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RESULTS OF THE HARVARD-ADELAIDE UNIVERSITIES ANTHROPOLOGICAL EXPEDITION, 1938-1939

TASMANOID TRIBES IN NORTH QUEENSLAND

BY NORMAN B. TINDALE AND JOSEPH B. BIRDSELL

Summary

During 1938-39 field-work was carried out for fourteen months under the joint auspices of the Division of Anthropology, Harvard University, and the Board for Anthropological Research at the University of Adelaide. This work, sponsored by the Carnegie Corporation of New York whose generous grants have made possible the field work and the elaboration of the data, has been assisted further by contributions from the South Australian Government and the University of Adelaide.

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Plates i-iv.

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INTRODUCTION.

The expedition traversed 16,000 miles; 2,458 full and mixed blood peoples in Australia were studied, and their social backgrounds and present status examined. Several papers have been published and others are in course of preparation.

Certain matters of immediate theoretical interest regarding the Australian full bloods are discussed in the present contribution. While early speculations regarding the origins of the Australian aborigines generally have postulated two waves of different ethnic type, reaching and populating the mainland of the Continent, and this idea has never been completely abandoned—recent anthropometric work among the living aborigines of Central Australia has tended to support another hypothesis that this interesting race is very homogeneous. A corollary to the latter statement is that the Tasmanians left little or no distinguishable imprint upon the continental peoples, and according to Wood Jones (1934), may have reached their historic location as the result of a lengthy sea voyage, or voyages, originating in the islands to the north-east of Australia.

Principal measured series of Australian aborigines in Australia have been obtained hitherto from Central and Northern Australia, and no mass of data has been available for the Eastern coastal areas, which are cut off from the rest of Australia by the Great Dividing Range, and divided into pockets by the mountainous terrain of the coastal ranges. That the eastern and south-eastern coast may have been a refuge area has been recognised by cultural anthropologists, but little information has been available about physical types.

Our studies demonstrate that in the eastern coastal and mountain region near Cairns is an area where exist several small tribes of a people characterized by a high incidence of relatively and absolutely small stature, crisp curly hair, and a tendency toward yellowish-brown skin colour. All of the tribes appears to be mixed in greater or lesser degree with the Australian aboriginal type, but preserve in their mixed condition characters recognizable as belonging to the Tasmanian aborigines. This may prove to be a fundamental discovery in Australian anthropology.

Our field observations have led to the further conclusion that the Australian aborigines are not derived from a single ethnic group, but result from the blending, in varying proportions, of three discrete ethnic elements, which tentatively may be called "Southern," "Northern," and "Tasmanoid."

For the purposes of this paper, it is not intended fully to describe and define the three types—but to record briefly the existence of a Tasmanoid group on the mainland, paying most attention to their occurrence on the Atherton Plateau region of Northern Queensland. Full descriptions and analyses of the three ethnic groups are being prepared for publication; these are based on the statistical examination of the data on approximately one thousand full-blooded aborigines, studied in Queensland, New South Wales, Victoria, South Australia, and the southern half of Western Australia, including full series of each of the three types. With the exception of South Australia, no valid series on the living have yet been published from these areas.

Between these three primary ethnic strains, intermixture has long continued on a generous scale, but it is still possible, in peripheral areas, to find blocs of tribes, where the majority of the individuals approximate in their traits to the prototypes.

No correlation between language and physical type is postulated; information obtained about language and culture in the area point, to a marked period of isolation of some of the peoples in the Atherton rain jungles. One of the languages, Barbaram, seems to be of such a relatively isolated type, that it may be regarded as having been linked with the Tasmanoid people of the Atherton Tableland for a relatively long period of time.

The Atherton Tableland and the coastal region inland from Cairns was first opened for white settlement about 1880, and after 1890 began to carry a large settled white population engaged in dairy-and-general-farming on the plateau, and sugar-cane farming on the coast. Although large areas remain of uncleared, rough mountain terrain, in large measure the natives have been led to abandon their nomadic habits and their dependence on hunting. Many of them have been compulsorily segregated on mission and government settlements at Yarrabah, Monamona, and Palm Island. A few of them, who have only been brought in from the dense jungle areas above Cardwell within the past six years, are still unable to speak any but their native tongue. These late arrivals claim that at least one family is still living in a completely wild nomadic condition in the rain jungles of the Cardwell hinterland. Several photographs taken by Mr. A. Atkinson in the early days of white settlement indicate the former appearance of these people. In one instance a child appearing in an old photograph, now an old man, was one of the subjects of our anthropometric studies.

The first detailed accounts of the life of people of the rain jungles of Queensland were those of the naturalist and traveller Lumholtz (1889), whose explorations were principally made on the Herbert River and in the area to the south; his published vocabularies show over 70 per cent. of Warekamai words, and the others are principally of Warungu and Newegi origin. His main observations did not therefore extend to the relatively unmixed pygmoid groups. Nevertheless his statements indicate he appreciated the discreteness of the rain forest folk and had observed the great variability in stature evident in the peripheral tribes; his accounts have not hitherto been treated with the respect due to them.

DISTRIBUTION OF THE TASMANOID TRIBES.

The distribution of the tribes as given, is perforce that of a period before tribal disruption and decay had set in with the growth of white settlement.

There is a central bloc of a dozen small tribes of the Tasmanoid people occupying an area one hundred miles wide (from Cape Grafton in the east to Lappa Junction in the west) and 180 miles long (from the headwaters of the Annan River in the north to near Cardwell and Ravenshoe in the south).

Ngatjan [ŋatjen]—belonging to the country from Atherton to Russell River.
Mamu ['Ma:mu]—from the coast at Russell River south to Murdering Point.
Wanjuru ['Wanjuru]—mouth of Russell River.
Tjapukai ['Tja:pukai]—on the broken table-top country from Mareeba and Kuranda to Port Douglas.
Barbaram ['Ba:berem]—Great Dividing Range from north of Mareeba nearly to Mount Garnet.
Idindji ['Idindji]—from Malanda and Lake Barrine to Gordon Vale.
Kongkandji [Koŋkandji]—Cape Grafton, and Peninsula.
Buluwai ['Buluwai]—in the mountain scrubs south of Kuranda.
Djiru ['Djiru:]—at Clump Point.
Djirubal ['Djirubal]—Herberton to Ravenshoe and down the Wild River to beyond Tirrabella Station.
Gulngai ['Gulŋai]—Murray and Tully Rivers.
Keramai ['Keramai]—At Kirrama and south of the inland scrubs of Murray River.

The details of the tribal boundaries are shown by Tindale (1940) on a map in a previous paper of this series. Population statistics have been gathered indicating the former presence of a population of about one thousand five hundred of these people. Grouped in a half-circle, and enclosing the area, except along the sea front, are other more mixed peoples, who include some pygmoids. They form a transitional type between the nucleus of Tasmanoid tribes and the more normal Australian ones.

In this group belong the:

Bandjin ['Bandjin]—Hinchinbrook Island.
Newegi ['Newegi]—Seaview Range above Ingham and southwards.
Agwamin [E'wamin]—head waters of Einasleigh and Copperfield Rivers.
Wakaman ['Wakamen]—Chillagoe to Mt. Surprise on the western side of the Great Dividing Range.
Muluridji ['Muluridji]—north of Mareeba on the head waters of the Mitchell River.
Djankun ['Djankun]—head waters of Walsh River as far west as Almaden and Chillagoe.
Irukandji ['Irukandji]—on the coast north of Cairns as far as Port Douglas.

A second belt of tribes, the members of which are, in their characters, essentially Australian aborigines of types met with in inland Queensland, touches the coast in the north near Cooktown, and, running down the western side of the Great Dividing Range, meets the coast at Townsville, thus completely enclosing the apparent refuge area and its transitional belt. Outliers of the Tasmanoid groups seem to occur, and in this category may perhaps be placed the Wulpura ['Wulpure] about whom insufficient data is yet available; traces of probable mixed pygmoid tribes appear in more southern coastal districts as far as New South Wales.

Within the relatively large Atherton jungle area the people thus tend to differ in various degrees from the Australian norms in physical characteristics. In points of their material culture, linguistics, and social organization there are suggestions that, although isolated for a long period in their specialized rain jungle environment, contact with other Australian tribes has led to their absorption of much which is culturally that of the surrounding Australians. There are indications that the additions which have been made to their fundamental culture are those characteristic of people who now inhabit southern Australia rather than those of the present inhabitants of north-central and northern Queensland.

ENVIRONMENT.

Much of the area occupied by the Queensland Tasmanoids is noted for its high, and relatively uniform, rainfall, and a great deal of it is covered in dense tropical jungle, interspersed with belts of Savannah forest in which species of *Eucalyptus* dominate. The rain jungles, more correctly shelter jungles, are locally known as "scrubs" and occasionally as "brushes." Strictly speaking they are not rain forests. Tall trees, of which some of the dominant members are *Agathis*, *Ficus*, *Flindersia*, and *Podocarpus*, form a high canopy of foliage, shutting sunlight from the vine and palm-stem entangled floor of the jungle.

The shelter jungles and the intervening belts of *Eucalyptus* savannah extend from the coast at sea level to a height of almost five thousand feet on the summits of Bartle Frere and Bellenden Ker. The general elevation of Atherton Plateau is two thousand feet, while that of the Herberton Plateau is nearly a thousand higher, and these are, or were covered with broad belts of jungle interspersed with savannah.

The mean temperature of the coldest month at Ravenshoe (2,957 feet) is 60°, while at sea level it is 70°. Rainfall varies from 50 inches at Atherton to 143 inches at Innisfail. The heavier rains occur in summer deluges, and there is a relatively dry winter period of about two months, when the average fall is below 1·5 inches per month.

As in Malaya and the Philippine Islands, the jungles and mountain plateaux constitute a special environment, and in conjunction with the rugged ranges which enclose the region they have been eminently suited as refuge areas. On their inland side, the jungles are backed by high, often sterile, granitic mountains of the Dividing Range from which deeply entrenched rivers run westwards towards the Gulf of Carpentaria. In the rugged country about this Dividing Range, rainfall is less heavy, and the rain jungles have contracted.

Soil seems to play a dominant part in the formation of the various types of forest. Sheltered areas, especially those covered with rich basaltic soils, have produced dense forests, whereas in the poorer, granitic areas the jungle is much impoverished. Usually there is a complete overhead canopy, and it is chiefly in the drier patches on relatively barren soils that the open parkland intervenes. Some of the open savannah is believed to be the result of man's activities and to have been caused by the fires of past generations of the native inhabitants.

PHYSICAL CHARACTERISTICS.

A historical resume of the problem of Australian and Tasmanian origins is to be given elsewhere. Howitt (1898) detailed early opinions and theories and Davidson (1937) has recently presented a useful summary of current trends of thought on physical and cultural relationships.

It is of some importance to consider the scope and geographical range of previously published work on the anthropometry of the living Australian aborigines. With the exception of several very small series from New South Wales, publications have been limited to the substantial series by Campbell, Gray, and Hackett (1936), based upon data collected by a number of University of Adelaide expeditions, over a period of years; by Burston (1913); and by Warner, published by Howell (1937). These three major contributions are limited to data collected from Central Australia and North Australia respectively.

At first sight this coverage may seem ample, but in reality these series are drawn from roughly but one-seventh of the continent, and do not include those regions which might be interpreted as the most important refuge areas, localities in which any lower layers of ethnic stratigraphy, should they occur, would most reasonably be expected to survive. It has been our good fortune that the major aim of the present expedition, the study of Australian hybrids, led to extensive attention being paid to the peripheral areas which hitherto had been neglected. A thousand full-bloods, of both sexes, have been examined anthropometrically, and over seven hundred blood grouped, both for the A–B series and the M–N series of agglutinogens (Birdsell and Boyd, 1940). Approximately four hundred of these measured are from Queensland, the remainder spread over New South Wales, Victoria, South Australia, and Western Australia.

In general, it may be said that the Tasmanoid bloc of tribes now reported from the Atherton area, represents a distinctly aberrant type of Australian aboriginal, which although undoubtedly mixed, is none the less relatively homogeneous within the given area, and as a physical type, is distinct from the surrounding peoples. Those traits in which they deviate from the Australian norms, as to date established by published material, all trend in one direction toward the characteristics of the extinct Tasmanians.

Before describing in a general way the traits in which this aberrancy is noted, it should be stated that, although little anthropometric work has been published from Queensland, for a number of years writers have commented upon the "frizzly" hair of some of the natives of coastal North Queensland. Lumholtz (1889) explained this aberrant hair form as originating in Melanesian contacts, and the problem was thus easily dismissed. From evidence at our disposal, it seems some relatively recent Melanesian influence can be detected in the natives of the northern part of Cape York Peninsula; the tribes in the Cairns region show none of this. There is ample data to indicate that the historic importation of Melanesians to work the canefields has no bearing upon this problem, and the authors conclude, from the study of known F_1 and F_2 generation Melanesian-Australian hybrids, that late prehistoric Melanesian contacts may likewise be ruled out as a major factor in this area.

The Tasmanoids in the Atherton Tableland area, when compared with the surrounding tribes, show significant diminutions in stature and body weight. Their extremities are notably gracile. Although straight and low wave hair forms are present, there is a relatively high incidence of crisp deep-wave, and crisp curly hair. No true frizzly hair is present. The nasal structure is aberrant in certain features, and the region of the upper integumental lip is usually relatively long and convex. Skin colour tends to be somewhat light, and reddish and yellowish tones are more common than among the surrounding peoples. Teeth show some interesting differences that cannot here be described in detail. The preliminary results of blood grouping tend to substantiate the distinctness of the bloc of tribes. In the authors' views, these people may be classed as originally similar to the Tasmanians, although through infiltration by and admixture with a principally "Southern" type of Australian aboriginal, they are now modified to a status which renders them distinct from either, but lying clearly between the norms of the two ancestral types. It is for this reason we have chosen to call them "Tasmanoids."

The analyses of the data appear to substantiate the above statements, and it seems clear that the ancestors of the Tasmanians were at one time well established upon the Australian mainland. Traces of their characteristics may reasonably be anticipated to survive in other marginal areas on the continent. Evidence in hand in indicative of this, and we conclude that the negritic Tasmanians represent part of an early wave of peoples who entered the continental area. Under the impact of succeeding waves of people of different ethnic type, they have been modified. While the virtually pure type survived in Tasmania until historic times, on the rest of the continent they were largely submerged, physically and culturally, by later arrivals.

If this hypothesis be correct, it is obvious that the Australian aboriginal no longer may be considered as a pure race of unusual homogeneity, but a well-blended group of at least dihybrid and probably trihybrid origin.

CULTURAL RELATIONSHIPS.

It is not intended to elaborate here the cultural data gathered about these people. A few general indications may be given.

The social organization of the Atherton Tasmanoids seems to have been influenced by both dual people along the coast and by four-class patrilineal people with named moieties from the plains in the west. Both these types of organization appear to be accretions of relatively recent date.

The Tjapukai and Idindji have patrilineal moiety systems with the terms ['Kurabana] and ['Kuraminja]; in the Kongkandji, these become ['Korabana] and ['Korakulu]. These dual systems seem to be the oldest ones surviving in the area, and have links with similar organizational types known in more southern parts of coastal Queensland. Barbaram, which linguistically seems to be one of the most characteristic of the tribes, has a four-class patrilineal organization clearly derived from tribes to the west. This has named moieties which are names of totems:

Kuritala (eagle) moiety: Tjikundji and Tjilandji subclasses.
Karak (night bird) moiety: Kupundji and Karpandji subclasses.

Marriage in Barbaram is normally by exchange of sisters, and the marriage is arranged through the mother and mother's mother. Wife's mother and father's sister are both avoided, and the prohibition extends up in each case to the mothers of these individuals. A man also refrains from speech with his son's wife and sister's daughter.

Barbaram folk were formerly, according to tradition, a people without initiation ceremonies. Their youths, according to this belief, were taken by the Wakaman people, who live to the south-west and by them subjected to rites which included the cutting of scars (cicatrices) on the chest. Circumcision is, of course, unknown in this part of Queensland.

The rites, which were in more recent times also carried out by the Barbaram and allied tribes themselves, are occasions for dances and singing. These continue by relays of men over a period of several days, the performers being divided, for this purpose into two groups, the [Aŋ'gor 'mok] or Sun men, and the ['Aːo 'mok] or Night men. During the rituals, the youth is ['japɪeir] (lit. set apart, almost sacred, perhaps corresponding to the ['nerambe] of the natives of the Tanganekald and Jarildekald tribes in South Australia), and his feet may not touch water, all his requirements being supplied from a dish; if a stream has to be crossed or followed he must be carried on the shoulders of others.

Burial customs include the smoking and partial mummification of the body by treatment with red ochre; subsequent disposal of the body is by cremation after a series of rites of remembrance. The lower jaw of the deceased is often carried for a further period before being destroyed. Food cannibalism was rife, and many who met their deaths at the hands of strangers, were eaten. In consequence of the practices of cremation and cannibalism, skeletal material of the Tasmanoids from the Cairns region is rare; fewer than a dozen crania are present in Australian collections. The principal examples are being examined and will be made the subject of separate studies.

LANGUAGE.

Comparative vocabularies indicate that, while the peripheral and intermediate zones of pygmoid peoples have languages allied to those of their taller neighbours, there is a central area where the languages appear to be nuclear and to have been strongly isolated. Barbaram seems best to represent this archaic type: Wakaman and Agwamin, which adjoin, show marked influences from the west. The northern and north-eastern Tasmanoid tribes reveal the influence of northern languages of the Koko Imudji type (Koko-yimidir of Roth). In Tjapukai, for example, the original Barbaram elements have been obscured and overlaid, surviving only in modified form.

Barbaram, which is regarded in this preliminary statement as most typical of the area of isolation, is characterized among other things by many monosyllabic words with consonantal endings: [ˈkaŋ] tree, [ˈmok] man, [ˈkok] water. In words of two or more syllables, principal stress is often placed on the second syllable: [aˈro] a species of kangaroo, [aˈrunda] head, [aːˈtja] three, [nˈkaːla] leg, [alˈmaːk] meat, [aˈbo] ground, [aˈwa] mother, [mˈbeːra] grass basket.

A glottal stop [ʻ] is evident in some words, and in others this is so marked that it seems to have almost the effect of a click, as in [nʻgara].

Terminal vowels are often indeterminate, and the voice may be raised a tone [nd^{a}], [atj^{a}], [k^{o}], [k^{a}]. The last-named word is an example in which the terminal vowel is very short.

Short texts and grammatical notes have been obtained from two of the tribes in this area, and parallel vocabularies from each of them. They will be the subject of a more detailed separate study.

MATERIAL CULTURE.

Cultural elements which seem to belong essentially to this area include the Tjapukai practice of carrying the skulls and the jaw bones of the deceased as ornaments upon the body for a lengthy period before disposal by burning.

The use of large decorated fighting shields made from the buttresses of *Ficus* trees is confined to the area. These shields are used in conjunction with a single-handed, flat-bladed and long, wooden, fighting sword, which elsewhere occurs only among the Kandju people of Coen and among some people who similarly inhabit rain forests near Brisbane, where recur some cultural, and not a few physical, characters of the Tasmanoids.

Clothing was confined to the use of beaten bark blankets, which seems to be an adaptation to wet climates of the custom of wearing animal skins, which is so highly characteristic of the marginal peoples along the eastern and southern coasts of Australia.

Cane baskets of several highly characteristic forms are made; the designs of these are confined to the inner group of Tasmanoid folk, so that their association with them may be rather old. Some of them are based on local models, being translations into basket ware of prototypes made from sewn fig tree bark. The Barbaram, Tjapukai, and Idindji make half-hitch coiled grass baskets closely similar in their appearance and technique of manufacture to those of the Tasmanians. The details of the processes of manufacture are recorded in the 16 m.m. film library of the South Australian Museum.

Several specialized techniques of food gathering such as would develop in a dense rain-forest environment are characteristic of these people. Food of the rain jungle tribes consists largely of roots, seeds, fruits, and honey, there being a general scarcity of meat except for an occasional cassowary, scrub wallaby, tree kangaroo, and flying fox. Human flesh was consumed as a luxury meat. Many of the seeds and nuts eaten contain actively poisonous alkaloids, which are eliminated only by special washings, leachings, roastings, and by fermentational methods. Many of the nuts and the bees' nests are very inaccessibly placed on high trees, and methods are practised of tree-climbing with a cane loop held in the hand, the climber appearing to run up the tree trunk by cleverly synchronized alternating steps and lifting movements of his knotted climbing cane. A motion picture (16 m.m. record) of this practice is also preserved in the film library of this Museum.

Stone axes are employed; the people on the coastward side of the area having trimmed and edge-ground cane-hafted axes, and those on the inland margin use axes which have been symmetrically trimmed by pecking and battering and ground on the edge. The principal function of the axe was in honey gathering from trees in the open savannah between the jungles. According to native tradition, the making of axes was formerly unknown, and they were brought from the west and traded by newcomers. Stone knives were made from irregular flakes of quartz; the handles are pieces of beeswax. Large stone slabs containing circular pits of approximately 2·5 cm. diameter are used in the breaking of the exceedingly hard Queensland Nut, which yields an important food item.

SUMMARY.

This is a report on one aspect of the work of the combined Harvard and Adelaide Universities Anthropological Expedition of 1938–39, financed by the Carnegie Corporation of New York.

The presence, in the Atherton Tableland, of a people of relatively small stature and crisp curly hair, is recorded. These people are identified as modified descendants of a Tasmanoid stratum on the Australian mainland. They inhabit an area of dense rain jungle and highland plateau in the wettest area of North Queensland. Their physical form appears to have been preserved, through isolation, in a relatively inaccessible and uninviting environment, not sought by the usual Australian tribes.

In their burial customs these people present some features reminiscent of the Tasmanian aborigines. Their essential cultural relationships are recognized as being rather with the people of Tasmania and of Southern Australia than with the folk of the northern tribes who surround them.

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EXPLANATION OF PLATES.

Plate i.

Camp scene on edge of rain jungle; huts roofed with wild banana leaves; Cairns District; period 1890, photo A. Atkinson.

Plate ii.

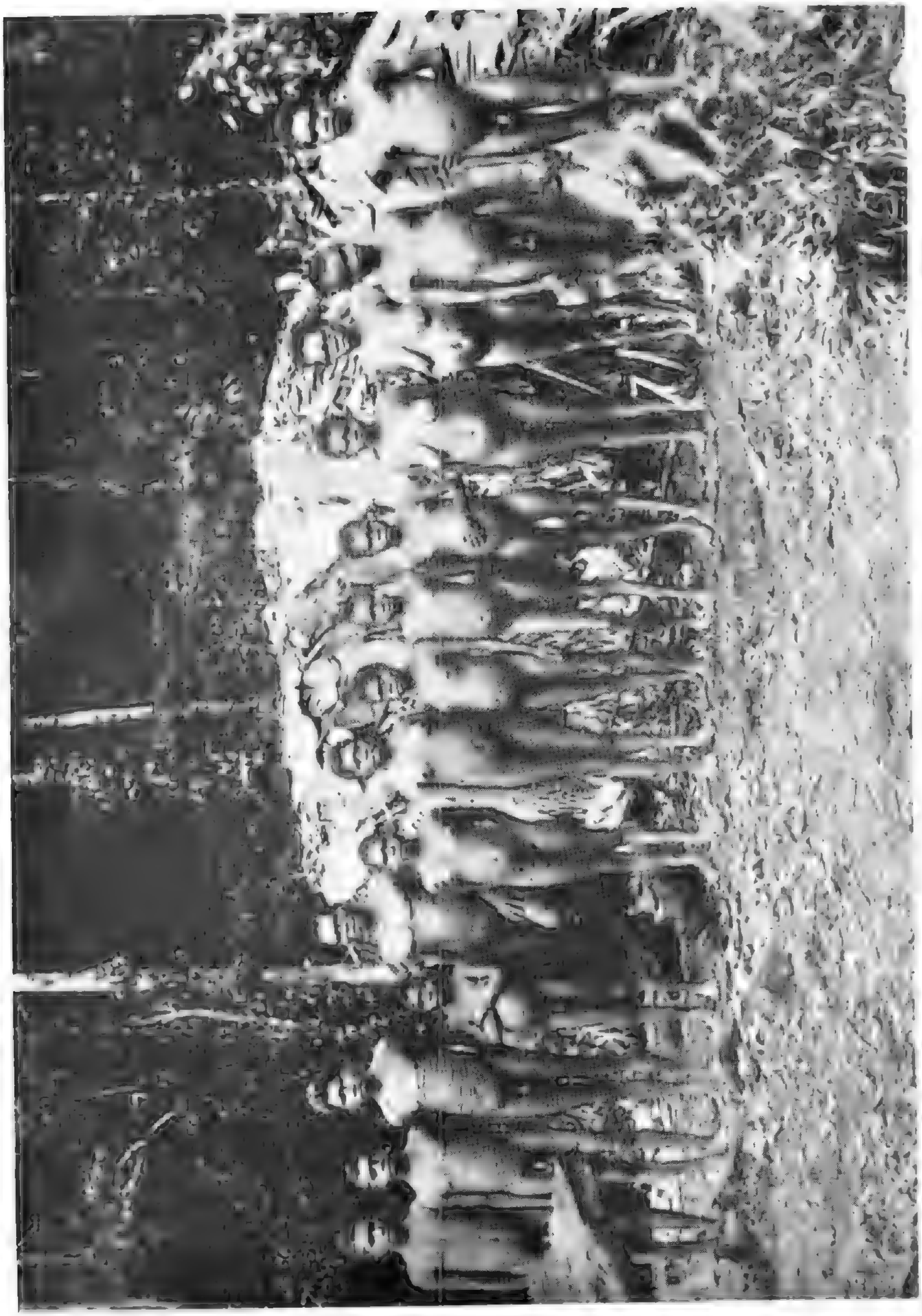
1. Idindji tribespeople near Babinda, about 1893 (the figure 5th from the left then was approximately 10 years of age; he was measured, at 55 years, under the number N. 822 by this Expedition; the figure at left holding a [ˈpaku:r] or wooden sword-club was a leading man, Burumbu, of Mulgrave River; 4th from left is Torunga of Warukeinju, a Korabana man, father of our N. 1108). The design of the shield [biku:n] held by the central standing figure relates to a species of fruit; the second shield from right bears a frog design.
2. Idindji women with cane baskets of types based on sewn bark originals.
3. An Idindji leading man, Jabulum, about 1890; father of Mandinggarabai (N. 611) who is shown in Plate iv, 1 and 2; he is wearing a [ˈbutju:l] ornament of white cockatoo feathers. Photos, A. Atkinson.

Plate iii.

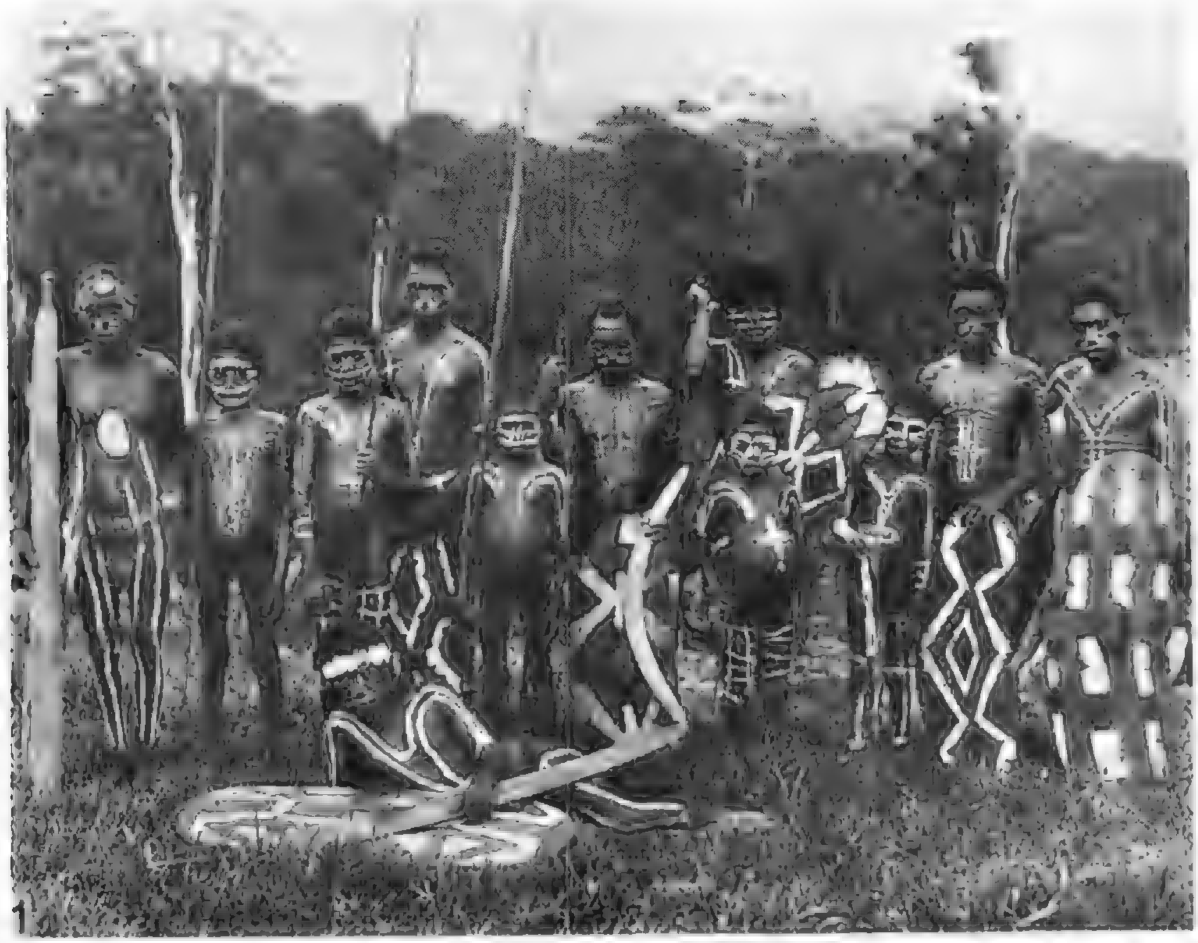
1. Tjapukai youth, 18 years (measured as N. 433 of this expedition).
2. Buluwai girl, 11 years (measured as N. 581).
3. Tjapukai man, 68 years (measured as N. 444).
4. Muluridji man wearing [ˈmeramba] a Tjapukai dancing ornament of sulphur-crested-cockatoo feathers, affixed to hair with beeswax. Photos, N. B. Tindale.

Plate iv.

1. Idindji man in position of defence with sword-club and a shield bearing a turtle and fish design.
2. Idindji man with shield and sword-club held in a position for attack (subject measured as N. 611, aged 55 years; stature 155 cm.; son of Jabulum, plate ii, fig. 3).
3. J. B. Birdsell and the shortest Kongkandji man, 24 years (N. 669; stature 140 cm.).
4. N. B. Tindale and Barbaram man (estimated age 60 years, measured as N. 482; stature 151 cm.).



QUEENSLAND RAIN JUNGLE CAMP SCENE



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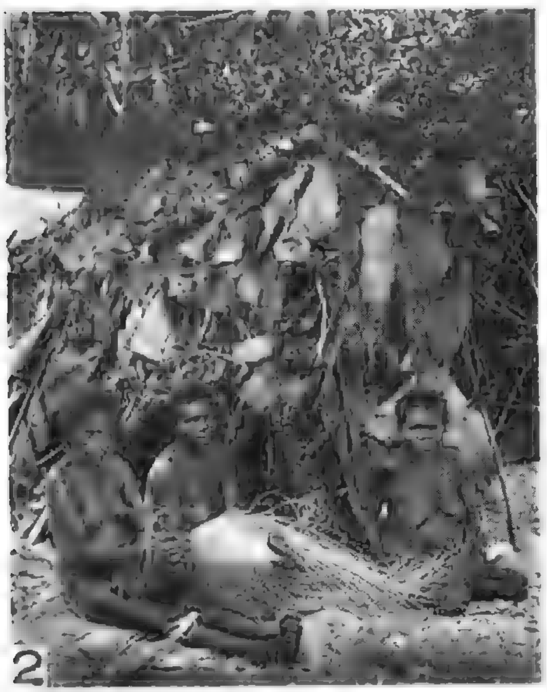

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IDINDJI JUNGLE FOLK

NORTH QUEENSLAND TASMANOIDS

NORTH QUEENSLAND TASMANOIDS

IMPROVED METHODS OF COLLECTING MARINE ORGANISMS

BY KEITH SHEARD

Summary

As much of the present-day study of marine organisms is concerned with the recording of associations, and with the relationship existing between animals and the physical condition of their environment, it follows that the value of such work is largely dependent on the thoroughness of the collecting methods used.

During recent years, work on marine crustacea carried out at the South Australian Museum has led to adaptations of various methods, resulting in a great increase in the number of species and total quantity of animals secured.

IMPROVED METHODS OF COLLECTING MARINE ORGANISMS

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Fig. 1.

As much of the present-day study of marine organisms is concerned with the recording of associations, and with the relationship existing between animals and the physical condition of their environment, it follows that the value of such work is largely dependent on the thoroughness of the collecting methods used.

During recent years, work on marine crustacea carried out at the South Australian Museum has led to adaptations of various methods, resulting in a great increase in the number of species and total quantity of animals secured.

One result of the employment of these methods has been to indicate that members of Orders such as Amphipoda, Cumacea, and Ostracoda, together with the various Sub-orders of the Isopoda, are much more abundant and are far greater factors in the food chains of fishes than has been appreciated by workers on this subject. Actually, there is some evidence to show that the occurrence of the larger pelagic fishes in any one locality is, to some extent, dependent on the distribution of organisms which are usually regarded as bottom living. In other words, while the general distribution of the Nekton may be determined by that of the Plankton, a factor of its particular occurrence may be the character of the underlying Benthos. On this point much enquiry is necessary.

The improvements detailed below cover the following techniques: full-speed plankton netting, submarine light methods, reef collecting, and dredging.

Full-speed Nets.

(Fig. 1).

The position with regard to these is well summarized in the B.A.N.Z.A.R.E. reports (Johnston, T. H., 1937, p. 6). In the majority of the nets, the mouth opening is of necessity small, and in addition the frontal wave at speed is so great that active swimmers and larger organisms have little difficulty in evading the net. Yet high speed nets are desirable, as even with efficient low speed nets of the "Discovery" type the frontal wave is large in comparison with the speed obtained, so that again the more active forms escape.

For the last twelve months I have been using a modification of the N70 type, which is towed at up to six knots, catching material ranging from large diatoms to Blue Sprats (*Stolephorus robustus*) of 7·5 cms. in length. During that time the net has suffered no apparent damage after covering about two hundred miles at a high speed. The organisms collected were little damaged. The net itself proved remarkably stable during towings.

Details of Construction.

Dr. Harold Thompson, of the C.S. & I.R., Division of Fisheries, kindly provided a net of the general N70 type (see Kemp and Hardy, 1929, p. 181, fig. 6). This net had a mouth opening of 61 cm. The first section was of canvas 1 foot

9 inches long; the second of No. 40 bolting cloth, 3 feet long, while the third was of No. 74 bolting cloth, 3 feet 6 inches long.

To adapt this for high speed work, a ring of 1 inch cane was made as a tow ring; the canvas section was removed and replaced by ¼ inch shrimp net, while a brass ring 3 inches in diameter was fitted to the bucket end of the net, three baskets being rove on to this, the bucket itself being dispensed with.

The bucket end of the net was then turned in on itself and drawn up, so that the brass ring came about half-way up the No. 40 bolting cloth. A second brass ring, 11 inches in diameter, was then slid down the inside of the net to keep the hind end distended. This was secured from the outside with brass clips. Three light marlin leads, each of a breaking strain of 164 pounds, were threaded from the beckets of the small brass ring and attached to the cane towing ring. (This marlin could be lighter if a greater safety margin were desired.)

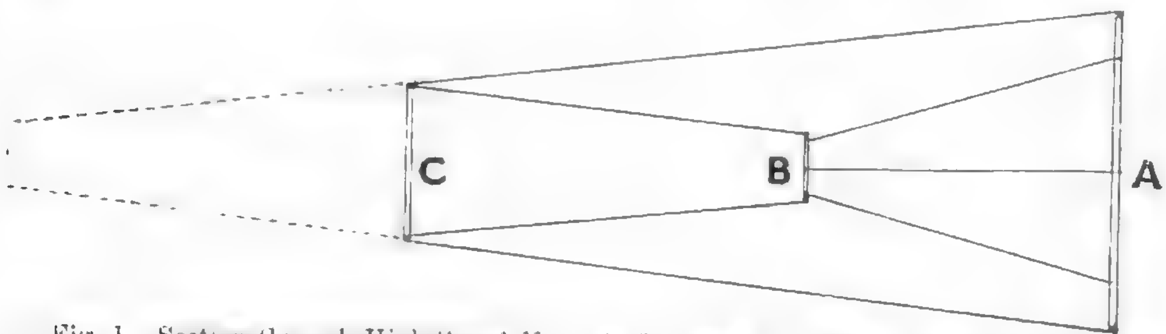

Fig. 1. Section through High Speed Net. A, Tow ring. B, Small brass ring. C, Large brass ring. Dotted lines indicate original position of hind end of net.

The completed net was towed at the end of about one hundred feet of light rope in order that the elasticity in this length would counter sudden jerks. A light accumulator could be used with a greater safety margin at speeds in excess of five knots, the strain at that speed being about 300 pounds.

The action of the net is an application of Bernoulli's Principle. The increase in speed of the water column in passing through the narrow orifice results in a lowering of pressure immediately behind it, consequently giving the net a greater filtering capacity. In addition, the swift, uninterrupted flow of a proportion of the water through the net eliminates the frontal wave, making it difficult for even fast swimming organisms to escape.

At slow speeds, the catching power is comparable with that of the standard net, increasing with the speed. The only difficulty occurs in removing organisms from the net, as the addition of an orthodox collecting device unduly increases the total strain. However, I have not found this to be a serious disadvantage.

The principle could easily be extended, and it should be possible by suitably varying the relative size of the large and small orifices to build nets which would tow, efficiently, at any reasonable speed, thus answering the objection raised by Marr (Marr, 1938) to the use of large plankton nets.

Submarine Light Methods.

Work done by Mr. H. M. Hale at Sellick Beach led us to consider whether the apparent inequality in distribution, and preponderance of males in certain areas, recorded in literature, might not be due to the bias given by current collecting methods.

Accordingly, I experimented with a modification of submarine light collecting methods. It was found that, by suitably decreasing the intensity of a light held near a glass jar containing a miscellaneous assortment of marine organisms, the bulk of these could be attracted toward the source of light. Further experiments at sea showed that the best all-round results were obtained when a light of low intensity was hung inside the mouth of a net a little above the sea bottom at about half an hour after sun-down. The light and net were left in position for thirty minutes.

One trial was made in the daytime at a depth of 180 metres. Fair results were obtained. Through the courtesy of Dr. A. L. Tostevin, it was possible to make a collecting trip on his yacht, "Nyroca", and in one sample taken at night at the Page Island (off Kangaroo Island) in nine fathoms of water on 12/4/41 between 7 and 7.30 p.m., representatives of the following groups of organisms were obtained:

Radiolaria, two species. Ctenophora, one species. Chaetognatha, one species; Annelida, three species. Ophiuridea, one species. Larvae of a reef-dwelling Trochid. Nebaliacea, one species; Cladocera, two species; Mysidae, one species; Euphausiacea, two species; Decapoda, both adult and larval, five species; Ostracoda, three species; Isopoda, three species; Amphipoda, nine species; Cumacea, a dozen species; Copepoda, eight species. Tunicata, one species. Fishes, *Stolephorus robustus* and *Engraulis australis*. In size, the organisms ranged from 0·5 mm. to 98 mm.

In preparing this apparatus, a short wire was soldered to the contact of a single contact 2·5 volt torch globe; the upstanding brass strip of a flat, 3 volt battery was then turned over to wrap around the metal stem of the globe, and the loose end of the wire was clipped on to the side strip of the battery to complete the circuit. The lighting unit was then placed into a quart clip-top preserving jar, together with some lead weights.

In use this light was hung with marlin so that it fell about 12 inches below the ring of an N70 type net, of which the first 21 inches was ¼ inch mesh shrimp net. This net was weighted in order to sink in any reasonable current, and lowered so the light and shrimp netting were clear of the bottom.

In a number of hauls, the only damage sustained was when a large shark attacked the apparatus, biting off the bucket and large weights as the net was being hauled inboard.

REEF AND BOTTOM COLLECTING METHODS.

This procedure was adapted from a suggestion made by Dr. K. H. Barnard, South African Museum, in a letter to Mr. H. M. Hale (Hale, H. M., 1929, p. 9; 1936, p. 404). It is as effective for removing small organisms from seaweed as it is from the crevices of rocks.

Stones, etc., brought carefully from the bottom so that the sand film is little disturbed, were immersed in a solution consisting of one part of commercial formalin to forty parts of sea water, i.e. a 1 per cent. solution. It is essential to have the concentration of formalin so low that the animals do not die immediately, yet strong enough to drive them from the crevices. After about fifteen minutes' immersion, the rocks or seaweed were shaken in the water and removed. The liquid was strained, the strainings together with the sediment from the bottom being bottled for examination.

Material dredged from deeper water was treated in the same manner. In this case the results were not quite as good since, in the long haul to the surface, some of the sand film on the rocks was lost. However, even with this disadvantage, the increase in the number of specimens obtained from dredgings was considerable in comparison with those gathered by the usual methods of hand picking and sieving.

Only too often in the course of marine expeditions has the best part of the catch been allowed to wash overboard again through the scuppers.

A further device for securing plankton forms living near the sea floor is detailed by Dakin and Colefax (1940, p. 17). This consists of a sled type of net which could possibly be adapted to work over a broken bottom, thus supplementing the submarine light catches.

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REVISION OF THE GHOST MOTHS[1] (LEPIDOPTERA HOMONEURA, FAMILY HEPIALIDAE)

PART IV

By Norman B. Tindale, B.Sc., South Australian Museum

Summary

In the course of the revision of the Australian Hepialidae it has become desirable to pay attention to genera and species from several other natural regions. The scope of the study is therefore widened. The presence in southern South America of genera and even species closely related to Australian ones, and the existence of other somewhat more distantly related ones, in the Gondwanan and Himalayan areas of India, has raised generic problems, while the archaic nature of these strange moths necessitates wide study of their relationships. In the present contribution attention is given amongst others to several Asiatic genera, and a new sub-family division is proposed.

REVISION OF THE GHOST MOTHS[1] (LEPIDOPTERA HOMONEURA, FAMILY HEPIALIDAE)

PART IV.

By NORMAN B. TINDALE, B.Sc., South Australian Museum.

Plates v–vii, and Text-fig. 1–51.

In the course of the revision of the Australian Hepialidae it has become desirable to pay attention to genera and species from several other natural regions. The scope of the study is therefore widened. The presence in southern South America of genera and even species closely related to Australian ones, and the existence of other somewhat more distantly related ones, in the Gondwanan and Himalayan areas of India, has raised generic problems, while the archaic nature of these strange moths necessitates wide study of their relationships. In the present contribution attention is given amongst others to several Asiatic genera, and a new sub-family division is proposed.

Since the preparation of earlier parts one new member of the Australian genus *Trictena* and another of *Bordaia* have come under notice, and these are described.

For some years it has been difficult to identify species of Hepialidae from countries outside Europe and the United States. One problem has been scarcity of material, even of species which are of considerable economic importance to forester and farmer. It is also unfortunate that types of the species are widely scattered in collections, and, in a group such as Hepialidae where the older determinations, unchecked by studies of the genitalia and venation, are subject to many doubts, research workers have been chary of describing their material.

Opportunities afforded in 1936–7 by the Carnegie Corporation of New York and by the Australian National Research Council, enabled the writer to spend brief periods in examining types of species preserved in the Berlin Museum; the Senckenberg Museum (Frankfurt-am-Main); the United States National Museum (Washington); American Museum of Natural History (New York); Tring Museum; British Museum (South Kensington), as well as in some smaller collections in the United States of America, Canada, Holland, and Belgium.

I am indebted to Mr. W. H. T. Tams for his assistance in the study of type material in the British Museum, and to Professor A. Seitz, Drs. G. D. H. Carpenter, W. Forbes, M. Hering, K. Jordan, J. McDunnough, W. Schaus, E. P. Van Duzee, and Messrs. T. Bainbridge Fletcher, T. R. Bell, J. C. M. Gardner, and F. C. Watson, who have been kind enough to provide material of this group for study. Types of several new species described in this revision are to be lodged in the British Museum; others are in the South Australian Museum, where, so far as is possible, a paratype series is also preserved. Through the courtesy of collectors and others it has been possible to bring together at Adelaide one of the most extensive extant series of Hepialidae.

The importance of the study of the genitalia, in both sexes, must be stressed; lack of attention to details of these organs has been one of the primary causes of the difficulty experienced in the recognition and classification of the insects. The complex genital armature of the female has been mistaken for that of the male, and in consequence the types of some species have masqueraded under wrong sex designations.

(1) Part 3, entitled Revision of the Australian Ghost Moths, was published in *Rec. S. Aust. Mus.*, v, 1935, pp. 275–332.

The homologies of the female genitalia in the Hepialidae have not hitherto been worked out. For the study of *Endoclita* and allied genera it is desirable to attempt to identify or define some of the principal parts.

It would appear that, for example, in *E. undulifer*, the seventh sternite is specialized to form a hood over the genitalia (fig. 1–2). Its posterior margin is strongly notched, evidently to enable the eighth sternite to be folded forward when extruded in the act of copulation. The eighth sternite or subgenital plate is itself drawn out posteriorly, and the lateral margins are folded over to form a hollow trough; this may serve as a guide to the intromittent organ of the male.

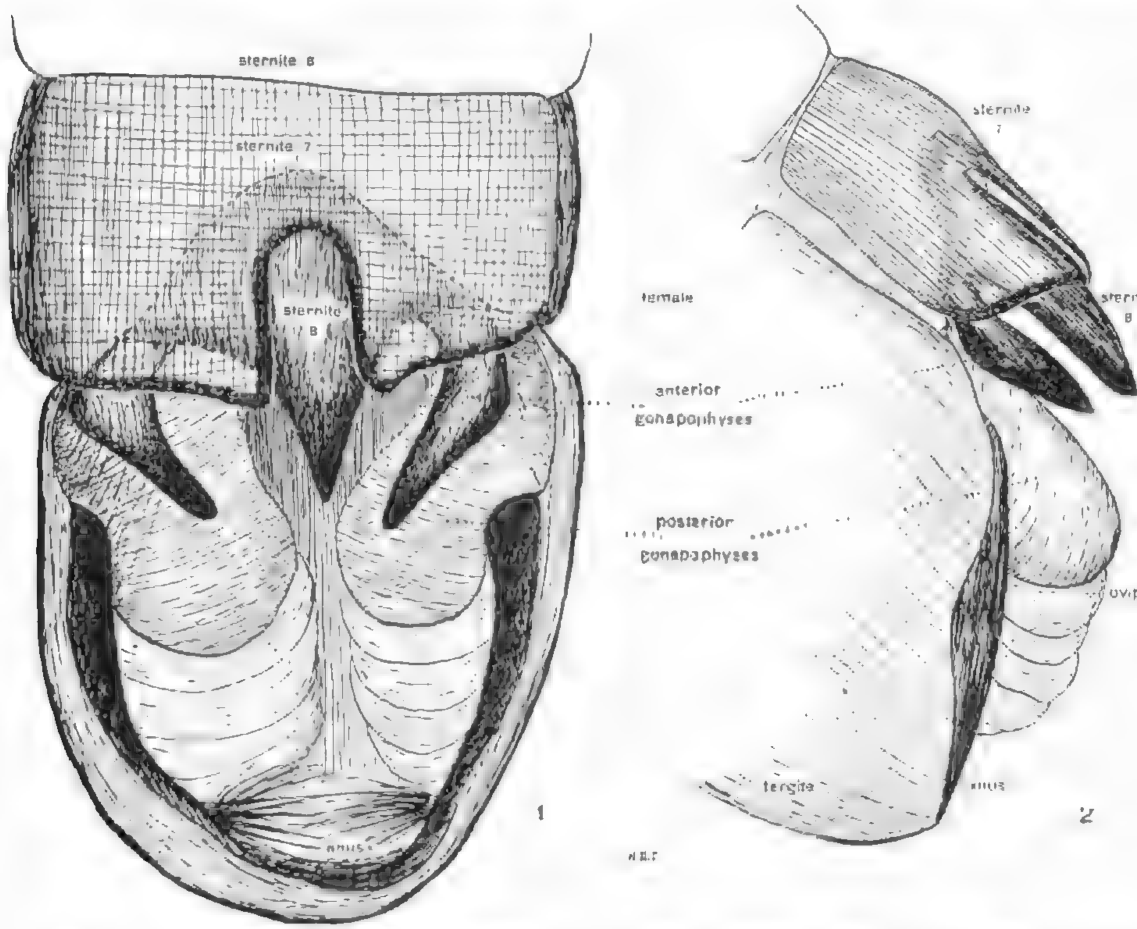


Fig. 1–2. *Endoclita undulifer* (Walker). 1. Ventral view of female genitalia. 2. Lateral view, composite sketch.

The copulatory opening is concealed beneath the eighth sternite on the margin between the eighth and ninth. Attached to the lateral margins of the eighth sternite are hollow, cylindrical pointed processes, one on each side, which may be homologous with the anterior gonapophyses of more primitive insects. Posterior to these are large swollen, strongly chitinized convex plates (perhaps homologous with the posterior gonapophyses) one on each side of an elongate cloaca-like median cavity leading to the oviporus. Posteriorly from these chitinized plates are curious concertina-like folded protuberances, which may represent rudiments of the lateral gonapophyses. The posterior and lateral gonapophyses can be considered to form an apparatus for carrying the newly extruded egg towards the posterior extremity of the body. There is an anal opening situated at the extremity of the abdomen.

In the interpretation of the wing veins it is now recognized that the 1A of Comstock and Needham (1898, 1899, *American Naturalist* 32, 33) should, following Snodgrass (1935, Principles of insect morphology) be regarded as a separate vein, the *post-cubitus*, while the following anal veins should be distinguished as *vannal* veins. The venational diagrams are marked accordingly; those reading earlier parts of this Revision should make the necessary adjustments.

ZENOPHASSINAE subfam. nov.

ZENOPHASSUS gen. nov.

Plate v, fig. 52; Text-fig. 3–6.

Head with antennae cylindrical, tapering to apex, composed of about 28 segments. A supposed post-antennal organ, composed of a single club-shaped member present at the anterior angle of the clypeus. Mouth parts with mandibles pre-

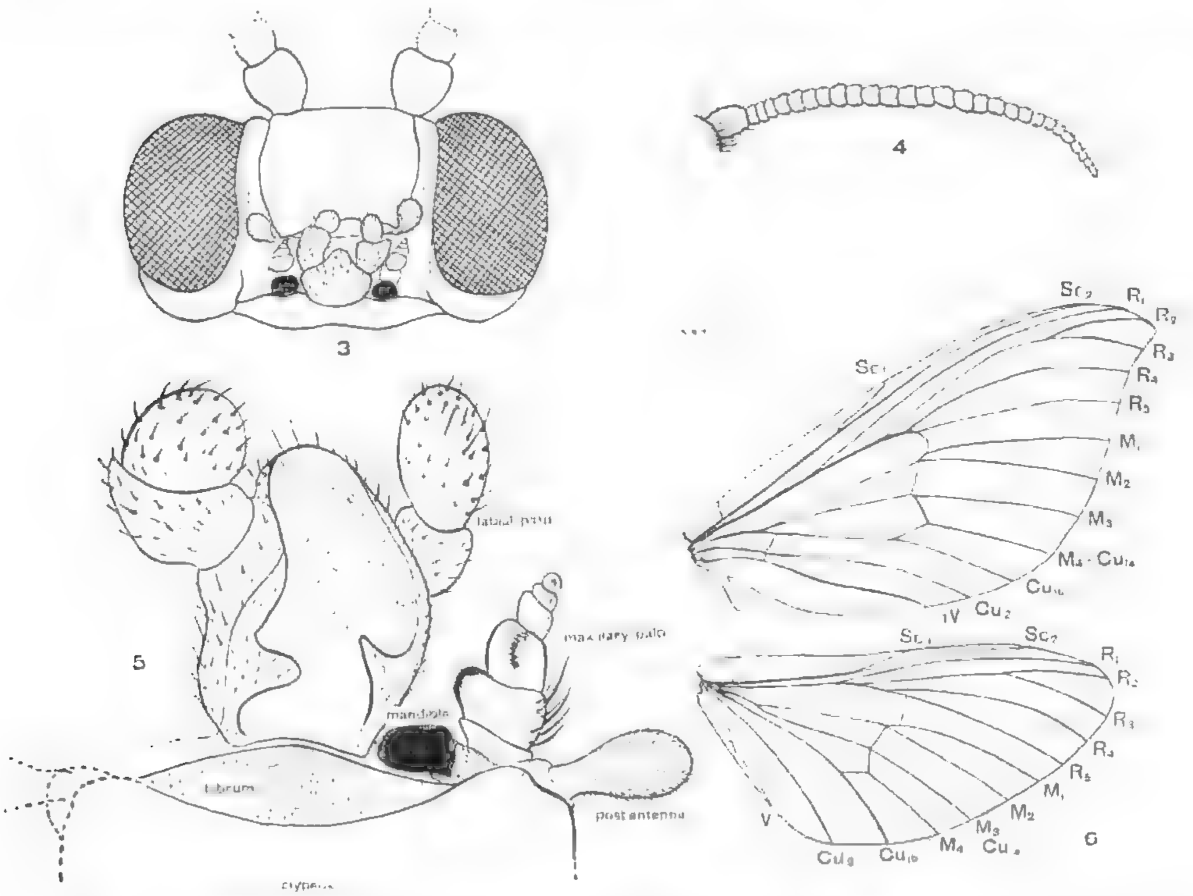


Fig. 3–6. *Zenophassus schamyl* (Christoph), male, Kuban, Caucasus. 3. Ventral view of head. 4. Antenna. 5. Mouth parts from dorsal aspect of hypopharynx. 6. Venation.

sent, rudimentary, but strongly chitinized, some obscure traces of dentition. Hypopharynx large, about as wide as long. Labial palpi two-segmented, occasionally segments almost fused, the division then only visible in microscope mounts. Maxillae present, reduced, at least five visible segments. Posterior legs in male with specialized tibial tuft. Forewings with Sc_1 present as a strong vein; R_1 and R_2 before apex; R_3 well separated from Sc; R_2 from R_3 near apex; R_4 from R_5 before r-m vein; Cu_2 a weak vein but reaching to margin; Pcu apparently obsolete; 1V a strong vein to posterior angle; 2V absent. Hindwing with Sc_1 present as a strong vein to costa; Cu_2 a strong vein; Pcu and two vannal veins apparently fusing near base, with 1V extending to hind margin.

Genotype: *Hepialus schamyl* Christoph. (1888, p. 309; 1889, p. 198).

Only one species has so far been recognized in this strange genus which seems to combine one or two specializations usually associated with genera like *Phassus* and *Sthenopis* with some of the most primitive features yet found in the Lepidoptera. The latter warrant its separation as a new subfamily, the Zenophassinae. The mandibles, apparently non-functional yet rather well developed, and the maxillae, are features which could be expected to occur in a primitive member of this archaic family, although they have only been noticed as traces in such species as *Fraus polyspila*. The supposed post-antennal organ, a single club-shaped segment, has apparently not hitherto been found in a lepidopterous insect, although such organs have been recorded for insects of other more primitive orders.

The presence of Sc_1 in both wings is another archaic feature. This vein is (e.g. Philpott 1926) sometimes considered to be absent in the Hepialidae, but may be seen in the forewing of members of several genera, its presence or absence being a useful diagnostic character for genera allied to *Sthenopis*. In no other Hepialid, so far as they have been examined, does it seem to be so strongly developed as in this genus.

Deegener and Schaposchnikow (Zeitschr. wiss. Zool., lxxviii, pp. 245–260, pl. xiv) have described scent organs present on the posterior legs of the male of *Z. schamyl*, while Slastshevskij (1929, pp. 189–199, fig., 1929a, pp. 39–56 and 1929b, pp. 51–60) has described its biology. The one known species occurs in the Caucasus Mountains, the specimens examined being from Kuban (July), Majkop (Sept.), and Elisabethpol.

Subfamily HEPIALINAE.

ENDOCLITA Felder 1874.

Endoclita Felder, 1874, iv, pl. lxxxi, f. 3. *Endoclyta* Felder, 1875, v, Erklär., p. 4 (*similis*). *Hypophassus* Le Cerf, 1919, xxv, p. 470 (*signifer*), new synonymy.

Antennae sparsely clothed with hairs, cylindrical, short, tapering, with about 22 segments (fig. 7). Labial palpi reduced, composed apparently of a single segment, with some indications of a second marked by a line and not articulated (fig. 8). Posterior legs of male with tibiae clothed with a large tuft of specialized hairs. Forewings with Sc_1 present as a branch to the costa; often a lobular expansion opposite Sc_1 (not evident in genotype); R_1 forking with R_s well before the middle of wing; R_1 and R_5 forked; Cu_2 becoming obsolete at one-half; Pcu and 1V anastomosing beyond middle and extending to margin; 2V present near base. Hindwings with Sc unbranched. R_1 from well before middle.

Genotype: (*Endoclita similis*) Felder = *Phassus damor* Moore.

The spelling of the generic name as *Endoclita* is accepted. This appeared on plate lxxxi of part IV of Felder's work which was published in November, 1874. The "Erklärung" published with part V (about July, 1875) gives an alternative spelling (*Endoclyta*). In the Zoological Record for 1874 and in the supplementary list of new genera, *Endoclita* is disguised under the misprint of *Sudoclita*. The original figure, with generic and specific name as given in 1874, can be accepted as a valid indication according to the International Rules for Zoological nomenclature. (See also Hemming, Generic names of Holarctic Butterflies, 1934, p. 8–9). In Felder's "Erklärung" the brief description "Endoclyta n.g. (Epialo affine; pedeo validi, corpus longum, al. post angulus internus expressus) *similis* F. ♂ Himalaya (Stoliczka)" gives no reason for an alteration in spelling.

Hypophassus is a valid name but it must be regarded as a synonym of *Endoclita* unless it is later on established that *E. signifer* can be separated generically from *E. damor.*

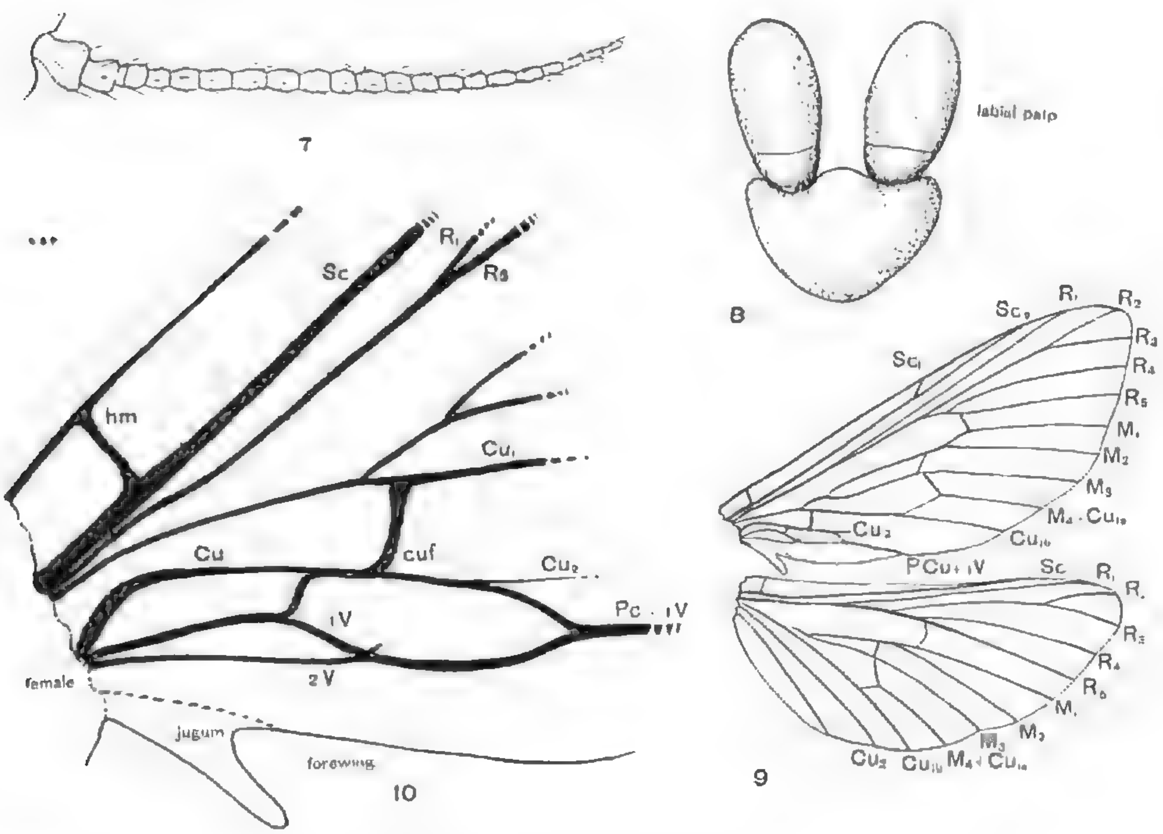


Fig. 7–10. *Endoclita damor* (Moore), female, Mussoorie. 7. Antenna. 8. Labial palpi. 9. Venation. 10. Venation of portion of forewing (much enlarged).

In the species placed in *Hypophassus* the costa of the forewings at Sc_1 is dilated, forming a lobular expansion; the condition reaches its climax in *E. crenilimbata* Le Cerf, from China, but is well marked in numbers of others, including *E. signifer.* It is absent in the genotype of *Endoclita.* When present it is about equally developed in the sexes, and may be of generic significance, but in the absence of a well-defined line of demarcation it is difficult to apply. If *Hypophassus* is regarded as a subgenus it will embrace *signifer, crenilimbata, gmelina,* and other, as yet undescribed East Indian species possessing a swollen costa; *E. chalybeata* is an intermediate form. Fourteen species are at present known from India, Burma, and Ceylon, and several are important timber pests.

Members of a group within this genus, embracing *E. punctimargo, buettneria, metallica, rustica, aurata,* and *chrysoptera* appear to have valid specific differences separating them, for in addition to rather striking variations in size, wing proportions, distribution of markings and of "metallic" scalings on the wing, there are observable differences in the genitalia. Nevertheless the genitalia show by their similarity that the differences may be of a lesser order than those separating some other members of the genus. An explanation which occurs to me is that these represent a complex of relatively lately evolved species, developed in the highlands of the Eastern Himalayas. Other more widely divergent members of the genus may belong to older forms representing survivals from earlier periods of species formation. In the Hepialidae, which are generally considered to be primitive and relatively stable, actively evolving groups may be observed in several different geographical areas, for example in the mountains of Papua, where many diverse, and yet related, forms of *Oxycanus* and of *Oenetus* appear, in the south of Australia (*Oxycanus, Oenetus* and *Oncopera*), and in the southern extremity of Africa.

KEY TO PRINCIPAL SPECIES OF ENDOCLITA.

(Based partly on the genitalia.)

a. Males.
- b. Tegumen with a posterior, ventrally directed spine.
  - c. Spine long, extending beyond rest of tegumen.
    - d. Eighth sternite deeply notched on posterior margin .. .. *damor*
    - dd. Eighth sternite not deeply notched on posterior margin .. *marginenotatus*
  - cc. Spine short, extending no further than tegumen .. .. .. *undulifer*
- bb. Tegumen without a posterior, ventrally directed spine.
  - e. Posterior margin of eighth sternite with a median projection .. *chalybeata*
  - ee. Posterior margin of eighth sternite without a median projection.
    - f. Tegumen, in lateral view, with margin entire and convexly dilated.
      - g. Margin of tegumen in ventral view diverging posteriorly.
        - h. Posterior margin of tegumen strongly transverse and only slightly excavated .. .. *gmelina*
        - hh. Posterior margin of tegumen strongly excavated *purpurescens*
      - gg. Margins of tegumen in ventral view, not diverging posteriorly.
        - i. Seventh sternite deeply notched on posterior margin *signifer*
        - ii. Seventh sternite transverse on posterior margin .. *albosignata*
    - ff. Tegumen in lateral view with only posterior half dilated.
      - j. Posterior margin of eighth sternite with a median notch *rustica*
      - jj. Posterior margin of eighth sternite transverse, and without median notch.
        - k. Hindwings clothed with metallic scales .. *metallica*
        - kk. Hindwings not clothed with metallic scales.
          - l. Expanse over 50 mm.
            - m. Forewings chocolate brown .. .. *buettneria*
            - mm. Forewings yellowish-brown and golden-yellow .. .. *chrysoptera*
          - ll. Expanse under 50 mm. .. .. .. *aurata*

aa. Females.
- n. Posterior margin of seventh sternite with deep median notch .. .. *undulifer*
- nn. Posterior margin of seventh sternite without deep median notch.
  - o. Anterior gonapophyses with apical spine. Penultimate tergite with antero-ventral margin produced.
    - p. Eighth sternite narrow, with parallel sides .. .. .. *microscripta*
    - pp. Eighth sternite broad, sides not parallel.
      - q. Seventh sternite much wider than long .. .. .. *punctimargo*
      - qq. Seventh sternite as long as wide .. .. *buettneria*
  - oo. Anterior gonapophyses without apical spine. Penultimate tergite with antero-ventral margin not produced.
    - r. Anterior gonapophyses a broad plate, not digitiform.
      - s. Eighth sternite swollen at apex of posteriorly produced portion.
        - t. Eighth sternite narrowly spatulate .. .. *signifer*
        - tt. Eighth sternite broadly spatulate .. .. *chalybeata*
      - ss. Eighth sternite not swollen at apex.
        - u. Eighth sternite with margins parallel sided .. .. *damor*
        - uu. Eighth sternite swollen near base, not parallel sided .. .. .. *purpurescens*
    - rr. Anterior gonapophyses digitiform not expanded into a broad plate .. .. *gmelina*

ENDOCLITA DAMOR (Moore).

Plate v, fig. 53–54, and Text-fig. 7–14.

Phassus damor Moore, 1859, ii, p. 437. *Endoclita similis* Felder, 1874, iv, pl. lxxxi, fig. 3. *Phassus damor* Butler, 1886, vi, p. 31, pl. cix, f. 3; Hampson, 1892, i, p. 319; Pfitzner and Gaede, 1933, x, p. 843, pl. lxxvii b.

♂ Antennae pale ochreous; head, sides of thorax and abdomen, pale brown; thorax above slightly paler; hind tibiae ornamented with large tuft of dull ochreous hairs. Forewings pale subhyaline brown, with a dull golden tinge, ornamented with obscure brown, silvery-grey, and white lunular markings; the brown of wing forms a broad oblique zigzag fascia free from silvery markings across discoidal area, starting from costa near base, and running across to termination of

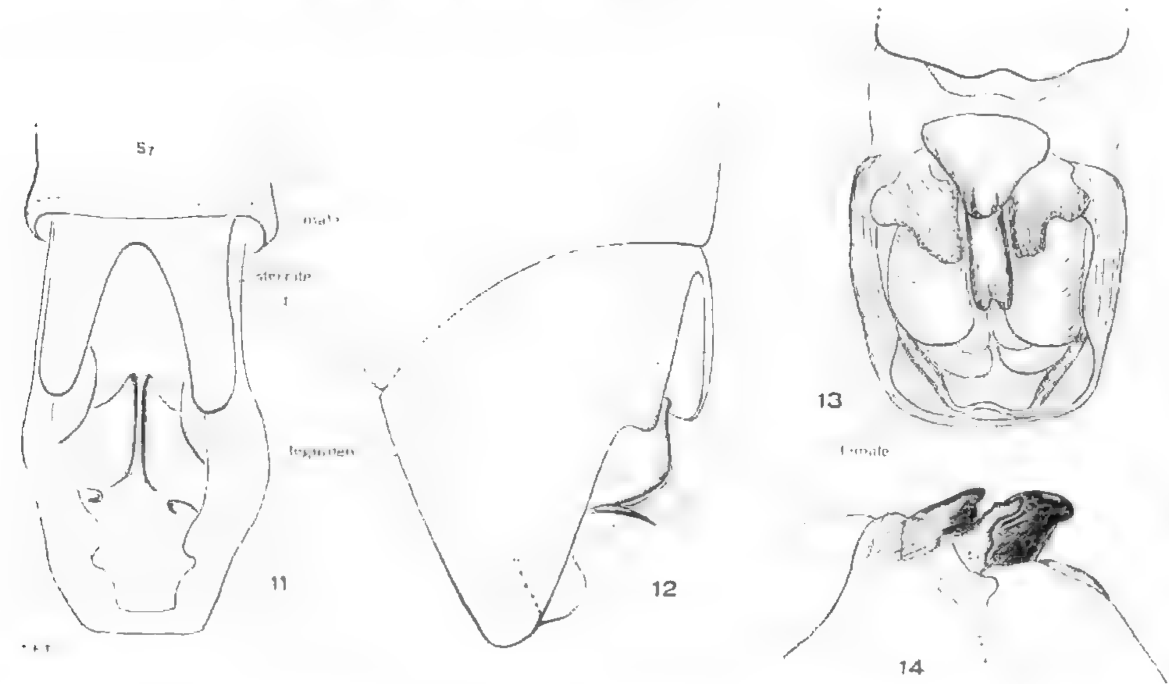


Fig. 11–14. *Endoclita damor* (Moore). 11. Male, Kangra Valley, genitalia, ventral aspect. 12. Male lateral aspect. 13. Female, Mussoorie genitalia, ventral aspect. 14. Female, lateral aspect.

Cu_2 where it is margined below by a clearly defined semi-circle of silvery-white markings enclosing a brown spot, and thence to costa at four-fifths, after making an angle to avoid an obscure triangular wedge of silvery-grey markings at two-thirds costa. Hindwings greyish-brown, darker towards apex, costal margin just before apex tinged with brown and bearing two obscure silvery-grey markings. Expanse 63 mm.

♀ Similar to male, but colour darker olivaceous brown, markings well defined, similar to male. Head and thorax above dull whitish-olivaceous; posterior tibiae without specialized hair tufts. Expanse 68 mm.

Loc. Sikkim: Darjeeling (type a female, expanse 88 mm. labelled "Darjeeling, Paris Exhib. 60–51 E.I.C." in British Museum).

United Provinces; Mussoorie. Punjab; Kangra Valley (4,500 ft.). 6. One male, three females.

The male described is from Kangra Valley, the female from Mussoorie. The differences in colour exhibited between the few examples examined suggests that, like many Australian Hepialidae, there may be considerable range in the shades of colour present on the wings.

The Mussoorie female, from our collection, has been closely compared with Felder's type of *Endoclita similis* in the Tring Museum. The latter is a female, expanse 63 mm., labelled "India Sept. type *Endoclita similis*, no. 6 in tab. Felder Coll." The no. 6 is evidently an error for "no. 3". The genitalia of this type specimen, as far as may be seen without dissection, agree closely with the one figured.

The type of *damor*, of which Butler's figure is a representation, is also a female; it is larger than our described specimen, but the markings are similar. The genitalia are so badly affected with mould that it was not possible to make a close examination of them. The figure in Seitz is an inferior copy of Felder's plate, and does not greatly resemble the original. Specimens of this species are present in the British, Tring, and South Australian Museum collections.

The male genitalia, which have been examined without dissection (fig. 11–12) have the tegumen, viewed from the side, somewhat evenly convex and smooth margined. There is a long-pointed cylindrical spine rising from its postero-lateral margin. The posterior margin of the eighth sternite is deeply notched, and the postero-lateral extremities are strongly rounded and chitinized.

The female genitalia, also drawn without dissection (fig. 13–14) show a rounded triangular seventh sternite, a strongly chitinized, narrow, straight-sided, end-notched, well-rounded eighth sternite; curious irregular flat, racket-like anterior gonapophyses are present, and the supposed posterior gonapophyses appear as rounded, subglobose, lateral lobes.

ENDOCLITA MARGINENOTATUS (Leech).

Plate vii, fig. 68 and Text-fig. 15.

Phassus marginenotatus Leech, 1898, p. 356.

The type of this species is figured, together with a representation of the male genitalia for comparison with species such as *E. chrysoptera*, which is superficially similar. The type example in the British Museum is from Western China and is labelled "Omei-Shan 3,500 feet, native collector, June and July, 1890, Leech Coll. 1900–64".

I am indebted to Mr. W. H. T. Tams for the photograph (pl. vii, fig. 68) and for his confirmation of my opinion that this species belongs to *Endoclita*. He wrote (13th Dec., 1937): "In *marginenotatus*, the venation is almost identical with that of *P. signifer*. Vein 3A in the forewing seems very weak, but I have looked at a specimen you labelled *Phassus signifer* and I saw that the condition was similar. There seems to be only a minor point of difference, and that is the slope of Sc_1 in the forewing. This is much more acute in *P. signifer*."

The male genitalia (fig. 15) have the tegumen, in lateral view, evenly rounded and there is a posterior, ventrally produced, long cylindrical spine of characteristic shape.

ENDOCLITA UNDULIFER (Walker).

Plate v, fig. 55 and Text-fig. 1–2, 16.

Phassus undulifer Walker, 1869, p. 102. *Phassus signifer* Hampson, 1892, i, p. 320 (*nec* Walker). *Phassus damajanti* Pfitzner and Gaede, 1933, x, p. 843, pl. lxxvi d.

♂ Head, thorax, abdomen, and legs dull ochreous brown. Forewings slightly acute at apex, costa not dilated, dull ochreous brown with darker markings; a rich brown, highly characteristic undulating mark from near apex to near base; traces of dull silvery-white marks, a large one at r-m vein, several near junction of M and Cu, and small ones among M_1 and near apex. Hindwings dull greyish-brown, a narrow ochreous suffusion along termen from apex, most evident at hinder angle, where it terminates rather abruptly. Expanse 56 mm.

♀ Similar to male, larger, silvery-white spot just before r-m vein well defined. Expanse 84 mm.

Loc. United Provinces: near Benares (type, a female; expanse 92 mm., labelled "Benares, John Graham, 1935–288" in British Museum). Sikkim: Senchal Range, Darjeeling 8; Assam: Khasia Hills 10 (allotype male I. 18937 in S. Aust. Museum); Upper Burma: Nanhlaing Res. Shwebo, 9, 10. Seven males, seven females.

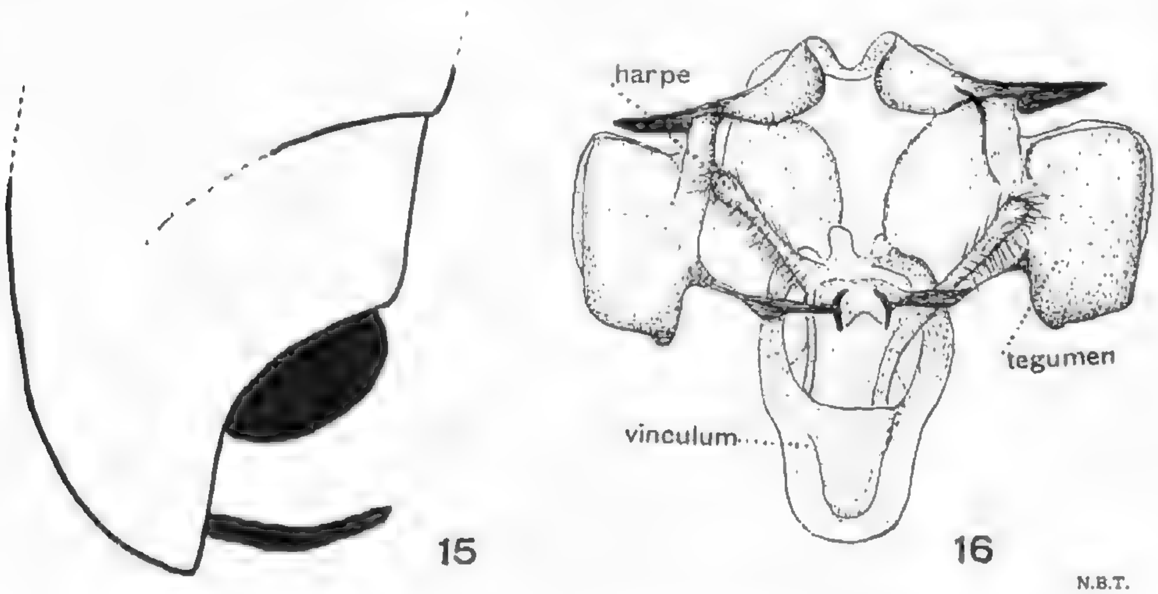


Fig. 15–16. 15. *Endoclita marginenotatus* (Leech), male genitalia, lateral view, from a freehand sketch of type in British Museum. 16. *Endoclita undulifer* (Walker), Shwebo, male genitalia, dissected, ventral view.

The type of this species was for many years in the Devon and Exeter Albert Memorial Museum, but in 1935 it passed into the British Museum collection.

The species is a distinct one, and has nothing to do with *E. signifer*, under which name Hampson, in the absence of the type, sought to place it.

The type of *damajanti*, a female expanding 72 mm. from the Khasia Hills, in the Senckenberg Museum, indicates the name is a direct synonym. Unfortunately the figure in Seitz is scarcely recognizable. The example is much worn, but agrees in markings and in the structure of its genitalia with typical material of *E. undulifer* in our collection.

Specimens of *E. undulifer* are preserved at the British, Tring, Senckenberg, and South Australian Museums.

The posterior legs of the male of this species, unlike other members of the genus, lack the specialized tuft of golden-coloured tibial plumes. It thus stands a little apart from its congeners, but it seems undesirable to use this secondary male sex character for generic separation, especially as in other respects it is too close to warrant separation.

The male genitalia (fig. 16) have the tegumen divided into a sub-quadrate, anterior, dilated portion with smooth edges, and a separate strongly chitinized, ventrally produced posterior spiny process, which does not project beyond the line of the rest of the tegumen; in dissected genitalia the harpes are seen as simple digitiform lobes, swollen at the apex, and bearing sensory hairs; the vinculum is of usual form.

The female genitalia are drawn in slightly diagrammatic manner in fig. 1–2, which are composites built up from observations on two specimens. The seventh sternite is sub-rectangular with a deep notch on the posterior margin; the eighth sternite has its posterior margin produced into an acute median spine; the anterior gonapophyses are angled spine-like processes; the posterior gonapophysis is a fat lamellate member, which is followed by several less well-chitinized folded plates forming the lateral gonapophyses. The following reared specimens have been submitted for determination by the Forest Research Institute, Dehra Dun:

F.R.I. LIST NO.	LOC.		SEX.	DATE.	HOST TREE.
27	Darjeeling		Male	2nd August, 1923	*Alnus nepalensis*
17	Shwebo, Burma		"	3rd October, 1936	*Buettneria pilosa*
18	"	"	"	5th October, 1936	*Buettneria pilosa*
19	"	"	"	1st October, 1936	*Buettneria pilosa*
20	"	"	"	29th September, 1936	*Buettneria pilosa*
28	"	"	Female	12th October, 1936	*Buettneria pilosa*
25	"	"	"	28th September, 1935	*Callicarpia arborea*

ENDOCLITA CHALYBEATA (Moore).

Plate v, fig. 58–59 and Text-fig. 17–20.

Phassus chalybeatus Moore, 1879, p. 412. *Phassus signifer* Hampson, 1892, i, p. 320, fig. 219 (*partim*).

♂ Head, thorax, abdomen, and legs pale yellow; posterior legs with tibiae ornamented with large tufts of ochreous hairs. Forewings with costa not markedly swollen at Sc_1; yellowish-brown with white suffusions; a series of six brown spots along costa; the middle of wing is occupied by a large brown area which partly encloses, at one-third, a sub-costal paler area, posterior to vein Cu_{1b}, which is suffused whitish buff; a large brown area in discoidal region and another from costa near apex to Cu_{1b} are margined with obscure arcuate marks; there is a white streak at r-m vein and traces of another just beyond it. Hindwings pale flesh-coloured, with traces of a paler mark on costa before apex. Expanse 80 mm.

♀ Slightly paler and duller in colour than male, markings slightly more defined, brown areas reduced, and white suffused areas somewhat larger; the white spot parallel to r-m vein larger, with traces of another on each side of it. Expanse 82 mm.

Loc. Sikkim: Darjeeling (type, a female, expanse 83 mm., labelled "Darjiling, Moore Coll. 94–106" in British Museum. Assam: Khasia Hills 3 (allotype male, I. 18935 in S. Aust. Museum). Sylhet 3. Burma: Namtu 5. Sandoway 4. Katha 4. S. Toungoo 5. Five males, seven females.

Moore's type, when examined in 1936, was found to have lost the abdomen; the Darjeeling female example described herein compares so well in other respects that the genitalia of it may be regarded as typical of the species.

The example figured by Hampson as the male of *E. signifer* may be a male of this species. It has nothing to do with true *E. signifer*. Unfortunately Hampson's specimen could not be found when examining the British Museum collections. It appears desirable therefore to describe as allotype male of *E. chalybeata* an example from Assam, which can be confidently associated with the type female, and the genitalia of which may be studied.

Fig. 18 is of the apex of the abdomen of the neo-allotype male, and fig. 17 shows a slide preparation of the genitalia of another example from Katha (Mohnyin). The genitalia are seen to have the eighth sternite shield-shaped and the posterior margin slightly concave on each side of the middle, which is slightly acutely terminated. The tegumen bears many serrations, rather evenly set and posteriorly directed; the harpes are reduced to simple, small, irregular, hair-beset digitiform processes. The ultimate tergite is bluntly rounded.

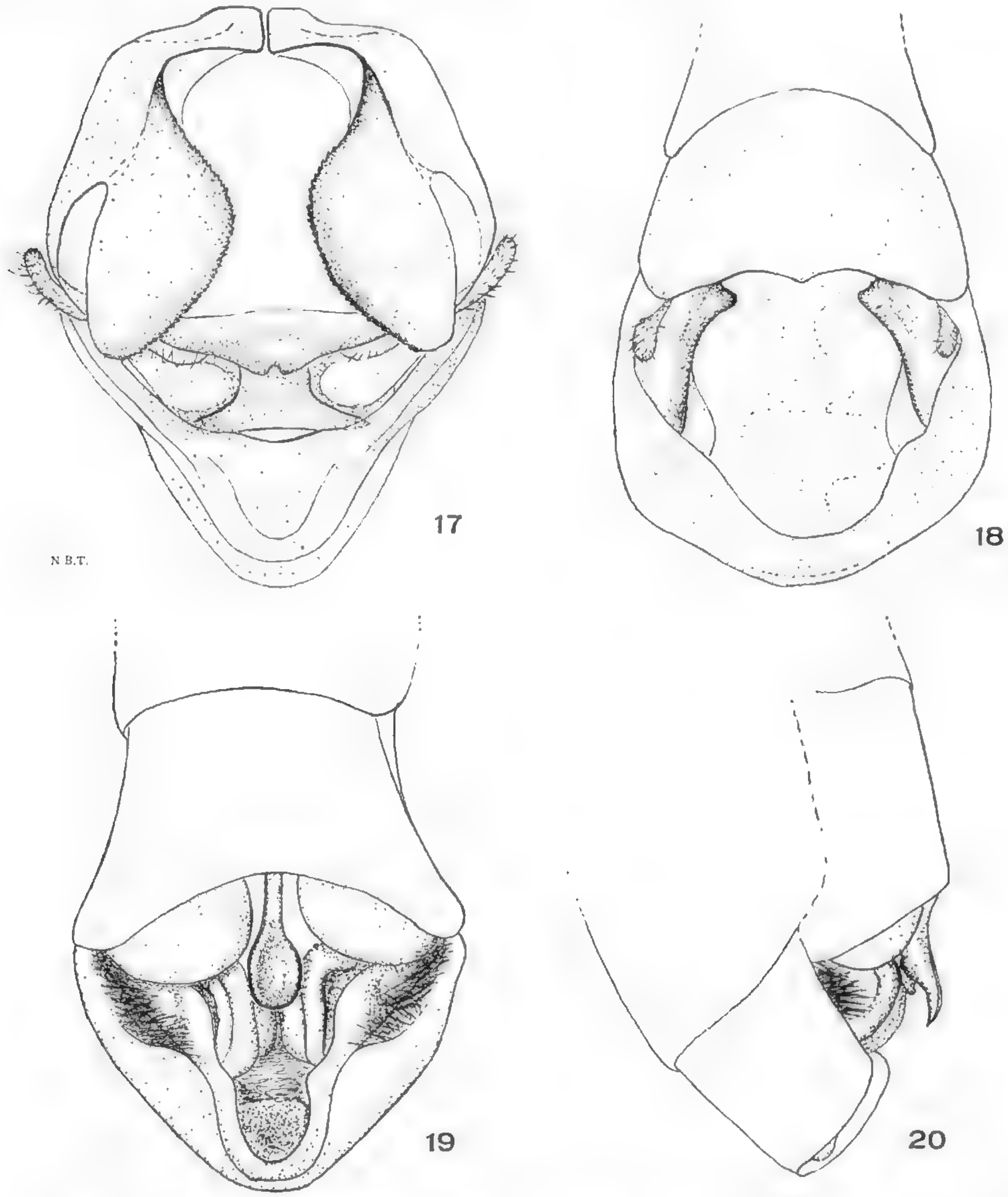


Fig. 17–20. ***Endoclita chalybeata*** **(Moore). 17. Male, Mohnyin, genitalia, dissected, ventral aspect. 18. Male, ventral aspect** ***in situ.*** **19. Female, Darjeeling, genitalia, ventral aspect. 20. Female, lateral aspect.**

From *E. signifer*, with which it has been confused, the male differs widely in the form of the posterior margin of the eighth sternite, in the differently shaped tegumen, in the absence of a carina on the harpes, as well as in the blunter appearance of the ultimate tergite.

The female genitalia (fig. 19–20) have been drawn from the described specimen, without dissection. The posterior margin of the seventh sternite is produced into a strongly chitinized spatulate process which is slightly concave on its ventral surface, and in lateral view is seen to be acutely pointed. The anterior gonapophyses are rounded plates; the posterior ones are carinate rounded lobes, while the ultimate tergite forms a double hood over the genitalia.

In the largest female examples examined, the eighth sternite appears to be hypertrophied as compared with more typical examples. This is probably a case of relative enlargement due to positive heterogonic growth of the female genitalia.

A pupal shell of a female of *E. chalybeata* has been preserved, but unfortunately lacks the facial mask; it is 67 mm. in length, 11 mm. in diameter, and of typical Hepialid form.

A fertilized example of the egg of this species was found attached at the opening of the oviporus of the described female example. When relaxed in dilute caustic soda it measured 0·58 mm. in diameter, was spherical, smooth, and slate-grey in colour.

E. chalybeata is of importance as a pest of young teak saplings, and has been reared from *Tectona grandis* and *Gmelina arborea*.

Up to the present this is the only species known to attack teak wood in Burma and Assam. The superficially similar but generically distinct *Sahyadrassus malabaricus* (Moore, 1879, p. 40, new combination) is also a teak feeder, but is strictly confined to the Western Ghats.(2)

At present a belt of dry country some 600 miles wide divides the areas occupied by the two forms. Only one species of Hepialid is common to both regions, and it is evident that the separation between the Hepialid faunas of the Himalayas and the Western Ghats must have been a long one. It is of some academic interest to speculate why these two superficially similar species, both teak feeders, should be so alike and yet structurally distinct.

If the loss of Se_1 in *Sahyadrassus malabaricus* is a specialization we may conclude that *E. chalybeata* represents more nearly an ancestral form (or archetype) from which both *S. malabaricus* and *E. chalybeata* may have been developed, and that the time interval since the two faunules last commingled has been sufficiently long for differences of generic rank to have become established. I have been informed that this is also true of other borers of teak; Malayan and Himalayan species do not extend into the Peninsula. It would be interesting to see whether some differences may not also occur in the host plant species of teak inhabiting these two areas; the systematic botanist seems at present to regard them as being specifically identical.

ENDOCLITA GMELINA sp. nov.

Plate vii, fig. 72 and Text-fig. 21–22.

♂ Head, thorax, anterior legs, and abdomen dark greyish-brown, sides of thorax black, fringes of anterior legs and the median and posterior legs brownish-black; posterior legs with an ochreous tibial tuft. Forewings broad, falcate, costal margin strongly expanded at Se_1; brown with darker markings and suffusions, a series of about six markings along costa; a very dark patch near base of discoidal area enclosing two silvery-white spots the larger of which is bi-sected by M_{1+2}; posteriorly from this and just above and beyond distal junction of 1A and 2A is a V-shaped black spot from which a dark suffused area extends to the r-m vein

(2) *Sahyadrassus* is a new genus, in which Se_1 of forewing is absent; the forewings have R_1 separate from R_2; R_4 and R_5 branching before or at the r-m vein and Pcu forming a Y fork with the vannal vein. Genotype *Phassus malabaricus* Moore. The genus will be more fully described in Part V.

where there is a cluster of three silvery-white spots; pale ochreous spots of small size lie in two irregular series parallel to and inwards from termen, while a dark suffused longitudinal streak lies between R_5 and M_1, and runs nearly to termen where it terminates at a small silvery-white spot. Hindwings wide, short, very shortly subfalcate at apex, greyish-brown with traces of brown markings along termen and at the apex. Forewings beneath with costal markings as above; those of hindwing even more pronounced than above. Expanse 90 mm.

♀ Larger than male; markings and colour similar; the black V-shaped mark of forewing broken into a series of three spots, two of them conjoined. Expanse 122 mm.

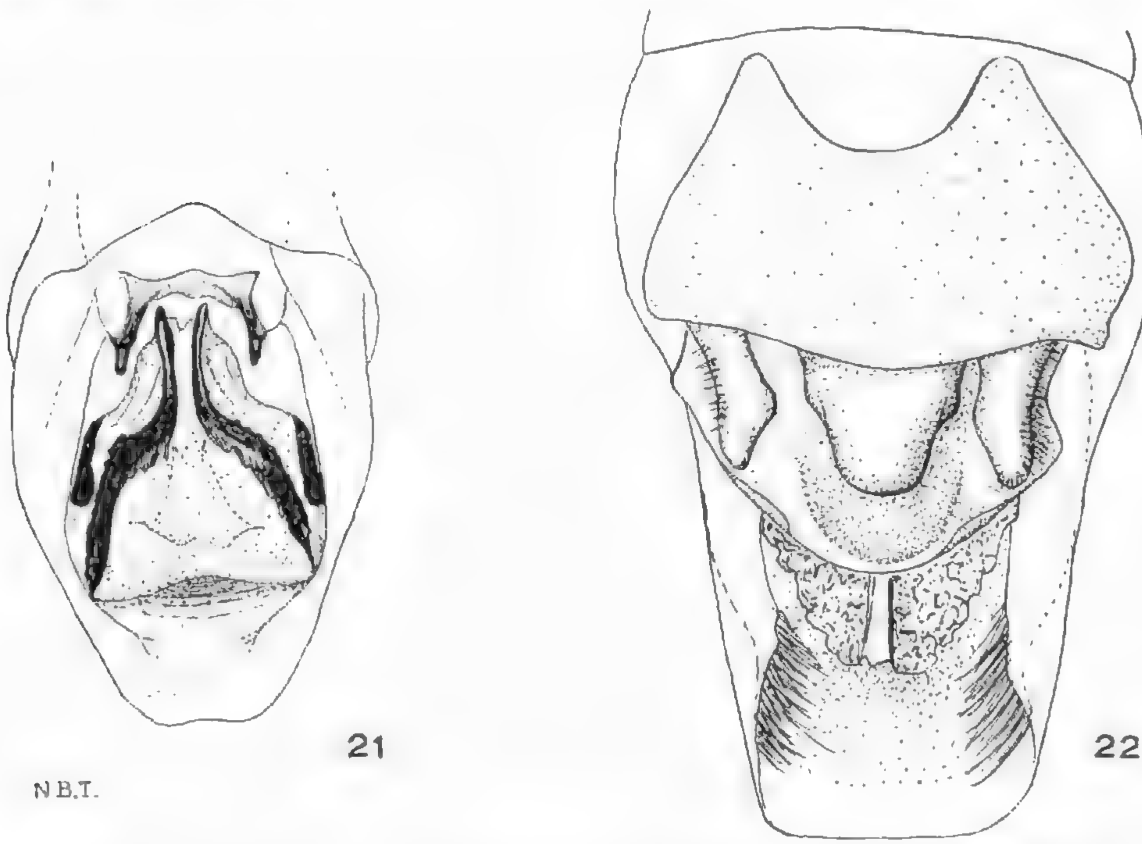


Fig. 21–22. *Endoclita gmelina* Tindale. 21. Paratype male, Panyhai, genitalia, ventral aspect. 22. Allotype female, Panyhai, genitalia, ventral aspect.

Loc. Burma: Panyhai Res. Namtu 5 (type, a male, 22 May, 1931, and allotype female, 10 May, 1931, collected by M. H. Desai, in British Museum; paratype male, 13 May, 1931, I. 18950 in S. Aust. Museum). Two males, one female. The three known examples were reared from *Gmelina arborea* at Namtu.

Another species sometimes found in *Gmelina* wood is *E. chalybeata*. From this it differs widely in proportions, in the colouring of the wings, and in the form of the genitalia. The species is apparently not close to any other described one.

In both sexes of this species the costal expansion at Sc_1 is very marked. In this character it is closest to *E. signifer*, from which it is otherwise distinct; it may also be compared with *E. crenilimbata* from China.

The male genitalia, drawn without dissection (fig. 21) have the vinculum furnished with cylindrical, posteriorly directed processes, one on each side; the tegumen is a curious shovel-shaped object, wide posteriorly, narrow anteriorly, with its ventral margins strongly chitinized and rather irregularly formed. There is a strongly chitinized lateral piece on the outer margin of the tegumen. Superficially the tegumen is similar to that of *E. purpurescens*, but it markedly different in details.

The female genitalia (fig. 22) are extraordinarily different from those of other described members of the genus; the seventh sternite is transverse, the anterior margin bent into a notched fold (which may be accentuated in the dried specimen) while the posterior margin is slightly convex; the eighth sternite is a convex rounded median process which appears to lie ventrally from a broad, much larger chitinized plate, concave in ventral view and with the side portions of its posterior margin bent over; this may be a further portion of the eighth sternite; the anterior gonapophyses are digitiform processes, angled before the apex and with the lateral margins beset with stout hairs (as on the internal margins of the male harpes of many species of Hepialidae). To satisfactorily determine the homologies of the posterior parts of the genitalia it would be desirable to have further material for dissection.

ENDOCLITA PURPURESCENS (Moore).

Plate v, fig. 56–57, and Text-fig. 23–26.

Phassus purpurescens Moore, 1883, ii, p. 156, pl. cxliii, f. 4. *Phassus purpurascens* (sic) Hampson, 1892, i, p. 319. *Phassus purpurascens* Pfitzner and Gaede, 1933, x, p. 843, pl. lxxviii d.

♂ Head, thorax, abdomen, and anterior and median legs dull brown with a faint purple tone, posterior legs with tibiae clothed with tufts of deep orange-coloured hair. Forewings dull brown with a purple tone (probably somewhat brighter in freshly-captured specimens); faint brown lunulate markings cover greater part of wing, except in a broad, brown, irregular band across discoidal region and a less well-defined strip running across from four-fifths costa to near hind margin; a yellowish-white spot just inside r-m vein and two minute ones external to it; another near base of wing; a series of minute black spots along costa, and several others near the posterior margin. Hindwings slightly darker than forewings, unicolorous greyish-brown with a faint purple tinge. Wings beneath pale uniform greyish-brown. Expanse 94 mm.

♀ Markings similar to male; the broad oblique brown band across discoidal region of forewing terminates in a clear-cut line near hinder margin with an L-shaped angular band of very pale purplish-brown; the posterior legs are not ornamented with orange plumes, and are concolorous with the other pairs. Expanse 118 mm.

Loc. Ceylon (type, a female; expanse 112 mm., described as a male, labelled "Phassus purpurescens Moore type" 52–62, in British Museum); Punduloya 5, 6; Maskeliya 1; Haputale 1; Dimbula 4. Four males, 10 females.

The species appears to be confined to Ceylon; the Perak record by Hampson is doubtful. Specimens are to be found in the British, Tring, Colombo, and South Australian Museums. Examples identified as this species at the Berlin Museum belong to other species.

Moore's type proves to be a female; at the time of its first description it was unique. His figure differs from the type only in the greater emphasis placed on the costal markings of the forewing; this is probably an artist's error for, in other respects, it is a good figure of the type specimen. The figure in Seitz Macrolepidoptera (lc. pl. lxxviii d) does not resemble the type in any particular, and may apply to one of the numerous Malayan species of this genus.

The venation of the male agrees closely with that of *E. damor*. Sc_1 is present in the forewing, but absent in the hindwing. There is no expansion of the costa at Sc_1. The posterior legs of the male are clothed with a large tuft of specialized orange-coloured hairs; these are absent in the female.

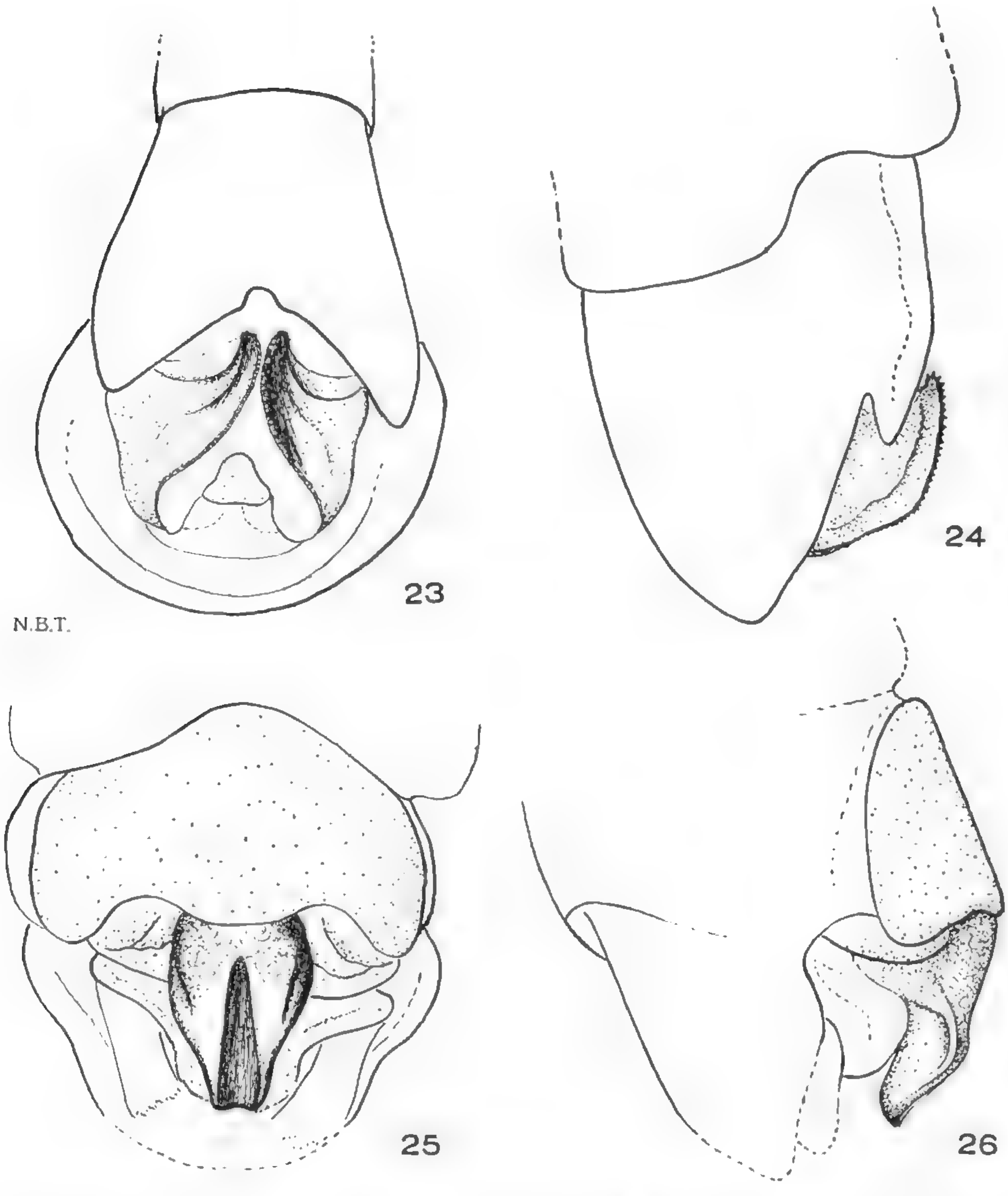


Fig. 23–26. *Endoclita purpurescens* (Moore). 23. Male, Punduloya, genitalia, ventral aspect. 24. Male, lateral aspect. 25. Female, Ceylon, genitalia, ventral aspect, extremity broken off. 26. Female, lateral aspect.

From an oblique angle the hindwing appears to be tinged with a purple sheen, hence the name *purpurescens;* this feature is not nearly so well displayed as in some of species from Malaya, which have been confused with it.

I am indebted to the Director of the Colombo Museum (P. P. Deraniyagala) for study material.

The male genitalia (fig. 23–24) have the posterior margin of the eighth sternite concave and further notched in the middle; the tegumen, viewed from the side, is evenly rounded, with its entire margin armed with fine teeth, a line of less evident serrations forms a carina on outer surface of the tegumen; this line fades away posteriorly. The harpes are not apparent in the undissected specimen.

The female genitalia, in the one example available for drawing (fig. 25-26) have the seventh sternite somewhat like an inverted shield, the posterior margin being concave on each side of the middle; the eighth sternite is large and bulbous with a median ventral groove; it is also notched along the side; the bases of what are probably the anterior gonapophyses are visible and appear to be dilated towards their apices.

ENDOCLITA SIGNIFER (Walker).

Plate vi, fig. 60–61 and Text-fig. 27–30.

Phassus signifer Walker, 1856, vii. p. 1568; Butler, 1886, vi, p. 30, pl. cix, fig. 2; Hampson, 1892, i. p. 320 (*partim*). *Hypophassus signifer* Le Cerf, 1919, xxv, p. 470. *Phassus signifer* Pfitzner, 1912, Seitz Macrolep. ii, p. 438, pl. liv a; 1933, x, p. 842 (*partim*).

♂ Head, thorax, anterior and median legs ochreous brown, abdomen dark greyish-brown, ochreous-tinged at apex, posterior legs reduced in size, ochreous, ornamented with specialized tuft of bright ochreous hairs. Forewings with costa swollen at Sc_1, apex sub-falcate, ochreous-brown with whitish-brown suffusions, seven rounded brown spots along costa, arranged in three pairs and margined narrowly with black and pale brown rings; a broad V-shaped patch of brown with its apices touching Sc at one-quarter and at three-fifths and enclosing, near each apex of the V, one or more white spots, narrowly margined with dark brown; subterminal and hind marginal areas paler, marked with transverse brown lines between the veins, and with obscure, usually paired tiny black spots. Hindwings dark greyish brown on basal half, costal margin with pattern as on forewings, termen dull brown with traces of the forewing pattern. Expanse 105 mm.

♀ Markings somewhat as in male but rather more conspicuous; ground colour dull olivaceous-brown with pale brown areas well defined. Hindwings with base suffused with greyish-brown pubescence, apex marked as in forewing; these markings merge posteriorly into a series of obscure dull greyish-brown patches running parallel to termen. Expanse 120 mm.

Loc. Assam: Sylhet (type, a female; expanse 154 mm., labelled "Silhet, 47–36" in British Museum); Khasia Hills (allotype male I. 18934 in S. Aust. Museum); Jaintia Hills; Cherrapunji. Nine males, 11 females.

The swollen costa at Sc_1 of forewing is noteworthy, and reappears in several Indian, Malayan, and Chinese species. If sub-generic division is desired, this species may be placed in *Hypophassus*.

The figured male is the allotype, and the female is a second example from Khasia Hills also in the S. Aust. Museum collection.

Walker's type of this species, of which Butler's figure is a good rendering, is a female from Sylhet; our example is smaller but agrees closely in other details. The other specimens associated with the type of *E. signifer* by Walker himself are not con-specific, and there has always been considerable doubt and confusion about the identity of the species. A review of the earlier literature shows that at one time or other most of the common Oriental species of the composite *Phassus* group have been regarded as synonyms under the name.

E. signifer is distinct from all other members of the genus by the combination of the sub-falcate forewings, repetition of portion of the pattern of the forewing on the hindwing, and by the peculiar genitalia. Hampson appears to have been confused about this species, and the figure given by him agrees best with that of the male of *E. chalybeata*.

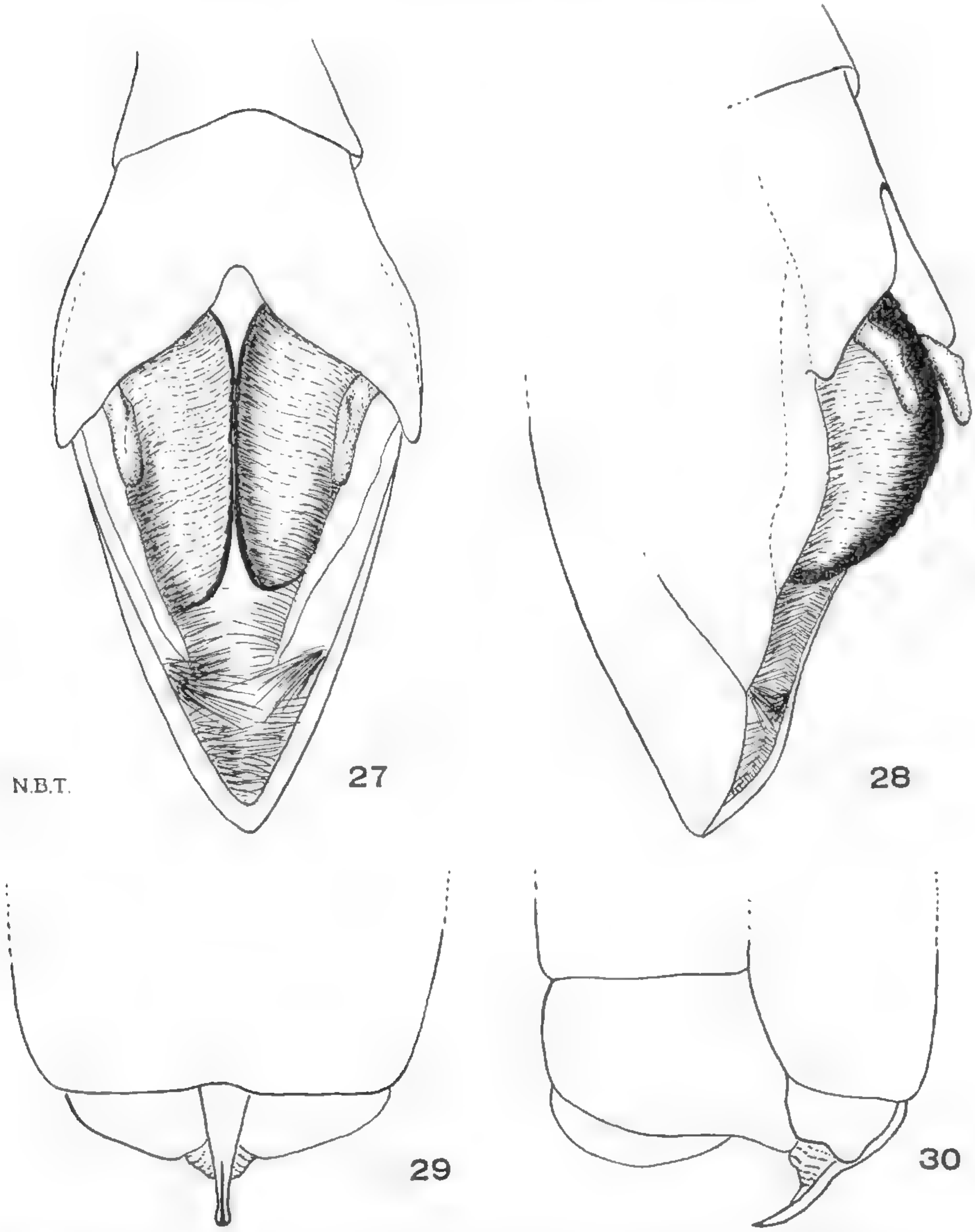


Fig. 27–30. *Endoclita signifer* (Walker). 27. Allotype male, Khasia Hills, genitalia, ventral aspect. 28. Allotype, lateral aspect. 29. Type female, Sylhet, genitalia, ventral aspect. 30. Type female, lateral aspect.

In Seitz Macrolepidoptera, Pfitzner has copied Butler's figure of the type female. Following Hampson, he and Gaede have grouped as races several rather widely different Oriental species, some belonging to the *Endoclita* series without the costal swelling, and others belonging to the subgenus *Hypophassus* in which the costa is expanded at Sc_1. It is the writer's present opinion that *E. signifer* is a species confined to Assam, and that no races have yet been established to exist outside India.

The male genitalia, examined *in situ* in the allotype male (fig. 27–28) have the harpes as a simple, slightly angled, smooth, cylindrical process with traces of a carina on the ventral surface. The tegumen in lateral view is evenly convex, the margin slightly bent outwards and irregularly serrated; serrations fine; the posterior margin of the eighth sternite is excavated in wide V-fashion.

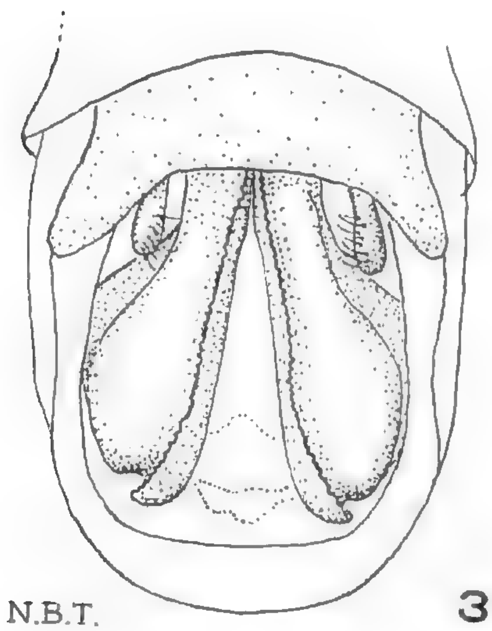
The species is represented in the British, Senckenberg, Tring, and South Australian Museums.

The genitalia of the type female have been drawn, without dissection (fig. 29–30). The seventh sternite has the posterior margin transverse and scarcely notched in the middle. The eighth sternite is produced into a long, tapering, upturned process; its ventral side is grooved apically where it ends in a slight spatulate swelling. Nearer the base the process is seen to be produced laterally as a thin membrane which is folded into several transverse rugae. The anterior gonapophyses take the form of flat lateral plates, with sinuate apical margins, which partly overlie the rugose part of the eighth sternite. The posterior gonapophyses are large, strongly chitinized, rounded, swollen plates.

ENDOCLITA ALBOSIGNATA sp. nov.

Plate vi, fig. 62 and Text-fig. 31–32.

♂ Head, thorax, abdomen, and legs pale brownish-fawn; posterior tibiae with orange-brown tufts of hairs. Forewings brownish-fawn with paler suffusions and traces of numerous scattered white spots faintly margined with dark brown; a



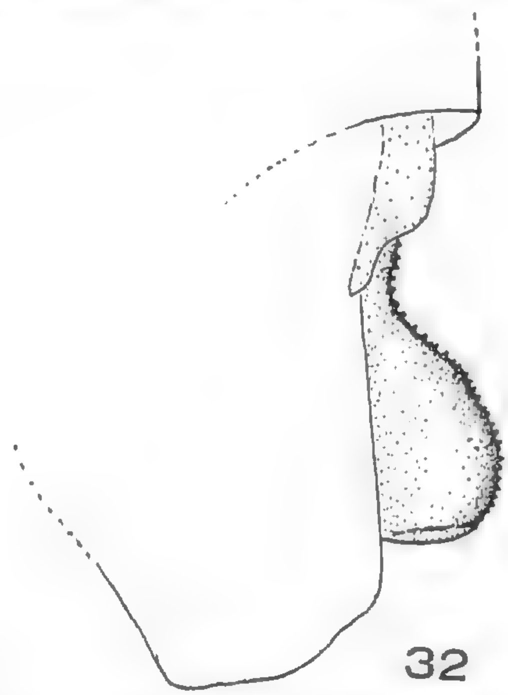


Fig. 31–32. *Endoclita albosignata* Tindale. 31. Type, a male, unique, Assam, genitalia, ventral aspect. 32. Male, lateral aspect.

white inverted T-shaped mark along M_1 and r-m vein. Hindwings dull greyish-brown with costal margin and termen brownish-fawn. Expanse 68 mm.

Loc. Assam: type, a male, unique I. 18942, in S. Aust. Museum.

This species differs markedly from its congeners. In the general form of the tegumen it is nearest to *E. signifer*, from which it differs in the absence of the costal expansion of forewing and in many other characters. With its rather narrow wings it is at first glance like *Sahyadrassus albofasciatus* (Moore, 1879, p. 413), but the presence of Sc_1 in forewing and an examination of the genitalia immediately separates them.

The male genitalia, drawn without dissection (fig. 31–32) show the eighth sternite with the posterior margin transverse, the tegumen, in lateral view expanded, and with the anterior two-thirds evenly convex, the posterior portion somewhat abruptly angled, and the ventral margin slightly turned outwards and freely and evenly serrated; in ventral view the sides of the tegumen are seen to be swollen, smooth and with a lateral carina; the harpes are present, digitiform and clothed with reversed hairs on their internal faces.

ENDOCLITA RUSTICA sp. nov.

Plate vi, fig. 63, 66, and Text-fig. 33.

♂ Head and thorax rich brown, antennae and legs darker; abdomen dull grey; posterior tibiae with ochreous yellow tufts. Forewings rich brown with golden-brown suffusions and traces of many short transverse dark brown streaks between the veins; traces of some white spots along termen and along outer half

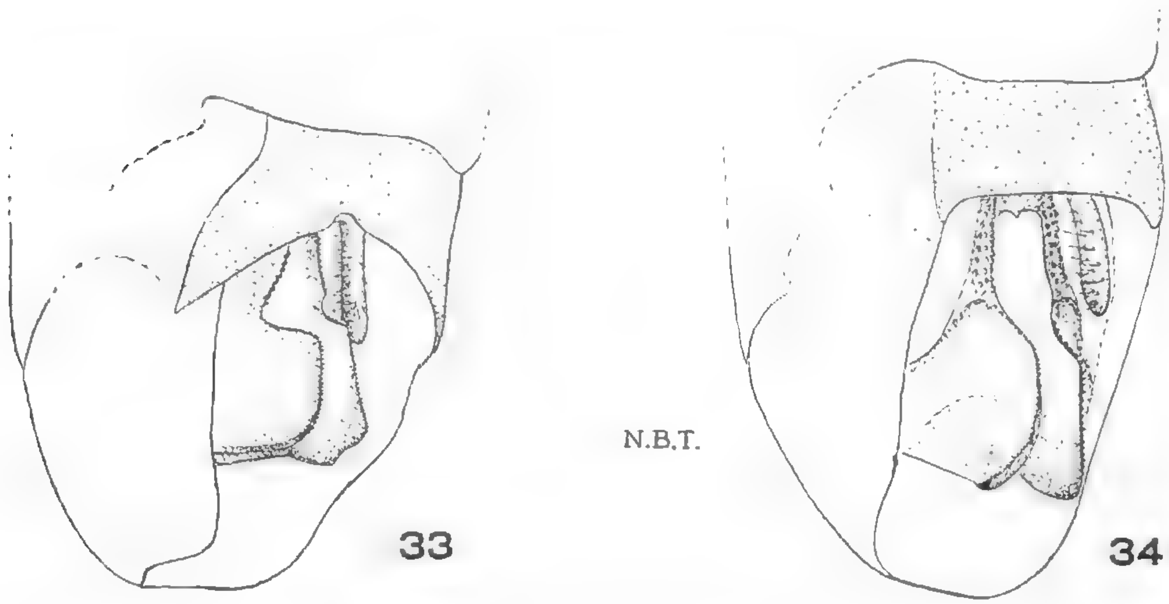


Fig. 33–34. 33. *Endoclita rustica* Tindale, type, a male, Shillong, genitalia, oblique aspect. 34. *E. metallica* Tindale, type, a male, Darjeeling, genitalia, oblique aspect.

of IV; traces of a golden-brown suffusion in a band from near base to termen at one-half. Hindwings dull grey, at apex narrowly tipped brown. Expanse 56 mm.

Loc. Assam: Shillong 9 (type, a male, I. 18943, in S. Aust. Museum) Khasia Hills (paratype male in Tring Museum). 2 males.

This rather distinct species, with its rich chocolate brown forewings and dull grey hindwings, is one of a group of allied species inhabiting the wet rain forests of Upper Assam and the Himalayas, and is more especially related to *E. chrysoptera*, from Sikkim. From the latter it differs in the narrower forewings, different coloured hindwings, and in the shape of the eighth sternite.

The male genitalia (fig. 33) have the posterior margin of the eighth sternite concave, and slightly notched in the middle; the tegumen has the posterior half dilated into a subrectangular lamella whose margin is serrated.

ENDOCLITA METALLICA sp. nov.

Plate vii, fig. 71 and Text-fig. 34.

♂ Head, thorax, and legs dark chocolate brown, posterior tibiae with orange-yellow tufts; abdomen dull brown. Forewings chocolate brown with traces of darker transverse bars between the veins; two large dark brown suffused spots, one along course of M_1 before r-m and one just after; a white scaled triangular spot at junction of r-m vein and M_1; from a very oblique angle two opalescent blue fasciae appear, the first from near apex to hind margin at four-fifths, the second from costa at three-fourths parallel to its as far as Cu_{1b}; the hind margin broadly tinged with same hue. Hindwings greyish-bronze with a strong metallic lustre. Expanse 54 mm.

Loc. Sikkim: Darjeeling (type, a male, "Darjeeling No. 69 Atkinson Coll." in Tring Museum; paratype male, *ditto*, I. 18944 in S. Aust. Museum). 2 males.

I am indebted to Dr. K. Jordan for permission to describe this species; the two known examples have had a varied history, having been incorrectly identified, at various times, as *Phassus punctimargo* Hampson and as *P. aboe* Moore. They passed from the Atkinson collection to Elwes and thence to Tring. The species is related to *E. rustica*, but differs in the dull metallic bronze lustre of the scaling of the hindwings, in the dark chocolate colour of forewings and in the relatively transverse eighth sternite as well as the similar, but differently armed tegumen. The paratype has the forewings darker than the type, but is otherwise similar.

The male genitalia (fig. 34) have the eighth sternite transverse and its posterior margin straight; the tegumen has the posterior half dilated into a lamella, portion of the serrated ventral margin of which is bent outwards; the serrations and denticules on the anterior half of tegumen appear in several rows.

ENDOCLITA BUETTNERIA sp. nov.

Plate vii, fig. 75 and Text-fig. 35–36.

♂ Head, thorax, and legs dark brown, abdomen greyish-brown; posterior tibiae with a small ochreous tuft of hairs. Forewings relatively short, apparently rounded at apex (slightly injured in both specimens available for study), costa straight without any expansion at Sc_1; dark brown with paler brown indefinite markings and suffusions which are still brighter near apex, in patches along costa, and in the middle of the wing; traces of a white spot at r-m vein and two faint brown lines of suffusion from costa to hind margin, the first extending from just before apex to hinder angle, and the other from three-fourths costa to three-fifths hind margin—these, when viewed from an oblique angle, glow with scintillating greenish-blue metallic colour, while from the same angle traces of similar colour may be seen to run along the hind margin. Hindwings dull greyish-brown with traces of a dull bronze lustre. Expanse 62 mm.

♀ Larger than male, with colour markings, so far as preserved, similar to those of males. Expanse (estimated) 90 mm.

Loc. Burma: Nanhlaing Res. Shwebo. (type, a male, 7th September, 1936, and allotype female, 25th September, 1936, collected by R. Hla Ogh, in British Museum; paratype male, expanse 68 mm., 24th September, 1936, I. 18938 in S. Aust. Museum).

The male genitalia are drawn without dissection from the type example (fig. 35); the posterior margin of the eighth sternite transverse, the tegumen with the anterior half strongly chitinized and its ventral margin serrated, the posterior half expanded into an angulate, laterally concave lobe, also strongly chitinized, and with the margin serrated; the ventral margin of this lobe is transverse or even slightly concave in outline when viewed from the side.

The female genitalia (fig. 36) have the seventh sternite more than three-fourths as long as wide, the eighth sternite is a rounded projection, whose sides are not constricted; and there is a swollen globose anterior portion largely concealed below the seventh sternite; the anterior gonapophyses are acute spines, rather dilated near base; in other respects the genitalia are similar to those of *E. punctimargo.*

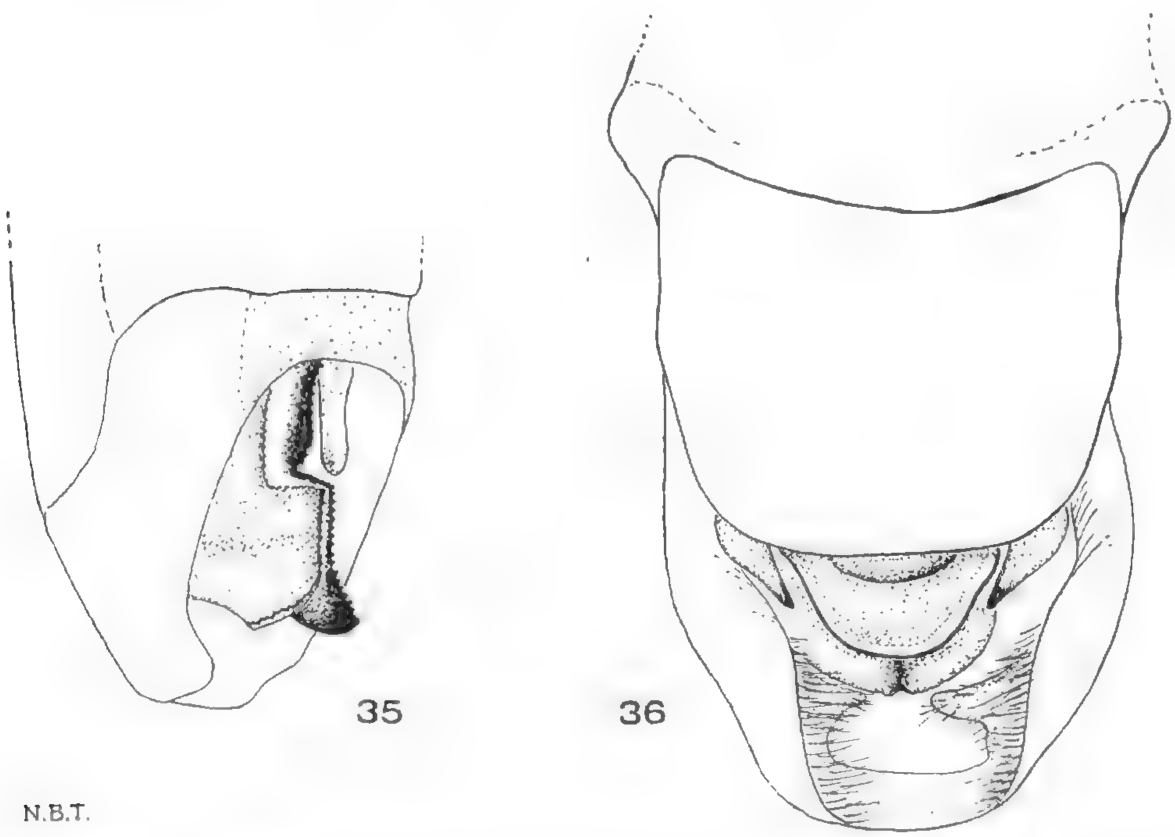


Fig. 35–36. *Endoclita buettneria* Tindale. 35. Type, a male, Nanhlaing, genitalia, oblique aspect. 36. Allotype female, Nanhlaing, genitalia, ventral aspect.

The three known specimens were reared from *Buettneria pilosa* and were submitted for identification by the Forest Research Institute at Dehra Dun, who have requested that the type specimens be lodged in the British Museum.

This species is allied to *E. punctimargo,* of which only the female is well known. It differs from that species in its darker and different markings, and in the form of the genitalia. The wider anterior gonapophyses, differently proportioned seventh sternite, and the wider eighth sternite (which is not constricted as in *E. punctimargo*) are good distinguishing characters. The males resemble *E. metallica,* but are larger, have well-defined transverse markings on forewings, lack the dull metallic mirror-like surface to hindwings, and have the ventral margin of the posterior half of the tegumen straight or slightly concave rather than evenly rounded as in that species.

ENDOCLITA CHRYSOPTERA sp. nov.

Plate vi, fig. 67 and Text-fig. 37.

♂ Head, thorax, abdomen, and anterior and median legs dull yellowish-brown, posterior legs clothed with tuft of dull ochreous specialized hairs. Forewings golden-yellow with pale chocolate-brown markings; costa with a series of seven well-defined wedge-shaped brown marks; a broad band of brown (occasionally flecked with minute patches of intensely white scales) extending from base of wing obliquely to inner margin at one-half, thence irregularly towards apex, where it is dilated to form an irregularly circular brown blotch just before apex; the large brown area is flecked with somewhat larger patches of white scales, a larger group than usual being associated with the junction of r-m and M_1; subcostal area from base to one-half golden-yellow with obscure brown markings; subterminal area dull golden-yellow with faint brown flecks and markings; termen with a narrow band of intensely blue-white scales between the veins. Hindwings rather uniformly pale fawn; apex tinged ochreous, termen with white scales between the veins. Expanse 63 mm.

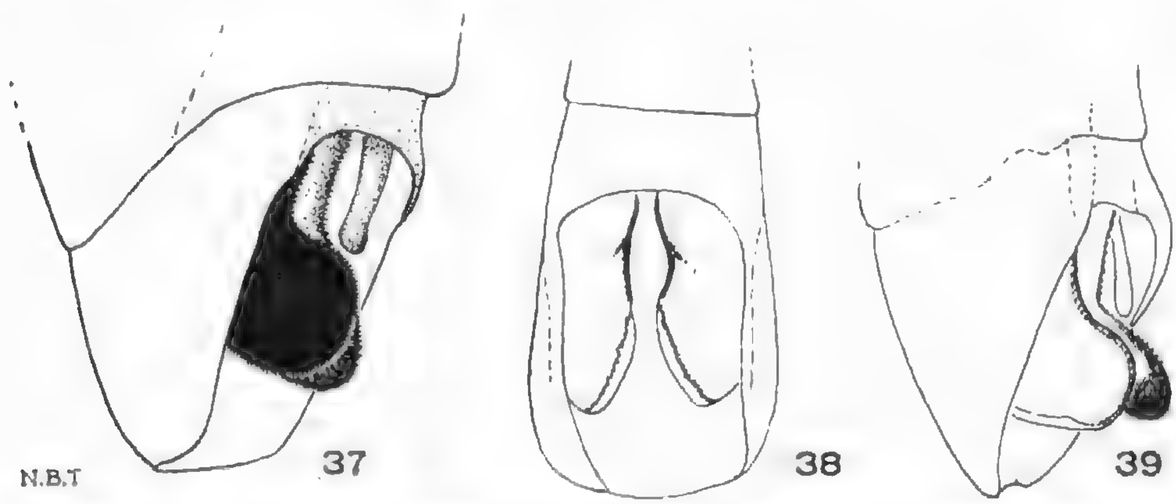


Fig. 37–39. 37. *Endoclita chrysoptera* Tindale, type, a male, unique, Senchal Range, genitalia, oblique aspect. 38–39 *E. aurata* (Hampson). 38. Male, Bernardmyo, genitalia, ventral aspect. 39. Male, a slightly oblique lateral view.

Loc. Sikkim: Senchal Range, Darjeeling 8 (type, a male, unique, reared August 3, 1923, from *Machilus edulis*, by J. C. M. Gardner; in British Museum).

Fig. 37 is an oblique view of the apex of the abdomen of the type male the genitalia of which have been drawn without dissection. The eighth sternite is rather evenly concave on the posterior margin and the tegumen is evenly and minutely serrated, the anterior half is straight and the posterior half is strongly dilated as a rounded rather flattened disc. The harpe is a simple digitiform process. This species is similar in general appearance and markings to *E. marginenotatus* (Leech, 1898) from Omei-Shan, China (at 3,500 feet in June or July), but differs in having the dark brown and golden-yellow areas differently disposed. The genitalia also are quite distinct, for the tegumen of the Chinese species is semi-circular in outline when viewed from the side and the posterior extremity of the tegumen is furnished with a long downwardly directed cylindrical process on each side. This is more than twice as long as the similar one in found *E. undulifer*. In *E. chrysoptera* there is no trace of such a spine.

ENDOCLITA AURATA (Hampson).

Plate vii, fig. 69 and Text-fig. 38–39.

Phassus auratus Hampson, 1892, Fauna Brit. Ind. Moths. i, p. 321.
Phassus auratus Pfitzner and Gaede, 1933, p. 843, pl. lxxvi d.

♂ Head, thorax and anterior and median legs brown, abdomen paler, posterior legs with brownish-yellow tibial tufts. Forewings rounded at apex, costa straight, without swelling at Sc_1; brown, with obscure darker brown transverse markings; a sub-metallic golden suffusion along basal half of costa and another at apex; traces of two dull grey fasciae parallel to termen in outer half of wing; when viewed from an oblique angle the hind marginal third of wing, the two fasciae and a subcostal patch glow with an opalescent blue suffusion. Hindwings subhyaline, greyish-fawn. Expanse 44 mm.

Loc. Burma: Bernardmyo, 5,500–7,000 feet (type, a male, expanse 39 mm., labelled "May, 1890, W. Doherty, Collection H. J. Elwes" in Tring Museum). Assam: Khasia Hills. 4 males.

The type expands only 39 mm., not 42 mm., as indicated in the original description. The specimen described above was taken with the type example and agrees closely with it.

The figure in Seitz is based on an example in the Senckenberg Museum doubtfully identified with this species; it is almost unrecognizable, for the markings are misplaced and the colouring is poor. The species is not a common one, and nothing is known of its life history. Its small size, rather angulate wings, and markings are distinctive.

The male genitalia (fig. 38–39) have the eighth sternite with the posterior margin transverse; the tegumen strongly chitinized; anterior half not dilated, and straight-margined, posterior half expanded into a semicircular portion; the whole of the ventral margin of tegumen is serrated with laterally set small blunt teeth.

ENDOCLITA MICROSCRIPTA sp. nov.

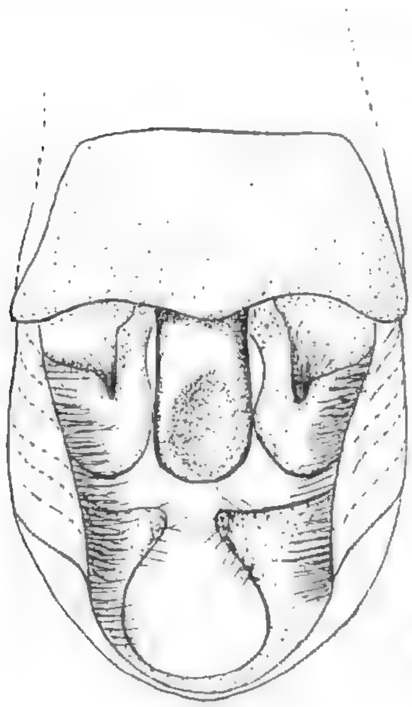
Text-fig. 40–41.

♀ Head, thorax, and legs brownish-fawn, abdomen slightly darker. Forewings brownish-fawn, almost completely covered with fine curved transverse lines between the veins; traces of four darker costal marks, the first at one-half followed by three smaller ones towards apex; traces of several lines of faint white spots between the veins, the first from near apex to hind margin at four-fifths, the second parallel and internal to it, from costa at five-sixths to M_1; a faint series also from r-m vein to hind margin at one-half, and a zigzag series between there and the base. Hindwing grey, the apex and termen narrowly tinged with fawn. Expanse 88 mm.

Loc. Madras: (type, unique, I. 18939 in S. Aust. Museum).

The female genitalia, drawn without dissection (fig. 40–41) have the seventh sternite transverse, the posterior margin sinuate, projecting in the middle; the eighth sternite is a conspicuous parallel-sided process, its posterior extremity is entire but with a depression before the apex; in lateral view it is seen to be slightly upturned at apex. The anterior gonapophysis is a broad plate with the apex drawn out into a spinous process; the penultimate tergite has ventral processes projecting towards the midline.

This is the only true *Endoclita* so far recorded from the east coast of peninsular India; one species is known from Ceylon. It is a distinct form. The genitalia are characteristic, with an eighth sternite which is nearest in form to species such as *E. damor*, but with anterior gonapophyses more like those of *E. punctimargo* and its allies.



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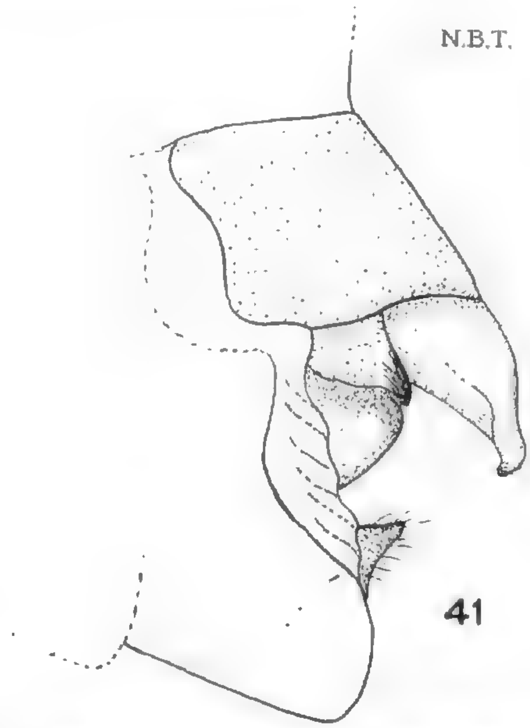

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Fig. 40–41. *Endoclita microscripta* Tindale. 40. Female, Madras, genitalia, ventral aspect. 41. Female, lateral aspect.

ENDOCLITA PUNCTIMARGO (Swinhoe).

Text-fig. 42–43.

Phassus punctimargo Swinhoe (Hampson m.s.), 1892, i, p. 291 (November). Hampson, 1892, i, p. 319 (December). Pfitzner and Gaede, 1933, x, p. 843.

♀ Head, thorax, and legs dull reddish-brown, abdomen dull greyish-fawn. Forewings reddish-brown with faint traces of yellowish-brown on costa; two parallel greyish-white post-median fasciae parallel to termen from costa, near apex, to posterior angle; each of these is bordered internally by a wide band of scales which, when viewed from an oblique angle, have a dull metallic sheen. Hindwings dull greyish-fawn. Expanse 108 mm.

Loc. Sikkim: Darjeeling, Senchal Range 8. 4 females.

Superficially examined, females of this species appear to bear considerable resemblance to *Nevina aboe* (Moore), and in the absence of authentically determined females of *N. aboe* and of males of *E. punctimargo* it might at first appear that they were merely the sexes of one species. Closer examination shows that in *E. punctimargo* Cu_2 of forewing is connected to 1V by a strong oblique vein Pcu. In *N. aboe* this is absent. It therefore seems certain that they are distinct.

Swinhoe anticipated Hampson's name (he has a month's priority). Both authors described the same specimens, and at least three examples were known to them. Two of these, both females, have been examined by the present writer. One example, 92 mm. in expanse, labelled "India, No. 1349, *Phassus punctimargo* Hampson", is in the Oxford University Museum, and is the example listed as specimen "a" in Swinhoe's catalogue. The other female is in the British Museum; it is 108 mm. in expanse, and is labelled "75–25 *Phassus punctimargo* Hampson type female". Swinhoe stated that his type was in the Elwes collection. On the evidence, the type is the example, expanding 54 mm., which Swinhoe regarded as a male. Unfortunately this specimen has not been traced, hence determinations can only be based on the two female examples associated with it. The British Museum example, 108 mm., may be regarded as the allotype female. Sketches of the genitalia of the Oxford female were prepared. The example described and figured in the present paper is closely similar. It is a rather battered female from the Forest Research Institute at Dehra Dun, labelled "Senchal Range, Darjiling, 6th August, 1923", and reared by Mr. J. C. M. Gardner from *Cryptomeria japonica*.

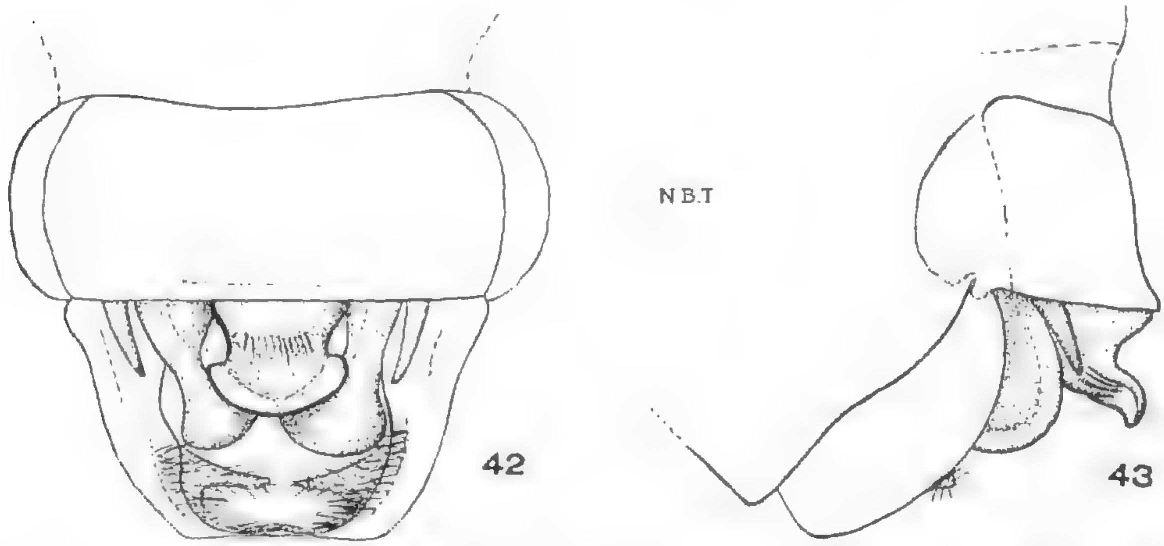

Fig. 42–43. *Endoclita punctimargo* (Swinhoe). 42. Female, Senchal Range, genitalia, ventral aspect. 43. Female, lateral aspect.

Female genitalia (drawn without dissection from the above-mentioned Senchal Range specimen, fig. 42–43) have the seventh sternite swollen at base, and drawn out into a process which is constricted in the middle and at first down-bent, but upturned at apex; in ventral view the process is seen to be expanded into a wide spade-like appendage; the anterior gonapophyses are simple, cylindrical, tapered processes, the posterior gonapophyses are semi-circular, laterally compressed lamellae overlying and slightly posterior to the eighth sternite. The inner fold of the ultimate tergite has its lateral margin drawn out and covered with irregularly disposed hairs so that from one oblique angle it appears as a digitiform process.

Examples of this species are to be found in the British, Tring, Oxford University, and South Australian Museums.

NEVINA gen. nov.

Male with antennae simple, cylindrical, tapering gradually towards apex, composed of about 22 segments, each segment armed with a few setae; palpi two-segmented, each about twice as long as wide. Forewings with Sc_1 present; R_1 from before middle of wing; R_2 from R_3; R_4 from R_5 before r-m vein; $M_1 + M_2$ and $M_3 + M_4$ separate at origin; Cu_2 not extending to margin; Pcu absent; 1V and 2V strongly Y-forked near base and extending to hind margin as a single vein. Hindwing with Sc_1 absent; R veins as in forewing; only one vannal vein present.

Genotype: *Phassus aboe* Moore.

In this genus archaic features such as the separate origins of $M_1 + M_2$ and $M_3 + M_4$ appear side by side with specializations; Cu_2 is reduced, while Pcu appears to have been entirely lost unless it is represented by the small vein forming an apparent cu-a. 1V and 2V appear as in *Endoclita* and anastomose, continuing to hind margin as a single vein. Only one species has been recognized.

NEVINA ABOE (Moore).

Plate vii, fig. 74 and Text-fig. 44–48.

Phassus aboe Moore, 1859, ii, p. 337. *Phassus salsettensis* Moore, 1879, p. 412, pl. xxxiv, f. 5. *Phassus aboe* Butler, 1886, vi, p. 30, pl. cix, f. 1; Hampson, 1892, i, p. 318.

