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VOLUME XXXI.

(PRESIDENTIAL ADDRESS).

QUEENSLAND FOSSIL FLORAS.

By A. B. Walkom, D.Sc.

(*Delivered before the Royal Society of Queensland, 24th March*, 1919).

The past year has been one of great activity amongst the members of the Society engaged in research work, as evidenced by the fact that Volume XXX. of the Proceedings contains no fewer than seventeen papers. That we have been able to publish a volume somewhat larger than usual is due to the financial assistance rendered by the University of Queensland and the Walter and Eliza Hall Fellowship Fund towards the publication of certain papers, and also to the continuance of the Government grant. We have to express our gratitude for this assistance, and especially to the Queensland Government, which, in a time of rigorous financial economy, has seen its way to recognise in a practical manner the value of the publication of the results of original scientific research work.

The membership of the Society remains about the same, and now that conditions may be expected to return gradually to normal, it is hoped that the number of members will show a steady increase. The attendance of members at the ordinary meetings of the Society has been far from satisfactory. As a result, a scheme has been brought before the Council whereby at certain meetings during the year lectures on popular subjects will supplement the papers, which are usually on more specialised branches of science. The object of this scheme is to make the meetings of more general interest. The Council has expressed its approval, and it is hoped to bring the scheme into operation during the coming year.

We are fortunate in being able to report that, as far as we know, those members of the Society who have been on active service during the past year are all safe, one of them, W. H. Bryan, M.Sc., having gained the Military Cross. We extend our hearty congratulations to him on this award.

Death has passed the Society by very lightly during the past year, and we have to record the loss of only one member, Percy Leonard Weston, by whose death in August, 1918, at the age of 38 years, a brilliant career was cut short. Mr. Weston obtained the degrees of B.Sc. and B.E. of the Sydney University in 1901 and 1904 respectively, gaining first-class honours with each degree, and in 1905 he was awarded the P.N. Russell gold medal for post-graduate engineering research, his thesis being "The mechanical production of ruled surfaces." Coming to Queensland in 1906, he entered into a consulting practice in partnership with Mr. A. C. F. Webb, in Brisbane, and during the succeeding eight years he designed and supervised the installation of numerous electric light and power plants in Southern Queensland. In 1914, he was appointed Lecturer in Mechanical and Electrical Engineering in the University of Queensland, which position he held at the time of his death. In 1917, he invented a steel belt drive on a magnetic pulley, and this invention has already been favourably commented on in Britain. He was closely associated for a number of years both with this Society and with the Queensland Institute of Engineers. He was a member of the Council of the former from 1910 to 1914, being Vice-President in 1911, and President in 1912, and has also occupied the position of President of the Queensland Institute of Engineers. His only contribution to our Proceedings was his presidential address, entitled "The internal combustion engine as a factor in national progress." Those of us who were privileged to know him well mourn the loss of a sincere friend, whose innate cheerfulness and readiness to help made him so many friends.

QUEENSLAND FOSSIL FLORAS.

For the scientific portion of my address I propose to give a short account of the fossil floras found in the stratified rocks in Queensland, with the object of making a contribution to the study of the distribution of floras during past geological periods.

This particular study—the geographical distribution of the floras of the past—is one of the most interesting aspects of the subject of palæobotany, and a treatment of even the Queensland fossil floras from this point of view could only be very inadequately carried out within the limits of such an address as this. My main object is, therefore, to indicate as concisely as possible, the extent to which our fossil floras are known. With regard to Queensland the time is opportune for the preparation of such a summary. Within the past few years a systematic examination of the Mesozoic floras has been carried out, revealing their variety and enabling them to be correlated, with some degree of certainty, with floras in other parts of the world. Earlier examinations had, in some cases, proved inconclusive and in others, largely as a result of paucity of material, erroneous correlations were made. Some of the latter have become so firmly established that it is a matter of some difficulty to eliminate them. The most notable example is with regard to the age of the Burrum Series which was formerly believed to be older than the Ipswich Series, mainly on account of the plants which were available at the time. It has been known definitely since 1912, and has repeatedly appeared in print, that the Burrum Series is much younger than the Ipswich Series, yet as late as 1917 such a well-known geologist as Professor Gregory still retained the old classification.*

The following account is intended to indicate the most recent opinions regarding the fossil-plant contents and the correlation of the strata, and to assist in clearing away any confusion which may still exist regarding the ages of the strata in Queensland.

Before proceeding to the details regarding the various floras I may be permitted to offer a few general remarks on the subject of Palæobotany and the difficulties with which the student has to contend. It must not be forgotten that fossil plants may be regarded from two distinct

*Report on Nomenclature of the Carboniferous, Permo-Carboniferous, and Permian rocks of the Southern Hemisphere. Brit. Ass. Adv. Sc., 1917 (p. 14 of report).

points of view, viz.: that of the botanist and that of the geologist.

From the purely botanical point of view only those remains in which structure is preserved are of value, and these are decidedly in the minority. Where conditions have been favourable, however, the preservation of structure is often very perfect, and the material exhibits detail of cell structure comparable with that of present-day plants. To illustrate this, it is sufficient to mention the completeness of our knowledge of the organisation of numerous extinct genera such as *Calamites*, *Lepidodendron* and *Lyginopteris* amongst Palæozoic forms and the Bennettiteæ from Mesozoic strata. The degree of preservation is often truly remarkable, amongst the most striking examples being (*a*) the flowers of the Mesozoic genus *Cycadeoidea*; (*b*) leaves of *Alethopteris* and *Neuropteris* from the Carboniferous, in which the cell contents after treatment have taken up certain stains differentially; and (*c*) the recognition of the embryo in numerous Palæozoic and Mesozoic seeds.

These extinct forms throw considerable light on the problem of the evolution of the flora of to-day, and without a knowledge of them a satisfactory solution of this problem could hardly be expected.

Geologically, plants are important for stratigraphical purposes, and it is very often useful to have distinctive names for plant remains which are of little value from a purely botanical point of view. Many botanists are apt to forget the value of fossil plant fragments in this connection, but *provided the fragments represent a distinctive and recognisable type*, there is no doubt of their value to the geologist, whether they show detailed structure or not.

Formerly, fossil plants were not relied on to any great extent in fixing stratigraphieal horizons, and, as a result, there has been a tendency to regard them as being much inferior to fossil invertebrates for this purpose. The amount of palæobotanical work that has been carried out within the past two or three decades, however, has shown that plants are of very considerable value in fixing the age of beds in which they occur.

That the study of fossil plants may have a definite economic value has been shown by the late Dr. Arber, whose application of palæobotany to the geology of coal resulted in an extensive consulting practice in that connection.

The greatest difficulty in dealing with fossil plants lies in the fact that usually the material is fragmentary, and, therefore, in the great majority of cases, it is not possible to obtain an accuracy comparable with that obtainable in the examination of recent plants. Nevertheless, even from the fragmentary material available, useful and reliable results may be obtained by careful observation and deduction. Unfortunately for the subject of Palæobotany, care has not always been exercised either in the choice of name or in the selection of specimens for naming. As Professor Seward has said :—" Worthless fossils are frequently designated by a generic and specific title ; an author lightly selects a new name for a miserable fragment of a fossil fern-frond without pausing to consider whether his record is worthy of acceptance at the hands of the botanical palæographer." Sir Joseph Hooker's remark in his Introductory Essay to the Flora of New Zealand, that " the naturalist has to seek truth amid errors of observation and judgment and the resulting chaos of synonymy which has been accumulated by thoughtless aspirants to the questionable honour of being the first to name a species," may be applied equally well to fossil floras. More recently, and nearer home, Mr. J. H. Maiden, speaking of the Australian Cainozoic flora, says :—" In the opinion of the most experienced botanists in Australia the botanical determinations and deductions built by some palæobotanists upon mere leaf impressions are to be regretted."

In the earlier stages of palæobotany there was undoubtedly a tendency to propose new names with too little reason, but it must be borne in mind that research work to-day is carried out under conditions which lend themselves far better to the production of accurate results than thirty years ago. And though such criticism as that by Mr. Maiden may be warranted in some few cases, I am pleased to be able to say that during some years of close study of Australian fossil floras, I have found that cases to which such criticism might be applied are the exception rather than the rule. The careful and detailed work of a large and increasing number of palæobotanists in the present century raises the hope that we have seen the last of even such exceptions, for there is no longer any excuse for inaccurate work.

In Queensland fossil plants occur in greater or less abundance on a number of horizons, and, in general, the assemblage of forms in each Series is sufficiently characteristic to enable it to be distinguished as belonging to that Series.

There are representatives of two floras of Palæozoic age, five of Mesozoic age, and possibly a number of Cainozoic, but we are unable, at present, to separate the Cainozoic flora into groups representing different horizons. The following table, representing portion of the Geological Record for Queensland, will serve to indicate the horizons on which fossil floras occur :—

		Series.
Cainozoic.		
Mesozoic.	Lower Cretaceous ..	*Styx Series* (freshwater) *Burrum Series* (freshwater) =Winton Series (freshwater)
	?Lower Cretaceous ..	*Maryborough Series* (marine) =Rolling Downs Series (marine)
	Jurassic	*Walloon Series* (freshwater)
	Triassic	?Bundamba Series (freshwater) *Ipswich Series* (freshwater)
Upper Palaeozoic.	Permo-Carboniferous	*Upper Coal Measures* Upper Marine Series *Lower Coal Measures* Lower Marine Series
	Carboniferous.. ..	*Star Series* (marine) =*Drummond Series* =*Rockhampton Series* =?*Herberton Series* =?Lawnhill Series =?Lower Gympie Series

Series in italics in the above table are those from which fossil plants have been obtained.

QUEENSLAND PALÆOZOIC FLORAS.

The Palæozoic floras in Queensland fall into two distinct groups representing the widely-distributed Carboniferous flora with *Lepidodendron* and the Permo-Carboniferous (or perhaps Permian) flora characterised by the abundance of *Glossopteris.*

(*a*) *The Carboniferous flora.* The oldest fossil flora yet described from Queensland is of Carboniferous age, occurring in the Star Series and its probable equivalents, the Drummond, Rockhampton and Herberton Series, respectively. The Star Series, from which members of this flora were originally described, was at the time believed to belong to the so-called Permo-Carboniferous System, and so, in the older descriptions, we find the flora of the Star Series described along with members of the typical *Glossopteris* flora. No work has been done on this flora for many years, and no attempt has yet been made to revise the older determinations and bring them into line with modern palæobotanical work.

The species which have been described or recorded from Carboniferous strata in Queensland are:—

	Star Series.	Drummond Series.	Rockhampton Series.	Herberton Series.
Archæocalamites scrobiculatus ..		x		
Calamites varians		x		
Calamites sp.			x	
Lepidodendron australe	x	x	x	
,, *veltheimianum* ..	x	x		
,, sp.		x		x
Stigmaria		x		
Cyclostigma australe		x		
Cyclostigma sp.	x		x	
Aneimites austrina		x		
Rhacopteris sp.				x
? *Cordaites australis*		x		

Of the species in this list there is a good deal of doubt with respect to the determination of the specimens referred to *Cyclostigma* and *Cordaites.* Apart from these, the general aspect of the flora is distinctly Carboniferous and the presence of a species of *Aneimites* in the Drummond Series and of *Rhacopteris* in the Herberton Series suggests the possibility of a correlation with the beds in New South Wales in which *Rhacopteris* is very abundant, and which are usually classed as Upper Carboniferous.

The number of definitely-determined species is very small and the preservation is, in general, so poor that we know very little of the structure of the Queensland specimens; it is, therefore, not possible in the present state of our knowledge, to make any detailed comparison with Carboniferous floras outside Australia. It is not even possible to make reasonable comparisons between the different Series in Queensland in which these plants are present. They may all represent approximately the one horizon within the Carboniferous, but it must be borne in mind that they may represent distinct horizons, and there is the possibility that one or more of the Series mentioned may be older than Carboniferous.

As matters stand at present we have to rely on the general Carboniferous facies of the flora and the fact that in some cases the plants are associated with marine fossils which also indicate a Carboniferous age.

FIG. 1—Map showing approximately the distribution of floras of Upper Carboniferous Age. (Mainly after David White).

That better-preserved material does exist is shown by the specimens collected by Daintree and presented by him to the National Museum in Melbourne; these were described by Mr. F. Chapman in 1904.* Future collecting may bring to light further well-preserved specimens.

The approximate distribution of floras of similar general character to this Queensland flora is indicated in figure 1.

(*b*) *The Permo-Carboniferous flora.* In Queensland there are many localities where typical members of the *Glossopteris* flora are found, but, as with the Carboniferous flora, little work has been carried out for many years past, and it is probable that a revision of the accumulated material would result in numerous alterations and additions. The widespread genus *Glossopteris* is typical of these occurrences, and there is at present no evidence of this genus transgressing the limits of the so-called Permo-Carboniferous System in Queensland, though it has been found in Triassic rocks in South Africa and Tonkin. *Gangamopteris*, which is usually associated with *Glossopteris* in this flora, has not yet been recorded in Queensland, but I have had the privilege of examining specimens of this genus obtained from near Warwick by Mr. J. Harward.

The following is a list of the species known in this flora in Queensland:—

Phyllotheca australis	*Glossopteris communis*
Archæocalamites scrobiculatus	,, *elegans*
Sphenophyllum speciosum	,, *indica*
Sphenopteris alata	,, *linearis*
,, *crebra*	,, *parallela*
,, *flexuosa*	,, *Wilkinsoni*
,, sp.	*Vertebraria* sp.
,, (*Mertensia*) *lobifolia*	*Cycadospermum Dawsoni*
Gangamopteris sp.	*Cordaites australis*
Glossopteris ampla	*Noeggerathiopsis* sp.
,, *Browniana*	*Araucarioxylon Daintreei*

An indeterminable fragment recorded from Bett's Creek as ? *Alethopteris* is not included in the above list.

In the Permo-Carboniferous System there are two series in which this flora is present, viz.:—The Lower

*Proc. Roy. Soc. Vic., xvi (ii), 1904, p. 306.

Coal Measures and the Upper Coal Measures, the two being separated by a series of marine deposits. It does not seem possible at present to separate the two series of Coal Measures by their floras, nor can we say just which forms occur in each Series, but there is no doubt of the presence of the typical *Glossopteris* Flora in each.

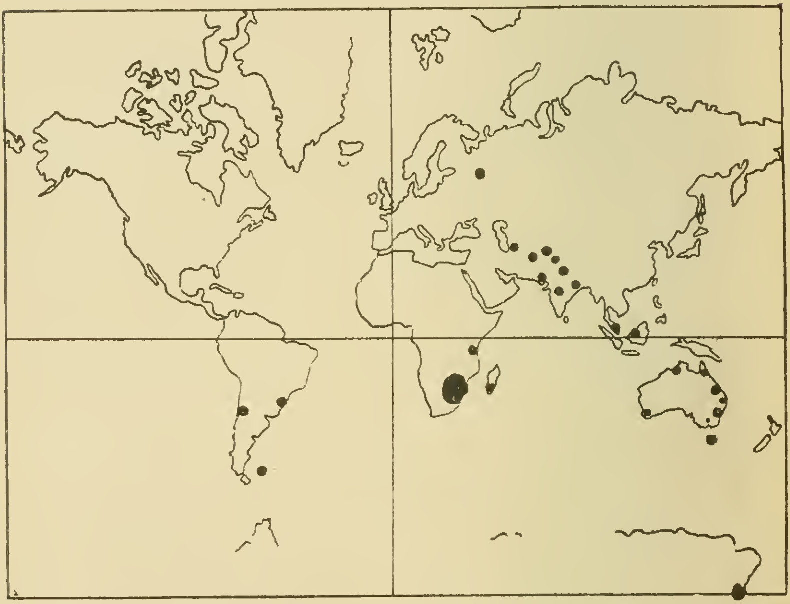

Fig. 2—Map showing approximately the distribution of the Glossopteris flora. (Mainly after David White).

The name Permo-Carboniferous in Australia arose under a misapprehension, and there has been considerable discussion during the past few years as to the advisability of discarding it. There is a more or less general agreement that the term is not a good one, but the difficulty lies in fixing the dividing line between Carboniferous and Permian. It is possible that the lower portion of the so-called Permo-Carboniferous System may be Carboniferous, but the faunas of the Lower and Upper Marine Series are very similar to one another, and both are very different from the Carboniferous fauna in Eastern Australia; in addition, the floras of the Lower and Upper Coal Measures can hardly be separated from one another, and there is reason to regard the Upper Coal Measures as Permian in age. To abandon the term Permo-Carboniferous before a satisfactory solution is obtained would probably cause much confusion, and in a recent paper I have followed the method of writing the name Permian (Permo-Carboniferous).

The distribution of the typical *Glossopteris* flora is indicated approximately in figure 2.

Queensland Mesozoic Floras.

When we pass on to rocks of Mesozoic age there is very abundant evidence of the plant life of the time in the presence of five distinct floras. The earliest of these is quite distinct from the Upper Palæozoic floras, and is indeed separated from the latest Palæozoic flora in Queensland by a considerable time interval. In New South Wales, there is an apparently conformable passage in places from the Upper Coal Measures to the Narrabeen Series and in places there is a slight mingling of the two floras. But in Queensland there are no Lower Triassic sediments, and consequently there is a distinct break between the floras of Palæozoic and Mesozoic age. Between the various Mesozoic floras, however, there is no such distinct break, but the floras themselves are distinct from one another. There are certain species which are present in more than one of the floras, but there are quite sufficient forms characteristic of each one to make them distinct. In addition, we can also take into account the general aspect of the flora and the proportions of the larger plant groups present.

These Queensland Mesozoic floras constitute a very good example of the value of a careful examination of fossil plants in stratigraphical geology. The whole of the Mesozoic Strata, from the Ipswich Series below to the Burrum Series above, appear to be quite conformable, but the floras of the different Series are distinct, and sufficiently so to enable their positions in the Geological Record to be fixed with a fair degree of certainty. They show the Ipswich Series to be Upper Triassic in age, the Walloon Series Lower Jurassic, and the Burrum Series Lower Cretaceous.

(*c*) *The Triassic flora.* The only series definitely Triassic in age in Queensland is the Ipswich Series, whose flora, as at present known, comprises some thirty-six species, as follows :—

Equisetites rotiferum	*Stenopteris elongata*
Equisetites sp.	*Bennettites* (*Williamsonia*) sp.
Phyllotheca australis	*Pterophyllum multilineatum*
Neocalamites hoerensis	*Tæniopteris Tenison-Woodsi*
Neocalamites cf. *Carrerei*	*Tæniopteris Carruthersi*
Schizoneura cf. *africana*	*Tæniopteris Dunstani*
Cladophlebis australis	*Tæniopteris lentriculiforme*
Cladophlebis Roylei	*Tæniopteris wianamattæ*
Coniopteris delicatula	*Tæniopteris crassinervis*
Dictyophyllum rugosum	*Ginkgo antarctica*
Thinnfeldia Feistmanteli	*Ginkgo digitata*
Thinnfeldia lancifolia	*Ginkgo* cf. *magnifolia*
Thinnfeldia odontopteroides	*Baiera Simmondsi*
Thinnfeldia acuta	*Baiera bidens*
Danæopsis Hughesi	*Baiera ipsviciensis*
Sagenopteris rhoifolia	*Baiera ginkgoides*
Sphenopteris lacunosa	*Stachyopitys annularioides*
Sphenopteris superba	*Stachyopitys Simmondsi*

In addition, gymnospermous seeds and coniferous woods are abundant.

The presence of a number of species whose systematic position is uncertain makes it inadvisable to state here the proportions of the larger plant groups. There may be noted, however, a relative abundance of ferns, cycads and ginkgos. A remarkable feature is the apparent absence of coniferous remains, with the exception of large silicified trunks which are probably coniferous, and are of rather common occurrence. Forerunners of Mesozoic conifers have been found in the Upper Palæozoic rocks in New South Wales, but have not yet been found in Queensland.

The flora of the Ipswich Series shows in general a resemblance to floras in various parts of the world, which have been regarded as of Rhætic age, and there seems little doubt that the position of the Ipswich Series in the Geological Record may be fixed as Upper Triassic.

The flora which shows the closest resemblance to the Ipswich flora is that of the Stormberg beds in South Africa, there being at least nine species which are identical or very closely allied in these two Series. In the Rhaetic strata of Sweden, Tonkin and North America there are also certain species which are identical with or very closely allied to species in the Ipswich Series.

The approximate distribution of Upper Triassic and Rhætic floras is shown in figure 3.

(*d*) *The Jurassic floras.* Floras of Lower Jurassic age are of widespread occurrence in the Walloon Series and

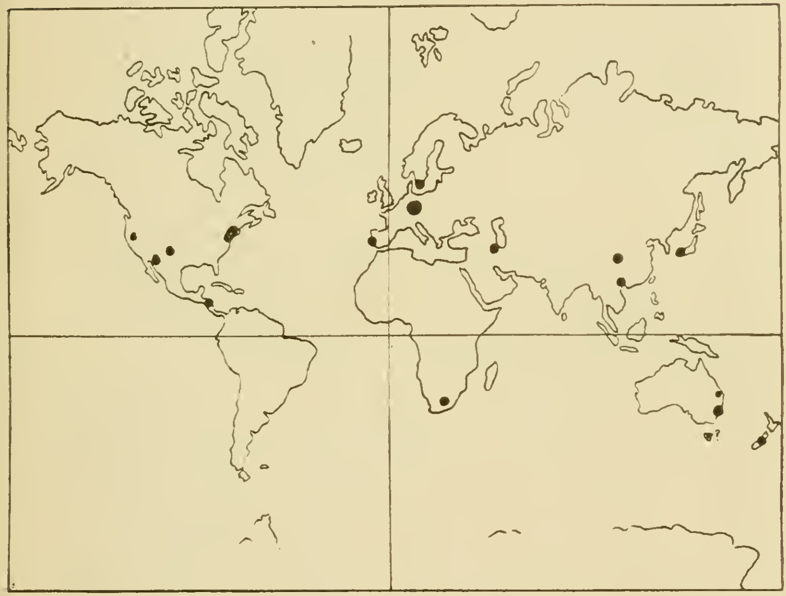

FIG. 3—Map showing approximately the distribution of floras of Upper Triassic (including Rhætic) Age.

its equivalents. The typical Walloon Series occurs in south-eastern Queensland; on the west of the main divide the series of sandstones, etc. extending from Cape York to the New South Wales border often referred to as the Artesian Series is the equivalent of the Walloon Series, as also is the Tiaro Series occurring to the west and south-west of Maryborough.

The plants known from these Series include some thirty-seven species, as follows :—

Equisetites rotiferum
Equisetites cf. *rajmahalensis*
Schizoneura sp. *a*
Schizoneura sp.
Cladophlebis australis
Cladophlebis Roylei
Phlebopteris alethopteroides
Dictyophyllum rugosum
Dictyophyllum Davidi
Hausmannia (?) *Buchii*
Thinnfeldia Feistmanteli
Thinnfeldia odontopteroides
Thinnfeldia lancifolia
Sagenopteris rhoifolia
Sphenopteris superba
Stenopteris elongata
Ginkgo magnifolia
Baiera Simmondsi
Ptilophyllum (*Williamsonia*) *pecten*
Pterophyllum abnorme
Pterophyllum contiguum
Pterophyllum Nathorsti
Pseudoctenis eathiensis
Otozamites queenslandi
Otozamites obtusus
Otozamites Feistmanteli
Otozamites Mandelslohi
Tæniopteris spatulata
Tæniopteris spatulata var. *major*
Tæniopteris Tenison-Woodsi
Tæniopteris Carruthersi
Tæniopteris lentriculiforme
Tæniopteris crassinervis
Araucarites polycarpa
Brachyphyllum crassum
Elatocladus planus
Phœnicopsis elongatus

Fig. 4—Map showing approximately the distribution of floras of Jurassic Age. (Mainly from the works of A. C. Seward).

This flora is distinct in a number of features from the earlier Ipswich flora. The more outstanding distinctions are the great increase in variety of the Cycads and the presence of coniferous remains other than silicified wood, in the form of vegetative shoots and portions of cones.

There is no doubt that the age of this flora is Lower Jurassic ; it shows a general agreement with typical floras of that age in various parts of the world, particularly as regards the type of plant present and also in the percentage representation of the various plant groups.

Floras of Lower and Middle Jurassic age are of world-wide distribution and they form the subject of a voluminous literature. A prominent feature is the very widespread occurrence of certain specific types and a general uniformity in the characters of these floras in regions which are subject to very different climatic conditions to-day. The approximate distribution of Jurassic floras is shown in figure 4.

(*e*) *The Cretaceous floras.* These are represented by plants from three Series of different ages, viz. :—the Maryborough Series, the Burrum Series and the Styx Series. The two latter are in all probability both of Lower Cretaceous age, but there is a distinct possibility that the Maryborough Series may be of Upper Jurassic age since the Burrum flora undoubtedly belongs to the lowest portion of the Cretaceous. This point is further discussed with the Burrum flora (see below, p. 17).

(*i*) *The flora of the Maryborough Series.* This series is of marine origin, and contains abundant marine fossils. Associated with these, however, a number of plant remains have been found. Although the number of actual specimens of the plants is small, we are particularly fortunate in that they show a considerable range of forms, the thirty-four specimens in the collection representing the following fourteen species :—

Equisetites cf. *rajmahalensis*	*Ptilophyllum* (*Williamsonia*?) *pecten*
Sphenopteris sp.	*Pterophyllum* sp.
Tæniopteris elongata	*Araucarites polycarpa*
Tæniopteris Tenison-Woodsi	*Araucarites mesozoica*
Tæniopteris sp.	*Araucarites* sp.
Ginkgo digitata	*Pagiophyllum Jemmetti*
Ginkgo sp.	?*Elatocladus* sp.

These plant remains have been carried down to the sea probably by river action and deposited along the shallow-water coastal belt; plants and marine shells (*Nucula*, etc.) have been found on the one specimen.

There is to be noted in this small collection a very decided increase in the proportion of Gymnosperms, and there is no doubt that the flora is distinctly newer than that of the Walloon Series.

The Maryborough Series is regarded as the equivalent of the Rolling Downs Series of Western Queensland, but so far no plant remains have been obtained from the latter. The Rolling Downs Series has generally been considered as of Lower Cretaceous age, but the determination of the age of the Burrum Series from its contained fossil plants throws some doubt on this (see below, p. 17).

(*ii*) *The flora of the Burrum Series.* An examination of the plant material from the Burrum Series has been completed, and the descriptions are now being published by the Queensland Geological Survey as Publication No. 263. This flora includes now thirty-five species, as follows:—

?*Neocalamites* sp.
Cladophlebis australis
?*Thinnfeldia lancifolia*
?*Dictyophyllum* sp.
Sphenopteris flabellifolia
Sphenopteris erecta
Sphenopteris burrumensis, sp. nov.
?*Chiropteris* sp.
Phyllopteris lanceolata, sp. nov.
Phyllopteris expansa, sp. nov.
Microphyllopteris gleichenioides
Microphyllopteris acuta sp. nov.,
Baiera bidens
Araucarites polycarpa
Araucarites Arberi, sp. nov.
Brachyphyllum crassum
Elatocladus planus
?*Elatocladus* sp.
Stenopteris elongata
Stenopteris laxum
Ptilophyllum (*Williamsonia*) *pecten*
Zamites takuraensis, sp. nov.
Nilssonia schaumburgensis
Otozamites sp.
Tæniopteris spatulata
Tæniopteris howardensis, sp. nov.
Tæniopteris sp.
Ginkgo digitata
Nageiopsis zamioides (?)
Pagiophyllum Jemmetti
Pagiophyllum peregrinum (?)
?*Sphenolepidium* sp.
Podozamites Kidstoni
Podozamites lanceolatus
Podozamites sp.

Nilssonia mucronatum occurs in Western Queensland in the Winton Series which is regarded as the equivalent of the Burrum Series, so it should perhaps be included in the above list.

The general proportions of the various groups and the affinities of the majority of the species in this flora point to its being of Lower Cretaceous age. It agrees in greatest detail in this respect with the American Kootanie and Patuxent floras and with the German Wealden flora, and we have little hesitation in pronouncing it a typical Lower Cretaceous flora equivalent to the Neocomian-Barremian or Wealden stages.

If the fossil plants can be relied upon in fixing the age of the Burrum Series—and I believe they can—an important question is raised concerning the age of the

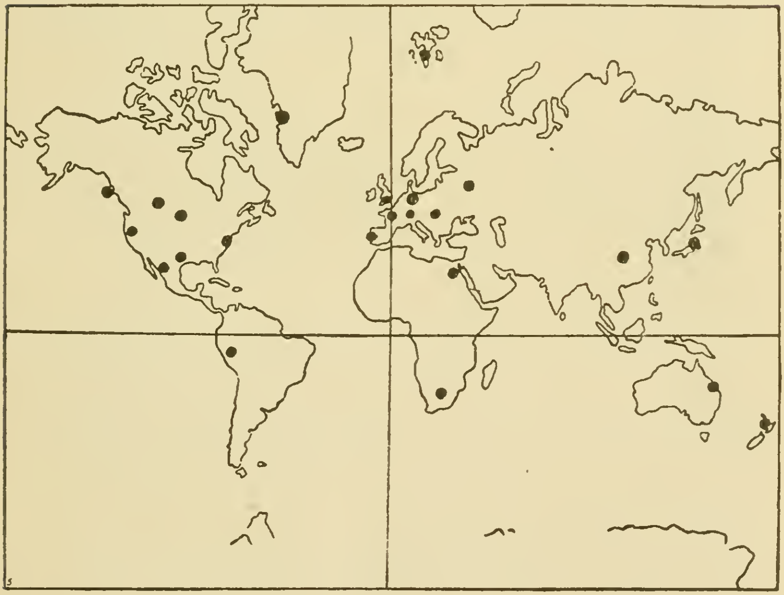

FIG. 5—Map showing approximately the distribution of floras of Lower Cretaceous Age. (Mainly after E. W. Berry).

Maryborough and Rolling Downs Series. The Rolling Downs Series has generally been regarded as Lower Cretaceous in age, but palæontologists appear to have been loth to refer it definitely to Upper Jurassic or Lower Cretaceous in spite of the fact that an extensive invertebrate fauna had been described. If we are correct in placing the Burrum Series at the base of the Cretaceous, then the Rolling Downs Series would be Upper Jurassic. A critical revision of the fauna of the latter would help in the solution of this problem.

This affords an excellent example of the advance in the study of fossil plants during recent years, and shows that they must now be ranked as of considerable importance in determining geological horizons.

(*iii*) *The flora of the Styx Series.* From the Styx Series a collection of fossil plants has been obtained by the Geological Survey, and the results of the examination of this material are being published with the description of the Burrum flora. The flora of the Styx Series comprises, as at present known, fourteen species, as follows :—

Equisetites sp.	*Tæniopteris howardensis*
Cladophlebis australis	*Araucarites* sp.
Nathorstia (?) *Willcoxi*, sp. nov.	?*Sphenolepidium* sp.
Phyllopteris lanceolata	*Podozamites* sp.
Microphyllopteris gleichenioides	?*Celastrophyllum* cf. *Hunteri*
Otozamites cf. *queenslandi*	?*Celastrophyllum* sp.
Tæniopteris spatulata	*Phyllites* sp.

The combination here of certain species characteristic of typical Mesozoic floras with a few undoubted Angiosperms stamps this flora at once as of Cretaceous age. In the field the Styx Series occupies a small isolated area, and field evidence gives little indication of its age. The determination of the contained fossils is, therefore, important in fixing the age of the Series.

There is a considerable degree of resemblance between the Styx flora and the Patapsco flora of North America, which has been referred to the Albian Stage of the Cretaceous by Professor E. W. Berry. Nearer home, there is a scanty Cretaceous flora occurring at Waikato Heads in New Zealand which Arber has referred to the Neocomian Stage on rather meagre evidence. The Styx flora also shows considerable resemblance to this Waikato Heads flora.

The predominance of typical Mesozoic (Triassic and Jurassic) forms in this flora indicates a Lower Cretaceous age, and the presence of a number of dictyledonous remains is sufficient to indicate that it is newer than the flora of the Burrum Series.

Queensland Cainozoic Flora.

Remains of plants in rocks of Cainozoic age are not uncommon in Queensland. They consist mainly of isolated dicotyledonous leaves, associated with which are stems and occasionally fern-fragments. As regards our present method of dealing with these remains they form, perhaps, the most unsatisfactory part of palæobotany. It is well known that in recent floras it is impossible to determine dicotyledons with anything like accuracy by merely studying isolated leaves, the same type of leaf in many cases occurring in widely-different familes.

Attempts have been made to compare these Tertiary leaves with present-day genera, but often the comparisons have been carried further than was justified, and this partly accounts for the hostile attitude of some botanists towards palæobotany.

There is no reason to suppose that these remains would not prove of some value in separating horizons within the Cainozoic, but it would seem necessary to adopt some arbitrary method of naming them. It is suggested that for purely stratigraphical purposes it might be worth while devising a conventional scheme for these remains, based on such characters as the type of venation, general dimensions of the leaf, nature of the margin, etc. The names used should not, in general, indicate relation to recent genera, and it would be clearly understood that such a scheme would be of no value botanically.

In addition to the plant remains already mentioned, there are abundant diatoms in the diatomaceous earths among the Cainozoic strata of Queensland.

From this account it will be seen that there is no lack of evidence as to the vegetation which has flourished in this part of the world during different geological periods ; it will also be observed that we have still much to learn before our knowledge of these floras is complete. I cannot conclude this address without expressing my appreciation of the efforts which Mr. B. Dunstan is making to clear up the palæontology of this State, and of my personal indebtedness to him in connection with the examination of the fossil floras. Although not doing any palæontological work himself, Mr. Dunstan is doing invaluable service to the geology of the State in having the various groups of fossils examined by scientists who are making a special study of these groups.

A PRELIMINARY LIST OF PLANTS OF THE NATIONAL PARK, MACPHERSON RANGE.*

By John Shirley, D.Sc.

(*Read before the Royal Society of Queensland, 24th March, 1919.*)

During a holiday of five weeks, spent in the National Park at heights of 3,000-3,600 feet, the following native plants were collected. For the determination of a few of the rarer species, and of two climbing plants not hitherto found in Queensland, I am indebted to Mr. J. H. Maiden, F.R.S., Government Botanist of New South Wales. My companion during this trip was Mr. H. Tryon, Government Entomologist, who was indefatigable in assisting in plant collection, and at the same time added largely to the store of insect specimens in the cabinets of the Department of Agriculture.

Most of the species indicated were gathered in the dense scrubs of Roberts Plateau, one of the highest parts of the Macpherson Range. The collection involved many difficulties, as the scrub trees are of enormous size. The flowers of these trees had first to be found with field glasses, and then by various ingenious means specimens were secured. The trees supported a wealth of climbing plants, whose enormous cables, and masses of foliage made observation of the flowers and fruits of their hosts a difficult task. Some of the climbing cables are the stems of plants of the grape family; one is a very prickly blackberry,

*[After this list had been handed to the Royal Society it was pointed out that a list of plants of the National Park had been published by the late F. M. Bailey. The two lists, however, do not overlap to any considerable extent.—Ed.]

which takes the place of the lawyer cane of the coastal scrubs and lower ranges; another, strange to say, is the plant with the large yellow flower, *Hibbertia volubilis*, well known for its unpleasant odour, and common along our beaches. Here it climbs to heights of 40 feet and over, and has stems eight to ten inches in diameter.

These high tablelands are very rich in ferns, and more than sixty species, including four kinds of treeferns, were observed.

Trees of the National Park.

(Found in flower or fruit, December, 1916, and January, 1917.)

No.	Species.	Family.	Local Name (if any).
1.	*Acacia longifolia*, Willd.	Leguminosæ ..	Long-leaved wattle.
2.	*Ackama Muelleri*, Benth.	Saxifrageæ ..	Corkwood of N.S. Wales.
3.	*Akania Hillii*, Hook. ..	Sapindaceæ ..	Turnip-wood.
4.	*Acronychia lævis*, Forst.	Rutaceæ ..	
5.	,, ,, v. *purpurea*, Bail.	Rutaceæ ..	
6.	*Actephila Mooreana*, Bail.	Euphorbiaceæ	
7.	*Alphitonia excelsa*, Reiss.	Rhamneæ ..	Red ash; Leather Jacket of N.S. Wales.
8.	*Alyxia ruscifolia*, R. Br.	Apocynaceæ ..	Necklace fruit.
9.	*Amoora nitidula*, Benth.	Meliaceæ ..	Jimmie Jimmie; Bog Onion (One of).
10.	*Anopterus Macleayanus*, F.v.M.	Saxifrageæ ..	Bridal Bells.
11.	*Archontophœnix Cunninghamii*, W. and D. ..	Palmeæ ..	Piccabeen or Bangalow Palm.
12.	*Baloghia lucida*, Endl.	Euphorbiaceæ	Scrub Bloodwood.
13	*Bosistoa sapindiformis*, F.v.M.	Rutaceæ ..	Union Nut.
14.	*Cadellia pentastylis*, F.v.M.	Simarubeæ ..	
15.	*Callicoma serratifolia*, Andr.	Saxifrageæ ..	Black Wattle of N.S.W.
16.	*Cleistanthus Cunninghamii*, Mull. Arg.	Euphorbiaceæ	
17.	*Codonocarpus australis*, A. Cunn.	Phytolaccaceæ	Bell-fruit.
18.	*Croton Verreauxi*, Baill..	Euphorbiaceæ	
19.	*Cryptocarya glaucescens*, R. Br.	Laurineæ ..	Brown Beech and Black Sassafras of N.S. Wales.
20.	*Cryptocarya obovata*, R.Br.	Laurineæ ..	Nucarn of N.S. Wales.
21.	,, *triplinervis*, R. Br.	Laurineæ ..	
22.	*Cupania pseudorhus*, A. Rich.	Sapindaceæ ..	Cowitch tree.

No.	Species.	Family.	Local Name (if any).
23.	*Decaspermum paniculatum*, Baill.	Myrtaceæ ..	
24.	*Diploglottis Cunninghamii*, Hook.	Sapindaceæ ..	Native Tamarind.
25.	*Doryphora sassafras*, Endl.	Monimiaceæ ..	Sassafras; Black Sassafras.
26.	*Duboisia myoporoides*,* R. Br.	Solanaceæ ..	
27.	*Dysoxylon Frazerianum*, Benth.	Meliaceæ ..	Pencil Cedar; Rosewood of N.S. Wales.
28.	*Elæocarpus grandis*, F.v.M.	Tiliaceæ ..	Brisbane Quandong; Blue Fig of N.S. Wales.
29.	*Elæodendron australe*, Vent.	Celastrineæ ..	Olive-wood.
30.	*Embothrium Wickhamii*, F.v.M., var. *pinnata*, M. and B.	Proteaceæ ..	Red Silky Oak
31.	*Evodia accedens*, Blume	Rutaceæ ..	
32.	,, *littoralis*, Endl. ..	Rutaceæ ..	
33.	,, *micrococca*, F.v.M.	Rutaceæ ..	Soapwood.
34.	*Eucalyptus eugenioides*, Sieb.	Myrtaceæ ..	Small-leaved White Stringybark.
35.	*Eugenia brachyandra*, M. and B.	Myrtaceæ ..	
36.	*Eugenia paniculata*, S. and B.	Myrtaceæ ..	One of the Scrub Cherries
37.	*Eupomatia laurina*, R.Br.	Anonaceæ ..	Native Custard Apple.
38.	*Euroschinus falcatus*, J. D. Hook.	Anacardiaceæ ..	Maiden's Blush of Queensland.
39.	*Fagus Moorei*†, F.v.M.	Cupuliferæ ..	Mountain Beech; Negro-headed Beech.
40.	*Flindersia Schottiana*, F.v.M.	Rutaceæ ..	Cudgerie and Ash of N.S. Wales.
41.	*Grevillea Helmsiæ*, Baill.	Proteaceæ ..	
42.	,, *Hilliana*, F.v.M.	Proteaceæ ..	White Yiel Yiel
43.	*Harpullia alata*, F.v.M.	Sapindaceæ ..	Wing-leaved Tulipwood.
44.	*Halfordia drupifera*, F.v.M.	Rutaceæ ..	
45.	*Homalanthus populifolius*, Grah.	Euphorbiaceæ	Bulli poison plant.

*A shrub on the coast, a tree with a diameter of two feet on the plateau. This plant is a close relation of that supplying the western blacks with Pituri.

†This species seems to be dying out. The main trunk is usually dead; its base has spread out laterally, and from it as many as 20 or 30 other stems may rise. The roots are often lifted in part above the ground, and form archways under which one can walk. The timber is red and very durable. Pieces long buried, and rotted on the outside, were found still red and unchanged within.

No.	Species.	Family.	Local Name (if any).
46.	*Hymenospermum flavum*, F.v.M.	Pittosporeæ ..	Bag Fruit.
47.	*Hypsophila Halleyana*, F.v.M.	Celastrineæ ..	
48.	*Laportea gigas*, Wedd.	Urticaceæ ..	Large Stinging Tree.
49.	*Litsea dealbata*, Nees. ..	Laurineæ ..	
50.	,, *reticulata*, Benth.	Laurineæ ..	Bally Gum; The Beech of N.S. Wales.
51.	*Marlea vitiensis*, Benth.	Cornaceæ ..	
52.	**Melicope pubescens*, Bail. = *Acronychia melicopoides* v. *laciantha* F.v.M. ..	Rutaceæ ..	
53.	*Myrsine crassifolia*, R.Br.	Myrsineæ ..	
54.	,, *variabilis*, R.Br.	Myrsineæ ..	
55.	*Myrtus rhytisperma*, F.v.M. v. *grandiflora*, Benth.	Myrtaceæ ..	
56.	*Orites excelsa*, R. Br. ..	Proteaceæ ..	Lofty Silky Oak; Prickly Ash of N.S.W.
57.	*Panax elegans*, F.v.M. ..	Araliaceæ ..	Mowbulan Whitewood.
58.	,, *Murrayi*, F.v.M.	Araliaceæ ..	Celery Tree.
59.	*Pennantia Cunninghamii*, Miers	Olacineæ ..	
60.	*Pentaceras australis*, Hook f.	Rutaceæ ..	Scrub White Cedar.
61.	*Pittosporum rhombifolium*, A. Cunn.	Pittosporeæ ..	Diamond-leaved Mock Orange
62.	*Pittosporum undulatum*, Vent.	Pittosporeæ ..	Mock Orange.
63.	*Psychotria Simmondsiana*, Bail.	Rubiaceæ ..	
64.	,, v. *glabrescens*, Bail.	Rubiaceæ ..	
65.	*Quintinia Sieberi*, D.C.	Saxifrageæ ..	Opossum Wood of N.S.W
66.	,, *Verdonii*, F.v.M	Saxifrageæ ..	
67.	*Rhodomyrtus psidioides*, Benth.	Myrtaceæ ..	Native Guava.
68.	*Rhodosphæra rhodanthema*, F.v.M.	Anacardiaceæ..	Deep Yellow-wood; Yellow Cedar of N.S.W.
69.	*Saccopetalum Bidwillii*, Benth.	Anonaceæ ..	
70.	*Sambucus xanthocarpa*, F.v.M.	Caprifoliaceæ	Native Elderberry.
71.	*Sarcopteryx stipitata*, Benth.	Sapindaceæ ..	
72.	*Sideroxylon australe*, Benth.	Sapotaceæ ..	Panunpin Plum; Scrub Crab; Scrub Apple; Scrub Plum.
73.	*Sloanea australis*, Benth.	Tiliaceæ ..	Maiden's Blush of N.S.W.

*Has a large fleshy acid fruit, yellow when ripe.

No.	Species.	Family.	Local Name (if any).
74.	*Stenocarpus salignus,* R. Br. v. *Moorei* ..	Proteaceæ ..	Beefwood; Silky Oak of N.S. Wales.
75.	,, *sinuatus,* Endl.	Proteaceæ ..	Wheel of Fire.
76.	*Sterculia discolor,* F.v.M.	Sterculiaceæ ..	Sycamore; Hat-tree.
77.	,, *quadrifida,* R.Br.	Sterculiaceæ ..	
78.	*Synoum glandulosum,* A. Juss.	Meliaceæ ..	Bastard Rosewood; Redwood of N.S. Wales.
79.	*Tarrietia actinophylla,* Bail.	Sterculiaceæ ..	Stavewood; Ironwood.
80.	*Trema aspera,* Blume ..	Urticaceæ ..	Peach-leaved poison plant.
81.	*Tristania laurina,* R. Br.	Myrtaceæ ..	Ironwood of Canungra; Beech and Swamp Mahogany of N.S.W.
82.	*Trochocarpa laurina,* R.Br.	Epacrideæ ..	Cogwheel Fruit.
83.	*Vitex lignum-vitæ,* A. Cun.	Verbenaceæ ..	Lignum-vitæ.
84.	*Weinmannia Benthami,* F.v.M.	Saxifrageæ ..	Red Carrabeen of N.S.W.
85.	*Wilkiea macrophylla,* D.C.	Monimiaceæ ..	Pigeon Berry of Tambourine.
87.	*Xanthoxylum brachyacanthum,* F.v.M. ..	Rutaceæ ..	Prickly Yellow-wood.

Vines of the National Park.

1.	*Aristolochia prævenosa,* F.v.M.	Aristolochiaceæ	Native Dutchman's Pipe
2.	*Clematis glycinoides,* D.C.	Ranunculaceæ	Virgin's Bower of N.S.W.
3.	*Deeringia altissima,* F.v.M.	Amarantaceæ	
4.	*Hibbertia volubilis,* Andr.	Dilleniaceæ ..	
5.	*Hardenbergia monophylla,* Benth.	Leguminosæ ..	Bushman's Sarsaparilla.
6.	*Legnephora Moorei,* Miers	Menispermaceæ	
7.	*Lettsomia Soutteri,* Bail.	Convolvulaceæ	
8.	*Lyonsia largiflorens,* F.v.M.	Apocynaceæ ..	
9.	*Lyonsia latifolia,* Benth.	Apocynaceæ ..	
10.	,, *straminea,* R. Br.	Apocynaceæ ..	
11.	*Lonchocarpus Blackii,* Benth.	Leguminosæ ..	Blood Vine.
12.	*Marsdenia Fraseri,* Benth.	Asclepediaceæ	
13.	*Melodinus acutiflorus,* F.v.M.	Apocynaceæ ..	
14.	*Milletia australis,* F.v.M.	Leguminosæ ..	Native Wistaria
15.	*Morinda jasminoides,* A. Cunn.	Rubiaceæ ..	
16.	*Muhlenbeckia gracillima,* Meiss.	Polygonaceæ ..	
17.	*Panax cephalobotrys,* F.v.M = *Aralia cephalobotrys* F.v.M.	Araliaceæ ..	
18.	*Parsonsia lanceolata,* R.Br.	Apocynaceæ ..	

No.	Species.	Family.	Local Name (if any).
19.	*Parsonsia Leichhardtii*, F.v.M. ..	Apocynaceæ ..	
20.	,, *velutina*, Roxb.	Apocynaceæ ..	
21.	*Piper novæ-hollandiæ*, Miq.	Piperaceæ ..	Native Pepper.
22.	*Rubus Moorei*, F.v.M. ..	Rosaceæ ..	Five-leaved Blackberry.
23.	,, ,, v. *Tryoni*,* Shirley	Rosaceæ ..	Five-leaved Blackberry.
24.	*Trichosanthes palmata*, Roxb.	Cucurbitaceæ	
25.	*Vitis nitens*, F.v.M. ..	Ampelideæ ..	Water-vines.
26.	,, *hypoglauca*, F.v.M.	Ampelideæ ..	Water-vines.
27.	,, *opaca*, F.v.M. ..	Ampelideæ ..	Water-vines.

Ferns of the National Park.

No.	Species.	Local Name (if any).
1.	*Adiantum æthiopicum*, L. ..	Common Maiden-hair Fern.
2.	,, *affine*, Willd. ..	Scrub Maiden-hair Fern.
3.	,, *diaphanum*, Bl. ..	Waterfall Maiden-hair Fern.
4.	,, *formosum*, R. Br.	Giant Maiden-hair Fern.
5.	,, *hispidulum*, Sw. ..	Rough Maiden-hair Fern.
6.	*Alsophila australis*, R. Br. ..	Rough-stemmed Tree Fern.
7.	,, *excelsa*, R. Br. ..	Scar-stemmed Tree Fern.
8.	,, *Leichhardti*, F.v.M.	Prickly-stemmed Tree Fern.
9.	*Arthrolepis Beckleri*, Mett. ..	Delicate Climbing Shield Fern.
10.	,, *obliterata*, J. Sm. ..	Large Climbing Shield Fern.
11.	,, *tenella*, J. Sm. ..	Dotted-leaved Climbing Shield Fern.
12.	*Asplenium adiantoides*, C. Ch.	Social Veined Fern.
13.	,, *bulbiferum*, Forst.	Budding Veined Fern.
14.	,, *flabellifolium*, Cav.	Fan-shaped Veined Fern.
15.	,, *japonicum*, Thunb.	Japanese Veined Fern.
16.	,, *nidus*, L.	Bird's Nest Fern.
17.	*Athyrium umbrosum*, J. Sm. v. *tenerum*, Bail. ..	Tall Scrub Fern.
18.	*Blechnum* (*Lomaria*) *capensis*, Willd.	Pickled Cabbage Fern.
19.	,, *cartilagineum*, Sw. ..	Bungwal.
20.	,, (*Lomaria*) *Patersoni*, Spr.	Double-fronded Creek Fern.
21.	*Cyclophorus serpens*, C. Ch. ..	Small Climbing Tongue Fern.
22.	,, *confluens*, C. Ch...	Large Climbing Tongue Fern.
23.	*Davallia dubia*, R. Br. ..	Mountain Bracken.
24.	,, *pyxidata*, Cav. ..	Hare's Foot Fern.
25.	,, *speluncæ*, Baker ..	Cave Fern.
26.	*Dennstædtia davallioides*, R. Br.	
27.	*Dicksonia antarctica*, Lab. ..	Woolly Tree Fern.
28.	*Diplazium maximum*, Don. ..	Great Scrub Veined Fern.

*Separated from the type by its smaller, narrower leaflets, and paler coloured leaves.

No.	Species.	Local Name (if any).
29.	*Doodia aspera* R. Br.	Caraway-seed Fern.
30.	,, ,, v. *heterophylla*, Dom.	Small Caraway-seed Fern.
31.	*Doodia caudata*, R. Br.	Tailed Caraway-seed Fern.
32.	,, ,, v. *media*, Benth.	
33.	*Dryopteris decomposita*, Ktze.	Common Shield Fern.
34.	,, *gongylodes*, Ktze. ..	Swamp Shield Fern.
35.	,, *punctata*, C. Ch. ..	Dotted Bracken.
36.	,, *Baileyi*, M. & B. ..	Shiny Shield Fern.
37.	,, *tenera*, C. Ch. ..	Black-bordered Shield Fern.
38.	*Histiopteris incisa*, J. Sm. ..	Batswing Fern.
39.	*Hymenophyllum bivalve*, Forst.	
40.	,, *flabellatum*, Lab.	Fan-shaped Filmy Fern.
41.	,, *javanicum*, Spr.	Javanese Filmy Fern.
42.	,, *Baileyana*, Dom.	Bailey's Filmy Fern.
43.	,, *tunbridgense*, Sm	English Filmy Fern.
44.	*Hypolepis tenuifolia*, Bernh. ..	Scrub Border Fern.
45.	*Nephrolepis cordifolia*, Presl. ..	Sword Fern.
46.	*Pellæa falcata*, R. Br.	Ear Fern.
47.	,, ,, v. *nana*, Bail.	Small Ear Fern.
48.	*Polypodium australe*, Metten ..	Class-roll Fern.
49.	,, *Brownii*, Wikst. ..	Spotted-leaved Tongue Fern.
50.	,, *membranifolium*, R. Br.	Parchment-leaved Tongue Fern.
51.	,, *pustulatum*, Forst.	Pustule-leaved Tongue Fern.
52.	,, *scandens*, Lab. ..	Branch-leaved Tongue Fern.
53.	*Platycerium bifurcatum*, C. Ch.	Elk-horn.
54.	*Pteridium aquilinum*, Kuhn. ..	Common Bracken.
55.	*Pteris tremula*, R. Br.	Trembling Bracken.
56.	,, *umbrosa* , R. Br. ..	Scrub Bracken.
57.	*Trichomanes caudatum*, Brack.	Tailed Bristle Fern.
58.	,, *venosum*, R. Br...	Veined Bristle Fern.
59.	*Vittaria elongata*, Sw.	Grass-leaved Fern.

