule but number and shape of elements indistinguishable. Oesophagus about 0·8 mm. long, with wider anterior part and short thin posterior part ending in bulb. Nerve ring appears to be around thinner part of oesophagus. Cervical papillae long, threadlike, at 0·25 mm. from anterior end of worm.

Male: Spicules short, about 0·8 mm. long, 1:10 of body length, with wide striated alae and bluntly rounded tips. Bursa large; ventral lobes small, not joined ventrally and almost separate from lateral lobes; dorsal lobe wide, long. Condition of specimen prevented disposition of bursal rays from being ascertained accurately. Ventral rays short, parallel, almost to edge of bursa; externo-lateral ray divergent from laterals for most of its length; laterals stout, cleft for half their length and reaching almost to bursa; externo-dorsal arising separately, long, stout, not reaching edge of bursa. Dorsal ray indistinct; two main branches apparently reaching edge of dorsal lobe and each giving off a lateral ray at about mid-length. Genital cone short.

Female: Ovejectors long, thin; vagina short, wide; vulva 0·8 mm., and anus 0·3 mm. from tip of tail. Tail long, tapering, ending in point. Eggs 0·13 mm. by 0·07 mm.

This species closely resembles *Spirostrongylus spirostrongylus* Y. & M. 1926 in the arrangement of the buccal capsule, but those authors do not indicate the presence of oral papillae. It has been assigned to *Macropostrongylus* on account of the buccal capsule, leaf crown, shape of bursa, general arrangement of rays, and character of female tail; but it differs from other species of this genus in that the lateral and submedian oral papillae are of equal size.

MACROPOSTRONGYLUS DISSIMILIS, n. sp. Figs. 34–36.

From *Macropus ualabatus*, Lower Hawkesbury.

Rather plump worms; males 6·5 mm.; females, often coiled, 6·8 mm. long. Anterior end truncated, bearing four small conical submedian papillae and two very small laterals. Buccal capsule continuous from oral opening, 10μ deep, 15μ in diameter, with chitinized walls. Oesophagus widening gradually towards base; 0·55 mm. long. Nerve ring at 0·19, excretory pore at 0·46, and threadlike cervical papillae 0·1 mm. from anterior end of worm. Anterior part of intestine surrounded by granular lobes.

Male: Bursa large; lobes not deeply separated from one another; rays all thin and reaching nearly to edge of bursa; externo-lateral divergent from laterals; externo-dorsal arising separately; dorsal ray stouter, bifurcating after half its length, each branch immediately giving off a lateral ray almost as long as itself. Genital cone small, pointed. Spicules 0·7 mm. long, 1:9 of body length, with wide striated alae. Apparently two gubernacula, the larger of which is more anteriorly situated and may be a chitinization of the spicule sheath.

Female: Body tapering suddenly at vulva; tail pointed, backwardly directed. Ovejectors 0·3 mm. long; vagina 0·35 mm. long; vulva 0·29 mm. and anus 0·2 mm. from tip of tail. Eggs 80μ by 50μ.

This species is placed in the genus with some reserve because of the absence of a leaf crown and because the submedian papillae are larger than the laterals. It seems related to *M. yorkei* which it resembles in many features but differs in its much smaller size, in the shape of the buccal capsule, and in the absence of a leaf crown, which we have recognized in our specimens of *yorkei*, though Baylis regarded its presence as doubtful.

BUCCOSTRONGYLUS Johnston & Mawson 1939.

Although the general appearance of the head of two species now to be described, *Buccostrongylus setifer* and *labiatus*, does not at first sight suggest that they belong to the same genus, they have essentially similar structure, the chief difference being in the size of the oral papillae and lips. In these features they represent extremes of which the type species of the genus, *B. buccalis*, is the mean. There is also a difference in the formation of the leaf crown which in the type is formed by the indented anterior edge of the buccal capsule, but in *B. setifer* by an accessory projection inwardly from the anterior edge of the buccal capsule. In the latter species there is also a difference in the form of the dorsal ray, the lateral branches coming off before instead of after the bifurcation, but these variations are not considered sufficient to justify the erection of a new genus.

BUCCOSTRONGYLUS BUCCALIS Johnston & Mawson 1939.

This species has been found in *Macropus thetidis* from New England, the nematodes possessing lips slightly more prominent and the spicules a little longer than those described previously from Queensland material.

BUCCOSTRONGYLUS AUSTRALIS Johnston & Mawson 1939.

Specimens of this species were found in *Macropus ruficollis* from Bathurst district. Previously recorded from two other species of *Macropus* from Queensland.

BUCCOSTRONGYLUS LABIATUS, n. sp. Figs. 37–38.

From stomach of *Macropus ruficollis*, Bathurst district.

Worms slender, short, usually coiled. Male 3·7–4·3 mm.; female 5–6 mm. long. Cuticle marked with fine longitudinal striations. Cuticle of mouth collar raised into six rounded lips, outgrowths of the subcuticular tissue between these form six small rounded papillae; four submedian lips each with a bristle; two lateral lips without bristle. Cuticle around mouth further raised into 6–8 peri-oral lips, the ventrals being larger than the others.

Within the mouth is a long straight chitinized buccal capsule or vestibule. In all specimens this is very indistinct, only its outline and posterior limits being perceptible; its termination is 0·043 mm. from top of lips and about 0·01 mm. wide (external), but the anterior end is not clear. It is not striated. Oesophagus thin, 0·65–0·75 mm. long, 1:7·5 of body length, terminating in large distinct bulb. Nerve ring surrounding oesophagus at about half length; excretory pore just behind nerve ring; cervical papillae not observed. Intestine without processes around base of oesophagus.

Male: Spicules about 1 mm. long, 1:3·7–4·3 of body length; with very wide striated curved alae; distal ends of spicules lying together, each surmounted by a small disc of thin chitinous material. Gubernaculum probably present; genital cone short. Bursa wide, much shorter ventrally than dorsally; lobes not separated by deep indentations. Ventral rays parallel, nearly reaching edge of bursa and cleft nearly all their length. Externo-lateral and externo-dorsal shorter than laterals with which they arise, and lifting side wall of bursa; laterals reaching practically to edge of bursa, and cleft for half length. Dorsal ray long, bifurcating after one-quarter of its length, almost immediately afterwards each branch giving off a short lateral ray and then continuing nearly to edge of bursa, the two branches coming closer together near their distal ends.

Female: Body tapering rapidly but evenly from region of vagina to end in blunt point. Ovejectors about 0·5 mm. long, narrow; vagina about 0·3 mm. long; vulva 0·37 mm., and anus 0·3 mm. from tip of tail. Eggs in vagina about 0·09 mm. by 0·05 mm.

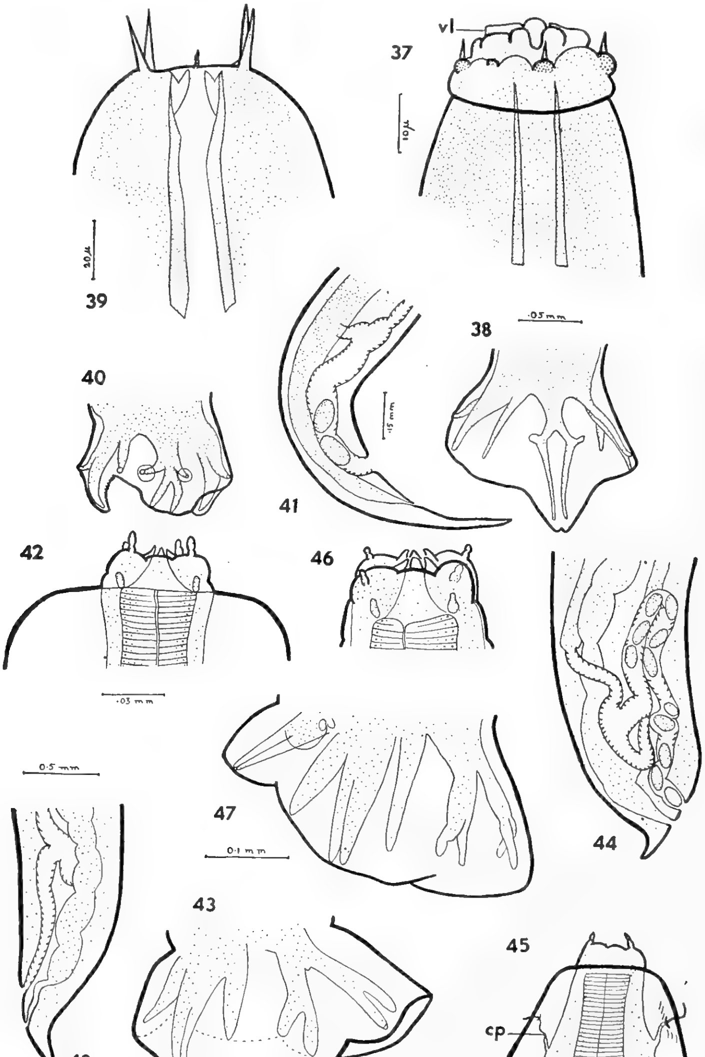
This species differs from *B. setifer* chiefly in regard to the lips and papillae.

BUCCOSTRONGYLUS SETIFER, n. sp. Figs. 39–41.

From stomach of *Macropus ruficollis*, Bathurst district.

Short worms, tapering to both ends, tending to be somewhat coiled. Cuticle with fine longitudinal striations. Male 4·8 mm.; female 6·5–7 mm. long. Mouth surrounded by six low rounded papillae, each with a tapering bristle, those in submedian positions being very long, and the two laterals short. The buccal capsule differs from that in other members of this genus in being much longer (0·075–0·085 mm.) and in enclosing a wider cavity near its anterior end, where the walls become narrowed to a fine rim around the mouth. This enlarged part is

0·015 mm. wide and about 0·02 mm. deep, while the succeeding portion is 0·01 mm. in internal diameter. It differs also in having a definite leaf crown of a few (4, perhaps 6) elements projecting from the wall of the anterior wide part of the capsule.



Figs. 37-38, *Buccostrongylus labiatus.* 37. head; 38. bursa.
Figs. 39-41, *B. setifer.* 39. head; 40. bursa; 41. posterior end of female.
Figs. 38 and 40 to same scale.
Figs. 42-45, *Cloacina expansa.* 42. head; 43. bursa; 44. posterior end of female; 45. anterior end.
Figs. 46-48, *C. obtusa.* 46. head; 47. bursa; 48. posterior end of female.
Figs. 42 and 46 to same scale; figs. 43, 45, and 47; figs. 44 and 48.

The anterior end differs from that of pharyngostrongyles in that there is no differentiation into buccal capsule and vestibule, the whole structure, referred to above as buccal capsule, being a continuous cylinder. There are also no striations on this structure. There is, as in other species of *Buccostrongylus*, a slight inflation of the cuticle around the anterior end.

Oesophagus 0·1 mm. long; with two parts, a long wide anterior and a shorter narrow posterior, the latter terminating in a slight bulb. Nerve cord not seen. Excretory pore near posterior end of anterior portion of oesophagus.

Male: Spicules stout, 1·3–1·4 mm. long, 1:4 of body length; with wide striated alae extending almost to the rounded tips. Bursa very closely resembling that of pharyngostrongyles in being small and covered with papillae on inner surface of ventral and lateral lobes. Lobes well separated from one another; dorsal widest and longest. Externo-lateral and externo-dorsal rays shorter than laterals with which they arise, projecting on wall of bursa. Dorsal ray with two lateral branches at about its mid-length, the main stem continuing a short distance before dividing into two rays reaching edge of bursa; lateral branches stout, entering into dorsally projecting pockets of bursal wall. Gubernaculum not observed.

Female: Body ending in tapering pointed tail, about 0·38 mm. long; distance from anus to vulva about 0·28 mm. Uteri long, straight; ovejectors narrow; vagina wide, quite long; eggs (in vagina) about 0·12 mm. by 0·06 mm.

This species differs from other members of the genus in the length of the buccal capsule, presence of a leaf crown, form of bursa, and shape of female tail.

CLOACINA Linstow 1898.

This imperfectly characterized genus was known only from the type species, *C. dahli*, from a wallaby in New Britain. In 1938 we recognized representatives amongst Australian material and, as a result, were able to give a diagnosis differentiating it from *Macropostrongylus* and to add fifteen new species from Central Australian kangaroos and wallabies. A study of material from Queensland has permitted recognition of five additional species (1939). We now describe five more new forms and record the occurrence of four known species from New South Wales Macropods.

CLOACINA EXPANSA, n. sp. Figs. 42–45.

From *Macropus major*, Coonamble (coll. A. S. Le Souef).

Male 9·6 mm.; female 15–18 mm.; cuticle widened at level of base of lips, inflated region thinning out to end near the level of the posterior end of the oesophagus; buccal capsule 0·05 mm. diameter, 0·01 mm. long. Oesophagus 0·55 mm. long; nerve cord at 0·3 mm., excretory pore at 1 mm. (i.e. about 0·35 mm. behind end of oesophagus), and cervical papillae at 0·12 mm. from head end.

Male: Bursa as in *C. longispiculata*; spicules 5·8 mm., 1:1·7 of body length.

Female: Anus at 0·3 mm., and vulva at 0·4 mm. from tip of tail; eggs 0·14 by 0·07 mm.

This species closely resembles *C. longispiculata* in general form, shape of bursa, oesophagus, submedian papillae; shape of posterior end of the female; and spicule:body-length ratio. It differs in the following features: slightly greater length; greater extension backwardly of the widened cuticular region at the head end; wider buccal capsule with thicker, shorter chitinous ring; absence of lateral papillae; cervical papillae nearer anterior end; and the longer, narrower vagina. The specific name is given because of the wide cuticular inflation anteriorly.

CLOACINA OBTUSA, n. sp. Figs. 46–48.

From *Macropus major*, Coonamble (coll. A. S. Le Souef).

Males 11·5–13 mm. long; females 18–22 mm.; not tapering markedly at anterior end which is truncate; six large lips, submedians with small two-jointed papillae. Buccal capsule 0·055 mm. wide; 0·015 mm. deep with base 0·04 mm. from top of lips. Leaf crown of six elements arising from base of capsule and bluntly pointed at distal ends. Oesophagus 0·75 mm. long, widening at base; surrounded by nerve ring about its middle. Excretory pore just in front of posterior end of oesophageal region; thus nerve ring is 0·36, and excretory pore 0·68 mm. from anterior end of worm.

Male: Bursa large, lobes not deeply separated. Ventral rays together, extending nearly to edge, cleft for most of their length; externo-lateral stout, tapering, almost reaching to edge; laterals extending nearly to edge, cleft for three-fourths of their length, tips separate; externo-dorsal arising separately, shorter than laterals. Dorsal ray stout, bifurcating after one-third length, each branch ending in two short processes, of which outer is shorter and stouter, neither reaching edge of bursa. Spicules about 3·5 mm. long, 1:3 of body length. Gubernaculum absent. Genital cone very short, rounded.

Female: Body tapering suddenly beyond vulva to end in pointed dorsally-directed tail, 0·27 mm. long. Vagina about 0·8 mm. long; vulva 0·2 mm. in front of anus; eggs in vagina 0·1 by 0·05 mm.

This species resembles *C. macropodis* in its head region but differs in its greater length; blunt elements of the leaf crown; longer buccal capsule; and in the spicule:body-length ratio. The specific name is given on account of the blunt tips of the elements of the leaf crown.

CLOACINA MAGNIPAPILLATA, n. sp. Figs. 49–52.

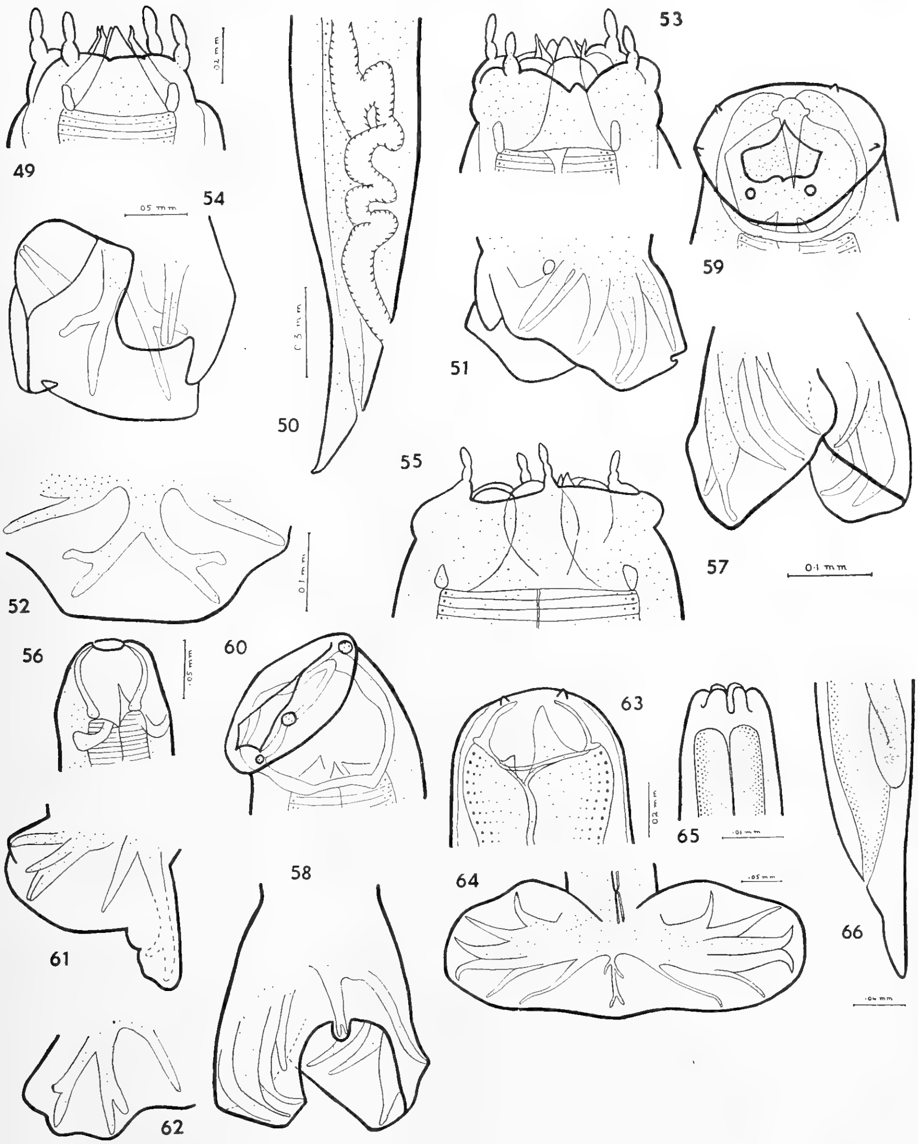
From *Macropus major* (type host), Coonamble (coll. A. S. Le Souef); and *M. rufus*, Wentworth (coll. A. L. Rait).

Male 10–11 mm.; female 12–15 mm. long; head with six low lips, submedians with long, two-jointed papillae, laterals each with small papilla; buccal capsule 0·032 mm. diameter, 0·01 mm. deep, base 0·02 mm. from top of lips. Elements of leaf crown arising from base of capsule; sharply pointed, with tips incurved. Oesophagus 0·75 mm. long (in male), wider at base but without definite bulb. Nerve ring at 0·35 mm., excretory pore at 0·7 mm., and cervical papillae at 0·09 mm. from anterior end.

Male: Bursa large; lobes not deeply divided except ventrals which are separate from one another. Ventral rays long, cleft nearly all their length; externo-lateral long; laterals cleft for three-fourths length, reaching nearly to edge of bursa; externo-dorsal as long as, and arising with, laterals. Dorsal ray bifurcating after one-third length, each branch giving off a shorter lateral ray after half length, neither reaching edge of bursa. Spicules 3·8 mm. long; 1:2·7 of body length. Genital cone small; accessory cone of two prominent processes. Gubernaculum not seen.

Female: Posterior end tapering gradually from region of vagina; tail 0·23 mm. long, ending in point. Vagina long, twisted; vulva 0·35 mm. in front of anus.

This species resembles *Cloacina curta* and *C. wallabiae* in the head region. In general characters it suggests the latter species but differs from it in size; form of the dorsal ray; spicule–body-length ratio; absence of definite oesophageal bulb; and less sudden tapering of the posterior end of the female.



Figs. 49-52, *Cloacina magnipapillata.* 49. head; 50. posterior end of female; 51. bursa; 52. dorsal ray.

Figs. 53-54, *C. wallabiae.* 53. head; 54. bursa.

Fig. 55, *C. thetidis,* head.

Figs. 49, 53 and 55 to same scale; figs. 51 and 52.

Figs. 56-58, *Globocephaloides thetidis.* 56. head, lateral view; 57. bursa, ventral view; 58. bursa, dorsal view.

Figs. 59-62, *Hypodontus thetidis.* 59. head, ventral view; 60. head, lateral view; 61. bursa, lateral view; 62. dorsal ray.

Figs. 58 to 62, to same scale.

Figs. 63-64, *Austrostrongylus wallabiae.* 63. head; 64. bursa.

Figs. 65-66, *Asymmetricostrongylus trichosuri.* 65. head; 66. posterior end of female.

CLOACINA WALLABIAE, n. sp. Figs. 53–54.

From *Macropus ualabatus*, Lower Hawkesbury district (coll. J. B. Cleland).

Only five specimens found; 4–6 mm. long; some rather coiled. Apparently only four outer lips, the laterals being absent and their position marked by a pair of small conical papillae; submedians each with long two-jointed papilla; inwardly from outer lips and from lateral papillae are six distinct rounded inner lips; inwardly from these latter, projecting beyond them, is the leaf crown of six finely-pointed triangular elements, 0·04 mm. long, arising from base of buccal capsule; latter 0·038 mm. in diameter internally, 0·01 mm. long, with walls 4μ thick. Oesophagus 0·55 mm. long, widening towards base to a more or less definite bulb; nerve ring at about mid-oesophagus; excretory pore at level of three-fourths length of oesophagus. Cervical papillae, long, threadlike, about 0·15 mm. from anterior end of worm.

Male: Spicules about 0·9 mm. long, 1:4 of body length, thin, with very wide striated alae. Ventral rays long, thin, cleft about half length; externo-lateral stout, tapering; laterals thinner and longer; externo-dorsal arising with laterals, shorter and divergent from them. Dorsal ray bifurcating near its origin, each branch continuing nearly to edge of bursa and giving off shorter lateral ray after about one-third of its length. Genital cone very short; accessory cone of two large projecting lobes.

Female: Body tapering suddenly beyond vulva, which is 0·5 mm. in front of anus; tail about 0·3 mm. long, ending in rounded point; vagina long, narrow; eggs 0·08 by 0·04 mm.

This species most closely resembles *C. robertsi* in the general appearance of the head but differs in the spicule–body-length ratio; shape of the dorsal ray; length of vagina; and in the position of the excretory pore; as well as in the rather different configuration of the head region.

CLOACINA THETIDIS, n. sp. Fig. 55.

From *Macropus thetidis*, New England.

Only one female found, 6·5 mm. long. Lips not distinct; four submedian papillae arising from elevations of mouth collar, each papilla consisting of two thin joints; leaf crown arising from base of buccal capsule giving appearance of six rounded inner lips, on two of which the inner edge can be seen projecting as a pointed tip like the leaf crown elements in other species of *Cloacina*; similar pointed tips presumed to be present on other lips though not seen. Buccal capsule 0·055 mm. diameter, of uneven height (0·008 mm.–0·01 mm.), base 0·034 mm. from anterior end. Oesophagus 0·6 mm. long, wide, straight. Nerve ring at 0·26 mm., and cervical papillae at 0·09 mm., from anterior end.

Posterior end of body tapering to a dorsally-directed point; tail 0·2 mm. long. Vulva 0·35 mm. from tip of tail. Specimen is probably young, eggs being present only in uterus, where they measure 0·11 by 0·08 mm.

This species differs from all known species in the wide shallow buccal capsule, the long thin papillae at the anterior end, and the rounded ends of the elements of the leaf crown.

CLOACINA SIMILIS Johnston & Mawson, 1939.

Females from stomach of *Macropus thetidis*, New England.

These nematodes very closely resemble *C. similis* and *C. petrogale* but, since males are absent, it is difficult to place them exactly. The head differs from that in these species in having a relatively wider buccal capsule, thinner papillae, and less obvious lips. The distinct leaf crown, the presence of a lateral papilla, the deep buccal capsule and the long, thin anteriorly-placed cervical papilla suggest both these species. The posterior end has the characteristic short conical tail, long vagina with rather small eggs, and anus equidistant from the vulva and the tip of the tail. The positions of nerve ring and excretory pore agree most closely with those in *C. similis*, but the oesophagus differs slightly in shape, the terminal bulb being more distinct and larger.

The parasites may be placed provisionally under *C. similis.*

CLOACINA BANCROFTORUM Johnston & Mawson 1939.

This species was recognized amongst material from *Macropus thetidis* from New England.

CLOACINA LONGISPICULATA Johnston & Mawson 1939.

We have identified the species from *Macropus rufus* from Wentworth, South-western New South Wales (coll. W. L. Rait).

CLOACINA MACROPODIS Johnston & Mawson 1938.

From *Macropus ualabatus*, Lower Hawkesbury district (coll. J. B. Cleland).

Our specimens differ a little from those from Central Australia, the oesophagus being somewhat longer and spicules slightly shorter. The general features and arrangement of parts, however, are similar in both and there does not appear to be sufficient justification for the erection of a new species.

CLOACINA SP.

Two poorly preserved female specimens of *Cloacina* were found in the stomach of *Macropus thetidis*, New England. Their condition has not permitted us to make a definite identification.

GLOBOCEPHALOIDES Yorke & Maplestone 1926.

The genus was based on female specimens described as *G. macropodis*, from a Northern Queensland *Macropus* sp. Recently (1939) we added two other species, *G. wallabiae* and *G. affinis*, also from Queensland, and have been able to extend the diagnosis on account of the finding of males. We now add another species, *G. thetidis*.

GLOBOCEPHALOIDES THETIDIS, n. sp. Figs. 56–58.

From the intestine of *Macropus thetidis*, New England.

Male 6 mm.; female unknown. Buccal capsule 60μ long, 50μ maximum width, 20μ wide at base; dorsal tooth projecting 20μ from base of capsule. Mouth opening 25μ diameter. Oesophagus 0·58 mm., 1:10 of body length. Nerve ring and excretory pore not seen. Spicules 0·045 mm., 1:13·3 of body length. Bursa with ventral lobes separated in front, ventral and lateral lobes continuous, dorsal lobe small and elongate. Ventral rays long, thin, separate, reaching edge of bursa; externo-lateral stouter, slightly shorter than ventrals; medio-lateral stout, distal part narrowing suddenly; postero-lateral slightly thinner than medio-lateral, narrowing as in latter ray; medio- and postero-lateral not quite reaching bursal edge; externo-dorsal thin, shorter than postero- and medio-laterals, raising edge of bursa into papilla-like structure. Dorsal ray ending in two short, probably bidigitate, processes.

The species differs from *G. macropodis* (female) in the size of the buccal capsule, relative size of the dorsal tooth, and length of oesophagus; from *G. affinis* (female) in the form of the chitinous support for the buccal capsule, and in the relative size of the tooth; from *G. wallabiae* (male) in size, relative length of the spicules, length of ventral rays, and form of the medio- and postero-lateral rays,

Hypodontus Mönnig 1929.

This genus, belonging to the Ancylostomatidae, Necatorinae, is so far known only from its type species, *H. macropi* Mönnig, whose name should be emended to *H. macropodis*. The host was *Macropus rufus* from Pretoria Zoological Gardens. We add a second species, *H. thetidis*.

Hypodontus thetidis, n. sp. Figs. 59–62.

From the caecum of *Macropus thetidis*, New England.

Male about 11 mm. long; female about 14 mm. Mouth collar with six very small papillae; buccal capsule with two dorsal cutting plates anteriorly, ventral margin notched. Dorsal gutter in buccal capsule, ending anteriorly in two short lateral arms, narrowing posteriorly. Anterior end of oesophagus with three pointed triangular teeth about 30μ long, projecting into buccal capsule. Cervical glands extending back about 0·5 mm. from anterior end. Oesophagus 1·05–1·1 mm. long, 1:10–11 of body length (in male). Nerve ring at 0·6 mm. from anterior end. Cervical papillae and excretory pore not seen.

Male: Dorsal lobe of bursa longest; ventrals not joined in front. Ventral rays short, together; externo-lateral short, tip diverging from laterals; laterals cleft at tips, not quite reaching edge of bursa; externo-dorsal arising separately, tapering, not reaching edge of bursa. Dorsal ray bifurcating soon after origin, each branch giving off a shorter lateral ray just after its mid-length, neither branch quite reaching edge of bursa. Prebursal papillae not seen. Spicules 0·87 mm., i.e. 1:12·6 of body length. Gubernaculum large, elongate.

Female: Vulva 0·3 mm., and anus at 0·1 mm. from tip of conical tail.

The species closely resembles *H. macropodis* whose males are 13–15 mm., and females 17–20 mm. long. The relative measurements agree closely; the chief differences between the two are the shorter gubernaculum, greater distance between the vulva and the tip of the tail, and the lower position of the bifurcation of the dorsal ray.

Austrostrongylus Chandler 1924.

This genus of Trichostrongylinae was based on *A. macropodis* Chandler from *Macropus bennetti* from Zoological Gardens, Houston, Texas. We added (1938) *A. minutus* from *M. dorsalis* in Queensland. We now give an account of another, *A. wallabiae* n. sp.

Austrostongylus wallabiae, n. sp. Figs. 63–64.

From the intestine of *Macropus ruficollis*, Bathurst district.

Worms very tightly coiled; tapering markedly at anterior end; cuticle with 6–8 longitudinal folds, marked with transversal striations, the cuticle between the folds being unstriated. The folds begin just posterior to the dilated cuticle around the head (0·08 mm. from anterior end) and extend in the female to the region just anterior to vulva; in the male to within a short distance of bursa where they give place to ringed striations; in the female there is little trace of striation between the vulva and anus, but on the tail fine rings are definite.

The worms are characterized by regularly-placed masses of granular tissue, forming a projection over the vulva, another a little anterior to the vulva, and one in the dorsal lobe of the bursa where it obscures the dorsal ray.

There are probably four small papillae at the anterior end, in submedian positions. Buccal capsule dome-shaped, 0·032 mm. diameter at base, 0·022 mm. long at centre, its thin chitinous walls with outwardly projecting ridge at their base; walls continuous inwardly with floor of buccal capsule and cuticular lining of oesophagus; dorsal tooth 0·02 mm. long, 0·01 mm. wide near base; ventral tooth about 4μ long. Oesophagus about 0·38 mm. long, widening slightly towards base. Nerve cord at 0·2 mm., and excretory pore at 0·28 mm. from anterior end of worm.

Male: About 5·3–5·5 mm. long, 0·2 mm. maximum diameter. Spicules very fine, proximal terminations hard to observe; probably between 0·4 and 0·8 mm. long. Gubernaculum not seen. Bursa distinctive in having a very short dorsal lobe and the two lateral lobes extended laterally, so that in their natural position (i.e. before flattening) they fold together, the bursa then having the appearance of a ventral outgrowth of the posterior end of the body. Lobes not asymmetrical. Ventro-ventral ray bending ventrally; postero-ventral almost straight; externo- and medio-laterals stout, tapering, with distal ends divergent from one another; postero-lateral thin, long; externo-dorsal long, thin, arising from same base as laterals but immediately separating from them. Dorsal ray short, thin, giving off a lateral branch at each side soon after its origin, the main stem dividing into two short branches at distal end; the lateral branches may be asymmetrical.

Female: About 6·9 mm. long; body narrowing suddenly about 0·1 mm. from posterior end to a tapering, pointed tail. Position of vulva (1·15 mm. from posterior end) marked by presence of a projecting mass of granular tissue just beneath its cuticle, probably a kind of protective flap, somewhat like that occurring in *Haemonchus*. Vagina short; ovejectors muscular; uteri divergent but hard to trace as specimens do not clear easily. Anus probably at beginning of narrow tail, about 0·08–0·09 mm. from posterior end.

The species closely resembles *A. macropodis* (from *Macropus bennetti*, which is the Tasmanian subspecies of *M. ruficollis*), but differs from it in the different form of the bursa, dorsal ray, length of postero-lateral ray and greater divergence of the externo- and medio-lateral rays. The characters of the head region, buccal cavity and cuticular ornamentation are similar.

The species differs from *A. minutus* in its greater size, wider bursa, form of the lateral rays, and relatively shorter dorsal tooth.

ASYMMETRICOSTRONGYLUS Nagaty 1932.

The name was proposed by Nagaty for *Trichostrongylus asymmetricus* Cameron 1926 (as type), *T. australis* Wood 1930, and *T. dissimilis* Wood 1930, but no diagnosis was given. The first was described from *Macropus bennetti* and the other two from *M. woodwardi*, Wood also recording *A. asymmetricus* from the latter marsupial. Lent and Freitas (1934, 252) consider the genus invalid.

ASYMMETRICOSTRONGYLUS TRICHOSURI, n. sp. Figs. 65–66.

From the oesophagus of *Trichosurus caninus*, Gosford district.

Only females were collected. Very thin filiform worms, about 4·5 to 5·1 mm. long, with maximum breadth about 50μ. Cuticle with fine longitudinal striations and with more widely separated transverse markings. Anterior end about 17μ in diameter, apparently surmounted by six lips. Oesophagus 0·86 mm. long, of even diameter. Vulva a narrow transverse slit, 1·68 mm. from posterior end of oesophagus and at about mid-length of worm; uteri divergent; eggs large, 60μ long, 27μ wide. Posterior end tapering, narrowing suddenly from anus to end in blunt point; tail 0·06 mm. long.

The absence of males prevents our comparing the species with those described from Australian marsupials. The type, *A. asymmetricus* (Cameron), is described as having six papillae and no buccal tooth. If these papillae resemble the structures which we refer to as lips, then our species could be placed under Nagaty's genus, as we have done.

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ECTOCARPUS CONFERVOIDES (ROTH) LE JOL.

By Valerie May, B.Sc., Linnean Macleay Fellow of the Society in Botany.

(Forty-six Text-figures.)

[Read 27th September, 1939.]

The Ectocarpales include the simplest known forms of the Melanophyceae (Phaeophyceae). Therefore, in any discussion of the origin of a land flora from marine plants, a knowledge of the life-history and cytology of these forms is advantageous.

The Ectocarpaceae comprise filamentous forms which may bear sexual and asexual reproductive structures on the same plant. As Knight (1923) indicated, a more intimate knowledge of these forms may lead to a better understanding of the problem of the origin of the alternation of generations among algae.

The life-history of *Pylaiella litoralis* Kjellm. has been investigated by Knight at Port Erin, Great Britain (1923); that of *Ectocarpus siliculosus* (Dillw.) Lyngb. by Berthold at Naples, Italy (quoted by Knight, 1929), by Knight at Port Erin (1929), by Kylin at Kristinberg, Sweden (1933), by Føyn at Herdla, Norway (1934), and by Papenfuss at Wood's Hole, U.S.A. (1935).

The investigation reported here has been concerned with the variation in form shown by *E. confervoides*, its host relationships, and particularly its cytology and life cycle. The coastline examined in detail extends from Five Islands, Wollongong, to Palm Beach, near Sydney, N.S.W.

Systematics.

The Species.—A difference of opinion exists as to whether *E. siliculosus* should be accorded the status of a species or should be regarded as a variety of *E. confervoides*. Batters, quoted by Knight (1929), respects the species-distinction; so also do Setchell and Gardner (1925), although they say: "We know full well from our own experience that it is difficult to draw a satisfactory line of demarcation between the two species, but feel that the best we can do is to keep them distinct and draw the line somewhat arbitrarily." The distinction, if any, between the two species is the *usual* presence of a terminal hair on the plurilocular structure of *E. siliculosus* and its absence from that of *E. confervoides*.

If this distinction be accepted, both *E. confervoides* and *E. siliculosus* occur near Sydney, N.S.W. Forms corresponding to the typical *E. confervoides* and *E. siliculosus* were found, but as a complete series of variation exists between the two extremes (Figs. 3, 6, 9, etc.), and since plurilocular structures terminated by hairs may occur in the form which is usually non-haired (Figs. 1 and 2), there seems to be no reason for regarding the form *siliculosus* as other than a variation of *E. confervoides*. The life cycle of *E. confervoides*, reported in this paper, is in agreement with that reported previously for *E. siliculosus*.