♂ Head, thorax, abdomen, and legs dull chocolate-brown; posterior tibiae armed with orange-coloured plumes. Forewings dull chocolate-brown with darker suffusions and numerous short transverse dark brown bars between the veins, each margined, on the inner side, with pale brown; more conspicuous ones arranged in several irregular lines, the one from costa at seven-eighths to hinder angle, another from three-fourths costa to two-thirds inner margin, and traces of a third from costa at one-half; the first two of these are margined internally by a wide suffused band of pale brown, a similar suffusion covers most of the wing below Cu_{1b}; a small white spot appears at r-m vein. Hindwings dull grey, subhyaline when worn. Expanse 46 mm.

Loc. Sikkim: Darjeeling (type, a male, 71 mm., labelled "Darjeeling East India Company 60–15 Paris Exhibition" in British Museum). Assam: Khasia Hills 6. Bombay Presidency: Bombay (allotype female, expanse 64 mm. Moore Coll. 94–106" in British Museum), Kodaikanal (7,000 ft.). Thirteen males, three females.

The type example was found, without definite type indication, in the British Museum collection, and has been marked, after checking with catalogue numbers with the original description, and with accounts given by Hampson. The allotype female, described under the name *salsettensis* by Moore, probably belongs to the same species although it was taken at Bombay, a great distance from the original locality. This species seems to have a rather wide distribution from Southern India to the Himalayas, but it is possible that the study of better series may indicate specific differences. Although superficially close to *Endoclita metallica* this species is structurally distinct and not closely related to any others.

The example figured in Seitz is a male, expanse 78 mm., from Khasia Hills; in the figure of the female given by Moore (1879, pl. xxxiv, f. 5) the markings are rather poorly indicated. For a formal description I have only males before me at Adelaide. The bodies of the males are strikingly distinct with their long spine-like rearward projection of the eighth sternite. Examples studied included one from the type locality Darjeeling; the other figured one is from Assam.

The male genitalia (fig. 47–48) drawn from the Assam example, have the eighth sternite with the posterior margin deeply excavated and the sides produced posteriorly as long spines; the tegumen has the ventral margin chitinized and

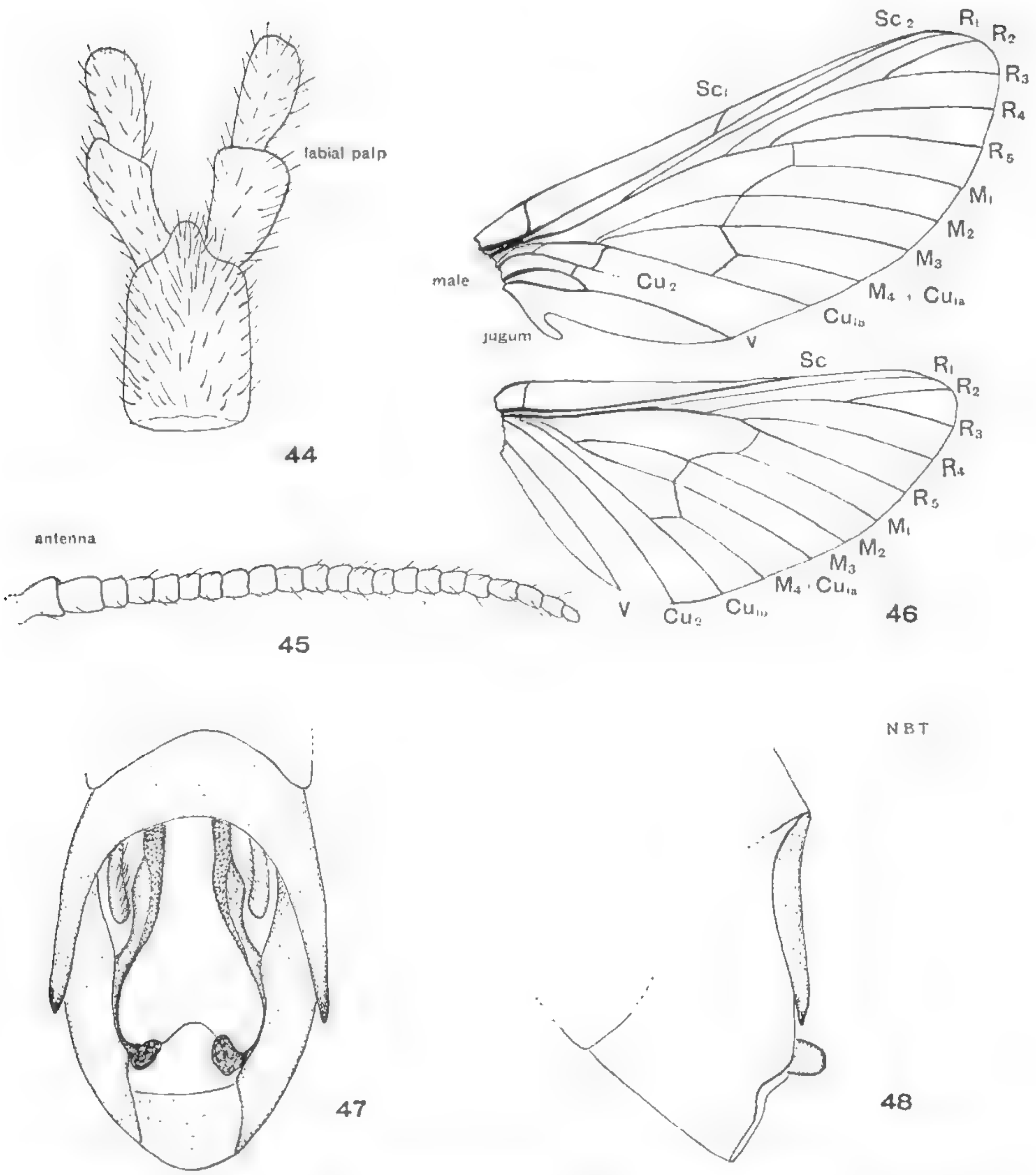

Fig. 44–48. *Nevina aboe* (Moore), Assam. 44. Labial palpi. 45. Antenna. 46. Venation of male. 47. Male, genitalia, ventral aspect. 48. Male, slightly oblique, lateral aspect.

armed with several rows of spines; the two sides diverge posteriorly, and the armature is less marked; the anal extremity of the tegumen is produced ventrally into a blunt recurved spine.

Examples of this species may be found in the British, Tring, Berlin, Senckenberg, and South Australian Museums.

STHENOPIS Packard.

Sthenopis Packard, 1864, iii, p. 390.

Antennae short, cylindrical, tapering, composed of about 23 segments. Hypopharynx large, shield-shaped, labial palpi small, composed of two segments, first twice as long as wide, second much smaller and globose, densely clothed in pubescence; maxillary palpi vestigial. Forewings with Sc_1 present, R_1 from before middle, R_2 and R_3 branching; R_2 to apex, R_4 from R_5 before r-m vein; Cu_2 not reaching to margin; Pcu and 2V not developed; 1V a strong vein to hind margin. Hindwings with Sc_1 absent; R_1 much reduced, R_2 and R_3 long-stalked.

Genotype: *Sthenopis argenteomaculatus* Harris, 1841.

The only member of this essentially Nearctic genus which has been recognized as belonging to the Eastern Hemisphere is *S. regius* from Tibet. *Sthenopis* differs from *Phassus* in the presence of Sc_1, and in the two-segmented labial palpi. From *Endoclita* and *Nevina* it is distinguished by the absence of 2V in the forewings, which, in both the latter genera, forms a Y-fork with 1V.

STHENOPIS REGIUS (Staudinger).

Plate vii, fig. 70 and Text-fig. 49–51.

Hepialus regius Staudinger, 1895, viii, p. 301, pl. v, fig. 11. *Phassus regius* Pfitzner, 1912, ii, p. 438, pl. liv b.

♂ Head, thorax, abdomen excluding base, and legs pale fawn, base of abdomen with pink suffusions; posterior legs with tibiae ornamented with specialized plumes. Forewings brownish-grey with white transverse bands; all the markings

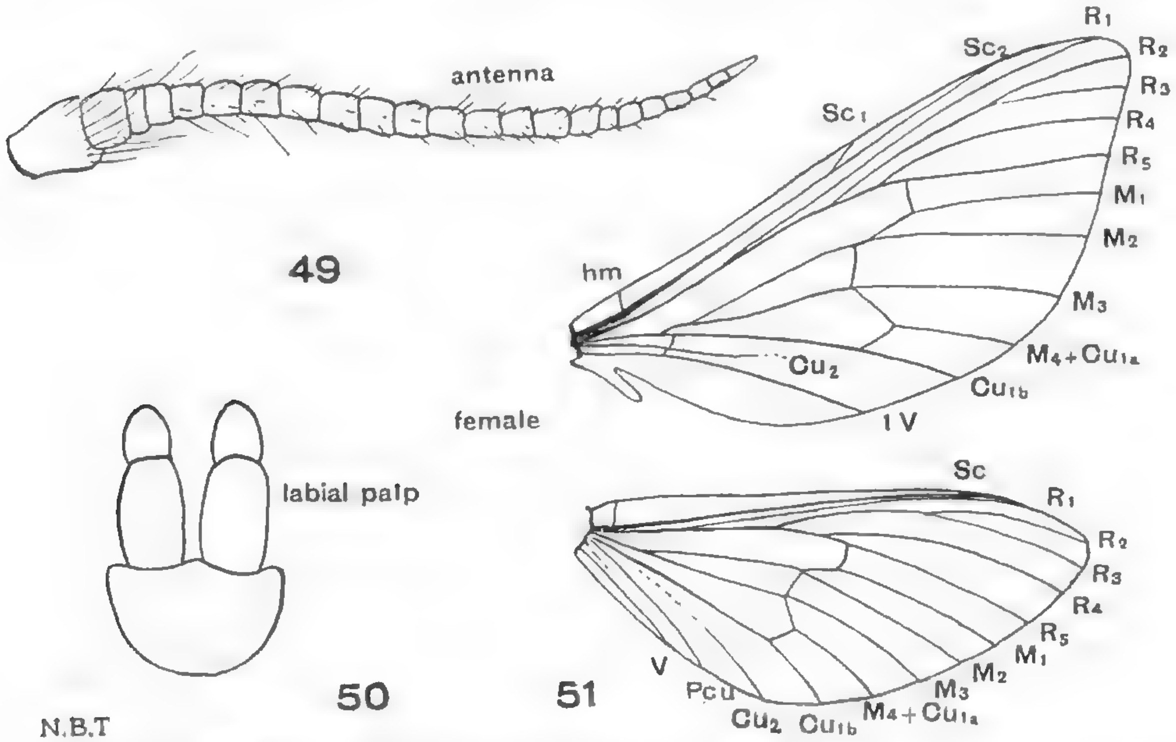

Fig. 49–51. *Sthenopis regius* (Staudinger). 49. Female, Tibet, antenna. 50. Labial palpi. 51. Venation.

edged with metallic golden colour. Hindwings with traces of white and brown markings at apex, otherwise white with a pink suffusion, rather variable in degree. Expanse 50 mm.

♀ Similar to male, posterior tibiae without specialized plumes. Expanse 52 mm.

Loc. Tibet: between Lop Nor and Kokonor (type not seen). Kokonor 6; Amdo. Kansu Province; Sining-fu. Szechwan Province; Ta-tsien-lu. Three males, three females.

Fig. 70 depicts a male from Amdo (in the Senckenberg Museum); this has the hind wings almost white; in other examples the roseate hue is more intense. The species is an exceedingly rare one, the few specimens examined being distributed among the Berlin, Senckenberg, United States National, and South Australian Museums. I have been unfortunately unable to see the types which are, according to published measurements, larger than in those available for description.

PHASSUS Walker.

Plate vii, fig. 73.

Phassus Walker, 1856, vii, p. 1566; Druce, 1887, i, p. 233; ii, 1898, p. 451; Kirby, 1892, i, p. 889 (*P. argentiferus*); Hampson, 1892, i, p. 318 (*P. hübneri*); Le Cerf, 1919, xxv, p. 469.

Antennae slender, simple, tapering, composed of about 28 segments. Labial palpi composed of three well-developed segments, each longer than wide. Maxillary palpi present but much reduced. Posterior legs, in male, with a tuft of specialized tibial hairs, usually orange-coloured; these are absent in female. Forewings with Sc simple, R_1 branching from R_s well before middle of wing; R_2 and R_3 short stalked; R_4 from R_5 before r-m vein; Cu_2 not reaching to margin; Pcu obsolete; 1V a strong vein to hind margin; 2V absent. Hindwings with Sc a simple vein; R and M as in forewings; Cu_2 present; Pcu absent or represented by a short transverse vein to Cu_2; 1V and 2V present.

Genotype *Phassus argentiferus* Walker, 1856, nominated by Kirby, 1892.

As first noticed by Le Cerf the genus *Phassus* of older authors is a heterogeneous collection of Hepialids. The genotype was nominated by Kirby, whose selection of *P. argentiferus* has priority over that made by Hampson. The generic name belongs to a well defined group of Central American species associated with *P. argentiferus* Walker, while the Indian and other Old World species formerly placed under this name appear to belong to rather distinct genera, several of which are defined in the present paper.

Phassus ss. is nearest to *Sthenopis*, but differs from it in the possession of three-segmented labial palpi. The reduction of Sc to a simple vein appears to be a recent specialization which has not extended to all the American species at present grouped under *Phassus*. The genotype is figured (pl. viii, fig. 73).

Additions to earlier parts of this revision are as follows:

TRICTENA BARNARDI sp. nov.

Plate vi, fig. 64.

♂ Head, with face and palpi greyish-brown, vertex slate-grey. Antennae greyish-brown, tripectinate, pectinations long and subequal. Thorax slate-grey with pale fawn undercoat; legs slate-grey and fawn. Abdomen grey. Forewings subhyaline grey, with numerous scriptose and watermark-like impressions; a greyish-white irregular longitudinal fascia from near base, and an oblique silvery-white, black- and white-bordered irregular streak from near apex to Cu_{1b}; parallel and internal to this a series of black spots extending from apex to Cu_{1a}; a similar shorter series from three-fourths costa to M_3. Hind wings opaque brownish-grey. Expanse 110 mm.

Loc. Western Australia: Lake Grace 4. (Type, a male, in Barnard Coll. at the Queensland Museum; paratype male I. 18946 in S. Aust. Museum.) Two males.

The examples were taken by the late Mr. W. B. Barnard, whose death is a great loss to those interested in the collecting of these primitive Lepidoptera. His collection is now in the Queensland Museum, Brisbane.

The two examples differ in size, that figured being 110 mm. in expanse, and the other 129 mm.

At first sight the species might be taken for a form of *Trictena argentata* (Herrich-Schaeffer, 1855, p. 5), to which it bears some resemblance in size and markings, but it is structurally distinct in the genitalia. In members of this genus the male genitalia have the tegumen large and rather weakly chitinized; except where distorted by post mortem changes it is of regular form, and may serve to distinguish the three known species, as follows:

a. Tegumen, in lateral view, distinctly lobed .. .. *argyrosticha*
aa. Tegumen in lateral view broadly rounded, not lobed.
  b. Tegumen subquadrately produced .. .. *argentata*
  bb. Tegumen rather evenly rounded .. .. *barnardi*

TRICTENA ARGENTATA (Herrich-Schaeffer, 1855).

Trictena argentata Tindale, 1932, iv, p. 500.

Several males and a female were taken, in early June, by Dr. C. T. Madigan's party, at the Hale River, on the western margin of the Arunta (or Simpson) Desert.

BORDAIA KARNKA sp. nov.

Plate vi, fig. 65.

♂ Head with face and palpi black; palpi short, not projecting, vertex black. Antennae long, pectinations long and slender, minutely ciliated. Thorax and legs long and slender, smoke-black, with a more greyish tone beneath. Forewings, opaque, greyish-black with faint scriptose markings and watermarks best evident along termen. An arcuate silvery-white fascia from base to middle of wing, broken toward middle; a faintly black margined series of conjoined white spots forming a band from near apex to Cu_{1a}. Hindwings greyish-black, paler towards base, venation with R_2 and R_3 rather long-stalked. Expanse 79 mm.

Loc. Western Australia; Lake Grace, 4. (Type, unique, in Barnard Collection at Queensland Museum; male genitalia I. 18945 in S. Aust. Museum.)

In the key to species of *Bordaia* Tindale (1932, p. 507), this species falls into section a, in which the forewings possess conspicuous silvery-white bands. The arrangement of the wing markings is like that of *Trictena argyrosticha* Turner (1929, p. 307). In form of antennae it is nearest to *B. pica* Tindale (1932), the antennal rami being even more slender than in that species.

In the male genitalia the form of the tegumen is distinctive in lateral view, having the anterior margin excavate and followed by a low rounded eminence, behind which the margin is concave, being unlike that of any of its three congeners. The venation differs from the genotype in the length of the stalking of R_2 and R_3 of hindwing, but is otherwise similar. The palpi of this species are much less conspicuously placed than in *B. moesta* Tindale, 1932, in which species they are visible from above.

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EXPLANATIONS OF PLATES.

Plate v.

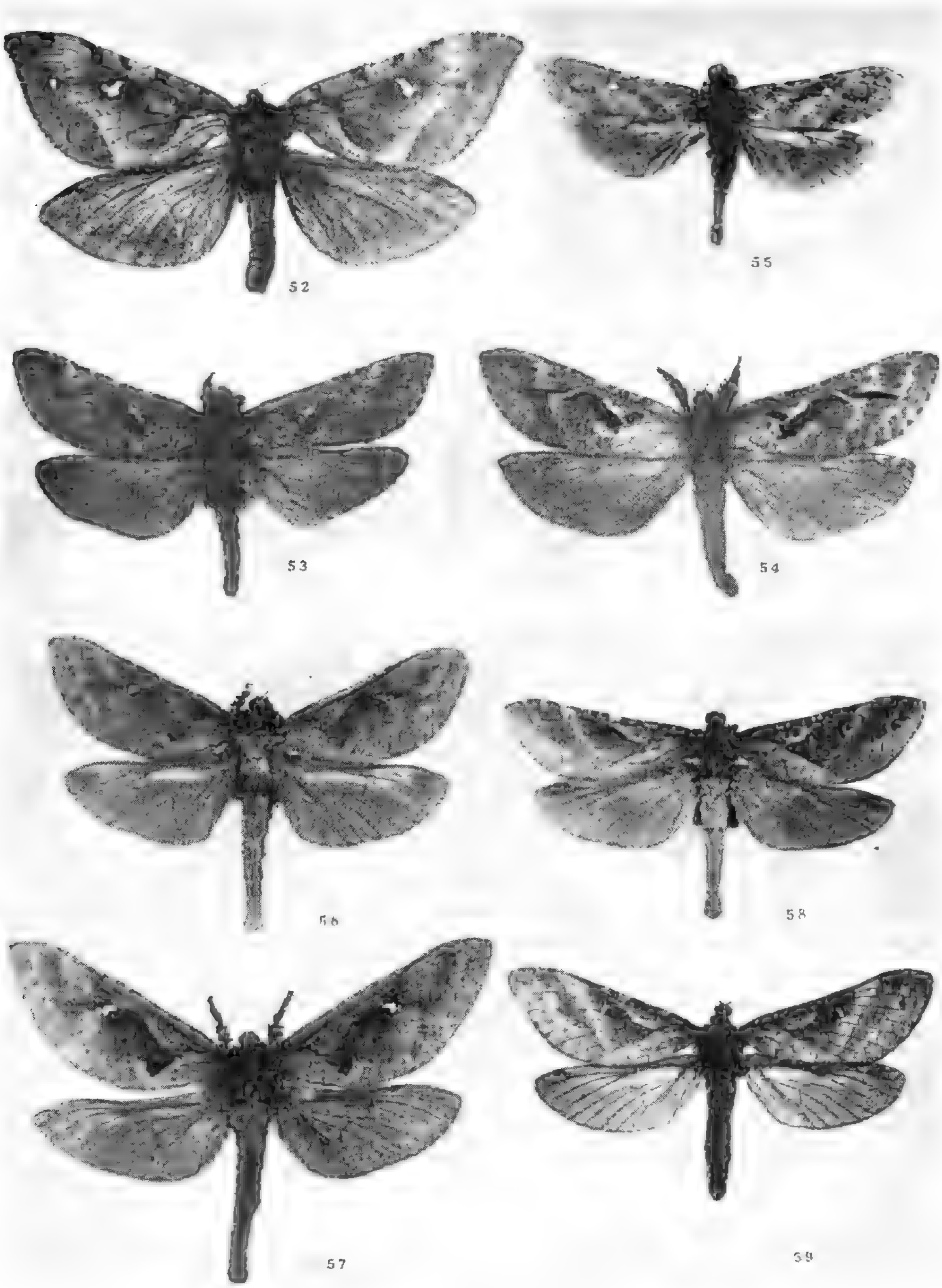
Fig. 52. *Zenophassus schamyl* (Christoph), male, Kuban, Caucasus Mountains, 83 mm.
Fig. 53. *Endoclita damor* (Moore), male, Kangra Valley, 63 mm.
Fig. 54. *Endoclita damor* (Moore), female, Mussoorie, 68 mm.
Fig. 55. *Endoclita undulifer* (Walker), allotype male, Khasia Hills, 56 mm.
Fig. 56. *Endoclita purpurescens* (Moore), male, Punduloya, Ceylon, 94 mm.
Fig. 57. *Endoclita purpurescens* (Moore), female, Maskeliya, Ceylon, 118 mm.
Fig. 58. *Endoclita chalybeata* (Moore), allotype male, Khasia Hills, 80 mm.
Fig. 59. *Endoclita chalybeata* (Moore), female, Darjeeling, 82 mm.

Plate vi.

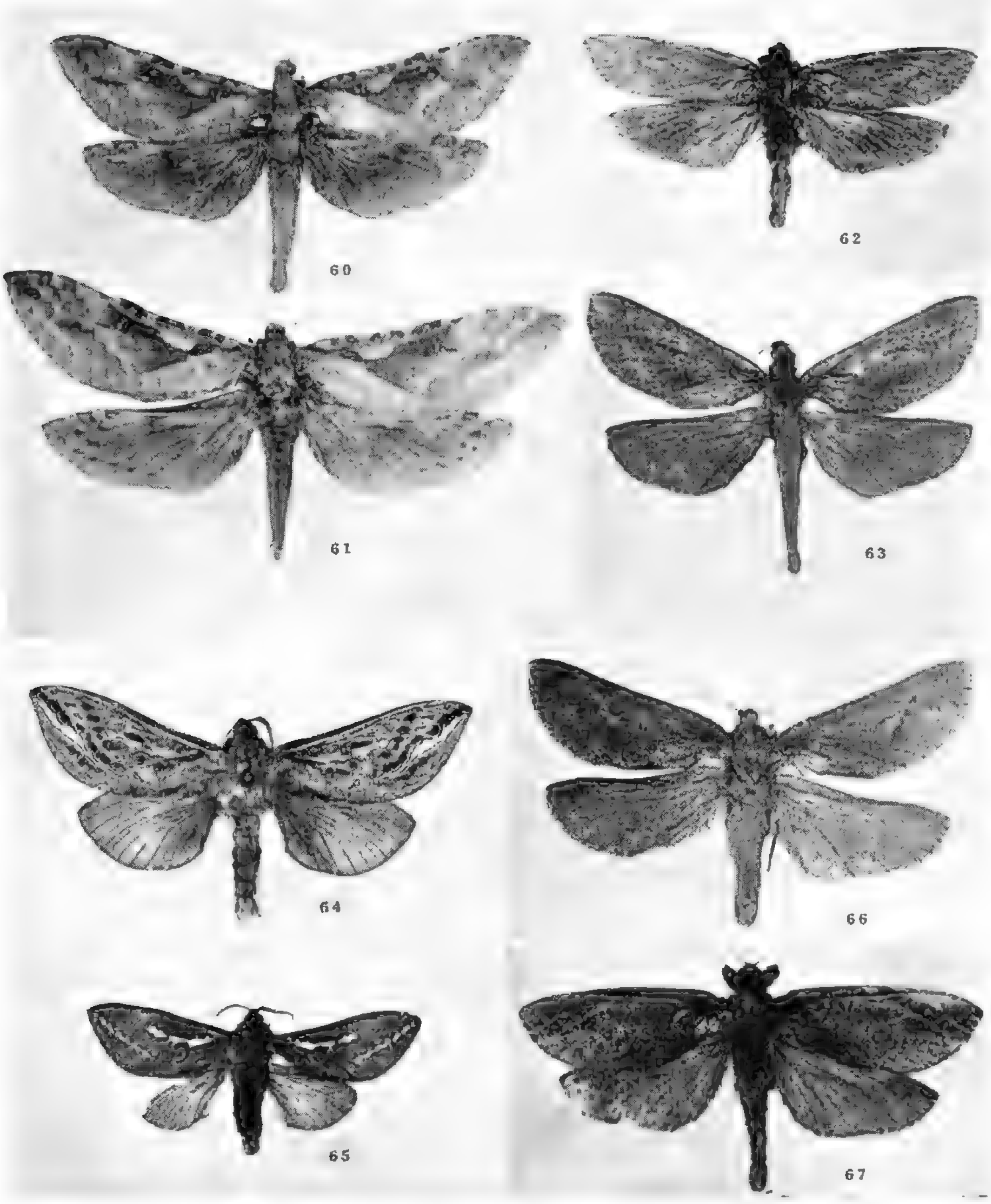
Fig. 60. *Endoclita signifer* (Walker), allotype male, Khasia Hills, 105 mm.
Fig. 61. *Endoclita signifer* (Walker), female, Khasia Hills, 120 mm.
Fig. 62. *Endoclita albosignata* Tindale, type, a male, Assam, 68 mm.
Fig. 63. *Endoclita rustica* Tindale, type, a male, Shillong, 56 mm.
Fig. 64. *Trictena barnardi* Tindale, type, a male, Lake Grace, 110 mm.
Fig. 65. *Bordaia karnka* Tindale, type, a male, Lake Grace, 79 mm.
Fig. 66. *Endoclita rustica* Tindale, paratype male, Khasia Hills, 64 mm.
Fig. 67. *Endoclita chrysoptera* Tindale, type, a male, Senchal Range, 53 mm.

Plate vii.

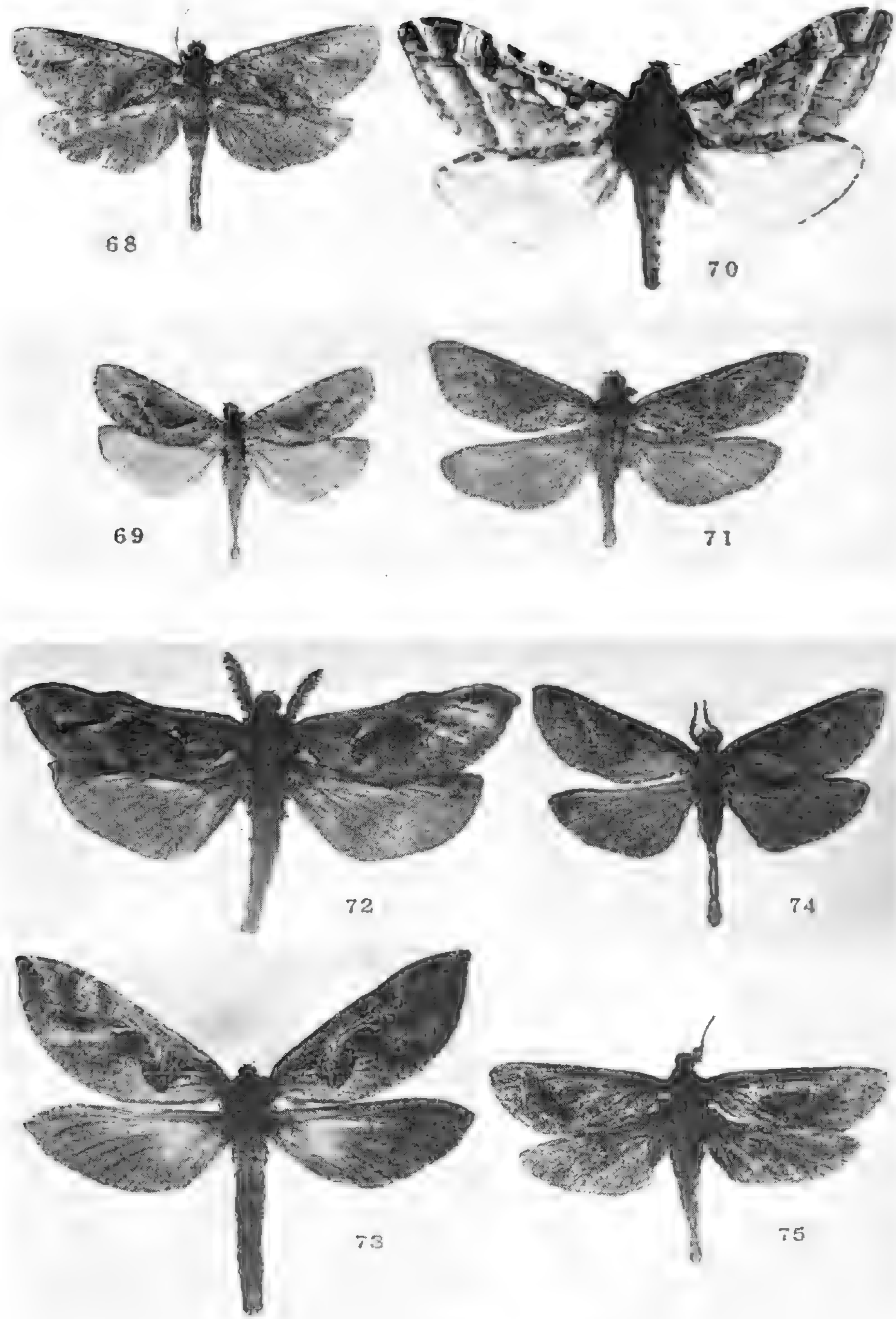
Fig. 68. *Endoclita marginenotatus* (Leech), type, a male, Omeishan.
Fig. 69. *Endoclita aurata* (Hampson), male, Bernardmyo, Burma, 44 mm.
Fig. 70. *Sthenopis regius* (Staudinger), male, Amdo, Tibet, 50 mm.
Fig. 71. *Endoclita metallica* Tindale, type, a male, Darjeeling, 54 mm.
Fig. 72. *Endoclita gmelina* Tindale, type, a male, Namtu, 90 mm.
Fig. 73. *Phassus argentiferus* (Walker), male, Jalapa, Mexico, 112 mm.
Fig. 74. *Nevina aboe* (Moore), male, Assam, 62 mm.
Fig. 75. *Endoclita buettneria* Tindale, paratype male, Shwebo, 68 mm.



CAUCASIAN AND INDIAN HEPIALIDAE



INDIAN AND AUSTRALIAN HEPIALIDAE



TIBETAN, INDIAN AND CENTRAL AMERICAN HEPIALIDAE

LIFE HISTORY OF A CONVOLVULUS FEEDING MOTH, AEDIA ACRONYCTOIDES (GUENÉE 1854): LEPIDOPTERA HETERONEURA, FAMILY NOCTUIDAE

By Norman B. Tindale, B.Sc., South Australian Museum

Summary

The lesser Bindweed (Convolvulus arvensis Linn.), originally perhaps a native of Europe and Asia, is a troublesome weed, now spreading widely in the settled districts of South Australia. Recently it has been rapidly dispersed by being included in the soil of nursery stock. In irrigation settlements it tends to choke water channels, and in city gardens may form dense mats of summer vegetation strangling all other plants in its vicinity.

In March, 1941, Mr. H. M. Hale first noticed the bindweed in his garden being heavily defoliated by a Noctuid larva, and specimens secured were reared at the South Australia Museum. The species proved to be Aedia acronyctoides (Guen.), the larva of which had not been previously described.

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Fig. 1–4.

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Several Palaearctic species of the genus *Aedia* Huebner, 1825 (formerly *Catephia* Treitschke, 1826), including the genotype *A. leucomelas* (Linn. 1758) and *A. funesta* (Esper 1787) are already known as feeders on members of the plant genus *Convolvulus*. It is not therefore surprising to find that the present species has similar habits. *A. acronyctoides* appears to be a native of Australia, but it occurs also in South Eastern Asia and possibly Africa. It has been recorded occasionally in this State since about 1881; no information has been available as to its life history or host plant. On general grounds the Australian bindweed (*Convolvulus erubescens*) may be suspected as a possible endemic food. The present observations are based on examples reared on the introduced species, and it will be of interest in the future to note whether or not *A. acronyctoides* will exert any measure of control over this pest weed.

In preparing these notes opportunity is taken to clarify and revise the generic synonymy and to give reasons for the adoption for members of the genus of the name *Aedia* rather than *Catephia*.

Aedia (Huebner).

Aedia Huebner (1825), p. 261 (genotype *leucomelas* Linn.); *Catephia* Ochsenheimer (1816), iv, p. 94 (non descr.); Treitsche (1826), v (3), p. 320 (genotype *leucomelas* Linn.); Hampson (1894), ii, p. 482; *Aedia* Swinhoe (1900), ii, p. 129; *Catephia* Hampson (1926), p. 49.

Hampson continued the use of the name *Catephia* in preference to *Aedia* on the assumption that Huebner's work did not appear until 1827, but Sherborn and Prout (1912, p. 175) give 1825 as the publishing date of the portion of the work containing this description. Hemming (1934, p. 16) indicates that the work was complete by 1826. It thus seems necessary to accept the term *Aedia* in preference to the more frequently used *Catephia*.

AEDIA ACRONYCTOIDES (Guenée).

Fig. 1–2; larva fig. 3.

Anophia acronyctoides Guenée (1854), iii, pp. 47, 1378; *Catephia acronyctoides* Hampson (1894), ii, p. 482; *Aedia acronyctoides* Swinhoe (1900), ii, p. 129.

Male. Head dark purplish-brown, with some paler scales forming a frontal disc; thorax dark purplish-brown, almost black, with transverse bands of white scales; abdomen dark purplish-brown, darker at apex; abdomen with dorsal tufts on basal segments, a conspicuous dorsal one on third segment; also lateral tufts of

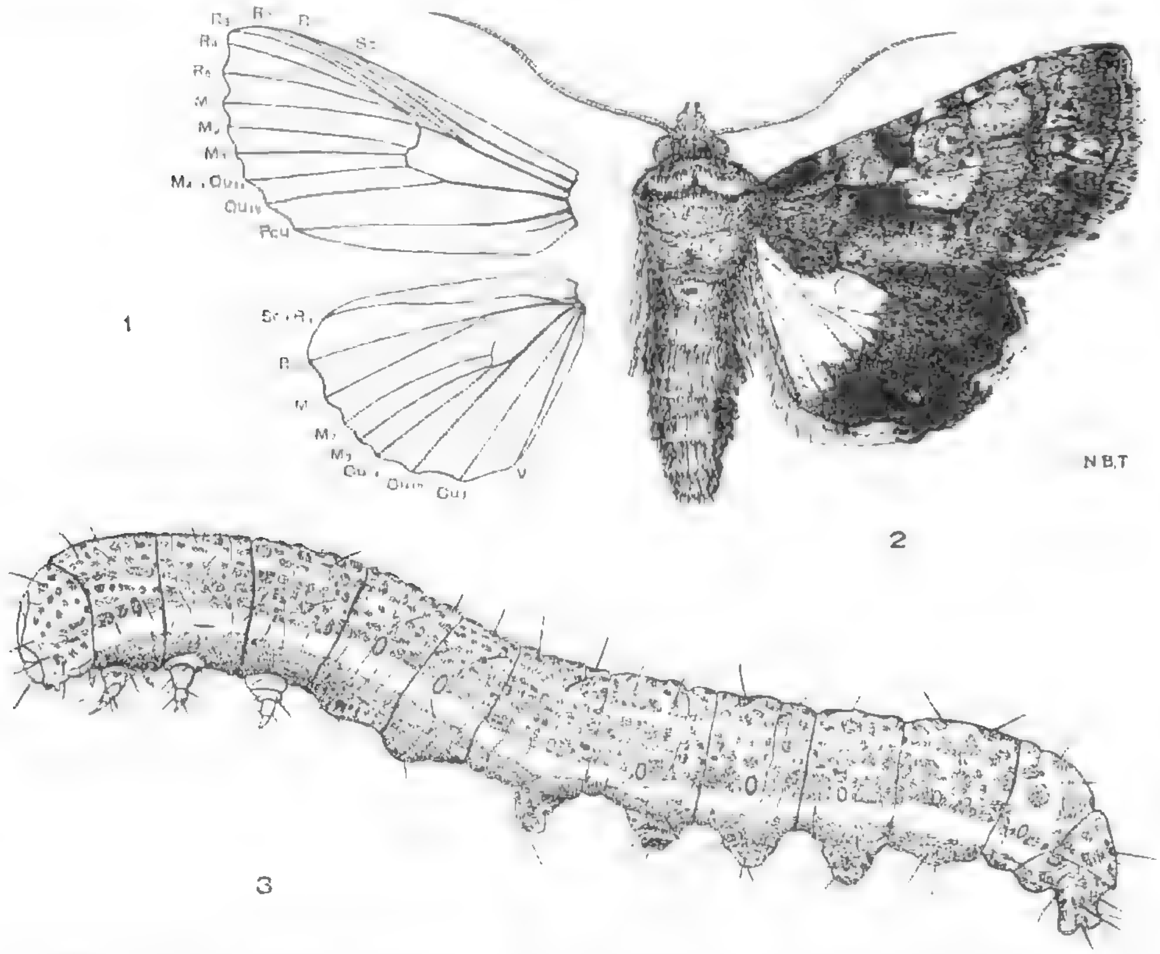

Fig. 1–3. *Aedia acronyctoides* (Guenée). 1. Venation. 2. Adult female, Adelaide, June, 36 mm. 3. Penultimate instar larva, 50 mm.

long golden yellow hair at base. Forewing brownish-black, with dark olive green and white scales arranged in a rosette in outer discal area; five white marks along costa; an irregular double line from near costa at three-quarters to inner margin at two-thirds; an irregular black fascia expanded into a subrectangular blotch at one-third, continues along Cu_1b to meet paired black lines; cilia brownish-black. Hindwings with basal half snow-white, outer half dull brownish-black. Cilia white except for an infuscation between M_3 and Cu_1b. Wings beneath white on basal, greyish-black on outer half; a yellowish suffusion near base and grey scales at costa; cilia grey flecked with white; a semi-lunate black mark on disc of forewing. Expanse 37–41 mm.

Female. Colour and markings similar to male; abdomen without lateral tufts of golden yellow hair at base; dorsal tufts only feebly developed. Wings beneath with only scant traces of yellow suffusion. Expanse 34–40 mm.

Loc. Queensland: Cooktown, Mackay, Brisbane. South Australia: Balhannah, 12; Norton Summit, 4; Adelaide, 3, 6, 11. North Australia: Tennant Creek, 9 males, 16 females, and 36 larvae.

The above descriptions have been drawn up from the particular examination of two examples (Reg. No. I. 18947 in S. Aust. Museum), a male expanding 38 mm., from Norton Summit, 7 April, 1884, and the reared female example (expanding 36 mm.) from Adelaide, 25 June, 1941; the latter is figured (fig. 2).

Mr. F. M. Angel has taken the species at Parkside, near Adelaide. It was particularly abundant in November, 1933, and occurred again in March of 1938 and 1939. It will be noticed that his emergence dates are a month earlier than those of the insects taken in the Mount Lofty Ranges. Examples in his collection from Tennant Creek, North Australia, appear to belong to a separate race.

The species were first recorded from Tasmania, and several distinct geographical races have since been described from Ke Island, Java, Borneo, Andaman Islands, Burma, India, China (Amoy), and West and South Africa. *A. acronyctoides discistriga* (Walker), the African form, which may be a distinct species, has been stated to have the white areas of hindwings reduced; in the Indian form *A. a. olivescens* (Guenée) the suffusion on forewings tends to be olive in tone.

LIFE HISTORY.

Batches of larvae (fig. 4) were taken at Adelaide on 6th and 17th April. The first series ceased feeding within a week, and by 18th all had burrowed in the earth. The series of the 17th were on the average more developed, and were actively feeding until the 18th, when they also commenced to burrow; all had

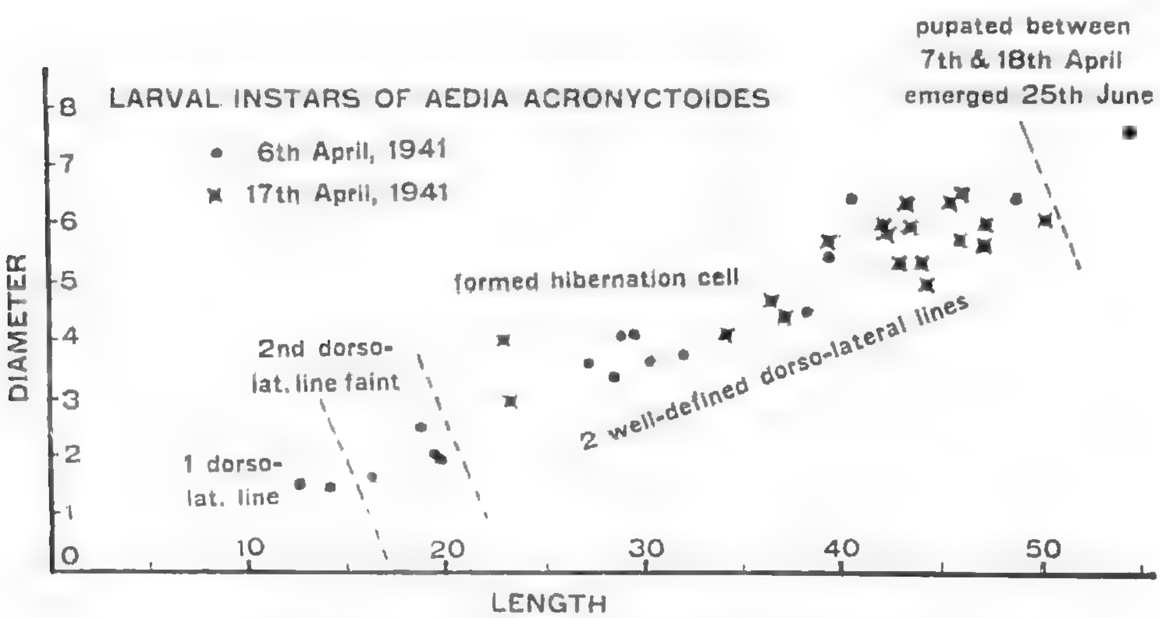

Fig. 4. Dimensions of larvae of several instars of *Aedia acronyctoides* (Guenée).

tunnelled in by the 22nd, their disappearance coinciding closely with the seasonal withering off of the bindweed. Most of the larvae formed ovate earthen cases lined with silk; one case was elongate oval in form, and had a prepared circular area situated assymetrically at one end, where the earth covering was weak.

On 25th June the only fully-fed larva (that measuring 54 mm.) emerged from the elongate oval case as an adult female. Its pupation period had been 38–42 days, and it was possibly a belated individual of an autumn brood, for dated adult examples previously known from South Australia have been taken in December (near Balhannah) and April (Norton Summit).

Examination of a sufficient sample of the ovate earthen cases on 26th June showed that larvae of the penultimate instar had not pupated but were hibernating in a flexed position within their earthen chambers. This may indicate the means by which the species bridges the six-month long period when the food plant is resting and no portions of it survive above ground.

DESCRIPTIONS OF LARVAE.

Larva 12·5 mm. in length. Diameter 1·5 mm., smooth, primary setae not conspicuous; setal pattern normal for family; colour blue-grey with many small irregular circular black spots arranged in rows; dorsally a median black-margined yellow line from second thoracic segment to posterior margin of third; this may be extended forward on to head as a pale grey line; a dorso-lateral yellow line extending full length of body. In lateral view a broadly black-bordered, cream-coloured band also extends the full length; on each segment it is overlaid by an irregular patch of orange suffusion; the ventral surface brownish-black with traces of a lateral longitudinal paler blue-grey line.

Larvae 17–20 mm. in length. Diameter 1·6–2·3 mm. Similar to earlier larva, but with traces of a second dorso-lateral pale yellow line.

Larvae 23–50 mm. in length (fig. 3). Diameter 3·0–6·5 mm. Markings basically similar to earlier instar larvae but blue-grey and black pattern accentuated, forming a slightly irregular reticulating network; a median, and dorso-lateral bands on the dorsum are conspicuously dark orange in colour, but are without black margins; the median one is most conspicuous on the thorax and near the anal extremity; the second dorso-lateral line is irregularly but well marked, and has an orange suffusion extending within it almost as a continuous central line; ventrally the larva is similar in colour to the dorsum, save that on each segment (except the head) there is a median large circular black mark.

Larva 54 mm. in length. Diameter 7·5 mm. The markings are similar to those of the previous instar, but just before pupation are dulled and matt in tone.

Pupa. Not examined; pupal skin pale reddish-brown. Pupa enclosed in an elongate-oval earthen cocoon of 13 x 33 mm. external, 8 x 18 mm. internal measurements.

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NOTES ON THE CHEYLETIDAE (ACARINA, TROMBIDOIDEA) OF AUSTRALIA AND NEW ZEALAND, WITH DESCRIPTIONS OF NEW SPECIES

By H. Womersley, A.L.S., F.R.E.S., South Australian Museum

Summary

This family of microscopic mites has hitherto been unrecorded from Australia or New Zealand. They may be distinguished by the morphological characters given in the following family diagnosis.

Comparatively little is known of their life-history. Many are free-living or predatory on other mites or on insects, while others are parasitic on animals or birds, or are predatory upon other mites living on or in the fur or feathers of mammals or birds. Rats. mice, bats, and even sheep are affected.

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Fig. 1–9.

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Hitherto none have appeared to be of direct importance to man, but in this paper is described a new species, *Psorergates ovis*, which seems likely to become a serious pest to sheep in Australia.

In the present paper fourteen species are recorded from Australia and one from New Zealand. Of these seven Australian species (and one genus) are described as new. The remainder are cosmopolitan or introduced forms.

Family CHEYLETIDAE Leach 1814.

Leach, W. E. 1814, Tr. Linn. Soc. London, *11*, 399.

Body rounded, oval to fairly elongate, not annulated, of soft texture. Larvae with three pairs of legs, later stages with four pairs. Pseudostigmal organ absent. Palpi four- to five-segmented, free, often forceps-like, tibial-claw present, tarsus thumb-like. Legs short and stumpy or long and slender, without strong spines. Claws two or one, sometimes absent on one or more legs. Body setae often branched or pectinated or fan-like. Terrestrial forms but frequently parasitic or predatory.

Key to the Known Genera.

1.	Legs I normal, adapted for walking or tactile use; with 2 or without claws ..	.. 2.
	Legs I very short, with a spiral-like claw adapted for grasping hair. Parasitic on mice, rats, bats, etc.	Gen. *Myobia* v. Heyden 1826.
2.	Palpi normal, not forming a pair of forceps	.. 3.
	Palpi forming a pair of forceps	.. 6.
3.	Palpi normal, cylindrical	.. 4.
	Palpi very short, swollen or conical	.. 5.
4.	Tarsal empodium bipectinate. In quills of birds ..	Gen. *Syringophilus* Haller 1880.
	Tarsal empodium as a pectinate V. Subcutaneous on Woodpeckers.	Gen. *Picobia* Haller 1878 (not Australian).
5.	Palpi swollen. Only on birds	Gen. *Sarcopterinus* Raillet 1893. syn. *Sarcoborus* Ouds. 1906 (not Australian).
	Palpi conical. On mice and sheep	Gen. *Psorergates* Tyrrell 1883.
6.	Palpal tarsus with comb- and sichel-like setae	.. 7.
	Palpal tarsus without above, only with small ordinary setae	Gen. *Cheletiella* Canest. 1886.

7. Palpal tarsus with 2 comb- and 2 sichel-like setae .. .. 8.
Palpal tarsus with 1 comb- and 2 sichel-like setae .. .. 13.
Papal tarsus with 2 sichel-like setae only .. Gen. *Cheletoides* Ouds. 1904a.
8. Dorsal setae feather-like. Free living .. .. .. Gen. *Cheyletus* Latr. 1797.
Dorsal setae in the form of strongly ciliated rods. With eyes Gen. *Cheletophyes* Ouds. 1914 (not Australian).
Dorsal setae fan-or scale-like, often slender .. .. 9.
9. Legs I normal, with claws, for walking .. .. 10.
Legs I without claws, tactile .. .. 12.
10. Claw of palp internally smooth or with few basal tubercles .. .. .. 11.
Claw of palp pectinate along entire inner edge .. Gen. *Cheletophanes* Ouds. 1904a.
11. One anterior dorsal shield .. .. Gen. *Cheletonella* nov.
Two dorsal shields, one on propodosoma and one on hysterosoma Gen. *Cheletia* Haller 1884.
Three dorsal shields, one on propodosoma and two, side by side, on hysterosoma Gen. *Cheletomimus* Ouds. 1904a.
12. Palpal claw entirely pectinate along inner margin Gen. *Cheletogenes* Ouds. 1905 (not Australian).
Palpal claw with basal inner tubercle or smooth .. Gen. *Cheletomorpha* Ouds. 1904a.
13. Two dorsal shields .. .. 14.
Anterior dorsal shield only .. .. .. Gen. *Cheletopsis* Ouds. 1904a.
14. Dorsal shields contiguous and covering entire dorsum Gen. *Chelonotus* Trt. in Berlese 1893 (not Australian).
Dorsal shields separate, encircled by soft cuticle .. .. 15.
15. Anterior shield trapezoidal .. .. .. Gen. *Acaropsis* Moq.-Tand. 1863.
Anterior shield pentagonal .. .. Gen. *Cheletosoma* Ouds. 1905 (not Australian).

Genus Myobia v. Heyden 1826.

von Heyden 1826, col. 613.

Myobia miniopteris sp. nov.

Text-fig. 1 A–E.

Description. Female. Elongate, 578μ by 238μ. Front of head flattened. Dorsal surface with characteristic setae as figured, these arranged 4, 4, 6, 4, 4, those of first and outer members of second row very much asymmetrically broadened at base and with 8–10 longitudinal striations, those of third and fourth rows and the middle pair of second and fifth rows less broadened, outer members of fifth row normal. Outer setae of first and second rows 180μ long, inner of these rows 105μ, remainder 75–90μ long. At apex of body a pair of setae about 510μ long. Ventrally with three pairs of long fine setae, one between coxae III, one just anterior of coxae IV and one just posterior of coxae IV; there is also a pair of small outer setae between coxae III, another pair outside of the third pair of long setae, and a pair of medium setae just before the apex of the body; the lengths of these setae are, first long 90μ, second long 90μ, third long 120μ, short 21μ, medium 51μ. Tarsi and claws of leg I normal for the genus, adapted for clasping hair; of leg II strong and evenly curved; of legs III and IV straighter and scythe-like; two claws on legs II–IV. Tibiae and tarsi of legs III and IV with three and two stout spines at the outer anterior angles. Tip of tarsi I with two stout long blunt setae. This species is remarkable for the prominent and large air cavities at the insertion of the legs. Leg I as figured.

Locality and Host. South Australia: one (type) from *Miniopteris schreibersi* Naracoorte 1893 (R. Fleming); another from *Chalinolobus gouldi* (no precise locality), M 401,506. N.B.: Bat hosts in South Australian Museum collections.

Remarks. Nearest to *M. rollinati* (Poppe) described from the Greater Horse Shoe Bat (*Rhinolophus ferrum equinum*) of Europe, but differs in the form of the longer expanded dorsal setae.

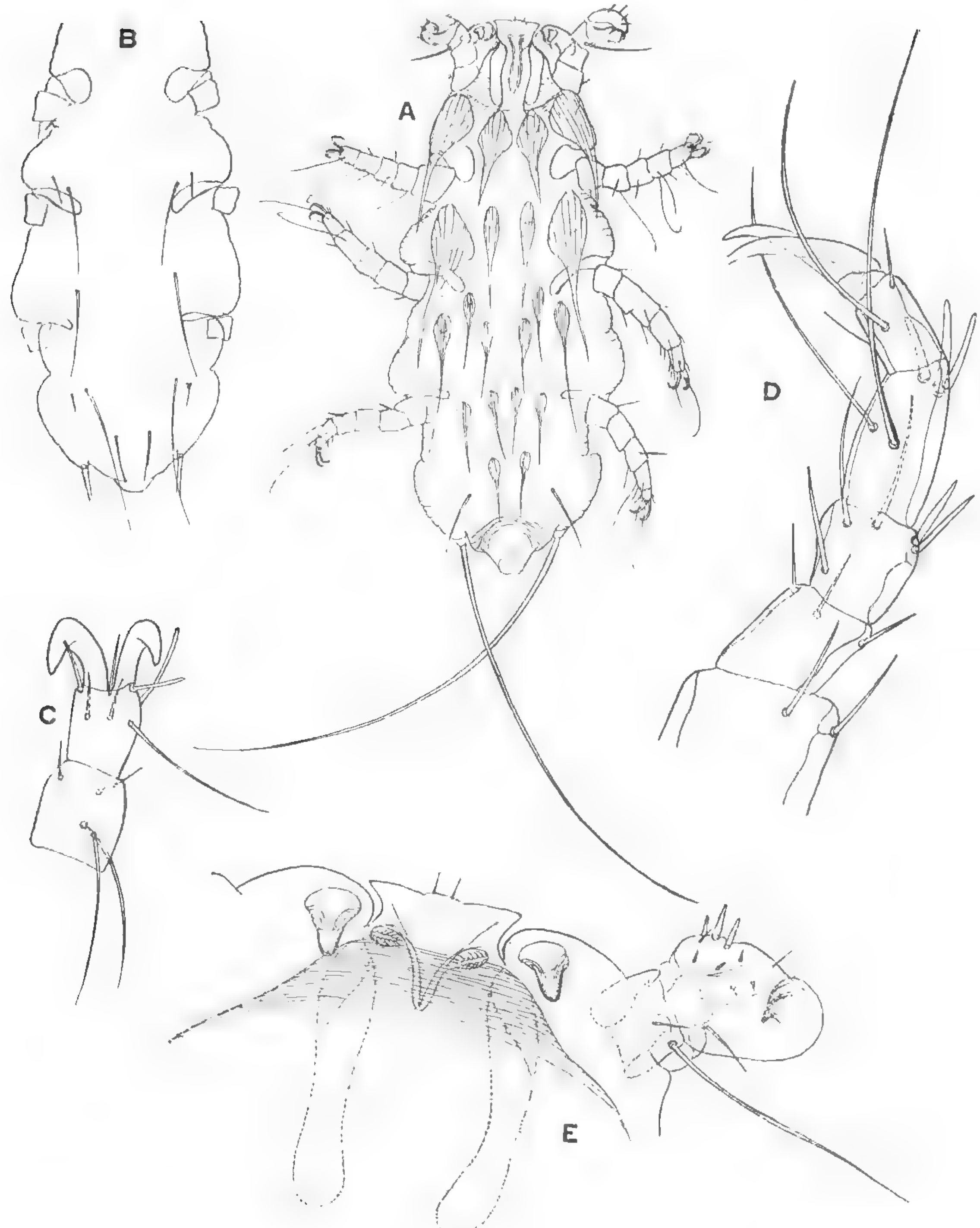

Fig. 1. *Myobia miniopteris* sp.nov. A, Entire dorsal view of female; B, ventral view of same, except gnathosoma and legs; C, tip of leg II; D, leg III or IV; E, capitulum and right palp from above.

MYOBIA CLARA sp. nov.

Text-fig. 2 A–B.

Description. Female. Elongate, length 425μ, width 170μ. Front of head lightly produced, snout-like. Dorsally with 22 setae, arranged 4, 4, 4, 2, 2, 2, 4, 2; all except the two posterior rows simple, as figured, moderately broad basally for rather more than half their length, and only indistinctly longitudinally striated;

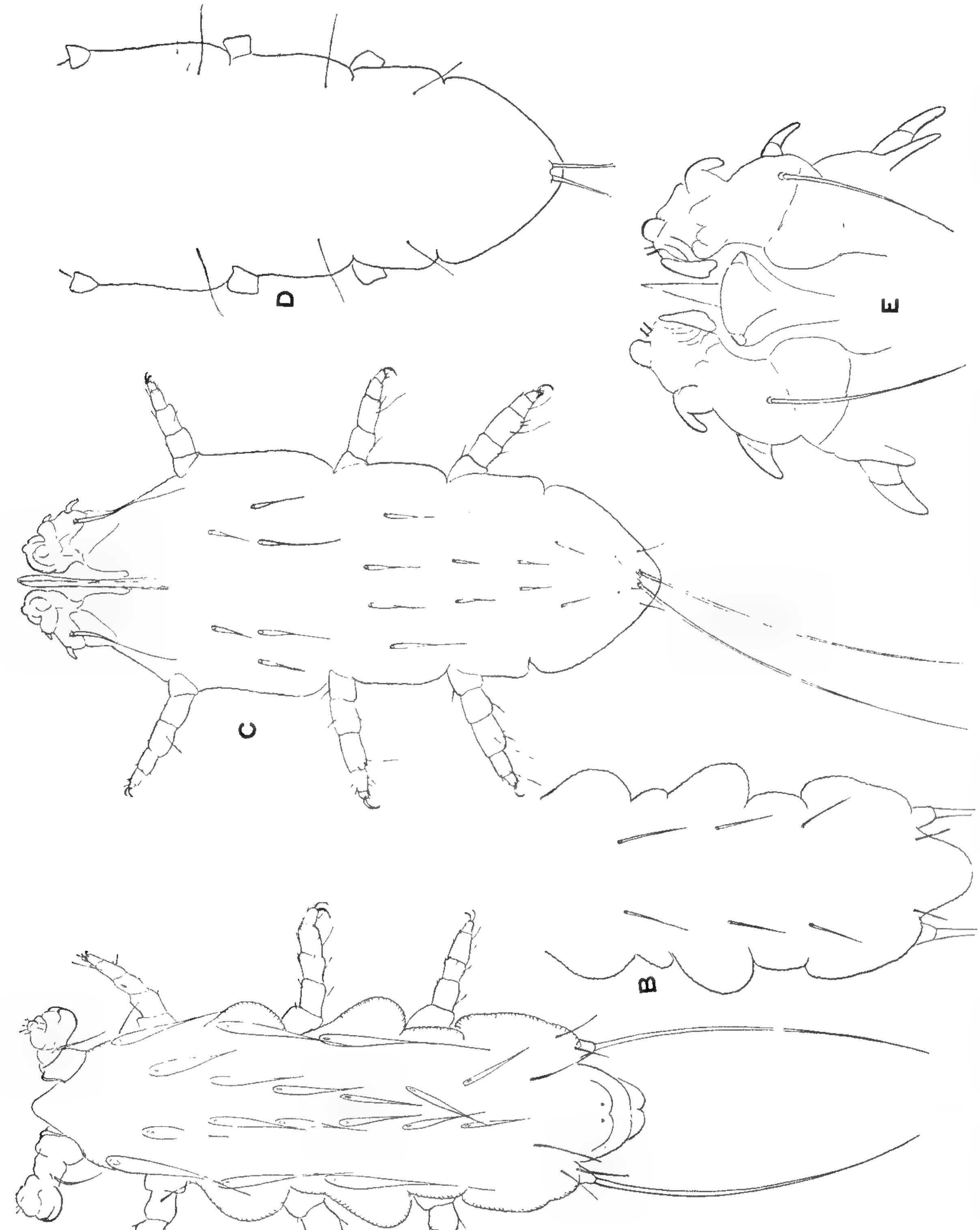

Fig. 2. *Myobia clara* sp.nov. Female: A, entire dorsal view; B, ventral view, except gnathosoma and legs. *Myobia minima* sp.nov. Female: C, entire dorsal view; D, ventral view, except gnathosoma and legs.

outer ones of first three rows 90μ long, the six central pairs 60–75μ, posterior six 60μ. The paired apical abdominal setae 330μ long. Ventrally with four pairs of setae, 60μ long and arranged as figured. Leg I normal for the genus; II to IV with paired claws which are all alike, slender and sichel-like. The prominent air chambers at the insertion of the legs present in the preceding species are absent.

Locality and Host. ? South Australia from bats M499 and 4418–21 in the South Australian Museum collections.

Myobia minima sp. nov.

Text-fig. 2C–D.

Description. Female. Elongate, length 340μ, width 136μ. Front of head flattened as in *miniopteris*. Dorsally with 20 setae arranged 2, 4, 4, 2, 2, 2, and then four small fine ones; the first six rows are somewhat thickened basally for not more than half their length; the median pair of the second row and the outer ones of the third row are 75μ long, the others 30–33μ; the pair of long apical setae are 180μ in length. Ventrally with three pairs of long fine setae, 45μ long, as figured, in front of the anterior pair is a pair of very small fine ones on each side. Leg I as figured, adapted for clasping hair; II to IV with only a single claw which is strongly curved and sichel-like. No air chambers at insertions of legs.

Locality and Host. ? South Australia on *Chalinolobus gouldi* M401, 506 in South Australian Museum collections.

Myobia chalinolobus sp. nov.

Text-fig. 3 A–C.

Description. Female. Of squat form, length 323μ, width 238μ. Front of head not flattened. Dorsally with three pairs of long slender setae each of which has a short accessory hairlet at about one-fourth from its tip; medially and anteriorly is a pair of very short setae, while posteriorly there are four short setae. The long dorsal setae are 120μ in length. The apical paired setae are 320μ long. On the venter coxae I with two fine setae, II with three, III with one, IV without any setae; between coxae IV a transverse row of four fine setae, and at apex two more. Leg I normal for the genus, as figured; legs II to IV all with paired stout evenly curved similar claws. At the insertion of the legs are slender invaginations representing air chambers.

Locality and Hosts. Type from *Chalinolobus gouldi*, M401, 506 from South Australia, in the collections of the South Australian Museum.

Myobia ensifera (Poppe 1896).

Text-fig. 3D.

Poppe, S. A. 1896, 341.

This is a well-known European species found on rats and mice. In Australia it has been found (1) on laboratory white rats, University, Adelaide, June, 1938 (T.H.J.) and (2) on rats at Cairns, Queensland, 1939 (W.G.H.).

Genus Psorergates Tyrrell 1883.

Tyrrell 1883, 332.

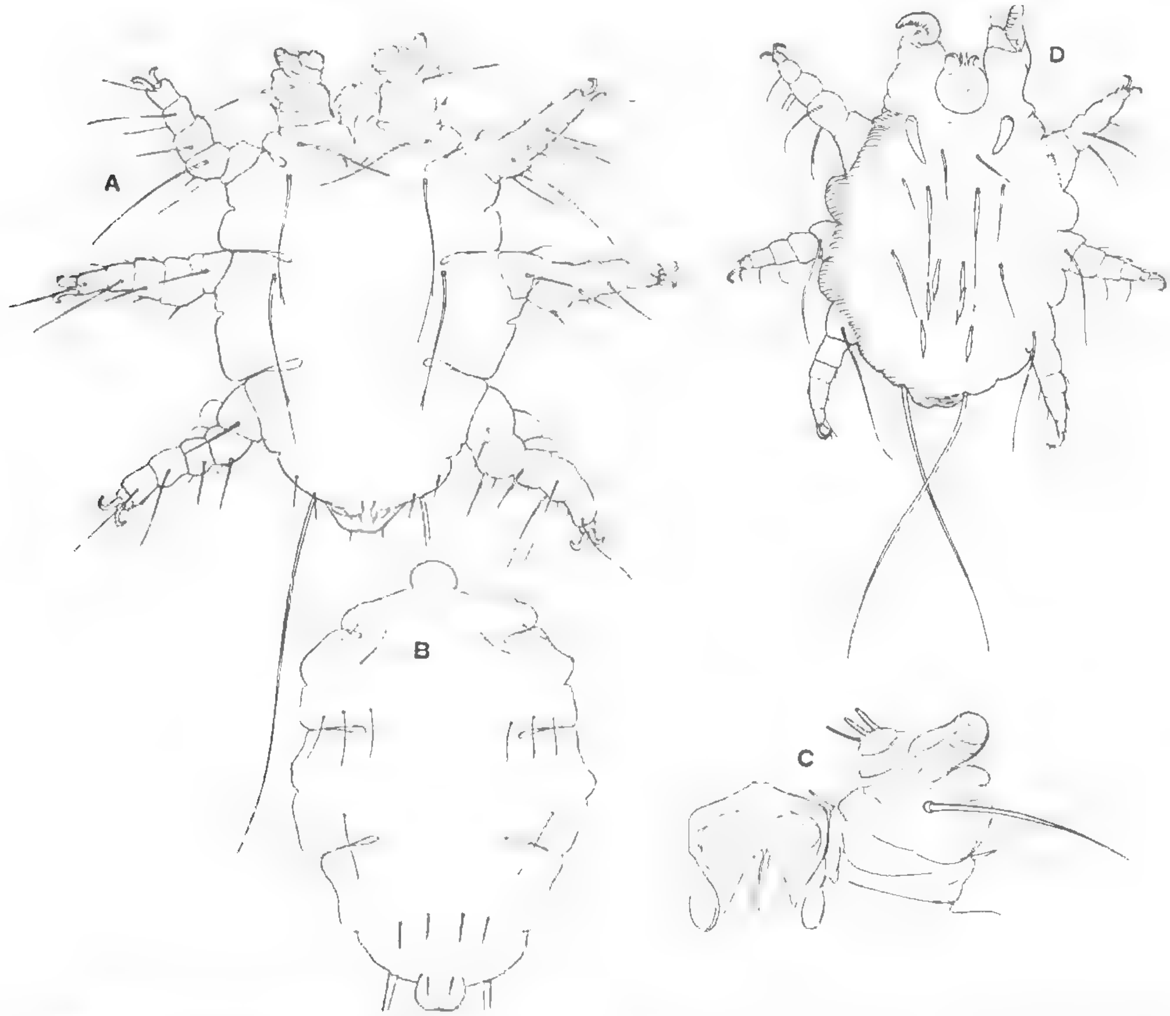

Fig. 3. *Myobia chalinolobus* sp.nov. Female; A, entire dorsal view; B, ventral view, except legs; C, right palp. *Myobia ensifera* Poppe. D, Entire dorsal view of female.

PSORERGATES OVIS sp. nov.

Text-fig. 4 A–J.

Description. General form rounded and flattened, rather narrower than long. Lateral margins indented slightly between the coxae. Claws furnished with paired claws. Palpi short and conical. Penis of male dorsal.

Female. Length 189μ, width 162μ. Palpi as figured, with a short stout somewhat clavate rod-like seta at the outer dorsal angle; tibia with a long and a short seta, and with well chitinized blunt claw. Legs short and stout, femur on outer margin below with a pair of adjacent long setae; tibia with a long outer seta and a stout curved tooth on inner surface; tarsus with outer tooth and two strong claws; all legs alike, but the long tibial seta is much longer on leg IV. Dorsum smooth, except for a narrow outer margin of longitudinally striated cuticle; with four pairs of stout setae as figured. Venter with a pair of short setae in the middle; a single setae on each coxa and apically with two pairs of long (68μ) setae arising from a pair of lobes.

Male. Length 167μ, width 116μ; differs from female only in having but a single pair of long setae apically and ventrally, which are rather shorter than in

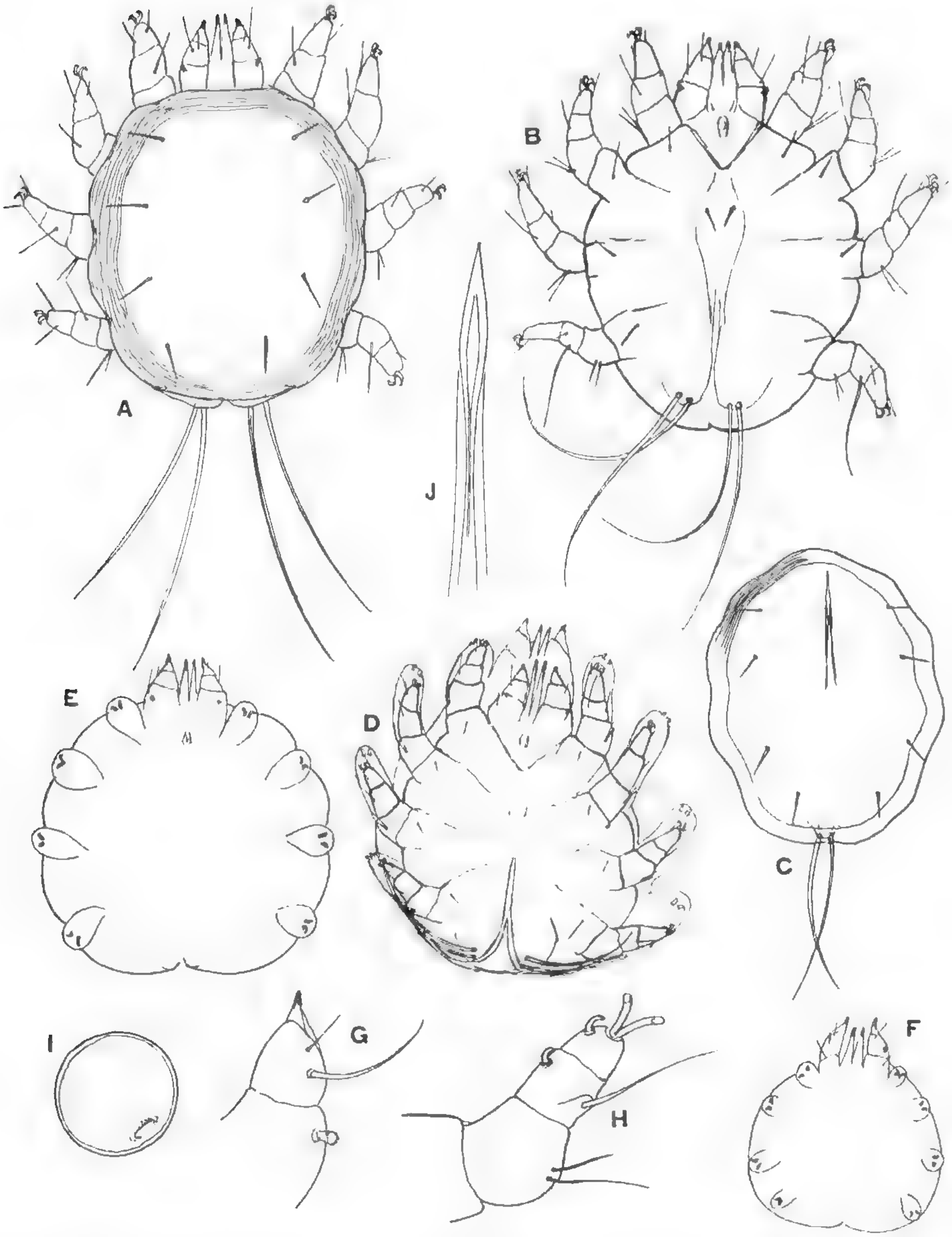

Fig. 4. *Psorergates ovis sp.nov.* A, Entire dorsal view of female; B, ventral view of same. C, Dorsal view of male except legs. D, Adult female within nymphal skin. E, Second nymph, ventral. F, First nymph, ventral. G, Palp from above; H, Leg I; I, ova; J, penis.

the female, and arises from a single medial tubercle. The dorsal penis arises near the middle, and extends almost to the anterior margin as figured.

Ovum. Round as figured, 48μ in diameter.

Larva. Length 108μ, width 95μ, with three pairs of rudimentary legs which are little more than stumps, but are furnished with distinct if rudimentary claws. No dorsal or ventral setae can be observed.

Nymph I. Length 121μ, width 108μ, as figured. With four pairs of legs, still rudimentary but rather more developed. No dorsal or ventral setae.

Nymph II. Length 155μ, width 135μ. Legs still more developed, but showing no signs of segmentation. No dorsal or ventral setae, but in this and the preceding stages the palpal setae are strongly evident. In one specimen of the later nymphal stage the adult female could be observed within the nymphal cuticle (see fig. 6D). Here it will be noticed that the apical long setae are curled within the nymphal skin.

Locality and Host. On sheep, Yass, Goulburn, New South Wales, and Canberra, Aust. Cap. Territory, May, 1941 (H. B. Carter).

Remarks. This species may become of serious import to the sheep industry of Australia. Its economic aspect is being investigated by Mr. H. B. Carter and other officers of the Council for Scientific and Industrial Research at the McMaster Laboratories, Sydney. I am indebted to Dr. Bull and Mr. Carter for bringing this interesting species to my notice, and for affording me the opportunity of describing it.

Its effect upon the sheep is to produce a chronic irritation of the skin, mainly along the sides and flanks, although specimens have been recovered from most regions of the body. The appearance of the fleece is similar to that of infestation by the common biting louse (*Bovicola ovis*).

Genus SYRINGOPHILUS Heller 1880.

Heller 1880, 186.

Goniomerus Michael, A. D. 1890, 405.

SYRINGOPHILUS TOTANI Ouds. 1904.

Text-fig. 5, A–B.

Oudemans, A. C. 1904a. Ent. Bericht. No. 19, 171; 1906, Mem. Soc. zool. Fr., *19*, 36, fig. 7, 8.

This species was described from the quills of the Swallow *Totanus calidris*, probably from France. My material, which was from a Magpie collected at Barringun, New South Wales (no date) by the late Stanley Hirst, does not appear to differ from the description and figures given by Oudemans.

Genus CHEYLETUS Latreille 1796.

Latreille, P. A. 1796, 179.

CHEYLETUS ERUDITUS Schrank 1781.

Text-fig. 5 C–D.

Schrank, F. v. P. 1781, 513.

This spécies is the type of the genus. It is almost cosmopolitan and occurs in and on various foodstuffs. It is predatory in habit, feeding upon insects and mites infesting the materials. It is frequently to be found in cultures of economic insect pests. I have material from the following Australian localities:

Queensland: On cheese, Brisbane, June, 1932 (F.H.S.R.).
New South Wales: On head of a fly, Sydney, 1909.
Victoria: On imported seeds, Dept. of Agric., Melbourne, August, 1932.
South Australia: In infested wheat, Adelaide, September, 1940.

Genus CHELETIELLA Canestrini 1886.

Canestrini, G. 1886, 170.

CHELETIELLA PARASITIVORAX Megnin 1878.

Text-fig. 5 E–F.

Megnin, P. 1878, 425, pl. xxviii.

This is a well-known predatory species found inhabiting the fur of rabbits where it probably feeds upon the Listrophorid mites living there. It is not yet

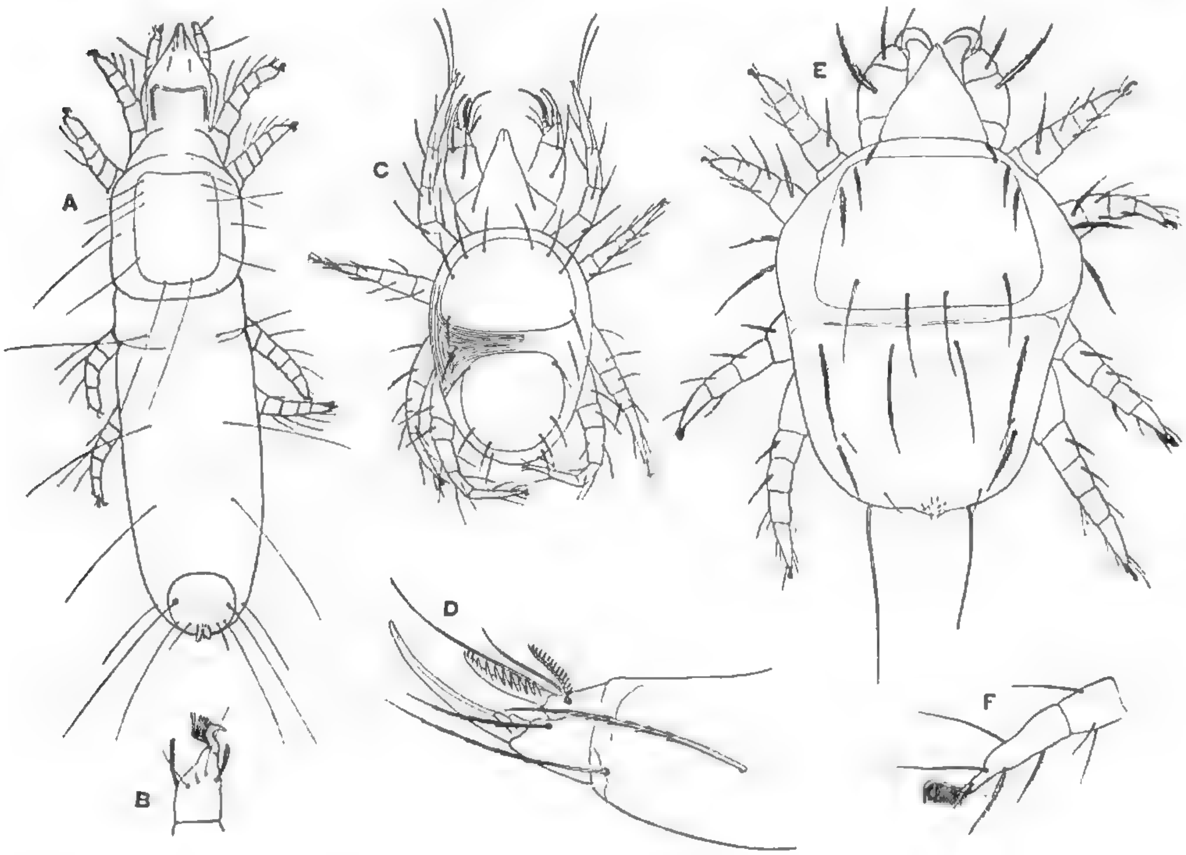

Fig. 5. *Syringophilus totani* Ouds. A, Entire dorsal view of female; B, tarsus. *Cheyletus eruditus* Schrank. Female; C, dorsal view; D, palp from above. *Cheletiella parasitivorax* Megnin. E, Dorsal view; F, tarsus.

known from Australia, but a few years ago I received material from the fur of Angora rabbits from Auckland, New Zealand (1935 L.M.).

CHELETIELLA PINGUIS Berlese 1889.

Text-fig. 6 A–C.

Berlese, A. 1889.

With somewhat similar habits to the above species, but found upon birds. My Australian material is from the parrot *Platycercus elegans* from Mansfield, Victoria, June, 1933 (A.E.B.).

Genus CHEYLETIA Haller 1884.

Haller, G. 1884, 233, 234.

CHEYLETIA FLABELLIFERA (Michael 1878).

Text-fig. 6 D–E.

Michael, A. D. 1878, 435.

To be found generally in similar habitat to *Cheletiella parasitivorax* and of the same habit. My Australian material was found among the debris of an old

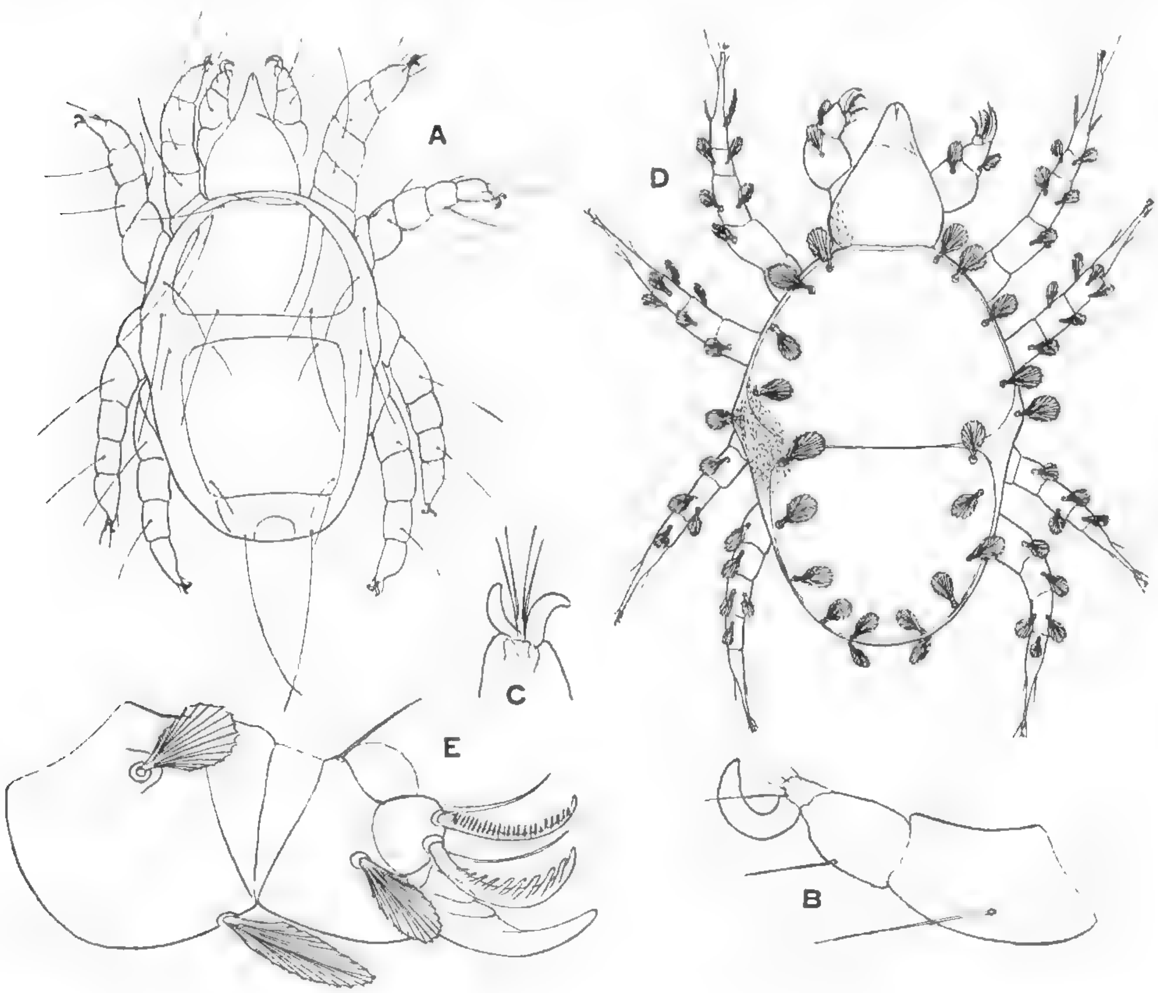

Fig. 6. *Cheletiella pinguis* Berlese. Female; A, dorsal view; B, palp; C, tip of tarsus. *Cheyletiella flabellifera* (Michael). Female; D, dorsal view; E, palp dorsal.

Yacca (*Xanthorrhoea*) stump in Torrens Gorge, South Australia, May, 1939 (R.V.S.). Probably rabbits were nesting nearby.

Genus CHELETONELLA nov.

Allied to *Cheyletia* but distinguished, as in the key, by having only an anterior dorsal shield.

CHELETONELLA VESPERTILIONIS sp. nov.

Text-fig. 7 A–D.

Description. Female. Length 580μ, width 260μ. Gnathosoma 195μ. Eyes ? Palpi strong; femur stout and thick, 67μ long by 72μ wide, tibial claw strong 54μ long, and furnished with three inner basal tubercles, tarsus with two combs

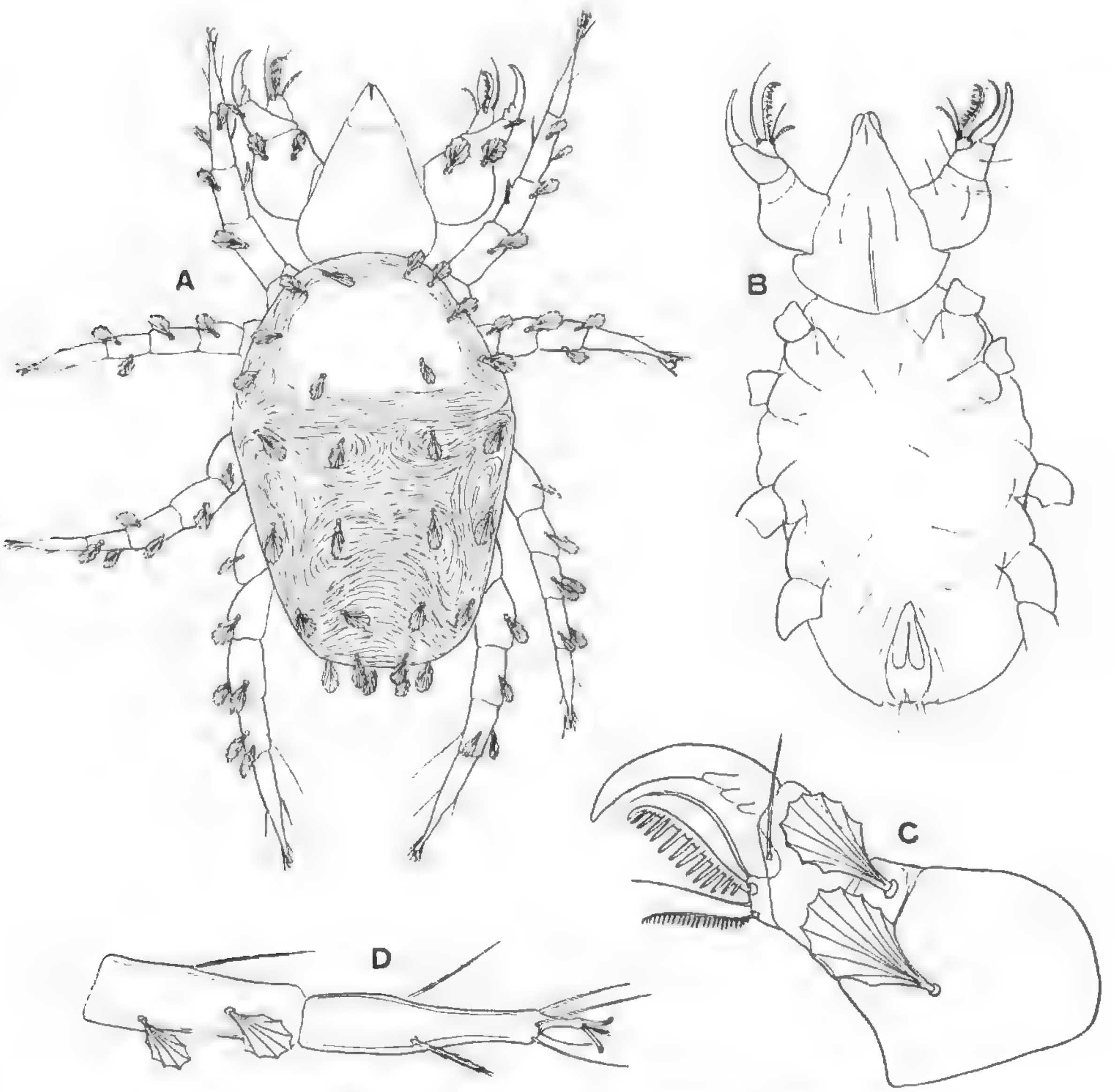

Fig. 7. *Cheletonella vespertilionis* gen. et sp.nov. Female; A, dorsal view; B, ventral view; C, palp from above; D, tibia and tarsus.

and two sichel-like setae, stronger comb with about 12 teeth; femur and tibia each with one fan-like seta. Dorsum with only a single indistinct shield on anterior half. Dorsal setae fan-like, 39μ by 19μ, arranged as figured. Legs comparatively short, I 340μ long, II 250μ, III 290μ, IV 375μ, tarsus as figured with a pair of simple claws and pulvilli of about four hairs. Ventral surface as figured.

Male. Unknown.

Locality and Host. A single specimen taken from a bat at Glen Osmond, South Australia, May, 1933 (D.C.S.).

Genus CHELETOMORPHA Ouds. 1904.

Oudemans, A. C. 1904a, No. 18, 162.

CHELETOMORPHA VENUSTISSIMA (Koch 1839).

Text-fig. 8 A–B.

Koch, C. L. 1839.

This is the genotype and only species of the genus. It is almost cosmopolitan, and is predatory upon other Acarids such as the Tyroglyphidae. My Australian records are:

South Australia: In hay, Two Wells, December, 1933 (D.C.S.); in chaff, Adelaide, May, 1935 (H.W.).
Western Australia: Denmark, July, 1932 (H.W.).

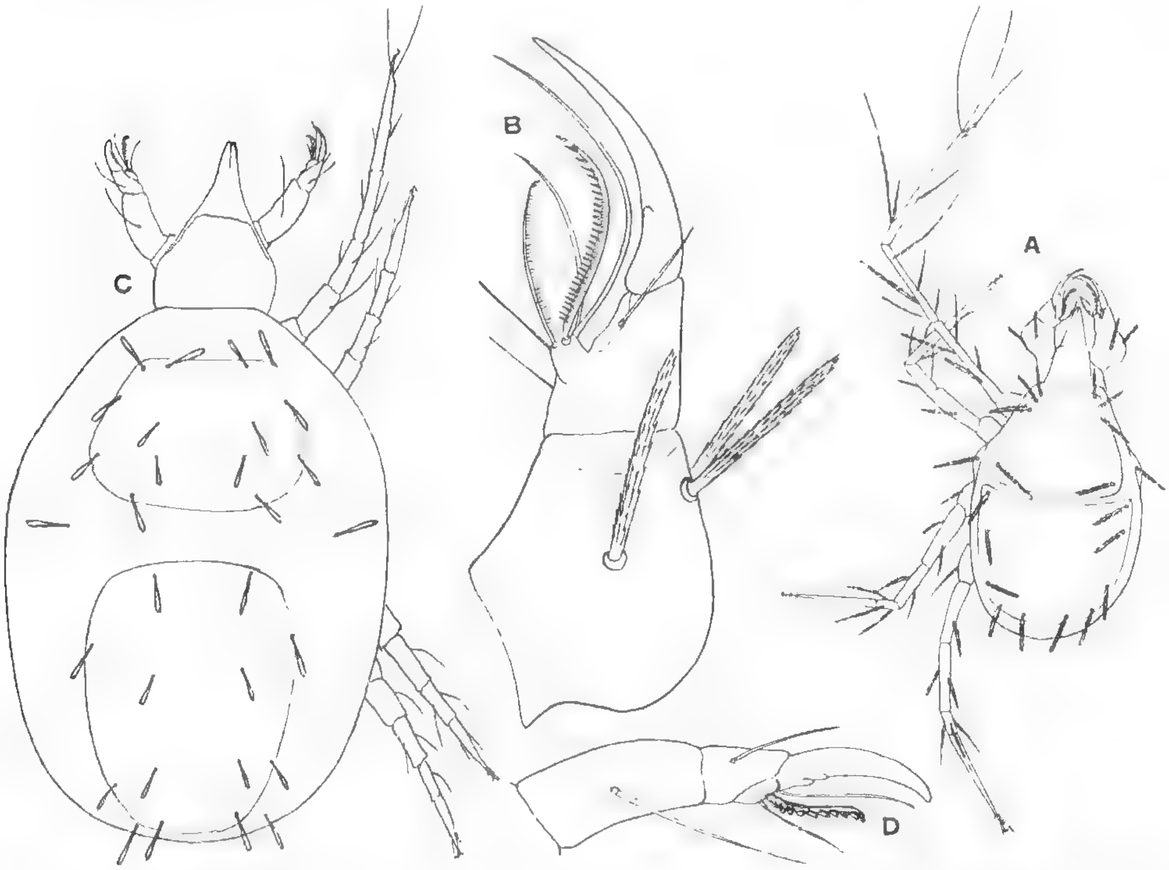

Fig. 8. *Cheletomorpha venustissima* (Koch). Female; A, dorsal view; B, palp dorsal. *Acaropsis docta* Berlese. Female; C, dorsal view; D, palp.

Genus CHELETOPHANES Ouds. 1904.

Oudemans, A. C. 1904a, No. 18, 162.

CHELETOPHANES RUGOSA sp. nov.

Text-fig. 9 A–D.

Description. Female. Length 475μ, width 255μ. Gnathosoma 153μ. Eyes ? 1-1. Palpi strong and stout; femur 62μ by 62μ, tibial claw strong 43μ long and entirely pectinate along inner edge, tarsus with two combs and two sichel-like setae, stronger comb with about 12–14 teeth which are about one-third the length of comb. Legs: I 600μ long, slender, with two claws and pulvilli as figured; II 390μ; III 410μ; IV 400μ. Dorsum with only anterior shield, this with four pairs of setae, of which the anterior two pairs are longer, about 54μ; setae on hysterosoma beyond those figured are uncertain owing to damage. Cuticle outside of shields rugose.

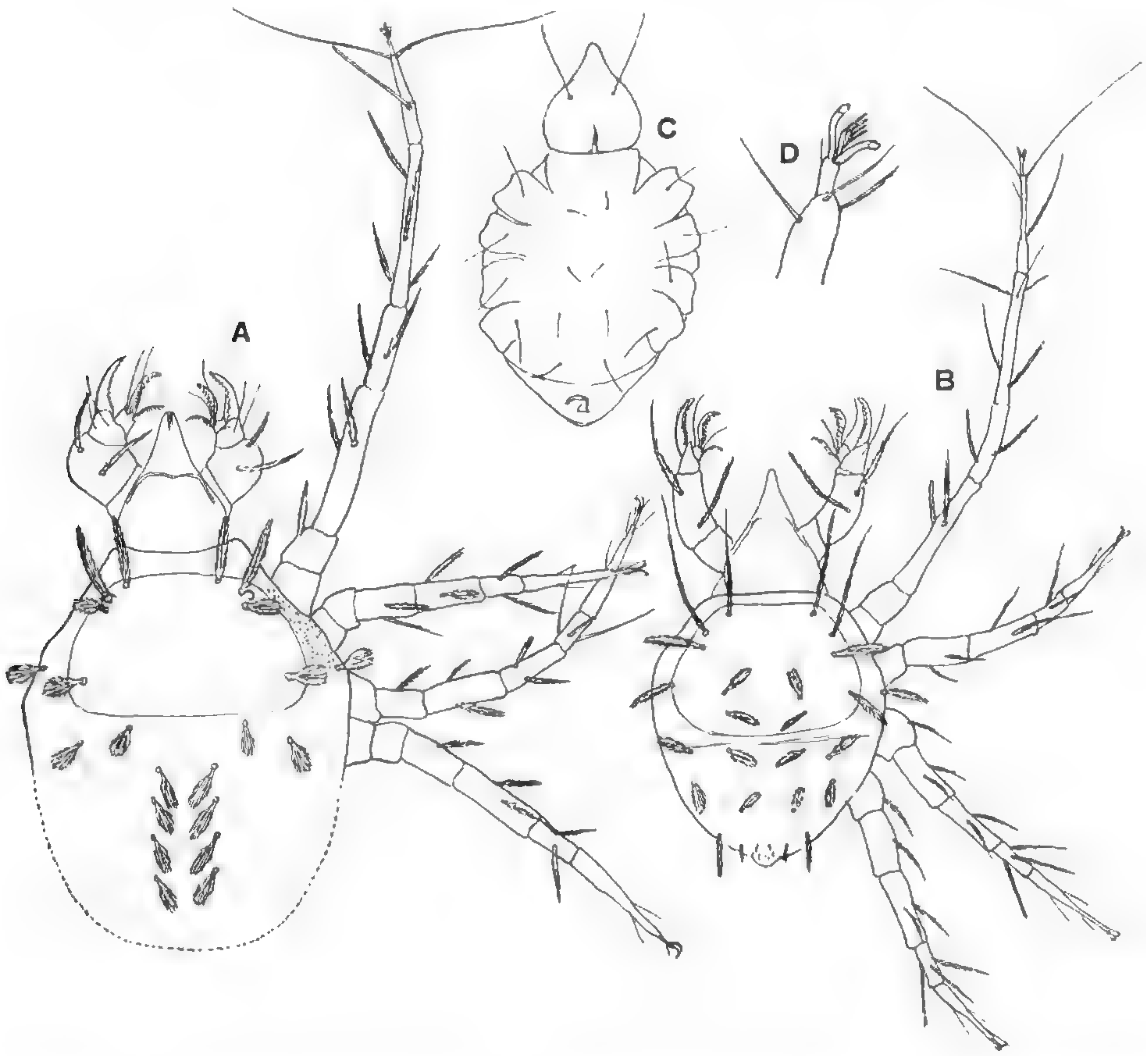

Fig. 9. *Cheletophanes rugosa* sp.nov. A, Female from above. B, Male from above; C, male from below. D, Tip of tarsus.

Male. Length 340μ, width 187μ. Gnathosoma 85μ. Palpi as in female but smaller, femur 54μ long by 43μ wide, claw 40μ and as in female. All other characters as in female.

Locality and Host. From *Calymmaderus* (Coleoptera) material Brisbane, Queensland, December, 1934 (A.R.B.). One female, two males.

Genus ACAROPSIS Moq.-Tand. 1863.

Moquin-Tandon 1863, 314; Oudemans, A. C. 1904, No. 18, 209.

ACAROPSIS DOCTA (Berlese 1886).

Text-fig. 8 C–D.

Berlese, A, 1886.

Frequently found in the dust of human habitations. My Australian records are from Western Australia; from *B. obtectus* culture, Dept. of Agric., Perth; on *Alyssia* sp., Perth, November, 1931 (B.A.O'C.).

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A REVISION OF THE FAMILIES DIOSACCIDAE SARS, 1906 AND LAOPHONTIDAE T. SCOTT, 1905 (COPEPODA, HARPACTICOIDA)

By A. G. Nicholls, Ph.D., University of Western Australia

Summary

I have recently had an opportunity of studying the collection of Copepoda in the South Australian Museum, a report on which appeared in the previous volume of these Records (Nicholls, 1941).

Arising out of this and some earlier work on a collection of copepods from the St. Lawrence, it has been found necessary to revise the two genera Amphiascus and Laophonte, and while engaged upon this revision a survey has been made of their respective families. This paper is an attempt to clarify the relationships of the genera comprising these families and, at the same time, to subdivide the two chief genera, both of which contain a large number of species, into homogeneous groups, clearly defined and easily separable. It is hoped that this paper will simplify the process of identification of species belonging to these two genera in particular.

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Arising out of this and some earlier work on a collection of copepods from the St. Lawrence, it has been found necessary to revise the two genera *Amphiascus* and *Laophonte*, and while engaged upon this revision a survey has been made of their respective families. This paper is an attempt to clarify the relationships of the genera comprising these families and, at the same time, to subdivide the two chief genera, both of which contain a large number of species, into homogeneous groups, clearly defined and easily separable. It is hoped that this paper will simplify the process of identification of species belonging to these two genera in particular.

In matters of nomenclature I gratefully acknowledge the assistance received from Professor G. E. Nicholls, of the University of Western Australia, and Mr. K. Sheard, of the South Australian Museum.

It has been necessary to borrow many books of reference from libraries in South Australia, Victoria, and New South Wales. In each case the librarians have been very helpful in sending books required and permitting their retention for several months. A few important works are not available in Australia, notably some of the earlier works of Claus and others.

It is appropriate here to express my thanks to Miss E. Wood, Librarian to the University of Western Australia, for obtaining the large amount of literature required.

Family DIOSACCIDAE Sars 1906.

As Sars (1911, p. 103) has already observed there is a close relationship between the Diosaccidae and Thalestridae. The chief characters distinguishing the two families are as follows:

THALESTRIDAE.	DIOSACCIDAE.
Rostrum usually small and comparatively immobile.	Rostrum large and mobile.
Exopod of first leg usually strongly modified.	Exopod of first leg comparatively unmodified.
Endopod of first leg strongly modified.	Endopod of first leg little modified, except in *Amphiascus* and related genera.
Inner seta on basal segment of first endopod inserted about the middle, or proximal thereto.	Inner seta on basal segment of first endopod always inserted distally.

These two families approach one another most closely in the genera *Dactylopusia* and *Amphiascus*, which have many points in common. Gurney (1927b, p. 512) has already discussed the similarity between them and finds five points of difference. He disposes of the significance, from the systematic aspect, of the number of egg-sacs which was regarded by Sars and Monard as important (see Monard's works, Gurney 1932, p. 17; and Lang 1935a).

The significance of the position of the inner seta on the basal segment of the first endopod is also somewhat questionable. In at least one species of Thalestrid (*Dactylopodella flava* (Claus)) it is inserted beyond the middle of the segment, and in *Robertsonia* (as defined below) which, it is now generally agreed, belongs to the Diosaccidae it tends to become less distal than is usual in typical Diosaccidae. This tendency reaches a climax in *Varnaia monardi* Klie, which I regard as a true *Robertsonia* (see p. 87). Here it approximates to the position it occupies in *Dactylopodella flava*.

The following genera have been ascribed to this family:

Stenhelia Boeck 1864; *Diosaccus* Boeck 1872; *Robertsonia* Brady 1880; *Pseudomesochra* T. Scott 1902; *Parastenhelia* Thompson and Scott 1903; *Amphiascus* Sars 1905a; *Schizopera* Sars 1905a; *Stenheliopsis* Sars 1906; *Pseudodiosaccus* T. Scott 1906; *Tydemanella* A. Scott 1909; *Diosaccopsis* Brian 1925; *Ialysus* Brian 1927; *Amphiascopsis* Gurney 1927b; *Teissierella* Monard 1935; *Varnaia* Klie 1937.

According to Lang (1936a) Sars' genus *Stenheliopsis* is synonymous with *Pseudomesochra* Scott and belongs to the Diosaccidae, while the same author (1934, p. 22) shows that *Parastenhelia* is a Thalestrid and synonymous with *Microthalestris* Sars.

The genus *Tydemanella* was placed by Scott in the Thalestridae but, as has been shown by Lang (1936c, p. 18), it belongs to the Diosaccidae. Brian (1927) described a new genus *Ialysus*, which bears a considerable resemblance to *Tydemanella*, and in a recent paper (1941) I regarded them as synonymous, in order to include a new species from South Australia which was intermediate. I have here separated them once again for reasons given below, and it has thus been necessary to establish a new genus for the Australian species, for which I propose the name *Parialysus* (defined p. 91).

Gurney's genus *Amphiascopsis* has been somewhat modified and enlarged to include a greater number of species, and from the remaining species of *Amphiascus* two new genera have been formed, leaving a small number still regarded as *Amphiascus* sens. str.

Teissierella, stated by Monard to be intermediate between *Amphiascus* and *Robertsonia*, is in fact composed of species belonging to these two genera and therefore lapses.

Varnaia Klie is identical with *Robertsonia*, as defined below.

The family, therefore, consists of the following genera, here arranged in chronological order:

STENHELIA Boeck 1864.

1864. *Stenhelia* Boeck.
1868. *Delavalia* Brady (pro. part.).
1905. *Beatricella* T. Scott 1905a.

DIOSACCUS Boeck 1872.

1863. *Dactylopus* Claus (pro. part.).
1872. *Diosaccus* Boeck.

ROBERTSONIA Brady 1880.

1880. *Robertsonia* Brady.
1894. *Dactylopus* T. Scott (pro. part.).
1902. *Stenhelia* A. Scott (pro. part.).
1903. *Stenhelia* Thompson and Scott (pro. part.).
nec. 1910. *Robertsonia* Brady.
1934. *Amphiascus* Monard.
1935. *Teissierella* Monard.
1935. *Teissierella* Monard 1935a (pro. part.).
1937. *Varnaia* Klie.

PSEUDOMESOCHRA T. Scott 1902.

1902. *Pseudomesochra* T. Scott.
1906. *Stenheliopsis* Sars.

AMPHIASCUS Sars 1905.

1863. *Dactylopus* Claus.
1866. *Dactylopus* Claus.
1868. *Dactylopus* Czerniavski.
1872. *Dactylopus* Boeck.
1872. *Diosaccus* Boeck.
1872. *Stenhelia* Brady.
1875. *Dactylopus* Brady and Robertson.
1880. *Dactylopus* Brady.

1880. *Stenhelia* Brady.
1882. *Dactylopus* Giesbrecht.
1882. *Stenhelia* Giesbrecht.
1893. *Stenhelia* I. C. Thompson.
1894. *Stenhelia* T. Scott.
1894. *Dactylopus* T. Scott 1894a.
1894. *Stenhelia* T. Scott 1894a.
1894. *Stenhelia* T. and A. Scott.
1895. *Stenhelia* T. Scott.
1895. *Stenhelia* T. and A. Scott.
1896. *Stenhelia* A. Scott.
1897. *Stenhelia* T. Scott.
1898. *Dactylopus* T. Scott.
1899. *Dactylopus* Brady.
1899. *Stenhelia* T. Scott.
1900. *Stenhelia* Brady.
1901. *Dactylopus* T. and A. Scott.
1902. *Dactylopus* Giesbrecht.
1902. *Dactylopus* T. Scott.
1902. *Stenhelia* T. Scott.
1902. *Dactylopus* A. Scott.
1902. *Stenhelia* A. Scott.
1903. *Dactylopus* T. Scott.
1903. *Dactylopus* T. Scott 1903a.
1903. *Stenhelia* T. Scott 1903b.
1903. *Dactylopusia* Thompson and Scott.
1903. *Stenhelia* Thompson and Scott.
1905. *Dactylopus* Wolfenden 1905a.
1905. *Dactylopusia* Norman and Scott.
1905. *Stenhelia* Norman and Scott.
1905. *Amphiascus* Sars 1905a.
1935. *Tríssierella* Monard.

SCHIZOPERA Sars 1905.

1891. *Dactylopus* Blanchard and Richard.
1905. *Schizopera* Sars 1905a.
1923. *Amphiascus* Klie.
1928. *Amphiascus* Monard 1928a.

PSEUDODIOSACCUS T. Scott 1906.

1893. *Diosaccus* T. and A. Scott 1893a.
1906. *Pseudodiosaccus* T. Scott.

TYDEMANELLA A. Scott 1909.

1909. *Tydemanella* A. Scott.

DIOSACCOPSIS Brian 1925.

1925. *Diosaccopsis* Brian.
1936. *Diosaccopsis* Monard.

IALYSUS Brian 1927.

1927. *Ialysus* Brian.
1927. *Ialysus* Gurney 1927b.
1941. *Tydemanella* Nicholls.

AMPHIASCOPSIS Gurney 1927.

1927. *Amphiascopsis* Gurney 1927b.

To which are added three new genera *Mesamphiascus* (defined p. 79), *Amphiascoides* (defined p. 81), and *Parialysus* (defined p. 91).

SUBDIVISION OF THE DIOSACCIDAE INTO SUBFAMILIES.

Gurney's genus *Amphiascopsis* links on to the Thalestrids by *Dactylopusia* on the one hand, and on the other, following a regular reduction in the number of setae, a series is formed through *Amphiascus* sens. str., *Mesamphiascus* and *Amphiascoides* to *Robertsonia* and *Schizopera*. This group is sufficiently homogenous to constitute a subfamily, here called the Amphiascinae.

The close relationship between *Dactylopusia* and *Amphiascopsis* is further emphasized by the fact that many species described by earlier workers as *Dactylopus(ia)* now find their true position in Gurney's genus, as it has here been modified. Lang (1936e, p. 29) lists 36 species and varieties of *Dactylopus(ia)* which have been wrongly identified, 28 of which, as he points out, belong to *Amphiascus*. Of these 28, two belong to *Robertsonia* or *Schizopera*, two of the varieties are synonyms, seven are placed by me in "*species inquaerendae*" or "not examined" and one in *Amphiascoides*; this leaves 16 species of which 12 belong to *Amphiascopsis* and four to *Amphiascus* sens. str., which in some respects is very close to Gurney's genus.

Of the remaining Diosaccids a second subfamily—the Diosaccinae containing *Diosaccopsis, Diosaccus, Pseudodiosaccus, Tydemanella, Ialysus* and *Parialysus* probably arose from *Amphiascopsis*. In these the two inner setae on the middle segments of the second and third endopods are retained (except in *Parialysus* which shows certain reductions); the long first endopod is prehensile in all, but somewhat shortened in *Tydemanella, Ialysus* and *Parialysus*; a slightly modified first exopod is present in both *Diosaccopsis* and *Pseudodiosaccus*; the inner lobe of the mandible palp is reduced to a seta in *Diosaccus* (except in one species), absent in *Ialysus* and *Parialysus*; and the remaining lobe is further reduced in *Pseudodiosaccus*; the exopod of the second antenna is one-segmented in all but *Pseudodiosaccus*.

The two remaining genera, *Stenhelia* and *Pseudomesochra*, form the third subfamily Stenheliinae. These, with two and one inner setae on the middle segments of the second and third endopods respectively, unmodified first exopod, and relatively long end segment in the first endopod, were probably derived from *Mesamphiascus*. Incidental support for this view is found in the fact that, of the 25 species of *Amphiascus* originally described as *Stenhelia*, 10 belong to *Mesamphiascus*. Of the others, one belongs to *Amphiascus* sens. str., five to *Amphiascoides*, and of the remaining nine, six cannot be placed with certainty though none is excluded from *Mesamphiascus*, and in most cases the probability is in favour of their inclusion in this genus. The last three are those whose descriptions I have not seen.

The name Stenheliinae was first used by Brady (1880, p. 31) for a subfamily of the Family Harpacticidae, and contained the genera *Delavalia, Jonesiella, Ameira*, and *Stenhelia*. This classification has since been superseded by that of Sars, and the name is used here in its restricted sense for *Stenhelia* and closely related genera.

KEY TO THE DIOSACCIDAE.

1.	Body without strong demarcation between metasome and urosome	2. (Amphiascinae) subfam. nov.
	Metasome more or less strongly demarcated from urosome	6.
2.	Proximal portion of 1st antenna 3-segmented	*Robertsonia* Brady 1880.
	Proximal portion of 1st antenna 4-segmented	3.
3.	End segments of exopods 2–4 with not more than 4 spines and/or setae.	*Schizopera* Sars 1905a.
	End segments of exopods 2–4 with more than 4 spines and/or setae	4.
4.	Middle segments of 2nd and 3rd endopods each with 2 inner setae	5.
	Middle segments of 2nd and 3rd endopods with 2 and 1 inner setae respectively.	*Mesamphiascus* gen. nov.
	Middle segments of 2nd and 3rd endopods each with 1 inner seta	*Amphiascoides* gen. nov.
5.	Middle segment of 1st exopod the largest; basal segment of 1st endopod at least 3 times 2nd and 3rd together and longer than whole exopod; seta formula for inner margins of endopods: 121, 123, 112, of exopods: 112, 113 or 2, 113 or 2	*Amphiascopsis* Gurney 1927b.
	Differing in one or more of these characters	*Amphiascus* sens. str.
6.	1st endopod prehensile; middle segment of 3rd endopod with 2 iner setae; caudal rami little or no longer than wide	(Diosaccinae) subfam. nov. 7.
	1st endopod natatory; middle segment of 3rd endopod with 1 inner seta; caudal rami usually at least twice as long as wide	(Stenheliinae) sens. str. 12.
7.	1st endopod 2-segmented	8.
	1st endopod 3-segmented	10.
8.	Mandible palp biramous	*Tydemanella* A. Scott 1909.
	Mandible palp uniramous	9.
9.	Middle segment of 2nd endopod with 2 inner setae; basal segments of exopods 2–4 with inner seta	*Ialysus* Brian 1927.
	Middle segment of 2nd endopod with 1 inner seta; basal segments of exopods 2–4 without inner setae	*Parialysus* gen. nov.
10.	4th endopod 2-segmented	*Pseudodiosaccus* T. Scott 1906.
	4th endopod 3-segmented	11.
11.	Basal segment of 2nd antenna divided	*Diosaccopsis* Brian 1925.
	Basal segment of 2nd antenna undivided	*Diosaccus* Boeck 1872.

12. 1st endopod 2-segmented .. .. 13.
1st endopod 3-segmented .. .. .. *Stenhelia* sens. str. Boeck 1864.

13. 1st endopod equal to or longer than exopod; 2nd antenna with 2-segmented exopod (3-segmented in *P. brucei*); 1st antenna 5- to 7-segmented *Pseudomesochra* T. Scott 1902.
1st endopod equal to or shorter than exopod; 2nd antenna with 3-segmented exopod; 1st antenna 8-segmented .. .. .. *Stenhelia* (*Delavalia*) Brady 1868.

AMPHIASCINAE subfam. nov.

Body elongate, tapering posteriorly, without demarcation between metasome and urosome. First antenna 6- to 9-segmented; 2nd antenna with exopod 2- or 3-segmented; mandible palp biramous, each ramus 1-segmented. Legs 1–4 3-segmented throughout; middle segment of 3rd endopod with 2 or 1 inner setae; caudal rami usually no longer, but much shorter than wide. 6 genera: *Amphiascopsis*, *Amphiascus* sens. str., *Mesamphiascus* (gen. nov.), *Amphiascoides* (gen. nov.), *Robertsonia*, and *Schizopera*.

Genus AMPHIASCUS Sars 1905.

1905. *Amphiascus* Sars 1905a, p. 380; 1906, *Amphiascus* Sars 1911, p. 148.

The genus was defined by Sars (1905a) to contain those species which had been incorrectly ascribed to *Stenhelia* Boeck by Brady and others. He named *Dactylopus longirostris* Claus firstly as an example of his new genus and added that *D. minutus* Claus *and D. debilis* Giesbrecht must also be transferred to his new genus. *Amphiascus longirostris* (Claus) can therefore be established as the type of *Amphiascus* sens. lat. (see p. 77). *A. minutus* (Claus) comes into Gurney's genus *Amphiascopsis*—here somewhat widened—while *A. debilis* (Giesbrecht) comes into the new genus *Amphiascoides*, defined below.

A revision of this genus has been made by Monard (1928a), but he later (1937, p. 32) withdrew his previous work, stating, however, that the basis of his division into groups is natural and could be retained. In his revision (1928a) he extended the seven groups outlined in his 1928 paper to thirteen, and since he also used the setation of the 2nd and 3rd endopods as the chief character for separation into groups, these can be compared with the genera outlined here. His first five groups, correspond to *Amphiascopsis* and *Amphiascus* sens. str. as defined here; the next five are comparable with *Mesamphiascus*, but include also species here regarded as belonging to *Robertsonia;* the remaining three groups correspond to *Amphiascoides*, but include species which belong to *Schizopera*.

The revision attempted here takes *Amphiascopsis* Gurney (1927b) as the starting point, and is based on the setation of the middle segments of the 2nd and 3rd endopods. Where possible, this character is supported by other features. The first and last genera, *Amphiascopsis* and *Amphiascoides*, are clearly defined while, of the other two, *Amphiascus* sens. str. contains those species which are grouped round *A. longirostris* and fall short, in one character or another, from inclusion in *Amphiascopsis; Mesamphiascus* is little more than an assemblage of species showing only one common characteristic, but as a whole clearly intermediate between *Amphiascus* sens. str. and *Amphiascoides*.

Broadly defined the new genera are as follows (further details are given below) :—

I. *Amphiascopsis* Gurney (modified) ; and II. *Amphiascus* sens. str. Species with 2 inner setae on the middle segments of the 2nd and 3rd endopods.

III. *Mesamphiascus*. Species with 2 inner setae on the middle segment of the 2nd endopod and 1 inner seta on the middle segment of the 3rd endopod.

IV. *Amphiascoides*. Species with 1 inner seta on the middle segments of both 2nd and 3rd endopods.

Armature of the Swimming Legs within the Genus.

As stated above, *Amphiascopsis* is the starting point of a series which links on with *Dactylopusia*. The remaining genera form a natural sequence in which the setation is gradually reduced. *Amphiascus* sens. str. forms a transitional group leading to *Mesamphiascus* but retaining the typical setation of the 2nd and 3rd endopods. *Mesamphiascus,* admittedly a grouping of convenience, is in turn regarded as transitional between *Amphiascus* sens. str. and *Amphiascoides.* The last forms a group as homogeneous as could be expected.

To illustrate the reduction in setation which is observable in the series of genera a summary in tabular form of the total number of "setae" in legs 1–5 is given for each genus. (The term "setae" is used in its widest sense to include spines.) Only 91 out of the total of over 110 species are dealt with in the table, since for the remainder nothing is known about the setation of the 2nd and 3rd legs, and in many of the examples included the information is often incomplete.

The following table shows the distribution of species according to total number of setae and spines on legs 1–5 within the genus *Amphiascus* sens. lat.:

Genus	p.1. exp.		p.2. end.		p.2. exp.		p.3. end.		p.3. exp.		p.4. end.		p.4. exp.		p.5. prox.		p.5. dist.	
	setae	species	setae	species	setae	species	setae	species	setae	species	setae	species	setae	species	setae	species	setae	species
Amphiascopsis	8	25	7	19	11	19	9	18	12	14	8	1	12	14	6	1	7	2
(30 species)	7	4							11	4	7	18	11	3	5	26	6	28
															4	3		
Amphiascus sens. str.	8	11	7	9	11	7	9	7	12	4	7	10	12	6	5	15	6	15
(15 species)	7	4	6	1	10	3	8	2	11	5	6	1	11	3				
							7	1	10	1			10	2				
Mesamphiascus	8	16	7	22	11	7	8	11	11	7	7	12	12	12	5	22	6	18
(26 species)	7	6	6	2	10	11	7	9	10	8	6	11	11	7	4	4	5	8
	6	4			9	2	6	4	9	3	5	1	10	4				
					8	3			8	1			9	2				
Amphiascoides	6	23	6	21	9	6	7	20	9	20	6	22	10	18	5	21	6	7
(23 species)					8	15							9	3	4	2	5	16

It can be seen from this table that there is a gradual reduction in the number of "setae" throughout the series as grouped here. In *Amphiascopsis* 25 of the species have the full number of "setae" on the 1st exopod; of those with only 7, *south-georgiensis* lacks the inner seta on the middle segment and the other 3 lack a "seta" from the terminal segment. In *Amphiascoides,* on the other hand, each of the species has only 6 "setae"—an outer spine on each of the first two segments, and 4 "setae" on the end segment.

A similar trend can be followed in the 2nd and 3rd legs; in the case of the endopods this is partly due to the loss of one inner seta on the middle segments, by which the genera have been defined. But in the 4th leg, only 3 of the 17 species of *Amphiascopsis* for which data are available have less than 12 "setae" on the exopods, whereas in *Amphiascoides,* where our knowledge is fairly complete, none of the 21 species has more than 10. In the endopods of this leg every species of *Amphiascopsis* has 7 "setae" (*fucicolous* apparently 8), while in *Amphiascoides* 6 is the constant figure.

It should further be noted that of the 3 species (*brevis, dentatus, obscurus*) known to have 7 "setae" on the distal segment of the 5th leg, 2 belong to *Amphiascopsis* (the position of *brevis* is uncertain) and that no species in this genus has less than 6; the majority of those in *Amphiascoides* have only 5. It may be of interest to note that the 6 species with 9-segmented 1st antennae

(Monard's *nasutus*-group) also belong to *Amphiascopsis*, to which may be added *australis* recently described from South Australia.

Amphiascus sens. str. and *Mesamphiascus* are clearly intermediate in reduction in number of setae.

It has been stated above that *Amphiascopsis* appears to be most closely related to *Dactylopusia*, it being suggested that both arose from a common stock in which the middle segments of the endopods in legs 2–4 all had 2 inner setae, a condition which occurs, for instance, in the Tisbidae, and that one of these setae was lost from the 2nd leg in *Dactylopusia* and from the 4th leg in *Amphiascus*. (1)

STRUCTURE OF THE FIFTH LEG WITHIN THE SUBFAMILY.

Those species of *Dactylopusia* with 7 "setae" on the distal segment of the 5th leg (*thisboides* and *micronyx*) have two thin terminal setae, with 2 inner and 3 outer spines; in those with 6 "setae" it is in an inner spine which is lost. The same happens in *Amphiascus*—in *obscurus*, *dentatus*, and *brevis*, the only species known to have 7 "setae" here, the arrangement is as in *Dactylopusia* and in the species with 6 "setae" it is an inner spine which goes, leaving two terminal setae, exserted, with 1 inner and 3 outer spines. The further reduction to 5 "setae" is attained by the loss of an outer spine, as in *varians* (*imus* of Sars, 1906, pl. xcvii).

The very wide basal and distal segments of the 5th leg in *Dactylopusia* are also retained in *Amphiascopsis*. It is interesting to note that the Dactylopusoid shape of the 5th leg is more prominent in those species of *Amphiascopsis* which retain the Dactylopusoid first leg; it occurs in 18 out of the 30 species listed here, the others show a gradual narrowing of the basal segment with elongation of the distal segment, finally reaching the condition found in *hamiltoni*.

In *Amphiascus* sens. str. only 2 species (*pallidus* and *abyssi*) have wide 5th legs, and these species differ from *Amphiascopsis* in the shortening of the middle segment of the exopod and basal segment of the endopod in the first leg, and elongation of the end segments of this endopod. The remaining species in this group of 15 all show an elongation of the distal segment of the 5th leg, culminating in the shape found in *ultimus*, *giesbrechti*, and *pestai*.

A moderately elongate shape is found throughout *Mesamphiascus*, accompanied in some cases by the loss of a spine from the distal segment. This elongation is carried to its extreme in *spinifer*, *normani*, *denticulatus*, and *blanchardi* in which the distal outer spine tends to become modified into a short spur. These species, and the majority of the others in this genus, have an inner seta on the middle segment of the 1st exopod and 5 "setae" on the end segment. Eight species, however, have lost this seta, and while four of these (*bulbifer*, *erythraeus*, *exiguus*, and *simulans*) have also lost a "seta" from the end segment, this is retained by the other four (*amblyops*, *pacificus*, *parvus*, and *sinuatus*). Of the last four, three are difficult to distinguish (*amblyops* differs from the others in having 2 inner setae on the end segment of the 3rd exopod instead of one).

Two species (*junodi* and *mathoi*) retain the inner seta on the middle segment but have lost one of the "setae" from the end segment, and are similar in other respects, while differing from *Mesamphiascus* in general. The four species mentioned above (*bulbifer*, etc.) have a first exopod of the type found in *Amphiascoides*. The 5th leg is of the general type for the genus.

Of the 23 "good" species of *Amphiascoides* listed here only 7 have 6 "setae" on the distal segment of the 5th leg (*ctenophorus*, *dictydiophorus*, *ecaudatus*,

(1) Apparently at least one species of *Dactylopusia* still retains the 2 inner setae on the middle segments of the endopods of legs 2, 3 and 4, as seen in *oculata* Gurney (1927b, p. 505).

ilievecensis, spinulosus, pygmaeus and *rostratus*) and in these the shape is usually that of the type found in *Mesamphiascus* (with the exception of *rostratus*, which has a subcircular distal segment), and a distribution of setae similar to that of the same genus.

In the remaining species the shape varies from the wide form to an elongate form, most of the species showing an intermediate condition, wide basally and tapering distally. The "setae", 5 in number on the distal segment, are 2 inner spines, a delicate terminal seta, and 2 outer spines. In some, the 2nd inner spine is less robust and siuated terminally, as in those forms with 6 "setae." The first arrangement is shown by *debilis* (cf. Sars, 1911, pl. civ), the second by *subdebilis* Willey (1935, Fig. 49). It is interesting to note that Willey's variety *subdebilis intermixtus* shows the *debilis* arrangement, which occurs in 13 of the species of *Amphiascoides*. This form, which has recently been found in South Australia, has been raised to specific rank.

In *Robertsonia* the same arrangement of "setae" on the 5th leg is found as in those species of *Amphiascoides* and *Mesamphiascus* which have 6 "setae"; in all, the segment is short and wide, without elongation.

Schizopera is interesting in that though the distal segment of the 5th leg may have 5 or 6 "setae" there is only *one* seta definitely terminal in position, showing its derivation from the reduced forms of*Amphiascoides*. I have not made an exhaustive study of the genus, but have examined a dozen species in this particular connection, from among those described by Sars (1909b) and by Gurney (1928).

COMPARISON OF THE MALES WITHIN THE FAMILY.

Support for the classification of the Diosaccidae outlined above is obtained from an examination of the males, though as with the females there is a certain amount of overlapping between genera.

Apart from the 1st antenna, the chief modifications in the males are in the basipod of the 1st leg, the endopod of the 2nd leg, and a reduction in the 5th leg. In the 1st leg either the inner spine on the basipod is enlarged or the inner edge of the basipod bears a number of short spurs or spines. Two species, *erythraeus* and *dactylifer*, show a combination of both forms of modification. In some cases there is no modification in the first leg, which is identical with that of the female.

The 2nd endopod is usually only 2-segmented in the males, the 2nd and 3rd segments being fused, but occasionally a 3-segmented endopod occurs as in *pacificus* and *spinulosus*. The endopod in a typical 2-segmented form, such as *cinctus* or *longirostris*, bears 1 inner seta on the basal segment, and 2 or 3 inner setae, 1 or 2 terminal setae, one of which may be modified into a slender spine, and 2 large outer spines, on the distal segment. Occasionally one of the outer spines is reduced and slender, sometimes occurring as a seta, while in other cases the two large spines appear to be fused into one much wider spine. Of the species with 3-segmented endopods, *pacificus* bears two inner setae on the 2nd segment, and *spinulosus* one, as in their respective females. In the former, the outer spine is clearly borne on the 2nd segment, whereas in *spinulosus* there are two large spines on the outer margin of the end segment. The end segment bears 1 inner and 2 terminal setae in *pacificus* and 1 inner and 1 terminal in *spinulosus*.

The 5th legs are smaller than those of the females, the basal segments of opposite sides are always united in the mid-line, and usually bear 2 spines, occasionally 3. The end segments bear 4–6 "setae" arranged in a manner comparable with those of their respective females. Males are known for 60 species.

In *Amphiascopsis* males have been described for 19 species. Of these the 1st leg has been described in 12 cases, in 8 of which the inner spine on the basipod is enlarged; in the other 4 cases there is no enlargement but a modification of the inner edge of the basipod. The 2nd endopod has been described in every case, and in 17 of these there are 2 large spines inserted on the outer margin of the fused end segments. In the other two cases the outer appendage is either a weak spine or a seta.

The 5th leg is described in 18 species, in 13 of which 6 "setae" are present, arranged as 2 inner spines, 1 thin terminal seta, and 3 outer spines; in one there are only 5 "setae" and in the other 4 there are only 4 "setae," but in every one of these there is a single thin terminal seta.

In *Amphiascus* sens. str. males are known for 10 of the species. The 1st leg has been described in all but two. Only 2 of these have an enlarged spine, in the other 6 there is a varying number of spurs or spines on the inner edge of the basipod. The 2nd endopod resembles that of the typical *Amphiascopsis* species in every case. The 5th leg has the Amphiascopsid number and arrangement of setae in 6 cases, the other 4 showing a reduction.

In *Mesamphiascus*, in which males are known for 16 species, the 1st leg has been described in only 8 instances. One of these shows the enlarged spine, 6 have the inner edge of the basipod modified, and one (*erythraeus*) shows a combination of both. The 2nd endopod is like that of *Amphiascopsis* in every case but two; in *parvus* there is a small outer spine accompanied by a seta, and *pacificus* has a 3-segmented endopod described above.

The 5th legs normally have 5 "setae," 2 inner spines, 1 thin terminal seta and 2 outer spines; this occurs in 10 species. Four of the remainder show the *Amphiascopsis* condition, and 2 have only 4 "setae," in both there is a single thin terminal seta.

In *Amphiascoides* males are known for 10 species, and the 1st leg has been described in 6 cases. None has the inner spine enlarged, 4 have the inner edge of the basipod with spurs, and 2 are quite unmodified. In those cases where the 1st leg has not been specially mentioned it is probable that it resembles the female, and is therefore unmodified.

The 2nd endopod is described in 10 cases. There is a large terminal spine in 7 of these, 4 of which have an outer spine as well, and the remaining 3 have an outer spine only. The 5th leg, described for 9 species, has the 2,1,2 arrangement of *Mesamphiascus*, except in *ctenophorus* which has 2,1,3.

Summarizing, it can be stated that in *Amphiascopsis*, *cinctus* is typical of the majority; inner spine on 1st basipod enlarged; 2nd endopod with 2 large outer spines inserted about the middle of the end segment and a large terminal spine as well as setae; 5th leg with 2 inner spines, 1 thin terminal seta and 3 outer spines on the distal segment. This condition becomes reduced through the series of genera, with a certain amount of overlapping between genera, to the *debilis* condition in *Amphiascoides*, in which the two end segments have become completely fused and all trace of a middle segment is lost. The end segment is produced into a large spine, and there are 2 inner setae, one of which probably represents a terminal seta.

Males are known for 5 of the species listed under "*Species inquaerendae*".

In *Robertsonia* males are known in every species except *irrasa*, and the sexual modifications are the same in each. The inner margin of the basipod bears a varying number of spur-like projections, but the inner spine is never enlarged. The 2nd endopod, normally 2-segmented but 3-segmented in *propinqua*, according to Sewell (1924) and stated to be 3-segmented in *celtica* (Monard, 1935), but of the usual appearance judging from the figure, bears 1 inner seta on the basal segment, 1 inner seta on the 2nd segment when free, and in a comparable position when fused with the end segment, and on what corresponds to the terminal segment 1 inner seta, 2 terminal setae, one of which may be spine-like, and 2 large outer spines.

The 5th leg shows 6 "setae"; 2 inner spines, 1 thin terminal seta, and 3 outer spines.

In those 5 species of *Schizopera*, of which I have seen descriptions of males, the 1st leg may be modified in either of the two ways described above or may be unmodified. The 2nd endopod shows one constant difference from preceding genera in that there is no inner seta on the basal segment. The 5th leg shows the condition found in *Amphiascoides*, except that the 2 outer spines of the distal segment are usually considerably reduced.

In the Diosaccinae the male of the monotypic *Pseudodiosaccus* is unknown; in *Diosaccus* males are known for *tenuicornis* and *spinatus*. In the first of these the inner edge of the first basipod bears a hook-like spur, and the spine is not enlarged; the second endopod is comparable with the condition in *Amphiascopsis*, but the fused end segments have become greatly reduced in size. In the fifth leg the distribution of setae is not clear, but is comparable with the condition in *A. similis* and *A. minutus*. *D. spinatus* is said to resemble *tenuicornis*, but with fewer setae on the fifth leg.

In *Diosaccopsis ismaelensis* the first basipod does not appear to be modified, the second endopod is three-segmented with two small outer spines on the end segment. The fifth leg is typical of that in *Amphiascopsis*.

Ialysus shows the enlarged spine on the first basipod, but this is not modified in *Parialysus*; the second endopod is two-segmented, with a pair of adjacent spines on the outer edge of the end segment in both genera. The fifth legs lack one inner spine, but the outer spines are well developed, and the thin terminal seta is present.

In general the structure of the males of the Diosaccinae supports the suggested derivation from *Amphiascopsis*.

The suggested derivation of the Stenheliinae from *Amphiascoïdes* receives strong support from the structure of the males. The first basipod shows no modification, the second endopod is almost exactly as in *A. debilis*, and the setae of the fifth leg are reduced in number.

AMPHIASCOPSIS Gurney 1927b.

The genus is herein defined by the following characters:

1. Middle segment of 2nd and 3rd endopods each with 2 setae.
2. Middle segment of 1st exopod longer than either 1st or 3rd segments, and always with an inner seta (2).
3. Basal segment of 1st endopod longer than whole exopod; 2nd and 3rd segments short, together not more than ½ of basal.
4. Legs 2–4 with the following seta formula for the inner margins:

	Endopod.	Exopod.
p.2.	1.2.1.	1.1.2.
p.3.	1.2.3.	1.1.3 or 2.
p.4.	1.1.2.	1.1.3 or 2.

5. Distal segment of 5th leg with at least 6 setae.

It will be seen that this definition includes all those species transferred by Gurney to this genus, and by extending the somewhat limited definition of his genus a large number of species fall naturally into it. One of the most characteristic features is the second in the above list, which expresses in a slightly altered form that placed first in Gurney's list of distinguishing characters (Gurney, 1927b, p. 515). In many cases where the number of setae on the second and third legs is unknown, species have been placed in this genus on the appearance of the first legs. The group is further characterized by showing little or no reduction from the full number of setae found in *Amphiascus* as a whole.

(2) *A. south-georgiensis* appears to lack the inner seta.

The type species for the genus is *cinctus* (Claus) as described by Sars (1911, p. 149, pl. xci, xcii). It may be inferred from the fact that it heads Gurney's list of species that he also regards this as the type, though he does not state so specifically.

The genus *Amphiascopsis* now contains the following species:

minutus (Claus) 1863; *cinctus* and *similis* (Claus) 1866; **hanseni* (Brady) 1899; **ceylonicus*, **dentatus*, **hamiltoni*, **hurcloeki*, *hirsutus* and **robustus* (Thompson and Scott) 1903; *maldivensis* (Wolfenden) 1905a; *attenuatus*, *obscurus*, and *phyllopus* (Sars), *nasutus* (Boeck Ms., Sars) 1906; *latifolius* (Sars) 1909a; *thalestroides* (Sars) 1911; **fucicolus* (T. Scott) 1912; *lagunaris* (Grandori) 1925; *aegyptius* and *hirtus* (Gurney) 1927b; *imperator*, *latilobus*, *sexsetatus* and *tenuiculus* (Monard) 1928; *banyulensis* (Monard) 1928; *monardi* (Lang) 1934; *gracilis* and *south-georgiensis* (Lang) 1936c; *australis* and *longipes* Nicholls 1941.

These species all show the typical structure of the first exopod. (Lang has not illustrated the first leg of *monardi*). Those whose seta formulae are unknown for any of legs 2–4 are marked by an (*). In addition there are a few species in which we do not know the number of setae on the basal segments of these legs (*banyulensis*, *lagunaris*, *sexsetatus*).

Of the above listed species *attenuatus* forms an exception in having the end segments of the first endopod together slightly more than one-third of the basal, and *sexsetatus* in having the middle segment of the first exopod no longer than the basal segment, though clearly longer than the end segment. Both of these species are otherwise good examples of the genus, so far as is known.

It should be noted here that none of the species which definitely come into *Mesamphiascus* and *Amphiascoides* has an enlarged middle segment in the first exopod.

With regard to the synonymy in this genus, *dubius* Jakub. (1933) is undoubtedly a form of *similis* (Claus). As described and figured by Jakubisiak there are minor differences, but as Monard has pointed out (1928, p. 379, fig. 28, 2; and 1935, p. 26) this form shows small variations from the type. There appears to be no real difference, apart from size, between *hirsutus* (Thompson and Scott) and *banyulensis* Monard; but the form described by Monard (1928) as *hirsutus* (Thompson and Scott) differs from *banyulensis* to a greater extent than does the original description.

The species described as *fucicolus* by T. Scott is unusual in that the fourth endopod shows three inner setae on the end segment; the first leg is clearly of the Amphiascopsid type.

For the setation of the legs of *lagunaris* I have relied on Monard (1928a, p. 369), in which it is indicated that this species has the full setation found in *cinctus*. Other details are given by Brian (1928).

Concerning *phyllopus* Sars (1906), Monard (1937, p. 36) states that the end segment of the fourth exopod has seven setae and not eight as stated in his revision, but he later remarks that examples from Banyuls had eight setae. Sars does not illustrate the fourth leg of *phyllopus*, but states that the natatory legs exhibit the full number of setae. If the number can vary between seven and eight, then *monardi* Lang (1934) would appear to be a synonym of *phyllopus* (unfortunately Lang does not illustrate the first leg, but his description shows that it is probably of the Amphiascopsid type); if the number is constant then Monard's specimens from Banyuls (1928) were *phyllopus*, while his Algerian material (1937) would be *monardi*. The illustration of the fifth leg given by Lang agrees well with Sars' figure for *phyllopus*, but the male second endopod appears to differ. The species are probably, therefore, distinct.

While it is tempting to widen the scope of *Amphiascopsis* to include such forms as *catharinae* and *demersus* with their typical first legs, particularly in the former, by admitting forms which lack an inner seta on the basal segments of one or more of the second to fourth exopods, there would then be little reason for excluding *varicolor*, which differs from these only in lacking one of the inner setae on the end segment of the second endopod; this form leads on to *valens*, with an identical seta formula, but has the end segments of the first endopod together considerably more than one-third of the basal. The division of *Amphiascus* into genera is beset with such problems as this, and Monard (1928a) considers that the genus forms such a natural series that it cannot be divided, even into subgenera. In attempting a division into genera it becomes necessary to draw a line somewhere, however arbitrary.

It should be noted that those species in the above list which have been marked with an (*) may later, when their setation is known, prove to belong not to *Amphiascopsis* but to *Amphiascus* sens. str.

KEY TO AMPHIASCOPSIS FEMALES.

1.	End segment of 3rd exopod with 2 inner setae	2.
	End segment of 3rd exopod with 3 inner setae	6.
2.	End segments of 1st endopod together about 1/3 of basal	*thalestroides* (Sars) 1911.
	End segments of 1st endopod together no more than 1/4 of basal	3.
3.	End segments of 1st endopod together about 1/4 of basal	*hirtus* (Gurney) 1927b.
	End segments of 1st endopod together no more than 1/5 of basal	4.
4.	End segment of 4th exopod with 2 inner setae	*sexsetatus* (Monard) 1928.
	End segment of 4th exopod with 3 inner setae	5.
5.	Distal segment of 5th leg elongate, oval, twice as long as wide	*tenuiculus* (Monard) 1928.
	Distal segment of 5th leg sub-circular, almost as wide as long	*gracilis* (Lang) 1936c.
6.	End segment of 4th exopod with 2 inner setae	7.
	End segment of 4th exopod with 3 inner setae	8.
7.	Distal segment of 5th leg elongate, oval, nearly twice as long as wide	*similis* (Claus) 1866.
	Distal segment of 5th leg sub-circular, almost as wide as long	*monardi* (Lang) 1934.
8.	2nd and 3rd segments of 1st endopod fused	*hanseni* (Brady) 1899.
	2nd and 3rd segments of 1st endopod separate	9.
9.	End segment of 4th endopod with 2 inner setae	10.
	End segment of 4th endopod with 3 inner setae	*fucicolus* (T. Scott) 1912.
10.	Exopod of 2nd antenna 2-segmented	11.
	Exopod of 2nd antenna 3-segmented	13.
11.	End segments of 1st endopod together about 1/3 of basal	*attenuatus* (Sars) 1906.
	End segments of 1st endopod about 1/5 of basal	12.
12.	Distal segment of 5th leg elongate, rectangular, twice as long as wide.	*hamiltoni* (Thompson and Scott) 1903.
	Distal segment of 5th leg oval, half as long again as wide.	*dentatus* (Thompson and Scott) 1903.
13.	End segments of 1st endopod together about 1/3 of basal	*australis* Nicholls 1941.
	End segments of 1st endopod together less than 1/3 of basal	14.
14.	Middle segment of 1st exopod with inner seta	15.
	Middle segment of 1st exopod without inner seta	*south-georgiensis* (Lang) 1936e.
15.	End segments of 1st endopod at least 1/4 of basal	16.
	End segments of 1st endopod no more than 1/5 of basal	22.
16.	Distal segment of 5th leg elongate, twice as long as wide.	*robustus* (Thompson and Scott) 1903.
	Distal segment of 5th leg sub-circular, almost as wide as long	17.
17.	Basal segment of 5th leg with 4 setae	*ceylonicus* (Thompson and Scott) 1903.
	Basal segment of 5th leg with 5 setae	18.
18.	Distal segment of 5th leg with 6 setae	19.
	Distal segment of 5th leg with 7 setae	*obscurus* (Sars) 1906.
19.	Caudal rami about as long as wide	20.
	Caudal rami at least twice as wide as long	21.
20.	Basal expansion of 5th leg wide and rounded	*latilobus* (Monard) 1928.
	Basal expansion of 5th leg sub-conical	*cinctus* (Claus) 1866.
21.	1st antenna 8-segmented	*imperator* (Monard) 1928.
	1st antenna 9-segmented	*maldivensis* (Wolfenden) 1905a.

22. Middle segment of 1st exopod 3 times as long as basal segment .. *latifolius* (Sars) 1909a.
Middle segment of 1st exopod about twice basal .. .. 23.
Middle segment of 1st exopod not more than half as long again as basal segment .. 26.

23. Distal segment of 5th leg half as long again as wide .. .. 24.
Distal segment of 5th leg almost as wide as long .. .. 25.

24. 1st antenna 8-segmented .. .. *minutus* (Claus) 1863.
1st antenna 9-segmented .. .. .. *nasutus* (Boeck MS., Sars 1906).

25. End segments of 1st endopod together $\frac{1}{10}$ of basal .. .. *lagunaris* (Grandori) 1925.
End segments of 1st endopod less than $\frac{1}{7}$ basal .. .. *longipes* Nicholls 1941.

26. 1st antenna 8-segmented .. .. 27.
1st antenna 9-segmented .. .. 29.

27. 1st exopod only half of whole endopod .. .. .. *aegyptius* (Gurney) 1927b.
1st exopod almost $\frac{2}{3}$ of whole endopod .. .. 28.

28. Distal segment of 5th leg oval .. .. .. *phyllopus* (Sars) 1906.
Distal segment of 5th leg almost square .. .. *havelocki* (Thompson and Scott) 1903.

29. Length 0·5 mm. .. .. *banyulensis* (Monard) 1928.
Length over 1 mm. .. .. .. *hirsutus* (Thompson and Scott) 1903.

AMPHIASCUS sens. str.

This genus, which is very close to *Amphiascopsis*, contains those species which depart from that genus in one or more respects. It can be defined as follows:

1. Middle segments of 2nd and 3rd endopods each with 2 setae;
2. Middle segment of 1st exopod usually not enlarged, but always with an inner seta;
3. Basal segment of 1st endopod usually little or no longer than exopod; 2nd and 3rd segments together usually greater than one-third of basal segment;
4. Legs 2–4 with seta formula usually as in *Amphiascopsis*, but with reduced setation if resembling *Amphiascopsis* in characters 2 and/or 3;
5. Distal segment of 5th leg with at least 6 "setae".