NOTES ON AUSTRALIAN CHAETOGNATHA.

By Professor T. Harvey Johnston, M.A., D.Sc., and B. Buckland Taylor

(Biology Department, University, Brisbane.)

(Text-figures 1-4.)

(*Read before the Royal Society of Queensland, 28th April, 1919*).

The Chaetognatha of the Australian coast have received very little attention. Apart from the collection made in Shark Bay, Western Australia, reported on by Ritter-Zahony (1910), no systematic attempt to investigate them seems to have been made.

No records have been published regarding their presence on the northern and southern coasts, though several species, viz., *Sagitta hexaptera*, *S. serratodentata* and *Eukrohnia hamata* have been reported from Antarctic waters due south of Australia (Fowler, 1907). A few casual determinations of species from the Eastern coast have been made by Ritter-Zahony in 1909 (*S. bipunctata*, *S. serratodentata* and *S. robusta*), and Johnston in 1909 (*S. australis*). Whitelegge (1889. p. 163) mentioned the occurrence of *Sagitta* sp. in Sydney Harbour, while Waite* reported that *Sagitta* was taken commonly in tow nets by the Thetis Expedition off the N.S.W. coast. Steinhaus recorded *S. enflata* from 160° E, some distance westward of New Caledonia, but the record cannot be considered as Australian. Ritter-Zahony (1909 p. 792) referred to the

* E. R. Waite, Memoirs Austr. Museum, 4 (1), 1899, p. 14.

capture of *S. enflata* forma *minor* by the "Gazelle" during a voyage between the Solomon Islands and Moreton Bay, but this record is not sufficiently localised to be regarded as Australian. *S. hexaptera* is known from New Guinea and New Britain (Ritt.-Z. 1909, p. 790).

We have examined tow-net material from Moreton Bay and Port Jackson, as well as that collected by Professor Haswell, F.R.S., in the s.s. "Miner," in June, 1906, at a locality fifty miles E. of Sydney. We take this opportunity to express our indebtedness to Professor Haswell.

To the three species of Chaetognatha reported from Eastern Australian waters, we are able to add six species of *Sagitta* and one of *Spadella*. The total number of species now known from the Australian coast is as follows: *Sagitta* eleven; *Pterosagitta* one; *Krohnitta* one; *Spadella* one; total fourteen.

Under each heading we have mentioned some of the outstanding features by which the species may be readily determined. A list of measurements is appended, and a simple key to the recorded Australian forms, which we have found to be of service, has been added for the convenience of Australian students.

1. *S. serratodentata* Krohn.

Syn: *Spadella serratodentata* Grassi, 1883.

We have examined a good many specimens of the species, and have found a considerable range of variation in the number of anterior and posterior teeth, and in the relative size of the jaws. Our specimens have from 2 to 3 anterior and 4 to 12 posterior teeth as compared with 8 to 10 and 17 to 20 respectively, as recorded by Fowler (1906, p. 20) and 6 to 9 anterior, 13 to 19 posterior, as recorded by Michael (1911, p. 39). The fins of the specimens were very torn, which probably accounts for the fact that we found less than 50% of the posterior fin on the body. Michael (1911, p. 39) has referred to the variability of this ratio. In a few of our specimens, which were very small, being less than 5mm. in length, some of the jaws were slender and apparently not serrated. Tactile papillae were present on nearly all, and in the mature forms the tail was filled with sperm morulæ.

Australian localities: Port Jackson (June, 1907); also Shark Bay, Western Australia (Ritter-Zahony, 1910, p.126); Great Sandy Island, Queensland (Ritt.-Z., 1909, p. 792).

Also recorded from the Atlantic Ocean; the East Indies; Japan; the Maldives; the Indian Ocean: the Mediterranean Sea; Southern California; the Straits of Magellan.

2. *S. australis* Johnston.

We have re-examined specimens of this species, declared by Ritter-Zahony (1911, p. 13) to be a synonym of *S. enflata*, and have come to the conclusion that the species is valid. There are four transparent, flaccid species with which it might at first sight be confused, but from all of which it is distinguished by the possession of a bilobed tail. They are *S. enflata*, *S. hexaptera*, *S. pulchra*, and *S. lyra*.

From *S. enflata* it differs markedly in the relative positions of the anterior fin and ventral ganglion. Ritter-Zahony (1911, p. 13), says, "Vorderflossen schmal, abgerundet, von Bauchganglion um dessen mehrfache Lange entfernt," which is borne out by his diagram in which the interval between the two is at least the length of the fin. As shewn in the original figure of *australis* (Johnston, 1909), the anterior fin begins in *front* of the ganglion. There is also a difference in the position of the widest portion of the posterior fin, this being at the tail septum in *enflata*, but behind the septum in *australis*. Again, the former has a small collarette, but no such structure has been observed in the latter.

From *S. pulchra* it is distinguished by the well marked neck, the presence of rays in the fins; also the maximum number of jaws in *pulchra* (7) is the minimum in *australis* (7-11); the tail percentage is lower in *australis* (16.5%, as compared with 18% in *pulchra*).

From *S. hexaptera* it differs in the number of anterior teeth (1-4 *hexaptera*; 6-12 *australis*); in the number of posterior teeth (1-6 *hexaptera* ; 9-11 *australis*) ; the anterior fin is remote from the ganglion in *hexaptera* and there is a greater distance between it and the posterior fin (11% compared to 8% in *australis*) ; there is also a difference in the relative length of the two fins, the posterior being the longer in *hexaptera*, but in *australis* they are equal, or the anterior may be slightly the longer ; a crest is present on the jaws of *hexaptera* but not on those of *australis* ; the latter is also distinguished by its marked neck.

From *S. lyra* it differs in the number of anterior teeth (4-8, *lyra*) ; in the position of the widest part of the posterior fin (in front of the septum in *lyra*) ; in the lesser distance between the fins (6.1% *lyra*) and in its well marked neck.

Australian record: Maroubra Bay, near Sydney, N.S.W. (Johnston, 1909).

3. *S. enflata* Grassi.

Syn : *S. lyra* Langerhans, 1880 (not Krohn, 1853). ;
Spadella enflata Grassi, 1881 ;
S. flaccida Conant, 1896 ;
S. gardineri Doncaster, 1902 ;
S. brachycephala Moltschanoff, 1907 ;
S. inflata Ritter-Zahony, 1908, 1909.

Body broad, transparent and flaccid ; neck marked ; anterior fin does not reach ventral ganglion. Posterior fin does not reach seminal vesicles but tail fin does. Very like *S. australis* in general appearance but the differences have been discussed under *S. australis*.

Australian localities : 50 miles E. of Sydney (common, June, 1906) ; Southport, Moreton Bay, Queensland, (Feb. 1919) ; already reported from Shark Bay, W.A. (Ritter-Zahony, 1910). Also recorded from the North Atlantic ; Mediterranean Sea ; Madeira ; Japan ; Indo-Pacific ; Maldives ; East Indies ; Southern California.

4. *S. pulchra* Doncaster.

We have identified this species from a solitary immature specimen. It is a transparent, flaccid form with numerous sensory papillae distributed over the entire animal. From the posterior end of the tail to the ganglion is 67% of the total length. A collarette is present.

Australian localities: Tasman Sea, 50 miles E. of Sydney—previously reported from Shark Bay, W. A. (Ritter-Zahony, 1910). Also recorded from New Guinea; the East Indies; Indo-Pacific; Maldives; and the North Pacific.

5. *S. minima* Grassi.

Syn: *Spadella minima* Grassi, 1881.

Transparent and comparatively stout, with a neck region visible, though there is no marked constriction. In one of our specimens, which was almost mature, the ovaries were compact and club-shaped, the whole tail filled with developing spermatozoa; the seminal vesicles, however, were very small. There is no constriction at the septum, but the decrease in size is rather sudden. 20% is the maximum tail percentage recorded, but one of our specimens has a percentage of over 23%. The anterior fin almost reaches the ganglion.

Australian localities: 50 miles E. of Sydney (June, 1906); already known from Shark Bay, W.A. (Ritter-Zahony, 1910). Also recorded from Japan; Indian Ocean; Mid Atlantic; and the Mediterranean Sea.

6. *S. bedoti* Beraneck.

Syn: *S. bipunctata* Aida, 1895.
S. polyodon Doncaster, 1902.

This form is not among our Eastern Australian material the following information being taken from Michael (1911, p. 75). No collarette; head small; sudden diminution at tail septum; anterior fin longer than posterior; posterior fin extends to seminal vesicles; less than 50% of posterior fin in front of tail septum.

Australian localities: Shark Bay, W.A. (Ritter-Zahony, 1910). Also recorded from the East Indies; Japan: Indo-Pacific; Maldives (as *S. polyodon*).

7. *S. regularis* Aida.

Syn: *S. bedfordii* Doncaster, 1902.

We have examined only one immature specimen, comparatively slender, firm and opaque, with a fairly uniform breadth to the septum. The corona ciliata is entirely on the body ; a very noticeable collarette is present extending over the whole head ; and apparently there is a thickening of the epidermis all over the body, bearing numerous tactile papillae.

Australian localities : 50 miles E. of Sydney (June, 1906) ; known also from Shark Bay, W.A. (Ritter-Zahony, 1910). Also recorded from the East Indies ; Japan, Indo-Pacific ; Maldives.

8. *S. robusta* Doncaster.

Syn : *S. hispida* (non Conant) Aida, 1897 ;
S. hispida Doncaster, 1902 ;
S. ferox Doncaster, 1902 ;
S. japonica Galzow, 1910.

A firm opaque form, about the same width from the ganglion to septum ; many sensory papillae over whole body and tail ; collarette marked, though not so conspicuous as in *regularis*, extending to the anterior fin ; the posterior fin reaching the characteristically shaped seminal vesicles in mature specimens, as does also the tail fin ; the jaws thick at the base and greatly curved in the terminal third ; lateral process of vestibular ridge blunt ; papillae irregular and rather pointed.

Australian localities : 50 miles E. of Sydney (June, 1906) ; reported also from Great Sandy Island, Queensland (Ritter-Zahony, 1909). Also recorded from New Guinea ; East Indies ; Sea of Japan ; Indian Ocean ; Maldives ; Atlantic Ocean.

9. *S. bipunctata* Quoy and Gaimard.

Syn : *S. multidentata* Krohn, 1853 ;
Spadella marioni Gourret, 1884.

This form was not found among our Eastern Australian material, the following information being taken from Michael 1911, p. 41). Body rigid ; constriction at tail septum evident ; collarette very short ; anterior fin never extending to ventral ganglion ; posterior fin longer than anterior, extending to seminal vesicles when the latter are tumid, being always more than 50% of fin in front of tail septum.

Australian localities: Great Sandy Island, Queensland (Ritter-Zahony, 1909; Shark Bay, W.A. (Ritter-Zahony, 1910). Also recorded from New Guinea; Altantic Ocean; North Sea; Baltic Sea; English Channel; Irish Sea; Mediterranean Sea; Carribean Sea; Indo-Pacific; Bay of Bengal; Southern California; S. of the Cape of Good Hope; Arctic Ocean.

10 *S. tenuis* Conant.

This species is placed by Ritter-Zahony in the synonymy of *S. bipunctata*, but Michael (1911, p. 72) declares it distinct. We refer to this species a solitary specimen which is opaque and firm, and more or less of even width. It is impossible to make out the limits of the fins, but all other measurements coincide with those of *S. tenuis*, though our specimen is 0.5mm. longer than any other recorded. There is a small collarette, a few papillae, and no neck; the tail is full of sperm morulae. It should be borne in mind that Ritter-Zahony has already recorded *S. bipunctata* from Great Sandy Island, on the Queensland coast.

Australian locality: Port Jackson (June, 1907). Previously recorded from Jamaica by Conant.

11. S. *neglecta* Aida.

Syn: *S. septata* Doncaster, 1902.

Our specimens ranged from 3.6 to 5.2mm. in length, none of which were fully mature. They were slender, firm and opaque. A collarette was visible on several. The anterior fin reached the seminal vesicles. There was less than 50% of the posterior fin in front of the tail septum. The fins were imperfect in all our material, which will account for the great variation in the interval between the fins as recorded in our table.

Australian localities: Caloundra and Southport, Moreton Bay, Queensland, May, 1918, Feb., 1919. Also recorded from the Indo-Pacific; Maldives; Japan; East Indies; Southern California.

12. *Pterosagitta draco* (Krohn).

Syn : *Pt. mediterranea* Costa, 1869 ;
Sagitta draco Krohn, 1853 ;
Spadella draco of authors ;
Spadella vaugai Beraneck, 1895.

This species was not present in our Eastern Australian material, the following description being taken from Michael (1911, p. 54). Body firm and opaque ; collarette very pronounced, measuring approximately 0.5% on each side of the body, and extending from head to tail septum ; ventral ganglion midway between head and tail septum.

Length 7mm. ; tail 43.6% ; tail to ventral ganglion 66% ; anterior teeth 4-8 ; posterior teeth 8-18 ; jaws 8-10.

Australian locality : Shark Bay, W.A. (Ritter-Zahony, 1910). Also recorded from the Atlantic Ocean ; Mediterranean Sea ; Indian Ocean ; Maldives ; Japan ; Southern California ; Agulhas ; Antarctic.

13. *Krohnitta subtilis* (Grassi).

Syn : *Sagitta subtilis* Grassi, 1881.
Spadella subtilis Grassi, 1883 ;
Krohnia subtilis Strodtmann, 1892 ;
K. pacifica Aida, 1897 ;
Eukrohnia subtilis (Grassi).

This species was not among out Eastern Australian material, the following description being taken from Michael (1911, p. 52). Body nearly transparent, long and slender ; neck evident ; seizing jaw very flat, broad, thin and evenly curved, points extremely fine and delicate.

Length 12-16mm. ; tail 30-34% ; to ventral ganglion 17-23% ; teeth 10-14 ; jaws 7-9.

Australian locality : Shark Bay, W.A. (Ritter-Zahony, 1910). Also recorded from the Atlantic Ocean ; Black Sea ; Mediterranean Sea ; Indian Ocean ; Bay of Bengal ; Southern California.

TABLE OF CHARACTERS OF SPECIES OF SAGITTA (recorded from Australian waters).

( ) denotes information obtained from the following sources: Fowler (1906); Michael (1908); and Ritter-Zahony (1911).

	Length in mm.	% of total length. Tail	Ant. fin.	Post. fin.	Dist. bet. fins	Anter. teeth	Poster. teeth	Jaws
S. serratodentata	3.4–16 (17)	20–30 (36)	(20–24)	14–17 (25)	(7.5)	2–3 (11)	4–12 (20)	6–7 (8)
S. australis.. ..	12–24	16–17	20–28	20.8	8	6–12	7–11	9
S. enflata	17.5 (20)	13–20 (25)	11–17	17	6.8	10	15 (17)	7–8 (10)
S. pulchra ..	5–8 (22)	27.5	(34.6)	(24)	(5.7)	(5–10)	(9–19)	11
S. minima ..	4.8–6 (10)	19–23				(3–5)	(7–14)	6–7 (8)
S. bedoti	(5–18)	(21–35)	(20)	(24)	(5.4)	(9–13)	(20–23)	(5–7)
S. regularis ..	5.8 (27)	29 (40)	(13)	(23)	6.8	(2–4)	(2–6)	9
S. robusta ..	14–16 (20)	20–29 (36)	14–17 (20)	18–24	10–12 (6.8)	6–7 (10)	10–13 (16)	8–9
S. bipunctata ..	(9–20)	(21.27)	(15–9)	(7.9)	(17)	(4–8)	(8–18)	(6–9)
S. tenuis	6	28.3 (29)	(12–13)	(25.6)	(16–17)	(5)	(9)	8
S. neglecta ..	3.6–5 (10)	24–32.8 (40)	11–18.4 (21)	17.6–23	6.4–11	2–4 (7)	6–10 (18)	6–7 (8)

14. *Spadella moretonensis* n. sp. (Text-figures 1-4).

A small robust species, 3.68mm. in length, with a pronounced neck region, which is masked by an extensive collarette, reaching the lateral fins and having a swelling on either side of the position of the corona, so that the neck region here appears almost as wide as the head. There are transverse muscles present throughout both body and tail, and the whole animal is covered with sensory papillae, each bearing several short tactile setae. The head is slightly broader than it is long, and has two prominences in front, each bearing 3 or 4 very stout curved teeth measuring .03mm. in length; the eyes are large but not pigmented. There are 9 jaws on each side, in form like those of *Eukrohnia subtilis*, the point not being inserted into the shaft, but they are more curved. The corona is almost circular, and lies on the neck and body. The animal is widest at the septum, where it measures (excluding fin) 0.4 mm. *i.e.*, 11.7% of the total length, and then tapers gradually towards the neck and tail. The lateral fin commences on front of the receptaculum seminis. It reaches its maximum width (which is 18% of the total length of the animal including the tail fin) in front of the tail, then narrowing in the region of the seminal vesicles, where it becomes confluent with the tail fin. The latter, as well as the lateral fins are entirely traversed by rays. The ovaries extend into the vicinity of the ganglion the ova being few and relatively very large (0.2mm.) A small receptaculum seminis opens on the dorso-lateral surface on each side just in front of the tail septum. The aperture is situated on a well-marked rounded prominence with a swollen extremity and a rather narrower stalk-like portion. The actual opening is trilobed in our specimen. The tail measures 56.5% of the total length. Most of its coelome is filled with sperm morulæ, the testis occupying only a small anterior position. The vesiculæ seminales are very small and inconspicuous, and lie in the posterior third of the tail, at the narrowest part of the fin width. The tail fin arises from the dorsal surface and there is a differentiated zone at the posterior end of the tail. There are sensory patches on both the lateral and tail fins. Two club-shaped papillated bodies are present on the posterior half of the tail, lying on the ventral surface at the right side. Though they became stained like the tissues of the animal, as a result of the use of hæmatoxylin, yet their asymmetrical arrangement and general appearance suggest that they are foreign bodies—perhaps of an algal nature. The largest measures 0.14mm. in length and 0..06mm. in maximum breadth; the other 0.10 and 0.04mm. respectively.

The following measurements were taken from the animal while in formalin; Length, including tail fin, 3.68 mm.; tail, 56.5% of total length; maximum breadth, excluding lateral fin, 11.7% of total length; maximum width of fin, 18.2% of total length; percentage of fin in front of tail septum, 3%; tail, including tail fin, to ventral ganglion, 75% of total length.

Sp. moretonensis differs from the other two valid species of *Spadella* in the following characters:—

Sp. schizoptera Conant, possesses two pairs of fins, its corona is triangular, its teeth are long and curved, and the tail is 51% of the total length.

Sp. cephaloptera Busch, possesses two rows of teeth, the fin begins behind the receptaculum seminis, the corona is a long oval and the collarette covers the whole body. The possession of a club-like tentacle on each side of the head is quoted as one of the distinguishing characters of the species. These however do not appear to have been seen by subsequent observers, at least some of whom have assumed that they had become lost from the specimens which they examined. The figures of *Sp. cephaloptera*, which are available to us, and which show the presence of these structures, suggest that they are probably not tentacles but are foreign organisms, probably algæ, which have accidently developed symmetrically on the head region. They remind us of the two club-like bodies present on our solitary specimen of *Sp. moretonensis*.

The known range of *Spadella* (sensu stricto) is as follows:—*Sp. cephaloptera*, Atlantic and Mediterranean coast of Europe, the Black Sea and the Irish Seas. *Sp. schizoptera* is known only from the Bahamas. *Sp. moretonensis* is the first species of the genus to be recorded from the Southern Hemisphere.

We take this opportunity to express our thanks to Mr. R. L. Higgins for this specimen, which was found among algæ at Caloundra, July, 1918.

KEY TO GENERA OF CHAETOGNATHA.

From Ritter-Zahony (1911, p. 44).

1. Transverse muscles on body 2
   No transverse muscles on body 4

2. Medium sized species, with 1 or 2 rows of numerous teeth on each side, and an extensive pair of fins extending over body and tail 3
   Small compact species with 1 or 2 rows of small teeth, a pair of fins on the tail, and may have a second small pair of fins on the body ....*Spadella*

3. Two rows of teeth on each side, transverse muscles in anterior third of tail ....*Heterokrohnia*
   One row of teeth on each side, small transverse muscles in tail ....*Eukrohnia*

4. One row of slender converging teeth on each side, one pair of lateral fins ....*Krohnitta*
   Two rows of conical teeth on each side 5

5. Two pairs of lateral fins, sometimes fused together ....*Sagitta*
   One pair of lateral fins on the tail, as the continuation of a voluminous collarette ....*Pterosagitta*

KEY TO SPECIES OF SAGITTA

recorded from Australian waters.

1. Body transparent and flaccid 3
2. Body firm and opaque 6
3. Neck constriction very marked 4
   Neck constriction not marked 5
4. Anterior fin extends in front of ganglion ....*australis*
   Anterior fin does not reach ganglion ....*enflata*
5. Collarette present ....*pulchra*
   Collarette absent ....*minima*
6. Teeth serrated ....*serratodentata*
   Teeth not serrated 7
7. Posterior teeth more than 20 ....*bedoti*
   Posterior teeth fewer than 20 8
8. Collarette extends over whole head and to anterior fin ......*regularis*
   Collarette extends from behind head to anterior fin ....*robusta*,
   Collarette very small 9
9. Posterior fin extends to seminal vesicles ....*bipunctata*
   Posterior fin does not extend to seminal vesicles 10
10. Anterior fin less than 15% total length ....*tenuis*
    Anterior fin more than 15% total length ....*neglecta*

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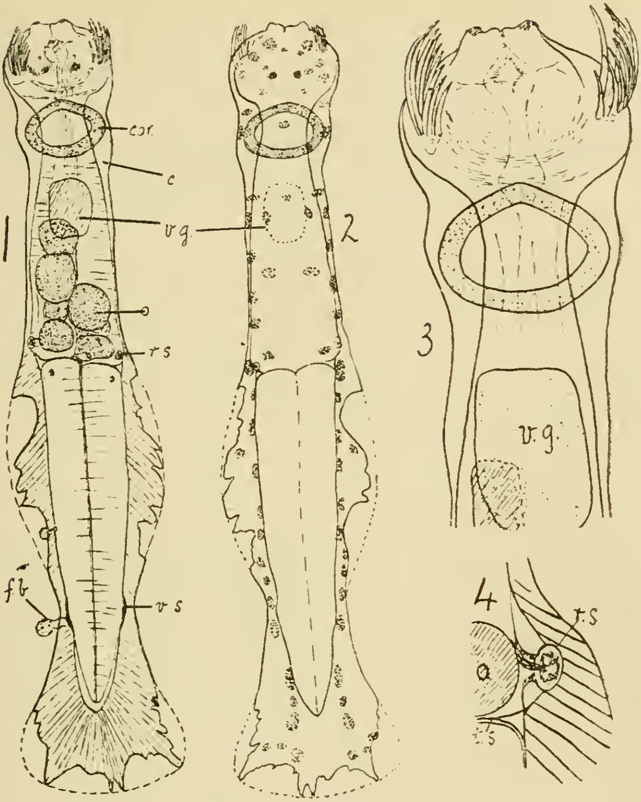

TEXT-FIGURES, 1-4.

Text-figure 1.—Entire specimen of *Spadella moretonensis*, viewed from the ventral surface as a transparent object: sensory areas omitted.

Text-figure 2.—Dorsal view to show arrangement of sensory areas on dorsal surface. To avoid confusion those on the ventral surface have been omitted.

Text-figure 3.—Enlarged view of head and anterior portion of body; ventral view, anatomy showing through.

Text-figure 4.—Region of a female aperture (dorsal view).

References to lettering:—C., collarette; cor., corona; f.b., foreign body?; o., ovum; r.s., receptaculum seminis; t.s., tail septum; v.g., ventral ganglion; v.s., vesicula seminalis.

ON THE OCCURRENCE OF ABORTIVE STYLES IN *BUCKINGHAMIA CELSISSIMA* F.v.M

By C. D. Gillies, M.Sc., and C. T. White.

(*Read before the Royal Society of Queensland, 26th May,* 1919).

(Text-figures 1-2).

In 1918, Longman and White described an interesting mutant in the Proteaceous tree *Buckinghamia celsissima* F.v.M., which is a monotypic species endemic to tropical Australia, but on account of its handsome appearance it has been introduced into gardens of Southern Queens-and. The flowers normally possess a semi-annular hypogynous gland situated at the base of the stipes, but in the mutant of Longman and White the gland was divided into a number of segments and two accessory styliform structures accompanied the pistil. This condition was observed to be constant in two consecutive generations, viz. (*a*) in a tree at Wooloowin, and (*b*) in a parent plant at Enoggera. Both of these localities are in the Brisbane district within a few miles of each other.

With the object of investigating the relationships of the hypogynous gland and the accessory styliform processes to one another, material was obtained from the Botanical Museum, Brisbane, off spikes of flowers collected in 1918 from the tree at Wooloowin. The specimens had been preserved in formalin for over six months, with the result that they had become discoloured and hardened, so safranin was used for staining. The paraffin method was used for embedding and on mounting it was found that the cytological detail was poor, this doubtless being due to the fact that the material was not immediately preserved in the formalin after collecting, for the specimens were not originally gathered for sectioning.

With reference to the hypogynous gland, Longman and White (1918, p. 162), state that "in practically every flower the hypogynous gland is divided into four or five segments (usually five) and two of these are much elongated into supplementary style-like processes," and later (p. 164), "There is no evidence of a graduated change from the tiny segments of the hypogynous gland, and it is therefore thought that this marked modification is better expressed as a mutation than as a variation." After a careful examination of our sections; we find that we cannot support the opinion that these style-like processes have any connection with the hypogynous gland, as it appears to us most conclusively on morphological and histological grounds, that they are neither hypogynous gland-segments nor a mutation from them. On the contrary, their resemblance to the style is very pronounced in regard to the following important features, viz. (*a*) general shape, (*b*) stigmoid extremity, and (*c*) microscopic structure. In Fig. 1. it will be noticed with reference to the histology of the stipes (which is similar to that of the style) and the style-like processes, that these organs are chiefly composed of lightly staining parenchyma (*par.*) surrounding a delicate central strand of vascular tissue (*v.b.*), and containing a few scattered deeply-stained cells (*c*). Contrasting and alternating with the stipes and the style-like processes are the segments of the hypogynous gland (*h*1, *h*2, *h*3), which stain deeply and consequently are conspicuous structures in section. We therefore conclude that the elongated organs referred to by Longman and White as segments of the hypogynous gland are really aborted styles and that their development has caused splitting of the hypogynous gland into distinct segments.

Early this year, one of us obtained typical flowers of *Buckinghamia celsissima* from the Brisbane Botanic Gardens, and sections for comparison were made. It will be observed that the hypogynous gland (Fig. 2, *h*) is entire and semi-annular in shape and that aborted styles are not present.

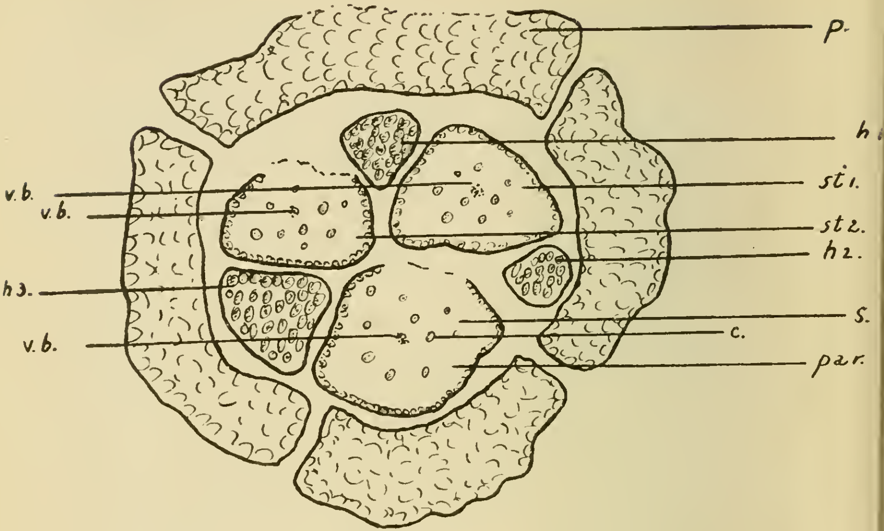

Fig 1.

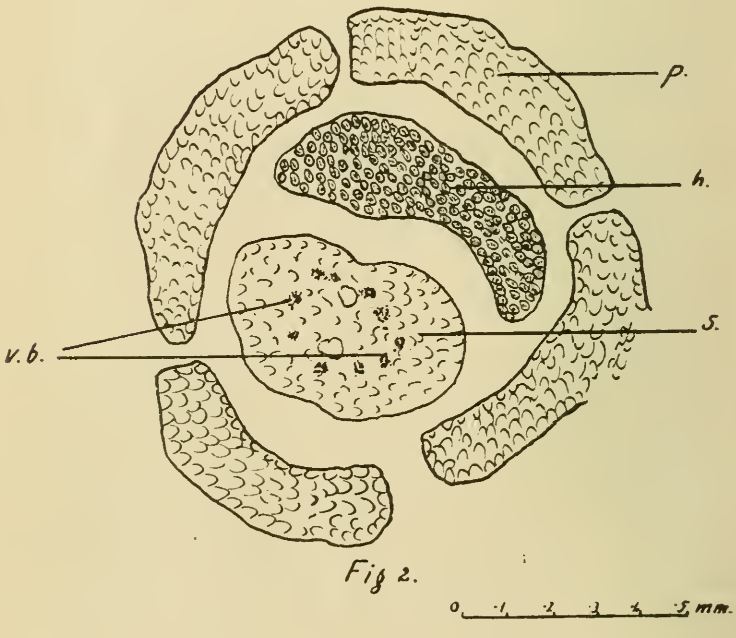

Fig 2.

Our thanks are due to Professor T. H. Johnston, who kindly allowed the section cutting to be performed in the laboratory of the Biology Dept., University of Queensland.

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Explanation of Text-figures.

Transverse sections across flowers of *Buckinghamia celsissima* F.v.M.

Fig. 1.—Mutant of Longman and White; *c*, deeply stained cells in parenchyma of stipes and aborted styles; *h*1, *h*2, *h*3, segments of hypogynous gland; *p*, perianth segments; *par*, parenchyma in stipes; *s*, stipes; *st*. 1, *st*. 2, aborted styles; *v.b.*, vascular bundles.

Fig. 2.—Normal flower; lettering similar to above; *h*, undivided, semi-annular hypogynous gland.

ALTERATION OF GENERIC NAME.

Note by J. Douglas Ogilby.

In these Proceedings, Vol. xxi, p. 91, I proposed the name *Eurycaulus* for a genus of belonoid fishes. This, having been previously used in Coleoptera by Fairmaire, 1868, I now change to *Tropidocaulus*.

THE LINGULIDÆ OF THE QUEENSLAND COAST.

——o——

By Professor T. Harvey Johnston, M.A., D.Sc., C.M.Z.S., and Otto S. Hirschfeld, B.Sc., Biology Department, University, Brisbane.

(*Read before the Royal Society of Queensland, 30th June, 1919*).

Plates I and II and Text-figures 1-8).

The following species of Lingula have been recorded from the Queensland Coast : *L. anatina* Lam. (*L. rostrum* Shaw), *L. murphiana* King, *L. tumidula* Reeve, *L. exusta* Reeve, *L. hians* Swainson, and *L. hirundo* Reeve, the first five named being reported from Moreton Bay and the last two from Port Curtis. Davidson in his list (1879, p. 402) mentioned only the second, third and fourth, while Thomson (1918, p. 43) referred to all six.

The genus is rarely found on the New South Wales Coast, only one species, *L. hians*, having been recorded from Port Jackson by Angas in 1867, and by Brazier (1879*a*, p. 370 ; 1879*b*, p. 402) as an extreme rarity, the latter author—a very keen and persistent collector—stating that he had found only one living specimen in Sydney Harbour during his 25 years' experience collecting there. Mr. C. Hedley, who succeeded Mr. Brazier as Conchologist to the Australian Museum, Sydney, informed us recently that he had never collected Lingula in Sydney, the only specimen from New South Wales that he had seen being the solitary form obtained in 1866 by Brazier who determined it.

Hedley in his catalogue of the marine mollusca of Queensland (1909, p. 371) evidently considered that one species alone was present, since his list contains only *L. anatina*, while in his check list of the marine molluscan fauna of New South Wales (1917, p. 113) he referred to *L. rostrum* Shaw (syn. *L. anatina*) alone. He, however, mentioned (1916, p. 695) that the species of Lingula had been discriminated usually from dry and probably distorted material and that little attention has been given to change in appearance at different stages of growth. "It may be, therefore, still a matter for investigation whether the names assigned to Australian forms, *L. tumidula* Reeve, *L. murphiana* Reeve, *L. exusta* Reeve, and *L. hirundo* Reeve, represent distinct species, geographical races, or growth forms of a single species."

Lingula rostrum Shaw.

This is better known as *L. anatina* Lam. but Hedley (1916, p. 694) has recently shown that Shaw's name has priority. The latter author described material from the Philippine Islands under the name of *Mytilus rostrum* in 1797.

Hedley evidently inclines to the view that there is only one species on the Queensland coast, since, as already stated above, he listed only *L. anatina* in 1909 (p. 371). Von Martens (1889, p. 263) stated that while the "Gazelle" was in quarantine at Peel Island, Moreton Bay, her naturalists found *L. anatina* to be common in the mud there; but the reference should be to *L. murphiana* King which is the representative of *L. anatina* in south-eastern Queensland. Thomson (1918, p. 43), following Hedley (1916), quoted Moreton Bay as an Australian locality for *L. rostrum*, but both of these records relate to *L. murphiana*.

Brazier (1879*a*, p. 390) rejected Schmeltz's record (in Mus. Godefroy Catalogue 5, p. 171) of *L. anatina* from Sydney, pointing out many other inaccuracies in the catalogue in regard to the localities given for certain mollusca. He stated, however, that *L. anatina* was rather common in mud flats in Moreton Bay and in New Caledonia. The former record may refer to either *L. hians* or *L. murphiana*.

both of which occur in Moreton Bay, but it is more likely to be *L. murphiana*. We suspect that his New Caledonian Lingula record should be referred to *L. hians* (see below).

The species very rarely met with in Port Jackson and identified by Angas (1867, p. 935), Brazier (1879*a*, 1879*b*) and Whitelegge (1889, p. 294) as *L. hians* was considered by Hedley (1916, p. 694 ; 1917, p. 113) to be *L. anatina* (=*L. rostrum*), but re-examination has proved that the species is *L. hians*. The same author (1898, p. 369) regarded as belonging to *L. anatina* some specimens collected in British New Guinea but they belong to *L. exusta*.

L. anatina has been described anatomically by Vogt (1845), Gratiolet (1860), King (1873), Hancock (1858), Davidson (1888), Blochmann (1900), and others ; and referred to incidentally by Morse (1902) and Yatsu (1902).

The habitat given by Davidson (1888, p. 207) includes the Indian Ocean ; Moluccas (between tide marks) ; off Yedo, Japan ; Philippines (where it is sometimes very common in sandy mud between tide marks) Timor and Fiji. Yatsu referred to its abundance in certain parts of Japan, as did also Morse. Reeve (1859) and Dall (1873, p. 203) mentioned only the Philippines and Moluccas, while Sowerby (p. 338) gave the latter locality and the Indian Ocean.* Semper (1862, 1864), Yatsu (1902) and Francois (1891) published an account of its habits in the Philippines, on the Japanese coast, and in the vicinity of Noumea, New Caledonia, respectively. There seems to be little difference in habits amongst the Lingulidæ, as far as known (Smith 1878 for *L. hians* ; Morse 1870 for *Glottidia pyramidata* ; Morse, 1902, for *G. pyramidata* and *L. lepidula*).

It is not unlikely that more than one species is included under the term *L. anatina* by the abovenamed authors. The type locality is the Philippines. †Blochmann, stated

*The "Indian Ocean" is of little value as a record. We do not know of any definite locality (if we exclude Timor) in the Indian Ocean where Lingula has been found, though no doubt it occurs in suitable situations on those parts of the East Indies whose shores are washed by the Indian Ocean.

†Zur. Systematik u. geogr. Verbreitung d. Brachiopoden. Z.f. wiss. Zool. 90, 1908 pp. 596-644—quoted by Thomson 1918, pp. 38-9.

that all known brachiopod larvæ except those of *Lingula* and *Discina*, were devoid of a mouth during their free swimming stage which, therefore, could not be long and, as a consequence, such species could not be distributed across ocean basins ; moreover the majority of brachiopods occur on the submarine slopes of continents and adjacent islands and such cannot cross the ocean floor where the depth is too great. It would be of interest to know how long the larval Lingula can live prior to settling down. Judging from our findings regarding the distribution of some species (*e.g. L. murphiana*) on the Queensland coast, we suspect either that this period must be very short or else such larvæ are very susceptible to temperature changes ; while in other cases (*e.g. L. hians*) the larvæ must either be more hardy or more long-lived and thus allow of greater distribution to the species.

A careful examination of forms of the *L. anatina* type from the East Indies (Moluccas and Timor) and from Japan might lead to the discovery of specific differences. Yatsu referred to variations in size in Japanese specimens, some agreeing with *L. anatina* and others with *L. murphiana.* We have found the ratio of length to breadth to be a fairly constant character and one that can be readily utilised to separate species which closely resemble each other in appearance, *e.g. L. murphiana* and *L. bancrofti* from the Queensland coast. The Fijian species is not likely to be L. *anatina.*

Davidson gives as sizes, one inch ten lines by ten lines, *i.e.*, a ratio of 2.2. Yatsu's largest specimen (1902, p. 62) measured 45 mm. by 20 mm., *i.e.*, a ratio of 2.25. Figures given by Adams (1858) Chenu (p. 234, fig. 1,203), Woodward (1910) and others, are too diagrammatic for measurements to have much value. Francois' figure (1895 fig. 315) gives a ratio of about 2.2 Sowerby's figures show a ratio from about 2.1 to 2.4.

We think it unlikely that *L. anatina* (*L. rostrum*) occurs on the coasts of New South Wales or of Southern Queensland. In view of the record (if correct) of the species from the Moluccas and Timor, its occurrence on the Northern Australian coasts is possible. For the present it should be struck off the list of known Australian Brachiopods.

L. tumidula Reeve.

Syn. *L. tumida* Davidson 1852, p. 377.
L. tumida Adams 1858, p. 586.

This large species was originally described and figured by Reeve (1841, p. 180, pl.. 125, fig. 4 ; 1841*a*, p. 100 Sowerby 1846, p. 339, pl. 67, fig. 7), New Holland being mentioned as the locality. In 1859 Reeve mentioned a few of the shell characters and figured a specimen (pl. 1, figs. 2*a* 2*b*) from "Moreton Bay." As an additional locality he gave Masbate, Philippine Islands, where specimens were collected by Cuming in sandy mud at low water, these being at first regarded by Reeve (1841*a*, p. 100) as belonging to a distinct species, *L. compressa*, but subsequently he considered them as a synonym or as a variety of *L. tumidula* (Reeve 1859 ; Sowerby 1846, p. 339). Dall (1871, p. 156) in referring to the species stated that, judging from Reeve's figure, it differed materially from the other species figured by him, in the broad form, the emarginations of the beaks, as well as in the size and position of the muscular impressions : *L. compressa* was mentioned as a variety from the Philippines.* Chenu (1862, figs. 1200, 1201) republished Reeve's figure. Adams (1863, p. 100) referred to finding the species in seven fathoms in mud in the Korean Archipelago. A single shell was present in Adams' original collection when re-examined in 1871 by Davidson who gave an account and figure of it (1871, p. 310, pl. 30, fig. 1, and 1888, p. 218, pl. 28, fig. 19). This led Dall (1873, p. 202) to regard it as distinct from *L. tumidula* and he consequently renamed Adams' shell as *L. adamsi*, the name being accepted by Davidson (1888, p. 219) who added another locality, viz. off Formosa. The only locality given by Dall (1873) for *L. tumidula* is "Moreton Bay" Davidson (1888, p. 216) mentioned the Philippines as well, one of his figures (pl. 28, fig. 14—from Sowerby) being drawn from a Philippine specimen and the other (fig. 15—copied from Reeve) from a Queensland shell. The former was apparently not distorted while the latter obviously was. The sizes given

*Thomson (1918, p. 43) has erroneously mentioned the Philippines as the type locality for the species, while Davidson in 1858 (p. 377) confused the two localities, giving its habitat as Masbate, New Holland.

by him are length 2 inches 2 lines and breadth 1 inch 5 lines—the ratio thus being 1.53. These dimensions agree with his fig. 14 (Philippine specimen—Sowerby's figure) which shows a ratio of 1.6. The "Moreton Bay" shell figured measures about 2.2 inches but owing to distortion, the true breadth cannot be measured, but the figure gives a ratio of about 1.6 In Reeve's original account (1841, 1841*a*) the sizes are given as 2.1 inches by 1.3, the ratio thus being 1.6.

In the Queensland Museum there are a few specimens of *L. tumidula* collected by Mr. C. Hedley in the Boyne River (Port Curtis)* and by Miss S. Lovell at Frazer Island (Great Sandy Island), Harvey Bay.

The species is characterised by the possession of large thin, horny, scarcely calcified shells whose edges (especially laterally) become curled dorsally as a result of drying†, such dried distorted specimens resembling Davidson's figure (1888, pl. 28, fig. 15—from Reeve 1859, pl. 1, fig. 2*b*). The colour of the Museum specimens is a dark brownish red with very distinct black lines of growth. Reeve stated that it was burnt olive red (1841). Davidson mentioned that the colour was coppery brown or reddish blue, sometimes bright green near the posterior margin. We suspect that he was referring to a Philippine form, since Sowerby's figure shows a brown colouration with a well defined green band along the margin of the free extremity of the shell. The lines of growth on our specimens are much more like those figured by Davidson for *L. adamsi* (pl. 28, fig. 19) than those figured for *L. tumidula* (fig. 14).

The umbones are distinct, though small, when the valves are fairly well preserved, but in most of the specimens examined by us they were scarcely recognisable. The least distorted of the few paired valves available measured 46 by 30.5 mm. the ratio of length to breadth thus being 1.51.

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*Mr. Hedley has informed us that he found the specimen dead at low tide on the beach at Boyne Island, immediately north of the mouth of the Boyne River, Port Curtis.

†Reeve in his original description (1841) mentioned the irregularly reflexed margin as being a character of the species.

Its outline resembled that figured by Davidson (1888, fig. 14, and Sowerby, fig. 7). Others measured 54 by 13 (ratio 1.58); 65 by 41 (1.59).

We have examined a specimen in some respects intermediate between *L. tumidula* and *L. adamsi* as figured by Davidson. Perhaps the latter may be a young form of the Philippine *L. tumidula*. The proportions however are not quite the same (ratio in *L. adamsi* =1.7), while the described coloration is distinct and—judging from the figures—the degree of calcification is different. Whether the Philippine and the Queensland forms belong to distinct species we are not at present able to definitely decide, but we are of opinion that an examination of fresh undistorted material from each locality would show specific differences. In such case, Reeve's name *L. compressa* would be available for the Philippine Lingula.*

Davidson stated (p. 216) that *L. tumidula* was the largest and finest recent species of the genus with which he was acquainted, being broader in proportion than any known recent form. Davidson's sizes were 2.15 inches in length and 1.4 in breadth. One valve examined by us reached 2.6 inches in length and 1.64 in width. The specimen which came from Hervey Bay, appears then to be the largest recent Lingula valve of which there is any record.

We do not know what on grounds Davidson considered *L. tumidula* to be closely related to *L. murphiana* (1888, p. 216). In 1879 (p. 402) he went so far as to state " *L. tumidula* and *L. murphiana* occur in the same locality and are of the same colour. I often ask myself whether they are distinct species or whether *L. tumidula* may not be a very wide variety of *murphiana*. This is a point which Australian zoologists must decide, as I have no opportunity of so doing as there are only two specimens of the form

*In his original account of *L. compressa* Reeve (1841) gave the dimensions as 1.8 and 1.1 inches respectively, the ratio thus being 1.63 The shell was stated to be brown olive, subquadrate oval, attenuated towards the apex, with the valves remarkably compressed and rather closely united all round; whereas the shell of *L. tumidula* was described as being burnt olive red in colour, subquadrate, and only slightly attenuated towards the apex.

tumidula in the British Museum ; the form *murphiana* is common, I have two or three specimens." The two species are quite dissimilar in their shell characters (see later under *L. murphiana*) and moreover, as far as we know, they do not occur in the same locality. All early records of plants and animals from "Moreton Bay" should be critically re-examined since the name was given, not only to the bay in South-eastern Queensland, but also to a very large district (the Moreton Bay District) embracing the whole of North-eastern Australia, which became subsequently (December, 1859) separated from New South Wales as a distinct colony under the name of Queensland. Our records show that *L. tumidula* occurs in Hervey Bay, which is in the vicinity of the main line of junction of the Indo-Pacific and southern elements of the Eastern Australian fauna, Frazer Island (Great Sandy Island) forming the boundary.

L. hirundo Reeve.

This was briefly desciibed as a little semi-transparent species, length 11 lines, breadth 4½ inches ; with the shell oblong square, thin, greenish, posteriorly abruptly attenuated, and umbones rather sharp. (Reeve 1859, pl. 2, fig. 7 ; Sowerby 1846, p. 339 ; Davidson 1888, p. 220, pl. 28, fig. 22). Reeve's material came from Port Curtis.

Davidson, who published Reeve's account and figure, placed it among the uncertain species, though Dall (1873, p. 203) accepted it as valid. Adams (1863, p. 101) in his very brief unfigured account of *L. smaragdina* Adams from mud from 10 fathoms from Japan and the China Seas, mentioned that it more closely resembled *L. hirundo*. Adams' species was subsequently figured by Davidson (1888, p. 220, pl. 28, fig. 25 ; 1875, p. 310, pl. 30, fig. 2), but an examination of it does not show any resemblance to *L. hirundo*. Davidson (1888) mentioned that the Japanese specimens examined by him bear much resemblance to the young of *L. anatina*. The ratio of length to breadth as published for *L. hirundo* is 2.44. The form and proportions do not agree with young specimens of *L. bancrofti* from Burnett Head which is in the vicinity of Port Curtis, whereas the ratio as well as the colour and shell characters as far as they have been noted, agree with *L. hians*. The ratio of length to breadth in the case of the latter (length 1 inch 10 lines, breadth 9 lines—Davidson 1888, p. 217) is also 2.44.

We have no hesitation in placing *L. hirundo* as a synonym of *L. hians* and consider it to be based on young specimens. *L. hians* is definitely recorded from a number of Queensland localities, including Port Curtis.

L. hians Swainson.

Syns.* *L. hirundo* Reeve, Port Curtis.
L. hians Brazier 1879, Pt. Jackson, Pt. Curtis, Noumea.
L. hians Angas 1867, Pt. Jackson, New Caledonia, Fiji.
L. hians Shirley 1910, Moreton Bay.
L. rostrum Hedley 1916, in part; 1917, Pt. Jackson.
L. anatina Hedley 1916, Pt. Jackson.
L. exusta Tapparone—Canefri 1873, Australia.
L. anatina Francois 1891, Noumea.
L. anatina Brazier 1879*b*, Noumea.
L. anatina Davidson 1888, Fiji.
Lingula sp. Jukes 1847, Cape York.

This species was recorded from Sydney Harbour by Angas (1867, p. 935) and Brazier (1879) and is mentioned by Whitelegge (1889, p. 295), but Hedley, as already stated earlier in this paper, regarded the specimens as belonging to *L. anatina* (=*L. rostrum*). Angas gave a brief description of the shell which was found in sandy mud in Middle Harbour, Port Jackson, mentioning as additional localities, Fiji, New Caledonia, China and the Philippines. Brazier (1879*b*, p. 402) referred to its presence in Port Curtis as well as in Port Jackson and New Caledonia, stating (1879*a*, p. 390) that *L. hians* was the only species found in Sydney Harbour and was so rare that he had found only one living specimen in 25 years' collecting there. Thanks to the courtesy and assistance of Mr. C. Hedley, we were able to re-examine Brazier's material from Noumea, and found it to be *L.*

*Only Australasian synonymy is quoted in each case.

hians. Mr. Hedley thereupon obtained from Mr. Brazier the solitary specimen that he had collected in 1866 in five fathoms of water off Sow and Pigs Reef, Port Jackson, compared it at our request with *L. hians* and informed us that it, as we had suspected, belonged also to that species as stated by Brazier (1879). We can accept the latter's record of *L. hians* from Port Curtis too.

Dr. Shirley who reported its occurrence in Moreton Bay (1910, p. 102) kindly allowed us to see his specimens which came from the Bribie sand banks, as well as some from Yeppoon. Keppel Bay. We confirm his identification. As already pointed out by us, *L. hirundo* Reeve from Port Curtis is based on young specimens of *L. hians*. In the Queensland Museum collection were many shells labelled as *L. hians* from Moreton Bay, but on examination they were all found to be *L. murphiana.*

The valves of *L. hians* have been described by a number of workers including Sowerby (1846, p. 338, pl. 67, fig. 4) ; Reeve (1859, pl. 2, fig. 12*a* and *b*) ; Chenu (1862, p. 234, fig. 1202, 1204) ; and Davidson (1886 p. 217 pl. 29 figs. 12, 13). Gratiolet (1860) referred to certain points in its anatomy and published figures. The locality generally given for the species is the China Seas while Dall (1873) adds Amboyna in the Moluccas.

In the Queensland Museum collection are many specimens of *L. hians*, two of which were in the same box as *L. exusta* from Torres Straits and were presumably from that locality. There are no data regarding the remainder, but they are probably from Moreton Bay, since Dr. Shirley has informed us that *L. hians* is not uncommon on certain of the banks there.

The specimens were all characterised by a thin horny translucent shell of a very pale green colour, with the lines of growth sometimes of a deeper green. Occasionally one noticed a splash of coppery or rusty tint near the middle of the shell. The edges were almost colourless, while the centre portion was whitish or creamy owing to calcification in the region of the main muscle insertions. The remainder of the shell was very little mineralised and, as a consequence, dried specimens became more or less distorted (hence the name *hians*), especially towards the umbonal end, where the valves contracted laterally in such a way that this portion of each became higher, narrower and much more pointed than under natural conditions. By placing such valves for a few minutes in warm water, they resumed their proper shape. All our measurements were made from specimens so treated and subsequently carefully wiped dry. The beak was much more pronounced on the ventral valves.

The length, breadth and ratio of length to breadth were as follows :—ventral valves—43 mm. by 18 mm. (2.38) ; 39 by 16 (2.43) ; 42 by 17 (2.47) ; 42 by 17 (2.47) ; 47 by 19.5 (2.41) ; 42 by 17.5 (2.40) ; 42 by 17.5 (2.40) ; dorsal valves—45 by 19 (2.37) ; 43 by 18 (2.38) ; 42 by 18 (2.33) ; 42 by 18 (2.33). Our specimens then ranged from 39 to 47 mm. in length and 16 to 19 mm. in breadth ; the smallest ventral valve being 39 by 16 mm., *i.e.* 1.56 inch by 0.64 inch ; and the longest 47 by 19.5 mm., *i.e.*, 1.88 inch by 0.78 inch. Davidson's sizes are 1 inch 10 lines by 9 lines, *i.e.*, 1.83 by 0.75 inch, the ratio being 2.44. His ratio falls within the limits observed by us for ventral valves, viz. 2.38 to 2.47. Most of ours were about 1.7 inches long and 0.72 inch wide.

In fully relaxed specimens the sides were practically parallel for the greater part of their length and were then greatly attenuated towards the apex. The lines of growth showed up quite distinctly through the very translucent shell, if held up to the light. They were wavy and could be readily noticed even on the inside of the shell. Davidson's fig. 12, pl. 29, was evidently based on a dried and rather distorted specimen.