Vegetative Anatomy.—The plant is filamentous, growth being intercalary and occurring usually at the base of the filaments (Fig. 3). Branching is irregular and usually not opposite. It occurs by the development of a "blow-out", usually at the upper end of a cell. The angle at which the branch emerges varies greatly; when most acute (Fig. 3*a*), the branch tapers to a long, terminal hair, the cells of which are elongated and possess but little protoplasm. The angle of branching becomes more obtuse as fewer hairs are formed (Fig. 9*a*). Knight (1929) reports that at Port Erin there is an increase in the angle of branching and a decrease in the production of hairs during the course of a season, plants in the upper and lower limits of the *Ectocarpus*-zone, however, maintaining the end-of-season form. At

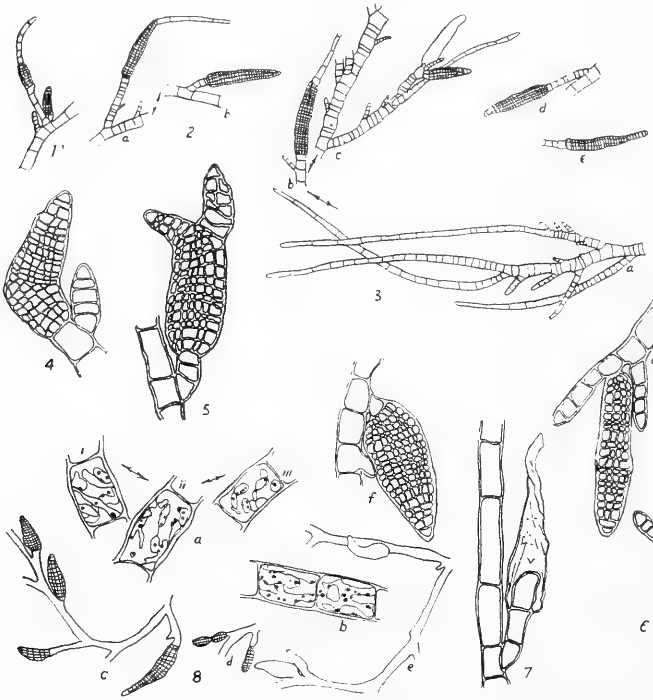

Fig. 1.—*E. confervoides* showing associated plurilocular structures, which are either hair-tipped or not. × 48.

Fig. 2.—As Figure 1, but reproductive structures are larger. *a* and *b* are from the same plant. × 48.

Fig. 3.—*a* shows the habit of the hair-producing form, intercalary growing regions occurring at the base of the hairs. *a, b* (haired plurilocular structure) and *c* (non-haired) are from the same plant; *d* and *e* show variations of the non-haired form of plurilocular reproductive structure. × 48.

Fig. 4.—An abnormal (bent) plurilocular reproductive structure. × 204.

Fig. 5.—An abnormal plurilocular reproductive structure, showing branching at the apex. × 204.

Fig. 6.—This shows how a stalked, terminal plurilocular structure (*b*) may become sessile and lateral (*a*) by sympodial development of a lateral branch. × 220.

Fig. 7.—Shows proliferation into the crumpled empty outer wall of a burst plurilocular structure. × 204.

Fig. 8.—*a* shows three cells which occurred in a single branch. In i the form of the chromatophore is banded, in ii it is intermediate, and in iii discoid. *b* shows an almost reticulate form of chromatophore. *c* and *e* show variation in the shape of the plurilocular structures of a filament. *d* shows a constricted plurilocular structure which is abnormal, due to failure of a central cell to divide. *f* shows a conical plurilocular structure, the opposite in form to such as in Fig. 3*b*. (*a, b, f* × 196; *c, d, e,* × 48.)

Sydney relatively little of the acute-angled, hair-producing form has been found at any time, and no evidence has been obtained of a seasonal change in appearance.

False cortex may occur in the basal portions of the plant. This is formed by one or more lateral branches, each originating near the base of a cell, growing downwards around the main axis (Fig. 9*g*). Where growth is dense, the loose intertwining of the basal filaments gives a further measure of mechanical support. The prostrate portion of the thallus is poorly developed.

The Vegetative Cell.—The size of the vegetative cell varies greatly (May, 1938, and Fig. 17); the average measurements are 20–80$\mu \times 30\mu$. Usually the lateral walls are thicker than the transverse ones, but this difference is less obvious than that between the outer and enclosed walls of the plurilocular reproductive structures. Chromatophores occur in the parietal cytoplasm; these range from large band-shaped and spirally-arranged forms (Fig. 8*b*), to small, numerous, discoid ones (Fig. 10*a*). Usually a single plant possesses one of these forms of chromatophores, but Figure 8*a* shows the transition in a filament from one extreme type to the other. Closely associated with the chromatophores are round, highly refractive

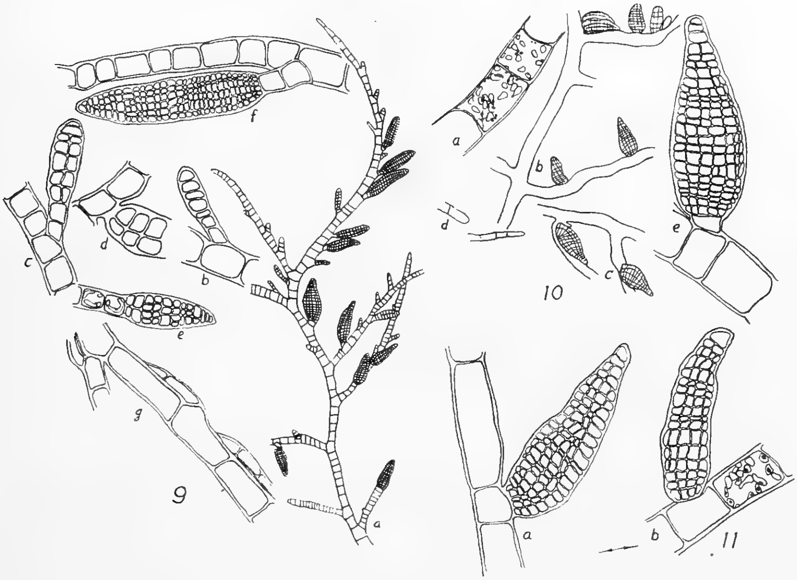

Fig. 9.—*a* shows a wide angle of branching and very slight production of hairs; this habit accompanies the broader form of plurilocular structure. Variation in the length of the stalk of the plurilocular structure is shown. *b*, *c*, *d* and *e* show developmental stages of a plurilocular structure. *f* is a mature plurilocular reproductive structure, in which the apical tiers have divided actively. *g* shows false cortex; the laterals have arisen from the basal end of the cells of the main axis and have grown down adpressed to the filament. (*a*, × 48; *b*-*g*, × 204.)

Fig. 10.—*a* shows an extreme form of discoid chromatophores; as usual, the pyrenoids are drawn black. *b*, *c* and *d* (apices of branches) show the habit of this form of *E. confervoides*, i.e. broad angle of branching and very little suggestion of hair-formation. The plurilocular structures possess usually not more than one stalk cell. *e* shows one plurilocular structure in greater detail. The apical cells have not divided as much, relatively, as those in Fig. 9*f*. (*a*, *e*, × 196; *b*, *c*, *d*, × 48.)

Fig. 11.—This shows plurilocular reproductive structures which are associated with forms as in Fig. 10*e*. *a* and *b* are from the same plant. × 204.

bodies, the "pyrenoids". Usually these appear on the surface of the chromatophores, though they may be free except for cytoplasmic connections. Figure 27 shows the variation which may occur in any one cell. The chromatophore often has a gap representing the former position of a pyrenoid. Knight (1929) and later Mathias (1935) suggested that the pyrenoid body is a transformed portion of the chromatophore.

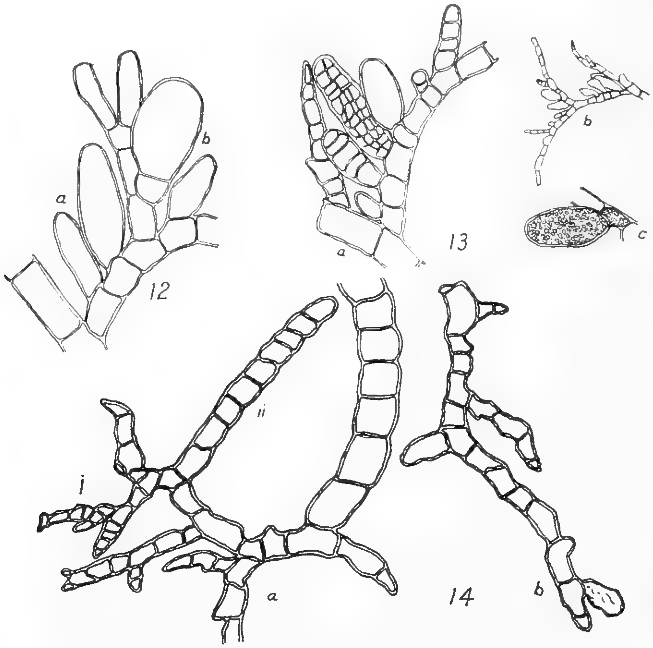

Fig. 12.—This shows unilocular structures, sessile (*a*) or with one stalk cell (*b*). × 204.

Fig. 13.—*a* shows uni- and plurilocular reproductive structures occurring together. *b* shows a series of unilocular structures, which vary in shape. *c* is a surface section of a unilocular structure; dense cytoplasm and many discoid chromatophores with pyrenoids are shown. (*a*, *c*, × 204; *b*, × 48.)

Fig. 14.—This shows stages in the growth of the diploid germling. *a* is an older plant than *b*. In *a* the upright (ii) and prostrate (i) portions of the thallus are clearly differentiated. × 212.

Glistening droplets of fucosan, which stain red in hydrochloric acid-vanillin (Knight, 1929), are usually present, especially near the nucleus. Non-staining droplets (freshly-formed fucosan? (Knight, 1929)) occur mainly near the chromatophores, but as hydrochloric acid-vanillin disturbs the cell-contents, the original positions cannot be stated with certainty. The size of these globules varies, but they are usually somewhat larger than the "pyrenoids". They were observed only in fresh material. Further work on the presence and relative abundance of fucosan has been done by Knight (1929), who believes it is a storage product and has correlated its absence with cell division. The nucleus occurs near the centre of the cell (Fig. 16). The nucleolus may contain one or more clear areas (Figs. 17*a* and 17*b*).

Reproductive Structures.—The plurilocular reproductive structures are very much more common than are the unilocular. The plurilocular structures arise as a short tier of cells occurring terminally or as a side branch. The densely cytoplasmic contents of the initials of the reproductive structures distinguish them from the vegetative cells. In Figure 24, from *c* to *b* are vegetative cells, while those from *b* to the apex of this same filament will later form a plurilocular structure. Each densely cytoplasmic cell of such a filament divides by vertical walls into first two (Fig. 18), then four (Fig. 20) cells. Further division is irregular, and the position of the cross walls varies (compare Figs. 22 and 23). Dividing nuclei were seen in longitudinal as well as transverse sections (compare Figs. 21 and 25); this indicates that cell division occurs also in the vertical plane. The mature plurilocular structure consists of numerous, small cells, approximately 4μ square, each with very dense contents (Fig. 8*f*, etc.). The outer wall of the whole structure is very much thicker than are any of the internal ones (Fig. 6). It remains after the contents are shed and the inner walls mainly dissolved (Fig. 7). Proliferation is common, i.e. new growth occurs at the base of the empty case (Fig. 7).

Two extreme forms are found, one in which the plurilocular structure is elongated, thin, cylindrical, and terminated by a fine hair. This form is stalked and usually associated with acute-angle branching (Fig. 3). The other form of plurilocular structure is short, thick, rather conical and not terminated by a hair. This form is sessile and is usually associated with obtuse-angle branching (Fig. 8). All gradations between the two exist. Both forms differ in the degree of division in the topmost two or three tiers of cells (compare Figs. 9*f* and 10*e*). The size of the mature plurilocular structure varies greatly.

Figure 6 shows how a stalked, terminal plurilocular structure (*b*) may become sessile and lateral (*a*) through the growth of a lateral branch. The structures shown in this figure are of a form which is approximately intermediate between the extremes possible for this species. On rare occasions some portion of the initial filament of the plurilocular structure may remain vegetative (Fig. 8*d*); other abnormal examples show bending (Fig. 4) or branching (Fig. 5), which may be due to injury.

Plants bearing unilocular reproductive structures are extremely rare, but those that are found bear the structures abundantly. They are associated with the plurilocular structures on the same plant (Fig. 13*a*). They are oval in shape and usually sessile, but they may possess a one-celled stalk (Fig. 12). Variations in shape are shown in Fig. 13*b*. No burst or empty containers have been found.

The initial of the unilocular reproductive structures arises as a densely cytoplasmic cell (Fig. 28), in which a central vacuole is soon visible (Fig. 29). The peripheral nuclei and plastids are at first indefinitely arranged (Fig. 30), but later they become associated; each group contains a single nucleus and presumably indicates a future zooid. At this stage the plastids are nearer the periphery than are the nuclei (Fig. 31).

Either type of reproductive structure is liable to occur in any season.

Field Observations.

Distribution.

General.—E. confervoides occurs in pools in the rock platforms of exposed coastal headlands, and is never exposed to the air. These pools nearly all become submerged at high tide and some extend downward at least to extra-low-tide mark. During the season of most abundant growth, *Ectocarpus* was found inside Sydney Harbour (Balmoral) and Broken Bay (near Church Point); these places are more sheltered than the normal habitats.

E. confervoides has been found in all its forms on *Hormosira Banksii*, which is at all times the most common host. Similar forms grow also on rocks and wood, and on various other plants, including *Ulva*, *Colpomenia*, *Ecklonia*, *Zonaria*, *Dictyota*, *Sargassum*, *Blossevillea*, *Amphiroa* and *Corallina* species. From this it appears that *Ectocarpus* in the Sydney district is not dependent on any particular host or hosts. Knight reports (1923) a definite host correlation in *Pylaiella litoralis* through the season, while Papenfuss (1935) indicates the presence of an *E. siliculosus*–host relationship which is obligate in the case of the sexual plant.

Seasonal.—During the course of a year there occurs a marked rise and fall in the abundance of *Ectocarpus*. The maximum abundance occurs about March to April. It is, however, fairly prevalent from January to June and it is possible to find plants at all times of the year in pools which are exposed at low tide for only a very short time. As conditions become favourable a progressive upward migration occurs, the plants occupying positions which are exposed at low tide for increasingly longer periods. As *E. confervoides* increases in abundance, it appears on any plants which happen to occur in suitable pools. Thus the seasonal change is related to conditions of the pools and not to distribution of a host. Later in the season the amount of *Ectocarpus* diminishes, the last remaining plants being limited to: (1) Deep pools, in which tufts of *Ectocarpus* occur occasionally; (2) Extensive, shallow, cliff-sheltered pools, in which *Ectocarpus* grows lithophytically; (3) Pools exposed for very short periods at low tide. This zone probably extends below the lowest tide mark, and is the only permanent habitat of *E. confervoides*.

Local distribution may be affected by a storm, the plants on occasion being smothered by sand.

As *E. confervoides* grows both on rocks and on *Hormosira Banksii*, which is plentiful throughout the year, the changes in its abundance are not connected with substrate. As the permanent habitat is rarely, if ever, exposed between tides, it is thought that seasonal migration may be connected with changes throughout the year in the conditions experienced during exposure. *Ectocarpus* plants in pools which are exposed during the day frequently exhibit a reversible plasmolysis, due, no doubt, to increased salinity of the pool water.

Bursting of the Plurilocular Structures and Development of Zooids.

Plurilocular reproductive structures at all stages of development may be found together. No factor could be correlated with the liberation of zooids, despite an analysis of the habitat-factors during twenty-four hours of *E. confervoides* plants growing in a pool at Narrabeen headland. Artificial methods which cause bursting are described by Knight (1929); these were not used by the writer.

The bursting of a plurilocular structure commences by a tear which appears at the apex, and the contents are freed in sudden bursts through this. The internal walls have previously been dissolved. After the zooids of the upper half have been freed, the rate of liberation becomes more rapid for a time; later, however, the rate decreases progressively. Usually about five zooids remain permanently inside the encasing wall. The rounded zooids within the plurilocular structure become elongated during a laboured passage through the aperture; they then escape rapidly and again assume their rounded form. These rounded, freed zooids form a dense ellipsoidal or spherical mass at the mouth of the bursting structure. The outer zooids of this mass soon become pyriform and active, cilia and an eye-spot are now distinguishable in addition to the chromatophores and pyrenoids. Knight (1929) reports that there are two chromatophores in each swarmer. Kylin (1933) says there is usually only one. As cells of the adult plant may contain one to numerous chromatophores (Figs. 8*b* and 10*a*) no importance need be attached to the number in the zooid. Each zooid rotates before moving away, and it retains this rotation throughout its motile stage. The motile zooids tend to radiate from, not congregate about, the plurilocular structures. On loss of motility, the zooids again become rounded. The time taken for these processes appears to vary. The inside of the empty outer wall of a plurilocular structure shows highly refractive protuberances; these mark the position of former main cross-walls. Very small, circular structures, apparently of the same substance, are freed with the zooids.

The size of the zooids, before and after motility, is usually constant. A series of them showing progressively greater size may, however, be found on occasion. The greater size is due to the presence of a greater volume of cytoplasm than is normal. It is suggested that the variation in size of these zooids depends upon the irregularity in the divisions of the plurilocular structures before bursting, and is in no wise connected with fusion. Equally large zooids may be found at the mouth of or inside the plurilocular structures. The inequality of size of the divisions of the unburst structure is shown in Figure 9*e*.

No sign of fusion of the zooids was ever observed, so that the zooids of the plurilocular structures function as zoospores, reproducing the plant asexually.

The resting zoospore has a thin enveloping wall. On germination, the contents pass out of this to form a rounded mass, from which a filament later arises. This produces a branching system of prostrate and upright filaments (Fig. 14). In some instances the substrate may be the parent plant, but it is thought that such epiphytes do not develop to maturity. Sometimes a loosened zoospore may germinate within the encasing walls of a plurilocular zoosporangium. Material kept in the laboratory in tanks showed the development of unloosened zoospores (aplanospores) from within the zoosporangium; the filaments grew freely through the surrounding walls. A similar development in another species has been seen under natural conditions. Kylin (1933) describes the development of *E. siliculosus* in detail.

Host Relationships.

Parasitism has been reported in *E. Padinae* Sauv. by Sauvageau (quoted by Williams, 1925); this suggested the advisability of an investigation of *E. confervoides* from this point of view. Plants of *Hormosira Banksii* (Turn.) Decne. and *Colpomenia sinuosa* (Roth) Derb. and Sol., on which *E. confervoides* was growing, were examined in section. The methods used in fixation, staining, etc., are described under the heading "Cytology".

In *Colpomenia* the large, central cells were unaltered, but the arrangement of the small, epidermal cells was disturbed by the filaments of the *Ectocarpus*. In all cases the filaments of *Ectocarpus* appear to pass between the epidermal cells, displacing them, but no case has shown the development of haustoria, and there is no close apposition between the cells of the two plants (Figs. 32 and 33). We may say, then, that *E. confervoides* on *C. sinuosa* behaves as an epiphyte, the basal portions of which are endophytic.

The results obtained in the case of *Hormosira* were rather more unusual. The epidermal cells of this plant develop a thick, cuticle-like layer to their outer wall. This layer is periodically shed, a new one replacing it (Fig. 37). A cast of the cell detail of the plant surface is retained usually by the portion shed. Successive layers may remain superimposed on the plant (Fig. 36). When epiphytes, often including *Ectocarpus*, are present on the surface of the "cuticle" they are shed with it (Fig. 37). However, *Ectocarpus* is able sometimes to continue growth through the "cuticle" layers as they are produced (Figs. 34, 35). This character, as well as re-infection, accounts for the continued growth of *Ectocarpus* on *Hormosira* throughout the season. In portions of *Hormosira* bearing *Ectocarpus*, occasionally there is no sign of the cuticle-like layer. In these parts, the large, inner, cortical cells of *Hormosira* lie nearer the surface, and the epidermal cells are rather more loosely arranged than usual. These portions may be termed *Ectocarpus*-galls (Figs. 38, 39). No haustoria have been observed, nor is there very close association of the cells of the two plants, so that parasitism does not seem indicated. The presence of foreign filaments within the "cuticular" surface apparently suffices to cause *Hormosira* to develop loose-celled galls, on which the "cuticle" layer is no longer formed. Figure 38 shows the change from normal to a gall.

It appears that from both *Colpomenia* and *Hormosira*, *E. confervoides* gains position but not nutrition, penetration of the outer layers of the host being endophytic, not parasitic. This conclusion is supported by the abundant growth of the same plant on rocks. Furthermore, parasitic algae are usually associated (Setchell, 1914) with specific hosts; this is certainly not the case here.

Cytology and Life History.

Method.—Cytological details were obtained from the non-haired variety of *E. confervoides*. This is the more common form in the Sydney district. The plants examined were mainly epiphytes on *H. Banksii*; those growing on *C. sinuosa* were found to possess the same number of chromosomes. Since the forms of *E. confervoides* found on various hosts (e.g. *Ulva*, *Colpomenia*, *Ecklonia*, *Zonaria*, *Dictyota*, *Sargassum*, *Blossevillea*, *Amphiroa*, and *Corallina* species) correspond microscopically to plants growing on *H. Banksii*, it appears highly probable that they are cytologically identical. A morphological difference has been reported as accompanying a difference in the number of chromosomes, when this has been found within the species *E. confervoides* (Papenfuss, 1935).

After fixation in 1% chrom-acetic acid in salt water, the material was washed well and then was embedded in paraffin. Sections for the study of host relationships were cut at thicknesses up to 6μ; for nuclear detail the most satisfactory thickness was 3μ. Staining presented many difficulties. There is very little differentiation shown by *Ectocarpus* when treated with the usual combinations of stains. The cleanest and clearest staining obtained was that given by magdala red and aniline blue, the sections being left for some days in the magdala red. Iron alum-Haematoxylin-light green was the staining combination used for confirmation of the chromosome number.

Observations.—In material treated as described above, the pyrenoid bodies and the nucleus appear more prominently than they do in the living state. The nucleus, except for the nucleolus, appears nearly uniform, and lightly-stained. The single nucleolus stains most heavily at its periphery; inside this band there may be one, two, or three colourless areas (Figs. 16, 17).

The cell detail is shown more clearly by the vegetative than by the reproductive cells. In some cases interpretation of the cell contents of the chambers of the plurilocular structure is almost impossible because of the small size, dense protoplasm, and especially the uniformity of staining.

The diameter of the nucleus usually measures approximately 3·6μ, that of the nucleolus 1·8μ. Serial sections 3μ thick showed all necessary nuclear detail in the one section.

The chromosomes are only slightly elongated, if not spherical. They are very small, but it is possible to count them, especially when at the metaphase stage of division.

The chromosome number in the normal vegetative cell (Fig. 15) and in the plurilocular zoosporangium (Figs. 21, 22, 25) is 16, so that the asexual zoospores also have 16 chromosomes. Meiosis occurs during the formation of the unilocular reproductive structure, so that the daughter nuclei and the zooids each carry the haploid number of chromosomes (Figs. 30, 31). The figures given here are similar to those of Knight (1929).

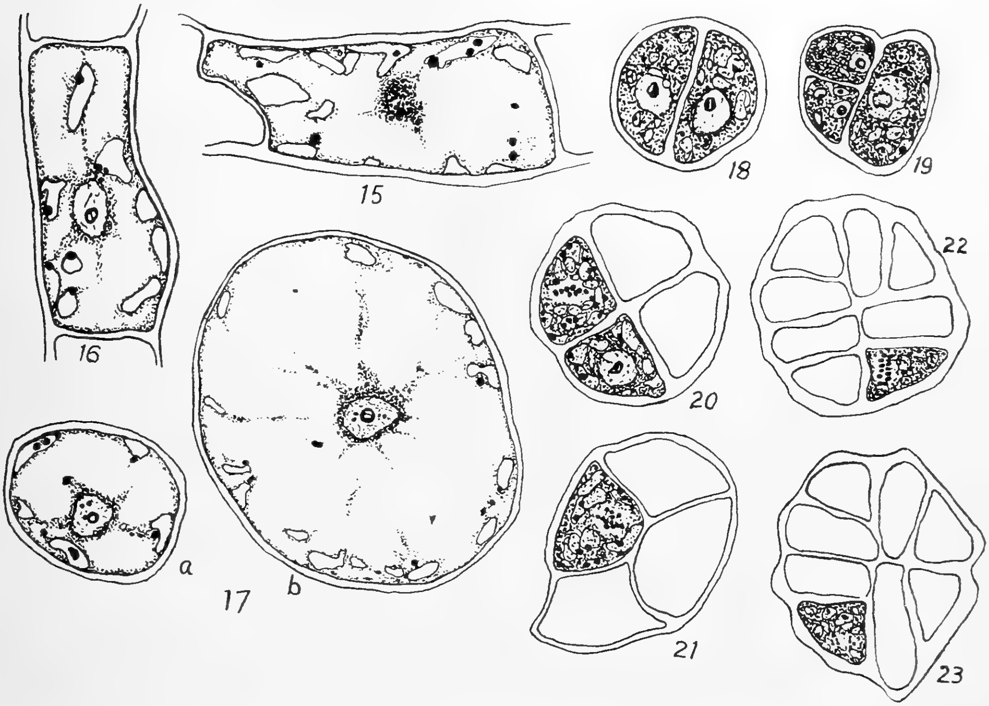

Fig. 15.—Longitudinal section of a vegetative cell showing mitosis. × 1,360.

Fig. 16.—Longitudinal section of a vegetative cell showing a resting nucleus. Nucleolus has two light areas. × 1,360.

Fig. 17.—Transverse sections of vegetative cells showing variation in size. The peripheral arrangement of the chromatophores in the cytoplasm is illustrated. The nucleolus contains one (*a*) or two (*b*) clear areas within it. × 1,360.

Fig. 18.—Transverse section of an initial of a plurilocular structure, after the formation of the first vertical wall. × 1,360.

Fig. 19.—Transverse section of an initial of a plurilocular structure, after the formation of the second vertical wall in one cell only. This view is less common than that shown in Fig. 20. × 1,360.

Fig. 20.—Transverse section of a plurilocular reproductive structure after the formation of the second vertical wall; one quadrant shows a nucleus dividing. × 1,360.

Fig. 21.—As Fig. 20. × 1,360.

Fig. 22.—Transverse section of a plurilocular reproductive structure at a later stage than shown above, further vertical walls having formed. Nuclear division is shown. × 1,360.

Fig. 23.—This figure shows a different order in the formation of vertical walls from that shown in Figure 22. × 1,360.

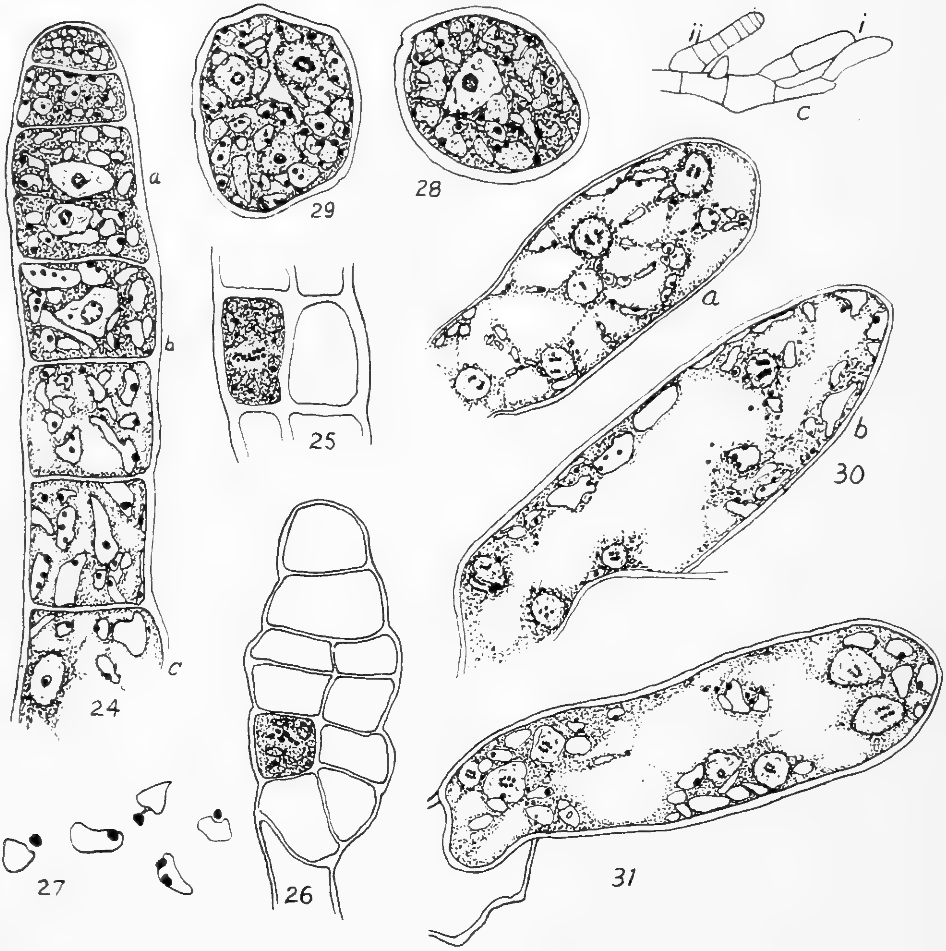

Fig. 24.—A longitudinal section of an initial of a plurilocular structure at the filament stage. The cells which are about to divide actively (from *b* to apex) can be distinguished from the normal vegetative cells (*c* to *b*) by their dense contents, especially cytoplasm. Wall formation is incomplete at *a*. × 1,360.

Fig. 25.—Longitudinal section of a plurilocular reproductive structure, in which mitosis is shown. There are sixteen chromosomes. × 1,360.

Fig. 26.—Longitudinal section of a young plurilocular reproductive structuré. × 1,360.

Fig. 27.—A selection of chromatophores and associated pyrenoids from a single cell. × 1,360.

Fig. 28.—Transverse section of an initial cell of a reproductive structure. It is distinguished from a vegetative cell (see Fig. 24) by the dense cytoplasmic contents. As the nucleus is resting, the cell could be the initial of a uni- or a plurilocular structure. × 1,360.

Fig. 29.—Transverse section of a unilocular structure showing three nuclei. Vacuole formation is apparent. The proportion of cytoplasm to vacuole is much greater here than in a more mature structure (compare Fig. 30*b*). In one nucleus chromosomes are visible. It is unusual for division in a unilocular structure not to be simultaneous (compare with Figs. 30 and 31). × 1,360.

From the above it appears that the plant is diploid ($2n = 16$); it reproduces asexually by means of diploid zoospores which are developed from plurilocular reproductive structures. Very rarely unilocular reproductive structures are developed from this diploid plant; this development is associated with meiotic division, so that the zooids produced are haploid, each carrying eight chromosomes.

Life History.—It has been shown above that the diploid plant gives rise freely to diploid zooids (from plurilocular structures) and, very rarely, to haploid zooids (from unilocular structures). Zooids from the plurilocular structures (zoosporangia) develop asexually, i.e. are zoospores. Zooids from the unilocular structures have not been observed by the writer. These zooids occur so rarely that their function must be of relative unimportance in this life history. A survey of the relevant literature (see below) suggests that their behaviour may be variable. Cytological evidence suggests they could either (1) fuse, and then produce the usual diploid plant, or (2) develop directly to a haploid soma (as yet not found in the field). This soma would be another phase of the life history and would finally give rise to cells capable of fusing and so reforming the normal diploid plant; asexual reproduction of this hypothetical soma would, of course, be possible. If reduction division followed the formation of a zygote, the result would be the same as if the zooids had developed without fusion; but a case parallel to this is unknown in the Melanophyceae so far.

It is unlikely that haploid plants occur within the district (Five Islands, Wollongong, to Palm Beach) examined by the writer. The examination of a wider area may disclose their existence, though material collected from some dozen places between Sydney, N.S.W., and Brisbane, Qsld., appeared identical with that which was found near Sydney.

No plants of *E. confervoides* which differ morphologically or cytologically from those described in this paper have been found by the writer at any season, and there appears to be no relationship between *E. confervoides* and its substrate. This differs from where (Papenfuss, 1935) an n and 2n soma have been found. Further, there is no seasonal drift from host to host, as was found in *Pylaiella litoralis* (Knight, 1923).

Kylin (1933) said: "Dass diese Pflanzen, wenn sie an der schwedischen Westküste überhaupt lebensfähig sind, besonders selten vorkommen, kann gar nicht Wunder nehmen, da unilokuläre Sporangien so selten sind", and "Wegen einer reichen vegetativen Vermehrung der diploiden Generation mittelst Schwärmer aus diploiden plurilokulären Sporangien ist aber der Generationswechsel weggefallen, und übrig bleiben dann nur diploide Individuen." These statements could well apply to the Sydney district.

The life history described above may be expressed diagrammatically as in Figure 44. The dotted line shows both methods of development possible for the haploid zooids from the unilocular structures.

This diagram may now be compared with other published results of *Ectocarpus*.

Discussion.—Knight (1923) has shown the life history of *Pylaiella litoralis* to be one of fluctuating alternation with similarity of form. The diploid plant is the

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Fig. 30.—*a* and *b* show longitudinal sections of vacuolated unilocular structures undergoing simultaneous nuclear division, eight chromosomes appearing in each nucleus. *a* is a surface section. Serial sections show seven peripheral nuclei in the next section and two surface ones (as here) in the third. *b* is a more median section than *a*, and shows the vacuole occupying a central position. *c* shows an initial of a plurilocular structure (ii) associated with unilocular structures (i). (*a*, *b*, × 1,360; *c*, × 216.)

Fig. 31.—As Fig. 30 *a* and *b*, but an association of nuclei with chromatophores is suggested. × 1,360.

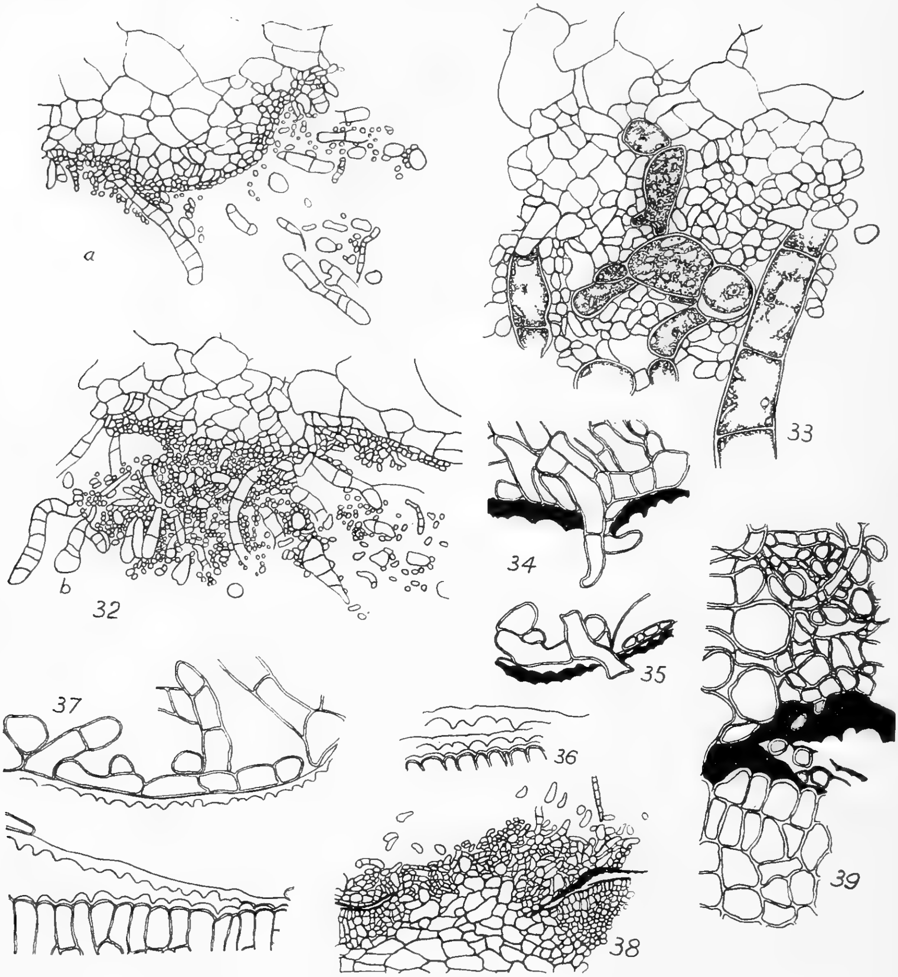

Fig. 32.—*a* Longitudinal section of a fold in *Colpomenia sinuosa.* The epidermal zone is disturbed by filaments of *Ectocarpus,* while the large central cells are unaltered. *b* shows a surface section of this same fold and so more detail of the narrow epidermal zone is obtainable. × 76.

Fig. 33.—This is the central portion of the tissue shown in Fig. 32*b*. The filaments of *Ectocarpus* only are shown in cell detail. The loose arrangement of the tissues is clearly shown. There is no sign of parasitism. × 316.