It will be seen that this genus is difficult to define as a whole, and really amounts to a grouping of those species which, while Amphiascopsid in most of their features, depart from the strict definition of that genus in one or more characters.

So far as a type can be selected under such circumstances the specimen described by Sars (1911, p. 159, pl. c, ci) and ascribed by him to *A. longirostris* (Claus) is typical of the majority of the species placed in this genus. It is unfortunate that Claus' description is so meagre that some considerable doubt was expressed by Sars (*loc. cit.* p. 160) as to whether his specimens should really be ascribed to Claus' species.

The following species are included here:

longirostris (Claus) 1863; *abyssi* (Boeck) 1872; *tenuiremis* (Brady and Robertson) 1875; *giesbrechti* and *pallidus* Sars 1906; *catharinae* T. Scott 1906a; ?*glacialis* Brady 1910; *varicolor* Farran 1913; *caudaespinosus* Brian 1927a; *valens* Gurney 1927b; *pyrocides* and *ultimus* Monard 1928; *brunneus* Willey 1931; *pestai* Monard 1935; *demersus* Nicholls 1939.

Concerning *glacialis* there is some doubt, since it is almost certain that Brady has figured the second leg, although it is labelled "dritter fuss" (possibly a translator's slip); it may, therefore, belong to *Mesamphiascus*.

The members of this genus all show the two inner setae on the middle segments of the second and third endopods and the inner seta on the middle segment of the first exopod, but differ from *Amphiascopsis* in some other particular, either in the first legs or in having a reduced number of setae on legs 2–4. In this respect they are intermediate between *Amphiascopsis* and *Mesamphiascus*.

Of these species *abyssi*, *giesbrechti*, *pallidus*, *tenuiremis* and *ultimus* have the middle segment of the first exopod as long as the end segment, and *demersus*, *pestai* and *valens* have this segment only very slightly longer than the end segment; in *abyssi*, *pallidus* and *giesbrechti* the first exopod is longer than the basal endopod, and in these three and the following additional species the end segments of the first endopod are together more than one-third of the basal segment: *glacialis*, *longirostris*, *pestai*, *pyrocides*, *tenuiremis*, *ultimus*, and *valens*. A few, *brunneus*, *catharinae*, *demersus*, *pyroeides* and *varicolor*, while retaining one or both of these Amphiascopsid characters, differ from the members of that genus in the reduction in setation. They, with the exception of *catharinae* and *demersus*, lack one of the "setae" from the end segment of the first exopod, while the same five species, with the possible exception of *pyrocides*, and the addition of *valens*, lack inner setae on the basal segments of the exopods.

Lacking information on the setation of the second and third legs it has not been possible to include *catharinae* in the key. Scott states that in some respects it comes very close to *minutus*, but since it differs from that species in the setation of the fourth exopod it would be unwise to assume no difference in the setation of legs 2 and 3.

Concerning *caudaespinosus*, Brian (1927a) does not illustrate or describe the swimming legs, but Monard (1928a, p. 369) includes it in his *cinctus*-group, and indicates that it has the full setation of the latter form. From Brian's figure of the first leg, however, it is clear that it does not conform to the condition found in *Amphiascopsis*, and must, therefore, be placed in *Amphiascus* sens. str. Assuming it has the *full* setation of *cinctus* it can be seen that it occupies a position intermediate between *pallidus* and *abyssi*, somewhat nearer the former, from which it can be distinguished on the proportions of the first endopod and fifth leg.

KEY TO AMPHIASCUS sens. str. FEMALES.

1. Basal segment of 2nd endopod without seta .. .. *brunneus* Willey 1931.
   Basal segment of 2nd endopod with seta .. .. 2.
2. Basal segment of 2nd exopod without inner setae .. .. 3.
   Basal segment of 2nd exopod with inner seta .. .. 4.
3. 1st exopod half length of whole endopod; end segments of endopod equal. *varicolor* Farran 1913.
   1st exopod ⅔ of whole endopod; end segment longer than middle segment. *valens* (Gurney 1927b).
4. End segment of 3rd exopod with 2 inner setae .. .. 5.
   End segment of 3rd exopod with 3 inner setae .. .. 8.
5. End segments of 1st endopod together about ⅓ of basal .. .. .. 6.
   End segments of 1st endopod together no more than ¼ of basal .. .. .. 7.
6. Caudal rami bulbous, hirsute .. .. .. *pestai* Monard 1935.
   Caudal rami normal, rectangular .. .. .. *ultimus* Monard 1928.
7. Basal segments of 3rd and 4th exopods without inner setae .. *demersus* Nicholls 1939.
   Basal segments of 3rd and 4th exopods with inner setae. *tenuiremis* (Brady and Robertson) 1875.
8. 1st exopod longer than basal endopod .. .. 9.
   1st exopod no longer, usually much shorter than basal endopod .. .. .. 12.
9. Distal segment of 5th leg twice as long as wide; caudal seta with pronounced lateral process. *giesbrechti* Sars 1906.
   Distal segment of 5th leg not more than half as long again as wide; caudal setae without processes .. .. 10.
10. End segments of 1st endopod subequal .. .. *caudaespinosus* Brian 1927a.
    End segment of 1st endopod twice as long as middle segment .. .. .. 11.
11. End segments of 1st endopod together equal to basal segment; segments of 1st antenna short and compressed .. .. *abyssi* (Boeck) 1872.
    End segments of 1st endopod together only ⅖ of basal; segments of 1st antenna normal. *pallidus* Sars 1906.
12. Exopod of 2nd antenna 2-segmented .. .. .. *pyroeides* Monard 1928.
    Exopod of 2nd antenna 3-segmented .. .. 13.
13. Caudal rami wider than long .. .. *longirostris* (Claus) 1863.
    Caudal rami longer than wide .. .. . *glacialis* Brady 1910.

MESAMPHIASCUS gen. nov.

Amphiascus having two and one inner setae on the middle segments of the second and third endopods respectively.

This group is a somewhat arbitrary collection of species showing considerable range in setation, some species such as *amblyops* having the number of setae approaching that of *Amphiascopsis*, while others show a reduced setation approaching the condition in the next genus. It is, therefore, difficult to select a type species, but perhaps *parvus* Sars (1906, p. 162, pl. ciii) is suitable, occupying a more or less central position in the genus, and having a fairly wide distribution. It has been recorded from the Mediterranean on three occasions, from Bermuda, and from Woods Hole, in addition to the original localities in Norway.

It is of interest to note that all those species having the more unusual shape of fifth leg shown by *denticulatus* are contained in this genus. The following species belong here:

imus (Brady) 1872; *denticulatus* (I. C. Thompson) 1893; *blanchardi* (T. and A. Scott) 1895; *erythraeus* (A. Scott) 1902; *confusus* (T. Scott) 1902; *simulans* and *varians* (Norman and Scott) 1905; *pacificus* (Sars) 1905a; *exiguus, parvus, propinquus, sinuatus, tenellus*, and *typhlops* (Sars) 1906; *amblyops, bulbifer, lagenirostris, normani* and *typhloides* (Sars) 1911; *spinifer* (Farran) 1913; *angustipes* (Gurney) 1927b; *junodi* (Monard) 1935; *mathoi* and *salammboi* (Monard) 1935a; *gauthieri* (Monard) 1936, ? = *angustipes* (Gurney) 1927b.

Sars (1906) identified a species as *A. imus* (Brady, 1872, 1880), but later (1911, p. 378) decided that his earlier identification was incorrect, and that it should have been recorded as *varians* (Norman and Scott, 1905, 1906) both having been described as distinct species by Norman and Scott. This appears to be correct, but Monard (1928, p. 389) finds no difference between Sars' *propinquus* (1906, p. 158, pl. xcix) and *imus* (Brady). As a matter of fact *propinquus* has a quite different setation in the fourth leg from that shown by Brady for *imus* (1880, pl. xliii), and *propinquus* so far from being a reduced form of *imus*, actually has more setae. The form identified as *imus* (Brady) by Monard is correctly allocated, but *propinquus* (Sars) is distinct, and approaches *varians* (Norman and Scott), from which it can be distinguished by the shape and armature of the fifth legs, proportions of the body, and of the rami of the fourth legs. These may prove to be unimportant, in which case *propinquus* would be a synonym of *varians* (described by Sars in 1906 as *imus*).

Monard (1935, p. 29) states that *sinuatus* (Sars) and *perplexus* (Thompson and Scott) are synonyms, and gives a setae formula for *perplexus* which, as is shown here, agrees with neither *perplexus* nor *sinuatus*. The formulae, so far as they are known and set out in the manner used by Monard for comparison, are as follows:

	sinuatus (Sars) 1906.		*perplexus* (Thompson and Scott) 1903.		*perplexus* (Monard) 1935.	
p.2.	6.	4.2.	—		6.	4.2.
p.3.	6.	6.1.	—		6.	5.1.
p.4.	8.	—	9.	5.1.	8.	4.1.

Thus, while it is clear that Monard is not dealing with *perplexus* (Thompson and Scott) the possibility of *perplexus* being synonymous with *sinuatus* is not excluded by the setae formula. But there are other differences which must be regarded as significant in this genus. The first legs of the two species differ in their proportions, and *perplexus* has an inner seta on the first endopod which is lacking in *sinuatus*; the basal segment of the fifth leg also differs in shape. Monard does not figure his *perplexus* and it is, therefore, uncertain with what species he was dealing, but it is clearly neither of these. As has been seen *perplexus* is inadequately described, and thus cannot with certainty be included in this genus. From Thompson and Scott's description it can be deduced that the natatory legs are "more or less" as in *imus*, but no importance can be given to this statement since the fourth legs, which are illustrated, are quite distinct from those of *imus*.

Monard (*loc. cit.*, p. 29) also re-establishes the species *tenax* Brian (1927a), regarded by Gurney (1937b, p. 521) as a synonym of *erythraeus* (A. Scott) 1902. The only apparent difference between the two is in the proportions of the distal segment of the fifth leg, which seems insufficient for the separation of a species, and Gurney's view is, therefore, accepted.

For the rest, *falklandiensis* Lang (1936c) is a synonym of *simulans* (Norman and Scott) 1905, 1906; and *sahelensis* Monard 1936 is a synonym of *normani* Sars 1911. This is very clear when one compares the description and figures of *sahelensis* (*loc. cit.*, figs. 4, 5) with Monard's description of *normani* (1928, p. 388, figs. 31, 3, and 32, 1) as well as with Sars (1911, Supp. pl. xix) and Norman and Scott (1906, p. 147, as *Stenhelia longirostris*).

It is doubtful whether *gauthieri* Monard (1936) should be regarded as a distinct species, since the only recorded feature in which it differs from *angustipes* Gurney (1927b) is the arrangement of the setae on the basal segment of the fifth leg.

Teissierella salammboi Monard (1935a) has been included here for the reasons given below (p. 87).

KEY TO MESAMPHIASCUS FEMALES.

1.	2nd endopod without inner seta on basal segment	2.
	2nd endopod with inner seta on basal segment	3.
2.	1st antenna 6-segmented; 2nd terminal seta of caudal ramus greatly swollen.	*bulbifer* (Sars) 1911.
	1st antenna 8-segmented; caudal setae normal	*junodi* (Monard) 1935.
3.	2nd exopod without inner seta on basal segment	4.
	2nd exopod with inner seta on basal segment	7.
4.	End segment of 2nd exopod without inner seta	5.
	End segment of 2nd exopod with 1 inner seta	6.
	End segment of 2nd exopod with 2 inner setae ..	*salammboi* (Monard) 1935a.
5.	Distal segment of 5th leg rectangular, with 6 setae	*exiguus* (Sars) 1906.
	Distal segment of 5th leg oval, with 5 setae	*mathoi* (Monard) 1935a.
6.	2nd segment of 1st antenna twice as long as basal segment.	*simulans* (Norman and Scott) 1905.
	2nd segment of 1st antenna about equal to 1st ..	*erythraeus* (A. Scott) 1902.
7.	End segment of 2nd exopod with 1 inner seta	8.
	End segment of 2nd exopod with 2 inner setae	17.
8.	End segment of 3rd endopod with 2 inner setae	9.
	End segment of 3rd endopod with 3 inner setae	12.
9.	Middle segment of 4th endopod without inner seta	*typhlops* (Sars) 1906.
	Middle segment of 4th endopod with inner seta	10.
10.	End segment of 4th endopod with 1 inner seta	11.
	End segment of 4th endopod with 2 inner setae ..	*blanchardi* (T. and A. Scott) 1895.
11.	Caudal rami straight, inner terminal seta with lateral process ..	*typhloides* (Sars) 1911.
	Caudal rami curved, setae normal	*confusus* (T. Scott) 1902.
12.	End segment of 3rd exopod with 1 inner seta	13.
	End segment of 3rd exopod with 2 inner setae	*amblyops* (Sars) 1911.
13.	End segment of 4th exopod with 2 inner setae	14.
	End segment of 4th exopod with 3 inner setae	15.
14.	Body segments fringed with spines; basal segment of 5th leg with outer distal process.	*spinifer* (Farran) 1913.
	Body segments without spines; 5th leg normal	*lagenirostris* (Sars) 1911.
15.	2nd segment of 1st endopod less than half of end segment; exopod of 2nd antenna with seta on middle segment	16.
	2nd segment of 1st endopod more than half of end segment; exopod of 2nd antenna without seta on middle segment	*parvus* (Sars) 1906.

16. Rami of 2nd and 3rd legs equal .. .. .. *sinuatus* (Sars) 1906.
Endopods of 2nd and 3rd legs shorter than exopods .. .. *pacificus* (Sars) 1905a.

17. End segment of 3rd endopod with 2 inner setae .. .. 18.
End segment of 3rd endopod with 3 inner setae .. .. 20.

18. 2nd segment of 1st antenna with spur .. .. *denticulatus* (I. C. Thompson) 1893.
2nd segment of 1st antenna without spur .. .. 19.

19. End segments of 3rd and 4th endopods with 2 and 1 inner setae respectively. *normani* (Sars) 1911.
End segments of 3rd and 4th endopods with 3 and 2 inner setae respectively. *propinquus* (Sars) 1906.

20. End segment of 1st endopod twice as long as 2nd segment .. .. .. 21.
End segment of 1st endopod at least 3 times as long as 2nd segment .. .. 22.

21. Setae on basal segment of 5th leg arranged as a terminal pair, a middle pair and a single proximal seta .. .. *gauthieri* (Monard) 1936.
Setae on basal segment of 5th leg equidistant .. *angustipes* (Gurney) 1927b.

22. Distal segment of 5th leg with 5 setae .. .. *varians* (Norman and Scott) 1905.
Distal segment of 5th leg with 6 setae .. .. 23.

23. Distal segment of 5th leg, elongate, oval .. .. .. *imus* (Brady) 1872.
Distal segment of 5th leg subrectangular .. .. *tenellus* (Sars) 1906.

AMPHIASCOIDES gen. nov.

The following characters define the genus:

1. Middle segments of 2nd and 3rd endopods each with 1 inner seta;

2. Middle segment of 1st exopod without an inner seta, and segment with only 4 setae and/or spines;

3. Legs 2–4 having basal segments of exopods always without inner seta, and the following seta formula for the margins of the endopods:

p.2.	1.1.1.
p.3.	1.1.2.
p.4.	1.1.1.

The setation of the exopods of these legs is reduced, of the type shown in *hispidus*, and in no case is the number as high as that found in *Amphiascopsis* (see Table, p. 13);

4. The reduction in the number of setae is shown also in the 5th legs in which the distal segment has only 5 setae (with 7 exceptions).

This genus—by virtue of the reduction in the number of setae—clearly forms the connecting link between *Amphiascus* (sens. lat.) and *Schizopera*. The type of the genus is regarded as *debilis* (Giesbrecht) as described by Sars (1911, p. 162, pl. civ).

The following species belong to the genus:

debilis (Giesbrecht) 1882; *intermedius* (T. Scott) 1897; *vararensis* (T. Scott) 1903; *hyperboreus* (T. Scott) 1903b; *neglectus* and *pygmaeus* (Norman and Scott) 1905; *hispidus* (Norman MS., Sars) and *nanus* (Sars) 1906; *nanoides* and *spinulosus* (Sars) 1911; *speciosus* (Brian) 1921; *dictydiophorus* (Monard) 1924; *invaginatus* and *sterilis* (Monard) 1926a; *rostratus* (Gurney) 1927b; *commensalis* (Sewell) 1928; *ctenophorus* (Monard) 1928; *ilicecensis* (Monard) 1935; *roberti* (Monard) 1935? = *vararensis* (T. Scott) 1903; *intermixtus* and *subdebilis* (Willey) 1935; *ecaudatus* and *langi* (Monard) 1936.

A. robinsonii, according to Gurney's seta formula (1927b, p. 526) would form an exception in that the fourth endopod appears to have two inner setae on the end segment. However, Willey (1930, p. 107) corrects this slip, and shows that there is only one inner seta here. The species, therefore, complies with the generic description. Gurney (*loc. cit.*) draws attention to the resemblance between this species and *hispidus*, *affinis* (= *vararensis*) and *intermedius*, and enlarges on Scott's original description of *robinsonii*. While the first two can be distinguished from *intermedius*, the distinctions between this and *robinsonii* seem so small that I regard them as synonymous.

According to Monard's figure (1935, fig. 64) the fourth exopod of *roberti* has eight "setae" on the end segment, whereas in the text (p. 35) he states that it has only seven. The latter is the usual number in this genus, no other species having eight. The species has been given a place in the key on the somewhat dubious assumption that the figure is correct; if the text is correct then the species would appear to be a synonym of *vararensis.*

Klie (1937, p. 24) states that *debiloides* Monard is a synonym of *speciosus* Brian, with which I agree.

The species described as *linearis* by Sars (1906) appears to be identical with *neglectus* (Norman and Scott) 1905, 1906. The size of *linearis* is only 0·63 mm. compared with 0·8 mm. for *neglectus* according to Norman and Scott, but Monard (1935, p. 30) finds *neglectus* only 0·62 mm.; the name *linearis,* therefore, should give way to *neglectus.* Monard (1937, p. 43), however, records the male of *linearis,* so that it is to be presumed that he does not find them to be synonymous. The only possible difference is in the setation of the exopod of the second antenna, but though Norman and Scott's figures differ from Sars' they state that the middle segment is somewhat indistinct, and therefore the seta shown on this segment may possibly occupy the position shown by Sars for *linearis.* The majority of species in this genus lack a seta on the middle segment, or have the exopod only two-segmented.

Stenhelia pygmaea Norman and Scott (1905, 1906), while clearly an *Amphiascus* (sens. lat.), approaches *Robertsonia* in the shape of the first endopod. It belongs to *Amphiascoides,* close to *nanoides* and *hyperboreus,* assuming the second and third exopods lack an inner seta on the basal segment, as does the fourth exopod. I have been unable to find any further reference to this species in the literature, and failing definite information on the second and third legs it cannot be included in the key.

KEY TO AMPHIASCOIDES FEMALES.

1. End segment of 2nd exopod without inner seta .. .. 2.
 . End segment of 2nd exopod with inner seta .. .. 16.
2. End segment of 4th exopod with 1 inner seta .. .. 3.
 End segment of 4th exopod with 2 inner setae .. .. 5.
 End segment of 4th exopod with 3 inner setae .. *roberti* (Monard) 1935 (3).
3. 1st exopod as long as basal endopod; distal segment of 5th leg at least twice as long as wide. *sterilis* (Monard) 1926a.
 1st exopod not more than ⅘ of basal endopod; distal segment of 5th leg less than twice as long as wide .. .. 4.
4. Width of body only ⅕ of length .. .. .. *debilis* (Giesbrecht) 1882.
 Width of body more than ¼ of length .. .. .. *nanus* (Sars) 1906.
5. Basal segment of 1st endopod distinctly longer than exopod .. .. .. 6.
 Basal segment of 1st endopod little or no longer than exopod .. .. .. 8.
6. Basal segment of 5th leg armed only with 5 short spine-like setae *speciosus* (Brian) 1921.
 Basal segment of 5th leg armed with normal setae .. .. 7.
7. Distal segment of 5th leg with 2 terminal setae .. .. *subdebilis* (Willey) 1935.
 Distal segment of 5th leg with 1 terminal seta .. . *intermixtus* (Willey) 1935.
8. 2nd and 3rd segments of 1st endopod together greater than half of basal segment .. 9.
 2nd and 3rd segments of 1st endopod together no more than half of basal segment .. 13.
9. Distal segment of 5th leg elongate, twice as long as wide .. .. .. 10.
 Distal segment of 5th leg short, oval, not more than half as long again as wide .. 12.
10. End segment of 1st endopod twice as long as 2nd segment .. .. .. 11.
 End segment of 1st endopod 3 times as long as 2nd segment .. *nanoides* (Sars) 1911.
11. Basal segment of 1st endopod approximately equal to exopod. *neglectus* (Norman and Scott) 1905.
 Basal segment of 1st endopod only ⅔ of exopod .. *hyperboreus* (T Scott) 1903b.
12. Basal segment of 1st endopod wide proximally, tapering distally; exopod of 2nd antenna 2-segmented .. .. *commensalis* (Seiwell) 1928.
 Basal segment of 1st endopod of same width throughout; exopod of 2nd antenna 3-segmented (3) .. .. *vararensis* (T. Scott) 1903.

13. Terminal setae of caudal rami greatly swollen basally, tapering abruptly, ending in fine hairs. *langi* (Monard) 1936.
Terminal setae of caudal rami thickened basally but not tapering abruptly .. 14.

14. Greatest width of body less than ⅕ of length .. *hispidus* (Norman MS., Sars 1906).
Greatest width of body more than ¼ of length .. .. 15.

15. Exopod of 2nd antenna 3-segmented .. .. *intermedius* (T. Scott) 1897.
Exopod of 2nd antenna 2-segmented .. .. *invaginatus* (Monard) 1926a.

16. 1st exopod distinctly shorter than basal endopod; 2nd and 3rd segments of endopod together less than half of basal .. .. 17.
1st exopod very little or no shorter than basal endopod; end segments of endopod together nearly as long as basal .. .. 19.

17. Outer seta of caudal ramus swollen, tapering to a fine hair *dictydiophorus* (Monard) 1924.
Caudal setae normal .. .. 18.

18. Basal segment of 5th leg with 2 long and 3 short setae .. *spinulosus* (Sars) 1911.
Basal segment of 5th leg with 2 long and 2 short setae, one of long setae with large lateral denticles .. .. *ilievecensis* (Monard) 1935.

19. Caudal rami very short, about ¼ or less of anal segment .. .. .. 20.
Caudal rami about ⅔ of anal segment .. .. *ctenophorus* (Monard) 1928.

20. Distal segment of 5th leg oval, length to width less than 3 : 2 *rostratus* (Gurney) 1927b.
Distal segment of 5th leg elongate, twice as long as wide *ecaudatus* (Monard) 1936.

SPECIES INQUAERENDAE.

There remains a number of species whose position cannot be determined with certainty until our knowledge of the second and third legs is complete. These are listed in chronological order:

accraensis (T. Scott) 1894; *dispar* (T. and A. Scott) 1894; *reflexus* (T. Scott) 1895; *herdmani* (A. Scott) 1896; *brucei* (T. and A. Scott) 1901; *brevicornis, dentipes, gracilicaudata, longicornis* and *perplexus* (Thompson and Scott) 1903; *littoralis* and *mixtus* (T. Scott) 1903; *faroensis* (T. Scott) 1903a; *brevis, congener* and *polaris* Sars 1909a; *mucronatus* Brady 1910; *lamellifer* Sars 1911; *proximus* T. Scott 1914; *elegans* and *ignotus* Brady 1918; *similoides* Monard 1928a; *dactylifer* Wilson 1932.

None of the species listed here could belong to *Amphiascopsis*, since this genus is so clearly characterized that even species whose second and third legs are unknown can, with reasonable certainty, be placed therein. The probability with the majority is that they should go into *Mesamphiascus*.

Of *accraensis* Scott states that the swimming legs are "nearly as in *imus*", which suggests that it belongs to *Mesamphiascus*; this is supported by the structure of the first exopod, which excludes it from *Amphiascoides*; it might, however, be included in *Amphiascus* sens. str.

The three species *brevicornis, gracilicaudata* and *longicornis* described as species of *Stenhelia* by Thompson and Scott, are excluded from *Amphiascus* sens. str. by the first exopod or fourth endopod or both, while *dentipes* of the same authors cannot be *Amphiascoides*; *perplexus* of the same authors is probably *Mesamphiascus*.

Of *brevis, congener* and *polaris* Sars states that their natatory legs are normal; these are not illustrated, but *congener* is stated to resemble *similis*, and *polaris* to resemble *imus*. From the drawings of their first exopods it is improbable that they belong to *Amphiascus* sens. str.; they cannot belong to *Amphiascoides* since the middle segment of the first exopod bears an inner seta and the end segment five "setae". Monard (1928a) regards *congener* as a synonym of *faroensis*.

Of *brucei*, the only information concerning the swimming legs is that "second, third and fourth legs similar to *stromi* (Baird)". The illustration of the fourth

(3) As already stated *roberti* is figured with 8 setae on the end segment of the 4th exopod, but described as having 7. If the figure is correct it forms an exception to the rule for the genus, and has been included in the key with that possibility in view; if, as is more probable, the text is correct, then this species is a synonym of *vararensis*.

leg suggests either *Mesemphiascus* or *Amphiascoides*; the first exopod, while typical of *Amphiascoides,* does not exclude it from the former.

Of *dactylifer,* Wilson (1932) states that the legs are of the "usual pattern in this genus". Since the first exopod is without an inner seta on the middle segment, and the end segment has only four "setae", it may belong to either *Mesamphiascus* or *Amphiascoides.*

The first four pairs of legs of *dispar* are stated to resemble those of *imus*; from the first and fourth, which are illustrated, this species could belong to either *Mesamphiascus* or *Amphiascoides.*

Of the two species described by Brady (1918) *ignotus* is known only from the male, while *elegans* is insufficiently described. From the third endopod, which has two inner setae on the middle segment, it would appear to belong to *Amphiascus* sens. str. If so it would be an aberrant form, since the reduced setation of this endopod, lacking outer setae on the end segment, is not found in any other species of *Amphiascus, on any of the endopods.* The description is too unsatisfactory for certain identification.

In the case of *faroensis,* described by T. Scott (1903a) as a variety of *Dactylopus stromi,* the first four pairs of legs are stated to be "almost similar to those of *D. stromi*". This species of *Dactylopus* was renamed by Sars as *vulgaris,* and Scott's variety differs from that in the proportions of the first legs. It appears to be either *Amphiascus* sens. str. or *Mesamphiascus*; it is definitely excluded from *Amphiascoides.*

Of *herdmani* and *similis* A. Scott states that the first four pairs of legs are similar to *imus,* suggesting once more that they belong to *Mesamphiascus*; *similis* is not excluded from *Amphiascoides* however. This species, being distinct from *similis* (Claus) has been renamed *similoides* by Monard (1938a), who places *herdmani* in his *varicolor*-group, and *similoides* in his *giesbrechti*-group, but in each case expresses some doubt. These two groups are among those which correspond to *Amphiascopsis* and *Amphiascus* sens. str., and there seems little justification for their inclusion in either of these genera.

Sars (1911) gives no information about the legs of *lamellifer,* beyond stating its affinities with *confusus, typhloides* and *typhlops,* and since the middle segment of the first exopod has an inner seta and the end segment five "setae", in all probability it belongs with the above species in *Mesamphiascus.*

A. littoralis (T. Scott) 1903, can be either *Mesamphiascus* or *Amphiascoides,* but not *Amphiascus* sens. str., since there is no inner seta on the middle segment of the first exopod, and only four setae on the end segment of the fourth endopod. Monard (1935, p. 31; and 1937, p. 42) identifies a species with *littoralis* (T. Scott) but the setation of Monard's form does not agree with that of Scott in that the end segment of the fourth exopod has seven appendages, whereas Scott's has only six. Further, Monard (1935, fig. 32) shows an inner seta on the middle segment of the first exopod, not present in *littoralis.* Monard's form cannot be identified without further details, but from the single seta present on the middle segments of the endopods, according to his seta formula, it would appear to be an *Amphiascoides,* but the inner seta on the first exopod (*op. cit.,* fig. 32) is not known in any other species of this genus.

Monard (1928a, p. 369) suggests that *mixtus* (T. Scott) is a synonym of *longirostris* (Claus); later (1937, p. 97), however, he identifies a species as *mixtus,* and gives its seta formula, which agrees exactly with that of *longirostris.* He states, also, that the first leg, first antenna and fifth leg agree with Scott's figures. There seems, therefore, no reason for retaining Scott's name, since the only apparent difference is one of size, especially as Scott's figures agree very closely with Sars' for *longirostris.*

The swimming legs of *reflexus* are described by T. Scott (1895) as "somewhat similar to *imus*", and since it is excluded from *Amphiascoides* by the inner seta on the first exopod, it probably belongs to *Mesamphiascus*, though not excluded from *Amphiascus* sens. str.

The species described by Brady (1910) as *mucronatus* is clearly not an *Amphiascus* but appears to be near to *Ameiropsis* Sars. It is, however, so inadequately described that certain identification is difficult.

Regarding *proximus* T. Scott (1914, p. 373) the description is somewhat inadequate but the appearance of the exopod of the second antenna, which is two-segmented with a very short end segment, and the position of the inner seta on the basal segment of the first endopod suggest affinities with *Ameiropsis* rather than with *Amphiascus*. Unfortunately we know nothing of the swimming legs or rostrum.

The remaining species are those of which I have not seen descriptions:

brevifurcus (Czerniavski) 1868; *limicolus* (Brady) 1900; *crassus* (Giesbricht) 1902; *angrapequensis* Pesta 1916; *rufescens* Brian 1925.

According to Monard (1935a, p. 34) *brevifurcus* (Cz.) is probably synonymous with *debilis* (Giesbrecht); and the same author (1928a, p. 382) states that *rufescens* Brian is known only from the male. In this latter paper he places *crassus* in his *varicolor*-group, which suggests that it belongs to *Amphiascopsis*; it would appear also that it is quite distinct from any other species of *Amphiascus* in having eight setae on the distal segment of the fifth leg. Brady's species *limicolus*, Monard places in his *debilis*-group, which suggests that it belongs to *Amphiascoides*. Of *angrapequensis* he makes no mention; this species is listed in the "Zoological Record", Vol. lv, for 1918.

COLLECTED LIST OF SYNONYMS WITH REFERENCES.

affinis Sars 1906,	= *vararensis* (T. Scott) 1903,	Mon. 1928,
angolensis Monard 1934,	= *Robertsonia*,	
clandestina Klie 1923,	= *Schizopera longicauda* Klie 1925,	Klie 1925,
debilioides Monard 1928,	= *speciosus* Brian 1921,	Klie 1937,
dubius Jakubisiak 1933,	= *similis* (Claus) 1866,	
falklandiensis Lang 1936e	= *simulans* (Norm. and Sc.) 1905,	
irrasus (A. Scott) Monard 1928a,	= *Robertsonia*,	
jugurtha (Bl. and Rich) Monard 1928a,	= *Schizopera*	
knoxi (Th. and Sc.) Monard 1928a	= *Robertsonia*,	
linearis Sars 1906,	= *neglectus* (Norm. and Sc.) 1905,	
longicaudus Sars Monard 1928a,	= *Schizopera*	
mixtus (T. Scott) 1903,	= *longirostris* (Claus) 1863,	Mon. 1928a,
mucronatus Brady 1910,	= Ameiridae,	
paradoxus Daday Monard 1928a,	= *Schizopera*	
parvulus (Cl.) Brian 1917,	= *Ameira parvula* (Claus) 1866,	Mon. 1928a,
productus Sars 1906,	= *blanchardi* (T. and A. Sc.) 1895a,	Sars 1911,
propinquus (Scott) Monard 1928a,	= *Robertsonia*,	
proximus T. Scott 1914,	= Ameiridae,	
robinsonii (A. Scott) 1902,	= *intermedius* (T. Scott) 1897,	
sahelensis Monard 1936	= *normani* Sars 1911,	
scotti Sewell 1924,	= *Robertsonia propinqua* (T. Sc.) 1894	Gurn. 1927b,
tenax Brian 1927a,	= *erythraeus* (A. Scott) 1902,	Gurn. 1927b,

The following are probably synonyms:

banyulensis Monard 1928,	? = *hirsutus* (Th. and Sc.) 1903,
gauthieri Monard 1936,	? = *angustipes* Gurney 1927b,
roberti Monard 1935,	? = *vararensis* (T. Sc.) 1903.

ROBERTSONIA Brady 1880.

There has been considerable difference of opinion as to whether this genus should be included in the Diosaccidae or Tachidiidae. It has recently been clearly demonstrated by Lang (1935a) that it must be included in the former, as suggested by Gurney (1927b).

The genus is here regarded as being characterized by the following combination of features:

1. 1st antenna 5- to 7-segmented, *having only 3 segments in the basal portion* (4);
2. 2nd antenna with exopod 2- or 3-segmented, but when 3-segmented then the middle segment is without a seta;
3. exopod of 1st leg with an inner seta on the middle segment, and usually with 5 ''setae'' on the end segment (1 exception, see p. 89);
4. endopods of legs 2–4 with only 1 inner seta on the middle segment;
5. exopods of legs 2–4 without inner seta on the basal segment.

It will be seen that the 4th and 5th characters are those of *Amphiascoides,* the 5th occurring occasionally in *Mesamphiascus;* the 3rd is that of *Amphiascopsis* and the less reduced forms, found also in *Mesamphiascus*; the 2nd is common to all the genera into which *Amphiascus* is here divided, in that the exopod may be 2- or 3-segmented, but the middle segment when present may be with or without a seta, and all three conditions are found in each genus—here, if there is a third segment, the middle one is without a seta. The 1st character, as pointed out by Willey (see footnote) is found only in *Robertsonia.*

This combination of features suggests that *Robertsonia* is derived from *Mesamphiascus,* retaining the unreduced 1st exopod found in that genus, but has undergone a reduction in the setation of legs 2–4, attaining the condition found in *Amphiascoides;* while the 1st antenna has undergone reduction in the number of segments, and the exopod of the 2nd antenna a reduction in the number of setae.

That *Robertsonia* is a distinct genus can be established by an examination of the genital area where it has been figured. That of *tenuis* has been shown by Lang (1935a, p. 6) along with that of *Amphiascus longirostris.* Its relationship to *Amphiascus* is clear, as pointed out by Lang (*loc. cit.*), while its distinctness from *Dactylopusia* is clearly seen by a comparison with the figures for species of this genus given by Lang (1936e, p. 22, figs. 25–28). Other illustrations of the receptacular portion of this apparatus are given by Monard (1926, p. 627) for *diademata* and Willey (1931, pl. xx, figs. 57, 58) for *hamata* and *flavidula.*

A possible exception to the 5th in the above list of generic characters is found in *knoxi* (Thompson & Scott) as described by Gurney (1927b, p. 534), but *diademata* Monard (1926, in 1928, fig. V, 1) which Gurney (*loc. cit.*, p. 530, and 1932, p. 17) regards as a synonym of *knoxi,* lacks the inner seta on the basal segment of at least the 3rd exopod. Monard (1926, p. 627) does not describe or figure the basal segments of the legs of *diademata.*

Amphiascus bulbifer Sars (1911), included by Gurney (1927b, p. 530), in *Robertsonia,* has the basal portion of the 1st antenna with 4 segments, the middle segment of the exopod of the 2nd antenna has a seta, the middle segment of the 1st exopod has an inner seta, and the middle segment of the 2nd endopod has 2 inner setae. In these respects it is a true *Mesamphiascus,* in spite of the 1st legs which, after all, differ very little from those of *exiguus* and *mathoi,* for example.

T. Scott (1894) described a species *Dactylopus propinquus,* which Sewell (1924) transferred to *Amphiascus* and renamed *Scotti,* since it was distinct from *A. propinquus* Sars (1906). As Gurney (1927b, p. 530) has pointed out, Scott's is the older name and should have been retained, but the point does not arise since, as Gurney states, the species really belongs to *Robertsonia.* Sewell points out the resemblance between *propinqua* (T. Scott) and *irrasa* (A. Scott 1902, as *Stenhelia*) which, as far as is known, are separable only on the proportions of the 1st endopod, since the setation of the swimming legs has not been indicated for *propinqua* by either Scott, Sewell, or Gurney. That of *irrasa* is given both by Gurney (*loc. cit.*,

(4) Willey (1931, p. 614) states: ''It is one of the leading characters of *Robertsonia* that the proximal portion of the antennule consists in the female of three joints only''.

p. 532) and by Monard (1935a, p. 28), but Monard's illustration of the 1st leg (*loc. cit.*, fig. 20) does not agree with those of A. Scott (1902, pl. iii, fig. 8) and Gurney (*loc. cit.*, fig. 146), but agrees closely with those of *propinqua* shown by T. Scott (1894, pl. x, fig. 49) and by Sewell (1924, pl. liv). Thus it would appear that Monard (1935a) was not dealing with *irrasa*, but with *propinqua*, unless these two are forms of the same species, as suggested by Sewell (*loc. cit.*, p. 823). The segmentation of the 1st antenna, according to Sewell, is variable and may be either 5 or 6 in the same species, so that unless there is a difference in the setation of the swimming legs only the long end segment of the 1st endopod distinguishes *irrasa* from *propinqua*. It can, therefore, be assumed that since *irrasa* of Monard (1935a) is in all probability *propinqua*, the seta formula given by Monard is that of the latter.

Amphiascus angolensis Monard (1934) is obviously a species of *Robertsonia*, under the definition given here, and the first leg is identical with that of *propinqua*, but the species differ in the seta formula of the 3rd leg. In *angolensis* there are 4 setae on the end segment of the 3rd endopod, in *propinqua* there are 6, as in *irrasa*.

It should be noted that although T. Scott shows the exopod of the 2nd antenna with a seta on the middle segment in *propinqua* (1894, pl. x, fig. 47), in Sewell's redescription of the species (1924, p. 819, pl. liv) this segment is without setae.

As a result of the inclusion of *Robertsonia* in the Diosaccidae, Monard's genus *Teissierella* (1935, 1935a) breaks down. This genus was created by Monard (1935, p. 24) for the species *T. celtica*, which he regarded as intermediate between *Amphiascus* and *Robertsonia*. Its resemblance to the former depends on the prehensile first leg and double egg-sac, to the latter on the reduced 1st antenna, armed with pectinated setae. Gurney (1927b, p. 532) has stated that these setae may sometimes be absent in *R. knoxi*, and dismisses them as unimportant. *T. celtica* must, therefore, be included in *Robertsonia*—a possibility which is admitted by Monard (1935a, p. 27, footnote)—while *T. salammboi* Monard (1935a, p. 28, figs. 21–30) appears to be a *Mesamphiascus* with somewhat unusual 5th legs.

The inclusion of *salammboi* in the genus *Teissierella* by Monard rested entirely on the pectinated setae of the 1st antenna, which is 8-segmented, with 4 segments in the basal portion. This feature, combined with the presence of 2 inner setae on the middle segment of the 2nd endopod, and inner setae on the basal segments of the 3rd and 4th exopods, clearly shows its affinities with *Amphiascus* and excludes it from *Robertsonia*.

Klie (1937) created a genus *Varnaia*, but did not apparently make a close comparison of this genus with *Robertsonia*. He regards his new genus as intermediate between *Amphiascus* and *Dactylopusia*, in spite of there being only one inner seta on the middle segments of legs 2–4, and later (p. 31) dismisses the setation of the swimming legs from consideration until other species are known. He relates *Varnaia* to *Dactylopusia* on the enlarged basal segment of the 1st endopod, and to *Amphiascus* on the rostrum, 2nd antenna, mandible, maxillule, 5th leg, caudal rami and male features, but separates it from both on the position of the inner seta of the 1st endopod. As pointed out above (p. 66), this is variable in both Thalestrids and Diosaccids, and particularly in *Robertsonia*, in which genus it may even be absent. In fact, *Varnaia monardi* is a good example of *Robertsonia* as defined above and, with the exception of the endopod of the 2nd antenna which Klie states to be indistinctly 3-segmented, all the features named by him as Amphiascoid agree extraordinarily well with Sars' (1911) figures of *R. tenuis*.

In any case, the position of the inner seta on the basal segment of the 1st endopod, unsupported by other distinguishing characters, is insufficient for the creation of a new genus.

Further support for the inclusion of *V. monardi* in *Robertsonia* is found in the 3-segmented basal portion of the first antenna, and the genital area of the female, which shows close agreement with those of *diademata*, *hamata*, and *flavidula*. In many details Klie's species closely resembles *R. flavidula* Willey (1931), while the reduction in size of the inner seta on the basal segment of the 1st endopod compares with the condition in *R. chesapeakensis* Wilson (1932a) in which it is absent.

The following species have been ascribed to *Robertsonia*:

tenuis Brady 1880; *propinqua* (T. Scott) 1894; *irrasa* (A. Scott) 1902; *knoxi* (Thompson and Scott) 1903; *normani* Brady 1910; *bulbifer* (Sars) 1911; *aculeifera* Klie 1913; *diademata* Monard 1926; *salsa* Gurney 1927a, *flavidula* and *hamata* Willey 1931; *chesapeakensis* Wilson 1932a.

Of these Gurney (1927b, p. 530) has stated that *normani* Brady is an Ectinosomid; *aculeifera* Klie is a synonym of *Thompsonula hyaenae* (I. C. Thompson 1889); and that *diademata* Monard and *salsa* Gurney are synonyms of *knoxi* (Thompson and Scott).

To the genus must be added *angolensis* (Monard) (1934; *celtica* (Monard) 1935; and *monardi* (Klie) 1937. As shown above *bulbifer* belongs to *Mesamphiascus*.

The genus, therefore, comprises the species listed below:

tenuis Brady 1880; *propinqua* (T. Scott) 1894; *irrasa* (A. Scott) 1902; *knoxi* (Thompson and Scott) 1903; *flavidula* and *hamata* Willey 1931; *chesapeakensis* Wilson 1932a, *angolensis* (Monard) 1934; *celtica* (Monard) 1935; *monardi* (Klie) 1937.

KEY TO ROBERTSONIA FEMALES.

1.	End segment of 2nd endopod with 1 inner seta	2.
	End segment of 2nd endopod with 2 inner setae	*celtica* (Monard) 1935.
2.	Segments of 1st endopod subequal	3.
	Basal segment of 1st endopod at least as long as 2nd and 3rd together	4.
3.	Distal segment of 5th leg with 5 setae	*tenuis* Brady 1880.
	Distal segment of 5th leg with 6 setae	*knoxi* (Thompson and Scott) 1903.
4.	End segments of 1st endopod together at least one-quarter of basal segment . ..	5.
	End segments of 1st endopod together no more than one-sixth of basal segment ..	7.
5.	End segment of 1st endopod twice as long as middle segment ..	*irrasa* (A. Scott) 1902.
	End segments of 1st endopod subequal	6.
6.	End segment of 3rd endopod with 6 setae ..	*propinqua* (T. Scott) 1894.
	End segment of 3rd endopod with 4 setae .	*angolensis* (Monard) 1934.
7.	1st exopod almost as long as basal segment of endopod ..	*hamata* Willey 1931.
	1st exopod little more than half of endopod	8.
8.	1st antenna 6-segmented	*monardi* (Klie) 1937.
	1st antenna 7-segmented	*flavidula* Willey 1931.

chesapeakensis Wilson (1932a) cannot be included in the key since the appendages of the female were not described.

SCHIZOPERA Sars 1905.

1905. *Schizopera* Sars, 1905a, p. 383; 1909. *Schizopera* Sars, 1909b, p. 39.

It is not proposed to deal with this genus in detail here since it is confined to fresh or brackish water. Its affinities with *Amphiascus* are very clear, and Monard (1935, p. 21) considers that it should be merged with that genus. This question has been discussed by Gurney (1927b, p. 514; 1932, p. 38) and Chappuis (1931, p. 585). The latter author includes a key to the species.

As stated above, it forms the last genus in the series included in the Amphiascinae, showing the greatest amount of reduction in the number of setae on the swimming legs, and is clearly derived from *Amphiascoides*.

SUMMARY OF DISTINGUISHING CHARACTERS OF THE AMPHIASCINAE.

Character.	*Amphiascopsis*	*Amphiascus* sens. str.	*Mesamphiascus*	*Amphiascoides*	*Robertsonia*	*Schizopera*
1. Number of setae on middle segments of 2nd and 3rd endopods respectively.	2.2.	2.2.	2.1.	1.1.	1.1.	1.1.
2. Middle segment of 1st exopod with inner seta.	yes	yes	yes or no	no	yes	no
3. Middle segment of 1st exopod greater than 1st or 3rd segments.	yes	yes or no	no	no	no	no
4. Number of setae on end segment of 1st exopod.	5	5 or 4	5 or 4	4	5(5)	4
5. End segments of 1st endopod together less than ⅓ of basal.	yes	yes or no	no	no	yes or no	yes or no
6. Number of inner setae on end segment of 3rd endopod.	3	3 or 2	3 or 2	2	3 or 2	1
7. Number of inner setae on end segment of 4th endopod.	2	2	2 or 1	1	2 or 1	1 or 0
8. Basal segments of exopods 2–4 with inner setae.	yes	yes or no	yes or no	no	no(6)	no
9. Number of segments in basal portion of 1st antenna.	4	4	4	4	3	4
10. Middle segment of exopod of 2nd antenna, when present, with seta.	yes or no	yes or no	yes or no	yes or no	no	always 2-segmented

DIOSACCINAE subfam. nov.

Body with metasome enlarged, distinctly wider than urosome and more or less strongly demarcated therefrom. First antenna 8-segmented; exopod of 2nd antenna 1-segmented (2-segmented in *Pseudodiosaccus*); mandible palp uniramous (biramous in *Tydemanella*, *Diosaccopsis*, and *Diosaccus truncatus*); rami of legs 1–4 usually 3-segmented, but 1st endopod 2-segmented in *Tydemanella*, *Ialysus* and *Parialysus*; 1st exopod slightly modified in *Diosaccopsis* and *Pseudodiosaccus*; 1st endopod always prehensile; middle segment of 3rd endopod with 2 inner setae; caudal rami little or no longer than wide. 6 genera: *Diosaccopsis, Diosaccus, Pseudodiosaccus, Tydemanella, Ialysus, Parialysus.*

DIOSACCOPSIS Brian 1925.

According to Monard (1936, p. 18), the genus, which was somewhat doubtful as first described by Brian, based as it was on a species (*rubeus*), which closely resembles *Amphiascus pyrocides* Monard 1928, has been firmly established by the inclusion of the species *D. ismaelensis* Monard 1936. 2 species.

D. rubeus Brian 1925, syn. *D. amphiasculus* Brian 1927; and *D. ismaelensis* Monard 1936.

(5) The one exception (referred to on page 86) is *chesapeakensis*, of which only the male appendages have been described.

(6) One exception, *knoxi*, whose seta formula is given by Gurney (1927b).

DIOSACCUS Boeck 1872.

The genus contains 5 species:

tenuicornis (Claus) 1863; *sordidus* Brady 1910; *ruber* Brian 1923; *truncatus* Gurney 1927b; *spinatus* Campbell 1929.

PSEUDODIOSACCUS T. Scott 1906.

This genus was created by T. Scott for the species *Diosaccus propinquus* T. and A. Scott (1893a), and at present contains only the one species.

In a recent paper (1941) I expressed the view that *Ialysus* was synonymous with *Tydemanella*, based chiefly on certain similarities which are evident, and supported by the discovery of a species which appeared to be intermediate between these genera. The finding in Western Australia of further material of the species described from South Australia as *T. robusta* has led me to revise my opinion as to their synonymy.

The result is that the Australian species has now to be placed in a new genus, for which I have (p. 91) suggested the name *Parialysus*, while the other two must be regarded as distinct. This is particularly evident from a comparison of the structure of the mouth parts, which are considerably reduced in *Parialysus*. The distinctive features of the three genera are set out below.

Character	*Tydemanella*	*Ialysus*	*Parialysus*
Ant. Body, depth: length	4:9	4:10	4:7
Urosome, length: width	—	5:3	almost equal
segments of first antenna	elongate	short and compact	short and compact
mandible palp	biramous	"long slender unbranched rod" (7)	like *Ialysus* but 2-segmented
maxillule, maxilla	"nearly similar to those of *Dactylopodella flava*" (8)	"as in *Dactylopusia*" (7)	strongly reduced and without lobes.
maxilliped	ditto	robust.	like *Ialysus*.
p.1. endopod	length: width — 13:4 1 terminal spine, and 2 setae.	length: width — 10:4 2 terminal spines only.	length: width — 14:4 as in *Ialysus*.
exopod	middle segment with inner seta.	middle segment with inner seta.	middle segment without inner seta.
p.2. endopod	"nearly similar to those of *Dactylopodella flava*" (8)	middle segment with 2 inner setae.	middle segment with 1 inner setae.
exopod		basal segment with inner seta.	basal segment without inner seta.
p.3. endopod		end segment with 3 inner setae.	end segment with 2 inner setae.
exopod		basal segment with inner seta.	basal segment without inner seta.
p.4. exopod		basal segment with inner seta.	basal segment without inner seta.
caudal rami	longer than wide, as long as anal segment.	little longer than wide, shorter than anal sgt.	as wide as long, shorter than anal sgt.

(7) Gurney, 1927b, p. 505.
(8) A. Scott, 1909, p. 217.

TYDEMANELLA A. Scott 1909.

The genus was regarded by Scott as a Thalestrid related to *Dactylopodella*, which it resembles in shape and in the relatively large basal segment of the first endopod. It is, however, as stated by Lang (1936e, p. 18), clearly a Diosaccid.

One species: *T. typica* A. Scott, 1909.

IALYSUS Brian 1927.

Brian placed this genus in the Diosaccidae; Gurney (1927b) discovered the same species independently and regarded it as a Thalestrid, in which view Monard (1935) supports him. In his revision of the Thalestridae Lang (1936e) confirms Brian's views regarding its systematic position.

One species: *I. rufus* Brian 1927.

PARIALYSUS gen. nov.

The opinion expressed by me (1941) that *Ialysus* is a synonym *of Tydemanella* cannot be upheld, and I am therefore compelled to establish a new genus for the species described as *Tydemanella robusta*, since the mouth parts show a very considerable reduction. Apart from these the species could probably be placed in *Ialysus*, in spite of the much more slender first endopod. The differences have been set out in the table above.

One species: *P. robusta* (Nicholls) 1941.

Subfam. STENHELIINAE sens. str.

Body with metasome enlarged, distinctly wider than urosome and demarcated therefrom. First antenna, 5-, 6-, or 8-segmented; exopod of 2nd antenna 2- or 3-segmented; mandible palp biramous (outer branch strongly developed and reflexed in *Stenhelia*). First exopod unmodified, endopod with long end segment, never prehensile; legs 2–4 with 3-segmented exopods and 2- or 3-segmented endopods; middle segment of 3rd endopod with 1 inner set; caudal rami at least twice as long as wide. 2 genera.

Stenhelia, Pseudomesochra.

STENHELIA Boeck 1864.

The genus is divided into 2 subgenera, according to the segmentation of the 1st endopod. In *Stenhelia (Stenhelia)* it is 3-segmented; in *S.* (*Delavalia*) 2-segmented. A key to the genus has been given in an earlier work (1939), from which 3 species were left out. Two of these *S.* (*D.*) *inopinata* (A. Scott) 1902 and *S.* (*D.*) *longifurca* Sewell 1934, were overlooked; *S. ? glacialis* Brady 1918 is insufficiently described, but appears to be a Thalestrid belonging to the subfamily Pseudotachidiinae Lang (1936e); further identification does not seem possible.

The following species referred to *Stenhelia* belong to *Amphiascus*:

ima Brady 1872; *hispida* Norman MS, Brady 1880; *ima* Giesbrecht 1882; *denticulata* I. C. Thompson 1893; *accraensis* T. Scott 1894; *dispar* T. and A. Scott 1894; *reflexa* T. Scott 1895; *blanchardi* T. and A. Scott 1895; *herdmani* and *similis* A. Scott 1896; *intermedia* T. Scott 1897; *limicola* Brady 1900; *confusa* T. Scott 1902; *erythraea* A. Scott 1902; *minuta, perplexa, brevicornis, gracilicaudata, longicornis* and *dentipes* Thompson and Scott 1903; *hyperborea* T. Scott 1903b; *neglecta, pygmaea, simulans, varians* and *longirostris* Norman and Scott 1905.

Of these the following have been renamed: *ima* Giesbrecht = *giesbrechti* Sars; *similis* A. Scott = *similoides* Monard; *minuta* Thompson and Scott = *angustipes* Gurney; *longirostris* Norman and Scott = *normani* Sars.

The following species referred to *Stenhelia* now belong to *Robertsonia*: *irrasa* A. Scott 1902, *knoxi* Thompson and Scott 1903.

PSEUDOMESOCHRA T. Scott 1902.

This genus has been discussed by Lang (1936a), who shows that *Stenheliopsis* Sars 1906 is synonymous. A key to the species is given by Lang (*loc. cit.*).

LAOPHONTIDAE T. Scott 1905.

1907. *Laophontidae* Sars.

Monard (1935) has discussed the relationship of the genera included in this family and lists the following genera:

Laophonte Phillippe 1840; *Asellopsis* Brady and Robertson 1873; *Platychelipus* and *Normanella* Brady 1880; *Esola* C. L. Edwards 1891; *Laophontodes* T. Scott 1894a; *Pseudolaophonte* A. Scott; *Laophontina* Norman and Scott 1905; *Harrietella* T. Scott 1906; *Laophontopsis* Sars 1908; *Hemilaophonte* Jakubisiak 1932; *Lobitella* Monard 1934.

The genus *Laophontella* Thompson and Scott (1903, p. 83) was regarded by the authors as a Laophontid, by Gurney (1932, p. 314) and Monard (1935, p. 83) as a Cletodid, but, as has been stated by Lang (1936d, p. 451), is clearly a Canthocamptid.

The following genera have been added to the family since Monard's review:

Sarsocletodes Wilson 1924 (for *Pseudocletodes* Sars 1921, preoccupied *Coleoptera* 1893 = *Pseudoplatychelipus* Lang 1936), *Cletopsyllus* Willey 1935, *Donsiella* Stephenson 1935.

Of the above genera Sewell 1924, p. 834, considered that *Laophontopsis* Sars 1908 should be known as *Cleta* since *lamellifera*, which must be regarded as the type, was originally so named by Claus (1863, p. 123); however, *Cleta* is twice preoccupied (Lepidoptera 1845 and Coleoptera 1850) so that Sars' name stands.

Laophontodes has justly been removed to the family Anchorabolidae by Lang (1936c).

Loaphontina was regarded by Sars (1911, p. 427) as not worthy of generic value and included by him in *Pseudolaophonte*; Monard (1934, p. 3) states that under such circumstances his genus *Lobitella* might well be included in Scott's genus. Monard's genus has, however, the second antenna with a reduced exopod, and is here regarded as a distinct genus, as also is *Laophontina*.

Esola, as remarked by Monard (1935, p. 66) appears to be a *Laophonte* with 1-segmented first exopod; it is probable that the four apparent setae on the basal segment of the first endopod are really long hairs, but until the species has been redescribed the generic name may be retained.

According to Lang (1936d, p. 451) *Pseudocletodes* Sars (1921) (preoccupied Coleoptera 1893), is not a Cletodid, and must be transferred to the Laophontidae, close to *Platychelipus*. Lang has renamed Sars' genus as *Pseudoplatychelipus*, being unaware that Wilson (1924) had already renamed it *Sarsocletodes*.

As Monard (1935, p. 65) dealing with the genera known at that time, has pointed out, the Laophontidae form a very homogeneous group, with the exception of *Normanella*. Excluding this genus the family has the following constant features:

1. mandible palp 1-segmented;
2. 1st exopod reduced, without inner setae;

3. 1st endopod with single terminal claw, strongly developed (weak in *Platychelipus*), accessory seta when present very small, no inner seta on end segment, seta on basal segment when present central in position (found only in *Laophontopsis*);

4. rostrum always fused with cephalosome;

5. males, where known, have 3rd endopod 2- or 3-segmented, usually modified; exopods 2–4 modified.

The above characters are constant in all the genera described before Monard's review except *Platychelipus* and *Normanella*. Of these, the former departs so little from these characters that it could be regarded as an aberrant member of the family. *Normanella* on the other hand disagrees with all the above listed features:

1. mandible palp bilobed;
2. 1st exopod of normal development, with inner seta;
3. 1st endopod has distal inner seta on basal segment, inner seta on end segment and long terminal seta in addition to claw;
4. rostrum distinctly defined basally;
5. swimming legs of male undifferentiated from those of female.

This genus, while it has some affinities with the Cletodidae, as exemplified by *Pontopolites*, differs in the first legs to such an extent that it cannot be included in this family. It is probably intermediate between the Cletodidae and Canthocamptidae, and for the present may be relegated to the latter very heterogeneous collection of genera.

Of the genera added since Monard reviewed the family, *Cletopsyllus* departs from the true Laophontid characters in several respects:

1. mandible palp 2-segmented;
2 and 3. 1st legs as in *Normanella*;
4. rostrum defined by suture;
5. (male unknown),

and, therefore, for the present *Cletopsyllus* must accompany *Normanella* into the Canthocamptida.

Unfortunately we know nothing of the mouth parts of *Donsiella*; the shape of the first leg, however, is typical of the Laophontidae, but there are two subequal terminal claws. The second and third legs have 3-segmented endopods in both sexes, the fourth endopod is 1-segmented in the male and absent in the female; the exopods of the male are like those of the female except for that of the second leg which is slightly modified. It cannot, therefore, remain in this family, where it was placed with some misgivings by its author, and appears to have Tachidiid affinities.

As for *Sarsocletodes*, Lang transfers it to the Laophontidae on account of the structure of the third endopod of the male, which he illustrates on p. 451 (1936d). In my opinion this does not differ from that of *Cletodes limicola*, an accepted Cletodid, to anything like the extent to which *C. limicola* differs from other Cletodids (cf. *Enhydrosoma curticaudatum* in Sars 1911, pl. ccv).

Sarsocletodes differs from the Laophontidae in that the first endopod is shorter than the exopod (a Cletodid character), and is armed with one inner and one terminal seta on the end segment.

The truth probably is that both *Platychelipus*, which departs somewhat from typical Laophontids, and *Sarsocletodes* should be placed in a separate family intermediate between the Laophontidae and Cletodidae. This would leave the Laophontidae a very clearly defined family.

Below is given a diagnosis of the family Laophontidae.

Body usually cylindrical, but flattened and considerably wider in front than behind in *Harrietella*, *Hemilaophonte* and a few species of *Laophonte*; segments defined by lateral incisions; rostrum prominent, always completely fused with the head. Antennules 4- to 8-segmented; antennae 2-segmented, the exopod 1-segmented with four setae, or reduced, even to a single seta; mandible palp always

1-segmented; maxillule usually well developed; maxilla with three inner lobes, the proximal sometimes reduced to a seta; maxilliped prehensile, usually strongly developed.

First legs with endopod always 2-segmented, longer than the exopod, basal segment with or without an inner seta (when present inserted about middle of segment), end segment always without an inner seta but having a single large terminal claw which may be accompanied by a small accessory seta; exopod 2- or 3-segmented, always without inner setae. Legs 2–4 usually with 3-segmented exopods and 2-segmented endopods, both rami reduced in some genera.

Male with third endopod almost always modified, exopods of legs 2–4 usually modified.

The following genera, arranged in chronological order, are here regarded as belonging to this family:

LAOPHONTE Philippi.

1840. *Laophonte* Philippi,
1850. *Canthocamptus* Baird (pro part.),
?1860. *Harpacticus* Fischer,
1863. *Cleta* Claus (pro part.),
1866. *Cleta* Claus,
1868. *Cleta* Czerniavski,
1875. *Tetragoniceps* Brady and Robertson (*T. longiremis*),
1907. *Laophonte* Sars (pro part.).

This genus contains over 100 species which are dealt with in the following pages.

LAOPHONTOPSIS Sars.

1863. *Cleta* Claus,
1908. *Laophontopsis* Sars,
1924. *Cleta* Sewell,
1928. *Laophontopsis* Monard,
1935. *Laophontopsis* Monard,
1935a. *Laophontopsis* Monard.
1937. *Laophontopsis* Monard.

This genus contains two species only: *Laophontopsis lamellifera* (Claus) 1863, and *L. secunda* (Sewell) 1924.

ASELLOPSIS Brady and Robertson.

1873. *Asellopsis* Brady and Robertson,
1895. *Laophonte* T. Scott,
1908. *Asellopsis* Sars.

There are four species known in this genus: *A. hispida* Brady and Robertson 1873; *A. intermedia* (T. Scott) 1895; *A. duboscqui* Monard 1926a; *A. littoralis* Nicholls 1939.

A key to these species has been given by Nicholls (1939).

ESOLA Edwards.

1891. *Esola* C. L. Edwards.

PSEUDOLAOPHONTE A. Scott.

1893. *Laophonte* I. C. Thompson,
1896. *Pseudolaophonte* A. Scott.
1911. *Pseudolaophonte* Sars.

One species: *P. spinosa* (I. C. Thompson) 1893, *syn. P. aculeata* A. Scott 1896.

LAOPHONTINA Norman and Scott.

1905. *Laophontina* Norman and Scott,
1906. *Laophontina* Norman and Scott,
1908. *Pseudolaophonte* Sars.

One species: *L. dubia* Norman and Scott 1905.

HARRIETELLA T. Scott.

1894. *Laophonte* T. Scott, 1894a,
1906. *Harrietella* T. Scott,
1921. *Harrietella* Sars,
?1935. *Laophonte* Stephensen.

One species: *H. simulans* (T. Scott) 1894a. As stated below (p. 98) the specimen described by Stephensen (1935) as probably the male of *Laophonte brevifurca* is much more probably a species of this genus, possibly the male of *H. simulans.*

HEMILAOPHONTE Jakubisiak.

1932. *Hemilaophonte* Jakubisiak.

One species: *H. janinae* Jakubisiak (1932).

LOBITELLA Monard.

1934. *Lobitella* Monard.

One species: *L. apoda* Monard (1934).

ECHINOLAOPHONTE gen. nov.

1876. *Cleta* Norman,
1908. *Laophonte* Sars (pro part.),
1927. *Laophonte* Gurney 1927b (pro part.),
1928. *Laophonte* Brian (pro part.),
1929. *Laophonte* van Douwe (pro part.),
1929. *Laophonte* Brian 1929a.

Laophonte having a single large recurved spur dorsally on the posterior margin of the head segment, and paired spines dorso-laterally on each of the following body segments except the last one or two. Rostrum large and expanded. First antenna 6-segmented, with four segments in the basal portion which is composed of three long segments and a short fourth, bearing the sensory filament; terminal portion with end segment longer than penultimate. First leg with basipod long and slender, its second segment about as long as the basal segment of the endopod; exopod 2-segmented—the two segments may be partially fused—very slender and not exceeding half the length of the basal segment of the endopod. Seta formula for legs 2–4 as follows:

	endopod.	exopod.
p.2.	0.120.	0.1.123 or 2.
p.3.	0.220.	0.1.223.
p.4.	0.120.	0.1.222 or 3.

Fifth leg with basal expansion narrow, with four or five setae, distal segment elongate, bearing only three setae. The above seta formula and this type of fifth leg are found in no other species of *Laophonte* which, together with the modification of the body and rostrum, justifies their removal to a separate genus.

The genus contains the following four species removed from *Laophonte*:

horrida Norman 1876, genotype; *brevispinosa* Sars 1908; *armiger* Gurney 1927b; *mirabilis* Gurney 1927b.

As pointed out below *hystrix* Brian (1928) and *steueri* van Douwe (1929) are synonyms of *armiger* Gurney 1927b.

It is of interest to note that this genus shows affinities with *L.* (*Mesolaophonte*). The seta formula closely resembles that of the *quinquespinosa* group, in at least one member of which body spines are developed. It should be noted, however, that spines are developed also in *dinocerata* which is a *Laophonte* sens. str.

KEY TO THE FEMALES.

1. Basal expansion of 5th leg reaching end of distal segment .. .. .. 2.
   Basal expansion of 5th leg not reaching middle of distal segment. *mirabilis* (Gurney) 1927b.
2. 1st endopod at least 3 times as long as exopod .. .. 3.
   1st endopod no more than twice as long as exopod .. .. *brevispinosa* (Sars) 1908.
3. Basal segment of 1st endopod longer than 2nd basipod; rostrum longer than wide. *horrida* (Norman) 1876.
   Basal segment of 1st endopod about equal to 2nd segment of basipod; rostrum wider than long .. .. *armiger* (Gurney) 1927b.

KEY TO THE MALES.

1. 3rd endopod 2-segmented, unmodified, bearing setae only .. *armiger* (Gurney) 1927b.
   3rd endopod 3-segmented, middle segment with spine .. .. .. 2.
2. End segment of 3rd exopod armed with 3 setae and 4 spines .. *brevispinosa* (Sars) 1908.
   End segment of 3rd exopod armed with spines only .. .. *horrida* (Norman) 1876.

The male of *mirabilis* is unknown; that of *armiger* is described by Willey (1930) and by Brian (1928) as *hystrix*

These 10 genera are closely allied and, as already stated, form a well defined family.

Laophonte is here divided into subgenera based on the setation of the swimming legs which, in most cases, show a constant segmentation—the exopod 3-segmented and the endopod 2-segmented. In *L.* (*Metalaophonte*) the fourth endopod is reduced in one or two species, and in the monotypic *L.* (*Neolaophonte*) the endopods of legs 2–4 are all 1-segmented.

The allied genera *Esola*, *Asellopsis*, *Echinolaophonte* and *Laophontopsis* appear to be derivatives of *Laophonte*, in which the body has undergone certain modifications without reduction in the segmentation of the legs. *Esola* differs very little from typical *Laophonte* species and, as stated above, is probably a true *Laophonte*. *Asellopsis* shows the full number of setae found in *Laophonte* sens. str. (see p. 98) but differs in the depressed body and short, lamellar caudal rami, with very short caudal setae. *Echinolaophonte* has the typical seta formula of the *L.* (*Mesolaophonte*) species, but again differs in the structure of the body by the development of a spiny armature and modification of the rostrum. *Laophontopsis* has the setal armature of the *L.* (*Metalaophonte*) species, but differs in the modified caudal rami and presence of an inner seta on the basal segment of the first endopod.

The remaining five genera of this family show a progressive reduction in the segmentation of the legs, and form two series according to whether this reduction proceeds from behind forwards or *vice versa*.

In the *Hemilaophonte* series the reduction starts in the fourth legs and proceeds forwards, as can be seen in the table given below:

	Segmentation of legs.					
	2nd		3rd		4th	
Genus.	exp.	end.	exp.	end.	exp.	end.
Hemilaophonte	3	2	3	2	2	2
Harrietella	3	2	3	2	2	1
Lobitella	3	2	3	1	1	1 (0)

whereas in the *Pseudolaophonte* Series the reduction takes place in the reverse direction:

	Segmentation of legs.					
	2nd		3rd		4th	
Genus.	exp.	end.	exp.	end.	exp.	end.
Pseudolaophonte	1	0	2	2	3	2
Laophontina	1	0	1	0	3	1

From this it is clear that while Sars' view that *Laophontina* should be included in *Pseudolaophonte* might be upheld, the further inclusion of *Lobitella* with these is not justifiable.

KEY TO THE LAOPHONTIDAE.

1. Exopods of legs 2–4 3-segmented .. .. 2.
   At least one of these exopods 1- or 2-segmented .. .. 6.
2. Caudal rami cylindrical, widely separated, armed with at least 1 long seta .. .. 3.
   Caudal rami lamellar, closely approximated, armed only with short spines and/or setae 5.
3. 1st endopod without inner setae on basal segment .. .. 4.
   1st endopod with 4 inner setae on basal segment .. .. *Esola* Edwards 1891.

4. Head with large dorsal spine, rostrum expanded .. .. *Echinolaophonte* gen. nov.
   Head without spine, rostrum normal .. .. .. *Laophonte* Philippi 1840.
5. Caudal rami long and tapering, at least twice as long as anal segment; basal segment of 1st endopod with inner seta .. .. *Laophontopsis* Sars 1908.
   Caudal rami short and rounded, little or no longer than anal segment; basal segment of 1st endopod without inner seta .. .. *Asellopsis* Brady and Robertson 1873.
6. 2nd and 3rd exopods 3-segmented, 4th exopod 1- or 2-segmented .. .. .. 7.
   2nd and 3rd exopods 1- or 2-segmented, 4th exopod 3-segmented .. .. .. 8.
7. 4th exopod 2-segmented, endopod 2-segmented .. *Hemilaophonte* Jakubisiak 1932.
   4th exopod 2-segmented, endopod 1-segmented .. .. *Harrietella* T. Scott 1906.
   4th exopod 1-segmented .. .. *Lobitella* Monard 1934.
8. 3rd and 4th endopods 2-segmented .. .. *Pseudolaophonte* A. Scott 1896.
   3rd endopod absent, 4th endopod 1-segmented .. *Laophontina* Norman and Scott 1905.

LAOPHONTE Philippi 1840.

A diagnosis of the genus has been given by Gurney (1932, p. 314) but needs a minor correction. The third endopod of the male should be described as 2- or 3-segmented.

Monard (1935, p. 66) enumerates 87 species and adds four more in the subsequent pages. To these must be added another 18 species; some of these were omitted from his list, while others have been described since:

mississippensis Herrick 1887; *quinquespinosa* Sewell 1924; *barbata*, *campbelliensis*, *tenuispina* and *gurneyi* Lang 1934; *lithophila* Monard 1934; *octavia* Monard 1935a; *corbula*, *longistylata* and *reticaudata* Willey 1935; *dieuzeidei* Monard 1936; *pauciseta* Lang 1936c; *spelaea* Chappuis 1938; *mendax* Klie 1939; *longiseta* Nicholls 1941; *laurentica* sp.nov.; *arenicola* sp.nov.

Of the species listed by Monard, *hecate* Brehm (1910) is a synonym of *Mesochra lilljeborgi*, according to Gurney (1932, p. 257);

exigua T. Scott (1912) is distinct from *exigua* Sars (1905a), and must therefore be renamed. It is proposed to name it *scotti*;

hystrix Brian (1928), of which *steueri* van Douwe (1929) is a synonym, as has been shown by Brian (1929a), is in turn a synonym of *armiger* Gurney (1927b). Gurney's description was published in 1927, that of Brian in 1928, though references to this paper are usually given as 1927, so Gurney's name has priority. This species is one of those here transferred to the new genus *Echinolaophonte*;

humilis Brian (1929) is a synonym of *mohammed*, according to Gurney (1932, p. 316);

echinata Willey (1930) has been removed by Lang (1936c) to the genus *Laophontodes*, and renamed *armatus*;

rosei Monard (1926) appears to be a synonym of *bulligera* Farran (1913), from which it differs only in the absence of the "sensory organ" described by Farran as present on the fourth endopod, and in the absence of one of the setae on the base of the fifth legs. This seta is inserted near the base of the proximal segment, a portion of which appears to have been lost in *rosei*. However, Dr. Farran in a personal communication informs me that the sensory outgrowth occurred in the same position on the fourth endopods of three individuals. In each case the endopod of one side was lacking, but it is reasonable to assume that the missing endopods were similar to those which were seen. The outgrowth he describes as "very tenuous and might escape notice in a mounted specimen". (I have taken the liberty of quoting from his letter.) He stresses the swollen base of the adjoining seta, which Monard also emphasizes (1926, p. 622) and later (1928, p. 418) compares with *bulligera*. In *rosei* the swollen base of the seta is "armée d'un fin chevelu de très fins poils raides et récurrents". No such armature is described for *bulligera*, but the sensory outgrowth is attached at a comparable position.

Unfortunately I have not had access to certain of the literature, and so have not seen descriptions of *parvula* (Claus) 1866, *uncinata* (Czerniavski) 1868, *nordlandica* Boeck 1872, and *mississipensis* Herrick 1887; *bafanus* Labbé, listed by Monard without reference, I have been unable to trace.

The specimen described by Stephensen (1935) as probably the male of *Laophonte brevifurca* is, in my opinion, a member of the genus *Harrietella*, and may be the male of *H. simulans*, the only known species, though the rostrum does not appear to be quite so well developed.

L. rhodiaca Brian (1928), known only from the male, may possibly be the male of *L. bulbifera* Norman (1911). The first antenna in both has two spurs on the basal segment, not known in any other species of the genus; the long slender exopod of the second antenna, common to both, is also noticeable; the first legs are very similar, and the fourth legs identical; the caudal rami of *rhodiaca*, though not bulbous, are somewhat modified.

The genus thus comprises about 100 species, somewhat variable amongst themselves, but held together by certain constant characters: the elongate first endopod with no inner seta on the long basal segment, which is followed by a short second segment and a large terminal claw, which may be accompanied by an accessory seta. The exopod of the second antenna is never more than 1-segmented, usually with four setae, though it may be reduced to little more than a knob with two setae or be absent. The first antenna varies from four to eight in its segmentation, and has either three or four segments in the basal portion; but those species with only three segments in the basal portion cannot be removed as a separate genus, since they show no other feature in common.

The genus can, however, be divided into subgenera on the setation of the endopods of the third legs. Thus the first group, for which the generic name must be retained since it contains the type species, *L. cornuta*, has three inner setae on the end segment of the third endopod. This group, *Laophonte* sens. str., is the largest, and the members show the following general agreement:

1. 2nd endopod with 2 inner, 2 terminal and 0 outer setae on the end segment (except *bulbifera*, *bulligera*, *longiremis*, *rosei* and *typhlops*, which have 2.2.1.; *curticauda*, *nordgaardi* and *reticaudata* which have 1.2.0.);
2. 3rd endopod with 3 inner, 2 terminal and 1 outer setae on end segment;
3. 4th endopod with number of setae on end segment varying from 1.1.1. to 2.2.1., including some forms lacking outer setae.

On the variation in the setation of the fourth endopod and other characters this subgenus can be further divided into groups (see below).

The second subgenus *Laophonte* (*Mesolaophonte*), contains those species in which the third endopod has two inner setae on the end segment.

1. End segment of 2nd endopod has 3 or 4 setae, of which 2 are always terminal. (In *spelaea* there are 5 setae, resembling those species of *Laophonte* sens. str. which have an outer seta on the end segment of this endopod;
2. end segment of 3rd endopod with 2 inner, 2 terminal and 1 outer seta (*quaterspinata* lacks the outer seta);
3. end segment of 4th endopod with 1 inner (2 in *spelaea*), 2 terminal and 0 or 1 outer setae.

Certain species which on the setation of the endopods would fall into this subgenus, but which have developed spines on the body and a modified rostrum, have been transferred to a new genus, *Echinolaophonte*, described above.

The third subgenus, *Laophonte* (*Metalaophonte*), contains those species which show a still further reduction in setation.

1. 2nd endopod with 3 setae on the end segment (4 in *depressa* and *koreni*);
2. 3rd endopod with 3 or 4 setae on the end segment;
3. 4th endopod with not more than 4 setae on the end segment.

The fourth subgenus, *Laophonte* (*Neolaophonte*), has affinities with the preceding subgenus, and contains those species which have their endopods reduced to one segment.

A fifth subgenus, *Laophonte* (*Monolaophonte*), is created for one species, *curvata* van Douwe (1929), also described by Monard (1937) which falls into none of the above subgenera since it has no inner setae on the end segment of the third endopod, and thus shows the greatest reduction in setation.

A number of species remains, which would probably fit into one or other of the subgenera proposed, but cannot as yet be placed with certainty owing to the lack of knowledge of their third legs. These are dealt with below under "*species inquaerendae*".

Keys are given to the females of the different subgenera, but owing to the incomplete state of our knowledge of the males they cannot be assigned to their respective subgenera, and a general key for the males is given.

KEY TO THE SUBGENERA OF LAOPHONTE

(Based on the Females).

1.	Endopods of swimming legs 1-segmented	*L.* (*Neolaophonte*).
	Endopods of at least 2nd and 3rd legs 2-segmented	.. .. 2.
2.	End segment of 3rd endopod with 0 inner seta	*L.* (*Monolaophonte*).
	End segment of 3rd endopod with 1 inner seta	*L.* (*Metalaophonte*).
	End segment of 3rd endopod with 2 inner setae	*L.* (*Mesolaophonte*).
	End segment of 3rd endopod with 3 inner setae	*L.* (*Laophonte*).

LAOPHONTE (LAOPHONTE) sens. str.

As defined above the subgenus contains those species of *Laophonte* with three inner setae on the end segment of the third endopod in the female. *L. cornuta*, though atypical in some respects, is widely distributed and was the first to be described; it is fully described and illustrated by Sars (1911, p. 235, pl. clvii, clviii), and conforms to the subgeneric definition in its setation. It is, therefore, regarded as the type species.

The following species are included in the subgenus:

cornuta Philippi 1840; *stromi* (Baird) 1850; *brevirostris* and *serrata* (Claus) 1863; *curticauda*, *longicaudata* and *thoracica* Boeck 1864; *similis* (Claus) 1866; *minuta* and *elongata* Boeck 1872; *australasica* Thomson 1883; *mohammed* Blanchard and Richard 1891 (⁹); *longipes* T. Scott 1894; *meinerti* Brady 1899; *perplexa* T. Scott 1899; *inornata* A. Scott 1902 (⁹); *longiremis* T. Scott 1905; *chathamensis* Sars 1905a; *congenera*, *nana*, *nordgaardi*, *parvula* and *typhlops* Sars 1908; *hyperborea* Sars 1909a; *bulbifera* Norman 1911; *karmensis* Sars 1911; *bulligera* Farran 1913; *tenera* Sars 1921; *dinocerata* and *rosei* Monard 1926; *sporadiensis* Brian 1928; *discophora* Willey 1929; *lunata* Willey 1931; *capillata*, *manifera* and *talipes* (⁹) Wilson 1932; *barbata*, *campbelliensis*, *gurneyi* and *tenuispina* Lang 1934; *bengalensis* Sewell 1934; *dominicalis*, *parvuloides* and *phycobates* Monard 1935; *octavia* Monard 1935a (⁹); *reticaudata* Willey 1935, *dieuzeidei* Monard 1936; *laurentica* sp.nov.

This rather large collection of species is divisible into a number of groups, which can be fairly well defined, partly by the number of setae on the fourth endopod.

(⁹) The inclusion of these species in this subgenus may be open to question. In *talipes* Wilson (1932, p. 261, pl. xiv) there appear to be 6 setae on the 2nd endopod and only 4 on the 3rd. It is assumed here that these legs have been transposed, as Lang (1936d, p. 449) has shown to have been the case for the first two legs of *Quintanus* Wilson (1932); if this is so than *talipes* fits naturally into the subgenus. Similarly it has been assumed that T. Scott (1894) has drawn the 3rd leg of *longipes*, though it is called the 4th; its seta formula agreeing exactly with that of the 3rd endopod in this subgenus. The same is presumed to have happened with *inornata* A. Scott (1902). Apart from these three cases there is only one other apparent case of 6 setae on the end segment of the endopod of any but the *third* leg; in his illustration of the 4th leg of *octavia* Monard (1935a, fig. 76) shows 6 setae, in the text, however (p. 63), it is stated that the 4th endopod has 4 setae. The figure is, therefore, presumed to represent the *third* leg.

1. The *cornuta* group. 1st antenna with segments short and compact mostly with spur on 2nd segment; 5th leg of *cornuta* type, somewhat modified in *dinocerata* and *sporadiensis*, and probably malformed in *laurentica* although very similar to *australasica* which probably comes into this group (see below). To this group belong: ***cornuta, dinocerata, dominicalis, laurentica, serrata*** and ***sporadiensis***.

2. The *typhlops* group. 1st antenna with segments long and slender, 2nd segment without spur; 5th leg of *typhlops* type. Here belong: ***barbata, bulbifera, bulligera, elongata, longiremis, rosei, thoracica*** and ***typhlops***.

3. The *brevirostris* group. 1st antenna with segments neither very compact nor very slender, but with a tendency to form a spur on the 2nd segment; this ranges from the condition in *octavia*, with no trace of a spur, through the bulge seen in *congenera* and *brevirostris* to the well developed recurved hook of *dieuzeidei*. Exopod of the 2nd antenna normal, 5th leg of female as in *brevirostris*, in the male the distal segment is small but distinct.

To this group belong: ***brevirostris, congenera, curticauda, dieuzeidei, gurneyi, hyperborea, karmensis, longicaudata, lunata, memerti, nana, nordgaardi, octavia*** (see footnote, p. 90), ***perplexa, tenera*** and ***tenuispina***.

4. The *stromi* group. 1st antenna as in preceding group, but no trace of a spur; exopod of 2nd antenna always reduced; 5th leg of female of *stromi* type, that is having a more or less distinct notch between the 1st and 2nd setae of the distal segment. This feature has already been stressed by Willey (1929, p. 531) and is most marked in *discophora* and least noticeable in *minuta*; 5th leg of male always reduced, the distal segment completely fused with the base.

The group contains: ***campbelliensis, discophora, manifera, minuta, phycobates*** and ***stromi***.

5. The *mohammed* group. These are fresh or brackish water forms. The group comprises ***mohammed, chathamensis*** and ***bengalensis***, which resemble one another in several respects. 1st antenna reduced (3rd and 4th segments fused) but the segments are not compact; exopod of 2nd antenna well developed; male 5th leg reduced (except in *mohammed*); 5th leg of female peculiar—might be derived from *cornuta* type. *L. mississipensis* Herrick 1887, was not mentioned by Monard (1935) and I have not seen the description. It is possible that it belongs to this group as a freshwater form.

6. There remains a number of species which do not fall into any of the above groups, but are intermediate between groups or are distinct. They are:

similis, with a moderately long 1st antenna with a trace of a spur on the 2nd segment, is intermediate between the *typhlops* and *brevirostris* groups, its 5th leg being clearly intermediate between these types;

capillata is intermediate between the *cornuta* and *stromi* groups; the 1st antenna is compact, the exopod of 2nd antenna and male 5th legs are reduced, the female 5th leg is like *dinocerata*;

talipes is intermediate between *brevirostris* and *stromi* groups; 1st antenna not compact, no spur, exopod of 2nd antenna somewhat reduced (2 setae), 5th legs with reduced setae, not unlike *stromi* in structure, male 5th leg with distinct distal segment (see footnote, p. 99);

parvula and ***parvuloides*** are intermediate between the *cornuta* and *brevirostris* groups, having the 1st antenna not very compact but with a spur, and 5th legs not unlike *dinocerata*. *L. inornata* is also in this intermediate group (see footnote, p. 99).

longipes probably belongs to the *brevirostris* group (see footnote, p. 99), while ***reticaudata*** is quite distinct from all others in the 1st antenna and 5th legs.

LAOPHONTE (LAOPHONTE) LAURENTICA sp. nov.

Females with the characters of the subgenus, the first exopod 3-segmented, and the first antenna 5-segmented. Males with the third endopod 2-segmented, with the end segment of normal shape bearing a spine on the outer margin. The fourth endopod is 2-segmented without inner setae, while the end segment of the fifth leg is fused with the basal segment.

Occurrence. Two specimens, one of each sex, were washed from *Fucus* growing on rocks in front of the Station at Trois Pistoles P.Q., Canada (Sample No. 11).

LAOPHONTE ARENICOLA sp. nov.

Males with the third endopod 3-segmented, basal segment without setae, second segment with a spine only, this extending beyond the end of the ramus. End segment of third endopod with three setae, two inner, one terminal. Second endopod with inner setae normal. Caudal rami twice as long as wide.

Occurrence. A single specimen, a male, was washed from coarse sand at a depth of 8 metres in the St. Lawrence (Sample No. 111).

Being known from the male only, this species cannot at present be assigned to a subgenus. It is described here for convenience, and should not be regarded as belonging to *L.* (*Laophonte*) sens. str.

This and the preceding species will be more fully described in "The Annals and Magazine of Natural History", London.

The sample numbers refer to those already published (Nicholls, 1939).

KEY TO FEMALES OF LAOPHONTE SENS. STR.

All the species in this subgenus have 3 inner setae on the 3rd endopod; since the 2nd and 4th legs are not known in many cases the key has, of necessity, been constructed on characters which are regarded as less reliable: segmentation of 1st antenna and 1st exopod.

1.	1st exopod 2-segmented	2.
	1st exopod 3-segmented	15.
2.	1st antenna 4-segmented	*cornuta* Philippi 1840.
	1st antenna 5-segmented	3.
	1st antenna 6-segmented	5.
	1st antenna 7-segmented	10.
3.	Caudal rami twice as long as anal segment; segments of 5th leg fused.	*bengalensis* Sewell 1934.
	Caudal rami no longer than anal segment; segments of 5th leg distinct	4.
4.	End segment of 5th leg not more than twice as long as wide, armed with 3 terminal setae.	*mohammed* Bl. and Rich. 1891.
	End segment of 5th leg 3 times as long as wide, with 1 terminal spine and 2 short lateral setae.	*chathamensis* Sars 1905a.
5.	Basal segment of 4th endopod with inner seta	*bulbifera* Norman 1911.
	Basal segment of 4th endopod without seta	6.
6.	4th endopod with 2 inner, 2 terminal and 1 outer setae	7.
	4th endopod with 1 inner, 1 terminal and 1 outer seta	8.
7.	2nd inner seta of 4th endopod with basal fringe of fine hairs	*rosei* Monard 1926.
	2nd inner seta of 4th endopod without fringe, but with sensory outgrowth.	*bulligera* Farran 1913.
8.	Both segments of 5th legs with only 3 setae	*talipes* Wilson 1932.
	Segments of 5th leg with 4 or 5 setae	9.
9.	End segment of 5th leg not extending beyond basal expansion; caudal rami no longer than anal segment	*nana* Sars 1908.
	End segment of 5th leg extending beyond basal expansion by half its length; caudal rami half as long again as anal segment	*similis* (Claus) 1866.
	End segment of 5th leg extending beyond basal expension by ¾ its length; caudal rami nearly 3 times anal segment	*elongata* Boeck 1872.
10.	Basal segment of 5th leg with 3 setae	*longipes* T. Scott 1894.
	Basal segment of 5th leg with 4 setae	11.
	Basal segment of 5th leg with 5 setae	*phycobates* Monard 1935.
11.	End segment of 5th leg with 4 setae	*karmensis* Sars 1911.
	End segment of 5th leg with 5 setae	12.
12.	Body with dorso-lateral backwardly projecting lobes	*lunata* Willey 1931.
	Body without such lobes	13.
13.	Caudal rami not more than twice as long as wide	14.
	Caudal rami 2½ times as long as wide	*hyperborea* Sars 1909a.
14.	End segment of 4th exopod with 1 inner seta	*tenera* Sars 1921.
	End segment of 4th exopod with 2 inner setae	*perplexa* T. Scott 1899.
15.	1st antenna 4-segmented	*australasica* G. M. Thomson 1883.
	1st antenna 5-segmented	*laurentica* sp. nov.
	1st antenna 6-segmented	16.
	1st antenna 7-segmented	23.
	1st antenna 8-segmented	*octavia* Monard 1935a.

16.	Each segment of 5th leg with 4 setae	*nordgaardi* Sars 1908.
	Basal segment with 4 setae, end segment with 5	17.
	Basal segment with 5 setae, end segment with 6	22.
17.	Caudal rami no more than twice as long as wide	18.
	Caudal rami more than twice as long as wide	20.
18.	1st antenna with recurved spur on 2nd segment	*dieuzeidei* Monard 1936.
	1st antenna with little or no projection on 2nd segment	19.
19.	4th endopod with 1 terminal seta; 1st endopod with finger-like process distally on basal segment	*capillata* Wilson 1932.
	4th endopod with 2 terminal setae; no process on basal segment of 1st endopod.	*brevirostris* (Claus) 1863.
20.	1st antenna with rounded protuberance on each side of basal segment; 2nd endopod with 1 inner seta	*reticaudata* Willey 1935.
	1st antenna without projections; 2nd endopod with 2 inner setae	21.
21.	End segments of 3rd and 4th exopods with 1 inner seta	*thoracica* Boeck 1864.
	End segments of 3rd and 4th exopods with 2 inner setae	*barbata* Lang 1934.
22.	1st antenna with spur on 2nd segment	*dominicalis* Monard 1935.
	1st antenna without spur	*manifera* Wilson 1932.
23.	Basal segment of 5th leg with 4 setae	24.
	Basal segment of 5th leg with 5 setae	27.
	Basal segment of 5th leg with 6 setae	*longiremis* T. Scott 1905.
24.	1st antenna with spur on 2nd segment	25.
	1st antenna without spur	26.
25.	End segment of 5th leg with 5 subterminal setae	*meinerti* Brady 1899.
	End segment of 5th leg with 2 inner and 4 subterminal setae	*gurneyi* Lang 1934.
26.	End segment of 4th exopod with 1.2.2. setae	*curticauda* Boeck 1864.
	End segment of 4th exopod with 2.2.3. setae	*congenera* Sars 1908.
27.	End segment of 5th leg with 4 setae	*sporadiensis* Brian 1928.
	End segment of 5th leg with 5 setae	28.
	End segment of 5th leg with 6 setae	31.
28.	2nd segment of 1st antenna with large triangular projection, bearing setae.	*dinocerata* Monard 1926.
	1st antenna with little or no spur	29.
29.	Basal segment of 4th endopod with inner seta	30.
	Basal segment of 4th endopod without seta	*inornata* A. Scott 1902.
30.	4th endopod with 2 terminal setae	*typhlops* Sars 1908.
	4th endopod with 1 terminal seta	*longicaudata* Boeck 1864.
31.	Exopod of 2nd antenna with only 2 setae	32.
	Exopod of 2nd antenna with 4 setae	33.
32.	Basal segment of 4th exopod swollen, middle segment short, end segment club-shaped.	*discophora* Willey 1929.
	Segments of 4th exopod of normal shape and proportions	*minuta* Boeck 1872.
33.	1st antenna with spur on 2nd segment	34.
	1st antenna without spur	36.
34.	End segment of 4th endopod with 1 outer seta	*serrata* (Claus) 1863.
	End segment of 4th endopod with no outer seta	35.
35.	End segment of 5th leg at least twice as long as wide	*parvula* Sars 1908.
	End segment of 5th leg about half as long again as wide	*parvuloides* Monard 1935.
36.	4th exopod without inner seta on end segment	*tenuispina* Lang 1934.
	4th exopod with 1 inner seta on end segment	*stromi* (Baird) 1850.
	4th exopod with 2 inner setae on end segment	*campbelliensis* Lang 1934.

LAOPHONTE (MESOLAOPHONTE) subgen. nov.

Laophonte species having two inner setae on the third endopod; the type species for this subgenus is *littoralis* T. and A. Scott (1893a), as described by Sars (1908, p. 255, pl. clxxv).

This subgenus can also be divided into groups, the members of which have much in common, based on the setation of the fourth endopod. The following species are included:

littoralis T. and A. Scott 1893a; *exigua* Sars 1905a; *proxima* Sars 1908; *applanata* Sars 1909a; *gracilipes* Brady 1910; *rottenburgi* T. Scott 1912; *quaterspinata* Brian 1917; *abbreviata* Sars 1921; *quinquespinosa* Sewell 1924; *taurina* Monard 1928; *sigmoides* Willey 1931; *lithophila* Monard 1934; *spelaea* Chappius 1938.

1. *spelaea* stands alone, having 5 setae on the end segment of the 4th endopod (2.2.1.).

2. The *exigua* group. With the exception of *taurina*, all have the 1st antenna without spur; the exopod of the 2nd antenna is well developed (except in *littoralis*); the 5th legs are more or less alike, except in *applanata* in which they are elongate; where the males are known all have their 5th legs with distinct distal segment (except *littoralis*).
The following species belong to this group: *abbreviata, applanata, exigua, gracilipes, littoralis, proxima* and *taurina*. These have 4 setae on the 4th endopod (1.2.1).

3. The *quinquespinosa* group. These are alike in having a reduced exopod on the 2nd antenna (only slightly reduced in *quaterspinata*); 5th legs of similar shape (again *quaterspinata* forms an exception); and no spur on 1st antenna. The 5th leg of the male has the distal segment fused with the base except in *quaterspinata*. The group consists of 4 species, perhaps a fifth: *lithophila, quaterspinata, quinquespinosa* and *sigmoides*. Of *rottenburgi*, which possibly belongs here, very little is known; the 1st antenna has a spur, 2nd antenna a reduced exopod, but 2nd and 4th legs are not known. These species have 3 setae on the 4th endopod (1.2.0).

KEY TO FEMALES OF LAOPHONTE (MESOLAOPHONTE).

All the species in this subgenus have 2 inner setae on the 3rd endopod.

1.	2nd and 4th endopods with 2 inner setae	*spelaea* Chappuis 1938.
	2nd and 4th endopods with 2 and 1 inner setae respectively	2.
	2nd and 4th endopods each with 1 inner seta	6.
2.	Basal segment of 5th leg with 2 setae	*quaterspinata* Brian 1917.
	Basal segment of 5th leg with 3 setae	*applanata* Sars 1909a.
	Basal segment of 5th leg with 4 setae	*gracilipes* Brady 1910.
	Basal segment of 5th leg with 5 setae	3.
3.	Exopod of 2nd antenna reduced, with 2 setae ..	*littoralis* T. and A. Scott 1893a.
	Exopod of 2nd antenna normal	4.
4.	1st antenna with pronounced recurved spur on 2nd segment ..	*taurina* Monard 1928.
	1st antenna without spur	5.
5.	Greatest width more than ⅓ of total length	*abbreviata* Sars 1921.
	Greatest width no more than ¼ of total length	*proxima* Sars 1908.
6.	4th endopod with 1 outer seta	*exigua* Sars 1905a.
	4th endopod with no outer seta	7.
7.	End segment of 5th leg with 5 setae	*lithophila* Monard 1934.
	End segment of 5th leg with 6 setae.	*quinquespinosa* Sewell 1924 and *sigmoides* Willey 1931 (10).

LAOPHONTE (METALAOPHONTE) subgen. nov.

Laophonte species having one inner seta on the end segment of the third endopod. The following species are included:

koreni Boeck 1872; *inopinata* T. Scott 1892; *denticornis* and *depressa* T. Scott 1894a; *subsalsa* Brady 1902; *brevifurca* Sars 1921; *baltica* Klie 1929; *klici* Monard 1935; *longistylata* Willey 1935; *pauciseta* Lang 1936e.

The species included here are alike in the general appearance of the first antenna, but *klici* has a prominence on the second segment which, in *denticornis* is developed into a large recurved hook; the exopod of the second antenna is normal throughout the group; and the fifth legs of the males, where known, have the distal

(10) These two species are separable only by comparison of the males, and then with difficulty. *L. rottenburgi* has not been included in the key since nothing is known of its 2nd and 4th legs.

segment distinct from the basal, except in *pauciseta*. To this group belong those species which have the endopods of the fourth legs reduced to 1-segment, namely: *inopinata* and *longistylata*, 1-segmented in both sexes, and *koreni*, 1-segmented in male only. In this feature the group leads on to the next subgenus containing those species in which the endopods are 1-segmented in legs 2, 3, and 4.

L. depressa T. Scott 1894a, as described by Sars (1908, p. 239, pl. clx), is selected as the type of the subgenus.

KEY TO THE FEMALES OF LAOPHONTE (METALAOPHONTE).

All the species in this subgenus have only 1 inner seta on the end segment of the 3rd endopod.

1.	4th endopod with 1 inner seta	2.
	4th endopod without inner seta	*longistylata* Willey 1935.
2.	3rd endopod with 2 terminal setae	3.
	3rd endopod with 1 terminal seta	9.
3.	3rd endopod with 1 outer seta	4.
	3rd endopod with no outer seta	8.
4.	4th endopod with 1 outer seta	5.
	4th endopod with no outer seta	*pauciseta* Lang 1936c.
5.	4th endopod with seta on basal segment	*koreni* Boeck 1872.
	4th endopod without seta on basal segment	6.
6.	3rd endopod with seta on basal segment	*depressa* T. Scott 1894a.
	3rd endopod without seta on basal segment	7.
7.	4th exopod with 5 appendages on end segment	*kliei* Monard 1935.
	4th exopod with 3 appendages on end segment	*subsalsa* Brady 1902.
8.	1st antenna with spur on 2nd segment	*denticornis* T. Scott 1894a.
	1st antenna without spur	*baltica* Klie 1929.
9.	2nd endopod with 2 terminal setae	*brevifurca* Sars 1921.
	2nd endopod with 1 terminal seta	*inopinata* T. Scott 1892.

LAOPHONTE (NEOLAOPHONTE) subgen. nov.

This subgenus contains two species referred to above, *trilobata* Willey (1929) and *corbula* Willey (1935). The endopods of legs 2–4 in these species are 1-segmented, and the setation of these endopods is reduced. *L.* (*N.*) *trilobata* Willey (1929, p. 531) is regarded as the type.

KEY TO THE FEMALES OF LAOPHONTE (NEOLAOPHONTE).

1.	2nd, 3rd and 4th endopods with 2 setae	*trilobata*.
2.	2nd and 3rd endopods with 3, 4th with 4 setae	*corbula*.

The male of *corbula* is unknown, but that of *trilobata* has 1-segmented endopods on legs 2–4, as in the female.

LAOPHONTE (MONOLAOPHONTE) subgen. nov.

Laophonte species without inner seta on end segment of third endopod.

This subgenus contains the single species *curvata* van Douwe (1929). The original description is not very fully illustrated, but further details are given by Monard (1937, p. 67, fig. 5). The exopod of the second antenna is very small, with three setae; endopods of legs 2–4 are 2-segmented with four, three and two setae respectively. The first endopod is unlike that of any other species in having the terminal claw pectinated. According to Monard (*loc. cit.*) the male has the fourth exopod only 2-segmented

SPECIES INQUAERENDAE.

The species included under this heading are those whose third endopods have not been described. They are:

australasica Thomson 1883; *pilosa* Car 1884; **brevicornis* and *pygmaea* T. Scott 1894; *gracilis* T. Scott 1903; *faroensis* T. Scott 1903a; **hirsuta* Thompson and Scott 1903; *macera* Sars 1908; **glacialis* and *varians* Brady 1910; **australis* and **wiltoni* T. Scott 1912; *insignis* T. Scott 1914; *huntsmani* Willey 1923; *oculata* and *sima* Gurney 1927b; *rhodiaca* Brian 1928; *zimmeri* Van Douwe 1929; **rogi* Jakubisiak 1932; *mendax* Klie 1939; **scotti* nom. nov. (*exigua* T. Scott).

The first of these, *australasica*, is almost certainly in the *cornuta* group, with its compact first antenna, well developed exopod of the second antenna, fourth endopod lacking only an outer seta (2,2,0.) and fifth legs like *laurentica*. This species has already been included in *Laophonte* sens. str. (p. 99).

L. faroensis is also probably in *Laophonte* sens. str., with its elongate first antenna, well developed exopod on the second antenna and rather long fifth legs.

L. gracilis with its compact first antenna and fifth legs of the *cornuta* type probably belongs to that group of *Laophonte* sens. str.

Of *huntsmani* Willey states that it is near to *nana* and *nordgaardi*, which would place it also in *Laophonte* sens. str.

L. insignis, with its first antenna neither elongate nor compact, second antenna with reduced exopod, fifth leg not unlike that of *stromi* in shape but lacking the distinctive notch, is probably like *talipes*, intermediate between *stromi* and *brevirostris*.

Of *macera* the swimming legs are stated by Sars to be of "normal structure"; it was placed by him between *perplexa* and *nordgaardi*, and probably belongs to *Laophonte* sens. str.

In the case of *oculata* unfortunately the seta formula given by Gurney (1927b) is incomplete, but the somewhat reduced exopod of the second antenna taken in conjunction with the appearance of the fifth legs suggests that it belongs in the *stromi* group of *Laophonte* sens. str.; Gurney suggests that it has affinities with *proxima*, which I have placed in the subgenus *Mesolaophonte*.

According to Monard (1928) *pilosa* Car (1884) has normal setation in its swimming legs; from the male third endopod it is probable that it belongs to *Laophonte* sens. str. (2,2,0. is the usual number of setae in the male when the female has 3,2,1.). The exopod of the second antenna is reduced, suggesting the *stromi* group, but Car's figure of the fifth leg does not enable any conclusion to be drawn.

In *pygmaea* the fifth leg is of the *stromi* type, the second antenna is stated to be like *brevicornis*, but is not described or figured for either.

Monard (1935a, p. 61) regards *sima* Gurney (1927b) as very close to *koreni* on the structure of the fifth leg. In my opinion it is much closer to *parvula* Sars, and both of these are very close to *inornata* A. Scott, in which case it also would belong to *Laophonte* sens. str.

The 1-segmented fourth endopod of *varians* suggests affinities with *L.* (*Metalaophonte*), but the description is too meagre for certain identification.

Van Douwe places his species *zimmeri* with *brevirostris*, *congenera* and *macera*, which would place it in *Laophonte* sens. str.

As stated above *rhodiaca* is known only from the male; while *mendax* cannot be placed until it has been more fully described.

The remaining species in the above list (marked with an (*)) are too indefinite for any conclusions to be drawn.

Of the species listed below I have not seen descriptions:

parvula (Claus) 1866; *uncinata* (Czerniavski) 1868; *nordlandica* Boeck 1872; *mississipensis* Herrick 1887; *bafanus* Labbé.

The name *parvula* was first used by Claus and the probability is that Sars' species of the same name will have to be renamed, but since I have not seen a description of Claus' species I have refrained from renaming Sars' species to avoid possible confusion.

As stated above I have been quite unable to trace Labbé's species *bafanus* quoted by Monard (1935, p. 66).

KEY TO LAOPHONTE MALES.

1.	3rd endopod 1-segmented	*trilobata* Willey 1929.
	3rd endopod 2-segmented	2.
	3rd endopod 3-segmented, 2nd segment without spine	*bengalensis* Sewell 1934.
	3rd endopod 3-segmented, 2nd segment with spine	16.
2.	End segment of 3rd endopod of normal shape, bearing setae only	3.
	End segment of 3rd endopod of normal shape, bearing spine on outer margin	6.
	End segment of 3rd endopod with outer distal corner produced into spine-like process	11.
3.	Basal segment of 3rd endopod without seta	4.
	Basal segment of 3rd endopod with inner seta	*varians* Brady 1910 (11).
4.	2nd endopod with 2 inner setae, one of them thickened basally	*perplexa* T. Scott 1899.
	2nd endopod with 1 unmodified inner seta	5.
5.	3rd and 4th endopods with 6 and 4 setae respectively	*capillata* Wilson 1932.
	3rd and 4th endopods each with 3 setae	*talipes* Wilson 1932.
6.	4th endopod 1-segmented	7.
	4th endopod 2-segmented	8.
7.	End segment of 5th leg well developed	*proxima* Sars 1908.
	End segment of 5th leg fused with basal	*curvata* Van Douwe 1929.
8.	Basal segment of 3rd endopod with inner seta	*subsalsa* Brady 1902.
	Basal segment of 3rd endopod without seta	9.
9.	End segment of 5th leg well developed	*typhlops* Sars 1908.
	End segment of 5th leg fused with basal	10.
10.	4th endopod with inner setae on 2nd and 3rd segments	*manifera* Wilson 1932.
	4th endopod without inner setae	*laurentica* sp. nov.
11.	End segment of 5th legs well developed, rectangular	*koreni* Boeck 1872.
	End segment of 5th legs fused with basal	12.
12.	2nd endopod with modified inner seta	13.
	2nd endopod with inner setae normal	14.
13.	1st inner seta of 2nd endopod swollen basally	*pilosa* Car 1884.
	1st inner seta of 2nd endopod a curved spine	*pauciseta* Lang 1936e.
	1st inner seta of 2nd endopod a curved spine, hooked distally	*stromi* (Baird) 1850.
14.	2nd endopod with 2 inner and 2 terminal setae	*minuta* Boeck 1872.
	2nd endopod with 1 inner and 2 terminal setae	15.
15.	2nd endopod no longer than 1st segment of exopod	*quinquespinosa* Sewell 1924.
	2nd endopod almost equal to 1st two segments of exopod	*sigmoides* Willey 1931.
16.	4th endopod 1-segmented	*littoralis* T. and A. Scott 1893a.
	4th endopod 2-segmented	17.
17.	Basal segment of 3rd endopod with seta	18.
	Basal segment of 3rd endopod without seta	22.
18.	2nd segment of 3rd endopod with seta as well as spine	19.
	2nd segment of 3rd endopod with spine only	*spelaea* Chappuis 1938.
19.	Basal segment of 4th endopod with inner seta	20.
	Basal segment of 4th endopod without seta	*longiseta* Nicholls 1941.

(11) Fig. 7 (p. 525) Brady 1910 is assumed to represent the 3rd endopod of *varians*, since it does not resemble the 2nd (fig. 6) of which it is stated to be the enlargement; the illustration of the endopod of the 3rd leg (fig. 10) is so small that an enlargement might be expected, and both the 3rd leg and fig. 7 show setae on the basal segment, not shown in the 2nd leg (fig. 6).

20. End segment of 2nd endopod with 2 inner, 2 terminal and 1 outer setae; spine on 3rd endopod not extending beyond end of ramus .. .. *rhodiaca* Brian 1928.
End segment of 2nd endopod with 2 inner and 2 terminal setae; spine on 3rd endopod extending beyond end of ramus .. .. 21.

21. Spine on 3rd endopod long and straight .. .. *cornuta* Philippi 1840.
Spine on 3rd endopod truncate, with serrated end .. *hirsuta* Thompson and Scott 1903.

22. Spine on 3rd endopod not extending beyond end of ramus .. .. .. 23.
Spine on 3rd endopod extending beyond end of ramus .. .. .. 26.

23. 1st exopod 2-segmented .. .. 24.
1st exopod 3-segmented .. .. 25.

24. Spine on 3rd endopod straight, reaching end of ramus .. *similis* (Claus) 1866.
Spine on 3rd endopod S-shaped, not reaching end of ramus .. *nana* Sars 1908.

25. Caudal rami nearly twice as long as wide, little longer than anal segment.
curticauda Boeck 1864.
Caudal rami nearly 3 times as long as wide, twice as long as anal segment.
huntsmani Willey 1923.
Caudal rami 4 times as long as wide, $2\frac{1}{2}$ times as long as anal segment *thoracica* Boeck 1864.
Caudal rami nearly 5 times as long as wide, $2\frac{1}{2}$ times as long as anal segment.
longicaudata Boeck 1864.

26. 2nd segment of 3rd endopod with seta as well as spine .. .. .. 27.
2nd segment of 3rd endopod with spine only .. .. 28.

27. End segment of 5th leg small, subcircular, with 2 setae; end segment of 3rd endopod with 4 setae .. .. *mohammed* Bl. and Rich. 1891.
End segment of 5th leg elongate, rectangular, with 4 setae and 1 spine; end segment of 3rd endopod with 3 setae .. .. *serrata* (Claus) 1863.

28. 2nd endopod with 1 of inner setae modified .. .. 29.
2nd endopod with inner setae normal .. .. 39.

29. 1st seta of 2nd endopod a curved spine .. .. 30.
2nd seta of 2nd endopod thickened basally .. .. 31.

30. Distal segment of 5th leg fused with basal .. .. *discophora* Willey 1929.
Segments of 5th leg distinct .. .. .. *tenuispina* Lang 1934.

31. 1st antenna with well developed spur on 2nd segment .. .. .. 32.
1st antenna with little or no projection from 2nd segment .. .. .. 33.

32. Spur on 1st antenna at right angles to segment .. .. *meinerti* Brady 1899.
Spur on 1st antenna recurved .. .. .. *laurina* Monard 1928.

33. End segment of 3rd exopod with 5 appendages .. .. 34.
End segment of 3rd exopod with 6 appendages .. .. *tenera* Sars 1921.
End segment of 3rd exopod with 7 appendages .. .. 35.

34. 1st exopod 2-segmented .. .. *lunata* Willey 1931.
1st exopod 3-segmented .. .. *zimmeri* van Douwe 1929.

35. 1st exopod 2-segmented .. .. 36.
1st exopod 3-segmented .. .. 38.

36. End segment of 3rd endopod with 1 inner and 2 terminal setae .. *macera* Sars 1908.
End segment of 3rd endopod with 2 inner and 2 terminal setae .. .. .. 37.

37. End segment of 4th exopod with 1 inner seta; 1st exopod $\frac{1}{3}$ of basal endopod.
karmensis Sars 1911.
End segment of 4th exopod with 3 inner setae; 1st exopod nearly $\frac{1}{2}$ of basal endopod.
hyperborea Sars 1909a.

38. 2nd endopod with modified seta inserted near middle of segment *brevirostris* (Claus) 1863.
2nd endopod with modified seta inserted in proximal third of segment *congenera* Sars 1908.

39. End segment of 3rd endopod with 2 setae (1 inner, 1 terminal) .. *baltica* Klie 1929.
End segment of 3rd endopod with 3 setae (2 inner, 1 terminal) .. .. .. 40.
End segment of 3rd endopod with 4 setae (2 inner, 2 terminal) .. .. .. 41.

40. Caudal rami not more than half as long again as wide .. *nordgaardi* Sars 1908.
Caudal rami twice as long as wide .. .. .. *arenicola* sp. nov.

41. Body flattened dorso-ventrally .. .. .. *applanata* Sars 1909a.
Body cylindrical .. .. 42.

42. 1st antenna 6-segmented .. .. *depressa* T. Scott 1894a.
1st antenna 7-segmented .. .. 43.

43. End segment of 3rd exopod with 5 appendages; end segment of 5th leg fused with basal. *campbelliensis* Lang 1934.
End segment of 3rd exopod with 6 appendages; segments of 5th leg distinct. *exigua* Sars 1905a.
End segment of 3rd exopod with 7 appendages .. .. 44.

44. Spine on 3rd endopod quite straight .. .. *gracilipes* Brady 1910 (12).
Spine on 3rd endopod slightly curved, serrate .. .. *sporadiensis* Brian 1928.
Spine on 3rd endopod sharply curved .. .. *faroensis* T. Scott 1903a.

With the following exceptions the descriptions of the males were obtained either from the original description or from Sars 1911:

pilosa Car 1884 (Monard 1928); *mohammed* Blanch. and Rich. 1891 (Gurney 1932, Wilson 1932); *hirsuta* Th. and Sc. 1903 (Gurney 1927b); *proxima* Sars 1908 (Klie 1929); *curvata* van Douwe 1929 (Monard 1937).

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(12) For the purposes of this key the male of *gracilipes* Brady (1910) is assumed to have a 7-segmented 1st antenna like the female; Brady makes no statement on the subject.

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INDEX TO GENERA.

(Descriptions, Tables, Keys, and Synonomy only.)

FURTHER RECORDS OF LIZARDS AND FROGS FROM KANGAROO ISLAND

BY H. T. CONDON, SOUTH AUSTRALIAN MUSEUM

Summary

Some reptiles and amphibians were collected by the members of the Tate Society, University of Adelaide, during an expedition to Flinders Chase, Kangaroo Island, in January, 1940, under the leadership of Dr. C. T. Madigan. In addition to some species previously recorded from this region by Waite (1927), five forms new to the locality, including two further geographical races, were collected. The parasitology of these specimens is being dealt with by Prof. T. Harvey Johnston and Miss P. Mawson.

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Some reptiles and amphibians were collected by the members of the Tate Society, University of Adelaide, during an expedition to Flinders Chase, Kangaroo Island, in January, 1940, under the leadership of Dr. C. T. Madigan. In addition to some species previously recorded from this region by Waite (1927), five forms new to the locality, including two further geographical races, were collected. The parasitology of these specimens is being dealt with by Prof. T. Harvey Johnston and Miss P. Mawson.

LACERTILIA.

Family GEKKONIDAE.

Gymnodactylus milii (Bory 1825).

Phyllurus milii Bory de St. Vincent, 1825, vii, p. 183, fig. 1.

Two specimens collected under rocks along Stunsail Boom River; the larger has the tail regenerating and measures 98 (81 + 17) mm. The smaller measures 103 (66 + 37) mm. Previously recorded by Waite.

Family SCINCIDAE.

Egernia whitei (Lacepede 1804).

Scincus whitii Lacepede 1804, iv, p. 192: Australia.
Lygosoma moniligera Dumeril and Bibron, 1839, v, p. 736: Australia.

In all six examples of this species were collected by the Tate Society. All are uniformly much darker below than the typical mainland forms. Two lack completely the characteristic dorsal black lines with pale brown spots, and present a dull brown appearance (No. R2160). They also differ from mainland individuals examined in that the parietals are completely separated by the interparietal, and there are no nuchal shields.

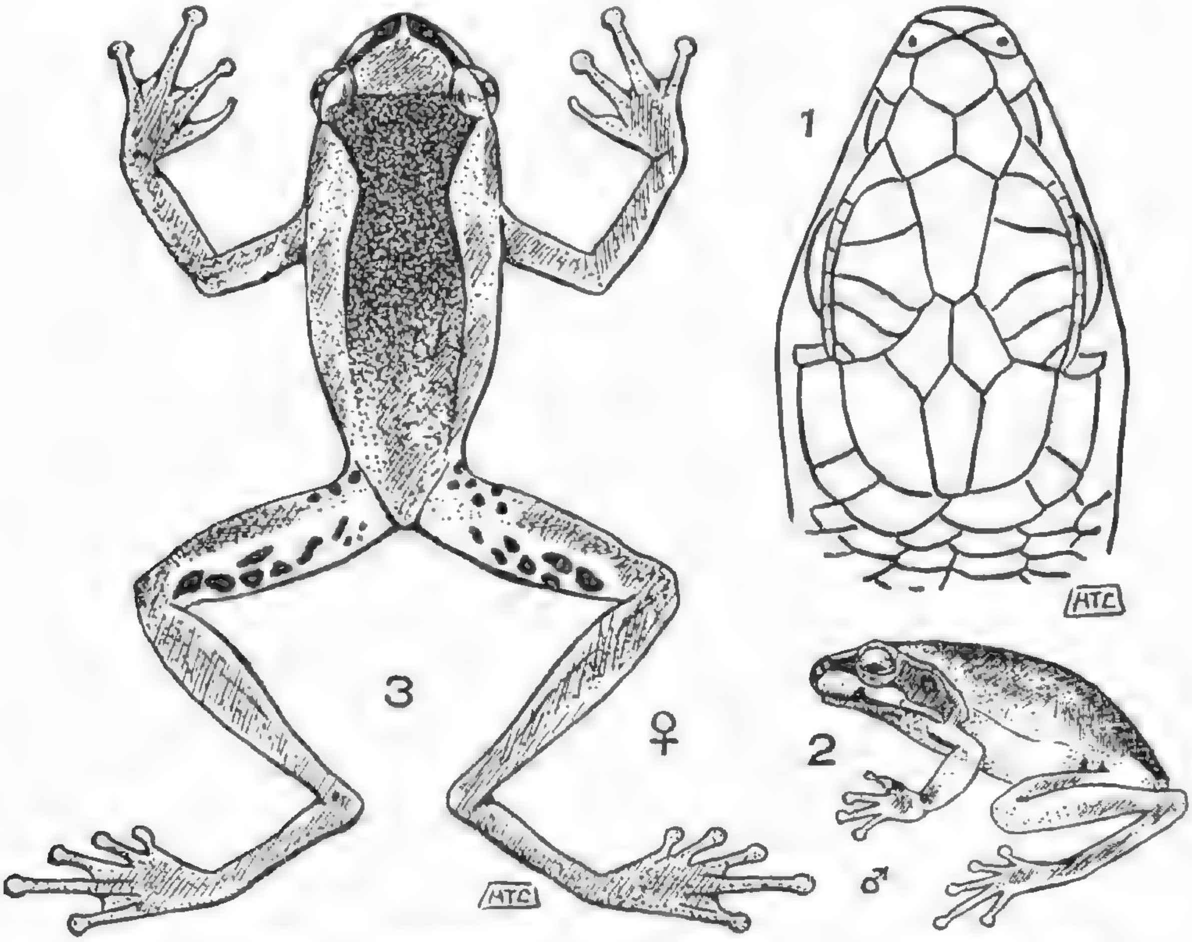
Tubb (1937) has recorded some colour variations of this skink on Lady Julia Percy Island, Victoria, and *whitei* is undoubtedly a very variable species. The Kangaroo Island specimens, however, both from the uniformly dark undersurface and other features, appear to constitute a distinct insular race, and it is proposed to separate them as follows:

Egernia whitei tenebrosa subsp. nov.

Description: Supranasals absent; eyelids well-developed; the lower eyelid scaly; prefrontals, frontoparietals and interparietal distinct; frontonasal widely separated from the frontal by the prefrontals which form a median suture; parietals completely separated by the interparietal which is nearly as large as the frontal; five supraoculars, the second the largest; 7–8 supraciliaries, the first greatly enlarged; three large temporals; no nuchals; 3–4 anterior lobules in the ear-opening; 34–38 smooth mid-body scales; 22–28 lamellae beneath the fourth toe; the adpressed limbs overlap; undersurfaces dark slaty grey.

Type: S.A. Museum Collection no. R2161, a subadult from Flinders Chase, Kangaroo Island, South Australia, collected by members of the Tate Society, January, 1940.

Measurements of type: Total length 210 mm.; tail 125; snout to anus, 85; forelimb 24; hindlimb 29.



Figs. 1–3. 1. Head of *Egernia whitei tenebrosa*, subsp. nov., S.A. Museum Collection No. R 2161, locality Kangaroo Island. 2. *Hyla jervisiensis*, Dumeril and Bibron, male, R 2071, locality Woodside, South Australia. 3. *Ditto*, female, R 2166, locality Rocky River, Kangaroo Island.

Remarks: This insular race is at once distinguished by being generally darker above and below, the characteristic dorsal markings being obscured or even absent, while the scalation also differs. Although this skink may grow to a length of 350 mm. (12 inches) or more, it is better known as a much smaller reptile, when in a general way it resembles members of the *Sphenomorphus* Section of *Lygosoma*; it may be recognized at once, however, by the characters of the head shields.

LYGOSOMA Hardw. and Gray.

SECTION LEIOLOPISMA Dumeril and Bibron.

Tridactylus (not of Latreille 1802) Cuvier, 1829, p. 64 (type *decresiensis*).
Tetradactylus (not of Merrem 1820) Cuvier, *supra cit.*, p. 64 (type *decresiensis*).
Peromelis Wagler, 1830, p. 160 (substitute name for *Tetradactylus* Cuvier).

Hemiergis Wagler, *supra cit.*, p. 160 (substitute name for *Tridactylus* Cuvier).
Leiolopisma Dumeril and Bibron, 1839, v, p. 742.
Chelomeles Dumeril and Bibron, *supra cit.*, p. 774 (type *quadrilineatus*).
Lampropholis Fitzinger, 1843, p. 22 (type *L. guichenoti*).
Eulepis Fitzinger, *supra cit.*, p. 22 (type *L. duperreyi = trilineatum*).
Mocoa Gray, 1845, p. 80 (type *guichenoti*).
Lygisaurus deVis, 1884, p. 77 (type *foliorum = mundus*).
Myophila deVis, *supra cit.*, p. 77 (type *vivax = blackmanni*).

LEIOLOPISMA ENTRECASTEAUXI (Dumeril and Bibron 1839).

Lygosoma entrecasteauxii Dumeril and Bibron, 1839, v, p. 717: Australia.

A single specimen collected on Flinders Chase (R2164); tail regenerating mid-body scale rows 28; ear-opening roundish and smaller than the palpebral disk; nostril pierced in nasal; no supranasal; frontonasal broader than long, forming narrow sutures with the rostral and the frontal; four supraoculars, the second the largest; six supraciliaries; frontal in contact with the first and second supraoculars; two frontoparietals; interparietal small, parietals forming a suture behind it; dorsal scales with distinct striations; subdigital lamellae 19; adpressed limbs just meet, pentadactyle. Colour: slate grey below, very dark olive-brown above without longitudinal black bands. This is a new record for Kangaroo Island.

LEIOLOPISMA PERONI (Fitzinger 1826).

Seps peronii Fitzinger, 1826, p. 53; Kangaroo Island.
Lygosoma (*Hemiergis*) *quadridigitatum* Werner, 1910, ii, p. 480.

Eight individuals were collected:

	Total length.
R 2162 (melanic)—very dark above and below	174 (75 + 99) mm.
R 2163	
A normally coloured	129 (55 + 74)
*B ,, ,,	65 + 0
*C very dark above, except tail, yellowish-white below	60 + ?
*D normally coloured	138 (61 + 77 ?)
E ,, ,,	131 (55 + 76)
F ,, ,,	114 (51 + 63)
*G ,, ,,	55 + 0

* Tail regenerating. Locality: along Stunsail Boom River, under rocks.

An undivided transparent disk in the lower eyelid, frontoparietals paired, interparietal large, subdigital lamellae not enlarged transversely, limbs tetradactyle, ear covered with scales, 18–21 mid-body scale-rows.

Formerly placed under *Hemiergis*, this species according to Dr. M. A. Smith (1937) should be included under *Leiolopisma*, as *Hemiergis* does not warrant recognition as a separate section in *Lygosoma*.

LEIOLOPISMA GUICHENOTI (Dumeril and Bibron 1839).

Lygosoma guichenoti Dumeril and Bibron, 1839, v, p. 713; Australia.

A single damaged example was taken (R2167). The suture between the rostral and frontonasal is almost as broad as the frontal, the interparietal is very small, mid-body scale-rows about 30; frontoparietal single; limbs pentadactyle, just meeting when adpressed; lamellae beneath fourth toe 26; preanals moderately enlarged.

Total length 102 (38 + 64) mm.

Locality: Near Stunsail Boom River.

This species has not previously been recorded from Kangaroo Island.

AMPHIBIA.

FAMILY LEPTODACTYLIDAE.

LYMNODYNASTES PLATYCEPHALUS Gunther 1867.

This species was not listed by Waite (1927), but has since been recorded from the Island by Loveridge (1935).

CRINIA Tschudi.

Crinia, Tschudi, 1838, Batr., p. 78.

As shown by Boulenger (1882) the members of this genus can readily be divided into two groups, namely those in which the under surfaces are granulate and those in which under surfaces are smooth. Species of the latter section include *tasmaniensis* (Gunther) 1864, *laevis* (Gunther) 1864, *l. froggatti* Fletcher 1891, *darlingtoni* Loveridge 1933, *rosea* Harrison 1928, *leai* Fletcher 1897, and *acutirostris* Andersson 1916.

The following is a key to members of the first-named group in which the lower surfaces are granular or areolate.

Lower surfaces granular, two metatarsal tubercles normally present.

I. Back with two prominent lyre-shaped dorsal plicae and small warts.
georgiana Tschudi 1838, *glauerti* Loveridge 1933, *signifera* (Girard) 1853.

II. Back smooth without dorsal lyre-shaped plicae .. .. *affinis* (Gunther) 1864.

The only species of *Crinia* previously recorded from Kangaroo Island is *signifera* (Waite, 1927), which is apparently of the typical race. The two known forms of *Crinia signifera* can be distinguished as follows:

a Lower surfaces white, very heavily covered with dark (brown or black) mottlings or spots.
signifera (Girard) 1853 (N.S.W., Vic., Tas., S.A.).

aa Lower surfaces lightly flecked with dark (brownish) markings or immaculate.
ignita Cope 1866 (W.A.).

No examples of *Crinia signifera signifera* were collected by the Tate Society Expedition, although a further race of *affinis* was taken and is described below.

The races of *Crinia affinis* can be separated as follows:

a Back uniformly grey or pale brown, with a black or brown lateral line (which may be interrupted above the arm).

b Throat and belly white or lightly flecked with brown .. *affinis* (Gunther) 1864, W.A.

bb Under surfaces heavily overlaid with brown or black markings
haswelli Fletcher 1894 (N.S.W., Vic., S.A.).

aa Back uniformly very dark brown or black, no dark lateral line, under surfaces lightly marbled with brown .. .. *halmaturina* subsp. nov. Kangaroo Island.

CRINIA AFFINIS HALMATURINA subsp. nov.

Description: Habit not as stout as *georgiana*, but more so than in *signifera*. Head about as broad as long; snout rather pointed; nostril slightly nearer tip of snout than anterior border of eye; canthus rostralis feebly marked; interorbital region slightly broader than upper eyelid; pupil horizontal; tympanum hidden; tongue oblong, slightly nicked and free behind; vomerine teeth absent. Fingers slender, first and last shortest, third longest; two metatarsal tubercles; a distinct metatarsal fold; subarticular tubercles present; toes slender, slightly fringed; the tibiotarsal articulation of the adpressed hind limb reaches to the temple; skin smooth above with a few small warts; below strongly granular. Colour, very dark olive-brown above, including the limbs; a whitish line from the eye to the elbow; no lateral black line; below, white and with sparse mottlings of dark brown; thighs (?) pale yellow, with brown mottlings. Total length 20·5 mm. Subadult. Sex: (?) male. Type in South Australian Museum Collection (R2165).

Locality: Flinders Chase, Kangaroo Island, South Australia. Two examples were collected by the Tate Society in January, 1940.

HYLA JERVISIENSIS Dumeril and Bibron 1841.

Hyla jervisiensis Dumeril and Bibron, 1841, viii, p. 580: Jervis Bay, N.S.W.
Hyla krefftii Gunther, 1863 (3), xi, p. 28, pl. iv, fig. C: Sydney, N.S.W.
Hyla calliscelis Peters, 1874, p. 620: Adelaide, South Australia.
Hyla unguinalis Ahl, 1935, cix, pp. 252–3; Adelaide, South Australia.

A single adult female apparently referable to this species was collected at Rocky River in January, 1940. (S.A.M. R2166.)

It is doubtful if all the frogs taken in South Australia in the past and identified by Waite and others as *Hyla ewingi* are of that species.

For many years *jervisiensis* has been known only from the type, taken at Jervis Bay, New South Wales, and we are indebted to Loveridge (1935) for suggesting that the later described *krefftii* is merely a synonym of it, as well as for clarifying the position of *ewingi*, of which for a number of years *kreffti* was regarded as a *synonym*.

Loveridge also records a South Australian specimen of *jervisiensis*, but Waite (1929) did not list the species for South Australia.

Comparisons of South Australian mainland material with specimens of *Hyla jervisiensis* from Tasmania, and with examples of *H. ewingi verreauxi* and *H.e. alpina* indicate that these frogs are not *ewingi*.

The main distinguishing feature of *jervisiensis* is the glandular fold at the corner of the mouth, and this is very distinct in one fully adult breeding male taken at Woodside, South Australia. In females which the writer has examined the glandular fold is slightly indicated. The colour markings and digital webbing, however, in all agree with that of *jervisiensis*.

Ahl (1935) described a new species of *Hyla* received from Zietz of Adelaide as *Hyla unguinalis*, and his description, based on six individuals, agrees well with the material now examined. In his description he does not include a glandular fold at the corner of the mouth, while the bright yellow thighs are not mentioned, although the other colours are those of *jervisiensis*. If the frogs under discussion can be regarded as true *jervisiensis*, then additional characters for the species might be the relatively more slender habit, as compared with *ewingi*, and also perhaps, the relatively greater length of the limbs in *jervisiensis*.

It is suggested, however, that *unguinalis* might eventually be proved to be a separate species, although the description given recalls that of *calliscelis* by Peters (1874), which was also described from Adelaide specimens, and thus this latter name would have to take precedence over Ahl's name.

There is some variation in the markings of the thighs in the specimens examined; the dark markings are either in the form of dark purplish streaks, blotches or small spots and fleckings, and there are similar small blotches on the groin, while in two specimens, females, there are also a few dark spots on the hinder parts of the flanks. There is no sign of yellow on the thighs. The vomerine teeth are situated between or slightly forward of the choanae.

Measurements:

No. R 2166	female, Rocky River, Kangaroo Island	38 mm.
No. R 1882	female, National Park, Belair, South Australia	35 mm.
	female, National Park, Belair, South Australia	34 mm.
No. R 2071	male, Woodside, South Australia	28 mm.
No. R 2079	immature, Launceston, Tasmania	24 mm.
	immature, Launceston, Tasmania	17 mm.

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THE AUSTRALIAN BROADTAILED PARROTS
(SUBFAMILY PLATYCERCINAE)

BY H. T. CONDON, SOUTH AUSTRALIAN MUSEUM

Summary

The birds forming the subject of this account comprise a mixed assemblage of medium-sized, long-tailed Parrots, and include such well-known forms as the Rosellas (Platycercus), the Ringneeks or Yellow-collared Parrots (Barnardius), and the various "Grass Parrots" (Psephotus).

In these birds the tail is longer than the wing, and has the central feathers more elongate than the outer rectrices. The principal other external features apart from plumage colour, by which they may be readily distinguished, are the horn-coloured bill and the peculiarly scalloped primaries.

The AUSTRALIAN BROADTAILED PARROTS

(Subfamily PLATYCERCINAE)

By H. T. CONDON, South Australian Museum.

Plate viii, and Text-fig. 1–3.

Introduction.

The birds forming the subject of this account comprise a mixed assemblage of medium-sized, long-tailed Parrots, and include such well-known forms as the Rosellas (*Platycercus*), the Ringnecks or Yellow-collared Parrots (*Barnardius*), and the various "Grass Parrots" (*Psephotus*).

In these birds the tail is longer than the wing, and has the central feathers more elongate than the outer rectrices. The principal other external features apart from plumage colour, by which they may be readily distinguished, are the horn-coloured bill and the peculiarly scalloped primaries. The structure of the wing feathers appears to be one of the most conservative features of the group, for it occurs in all the Australian forms as well as in related exotic genera such as the Pacific Parrots (*Cyanorhamphus*) of New Zealand and adjacent regions. In all, the second, third, fourth, and fifth primaries are markedly scalloped on their outer edges, exactly as occurs in the Cockatoos (Kakatoeinae). As noted by Thompson (1899), the affinities between the Platycercinae and Kakatoeinae may be closer than is usually recognized. Not only are there some similarities between the cranial osteology of certain forms, but both groups are characterized by the absence of an ambiens leg muscle and the presence of an oil gland, although this latter feature may not be important taxonomically. In the Cockatoos the orbital ring is complete in the adult, but as in the Subfamily Pezoporinae, in which a similar arrangement occurs, the completion of the orbital ring can only be regarded as a secondary development.

In the Platycercinae the orbital ring is incomplete, and while we can trace other structures in the cranium of this group which are homologous with those found in the Kakatoeinae, it is apparent that the development of the architecture of the skull of the former has not proceeded as far as in the last-named.

Another feature generally quoted as characteristic of the Broad-tails is the absence of a furculum, but this structure has also been lost in the Pezoporinae, and its presence or absence is probably not of great taxonomic importance. The primaries of the Pezoporidae, which include such genera as the New Zealand Kakapo (*Strigops*), the Night Parrot (*Geopsittacus*), Budgerigar (*Melopsittacus*) and Ground Parrot (*Pezoporus*), are unscalloped, and it may be that these forms are only remotely connected with the Platycercinae.

The small parrots of the genus *Neophema*, which are usually associated with the Platycercinae, have no furculum and ambiens, and the primaries are only slightly scalloped.

Peters (1937) has provided the most recent taxonomic arrangement of the group, and the present paper is a review of the distribution and status of all the known genera, species, and subspecies.

CLIMATE AND GEOGRAPHICAL DISTRIBUTION.

The larger Australian Broadtails are non-migratory, and the various species appear to be confined to distinct climatic zones.

Their evolution and distribution is intimately connected with the past history of the Australian continent. The serious deterioration of the climate in late Pleistocene times probably exterminated species of which now there is no trace, whilst those which were able moved before the encroaching eremeae, and at present inhabit the wetter peripheral districts.

With the more accurate discrimination of many of the subspecies of Broadtails, the nature of the regions in which they occur may be examined to discover, if possible, the factors responsible for their development and distribution apart from food and competition. It seems apparent that the breeding cycles of many are dominated by the incidence of seasonal rains, but less obvious is the question of changes of climate and geography in Australia since the last geological period. Many of the avian forms now living in the wetter peripheral districts of the Continent are probably remnants of races which once extended much further inland, and it is often difficult to decide whether those subspecies now confined to the various concentric climatic zones have originated in those areas or whether they, too, have moved outwards towards the sea from the interior before the spread of the successive eremeae, which have been considered to be the recurring characteristic of world climatic history since the end of the Pleistocene.

Most parrots are good indicators of present climatic conditions, and if we can assume that present-day forms evolved in Pleistocene times, it may be possible to trace their former distribution with reference to the climatic zones of that time. In this connection it would appear that those forms now living in regions in the north of Australia have not moved far from the areas they originally occupied, as here the districts which have experienced climatic changes are much less extensive than those in the south.

In recent years several generalized climatological maps have been published, and the zones indicated approximate closely to the accepted areas of subspeciation at present recognized in Australian ornithology. This observation is supported by reference to many groups of birds.

Prescott (1931) published a vegetation map of Australia, and there is a close correlation between vegetation types and the avifauna. It is probable, however, that the occurrence of many species is dependent not only on the physical environment, but is intimately connected with temperature, rainfall, and also, perhaps, the duration of the arid period, which is a feature of the climate of many parts of Australia at the present time. Davidson (1936) discusses the climate in relation to insect ecology, and considers that owing to the mild climate and markedly seasonal rainfall, moisture is the main influence affecting the distribution of these creatures. This idea could probably be extended to many other groups of animals, and is well illustrated in the Broadtailed Parrots.

The areas occupied by the many geographical races correspond closely with the zones indicated in maps showing the mean duration in months of the arid period (Andrews and Maze, 1933), and the mean annual values of the Meyer Ratio (Prescott, 1934).

Davidson (1936) constructed a map of bioclimatic zones based on a critical ratio of rainfall to evaporation of 0·5 for each month. From published data and further information it has been possible to prepare a revised map of the moisture zones based on influential rainfall and available moisture (fig. 1).

The margins of the majority of the zones indicated are the same as those of Davidson, but the southern boundaries of the "desert" areas have been modified and additional "humid" areas have been included based on the known occurrence of large rain jungles in the Coen district of North Queensland, and smaller areas on Groote Eylandt and elsewhere in Northern Australia.

The nomenclature used is that of Davidson, being based on the number of consecutive months during the year the value of the Precipitation/Evaporation ratio is greater than 0·5, as follows: Desert zone (0 months); Arid zone (1–3 months); Semi-arid zone (4–6 months); Semi-humid zone (7–9 months); and Humid zone (10–12 months).

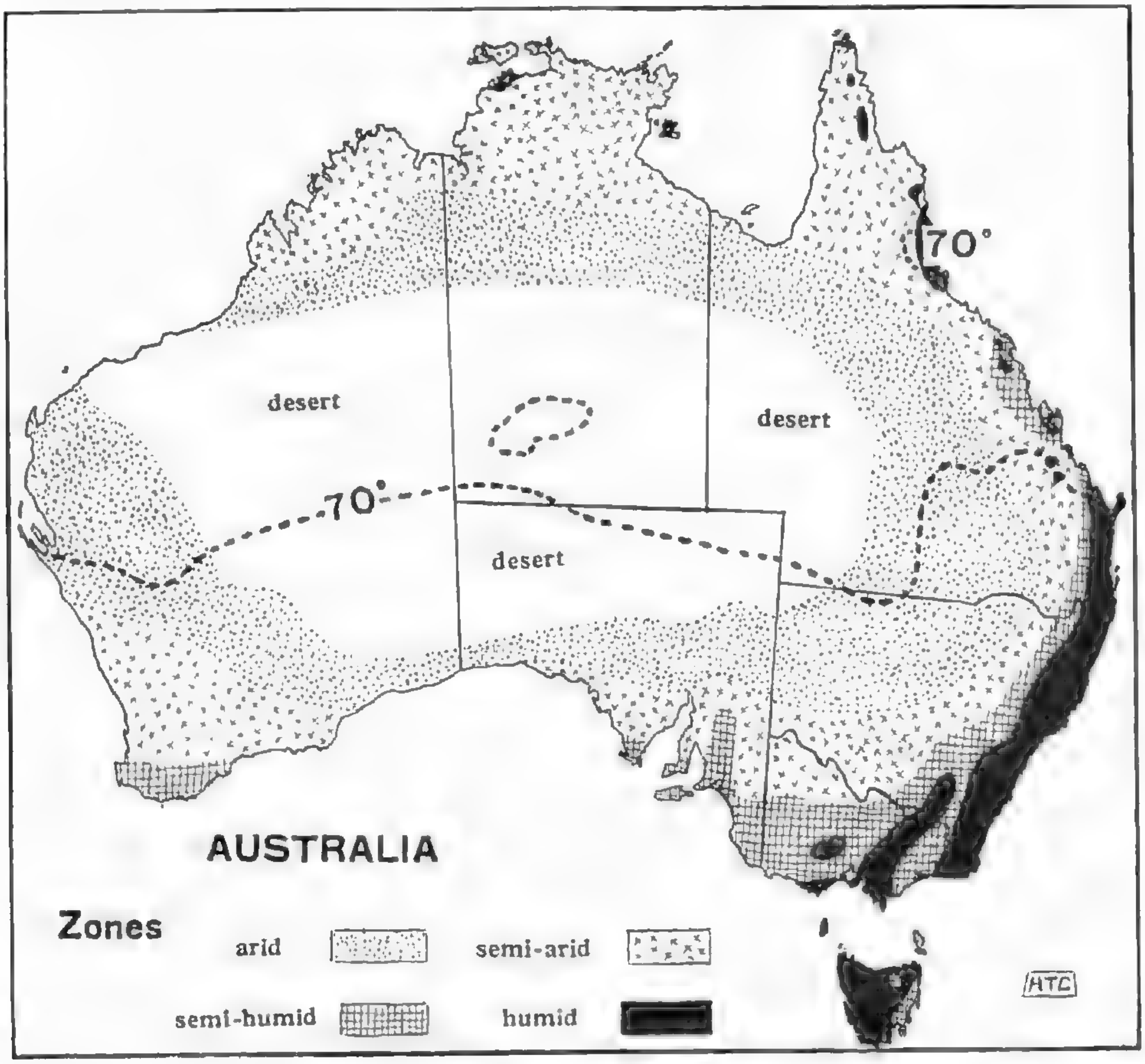

Fig. 1. Moisture Zones of Australia, based on number of consecutive months P/E is greater than 0·5.

In the north the approximate margins of the desert areas shown in fig. 1 correspond closely with a value of 10 for de Martonne's Index of Aridity for mean annual conditions (Andrews and Maze, 1933), but in the south this index figure marks the limits of the arid region. Similarly a value of 20 marks the approximate limits of the semi-arid belt in the north and south. A table has been prepared of the ranges of the various subspecies of Platycercines with reference to the moisture zones (fig. 2), and the various niches they occupy are indicated.

From this table it will be seen that the races of *Barnardius*, *Northiella*, and *Psephotus* predominate in the more arid or even desert zones, while the Rosellas

(*Platycercus*) and *Purpureicephalus* are confined to humid, semi-humid, or more rarely semi-arid areas which are subject to some influential summer as well as winter rains.

It is suggested that those forms which are shown in the diagram to occur in more than one zone may be further divided subspecifically, or alternatively that they are relatively more recent arrivals from other areas.

The above intimate relationship between race and moisture does not seem to hold for all Australian birds, however, as in some Passeriformes local fluctuations in their occurrence is largely determined by seasonal weather changes in which temperature is an additional dominant factor.

PHYLOGENY AND CLASSIFICATION.

The Psittaciformes are an extremely ancient group, and in the present state of our knowledge it is difficult to trace the phylogeny of the entire order. The divisions proposed by many modern workers may not be based on sound anatomical features, for the true value of many quoted characters has never been properly decided.

The features on which genera are separated appear to be contradictory, and it is felt that undue importance has been placed on certain osteological characters and other internal features which occur in widely differing groups and may have evolved independently. Several distinct lines of evolution are recognizable, and the highest forms superficially have come to resemble one another. Such characters as the loss of the furculum, the completion of the orbital ring and the appearance of other cranial ossifications, as well as the loss of the ambiens leg muscle, while valuable in demonstrating minor relationships, are only secondary developments in the various subfamilies. Even the aborted condition of the sternal keel in *Strigops* may not in itself be of more than generic importance.

The Platycercinae belong to a section of the Parrot tribe in which the second to fifth primaries are markedly scalloped, and are apparently allied to the Kakatoeinae (Cockatoos), Pioninae (Amazons and others) in which there is a similar condition. It is conceivable that the loss of certain skeletal structures in response to changes in habits has occurred independently in many genera, and is further evidence supporting the antiquity of the group. The number of species and genera in former times must have been much greater than it is to-day. Owing to the disappearance of many related forms, present-day species which are only remotely connected have often been associated in the various families and subfamilies.

Forbes (1879) made much of the similarities between the pterylosis, osteology and other anatomical features of *Lathamus* and *Platycercus*, but examination of further material seems to indicate that the affinities of the former are with those parrots in which the primaries are unscalloped, such as the Loriinae (Lories), and we may dismiss the genus from further discussion in this paper.

Salvadori (1891) proposed separating the Australian Broadtails as a distinct subfamily, Platycercinae, of the Psittacidae, one of the six major families of Parrots recognized by him.