Tapparone-Canefri (1873, p. 255) identified as *L. exusta* a shell given by Dr. J. C. Cox as *L. murphii*. In the short account, kindly transcribed for us by Mr. Chas. Hedley, mention is made of the subrostrate apex and of its form approaching that of *L. hians* from the China Seas and that there could thus be no doubt that the shell should be referred to *L. exusta*, the Australian representative of that species. He noted, however, that the colour differed from Reeve's account, there being concentric zones of a fine green colour. From these scanty remarks we think it probable that the correct determination should be *L. hians* since the remarks quoted do not apply to *L. exusta* as well as they would to that species which is now known to be so widely distributed.*

L. hians extends from the China Sea to Torres Straits, thence down the Eastern Australian coasts to Moreton Bay and occasionally to Port Jackson ; and also easterly to New Caledonia. There can be little doubt but that it occurs in suitable situations in New Guinea, the Solomons and New Hebrides. Perhaps the Fijian *L. anatina* may be *L. hians*.

At Noumea, both *L. hians* and *L. anatina* have been reported by Brazier (1879*b*, p. 402) and Francois (1891) respectively. The former mentioned in an earlier paper (1879*a*, p. 390) that *L. anatina* was rather common in mud flats there. His material was, as already stated, *L. hians*. We have not had access to Francois' original papers and therefore cannot pass definite opinion regarding his identification, though we doubt the likelihood of *L. anatina* occurring in that locality. A brief note regarding the habits of *L. hians* in the China Sea was published by E. A. Smith (1878, pp. 820-1) who stated that it lived in mud or sandy clay at low water mark, its presence being indicated by the occurrence of oval orifices in the mud.

The wide distribution of the species suggests that the larva has a fairly extended life and is able to adapt itself to rather wide limits of temperature, since the adult occurs in tropical, sub-tropical and warm temperate waters in the Eastern Pacific.

Lingula sp.

Jukes† in his "Voyage of the Fly" (1847, p. 144) gave the following account of a Lingula occuring near Cape York, North Queensland :—"I procured also from a muddy bay, to the east of Evans Bay, a number of the genus Lingula alive. The shells lay buried in a close unctuous mud.

*Dr. J. C. Cox in his privately issued "Exchange list of Land and Marine Shells from Australia and the adjacent Islands" 1868, mention is made on p. 30 of No. 456, *Lingula hians* Swainson, Middle Harbour (Port Jackson)—*fide* Mr. C. Hedley. It was in this locality that Angas obtained his specimens.

†We are indebted to Mr. C. Hedley for this reference.

two or three inches deep. They were always in a vertical position, with the beak downwards. The fleshy or gelatinous pedicle which passed from between the beaks was five or six times as long as the shell and passed down into the mud, ending in a thickened knob. These pedicles did not appear to be attached to anything. On pulling at the shell, a slight resistance was felt, but not more than would be caused by the knob being drawn through the narrower hole in which the pedicle lies." This description does not allow one to identify the animal but the species was probably either *L. hians* or *L. exusta.* The very long peduncle suggests the former, since this organ is short in the latter.

Lingula murphiana King.

(Text-figure 8 ; Plate 2, figs. 5 and 6).

Syns : *L. anatina* Hancock 1858.
L. anatina Dall 1871 (in part).
L. anatina Brazier 1879*a*—Moreton Bay.
L. anatina Martens 1889—Peel I., Moreton Bay.
L. anatina Hedley 1909 (in part), Moreton Bay.
L. rostrum Hedley 1916—Moreton Bay.
L. rostrum Thomson 1918—Moreton Bay.
L. murphiana of authors.

The species was described by Reeve (1859, pl. 1, fig. 3) who retained the MS. name given to it by Capt. King, one of the early explorers of Australia. Some of Reeve's information was published by Chenu (fig. 1199, p. 233). Davidson gave a very good account and several excellent figures of the shell (1888, p. 215-6, pl. 29, fig. 11 ; pl. 30, figs. 1-3), at the same time expressing the belief that Hancock (1858) had described the anatomy of this species under the name of *L. anatina* and that his *L. affinis* was probably *L. anatina* Lam. Hancock's specimen of the former was examined by Davidson who stated (p. 215) that its size and colour agreed with those of *L. murphiana*, but that the identity could not be settled until the animal of *L. murphiana* had been again examined.

Davidson's concise account of the shell is as follows :—
"Shell large, squarish oblong, longer than wide, sides almost parallel, slightly curved inwards towards the middle of their length. Anterior edge gently rounded, with angular projection in the middle ; beaks attenuated, that of the ventral valve pointed and the longest. Valves about equally convex, with a flatness commencing close to the beaks and extending to the front and on each side, sloping to the lateral edges. Colour coppery red, with bands of different shades of green and brown. In the interior of the valves, the muscular area is white, the remainder of the surface light and dark green. Shell structure horny and calcareous. Length of shell 2 inches 6 lines, breadth 1 inch 1 line ; length of peduncle 6½ inches."

L. murphiana is not uncommonly found in the sandy mud between tide marks at certain localities in Moreton Bay, *e.g.*, at Sandgate (to the north of the mouth of the Brisbane River), and at Burpengary Creek, Deception Bay.

In addition to our own material, we examined a number of specimens belonging to the Queensland Museum collection, all from the same localities. Marten's *L. anatina* from Peel Island, Moreton Bay, almost certainly belongs to this species which resembles *L. anatina* rather closely. As already mentioned, the brachiopods from Moreton Bay referred to under the latter name by Brazier (1879*a*) and Hedley (1909), and as *L. rostrum* by Hedley (1916), and Thomson (1918), belong to *L. murphiana*. Dall (1871, p. 55) doubted the validity of the species stating that "this species (?) much resembles *L. anatina*," while in 1873 (p. 203) he included it as a ?synonym of the latter, but omitted to include Moreton Bay amongst the known localities.

The length, breadth and ratio of length to breadth of specimens and ventral valves examined by us, were as follows :—59 mm. by 26, ratio 2.27 ; 59 by 26 (2.27) ; 59 by 25.5 (2.31) ; 57 by 26 (2.19) ; 57 by 25.5 (2.23) ; 57 by 25 (2.28) ; 57 by 25 (2.28) ; 55 by 26 (2.1) ; 54 by 24 (—a shrunken specimen—ratio 2.25) ; 52 by 23 (2.26) ; 51 by

23 (2.22); 50 by 22 (2.27).* Through the kindness of Professor Sir Baldwin Spencer F.R.S., we were able to examine two specimens in the Melbourne University collection (locality, ?Brisbane), measuring 58 mm. by 25 mm. (ratio 2.32), and 50 by 21 mm. (ratio 2.38) respectively. Davidson mentioned as sizes 2 inches 6 lines by 1 inch 1 line, the ratio being 2.3. The ratio of all measured specimens is then practically constant being between 2.1 and 2.3. *L. anatina* has much the same viz. 2.2, but as already mentioned, its valves are less strongly calcified and do not attain to the same length and breadth, while the outline is not so square at the free extremity.

The valves of *L. murphiana* are strongly calcified, relatively thick and practically opaque. Even after prolonged treatment (for several weeks) in 5 per cent. acid alcohol, they do not lose their form as a result of subsequent drying, whereas the shell of *L. bancrofti* does under such conditions. The rectangular outline has been already referred to and is well illustrated by Davidson. The entire animal is comparatively thick and a transverse section shows a more or less elliptical outline, there being no depressed area on each side of the mid region of each valve. A considerable overlap of the dorsal valve by the ventral was commonly noticed, the amount being about two millimetres.

The deltidial region is very well developed and the muscle scars quite prominent, the median ridge being well marked especially on the dorsal valve. This was noted by Davidson (1888, p. 211) who published excellent figures showing the inner faces of the valves (pl. 30, figs. 1-3). The projecting point shown in his figure (pl. 30, fig. 1) is fairly characteristic, though not usually as sharply marked as indicated therein. It is best seen on the dorsal valve. The shell occasionally gapes slightly. The colouration has been noted by Reeve and Davidson. We found, how ever, that the amount of green present varied, but that the coppery red tint predominated and was often blotchy.

*There is also a specimen (?locality) measuring 43.5 by 20 mm. (ratio 2.17) which may belong to *L. murphiana* but we are inclined to regard it as *L. exusta*.

The entire shell may be red brown to pinkish, interspersed with shades of green. The general colour is very like the brown variety of *L. bancrofti.* There is commonly a deposit of thick, almost black, readily removable, pigment on the surface of the valves, especially in the vicinity of the peduncle. The latter is rather long and fleshy, measuring from 110 to 155 mm. in length in our preserved specimens. A tube of sand covers only the cylindrical ampulla at its extremity.

The setæ are arranged at the free end as in *L. anatina* while the laterals are short and the postero-laterals well marked. We were unable to detect pallial pigmentation in our material which had been preserved several years. Perhaps the densely calcified condition of the shell may be correlated with the lack of pigment, if this feature be normal. The arrangement of the musculature resembles in detail that figured (under the name *L. anatina*) by Hancock whose excellent drawings show also the typical form of the cœlome as seen when either the dorsal or ventral valve is removed.

The intestine, which is relatively wider and thinner walled than in *L. bancrofti*, is thrown into a few wide loops differing in position from those of that species and *L. anatina.* The anus lies somewhat dorsally on the right side anteriorly to the insertion of the oblique muscles. It is not situated on a distinct elevation and is, as a consequence, inconspicuous. The liver and gonads occupy positions as shown by Hancock. The nephridia are maroon coloured organs, covered in greater part by the gonads.

Occasionally one notices specimens in which only a few of the pallial sinuses branch in the manner figured by Hancock (pl. 64, fig. 4) ; but in many cases, a fair number of the most anteriorly situated vessels divide up to a considerable degree, so that a plexus-like condition is seen. There may be frequent anastomoses. Between the anterior termination of each main sinus is a space which to the naked eye appears as a non-vascular whitish area, on account of the absence of prominent branches from the inner aspect of each terminal sinus. The majority of the outer vessels from each pallial sinus travel outwardly almost in a straight line. The posterior pallial sinuses are relatively large branching vessels which may be gorged with purplish blood. A well defined visceral vessel is also at times readily recognisable, its appearance reminding one of that figured by Hancock (pl. 64, fig. 1).

This latter condition was not observed in any of our specimens of *L. bancrofti.* The form and position of the canals in the arms (text-figure 8) is different from that described for the last named species. In *L. murphiana* the anterior canal, as seen in section, is not circular, while the posterior canal is less extensive, and the brachial fold is rather thin and narrow.

The habits of *L. murphiana* as far as we know them, resemble those of *L. anatina* and other littoral species of Lingula.

Relationships :—Reeve (1859) remarked " whether this should be regarded as an Australian form of *Lingula anatina* or as a distinct species, it is certain that the differences are obvious and constant." He went on to say that all the specimens examined by him were distinguished from *L. anatina* which is common in the Bay of Manila, Philippine Islands, by a more square outline and a peculiarly coppery-red tone of colour.

Davidson (1888, p. 216) referred to the shell being wider in comparison to its length, thicker and differing in colour. He thought it nearly allied to *L. tumidula* and in a letter to Brazier (Davidson 1879, p. 402) had doubted whether the two species were really distinct, suggesting that as they occurred in the same locality and were of the same colour, *L. tumidula* might be only a very wide variety of *L. murphiana.* As pointed out by us when dealing with the former, there is no resemblance either in colour, consistency of shell, or shell proportions ; and, moreover, they do not occur in the same locality as far as we know, though the name " Moreton Bay " was stated as the locality in each case. We have mentioned elsewhere the likelihood of confusion between Moreton Bay, an inlet in the south-eastern corner of Queensland, and Moreton Bay, the district which subsequently became the colony of Queensland.

Blochmann (1900, pp. 94-5; quoted by Yatsu 1902) enumerated several distinguishing characters separating this species from *L. anatina*, but Yatsu believed the mode of branching to be the only reliable criterion, considering the remaining points to be mere individual differences. He found that Japanese forms, regarded as *L. anatina* varied in their proportions of length, breadth, and thickness so that some agreed with *L. anatina* and others with *L. murphiana*. We regret that we have not been able to consult Blochmann's paper either in Brisbane or Sydney.

L. exusta Reeve.

Syns :—*L. anatina* Hedley 1898, Brit. New Guinea
L. anatina Banfield 1918, Dunk I., N.Q.
L. exusta Tapparone-Canefri, 1873.

The best account is that published by Davidson (1888, p. 217-8, pl. 28, figs. 20, 21, 21*a*), the original being very short (Reeve 1859, pl. 2, fig. 9; Sowerby, 1846, p. 339). Reeve considered it related to *L. hians* and thought that it was perhaps the Australian representative of that species. The description given by Davidson is as follows :—" Shell oblong, much longer than wide, a little broader anteriorly; sides almost subparallel, slightly curved inwards near the middle of their length; front line very gently curved, with a projecting angle in the middle. Valves convex, beaks obtusely angular, surface smooth, shining, darkish coppery yellow-brown, especially towards the lateral and frontal margins. Length of shell 1 inch 7 lines, breadth 8 lines." The ratio of length to breadth is then 2.37. The only locality mentioned for the species is " Moreton Bay." Davidson remarked that he had seen a number of specimens and that they all presented the same shape and marked dark colour. In addition to republishing Reeve's figure, he illustrated a shell from the British Museum collection (pl. 28, fig. 21, 21*a*), the locality being given as Moreton Bay.

We have examined a number of valves belonging to the Queensland Museum, collected by Hartmann in Torres Straits. These agree with Davidson's account and figure. The shell is strongly calcified especially when adult, maintaining its form when dry. In these two points the species is quite distinct from *L. hians*. Though its proportions may approximate those of the latter, the consistency and colour of the valves are more suggestive of *L. anatina.* There is usually a very deep green margin and a green tinge is common throughout the shell, especially in its anterior half. Sometimes a distinct metallic appearance is visible on parts of the valves. This has been referred to by Reeve as a peculiar coppery redness which assumes in this species " a dark, shining, swarthy tone of colour." This is at times very evident in old specimens, especially anteriorly and around the margins, when the green colour then becomes much less noticeable. The muscle impressions are very obvious.

L. exusta is the smallest species known from the Queensland coast. The following is a list of measurements (length, breadth and ratio of length to breadth) made by us from odd valves : ventral valves—37 mm. by 15 mm. (2.46) ; 34 by 13.5 (2.52) ; 32 by 13 (2.46) ; 32.5 by 13.5 (2.41) ; dorsal valves—31 by 14 (2.21) ; 31 by 13 (2.38). Occasionally the free margin was the widest portion of the shell.

There is in the Queensland Museum collection a specimen collected by C. J. Wild, at Port Douglas, North Queensland, measuring 42 mm. by 19 mm., the ratio being 2.2. It has a strongly calcified shell, brownish and greenish in colour, with the sides practically parallel. Its general appearance agrees sufficiently closely with that of *L. exusta*, though in some points it suggests *L. murphiana*.

Owing to the kindness of Professor S. J. Johnston, of the Zoology Department, University, Sydney, we were able to examine two specimens of Lingula which Professor W. A. Haswell, F.R.S., informed us were given to him in 1883, by Rev. J. E. Tenison-Woods. The latter said that these had been obtained in Port Jackson. They proved to be *L. exusta*. Their measurements were as follows : length 37 and 34 mm. ; breadth 14.5 and 14 mm. ; peduncle 42 and 37 mm. respectively. The ratios of length to breadth were thus 2.55 and 2.43. The well calcified valves had a slight coppery appearance but were yellowish and greenish towards the free end which was slightly widened and bore a small but distinct median prominence. They curved gently on each side from the midline so that the cavity of the shell was comparatively deep, as in *L. murphiana.* The anterior setæ were seen to be arranged in three groups as in *L. anatina.* The brownish peduncle terminated in a small ampullary region enclosed in a sandy tube about 5 mm. long. Since Tenison-Woods collected extensively in Northern Queensland, and seeing that all definitely known Australian localities for the species are in that region, it is quite probable that confusion in regard to localities has arisen. We feel justified in declining to recognise Port Jackson as a habitat, Prof. Haswell agreeing with our action in this matter.

E. J. Banfield in his recent book "Tropic Days" 1918, pp. 106-7) referred to the occurrence of a Lingula on Dunk Island, to the north of Rockingham Bay, North Queensland. "In the mud close to the edge of the beach sand one of the most singular of marine animals exists and often its empty, horny, flexible semitransparent shell always tinted green, may be found. It is known in some works as *Lingula anatina*, and by the natives of this Isle, by whom a certain part is eaten, as 'Mill-ar-ing.' A pinhole in the mud indicates the presence of the animal and the hungry black boy, thrusting his hand with outspread fingers below it, closes the fingers and withdraws anything but an inviting morsel. To the tongue-shaped shell is attached a pedicle or stalk, attaining a length of ten inches, opaque and tough, which is broken off, seared over the fire, and eaten with apparent relish. It is remarkable that in localities where this mollusc is found, a seaweed occurs similar in shape and size, the chief difference in appearance being in the length of the stalk which in the plant is thin and membranous." (? *Halophila ovata* T.H.J.).

The "empty horny, flexible, semitransparent shell, always tinted green" suggested *L. hians*, but in answer to our request for specimens, Mr. Banfield kindly sent down a goodly number collected in a few minutes in sandy mud near Brammo Bay, Dunk Island. The species has been determined by us as *L. exusta.* Either *L. hians* occurs in addition, or the above remarks regarding shell characters relate to young specimens of *L. exusta* which are rather difficult to distinguish from *L. hians.* The adults are quite distinct and readily separable. Three young animals all with rather thin, horny, semitransparent valves through which the viscera, pallial pigmentation and pallial sinuses could be seen, were found to measure 26 mm. by 12.5 mm. (ratio 2.08) ; peduncle 35 mm. ; 29.5 by 14.5 (ratio 2.03) ; 32 by 14.5 (ratio (2.20) ; peduncle 32 mm., this specimen showing the presence of dark green pigment at the free extremities while the rest of the valves was yellowish brown, the shell being more calcified than those of the other two just referred to. Eight others, all adults with strongly calcified valves, were measured :—38 by 16. 5 (ratio 2.30) ; 39 by 17.5 (2.23) ; 39 by 18 (2.17) ; 40.5 by 18.5 (2.19) ; 40.5 by 19 (2.13) ; 41.2 by 19.5 (2.22) ; 42 by 17.7 (2.37) ; 42 by 19.2 (2.3). The contracted peduncle in this species is small, ranging up to 70 mm. but usually much shorter. All adults examined showed the same general colouration—a very dark green pigmentation, especially towards the free extremities, with green, golden and pale yellowish areas elsewhere. Occasionally a coppery tint was to be observed. The form of young shells was practically elliptical though somewhat broadened anteriorly, while that of adults was more rectangular with the sides subparallel and corners obtusely rounded, the anterior border possessing a well marked median prominence. Erosion of valves was commonly seen. The ratio of length to breadth varies within considerable limits even in adults. Young forms are relatively broader. Since these measurements were made from preserved animals, they are more likely to be correct than those previously given, based on separated valves. The ranges of sizes in the two cases overlap, however, the ratios varying from 2.03 to 2.20 in young transparent forms, 2.13 to 2.37 in preserved adults ; and 2.37 to 2.52 in the case of separated ventral valves. No doubt amongst the latter there has been a slight lateral contraction owing to drying, and this would cause the shell to appear longer and the ratio greater.

Since this paper was practically completed before Mr. Banfield's specimens arrived, we have not included an account of the anatomy of *L. exusta*. The pallial pigmentation is very heavy and is characteristically arranged being intermediate between that figured by Morse (figs 10 and 11) for *Lingula* sp. from Nagasaki, Japan, and that for *L. anatina.*

Mr. Hedley sent us a small specimen collected at Fyfe Bay near the south-eastern corner of British New Guinea (Lat. 10° 35′S., Long. 150° E.) and recorded by him as *L. anatina* (1898, p. 369). It measured 34 by 14.5 mm. (ratio 2.34) and had a small peduncle 28 mm. long. The shell characters were those of a young *L. exusta.*

As already mentioned when dealing with *L. hians*, Tapparone Canefri identified an Australian specimen sent by Dr. Cox under the name of *L. murphii* as being *L. exusta*, but we believe it to have been *L. hians.*

Lingula bancrofti n.sp.

(Text-figures 1-7 ; pl. I, figs. 1-4).

Representatives of this new species were collected by Dr. T. L. Bancroft and Miss M. J. Bancroft in December, 1916-January, 1917, at Burnett Head. They obtained their specimens by digging a large hole in the wet sand and then picking out *Lingula*, *Thalassema* and other invertebrates as the sides of the excavation fell in. By this means several very small brachiopods were gathered. We subsequently visited the locality on different occasions during 1918 and obtained additional material. Two dead Lingulas collected by Miss G. James on Pialba beach to the southward, belonged to the same species. No doubt *L. bancrofti* will be found to occur on many of the same mud flats on the shores of Hervey Bay, of which Burnett Head constitutes one boundary.*

This Lingula was met with at the Head in a portion of a bay-like area, exposed at low tides, and partly enclosed by the breakwater on the southern side of the entrance to the Burnett River. Its presence was detected by the occurrence of slit-like apertures in the mud from about ten yards from high water mark down to the furthermost limit of low tide. The animal appeared to be social in habit. It is worthy of note that the mud-inhabiting crabs were

*Miss James has forwarded others collected at Torquay and Urangan, on the coast of Hervey Bay (June, 1919).

absent from the places where Lingula was plentiful though they were very abundant on other portions of the sand-mud beach. As Lingula was found to be very common in a gutter which contained water, while the banks were exposed, observations on its habits were made. In such a situation the brachiopods could be located owing to the reflection of light from the waving setæ projecting just above the surface of the mud. The setæ and the rounded portion of extremity of the valves could be protruded above the surface of the mud, so that about ¼inch of shell projected under favourable conditions. The habits were similar to those described for *L. anatina*.

A few specimens were obtained in rather soft mud, but nearly all were collected in muddy sand. A greenish form was more common where the beach was rather muddy, while a brownish variety was commoner where the ground was more sandy, but both kinds were in abundance in a little gutter.

The shell corresponds rather closely with the account of that of *L. anatina* given by Davidson (1888, p. 207), Gratiolet (1860, p. 52, figs. 1 and 2) and Reeve (1895, pl. 2, fig. 10). Some dried specimens which had been previously preserved in spirit, coincide with certain of Sowerby's figures of *L. anatina* (figs. 9 and 10). Occasionally the valves are slightly wider near the beak than more distally. They are approximately equally convex and possess a ridge on their inner surfaces. The ventral valve extends slightly beyond the dorsal at the distal free pallial edge. The shell is quite smooth, though the lines of growth are readily noticed. Umbones are distinct.

The angles of the valves project so that the free extremity is rather squared, although there is often a slight median prominence. The shape of this portion is more like that figured by Sowerby's (figs. 9 and 10) for the dark and brown varieties of *L. anatina* than his fig. 2 and 3, although occasionally that shape is to be seen too. The free end is rounded in very young specimens. The general colour is like that of *L. anatina* (Davidson, Reeve). In some the prevailing tint is distinctly brown, in others brown with some green, in others bright green with some brown.

None were found to be entirely brown though that colour predominates in the thicker parts of the shell of all specimens and in preserved material tends to become dominant. Sometimes the colour is almost a pure pale green, but brown tints are visible in the central portion of the valves. Longitudinal lines and also lines of growth are readily seen in decalcified valves.

Morse (p. 320) in speaking of *L. anatina* from Japanese waters mentioned that he found a proportion of the shells thickened, discoloured and eroded, forming a marked contrast to other specimens, equally large, but with clear green shells, thinner in texture and more perfect in condition. He believed that the animals with rougher and thicker valves were probably a year or more older than the others. We found such eroded thicker shells amongst the rather thinner shelled forms.

Our smallest specimens measure 10.5 by 5.0 mm. with a peduncle of 100 mm. long, the ratio of the length of the ventral valve to its breadth being 2.1 ; 13.5 by 6.4 mm. (ratio 2.11), peduncle 20 mm. ; 12 by 5.6 (ratio 2.14) ; 20.5 by 10 (ratio 2.05), peduncle 35 mm. ; 21.0 by 10.8 (ratio almost 2) ; 23 by 11 (ratio 2.1). Many of the collected specimens measured about 41 mm. in length by 20.5 mm. in breadth (ratio 2.0). A few large forms with thickened shell and light coppery tint reminding one of *L. murphiana*, measured 50 by 24 mm. (ratio 2.08). Another with a typical greenish shell not specially thickened had the same measurements. Of the 45 adults measured, 29 were between 40 and 50 millimetres in length, 35 were between 32 and 48 mm. The majority were between 43 and 46 mm. Thirty-eight had a breadth ranging between 20 and 24 mm. We find that the ratio of length to breadth is a very useful character in distinguishing Lingulids, being, at least in some species, a comparatively constant feature. Out of the 45 specimens measured, in two cases it was 1.9 ; in 19, 2.0 ; 14, 2.1 ; 6, 2.2 ; 3, 2.3 ; while in one it was 2.4. The average was 2.08. In 33 the ratio was between 2.0 and 2.1. In the longest specimen it was 2.08. Even in all the young animals measured it was found to range between 2.0 and 2.14. Owing to the horny nature of the edges, the sides of the valves may undergo some distortion during drying. All the foregoing measurements, however, were taken from preserved animals.

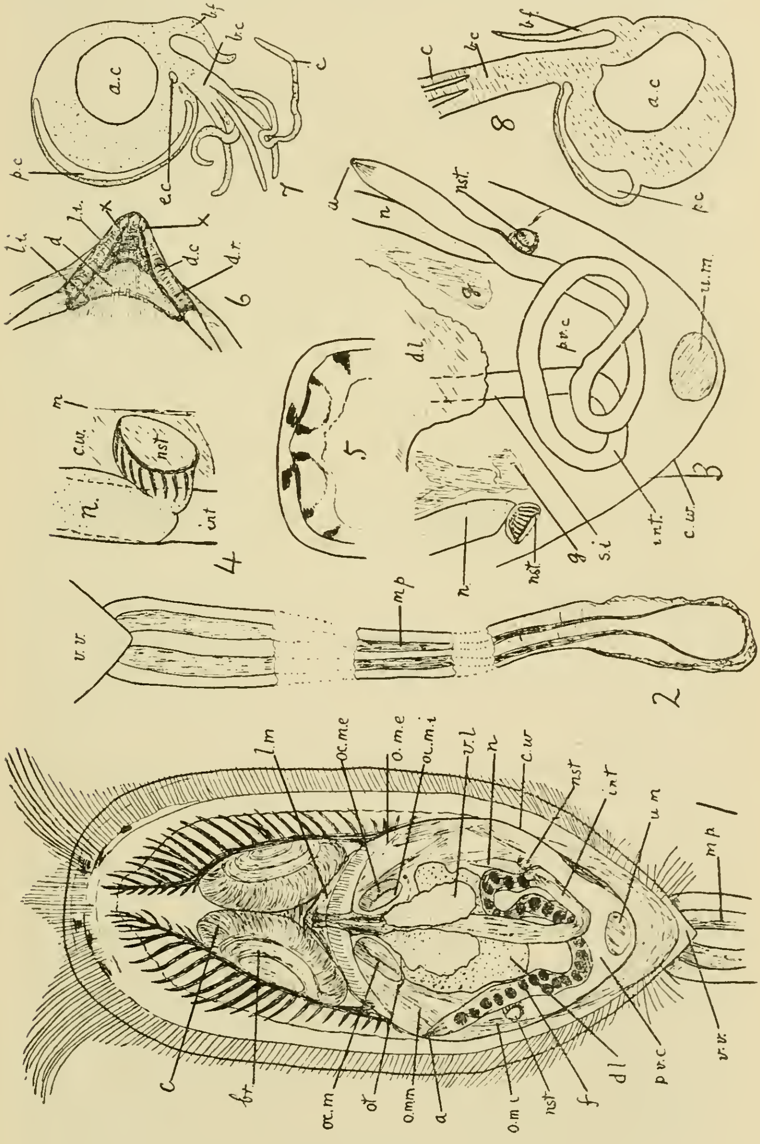
The sizes mentioned and the figures published for *L. anatina* by Davidson, Yatsu and others show a ratio of 2.2. Sowerby's fig. 3, has a ratio of 2.4, while figs. 9 and 10 (brown and dark varieties respectively) show a ratio of 2.1. *L. bancrofti* then can usually be distinguished from *L. anatina*, which it closely resembles in most of its shell characters, by its ratio of length to breadth being rather less. *i.e.*, the shell is relatively somewhat broader. Sowerby's figs. 9 and 10 are very suggestive of our species.

In *L. murphiana*, the other Queensland species with which the shell might be confused, the ratio is about 2.3, and, moreover, the adult shell is longer, thicker, more mineralised and the coppery colour more pronounced. Besides, just distally from the umbones, a section of the paired valves is more rounded than in *L. bancrofti*, a depressed area being present on each side of the mid-region of the valve in the latter species. There are also marked anatomical differences to be noted later.

The proportions correspond with those of *L. jaspidea*, viz., 2.0, and *L. reevei*, 2.1 (Davidson pl. 28, fig. 23, 24 and fig. 18 respectively), but the form is quite different in the three species. In young individuals the shell is sufficiently transparent to allow one to see the arms, pallial sinuses, nephridia, rectum, liver and muscle impressions. The anatomy of small and medium sized specimens can be easily studied in Canada balsam after prolonged decalcification in rather strong acid alcohol (70 per cent. alcohol with 3 per cent. HCl.) followed by gradual dehydration and clearing in clove oil. The use of a weak solution of Ehrlich's or Delafield's hæmatoxylin followed by careful and prolonged decolorisation, gives a very good result.

The muscle scars are arranged as in *L. anatina*. No marked submarginal scar for the insertion of the setæ musculature was recognised. King (p. 12, fig. 5) did not observe it in *L. anatina*. The deltidial region (text-figure 6) resembles in most details that described by this author for *L. anatina*.

The pallial pigment is constant in position (text-figure 5), resembling somewhat that figured by Morse (pl. 52, fig. 10) for the Japanese *L. anatina*. Sometimes the pigmentation is not so heavy and consequently not so evident



TEXT-FIGURES 1-8.

but the general disposition of the patches is constant. Morse believed the arrangement to be of specific value. We agree with his suggestion (p. 349) that these areas are probably sensitive to light. They are restricted to those portions of the pallium lying in the translucent region of the shell which can be projected above the surface of the sand.

The peduncle is highly contractile (text-figure 2). In life the centre is creamy in colour but has a tinge of pink after preservation. The horny envelope is quite transparent. The whole peduncle and also its inner muscular portion gradually become narrowed as they pass back from the insertion into the ventral valve, being narrowest just in front of the ampulla where the stalk widens as a thin walled organ. The horny layer of the anterior part of the ampulla is considerable thickened. Surrounding the ampulla is a tube of agglutinated sand grains. The structure of the peduncle is like that described by Gratiolet (1860, pp. 63-70) and King (1873, p. 14).

The arrangement of the setæ resembles that in *L. anatina* (Morse pl. 40, fig. 16 ; Francois 1891, 1895, fig. 315), the median and anterior clusters projecting freely, the lateral setæ only slightly, while the posterior cluster is very distinct on each side. Rather long setæ surround the base of the peduncle. The anterior lateral setæ are very long in young specimens (text-figure 1), measuring as much as 3.5 mm. in a form 12 mm. long. In the lateral and posterior setæ which are doubtless the organs by which Lingula climbs up its tube, one notices a strongly marked alternation of brown and colourless regions, particularly in the basal portion of each seta.

In *L. bancrofti* the pallial sinuses resemble those figured by Hancock* (pl. 64, fig. 3) for *L. anatina* except that there is commonly a certain amount of branching of the most anterior channels and, at times, of some of the laterals also. Gratiolet published figures (pl. 7, fig. 1 ; p. 89. fig. 15) showing occasional branching of the anterior pallial sinuses in *L. anatina*, such a condition being also indicated in one of his figures of *L. hians* (pl. 9, fig. 1). In *L. affinis* the sinuses are few and branch in a marked manner

*Hancock's *L. anatina* is not *L. anatina* Lam. but *L. murphiana*.

(Hancock, pl. 66, figs. 1, 2, 3 ; Davidson pl. 29, fig. 9). The arrangement in New Caledonian specimens of *L. anatina* is shown in Francois' figure (1895, p. 315) as being simple ; likewise also in Woodward's figures. Occasionally the terminal portions of the sinuses in *L. bancrofti* are somewhat swollen, resembling the condition figured by Gratiolet (p. 89, fig. 15 ; pl. 8, fig. 1).

The posterior pallial sinus on each side is inconspicuous and bears very short branches since this region of the body is very narrow owing to there being little room between the oval perivisceral cavity and the lateral edge of the body. In *L. anatina* and *L. murphiana* there is a considerable space in this position on each side and the posterior sinus is consequently large and gives off numerous short branches (Francois, King, Gratiolet, Hancock). The structure of a branch of the anterior sinuses is like that described and figured by Morse (p. 351, pl. 53, fig. 4), the ciliate ridge dividing the channels or lacunæ being rather wide and shallow.

The arms or brachia do not call for comment. They are pearly, whereas in *L. anatina* Morse states (p. 332) that they are pure white with a border and collar of a dark brown and the sides of the cirri also brown. Though this author recorded that the arms could be protruded to a considerable distance beyond the shell (pl. 40, fig. 17), we did not observe such action, some of the cirri being the only projecting structures. Yatsu (p. 64) reported that the Japanese *L. anatina* could project only the comb-like row of cirri of the largest whorl of the arm, the tip of the brachium being always retained within the mantle cavity.

If a section be cut across an arm (text-figure 7), the anterior canal (which is circular in section) is seen to be comparatively large while the posterior canal is long and very narrow, lying just below the surface. The brachial fold is prominent. The general appearance is like that of *L. anatina* as figured by Gratiolet and that given by Hancock for his *L. anatina* (pl. 65, fig. 7) which is really *L. murphiana*.

We have compared the muscular system with the available accounts given for *L. anatina* and *L. lepidula*, but have not been able to consult Blochmann's important paper on the subject (1900).

The anterior occlusors (central muscles of King and Davidson), as seen on removing the dorsal valve, are relatively larger and more distinctly pyriform than they are in *L. anatina*, while the anteriorly directed narrow portion of each approximates its fellow so that a very narrow interval separates them from each other and from the hinder border of the lateralis muscles (anterior laterals of King and Davidson). These anterior occlusors are relatively larger than those of *L. lepidula* (Morse, pl. 48, fig. 2) and of about the same relative size as those of *L. affinis*, but they approach each other more closely in *L. bancrofti* than in the last-named species. The lateralis is relatively smaller than in *L. anatina* (Hancock, Woodward, King) and *L. lepidula* (Morse). The posterior occlusor (umbonal) muscle is well developed and is circular or elliptical in outline.

If the ventral valve be removed the appearance of the muscular system is somewhat like that figured by Hancock (pl. 64, fig. 2) for his *L. anatina* (which is really *L. murphiana*) except that the posterior lateral pallial region is much narrower and the lateralis better developed in *L. bancrofti*. In the latter the internal oblique (transmedian of King and Davidson) is more powerful and covers the posterior parts of the nephridium, while the anteriorly situated band of its divided fellow of the opposite side is considerably wider than the posteriorly directed portion, reminding one of the condition figured by Gratiolet (p. 77, fig. 11) for *L. anatina*, and by Morse (pl. 48, fig. 2) for *L. lepidula*. In *L. affinis* they are subequal (Hancock, pl. 65, fig. 2).

The mouth, an elongate aperture with a crenate border, leads into an œsophagus which is thick walled, especially near the mouth and in the vicinity of the insertion of the mesentery. The stomach is more marked than in Hancock's figure (pl. 65, fig. 4) but less pronounced than in *L. lepidula* (Morse pl. 47, figs. 5 and 6). The gastric or stomachal glands (" liver " or hepatic diverticula) occupy a great deal of the perivisceral cœlome, the dorsal portion being more extensive than the ventral. The straight intestine proceeds posteriorly in line with the œsophagus and stomach, but just in front of the umbonal muscle it becomes bent forwards on the left side sometimes reaching the ventral lobe of the liver. In young specimens (text-figure 1) it then bends backwards to travel between the straight intestine and the first loop, or else above the straight intestine (*i.e.*, on the left side of the cœlome). It then crosses above the latter to travel obliquely forward to terminate at the arms on the right side. In adult animals (text-figure 3) the intestine appears to have elongated to a much greater extent than the cœlome and as a consequence has become thrown into a pronounced loop which is barely indicated in young specimens. The tube after reaching the vicinity of the liver forms a large open loop extending dorsally into the right side of the cœlome above the straight intestine and commonly above the rectum also, returning to the left side to form another loop before continuing as the rectum which has the same relative position as in young animals. The coiling of the intestine resembles that described by Gratiolet for *L. hians* (fig. 19, p. 133) rather than that figured for *L. anatina* (Woodward), and *L. affinis* (Hancock, pl. 65, fig. 4). In these two species the loops are closer, the coils forming a loose ball. In the adult of *L. bancrofti* the coiling is intermediate between the condition seen in *L. hians* and *L. anatina.*

The intestine, stomach and gastric glands of several small specimens which had been cleared and mounted were found to be filled with the valves of a number of different genera of diatoms. The contents of the posterior half of the intestine were arranged in more or less rounded fæcal pellets in which diatoms could be seen.

In a young decalcified specimen in a position similar to that in which Morse found an otocyst in *L. lepidula* (pl. 47, figs. 5 and 6) we observed a small spherical organ 0.15 mm. in diameter. This otocyst was situated just behind the occlusor and laterally from the stomach. Morse noted its presence in *L. anatina* also (p. 348) but mentioned that he had not been able to see them in any Lingulas preserved in alcohol. We observed them in only two out of several submitted to microscopical examination.

The gonads are obvious structures in adults but are not recognisable in our smallest specimens. They occupy positions similar to those of *L. anatina*, the ovary being pale brownish and the spermary whitish or faintly pinkish.

The glandular portion of each nephridium is flattened and brightly coloured—red brown to deep orange—especially towards the nephrostome, shading into a pale yellow towards its outer opening (text-figures 3 and 4). This coloured part can be readily seen through the valves in most specimens the colour persisting in specimens which had been over two years in alcohol and formalin. In *L. anatina* it is marked by dark maroon lines (Morse p. 361). In one of our specimens, a young adult, a few deeper coloured longitudinal lines were noticed, but whether they were merely accidental folds or not we are unable to say. There is a sharp line of demarcation between the coloured glandular nephridium and its colourless nephrostome, a deep constriction separating the two. The latter, which is about a millimetre in diameter, in a specimen 35 mm. long, is intermediate in form between those of *L. anatina* and *L. lepidula* as figured by Morse (pl. 54, fig. 11 ; pl. 55, fig. 1). The margin is simple and the rim is bent over outwardly, one part of the rim being confluent with the body wall. The vessels in the wall of the nephrostome stain readily with hæmatoxylin.

A characteristic difference between *L. bancrofti* and most other species whose anatomy is known, relates to the form of the perivisceral cœlome as seen when either valve is removed. If one compares its shape (figs. 2 and 3 and text-figure 1) with the figures of *L. anatina* (King, figs. 1 and 2 ; Gratiolet, fig. 11 ; Hancock, pl. 64, figs. 1 and 2 =*L. murphiana*) and *L. affinis* (Hancock, pl. 66, fig. 1), it will be noted that the portion of the body cavity lying posteriorly to a line joining the insertions of the oblique muscles is greatly narrowed in the two species referred to, particularly when viewed from the dorsal surface. Consequently the oblique muscles and the nephridia lie in a wide cœlomic bay. In *L. bancrofti* the sides of the body wall do not project inwards to the same degree, the curvature being much more gradual. In this respect it is rather like *L. lepidula* where it is almost circular according to Morse. In the Burnett species it is a short oval if viewed in its mid horizontal region, since the lateral projections do not involve this portion but cover the dorsal and ventral postero-lateral edges as a thin sheet. We have used the term "perivisceral cœlome" widely so as to include the perigastric cavity. The periœsophageal cavity does not call for comment.

L. bancrofti is closely related to both *L. murphiana* and *L. anatina* (*L. rostrum*). Type specimens have been deposited in the collections of the Queensland Museum, Brisbane, and the Australian Museum, Sydney.

General Remarks.

Our brief acquaintance with the Lingulidæ has led us to regard the following features as being of value for specific determination. *Shell characters* :—Opacity or transparency of the adult shell ; degree and extent of calcification ; general form of valves ; convexity of valves ; ratio of length to breadth ; maximum length ; character of the umbonal regions ; presence or absence of well marked median ridges on the valves internally ; prevailing colour. *Anatomical characters* :—shape of cœlome ; arrangement of musculature ; disposition of setæ ; branching of pallial sinuses ; pigmentation of pallium ; shape of nephrostome ; coiling of intestine. The peduncular length should also be noted.

The Queensland species fall into four groups, (*a*) *L. tumidula*, (*b*) *L. hians*, (*c*) *L. murphiana* and *L. bancrofti* which resemble *L. rostrum* in general appearance, (*d*) *L. exusta* which reminds one of a small and very narrow *L. rostrum*.

Key to Queensland species of Lingula, based on shell characters :—

1. Breadth of valves considerably more than half the length ; shell thin, reddish brown........ *L. tumidula*

2. breadth of shell not more than half length, shell greenish or copper coloured.............. 3

3. *a*. valves very thin, horny, readily distorted so that beaks become very prominent in dried

specimens, shell translucent, colour pale green and bright green .... *L. hians*

b. valves more or less calcified, maintaining form more or less completely. 4

4. *a.* large opaque strongly calcified valves of pale or coppery red colour, ratio of length to breadth 2.2 to 2.3—no depression on either side of mid-line .... *L. murphiana*

b. fairly large shells, well calcified, translucent at free end, greenish or copper coloured, slight depression on either side of midline, ratio generally 2.0—2.1 .... *L. bancrofti*

c. Shell small, narrow, valves generally dark green at free extremity, rest may be coppery in tint, free extremity rather squared with median prominence, ratio of length to breadth variable, 2.2 to 2.5 in adults .... *L. exusta.*

Thomson (1918, p. 51) in referring to the distribution of Brachiopods in the Southern Hemisphere, stated that, if we exclude deep sea forms, there were few species common to the Southern and Northern Seas and that in the case of *Lingula* and of *Platidia*, the identifications of the southern forms were in need of confirmation. In the list of five such species mentioned by him are three of *Lingula*, viz., *L. rostrum* from Moreton Bay, the Indian Ocean and Japan ; *L. hians* from Port Jackson and the China Sea ; *L. tumidula* from Moreton Bay and the Philippines. We have shown that there is no undoubted record of *L. rostrum* (*L. anatina*) from Australia ; that *L. hians* is widely distributed in north eastern Australia and adjacent islands ; and that *L. tumidula* occurs in Hervey Bay and is probably quite distinct from the Philippine species *L. compressa.*

The following table represents an attempt to show the relationships of different species in various Eastern Pacific regions. We think that a comparison of the East Indian and Japanese *L. rostrum* with the Philippine typical form should be carefully made—hence our query regarding such identifications.

Australasia	E. Indies	Philippines	S. Japan
L. hians	L. hians	?	?
L. murphiana L. bancrofti }	? L. rostrum	L. rostrum	? L. rostrum
L. tumidula	?	L. compressa	L. adamsi
L. exusta	?	?	?

Summary.

1. There are at least five species of Lingula known from the Eastern Australian coast :

(*a*) *L. hians* Swainson—Torres Straits ; Keppel Bay ; Port Curtis ; Moreton Bay ; ?Cape York ; also from Sydney Harbour as an extremely rare animal.—(New Caledonia).

(*b*) *L. murphiana* King—Moreton Bay.

(*c*) *L. bancrofti* Johnston and Hirschfeld—Burnett Head, Urangan, Torquay and Pialba (Hervey Bay).

(*d*) *L. exusta* Reeve—Torres Straits ; Dunk Is., N.Q.—(British New Guinea).

(*e*) *L. tumidula* Reeve—Hervey Bay ; Port Curtis. This is probably not a littoral species but an inhabitant of comparatively shallow waters.

2. There are no undoubted records of *L. anatina* (*i.e.*, *L. rostrum*) from Australian waters.

3. The ratio of length to breadth is fairly constant for the species. In the case of ventral valves of adults of Australian Lingulids they are as follows :—*L. hians* 2.3 to 2.47, variable ; *L. murphiana* 2.2 to 2.3 (practically the same as *L. anatina*, 2.2) ; *L. bancrofti* 2.0 to 2.1 ; *L. exusta* 2.2 to 2.5, variable ; *L. tumidula* apparently about 1.5 to 1.6.

We desire to acknowledge our indebtedness to Mr. H. A. Longman, Director of the Queensland Museum, for permission to examine the collection under his care; Dr. T. L. Bancroft, Miss M. J. Bancroft and Mr. E. J. Banfield, for supplies of brachiopods; and especially to Mr. Chas. Hedley, Assistant Curator of the Australian Museum, Sydney, for his kindness in supplying information from many sources which were either unknown or inaccessible to us, and in forwarding for our examination specimens from New Guinea, New Caledonia, etc. The figures on plates I and II were drawn by Mr. Hubert Jarvis, Assistant Entomologist, Brisbane.

LETTERING AND EXPLANATION OF PLATES.

Text-figures 1-7, *L. bancrofti*, fig. 8 *L. murphiana*. All except text-figure 5 are from camera lucida drawings.

1. *L. bancrofti*, young specimen 13.5 mm. long, stained and viewed from ventral aspect as a transparent object.
2. part of peduncle of specimen shown in fig. 1 (full length 20 mm).
3. part of cœlome showing anatomy.
4. nephrostome and portion of nephridium.
5. free extremity of pallium of a small adult, to show arrangement of pigment (freehand sketch).
6. deltidium.
7. T.S. brachium (basal portion) of *L. bancrofti*.
8. T.S. brachium of *L. murphiana*.

PLATE 1. *L. bancrofti*.

Fig. 1. view of entire adult animal.
2. dorsal do. do. do. dorsal valve removed.
3. ventral do. do. do. ventral valve removed.
4. view of entire adult animal, pallium reflected, to show brachia pigmentation of pallium, pallial sinuses, etc.

PLATE 2. *L. murphiana*.

Fig. 5. dorsal view of animal, dorsal valve removed.
6. ventral do do ventral do do.

REFERENCES TO LETTERING ON TEXT-FIGURES AND PLATES.

a., anus; *a.c.*, anterior canal of brachium; *b.c.*, base of cirrus; *b.f.*, brachial fold; *br.*, brachium; *c.*, cirrus; *c.w.*, cœlomic wall; *d.*, deltidium crossed by alternating pale and yellowish-brown bands; *d.c.*, deltidial callosities on deltidial ridges; *d.l.*, dorsal portion of "liver"; *d.r.*, deltidial ridge; *e.c.*, efferent canal of cirrus; *f.*, fæcal pellet; *g.*, gonad; *int.*, intestine; *l.i.*, "lineated impression" (of King), marking position of anterior end of horny layer of peduncle: *l.m.*, lateralis muscle; *m.*, muscle; *m.p.*, musculature of peduncle; *n.*, nephridium; *nst.*, nephrostome; *o.m.e.*, external oblique muscle; *o.m.i.*, internal oblique muscle: *o.m.m.*, median oblique muscle; *oc.m.*, occlusor (anterior occlusor) muscles; *oc.m.e.*, external occlusor; *oc.m.i.*, internal occlusor; *ot.*, otocyst; *p.c.*, posterior canal of brachium; *p.v.c.*, perivisceral cœlome; *s.i.*, straight portion of intestine; *u.m.*, umbonal (posterior occlusor) muscle; *v.l.*, ventral portion of "liver"; *v.v.*, ventral valve; *x.*, marks limits of aperture through which the peduncle passes to its insertion into the ventral valve.

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MARINE MOLLUSCA COMMON TO AUSTRALIA AND SOUTH AFRICA.

By John Shirley, D.Sc., F.M.S.

(*Read before the Royal Society of Queensland, 28th July,* 1919).

In a former paper* the extremely wide range of marine shells found on the Queensland coasts, and the large percentage of species common to such distant places as Queensland and the Philippine Islands have been dealt with at length. Melville and Standen in their "Shells from Lifu" refer constantly to similarity of species in the molluscan faunas of Mauritius and the Loyalty Islands, places separated by 3,000 miles of sea. They notice particularly the presence of a Galapagos shell, *Cerithium zebrum* Kiener, at Lifu, also reported by the writer from Murray Island in Torres Strait. Queensland species are found inhabiting the Red Sea and Persian Gulf, and others range as far as the coasts of China and Japan. Keeping their extraordinarily wide distribution in view, especially in the Indo-Pacific regions, it is curious to meet with statements like the following,— †"The species," referring to *Ziziphinus bicingulatus* Lamarck, "is South African according to the British Museum collection, and the Queensland locality is necessarily false." Again, the same writer in referring to *Cymatium doliarium*

*Shirley, Proc. Roy. Soc. Queens., XXV, 1914, pp. 5-12.

†Hedley, Studies of Australian Mollusca, Part XI, 1913 p., 279.

L. says, *"All the specimens in the British Museum collection are from South Africa. There can be no doubt that these Australian records are fictitious." In a preliminary index of the Mollusca of Western Australia the same argument is used: †"This record by Menke from W. Australia of an African shell is considered an error by Von Martens." In each of these cases it is not the decision as to nomenclature that is here objected to, but the assertion that a South African habitat denies the possibility of the shell being found in Australian waters.

Having a small collection of shells from Cape Colony and Natal, an examination proved that about one-sixth of these are also known to inhabit the coasts of Australia. This led to a careful search through the works of the chief conchologists and the compilation of the following list of species common to South Africa and the Australian continent, a list of some three hundred and fifty species. From the list some curious facts may be drawn. The common species are found mainly in the Solanderian and Dampierian or northern faunal provinces, while very few South African shells range to the nearer Adelaidean province, lying between Shark Bay and Wilson's Promontory. Among Pelecypoda the genera *Arca*, *Cardita*, *Mactra*, *Paphia* and *Tellina* show the greatest percentage of species common to the coasts of the Union and the Commonwealth; and among Gasteropods the following:—*Arcularia*, *Cerithium*, *Conus*, *Cypraea*, *Drupa*, *Mitra*, *Pyrene*, *Terebra*, *Triton or Cymatium*. It is to be expected that such far-wandering ocean travellers as *Cavolinia* and *Janthina* will prove common to the two areas; but it is a surprise to find small shells as *Erato sulcifera* Gray, *Monoptygma casta* A. Adams, *Phos roseatus* Hinds, *Pteria zebra* Reeve, *Pyrene varians* Sowerby, *Rissoina elegantula* Angas, and *Rissoina crassa* Angas, common to these two southern lands.

Another point worthy of mention is the scanty number of shells in common of the very large families, Turbinidae and Pyramidellidae.

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*Loc. cit. p. 297.

†Jour. Roy. Soc. W. Australia, I, 1916, pp. 19. 29, 65.

Mollusca Common to South Africa and Australia.

Acanthopleura spinigera Sowerby =*gemmata* Blainville.
Akera soluta Gmelin.
Ancilla anceps Lamarck.
Anomia ephippium Linnaeus.
Antigona listeri Gray.
Aplustrum amplustre Linnaeus.
Arca divaricata Reeve.
domingensis Lamarck.
imbricata Bruguiere.
navicularis Bruguiere.
nivea Chemnitz.
squamosa Lamarck.
† *Architectonica cingulum* Kiener.
maximum Philippi.
† *Arcularia algida* Reeve.
arcularia Linnaeus.
bicallosa Smith.
clathrata Adams and Reeve.
†*coronata* Bruguiere.
filmerae Sowerby.
†*gaudiosa* Hinds.
gemmulata Lamarck.
lentiginosa A. Adams.
picta Dunker.
† *Aspella anceps* Lamarck.
Ataxocerithium serotinuma A. Adams.
Atys cylindrica Helbling.
elongata A. Adams.
Bankivia varians Becquard.
† *Bullaria ampulla* Linnaeus.
Bullina scabra Gmelin.
Bursa affinis Broderip.
granifera Lamarck.
†*lampas* Lamarck= *B. rubeta* Bolten (L).
†*pusilla* Broderip.
Calliostoma Meyeri Philippi.
Cancellaria lamellosa Hinds.
Cardita calyculata Lamarck.
concamerata Bruguiere.
†*variegata* Bruguiere.
Cardium papyraceum Chemnitz.
rubicundum Reeve.
rugosum Lamarck.
tenuicostatum Lamarck.
Cassis achatina Lamarck.
areola Lamarck.
†*pila* Reeve.
†*torquata* Reeve.
Cavolinia uncinata Rang.
quadridentata Lesueur.
trispinosa Lesueur.
Cerithiopsis purpurea=*Seila albo-sutura* T. Wds.
Cerithium citrinum Sowerby.
†*columna* Sowerby.
echinatum Lamarck.
kochii Philippi.
lacteum Kiener.
†*obeliscum* Bruguiere.
pingue A. Adams.
rugosum Wood.
taeniatum Sowerby.
†*zebrum* Kiener.
Charonia aquatilis Reeve.
Chitonellus striatus Lamarck.
Conus aplustre Reeve.
†*arenatus* Hwass.
betulinus Linnaeus.
†*capitaneus* Linnaeus.
ceylanensis Hwass.
conspersus Reeve.
flavidus Lamarck.
†*geographus* Linnaeus.
glans Bruguiere.
†*hebraeus* Linnaeus.
†*lineatus* Chemnitz.
†*lividus* Lamarck.
†*miles* Linnaeus.
miliaris Hwass.
†*minimus* Linnaeus.
†*quercinus* Bruguiere.
rattus Lamarck.
tessellatus Born.
†*textile* Linnaeus.
†*vermiculatus* Lamarck.
†*vexillum* Gmelin.