Fig. 34.—Penetration of the "cuticle" of *Hormosira Banksii* by filaments of *Ectocarpus.* × 204.

Fig. 35.—As Fig. 34, but the tip of the penetrating filament is flattened into a "holdfast". × 204.

Fig. 36.—Transverse section of the thallus of *Hormosira Banksii* showing shed "cuticle" layers. × 264.

Fig. 37.—As Fig. 36, but epiphytic *Ectocarpus* is being shed with the "cuticle". × 264.

Fig. 38.—Longitudinal section of a gall on *Hormosira Banksii.* As in Figs. 34, 35 and 39, the "cuticle" is shown as black. The large-celled, central tissue of *Hormosira* protrudes towards the surface. Filaments of *Ectocarpus* and epidermal cells of *Hormosira* are associated in the gall. The apparent difference in the thickness of the "cuticle" on either side of the gall is due to the "cuticle" having been torn loose in one case. × 60.

Fig. 39.—The edge of a gall is shown in detail; penetration of the "cuticle" by filaments of *Ectocarpus* is illustrated. × 264.

more prevalent and reproduces itself asexually by zooids which are formed in the plurilocular zoosporangia. Reduction occurs in the first division of the unilocular gametangium, whose haploid zooids either straightway fuse (Knight, 1929), and presumably give rise to the diploid plant or, much more generally, form a haploid soma (Knight, 1923). The plurilocular structure of the haploid soma gives rise to gametes which either fuse, then give rise to the diploid plant, or develop asexually to produce anew the haploid soma. Diagrammatically this may be shown as Figure 40.

Papenfuss (1935) has summarized the contradictory reports of early workers regarding the behaviour of zooids of *E. siliculosus*. Sauvageau (1896–7) and Kuckuck (1891–1912) held that the zooids of the plurilocular structures were asexual. Kuckuck (1891) and Reinhardt (1884) reported the zooids of the unilocular structure as asexual. Oltmanns (1899) reported that sexual zooids were produced from the plurilocular structures. Detailed work on this species has been done by Berthold (quoted by Knight, 1929); Knight (1929); Kylin (1933); Føyn (1934), and Papenfuss (1935).

Plants collected at Naples by Berthold were haploid, with eight chromosomes (Knight, 1929). Their plurilocular structures produced gametes which usually fused before further growth, but which could develop asexually. The culture obtained from the products of the plurilocular structures contained small plants, some bearing plurilocular structures only (plants, haploid, i.e. from the unfused zooids?), others bearing pluri- and unilocular structures (plants developed from zygotes?). It may be that reduction occurs in the diploid unilocular structure, the zooids produced then giving rise to the usual haploid plants. Unfortunately, work was not continued on these cultured plants; their cytology was not investigated.

Knight (1929) reaffirmed the sexual nature of the zooids described by Berthold, and determined the chromosome number (eight) of the plants which grow freely near Naples.

Bjørn Føyn (reported by Føyn, 1934) repeated and extended the investigation of Berthold. Gametes from plurilocular structures of plants of different sex were mixed and copulation occurred. Zygotes, with which were associated a few female gametes, were then cultured. Plurilocular structures on the resultant plants gave rise to asexual zoospores. Zooids from unilocular structures (which might occur on plants which bore plurilocular structures) also germinated directly.

Føyn summarizes thus: "Es ist bei dem neapler Material ein Generationswechsel vorhanden zwischen einer haploiden sexuellen Generation, die nur pluriloculäre Behälter erzeugt, und einer diploiden, vegetativen Generation mit zwei Sorten von Behältern: pluriloculäre mit diploiden Schwärmern und uniloculäre mit haploiden Zoosporen. Dass Gameten, die nicht zu Kopulation kommen, sich parthenogenetisch entwickeln können, hat schon Berthold gezeigt, dass die sich direkt zu Geschlechtspflanzen entwickeln, wissen wir von Hartmann (1929)."

It is highly probable that the diploid plant, readily obtained in culture, occurs naturally at Naples. As Papenfuss (1935) says: ". . . it is evident that such plants exist there. Both Berthold and Oltmanns observed "neutral" spores from plurilocular sporangia, and Oltmanns states that these are generally larger than the gametes, facts which indicate that these zoids were diploid zoospores."

A diagrammatic scheme is shown in Figure 41.

The results obtained by Knight at Port Erin were that the plants were diploid (sixteen chromosomes) and gave rise to asexual zoospores from the plurilocular structures. Reduction occurred in the first division of the unilocular structures, the zooids thereof (each with eight chromosomes) fusing after liberation. The zygote produced the normal, diploid plant. Diagrammatically this may be represented as in Figure 42.

The main difference between these two sets of results is that the prevalent plant was haploid in one case and diploid in the other; also that the plurilocular structures gave rise to potentially sexual zooids in one case and to asexual zooids in the other.

Figure 45 is a theoretical scheme showing the range of development possible in the complete life cycle of *Ectocarpus confervoides*. In certain localities, phases of the life history may be absent. The form of the life history occurring at any one place may be determined by the habitat there. This scheme would account for the existence of conflicting reports.

Kylin (1933), at Kristinberg, found individuals of *E. siliculosus* (presumably diploid), which bore plurilocular structures. The swarmers from these developed directly to new individuals, which were morphologically the same as the parent plant. Unilocular structures occurred extremely rarely and never in his cultures; when present they either occurred alone or were associated with the plurilocular structures. No haploid plants were found. Kylin says: ". . . erkläre ich den Wegfall des Generationswechsels mit einer vegetativen Vermehrung der vorhandenen diploiden Individuen mittelst diploider rein vegetativer Schwärmer aus diploiden plurilokulären Sporangien." As in the plant cycle as lived at Sydney, the products of the unilocular structures are negligible, and Kylin says further (1933): "Primär liegt meiner Meinung nach bei *Ectocarpus siliculosus* an der schwedischen Westküste ein Generationswechsel mit zwei einander morphologisch gleichen Generationen vor. Wegen einer reichen vegetativen Vermehrung der diploiden Generation mittelst Schwärmer aus diploiden plurilokulären Sporangien ist aber der Generationswechsel weggefallen, und übrig bleiben dann nur diploide Individuen." These results are shown in Figure 44.

Papenfuss (1935), at and near Wood's Hole, found both haploid (eight chromosomes) and diploid (sixteen chromosomes) plants. The haploid form was represented only at Penikese Island, 20 miles from Wood's Hole, while the diploid plants occurred also at Wood's Hole itself. The more common plant was the diploid, and it bore both unilocular and plurilocular structures. Zooids formed in the plurilocular zoosporangia were asexual. Meiosis occurred during the development of the unilocular structures; the zooids produced from these gave rise to the haploid soma. The haploid plant was inferior to the diploid in size, length of cells, and size of plurilocular structures. These reproductive structures produced gametes, all those from one plant being of the same sex. The male and female gametes both varied greatly in size; so, as a result, did the zygotes. The zygote developed into the normal diploid plant. Parthenogenetic development of either gamete led to the re-formation of the haploid plant. This scheme is represented diagrammatically in Figure 43.

Føyn (1934) at Herdla, obtained results which are in agreement with those of Papenfuss.

This life history differs from that reported by Knight (1929) in the behaviour of the haploid zooids produced in the unilocular structures. Papenfuss suggests that this difference is due to a misinterpretation by Knight. Kylin (1933) also criticizes Knight's work and thinks that the copulation described by her was merely the blundering and sticking together of asexual zooids. Knight describes fusions as being rare and associated with clump formation, the fusing zooids both being motile and taking about 20 minutes to coalesce. In contrast, Papenfuss states that the fusions between zooids from the haploid plurilocular gametangia are numerous, the female zooids are non-motile at fusion, clump formation does not occur, and the time of fusion is less than half a minute. He suggests Knight's observations were of abnormalities and that both localities present life histories identical with that reported from the United States of America. Papenfuss reports that the haploid plant was absent if the specific host were not present. This fact may account for Knight's failure to find this form at Port Erin, if indeed it does form part of the life history in Britain.

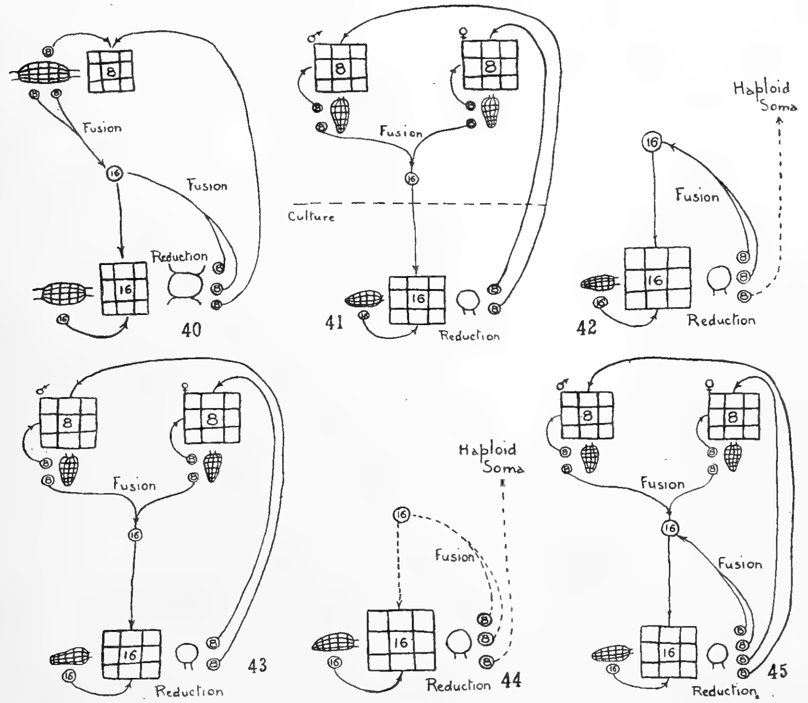

Fig. 40.—*Pylaiella litoralis,* Port Erin (Knight). Haploid and diploid plants are morphologically identical and are most abundant at different seasons.

Fig. 41.—*Ectocarpus siliculosus,* Naples (Berthold, Knight, and Føyn). The haploid plant occurs naturally. The diploid plants were produced in culture by Berthold and, later, by Føyn; if this soma occurs naturally, the life history is the same as that shown in Figure 43.

Fig. 42.—*Ectocarpus siliculosus,* Port Erin (Knight). Haploid plants absent (or missed?). Fusion of haploid zooids questioned by Papenfuss (1935) and Kylin (1933).

Fig. 43.—*Ectocarpus siliculosus,* Herdla (Føyn), Wood's Hole (Papenfuss). The haploid plants are smaller than the diploid, and they bear male or female gametes. No fusion of zooids from unilocular reproductive structures was noted. The haploid plants are absent if the specific host is not present.

Fig. 44.—*Ectocarpus confervoides* (= *siliculosus*), Kristinberg (Kylin), Sydney (May). Unilocular reproductive structures are extremely rare, and the behaviour of the haploid zooids is unknown. A haploid soma has not (yet?) been seen.

Fig. 45.—*Ectocarpus confervoides* (= *siliculosus*), theoretical scheme. This theoretical scheme includes all reported forms of the life history. Any haploid zooid may develop either sexually or asexually. In certain localities a phase of the life history may not occur.

Whether the Port Erin–Wood's Hole life-histories are the same or not, all reported life-histories of *E. confervoides* (including *E. siliculosus*), including that presented in the present paper, fit the scheme given in Figure 45.

Great differences exist in the proportion of haploid to diploid phases in the life cycle—the relative importance of any phase varying with locality. At Naples conditions favour the haploid plant (diploid not yet recorded as occurring naturally); at Port Erin, Kristinberg, and Sydney, they favour the diploid (haploid occurring rarely, if ever) and at Wood's Hole and Herdla the balance between the haploid and diploid phases is more even—both occurring relatively commonly. We do not know yet what factor or factors control these relative proportions, except that at Wood's Hole the occurrence of the haploid phase is known to be dependent on the presence of a specific host. In those localities where a haploid soma has not been found, unilocular structures are very rare. Papenfuss (1935) says: "The absence of the sexual generation of *Ectocarpus* in certain localities is due, undoubtedly, to an effect of the environment which inhibits the formation of unilocular sporangia. . . . It is probable that a very slight difference in the environment may determine the absence of unilocular sporangia, for the writer found that asexual plants growing on *Spartina* at Grassy Island bore plurilocular sporangia only, while the plants which grew on *Chorda* in the same locality but in slightly deeper water, bore both plurilocular and unilocular sporangia."

The problem now existing is to find what conditions are responsible on one hand for the production of an abundant crop of unilocular structures as against where there is an almost complete inhibition of the formation of these reproductive structures. In the first case, an alternation of haploid and diploid somas occurs

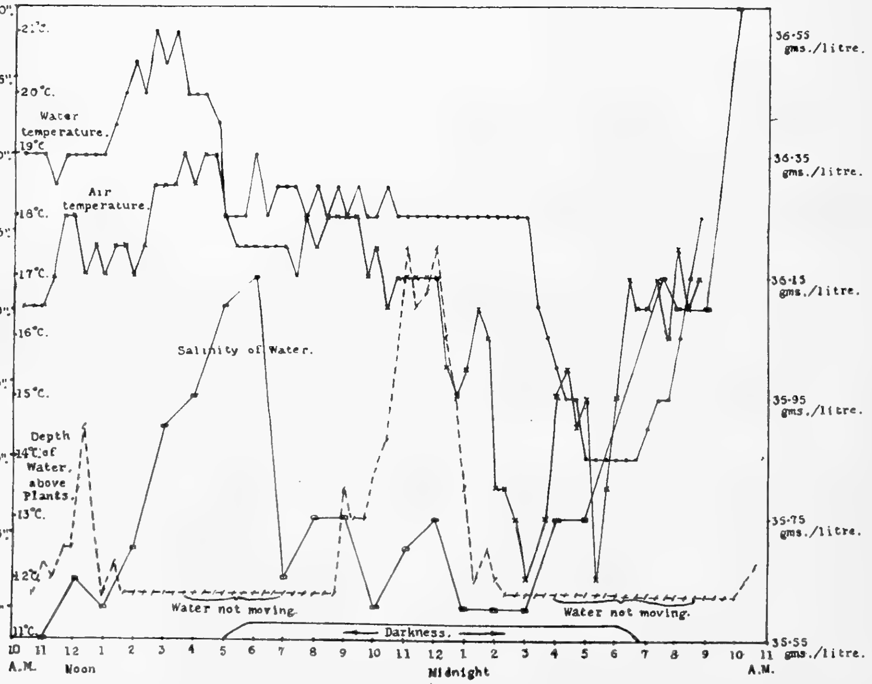

Fig. 46.—An analysis of the habitat factors for twenty-four hours (April 25-26, 1936) of *E. confervoides* growing in a rock pool at Narrabeen headland, near Sydney.

(e.g. Wood's Hole, Herdla, and probably Naples), while in the second case the alternation of generations is overwhelmed and there remain no, or practically no, haploid individuals (e.g. Port Erin, Kristinberg, and Sydney).

The only evidence we have as to the conditions favouring the formation of unilocular structures on asexual plants is that given by Papenfuss (1935) and quoted above, i.e. that slightly greater depth (or specific hosts?) favours the formation of unilocular structures. The fact that Føyn, at Herdla, Norway, has reported the occurrence of haploid plants, and Kylin, at Kristinberg, Sweden, has been unable to find these, suggests that the form of the life cycle is determined by relatively local factors.

It would be most advantageous if one could compare the conditions under which *E. confervoides* thrives in those localities in which it has been studied. To facilitate this comparison, there is given here, in graph form (Fig. 46), an analysis for 24 hours of the habitat of *E. confervoides* on the coast near Sydney at the season of its maximum prevalence.

Summary.

1.—An investigation has been made of *E. confervoides* found growing on the coast near Sydney, N.S.W.

2.—A systematic examination led to *E. siliculosus* (Dillw.) Lyngb. being regarded as merely a variety of *E. confervoides* (Roth) Le Jol.

3.—A seasonal migration up and down the rock platform is reported.

4.—Host relationships have been investigated. *E. confervoides* has been shown to be slightly endophytic in *Colpomenia sinuosa* and *Hormosira Banksii.* In the latter, curious gall-formations are formed.

5.—A cytological investigation has been carried out on *E. confervoides* found growing near Sydney. The chromosome numbers are 16 and 8; all plants found so far are diploid; reduction division occurs in the unilocular structure. Asexual zoospores from plurilocular reproductive structures may, under artificial conditions, act as aplanospores.

6.—A discussion is given of the life cycle of *E. confervoides* as reported from various localities. The conditions under which it flourishes near Sydney are noted in order to facilitate comparisons.

Work described in this paper was performed by the writer while holding a Caird Scholarship (1936) and a Science Research Scholarship (1937).

This investigation was carried out under the supervision of Assistant Professor J. McLuckie, University of Sydney. Thanks are also due to Dr. L. Fraser, University of Sydney, for her assistance and encouragement, and to Professor J. Turner, University of Melbourne, for his criticism of the manuscript.

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A NOTE ON THE RE-EXAMINATION OF AUSTRALIAN SPECIES OF CERATOPOGONIDAE (DIPTERA).

By J. W. S. Macfie.
(*Communicated by Frank H. Taylor, F.R.E.S., F.Z.S.*)

(Three Text-figures.)

[Read 25th October, 1939.]

In 1889 Skuse described 17 species of Ceratopogonidae collected in Australia. Thanks to the courtesy of Mr. A. R. Woodhill and Mr. Frank H. Taylor, I have been permitted to re-examine one or both sexes of 6 of these species, namely those named by Skuse *Ceratopogon subnitidus*, *sydneyensis*, *marmoratus*, *molestus*, *aeratipennis*, and *minusculus*, and also the type material of *Culicoides multimaculatus* Taylor and *C. townsvillensis* Taylor.

Two of these species, namely *C. marmoratus* and *C. molestus*, are *Culicoides*, and should be recognizable from the figures of the wings given by Skuse. The descriptions of the others, published fifty years ago, are not sufficiently detailed to enable the insects to be recognized now, or to be separated from other species of the same genera. They are, indeed, insufficient to indicate to what genera the insects belong, and thus Kieffer (1917) supposed all four to be *Culicoides*, whereas in fact one is *Forcipomyia*, one *Apelma*, and two *Dasyhelea*.

The brief notes which follow may assist in the recognition of these species.

Forcipomyia subnitida (Skuse).

Proc. Linn. Soc. N. S. Wales, xiv, 1889, 299.

This insect is a *Forcipomyia*, not a *Culicoides* as Kieffer (1917) supposed. Dickinson and Hill (1916), and McEachran and Hill (1916) have referred to this species in connection with their work on *Onchocerca gibsoni*, but as it is a *Forcipomyia* this reference requires confirmation. The male (which is not known) is more likely to show characteristic features, but the following details about the female may assist recognition.

♀. *Head* with palpi rather dark brown, third segment with deep pit of moderate size. Antennae dark brown, segments forming an almost continuous series: 4–14 from sub-spherical to flask-shaped, ranging from about 9 by 9 to 10 by 7 (maximum) units;* 15 about 15 (including nipple-like stylet of about 3 units) by 6 units. *Thorax* and scutellum very dark brown or blackish. *Wings* unadorned, as shown in Skuse's figure. *Legs* with femora and tibiae uniformly dark brown, tarsal segments (excepting last which is infuscated) paler brown. Knees not pale. No tibial spines. Without scales. T.R. about 2. *Abdomen* very dark brown or blackish; without scales. Spermathecae two, highly chitinized, pyriform, subequal; total length about 70μ and greatest breadth 45μ.

* The unit used is approximately 3·5μ.

APELMA SYDNEYENSIS (Skuse).

PROC. LINN. SOC. N. S. WALES, xiv, 1889, 302.

This insect is now much damaged and lacks the hypopygium. It is a species of *Apelma*, not a *Culicoides* as Kieffer (1917) supposed, but in its present condition shows no clear means by which it might be distinguished from other known species.

CULICOIDES MARMORATUS (Skuse).

PROC. LINN. SOC. N. S. WALES, xiv, 1889, 304.

This insect is a *Culicoides*, and should be readily recognized by the adornment of the wings. The male (which is not known) may furnish additional diagnostic characters. The following details about the female may facilitate recognition.

♀. *Head* with palpi very dark, third segment longer than fourth and fifth together, with a small sub-apical pit. Antennae brown: segments 4–10 from sub-spherical to oval, ranging from about 10 by 10 to 11 by 8 units; 11–14 more elongate, ranging from about 16 by 8 to 21 by 9 units; 15 about 31 by 8 units, without stylet. The combined lengths of segments 3–10, 4–10 and 11–15 about 88, 73 and 105 units respectively. *Wings* densely clothed with macrotrichia which, indeed, cover almost the whole surface. Adornment as shown in Skuse's figure. The pale spot just beyond end of costa is double; that enveloping cross-vein rather small, covering only base of first radial cell. *Legs* with femora and tibiae uniformly dark brown. Knees not pale. T.R. about 2·1. Fourth tarsal segments not cordiform.

CULICOIDES MOLESTUS (Skuse).

PROC. LINN. SOC. N. S. WALES, xiv, 1889, 305.

This insect is a *Culicoides*, and should be recognizable by the adornment of the wings, and the cordiform fourth tarsal segments. The male (which is not known) may furnish additional diagnostic characters. The following details about the female may facilitate recognition.

♀. *Head* with antennae brown: segments 4–10 from sub-spherical to shortly oval, ranging from about 8 by 7–8 to 9 by 7 units; 11–14 slightly longer, ranging from about 11 by 6–7 to 14 by 6 units; 15 about 21 by 7 units, without stylet. The combined lengths of segments 4–10 and 11–15 about 57 and 72 units respectively. *Wings* with macrotrichia rather scanty, mostly at tip. Adornment as shown in Skuse's figure, but in the specimen examined by me the pale spot enveloping cross-vein larger, covering proximal half of first radial cell, and the spot between branches of Cu more central, not abutting on Cu_1. *Legs* darkish brown with paler knees. T.R. about 2·2. Fourth tarsal segments cordiform.

CULICOIDES MULTIMACULATUS Taylor. Fig. 3.

Aust. Zoologist, i, pt. 6, 1918, 169.

Thanks to the kindness of Mr. F. H. Taylor, I have had the opportunity to examine two females of this species, the type and another specimen taken with it. A few details may therefore be added to the original description (published in 1918) to assist in differentiation from other species now known.

The eyes are bare, narrowly separated above. Palpi relatively short, the third segment inflated about middle, with a large, shallow pit, which is subdivided: lengths of last three segments about 25, 8, and 11 units respectively. Antennae with segments 4–10 oval to vasiform, ranging from about 11 by 8 to 12 by 7 units; 11–14 more elongate, subequal, 17–20 by about 7 units; 15 about 30 by 9 (maximum) units, without stylet. The combined lengths of segments 3–10, 4–10, and 11–15 about 102, 85, and 103 units respectively. Wings finely adorned, the distribution of the pale spots as shown in diagram (Fig. 3). In addition to these pale spots, certain parts of the wing are paler than the rest, namely, the area immediately below R_{4+5}, and narrow zones along veins M_1, M_2, Cu, Cu_1, and Cu_2. Macrotrichia abundant, covering almost whole surface excepting radial areas, and extending to base between M and Cu. Legs with all knees dark, and a narrow pale band both a little above and a little below them. T.R. almost 2. Fourth tarsal segments sub-cylindrical, not cordiform.

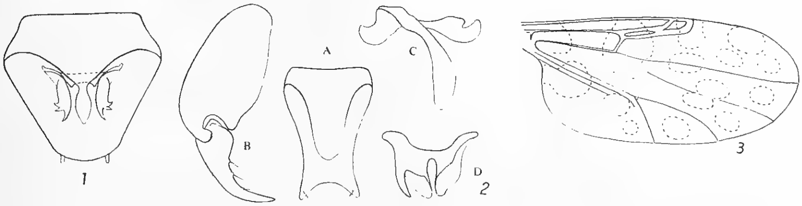

Fig. 1.—*Dasyhelea aeratipennis* (Skuse). Hypopygium, ventral view, to show ninth segment and aedeagus only.

Fig. 2.—*Dasyhelea minuscula* (Skuse). Hypopygium, ventral view. A, ninth segment (at lower magnification than other figures); B, side-piece and clasper; C, harpes; D, aedeagus (perhaps abnormal).

Fig. 3.—*Culicoides multimaculatus* Taylor, female. Diagram to show adornment of wing.

Dasyhelea aeratipennis (Skuse). Fig. 1.

Proc. Linn. Soc. N. S. Wales, xiv, 1889, 303.

This insect is a *Dasyhelea*, not a *Culicoides* as Kieffer (1917) supposed. The following details may be added to the original description to facilitate future recognition.

♂, ♀. *Head* with eyes densely hairy. Palpi brown, third segment about as long as fourth and fifth together, without definite pit. Antennae rather dark brown. In male, segments 4–11 gradually narrowing from about 9 by 11 to 10 by 7 units; 12–14 binodose, elongate, subequal, lengths about 20 units; 15 about same length, without stylet. In female, segments forming an almost continuous series: 4–10 from sub-spherical to oval, ranging in one specimen from about 7 by 8 to 9 by 5–6 units; 11–14 subequal, about 10–11 by 5–6 units; 15 about 14 by 5–6 units, without stylet. The combined lengths of segments 4–10 and 11–15 about 59 and 56 units respectively. *Thorax* with scutellum yellow, bearing 5 bristles and one or two small hairs. *Wings* well clothed with macrotrichia which, however, are not as dense as is suggested in Skuse's figure, but are distributed in the normal manner. Second radial cell small, almost square in male, slightly longer than broad in female. *Legs* with femora and tibiae darkish brown, and tarsal segments (excepting last which is infuscated) almost colourless. T.R. in both sexes about 2·5. *Abdomen* blackish. Spermatheca single, highly chitinized, collapsed in the specimen examined, but probably oval. Hypopygium (Fig. 1) very dark brown. Ninth sternite without bristles, prolonged posteriorly in middle line as a conical process with an expanded and somewhat scoop-shaped end. Side-pieces short, broadest near apex; claspers short, very dark. Harpes apparently similar to those of *D. similis* C.I. & M., an irregularly-shaped transverse band on each side, with a rather feebly chitinized posterior extension between. Aedeagus with lateral bars strongly denticulated.

DASYHELEA MINUSCULA (Skuse). Fig. 2.

PROC. LINN. SOC. N. S. WALES, xiv, 1889, 299.

This insect is a *Dasyhelea*, not a *Culicoides* as Kieffer (1917) supposed. The following details may be added to the original description to facilitate future recognition.

♂. *Head* with eyes densely hairy. Palpi darkish brown, short, third segment without definite pit. Antennae darkish brown, with ample dark plume, and finely sculptured segments: segments 4–11 ranging from about 8 by 10 to 9 by 6 units; 12–14 elongate but not clearly binodose, their lengths about 16, 15, and 11 units respectively; 15 about 18 by 6 units, without stylet. *Thorax* very dark brown with traces of usual adornment. Scutellum yellowish, bearing 4 bristles. *Wings* with both radial cells completely obliterated. Venation and distribution of macrotrichia as shown in Skuse's figure, but junction of R_{1+5} squarer, more normal. *Legs* rather pale brown, especially segments 1–4 of tarsi. T.R. about 2. *Abdomen* very dark brown. Hypopygium (Fig. 2) with ninth sternite devoid of bristles, prolonged posteriorly beyond aedeagus. Ninth tergite with a pair of large conical processes posteriorly, and apparently no hairy processes. Claspers very highly chitinized, much attenuated distally, almost claw-like. Harpes forming an irregularly-shaped transverse band with a long posterior process, the end of which is expanded and feebly chitinized. Aedeagus perhaps abnormal in the specimen examined, asymmetrical, the chitinized parts in ventral view as shown in the figure.

LASIOHELEA TOWNSVILLENSIS (Taylor).

Aust. Zoologist, i, pt. 6, 1918, 169 (*Culicoides*).

Mr. F. H. Taylor has kindly permitted me to examine specimens (females) of this species, including the type. The insect, originally described (1918) as a *Culicoides*, would now be placed in the genus *Lasiohelea* Kieffer 1921. It resembles closely *L. lefanui* Carter, an African species, and may indeed prove to be conspecific. Very similar if not identical forms have been taken in Malaya and elsewhere.

Several of the species of *Lasiohelea* differ to only a very slight degree. The following additional characters of this species may therefore be helpful in differentiating it from other species which may be found in Australia.

The eyes are bare. Palpi with third segment much inflated, with large shallow pit: lengths of last three segments in one specimen about 15, 6, and 9 units respectively. Antennae with segments 4–10 from disc-shaped to oval, ranging in this specimen from about 6 by 8 to 8 by 6 units; 11–14 elongate, subequal, 17–18 by 5–6 (maximum) units; 15 about 22 (including nipple-like stylet of about 2 units) by 5 units. The combined lengths of segments 3–10, 4–10, and 11–15 about 60, 50, and 93 units respectively. Wings as in *L. lefanui*, but bare areas along veins not quite so conspicuous. T.R. about 2. Claws and empodium normal. Spermatheca single, of the same type as that of *L. lefanui*, its diameter about 70μ.

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TAXONOMIC NOTES ON THE ORDER EMBIOPTERA. XI–XIV.

By Consett Davis, M.Sc., Lecturer in Biology, New England University College.

(Fifty-one Text-figures.)

[Read 29th November, 1939.]

PART XI: A NEW GENUS FROM THE CONGO.

(Seven Text-figures.)

Genus Dinembia, n. gen.

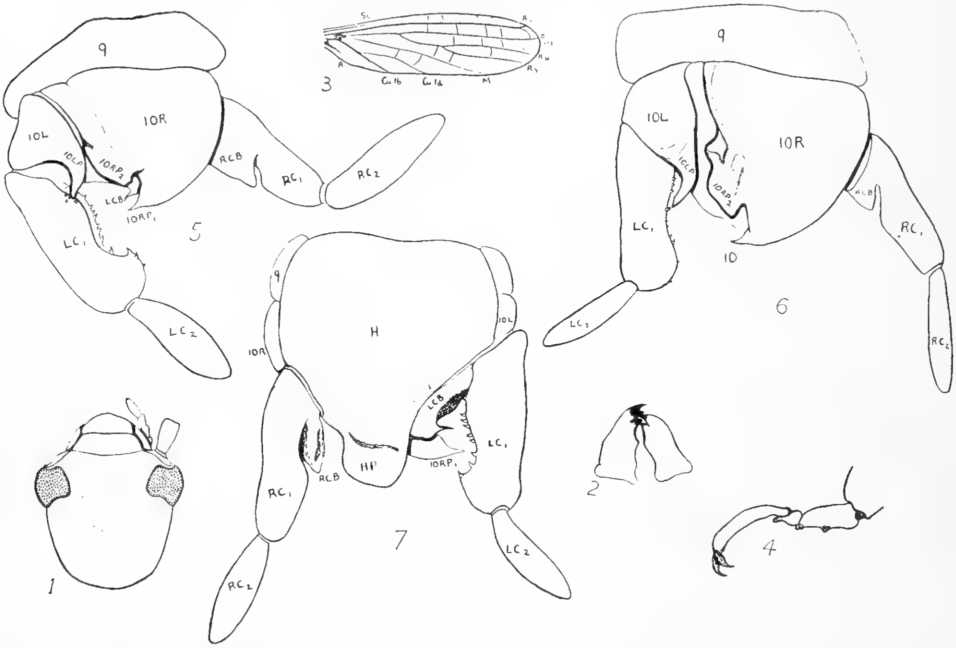
Genotype, *Dinembia ferruginea*, n. sp.

Fairly large Embioptera, the males with the following characters: Winged, R_{4+5} forked, fork longer than stem; M simple; cubitus two-branched. Hind tarsi with two relatively small ventral bladders on the first segment, one on the second. Terminalia with tenth abdominal tergite completely cleft; right hemitergite large, processes much as in *Embia* Latreille, but with the inner flap-like process continuous with the hemitergite, not separated by membrane as in *Embia*. Process of left hemitergite simple. First segment of left cercus produced inward subterminally, process not prominent; relatively few, but large, sharp teeth, directed forward, along the whole of the inner margin anterior to the subterminal projection; teeth practically in a single row. Right cercus-basipodite large, produced inward and backward, incompletely sutured off from first segment of cercus.

Differs from *Embia* Latreille in the form and dentition of the left cercus; the right cercus-basipodite; and the number of bladders on the hind tarsi. The terminalia of the single species are throughout different from those of *Embia savignyi* Westw., the genotype of *Embia*, and of its numerous fairly homogeneous congeners. The separation of *Dinembia* is further justified by geographic considerations, as species of *Embia*, relatively closely related to *Embia savignyi*, occur in the same region, while no transitional species are known connecting *Dinembia* with any of the true species of *Embia*.

Dinembia ferruginea, n. sp. Figs. 1–7.

♂. Length 11·5–12 mm.; head, length 1·9 mm., breadth 1·6 mm.; forewing, length 10–11 mm., breadth 2·3–2·5 mm. General colour ferruginous, head and thoracic nota a little paler than the remainder; eyes black; wing-veins dark brown bordered by brown bands. Head (Fig. 1) with eyes relatively large; sides behind eyes converging, rounded posteriorly. A raised area, more or less semicircular, is present in the middle of the epicranium. Antennae incomplete. Mandibles (Fig. 2) with acute teeth terminally, and subterminally on the inner face, the left with three, the right with two. Wings (Fig. 3) as in the generic diagnosis, cross-veins rather numerous. Hind tarsi (Fig. 4) as in generic description. Terminalia (Figs. 5–7) with right hemitergite (10R) massive, convex, posteriorly produced inward and downward to an acute process ($10RP_1$). Inner margin of 10R represented by a heavily-sclerotized strip ($10RP_2$), directly continuous with 10R, without separating membranes; free edge of $10RP_2$ sinuate and posteriorly corrugated. Left hemitergite (10L) small, inner margin produced backward as a rather short process (10LP), obliquely truncate at tip, subacute; 10LP basally marked off from 10L by a clear boundary. First segment of left cercus (LC_1) with inner margin depressed in a shallow concavity medially, distally enlarged to a slight swelling or process; entire inner margin anterior to process armed with large, sharp, forwardly-directed teeth, nearly all of which are in a single longitudinal row. Second segment of left cercus (LC_2) shorter and thinner, subcylindrical. First segment of right cercus (RC_1) subcylindrical, basally separated from basipodite (RCB) by an internal groove, not by a complete suture. RCB produced backward



Figs. 1-7.—*Dinembia ferruginea*, n. gen. et sp., ♂.

1. Head from above, × 12. 2. Mandibles from above, × 12. 3. Right forewing, × 2·7. 4. Hind tarsus viewed laterally, × 22·5. 5. Terminalia from above, × 22·5. 6. Terminalia from above, × 22·5 (different aspect). 7. Terminalia from below, × 22·5.

Fig. 3 semi-diagrammatic, remainder based on camera lucida outlines. All setae omitted. Figs. 1-5, 7, from the holotype; Fig. 6 from paratype, viewed from a different angle, stippling on $10RP_2$ proportional to sclerotization.

on inner side, obtusely tapered. Second segment of right cercus (RC_2) similar to LC_2. Ninth sternite (H) with hind margin extended to a blunt subquadrate process (HP). Left cercus-basipodite (LCB), between HP and base of LC_1, produced to the left into a sharp spine.

♀ unknown.

Locality.—Elisabethville, Belgian Congo, 11° 40′ S., 27° 34′ E.; holotype ♂ (numbered 2263) and paratype ♂ (2979) in the Museum of Comparative Zoology, Harvard University.

Conventional lettering on Text-figures: 9, ninth abdominal tergite; 10L, 10R, left and right hemitergites of tenth abdominal segment; 10LP, 10RP, processes of 10L, 10R; $10RP_1$, $10RP_2$, posterior and inner processes of 10R; LC_1, LC_2, RC_1, RC_2, first and second segments of left and right cerci; LCB, RCB, left and right cercus-basipodites; H, ninth abdominal sternite (hypandrium); HP, process of H.

PART XII: THE GENUS HAPLOEMBIA VERHOEFF.

(Fifteen Text-figures.)

Genus Haploembia Verhoeff 1904.

Abh. Leop.-Carol. Akad. Naturf. Halle, Bd. 82, p. 201 (as subgenus of *Embia* Latr.). Raised to generic rank, Enderlein, 1909, *Zool. Anz.*, 35, p. 188.

Genotype, *Embia solieri* Rambur 1842, *Hist. nat. Névroptères*, p. 313.[1]—(Synonym, *Dityle* Friederichs 1907, *Verh. Zool. bot. Ges. Wien*, Bd. 57, p. 272.)