Mathews (1931) regarded them as a distinct family Platycercidae. According to his arrangement the Pezoporine (Ground-Night Parrot) group should be regarded as a separate family, Pezoporidae, although Salvadori and other authors have included them with the Broadtails. It is here suggested that the first-named are closer to the Strigopinae, and with them may constitute a separate family.

The genera comprising the Platycercidae, according to Mathews are as follows: *Platycercus, Barnardius, Purpureicephalus, Psephotus, Northiella, Psephotellus, Neopsephotus, Neonanodes, Neophema, Cyanorhamphus, Bulleria*, and *Lathamus*.

Moisture Zones and Geographical Races

Genus	Subspecies	desert	arid	semi-arid	semi-humid	humid
Barnardius	semitorquatus				■	
	dundasi			■		
	zonarius		■			
		■		■		
	myrtae	■				
	occidentalis		■			
	connectens		■			
Barnardius	macgillivrayi		■			
	barnardi			■		
			■			
	augustus			■		
	whitei		■			
Purp.	spurius				■	
Northiella	pallescens	■				
	narethae		■			
	haematogaster		■			
				■		
	alter			■		
	haematorrhous			■		
Platycercus	venustus			■		
	adscitus			■		
	palliceps			■		
					■	
	xanthogenys			■		
	icterotis				■	

Genus	Subspecies	desert	arid	semi-arid	semi-humid	humid
Platycercus	caledonicus					■
	flaveolus			■		
	subadelaidae		■			
	adelaidae				■	
	fleurieuensis				■	
	melanoptera				■	
	victoriae				■	
	elegans				■	■
	nigrescens					■
Platycercus	cecilae				■	■
	eximuis				■	
	diemenensis					■
Psephotus	haematonotus				■	
				■		
			■			
	caeruleus	■				
	ethelae	■				
	exsul		■			
	varius		■			
				■		
Psephotus	orientalis			■		
	pulcherrimus				■	
	chrysopterygius			■		
	dissimilis			■		

Fig. 2. Table showing correlation between distribution of subspecies and moisture zones.

The last-named is best excluded from this list, while *Psephotellus, Neopsephotus* and *Neonanodes* do not seem worthy of generic rank. The remaining genera may then be regarded as a subfamily, Platycercinae, although *Neophema* is a doubtful inclusion.

Peters (1937) in revising the taxonomy of the Parrots of the world included the Broadtails in the subfamily Psittacinae, in which he includes also the Macaws and a host of other forms. This author's arrangement differs greatly from that of other workers in that he recognizes only one family, with six subfamilies, for the whole order Psittaciformes.

It is anticipated, however, that the Psittacinae of Peters later on will be further subdivided, when the Broadtails, probably together with other Australian and New Guinea forms not now associated with them, will be recognized as a distinct family group. The osteology and other anatomical details of many genera is still quite unknown, and it is difficult to assess the true value of many superficial features, such as differences in colour pattern. It is believed that these characters may later be proved to be good indices for the separation of the different groups and will be supported by more deep-seated structural characters, when further anatomical studies are undertaken.

It is reasonable to assume from the development of present-day forms that the generalized ancestral type was a plain green bird, which in turn may have previously passed through a blue stage, although this is scarcely more than conjecture. From these birds the various highly-coloured species of Broadtails we know to-day have evolved. In this connection it is significant that those forms of *Cyanorhamphus* which are found in the region of the south-western Pacific are reminiscent of the immature stages of many Australian species.

The following artificial key may indicate the affinities between the Australian genera:

I. Second to fifth primaries markedly scalloped on their outer edge.
- a. Bill with hook greatly lengthened .. .. *Purpureicephalus*
- aa. Bill short, hook not lengthened.
  - b. Well-defined cheek-patches.
    - c. Feathers of back uniform.
      - d. A yellow collar around the hindneck . .. .. *Barnardius*
      - dd. No yellow collar .. .. *Northiella*
    - cc. Feathers of back bicoloured .. .. *Platycercus*
  - bb. No well-defined cheek-patches .. .. *Psephotus*

II. Second to fifth primaries only slightly scalloped .. .. *Neophema* (not dealt with herein).

REVIEW OF SPECIES AND GEOGRAPHICAL RACES.

In the discussion which follows no complete references to the genera, species, and subspecies are given, and for the full quotation of the original place and date of publication of the various scientific names reference may be made to the R.A.O.U. Check-list (1926 edition), and Mathews' "A List of the Birds of Australasia", 1931, pp. 196–210. The first of the quoted vernacular names are those which were adopted by the R.A.O.U. Check-list Committee (1926), and they are followed by names used by Gould, North, Campbell, Hall, and others, including those applied to subspecies. The use of common names for subspecies is not advocated, however; many were originally used for forms which were then regarded as full species.

Genus PURPUREICEPHALUS Bonaparte 1854.

Diagnosis: Strongly characterized by the long projecting bill and distinctive coloration. The pre-orbital process is larger than in other genera and the post-frontal process is reduced, while the whole cranium is more slender than in allied forms. The orbital ring is incomplete as in other Platycercinae, and the articulation of the quadrate is unobscured. The form of the primaries is exactly as in related genera, the second to fifth feathers being markedly scalloped.

There are no well-marked cheek-patches as in *Barnardius*, *Northiella* and *Platycercus*, but the entire facial region, with the exception of the lores, is bright yellowish-green. Genotype: *Purpureicephalus spurius* (Kuhl, 1820).

Discussion: Confined, so far as is known, to the coastal areas of South-western Australia, where it is called the "King Parrot", this species is remarkable for the greatly elongated upper mandible.

No evidence is yet available as to the special uses of the beak, which is quite unlike that of any other Platycercine, but Serventy (1938) has suggested that it may be a case of over-specialization, comparable in some ways with the excessive development of the wide beak of the Tawny Frogmouth (*Podargus*). The over-development of the beak may have been partly responsible for the extinction of the genus in other parts of Australia, its possession proving a handicap in competition with other forms of a more generalized type.

We can be moderately certain that the species did not originate in South-western Australia, and it is the sole surviving member of an assemblage of parrot forms which became extinct probably in the Pleistocene, and may have been more widely spread than at present.

Although many authors have suggested that *Purpureicephalus* has affinities with *Barnardius*, it is more likely that it is an independent development from the ancient prototype of the larger Platycercines. Not only is the colour pattern unique, but the absence of blue cheek-patches at once marks it as distinct; as a matter of fact, it is unnecessary to go beyond the feature of the cranial structure to emphasize its isolated position in the Australian parrot fauna.

Differences between Juveniles and Adults: The immature plumage differs markedly from that of the adult. According to Tavistock (1929), the adult plumage is acquired with the first moult when the bird is little less than a year old. In young birds the red-cap is absent, being simply represented by a narrow red bar across the forehead, the under tail coverts are mainly yellow with red streaks instead of entirely red, and the upper breast is dull green with faint red transverse barrings, while the abdomen is pale mauve. The back and upper tail are yellowish-green, and the rump is yellow. As noted recently by Lendon (1940, p. 91) there is a well-marked white "wing stripe" in the young of both sexes.

Sexual Differences: The adult female is considerably duller than the male, and resembles the immature bird. There is no red cap, but a restricted frontal band of red and the mauve of the breast is much duller. As in most Platycercines, females are further distinguished by the presence of a "white wing stripe".

PURPUREICEPHALUS SPURIUS (Kuhl 1820).

Synonyms: *pileatus* (Vigors), *rufifrons* (Lesson), *purpureocephalus* (Quoy and Gaimard), *carteri* Mathews.

Names: Red-capped Parrot, King Parrot, and Pileated Parrakeet.

Range: South-west Australia.

Mathews (1931) proposed distinguishing two races, *spurius* and *carteri*. The typical form is stated to be confined to the coastal areas; *carteri* occurs further inland.

Mathews (1915, p. 128, and 1917, fig.) gives the following characters for *carteri*: "Differs from *P.s. spurius* in being darker above, the cheeks greener and the under-surface dark purple."

Examination of five specimens from representative localities has failed to lend support to this proposed subdivision.

Genus BARNARDIUS Bonaparte 1854.

Diagnosis: The Ringnecks (genus *Barnardius*) are a purely Australian group characterized by the presence of a "yellow collar" around the hindneck, reminiscent in some ways of the vivid pink neck-ring of some of the Asiatic Ring-necked Parrots (*Psittacula*). The cranial osteology of all species differs from that of *Platycercus*, especially in the auditory region. The condition to be noted is similar to that found in the genera *Northiella*, *Psephotus* and *Purpureicephalus*. In these last-named Platycercines the articulation of the quadrate with the cranium is clearly visible and similar to that found in the Polytelitine parrots (*Aprosmictus* and *Polytelis*) and the Lories (such as *Trichoglossus*). In *Platycercus* there is a well-developed bridge of bone which connects the zygomatic process with the supra-meatal tubercle and which conceals the articulation of the quadrate with the cranium. (See fig. 3.)

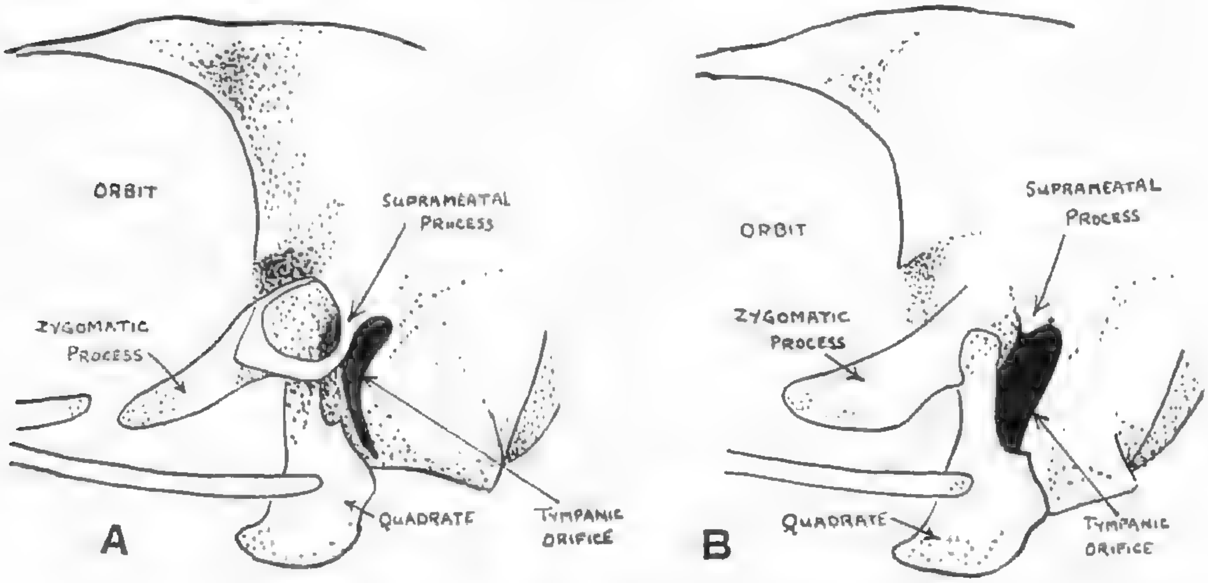

Fig. 3. Auditory Region of crania of (A) *Platycercus*, and (B) *Barnardius*, showing structural differences. About twice natural size.

As in related forms, *Barnardius* has the orbital ring incomplete, the post-frontal process small, and the squamosal process crossed at its base by a deep groove above the meatus and in front of the supra-meatal process or tubercle.

The upper mandible is relatively large and heavier than in *Platycercus*, and the auditory meatus is narrowed and curved. The furculum is also absent as in other members of the subfamily.

Barnardius is characterized by the presence of blue cheek-patches exactly as occur in *Platycercus*, but the colour pattern of the plumage differs markedly from all the other genera of the subfamily. Genotype: *B. typicus* = *Platycercus barnardi* Vigors and Horsfield.

Discussion: Some workers prefer to include all the forms of *Barnardius* under *Platycercus* as members of a single species (e.g. Peters, 1937), but this view is not supported herein.

Peters says (p. 263): "There are no structural characters of importance that justify the existence of the genus *Barnardius*; those who do admit it do so only on the basis of colour."

Examination of crania of *Barnardius* and *Platycercus* reveals that there are differences between the two in the auditory region, and these give support to the contentions of Salvadori (1891) and Mathews (1918) that *Barnardius* is worthy of recognition.

Advocates of the distinctness of *Barnardius* have always stressed the differences in colour pattern between the two genera; these are obviously of more than superficial importance.

It is anticipated that Peters' (1937) proposed scheme, including all the forms of *Barnardius* as members of a single species will not be acceptable to Australian ornithologists.

Rather it is suggested that there are two Formankreise the members of which form excellent examples of Huxleyian geocline series; the character gradients involve size and colour. One series occurs west of about 138 deg. east longitude, the other east of that line.

zonarius Formenkreis. | *barnardi* Formenkreis.

(West of about 138° east long.) | (East of about 138° east long.)

The most conservative feature in *Barnardius* seems to be the coloration of the cheek-patches, which are blue-violet in *zonarius* and green-blue in *barnardi*. The geographical races of both species which inhabit more humid southern zones have retained the red forehead band which was probably characteristic of their common ancestor.

Juvenile Plumage: Immature birds resemble adults but are generally paler and duller with the markings less clearly defined. In *B.z. semitorquatus* the red forehead band is completely assumed in the adult only, while in *B. barnardi* the head is uniformly dark-coloured in the young, changing to green in certain races. There is a white wing stripe in both sexes which is usually retained in the adult female.

Sexual Differences: Females differ from males in being slightly smaller and duller in colour, having the head and beak smaller. In those forms with a red forehead band, this is greatly reduced in extent in the female. As stated above, females may be further distinguished by a white wing stripe which is almost invariably present.

Distribution: The members of *Barnardius* are mainly confined to the drier interior, and with a few exceptions occur within the 15 inch isohyet. From the accompanying table (fig. 2) it will be seen that nearly all the races of *Barnardius* are confined to warm or hot arid moisture zones which receive no influential summer rains. Two exceptions occur. In the semi-humid coastal zone of South-western Australia, which receives some effective summer rain, there lives the large, distinctive race, *B.z. semitorquatus*. In the Cloncurry district of North Queensland is a hot arid area which receives no effective winter rains, but has $P/E > 0 \cdot 5$ for from one to three months in the summer. Here we find another most distinctive race *B.b. macgillivrayi*. These forms are best regarded as the "end members" of the various cline series and not as full species.

BARNARDIUS ZONARIUS (Shaw 1805).

Names: Port Lincoln Parrot, Yellow-banded Parrot, Yellow-collared Parrot, Twenty-eight Parrot, Yellow-naped Parrot, Banded Parrot, Bauer's Parrot or Parrakeet, and North Parrakeet.

Range: Australia west of about longitude 138 deg. and south of about 20 deg. South latitude.

Races: *Barnardius zonarius semitorquatus* (Quoy and Gaimard) 1830; *B.z. dundasi* (Mathews) 1912; *B.z. zonarius* (Shaw) 1805; *B.z. myrtae* (S. A. White) 1915; *B.z. occidentalis* (North) 1893.

In 1929, Kinghorn expressed views on the status of the various forms of *Barnardius*, and published a distribution map. Jenkins (1931) reviewed the western forms of *Barnardius zonarius*, and his findings are approximately the same as those of Mathews (1931). Examination of further material confirms most of the suggestions offered by these workers, although it seems preferable, in the light of further knowledge, to regard as subspecies some of the species recognized by Kinghorn.

BARNARDIUS ZONARIUS SEMITORQUATUS (Quoy and Gaimard 1830).

Names: Twenty-eight Parrot, Yellow-naped or Yellow-banded Parrakeet, Yellow-collared Parrot.

Synonym: *woolundra* Mathews.

In regarding the Twenty-eight Parrot as a race of *zonarius* the modern trend towards a broader concept of species is followed, while it is also felt that such is the consensus of opinion among present-day Australian ornithologists.

Earlier workers allotted *semitorquatus* full specific rank, as also did Kinghorn (1929), despite the fact that there are intergrades between it and *zonarius*. This is one of the exceptional forms of *Barnardius*, and inhabits districts subject to influential summer rains, as well as winter rains. The total number of months $P/E > 0 \cdot 5$ is 7–8, which is relatively higher than that of areas where other races of *zonarius* occur. The mean annual temperature also is less, being 55–60 deg. F., as compared with 65–75 or even 80 deg. F. of areas inhabited by other races. Mathews was probably the first to regard *semitorquatus* as a race of *zonarius*, but in this he was not followed by the R.A.O.U. Check-list Committee (1926). The various intermediates produced by the natural interbreeding between *semitorquatus* and *zonarius* along their line of contact, such as *woolundra*, might almost be disregarded as true geographical races; they comprise very variable populations and furnish good examples of genocline series.

The green plumage of this race has a more yellowish tinge than that of *zonarius*; the yellow abdominal band varies greatly in extent and may be absent or greatly restricted, and is never as wide as in adjacent forms.

Range: South-western Australia, principally in the wetter (semi-humid) coastal areas with an average rainfall of from 20 to above 40 inches, comprising six months of winter rains and one to two months of influential summer rains.

BARNARDIUS ZONARIUS DUNDASI (Mathews 1912).

Name: Dundas Yellow-collared Parrot.

Characters: "Differs from *P.z. semitorquatus* in lacking the red frontal band; and from *P.z. zonarius* in the deep green of the upper surface." (Mathews, 1912, p. 274.)

Jenkins noted (1931, p. 259) that the female of *dundasi* which he examined was "smaller than typical *zonarius*, back darker . . . . in other respects resembles *B.z. woolundra*".

Although recognized by Mathews (1931) and Peters (1937) this is a doubtful race, and it might more correctly be regarded a synonym of *zonarius*. For further remarks see under that name.

Range: Drier interior of South-western Australia, roughly between the 10 and 20 inch isohyets.

BARNARDIUS ZONARIUS OCCIDENTALIS (North 1893).

Name: North Parrakeet, Northern Yellow-banded Parrot.

Synonym: *connectens* Mathews 1912.

Characters: "In the disposition of its markings *P. occidentalis* resembles *P. zonarius*, but it differs from that species in having light blue (i.e. pale blue-violet) instead of dark blue cheeks; in the greater extent of the conspicuous lemon-yellow of the lower portion of the breast and the whole of the abdomen *and which extends as far as the vent*, instead of the deep gamboge yellow of the centre of the abdomen only; in the verditer green of the chest, back, wings, scapulars and inter-scapular region, instead of the dark green, and in the absence of the narrow black band immediately below the collar." (North, 1905.)

Of *connectens* Mathews (1912, p. 274) says: "Differs from *P.z. occidentalis* in having the rump uniform with the back; the yellow band of the abdomen more distinct, but not as bright as *P.z. zonarius*."

Jenkins stated of *connectens*: "Resembles *B.z. occidentalis*, but the band of yellow on the under-surface is much deeper in tone, having an orange tinge." There is some confusion as to the extent of the range of *occidentalis* and *connectens*. Kinghorn (1929) shows *connectens* about Geraldton and the Murchison, with *occidentalis* to the north beyond Roebourne.

Jenkins (1931) gives *occidentalis* in the Murchison area, with *connectens* further north, which is exactly the reverse of Kinghorn's statement. Specimens examined from the Fortescue River are of both forms, and do not support the proposed differences between the two, although a North-west Cape example is typical *occidentalis*. This race inhabits the hot arid and desert zones of North-west Australia, and its paler, more yellowish coloration is probably an expression of this difference in climate, where the mean annual temperature (70–80 deg. F.) is far higher than that experienced by other races.

Although recognized by Jenkins, *connectens* is not now regarded as valid by Mathews (1931) or Peters (1937).

Range: North-west Australia from the Fortescue River in the north, south to the Murchison district, Geraldton and eastwards to Lake Way.

BARNARDIUS ZONARIUS MYRTAE S. A. White 1915.

Name: Central Australian Yellow-banded Parrot.

This form, which is regarded as a synonym of *zonarius* by Mathews (1931), should nevertheless be recognized as a distinct race. In the specimens examined the green of the back is of a lighter (yellower) shade than in typical *zonarius*. Examples in fresh plumage from the MacDonnell Ranges differ slightly in colour, being of a more bluish shade above.

Range: Northern South Australia (interior), from about Oodnadatta northwards to the MacDonnell Ranges and beyond to Tennant Creek, Northern Territory.

BARNARDIUS ZONARIUS ZONARIUS (Shaw 1805).

Names: Port Lincoln Parrot, Bauer's Parrot, Yellow-banded Parrot, and Banded Parrot.

Synonyms: *Psittacus viridis* (Shaw) 1812; *Ps. cyanomelas* (Kuhl) 1820; *Ps. melanocephalus* (Kuhl) 1820; *Ps. baueri* (Temminck) 1821.

Normal examples do not exhibit a red frontal band, which is characteristic of the South Western Australian wet-country form. Some individuals, however, occasionally show traces of red on the forehead. This race is an inhabitant of the warm arid zone of the interior of southern Australia, where there are no influential summer rains and where $P/E > 0 \cdot 5$ exists only for from one to four winter months.

The form *dundasi* (q.v. supra) probably refers to this race, and the example figured by Mathews (1917) may be an abnormally pale individual. A skin of a male in the collection of Dr. D. L. Serventy (No. 742), taken at Salmon Gums, 25 miles south of Lake Dundas, is of the typical form. It resembles examples of *B.z. zonarius* from Eyre's Peninsula, South Australia. Examples of this race have also been taken as far west as Bunbury, South-western Australia. With the exception of *semitorquatus*, the members of this race exhibit traces of the red frontal band more frequently than any other.

Range: Interior of Western Australia, eastwards to Eyre Peninsula and the western slopes of the Flinders Ranges, South Australia.

THE RACES OF *Barnardius zonarius*.

(Based on plumage differences—colours according to Ridgway.)

	Forehead.	Back.	Cheeks.	Upper breast.	Abdomen.
semitorquatus	scarlet-red	grass green	dark soft blue-violet	grass green	variable (grass green, calliste green, lemon yellow abdominal band present or absent)
zonarius	usually a few scarlet-red feathers	meadow green	dark soft blue-violet	meadow green	lemon chrome abdominal band
occidentalis	red absent	bice green	clear cadet blue	light oriental green	pale lemon yellow band on abdomen
myrtae	red absent	Ackermann green	dark soft blue-violet	Ackermann green	strontian yellow abdominal band

BARNARDIUS BARNARDI (Vigors and Horsfield 1827).

Names: Ringneck Parrot, Mallee Parrot, Barnard's Parrakeet, Bulla-Bulla, Buln Buln, and Cloncurry Parrot.

Range: South-east portion of the Lake Eyre Basin, Flinders Ranges, Yorke Peninsula, Murray Mallee areas, South Australia; north-west Victoria, interior of New South Wales, east to Moree; interior of Queensland, east to Barcaldine and north to Windorah; Cloncurry district, north Queensland.

Races: *Barnardius barnardi macgillivrayi* (North) 1900; *B.b. whitei* (Mathews) 1912; *B.b. augustus* (Mathews) 1912; *B.b. barnardi* (Vigors and Horsfield) 1827.

BARNARDIUS BARNARDI MACGILLIVRAYI (North 1900).

Name: Cloncurry Parrot.

Universally known as the Cloncurry Parrot, this exquisite race is quite distinct from the remaining forms of *barnardi*.

North named it as a full species, while both the R.A.O.U. Check-list Committee (1926) and Kinghorn (1929) have treated it likewise. Its association with the *barnardi* Formenkreis, however, is indicated by the possession of blue-green cheek patches.

The race *whitei* somewhat resembles it, being only a shade duller on the back, although it is distinguished from *macgillivrayi* by its red forehead and dark head.

Range: About 20 deg. South latitude, North Queensland, in the Cloncurry-Camooweal districts.

BARNARDIUS BARNARDI WHITEI (Mathews 1912).

Name: South Australian Mallee Parrot.

Characters: "Differs from *P.b. barnardi* in having the head, from the red forehead band to the yellow collar, uniform dark brown." (Mathews, 1912.) Examination of specimens from the northern Flinders Ranges suggests that in addition, this race may be distinguished by the back, which is only slightly darker than the rump; this feature also links it with the preceding form.

An example from Yanco Glen, near Broken Hill, New South Wales, is intermediate between *whitei* and *barnardi*. A further race may be recognized later for the arid interior of New South Wales and Queensland.

Range: Northern Flinders Ranges from above Port Augusta to beyond Leigh Creek and the lower Lake Eyre Basin.

BARNARDIUS BARNARDI AUGUSTUS (Mathews 1912).

Synonyms: *lindoi* S. A. White (*whitei* Mathews 1917, pl. cccvii, nec Mathews, 1912, p. 273).

Name: South Australian Mallee Parrot.

Characters: "Differs from *P.b. whitei* in having a green, not blue, back." There is some confusion as to the correct name for the race of the Mallee Ringneck which occurs in the Flinders Ranges, for both *augustus* and *lindoi* are generally quoted as synonyms of *whitei*, and Mathews' original figure and description are contradictory. Although Mathews did not mention the colour of the back in his original description of *whitei*, the bird figured had a "myrtle green" back, and the colour of the head and cheeks is that of a southern dark-headed bird, rather than typical *whitei* as represented by a topotypical series. It is suggested, therefore, that this illustration should be referred to *augustus*, and also that in the original description an error crept in and for "*whitei*" we should read "*barnardi*", as this is the only form which has a "blue" back.

The writer is of the opinion that there are two distinct forms in the Flinders Range area, *whitei* in the north, and *augustus* further south. Southern examples from mallee areas west of the River Murray have dark heads, but the back is blue as in *B.b. barnardi*. They are thus intermediate between *augustus* and *barnardi*.

Range: From about Port Augusta southwards to Yorke Peninsula, and the mallee areas west of the River Murray as far south as Lake Alexandrina.

BARNARDIUS BARNARDI BARNARDI (Vigors and Horsfield 1827).

Synonyms: *B. typicus* Bonaparte; *crommelinae* Mathews.

Names: Ringneck Parrot, Mallee Parrot, Barnard's Parrakeet, Bulla-Bulla, Bulu Bulu.

This form is immediately distinguished by the deep indigo-blue back, and also the emerald-green crown of the head. The abdominal band varies in extent, and may be yellow or orange and large, or almost absent in different individuals.

B. crommelinae of Mathews is now generally regarded as an extreme variant which was produced in captivity.

Range: Murray Mallee areas of South Australia, Victoria, and New South Wales as far north as Windorah and Barcaldine in Queensland, east to the Moree district in New South Wales.

THE RACES OF *Barnardius barnardi.*

(Based on plumage differences—colours according to Ridgway.)

	Forehead band.	Top of head.	Nape.	Back.	Rump.
macgillivrayi	absent	mineral green	civette green	mineral green	emerald green
whitei	scarlet	dark olive	dark olive	dark green	cobalt green
augustus	carmine	meadow green	dark greenish olive	myrtle green	mineral green
barnardi	spectrum red	emerald green	green-blue slate	dark green-blue slate	emerald green

Genus NORTHIELLA Mathews 1912.

Diagnosis: As emphasized by its author (1912, p. 276) this genus may be at once recognized by the first five primaries which are all attenuated into spatulate tips. Considered alone, however, this structural feature might not be of generic importance, but when taken together with other characters such as the presence of blue cheek patches and other colour differences, *Northiella* is at once seen to be distinct from *Psephotus,* with which it has been usually placed.

It is here suggested that *Northiella* has closer affinities with the *Barnardius* group. Osteologically it is similar to all other Platycercines except *Platycercus.* The upper mandible is slightly more massive than that of *Psephotus,* and most of the races are larger than those of that genus.

Discussion: *Northiella* is to-day represented by a single species, the Blue Bonnet (*N. haematogaster*), which occurs widely in the dry interior of the Continent. Several races are readily recognized and are apparently confined to distinct moisture zones, as shown in the table (fig. 2).

Originally associated with *Platycercus,* and later with *Psephotus,* there is little doubt that *Northiella* is distinct from both genera.

Juvenile Plumage: Immature birds are very similar to the adult, but the colours of the plumage are less brilliant, and as in *Platycercus* the blue cheek patches are less extensive than in the adult. As noted by Lendon (1940) the wing stripe is fairly constant in young birds of both sexes, although it may be less marked in males.

Sexual differences: There is no marked difference in the plumage of the two sexes, although the female is slightly duller. Tavistock (1929) states that females may be distinguished by the flatter skull; a wing stripe is also characteristic of adult females.

NORTHIELLA HAEMATOGASTER (Gould 1838).

Names: Blue Bonnet, Crimson-bellied Parrot, Yellow-vented Parrakeet, Bulloak Parrot, Red-vented Parrot, also Naretha Parrot.

Range: Arid interior of southern Queensland, New South Wales, Victoria (mallee), South Australia, lower Northern Territory, and interior of Western Australia, and Nullarbor Plain.

Races: *Northiella haematogaster narethae* (H. L. White) 1921; *N.h. pallescens* (Salvadori) 1891; *N.h. haematogaster* (Gould) 1838; *N.h. alter* (Mathews) 1912; *N.h. haematorrhous* (Gould) 1865.

NORTHIELLA HAEMATOGASTER NARETHAE (H. L. White 1921).

Names: Little Blue Bonnet, Naretha Parrot.

Originally described as a separate species, this, the smallest form, has been recently accorded subspecific rank by the R.A.O.U. Check-list Committee (1941, p. 88), as *Psephotus haematogaster narethae*.

Range: Nullarbor Plain, Western Australia.

NORTHIELLA HAEMATOGASTER PALLESCENS (Salvadori 1891).

Name: Pallid Yellow-vented Parrot.

The type upon which this well-marked desert race is based, came from Cooper Creek, South Australia. It may be distinguished by the very pale upper surface and pale breast, and also by the olive patch on the median wing coverts, which is yellower than in the other forms. This is another distinctive bird peculiar to the Lake Eyre Basin, and has apparently evolved under the influence of the extremely dry conditions of the area. The mean annual value of the Meyer Ratio (Precipitation to Saturation Deficit) is probably the lowest in Australia (0–15 according to Prescott, 1934), and according to Davidson's nomenclature (1936) the area in which the Blue Bonnet occurs may be termed the warmer temperate desert zone of the southern half of the Basin.

The other races of *N. haematogaster* occur in progressively "wetter" zones, and a succession of changes in plumage colour may be noted. Those living in the more humid parts exhibit more red in the plumage markings, while the "drier" forms are paler or with more yellow.

Range: Lake Eyre Basin, South Australia.

NORTHIELLA HAEMATOGASTER HAEMATOGASTER (Gould 1838).

Synonym: *xanthorrhoa* Bonaparte.

Name: Yellow-vented Parrot.

This geographical race has an extensive range in the desert, arid and drier sub-arid zones of the interior of the Continent. In the eastern portion of New South Wales it merges with the red-vented form, *haematorrhous*, and intermediates between the two are known. In the south it meets the pale yellow-vented race, *alter*, which is confined to the Murray mallee areas of Victoria and South Australia. This form separates *pallescens* and *narethae*, *pallescens* and *alter*, and *pallescens* and *haematorrhous*.

Range: Arid interior of South Australia (northern mallee and saltbush and bluebush country), far-western New South Wales, southern Queensland (Interior).

NORTHIELLA HAEMATOGASTER ALTER (Mathews 1912).

Name: Green-vented Parrot.

Characters: "Differs from *P.h. xanthorrhous* in its much larger size, and in having the under tail coverts greenish yellow." (Mathews, 1912, p. 275.) The author gives the type locality as "Muttoa, Victoria", but this is an error for Murtoa.

In the original description the author states that the under tail coverts were greenish-yellow, but later altered this to green (1931, p. 204). Examination of a series from the Victorian and South Australian Mallee shows that the under tail coverts are very pale lemon-yellow, and there is no greenish colour. The adult Blue Bonnet seems to vary considerably in size, some individuals being much larger than others.

Mathews' statement that the race under consideration is much larger in size than the previous race is not borne out by specimens examined.

Range: Mallee areas of Victoria and South Australia.

NORTHIELLA HAEMATOGASTER HAEMATORRHOUS (Gould 1865).

Names: Red-vented Parrot, Red-vented Blue Bonnet.

Besides the crimson-red under tail coverts fully adult males of this subspecies usually have the inner median and greater wing coverts blood-red in colour (often incorrectly referred to as "chocolate-coloured"). Mathews (1931) has given the range as "South New South Wales, Victoria, and South Australia", but this may be modified in the light of present knowledge.

Range: Semi-arid interior of Northern New South Wales and Southern Queensland.

Genus PLATYCERCUS Vigors 1825.

Diagnosis: The Rosellas (genus *Platycercus*) are at once distinguished in the adult by the scalloped appearance of the back, and have well-defined cheek-patches as in *Barnardius*, and *Northiella*. Anatomically they resemble other Broadtails, having no furculum or ambiens muscle. The chief differences are to be noted in the cranial osteology. The upper mandible is relatively weaker than in *Barnardius*, but a much more important difference occurs in the auditory region. Examination of crania of *Platycercus caledonicus*, *P.c. elegans*, *P.c. adelaidae*, *P. eximius*, *P. adscitus*, *P. venustus*, and *P. icterotis* reveals that in the adult the zygomatic process of the squamosal is connected with the supra-meatal process by a well developed ring or bridge of bone. This fact was first stated by D'Arcy Thompson (1899) for *P. elegans*, but as he did not mention the differences in the cranial characters of *Barnardius* this distinctive feature has never been accorded the importance it undoubtedly deserves. In undamaged crania this structure is clearly seen, and forms an elevated "auditory ring", slightly above and in front of the actual tympanic orifice.

A single imperfect cranium of *Cyanorhamphus novae-zelandiae* has been examined. Here there is a similar ring in the auditory region, but it is much heavier and more extensive, and the tympanic aperture appears to be completely enclosed by this accessory structure. This apparently represents the extreme development of the arrangement found in the auditory region of *Platycercus*.

In *Barnardius* the articulation of the quadrate with the skull is unobscured, but in *Platycercus* it is concealed by the "auditory ring" (see fig. 3).

The structural difference, together with the more advanced colour pattern indicates that the members of *Platycercus* constitute a more highly evolved section of the Platycercines, and should be recognized as a separate genus. Genotype: *P. pennantii* Latham = *P. elegans* Gmelin.

Discussion: The name "Rosella", originally applied to one species only, namely *Platycercus eximius*, the "Rosehill Parrakeet", was adopted with advantage by the R.A.O.U. Check-list Committee (1926) for all forms of *Platycercus*.

Unlike *Barnardius*, the genus *Platycercus* is confined to the more humid areas of Australia, in which influential rains fall in summer as well as winter. Dry country forms occur in the Murray Valley (semi-arid), and in the Flinders Ranges (arid moisture zone). In South-western Australia occurs a diminutive species (*icterotis*) with distinctive races in the semi-humid and semi-arid areas. Here the climatic and other factors appear to have affected plumage colour and size. Distinctive species of *Platycercus* occur in the semi-arid zones of tropical Northern Australia, and in one instance (*P. adscitus*) it is of interest to note that where this enters an area of winter as well as summer rains, a distinctive geographical race occurs.

The evolution of the plumage colour in *Platycercus* presents an interesting problem. The ancestral type of this genus was probably a red bird which was derived from a green form, of somewhat similar appearance to the immature stage of present-day species. The green colour is produced by a combination of melanin and yellow lipochrome pigments deposited in the feathers. Slight alterations of either pigment will result in a change of plumage colour, such as is demonstrated in albinos, where the deposition of melanin is inhibited. Species now living in wetter districts are mainly blackish- or reddish-hued, while those occurring in arid zones are characterized by an accumulation of yellow or reddish-brown (phaeomelanin) pigmentation. This fundamental rule, which was recognized by Gloger more than one hundred years ago, seems to apply to many Australian birds and mammals, and environmental stimuli such as temperature or humidity or a combination of both are probably responsible for such colour changes or differences. It is conceivable, therefore, that those species of *Platycercus* which now exhibit much yellow pigmentation may have evolved under arid conditions, examples being *P. elegans flaveolus*, *P. caledonicus*, *P. venustus*, and *P. adscitus*. Our limited knowledge of former climatic conditions during the Pleistocene together with present-day distribution supports such an idea. Later environmental changes probably increased the melanin pigmentation, and this has resulted in the secondary blackish suffusion of the upper surfaces of *venustus*, and the blue coloration of *adscitus*. The young of these two forms are similar, except for the colour of the head, and it is apparent that they are closely allied. The young of *venustus* are yellower on the tail than those of *adscitus*, however, and it is probable that the first-named was once much yellower than it is to-day. It is also probable that *venustus* has always been limited to the northern areas it now inhabits, and has been subjected to successive climatic changes.

From the red under-tail coverts it can be deduced that *venustus*, *adscitus*, and *caledonicus* have retained this feature from a "red" ancestor, which may also have been the common ancestor of both *elegans* and *icterotis*. Similar conclusions could be deduced in other Platycercine genera.

The blue of the cheek feathers is apparently the dominant feature in *Platycercus*, although it is now in the process of being lost in two species, namely *adscitus* and *venustus*. Even in *icterotis* (yellow cheeks) and *eximius* (white cheeks) the young still exhibit some blue feathers on the cheeks, which are only lost at maturity.

Many forms originally described as separate species can now only be regarded as geographical races, and after examination of much material only the following are recognized as valid species of the genus.

Platycercus caledonicus (Gmelin); *P. elegans* (Gmelin); *P. eximius* (Shaw); *P. venustus* (Kuhl); *P. adscitus* (Latham); *P. icterotis* (Kuhl).

The form *Platycercus flaveolus* Gould, which up till now has enjoyed full specific rank almost without question, is to my mind only a colour phase of *elegans*. Peters's association of it with *caledonicus* indicates that he had some misgivings as to it warranting specific rank, but it is anticipated that few Australian ornithologists would concur with his arrangement. Other ornithologists have advocated that *adelaidae* be accorded specific rank; a general opinion is that it is only a race of *elegans*.

Two alternatives seem to be open with regard to these forms, namely to regard all three as distinct, or alternatively to regard them all as races of *elegans*. The latter arrangement is here chosen because, apart from minor differences in the plumage colour of the adult, there do not seem to be any important differences in the young of the first juvenal plumage or in the habits of the three forms.

Juvenile Plumage: Immature birds have plain green backs, and the scallopings characteristic of the adult are not assumed until the birds are several months old. Following this intermediate stage most species assume the fully adult plumage when just over twelve months old. Young males are usually distinguished by their slightly brighter coloration almost from birth, and the bill, which is at first yellowish-white, soon darkens in colour. A white wing stripe occurs in both sexes.

In those forms which have white or yellow cheek patches (e.g. *erimius* and *icterotis*), there are apparently always some blue cheek feathers in the young stages.

Sexual Differences: Females are smaller and less richly coloured than males, with smaller heads and beaks. In *Platycercus elegans flaveolus* the adult female apparently has some red on the breast, while the male is usually pure yellow beneath. Females exhibit a white wing stripe, formed by white spots on the individual primaries.

PLATYCERCUS CALEDONICUS (Gmelin 1788).

Names: Green Rosella, Yellow-bellied Parrakeet, Tasmanian Mountain Parrot, and Green Parrot.

Range: Tasmania, also King, Flinders, and other Islands, in Bass Strait.

Races: *Platycercus caledonicus caledonicus* (Gmelin) 1788; *P.c. henriettae* Mathews 1915; *P.c. flindersi* Mathews 1917. (Two last-named doubtful.)

PLATYCERCUS CALEDONICUS CALEDONICUS (Gmelin 1788).

Synonyms: *Psittacus brownii* Kuhl 1820; *Ps. flavigaster* Temminck 1821; *Ps. flaviventris* Temminck 1821; *xanthogaster* Stephens 1826.

Mathews (1918) has suggested that the nearest living representative to the prototype of the *Platycercus* group is *P. caledonicus*. From its restricted range in Tasmania it seems very probable that this form is indeed an ancient one, although possibly derived from a "red" ancestor. Its occurrence on the islands of Bass Straits shows that the avifauna of these areas has greater affinities with Tasmania than with the Australian mainland. As noted by North, Campbell, Mathews and others this species takes several years to assume the fully adult plumage, and in this respect is similar to *elegans*.

It is possible that the two described races were based on immature individuals, and until large series are examined their status must remain open to doubt.

Of *P.c. henriettae* Mathews (1915) says: "Differs from *P.c. caledonicus* in having more red on the head, and in having the under tail coverts red. Type, King Island." Two specimens loaned by the National Museum, Melbourne (Nos. B420, B421) differ not at all from immature birds from Tasmania, being smaller and duller than adults from that area. Mathews (1912) said: " . . . . the birds from Flinders Island (and probably the Kent group too) are the darkest of all, at the same time they are smaller than those from the mainland" (i.e. of Tasmania). I have not seen any specimens of this doubtful race (*flindersi*), but would suggest that the characters given are those of immature birds.

PLATYCERCUS ELEGANS (Gmelin 1788).

Names: Crimson Rosella, Crimson Parrot, Pennant's Parrakeet, Red Lory, Mountain Lowry, also Adelaide Rosella, Hindmarsh Parrot, Campbell Parrakeet, Yellow Rosella, Yellow-rumped Parrakeet, Swamp Lory and Blam Blam.

Range: North Queensland, New South Wales, Victoria, South-east of South Australia, Kangaroo Island, Norfolk Island (introduced).

Races: *Platycercus elegans nigrescens* Ramsay 1888; *P.e. elegans* (Gmelin) 1788; *P.e. melanoptera* North 1906; *P.e. fleurieuensis* Ashby 1917; *P.e. adelaidae* Gould 1841; *P.e. subadelaidae* Mathews 1912; *P.e. flaveolus* Gould 1837.

PLATYCERCUS ELEGANS NIGRESCENS Ramsay 1888.

Names: Campbell Parrakeet, Northern Crimson Parrot.

Characters: " . . . . smaller size, thicker and more robust bill, and the deeper tint of crimson in its plumage; in some a few violet feathers appear on the chest;

those on the head, hind neck, and back are almost black, which colour extends also on to the cheeks in one specimen." (Ramsay, 1888.)

This small, dark race is instantly recognizable, and supports Gloger's Rule that birds inhabiting warm humid regions have more melanin pigmentation than races of the same species in cooler drier regions. A geographical race may occupy an area ranging from a few hundred to many thousands of square miles. In this case, *nigrescens* is confined to a relatively small humid area on the eastern coast of North Queensland. The type was taken on Mount Bellenden Ker, and specimens have been examined which were taken at Allumbah (equals Aloomba), near Cairns.

PLATYCERCUS ELEGANS ELEGANS (Gmelin 1788).

Names: Crimson Rosella, Crimson Parrot, Pennant's Parrakeet, Red Lory, Mountain Lowry.

Synonyms: *pennanti* (Latham) 1790; *gloriosus* (Shaw) 1791; *splendidus* (Shaw) 1792; *viridis* (Kerr) 1792; *phillippi* (Kerr) 1792; *nobbsi* Tristram 1885.

This large, brightly-coloured race inhabits the humid coastal zones of southern Queensland, New South Wales, and probably north-eastern Victoria. Intermediates occur where the range of this subspecies meets that of *nigrescens*.

PLATYCERCUS ELEGANS VICTORIAE Mathews 1912.

Characters: "Differs from *P.e. elegans* in the deeper, duller red, especially noticeable on the rump and under-surface, and in the more extensive black markings on the back." (Mathews 1912.)

Some examples of this race approach closely the dark coloration of the Kangaroo Island form, *melanoptera*. The type was taken at Woori Yallock, a place 37 miles north-east of Melbourne, and near Lilydale.

An example from Healesville, in the National Museum collection at Melbourne (No. B331) would appear to be of this race. On the other hand an example taken at Monegeetta, 37 miles north-west of Melbourne, in the direction of Bendigo (S.A. Museum No. B20170) is of the coloration of the typical form. Both specimens were taken in the month of July.

If *victoriae* is indeed valid, then its range would appear to be the semi-humid zone of southern Victoria and the south-east of South Australia, as far west as Robe, or perhaps Kingston.

PLATYCERCUS ELEGANS MELANOPTERA North 1906.

Name: Kangaroo Island Crimson Parrot.

North (1906, p. 78) separated this race on the fact that it differed from *P.e. elegans* not only "by the greater amount of black on the feathers of the back, but principally by the inner half of the upper wing-coverts (except the margins of some of the median and greater series) being black . . . ." The stronghold of the Crimson Rosella on Kangaroo Island is apparently the western half to Cape Borda, it being numerous on Flinders Chase and in the Vivonne Bay, Middle River and Western River districts.

PLATYCERCUS ELEGANS FLEURIEUENSIS Ashby 1917.

Name: Hindmarsh Parrot.

Characters: "This race (Ashby 1917) is distinguished from all other forms of *P. elegans* (with the exception of *P. adelaidae*) by the scarlet colour replacing the crimson, and from the latter in the generally more brilliant scarlet plumage, and in the case of old specimens the green feathers on rump and back are entirely replaced by scarlet." It might also be pointed out that the nape is not yellowish-green as in typical *adelaidae*, but scarlet-red. The type, a male (No. B2323) is in the South Australian Museum.

This form is the end member of a well-defined geocline series which comprises *fleurieuensis*, *adelaidae* and *subadelaidae*, the character gradient being a progression of colour changes from scarlet in the birds of the south to yellow in those of the northern Flinders Ranges. The close proximity of Kangaroo Island to Fleurieu Peninsula, where *fleurieuensis* occurs, has long led certain workers to postulate that the deeper coloration of the southern mainland bird is due to "an infusion of blood" from the Kangaroo Island race. Although Kangaroo Island is only eight-nine miles distant from the mainland, there is no evidence to show that *melanoptera* at any time crosses this expanse of water. Parrots are weak fliers, and it seems preferable to regard the more intense pigmentation of *fleurieuensis* to be an independent expression of the wetter climatic conditions or other factors present on Fleurieu Peninsula.

Range: Fleurieu Peninsula, from Cape Jervis to about Mount Compass.

PLATYCERCUS ELEGANS ADELAIDAE Gould 1841.

Name: Adelaide Rosella.

This form was described as a full species by Gould, and for many years its status has formed the basis of much discussion. Earlier workers, such as North, Morgan, and Ashby, did not recognize that the northern yellow race, *subadelaidae*, was intimately connected with *adelaidae*, and regarded it as *flaveolus*.

Ashby's writings, however, show that he suspected the northern yellow race had affinities with the southern birds, although he refrained from expressing any interpretation contrary to accepted notions held at the time. He said: " . . . . commencing with the northernmost *flaveolus* and ending with the southernmost *adelaidae* . . . . the result will show, I believe, a complete gradation from the highly coloured *fleurieuensis* in the south to the extreme pale yellow form in the north or drier districts." Ashby also suggested that *adelaidae* might be regarded as a red form of *flaveolus*, and *fleurieuensis* an extremely red form of the Yellow Rosella. In other words he discounted entirely the idea that the Adelaide Rosella (*adelaidae*) was a race of *elegans*. There is little doubt, however, that *adelaidae* is a direct derivative of *elegans*, or vice versa, while *flaveolus*, too, can only be regarded as a development of *adelaidae*.

Considerable variation exists among individuals of *adelaidae*, but in general an average type may be recognized. Changes due to age are incompletely understood; older birds and males tend to become redder. In the field these birds often appear much deeper in colour than is actually the case, and examination in the hand proves them to be much paler than either *fleurieuensis* or *elegans*. Generally speaking an adult male may be said to be "scarlet" (Ridgway) below and on the crown of the head, while the interscapular feathers are edged with "tea green" often with a tinge of scarlet. The nape is tea green, and merges into the scarlet of the crown.

Range: Mount Lofty Ranges, from about Mount Compass in the south to Burra, and beyond in the north of South Australia.

PLATYCERCUS ELEGANS SUBADELAIDAE Mathews 1912.

Name: Northern Adelaide Rosella.

If *flaveolus* be regarded as a full species, *subadelaidae* cannot be regarded as a race of it, although Mathews (1931) and Peters (1937) treat it as such.

Early workers, too, regarded this form as *flaveolus*, but there is now good reason to believe that the yellow coloration is simply an expression of Gloger's Rule, which states that races inhabiting arid regions are characterized by an accumulation of yellow or reddish-brown pigmentation. Mathews originally considered it to be a form of *elegans*, but later placed it under *flaveolus* (1931, p. 198).

In the original description he said: "Differs from *P.e. adelaidae* in being less brilliant below and in having less red on the crown." To this might be added the fact that the black feathers of the interscapular region are edged pale yellow, as in *flaveolus*, without any scarlet edging as in typical *adelaidae*; the birds are much redder below than *flaveolus*.

This race forms a true connecting link between *adelaidae* and *flaveolus*, but as mentioned above has slightly greater affinities with the former than the latter. The intimate connection between its distribution and coloration supports Gloger's Rule. The type was taken at Port Augusta, and the race apparently extends as far south as Wilmington and Laura, also being found in the Flinders Ranges north to Leigh Creek and beyond.

Range: Flinders Ranges, South Australia, approximately between 15 inch and 8 inch isohyets.

PLATYCERCUS ELEGANS FLAVEOLUS Gould 1837.

Names: Yellow Rosella, Yellow-rumped Parrakeet, Swamp Lory, Murray Smoker, Blam Blam.

Synonym: *innominatus* Mathews.

The association of this species with *P. caledonicus* by Peters is wholly unwarranted, and the author may have been misled by North's statement (1911, p. 119) that " . . . . in general appearance, when viewed on the under parts, the Yellow-rumped Parrakeet (i.e. *flaveolus*) closely resembles *Platycercus flaviventris* (equals *P. caledonicus*) the only difference being in the depth and intensity of the yellow colouring."

Ashby, in his various discussions on the Adelaide Rosella (*adelaidae*), emphasized the affinities between that bird and the present form, and indeed it may be proved later that the *adelaidae-flaveolus* group is distinct from the *elegans* group, in which case three species would have to be recognized, namely *elegans*, *adelaidae*, and *flaveolus*.

The R.A.O.U. Check-list (1926), Mathews (1931), and Peters (1937) all regard *subadelaidae* as a race of *flaveolus*. This conception probably arose from the fact that many true *flaveolus* in the adult (? females) exhibit a reddish pigmentation on the upper breast, and in this they approach *subadelaidae*. *Flaveolus*, however, is a much smaller bird than any of the other forms of *elegans*, except *nigrescens*. The young of *adelaidae*, *subadelaidae*, and *flaveolus* are indistinguishable from each other in the first juvenal plumage, while young of *elegans*, *melanoptera*, etc., can be distinguished often because they exhibit to a greater or lesser degree the crimson coloration of the adult on the crown, rump, and upper breast.

Mathews (1912) has described one race of *flaveolus*, namely *innominatus*, from South Australia. The quoted characters are: "Differs from *P.f. flaveolus* in its paler coloration, especially noticeable on the head and rump, altogether lacking the green tinge characteristic of the typical form." From the limited material available I am unable to recognize this form.

Range: Confined to the areas immediately adjacent to the Rivers Darling, Murrumbidgee, and Lachlan (New South Wales), River Murray, Victoria, and their tributaries, and normally as far south as Mannum, South Australia.

PLATYCERCUS EXIMIUS (Shaw 1792).

Names: Eastern Rosella, Rosella, Rosehill Parrakeet, Red-backed Rosella, Nonpareil Parrot, Yellow-mantled Parrot, and Golden-mantled Rosella.

Range: Southern Queensland, through New South Wales to Victoria and the south-east of South Australia; Mount Lofty Ranges, South Australia; Tasmania.

Races: *ceciliae* Mathews 1911; *eximius* (Shaw) 1792; *diemenensis* North 1911.

PLATYCERCUS EXIMIUS CECILAE Mathews 1911.

Names: Splendid Parrakeet, Golden-mantled Parrakeet, Yellow-mantled Parrot.

Synonym: *splendidus* Gould 1845.

This well-marked race with its "golden mantle" and blue-green rump is readily recognizable, being originally described as a separate species. Although apparently originally confined to the Darling Downs it is rapidly extending its range.

Range: North of the Darling Downs, South Queensland, southwards along the coastal regions of northern New South Wales to Scone, Merriwa, and beyond.

PLATYCERCUS EXIMIUS EXIMIUS (Shaw 1792).

Synonyms: *colei* Mathews, (?) *erythropeplus* Salvadori.

Names: Eastern Rosella, Rosella, Rosehill Parrakeet.

Mathews (1917, p. 360) proposed separating the Victorian members of *eximius* as *colei*, but there appears to be little or no difference in examples from southern New South Wales, Victoria, south-east of South Australia and the Mount Lofty Ranges.

The status of the species in South Australia is somewhat obscure, and at present it is difficult to decide whether or not birds in the Mount Lofty Ranges are descendants of escaped cage-birds introduced from the eastern States. Examples collected at Happy Valley and Cherry Gardens appear to be typical *eximius*, and it is possible that they were accidentally liberated at an early date in the history of the colony. In any case they do not occur in large numbers, which may tend to support this supposition.

P. erythropepuls, generally regarded as a hybrid, may eventually be proved an indigenous race of *eximius* in the Mount Lofty Ranges; certain individuals resembling Salvadori's original coloured plate have been noted, although none have yet been taken which can be definitely referred to it.

Robe or Kingston in the south-east of the State appears to be the natural western limit of *eximius*, and it does not normally occur in the 90 miles of mallee country separating this area from the Mount Lofty region.

A. G. Campbell (1906, p. 145) recorded *eximius* from Kangaroo Island, but no specimens have been taken, and it is suggested that this record may be incorrect.

Characters of *P.e. colei* according to Mathews are: " . . . . the yellow of the back is missing, the greenish tips being smaller, the rump being of a greenish shade, while the underneath coloration of the abdomen is greener." (Ballarat, Victoria.)

Range: Southern New South Wales, Victoria, south-east of South Australia, (?) Mount Lofty Ranges.

PLATYCERCUS EXIMIUS DIEMENENSIS North 1911.

Name: Tasmanian Rosella.

This is a well-marked race characterized by North as having a "conspicuously larger white cheek patch . . . . also richer and darker scarlet head and breast, the latter of which extends lower down the body than it does in birds from the mainland."

Range: Tasmania.

PLATYCERCUS VENUSTUS (Kuhl 1820).

Names: Northern Rosella, Brown's Parrot, Smutty Rosella, Smutty Parrot.
Range: North-west Australia, Northern Territory, Bathurst and Melville Islands.
Races: *Platycercus v. venustus* (Kuhl) 1820; *Platycercus v. melvillensis* Mathews 1912, status doubtful; *Platycercus v. hilli* Mathews 1910, status doubtful.

PLATYCERCUS VENUSTUS VENUSTUS (Kuhl 1820).

Synonym: *brownii* (Temminck).

Examination of specimens from the Northern Territory and Bathurst Island suggest that the races proposed by Mathews (q.v. *supra*) may not be valid.

Of *melvillensis* Mathews says in his original description: "Differs from *P.v. venustus* in its much blacker back, the feathers of the mantle being black with a very faint edge of greenish-yellow. Type, Melville Island, Northern Territory, No. 10,897. Range, Melville Island." Specimens from this locality have not been available, but a large series from Bathurst Island, a part of the same insular mass, agrees with his description, as do also two from the adjoining mainland.

Of *hilli* the same author says: "Differs from *P. venustus* Kuhl, in having the white feathers of the face reduced to a narrow line, the blue spreading nearly all the way up to the black below the eyes. The blue on the primary coverts is also very much more intense." The type came from Napier Broome Bay, North-west Australia.

Observation of aviary birds as well as examination of a large series of skins reveals that this is an extremely variable form, and Northern Territory birds answer to both descriptions given above.

It is suggested, therefore, that only one form is recognizable at present; the extent of the blue cheek-patches is not a reliable character. The insular race described by Mathews, if not proved valid at some future date, should be regarded as a synonym of the typical form, and not of *hilli* as suggested by Mathews (1931).

This species is closely allied to the following, viz. *P. adscitus*.

PLATYCERCUS ADSCITUS (Latham 1790).

Names: Pale-headed Rosella, Moreton Bay Rosella, Blue-cheeked Parrot, Grey-rumped Parrot.
Range: Eastern Queensland and northern New South Wales.
Races; *Platycercus adscitus adscitus* (Latham) 1790; *Platycercus adscitus palliceps* Lear 1832.

The status of the several described forms of this very variable species has been the subject of some confusion. North (1912, p. 124) attempted to describe a typical individual, but noted that "it is possible for one to obtain a dozen or more variations of it."

Mathews (1917, p. 343) recognized four subspecies: *P. adscitus adscitus* (Latham), Cooktown to Mackay, Queensland; *P.a. amathusiae* Bonaparte, Cape York; *P.a. elseyi* Mathews, Gulf of Carpentaria; *P.a. palliceps* Lear, New South Wales.

In his 1931 List, Mathews regarded *amathusiae* as a synonym of *adscitus*. Peters (1937, p. 262) followed Mathews in recognizing three races, although he noted that *elseyi* was doubtfully distinct from *P.a. adscitus*. Here it is proposed that only two races be recognized.

PLATYCERCUS ADSCITUS ADSCITUS (Latham 1790).

Synonyms: *cyanogenys* Gould; *amathusiae* Bonaparte; *elseyi* Mathews.
Names: Pale-headed Rosella, Blue-checked Parrot, Moreton Bay Rosella.
According to Mathews (1912, p. 271) *elseyi* "differs from *P.a. amathusiae*

in its paler rump". Specimens examined indicate that this feature may not be constant.

In a general way this may be referred to as the yellow-rumped race; formerly it was often referred to as "blue-cheeked", but the colour of the cheek-patch is unimportant as there are many intermediates, and blue-checked individuals may also occur in the southern race which is often called the "white-checked" race.

Range: Cape York Peninsula, south to beyond Cairns; also Gulf of Carpentaria, North Queensland.

PLATYCERCUS ADSCITUS PALLICEPS Lear 1832.

Synonym: *coelestis* Lesson.

Names: Pale-headed Parrot, White-cheeked Rosella, Grey-rumped Parrot.

This is the "blue-rumped" or "white-cheeked" race which extends from northern New South Wales northwards to Cairns where intermediates of the two races are to be found. As noted above, the amount of blue on the cheeks varies in extent.

Specimens from Charleville and Logan River, south Queensland, agree with examples taken in northern New South Wales.

Range: From below Cairns, North Queensland, south to northern New South Wales.

PLATYCERCUS ICTEROTIS Kuhl 1820.

Names: Western Rosella, Yellow-cheeked Parrakeet, Stanley Parrakeet, Red-mantled Parrot.

Range: South-west Australia.

Races: *Platycercus i. icterotis* Kuhl 1820; *Platycercus i. xanthogenys* Salvadori 1891.

Both the above races of the Western Rosella are now recognized by the R.A.O.U. Check-list Committee (1941) (*vide* Emu xli, 1941, p. 88).

PLATYCERCUS ICTEROTIS ICTEROTIS 1820.

Synonyms: *stanleyi* Vigors; *salvadori* Mathews.

Names: Western Rosella, Red-mantled Rosella, Stanley Parrakeet.

Range: South-west Australia (coastal).

PLATYCERCUS ICTEROTIS XANTHOGENYS Salvadori 1891.

Synonym: *whitlocki* Mathews.

Name: Dundas Yellow-cheeked Rosella.

Characters: Differs from *icterotis* "in being larger and having the cheeks of a paler yellow, the feathers of the back edged with red, the rump feathers and the upper tail coverts edged with greyish olive, the central tail-feathers blue, with no green" (Salvadori). Ogilvie-Grant (1910) said: "It is very easily distinguished from *P. icterotis* (Kuhl) by the darker greenish-grey (not sap-green) colour of the back and the margins of the innermost secondaries, while the middle pair of tail feathers are mostly dark purplish-blue, instead of green."

Range: South-west Australia (drier areas).

Genus PSEPHOTUS Gould 1845.

Synonyms: *Clarkona* Mathews; *Psephotellus* Mathews.

Diagnosis: Members of this genus are medium-sized Broad-tails with uniformly coloured backs, rumps of distinctive colour, and the two central tail feathers slightly longer than the succeeding pair. Osteologically they resemble other Platycercines, the furculum also being absent. There are no well-marked cheek-patches, but the wing feathers are scalloped as in *Platycercus*, *Barnardius*, *Cyano-*

rhamphus, etc., and the individual primaries are of similar proportions. Genotype: *Platycercus haematonotus* Gould.

Discussion: Damaged crania of three species of this genus have been examined, namely *haematonotus*, *varius*, and *dissimilis*, and all present similar features. The auditory region is similar to that of *Barnardius* and *Northiella*, and from the limited material I have been unable to detect any differences which might warrant the recognition of *Clarkona* and *Psephotellus* as proposed by Mathews (1931). Members of the genus are confined to the desert, arid and semi-arid moisture zones of Australia, and do not occur on Tasmania (humid).

Juvenile plumage: Generally speaking young birds resemble the adult female, and males usually assume the adult plumage during the first or second year. Young of both sexes exhibit a white "wing stripe".

Sexual differences: Females are always duller in colour than males. In *Psephotus haematonotus* the female lacks the red rump of the male, and is a dull green bird, with the rump of a brighter shade. From below the upper breast is pale olive-green instead of bright green, and the abdomen is whitish instead of yellow. Young males resemble the female, but are greener.

In *P. varius* the female has a dull red shoulder patch instead of orange-yellow as in the male, and there is no red abdominal patch, while the birds are generally duller. Immature males resemble the female.

In *P. dissimilis* the black of the head and back of the male is entirely absent in the female, which is green; also the extensive yellow on the wing is absent. The rump is blue, and the under tail coverts red as in the male. The wing stripe is present in the females of all the foregoing. Examples of both sexes of the forms *pulcherimmus* and *chrysopterygius* have not been examined.

PSEPHOTUS HAEMATONOTUS (Gould 1837).

Names: Red-backed Parrot, Red-rumped Parrot, Grass Parrot.

Range: New South Wales, Victoria, South Australia as far north as the Lake Eyre Basin South, and west of the Flinders Ranges.

Races: *Psephotus haematonotus haematonotus* (Gould 1837). *P.h. caeruleus* subsp. nov.

PSEPHOTUS HAEMATONOTUS HAEMATONOTUS (Gould 1837).

Synonym: *virescens* Mathews.

Large series of this species reveal that this bird is extremely variable throughout its range, older individuals apparently being much more brilliant in colour than younger ones. In the immature the male and female are approximately the same colour.

Specimens of males from semi-arid and arid areas, such as the Murray mallee and northern Flinders Ranges appear slightly smaller and paler, especially on the rump.

Range: New South Wales, Victoria, South Australia.

PSEPHOTUS HAEMATONOTUS CAERULEUS subsp. nov.

Adult male: Top of head beryl green instead of emerald green as in southern birds; back beryl green, slightly duller; rump grenadine red (instead of brazil red as in the typical form); upper tail coverts cobalt green (instead of Scheele's green); tail feathers with a wash of Tyrian blue (instead of a wash of bice green); cheeks and upper breast beryl green; lower breast wax yellow; abdomen and under tail coverts white; spurious wing pale yellow green, wing coverts beryl green; wing 124 mm.; tail 147 mm.

Range: Interior arid and desert areas of South Australia; type (B2237 in S. Aust. Museum) from Innamincka Station (Lake Eyre Basin), collected by the South Australian Museum Expedition, 30th September, 1916.

Remarks: This race differs from the typical form in its generally bluer coloration, and paler appearance; the size also is smaller.

The head and back present a uniform blue-green appearance, whereas in the typical form the head is much greener than the back.

A specimen from the National Museum, Melbourne, and said to have been taken at Cooper Creek (Lake Eyre Basin) by A. W. Howitt, of the South Australian Relief Expedition to Burke and Wills in 1861-2, is closer to the type of *caeruleus* than it is to the southern birds. The rump is of the same shade, but the colour of the head is intermediate between that of *caeruleus* and the Red-rumped Parrots of the northern Flinders Ranges. The upper surface of the middle tail feathers also much paler than in typical birds from the south, as in *caeruleus*.

For years there have been persistent reports of this small "blue" parrot in the arid interior of South Australia. A recent one is by Higginson (1938), who wrote: "Size a little longer than a Mulga Parrot (*Psephotus varius*), but slimmer and smaller than a Port Lincoln Parrot. Colour: head, back, wings and tail very bright turquoise-blue, something similar to a sky-blue Budgerigar (*Melopsittacus*), but of a slightly more greenish tinge, the head being a little darker in shade. . . . Just before the bird flew it turned around in the bush, and I noted a bar of dirty white or an extremely pale blue colour (? equals red—H.T.C.) about half an inch wide across the back just above the tail. This was the only break in the turquoise colour that I noted . . . . female (?) . . . . appeared to be a uniform drab green." The locality given was 391 miles north-west of Port Augusta.

This description suggests that the birds seen were *P.h. caeruleus*, but the locality given is a considerable north-westerly extension of the range hitherto accepted for *haematonotus*.

Range: Interior of South Australia, from the Lake Eyre Basin in the south extending westwards and northwards.

PSEPHOTUS VARIUS Clark 1910.

Names: Mulga Parrot, Many-coloured Parrot, and Varied Parrot.

Range: Mid-western Australia, South-west Australia, Central Australia, South Australia (dry interior), Victoria (mallee), interior of New South Wales, and south-western Queensland.

Races: *Psephotus v. ethelae* Mathews 1917 (?); *Ps. v. exsul* Mathews 1912 (?); *Ps. v. varius* Clark 1910; *Ps. v. orientalis* Mathews 1917.

PSEPHOTUS VARIUS ETHELAE Mathews 1917.

Characters; "Paler in general coloration, with less and paler red on the abdomen. A peculiar feature would be the retention of the female red shoulder coloration of the males."

Lack of sufficient material makes the status of this race doubtful, for examples seen from the region of the River Finke are of the typical form. On the other hand the type locality is situated in a hot desert region, and on theoretical grounds the race may prove recognizable when further specimens are collected.

Range: MacDonnell Ranges, Northern Territory.

PSEPHOTUS VARIUS EXSUL Mathews 1912.

Name; Western Varied Parrot.

Characters: "Differs from *P.v. varius* in its bluer coloration above and below, especially noticeable on the cheeks, which are blue, not green. Mount Magnet, West Australia." (Mathews, 1912).

No examples from the type locality have been seen, but specimens taken at Wiluna, near Lake Way, and only 150 miles away from Mount Magnet, are of the typical race, as are also those from Kalgoorlie. On theoretical grounds it may be possible to say that this form will be proved valid when further material is obtained.

Range: Western Australia (Mount Magnet, type locality).

PSEPHOTUS VARIUS VARIUS Clark 1910.

Synonyms: *multicolor* (Kuhl 1820); *dulcei* Mathews 1911; *rosinae* Mathews 1912.

Names: Mulga Parrot, Many-coloured Parrot, Southern Many-coloured Parrot.

According to Mathews (1917, p. 408) the type was taken at the head of Spencer Gulf, South Australia. A series of specimens shows that this form has less red on the abdomen than any other race except *ethelae*. There is also much individual variation, both in size and colour.

Range: Interior of Western Australia, Eyre Peninsula, Yorke Peninsula, and northern South Australia.

PSEPHOTUS VARIUS ORIENTALIS Mathews 1917.

Examples taken from various localities in the range given below are at once distinguished by the generally brighter coloration and deeper and more extensive red patch on the abdomen in the male.

Range: Mallee areas of South Australia, Victoria, and New South Wales, also southern Queensland.

PSEPHOTUS PULCHERRIMUS (Gould 1845).

Names: Paradise Parrot, Beautiful Parrot, Ground Parrot, Elegant Parrot, and Anthill Parrot.

Synonym: *dubius* Mathews.

The only example seen by the writer is a mounted specimen of a male in the collection of Dr. A. H. Lendon. Mathews originally named one subspecies *P.p. dubius*, the characters being "darker above" than the typical form. The author retracted his proposal in 1917, saying that the differences were probably based on individual variation. A complete account of the re-discovery of the species is given by Chisholm (1922).

Range: Semi-humid districts of south-eastern Queensland, as far north as Rockhampton, and south to Northern New South Wales.

PSEPHOTUS CHRYSOPTERYGIUS Gould 1858.

Names: Golden-shouldered or Golden-winged Parrot.

Synonym: *nova* Mathews.

Range: Cape York Peninsula (western portion), North Queensland.

PSEPHOTUS DISSIMILIS Collett 1898.

Names: Hooded or Black-hooded Parrot.

Synonyms: *cucullatus* North; *blaauwi* Van Oort; *dorotheae* Mathews.

Although Peters (1937) has again relegated this form to subspecific rank, the weight of evidence seems to indicate that it is a separate species (e.g. see LeSouef and Kinghorn, 1924). There is little doubt, however, that the two forms, *chrysopterygius* and *dissimilis*, on structural grounds, are very closely allied.

Range: Semi-arid areas of the Northern Territory from Darwin, east to Gulf of Carpentaria.

SUMMARY.

As a result of this review, it is shown that further collecting is still required before the status and distribution of many races can be properly understood. This applies particularly to forms inhabiting the Interior and Northern parts of the Continent. There appears to be a close correlation between climate and the occurrence of geographical races, although careful ecological studies may be required in some instances to confirm this finding. Nine races proposed by Mathews in his 1931 List are not recognizable from available material, and are almost certainly not valid; five others are only doubtfully distinct. Two forms of *Platycercus* previously regarded as full species are relegated to subspecific rank, as also are two of *Barnardius*. Although not recognized by Peters (1937) *Barnardius* is considered a valid genus on osteological grounds. A further race of *Psephotus haematonotus* has been described, and Salvadori's (1891) conclusions are confirmed that the Australian Broadtailed Parrots should be recognized as a distinct subfamily, the Platycercinae.

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EXPLANATION OF PLATE.

Plate viii.

Red-backed Parrot (*Psephotus haematonotus caeruleus* Condon). Adult male, from Innamincka, South Australia.

RED-BACKED PARROT

Psephotus haematonotus caeruleus Condon

SOME NEMATODES FROM KANGAROO ISLAND, SOUTH AUSTRALIA

BY T. HARVEY JOHNSTON AND PATRICIA M. MAWSON, UNIVERSITY OF ADELAIDE

Summary

The parasites recorded in this report were collected at Flinders Chase by members of the Ralph Tate Society, led by Dr. C. T. Madigan, during an excursion to Kangaroo Island in January, 1940. For identification of some of the hosts we are indebted to the staff of the South Australian Museum, in which institution the types of the new species have been deposited. We thank the Trustees of the Flinders Chase Sanctuary for permission to collect the material studied; and acknowledge assistance received from the Commonwealth Research Grant to the University of Adelaide. The specific name kartana given to several of the new parasites is based on Karta, which, according to Tindale and Maegraith (Rec. South Austr. Mus., 4 (3), 1931, p. 286) is the native name for Kangaroo Island.

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Fig. 1–14.

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List of hosts and nematodes identified:

Hyla jervisiensis Dumeril and Bibron: *Hedruris hylae* sp. nov.; *Aplectana flindersi*, sp. nov; *Raillietnema kartanum* sp. nov.

Varanus gouldi Gray: *Physaloptera antarctica* Linst. (var. *typica* Irw. Smith).

Hemiergis peroni (Fitzinger): *Thelandros kartana* sp. nov.

Gymnodactylus milii Bory de St. Vincent: *Pharyngodon kartana* sp. nov.

Thylogale eugenii Peron and Lesueur: *Cloacina curta* J. and M.; *C. petrogale* J. and M.; *Zoniolaimus eugenii* J. and M.

Thelandros kartana sp. nov.

Fig. 1–3.

From a lizard, *Hemiergis peroni*.

Males about 2 mm. long; females 4·5 to 6·3 mm. long. Head rounded; six low lips each with small papilla. Mouth leading to vestibule 15μ wide, 12μ long, with three rounded teeth at base. Oesophagus long (0·34 mm. in male; up to 1 mm. in female), narrow, ending in bulb. Nerve ring 0·15 mm. from head end in female 4·9 mm. long.

Male: Anus on prominence about 15μ in front of rounded posterior region from which projects the tail, 50μ long. One pair adanal papillae; one pair postanal, more laterally situated; one median postanal; a pair nearly midway along narrowed portion of tail. Spicule 55μ long, very slightly chitinized.

Female: Tail 0·36–0·4 mm. long, tapering to sharp point. Vulva 1·5 mm. in front of posterior end of body. Eggs 75–90μ by 35–45μ, with pitted shell.

The species resembles closely *T. maplestoni* (Chatterji) Baylis 1936 in general form and size, but differs in the length of the tail and the spicule in the male, the position of the vulva, the number of lips and the presence of cephalic papillae.

Pharyngodon kartana sp. nov.

Fig. 4–6.

From two geckoes, *Gymnodactylus milii*.

Males 2·2–2·6 mm. long; females 4–5 mm. Head with three low lips; buccal cavity funnel-shaped, chitinized, 10μ long in male. Oesophagus 0·33 mm. long in male, 0·47 mm. in female; its terminal bulb with chitinous blades. Nerve ring 0·15 mm. and excretory pore 0·56 mm. in male, 0·62 mm. in female, from head end. Excretory pore large, circular, with strongly chitinized margin; the structures variously described as "cilia" and "bristles" present, but appearing in our specimens rather as grooves or creases on posterior part of margin; pore leading directly to spherical vesicle connected with two anterior and two posterior lateral ducts.

Male: Tail characterized by great length of narrow terminal portion, 0·3 mm. long. Lateral alae extending from mid-oesophageal region to anterior end of caudal alae, widening gradually to greatest breadth just before termination. Anterior (preanal) pair caudal papillae sessile; near their bases a projection of body wall supporting anterior end of caudal alae. Adanal pair papillae bifurcated; postanal pair wide, conical, included in alae. Posterior lip of cloaca projecting as blunt spike. Spicule, if present, very lightly chitinized, 60μ long.

Female: Tail tapering suddenly 0·25 mm. posterior to anus, ending in long narrow portion 0·95 mm. long, provided with about seven spines on proximal two-thirds of length. Vulva immediately behind excretory pore. Eggs 115μ x 30μ with one side slightly flattened, and with plug-like structure at each end, embryo in early segmentation.

This species agrees with *P. tiliquae* Baylis from *Tiliqua scincoides* from Queensland, and with *P. hindlei* Thapar from the same host species (recorded in error as *T. scincordis*) in the number and arrangement of papillae on the male tail, but differs in the length of the tail in both male and female, and in the size of the spicule (if present). It also differs from *P. tiliquae* in the width of the lateral alae in the male; and from *P. hindlei* in the absence of two additional pairs of papillae. It differs from *Pharyngodon* sp. Thapar 1925 from *Egernia cunninghami* in the absence of spines on the female tail, as well as in the length of the latter.

RAILLIETNEMA KARTANUM sp. nov.

Fig. 7–8.

From a frog, *Hyla jervisiensis.*

Males 3–3·3 mm. long; female 4 mm. Lateral alae present in both sexes, in male extending to cloaca, in female to level of caudal papillae. Mouth with three lips; presence of cephalic papillae doubtful—true buccal cavity absent but chitinous lining of oesophagus covers inner border of each lip and projects as three thin plates resembling elements of a leaf crown. Oesophagus 0·48 mm. long in male, narrow, with terminal bulb longer than wide. Nerve ring at about midlength of oesophagus. Excretory pore slit-like, at level of anterior end of bulb.

Male: Caudal alae with seven pairs pedunculate papillae; also six sessile preanal pairs, three adanal pairs, a pair at midlength, and a pair near tip of tail. Body gradually narrowing posteriorly to anus; tail 0·14 mm. long, ending in sharp point. Spicules 0·13 mm. long, subequal, similar, acicular, not strongly chitinized but marked with transverse striations.

Female: Tail 0·3 mm. long, tapering to blunt point; pair of caudal papillae 0·12 mm. from tip. Only specimen present is immature, with eggs not yet fertilized and vulva not recognizable.

We assign the species to *Raillietnema* with some reserve. It agrees in the possession of caudal alae and the absence of a gubernaculum. It differs from the type species of *Oxysomatium* in these features, as well as in the number of cephalic papillae; and from other species of the genus in the number and arrangement of the caudal papillae and in the length of the spicules.

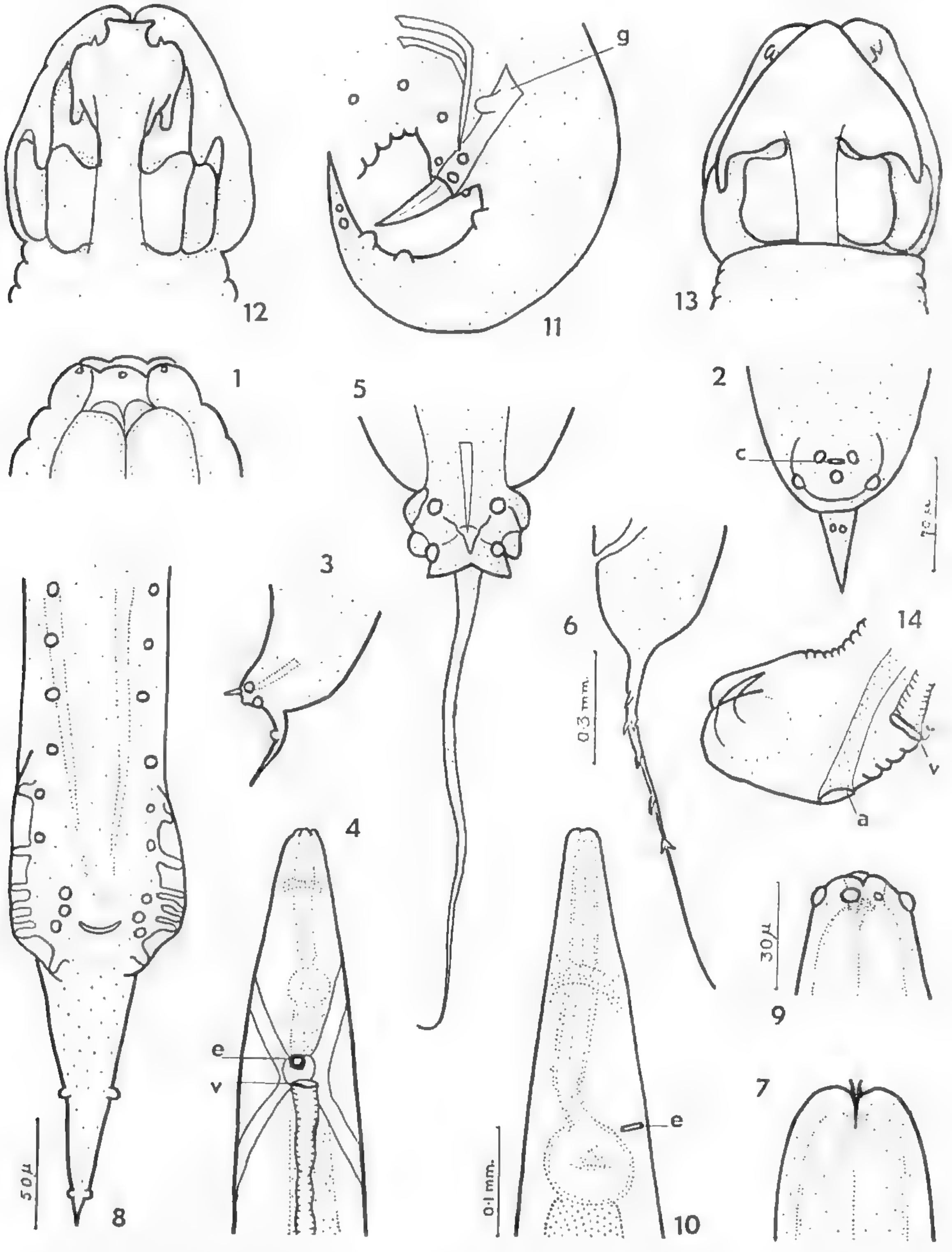

Fig. 1–3. *Thelandros kartana.* 1, head; 2, male tail, ventral view; 3, male tail, lateral view.

Fig. 4–6. *Pharyngodon kartana.* 4, anterior end; 5, male tail; 6, female tail.

Fig. 7–8. *Raillietnema kartanum.* 7, head; 8, male tail.

Fig. 9–11. *Aplectana flindersi.* 9, head; 10, anterior end; 11, male tail.

Fig. 12–14. *Hedruris hylae.* 12, head, lateral view; 13, head, ventral view; 14, tail, lateral view.

Fig 1, 7 and 9 to same scale; 2, 3, 5 and 11; 4, 6 and 14; 10, 12 and 13. a, anus; c, cloaca; e, excretory pore; g, gubernaculum; v, vulva.

APLECTANA FLINDERSI sp. nov.

Fig. 9–11.

From a frog, *Hyla jervisiensis.*

Only one male available, 2·1 mm. long. Head with three shallow lips; behind latter four large and two small papillae. Buccal cavity 10μ wide, 7μ long, with three teeth at base. Oesophagus 0·34 mm. long (including posterior bulb, 70μ long, 80μ wide); bulb slightly constricted from remainder. Nerve ring 0·13 mm. from head end. Excretory pore slit-like, at level of anterior end of bulb. Posterior end curved ventrad; tail about 0·17 mm. long, tapering to point. Two pairs precloacal papillae. Cloaca on elevation surrounded by three pairs small papillae; laterally from latter two pairs; posteriorly five pairs arranged as in fig. 11. Spicules similar, equal, 110μ long, very fine but well chitinized. Gubernaculum 130μ long, much stouter and more strongly chitinized than spicules, and protruding through cloaca; with two stout lateral projections near proximal end.

We have assigned the species to *Aplectana* because of the presence of a buccal cavity, two equal spicules and a gubernaculum. It is distinguished from other species of the genus of which accounts are available, by the large size of the gubernaculum relative to the spicules.

HEDRURIS HYLAE sp. nov.

Fig. 12–14.

From a frog, *Hyla jervisiensis.*

One female present; 9 mm. long, 0·55 mm. wide. Head 0·23 mm. long, 0·23 mm. in maximum breadth. Lips narrower than interlabia, but of essentially similar shape; each lip and interlabium with a median, two antero-lateral and two postero-lateral projections; median anterior projection on lips more sharply differentiated from anterio-laterals; each latter with small conical papilla. Oesophagus ending 1·4 mm. behind anterior end. Nerve ring at 0·35 mm. and excretory pore at 0·43 mm. behind head end. Cervical papillae very small, 0·54 mm. behind base of lips. Sucker-like invagination of tail in dorsal position, hook 0·3 mm. long. Anus 0·35 mm. from posterior end; vulva 0·2 mm. in front of anus; eggs thick-shelled, 35μ diameter.

The species differs from all others whose description is available to us, in the shape of the lips. The genus had not been identified previously from Australia.

OTHER SPECIES OF NEMATODES.

The parasites listed above from the Kangaroo Island wallaby, *Thylogale eugenii,* and from the lizard, *Varanus gouldi,* present no new features of interest.

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CEREMONIAL OBJECTS OF THE DIERI TRIBE, COOPER CREEK, SOUTH AUSTRALIA

(OCHRE BALLS, WOVEN STRING WRAPPERS, AND POINTING STICKS) CALLED THE "HEARTS OF THE TWO SONS OF THE MURAMURA DARANA"

BY T. VOGELSANG, SOUTH AUSTRALIAN MUSEUM

Summary

Among recent ethnological acquisitions the South Australian Museum has received (Reg. No. A.31127) a large parcel of pointing sticks, two large oval balls apparently made by successive layers of ochre and grease, enclosing some sort of core, and two pieces of woven string wrapper, the whole packed in a heap of ochre and grease-stained emu feathers. The two oval balls are the "hearts" of the two sons (Dara-ulu) of the great Dieri mythical being Darana.

CEREMONIAL OBJECTS OF THE DIERI TRIBE, COOPER CREEK, SOUTH AUSTRALIA

(Ochre Balls, Woven String Wrappers, and Pointing Sticks) called The "Hearts of the Two Sons of the Muramura Darana"

By T. VOGELSANG, South Australian Museum.

Among recent ethnological acquisitions the South Australian Museum has received (Reg. No. A.31127) a large parcel of pointing sticks, two large oval balls apparently made by successive layers of ochre and grease, enclosing some sort of core, and two pieces of woven string wrapper, the whole packed in a heap of ochre and grease-stained emu feathers. The two oval balls are the "hearts" of the two sons (Dara-ulu) of the great Dieri mythical being Darana.

Ngantjalina, a member of the Darana Totem, has informed the writer that these two objects have been for several generations under the care of a trustworthy person aided by a council of six or seven men and women. When the father of Ngantjalina grew old, he requested his son to take over the charge of these sacred stones, but the son, who lived at the now abandoned Killalpaninna Mission, refused, saying that the secrets and beliefs in connection with these hearts did not agree with his Christian outlook.

In attempting to learn details of the secrets, I requested Ngantjalina to mention some of the beliefs, but he refused, saying that he had promised his father never to give away the secrets and he felt that he could not break his word. Instead he told me that there were quite a number of dangerous pointing sticks preserved in the parcel, together with the "hearts". Each of the sticks had been used in the killing of a person who had attempted to give away the secrets of the cult; for fear of these sticks, none of the members of the council would give them up, or mention anything about them.

Mr. N. B. Tindale points out that several of the sticks are of the slender double-ended kind used in the Murray River district as killing agents; the victim was seized and the stick, previously soaked in dead body juices, was forced into the body cavity inside the anus so that there was no external wound.

Ngantjalina further stated that from his father and grandfather he had learned that Darana was the most powerful Muramura of them all. He was the first one to come out of the earth. Darana came out of the earth at Kandrimoku Lake, about 16 miles east of the late Killalpaninna Mission Station, on the Cooper's Creek, was the controller of the sky, and of the winds, and could cause droughts and make rain to fall, especially around Pandu Pirna (Lake Hope). Once a great number of 'muluru or Witchetty grubs appeared in the ground after a heavy rain, the Muramura Darana gathered together a great many of them by singing one of his songs; he dried them and put them into string bags which he hung on a tree. When his two sons, the Dara-ulu, came to the place and saw the bags hanging, they mischievously threw their boomerangs at them. One of them struck a bag, causing a great rent in it; dust poured out and blew everywhere, the far-reaching clouds of dust darkened the sun and caused a terrible drought.

During the drought Darana was asked by one of his friends, another Muramura, to come and share a 'paua or grass seed feast. He went to his friend's country, taking all his starving people; some were cripples and others were so weak that "they crawled along on their elbows." When the Muramuras learned what the Dara-ulu youths had done by their mischievous scattering of the dried caterpillar dust, they quickly followed and strangled them. The old Muramura Darana interfered at once with their intention and magically brought the lads back to life again. However, they were again both strangled and the Muramura rolled their bodies up to form the two egg-shaped "hearts" which have now been revealed. To this day the natives believe that the Dara-ulu objects bring rain, and at every rain-making ceremony the two stones were freshly smeared with fat.

An event at Killalpaninna, about the year 1917, while the writer was at the Mission station throws indirect light on the significance of these objects. An old native named George frequented the camps near Killalpaninna; he was one of the members of the Darana cult. Indeed, he claimed to have received, from Darana, special powers enabling him to kill people with the aid of lightning or by means of ['Marda turu]—literally "stone fire"—that is, by aid of meteors. At the time of the incident George was living in a camp at a place about a quarter of a mile west of the Killalpaninna Station, with his "niece" (exact social relationship not known) and her husband, named Ned. Every morning before sunrise, for over a week, George kept the camp awake by shouting boasts in a singing voice and talking about the power he had of killing others by means of ['Marda turu]. In the course of his boastings, he claimed to have used this power upon some women at Murnpiowi. It was about this time that a meteorite actually fell at Murnpiowi and shortly after several individuals died. A cast of this meteorite is in the South Australian Museum. The continued boasting so annoyed Ned and his wife, that the latter struck him unconscious with a fighting boomerang, and he was then dispatched by Ned. Some details of the killing of George are mentioned by Horne and Aiston ("Savage Life in Central Australia," pp. 147-8). The information there recorded was principally supplied by myself. A few of the details of the published record are confused; George was not a true "kurdaitcha," and the incident of the killing by lightning was at Murnpiowi, not Innamincka. The old man when attacked by his "niece" retired only a short distance away, not to Nganangana Lake. The weapon used in the killing was a 'mariwira or fighting boomerang. Mr. Aiston did not hear the actual challenge as he was at Mungeranie, fifty miles away, during the period of the events narrated.

The writer has known of these two sacred objects of the Darana totem for many years, and for the last eight years has followed the movements of the natives who have had charge of the stones, in the hope that they might be secured eventually for this Museum. This was done by corresponding with natives who had grown up with me and who can read and write in their own language. I first heard of the objects when they were kept at Murnpiowi. Later on they were taken to Kunauwina (Kanowinna), then to Kaladear Bore, whence they were returned to Murnpiowi. From this place they were taken to Pandipandi, thence to Kurinima, and lastly back to Kunauwina where the last member of the council died. They were dispatched from Kunauwina to the South Australian Museum.

LITERATURE.

Howitt, A. W. (1904): Native Tribes of South-East Australia, p. 396 (after Gason) and pp. 798–800.

REVISION OF THE GHOST MOTHS[1] (LEPIDOPTERA HOMONEURA, FAMILY HEPIALIDAE)

PART V.

By Norman B. Tindale, B.Sc., South Australian Museum

Summary

Sahyadrassus Tindale 1941.

Sahyadrassus Tindale, 1941, p. 26 (footnote).
Antennae tapering, cylindrical, short, sparsely ornamented with hairs, composed of about twenty segments. Mouth much reduced, labial palpi short, two-segmented, each segment spherical and subequal in length. Traces of mandibles present as circular discs at base of hypopharynx; traces of feebly chitinized maxillary palpi visible in microscope mounts. Posterior legs of male with tabiae clothed with a tuft of specialized orange coloured hairs. Forewings with Sc_1 absent; R_s from before middle; R_2 and R_3 short-stalked; R_4 from R_5 before r-m vein. Cu_2 obsolete in distal half. Pcu anastomosed with Cu_2 to well beyond cuf, then Y-forking with 1V. Hindwings with Sc_1 absent ; Pcu obsolete in male except for traces at base; 1V and 2V present, but the latter reduced (in some species 1V and 2V may be approximated at base and 2V much reduced); in females all three vannal veins Pcu, 1V and 2V are usually present.

REVISION OF THE GHOST MOTHS[1] (LEPIDOPTERA HOMONEURA, FAMILY HEPIALIDAE)

PART V.

By NORMAN B. TINDALE, B.Sc., South Australian Museum.

Plates ix–xi, and Text Figs. 1–30.

Sahyadrassus Tindale 1941.

Sahyadrassus Tindale, 1941, p. 26 (footnote).

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Genotype: *Phassus malabaricus* Moore.

Differs from *Endoclita* in the absence of vein Sc_1 in the forewing, in the number of vannal veins of hindwing, and in the mouth parts.

The genus was briefly defined in a footnote to a previous page of these studies.

The absence of Sc_1 in all the principle Hepialids of this group from the Western Ghats and its presence in all members living in the Himalayan subregion is of some theoretical interest.

S. malabaricus seems to represent most closely the archetype of the present genus, and shows relationships with *Endoclita chalybeata*, its parallel form in the Himalayan subregion. It may therefore be considered to be an old continental Indian specialization of the more generalized genus *Endoclita*.

Some members of *Sahyadrassus* have developed curious modifications of wing form; these reach their extreme in the male of *S. albofasciatus* in which the apical portions of the wing have become elongated, and the posterior halves dilated. The venation is similar to that found in the genotype.

The distribution of Hepialids in the Western Ghats appears to be strongly governed by rainfall. Not only does a high summer rainfall seem necessary for their existence, but the continuance of some measure of rain is also required in the critical periods November to December, and March to May, when the imagines appear. The area occupied by these insects therefore, does not extend much further north than Mangalore or south of Cochin. Within this high rainfall belt species are known from about sea level to 8,000 feet elevation.

The species of *Sahyadrassus* may be readily keyed by means of characters of the genitalia:

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(1) Pt. IV was published in these Records VII, No. 1, Oct. 27th, 1941, pp. 15–46.

KEY TO THE SPECIES OF SAHYADRASSUS.

a. Males.
  b. Tegumen with strongly chitinized processes meeting in the mid-line.
    c. Posterior extremity of tegumen with posteriorly directed lateral spine .. *malabaricus*
    cc. Posterior extremity of tegumen with spine directed towards mid-line .. *magnus*
  bb. Tegumen with strongly chitinized processes not meeting in mid-line.
    d. Tegumen with margin spine-like .. .. *albofasciatus*
    dd. Tegumen with margin not spine-like .. .. *viridis*
      e. Teguminal margin broadly triangular when viewed from below *strobilanthes*
      ee. Tegumen rounded when viewed from below .. .. .. *viridis*
aa. Females.
  f. Eighth sternite with posterior extremity notched.
    g. Eighth sternite upturned at extremity .. .. *malabaricus*
    gg. Eighth sternite not upturned at apex .. .. *albofasciatus*
  ff. Eighth sternite with posterior extremity not notched .. .. .. *strobilanthes*

SAHYADRASSUS MALABARICUS (Moore).

Plate ix, fig. 78–79, Plate x, fig. 81, and Text fig. 1–3, 5–6.

Phassus malabaricus Moore, Proc. Zool. Soc., 1879, p. 412.

Phassus malabaricus Hampson, 1892, Fauna Brit. Ind., Moths, I, p. 321.

♂ Head, thorax and legs dull brown, posterior legs with tibiae clothed with dense orange hairs: abdomen pale brown with fawn pubescence which has a pink tinge at base. Forewings dull brown with whitish-fawn suffusions and bands; costa brownish, ornamented with about nine irregularly spaced, semilunate, and ovate small black spots, each margined with pale fawn; a large obliquely placed sub-rectangular brown patch in middle of wing, its inner angle terminated by a lunate creamy-white spot, surrounded by brown, its distal extremity at r-m vein also marked by a pair of white spots, a series of subterminal fawn suffusions from near apex to hind margin at two-thirds; between these two is a rather well defined brown fascia, slightly bent outwards at R_5 and bearing traces of darker markings between the veins; hind margin broadly suffused with pale fawn, with slightly darker elongate, ovate marks between the veins. Hindwings dull fawn with a pink tinge. Expanse 78 mm.

♀ Much larger, markings paler, much more suffused than in male, but with same general pattern. Expanse 128 mm.

Loc. North Kanara: Karwar 6, 7. Sirey (type, a male, t. Moore) Yellapur 6. South Kanara: Mangalore (400 ft.) 6, Barkur 6. Coorg: Tithimatti Reserve 5; Mercara 4,000 ft. 5. Nilgiri Hills: Coonoor, Ootacamund (allotype female, expanse 126 mm., labelled "Ooty. Nilgiris, Dr. Day, Moore Col., 94·106" in British Museum). South Malabar: Nilambur 6. 6 males, 8 females.

The type male (from Sirey in North Kanara) is missing from the Moore Collection at the British Museum, but the allotype female from Ootacamund is preserved and has been studied.

Females are variable in size; the smallest examined is a well-marked example from North Kanara expanding only 67 mm. while the largest, from Yellapur measures 130 mm. Large examples are generally duller in colour and less well-marked than smaller ones, which usually bear a close resemblance to the males.

The male described, which in the absence of the type specimen may be regarded as the neotype, is a typical example from Coorg.

The male genitalia have been drawn from the dissection of an example from Mangalore (text fig. 3). The eighth sternite is strongly and rather evenly concave, the vinculum is of the rather familiar triangular form; the tegumen has a strongly chitinized median prolongation which runs in an oblique direction towards the mid-line. In the undissected specimen this appears as a keeled ridge obliquely directed towards the middle and bearing series of minute and obscure serrations. The posterior extremity of the tegumen is drawn out into a posteriorly directed spine; the harpe is a simple club-shaped process.

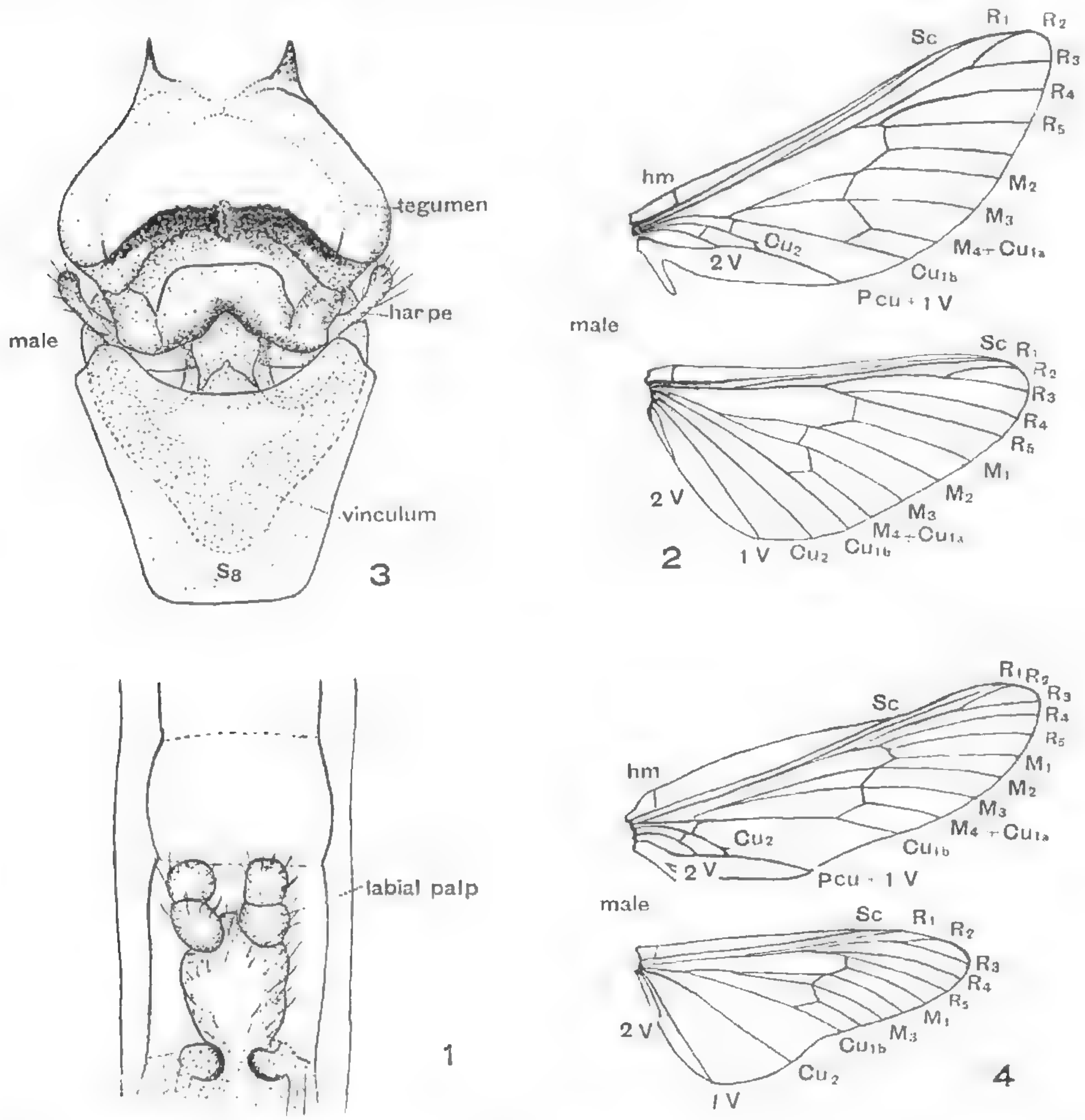


Fig. 1–4: 1–3 *Sahyadrassus malabaricus* Moore, male, South Mangalore; 1. labial palpi; 2. venation; 3. male genitalia, dissected; 4. *S. albofasciatus* Moore, venation of male.

The female genitalia, drawn from the described example from Yellapur (text fig. 5–6) have the seventh sternite sub-rectangular, with the posterior margin straight. The eighth sternite, viewed from below, is a swollen, posteriorly notched, process which is upturned near the apex; the anterior gonapophyses are triangular plates; the posterior gonapophyses are rather smooth, rounded, obliquely disposed processes overlying the eighth sternite; the inner fold of the penultimate tergite bears a curious irregularly notched subrectangular projection; this divides the space enveloped by the hood-like tergite and presents what becomes almost a circular posterior aperture for the oviporus.

This species has a wide distribution within the areas of higher rainfall in South India, occurring not only in evergreen forested areas of high equable temperatures and high rainfall (116 inches) as at Karwar headland, but also in the deciduous forests and on the plateau of the Western Ghats up to 6,500 feet above sea level, where the temperatures and rainfall are lower (rainfall 63-67 inches), and there is a dry period from December to April.

In common with *Endoclita chalybeata* this species is a pest of teak. Its list of known host plants is much longer than in *chalybeata*, so that it may be regarded as a general feeder.

The following series of specimens (most of them reared) have been submitted for identification by the Forest Research Institute at Dehra Dun.

No.		Sex.	Date.	Host Tree.
4	S. Mangalore	Male	7th June, 1930	*Gmelina* sp.
6	Tithimatti	"	2nd May, 1923	"on leaf"
3	S. D. Kanara	"	19th May, 1923	*Macarange tomentosa*
2	S. D. Kanara	Female	10th May, 1923	*Macaranga tomentosa*
5	Mercara	"	11th May, 1933	*Macaranga Roxburghii*
1	Nilambur	"	5th June, 1933	*Tectona grandis*

I am indebted to Mr. T. R. Bell for some material of this species from North Kanara. Specimens are to be found in the British, Harvard University and South Australian Museums.

Sahyadrassus magnus sp. nov.

Text fig. 7.

♂ Head, thorax, legs and abdomen ochreous, the abdomen at base clothed with dull pink hairs, posterior legs ornamented with large tufts of ochreous-pink hairs. Forewings rather uniformly dull golden-yellow with traces of transverse markings like watermarks, between the veins; veins prominent, costa with obscure dull watermarkings; a silvery-white semilunate mark above and just beyond base of $M_1 + M_2$ and traces of two others at r-m vein. Hindwings dusky ochreous pink, veins prominent. Expanse 116 mm.

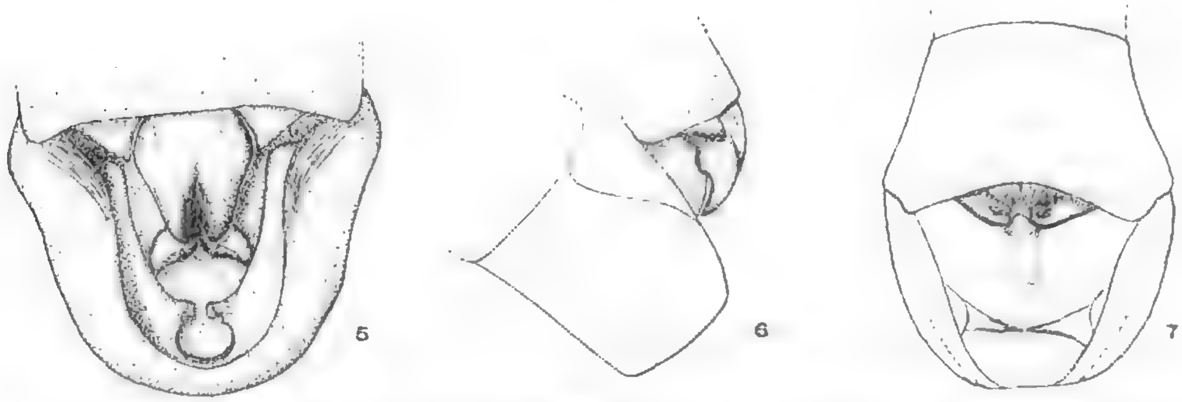


Fig. 5-7, 5-6: *Sahyadrassus malabaricus* Moore; 5. female genitalia, ventral aspect; 6. ditto lateral aspect; 7. *S. magnus* Tindale, male, Palni Hills, genitalia, ventral aspect.

Loc. South India: Palni Hills (type, a male, unique, I. 18936 in South Australian Museum).

This is a distinctive species because of its large size, dull golden-yellow forewings and pink-tinged hindwings. If the usual sex ratios for size hold in this species, we may expect the female to measure upwards of 160 mm. in expanse, and to be one of the largest of Indian Hepialids.

The environment of this species is among the grass covered downs and thickly wooded valleys of the plateau of the Palni Hills, where the annual rainfall of 65 inches is rather evenly distributed throughout the year.

The male genitalia, examined without dissection in the unique type, have (text fig. 7) the posterior margin of the eighth sternite evenly concave; the tegumen, partly concealed beneath this sternite, runs obliquely to the mid-line, where its strongly chitinized posterior margin is rather evenly notched and joined to its opposite member; the aedeagus appears below it (in ventral view); a stout and long spine-like process, doubtless corresponding to the similarly situated and posteriorly directed spine of *S. malabaricus*, is present towards the anal extremity, it is directed towards the middle where it almost touches its fellow from the other side.

SAHYADRASSUS ALBOFASCIATUS (Moore).

Text fig. 4, 8–9.

Phassus albofasciatus Moore, Proc. Zool. Soc., 1879, p. 413, pl. 34, fig. 8,
Phassus albofasciatus Hampson, Ill. Lep. Het. Brit. Mus., vii, 1891, p. 67.
Phassus albofasciatus Hampson, Fauna Brit. Ind., Moths., i, 1892, p. 321.
Phassus albofasciatus Gaede, in Seitz Macrolep., x, 1933, p. 843.

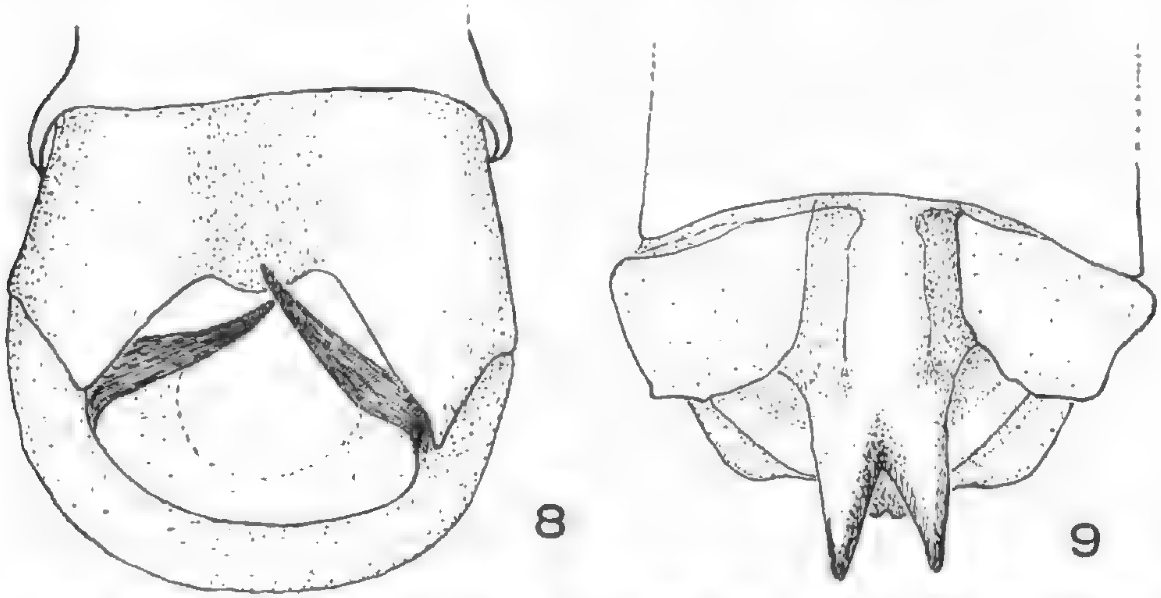


Fig. 8–9. *Sahyadrassus albofasciatus* Moore: 8. male, Nilgiri Hills, genitalia, ventral aspect; 9. female, Anshi, genitalia, ventral aspect.

♂ Head, thorax, and anterior and median legs dull umber brown, abdomen paler; posterior legs gaily clothed with long golden-yellow tibial plumes. Forewings elongated, narrow, basal half of hind margin dilated, costal margin irregularly concave at two-thirds, pale umber brown, slightly darker along costa and with traces of a broken longitudinal median fascia bearing white scales; margins, particularly near apex and along termen, marked with a line of fine black dots, a few others internally from the apex. Hindwings subhyaline, narrow, basal half of hind margin somewhat dilated, pale greyish-umber with traces of two minute black specks on costal margin just before apex. Expanse 65 mm.

♀ Similar to male, but larger, abdomen more ochreous-coloured, posterior legs not ornamented with yellow tibial plumes. Forewing not quite so narrow and basal half less dilated, markings somewhat as in male; the longitudinal fascia less apparent, but traces of numerous faint labyrinthine black markings slightly more evident over the wing. Hindwings with basal half of hind margin dilated as in male, dull greyish-umber without markings. Expanse 76 mm.

Loc. Nilgiri Hills (type, a male, exp. 65 mm., labelled "Nilgiris F. Moore Coll." and allotype female, exp. 84 mm. labelled "Nilgiri plateau 7,000–8,000 feet" in British Museum). North Kanara: Anshi 2.

The examples described have been compared with the types in the British Museum. The allotype female is an example described by Hampson in 1892; Moore's figure of the type is an excellent one.

The male genitalia, examined without dissection (text fig. 8) have the eighth sternite deeply notched, with a rounded projection in the middle; the tegumen has strongly chitinized, vertically produced and slightly anteriorly directed spinous processes, whose acute apices are not joined in the mid-line.

The female genitalia, when viewed from below (text fig. 9) have the posterior margin of the seventh sternite rather transverse and slightly but evenly concave; the eighth sternite is produced into a large, rounded, terminally bifurcate member, whose ventral surface is raised in a broad keel; the anterior gonapophyses are irregularly shaped flat plates, one on each side of the eighth sternite.

Examples of this strange species are preserved in the British, Tring, and South Australian Museum Collections.

SAHYADRASSUS VIRIDIS (Swinhoe).

Text fig. 10–11.

Phassus viridis Swinhoe, Cat. Lep. Oxford, i, 1892, p. 291 (November).

Phassus viridis Hampson, Fauna Brit. Ind., Moths, i, 1892, p. 321 (December).

Phassus viridis Pfitzner and Gaede, Seitz Macrolep., x, p. 1933, p. 843.

Phassus viridis Tindale, S. Aust. Naturalist, xix, 1938, p. 6, fig.

♂ Head, thorax, anterior and median legs green; posterior legs somewhat reduced, with tibial tuft of orange-yellow hairs; abdomen greyish-brown. Forewing rather uniformly dull green, with veins and ciliae distinctly indicated; a white quadrate spot at lower internal extremity of r-m vein, and a smaller one externally. Hindwings subhyaline, uniformly greyish-brown. Expanse 88 mm.

Loc. Nilgiri Hills (type, a male, expanse 88 mm., labelled "Nlghy Ms. No. 1350" in Oxford University Museum). 2 males.

The type example has been examined. It is the same one described by Hampson, who recorded the expanse as 86 mm. There is a second male example from the Nilgiri Hills in the British Museum (B.M. 1926—465). It was collected by Lt.-Col. J. C. Frazer and expands 76 mm. Both examples are closely similar in colour. The venation agrees closely with that of *S. malabaricus*.

The male genitalia of the type, drawn without dissection, are seen to have the hind margin of the eighth sternite rather strongly concave, while the tegumen is an evenly rounded and strongly chitinized lateral process; the two sides do not meet in the mid-line (text fig. 10–11). The extremity of the abdomen of the type could not be examined, but the form of the tegumen alone will enable it to be distinguished from all its known congeners, while the green colour of the forewings is unique in this section of the Hepialidae. Nothing is known about the life history, and from the rarity of this and other species in collections, it seems evident that the Hepialid fauna of the Western Ghats has as yet been imperfectly gathered.

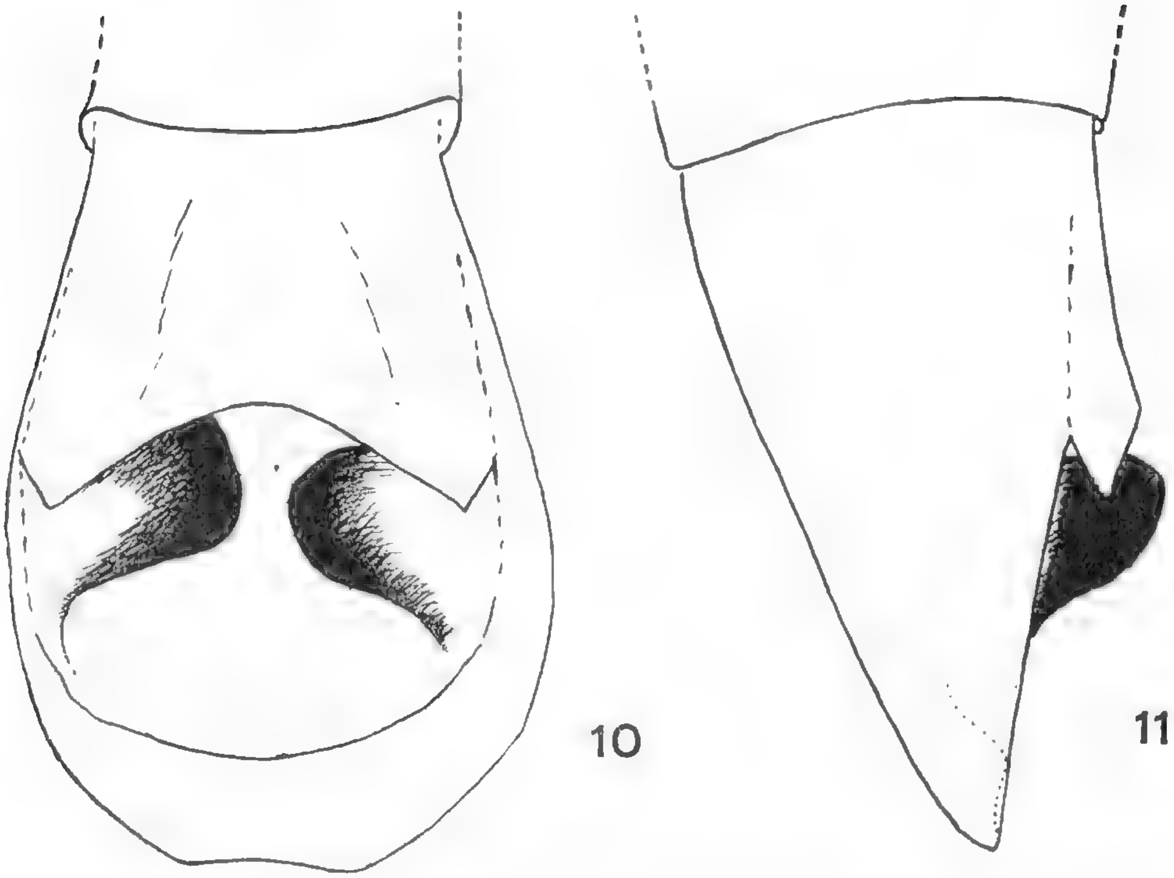


Fig. 10–11. *Sahyadrassus viridis* (Swinhoe), male, Nilgiri Hills: 10. genitalia, ventral aspect; 11. ditto lateral aspect, from freehand sketches of type.

SAHYADRASSUS STROBILANTHES sp. nov.

Plate x, fig. 82–83 and Text fig. 12–13.

♂ Head, thorax and abdomen pale greyish-fawn, legs slightly ochreous fawn, posterior tibiae with a small tuft of ochreous hairs. Forewings with costa straight or slightly concave and termen continuously rounded with hind margin brown with paler suffusions, a dull greyish-white fascia from costa at three-fourths to fork of Cu_{1a} and Cu_{1b} thence in an obscure band to base of wing; traces of a faint fascia parallel to termen from near apex to near hind margin where it is obsolescent. Hindwings subhyaline, brownish-fawn. Expanse 36 mm.

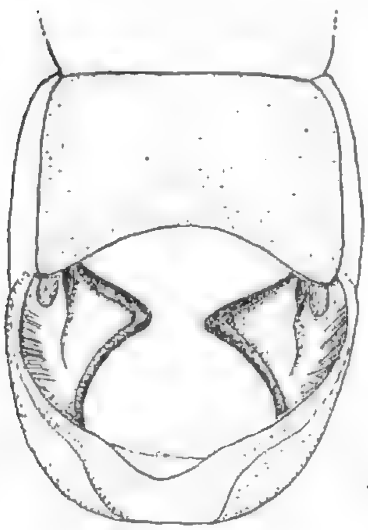
♀ Larger than male, forewings subhyaline, longer than in male, apex slightly more rounded, colour similar but with pale markings larger, more diffused, and with paler suffused areas more marked. Expanse 48 mm.

Loc. North Kanara: Anshi (1,800 ft.) 6. (Type, a male, 20th June, 1907, and allotype female, 23rd June, 1909, T. R. Bell, in British Museum, paratypes I. 18941 in South Australian Museum). 4 males, 5 females.

This is the smallest member of the genus. The males range from 36 mm. to 46 mm. while the females expand from 48 mm. to 60 mm. The wings are elongated as in *S. albofasciatus* but the hind margin is not expanded as in that species. A brown form of the male in which the forewing markings are almost suppressed and suffused with pale brown, is taken with the typical one; this may be known as *f. brunneus* (type, a male, expanse 44 mm., 9th June, 1909, T. R. Bell, in Br. Museum). Structurally the two forms are identical.

The species has been bred by Mr. Bell from a gregarious shrub, *Strobilanthes neesianus*, and I am indebted to him for material for study and description. At his request the types have been placed in the British Museum Collection.

The male genitalia have the seventh sternite with posterior margin evenly concave (text fig. 12); the tegumen in ventral view broadly triangular with the margin strongly chitinized and smooth; there is also a longitudinal lateral carina, widest anteriorly; the harpe is visible as a short, simple, digitiform lobe.



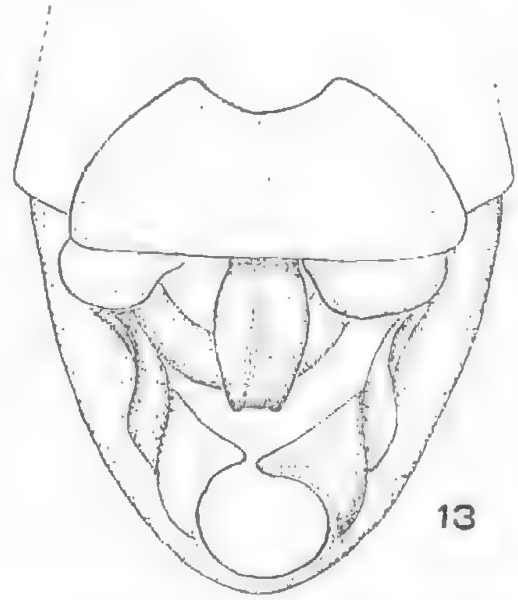


Fig. 12–13. *Sahyadrassus strobilanthes* Tindale; 12, type, male, Anshi, genitalia, ventral aspect; 13. allotype female, Anshi, genitalia, ventral aspect.

The female genitalia (text fig. 13) have the seventh sternite narrow, concave on the anterior margin, and transverse and wide on the posterior; the eighth sternite is a shovel-shaped process, ventrally rather feebly grooved, and with the posterior margin transverse; the anterior gonapophyses are smooth, shining, rounded plates; the ultimate tergite is rather complexly folded on the ventral surface, and the penultimate one has ventral spinous prolongations which nearly meet in the mid-line.

PALPIFER Hampson.

Palpifer Hampson, Fauna Brit. Ind., Moths, i, 1892, p. 316.

Palpifer Gaede, Seitz Macrolep., x, 1933, p. 844.

Antennae (text fig. 17) short, subcylindrical, somewhat subescent, composed of about 38 segments, towards apex with traces of incipient unipectination. Labial palpi well developed, densely clothed in pubescence and carried at an angle of 45° away from mid-line; apparently three-segmented, two basal spherical segments and a third, greatly elongated one, which bears an ill-defined suture near its apex (text fig. 18). Maxillary palpi not observed. Forelegs with moderate strigil-like fold at base of tibia. Median and posterior legs unarmed. Forewings with Sc_1 present; R_1 from R_s before middle; R_2 and R_3 short-forked, R_4 from R_5 after r-m vein; i-m cross vein after forking of M_1 and M_2; Cu_2 reduced, not extending to margin, Pcu apparently obsolete, 1V in male bearing a large scent gland near base. Hindwings with traces of Sc_1; R_1 from R_s before middle; R_2 and R_3 forked;

R_4 from R_5 after r-m vein; i-m cross vein very shortly after, or at, forking of M_1 and M_2.

Genotype: *Palpifer sexnotatus* Moore, designated by Hampson (1892).

The strigil-like fold at base of tibia is probably not homologous with the true strigil of many heteroneurous Lepidoptera. There is a curious scent sac situated on the base of 1V of forewing. This appears to be formed as an invagination from the dorsal surface of the wing on the line of 1V. Pcu in this insect is obsolete beyond the basal area unless it is represented by the vein, interpreted by Tillyard as the crossvein cu-a, which runs up to meet Cu_1, just beyond cuf. It would appear that the strong vein running to the margin is 1V while 2V is represented by a simple vein. This interpretation approaches that of Comstock and runs counter to the views of Tillyard, who regarded the strong analis vein as 1A. The interpretation of the origins of 1A differs however from that of Comstock who considered 1A to be fused with cu right from the base. The present view appears to reconcile the opposing theories of these two workers and seems to account for apparent anomalies such as the supposed entire disappearance of 3A (2V) from the forewing of the Hepialidae. It also makes possible a clearer interpretation of the venation of the forewing of some species of the genus *Sahyadrassus* whose venations are also discussed in this paper.

Material is scanty for several of the Indian species of this genus, two species are only known from badly preserved type specimens, and another one was described from a single type sample, the present location of which is unknown. The following key is, of necessity, based on obvious, superficial features. With more material the characters of the male genitalia should provide clear cut distinctions for, in the species studied, and in numerous Far Eastern forms, not yet described, they are highly characteristic.

Palpifer minutus Hampson, formerly referred to this genus, belongs to the homoneurous family Palaeosetidae and has been placed by Issiki and Stringer (Stylops, i, 1932, pp. 71 and 73) as the type of a genus *Genustes*.

KEY TO SOME SPECIES OF PALPIFER.

a. Wings opaque, well scaled.
  b. Hindwings with basal portion brightly ochreous, outer half dark brown.
    c. Forewings with several creamy yellow spots .. .. *sexnotatus*
    cc. Forewings without creamy spots (*fide* Hampson) .. .. .. *tavoyanus*
  bb. Hindwings with basal portion of wing dark, purplish-brown, and concolorous with rest of wing.
    d. Base of abdomen and portion of thorax ochreous, apex of abdomen dark brown .. .. *taprobanus*
    dd. Base of abdomen purplish-brown, and concolorous with apex of abdomen.
      e. Forewings with moderately large white spot between rf and mf *murinus*
      ee. Forewings with white spot reduced or absent .. .. .. *pellicia*
aa. Wings subhyaline, rather poorly scaled .. .. *umbrinus*

PALPIFER SEXNOTATUS (Moore).

Plate xi, fig. 84–85 and Text fig. 14–18, 22–23.

Hepialus sexnotatus Moore, Proc. Zool. Soc., 1879, p. 413.

Palpifer sexnotatus Hampson, Fauna Brit. India, Moths, i, 1892, p. 316, fig. 217.

Palpifer sexnotatus Pfitzner, Seitz Macrolep., viii, 1912, p. 437, pl. 54 d.

♂ Head, antennae, thorax, legs and greater part of abdomen dark brown, a dense clothing of hair at base of abdomen and on metathorax, dull yellowish-ochreous. Forewing dull rusty-brown with some eight white spots, two small subcostal ones faintly ochreous tinged at two-thirds and four-fifths, one at r-m vein, a group of three, one rather large and silvery-white, in basal fourth, traces of a smaller one near inner margin; a minute marginal black spot between Cu_{1b} and the analis vein. Hindwings with basal half bright ochreous-yellow, apical half and inner margin purplish-brown except for a subrectangular dull yellow terminal spot between veins M_1 and M_3. Expanse 25 mm.

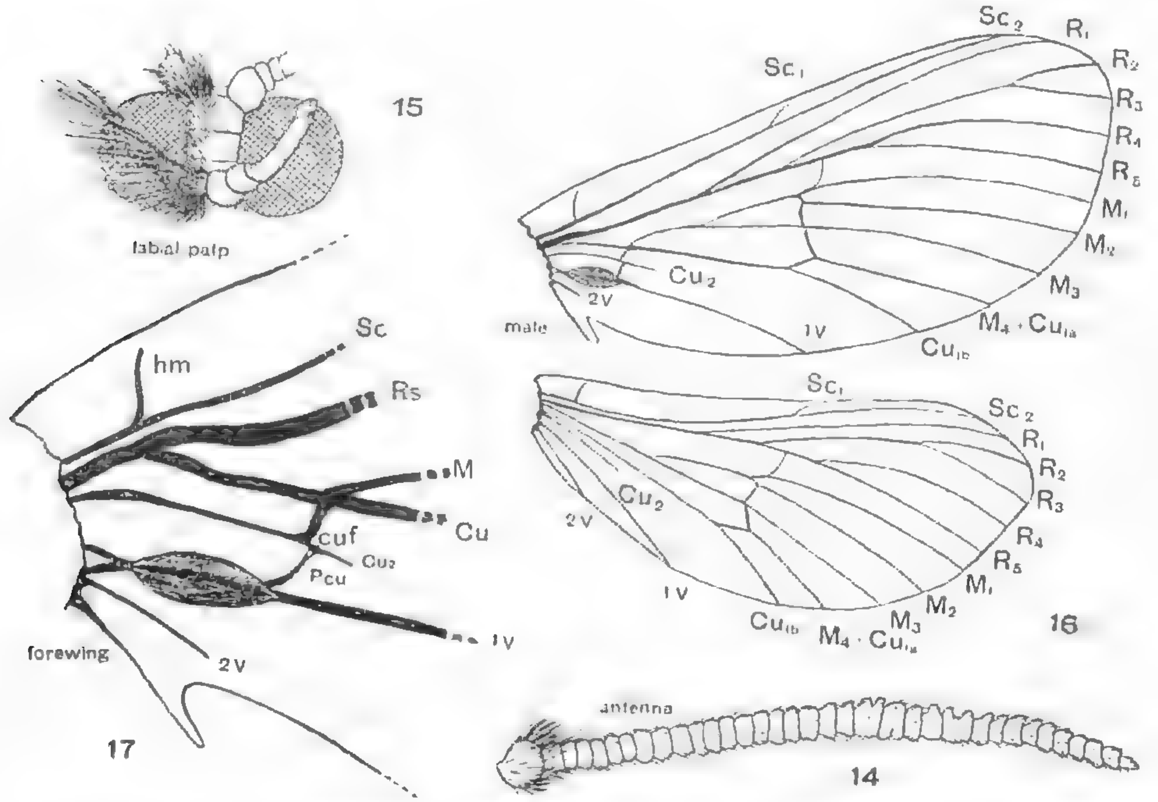


Fig. 14–17. *Palpifer sexnotatus* Moore, male, Nainital: 14. antenna; 15. anterior aspect of head to show labial palpi; 16. venation; 17. base of forewing, ventral aspect, to show scent gland.

♀ Larger than male; dense clothing of hair at base of abdomen and on metathorax brightly ochreous. Forewings rusty-brown with two rows of subterminal dark brown spots in outer half of wing; basal series of white spots well defined, black spot at posterior margin well defined. Hindwings with basal third bright ochreous yellow, rest of wing dark brown, with traces of terminal yellow spot between M_1 and M_3 as in male. Expanse 38 mm.

Loc. Sikkim: Darjiling, 7 (type, a female, abdomen missing, expanse 38 mm., labelled "Darjiling, Moore Coll. 94–106" in British Museum), Gopaldara, Mirik. Bhutan; Buxar, 8.

A female specimen in the South Australian Museum, from the type locality, agreeing closely with the type example, and a male from the Khasia Hills (pl. xi, fig. 84) have been used in drawing up the above description. Another female, from Khasia, has been figured (pl. xi, fig. 85).

Specimens are to be found at the British, Tring, Senckenberg and South Australian Museums.

P. murinus and *P. taprobanus* have been included in the synonymy of this species by some authors, but a close examination of the types and genitalia studies indicate that they are distinct.

The male genitalia have a broadly four-sided vinculum with straight anterior and posterior margins. The harpe has a large, expanded, and flattened hood-like sacculus and a long slender digitiform cucullus; the tegumen; is strongly chitinized with round, pointed antero-ventral extremity and double-spined posterior projection. Text fig. 18 has been drawn from a slide preparation.

The female genitalia (text fig. 22-23) drawn, without dissection, for comparison with a similar sketch of the type of *P. umbrinus*, shows a complicated process formed from what is probably the eighth sternite.

PALPIFER TAVOYANUS (Moore).

Hepialus tavoyanus Moore, Journ. Asiat. Soc. Beng., v, 1886, p. 98.

Palpifer tavoianus Hampson, Fauna Brit. Ind., Moths, i, 1892, p. 317.

♂ Pale, vinous brown; after-margin of metathorax and first segment of abdomen clothed with ochreous hairs. Forewing with some dark quadrate costal marks, others in and below the cell; an irregular medial band with dentate margin; a series of small marginal lunules and a black spot above outer angle; all these markings with narrow ochreous edges. Hindwing dark vinous brown, at base; ciliae ochreous from M_3 to posterior angle (after Hampson). Expanse 77 mm.

Loc. Lower Burma: Tavoy.

This species is not represented in any of the collections examined and the type has not been traced. The specimen is said to be a male; if correct this species should have a female even larger in size and thus much larger than any of the other known species. The generic placing may be in error.

PALPIFER TAPROBANUS (Moore).

Plate xi, fig. 87 and Text fig. 20–21.

Hepialus taprobanus Moore, Lep. Ceyl., iii, 1887, p. 545, pl. ccxii, fig. 6.

Palpifer sexnotatus Hampson (*nec* Moore), Fauna Brit. Ind., Moths, i, 1892, p. 317.

Palpifer sexnotatus form *taprobanus* Gaede, Seitz Macrolep., x, 1933, (part), p. 845.

♀ Head, palpi, thorax, abdomen and legs purplish-brown, a bright orange-coloured band of hairs at base of abdomen. Forewings purplish brown with a grey tinge, base densely clothed with darker brown scales, the distal area crossed by faint traces of darker brown broken zig-zag bands followed by a marginal row of spots; a single white spot above mf and a clearly defined black spot at margin between veins Cu_{1b} and 1V. Hindwings purplish-brown; costal margin and the ciliate tinged ochreous; the base clothed with orange-coloured hairs. Expanse 50 mm.

Loc. Ceylon; Wattegama 3 (type, a female, expanse 43 mm., labelled "W'gama, March, 1884, Moore Coll. 94–106", in British Museum). Kekirawa 11, Madulsima 11, 3 females.

The type in the British Museum has been examined, but it was not possible to study the genitalia. The one described, from Madulsima, is somewhat larger.

The species is quite distinct from *P. sexnotatus*; the bright orange at the base of abdomen, the single white discoidal spot, which is smaller in the described specimen than in the type, and the black spot at the hinder angle of forewings are characteristic. Unlike *sexnotatus* the brown markings of forewing are distributed all over the wing and are not confined to two subparallel bands and there is also no orange-yellow terminal mark between M_1 and M_3 of hindwings.

The female genitalia (text fig. 20-21) have the eighth sternite produced into a curious process, awl-shaped in ventral view, while what may be the penultimate tergite is in the form of a curiously lipped scoop; the homologies are uncertain.

PALPIFER MURINUS (Moore).

Plate xi, fig. 86 and Text. fig. 19.

Hepialus murinus Moore, Proc. Zool. Soc., 1879, p. 413

Palpifer sexnotatus Hampson (*nec* Moore). Fauna Brit. Ind., Moths, i. 1892, p. 317 (part).

Palpifer caerulescens Swinhoe, Ann. Mag. Nat. Hist. (6), xiv, 1894, p. 440 (new synonymy).

Palpifer caerulescens Hampson, Fauna Brit. Ind., Moths iv, 1896, p. 473.

Palpifer coerulescens Pfitzner and Gaede, Seitz Macrolep., x, 193, p. 845, pl. lxxv B.

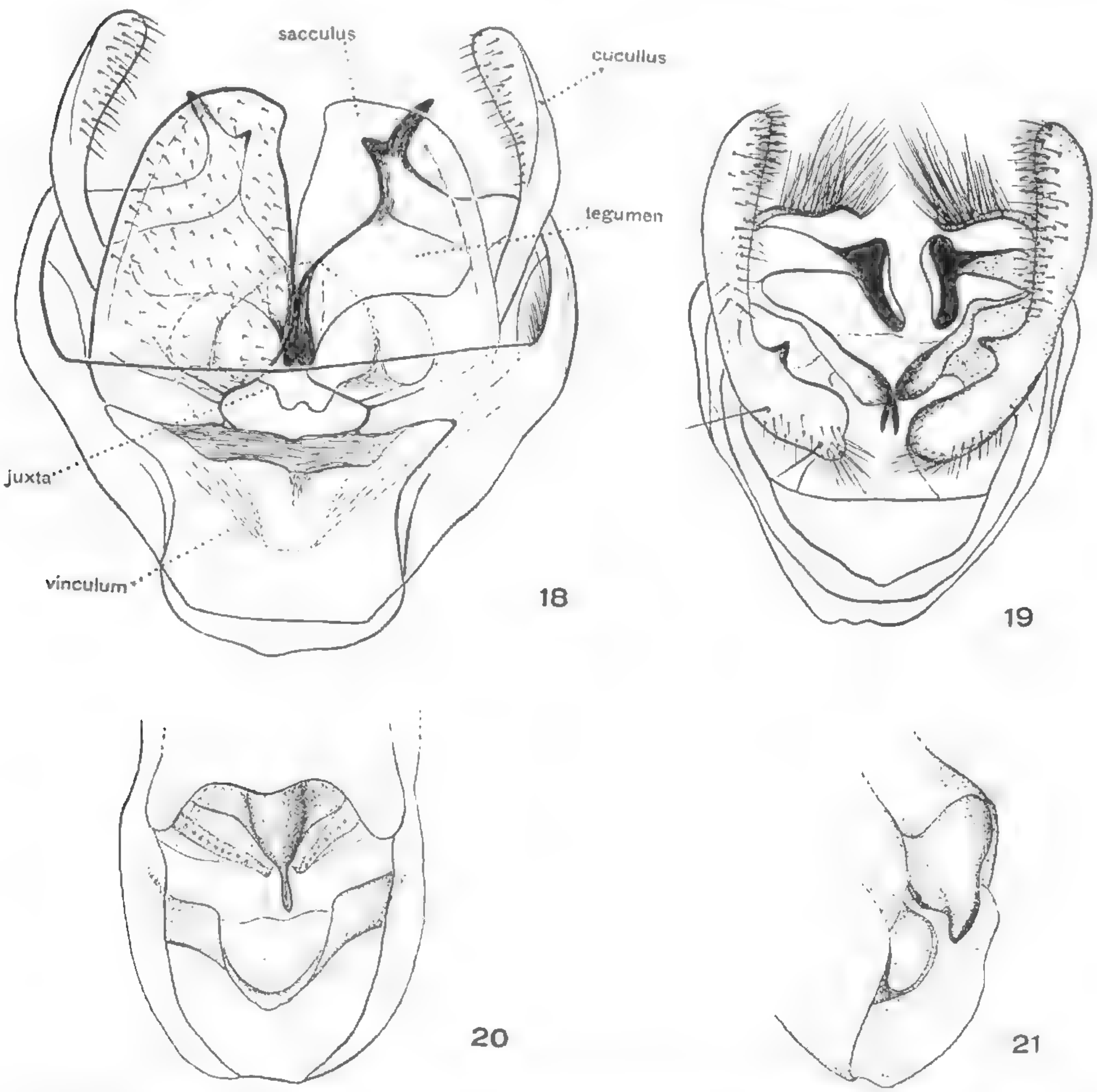


Fig. 18–21. 18. *Palpifer sexnotatus* Moore, male, Nainital, genitalia, ventral aspect of dissected example; 19. *P. murinus* Moore, male, Khasia Hills, genitalia, ventral aspect of dissected example. 20–21. *P. taprobanus* Moore, female, Madulsima: 20. genitalia, ventral aspect; 21. lateral aspect somewhat oblique.

♂ Antennae pale brown; head, thorax and legs pale chocolate brown, abdomen somewhat darker. Forewing chocolate brown with obscure darker chocolate spots forming two indistinct lines parallel to termen; a creamy white spot below radial fork. Hindwings dark chocolate brown with slightly opalescent lustre when viewed from one oblique direction, a dull white terminal quadrate spot continued into the cilia between M_1 and M_3. Expanse 29 mm.

Loc. Jalandhar: Dharmsala (type, a male, expanse 29 mm., abdomen lacking, labelled "Dharmsala, Moore Coll. 94–106" in British Museum). Assam: Khasia Hills 4, 5, 10; Cherrapunji. 20 males.

The above description is based on a male from the Khasis taken in May, which agrees rather well with the type. This specimen has also been compared and found to agree in great detail with the type of *caerulescens* Swinhoe (type, a male, 26 mm. in expanse, labelled ,'Cherrapunji, Khasis, 96–121", in British Museum).

The male genitalia (text fig. 19) have the tegumen irregular in form, with the posterior margin thickened and folded and produced anteriorly into a spine, its median portion is produced into a hammer-shaped member and the posterior part into a hair-beset flagellum; the harpe has a large digitiform cucullus and a small spine-like sacculus.

PALPIFER PELLICIA Swinhoe.

Palpifer pellicia Swinhoe, Ann. Mag. Nat. Hist. (7), xv, 1905, p. 152.

♂ Head, thorax, and abdomen dull uniform brown, legs brown, clothed with slightly reddish-tinged hairs. Forewings sparsely clothed in scales, dull brown, a single small white spot between rf and mf (absent in same examples). Hindwings rather uniformly dull brown; a moderately large subrectangular marginal yellow spot on outer margin. Expanse 22 mm.

♀ Similar to male. Expanse 28 mm.

Loc. Assam: Khasia Hills 9 (type, a male, expanse 22 mm., labelled "Khasis, Nat. Coll. 1905-65"; allotype female, expanse 28 mm., in British Museum). Cherrapunji. 5 males, 1 female.

This species is nearest to *P. murinus* from which it differs in its smaller size and obscure markings. Specimens are present in the British Museum and at Tring; it has not yet been possible to study the genitalia.

PALPIFER UMBRINUS (Moore).

Text fig. 24–25.

Hepialus umbrinus Moore, Desc. new Ind. Lep. Ins. Coll. Atkinson, Calcutta, 1879, p. 88.

♀ Head with antennae and palpi, thorax except posterior margin, abdomen and legs dark umber brown, posterior margin of thorax ochreous. Forewings hyaline, rather sparsely scaled, pale, umber brown with vinous tint externally and sparsely irrorated with dark brown scales; fringe at base of wing ochreous, costal margin and ciliae dark purplish-brown with a darker row of lunular spots on outer margins. Hindwings hyaline, sparsely scaled, colour as in forewing costal margin and ciliae dark purplish-brown. Expanse 51 mm.

Loc. Sikkim: Darjeeling (type, a female, labelled "Darjiling Coll. Atkinson, Staudinger K. 740" in Berlin Museum). 1 female.