† Shells so marked range also to Lifu, Loyalty Islands.

Corbula tunicata Hinds.
Crepidula aculeata Gmelin.

Cymatium australe Lamarck.
†*bracteatus* Hinds.
†*chlorostoma* Lamarck.
cutaceus Linnæus.
doliarium Lamarck.
elongatum Reeve= *ves-encausticum* Reeve.
exaratus Reeve.
†*gemmatus* Reeve.
†*labiosum* Wood.
olearium Linnaeus.
†*pyrum* Reeve.
paceum Reeve.
†*rubeculum* Lamarck.
†*tuberosum* Lamarck.
vespaceum Lamarck.

Cypraea angustata Gmelin.
†*annulus* Linnaeus.
†*arabica* Linnaeus.
†*caput-serpentis* Linnaeus.
†*carneola* Linnaeus.
†*caurica* Linnaeus.
†*clandestina* Linnaeus.
costata Gmelin.
†*cribraria* Linnaeus.
cruenta Gmelin.
†*erosa* Linnaeus.
felina Gmelin.
fimbriata Gmelin.
†*helvola* Linnaeus.
†*isabella* Linnaeus.
†*lynx* Lamarck.
miliaris Gmelin.
†*moneta* Linnaeus.
neglecta Sowerby.
ocellata Linnaeus.
quadripunctata Gray.
†*staphylaea* Linnaeus.
stolida Linnaeus.
†*tabescens* Solander.
undata Lamarck.
†*vitellus* Linnaeus.
†*ziczac* Linnaeus.

Cypricardia angulata Lamarck.

Cytherea hebraea Lamarck.

Dentalium longitrorsum Reeve.

Distortrix anus Lamarck.
decipiens Reeve.

Dolabella rumphii Cuvier=*scapula* Martyn.

Dolium costatum Menke.
finbriatum Sowerby.
variegatum Lamarck.

Donax nitida Deshaye =*veruinus* Hedley.

Dosinia lamellata Reeve.

Drillia bijubata Reeve.

†*Drupa aspera* Lamarck.
†*arachnoides* Lamarck.
fiscella Lamarck.
heptagonalis Reeve.
marginatra Blainville.
†*ricinus* Linnaeus.
undata Chemnitz.

†*Engina anaxares* Duclos.

Epitonium aculeatum Sowerby.
clathratulum Montagu.
jukesianum Forbes.
replicatum Sowerby.

Erato sulcifera Gray.

Ervilia bisculpta Gould.

†*Fasciolaria filamentosa* Lamarck.

Fissurella fimbriata Reeve.
scutella Say.
similis Sowerby.

Gafrarium divaricatum Chemnitz.
pectinatum Linnaeus.

Gibbula townsendi Sowerby.
affine Pease.

Gyrineum ranelloides Reeve.

Haminea subcylindrica Sowerby.

Harpa conoidalis Lamarck.
crassa Philippi.
ventricosa Lamarck.

Heliacus luteus Lamarck.

Hipponyx acuta Quoy.
†*antiquata* Linnaeus.
†*australis* Quoy and Gaimard.
†*barbata* Sowerby.

Hydatina physis Linnaeus

Ischnochiton lentiginosus Sowerby

† Shells so marked range also to Lifu, Loyalty Islands.

Janthina communis Lamarck.
globosa Swainson.
exigua Lamarck.
Lima squamosa Lamarck=*lima* Linnaeus.
†*tenera* Chemnitz.
†*Lioconcha picta* Lamarck.
Lotorium gracile Reeve.
†*Lucina exasperata* Reeve.
globosa Forskal.
Lutraria oblonga Chemnitz.
Lyria mitraeformis Lamarck.
Macroschisma producta A. Adams.
Mactra achatina Chemnitz.
australis Lamarck.
ovalina Lamarck.
polita Chemnitz.
Margaritifera vulgaris Schumacher
Marginella fusiformis Hinds.
inconspicua Sowerby.
metcalfei Angas= *ochracea* Ang.
Megatabennus concatanatus Cross and Fischer.
Merria deshayesiana Recluz.
†*Mitra cadaverosa* Reeve.
carbonacea Hinds.
circula Kiener.
crenifera Lamarck.
crenulata Lamarck.
cylindracea Reeve.
†*episcopalis* Linnaeus
†*exasperata* Gmelin.
flammea Quoy.
interlirata Reeve.
limbifera Lamarck.
†*litterata* Lamarck.
obeliscus Reeve.
†*paupercula* Linnaeus.
†*rufescens* A. Adams.
zephyrina Duclos.
Modiola auriculata Krauss.
lignea Reeve.
Modiolaria cuneata Gould.
cumingiana Dunker.
Monodonta australia Deshayes.
Monoptygma casta A. Adams.
Montfortia conoidea Reeve.

Murex axicornis Lamarck.
banksii Sowerby.
brevispina Lamarck.
ramosus Linnaeus.
Natica areolata Recluz.
didyma Bolten.
†*mamilla* Lamarck.
marochiensis Gmelin.
†*simiae* Chemnitz.
†*Nerita albicilla* Linnaeus.
melanostoma Gmelin.
†*plicata* Linnaeus.
†*polita* Linnaeus.
Neritina crepidularia Lamarck.
Odostomia angasi Tryon.
Oliva caerulea Bolten.
elegans Lamarck.
Ostrea cucullata Born.
Paphia cumingii Sowerby.
deshayesii Hanley.
textrix Chemnitz=*textile* Lamarck.
sulcaria Lamarck.
Pecten limatula Reeve.
Philine aperta Linnaeus.
schroeteri Philippi.
Phos roseatus Hinds.
Pinna madida Reeve.
serra Reeve.
vexillum Born.
Planaxis sulcatus Quoy and Gaimard.
Pleurotoma marmorata Lamarck.
monilifera Pease.
tigrina Lamarck= *Turris acuta* Perry.
Plicatula australis Lamarck.
Psammobia ornata Deshayes.
Pteria zebra Reeve.
†*Pupa affinis* A. Adams.
suturalis A. Adams.
†*solidula* Linnaeus.
Pyramidella dolabratus Linnaeus.
†*mitralis* A. Adams.
†*sulcatus* A. Adams.
†*Pyrazus palustris* Bruguiere.

† Shells so marked range also to Lifu, Loyalty Islands.

Pyrene flava Bruguiere.
†*filmerae* Sowerby.
lactea Duclos.
mendicaria (var.) Lamarck.
pulchella Sowerby.
†*varians* Sowerby.
†*versicolor* Sowerby.

Pyrula reticulata Lamarck.

Rapana nodosa A. Adams.

† *Rissoina elegantula* Angas.

† *Rissoina crassa* Angas.

Rochfortia paula A. Adams= *peculiaris* A. Adams.

Sanguinolaria donacioides Reeve.

Saxicava arctica Gmelin.=*australis* Lamarck.

Scutum imbricatum Quoy and Gaimard.
unguis Linnaeus.

Seila albosutura T. Wds.

Sepia hierredda Rang.

†*Septa pileare* Lamarck.

Sigaretus papillus Gmelin.
planulatus Recluz.

Solen sloanei Gray.

Spondylus nicobaricus Chemnitz.

Stomatella sulcifera Lamarck.

†*Strombus floridus* Lamarck.
†*gibberulus* Linnaeus.
lamarckii Gray.
lentiginosus Linnaeus.

Tellina capsoides Lamarck.
†*dispar* Conrad.
pharaonis Hanley.
rastellum Hanley.
†*rhomboides* Quoy and Gaimard.
rosea Spengler.
semen Hanley.
umbonella Lamarck.
†*virgata* Linnaeus.
virgulata Hanley.
†*vulsella* Chemnitz.

† *Terebra affinis* Gray.
babylonia Lamarck.
cingulifera Lamarck.
fictilis Hinds.
monilis Quoy and Gaimard.
pertusa Born.
†*straminea* Gray.
†*subulata* Lamarck.
†*textilis* Hinds.
†*dimidiata* Lamarck.

Thais bufo Lamarck.
mancinella Lamarck.
persica Lamarck.
succincta Lamarck.

Torinia caelata Hinds.
dorsuosa Hinds.
variegata Gmelin.

Trapezium angulatum Lamarck.

Tridacna elongata Lamarck.

Triphora corrugata Hinds.

Tritonidea subrubiginosa Smith.

† *Trivia insecta* Mighels.
†*pellucidula* Gaskoin.
†*vitrea* Gaskoin.
†*oryza* Lamarck.

Trochus impervius Menke.
virgatus Gmelin.

Trophon contractus Reeve.

Turbinella incarnata Reeve.
nassatula Lamarck

† *Turbo chrysostomus* Linnaeus.
intercostalis Menke.

Turbonilla bifasciata A. Adams.
fusca A. Adams.
hofmani Angas.

Turris acuta Perry.

Umbonium vestiarium Linnaeus.

Umbrella indica Lamarck.

Venerupis rugosa Reeve.

Vermetus tricuspe Morch.

Vexillum vexillum Lamarck.

Volvulella rostrata A. Adams.

Ziziphinus euglyptus A. Adams= *Calliostoma Meyeri* Philippi.

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† Shells so marked range also to Lifu, Loyalty Islands.

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ZIPHIUS CAVIROSTRIS ON THE QUEENSLAND COAST.

By Heber A. Longman, F.L.S., Director of the Queensland Museum.

Plates III and IV.

(*Read before the Royal Society of Queensland, 28th July,* 1919).

In December, 1918, Mr. B. H. Todd kindly informed me that the remains of a large marine animal were stranded on the coast at Nikenbah, near Maryborough, South Queensland, on the property of Mr. Emil Jensen. Fortunately the remains were above tidal influence, and the opinion was expressed by Mr. Todd that the animal must have "committed suicide" to get ashore in such a way. Probably it was endeavouring to escape from some enemy. On being communicated with, Mr. Jensen kindly covered the remains with sand, to facilitate cleaning, and in February forwarded to the Queensland Museum all the bones obtainable. Special care was taken to preserve the cranium, the detached rami of the lower jaw and a single tooth. Examination shows that the bones are those of a specimen of Cuvier's Whale, *Ziphius cavirostris*, which has not previously been recorded from the Coasts of Australia. Reg. No. Q.M.J. 3262.

The distribution of this interesting Cetacean was dealt with by Dr. S. F. Harmer, in 1915, who reviewed the previous references and recorded the occurrence of two specimens on the Southern Coast of Ireland.* Previous records included specimens from both sides of the Atlantic, Bering

*Harmer, Proc. Zool. Soc., 1915, pp. 559-566.

Sea, the Mediterranean, South Africa and New Zealand, but notwithstanding its wide range *Ziphius cavirostris* seems to be one of the rarer Ziphioid whales. The affinities of the New Zealand specimens, first described by Haast and Hector as distinct species, were demonstrated by Turner.* A specimen reported from Liscannor, Co. Clare, Ireland, was subsequently found to be True's *Mesoplodon mirum.*†

Skull,—The majority of the sutures are markedly open, as may be seen from the illustrations. In the occipital plane, the lateral sutures separating the parietals may be distinguished. There is a median suture between the frontals. The massive, conjoined nasals include an asymmetrical bone which protrudes in advance of the frontals for some distance in the median suture. A partial suture is also present on the right nasal. The prenarial basin, so characteristic of adult forms, is not strongly developed. The premaxillæ in this region are flattened, especially that on the right, whilst a longitudinal groove is present on the left. The foramen of the left premaxilla is smaller and is situated a little anteriorly to that on the right. The mesorostral ossification is not prominent, only appearing on the floor of the deep groove formed in the rostrum by the semi-tubular premaxillæ. For some distance in front of their lateral expansions, the maxillæ have a well-marked double (ectomaxillary) ridge. The maxillary prominences are small and unequally developed, that on the right side being the larger.

The anterior part of the palatal surface of the rostrum is formed by the premaxillæ, the vomer appearing 145mm. from the tip. The converging sides of the maxillæ are produced between the palatine strips and just exclude the vomer, which reappears after a few millimetres and separates the palatines as they junction with the pterygoids. The palatine strips are only about 8 mm. across in this region. The slender jugals are lost, with the exception of an anterior fragment on the left side. The ear-bones were misplaced in transit, and in Plate IV. the mastoid portion is missing in the postero-lateral contour. Although detached, both tympanic and both periotic

*Turner, Challenger Zoology, vol. 1, No. iv, 1880, p. 27.

† "Nature," May 22nd, 1919, p. 237.

bones are present. When compared with the interesting series figured by True, they are found to agree best with No. 4, which is the type of *Z. grebnitzkii*. In one periotic the fenestra ovalis was closed by a simple rod of bone representing the stapes.

Mandible.—The rami of the mandible are not anchylosed. The superior contours agree well with figure 1 in Plate 22 of F. W. True's work on the Ziphiidae.* The alveolus terminating the right side has an open groove anteriorly, but this may be abnormal ; unfortunately the corresponding portion of the left ramus is broken, and cannot be compared. The single tooth forwarded is 51mm. in length. It tapers from a basal diameter of 12 mm. to an acuminate enamelled tip. In section it is sub-circular ; the root is hollow and the cavity extends to within 12 mm. of the tip. When placed in the alveolus only the tip protrudes.

In certain characters, notably the small conical tooth, the absence of a mesorostral ossification and of a pronounced prenarial basin, our specimen exhibits the characters of an immature female.

F. W. True has shown that *Ziphius gervaisii* (Duvernoy) represents a female of *Z. cavirostris*, and Dr. S. F. Harmer also accepts this principle of sexual diagnosis (loc. cit.), so there is sound reason for classifying these remains as a female of Cuvier's species. So long ago as 1870, Owen referred to the small size of the mandibular teeth as typifying a female.†

No actual measurements were taken by the discoverers, but the specimen when first stranded is said to have been "about nineteen feet."

Dimensions of Cranium and Mandible :—

Total length of cranium	830mm
Maximum breadth (between zygomatic processes of the squamosal)	467mm
Maximum height (from inferior border of pterygoids to vertex)	414mm
Distance from tip of rostrum to posterior median margin of pterygoids	636mm

*True, Bull. 73, United States Nat. Mus., 1910.

†Owen, Mon. Brit. Foss. Cretacea, No. 1, 1870, p. 12.

Ziphius cavirostris Cuvier.

Ziphius cavirostris Cuvier.

Length of rostrum	450mm
Distance from tip of rostrum to anterior border of nasals	580mm
Length of mandible	740mm
Depth of mandible at coronoid	147mm
Length of symphysis	130mm

Vertebrae.—There are four coalesced cervical vertebrae. In the atlas the foramina in the arch for the exit of the first pair of spinal nerves are complete on each side ; the inferior lateral processes are thick and strong and slightly bent backwards, the maximum diameter between them being 250 mm.

There are seven thoracic vertebrae, probably being the 2nd, 3rd, 4th, 5th, 7th, 8th and 9th. The last three have facets for the articulation of ribs on the transverse processes only.

There are fourteen post-thoracic vertebrae, four of which are caudal centra only. Four incomplete ribs, one chevron bone and five epiphyseal discs are present.

Three vertebrae of a dugong and the coracoid of a turtle were forwarded at the same time, and testify to the efforts of the donor to secure as many bones as the circumstances permitted.

THE STRUT PROBLEM.

By R. W. H. Hawken, B.A., M.E. (Sydney), M. Inst. C.E.,
Professor of Engineering, University of Queensland.

(*Read before the Royal Society of Queensland, August 25th, 1919*).

In engineering and architectural construction the problem of strut design constantly occurs ; many elaborate theoretical analyses have been made, and much money spent in experiment to determine formulae and principles governing the design of such members.

The failure of the Quebec Bridge in 1907, when many lives were lost, and hundreds of thousands of pounds fell into the river, showed that our knowledge of column design was not complete.

The author, in a series of papers collected and published under the title of "Column Analysis and Design,"* has made a comparison of the various formulae proposed, and has deduced sets of curves for the purpose of analysing experimental results and for use in the design of columns.

The deductions made in the paper mentioned were based on interpretations of previous work, and on new methods of analysis, which it is the purpose of this paper to explain and discuss.

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*Published by the University of Queensland and the Sydney University Engineering Society.

The basic result is that of Euler (1707-1783), which will be here stated in the notation to be adopted throughout. (See Fig. 1).

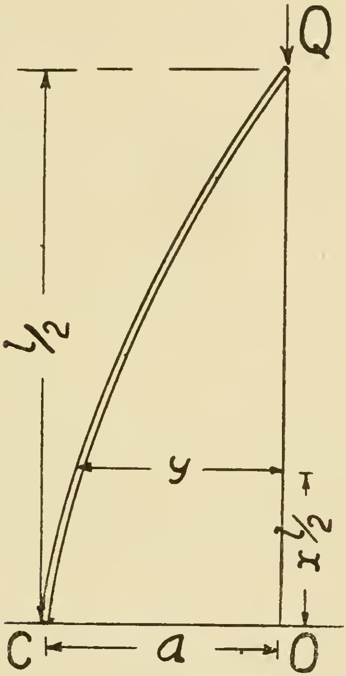


FIG. 1.

Let O be the centre of coordinates

$\frac{l}{2}$ be the length of a column fixed at one end and free at the other (equivalent to a column length 'l' pin ended).

y be the ordinate of the deflection curve

$x - \frac{l}{2}$ the abscissa measured from O

E be the Modulus of Elasticity of the material

I be the Moment of Inertia of the cross section

Q be the Load centrally applied.

The differential equation of equilibrium

$$\text{is EI}\ \frac{d^2y}{dx^2} = -Qy \qquad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (1)$$

The solution of this equation is a cosine curve

$$\textit{i.e.}\ y = a \cos x \frac{\pi}{2} \qquad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (2)$$

and it has been proved that Q can have only one value, viz.

$$Q = \frac{\pi^2 EI}{l^2} \qquad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (3)$$

which will be called the 'Euler Value' or 'Q' of the column ....(3*a*)

The results (2) and (3) were deduced a century and a-half ago by Euler; the derivation of the Euler results appears in almost any book on infinitesimal calculus, or on the theory of structures, yet it is with their meaning and interpretation that this paper deals, because the author thinks that neither has been fully nor correctly understood.

Mathematicians and Engineers using the results (2) and (3) of Euler gave various explanations of their meaning, such as :—

(*a*) the column is in 'neutral' or 'unstable' equilibrium,

(*b*) a deflection occurs under one load only, and is then indeterminable,

(*c*) it is true only for long thin columns,

(*d*) the Euler load always causes collapse,

(*e*) and many others. . . .

To make clear the proposed explanation, it will be necessary to examine a modified case, shown in Fig. (2), that is, instead of the load being central it is applied with an eccentricity 'e,' the differential equation is then

$$EI\ \frac{d^2y}{dx^2} = -Py \qquad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (4)$$

and it will be seen at once from (2) above that

$$y=(a+e)\cos x\frac{\pi}{2} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (5)$$

and $$P=\frac{\pi^2 EI}{(l')^2} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (6)$$

A solution was first deduced* as if it were a separate problem from that of Euler by Prof. R. H. Smith, in 1878, who left it in the form

$$(y_1+e)=(a+e)\frac{l}{2}\cos\sqrt{\frac{P}{EI}} \quad \ldots\ldots\ldots\ldots\ldots\ldots (7)$$

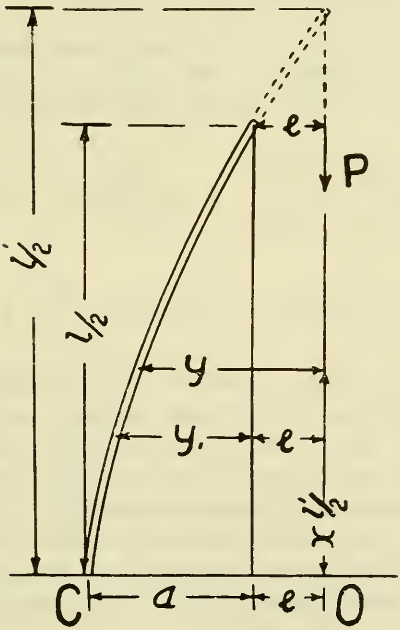


Fig. 2.

Prof. Smith wrote his paper to express the view that there was no such thing as perfectly central loading, and that the correct case to consider for any column was for an eccentric load ; he went on to use his equation to deduce some results which are probably correct, but he

*Proc. Edinburgh and Leith Engineering Society, 1878.

would not acknowledge any practical meaning* of result (3) or the 'German Rule,' as he called it, though admitting the accuracy of the mathematics. He deduced l' of (6) as $\sqrt{\frac{\pi^2 EI}{P}}$ but saw no practical application in his result.†

Apparently he did not realise that he was virtually repeating Euler's analysis.

Smith's work was somewhat neglected by subsequent writers; in many Engineering text-books it is not mentioned,‡ but, later, equation (7) has been quoted as 'Professor Smith's Formula,'§ but often under a special heading of eccentrically loaded columns.

The author|| (who at the time did not know of Smith's work) put the solution of the differential equation in the form shown in (5) and using (6) has proceeded as follows :—

$$\left.\begin{aligned} &\text{since } P = \frac{\pi^2 EI}{l'^2} = \frac{Ql^2}{l'^2} \therefore l' = \sqrt{\frac{Q}{P}}.\, l \\ &\text{or if } q = \frac{Q}{A} \text{ and } p = \frac{P}{A} \text{ then } l' = \sqrt{\frac{q}{p}}\, l. \end{aligned}\right\} \quad \ldots\ldots(8)$$

that is to say, every column bends as if it has a 'virtual length,' according to the load applied, provided Q is assumed a constant. He adopted 1st (with Smith) the view that there is an 'essential eccentricity' of loading small or large according to practical conditions of making and adjustment; 2nd, that absolutely central loading is a mathematical conception only, but (in disagreement with Smith) the 'Euler Value' 'Q' has a very practical application, as will be shown below.

*See Footnotes, pages 101 and 102; also pp. 36, 37, "Column Analysis and Design."

†See pp. 35, 36, 37 of paper by author, "Column Analysis and Design."

‡*Vide* Morly "Theory of Structures," who solves the differential equation (4) and apparently was not aware of Smith's work.

§Jamieson "Applied Mechanics."

||*Vide* Proc. Inst. C.E., Vol. 204, paper No. 4207.

The problem, as it occurs in Engineering Practice, will now be stated.

The design of a column depends mainly on the maximum stress at the extreme fibre; to get this it is necessary to take account of both direct compression and bending stress, thus :—Referring to Fig. 1 or Fig. 2,—

if P be the load on the column

A be area of cross section

γ be distance of extreme fibre from neutral axis

f_b be stress at extreme fibre due to bending only

I be moment of inertia of section and r radius of gyration where $I = Ar^2$

f be total stress at the extreme fibre at the point C on the column $= f_b + p$

n be maximum deflection

p be $\dfrac{P}{A}$

then

$$f_b = \frac{P \times n \times \gamma}{I} = \frac{pn\gamma}{r^2} \qquad \ldots\ldots(9)$$

and $f = p + f_b = p + \dfrac{pn\gamma}{r^2}$ ......(10)

so that if we know the quantity 'n' we can calculate f and from (10) we can express p in terms of f, thus :—

$$p = \frac{f}{1 + \dfrac{n\gamma}{r^2}} \qquad \ldots\ldots(11)$$

and thus say, for any material, what direct stresses can be applied to a column to cause a certain allowable stress f, according to the material used, at the extreme fibre.

The difficulty is that from the assumptions of central loading, n is indeterminate, and various devices have been adopted to make practical use of (11): the best known is that of Professor Rankine, who, following the analogy* of beam deflection, said n for a constant $f=c\frac{l^2}{\gamma}$ where c is constant for the material, and thus obtained the familiar Rankine-Gordon formula

$$p=\frac{f}{1+c\frac{l^2}{\gamma}\frac{\gamma}{r^2}}=\frac{f}{1+c\frac{l^2}{r^2}} \quad \text{..................(12)}$$

this is still extensively used, it has been modified empirically to the 'parabolic formula' $p=f\left\{1-c\left(\frac{l}{r}\right)^2\right\}$..(12*a*)

and to the 'straight line formula' $p=f\left(1-k\frac{l}{r}\right)$....(12*b*)

these latter are easy of application, and, over limited ranges for f and k chosen with judgment are suitable for ordinary design.†

---

*The analogy of beam and strut is not nearly complete and may be deceptive. In a beam the deflection varies directly as the load, whereas in a column the rate of change of deflection increases with the load, for this reason breaking test results for apparent central loading which may and do conform to Rankine's formula, do not give a true indication of what will happen under loads used in practice. The curves appended show this; f/p is not constant for the same column, in fact the curves have been drawn to deduce the varying amount; in a beam the various curves would be straight lines parallel to the axis. For these reasons any table of breaking strengths of columns can only be a very rough indication of how the column is stressed under working conditions. For columns with a definite eccentricity of loading these remarks apply with equal force. Plate VI illustrates these remarks; both when results are being determined in terms of l/r and of $(l/r)^2$.

†That is if the fact is kept in mind that the ratio $\frac{f}{p}$ varies with f (see Plate VI.)

Continental Engineers specify that columns shall be loaded only to a proportion of the Euler Value* (generally 1/5), *i.e.*, that P=Coefficient ×Q....................(13)

To apply the results (1) to (6) to the solution of (11).

The author considers that in practice we can no more realise the Euler condition than we can make a perfect sphere—we can only approach either to the limit of accuracy of workmanship or of the measuring instruments, consequently every material column has some eccentricity of loading. It is quite possible that the deviation† from the ideal conditions is not exactly that shewn diagrammatically in Fig. 2. The column may be in a bent state though unstrained, or the sources of eccentricity may lie in different amounts of strain on compressive and tensile sides (*vide* Fidler's 'Bridge Construction'), but the assumption made allows of exact solutions and visualising methods and may be reasonably considered as a summary of sources of difference from ideal loading.

The phenomena shewn by experiment confirm what has been stated above; in the most carefully conducted experimental work the Euler condition cannot be realised though various experimenters have thought it so: it is only a close approximation that has been reached, and experimentally 'unstable equilibrium' cannot be attained, some residual friction at supports‡ or want of centrality

---

* . . . "And yet it is this value $Q=\pi^2\frac{EI}{L^2}$, which has been stated to be the theoretically (sic) safe (!) load, and the framers of the formula who were, of course, perfectly well aware that the formula gave results as far away from the results of experiment as the sun is from the moon, proceeded gravely to divide the modulus of elasticity E by a factor of safety varying from 6 to 12. . . . The idea of dividing a modulus of elasticity by a factor of safety is sufficiently grotesque in any circumstances, but the idea that it may possibly be six or twelve times as great as we think it is, is a strange absurdity." (Extract from Professor Smith's paper on "The Strength of Struts.").

†See p. 38-39 of "Column Analysis and Design."

‡This might cause an approach to fixation, consequently the virtual length may be shorter than the actual length and a column apparently be able to carry more than its Euler Value.

is sufficient to ensure some variation from the ideal condition, and, as the deflection is nearly infinite in its ratio to eccentricity of loading when the load is nearly the Euler load (see equation (18)), an infinitely small eccentricity may cause a definite deflection; in the language of mathematics, $\infty \times 0 = a$; more strictly—nearly ∞ $\times$ nearly $0 =$ nearly a.

It is inconceivable that an absolutely different set of conditions obtains in the two cases of (*a*) absolute centrality, and (*b*) infinitely close to absolute centrality, yet this is what Smith apparently assumed.*

The explanation of the apparent anomalies lies probably in the fact that the primary differential equation solved by Euler, and later in a modified form, by Smith, is not itself exact. This important point seems to have been missed in the numerous discussions of column formulae. Let H be the load applied.

The exact equation is

$$\frac{d^2y}{dx^2} = -H.y\left\{1+\left(\frac{dy}{dx}\right)^2\right\}^{\frac{3}{2}} \quad \text{............(14)}$$

the ordinary equation assumed, see (1), is $\dfrac{d^2y}{dx^2} = -Hy$

that is $\left(\dfrac{dy}{dx}\right)^2$, being small, is neglected, yet it is quite conceivable that even though negligible so far as arithmetical results are concerned, yet if taken into account, it may provide the element of stability.

* "The error is not in pure mathematics. From first to last Grashof's careful and elaborate investigation is correct, so far at least as I have detected. His mathematical deduction from his final equation is substantially right, but his mistake consisted in assuming that the case $e=0$ was one which commonly occurred in practice, and thus in inferring that the mathematical results of assumption has a bearing on the practical question of the strength of struts. This case never occurs in practice, and although e may often be very small, still its slightest variation from absolutely 0 altogether destroys the validity of the conclusions drawn." (Extract from Professor Smith's Paper, 1878).

This view is confirmed by the solution of (14) using elliptic functions by R. W. Burgess,* he shows that each central load is accompanied by a definite deflection, and, as was to be expected, that the cosine curve is quite inaccurate when the slope $\left(\frac{dy}{dx}\right)$ becomes appreciable.

Keeping to the assumption of Q as a unit basis for all loads for the column and putting H for the actual central load, some figures of Burgess† have been put into the form of Table I.

TABLE I.

Values of $\frac{\pi}{2}\sqrt{\frac{p}{q}}$ for pin-jointed columns.	In the Author's notation.	Corresponding values of a/l, i.e. $\frac{\text{Deflection}}{\text{Length}}$
1.57080	*i.e.*, H=Q	0.0000
1.57092	H=1.00014 Q	0.0111
1.58284	H=1.01 Q	0.1097

The figures of Table I. show that for any deflection to take place the load must be somewhat greater than Q, but when the load is $\frac{Q}{7500}$ greater than Q, the deflection is 1% of the length, an amount beyond that usually allowable in Engineering practice, so that the error in assuming Q as the unit maximum load is less than 1 in 10,000 ; yet Q is not necessarily a load causing collapse, nor is there instability even for a central load.

Professor Chapman, of Adelaide University, has deduced by exact analysis for eccentric load

that $\frac{e}{a+e} = \text{cn}\ (\theta, v\theta)$ where $v = \frac{a+e}{l}$ and $\theta = \sqrt{\frac{p}{q}}\frac{\pi}{2}$

$$\text{and thus } v\theta = \frac{a+e}{l}\sqrt{\frac{p}{q}}\frac{\pi}{2} \quad \ldots . (15)$$

*Physical Review, March, 1917.

†The table has been prepared by the author in the way shewn from figures kindly supplied by Professor Chapman, of Adelaide University. See Proc. Roy. Soc. South Australia, Vol. xlii, 1918.

The Smith-Euler analysis as modified by the author gives $\frac{e}{a+e} = \cos\theta$, see later equation (18) ....(16)

By expanding both series the error of (16) is only ·2% when $v\theta = ·1$. In Engineering practice $v\theta$ is rarely greater than ·01.

The results just stated for exact solutions show that the assumptions of a cosine curve, and of Q as a unit maximum load have very small errors which are quite negligible in Engineering Design.

Granting an essential eccentricity 'e,' as argued above, and using equations (5) and (8) the Author deduced the following result :—

In (5) when $x = \frac{l}{l'}$ then $y = e$ and $\frac{l}{l'} = \sqrt{\frac{p}{q}}$ from (8)

$$\therefore e = (a+e) \cos \sqrt{\frac{p}{q}} \frac{\pi}{2} \quad \text{..............(17)}$$

$$\text{or } (a+e) = e \sec \sqrt{\frac{p}{q}} \frac{\pi}{2} \quad \text{................ (18)}$$

Consequently curves may be plotted* showing (a+e) or maximum deflection in terms of 'e' as the load P varies ; when P=Q the deflection is infinite (see Plate V). Curves have been plotted usually with abscissa $\frac{p}{q}$ ranging from O to 1, showing all variations of stress as the load varies, and thus the actual meaning and accuracy of various formulae are clearly shown.

The many tables and curves of the author of which some examples are shown*, should allow of experimental results being properly interpreted, and probably a formula evolved, showing how 'e' varies with the dimensions and construction of practical columns : if this were known authoritatively the theory of design of columns might become as satisfactory as that of a simple beam.

*See diagrams appended. Plates V and VI.

When this variation is known, possibly formulae eliminating intermediate computation based on 'e' may be evolved : this at present those of (12) and (13) attempt to do, but they are not sufficiently rational.

The method of the author seems to bring into touch, and reconcile, the various deductions made for columns thus :—

Taking as the basis the pin ended column of length l

it has an Euler value $Q = \frac{\pi^2 EI}{l^2}$ .... (19)

All practical columns bend with a virtual length

$l' = \sqrt{\frac{Q}{P}}\, l$ where P is the load applied .... (20)

The extreme cases are for ideal conditions.*

(*a*) Fixed at both ends then $P = 4Q$ and virtual length

$$l' = \sqrt{\frac{Q}{4Q}}\, l = \frac{l}{2} \qquad \text{...................... (21)}$$

(*b*) Fixed at one end and free at the other then $P = \frac{Q}{4}$

and virtual length $l' = \sqrt{\frac{Q}{Q/4}}\, l = 2l$ .... (22)

Between these extreme cases every column bends with a virtual length according to the partial fixing and *the amount of load.*

In Engineering Practice judgment will have to be exercised in deciding on the amount of fixing or otherwise to be allowed for.

---

* "The deflection of a column with fixed ends does not depend on the eccentricity of loading. Extra strain is brought on the fixed ends, but not on the column itself." (Extract from Prof. Chapman's correspondence with the author).

APPENDIX.

Applying (18) to (11)

$$p=\frac{f}{1+\frac{e\gamma}{r^2}\sec\sqrt{\frac{p}{q}}\frac{\pi}{2}} \qquad \text{.................}(a)$$

or writing $\frac{e\gamma}{r^2}=\varphi$

$$p=\frac{f}{1+\varphi\sec\sqrt{\frac{p}{q}}\frac{\pi}{2}} \qquad \text{...............}(b)$$

This does not allow of p being deduced in terms of f unless an algebraical expression for $\sec\sqrt{\frac{p}{q}}\frac{\pi}{2}$ may be found: many attempts have been made at this, and the author has put forward the expression*

---

*Interesting and probably very useful deductions may be made from this. It will be seen that if "a" be the induced deflection, applying the suggested approximation to (18)

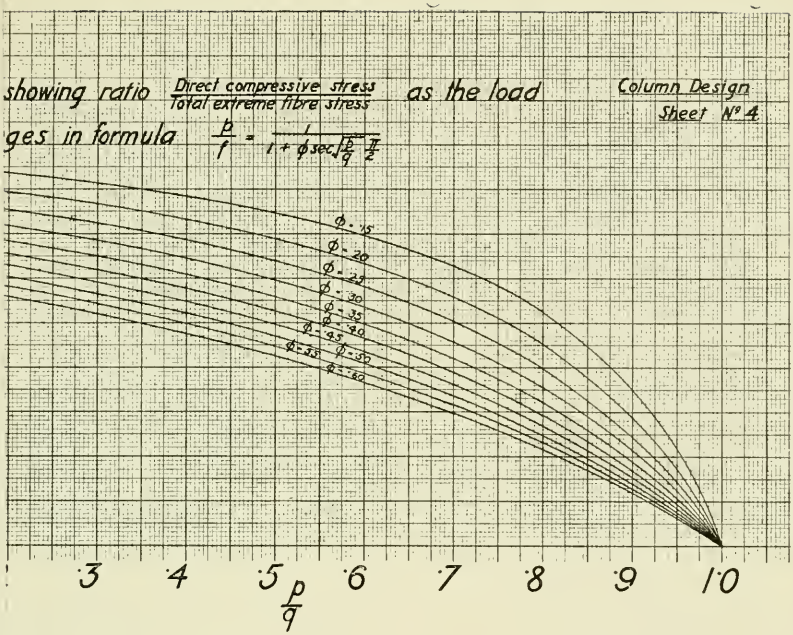
$$\text{then } a=1{\cdot}25\,e.\frac{\frac{p}{q}}{1-\frac{p}{q}} \qquad \text{......................... (i)}$$

so that the deflection of a column may be computed mentally.

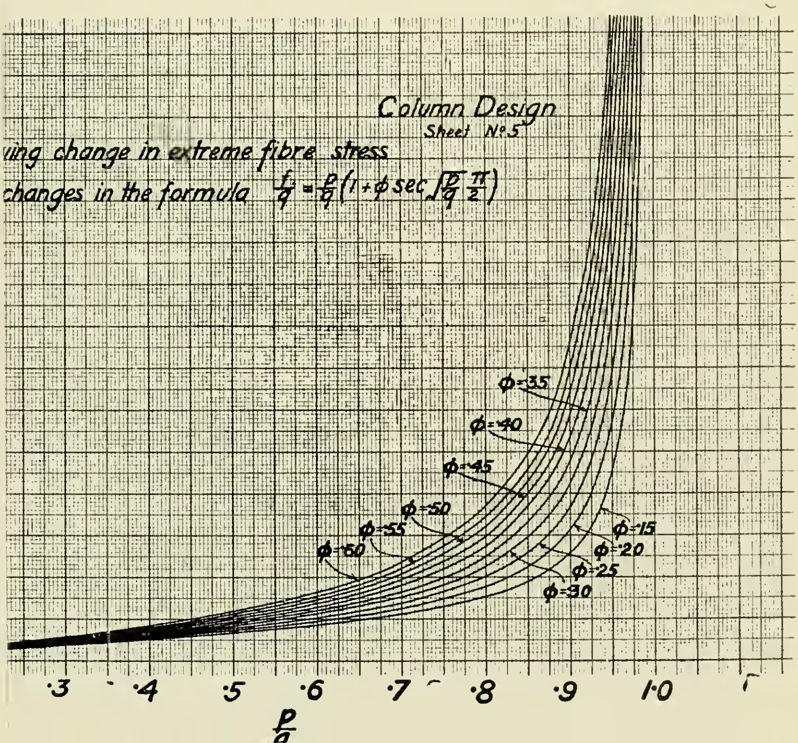
The assumption of original bending of an amount e (followed by Fidler, Hutt, Andrews and others) gives :—

$$a=e.\frac{\frac{p}{q}}{1-\frac{p}{q}} \qquad \text{.................................. (ii}$$

that is 20% less than (i)


showing ratio Direct compressive stress / Total extreme fibre stress as the load
Column Design
Sheet Nº 4
ges in formula p/f = 1 / (1 + φ sec √(p/q) π/2)
φ = ·15
φ = ·20
φ = ·25
φ = ·30
φ = ·35
φ = ·40
φ = ·45
φ = ·50
φ = ·55
φ = ·60
·3
·4
·5
·6
·7
·8
·9
1·0
p/q

Blakey.


Column Design
Sheet Nº 5
ing change in extreme fibre stress
changes in the formula f/q = p/q (1 + φ sec √(p/q) π/2)
φ = ·35
φ = ·40
φ = ·45
φ = ·50
φ = ·55
φ = ·60
φ = ·15
φ = ·20
φ = ·25
φ = ·30
·3
·4
·5
·6
·7
·8
·9
1·0
p/q

CURVES FOR STRESS ANALYSIS AND DESIGN OF COLUMNS.

By R. W. H. HAWKEN, B.A., M.E. (Sydney), M. Inst. C.E.,
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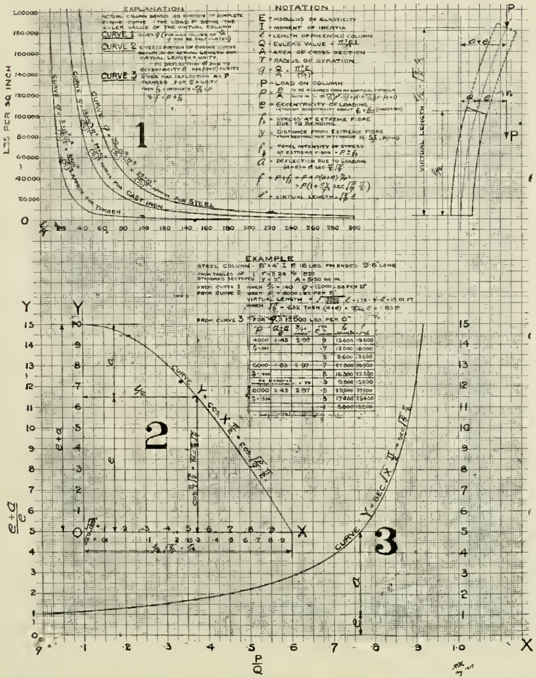
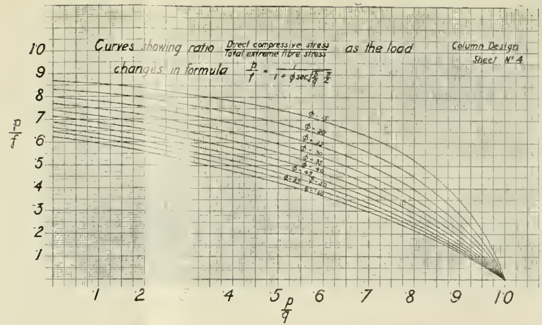
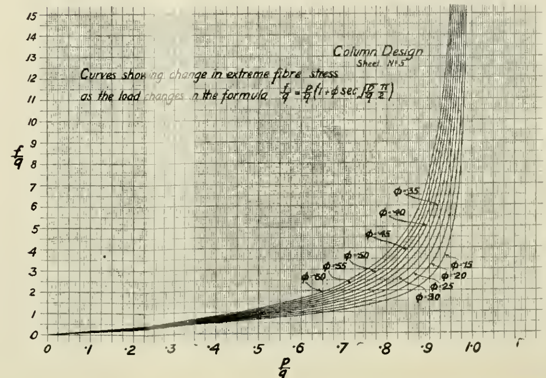
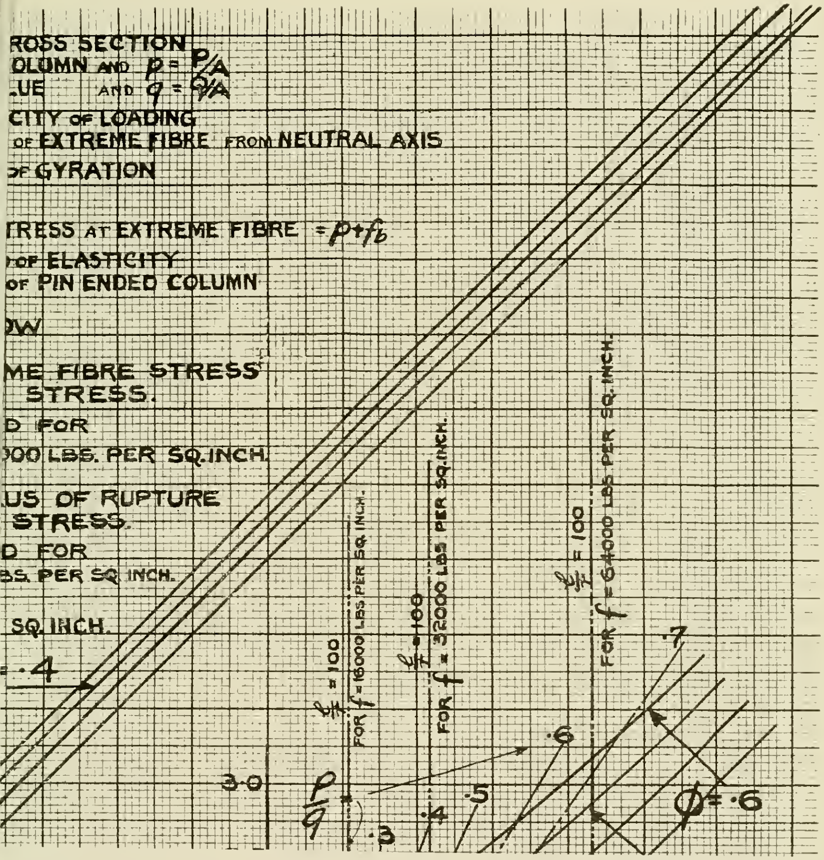




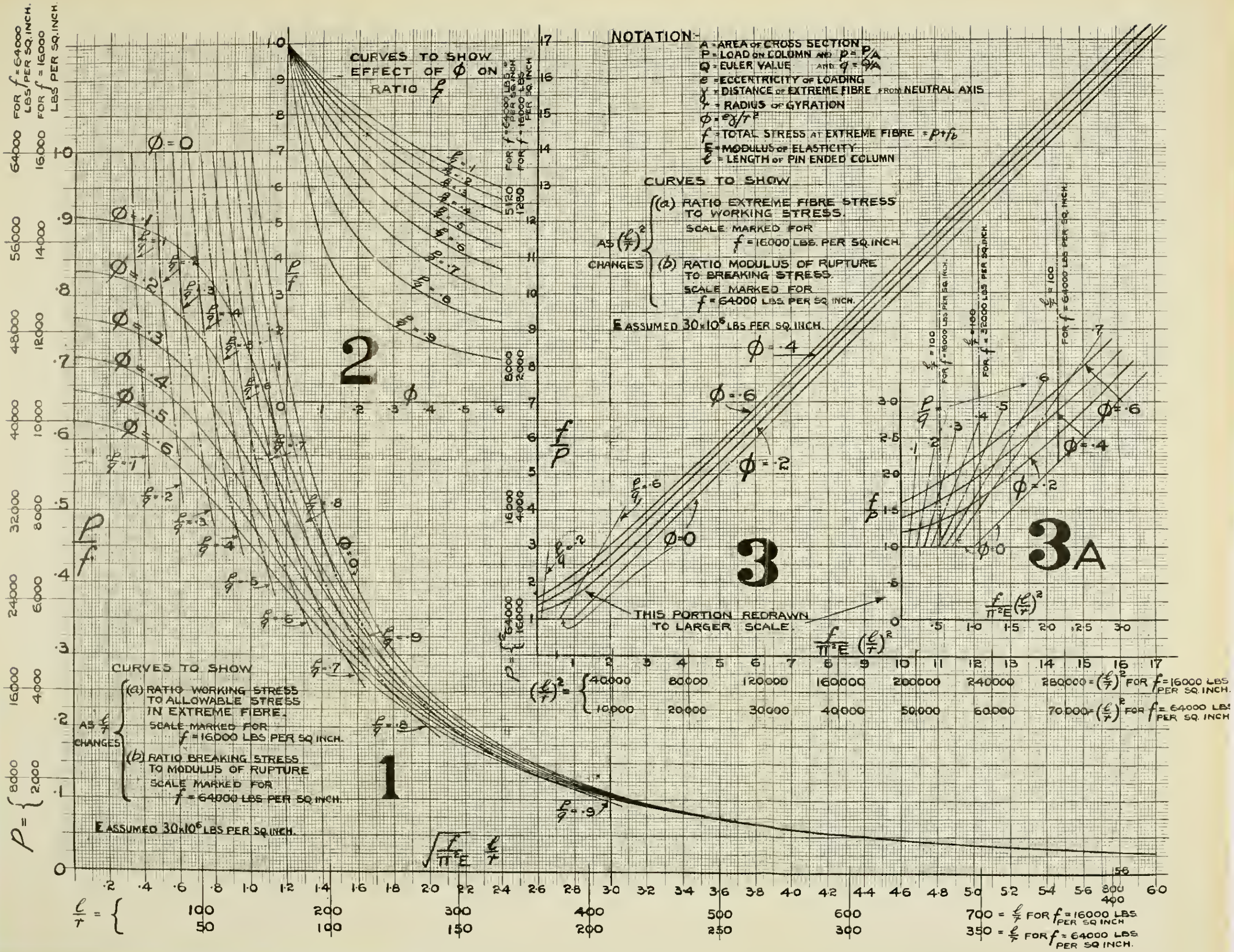
Blakey.



Foster. Longbottom



ROSS SECTION
OLUMN AND p = P/A
UE AND q = Q/A
CITY OF LOADING
OF EXTREME FIBRE FROM NEUTRAL AXIS
OF GYRATION
TRESS AT EXTREME FIBRE = p+f_b
OF ELASTICITY
OF PIN ENDED COLUMN
W
ME FIBRE STRESS
STRESS.
D FOR
000 LBS. PER SQ. INCH.
US OF RUPTURE
STRESS.
D FOR
BS. PER SQ. INCH.
SQ. INCH.
·4
3·0
p/q
·3
·4
·5
·6
·7
φ = ·6
l/r = 100
FOR f = 16000 LBS PER SQ. INCH.
l/r = 100
FOR f = 32000 LBS PER SQ. INCH.
l/r = 100
FOR f = 64000 LBS PER SQ. INCH.


NOTATION:-
A = AREA OF CROSS SECTION
P = LOAD ON COLUMN AND p = P/A
Q = EULER VALUE AND q = Q/A
e = ECCENTRICITY OF LOADING
y = DISTANCE OF EXTREME FIBRE FROM NEUTRAL AXIS
r = RADIUS OF GYRATION
φ = ey/r²
f = TOTAL STRESS AT EXTREME FIBRE = p+fb
E = MODULUS OF ELASTICITY
ℓ = LENGTH OF PIN ENDED COLUMN
CURVES TO SHOW EFFECT OF φ ON RATIO p/f
CURVES TO SHOW
AS (ℓ/r)² CHANGES
(a) RATIO EXTREME FIBRE STRESS TO WORKING STRESS. SCALE MARKED FOR f = 16000 LBS. PER SQ. INCH.
(b) RATIO MODULUS OF RUPTURE TO BREAKING STRESS. SCALE MARKED FOR f = 64000 LBS. PER SQ. INCH.
E ASSUMED 30×10⁶ LBS PER SQ. INCH.
THIS PORTION REDRAWN TO LARGER SCALE.
CURVES TO SHOW
AS ℓ/r CHANGES
(a) RATIO WORKING STRESS TO ALLOWABLE STRESS IN EXTREME FIBRE. SCALE MARKED FOR f = 16000 LBS PER SQ INCH.
(b) RATIO BREAKING STRESS TO MODULUS OF RUPTURE SCALE MARKED FOR f = 64000 LBS PER SQ INCH.
E ASSUMED 30×10⁶ LBS PER SQ. INCH.
1
2
3
3A
700 = ℓ/r FOR f = 16000 LBS PER SQ INCH
350 = ℓ/r FOR f = 64000 LBS PER SQ. INCH.
280000 = (ℓ/r)² FOR f = 16000 LBS PER SQ. INCH.
70000 = (ℓ/r)² FOR f = 64000 LBS PER SQ. INCH

$$\sec\sqrt{\frac{p}{q}}\,\frac{\pi}{2} = \frac{1+\cdot25\,\frac{p}{q}}{1-\frac{p}{q}}$$

the error of which is negligible, but it is more conclusive and just as easy to use the secant curve, consequently all the curves and data have been deduced on the latter basis.

As shewn in the previous paper this does not cause anything like 20% difference in results for $\frac{f}{p}$

It is apparent that $\dfrac{\frac{p}{q}}{1-\frac{p}{q}}$ is the sum of a Geometrical Progression, so that

$$\frac{\text{Induced Deflection}}{\text{Eccentricity of Loading}} = 1\cdot25 \times \frac{p}{q}\left\{1+\frac{p}{q}+\left(\frac{1}{q}\right)^2+\ldots\right\} \quad \ldots \text{(iii)}$$

which is easily visualised.

THE AUSTRALIAN GELECHIANAE (*LEPIDOPTERA*).