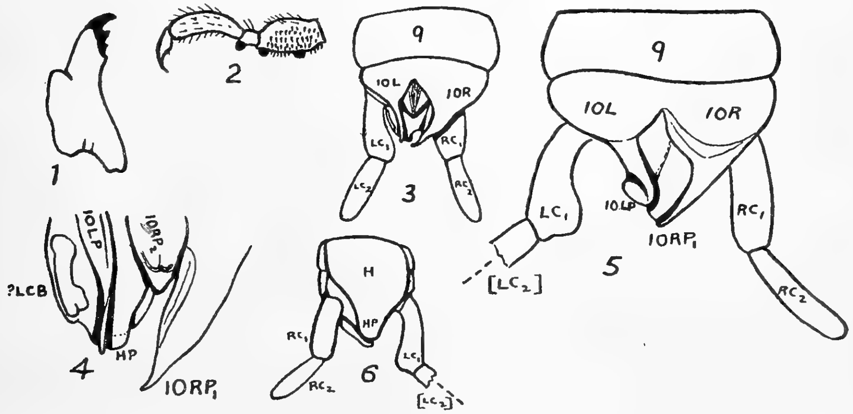
Rambur's type (de Selys Collection) is a female, lacking head and legs (Enderlein, 1912, p. 66). I follow the interpretation of Enderlein (l.c.) and Krauss (1911) as to the identity of Rambur's species, and the structure of the male. It would be beneficial if a male specimen, agreeing with this concept and collected near the type locality (environs of Marseilles), could be selected as an allotype for this species, fixing it with certainty.

Medium to small Embioptera, the males with the following characters: Wingless; two ventral bladders on the first segment of the hind tarsus, one on the second. Right hemitergite of tenth abdominal segment produced backward and inward to a long process. First segment of left cercus somewhat clavate, but without nodules.

Haploembia solieri (Rambur 1842). Figs. 1–4.

Embia solieri Rambur 1842, l.c.—*Embia grassii* Friederichs, 1906, *Mitt. Zool. Mus. Berlin*, Bd. 3, p. 227.

♂ (after Krauss). Length 8–9 mm. General colour dark brown, with or without paler flecking. Head elliptical or slightly trapezoidal, eyes small, antennae with 18–20 segments. Mandibles (Fig. 1) elongate, incurved. Hind tarsi (Fig. 2) with two metatarsal (basitarsal) bladders. Tenth abdominal tergite (Figs. 3–4)



Figs. 1-4.—*Haploembia solieri* (Ramb.), ♂, from Crete (after Krauss, 1911, Pl. iii, figs. 17D, F, H and J respectively). 1. Left mandible. 2. Tarsus of right hind-leg from inside. 3. Terminalia from above. 4. Part of same, further enlarged.

Figs. 5-6.—*Haploembia megacephala* Krauss, ♂ (after Krauss, 1911, Pl. ii, figs. 16A, B). 5. Terminalia from above. 6. Terminalia from below.

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[1] As Verhoeff (l.c., p. 167) states that this species has two hind metatarsal bladders, some of his material must have been determined correctly. However, his figure (Pl. iv, fig. 26) of a male from Sicily, given as *H. solieri* (Ramb.), appears to be of a species of *Embia* (perhaps *E. ramburi* R.-Kors.). *Haploembia* was therefore based on a partly misidentified series.

deeply cleft, right hemitergite (10R) produced backward and inward from outer margin to an elongate, acutely-tapered process ($10RP_1$), sinuous, terminally directed slightly either to the right or to the left. Basally, the inner margin of $10RP_1$ overlies an obtuse flap-like process ($10RP_2$), similar to that in *Oligotoma*; I follow Krauss (1911, explanation to Pl. iii, fig. 17J) in referring to this as a process of 10R, not as a 'median plate'. Process of left hemitergite (10LP) elongate, narrowly tapered, acute, rotated about axis. Right cercus composed of two subcylindrical segments (RC_1, RC_2), the first thicker, curved inwards a little and slightly clavate. Left cercus composed of similar segments (LC_1, LC_2), the first with curvature and distal swelling stronger than in RC_1. Ninth sternite produced back to an obtuse lobe (HP), on the left of which is an elongate chitinous structure, possibly homologous with the structure referred to in other genera as the left cercus-basipodite.

♀. See Enderlein (1912) and Krauss (1911). Not important taxonomically.

Note.—The species seems to have a wide distribution around the Mediterranean, exclusive of Syria. Males agreeing with this concept are recorded from Crete (figured in this paper, after Krauss), Dalmatia (figured by Krauss, 1911, and Enderlein, 1912), the French Riviera (Friederichs, 1906), and Sicily (Grassi and Sandias, 1893–4). Many of the records cited by Krauss (l.c.) are based on females or larvae, and do not therefore prove the occurrence of this species.

Haploembia taurica (Kusnezov 1903).

Embia taurica Kusnezov, 1903, *Rev. russe Entomol.*, 3, p. 208.—*Haploembia taurica* (Kusnezov), Krauss, 1911, p. 53.

♂ (after Kusnezov, l.c.). Length 8–11 mm. General colour dark brown, shiny, legs and antennae paler. Head subtriangular, eyes fairly large, subreniform. Number of antennal segments 18–19. Tarsi as in *H. solieri.* Terminalia similar to *H. solieri,* but with the process of the left hemitergite bent to the left in the form of a hook.

♀. See Kusnezov (l.c.). Not of taxonomic importance.

Locality.—South Coast of the Crimea, from Cape Sarytsch to the Bay of Alushta, up to 150 metres above sea-level.

Although no figures exist, and no types seem to be extant, the species may be listed as recognizable, at least being capable of differentiation from the other known species. The selection and complete description of a neotype (♂) from the type region would be very advisable.

Haploembia megacephala Krauss 1911. Figs. 5–6.

Zoologica, Hft. 60, Bd. 23, p. 53, Pl. ii, figs. 16–16B.

♂ (after Krauss, l.c.). Length 15 mm.; head 3 mm. × 2 mm. General colour very dark rust-brown. Head very large, broadly elliptical. Mandibles elongate, bidentate. Terminalia (Figs. 5–6) similar to the two preceding species; but with the process of the left hemitergite (10LP) flat, terminally outcurved in an ovoid knob. First segment of left cercus more clavate than in *H. solieri.*

♀ unknown.

Locality.—Syria (holotype ♂ in Vienna Museum).

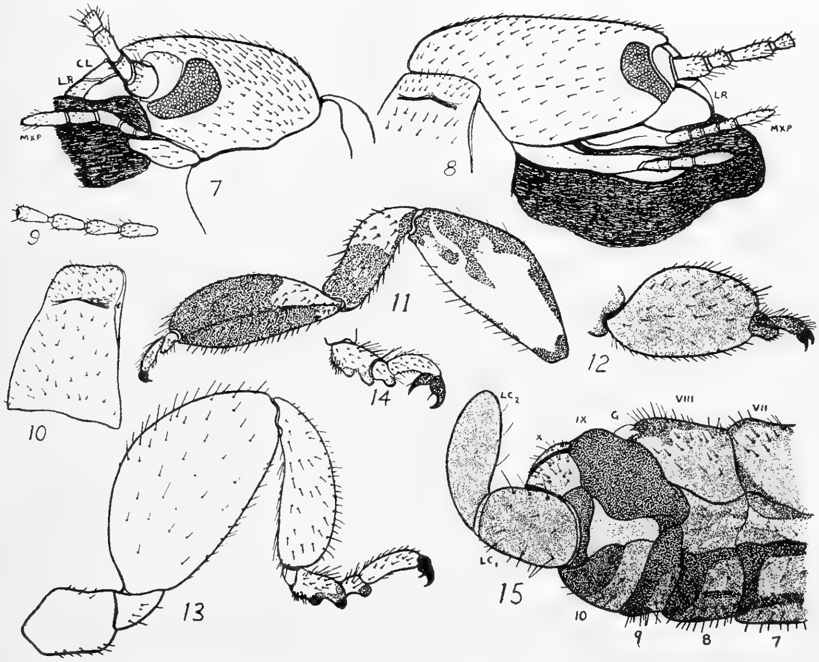
Haploembia antiqua (Pictet 1854). Figs. 7–15.

Embia antiqua Pictet, 1854, Traité de Paléontologie ou Histoire naturelle des animaux fossiles, 2nd edition, vol. 2, p. 370.—Pictet and Hagen, 1856, Neuroptera, in Berendt, Die im Bernstein befindlichen organischen Reste der Vorwelt, vol. 2,

p. 56.—*Oligotoma antiqua* (Pictet), Hagen, 1885, *Canad. Entomologist*, 17, p. 176; Krauss, 1911, *Zoologica*, Hft. 60, Bd. 23, p. 47; Enderlein, 1912, in Coll. zool. de Selys-Longchamps, fasc. 3, p. 95.

The following description is from an excellently-preserved female, in Baltic Amber (as were the original specimens). It is in the Harvard University collection (number 9306). It must be freely admitted that there is no certainty that it belongs to Pictet's species, or even to the genus *Haploembia*, but the present course involves the least addition to the nomenclature of the Order compatible with the facts observed.

The early descriptions do not fix the species, nor do any types appear to be extant; the present specimen may therefore be referred to Pictet's specific name. As it is a female, the main generic characters are lacking, but the tarsal bladders prove that the specimen cannot be referred either to *Embia* Latr. or to *Oligotoma* Westw. If such a female were found in Europe to-day, it would certainly be



Figs. 7-15.—*Haploembia antiqua* (Pictet), ♀. 7. Head viewed obliquely, from left, below and anteriorly, × 25. Labial palp obscured. 8. Head viewed from behind and to the right, × 25. 9. Four of distalia of antenna, × 25. 10. Pronotum from above and to the right, × 25. 11. Right foreleg from below, inside and anteriorly, × 25. 12. Tarsus of left foreleg from outside, × 25. 13. Left hind-leg from outside, × 25. 14. Tarsus of right hind-leg, from inside and distally, × 25. 15. Terminalia viewed laterally, from the left, × 25.

Figs. 1-6, magnifications not stated by Krauss. Figs. 7-15 based on camera lucida outlines. Stippling in Figs. 11 and 15 to represent degree of pigmentation. The black areas of Figs. 7 and 8 represent a mouth-secretion, obscuring certain structures. MXP, maxillary palp; LR, labrum; CL, clypeus; 7, 8, 9, abdominal tergites; 10, tenth abdominal tergite of ♀; ? LCB, structure probably representing left cercus-basipodite; VII, VIII, IX, abdominal sternites of ♀; X, longitudinally-cleft tenth abdominal sternite of ♀; G, position of ♀ genital aperture.

referred to *Haploembia*; this does not prove, however, that the genus, as defined on the characters of the male (above), existed in Oligocene times.

Two points may be noted supporting the present classification. First, Hagen (1885, p. 177) noted that the original specimens (wingless, length 10 mm., colour as in the present specimen) had the last tergite asymmetrical, and concluded that he was studying males; the males of the recent species of *Haploembia* are wingless. Secondly, it would not be surprising to find such a highly-specialized type as *Haploembia* in the Oligocene; a very highly-specialized Embiopteron (*Burmitembia*) is known from Burmese Amber (? Miocene).

In view of the general entomological interest of this specimen, it is described rather fully.

♀. Length just over 9 mm.; length of head 1·6 mm.; breadth of head not discernible, as only oblique views could be obtained. General colour (to judge from the amber specimen) dark chocolate-brown, with paler areas, especially on thorax and inner parts of legs; no trace of pattern on head. Head (Figs. 7–8) ovoid, pilose, eyes subreniform, broadest behind, extending forward below insertion of antennae, with some 200 ommatidia, and with a few setae interspersed. Antennae some 3 mm. long, each with 19 segments exclusive of the subannular basal sclerite fused to the head-capsule. Basal segments of same general relative sizes as in recent Embioptera (Figs. 7–8); distalia (Fig. 9) subcylindrical, each slightly swollen distally. Palps as in recent Embioptera, maxillary with 5, labial with 3 subcylindrical segments, terminal segment longest in each case. Whole of mouth-region obscured by a secretion, such as is noted when living Embioptera are placed in fixative (e.g. Carnoy). Pronotum (Fig. 10) trapezoidal, broader behind, with a transverse sulcus in anterior third (cf. Hagen, 1885, p. 177); trace of a shallow longitudinal furrow medially in front of transverse sulcus (i.e. on 'prozona'), none behind (on 'metazona'). Forelegs (Fig. 11) as in recent Embioptera, with femora somewhat swollen, tarsi three-segmented (Figs. 11–12), the first segment very greatly dilated, plantar surface flattened, with spinning-hairs; second segment small, basally embedded in first; third segment longer than second, more slender at base, with two sharp claws distally. Second pair of legs slender, as in recent Embioptera. Hind legs (Figs. 13–14) with coxae small, fused to thorax. Trochanter small, oblique; femur greatly swollen, to accommodate flexor muscles; tibia more slender, somewhat curved. Three tarsal segments, the first with two ventral bladders, one medial, one terminal; second segment short, with a terminal ventral bladder; third segment a little longer than first, slender, curved, with two well-developed claws.

Mesonotum and metanotum subrectangular. Wings absent. First eight abdominal tergites subrectangular, subequal, ninth shorter, transverse, tenth entire, subtriangular; abdominal tergites except 9 and 10 paler than head and thorax. Pleurites represented by dark longitudinal bars placed laterally on abdominal segments 2–8. Abdominal sternites ii–viii subrectangular, viii large, with medial and posterior sclerotized areas. Ninth sternite large, heavily-sclerotized. A membraneous pad marks the position of the genital aperture between the eighth and ninth sternites. Tenth sternite divided longitudinally, halves subtriangular. Cercus-basipodites small, subannular. Cerci apparently symmetrical; first segment short, little longer than thick; second difficult to see, being at the end of the amber block, but apparently longer and thinner than first (Fig. 15).

The whole structure of the specimen is scarcely distinguishable, if at all, from that of a female of a recent species of *Haploembia*, or of certain other genera not closely related (e.g. *Notoligotoma*, *Metoligotoma*, *Parembia*).

Species incorrectly referred to Haploembia.

The genus *Dictyoploca* contains two species previously referred to *Haploembia* (*H. capensis* Esb.–Petersen, *H. sjöstedti* (Silv.) End.); the genus has been dealt with previously (Davis, 1939). *Anisembia wheeleri* (Mel.) Krauss was incorrectly referred to *Haploembia* by Enderlein (1912). Both *Dictyoploca* and *Anisembia* have the left cercus echinulate in the male, the second segment being reduced in *Anisembia*. To judge from the other characters of the male (especially the hemitergites), neither genus is at all closely related to *Haploembia*, though *Dictyoploca*, in common with many other genera, has the two hind metatarsal bladders as in *Haploembia*.

Navás has described a number of species in the genus *Haploembia* which belong to *Monotylota* Enderlein (recte *Embia* Latr., of which *Monotylota* must be regarded as a synonym). Navás's generic classification is based on a complete misapprehension, as indicated by his remarks (1918, p. 361) concerning *H. laufferi* Nav.: 'I refer it to *Haploembia*, not admitting as distinct the genus *Monotylota* Enderlein, erected on a character of little importance, namely, that the third segment of the tarsi of the hind legs carries one callus on the lower part, as against two in *Haploembia*. . . . Such a character . . . is difficult to perceive.' Navás apparently confuses the term 'metatarsus', taking it as the third instead of the first segment. The 'difficulty to perceive' the character is not significant. Any adequate description of a member of this Order entails maceration of at least some parts; even in very old dried material, maceration allows the tarsal bladders to be seen with ease, even with the dissecting microscope, if a search is made on the correct segment.

Actually, '*Monotylota*' is exceedingly different from *Haploembia*, quite apart from the tarsi; its male terminalia are on exactly the same general lines as *Embia savignyi* Westw. (the genotype of *Embia*), and its numerous winged congeners. '*Monotylota*' differs from *Embia*, in fact, only in the absence of wings, which is known to be a very subsidiary character in this Order. *Monotylota* should, therefore, be rejected as a synonym of *Embia* Latr. Some of the more obvious differences from *Haploembia* lie in the echinulate first segment of the left cercus, and in the processes of the right hemitergite, in the male.

Navás (1918) has described *Haploembia* (*Monotylota*) *laufferi* (p. 360), and re-described *Embia duplex* Navás (1908, p. 288), as *Haploembia duplex*, on page 359 of the same work; both descriptions are from males, from Spain, and are accompanied by figures of the terminalia. These figures (l.c., 14 and 15) bear no resemblance to *Haploembia*, but appear to be almost incredibly bad delineations of *Embia ramburi* Rimsky-Korsakov; the figure of *H. duplex* shows the left cercus echinulate, and although these nodules are omitted in the figure of *H. laufferi*, the general facies of an *Embia* is not obscured even by the poor drawing. The difference between *H. laufferi* and *H. duplex* appears to lie in the shorter second segment of the left cercus of the former, a difference which may be individual, e.g., following regeneration from a damaged larval cercus.

I have examined a male of *Embia ramburi* Rimsky-Korsakov (determined by Rimsky-Korsakov), from Ronda, Spain (Museum of Comparative Zoology, Harvard University). It agrees well with the current concept of the species (cf. Friederichs, 1934, fig. 2a, ♂ from Barcelona; Friederichs had studied males from the type locality, and has given (1923, fig. 3) a semi-diagrammatic figure).

It may be assumed that *H. duplex* and *H. laufferi*, and also *Embia cephalotes* Navás 1908 (referred by Enderlein, 1912, to *Haploembia solieri*, with a query), are referable to *Embia ramburi*, and, in any case, not to *Haploembia*. The same probably applies to *Haploembia codinai* Navás (1922, p. 126), from Ceuta, Morocco.

The type of *E. cephalotes* is a female, and no information of a specific nature could be obtained from it. The types (♂) of *H. laufferi* and *H. codinai* are recorded as being in Spain (Navás Collection and Mus. Cataluña respectively), and may be no longer extant. The four species are best deleted from any subsequent lists, as unrecognizable, but probably synonyms of *Embia ramburi*. The same may be said of *E. silvanoi* Navás (1908, p. 269).

Haploembia algerica Navás (1930, p. 136) is a wingless species of *Embia*. I have examined the type (♂) in the Paris Museum. The species will be re-described when the genus *Embia* is dealt with. Navás's figure (1930, fig. 45) bears no similarity to the actual type.

Haploembia bourgi Navás (1923, p. 15) was described from a female from Africa (Galla Aroussi, Valley of the Ouébi, Djiboanno). I have examined the specimen (Mus. Paris); it is impossible to say to what species or genus it belongs. It should be deleted from future lists as unrecognizable. There is no evidence that *Haploembia* extends to this region.

Navás (1923) described two species (*Haploembia collaris*, *H. clypeata*) from females from Elisabethville, Belgian Congo. He later (1928) transferred the former species to *Oligotoma*, on the basis of two males from Carin Chebà, Birmania (Burma), which showed some resemblance in colour (dark brown with orange prothorax). These two males (Genoa Museum) are certainly referable to *Oligotoma*, but cannot of course be referred to *collaris* Nav., from geographic considerations; they will be redescribed in due course under the genus *Oligotoma*, as a new species. Actually, there are several species from the Congo region with dark brown body and orange pronotum (e.g. *Embia lunaris* Nav., *Enveja bequaerti* Nav., *Embia femorata* Nav.), to any of which either one or both *H. collaris* or *H. clypeata* might belong. As these two species cannot be established even by collection of males from the same locality (since numerous species occupy this region, rendering identification of a male with a previously-collected female impossible), they should be deleted from subsequent lists.

It will be seen that records of recent species rightly referable to *Haploembia* are, in fact, restricted to regions not far from the coasts of the Mediterranean and Black Seas.

Relationships of Haploembia.

The differences of *Haploembia* from *Dictyoploca* and *Embia* (syn. *Monotylota*) are clearly marked, and no close relationship seems to exist. The affinities of *Haploembia* seem to tend rather towards *Oligotoma*, as noted in the family classification of Krauss (1911). This affinity is to be seen in the smooth left cercus, and in both processes of the right hemitergite, in the male. The long outer process of this hemitergite overlies an obtuse medial flap in both genera; even the medial sclerotization of this flap, characteristic of *Oligotoma*, is present in *Haploembia*, to judge from Krauss's figures (1911, Pl. iii, figs. 17B, H and J). *Haploembia* is wingless; *Oligotoma* possesses species with wingless forms in the male. The only generic difference that can be readily selected lies in the tarsal bladders, which seem to be a fairly reliable supplementary generic character throughout the Order, showing intrageneric variability in only one exceptional case.

Key to the Species of Haploembia (♂).

1. Oligocene .... *antiqua* (Pictet)
   Recent 2
2. Process of left hemitergite of tenth abdominal segment acutely tapered, not bent to the left terminally .... *solieri* (Rambur)
   Process of left hemitergite not as above 3

3. Process of left hemitergite ending in an ovoid knob bent to the left .... *megacephala* Krauss
Process of left hemitergite terminally bent to the left in the form of a hook .... *taurica* (Kusnezov)

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PART XIII: A NEW WEST AFRICAN GENUS.

(Twenty-two Text-figures.)

Genus BERLANDIELLA, n. gen.

Genotype, *Embia* (*Dihybocercus*) *berlandi* Navás, 1922, *Rev. Acad. Cienc. Zaragoza,* vii, p. 30.—*Dihybocercus berlandi* Navás, 1931, *Rev. Zool. Bot. africaines* (*Tervueren*), vol. 21, fasc. 2, p. 134.

Rather large, pale-coloured African Embioptera, the males with the following characters: Winged, R_1 not confluent with R_{2+3}, R_{4+5} forked, M simple; cubitus with more than two branches (rarely up to six branches), the extra branches usually given off posteriorly in pectinate arrangement from the first anterior branch of the main stem. Hind tarsi with two prominent ventral bladders on first segment, one on second. Tenth abdominal tergite with a complete longitudinal division; right hemitergite as in *Embia* Latr., with an acute postero-ventral process directed inward, and an inner flap-like process. Process of left hemitergite simple, as in *Embia*. First segment of left cercus with inner margin composed of two longitudinal ridges, one above the other, with a shallow longitudinal concavity between; ridges smooth or undulating in general contour, furnished along practically the entire length with small blunt teeth or nodules. Hypandrium and cercus-basipodites as in *Embia*.

Three species: Portuguese Guinea to Southern Nigeria, and inland.

The new genus is differentiated from *Embia* by the venation (R_1–R_{2+3} and Cu_{1a}) and the number of tarsal bladders. The first segment of the left cercus is different from that of any true *Embia*. *Berlandiella* stands perhaps closest to *Dinembia* Davis, from the Congo, which agrees in the number of tarsal bladders (as opposed to *Embia*). The form of the cubitus and of the right cercus-basipodite differentiates *Dinembia* from *Berlandiella*; the first segment of the left cercus of the former is also highly characteristic, with one series of large pointed teeth.

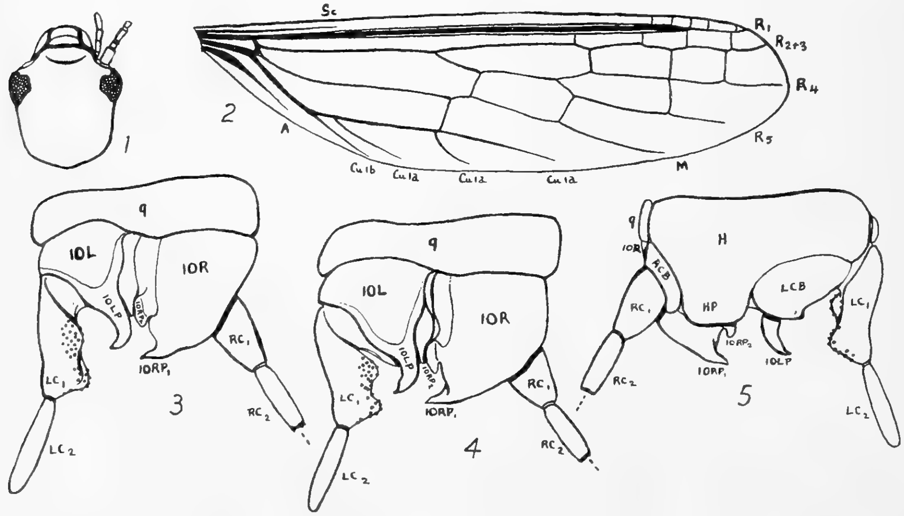
Berlandiella is very obviously different from *Dihybocercus* End., especially in the process of the left hemitergite, which is complex in the latter genus. *Berlandiella* resembles *Leptembia* Krauss in the venation, tarsal bladders and left hemitergite, but differs in the right hemitergite and in the first segment of the left cercus, which in *Leptembia* carries a forwardly-directed echinulate lobe, longer than thick.

Berlandiella berlandi (Navás 1922). Figs. 1–5.

Embia (*Dihybocercus*) *berlandi* Navás, 1922, l.c.

The following description is from Navás's type (Mus. Paris):

♂. Length 15 mm.; head 2·4 mm. × 1·9 mm.; forewing 10 mm. × 2·7 mm.; hindwing 9 mm. × 2·5 mm. General colour pale ferruginous, eyes black, veins dark brown (R_1) to pale golden-brown (remainder), longitudinal bands bordering veins very pale yellowish-brown, almost hyaline; intervenal lines hyaline. Head (Fig. 1) with eyes relatively large, prominent; sides behind eyes converging only



Figs. 1–5.—*Berlandiella berlandi* (Navás), holotype ♂ (Baraguine, Middle Niger). 1. Head, × 8. 2. Right forewing, × 8. 3. Terminalia from above, × 15. 4. The same, viewed more from the left, × 15. 5. Terminalia from below, × 15.

slightly; clypeus with a curved furrow, concave side anterior. Antennae with 27 segments. Wings as in generic diagnosis; cubitus 4-branched in right forewing (Fig. 2), 3-branched in other wings. Hind tarsi as in generic description. Terminalia (Figs. 3–5) with right hemitergite (10R) produced postero-ventrally to an acute inwardly-directed process ($10RP_1$). Inner margin of 10R with a rather short flap-like process ($10RP_2$). Left hemitergite (10L) subtriangular, process (10LP) tapered, acute, curved to the left terminally. Right cercus with two subcylindrical segments (RC_1, RC_2), the first thicker, the second damaged in the type; right cercus-basipodite (RCB) subannular. First segment of left cercus (LC_1) massive, inner face with a shallow longitudinal concavity or groove; longitudinal ridges, of rounded contour, above and below groove, the upper ridge bilobed (especially obvious viewed from the left and above); both ridges with a number of nodules throughout whole length, arranged haphazard, not uniseriate. Second segment (LC_2) subcylindrical. Hypandrium (H) produced back to a blunt process (HP) somewhat to the right of the mid-line; left cercus-basipodite (LCB), between HP and LC_1, large, without any prominent process.

♀ unknown.

Locality.—The type carries the following labels: 'Embia Berlandi Nav.; Navás S.J. det.'; 'Type'; 'Muséum Paris: Bassin du Moyen Niger, Baraguine. R. Chudeau, 1909'; 'Mai'. In the same collection are three specimens (♂) collected in the same month, but with 'Doko' replacing 'Baraguine' on the label. Their lengths range from 12 mm. to 17 mm. The colour, venation, etc., agree with the type. In the limited time at my disposal in Paris, I was unable to prepare the terminalia; examination in the dry condition suggested that they were the same as the type.

BERLANDIELLA GROMIERI (Navás 1934). Figs. 6–18.

Embia gromieri Navás, 1934, *Brotéria*, Série trimestral, vol. 3, fasc. 1, p. 18.

The following description is from Navás's type (Mus. Paris):

♂. Length 12 mm.; head 2·2 mm. × 1·9 mm.; forewing 10 mm. × 2·5 mm. Colour as in *B. berlandi*. Head (Fig. 6) much as in *B. berlandi*. Wings in general as in *B. berlandi*; right forewing (Fig. 7) with R_5 terminally forked, cubitus 4-branched, two of the branches coalescing. Left hindwing with cubitus 4-branched; in other wings 3-branched. Hind tarsi (Fig. 8) as in *B. berlandi*. Terminalia scarcely different from *B. berlandi*, but with the left cercus (Fig. 9) less prominently bilobed on the inner face.

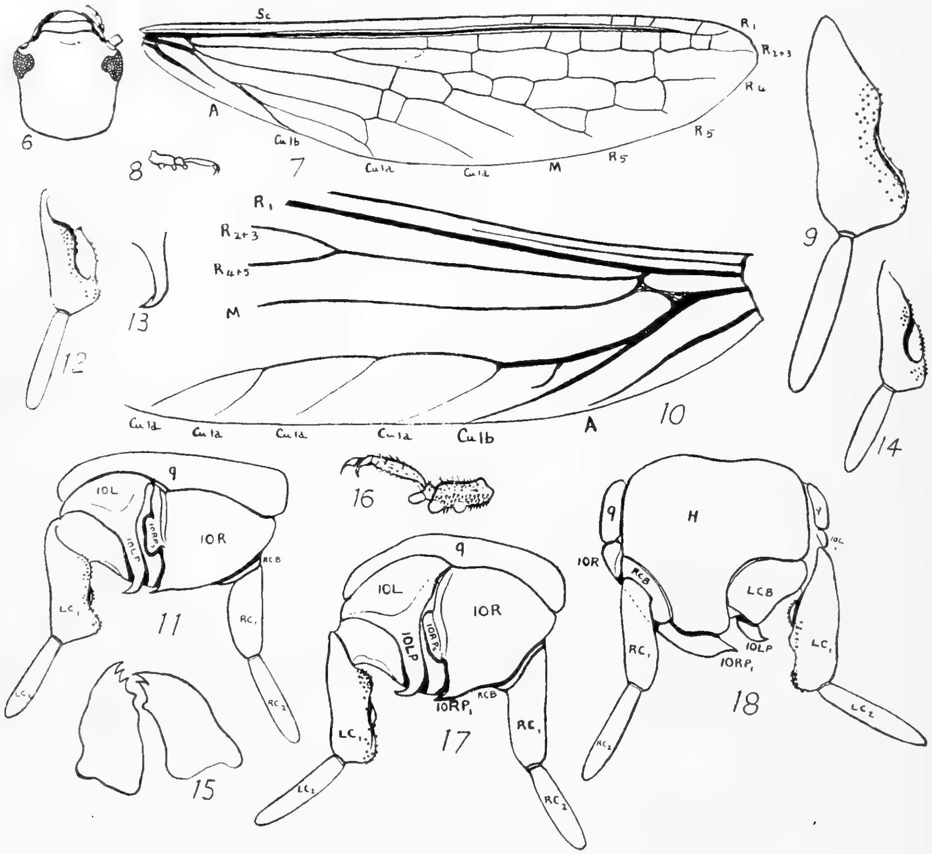
♀ unknown.

Locality.—Kindia, French Guinea, coll. Dr. Gromier, 1927.

This species is scarcely worthy of separation from *B. berlandi* (Nav.), the only significant difference lying in the left cercus. This difference is very slight, and examination of longer series might lead to the rejection of *B. gromieri*, or at least its reduction to a subspecies of *B. berlandi*. It is perhaps significant that Navás (1928) refers to *Embia berlandi*, a specimen from Portuguese Guinea (described below), which, on the valid characters of the terminalia, differs more from *B. berlandi* than does *B. gromieri*. None of Navás's specimens, however, had had the terminalia prepared for examination in any way.

Other localities.—A series of males (Mus. Paris) from Man, Ivory Coast (12.iv.30, coll. Ch. Alluaud and P. A. Chappuis), appears to be referable to *B. gromieri* (Figs. 10–12): Length 11 mm.–15 mm.; head, length 1·8–2·2 mm., breadth 1·5–1·7 mm.; forewing, length 9–11 mm., breadth 2·2–2·4 mm.; hindwing, length 8–10 mm., breadth 2·2–2·4 mm. Colour, form of head, and tarsi, as in the type; antennae up to 4·2 mm., with 28 segments. Wings with cubitus composed of three or more branches. (In one specimen, 3-branched in all wings; in another, 4-branched in all wings; in a third, 6-branched in left forewing (Fig. 10), suggestive of the cubital system in Isoptera; 5-branched in both hindwings, 4-branched in right forewing.) Terminalia (Figs. 11–12) agreeing with the type, left cercus scarcely distinguishable.

A single specimen (♂) from Danané, Ivory Coast (Mus. Paris; date and collectors as above) seems to be conspecific: Length 12·5 mm., forewing 10 mm. × 2·2 mm., hindwing 9 mm. × 2·4 mm. Colour and structure (including terminalia; Figs. 13–14) as in the specimens from Man. Cubitus 4-branched in left hindwing, 3-branched in other wings (second branch weak in right forewing).



Figs. 6-9.—*Berlandiella gromieri* (Navás), holotype ♂ (Kindia, French Guinea). 6. Head from above, × 8. 7. Right forewing, × 8. 8. Hind tarsus viewed laterally, × 8. 9. Left cercus (aspect as in Fig. 4), × 28.

Figs. 10-12.—*Berlandiella gromieri* (Navás), ♂ (Man, Ivory Coast). 10. Base of left forewing, showing exceptionally well-developed cubital system, × 20. 11. Terminalia from above, × 20. 12. Left cercus viewed from above and to the right, × 20.

Figs. 13-14.—*Berlandiella gromieri* (Navás), ♂ (Danané, Ivory Coast). 13. Process of left hemitergite from above, × 20. 14. Left cercus (aspect as in Fig. 12), × 20.

Figs. 15-18.—*Berlandiella gromieri* (Navás), ♂ (Ibadan, Southern Nigeria). 15. Mandibles from above, × 20. 16. Hind tarsus viewed laterally, × 20. 17. Terminalia from above, × 20. 18. Terminalia from below, × 20.

A single male from Ibadan, Southern Nigeria (25.2.10, coll. S. J. Simpson; British Museum of Natural History) extends the range of the species a considerable distance to the east. Dimensions: Length 14·5 mm.; head 2·0 mm. × 1·6 mm.; forewing 10 mm. × 1·8 mm.; hindwing 9 mm. × 1·8 mm. Colour and general structure as in the type (Figs. 15–18); cubitus 3-branched in all wings. As the specimen cleared well when prepared, I figure the mandibles (not cleared in the type specimen). They have sharp teeth terminally and subterminally on the inner side (the left three, the right two), and a blunt tooth further back on the inner margin. The ventral view of the terminalia (Fig. 18) agrees with the type.

Berlandiella errans, n. sp. Figs. 19–22.

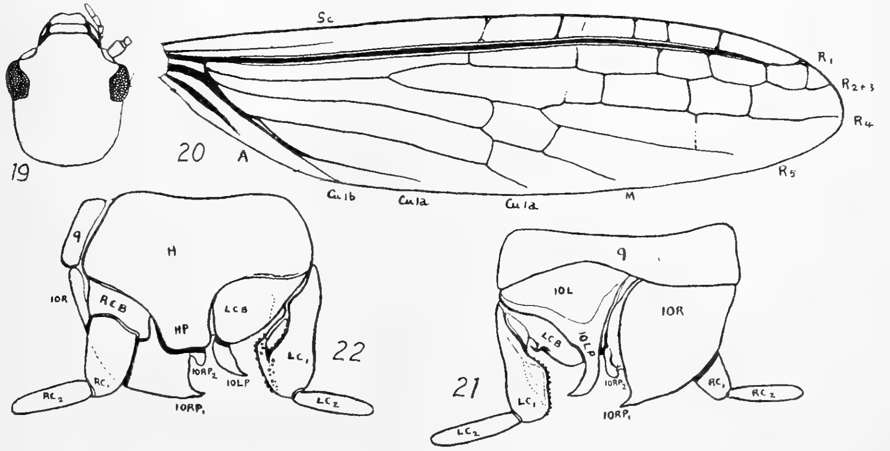
Embia berlandi Navás, 1928, *Ann. Mus. Civ. Storia Naturale Genova*, vol. 53, p. 388.

♂. Length 13 mm.; head 2·6 mm. × 2·0 mm.; forewing 11·5 mm. × 3 mm.; hindwing 11 mm. × 3 mm. Colour as in *B. berlandi* and *B. gromieri*. Head (Fig. 19) and tarsi as in the preceding species; wings (Fig. 20) with cubitus 3-branched. Terminalia (Figs. 21–22) closely similar to the two preceding species; first segment of left cercus (LC_1) with upper ridge almost straight in dorsal view, not strongly bilobed as in the other species; left cercus-basipodite (LCB) with a small outwardly-directed spine; this was not observed in the other species, but may possibly be present, being very small and obscure.

♀ unknown.

Locality.—Farim, Portuguese Guinea, coll. L. Fea, iv–v, 1899; holotype ♂ in Museo Civico di Storia Naturale, Genoa (carried the label: 'Embia Berlandi Nav.; P. Navás S.J. det'.).

There seems no course open but to give specific status to this specimen, if it is to be allowed that *B. gromieri* is specifically distinct from *B. berlandi*. Further collecting may indicate that there is a continuously-varying population, in which case the three units might be treated as subspecies, *B. errans* occurring in



Figs. 19-22.—*Berlandiella errans*, n. sp., holotype ♂ (Farim, Portuguese Guinea). 19. Head from above, × 8. 20. Right forewing, × 8. 21. Terminalia from above, × 15. 22. Terminalia from below, × 15.