The unique type has been examined. It is a female, rather worn, and the venation is conspicuous owing to the feebleness of the scaling. When fully clothed the wings were probably a subhyaline and opalescent dark brown with dull golden hairs at the base of hindwings and at base of abdomen. Text fig. 24–25 show free-hand sketches of as much of the outline of the female genitalia as may be seen on the type without dissection. From the genitalia of the female of *P. sexnotatus* this species differs in having a median line of four stout tuberous swellings on the seventh sternite; the interpretation of the rest of the genitalia must await additional material. If ratios of wing length are the same in all species of this genus the male

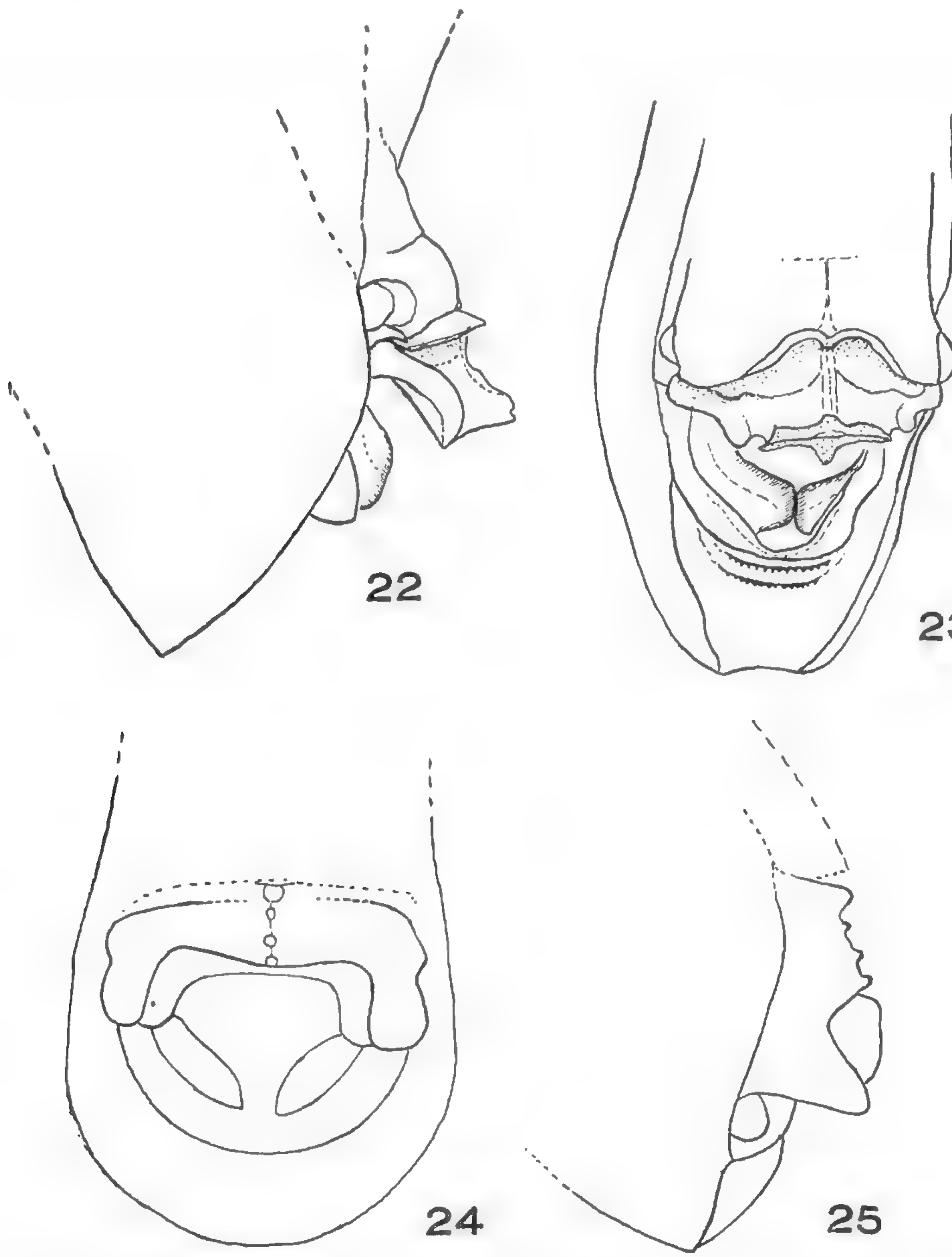


Fig. 22–25: 22–23 *Palpifer sexnotatus* Moore, female, Darjiling; 22. genitalia lateral aspect; 23. ditto ventral aspect. 24–25. *P. umbrinus* Moore, type, a female, Darjiling: 24. genitalia, from freehand sketches, ventral aspect; 25. ditto lateral aspect.

of this species should be an insect of about 35 mm. in wing expanse and therefore larger than males of *P. murinus*.

HEPIALISCUS Hampson.

Hepialiscus Hampson, Fauna Brit. Ind., Moths, 1, 1892, p. 317.

Male with antennae filiform, almost naked, and short, composed of about nineteen segments. Labial palpi reduced to a single spherical segment. Maxillary palpi obsolete, a three-segmented process apparently represents a rudiment of the maxilla. Forelegs with a small tibial strigil situated at the base of the segment. Median legs unarmed. Hindlegs with tibiae unarmed. Unexpanded and not ornamented with specialized hair tuft. Forewings with Sc unbranched; R_1 becoming very weak after rf, R_3, R_4 and R_5 from R_2; R_2 before apex; Cu_2 obsolete in distal half; Pcu apparently fused with 1V at base, branching up to meet Cu_2 at cu-f. 1V reaching to margin, 2V visible as a small basal vein. Hindwings with Sc unbranched, R_1 almost obsolete, Rs with R_3, R_4 and R_5 from R_2; R_2 at apex. Apparently only one vannal vein present.

Genotype: *Hepialiscus nepalensis* (Walker) designated by Hampson (1892). This genus is somewhat similar in its wing venation to *Oxycanus* but differs in the reduction of the palpi. It superficially resembles *Elhamma*, in which the palpi have become reduced to the two-segmented condition and in which R_1 is undergoing reduction by virtual fusion with R_s to beyond the middle. In one male specimen of *H. nepalensis* in our collection R_1 is so reduced that it appears only as a rudiment at the radial fork. The hindwing of the female has the same number of vannal veins as in the male.

The larvae are stated to feed in or on the roots of grasses.

HEPIALISCUS NEPALENSIS (Walker).

Plate xi, fig. 88–91 and Text fig. 26–31.

Hepialus nepalensis Walker, List Lep. Ins. Brit. Mus., vii, 1856, p. 1557.

Hepialus indicus Walker, *loc. cit.*, p. 1558.

Hepialus pauperatus Walker, *loc. cit.*, xxxii, 1865, p. 593.

Hepialus marcidus Butler, iii, Lep. Het., Brit. Mus., vi, 1886, p. 29, pl. cviii, fig. 4–5.

Hepialus pauperatus Butler, *loc. cit.*, vi, 1886, p. 30, pl. cviii, fig. 6–7.

Hepialus marcidus Butler, Ann. Mag. Nat. Hist. (5), vi, p. 69.

Hepialiscus nepalensis Hampson, Fauna Brit. Ind., Moths, i, 1892, p. 317, fig. 218.

Hepialiscus nepalensis Pfitzner, Seitz Macrolep., viii, 1912, p. 437, pl. liv d, male.

♂ Antennae brown, each segment paler at apex giving a somewhat banded appearance to antennae. Head with eyes reddish-bronze, thorax and abdomen grey, sometimes orange-brown; legs orange-brown. Forewings subhyaline, pale brown with obscure subhyaline white, paired ring markings, arranged in two series parallel to termen; similar markings, somewhat more irregular in form in basal half of wing. Hindwings hyaline grey, slightly tinged with ochreous along costal margin. Expanse 40 mm.

♀ Larger than male. Head, thorax and abdomen greyish-brown. Forewing subhyaline, flecked with greyish-brown and ochreous scales, the latter forming irregularly transverse series of ochreous yellow spots, margined with greyish-brown, arranged as in male. Hindwings hyaline, sparsely clothed with greyish-brown scales. Expanse 56 mm.

Loc. Punjab: Dalhousie.

Hill States: Simla (7,000 ft.) Subathu 6, Kulu, Nepal (type a female, abdomen missing, unset, estimated expanse 49 mm., labelled "Hardwicke Bequest Nepal" in British Museum).

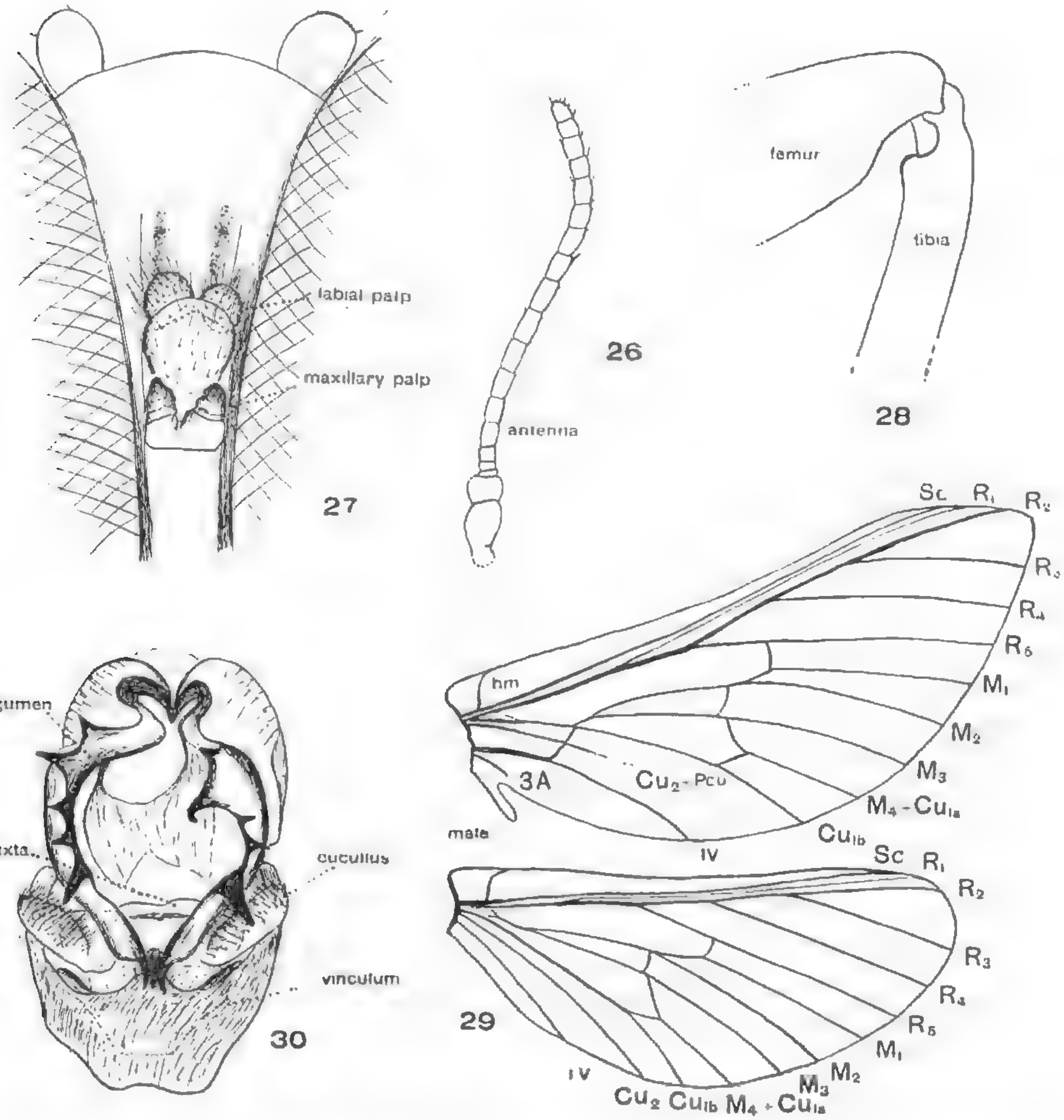


Fig. 26–30. *Hepialiscus nepalensis* Walker, male, Subathu: 26. antenna; 27. mouth parts; 28. base of anterior tibia; 29. venation; 30. genitalia, ventral aspect of dissected specimen.

Sikkim: Darjiling 4, 5, 6, 7. Assam: Khasia Hills, 2. 19 males, 24 females.

The types of *H. nepalensis pauperatus* (a female of *nepalensis* with abdomen partly broken off, 58 mm. in expanse, labelled "E Ind.") and *marcidus* (a male of *nepalensis*, expanse 48 mm. labelled "Darjiling 79.56") have been studied but that of *indicus* was not seen. The following possess material of the species: British, Tring, Senckenberg, Harvard, and South Australian Museums.

The specimens described above are a male from Subathu and a female (pl. xi, fig. 89) from Darjeeling; the latter was selected because of its general agreement with the type example. Pl. xi, fig. 89–91 represent a small form taken at Darjeeling. The figure of the male in Seitz (l.c. pl. 54 d) is a good one, representing the typical form.

The male genitalia of this species, from a specimen from Subathu (text fig. 30) have the vinculum well rounded and transverse; the posterior margin with a well marked convex lip beset with some bristles; the tegumen is relatively large, well chitinized, and bears marginal spines, including two large and three smaller ones on each side; the harpes are small and simple. The present species is confined to the Himalayas, another one is known from Borneo.

REFERENCES CITED.

A list of references is given in Pt. IV of this series of papers.

EXPLANATION OF PLATES.

Plate ix.

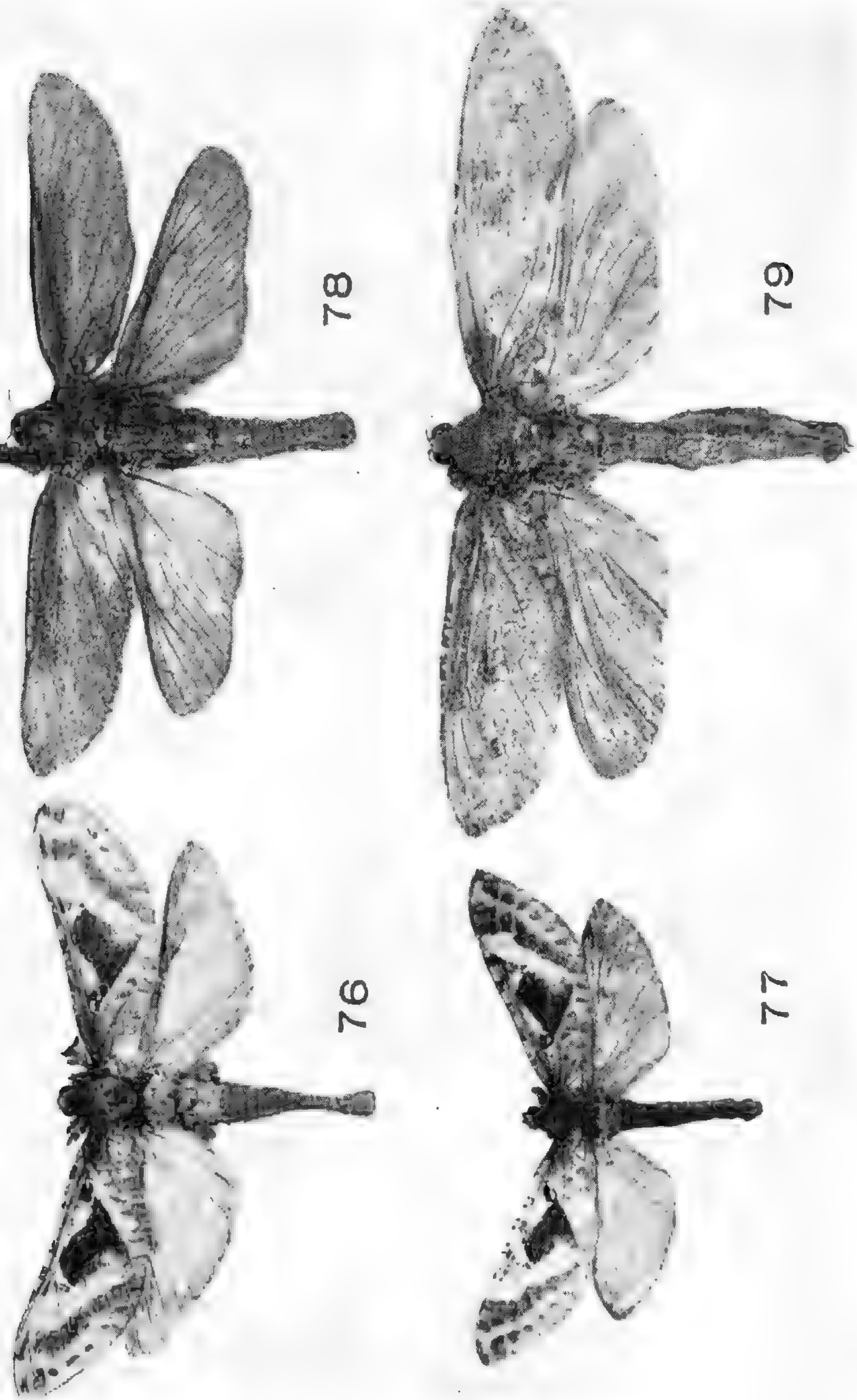
Fig. 76. *Sahyadrassus malabaricus* Moore, male, Tithimatti River, 78 mm.
Fig. 77. *Sahyadrassus malabaricus* Moore, small form of female, North Kanara, 67 mm.
Fig. 78. *Sahyadrassus albofasciatus* Moore, male, Nilgiri Hills, 65 mm.
Fig. 79. *Sahyadrassus albofasciatus* Moore, female, Anshi, N. Kanara, 76 mm.

Plate x.

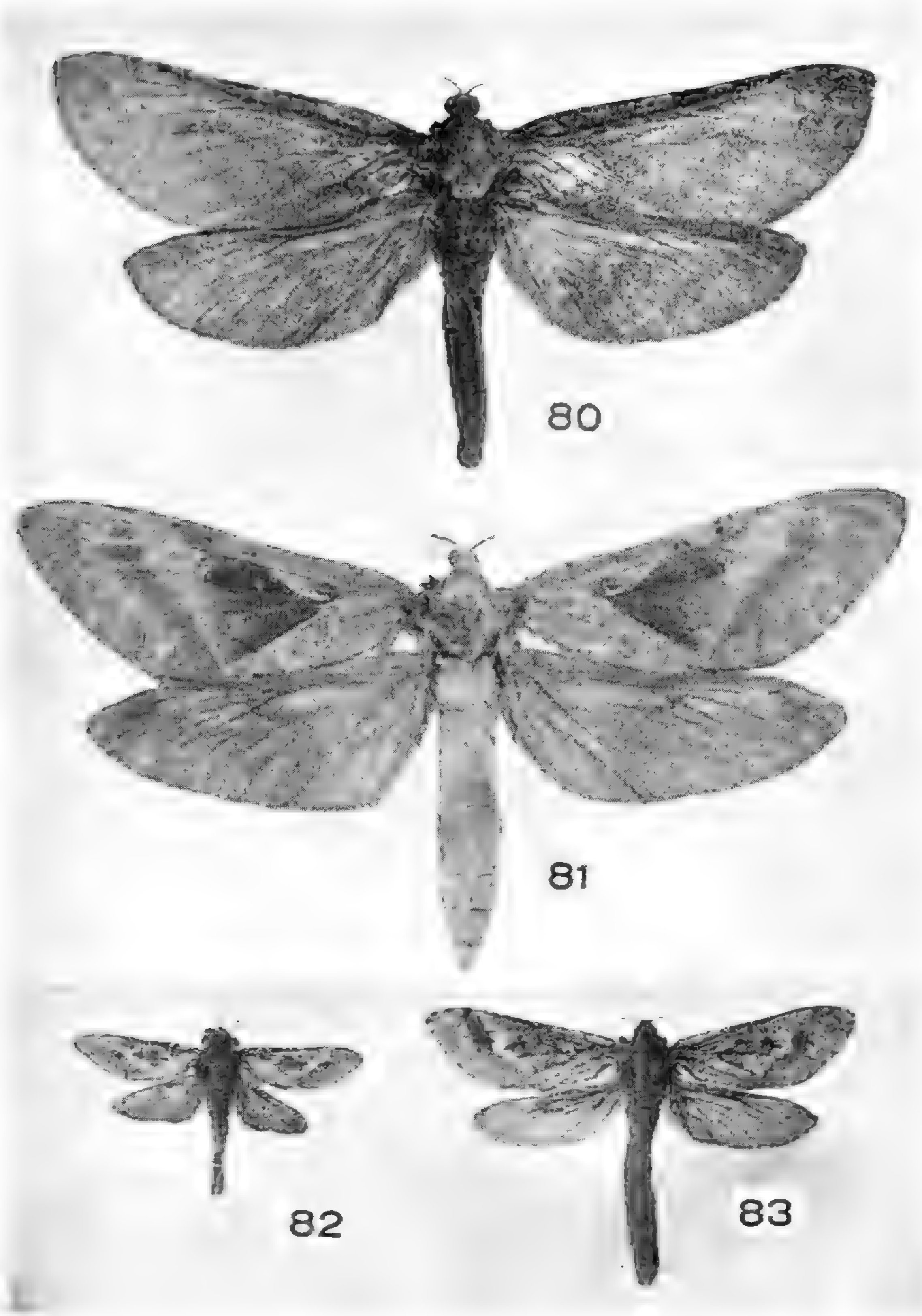
Fig. 80. *Endoclita microscripta* Tindale, type, a male, Madras, 88 mm.
Fig. 81. *Sahyadrassus malabaricus* Moore, female, Yellapur, 130 mm.
Fig. 82. *Sahyadrassus strobilanthes* Tindale, type, a male, Anshi, 36 mm.
Fig. 83. *Sahyadrassus strobilanthes* Tindale, paratype female, Anshi, 60 mm.

Plate xi.

Fig. 84. *Palpifer sexnotatus* Moore, male, Khasia Hills, 25 mm.
Fig. 85. *Palpifer sexnotatus* Moore, female, Khasia Hills, 38 mm.
Fig. 86. *Palpifer murinus* Moore, male, Khasia Hills, 29 mm.
Fig. 87. *Palpifer taprobanus* Moore, female, Madulsima, Ceylon, 50 mm.
Fig. 88. *Hepialiscus nepalensis* Walker, male, Subathu, 40 mm.
Fig. 89. *Hepialiscus nepalensis* Walker, female, Darjiling, 56 mm.
Fig. 90. *Hepialiscus nepalensis* Walker, male, Darjiling, 42 mm.
Fig. 91. *Hepialiscus nepalensis* Walker, female, Darjiling, 42 mm.



INDIAN GHOST MOTHS



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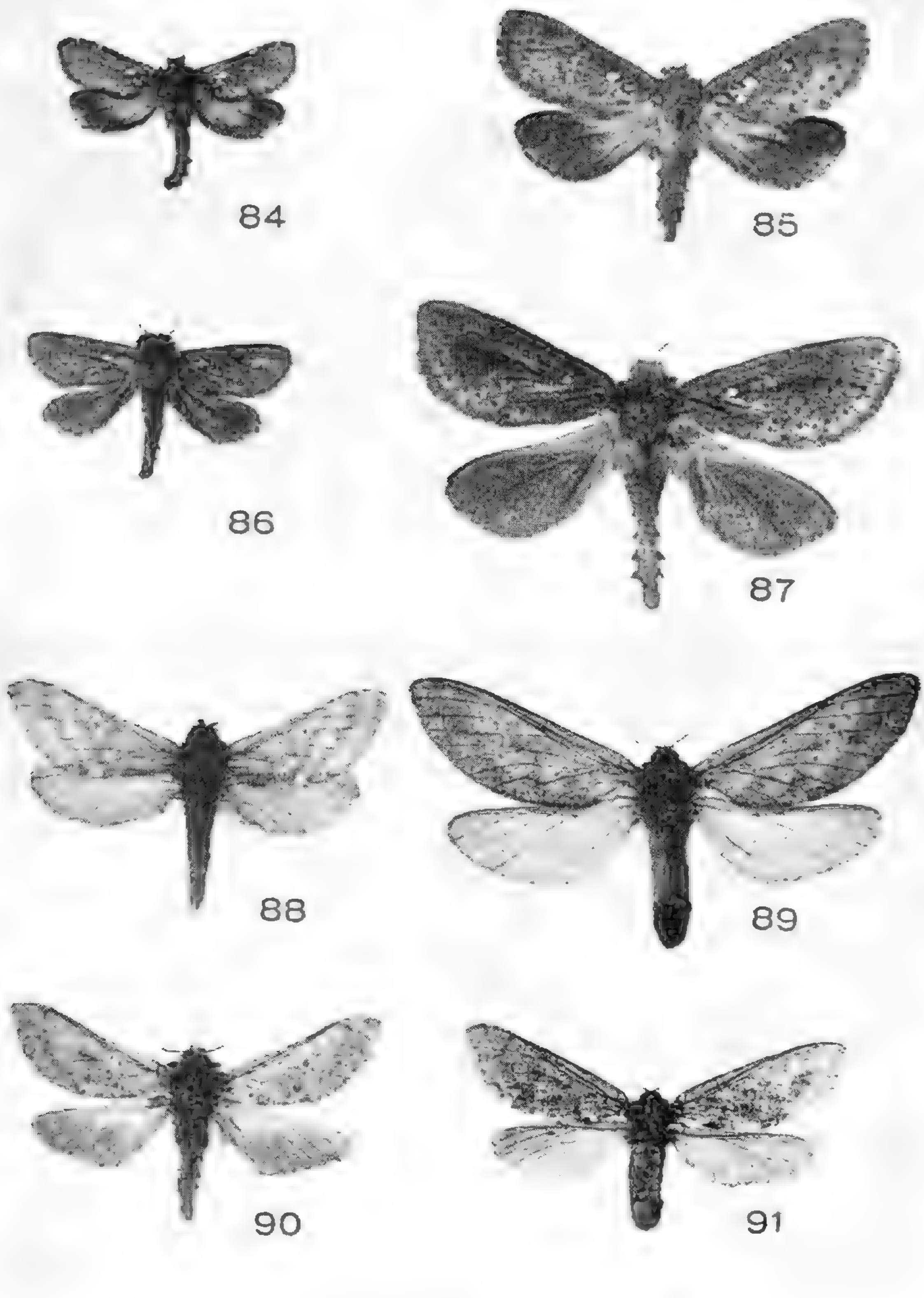

INDIAN GHOST MOTHS

ADDITIONS TO THE ACARINA OF AUSTRALIA (TROMBIDIIDAE AND CALYPTOSTOMIDAE)

*BY H. WOMERSLEY, F.R.E.S., A.L.S., ENTOMOLOGIST,
SOUTH AUSTRALIAN MUSEUM*

Summary

Family **Trombidiidae** Leach 1814.

Subfamily **Trombellinae** Sig Thor 1935.

Zool. Anz, 1935, cix, p. 108

Genus **Chyzeria Canestrini** 1897.

"Acari della Nuovi Guinea" Atti Soc. Venit., 1897, p. 463.

Chyzeria Queenslandica n. sp.

Description: Colour red. Length 3.2 mm., width 1.6 mm. across shoulders. Dorsally with a long antero-median and two straight, longer, antero-lateral processes followed by four pairs of shorter lateral processes which are well chitinsed and strongly curved inwards; no median posterior process either dorsally or ventrally. Crista present, short and wide, at the anterior end forming a pair of lobes overlapping the bases of the sensillary setae. Eyes 2+2, small, sessile. Palpi as figured; tibia with short blunt claw, and rather smaller, blunt, accessory claw, and a row of spines.

ADDITIONS TO THE ACARINA OF AUSTRALIA (TROMBIDIIDAE AND CALYPTOSTOMIDAE)

By H. WOMERSLEY, F.R.E.S., A.L.S., Entomologist, South Australian Museum.

Fig. 1–10.

Family TROMBIDIIDAE Leach 1814.

Subfamily Trombellinae Sig Thor 1935.

Zool. Anz., 1935, cix, p. 108.

Genus Chyzeria Canestrini 1897.

"Acari della Nuovi Guinea" Atti Soc. Venit., 1897, p. 463.

Chyzeria queenslandica n. sp.

Description: Colour red. Length 3·2 mm., width 1·6 mm. across shoulders. Dorsally with a long antero-median and two straight, longer, antero-lateral processes followed by four pairs of shorter lateral processes which are well chitinised and strongly curved inwards; no median posterior process either dorsally or ventrally. Crista present, short and wide, at the anterior end forming a pair of lobes overlapping the bases of the sensillary setae. Eyes 2 + 2, small, sessile. Palpi as figured; tibia with short blunt claw, and rather smaller, blunt, accessory claw, and a row of spines.

Legs long, I 2·7 mm., II 1·7 mm., III 1·95 mm., IV, 3·05 mm.; tarsus I 697μ long, 204μ high; metatarsus I 425μ long.

The setae of the dorsum and dorsal processes are numerous and long, to 95μ, simple spines, interspersed, particularly on processes, with long, 108μ ciliated setae, of which the stem is almost as strong as the spines. Sensillae 108μ long.

Loc. A single ♀ from Cairns, Queensland, 1939 (W. G. Heaslip).

Remarks: In the long antero-median process this species is near to *C. australiense* v. *musgravei* Hirst, but differs in that this process is very much longer.

It also differs in the lack of the very fine, numerous setae interspersed amongst the dorsal spines of *australiense*, as well as in the more pronounced and curved lateral dorsal processes.

As Hirst states (Proc. Zool. Soc., 1929, (1), p. 165) that Canestrini's *C. ornata* (the genotype) also has a long antero-median process, this new species may possibly be the same, but Canestrini's brief description without figures, is inadequate.

Subfamily Johnstonianinae Sig Thor 1935.

Zool. Anz., 1935, cix, p. 108.

Genus Centrotrombidium Kramer 1896.

Zool. Anz., 1896, xix, p. 445.

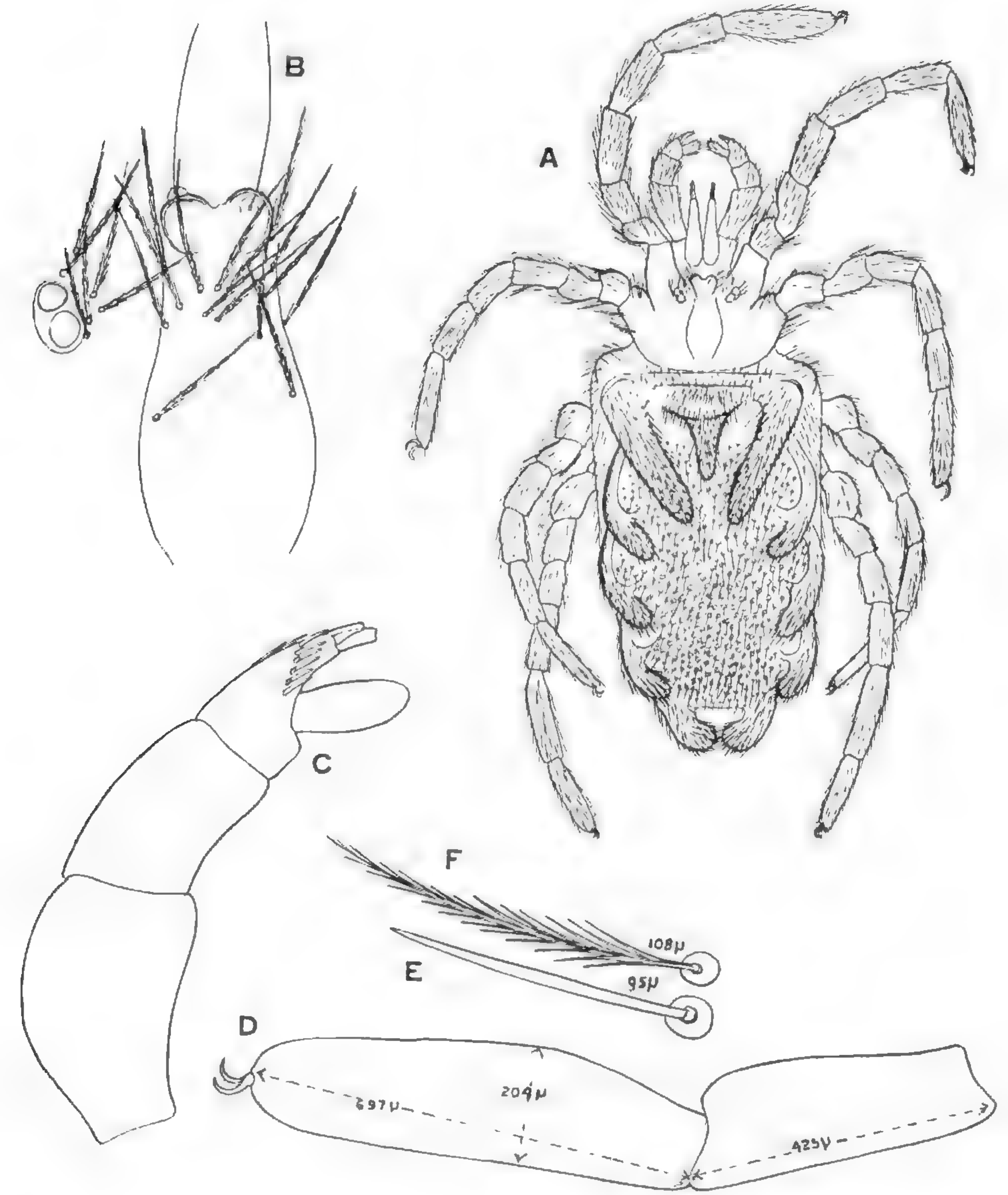

Fig. 1. *Chyzeria queenslandica* n.sp. A. dorsal view; B. crista and left eyes; C palp; D. front tarsus and metatarsus; E. spine-like dorsal seta; F. ciliated dorsal seta.

CENTROTROMBIDIUM AUSTRALASIAE n. sp.

Description: Adult, in life probably red, mounted brownish. Body with prominent squarish shoulders, parallel sides and rounded apex; anterior end as a short blunt snout. Length 1020μ, width 510μ. Crista short with large subposterior sensory area, 62μ wide, carrying a pair of long, slender, naked, apically clavate sensillary setae, 130μ long; anterior of these setae is a pair of strong, curved, indistinctly ciliated setae, 48μ long. Ocular shields on each side of sensillary area triangular, sessile, with two eyes on each, of which the anterior are much the larger.

The dorsal cuticle is strongly chitinized with numerous fine, simple, short, 12μ, curved setae arising from platelets which are closely packed together. Palpi and legs strongly chitinized with prominent reticulations. Palpi (fig. 2 B) large and stout; tibia with strong claw, tarsus with numerous simple setae, the two apical ones being strong and awl-like, and some of the others widened basally. Mandibles as in fig. 2 D. Legs relatively short, I 570μ, II 540μ, III 485μ, IV 620μ; tarsus I 175μ long by 95μ wide, metatarsus I 80μ long. All tarsi without scopulae. Leg setae feathered on one side; on tarsus I interspersed with simple short clavate setae (cf. fig. 2 F).

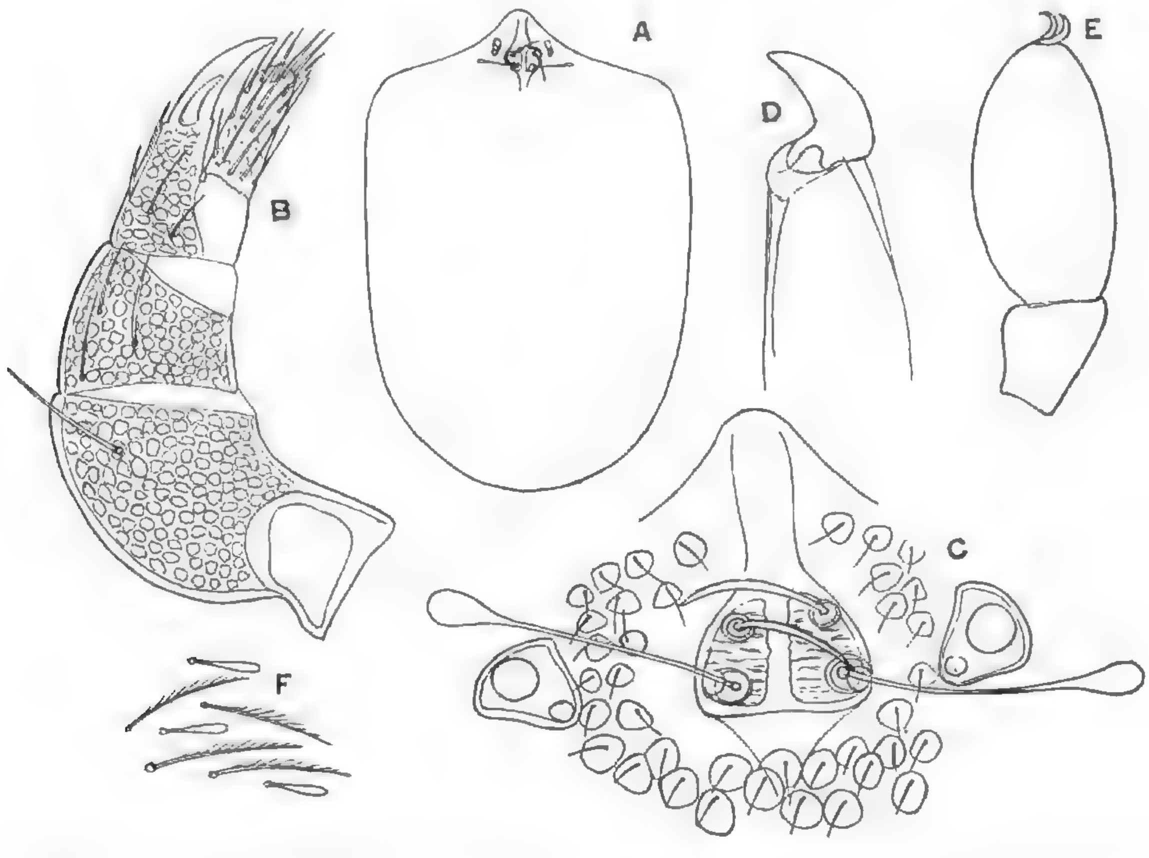

Fig. 2. *Centrotrombidium australasiae* n.sp. A. dorsum; B. palp; C. crista and eyes; D. chela; E. front tarsus; F. setae from front tarsus.

Loc. Seven specimens from moss. Cairns, Queensland, 1939 (W.G.H.).

Remarks: This genus was established by Kramer for *C. schneideri* from the island of Borkum, Germany. Up to the present time no other species has been described, so that it is particularly interesting to find a second species, this time from Australia.

Kramer *loc. cit.* only figures the palp of *schneideri,* but Vitzthum 1939 in the Handbuch Zool. Bd. III, Hft. 2, p. 63, gives an excellent figure of the crista, eyes, etc., and from this our species can be differentiated by (1) the very long and slender stalked sensillary setae, (2) the more pronounced and slender nasus, and (3) the smaller and less compact dorsal platelets.

Genus CROSSOTHROMBIUM Womersley 1939.

Trans. Roy. Soc., S. Aust., 1939, lxiii (2), p. 152.

CROSSOTHROMBIUM PARKHOUSEI Womersley 1939.

loc. cit.

Originally described and recorded from Second Valley, South Australia, it has recently been collected by Mr. N. B. Tindale in Victoria, 1942.

Subfamily PODOTHROMBIINAE Sig Thor 1935.

Zool. Anz. 1935, cix, p. 109.

Genus PODOTHROMBIUM Berlese 1910.

Redia, 1910, vi, fasc. 2, p. 354.

PODOTHROMBIUM TUBBI n. sp.

Description: Colour in spirit white, in life unknown. Shape cordate, swollen, very slightly constricted medially, and anterior of opisthosoma overhanging prosoma. Length 2·5 mm., width 1·75 mm. Crista with well developed sensillary

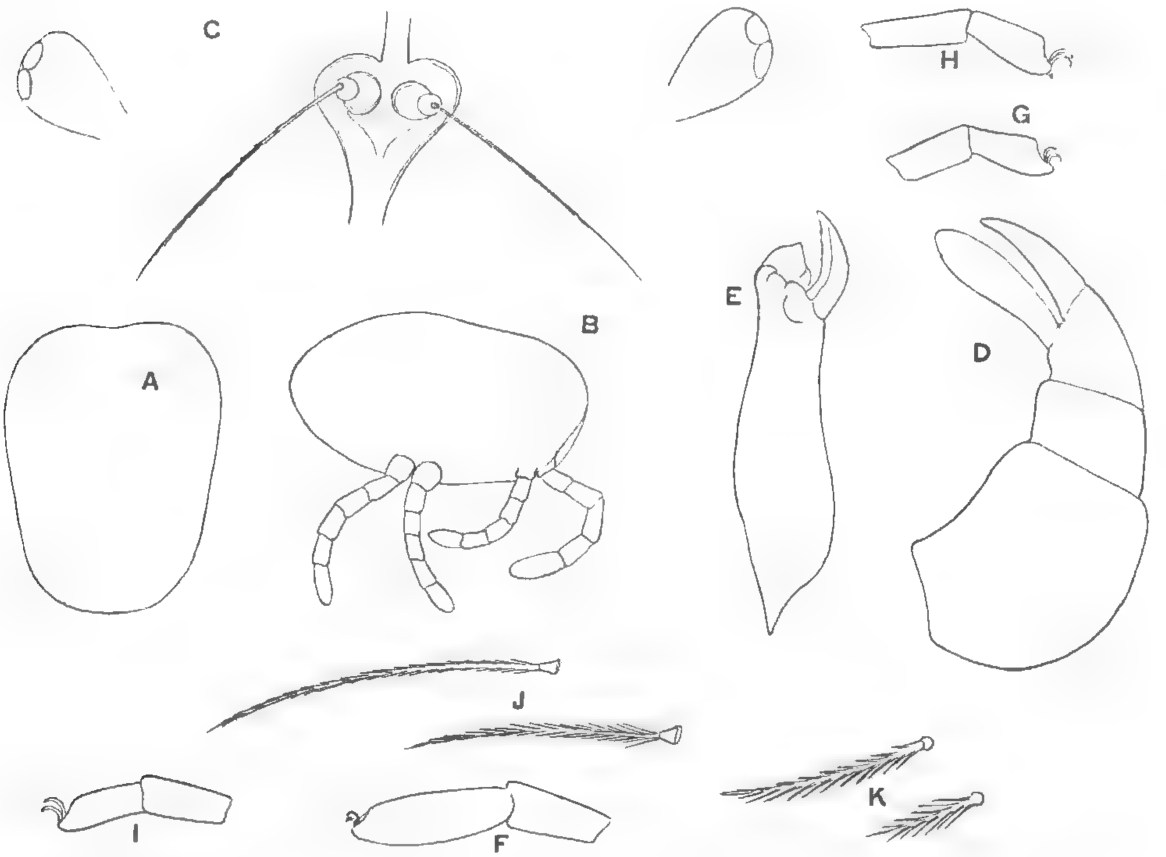

Fig. 3. *Podothrombium tubbi* n.sp. A. dorsum; B. side view; C. crista and eyes; D. palp; E. mandible; F. tarsus and metatarsus, leg I; G. same, leg II; H, same, leg III; I. same, leg IV; J. dorsal setae; K. ventral setae.

area, but very short anterior and posterior stem, its whole length 170μ; sensillary setae only indistinctly ciliate, 170μ long. Eyes 2 + 2, on long, 78μ, outstanding peduncles. Chelae of mandibles with finely serrated inner edge. Palpi as in figure, tibia with only one claw, no accessory claw or spines; tarsus slightly clavate and overreaching tip of tibial claw. Legs short, I 1170μ, II 1000μ, III 850μ, IV 850μ long, tarsus I elongate ovate, 335μ long by 117μ high, metatarsus I 250μ long.

Dorsal setae of two sizes, 100μ and 65μ, slender with moderately long ciliations; ventral setae similar but somewhat stouter, 65μ and 30μ long.

Loc. Two females from Julia Percy Island, New South Wales, Feb. 1936 (A. Tubb).

Remarks: At first sight this species suggests a *Trombicula* but differs therefrom in the pedunculate paired eyes, the lack of accessory claw and spines on the palpal tibia and the serrate mandibular chela. It appears to fall into Berlese's *Podothrombium* and is tentatively placed there, although the ocular peduncle is not short as in the known European species of that genus.

Subfamily TROMBICULINAE Ewing 1929.

Monog. External Parasites, 1929, p. 23.

Genus TROMBICULA Berlese 1905.

Acari nuovi Manip., 4, 1905, p. 155.

TROMBICULA ELEGANS n. sp.

Description: Female. Very narrow elongate species; length 1·67 mm.; width of both prosoma and opisthosoma 0·58 mm., opisthosoma about twice length of

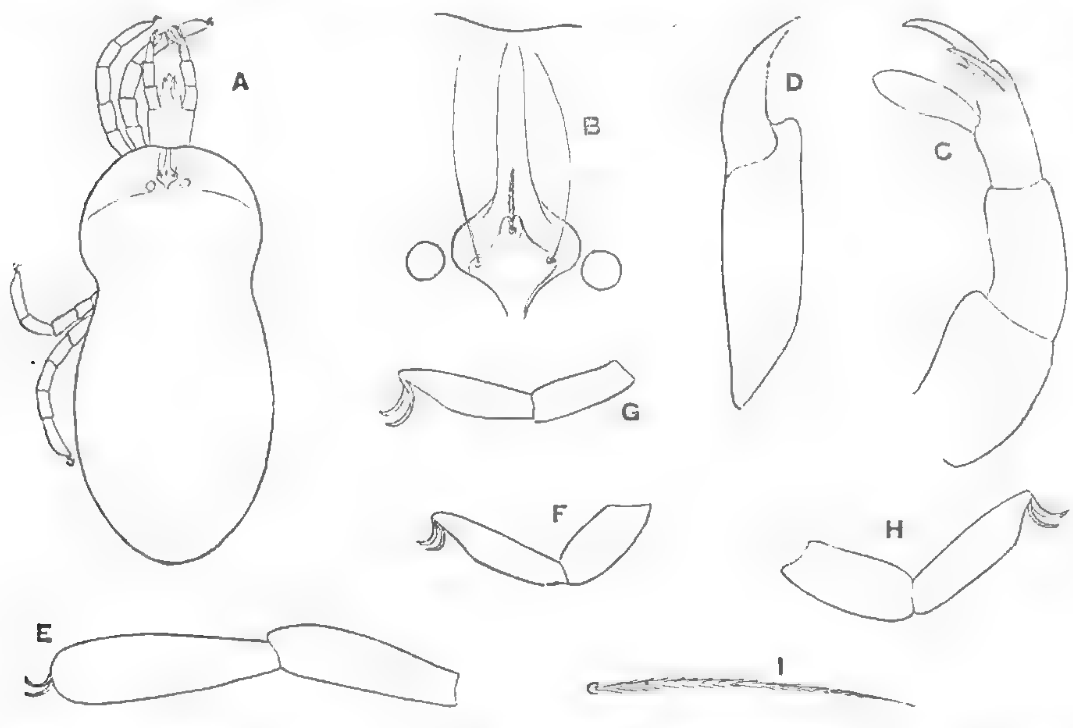

Fig. 4. *Trombicula elegans* n.sp. A. dorsal view; B. crista and eyes; C. palp; D. mandible; E. tarsus and metatarsus, leg I; F. same, leg II; G. same, leg III; H. same, leg IV; I. dorsal seta.

prosoma. Colour in spirit white. Crista normal, with a single closely adjacent eye on each side on a level with the bases of the sensillae. Sensillae long and apparently nude. Palpi as in fig. 4 C, tibia with claw, accessory claw and one strong spine, tarsus slightly overreaching tip of claw. Chela of mandible with slightly serrate inner edge. Legs short, I 1000μ, II 665μ, III 650μ, IV 900μ long; tarsus I 275μ long by 67μ high, metatarsus 275μ long.

Dorsal setae numerous, fine and slender, with ciliations, to 70μ in length, uniform.

Loc. Two females from Lush Is., South Australia, December 1936. McCoy Exped.; from just about high water mark.

Remarks: Differs from the other adult species of *Trombicula* known from Australia in its elongate build; from *T. tindalei* Wom. in the presence of eyes and from *T. signata* in the palp and dorsal setae.

Subfamily OTTONIINAE Sig Thor 1935.

Zool. Anz. 1935, cix, p. 110.

= *Microtrombidiinae* Wom. 1937. Rec. S. Aust. Mus. vi (1), p. 82.

Genus CALOTHROMBIUM Berlese 1919.

Redia, 1019 xiii, p. 94, p. 190, p. 199.

CALOTHROMBIUM HEASLIPI n. sp.

Description: Colour red. Length 1360μ, width 850μ, broadest across shoulders. Eyes 2 on each side, sessile. Crista normal 189μ long, with posterior sensillary area and paired fine sensillae. Legs stout and relatively short, I missing, II

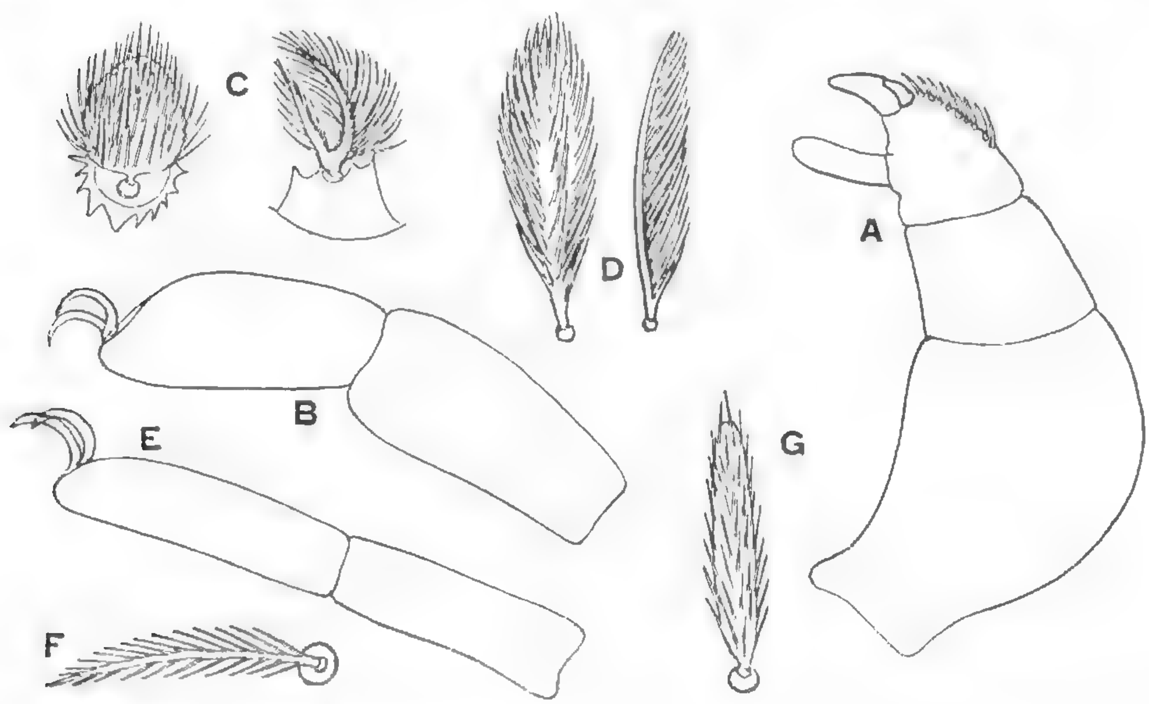

Fig. 5. A–D. *Calothrombium heaslipi* n.sp. A. palp; B. tarsus and metatarsus IV; C. dorsal setae; D. leg setae. E–H. *C. tubbi* Wom. for comparison; E. tarsus and metatarsus IV; F. seta from front of opisthosoma; G. leg seta.

680μ, III 765μ, IV 1450μ; tarsus IV 240μ long by 102μ high, metatarsus IV 255μ long. Dorsal setae bifurcate, as figured, somewhat similar to *C. tubbi* Wom. but with longer ciliations and longer basal tubercle, 21·5μ, on anterior margin of hysterosoma and around the sensillary area the hairs are simple and elongate, 32μ long as figured; on the basal leg segments as in fig. 5 D, 32μ long. Palpi stout as in fig. 5 A.

Loc. A single specimen from Cairns, Queensland, 1939 (W.G.H.).

Remarks: Very close to *C. tubbi* in the form of the dorsal setae, but these have much longer cilia on the lamellae. It also differs in the setae on the front of the hysterosoma and around the sensillary area which in *tubbi* are long, 41μ, and pointed. The legs of this new species are also very much stouter.

Genus MICROTROMBIDIUM Haller 1882.

Jahresh. Ver. Wurttemb. 1882, xxxviii, p. 322.

Subgen. MICROTROMBIDIUM Haller 1882, s. str. Berlese 1912.

MICROTROMBIDIUM (M.) MACULATUM n. sp.

Description: Colour dark red except in the area of the crista and the eyes, and on fifteen circular areas on the dorsum which are whitish. Shape elongate oval, wider on anterior half. Length 1040μ, width 720μ. Eyes 2 + 2, on distinct ocular

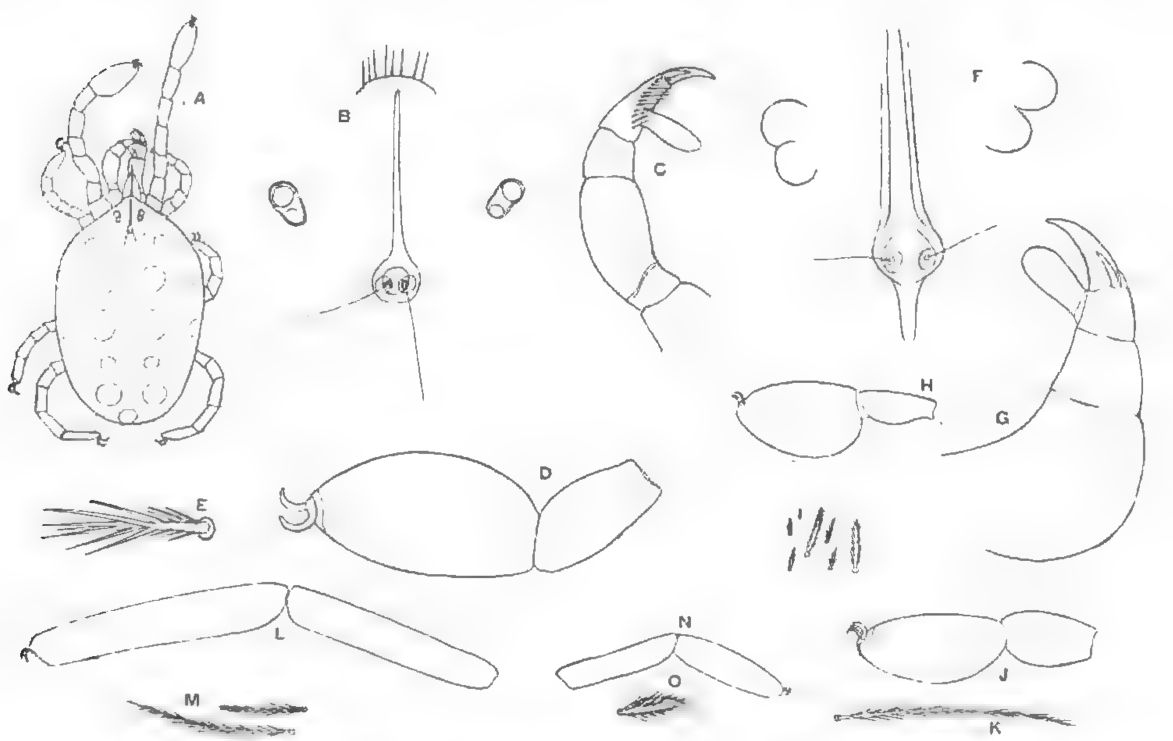

Fig. 6. A–E. *Microtrombium (M.) maculatum* n.sp. A. dorsal; B. crista and eyes; C. palp; D. front tarsus and metatarsus; E. dorsal seta. F–I. *M. (M.) tubbi* n. sp. F. crista and eyes; G. palp; H. front tarsus and metatarsus; I. dorsal setae. J–K. *M. (Dromeothrombium) macropodum* Berl. J. front tarsus and metatarsus; K. dorsal seta. L–M. *M. (D.) dromus* Wom. L. front tarsus and metatarsus; M. dorsal setae. N–O. *M. (D.) attolus* (Banks). N. front tarsus and metatarsus; O. dorsal seta.

shields; posterior eyes the smaller. Crista present, 240μ long, with posterior sensillary area bearing a pair of long filamentous sensillae 108μ long. Legs relatively short, I 1040μ, II 608μ, III 480μ, IV 720μ; tarsus I 255μ long by 125μ high, widest slightly before the middle, metatarsus I 150μ. Dorsal setae numerous and uniform, 30μ long as figured; all the setae are densely pigmented except those on the white patches.

Remarks: Unlike any other Australian species in the dorsal spots.

Loc.: A single specimen from a rotting tree-fern log at Belgrave, Victoria, November, 1941 (O.W.T.).

MICROTROMBIDIUM (M.) TUBBI n. sp.

Description: Colour uniformly red. Shape cordate. Length 1·5 mm., width 1·0 mm. Crista with posterior or subposterior sensillary area with relatively short fine sensillae. Eyes 2 + 2, large, anterior of sensillary area, the anterior eyes the larger. Palpi as figure, tibia with strong claw and two accessory claws, tarsus clavate, not quite reaching tip of claw. Legs of only moderate length, none longer than body. Tarsus I 275μ long by 156μ high, with a distinct basal angle and widest at one-third from base. Dorsal setae of two different lengths, but generally similar, long setae 33μ, short 16μ, long ones not tapering apically.

Loc. Two specimens from Julia Percy Island, New South Wales, February 1936 (A. Tubb).

Remarks: This species is close to *M.(M.) karriense* Wom. and also to *M.(M.) tasmanicum* Wom. in the shape and dimensions of the front tarsus but differs in the two lengths of the dorsal setae and in the accessory spines or claws of the palpal tibia.

Subgen. DROMEOTHROMBIUM Berlese 1912.

Redia, 1912, viii, p. 131, p. 132.

KEY TO THE AUSTRALIAN SPECIES.

1. Dorsal setae of two sizes, but uniform about 100μ and 50μ. Tarsus I 600μ long by 100μ high. *M. (D.) dromus* Wom. Fig. 6 L–M.
   Dorsal setae uniform in size. Tarsus I shorter, about 300–350μ .. .. 2.
2. Front tarsus 340μ by 178μ, elliptical, metatarsus shorter than tarsus. Dorsal setae slender, to 54μ, with ciliations. Front legs very thick. *M. (D.) macropodum Berl.* Fig. 6, J–K.
   Front tarsus 300μ by 85μ, elongate, metatarsus about equal to tarsus. Dorsal setae short, 27μ, and thick with long ciliations. Front legs more slender. *M. (D.) attolus* Sands. Fig. 6 N–O.

Genus ECHINOTHROMBIUM Womersley 1937.

Rec. S. Aust. Mus. 1937, vi (1), p. 89.

ECHINOTHROMBIUM QUEENSLANDIAE n. sp.

Description: Colour in life red. Length 1600μ, width 1200μ. Crista with posterior sensory area, with paired sensillary setae, length 148μ. Dorsal setae of two kinds, long and slender, with conspicuous short ciliations which are more distinct on the more anterior setae; these long setae are to 85μ by 3·5μ wide; short setae are 21μ long by 8μ wide, somewhat compressed laterally and not cylindrical, with rows of pointed serrations. Palpi stout as figured, tibia with short stout claw, similar but smaller accessory claw, and a row of about 12 spines. Legs short, I 715μ, II 475μ, III 529μ, IV 765μ, tarsus I as figured, 162μ long by 95μ wide, metatarsus I 108μ. Ventrally the setae are as on the dorsum. Eyes sessile, two on each side.

Loc. A single female from Lantana debris, Gympie, Qld., 27 April, 1940. (D.J.W.S.).

Remarks: This species is very close to *E. southcotti* Wom. differing in the more slender and more ciliated major dorsal setae, the minor setae having serrations rather than long ciliations, and in the smaller front tarsi.

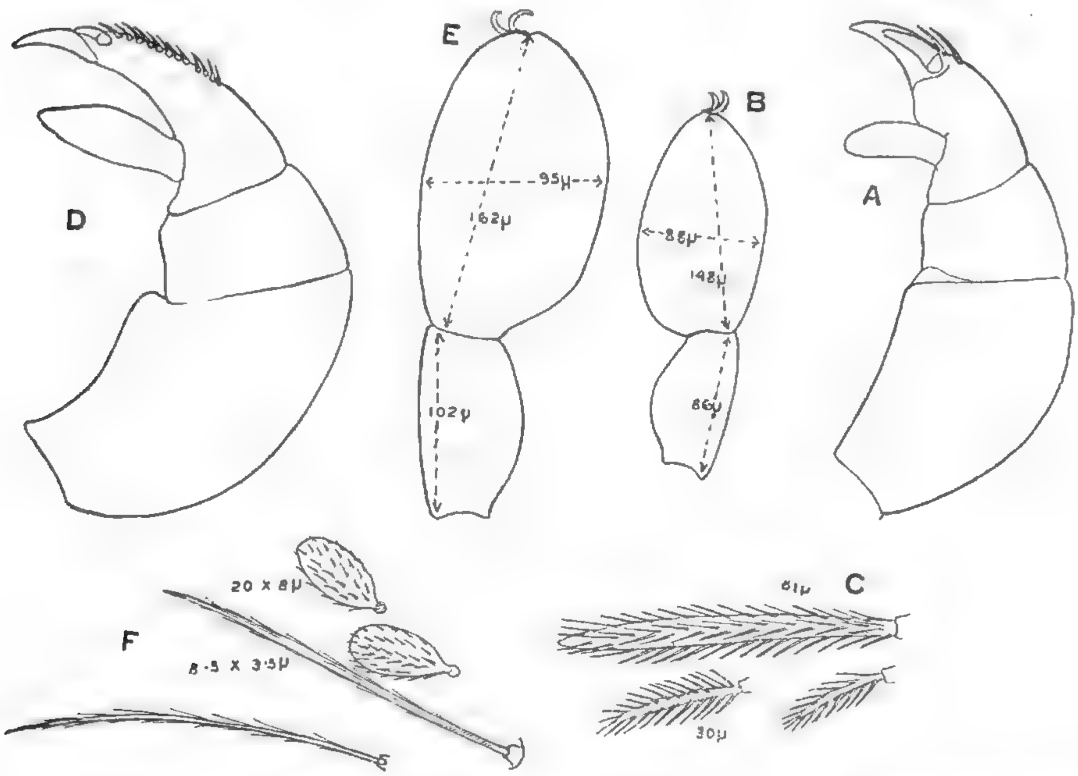

Fig. 7. A–C. *Echinothrombium hystricinum* (Canest). A. palp; B. front tarsus and metatarsus; C. dorsal setae. D–F. *E. queenslandiae* n. sp. D. palp; E. front tarsus and metatarsus; F. dorsal setae.

ECHINOTHROMBIUM HYSTRICINUM (Canest 1897).

Ottonia hystricina G. Canestrini 1897. Termes Fuzet, xxi, p. 193.

Microtrombidium hystricinum Berlese 1912, Redia viii, p 160.

Microtrombidium hystricinum Vitzthum 1926, Treubia viii, p. 133.

Originally described from Berlinhafen, New Guinea, it was later recorded by Vitzthum from Prince Island, Sunda Strait.

I have material from the following Queensland localities: Malonda, Aug. 1935 (Parkhouse); Gympie, April 1940, in Lantana debris (D.J.W.S.).

Genus ENEMOTHROMBIUM Berlese 1910.

Redia, 1910, vi, fasc. 2, 258.

ENEMOTHROMBIUM GAMBIENSE n. sp.

Description: Colour red. Length 3·0 mm., width 2·3 mm. Crista with sensillary area at one-third from posterior end, with paired sensillary setae. Eyes 2 + 2, sessile. Dorsal setae of two kinds and two sizes; larger 40μ, cup-shaped with distinct septum and open end, with long ciliations; smaller 16μ, broadly cup-shaped with shorter ciliations. At the anterior end of crista is a bunch of long, 80μ, slender, ciliated setae, and on each side of these some stouter, shorter, 30μ, ciliated setae; on the dorsal surface of the legs the seta are 30μ long, clavate and ciliated. Legs, I 1700μ, II 1275μ III 1275μ, IV 1870μ; tarsus I 340μ long by 120μ high, metatarsus 255μ. Palpi normal, fairly stout, with stout tibial claw and accessory claw, and row of accessory spines.

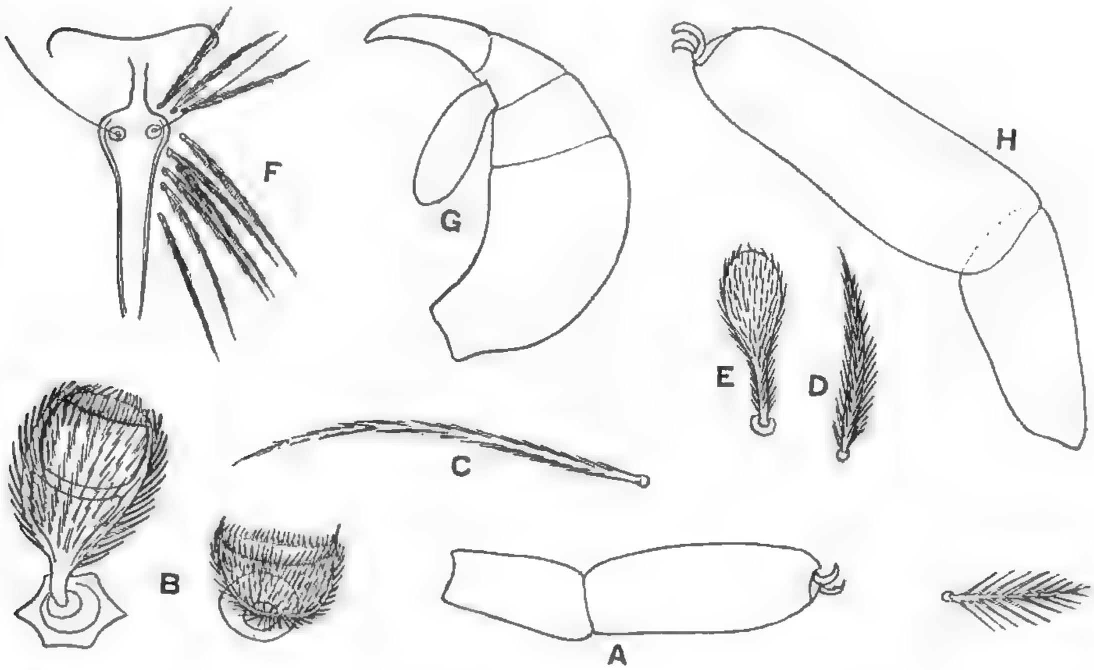

Fig. 8. A–E. *Enemothrombium gambiense* n.sp. A. front tarsus and metatarsus; B. dorsal setae; C. seta from front of crista; D. seta at side of crista; E. seta from dorsal surface of leg. F–I. *Caenothrombium burraensis* n.sp. F. crista; G. palp; H. front tarsus and metatarsus; I. dorsal seta.

Loc. A single specimen under a log, Shoulder of Mutton Lake, Mount Gambier, South Australia, January, 1941 (J.S.W.).

Remarks: In the form of the dorsal setae this species does not fit in with any known form in which the major setae are septate.

Subfamily TROMBIDIINAE Mich. 1883 (part) Sig Thor 1935.

Zool. Anz., 1935, cix, p. 111.

Genus CAENOTHROMBIUM Oudemans 1927.

Ent. Bericht, 1927, vii, p. 230.

CAENOTHROMBIUM BURRAENSIS n. sp.

Description: Colour in life red. Length 935μ, width across shoulders 680μ. Eyes 2 + 2, pedunculate. Crista typical of the genus, 162μ long, as figured. Dorsal setae on propodosoma long and ciliated, 68μ; on hysterosoma uniform and short with long ciliations, 25μ. Legs I 1240μ, II 756μ, III 680μ, IV 985μ; tarsus I 374μ by 136μ, with almost parallel sides; metatarsus I 255μ.

Remarks: This relatively small species differs from all known Australian forms in the uniformly short dorsal setae.

Loc. A single specimen from an ants' nest, Burra, South Australia, August 4th, 1940 (J.S.W.).

Genus TROMBIDIUM Fabr. 1775.

Syst. Ent. 1775, p. 430.

TROMBIDIUM HEMISTRIATUM n. sp.

Description: Larva, newly hatched and unfed. Length 279μ, width 162μ, widest between coxae II and III. Mouth parts not visible from above, enclosed in a chitinous ring. Dorsal surface with two median scuta, anterior with 6 normal feathered setae and a pair of sensillary setae which are apparently naked; anterior portion of this scutum going over on to the venter, but all the setae on the dorsal part, the scutum is porous and longitudinal striated laterally, it is 162μ long and 135μ wide; the posterior dorsal scutum is 35μ long and 135μ wide, with 2 ciliated setae, porous and longitudinally striated laterally. Eyes 2 + 2 on distinct ocular shields, the posterior eye the smaller. Dorsal setae feathered, arranged 4.4.6.4.2.2 the median pairs of first and second rows on small platelets. Ventrally coxae I and II touching, coxae I with two feathered setae, II and III with one, no setae between coxae I but a pair between coxae III; posterior of III with 2.4.2 setae, the posterior pair longer. Legs as figured, I 243μ long (including coxae), II 200μ, III 230μ; tarsus III with deformed claw as figured.

Fully engorged larva, 700μ long, 440μ wide as figured.

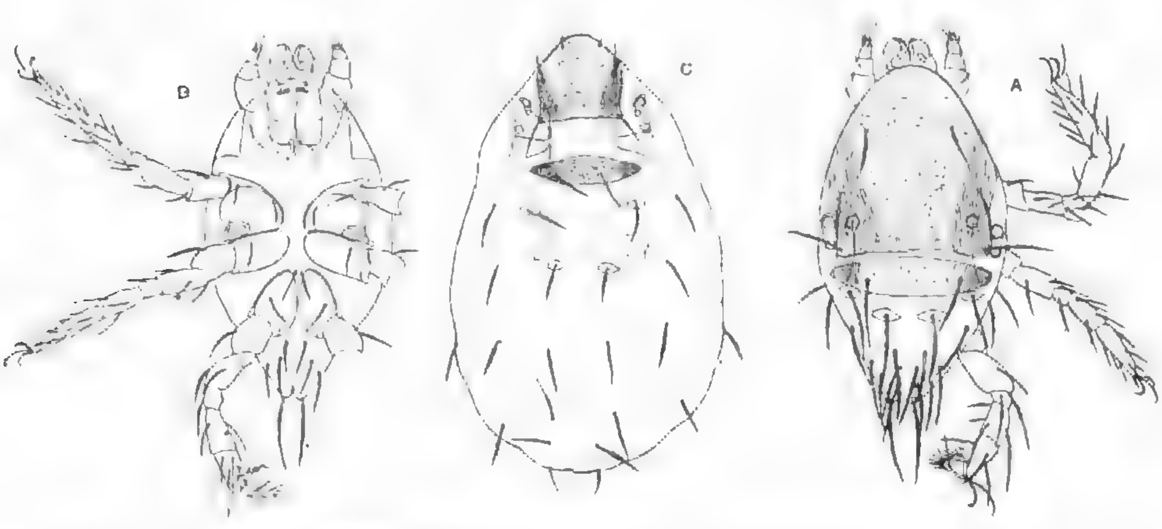

Fig. 9. *Trombicula hemistriatum* n.sp. (larva). A, dorsal, unfed; B, ventral, same; C, dorsal, fully gorged.

Remarks: In his key, Oudemans 1912, separates the genera of larval *Trombidiidae* into two groups, A2 B1 with the dorsal scuta porous but not striated and A2 B2 with the scuta longitudinally striated. The genus *Trombidium* falls into the second group.

The species described here, while having only partially striated scuta, fits entirely in *Trombidium*. It is, in fact, in the arrangement of dorsal setae, with the median members of the first and second rows on platelets, very close to *Trombidium demeyeri* Ouds. from Holland.

From *T. clarki* Wom. from Victoria it differs in the partially striated scuta, and in the dorsal setae not being arranged 2.4.4.4.2, with none on platelets.

Loc. and Host: Ten specimens, 4 fully engorged, the rest unfed, from a fly, Kenilworth, Queensland, 4 March, 1940 (D.J.W.S.).

FAMILY CALYPTOSTOMIDAE Oudemans 1923.

Genus CALYPTOSTOMA Cambridge 1875.

Ann. Mag. Nat. Hist., 1875 (4), xvi, p. 384.

CALYPTOSTOMA VELUTINUS (O. F. Müll. 1776).

Acarus velutinus O. F. Müller Zool. Dan. Prodr. 1776, p. 187.

Trombidium expalpe Hermann Mem. Apt. 1804, p. 30.

Smaris expalpis Berl. A.M.S. ital. Rept. 1887, fasc xxxix, No. 2.

Calyptostoma velutinus Ouds. Krit. hist. averz. Acar. 1929, ii, p. 596.

Description: Adult. Colour in life red, with conspicuous eyes and sensillary bases. Mouth parts hidden from above. Eyes 2 + 2, placed well behind the sensillae. Crista absent. Paired sensillary setae 108μ long, indistinctly ciliated and arising from a pair of adjacent bases as in fig. 10 D; these bases are 290μ behind the apex of body. The body shape is as figured by Berlese (*loc. cit.*). Dorsal setae 54μ long, curved, arising from platelets (fig. 10 E) between which the cuticle is reticulated; the setae are numerous and uniform and shaped as in fig. 10 K. Palpi as in fig. 10 B, apical segment twice as long as wide, with numerous long setae, but no very definite tibial claw. Mandibles (fig. 10 C) long and slender with a single chela. Ventrally with the coxae in two pairs and all coxae with numerous setae; the cuticle reticulated (fig. 10 F) but the setae fine and straight and arising from platelets. Legs relatively short, I 1020μ, II 935μ, III 935μ, IV 1200μ; tarsus I 243μ long by 120μ wide; all tarsi without scopulae; claws two.

Nymph: Similar to adult, but genital opening with only two pairs of discs. Length 1600μ, width 1190μ. Sensillae 235μ back from apex of body. Legs I 1190μ long, II 935μ, III 1100μ, IV 1190μ; tarsus I 216μ by 81μ; claws two.

Larva: Colour red. With only 3 pairs of legs, tarsi with 3 claws, otherwise as in nymph and adult. Length 357μ, width 290μ. Sensillae 108μ back from apex of body. Palpi short and stumpy (fig. 10 I). Mandibles relatively shorter and stouter than in adult. Legs I 340μ, II 306μ, III 350μ; tarsus I 108μ by 40μ; coxae I and II touching with the stigmata between, all coxae as in nymph and adult but with fewer setae.

Loc. Fiji, one adult Viti Levu in the South Australian Museum (coll. A. M. Lea), Australia. Queensland; Cairns 4 nymphs, 2 larvae (coll. W. G. Heaslip 1939).

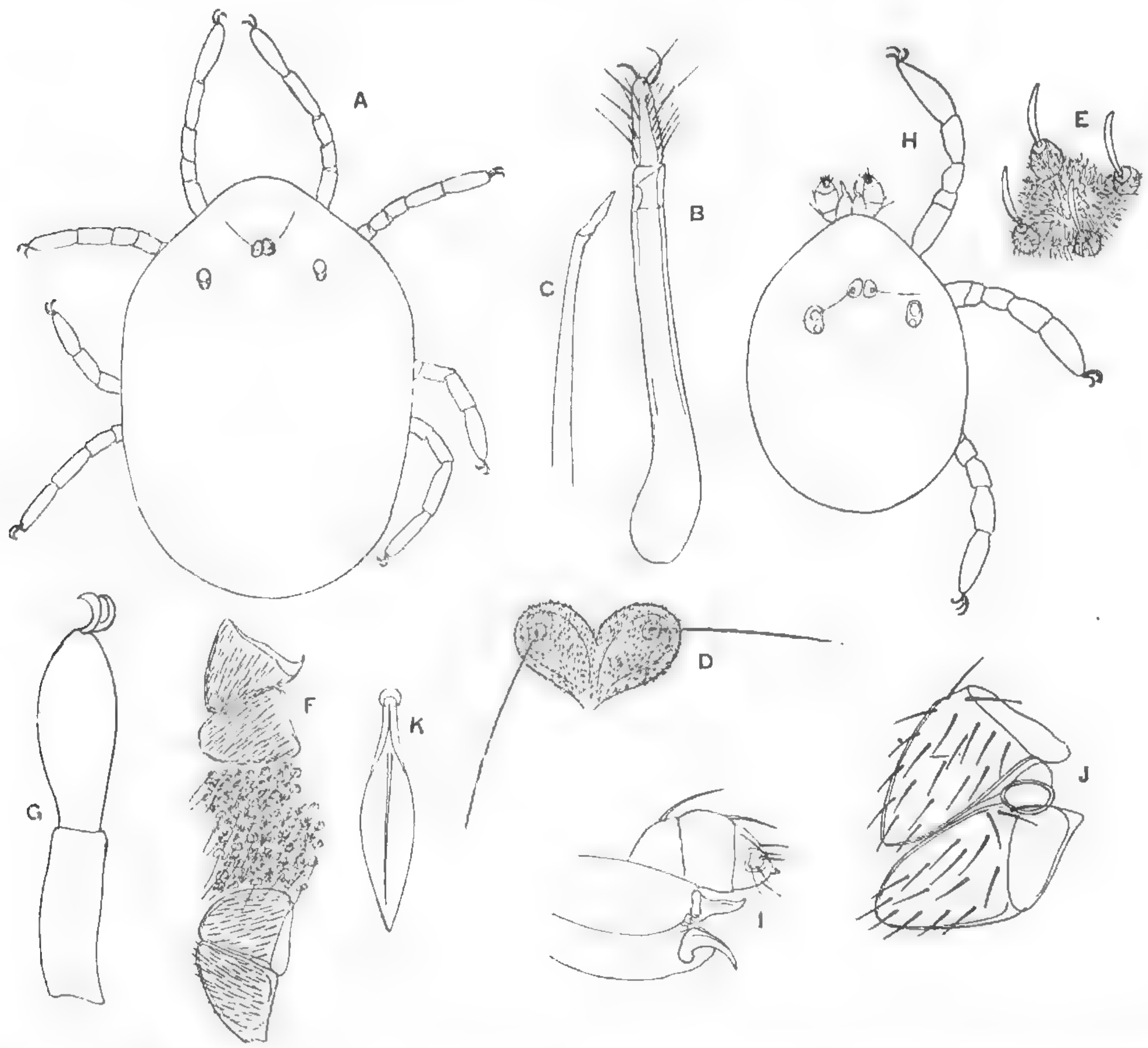

Fig. 10. *Calyptostoma velutinus* (O. F. Müll). A. dorsal; B. palp; C. mandible; D. sensillary area and setae; E. dorsal setae; F. right coxae; G. front tarsus and metatarsus; H. dorsal, larva; I. chelicerae and palp, larva; J. anterior right coxae, larva; K. dorsal seta, larva.

Remarks: In spite of the countries from which I now record this species I cannot find any differences from Berlese's figures to warrant describing it as a new species. In his fine work on the history of Acarology Oudemans refers Herman's species to *velutinus* O. F. Müll. and I have found him in the synonymy.

Calyptostoma caelatum (Berl.) Vitz. from Malaya differs in having some simple, long and fine setae between the normal dorsal setae.

REMARKS ON SOME PARASITIC NEMATODES

By T. Harvey Johnston and Patricia M. Mawson,
University of Adelaide

Summary

The examination of this small collection of nematodes was undertaken as part of our investigations which are assisted by the Commonwealth Research Grant to the University of Adelaide. Messrs. G. Jaensch and L. Ellis, of Tailem Bend, have generously helped us in regard to the local material. Types and allotypes have been deposited in the South Australian Museum. The following is a list of parasites arranged under their hosts:

REMARKS ON SOME PARASITIC NEMATODES

By T. HARVEY JOHNSTON AND PATRICIA M. MAWSON, University of Adelaide.

Fig. 1–8.

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LAGENORHYNCHUS OBSCURUS Gray (New Zealand): *Anisakis simplex* (Rud.).
KOGIA BREVICEPS (Blainville), (Queensland; South Australia): *Anisakis simplex* syn. *A. kogiae* Johnston and Mawson.
PACHYPTILA DESOLATA Gmel. (St. Vincent's Gulf, S.A.): *Paryseria pachyptilae* Johnston and Mawson; *Anisakis* sp. (? *diomedeae*).
PELECANUS CONSPICILLATUS Temm. (Tailem Bend, S.A.): *Dispharynx pelecani* n.sp.; *Cosmocephalus jaenschi* Johnston and Mawson. *Tetrameres pelecani* Johnston and Mawson.
PHALACROCORAX FUSCESCENS Vieill. (Tailem Bend, S.A.): *Eustrongylides phalacrocoracis* Johnston and Mawson.

ANISAKIS SIMPLEX (Rudolphi 1809).

Fig. 1–3.

From a dolphin, *Lagenorhynchus obscurus*, from Cook Strait, New Zealand, material collected and forwarded by Professor H. B. Kirk, Victoria University College, Wellington. The material consists of a male 45 mm. long, two young females, and an older female 76 mm. long. Dorsal lip rather shorter than laterals, with two wide lateral expansions and slightly bilobed anterior expansions, latter bearing teeth along free edge. Each lateral lip with a hump bearing a papilla on its ventral side; bilobed dentigerous ridge present, not visible from outside of lip. Cervical papillae rounded, ·5 mm. from anterior end in male, ·72 mm. in female. Nerve ring at about same level as cervical papilla. Oesophagus excluding ventriculus 2·86 mm. long in male, 5·2 mm. in female; ventriculus 1·1 mm. in male, 1·2 mm. in female.

Male: Spicules 1·2 mm. and 2 mm. in length, tail ·35 mm. long. Narrow caudal alae present. Six pairs of postanal papillae arranged as in fig. 3. Numerous preanal papillae arranged in an irregular longitudinal series on each side.

Female: Vulva not seen, probably about middle of body. Eggs small, more or less spherical, 32–36μ in diameter. Tail very short, rounded.

Our specimens agree in most points with the description of *Anisakis simplex* given by Lyster (1940), but the ventriculus is rather longer, and the papillae on the male tail are somewhat differently arranged. They differ from the account by Baylis (1920) in the possession of unequal spicules, although in this feature they resemble *A. dussumieri*, *A. kukenthalii* and *A. typica*, which are considered synonyms of *A. simplex*.

In 1939 we described *A. kogiae* as a new species because of differences from *A. simplex* and allied forms as described in such accounts as were then available. Quite recently Lyster (1940) has given a much more satisfactory account of *A. simplex*; we believe that our *A. kogiae* is covered by his description and we therefore place it as a synonym of *A. simplex*.

ANISAKIS sp.

Some very young *Anisakis* sp. were taken from *Pachyptila desolata* at Henley Beach, S.A. The specimens are quite immature, each having still a larval tooth; they agree exactly with *Anisakis* sp. larvae recorded by us (1942), from various albatrosses and petrels as likely to be young forms of *Anisakis diomedeae* (Linst.).

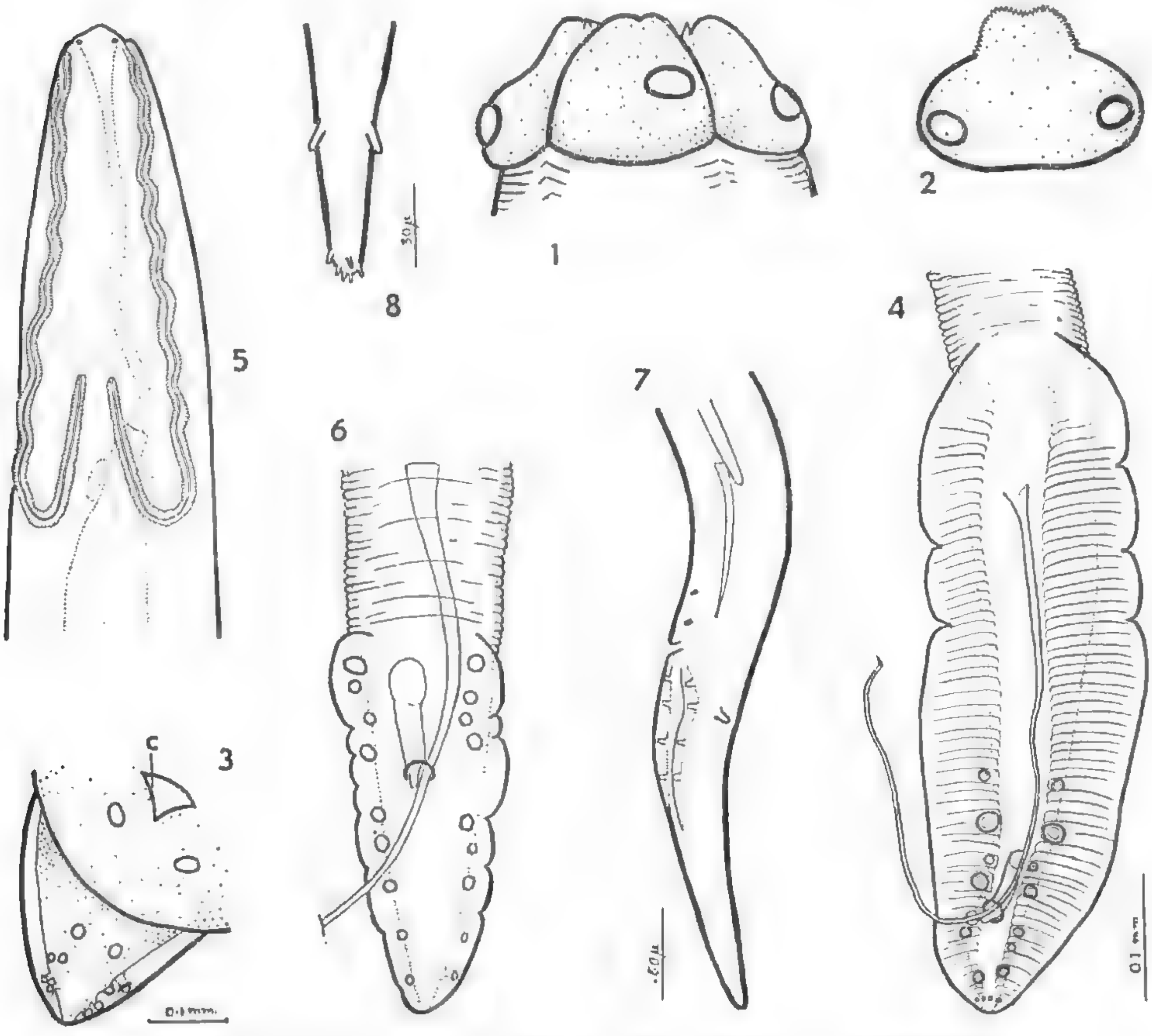

Fig. 1–3. *Anisakis simplex.* 1. head, lateral view; 2. dorsal lip; 3. male tail.
Fig. 4. *Paryseria pachyptilae,* male tail.
Fig. 5–6. *Dispharynx pelecani.* 5. anterior end; 6. male tail.
Fig. 7–8. *Tetrameres pelecani.* 7. male tail; 8. female tail.
Figs. 1, 2 and 4 to scale beside 4; Figs. 5, 6 and 7 to scale beside 7. c, cloaca.

PARYSERIA PACHYPTILAE Johnston and Mawson, 1942.

Fig. 4.

A male and two females of this species were taken from a dove Prion, *Pachyptila desolata*, washed ashore at Henley Beach, South Australia. The species was originally described from a single female from *P. vittata*. The present worms agree with the type specimen except that in the two shorter worms (the male 3·4 mm. and the female 5·9 mm. long) the vestibule is relatively longer (·13 mm.

and ·1 mm. respectively). The cuticle is striated transversely except at the lateral lines, each of which is marked by two longitudinal rows of small bosses.

In the male the caudal alae are wide, the entire ventral surface of the alae and body in this region being strongly marked with transverse striations. Four pairs of preanal and five pairs of postanal papillae are present, arranged as in fig. 1. The spicules are very unequal; the shorter 70μ long, forming a groove in which moves the longer, which is ·7 mm. long, needle-like, and ends in a sharp tip.

The vulva, in the case of the female 5·4 mm. long, is 1·5 mm. from the posterior end of the body. The thick-shelled eggs are 19μ by 30μ.

The species is distinguished by the characters of the collar, cervical papillae and vestibule, and by the structure of the posterior end of the male.

DISPHARYNX PELECANI n.sp.

Fig. 5–6.

From *Pelecanus conspicillatus*, from Tailem Bend, South Australia. Males 3·5–4 mm. long, females 4–4·2 mm. Lips not markedly conical. Cuticle at anterior end slightly expanded dorsally and ventrally; cordons ·26 mm. long in female, recurrent for about a quarter of their length. Vestibule ·14 mm. long in male, ·22 mm. in female, its walls striated transversely; oesophagus directly following vestibule narrowed and surrounded by nerve ring, then widening. Anterior part of oesophagus ·2 mm. long in male, ·27 mm. in female; posterior part 1·4 mm. long in male, ·2 mm. in female. Cervical papillae some distance behind cordons, ·16 mm. in male, ·17 mm. in female, usually bicuspid, but sometimes one or both papillae of a specimen have an additional small median cusp. Lateral alae present, extending from cervical papillae to past midlength of the body.

Male: Longer spicule ·27 mm. in length, tapering, but ending in flattened piece at right angles to the main shaft. Shorter spicule ·1 mm. long, broad, ending in blunt tip. Caudal alae supporting four pairs of preanal and five pairs of postanal papillae.

Female: Tail blunted roundly, ·6 mm. long. Vulva just behind posterior end of oesophagus, 1·5 mm. from tail. Eggs thick-shelled, 21μ by 36μ.

The species differs from others of the genus in the length of the vestibule, the position of the cervical papillae, and the form of the male tail and the spicules.

COSMOCEPHALUS JAENSCHI Johnston and Mawson, 1941.

This species was described from two male worms taken from *Phalacrocorax carbo* at Tailem Bend. One female worm of the same species is now recorded from *Pelecanus conspicillatus* from the same locality. In relative lengths of cordons, vestibule and oesophagus, and in the positions of nerve ring and cervical papillae, the female agrees exactly with the male. The shape of the cervical papillae, however, differs, those of the male being tricuspid, while those of the female are bicuspid.

The measurements of the female are as follows: Length 16 mm.; vestibule ·44 mm.; anterior portion of the oesophagus 1·1 mm.; posterior region of the oesophagus 4·6 mm.; tail tapering, blunt-tipped, ·23 mm. long; vulva 7·5 mm. from the head. Eggs thick-shelled, 20μ by 35μ.

TETRAMERES PELECANI Johnston and Mawson, 1942.

Fig. 7–8.

This species was described from a single male specimen from *Pelecanus conspicillatus* from Tailem Bend, S.A. Recently several similar worms were obtained from the same host species in the same locality, the material comprising three males and an immature female. In general appearance and size and in the relative lengths of the spicules the males agree with the type specimen, but they differ in the number of caudal papillae, there being two pairs of small preanal and five pairs of postanal; there are also narrow caudal alae, not observed in the type specimen.

The measurements of the present material are as follows: Length of males 4·1 mm.–5·7 mm., of females 3·1 mm.; vestibule of male 27μ–30μ, of female 20μ; Oesophagus of male ·85–1 mm., of female ·75 mm.; nerve ring ·2 mm. from head in male; tail ·17–·2 mm. long in male, ·1 mm. in female, the female tail possessing a pair of papillae half way along its length and about six terminal spines; longer stouter spicule ·8 mm., shorter ·08–·1 mm. in length.

EUSTRONGYLIDES PHALACROCORACIS Johnston and Mawson, 1941.

This species is now recorded from a new host, *Phalacrocorax fuscescens,* from Tailem Bend, S.A.

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THE METACERCARIA STAGE OF AUSTRALIAN SPECIES OF CLINOSTOMUM

BY T. HARVEY JOHNSTON, UNIVERSITY OF ADELAIDE

Summary

The material examined consists of three specimens, each from a different species of fish host, all of them from Queensland and all of them collected during August (1918, 1919). Though the metacercaria stages of some species of the trematode genus, Clinostomum, have been described from Europe, America and Japan, it has not been reported for either of the two known Australian species. The present paper forms part of the series relating to investigations concerning the life history of Australian trematodes, undertaken in connection with the Commonwealth Research to the University of Adelaide. Acknowledgement is made of assistance from the late Dr. T. L. Bancroft of Eidsvold, Upper Burnett River, Queensland, and from his daughter, Dr. M. J. Mackerras, for the material studied.

The METACERCARIA STAGE of AUSTRALIAN SPECIES of CLINOSTOMUM

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Fig. 1–6.

The material examined consists of three specimens, each from a different species of fish host, all of them from Queensland and all of them collected during August (1918, 1919). Though the metacercaria stages of some species of the trematode genus, *Clinostomum*, have been described from Europe, America and Japan, it has not been reported for either of the two known Australian species. The present paper forms part of the series relating to investigations concerning the life history of Australian trematodes, undertaken in connection with the Commonwealth Research to the University of Adelaide. Acknowledgment is made of assistance from the late Dr. T. L. Bancroft of Eidsvold, Upper Burnett River, Queensland, and from his daughter, Dr. M. J. Mackerras, for the material studied.

Clinostomum australiense S. J. Johnston.

(Fig. 1–2).

This large species was described by S. J. Johnston (1917, 230) from specimens taken from the oesophagus of a darter, *Anhinga novaehollandiae*, from the Burnett River. I have restudied the type material (Johnston, 1942).

In August, 1918, Dr. Bancroft sent me a single larval trematode taken from a bony bream, *Nematalosa elongata* Macleay, at Eidsvold, Burnett River. Recent examination proved it to be a very large metacercaria whose anatomy in all essentials resembled that of *C. australiense*, as figured by S. J. Johnston (1917) and myself (1942). The type specimens themselves are metacercariae, not adults, and it is probable that the darter may not be the normal bird host, since species of *Clinostomum* occur almost exclusively in Ardeiform birds. Cort (1913, 177) mentioned finding the adult stage in a North American gull, as well as in herons. Ward (1918, 408) referred to other fish-eating bird hosts in the United States. He also mentioned the presence of encysted metacercariae in various fresh-water fish, stating that these larval stages were so abundant in some localities that food fish were rendered unfit for use by the middle of June, but that the cysts were deserted by the late autumn, so that fish were free from infection in winter. It is probably unlikely that these conditions apply to Australia where the climate is milder. The few *Clinostomum* larvae examined by me were all taken in August, i.e. at the end of winter which in Queensland does not necessarily mean cold weather.

The following are the measurements in millimetres of the larva from *Nematalosa*, the corresponding figures for the type specimen from *Anhinga* being added in parentheses: length 9·7 (11); maximum breadth 3 (3·25); breadth at waist in acetabular region 1·7 (1·9), at the genital pore which is in the midline 3 (3·2), at the level of the ovary 3 (3·2), at the level of the posterior testes 2·8 (3·2), across the oral field at the mid-level of the oral sucker 1·3 (1·3); maximum breadth between the suckers 1·8 (2·1); oral sucker ·54 in diameter (·54); acetabulum 1·3 diameter (1·26); oral field 1 mm. long by 1·2 (1 by 1·5); ratio of oral to acetabular diameters 1 : 2·4 (1 : 2·3); front edge of acetabulum to head end of worm 1·5 (1·5); posterior edge of acetabulum to tail end of worm 7·0 (8·2); ratio of preacetabular length to body length 1 : 6·5 (1 : 7·3); distance of genital

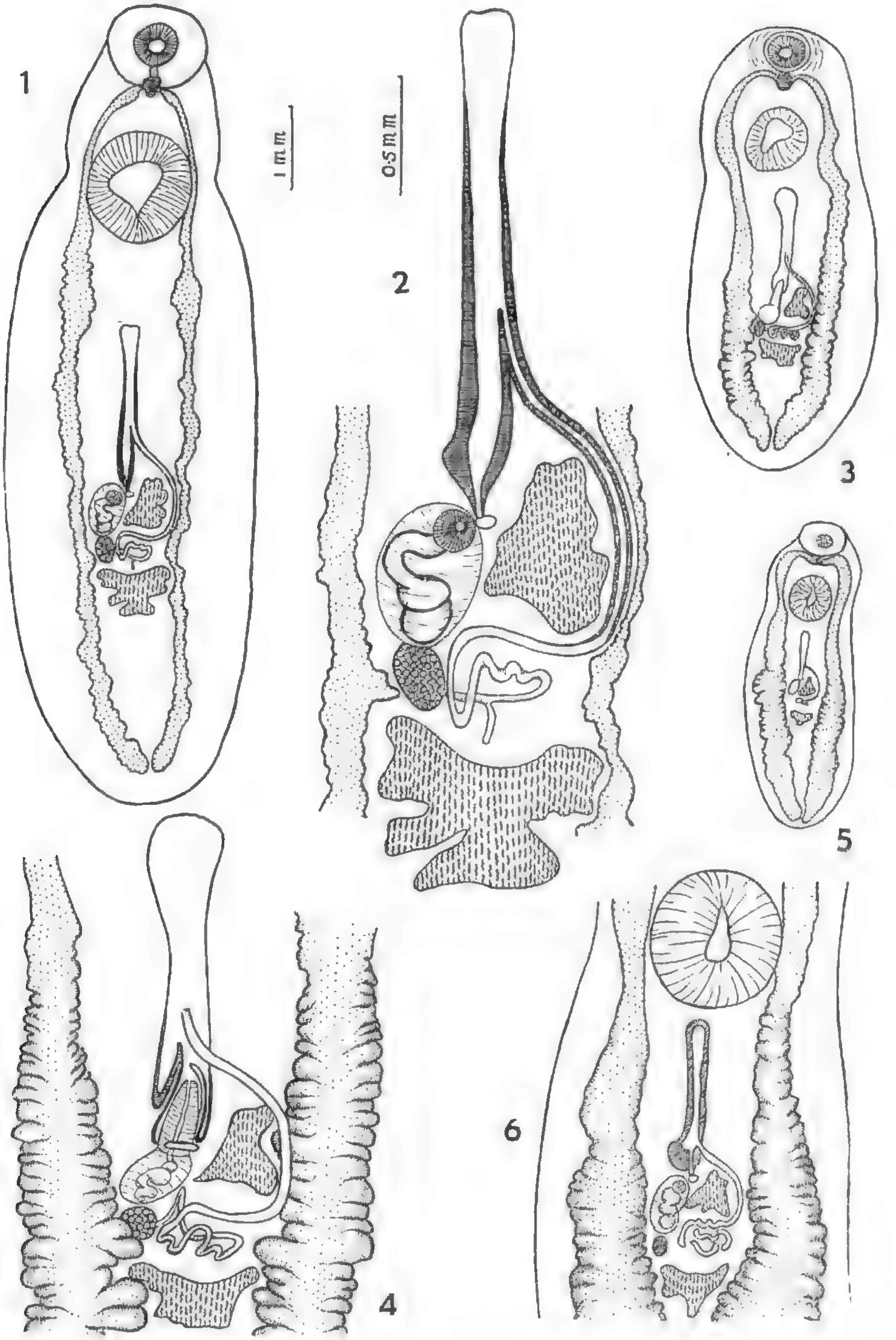

Fig. 1–2. *Clinostomum australiense.* 3–4. *C. complanatum* from *Therapon hillii.* 5–6. *C. complanatum* from *Carassiops galii.* (Fig. 1, 3, and 5 to scale beside fig. 1; 2, 4 and 6 to scale beside fig. 2).

pore from head end of worm 6 (7), and its ratio to body length 7 : 11 (7 : 11); anterior testis ·75 mm. long by ·5 transversely (·78 by ·69); posterior testis ·5 long by ·9 broad (·4 by ·9); testes ·5 apart (·5); ovary ·3 long by ·25 (·33 by ·25); cirrus sac ·6 to ·45 (·6 by ·3); length of uterine sac, excluding metraterm, 1·8 (3·0), ratio of that length to body length 1 : 5·4 (1 : 3·7); distance from front of ovary to head end of worm 6·5 (7·6), ratio of that length to body length 1 : 1·5 (1 : 1·45) hence the ovary lies in the posterior half of the worm and in the vicinity of the anterior limit of the posterior third of the body; distance from front of ovary to the posterior edge of the acetabulum 3·6 (4·7), i.e just behind the middle of the postacetabular length; distance from anterior end of the uterine sac to the posterior end of the acetabulum 1·0 (1·0), and its ratio to the postacetabular length 1 : 7 (1 : 8).

CLINOSTOMUM COMPLANATUM (Rud.).

Fig. 3–6.

Syn. *C. hornum* Nicoll.

This is a much smaller worm than the preceding and is known from ardeiform birds in Europe (Braun 1900a, b; Lühe 1900; Ciurea 1911; Sprehn 1932) and Japan (Yamaguti 1933). The only Australian record is that by Nicoll (1914, 123) who described it as *C. hornum*, his material (all from North Queensland) having been taken from *Nycticorax caledonicus*, while some immature specimens from *Botaurus poeciloptilus* appeared to him to belong to the same species. He mentioned that *C. hornum* was close to *C. marginatum* and *C. complanatum*, differing from the latter in having the acetabulum nearer the middle of the body and in possessing a larger oral sucker, while the lateral position of the genital aperture differentiated it from *C. marginatum*. Yamaguti (1933, 66) gave a good account and figure of *C. complanatum* from Japanese herons and mentioned three species of freshwater fish as hosts for the metacercaria. The adult stage was obtained by him experimentally by feeding cysts to *Nycticorax*, maturity being attained in forty-five hours. He considered *C. hornum* to be a synonym of *C. complanatum*.

	a	b	c	d
length:	4·6	4·6	5·3	3·7
maximum breadth:	1·68	1·45	2·3	1·35
oral sucker, length, breadth:	·28 × ·33	·4 × ·4	·33 × ·44	·22 × ·22
oral field:	·55 × ·8	·45 × ·8	·45 × ·6	·4 × ·7
acetabulum:	·7 × ·7	·7 × ·7	·75 × ·8	·63 × ·55
anterior testis:	·4 × ·7	·65 × ·55	·4 × ·3	·22 × ·18
posterior testes:	·25 × ·79	·56 × ·75	·2 × ·6	·2 × ·3
distance between testes:	·2	·1	·3	·2
ovary:	·25 × ·16	·15 × ·25	·18 × ·15	·1 × ·08
max. breadth between suckers:	1·5	1·25	1·7	1·1
breadth at acetabulum:	1·5	1·45	2·0	1·0
breadth at sex pore:	2·0	1·3	2·3	1·33
breadth at posterior testes	1·85	1·3	2·25	1·33
breadth at ovary	1·9	1·3	2·25	1·33
front acetab. to head end:	1·0	·9	1·0	·7
post. end acetab. to tail end:	2·7	3·0	3·6	2·5
pre-acetab. length: body length:	1 : 4·7	1 : 5·1	1 : 5·3	1 : 5·3
genit. pore to head end:	2·8	2·6	3·4	2·0
front ovary to post. edge acetab.:	1·3	1·25	1·8	1·0
front ovary to head end:	3·1	2·85	3·6	2·2
oral sucker: acetab.:	1 : 2·1–2·5	1 : 1·8	1 : 2	2 : 5
cirrus sac:	·28 × ·18	1·45 × ·25	·27 × ·2	·27 × ·12
length uterine sac (excluding metraterm):	·7	1·85	1·2	·6
eggs:	·114–·136 × ·072–·078	·105–·11 × ·066	—	—

The metacercariae examined by me were taken by Dr. J. M. Mackerras from the peritoneal cavity of a goby, *Carassiops galii* Ogilby, from the Burnett River at Eidsvold and from a cyst in the gill of *Therapon hillii* Castln. from the Thompson River at Longreach. The preceding tabulation of measurements in millimetres of (a) adult *C. complanatum* (based on Yamaguti's account and figure), (b) adult *C. hornum* (from Nicoll's figure), (c) metacercaria from *Therapon hillii*, and (d) metacercaria from *Carassiops galii*, will indicate that all belong to the same species.

It will be noticed that the larva from *Therapon* agrees closely in dimensions with the adults. In all, the anterior end of the uterine sac extends forwards to end only a short distance behind the acetabulum, and the genital pore is displaced from the median line. The main difference between the two Australian larvae is that of size, the parasite from *Carassiops* having its reproductive system just as differentiated as that of the worm from *Therapon*.

Yamaguti (1933) gave a short account of the metacercaria stage which he found chiefly in the tissues around the mouth, operculum and pharynx, and less commonly in the muscles or under the skin of Japanese fish. The very thin fibrous cysts were fragile and readily burst. He reported that larvae were ·28–4·7 mm. long by 1·0–1·5 mm. broad; the oral sucker ·21–·23 mm. in length by ·23–·25 in width; and the acetabulum ·53–·55 by ·55–·57 mm. The more marked digitation of the testes, and the presence of a well developed cellular coating of the uterus were distinctive features of the metacercariae. Both of these characteristics were obvious in the Australian specimens.

Yamaguti mentioned that in two of his larvae the cirrus was inserted into the metraterm, and in one of these the organ reached further forward than the front edge of the anterior testis. In my specimen from *Therapon* a similar condition was observed and is indicated in fig. 4, the uterine sac being partly invaginated as a result of the cirrus and the surrounding metraterm having been pushed so far forward.

Braun, who gave an account of *C. marginatum* (1900a, 28; 1900b, 25) from Brazilian herons, doubted whether *C. complanatum* was distinct from it (1900c, 141), and reported that *C. gracile* Leidy was probably the young stage of *C. marginatum* (1899, 491). He also stated that *C. heterostomum* of MacCallum (1899) from a Canadian heron was not the same as Rudolphi's species, but was *C. marginatum* (1900c, 141). Osborn's (1912) account of the latter from North American frogs, fish and herons is not available.

Ciurea (1911) published an account and figures of the larva of *C. complanatum* from the musculature of *Perca fluviatilis* from the Danube. The dimensions were length 4·3–4·7 mm.; neck region ·76 mm. long by 1·67 mm. broad; oral sucker ·26–·32 by ·39–·52 mm.; acetabulum ·7 mm. diameter; both testes much incised; anterior testis ·48 mm. transversely; posterior testis ·58 mm.; ovary ·25 mm. diameter. He figured extensive vitellaria but no other author seems to have referred to the presence of these glands in the metacercaria. His figure suggests that he illustrated the very extensive and characteristic excretory canals which are such a conspicuous feature of both larval and adult stages. His figure was reproduced by Sprehn (1932, fig. 177). Ciurea also figured the cirrus everted into the metraterm in his larva.

Cort (1913) gave an account of *Clinostomum* larvae from North American freshwater fish and frogs, and came to the conclusion that those from fish belonged to *C. marginatum*, a widely distributed species in North and South America, while those from frogs belonged to *C. attenuatum* Cort (1913, 171). He figured the two kinds of larvae, as well as the adult stage of *C. marginatum*.

Travassos (1928, 334) dealt with several Brazilian species of *Clinostomum*, all from herons and their allies, and reported finding the young stages in the gills viscera and subcutaneous tissues of freshwater fish.

SUMMARY.

The metacercaria of *Clinostomum australiense* S. J. Johnston is recorded from the bony bream, *Nematalosa elongata,* from the Burnett River, Queensland.

The metacercaria of *C. complanatum* Rud. (of which *C. hornum* Nicoll is a synonym) is now recorded from the fish *Therapon hillii* from Western Queensland, and from *Carassiops galii* from the Burnett River.

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ECHINODERMATA OF THE FLINDERSIAN REGION SOUTHERN AUSTRALIA

BY BERNARD C. COTTON AND FRANK K. GODFREY

Summary

The Phylum Echinodermata appears to have been somewhat neglected by South Australian zoological workers.

Tenison-Woods (1877) gave a list of the Sea-urchins of Australia. Thirteen species are there said to inhabit our shores, and in a supplementary paper (1878) another one is added. A large number of Australian Sea-stars was described by Gray in an appendix to Jukes' Voyage of the "Fly". Qouy and Gaimard, "Voyage Astrolabe", described three species of Australian Holothurians. Tate (1882) supplied a short list of Sea-urchins from South Australia.

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Plate xii.

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Tenison-Woods (1877) gave a list of the Sea-urchins of Australia. Thirteen species are there said to inhabit our shores, and in a supplementary paper (1878) another one is added. A large number of Australian Sea-stars was described by Gray in an appendix to Jukes' Voyage of the "Fly". Quoy and Gaimard, "Voyage Astrolabe", described three species of Australian Holothurians. Tate (1882) supplied a short list of Sea-urchins from South Australia.

Dr. H. L. Clark (1928) named a number of Sea-lilies, Sea-stars, Brittle-stars and Sea-urchins, mainly the results of dredgings by Sir Joseph Verco, and forwarded by the South Australian Museum. Dr. Clark, in company with Mr. H. M. Hale, collected Echinoderms during a brief visit to Port Willunga in 1932, as recorded by him in 1938. The same author described a new Basket-star from Cape Dutton, South Australia, in 1939.

The present authors now endeavour to systematize the *Echinodermata* recorded from the Flindersian Region, the whole coastline from Wilson's Promontory, Victoria, to Geraldton, Western Australia, and including the northern and western coasts of Tasmania. Where a species apparently belongs to the Dampierian Region and is recorded north of Cape Leeuwin, its extralimital character is noted. The same applies to Peronian species recorded at the eastern end of the Flindersian. Following the type locality, we have listed the exact localities in the Flindersian Region of authentic specimens.

We have found that the determination of genotypes, and the fixing of type localities, are primary necessities in any account of a zoological nature, therefore we have endeavoured to determine and fix this basic information first.

Dr. Clark in his work "Echinoderms of Australia", indicated that conclusions arrived at by a distant zoologist were not the most satisfactory, and it required local students to intensify the study. We take this step having the knowledge that at present there is no worker giving this phylum special attention here.

In the previous sectional lists published, several localities are inaccurate, and we have endeavoured to give exact localities wherever possible. A little disorder has arisen in Dr. Clark's work through the failure to recognize natural Zoological Regions, and this has tended to confuse results.

The material, the basis of this list, includes the results of Verco's dredgings, besides original South Australian Museum specimens.

Dr. Clark's 1928 holotypes are in the South Australian Museum and are here referred to under our registration numbers; his 1938 collection was, however, taken by him to America. We have received valuable assistance, with specimens, from the members of the Malacological Society of South Australia, especially Messrs. G. Pattison and W. G. Buick. The results of our own collecting are also recorded.

Phylum ECHINODERMATA

CLASS ASTEROIDEA

Order PHANEROZONIA.

FAMILY ASTROPECTINIDAE.

Genus ASTROPECTEN Gray 1840.

Genotype: *Astropecten aurantiacus* Tiedemann 1816 = *Astropecten aranciacus* Linné 1758 (Mediterranean).

ASTROPECTEN PECTINATUS Sladen 1883.

Astropecten pectinatus Sladen 1883, p. 251.

Type locality. Port Jackson, New South Wales. Döderlein (1917, p. 166) records this species from Bass Strait and Port Phillip. The specimen recorded by H. L. Clark (1928, p. 371), from Petrel Bay, St. Francis Island, South Australia, appears to be this species. (K.38 S.A.M.).

ASTROPECTEN PREISSII Müller and Troschel 1843.

Astropecten preissii Müller and Troschel 1843, p. 119.

Type locality. Fremantle, Western Australia.

Distribution. South Australia: Marino, Port Noarlunga, Port Willunga, Sellicks, Spencer Gulf, north coast of Kangaroo Island, Flinders Island 37 fathoms. Western Australia: Fremantle, Shark Bay.

South Australian examples are reddish brown in life.

The subspecies *albanicus* Döderlein (1917, p. 162) is a wide armed variety and we have it from Spencer Gulf (K.43 S.A.M.). The dimensions of this specimen are R = 60 mm., r = 15 mm., br. = 17 mm.

ASTROPECTEN TRISERIATUS Müller and Troschel 1843.

Astropecten triseriatus Müller and Troschel 1843, p. 118.

Astropecten arenarius Perrier 1876, p. 286.

Type locality. South-western Australia.

Distribution. Western Australia: Fremantle, also north-western Australia. We have not taken this species in South Australia, and the record is probably extralimital from the Dampierian Region.

ASTROPECTEN VAPPA Müller and Troschel 1843.

Astropecten vappa Müller and Troschel 1843, p. 119.

Type locality. South-west Australia.

Distribution. South Australia: Spencer Gulf, juvenile (K.44). Western Australia: Shark Bay, Albany.

ASTROPECTEN SYNTOMUS H. L. Clark 1928.

Astropecten syntomus H. L. Clark 1928, p. 372.

Holotype: Reg. No. K.45. South Australia.

ASTROPECTEN SCHAYERI Döderlein 1917.

Astropecten schayeri Döderlein 1917, p. 60.

Type locality. Tasmania.
Distribution. Victoria: Portland. Tasmania.

Genus LONCHOTASTER Sladen 1885.

Genotype: *Lonchotaster tartareus* Sladen 1889 (Atlantic and Southern Oceans)

LONCHOTASTER MAGNIFICUS H. L. Clark 1916.

Lonchotaster magnificus H. L. Clark 1916, p. 30.

Type locality. Great Australian Bight, 80–120 fathoms.

LONCHOTASTER FORFICIFER Sladen 1889.

Lonchotaster forficifer Sladen 1889, p. 106.

Type locality. Near Antarctic Circle, lat 62° 26′ S., long. 95° 44′ E., depth 1975 fathoms, Diatom ooze.
Distribution. Also South Australia, lat. 53° 55′ S., long. 108° 35′ E., 1950 fathoms from Diatom ooze.

Genus PSILASTER Sladen 1885.

Genotype: *Astropecten andromeda* Müller and Troschel 1842. (Europe).

PSILASTER ACUMINATUS Sladen 1889.

Psilaster acuminatus Sladen 1889, p. 225.

Type locality. North-west of Port Hardy, New Zealand, 150 fathoms.
Distribution. South Australia: Great Australian Bight. Bass Strait. Victoria, Gabo Island, 80–200 fathoms.

FAMILY LUIDIIDAE.

Genus LUIDIA Forbes 1839.

Genotype: *Luidia fragilissima* Forbes 1939 = *Luidia ciliaris* Philippi 1837. (Europe).

LUIDIA MACULATA Müller and Troschel 1842.

Luidia maculata Müller and Troschel 1842, p. 77.

Type locality. East Indies.
Distribution. South Australia: Flinders Island, 37 fathoms. New South Wales. Queensland: Fraser Island, 25–30 fathoms. Western Australia: Broome.

This seems distinct from the Flindersian *Luidia australiae* Döderlein. It has been recorded from the Dampierian and Peronian Regions. We have not specimens from the Flindersian Region which could be regarded as this species, although H. L. Clark (1916, p. 29), records it from Flinders Island, South Australia, 37 fathoms.

LUIDIA AUSTRALIAE Döderlein 1920.

Luidia australiae Döderlein 1920, p. 266.

Type locality. Fremantle, Western Australia.
Distribution. South Australia: Gulf St. Vincent, Kangaroo Island. Western Australia: Rottnest Island.

All Flindersian examples examined by us have seven arms, and differ characteristically from *Luidia maculata* in the paxillae on the distal part of the arm. Compared with *maculata*, *australiae* has the median paxillae larger of markedly unequal size, and the lateral paxillae less regular. Two large specimens recently taken at Sellicks Beach, one by H. M. Hale, Director of South Australian Museum, and one by Mrs. Dickensen:

1. Reg. No. K.429. Sellicks Beach, six fathoms, seven arms, R = 160 mm. Colour in life, variegated yellow and blackish.
2. Reg. No. K.563. Sellicks Beach, seven arms, R = 190 mm. Colour, variegated yellow and blackish (figured).

FAMILY ARCHASTERIDAE.

Genus ARCHASTER Müller and Troschel 1842.

Genotype: *Archaster typicus* Müller and Troschel 1842 (Indian Ocean). *Archaster hesperus* Müller and Troschel 1842, is recorded from Japan, and the third species described when the genus was introduced, namely *Archaster angulatus,* came from "Java; Isle de France".

ARCHASTER LAEVIS H. L. Clark 1839.

Archaster laevis H. L. Clark 1938, p. 75.

Type locality. Broome, Western Australia, 5–8 fathoms.

A large series of this species was forwarded from Fremantle, Western Australia, by Mr. H. Rossell, also two large examples were donated by Mr. W. R. Steadman. Specimens in this Museum were labelled "*Asterias angulatus*". *Archaster angulatus* Müller and Troschel is from Mauritius, and has been doubtfully recorded from Java, and the Philippine Islands. The distribution of *Archaster angulatus* (? = *mauritianus* Gray) is recorded by Sladen (1889, p. 123) as the Indian Ocean, with Mauritius as the metropolis. H. L. Clark (1938, p 76), when describing *Archaster laevis* remarks "that this handsome *Archaster* is nearly related to *Archaster angulatus* admits of no doubt, but the smooth tessellated aboral surface caused by the crowded, truncate, prismatic granules of the paxillae gives it a very characteristic appearance, quite unlike that of any specimens of *angulatus* available for comparison".

Under the Museum registration K.49, nineteen specimens, taken in October, 1934, are entered. The species is apparently common in shallow water at Fremantle. Mr. Harold Rossell when forwarding them writes: "You will notice these stars are nearly all five-rayed, though occasionally a six-rayed specimen is found.

I noticed that out of about sixty stars of this species I only found two six-rayed, one of which I am sending in this parcel". The largest specimen has R = 110 mm., r = 15 mm., and maximum br. = 17 mm. at the disc. The smallest juvenile has R = 45 mm., r = 9 mm., and maximum br. = 10 mm. at the disc. The aboral surface is flat, but frequently the middle of the rays is actually sunken in dried specimens, giving it a channel-like effect up to the distal quarter of the ray. The six-rayed specimen has R = 75 mm., r = 13 mm., br. = 14 mm.

K.575 from Shark Island, Fremantle, two large specimens. The largest has R = 125 mm., r = 27 mm., br. = 17 mm.

So far we have no record of this species from South Australia. It is probably extralimital from the Dampierian Region.

FAMILY GONIASTERIDAE.

Genus NECTRIA Gray 1840.

Genotype: *Asterias ocellifera* Lamarck 1816 (Australian Seas).

NECTRIA MULTISPINA H. L. Clark 1928.

Nectria multispina H. L. Clark 1928, p. 375.

Holotype: Reg. No. K.50. Gulf St. Vincent, South Australia.

Distribution. South Australia: Gulf St. Vincent, Port Willunga, Marino, Spencer Gulf. Western Australia: Albany.

The species is probably equally as common as *Nectria ocellata* Perrier, in South Australia. A living specimen before us now is bright red with five obscure cream-coloured blotches situated on the disc, near the base of the arms; the tube feet are dark blood-red. This example, Reg. No. K.564, from Sellicks Beach (H. M. Hale), is typical; R = 45 mm.

Although *multispina* is regarded as distinct from *ocellata*, some specimens are difficult to separate.

NECTRIA OCELLATA Perrier 1876.

Nectria ocellata Perrier 1876, p. 4.

Type locality. Tasmania.

Distribution. South Australia: Gulf St. Vincent, Spencer Gulf, Granite Island, Kingston, Great Australian Bight, and taken by us from the reefs at Marino, Port Willunga, and Sellicks (all Gulf St. Vincent). Also recorded from Tasmania, Devonport, Bass Strait.

Genus PENTAGONASTER Gray 1840.

Genotype: *Pentagonaster pulchellus* Gray 1860 (New Zealand).

PENTAGONASTER DÜBENI Gray 1847.

Pentagonaster dübeni Gray 1847, p. 79.

Type locality. Western Australia.

Distribution. South Australia: Gulf St. Vincent, Spencer Gulf. Western Australia: Point Peron.

Genus NYMPHASTER Sladen 1885.

Genotype: *Nymphaster symbolicus* Sladen 1889 (Philippine Islands).

NYMPHASTER PENTAGONUS H. L. Clark 1916.

Nymphaster pentagonus H. L. Clark 1916, p. 36.

Type locality. Great Australian Bight, South Australia, 250 fathoms.

Genus TOSIA Gray 1840.

Genotype: *Tosia australis* Gray 1840 (Swan River, Western Australia).

TOSIA AUSTRALIS Gray 1840.

Tosia australis Gray 1840, p. 281.

Type locality. Swan River, Western Australia.

Distribution. South Australia: Gulf St. Vincent, Port Noarlunga (Miss I. Davies) [Adelaide University, No. 63], Port Willunga (W. M. Nielsen), Marino, Spencer Gulf, Kangaroo Island, Port Lincoln, Wallaroo. Victoria: Port Phillip, Westernport. Bass Strait: King Island. Tasmania: d'Entrecasteaux Channel. Western Australia: Lucky Bay, King George Sound.

The species is very common throughout the Flindersian Region. The colouration is variable. A specimen (Reg. No. K.566) from Marino has a five-rayed salmon-coloured star pattern in the middle, the interstices being light violet; the superomarginal plates are mottled light and dark violet, while the inferomarginals are lighter coloured; the underside is predominantly of a cream-coloured ground sparsely spotted with light violet-coloured plates irregularly disposed. This example is a juvenile, R = 15 mm., and r = 10 mm. The superomarginals are six on each side, the terminal ones being slightly larger; the inferomarginals number six corresponding with those above.

Reg. No. K.567, is a typical half grown specimen taken by one of us at Port Fairy, Victoria.

TOSIA ASTROLOGORUM Müller and Troschel 1842.

Astrogonium astrologorum Müller and Troschel 1842, p. 54.

Tosia australis var. *astrologorum* H. L. Clark 1928, p. 384.

Type locality. New Holland. We designate Port Willunga, South Australia.

Distribution. South Australia: Port Willunga, Port Noarlunga (Miss I. Davies) [Adelaide University No. 63a], Spencer Gulf. Victoria: Port Phillip. Tasmania: d'Entrecasteaux Channel, 5 fathoms. Western Australia.

This species is probably quite distinct from *Tosia australis*, and living adult specimens can be readily separated. It is characterized by the produced pointed rays, large distal superomarginal plates, and centrally elevated median superomarginals. Reg. No. K.568, from Marino, measures R = 25 mm., and r = 16 mm. Colour is predominantly dark violet. A specimen from Normanville, S.A., Nov., 1941, has orange and red maculations aborally, lighter coloured beneath; R = 25 mm. and r = 17 mm.

TOSIA GRANDIS Gray 1847.

Tosia grandis Gray 1847, p. 80.

Tosia aurata Gray 1847, p. 80.

Type locality. *T. grandis,* Western Australia; *T. aurata,* Australia.
Distribution. Western Australia. South Australia. Victoria: Port Phillip. Tasmania: Oyster Bay, 20–30 fathoms, d'Entrecasteaux Channel, 5 fathoms.

There seems little doubt but that *grandis* and *aurata* are one and the same species. Livingstone (1932, p. 373), when discussing the status of the two names wrote, "*T. aurata* Gray (valid)" and beneath, "*T. grandis* Gray (? synonym of *T. aurata* Gray)". However if the original descriptions are referred to it will be seen that *grandis* has line priority over *aurata*.

Genus MEDIASTER Stimpson 1857.

Genotype: *Mediaster aequalis* Stimpson 1857 (Alaskan Peninsula to Panama).

MEDIASTER AUSTRALIENSIS H. L. Clark 1916.

Mediaster australiensis H. L. Clark 1916, p. 39.

Type locality. Flinders Island, Bass Strait, 40 fathoms.
Distribution. Bass Strait. Tasmania.

FAMILY OREASTERIDAE.

Genus ASTERODISCUS Gray 1847.

Genotype: *Asterodiscus elegans* Gray 1847 (North-east China).

ASTERODISCUS TRUNCATUS Coleman 1911.

Asterodiscus truncatus Coleman 1911, p. 699.

Nectria ocellifera H. L. Clark 1909, p. 529 (non Lamarck).

Type locality. Botany Bay, New South Wales, 79–80 fathoms, sand and stones.
Distribution. South Australia: Great Australian Bight, 15 miles south of St. Francis Island, 30 fathoms. Bass Strait. Victoria. New South Wales. Western Australia: Western end of Bight, 90 fathoms.

FAMILY ANTHENEIDAE.

Genus ANTHASTER Döderlein 1915.

Genotype: *Oreaster valvulatus* Müller and Troschel 1843 (South-west Australia).

ANTHASTER VALVULATUS Müller and Troschel 1843.

Oreaster valvulatus Müller and Troschel 1843, p. 115.

Type locality. South-west Australia.
Distribution. South Australia: Glenelg, Kangaroo Island, Althorpe Islands. Western Australia: Rottnest Island, Cottesloe.

FAMILY LINCKIIDAE.

Genus PSEUDOPHIDIASTER H. L. Clark 1916.

Genotype: *Pseudophidiaster rhysus* H. L. Clark 1916 (Great Australian Bight, 80–120 fathoms).

PSEUDOPHIDIASTER RHYSUS H. L. Clark 1916.

Pseudophidiaster rhysus H. L. Clark 1916, p. 55.

Type locality. Great Australian Bight, 80–120 fathoms.
Distribution. South Australia: Great Australian Bight. Bass Strait. Victoria: South of Gabo Island, 200 fathoms. Tasmania: Oyster Bay, 60 fathoms.

FAMILY ASTEROPIDAE.

Genus PETRICIA Gray 1847.

Genotype: *Asterias vernicina* Lamarck 1816 = *Petricia punctata* Gray 1847 (Southern Australia).

PETRICIA VERNICINA Lamarck 1816.

Asterias vernicina Lamarck 1816, p. 554.
Petricia punctata Gray 1847.

Type locality. South Australia ("les mers Australes?" Lamarck).
Distribution. South Australia: Twenty specimens from Port Willunga (Reg. No. K.539) are typical; Port Noarlunga (Adelaide University, Reg. No. 143) taken by Miss I. Davies, preserved in glycerine has retained the dark red colour so typical of the living specimens; Cape Jervis (G. Pattison), taken alive under a rock at half tide mark, November, 1941, R = 52 mm., r = 24 mm., br = 44 mm., thickness in centre (living) 16 mm., tapering only slightly to 12 mm. at end of arms; colour, a blend of scarlet, orange and yellow; a kind of skin covered the entire animal, so highly coloured that the collector's hands were stained; aboral surface lumpy and uneven. The species is also recorded from Spencer Gulf.

PETRICIA OBESA H. L. Clark 1923.

Petricia obesa H. L. Clark 1923, p. 241.

Type locality. Western Australia.
Distribution. Western Australia: Bunkers Bay, Point Peron.

Order SPINULOSA.

FAMILY ASTERINIDAE.

Genus ASTERINA Nardo 1834.

Genotype: *Asterias minuta* Nardo 1834 = *Asterias gibbosa* Perrier. (Europe).

ASTERINA ATYPHOIDA H. L. Clark 1916.

Asterina atyphoida H. L. Clark 1916, p. 57.

Type locality. Fifteen miles north-west of Cape Jervis, South Australia, 17 fathoms.

Distribution. South Australia: Gulf St. Vincent, Spencer Gulf, Backstairs Passage, Troubridge Shoal, Cape Marsden, The Pages, Kangaroo Island.

ASTERINA SCOBINATA Livingstone 1933.

Asterina scobinata Livingstone 1933, p. 1.

Type locality. Tasmania.

Distribution. Tasmania: Hobart, Eagle Hawk Neck, Wynyard. The species may be extralimital from the Peronian, Maugean subregion. It has been recorded in the Flindersian at Wynyard, north-western Tasmania. The exact type locality in Tasmania is not given by Livingstone in the original description. We have not taken it in South Australia.

Genus PATIRIELLA Verrill 1913.

Genotype: *Asterina regularis* Verrill (New Zealand and Australia).

PATIRIELLA CALCAR Lamarck 1816.

Asterias calcar Lamarck 1816, p. 557.

Type locality. King George Sound, Western Australia.

Distribution. South Australia: Guichen Bay, Encounter Bay, Gulf St. Vincent, Spencer Gulf, Kangaroo Island. Western Australia. Tasmania: Hobart. New South Wales.

This is a common intertidal species in New South Wales, and it is very common in South Australia above low tide mark at Port Willunga, Sellicks, Marino, and Cape Jervis on rocky reefs.

South Australian specimens above are orange coloured ground, and olive green on the rays; underside cream coloured except the tips of the rays which are tinged with olive green. A typical series of ten from Cape de Couedic, Kangaroo Island (Reg. No. K.569), average R = 50 mm. All South Australian specimens of this common Asteroid which we have examined, numbering hundreds, have eight rays and are of the typical green colour. A large example from Guichen Bay (K.108) has R = 60 mm.

PATIRIELLA GUNNII Gray 1840.

Asterina gunnii Gray 1840, p. 289.

Type locality. Tasmania (Van Diemens Land, Gray).

Distribution. South Australia: Gulf St. Vincent, Spencer Gulf, Port Lincoln, Kangaroo Island, St. Francis Island. Western Australia.

This species is common on reefs in both Gulfs, and is just as common on the open ocean reefs, too. We have taken it at Reevesby Island, and on the local reefs at Port Willunga, Marino, and Sellicks. It lives at about low tide mark, and the aboral surface is a dark purple colour in life, sometimes grading into cream orally towards the middle. We have taken specimens of this colour at Marino (K.570).

PATIRIELLA EXIGUA Lamarck 1816.

Asterias exigua Lamarck 1816, p. 554.

Type locality. Indian Ocean (Lamarck records, habites les mers d'Amerique).
Distribution. South Australia: Gulf St. Vincent, Spencer Gulf, Kangaroo Island. Tasmania. New South Wales. North Australia. Lord Howe Island. Also Cape of Good Hope and East Indies.

In February, 1926, Messrs. Hale and Tindale took 47 specimens of this species at Kingscote, Kangaroo Island (K.118). These serve to give a good idea of the South Australian form. Mr. Hale describes the living star as very plentiful and blue in colour (somewhat like *gunnii*). The average of these specimens has R = 10 mm., and r = 8 mm. All have the characteristic bare, smooth area, in the actinal interradii. The radial extent of this area varies somewhat but averages 3–5 mm. in radial extent. Forty-five specimens have five rays and two have four rays. The species has been recorded from the Atlantic, Pacific, and Indian Oceans, and the Eastern Archipelago. Whether the South Australian examples are conspecific with those from other parts of the world remains to be seen.

PATIRIELLA BREVISPINA H. L. Clark 1938.

Patiriella brevispina H. L. Clark 1938, p. 166.

Type locality. Bunbury, Kombana Bay, 5–8 fathoms. Western Australia.
Distribution. South Australia: Port Willunga. Western Australia: Bunbury.

PATIRIELLA INORNATA Livingstone 1933.

Patiriella inornata Livingstone 1933, p. 17.

Type locality. Western Australia.
Distribution. Western Australia.

Livingstone does not say from what part of Western Australia his holotype comes. There are no other records known of this species.

Genus PARASTERINA Fisher 1908.

Genotype: *Patiria crassa* Gray 1840 (Indian Ocean).

PARASTERINA TROUGHTONI Livingstone 1934.

Parasterina troughtoni Livingstone 1934, p. 179.

Type locality. Albany, Western Australia.
Distribution. Western Australia, three examples in all.

PARASTERINA OCCIDENTALIS H. L. Clark 1938.

Parasterina occidentalis H. L. Clark 1938, p. 180.

Type locality. From a small cavern under a big rock at Point Peron, Western Australia.
Distribution. Western Australia: Shag Rocks (Penguin Island), Fremantle, Cottesloe, Garden Island.

A well defined species inhabiting the western end of the Flindersian Region. We have not taken it in South Australia.

Genus ASTERINOPSIS Verrill 1913.

Genotype: *Asterias penicillaris* Lamarck 1816 (? Red Sea).

ASTERINOPSIS GRANDIS H. L. Clark 1928.

Nepanthia grandis H. L. Clark 1928, p. 393.

Holotype: Reg. No. K.152. Gulf St. Vincent and Spencer Gulf, South Australia.

Distribution. South Australia: Gulf St. Vincent, Spencer Gulf, Tumby Bay.

This species is not uncommon in Spencer Gulf and the Great Australian Bight. The holotype was dredged by Verco in South Australian waters, but the exact locality is not given. The words "S.A. coast, Verco" appear on the label. Paratypes are labelled "Spencer Gulf". Of ten juveniles from Spencer Gulf, only one is six-rayed; of Clarks' 26 specimens, three are six-rayed. The colour in life is reddish-orange.

ASTERINOPSIS ROSEA H. L. Clark 1938.

Paranepanthia rosea H. L. Clark 1938, p. 161.

Type locality. North-east corner of Rottnest Island, Western Australia.

Distribution. Western Australia.

The generic location of this and the preceding species is questionable. H. L. Clark (1938), placed *grandis* in *Paranepanthia* Fisher, but that is probably a synonym of *Asterinopsis*. Unfortunately, *Asterinopsis* is based on *penicillaris*, a species of doubtful validity. We have, however, accepted *Asterinopsis* for the present.

FAMILY ECHINASTERIDAE.

Genus ECHINASTER Müller and Troschel 1842.

Genotype: *Echinaster spinosus* Müller and Troschel 1842, p. 22 (North America).

ECHINASTER ARCYSTATUS H. L. Clark 1914.

Echinaster arcystatus H. L. Clark 1914, p. 148.

Type locality. South-western Australia.

Distribution. South Australia: Gulf St. Vincent. Western Australia.

We have never taken this species in South Australia, though more extensive collecting may result in its discovery. A typical, though juvenile, specimen in the Museum collection labelled "S.A.?" measures R = 70 mm., r = 15 mm., br. = 17 mm. The only authentic record of this species from South Australia is that mentioned by H. L. Clark (1918, p. 395), "Between Backstairs Passage and the Pages, dredged in 25 fathoms. Field Naturalist Expedition, April, 1888".

ECHINASTER GLOMERATUS H. L. Clark 1916.

Echinaster glomeratus H. L. Clark 1916, p. 62.
Echinaster glomeratus extremus H. L. Clark 1928, p. 396.

Type locality. Kangaroo Island, South Australia.

Distribution. South Australia: Gulf St. Vincent, Kangaroo Island.

The variety *extremus* H. L. Clark (1928) (Holotype: K.156, Gulf St. Vincent), is a well preserved dried specimen showing prominent heaps of spinelets which tend to give it a slightly different appearance from *glomeratus*. A close examination of specimens has convinced us that the varietal name is not required, and they all represent one species. The grouped spinelets of both *glomeratus* and its variety *extremus* suggest that the species should be placed in the following genus *Henricia*. More Australian material must be examined, however, before a definite decision can be given.

Genus HENRICIA Gray 1840.

Genotype: *Henricia oculata* Gray 1840 = *Asterias sanguinolenta* O. F. Müller 1776. (North Atlantic, both sides).

HENRICIA HYADESI Perrier 1891.

Cribella hyadesi Perrier 1891, p. K100.

Type locality. Southern South America.

Distribution. Western Australia: Great Australian Bight, 80–150 fathoms. Victoria: Gabo Island, 200 fathoms. Bass Strait: Babel Island, 50–60 fathoms. Tasmania: East of Maria Island, 78 fathoms.

We have not yet seen a specimen of this deep-water species from South Australia.

Genus PLECTASTER Sladen 1889.

Genotype: *Echinaster decanus* Müller and Troschel 1843 (New Holland).

PLECTASTER DECANUS Müller and Troschel, 1843.

Echinaster decanus Müller and Troschel 1843, p. 114.

Type locality. We designate Port Jackson, New South Wales.

Distribution. South Australia: Gulf St. Vincent, Spencer Gulf. Western Australia: Western end of the Great Australian Bight, 33° 15′ S. × 126° 22′ 15″ E., 90 fathoms.

The first figure of this peculiar species was given by H. L. Clark (1916, p. 66), pl. xxvi, figs. 1 and 2, from a specimen taken at Port Jackson, New South Wales. As it is desirable to designate type localities, wherever possible, we thus cite Port Jackson (Müller and Troschel merely indicated "New Holland"). The species inhabits the Peronian Region, and the Flindersian to the western end of the Great Australian Bight. A large specimen from Gulf St. Vincent, K.157, has the following measurements: R = 130 mm. in the longest ray and 115 mm. in the shortest, with corresponding br = 28 mm. and 21 mm., also r = 30 mm. The species does not appear to be common in South Australia.

FAMILY ZOROASTERIDAE.

Genus ZOROASTER Wyville-Thomson 1873.

Genotype: *Zoroaster fulgens* Wyville-Thomson 1873 (Faröe Channel).

ZOROASTER MACRACANTHA H. L. Clark 1916.

Zoroaster macracantha H. L. Clark 1916, p. 68.

Type locality. Great Australian Bight, 129° 28′ E., 250–450 fathoms.

FAMILY ASTERIIDAE.

Genus ALLOSTICHASTER Verrill 1914.

Genotype: *Asteracanthion polyplax* Müller and Troschel 1844 (Australia and New Zealand.

ALLOSTICHASTER POLYPLAX Müller and Troschel 1844.

Asteracanthion polyplax Müller and Troschel 1844, p. 178.

Type locality. Australia. We designate Port Willunga, South Australia.
Distribution. South Australia: Port Willunga, Coobowie, Tumby Bay, Guichen Bay, "between Troubridge Light and Backstairs Passage" (H. L. Clark). We have taken it at Marino and Sellicks Reefs. Also recorded from Tasmania. Victoria. Western Australia. New South Wales. New Zealand.

Specimens examined by us provide the following information:

K.166. Yorke Peninsula, R = 33 mm., r = 5 mm. Rays 7.
K.167. Gulf St. Vincent, R = 20 mm., r = 4 mm. Rays 8.
K.173. Gulf St. Vincent, R = 32 mm., r = 5 mm. Rays 7.
K.168. Spencer Gulf, R = 22 mm., r = 5 mm. Rays 8.

ALLOSTICHASTER REGULARIS H. L. Clark 1928.

Allostichaster regularis H. L. Clark 1928, p. 400.

Holotype: Reg. No. K.169. Gulf St. Vincent, South Australia.
Distribution. South Australia: Gulf St. Vincent, Spencer Gulf.
A juvenile star, K.170, from Gulf St. Vincent, appears to be this species. This specimen measures R = 10 mm., r = 2 mm., br. = 2 mm. Rays 5.

Genus SMILASTERIAS Sladen, 1889.

Genotype: *Asterias scalprifera* Sladen 1889. (Kerguelen, Marion and Heard Islands, 50–150 fathoms).

These localities and depths cover the two species, *scalprifera* (type) and *triremis* of the genus.

SMILASTERIAS IRREGULARIS H. L. Clark 1928.

Smilasterias irregularis H. L. Clark 1928, p. 402.

Holotype: Reg. No. K.171. Spencer Gulf, South Australia.
Distribution. Spencer Gulf.
The holotype is unique and so far we have not taken further examples. The species is doubtfully placed in *Smilasterias*, but more material might decide its ultimate generic location. Compared with the genotype of this genus (*S. scalprifera*) the principal differences may be summarized as follows:

S. scalprifera. Inferomarginal spines three or four set very obliquely on the plate; adambulacral plates triplacanthid.

S. irregularis. Inferomarginal spines two, flat, square cut, side by side, or placed slightly obliquely; adambulacral plates diplacanthid.

Genus COSCINASTERIAS Verrill 1867.

Genotype: *Coscinasterias muricata* Verrill = *C. calamaria* Gray (Australia; Indian Ocean).

COSCINASTERIAS CALAMARIA Gray 1840.

Asterias calamaria Gray 1840, p. 179.

Coscinasterias muricata Verrill.

Type locality. Australia (? South Australia).

Distribution. South Australia: Kangaroo Island 28 fathoms, Althorpe Island, Port Vincent, Port Willunga, Cape Jervis, Black Point, Largs Bay, Grange. Western Australia. Tasmania. New South Wales.

This common large sea-star is frequently taken on the South Australian reefs. Specimens taken by us have been chiefly at Cape Jervis, and at the entrance of and just outside Gulf St. Vincent. It has been taken alive down to 28 fathoms, but is often found washed off the shallow shore reefs.

We have examined the following examples:

K.572. Cape Jervis. August, 1941. Colour: brown ground, with extensive blue maculations, spines bright blue at the bases, grading to brownish yellow at the tips. Rays 11. R = 135 mm., r = 30 mm., br. = 22 mm. maximum.

K.2. Encounter Bay. September 25, 1935. Colouration similar to K.572. Rays 11. R = 150 mm., r = 25 mm., br = 30 mm.

K.546. Gulf St. Vincent. 10 Rays.

K.573. Port Myponga. April 27, 1923. Rays 11. R = 260 mm., r = 35 mm., br. = 36 mm.

K.574. Sellicks. July 18, 1937. Rays 11. Colouration similar to K.572. R = 200 mm., r = 25 mm., br. = 30 mm.

K.4. Kangaroo Island. September, 1935. Juvenile. R = 90 mm., r = 20 mm., br. = 15 mm.

COSCINASTERIAS DUBIA H. L. Clark 1909.

Coscinasterias dubia H. L. Clark 1909, p. 532.

Type locality. Botany Bay, New South Wales, 20–23 fathoms.

Distribution. South Australia: Southern coast. Victoria. Bass Strait. Tasmania.

We have never seen specimens of this species from South or Western Australia.

Genus UNIOPHORA Gray 1840.

Genotype: *Uniophora globifera* Gray 1840 = *Asterias granifera* Lamarck 1816 (South Seas).

UNIOPHORA GRANIFERA Lamarck 1816.

Asterias granifera Lamarck 1816, p. 560.

Uniophora globifera Gray 1840, p. 288.

Type locality. South Seas.

Distribution. South Australia: Gulf St. Vincent. New South Wales: Bottle and Glass Rocks, Port Jackson.

H. L. Clark, during his collecting trip, did not take this species in either South Australia or Western Australia but found it at Port Jackson, New South Wales.

We have found but one South Australian record:

K.175. Glenelg. Typical, though not adult example. Deep reddish-brown. Rays 5. Longest R = 47 mm., br. = 14 mm., shortest R = 25 mm., br. = 9 mm., r = 7 to 15 mm. This is apparently far less common in South Australia than *Uniophora multispina.*

UNIOPHORA GYMNONOTA H. L. Clark 1928.

Uniophora gymnonota H. L. Clark 1928, p. 405.

Holotype: Reg. No. K.179. Backstairs Passage near The Pages, 25 fathoms.

Distribution. South Australia: Gulf St. Vincent, Spencer Gulf.

The largest specimen from South Australia has R = 75 mm. We have not taken further examples of this peculiar smooth sea-star.

UNIOPHORA MULTISPINA H. L. Clark 1928.

Uniophora multispina H. L. Clark 1928, p. 407.

Holotype: Reg. No. K.184. Henley Beach, South Australia.

Distribution. South Australia: Port Adelaide River, Henley Beach.

This species is fairly common on the beaches of Gulf St. Vincent where we have taken it at Port Willunga, Sellicks, Marino, and Christie's Beach.

K.520 from Semaphore (South Australia), a large specimen collected by H. M. Hale, June, 1923, after storms. R = 100 mm., r = 20 mm., br. = 30 mm. maximum.