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

(*Read before the Royal Society of Queensland, 29th October*, 1919.)

The Gelechianae are rather a difficult group, and I have only lately studied them seriously. With the help of a small number of species named for me by Mr. Meyrick, but especially by the study of Mr. Meyrick's admirable revision (Proc. Linn. Soc. N.S.W. 1904, p. 255), of which I cannot speak too highly, I have found the genera not so hard to understand as might have been expected.

Moths of this sub-family are mostly small, sometimes minute, mostly of dull and inconspicuous colouring (the genus *Crocanthes* is an exception), and of very retired habits, so that isolated examples of new species have occurred rather frequently, and until the larvæ have been discovered, many species will remain poorly represented in collections. The species of *Crocanthes*, *Dichomeris*, and some others are usually abundant, and some species are taken freely at light. One species *Dichomeris capnitis*, Meyr., sometimes occurs in countless millions. I came upon one of these swarms near Gympie, Queensland, on April 15th, 1906. For twenty yards in length and several yards in breadth along the bank of a small creek the eucalyptus saplings, some of considerable size, were so covered with moths that not only was their foliage completely blackened, but the saplings themselves were actually bowed with the weight. On beating a sapling with a stick it recovered its uprightness while the moths arose in a dense black cloud, and the rustling sound of their wings was distinctly audible. The moths were imbricated on the leaves like the scales of a roof. In order to form some estimate of their numbers I captured with a sweep of the net the moths on two large leaves (at the utmost 5 x 2 inches) and counted 710 specimens. As the leaves on the shrubs were numerous and the shrubs fairly close together the total number of insects must have been beyond computation.

Among the new genera I have made, it is possible that some may be identical with extra-Australian genera with which I am unacquainted. Among the species I have had most difficulty with those of the large genus *Protolechia*. The species of this genus are mostly obscure and sometimes variable, and of the 85 species described by Mr. Meyrick I have so far identified only 33.

Fam. TINEIDÆ.

Subfam. Gelechianæ.

Epiphthora psolosticta *n. sp.*

ψολοστικτος, spotted with black.

♂. 11 mm. Head and thorax whitish. Palpi whitish with a few fuscous scales; second joint with an anterior apical tuft, which is longer than terminal joint; terminal joint $\frac{1}{4}$, rather loosely scaled. Antennæ whitish. Abdomen grey-whitish. Legs whitish; anterior pair with fine transverse dark-fuscous striæ; middle pair with some fuscous irroration most pronounced on tarsi. Forewings narrow, costa rather strongly arched, apex acute; whitish with scanty pale ochreous-fuscous irroration, denser towards apex; a line of three blackish subcostal dots near base; a blackish subcostal dot at $\frac{1}{3}$, a second opposite to it beneath fold, a third above fold before middle; a short blackish subcostal line from middle; blackish dots above tornus, before termen above middle, and at apex; cilia whitish with some fuscous irroration round apex. Hindwings with emargination rectangular, apical process $\frac{1}{4}$; pale-grey; cilia ochreous-whitish.

N.S.W., Glen Innes, in March; one specimen.

Epiphthora poliopasta *n. sp.*

πολιοπαστος, sprinkled with grey.

♂ 13 mm. Head whitish. Palpi whitish; second joint fuscous externally except at apex, an apical tuft not quite so long as terminal joint; terminal joint $\frac{1}{5}$. Antennæ whitish. Thorax whitish irrorated with grey. Abdomen ochreous-whitish. Legs, anterior pair dark-fuscous irrorated with whitish; middle pair whitish irrorated with fuscous, more densely on tarsi; posterior pair ochreous-whitish. Forewings with costa rather strongly arched, apex pointed; whitish uniformly irrorated with ochreous-grey; a few blackish scales but no defined dots; cilia whitish, round apex irrorated with fuscous. Hindwings with emargination rectangular, apical process $\frac{1}{5}$; whitish-grey, cilia ochreous-whitish.

Q., Maroochydore near Caloundra, in August; one specimen.

Epiphthora acropasta *n. sp.*

ἀκροπαστος, sprinkled at the apex.

♂ 8 mm. Head, antennæ, thorax and abdomen white; Palpi white; second joint slightly thickened anteriorly but not tufted; terminal joint $\frac{2}{3}$. Legs white; anterior pair with a few fuscous scales. Forewings with costa moderately arched; apex acute; white with scanty pale ochreous-fuscous irroration, more pronounced near apex; discal dots not defined; an ochreous-fuscous dot at tornus, another beneath costa at $\frac{4}{5}$, and several between this and apex; cilia whitish. Hindwings with emargination rounded-rectangular, apical process $\frac{1}{4}$; whitish; cilia whitish.

Q., Stradbroke Island, in November; one specimen.

Epiphthora leptoconia *n. sp.*

λεπτοκονιος, slightly dusty.

♂ 13 mm. Head and thorax whitish with slight fuscous irroration. Palpi whitish with a few fuscous scales; second joint with a very short apical tuft; terminal joint $\frac{1}{3}$. Antennæ grey, towards base whitish. Abdomen grey. Legs whitish irrorated with fuscous, more densely on anterior pair. Forewings with costa gently arched, apex acute; whitish sparsely irrorated with fuscous; sometimes dots beneath fold at $\frac{1}{6}$, $\frac{1}{3}$ and tornus, but these are not always defined, cilia whitish, irrorated with fuscous round apex. Hindwings with emargination rectangular, apical process $\frac{1}{4}$; whitish-grey, cilia ochreous-whitish.

N.S.W., Mt. Kosciusko (5,000 feet), in March; four specimens.

Gen. IDIOBELA *nov.*

ἰδιοβελος, with peculiar weapons (palpi).

Antennæ shorter than forewings, without pecten. Labial palpi long, curved, ascending, second joint smoothly and densely scaled with short projecting apical tuft beneath, terminal joint shorter than second, rather stout, acute, a series of long hairs posteriorly from base to middle, forming a posterior tuft, which does not extend so far as apex. Forewings narrow, 2 and 3 separate, 7 and 8 stalked, 7 to costa. Hindwings elongate-trapezoidal, apex acute, produced, termen emarginate; cilia 3 to 4; 3 and 4 remote, 5 approximated to 4, 6 and 7 approximated at base, Posterior tibiæ of ♂ with inner middle spur very long.

A development of *Megacraspedus.*

IDIOBELA ISCHNOPTILA *n. sp.*

ἰσχνοπτιλος, narrow-winged.

♀. 11 mm. Head, thorax, and abdomen ochreous-whitish. Palpi ochreous-whitish, external surface of second joint except base and extreme apex, and apex of terminal joint, dark-fuscous irrorated with fuscous. Antennæ whitish annulated with fuscous. Legs ochreous-whitish; anterior tibiæ and tarsi densely, middle slightly irrorated with fuscous. Forewings narrow-elongate, apex acute; ochreous-whitish irrorated with pale-fuscous, an elongate blackish subcostal dot near base, and another at $\frac{1}{4}$; blackish dots in disc on fold at $\frac{1}{3}$, a second before middle, and a third at $\frac{2}{3}$ above tornus; wing beyond third dot more fuscous; cilia ochreous-whitish dotted with fuscous towards apex. Hindwings and cilia pale grey.

Q., Burpengary, near Brisbane, in April; one specimen.

Megacraspedus aenictodes *n. sp.*

αἰνικτωδης, obscure.

♀. 11-12 mm. Head and thorax grey-whitish. Palpi whitish; external surface of second joint fuscous-grey except at apex, tuft longer than terminal joint; terminal joint $\frac{1}{2}$. Antennæ fuscous. Abdomen grey, tuft whitish-ochreous. Legs grey. Forewings with costa gently arched, apex acute; fuscous; a rather narrow whitish costal streak from near base to $\frac{3}{5}$, cilia grey with some basal blackish scales on costa and termen towards apex. Hindwings with apex acute, termen obtusely emarginate; grey; cilia grey.

Q., Brisbane; three specimens.

Iulota ischnora *n. sp.*

ἰσχνορος, thin.

♂. 10 mm. Head and thorax whitish with a few fuscous scales. Palpi whitish, anterior surface of second joint fuscous, terminal joint $\frac{1}{2}$. Antennæ grey, paler towards base. Abdomen whitish-grey. Legs whitish; anterior pair fuscous; middle pair irrorated with fuscous. Forewings narrow, costa gently arched, apex acute, termen very oblique; ochreous-whitish irrorated with dark-fuscous, which tends to be arranged in longitudinal streaks; first discal obsolete; other stigmata indicated, with an additional dot above middle; termen irrorated with dark fuscous; cilia whitish irrorated with dark fuscous. Hindwings 1, apex acute, strongly produced, termen rectangularly emarginate; whitish; cilia whitish.

Q., Brisbane, in April; two specimens.

Iulota phauloptila *n. sp.*

φαυλοπτιλος, with shabby wings.

♂ ♀. 11-14 mm. Head, palpi, and thorax whitish. Antennæ whitish annulated with fuscous. Abdomen whitish-grey. Legs ochreous-whitish. Forewings with costa moderately arched, apex acute; whitish with scanty pale fuscous irroration; discal dots obsolete; cilia whitish. Hindwings and cilia whitish. An obscure little species.

N.S.W., Mt. Kosciusko (5,000 feet), in February and March; 6 specimens.

ARISTOTELIA EPICHARTA *n. sp.*

ἐπιχαρτος, delightful.

♂. 9 mm. Head, palpi and thorax whitish. Antennæ pale grey, towards base whitish. (Abdomen broken). Legs pale-fuscous; tarsi annulated with whitish; posterior pair whitish. Forewings narrow, costa gently arched, apex pointed, termen very oblique; 6 separate; whitish sparsely irrorated with fuscous; an ochreous streak irrorated with fuscous on costa from middle to $\frac{3}{4}$, giving off at its extremity a transverse fascia to tornus, interrupted in middle; an ochreous terminal line; terminal edge irrorated with blackish; a blackish dot at apex; cilia whitish with a blackish median line round apex. Hindwings with apex acute, produced, termen emarginate; whitish-grey; cilia whitish-grey.

N.S.W., Sydney, in April; one specimen in Coll. Lyell.

ARISTOTELIA STICHERIS *n. sp.*

στιχερις, streaked.

♂. 12 mm. Head whitish. Palpi whitish; external surface of second joint irrorated with fuscous except at apex; apex of terminal joint fuscous. Antennæ fuscous. Thorax whitish mixed with fuscous. Abdomen grey, tuft whitish. Legs fuscous; posterior pair whitish. Forewings elongate, costa gently arched, apex acute, 8 and 7 out of 6, pale-grey with some fuscous irroration; a fine blackish streak along fold from base, and another from base beneath costa to $\frac{1}{5}$; a blackish dot in middle of disc at $\frac{3}{5}$ connected by a fine line with another at $\frac{4}{5}$; cilia pale-grey. Hindwings and cilia pale-grey.

Allied to *A. thetica*, readily distinguished by the longitudinal streaks.

Q., Coolangatta, in September; one specimen.

ARISTOTELIA THEMERASTIS *n. sp.*

θεμεραστις, grave, serious.

♂ ♀. 13-14 mm. Head, thorax and abdomen grey. Palpi with second joint long and stout, abruptly truncate at apex, rough-scaled anteriorly, fuscous, internal surface whitish; terminal joint $\frac{3}{5}$, whitish, sub-basal ring and apex blackish. Antennæ whitish annulated with blackish. Legs fuscous; tarsi annulated with whitish; posterior pair mostly whitish. Forewings with costa straight except near extremities, apex pointed; 6 separate; pale-grey irrorated with darker grey; four fuscous discal dots, often partly obsolete, first at $\frac{1}{3}$ second on fold obliquely beyond first, third at $\frac{2}{3}$, fourth beneath and beyond third; a slight blackish irroration at apex and along termen; cilia grey-whitish irrorated with blackish. Hindwings and cilia grey-whitish.

Resembles *A. thetica* rather closely, but the forewings are grey, not fuscous, and the antennæ annulated with whitish, the neuration is also different.

N.S.W., Mt. Kosciusko (5,000 feet, near Hotel), in January; 5 specimens.

Aristotelia crypsixantha *n. sp.*

κρυψιξανθος, with hidden yellow.

♂. 12-13 mm. Head and thorax fuscous, slightly ochreous-tinged. Palpi with second joint rough-scaled anteriorly, fuscous, a few scattered scales and internal surface whitish; terminal joint $\frac{3}{5}$, whitish, sub-basal ring and apex blackish. Antennæ blackish. Abdomen dark-fuscous. Legs dark-fuscous. Forewings with costa straight except towards extremities, apex pointed; 6 separate; grey; obscure ochreous streaks from base beneath costa to $\frac{1}{3}$, along fold, and in middle from $\frac{1}{3}$ to termen; a short blackish streak on fold near base; a blackish discal dot at $\frac{1}{3}$ and sometimes another at $\frac{2}{3}$; some blackish scales at apex; cilia pale-grey irrorated with dark-fuscous. Hindwings and cilia grey.

Nearly allied to the preceding but distinct by the wholly blackish antennæ, ochreous streaks on forewings, and darker hindwings. It was taken in the same week on a different part of the mountain.

N.S.W., Mt. Kosciusko (5,500 to 6,000 feet, near "Pretty Point"), in January; two specimens.

Aristotelia ferritincta *n. sp.*

ferritinctus, rusty-tinged.

♂. 10-11 mm. Head ochreous-whitish with some fuscous irroration on crown. Palpi ochreous-whitish irrorated with dark-fuscous, second joint with sub-basal and subapical, terminal joint with basal and subapical dark fuscous rings. Antennæ grey with dark-fuscous annulations. Thorax ochreous-whitish irrorated with fuscous. Abdomen grey, basal segments ochreous-tinged on dorsum. Legs dark-fuscous irrorated, and tarsi annulated, with ochreous-whitish. Forewings with costa gently arched, apex pointed ; 6 separate ; ochreous-whitish densely irrorated with dark fuscous ; a ferruginous sub-costal dot near base ; a ferruginous line along fold from base ; discal dots surrounded by ferruginous, first discal at $\frac{1}{3}$, plical immediately beneath it, third dot above middle, fourth above tornus ; cilia pale-grey with some dark-fuscous basal irroration. Hindwings and cilia pale-grey.

Q., Toowoomba, in April ; two specimens.

Aristotelia eurypsola *n. sp.*

εὐρυψολος, broadly dark.

♂. 16 mm. Head, palpi, antennæ, and thorax fuscous. Abdomen grey, beneath ochreous-whitish. Legs fuscous ; posterior pair ochreous whitish. Forewings elongate, costa nearly straight except towards apex ; apex acute ; 6 separate ; fuscous ; markings dark-fuscous ; an oblique line from costa near base to fold ; a costal dot at $\frac{1}{4}$, an irregular discal blotch before middle, limited beneath by fold ; another blotch at tornus ; a costal dot at $\frac{2}{3}$, and an apical suffusion ; cilia fuscous. Hindwings and cilia dark-grey.

N.S.W., Sydney, in August ; one specimen received from Dr. R. J. Tillyard.

Aristotelia turbida *n. sp.*

turbidus, confused.

♂. 10 mm. Head whitish. Palpi whitish ; second joint with basal and subapical blackish bars on external surface ; terminal joint with blackish basal and subapical annulations. Antennæ fuscous. Thorax ochreous-whitish with some fuscous irroration. Abdomen grey, tuft whitish. Legs fuscous irrorated, and tarsi annulated, with whitish. Forewings with costa gently arched, apex pointed; 6 separate; ochreous-whitish irrorated with dark-fuscous; a dark-fuscous dot near base above fold; a discal dot at $\frac{1}{3}$ confluent with another beneath it on fold to form an irregular spot; a spot above middle before $\frac{1}{2}$, and another beneath middle beyond $\frac{1}{2}$; cilia pale-grey with some dark-fuscous irroration around apex. Hindwings and cilia pale-grey.

Q., Brisbane, in January; one specimen.

Thiotricha acrocelea *n. sp.*

ἀκροκηλεος, shining at the apex.

♀. 9 mm. Head and thorax shining-white. Palpi white. Antennæ white towards base, towards apex dark grey. Abdomen grey-whitish. Legs white; anterior tibiæ and tarsi dark grey. Forewings narrow, costa straight, apex round-pointed; shining-white; apical fourth bright orange from costa to termen; a suffused grey dorsal spot precedes orange area; a black spot at apex; a black dot on termen above middle preceded by a white dot; cilia pale grey, round apex ochreous-tinged with a thick blackish median line. Hindwings with apical process $\frac{1}{4}$; pale-grey; apical process ochreous-tinged towards extremities with a black dot on extreme apex; cilia pale-grey, on apex whitish with a blackish median dot.

The ornamentation of apex of hindwings should be noted. This and the following two species are very similar. In *acrocelea* the orange patch extends across forewing from costa to termen, in *prosoestea* it is separated from termen by two white dots, in *panglycera* it is separated also from costa by a grey streak containing a white dot.

N.Q., Cairns district; one specimen received from Mr. F. P. Dodd.

Thiotricha prosoestea *n. sp.*

προσοιστεος, additional.

♂. 8 mm. Head and thorax shining-white. Palpi white. Antennæ towards base white, towards apex grey;

ciliations in ♂ 3. Abdomen pale-grey, tuft whitish. Legs white; anterior tibiæ grey; all tarsi mostly grey. Forewings narrow, costa straight, apex round-pointed; shining white some grey suffusion along dorsum; a bright orange apical patch occupying apical fifth of wing, but separated from termen by two white spots divided by grey; a broad grey fascia precedes apical patch; a black apical dot continued along upper part of termen; cilia grey-whitish, a dark-fuscous median line around apex. Hindwings with apical process $\frac{1}{4}$; pale-grey; a black dot at apex; cilia pale-grey, at apex white with a blackish median bar.

N.Q., Kuranda near Cairns, in October; three specimens received from Mr. F. P. Dodd.

Thiotricha panglycera *n. sp.*

παγγλυκερος, sweetest of all.

♂ ♀. 10-12 mm. Head and thorax shining-white. Palpi white, apex of terminal joint grey; terminal joint of ♂ thickened and rough-scaled posteriorly towards apex. Antennæ towards base white, towards apex grey, ciliations of ♂ 5. Abdomen pale-grey, tuft ochreous-whitish. Legs white; anterior tibiæ and tarsi fuscous; middle and posterior tarsi with fuscous annulations. Forewings narrow, costa straight, apex round-pointed; shining white; apical $\frac{2}{5}$ grey, line of junction suffused; a broad orange subcostal streak from $\frac{2}{3}$ to near apex; a white dot between this and costa at $\frac{5}{6}$; an oblique white streak from tornus to centre of orange mark, nearly confluent with a shorter white streak from termen; a blackish dot separates this last from a white streak along termen to apex; a subapical blackish dot; cilia pale-grey, a dark-fuscous line around apex. Hindwings with apical process $\frac{1}{4}$; pale-grey; apical process ochreous-tinged with a blackish dot at apex; cilia pale-grey, at apex white with a median transverse blackish bar. Very like *T. oxytheces* (which has ♂ ciliations 3), but with peculiar ♂ palpi, forewings whiter with bright orange streak.

N.Q., Cairns and Kuranda, in June; 13 specimens.

Thiotricha argyrea *n. sp.*

ἀργυρεος, silvery.

♀. 12 mm. Head and thorax shining-white. Palpi white. Antennæ white, towards apex dark-fuscous. (Abdomen broken). Legs white; anterior tibiæ and tarsi blackish; middle and posterior tarsi annulated with blackish. Forewings with costa straight, apex pointed; shining-white; three suffused grey dorsal blotches, sub-basal, median and tornal; a short oblique grey streak from $\frac{5}{6}$ costa, succeeded by a narrow parallel blackish streak; a blackish apical dot; cilia grey, on middle of termen bases white, with a shining metallic oblique bar beneath apex. Hindwings with apical process $\frac{1}{6}$; grey; cilia grey, at apex white with a subapical fuscous bar.

N.Q., Atherton, in June; one specimen.

Thiotricha acronipha.

ἀκρονιφος, with snow white apex.

♀. 11 mm. Head, palpi and thorax white. Antennæ white, extreme apex grey. Abdomen whitish. Legs whitish; anterior tibiæ and tarsi fuscous anteriorly. Forewings with costa straight, apex pointed; whitish, towards apex slightly ochreous-tinged; a short longitudinal fuscous streak ending in termen below middle; from its anterior end a similar streak parallel to termen; a short oblique streak from costa at $\frac{5}{6}$; an elongate clear white apical dot edged above with black beneath with fuscous; cilia pale-grey, bases ochreous-tinged on apex with a slight fuscous median line. Hindwings with apical process $\frac{1}{5}$; pale-grey; a minute fuscous apical dot; cilia pale-grey, on apex whitish with fuscous apices.

Q. Stradbroke Island, in December; one specimen.

Thiotricha hemiphaea *n. sp.*

ἡμιφαιος, half-dusky.

♂. 10 mm. Head shining-white. Palpi fuscous, internal surface white. Antennæ fuscous, darker towards apex, basal joint white, ciliations in ♂ 3. Thorax grey-whitish. Abdomen grey. Legs white; anterior tibiæ and tarsi dark-fuscous; middle and posterior tarsi suffused with grey. Forewings with costa straight, apex round-pointed; grey; towards base suffused with silvery white except for a long dorsal wedge, broadest at base; a white costal dot at $\frac{5}{6}$; black dots on apex and mid-termen, edged anteriorly with white; cilia grey, round apex with bases ferruginous. Hindwings with apical process $\frac{1}{5}$; grey; an apical fuscous dot, cilia grey, on apex whitish with a fuscous subapical dot.

Q., Toowoomba, in October; one specimen.

Gen. HELCYSTOGRAMMA.

Dectobathra Meyr., P.L.S. N.S.W., 1904, p. 299.

In *choristis* Meyr. and *amethystina* Meyr. veins 2 and 3 of forewings are stalked, and to these the name *Dectobathra* should be restricted. This has been recognised by Mr. Meyrick (Exot. Micro. ii, p. 144), but in the same place he has sunk this name to *Helcystogramma*, a genus for which I at present do not know the reference. He also establishes the genus *Iulactis* with a new species *semifusca* (which I possess) as the type, to include also *insignis* Meyr. But in my opinion these last two species are *Xyloryctinæ*, and should be referred to the genus *Plectophila* Meyr. or at least very near it. Vein 2 of the forewings in them arises from $\frac{2}{3}$ or $\frac{3}{4}$.

HELCYSTOGRAMMA ZAPYRODES *n. sp.*

ζαπυρωδης, fiery.

♀. 10 mm. Head fuscous. Palpi grey; second joint marked by transverse ridges on external surface; inner surface of terminal joint whitish. Antennæ dark-fuscous. Thorax fuscous with some ochreous scales posteriorly. Abdomen dark-fuscous, beneath ochreous, tuft whitish. Legs whitish on under surface, upper surface fuscous with whitish bars. Forewings elongate-oblong, dilated posteriorly, costa straight, obtusely angled before apex, apex rounded, termen straight, transverse, obtusely angled above tornus; fuscous,; an orange dorsal patch containing some fuscous scales; three oblique leaden-metallic lines from costa, first near base, second at $\frac{1}{3}$, third from middle; second line longer, acutely angled in disc, and extending to dorsal patch ; third line giving off a fine orange line to tornus, obtusely bent in disc, and preceded by two or three longitudinal orange streaks ; a leaden-metallic transverse line from tornus to angle of costa ; beyond this an orange apical patch partly traversed by some black lines from anterior edge ; a black terminal line ; cilia orange, on mid-termen bases leaden-metallic. Hindwings dark-fuscous, towards base suffusedly orange ; cilia fuscous, on apex yellowish, on dorsum orange.

N.Q., Kuranda, near Cairns, in June ; one specimen taken flying by day.

Helcystogramma euargyra *n. sp.*

εὐαργυρος, well-silvered.

♂. 12 mm. Head and thorax fuscous. Palpi fuscous. Antennæ fuscous, apices whitish. Abdomen grey, towards base ochreous-whitish. Legs whitish on lower surface, upper surface fuscous barred with whitish. Forewings elongate, posteriorly dilated, costa straight, obtusely angled before apex, apex round-pointed, slightly projecting, termen straight, transverse, towards tornus strongly oblique ; whitish ; on dorsal half suffused with fuscous ; a short fuscous strigula on costa at $\frac{1}{3}$ and another on middle ; an elongate-triangular fuscous spot on costa at $\frac{2}{3}$; a broad silvery transverse line from termen beyond tornus to near costa before apex ; four longitudinal black streaks beyond this ; a black terminal line ; cilia whitish with fuscous apices, on mid-termen silvery. Hindwings grey, towards base ochreous-whitish ; cilia grey, on apex and dorsum ochreous-whitish.

Q., Killarney, in November ; one specimen.

Gen. Pauroneura.

παυρονευρος, with few nervures.

Antennæ shorter than forewings, without pecten. Labial palpi very long, smooth-scaled, slender, recurved ; second joint exceeding base of antennæ ; terminal joint longer than second, acute. Forewings with 2 and 3 separate, 3 and 4 connate or approximated, 5 absent, 7 to costa, 8 absent. Hindwings considerably over one, apex obtuse, termen not sinuate, cilia $\frac{1}{4}$; 3 and 4 connate, 5 approximated to 4, 6 and 7 rather approximated, 7 arising from before angle.

Allied to *Chaliniastis*, with the loss of an additional vein in the forewing, which is peculiarly shaped. Both genera are allied to *Helcystogramma.*

Pauroneura brachysticha *n. sp.*

βραχυστιχος, short-streaked.

♀. 16 mm. Head, palpi, thorax and abdomen brownish-fuscous. Antennæ dark-fuscous. Legs ochreous-whitish beneath, upper surface fuscous with whitish bars on tarsi. Forewings moderately elongate, costa rather strongly arched, more so towards apex, apex obtuse, termen short, at first transverse, then obliquely rounded ; whitish, unevenly suffused with brownish fuscous ; a moderate dark basal patch, short on costa, longer on dorsum ; a dark costal mark at $\frac{1}{3}$; a large dorsal blotch confluent with a terminal suffusion ; a short outwardly oblique whitish streak from $\frac{2}{3}$ costa, narrowly edged with dark-fuscous, followed by three whitish dots similarly edged ; a suffused silvery-white transverse mark from termen beyond tornus not reaching costa, cutting across two whitish dark-centred longitudinal streaks from $\frac{3}{4}$ to termen ; an elongate whitish apical dot, with a large dark-fuscous spot beneath it ; cilia ochreous-whitish with a dark-fuscous median line, beneath apex with fuscous apices. Hindwings and cilia fuscous ; base of costa white.

N.Q., Kuranda, near Cairns, in November and May ; two specimens received fiom Mr. F. P. Dodd.

Gen. Scindalmota *nov.*

σκινδαλμοτος, like a splinter.

Antennæ $\frac{3}{4}$; without pecten, in ♂ minutely ciliated. Labial palpi moderately long, recurved ; second joint smooth-scaled ; terminal joint nearly as long as second, acute. Forewings with 2 and 3 separate, parallel, 6, 7, 8 stalked, 6 separating before 8, 7 to costa. Hindwings about $1\frac{1}{2}$, apex acute, produced, termen strongly sinuate ; 3 and 4 long-stalked, 5 parallel, 6 and 7 long-stalked.

In the neighbourhood of *Anacampsis*, Curt. (*Apoœrema*, Durr.) The stalking of both 3 and 4, and 6 and 7, of hindwings nearly to margin seems sufficient distinction.

Scindalmota limata *n. sp.*

limatus, polished.

♂. 14 mm. Head and palpi white. Antennæ grey ; ciliations in ♂ $\frac{1}{2}$. Thorax whitish-ochreous. Abdomen pale-grey, tuft whitish. Legs fuscous annulated with whitish ; posterior pair mostly whitish. Forewings narrow, costa straight, apex acute, termen very oblique ; whitish mostly suffused with whitish-ochreous ; a large central brownish spot partly outlined by blackish scales, connected with dorsum before tornus ; a brownish dot on costa just beyond middle ; a brownish fascia partly outlined by blackish scales from $\frac{2}{3}$ costa to tornus, constricted towards tornus ; cilia grey with slight fuscous irroration. Hindwings and cilia pale-grey.

Q., Sandgate, near Brisbane, in September, one specimen.

Gen. Catameces *nov.*

καταμηκης, very long.

Antennæ $\frac{3}{4}$; without pecten. Labial palpi long ; second joint very long, anteriorly thickened with long rough scales which form a small apical tuft ; terminal joint about $\frac{1}{2}$ second, rather stout, acute. Forewings with 2 and 3 separate, 7 and 8 stalked, 7 to apex. Hindwings 1, apex pointed, strongly produced, termen sinuate ; 3 and 4 widely separate, 5 arising from nearer 6 than 4, 6 and 7 separate, nearly parallel.

A distinct and isolated genus of uncertain affinity.

Catameces thiophara *n. sp.*

θειοφαρος, sulphur-robed.

♂. 20 mm. Head, palpi, antennæ and thorax pale-yellow. (Abdomen broken). Legs pale-yellow. Forewings elongate, costa slightly arched, apex pointed, termen nearly straight, very oblique; pale-yellow; an apical blotch of brownish-ochreous irroration with a suffused margin extending from $\frac{3}{4}$ costa to termen beyond tornus; cilia ochreous. Hindwings pale-grey; cilia ochreous.

Q., Adavale, in April; one specimen.

GELECHIA PYRAMIDOPHORA *n. sp.*

πυραμιδοφορος, with pyramidal markings.

♂. 13 mm. Head ochreous-whitish. Palpi ochreous-whitish; second joint with sub-basal and subterminal dark-fuscous rings; terminal joint with apex and a broad median ring dark-fuscous. Antennæ ochreous-whitish with fuscous annulations. Thorax fuscous-brown. Abdomen grey. Legs fuscous irrorated, and tibiæ and tarsi annulated, with ochreous-whitish. Forewings narrow, costa straight except near base and apex, apex pointed, termen extremely oblique; ochreous-grey-whitish; markings fuscous; a spot on base of costa, another at $\frac{1}{6}$, several dots between this and middle, a narrow costal blotch beyond middle and a large spot before apex; an angular blotch on base of dorsum reaching fold; a large pyramidal blotch on $\frac{1}{3}$ dorsum, its apex nearly reaching costa; a smaller similar blotch on tornus, its apex reaching middle of disc; cilia ochreous-grey-whitish. Hindwings about 1, apex acute, strongly produced, termen rectangularly emarginate; pale-grey; cilia grey-whitish.

Q., Adavale, in April; one specimen.

GELECHIA CHALCOTORA *n. sp.*

χαλκοτορος, brassy.

♂. 14 mm. Head brassy-whitish. Palpi whitish; second joint slightly roughened anteriorly. Antennæ fuscous. Thorax brassy-fuscous. Abdomen grey, tuft whitish. Legs fuscous; posterior pair paler; tarsi and apices of tibiæ grey-whitish. Forewings with costa nearly straight except close to base and apex, apex round-pointed, termen obliquely rounded; brassy-fuscous; an ill-defined, rather broad, median, transverse, pale fascia; cilia grey, apices paler. Hindwings with termen strongly sinuate; 6 and 7 closely approximated at base; grey; cilia grey.

Q., Toowoomba, in April; one specimen.

Gen. PLATYEDRA.

Platyedra, Saund., Meyr., Exot. Micro. ii, p. 136.

Closely allied to *Gelechia*, but differing in the presence of a pecten on the basal joint of antennæ.

PLATYEDRA GOSSYPIELLA *Saund.*

♂ ♀. 15-18 mm. Head whitish-brown. Palpi whitish-brown; second joint barred with dark-fuscous on external surface at base and before apex; terminal joint with basal and subterminal dark-fuscous annulations. Antennæ brownish; basal joint with a pecten of five or six scales. Thorax brownish. Abdomen grey. Legs dark-fuscous annulated with whitish; dorsal hairs on posterior tibiæ whitish. Forewings rather narrow, costa nearly straight, apex rounded; pale-brown unevenly irrorated with dark-fuscous; markings obscure, a narrow sub-basal fascia, a discal dot at $\frac{1}{3}$, a second beneath it on fold, and a third below middle at $\frac{2}{3}$, but these may be obsolete and lost in suffusion; a suffused subapical fascia; cilia pale-grey, bases partly fuscous. Hindwings with apex slightly produced, termen sinuate; pale-grey; cilia pale-grey.

A pest to the cotton, doubtless introduced. I suspect it feeds on other *Malvaceæ*.

N.A., Port Darwin and Batchelor (G. F. Hill).

Q., Brisbane, in August, December and March.

STEGASTA TENEBRICOSA *n. sp.*

tenebricosus, dark.

♀. 20 mm. Head and thorax blackish with scanty whitish irroration. Palpi blackish with some white scales, internal surface mostly whitish. Antennæ blackish. Abdomen dark-grey. Legs dark-fuscous; tarsi annulated with whitish; posterior tibiæ mostly whitish. Forewings with costa moderately arched, apex rounded, termen obliquely rounded; blackish sparsely irrorated with whitish;

without defined markings ; cilia dark-grey, bases blackish obscurely barred with whitish. Hindwings nearly twice as broad as forewings, apex round-pointed, termen slightly sinuate ; pale-grey ; cilia pale-grey.

The palpi are considerably shorter than in the type species, and scarcely reach vertex ; veins 3 and 4 are stalked in both wings.

Q., Redcliffe, near Brisbane, in August ; one specimen.

PHTYORIMAEA SILIGNITIS *n. sp.*

σιλιγνιτις, floury.

♂ ♀. 10-12 mm. Head, palpi and antennæ whitish. Thorax ochreous-whitish. Abdomen whitish, base of dorsum ochreous-tinged. Legs whitish. Forewings narrow, costa slightly arched, apex acute ; ochreous-whitish with scanty pale ochreous-fuscous irroration more or less pronounced ; a fuscous dot on fold before middle and another above tornus ; cilia whitish, sometimes with fuscous irroration. Hindwings as broad as forewings, apex acute and strongly produced, termen emarginate ; whitish ; cilia whitish.

N.Q., Cardwell in August ; Townsville in September ; Mareeba in August. Q., Brisbane in August, September and February ; Mt. Tambourine in October ; Dalby in April ; thirteen specimens.

PHITHORIMAEA NONYMA *n. sp.*

νωνυμος, undistinguished.

♂. 12 mm. Head, palpi and thorax whitish-brown. Antennæ grey. Abdomen grey. Legs pale-fuscous ; posterior pair ochreous-whitish. Forewings narrow, costa gently arched, apex pointed, termen extremely oblique ; whitish-brown with a few fuscous scales towards apex ; stigmata fuscous, first discal before middle, second discal beyond middle, plical beneath first discal ; cilia whitish with some brown irroration. Hindwings with apex tolerably pointed, termen sinuate ; whitish ; cilia whitish.

Nearest *P. petrinodes* Meyr., but with fewer spots.

V., Gisborne, in November ; one specimen in Coll. Lyell.

Phthorimaea plaesiosema *n. sp.*

πλαισιοσημος, with squarish marking.

♂. 15 mm. Head and thorax whitish. Palpi whitish; second and terminal joints with basal and subapical fuscous rings. Antennæ whitish with fuscous annulations. Abdomen ochreous-whitish, dorsum of basal segment irrorated with fuscous except apices. Legs fuscous irrorated, and tarsi annulated, with fuscous; posterior pair paler. Forewings narrow, costa slightly arched, apex round-pointed, termen very oblique; whitish with fuscous irroration and markings; an obscure sub-basal fascia; an oblong blotch extending on costa from $\frac{1}{5}$ to $\frac{2}{5}$ reaching fold; a median spot; a brownish apical suffusion; cilia whitish irrorated with fuscous. Hindwing with apex pointed, termen strongly sinuate; grey-whitish; cilia whitish.

Nearest *P. leucocephala*, Low. Type in Coll. Goldfinch, N.S.W., Sydney, in November; one specimen.

Sarotorna myrrhina *n. sp.*

myrrhinus, yellowish.

♂ ♀. 12-18 mm. Head white; sides and lower edge of face fuscous. Palpi rather short, not much exceeding vertex; second joint much thickened with rough scales anteriorly; terminal joint less than half second, rather stout, acute; white, basal third of second joint fuscous on external surface. Antennæ whitish, towards base fuscous. Thorax white, anterior margin fuscous, more broadly so in centre. Abdomen pale ochreous-brown, tuft whitish. Legs fuscous annulated with ochreous-whitish; posterior pair pale-ochreous. Forewings with costa slightly arched, apex round-pointed, termen obliquely rounded; pale ochreous fuscous; markings white, ill-defined; a broad sub-basal fascia; a dorsal suffusion confluent with fascia; an ill-defined costal mark at $\frac{1}{3}$, a more distinct inwardly-oblique curved line from $\frac{5}{6}$ costa to tornus; cilia pale-ochreous, bases irrorated with fuscous. Hindwings over 1, apex pointed, slightly produced; pale-grey; cilia pale-ochreous.

Q., Mt. Tambourine in November; Warwick and Killarney in October; three specimens.

Gen. LIOZANCLA *nov.*

λειοζαγκλος, with smooth sickles (palpi).

Antennæ about $\frac{3}{4}$; basal joint with a moderate pecten of half a dozen scales; in ♂ slightly serrate towards apex, otherwise simple. Palpi moderately long, recurved; second joint rather slender, smooth-scaled; terminal joint nearly as long as second, slender, acute. Forewings with 2 and 3 widely separate, parallel, 7 and 8 stalked, 7 to costa. Hindwings 1, apex round-pointed, termen not sinuate; 3 and 4 connate, 4, 5, 6, 7, equidistant, parallel.

Differs from *Phthorimaea* in the antennal pecten and smooth palpi.

LIOZANCLA HOLOPHÆA *n. sp.*

ὁλοφαιος, wholly dark.

♂. 12-14 mm. Head, palpi, antennæ and thorax dark-fuscous. Abdomen fuscous. Legs fuscous; (posterior pair broken). Forewings rather narrow, costa straight, bent towards apex, apex round-pointed, termen very obliquely rounded; dark-fuscous; cilia fuscous. Hindwings and cilia grey.

N.S.W., Ebor, in January; V., Gisborne in November and December; three specimens.

EPIMIMASTIS CATOPTA *n. sp.*

κατοπτος, conspicuous.

♂. 10-14 mm. Head pale-yellow; face dark-fuscous. Palpi dark-fuscous; terminal joint pale-yellow. Antennæ and thorax pale-yellow. Abdomen grey, tuft pale-yellow. Legs grey; tarsi annulated with whitish. Forewings with costa nearly straight, slightly arched before apex, apex rounded, termen obliquely rounded; pale-yellow; markings dark fuscous; a triangular spot on costa from $\frac{1}{4}$ to middle, thickening towards apex; a dot on fold, another on costa at $\frac{2}{3}$, an apical triangular spot traversed by a fine wavy oblique white line; a blackish terminal line round apex; cilia pale-yellow. Hindwings with apex pointed, termen slightly sinuate; pale-grey; cilia pale-grey.

Q., Brisbane, in October and April; eight specimens.

Gen. Elachypteryx *nov.*

ἐλαχυπτερυξ, small-winged.

Antennæ less than 1; without pecten; in ♂ simple. Palpi moderately long; second joint thickened and slightly roughened anteriorly; terminal joint nearly as long as second, slender, acute. Forewings with 2 and 3 separate and parallel, 7 to costa, 8 absent. Hindwings 1, termen not sinuate, 3 and 4 connate, 5, 6, 7, separate, nearly parallel.

Type *E. suffusca.* The genus consists of two small inconspicuous species which in their neuration resemble *Chaliniastis* Meyr., but may be distinguished by their much narrower hindwings. I do not think there is any really near relationship.

Elachypteryx analcis *n. sp.*

ἀναλκις, weak.

♂. 9-10 mm. Head, thorax, and abdomen fuscous-brown. Palpi fuscous-brown, internal surface whitish. Antennæ fuscous-brown becoming fuscous towards apex. Legs ochreous-whitish; upper surface of anterior and middle tibiæ and tarsi white, but apical tarsal joint of anterior pair fuscous. Forewings with costa gently arched, apex pointed, termen very obliquely rounded; fuscous-brown; cilia whitish-brown. Hindwings and cilia pale-grey.

N.Q., Kuranda, near Cairns; Q., Mt. Tambourine, in November; five specimens.

Elachypteryx suffusca *n. sp.*

suffuscus, dark-brown.

♂ ♀. 10-12 mm. Head and thorax dark fuscous-brown. Palpi pale-ochreous. Antennæ fuscous. Abdomen fuscous-brown. Legs ochreous-whitish; upper surface of anterior and middle tibiæ white, the former with a dark-fuscous internal streak; upper surface of anterior tarsi white with three dark-fuscous bars; upper surface of middle tarsi dark-fuscous with one white bar. Forewings with costa gently arched, apex pointed, termen very obliquely rounded; brown with slight fuscous irroration; a transverse fuscous mark from tornus half across disc; cilia brown. Hindwings and cilia grey-whitish.

The coloration of the legs, which as in the last species is peculiar, is alike in both sexes.

Q., Mt. Tambourine in September; Killarney in November; five specimens.

CRASPEDOTIS DIASTICHA *n. sp.*

διαστιχος, with a line running through.

♀. 13 mm. Head, thorax and abdomen grey. Palpi very long; second joint exceeding vertex; terminal joint $\frac{2}{3}$, grey-whitish. Antennæ pale-grey. Legs grey-whitish; posterior pair whitish. Forewings with costa rather strongly arched, apex pointed, termen oblique; whitish-grey; a broad fuscous median streak from base to apex, giving off a short branch along fold; a fuscous terminal line from apex to a large tornal spot nearly confluent with median streak; cilia whitish-grey. Hindwings and cilia grey-whitish

N.S.W., Sydney, in January; one specimen.

PRODOSIARCHA GLAGERA *n. sp.*

γλαγερος, milky.

♂. 11 mm. Head, palpi, antennæ and thorax whitish. Abdomen grey. Legs whitish. Forewings with costa gently arched, apex round-pointed, termen very oblique; whitish, with pale ochreous-grey irroration which forms slender streaks along fold, from base of costa through disc to apex, and along costa; cilia whitish with a few pale ochreous-grey scales. Hindwings over 1, apex pointed, termen slightly sinuate; whitish, cilia whitish.

N.Q., Cairns, in October; one specimen.

Gen. CORYNÆA *nov.*

κορυναιος, clubbed (in allusion to second joint of palpi)

Antennæ $\frac{3}{4}$; in ♂ simple; without pecten. Palpi long; second joint greatly thickened towards apex by long appressed hairs, at apex its breadth is half length of joint; terminal joint $\frac{1}{2}$, slender, acute. Forewings with 2 and 3 stalked, 7 and 8 stalked, 7 to costa. Hindwings $1\frac{1}{2}$, apex pointed, termen scarcely sinuate; 3 and 4 stalked, 5 approximated at base to 4, 6 and 7 stalked.

Near *Hemiarcha* Meyr., from which it is distinguished by the palpi.

Corynæa dilechria *n. sp.*

διλεχριος, twice oblique.

♂. 12 mm. Head, palpi, and thorax fuscous. Antennæ fuscous annulated with blackish. (Abdomen broken). Legs dark-fuscous; posterior pair except tarsi grey; all tarsi annulated with whitish. Forewings narrow, costa arched near base, thence straight, apex obtusely pointed, termen very obliquely rounded; fuscous; basal and terminal areas suffused with ochreous-brown; a broad, outwardly oblique, ochreous-whitish streak from $\frac{1}{6}$ costa not reaching dorsum, broadly edged with dark-fuscous; an inwardly oblique, inwardly curved, ochreous-whitish fascia from $\frac{3}{4}$ costa to tornus; an interrupted blackish terminal line; cilia fuscous, bases whitish-ochreous. Hindwings and cilia grey.

N.Q., Atherton (2,500 feet), in June; one specimen.

Gen. Macrozancla *nov.*

μακροζαγκλος, with long sickles (palpi).

Antennæ $\frac{3}{4}$; without pecten. Palpi very long, recurved; second joint moderately long, apical half thickened with rough scales above and beneath; terminal joint twice as long as second, slender, acute. Forewings with 2 and 3 stalked, 7 and 8 stalked, 7 to costa. Hindwings nearly $1\frac{1}{2}$, termen sinuate; 3 and 4 connate, 5 parallel, 6 and 7 stalked.

A derivative of *Hemiarcha* differing only in the palpi.

Macrozancla mendica *n. sp.*

mendicus, beggarly.

♀. 15 mm. Head and thorax whitish-grey; sides of face fuscous. Palpi whitish; outer surface of second joint except apex fuscous. Antennæ pale-grey. Abdomen grey. Legs ochreous-whitish. Forewings moderately broad, costa gently arched, apex round-pointed, termen obliquely rounded; whitish-grey; some minute fuscous dots near base beneath costa, and above and beneath fold; a dot on fold before middle, other discal dots obsolete; a dot on tornus and a few fuscous scales before termen ; cilia whitish-grey (much abraded). Hindwings and cilia dark-grey.

Q., Gympie, in April ; one specimen.

Gen. EURYZANCLA *nov.*

εὐρυζαγκλος, with broad sickles (palpi).

Antennæ $\frac{3}{4}$; without pecten ; in ♂ minutely ciliated. Palpi moderately long, recurved ; second joint much thickened with scales towards apex, anteriorly rough-scaled, posteriorly with loose spreading hairs on apical half ; terminal joint as long as second, slender, acute. Forewings with 2 and 3 stalked, 7 and 8 stalked, 7 to costa. Hindwings broader than forewings (about $1\frac{1}{2}$), apex obtusely pointed, termen slightly sinuate ; 3 and 4 connate, 5 somewhat approximated to 4 at origin, 6 and 7 stalked.

Type *E. melanophylla.* Differs from *Hemiarcha* in the palpi, of which the second joint is strongly dilated at apex with rough projecting hairs posteriorly.

EURYZANCLA MELANOPHYLLA *n. sp.*

μελανοφυλλος, black-winged.

♂. 13 mm. Head, palpi, and thorax blackish-fuscous. Antennæ blackish-fuscous ; ciliations in ♂ $\frac{1}{3}$. Abdomen dark-grey. Legs blackish-fuscous ; posterior pair grey. Forewings rather narrow, not dilated costa gently arched, apex obtusely-rectangular, termen slightly oblique ; blackish-fuscous with obscure blackish dots ; a median spot at $\frac{1}{5}$ extending on both sides of fold, a median dot at $\frac{2}{5}$, shortly preceded by a dot nearer costa, and by another on fold, and another median dot a $\frac{3}{5}$; terminal edge blackish, cilia grey with two or three fuscous bars. Hindwings and cilia grey.

Q., Brisbane, in February ; one specimen.

EURYZANCLA POLYOMMATA *n. sp.*

πολυομματος, many-eyed.

♀. 14 mm. Head, palpi, and thorax dark-grey. Antennæ grey with fuscous annulations. Abdomen grey, tuft ochreous-whitish. Legs dark-grey ; posterior pair paler. Forewings of moderate breadth, slightly dilated posteriorly, costa gently arched, apex pointed, termen rather strongly oblique ; grey with conspicuous blackish dots ; a larger median dot at $\frac{1}{5}$, preceded by a smaller dot beneath fold, a small median dot at $\frac{2}{5}$, preceded by a larger dot on fold, a dot above middle, and a median dot at $\frac{3}{5}$, a dot on tornus, another between this and third median dot, and sometimes a dot preceding this last ; a series of dots round apex and on termen ; cilia grey. Hindwings and cilia grey.

N.S.W., Sydney, in March ; one specimen.

HEMIARCHA BLEPTODES *n. sp.*

βλεπτωδης, conspicuous.

♀. 14 mm. Head white, anterior part of crown fuscous. Palpi white ; second joint with basal and subapical terminal joint with subapical, blackish rings. Antennæ blackish. Thorax blackish with some whitish irroration. Abdomen grey. Legs dark-fuscous annulated with whitish ; posterior pair mostly whitish. Forewings somewhat dilated posteriorly, costa nearly straight, apex obtusely pointed, termen obliquely rounded ; blackish suffused and irrorated with white ; markings white ; six dots on costa, the three basal rather elongate and more or less produced into disc ; an oblique fascia from $\frac{1}{3}$ costa to mid-dorsum, its anterior edge twice indented, posterior edge less defined ; a postmedian central discal spot divided by a narrow transverse septum ; an ill-defined narrow subterminal fascia ; a slender interrupted submarginal line ; cilia white, bases barred with fuscous, apices fuscous. Hindwings with apex round-pointed, termen scarcely sinuate ; pale-grey ; cilia whitish with a pale-grey sub-basal line.

N.S.W. Glen Innes (3,500 feet) in October ; one specimen. Since writing this description I have come across a second example which shows that the species is somewhat variable. ♂. 12 mm. Palpi with terminal joint blackish at base. Forewings more suffused with whitish, a broad whitish sub-basal fascia preceding an irregular blackish discal spot ; median fascia reduced to an ill-defined central suffusion.

Q., Warwick, in November.

Hemiarcha tetrasticta *n. sp.*

τετραστικτος, four-spotted.

♂. 10-12 mm. Head whitish-brown. Palpi whitish-brown irrorated with fuscous. Antennæ dark-fuscous. Thorax and abdomen whitish-brown more or less suffused with fuscous. Legs ochreous-whitish with some fuscous irroration; anterior pair fuscous. Forewings with costa gently arched, apex obtusely pointed, termen very obliquely rounded; whitish-brown more or less suffused with fuscous; four conspicuous dark-fuscous spots, a median spot at $\frac{1}{6}$, first discal at $\frac{1}{3}$, plical before first discal, second discal before $\frac{2}{3}$; cilia whitish-brown mixed with fuscous. Hindwings with apex acute, termen strongly sinuate; pale-grey; cilia pale-grey, bases sometimes ochreous-whitish.

Q., Brisbane, in January, April and May, and a wasted example, perhaps hibernated in August; eight specimens.

Hemiarcha polioleuca *n. sp.*

πολιολευκος, grey-white.

♀. 13 mm. Head and thorax pale-grey. Palpi pale-grey; apex and inner surface of second joint whitish. Antennæ grey, towards base whitish. Abdomen grey-whitish. Legs pale-grey; posterior pair whitish. Forewings with costa strongly arched, apex pointed, termen very oblique; pale-grey; costa suffusedly whitish from base to $\frac{3}{4}$; cilia pale-grey. Hindwings with termen scarcely sinuate; whitish; cilia whitish.

Q., Brisbane, in September; one specimen.

Hemiarcha caliginosa *n. sp.*

caliginosus, foggy, misty.

♂. 11 mm. Head and thorax pale brownish-ochreous. Palpi ochreous-whitish. Antennæ grey. Abdomen grey, tuft ochreous-whitish. Legs ochreous-whitish. Forewings with costa nearly straight, apex pointed, termen very oblique; ochreous-whitish with general but somewhat patchy fuscous suffusion; discal dots indistinct, first before middle, plical shortly before first discal, second discal at $\frac{2}{3}$; cilia ochreous-whitish with some fuscous admixture. Hindwings with apex acute, produced, termen strongly sinuate; pale-grey; cilia pale-grey.

A very obscure species.

Q., Brisbane, in November and December; two specimens.

Gen. HETEROZANCLA *nov.*

ἑτεροζαγκλος, with different sickles (palpi).

Antennæ $\frac{3}{4}$; without pecten; in ♂ slightly serrate. Palpi long, recurved; second joint very long, much thickened, with loosely appressed scales throughout, with some loose diverging scales on posterior aspect at apex; terminal joint short (about $\frac{1}{4}$), slender, acute. Forewings with 2 and 3 connate, 7 and 8 stalked, 7 to costa. Hindwings 1, apex obtuse, termen not sinuate; 3 and 4 connate, 5 approximated at base to 4, 6 and 7 separate, parallel.

A derivative of *Protolechia* differing in the palpi.

HETEROZANCLA RUBIDA *n. sp.*

rubidus, reddish.