Figs. 1-9 prepared with constant use of ocular micrometer; all other figures based on camera lucida outlines. Setae omitted except in Fig. 16.

Portuguese Guinea, *B. gromieri* with a more or less coastal distribution to the south and east, and *B. berlandi* inland. *B. berlandi* has specific priority.

The complexity of the cubital system seems well established for the genus, not being due to individual aberration; 13 males, referred to three species, from seven localities, have been studied, and in no case was the cubitus less than three-branched in any of the wings.

Key to the Species of Berlandiella (♂).

1. Inner margin of first segment of left cercus not bilobed in dorsal view (Fig. 21) .... *errans*, n. sp.
   Inner margin of first segment of left cercus bilobed in dorsal view 2
2. Concavity between lobes of dorsal ridge of first segment of left cercus deep (Fig. 4) .... *berlandi* (Navás)
   Concavity between lobes shallow (Fig. 9) .... *gromieri* (Navás)

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———, 1931.—Insectes du Congo Belge (Série vi). *Rev. Zool. Bot. africaines,* vol. 21, fasc. 2 (Tervueren).

———, 1934.—Décadas de insectos nuevos (Década 25). *Brotéria,* Série trimestral, vol. 3, fasc. 1.

PART XIV: THE IDENTITY OF EMBIA RUFICOLLIS DE SAUSSURE AND OF OLIGOTOMA VENOSA BANKS.

(Seven Text-figures.)

De Saussure (1896) described a single male specimen as *Embia ruficollis,* giving the locality as 'America Centralis'. The only points of note in his description are the size (length 6·5 mm., wing length 5 mm.), the colour (dark brown with orange-ferruginous pronotum), and the venation (R_{4+5} simple, distinct only at base; M, Cu_{1a} obsolete). The brief mention of the terminalia does not seem to be based on a critical examination; it may be assumed to be as inaccurate as the descriptions of the terminalia of other species (*E. trinitatis, E. urichi*) in the same paper, which do not agree with the types.

Krauss (1911) briefly re-described the type (Muséum d'Histoire naturelle, Geneva), as *Oligotoma ruficollis,* figuring only the head and prothorax (1911, Pl. ii, fig. 10). His brief description of the terminalia (Supra-anal plate asymmetrical, right process short, dagger-shaped, left hooked at the end; cerci only a little asymmetrical, first and second segments of equal length) is valuable, although, if the specimen described below is really conspecific, he has confused the right process with the left. Krauss also gives a detailed locality (Bugaba, Central America, 250–400 metres), presumably from the type label. Krauss's reference of the species to *Oligotoma* has been followed by all subsequent authors.

In the Paris Museum there is a single specimen (♂) from Costa Rica (coll. Paul Serre, 1920). It has been identified as *Oligotoma ruficollis* by Navás (1924). I believe the specific identification to be correct, but the specimen is not referable to *Oligotoma.* The new genus here proposed is based on this specimen, rather than on de Saussure's; if it should prove not conspecific, the present specimen, not de Saussure's name, should be retained as the genotype.

The specimen under discussion seems to be conspecific with two males described and semi-diagrammatically figured by Friederichs (1934), as *Oligotoma ruficollis.* Friederichs's specimens were also from Costa Rica (Mojica, Guanacaste, Rio Bianco: Farm La Caja, nr. San José; Mus. Hamburg).

Genus SAUSSURELLA, n. gen.

Genotype, *Embia ruficollis* de Saussure, 1896, *Mitt. Schweiz. entomol. Gesellschaft*, Bd. 9, Hft. 8, p. 353.

Small Neotropical Embioptera, the males with the following characters: Winged, R_{4+5} simple, terminally subobsolescent; M and Cu_{1a} simple, subobsolescent. Hind tarsi with only one metatarsal bladder. Tenth abdominal tergite completely cleft, right hemitergite with an elongate posterior process, but without any process on the inner margin. Process of left hemitergite simple. Left cercus composed of two subcylindrical segments, of equal length, the first very slightly thickened distally, but without nodules.

The genus differs from *Oligotoma* Westw. in the right hemitergite, which lacks the inner flap-like process characteristic of the latter genus. It is to be considered as fairly closely convergent to *Oligotoma*, rather than as fairly closely related. It differs from two other Neotropical genera (*Diradius* Fried., *Oligembia* Davis) in the simplicity of the trace of R_{4+5}, which is forked in these genera; they have the tenth abdominal tergite only incompletely cleft, a further important difference. *Saussurella* is probably most closely related to the Antillean genus (undescribed), to which '*Oligotoma*' *hospes* Myers belongs; this genus* may be ancestral. It is much larger, with less obsolescent venation; its chief difference, however, lies in the clavate, echinulate first segment of the left cercus.

SAUSSURELLA RUFICOLLIS (de Saussure 1896). Figs. 1–4.

Embia ruficollis de Saussure, 1896, l.c.—*Oligotoma ruficollis* (de Saussure), Krauss, 1911, *Zoologica*, Hft. 60, Bd. 23, p. 42, Pl. ii, fig. 10; Navás, 1924, *Brotéria*, Série Zoológica, vol. xxi, fasc. 2, p. 63; Friederichs, 1934, *Arch. f. Naturg.*, N.F., Bd. 3, Hft. 3, p. 417, fig. 6.

♂. Length 6 mm.; forewing 4 mm. × 1·2 mm.; head 1·1 mm. × 0·9 mm. General colour dark chocolate-brown, head almost black, pronotum orange-red; wing-veins dark brown, bordered by mid-brown bands. Head (Fig. 1) elongate, eyes somewhat prominent, sides behind eyes rounded, converging behind. Antennae defective. Wings (Fig. 2) with R_1 strong, R_{2+3} distinct, the two veins not confluent terminally, but joined by several cross-veins. R_{4+5} simple, distal half represented only by a row of macrotrichia; M and Cu_{1a} simple, subobsolescent, as the distal part of R_{4+5}. Stem of cubitus strong; anal short but distinct.

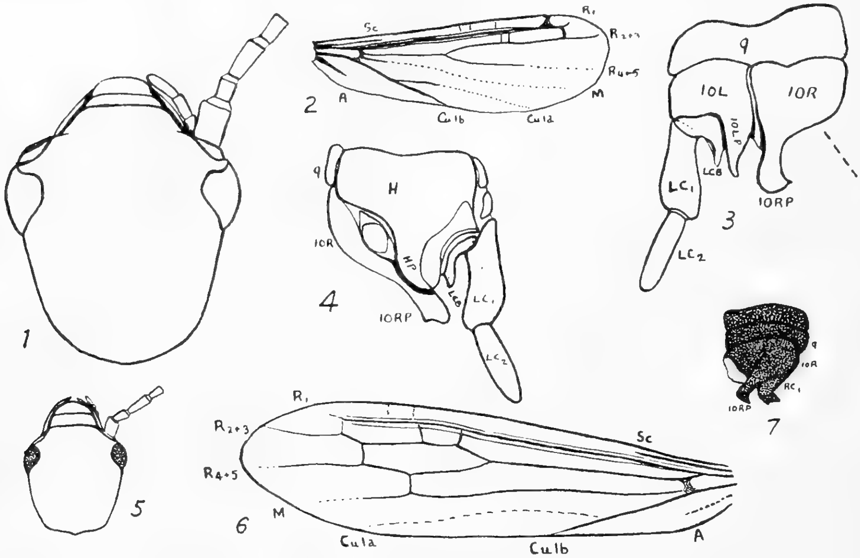
Hind tarsi with one metatarsal bladder. Tenth abdominal tergite (Fig. 3) completely cleft by a median longitudinal division; inner edge of right hemitergite (10R) straight, simple; 10R produced backward to an elongate process (10RP), expanded distally, and curving to the right; left-hand margin rounded near tip; outcurved portion acute. Left hemitergite (10L) produced backward from inner margin to a simple, tapered, subacute process (10LP). Right cercus missing (in the specimens described by Friederichs, l.c., with two subcylindrical segments). Left cercus with two segments, the first (LC_1) very slightly swollen distally, without nodules; the second (LC_2) thinner, of subequal length. Ninth sternite (H) (Fig. 4) tapered backwards to an elongate process (HP), curved to the left;

* This genus will shortly be described by Mr. E. S. Ross, of the University of California.

left cercus-basipodite (LCB) slender, obtusely tapered; space between HP and LCB largely membraneous.

Locality.—Costa Rica (Mus. Paris). The specific identification requires checking against the type (Mus. Geneva).

Note.—Friederichs (l.c.) has described a female from Costa Rica, which he believes to be referable to this species. It possesses no features of taxonomic importance.



Figs. 1-4.—*Saussurella ruficollis* (Sauss.), ♂, Costa Rica (Mus. Paris). 1. Head from above, × 35. 2. Right forewing, × 10. 3. Terminalia from above, × 35 (right cercus missing). 4. Terminalia from below, × 35. (Based on constant use of ocular micrometer.)

Figs. 5-7.—*Saussurella venosa* (Banks), holotype ♂, Santa Clara, Cuba (Museum of Comparative Zoology, Harvard University). 5. Head from above, × 16·5. 6. Left forewing, × 16·5. 7. Appearance of damaged terminalia from above, × 16·5. (Based on camera lucida outlines.)

Saussurella venosa (Banks 1924). Figs. 5–7.

Oligotoma venosa Banks, 1924, *Bull. Mus. Comp. Zool. Harvard*, vol. 65, no. 12, p. 421.

Banks's type ♂, from Santa Clara, Cuba, is in the Museum of Comparative Zoology, Harvard University. It is in such a battered state that a valid specific description cannot be prepared; but it is sufficiently well preserved to prove with certainty that it cannot be referred to *Oligotoma*. I refer it to *Saussurella* provisionally; another possibility is that it belongs to the undescribed genus containing '*Oligotoma*' *hospes* Myers, or perhaps even to *Anisembia* Krauss, both of these genera being known to occur in Cuba. The differential feature between these genera (the left cercus) is missing in the type; the right hemitergite, as preserved in the type, does not place the species, as this structure, and its process, agree in general form in '*Oligotoma*' *hospes* Myers (also from Cuba), and *Saussurella ruficollis* (Sauss.).

Further collecting from the type region may clear this matter up; I submit further details of the type as a step in this direction.

♂. Length not discernible in broken type; forewing 4·0 mm. × 1·1 mm. Colour (in balsam) black. Head (Fig. 5) similar in size and general form to *S. ruficollis*. Wings (Fig. 6) as in *S. ruficollis*, but with R_{4+5} and M stronger, and cross-veins strong, influencing the direction of the main veins. Terminalia (Fig. 7) much battered; process of right hemitergite (10RP) apparently as in *S. ruficollis*; process of left hemitergite obscured. Left cercus missing; first segment of right cercus (RC_1) subcylindrical, partly obscured; second segment broken.

The specimen is very much smaller than *O. hospes* Myers.

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THE GENERAL GEOLOGY OF THE DISTRICT EAST OF YASS, N.S.W.

By Kathleen Sherrard, M.Sc.

(Plate xii; three Text-figures.)

[Read 29th November, 1939.]

The district of which the geology is described in this paper lies across the common boundary of the Counties of Murray and King in New South Wales and includes parts of the Shires of Goodradigbee and Gunning. It comprises the whole of the Parishes of Manton, Mundoonen and Morumbateman, with the portions in Bango, Jerrawa, Dixon, Nanima, Toual and Hume adjoining them, covering in all about 150 square miles. Its western boundary is 3 miles east of the town of Yass and 185 miles south-west of Sydney by road, and in part adjoins the eastern boundary of an area described previously (Sherrard, 1936).

The general geology of the area shown in the sketch-map (Fig. 1) has been investigated, particularly in regard to the nature of rock types, to the junctions between sedimentary and igneous rocks, to the determination of the age of the sedimentary rocks, and to the structural and age relationships of the sediments to each other.

Acknowledgements.—The author wishes to acknowledge gratefully the courtesy of Professor L. A. Cotton, M.A., D.Sc., in granting her facilities for study in the Geological Department of the University of Sydney, and of Mr. R. A. Keble, F.G.S., Palaeontologist to the National Museum, Melbourne, who has kindly advised her in the determination of graptolites. She also wishes to express her appreciation to Miss Irene Crespin, B.A., Commonwealth Palaeontologist, Canberra, and to Dr. Dorothy Hill, M.Sc., Ph.D., of the University of Queensland, who have been good enough to examine specimens for her. She is also grateful to Dr. Ida Brown, D.Sc., of the University of Sydney, for much helpful discussion.

Previous Literature.

No detailed description of the geology of the whole of this area has been published hitherto. In the geological map of New South Wales published by the Department of Mines in 1914, it is shown as composed of porphyry in its western half with Silurian sediments to the east.

Some localities, especially Morumbateman (or Nanima) Creek and Jerrawa, have figured in gold, bismuth, silver, copper, iron and other mineral mining (*Ann. Reps.*, 1888, 1907, 1916, 1921; Watt, 1897). Shearsby (1911) included the north-western part of this area in his "Geology of Yass". He named and described the Bango Limestone Bed of the Silurian Series, named the igneous rock east of it, "No. 1 Porphyry", and called the sediments further east the "Jerrawa Shales", regarding them as the lowest member of the Silurian Series, no fossils having then been obtained from them. In 1937 descriptions of graptolites from this district were published (Sherrard and Keble, 1937).

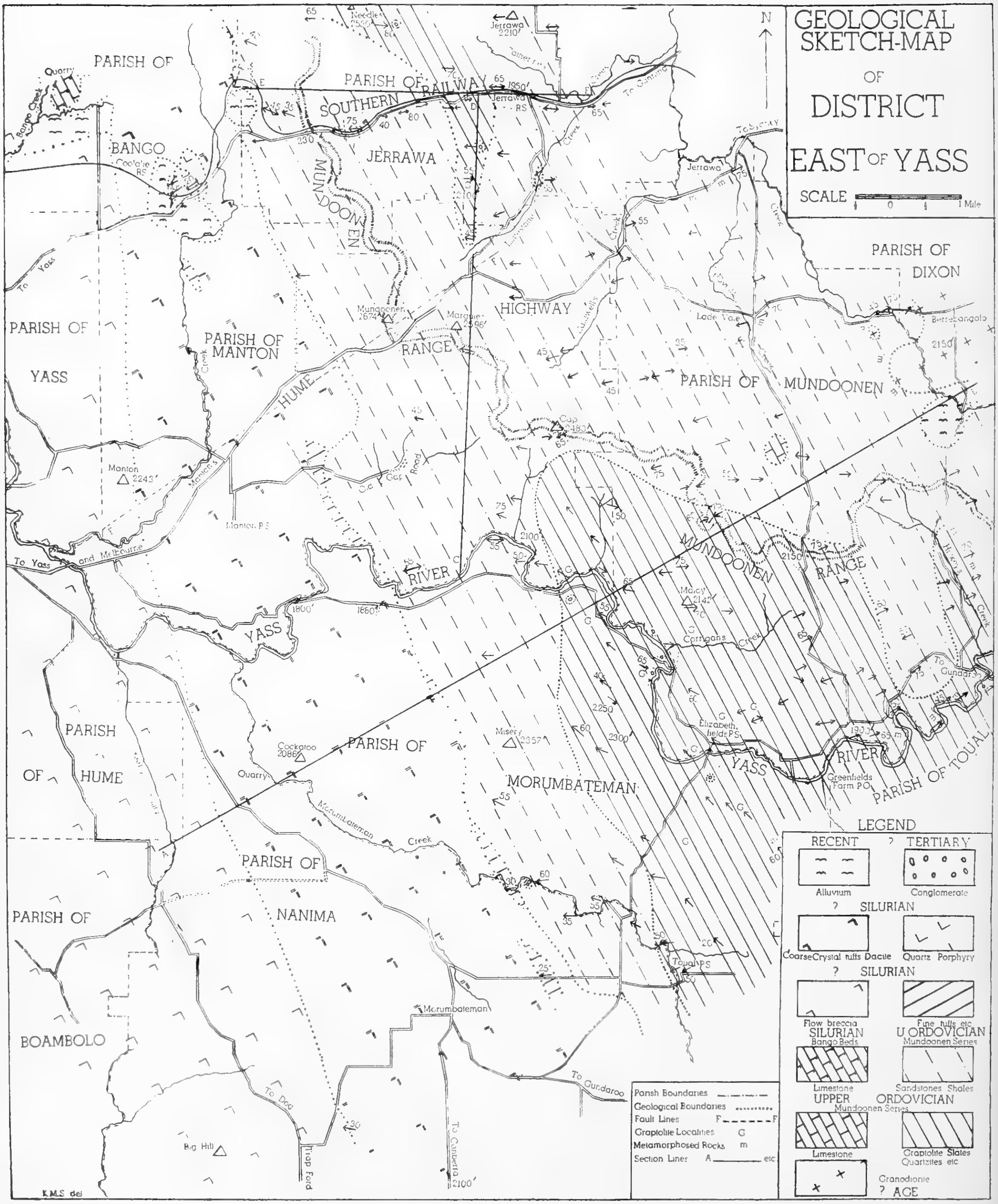
GEOLOGICAL SKETCH-MAP OF DISTRICT EAST OF YASS
SCALE
1 Mile
PARISH OF BANGO
PARISH OF JERRAWA
PARISH OF DIXON
PARISH OF YASS
PARISH OF MANTON
PARISH OF MUNDOONEN
PARISH OF HUME
PARISH OF MORUMBATEMAN
PARISH OF NANIMA
PARISH OF BOAMBOLO
PARISH OF TOUAL
SOUTHERN RAILWAY
HUME HIGHWAY
MUNDOONEN RANGE
YASS RIVER
LEGEND
RECENT
? TERTIARY
Alluvium
Conglomerate
? SILURIAN
Coarse Crystal tuffs Dacite
Quartz Porphyry
? SILURIAN
Flow breccia
Fine tuffs etc
SILURIAN
Bango Beds
Limestone
U. ORDOVICIAN
Mundoonen Series
Sandstones Shales
UPPER ORDOVICIAN
Mundoonen Series
Limestone
Graptolite Slates Quartzites etc
Granodiorite
? AGE
Parish Boundaries
Geological Boundaries
Fault Lines F F
Graptolite Localities G
Metamorphosed Rocks m
Section Lines A etc
K.M.S. del

Fig. 1.

Physiography.

The area lies in the Southern Highlands of New South Wales, and is one of varied relief, ranging from 2,674 feet above sea-level at Mt. Mundoonen, the highest point of the Mundoonen Range, to 1,800 feet, where the Yass River leaves it in the west.

The igneous rocks outcropping in the west provide an undulating surface, which slopes to a rather steep-sided valley in which the Yass River flows. More marked relief is shown where sedimentary rocks outcrop.

A strip of rugged and heavily timbered country, comprising a section of the Mundoonen Range, rises 600 to 700 feet above the general level. From the north of the map the Range runs nearly due south for about 3 miles, being composed in that portion of coarse sandstone generally dipping to the west. At about its highest point, Mt. Mundoonen, the range turns abruptly to a nearly easterly direction for the remainder of its passage through this district, a further 6 miles, falling in altitude towards the east and running generally across the strike of the country which is here composed of alternate bands of sandstones and shales.

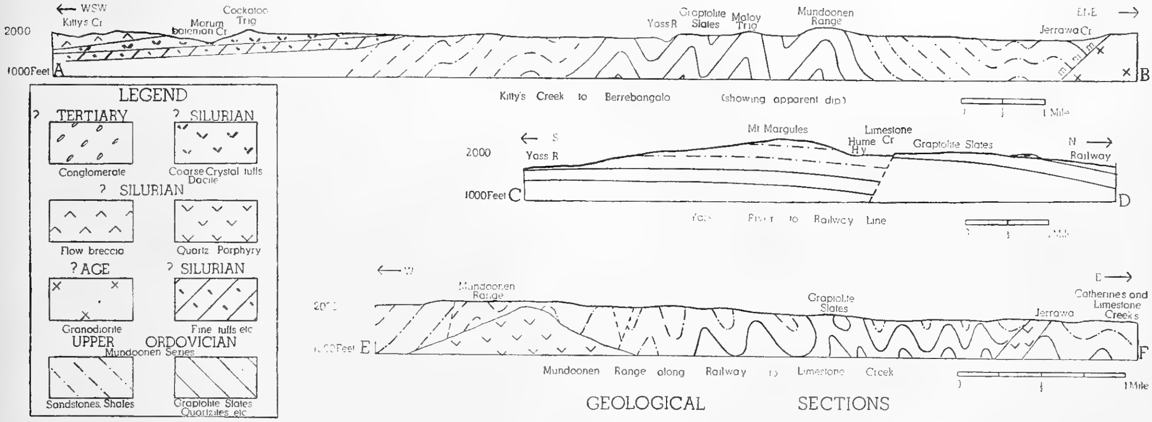

Fig. 2.

The coarse sandstone of the western Mundoonen Range, striking in an almost meridional direction, must have stood for some time as a barrier against erosion by the western part of the Yass River. The Range would then have been a north and south one throughout its length and all drainage to the east would have been carried by the ancestral Jerrawa Creek system. Misery Trigonometrical Station and the rugged ground around it and in the south-east of the Parish of Manton are relics of the original Mundoonen Range. Active erosion by the lower part of the Yass River at the time when its course probably lay near the present line of Morumbateman Creek, and by its tributaries from the east, caused the change to the present direction of the Divide. The river, probably aided by faulting, of which there is confirmatory evidence elsewhere, eventually effected a passage through it. A valley was more easily eroded in the softer rocks dipping beneath the sandstone, on which the river now flows at a level of 1,800 to 1,900 feet above sea-level in a valley one mile in width with sides rising abruptly 200 feet. Here is revealed the widest exposure of the graptolite-bearing slate. The river flows north for about three miles along the strike of the slates, the greatest distance during which it deserts its generally western route. Alluvium and gravel, 10–20 feet thick, lie along the river, making flats in places up to 400 yards wide. On this account exposures of older rocks can seldom be obtained on the banks of the river. The valley is narrower upstream, when the river is flowing through the metamorphosed rocks of the south-east of the Parish of Mundoonen.

Manton's Creek, after leaving the ranges round Mount Hawkins where it rises, reaches the relatively level ground in the neighbourhood of the railway and, slackening speed, has built up thick beds of gravel and alluvium, on which several branches of the creek now meander. Rejuvenation of the stream subsequently caused these branches to cut beds 8 to 10 feet deep through the alluvium. Next it reaches igneous rocks, running nearly due south for five miles, its course apparently controlled by the meridional strike of the tuffs and lavas. Running parallel with the stream and a mile west of it, rising 400 feet above it, lies the north and south ridge terminated by Manton Trig. The creek turns west round the Trig. Station where the ridge seems to be cut off by a fault.

The other important drainage-carrier of the south-western area, Morumbateman Creek, flowing from south-east to north-west, has deposited less alluvium than the other streams.

The sector of the district to the north-east of the Mundoonen Range is drained by Jerrawa and Hovell's (or the western branch of Jerrawa) Creeks and their tributaries, all of which flow to the Lachlan River. In the extreme east of the area, where Jerrawa Creek has uncovered granodiorite, a deep deposit of alluvium was the result of the arrest of the stream's flow before a passage was cut through the igneous intrusion.

Uplift of the area is responsible for the rejuvenation which all the streams have experienced.

General Geology.

The rocks outcropping in this area include igneous and sedimentary types. The oldest rocks are sedimentary, in places having been metamorphosed by those of igneous origin. Ordovician and Silurian fossils have been found in some of the sediments, but over a large area they have so far proved unfossiliferous. The bedded rocks have been classified as follows:

Age	Nature of Rocks	Approximate Thickness
Silurian	? Tuffs and Lavas Limestone (Bango Beds) ? Tuffs and Lavas	?
Upper Ordovician	(ii) Sandstone with narrow bands of shale; Micaceous sandstone, shale and limestone	about ? 5,000 feet
(Mundoonen Series)	(i) Graptolite slates, interbedded with narrow bands of sandstone and quartzite	about ? 2,000 feet

Upper Ordovician.

Mundoonen Series.

Rocks of this age include slates, sandstones, quartzites, shales and a subordinate amount of limestone. They are grouped as the Mundoonen Series, since they are typically developed in the Parish of that name. The former designation, Jerrawa Shales (Shearsby, 1911), which covered at any rate some of these sediments, is not being used here since confusion might be caused through the Jerrawa Shales having been regarded as of Silurian age. In addition, a somewhat similar name has been given to a rock series in another locality.

The Mundoonen Series is strongly folded, with dips up to 70 degrees, the folding being along an axis not quite meridional. However, the folding is irregular, and in places the beds are contorted, puckered and overfolded, and faults can be observed. The series has been folded into a great dome-shaped fan-fold, so that the oldest beds, the graptolite slates, are exposed by erosion only in the central anticlines of the dome, the anticlines on either side being less strongly marked folds where only younger rocks have been brought up (see Section A–B, Fig. 2).

(i) The Graptolite Slates.

The central anticline passes through the middle of the area mapped and the oldest rocks revealed in it are a series of blue-black graptolite-bearing slates interbedded with layers of unfossiliferous sandstones and quartzites, these beds together being probably about 2,000 feet thick. The slates are not all fossiliferous, but in parts of the area graptolites are fairly common; for instance, in the valley of the Yass River near the junction of the Parishes of Manton, Mundoonen and Morumbateman, where the river flows close to the central axis of the dome at its greatest breadth revealing the slates over a strip of country about 4 miles from east to west and about 4 miles from north to south. To north and south of this outcrop the strip of slate narrows, because of the pitch of the dome fold, as well as on account of the rising contours of the country from which younger overlying sediments have not been eroded away to so great an extent, preventing the exposure of the slate on the Mundoonen Range. In the exposed slate, graptolites have been found in about thirty localities, though not always well preserved (see Map, Fig. 1).

The second exposure of slate which yields graptolites is a narrow band, which in the extreme north of the area forms the country surrounding the Needles Trig. Station, and can be traced south as a ridge crossing the railway line in Portion 239, Parish of Jerrawa, 1½ miles west of Jerrawa Railway Station, after which it can be followed continuously to the south, still forming a ridge, nearly to the Hume Highway, until in Portion 200, Par. Manton, it is cut off, apparently by a fault (see Section C–D, Fig. 2). In four places in this band graptolites have been found.

The following graptolites have been obtained:

SOUTHERN LOCALITIES: *Climacograptus bicornis* (Hall), *C. tubuliferous* Lapworth, *C. missilis* Keble and Harris, *Diplograptus* (*Orthograptus*) *calcaratus* Lapworth, *D.* (*O.*) *calcaratus* var. *basilicus* Lapworth, *D.* (*O.*) cf. *truncatus* Lapw., *Cryptograptus tricornis* (Carruthers), *Glossograptus hincksii* Hopk., *Dicellograptus* cf. *complanatus* Lapworth, *D. divaricatus* Hall var. *rigidus* Lapworth, *D.* cf. *sextans* Hall, *D. elegans* Carruthers, *D.* cf. *moffatensis* Carruthers, *D.* cf. *pumilus* Lapworth, *D.* cf. *smithi* Ruedemann, *Dicranograptus ramosus* Hall, *D. hians* T. S. Hall, *D. zic-zac* Lapw., *Retiograptus yassensis* Sherrard and Keble, and *Leptograptus* sp.

NORTHERN LOCALITIES: *Diplograptus* (*Orthograptus*) *calcaratus* var. *vulgatus* Lapw., *D.* (*O.*) cf. *calcaratus* Lapw., *Dicellograptus elegans* Carruthers, *Retiograptus latus* Keble and Benson, *Retiograptus* sp., and cf. *Leptograptus*.

These forms indicate an horizon about the top of the Eastonian and base of the Bolindian zones of the Upper Ordovician.

It is hoped that a more detailed map of the occurrence of the graptolites, with the zones in the Upper Ordovician represented, may be published later.

The stratigraphic relation between the northern and southern graptolite localities has not been established definitely. The northern slate band, as has been said, breaks off in Portion 200, Par. Manton, where the ground drops abruptly about 50 feet. This is about 300 yards from a road connecting Jerrawa railway station with the Hume Highway. Limestone Creek rises near this point, and has cut a valley across the strike of the slate, but all efforts to trace the blue slate band on the opposite side of the creek, that is, the south bank of the valley, have been unsuccessful (see Section C–D, Fig. 2). Search to the south on the rugged and heavily-timbered Mundoonen Range reveals only sandstones and narrow bands of reddish-purple shale, which overlie the blue slate. The conclusion has been drawn that an east and west fault cuts off the slate band and may, indeed, have formed Gunning Gap between Mts. Mundoonen and Margules, through which the Hume Highway climbs the Mundoonen Range near this point, and continuing west, have cut off the north and south ridge through Manton Trig. As well as the abruptly terminated slate ridge in Portion 200, there are similar cut-off spurs to either side of it along the line of the suggested fault.

There is undoubtedly faulting in other parts of the Range, for instance, in a railway cutting in Portion 42, Par. Jerrawa (described later). The narrow ridges on the top of the Range, in places bounded by precipitous sides, such as near the Gap Trig., may also be due to faulting. Wide time-gaps would separate such faults.

The slate in the extreme north of the area near the Needles Trig. Station shows strong crumpling and twisting and overfolding to the west. Actually the graptolites in the northern outcrop seem to be contained within a synclinal pucker. A railway cutting in Portion 239, Par. Jerrawa, 30 yards long, exposes a section through this apparent syncline. It seems probable that an eroded overfolded anticline rather than a syncline is exposed. At the western end of the cutting white and purple sandstones dip east at 45 degrees. They are overlain by heavily mineralized slates which, however, immediately bend round and dip to the west (see Section E–F, Fig. 2), the westerly dipping slate containing graptolite fragments. Twenty yards further east, the slate, after being folded into a compressed anticline, possibly faulted, is overlain by a red gritty sandstone dipping east at 70 degrees. Since the blue slate, well exposed near the Needles, 2 miles to the north of this outcrop, is greatly crumpled and contorted, and, as well, much bending and twisting can be observed in the yellow bleached splintery slate in road cuttings near the railway line, 50 yards to the west of the blue slate and also in slate 400 yards east, it is considered that overfolding has caused the apparent dip to the east in the railway cutting as well as elsewhere in slate outcrops in the north of the area.

Though fewer fossil forms have been found in the northern area than in the southern, all genera found in the north are represented in the south and, consequently, it is likely that there is no wide time-gap between the deposits in the two localities. It seems probable, therefore, that in the north, or Jerrawa area, the outcrop is that of the same dome as in the south, or Yass River district. It is narrower, however, because of the northward pitch of the dome (see Sections C–D and E–F, Fig. 2).

In Portion 131, Par. Morumbateman, *Glossograptus hincksii* and *Diplograptus* sp. are preserved among other forms as ferruginous impressions on a contorted and fractured quartzitic slate dipping north-west at 50 degrees. The blue slate underlying this bed in the south-east of the same Parish, in Portions 38, 141 and 150, is spotted with smudges of red oxide of iron, perhaps replacing graptolites. The beds dipping beneath this spotted slate have been metamorphosed, becoming altered to a baked slate-like hornfels in which no fossils are found. The metamorphosed beds are described later. Further south and south-east lies the area which has been worked for gold, bismuth, etc.

The sandstones and quartzites interbedded with the slates have yielded neither macroscopic nor microscopic fossils. The quartzite occurring in beds about 30 feet wide is seen in thin section to be built up of angular quartz grains, most of which are in contact, with only a minimum of cementing secondary silica. It has caused small waterfalls across several of the creeks where it outcrops, for instance in Portion 1, Par. Mundoonen. Bands of chert are intercalated with the sandstone in places, as on the west side of Portions 90 and 152, Par. Morumbateman, outcropping on the Yass-Gundaroo road, 300 yards east of the 12th milepost.

(ii) Sandstones, shales, etc.

Overlying the graptolite slates, etc., with conformable dip and strike, is a series of about 5,000 feet of brown micaceous sandstone, yellow and purple shales, and massive sandstones and quartzites, in which no fossils have been found. No macroscopic fossils having been found, thin sections of many of the rocks were submitted to Miss Irene Crespin, Commonwealth Palaeontologist, who was unable to find any trace of microscopic fossils. Though the Upper Ordovician graptolite slates beneath these beds are more intensely folded, probably on account of their lithological character, the direction of dip and strike is generally the same in both, and there seems no unconformity between them (see Section A–B).

The axes of the folds in these upper beds of the dome above the graptolite slates are spaced about 1 mile apart, as shown best in exposures along the railway line and along the Yass River in the Parish of Manton, especially Portion 164. The strata show small fractures in places. A good example of a fluted anticline occurs in the bed of Jerrawa Creek, where it is crossed by the Berrebangalo road in Portion 2, Par. Mundoonen (Pl. xii, fig. 1). These beds outcrop along the ridge of the Mundoonen Range, covering the graptolite slates, whose outcrop is only found along the top of the range in one small patch.

Ironstone.—Bands of ironstone are interpolated between many of the beds of the series. Sometimes these are merely deposits along joint planes less than an inch wide, but in other places their width has attracted attempts to mine them, for instance in Portion 50, Par. Mundoonen (*Ann. Rep.*, 1921), where a hematitic iron occurs. White shales from which the iron has leached to form this deposit or others, can be seen in railway cuttings near Jerrawa.

Limestone.—On the east of the main anticline two small outcrops of limestone occur, one in Portion 30, Par. Mundoonen, where it was formerly burned for lime. A weathered surface shows a grey saccharoidal rock with traces of banding or bedding. Opaque white lumps are caught in some of the layers. The other, a very small outcrop, on Limestone Creek, in Portion 8, Par. Jerrawa, is a dull, grey rock, with small protuberances on a weathered surface. Dr. Dorothy Hill has kindly examined thin sections cut from these limestones, but reports that no organic structure whatever can be observed.

The Mundoonen sandstone, near the top of the series, is generally found in beds about 1 foot in thickness. Quartzitic layers occur within it and rare narrow bands of well-cleaved grey and purple micaceous shale, a few inches thick only, though at the top of the whole series wider bands of the same nature occur. These uppermost Mundoonen beds have generally a uniform dip to the west, but pressure has caused a few wide open folds in these resistant rocks, as well as some faults. One is well exposed in a railway cutting in Portion 42, Par. Jerrawa, almost at the contact of sedimentary and igneous rocks (Pl. xii, fig. 2). A nearly vertical slip to the west of more than the height of the cutting (40 feet) has occurred. On the downthrow side (west), a soft closely-bedded sandy shale dipping to the west is in contact, along the fault plane, with a hard and massive sandstone whose irregular beds, up to 1 foot in thickness, dip to the west at 70 degrees. The fault channel is very clean and narrow, not more than ½ inch of iron-impregnated breccia filling it. The direction of dip in the sediments is unaltered by this fault.

SILURIAN.

Limestone.

In the extreme north-west of the area in Portion 22, Par. Bango, a limestone occurs, which has been placed by Shearsby (1911) among the Bango Beds of the Silurian System. It is revealed only by excavation, as its outcrop is covered by alluvium. A face of about 40 feet is exposed in a quarry which has not reached the bottom of the bed. An alluvial overburden of about 10 feet rests on the limestone. The quarry, which is not worked now, lies in an angle formed by the junction of Bango and Hard's Creeks, which have deposited in this neighbourhood at least 10 feet of alluvium. Alluvium covers all outcrops west of the quarry to Bango Creek, a distance of about half a mile. In places the creek has cut through the alluvium, exposing flow breccia (described later) in its bed, and the same rock occurs in Portion 6, Par. Bango, immediately west of the creek, where the igneous rock dips or is jointed at 20 degrees to the south-west. Alluvium also bounds the limestone for a quarter of a mile to the east, but in Portion 39, Par. Bango, flow breccia is met again.

Though limestone outcrops through alluvium to the north beyond the limit of the present map (Shearsby, 1911), flow breccia rises out of the alluvium 150 yards north of the quarry in Portion 40, Par. Bango. In Hard's Creek, ¼ mile south-west of the quarry, is more of the same rock, while a 5-foot-high railway cutting 1 mile immediately south of the quarry exposes only a rather decomposed igneous rock closely related to the others, and no limestone. Nor has it been picked up further to the south.

The mask of alluvium makes it impossible to determine the exact relation of the limestone to the igneous rock, but it seems possible that it was deposited during a temporary lull in volcanic activity, and was subsequently covered by the igneous rock now to the west of it, when activity recommenced, this overlying lava converting the limestone to marble. It will be shown later that, in Portion 28, Par. Bango, 2 miles to the east of the limestone quarry, calcareous fossils are entangled in coarse crystal tuff as a result of a shorter interruption in igneous activity than the relationship suggested at Bango quarry would represent.