UNIOPHORA OBESA H. L. Clark 1928.

Uniophora obesa H. L. Clark 1928, p. 409.

Holotype: Reg. No. K.190. Eastern Cove, Kangaroo Island, South Australia.

UNIOPHORA SINUSOIDA Perrier 1875.

Asteria sinusoida Perrier 1875, p. 338.

Type locality. Hobart, Tasmania.

Distribution. South Australia: Gulf St. Vincent, Spencer Gulf.

UNIOPHORA UNISERIALIS H. L. Clark 1928.

Uniophora uniserialis H. L. Clark 1928, p. 413.

Holotype: Reg. No. K.193. Gulf St. Vincent, South Australia.

Distribution. South Australia: Gulf St. Vincent, Spencer Gulf.

UNIOPHORA NUDA Perrier 1875.

Asterias nuda Perrier 1875, p. 335.

Type locality. Port Lincoln, South Australia.

H. L. Clark (1928, p. 417), points out that Perrier gives "Port Lincoln (détroit de Torres)" as the type locality of *A. nuda*, which probably means Port Lincoln, South Australia, as there is no Port Lincoln in the Torres Strait region of Northern Australia. Also, no representative of family *Asteriidae* occurs on the northern coast of Australia.

Clark's key definitely separates this species from *U. gymnonota*; the latter has the pedicellariae rare or wanting, except on the inner end of the oral plates. *U. nuda* has the pedicellariae numerous both in the ambulacral furrow and external to the adambulacral spines (Perrier).

UNIOPHORA FUNGIFERA Perrier 1875.

Asterias fungifera Perrier 1875, p. 337.

Type locality. Australia. (? Southern Australia).

This species was recorded vaguely as from Australia, and for reasons similar to those given in the case of *Uniophora nuda*, we suggest that the type locality is probably somewhere in the Flindersian Region. Again the key given by H. L. Clark (1928, p. 415), shows this species as quite distinct from others of the genus. Briefly, the distinguishing features are here quoted so that the species may be recognized when it is taken, as most likely it will be now that a number of enthusiasts are collecting hereabout: Large, straight pedicellariae rare or wanting, except on inner end of oral plates. Dorsal spines conspicuously capitate, globose, or fungiform, the dorsal spines crowded.

In his "Echinoderms from Australia", H. L. Clark (1938, p. 196) records only one species, *granifera*, taken during his extensive and valuable personal investigations in Australia. It appears, however, that off the South Australian coast alone, there must be at least eight species of *Uniophora*.

UNIOPHORA DYSCRITA H. L. Clark 1923.

Uniophora dyscrita H. L. Clark 1923, p. 244.

Type locality. Western Australia.

CLASS OPHIUROIDEA

Order PHRYNOPHIURIDA.

FAMILY OPHIOMYXIDAE.

Genus OPHIOMYZA Müller and Troschel 1842.

Genotype: *Ophiomyxa pentagona* Müller and Troschel 1842.

OPHIOMYXA AUSTRALIS Lütken 1869.

Ophiomyxa australis Lütken 1869, p. 45.

Type locality. Australia.

Distribution. South Australia: Gulf St. Vincent, Spencer Gulf, Salt Creek, Coobowie, Port Willunga, Port Vincent, Tumby Bay, Kingston 30 fathoms. Tasmania. New South Wales: Wollongong, 55–56 fathoms.

Genus OPHIOCREAS Lyman.

OPHIOCREAS SIBOGAE Koehler 1904.

Ophiocreas sibogae Koehler 1904, p. 165.

Type locality. Indian Ocean.

Distribution. Great Australian Bight 200–300 fathoms. Bass Strait: Flinders Island 80–300 fathoms.

Colour of holotype is given as reddish-purple-violet. The cotype is uniformly yellow, and the Australian "Endeavour" specimens are described by H. L. Clark (1916) as reddish flesh-colour with a more or less heavy purple cast.

FAMILY GORGONOCEPHALIDAE.

Genus ASTROCONUS Döderlein 1911.

Genotype: *Astrophyton australe* Verrill 1876 (Australia).

ASTROCONUS AUSTRALIS Verrill 1876.

Astrophyton australe Verrill 1876, p. 74.

Distribution. South Australia: Gulf St. Vincent, Spencer Gulf, Encounter Bay, Edithburgh, Flinders Island 37 fathoms, St. Francis Island 30 fathoms, Cape Wiles 75 fathoms, Sanders Bank (Kangaroo Island) 28 fathoms, Kingston 30 fathoms, off Murray River Mouth 17 fathoms. Victoria. Tasmania: Devonport, Launceston, east coast Tasmania. Bass Strait: King Island.

ASTROCONUS PULCHER H. L. Clark 1939.

Astroconus pulcher H. L. Clark 1939, p. 207.

Holotype: Reg. No. K.561. Cape Dutton, South Australia, 20 fathoms in crayfish pot.

ASTROCONUS OCCIDENTALIS H. L. Clark 1938.

Astroconus occidentalis H. L. Clark 1938, p. 205.

Type locality. Fremantle, Western Australia.

Genus CONOCLADUS H. L. Clark.

Genotype: *Conocladus oxyconus* H. L. Clark 1909 (Eastern and South Australia).

CONOCLADUS OXYCONUS H. L. Clark 1909.

Conocladus oxyconus H. L. Clark 1909, p. 132.

Type locality. Port Jackson, New South Wales.

Distribution. South Australia: Cape Wiles. New South Wales.

Genus ASTROBOA Döderlein.

ASTROBOA ERNAE Döderlein 1911.

Astroboa ernae Döderlein 1911, p. 82.

Type locality. Western Australia.

Distribution. South Australia: Kangaroo Island, Edithburgh, Victor Harbour. Western Australia.

FAMILY TRICHASTERIDAE.

Genus EURYALE Lamarck 1816.

Genotype: *Euryale verrucosum* Lamarck 1816 (Indian Ocean).

EURYALE EUOPLA H. L. Clark 1938.

Euryale euopla H. L. Clark 1938, p. 203.

Type locality. Bald Island, Albany, Western Australia.

FAMILY OPHIACANTHIDAE.

Genus OPHIACANTHA Müller and Troschel 1842.

Genotype: *Ophiacantha setosa* Müller and Troschel 1842.

OPHIACANTHA HETEROTYLA H. L. Clark 1909.

Ophiacantha heterotyla H. L. Clark 1909.

Type locality. Port Hacking, New South Wales, 22–38 fathoms, sand.

Distribution. Between Devonport and Launceston, Tasmania. New South Wales: Port Hacking, Crookhaven River 11–15 fathoms sand to rock, Wata Mooli 54–59 fathoms mud.

OPHIACANTHA BRACHYGNATHA H. L. Clark 1928.

Ophiacantha brachygnatha H. L. Clark 1928, p. 420.

Holotype: Reg. No. K.208, Spencer Gulf, South Australia.

Distribution. Spencer Gulf and Gulf St. Vincent.

OPHIACANTHA CLAVIGERA Koehler 1907.

Ophiacantha clavigera Koehler 1907, p. 247.

Type locality. Bunbury, Western Australia.

Distribution. Western Australia: Bunbury, Fremantle, Broome.

Genus OPHIOCOMINA Koehler.

OPHIOCOMINA AUSTRALIS H. L. Clark 1928.

Ophiocomina australis H. L. Clark 1928, p. 422.

Holotype: Reg. No. K.211, Spencer Gulf, South Australia.

Distribution. South Australia: Troubridge Island, Backstairs Passage, Port Vincent.

Order GNATHOPHIURIDA.

FAMILY AMPHIURIDAE.

Genus AMPHIURA Forbes 1845.

AMPHIURA TRISACANTHA H. L. Clark 1928.

Amphiura trisacantha H. L. Clark 1928, p. 425.

Holotype: Reg. No. K.212, Spencer Gulf, South Australia.

AMPHIURA CONSTRICTA Lyman 1879.

Amphiura constricta Lyman 1879, p. 22.

Type locality. Port Jackson, New South Wales.
Distribution. All round Australia and Tasmania.

AMPHIURA MICROSOMA H. L. Clark 1915.

Amphiura microsoma H. L. Clark 1915, p. 228.

Type locality. Murray Islands, Great Barrier Reef.
Distribution. Western Australia: Rottnest Island, Broome.

AMPHIURA NANNODES H. L. Clark 1938.

Amphiura nannodes H. L. Clark 1938, p. 230.

Type locality. Rottnest Island, Western Australia.

Genus AMPHIODIA Verrill.

AMPHIODIA OCHROLEUCA Brock 1888.

Amphiura ochroleuca Brock 1888, p. 484.

Amphiodia mesopoma H. L. Clark 1915, p. 247 (Torres Strait).

Distribution. South Australia: Gulf St. Vincent, Spencer Gulf. Victoria: Westernport. Western Australia. Torres Strait.

Genus AMPHIPOLIS.

AMPHIPOLIS SQUAMATA Delle Chiaje 1828.

Asterias squamata Delle Chiaje 1828, p. 74.

Distribution. South Australia: Port Willunga. All round Australia.

Genus OPHIACTIS Lütken 1856 (1857).

Genotype: *Ophiocoma ballii* Thompson 1840.

OPHIACTIS RESILIENS Lyman 1879.

Ophiactis resiliens Lyman 1879, p. 36.

Distribution. South Australia: Cape Martin 21 fathoms, Kingston 30 fathoms. Western Australia: Rottnest Island. Victoria. New South Wales.

OPHIACTIS TRICOLOR H. L. Clark 1928.

Ophiactis tricolor H. L. Clark 1928, p. 427.

Holotype: Reg. No. K.213, Spencer Gulf, South Australia.
Distribution. South Australia: Gulf St. Vincent, Spencer Gulf, Cape Borda 40 fathoms.

OPHIACTIS LAEVIS H. L. Clark 1938.

Ophiactis laevis H. L. Clark, 1938, p. 268.
Type locality. Bunbury, Western Australia, 5–8 fathoms.

FAMILY OPHIOTHRICIDAE.

Genus OPHIOTHRIX Müller and Troschel 1842.

Genotype: *Asterias fragilis* Abilg 1789 (Europe).

OPHIOTHRIX ALBOSTRIATA H. L. Clark 1928.

Ophiothrix albostriata H. L. Clark 1928.

Holotype: Reg. No. K.215, Great Australian Bight.

OPHIOTHRIX CAESPITOSA Lyman 1879.

Ophiothrix caespitosa Lyman 1879, p. 53.

Ophiothrix acestra H. L. Clark 1909, p. 544.

Distribution. South Australia: Gulf St. Vincent, Troubridge Island, Backstairs Passage, Spencer Gulf, Kingston 30 fathoms, Sanders Bank (Kangaroo Island) 28 fathoms, Cape Jervis 17 fathoms. Western Australia: Bunbury, Fremantle, Rottnest Island. New South Wales. Queensland.

OPHIOTHRIX HYMENACANTHA H. L. Clark 1928.

Ophiothrix hymenacantha H. L. Clark 1928, p. 431.
Holotype: Reg. No. K.217, Great Australian Bight.

OPHIOTHRIX FUMARIA Müller and Troschel 1842.

Ophiothrix fumaria Müller and Troschel 1842, p. 113.

Ophiothrix spongicola Stimpson 1855, p. 385.

Type locality. Port Jackson, New South Wales.
Distribution. South Australia: Cape Jervis, Gulf St. Vincent, Troubridge Shoal, Backstairs Passage, Tumby Bay. The species is known to range from Abrolhos Islands on the west coast of Australia, along the whole southern coast, to Broken Bay, New South Wales.

OPHIOTHRIX LINEOCAERULEA H. L. Clark 1928.

Ophiothrix lineocaerulea H. L. Clark 1928, p. 432.

Holotype: Reg. No. K. 218. Spencer Gulf, South Australia.

Order CHILOPHIURIDA.

FAMILY OPHIOCHITONIDAE.

Genus OPHIONEREIS Lütken.

OPHIONEREIS SCHAYERI Müller and Troschel 1844.

Ophiolepis schayeri Müller and Troschel 1844, p. 182.

Ophionereis porrecta H. L. Clark 1923, p. 247. (Abrolhos Islands, Western Australia).

Distribution. South Australia: Spencer Gulf, Gulf St. Vincent, Tumby Bay, Port Willunga. Western Australia: Abrolhos Islands. Tasmania: between Devonport and Launceston.

OPHIONEREIS SEMONI Döderlein 1896.

Ophiotriton semoni Döderlein 1896, p. 288.

Distribution. South Australia: Spencer Gulf, Gulf St. Vincent. Queensland: Torres Strait, Cairns.

FAMILY OPHIOCOMIDAE.

Genus OPHIOCOMA Agassiz.

OPHIOCOMA CANALICULATA Lütken 1869.

Ophiocoma canaliculata Lütken 1869, pp. 46, 99.

Distribution. South Australia: Edithburgh, Gulf St. Vincent, Spencer Gulf.

OPHIOCOMA CANALICULATA PULCHRA H. L. Clark 1928.

Ophiocoma canaliculata var. *pulchra* H. L. Clark 1928, p. 439.

Holotype: Reg. No. K.241. Spencer Gulf, South Australia.

FAMILY OPHIODERMATIDAE

Genus OPHIURODON Matsumoto.

OPHIURODON OPACUM H. L. Clark 1928.

Ophiurodon opacum H. L. Clark 1928, p. 440.

Holotype: Reg. No. K.243, Gulf St. Vincent, South Australia.
Distribution. South Australia: Port Vincent, Gulf St. Vincent.

Genus PECTINURA Forbes.

PECTINURA ARENOSA Lyman 1879.

Pectinura arenosa Lyman 1879, p. 48.

Distribution. South Australia: Gulf St. Vincent, Spencer Gulf, Tumby Bay, Ardrossan, Troubridge Island, Backstairs Passage.

PECTINURA ASSIMILIS Bell 1888.

Ophiopeza assimilis Bell 1888, p. 282.

Distribution. South Australia: Tumby Bay, Gulf St. Vincent, Spencer Gulf.

Genus OPHIARACHNELLA Ljungman.

OPHIARACHNELLA RAMSAYI Bell 1888.

Pectinura ramsayi Bell 1888, p. 281.

Type locality. Port Jackson, New South Wales.
Distribution. South Australia: Gulf St. Vincent, Spencer Gulf, Queenscliff (Kangaroo Island), Edithburgh. Western Australia: Rottnest Island, Fremantle. New South Wales.

FAMILY OPHIOLEPIDIDAE.

Genus AMPHIOPHIURA Matsumoto.

AMPHIOPHIURA COLLETA H. L. Clark 1916.

Amphiophiura colleta H. L. Clark 1916, p. 93.

Type locality. East of Babel Island, Bass Strait, 60–80 fathoms.
Distribution. South Australia: Gulf St. Vincent. Bass Strait.

Genus OPHIURA Lamarck 1816.

OPHIURA KINBERGI Ljungman 1866.

Ophiura kinbergi Ljungman 1866, p. 166.

Distribution. South Australia: Gulf St. Vincent, Spencer Gulf. Victoria: Port Phillip. New South Wales: Port Jackson.

OPHIURA OOPLAX H. L. Clark 1911.

Ophiocten ooplex H. L. Clark 1911, p. 99.

Type locality. Japan.
Distribution. South Australia: Gulf St. Vincent, Spencer Gulf. Also Japan.

Genus OPHIOMUSIUM Lyman 1869.

OPHIOMUSIUM ANISACANTHUM H. L. Clark 1928.

Ophiomusium anisacanthum H. L. Clark 1928, p. 446.

Holotype: Reg. No. K.254, Gulf St. Vincent, and Spencer Gulf, South Australia.

OPHIOMUSIUM APORUM H. L. Clark 1928.

Ophiomusium aporum H. L. Clark 1928, p. 447.

Holotype: Reg. No. K.255, Gulf St. Vincent and Spencer Gulf, South Australia.

OPHIOMUSIUM SIMPLEX AUSTRALE H. L. Clark 1928.

Ophiomusium simplex var. *australe* H. L. Clark 1928, p. 449.

Holotype: Reg. No. K.256, Spencer Gulf, South Australia.

Genus OPHIOZONELLA Matsumoto.

OPHIOZONELLA ELEVATA H. L. Clark 1911.

Ophiozona elevata H. L. Clark 1911, p. 31.

Type locality. Japan.
Distribution. South Australia: Spencer Gulf, Gulf St. Vincent. Also Japan.

Genus OPHIOCROSSOTA H. L. Clark 1928.

Genotype: *Ophiocrossota heteracantha* H. L. Clark 1928, p. 450.

OPHIOCROSSOTA HETERACANTHA H. L. Clark 1928.

Ophiocrossota heteracantha H. L. Clark 1928, p. 451.

Holotype: Reg. No. K.258, Gulf St. Vincent, and Spencer Gulf, South Australia.

CLASS ECHINOIDEA

Order CIDAROIDA.

FAMILY CIDARIDAE.

Genus PHYLLACANTHUS Brandt 1835.

Genotype: *Cidarites dubia* Brandt 1835.

The genotype is known only from the Bonin Islands. Four of the six species in the genus are known only from Australia, and the remaining one, *imperialis*, occurs all over the Indo-Pacific.

PHYLLACANTHUS IRREGULARIS Mortensen 1928.

Phyllacanthus irregularis Mortensen 1928, p. 74.

Type locality. Fremantle, Western Australia.
Distribution. Western Australia: Fremantle to Bremer Bay.

Phyllacanthus irregularis kimberi subsp. nov.

Pl. xii. Fig. 1 and 2.

Holotype: Reg. No. K.576. Port Willunga, South Australia.

Distribution. South Australia: Port Willunga, Levens Beach, d'Estree Bay (Kangaroo Island), Halletts Cove.

Test large and round, flattened above and below; horizontal diameter 115 mm., vertical diameter 75 mm. Primary spines short, 53 mm. in length, about half the horizontal diameter of test, comparatively slender, fusiform, tapering to the rounded tip, maximum diameter 6·5 mm.; colour of spines dark purplish-violet with an indistinct white band about one-third of the length from the tip; sculpture of fine granules forming into fine ridges from about the position of the white band to the tip. The secondary spines are a little wider at the tip than those of *irregularis*, and have distinct brownish colouration, although there are traces of the dark purplish colour seen in the primaries. The apical system generally resembles that of *irregularis*, but the genital pores are comparatively smaller and closer to the edge, while the tubercles along the inner edge of the genital plates are comparatively smaller and more numerous, though still larger than those of the rest of the genital plates. The formation is intermediate between that of *parvispina* and *irregularis*, but the ambulacral spines are pointed and resemble those of *irregularis* and not *parvispina*. In most other respects the subspecies resembles the typical Western Australian *irregularis*. We key the differences:

a. A series of larger spines along the inner edge of the genital plate; spines on apical system pointed; marginal ambulacral tubercles irregular.

  b. Primary spines about six times as long as wide; tubercules along the inner edge of genital plates conspicuously larger, numbering about five; genital pores large, not close to the edge of the genital plates .. .. .. *irregularis.*

  bb. Primary spines about eight times as long as wide; tubercles along the inner edge of genital plates slightly larger, numbering about eight; genital pores large, not close to the edge of the genital plates .. .. *irregularis kimberi.*

aa. No larger spines along the inner edge of the genital plates; spines on apical system broad; marginal ambulacral tubercles very regular .. .. .. *parvispina.*

A specimen of this subspecies was taken some years ago by W. J. Kimber at Port Willunga, which H. L. Clark (1938, p. 373) suspected as being different from the typical south-western Australian *Phyllacanthus irregularis* Mortensen 1928. Dr. Mortensen examined the specimen (H. L. Clark 1938, p. 373) and suggested it might be a variety of the Peronian *Phyllacanthus parvispina*.

We regard *parvispina* as a distinct species from *irregularis*, but have decided to give *kimberi* subspecific status only, for the present.

The following are some of the South Australian specimens in the South Australian Museum:

K.552. Levens Beach, Yorke Peninsula, April, 1936. Height 50 mm., diameter 80 mm. Primary spines 48 mm.

K.551. Levens Beach. Height 48 mm., diameter 70 mm. Primary spines 43 mm. Primaries encrusted with *Bryozoa*.

K.577. D'Estree Bay, Kangaroo Island. Height 75 mm., diameter 110 mm. Primary spines 55 mm.

K.8. Christie's Beach. January 8, 1931. Height 53 mm., diameter 80 mm. Primary spines 45 mm.

K.553. Levens Beach, Yorke Peninsula. April, 1936. Height 54 mm., diameter 85 mm. Primary spines 45 mm.

Two bare tests from South Australia, K.286, in the Museum collection and labelled *Prionocidaris bispinosa* Agassiz, are not that species but are juvenile *Phyllacanthus irregularis kimberi*.

A perfect large living specimen has been taken, since the above was written, on January 25, 1942, at Port Willunga, first reef south, at low tide. More recently a juvenile specimen was taken by G. Buick at Little Gorge, Normanville.

Genus ADELOCIDARIS nov.

Genotype: *Cidarites tubaria* Lamarck 1816 (Australia).

H. L. Clark (1938, p. 369) points out that the genotype of *Goniocidaris*, *Cidarites geranoides* Lamarck 1816 (East Indies), is probably unidentifiable. It certainly has nothing to do with *tubaria* and does not belong to the family *Cidaridae*, since the figures of *geranoides* show gills which are lacking in the species of this family. In order to clear up the matter we have introduced a new genus for the Australian species *tubaria impressa*, and the New Zealand *umbraculum*, while leaving *geranoides* with its genus *Goniocidaris* Agassiz and Desor (1846) for future attention.

Briefly, the new genus may be described as follows: Test stout, primary spines large, primary tubercles perforate; ambulacra wide; median interambulacral areas conspicuously bare and sunken, especially at angles of coronal. Otherwise typical of the family *Cidaridae*.

ADELOCIDARIS IMPRESSA Koehler 1926.

Goniocidaris impressa Koehler 1926, p. 24.

Distribution. South Australia: Grange, Kingston 30 fathoms, Cape Marsden 17 fathoms, St. Francis Island 35 fathoms. Tasmania: Port Davey 88 fathoms, Rocky Point, also East Coast Tasmania. Queensland: Port Curtis (Zool. Dept., Adelaide University).

Mortensen (1928, pp. 162–163) adopts the name *tubaria* var. *impressa* (Koehler), for the form related to *tubaria*, but having less elaborate primary spines, more extensive tuberculation, leaving scarcely more than the admedian part of the horizontal sutures bare, in both ambulacral and interambulacral areas, therefore no continuous sunk median line, but only isolated grooves, in a conspicuous ladder-like arrangement; apical system with genital and ocular plates more completely (than *tubaria*) covered with tubercles of uniform size; female genital pores larger. The species is common in Tasmania, but compared with the occurrence of *tubaria* it is much rarer in South Australia.

Two typical specimens (K.269) have both the primary and secondary spines notably more slender.

ADELOCIDARIS TUBARIA Lamarck 1816.

Cidarites tubaria Lamarck 1816, p. 57.

Type locality. Australia. (Habite les mers de la Nouvelle Hollande).

Distribution. South Australia: Kingston 30 fathoms, Cape Marsden 17 fathoms, St. Francis Island 35 fathoms, Normanville beach, Henley, Queenscliffe (Kangaroo Island), Cape Jaffa 90 fathoms.

At Normanville, 2nd November, 1941, we took twenty typical living specimens of this species on the beach at low tide. Naked test brownish; primary spines cream, thorns and ridges violet, base of spine also collar and milled ring deep red; secondary spines cream to yellow.

Order DIADEMATOIDA.

Suborder CAMARODONTA.

Family TEMNOPLEURIDAE.

Genus Genocidaris A. Agassiz 1869.

Genotype: *Genocidaris maculata* A. Agassiz 1869 (West Indies).

Genocidaris incerta H. L. Clark 1928.

Genocidaris incerta H. L. Clark 1928, p. 457.

Holotype. Reg. No. 293. Cape Jaffa, South Australia, 300 fathoms.
Distribution. South Australia: Cape Borda, Cape Jaffa, Beachport, all from 60–300 fathoms.

It may presently be shown that this species represents a new genus. We certainly doubt the correctness of its location in *Genocidaris*.

Genus Temnopleurus L. Agassiz 1841.

Genotype: *Cidaris toreumatica* Leske 1778. (China Seas, Japan, India).

Temnopleurus michaelseni Döderlein 1914.

Salmacis michaelseni Döderlein 1914, p. 454.

Temnopleurus australis H. L. Clark 1928, p. 458 (Reg. No. K.298).

Type locality. South-western Australia.
Distribution. South Australia: Gulf St. Vincent, Spencer Gulf, Port Lincoln, Wallaroo, Yankalilla Bay, Backstairs Passage, Troubridge Shoal. Western Australia: Cottesloe Beach, Fremantle, Rottnest 3–22 fathoms, Bunbury.

The type locality of *T. australis* Clark, is Port Lincoln, South Australia. On examining our specimens we are inclined to think that there are subspecific differences present, and the South Australian form might take the name *Temnopleurus michaelseni australis* H. L. Clark (1928).

Genus Microcyphus Agassiz and Desor 1846.

Genotype: *Microcyphus maculatus* Agassiz and Desor 1846. (Mauritius and Andaman Islands).

Microcyphus annulatus Mortensen 1904.

Microcyphus annulatus Mortensen 1904B, p. 101.

Type locality. Port Phillip, Victoria.
Distribution. South Australia: Investigator Strait, Gulf St. Vincent, Spencer Gulf. Bass Strait: off East Moncoeur Island. Victoria. Tasmania: east coast. Dredgings to 40 fathoms.

MICROCYPHUS COMPSUS H. L. Clark 1912.

Microcyphus compsus H. L. Clark 1912, p. 322.

Microcyphus elegans Mortensen 1904B, p. 100, preoccupied.

Type locality. Port Phillip, Victoria (*M. elegans*).
Distribution. South Australia: Gulf St. Vincent, Spencer Gulf, Cape Borda (Kangaroo Island), Cape Jaffa, Backstairs Passage, down to 60 fathoms. Victoria: Port Phillip.

MICROCYPHUS PULCHELLUS H. L. Clark 1928.

Microcyphus pulchellus H. L. Clark 1928, p. 462.

Holotype: Reg. No. K.340. Spencer Gulf, South Australia. This is known only from the holotype.

MICROCYPHUS ZIGZAG Agassiz and Desor 1846.

Microcyphus zigzag Agassiz and Desor 1846, p. 358.

Type locality. Port Phillip, Victoria.
Distribution. South Australia: Backstairs Passage 23 fathoms. Victoria: Port Phillip. Bass Strait.
A juvenile specimen is the only record of the species from South Australia.

Genus TEMNOTREMA A. Agassiz 1863.

Genotype: *Temnotrema sculpta* A. Agassiz 1863. (Japan and Korea).

TEMNOTREMA NOTIUM H. L. Clark 1938.

Temnotrema notium H. L. Clark 1938, p. 387.

Type locality. King George Sound, Western Australia.

Genus AMBLYPNEUSTES L. Agassiz 1841.

Genotype: *Echinus griseus* Blainville 1825 = *Echinus ovum* Lamarck 1816 (Australia).

There is some difficulty in identifying the species of this complex assemblage, so the following distinguishing features may be of assistance:

1. Primary spines bright red; test dark, height about 0·9 of the horizontal diameter *formosus.*
2. Primary spines pink, purple, lavender, or green; test light, pale brown, or dirty white, height about 0·95 of the horizontal diameter .. .. *pallidus.*
3. Primary spines dirty white; test greenish, height and diameter about equal. .. *ovum.*
4. Primary spines, dull green or brown, whitish at the tip; test dull green or brown, height about 0·8 of the horizontal diameter .. .. *pachistus.*
5. Primaries pale brown, dull pale red, or cream; test somewhat flattened, height about 0·7 of the horizontal diameter .. .. *grandis.*
6. Primary spines green or brown; test brown, height about 0·9 of the horizontal diameter *leucoglobus.*

We doubt the specific differences in some of the species, particularly those of *ovum* and *leucoglobus.* These two may be the same species or only geographical subspecies.

AMBLYPNEUSTES FORMOSUS Valenciennes 1846.

Amblypneustes formosus Valenciennes 1846, pl. ii, fig. 2.

Type locality. Bass Strait.

Distribution. South Australia: Gulf St. Vincent, Spencer Gulf. Bass Strait. Victoria. Tasmania. Western Australia. This is the rarest *Amblypneustes* species in South Australia.

AMBLYPNEUSTES PALLIDUS Lamarck 1816.

Echinus pallidus Lamarck 1816, p. 48.

Type locality. We designate Encounter Bay, South Australia.

Distribution. Port Willunga, South Australia, to the Abrolhos Islands, Western Australia. Very common all along the South Australian coast.

Numerous specimens were taken at Normanville, S.A., thrown up on the beach

AMBLYPNEUSTES OVUM Lamarck 1816.

Echinus ovum Lamarck 1816, p. 48.

Type locality. Australia. We designate Encounter Bay, South Australia.

Distribution. South Australia: Port Willunga, all round Yorke Peninsula, Spencer Gulf, Encounter Bay, Cape Jervis, Robe, Port McDonnell, Port Lincoln, Outer Harbour, Henley Beach, Glenelg, Sellicks. Bass Strait. Tasmania. Victoria. Western Australia. The commonest sea-urchin in South Australia.

AMBLYPNEUSTES PACHISTUS H. L. Clark 1912.

Amblypneustes pachistus H. L. Clark 1912, p. 327.

Type locality. Western Port, Victoria.

Distribution. South Australia: Gulf St. Vincent, Port Willunga, Spencer Gulf, Kingston, down to 30 fathoms. Bass Strait: Flinders Island. Victoria. Tasmania: east coast. New South Wales: Clarence River.

The characteristic colouration of the species is a pale brown test when dry, more nearly olive when moist; small spines, pale cream or whitish; large spines, deep olive-green or greenish-brown, more or less extensively tipped with whitish. This is essentially the colouration of the holotype.

AMBLYPNEUSTES GRANDIS H. L. Clark 1912.

Amblypneustes grandis H. L. Clark 1912, p. 329.

Type locality. Southern Australia.

Distribution. South Australia: Gulf St. Vincent, Cape Marsden 17 fathoms. Victoria. Western Australia. Bass Strait: Flinders Island. New South Wales.

In colouration there is considerable diversity.

AMBLYPNEUSTES LEUCOGLOBUS Döderlein 1914.

Amblypneustes leucoglobus Döderlein 1914, p. 463.

Type locality. Geraldton, Western Australia.

Distribution. Western Australia: Rottnest, Bunbury, Geraldton, Fremantle. Has not so far been definitely recognized from South Australia. Some specimens taken seem very close to this species.

Genus HOLOPNEUSTES Agassiz and Desor 1846.

Genotype: *Holopneustes porosissimus* Agassiz and Desor 1846, p. 364. (Southern and Eastern Australia).

HOLOPNEUSTES INFLATUS A. Agassiz 1872.

Holopneustes inflatus A. Agassiz 1872, p. 56.

Holopneustes purpurescens A. Agassiz 1873, pl. viiic. figs. 5 and 6.

Type locality. Southern Australia.
Distribution. South Australia: Port Willunga. Victoria: Port Phillip Heads, Warrnambool. New South Wales: Port Jackson. Tasmania. Western Australia: Rottnest, Fremantle.

HOLOPNEUSTES POROSISSIMUS Agassiz and Desor 1846.

Holopneustes porosissimus Agassiz and Desor 1846, p. 364.

Type locality. We designate Port Phillip Heads, Victoria.
Distribution. South Australia: Port Adelaide, Cape Marsden. Victoria: Port Phillip Heads, Warrnambool. Western Australia: Cape Leeuwin, Ellen Brook, Fremantle.

FAMILY ECHINIDAE.

Genus PSEUDECHINUS Mortensen 1903.

Genotype: *Echinus albocinctus* Hutton 1882. (New Zealand).

PSEUDECHINUS HESPERUS H. L. Clark 1938.

Pseudechinus hesperus H. L. Clark 1938, p. 395.

Type locality. Rottnest Island, Western Australia.
Holotype unique.

FAMILY STRONGYLOCENTROTIDAE.

Genus PACHYCENTROTUS H. L. Clark 1912.

Genotype: *Sphaerechinus australiae* A. Agassiz 1872. (Victoria and Tasmania).

PACHYCENTROTUS AUSTRALIAE A. Agassiz 1872.

Sphaerechinus australiae A. Agassiz 1872, p. 55.

Type locality. Port Phillip, Victoria.
Distribution. South Australia: Port Willunga, Kangaroo Island, Gulf St. Vincent, Spencer Gulf. Tasmania. Bass Strait. Victoria: Port Phillip.

Genus HELIOCIDARIS Agassiz and Desor 1846.

Genotype: *Echinus amalostoma* Valenciennes 1846 = *Echinus tuberculatus* Lamarck 1816. (Australia).

Apparently there are two species in South Australia. *H. erythrogramma* is the common New South Wales, but rarer South Australian species, in which the primary spines are comparatively long and the colour light-green.

HELIOCIDARIS ERYTHROGRAMMA Valenciennes 1846.

Echinus erythrogramma Valenciennes 1846, pl. vii, fig. 1.

Type locality. We designate Port Jackson, New South Wales.
Distribution. South Australia: Wallaroo Bay 15 fathoms, Investigator Strait 14 fathoms, Outer Harbour, Marino, Port Willunga, Christie's Beach, Sellicks,

Cape Jervis, Encounter Bay, Kingston, Robe, Port McDonnell, Port Lincoln (common). Western Australia to the Abrolhos Islands. Victoria. Tasmania. New South Wales: Port Stephens southward.

The species ranges through the entire Peronian and Flindersian Regions.

In several hundred specimens of *Heliocidaris* examined by us at Marino, we have noticed that the typical light-green primary spined species is less common than the next, *armigera*.

The following are no more than local variants:

Heliocidaris erythrogramma parvispina H. L. Clark 1938, p. 404. Point Peron. Western Australia.

Heliocidaris hartmeyeri Döderlein 1914, p. 475. Shark Bay, Western Australia.

Heliocidaris meridionalis Döderlein 1914, p. 479. South Australia.

HELIOCIDARIS ARMIGERA A. Agassiz 1872.

Strongylocentrotus armiger A. Agassiz 1872, p. 55.

Type locality. Swan River, Western Australia.

Distribution. South Australia: Marino, Port Willunga, Christie's Beach, Glenelg, Encounter Bay, off Semaphore 6 fathoms, Robe, Wool Bay, Levens, Hardwicke Bay, Salt Creek. Western Australia: Swan River.

This species, with its short stout brown or purple spines, is quite common in South Australia at Port Willunga and Marino Reefs, in crevices and on the undersurface of rocks just below low water mark. It is much commoner here than *erythrogramma*.

HELIOCIDARIS TUBERCULATA Lamarck 1816.

Echinus tuberculatus Larmack 1816, p. 50.

Type locality. Australia.

Distribution. Victoria: Port Phillip Heads. New South Wales: Sydney. Lord Howe Island. Kermadec Islands.

Apparently this species is uncommon in Australia. H. L. Clark did not take it during his collecting trip here, and we have seen no signs of it in South Australia. Clark describes it as very common at Lord Howe Island. It appears to be as variable as *Heliocidaris erythrogramma*, if not in colour, in the relative size and proportions of the primary spines. The species may enter the eastern edge of the Flindersian Region but does not reach South Australia.

Order EXOCYCLODIA.

Suborder CLYPEASTRINA.

FAMILY CLYPEASTRIDAE.

Genus CLYPEASTER Lamarck 1801.

Genotype: *Echinus rosaceus* Linné 1758. (West Indies).

CLYPEASTER AUSTRALASIAE Gray 1851.

Echinanthus australasiae Gray 1851, p. 34.

Type locality. Brisbane Water, New South Wales.

Distribution. Victoria: Port Phillip. New South Wales. Queensland. Bass Strait.

CLYPEASTER TELURUS H. L. Clark 1914.

Clypeaster telurus H. L. Clark 1914A, p. 166.

Type locality. Fremantle to Geraldton, Western Australia.
Distribution. Western Australia: Rottnest Island, Fremantle, Geraldton. Queensland.

Genus HESPERASTER H. L. Clark 1938.

Genotype: *Hesperaster arachnoides* H. L. Clark 1938. (Western Flindersian).

HESPERASTER ARACHNOIDES H. L. Clark 1938.

Hesperaster arachnoides H. L. Clark 1938, p. 411.

Type locality. Rottnest Island, Western Australia, 10–12 fathoms.
Distribution. Western Australia: Rottnest, Cape Leeuwin, Fremantle.

HESPERASTER CRASSUS H. L. Clark, 1938.

Hesperaster crassus H. L. Clark 1938, p. 413.

Type locality. Rottnest Island, Western Australia. Quaternary deposit near salt lake.

FAMILY ARACHNOIDIDAE.

Genus AMMOTROPHUS H. L. Clark 1928.

Genotype: *Ammotrophus cyclius* H. L. Clark 1928, p. 471. (South Australia).

AMMOTROPHUS CYCLIUS H. L. Clark 1928.

Ammotrophus cyclius H. L. Clark, 1928, p. 471.

Holotype. Reg. No. K.401. Gulf St. Vincent, South Australia, 10 fathoms.
Distribution. South Australia: Gulf St. Vincent, Spencer Gulf, Encounter Bay.

The specimens dredged by Verco in Gulf St. Vincent and Spencer Gulf were, in all probability, taken at the following depths: Gulf St. Vincent 10 fathoms: Spencer Gulf 15 fathoms.

K.578, Verco, Beachport 25 fathoms, December 26, 1905, two specimens, recently picked from the mixed material of the Verco dredgings, extend the range of this rare species to the south-east of South Australia. Test 42 mm. × 42 mm. × 6 mm. high for the larger, and 30 mm. × 30 mm. × 3 mm. high for the smaller of the two.

A specimen of this species from Robe (No. 787, Zoological Museum, Adelaide University) is the largest recorded, measuring 73 mm. × 73 mm. × 10 mm. high; petals 22 mm. long × 13 mm. wide in the average; periproct centre 9 mm. from posterior margin of test, 5 mm. long and 3 mm. wide. The test is bare, all the spines are missing.

AMMOTROPHUS PLATYTERUS H. L. Clark 1928.

Ammotrophus platyterus H. L. Clark 1928, p. 474.

Holotype. Reg. No. K.477. Gulf St. Vincent, South Australia. The specimen described as holotype still remains unique.

FAMILY LAGANIDAE.

Genus PERONELLA Gray 1855.

Genotype: *Laganum peronii* L. Agassiz 1841. (Peronian and Flindersian Regions).

PERONELLA PERONII L. Agassiz 1841.

Laganum peronii L. Agassiz 1841, p. 123.

Type locality. Western Australia? (Habite les mers de l'Inde).

Distribution. South Australia: Gulf St. Vincent, Spencer Gulf, Beachport to 200 fathoms, Cape Borda 62 fathoms, Point Marsden 17 fathoms, American River 8 fathoms, Yankalilla Bay, Neptune Islands, Investigator Strait, Backstairs Passage 22 fathoms, Cape Jaffa 90 fathoms, Yorke Peninsula, Port Lincoln, and Normanville. Western Australia: Great Australian Bight 60 miles west of Eucla. Victoria. Tasmania. New South Wales. Queensland.

A recent addition (K.579) from Wallaroo, South Australia, measures 17 mm. × 15 mm. × 3 mm.

PERONELLA LESUEURI L. Agassiz 1841.

Laganum lesueuri L. Agassiz 1841, p. 116.

Type locality. Western Australia.

The species was recorded from Fremantle and Albany by Döderlein (1914, p. 490) and by H. L. Clark (1938, p. 418). The specimen K.403 recorded by H. L. Clark (1928, p. 475) from unknown locality, is labelled "S.A.?" It is common in the Banksian and Dampierian Regions. Two large examples from Yorke Peninsula, South Australia (K.421), are in the Museum Collection and we have carefully compared them with a perfect specimen from Broome and find them identical. The larger measures 103 mm. × 90 mm. × 12 mm., and the smaller 98 mm. × 90 mm. × 10 mm.

FAMILY FIBULARIIDAE.

Genus ECHINOCYAMUS Leske 1778.

Genotype: *Echinocyamus angulosus* Leske 1778 = *Echinus minutus* Pallas 1774. (England, Mediterranean, North Sea).

ECHINOCYAMUS PLATYTATUS H. L. Clark 1914.

Echinocyamus platytatus H. L. Clark 1914B, p. 63.

Type locality. Victoria.

Distribution. South Australia: 12–200 fathoms, Cape Jaffa, Beachport, Backstairs Passage, St. Francis Island, Gulf St. Vincent. Western Australia: King George Sound 12–25 fathoms, Hopetoun beach. Tasmania: Devonport, Launceston.

Genus FIBULARIA Lamarck 1816.

Genotype: *Fibularia trigona* Lamarck 1816 = *Echinocyamus craniolaris* Leske 1778. (Gulf of Suez; Maldive Islands, North Mole).

FIBULARIA VOLVA Agassiz and Desor 1847.

Fibularia volva Agassiz and Desor 1847, p. 142.

Type locality. Red Sea.

Distribution. Western Australia: Albany, Broome. North Australia: west of Torres Strait, 28 fathoms. Madras: Gulf of Manaar. Korea.

FIBULARIA PLATEIA H. L. Clark 1928.

Fibularia plateia H. L. Clark 1928, p. 477.

Holotype: Reg. No. K.448. Wallaroo Bay, South Australia, 15 fathoms.
Distribution. South Australia: Beachport, Backstairs Passage, Newland Head, Wallaroo Bay, Gulf St. Vincent, St. Francis Island, Cape Borda, Cape Jaffa, Neptune Islands, depths from 15–130 fathoms. Western Australia: Bunbury, 22 fathoms.

FIBULARIA CRANIOLARIS Leske 1778.

Echinocyamus craniolaris Leske 1778, p. 150.
Fibularia trigona Lamarck 1816.

Type locality. Gulf of Suez.
Distribution. South Australia: Yankalilla Bay, Investigator Strait, Backstairs Passage, Point Marsden (Kangaroo Island), Gulf St. Vincent, Neptune Islands, Spencer Gulf, depths from 17–25 fathoms. Western Australia: King George Sound, 12–25 fathoms.

There are some hundreds of specimens in the South Australian Museum Collection ranging from Encounter Bay, South Australia, to King George Sound, Western Australia. Great differences in general shape and size are presented, although the principal specific characters are constant. The species must have a wide distribution, as the British Museum specimens are recorded as from Gulf of Suez, also Maldive Islands, North Mole. There does not appear to be any record of the species from any other Australian Region.

Suborder NUCLEOLITINA.

FAMILY NUCLEOLITIDAE.

Genus APATOPYGUS Hawkins 1920.

Genotype: *Nucleolites recens* Milne-Edwards 1836, pl. xiv, fig. 3. (New Zealand).

APATOPYGUS OCCIDENTALIS H. L. Clark 1938.

Apatopygus occidentalis H. L. Clark 1938, p. 497: non *Apatopygus recens* Milne-Edwards 1836, pl. xiv, fig. 3.

Type locality. Between Rottnest Island and Fremantle, Western Australia.
Distribution. Western Australia: Rottnest Island, Bunbury 22 fathoms.

H. L. Clark (1928, p. 479) referred to the remarkable occurrence at Bunbury of a species of *Apatopygus*, and doubtfully recorded it as *A. recens*, a New Zealand species and the only living representative of the genus, although there are Australian Tertiary species. He remarked on the differences noted in the pedicellariae of the Western Australian specimen. Later, Clark (1938, p. 497) described a second specimen of this different Australian species from "between Rottnest Island and Fremantle, in ten fathoms", and named it *Apatopygus occidentalis*, noting that Verco's Bunbury specimen also belonged to that species. Verco's specimen, K.478, is now before us and we note that it is considerably smaller than the holotype. The characteristic features of the species are in complete agreement with Clark's description.

Suborder SPATANGINA.

FAMILY HEMIASTERIDAE.

Genus PROTENASTER Pomel 1883.

Genotype: *Desoria australis* Gray 1851. (Australia).

PROTENASTER AUSTRALIS Gray 1851.

Desoria australis Gray 1851, p. 132.

Type Locality. Flinders Island, Bass Strait, Tasmania.

Distribution. South Australia: Murat Bay. Tasmania. Western Australia: Ellen Brook.

A specimen in the South Australian Museum (K.479) from Ellen Brook, Western Australia, is typical of the species, and a further broken juvenile specimen from the same locality is probably that species. An excellent example (K.580) from Murat Bay (Verco) extends the distribution of this species into South Australia.

Genus MOIRA A. Agassiz 1872.

Genotype: *Spatangus atropos* Lamarck 1816.

MOIRA STYGIA L. Agassiz 1872.

Moira stygia L. Agassiz 1872, p. 58.

Type locality. Mediterranean.

Distribution. South Australia; Port Willunga, Port Noarlunga, Sellick's Beach (Zool. Mus., Adelaide University), Kangaroo Island. Western Australia: Broome. Suez. Red Sea. Andaman Islands.

This *Moira* species is known from only a few specimens. The only record from the Flindersian Region mentioned by H. L. Clark (1938, p. 433) is a bare test taken by W. J. Kimber at Port Willunga. Clark remarks "that *Moira* should occur on the southern coast of Australia is certainly astonishing. This record extends the range of the species (and of the genus too) fully 1400 miles, more than half of which is an extension to the south".

We have the following specimens at the Museum:

K.581. Two partly bare tests, typical; measurements, 50 mm. × 43 mm. × 35 mm.; and 45 mm. × 35 mm. × 30 mm.; colour pale brown; spines remaining posteriorly are whitish. Port Noarlunga, on the beach.

K.515. One bare bleached test, typical; measurements, 47 mm. × 35 mm. × 35 mm. South Australia.

K.514. Two partly bare tests, typical; measurements, 45 mm. × 35 mm. × 30 mm.; and 35 mm. × 30 mm. × 25 mm.; colour bleached white; spines in the posterior slit pale brown. South Australia.

K.555. It was taken at Penneshaw, Kangaroo Island, by the Rev. H. A. Gunter. Length 60 mm., width 45 mm., height 40 mm., being the largest recorded. The test is yellowish white, the spines pale brown, very dense and bristle-like.

No. 715. Zoological Museum, Adelaide University. Two typical specimens, dried test, taken by Prof. Harvey Johnston at Sellick's Beach, South Australia, October, 1928.

No. 24. Zoological Museum, Adelaide University. Two well preserved specimens in alcohol from Moreton Bay, Queensland; tests and bristles are white, evidently from fading.

FAMILY SPATANGIDAE.

Genus EUPATAGUS Agassiz and Desor 1847.

Genotype: *Eupatagus valenciennesii* Agassiz and Desor 1947. (Australia).

EUPATAGUS VALENCIENNESII Agassiz and Desor 1847.

Eupatagus valenciennesii Agassiz and Desor 1847, p. 9.

Type locality. Australia. (Nouvelle Hollande).
Distribution. Victoria: Port Phillip. Bass Strait: Flinders Island. Tasmania: Port Dalrymple. New South Wales: Port Jackson.
The species does not appear to occur in South Australia, and only enters the eastern end of the Flindersian Region from the Peronian.

Genus GONIMARETIA H. L. Clark 1917.

Genotype: *Gonimaretia tylota* H. L. Clark 1917, p. 241. (Kei Islands, between New Guinea and Timor).

GONIMARETIA INTERRUPTA Studer 1880.

Type locality. Western Australia, 30 fathoms.

The single specimen, K.513, before us, is the one referred to by H. L. Clark (1928, p. 480). There is little doubt that this is one of Verco's speciment and therefore came from South Australia or Western Australia.

Genus ECHINOCARDIUM Gray 1825.

Genotype: *Spatangus pusillus* Leske 1778 = *Echinus cordatus* Pennant 1777, p. 69. (Europe, Korea, Australia, Tasmania, New Zealand).

ECHINOCARDIUM CORDATUM Pennant 1777.

Echinus cordatus Pennant 1777, p. 69.

Echinocardium australe Gray 1825.

Type locality. Europe.
Distribution. World wide. South Australia: Port Willunga, American River, Warooka, Yankalilla Bay, St. Francis Island 20 fathoms, Gulf St. Vincent, Spencer Gulf. Bass Strait: Flinders Island. Tasmania. Victoria: Port Phillip. Western Australia: Fremantle, Rottnest Island.
No one appears to have succeeded in separating the southern hemisphere form (*E. australe* Gray 1825) from *E. cordatum*. It seems surprising that this variable species should occur all over the world.

FAMILY BRISSIDAE.

Genus BRISSUS Leske 1778.

Genotype: *Spatangus brissus unicolor* Leske 1778.

BRISSUS LATECARINATUS Leske 1778.

Spatangus brissus var. *latecarinatus* Leske 1778, p. 185.

Type locality. Red Sea?
Distribution. South Australia, North Australia, Lord Howe Island, Red Sea, Mauritius. Solomon Islands. Madras, Philippine Islands, Japan, Hawaiian Islands. Samoa.

In the British Museum is a specimen labelled "Adelaide", and H. L. Clark (1925, p. 20) queries the correctness of the locality. A fine bare test from Port Lincoln (No. 347, Zoological Museum, Adelaide University), confirms the occurrence of this species in South Australia. Length 78 mm., breadth 62 mm., height 40 mm. There are black spots on the posterior half of the dorsum, indicating the position of the large globiferous pedicellariae, while the general colour of the test is pale brown dorsally and white on the ventral, although it is, of course, somewhat bleached. Compared with a test from New Hebrides, the South Australian specimen is very close in every detail.

CLASS HOLOTHUROIDEA

Order ACTINOPODA.

FAMILY HOLOTHURIDAE.

Genus HOLOTHURIA Linné 1758.

Genotype: *Holothuria tremula* Gunnerus (Cosmopolitan).

HOLOTHURIA HARTMEYERI Erwe 1913.

Holothuria hartmeyeri Erwe 1913, p. 383.

Type locality. Oyster Bay, Albany, Western Australia.
Distribution. Flindersian.

HOLOTHURIA FUSCOCINEREA Jäger 1833.

Holothuria fuscocinerea Jäger 1833.

Type locality. Indo-Pacific.
Distribution. South Australia.

This species was taken in great numbers at Glenelg on July 5 and September 24, 1942, following unusually heavy storms.

HOLOTHURIA VAGABUNDA Selenka.

Holothuria vagabunda Selenka.

Genus STICHOPUS Semper 1868.

Genotype: *Stichopus variegatus* Semper 1868. (Flindersian).

STICHOPUS LUDWIGI Erwe 1913.

Stichopus ludwigi Erwe 1913, p. 388.

Type locality. South-western Australia.
Distribution. South Australia. Western Australia.

FAMILY DENDROCHIROTAE.

Genus CUCUMARIA Blainville 1830.

CUCUMARIA SQUAMATA Ludwig 1898.

Cucumaria squamata Ludwig 1898.

Distribution. South Australia: Encounter Bay.

CUCUMARIA INCONSPICUA Bell 1887.

Cucumaria inconspicua Bell 1887, p. 532.

Type locality. Port Phillip Heads, Victoria.
Distribution. South Australia. Victoria.

CUCUMARIA STRIATA Joshua and Creed 1914.

Cucumaria striata Joshua and Creed 1914, p. 18.

Type locality. Great Australian Bight.
Distribution. South Australia.

CUCUMARIA MUTANS Joshua 1914.

Cucumaria mutans Joshua 1914.

Type locality. Port Phillip, Victoria.
Distribution. Victoria: Western Port and general. South Australia: Gulf St. Vincent. Western Australia: Bunkers Bay, Cottesloe Beach.

Genus PSEUDOCUCUMIS.

PSEUDOCUCUMIS BICOLUMNATUS Dendy.

Pseudocucumis bicolumnatus Dendy.

Type locality. New Zealand.
Distribution. South Australia. New Zealand.

Genus LIPOTRAPEZA H. L. Clark 1938.

Genotype: *Phyllophorus vestiens* Joshua 1914. (Flindersian).

LIPOTRAPEZA VENTRIPES Joshua and Creed 1914.

Phyllophorus ventripes Joshua and Creed 1914, p. 19.

Type locality. Gulf St. Vincent, South Australia.
Distribution. South Australia.

LIPOTRAPEZA VESTIENS Joshua 1914.

Phyllophorus vestiens Joshua 1914, p. 5.

Type locality. Port Phillip Bay, Victoria.
Distribution. Victoria (general). This species apparently enters the Flindersian Region at Western Port Bay.

Genus THYONE Oken 1815.

THYONE VERCOI Joshua and Creed 1914.

Thyone vercoi Joshua and Creed 1914, p. 19.

Holotype: Reg. No. K.517. Gulf St. Vincent, South Australia.
Distribution. South Australia.

THYONE NIGRA Joshua and Creed 1914.

Thyone nigra Joshua and Creed 1914, p. 20.

Type locality. Gulf St. Vincent, South Australia.
Distribution. South Australia.

Genus COLOCHIRUS.

COLOCHIRUS DOLIOLUM Pallas.

Colochirus doliolum Pallas.

Distribution. Flindersian Region.

COLOCHIRUS QUADRANGULARIS Lesson.

Colochirus quadrangularis Lesson.

Distribution. Great Australian Bight.

FAMILY SYNAPTIDAE.

Genus TROCHODOTA Ludwig 1892.

Genotype: *Chirodota studeri* Ludwig 1892 = *Holothuria (Fistularia) purpurea* Lesson 1830. (New Zealand, South America, Bay of Naples, Southern Australia).

TROCHODOTA ALLANI Joshua 1912.

Taeniogyrus allani Joshua 1912.

Type locality. New Zealand.
Distribution. South Australia: Kangaroo Island. Victoria: Port Phillip, Western Port Bay, Corio Bay.

FAMILY MOLPADIIDAE.

Genus CAUDINA Stimpson 1853.

Genotype: *Chirodota arenata* Gould 1841. (America).

CAUDINA CHILENSIS J. Müller.

Caudina chilensis J. Müller.

Distribution. South Australia.

CLASS CRINOIDEA

Order ARTICULATA.

FAMILY COMATULIDAE.

Genus COMATULA Lamarck 1816.

Genotype: *Comatula solaris* Lamarck 1816. (Australian Seas).

COMATULA SOLARIS Lamarck 1816.

Comatula solaris Lamarck 1816, p. 533.

Type locality. Australian Seas.

Distribution. North Australia. Western Australia. Queensland. The species is recorded from East Wallaby Island and Long Island, in the Abrolhos group, Western Australia by H. L. Clark, and is therefore probably extralimital in the extreme west of the Flindersian Region.

Genus COMATULELLA.

COMATULELLA BRACHIOLATA Lamarck 1816.

Comatula brachiolata Lamarck 1816, p. 535.

Type locality. ? Atlantic Ocean (in error). South Australia.

Distribution. South Australia: Gulf St. Vincent, Spencer Gulf. Western Australia: Koombana Bay 14·5–18 metres rocky bottom, King George Sound. Victoria: Port Phillip. This species is confined to southern and south-western Australia.

Genus COMANTHUS A. H. Clark 1908.

Genotype: *Alecto parvicirra* J. Müller 1841, p. 145.

Distribution of genus. Madagascar, Mauritius, Australia, Fiji, Southern Japan, China etc., Ceylon.

COMANTHUS PARVICIRRA J. Müller 1841.

Alecto parvicirra J. Müller 1841, p. 185.

Type locality. ? We designate Indian Ocean.

Distribution. Western Australia: Between Fremantle and Geraldton, Abrolhos, Cape Joubert, Cape Baudin. The species is very variable and is very widely distributed in the Indian Ocean and south-west Pacific.

COMANTHUS TRICHOPTERA J. Müller 1846.

Comatula trichoptera J. Müller 1846, p. 178.

Type locality. King George Sound, Western Australia.

Distribution. South Australia: Encounter Bay, Spencer Gulf, Tumby Bay, Gulf St. Vincent.

FAMILY THALASSOMETRIDAE.

Genus PTILOMETRA A. H. Clark 1907.

Genotype: *Comatula macronema* J. Müller 1846.

PTILOMETRA MACRONEMA J. Müller 1846.

Comatula macronema J. Müller 1846, p. 179.

Type locality. King George Sound, Western Australia.
Distribution. South Australia: Great Australian Bight about 131° E., Flinders Island, Kangaroo Island, Kingston, Encounter Bay, Gulf St. Vincent, Spencer Gulf, Althorpe Island. Western Australia: Dirk Hartog Island 7 fathoms, King George Sound. Victoria: Port Phillip.

FAMILY ANTEDONIDAE.

Genus COMPSOMETRA A. H. Clark 1908.

Genotype: *Antedon loveni* Bell 1882 = *Antedon pumila* Bell 1884. (Australia, etc.).

COMPSOMETRA INCOMMODA Bell 1888.

Antedon incommoda Bell 1888A, p. 404.

Type locality. Port Phillip, Victoria.
Distribution. South Australia: Flinders Island 37 fathoms. Victoria. Also recorded from Part Jackson, New South Wales, as *Compsometra lacertosa.*

Genus EUANTEDON A. H. Clark.

Genotype: *Antedon moluccana* A. H. Clark 1912. (Tahiti, Moluccas, China, Australia).

EUANTEDON PAUCICIRRA H. L. Clark 1928.

Euantedon paucicirra H. L. Clark 1928, p. 369.

Holotype: Reg. No. K.37, Gulf St. Vincent, South Australia.
Distribution. This species occurs on the reef at Marino, South Australia.

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EXPLANATION OF PLATE.

Plate xii.

1. *Phyllacanthus irregularis kimberi* subsp. nov., oral view, × 0·5. 2. *Phyllacanthus irregularis kimberi* subsp. nov., lateral view, × 0·5.

IDIELLANA, A NEW NAME FOR THE PREOCCUPIED GENUS *IDIELLA* STECHOW

(COELENTERATA—FAMILY SERTULARIIDAE)

By BERNARD C. COTTON AND FRANK K. GODFREY.

THE genus *Idiella* Brauer and Bergenstamm 1890, Denkschr. Acad. Wiss. Wien, 56 (1), 154, was first used for a genus of Diptera in the Insecta.

Idiella Stechow 1919, Zool. Jahrb., Syst., 42, 106, was introduced as a new name for *Idia* Lamouroux 1816, Hist. Polyp., 199 preoccupied by *Idia* Huebner 1809, Erste. Zutr., 5; Zutr. Samml. Exot. Schmett., 1, pl. xxiii, a genus of the Lepidoptera. *Idiella* Stechow 1919 is therefore not available so we introduce the name *Idiellana* for the genus belonging to the family Sertulariidae in the Phyllum Coelenterata.

Idiellana is represented in the Flindersian Region, Southern Australia, by *I. pristis* Lamouroux, a species recorded from Victoria and south-western Australia. We make this correction here as we are preparing an annotated list of certain Southern Australian Invertebrates which we hope to publish this year in Publication No. 3 of the Malacological Society of South Australia.

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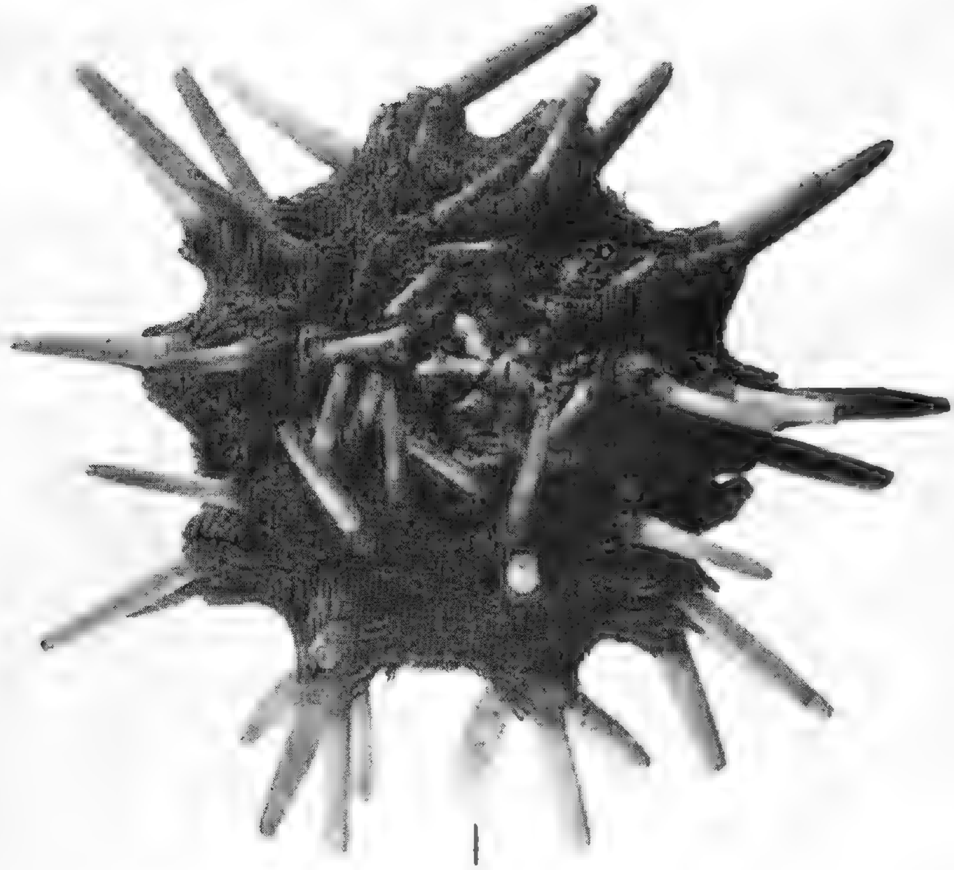


1

2

A SUGGESTED RECONSTRUCTION OF THE MISSING ANTERIOR TEETH OF THE COHUNA SPECIMEN

BY T. D. CAMPBELL, UNIVERSITY OF ADELAIDE

Summary

The accompanying photographs are published to illustrate an attempt at what is considered a more feasible reconstruction of the missing anterior teeth of the Cohuna specimen than that presented in the plaster replica which has been produced for museum purposes.

A SUGGESTED RECONSTRUCTION OF THE MISSING ANTERIOR TEETH OF THE COHUNA SPECIMEN

By T. D. CAMPBELL, University of Adelaide.

Plate xiii.

The accompanying photographs are published to illustrate an attempt at what is considered a more feasible reconstruction of the missing anterior teeth of the Cohuna specimen than that presented in the plaster replica which has been produced for museum purposes.

The plaster models available in the South Australian Museum are (1) a replica of the Cohuna cranium, containing reconstructed anterior teeth; and (2) a cast of the upper jaw only, representing the original arch with its front teeth missing. The present reconstruction has been made by using a separate model derived by dental impression methods from the upper jaw cast. The missing teeth were added in accordance with the writer's conception of what the anterior part of the dental arch might have been like; and based on a previous extensive study of Australian aboriginal teeth and jaws. This revised reconstruction is put forward only as a tentative improvement on that given in this Museum's plaster cranial replica (1) and is mainly for display purposes. As no complete set of measurements of the teeth and jaws of the original specimen is available, nor any knowledge as to how faithfully the plaster replica represents the original, it has not been possible to attempt a reconstruction by thoroughly critical methods. However, it is felt that this suggested fresh model is an improvement, as it does away with the cumbersome and incongruous design of the incisors in the original reconstruction. The intact, major portion of the Cohuna dental arch is a typical picture of a large-sized aboriginal dental arch, and there seems to be no need to depart radically from the usual human features of tooth and arch form—excepting that Cohuna man probably possessed unusually large anterior teeth. But even allowing for this latter probability, the merest glance at the official reconstruction shows the size of the lateral incisors, for example, to be out of all reasonable proportion to that of the natural canine and premolars. And these, with the type of central incisors given, make the front of the arch entirely foreign in appearance to that which seems fairly obviously inferred by the major portion of the dental arch which is intact in the original find. Furthermore, the attrition of the posterior teeth presents a picture which is typical of aboriginal dentitions; whereas the type of wear suggested by the reconstructed incisors also helps to make up an entirely incongruous effect. The writer's reconstruction definitely lessens the length of dental arch and reduces the amount of prognathism expressed by the official cast.

EXPLANATION OF PLATE.

Plate xiii.

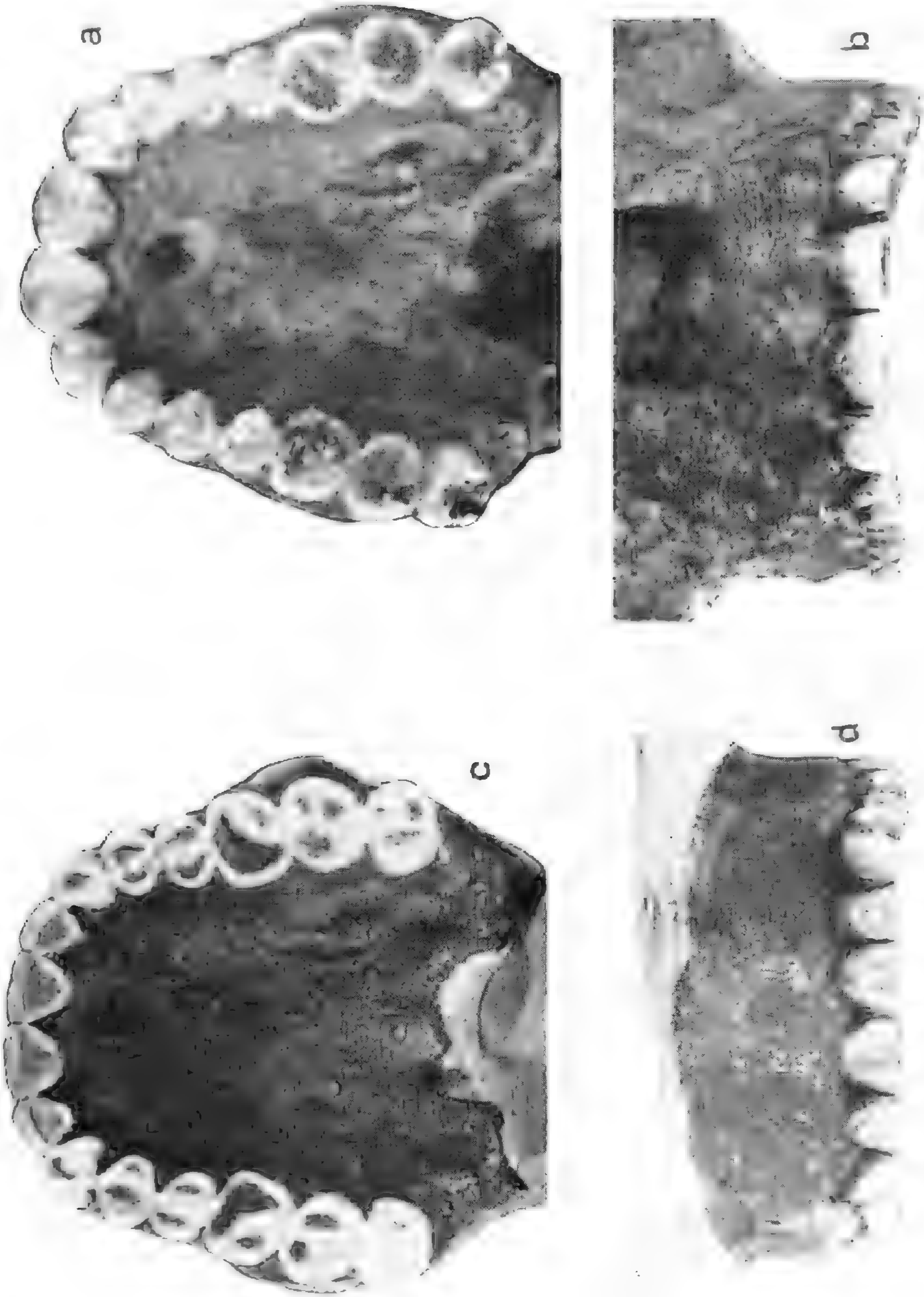
a. Palatal view of the plaster réplica of the reconstructed Cohuna dental arch—referred to as (1) in the above text.

b. Anterior view of same.

c. Palatal view of the present writer's version of the Cohuna arch; carried out on a plaster copy of model (2) referred to in above text.

d. Anterior view of present writer's reconstruction.

Thanks are due to Miss G. Walsh of this Museum for her careful preparation of the illustrations.



COHUNA DENTAL ARCH

RECORDS

OF THE

SOUTH AUSTRALIAN MUSEUM

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ENDOPARASITES FROM THE SUBANTARCTIC ISLANDS OF NEW ZEALAND

BY T. HARVEY JOHNSTON AND PATRICIA M. MAWSON, UNIVERSITY OF ADELAIDE

Summary

Toward the end of 1907 an expedition organized by the Philosophical Institute of Canterbury, and supported by the Government of New Zealand, visited the subantarctic islands of that Dominion : The Snares (48° S. 167´ E.), Antipodes Island (49° 41´ S., 178° 43´ E,), Bounty Island, Auckland Island (50° 50´ S., 166° E.), and Campbell Island (52° 30´ S., 169° 10´ E.). The positions stated are those given by various authors in reports appearing in "The Subantarctic Islands of New Zealand". The latter, edited by Chilton (1909), contains reports on various groups of organisms collected by the expedition. Macquarie Island (54° 31´ S., 158° 58´ E.) is excluded, as it belongs politically to Tasmania.

ENDOPARASITES FROM THE SUBANTARCTIC ISLANDS OF NEW ZEALAND

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TOWARD the end of 1907 an expedition organized by the Philosophical Institute of Canterbury, and supported by the Government of New Zealand, visited the subantarctic islands of that Dominion: The Snares (48° S, 167° E.), Antipodes Island (49° 41′ S., 178° 43′ E.), Bounty Island, Auckland Island (50° 50′ S., 166° E.), and Campbell Island (52° 30′ S., 169° 10′ E.). The positions stated are those given by various authors in reports appearing in "The Subantarctic Islands of New Zealand". The latter, edited by Chilton (1909), contains reports on various groups of organisms collected by the expedition. Macquarie Island (54° 31′ S., 158° 58′ E.) is excluded, as it belongs politically to Tasmania.

The parasitic helminths obtained were not dealt with in the official report, except for a casual reference by Waite (1903, 594) to the presence of fleshworms in, and external flukes (*Tristoma* sp.) on, fish. The small collection was, later, handed over to us by Sir W. B. Benham, F.R.S., who accompanied the expedition as one of its zoologists. The material comprised heterocotylean trematodes from *Notothenia colbecki* and *N. macrocephala* from Antipodes Island; larval nematodes from the two species of fish just mentioned, from *N. microlepidota* from Auckland Islands, from *Rhombosolea tapirina* from Campbell Island, and from *Thyrsites atun* from Port Chalmers, New Zealand; nematodes from a seal, *Arctocephalus hookeri*, from Campbell Island; and nematodes from a bird, *Phalacrocorax colensoi*, from Auckland Islands.

We desire to acknowledge our indebtedness to Sir W. B. Benham for giving us the opportunity to study the collection. The work has been carried out in connection with the Commonwealth Research grant to the University of Adelaide. The material has been deposited in the South Australian Museum.

Some of the islands belonging to the group have been visited by other scientific expeditions: Auckland Islands by D'Urville in the "Astrolabe" and Zélée (1839); "The Porpoise" (Wilkes' U.S. Exploring Expedition, 1839); "Erebus" and "Terror", 1840 (Sir James Clark Ross—Sir J. D. Hooker being a member of the scientific staff); National Antarctic Expedition (Capt. R. F. Scott) in the "Discovery" (1904); and the "Aurora" in July, 1912, during the first subartarctic cruise, Australasian Antarctic Expedition, E. R. Waite being on board as Zoologist.

Campbell Island: Ross, 1840 ("Erebus" and "Terror"); the French expedition to observe the transit of Venus, 1874 (Dr. Filhol was the naturalist); Bull in the "Antarctic", 1894; Borchgrevinck in the "Southern Cross", 1900. The "Terra Nova" (Scott's second Antarctic Expedition) passed near Auckland, Campbell and Antipodes Islands on its return voyage to New Zealand (1913) but did not visit any of them. Auckland and Campbell Islands were visited by Kirk in 1890 and by Hutton in 1900.

Parasitic material from the region was identified by Chatin (collected by Filhol during the French expedition in 1874), but his report is unfigured and his accounts are very unsatisfactory and in some cases he did not indicate whether his specimens came from Campbell Island or from New Zealand. Hutton (1879) and Waite (1909; 1916) made casual reference to some parasites of the fish from the islands. Leiper and Atkinson (1914, 226; 1915, 24) in their account of the parasites taken by the "Terra Nova" described a nematode, *Kathleena* (= *Contracaecum*) *scotti*, from an albatross, *Diomedea melanophris*, captured in 52° 20′ S., 167° 30′ E., between Campbell and Auckland Islands. Baylis (1920) reported that he had examined specimens of the nematode, *Contracaecum spiculigerum*, from the cormorant, *Phalacrocorax campbelli* ("Discovery" collection), but gave no locality. These records will be referred to in a later part of this report.

The dominant fishes of the antarctic and subantarctic coasts and islands belong to the Nototheniidae and, to a less extent, to closely related families of the Notetheniiformes. In the Subantarctic the most widely distributed genus is *Notothenia* which has many species, especially in the American sector where the Antarctic and Subantarctic merge. In the Subantarctic Islands of New Zealand and at Macquarie Island the species are few and widely distributed in the region though the fish are abundant. Their distribution was mentioned by Waite (1909; 1916).

Waite (1916, 6) stated that the fishes of the genus *Notothenia* were unfavourably known to all who had visited these subantarctic lands, on account of the parasites which infested the flesh, while revulsion was occasioned to some by a mere sight or handling of the fish, due to the presence of external parasites. The former are larval nematodes and the latter are monogenetic trematodes. *Anisakis* larvae have already been recorded as occurring in the peritoneal region of three species of the genus from Macquarie Island, viz. *N. coriiceps macquariensis* (= *N. rossi* according to Norman), *N. colbecki* and *N. macrocephala*. The adult stage of these larvae is without doubt *A. similis* which occurs in the stomach of the sea elephant, *Mirounga leonina*, as well as the sea leopard, *Hydrurga leptonyx*, which frequent that island (Johnston 1938, 18, 19). Our present studies indicate that the fleshworms occurring in fishes of the islands south of New Zealand are larval stages of a species belonging to a related genus, *Porrocaecum*.

PSEUDOBENEDENIA NOTOTHENIAE Johnston.

This rather large heterocotylean trematode was described by one of us (1931, 91 6; 1937, 5–18) from material collected by Sir W. B. Benham from the fish, *Notothenia colbecki* and *N. macrocephala*, from Antipodes Island. *P. nototheniae* was also recorded from the latter species from Macquarie Island where it was collected by the Australasian Antarctic Expedition. They were found gliding over the surface. Waite (1909, 594; 1916, 689) mentioned that many specimens of *N. colbecki* from Antipodes Island were found to harbour these parasites which Benham had identified as *Tristoma* sp.

Waite did not include *N. macrocephala* amongst the fish taken at Antipodes Island, but mentioned its presence at Campbell Island and the Aucklands and stated (1916, 50) that it occurred in New Zealand waters also. It has a lengthy synonymy, no less than seven different specific names being given to it (Waite 1916, 66).

PORROCAECUM DECIPIENS (Krabbe).

This widely distributed nematode parasite of seals has now been identified from the hair seal, *Arctocephalus hookeri* Gray, from Campbell Island. The range of this seal includes also the Auckland Islands and the Snares.

Larval stages (flesh worms) were collected from the following fish, *Rhombosolea tapirina* from Campbell Island; *Notothenia microlepidota* from the Aucklands; and *N. colbecki*, as well as *N. macrocephala*, from Antipodes Island.

Hutton (1879) was the first to draw attention to these parasites. When reporting on a collection of animals from Auckland and Campbell Islands he dealt with the following fish: *Notothenia angustata*, *N. microlepidota*, *N. parva*, and *Tripterygium jenningsi* from the former group, and *N. arguta* from Campbell Island. He mentioned (1879, 340) that most of the fish at the Auckland Islands were attacked by parasites in a most remarkable way; in some cases the whole of the lateral muscles were full of a round worm about an inch in length; and so bad was the infestation that nothing but sheer necessity would induce anyone to eat fish at these islands. Waite (1909; 1916) quoted *N. parva* Hutton, *N. angustata* Hutton, and *Tripterygium jenningsi* Hutton as synonyms of *N. microlepidota*, *N. macrocephala* and *T. varium* Forst., respectively, while *N. parva* Hutton was also included as synonymous with *N. macrocephala*. Waite (1916, 6) has applied Hutton's remarks to *N. microlepidota* but they must have referred to *N. macrocephala* as well. Waite (1909, 597) mentioned that *Tripterygium varium* was extremely abundant in rock pools and under stones between tide marks at Auckland Islands. Hence it is probable that this small blenny will be found to be similarly parasitized by fleshworms. Waite (1909, 594; 1916, 6, 69) referred to the occurrence of these fleshworms in *Notothenia colbecki* at Antipodes Island and in *N. microlepidota* at the Snares and the Auckland Islands.

Fleshworms having a similar habit are common in *Notothenia* spp. at Macquarie Island, having been referred to by Ainsworth (1915, 193, 235) and Waite, the latter (1916, 6, 69) mentioning *N. colbecki* and *N. macrocephala*. The presence of the adult stage in the elephant seal and leopard seal at the island has already been recorded by one of us (1938, 8). Since larvae of *Anisakis* sp. were the only kind identified from Macquarie Island by Johnston (1938, 27), it was assumed that the flesh-worms referred to by the observers mentioned above were perhaps of the same kind, and were accordingly recorded as *Anisakis* sp. though it was recognized that some of them might have been larval *Porrocaecum* or *Contracaecum* (1938, 20).

Kahl (1938) has given an excellent account of the process of encapsulation of the larvae of *P. decipiens* in various European marine fish.

CONTRACAECUM SPICULIGERUM (Rud.).

This species was identified from *Phalacrocorax colensoi* from Auckland Islands. It had already been recorded from *Ph. campbelli*. Alexander in his book on "Birds of the Ocean" (1928) stated that the latter species was restricted to Campbell Island, though Waite (1909, 581) recorded the presence of both species on the Aucklands, stating that the immature stages of the two closely resembled each other.

Baylis (1920, 256 and footnote) mentioned having examined material (in the British Museum) of *C. spiculigerum* from *Phalacrocorax verrucosus*, *P. campbelli* and *P.* sp. Localities were not given but it was stated that two of the three lots of specimens belonged to the "Challenger" and "Discovery" collections respectively and had been identified by Linstow as *Ascaris spiculigera*. Linstow had already recorded the species from *P. verrucosus* from Kerguelen ("Challenger" Reports), and published a very short report (1902, 285) on the nematodes and cestodes brought back by the "Southern Cross" Expedition to the Antarctic, all these collections being housed in the British Museum. The "Southern Cross" visited Campbell Island and collected *P. campbelli* there (Sharpe 1902, 173). The National Antarctic ("Discovery") Expedition omitted Campbell Island from its itinerary, but went to the Auckland Islands in 1904 and probably obtained *P. colensoi*, since Wilson, in his report on the birds (1907, 81), made casual mention of that cormorant when dealing with the mutton bird, *Puffinus griseus*, which was also taken at the Aucklands. From the foregoing remarks there seems to be little doubt that the material referred to by Baylis as having been taken from *P. campbelli* was obtained by the "Southern Cross" from Campbell Island, and not by the "Discovery". We have accordingly so indicated it in the host-parasite list at the end of this paper. The species has been collected by one of us in an adjacent subantarctic locality, Macquarie Island, whilst a member of the British, Australian and New Zealand Antarctic Research Expedition, its host there being *Phalacrocorax purpurascens*. The larval stages of *C. spiculigerum* can be expected to be found in subantarctic fish. We have already recorded the adult stage from four species of Australian cormorants, as well as from some allied birds (Johnston and Mawson 1941, 111).

ANISAKIS SIMPLEX (Rud.) larva.

Many closely-coiled encapsulated larvae (*Anisakis* sp.) from below the peritoneum of the barracouta, *Thyrsites atun*, were obtained at Port Chalmers, Southern New Zealand. These larvae will be dealt with in a paper now in preparation relating to some nematodes from Australian fish, the parasite being abundant in barracouta from southern Australian waters. The larvae are suggestive of *A. simplex* which occurs in dolphins in many parts of the world, including Australia and New Zealand, from both of which regions we have already reported it (Johnston and Mawson 1941, 433; 1942, 183). We know that dolphins prey upon barracouta as well as on many other kinds of fish. In a later part of the report we indicate that *Ascaris filholi* Chatin probably belongs to the same species as that infesting the barracouta so commonly.

CHATIN'S SPECIES OF PARASITES.

Chatin (1885) gave brief unfigured descriptions of some parasites from Campbell Island and New Zealand. They included *Spiroptera campbelli* from a fish, *Notothenia filholi*, from the former locality; *Ascaris apterygis* from an *Apteryx*, no locality being stated, but it must have been New Zealand; *Ascaris filholi* from fish, without any mention of species or locality; *Agamonema campbelli* from the flesh of various fish (unnamed) at Campbell Island; and *Taenia apterycis*, a cestode from *Apteryx*, whose locality must have been New Zealand. Brief mention of Chatin's parasites was made by one of us (Johnston 1938, 27). We will now consider each of the three species taken from fish.

ASCAROPHIS CAMPBELLI (Chatin) Johnston and Mawson.

Syn. *Spiroptera campbelli* Chatin (1885, 37).

The host was said to be *Nolotaenia filholi*, an error for *Notothenia filholi*. The parasite was stated to have an average length of 25 mm., and to possess genital organs resembling those of *Spirura talpae* as described by E. Blanchard in 1849. No other dimensions are given and the account of the organization is quite general. The main distinguishing features seem to be the small oval mouth surrounded by a thick labial pad or cushion; the presence of membranous expansions on either side of the mouth giving the head end a characteristic appearance; the presence of a long cylindrical oesophagus which becomes narrowed anteriorly; and the unequal spicules. We think that it may be a species of *Ascarophis* and accordingly list it provisionally as *Ascarophis campbelli*.

The host species, *Notothenia filholi*, was poorly described by Sauvage in 1880 and does not seem to have been recognized since. The name is probably synonymous with that of one of the three species occurring commonly in the area. *N. colbecki* seems the most likely, judging from Boulenger's synopsis of the species (1902, 184) and, if so, the name *N. filholi* would have priority.

AGAMONEMA CAMPBELLI Chatin (= larva of PORROCAECUM DECIPIENS).

Agamonema campbelli from the flesh of various fish from Campbell Island was stated to be 18–33 mm. long, with its mouth surrounded by a thin fold without definite papillae or tubercles (lips were thus presumably not well differentiated), and with the oesophagus slender but widening to pass into the intestine. Male and female organs were referred to in spite of the assignment of the parasites to *Agamonema*—probably due to a wrong interpretation of structures. It seems reasonable to assume that these fleshworms which parasitize various species of fish, are of the same kind as those referred to by Waite, Hutton and others as occurring commonly in the flesh of *Notothenia* spp. etc., not only at Campbell Island, but also in the waters of the other subantarctic islands. *A. campbelli* is probably a larval Anisakine worm and we propose to place it under the synonymy of *Porrocaecum decipiens* in spite of some of the features mentioned by Chatin.

ASCARIS FILHOLI Chatin (1885, 39–41).

Syn. *A. nelsonis* Chatin (1885, 41) (= larva of *Anisakis simplex*).

A. filholi was said to have been obtained from fish, but whether at Campbell Island or in New Zealand waters, was not stated. The following particulars were given: average length 36 mm.; body fairly thick and relatively wide; head region sharply limited by a sudden narrowing, giving a characteristic appearance; three prominent lips; and the oesophagus hardly distinct from the intestine, both having the same diameter. A short account of the male and female systems was given and the spicules were said to be approximately equal. The characters were stated to place the species (which he also called *A. nelsonis*) between *Ascaris rotundata* and *A. constricta*. Chatin's remarks suggest that he may have been dealing with adult worms related to *Anisakis* and *Paranisakis*, but it is quite likely that he misinterpreted various structures as genital organs, just as he must have done in the case of his *Agamonema campbelli*. Species belonging to *Paranisakis* possess intermediate lips.

A. rotundata Rud. is the type of *Anacanthocheilus* Wuelker 1929 which has three poorly developed lips and has no interlabia. Its species, in the adult stage, occur in sharks and rays, while the larvae infest marine teleosts where they are found rolled up on the viscera and peritoneum. Wuelker (1930, 14) reported that these larvae (which he figured) were often referred to under the group names, *Ascaris capsularia* and *Filaria piscium*.

Ascaris constricta Rud., a larval form from various kinds of European fish was placed by Stossich (1896) as a synonym of *A. capsularia*. Linstow (1880) had previously referred to their similarity. Baylis attempted to disentangle the confusion associated with the name *Ascaris capsularia* (which he regarded as the larval stage of *Porrocaecum decipiens*) and included under it some specimens previously identified as *A. constricta* (1916, 369), but one of his figures (pl. 1, fig. 1) seems to us to be that of a typical *Anisakis* larva.

Recent papers indicate that *Porrocaecum* larvae can be excluded from *A. capsularia* whose characteristic habit is shared by larvae of *Anisakis* and to some extent by those of *Contracaecum*. The probability is that the true *Ascaris capsularia* is the encapsuled larval stage of *Anisakis simplex*, a widely distributed parasite of dolphins and porpoises.

We have already stated earlier in this report that closely-coiled larvae occur commonly in the peritoneal and mesenteric tissues of marine fish (including the barracouta) and that they belong to *Anisakis*, probably *A. simplex* from dolphins.

The fact that Chatin used the name *Ascaris nelsonis* in his account of *A. filholi* may indicate that the worms were collected in the vicinity of Nelson, on the southern shores of Cook Strait, New Zealand, from which locality we have already recorded the occurrence of *Anisakis simplex* in the dolphin, *Lagenorhynchus obscurus* (Johnston and Mawson 1942, 183). We suggest that *Ascaris filholi* and *A. nelsonis* (which is a lapsus and accordingly a synonym of the former) should be placed in the synonymy of *Anisakis simplex* and that the locality for Chatin's species was New Zealand.

HOST-PARASITE LIST.

The following abbreviations are used: FTV, French Expedition to observe the Transit of Venus, SANZ, Expedition to the Subantarctic Islands of New Zealand; SC, "Southern Cross" Antarctic Expedition; TN, "Terra Nova", Scott's second Antarctic Expedition; J. & M. for Johnston and Mawson.

HOST.	LOCALITY AND EXPEDITION.	PARASITE.	RECORDER AND DATE.
Notothenia filholi	Campbell I, FTV	*Spiroptera campbelli*	Chatin 1885
		= *Ascarophis campbelli*	J. & M. 1943
N. microlepidota	Aucklands } SANZ Snares }	*Porrocaecum decipiens*	J. & M. 1943
N. macrocephala	Antipodes, SANZ	*Porrocaecum decipiens*	J. & M. 1943
		Pseudobenedenia nototheniae	J. 1931, 1937; J. & M. 1943
N. colbecki	Antipodes, SANZ	*Porrocaecum decipiens*	J. & M. 1943
		Pseudobenedenia nototheniae	J. 1931, 1937; J. & M. 1943
Rhombosolea tapirina	Campbell I, SANZ	*Porrocaecum decipiens*	J. & M. 1943
Thyrsites atun	N.Z., SANZ	*Anisakis simplex*	J. & M. 1943
Fish	Campbell I, FTV	*Agamonema campbelli*	Chatin 1885
		= *Porrocaecum decipiens*	J. & M. 1943
Fish	loc.? FTV	*Ascaris filholi*	Chatin 1885
	prob. N.Z.	= *Anisakis simplex*	J. & M. 1943
Phalacrocorax colensoi	Aucklands, SANZ	*Contracaecum spiculigerum*	J. & M. 1943
P. campbelli	Campbell I, SC	*C. spiculigerum*	Baylis 1920; J. & M. 1943
Diomedea melanophris	Off Campbell I, TN	*Kathleena scotti*	Leip. & Atk. 1914; 1915
		= *Contracaecum scotti*	Baylis 1920
Arctocephalus hookeri	Campbell I, SANZ	*Porrocaecum decipiens*	J. & M. 1943

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AUSTRALIAN ACARINA OF THE FAMILY TRICHADENIDAE

By H. Womersley, F.R.E.S., A.L.S., Entomologist, South Australian Museum

Summary

Family **Trichadenidae** Oudemans 1938.

So far this family comprises only the two genera Trichadenus Rondani 1870 and Raoiella Hirst 1924, both of which are now known to occur in Australia. As with the closely related Tetranychidae all the species are phytophagous and of economic importance.

The two genera may be separated on the structure of the tarsal claws and empodium as follows:

1. Claws distinctly claw-like and with a pair of lateral long clavate tenent hairs; empodium bifurcate with ciliations. Genus Raoiella Hirst 1924.
2. Claws modified, not claw-like, bifurcate, the inner branch short, with ciliations,
   outer branch long, seta-like with clavate apex; empodium bifurcate in apical half, stem and branches with ciliations. Genus Trichadenus Rondani 1870.

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Genus Trichadenus Rondani 1870.

Bull. Soc. ent. ital., ii, 168 (genotype *Trichadenus sericariae* Rondani 1870) = *Pseudoleptus* Bruyant 1911, Zool. Anz., xxxvii, p. 340 (genotype *Pseudoleptus arechavaletae* Bruyant 1911).

According to Oudemans, Tijds. Entom., lxxxi, Verslag, p. vii, Banks' *Stigmaeus floridanus* (U.S. Dept. Agric., Rept. 108, 1915, p. 36, fig. 47) is a *Pseudoleptus*, and *Pseudoleptus* Bruyant 1911 is synonymous with *Trichadenus* Rondani 1870.

Trichadenus australianus n.sp.

Fig. A–H.

Description: ♀ Length 410μ, width 190μ, elongate oval but with a conspicuous constriction and suture between the proterosoma and hispidosoma. Cuticle dorsally and ventrally granulate striate. Mandibles long and styliform. Palpi 3-segmented, basal segment very small, second the longest about twice as long as broad, apical spherical with a stout short sensory seta, and a longer simple pointed seta. Eyes 2 + 2, small, lateral and about midway on the proterosoma. Legs, 6-segmented, short, segments not wrinkled; tarsal claws modified, not claw-like, with a short inner ciliated branch, and a longer outer seta-like branch which is apically knobbed; tarsi III and IV with a long subapical recurved seta. I and II with a subapical stout outer sensory seta; leg I 105μ, II 87μ, III 77μ, IV 77μ. Peritreme typical of the family (cf. fig. E). Dorsal setae few and short; an anterior pair and one behind each pair of eyes on proterosoma; on hispidosoma, there are 6 subapical simple setae, the median one on each side being the longest, 30μ; laterally and an-

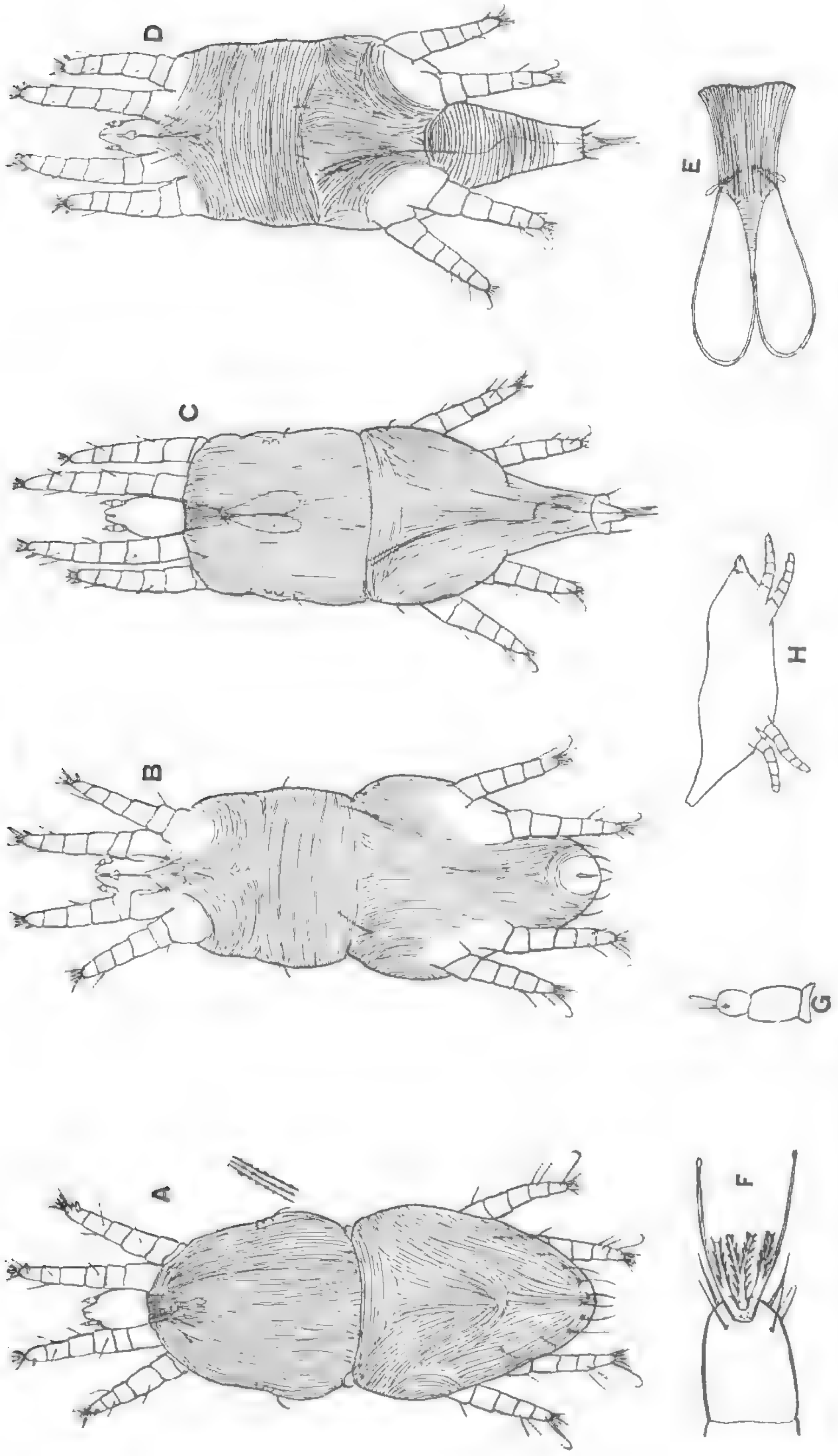

Fig. 1. *Trichadenus australianus* n.sp. A, ♀ dorsal; B, ♀ ventral; C, ♂ dorsal; D, ♂ ventral; E, peritreme; F, tarsus of leg 1 from below showing structure of claws and empodium; G, palp; H, diagrammatic side view of ♂.

terior of these apical setae are two short setae. Ventrally with a pair of long anterior setae, 40μ, near to coxae I, and another pair, possibly belonging to coxae III but placed close to the suture line.

♂ Generally as in ♀, length 350μ, width 160μ; posteriorly of coxae IV the hispidosoma tapers to a blunt truncate apex, and that portion of the body is strongly elevated (cf. fig. II). Dorsal and ventral setae as in ♀, except that the apex has only 4 dorsal and 6 ventral setae, of which the four inner ones are very short. From the truncate apex of the abdomen arises a tubular projection, through which the long fine penis is extruded. The legs are as in ♀, I 118μ, II 100μ, III 79μ, IV 92μ.

Loc. and Host. Numerous specimens on "couch" grass, *Cynodon dactylon* Rich. on a bowling green at Gayndah, South Queensland, January and February, 1943 (A. May).

Mr. Alan May of the Queensland Department of Agriculture and Stock, to whom I am indebted for this material, states that the mites were "attacking the grass *Cynodon dactylon*, and confined their attentions to the nodes being protected by the leaf sheath. Affected grass becomes clumped and somewhat stunted in habit, although there is a general thickening of the stems. Runners are not produced and the grass eventually dies out leaving bare patches. On removal of the leaf sheath, the mites are found clustering in large numbers at the nodes, and are accompanied by a general brown discoloration. The mites are bright red in colour and move very sluggishly when disturbed. On account of their position within the leaf sheath, direct control measures are out of the question.

LIST OF DESCRIBED SPECIES.

Trichadenus sericariae Rond. 1870, Italy, on *Morus*.
„ *arechavaletae* Bruyant 1911, Uruguay, on *Distichlis scoparia* Arech.
„ *floridanus* (Banks) Florida, on bananas.
„ *australianus* n.sp. Queensland, on *Cynodon dactylon* Rich.

Genus RAOIELLA Hirst 1924.

Ann. Mag. Nat. Hist. 1924 (9), xiv, p. 522, pt. xvi, fig. 1–6 (genotype *R. indica*).

— *Rondanacarus* Ouds. 1938, iv, Tijds. Ent., 81, Verslagen, p. vii (genotype *Acarus mori* Rondani 1870).

As previously stated all the known species of this family are plant feeders, normally at least. *Trichadenus sericariae* Rondani 1870, was originally described from the cocoons of *Sericaria mori* (Linn. 1758) the silk-worm of commerce, but this habitat was probably accidental for the mites were later found on the under sides of the leaves of mulberry (*Morus*), used as food for the silk worms.

Banks' *floridanus* occurred at the bases of the leaves of pine apple (*Ananassa*) and *Pseudoleptus arechavaletae* Bruyant 1911 was recorded from the grass *Distichlis scoparia* Arech. from Montevideo, Uruguay. This species was known by the vernacular name of "bicho colorado" but this appears to have been widely used and to include any minute red mites, including the larval Trombids, etc., capable of biting man. The species described in this paper was found attacking "couch" grass, *Cynodon dactylon* Rich. on a bowling green at Gayndah, Queensland, in January and February, 1943.

In the genus *Raoiella*, the genotype *R. indica* Hirst (Ann. Mag. Nat. Hist. (9), xiv, 1924, p. 522, pl. xvi, fig. 1–6) was recorded from coconut leaves from Coimbatore, S. India. The two known Australian species are both from Eucalypts, *R. australica* Wom. 1940 (Tr. Roy. Soc. S. Aust., lxiv (2), p. 264) from an un-identified species from New South Wales, and from *E. andrewsiana* and *E. tereticornis* from Queensland, *R. queenslandica* Wom. 1942 (Tr. Roy. Soc. S. Aust., lxvi (1), p. 88) was from *E. micrantha,* Queensland. Rondani's *mori* was from *Morus.*

List of Described Species.

Raoiella australica Wom. 1940, Australia, New South Wales, on Eucalyptus.
,, *indica* Hirst 1924, Southern India, on coconut leaves.
,, *mori* (Rondani 1870) Italy, on mulberry.
,, *queenslandica* Wom. 1942, Australia, Queensland, on Eucalyptus.

A REVISION OF THE SPIDERS OF THE GENUS MISSULENA WALCKENAER 1805

By H. Womersley, A.L.S., F.R.E.S., South Australian Museum

Summary

Suborder **Mygalomorphae**

Superfamily **Octostiatae**

Family **Ctenizidae**

Subfamily **Actinopodinae**

Genus **Missulena** Walckr. 1805, Tabl. Aran., p. 6 (type occatoria)

Eriodon Latr. 1804, Nouv. Dict. Hist. Nat., xxiv, p. 134 (nom. Nud.); Lucas 1865, Ann. Soc. Ent. Fr. (4) v. p, 309, p1. 8; Auss. 1871, Verb. Z. b. G. Wien, xxi, p. 142; L. Koch 1873, Die Arachn. Austr., i. p. 454; Simon 1892, Hist. Nat. d. Araignees, i, p. 81; Hogg 1891, P.Z.S., p. 219, ibid. 1901, p. 223 ; Rainbow 1911, Rec. Austr. Mus., ix (2), p. 107.

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Fig 1.

Suborder MYGALOMORPHAE.

Superfamily OCTOSTIATAE.

Family CTENIZIDAE.

Subfamily Actinopodinae.

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= *Eriodon* Latr. 1804, Nouv. Dict. Hist. Nat., xxiv, p. 134 (nom. nud.); Lucas 1865, Ann. Soc. ent. Fr. (4) v, p. 309, pl. 8; Auss. 1871, Verh. z. b. G. Wien, xxi, p. 142; L. Koch 1873, Die Arachn. Austr., i, p. 454; Simon 1892, Hist. Nat. d. Araignees, i, p. 81; Hogg 1891, P.Z.S., p. 219, *ibid*. 1901, p. 223; Rainbow 1911, Rec. Austr. Mus., ix (2), p. 107.

Pachyloscelis Lucas 1834, Ann. Soc. ent. Fr., iii (ad part *nigripes, rufipes*) p. 363–4.

Sphodros Walckr. 1837, Ins. Apt., i, p. 246.

Closterochilus Auss. 1871, Verh. z. b. G. Wien, xxi, p. 141.

Theragretes Auss. 1871, *ibid*, p. 142.

Missulena Rainbow and Pulleine 1918, Rec. Austr. Mus., xii (7), p. 87.

Actinopus Rainbow 1896, Proc. Linn. Soc. N.S.W., xxi, p. 328, pl. xx, *op. cit*. 1897, xxii, p. 253.

Pars cephalica very high and wide. Ocular area wide (occupying almost the entire width of the front of the pars cephalica) and narrow. Eyes small, anterior row straight or only slightly procurved, AME close together and widely separated from ALE; posterior row strongly recurved so that the PME lie almost in a line with the anterior eyes, and nearer to ALE than to PLE. Chelicerae thick and strong, their bases occupying the entire front of the cephalothorax, apex of basal segment rounded and armed with a rastellum. Maxillae without a lobe but with the inner anterior corner produced into a blunt process, furnished with numerous blunt short spines in female (often incipient or absent in male). Labium longer than broad at the base, inserted immovably in the front of the sternum, apically rounded, often with numerous short stout spines especially in female. Sternum as long as broad, with 3 pairs of distinct sigilla, the posterior pair large and oval and distinctly separated from margins, the anterior pairs are small and there is actually a small fourth pair immediately behind the insertion of the labium, the third pair is frequently divided into two lying side by side. The sexes are well differentiated.

♀ Large and robust with relatively short stout legs. Pars cephalica and chelicerae generally concolorous with the rest. Tarsi and metatarsi with numerous ventral spines. Claws 3, upper claws slightly dissimilar, mostly with a single large inner basal tooth. Palpal tarsus with a single claw similar to upper claws of legs. Spinnerets 4, superior 3-segmented, basal segment largest, apical shortest; inferior 2-segmented.

♂ Usually much smaller and with more slender legs. Pars cephalica and chelicerae frequently of a bright red and so differentiated from the rest of the body. Metatarsi and tarsi of legs III and IV with scopulae. Patella of legs I and III dorsally with a pad of short stout spines. Palpal tarsus with a spiral haematodocha and a long slender stigma. Claws 3, upper with a single row of a number of teeth, often dissimilar, lower with fewer teeth. Spinnerets 4, superior 3-segmented as in female, inferior 1-segmented.

This genus of trap-door spiders is confined to Australia. Hogg (P.Z.S. 1901) lists eleven species as having been described, in every case from only one sex or the other. He considers that they can be reduced to at least eight species. Since his paper, however, two other very distinct species, *M. bradleyi* (Rainbow 1914) and *M. reflexa* R. and P. 1918 have been added, in each case from male specimens only.

In this paper a large amount of material from the South Australian Museum collection, and loaned from the collections of the Australian Museum, Sydney, the West Australian Museum, Perth, and Dr. V. V. Hickman, of Hobart has been examined, the result of which shows that at present not more than 6 valid species can be recognized, excluding the two species described by Lucas in 1834 as *nigripes* and *rufipes* but not recognized since. According to Hogg (1901) these are possibly ♂ and ♀ of the one species, and Simon (1892) after examining the type of *nigripes* finds it to be a typical *Missulena* (*Eriodon*) and regards the locality, South America, as erroneous.

In his key to the species Hogg (1901) gives the AME of *M. formidabile* (Cambr.) as being 4 diameters apart, although Cambridge's figures (J. Linn. Soc. London, x, 1868, pl. i, fig. 3 and 4) show them to be not more than 2 diameters apart. Amongst the large number of specimens of this genus which I have been able to examine, not one has such widely separated AME as stated by Hogg. The AME (post bacillar) of species of *Missulena* show a very distinct iris which is much more easily observable and measurable than the larger cornea, and it would seem that Hogg in re-examining the type of *formidabile* measured the iris and not the cornea. In addition Hogg states that *formidabile* is a much larger species than *occatoria*, 26 mm. as against 20 mm. in length. The females of specimens of the latter species are very variable in size and some quite reach the length of 26 mm. given for *formidabile*.

Judging from the number of specimens available the females of *rubrocapitata* and the males of *occatoria* are the most abundant and widespread species, yet I have not been able to separate any females as belonging to *occatoria* or any males as *rubrocapitata*. The so-called ♀ of *rubrocapitata* described by Rainbow (Rec. Austr. Mus. 1903, v (1), p. 65) is that of *insigne* (O.P. Cambr. 1877) of which I have a number of specimens of both sexes. It follows then that both *formidabile* and *rubrocapitata* are females of and synonymous with *occatoria*.

M. incertum (Cambr. 1877) is, I consider, the same as *granulosum* (Cambr. 1870) but *M. incertum*, Hogg 1901, is a different species for which the new name, *hoggi* is proposed.

To help in clearing up what has been a tangle for some years, redescriptions of the species considered as valid are given in much detail based on morphological characters now recognized by Arachnologists. Of the six species now recognized, four are known from both sexes.

Little seems to be known about the tubes constructed by species of this genus, beyond the observation of Dr. Pulleine (Rec. Austr. Mus. 1918, xii (7), p. 82) that the tubes of *M. occatoria* have a door of the wafer type without any admixture of soil particles.

MISSULENA OCCATORIA Walckr. 1805.

Missulena occatoria C. A. Walckenaer 1805, Tabl. d. Aran., p. 8, pl. ii, fig. 11–14; *id.* Ins. Apt. 1837, i, p. 252.

Eriodon occatorium Lucas 1865, Ann. Soc. ent. Fr., ser. 4, v, p. 309, pl. viii; L. Koch 1873, Die Arachn. Austr., p. 457; Hogg 1901, Proc. Zool. Soc., p. 220; Rainbow 1903, Rec. Austr. Mus., v, No. 1, p. 62, fig. 5.

Eriodon formidabile O.P. Cambridge 1868, J. Linn. Soc. London, x, p. 266, pl. ix; L. Koch, Die Arachn. Austr., 1873, p. 454; Hogg 1901, Proc. Zool. Soc., p. 222.

Eriodon rubrocapitatum Auss. 1875, Verh. z. b. Ges. Wien, xxv, p. 140, pl. v, fig. 1–4; Hogg 1901, Proc. Zool. Soc., p. 226, fig. 23a; nec Rainbow 1903, Rec. Austr. Mus., v, No. 1, p. 64, fig. 6.

Eriodon semicoccineum Simon 1896, in Semon, Zool. Forschr. Austr. Malay Archipel., Lfg. viii, p. 343; Hogg 1901, Proc. Zool. Soc., p. 228.

Actinopus formosus Rainbow 1896, Proc. Linn. Soc. N.S.W., xxi, p. 328, pl. xx; *op. cit.* 1897, xxv, p. 253.

Missulena (Eriodon) occatoria Hogg 1908, Proc. Zool. Soc., p. 335, fig. a–d.

Missulena rubrocapitata Rainbow and Pulleine 1918, Rec. Austr. Mus., xxi, No. 7, p. 88, pl. xii, fig. 1–2.

Missulena formidabile R. and P. 1918, Rec. Austr. Mus., xv, No. 7, p. 89.

Text fig. 1A–N.

♂ (One of two specimens in S.A. Museum collected from Mt. Lofty, S. Aust., May 1937, R. Lowe.)

Total length (excluding chelicerae and spinnerets)	12·5 mm.
Length of Cephalothorax	6·0 mm.
Width of Cephalothorax	7·0 mm.
Length of Abdomen	7·0 mm.
Width of Abdomen	6·0 mm.

Lengths of leg and palpal segments in millimetres.

	Femur.	Patella.	Tibia.	Metatarsus.	Tarsus.	Total.
Leg I	5·3	2·7	3·0	2·6	2·1	15·7
Leg II	4·8	2·6	2·5	2·5	2·0	14·4
Leg III	4·5	2·5	2·2	2·5	2·0	13·7
Leg IV	5·1	2·8	3·3	3·0	2·2	16·4
Palp	4·8	2·5	4·0	—	1·5	12·8

Width of 1st patella at "knee" 1·5 mm.; tibial index 26·3.

Width of 4th patella at "knee" 1·6 mm.; tibial index 26·2.

Carapace. Ovate, truncate in front, 6·0 mm. long, 7·0 mm. wide, rear margin incised. Thoracic fovea deep medially and strongly procurved, radial furrows distinct, a deep longitudinal groove from behind middle of fovea, lateral margins reflexed. Pars cephalica 3·0 mm. high, 3·8 mm. long, bright scarlet and finely rugose, with a fine longitudinal line from middle of ocular area; clypeus white, separated from AME by two eye diameters and laterally widening to its distance from ocular area. Pars thoracica black, slightly and finely rugose, apparently without hairs except a few black ones on margins.

Eyes. Ocular area much wider than long, 3·7 mm. by 0·7 mm. AME on a slightly raised, dark pigmented tubercle, each eye circular, 0·25 mm. in diameter. Anterior row of eyes slightly procurved, posterior row strongly recurved ALE raised, oval, inclined, 0·2 mm. diam., 1·3 mm. from AME, base black. PLE raised, oval, inclined, 0·2 mm. diam., 0·7 mm. from ALE and 3·0 mm. apart; PME oval, sessile ·18 mm. diam., their anterior edge in line with posterior edge of ALE, 2·4 mm. apart.

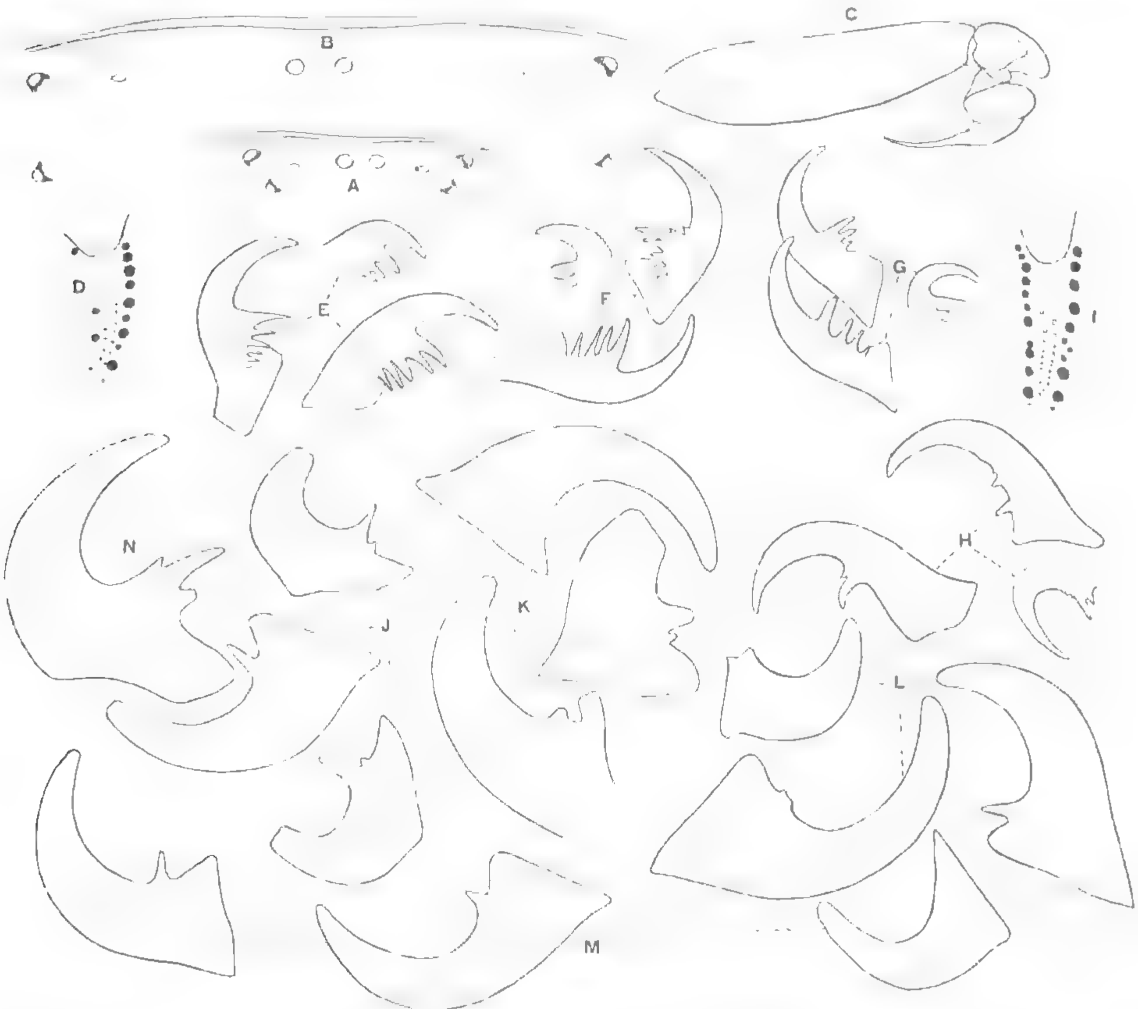

Fig. 1. *Missulena occatoria* Walckr. A. eyes of ♂ × 9, B. eyes of ♀ × 9, C. palp of ♂, D. cheliceral teeth ♂, E. claws of leg I ♂, F. ditto leg II, G. ditto leg III, H. ditto leg IV, I. cheliceral teeth ♀, J. claws of leg I ♀, K. ditto leg II, L. ditto leg III, M. ditto leg IV, N. claw of palp ♀.

Chelicerae. Basal segment 4·5 mm. long, bright scarlet, shining with transverse striations, rastellum of 10–12 black spines; fangs dark, 2·5 mm. long, curved, promargin of furrow with 8–9 medium to large teeth (cf. fig. 1, D), retromargin with 3 small teeth, a few tuberosities between margins, a scopula of reddish hairs present.

Labium. Longer than broad, 1·6 mm. by 1·0 mm., sides tapering, apically rounded with only short spines. Colour reddish with black hairs.

Sternum. 3·8 mm. long by 3·8 mm. wide, almost black in colour except for a narrow reddish band just behind insertion of labium. Sigilla 4 pairs, posterior large and oval, occupying about half of sternum and distinctly separated from margins; anterior pairs of sigilla small, second pair from front subdivided. Clothing of black hairs.

Maxillae. 2·8 mm. long by 1·8 mm. wide, with a strong scopula of brownish red hairs and furnished with a number of short, almost incipient spines. Colour reddish with black hairs.

Legs. 4·1·2·3. Black or dark brown with light brown hairs. Trichobothria on all tibia, tarsi and metatarsi. Tarsal claws 3, upper claws with 3–6 teeth dissimilar (cf. fig. 1, E–H), lower claws with 2–3 teeth. Tarsi and metatarsi III and IV with a ventral scopula of short blunt red hairs.

Palpi. Blackish with black hairs. Genital bulb reddish black. Stigma very slender, about ⅗ length of tibia, blackish.

Spines. Patella, tibia, metatarsus and tarsus of all legs with numerous strong spines ventrally, those on metatarsi and tarsi of legs III and IV ventrolateral. Patella of all legs with strong, short, inclined spines, dorsal and few on II and IV, more, and forming a pad or accessory rastellum, on I and III and placed somewhat prolateral. All spines black.

Abdomen. Ovate, arched, and slightly overhanging base of cephalothorax, dorsally black with long black hairs and short fine spine-like hairs, not shining. Venter similar except that in front of epigastric furrow it is chitinized, shining and with a brown tinge concolorous with the sternum.

Spinnerets. Four, basal segment of superior and the inferior spinnerets black; other segments of superior brownish black; intersegmental membrane white. Superior 2·2 mm. long, inferior 0·9 mm. long.

♀ (Specimen from Whyalla, S. Aust., August 1938).

Total length (excluding chelicerae and spinnerets)	26·0 mm.
Length of Cephalothorax	12·0 mm.
Width of Cephalothorax	12·7 mm.
Length of Abdomen	17·0 mm.
Width of Abdomen	14·0 mm.

Lengths of leg and palpal segments in millimetres.

	Femur.	Patella.	Tibia.	Metatarsus.	Tarsus.	Total.
Leg I	7·1	5·0	4·2	3·7	2·5	22·5
Leg II	6·3	5·0	4·0	3·7	2·6	21·6
Leg III	6·5	5·4	4·0	3·8	2·8	22·5
Leg IV	8·0	6·0	5·0	3·8	2·7	25·5
Palp.	6·2	4·0	4·2	—	4·5	18·9

Width of 1st patella at "knee" 3·0 mm.; tibial index 32·6.

Width of 4th patella at "knee" 3·5 mm.; tibial index 31·8.

Carapace. Broadly ovate, shining, wider than long, 12·0 mm. by 12·7 mm., truncate in front, incised posteriorly. Thoracic fovea deep medially, strongly procurved, radial furrows distinct, a fairly deep longitudinal groove from middle of fovea, margins strongly reflexed. Pars cephalica 7·0 mm. high, 8·5 mm. long, a dark chocolate brown in colour with a few dark hairs in front of ocular area and along a slight depressed longitudinal line from middle of ocular area, and a few sparse hairs on disc. Clypeus white, as wide as the diameter of one AME and separated therefrom by two diameters. Pars thoracica smooth, shining, concolorous with pars cephalica, slightly raised on disc.

Eyes. Ocular area very much wider than long, 7·5 mm. by 1·8 mm. AME sessile, 0·2 mm. diam. and two diameters apart. Anterior row practically straight, posterior row strongly recurved so that PME are almost in line with anterior eyes. ALE raised, oval, inclined, 0·2 mm. diam., separated from AME by 3·2 mm. PLE raised, oval, inclined, 0·18 mm. diam. separated from each other by 7·0 mm. and from ALE by 1·1 mm., PME oval, horizontal, sessile 0·25 mm. diam. and 2·0 mm. apart from AME, their anterior edges in line with posterior edges of AME and ALE.

Chelicerae. Basal segment large, 10·2 mm. long, chocolate brown in colour, with thick clothing of reddish brown hairs, with rastellum of 12–20 stout reddish brown spines; fangs dark chocolate brown to black at the tip, 8·5 mm. long, strong and curved; promargin of cheliceral groove with 7–8 large and almost uniform teeth, retromargin with 11–12 only slightly smaller and rather less uniform teeth, numerous tuberosities between the margins; with slight scopula of brownish hairs.

Labium. Longer than broad, 4·5 mm. by 2·7 mm., sides tapering, apex rounded, with numerous spines and reddish black hairs; colour reddish brown.

Sternum. 8·0 mm. wide by 8·0 mm. long, chocolate brown; with 4 pairs of sigilla, posterior pair oval, large, well separated from margins; second pair from front subdivided; clothing of blackish hairs.

Maxillae. 6·5 mm. long, 4·0 mm. wide with scopula of long reddish hairs, and furnished with numerous strong spines.

Legs. 4·3·1·2. Stout, dark chocolate brown; all tibiae, metatarsi and tarsi with trichobothria. Tarsal claws 3, superior with one strong inner basal tooth and occasionally a small one in the basal angle; inferior claw with one or no teeth. All legs without scopulae.

Palpi. Dark chocolate brown, intersegmented membrane white; patella, tibia and tarsus with trichobothria and all segments with strong black hairs; tarsus with a single claw with a strong inner basally trifurcate tooth, the outer denticles of which are shorter than the inner.

Spines. Tibiae, metatarsi and tarsi with a number of spines ventrally, those on tarsi and metatarsi III and IV extending laterally. No spines on the patella of any leg.

Abdomen. Ovate, arched, overhanging base of cephalothorax; dorsally and ventrally dark chocolate brown, barely shining, finely granulose, with long black hairs interspersed with shorter and slightly stronger hairs. In front of epigastric furrow shining and concolorous with sternum.

Spinnerets. Four, superior 4·2 mm. long, chocolate brown, with white intersegmental membrane; inferior 1·2 mm. long.

Loc. of the specimens examined.

♂♂ South Australia: Meadows 1908 (2); Mt. Lofty 5/1933 (2), 5/1937 (2); Pinda 4/1936 (1); Adelaide 1937 (2); Tumby Bay 6/1938 (1); Bridgewater 4/1940 (1); Peterborough 4/1940 (1); unlocalized (3).

Western Australia: 90 Mile Desert 10/1907 (2); Bridgetown 26/322 (1); Laverton 26/715 (1); Buniche 32/417 (1); Wurarga 32/1434 (1); Wubin 33/1614 (1); Canning Br. 33/1537 (1).

New South Wales: Tarcoon 6/1927, K 56291 (1); Canley Vale 3/1928, K 58932 (1); Macquarie Fields 6/1929, K 61640 (1); East Hills 6/1929, K 59698 (1); Wentworthville 3/1930, K 61597 (1); Longreach, K 3914 (2, as *formosus*); Rydal, K 19073 (1).

31 specimens.

♀♀ South Australia: Mallala 5/1908 (1); Lameroo 5/1935 (1); Adelaide 1937 (1); Cadell 5/1937 (1); Whyalla 8/1938 (1); Ardrossan 8/1938 (1); Belair 8/1938 (1); Mt. Lofty (no date, 1); Adelaide 11/1929; S. Aust. unlocalized, K 46833 (2).

Victoria: Swan Hill 5/1928 (1).

Western Australia: 90 Mile Desert 10/1907 (2); Mt. Lawley 9/1928–630; Perth 1915–467.

New South Wales: Stewart Town K 9420 (as *formidabile*) (1); Granville K 4367 (as *formidabile*) (1); N. Strathfield 6/1929, K 59217; Willcannia K 35100 (1); Chatswood K 3309 (1); Mosman K 14173 (1).

22 specimens.

MISSULENA INSIGNE (O.P. Cambridge 1877).

Eriodon insigne O.P. Cambridge 1877, Ann. Mag. Nat. Hist., ser. 4, xix, p. 29; ? nec Hogg, Proc. Zool. Soc. 1901, p, 223, fig. 21a, b.

Eriodon rubrocapitatum, ♀, Rainbow 1903, Rec. Austr. Mus., v, No. 1, p. 64, fig. 6.

Missulena insigne, Rainbow and Pulleine, 1918, Rec. Austr. Mus., xii, No. 7, p. 87.

Text fig. 2A–1.

♂ Total length (excluding chelicerae and spinnerets)	8·5 mm.
Length of Cehpalothorax	5·0 mm.
Width of Cephalothorax	6·0 mm.
Length of Abdomen (shrivelled)	4·5 mm.
Width of Abdomen	4·0 mm.

*Lengths of leg and palpal segments in millimetres.**

	Femur.	Patella.	Tibia.	Metatarsus.	Tarsus.	Total.
Leg I	5·0	1·9	3·2	3·0	1·8	14·9
Leg II	4·4	2·0	2·6	2·6	1·8	13·4
Leg III	3·8	1·9	2·1	2·4	1·8	12·0
Leg IV	4·2	2·0	3·0	3·1	1·8	14·1
Palp.	4·5	2·5	4·0	—	1·0	12·0

Width of 1st patella at "knee" 1·0 mm.; tibial index 19·6.

Width of 4th patella at "knee" 1·0 mm.; tibial index 20·0.

Carapace. Ovate, truncate in front, 5·0 mm. long, 6·0 mm. wide, posterior margin incised. Thoracic fovea deep procurved, radial furrows distinct, lateral margins reflexed. Pars cephalica 1·7 mm. high, 3·0 mm. long, bright red, faintly rugose with slight medial longitudinal line. Clypeus narrow, equal to diameter of one AME and about two diameters therefrom. A few long black hairs in front of ocular area and some shorter ones along medial line. Pars thoracica chocolate brown with slight purplish tinge, rugose, slightly raised medially, a few brownish black hairs on margin.

Eyes. Ocular area very much wider than long, 2·6 mm. by 0·7 mm. AME on slightly raised tubercle pigmented with black, each eye 0·15 mm. diam., round and separated from its neighbour by 1 diameter, each eye surrounded by black pigment touching in the mid-line. Anterior row of eyes straight or very slightly procurved, posterior row strongly recurved. ALE raised, oval, inclined, 2·5 mm. apart, 0·2 mm. diam., the base with black pigment, and separated from AME by slightly more than 5 diameters. PLE raised, oval, inclined, 0·15 mm. diam. and separated

* Average of three specimens, one each from Latham and Forest Grove, Western Australia, and one from Keith, South Australia.

by 2·0 mm., base black, 0·35 mm. from ALE. PME sessile, oval, 0·12 mm. diameter. 1·5 mm. apart, their anterior edges in line with posterior edges of AME and ALE.

Chelicerae. Basal segment bright red, 3·0 mm. long with transversely lightly rugose surface with light clothing of long black hairs especially distally, with rastellum of 2–5 spines. Fangs 2·0 mm. long, brownish red, curved. Promargin of furrow with 3–4 large and about 6 small teeth, retromargin with 2 moderately large and 4 small teeth, a few small tubercles basally between furrow margins (cf. text fig. 2E), with a slight scopula of long hairs.

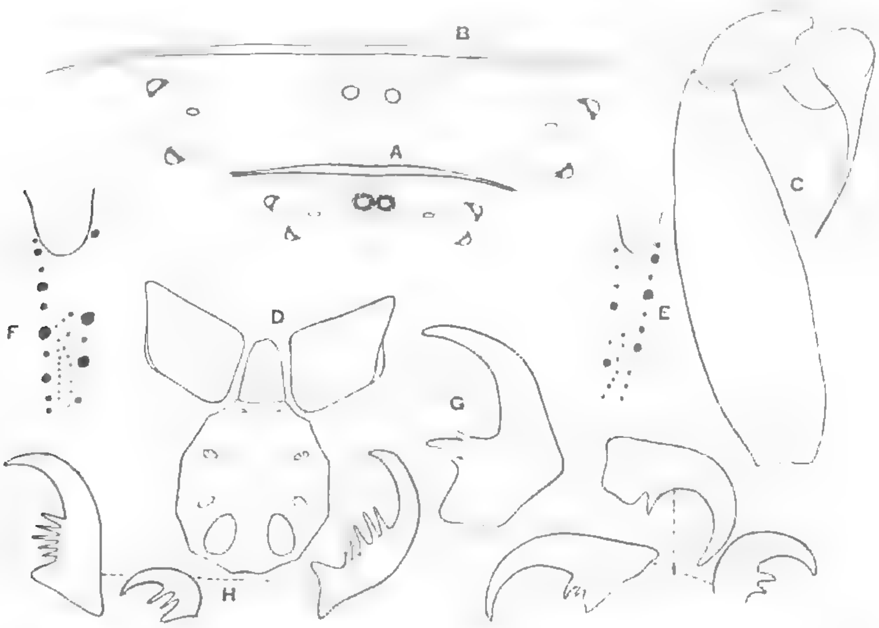

Fig. 2. *Missulena insignè* (Cambr.). A. eyes of ♂ × 9, B. eyes of ♀ × 9, C. palp of ♂. D. labium, sternum and maxillae ♂, E. cheliceral teeth ♂, F. ditto ♀, G. claw of palp ♀, H. claws of leg I ♂, I. ditto ♂.

Labium. Longer than broad at base, sides tapering anteriorly, apex rounded. with long hairs but no spines. not even incipient ones. Colour reddish.

Sternum. Bright reddish, tinged with brown posteriorly, 2·5 mm. long by 2·5 mm. wide, with long reddish hairs. Sigilla 4 pairs, distinct, posterior large, oval, distinctly separated from margins, others small.

Maxillae. 2·0 mm. long by 1·5 mm. wide, with a scopula of long reddish hairs. but no spines. Colour reddish.

Legs. 1·4·2·3. Chocolate brown with slight purplish tinge. Trichobothria on all tibiae, metatarsi and tarsi. Tarsi and metatarsi III and IV with a scopula of short blunt yellowish hairs. Tarsal claws 3, upper with 5 teeth only, slightly dissimilar, lower with 2 teeth.

Palpi. Chocolate brown with purplish tinge, clothed with blackish brown hair. Genital bulb spiral, stigma slender, about half the length of tibia.

Spines. Patella, tibia, metatarsus and tarsus of all legs ventrally with rather long strong spines, those on metatarsus and tarsus III and IV ventrolateral. Patella of all legs with a number of short strong inclined spines dorsally, few on II and IV, more and forming a pad or accessory rastellum on I and II and placed somewhat prolaterally. All spines black.

Abdomen. Ovate, arched and slightly overhanging base of cephalothorax. dorsally, with long black hairs and short fine spine-like hairs, not shining; ventrally similar except anterior of epigastric furrow which is chitinized, shining and concolorous with sternum.

Spinnerets. Four. Superior 1·2 mm. long, basal segment the longest, apical very short. Inferior 0·5 mm. long. Colour brown.

♀ Total length (excluding chelicerae and spinnerets)	17·0 mm.
Length of Cephalothorax	8·0 mm.
Width of Cephalothorax	9·0 mm.
Length of Abdomen	10·0 mm.
Width of Abdomen	8·0 mm.

Lengths of leg and palpal segments in millimetres.

	Femur.	Patella.	Tibia.	Metatarsus.	Tarsus.	Total.
Leg I	6·3	3·6	3·2	3·0	2·0	18·1
Leg II	5·5	3·5	4·0	3·0	2·0	18·0
Leg III	5·2	3·0	3·0	3·2	2·0	16·4
Leg IV	5·5	4·0	3·5	3·0	2·0	18·0
Palp.	5·5	2·5	3·0	—	2·5	13·5

Width of 1st patella at "knee" 2·0 mm.; tibial index 32·3.

Width of 4th patella at "knee" 2·5 mm.; tibial index 33·3.

Carapace. Ovate, dark chocolate brown except in front of pars cephalica where it is reddish, front margin truncate, posterior margin incised, 7 mm. long, 9·0 mm. wide. Thoracic fovea deep, procurved, radial furrows distinct, margins reflexed. Pars cephalica 4·5 mm. high, 3·5 mm. long, smooth, shining. Clypeus narrow, equal to one AME in width and separated by two diameters therefrom. A few long brown hairs in front of ocular area and scattered on disc. Pars thoracica dark chocolate, smooth, with scattered brown hairs; slightly raised medially and on margins.

Eyes. Ocular area much wider than long, 5·5 mm. by 1·1 mm. AME on a very slightly raised tubercle round, 0·2 mm. diam., each eye separated by 1½ diam., no surrounding black pigment. Anterior row of eyes straight, posterior row strongly recurved. ALE broadly oval, raised, inclined, 0·25 mm. diam., 5·5 mm. apart, 2·3 mm. from AME, base with black pigment. PLE oval, inclined, raised, 0·25 mm. diam., 0·7 mm. from ALE and 5·0 mm. apart, base black pigmented. PME oval, horizontal, sessile, white, 0·17 mm. diam., 4·5 mm. apart, anterior edges slightly behind line of posterior edges of ALE.

Chelicerae. Basal segment reddish, but not scarlet as in ♂, smooth, shining, 6·5 mm. long, with numerous long reddish hairs; rastellum of 10–12 dark stout spines. Fangs 4·5 mm. long, black, curved, moderately thick. Promargin of furrow with 4–5 large teeth and 5–6 small ones, retromargin with 4 large teeth, with slight scopula.

Labium. Longer than broad at the base, sides only slightly tapering, 2·6 mm. by 1·8 mm., apex rounded with a number of short peg-like spines. Colour chocolate brown.

Sternum. Chocolate brown 5·0 mm. long by 5·0 mm. wide, with long blackish hairs. Sigilla 4 pairs, second pair subdivided, posterior pair large, oval, and well separated from margins.

Maxillae. 4·5 mm. long by 4·0 mm. wide, with scopula of reddish hairs and numerous short peg-like spines. Colour chocolate brown.

Legs. 1·4·2·3. Chocolate brown with slight purplish tinge, trichobothria on all patellae, tibiae, metatarsi and tarsi. No legs with scopulae. Tarsal claws 3, superior with 1 or 2 teeth, dissimilar, inferior with 2 teeth (cf. fig. 2H).

Spines. Tarsi and metatarsi of all legs with many long strong spines ventrally, on legs III and IV also ventrolaterally.

Abdomen. Dark brown with long brown hairs dorsally and ventrally; hardly overlapping cephalothorax.

Spinnerets. Four, superior 1·8 mm. long, inferior 0·8 mm., chocolate brown.

Remarks. As with most of the described species of this genus, only one sex was included in the original descriptions, in this case the male; and all hitherto published records are of the same sex. Amongst the material sent to me from the West Australian Museum, Perth, are two females which can definitely be correlated with the male, and the above description of that sex is drawn up from one of these. The specimen described by Rainbow (1903) as the then unknown female of *rubrocapitatum* and which I have been able to examine is undoubtedly to be referred to *insigne* as will be evident when his description is compared with the one given above. Rainbow's specimen was from Kalgoorlie, Western Australia, and was sent to him with a male from the same locality. The male, however, was not described but only referred to the same species, so that it is not possible to say whether it belongs to *insigne* or not. Hogg's description (1901) from several males from Dimboola, Victoria, is somewhat doubtful for he states that the colour of the pars thoracica, abdomen and legs was black, whereas the original description of Cambridge gives the pars thoracica as "brownish black", and the legs and palpi as "a dark shining brown colour, tinged very slightly with metallic purplish", which agrees fully with the material before me. *M. insigne* is the only species so far known, in which the ♀ has the pars cephalica in part and the chelicerae wholly red, although not of the bright colour of the males of this and some other species.

Loc. and specimens examined.

♂ ♂ South Australia: Keith, no date (4), (2. K 40831); Warburton Ranges, no date (1).

Western Australia: Kondinum 24-616 (1), Merredin 25-424 (1); Nukarni 27–838 (1); Morawa 29–437 (1); Latham 30–466 (1); Forest Grove 31–660 (1).

New South Wales: Loc. ?, K 12868 (1) as *formosum*; Leeton 4/29 (1); Rankines Springs, Pembroke Potts 5/27, K 56267; Tumblong 4/28, K 57756; Wija via Wyalong 4/28; Penrith 4/28, K 57749; Cowra 1928, K 57696; Canley Vale 5/29, K 58929.

Queensland: Brisbane, no date (1).

20 specimens.

♀ ♀ Western Australia: Worawa, 29–440 (1); Burracoppin, 32–1429 (1); Mukinbudin, 33–1523 (1); Kodanooka, 33–1518 (1); Kalgoorlie, K 11920 (as Rainbow's type of *rubrocapitatum*) (1).

New South Wales: West Wyalong, K 48135 (1).

6 specimens.

MISSULENA GRANULOSA (O.P. Cambridge 1870).

Eriodon granulosum O.P. Cambridge 1870, J. Linn. Soc., London (Zool.), x, p. 268; Hogg 1901, Proc. Zool. Soc. (2), p. 222.

Eriodon crassum O.P. Cambr. 1870, J. Linn. Soc. London (Zool.), x, p. 269; Hogg 1901, Proc. Zool. Soc. (2), p. 222.

Eriodon incertum O.P. Cambr. 1877, Ann. Mag. Nat. Hist., ser. 4, xix, p. 30; nec Hogg 1901, Proc. Zool. Soc. (2), p. 224.

Text fig. 3A–N.

♂ Total length (excluding chelicerae and spinnerets)	12·0 mm.
Length of Cephalothorax	6·5 mm.
Width of Cephalothorax	8·0 mm.
Length of Abdomen (shrivelled)	7·5 mm.
Width of Abdomen	6·0 mm.

Lengths of leg and palpal segments in millimetres.

	Femur.	Patella.	Tibia.	Metatarsus.	Tarsus.	Total.
Leg I	6·5	3·0	3·7	3·2	2·0	18·4
Leg II	5·5	3·0	3·4	3·2	2·0	17·3
Leg III	5·0	2·8	2·7	3·0	2·0	15·3
Leg IV	6·0	3·2	3·5	3·5	2·0	18·2
Palp.	6·0	3·2	4·5	—	2·0	15·7

Width of 1st patella at "knee" 1·5 mm.; tibial index 22·4.

Width of 4th patella at "knee" 1·8 mm.; tibial index 26·8.

Carapace. Ovate, truncate in front, 6·5 mm. long by 8·0 mm. wide, rear margin slightly incised. Thoracic fovea deep medially, strongly procurved, radial furrows distinct, lateral margins reflexed and granulose. Pars cephalica 3·5 mm. high and 4·0 mm. long, black without any trace of red, strongly rugose, almost tuberculate, with longitudinal median line from behind ocular area. Clypeus reddish, about one AME in width, separated from AME by two eye diameters. A few long black hairs in front of AME and on disc. Pars thoracic black, rugose, the rugosites tending to form lines parallel to radial furrows. A few black hairs on margins.

Eyes. Ocular area very much wider than long, 4·2 mm. by 1·2 mm. AME on slightly raised prominence, each eye 0·25 mm. in diam., round, and 2 diams. apart. Anterior row of eyes slightly procurved, posterior row strongly recurved. ALE raised, oval, inclined, 0·2 mm. in diam. and separated from AME by 1·5 mm., PLE raised, oval, inclined, 0·3 mm. in diam., 3·8 mm. apart and 1·1 mm. from ALE. PME 2·5 mm. apart, oval, sessile, 0·25 mm. diam. and 1·0 mm. from PLE and ALE, their front edges slightly behind line joining posterior edges of ALE.

Chelicerae. Basal segment 5·0 mm. long, rugose, black, with touch of red laterally and dorsally on apical half, rastellum of 6–8 black spines. Fangs black, 3·5 mm. long, curved. Promargin of cheliceral furrow with 6–7 large and 2–3 small teeth, retromargin with 5 large teeth, and a number of tuberosities between margins; with a slight scopula.

Labium. Longer than broad, 1·7 mm. by 1·3 mm., sides tapering, apex rounded, with long black hairs and distally with short stout spines; colour black except tip, which is reddish tinged.

Sternum. Black with black hairs, rather longer than wide, 5·0 mm. by 4·0 mm. Sigilla 4 pairs, second pair divided, posterior large, oval, and well separated from margins.

Maxillae. Black, 4·0 mm. long, 2·5 mm. wide, with scopula of long brownish black hairs, and some very short spines.

Legs. 1·4·2·3, shining black, trichobothria on all patellae, tibiae, metatarsi and tarsi. Tarsi and metatarsi with slight scopulae of short, close, slightly brownish hairs. Tarsal claws 3, superior slightly dissimilar, with 6–10 long teeth, inferior with 4–5 teeth (cf. fig. 3F–I).

Palpi. Black clothed with long brownish black hairs. Genital bulb brownish, stigma slender, more than half as long as tibia.

Spines. Patella, tibia, metatarsus and tarsus of all legs with many long strong black spines ventrally, those on metatarsus and tarsus of III and IV being latero-ventral; patella I and III retrodorsally rather swollen and pad like, especially I, with numerous, anteriorly directed, inclined or adpressed short stout spines forming a rastellum.

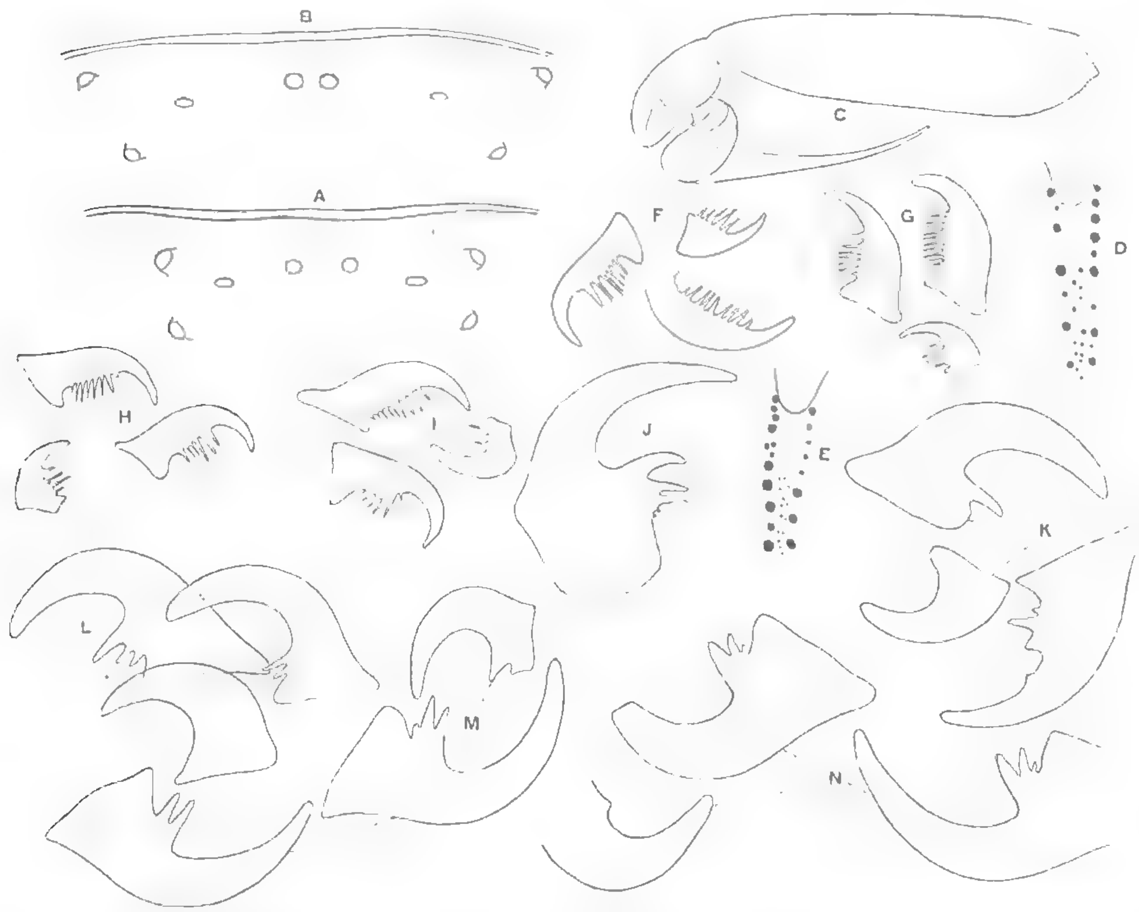

Fig. 3. *Missulena granulosa* (Cambr.). A. eyes of ♂ × 9, B. eyes of ♀ × 9, C. palp of ♂, D. cheliceral teeth ♂, E. ditto ♀; F. claws of leg I ♂, G. ditto leg II, H. ditto leg III, I. ditto leg IV, J. claw of palp ♀, K. claws of leg I ♀, L. ditto leg II, M. ditto leg IV, N. ditto leg IV.