♂. 20 mm. Head and thorax fuscous; face paler. Palpi, second joint fuscous mixed with whitish, with a fuscous subapical ring; terminal joint whitish with subbasal and apical dark-fuscous rings. Antennæ fuscous. Abdomen ochreous-grey-whitish. Legs fuscous irrorated, and tarsi annulated, with whitish; anterior tibiæ barred with reddish. Forewings moderately broad, costa rather strongly arched, apex pointed, termen oblique; pale-reddish mixed with whitish and suffused with fuscous; stigmata blackish, first discal at $\frac{1}{3}$, succeeded by a whitish dot; plical beyond first discal, second discal before $\frac{2}{3}$, preceded by a whitish dot; a blackish streak between first and second discal, prolonged beyond the latter to apex; area between median streak and costa fuscous; a terminal blackish line not reaching apex; cilia whitish, towards apex reddish, bases grey, apices fuscous. Hindwings and cilia whitish-grey.

Type in Coll., Lyell.

V., Lorne, in February; one specimen.

Protolechia hilara *n. sp.*

ἱλαρος, cheerful.

♀. 16 mm. Head and thorax dark-fuscous. Palpi dark-fuscous, with a few whitish scales; terminal joint as long as second. Antennæ dark-fuscous. Abdomen dark-fuscous; tuft orange, beneath whitish. Legs dark-fuscous irrorated, and tarsi annulated, with whitish; posterior tibiæ yellow. Forewings rather narrow, costa rather strongly arched, apex round-pointed, termen oblique; 2 and 3 stalked; dark-fuscous with a few scattered whitish scales; stigmata blackish, scarcely discernible; a whitish suffused spot above tornus; cilia fuscous, apices whitish. Hindwings scarcely sinuate; orange; some fuscous scales on apex and termen; cilia fuscous.

Conspicuous by the orange hindwings.

V., Gisborne, in October; one specimen in Coll. Lyell.

Protolechia euryarga *n. sp.*

εὐρυαργος, broadly white.

♂ ♀. 8-11 mm. Head white, base of side tufts fuscous-brown. Palpi rather short; terminal joint as long as second; white, external surface of second joint fuscous. Antennæ fuscous. Thorax white; patagia fuscous-brown. Abdomen grey, tuft whitish. Legs fuscous; posterior pair mostly whitish. Forewings with costa moderately arched, apex rounded, termen very obliquely rounded; 2 and 3 stalked; fuscous-brown; a broad white costal streak from base to apex, narrowing at extremities, containing some brownish scales towards costa posteriorly, narrowly edged with fuscous beneath, and slightly indented at $\frac{1}{3}$ and $\frac{2}{3}$, the indentations representing discal stigmata; some white suffusion along dorsum and tornus; cilia white, on apex fuscous. Hindwings rather strongly sinuate; whitish, towards apex grey-whitish, in ♀ pale-grey; cilia grey-whitish becoming whitish on dorsum.

Nearest *P. invalida* Meyr., but smaller, forewings of costa more strongly arched, and costal streak proportionately broader.

Q., Brisbane, in August, September, October and May; six specimens.

PROTOLECHIA LEPTOSTICTA *n. sp.*

λεπτοστικτος, lightly spotted.

♂ ♀. 12-14 mm. Head and thorax fuscous-grey; face whitish. Palpi fuscous irrorated with whitish; terminal joint nearly as long as second. Antennæ fuscous; in ♂ slightly serrate. Abdomen grey; tuft in ♂ whitish grey. Legs fuscous; tarsi annulated with whitish; posterior pair except tarsi mostly whitish. Forewings with costa gently arched, apex rounded, termen oblique; 2 and 3 approximated; whitish closely irrorated with grey; suffused indistinct fuscous-grey transverse fasciæ at $\frac{1}{4}$ and beyond middle, the latter connected by a bar from its middle with apex; stigmata fuscous, indistinct, first discal at $\frac{1}{3}$ followed by a whitish dot, second discal before $\frac{2}{3}$, preceded by a whitish dot, a fuscous dot between these two, plical slightly beyond first discal, sometimes confluent with it; cilia whitish with grey or fuscous median and apical lines, the latter developed only towards apex. Hindwings with termen strongly sinuate; whitish-grey; cilia grey-whitish.

V., Beaconsfield and Flinders, in February; two specimens in Coll. Lyell.

PROTOLECHIA ELASSOPIS *n. sp.*

ἐλασσωπις, tiny.

♂. 9 mm. Head and thorax grey-whitish. Palpi dark-fuscous, inner surface mostly whitish; terminal joint shorter than second. Antennæ grey, paler towards base, apical joints in ♂ triangularly dilated. Abdomen pale-grey, tuft whitish. Legs grey; tarsi annulated with whitish; upper surface of posterior tibiæ whitish. Forewings with costa gently arched, apex rounded, termen very obliquely rounded; 2 and 3 connate; whitish irrorated with grey, more closely so beneath costa and towards termen; stigmata blackish, minute, plical beyond first discal; cilia grey with a darker sub-basal line. Hindwings with termen sinuate; pale-grey; cilia pale-grey.

Q., Caloundra, in September; one specimen.

PROTOLECHIA CREPERRIMA *n. sp.*

creperrimus, very dark.

♂. 14 mm. Head glossy, fuscous. Palpi fuscous; terminal joint shorter than second. Antennæ fuscous. Thorax dark-fuscous. Abdomen fuscous. Legs fuscous; tarsi with fine whitish annulations. Forewings narrow, costa gently arched, apex round-pointed, termen very obliquely rounded; 2 and 3 connate; dark-fuscous, stigmata obsolete, cilia dark fuscous. Hindwings with termen slightly sinuate; grey; cilia grey.

Q., Brisbane, in January; one specimen.

PROTOLECHIA HYPOCNECA *n. sp.*

ὑποκνηκος, pale yellow beneath.

♂. 11 mm. Head fuscous; face irrorated with whitish. Palpi rather short, terminal joint as long as second; fuscous, apex of second joint narrowly white. Antennæ fuscous. Thorax fuscous; a posterior spot of whitish irroration. Abdomen fuscous; base of dorsum and tuft whitish-ochreous, beneath whitish. Legs fuscous irrorated, and tarsi annulated with whitish. Forewings narrow, costa gently arched, apex rounded, termen very obliquely rounded; 2 and 3 connate; dark-fuscous closely irrorated with whitish, more so towards margins; stigmata obsolete; cilia grey, bases dark-fuscous mixed with whitish. Hindwings with termen slightly sinuate; very pale whitish-ochreous; apical $\frac{1}{3}$ grey, cilia grey.

Q., Warwick, in September; one specimen.

PROTOLECHIA MELICRATA *n. sp.*

μελικρατος, mixed with honey.

♂ ♀. 10-12 mm. Head and thorax whitish-ochreous. Palpi ochreous-whitish with a few fuscous scales; terminal joint as long as second. Antennæ ochreous-whitish, towards apex pale-grey. Abdomen pale-grey, tuft ochreous-whitish. Legs fuscous; tarsi annulated with ochreous-whitish; posterior pair ochreous-whitish. Forewings with costa gently arched, apex rounded, termen very obliquely rounded; 2 and 3 stalked; whitish-ochreous; stigmata obsolete or rarely faintly indicated by minute ochreous dots; cilia whitish-ochreous. Hindwings with termen moderately sinuate; pale-grey; cilia pale-grey.

N.Q., Cairns, in June, July and August; Lucinda Point, near Ingham, in July; seven specimens.

Protolechia mitophora *n. sp.*

μιτοφορος, thread-marked.

♂. 17-19 mm. Head ochreous-whitish. Palpi with second joint long, terminal joint ½; whitish, terminal joint sometimes fuscous posteriorly. Antennæ fuscous. Thorax fuscous. Abdomen grey. Legs fuscous; posterior pair ochreous-whitish. Forewings with costa straight except towards base and apex, apex pointed, termen slightly sinuate, slightly oblique; 2 and 3 stalked; whitish unevenly irrorated with pale-fuscous, which in posterior part of disc forms streaks on veins; stigmata dark-fuscous, minute, plical beyond first discal; a series of blackish dots on apical part of costa and termen, that beneath apex larger; cilia whitish with a median fuscous line. Hindwings with termen very slightly sinuate; pale-grey; cilia whitish, basal half pale-grey except on tornus and dorsum.

Near *P. actinota* Meyr.

Q., Coolangatta, in September; Stanthorpe in September; two specimens.

Protolechia enchotypa *n. sp.*

ἐγχοτυπος, spear-marked.

♂. 16 mm. Head whitish-grey; face whitish. Palpi blackish irrorated with whitish; terminal joint as long as second. Antennæ fuscous. Thorax grey with blackish lateral stripes and a less distinct median longitudinal fuscous line. Abdomen grey. Legs fuscous irrorated, and tarsi annulated, with fuscous. Forewings narrow, costa slightly arched, apex acute, termen extrenely oblique; 2 and 3 stalked; fuscous more or less irrorated with whitish; a rather broad whitish streak above middle from base narrowing to a point at apex, edged above and beneath by blackish lines, somewhat incomplete and interrupted, and cutting into streak before apex, the streak also contains a short blackish longitudinal line near base ; a fine blackish line on fold ; cilia grey with a fuscous median line and some whitish irroration at bases. Hindwings with termen not sinuate ; pale-grey, darker towards apex ; cilia grey.

Allied to *P. aversella* but more neatly and distinctly marked. The forewings are narrower with more acute apex, the dorsal area is darker, and there is a complete absence of ochreous or ferruginous markings.

Type in Coll. Lyell.

V., Gisborne, in October ; two specimens.

PROTOLECHIA FURCIFERA *n. sp.*

furciferus, with forked markings.

♂ ♀. 18-20 mm. Head ochreous-whitish. Palpi fuscous, apex and inner surface of second joint ochreous-whitish ; terminal joint as long as second. Antennæ fuscous, paler towards base, basal joint whitish. Thorax brown with a fine median and broader lateral dark-fuscous longitudinal lines. Abdomen grey, apices of segments whitish. Legs ochreous-whitish ; anterior and middle tibiæ and tarsi mixed with fuscous. Forewings narrow, costa slightly arched, apex pointed, termen very oblique ; 2 and 3 stalked ; reddish-brown ; costal area whitish with fuscous irroration ; a blackish costal mark at $\frac{1}{3}$; a fine whitish subcostal line from middle, edged beneath with blackish, and giving off four short whitish streaks to apical third of costa and apex ; an irregular whitish longitudinal streak above middle edged beneath with blackish from base, giving off an oblique streak at middle to subcostal line ; soon after it forks, each arm of fork is deflected upwards into sub-costal line ; some blackish scales on fold, on base of dorsum, and on termen ; cilia whitish-brown with median and terminal fuscous lines. Hindwings with termen scarcely sinuate ; pale-grey ; cilia grey-whitish.

Type in Coll. Lyell.

V., Gisborne, in November and December ; two specimens.

PROTOLECHIA PHLOEOPOLA *n. sp.*

φλοιοπολος, haunting bark.

♂. 20-23 mm. Head whitish. Palpi fuscous, second joint mixed with whitish; terminal joint as long as second. Antennæ fuscous. Thorax fuscous, base of patagia whitish. Abdomen grey. Legs fuscous irrorated, and tarsi annulated, with whitish. Forewings narrow, costa gently arched, apex pointed, termen very oblique; 2 and 3 stalked; fuscous; a broad ochreous-whitish costal streak, its lower edge irregular, reaching nearly to middle, its costal edge more or less irrorated or suffused with fuscous, which tends to form discrete spots; some ochreous suffusion mostly towards apex; some whitish scales near termen; cilia whitish ochreous with some indistinct basal bars towards tornus grey. Hindwings with termen not sinuate; grey; cilia grey.

Type in Coll. Lyell.

V., Melbourne, in September; Gisborne, in September and December; three specimens.

PROTOLECHIA CHALAZODES *n. sp.*

χαλαζωδης, like hail (in allusion to hindwings).

♂. 14 mm. Head whitish. Palpi whitish, second joint fuscous anteriorly; terminal joint as long as second. Thorax whitish suffused with brown. Abdomen dark-fuscous densely irrorated with whitish, tuft and underside whitish. Legs whitish; anterior and middle tibiæ and tarsi dark-fuscous annulated with ochreous-whitish. Forewings rather narrow, costa nearly straight, apex pointed, termen extremely oblique; 2 and 3 stalked; brown irregularly mixed with ochreous-whitish, towards termen reddish-brown; fuscous dots on costa at $\frac{1}{6}$ and $\frac{1}{3}$; a fine median longitudinal fuscous line from $\frac{1}{3}$ to $\frac{2}{3}$, a similar line from $\frac{2}{3}$ costa to apex; cilia ochreous-whitish with a median fuscous line around apex, and a fuscous bar before apex. Hindwings with apex pointed, termen scarcely sinuate; dark-fuscous densely irrorated with whitish; cilia whitish.

Very distinct by the peculiar coloration of hindwings and dorsum of abdomen, but this is probably confined to the male sex.

Q., Mt. Tambourine. in November; one specimen.

PROTOLECHIA PYRRHICA *n. sp.*

πυρρικος, red.

♀. 11 mm. Head and thorax reddish-brown. Palpi reddish-brown; terminal joint nearly as long as second, its anterior edge fuscous. Antennæ grey with darker annulations, towards base tinged with reddish brown. Abdomen grey. Legs pale-grey, tibiæ and tarsi annulated with whitish (posterior pair broken). Forewings gently arched near base, thence straight, apex rounded, termen slightly oblique; 2 and 3 stalked; reddish-brown; stigmata obsolete; a fine fuscous line on apical half of costa interrupted by several minute whitish-ochreous dots; a dark-fuscous apical spot giving off a fine line along upper part of termen; cilia reddish-brown, on apex fuscous. Hindwings with termen slightly sinuate; grey; cilia whitish, with a grey sub-basal line not extending to tornus.

Q., Coolangatta, in September; one specimen.

PROTOLECHIA MEGALOSTICTA *n. sp.*

μεγαλοστικτος, large-spotted.

♂ ♀. 13-14 mm. Head, thorax, and abdomen grey; face fuscous. Palpi dark-fuscous; terminal joint as long as second. Antennæ dark-fuscous; in ♂ slightly serrate. Legs dark-fuscous; tarsi annulated with whitish; posterior pair wholly whitish. Forewings with costa gently arched, apex rounded, termen only slightly oblique; 2 and 3 short-stalked; pale-grey; markings dark-fuscous; a dot near base of costa and another on costa at $\frac{1}{6}$; a dot near base of dorsum and another on dorsum at $\frac{1}{4}$; first discal at $\frac{1}{3}$, minute, second discal larger at $\frac{2}{3}$, plical beyond first discal and large; a large fuscous suffusion beyond second discal extending to tornus; a terminal fuscous suffusion; cilia grey with a fuscous median line. Hindwings with termen not sinuate; grey-whitish; cilia grey-whitish.

N.S.W., Sydney (Woodford, Como), in March and April; two specimens in Coll. Lyell.

PROTOLECHIA BLACICA *n. sp.*

βλακικος, sluggish.

♀. 14 mm. Head fuscous, back of crown ochreous-whitish. Palpi dark-fuscous; terminal joint shorter than second, whitish towards apex. Antennæ dark-fuscous, basal $\frac{1}{4}$ whitish. Thorax ochreous-whitish. Abdomen grey, tuft whitish. Legs fuscous mixed with whitish; posterior pair mostly whitish. Forewings with costa nearly straight, apex rounded, termen very obliquely rounded; 2 and 3 stalked; dark-fuscous; a narrow basal ochreous-whitish fascia; a broad ochreous-whitish fascia from $\frac{3}{4}$ costa narrowing to tornus; cilia dark-fuscous. Hindwings with termen slightly sinuate; thinly scaled, pale-grey; cilia pale-grey.

Q., Brisbane; one specimen bred from *Eucalyptus* twenty-five years ago and not met with since.

Protolechia albifrons *n. sp.*

albifrons, white anteriorly.

♂. 11 mm. Differs from *blacica* only as follows—Head and palpi wholly white. Abdomen and legs mostly whitish beneath.

N.A., Port Darwin, in February; one specimen received from Mr. F. P. Dodd. It is possible that the differences between this and the preceding may be merely sexual.

Protolechia involuta *n. sp.*

involutus, confused.

♀. 18 mm. Head whitish irrorated with fuscous. Palpi fuscous with some whitish irroration; terminal joint as long as second. Thorax and antennæ dark-fuscous with some whitish scales. Abdomen grey, tuft whitish-ochreous. Legs fuscous irrorated, and tibiæ and tarsi annulated, with whitish. Forewings with costa moderately arched, apex round-pointed, termen very obliquely rounded; 2 and 3 stalked; whitish densely irrorated with dark-fuscous; markings dark-fuscous edged with whitish; a spot on base of dorsum, a small median spot at $\frac{1}{4}$, another larger but less defined between this and middle, a third at $\frac{3}{4}$, and a fourth at apex, both rather large; five costal dots in posterior $\frac{2}{3}$; a fine subterminal line from apical spot to tornus; cilia fuscous with three rows of whitish dots, the last apical. Hindwings with termen not sinuate; dark-grey; cilia grey-whitish with a grey sub-basal line.

N.Q., Townsville, in April; one specimen received from Mr. F. P. Dodd.

Protolechia gypsocrana *n. sp.*

γυψοκρανος, with chalky head.

♂. 10-12 mm. Head whitish. Palpi whitish with a few fuscous scales; terminal joint shorter than second. Antennæ ochreous-whitish, sometimes with fuscous annulations. Thorax whitish with pale-fuscous irroration. Abdomen whitish-grey. Legs fuscous mixed with whitish; posterior pair wholly whitish. Forewings with costa moderately arched, apex rounded, termen very obliquely rounded; 2 and 3 connate; whitish irrorated with pale-fuscous; stigmata rather large, ill-defined, plical beyond first discal; cilia whitish irrorated with fuscous. Hindwings with termen not sinuate; whitish; cilia whitish.

Q., Brisbane, in August and September; Toowoomba in September; Stradbroke Island in July; six specimens.

Protolechia annularia *n. sp.*

annularius, ringed.

♂. 14 mm. Head whitish-grey; face whitish. Palpi whitish; terminal joint $\frac{2}{3}$, fuscous except at base. Antennæ fuscous. Thorax grey. Abdomen pale-grey. Legs whitish mixed with grey. Forewings narrow, costa gently arched, apex rounded, termen obliquely rounded; 2 and 3 approximated; whitish densely irrorated with fuscous; stigmata large, longitudinally oval, fuscous, ringed with whitish, plical beyond first discal, second discal specially large, median, narrowly separated from first discal, cilia whitish, bases distinctly barred with fuscous, apices grey. Hindwings over 1, apex obtuse, termen not sinuate; grey-whitish; cilia grey-whitish.

Q., Brisbane, one example taken twenty-five years ago.

Protolechia taracta *n. sp.*

ταρακτος, confused.

♂. 12-14 mm. Head and thorax dark brown. Palpi brown, external surface irrorated with dark-fuscous, terminal joint shorter than second. Antennæ brown. Abdomen grey, tuft grey-whitish. Legs fuscous irrorated, and tarsi annulated with ochreous-whitish; posterior pair mostly ochreous-whitish. Forewings slightly dilated posteriorly, costa gently arched, apex pointed, termen slightly oblique ; 2 and 3 stalked ; dark-brown ; markings fuscous, very obscure ; an irregular angulated blotch at $\frac{1}{3}$ comprising first discal and plical, a dot above middle, and two dots placed transversely at $\frac{2}{3}$; several dots on costa towards apex ; cilia dark-fuscous, apices whitish-brown except on apex. Hindwings with termen slightly sinuate ; pale-grey becoming whitish towards base ; cilia whitish with a grey sub-basal line not extending to tornus.

Q., Montville (1,500 feet), near Nambour, in October ; Mt. Tambourine, in November ; Toowoomba, in September ; four specimens.

Protolechia sporodeta *n. sp.*

σποροδετος, with spotted edge.

♂. 14 mm. Head and thorax ochreous-whitish, sides of face fuscous. Palpi ochreous-whitish irrorated with fuscous ; terminal joint $\frac{2}{3}$. (Abdomen broken). Legs ochreous-whitish, anterior and middle pairs partly suffused with fuscous. Forewings rather broad, costa strongly arched to middle, thence nearly straight, apex rectangular, termen scarcely oblique, rounded beneath ; 2 and 3 stalked ; ochreous-whitish with numerous dots and a few scattered scales dark-fuscous ; subcostal and subdorsal dots near base ; a subdorsal dot at $\frac{1}{6}$; stigmata larger and rather suffused, plical beyond first discal, second discal before $\frac{2}{3}$; a series of dots on apical half of costa and near termen ; cilia ochreous-whitish. Hindwings over 1, apex obtuse, termen scarcely sinuate ; whitish with pale-grey suffusion towards apex ; cilia grey-whitish.

Q., Killarney, in November ; one specimen.

Protolechia mesopsamma *n, sp.*

μεσοψαμμος, sandy in the middle.

♂. 13 mm. Head whitish-brown. Palpi whitish-brown with a few fuscous scales ; terminal joint shorter than second. Anetnnæ fuscous, towards base whitish-brown. Thorax fuscous ; patagia whitish-brown. Abdomen pale-grey, tuft ochreous-whitish. Legs fuscous irrorated, and tibiæ and tarsi annulated, with ochreous-whitish ; posterior pair almost wholly ochreous-whitish. Forewings with costa strongly arched, apex pointed, termen rounded, moderately oblique ; 2 and 3 stalked ; dark fuscous with slight whitish irroration ; markings whitish-brown ; a broad costal streak from base to $\frac{1}{3}$; a fine short sub-basal dorsal streak ; a series of fine dots on apical third of costa and termen ; cilia whitish brown mixed with dark-fuscous. Hindwings with termen slightly sinuate ; pale-grey ; cilia whitish-grey.

Q., Rosewood, in April ; one specimen.

Protolechia hedana *n. sp.*

ἥδανος, pleasant.

♂. 18 mm. Head whitish. Palpi whitish irrorated with fuscous anteriorly ; terminal joint $\frac{2}{3}$, Antennæ whitish, annulated with dark-fuscous. Thorax purple-grey with fine whitish irroration. (Abdomen broken). Legs grey mixed with whitish ; posterior pair whitish. Forewings with costa gently arched, apex round-pointed, termen very obliquely rounded ; 2 and 3 stalked ; whitish closely irrorated with purple-grey ; markings reddish-brown mixed with fuscous ; three ill-defined fuscous spots on basal third of costa, the surrounding area suffused with reddish brown ; a sub-dorsal spot at $\frac{3}{4}$, a discal spot slightly beyond it at $\frac{2}{3}$, and two terminal spots above and below middle ; cilia reddish-brown, bases whitish mixed with grey, on tornus wholly grey. Hindwings with termen slightly sinuate ; whitish becoming pale-grey towards apex ; cilia whitish.

Q., Brisbane, in August ; one specimen.

Protolechia celidophora *n. sp.*

κηλιδοφορος, blotched.

♂. 12-17 mm. Head whitish-brown ; face and sides of crown fuscous. Palpi fuscous with a few whitish scales ; terminal joint $\frac{2}{3}$. Antennæ whitish-brown, basal joint fuscous. Thorax pale-brown. Abdomen grey, tuft whitish-ochreous. Legs fuscous mixed with whitish ; posterior pair mostly ochreous-whitish. Forewings with costa rather strongly arched apex acute, termen slightly oblique, rounded beneath : 2 and 3 stalked ; pale-brown ; markings and a few scattered scales fuscous ; an outlined blotch, ill-defined dorsally, including plical and first discal, a dot above middle second discal at $\frac{2}{3}$; a large tornal and terminal blotch narrower at apex; some whitish-brown terminal dots; cilia whitish-brown with some fuscous scales, on apex and dorsum fuscous. Hindwings with apex pointed, termen sinuate; whitish-ochreous; apical $\frac{1}{2}$ grey; cilia grey, towards tornus sometimes whitish-ochreous.

Allied to *P. gorgonias* Meyr., distinguished by the fuscous palpi and tornal blotch.

N.Q., Cairns district (Dodd); Q., Eumundi, near Nambour, in November; two specimens.

Protolechia eustephana *n. sp.*

εὐστεφανος, well-crowned.

♂. 14-16 mm. Head pale-ochreous. Palpi pale-ochreous with some fuscous irroration; terminal joint shorter than second. Antennæ ochreous-whitish annulated with fuscous. Thorax fuscous. (Abdomen broken). Legs fuscous irrorated, and tarsi annulated, with ochreous-whitish; posterior pair almost wholly ochreous-whitish. Forewings slightly arched, apex rounded, termen very obliquely rounded; 2 and 3 stalked; fuscous-whitish with patchy fuscous irroration; an angular spot at $\frac{1}{3}$ of disc, moderate in size, embracing first discal and plical stigmata, second discal before $\frac{2}{3}$, transversely elongate; a sub-apical blotch and terminal line fuscous; cilia whitish with median and apical fuscous lines. Hindwings with termen slightly sinuate; pale-grey; cilia whitish.

Resembles *P. eumela* Low., but at once distinguished by the ochreous head. It has not the peculiar palpi of that species.

Q., Brisbane; three specimens taken twenty-five years since, now in poor condition.

Protolechia semiographa *n. sp.*

σημειογραφος, bearing a mark.

♀. 20 mm. Head and thorax pale-fuscous. Palpi fuscous-whitish with some fuscous irroration; terminal joint $\frac{2}{3}$. Antennæ pale-fuscous. Abdomen grey. Legs fuscous mixed with ochreous-whitish; posterior pair mostly ochreous-whitish. Forewings dilated posteriorly, costa slightly arched, more strongly towards base, apex rounded-rectangular, termen nearly straight, scarcely oblique; 2 and 3 stalked; pale-fuscous with a few fuscous scales; a sharply defined blackish blotch in disc at $\frac{1}{3}$ including plical and first dorsal stigmata, its outline very irregular; cilia pale-fuscous. Hindwings $1\frac{1}{2}$, termen very slightly sinuate; pale-grey; cilia whitish-grey with a grey sub-basal line.

Very distinct but allied to *P. loemias* Meyr

Q., Mount Tambourine, in November; one specimen.

Protolechia lechriosema *n. sp.*

λεχϱιοσημος, with oblique mark.

♂. 14 mm. Head and thorax fuscous. Palpi fuscous, inner surface of second joint whitish; terminal joint nearly as long as second. Antennæ fuscous. Abdomen grey, tuft ochreous-whitish. Legs pale-fuscous; tibiæ and tarsi annulated with ochreous-whitish; upper surface of posterior tibiæ ochreous-whitish. Forewings rather broad, costa gently arched, apex pointed, termen moderately oblique; 2 separate from near angle; ochreous-whitish irrorated with fuscous, towards termen sparsely irrorated with pale-brown; stigmata small, indistinct, plical beneath first discal, connected by a suffusion with dorsum, a dot beneath second discal, connected by an oblique wedge-shaped mark with tornus; a series of dark-fuscous dots on apical third of costa and on termen; cilia ochreous-whitish with a few fuscous scales. Hindwings with apex obtuse, termen not sinuate; 6 and 7 slightly approximated at base; whitish-grey; cilia whitish with a pale-grey basal line.

Q., Mt. Tambourine, in November; one specimen.

Gen. Prosomura *nov.*

πϱοσομουϱος, adjacent.

Antennæ $\frac{3}{4}$; without pecten; in ♂ simple, thicker than in ♀. Labial palpi long, recurved; second joint thickened and slightly rough anteriorly; terminal joint shorter than second, rather stout, acute. Forewings with 2 and 3 stalked, 7 and 8 coincident, 7 to costa. Hindwings 1, apex round-pointed, termen scarcely sinuate; cilia $\frac{4}{5}$; 3 and 4 connate, 5 parallel, 6 and 7 stalked.

Allied to *Pancoenia* Meyr., but with 6 and 7 of hindwings stalked, and ♂ antennæ thickened.

Prosomura symmetra *n. sp.*

συμμετρος, similar.

♂ ♀. 8-9 mm. Head and thorax pale brownish-ochreous. Palpi pale brownish-ochreous; terminal joint with basal and subapical fuscous rings. Antennæ pale-ochreous with fuscous annulations, thickened in ♂. Abdomen grey, tuft whitish-ochreous. Legs fuscous; posterior pair ochreous-whitish. Forewings with costa slightly arched, apex round-pointed. termen very obliquely rounded; pale brownish-ochreous with fuscous irroration and markings; a subcostal spot near base; first discal at $\frac{1}{3}$, plical shortly before first discal, second discal at $\frac{2}{3}$; a dot on mid-costa, a second at $\frac{2}{3}$ and two more between this and apex; a series of terminal dots sometimes not quite on margin; cilia whitish-ochreous. Hindwings and cilia grey-whitish.

Very similar to *Pancoenia pygmaea*, but independently of the neuration distinguishable by the costal and terminal dots, whitish hindwings, and annulated antennæ.

N.Q., Cardwell, in August; five specimens.

Pancoenia pygmaea *n. sp.*

πυγμαιος, small.

♂. 9-10 mm. Head and thorax pale brownish-ochreous. Palpi fuscous, inner surface ochreous-whitish; second joint with a sub-apical dark-fuscous ring. Antennæ fuscous. Abdomen grey, tuft ochreous-whitish. Legs fuscous annulated with ochreous-whitish; posterior pair ochreous-whitish. Forewings with costa moderately arched, apex obtusely pointed, termen very oblique; fuscous-whitish; spots dark-fuscous; first discal at $\frac{1}{3}$, plical shortly before first discal, second discal at $\frac{2}{3}$; cilia ochreous-whitish. Hindwings and cilia pale-grey.

N.Q., Kuranda, near Cairns, in June and October; four specimens.

Gen. Anaptilora.

Anaptilora Meyr., P.L.S., N.S.W., 1904, p. 390.

The definition of this genus should be enlarged as regards the palpi as follows :—Palpi long, recurved, second joint thickened with appressed hairs, often with a small tuft of loose spreading hairs posteriorly at apex, terminal joint acute, in ♀ moderately slender, in ♂ stout, and often with a posterior tuft of hairs about middle. This is to admit the two following species, which are closely allied to *A. eremias*, and agree with it structurally except in the palpi. In *A. basiphaea* the posterior tuft of second joint, and of terminal joint in ♂ are both very small but recognisable, in *haplospila* they are both absent.

Anaptilora basiphæa *n. sp.*

βασιφαιος, dusky at the base.

♂. 18 mm. Head whitish-ochreous. Palpi whitish-ochreous with some fuscous irroration. Antennæ pale-grey. Thorax whitish-ochreous with some fuscous scales posteriorly. Abdomen and legs ochreous-whitish. Forewings somewhat dilated posteriorly, costa slightly arched, apex rounded, termen obliquely rounded ; ochreous-whitish with a few scattered fuscous scales ; markings fuscous ; a narrow basal fascia slightly produced on dorsum ; discal dots at $\frac{1}{3}$ and $\frac{2}{3}$, plical slightly beyond first discal ; a terminal series of dots ; cilia ochreous-whitish. Hindwings and cilia whitish.

N.Q., Townsville, in August ; two specimens.

Anaptilora haplospila *n. sp.*

ἁπλοσπιλος, simply spotted.

♂ ♀. 12-13 mm. Head whitish-ochreous. Palpi whitish-ochreous with slight fuscous irroration ; terminal joint sometimes with a subapical fuscous ring. Antennæ whitish-ochreous, basal joint sometimes fuscous. Thorax whitish-ochreous, sometimes with two blackish dots on posterior margin. Abdomen whitish-ochreous, towards base sometimes grey. Legs fuscous with obscure ochreous whitish annulations, or wholly whitish-ochreous. Forewings not dilated, costa rather strongly arched, apex rounded, termen obliquely rounded ; ochreous-whitish ; dots blackish ; first discal before middle, second at $\frac{2}{3}$, plical before first discal or obsolete ; some terminal dots ; cilia ochreous-whitish. Hindwings and cilia grey-whitish.

Q., Brisbane, in January and March ; two specimens differing slightly in markings, the ♂ being the darker-marked.

Gen. SYNDESMICA *nov.*

συνδεσμικος, linking together.

Antennæ $\frac{3}{4}$; without pecten ; in ♂ simple. Palpi long, recurved ; second joint thickened with appressed hairs, slightly rough anteriorly, somewhat expanded at apex but not tufted ; terminal joint stout, acute. Forewings with 2 and 3 stalked, 7, 8, 9 stalked, 7 to apex. Hindwings over 1 apex pointed, termen sinuate ; 3 and 4 connate, 5 parallel, 6 and 7 connate.

Allied to *Anaptilora* which has developed from it. It is evident that in the latter 8 and 9 are coincident.

SYNDESMICA HOMOGENES *n. sp.*

ὁμογενης, akin.

♀. 18-19 mm. Head pale-ochreous. Palpi pale-ochreous, terminal joint fuscous. Antennæ fuscous, basal joint pale-ochreous. Thorax fuscous. Abdomen whitish-ochreous. Legs pale-ochreous irrorated, and tarsi annulated, with fuscous. Forewings not dilated, costa rather strongly arched, apex round-pointed, termen very obliquely rounded ; ochreous-grey irrorated with fuscous, more so towards costa and termen ; dots fuscous, plical before first discal ; first discal before middle, second discal before $\frac{2}{3}$; cilia greyish-ochreous irrorated with fuscous. Hindwings and cilia grey.

N.Q., Kuranda, near Cairns, in October ; two specimens received from Mr. F. P. Dodd.

AULACOMIMA CERAMOCHROA *n. sp.*

κεραμοχροος, clay-coloured.

♂. 12 mm. Head ochreous-whitish. Palpi ochreous-whitish, a few grey scales on second joint. Antennæ grey. Thorax whitish-brown. Abdomen pale-grey. Legs ochreous-whitish ; anterior pair grey anteriorly. Forewings with costa straight except towards base and apex, apex round-pointed, termen obliquely rounded ; whitish-brown suffused with pale-fuscous except towards base ; a short dark-fuscous streak surrounded by ochreous on fold before middle ; an ochreous spot in disc before middle, and another shortly beyond middle, sometimes connected by a fuscous streak ; a similar longitudinal streak precedes first spot, and there may be another on costal side of that spot ; cilia fuscous with minute pale dots. Hindwings pale-grey ; cilia pale-grey with a whitish basal line succeeded by a grey line.

Q., Brisbane, in February ; one specimen.

Gen. Aprosoesta *nov.*

ἀπροσοιστος, irresistible.

Antennæ over 1 ; without pecten ; in ♂ simple. Labial palpi long, recurved ; second joint smooth-scaled ; terminal joint in ♀ longer than second, slender, acute ; in ♂ aborted, very short, ending in a strongly triangularly dilated tuft of hairs. Forewings with 2 absent, 3 and 4 stalked, 7 and 8 stalked, 7 to costa 9 and 10 absent, discocellulars obsolete. Hindwings over 1, trapezoidal, apex pointed, termen strongly sinuate ; cilia 1 ; 3 and 4 connate, 5 absent, 6 and 7 connate.

A development of *Crocanthes* ; the hindwings are as highly ornamented as the forewings giving a very peculiar *facies*. The ♂ palpi are anomalous.

Aprosoesta pancala *n. sp.*

παγκαλος, all beautiful.

♂. 13 mm. Head whitish, posterior part of crown fuscous. Palpi whitish, base of terminal joint fuscous. Antennæ yellowish, basal joint fuscous. Thorax yellowish. Abdomen ochreous-grey, tuft ochreous-whitish. Legs yellowish ; apices of tibiæ ringed with dark fuscous ; posterior tibiæ with also a median dark-fuscous ring. Forewings narrow, costa nearly straight, apex acute, termen concave, slightly oblique ; pale-yellow partly suffused with deeper yellow ; markings fuscous ; an inwardly oblique narrow fascia from costa near base to base of dorsum ; a second similar parallel fascia shortly beyond this ; a short line or transverse discal mark before middle ; a third fascia at $\frac{2}{3}$, and a fourth subterminal, the latter ill-defined anteriorly ; a broad terminal line ; cilia yellowish, on tornus fuscous. Hindwings whitish partly suffused with yellow ; a basal fuscous patch ; a yellow dot edged with fuscous in disc at $\frac{1}{3}$; a median transverse fuscous fascia enclosing two yellow dots ; an irregular subterminal fascia and a terminal line fuscous ; cilia yellowish, bases fuscous, on tornus wholly fuscous.

♀. 15 mm. Similar but deeper yellow and darker fuscous. Palpi, second joint fuscous at base and apex ; terminal joint fuscous externally.

N.Q., Kuranda, near Cairns in October and November ; two specimens received from Mr. F. P. Dodd.

Crocanthes trizona *n. sp.*

τριζωνος, with three bands.

♂ ♀. 11-12 mm. Head whitish. Palpi whitish ; terminal joint in ♂ short. Antennæ whitish, barred with dark-fuscous on upper surface. Thorax whitish or pale-yellowish. Abdomen whitish. Legs whitish tinged with yellowish ; tibiæ and tarsi annulated with fuscous. Forewings narrow, costa slightly arched, apex round-pointed, termen oblique ; pale-yellowish, sometimes whitish towards base ; three dark-fuscous transverse lines, first sub-basal, second at $\frac{1}{3}$, third at $\frac{2}{3}$; a short outwardly oblique dark-fuscous discal streak precedes third line ; cilia pale-yellowish, apices fuscous. Hindwings and cilia whitish.

N.Q., Kuranda, near Cairns, from September to December ; Innisfail, in July and November ; seven specimens.

Gen. Sarisophora.

Sarisophora Meyr., P.L.S., N.S.W., 1904, p. 403.

I should state the neuration of the hindwings thus, 4 absent (coincident with 3), 3 and 5 connate. This makes the genus a simple derivative of *Lecithocera*, Hb., in which 3 and 4 are stalked, 5 well separate at origin. The variation of the origin of vein 9 of forewing occasionally out of 7 occurs in both genera. *Styloceros* Meyr., differs only in the shorter antennæ, which are otherwise very similar.

Sarisophora tenella *n. sp.*

tenellus, delicate.

♂ ♀. 9-11 mm. Head whitish, middle of crown ochreous-tinged. Palpi whitish, external surface of second joint whitish-ochreous. Antennæ ochreous-whitish, upper surface barred with dark-fuscous. Thorax purple-grey, patagia whitish. Abdomen greyish-ochreous. Legs ochreous; poterior pair ochreous-whitish. Forewings with costa nearly straight, apex very obtusely rounded, termen obliquely rounded; purple-grey; a broad whitish costal streak to middle; apical area whitish with some fuscous irroration, sharply separated from ground-colour by a line from $\frac{2}{3}$ costa to tornus; cilia fuscous, bases paler, a fine white median line, on tornus whitish. Hindwings and cilia pale-grey.

Very distinct specifically; owing to the peculiarly rounded apex of forewings, it is difficult to say whether 7 runs to apex or termen.

N.Q., Cairns, in June, August and October. Q., Nambour, Caloundra and Brisbane, in October; six specimens.

Sarisophora terrena *n. sp.*

terrenus, terrestrial.

♂ ♀. 15-17 mm. Head whitish-ochreous. Palpi whitish-ochreous; outer surface of second joint pale-fuscous except at apex. Antennæ whitish ochreous; in ♂ outer surface of basal joint, a few bars on upper surface near base, and apical $\frac{1}{8}$ fuscous. Thorax and abdomen ochreous-grey-whitish. Legs ochreous-whitish with a few fuscous scales; anterior pair fuscous. Forewings with costa gently arched, apex pointed, termen oblique; 9 out of 7; ochreous-grey-whitish; first discal dot at $\frac{1}{3}$, dark fuscous, distinct; plical obsolete; second discal before $\frac{2}{3}$, nearly obsolete, some fuscous irroration between it and tornus; some fuscous irroration on termen; cilia whitish-ochreous, apices paler. Hindwings grey-whitish; cilia as forewings.

Easily recognised by the neuration.

N.Q., Kuranda, near Cairns, in June; four specimens.

Sarisophora nyctiphylax *n. sp.*

νυκτιφυλαξ, a night watchman.

♀. 15 mm. Head fuscous. Palpi whitish; second joint with an oblique fuscous bar on external surface from before middle of upper edge to beyond middle of lower edge, and fuscous at apex; terminal joint wiih anterior edge fuscous. Antennæ ochreous-whitish, with some fuscous scales towards base. Thorax and abdomen fuscous. Legs ochreous-whitish mixed with fuscous. Forewings with costa straight except towards base and apex, apex rounded, termen obliquely rounded; 7 to apex; brownish-fuscous with a few scattered blackish scales; discal dots nearly obsolete, plical below first discal; cilia brownish-fuscous, bases paler. Hindwings grey; basal third whitish-ochreous its edges suffused; cilia grey, on dorsum whitish-ochreous.

Near *S. chlœnota* Meyr., as shown by the coloration of hindwings, but the oblique bar on palpi should be sufficient distinction.

Q., Mt. Tambourine, in November; one specimen.

Sarisophora leucoscia *n. sp.*

λευκοσκιος, shaded with white.

♂. 15 mm. Head whitish, centre of crown pale-grey. Palpi whitish; external surface of second joint with a broad oblique dark-fuscous bar, covering all but base and apex; extreme apex of terminal joint fuscous. Antennæ whitish. Thorax grey with a darker median line, inner half of patagia dark-fuscous. Abdomen ochreous-whitish, tuft and under surface fuscous. Legs fuscous. Forewings with costa slightly arched. more strongly towards base and apex, apex pointed, termen obliquely rounded; 7 to termen; whitish suffused with fuscous, leaving basal costal area, a median streak, and much of central area whitish; a broad rounded dark-fuscous dorsal patch from near base to beyond middle;

discal spots dark-fuscous, first discal at $\frac{1}{3}$, second discal just beyond middle, plical included in dorsal patch ; a dark-fuscous subcostal line from base to $\frac{1}{4}$; some dark-fuscous scales on postmedian veins ; cilia fuscous with fine whitish spots, bases ochreous-whitish, on costa and tornus ochreous-whitish. Hindwings pale-grey ; cilia pale-grey, on tornus and dorsum ochreous-whitish.

Q., Mt. Tambourine, in November ; one specimen.

Sarisophora pycnospila *n. sp.*

πυκνοσπιλος, with thick spots.

♂ ♀. 13-17 mm. Head whitish. Palpi whitish, external surface irrorated with fuscous. Antennæ whitish. Thorax fuscous. Abdomen grey. Legs fuscous ; posterior pair mixed with ochreous-whitish. Forewings with costa slightly arched, apex round-pointed, termen obliquely rounded ; 7 to apex ; grey-whitish suffused with fuscous ; markings and some scattered irroration dark-fuscous ; discal spots large, first discal at $\frac{1}{3}$, plical slightly before it, the two nearly confluent, second discal at $\frac{2}{3}$; three or four obscure spots on costa beyond middle ; cilia grey, bases whitish. Hindwings pale-grey ; cilia pale-grey, bases whitish.

N.Q., Thursday Island ; Mareeba in May : Q., Stanthorpe, in November ; three specimens.

Lecithocera chamela *n. sp.*

χαμηλος, haunting the ground.

♂ ♀. 12-17 mm. Head whitish-ochreous. Palpi whitish-ochreous ; outer surface of second joint fuscous except at apex. Antennæ whitish-ochreous, upper surface sometimes barred with fuscous. Thorax brown. Abdomen ochreous-grey-whitish. Legs fuscous more or less mixed, and tarsi annulated, with whitish-ochreous ; posterior pair mostly whitish ochreous. Forewings with costa nearly straight, apex pointed, termen obliquely rounded ; 7 to termen, 9 separate ; pale reddish-brown with a few scattered fuscous scales ; a fuscous dot on base of costa ; first discal at $\frac{1}{4}$, fuscous , plical obsolete, second discal beyond middle with a spot beneath it ; cilia pale-brown. Hindwings and cilia grey-whitish.

Distinguished by the whitish hindwings and reddish-brown forewings with 7 to termen.

Q., Mt. Tambourine, in September, October and November ; Coolangatta in August ; twelve specimens.

Lecithocera alampes *n. sp.*

ἀλαμπης, dark.

♂ ♀. 13-17 mm. Head purple-brown, sides of crown whitish-ochreous, Palpi fuscous-brown, inner surface more or less whitish. Antennæ ochreous-whitish, sometimes with fuscous annulations. Thorax brown with purplish reflections. Abdomen ochreous-fuscous or ochreous. Legs anterior pair fuscous ; middle pair whitish ; posterior pair whitish above, fuscous beneath. Forewings rather narrow, costa very slightly arched, apex round-pointed, termen slightly oblique ; 7 to apex, 9 separate ; brownish-fuscous or fuscous ; stigmata very obscure, plical beneath first discal, second discal double ; cilia brownish-fuscous or fuscous. Hindwings and cilia grey.

Differs from *L. cyamitis* Meyr. in the darker forewings with obsolescent stigmata, plical being beneath first discal, and the ochreous-tinged abdomen.

N.Q., Cairns ; N.S.W., Sydney, in April ; five specimens.

Gen. Styloceros.

Styloceros Meyr., P.L.S., N.S.W., 1904, p. 408.

I am of opinion that the missing vein in the hindwing is not 5 but 3 or 4, which are coincident, a development from *Lecithocera* in which 3 and 4 are stalked ; secondarily 5 may become stalked with 4. The same remark applies to *Sarisophora*. I would broaden the definition of *Styloceros* as follows,—Forewings 2 and 3 connate, stalked, or coincident, 7 and 8 stalked, 7 to apex or termen, 9 sometimes out of 7 ; hindwings 3 and 4 coincident, 5 approximated, connate, or stalked with 4. Ultimately *Styloceros* will, I think, be merged in *Sarisophora* ; the two differ only in the length of their antennæ, and by little.

Styloceros brachymita *n. sp.*

βραχυμιτος, with short threads or lines.

♂. 16 mm. Head ochreous-whitish. Palpi fuscous; apex of second joint whitish; terminal joint whitish. Antennæ ochreous-whitish, near apex grey. Thorax fuscous. Abdomen ochreous-whitish. Legs fuscous, tibiæ and tarsi annulated with ochreous-whitish. Forewings with costa slightly arched, apex rounded, termen obliquely rounded; 7 to apex; whitish-ochreous suffused with fuscous; some dark-fuscous irroration; markings dark-fuscous; a fine subcostal line from base to one-third; first discal before middle, plical beneath it, elongate, second discal ill-defined, a spot at tornus; a fine whitish-ochreous streak along fold, interrupted by plical; a similar short streak between first and second discal; cilia fuscous with fine whitish points and slender whitish ochreous bars. Hindwings and cilia pale-grey.

Q., Eidsvold; Warwick, in October and March; four specimens.

Styloceros dispila *n. sp.*

δισπιλος, two-spotted.

♂. 11 mm. Head ochreous-whitish; face fuscous. Palpi fuscous, posterior surface whitish. Antennæ ochreous-whitish. Thorax fuscous. (Abdomen broken). Legs ochreous-whitish; anterior pair fuscous. Forewings narrow, costa gently arched, apex round-pointed, termen slightly oblique; fuscous; stigmata dark-fuscous, first discal large, round, at $\frac{1}{3}$, second discal similar, before $\frac{2}{3}$, plical minute, beneath first discal; cilia fuscous. Hindwings 4 and 5 stalked; pale-grey; cilia pale-grey.

N.A., Port Darwin; one specimen received from Mr. G. F. Hill.

Styloceros concinna *n. sp.*

concinnus, neat.

♂. 12 mm. Head and thorax whitish-ochreous. Palpi whitish-ochreous; second joint fuscous posteriorly, with a short anterior apical tuft. Thorax pale ochreous-grey. Abdomen grey, tuft whitish-ochreous. Legs fuscous; posterior pair whitish-ochreous. Forewings moderately broad, costa gently arched, apex round-pointed, termen slightly oblique; 2 and 3 stalked, 7 to termen; pale ochreous-grey; discal dots blackish, first at $\frac{1}{4}$, second before $\frac{2}{3}$, plical obsolete; a terminal series of blackish dots; cilia grey-whitish. Hindwings with 3 and 4 coincident, 5 approximated, 6 and 7 short-stalked, widely diverging; pale ochreous-grey; cilia grey-whitish.

Somewhat aberrant in the genus by the tufted palpi and neuration of hindwings this species may perhaps ultimately form a new genus.

N.Q., Bellenden-Ker, base of mountain; one specimen received from Dr. Hamilton Kenny.

Styloceros isophanes *n. sp.*

ἰσοφανης, similar.

♂. 10 mm. Head and antennæ whitish. Palpi whitish; second joint irrorated with fuscous. Thorax pale-fuscous. Abdomen grey. Legs pale-fuscous; posterior pair whitish. Forewings narrow, costa gently arched, apex pointed, termen very obliquely rounded; 2 and 3 coincident, 7 to termen; pale-fuscous; two blackish discal spots, first at $\frac{1}{3}$, second before $\frac{2}{3}$, plical obsolete; some dark-fuscous scales on termen; cilia pale fuscous. Hindwings with 3 and 4 coincident, 5 somewhat approximated, 6 and 7 long-stalked; pale-grey; cilia pale-grey.

Very similar to *Sarisophora dispila* though differing structurally and in shape of forewing.

N.Q., Kuranda, near Cairns; one specimen received from Mr. F. P. Dodd.

Styloceros noseropa *n. sp.*

νοσερωπος, of sickly appearance.

♂. 10 mm. Head, palpi, and thorax ochreous-whitish. Antennæ ochreous-whitish annulated with grey, towards apex wholly grey. Abdomen pale-grey, tuft ochreous-whitish. Legs ochreous-whitish; anterior pair tinged with grey. Forewings narrow, costa gently arched, apex round-pointed, termen obliquely rounded; 2 and 3 coincident, 7 to termen, 9 separate; brown-whitish with slight fuscous irroration; stigmata obsolete; cilia pale-grey. Hindwings with 3 and 5 approximated at origin, 6 and 7 long-stalked; pale-grey; cilia pale-grey.

A small and very inconspicuous species.

N.Q., Kuranda, near Cairns, in October; one specimen.

Gen. Loboptila *nov.*

λοβοπτιλος, with lobed wing.

Antennæ $\frac{3}{4}$; without pecten; (♂ unknown). Labial palpi very long, recurved; second joint exceeding base of antennæ, slender, smooth-scaled; terminal joint longer than second, slender, acute. Forewings rather broad, subquadrate, basal half of costa expanded in a rounded lobe; 2 and 3 separate, parallel, 7 and 8 stalked, 7 to apex Hindwings $1\frac{1}{3}$, apex round-pointed, termen sinuate; 2 from near end of cell, 3, 4, 5, nearly connate, 6 and 7 separate. slightly approximated at base, 8 widely separate from cell, but connected with it by a long oblique bar, which arises from cell before middle.

A very isolated genus in the Australian fauna.

Loboptila leurodes *n. sp.*

λευρωδης, polished.

♂. 15-16 mm. Head and thorax white. Palpi white; basal $\frac{2}{3}$ of second joint fuscous; apex of terminal joint dark-fuscous. Antennæ white, towards apex grey with some blackish scales. Abdomen pale-grey. Legs whitish; tarsi with three elongate fuscous dots on upper surface; anterior pair suffused with fuscous. Forewings with basal half of costa expanded into a rounded lobe, thence sinuate, apex pointed, termen sinuate; white; markings and a few scattered scales dark-fuscous; a dot on dorsum at $\frac{1}{6}$; discal dots minute, first before middle, second at $\frac{2}{3}$, plical obsolete; an elongate mark at $\frac{3}{4}$, connected by irroration with tornus and representing a posterior line; two or three dots on costa towards apex; a terminal line; cilia ochreous-whitish with a median fuscous line. Hindwings and cilia whitish-grey.

N.Q., Kuranda, near Cairns, in October; four specimens received from Mr. F. P. Dodd.

Gen. Croesopola.

Croesopola Meyr., P.L.S., N.S.W., 1904, p. 410

Antennæ of ♂ moderately ciliated (1).

Croesopola eudela *n. sp.*

εὔδηλος, conspicuous.

♀. 16 mm. Head and thorax fuscous. Palpi fuscous; apex of terminal joint whitish. Antennæ fuscous, paler towards apex. Abdomen pale-fuscous. Legs fuscous; outer surface of anterior tibiæ and tarsi whitish; middle and posterior tibiæ with two whitish rings; upper surface of posterior tibiæ and tarsi ochreous-whitish. Forewings with costa gently arched, apex acute, termen strongly sinuate, not oblique; grey; markings blackish-fuscous narrowly edged with whitish-ochreous; an elongate sub-basal spot beneath costa; a rounded dorsal blotch before middle reaching $\frac{4}{5}$ across disc; a round discal spot at $\frac{2}{3}$, indented anteriorly; an elongate triangular mark on mid-costa; an apical patch bounded by a line from $\frac{2}{3}$ costa to tornus, its lower part crossed by four incomplete, whitish-ochreous, longitudinal lines; a grey terminal line, but terminal edge fuscous; cilia whitish-ochreous, apices grey, on tornus grey. Hindwings $1\frac{1}{2}$, apex round-pointed, termen not sinuate; rather dark grey; cilia grey; bases ochreous-whitish, a sub-basal dark line not extending to tornus, towards tornus wholly ochreous-whitish.