The rock is coloured creamy-yellow on a weathered surface and it is only on such a surface that fossils are found, since the rock is entirely recrystallized, and freshly broken rock reveals only an interlocking mass of calcite crystals coloured in streaks of white and brown. Dr. Dorothy Hill has kindly examined specimens and identifies the following forms: *Halysites* sp., fine dendroid *Favosites*, and some which "may be excessively altered *Alveolites*". She says: "The specimens of *Halysites* have the general aspect of the species of *Halysites* occurring at Mt. Canoblas (Gap, etc.), but I am unable to give a precise specific determination owing to the poor preservation. The assemblage is thus Upper Ordovician or Silurian and a more precise determination on this material alone would not be justifiable."

POST UPPER ORDOVICIAN.

I. Fine Tuffs, etc.

In the bed of Morumbateman Creek, while travelling west, the Mundoonen Series can be followed upward from typical massive sandstone, through purple shale and clay slate all dipping almost due west at high angles, about 50 to 60 degrees, until a well bedded tuff is reached, which dips nearly west at 30 degrees and overlies the more steeply dipping shales and slates of the Mundoonen Series (see Section A–B). In a southward bend of the creek in Portion 43, Par. Morumbateman, in a bank 12 feet high, a series of several beds of tuff, all dipping 5 degrees north of west at 30 degrees, rest on micaceous slate dipping at 55 degrees in a direction 10 degrees south of west. Further downstream, 20 yards after the creek has turned west again, it has cut through the tuff cover, showing it to rest unconformably on a micaceous slate bed about 45 feet wide dipping west at 45 degrees. In this, the highest exposed bed of the Mundoonen Series, a thin section (S.1089) shows that bedding planes are marked by undulose strings of brown and bleached mica, about 0·5 mm. apart, between which is an interlocking mosaic of quartz grains and minute mica flakes. It is possible that this slate may be of tuffaceous origin itself, and that the heat of the overlying younger tuff has promoted the growth of mica in the older slate.

The overlying tuff series shows considerable variation in grain size in its different beds, each of which is about 2 feet thick. The lowest (S.1100) consists of a vesicular banded, greenish-grey, medium-grained rock with some porphyritic crystals of felspar and quartz. In thin section may be seen an occasional larger crystal up to 0·5 mm. long (making up less than 5% of the whole) which is set among fragments one-fifth that size in a devitrified ground-mass. The fragments are principally felspar, plagioclase and orthoclase, with subordinate quartz, while the constituents of the devitrified ground-mass are indeterminate, but are probably felspar and quartz. Limonite and chlorite are present. The proportion of fragments to ground-mass in so fine-grained a rock is difficult to determine, but is probably about 1 : 3. When compared with rocks previously described from the Yass District, this type would be classified as a medium tuff, Type 1 (Sherrard, 1936, Pl. vi, fig. 7), but would be called a "fine essential tuff" in the classification of Wentworth and Williams (1930), since the mineral fragments are less than ¼ mm. in length.

Above this band lies a coarse crystal tuff (coarse essential tuff, Wentworth and Williams, 1930) with felspar predominating over quartz fragments, both of which average about 1 mm. in length. The fragments of both quartz and felspar are somewhat rounded and are packed fairly closely, making up about 75% of the rock, and are set in a ground-mass, devitrified and showing spherulitic structure. Overlying this bed is another fine essential tuff, while above again is an extremely fine-grained rock (S.1103) which is regarded as a sediment which has been recrystallized by the heat of the overlying tuff. Similar interbedded altered sediments are described later. The 12-foot bank in Morumbateman Creek is capped by a coarse crystal tuff (S.1106) of which the mineral contents, grain-size and shape, and ground-mass are similar to those in the coarse crystal tuff described above. Traces of bedding are noticeable in both. In places this uppermost tuff is rich in fragments of recrystallized calcium carbonate. Other bands are very porous, with carbonates in the cavities. All the tuffs are comparatively rich in apatite.

Although there is no continuous outcrop, the tuffs of Morumbateman Creek can probably be connected up to the south with a vesicular tuff outcropping at the south-east corner of Portion 24, Parish of Nanima, 1½ miles east of Morumbateman village. It dips west at 25 degrees, and a thin section shows that angular quartz grains predominate over felspar, and rough bedding planes are outlined by thin biotite flakes. Though the majority of fragments in this fine essential tuff are less than ¼ mm. in length, yet there is an unusually large number, perhaps 10% of the rock, of both quartz and felspar grains 1 mm. long.

Travelling north from Morumbateman Creek outcrops of fine tuffs can only be picked up irregularly, until the Yass River in Portion 85, Par. Manton, is reached, where a series of tuffs and sediments, probably tuffaceous, is exposed, but no vertical section exists to show their true relation to each other and to underlying rocks. The upturned edges of the beds are separated by alluvium and their quasi-parallelism of direction of dip and strike is all that can be ascertained. The lowest bed exposed dips due west at 45 degrees. It is a micaceous slate (S.1447) which may be tuffaceous in origin. In thin section it is similar to the micaceous slate at the top of the Mundoonen Series in Morumbateman Creek (S.1089) and below the lowest tuff there. Twenty yards of alluvium separates the slate from the overlying dense, waxy-lustred, fine-grained, blue-grey rock, which dips at 45 degrees in the direction 15 degrees south of west. It outcrops in the bed of a small tributary creek entering the Yass River at this point. It is composed of rather rare small angular fragments of quartz, arranged with their long axes parallel, and of discontinuous threads of brown mica set in a matrix of secondary quartz. It is a shale, possibly tuffaceous in origin. The overlying rock, a fine tuff, separated from the last-mentioned by alluvium, is coarser grained than it and is well-bedded. As well as quartz fragments about ¼ mm. long, it contains, caught between threads of biotite, prisms of calcite 1 mm. across, which are probably altered from plagioclase felspar. A shale overlies this tuff, and it is succeeded by a closely-cleaved slate dipping 10 degrees north of west at 50 degrees, which in turn is overlain by a dense greenish waxy-lustred fine-grained recrystallized sediment of the type common in the district, though this one is distinguished by an abundance of calcite. It dips at 35 degrees in the same direction as the preceding. Above this is a coarse crystal tuff with closely-packed fragments of quartz 1 mm. long, and of altered plagioclase and chlorite. The next rock to the west is porphyritic, with white earthy phenocrysts and a rare quartz grain set in a dull greenish-black ground-mass. Its dip cannot be determined, and it is separated by 20 yards of alluvium from the previous rock. It may overlap and conceal some of the finer tuffs such as outcrop in Morumbateman Creek. In thin section it is found to be highly altered. Idiomorphic felspar prisms are clouded by alteration to sericite and secondary quartz has also developed in them. Primary quartz is rare. The micro-spherulites of the devitrified ground-mass have broken up so that minute fragments of secondary quartz are scattered through the mass and entangled with isotropic chlorite. There is also some calcite. The rock is an andesitic tuff or lava. It forms a ridge 40 feet high and 100 yards wide. In this sequence from well-bedded sediments, comparable to those regarded as Upper Ordovician in Morumbateman Creek, to coarse tuff and lava, though the evidence is not conclusive, it is suggested that they form a conformable series.

In low cuttings on the Yass–Gundaroo Road, 100 yards to the south, the andesitic lava outcrops in an even more altered form than on the Yass River. It is accompanied by the outcrop of an altered fine-grained sediment only. North of the Yass River, outcrops of the tuffs, interbedded sediments, and lavas can be followed continuously to the old Gap Road, near which, in Portions 129, 106 and 165, Par. Manton, sparse outcrops occur of westerly dipping beds, which pass upward from unaltered sediments through fine essential tuffs to recrystallized shales, coarse tuffs and andesitic lavas. To the north the fine tuffs are lost and do not outcrop in cuttings on the Hume Highway.

However, in Portion 106, Par. Bango, at a point ¾ mile east of Coolalie railway station, where the road from Yass to Jerrawa approaches closest to the railway line, a disused railway cutting reveals a series of bedded tuffs resting on a coarser-grained igneous rock. The cutting is about 10 feet deep and exposes a well-bedded series dipping 20 degrees south-west (Pl. xii, fig. 3). The rock in these beds is green and even-grained, feels gritty, and contains much quartz. Distinct white bands are shown in places. Thin sections show variations in texture in different layers within the same field of view. Angular quartz and felspar grains, with long axes parallel and never quite in contact, and a few chlorite grains are set in a devitrified ground-mass. The chlorite flakes are green, though sometimes darkened by magnetite grains along cleavage cracks. Quartz is always in considerable excess over felspar. The bedding is strongly marked. The mineral fragments in some layers average just less than ¼ mm. in length, bringing them into the fine essential tuffs (Wentworth and Williams, 1930), while other layers are finer with fragments about one-tenth of a millimetre. The proportion of fragments to matrix also varies from about 1 : 1 to 1 : 3.

There is a thickness of about 4 feet of bedded tuffs overlying the coarse-grained igneous rock, a porphyry, to be described, and resting upon the tuffs is a coarse crystal tuff which is at the top of the cutting. The average size of the mineral grains in this rock (S.950) is just greater than ¼ mm., but there are many larger, and also some rounded aggregates built up of secondary quartz. Quartz is in excess of felspar, which is principally plagioclase. Iron oxide has collected along the cleavage planes in the bleached chlorite. Apatite is present. The ground-mass consists of micro-spherulites, probably of quartz and felspar. Compared with other coarse crystal tuffs in the district, this one contains smaller fragments and they are less closely packed. Bedded tuffs are also exposed in the 5-foot-high bank of a dam nearby.

As explained in the section "Physiography" above, Manton's Creek in the neighbourhood of the railway lies at the bottom of 10 feet of alluvium. In the bed of one of its branches, four hundred yards to the west of the tuffs just described, and ½ mile east of Coolalie railway station, shales dipping south-west at 20 degrees, and therefore apparently overlying the tuffs of Coolalie cutting, are revealed. The shales are dense, of a resinous lustre and coloured yellow-brown, and in thin section found to be extremely fine-grained with minute flakes of brown mica indicating bedding planes. Contact metamorphism seems to have caused secondary recrystallization.

Summing up the information regarding fine tuffs, etc., which has been obtained, it is found that the types of tuff do not correspond exactly in the different outcrops. In general, it may be said the lowest tuffs, which are fine-grained, rest on a tuffaceous slate belonging to the Mundoonen Series. This lowest tuff is not always well bedded and is sometimes richer in quartz than felspar, and sometimes the reverse. Variations in coarseness are also observed. It is succeeded by a coarse crystal tuff bed. Clastic sedimentary deposits usually intervene at this level and were subsequently altered by the coarse tuffs or lavas which overlie them.

II. Coarse-Grained Igneous Rocks.

West of the fine-grained tuffs the country is covered by coarse-grained igneous rocks, which outcrop over a strip stretching from Portion 117, Par. Bango, in the north to beyond the southern limit of the area mapped, that is, more than 15 miles, and widening, from east to west, from 3 miles in the north to 5 miles in the south. To the west these rocks junction with others described previously (Sherrard, 1936).

Throughout this area the coarse-grained igneous rocks are indistinguishable in the hand-specimen. They are greenish- or bluish-grey in colour, all rich in glassy quartz grains, containing phenocrysts of dull-white felspars and a subordinate amount of a black ferro-magnesian mineral. The ground-mass is dense and waxy-lustred. Thin sections, however, reveal differences and enable the rocks to be divided into two distinct groups. The rocks of one group show a fragmental texture and are coarse crystal tuffs with rounded or angular mineral grains packed in close contact with the minimum of matrix. In the second group, the rocks are porphyritic, with crystal phenocrysts, often idiomorphic, set in a devitrified ground-mass, the phenocrysts being present in about equal proportion to the ground-mass. These rocks are either lavas or hypabyssal types, and textural differences or field relations, to which reference will be made later, permit the sub-division of this group into quartz-porphyry, dacitic flow breccia and dacite.

(i) Quartz-Porphyry.

The origin by intrusion of the quartz-porphyry is clearly demonstrated in the instructive section exposed in the disused railway cutting near Coolalie railway station, to which previous reference was made. The porphyry which outcrops near here in the form of low rounded tors, was quarried through to a depth of about 10 feet in order to form the railway bed, thus revealing a diagrammatic section illustrative of intrusion by stoping (Pl. xii, fig. 4). At the upper surface of the intrusion a rectangular block of porphyry nearly 2 feet square has replaced a block of the overlying bedded tuffs described above, which has foundered and fractured, leaving irregular small pieces strewn through the porphyry. A rim of about 4 feet of mixture of lumps of bedded rock within porphyry surrounds the entire upper surface of the intrusion.

Hand-specimens of the intrusive rock are greyish-green, speckled by phenocrysts of quartz and opaque white felspars, both large, set in a lustreless ground-mass. In thin section the porphyry is found to be of the type normal to the Yass District (Sherrard, 1936, Pl. vi, fig. 1), with large allotriomorphic quartz crystals, whose edges have been corroded, prismatic twinned plagioclases, some about $Ab_{60}An_{40}$, others zoned and clouded by alteration to sericite, which has developed along cleavage cracks. Large prismatic sections of mica occur, showing strong pleochroism from green to straw-yellow. Large apatites, ilmenite and leucoxene are accessories. The ground-mass, present in about equal proportion to the phenocrysts, is highly devitrified, with spherulites probably composed of quartz and felspar (S.319).

Hand-specimens from the actual line of contact of porphyry and tuff show it to be a sharp one as far as the unaided eye can detect, though in places fractures about ½ inch in throw disturb its line. Thin sections cut along the contact show crystals from the porphyry becoming separated from each other and pressed into the tuff as separate individuals surrounded by tuff, becoming cracked and torn apart in the process. Some of the mineral chips in the overlying tuff

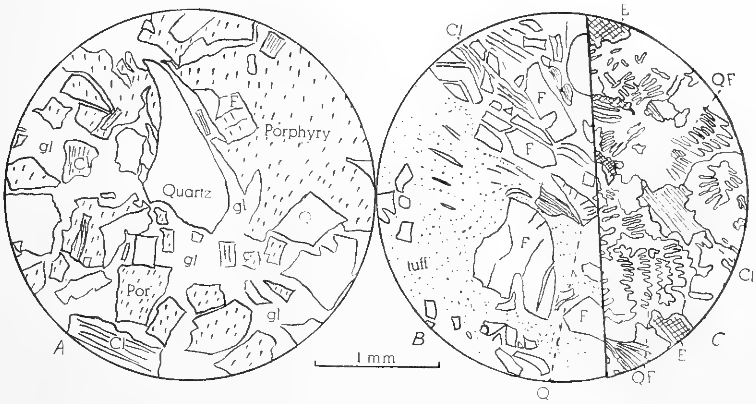

Fig. 3.—A. Crystal-lithic tuff, Portion 106, Par. Bango (S.942). Ordinary light. Phenocrysts breaking away from porphyry fragments.—B. Quartz-porphyry intruding tuff, Railway Cutting near Coolalie (S.383). Ordinary light. Quartz and felspar have developed radial cracks and bedding planes in tuff bent round xenocrysts.—C. Rock at contact with granodiorite. Portion 85, Par. Dixon (S.998). Ordinary light.

(Por) porphyry, (gl) glass, (Q) quartz, (F) felspar, (QF) intergrown quartz and felspar, (E) epidote, (Cl) chlorite.

have been derived in this manner, though it cannot be said in what proportion. Nockolds (1933) describes minerals of a magma wedging their way into xenoliths at Bibette Head, Alderney, and Thomas and Campbell Smith (1932) describe porphyritic felspars from granite which have been introduced into a contact rock "at any rate a foot or so from the contact". At Coolalie, bedding planes of the tuff are bent around these inclusions, simulating flow structure, but this appearance is quite plainly due to the forcing in of the xenocrysts. Another effect is the development of radial cracks in quartz and felspar crystals, ultimately shattering them (S.383, see fig. 3, B).

Although at the junction some of the quartz crystals are markedly corroded, and secondary quartz and calcite and an occasional garnet have developed, the chemical effect of the intrusion has extended through an extremely narrow zone, no doubt because the junction observed is one made by an almost solid magma which had become viscous and inert before reaching this level (Daly, 1908). This condition also accounts for the rim of xenoliths of tuff seen within the porphyry near its upper surface, which could not sink further through the viscous magma. The calcite along the junction must have developed from solution of felspar, since there is no reaction for carbonate from the unaltered tuff. Secondary silica has replaced many cleavage laminae of mica.

A thin section made from the junction of a xenolith with its porphyry host shows developments similar to those at the upper contact. Marked corrosion has occurred round the borders of the crystals from the porphyry which have been forced into the tuff, and secondary quartz sheaths have enveloped some of them. Secondary quartz can also be seen replacing mica laminae.

Another instance where intrusion has occurred can be seen in a railway cutting in Portion 233, Par. Jerrawa, near the crest of the Mundoonen Range, where porphyry is revealed beneath bedded sediments about 10 feet below the surface. It does not outcrop here (Pl. xii, fig. 5). It has reached the surface in a low railway cutting immediately west of Jerrawa station, where porphyry outcrops for about 200 yards. A narrow dyke may be seen in a cutting on the Hume Highway, 13 miles east of Yass in the south-eastern corner of Portion 80, Par. Manton, which contains a green, porphyritic rock with white phenocrysts. In thin section, it differs from other rocks examined, through the crowd of small idiomorphic, zoned plagioclases set in a glassy ground-mass, which in some cases can be seen actually to have solidified just as some of the small felspars were splitting away along the cleavage of the large felspars (S.1370).

No connection at the surface has been found, but it seems probable that the quartz-porphyry and dykes originate from the same magma as the big Gunning granitic outcrop, whose western margin reaches the area mapped. It is described below.

(ii) Dacite.

There is insufficient field evidence from exposures in cuttings, quarries, etc., to prove that all the rocks with porphyritic crystals are intrusive in the manner of that at the Coolalie railway cutting. For reasons to be given later, the rock outcropping in the west of the area has been classified as a dacitic flow breccia. Thin sections from outcrops occurring between the flow breccia on the west and the sedimentary rocks in the east prove that both coarse crystal tuff and dacite occur among them, but the determination of the exact limits of the outcrop of each would require the examination of an almost infinite number of thin sections, on account of their similarity in the hand-specimen. Fifty thin sections which have been examined show these two types outcropping in three alternating north and south strips with coarse crystal tuff bands on either side of dacite, suggesting that they may form an interbedded series, though it is possible that in places the outcrop of dacite is the result of intrusion along a dyke channel.

Like the others, the dacite is a greenish-grey medium-grained porphyritic rock with crystals of quartz, felspar and black mica set in a dull ground-mass. In thin section are found large quartz crystals, well rounded and sometimes embayed by corrosion, hypidiomorphic prisms of plagioclase which is determinable when fresh enough as $Ab_{65}An_{35}$. Small prisms of pleochroic brown or green biotite, occasionally chloritized, also occur. Small chips of quartz and plagioclase are set between the large phenocrysts. Apatite is common as an accessory. The ground-mass is highly devitrified and is a mosaic of minute interlocking crystals, probably of quartz and felspar. The proportion of phenocrysts to ground-mass is about 2 : 3. The rock seems best described as a dacite and is closely similar in texture to some of the dacites of Victoria. With less quartz it passes into andesite, as above.

Dacite outcrops in a narrow band from Portion 117, Parish of Bango, in the north near the railway line, then along Manton's Creek and later running south-south-east to the north-west corner of Portion 255, Par. Nanima. The rock from the bed of Manton's Creek, Portion 93, Par. Manton, is typical (S.1549).

There is some field evidence in support of a bedded origin for this dacitic lava. On the railway line in Portion 30, Par. Bango, where the present line swings away from a disused railway mound, a low cutting reveals recrystallized fine sediment underlying altered dacite (Pl. xii, fig. 6). The same relation is seen in cuttings in Portion 118, slightly north. In the south of Portion 225, Par. Manton, in the valley of Manton's Creek, at its junction with a tributary from the west, a fine-grained sediment and a glassy tuff dip beneath altered dacite. In these localities at any rate the dacite originated as a bedded flow.

(iii) Coarse Crystal Tuff.

The coarse crystal tuffs are everywhere uniform in appearance. They are coarse in grain, greyish-green in colour, rich in quartz, with felspar generally white and opaque and a subordinate femic mineral. They sometimes contain fragments of other rocks. In thin section they are fragmental, being made up of angular grains of quartz and felspar, just under 1 mm. long on the average, though they range up to 3 mm. in length in the tuff from Portion 207, Par. Manton, ½ mile north-east of Manton Trig. They would be classed among the coarse essential tuffs and coarse accidental tuffs of Wentworth and Williams (1930). The large quartz crystals are generally more or less rectangular, but sometimes are corroded and embayed. Plagioclase is often considerably clouded by alteration to sericite. The mica in some of the tuffs is a green pleochroic biotite, occasionally having iron oxide lodged along the cleavage planes; in others it is present in the form of green chlorite showing ultra-blue polarization colours. Occasional lithic fragments are present. Between the mineral fragments are closely packed small chips of quartz, altered felspar, some apatites up to 0·5 mm. long, isotropic green chlorite, calcite and ilmenite, all of which are set in a ground-mass making up perhaps one-sixth of the rock, which is in some cases isotropic, but has usually been devitrified sufficiently to show a spherulitic structure. Traces of flow structure are also present as a rule. A similar coarse crystal tuff was illustrated previously (Sherrard, 1936, Pl. vi, fig. 4).

The only vertical section exposing any thickness of this tuff is in a road-metal quarry in Portion 21, Par. Nanima, ¼ mile south of Cockatoo Trig., and beside Morumbateman Creek. A face 30 feet deep has been exposed, the upper 15 feet of which shows pronounced spheroidal weathering, divided off by more or less horizontal joint planes. In the lower 15 feet the rock is solid, without any jointing. The bedding planes seen in the tuffs exposed in the vertical section at Portion 43, Par. Morumbateman, are not seen here. The rock in the quarry is the normal fragmental type. In places vughs of white carbonate with copper and iron pyrites occur. A thin section (S.879) made from the solid rock in the quarry 20 feet below the surface, where neither spheroidal nor horizontal joints disturb the mass, shows normal coarse crystal tuff with more than 75% of the rock consisting of fragments of quartz and plagioclase, the latter in the greater quantity, and only a few lithic fragments of devitrified glass and of a porphyritic rock. Apatite is common. There is a rough parallelism of arrangement of the fragments. The rock at the top of Cockatoo Trig., 200 feet above the quarry and ¼ mile north of it, consists largely of lithic fragments of porphyry or dacite with a fragmental tuffaceous matrix between them.

A crystal-lithic tuff (S.942) outcropping ½ mile north-east of Coolalie railway station contains an unidentifiable organic fragment. A thin section shows large pieces of porphyritic rock which were cracked and dragged apart before the solidification of the tuff. Pieces of porphyry now form both large and small fragments in the tuff. In addition, many of the separate crystal fragments of this tuff were originally the quartz, felspar and mica phenocrysts of the porphyry (see Fig. 3, A). The sparse matrix is devitrified.

In Portion 28, Par. Bango, on the eastern margin of that parish, a railway cutting has exposed an igneous rock of the usual greyish-green coarse-grained type which contains many white calcareous inclusions, up to 1 inch across, with protruding knobs on their surfaces. In addition, fragments of a porphyritic rock up to 4 inches in diameter can be seen. In thin section, the rock is found to be fragmental, with pieces of porphyry or dacite, angular quartz and felspar grains just under 1 mm. in length, recrystallized calcite, green chlorite and apatite set in a nearly opaque ground-mass, which is, however, devitrified in places. Some of the quartz and felspar grains in this tuff, also, have been derived from porphyry fragments, and can be seen splitting away from them. Cracks can be seen through porphyry pieces, movement along which has detached crystal particles. This rock is a coarse accidental tuff. The fossils which now form white calcareous inclusions, have become almost entirely recrystallized and little structure is left. Dr. Dorothy Hill, who kindly examined them, reports "the slides and specimens are unidentifiable. The recrystallized calcite patches may have had an algal rather than a coral origin."

These occurrences form part of the band of crystal tuff which outcrops immediately east of the flow breccia in a band from 1 to 2 miles wide. It is found in the north in Portion 106, Par. Bango (S.942 above), immediately east of Manton Trig. and along the Yass-Canberra road.

The second band of coarse crystal tuff is a narrow one and not continuous. The tuffs are found in thin beds, perhaps only 2 feet thick as in the vertical section in Portion 43, Par. Morumbateman, in Portions 86 and 106, Par. Manton, in all of which places they are interbedded with fine tuffs and clastic sediments. Some of the tuffs are rich in calcite, in some cases derived from organic fragments and in others from altered plagioclase.

(iv) Flow Breccia.

In the west of the area the rock-type designated here "flow breccia" occurs. It outcrops over a strip of country about 2 miles wide running south-south-east from Portion 6, Parish of Bango, near the junction of Bango and Hard's Creek to the southern border of the area. On the west it passes into the rock described and figured previously as quartz-porphyry tuff (Sherrard, 1936, p. 139, Pl. vi, figs. 2, 3). Its eastern boundary is marked by a pronounced north and south scarp, which runs parallel to and about 1 mile west of Manton's Creek, rising about 400 feet above the creek. Manton's Creek and the Yass River have cut through the scarp just south of Manton Trig. It has been suggested earlier that a fault cuts through the scarp at this point, south of which a lower scarp runs south, parallel to Dog Trap Ford road near the western boundary of the Parish of Nanima.

The rock is well jointed, outcropping in low jagged tooth-like boulders which become like a series of tombstones in Portion 189, Par. Nanima, 12 miles south of Yass. Several small quarries for building-stone for local use, in Portion 233, Par. Nanima, show vertical joints from 4 to 8 inches apart. The outcrops of flow breccia form a series of ridges, ¼ mile apart, striking across country west-south-west and rising in height towards the south-south-east from not more than a foot or two near the mouth of Kitty's Creek until in Portion 30, Par. Hume, the creek has cut a gorge with sides about 50 feet high through one of them. This gorge is only 20 yards wide, and the rock forming it is either jointed or dips at 15 degrees in a direction 25 degrees west of south.

In a hand-specimen this is another of the coarse-grained, greyish-green rocks with glassy quartz and opaque white felspars set in a dense resinous-lustred ground-mass. However, thin sections from this outcrop distinguish it from the other types. These sections, nevertheless, show confusing features, in some respects suggesting an intrusive rock, in others a tuff, while flow structure is not uncommon. Large crystals of quartz are corroded and embayed and up to 3 mm. long. Small hypidiomorphic plagioclases (1 mm. long), about $Ab_{65}An_{35}$, and a green pleochroic biotite occur, with apatite as a common and galena as a rare accessory mineral. Angular chips of quartz and felspar, ¼ mm. long and less, are seen between the phenocrysts. In the devitrified ground-mass, which is present in proportion to crystals of about 2 : 3, flow structure is often shown, though it seems less marked towards the south near Big Hill. Some of the large quartz and felspar crystals have been fractured apart, but the pieces remain close enough together for the original shape of the phenocryst to be seen. The rock (S.1516) from Portion 38, Par. Nanima, is typical. In considering the origin of this rock, at first sight the phenocrysts and comparatively large percentage of ground-mass in it suggest a dyke rock which picked up the interstitial angular fragments during its intrusion. Moreover, the presence in this neighbourhood of quartz reefs and the advanced silicification of the rock along its western border through Portions 8′, 31, 186, 190 and 191, Par. Nanima, might be expected to have followed intrusion as a dyke. But such an origin would not produce a rock with flow structure, which also remains unexplained if the angular chips of quartz are regarded as due to an early stage of metamorphism, producing shattering of quartz crystals through unequal expansion in an acid igneous rock (Harker, 1932). At Coolalie, where an apparent flow structure has developed as described above, the xenocrysts were forced into an already closely-bedded rock, which is not the case here. However, Williams (1926), quoting Fenner in Alaska, says flow structure is no proof of a lava origin and pyroclastic material is capable of flowing by mobility of the associated gases. On the other hand the high proportion of ground-mass in this rock (two-fifths) would not usually occur in a coarse tuff, and the rock seems most satisfactorily explained as a *flow breccia* according to Iddings' definition (1909), where fragments of a molten magma after having been exploded are pictured as falling back within the crater or mouth of the fissure and subsequently flowing like other lava. To describe the rock more fully, the term "dacitic flow breccia" is used. The rocks described here respectively as dacite and dacitic flow breccia are undoubtedly much alike, but the latter is distinguished by flow structure and by a closer packing of hypidiomorphic phenocrysts and mineral chips than in the former.

Support for a bedded origin is lent by the occurrence in Portion 41, Par. Nanima, immediately to the east of any observed outcrop of flow breccia, of a rather finer type dipping west at 30 degrees. It contains quartz and plagioclase phenocrysts, often hypidiomorphic, more than 1 mm. in diameter, but a predominating number of small angular chips less than ¼ mm. The devitrified ground-mass makes up at least 50% of the rock. This rock (S.519) is assumed to be a border phase of the flow breccia dipping beneath the main mass. Its outcrop is not continuous to the north, but a fine-grained tuff or tuffaceous sediment striking north is found in Portion 33, Par. Nanima, one mile to north of the other. The difference between S.519 and rocks described from nearer Yass previously (Sherrard, 1936, Pl. vi, fig. 7) as medium tuffs, is in the higher proportion of ground-mass and the occurrence of hypidiomorphic phenocrysts in the former.

Thin sections of lavas from Marysville and Taggerty in Victoria (Hills, 1929, 1932), kindly made available for comparison by Dr. E. S. Hills, show marked resemblances in one case to the rock described here as "dacitic flow breccia" and in another to its border phase.

The cause of the silicification in rocks in the Parish of Nanima mentioned above, may be pictured as due to vapours rising between bedding planes of the flows. An earthy-brown porphyritic rock outcropping in Portion 186, Par. Nanima, is seen in thin section to retain the texture of a flow breccia, and has phenocrysts of quartz, plagioclase and a little bleached chlorite, but it has a ground-mass formed of an interlocking mosaic of secondary silica (S.1018). In Portion 31, a fine-grained pinkish porphyritic rock consists entirely of a mosaic of small angular secondary quartz grains (the original ground-mass probably) with occasional patches composed of rather larger but still angular interlocking quartz grains, which have apparently replaced the original phenocrysts. The quartzite in Portion 8, half a mile south-west of the junction of Morumbateman Creek and the Yass River, which contains large well-shaped quartz grains showing strain polarization and aggregates of secondary quartz set in a mosaic of fine secondary quartz, may also have originally been an igneous rock.

Another altered form of flow breccia occurs in Portion 34, Par. Bango, ¼ mile south-east of the limestone quarry. It is a green medium-grained granular rock with numerous elliptical cavities up to an inch across, into which acicular quartz crystals have grown. A thin section shows an intergrown mass of epidote and quadrangular quartz grains in about equal quantities. There are also some aggregates of secondary quartz. It would seem that solutions derived from the limestone have caused development of epidote here.

In comparing thin sections of dacitic flow breccia with those of rocks described in a previous communication as quartz-porphyry tuff and rhyolite tuff, whose outcrops traced on a previous map (Sherrard, 1936) abut against flow breccia as shown on the present map, sections of the two types of tuff show a higher proportion of crystals to ground-mass than does typical flow breccia. Examination of a number of sections suggests the likelihood of one grading into the other, due perhaps to the existence of a series of superimposed flows and tuffs. A section from the rock in Portion 6, Par. Bango, 150 yards to the west of Bango Creek and more than half a mile west of the limestone quarry, while still a flow breccia, shows affinities with the coarse crystal tuffs, with a greater proportion of crystals to ground-mass than in typical flow breccia.

The eastern boundary of the flow breccia can only be traced with exactness in those places where its border phase outcrops or where siliceous solutions have penetrated, presumably along a junction.

Age of the Igneous Rocks.

The age of the igneous rocks in this area is not determinable with certainty. Exposures along Morumbateman Creek give more evidence than any others. The banks of the creek are generally low, and vertical sections are not seen, but the dips and strikes obtained from the upturned edges of the beds in the creek suggest a conformable passage. Passing downstream from the slate of Portion 37, Par. Morumbateman, which graptolites prove to be of Upper Ordovician age, sediments conformably dipping above one another can be followed for two miles, with few breaks on account of an alluvium cover, until Portion 43, where the creek is flowing south for a short distance over a micaceous slate, possibly tuffaceous, still in the Mundoonen Series, which dips at 55 degrees in a direction 10 degrees south of west. Twenty yards south-west of it on the west bank of the creek is the vertical bank of fine tuffs described above with their lowest member dipping 30 degrees in a direction 5 degrees north of west. Micaceous slate can be picked up again 20 yards downstream after Morumbateman Creek has turned west once more, where it dips west at 45 degrees, outcropping for 15 yards with upturned edges underlying tuff on the river bank above. These relations indicate a slight unconformity between the Mundoonen Series and the tuff, though probably they do not mark any great time interval (see Section A–B).

The outcrops along the Yass River in Portion 85, Par. Manton, are each separated from the other by alluvium, though conformity between slates and tuffs is suggested by parallelism of dip and strike. Along the railway line the overfolding in graptolite-bearing slate in Portion 239, Par. Jerrawa, gradually smooths out and to the west the slate is overlain by conformable sandstones. Lack of sections in railway cuttings or elsewhere prevents observation of the complete sequence before the igneous rocks outcrop, one of the lower tuffaceous members of which contains remnants of calcareous fossils whose age is indeterminate.

The quartz-porphyry is younger than the fine tuffs since it has intruded them.

All that can be said with certainty is that the interbedded fine tuffs, coarse crystal tuffs, lavas, etc., are post-Upper Ordovician in age. If the suggestion of the limestone of Portion 22, Par. Bango, being interbedded with flow breccia can be upheld, these igneous rocks are probably of Silurian age, and the junction between tuffs and sediments in Portion 43, Par. Morumbateman, is then an Upper Ordovician-Silurian one.

Metamorphism Due to Tuffs, etc.

In each outcrop of the junction of tuffs with sedimentary rocks which has been examined, there has been found an extremely fine-grained rock interbedded with the lower members of the tuff series. In a hand-specimen, each of these is a dense, either lustreless or slightly waxy, uniform-textured rock of a dirty grey, greenish or yellowish colour with a conchoidal fracture. In thin section with magnification about 35 times, little can be determined from the dense even-grained texture of yellow or grey colour. Bedding planes are generally faintly marked by parallel arrangement of minute pleochroic brown-mica flakes. Sometimes secondary quartz is in the act of replacing these flakes. Prisms entirely composed of a mosaic of secondary quartz are also present. Clastic grains of quartz and felspar and rounded aggregates of secondary quartz corroded by the matrix are only rarely found. With higher magnification (about 100 times), the matrix is seen to be composed of a mosaic of crystalline material, probably secondary quartz. A thick powdering of black grains of ilmenite, or of yellow grains and washes of limonite determine the colour.

Typical examples of this change have been found in Portion 142, Par. Morumbateman, in a rock which dips below slate containing *Glossograptus hincksii*, to which reference was made previously. This locality is passing into the contact zone of the granodiorite. In one example (S.1305) numerous round, white blebs are seen in thin section one-tenth millimetre across, which is about fifteen times the size of the average single grain. These aggregates are made up of interlocking grains of secondary quartz. Sometimes there is a dark centre in these white blebs, which is composed of rosettes of stumpy green chlorite flakes. Between the blebs in the ground-mass, with magnification about 100 times, a cloud of minute colourless mica flakes is recognizable by the high polarization colours, but whether the material with low polarization colours wrapped around by the mica is quartz or felspar, cannot be determined.

A similar baking of the shale is found in railway cuttings in Portions 30 and 118, Par. Bango, where it underlies dacite (Pl. xii, fig. 6).

With regard to the origin of these rocks, their extremely fine grain separates them from an ordinary sediment, to which they might be referred on account of the traces of bedding planes. An origin as an argillaceous sediment which has been entirely recrystallized to a rock of the adinole type by contact metamorphism seems to describe them best. This change is known in the neighbourhood of acid igneous rocks (Harker, 1932, p. 132).

Rocks closely similar in hand-specimen and thin section, which occur to the west of Yass, were described and figured previously (Sherrard, 1936, Pl. vi, figs. 9, 10). They were then doubtfully described as tuffs, but their relation to adinoles seems closer. There is a noticeable resemblance between plates published then and those of Milch (1917) illustrating his description of adinoles.

Granodiorite.

In the extreme north-east of the area, along the junction of the Parish of Mundoonen with that of Dixon, outcrops the western fringe of a large igneous intrusion which centres around the town of Gunning, 25 miles east of Yass. Several granite hills crowned by tors rise out of the micaceous sandstone of the Mundoonen Series, which here dips east forming part of the east limb of the main Upper Ordovician anticline.

The coarse-grained black and white granitic rock of Portion 85, Par. Dixon, is seen in thin section to be very rich in quartz, in which small idiomorphic, fresh prisms of twinned plagioclases are in places graphically intergrown. Many of the felspars are zoned, others by their extinction angles approximate to $Ab_{70}An_{30}$. This rock has two ferro-magnesian minerals, unlike the other igneous rocks of the district. Large prisms of highly pleochroic brown biotite occur, as well as a little brown hornblende, which also shows strong pleochroism, and is in places being replaced by biotite. There is less apatite in this rock than in other types in the area. The rock is a granodiorite. Small basic segregations are not uncommon.