Abdomen. Brownish grey, with black hairs dorsally and ventrally; book lungs and in front of epigastric furrow concolorous. Ovate, slightly overlapping pars thoracica.

Spinnerets. Four, superior 1·8 mm. long, black; inner 0·5 mm. long.

♀ Total length (excluding chelicerae and spinnerets)	22·0 mm.
Length of Cephalothorax	10·0 mm.
Width of Cephalothorax	11·0 mm.
Length of Abdomen	12·0 mm.
Width of Abdomen	11·0 mm.

Lengths of leg and palpal segments in millimetres.

	Femur.	Patella.	Tibia.	Metatarsus.	Tarsus.	Total.
Leg I	6·0	3·8	3·5	3·2	2·4	18·9
Leg II	5·5	3·8	3·0	3·2	2·4	17·9
Leg III	5·7	4·4	2·8	3·5	2·5	18·9
Leg IV	6·9	4·5	4·0	4·0	2·5	21·9
Palp.	5·6	3·0	3·0	—	2·8	14·4

Width of 1st patella at "knee" 2·0 mm.; tibial index 27·4.

Width of 4th patella at "knee" 2·5 mm.; tibial index 29·4.

Carapace. Ovate, truncate in front, 10·0 mm. long by 11·0 mm. wide, rear margin incised, lateral margins slightly reflexed. Thoracic fovea fairly deep medially, procurved, radial furrows not very distinct. Pars cephalica 6·5 mm. high, 8·5 mm. long, piceous black, smooth, shining, with long piceous hairs in front of ocular area and along median longitudinal line and sparsely on disc. Clypeus black, narrow, about 2½ diams. in front of AME. Pars thoracica concolorous, smooth, shining, with sparse hairs.

Eyes. Ocular area very much wider than long, 5·7 mm. long, 1·5 mm. wide. AME on very slightly raised area, each eye 0·25 mm. diam., ¾ diam. apart. Anterior row procurved, posterior row strongly recurved. ALE oval, slightly raised, inclined, 0·25 mm. diam. and 2·5 mm. from AME. PLE oval, slightly raised, inclined, 0·25 mm. diam., 2·2 mm. from AME and 5·0 mm. apart, and 1·0 mm. from ALE. PME horizontal, oval, sessile, 0·2 mm. diam. and 3·0 mm. apart, front edges in the curved line joining posterior edges of ALE and AME.

Chelicerae. Basal segment 7·0 mm. long, piceous, shining, with black hairs, except at inner apical angle where they are reddish, rastellum of 12–20 short black spines. Fangs 5·0 mm. long, piceous, fairly stout. Promargin of furrow with about 6 median to large, and 6–7 small teeth, retromargin with 5 small and 3 moderately large teeth basally, a number of tuberosities between margins; margins furnished with scopulae of reddish hairs.

Labium. Longer than broad, 3·0 mm. by 2·0 mm., sides only slightly tapering, piceous with black hairs, except at extreme tip where it is tinged with red and with red hairs, with numerous short spines apically.

Sternum. Piceous, with slight tinge of red medially, slightly wider than long, 6·0 mm. by 5·5 mm. With 4 pairs of sigilla, anterior pair almost obsolete, second pair subdivided, fourth pair large, oval, well separated from margins, hairs black.

Maxillae. 5·2 mm. long by 4·0 mm. wide, reddish piceous, with black hairs on disc, and scopulae of long red hairs, with many small blunt spines.

Legs. 4·1·3·2. Piceous, shining, trichobothria on all legs from patella to tarsus, same segments with many strong spines ventrally, no scopulae on any tarsi or metatarsi. Claws 3, upper claws with 2–3 teeth, slightly dissimilar, lower claw with 0–1 teeth (cf. fig. 3K–N).

Palpi. Piceous with long black hairs. Tarsus with single strong claw with three large inner basal teeth and traces of two smaller ones.

Spines. Tibiae, metatarsi and tarsi with many ventral spines. No spines on patella of any leg.

Abdomen. Arched, ovate, overhanging base of cephalothorax slightly, piceous in colour but dull with long brownish black hairs. In front of epigastric furrow chitinized, shining, brownish piceous, and concolorous with sternum and coxae.

Spinnerets. Four; superior concolorous with abdomen, stout, about 3·5 mm. long; inferior 1·0 mm. long.

Loc. ♂ ♂ Western Australia: Maida Vale, 26–283; Bridgetown, 26–322; Yotting, 26–693/4 (2 spec.); Wembley Park, 29–453; Palmyra, 30–424; Hollywood, 31–651; Mt. Lawley, 31–652; Bassendean, 32–1103; Nedlands, 32–1104; Cottesloe, 32–1461; W.A., K 8847; Perth, K 15260.

13 specimens.

♀ ♀ North Perth, 32–150; Cannington, 32–1427; Boologooro Sta., Carnarvon, no date.

3 specimens.

MISSULENA HOGGI nom. nov.

Eriodon incertum Hogg 1901, Proc. Zool. Soc. (2), p. 224, nec *E. incertum* O.P. Cambridge 1877, Ann. Mag. Nat. Hist., ser. 4, xix, p. 30.

Text fig. 4A–G.

The specimen described by Hogg from Swan River, Western Australia (coll. H. W. J. Turner) does not agree with Cambridge's original description, also from a Swan River specimen, but does agree with a second specimen referred to later by Cambridge (*loc. cit.* p. 31), hence the necessity for a new name. Further, Cambridge's original description of *incertus* agrees with that of his species *granulosum*, and these two species become synonymous.

Only known as yet from the male sex.

♂ Total length (excluding chelicerae and spinnerets)	10·0 mm.
Length of Cephalothorax	5·5 mm.
Width of Cephalothorax	6·0 mm.
Length of Abdomen	5·5 mm.
Width of Abdomen	4·0 mm.

Lengths of leg and palpal segments in millimetres.

	Femur.	Patella.	Tibia.	Metatarsus.	Tarsus.	Total.
Leg I	5·1	2·6	3·0	2·8	1·8	15·3
Leg II	4·5	2·5	3·0	2·6	1·8	14·4
Leg III	4·2	2·2	2·1	2·8	1·8	13·1
Leg IV	5·0	2·5	3·0	2·9	1·8	15·2
Palp.	4·5	2·5	3·5	-	1·6	12·1

Width of 1st patella at "knee" 1·2 mm.; tibial index 21·4.

Width of 4th patella at "knee" 1·5 mm.; tibial index 27·3.

Carapace. Ovate, truncate in front, 5·5 mm. long, 6·0 mm. wide, rear margin incised medially. Thoracic fovea deep medially, strongly procurved, radial furrows distinct. Pars cephalica 2·2 mm. high, 3·0 mm. long, almost black but with a tinge of dark red, strongly rugose but less so than in *granulosa*, a slight longitudinal line from behind middle of ocular area; a few long hairs in front of ocular area. Clypeus brown, about one AME in width, and two eye diameters away therefrom. Pars thoracica black, rugose, the rugosities tending to form lines parallel to the radial furrows, lateral margins reflexed and rugose, with a few hairs on margins but none on disc.

Eyes. Ocular area very much wider than long, 3·0 mm. by 0·7 mm. AME on slightly raised area, 0·2 mm. diam., and separated from each other by 1 diameter. Anterior row of eyes very slightly procurved, posterior row strongly recurved. ALE oval, inclined, raised, 0·2 m.. diam., separated from AME by 1·1 mm. PLE oval, inclined, raised, 0·15 mm. diam., 2·8 mm. apart. PME oval, horizontal, sessile, 0·15 mm. diam., 0·8 mm. from ALE, and front edges slightly behind line joining posterior edges of AME.

Chelicerae. Basal segment 4·0 mm. long, entirely bright red, lightly rugose with black hairs; rastellum of 8–10 stout black spines. Fangs dark red to black, 2·5 mm. long, curved. Promargin of furrow with about 3 large and 7–8 small teeth, retromargin with 3 large and 3–4 small teeth. A number of small tuberosities between furrow margins. A light scopula of reddish black hairs.

Labium. Longer than broad, 1·5 mm. by 1·0., sides tapering anteriorly, apex rounded, with long black hairs and distally small blunt almost incipient spines; colour reddish black.

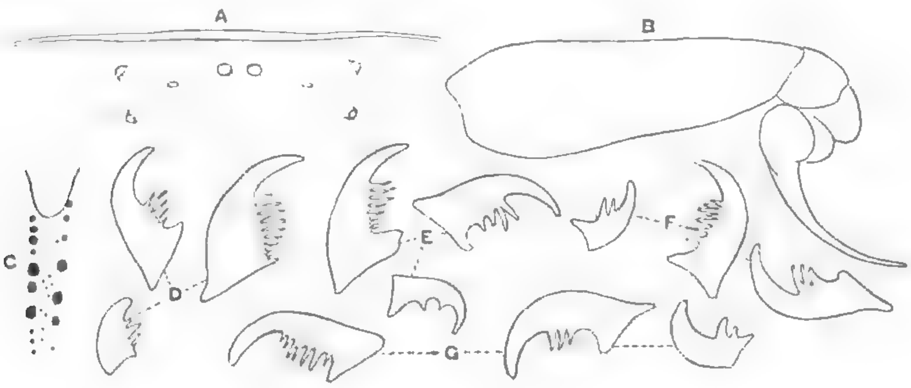

Fig. 4. *Missulena hoggi* n.n. ♂. A, eyes × 9, B, palp, C, cheliceral teeth, D, claws leg I, E, ditto leg II, F, ditto leg III, G ditto leg IV.

Sternum. Oval, a little longer than wide, 3·5 mm. by 3·0 mm., blackish red, with concolorous hairs. Sigilla, 4 pairs, second pair subdivided, fourth pair large, oval, and well away from margins.

Maxillae. 2·8 mm. long by 1·6 mm. wide, with black hairs on disc, numerous small incipient spines and a scopula of long reddish hairs; colour dark reddish black.

Legs. 1·4·2·3. Shining black, light brownish scopula on tarsi and metatarsi of III and IV; trichobothria on all legs from patella to tarsus. Tarsal claws 3, upper with 3–9 teeth, dissimilar; lower with 2–3 teeth (cf. fig. 4D–G).

Palpi. Black, clothed with long black hairs. Genital bulb black, spiral; stigma rather less than half length of tibia, red basally, black apically.

Spines. Patella to tarsus of all legs with many long strong spines ventrally, those on tarsus and metatarsus of III and IV lateroventral. Patella I and III with short, curved, forwardly directed spines forming an accessory rastellum.

Abdomen. Greyish black with concolorous long hairs dorsally and ventrally; in front of epigastric furrow concolorous.

Spinnerets. Four, superior 1·5 mm. long, inferior 0·6 mm.

Loc. Western Australia: Darkan, 25–565; Williams, 38–2232; Pithara, 31–903; Mundaring, 28–625; Toodyay, 28–678.

5 specimens.

MISSULENA REFLEXA Rainbow and Pulleine 1918.

Australian Trap-door Spiders, Rec. Austr. Museum, 1918, xii (7), p. 87, pl. xxi. fig. 33, 34.

Text fig. 5A–G.

Redescription of Type specimens.

♂ Total length (excluding chelicerae and spinnerets)	9·5 mm.
Length of Cephalothorax	5·2 mm.
Width of Cephalothorax	5·5 mm.
Length of Abdomen	5·5 mm.
Width of Abdomen	5·1 mm.

Lengths of leg and palpal segments in millimetres.

	Femur.	Patella.	Tibia.	Metatarsus.	Tarsus.	Total.
Leg I	5·0	2·3	3·2	2·7	2·0	15·2
Leg II	4·0	2·2	2·7	2·5	2·0	13·7
Leg III	3·5	2·2	2·7	2·5	2·0	12·9
Leg IV	4·2	2·2	2·6	2·6	2·3	13·9
Palp.	4·7	2·5	4·3	—	1·2	12·7

Width of 1st patella at "knee" 1·0 mm.; tibial index 18·2.

Width of 4th patella at "knee" 1·2 mm.; tibial index 25·0.

Carapace. Broadly ovate, shining, truncate in front, 5·2 mm. long, 5·5 mm. wide, rear margin somewhat incised. Thoracic fovea deep medially, and strongly procurved (given as recurved by R. and P.), a deep longitudinal furrow from middle of fovea to posterior margin, radial furrows distinct, margins thick and

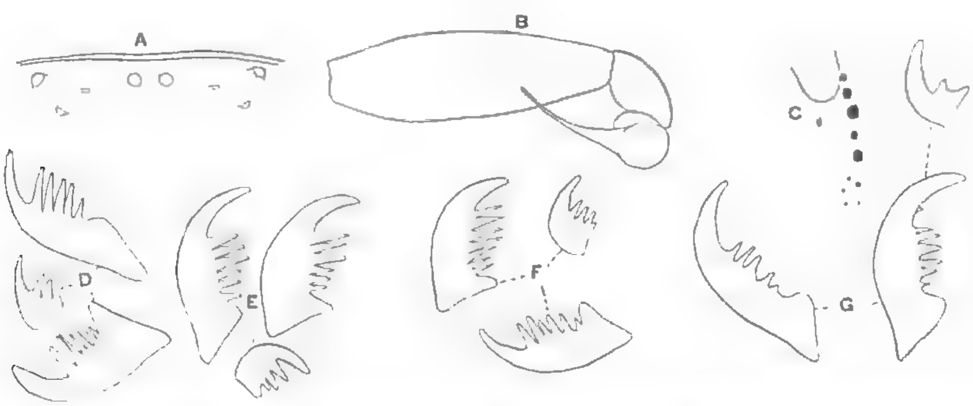

Fig. 5. *Missulena reflexa* R. and P. ♂. A. eyes × 9, B. palp, C. cheliceral teeth, D. claws leg I, E. ditto leg II, F. ditto leg III, G. ditto leg IV.

reflexed. Pars cephalica 2·0 mm. high, 2·6 mm. long, bright red, rugose, with a longitudinal depressed line from centre of ocular area. Clypeus concolorous, sinuous, medially as wide as 1 AME diam. and about 2 diameters away therefrom, with a few reddish hairs in front of AME. Pars thoracica chocolate brown finely granular, margin reddish, a few hairs on margins.

Eyes. Ocular area wider than long, 3·0 mm. by 0·7 mm. AME on slightly raised prominence, each eye 0·2 mm. diam. and 1 diameter apart. Anterior row slightly procurved, rear row recurved. ALE inclined, oval, only slightly raised, 0·2 mm. diam., 1·0 mm. from AME. PLE oval, inclined, about as pedunculate as ALE, 0·1 mm. diam., 2·2 mm. apart, and 0·5 mm. from ALE. PME 0·1 mm. diam., broadly oval, 1·5 mm. apart, in line with posterior edge of AME.

Chelicerae. Basal segment 3·8 mm. long, concolorous with pars cephalica, shining, hairy with transverse striations, rastellum of 16–20 fairly long spines, dark red, in two or three rows. Fangs darker in colour, curved, 2·5 mm. long; promargin with 7 teeth, 2 large and 5 small; retromargin with 3 small as in figure; with scopula of reddish hairs.

Labium. Longer than broad, 1·2 mm. by 0·7 mm., sides tapering, apex rounded, without spines, red in colour.

Maxillae. 2·0 mm. long by 1·7 mm. wide, red, with scopula of reddish hairs, but no spines.

Sternum. As wide as long, 3·0 mm., reddish yellow in front, a little darker behind; sigilla distinct, 4 pairs, away from margins; posterior large, oval, anterior small; clothed with long reddish black hairs.

Legs. 1·4·2·3. (R. and P. say 4·1·2·3). Chocolate brown in colour, shining. Tarsal claws 3, superior claws with 5–7 teeth, inferior claw with 1–3 teeth.

Palpi. Chocolate brown in colour, with brownish hairs. Genital bulb reddish (fig. 5B), stigma lighter in colour, slender, curved, ⅖ length of tibia.

Spines. Spination of leg-segments much as in other members of the genus.

Abdomen. Ovate, arched and slightly overhanging base of cephalothorax dorsally, clothed with long black hairs, colour as given in the original description, with a light yellowish patch anteriorly. Anterior of epigastric furrow and posterior booklungs concolorous with sternum.

Spinnerets. Four, concolorous with venter of abdomen, superior 1·0 mm. long, inferior 0·4 mm. long.

Loc. Type from Keith, South Australia. Australian Mus. Coll., K 40832.

MISSULENA BRADLEYI Rainbow.

Studies in Australian Araneidae, No. 6. The Terretelariae, Suppl., Rec. Aust. Museum, 1914, x (8), pp. 267–270, fig. 73–75.

Text fig. 6A–N.

Redescription of type specimen aided by additional material.

♂ Total length (excluding chelicerae and spinnerets)	10·5 mm.
Length of Cephalothorax	6·0 mm.
Width of Cephalothorax	7·0 mm.
Length of Abdomen	6·0 mm.
Width of Abdomen	5·0 mm.

Lengths of leg and palpal segments in millimetres.

	Femur.	Patella.	Tibia.	Metatarsus.	Tarsus.	Total.
Leg I	4·7	2·2	3·0	2·7	1·5	14·1
Leg II	4·5	2·2	3·0	2·5	1·3	13·5
Leg III	4·2	2·2	3·0	2·5	1·5	13·4
Leg IV	4·7	2·5	3·0	3·0	1·6	14·8
Palp.*	4·0	2·2	3·5	—	1·6	11·3

Width of 1st patella at "knee" 1·4 mm.; tibial index 26·9.

Width of 4th patella at "knee" 1·5 mm.; tibial index 27·3.

* Rainbow (*loc. cit.*) p. 269 gives the dimensions in mm. of the palpal segments as: "trochanter 10·2; patella and tibia 9·8; radial joint 1; total 21", thus making the palp considerably longer than the legs; which is not the case in the type or in 3 other male specimens.

Carapace. Broadly ovate, shining, truncate in front, 6·0 mm. long, 7·0 mm. wide, rear margin slightly incised. Thoracic fovea deep medially and strongly procurved, radial furrows distinct, a deep longitudinal furrow from middle of fovea to posterior margin, margins reflexed. Pars cephalica 3·0 mm. high, 3·7 mm. long, not black (Rainbow) but a very dark chocolate brown, no trace of red; with a fine longitudinal groove from behind ocular area, surface finely granular. Clypeus reddish, about half the width of one AME and separated therefrom by one AME diameter, with 3 or 4 long black hairs in front of AME. Pars thoracica concolorous with pars cephalica and similarly slightly and finely granular, apparently without hairs.

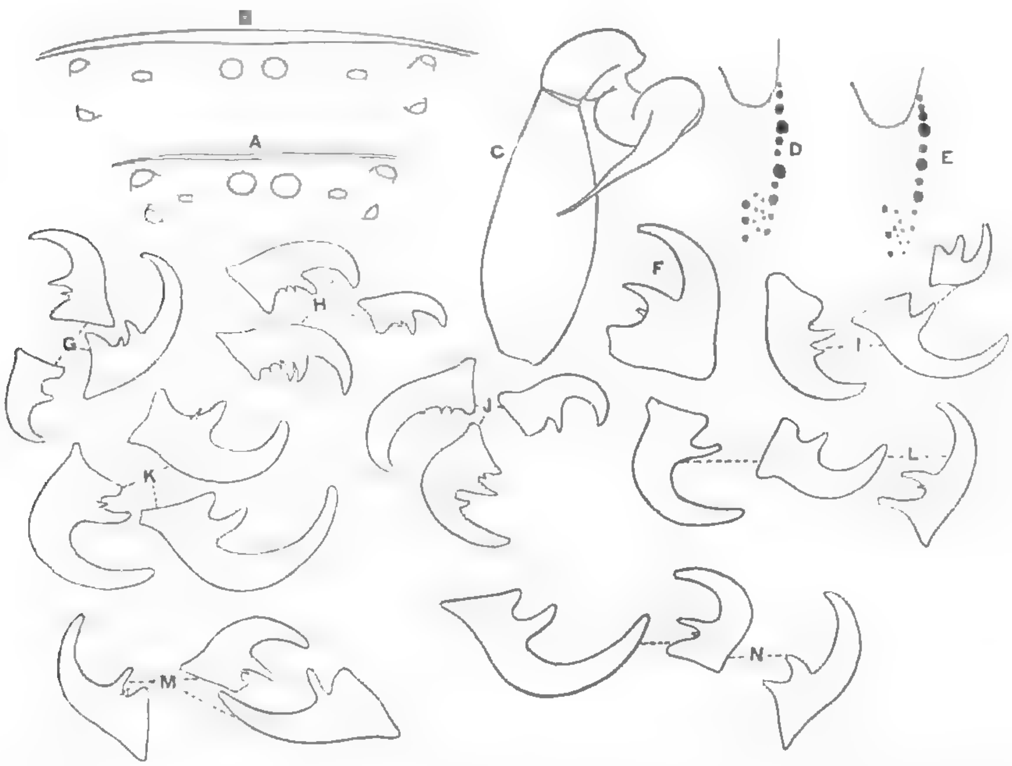

Fig. 6. *Missulena bradleyi* Rainbow. A. eyes of ♂ × 9, B. eyes of ♀ × 9, C. palp of ♂, D. cheliceral teeth ♀, E. ditto ♂, F. claw of palp ♀, G. claws of leg I ♂, H. ditto leg II, I. ditto leg III, J. ditto leg IV, K. claws of leg I ♀, L. ditto leg II, M. ditto leg III, N. ditto leg IV.

Eyes. Ocular area much wider than long, 3·8 mm. by 0·8 mm. AME on slightly raised prominence, each eye 0·37 mm. in diameter, round, and half a diameter apart. Anterior row of eyes slightly procurved, posterior row recurved. ALE inclined, oval, raised 0·3 mm. in diam. and separated from AME by 1·0 mm. PLE oval, raised, inclined, 0·25 mm. diam., 2·6 mm. apart, and 0·4 mm. from ALE. PME 0·2 mm. long, oval, long diam. in line with posterior edge of AME, 0·37 mm. from AME.

Chelicerae. Basal segment 4·5 mm. long, concolorous with cephalothorax, shining, with fine transverse striations, rastellum with 5–6 spines of same colour. Fangs concolorous, 2·2 mm. long, curved, promargin with 3 small gradually increasing teeth, then 3 large, followed by 2 medium and 20 small teeth, retromargin with only 3 small teeth near base, a few small tuberosities between margins, with slight scopula.

Labium. Longer than broad, 1·5 mm. by 1·2 mm., sides tapering, apex rounded, with brown hairs, and only incipient spines apically; colour rather light chocolate brown.

Maxillae. 2·0 mm. long by 1·7 mm. wide, with scopula of brown hairs, and on inner basal angle a few incipient spines. Colour light chocolate brown.

Sternum. 3·0 mm. long by 3·0 mm. wide. Light chocolate brown with brownish hairs. Sigilla distinct, 4 pairs, posterior large, oval, well separated from margin, anterior small, second pair entire.

Legs. 4·1·2·3, chocolate brown in colour; scopulae on tarsi and metatarsi III and IV, trichobothria on all tibiae, tarsi and metatarsi. Tarsal claws 3, superior claws with 2–4 teeth, some often very small (cf. fig. 6G–J), inferior claw with 1–2 teeth, second tooth if present, small.

Palpi. Chocolate brown with brown hairs. Genital bulb concolorous (fig. 6C), stigma slender, rather less than half length of tibia, darkened towards apex.

Spines. A distinct pad of many spines on distal inner half of patella I and III. A few in same position on leg II, none on IV; tibia, metatarsus and tarsus of all legs with a number of strong spines ventrally, those on tarsus and metatarsus of III and IV latero-ventral.

Abdomen. Ovate, arched, slightly overhanging base of cephalothorax, dorsally dark chocolate brown with minute yellow spots and on anterior half a large patch of bluish grey or yellow; sides concolorous with posterior portion of dorsum; dorsum with short spine-like hairs, interspersed sparsely with longer hairs; venter dark chocolate brown, with long hairs, and also spotted with yellow; in front of the epigastric furrow and the posterior booklungs strongly chitinized and concolorous with the sternum and legs.

Spinnerets. Four, light yellowish chocolate brown; superior 1·2 mm. long, 3 segmented, basal segment the longest, apical very short; inferior 1-segmented, thin, 0·5 mm. long.

♀ Total length (excluding chelicera and spinnerets)	15·0 mm.
Length of Cephalothorax	7·2 mm.
Width of Cephalothorax	8·0 mm.
Length of Abdomen	9·3 mm.
Width of Abdomen	9·0 mm.

Lengths of leg and palpal segments in millimetres.

	Femur.	Patella.	Tibia.	Metatarsus.	Tarsus.	Total.
Leg I	4·0	2·4	2·1	1·9	1·4	11·8
Leg II	3·8	2·8	2·2	2·0	1·5	12·3
Leg III	4·7	3·0	2·1	2·1	1·6	13·5
Leg IV	5·2	3·1	2·9	2·9	2·4	16·5
Palp	3·5	1·8	2·0	—	2·0	9·3

Width of 1st patella at "knee" 1·5 mm.; tibial index 33·3.

Width of 4th patella at "knee" 1·8 mm.; tibial index 30.

Carapace. Broadly ovate, shining, slightly wider than long, 7·2 mm. wide, 8·0 mm. long, truncate in front, incised in posterior margin. Thoracic fovea deep medially, strongly procurved, radial furrows distinct, longitudinal furrow from middle of fovea not so evident as in ♂, margins reflexed. Pars cephalica 4·0 mm. high, 4·6 mm. long, chocolate brown in colour, somewhat lighter at margins; with a few brown hairs in front of ocular area and scattered on disc. Clypeus whitish, as wide as the diameter of one AME and separated therefrom by the same distance. Pars thoracica smooth, shining, concolorous with pars cephalica, but a shade lighter, especially on margins.

Eyes. Ocular area very much wider than long, 4·7 mm. by 1·2 mm. AME almost sessile; each eye 0·25 mm. in diam., round, one diameter apart, each eye surrounded by dark pigment. Anterior row slightly procurved, posterior row recurved. ALE slightly reclined to horizontal, raised, 0·25 mm. in diam., base dark pigmented, separated from AME by 1·7 mm. PLE 0·25 mm. diam., raised, oval, inclined, 3·9 mm. apart and 0·6 mm. from ALE. PME 0·25 mm. diam., oval, 0·85 mm. from AME.

Chelicerae. Basal segment 6·0 mm. long, concolorous with cephalothorax, shining, with fine transverse striations, with slight scopula of brown hairs, rastellum with 10–12 short spines of same colour. Fangs a little darker, especially towards the tip, 4·0 mm. long, curved; promargin with 3 gradually increasing teeth, then 1 large, 2 small, 1 large, 1 small, 1 medium, then 2 small teeth; retromargin with only 3 small teeth near base, and a few tuberosities between.

Labium. Longer than broad, 2·5 mm. by 2·0 mm.; sides tapering, apex rounded, with about 20–30 short stout spines; with long brown hairs. Colour, chocolate brown.

Maxillae. 3·2 mm. long, 2·7 mm. wide, with scopula of brown hairs and on inner angle a number of stout spines. Colour as for labium.

Sternum. 4·5 mm. wide and 4·5 mm. long. Colour yellowish chocolate brown. Sigilla in 4 pairs, away from margins, posterior pair large, oval; anterior small, second pair entire.

Legs. 4·3·2·1, yellowish chocolate brown in colour, dorsally rather darker. No tarsal and metatarsal scopulae; trichobothria on all tibia, tarsi and metatarsi; tarsal claws 3, superior claws with one large inner tooth, and usually a very small fine tooth in the inner angle of the large tooth; inferior claw similar. Hairs brownish.

Palpi. Concolorous with the legs; clothed with brownish hairs. Tarsus with single claw with large inner tooth, ventrally with strong spines in distal half.

Spines. Patella I and II without spines, III and IV with a few on the distal outer side; tibia III and IV with 2 dorsal subapical spines, metatarsi III and IV with 3–4 dorsal subapical spines, tarsus of all legs with ventral spines.

Abdomen. Ovate, arched, overhanging base of cephalothorax, dull chocolate brown in colour with a number of fine yellow spots but without the bluish grey anterior patch of the male, although this area is indistinctly indicated by a change in the corrugations or striations of the cuticle. With short spines arising from tubercles, and long fine hairs brown in colour. Venter except for the posterior booklungs concolorous with abdomen. Anterior of the epigastric furrow, and also posterior booklungs, concolorous with sternum and legs, a yellowish chocolate brown, strongly chitinized.

Spinnerets. Four, light yellowish brown. Superior 2·5 mm. long, 3-segmented and stout, inferior 1·0 mm. long, 1-segmented, thin.

Loc. Allotype ♀. Willoughby, N.S.W., Feb. 1928, Aus. Mus. Coll., K 57495. ♂ ♂ K 36151 (holotype); Wahroonga, 4/27 K 56174; N. Sydney, K 38153; K 62340; Eastwood, K 36064.

5 specimens.

KEY TO THE SPECIES OF *Missulena* Walckr.

♂♂

1. Abdomen dorsally with a light bluish or yellowish patch anteriorly, or entirely cinnamon yellow .. .. 2.
   Abdomen dorsally entirely dark coloured .. .. 3.
2. AME large in proportion to length of ocular area, separated by ½ an eye diam., and from PME by 1 diam. Superior claws of legs with not more than 4 teeth. Pars cephalica a dark chocolate brown without any trace of red. Abdomen dark with anterior bluish or yellowish patch. *M. bradleyi* Rainbow 1914.
   AME small in proportion to length of ocular area, separated by 1 eye diam. and from PME by 2½ diam. Superior claws of legs with 5–7 teeth. Pars cephalica bright red. Abdomen entirely yellow. *M. reflexa* R. and P. 1918.
3. Pars cephalica entirely bright red .. .. 4.
   Pars cephalica entirely black or with only a trace of dark red anteriorly. .. .. 5.
4. Pars thoracica, legs and generally, a light chocolate brown with slight purplish tinge. AME separated by 1 eye diam., and from PME by 3 diam., surrounded with black pigment. Superior claws with 5 teeth. Labium and maxillae entirely without spines, even incipient ones. Promargin of chelicerae furrow with 3–4 large and 6 small teeth. *M. insigne* (Cambr. 1877).
   Pars thoracica, legs and generally, black. AME separated by 1 eye diam., and from PME by 2 diam. Superior claws with 4–6 strong teeth. Labium and maxillae with short but distinct spines. Promargin of cheliceral furrow with 8–9 large teeth. *M. occatoria* Walckr. 1805.
5. Pars cephalica strongly rugose, almost tuberculate, entirely black. AME separated by 2 eye diam., and from PME by 2½ diam. Superior claws with 8–10 teeth. Labium and maxillae with short stout spines. Promargin of cheliceral furrow with 6–7 large and 2–3 small teeth. *M. granulosa* (Cambr. 1870).
   Pars cephalica less rugose, anteriorly with a tinge of dark red. AME separated by 1 eye diam. and from PME by 3 diam. Superior claws with 3–8 teeth. Labium and maxillae with numerous but incipient spines. Promargin of cheliceral furrow with 3 large and 7–8 small teeth. *M. hoggi* nom. nov.

♀♀

1. Basal segment of chelicerae, and anterior part of pars cephalica at least, reddish but not a bright red. Legs, pars thoracica and generally, a light chocolate brown with purplish tinge. AME separated by 2 diam. Superior claws with 1 large tooth, and sometimes a small one in inner angle. Palpal claw with trifurcate tooth. Promargin of cheliceral furrow with 4–5 large and 5–6 small teeth. *M. insigne* (Cambr. 1877).
   Basal segment of chelicerae and pars cephalica concolorous with pars thoracica. .. 2.
2. Eyes relatively small. PME very much nearer laterals than to AME, latter 2 diam. apart and 10 diams. from PME. Palpal claw with strong, basally trifurcate tooth. *M. occatoria* Walckr.
   Eyes relatively larger. PME about midway between AME and the laterals. .. 3.
3. AME 1 diam. apart and 3 diams. from PME. Palpal claw with 1 large simple tooth with accessory small tooth. *M. bradleyi* Rainbow 1914.
   AME ¾ diam. apart and 5 diams. from PME. Palpal claw with large 3-pronged tooth. *M. granulosa* (Cambr. 1870).

SOME ABORIGINAL STONE IMPLEMENTS OF WESTERN AUSTRALIA

BY H. V. V. NOONE, F.R.A.I.

Summary

In collaboration with the Director of the Perth Museum, Mr. L. Glauert, the collection there of stone implements found in Western Australia has been studied and classified. A short account of many of the specimens is now given to make known the various types represented, and the localities wherein they were found. Sketches in outline of some of the specimens are shown.

SOME ABORIGINAL STONE IMPLEMENTS OF WESTERN AUSTRALIA[1]

By H. V. V. NOONE, F.R.A.I.

Fig. 1–31.

In collaboration with the Director of the Perth Museum, Mr. L. Glauert, the collection there of stone implements found in Western Australia has been studied and classified. A short account of many of the specimens is now given to make known the various types represented, and the localities wherein they were found. Sketches in outline of some of the specimens are shown.

The Australian Aboriginal has been referred to on occasion as a sort of savage survival of the horrid past, in fact, no credit to his Maker. Those, however, who study him will find ample evidence that in his own sphere his intelligence and character are of no mean order. He can lay claim to being one of the most successful human examples of environmental adaptation, in fact so intimate is his association with his familiar surroundings that too often he does not survive when deprived of them. It is a great pity this fact has not been realized always and that he was not left alone to follow his own destiny.

Other peoples of the world have made use of some sort of throwing stick, but the Australian aboriginal has gone much further, for he has evolved a weapon of specialized and varied form and armed himself with a projectile that he can use effectively against the largest of the animals which he encounters. There are some who would deny him the invention of this remarkable weapon, the boomerang, but they could not filch from him the credit of having developed the idea to its perfection.

The aborigine's work in stone also testifies to his resourcefulness and dexterity. It is remarkable that, almost without exception, there is no way of producing tools and weapons from stone, practised by the primitive people of the rest of the world, that was not used by the Australian aboriginal.

Man's simplest method of fracturing stone into shape, knapping, may be outlined thus: after selection of a suitably shaped pebble of flakeable material another is found of sufficient weight and convenient form to use as a striker. A well placed flattish spot (striking platform) on the pebble having been found, or made, a smart blow with the striker is delivered there in an outward direction and at a slightly acute angle. A flake is thus detached, and by such blows, repeated on selected spots, sometimes it may be on the scar left by a previous flake struck off, the unwanted portions of the pebble are knapped off until the desired shape, a "core-implement", such as say an axehead, is eventually produced. Less severe knocks are employed to regularize and sharpen the edge (i.e. secondary work or trimming). The pebble when knapped may be held, or embedded, in one hand, or rested on a rock, or the striking stone may be dispensed with and the pebble itself carefully struck upon a rock or stone anvil. Of the flakes detached in producing the core implement some may be suitable for service as knives, etc. Should such flakes or "blades" (distinguishable from a flake by being over twice as long as broad and having comparatively regular side margins), be specially required, the worked-on

(1) The main part of this paper was communicated to the Royal Society, Western Australia, at its meeting held on 10th March, 1942.

face of the pebble selected as nucleus is carefully prepared, and off this the required kind of flake or blade is knapped. In this case a wide striking platform is first prepared at a favourable angle, and this base is used to prepare the worked-on face of the nucleus. Some of the famous quartzite knife blades, and spearheads, of the Northern Tribes of Australia prove to have been the direct product of only three knapping blows, one each forming the two faces that flank the midridge, and a final blow detaching the pointed piece from the nucleus. Though the material commonly used is a favourable medium, such superb examples of knapping skill, as are some of these quartzite blades, can hold their own against the craftsmanship of any of the world's stone workers. One of these blades in the Adelaide Museum measures 27 cm. in length, probably was 27·50 as the tip is broken off. Among the microlithic implements also may be found excellent examples of fine knapping and trimming work done on selected material. The casual and every-day work, however, of some of our stone-using aborigines of to-day, may not go beyond striking a selected part of a pebble, or stock-core, until a piece comes off that will serve the purpose of the cutting or incising to be done, and if the edge is robust enough the flake is used untrimmed.

The trimming or secondary working which shapes, regularizes, and during use re-edges, certain parts of the stone, especially the working edge, is usually done by carefully repeated taps on, or with, a small pebble, piece of bone, or hard wood, the stone implement sometimes being bedded in the palm of the other hand, and in the case of the "tula", or flake-adze, the stone may be overturned in the gum setting so as to be at right angles to the handle, being returned to lie axially after re-edging. The use of a stone applied sharply against the edge of the implement, much as in the way that a rasp is applied, may be one of the methods employed in trimming. On occasion some aborigines will use their teeth to bite off small scales to shape, or re-edge, their stone implement. The various kinds of trimming are called abrupt, long, channel, step, nibbled, serrated, etc. In place of tapping, that is percussion, the force used in trimming and secondary work by certain of the Northern tribes is pressure. This method has been highly specialized in the Kimberleys to produce the well known biface-worked knives and spearheads from stone, glass and porcelain. This process is usually carried out by means of a piece of bone or hardwood grasped in one hand, the pointed end being applied by heavy body pressure at carefully selected spots on the margin of a piece of stone (such as a knapped-off quartzite blade, if necessary already worked into rough shape by percussion) which is held in place on a pad. A variation of this is to forcibly press the stone blank itself upon a hardish substance, such as a large bone, used as a kind of anvil. The fine serrations seen on many of these Kimberleys pieces are made by pressing with a finely pointed bone, or when available wire. Some of the fine attenuated points of these pieces are evidence of very deft and painstaking work.

In the north-eastern part of Western Australia there is also practised another method of shaping stone to form a working edge. This is a grinding process, and it produces a more robust and lasting edge than by the older method of knapping and trimming only, besides enabling the utilization of such tough stone material as will not satisfactorily flake to form a good edge. After roughly knapping the pebble into the required shape the actual working edge is obtained by prolonged rubbing on a wetted block of sandstone or similar rock. This labour, however, is seldom carried on by the aboriginal beyond sufficient grinding on both faces to form and sharpen the actual working edge, and smooth off the surface immediately adjacent. (Such pieces may therefore be conveniently distinguished by calling them "edge-ground"). Nevertheless, such restriction left the axe, or knife, quite efficient for the work required of it, and considering the roaming, hunting and ceremonial demands upon an aboriginal's time, further labour could be extravagant.

There are certain pieces, rare in Western Australia, brought in from tribes farther east, which show another process used in working at a pebble in addition to forming the edge by grinding. This method is pecking, or hammer dressing, and is apparently done by crushing off small fragments from a selected pebble, by blows with a suitably shaped tool such as a stone with a prominent strong point on its surface. The blows are directed into the body of the piece resulting in the pecking out of many small pits which serve to both level and shape the surface of the implement. Such a method is well suited to coarse material that will not satisfactorily flake, as also when a rounded surface on the body of the implement is required, and to roughen the smooth pebble face, providing a better hold for hand or haft.

Apart from our want of knowledge as to the actual purpose for which some of the specimens referred to below were produced, many of them have most probably been employed for more than one kind of work. In consequence, nomenclature in vogue for our modern specialized tools has as far as possible been avoided. It is believed that the most satisfactory term for a stone implement is one which makes familiar its form (in some cases size) and method of production.

Leaving aside the ubiquitous milling stones, pounders, etc., the most diverse group of stone implements in the Museum collection comes from:

KIMBERLEYS AREA.

Characteristic types are:

I. (a) Ovate (fig. 1) and (b) cordiform (fig. 2) biface-worked pieces. They are of archaic form but it is not certain that these specimens were not to be finished off by edge-grinding.

II. Some very well made discoidal cutting flakes.

III. Denticulated biface spearheads (a) squat (fig. 3), (b) narrow (fig. 4–5) and (c) miniature (fig. 6). These forms are very probably of an early type.

IV. Biface-worked lanceolate spearheads in (a) coarse (fig. 7), (b) bay-leaf, (c) narrow (fig. 8) and (d) squat (fig. 9) varieties most of which show rounded bases and serrated side margins, a few specimens being also denticulated towards the butt end. One piece shows the pressure trimming on one face only, and a similarly treated piece is in form like a "pirri" point (fig. 9), with the plain or inner face edge-trimmed.

V. Edge-ground axes have been classified by form into (a) ovate, (b) ellipsoidal, (c) rectangular, (d) pick, (e) narrowed butt and (f) miniature. The ellipsoidal is the commonest type, then the ovate and pick. There are also decorated axeheads, one of which is 23·25 cm. in length, produced by pecking and grinding a well-shaped pebble, and is said to have been used for ceremonial purposes. This comes from Hall's Creek, where the pecking technique is not one of the methods employed for working on a stone implement, and it is possible this fact made this particular piece suspect as a spirit production invested with mysterious potency. In the circumstances special ceremonial handling and control by the experienced elders of the tribe may have been thought expedient.

Small edge-ground cutting tools, some handled in gum, are also reported from this area.

VI. There are two special axe pieces (fig. 10–11), and possibly a third (fig. 12), found in this region which show "alien" affinities. The uncommon aspect due to the all-surface grinding, the fashioning of the edge by a bevel, and the

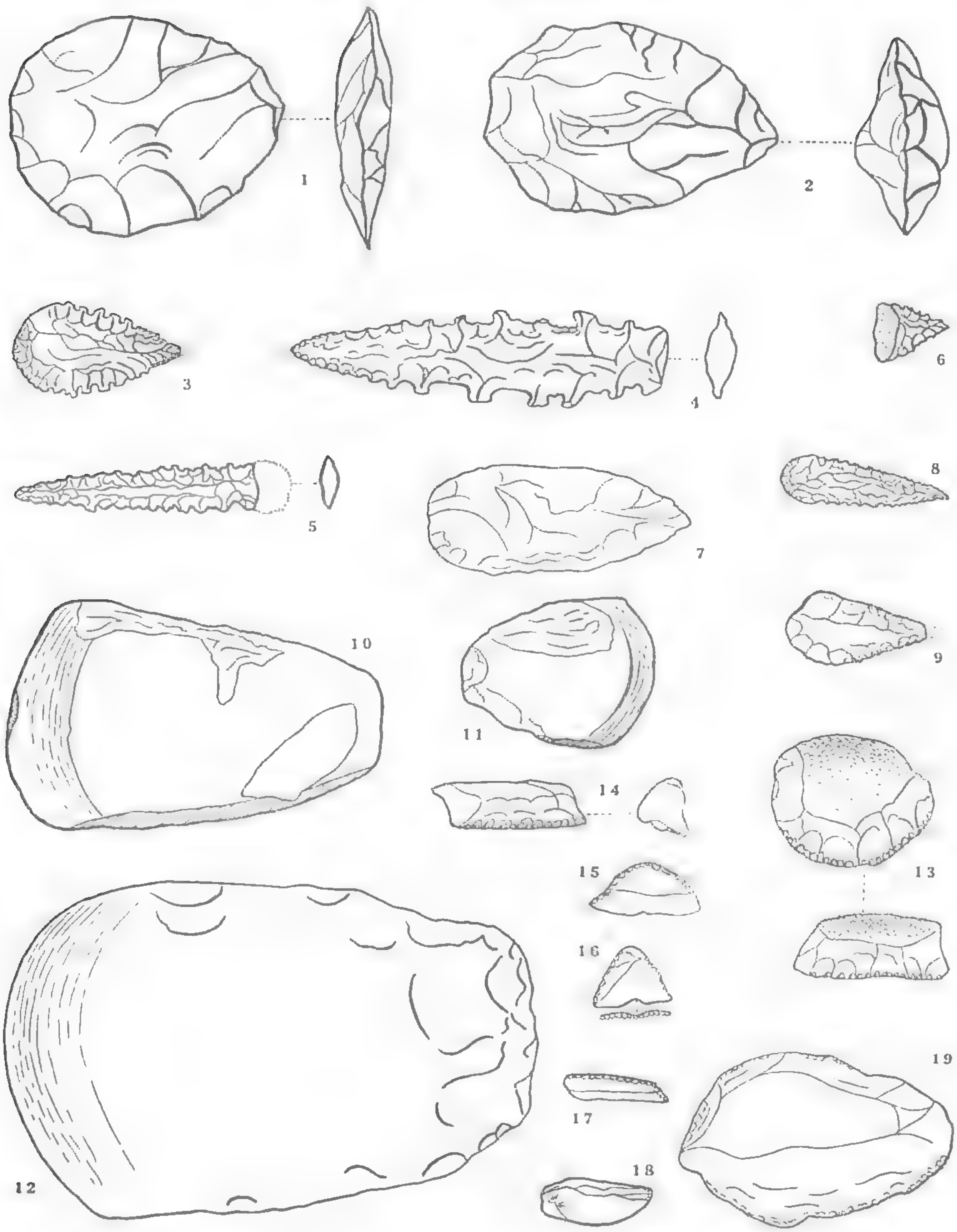

Fig. 1–19.

1. Ovate biface, Kimberleys. 2. Cordiform biface, Kimberleys. 3. Squat denticulated biface spearhead, Kimberleys. 4. Narrow denticulated biface spearhead, Kimberleys. 5. Narrow denticulated biface spearhead, Kimberleys. 6. Miniature denticulated biface spearhead, Kimberleys. 7. Coarse lanceolate biface spearhead, Kimberleys. 8. Narrow lanceolate biface spear head, Kimberleys. 9. Squat uniface spearhead, Kimberleys. 10. Axe, Napier Range, No. 10406, collected 1887. 11. Axe, Grant Range, No. 10415. 12. Axe, unknown locality. 13. Discoidal flake, Canning Stock Route. 14. Steep sided "Slug", Canning Stock Route. 15. Segment, Millstream Station. 16. Triangle, Millstream Station. 17. Oblique point, Millstream Station. 18. Burinate form, Millstream Station. 19. Large trimmed flake, Shark Bay.

(All drawings one half natural size.)

more or less squaring-off of the side margins, is more in keeping with a foreign (viz. Indonesian) facies. These and three pieces from the South-West area, together with some other pieces reported by D. S. Davidson, and some of similar unorthodox form in the Museums of the other States, require special study. This merely serves to put these Western Australian specimens on record. It is suggested by L. Glauert that the possibility of foreign pieces having been introduced by white residents, who acquired them as curios, should not be overlooked.

TOBIN LAKE AREA.

From the Canning Stock Route, between wells 24 and 48, come some thick discoidal flakes (fig. 13) and a few thinner which could have been used as flake-adzes. A well knapped-off blade is a kind of saw-knife, and there is a steep sided "slug" form (fig. 14) somewhat like a worn adze-flake, though there seems to be barely enough material left behind the edge to hold in the gum setting.

WEST PILBARA AREA.

A very interesting collection has been made by K. S. Newall at Millstream Station on the Fortescue River. This comprises mostly well made microliths (about 3 cm. and less in length). As with these small tools found in other parts of the world geometrical forms occur, some rounded such as segments (fig. 15) and others angular such as triangles (fig. 16). There are also several coarse and fine abrupt-trimmed bladelet points (sometimes called scarifiers, lancets, backed or chipped-back knives, Sydney and Bondi Points), one of which is trimmed obliquely (fig. 17). The occurrence of these narrow pointed bladelets in this area is puzzling because they are rare in the similar microlithic industry of South Australia, where the pressure formed leaf-shaped pirri point (somewhat like No. 9) is the outstanding piece. Those points which are found in that area to be abrupt-trimmed are often comparatively broad, in fact they more nearly approach the pirri form and proportion of width to length. The Adelaide abrupt-trimming seems to have been employed to utilize an ill-formed blade and make it symmetrical like the pirri, the actual point-tip being brought as near as possible to the line of the longitudinal axis. It is almost invariably trimmed only from one face, and not from both faces as so often seen on the Eastern (Bondi) point. Points like the Millstream specimens are found in quantity in both Victoria and the coastal area of New South Wales from which the pirri is absent. It would seem that a pressure-formed pirri point industry has cut across that of an abrupt-trimmed bladelet, whilst there seem to be indications that an adze-flake industry has penetrated the middle part of Western Australia from the East, or North East.

Outside Australia no such comparable microlithic industry of definite forms has been so far reported from New Guinea, Dutch East Indies or Malaya, but in Ceylon are found various geometrical microliths such as segments, triangles and trapezoids beautifully made in clear rock crystal (Noone, N. A. and H. V. V., 1940). In spite of some seven almost identical micro types found in Australia and Ceylon there seem to be no grounds for explaining this as due to diffusion. Hale and Tindale (1930) have found microlithic implements at Devon Downs shelter at a depth of nearly five metres in undisturbed deposit. The modern Australian and Ceylon aborigines are reported as knowing nothing about these small implements or their uses. It is not impossible that some of the geometrical forms were assembled in a composite weapon like the chip-barbed "death-spear", used up to recent times in Western and South Australia and New South Wales, or as a tool like the quartz-chip saw-knife, both of which could be crude survivals. The localities where

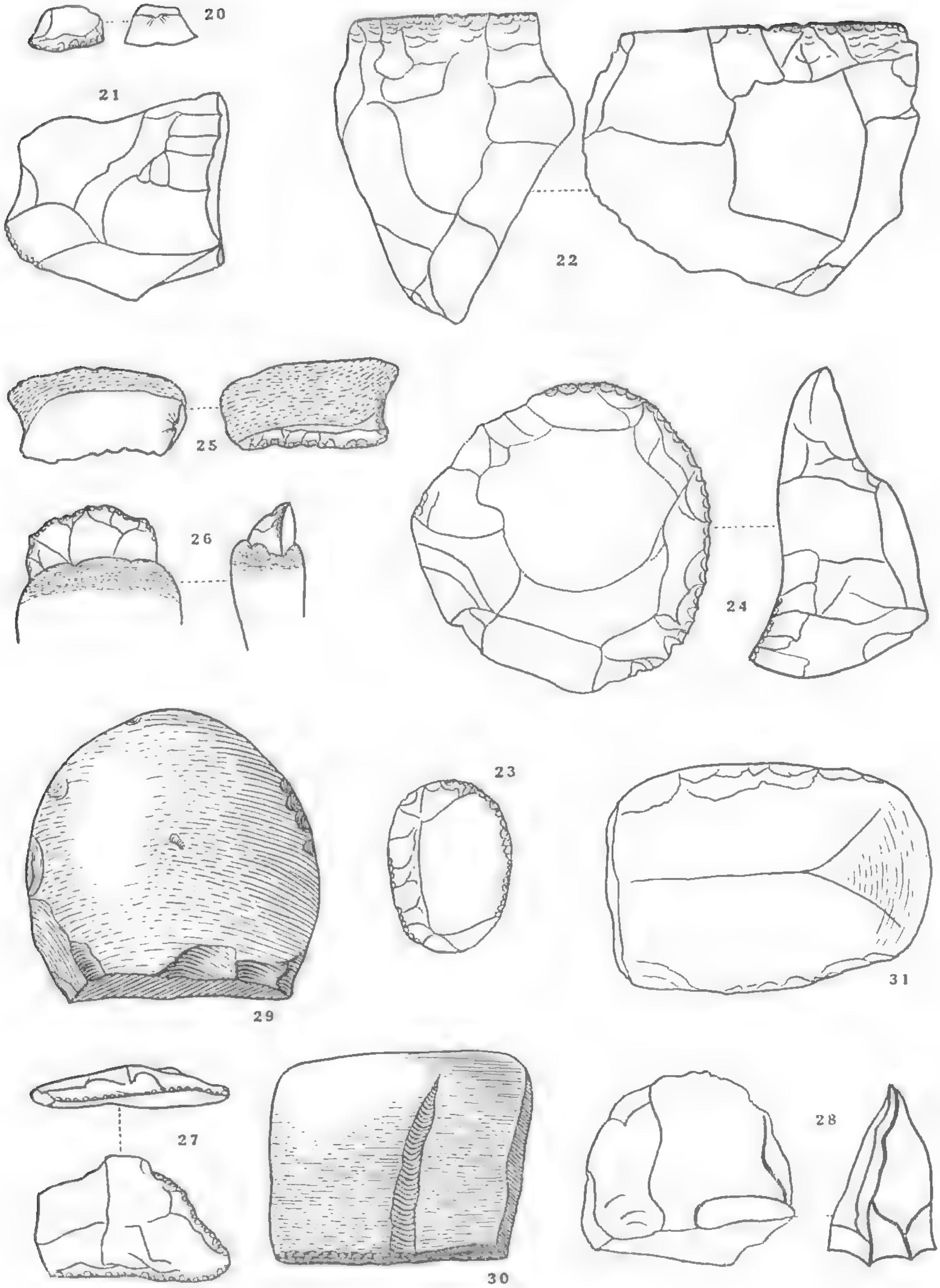

Fig. 20–31.

20. Small adze-flake, Shark Bay. 21. Prismatic nucleus, Murchison River. 22. Horsehoof, Murchison River, 8372. 23. Trimmed oval flake, Beria. 24. Arapia, Pallinup River. 25. Loose Elouera-like adze-flake, Ashburton River. 26. Loose tula adze-flake, near Perth. 27. Subtriangular Adelaide adze-flake, Morphett Vale, South Australia. 28. Blade of W.A. flaked-hatchet, Rushy Pool, No. 10067. 29. Fully ground axe, Chidlows Well, No. E596. 30. Lightly ground axe, Lake Magenta, No. 10492. 31. Semi-ground axe, Dinninup, No. 10063.

(All drawings one half natural size.)

the microliths are found roughly correspond with those where the "death-spear" was known to be in use. (A definite relationship between the Western Australian "death-spear" and the North Queensland chip-barbed spear appears to me questionable in spite of some similarity. The Queensland saw-knife is made with sharks' teeth and the spear shows similar pointed pieces, that might be copies of the teeth, carefully gummed in to point forward). In France a few authorities think some of the segments and triangles may have been used as fish hooks. The ideal chip used in the West Australian "death-spear" is apparently of somewhat rectangular form with a bevelled cutting edge, the gum employed being of a not very adhesive nature.

In addition to these small micro pieces a concave scraper, a well knapped pointed blade (spearhead?), and an example of what may be called the "burinate" form (fig. 18) were also collected. Similar burinate specimens have been identified by me in South Australia, New South Wales, and Queensland. There are also an end-scraper at end of a blade, and a highback "slug" form, which may be adze-flakes.

SHARK BAY AREA.

Of a few pieces collected here a large trimmed flake (fig. 19), which may have been used for cutting tribal marks, and a small adze-flake (fig. 20) may be noted.

MURCHISON RIVER AREA.

Several particularly interesting specimens have been collected near Milly Milly Station by L. Glauert. There are a few thick discoidal flakes like those from the Tobin Lake Area, and some oval and quadrangular well trimmed pieces which would make good cutting flakes. There is also a kind of prismatic core or nucleus (fig. 21), on which a single common striking platform appears. This is the first core of such a type (which is usually taken to indicate a developed knapping technique) found on this side of Australia. The butt of a prismatic nucleus has recently been found by R. O. Noone in the Vicinity of Peak Hill, Western Australia. Other significant pieces from this area are two examples of the core-like implement known as the "horsehoof" (fig. 22), which is also a type not hitherto found in Western Australia. It would seem that the perfected form of this tool is one having some sort of crest, often showing signs of use, opposed to the flat face such as appears on the piece No. 8372. A variant has a more or less rounded or flat top, some being of tablet form. I am told by H. M. Cooper that at some camp sites in South Australia the stone implements found are almost entirely of the horsehoof and kindred types.

These two specimens bear signs of use as a kind of chopping or mashing implement, their flat faces showing bruised or rounded-off margins. On certain spots on this margin pits may be seen as if some blows had been delivered there with a pick form of striker. One of the functions of this "horsehoof" implement may be use at the edge as an anvil or a hammer, say in breaking bones. It is a characteristic Australian stone implement.

EASTERN GOLDFIELDS AREA.

Several of the specimens from this region would be suitable for use as flake-adzes, whilst a large trimmed flake is similar to the one found in Shark Bay area. There is also a fine well trimmed oval flake (fig. 23).

SOUTH WEST AREA.

Round about Perth and south to the coastal region there have been collected a variety of types. Two specimens are like the implement known as "Arapia" (fig. 24) which may be a kind of heavy hand adze. Fine specimens of this tool were found at Lindum, near Brisbane, and the piece is also well known in Central and South Australia and New South Wales.

Near Caro, west of Moora, Dr. Carroll collected a kind of small abrupt-trimmed point and an oblique trimmed bladelet which perhaps indicate that other microlithic types, such as the geometrical forms, are to be found in this vicinity. This is farther south on this side of Australia than they have been hitherto discovered. (I have since learnt from N. B. Tindale that he has found microlithic pieces in this area, and also at Pallinup and Newman Rocks, including a rough pirri at the latter place.)

In the neighbourhood of Scaddon, near Esperance, has been found a remarkable biface implement in flint, with unfortunately the point broken. This shows dark stained patination, and is in form and appearance strikingly similar to the Lower Paleolithic biface implements found in England. Other special pieces from this area are mentioned elsewhere in this paper.

EUCLA AREA.

From this region comes a cutting flake of light brown flint evidently of material from the deposits in the coastal cliffs some miles east. A hoard of similar flint flakes from this area is in the Adelaide Museum (Tindale, N. B. and Noone, H. V. V., 1941).

Among pieces in the Museum that were found over the border, near Ooldea, is a good example of the small uniface-worked point called "pirri", which is found in quantity in South Australia as far north as the Musgrave Ranges and westward almost to the border of Western Australia. The pirri has been proved by Hale and Tindale to be an early type of implement, being found some 5 metres below the surface in undisturbed deposit (Hale, H. M. and Tindale, N. B., 1930). This Ooldea specimen of an obsolete implement shows the use of a pressure trimming technique such as is even now practised in making the Kimberleys biface spearheads. A relationship between the South Australian pirri point and the working traditions of the Kimberleys craftsmen seems to be definitely indicated.

CONCLUSIONS.

A noticeable feature of the Perth collection is the almost complete absence of large flaked implements such as were made from pebbles in the other States, but this may be due to their being overlooked by collectors, or their inconvenience of transport. Only one specimen is in the collection which might have been used for piercing or boring, a piece from Millstream. Several of the throwing sticks and other weapons in the Museum have been carefully preserved with their stone tools still embedded in the gum. Six of these show that flakes, which are like the New South Wales tool known as the "elouera" (fig. 25), have been made use of for adze, etc., work. It would therefore seem that, on occasion, this type of stone implement, which has its working edge on the side margins, was employed to take the place of the specialized tula (fig. 26) just as any suitable flake with a good enough edge at any part of the margin may be, as is seen in the varied type of adze-flake produced by the Adelaide craftsman (fig. 27). Either the thin or thick margin was perhaps brought into use as circumstances required. The above is not meant to exclude the possibility of the elouera being employed for other work. The range of a form like the elouera is extensive, as I have recognized one in a collection from Bundaberg, Queensland, and another from Stradbroke Island, as also some found by Dr. T. D. Campbell in the South-eastern part of South Australia, and at Ooldea. One was found in the Pirrian level of Devon Downs.

The typical Adelaide adze-flake, as distinguished by N. B. Tindale, who identified it, is usually of irregular quadrangular or triangular form, the main working edge being often straight and formed on the side margins of the flake, not as in the tula at the ends. The tula is a highly specialized discoidal form of adze flake with characteristic broad sloped platform and convex bulbar or inner face, skilfully produced by experienced workmen to be bartered over a wide area. According to a communication from N. B. Tindale, "The most striking feature of the true tula is that it is practically a manufactured article made for trade, of standardized form and size". As a general name for these pieces (i.e. tula, Adelaide, elouera or nondescript stone flake) the term "adze-flake" has been found convenient, and the term "flake-adze" is suggested for the tool when axially mounted in gum at end of stick or spearthrower. This bringing into sevice of a wooden weapon as a handle to provide weight and comfortable gripping surface, together with the reduction of stone material thereby, is ingenious and a good example of intelligent economy of impedimenta. It is a characteristically Australian tool especially in the spearthrower form, a combination apparently never thought of by the peoples of the islands surrounding Australia. It may be mentioned that the spearthrower-cum-flake-adze (the last mentioned functioning as a set of tools in itself) has been reported as occasionally employed for other purposes such as (a) in making fire, (b) as a paddle, (c) a platter or dish, (d) a parrying shield, (e) when notched along margin, and rubbed with a stick, a musical instrument, and (f) a striking weapon. This is surely the most useful all-round implement ever evolved by primitive man.

Other interesting pieces in the Museum, still complete with their stone parts, are the quartz chip saw-knife, the chip-barbed "death-spear", and the Western Australian flaked-hatchet as it may be called, all characteristic of S.W. Australian aboriginal culture. W. A. Cawthorne (1844) mentions a single blade quartz hatchet (kandappi) as being in use in the Adelaide tribe as also the "death-spear". The stones, more often two, fitted in the flaked-hatchet are usually of somewhat semi-discoidal form very crudely fashioned, and when the haft and gum are absent not easily recognized as hatchet blades. Their use for woodcutting shows with what crude ill-formed tools some aborigines managed to obtain their requirements in life (Mountford, C. P., 1941). Sometimes a mere blunt stone block is used as one of the stones in the hatchet, perhaps, besides for hammering bark, to provide weight and balance. A well made piece, however, which is said to be a flaked-hatchet blade, comes from Rushy Pool (fig. 28). It shows a sharp edge and is of semi-discoidal shape. Of somewhat similar shape, though an outsize, is a specimen from Chidlows Well (fig. 29). This, however, is unorthodox as it has been ground carefully on both faces and may be a single axehead. The material used is said to be obtainable in the locality, but ground axes are thought not to have been produced in this region. Strangely enough, another specimen of "alien" aspect and made of similar material, lighty ground on both faces to produce a rectangular axe-blade, comes from Lake Magenta (fig. 30). The maker of this implement has taken advantage of a convenient natural shape. A third piece, showing an edge formed by grinding, and a midridge naturally formed, was found at Dinninup (fig. 31). As already mentioned these pieces of "alien" technique are worthy of special study.

So much evidence has been put forward to indicate that the Australian aboriginal has brought, or borrowed, many traits of his culture from overseas sources, that one is led to look for anything of his that is left. It is here suggested that among the items which show at least distinct Australian inventive genius and development may be placed (a) the elaboration of the throwing-stick-boomerang weapon, (b) the spearthrower, with (c) the flake-adze, (d) certain varieties of spear shafts and barbs, (e) certain forms of stone implements such as horsehoof, flaked-pick, composite saw-knife, flaked-hatchet, and "death-spear" as also cylindro-conical stones and tjurungas, (f) microlithic industry, (g) pressure working of stone, (h) mastic materials and gum hafting, (i) edge-grinding of flaked axes, and (j) highly developed flaking technique.

Little or nothing has been said of the antiquity of these stone implements in the Museum because, almost without exception, they are surface finds and any estimate of age is unwarranted without support from definite stratificatory evidence, adequately confirmed, which unfortunately is still wanting in this State.

My deep indebtedness to Mr. L. Glauert for his most valuable assistance and advice is gratefully acknowledged.

To Miss G. Walsh my thanks are due for her drawings, which bring out so well the salient features of the implements.

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SOUTH AUSTRALIAN MICROLITHIC STONE IMPLEMENTS

By T. D. Campbell and H. V. V. Noone, F.R.A.I.

Summary

South Australian stone implements, not more than about three centimetres in largest dimension, sometimes called "pygmies", but now termed "microliths", have been referred to from time to time in various publications, and some of them described. No detailed classification or description of the South Australian microlithic industry as a whole has been hitherto put on record. The present paper is an attempt to supply this want. It is hoped that a similar analysis of the microlithic industries of the other States will be undertaken in the near future and results published.

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Fig. 1–117.

South Australian stone implements, not more than about three centimetres in largest dimension, sometimes called "pygmies", but now termed "microliths", have been referred to from time to time in various publications, and some of them described. No detailed classification or description of the South Australian microlithic industry as a whole has been hitherto put on record. The present paper is an attempt to supply this want. It is hoped that a similar analysis of the microlithic industries of the other States will be undertaken in the near future and results published.

These attractive little pieces play a very important and significant part in Australian prehistory. They are usually found on, or near, the surface of wind-blown camp sites, either in quantity or sparsely distributed, in most parts of this State. As in Europe and elsewhere, full-sized tools accompany them; but though these may be part and parcel of the same culture, it is not the purpose of the present study, except in the case of the pirri, to deal with any but those of microlithic size. Though we are treating these small pieces as a whole, this does not imply we consider them as being components of only one industry, phase, or culture; that can only be determined by stratificatory evidence.

In some parts of the world microliths seem to have been of comparatively recent manufacture; but in Europe they led the way to the decline and eventual abandonment by man of a dependence upon stone for his tools and weapons. There microliths appear most prominently during the age called Mesolithic, which followed the final stages of the Upper Paleolithic (Magdalenian); but their production is carried on well into the Neolithic Age. Stone implements of microlithic dimensions are actually found sparsely in the deposits of the Upper Paleolithic, especially of the abrupt-trimmed bladelet form, which the French call "lamelle à dos abattu"; but it is in the Mesolithic Sauveterrian, and especially the Tardenoisian I, II and III, of the French sites, that they are the predominant form of implement. Then they reach their full development in the production of various precise geometrical forms. In fact the true Mesolithic period is mainly characterized by microlithic tools in great quantities, and made from bladelets produced by careful knapping.

In the following account the South Australian microliths are described in various sections dealing with: their distribution, so far as present knowledge goes; the materials used; the technique which was probably employed in their manufacture; a classification of the various types and their description, with some special consideration to one or two outstanding forms; some discussion on their antiquity and other features of interest; and finally a comparison with the occurrence of microliths in France and Ceylon.

DISTRIBUTION.

In South Australia most of the known microlithic types were used. Their recognized distribution is, of course, dependent upon the extent of collection, which requires at least some degree of expert knowledge. The list of recorded locations which will be found at the end of the paper gives a fair idea of the wide range of distribution. From these records it will be seen that with relatively limited collecting, the occurrence of microliths ranges practically over the whole of the State.

Collections made outside this State show these implements have been found here and there throughout the south and eastern littoral of Australia, and also in the west of the continent on the Fortescue River, and around Perth. Central Queensland, and even Central Australia as far north as the Macdonald Downs, have also given evidence of a microlithic industry in these areas. It is probable that this distribution area will be extended as time goes on, as unfortunately these small pieces, sometimes quite minute, are only too easily overlooked except by experienced collectors, who already know for what shapes and appearance to search.(1)

Besides being widespread and well-developed, the microlithic industry of Australia would seem to be unique for this part of the world. Up to the present, the nearest similar industry is found no nearer than Ceylon, where several types identical with those found in Australia were produced. In Tasmania, Legge, R. W. (1929) has recorded the finding of small "thumbnail", nosed, and high-backed scrapers which may be indications of a tendency towards a microlithic industry of geometric forms.

MATERIALS USED.

Some of these materials are, of course, rather restricted to certain areas; for this reason, the general design and finish of implements tend to vary according to the nature of the raw material locally available. For example, the finest workmanship and quality of the implements collected in this State are represented in those which occur in a wide east-west belt in the latitude of, and just below, Lake Eyre (approximately between degrees 28 and 31). It is in this terrain that excellent material, particularly the fine chalcedonized sandstones and porcellanites, are available. These smooth, very fine-grained rocks are almost ideal for clean, delicate, and well controlled fracturing. On the other hand, for example, the blue, light brown, and grey quartzite material predominant in the implements of the Adelaide region is a much coarser grained material, and the briefest experiment in its fracturing qualities will readily convince one of the difficulties presented in producing finely chipped implements of microlithic size. Nevertheless, in spite of this, many examples of this latter region are well formed and delightful little pieces, and show a thorough appreciation of the technique involved in the microlithic work.

In the south-eastern area of the State, local flint has been used which for the purpose of making small implements is particularly suitable in spite of its somewhat inferior quality.

Microliths are usually made of carefully selected material, their small dimensions necessitating the use of the best obtainable fine-grained stone. Here in this State they are mostly made of the following materials: agate, chalcedonic clays and sandstone, jasper, chert, porcellanite, potch opal, australite, indurated slate and shale, quartzite, milky quartz, and occasionally quartz crystal and flint.

TECHNIQUE OF MANUFACTURE.

The question of manufacture of some of these small types of implements has been discussed in a few of the published accounts, but there appears to be some variance of opinion on the matter.

(1) We would strongly advocate that where material is sufficient, all collectors follow the practice of not only picking up known forms and all trimmed pieces, but before leaving a site, also of gathering at least four good handfuls of what appears to be discarded scrap, especially the smaller pieces of stone

Horne and Aiston (1924) record their observations on the manufacture of some of the smaller tools, but while their statements concerning the use of percussion in shaping the flake, and pressure for subsequent fine trimming, are, to some extent, in accord with the likely technical proceedure, their information was gathered from living aborigines who, on their own statements (Horne and Aiston), were obviously unacquainted with this microlithic industry.

Hale and Tindale (1930) express the belief (p. 205) that the margin trimming of the pirri ". . . seems to have been fashioned entirely by hammer flaking, not by pressure"; but no reason is given for excluding the latter possibility.

Howchin does not discuss the manufacture of microliths, and merely refers to the fine trimmed edges as "very symmetrically and minutely chipped".

There has undoubtedly been an impression among local students that the fine long low-angled trimming of pirris, and the vertical or abrupt trimming of other microlithic forms, was done by light percussive work and not by pressure; enquiries from living aborigines having tended towards adoption of this opinion. But also it has been generally accepted that living natives actually showed little appreciation or knowledge of these smaller types of finely trimmed implements. The present writers feel convinced that from what is definitely known of the technique required for this particular kind of trimming, that the prehistoric South Australian aborigines, too, must have been acquainted with the use of pressure trimming, in order to produce the extraordinarily beautiful and delicate work displayed in some of their implements. The very nature of some of these miniature tools, with their delicate edges and points, seems to exclude percussive trimming for such small, fine work. Moreover, pressure trimming is a technique well known to the aborigines of the north west of the continent; and a critical examination of the trimming detail, of the South Australian uniface pirri for example, shows it to be identical —though the ultimate tool may differ in form—with that of the biface trimmed spearheads of the north-west.

The microlith was not only made of carefully selected fine-grained material whenever available, but in some groups of users the delicate handling necessitated by their smallness, led to their production by specialists—if one can judge by their frequent occurrence in clumps or groups—who carefully hoarded their output after production. A developed blade technique was often employed in obtaining the fine, regular bladelets and specially shaped flakes from which the various types were trimmed; this is particularly noticeable in the points and trapezes. Here we would mention that small flakes or bladelets can be knapped from large as well as small nuclei. The abrupt or vertical trimming was used to strengthen the piece as well as shape or regularize it. This part of the work was quite as delicate in its way as the careful knapping-off of the required shape of small flake or bladelet, and even more so when fashioning the ends to a sharp point. With largish, thick pieces, percussion by small pebble tapping would be used, but the more precise pressure trimming, possibly with hardwood or bone point, was most likely applied to the thinner pieces and the delicate points. Careful tapping or pressing on the implement, with its edge held against a stone or bone anvil, or drawing the edge, carefully exerting pressure, over a hard or roughish surface, with a rasping effect, may have been other methods employed. It is not impossible that the teeth may also have been used for exerting a form of pressure; this has been recorded by Horne and Aiston (1924). These writers have also mentioned the trimming of the tula adze-flake, and the latter (1929) the pirri, whilst embedded in gum on a stick. This to some extent gives support to our impression that in order to provide the requisite rigidity and holding area when trimming the smaller micros, the piece was probably fixed in gum, cleft stick, or other device. On occasion one sees the trimming has been done on the inner face of the piece instead of, as is usual, only on the outer.

This variation is usually due to the inner face being more easily worked upon as a base. The striking platform or bulb top is not often found on the microliths of geometric shapes; but observations, on what evidence is available, show that a diffused bulb is of most frequent occurrence, and the inner platform angle is usually just above 100°.

CLASSIFICATION.

In the matter of classification, the amount of available South Australian material obviously presents limitations. As stated above, these microliths require at least some measure of expert experience in their recognition; and while appreciable collections of implements have been made in this State, only a few workers have given any attention to these miniature types. Mention may be made here of an excellent summary of small Victorian implements made by A. S. Kenyon (1927). Our studies, therefore, have been to a large extent, confined to such specimens as have been selected, and kept for their familiarity, or attractivness. We would here emphasize that all surface or excavatory collecting concerned with the past, should be undertaken primarily with the object of acquiring knowledge, and not merely specimens for exhibition. One of the features that became obvious, as research and excavation progressed in Europe, was that certain stone tool types and varieties were so significant and distinctive that they supplied a reliable guide to differentiation of the successive cultures, and even in cases where only one habitation layer was found at a site. In some cultures, as also in their phases, the existence or predominance of a type, or variety, of stone or bone implement such as the Mousterian Point, Solutrean "face plan", "feuille de laurier", and "pointe a cran" points, Magdalenian barbed bone harpoon and bec de perroquet burin are found to be definite indications in the deposit of those cultures. For this reason alone it is, therefore, most advisable that a detailed classification should be worked out.

In the past classifications of the Australian microliths that have so far been collected and described, very little attempt has been made to discriminate between the various types or varieties presented. Such terms as microliths, pygmy implements, midgets, chipped-back knives, crescents, pirris, etc., all seem to have been quite loosely applied.

As the aboriginal was not dominated by any such thing as classification, but instead by his opportunist idea of what he required for his purpose, pieces are found on the borderland between two varieties or types differentiated by us; as also some showing more than one kind of working edge. For purposes of the present classification we have had recourse to making what seemed the main use of the implement its major feature.

Use in classificatory nomenclature of any assumed function of a stone implement utilized by an Australian aboriginal is to be avoided as far as possible. We believe it preferable to use terms which make familiar form and method of production of the implement, and when pertinent, the size.

Several of the types such as scrapers, triangles, and points may be also found in certain areas large enough to be classed as full sized implements or macroliths.

The following classification has been adopted by us as applicable to the material examined, and is here put forward as a basis for future collecting and description.

In our description of pieces the term "outer" signifies that face of the implement which was made first, and "inner" the other face which was subsequently formed when the piece was detached from the core; this latter face often still bears on the implement the mark of the conchoidal fracture and bulb. For other details see Tindale and Noone (1941).

The salient features of the types and varieties are shown by line drawings which accompany the paper.

FLAKE AND BLADE IMPLEMENTS.

A. POINTS.

- I. Symmetrical, leaf-shape.
  - (a) South Australian Pirris.
    - (1) *Typical.*
    - (2) *Fulham.*
    - (3) *One margin trimmed.*
  - (b) Abrupt trimmed.
    - (1) *Adelaide type.*
    - (2) *Bimarginal.*
  - (c) Untrimmed.
- II. Asymmetrical.
  - (a) Bondi.
  - (b) Oblique.

B. PIERCERS.

C. MICRO-BURINS.

D. BURINATE.

E. TRIMMED AND UTILIZED BLADELETS AND SMALL FLAKES.

- I. Abrupt Trimmed.
- II. Knives and Saws.
- III. Punches, Chisels and battered pieces.
- IV. Sundry.

F. SCRAPERS.

- I. At end of bladelet.
  - (a) Ordinary.
  - (b) Peaked.
- II. Semi-discoidal.
- III. Butt-end.
- IV. Raclette.
- V. Nosed.
- VI. Concave.
- VII. Carinate.

G. QUARTZ, ETC., SPEAR BARBS.

GEOMETRIC PIECES.

A. ROUNDED.

I. SEGMENTS.

(a) Crescent.
(b) Ordinary.
(c) Narrow.
(d) Half-moon.
(e) Rudder.
(f) Cupid's bow.
(g) Semi-segment.

II. DISCOIDAL SCRAPERS.

B. ANGULAR.

I. TRIANGLES.

(a) Equilateral.
(b) Obtuse.
(c) Scalene.
(d) Isosceles.
(e) Bracket.

II. TRAPEZES.

(a) Symmetrical.
(b) Asymmetrical.

MISCELLANEOUS.

A. PERCUTERS.

I. PEEBLES.

II. NUCLEIFORM.

B. NUCLEI.

C. BIFACES.

I. DISCOIDAL.

II. SEMI-DISCOIDAL.

D. PEBBLE IMPLEMENTS.

FLAKE AND BLADE IMPLEMENTS.

A. POINTS.

We adopt this general term as free of implications of restricted function.

1. SYMMETRICAL LEAF-SHAPE POINTS.

(a) South Australian Pirri Point.

First and foremost of these leaf-shape points is the uniface piece which we call South Australian Pirri Point of beautiful workmanship and symmetry. This piece though found in quantity of micro size, down to 1·5 cm. in length, was also made of long dimensions up to 7·5 cm. in length. The distribution of the S.A. Pirri, both in small and large size, is widespread over this State. From published accounts, a study of collections, and from unpublished information, the following list of regions and specified sites has been drawn up to indicate the localities of their occurrence; these sites will probably be increased in number with further collecting. Stuart Range, Miller Creek, Ooldea, Lake Hart, Coward Springs, Marree, Lower Cooper Creek region, Flinders Range, Port Augusta, Moonta, Wallaroo, Burra, Sutherland, Jutland, Nuriootpa, Bowmans, all littoral camp sites from Adelaide to Normanville, Port Elliot, Goolwa, Devon Downs, just over W.A. border at Eucla, over N.S.W. border at Boolka Lake, and Ned's Corner over Victorian border. The Cooper and Miller Creek regions show the greater proportion of the longer varieties and also some of the best workmanship, both probably, to some extent, fostered by the fine grade of material available. A point of interest arising from our survey of pirri distribution, according to finds up to date, is that the River Murray forms an approximate limit of the distribution South and East.

As this particular South Australian implement occupies an exceedingly important and interesting place among the stone implements under discussion, it seems to the present writers that, even at the risk of some lengthy discussion and quotation, it warrants critical survey. In South Australia the pirri has been found in large numbers from widely distributed sites; and by early collectors has been vaguely labelled as a point, chipped point, or spearhead, and later, graver, drill, etc. Apart from this it seems to have aroused little interest even among those working on Australian aboriginal ethnography. By only a few writers in relatively recent years have these delightful tools received any detailed discussion. The following quotations from Horne and Aiston (1924), Hale and Tindale (1930), and Howchin (1934), provide most of what has been said of the pirri concerning its occurrence and study in this State.

Horne and Aiston in describing the stone implements of the aborigines on the east side of Lake Eyre, write as follows (p. 90): "The last stone of the ideal type to be described is the pirrie; this is a small, pear-shaped tool running to a fine point. It is used as a graving tool to make decorative marks on wooden weapons, and occasionally it is used as a drill for light boring work, such as making the hole to take the string of an inchitcha (bull-roarer). . . . . The art of making these seems to be lost among the tribes here, though one old man showed me how they were made by pressure. I have found hundreds that were beautifully chipped".

Further remarks on the pirri (p. 107) are: "The workman now takes up a koondi tuhla having a fine-pointed piece of stone set in the other end, mounted in gum, and holding it steady between the first two fingers of both hands he traces out the design. This tool is called a pirrie".

On p. 108 they state: "At some time there must have been a master at making pirries here. I have found dozens of beautiful specimens. Mr. Aiston says the blacks are always trying to get him to give the pirries to them, and there is no one here who can make them so well. . . . These were made, first by chipping a flake off the original stone, and the workman, by long experience, was an expert in finding the line of cleavage of any stone. This was roughly chipped up with a kulki until nearly the shape desired. The pirrie had then the final dainty chipping, done by pressure. For this a heavy kalara was used. It was then either mounted in gum on a koondi or put away until wanted".

Among their various references to the finding of pirri implements during their excavatory work in the Murray Valley, Hale and Tindale (1930) state (p. 194): "Among the stone implements are fifteen examples of a type which is not found in any layer above; these are leaf-shaped points, fashioned from flakes of dull chert (figs. 176 and 183-189). In the manufacture it would appear that an elongate leaf-like flake, triangular or trapezoidal in cross section, was struck off from a prepared core which had a striking platform. This flake was thinnest at the point of final separation from the core. Its ventral surface is usually free from marked ripples, while radiating fissures are generally confined to the point of impact; a positive bulb of percussion is often apparent. The dorso-lateral margins and posterior angles are retouched by hammer flaking, and the basal portion (striking platform) may or may not be retouched. This type of implement has been figured by Horne and Aiston (1924, pp. 90-91) under the name of "pirrie" (pirri); and although their application was seemingly made in error (see p. 205), this published name is here adopted in preference to any other".

These writers (Hale and Tindale) go on to state (p. 205): "The 'leaf-point' stone artifacts characteristic of layers VIII to X (figs. 176–189 and 230–241), and for which the name pirri is herein adopted, have long been known from old camp-sites in many parts of southern Australia, but their use among living tribes has not been observed. Horne and Aiston (1924, pp. 90–91, etc., and fig. 67), illustrate examples of this implement under the Wonkanguru name "pirrie", regarding it as the forerunner of a simpler flake in use to-day; this less developed flake is fastened to a stick with gum and used as a drill (see also Brough Smyth, 1878, p. 380, fig. 200)". After quoting some remarks by Horne and Aiston, they go on to write: "Thus it is evident that the elongate triangular implement with retouched edges and prepared butt is unknown among living Wonkanguru natives. It seems possible that this artifact may have been a spearhead; certainly it is typologically distinct from the modern flake-drill, and seems to have been fashioned entirely by hammer flaking, not by pressure. Nevertheless, it seems convenient to adopt the name applied by Horne and Aiston to the 'leaf-flake' in order to avoid further confusion, and to regard the examples figured by them as typical".

Howchin writes (p. 63): "This is a very distinct type of implement, and in its better examples showing the highest standard of manipulation among the remains of the Adelaide tribe. The underside of the tool was formed by a clear fracture, producing a smooth surface with a distinct bulb of percussion. The upper surface was formed, in the greater number of examples, by the removal of two or three longitudinal flakes, blending in a point, with secondary chipping, and, as a tool, trigonal in transverse section. In some examples the upper surface has been very symmetrically and minutely chipped, effacing the central ridge or ridges, and in transverse section forms the segment of a circle. In all cases the point is very sharp. When first discovered I was disposed to regard these implements as the stone points of small spears, to which they bore a striking likeness. Although flat on one side this formed no valid objection to such a supposition, as quartzite spear points, with a flat face on one side and trigonal in transverse section are still in use by the natives of northern Australia precisely similar to their quartzite knives".

Howchin then goes on to state his subsequent doubt as to their use as spearheads, and quotes Horne and Aiston in their descriptions and uses of the implement.

After further discussion on their possible uses, Howchin goes on to conclude: "The pirrie was evidently a very important tool among the black man's artifacts, giving expression to his symbolic ideas and a sense of pleasure in artistic figures. That the Adelaide Tribe appreciated the value of this tool is seen in the very great numbers that they left behind among their remains. Among the more highly-finished examples were some that possessed exceedingly sharp points, that could not bear the pressure used with a graving tool without fracture; it is, therefore, probable that these beautifully-finished and delicately-pointed specimens were held as a matter of pride as to execution rather than as tools".

From the above quotations the following main points may be derived. No clear-cut and adequate definition has been given of the typical features of the pirri and its various forms; its distribution has been stated only in general terms; its use or uses have been discussed, but no apparent finality arrived at; its manufacture has been variously described. In the space possible in this communication, the present writers hope, to some extent, to clarify the position.

It is obvious that some confusion has arisen by the use of the term "pirri" for an implement, when it can also mean the "making of a fine line", and, by inference, any tool so used. Horne and Aiston accepted the aborigines' evidence as definitely connecting the obsolete pirri with a more robust tool for making fine lines, used by the Wongkongurus (Merna Wadna?). Actually it would seem that the Wonkongurus were not identifying the obsolete implement at all, but saying in what way they thought they could use it. It seems that they were not old enough witnesses to say for what the prehistoric pirri was used, nor how it was made.

Howchin appears to have too readily accepted a statement, made by Gillen, that no stone spearheads were used by South Australian aborigines, as such an opinion was necessarily only applicable to modern times; the pirri being an obsolete implement. Mrs. James Smith (1880, p. 13) in recording a reported recent event says: "Madly they shook their flint-headed spears and flung them at her . . . one of them went through her heart". She uses the term "flint-headed" spears, but the stone-barbed "death spear" may have been intended.

Although many of the pirri points are microlithic (the majority of such points found at Devon Downs are of small size) some large examples are found in South Australia, and many large size of the untrimmed leaf shape form. Moreover, stone spearheads, classable as pirri points, have been found by us still attached to their shafts, both in the Perth (2) and Adelaide (2) Museum collections. We are of the opinion that Hale and Tindale were correct in saying: "It seems possible that this artifact may have been a spearhead". The point is alway trimmed to a piercing sharpness, and carefully strengthened by a median ridge on the outer or worked face. The butt is frequently thinned and rounded, and both these features are special characteristics of the Kimberleys spearhead of modern times. In fact the only dissimilarities are that the pirri point is uniface worked, while the Kimberleys is biface worked with serrations on the margins. In this connection it is interesting to mention that the Solutrean bay-leaf biface worked point (feuille de laurier), so like the Kimberleys spearhead, was preceded by a uniface form (Face plan), somewhat like the pirri point. The modern Koondi Pirri (Merna Wadna) is a much stouter and more rudely trimmed piece than the fragile pointed pirri point, and usually lozenge shape from

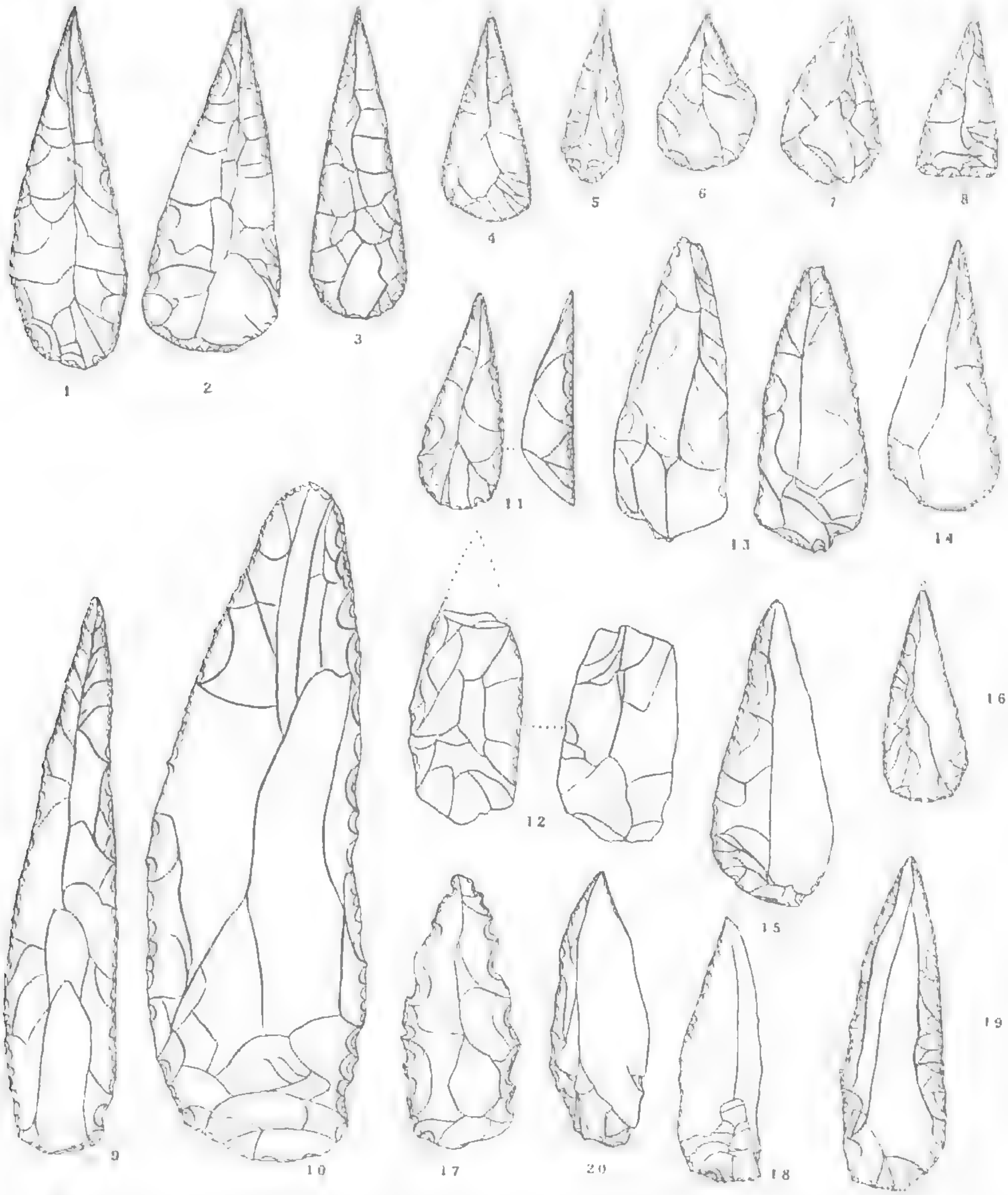

Fig. 1–20: 1–4, typical pirri; 5, typical pirri, small, narrow; 6–7, typical pirri, squat; 8, typical pirri, triangular; 9, typical pirri, long, narrow; 10, typical pirri, large; 11, Fulham pirri; 12–13, biface worked pirri; 14–15, one margin trimmed pirri; 17, unfinished pirri; 18, nibble trimmed point; 19, abrupt and long trimmed point; 20, Adelaide abrupt trimmed point. (All nat. size.)

butt to point in transverse section, not plano-convex at base and then triangular up to point as most often in the pirri.

The pirri point being a piece upon which the best workmanship is found, we have selected the finer trimmed and shaped samples as the standard type (indeed in certain areas it is the most numerous form), thus differing from Howchin, who would make the standard an untrimmed, leaf-shape point. It is noticeable when examining a large collection of these pieces that owing to variations in trimming and extent of same, a few examples appear which show features similar to the other types of these leaf-shape points so that actually one type merges into the others.

(1) *Typical South Australian Pirri.*

They are made from bladelets which have been carefully predesigned, before detachment from the nucleus, so as to bear a median ridge; (a) extending from two short converging ridges at butt end, or (b) running full length; as nearly as possible at right angles to the striking platform. By striking on the platform just behind this ridge, a symmetrical leaf-shaped bladelet is detached, ending in a centralized point by reason of the directing control of the ridge. Sometimes more than one ridge was formed in the preparation of the nucleus; and if these converged, a most suitable bladelet could be struck off. The margins were then trimmed on outer face by removal of long scales by pressure so as to make the piece more symmetrical and robust, and the point carefully brought to a fine, penetrative sharpness. Great skill was shown in maintaining the median ridge so as to strengthen the attenuated point. The butt was thinned and rounded, often removing in the process the bulge of the bulb and the striking platform. In the vicinity of the butt, this trimming was also often done on the inner face, and very occasionally this face shows trimming scars on the side margins of the piece making it almost a biface. We found three biface worked specimens. The completed implement of the standard type may therefore be described as a flat, leaf-shape symmetrical point, with long pressure trimming on the outer face from both margins, up to, and sometimes over the midridge in the vicinity of the butt, the latter being thinned and rounded while a median ridge strengthens the fine point. The transverse section is plano-convex at butt end and triangulate at pointed end. The size varies considerably. Some are squat, of triangular arrowhead form, some medium and others narrow. A variety has the butt untrimmed, and therefore bearing the striking platform and bulb.

(2) *Fulham Pirri.*

An important variety of the type form, probably to some extent the outcome of the material used, which is also with a thinned and convex butt, is not flat, but has a high midridge. These are usually small, and may be distinguished as the "Fulham Pirri". They are found in quantity at Moonta.

(3) *One margin trimmed.*

A third variety shows the long, low angled trimming done from one margin only, and is usually with an untrimmed butt. Then again, rare specimens also show some abrupt trimming on the other margin.

A few specimens are found to have denticulated and nicked margins, presumably being in process of manufacture, the pressure trimming process being not complete.

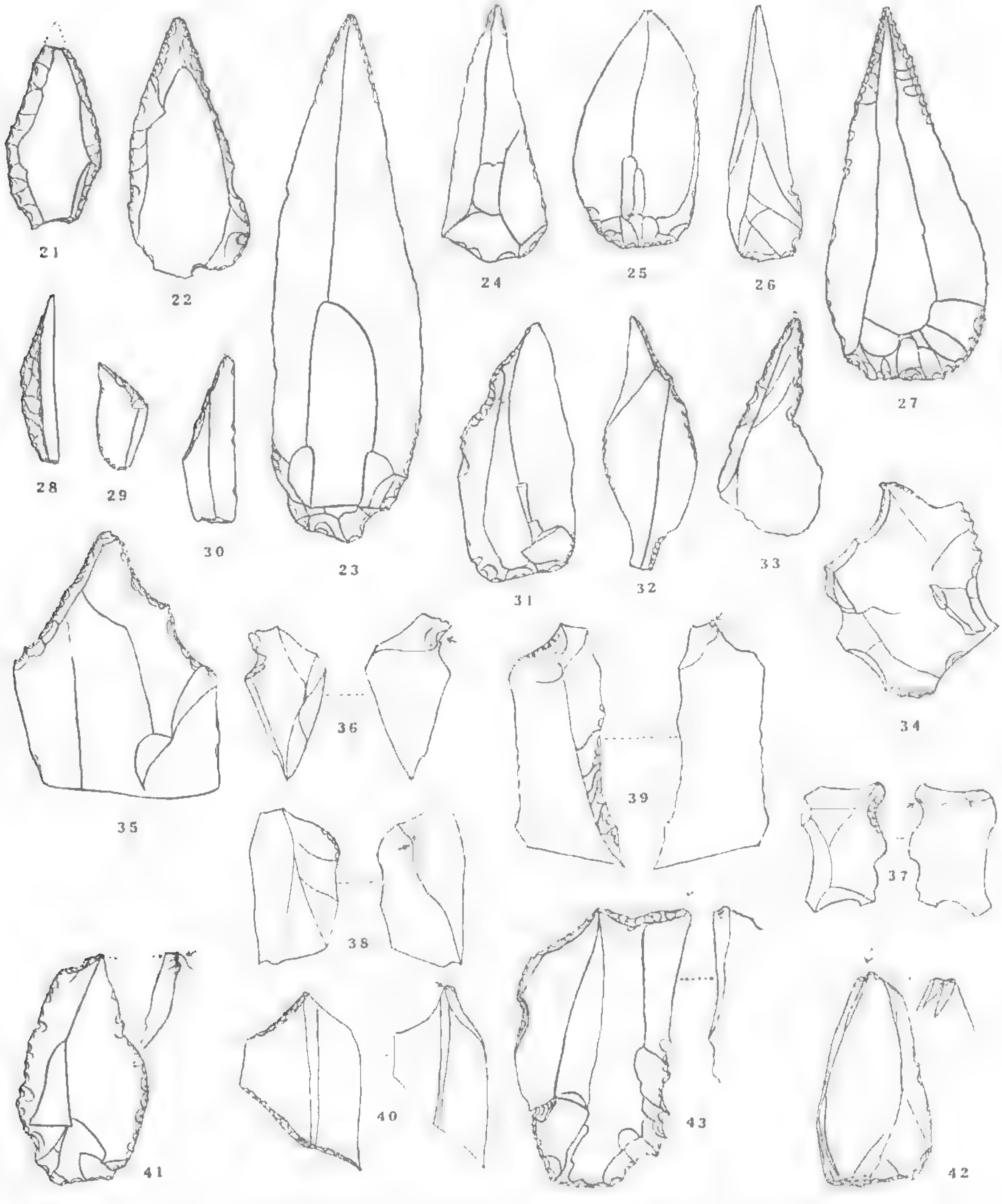

Fig. 21–43: 21–22, bimarginal abrupt trimmed point; 23, untrimmed leaf-shape long point; 24, untrimmed leaf-shape point; 25, untrimmed leaf-shape squat point; 26, untrimmed leaf-shape narrow point; 27, tip trimmed leaf-shape point; 28, Bondi asymmetrical point, small; 29–30, oblique trimmed asymmetrical point; 31–32, oblique trimmed asymmetrical large point; 33, typical piercer or awl; 34, fine pointed piercer; 35, large angled piercer; 36, typical micro-burin found at Lyndhurst, South Australia; 37–41, pieces showing stigmate; 42, spalled burinate; 43, scaled burinate. (All nat. size.)

(b) Abrupt trimmed points.

These pieces differ from the pirri in their method of manufacture.

(1) *Adelaide Type.*

Another of the leaf-shape points which, however, is not a pirri point, is one which for distinction we call the "Adelaide" abrupt trimmed point, as they appear more common in the southern regions of the State. These are also usually symmetrical in outline; in fact we believe intentionally made so from ill-formed asymmetrical blades, to function in the same way as the pirri point. They are without the central midridge or the consequent long trimming as on the pirri point. Instead, on account of their knapped-off form, the vertical or abrupt form of trimming was used, along one of the margins, in making the piece symmetrical, and at the same time strengthening it and providing a robust point by the supporting ridge. This trimming is almost invariably done from one face only: the inner (or bulbar). The butt is usually left untrimmed, and the striking platform therefore intact. The transverse section is usually triangular or asymmetrically trapezoidal. On occasion this piece is found with a short nibbling trimming on one or both margins, but these examples are rare. The term "chipped-back knife", etc., is frequently applied to this kind of implement, but we deal with this matter later. This point varies in form as does the standard pirri, and similar squat, medium, narrow, and outsize specimens are found.

(2) A few pointed specimens are found showing *bimarginal* abrupt trimming, such treatment resulting from the malformation of the piece utilized. The French Sauveterrian point is a finer, narrower form of this type.

(c) The *Untrimmed leaf-shape point* which is frequently found is, according to this classification, not a true pirri point, though in shape, with its more or less central midridge, similar to that specially trimmed piece. As its name implies, it is untrimmed, and in the same state as when struck off the nucleus. Some of these, of course, may be blanks which were to be trimmed into pirri points, but others appear good enough for use as they are. Occasionally a faint trimming may be noticed in the near vicinity of the tip. Squat, medium, narrow, and, as with the pirris, outsize varieties also occur and are in appreciable quantities.

II. ASYMMETRICAL POINTS.

(a) Abrupt trimmed *Bondi point* is the more important of these. It is sometimes called lancet, chipped-back knife, scarifier, etc. These are rare in South Australia, but typical examples have been collected in the south-eastern region of the State, where their appearance is possibly due to influence from Victoria. Actually they are not a characteristic type of our microlithic pieces, their predominant position in the Victoria and New South Wales cultures being taken in South Australia by the pirri point.

Owing to the general application given by various authors to the term "chipped-back knife", and the use of the term to designate all forms and sizes of pieces which showed the employment of abrupt trimming in their manufacture, some confusion has arisen. Not only enormous implements like the New South Wales worimi, reaching some 12 cm. in length, but also the microlithic triangle and segment (crescent) and even the trapeze and the conventionalized elouera, have been brought under the description "chipped-back knife". Actually there is no evidence that these particular obsolete implements were used as knives. As in the case of the pirri, the fact that modern aborigines thought they might do for such purposes, seems to have been overvalued as evidence in the case of an obsolete implement. A careful scrutiny of many specimens will show the edge that could be used for cutting is usually devoid of any signs of such use; some specimens with a flat edged thinner margin lack a sharp knife edge.

The Bondi abrupt trimmed point may be briefly described as made from a carefully knapped off bladelet of asymmetrical form, being abrupt trimmed along its thickest margin so as to give it a narrow pointed form, this margin often being convex in outline lengthwise, and the thinner margin may be straight or concave. The trimming is frequently from both outer and inner faces, and, as in the pirri point, a ridge is usually preserved to support the point, forming often a triangular transverse section. The butt is usually intact, with striking platform and bulb; but sometimes it shows sparse trimming and rounding off. It will be realized that in several ways this asymmetrical implement is dissimilar to the symmetrical leaf-shape piece we have distinguished as the Adelaide abrupt-trimmed point. However, this does not mean that it is unlikely the Bondi point was used for the same purpose. Judging by the stoutness and size of some of the longer specimens of this piece, some would be suitable as spearpoints. Mr. F. D. McCarthy has communicated to us his suggestion that they were used as spear barbs, which seems possible.

(b) Oblique Point.

This is another asymmetrical piece. It is not very common in this State, and is of varied shape, both squat and long varieties being found. It is formed on a bladelet or small flake, by abrupt-trimming the end, never the butt apparently, transversely and obliquely to the long axis. It is a not uncommon type in the European microlithic cultures, and is especially prominent in Great Britain, and when completely trimmed along the whole of the thicker margin was characteristic of the early Magdalenians.

B. PIERCERS.

These are varied in outline, but at least one conventionalized form is noticeable. This shows a fine, long, well-backed narrow point with trimmed margins. It has been formed on a conveniently pointed stoutish flake. A few show larger angle points, some being on thick flakes, and others are small with finer trimming.

C. MICRO-BURINS.

This delicate little European implement, called the Tardenoisian or Sebilian micro-burin, is one of the aristocrats of stone implements, for the technique which produced it was seemingly never employed in making other stone implements of the cultures in which it appears, even to produce the burins of the older types which are sometimes found associated. Again, whereas examples of most other stone implements may be found here and there in widely separated localities of the world, this piece seems to have been restricted to Western Europe and North Africa. Though it is called a micro-burin, and is somewhat like one type of the burins, its occasional minuteness and lack of evidence of use have caused considerable controversy as to its function. M. Perony and one of the present writers (H.V.V.N., 1938) have suggested its possible use as a spear barb.

Whatever the actual method of production, the result was that a distinctive bulb scar (called stigmate), near a trimmed concave, was left on the piece in detaching an oblique spall "en biais" from the inner face. The ordinary burin always shows a dimple or negative bulb depression at the top of the spall scar; and here was the mystery—in making the micro-burin some special technique must have been employed which had the opposite effect, that is, producing a small protuberance instead of a dimple or depression. MM. Siret and Vignard think, so far as the Sebilian sites are concerned, that the micro-burin is really a by-product resulting from a special way of making a microlithic trapeze, triangle, or oblique point, but at some other sites the trapeze is said to appear without the micro-burin. Whether it be a specially produced implement, a mere by-product, or a utilized

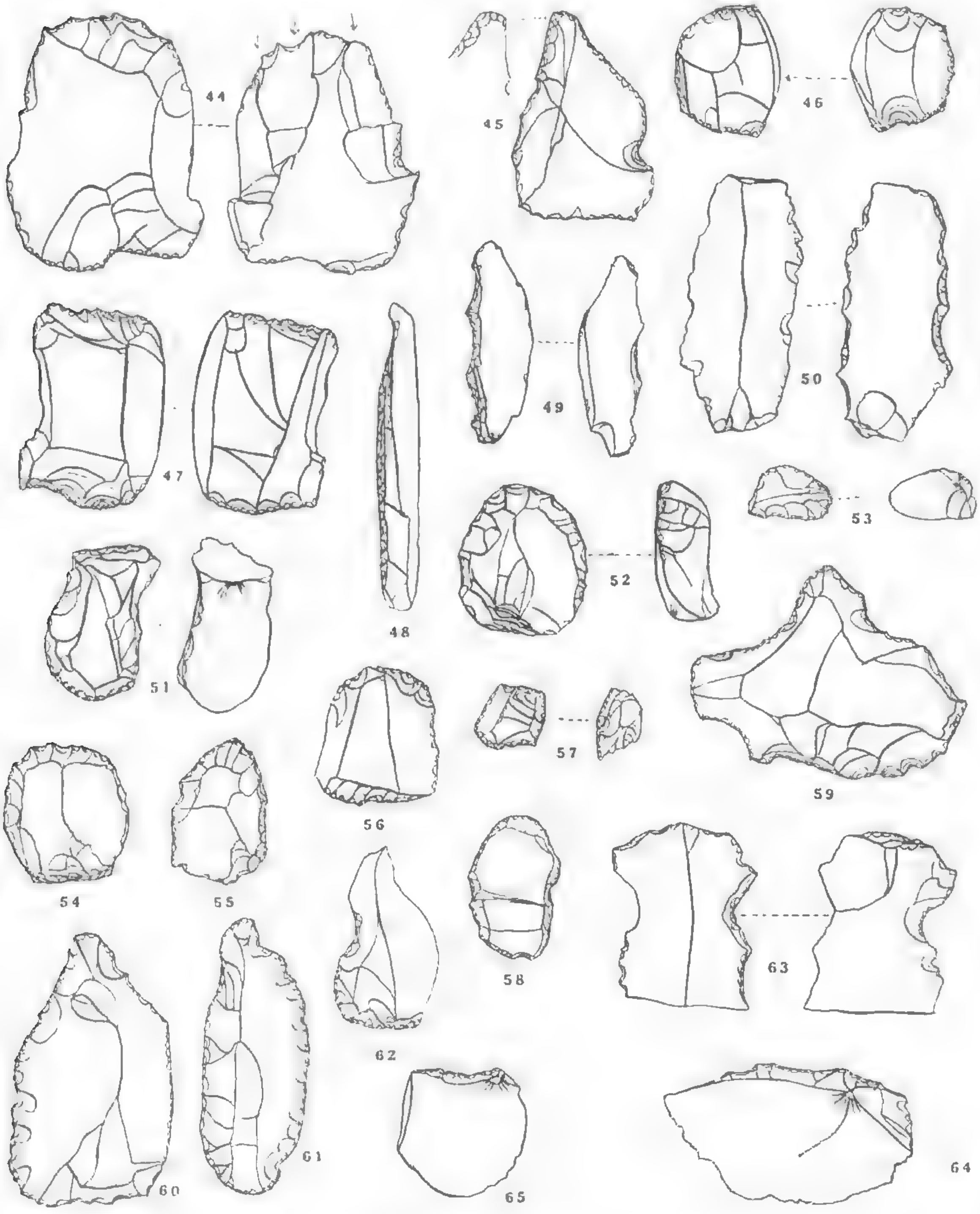

Fig. 44–65: 44, scaled burinate twins; 45, counter-scaled burinate; 46, biface punch or wedge in australite; 47, biface punch or wedge; 48–49, abrupt trimmed bladelet; 50, saw-knife; 51, end-scraper on bladelet; 52, peaked end-scraper; 53, small end-scraper in australite; 54, semi-discoidal scraper; 55, ogival scraper; 56, double scraper; 57, double scraper, small, in australite; 58, raclette; 59–60, nosed scraper; 61, nosed scraper on bladelet; 62, concave scraper; 63, concave scraper, double (etrangler); 64–65, butt-end scraper. (All nat. size.)

by-product, or what use was made of it, if any, and also what was its actual method of production, are all matters still under discussion. However, its occurrence in quantity at several European and African microlithic sites, shows it to be an important production of those stone industries. It is always made on some portion of a bladelet, either the tip, butt, or middle; but more often on the butt.

We have now found indications that examples of this very distinctive little piece are not, as was hitherto thought, entirely absent from the Australian microlithic industry, although, so far as our researches go, we have not yet identified a sufficient number of specimens to say it is a conventionalized type here. The first example to be recognized was among some material collected by one of us (T.D.C.) at Lyndhurst, fig. 36. It shows all the main characteristics of the Tardenoisian implement, with the minor difference that a crevassed gap takes the place of the usual trimmed concavity. It is the tip of a bladelet, and the essential stigmate or bulbar protuberance at the beginning of the oblique spall scar, is clearly visible on the inner face of the piece. Actually a trimmed concave is not invariably present on the micro-burin; it can be made by removal of one scale or otherwise. A few other likely examples have been found, and now that attention has been called to their existence, form, and appearance, it is hoped a sufficient number will be collected to establish its occurrence in other areas.

D. BURINATE.

The identification of a kind of burin form of implement in Australia was made by one of us (H.V.V.N.) some two years ago; and since then various examples from widespread localities have been recognized. Evidence that a burin producing technique or tradition was habitually practised is, however, so far wanting. The examples found suggest that in response to the need for this kind of tool such method of producing a burin kind of working edge as occurred to the worker was put into operation. The greater number of examples are what we call the spalled type, but rare examples of some of the scaled types also occur. Many seem to be "chance" pieces, used for burin work, whilst others have been converted by a well directed blow, removing a spall in the orthodox fashion. Some fragments have been found similar to spalls, such as are struck off in shaping or re-edging the orthodox European burin. The pieces we call Burinate may also have been used for punching, knapping, or trimming. The types we have found are spalled (central), scaled (oblique), a double scaled (rectangular), and the counterscaled.

E. TRIMMED AND UTILIZED BLADELETS AND SMALL FLAKES.

I. ABRUPT TRIMMED BLADELET.

This is the type of implement called by the French "lamelle à dos abattu"; in England it is sometimes called the "blunted back blade". We here confine it to pieces not ending in a point, in accordance with the original use of the French term; the pointed pieces, usually longer, being termed Audi, Chattelperron, and LaGravette points, according to their slenderness and period. The Bondi point, for instance, is of the LaGravette type, though often on the small side. Examples of the pointless abrupt trimmed bladelets, the formation of which shows they are not fragments of fine Bondi points, are rare in South Australia, but a few specimens have been found. By some prehistorians they are thought to be units of a composite tool or weapon.

II. KNIVES AND SAWS.

These are not common; perhaps because the aboriginal habit, as nowadays, was to utilize any handy sharp-edged piece, or knap off a flake for the purpose as occasion required.

III. PUNCHES, CHISELS AND BATTERED PIECES.

These show splintering and pulverizing at one or both ends; they are often fragments of blades or flakes, but some are biface worked and like wedges. There is a form well known in France, found at Upper Paleolithic sites called "piece esquille", and some specimens are like this. Besides other uses, a tool of this kind would be convenient in obtaining greater precision in knapping, and some of these small, stout flakes or blade fragments may have been used for trimming.

IV. SUNDRY PIECES.

On many sites numerous untrimmed chips, flakes, blades, and other scrap of various sizes may be found representing the by-products of stone working. Whilst the majority of these may be only primary, or shaping and preparing fragments, in view of the well known habit of the aboriginal to strike off or make use of any odd scrap of sharp stone for cutting or incising purposes, it is quite possible that some few of them have been utilized at one time or another, or even produced, to serve some purpose. In the absence of any definite vestiges of such use, or if they are not of recognizable standard form, such as the untrimmed pirri, they cannot be definitely assigned to any classified type, with the possible exception that some of them may be considered knives, or suitable for cutting purposes.

F. SCRAPERS.

Long usage has so established the name of scraper for this class of tool that we are retaining it with the reservation that the pieces dealt with under this description are not merely scrapers, because some may have been used mainly for other purposes. The side scraper does not seem to be a conventionalized Australian tool. The discoidal scraper is dealt with under the geometrical pieces.

I. END-SCRAPER.

Two forms are characteristic of the microlithic scrapers at end of bladelet, which are seemingly among the earliest types of minature tools in any micro lithic industry; just as the larger scraper at end of blade (duckbill, grattoir en lame) is one of the dominant tools of all world stone cultures that have reached a blade-knapping technique.

(a) Ordinary.

One of the two forms is a small example of this old type, and may be called ordinary end-scraper on bladelet. The other form is (b) a high crested or *Peaked* form with a steep angled working edge which may have been produced for heavier work. A few specimens show side margin trimming. Only a few examples of the end-scraper on bladelet are found. One of their distinctive characteristics, in addition to that of the presence of bulb and striking platform, is the sharp angled working edge due to a curvature inwards at the end of the inner face of the piece, whereas the tula adze-flake, squatter usually, has its working edge usually formed by the meeting of two convex faces. Some pieces show a rectilineal working edge. Among these small implements the discoidal and thumb-nail scrapers are evidently the more popular tools.

II. SEMI-DISCOIDAL.

Another micro scraper is sometimes aptly called the "thumb-nail" scraper, on account of its semi-discoidal outline. These are made on small squat flakes, the semi-circular or semi-oval working edge being formed on the end of the flake and the butt being untrimmed, and usually showing the striking platform and accompanying bulb. A few, however, have been seemingly made by snapping off the trimmed end of a blade. In the majority of cases, the force fracturing the blade was applied on the inner or bulbar face. In appearance some are miniature replicas of the well-known large adze-flake tool, the tula, suggesting the possibility that they functioned in the same way, and, as with the tula, small worn examples are found. A few have an

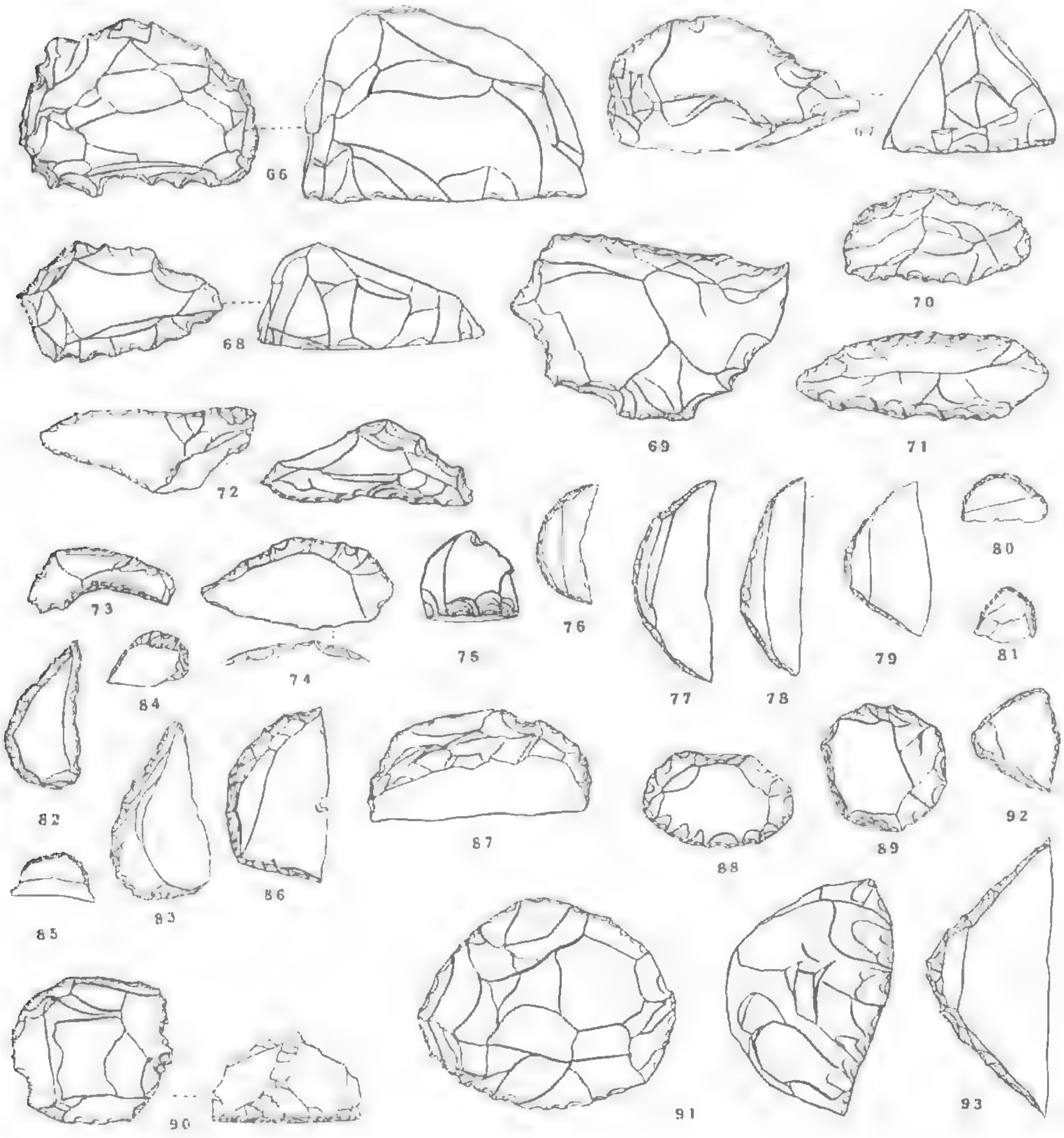

Fig. 66–93: 66, carinate scraper; 67–69, carinate scraper with pointed end; 70, slug-like scraper; 71, piece like small adze-flake; 72–73, piece like small adze-flake worn; 74, piece like small adze-flake, trimmed also inner face; 75, corette; 76, crescent segment; 77, ordinary segment; 78, narrow segment; 79, half-moon segment; 80–81, minute segment; 82–83, rudder segment; 84, rudder segment; 85, cupid's bow segment; 86, semi-segment; 87–88, eloucra-like segment; 89, discoidal scraper; 90, discoidal scraper, high; 91, discoidal scraper, large; 92, equilateral triangle; 93, obtuse triangle. (All nat. size.)

ogival shaped working edge and rare examples are of rectilinear, other of pointed working edge. The existence of sharp acute angled, large angled, and steep angled (in elevation) working edges would seem to indicate different stages produced by re-edging during use.

Very attractive looking little doubles are not rare, some almost rectangular in outline.

III.

A few examples of the "*butt-end*" scraper have been recognized.

IV.

A rare piece, reminiscent of the early Magdalenian "*raclette*" is sometimes found; this is formed on a flattish flake, the trimming being of the abrupt type.

V.

A few examples of the *nosed scraper* (sometimes miscalled "duckbill"), are found of the well-known form. In spite of the appearance of this tool at all periods and in all stone cultures—a dominant type in Tasmania—its method of use and purpose remains a mystery, as also whether the nose or adjacent concaves were the main working feature. Various suggestions such as skin trimming, marrow scooping, stone implement trimming, wood graving, shaft shaving, making cup depression for fire drill, etc., have been made, but none generally accepted. The fact that it was almost the only stone tool among the many flint implements said to have been fabricated by the Tasmanian women, who accompanied the white whalers at their camp on Kangaroo Island, should restrict the selection of possible uses, eliminating such as stone implement trimming, spear shaft shaving, cupping for fire drill, and wood graving.

VI.

The *concave scraper* (sometimes called "hollow") is a comparatively rare piece in the industry; possibly because when the wooden spear-point, for instance, reached a small diameter, a rasp, such as a piece of sandstone, or shell, was more frequently used. Typical examples of the bladelet with multiple concaves, characteristic of the Tardenoisian culture, are lacking. The width of the concave ranges from about ¼ to just over ½ inch.

VII.

A heavy piece of varied form made on blocks rather than flakes, like the well-known Caréné scraper of French stone cultures, occurs in quantity and may be called the *carinate scraper*. These are high back or crested, and some long forms are slug-like. They are steep trimmed small blocks, usually flat based, and without striking platform or accompanying bulb. This absence and the fact that the base, instead of being convex, is flat, distinguish them from the "worn tula" adze-flake. One form, not uncommon, shows a circular or irregular working edge at one end, whilst it is trimmed at the other end to form a point.

There are a few very small pieces in shape like prismatic conical nuclei or tea cosies which show squilling on the chipped periphery of the flat face; these we call *corettes*.

G. QUARTZ, ETC., SPEAR BARBS.

Particles of quartz, etc., which would be suitable for use on the "death spear" are found at some sites; but whether they were produced for such a purpose, or even whether such a type of composite spearhead was customary at the time microliths were in vogue, is not known.

GEOMETRIC PIECES.

These can conveniently be divided into Rounded and Angular. Despite their varied shape, they have been frequently all included under the term "crescents"; therefore, it is necessary for our purpose to make a more precise classification, and one more in keeping with that used overseas. Some specimens show squilling caused by some sort of usage of the thin edge, but this is an uncommon feature. Their function is problematical, though by some authorities they are thought to be units of a composite implement. Size ranges down to as small as 0·6 cm.

A. ROUNDED.

I. SEGMENTS.

On account of their varied form, this general term has been found preferable to crescents, lunates, demi-moons, etc. The majority are made from well knapped bladelets. The more or less vertical or abrupt trimming is done on occasion from both faces, especially if the worked margin is wide. Rarely one of the points is trimmed to a retroussé or cocked-up shape. Workmanship, thickness, and size vary. Some largish heavy specimens of this type are suggestive of small examples of the elouera type of implement, full sized examples of which have been found near Millicent, Adelaide, Moonta, and Ooldea. (a) The true *crescent-moon* shape is very rare. The more common shape is the (b) *ordinary*, which is between the (c) *narrow* and the (d) *half-moon*. One special shape which recurs fairly frequently, as if an intentional variety, is (e) in outline like a *rudder*, with a greater convexity in the vicinity of one of the ends. When the two points are cocked or turned upwards, which variety is sometimes found, the piece is a (f) *cupid's bow* or cocked hat variety. An asymmetrical variety (g) really a *semi-segment*, has one end truncated by trimming, or shows the striking platform.

II. DISCOIDAL SCRAPERS.

These pieces are beautifully made little implements, for which, for purposes of classification, we retain the name scrapers. Some seem too small to be used even in the fine thin fingers of the aborigines, and were possibly for fixture in a handle. The discoidal scraper is an early and characteristic type of most microlithic cultures. It is a common type at Moonta, in fact largely outnumbers the other geometric shapes, the significance of which fact is not at present apparent. Some are flat and others high backed heavier pieces. Occasionally the outline is more an oval. Comparatively large pieces are found as well as small.

B. ANGULAR.

I. TRIANGLES.

Several of these are of coarser and heavier appearance than the segments. The same technique of abrupt trimming is employed, and they are sometimes worked from both faces. The varieties found are: (a) *equilateral*, (b) *obtuse*, and a few (c) *scalene*, as also (d) *isosceles*. Some of these triangles are thick enough to have been percussively trimmed. A few examples are found in form to be a sort of hybrid triangle-cum-segment which takes the shape of (c) a *bracket*. Sizes range from minute to large.

Some of the rare isosceles shape show trimming also of the base much like the typical Tardenoisian point.

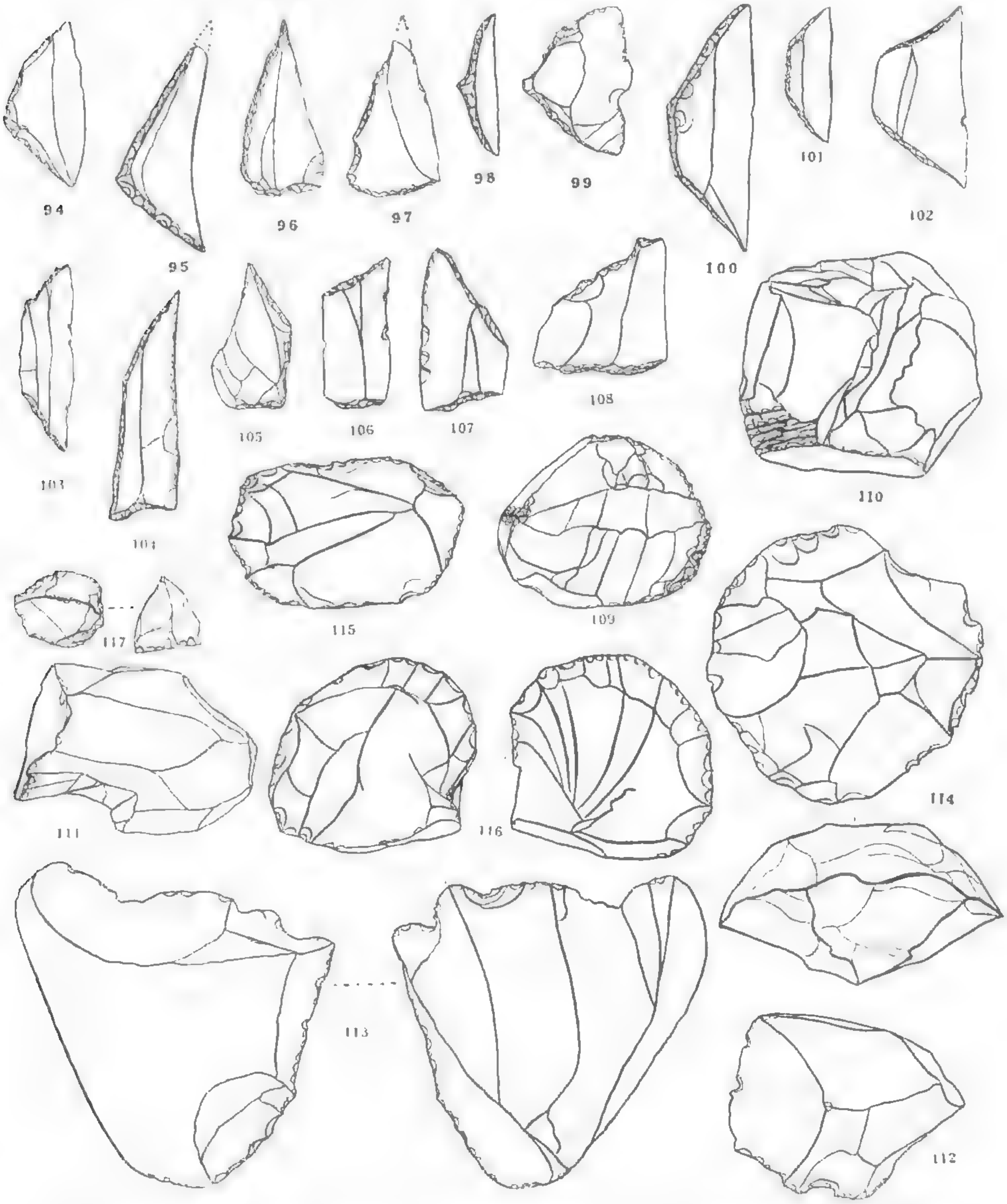

Fig. 94–117: 94, obtuse triangle; 95, scalene triangle; 96–97, isosceles triangle (Tardenoisian form); 98–99, bracket form; 100–101, symmetrical trapeze; 102–103, symmetrical trapeze an untrimmed margin; 104–105, asymmetrical trapeze; 106–108, asymmetrical trapeze an untrimmed margin; 109–110, nucleiform percutor; 111, prismatic nucleus; 112, polyhedral nucleus; 113, discoidal nucleus; 114, pyramidal discoidal biface; 115, ovate biface; 116, semi-discoidal biface; 117, semi-discoidal biface minute. (All nat. size.)

II. Trapezes.

These are more delicate than the triangles, being made more often from thinner bladelets. The technique is the same as for the other abrupt trimmed microliths. The trimming from both faces is seldom found. They can be differentiated into: (a) *symmetrical,* with three margins trimmed, and a variety which has only the ends trimmed with an untouched margin between, like a double oblique. Of these latter, some are quite long, others are squat. The (b) *asymmetrical* form is usually trimmed at the base and the other end of the piece trimmed to an oblique point, but the trimming of all three margins is sometimes found.

MISCELLANEOUS.

A. PERCUTERS OR HAMMER STONES.

I. It is likely a small *pebble percuter* would be used for obtaining bladelets, but examples are few, and there is the possibility of their use for trimming.

II. Certain shaped specimens of *nuclear form,* some of quartz, are more in evidence, and in view of the greater precision required to produce small flakes and blades, it is possible such prepared tools were frequently used as percuters instead of round surfaced pebbles. These nucleiform pieces provided prominent points and edges more suitable for precise knapping.

Softer materials may have been used, but no definite evidence can be said to exist that this was so. The possible use of a punch in knapping has been already mentioned.

B. NUCLEI.

These, of small size, are found in rough *prismatic* type, but are scarce. Mostly they are conical, but some are *polyhedral,* and on occasion a *discoidal* type is found. No definite examples have been found of such pieces being used as concave scrapers. Some specimens, however, show utilization, possibly for scraping. It is not necessary to work at only a small nucleus to produce bladelets or small flakes.

C. BIFACES.

I. Discoidal Biface Worked Pieces.

These are not simple discoidal nuclei but utilized pieces. At least one specimen shows shaping of one of the faces to a pyramidal form, which is reminiscent of a similar variety found in Ceylon. A few are approximately ovates, also somewhat like those found in Ceylon.

II. Semi-discoidal Biface Worked Pieces.

These and the discoidals are the only implements except rare pirris and some punches, worked on both faces. In appearance they are just like small replicas, one is minute, of a well-made blade of the West Australian flake-hatchet, an implement, according to Cawthorne (1844), which was also in use, single bladed, among the Adelaide tribe in his time. It is not, however, supposed that this must have been their use. Similar pieces are found in Ceylon.

D. PEBBLE IMPLEMENTS.

We have found no definite examples of these of microlithic size.

ANTIQUITY.

The only evidence of any sort as to the age of these small implements, apart from the absence of any reference to their use by early settlers, and the modern aboriginal's ignorance of them, is that afforded us by the excavation of the shelter at Devon Downs. There small implements including scrapers, pirris, and pieces like miniature specimens of the worn tula adze-flake are found in undisturbed deposit down to some 5 metres below the surface. This shows that the micros are of some antiquity in that part of the Murray Valley, and it is significant that pirris are absent in the subsequent culture remains found in the upper levels of the deposit. Confirmatory stratification in other localities is, however, wanting, and until this is available approximate dating of the micro industry is not possible. Patination is in our experience a most unsound and misleading indication of age, largely dependant on the material and environment. Open air wind blown sites and alluvial deposits are subject to natural disturbances which make them, except under certain infrequent and unusual conditions affording definitely associated flora and fauna which is dateable, also unreliable. A coincidence which may have some connection with the microlithic implements is the fact that composite implements such as the stone barbed "death spear", flake hatchet, and quartz chip saw-knife were in use during recent times in the regions where microliths occur. It is not impossible that the sequence of development in some forms of barbed spear heads has been (a) attached (gum or sinews) stone barbs, (b) attached bone or wood barbs, (c) the barbs cut out of the wooden shaft. In the present state of our knowledge we feel we can say no more than that the microliths are implements of an extinct aboriginal culture, and their use may have continued, in some areas, up to comparatively recent times.

It is very rarely that one finds pieces that have been damaged by fire and heat.

COMPARISON WITH SOME OTHER INDUSTRIES.

Table 1 shows a comparison of some characteristic implements of the French, Ceylon, and South Australian microlithic industries. Except in France, no stratificatory evidence has been found to reveal the phases or cultures that made micro implements. In France the industries recognized by some authorities are Azilian, Sauveterrian, Tardenoisian I, II, III, Tardenoisian-Campignian, Tardenoisian-Robenhausian, and Tardenoisian-Campignian-Robenhausian. As time went on the cultures became more and more affected by outside contacts. It will be noticed that, while there are similarities, each of the three countries shows certain distinctions. Thus France has the Sauveterrian and Tardenoisian points, Tardenoisian multiple concave scraper, Azilian harpoon, and painted pebbles, the tranchet and barbed and beaked points, as also the micro-burin.

Ceylon has the arrowheads and narrow segments, as also miniscule piercers, corettes, and biface worked ovates.

South Australia has the microlithic pirris, and abundant thumb-nail and discoidal scrapers.

It must be borne in mind that research in this State, unlike France, has still a large field to cover, and from that point of view much headway to make. Types not yet identified or distinguished as South Australian may, therefore, some day in the future be added to our list.

GENERAL.

A noticeable characteristic of the Australian stone implements is the range of sizes in which certain shapes of tools are made, thus: (1) the segment shape is found as a minute and large microlith, and also as the elouera, and (2) the triangle shape as a minute and large micro and the giant worimi, also of somewhat triangular form; (3) the circular shape as the microlithic discoidal and thumb-nail scraper, the tula adze-flake, the arapia, and the large horsehoof implement; (4) the leaf-shape as the microlith of squat and ordinary size, the long and narrow, and the large outsize pirris, as also the Kimberleys spearhead; (5) the Adelaide point also has its micros, ordinary and outsizes, whilst (6) the untrimmed point has a similar range; (7) the carinate and slug-like forms will also be found to have a similar range.

The almost inexplicable minuteness of some of the specimens such as the corettes, the segments, and the adze-flake like pieces, as also the pirris, is another noticeable characteristic.

As regards technique, the skill and variety of methods show that the bygone aboriginal was no tyro or mean craftsman, indeed in both knapping and trimming he could hold his own with the best of the world's primitive stone implement makers. Some of the finer specimens of the South Australian pirri point are so attractive that though it is obvious they are most efficient implements, it is hard to explain their extra careful finish and beauty by any other stimulus than artistic endeavour. Many specimens may be found made of inferior material which are eloquent testimony to the patience and clever technical skill of the South Australian stone worker.

This paper is concerned mainly with setting out a general classification and description of microlithic pieces. It is felt that it will serve for their future collection, recognition, and description. We realize that much still remains to be done in the way of specialized research such as the differentiation of new types and varieties, and a more detailed study of various individual types, together with their relation to localities and raw material. We would again impress upon amateur collectors the necessity for systematic collecting and prompt locality marking of specimens, as also the great desirability of pooling their material in a properly organized and recorded Museum collection. By such means much more effective research is made possible, as usually every encouragement and facility is readily provided by such institutions to those wishing to pursue serious study of the often exclusive material thus centralized.

It will have been noted that special and extended attention has been given to the South Australian pirri. Of all the many varieties of implements which make up the Australian stone industries, the pirri is, so far as present knowledge goes, pre-eminently a South Australian product.

The writers wish to record their thanks to the Museum Director, Mr. H. M. Hale, to the acting ethnologist, Mr. H. M. Cooper, and the librarian, Miss G. M. Bishop, as also to Miss Gwen Walsh who drew the illustrations, for their wholehearted co-operation; also to the Museum Board who are so ready to place their collections and facilities at the disposal of students. The Adelaide Museum's collection of microliths has been from time to time enriched by donations from private collectors such as the late Prof. W. Howchin, and Messrs. C. P. Mountford, H. Sheard, and J. E. Johnson, to all of whom we are also indebted.

SUMMARY.

This paper deals with a survey, classification, and description of the microlithic stone implements found in South Australia, and is based on a study of available material in the South Australian Museum collection.

The classification is put forward in the hope that it will be useful as a basis for future collecting and describing as more precise terminology than hitherto is employed.

Several hitherto undifferentiated types and varieties, including the microburin, have been now placed on record, and some named.

Particulars are given showing the wide distribution and range of microliths in this State, as also a list of the materials used in their production.

The technique of their manufacture is discussed. Certain characteristics of the implements, such as range of sizes, shapes, and varieties of technique are touched upon.

Attention is called to the outstanding workmanship and significance of a masterpiece of the aboriginal stone worker—the South Australian pirri.

The evidence which is available giving any idea of the antiquity of the microliths is considered.

A comparative table is given setting out the characteristic types of microlithic stone implements found in France, Ceylon, and South Australia, showing that many of the main types that have been in use in the first two regions are represented in South Australia.

COMPARISON OF CERTAIN MICROLITHIC INDUSTRIES.

X = In Quantity; R = Rare; — = Absent.

Implement.	S.A.	Ceylon.	France.
I. Abrupt Trimmed:			
(a) Narrow, straight (lamelle à dos abattu) ..	VR	X	X
(b) Narrow, straight pointed (Bondi) . ..	R	R	X
(c) Bimarginal trimmed (Sauveterrian point)	VR	R	X
(d) Obilque trimmed (pointe oblique) . ..	R	X	X
II. Scrapers:			
(a) Semi-discoid or thumb-nail	X	R	R
(b) Concaves (encoche)			
1. Single	R	X	X
2. Multiple (Tardenoisian)	—	—	X
III. Geometrical:			
(a) Rounded			
1. Segments (lunates, crescents, segment de circle)			
Ordinary	X	X	X
Narrow	R	X	R
Rudder	X	X	R
2. Discoidal scraper (Azilian)	X	R	R
(b) Angular			
1. Triangles			
Equilateral	R	X	X
Scalene	R	X	X
Isosceles (Tardenoisian point) ..	VR	VR	X
Barbed (Pointe de fleche asymetrique)	—	—	X
Beaked (en bec)	—	—	X

Implement.	S.A.	Ceylon.	France.
2. Trapezes			
Symmetrical	X	X	X
Asymmetrical	X	X	X
IV. Leaf shape points (pirri, point foliacee, feuille de gui)	X	—	R
V. Micro-burin (Tardenoisian)	VR	—	X
VI. Miniature biface ovate (Bandarawelian)	R	X	—
VII. Miniature piercer (Bandarawelian)	—	X	—
VIII. Corettes (Bandarawelian)	R	X	—
IX. Harpoons (Azilian)	—	—	R
X. Painted Pebbles (Azilian)	—	—	X
XI. Tranchet	—	R	X
XII. Discoidal biface	X	X	—
XIII. Semi-discoidal biface	X	X	—
XIV. Arrowheads	—	X	—

RECORDED SITES IN SOUTH AUSTRALIA WHERE MICROLITHIC IMPLEMENTS HAVE BEEN FOUND.

Far north: Mt. Dare (near the South Australian-Northern Territory boundary). Coward Springs, Cooper Creek, Maree, Lyndhurst, Flinders Range.
Far north-west: Stuart Range, Mt. Eba, Miller Creek, Lake Hart, Eucolo.
Far west: Ooldea.
Mid north: Koolunga, Burra, Oakvale, Bute, Port Augusta.
Eyre Peninsula: Near Tumby Bay, Gawler Ranges.
Yorke Peninsula: Cape Spencer, Moonta, Ardrossan.
Adelaide region: Adelaide to Normanville.
Kangaroo Island: Cape Cassini.
Lower Murray region: Devon Downs, Framms Landing, Murrundi, Goolwa, Port Elliot, Coorong.
East of Mt. Lofty Ranges: Eden Valley, Sutherland.
East: Bordertown, Pinnaroo, Tintinara, Ral Ral.
Lower South East: Kingston, Woakwine Range, Millicent, Mt. Gambier, Cape Northumberland.

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THE COWRIES (CYPRAEIDAE) OF FIJI

BY THE REVEREND W. R. STEADMAN AND BERNARD C. COTTON,
CONCHOLOGIST, SOUTH AUSTRALIAN MUSEUM

Summary

The reefs and estuaries of the numerous islands in the Fiji Group constitute one of the most prolific fields for the study of Conchology. Some species of shells are rare, but in many places both reef and shore are teeming with various kinds of Mollusca and other marine life.

The Cowries here enumerated were collected by the Rev. and Mrs. W. R. Steadman during twenty-five years' residence in Fiji. A total of sixty-one species and subspecies are included in this list, of which two only were not found by the Steadmans, namely Ovatipsa chinensis Gmelin 1791 (= cruenta Gmelin 1791 = crenata Bolton 1798 = morbillosa Bolton 1798 = variolaria Lamarck 1810) and Cypraeovula adamsoni Gray 1832.

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INTRODUCTION.

The reefs and estuaries of the numerous islands in the Fiji Group constitute one of the most prolific fields for the study of Conchology. Some species of shells are rare, but in many places both reef and shore are teeming with various kinds of Mollusca and other marine life.

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Doctors F. A. and M. Schilder in their recent "Prodrome of a Monograph on Living Cypraeidae" (*Proc. Mal. Soc.*, 1939, xxiii, pt. iv, pp. 119-231) list several species from the Western Samoa = Fijian Region (p. 216) which have not been found by the Steadmans, and there are other species that have been taken by them in Fiji which do not appear in the Schilders' list for this locality.

Cowries listed by Schilders for Fiji-Samoan Region, but not taken by the authors:

Epona mariae Schilder (1927).
Ipsa childreni Gray (1825).
Naria irrorata Gray (1828).
Lyncina leviathan Schilder-Schilder (1937) giant *carneola*.
Cribraria goodalli fuscomaculata Pease (1865).
Cribraria teres subfasciata Link (1807) loc. Mauritius.

In preparing this account of Fijian Cowries we have given, with our identification, a full description of the shell, minimum and maximum adult size, and relative frequency of occurrence and locality. Some examples were taken by natives, and others were found on the beach after storms. In several cases the live animal was not observed, although many shells of the species were taken. In the case of *Callistocypraea aurantium turanga* subsp. nov., one example was seen with the animal in the shell; the specimen was taken by a native, and had been out of water for some time when examined. Being dead, only the general colour of the animal could be given. It is realized that a description of the animal is of great importance, and in every case possible fullest details are given. We are preparing figures of these shells, including animals where possible, for publication at a later date. Some will appear in the South Australian Naturalist, Vol. 22, No. 2, 1943.

The wide distribution of most cowries is explained by the fact that they have a comparatively long free-swimming larval-stage, resulting in the formation, in far-flung zoogeographical regions, of readily distinguishable subspecies. This is evident in the hitherto little studied Fijian Region, and thus a number of new names have been introduced here. Fijian names of local objects and places, with the approximate phonetic spelling, have been largely used by us as a basis for this new subspecific nomenclature. It must be noted that in Fijian words *b* is always pronounced *mb*, *c* as *th* in *that*, *d* as *nd*, *g* as *ng* in *sing*, and *q* as *ng* in *hunger*.