N.Q., Kuranda, near Cairns, in March; one specimen received from Mr. F. P. Dodd.

Cymatomorpha scotia *n. sp.*

σκοτιος, dusky.

♂. 12 mm. Head and thorax ochreous-whitish, suffused with pale-fuscous. Palpi with apical tuft of second joint long; ochreous-whitish; second joint with some fuscous irroration on external surface; terminal joint with basal, median, and subapical dark-fuscous rings. Antennæ grey. Abdomen fuscous. Legs fuscous; tibiæ and tarsi annulated with whitish. Forewings narrow, costa gently arched, apex pointed, termen very oblique; 6 separate; ochreous - whitish uniformly suffused with fuscous;

several tufts of raised scales on or near costa, one especially large at ½; cilia grey, bases ochreous-whitish with some fuscous admixture. Hindwings with apex pointed, only slightly produced; grey; cilia grey.

Although I think congeneric, it differs from the type in the longer palpal tuft, separation of 6 of forewings, and less produced apex of hindwings.

N.Q., Kuranda, near Cairns, in June; one specimen.

Anarsia patulella.

Gelechia patulella Wlk., Cat. Brit. Mus. xxix, p. 635.

♂ ♀ 14-16 mm. Head and thorax grey. Palpi grey; external surface of second joint except apex fuscous; terminal joint in ♀ with broad median and apical fuscous rings. Antennæ fuscous. Abdomen fuscous, tuft ochreous-whitish. Legs fuscous; posterior pair grey-whitish on upper surface. Forewings narrow, costa slightly arched apex pointed, termen very oblique; whitish irrorated with grey; markings and some scattered scales dark-fuscous; costal dots at ¼ and ⅝; a small triangular median costal patch, with an oval spot beneath it in disc; sometimes a dot on fold near base, and two dots beneath fold; an indistinct tornal spot; some dots on costa towards apex and on termen; cilia grey with whitish points. Hindwings and cilia grey.

Q., Brisbane, in July, August, February and April. N.S.W., Sydney (Narrabeen), in November; eight specimens. Also from India and Ceylon.

Gen. Episacta *nov.*

ἐπεισακτος, foreign.

Antennæ ¾; without pecten; in ♂ serrate towards apex. Labial palpi very long, recurved; second joint with two large triangular tufts, one at base, another at apex; terminal joint longer than second, rather stout, acute, with small posterior tufts at middle and ¾. Forewings narrow, with small raised tufts of scales in disc and on costa; 2 and 3 separate, parallel, 7 and 8 out of 6, or 6 separate, 7 to costa. Hindwings about 1½, apex round-pointed, termen not sinuate; cilia about ⅔; 3 and 4 separate, 5 approximated to 4 at base, 6 and 7 stalked.

Type *Chelaria discissa* Meyr. (Exot. Micro. i, p. 581), from Kuranda, near Cairns. Nearly allied to *Chelaria* Haw., but differs in having two tufts on each palpal joint instead of one, and in the raised scales on forewings. The latter character is better marked in the species described below than in the type. *Discissa* has vein 6 of the forewings stalked; this is an inconstant character in many genera.

Episacta toreuta *n. sp.*

τορευτος, carved in relief.

♂. 14 mm. Head whitish. Palpi whitish; external surface of second joint including tufts with two transverse fuscous bars; terminal joint pale-fuscous, apex and apices of tufts whitish. Antennæ whitish with fine grey annulations. Thorax and abdomen whitish. Legs whitish; anterior and middle tibiæ and tarsi fuscous with whitish annulations. Forewings narrow, costa gently arched, apex rounded, termen very obliquely rounded; 6 separate; whitish, markings and some scattered irroration fuscous; a small tuft of whitish scales on costa at $\frac{3}{4}$; several tufts of raised scales towards base, two of them larger, first above fold at $\frac{1}{4}$, second beneath fold beyond first; a triangular blotch on costa from $\frac{1}{5}$ to $\frac{3}{5}$, its apex reaching to fold; a spot on termen beyond tornus; an ill-defined subapical suffusion; a line of indistinct dots before and parallel to termen; cilia whitish, indistinctly barred with fuscous around apex. Hindwings pale-grey becoming whitish towards base; cilia pale-grey, on dorsum whitish.

N.Q., Kuranda, near Cairns, in June; one specimen.

Gen. Tituacia.

Tituacia Wlk., Cat. Brit. Mus. xxix, p. 812.

Antennæ $\frac{3}{4}$; without pecten; in ♂ simple. Labial palpi very long, recurved; second joint with a small anterior apical tuft; terminal joint longer than second, rather stout, acute, with a moderate posterior tuft at middle, and a second larger at $\frac{3}{4}$. Forewings with tufts of raised scales in disc and on costa; 2 from well before angle, 3 and 4 connate or stalked from angle, 7 and 8 stalked, 7 to costa. Hindwings about $1\frac{1}{2}$, apex rounded, termen not sinuate; cilia about $\frac{1}{3}$; 3 and 4 connate, 5 curved and closely approximated to 4 at base, 6 and 7 stalked.

Also allied to *Chelaria* but differs from this and the preceding genus in having 3 and 4 of hindwings connate.

TITUACIA DEVIELLA.

Tituacia deviella Wlk., Cat. Brit. Mus. XXIX, p. 812.

♂ ♀. 18-20 mm. Head and thorax grey with a few fuscous scales. Palpi grey with fuscous tufts and irroration. Antennæ grey-whitish with slender fuscous annulations. Abdomen whitish-grey. Legs whitish; tarsi fuscous with whitish annulations Forewings moderately broad, costa bisinuate with several scale-tufts, one larger at $\frac{3}{4}$, apex rounded, termen obliquely rounded; whitish-grey with patchy fuscous irroration; median fuscous dots at $\frac{1}{12}$ and $\frac{1}{6}$, another intermediate beneath fold; an ill-defined subtriangular fuscous costal blotch on middle third; a blackish apical spot with smaller blackish dots above and beneath it; cilia pale-grey, bases barred with brownish-fuscous. Hindwings grey, paler towards base; cilia pale-grey.

Q., Brisbane; two specimens taken 25 years since. Also from Ceylon.

Gen. BRACHYACMA.

Brachyacma Meyr., Tr. E.S., 1886, p. 278.

Antennæ $\frac{3}{4}$; without pecten; in ♂ simple. Labial palpi moderately long, recurved; second joint thickened with appressed hairs, somewhat rough beneath towards apex, above with a strong median tuft of loose hairs, diminishing to apex; terminal joint less than $\frac{1}{2}$ second, slender, acute. Forewings with 2 from well before angle, 7 and 8 stalked, 7 to costa. Hindwings about 1, apex round-pointed, projecting, termen emarginate; cilia $1\frac{1}{2}$; 3 and 4 connate, 5 somewhat approximated to 4 at origin, 6 and 7 stalked.

Type *B. epiochra* Meyr., from Fiji.

BRACHYACMA EPICHORDA *n. sp.*

ἐπιχορδος, striped.

♂. 14-18 mm. Head and thorax ochreous-grey. Palpi ochreous-grey; apex of second joint ochreous-whitish;

terminal joint whitish, at apex blackish. Antennæ grey. Abdomen ochreous-brown. Legs fuscous. Forewings narrow-elongate, costa very slightly arched, apex rounded, termen very obliquely rounded ; fuscous ; a whitish streak from base to apex, posteriorly brownish-tinged, running along costa to $\frac{1}{3}$ leaving only costal edge fuscous, thence separated from costa by a fuscous-brown streak attenuated at extremities ; three dark-fuscous terminal dots more or less developed ; cilia grey. Hindwings and cilia grey.

Q., Brisbane, in January, February and April ; Toowoomba, in March ; six specimens.

Nothris apentheta *n. sp.*

ἀπενθητος, cheerful.

♂. 10 mm. Head white. Palpi white ; external surface of second joint and apex of terminal joint fuscous. Antennæ fuscous. Thorax fuscous ; tegulae white. Abdomen grey, base of dorsum ochreous-tinged. Legs grey ; tarsi with fine whitish annulations. Forewings with costa straight in middle, rather strongly bent towards base and apex, apex acute, termen very oblique ; fuscous-grey ; a broad white streak from base to apex, running along costa to middle, then through disc, interrupted before apex ; costal edge towards base fuscous ; an interrupted narrow dark-fuscous longitudinal line slightly above middle from base to $\frac{2}{3}$, edged above and beneath with ochreous ; cilia grey with whitish points, a blackish basal line on costa, forming beneath apex a median hook, which is preceded by a short basal blackish streak. Hindwings and cilia pale-grey.

N.S.W., Sydney, in March ; one specimen.

Nothris acromelas *n. sp.*

ἀκρομελας, black at the apex.

♂. 14 mm. Head and thorax whitish. Palpi whitish ; external surface of second joint except apex fuscous. Antennæ whitish-grey annulated with dark-fuscous. Abdomen grey. Legs fuscous ; tarsi with obscure whitish annulations. Forewings with costa nearly straight except towards base and apex, apex pointed, termen very oblique; whitish with slight brownish suffusion; discal dots and a few scattered scales blackish; first discal at $\frac{1}{3}$, second at $\frac{2}{3}$, plical well beyond first discal; a small irregular apical blackish spot, with some marginal blackish dots on costa towards apex and on termen; cilia grey-whitish. Hindwings and cilia grey.

N.S.W., Murwillumbah, in September; one specimen.

Nothris centrospila *n. sp.*

κεντροσπιλος, with central spot.

♂. 15 mm. Head whitish. Palpi whitish; second joint with external surface except apex fuscous; terminal joint with sub-basal, median, and subapical fuscous rings. Antennæ fuscous, towards base whitish. Thorax grey-whitish. Abdomen grey. Legs fuscous; posterior pair ochreous-whitish. Forewings with costa strongly arched, apex pointed, termen very obliquely rounded; grey-whitish; some fuscous irroration along costa and termen; a longitudinally-elongate dark-fuscous central discal spot; cilia grey-whitish. Hindwings pale-grey, darker towards apex; cilia pale-grey.

Q., Brisbane, in December; one specimen.

Nothris cyrtopleura *n. sp.*

κυρτοπλευρος, with bent costa.

♂ ♀. 15-16 mm. Head and thorax grey-whitish. Palpi whitish; external surface of second joint except apex fuscous; terminal joint with sub-basal, median, and subapical blackish rings, the two latter sometimes confluent. Antennæ whitish annulated with fuscous, towards apex wholly fuscous. Abdomen pale grey. Legs fuscous; tarsi annulated with whitish; posterior pair whitish with grey irroration. Forewings elongate-oval, costa strongly arched, apex pointed, termen very oblique; grey-whitish with fuscous irroration and markings, the latter somewhat ill-defined; four or five costal dots at $\frac{1}{6}$, $\frac{1}{3}$, middle and towards apex; two suffused dorsal spots, before middle and at tornus; median discal spots at middle and $\frac{3}{4}$, more or less defined; some terminal dots: cilia grey-whitish with obscure fuscous bars around apex. Hindwings and cilia pale-grey.

N.A., Port Darwin (in Coll. Meyrick); N.Q., Kuranda, near Cairns, in September; Q., Brisbane, in August, December and February; four specimens.

NOTHRIS MESOPHRACTA *n. sp.*

μεσοφρακτος, with median bar.

♂. 24 mm. Head whitish; sides of face fuscous. Palpi whitish; second joint with external surface dark-fuscous except at apex, tuft long; terminal joint with apex dark-fuscous. Antennæ fuscous. Thorax whitish, patagia and a fine median line dark-fuscous. Abdomen pale-ochreous, towards apex ochreous-whitish. Legs fuscous; upper surface of posterior pair whitish. Forewings narrow, costa slightly arched, apex pointed, termen extremely oblique; whitish with a few fuscous scales mostly on veins; a broad median dark-fuscous streak from base to apex, and prolonged through cilia; cilia grey, apices whitish. Hindwings with termen strongly sinuate; whitish-grey; cilia grey-whitish.

Type in Coll. Lyell.

V., Wandin, in November; one specimen.

Gen. RHADINOPHYLLA *nov.*

ραδινοφυλλος, slender-winged.

Antennæ $\frac{4}{5}$; without pecten; in ♂ (unknown). Labial palpi long, recurved; second joint rough-hairsd above towards apex, and with a long anterior apical tuft; terminal joint longer than second, slender, acute. Forewings with 2 and 3 coincident, 7 and 8 stalked, 7 to costa. Hindwings less than 1, apex acute, strongly produced, termen obtusely emarginate; cilia $2\frac{1}{2}$; 3 and 4 connate, 5 somewhat approximated to 4, 6 and 7 stalked.

This and the following are derivatives of *Dichomeris* differing in the neuration of the forewings.

RHADINOPHYLLA SIDEROSEMA *n. sp.*

σιδηροσημος, iron-marked.

♀. 10 mm. Head and thorax pale-grey. Palpi grey; apex of second joint white. Abdomen grey. Legs fuscous; tarsi with obscure whitish annulations. Forewings narrow, costa nearly straight, apex rounded, termen very oblique; whitish closely irrorated with grey except towards costa; costal edge towards base dark-fuscous; some dark-fuscous dots, one on fold at $\frac{1}{6}$, first discal at $\frac{1}{3}$, second discal at $\frac{2}{3}$, plical beyond first discal; a costal dot at $\frac{2}{3}$, another at tornus, the two connected by a narrow transverse ferruginous fascia, which touches second discal dot; a series of ferruginous-fuscous dots on termen and apical third of costa; cilia whitish with a fine fuscous median line round apex. Hindwings and cilia grey.

N.Q., Mourilyan Harbour, near Innisfail, in July; one specimen.

Gen. Eurysara *nov.*

εὐρυσαρος, with broad brushes.

Antennæ $\frac{4}{5}$; without pecten; in ♂ simple. Labial palpi long, recurved; second joint greatly thickened toward apex, forming a very broad rough-scaled tuft, its breadth being as long as second joint; terminal joint about as long as second, very slender, acute. Forewings with 2 and 3 stalked, 8 and 9 out of 7, 7 to apex. Hindwings about $1\frac{1}{3}$, apex pointed, termen sinuate; cilia $\frac{2}{3}$; 2 and 3 connate, 5 somewhat approximated to 4, 6 and 7 stalked.

A derivative of *Dichomeris*, differing in the neuration of forewing, and the greatly dilated second joint of palpi.

Eurysara pleurophæa *n. sp.*

πλευροφαιος, with dusky costa.

♂. 18 mm. Head fuscous, face grey. Palpi dark-fuscous, inner surface paler. Antennæ pale-fuscous annulated with black. Thorax pale ochreous-brown, patagia fuscous. Abdomen fuscous. Legs, fuscous; tarsi annulated with whitish. Forewings moderately elongate, costa straight except near base and apex, apex round-pointed, termen obliquely rounded; pale ochreous-brown; costa dark-fuscous throughout, commencing as a broad line from base, widening at $\frac{1}{4}$ to a blotch extending half across disc, narrowing to a point shortly before apex; a minute fuscous dot on fold in middle, and another above tornus; a transverse ferruginous-brown line from apex of costal patch to termen ; apex suffused with ferruginous-brown ; cilia grey with whitish points, bases ferruginous-brown barred with fuscous. Hindwings and cilia dark-grey.

Q., Coolangatta, in March ; one specimen.

DICHOMERIS XUTHOCHYTA *n. sp.*

ξουθοχυτος, with tawny suffusion.

♂. 10 mm. Head, antennæ, thorax, and abdomen fuscous. Palpi with tuft long ; fuscous. Legs fuscous ; posterior pair whitish-ochreous, spurs and tarsal rings fuscous. Forewings narrow, costa nearly straight, apex rounded, termen very obliquely rounded ; fuscous ; discal dots very obscurely darker, plical beyond first discal ; cilia fuscous, bases narrowly whitish-ochreous. Hindwings fuscous ; a large tornal ochreous blotch extending from mid-dorsum to mid termen ; cilia fuscous, on blotch ochreous.

Q., Brisbane, in November and February ; two specimens.

DICHOMERIS PERLEVIS *n. sp.*

perlevis, very light.

♂ ♀. 12 mm. Head and thorax grey-whitish. Palpi with tuft moderately long ; fuscous ; apex of second joint and posterior surface of terminal joint white. Antennæ pale-grey. (Abdomen broken). Legs fuscous ; posterior pair ochreous-whitish. Forewings narrow, costa slightly arched, apex pointed, termen very oblique ; whitish suffused with grey ; dots fuscous, one on fold at $\frac{1}{4}$, first discal about middle, second at $\frac{3}{4}$, plical before first discal ; an interrupted blackish line round apex and termen ; cilia pale-grey slightly ochreous-tinged. Hindwings and cilia pale-grey.

Q., Montville (1,500 feet), near Nambour, in October ; Mount Tambourine, in February ; two specimens.

DICHOMERIS ACROGYPSA *n. sp.*

ἀκρογυψος, chalky at the apex.

♂. 13 mm. Head and thorax pale-fuscous. Palpi with tuft long, whitish ; second joint except apex, and anterior edge of terminal joint fuscous. Antennæ fuscous. Abdomen pale-grey. Legs fuscous ; posterior tarsi whitish.

Forewings with costa straight to $\frac{3}{4}$, thence arched, apex round-pointed, termen very obliquely rounded; fuscous with a slight purple tinge; fine blackish dorsal strigulæ; apical $\frac{1}{4}$ whitish with a few fuscous and blackish scales; cilia whitish, on apex and tornus fuscous. Hindwings and cilia grey.

Q., Rosewood, in April; one specimen.

DICHOMERIS CIRRHOSTOLA *n. sp.*

κιῤῥοστολος, in yellowish robe.

♂. 14-17 mm. Head, thorax and abdomen whitish-ochreous. Palpi with tuft long; whitish-ochreous. Legs whitish-ochreous; anterior pair suffused with fuscous. Forewings with costa gently arched, apex rounded, termen rounded, slightly oblique; whitish-ochreous; costal edge at base fuscous; some ochreous-fuscous irroration before lower part of termen; cilia whitish-ochreous. Hindwings and cilia ochreous-whitish.

Q., Adavale in April and May; two specimens.

DICHOMERIS PLEUROLEUCA *n. sp.*

πλευρολευκος, with white costa.

♀. 20 mm. Head and thorax whitish-ochreous. Palpi with tuft long; whitish-ochreous; basal $\frac{2}{3}$ of external surface of second joint fuscous; terminal joint except extreme apex fuscous. Antennæ whitish annulated with grey. (Abdomen broken). Legs fuscous; posterior pair whitish. Forewings with costa moderately arched, apex round-pointed, termen very obliquely rounded; fuscous; a broad ochreous-whitish costal streak from base nearly to apex, narrowing posteriorly, with a small angular projection on lower edge at $\frac{1}{3}$; cilia whitish with two obscure grey lines. Hindwings grey-whitish; cilia whitish.

Q., Eidsvold; one specimen received from Dr. T. Bancroft.

DICHOMERIS ANCYLOSTICHA *n. sp.*

ἀγκυλοστιχος, with bent line.

♂. 20 mm. Head and thorax fuscous. Palpi with second joint extremely long, upper surface densely rough-scaled on posterior $\frac{2}{3}$, a small anterior apical tuft; terminal joint about $\frac{1}{2}$ second, slender, acute; fuscous, posterior surface of terminal joint except apex whitish. Antennæ grey annulated with dark-fuscous. (Abdomen broken). Legs fuscous; (posterior pair missing). Forewings with costa strongly arched near base, thence straight nearly to apex, apex rounded, termen obliquely rounded; fuscous; a broad median blackish streak from base, soon bent to above fold and narrowing to a point at $\frac{2}{5}$; first discal touching or just beyond apex of streak, second at $\frac{3}{5}$, plical before first discal, blackish; a whitish costal suffusion containing some ferruginous scales; cilia fuscous, on termen partly whitish. Hindwings and cilia dark-grey.

This species differs considerably from others in the form of the palpi.

Q., Eidsvold, in September; one specimen received from Dr. T. Bancroft.

Dichomeris dysorata *n, sp.*

δυσορατος, hard to see.

♂. 20 mm. Head and thorax grey. Palpi fuscous, apex of second joint whitish, tuft moderately long. Antennæ grey; ciliations in ♂ $\frac{2}{3}$. Abdomen grey. Legs fuscous; posterior pair whitish-grey. Forewings rather narrow, costa slightly arched, apex rounded, termen oblique; grey with slight fuscous irroration; stigmata very obscure, plical beyond first discal, an additional median dot, and another beneath second discal; a series of blackish dots, one before apex, one at apex, and several on termen; cilia grey. Hindwings obtusely pointed, termen not sinuate, pale-grey; cilia pale-grey.

Type in Coll. Goldfinch.

N.S.W., Sydney (Como), in September; one specimen.

Gen. Trigonophylla *nov.*

τριγονοφυλλος, with triangular wings.

Antennæ about $\frac{4}{5}$, without pecten; in ♂ with long ciliations. Palpi long, recurved; second joint thickened towards apex, with an anterior apical tuft of loose hairs; terminal joint nearly as long as second, slender, acute. Forewings with 2 from before angle, well separate from and parallel with 3, 7 and 8 stalked, 7 to apex. Hindwings over, apex obtuse, termen slightly sinuate ; 3 and 4 connate, 5 somewhat approximate and parallel to 4, 6 and 7 separate, parallel.

A primitive genus near the stem of origin of *Nothris* and *Dichomeris*.

Trigonophylla tarachodes *n. sp.*

ταραχωδης, confused.

♂. 18 mm. Head and thorax pale ochreous-fuscous. Palpi whitish, external surface irrorated with fuscous. Antennæ ochreous-grey-whitish ; ciliations in ♂ 3. Abdomen pale-grey, with broad ferruginous bars on dorsum except near base ; beneath pale-reddish irrorated with fuscous. Legs ochreous-whitish irrorated with fuscous ; posterior pair irrorated beneath only. Forewings triangular, costa stright except near base and apex, apex acute, termen sinuate, hardly oblique ; pale ochreous-fuscous ; a fuscous dot in disc at $\frac{2}{3}$; three ill-defined transverse bands of fuscous irroration, first from $\frac{1}{4}$ costa to mid-dorsum, second from mid-costa to tornus, third from costa to tornus parallel to termen ; cilia pale-fuscous with whitish points. Hindwings whitish-ochreous, towards termen suffused with pale-ochreous-fuscous ; cilia whitish.

Q., Eidsvold ; one specimen received from Dr. T, Bancroft.

Gen. Aproöpta *nov.*

ἀπροοπτος, unforseen.

Antennæ about $\frac{2}{3}$; basal joint stout, without pecten ; in ♂ with fascicles of long cilia. Palpi moderately long, recurved ; second joint not reaching base of antennæ, thickened with smoothly appressed scales ; terminal joint short ($\frac{1}{2}$), slender, acute. Forewings with 2 separate from angle, 3 and 4 approximated from above angle, 7 and 8 stalked, 7 to apex. Hindwings twice as broad as forewings, apex obtuse, termen very slightly sinuate ; 3 and 4 stalked, 5 somewhat approximated to 4 at origin, 6 and 7 stalked, 8 approximated to end of cell.

The structure of the ♂ antennæ is one very unusual in this subfamily.

Aproopta melanchlæna *n. sp.*

μελαγχλαινος, black-cloaked.

♂. 24 mm. Head and thorax blackish. Palpi blackish with a few whitish scales. Antennæ blackish; ciliations in ♂ 3. Abdomen pale-grey. Legs fuscous; posterior pair whitish. Forewings rather narrow, costa gently arched, apex rounded, termen very obliquely rounded; blackish, towards termen with slight whitish admixture; cilia blackish. Hindwings and cilia pale-grey.

Type in Coll. Goldfinch.

N.S.W., Katoomba, in October; one specimen.

TICK RESISTANCE IN CATTLE: A REPLY TO CRITICISM.

By Prof. T. Harvey Johnston, M.A., D.Sc., and M. J. Bancroft, B.Sc., Walter and Eliza Hall Fellow in Economic Biology, University, Brisbane.

Last year we published a paper on tick resistance in cattle (J. and B. 1918), that portion of it relating to the claims of Mr. Munro Hull, of Eumundi, and Mr. Pound's comments regarding them having been abstracted by us and issued as a report in the Queensland Agricultural Journal of January last (J. and B. 1919). The latter was adversely commented on by Mr. Pound (1919), to whose criticisms we now propose to reply.*

We would like to point out, as we did last year, that we were not concerned with Mr. Hull's letters and reports written many years ago, but took as the basis of our inquiry the official statement of his claims and Mr. Pound's findings regarding them, as set out in Parliamentary Papers, 1914, vol. 2, p. 941, and in the Report of the Select Committee issued 17th December, 1915.

In our report (1919, p. 33) we stated that when the animals were under conditions of natural infestation our observations led us to agree with certain of Mr. Hull's contentions which were numbered 1, 2, and 3 in that report (p. 31).

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*The greater part of the present reply was given before the Royal Society of Queensland in April last year, when the paper (J. and B., 1918) was under discussion. In order to reply to certain objections then raised by Mr. Pound, we deferred publishing this paper until we were able to answer them.

These claims as set out read as follows :—

1. That these cattle never mature more than a few odd female ticks during the course of a year—a total of from 50 to 100 per year being the highest estimate, though the animals are regularly infested (naturally) by myriads of larvæ, the majority of which die while still very minute.
2. That as a result of such freedom from developing ticks, these cattle do not require any attention as regards ticks, and may be turned out on any country for indefinite periods without experiencing tick worry, and consequently present a clean, sleek appearance.
3. That this peculiarity is transmissible to other cattle by "contact" (*i.e.*, natural infection) and by vaccination, and is transmitted in every case to the progeny of such animals, but does not manifest its presence in the offspring until after the first year of life.

With regard to No. 1, Mr. Pound stated that "the observations as conducted on the question as to the number of ticks found on cattle at Mr. Munro Hull's farm at Eumundi must be regarded as only of relative value compared with the definite and positive results obtained by Messrs. Watson and Carmody at Yeerongpilly, on which occasion the cattle were not artifically infested, the animals having been brought from a ticky paddock and placed in stalls for convenient and exact observations." Judging from these remarks, he is evidently quite satisfied that the report of Messrs. Watson and Carmody is a sufficient answer to this claim. We propose to examine that report in detail.

On May 12th, 1914, the animals were placed along with ticky stock in a paddock belonging to a Mr. Chambers, of Yeerongpilly, whose property was adjacent to Mr. Pound's laboratory, where on June 8th they were brought into stalls, having been for 27 days exposed to infection.

The following results are tabulated from Watson's reports (R.S.C., pp. 31-2) regarding "Tinkerbell," one of the two animals; since in the other case, "Clover," no details were given. Only the number of mature ticks actually collected was recorded, mention having been made, however, that a number were also seen on the floor. Mr. Watson's record was checked on each occasion by Mr. Carmody, a stock inspector of the Agricultural Department.

Date.	Days from date of commencement of exposure to infestation.	Days from date of placing in stalls.	No. of inspections.	No. of fully developed ticks found on animal.	Remarks.
June 8th	28	—	1	0	12 ticks 14 to 16 days old seen; numerous small ticks.
June 9th	29	1	0	—	
June 10th	30	2	1	1	
June 11th	31	3	1	1	15-18 ticks from 16-18 days old.
June 12th	32	4	1	3	Numerous small ticks.
June 13th	33	5	0	—	
June 14th	34	6	1	2	
June 15th	35	7	1	3	
June 16th	36	8	—	0	Numerous ticks developing.
June 17th	37	9	1	3	
June 18th	38	10	1	7	
June 19th	39	11	2	10	
June 20th	40	12	0	—	
June 21st	41	13	0	—	
June 22nd	42	14	2	37	
June 23rd	43	15	2	32	
June 24th	44	16	2	65	
June 25th	45	17	2	66	
June 26th	46	18	2	64	
June 27th	47	19	1	67	
June 28th	48	20	0	—	No inspection.
June 29th	49	21	2	100	
June 30th	50	22	2	135	
July 1st	51	23	2	126	
July 2nd	52	24	1	84	
July 3rd	53	25	1	45	

Total collected, 851.

Mr. Chambers, in whose paddocks—admitted by both Mr. Pound and himself to be ticky—these animals had been pastured between the 12th May and 8th June, stated that no ticks were found on them. That they must have been practically tick free is shown by Mr. Watson's findings, he having been able to collect thirty mature ticks as a result of ten separate examinations between the 8th and 19th June, each examination having been stated as lasting about half an hour. It was remarked, however, that a few mature ticks were found on the floor. Even supposing that as many had dropped off as there were found on the animal, it would show that the cow under inspection and kept in a stall after a sojourn in a ticky paddock, had for some reason or another, not matured more than a few ticks during that period.

During the first ten days there were actually taken from the animal only 20 engorged ticks. During the next ten days the total was 341, while in the succeeding five days 490 were collected. In other words, during the first nineteen days of stalling, 361 were obtained. There was no inspection on the 20th day. From the 21st to the 25th day inclusive, there were eight inspections and about 150 more ticks were obtained during that time than during the whole of the preceding period. The maximum number was collected on the 22nd day and nearly as many on the 23rd day.

Schroeder states that 22 days is the normal parasitic period of a cattle tick in the U.S.A., the limits being 15 to 40 days. Graybill reported that it extended from 22 to 25 days in May and June in the southern part of the U.S.A., and from 25 to 34 in February and March, *i.e.*, during late winter. The climate in the American regions referred to is much colder than that of Brisbane, hence the tick parasitic periods are likely to be longer than they are in our locality. Experimental work carried out in Southern Queensland under the direction of the senior author has shown that the periods average approximately 22 or 23 days from April to May, and 24 or 25 days in June and early July. The available evidence then points to the experimental animal having become parasitised by larval ticks at about the time of, or immediately after, stalling.

Mr. Watson's report, in our opinion, proved that the animal was able to mature ticks when confined in a stall. It also shows quite conclusively that extremely few ticks became engorged in spite of the cow's prolonged sojourn under natural conditions of infestation in an admittedly ticky paddock.

Mr. Pound ignores the evidence of various observers who had had the same animals under their care (see our previous paper, 1918, pp. 243-7

We feel justified in reiterating our previous remark (1918, p. 247), that the evidence before us was sufficient to justify the statement that under conditions of ordinary natural infestation, the test cattle did not mature ticks in sufficient numbers to require any treatment to prevent tick worry (claim No. 2).

The report criticised by Mr. Pound was merely an abstract from the larger paper and owing to inadvertence an error was introduced. We do not agree with claim No. 3 in the short report (1919, p. 31). That such is the case is readily seen by a perusal of the report (p. 34-5), as well as Mr. Pound's remarks relating to the transmissibility of tick resistance.* We know that disease resistance is a hereditarily transmissible quality both in plants** and animals.†

Mr. Pound (p. 38) states that our remarks relating to the death of one of the animals (Clover) were not borne out by Mr. Hull's letters, and yet he goes on to say (p. 39) that he was greatly surprised to find that the animal which was returned to him was not Clover but Tinkerbell. We have already referred to the confusion regarding the two animals (1918, p. 247). We have a letter from Mr. H. A. Jones, Secretary of the Wide Bay and Burnett Pastoral and Agricultural Society, dated 1st February, 1916, containing a report from Messrs. Butcher and Rex who had the two animals under their care. The names of the two cows were transposed. "Tinkerbell" (*i.e.*, the real Clover), as a result of drought, became low in condition and badly infested with ticks, a minor accident, together with age and poverty, causing her death.

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*In reference to our suggestion (1918) that the serum of tick resistant cattle may differ from that of non-resistant animals, it is of interest to note that Hall and Wigdor (Arch. Internal Medicine, Nov., 1918, 22, pp. 601-9), in their experimental study of serum therapy in Trichinosis refer to the effects of injecting serum from recovered individuals as a means of counteracting trichina poisoning.

**Disease resistance in plants has been made use of economically, *e.g.*, Phylloxera resistant stocks for grapes, rust resistance in wheat, etc. See also Botanical Abstracts 1 (4), Dec., 1918, p. 155, No. 903.

†Metchinkoff, Immunity in Infective Diseases, Cambr. Univ. Press, 1907, p. 445, etc.

Mr. Pound (p. 39), stated that on the return of " Tinkerbell " to Yeerongpilly, after careful search, he failed to find any ticks, but that there was ample evidence of recent heavy tick infestation, also positive evidence that the cow had been treated with some arsenical compound. We have a letter from the Secretary of the above named Pastoral and Agricultural Society stating that the local Stock Inspector would not permit the animal to travel unless dipped. Consequently the presence of arsenic would be expected.

In order to meet objections to our remarks relating to Mr. Hull's so-called " winter ticks " and to the temperatures of his animals during winter, one of us examined his herd in July last. The shade temperatures during the afternoon on 28th July were 72.2 degrees F., at 2 p.m., and 67 at 4 p.m. The animals were either feeding quietly or ruminating in the paddocks, and were not disturbed in any way, so that the temperatures registered per vaginam can be regarded as normal. Opportunity was taken to inspect the cattle for the presence of exudate and ticks. Those marked " R " are considered by Mr. Hull to be tick resistant.

Kittiwake, R., 102.4, no trace of ticks other than nymphs and larvae. dried exudate plentiful ; Sprite, R., 101.6, a few small pale immature ticks ; Lotus, R., 102.1, a few engorged ticks present ; Wallum, R., 99.9, no ticks seen ; Dawn, 103.0 (previously resistant), poor condition, numerous fully engorged ticks ; Wallum's steer, ?R., 102.3, a few developing ticks noticed ; Tinkerbell, 4., R., 101.8, no ticks seen ; Yellow 3, R., 103.8, just about to calve, traces of exudate ; Spot, 102.3, a number of engorged ticks present ; Donkey, R., 102.1, traces of exudate, very few young ticks seen, no adults ; Seagull, R., 102.4, clean, traces of exudate ; Brownie, 102.4, engorged ticks present ; Sweetbriar, R., 101.6, clean, except for the presence of some early nymphs, small amount of exudate ; Peewee, R., 102.7, clean ; Isis, R., 102.1, a few ticks seen ; Squib, R., 102.2, clean ; Greedy, 103.8, poor condition, calved one week previously, engorged ticks present, also exudate, normally a resistant animal but reported by Mr. Hull as ticky this year ; Primula (from Primrose) R., 102.9, clean ; Baby, R., 102.0, dried exudate present, also a few ticks ; Pride, 102.6, ticky : Fairy, R., 102.8, clean, traces of exudate.

It will be seen then that Mr. Hull's contention that his resistant animals have a normal temperature one to 2½ degrees higher than the others during the winter months, is not borne out by our observations, as the variations noticed fall within the normal limits. Again, his contention that, during the winter months, such resistant cattle allow more ticks to mature on them than during summer, while the reverse is the case with non-resisting stock, is also not verified by our observations.

Mr. A. W. Johnston, of Cowleigh, Thagoona, forwarded us (31/5/19), a report on the animals which had been running for so long on Mr. Hull's property (J. and B., 1918, p. 263-5) On the red heifer R.O.8 and the red and white R.O.8 only an odd tick was to be seen at any time. J.4.V. was in the same condition though running regularly with a herd that was badly tick infested. None of these three animals had at any time since their return carried ticks in sufficient numbers to warrant dipping, though they had been so treated along with the rest of the herd. The remaining two heifers T.3.O. were not at the time available for inspection, but Mr. Johnston stated that when last seen they were decidedly less infested than the remainder of the herd in whose company they were. The exudate referred to in our previous paper had not been noticed. We are not at present in a position to comment on this report.

Mr. I. Titmarsh, Carrington, Kalbar, wrote in September last stating that he had reluctantly followed Mr. Hull's ideas, and had not dipped his herd for the past two years, yet his cows and calves were free from ticks. Ticky stock had been introduced from elsewhere, but after having been on his property for a year had become tick-free.

1918—Johnston, T. H., and Bancroft, M. J., A tick resistant condition in cattle, P.R.S., Q'land, 30 (17), 1918, pp. 219-317 (summary republished in "The cattle tick pest" Bull. 13, Advisory Council of Science and Industry, 1919, p. 39).

1919—Johnston, T. H. and Bancroft, M. J., Report on Mr. Munro Hull's claims regarding tick resisting cattle. Q'land Agric. Jour., January, 1919, pp. 31-35.

1919—Pound, C. J., Comments (on Johnston and Bancroft, 1919), Q'land Agric. Journ. January, 1919, pp. 36-39.

1915—R.S.C. Report on the Select Committee into the alleged discovery of a remedy for cattle tick, etc. Parliamentary Papers. Govt. Printer, Brisbane, December, 1915.

THE LIFE HISTORIES OF *MUSCA AUSTRALIS* MACQ., AND *M. VETUSTISSIMA* WALKER.

By Professor T. H. Johnston, M.A., D.Sc., and M. J. Bancroft, B.Sc., Walter and Eliza Hall Fellow in Economic Biology, University, Brisbane.

(26 Text-figures).

For some time past we have been engaged in the study of Australian diptera as transmitters of certain nematode parasites of stock. This has involved the dissection of large numbers of adults, pupae, and larvae of various species, and has necessitated a study of the life history of the commoner forms in the district (Eidsvold, Upper Burnett River, Queensland) where the work has been carried out.

On account of the inadequacy of the available descriptions of the two "bush flies" especially dealt with in this paper, we have deemed it advisable to supplement them and to add figures of the two sexes of each species.

In regard to these two species of flies, *Musca australis* Macq. and *M. vetustissima* Walker, we may state that in the Upper Burnett district they are both abundant during the summer, but during the winter the latter is rarely seen, while the former remains fairly common except during midwinter, when it becomes scarce. Neither of them occurs indoors unless attracted by the presence of dead animal matter, etc., *e.g.*, in the laboratory.

Certain other flies found in the district may be referred to. Many of the local Tabanids have been worked out by E. E. Austen, of the British Museum, and by F. H. Taylor, late of the Australian Institute of Tropical Medicine. Both of these dipterologists have kindly identified some of the flies referred to in this list. *Musca* *domestica* is common in houses, but *Fannia scalaris* and *F. canicularis* have not yet been noticed, nor has *Muscina stabulans*, though the last two-named occur in Brisbane. *Stomoxys calcitrans* is decidedly scarce in the bush, but common in the vicinity of stables in certain outlying districts. Though there are plenty of suitable breeding places in Eidsvold, yet specimens of the species have not been noticed in the township Amongst blowflies one notes that *Anastellorhina augur* Fabr. (syn. *Calliphora oceaniae*) is very common right through the year, while others which occur in the district are *Neocalliphora ochracea*, *Pollenia stygia* Fabr. (syn. *Calliphora villosa*), and the metallic blowflies *Lucilia sericata*, *Calliphora incisuralis*, *Pycnosoma rufifacies* and *P. varipes*. Belonging to the Anthomyidæ are *Ophyra nigra*; also a small black *Fannia* sp., very commonly seen on stock; and, in addition, a slightly larger slaty grey species (*Fannia* sp.) which is rather uncommon—both of these breeding in cowdung, while *Oph. nigra* is one of the "sheep maggot flies." There is also a rather small blowfly (*Lasiopyrellia*) of a bright metallic green colour (like that of a *Pycnosoma*) when alive, but changing to a fine cobalt blue in from one to two days after death. This species is rather broader and shorter than typical examples of *M. australis*. It deposits its eggs in cow manure. Also ovipositing in the same material is a very small blowfly (probably a *Pseudopyrellia*) resembling the *Lasiopyrellia* in colouration when alive, but when dead the blue is less intense and slightly greenish, and the wings more iridescent. This fly possesses habits similar to those of *Pseudopyrellia australis* mentioned by Cleland (1913, p. 566). *Sarcophaga misera* Walker is common, especially during summer. In addition to the above one might mention the presence of a Muscid, *Musca* sp. indet., which is rare in the locality and lays its eggs in horse dung.

MUSCA AUSTRALIS *Macquart.**

(Text-figures 1, 4, 7, 10, 12, 16, 18, 20, 23, 24, 25.)

The original description (Macquart, 1842, p. 152), is as follows :—

*See Addendum regarding this specific name.

Musca australis, Nob. Voyage autour du monde, de M. Leguillon. ♂ Fronte sublarga. ♀ Cinerea. Thorace quadrivittata. Abdomine nigro tessellato. Squamis flavidis. Nervo transverso cellulae discoidalis subrecto. (Tab. 20, fig. 10).

Long. 31. ♀. Semblable à la *M. corvina* ; elle n'en diffère que par les cuillerons un peu jaunatres au lieu de blancs, et par la nervure terminale de la cellule discoidale des ailes, qui est presque droite au lieu de sinueuse.

Des îles Salomon et des îles Viti.

Male : Front etroit que dans le *M. corvina.* De plus, les mêmes différences specifiques que dans la femelle.

De Hobart-Town, dans la Tasmanie, et de Vanoo, aux îles Viti

Un individu ♀ a l'abdomen dépouillé de duvet. Une variété du mâle a l'abdomen fauve seulement sur une petite partie des côtes.

Une variété a l'abdomen fauve comme le mâle, avec une ligne dorsale noire.

The general colour is lighter than that of the house fly*. The normal length of both sexes is 7 mm. When at rest the wings of the male lie obliquely in relation to the plane of the body, the costa being raised : those of the female lie closer to the body.

General habits. The flies† frequent cattle and horses, clustering round the eyes, mouth and nostrils, and any

*To simplify comparisons we have taken as a standard description that given by Graham-Smith for Musca domestica, 1914, p. 19.

For our drawings and descriptions of colouration we have examined specimens with the posterior region of the animal towards the light. We deem it necessary to make this statement since if the insect be viewed with the light from the opposite quarter then very often the parts which were light coloured in the first instance become dark, and *vice versa.* This is particularly obvious in the case of the thoracic stripes but also holds good for certain other structures, including the frontal stripe and adjacent frons.

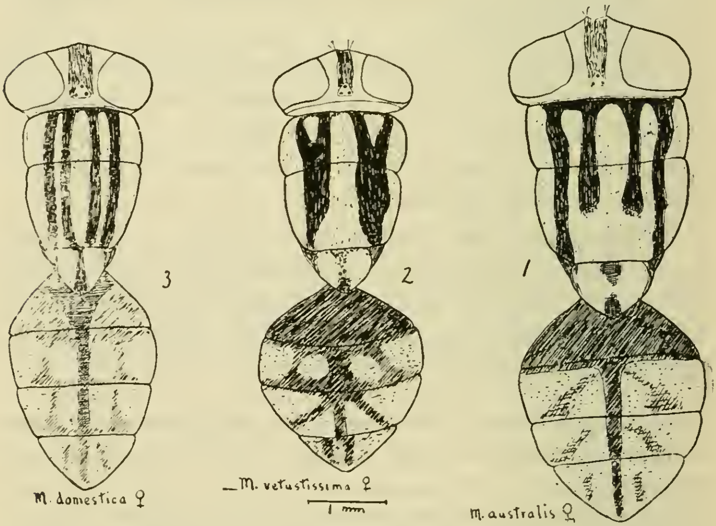
†These flies may be parasitised by larval mites, a red one probably *Acarus muscarum* Linn. and also a minute whitish species.

sore or abrasion of the skin. They suck the weat and mucus and also blood if a raw surface is available. They alight on fresh dung for feeding purposes as well as for the deposition of larvae.

Male.

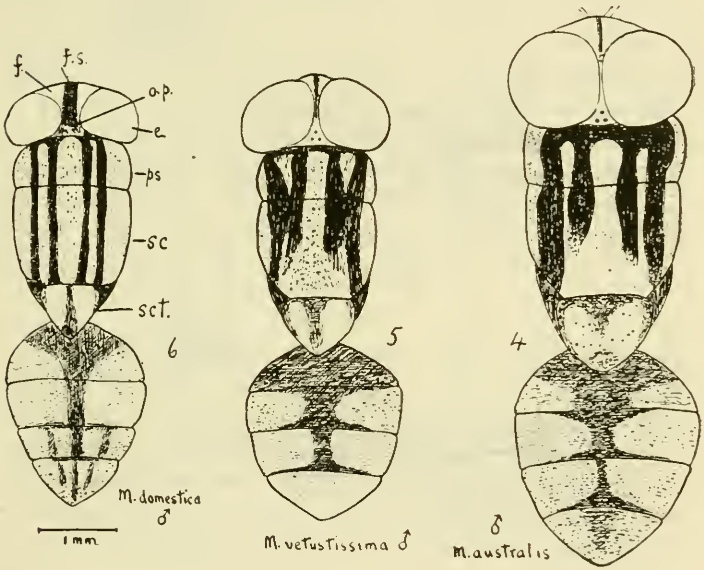
Head. The eyes practically touch for a considerable distance, the ocellar tubercle being closely hemmed in between the inner and posterior borders of the eyes and separated from them by a very narrow silvery stripe. The black frontal stripe is extremely narrow.

Frontal margin of the eye practically obliterated. Cheeks and face silvery. Antennae dark silvery-grey. Aristae black and feathered (fig. 10) very like those of the house fly. Palps black.



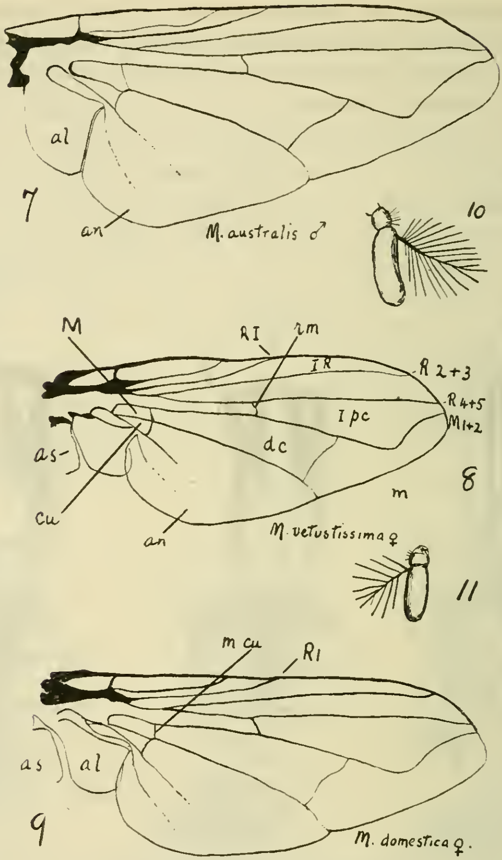
Thorax. If the light comes from the anterior end the general effect is black, but if viewed from the opposite quarter it is silver-grey with four well-defined black longitudinal bands, the outer ones on each side extending to the end of the scutum, whilst the two median bands reach to the vicinity of the middle of the scutum but may be continued a little further and may merge into the lateral lines.

The latter on the prescutum generally diverge outwardly (fig. 4). The scutellum is silvery-grey with a black triangular patch at its anterior border, the apex of the triangle directed backwards. There is also a faint dark marking at the posterior end of the scutellum. It is not proposed to refer to the chaetotaxy, though the fly is very hairy.



Wings. The wings are clear, and the veins pale brownish-yellow towards the base. The venation is figured in fig. 7. The wing is a stouter and broader structure than that of the house fly. The radial longitudinal nervure R 4+5 is nearly straight, as is also R 2+3.

Macquart (p. 153, pl. 20, fig. 10) states that the nerve of the discoidal cell, *i.e.*, the medial transverse nervure bounding the first medial cell, is almost straight. It is, however, slightly sinuous and approximates that of *M. domestica*. The medio-cubital transverse nervure is relatively long and more inclined than in *M. domestica*. The medial cell is somewhat differently shaped as will be seen on comparing figs. 7 and 9. The alula is relatively slightly larger than in the house fly.



EXPLANATION OF LETTERING.

a. anus; *ac.g.* accessory gland; *al.* alula; *an.* anal lobe of wing; *as.* antisquama; *a.sp.* process of anterior spiracle; *c.e.*. clear envelope surrounding process of anterior spiracle; *cg.g* conglobate gland; *c.r.* chitinous rim of spiracle; *cu.* cubital cell; *d.c.* discal cell (=first second-medial cell); *e.* eye; *f.* frons; *f.s.* frontal stripe; *M.* medial cell; *m.* medial transverse nervure (posterior cross vein); *M* 1+2 median longitudinal vein (fused first and second); *M.cu.* medio-cubital transverse nervure; *mus.* muscle; *n.c.* nurse cell of ovum; *o.* ovary *od.* oviduct; *od.c.* common oviduct; *o.f.* ovarian follicles; *o.p.* ocellar plate or tubercle with three ocelli; *o.t.* so-called optic tubercle; *ov.* ovum; *ov.d.* developing embryo. *I.pc.* 5th radical cell; *ps.* prescutum; *R I.* first radial longitudinal vein; *R* 2+3 fused 2nd and 3rd rad. longit. vein; *R* 4+5 fused 4th and 5th; *r.m.* radial median crossvein (discal nervure, anterior transverse vein); *S* 2 spiracle of second instar; *S* 3. spiracle of third instar; *sc.* scutum; *sct.* scutellum; *sp.* spermatheca; *sp.p.* spiniferous pads; *s.s.* spiracular slits; *tr.* trachea; *ut.* uterus.

The squame is pale grey posteriorly shading to yellowish-grey anteriorly. The halteres are pale yellow and are covered by the squame.

Legs. The legs are very dark brown, practically black, with pale foot cushions.

Abdomen. The general colour viewed dorsally from behind is light yellowish-brown. When viewed microscopically the margins are seen to be silvery with prominent brown golden blotches laterally separating the silvery margins. The anterior part and mid-dorsal portion of the first segment are dark brown, the remainder of segment a paler brown. Succeeding segments are dark brown along the mid line but the colouration is not so pronounced in the last segment. The under surface of the abdomen is yellow with dark brown markings at the posterior end in the vicinity of the genital aperture.

Female.

The female differs from the male in the following particulars :—The eyes are separated by a space equal to about a-third of the width of the head, this inter-ocular region being occupied by the wide pale golden frontal margins and the wide dark brown frontal stripe. The black bands on the thorax are rather narrower than those of the male and consequently the general colouration is lighter.

The first abdominal segment dorsally is practically black, while there is a median dark, more or less continuous, band on the remaining segments with dark brown blotches lying laterally. The general effect is shewn in fig. 1. Ventrally the colouration resembles that of the male.

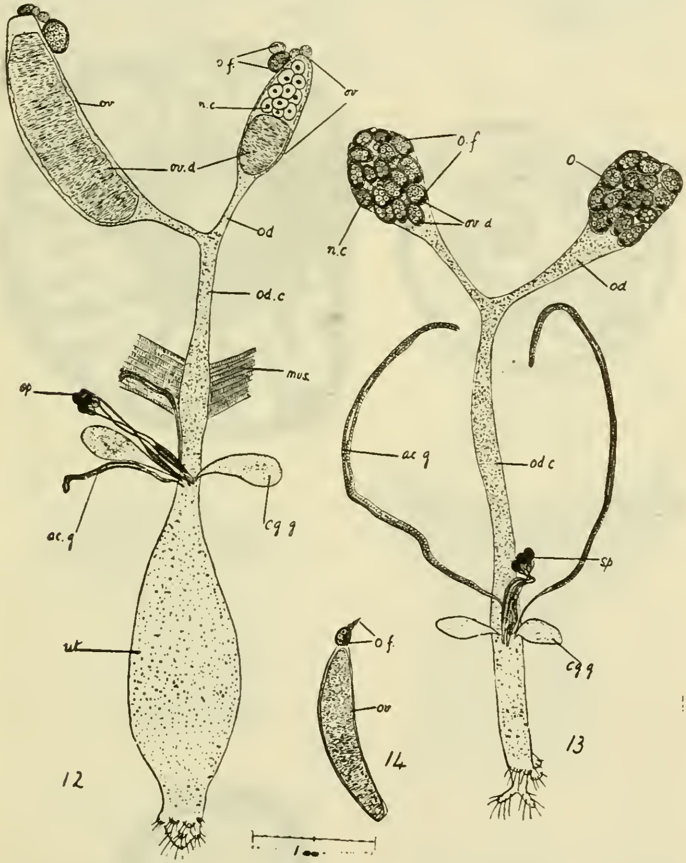
Breeding habits. The species is a larviparous one, one larva being deposited at each birth. The flies frequent isolated patches of fresh cow-dung for larviposition. They will also deposit larvae on horse-dung, but less frequently as the latter substance is usually drier, coarser and more friable, therefore forming a less suitable nidus for the developing larvae. The flies show considerable discrimination in the choice of a suitable patch of cow-dung, selecting that which is of thinner consistency in preference to that which, though fresh, is naturally drier and harder. Thus scores of flies will visit the former for larviposition in comparison with one or two visiting the latter. This instinct is of great value to a fly which has to contend with excessive heat and aridity.