From the rock outcropping 4 miles to the north on the Hume Highway, Portion 153, Par. Dalton, a specimen was examined. This is further into the heart of the granitic mass and outside the area mapped. The rock here is darker in colour, with a higher proportion of femic minerals and less quartz than in the previous rock. A thin section shows more hornblende, some of which is being replaced by biotite. Graphic intergrowth between quartz and the zoned plagioclases is also noticeable in this rock. All but the outermost zone of the felspar shows a development of epidote (S.1286).

Effects of the Intrusion.

The intrusion of granodiorite has disturbed the usual north and south strike of the country rock, which in its neighbourhood has swung round to east and west. A typical example of the country rock forms a hill ½ mile south of the granodiorite. It is a micaceous, felspathic sandstone, which under the microscope shows small clastic grains of quartz embedded in a mass of sericitized felspar, pleochroic green mica and some epidote. Not more than 40 yards from the granite a micaceous sandstone, dipping 35 degrees due south and striking at right angles to the edge of the granite, is found (S.1274). The junction between it and the granite is covered. In thin section, the sandstone is fine-grained with small quartz grains caught in bunches of mica flakes. The matrix is of secondary quartz and sericite flakes, which may represent metamorphosed felspar. It is, in fact, similar to the last-mentioned, although so much closer to the granite outcrop.

Thirty yards north of it and parallel in strike is a series of rather obscure rock types, which protrude from the grass surrounding the actual outcrop of the granodiorite and only 20 yards from it, in parallel bands about 12 feet in width. One of these (S.986) is a dense, green, greasy-looking fine-grained rock, which a thin section shows is principally composed of spherulites of secondary quartz and felspar, about 0·5 mm. in diameter, with which a profusion of pleochroic green mica needles of the same length have intergrown.

More highly recrystallized types have, in the hand-specimen, the even-grained appearance and light colour of aplite. The principal constituents of one of these (S.988) are well-shaped simply-twinned felspars, 0·5 mm. long, showing spherulitic structure, with which secondary quartz may be intergrown. Epidote crystals up to 1 mm. long are developed also. A coarser black and white variety (S.998) contains felspar which is micrographically intergrown with quartz, chlorite with ultra-blue polarization colours, and crystals of epidote 1 mm. long (see Fig. 3, C). Small rare angular grains of quartz which could be called clastic are present in all the types.

Half a mile north-west of the granodiorite, near the Berrebangalo crossing of Jerrawa Creek, a dyke-like outcrop of a coarse white granular rock with faint, dark parallel banding occurs (S.1261). A thin section shows entire recrystallization to a mosaic of small interlocking grains of quartz, which surround a few large grains showing intense strain, and all of which are arranged with their long axes parallel. Epidote in narrow parallel strings gives the banded appearance noticeable in a hand-specimen.

It is difficult to determine if these rocks were originally aplites or felspathic sandstones, which remained as roof pendants in the granodiorite. Their disposition in the field in parallel bands, rising out of a grassy paddock, with direction of strike parallel to that of the country rock here, does not serve to differentiate between these alternative origins. Micrographic intergrowth of quartz and felspar can be developed in either type as a result of contact metamorphism (Harker, 1932). The development of epidote in the main granodiorite mass itself, as well as in the metamorphosed types, seems to link them together, and suggests that these altered rocks were originally dykes which have been metamorphosed, as apparently has the entire western margin of the granodiorite mass itself also. However, the conformity of the metamorphosed rocks with what seems an undoubted sediment (S.1274), supports a sedimentary origin for them, which on the whole seems the more likely.

Further afield, the effect of the intrusion is also pronounced. On the Hume Highway, near Hovell's Creek, the easterly dipping sediments have been altered to strongly-cleaved greasy schists, seen in thin section to consist of elongated flakes of somewhat bleached brown mica, highly polarizing talc and small flakes of colourless chlorite showing ultra-blue under crossed nicols, all set between interstitial layers of secondary quartz (S.1217). Along the Yass River in Portion 126, Par. Mundoonen, in the south-east corner of the area, another typical specimen is a greenish-blue well-cleaved quartz-schist also dipping to the east, which shows in thin section much secondary quartz caught between fibres of bleached pleochroic brown mica (S.1048).

These schists have developed from the micaceous sandstone of the eastern limb of the main anticline of the Mundoonen Series. The eastern limb of the overlying massive sandstone does not outcrop within the limits of the area mapped. It may have been stoped away during the intrusion of the granodiorite. Alteration in sandstone of the western limb is seen in a railway cutting, in Portion 233, Par. Jerrawa, just west of the top of the Mundoonen Range, at a point where the igneous rock has nearly reached the surface, brown spots having developed in cream-coloured sandstone due to the crystallization of iron oxide in magnetite cubes.

The igneous intrusion, no doubt, also introduced the broad quartz reefs commonly traversing the graptolite slates and overlying beds, as, for instance, in Portion 1, Par. Mundoonen, at the junction of the road from Morumbateman Creek with the Yass–Gundaroo road. A similar origin is pictured for the white films of finely divided silica, which, east of about Portion 3, Par. Mundoonen, near Greenfields Farm Post Office, have penetrated along bedding and joint planes in the slates, masking any graptolites which may have been present.

? Tertiary.

Along the banks of the Yass River are found remnants of a horizontal deposit of a coarse, consolidated but porous conglomerate, deeply stained with iron. It is about 5 feet thick and is found at varying heights above the present river level. In places it is 5 feet above that datum, but can be found at heights up to 100 feet. In Portion 138, Par. Toual, near the causeway crossing the Yass River, the conglomerate is only 5 feet above the river, but ½ mile south-east of that point, an outcrop half an acre in extent is found 100 feet above river level. These variations must be due to differential earth movements, since the deposition of the conglomerate. The river, in eroding its present valley, has sometimes undercut the conglomerate, causing blocks to tilt over. Otherwise it is always horizontal.

Fragments in the conglomerate are principally of reef quartz with fewer pebbles of slate and sandstone. Fragments of reef quartz up to 5 inches across can be found, though the average diameter is about 1 inch. They show a roughly parallel arrangement. In the Yass River valley the conglomerate has only been found resting on slate, its outcrop furthest downstream being in an old stream course 100 yards south of the river, in Portion 19, Par. Morumbateman. Deposits have also been recognized on Morumbateman Creek, in Portion 43, Par. Morumbateman, and as far as half a mile south of the Yass River's present course, in Portions 69 and 132, Par. Morumbateman.

To the north of the Mundoonen Range, similar conglomerate has been observed in Portion 173, Par. Jerrawa, a mile south-west of Jerrawa railway station, and in the south-east corner of Portion 164 in the same parish, 1½ miles north-west of Jerrawa railway station.

No fossils have been found in this conglomerate. It is, however, tentatively correlated with a leaf-bearing conglomerate found in Portion 35, Par. Dalton (Shearsby, 1911), 9 miles north-east of Jerrawa, from which *Cinnamomum* has been obtained (Ettingshausen, 1888) and which is therefore probably of Middle or early Tertiary age (Hills, 1939). At Dalton much of the conglomerate has been silicified, and is but slightly iron-stained, while the fragments are generally smaller. A thin section cut from the conglomerate of Portion 28, Par. Morumbateman, shows a matrix of red-brown oxide of iron which coats many of the fragments, penetrating some of them, but there are many voids between them.

The origin of this conglomerate is pictured as being due to a temporary base-level having been reached by the ancestral Yass River, which, having slowed down, deposited its load of detritus. Subsequent uplift, apparently differential, from the present varying heights of the conglomerate, rejuvenated the Yass River which cut a new valley, removing by erosion much of the conglomerate deposited.

Summary.

This paper deals first with the structural and stratigraphical relations of slates containing graptolites belonging to the top of the Eastonian and base of the Bolindian zones of the Upper Ordovician period, and of arenaceous non-fossiliferous sediments conformable with them, the whole making up the Mundoonen Series, which in the east of the area has been intruded and metamorphosed by granodiorite.

The Mundoonen Series is overlain with a slight unconformity by a westerly-dipping series of narrow beds of alternating fine and coarse tuffs sometimes interbedded with recrystallized sediments. The uppermost of the thin beds is of coarse crystal tuff which in places contains unidentifiable fossils. This tuff is succeeded to the west, in turn, by dacitic lava, more coarse crystal tuff and finally by dacitic flow breccia. Although no vertical section reveals the exact relations of these last four to one another, as are revealed those of the thin beds of tuff, they, too, are considered to be a bedded series dipping west.

A restricted outcrop of limestone with Silurian or Upper Ordovician fossils occurs between outcrops of flow breccia, its exact relation to which is obscured by alluvium, but it may also be a member of the interbedded series.

Quartz-porphyry has intruded fine tuff in one place, and the Mundoonen sediments in others.

The deposition of conglomerate, probably in Lower to Middle Tertiary times, and the subsequent physiographical history and recent deposition of alluvium are also described. (Numbers, such as (S.319), etc., refer to thin sections and specimens in the author's collection.)

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EXPLANATION OF PLATE XII.

1.—Double anticline in Upper Ordovician sediments, Jerrawa Creek, Berrebangalo.

2.—Fault in Upper Ordovician sediments, Portion 42, Par. Jerrawa.

3.—Beds of fine tuff, Portion 106, Par. Bango, near Coolalie.

4.—Porphyry which has replaced stoped block of tuff, Portion 106, Par. Bango, near Coolalie.

5.—Upper Ordovician sediments intruded by porphyry, Portion 233, Par. Jerrawa.

6.—Sediments underlying lava, Portion 30, Par. Bango. (Hammer head lies along junction.)

Geology of district east of Yass, N.S.W.

CONTRIBUTIONS TO THE MICROBIOLOGY OF AUSTRALIAN SOILS. V.

ABUNDANCE OF MICROORGANISMS AND PRODUCTION OF MINERAL NITROGEN IN RELATION TO TEMPERATURE.

By H. L. Jensen, Macleay Bacteriologist to the Society.

(Five Text-figures.)

[Read 29th November, 1939.]

Although much research work has been devoted to the study of the influence of temperature on microbial processes in the soil, we still possess little knowledge concerning the influence of this factor on the actual abundance of soil organisms in general and total numbers of bacteria in particular. Plate counts from soil have usually revealed little or no correlation between bacterial numbers and soil temperature (review of literature is given by Taylor, 1936; cf. also Eggleton, 1938), although frozen soils have sometimes been reported to show increased numbers of bacteria (cf. Waksman, 1932). Russell and Hutchinson (1913) carried out plate counts from soil stored at different temperatures, and found no definite correlation between bacterial numbers and temperature of storage. Similar experiments were undertaken by Taylor (1936), who used the method of direct microscopic counting; no significant differences were found between numbers of bacteria in soil stored at 5°C. and at approximately 16°C. for 8–9 days. Using both plate and direct methods, the present author (Jensen, 1936) found similar results with soils kept for 10 days at temperatures from 5°C. to 37°C. without addition of organic matter. In the presence of decomposable organic materials, microorganisms tended to accumulate in higher numbers at lower temperatures, although the intensity of the decomposition, as expressed by the evolution of carbon dioxide and in some instances also the formation of nitrate, increased with the temperature. It was deemed desirable to extend some of these observations over a longer interval of time, using the production of nitrate and ammonia as an index of decomposition.

Experimental.

Two soils were used for the experiments. The first (*A*) was a heavy loam of acid reaction, rich in organic matter, from grass field; it was mixed with 3 parts of sand and then with 1% $CaCO_3$; the pH of the mixture was 7·8, total N-content 0·120%. The other soil (*B*) was a heavy alkaline loam, fairly rich in organic matter, from a flower bed; this was mixed with equal parts of sand; pH 7·7, total N-content 0·103%. Soil *A* was incubated with and without addition of 1% dried and finely ground mycelium of *Penicillium* sp., and soil *B* with and without addition of 1% hay (dried and finely ground mixture of young grass and clover plants). The C- and N-contents of these two materials are given elsewhere (Jensen, 1936). Portions of 600 gm. of air-dry soil were adjusted to approximately two-thirds of their water-holding capacity and kept in big glass dishes (internal diameter 18·5 cm., depth 4·5 cm.) for about 3 months at 4 levels of temperature: 4–6°C. (soil *B*) or 6–8°C. (soil *A**); 14–16°C.; 24–26°C.; and 37°C. The moisture content was kept as constant as possible by restoration of the loss of weight due to evaporation every 3–4 days with distilled water. Periodical determinations were made of: total bacteria by direct microscopic counting; bacteria and actinomycetes by plate counting; density of fungal mycelium; NH_4– and NO_3–N. The glass slides for estimation of fungal mycelium were left in contact with the soil for 7 days prior to each examination, except in soil *B* with hay, where examinations were also made after 4 days at 25°C. and 37°C. All methods were the same as previously described (Jensen, 1936).

The experimental results are shown graphically in Text-figures 1–4. In soil *A* without addition of organic matter (Fig. 1) the direct counts of bacteria fluctuate irregularly without any marked influence of the temperature (cf. Taylor, 1936). The plate counts, on the other hand, show a marked increase after the first 15 days, and then a gradual decline. The influence of the temperature stands out clearly: the lower the temperature of incubation, the higher is the maximal number and the slower the decline. It is noteworthy that after the

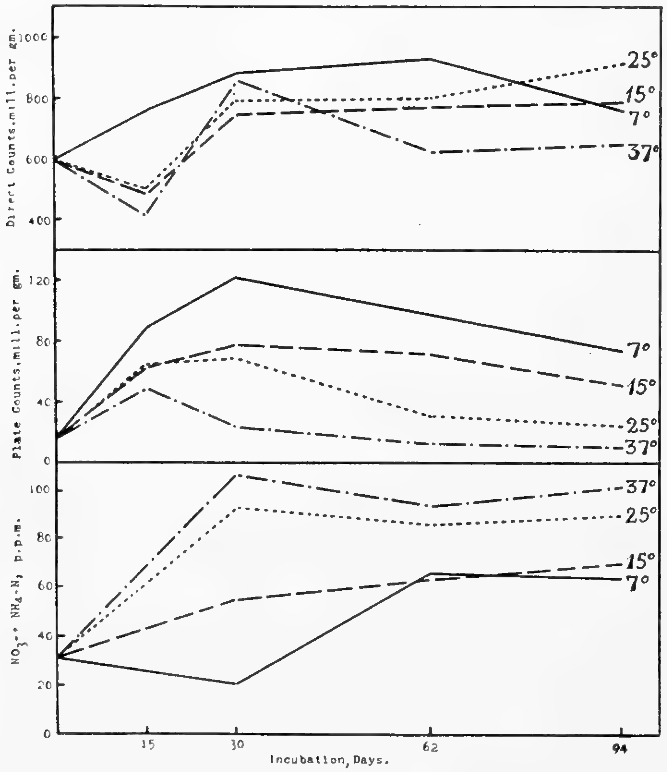

Fig. 1.—Multiplication of microorganisms and production of ammonia and nitrate in soil *A* without addition of organic matter. Here, as in Figs. 2-4, numbers of bacteria (incl. actinomycetes) are expressed in millions per gm. and amounts of ammonia and nitrate in parts per million of soil dried at 98°C.

* The refrigerator, which was used as an incubator, was running at a somewhat lower temperature when the experiments with soil *B* were carried out.

30th day the direct counts are at 7°C. only 8 to 10 times as high as the plate counts, but at 37°C. 40 to 60 times as high. The plate counts were almost entirely due to bacteria; actinomycetes never exceeded 1 mill. per gm.

The figures for mineral nitrogen (nearly all nitrate) are almost reciprocals of the plate counts. At the two highest temperatures the curves rise rapidly during the first 30 days and then remain about level, while at the low temperatures the nitrate formation is much less vigorous and at 7°C. not noticeable until after 62 days.

The corresponding sets of figures for soil *B* (Fig. 2) are even more striking. The direct counts are here practically stationary at 25°C. and 37°C., but at the lower temperatures, and especially at 5°C., they tend to rise with advancing time of incubation.

The plate counts show the same general trend: at 37°C. a slow but conspicuous decline, at 15°C. and 25°C. comparatively little change, and at 5°C. first a small increase during the first 28 days and then a big rise towards the end of the

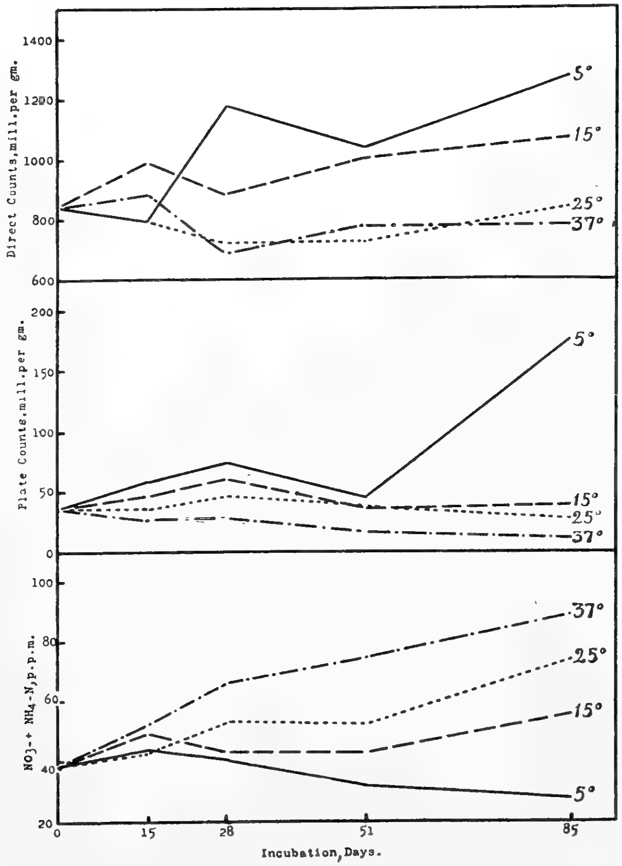

Fig. 2.—Multiplication of microorganisms and production of ammonia and nitrate in soil *B* without addition of organic matter.

experiment. In this soil, too, actinomycetes were rather scarce (max. 3 mill. per gm.).

The curves for mineral nitrogen (chiefly or exclusively nitrate) are even more clear-cut than in soil *A*. At 5°C. the nitrate content actually declines during incubation, at 15°C. the process of nitrification is little active, but gains strongly in activity with increasing temperature. The observation of Prescott and Piper (1930), that differences in temperature between 11°C. and 34°C. have little influence on the rate of nitrate production, can thus hardly be considered generally valid. As to the decrease in nitrate content at 5°C., it is interesting to note, although no exaggerated importance should be attached to this single observation, that the disappearance of 10 parts per million (i.e. 10γ per gm. of soil) of mineral nitrogen has coincided with an increase in total bacteria equal to about 450 mill. cells per gm. of soil, which quantity may be estimated to contain approximately 9γ of organic nitrogen. The suggestion lies close at hand that disappearance of

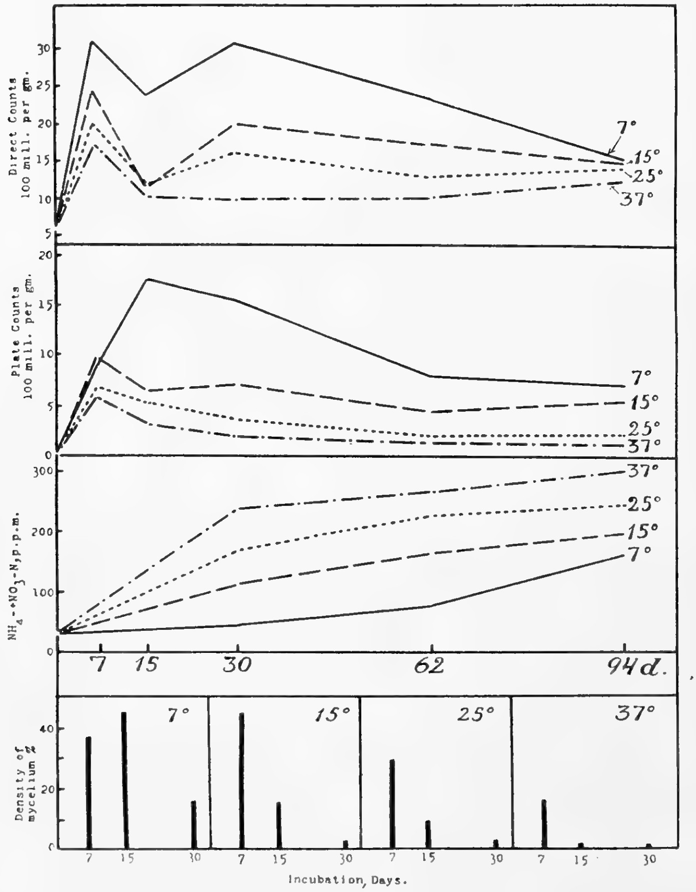

Fig. 3.—Multiplication of microorganisms and production of ammonia and nitrate in soil *A* with addition of 1% fungal matter. Densities of mycelium as in Fig. 4 expressed as percentage of microscopic fields showing presence of fungal hyphae.

nitrate at low temperature may be due simply to nitrate consumption by multiplying bacteria, and not to a preponderance of denitrifying bacteria at this temperature, as suggested by Lebrun and Radet (1933).

In both soils fungal mycelium was generally very sparsely represented, except for a few isolated instances (soil *A* at 7°C. after 15 days, and soil *B* at 25°C. after 15 days) where densities of about 6% were observed. Otherwise the density was at the most 1·1%, without any correlation with temperature or time; these figures have therefore not been included in the graphs.

It thus applies to both control soils that incubation at increasing temperature results in a stronger mineralization of the humus nitrogen but in a less abundant microflora, especially bacteria capable of developing on agar plates.

Figure 3 shows the results from soil *A* with addition of mycelium. They agree completely with those of former experiments in shorter intervals of time (Jensen, 1936): numbers of bacteria, total as well as plate counts, show first a rapid rise and then a gradual decline, at 37° C. approaching a constant level already after 15 days. At each point of time, even after 7 days, we find an almost

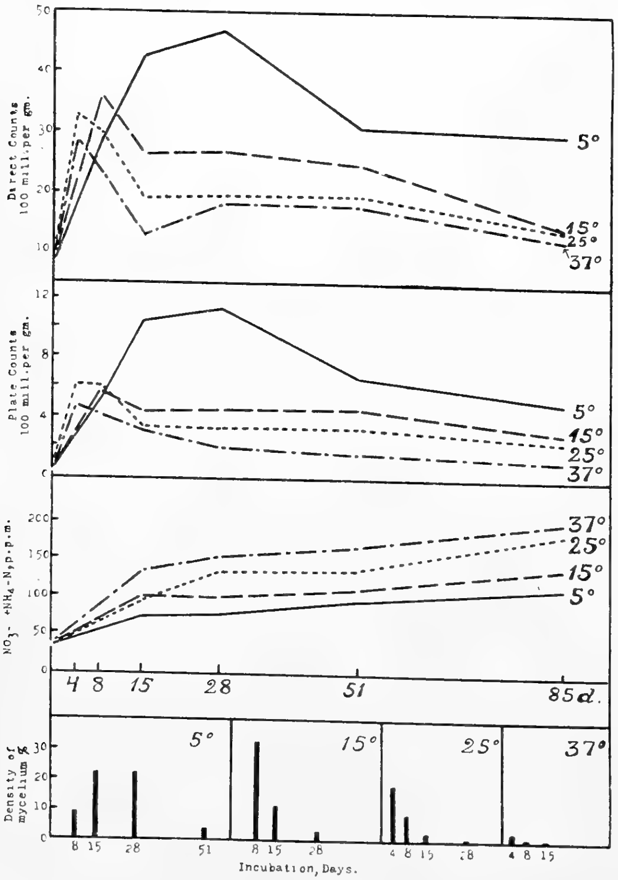

Fig. 4.—Multiplication of microorganisms and production of ammonia and nitrate in soil *B* with addition of 1% hay.

perfect inverse relationship between temperature and numbers of organisms. The growth of fungal mycelium behaves similarly: maximal development, which reaches its highest values at 7–15°C. and is least at 37°C., takes place during the first 7 to 15 days and is followed by a decline which is slowest at 7°C. and most rapid at 37°C. After the 30th day all densities of mycelium were very low at all temperatures, and have therefore been omitted from the graph. The curves for mineral nitrogen are here again almost complete reciprocals of the bacterial numbers and the mycelial densities. At 7°C. there is hardly any formation of mineral nitrogen during the first 30 days, but a definite increase takes place during the last 32 days, when nearly all fungal growth has ceased and the numbers of bacteria are falling. At 37°C., on the other hand, most of the mineral nitrogen is produced after 30 days, at which time mycelial growth has already disappeared and the numbers of bacteria have reached an almost constant level.

In soil *B*, which was exposed to a still lower minimum temperature, the results are similar but even more striking (Fig. 4), in respect of both total counts, plate counts, growth of mycelium, and production of mineral nitrogen, except that the initial rise in bacterial numbers is somewhat more rapid at the higher temperatures, especially 25°C., in the very early stages of decomposition (4 to 8 days).

In both soils with addition of organic matter, but especially *B*, actinomycetes figured prominently in the plate counts at 25° and 37°C., but were less numerous at 15°C. and very sparse at 5° and 7°C.

Very little accumulation of ammonia took place except at the lowest temperature, where the following amounts of NO_3– and NH_4–N (in parts per million) were found:

Soil *A* (7°C.)		
Days	NO_3–N	NH_4–N
0	31	0
30	(0)	45
62	48	25
94	147	13

Soil *B* (5°C.)		
Days	NO_3–N	NH_4–N
0	30	8
15	37	37
28	33	43
51	50	48
85	63	55

Even at 5°C. nitrification thus goes on, although slowly and without keeping pace with the ammonia production (cf. Schönbrunn (1922), who observed the same phenomenon even at 0°C.). The lack of nitrate accumulation in the corresponding control soil without addition of organic material is thus not due to complete inhibition of the nitrifying bacteria by the low temperature, but must be ascribed to more complex causes—perhaps inactivity of microorganisms capable of producing ammonia from the resistant humus compounds, or the accumulation of an abundant microflora capable of utilizing the otherwise nitrifiable nitrogen for cell synthesis.

From the direct counts of bacteria we may roughly estimate the quantities of nitrogen present as bacterial substance, by assuming that 1,000 mill. bacterial cells of average size represent 1 mgm. of protoplasm with 20% dry matter containing 10% N, i.e. 1,000 mill. bacteria represent 20γ of nitrogen. If we regard all the bacteria found after 4–7 days and onwards, as well as the mineral nitrogen formed, as derived from the organic matter added (since it is by no means certain that the soil humus would be attacked to the same extent as in the control soils without addition of organic material), we may tentatively account for the percentages of added nitrogen that have been transformed into bacterial protoplasm plus mineral nitrogen in the two soils with addition of fungal mycelium and hay at the different times and temperatures. This calculation is shown graphically in Figure 5; it is to be noted that soil *A* received 352 parts per million of N in mycelial substance, and soil *B* 273 p.p.m. of N in hay. We see that at the end of the experiment some 75–80% of the added nitrogen can be accounted for at 37°C., and of this only a very small fraction is represented by bacterial substance. At 5° and 7°C. only approximately one-half of the added N can be accounted for, and a good deal of this, especially in soil *B*, is present as bacteria. The intermediate temperatures occupy intermediate positions. In the early stages of the decomposition the calculated amount of bacterial nitrogen far exceeds that of mineral nitrogen at the lowest temperatures, but the ratio of mineral nitrogen to bacterial nitrogen is widened with both advancing time and increasing temperature, yet at each stage being narrower at lower temperature; if it had been possible to calculate the amount of nitrogen in vegetative fungal mycelium, which is produced most abundantly at low temperatures, and to add it to the bacterial nitrogen, it would further have accentuated the general principle of increasing synthesis of microbial substance with decreasing temperature.

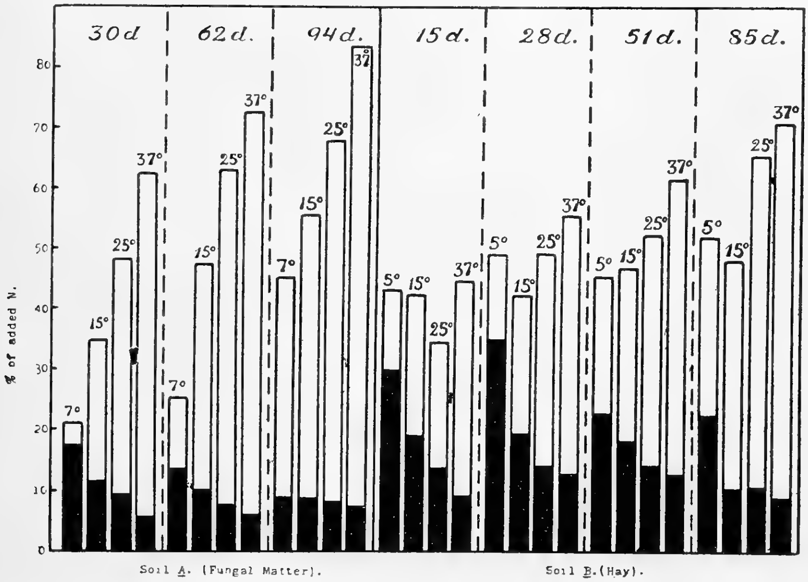

Fig. 5.—Calculated percentages of added nitrogen accounted for as bacterial substance + $(NH_4 + NO_3)N$. Black parts of columns: nitrogen estimated as present in bacterial cells. White parts: $(NH_4 + NO_3)N$.

Conclusions.

The results as a whole agree completely with what was previously found in short-period experiments: the rapidity of decomposition of organic matter, as measured by formation of carbon dioxide, nitrate and ammonia, increases with increasing temperature, but the abundance of microorganisms decreases. When the accumulation of soil humus is known generally to increase with decreasing temperature (cf. Waksman, 1936), the explanation must be sought not merely in the general retarding influence of temperature decrease on biological processes according to the law of van't Hoff, but also to the fact that decreasing temperature causes larger proportions of the transformed organic material to be converted into microbial substance, certain constituents of which contribute to the humus of the soil. In its relation to temperature the soil microflora as a whole thus seems to conform to a general biological rule governing the size of populations; this has previously been most clearly observed in plankton populations, which reach their greatest density in cold sea-water (cf. Bělehrádek, 1935). No doubt this phenomenon has also something to do with the high numbers of bacteria sometimes observed in frozen soil; a reinvestigation of this problem by means of direct counting methods might prove fruitful. When no definite correlation is usually found to exist between soil temperature and numbers of bacteria under natural soil conditions, it must be remembered that a complicating factor is here represented by the food supply in the form of residues of higher plants, the growth of which in its turn depends on the temperature (Eggleton, 1938). It seems quite likely, however, that the frequently observed spring and autumn maxima in bacterial numbers (Taylor, 1936) may arise, if at these seasons there prevails a soil temperature insufficiently low to check the growth of bacteria altogether (such as might happen in winter time), yet low enough to permit the accumulation of higher numbers of bacteria than in summer time.

Summary.

Two soils were incubated with and without addition of decomposable organic material (hay and fungal mycelium) for about 3 months at 4 ranges of temperature, from 5°C. to 37°C. Determinations were made at different time-intervals of the abundance of microorganisms, by both microscopical and plate methods, as well as of ammonia and nitrate. The rate of nitrate accumulation, from the soil humus as well as from the added materials, increased with the temperature, whereas the numbers of bacteria and the densities of fungi showed an inverse relationship, becoming highest at the lowest temperature, i.e. the lower the temperature of decomposition, the greater a proportion of nitrogen in the transformed organic matter is temporarily locked up as microbial substance before eventually appearing as ammonia and nitrate. At 5°C. the numbers of bacteria were occasionally so high as to account for approximately one-third of the nitrogen present in the added organic material.

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ABSTRACT OF PROCEEDINGS.

ORDINARY MONTHLY MEETING.

31st May, 1939.

Mr. E. C. Andrews, B.A., Vice-President, in the Chair.

Miss Marion W. Hutley, B.Sc., was elected an Ordinary Member of the Society.

The Chairman offered congratulations to Dr. H. G. Raggatt on attaining the degree of Doctor of Science of the University of Sydney, and to Dr. C. J. Magee on attaining the degree of Doctor of Science in Agriculture.

The Donations and Exchanges received since the previous Monthly Meeting (26th April, 1939), amounting to 10 Volumes, 146 Parts or Numbers, 4 Bulletins, 4 Reports and 8 Pamphlets, received from 87 Societies and Institutions, were laid upon the table.

PAPERS READ.

1. A New Species of Chalcid (Genus *Eurytoma*) associated with *Tepperella trilineata* Cam., a Wasp causing Galling of the Flower Buds of *Acacia decurrens*. By N. S. Noble, D.Sc.Agr., M.Sc., D.I.C.
2. The Upper Palaeozoic Rocks between Mount George and Wingham, New South Wales. By A. H. Voisey, M.Sc.
3. The Lorne Triassic Basin and Associated Rocks. By A. H. Voisey, M.Sc.
4. Taxonomic Notes on the Order Embioptera. ii. Description of a New Neotropical Genus. By Consett Davis, M.Sc.

NOTES AND EXHIBITS.

Professor J. Macdonald Holmes sent, for exhibition, several plants collected in the Lismore district.

ORDINARY MONTHLY MEETING.

28th June, 1939.

Mr. E. Cheel in the Chair.

Letters were received from Dr. H. G. Raggatt and Dr. C. J. Magee, returning thanks for congratulations.

The Chairman announced that the Royal Zoological Society of Victoria has decided to offer a prize of £25 for an essay on any scientific aspect of the fauna of Australia. The prize is open to all interested persons and essays should be forwarded to the Hon. Secretary, Royal Zoological Society of Victoria, 80 Swanston Street, Melbourne, C.1, on or before 30th December, 1939.

The Chairman announced that members were invited by the Biological Society, Sydney University, to a symposium on "The Origin of Life", on Wednesday, 12th July, at 8 p.m., in the Organic Chemistry Lecture Theatre, University of Sydney.

The Donations and Exchanges received since the previous Monthly Meeting (31st May, 1939), amounting to 11 Volumes, 136 Parts or Numbers, 3 Bulletins, 4 Reports and 12 Pamphlets, received from 69 Societies and Institutions and 2 private donors, were laid upon the table.

PAPERS READ.

1. A New Species of *Megastigmus* parasitic on *Tepperella trilineata* Cam., a Wasp causing Galling of the Flower Buds of *Acacia decurrens.* By N. S. Noble, D.Sc.Agr., M.Sc., D.I.C.

2. A Reconnaissance Survey of the Vegetation of the Myall Lakes. By Professor T. G. B. Osborn, D.Sc., F.L.S., and R. N. Robertson, Ph.D., B.Sc.

3. The Genus *Adrama*, with Descriptions of Three New Species (Diptera, Trypetidae). By J. R. Malloch. (*Communicated by F. H. Taylor, F.R.E.S., F.Z.S.*)

4. A New Family of Lepidoptera. By A. Jefferis Turner, M.D., F.R.E.S.

NOTES AND EXHIBITS.

Mr. E. Cheel exhibited specimens and drawings of grasses with notes thereon as follows: (1) *Cynodon.*—Four species of the genus are recorded for Australia by Bentham (*Fl. Aust.*, vii, 1878, p. 608), namely, *C. dactylon*, *C. tenellus*, *C. convergens* and *C. ciliaris.* The three latter species are classed in the genus *Microchloa* by Domin, and *Brachyachne* by the late Dr. O. Stapf and C. E. Hubbard of Kew, England. The common "Couch Grass" of Australia is still retained in the genus *Cynodon* by the Kew authorities and the species *C. dactylon* is noted for its variability, but only one variety has been recorded in botanical literature, namely, var. *pulchellus* (Bentham, l.c.). Specimens collected by E. Cheel at Hillston in November, 1926, and Inverell by Mr. Sommerlad in May, 1939, were exhibited which may belong to the latter variety, but as there are no authentic specimens available for comparison they are tentatively recorded under this varietal name. (2) *Brachiaria notochtona* Stapf.—Originally described by Dr. Domin of Prague under the name *Panicum notochtonum*, and recorded and illustrated by Maiden and Cheel (*Agric. Gaz. N.S.W.*, 1914, p. 1034) under Domin's name, afterwards by Hughes as *Urochloa notochthona.* (3) *Brachiaria piligera* (F.v.M.) Hughes var. *intercedens* C. E. Hubbard.—Recorded and illustrated as *Panicum intercedens* Domin by Maiden and Cheel (*Agric. Gaz. N.S.W.*, 1914, p. 1035), and *Panicum helopus* Maiden, not Bentham or Trin. (*Agric. Gaz. N.S.W.*, 1903, p. 241). (4) *Themeda arguens* C. E. Hubbard, syn. *Anthistria frondosa* R. Br.—Darwin, F. H. Taylor, March, 1939.

ORDINARY MONTHLY MEETING.

26th July, 1939.

Professor J. Macdonald Holmes, B.Sc., Ph.D., President, in the Chair.

Dr. C. E. M. Gunther, New Guinea, and Miss Joan Johnston, Bexley, were elected Ordinary Members of the Society.

The President announced that the proclamation protecting certain wild flowers had been extended for another year from 1st July, 1939. Five species, *Clianthus Dampieri*, *Grevillea asplenifolia*, *G. Caleyi*, *Sprengelia incarnata*, and *Persoonia pinifolia*, have been added to the list this year.

The President drew attention to the following International Congresses to which the Society has been invited to nominate representatives: 7th International Botanical Congress, Stockholm, 17th–25th July, 1940; 18th International Geological Congress, London, 31st July–8th August, 1940; 13th International Zoological Congress, Paris, July, 1940. Any members who may be likely to attend any one of these three Congresses are invited to inform the Secretary of their intention.

The Donations and Exchanges received since the previous Monthly Meeting (28th June, 1939), amounting to 25 Volumes, 164 Parts or Numbers, 5 Bulletins and 4 Pamphlets, received from 89 Societies and Institutions, were laid upon the table.

PAPERS READ.

1. Australian Coleoptera. Notes and New Species. No. xi. By H. J. Carter, B.A., F.R.E.S.

2. Observations on the Bionomics and Morphology of seven Species of the Tribe Paropsini (Fam. Chrysomelidae). By D. Margaret Cumpston, M.Sc., Linnean Macleay Fellow of the Society in Zoology.

3. Hymenopterous Parasites of Embioptera. By Alan P. Dodd.

4. Miscellaneous Notes on Australian Diptera. vi. Dolichopodinae. By G. H. Hardy.

NOTES AND EXHIBITS.

Mr. E. Cheel exhibited fresh flowering specimens of *Calythrix* from cultivated plants raised from seed obtained from Denman. The species is allied to *C. tetragona* and has been regarded as a form of that species, but it is proposed to describe it as a new species when investigations are complete.

Professor J. Macdonald Holmes showed some coloured slides of the Kyogle and Broken Hill districts.

ORDINARY MONTHLY MEETING.

30th August, 1939.

Mr. F. H. Taylor, F.R.E.S., F.Z.S., in the Chair.

The Donations and Exchanges received since the previous Monthly Meeting (26th July, 1939), amounting to 7 Volumes, 117 Parts or Numbers, 1 Bulletin, 4 Reports and 7 Pamphlets, received from 69 Societies and Institutions and 1 private donor, were laid upon the table.

PAPERS READ.

1. The Geology of the Lower Manning District of New South Wales. By A. H. Voisey, M.Sc.

2. The Geology of the County of Buller, New South Wales. By A. H. Voisey, M.Sc.

3. The Diptera of the Territory of New Guinea. No. x. Family Ceratopogonidae. By J. W. S. Macfie, M.A., D.Sc., F.R.E.S. (*Communicated by F. H. Taylor, F.R.E.S., F.Z.S.*)

4. Taxonomic Notes on the Order Embioptera. iii–v. By Consett Davis, M.Sc.

5. The Diptera of the Territory of New Guinea. No. xi. Family Trypetidae. By J. R. Malloch. (*Communicated by F. H. Taylor, F.R.E.S., F.Z.S.*)

6. A Note on the Synonymy of *Leptops* (Coleoptera: Curculionidae). By K. C. McKeown.

ORDINARY MONTHLY MEETING.

27th September, 1939.

Professor J. Macdonald Holmes, B.Sc., Ph.D., President, in the Chair.

Messrs. S. L. Allman, B.Sc.Agr., Sydney, T. Langford-Smith, Chatswood, and A. J. Marshall, Newtown, were elected Ordinary Members of the Society.

The President announced that the Council is prepared to receive applications for four Linnean Macleay Fellowships tenable for one year from 1st March, 1940, from qualified candidates. Applications should be lodged with the Secretary, who will afford all necessary information to intending candidates, not later than Wednesday, 1st November, 1939.

The attention of members was drawn to a meeting of the proposed Australian Association of Scientific Workers to be held at the Botany School, University of Sydney, on Wednesday, 4th October, 1939, at 8 p.m.

The President referred to the death of William Butler Gurney, Government Entomologist, who had been a member of the Society since 1901.

The Donations and Exchanges received since the previous Monthly Meeting (30th August, 1939), amounting to 16 Volumes, 129 Parts or Numbers, 6 Bulletins and 2 Pamphlets, received from 69 Societies and Institutions, were laid upon the table.

PAPERS READ.

1. The Association between the Larva described as *Trombicula hirsti* var. *buloloensis* Gunther and *Trombicula minor* Berlese. By C. E. M. Gunther, M.B., B.S., D.T.M.

2. Observations on the Life-history of *Neoschöngastia kallipygos* Gunther (Acarina, Trombidiidae). By C. E. M. Gunther, M.B., B.S., D.T.M.

3. *Ectocarpus confervoides* (Roth.) Le Jol. By Valerie May, B.Sc., Linnean Macleay Fellow of the Society in Botany.

4. Taxonomic Notes on the Order Embioptera. vi–x. By Consett Davis, M.Sc.

NOTES AND EXHIBITS.

Mr. E. Cheel exhibited samples of material known in the trade as "Rice-Paper", which is used to make artificial flowers. A Sydney firm submitted the material for identification with a view of extensive cultivation in Australia. With the assistance of Dr. Samuel Record, Professor of Forest Products in the Yale University, New Haven, Connecticut, it has been classified as *Tetrapanax papyriferum* (Hook.) K. Koch. A closely related plant is cultivated in the Botanic Gardens, Sydney, and a few private gardens under the name *Fatsia japonica* (Thunb.) Dcne., and is frequently mistaken for the true Rice-Paper plant listed in catalogues as *Fatsia papyrifera* and *Aralia papyrifera*.

Mr. Cheel also submitted the following notes on recent classification of certain species of Australian grasses: (1) *Chamaeraphis spinescens* of Maiden figured in *Agric. Gaz. N.S.W.*, September, 1900, is *Chamaeraphis squarrosa* Chase. Specimens collected at Hillston in November, 1926, were exhibited; (2) *Panicum reversum* F.v.M., of Maiden with an illustration (*Agric. Gaz. N.S.W.*, September, 1897) is *Paractaenum novae-hollandiae* Beaud. (Syn. *Panicum paractaenum* Kunth. vide Royal Herbarium, Kew (England) authorities).

A series of cultivated specimens of nine species and varieties of *Callistemon* were exhibited to show the fugacious nature of the chaff-like bracts which support the individual flowers arranged in the spike-like inflorescence. The bracts in most species are shed before the petals and filaments are expanded. In *Callistemon acuminatus* the bracts are shed simultaneously with the petals and filaments. The leaves of *Callistemon viminalis* are shed just before spring and renewal of foliage takes place about three weeks after defoliation. The seed capsules and seeds are fully matured in ten to twelve months. The other species are not fully developed until about two and a half years.

Miss J. Vickery exhibited specimens, from the Broken Hill district, of *Trisetum pumilum* Kunth., a small European grass already naturalized in South Australia; *Eragrostis barrelieri* Daveau, a Mediterranean grass species which has sometimes been confused with *E. cilianensis*; *Statice Thouini* Viv., a native of the Eastern Mediterranean region which has appeared spontaneously in an irrigated area at Broken Hill. It occurs in South Australia and had probably been introduced from there; two forms of *Atriplex spongiosum* F. Muell. collected from the same locality; *Galenia secunda* Sond., a native of South Africa, a species which has only been collected previously in New South Wales near Newcastle and Maitland; *Swainsona fissimontana* J. M. Black, a native pea described from the Broken Hill district.

The first three of the species exhibited do not appear to have been recorded previously from New South Wales.

Dufay colour photographs of some aspects of the ground flora in the Wilcannia, Broken Hill and Silverton districts, and a number of specimens illustrating some of the more important and conspicuous herbaceous elements of the vegetation were also exhibited.

Professor E. Ashby exhibited lantern slides and a specimen of wood illustrating the activities of beavers in the construction of dams, using *Populus tremuloides*.

ORDINARY MONTHLY MEETING.

25th October, 1939.

Professor J. Macdonald Holmes, B.Sc., Ph.D., President, in the Chair.

The President reminded candidates for Linnean Macleay Fellowships, 1940–41, that Wednesday, 1st November, 1939, was the last day for receiving applications.

The President referred to the death of Bishop Dwyer, who had been a member of the Society since 1920.

The Donations and Exchanges received since the previous Monthly Meeting (27th September, 1939), amounting to 18 Volumes, 70 Parts or Numbers, 7 Bulletins and 2 Reports, received from 47 Societies and Institutions, were laid upon the table.

PAPERS READ.

1. Elementary Hydrography of South-eastern Australia. By F. A. Craft, B.Sc.
2. A Note on the Re-examination of Australian species of Ceratopogonidae. By J. W. S. Macfie, M.A., D.Sc., F.R.E.S. (*Communicated by F. H. Taylor, F.R.E.S., F.Z.S.*)
3. Strongylate Nematodes from Marsupials in New South Wales. By Professor T. Harvey Johnston, M.A., D.Sc., F.L.S., and Patricia M. Mawson.

NOTES AND EXHIBITS.

Mr. E. Cheel exhibited flowering specimens taken from cultivated plants: *Leptospermum emarginatum*, *Callistemon hortensis* Hort., *C. acuminatus*, *Callistemon* hybrid (*C. acuminatus* × *C. lanceolatus*), *C. linearis*, *C. pinifolius* and *C. pachyphyllus*.

Mr. J. A. Dulhunty exhibited specimens and photographs of *Macrozamia Macdonnelli* from Macdonnell Range, Central Australia. The species is confined to this region, and is closely related to coastal types, but has much larger seeds. It grows near permanent water and fresh springs, but not near the mound springs. It has remained isolated in Central Australia on account of surrounding desert conditions, which have evidently persisted since late Cretaceous or early Tertiary time.

Mr. J. R. Kinghorn exhibited a specimen of *Bufo marinus* Linn., the Giant Toad, introduced into Queensland cane-fields from Hawaii in 1934 to control the cane borer. It was stated at a conference of sugar planters in Puerto Rico the same year that "if conditions in Australia and Fiji are at all comparable to those in Puerto Rico, the white grub problem in those countries would be solved within ten or fifteen years". In a recent letter Dr. K. J. A. W. Lever, of the Department of Agriculture, Fiji, stated that the toad was not introduced into Fiji until 1936, and that among other insects in the stomach of one specimen examined were two banana borers, *Cosmopolites sordidus* Chevr., the first record for Fiji. No records are yet to hand regarding its economic status in Queensland, into which State its introduction did not go unchallenged. The Giant Toad is a very prolific breeder and is now extremely plentiful in the Cairns–Gordonvale district and is spreading rapidly over the country. The fear is that the toad may interfere seriously with the endemic herpetological fauna.

The Secretary referred to the recent death of Mr. Fred Turner, at the age of 87. Mr. Turner had been a member of the Council from 1897 to 1912 and during that period had been an active member of the Society. He was a member of the Society from 1891 to 1923.

ORDINARY MONTHLY MEETING.

29th November, 1939.

Professor J. Macdonald Holmes, B.Sc., Ph.D., President, in the Chair.

The President announced that the Council had reappointed Miss Ilma M. Pidgeon, M.Sc., Miss Valerie May, B.Sc., and Miss Margaret Cumpston, M.Sc., to Linnean Macleay Fellowships in Botany, Botany and Zoology respectively, for one year from 1st March, 1940, and had appointed Mr. J. A. Dulhunty, B.Sc., to a Linnean Macleay Fellowship in Geology for one year from 1st March, 1940.

The Donations and Exchanges received since the previous Monthly Meeting (25th October, 1939), amounting to 8 Volumes, 79 Parts or Numbers, 2 Bulletins, 7 Reports and 4 Pamphlets, received from 55 Societies and Institutions, were laid upon the table.

PAPERS READ.

1. The General Geology of the District east of Yass, N.S.W. By Kathleen Sherrard, M.Sc.

2. Taxonomic Notes on the Order Embioptera. Parts xi–xiv. By Consett Davis, M.Sc.

3. Contribution to the Microbiology of Australian Soils. v. Abundance of Microorganisms and Production of Mineral Nitrogen in relation to Temperature. By H. L. Jensen, Macleay Bacteriologist to the Society.

NOTES AND EXHIBITS.

Professor Macdonald Holmes handed to the Society a set of about 160 photographs taken by Dr. Brough and Messrs. Beadle and Langford-Smith during the excursion to the far west of New South Wales in August, 1939.

Dr. H. L. Kesteven exhibited a vertical projector designed for examination of large sections and for use in place of a camera lucida.

DONATIONS AND EXCHANGES.

Received during the period 27th October, 1938, to 25th October, 1939.

(*From the respective Societies, etc., unless otherwise mentioned.*)

ABERYSTWYTH.—*Welsh Plant Breeding Station, University College of Wales.* Bulletin, Series H, No. 15 (1939); "The Welsh Journal of Agriculture", xv (1939); "Ley-farming and a Long-term Agricultural Policy", by R. G. Stapledon (From *Herbage Reviews*, vi, 3, 1938).

ACCRA.—*Geological Survey Department, Gold Coast Colony.* Report for the Financial Year 1937-38 (1938).

ADELAIDE.—*Department of Mines: Geological Survey of South Australia.* Annual Report of the Director of Mines and Government Geologist for 1937 (1938); Bulletin No. 18 (1939); Mining Review for the Half-years ended 30th June, 1938 (No. 68) (1938) and 31st December, 1938 (No. 69) (1939).—*Field Naturalists' Section of the Royal Society of South Australia and South Australian Aquarium Society.* "South Australian Naturalist", xix, 2-4 and Supplement (1938-1939).—*Public Library, Museum and Art Gallery of South Australia.* 54th Annual Report of the Board of Governors, 1937-38 (1938); Records of the South Australian Museum, vi, 2 (1938).—*Royal Society of South Australia.* Transactions, lxii, 2 (T.p. & c.) (1938); lxiii, 1 (1939).—*South Australian Ornithological Association.* "The South Australian Ornithologist", xiv, 8 (1938); xv, 1-3 (1939).—*University of Adelaide.* "The Australian Journal of Experimental Biology and Medical Science", xvi, 4 (T.p. & c.) (1938); xvii, 1-3 (1939).—*Woods and Forests Department.* Annual Report for the Year ended 30th June, 1938 (1938).

ALBANY.—*New York State Library, University of the State of New York.* New York State Museum Bulletin Nos. 314-316, 318, 319 (1938-1939).

ALGER.—*Institut Pasteur d'Algerie.* Archives, xvi, 3-4 (T.p. & c.) (1938); xvii, 1-2 (1939).—*Société d'Histoire Naturelle de l'Afrique du Nord,* Bulletin, xxix, 6-9 (T.p. & c.) (1938); xxx, 1-3 (1939).

AMSTERDAM.—*Koninklijke Akademie van Wetenschappen.* Proceedings, xli, 6-10 (T.p. & c.) (1938); xlii, 1-2 (1939); Verhandelingen Afdeeling Natuurkunde, 2e Sectie, xxxvii, 5-7 (1938).—*Nederlandsche Entomologische Vereeniging.* Entomologische Berichten, x, 222-227 (1938-1939); Tijdschrift voor Entomologie, lxxxi, 3-4 (T.p. & c.) (1938); lxxxii, 1-2 (1939).

ANN ARBOR.—*University of Michigan.* Contributions from the Laboratory of Vertebrate Genetics, No. 7 (1938); Miscellaneous Publications of the Museum of Zoology, No. 40 (1938); Occasional Papers of the Museum of Zoology, T.p. & c. for Nos. 296-342 (Vol. xiii) (1934-1936); Nos. 378-390; T.p. & c. for Nos. 343-390 (Vol. xiv) (1936-1938); Nos. 391-402 (1938-1939).

ATHENS.—*Zoological Institute and Museum, University of Athens,* Acta, ii, 3-4 (1939).

AUCKLAND.—*Auckland Institute and Museum.* Annual Report, 1938-39 (1939); Records, ii, 3 (1938).

BALTIMORE.—*Johns Hopkins University.* Bulletin of the Johns Hopkins Hospital, lxiii, 4-6 (T.p. & c.) (1938); lxiv, 1-6 (T.p. & c.) (1939); lxv, 1-3 (1939).

BANDOENG.—*Dienst van den Mijnbouw in Nederlandsch-Indie.* Bulletin of the Netherlands Indies Vulcanological Survey, Nos. 84-86 (1938-1939); Publications of the Mining and Geological Survey Department in the Netherlands Indies during 1900-1939 (1939); Wetenschappelijke Mededeelingen, No. 27, 1e Stuk (1938); "On *Polylepidina, Orbitocyclina* and *Lepidorbitoides*" by Dr. Ir. Tan Sin Hok (Batavia-Centrum, 1939).

BASEL.—*Naturforschende Gesellschaft.* Verhandlungen, xlix, 1937-38 (1938).

BATAVIA.—*Departement van Economische Zaken.* Bulletin du Jardin Botanique, Serie iii, Supplement Vol. i, Index; Supplement Vol. iii, 1 (1938); xvi, 1-2 (1938-1939); "Treubia", xvi, 4 (T.p. & c.) (1938); xvii, 1-3 (1939).—*Koninklijke Natuurkundige Vereeniging in Nederlandsch-Indie.* Natuurkundig Tijdschrift voor Nederlandsch-Indie, xcviii, 5-6 (T.p. & c.) (1938); xcix, 1-5 (1939).—*Natuurwetenschappelijke Raad voor Nederlandsch-Indie te Batavia (Netherlands India Science Council).* Publication, Nos. 14-16 (1939).

BERGEN.—*Bergens Museum.* Arbok, 1938, 1 (1938); Arsberetning, 1937-38 (1938).

BERKELEY.—*University of California.* Bulletin of the Department of Geological Sciences, xxiv, 11-12 (1938-1939); Publications, Botany, xviii, 6-7 (1938); xix, 7 (1939); Physiology, viii, 4 (1938); Zoology, xlii, 6 (1938); xliii, 9-10 (1939); Publications of the University of California at Los Angeles in Biological Sciences, i, 10-12 (1939).

BERLIN.—*Deutsch-Auslandischer Buchtausch.* "Flora", Neue Folge, xxxiii, 1-4 (T.p. & c.) (1938-1939).—*Zoologische Museum.* Mitteilungen, xxiii, 2 (T.p. & c.) (1938).

BERLIN-DAHLEM.—*Botanisch Garten und Museum.* Notizblatt, xiv, 123-124 (1938-1939).—*Deutsches Entomologisches Institut.* Arbeiten uber morphologische und taxonomische Entomologie aus Berlin-Dahlem, v, 4 (T.p. & c.) (1938); vi, 1-3 (1939); Arbeiten uber physiologische und angewandte Entomologie aus Berlin-Dahlem, v, 3-4 (T.p. & c.) (1938); vi, 1-2 (1939); Entomologische Beihefte aus Berlin-Dahlem, vi (1939).

BERN.—*Naturforschende Gesellschaft.* Mitteilungen a.d. Jahre 1938 (1939).—*Schweizerische Naturforschende Gesellschaft.* Verhandlungen, 119. Jahresversammlung, 1938 (1938).

BIRMINGHAM.—*Birmingham Natural History and Philosophical Society.* List of Members, 1939 and Annual Report for 1938; Proceedings, xvii, 1 (1939).

BLOEMFONTEIN.—*Nasionale Museum.* Argeologiese Navorsing, i, 9-10 (1939); Soologiese Navorsing, i, 8 (1939).

BOMBAY.—*Bombay Natural History Society.* Journal, T.p. & c. for xxxix, 3-4 (1938); xl, 2 (T.p. & c. for xl, 1-2) (1938); 3-4 (1938-1939); xli, 1 (1939).—*Haffkine Institute.* Report for the Year 1937; 1938 (1939).

BONN.—*Naturhistorischer Verein der Rheinlande und Westfalens.* "Decheniana", xcvii (A and B); xcviii, A, 1 (1938).

BOSTON.—*American Academy of Arts and Sciences.* Proceedings, lxxiii, 1-4 (1938-1939).—*Boston Society of Natural History.* Proceedings, xli, 6-7 (1939).

BRISBANE.—*Department of Agriculture.* Queensland Agricultural Journal, l, 4-6 (T.p. & c.) (1938); li, 1-6; lii, 1-3 (1939).—*Department of Mines: Geological Survey of Queensland.* "Queensland Government Mining Journal", xxxix, Sept.-Dec., 1938 (T.p. & c.) (1938); xl, Jan.-Aug., 1939 (1939).—*Queensland Museum.* Memoirs, xi, 3 (T.p. & c.) (1939).—*Queensland Naturalists' Club and Nature-Lovers' League.* "The Queensland Naturalist", xi, 1-3 (1939).—*Royal Society of Queensland.* Proceedings, xlix, 1937 (1938); l, 1938 (1939).—*University of Queensland.* University of Queensland Papers, Department of Biology, i, 10 (1939); "Water Conservation in Australia", by H. H. Dare (John Murtagh Macrossan Lectures for 1939) (1939).

BRNO.—*Prirodovedecka Fakulta, Masarykovy University.* Spisy (Publications) (Botanical only), Cis. 263, 267 (1938); "The Profile of Equilibrium as a Basis of the Study of River Terraces" by Jan Krejci (1939).

BROOKLYN.—*Brooklyn Botanic Garden.* "Genetics", xxiii, 6 (T.p. & c.) (1938); xxiv, 1-5 (1939).

BRUXELLES.—*Académie Royale des Sciences, des Lettres et des Beaux-Arts de Belgique.* Annuaire, 1939, 105me Année (1939); Bulletin de la Classe des Sciences, 5me Série, xxiv, 3-12 (T.p. & c.) (1938).—*Musée Royal d'Histoire Naturelle de Belgique.* Bulletin, xiv, 1-60 (T.p. & c.) (1938); Mémoires, Nos. 82-85 (1938); Mémoires, 2me

Série, Fasc. 13-14 (1938); Mémoires, Hors Série (Résultats Scientifiques du Voyage aux Indes Orientales Néerlandaises), ii, 19; iii, 18-19 (1938).—*Société Entomologique de Belgique.* Bulletin and Annales, lxxviii, 3-12 (T.p. & c.) (1938); lxxix, 1-5 (1939).—*Société Royale de Botanique de Belgique.* Bulletin, lxx, 2 (T.p. & c.); lxxi, 1-2 (T.p. & c.) (1938-1939).—*Société Royale Zoologique de Belgique.* Annales, lxviii, 1937 (1938); lxix, 1938 (1939).

BUDAPEST.—"Index Horti Botanici Universitatis Budapestinensis", iii (1938).

BUENOS AIRES.—*Ministerio de Agricultura de la Nacion: Direccion de Propaganda y Publicaciones.* Publicacion Miscelanea, No. 43 (1938).—*Sociedad Argentina de Ciencias Naturales.* Revista, "Physis", xii, 44 (T.p. & c.) (1938).

BUITENZORG.—*Nederlandsch-Indische Entomologische Vereeniging.* Entomologische Mededeelingen van Nederlandsch-Indie, iv, 3-4 (1938); T.p. & c. for ii-iv, 1937-1938 (1939); v, 1-3 (1939).

CAEN.—*Société Linnéenne de Normandie.* Mémoires, Nouvelle Série, Section Botanique, i, 4 (T.p. & c.) (1938).

CAIRNS.—*North Queensland Naturalists' Club.* "North Queensland Naturalist", vii, 56-58; viii, 59 (all with Supplements) (1938-1939).

CALCUTTA.—*Geological Survey of India.* Memoirs, lxxii, 2 (T.p. & c.) (1938); lxxiii (1939); Memoirs, Palaeontologia Indica, N.S. xxv, 1; xxvi, 1; xxvii, 1 (1939); Records, lxxii, 4 (T.p. & c.) (1938); lxxiii, 2-3 (1938); lxxiv, 1 (1939); Geographical Index to the Memoirs, Vols. i-liv, Records, Vols. i-lxv and General Reports of the Director for the Years 1897-1903 by T. H. D. La Touche (1938).—*Zoological Survey of India.* Report for the Years 1935 to 1938 (1938); Memoirs of the Indian Museum, xiii, 1 (1938); Records of the Indian Museum, T.p. & c. for xxxix; xl, 1-4 (1938).

CAMBRIDGE.—*Cambridge Philosophical Society.* Biological Reviews, xiii, 4 (T.p. & c.) (1938); xiv, 1-3 (1939).—*University of Cambridge.* Abstracts of Dissertations approved for the Ph.D., M.Sc., and M.Litt. Degrees during the Academical Year 1937-38 (1939).

CAMBRIDGE, Mass.—*Museum of Comparative Zoology at Harvard College.* Annual Report of the Director for 1937-38 (1938); Bulletin, lxxxii, 3-6 (T.p. & c.) (1938); lxxxiii; lxxxiv (1939); lxxxv, 1-3 (1938-1939).

CANBERRA.—*Administration of the Territory of New Guinea.* Geological Bulletin, No. 1 (1939).—*Commonwealth Bureau of Census and Statistics.* Official Year Book, No. 31, 1938 (1939).—*Council for Scientific and Industrial Research: Divisions of Economic Entomology and Plant Industry.* Contributions (Economic Entomology), Nos. 128-140; (Plant Industry), Nos. 101-109 (1938-1939).

CAPE TOWN.—*Royal Society of South Africa.* Transactions, xxvi, 4 (T.p. & c.) (1938); xxvii, 1 (1939).—*South African Museum.* Annals, xxiv, 5 (T.p. & c.); xxxii, 4 (1938); List of Papers published in Vols. i-xxx, together with an Index to Authors and Subjects (1938).

CHANGSHA (formerly Peiping).—*National Geological Survey of China.* Geological Bulletin, Nos. 31-32 (1938).

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PRIVATE DONORS (and Authors, unless otherwise stated).

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1898 Stead, David G., "Boongarre", Pacific Street, Watson's Bay.
1935 Still, Jack Leslie, B.Sc., Bio-chemical Laboratory, University of Cambridge, Cambridge, England.
1905 Stokes, Edward Sutherland, M.B., Ch.M., 15 Highfield Road, Lindfield.
1911 *Sulman, Miss Florence, "Burrangong", McMahon's Point.
1904 Sussmilch, Carl Adolph, F.G.S., 11 Appian Way, Burwood.

* Life Member.

1930 Taylor, Frank Henry, F.R.E.S., F.Z.S., School of Public Health and Tropical Medicine, Sydney University.
1938 Tonnoir, André Léon, Council for Scientific and Industrial Research, Box 109, Canberra City, A.C.T.
1921 *Troughton, Ellis Le Geyt, C.M.Z.S., Australian Museum, College Street, Sydney.
1902 Turner, A. Jefferis, M.D., F.R.E.S., Dauphin Terrace, Brisbane, Queensland.
1904 Turner, Rowland E., F.Z.S., F.R.E.S., c/o Standard Bank of South Africa, Adderley Street, Cape Town, South Africa.

1917 Veitch, Robert, B.Sc., F.R.E.S., Department of Agriculture, William Street, Brisbane, Queensland.
1930 Vickery, Miss Joyce Winifred, M.Sc., National Herbarium, Botanic Gardens, Sydney.
1934 Voisey, Alan Heywood, M.Sc., New England University College, Armidale, N.S.W.

1909 Walkom, Arthur Bache, D.Sc., Science House, Gloucester and Essex Streets, Sydney.
1930 Ward, Melbourne, Pasadena Flats, Cross Street, Double Bay, Sydney.
1911 Wardlaw, Henry Sloane Halcro, D.Sc., Physiology Department, The University, Sydney.
1936 Waterhouse, Douglas Frew, M.Sc., Council for Scientific and Industrial Research, Box 109, Canberra, A.C.T.
1897 *Waterhouse, Gustavus Athol, D.Sc., B.E., F.R.E.S., 39 Stanhope Road, Killara, Sydney.
1928 Waterhouse, Lionel Lawry, B.E., "Rarotonga", 42 Archer Street, Chatswood.
1927 Waterhouse, Walter Lawry, D.Sc.Agr., M.C., D.I.C. (Lond.), Faculty of Agriculture, Sydney University.
1911 Watt, Professor Robert Dickie, M.A., B.Sc., University of Sydney.
1926 *Whitley, Gilbert Percy, Australian Museum, College Street, Sydney.
1934 Wilson, Miss Janet Marion, B.A., 8 Lloyd Avenue, Hunter's Hill.
1938 Wilson, Ralph Dudingston, M.Sc., M.Sc.Agr., Biological Branch, Department of Agriculture, Farrer Place, Sydney.
1934 Womersley, Herbert, F.R.E.S., A.L.S., South Australian Museum, Adelaide, South Australia.
1932 Woodhill, Anthony Reeve, B.Sc.Agr., Department of Zoology, Sydney University.
1925 Wright, Fred, 35 Bligh Street, Sydney.
1936 Zeck, Emil Herman, 268 Blaxland Road, Ryde.

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1923 Wilson, Professor J. T., LL.D., M.B., Ch.M., F.R.S., Department of Anatomy, the New Museums, Cambridge, England.

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1888 Bale, W. M., F.R.M.S., 63 Walpole Street, Kew, Melbourne, Victoria.
1902 Broom, Robert, M.D., D.Sc., F.R.S., Transvaal Museum, Pretoria, Transvaal, South Africa.

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1934 Waterhouse, John Talbot, 39 Stanhope Road, Killara.

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INDEX.

(1939.)

(a) GENERAL INDEX.

(b) BIOLOGICAL INDEX.

New names are printed in SMALL CAPITALS.

This biological index is now restricted to genera and species of which there is some description, synonymy, reference to previously published description, or other record of importance.

Lists of species in this volume which are not indexed individually include:

Species of plants in Upper Williams River and Barrington Tops Districts (pp. 2-33);
Marine Algae of N.S.W. (Melanophyceae) (pp. 206-214);
Fossils from the Macleay Series, Manning River district (pp. 250-251);
Fossils from the Lorne Triassic Basin (pp. 259-260);
Plants from the Myall Lakes district (pp. 284-295);
Upper Ordovician Graptolites from district east of Yass, N.S.W. (p. 581).

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PROCEEDINGS, 1939.

LIST OF FAMILY AND GENERA DESCRIBED AS NEW IN THIS VOLUME (1939).

(Issued 15th May, 1939.)

Vol. LXIV. Nos. 281-282
Parts 1-2.

THE

PROCEEDINGS

OF THE

LINNEAN SOCIETY

OF

NEW SOUTH WALES

FOR THE YEAR

1939.

Parts I–II (Pages i–xxxii; 1–215).

CONTAINING THE PROCEEDINGS OF THE ANNUAL MEETING AND PAPERS READ IN MARCH-APRIL.

With five plates.
[Plates i-v.]

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1877	4 0	4 0	4 0	—	1900	8 0	10 6	10 6	17 6
1878	5 0	5 0	6 0	7 6	1901	10 0	9 0	5 0	17 6
1879	6 0	6 0	8 0	6 6	1902	7 0	7 6	7 6[3]	15 0
1880	6 6	—	7 6	7 6	1903	9 0	12 6	14 0	15 0
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1936 ..	6 6	7 0	9 9
1937 ..	6 0	9 3	8 9
1938 ..	6 3	11 6	9 9
1939 ..	12 3		

INDEX TO VOLUMES I-L OF THE PROCEEDINGS [Issued 15th February, 1929]. Pages 108. Price 5s.

The MACLEAY MEMORIAL VOLUME [Issued 13th October, 1893]. Royal 4to, li and 308 pages, with portrait, and forty-two plates. Price £2 2s.

DESCRIPTIVE CATALOGUE OF AUSTRALIAN FISHES. By William Macleay, F.L.S. [1881]. A few copies only. Price £1 net.

The TRANSACTIONS OF THE ENTOMOLOGICAL SOCIETY OF NEW SOUTH WALES, 2 vols., 8vo. [Vol. I (complete in five parts, 1863-66), price 70s. net, Parts 2-5 10s. each; Vol. II (complete in five parts, 1869-73), price 30s. net, or single Parts 7s. 6d. each.]

PROCEEDINGS, 1939, PARTS 1-2.

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(*Issued 15th September, 1939.*)

Vol. LXIV. **Nos. 283-284.**
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THE

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OF

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[Plates vi–xi.]

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EXPLANATION OF PLATE XI.

Fig. 1.—*Dacus papuaensis*, n. sp. Wing, type. × 6·5.
Fig. 2.—*Dacus albolateralis*, n. sp. Wing, type. × 6·5.
Fig. 3.—*Pseudosophira bakeri*, n. sp. Wing, type. × 5.
Fig. 4.—*Polyara insolita* Walker. Wing. × 5.
Fig. 5.—*Themarohystrix flaviceps*, n. sp. Wing, paratype. × 5.
Fig. 6.—*Themarohystrix suttoni*, n. sp. Wing, paratype. × 6·5.
Fig. 7.—*Clusiosoma biseriata*, n. sp. Wing, paratype. × 6·5.
Fig. 8.—*Clusiosoma puncticeps*, n. sp. Wing, type. × 6·5.
Fig. 9.—*Acanthoneura nigriventris*, n. sp. Wing, type. × 5.
Fig. 10.—*Neothemara formosipennis* Walker. Wing. × 5.
Fig. 11.—*Pseudacanthoneura septemnotata*, n. sp. Wing, type. × 5.
Fig. 12.—*Diarrhegmoides hastata*, n. sp. Wing, allotype. × 6·5.
Fig. 13.—*Hexacinia multipunctata*, n. sp. Wing, paratype. × 6·5.
Fig. 14.—*Pseudina buloloae*, n. sp. Wing, type. × 6·5.
Fig. 15.—*Anomoea nigrithorax*, n. sp. Wing, type. × 6·5.
Fig. 16.—*Pseudospheniscus taylori*, n. sp. Wing, type. × 6·5.
Fig. 17.—*Ceratitella loranthi* (Froggatt). Wing. × 6·5.
Fig. 18.—*Tephrella australis*, n. sp. Wing, type. × 6·5.
Fig. 19.—*Spathulina acroleuca* (Schiner). Wing. × 6·5.
Fig. 20.—*Chrysotrypanea trifasciata*, n. sp. Wing, type. × 6·5.
Fig. 21.—*Platensina parvipuncta*, n. sp. Wing, type. × 6·5.
Fig. 22.—*Sphenella marginata* Fallen. Wing. × 6·5.
Fig. 23.—*Camaromyia bullans* Wied. Wing. × 6·5.
Fig. 24.—*Tephritis pelia* Schiner. Wing. × 6·5.
Fig. 25.—*Trypanea glauca* Thoms. Wing. × 6·5.
Fig. 26.—*Paroxyna sororcula* Wied. Wing. × 6·5.

Note re *Ceratitella* (pp. 442, 452 supra), added 6 September, 1939.—The Formosan genus *Paratrirhithrum* Shiraki (*Mem. Fac. Sci. and Agric., Taihoku Imp. Univ., Formosa*, viii, 1933, Ent. No. 2, 137) differs in having the third antennal segment tapered to the narrowly rounded apex, the apex of the subcostal vein farther from the apex of the first and the latter running into the costal vein at a much more acute angle, not almost rectangularly bent forward to join that vein, while the third vein is much more arched on its apical portion, the apex being distinctly more deflected. The scutellum is also entirely black, though this is hardly a generic character.

PROCEEDINGS, 1939, PARTS 3-4.

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(Issued 15th December, 1939.)

Vol. LXIV. Parts 5-6. Nos. 285-286.

THE

PROCEEDINGS

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FOR THE YEAR

1939.

Parts V–VI (Pages 466–608); xxxiii–lxvii.

CONTAINING PAPERS READ IN SEPTEMBER-NOVEMBER, ABSTRACT OF PROCEEDINGS, DONATIONS AND EXCHANGES, LIST OF MEMBERS, AND INDEX.

With one plate.

[Plate xii.]

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1928	2 0	8 6	8 9	10 0	9 0	2 0
1929	2 0	6 3	8 6	11 0	12 6	2 0
1930	2 0	10 0	8 9	8 6	16 3	2 0
1931	2 0	8 0	7 0	7 3	8 9	2 0

Year.	Parts 1–2.	Parts 3–4.	Parts 5–6.
	s. d.	s. d.	s. d.
1932 ..	6 6	9 6	8 6
1933 ..	8 0	11 9	8 6
1934 ..	6 6	8 6	10 9
1935 ..	7 9	10 3	11 3
1936 ..	6 6	7 0	9 9
1937 ..	6 0	9 3	8 9
1938 ..	6 3	11 6	9 9
1939 ..	12 3	12 3	8 9

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