We have found *M. australis* breeding naturally only in cow and horse dung. Under experimental conditions, flies deposited larvae on wallaby dung and larvae reared at first in cow manure, when transferred to wallaby faeces, bred out. We do not think that the pellets of wallaby dung under ordinary conditions serve as a suitable nidus, but when they become broken up and moistened with water, then, as we have observed, larvae can be reared to maturity from such material.

We have bred out specimens from bird excrement collected on the wet sand along the edge of the Burnett River, early larvae having first been transferred to a mass of such material from cow manure. Fowlyard manure does not seem to offer a suitable nidus for *M. australis*, though *M. domestica* as well as blowflies visit it for ovi- or larviposition.

As cattle and horses have been introduced into Australia, some other material than their manure must previously have served as the natural breeding place of *M. australis* as well as *M. vetustissima*. Probably it breeds in decomposing vegetation, as the latter under the name of *M. corvina* has been reported to do.

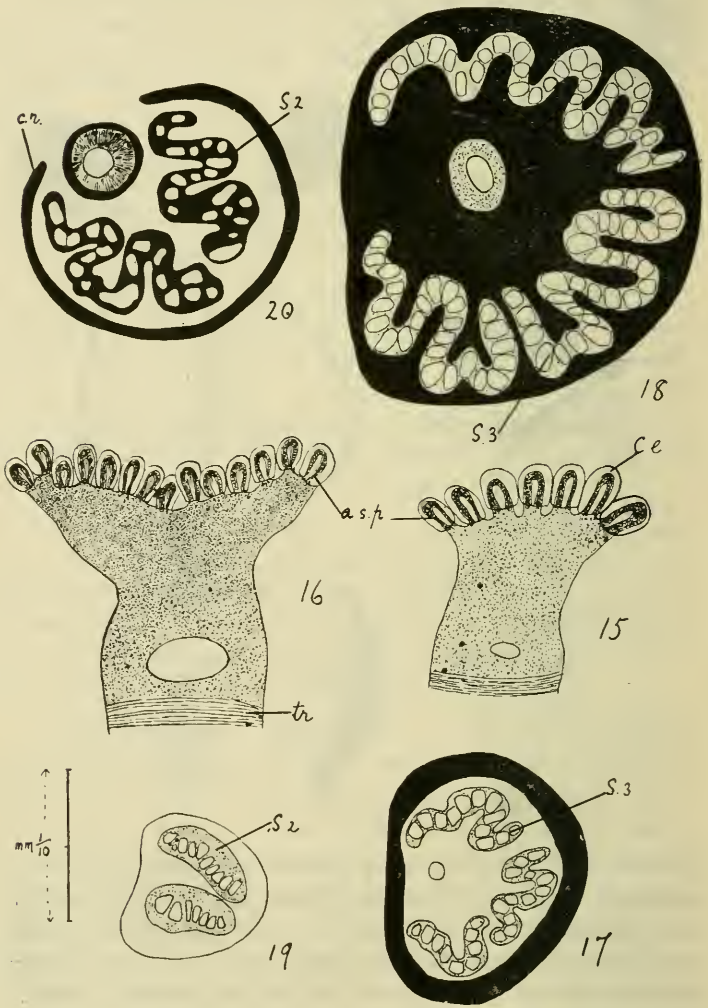
Genital system. The genitalia of the female differ from those of *M. domestica* and resemble those of *M. bezzii* described and figured by Patton and Cragg (1913, p. 140, and pl. xxx, fig. 2). Each ovary consists of a single ovariole ; the ovarioles functioning alternately in passing an ovum into the uterus or terminal portion of the common oviduct which is greatly enlarged in this species. The relationship of the various parts will be best understood by reference to fig. 12. The two conglobate glands or accessory copulatory vesicles are comparatively large while the accessory glands are relatively much shorter than those of *M. domestica* (Hewitt., p. 49, figs. 20, 21), being of about the same length as the three spermathecae. The latter have the same general arrangement and structure as in *M. domestica.* Attached to the common oviduct above the point of entry of the various accessory glands there is a strong band of muscle which probably assists in supporting the more posteriorly situated parts of the system.



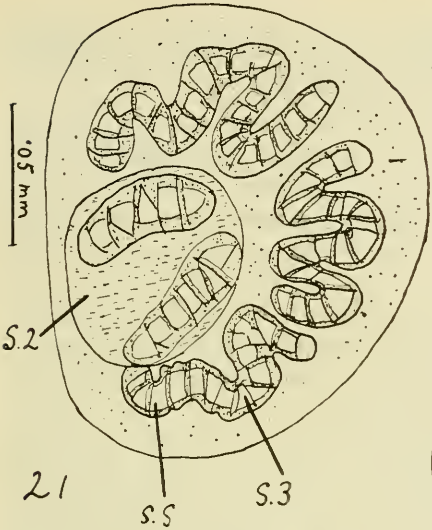
The wall of the uterus is composed of large cells with prominent nuclei, the cell cytoplasm not staining readily with Delafield's haematoxylin. If the uterus be crushed a fat-like emulsion is obtained, this probably being material for the nourishment of the developing embryo. The ovipositor is markedly abbreviated.

Larva. The first larval instar is passed through within the uterus of the parent and measures about 1.5 mm. in length.

Its posterior spiracles are in form of two small dark-brown projections each with an opening at its summit. There are no anterior spiracles. The second instar is marked by the appearance of the anterior spiracles each of which contains 11 to 14 processes (fig. 16). The posterior spiracles are much larger, a black chitinous D-shaped structure



appearing round the original knob, and containing two sinuous slits (fig. 20). At this stage the larva is deposited by the female, but is still enclosed in its thin, delicate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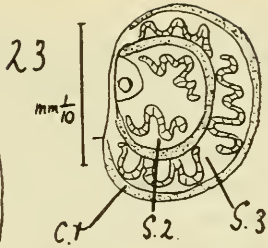
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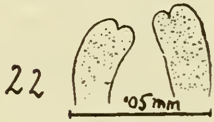
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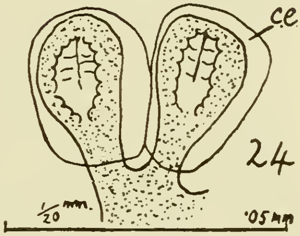
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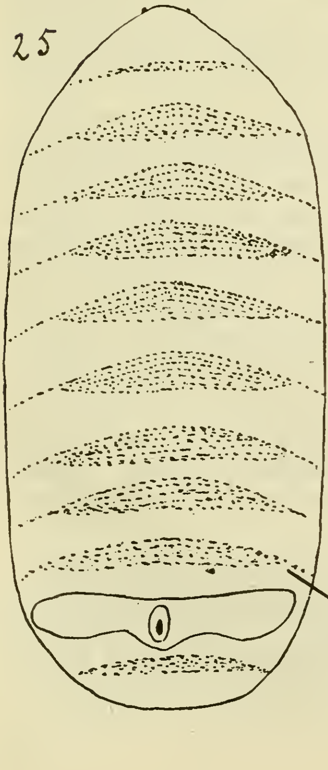
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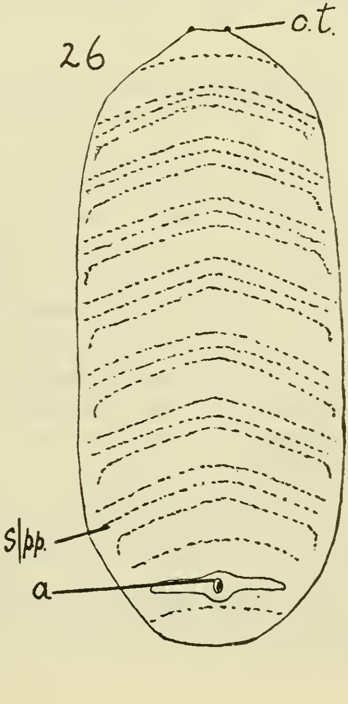
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eggshell.* A few active movements of the larva, however, suffice to split the shell longitudinally, and the escaping larva burrows rapidly into the dung.

In hot weather the larvae grow very rapidly and have usually finished feeding by the end of the second day and have pupated by the third day after deposition. Fully formed pupae have been found occasionally on the second day after deposition. In winter the larval stage is prolonged to about six days. During the beginning of October, when the larval stage was occupying four days., the following periods were noticed and measurements of the larvae made. The larvae were fixed in nearly boiling water and preserved in formalin.

The larva at birth measures 3.5 mm. long by 1 mm. and is in the second instar. During the first 24 hours it grows enormously and at the end of that period measures 7.5 to 9 mm. by 1.5 to 2 mm., by which time it is usually moulting. The anterior spiracles increase in size and each contains 13-17 processes ; the posterior spiracles also increase greatly in size and issue in three much convoluted slits (fig. 18). The chitin is thicker and blacker. These large black spiracles are rather characteristic of the larva. On the second day it measures 11 mm. by 2.5 mm. attaining on the third day its maximum size, now measuring 11.5-13 mm. in length by 2.5 to 3 mm. in breadth ; on the fourth day the larva is mature, ceases feeding and shrinks somewhat in size, measuring 10-11 by 2.5 mm. ; the alimentary tract becomes emptied of food and the larva assumes a pale yellow colour with a deeper yellow patch on the anterior dorsal surface. At this stage the larva burrows up to the surface of the dung, then retreats a short distance—about half an inch—in its burrow and pupates, with the hed end pointing outward. Under laboratory conditions the larvae will leave the dung and pupate in damp sand.

The puparium measures 7 to 7.5 mm. by 2.5 to 3 mm., and is at first yellowish grey in colour becoming dark grey

*In one case an *egg* was laid in captivity. This, however, is quite exceptional.

as the development of the fly proceeds. When the imago emerges, it crawls out of the burrow, pushing any loose debris aside by inflating and deflating its ptilinal sac. In summer at Eidsvold, Burnett River, Queensland, the pupation period is from 9-15 days ; in winter 27-32 days These periods were observed under laboratory conditions without artificial heating and are probably longer than would obtain under natural conditions owing to the higher day temperatures outside.

Of a given batch of larvae deposited by flies on the same day, females will, as a rule, be the first to emerge, then follows a period in which both males and females appear, and then a period in which only males emerge. There is usually a slight preponderance of males among bred flies, thus for over 300 flies bred out, the percentages were, males 57 % and females 43 %. When flies are captured on stock the males are decidedly in the minority, since out of over 500 captured flies, only 7 % were males. Froggatt's (1916, p. 10) observations regarding blowflies in New South Wales were somewhat similar, he having found that among captured flies only about 3 % were males.

Often large numbers of flies may be bred from a single isolated dropping of cowdung ; thus one such deposit yielded 120 flies (70 males and 50 females). It must be remembered that a female fly deposits only one larva at a time, hence at least 120 females must have visited the mass for larviposition. Flies which have been bred and kept in captivity have never been observed to copulate or deposit larvae though both sexes were present. Perhaps copulation does not occur under such circumstances, as sperms have not been found in the spermathecae of such flies. In one insect which was kept in captivity for two months two equally developed ova were found in each ovary but there was no larva in the uterus. Attempts to discover the period between emergence and larviposition, and also between successive larvipositions have not been successful. Captured female flies will readily deposit one larva, but have not been observed to do so a second time.

Particular notice of the number of follicles was not taken but in the specimen drawn (fig. 12) there was a larva in the uterus, a developing egg and four follicles on each side. Thus the total was eleven, the twelfth must have been already born. We may then assume that the possible number of larvipositions is at least twelve.

Patton and Cragg (1913, p. 130-139) discuss the pupiparous habit among flies. There are three distinct degrees of this habit. In many Tachinids which are not blood-suckers the larvae are delivered almost as soon as they hatch out of the egg. They undergo little or no development in the uterus and are laid in a large batch exactly as eggs are laid. The next degree is instanced by two cases *M. corvina* Fab. var. *vivipara* Portschinski and *M. bezzii* Patton and Cragg which are both blood feeders. Here the larva is retained and nourished for part of its life in the genital tract of the female but is deposited while still young and completes its growth under conditions similar to those of its allies. We may now add *M. australis* to the category. In the third degree the larva is retained until it is ready to pupate, *e.g.*, *Glossina* and *Hippobosca*.

The authors then go on to discuss the reasons for the acceleration of the larval stages. In the Tachinids it is due to the fact that the food is usually the living larvae of other insects. The larval stage of the parasite must be complete before, or soon after, the host pupates lest the food supply be exhausted. In the other two cases there is no such obvious explanation, and it is probable that two factors enter into it. Firstly, the advantage of having the young larva protected within the body of the parent; and, secondly, the rich food supply obtained by blood sucking insects appear to have some relation to the pupiparous habit. The number of pupiparous forms is high in comparison with the number of blood-sucking forms. The authors state that "the subject is a very obscure one, but the association of the blood-sucking habit with the pupiparous habit is clear enough, and one should always be on the look out for larviparous forms among those known to suck blood, whether they are biting flies or not." *M. australis* is not dependent on blood for a living, but lives on any secretion; it will, however, greedily suck tke blood and juices from a sore or wound.

We would like to point out that in the case of blowflies the larviparous habit is not necessarily associated with blood-sucking. Besides, mosquitoes and Tabanids, which are blood-suckers, do not practise larviposition.

MUSCA VETUSTISSIMA *Walker.*

(Text-figures 2, 5, 8, 11, 13, 14, 15, 17, 19, 21, 22, 26.)

As far as we are aware the male has not been described. The following is Walker's original description (1849, p. 902) of the female. It has also been quoted by Cleland (1913, p. 18-19).

" *Musca vetustissima* n.s. fem.—Cana, capite albo micante, thoraci vittis duabus latis nigris, abdomine cano-cinereo, palpis nigris, antennis piceis basi nigris, pedibus piceis, alis limpidis basi albis. Body hoary, clothed with black hairs and bristles; head adorned with white lustre; a black stripe between the eyelets and the feelers; epistoma not prominent; sides of the face feathered with bristles at the base; eyes red; fore part flat, its facets a little larger than those elsewhere; sucker pitchy, clothed with tawny hairs; palpi black, beset with black bristles; feelers black, a little shorter than the face; third joint pitchy, linear, rounded at the top, about thrice the length of the second joint; chest adorned with two broad black stripes; abdomen obconical, grey, with hoary reflections, a little broader, but not longer than the chest; legs pitchy, clothed with black hairs and bristles; foot-cushions tawny; wings colourless white at the base; wing-ribs and vein pale tawny; veins darker towards the tips; tip cross-vein forming an obtuse angle with the fourth longitudinal vein, very slightly inclined inwards along the whole length, joining the border a little above the tip of the wing; lower cross-vein nearly straight; squame white; poisers pale yellow. Length of the body 2 lines; of the wings 4 lines. New Holland. . . . ."

M. vetustissima is a fly with a dark body and very lightly coloured abdomen in the case of the male, but with a dusky abdomen in the female. The length of a normal male or female is about 6 mm. though one may frequently meet with very small specimens ranging in length from 3.5 mm. upwards. The length given by Walker in his original account suggests that he was dealing with under-sized material.

In the case of the female the wings, when at rest, overlap to a greater extent than they do in *M. australis*, whereas the position is alike in the males of both species.

Male.

Head. The eyes are very close, particularly in one region where they are separated only by the frontal stripe, the later being dark grey. Face and frontal region silvery but the latter does not extend dorsally beyond the point where the eyes approximate most closely ; it is therefore practically unrepresented in the region of the ocellar tubercle. Antennæ brown with silvery tints. Arista (fig. 11) plumose somewhat as in *M. domestica*. Palps black.

Thorax. The thorax is dark and shiny when lighted from the front. When the light falls on it posteriorly broad black bands can be seen. There are really four of these but the two of each side become more or less fused so that it is only in the prescutum that the four are usually recognisable. In the scutum there is a very broad band on each side especially anteriorly, while in the posterior part of scutum only the lateral band of either side is represented, These bands are joined together in the extreme anterior end of the prescutum. The central silver-grey band is variable in form. its sides being at times subparallel, while at other times they converge anteriorly so that the stripe resembles an elongate triangle. One then usually recognises the central silver-grey band, a lateral silver-grey band on either side and vestiges of silver-grey bands in the anterior part of the prescutum—one on either side. The scutellum has a darker patch in its anterior region and one at its extremity as well as a lateral pair (fig. 5).

Wings (fig. 8). The wings are clear throughout. Each is relatively shorter than *M. domestica*. The nervure R 4+5 is almost straight like that of *M. australis*. The first posterior cell is relatively shorter and the distal bent portion of nervure M 1+2 is rather more bent than in *M. domestica*, while the angle approaches much more nearly to the hinder border of the wing. The median transverse vein is almost straight. The discal nervure is distinctly curved with the concavity facing towards the base of the wing. The alula is rather more rhomboidal than that of *M. domestica.* The squame is very pale or whitish. Halteres are long and yellowish. The legs are black.

Abdomen. The first segment is black with colouration extending backwardly as in fig. 5, forming a fairly broad median stripe with lateral extensions in the hinder portion of each segment, these varying in different individuals. The greater part of the dorsum of the abdomen is of a pale golden hue which stands out in sharp contrast with the black median band. The abdomen is densely setose. Ventrally it is yellowish with black colouration in the region of the genital aperture.

Female.

The general appearance of the female is markedly different from that of the male, chiefly on account of the tessellated appearance of the abdomen dorsally, while ventrally it has a more or less uniform smoky-grey colour. The thoracic region is distinctly greyer. The fly then appears to have a rather lighter coloured thorax and a darker abdomen than the male. The main points of difference are as follows: Eyes widely separated by a distance approximating a-third of the width of the head; a broad frontal stripe about half the width of the area between the eyes: the frontal margins extending upwards on either side of the frontal stripe downwards as a very distinct silvery band on either side of the antennæ.

Thorax. The thoracic markings are arranged much the same as in the male, similar variations also being met with (fig. 2).

Abdomen. The markings on the dorsal surface of the abdomen are characteristic—their arrangement being indicated in fig 2. The first segment is black On succeeding segments there is a median dorsal stripe resembling that of the male, but there is laterally on each segment a dark band extending somewhat obliquely from the anterior to the posterior margin of each segment. The pigment patch on the first segment commonly invades the anterior portion of the succeeding segment.

General Habits. Like *M. australis* this species lives in association with cattle and horses. It is, however, a more troublesome fly to man, attaching itself to his person and making persistent attempts to reach the eyes. Dr. Cleland (1913, p. 565) has described the habits of this fly, which is essentially an outdoor species and is very rarely found within the house. It has been found in abundance feeding on the blood and pus from sores on the heads of sheep. If one ventures outside in the warm weather this species soon attaches itself to one's person and that part of one's clothing (especially if black) which is sheltered from the wind may be covered with a dense mass of these insects. They render themselves especially annoying by hovering around and finding their way into one's eyes, nose and mouth. The abundance of the fly makes it likely that if epidemic conjunctivitis and trachoma are transmitted by flies this is the species likely to be incriminated. Cleland (1913, pp. 560-2) has referred to the intense annoyance experienced by early Australian navigators and explorers as a result of attacks by myriads of flies which he believed to have been *M. vetustissima.* He has shown that it can feed on dried anthrax blood and that the bacilli pass unharmed through its alimentary canal (p. 565). Owing to its habits, the species could no doubt set up anthrax infection.

Mr. G. F. Hill, F.E S., of the Australian Institute of Tropical Medicine, Townsville, wrote to us stating that this species is responsible for the serious condition of horses' eyes in the gulf country of the Northern Territory.

Specimens have been collected in numerous localities in Western Australia, Northern Territory, Central Australia, South Australia, and Victoria by Mr. G. F. Hill. It occurs commonly in Queensland, New South Wales, Victoria and Tasmania. We have captured it on board ships travelling between Brisbane, Sydney and Melbourne. In the last named city, the species occurs in immense numbers in the streets, making itself a nuisance to human beings and horses.

Breeding habits. It is an oviparous species—the female laying her eggs in fresh cow or horse dung, usually the former, only a limited number, 20 to 40, being deposited at one time. The eggs are large in comparison with the size of the fly, measuring 1.5 mm. by 0.4 mm. The female organs resemble those of *M. domestica* but the maximum number of ovarioles observed in each ovary was 20 (fig. 30). The accessory glands are very long. The oviduct is a more muscular structure than that of *M. australis*. There is a long ovipositor.

The eggs are laid in a mass and placed below the surface of the dung. The egg shell is a thin, delicate structure covered with minute hexagonal markings. In warm weather the eggs hatch in less than 24 hours after deposition. The larva emerges as a first instar measuring 2 mm. by 4 mm. It grows rapidly and in a few hours moults. The second larval instar is marked by the appearance of the anterior spiracles each containing 6 to 8 processes. The posterior spiracles are now in the form of two almost straight slits (fig. 19). In 24 hours the larva measures 5.5 mm. by 1 mm. It now moults for the second time, the anterior spiracles enlarge (fig. 15), likewise the posterior pair. which are now in the form of three sinuous slits surrounded by a black chitinous rim (fig. 17). During the next day the larva increases greatly in size, measuring 10 mm. by 1.5 mm. No further appreciable growth takes place and by the fifth day the larva is mature and has entered upon the resting stage. The alimentary canal becomes emptied of food. The larva is now of a pale yellow tint and has become somewhat shorter and stouter, measuring 8.5 mm. by 2 mm. The puparium is yellowish brown to brown and measures 5 to 5.5 mm. by 2 mm. The pupal period occupies about 6 days in the summer and 10 to 14 days in the winter. The larvae pupate in the dung, but under laboratory conditions, at least, will leave it to do so.

Relationships of *M. australis* and *M. vetustissima*.

It appears that *M. australis* Macq., *M. bezzii* Patton and Cragg, and *M. corvina* Fabr., var. *vivipara* Portschinski are closely related flies. *M. bezzii*, a very common fly in certain parts of India, described and figured by Patton and Cragg (p. 352 and pl. xlv, fig. 2), is apparently very like *M. australis* in size and colouration. It is also a larviparous species depositing one larva at a time on cow dung.

The mature larva is greyish-white with a lemon-yellow dorsum, while the puparium is of a dirty grey colour with a yellowish tinge. The female genitalia, however, are slightly different from those of *M. australis*, there being only one pair of accessory glands which are stated to be larger than those found in oviparous forms. *M. corvina* var. *vivipara* closely resembles *M. bezzii* but its puparium is dark brown. It is common in Europe and parts of Northern Africa.

M. corvina Fabr. var. *ovipara* Portschinski, on the other hand, is evidently close to *M. vetustissima* Walk. The size and markings are similar. According to Portschinski the former lays 24 eggs on cow dung, each egg being 1.5 mm. long and possessing a delicate dark spine 2/3 of its length. The puparium is white. It seems likely, as Patton and Cragg remark, that Portschinski confused two closely allied muscids, one larviparous and the other oviparous.

There are a number of references to *M. corvina* Fabr. in Australian literature. Froggatt in his work on Australian Insects (1907), mentions this species and states that it is the common bush fly swarming from the eastern coast to the interior, also having a wide range over Europe, North America, Ceylon and Malay Archipelago. It is a darker tinted species than the house fly and shows only two parallel bands on the thorax. A figure of the fly is given on Plate 29, fig. 5.

Froggatt (1915, pp. 27-28), again mentions *M. corvina* as the common bush fly. He gives a short description of both sexes and states that it was found breeding in decaying vegetable matter, in the decaying mass in the paunch of most of the dead animals (sheep) that were examined, and also in horse dung from the Yarrawin horse yards, New South Wales. On 27th February, 1914, 200 specimens were caught in the tent, examination shewing that 198 were females, these containing eggs ranging in number from 22 to 35. Froggatt's description would apply equally well to *M. vetustissima* and there is little doubt but that this is really the species under discussion.

Graham-Smith (1914, p. 22) describes *M. corvina*, the size and markings being similar to those of *M. vetus-*

tissima, but the arista is slightly different, the terminal fourth not being feathered. He states that it resembles the house fly in general appearance, but the male has a yellow abdomen, with very distinct black longitudinal stripe, and the female a chequered abdomen.

Acknowledgments :—We desire to express our indebtedness to Dr. E. W. Ferguson, Health Department, Sydney ; Mr. Gerald Hill, F.E.S., Institute of Tropical Medicine ; and Mr. W. A. Rainbow, Librarian of the Australian Museum, Sydney, for their kindness in transcribing and forwarding literature.

Addendum.

We have been informed recently by Dr. E. W. Ferguson, who is a worker in Australian dipterology, that Macquart's specific name *M. australis* is preoccupied by *M. australis* Boisduval (Voyage de l'Astrolabe, 2, 1835, p. 669) given to a quite different muscid. The name then cannot stand. Macquart's short account of the female was based on specimens from the Solomon and Fiji Islands, and that of the male on flies from Tasmania and Fiji. His description is very short and might include *M. vetustissima* also, except for the " quadrivittate thorax." The " black tessellated abdomen " is more characteristic of the latter species than it is of *M. australis*. We should not be surprised if more than one species be included in the scanty account. We therefore propose to name that species which occurs in Queensland as *M. fergusoni* n.sp. Should the fly from Fiji and the Solomons be shown on re-examination to be specifically identical with the Queensland forms, the name will still stand owing to Macquart's use of a preoccupied specific name, but if found to be different then a new name must be given to the Pacific species. Macquart's Tasmanian forms are probably *M. vetustissima*. We might mention that Mr. E. Austen, of the British Museum, identified some of our Eidsvold specimens as *M. australis* Macq.

Our creation of a new species rather than the renaming of the old species seems to be the most satisfactory method of dealing with the difficulty so that the synonymy in view of our present knowledge might be indicated thus, *M.*

fergusoni Jnstn. and Bancr. Syn. *M. australis* Macq. 1842 non Boisduval 1835, in part; *M. australis* J. and B. (in the preceding portions of this paper).

Types and typical specimens will be deposited in the Queensland Museum, Brisbane, and the Australian Museum, Sydney.

TEXT-FIGURES 1-3.

Camera lucida outline drawings of female specimens to show disposition of pigment dorsally. Figures 1 to 6 have been drawn to same scale.

Fig. 1. *Musca australis*; fig. 2. *M. vetustissima.*
Fig. 3. *M. domestica* (Brisbane specimens).

TEXT-FIGURES 4-6.

Fig. 4. *Musca australis* (male); fig. 5. *M. vetustissima* (male)
Fig. 6. *M. domestica* (male)—Brisbane specimen.

TEXT-FIGURES 7-11.

Fig. 7. Right wing of *M. australis* (male).
Fig. 8. Right wing of *M. vetustissima* (female).
Fig. 9. Right wing of *M. domestica* (female).
Fig. 10. Arista and antenna of *M. australis* (male).
Fig. 11. Arista and antenna of *M. vetustissima* (male).

TEXT-FIGURES 12-14.

All figures drawn to same scale.

Fig. 12. Female genitalia of *M. australis* (embryo removed from uterus).
Fig. 13. Female genitalia of *M. vetustissima.*
Fig. 14. Single ovariole of *M. vetustissima* containing nearly mature ovum.

TEXT-FIGURES 15-20.

All figures drawn to the same magnification.

Fig. 15. Anterior spiracle of mature larva of *M. vetustissima.*

Fig. 16. Anterior spiracle of mature larva of *M. australis.*

Fig. 17. Posterior spiracle of mature larva of *M. vetustissima.*

Fig. 18. Posterior spiracle of mature larva of *M. australis.*

Fig. 19. Posterior spiracle of second instar of *M. vetustissima.*

Fig. 20. Posterior spiracle of larva (second instar) from uterus of *M. australis.*

TEXT-FIGURES 21-26.

Fig. 21. Posterior spiracles of larva of *M. vetustissima* moulting from 2nd to 3rd instar, showing the two sets of spiracles, the larger developing below those of the second instar which are about to be thrown off.

Fig. 22. Posterior spiracles of first larval instar of *M. vetustissima.* Figs. 21 and 22 are drawn to the same scale.

Fig. 23. Posterior spiracle of 24 hours old larva of *M. australis* showing new spiracles of third instar developing below those of the second instar which are about to be cast off.

Fig. 24. Highly magnified view of two process of the anterior spiracle of a mature larva of *M. australis.*

Fig. 25. Puparium of *M. australis.*

Fig. 26. Puparium of *M. vetustissima.*

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THE

Royal Society of Queensland.

Abstract of Proceedings.

REPORT OF COUNCIL FOR 1918.

TO THE MEMBERS OF THE ROYAL SOCIETY OF QUEENSLAND.

Your Council has pleasure in submitting its report for the year 1918.

The work of the year has been very satisfactory. During the year seventeen papers were accepted and printed in Volume XXX. of the Proceedings, which is the largest within recent years.

We have to acknowledge our indebtedness to the Queensland Government, who have again voted a sum of £50 to aid the publication of research work. In addition, our thanks are due to the University of Queensland for its assistance in the publication of the paper by Dr. H. C. Richards on "The Building Stones of Queensland," and also to the Trustees of the Walter and Eliza Hall Fund for assistance in the publication of the paper on "A Tick-Resistant Condition in Cattle," by Dr. T. H. Johnston and Miss M. J. Bancroft, B.Sc., Walter and Eliza Hall Fellow in Economic Biology.

There have been ten meetings of the Council, the attendances being as follows :—A. B. Walkom 10, E. H. Gurney 6, H. A. Longman 7, W. R. Colledge 8, C. D. Gillies 10, T. H. Johnston 8, H. C. Richards 9, J. Shirley 7, F. Smith 3, C. T. White 9.

The membership list consists of 87 ordinary and associate members, and 10 corresponding members. During the year seven members were admitted, two resigned and one died (Mr. P. Weston). We have to express our regret at the loss of Mr. Weston and extend our sympathy to his relatives.

The financial statement for the year shows a credit balance of £4 0s. 9d., but there is an outstanding printer's bill of £53/15/8 against which we have £40 in hand.

Signed, C. D. GILLIES, *Hon. Secretary.*

Signed, A. B. WALKOM, *President.*

28th February, 1919.

THE ROYAL SOCIETY OF QUEENSLAND.

Cr. **BALANCE SHEET for Year ending 31st December, 1918.** **Dr.**

RECEIPTS.	£	s.	d.
Balance from 1917	1	8	11
Subscriptions	65	12	6
Government Subsidy	50	0	0
University endowment for special papers ..	45	0	0
Sale of Copies of Proceedings	4	14	0
Hire of Lantern	3	0	0
	£169	15	5

EXPENDITURE.	£	s.	d.
Printing	155	6	3
Insurance	1	0	0
Secretary—Postage and Petty Cash	5	9	4
Treasurer's Expenses		6	0
Librarian—Postage and Petty Cash	2	0	0
Dishonoured Cheque	1	1	0
Bank Charge and Exchange		12	1
Total	165	14	8
Bank Balance	4	0	9
	£169	15	5

There is still a debt of £53 15s. 8d. due for Printing.

Treasurer, JOHN SHIRLEY.
Hon. Auditor, H. J. PRIESTLEY.

ABSTRACT OF PROCEEDINGS, 24TH MARCH, 1919.

The Annual General Meeting of the Royal Society of Queensland was held on Monday, 24th March, 1919, at 8 p.m., in the Geology Lecture Theatre, University.

Dr. A. B. Walkom, President, in the chair.

The minutes of the previous Annual General Meeting were read and confirmed.

The Annual Report of the Council and the Annual Financial Statement were adopted on the motion of Dr. Shirley and Mr. Longman.

Dr. A. Sutton, C.B., C.M.G., and Mr. E. H. F. Swain, Director of Forests, were proposed for membership.

The President, on behalf of the Society and Council, congratulated Professors T. H. Johnston and H. C. Richards on their promotion to the Chairs of Biology and Geology respectively, in the University of Queensland.

The following Officers were elected for 1919 :—

Patron : His Excellency Sir Hamilton Goold-Adams G.C M.G., C.B., etc.

President : H. A. Longman, F.L.S.

Vice-Presidents : A. B. Walkom, D.Sc. (*ex officio*), F. Smith, B.Sc., F.I.C.

Hon. Secretary : C. D. Gillies, M.Sc.

Hon. Treasurer : J. Shirley, D.Sc.

Hon. Editor : H. A. Longman, F.L.S.

Hon. Librarian : S. B. Watkins, M Sc.

Members of Council : F. Butler-Wood, D.D.S., E H. Gurney, Prof. T. H. Johnston, Prof. H. C Richards, C. T. White.

Hon. Auditor : Prof. H. J. Priestley, M.A.

The newly elected President was installed and returned thanks for his election. He moved : "That this Society places on record its keen appreciation of the work accomplished in its interests, as Secretary, Editor and President, by Dr. A. B. Walkom, and also congratulates him on his appointment as Secretary to the Linnean Society of New South Wales." This motion was seconded by Dr. Shirley and supported by Mr. Dunstan and Professors Richards and Johnston. On being put to the meeting it was carried unanimously with acclamation. Dr. Walkom suitably responded, and delivered his Presidential Address on "Queensland Fossil Floras." At the conclusion of the address a vote of thanks was moved by Dr. Shirley and Prof. Richards, and carried unanimously.

The following paper by Dr. Shirley was taken as read: "A Preliminary List of the Plants of the National Park."

Abstract of Proceedings, 28th April, 1919.

The ordinary monthly meeting of the Royal Society of Queensland was held on Monday, 28th April, at 8 p.m., in the Geology Lecture Theatre, University.

Mr. H. A. Longman, President, in the Chair.

The minutes of the previous ordinary meeting were read and confirmed.

Dr. A. Sutton, C.B., C.M.G., was re-elected, and Mr. E. H. F. Swain was elected to ordinary membership of the Society.

Mr. R. A. Wearne, B.A., was proposed for membership by Dr. Shirley and Prof. Richards.

Dr. Shirley exhibited a shell of the Cephalopod, *Sepia hercules* Pilsbry, from Southport, which had been donated to the Queensland Museum by the Hon. J. G. Appel.

Messrs. F. Smith, B.Sc., F.I.C., and C. T. White exhibited specimens of *Lomatia silaifolia* R. Br. *var. induta* F. v. M., from the following localities :—Parish of Deongwar, Warwick District (W. E. Moore); Candle Mountain (C. T. White); Buderim Mountain (C. T. White). These extend our knowledge of the plant's range. In the Proceedings of this Society, Vol. XXX., p. 88, the exhibitors have recorded the flowers of *L. silaifolia* as cyanophoric and now record that tests made for hydrocyanic acid with the flowers of the variety *induta* gave strong positive re-actions, though foliage leaves yielded negative results.

Miss B. B. Taylor read a paper: "Notes on Australian Chaetognatha," written by Prof. T. H. Johnston and herself.

The main business of the evening was a discussion on the paper: "A Tick-resistant Condition in Cattle," by Prof. T. H. Johnston and Miss M. J. Bancroft. Those who took part were Prof. Johnston, Messrs. C. J. Pound, F.R.M.S., and Munro-Hull.

Abstract of Proceedings, 26th May, 1919.

The Ordinary Monthly Meeting of the Royal Society of Queensland was held on Monday, 26th May, at 8 p.m., in the Geology Lecture Theatre, University.

Mr. H. A. Longman, President, in the chair.

The minutes of the previous meeting were read and confirmed.

Mr. R. A. Wearne, B.A., was elected to ordinary membership of the Society.

Mr. F. L. Berney was proposed for membership by Dr. J. Shirley and Mr. E. H. Gurney.

Dr. Shirley exhibited specimens of the following rare marine shells of Queensland:

> *Columbarium spinicinctum* Mart., *Conus coccineus* Gmel., *Conus cuvieri* Crosse, *Conus tenuistriatus* Sby., *Drillia livida* Gmel., *Mitra peasei* Dohrn, *Natica columnaris* Reclus.

Mr. H. A. Longman exhibited a portion of a Cetacean cranium, allied to *Delphinus delphis* but too fragmentary to be specifically determined, which had been found at a depth of fifteen feet during excavations at Luggage Point, Moreton Bay.

Mr. C. D. Gillies read a paper by Mr. C. T. White and himself "On the Occurrence of Abortive Styles in *Buckinghamia celsissima* F. v. M." Dr. Shirley, Messrs. Longman and Gillies took part in the discussion which followed.

Abstract of Proceedings, 30th June, 1919.

The Ordinary Monthly Meeting of the Royal Society of Queensland was held on Monday, 30th June, at 8 p.m., in the Geology Lecture Theatre, University.

Mr. H. A. Longman, President, in the chair.

The minutes of the previous meeting were read and confirmed.

Mr. F. L. Berney was elected to ordinary membership of the Society.

Dr. Shirley exhibited a specimen of *Cucullœa concamera* Brug., the dimensions of which were: length 117 mm., height 82 mm., thickness 75 mm. This fine specimen was secured by the State trawler and donated to the Queensland Museum.

Mr. H. A. Longman exhibited specimens of the constricting snake *Nardoa boa* (Schlegel), which were captured near Rabaul, New Britain, by Warrant-Officer J. Wilson, and donated to the Queensland Museum.

Professor T. Harvey Johnston read a paper entitled "The Lingulidæ of the Queensland Coast," by himself and Mr. O. S. Hirschfeld, illustrating his remarks by a series of specimens. Dr. Shirley and the President contributed to the subsequent discussion.

Abstract of Proceedings, 28th July, 1919.

A Special Meeting of the Royal Society of Queensland was held on Monday, 28th July, at 8 p.m., in the Geology Lecture Theatre, University.

Mr. H. A. Longman, President, in the Chair.

The minutes of the previous meeting were read and confirmed.

Dr. J. Shirley moved:—"That the Society extend the scope of the resolution passed on the 28th June, 1915, and remits the annual subscription of members engaged as war workers abroad for their period of engagement." This motion was seconded by Prof. H. C. Richards, and carried unanimously.

The President introduced Dr. F. X. Williams and Mr. Muir, of Hawaii, to the Society.

Prof. Richards exhibited (*a*) a number of stone axes which had been submitted to him by the Queensland Museum for petrological examination, and (*b*) a nodule of phosphorite from Talgai.

Mr. C. D. Gillies exhibited (*a*) the base of the aorta of an ox, opened to show the semilunar valves and the apertures of the coronary arteries, and (*b*) the skeleton of the pectoral fin of Ceratodus, illustrating the archipterygial type of limb.

The following papers were read :—

(1) " Alteration of Generic Name," by Mr. J. Douglas Ogilby, in which *Eurycaulus* Ogilby, a genus of belonoid fishes, was altered to *Tropidocaulus* Ogilby. (Communicated by the President).

(2) " Mollusca Common to S. Africa and Australia," by Dr. J. Shirley. This paper was written to combat the notion that a shell found in South Africa must necessarily be absent from Australia. The list gives 350 species common to the two regions. Opportunity was taken to do justice to the memory of Mr. Hugh Cumming, the great collector of Pacific Island shells.

(3) " *Ziphius cavirostris* on the Queensland Coast," by Mr. H. A. Longman. The evolution of Cetaceans from four-footed land animals and their remarkable adaptation to marine life was briefly outlined and illustrated by the architecture of the skull and other bones.

Contributions to the subsequent discussions were made by Prof. Richards, Messrs. White, Muir and Gillies.

ABSTRACT OF PROCEEDINGS, 25TH AUGUST, 1919.

The Ordinary Monthly Meeting of the Royal Society of Queensland was held on Monday, 25th August, at 8 p.m., in the Geology Lecture Theatre, University.

Mr. H. A. Longman, President, in the Chair.

Apologies were received from Dr. Butler-Wood, Mr. Watkins, and Dr. Shirley.

The minutes of the previous meeting were read and confirmed.

Dr. A. R. Walker was proposed for ordinary membership by Mr. Gurney, seconded by Mr. Smith.

Prof. Richards exhibited (*a*) specimens from the lead-silver lode at Indooroopilly, which had been presented to the Queensland Museum; and (*b*) a specimen of white marble from Eulam, near Rockhampton. The stone is coarse grained, of good colour, and should be of considerable mural value.

The President exhibited a specimen of the lizard *Diplodactylus hillii*, Longman, from Mungana, Chillagoe Line, North Queensland. Previously this species had only been known from a single specimen collected at Port Darwin.

Professor R. W. H. Hawken, B.A., M.E., M. Inst. C.E., read a paper on "The Strut Problem."

The author examined :—

(1) The original mathematical deduction for central loading by Euler.

(2) The modified mathematical result for eccentric loading by Prof. R. H. Smith.

(3) The problem as it appears in Engineering Design, where the strength of the material is an important factor.

(4) The exact result deduced by R. W. Burgess.

The 'resilient' effect or 'Euler Value' the author assumes as a maximum unit load, and that any other load may be considered a fraction of the unit load, in this way the mistakes and inconsistencies of the many proposed formulae may be shewn; and curves have been drawn which enable stress conditions to be examined for all loads.

The author examines, and reconciles, the apparently inconsistencies of the results of (1) and (2), and shews also that the result (4) which, deduced from an exact equation, at first sight appears to shew (1) and (2) inaccurate, has a definite explanation which proves his previous deductions to have been justified.

The President, Prof. Richards, and Mr. Wilson contributed to the subsequent discussion.

Abstract of Proceedings, 29th September, 1919.

The Ordinary Monthly Meeting of the Royal Society of Queensland was held on Monday, 29th September, 1919, at 8 p.m., in the Geology Lecture Theatre, University.

Mr. H. A. Longman, President, in the Chair.

Apologies were received from His Excellency the Governor, Dr. Butler-Wood and Mr. Watkins.

The minutes of the previous meeting were read and confirmed.

Dr. A. R. Walker was elected to Ordinary Membership of the Society.

The business of the evening was devoted to a Lecture by Captain S. A. White, C.M.B.O.U., of Adelaide, on his experiences in Central Australia. The lecture was well illustrated with lantern slides and was highly appreciated by a very large audience.

Professor Johnston moved a vote of thanks, which was seconded by Dr. Shirley, supported by the President, and carried by acclamation.

Abstract of Proceedings, 29th October, 1919.

The Ordinary Meeting of the Royal Society of Queensland was held on Wednesday, 29th October, 1919, at 8 p.m., in the Geology Lecture Theatre, University.

Mr. H. A. Longman, President, in the Chair.

An apology for absence was received from Prof. Johnston.

The minutes of the previous meeting were read and confirmed.

Dr. Shirley exhibited specimens of two plants :—

(1) *Bosistoa euodiformis* Benth., a plant of the Orange family, a native of N.S.W., and common on Roberts' Plateau, National Park—an addition to our native flora ; (2) *Calcycothrix longiflora* F.v.M., of the Myrtle family, a beautiful heath-like shrub with pink flowers, a native of Central Queensland. This specimen was sent down by Mr. Blunt, of Charleville.

In the discussion which followed, Mr. C. T. White stated that in the same locality he had gathered specimens (in leaf only) of *Bosistoa euodiformis* in December, 1918, and had lately received good flowering specimens from Asst.-Forester W. E. Moore.

Mr. C. T. White exhibited a collection of plants from the desert country at Yelarbon, between Inglewood and Goondiwindi. Among the more interesting species were a *Westringia* (probably new) which grows in the centre of the Spinifex bushes (*Triodia pungens*), *Casuarina Luehmanni* (Desert Oak), *Eucalyptus odorata* Behr. and Schlecht., var. *Woolsiana* Maid. (Ribbon Box) ; the determination of this last had been verified by Mr. J. H. Maiden.

Prof. T. H. Johnston sent for exhibition living specimens of *Strongyloides intestinalis*, hatched out from a heavily-infected sample of human faeces sent from Charters Towers over a month previously by Mr. O. W. Tiegs. Infective larvae, as well as rhabditiform males and females, were present in abundance.

Mr. H. A. Longman exhibited a series of photographs (by Mr. P. Bennett), and specimens illustrating variation in the number and position of the fangs in venomous snakes.

Dr. A. Jefferis Turner read a paper on "The Australian Gelechianae."

Those who contributed to the subsequent discussion included Dr. Shirley, Messrs. White and Gillies.

Abstract of Proceedings, 26th November, 1919.

The Ordinary Monthly meeting of the Royal Society of Queensland was held on Wednesday, 26th November, 1919, at 8 p.m., in the Geology Lecture Theatre, University.

Mr. H. A. Longman, President, in the Chair.

An apology for absence was received from Prof. H. C. Richards.

It was moved by Dr. Shirley, seconded by Mr. C. T. White, that a message of condolence be sent to Prof.

Skertchly on the loss of his wife, Mrs. Skertchly. The motion was supported by the President and carried in silence, the members expressing their sympathy by rising.

The President announced that the following papers had been accepted by the Council for publication :—

(*a*) "Tick Resistance in Cattle :—A reply to criticism," by Prof. T. H. Johnston and Miss M. J. Bancroft.

(*b*) "Life histories of the bush flies *Musca australis* and *M. vetustissima*," by Prof. T. H. Johnston and Miss M. J. Bancroft.

Dr. Shirley exhibited the molluscs *Onchidium verruculatum* Semper from Cairns, and *Onchidina australis* Semper from Bribie Island.

Mr. C. T. White exhibited a collection of plants from the Bunya Mountains, gathered during the visit of the Royal Australian Ornithologists' Union to the locality.

The President exhibited a live specimen of *Gymnodactylus miliusii*, a gecko from Wallumbilla, W.Q.; and a specimen of *Juncella gemmacea*, a whip-like Alcyonarian, collected by Captain Hoult of the State trawler.

Prof. T. H. Johnston exhibited (1) specimens of a large *Phoronis*, probably *P. australis*, from between tide-marks on various banks in Moreton Bay; *e.g.*, Coochie Mudlo (coll. T. H. Johnston, 1916), Southport (coll. C. D. Gillies and B. B. Taylor, 1919), Bribie (coll. Field Naturalists' Club, 1919); it occurs in societies associated with the tube of a large species of *Cerianthus*; (2) specimens of *Phoronis australis* Hasw. from Port Jackson; (3) specimens of the remarkable Echiuroid *Pseudobonellia biuterina* Johnston and Tiegs, found in the lagoons at Masthead and North West Islets of the Capricorn Reefs. He also exhibited on behalf of Miss Bancroft and himself (4) a complete series of stages in the life history of the two common bush flies, *Musca vetustissima* Walker and *M. fergusoni* J. and Bancr. (more commonly known as *M. australis* Macquart).

Those who contributed to the subsequent discussions included the President, Prof. Johnston, Dr. Shirley, Messrs. White, Smith, Bennett and Gillies.

Publications were received from the following Institutions and Societies during 1919.

AFRICA.

Government of the Gold Coast.
Natal Museum, Pietermaritzburg, Natal.
South African Association for Advancement of Science.

AMERICA.

BRAZIL.

Instituto Oswaldo Cruz, Rio Janeiro.
Museu Paulista Suo Paulo.
Minesterio da Agricultura Industria and Commercio, Rio Janeiro.
Servio Geologio e Mineralogico de Brazil, Rio Janeiro.

CANADA.

Dept. of Mines, Ottawa.
Institute of Natural Science, Nova Scotia.
Royal Astronomical Society of Canada, Toronto.
Royal Canadian Institute, Toronto.
Royal Society of Canada, Ottawa.

UNITED STATES.

Academy of Natural Science, Philadelphia.
American Geographical Society, New York.
American Museum of Natural History, New York City.
American Philosophical Society, Philadelphia.
Californian Academy of Science, San Francisco.
Bureau of Standards Dept. of Commerce, Washington.
Florida Geological Survey, Tallahassee, Florida.
Illinois State Laboratory, Urbana Illinois.
Indiana Academy of Science, Indianopolis, Indiana.
Kansas Academy of Science, Topeka, Kansas.
Librarian of Congress, Washington.
Librarian University of Michigan, Ann Arbor, Michigan.
Missouri Botanic Gardens, St. Louis, Missouri.
National Academy of Science and Smithsonian Institute, Washington.
Librarian Ohio State University, Columbus.
University of California, Berkeley.
University of Minnesota Minneapolis, Minnesota.
Wilson Ornithological Club, Oberlin College Library, Oberlin, Ohio.

OCEANIA.

Bernice Pauahi Bishop Museum, Honolulu, Hawaii Islands.

MEXICO.

Instituto Geologico de Mexico, Mexico.
Sociedad Cientifica.

ASIA.

India.

- Director Agricultural Institute, Pusa, Bengal.
- Board of Scientific Advice for India, Calcutta.
- Director Geological Survey of India, Calcutta.
- Superintendent of Govt. Printing, Calcutta.

Java.

- Department van Landbrouw.

Philippine Islands.

- Librarian Bureau of Science, Manilla.

AUSTRALASIA AND NEW ZEALAND.

New Zealand.

- Auckland Institute, Auckland.
- Dominion Laboratory, Wellington.
- Geological Survey of New Zealand, Wellington.
- New Zealand Institute, Wellington.
- New Zealand Board of Science and Art.

Queensland.

- Department of Mines, Brisbane.
- Geological Survey of Queensland.
- Queensland Museum, Brisbane.

New South Wales.

- Australian Museum, Sydney.
- Director of Botanic Gardens, Sydney.
- Department of Agriculture, Sydney.
- Geological Survey of N.S.W., Sydney.
- Linnean Society of N.S.W., Sydney.
- Naturalists' Society of N.S.W., Sydney.
- Royal Society of N.S.W., Sydney.
- University of Sydney.

South Australia.

- Geological Survey of South Australia, Adelaide.
- Public Library of S. Australia, Adelaide.
- Royal Geographical Society, Adelaide.
- Royal Society of S. Australia, Adelaide.

Tasmania.

- Geological Survey of Tasmania, Hobart.
- National Park Board.
- Royal Society of Tasmania.
- University of Tasmania.

Victoria.

- Advisory Council Science and Industry, Melbourne.
- Australasian Institute of Mining Engineers, Swanston St., Melbourne.
- Commonwealth Statistician, Melbourne.
- Department of Agriculture of Victoria, Melbourne.
- Department of Fisheries, Commonwealth, Melbourne.
- Department of Mines.

Field Naturalists' Club of Victoria, Melbourne.
Royal Australasian Ornithologists' Union, Melbourne.
Royal Society of Victoria, Melbourne.
Scientific Australian, Melbourne.

WESTERN AUSTRALIA.
Geological Survey of W. Australia, Perth.
Royal Society of W. Australia, Perth.

EUROPE.

BELGIUM.
Société Royale de Botanique de Belgique.

ENGLAND.
Cambridge Philosophical Society, Cambridge.
Cambridge University Press, Cambridge.
Conchological Society, Blackpool.
Imperial Institute, S. Kensington, London.
Literary and Philosophical Society, Manchester.
Royal Botanic Gardens, Kew, London.
Royal Colonial Institute, London.
Royal Society of London.

FRANCE.
Le Prince Bonaparte, Paris.

ITALY.
Rassenga Monsile di Botanica, Catania.
Società Africana d'Italia, Naples.
Società Toscana de Scienze Naturale, Pisa.

PORTUGAL.
Academia Polytechnica, Porto.

SCOTLAND.
Royal Botanic Gardens, Edinburgh.
Royal Society of Edinburgh.

SPAIN.
Academia Real de Ciencias, Madrid.
Academia Real dell Ciencias y Artes, Barcelona.

SWEDEN.
Geological Institute, University of Upsala.

SWITZERLAND.
Naturforschende Gesellschaft, Zürich.
Sociètè de Physique et d'Histoire, Geneva.

List of Members.

CORRESPONDING MEMBERS.

‡ Danes, Dr. J. V.	Czech University, Bohemia.
David, Professor T. W. E., F.R.S.	The University, Sydney, N.S.W.
‡ Domin, Dr. K.	Czech University, Prague, Bohemia.
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ORDINARY MEMBERS, ETC.

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* Associate Members.

† Life Members.

‡ Members who have contributed papers to the Society.

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PROCEEDINGS

OF THE

ROYAL SOCIETY

OF

QUEENSLAND

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