We have to acknowledge the ready and helpful assistance given by the late Mr. W. J. Kimber, of Adelaide, and Mr. Tom Iredale, Conchologist of the Australian Museum, Sydney.

FAMILY CYPRAEIDAE.

Subfamily NARIINAE.

The Schilders 1939 admitted four species, including *tessalata*, in *Pustularia*, but, as Iredale (1939) has pointed out, the latter represents a distinct genus, and is not admissible to the *cicercula* group. This leaves three species of *cicercula*, but Fijian shells reveal five distinct species, each of which has its uniform characteristics. We have separated *margarita* under the Subgenus *Annepona*, as it is nearer in form to *mariae*; we have accepted the names *bistrinotata sublaevis* and *globulus sphaeridium*, but have added *circercula jennisoni* (subsp. nov.) and *tricornis vulavula* (subsp. nov.), retaining old names with subspecific Fijian names. Although the generic name indicates pustules, only one of the five species (*tricornis vulavula*) has a rough surface, and *bistrinotata sublaevis* has nearly obsolete granulations. Three of the species are quite smooth, and cannot be placed with granulated specimens, apart from the fact that there are also other distinct characteristics which appear in the detailed descriptions.

PUSTULARIA Swainson 1840.

Subgenus ANNEPONA Iredale 1935.

PUSTULARIA MARGARITA THEEVA subsp. nov.

Shell sub-globular, produced at extremities, anterior acuminate, posterior callosed; dorsum smooth, slightly humped, coloured pearly cream with faint white lacunae distributed sparsely; slight marginal ridge; inner wall of dorsum white; base white, convex, slight bulge at centre and turned upwards towards posterior outlet; aperture narrow, with slight turn to left at posterior outlet; outer lip declivous at anterior outlet; teeth fine, not produced across base, obscure in centre, heavier at extremities, heavy terminal ridge at anterior outlet; sulcus wide and shallow, fossula concave and denticulate. Animal not observed. Six specimens taken at Nadroga.

Habitat, inside main reef.

Length 12–14 mm., width 7–9 mm., height 6–7 mm.

Type in South Australian Museum, Reg. No. D.14137.

Teeth (holotype 14 mm. in length), Labial 30; Columella 24.

Loc. Kadavu, Suva, Levuka; six specimens taken at Nadroga (type loc.).

Named *theeva* from the Fijian word for pearl shell, adopted for this shell because of its pearly appearance.

Subgenus PUSTULARIA Swainson 1840.

PUSTULARIA CICERCULA JENNISONI subsp. nov.

Shell globular, light brown above and beneath, produced at extremities which are prominently acuminate, peculiar wart-like dorsal callosity above posterior outlet; dorsum smooth and humped, dark brown specks all over dorsum, faint at apex, more definite at sides, no dorsal line; inner wall of dorsum cream; base convex, turning upwards towards posterior outlet; aperture narrow, with slight turn to left at posterior outlet, raised ridge towards anterior outlet, outer anterior lip declivous; two widely spaced small brown blotches on each side of aperture; teeth fine and regular to half way across base; sulcus and fossula white, shallow, and denticulate. Animal not observed.

Habitat, inside main reef.

Length 13–20 mm., width 9–12 mm., height 6–10 mm.

Type in South Australian Museum, Reg. No. D.14138.

Teeth (holotype, 18 mm. in length), Labial 30; Columella 24.

Loc. Levuka, Beqa; twelve specimens taken at Suva, Taveuni (type loc.), and Naselai.

Named *jennisoni* after the Rev. J. C. Jennison, a missionary in Fiji for many years, who collected shells at Taveuni, and presented the holotype to the South Australian Museum.

PUSTULARIA BISTRINOTATA SUBLAEVIS Schilder 1939.

Shell globular, light brown above and beneath, produced at extremities which are acuminate, peculiar wart-like dorsal callosity above posterior outlet; dorsum humped, smooth across apex but with almost obsolete granules towards extremities, faint brown specks all over dorsum, lateral specks more definite, three pairs of blotches on either side of a faint dorsal line; inner wall of dorsum cream; base convex turning upwards towards posterior outlet; aperture narrow, slight turn to left at posterior outlet, outer anterior lip declivous, two widely spaced brown blotches on each side of aperture; teeth fine and regular to half way across base, but becoming shorter along posterior half of columella; sulcus and fossula wide, shallow, creamy, and denticulate. Animal not observed.

Habitat, inside main reef.

Length 13–18 mm., width 7–11 mm., height 6–10 mm.

Teeth (for specimen 18 mm. in length), Labial 30; Columella 24.

Loc. Fiji (type loc.), Kadavu, Taveuni; ten specimens taken at Suva and Nadroga.

PUSTULARIA TRICORNIS VULAVULA subsp. nov.

Shell globular, milky white in colour; extremities produced and acuminate, axis umbilicate; dorsum humped and finely granulated all over, dorsal groove along whole length; inner wall of dorsum white; base convex turning upwards towards posterior outlet; aperture narrow turning to left at posterior outlet, and having raised ridge towards anterior outlet, outer anterior lip slightly declivous; teeth fine and regular, produced right across base on both sides, but shorter towards posterior outlet; sulcus and fossula wide, concave, and denticulate. Animal not observed.

Habitat, inside main reef.

Length 13–18 mm., width 8–12 mm., height 6–10 mm.

Type in South Australian Museum, Reg. No. D.14139.

Teeth (holotype, 18 mm. in length), Labial 35; Columella 24.

Loc. Nadroga (type loc.), Kadavu, Taveuni; ten specimens taken at Nadroga and Suva.

Named *vulavula*, from the Fijian word for white.

PUSTULARIA GLOBULUS SPHAERIDIUM Schilder 1939.

Shell globular, extremely humped, coloured pearly cream with faint brown diffused spots sparsely distributed over dorsum, no dorsal line, axis umbilicate, extremities produced and acuminate; inner wall of dorsum cream; base convex, coloured ivory white turning upwards towards posterior outlet; aperture narrow, with sharp turn to left at posterior outlet, outer anterior lip slightly declivous; teeth becoming obsolete at centre, produced to about half way across base, four teeth towards posterior end of columella heavily formed; sulcus wide, fossula concave, both denticulate. Animal not observed.

Habitat, inside main reef.

Length 10–17 mm., width 7–10 mm., height 6–9 mm.

Teeth (for specimen 17 mm. in length), Labial 34; Columella 24.

Loc. Central Melanesia (type loc.), Levuka, Kadavu, Taveuni; eight specimens taken at Nadroga and Suva.

Subfamily STAPHYLAEINAE.

STAPHYLAEA Jousseaume 1884.

Subgenus STAPHYLAEA Jousseaume 1884.

STAPHYLEA CONSOBRINA Garrett 1879.

Shell elongate ovate, dark grey inner wall of dorsum appearing faintly beneath a pearly white upper surface with white pustules small at apex and larger at sides of dorsum, grooved dorsal line towards right of apex; extremities rostrate, coloured brown and pitted; lateral pitted ridges, turning upwards at left centre; base white and convex, teeth brown, well formed, oblique towards extremities, several bifurcate at centre of columella; sulcus wide, fossula concave and denticulate. Animal dark red, further details not observed.

Habitat, inside main reef.

Length 18–30 mm., width 11–18 mm., height 9–14 mm.

Teeth (for specimen 27 mm. in length), Labial 20; Columella 19.

Loc. Central Pacific (type loc.), Levuka, Kadavu, Taveuni; twelve specimens taken at Suva and Nadroga.

STAPHYLEA NUKULAU sp. nov.

Shell ovate, smaller than *consobrina*, with similar colouring (some specimens, however, have brownish instead of greyish shade), numerous minute granules all over dorsum; dorsal line finely grooved; extremities and teeth brown; base convex, teeth conspicuous and produced evenly right across base to margins which are clearly defined and slightly ridged, teeth oblique at extremities, several columella teeth are bifurcate; aperture turns to left at posterior outlet; sulcus wide and shallow, fossula slightly concave, both strongly denticulate. Animal red, further details not observed.

Habitat, inside main reef.

Length 11–18 mm., width 7–12 mm., height 5–8 mm.

Type in South Australian Museum, Reg. No. D.14140.

Teeth (holotype, 18 mm. in length), Labial 19; Columella 17.

Loc. Nukulau (type loc.), Levuka, Kadavu; twenty specimens taken at Suva and Nadroga.

This species is distinct from *consobrina* in having uniformly minute granules all over dorsum instead of heavy pustules, and the teeth are conspicuously carried right across base to clearly defined margins instead of half way across. The name *nukulau* is taken from Nukulau Island near Suva, where numerous varieties of shells are found.

Subgenus PURPEROSA Iredale 1935.

STAPHYLEA PURPEROSA RUVAYA subsp. nov.

Shell ovate; dorsum light brown, with whitish lacunae of varying sizes all over, a scarcely perceptible dorsal groove on right side, dorsal surface smooth; extremities brown, rostrate and pitted; right margin ridged and pitted; inner wall of dorsum light violet; base convex, white, central base of columella raised above level of opposite side; teeth brown and conspicuous, very oblique towards posterior columella extremity, produced half way across base; sulcus and fossula shallow and denticulate. Animal red, further details not observed.

Habitat, inside main reef.

Length 12–21 mm., width 7–13 mm., height 6–10 mm.

Type in South Australian Museum, Reg. No. D.14141.

Teeth (holotype, 21 mm. in length), Labial 20; Columella 19.

Loc. Levuka, Kadavu; four specimens taken at Suva (type loc.), and Nadroga.

The Schilders (1939) use the name *limacina facifer*, but we have accepted Iredale's name, *purperosa*. This species has no "dorsal tubercles" as mentioned by the Schilders, page 129; the dorsal surface is quite smooth. One specimen taken by the Rev. W. O. North has a few lateral spots slightly pustulose. The word ruve, pronounced ruvay, is Fijian for dove. The name *ruvaya* is used to distinguish the Fijian from the Queensland *purperosa facifer*, mainly because the teeth are finer and produced somewhat further across the base.

Subgenus NUCLEARIA Jousseaume 1884.

NUCLEARIA NUCLEUS GEMMOSA Perry 1811.

Shell ovate with heavy rough cream coloured pustules all over a light grey dorsum, dorsal line grooved; base convex, extremities acuminate, base has upward turn at posterior extremity; aperture has sharp turn to left at posterior outlet; margins ridged and coloured darker shade, slightly bent up on right side; teeth conspicuous, light brown in colour, bifurcate along most of columella side, produced right across base and over margins to form striae on each side of dorsum; sulcus very shallow and denticulate, fossula shallow with prominent ridge on lower inner edge carried through outwards to left anterior extremity; inner wall of dorsum purple. Animal dark gray, further details not observed.

Habitat, inside main reef.

Length 15–26 mm., width 11–17 mm., height 8–12 mm.

Teeth (for specimen 26 mm. in length), Labial 26; Columella 18.

Loc. Central Pacific (type loc.), fairly general throughout Fiji; thirty specimens taken at Suva and Nadroga.

The Schilders (1939) in their description of this species state that the extremities are "short to blunt", but the Fijian specimens have well produced extremities, acuminate, perhaps inclined to an upwards rostrate tendency. We have, however, accepted the name as other characteristics apply.

Subfamily EROSARIINAE.

EROSARIA Troschel 1853.

Subgenus RAVITRONA Iredale 1930.

EROSARIA CAPUTSERPENTIS ARGENTATA Dautzenberg and Bouge 1933.

Shell ovate and depressed, with wide heavy chocolate brown margins, plain in colour half way to apex of dorsum, where the colouring breaks into a network of numerous irregular white lacunae, appearing through brown connecting threads, and sometimes gray zonal shadings showing through from below; white dorsal line crooked, often missing; inner wall of dorsum and extremities violet; light patch above posterior extremity, anterior extremity somewhat attenuated; base depressed, shaded from dark at margins to cream at aperture; aperture turning left at posterior outlet; sulcus shallow, fossula narrow, concave, slightly denticulate; teeth not produced across base, inclined to be short and heavy, oblique towards posterior outlet. Animal has variegated dark brown mantle, with filaments in which red and brown appear, siphon and tentacles gray.

Habitat, among brown weeds in vermiculated grooves on outer edge of main reef where there are big breakers at high tide.

Length 20–36 mm., width 15–25 mm., height 9–16 mm.

Teeth (for specimen 36 mm. in length), Labial 16; Columella 14.

Loc. Central Pacific (type loc.), common throughout Fiji; numerous specimens taken at Suva and Nadroga.

Subgenus Erosaria Troschel 1863.

Erosaria erosa chlorizans Melville 1888.

Shell ovate; dorsum light brown with numerous gray lacunae often enclosed by brown rings irregularly placed, dorsal line gray on right side, sometimes missing; inner wall of dorsum light purple; margins heavily calloused and ridged, with brown spots; extremities heavily ridged, with brown lines above; large dark brown blotches above and beneath centre of margins; base depressed, cream; aperture wide, turns left at posterior outlet; sulcus and fossula shallow and denticulate; teeth heavy, produced well across base to right margin, but not on left, oblique towards posterior outlet. Animal gray, mantle yellowish gray with prominent delicate filaments shaded to dark brown, siphon light brown, tentacles darker brown.

Habitat, both on outer and shore reefs, usually larger specimens taken on outer reef.

Length 20–43 mm., width 13–27 mm., height 8–18 mm.

Teeth (for specimen 43 mm. in length), Labial 16; Columella 14.

Loc. Central Melanesia (type loc.), common throughout Fiji; numerous specimens taken at Suva and Nadroga.

Erosaria poraria scarabaeus Bory 1827.

Shell ovate; dorsum light brown, with numerous white spots enclosed in violet-brown rings, dorsal line violet-gray, often missing; margins violet, slightly ridged and pitted towards extremities; base slightly convex, shaded from violet at margins to white at aperture; aperture turns left at posterior outlet; inner wall of dorsum deep violet, sulcus shallow, fossula concave and denticulate; teeth white, finely chiselled on both sides of aperture, produced half way across base on right side, but shorter on left, oblique towards posterior outlet. Animal red, mantle gray, filaments white and gray.

Habitat, inside main reef.

Length 15–21 mm., width 10–15 mm., height 5–9 mm.

Teeth (for specimen 21 mm. in length), Labial 16; Columella 14.

Loc. Central Pacific (type loc.), Kadavu, Levuka, Taveuni; twenty specimens taken at Suva and Nadroga.

Erosaria helvola callista Shaw 1909.

Shell ovate, depressed, with wide heavy plain brown margins shaded to darkest half way to apex of dorsum, where the plain colouring breaks into a network of minute closely packed white lacunae on a bluey gray surface, and many irregularly placed brown spots superimposed upon this network, no perceptible dorsal line; base depressed, brown in colour; extremities shaded violet on upper side; teeth heavy, produced to margin on right side, short especially at centre on left side, oblique towards extremities; inner wall of dorsum violet; sulcus and fossula narrow, the latter slightly denticulate. Animal orange, mantle mottled with lighter shaded filaments, siphon and tentacles shaded yellow to red.

Habitat, inside main reef.

Length 12–20 mm., width 8–14 mm., height 6–9 mm.

Teeth (for specimen 20 mm. in length), Labial 15; Columella 15.

Loc. Polynesia (type loc.), common throughout Fiji; thirty specimens taken at Suva and Nadroga.

EROSARIA HELENAE NASESE subsp. nov.

Shell elongate ovate; dorsum brownish gray, with numerous tiny whitish gray spots all over dorsal surface, dorsal line indicated by gray shadowy break in pattern; inner wall of dorsum purple; both margins ridged, with dark brown spots on upper side; extremities rostrate, anterior especially prominent, with brown markings above; base convex, white in colour; aperture constricted at labial anterior extremity, turning slightly to left at posterior outlet; teeth produced to margin on right side, but short on left, oblique towards columella posterior outlet; fossula shallow and denticulate; prominent terminal ridge at anterior columella extremity. Animal not observed.

Habitat, inside main reef.

Length 14–16 mm., width 8–10 mm., height 6–7 mm.

Type in South Australian Museum, Reg. No. D.14142.

Teeth, (holotype, 14 mm. in length), Labial 14; Columella 14.

Loc. Three specimens taken at Suva (type loc.); probably occurs at other localities, but not observed.

Schilders (1939) reject *flaveola* Gray 1825, and use the name *labrolineata* Gaskoin 1848. Iredale (1939) rejects *labrolineata*, regarding it as a synonym for *helenae* Roberts 1869. We have adopted *helenae*, and added *nasese* to distinguish the Fijian specimen. *Nasese* is the name of a suburb of Suva, where there is a coastal reef with a fine lot of shells.

EROSARIA EBURNEA Barnes 1828.

Shell ovate, pearly white both above and beneath; inner wall of dorsum light brown; anterior extremity has conspicuous pitted ridge, posterior extremity slightly produced on right side; base convex; aperture wide, slightly constricted on labial anterior end, turning left at posterior end; no sulcus, fossula shallow and narrow, prominent terminal ridge at left anterior extremity; obsolete ridge along right margin; teeth large, not produced across base, oblique towards posterior columella outlet. Young shells have a bluish shading appearing beneath the pearly white covering of the dorsum, but as shell matures and dorsum thickens this dark undershade disappears. Animal brownish gray, mantle gray with tiny filaments edged with light brown, fringed siphon and tentacles brown.

Habitat, in sand around shore rocks between tides.

Length 27–50 mm., width 17–30 mm., height 12–23 mm.

Teeth (for specimen 50 mm. in length), Labial 18; Columella 15.

Loc. Fiji (type loc.), Nadi, Nadroga, Kadavu; thirty specimens taken at Tavua and Suva.

MONETARIA Troschel 1863.

Subgenus ORNAMENTARIA Schilder-Schilder 1936.

MONETARIA ANNULUS NOUMEENSIS Bernardi 1861.

Shell pyriform; dorsum slightly humped, sloped equally at sides, pearly gray at margins, and half way to apex darker greeny grey with erratic orange line, lighter bluish gray around apex within the orange line; inner wall of dorsum purple; base depressed, pearly gray in colour; aperture wide, somewhat constricted at labial anterior extremity, slight turn to left at posterior outlet; sulcus and fossula obsolete; teeth not produced across base, oblique towards posterior outlet on columella side. Animal dark gray, mantle dark green, flecked with black and white patches, filaments light coloured with pink shadings, siphon gray with pink fringe, tentacles pink.

Habitat, among small rocks and broken coral on shore reefs, where it is taken in great numbers, also on outer reefs where surface is left bare by receding tide.

Length 13–25 mm., width 8–16 mm., height 7–14 mm.

Teeth (for specimen 25 mm. in length), Labial 12; Columella 11.

Loc. New Caledonia (type loc.), very common throughout Fiji; numerous specimens taken at Suva and Nadroga.

MONETARIA ANNULUS DRANGA Iredale 1939.

This species differs from *noumeensis* in being proportionately wider, dorsum depressed instead of slightly humped, calloused at margins, with slight torus, revealing a tendency towards *obvelata*; teeth further produced across columella base; aperture has greater turn to left at posterior outlet, both lips raised in centre. No apparent differences observed in the animal from that of *noumeensis*.

Habitat, usually found near *noumeensis* in similar conditions.

Length 16–23 mm., width 13–19 mm., height 9–12 mm.

Teeth (for specimen 23 mm. in length), Labial 12; Columella 10.

Loc. Samoa (type loc.), common throughout Fiji; numerous specimens taken at Suva and Nadroga.

Whilst there are numerous true specimens of both *noumeensis* and *dranga*, showing clearly the distinct features described above, there are also a great number of intermediate specimens tending either towards one or the other. In view of this we would venture the suggestion that there are two tribes, but quite a lot of cross breeding.

Subgenus MONETARIA Troschel 1863.

The Schilders (1939) list *moneta barthelemyi*, locality, Central Pacific, as from the Fiji region, but this name applies to a New Caledonian aberration, as pointed out by Iredale (1939) and cannot be used for the Fijian specimens. There are three distinct species of *moneta* in Fiji easily identified by (1) slightly humped dorsum, equally sloped sides, cream base, (2) depressed dorsum, heavy tubercles, cream base, (3) slightly humped dorsum, milky white margins and base. We have given these three species subsp. names of *endua*, *erua*, and *etolu*, Fijian words for one, two and three. At the same time, whilst there are numerous true specimens showing clearly the distinct features described above, as in the case of *annulus*, there are many intermediate specimens tending either towards one or the other. The suggestion may again be made that there are probably three distinct kindred tribes, but also an amount of cross breeding.

MONETARIA MONETA ENDUA, subsp. nov.

Shell pyriform, heavily calloused at margins and extremities; dorsum slightly humped, colour deep cream, with greenish under shading across upper half of dorsum, and darker zonal bands. Some specimens are bright canary yellow, and others again have faint orange lateral lines similar to *annulus*; inner wall of dorsum purple; base depressed, shaded deep cream at margins to ivory white at aperture; aperture wide, constricted at anterior outlet, turns slightly to left at posterior outlet; teeth large, not produced across base, becoming obsolete towards posterior end of columella; sulcus and fossula missing; columella base raised in centre above level of opposite side. Animal gray, mantle mottled gray and yellow, filaments small, shaded cream and purple, siphon gray, fringed, tentacles gray touched with yellow.

Habitat, both *annulus* and the three species of *moneta* are usually found in proximity, congregated in colonies among small rocks and broken coral on shore reefs, and also found in less numbers on outer reefs.

Length 15–33 mm., width 9–22 mm., height 8–17 mm.

Type in South Australian Museum, Reg. No. D.14143.

Teeth (holotype, 30 mm. in length), Labial 14; Columella 13.

Loc. Common throughout Fiji; numerous specimens taken at Suva (type loc.) and Nadroga.

MONETARIA MONETA ERUA subsp. nov.

Shell broader than *moneta endua*, dorsum somewhat depressed, margins and extremities heavily calloused with coarse tubercles especially towards posterior extremity; dorsal colouring deep cream to bright canary yellow, some specimens having greenish shading on upper half of dorsal surface, and dark zonal bands, some have also the orange lateral lines similar to annulus; inner wall of dorsum purple; base depressed, deeper cream on under margins, shaded to ivory white at aperture; aperture rather less wide than in *endua*, scarcely any turn to left at posterior outlet; teeth heavy with tendency to become tuberculose, not produced across base; sulcus and fossula obsolete. Animal similar to that of *endua*.

Habitat, similar to that of *endua*.

Length 18–28 mm., width 13–22 mm., height 9–15 mm.

Type in South Australian Museum, Reg. No. D.14144.

Teeth (holotype, 28 mm. in length), Labial 12; Columella 12.

Loc. Common throughout Fiji; numerous specimens taken at Suva (type loc.) and Nadroga.

MONETARIA MONETA ETOLU subsp. nov.

Shell pyriform, dorsum slightly humped and shaded creamy gray over upper half, with three dark greenish zonal bands; margins, extremities, and base milky white; inner wall of dorsum purple; base depressed; aperture wide, almost straight, wider at anterior outlet; teeth large, not produced across base; sulcus and fossula obsolete. Animal similar to that of *endua* and *erua*.

Habitat similar to that of *endua* and *erua*.

Length 17–23 mm., width 14–17 mm., height 10–13 mm.

Type in South Australian Museum, Reg. No. D.14145.

Teeth (holotype, 23 mm. in length), Labial 14, Columella 14.

Loc. Common throughout Fiji; numerous specimens taken at Suva (type loc.) and Nadroga.

Subfamily ERRONEINAE.

CRIBRARIA Troschel 1863.

CRIBRARIA CRIBRARIA NORTHI subsp. nov.

Shell pyriform-elongate; dorsum has white spots on brown surface making a somewhat sieve-like appearance (whence the specific name); margins, extremities and base white, right margin and extremities ridged; abrupt change in dorsal pattern to a much lighter shade along a line about 2 mm. from right lateral edge; inner wall of dorsum white; base convex; teeth heavier and produced across base on labial side, more numerous and finer on columella side; sulcus wide, fossula slightly concave, both denticulate; aperture turns left towards posterior outlet. Animal not observed.

Habitat, inside main reef.

Length 19–31 mm., width 12–18 mm., height 9–14 mm.

Type in South Australian Museum, Reg. No. D.14146.

Teeth (holotype, 28 mm. in length), Labial 17; Columella 21.

Loc. Beqa, Kadavu, Levuka, Taveuni; twenty specimens taken at Suva and Nadroga (type loc.).

The Schilders (1939) list *cribraria melwardi* Iredale (1930), from the Fiji region, but as Iredale (1939) points out, *melwardi* is "a shining stout white shell" quite distinct from the typical *cribraria*. For the Fijian specimens we have given the subspecific name of *northi* after the Rev. W. O. North, who was for many years a missionary in Fiji, and who took specimens of this shell near his home at Nadroga.

BISTOLIDA Iredale 1939.

BISTOLIDA STOLIDA THAKAU subsp. nov.

Shell elongate; extremities produced; apex depressed, light gray along length of dorsum, with irregular shaped large light brown macula in centre, and erratic lateral light brown lines from sides of macula to extremities; margins ivory white, with two yellow transverse markings on each side; inner wall of dorsum white; slight marginal ridge on right side; base white, convex; aperture has very slight turn to left at posterior outlet; sulcus wide and shallow, fossula slightly concave and denticulate; teeth produced half way across base. Animal not observed.

Habitat, inside main reef.

Length 26 mm., width 15 mm., height 11 mm.

Type in South Australian Museum, Reg. No. D.14147.

Teeth (holotype, 26 mm. in length), Labial 19; Columella 20.

Loc. Nadroga, Kadavu; one specimen taken at Suva (type loc.).

The Fijian specimen has extremities more attenuated than specimens from regions further west. The subspecific name of *thakau*, Fijian for reef, has been given to distinguish the Fijian specimen.

BISTOLIDA FLUCTUANS NANDRONGA subsp. nov.

Shell elongate, extremities produced; apex depressed; dorsum light pinkish gray, with dark brown macula in centre, but no lateral lines, minutest light brown specks along margins; marginal ridge on right side, with small light brown marks along both margins, axis umbilicate; inner wall of dorsum light brown; base depressed; aperture wide, with turn to left at posterior outlet; teeth produced across narrow labial side of base, but only half way across left side; no sulcus, fossula narrow and slightly concave, denticulate within. Animal not observed.

Habitat, inside main reef.

Length 25 mm., width 14 mm., height 12 mm.

Type in South Australian Museum, Reg. No. D.14148.

Teeth (holotype, 25 mm. in length), Labial 15; Columella 16.

Loc. One specimen taken at Nadroga (type loc.); other localities not known but probable.

Iredale (1935) introduced the name *fluctuans* for specimens of a similar shell from North Australia. The Fijian specimen is more elongate than the North Australian, and has finer teeth; it has also a brown blotch on the apex of the dorsum. We have, therefore, given this shell the subspecific name of *nandronga* (spelt Nadroga in Fijian) from the name of a district in Fiji, where a great variety of shells is found.

TALOSTOLIDA Iredale 1931.

TALOSTOLIDA SUBTERES VAVA subsp. nov.

Shell sub-cylindrical; dorsum depressed, greenish gray, with numerous more or less agglomerate tiny brown specks, and erratic brown markings, arranged somewhat irregularly in a series of zonal lines; callonsed extremities produced; calloused labial margin ridged, with dark brown spots; inner wall of dorsum purple; base convex, white; aperture rather narrow, slight turn to left at posterior outlet; sulcus and concave fossula denticulate, strong acuminate ridge at left side of anterior outlet; teeth produced half way across base on right side, but not on left. Animal not observed.

Habitat, inside main reef.

Length 23–27 mm., width 14–16 mm., height 11–13 mm.

Type in South Australian Museum, Reg. No. D.14149.

Teeth (holotype, 27 mm. in length), Labial 23; Columella 24.

Loc. Beqa, Kadavu; ten specimens taken at Suva (type loc.) and Nadroga.

The Schilders (1939) list *teres subfasciata* Link (1807) from the Fijian region, but Iredale (1939) states that this subspecies came from Mauritius, and the name is, therefore, not applicable to the Pacific subspecies. The Fijian specimens seem to belong to the *subteres* species, and we have added the subspecific name of *vava*, Fijian for a shoe.

PAULONARIA Iredale 1930.

PAULONARIA MINORIDENS SUVAENSIS subsp. nov.

Shell cylindrical and fragile; dorsum biscuit coloured, with three fulvous zonal markings, of which that across the apex comprises a series of short curved stripes, the whole of the dorsal surface is covered with minutest fulvous specks; extremities tinged with a bright fuchsia colouring, which is continued well within the anterior outlet; inner wall of dorsum buff coloured; base white on the narrow labial side, buff dorsal shading continued over left margin and across columella site of base; aperture wider at anterior outlet; no turn left at posterior outlet; fossula slightly concave and denticulate; teeth fine, obsolete on most of columella centre. Animal gray, mantle bright red, with minutest filaments of same colour, siphon gray and pink, tentacles shaded red.

Habitat, on rocks inside main reef.

Length 9–12 mm., width 5–6 mm., height 3–4 mm.

Type in South Australian Museum, Reg. No. D.14150.

Teeth (holotype, 10 mm. in length), Labial 15; Columella 15.

Loc. Eight specimens taken at Suva (type loc.); probably occurs at other localities but not observed.

The names *fimbriata, minoridens,* and *microdon* seem to have been somewhat confused, and *minoridens* has been called both *fimbriata* and *microdon.* We have adopted the name *minoridens,* adding the subspecific name of *suvaensis,* from the town of Suva, and *microdon* is used below for a pyriform species with finer teeth.

PAULONARIA MICRODON GRANUM Schilder 1938.

Shell subpyriform; dorsum slightly inflated; extremities rostrate; base white, convex; aperture narrow, slight turn left at posterior outlet; teeth very fine, not produced across base; sulcus wide and shallow, fossula concave and slight denticulate. Animal not observed.

Habitat, the one specimen taken is from the beach, and dorsal markings are eroded.

Length 9 mm., width 5 mm., height 4 mm.

Teeth, Labial 15; Columella 15.

Loc. Fiji (type loc.). One specimen taken at Nadroga; other localities not known.

EVANARIA Iredale 1930.

EVANARIA ASELLUS KAWAKAWA subsp. nov.

Shell elongate pyriform; dorsum has three broad chocolate (or in some cases black) bands transversely placed over a white surface, and continued obscurely across columella within aperture; margins, extremities, and base white, right margin slightly ridged; inner wall of dorsum white; axis depressed; aperture has very slight turn left at posterior outlet; teeth fine, produced half way across base, columella teeth inclined to be tuberculose towards posterior outlet; sulcus wide and shallow, fossula concave and denticulate. Animal black, mantle, miniature processes, siphon and tentacles black, the latter with red tips.

Habitat, on rocks inside main reef.

Length 11–21 mm., width 6–11 mm., height 5–9 mm.

Type in South Australian Museum, Reg. No. D.14151.

Teeth (holotype, 14 mm. in length), Labial 16; Columella 14.

Loc. Levuka, Kadavu, Taveuni; twelve specimens taken at Suva (type loc.) and Nadroga.

The Schilders list *asellus bitaeniata* Geret (1903) for the Pacific region, but Iredale (1939) points out that Geret's name was given to a freak colouration with two bands instead of three. We have given the subspecific name of *kawakawa,* Fijian for a bridge, to distinguish the Fijian shell.

EVANARIA HIRUNDO KOROLEVU subsp. nov.

Shell pyriform, rather plump in appearance; two irregular white zonal markings across light brown coloured dorsum; apex of dorsum depressed, falling away quickly to posterior, and more obliquely to anterior extremity; axis depressed, brown specks distributed sparsely over dorsum and on margins; right margin slightly ridged; extremities white and rostrate, brown spots on both upper sides; inner wall of dorsum purple; base convex, creamy white; aperture turns left at posterior outlet; teeth produced across most of base, bifurcate at columella centre; sulcus and fossula wide, shallow and denticulate. Animal not observed.

Habitat, inside main reef.

Length 13–32 mm., width 8–14 mm., height 7–10 mm.
Type in South Australian Museum, Reg. No. D.14152.
Teeth (holotype, 16 mm. in length), Labial 18; Columella 18.
Loc. Korolevu (type loc.), Beqa, Kadavu, Taveuni; thirty specimens taken from Suva and Nadroga.

The Schilders have used *hirundo rousi* Ancey (1882) for Melanesian types of this species, but their descriptions do not agree with the Fijian specimens. We have, therefore, introduced a new subspecific name of *korolevu*, from a town on the south coast of the island of Viti Levu, where many of these shells are taken.

EVANARIA URSELLUS VITIENSIS subsp. nov.

Shell subcylindrical, with two erratic whitish zonal markings across dorsum, leaving a curious pattern of gray markings, the whole dorsal surface being covered with a filmy pearly cream coating; minute brown specks sparsely distributed over dorsum; extremities rostrate, white, with two dark brown spots on upper side at each end; right margin very slightly ridged with brown specks; base convex, white; aperture slight turn left towards posterior outlet; inner wall of dorsum shows brown outer pattern; teeth produced across base; sulcus shallow, fossula concave and denticulate. Animal not observed.
Habitat, inside main reef.
Length 10–16 mm., width 5–9 mm., height 4–7 mm.
Type in South Australian Museum, Reg. No. D.14153.
Teeth (holotype, 14 mm. in length), Labial 16; Columella 16.
Loc. Beqa, Kadavu, Taveuni; twenty specimens taken at Suva (type loc.) and Nadroga.

Various names have been used for this species, the Schilders using *kieneri*, but we have followed Iredale in using *ursellus*, and have added the subspecific name of *vitiensis*, i.e. "Fijian". The native spelling of Fiji is Viti.

EVANARIA PUNCTATA TRIZONATA Sowerby 1870.

Shell elongate pyriform; dorsum ivory white, with brown specks sparsely and irregularly placed, axis depressed towards left; extremities rostrate; slightly larger spots along both margins; base cream, slightly depressed; inner wall of dorsum white; aperture slight turn left towards posterior outlet; teeth produced half way across narrow labial side of base, not across columella side; sulcus and fossula shallow and denticulate. Animal not observed.
Habitat, on inner reefs.
Length 8–15 mm., width 5–9 mm., height 4–7 mm.
Teeth (for specimen 15 mm. in length), Labial 15; Columella 16.
Loc. Polynesia (type loc.); twelve specimens taken at Suva and Nadroga, other localities not known but probable.

PALMADUSTA Iredale 1930.

PALMADUSTA CLANDESTINA CANDIDA Pease 1865.

Shell pyriform, dorsum white, with three large obscure very light brown erratic shaped zonal markings, and a number of faint light brown zigzag gossamer lines stretched across; inner wall of dorsum white, but showing faintly the zonal shadings above; margins and extremities pearly white; base convex, white; aperture turns left at posterior outlet; sulcus and fossula shallow, slightly denticulate; teeth produced half way across base. Animal not observed.

Habitat, inside main reef.

Length 10–16 mm., width 5–10 mm., height 4–8 mm.

Teeth (for specimen 16 mm. in length), Labial 20, Columella 18.

Loc. Central Pacific (type loc.), Suva, Beqa, Kadavu; two specimens taken at Nadroga.

PALMADUSTA LUTEA YALOKA subsp. nov.

Shell pyriform; dorsum covered with scattered brown spots upon whitish zonal bands separated by light brown, the central white band narrow; the brown spots are continued over the base, which is convex, and has a yellowish shading; inner wall of dorsum light brown; aperture turns left at posterior outlet; teeth not produced across base, white teeth on labial side; columella white within; fossula slightly concave. Animal not observed.

Length 19 mm., width 12 mm., height 10 mm.

Type in South Australian Museum, Reg. No. D.14154.

Loc. Nadroga (type loc., specimen taken by Rev. W. O. North); another specimen was taken there by Steadman.

The Schilders list *lutea humphreysii* Gray (1825) for a wide area from South Melanesia and Sydney to Tonga in the Central Pacific, but the Fijian specimens do not agree with the descriptions given, and we have introduced a new subspecific name of *yaloka*, Fijian for bird's egg, for the Fijian shell.

SOLVADUSTA Iredale 1935.

SOLVADUSTA SUBVIRIDIS KESATA subsp. nov.

Shell pyriform; dorsum gray, with large brown macula on apex, and smaller maculae on sides; margins extremities and base white, anterior extremity and posterior labial extremity produced; aperture wide, especially at anterior end; inner wall of dorsum purple; teeth not produced across base, and very lightly formed on posterior end of columella; fossula small, concave, and denticulate; columella raised above opposite side of aperture. Animal not observed.

Habitat, inside main reef.

Length 28 mm., width 17 mm., height 16 mm.

Type in South Australian Museum, Reg. No. D.14155.

Teeth (holotype, 28 mm. in length), Labial 17; Columella 19.

Loc. One specimen taken at Suva (type loc.); other localities not known.

S. subviridis has been listed from Australia and Melanesia, and Fiji can now be added, although only one specimen has been taken by Steadman, and we have seen no other specimen from Fiji. The name *kesata*, Fijian for stained, has been given to denote the Fijian subspecies.

MELICERONA Iredale 1930.

MELICERONA MELVILLI VATU subsp. nov.

Shell sub-cylindrical; dorsum has four more or less broken black zonal bands, and a yellow patch behind the anterior band, otherwise the shading is greenish gray between bands, with numerous brown specks all over; several large black-brown spots at margins, and black-brown markings on upper side of extremities; inner wall of dorsum gray; base pearly cream, but the four black zonal bands are continued obscurely across left side to within columella; aperture fairly wide; teeth fine, not produced across base, but four of them are prominent across shallow fossula, and small along rest of columella side. Animal dark gray, mantle mottled dark brown with minute filaments of same colour, siphon brown, tentacles gray.

Habitat, inside main reef.

Length 13–22 mm., width 7–12 mm., height 4–7 mm.

Type in South Australian Museum, Reg. No. D.14156.

Teeth (holotype, 22 mm. in length), Labial 14; Columella 14.

Loc. Beqa, Kadavu, Levuka; thirty specimens taken at Suva (type loc.) and Nadroga.

The Schilders list *felina melvilli* Hidalgo (1906), from a wide region stretching from Samoa to the Western Pacific. Iredale (1939) designates Amboina as the type locality for *melvilli*, and proposes *melvilli velesia* for shells from the East Australian coast. The Fijian specimens appear more elongate than the *melvilli velesia* illustrated by Iredale, and we have thus given the name *melvilli vatu* for the Fijian shells; *vatu* is the Fijian word for a stone.

BLASICRURA Iredale 1930.

BLASICRURA RHINOCEROS VIVIA subsp. nov.

Shell cylindrical; dorsum greenish gray, with numerous light brown specks, and four faint dark brown zonal markings; margins and base cream with a few small brown spots; inner wall of dorsum purple; aperture almost straight; teeth produced half way across base; sulcus wide and shallow becoming denticulate towards fossula, which is shallow and heavily denticulate. Animal not observed.

Habitat, inside main reef.

Length 15–24 mm., width 8–13 mm., height 6–10 mm.

Type in South Australian Museum, Reg. No. D.14157.

Teeth (holotype, 18 mm. in length), Labial 20; Columella 19.

Loc. Numerous specimens taken at Suva (type loc.) and Nadroga; other known localities fairly common throughout Fiji.

The Schilders (1939) list *pallidula rhinoceros* from Western to Central Pacific, but the Fijian shell seems more elongate than the Melanesian, and the zonal lines more distinct. We have, therefore, distinguished the Fijian shell with the name *rhinoceros vivia*, the word *vivia* being Fijian for rolled round or banded.

BLASICRURA QUADRIMACULATA GARRETTI Schilder 1939.

Shell elongate; dorsum gray, with numerous light brown specks, and speckled light brown dorsal line, two large very dark brown spots at each extremity, one of these spots on axis, which is sunken; inner wall of dorsum wine coloured; margins, extremities, and base ivory white; anterior extremity extended to give slender appearance; aperture almost straight; teeth produced half way across base, at posterior end of columella inclined to be tuberculose; fossula slightly concave and denticulate. Animal not observed.

Habitat, inside main reef.

Length 13–21 mm., width 7–11 mm., height 6–9 mm.

Teeth (for specimen 21 mm. in length), Labial 17; Columella 17.

Loc. Fiji (type loc.); two specimens taken at Suva.

PALANGEROSA Iredale 1930.

PALANGEROSA CYLINDRICA WANGGA subsp. nov.

Shell cylindrical; dorsum has gray shading with numerous light brown specks all over, and darker brown patch near apex; anterior extremity greatly produced and rostrate, with pronounced ridge carried back to margins, posterior extremity less produced, axis depressed, dark brown markings on both upper sides of extremities; inner wall of dorsum purple; base convex, pearly white; aperture wide and constricted towards anterior outlet, slight turn left at posterior outlet, teeth thin and widely spaced extending across inner side of columella, but not across base. Animal not observed.

Habitat, on inner reefs.

Length 29–32 mm., width 15–16 mm., height 11–12 mm.

Type in South Australian Museum, Reg. No. D.14158.

Teeth (holotype, 30 mm. in length), Labial 17; Columella 19.

Loc. Three specimens taken at Suva (type loc.).

Iredale (1939) gives the type locality of *cylindrica* as Amboina, and we have added the subspecific name *wangga*, Fijian for boat, to distinguish the Fijian species.

ERRONEA Troschel 1863.

ERRONEA NIMISSERANS KALAVO subsp. nov.

Shell subcylindrical, dorsum has greenish gray undershade, with numerous brown specks all over, and random dark brown patch near the apex (in some specimens the brown specks form lines along the length of the dorsum, and there is no dark brown patch); axis depressed; margins, extremities, and base plain buff colour (some specimens have dark brown spots on upper side of anterior extremity); inner wall of dorsum purple; base convex; aperture wide, and constricted towards labial anterior outlet, columella side of aperture raised above level of opposite side; teeth diminished, columella teeth becoming obsolete, short, and more prominent across shallow fossula. Animal gray, mantle greeny gray with whitish flecks, filaments gray and yellow, siphon gray with yellow fringe, tentacles orange.

Habitat, on rocks and broken coral on both shore and outer reefs; larger specimens usually on outer reefs.

Length 19–30 mm., width 10–16 mm., height 7–12 mm.

Type in South Australian Museum, Reg. No. D.14159.

Teeth (holotype, 30 mm. in length), Labial 13; Columella 13.

Loc. Numerous specimens taken at Suva (type loc.) and Nadroga; other known localities, common throughout Fiji.

The Schilders (1939) list *errones coerulescens* from the Pacific regions, but the true *errones* has red lips, which does not obtain in the Fijian species. We have, therefore, adopted the name *nimisserans* used by Iredale (1939), adding the subspecific name *kalavo*, Fijian for mouse, for the Fijian species.

ERRONEA NIMISSERANS VIVILI subsp. nov.

This shell is related to *nimisserans kalavo*, uniformly smaller, and of a much lighter shade; the dorsum is of a light bluish gray undershading, with numerous light brown specks all over, the base is ivory white, otherwise characteristics are similar.

Length 18–22 mm., width 9–12 mm., height 7–9 mm.

Type in South Australian Museum, Reg. No. D.14160.

Teeth (holotype, 19 mm. in length), Labial 11; Columella 13.

Loc. Suva (type loc.).

The name *vivili*, Fijian for small sea shells, is given to distinguish this subspecies.

ERRONEA CAURICA THEMA Iredale 1939.

Shell subcylindrical; dorsum faintly zoned in three darker and two lighter bands, apex of dorsum level for two-thirds of length, and falling precipitately to sunken axis, more obliquely to anterior extremity, multitudinous brown specks all over, tending to agglomerate in places, cream undershading beneath these specks; margins heavily calloused especially on right side, which is unevenly ridged; margins, extremities and base coloured dark cream, large dark brown spots regularly placed on right margin, smaller random spots on left margin, dark brown patches on upper side of anterior extremity, and over axis; extremities produced; inner wall of dorsum light violet; base depressed at centre; aperture wide especially at anterior outlet, turns left towards posterior outlet; teeth coarse, widely placed, with orange colouring between, produced half way across base. Animal not observed.

Habitat, on rocks and broken coral on inner reefs.

Length 25–50 mm., width 14–26 mm., height 10–18 mm.

Teeth (for specimen 50 mm. in length), Labial 16; Columella 17.

Loc. New Caledonia (type loc.), Beqa, Kadavu, Nadroga; twenty specimens taken at Suva and Ba.

OVATIPSA Iredale 1931.

OVATIPSA CHINENSIS Gmelin 1791.

Specimens in collection of Mr. S. Levy, Suva.

Shell ovate; dorsum light brown, with numerous creamy gray lacunae frequently agglomerate; margins and extremities calloused, cream in colour with many violet spots; inner wall of dorsum gray; base convex, labial side raised above level of opposite side; aperture wide, teeth coarse with orange interstices, sulcus wide and shallow, fossula slightly concave, both denticulate. Animal not observed.

Loc. China (type loc.), Amboina, New South Wales, Queensland, New Guinea. Steadman did not take a specimen, but Mr. Levy has obtained several specimens from Fijian natives at Kadavu. Another specimen obtained at Levuka by Commander W. Burrows, R.N., was seen.

Subfamily TALPARIINAE.

TALPARIA Troschel 1863.

TALPARIA TALPA SATURATA Dautzenberg 1903.

Shell elongate; dorsum fawn, with two darker brown transverse shadings forming somewhat indefinite zonal bands, extremities, margins, and base glistening chocolate brown, anterior extremity and labial posterior extremity produced; inner wall of dorsum white; base convex, aperture almost straight, teeth fine, chocolate with white interstices, continued to edge of extremities, last member at columella anterior outlet massive, anterior outer extremity declivous, fossula wide, white, concave, and denticulate with pronounced bulge above. Animal dark brown, mantle brown with small rough protuberances flecked in lighter shades, siphon and tentacles dark brown.

Habitat, on rocks inside main reef.

Length 53–85 mm., width 27–43 mm., height 24–38 mm.

Teeth (for specimen 85 mm. in length), Labial 49; Columella 48.

Loc. Central Pacific (type loc.), moderately frequent throughout Fiji; forty specimens taken at Suva and Nadroga.

ARESTORIDES Iredale 1930.

ARESTORIDES ARGUS VENTRICOSA Gray 1824.

Shell elongate; dorsum depressed, with light fawny gray colouring upon which are four dark zonal bands and numerous brown rings of varying sizes all over and continued well down on margins; anterior extremity produced and acuminate, labial posterior extremity produced beyond length of opposite side; inner wall of dorsum light gray; base convex, coloured darker fawn, with two dark brown smudges on each side of aperture; aperture wide and obliquely constricted at anterior labial outlet, teeth ridges dark brown, not produced across base; sulcus shallow, fossula wide and concave, teeth continued strongly right across both sulcus and fossula, last member on anterior columella side massive. Animal not observed.

Habitat, on rocks inside main reef.

Length 62–86 mm., width 34–48 mm., height 28–37 mm.

Teeth (for specimen 86 mm. in length), Labial 35; Columella 36.

Loc. Central Pacific (type loc.), other localities moderately frequent throughout Fiji: twenty specimens taken at Suva and Nadroga.

BASILITRONA Iredale 1930.

BASILITRONA ISABELLA CAVIA subsp. nov.

Shell cylindrical; dorsum fawnish-gray (in some bluish-gray), with three very faint darker zonal bands and black broken thin longitudinal lines; at each extremity red markings in centre of which are dark brown spots; base convex, pearly white, with small depression in centre on each side of aperture; aperture narrow with slight turn left towards posterior outlet; teeth fine, not produced across base; sulcus wide, fossula concave, heavily denticulate on inner margin; red markings at extremities continued well within both outlets; anterior labial outlet slightly declivous. Animal black, mantle black with rough surface, no filaments, siphon and tentacles dark gray.

Habitat, inside main reef.

Length 19–36 mm., width 10–22 mm., height 9–19 mm.

Type in South Australian Museum, Reg. No. D.14161.

Teeth (holotype, 34 mm. in length), Labial 33; Columella 27.

Loc. Numerous specimens taken at Suva (type loc.) and Nadroga; fairly common throughout Fiji.

The Schilders (1939) list *isabella lekalekana* Ladd (1934) from the Central Pacific, but the description does not fit the Fijian specimens. We have therefore introduced the name *cavia*, the Zoological name for guinea-pig, which they seem to resemble.

CHELYCYPRAEA Schilder 1927.

CHELYCYPRAEA TESTUDINARIA TESTUDINOSA Perry 1811.

Shell cylindrical; dorsum depressed with pinky gray undercolouring, upon which are larger dark brown and purple shadings, with numerous dark brown spots, and a curious dusting effect, as though the whole dorsum has been thinly sprinkled with finest white sand; extremities produced and heavily calloused; inner wall of dorsum white; base convex, light brown, depressed in centre; aperture wide, white, and nearly straight, outer lip declivous at anterior outlet, teeth not produced across base, becoming obsolete towards posterior end of columella; sulcus wide, shallow, and slightly denticulate; fossula deeply concave and denticulate, deep depression at anterior end of columella, which is produced acuminately. Animal not observed.

Habitat, on rocks inside main reef.

Length 81–118 mm., width 40–58 mm., height 30–47 mm.

Teeth (for specimen 118 mm. in length), Labial 46; Columella 46.

Loc. Twenty specimens taken at Suva and Nadroga; Samoa (type loc.) (West Indies, Perry, in error); fairly common throughout Fiji.

Subfamily CYPRAEINAE.

ARABICA Jousseaume 1884.

ARABICA ARABICA RETICULATA Martyn 1784.

Shell ovate; dorsum dark brown, with numerous confused creamy gray lacunae, and creamy gray longitudinal lines, dorsal line indicated by gray gap in dorsal pattern; margins heavily callonsed, with lateral torus at extremities, numerous agglomerate black spots on bluish gray; inner wall of dorsum light purple; base depressed, shaded from bluish-gray at margins to purplish-cream at aperture; anterior extremity acuminate; aperture turns slightly left at posterior outlet, outer lip declivous at anterior outlet; teeth dark brown with cream interstices, not produced across base; sulcus wide and shallow, fossula wide and concave, both denticulate. Animal dark gray, mantle mottled dark gray, with numerous tiny black filaments, siphon and tentacles dark gray.

Habitat, on inner reefs.

Length 43–65 mm., width 26–43 mm., height 20–33 mm.

Teeth (for specimen 65 mm. in length), Labial 26; Columella 26.

Loc. Friendly Islands (type loc.); numerous specimens taken at Suva and Nadroga; fairly common throughout Fiji.

Aribica maculifera Schilder (1932) is a direct synonym.

ARABICA EGLANTINA MOMOKITI subsp. nov.

Shell elongate ovate; dorsum has a reticulated pattern of numerous brown lines on gray undercolouring, and numerous confused gray lacunae, dorsal line indicated by wide gray break in dorsal pattern; margins rounded, pinkish gray with a number of purplish brown spots below edge of dorsal pattern; inner wall of dorsum light purple; base convex, pinkish gray, anterior extremity acuminate and declivous on outer lip; aperture turns slightly left at posterior outlet; teeth dark brown, with pinkish gray interstices, not produced across base, sulcus wide and very shallow, obsoletely denticulate, fossula concave wide, white and denticulate. Animal dark gray, mantle covered with mottled black nodules, siphon and tentacles dark gray.

Habitat, on inner reefs.

Length 51–70 mm., width 30–40 mm., height 24–33 mm.

Type in South Australian Museum, Reg. No. D.14162.

Teeth (holotype, 58 mm. in length), Labial 29; Columella 32.

Loc. Numerous specimens taken at Suva (type loc.) and Nadroga; fairly common throughout Fiji.

The Schilders (1939) list the Melanesian *eglantina eglantina* Duclos (1833) for Fiji, but the specimens taken by Steadman do not agree in all points with the description given, and we have, therefore, given the subspecific name *momokiti*, Fijian for rounded, to distinguish the Fijian shell.

ARABICA INTERMEDIA Gray 1824.

Shell elongate ovate; similar to *eglantina momokiti* in shape, but the dorsal pattern is of a general bluish colour, with confused brown zigzag markings along whole length; fewer spots on margins; teeth very light brown instead of dark.

Habitat, on inner reefs.

Length 48–67 mm., width 28–40 mm., height 23–32 mm.

Teeth (for specimen 67 mm. in length), Labial 33; Columella 33.

Loc. Melanesia (type loc.), Kadavu, Levuka; fourteen specimens taken at Suva and Nadroga.

ARABICA DEPRESSA Gray 1824.

Shell ovate; dorsum has reticulated pattern of small round lacunae, interlaced with brown on a bluish gray and light fawn undercolouring; this pattern continued to half way from apex to margins, dorsal line gray; inner wall of dorsum gray; margins heavily callonsed, with torus at extremities, and bent up in centre on each side, coloured gray, with numerous purplish brown spots more or less confused; base ivory and depressed, anterior extremity acuminate on both sides, aperture turns left at posterior outlet, slightly declivous at outer anterior lip; teeth dark brown, heavy, with ivory interstices, produced about a third of the way across base; sulcus wide and shallow, obsoletely denticulate, fossula concave, white and denticulate. Animal not observed.

Habitat, on inner reefs.

Length 40–48 mm., width 28–34 mm., height 22–24 mm.

Teeth (for specimen 48 mm. in length), Labial 20; Columella 19.

Loc. Central Pacific (type loc.); four specimens from Macuata, Vanau Levu (the northern island of the Fiji Group). This shell appears in the northern islands of Fiji but we have not known of it being taken in the central or southern Fiji Islands.

ARABICA SCURRA VONO subsp. nov.

Shell cylindrical; dorsum has a mosaic pattern composed of numerous bluish gray lacunae interlaced with light brown lines; margins and base pinkish brown, with many purplish brown spots; extremities produced, anterior extremity acuminate on both sides, callonsed axis protruding at posterior extremity; inner wall of dorsum light purple; aperture narrower at posterior outlet, nearly straight, declivous at outer anterior lip; teeth fine, dark brown, with pinkish brown interstices, not produced across base; fossula white, deeply concave and faintly denticulate. Animal not observed.

Habitat, on inner reefs.

Length 31–48 mm., width 28–31 mm., height 25–27 mm.

Type in South Australian Museum, Reg. No. D.14163.

Teeth (holotype, 40 mm. in length), Labial 37; Columella 36.

Loc. Kadavu, Levuka; twelve specimens taken at Suva (type loc.) and Nadroga.

The Schilders (1939) list *scurra retifera* Menke (1829) for East Polynesian shells of this species, but Iredale points out that *retifera* does not belong to that region. We have, therefore, adopted the subspecific name *vono*, Fijian for "inlaid with pearl", for distinguishing the Fijian shells.

MAURITIA Troschel 1863.

MAURITIA MAURITIANA CALXEQUINA Melvill-Standen 1899.

Shell ovate with flattened base; dorsum humped, dark brown, with numerous spots, some of which are pinkish grey, and others deep cream; most specimens have an irregular pinkish gray dorsal line on right side, dorsal pattern ends with plain dark brown of margin colouring about two-thirds of distance from apex to lateral edge; margins and extremities heavily calloused, chocolate coloured, in some specimens almost black; anterior extremity greatly produced and acuminate, axis completely covered; inner wall of dorsum purple; base flattened, dark chocolate or black; aperture wide, declivous at outer anterior outlet, where both edges of acuminate extremity turn downwards, sharp turn to left at posterior outlet; teeth coarse, chocolate coloured, with gray interstices, produced only slightly across base; sulcus wide and shallow, fossula cream coloured and slightly concave, both denticulate. Animal not observed.

Habitat, on main reefs.

Length 58–103 mm., width 36–69 mm., height 28–50 mm.

Teeth (for specimen 100 mm. in length), Labial 25; Columella 27.

Loc. Central Pacific (type loc.); other localities, fairly common throughout Fiji; twenty specimens taken at Suva and Nadroga.

LEPORICYPRAEA Iredale 1930.

LEPORICYPRAEA MAPPA REWA subsp. nov.

Shell inflated ovate; dorsum coloured light brown, with somewhat confused lines upon a creamy gray undersurface, and several spots becoming obsolete, and the very distinctive creamy gray dorsal marking that resembles the strange course of a river; inner wall of dorsum very light gray; margins round and somewhat calloused, creamy coloured with purple brown spots; extremities acuminate and purplish gray; base convex, heavily calloused, purplish gray; aperture declivous at labial anterior outlet, turning left at posterior outlet, outer posterior lip extended beyond opposite side; teeth bright orange, not produced across base; sulcus wide and shallow, fossula concave, both denticulate. Animal not observed.

Habitat, on rocks within main reef.

Length 61–73 mm., width 38–44 mm., height 35–42 mm.

Type in South Australian Museum, Reg. No. D.14166.

Teeth (holotype, 60 mm. in length), Labial 26; Columella 27.

Loc. Moderately frequent throughout Fiji; forty specimens taken at Suva (type loc.) and Nadroga.

The Schilders (1939) list *mappa viridis* Kenyon (1902), for the Pacific region, but the description does not fit the Fijian specimens. We have, therefore, given the name *rewa*, a well-known district in Fiji, the coast of which is famous for the variety of shells found there, to distinguish the Fijian shell.

CALLISTOCYPRAEA Schilder 1927.

CALLISTOCYPRAEA AURANTIUM TURANGA subsp. nov.

Shell ovate; dorsum inflated, glistening aureate uniformly over whole surface and well down over margins; base and extremities pearly cream; axis has two semicircular grooves, milky white on upper side, and orange between; aperture wide, deeply grooved at both outlets, slightly declivous at outer anterior outlet, turning left at posterior outlet; inner wall of dorsum white; base convex, deep cream in colour; teeth orange, with deeper shade on interstices, not produced across base; sulcus wide and shallow, fossula very wide and concave, both heavily denticulate, large terminal ridge at anterior columella outlet. Animal pinkish gray, but further details not observed as it was withdrawn.

Habitat, Fijian natives state that this cowry lives in deep water in practically inaccessible positions on the outside ledges of the main reef, and is mainly taken on top of the main reef after having been thrown up during a heavy storm.

Length 90–110 mm., width 57–70 mm., height 46–60 mm.

Type in South Australian Museum, Reg. No. D.14165.

Teeth (holotype selected from South Australian Museum Collection, 106 mm. in length), Labial 36; Columella 36.

Loc. Twelve specimens obtained from Fijian natives at Nadroga (type loc.); other localities, rarely taken throughout Fiji islands, but Nadroga seems to be the main locality.

This very beautiful shell is found in many parts of the Pacific, but to distinguish the Fijian specimens we have added the subspecific name *turanga*, Fijian for chief, as it was the prerogative of Fijian chiefs to wear this shell as an ornament tied on the neck.

LYNCINA Troschel 1863.

LYNCINA LYNX PACIFICA subsp. nov.

Shell elongate ovate; dorsum colouring bluish (varies from mottled brown to bluish), several black spots of varying sizes erratically placed, orange dorsal line; margins rotund; anterior extremity produced; inner wall of dorsum light gray; base flattened, white; aperture narrow, slight turn left at posterior outlet; teeth white with interstices deep orange; shallow sulcus and concave fossula denticulate. Animal dark gray, mantle has whitish branching filaments, siphon and tentacles gray.

Habitat, on inner reefs.

Length 30–50 mm., width 18–30 mm., height 17–27 mm.

Type in South Australian Museum, Reg. No. D.14166.

Teeth (holotype, 50 mm. in length), Labial 24; Columella 22.

Loc. Common throughout Fiji; numerous specimens taken at Suva (type loc.) and Nadroga.

The Schilders (1939) list *lynx caledonica* Crosse (1869) for Fiji, but the New Caledonian specimens are mostly abnormal crassate shells unlike those from other regions. To distinguish the Fijian specimens we have added the subspecific name *pacifica*.

PONDA Jousseaume 1884.

PONDA CARNEOLA PROPINQUA Garrett 1879.

Shell elongate ovate; dorsum reddish fawn, with four darker shaded zonal bands; margins and extremities dark fawn, minutely speckled; base fawn, with bulge in columella centre; aperture wide, very slight turn to left at posterior outlet; inner wall of dorsum white; teeth deep violet; wide sulcus and concave fossula, both heavily denticulate; teeth not produced across base; anterior extremity has tendency to be nodulose. Animal creamy gray, mantle mottled light brown and gray with small black and gray markings, siphon and tentacles black.

Habitat, inside main reef.

Length 24–55 mm., width 14–34 mm., height 12–30 mm.

Teeth (for specimen 53 mm. in length), Labial 26; Columella 26.

Loc. Moderately frequent throughout Fiji; Paumotu Is. (type loc.); numerous specimens from Suva and Nadroga.

The Schilders (1939) list *leviathan* Schilder-Schilder (1937), apparently a giant *carneola*, from Fiji among other regions, but whilst *carneola* in Fiji is taken up to 55 mm. in length, the specimens of varying sizes seem uniform, and hardly warrant the division into two species.

PONDA SCHILDERORUM Iredale 1939.

Shell ovate; dorsum light brown, with five transverse gray zonal bands; margins speckled fawny, turned up at centre; base convex, shaded from fawn at margins to white on either side of aperture; inner wall of dorsum light gray; aperture slight turn to left at posterior outlet, slightly declivous at outer anterior extremity; teeth fine, white, not produced across base; wide sulcus and concave fossula heavily denticulate. Animal not observed.

Habitat, on inner reefs.

Length 28–32 mm., width 20–24 mm., height 15–18 mm.

Teeth (for specimen 32 mm. in length), Labial 25; Columella 25.

Loc. Four specimens taken at Lomaloma and Lakeba; Annaa Is., Paumotu Islands (type loc.); this species seems to be found only in the northern and north-eastern islands of Fiji. We have not known it taken in the southern or western parts of the Group.

P. schilderorum was introduced as a new name for *arenosa*.

PONDA VENTRICULUS TOPEE subsp. nov.

Shell ovate, shaped like an Indian topee; dorsum has irregular bluish white strip along centre, with alternate lateral shadings of brown, chocolate, and at margins purplish fawn; margins have numerous whitish gossamer lines transversely across sides, margins and extremities calloused; inner wall of dorsum light gray; base depressed, coloured dark cream at margins to light cream at aperture; teeth heavy, oblique at posterior outlet, where aperture turns slightly left: shallow sulcus and concave fossula heavily denticulate. Animal not observed.

Habitat, inside main reef.

Length 35–50 mm., width 24–34 mm., height 17–24 mm.

Type in South Australian Museum, Reg. No. D.14167.

Teeth (holotype, 35 mm. in length), Labial 19; Columella 19.

Loc. Three specimens taken at Kadavu (type loc.); other localities uncertain. One or two specimens taken in Fiji have been seen in private collections there, but the species appears to be rare.

The Fijian specimens of this shell, whilst having the very distinctive and striking dorsal pattern and colouring of *ventriculus*, are on the average smaller, and the dorsal lighter colourings are wider than specimens from regions further west. We have, therefore, introduced the new subspecific name, *topee*, from their resemblance in shape to the Indian topee, or sun helmet.

MYSTAPONDA Iredale 1930.

MYSTAPONDA VITELLUS POLYNESIAE Schilder 1938.

Shell pyriform; dorsum coloured light brown, with several gray spots of varying sizes, darker brown shading, with faint gossamer lines, from half way to margins, spots continued faintly right across the rounded margins; inner wall of dorsum gray; extremities calloused; base convex, coloured fawny to pinkish cream, gossamer lines continued faintly across base; aperture wide, slight turn left at posterior outlet; teeth coarse, not produced across base; shallow sulcus and concave fossula, both heavily denticulate. Animal greenish gray, mantle has long slender branching filaments of mottled brown and gray, siphon light brown, tentacles darker brown.

Habitat, inside main reefs.

Length 34–77 mm., width 23–46 mm., height 18–40 mm.

Teeth (for specimen 55 mm. in length), Labial 22; Columella 23.

Loc. Fiji (type loc.); numerous specimens from Suva and Nadroga; fairly common throughout Fiji.

CYPRAEA Linne 1758.

CYPRAEA TIGRIS VOLAI subsp. nov.

Shell pyriform, inflated; colouring of dorsum varies considerably, holotype has numerous more or less agglomerate black spots on pinkish gray undersurface and a bright orange dorsal line (sometimes the undersurface is of bluish gray, in other specimens the black spots are so very numerous as to give the appearance of almost a black shell, others again have a light brown undersurface with dark spots); margins rotund, swollen, and white with fewer black spots; inner wall of dorsum gray; extremities calloused; base white, convex; aperture wide, turns left at posterior outlet; teeth coarse, white, inclined to be tuberculose on posterior end of columella; fossula wide and concave, obsoletely denticulate. Animal gray with mottled gray mantle.

Habitat, on both inner and outer reefs.

Length 72–110 mm., width 46–75 mm., height 38–60 mm.

Type in South Australian Museum, Reg. No. D.14168.

Teeth (holotype, 80 mm. in length), Labial 22; Columella 23.

Loc. Numerous specimens taken at Suva (type loc.) and Nadroga; other localities common throughout Fiji.

There appear to be two species of *tigris* in Fiji; the one is darker in colour, and has a gray inner dorsal wall, and a bright orange dorsal line, which distinguishes it from the other type described below. We have given the new name *volai*, Fijian for spotted, for this species.

CYPRAEA TIGRIS AMBOOLEE subsp. nov.

Shell pyriform, inflated; dorsum white, with both small and large purplish black spots, colourless dorsal groove (some specimens have a coating of bright yellow all over dorsum, others have yellow shade along summit of dorsum); margins rotund, swollen, and spotted; inner wall of dorsum white; aperture wide, turns left at posterior outlet; extremities calloused; base white, convex; teeth coarse, white; fossula wide and concave, denticulate. Animal has no features observed to distinguish it from *volai*, described above.

Habitat, both on inner and outer reefs.

Length 72–103 mm., width 47–67 mm., height 35–55 mm.

Type in South Australian Museum, Reg. No. D.14169.

Teeth (holotype, 76 mm. in length), Labial 23, Columella 19.

Loc. Numerous specimens taken at Suva (type loc.), Nadroga and Nairai; other localities, taken mostly in eastern parts of Fiji.

This species is lighter in colour, has white inner dorsal wall, and colourless dorsal groove, instead of orange dorsal line. We have given this species the name *amboolee* Fijian (spelt buli in Fijian) the native name for this shell.

Subfamily PSEUDOCYPRAEA.

CYPRAEOVULA ADAMSONI Gray 1832.

Mr. T. Dranga of Hawaii, who spent a month collecting specimens of shells at Beqa Island in Fiji in 1938, said that he had taken one specimen of *C. adamsoni* there, but we did not see the specimen, and have not heard of anyone else taking it in Fiji. We have included this species in this list of Fijian cowries on Mr. Dranga's testimony.

CLASSIFICATION OF FIJI COWRIES.

FAMILY CYPRAEIDAE.

Subfamily NARIINAE.

PUSTULARIA.		
Subgenus ANNEPONA	MARGARITA THEEVA	subsp. nov.
Subgenus PUSTULARIA	CICERCULA JENNISONI	subsp. nov.
	BISTRINOTATA SUBLAEVIS	Schilder 1939.
	TRICORNIS VULAVULA	subsp. nov.
	GLOBULUS SPHAERIDIUM	Schilder 1939.

Subfamily STAPHYLAEINAE.

STAPHYLAEA	STAPHYLAEA CONSOBRINA	Garrett 1879.
	NUKULAU	sp. nov.
PURPEROSA	PURPEROSA RUVAYA	subsp. nov.
NUCLEARIA	NUCLEUS GEMMOSA	Perry 1811.

Subfamily EROSARIINAE.

EROSARIA.		
Subgenus RAVITRONA	CAPUTSERPENTIS ARGENTATA	Dautzenberg and Bouge 1933.
Subgenus EROSARIA	EROSA CHLORIZANS	Melville 1888.
	PORARIA SCARABAEUS	Bory 1827.
	HELVOLA CALLISTA	Shaw 1909.
	HELENE NASESE	subsp. nov.
	EBURNEA	Barnes 1828.
MONETARIA.		
Subgenus ORNAMENTARIA	ANNULUS NOUMEENSIS	Bernardi 1861.
	ANNULUS DRANGA	Iredale 1939.
Subgenus MONETARIA	MONETA ENDUA	subsp. nov.
	MONETA ERUA	subsp. nov.
	MONETA ETOLU	subsp. nov.

Subfamily ERRONEINAE.

CRIBRARIA	CRIBRARIA NORTHI	subsp. nov.
BISTOLIDA	STOLIDA THAKAU	subsp. nov.
	FLUCTUANS NANDRONGA	subsp. nov.
TALOSTOLIDA	SUBTERES VAVA	subsp. nov.
PAULONARIA	MINORIDENS SUVAENSIS	subsp. nov.
	MICRODON GRANUM	Schilder 1938.
EVANARIA	ASELLUS KAWAKAWA	subsp. nov.
	HIRUNDO KOROLEVU	subsp. nov.
	URSELLUS VITIENSIS	subsp. nov.
	PUNCTATA TRIZONATA	Sowerby 1870.
PALMADUSTA	CLANDESTINA CANDIDA	Pease 1865.
	LUTEA YALOKA	subsp. nov.

SOLVADUSTA	SUBVIRIDIS KESATA	subsp. nov.
MELICERONA	MELVILLI VATU	subsp. nov.
BLASICRURA	RHINOCEROS VIVIA	subsp. nov.
	QUADRIMACULATA GARRETTI	Schilder 1939.
PALANGEROSA	CYLINDRICA WANGGA	subsp. nov.
ERRONEA	NIMISSERANS KALAVO	subsp. nov.
	NIMISSERANS VIVILI	subsp. nov.
	CAURICA THEMA	Iredale 1939.
OVATIPSA	CHINENSIS	Gmelin 1791.

Subfamily TALPARIINAE.

TALPARIA	TALPA SATURATA	Dautzenberg 1903.
ARESTORIDES	ARGUS VENTRICOSA	Gray 1824.
BASILITRONA	ISABELLA CAVIA	subsp. nov.
CHELYCYPRAEA	TESTUDINARIA TESTUDINOSA	Perry 1811.

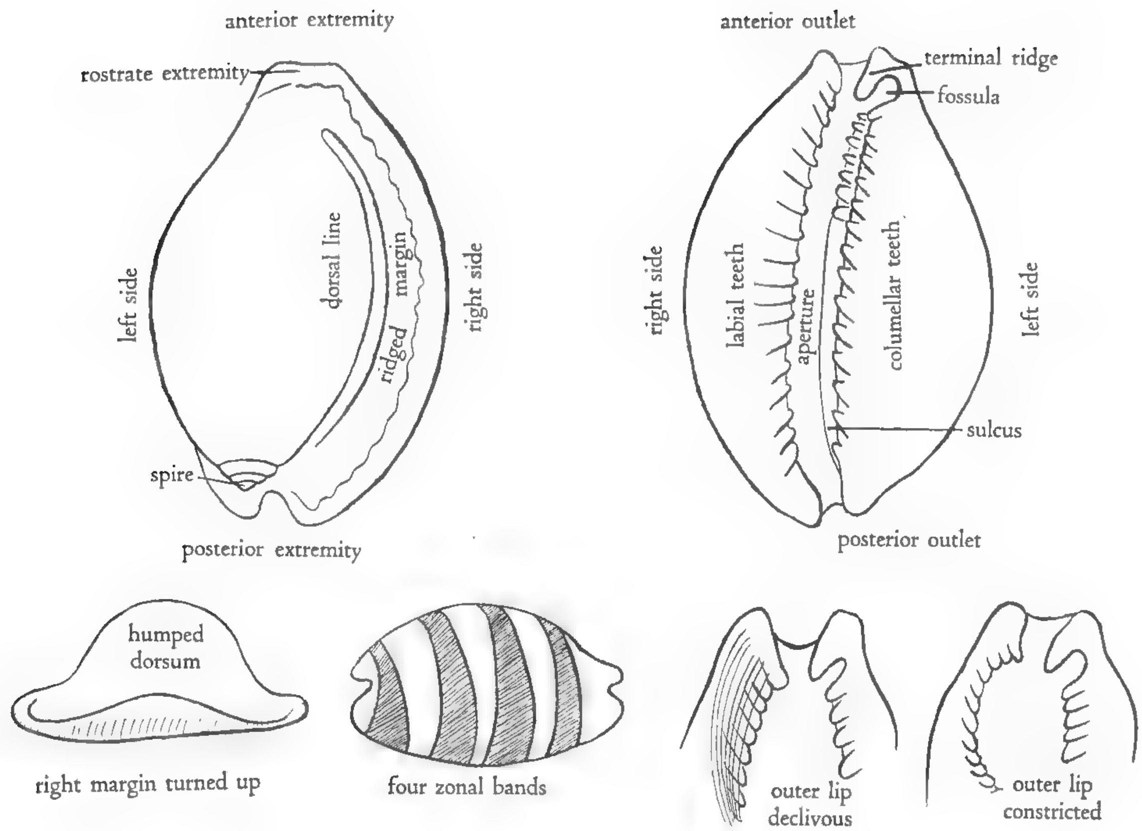
Subfamily CYPRAEINAE.

ARABICA	ARABICA RETICULATA	Martyn 1784.
	EGLANTINA MOMOKITI	subsp. nov.
	INTERMEDIA	Gray 1824.
	DEPRESSA	Gray 1824.
	SCURRA VONO	subsp. nov.
MAURITIA	MAURITIANA CALXEQUINA	Melville-Standen 1899.
LEPORICYPRAEA	MAPPA REWA	subsp. nov.
CALLISTOCYPRAEA	AURANTIUM TURANGA	subsp. nov.
LYNCINA	LYNX PACIFICA	subsp. nov.
PONDA	CARNEOLA PROPINQUA	Garrett 1879.
	SCHILDERORUM	Iredale 1939.
	VENTRICULUS TOPEE	subsp. nov.
	VITELLUS POLYNESIAE	Schilder 1938.
CYPRAEA	TIGRIS VOLAI	subsp. nov.
	TIGRIS AMBOOLEE	subsp. nov.

Subfamily PSEUDOCYPRAEA.

CYPRAEOVULA	ADAMSONI	Gray 1832.

INDEX TO GENERA, SUBGENERA, SPECIES AND SUBSPECIES OF FIJIAN COWRIES



Terminology of the Cowry Shell.

NOTES ON TWO SAND-DWELLING CUMACEA (GEPHYROCUMA AND PICROCUMA)

BY HERBERT M. HALE, DIRECTOR, SOUTH AUSTRALIAN MUSEUM

Summary

During the preparation of a previous paper (Hale 1936, pp. 393-438) the writer collected sample catches of the burrowing Crustacea (Amphipods, Cumacea, etc.) occurring at the edge of the sea in Aldinga Bay, St. Vincent Gulf, South Australia. These were placed in glass jars of seawater for observation and the following general notes concerning them were made.

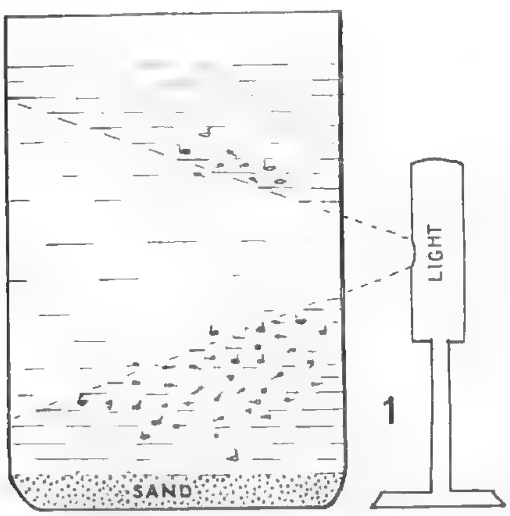
NOTES ON TWO SAND-DWELLING CUMACEA (*GEPHYROCUMA* AND *PICROCUMA*)

By HERBERT M. HALE, Director, South Australian Museum.

Fig. 1–9.

INTRODUCTION.

During the preparation of a previous paper (Hale, 1936, pp. 393–438) the writer collected sample catches of the burrowing Crustacea (Amphipods, Cumacea, etc.) occurring at the edge of the sea in Aldinga Bay, St. Vincent Gulf, South Australia. These were placed in glass jars of seawater for observation and the following general notes concerning them were made.



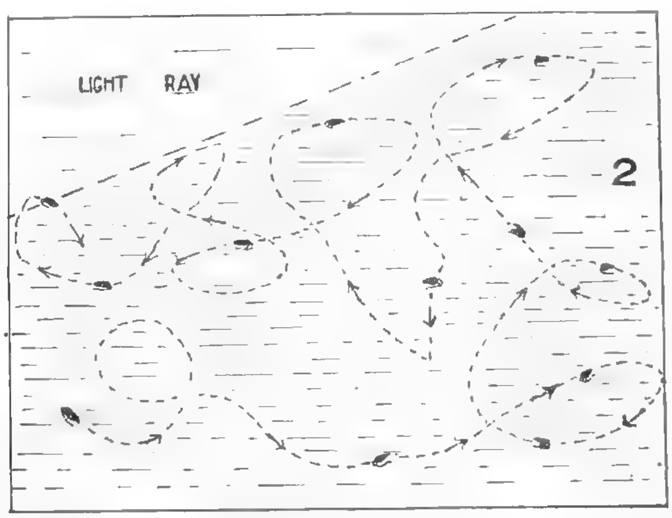


Fig. 1. Response of *Picrocuma* and *Gephyrocuma* to stimulus of light.
Fig. 2. Track of *Picrocuma* approaching light ray with pleon folded under thorax.

A layer of about three inches of sand was placed in some of the vessels. In these the fossorial Crustacea were rarely seen in bright daylight; under the same conditions, with jars containing water only, activity was very restricted. Movement became accelerated towards dusk whether sand was present or not but, later in the evening, in complete darkness, activity continued where sand was absent, but few or no swimmers were apparent in the jars containing sand.

To facilitate observations at night and to test response to the stimulus of light, a cone of light of low candle-power intensity was thrown through an aquarium otherwise in darkness (fig. 1).

Two species of Cumacea, *Gephyrocuma* and *Picrocuma*, readily separable with the naked eye from the other material and from each other, were placed in this illuminated tank.

These Cumacea were definitely attracted by the light, but in general did not congregate in the brightest part of the ray but, for a considerable period at least, just outside it (fig. 1; see also Foxon, 1936, p. 379). Progress towards a brighter light under one observation was slower.

In complete darkness both Cumacea became pale, almost white.

A dim submarine light has been used successfully for the collecting of large numbers of Cumacea and other small Crustacea (Sheard, 1941, p. 12); it seems that the most profitable period for its employment is just after nightfall.

PICROCUMA HALE.

Picrocuma peocilota Hale, 1936, p. 415, fig. 7–8.

Specimens are now available from several localities in St. Vincent Gulf, South Australia. As the male is unknown the species was referred provisionally to the Bodotriidae.

SWIMMING HABITS.

As noted by Foxon (1936, p. 378): "Cumaceans do not respond to light in the marked manner of Decapod larvae, and they employ various methods of locomotion". *Picrocuma* readily follows the light of a torch to one side or other of an aquarium, and also to the surface of the water; in daylight it does not ascend more than two or three inches above the sand layer unless it be at dusk or indoors in a dim light, under which circumstances it may be found near the surface.

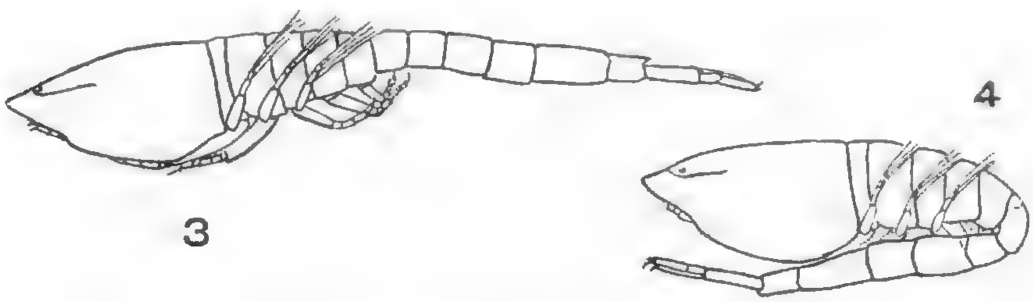


Fig. 3, and 4. Swimming attitudes of *Picrocuma poecilota* (× 35).

The animal may progress with a relatively smooth motion, propelling itself with rapid vibratory movements of the exopods of the anterior thoracic appendages; the yellowish pleon may be extended (fig. 3) or may be carried adpressed to the body (fig. 4) and only occasionally extended. Even when the pleon is extended during swimming it is folded against the body directly effort ceases and the animal commences to sink. Swimming with the pleon against the body the crustacean progresses in a manner reminiscent of an Ostracod and tends to pursue a rather rambling course in its approach to a light ray. The approximate track of an individual is shown in fig. 2.

At times swimming is assisted by rapid up and down movements of the pleon, similar to those of the pupa of a *Culex*; these motions, however, seem to play a subsidiary part in defined progress.

BURROWING, ETC.

As mentioned above, *Picrocuma*, when swimming ceases, folds the pleon under the body; it then sinks at the rate of about one inch per second; in this position it awkwardly reaches the bottom and may rest for a time on its side. Righting itself it is able to move rapidly *through* the top layer of sand, "breasting" along with the thorax obliquely upright and the pleon directed obliquely upwards and backwards (fig. 5) or sometimes curved in the position shown in fig. 6.

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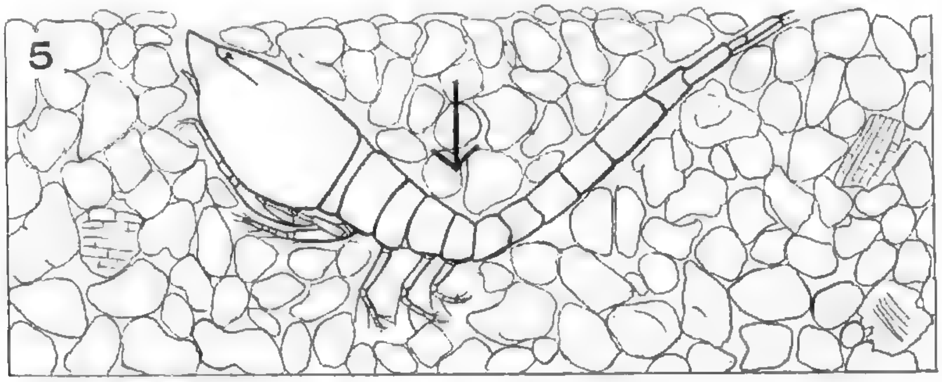

Fig. 5. Attitude of *Picrocuma poecilota* when buried in the sand; arrow shows direction of entry (× 35).

Observation of burrowing, etc., was made in a watch glass. As a rule the animal burrows straight down in the attitude it assumes when travelling in the upper layer of sand. A forward motion may be suddenly arrested and a downward movement commenced; the three posterior pairs of thoracic appendages are mainly responsible for both operations although the first pair of peraeopods are sometimes used to push aside sand grains in the last stages.

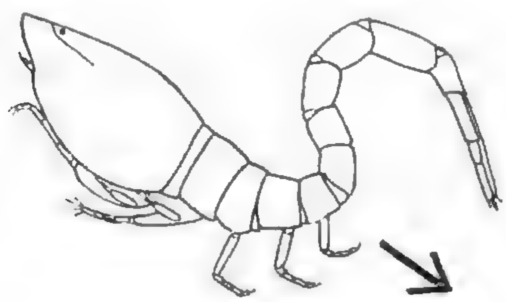

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Fig. 6. Occasional burrowing attiude of *Picrocuma poecilota*; arrow shows direction of entry (× 35).

Fig. 7. Rami of uropoda of *Picrocuma poecilota* (× 250).

A few individuals were seen to burrow in the attitude shown in fig. 6; in this position they entered the sand "backwards", at an oblique angle.

Picrocuma is often completely concealed below the sand or has only the tips of the uropods visible (fig. 5); when so hidden a tiny depression marks its presence. It also travels just *beneath* the surface of the sand, its rapid progress being easily followed by disturbed grains.

The addition of fresh seawater accelerates the respiratory movements, the anterior exhalent tubes "flickering" with great rapidity.

In feeding, sand-grains are grasped with the first pair of legs and rotated rapidly in front of the mouth. It may be noted here that the sand at Aldinga Bay is rather coarse, individual grains ranging from 0·15 mm. up to 0·35 mm. in greatest diameter; the adult female of *Picrocuma* is 1·9 mm. in total length. The camera lucida drawing in fig. 5 shows the relative size of the grains.

USE OF UROPODS.

In one observation only the pleon (held as in fig. 6) was thrust into the sand in the initial burrowing motions; the appressed uropods, forming an awl-like point, were first pressed down between the grains.

The uropods, with their terminal spines, are used to clean the mouth parts, the first antennae, to comb the hairs of the peraeopods and even to brush over the sides of the carapace; the finely serrated inner margin of the endopod may be of use here (fig. 7).

SUMMARY.

The thoracic exopods are the principal swimming organs and the pleon apparently plays no major part in either burrowing or swimming; these notes, however, concern sub-adult specimens and the adult male is unknown. The first peraeopods are used mainly for food-getting although they sometimes assist burrowing by pushing to one side the larger grains of sand.

The use of the uropods as toilet combs was observed.

GEPHYROCUMA HALE.

Gephyrocuma pala Hale, 1936, p. 412, fig. 5–6.

Since its description *ut supra* adult males of this curious species have been taken in New South Wales at depths down to fifty metres, on sandy bottoms.

SWIMMING HABITS.

The species is larger and bulkier than *Picrocuma* and in sharp distinction to the last-named the transparent pleon is held always upwards and straight or slightly curved, more or less at a right angle to the thorax; the position is well shown in the original figures of the species (Hale, 1936, p. 413, fig. 5, a and c).

Both males and ovigerous females are rather active swimmers; the movements can best be described as "jerky", particularly when travelling upwards. In general the behaviour is much as in *Picrocuma* and the response to light is similar.

BURROWING, ETC.

When swimming movements cease the animal sinks, with pleon still erect, at the rate of about one inch each second. It lands haphazard on the bottom, often on the side.

Gephyrocuma can skip rapidly over the surface of the sandy bottom with a series of flea-like hops (fig. 8).

In burrowing the creature enters the sand with the thorax in an upright, or almost upright position, sometimes slightly laterally oblique, sometimes backwardly oblique; the pleon remains directed at approximately a right angle to the thorax. The greater part of the animal disappears in a flash. The rakes of spines with which the transparent posterior peraeopods are armed (Hale, 1936, p. 414, fig. 6, f, g and h) rapidly thrust aside the grains of sand to clear a space for the stout body. Movement of the pleon suggests that, with an upward thrust below the sand, it assists in pulling the thorax deeper, but it was not possible to substantiate this definitely.

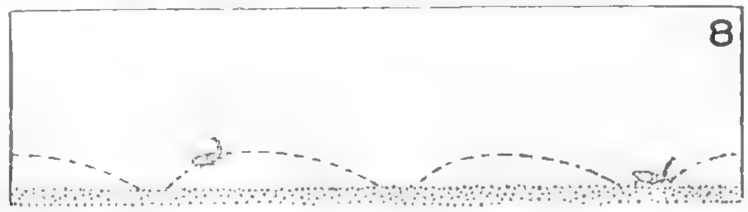

Fig. 8. *Gephyrocuma pala,* underwater "skipping" progress over sand surface.

The attitude when buried is illustrated in fig. 9. A dorsal view shows the frons well exposed (not concealed or almost so as in *Picrocuma*); a slight shock—such as a tap on the containing vessel—causes the creature to withdraw more deeply into the sand but the frons still remains visible. The chalky white distal portions of the carapace and first peraeopods simulate the shell fragments in the sand and grit.

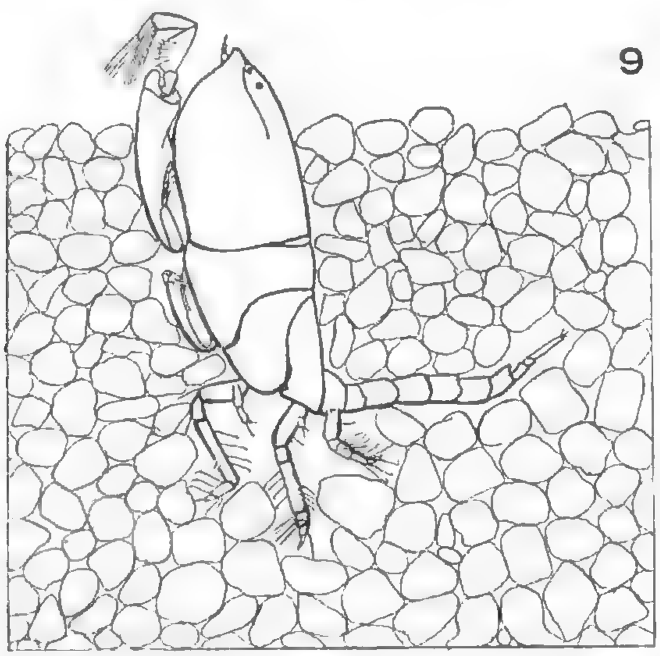

Fig. 9. Attitude of *Gephyrocuma pala* when buried in sand (× 32).

Viewed from above, apparent movements are jerking of the first antennae and grasping motions of the five transparent terminal segments of the first peraeopods. The exhalent aperture is single, large and oval in shape, and the current is strong, moving flocculent material on the sand surface.

A buried example often pops out from the sand and skips to a fresh spot and immediately disappears below save for the exposed frons.

The adult *Gephyrocuma* is about 2·5 mm. in length. Its relation in size to the grains of sand into which it burrows is illustrated in fig. 9.

SUMMARY.

The position in which the relatively short pleon is consistently carried is characteristic of *Gephyrocuma*. The species spends little time *wholly* concealed in the sand.

Details of the burrowing procedure are difficult to observe because of the speed with which the operation is carried out. It seems certain, however, that the spines of the three pairs of stout posterior peraeopods constitute an important apparatus for fast burrowing, as a considerable displacement is necessary to accommodate the bulky thorax.

The mechanism of the rapid "skipping" progress over the sand surface could not be determined.

Feeding was not detected although, as mentioned, grasping or "casting" movements were made with the first peraeopods. The specialized structure of these limbs, with their widened terminal segments, forming efficient supports for the unusually large brushes of plumose setae (see Hale, 1936, p. 414, fig. 6d) presents interesting possibilities.

The first legs of *Leptocuma australiae* Zimmer (1921, fig. 1 and 5) are remarkably similar in general form to those of *Gephyrocuma*.

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LARGE STONE IMPLEMENTS FROM SOUTH AUSTRALIA

BY H. M. COOPER, ASSISTANT IN ETHNOLOGY

Summary

On nearly all ancient camp sites in this State some outsize stone implements may be found ; many are of the coroid class, which on account of the usual signs of utilization are distinguishable from nuclei. Among the best known of these larger pieces are the types named horsehoof, karta, arapia and the important series of pebble implements, with certain varieties which will be described later.

Some have already been recorded by White (1919), Hossfeld (1926), Tindale and Maegraith (1931), Tindale (1937) and others ; but in the last few years several extensive camp sites have been exposed by the plough, adding considerably to the amount of material available for study.

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INTRODUCTION

Fig. 1–96.

On nearly all ancient camp sites in this State some outsize stone implements may be found; many are of the coroid class, which on account of the usual signs of utilization are distinguishable from nuclei. Among the best known of these larger pieces are the types named *horsehoof*, *karta*, *arapia* and the important series of pebble implements, with certain varieties which will be described later.

Some have already been recorded by White (1919), Hossfeld (1926), Tindale and Maegraith (1931), Tindale (1937) and others; but in the last few years several extensive camp sites have been exposed by the plough, adding considerably to the amount of material available for study.

It has been found, for instance, that at a few of the sites these outsize implements are unaccompanied by any kind of flake or blade implement and therefore apparently represent a distinct culture. This applies especially to many of the Kangaroo Island sites. During the last ten years the writer has collected on this Island and on the adjacent mainland, about 2,000 specimens of the types it is proposed to review. He believes that detailed description and suggested classification will be of interest and that the sites concerned are worthy of record.

No attempt is made to assign the material to any defined culture or sequence of such, unless supported by suitable data. The evidence, however, of the Kangaroo Island sites, with their lack generally of flake or blade implements, seems to indicate that these large artefacts are the relics of a distinct culture and in consequence may be taken to represent the type standard of the pebble implement industry of South Australia.

Drawings of certain selected specimens are reproduced herein; weights are given in order to suggest the possible uses to which the various types could be put.

For convenience, the area from which these pieces have been systematically collected is divided into three regions thus:

(1) Kangaroo Island.

(2) Quorn, northward to Marree and extending roughly east and west in the direction of Lake Frome and Lake Torrens.

(3) Adelaide Plains, southward along, and adjacent to the coast, through Morphett Vale, Normanville and Rapid Bay to Cape Jervis, thence eastward to Goolwa.

Certain localities in these areas have not yet been examined, and therefore, this cannot claim to be a complete survey of the districts enumerated.

The following is a list of the more important sites from the above three regions whereon the larger implements to be described were collected:

REGION 1.

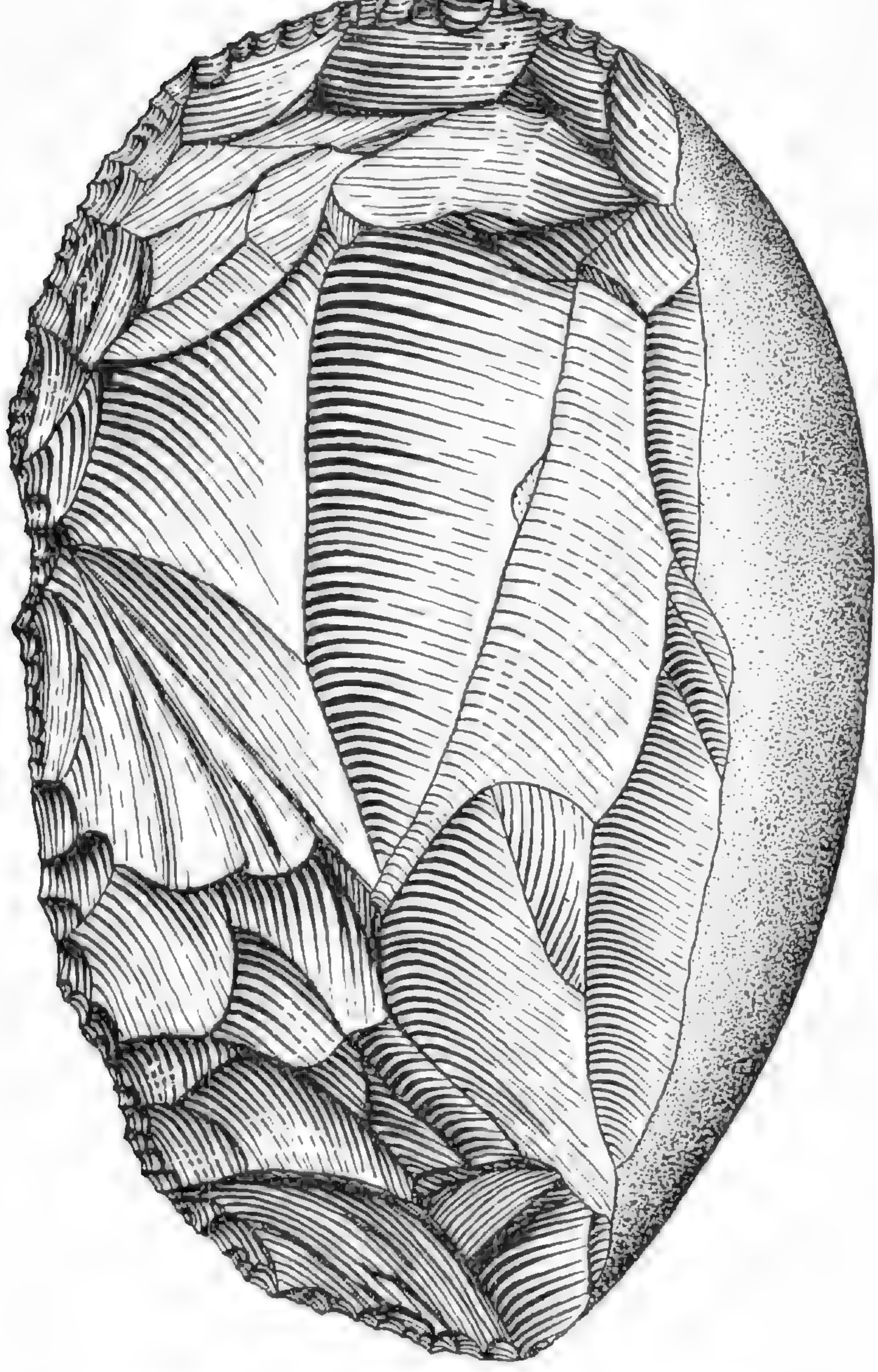
Muston (3 sites)
Pennington Bay
Hog Bay River (5 sites)
Deep Creek, Nepean Bay
Taylor's Lagoon
Cape Hart
Creek Bay Station
Waller's, Pelican Lagoon
Bay of Shoals (2 sites)
Discovery Lagoon
Tentree Lagoon
Buick's, Pelican Lagoon
Creek Crossing, Muston-Redbanks Road
Point Morison
Distillery Lagoon, Hawk's Nest Road
Kiawarra
Hawk's Nest
Cape Borda Road, near Cygnet River
Western River
Stokes Bay
Smith's Bay
Emu Bay
Wisanger Gap
Cuttlefish Bay Station
Gap Road, Cygnet River
Jack's Creek, Hog Bay
Neave's, Hog Bay River
Lashmar's Lagoon
Near Red Banks
Cape Cassini

REGION 2.

Brachina Creek
Kanyaka Springs
Third Waters
Wirreanda Creek
Yappala Waters
Port Augusta West
Wonoka Creek (2 sites)
Oratunga Springs
Matthewson's Springs
Emu Springs
Workshop Hill, Wirrealpa
Parawilya Springs
Kanyaka Creek
Mt. Chambers Creek (near rock carvings)
Yappala Lagoon (2 sites)
Balcoracana Creek, Little Bunkers Range
Nilpena Creek
Arrowie
Sand Hills, Old Hookina
Artipena Water
Oratunga
Elka Creek, Moralana
Horn's Camp Creek, Parachilna Pass
Yadlamalka
Boorloo Creek, near Marree (at rock carvings)
Motpena
Italowie Gorge
Yorkey's Crossing
Balcanoona Gorge
Coolong Springs, near Marree
Parachilna Pass
Redbanks, Wirrealpa
Edeowie Sand Hills
Wirrealpa Head Station (near)

REGION 3.

Christie's Beach North
Noarlunga (near)
Sellick's Beach
Aldinga Beach
McLaren Vale (near)
Hallett's Cove (5 sites)
Moana
Blanche Point (north of)
Haycock Point
Rapid Bay
Carrickalinga Hill
Fishery (3 miles east of Cape Jervis)
Normanville (near)
Salt Creek (south of Rapid Bay)
Waitpinga Creek
Carrickalinga Head (1 mile inland)
Cape Jervis (1 mile N.E. of)
Cape Jervis (near Cable Hut)



Typical Kangaroo Island Pebble Implement from Hog Bay River; weight, 47 ounces (nat. size).

REGION 1. KANGAROO ISLAND. (900 PIECES).

The chief industry here was a pebble one and with but three exceptions (made from pebble flakes), all finished implements collected in this class may perhaps be regarded as pebble artefacts, the characteristic tool being the *semi-uniface pebble chopper*. A range of examples selected from over 800 specimens is shown in fig. 48 to 54, etc.

Horschoofs, derived from blocks, constitute nearly all the remaining implements of large size from this Island; these comprise 8 per cent. of the total.

Large cleavers (see fig. 84 to 87), were not recorded and only one true arapia was discovered.

It is important to note that practically all the large implements collected by the writer on Kangaroo Island had been fashioned from quartzite. The nearest points whence this material could have been derived was often at a considerable distance from its place of use, on occasions almost thirty miles away. Inferior local stone was invariably passed over.

The extensive Hog Bay River series of camp sites had at least one possible source of supply at Cape Hart, about seven miles to the south-east, where quartzite pebbles exist. However, although suitable nodules of flint (another excellent material for flaking and trimming) are also available at Cape Hart, not a single large implement of this material appears to have been noted.

Furthermore, at Cape Hart various smaller implements collected by the writer and attributed to Tasmanian women associated with sealers and whalers, Tindale (1937), Harvey (1941), have all without exception, been fashioned from flint, a material with which they were probably familiar in their homeland. They, in turn, had rejected the quartzite.

The reason for the passing over of such admirable material as flint by the extinct Kangaroo Islanders, remains unexplained.

REGION 2. QUORN TO MARREE.

Numerous examinations of this district suggest that the pebble industry, derived from rounded symmetrical material, had not been developed to any appreciable degree. A few implements, however, were noted, as in fig. 62 and 63, and also a small number shaped from angular pebbles.

Horsehoof types made from blocks and arapias which show considerable skill in workmanship, constitute the bulk of the larger implement industry in this area.

Cleavers occur sparingly and, as mentioned above, pebble implements such as the semi-uniface, appear to be rare.

REGION 3. ADELAIDE PLAINS AND ADJACENT SOUTHERN COAST LINE.

A small number of implements trimmed from rounded pebbles was collected, mainly from the vicinity of Moana and Sellick's Beach, denoting the existence of a small pebble industry; but the whole of this region was almost exclusively productive of the horsehoof type. This is particularly apparent in the vicinity of Cape Jervis, adjacent to and within sight of Kangaroo Island, an interesting comparison to the firmly established pebble industry of that Island. Rounded quartzite material, excellent in texture and form, was available on many parts of the coast, but very little used.

The occurrence of the cleaver and the arapia is limited.

KANGAROO ISLAND PEBBLE INDUSTRY.

The possible origin of the characteristic implements of the Island warrants a short discussion.

It is somewhat perplexing that no defined evidence of this elongate-oval type pebble industry has been discovered by the writer on the mainland, even although suitable material is available at many places. Therefore, it is suggested that it may have been developed after all communication was severed with the mainland because of the following reasons; 98 of the large implements collected in the region of Cape Jervis—as an example—were horsehoof types, but pebble implements of symmetrical material were absent.

On more than fifty Kangaroo Island sites (excepting Cape Cassini, which is mentioned below), the writer collected 54 horsehoof types and 823 smooth pebble implements, such as the semi-uniface chopper and its varieties.

It must be admitted, however, that a few pebble implements derived from material of more or less rounded shape have been collected from widely scattered sites on the mainland (see fig. 62 to 64).

If the above suggestion be correct, it seems possible that the Islanders carried the horsehoof design with them from the mainland, but later evolved the pebble type which gradually supplemented it.

CAPE CASSINI SITE.

At Cape Cassini (see fig. 88 to 92) the relative figures are 16 horsehoof and 8 pebble implement types; the former being comparable with other rather inferior stone tools from near Cape Jervis.

The *pebble implements* from Cape Cassini are also poor in workmanship and technique (see fig. 92), and possibly suggest an early and elementary attempt at a new design.

The Cape Cassini site and possibly others yet to be discovered in the same region, may have been the scene of a transition period during which the pebble implement was in process of development before it became the dominant Kangaroo Island type of tool tending to displace the older horsehoof.

DISAPPEARANCE OF KANGAROO ISLANDERS.

This subject has been discussed by Tindale and Maegraith (1931), but it might be mentioned here that the non-discovery of skeletal remains and rock shelters showing artefacts *in situ*, has seriously restricted our knowledge of the extinct peoples of the Island.

The complete and final disappearance of its former inhabitants (and the surviving concrete evidence of their many implements indicates that their numbers may not have been inconsiderable) is surprising.

Many explanations, well considered, could be brought forward as a solution, but they all lack tangible proof. Examples, briefly, could have been fierce local tribal fights, or some wide-spread and overwhelming disease.

However, it can be said, that if their pebble culture had been derived from the mainland, or by contact with casual visitors therefrom, these typical Kangaroo Island implements would surely survive, even if sparingly, in other places. The disappearance of their makers from a land where nature, by present standards at least, provided in the air, in the sea, and on land, all which primitive man required presents a truly difficult and complex problem. Apart from stone implements, the only other important traces of the Island's former occupants so far noted appear to be those discovered by the writer on an indurated eroded floor laid bare by the retreat of sand dunes near Pennington Bay. They included mounds of burnt ashes and earth, associated with heaps of shells (many of them intentionally crushed for the removal of their contents and in an excellent state of preservation), and also burnt hearth stones. Lying nearby were well worn hammerstones and pebble implements. Mr. B. C. Cotton, Conchologist at the South Australian Museum, has kindly identified the following shells:

Katelysia corrugata	*Austrocochlea torri*
Cellana tramoserica	*Brachyodontes erosus*
Ostrea sinuata	*Mytilus hirsuta*
Nerita (Melanerita) melanotragus (Crushed intentionally)	*Austrocochlea concamerata* (Crushed intentionally)

This site is briefly mentioned by Tindale (1937).

A few shells of the Port Lincoln oyster (*Ostrea sinuata*), associated with pebble implements partly weathered out, were also observed by the writer on the margin of a fresh water swamp near Muston (Tindale, 1937).

USES.

There seems to be no positive evidence insofar as the mainland localities are concerned, regarding the uses of these implements. Information relative to Kangaroo Island, unpopulated at the time of the first European occupation, is of course unobtainable.

In attempting to formulate suggestions for possible uses, the writer spent some time in country typical of the areas examined, experimenting with pebble and horsehoof implements in work and requirements which suggested themselves as necessary for the simple needs of man, living under those conditions.

In inexperienced hands, all proved efficient in such directions as removing bark, cutting through limbs of trees, trimming twigs, and scooping out holes in the earth. The weight of the larger types was found to be of considerable advantage and this factor was evidently utilized in designing those intended for heavier work.

Two such experimental tests are as follow:

(1) A bark shield of oval shape and 30 inches in length was removed from a tree (*Eucalyptus leucoxylon*) within a period of ten minutes by means of a horsehoof implement similar to fig. 1.

(2) Utilizing a pebble chopper, such as fig. 50, a sapling (*Eucalyptus baxteri*) eleven inches in circumference, was cut down in four minutes.

Many, on account of their weight and size, appear to have required both hands for their manipulation. It may therefore be assumed that in skilled hands they effectively met the demands of those who designed and used them.

Although they may seem crude and clumsy to collectors more familiar with the smaller examples of native craftsmanship, closer examination will show considerable evidence of ingenuity and skill of a high order. A study of the implements described in this paper reveals that the designer aimed at carefully trimming the working edge in order to provide his several requirements, such as cutting, chopping and scraping, while the remainder of the material was roughly shaped only to such an extent as to provide ease in handling and to give the desired weight and balance. The aboriginal was a practical worker totally indifferent to useless embellishment and wasting neither time nor energy where not essential.

An example of his versatility is shown in fig. 56, where he has cleverly provided a broken implement with a further period of usefulness by skilfully rounding and trimming the damaged end portion.

Many Kangaroo Island pebble implements, as noted by Tindale (1931), show considerable pitting on the pre-existing smooth surfaces denoting apparently, their utilization for crushing shellfish or bones, and similar uses. This condition also appears on the flat bases of horsehoof types.

The upper, roughly-shaped margin of pebble artefacts from that Island often exhibits the smoothing effects resulting from long sustained use of bruising. The existence of such evidence seems rather to suggest that, generally, the user carefully guarded the trimmed margin of his implement against unnecessary damage, reserving it solely for such purposes as he had intended.

In correctly assessing the relative skill and resulting concrete evidence of the labour of primitive man, it may be well to bear in mind his requirements, the grade of material available and his individual skill as a workman.

The Kangaroo Island Industry shows a remarkable range in size, and its products may be considered highly efficient and well designed artefacts. The weights of those collected (given elsewhere in this paper), varied between 6 ounces and 116 ounces.

The ratio of small implements in relation to the incidence of the pebble and horsehoof industries on certain hitherto undisturbed camp sites examined by the writer, tends to confirm the assumption that on the Island at least, the larger types were "general purpose" tools. There is, indeed, at present nothing to suggest that even all the smaller implements were contemporaneous with the larger. The latter then, may be the product of a separate culture.

Little definite information is available wherewith to allot any of these large implements to their correct cultural sequence, but the following facts are worthy of note.

No such material was discovered by Hale and Tindale (1930) in their systematic excavations at Tartanga and Devon Downs, although they may exist there in layers yet untouched. However, on certain camp sites examined by the writer, including some completely weathered out, larger implements were not apparent.

The existence of horsehoof implements at Fulham (Tindale, 1937), on the old horizon and under the pirrian culture, apparently proves them to be older than the pirrie, at least in that region.

With the exception of localities laid bare by drift or where the existing surface is of a stony nature, the Kangaroo Island industry remains hidden until disturbed by ploughing and cultivation.

A horsehoof implement was uncovered under three feet of drift during road-making operations in the Parachilna Pass, Northern Flinders Ranges, in 1942. Another was collected by R. Peake and the writer during 1941 on the rocky floor of Jauarwing Cave, hitherto unexamined. Its inaccessibility and present conditions preclude, for the time being at least, a systematic but highly promising field of search.

Horsehoof and other types discovered by Tindale (1937) and the writer near Hallett's Cove, were from land recently uncovered by cultivation.

A trimmed horsehoof was shown to a group of the older aboriginals at Jay Creek, Central Australia, by C. P. Mountford, Honorary Ethnogolist at the South Australian Museum, but they were all ignorant of its existence and uses, merely remarking that it was only a stone.

Therefore, although there seems to be no concrete evidence available, the above as a whole, suggests that at least many of the implements under discussion are of considerable age, their technique and morphology being distinctly archaic.

A further series of systematic excavations in rock shelters could well prove invaluable.

PATINATION; WEATHERING; DETERIORATION.

Patination. Many of the implements reviewed herein have patination developed to a high degree and others exhibit considerable outward evidence of weathering and deterioration.

Acceptance of any of these conditions alone, as proof of age, is apt to be dangerous. Regarding patination, H. V. V. Noone and the writer, experimenting with flint flakes collected at Cape Hart, Kangaroo Island, and attributed to Tasmanian women associated with whalers (Tindale, 1937), and therefore, probably only about 120 years of age, found that considerable patination occurs on the worked faces of some of them, whilst others show none at all.

Weathering and Deterioration. Local atmospheric conditions and soil content have considerable bearing on weathering and deterioration shown by artefacts in a corresponding particular locality (see fig. 93, 94, 95 and 96).

DESCRIPTION OF TYPE DRAWINGS.

HORSEHOOF SERIES.

The self-explanatory term "horsehoof" has been applied by Tindale (1937) to the group of implements which may be described as fashioned from fairly large blocks. They are flat-bottomed and neatly trimmed by stepped retouching to form a peripheral working edge at the base, which is usually discoidal or nearly so. Sides and/or crest (apex) are roughly shaped by flaking. When first made the angle formed by this working edge with the crest is relatively acute, the maker thus providing material for future wear and re-sharpening, which gradually caused the angle to become more and more obtuse, until finally the walls and apex might actually overhang the base (see examples which follow). Various distinct sub-types of horsehoof design are included.

Fig. 1 to 27 are all implements derived from blocks.

Fig. 1 illustrates a horsehoof of the pointed apex type and base trimmed around portion of its margin. Old Oratunga station. 58 ounces.

Fig. 1A. 1 mile north-east of Cape Jervis. 68 ounces.

Fig. 2. Base has diminished in area due to wear and consequent retrimming. Overhang of walls is becoming apparent. Mt. Chambers Gorge, Wirrealpa.

Fig. 3. Base much reduced but still a serviceable implement as evidenced by trimming. Overhang pronounced. Brachina Creek, Oraparinna. 12 ounces.

Fig. 4. Similar to fig. 2. Hog Bay River, Kangaroo Island.

Fig. 5 to 8. Illustrate another horsehoof type, relatively plentiful. Here, however, the apex retains the pre-existing surface of the block. It has a flat base which is trimmed around part of its margin only. Angular blocks of any suitable shape were utilized. Maximum weight noted was 80 ounces.

Fig. 5. Fishery, 3 miles east of Cape Jervis. 47 ounces.

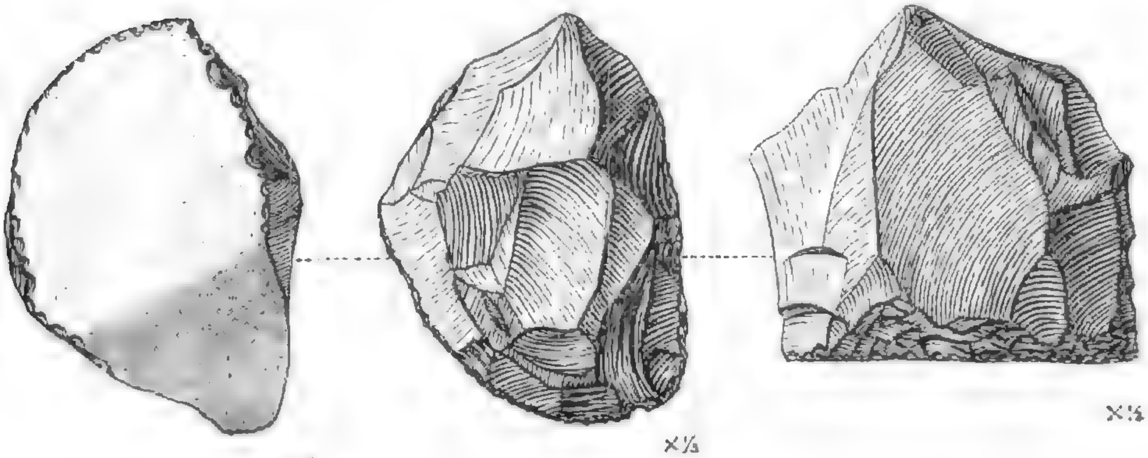
Fig. 6. Horn's Camp Creek, Parachilna Pass.

Fig. 7. Showing evidence of wear (overhang). Fishery, 3 miles east of Cape Jervis.

Fig. 8. Overhang appearing, due to base being worn and reduced by retrimming as in fig. 7. Cape Cassini, Kangaroo Island.

Fig. 9 to 11. Advantage has been taken of suitably shaped blocks wherewith to trim two or more base margins on different planes.

Fig. 9. Trimmed on two margins. This type occurs comparatively frequently. Salt Creek, 3 miles south of Rapid Head.



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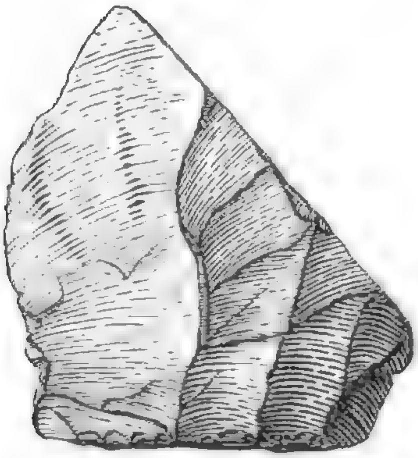

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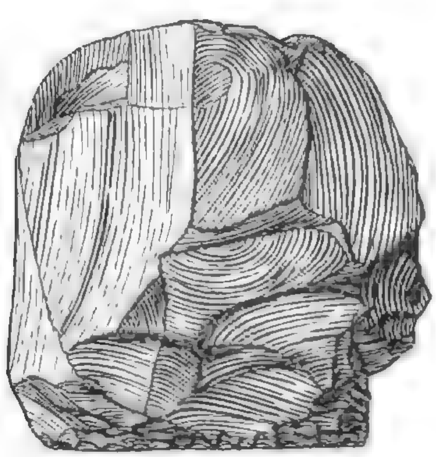

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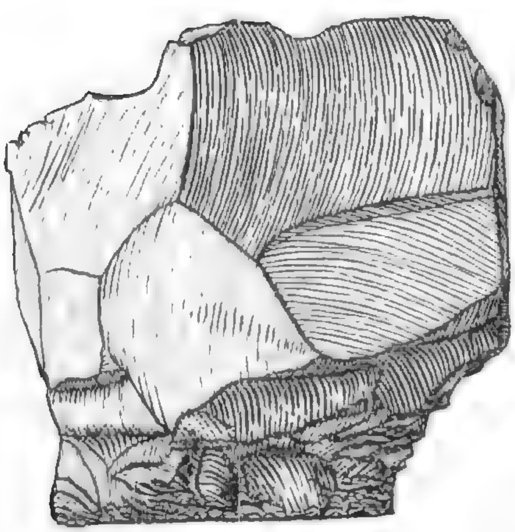

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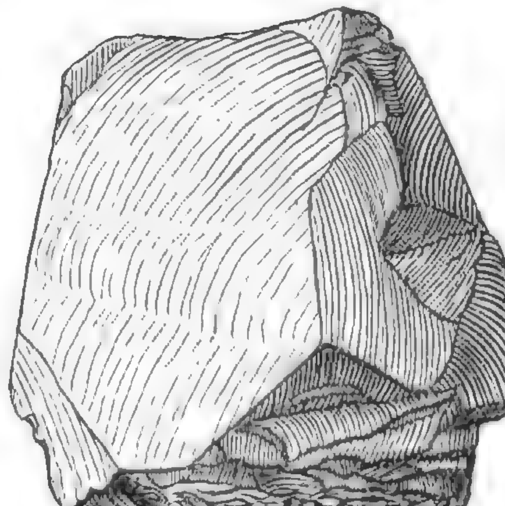

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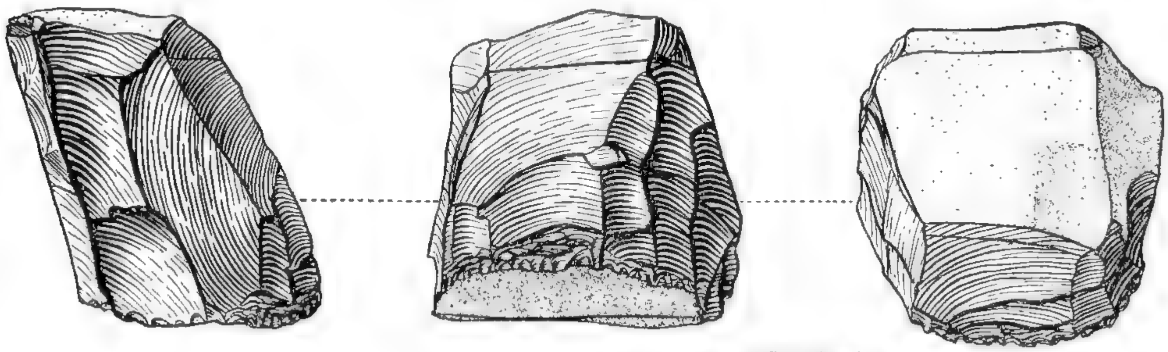

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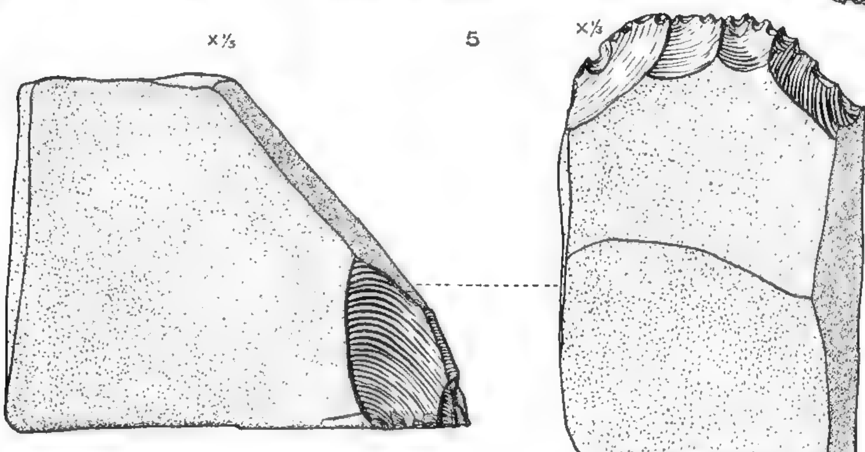

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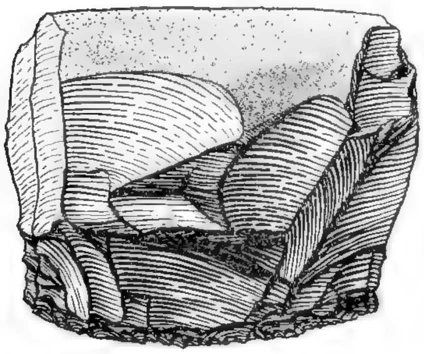

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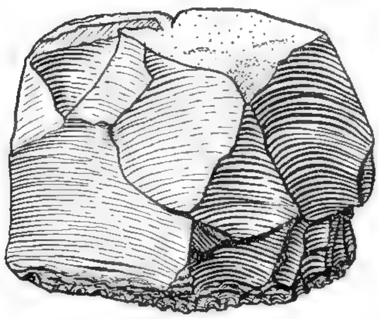

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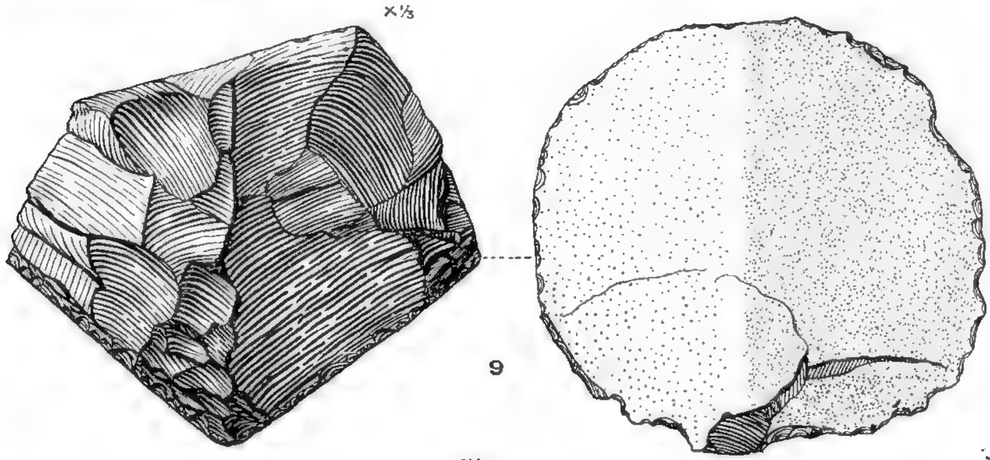

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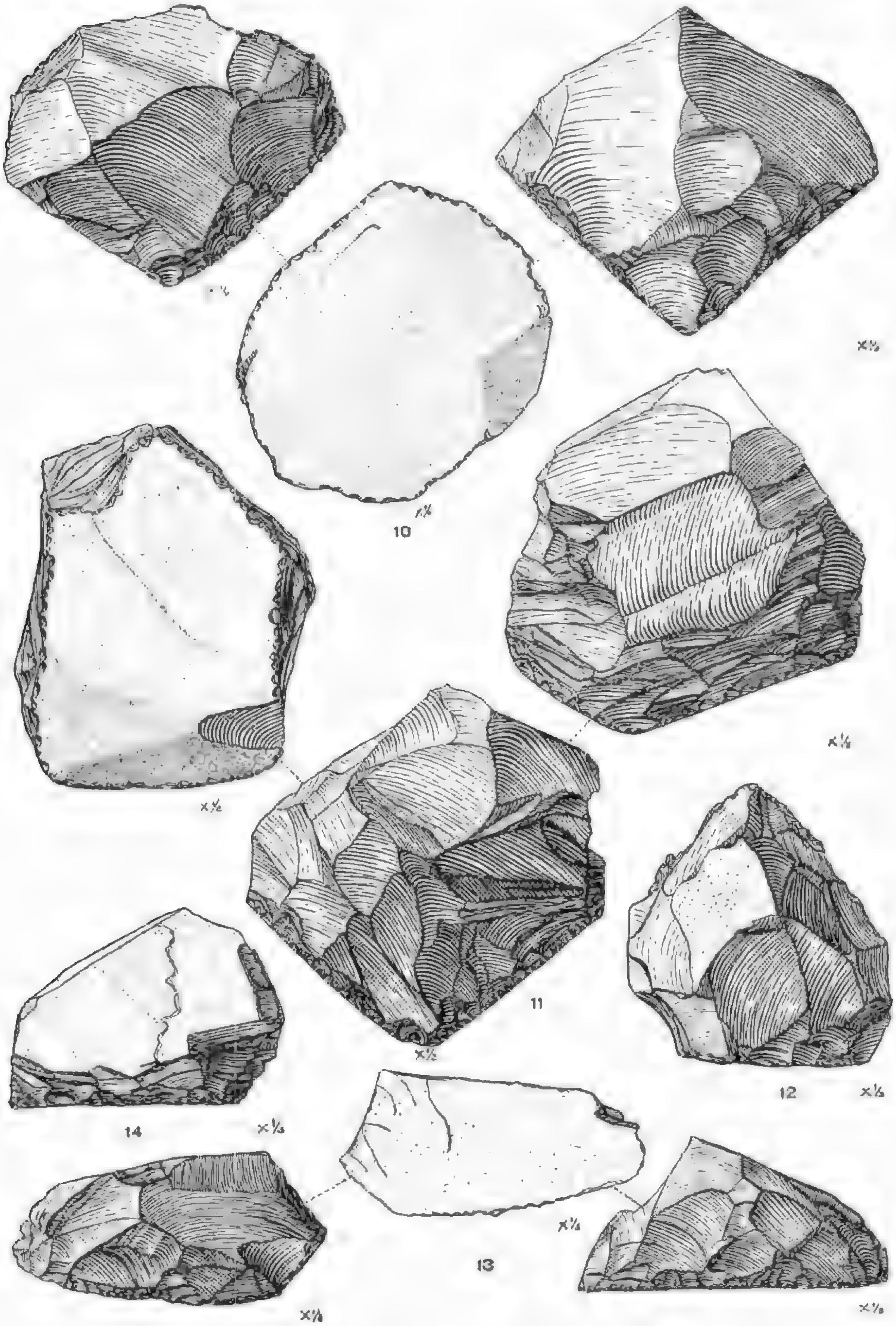
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Fig. 10. Worked along three margins on a smooth but angular block. Such implements are uncommon. Werta Creek, Parachilna Pass. 27 ounces.

Fig. 11. This implement with base irregular in contour, has been skilfully trimmed around its entire periphery. It is really four sided. 4 miles south-east of Mt. Lyall, Wirrealpa.

Fig. 12. Irregularly shaped horsehoof, rather crudely trimmed, discovered beneath three feet of drift during road-making operations in Parachilna Pass, two miles within its western entrance. 45 ounces. A core, similar in type, was uncovered at the same time.

Fig. 13 to 15. Elongate oval flat base, trimmed along portion of its margin and high narrow crest.

Fig. 13. 5 miles north of Wilpena Head Station. 29 ounces.

Fig. 14. Brachina Creek.

Fig. 15. Discovery Lagoon, Kangaroo Island.

Fig. 16 to 19. Flat base, lozenge shaped with one long margin invariably trimmed. Irregularly chipped crest which is relatively low.

Fig. 16. Emu Springs, Wirrealpa. 29 ounces.

Fig. 17. Brachina Creek.

Fig. 18. Discovery Lagoon, Kangaroo Island.

Fig. 19. Hallett's Cove.

Fig. 20 to 23. Tablet shaped and comparatively thin; flat top and base, the latter trimmed along its margin except where portion of pre-existing surface was retained in the nature of a working platform.

Fig. 20. Fishery, 3 miles east of Cape Jervis.

Fig. 21. Brachina. 21 ounces.

Fig. 22. Hawk's Nest, Kangaroo Island.

Fig. 23. Well worn example, showing development of overhang. 1 mile north-east of Cape Jervis.

Fig. 24 to 27. Characteristically horsehoof in shape, high roughly chipped apex. Flat circular base with margin trimmed around the entire periphery.

Fig. 24. Derived from close-grained quartzite. Discovery Lagoon, Kangaroo Island. 40 ounces.

Fig. 25. Showing wear of base due to usage and re-trimming, causing gradual appearance of overhang. Hog Bay River, Kangaroo Island.

Fig. 26. Worn specimen. 1 mile north-east of Cape Jervis.

Fig. 27. Exhibiting extreme diminution in size and weight, due to long continued use and re-trimming but still retaining a good working edge. Emu Springs, Wirrealpa. 11 ounces.

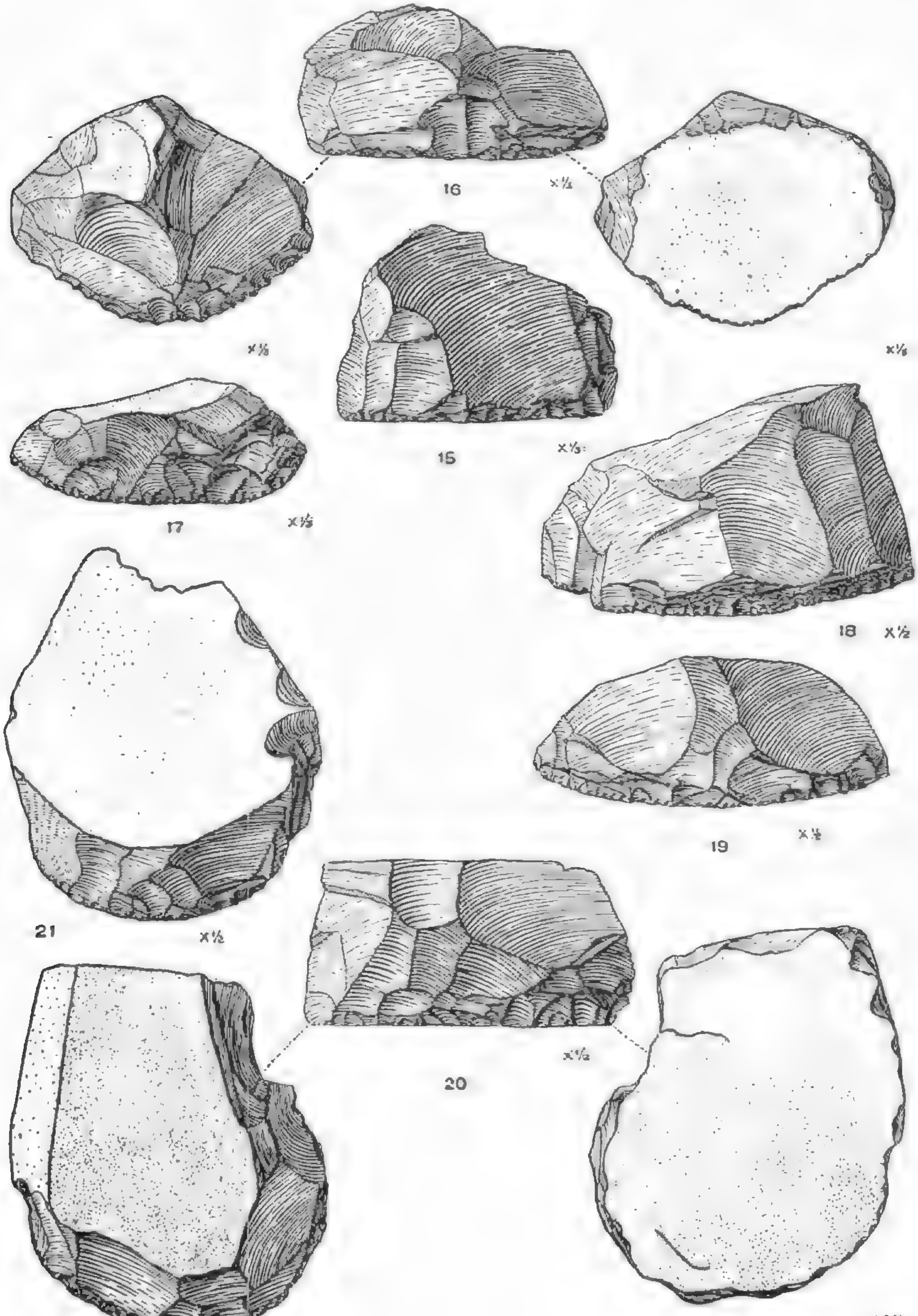
TYPES DERIVED FROM FLAKES.

Fig. 28 to 30. Flat, almost discoidal base but as portion of working platform is retained, margin is not trimmed all round. These are large flakes and therefore, strictly speaking, high crested arapias. Tindale (1931). Horsehoof in shape.

It may be convenient to mention at this point the discoidal adze flake or tula, a typically Australian implement, relatively common throughout large areas in the continent and similar in technique to the arapia of which it is, in reality, a small replica.

After careful study of tulas still mounted with gum on the ends of smoothed wooden sticks and wommeras (spear throwers), in the South Australian Museum and elsewhere, it has been found that the diameter of the largest tulas was in the region of four inches.

It is suggested that such a measurement could be tentatively adopted as a dividing line between this implement and the, presumably, unmounted arapia.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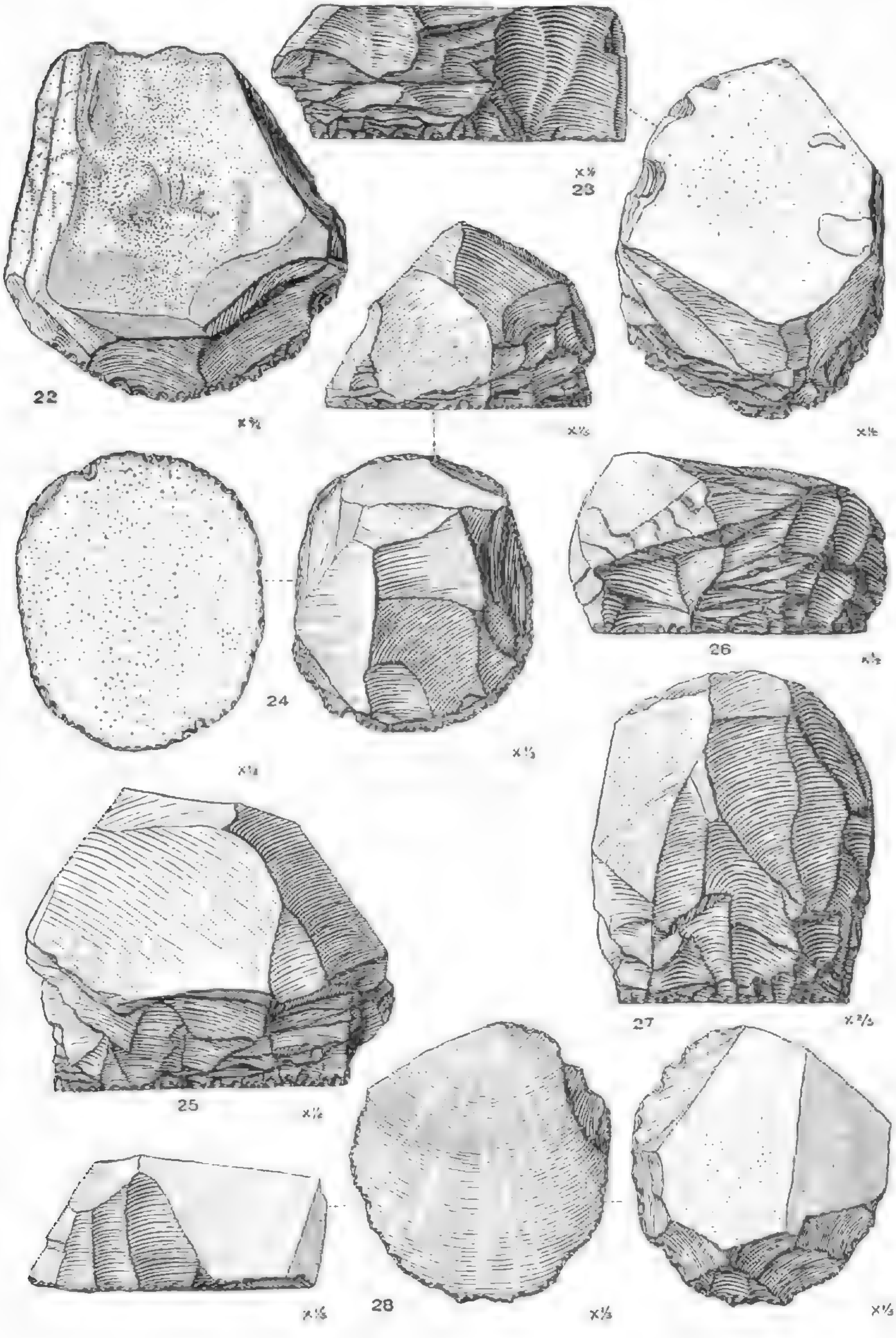
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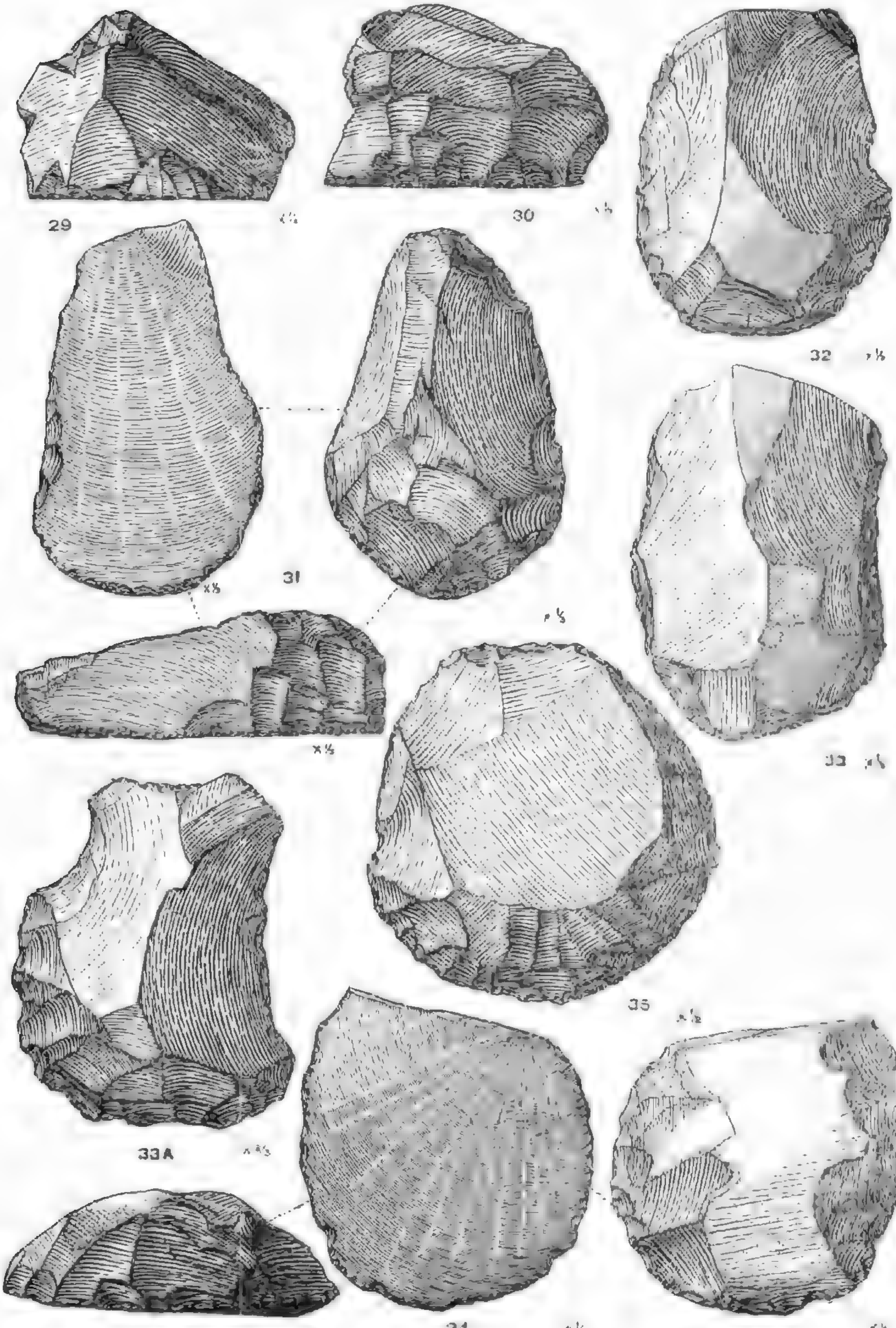
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Fig. 28. Highly patinated example in blue quartzite. Hallett's Cove, 35 ounces.

Fig. 29. Showing a little wear (overhang) but good trimming still evident. Old Hookina.

Fig. 30. Fashioned from blue quartzite. Hog Bay River, Kangaroo Island.

Fig. 31 to 33. Flake implements which are distinctive in form and could, perhaps, be termed "comet-shaped arapias". Occur sparingly in areas 2 and 3.

Fig. 31. Typical specimen, considerably weathered but still showing evidence of skilful trimming. Emu Springs, Wirrealpa. 28 ounces.

Fig. 32. Emu Springs, Wirrealpa.

Fig. 33. Hallett's Cove.

Fig. 33A. Emu Springs, Wirrealpa.

Fig. 34 to 36. Arapia (flake) implements. Discoidal base with working platform retained and pronounced percussion bulb. Skilful flaking and trimming.

Fig. 34. Yadlamalka, east of Lake Torrens. 40 ounces.

Fig. 35. Lyndhurst, 20 miles south of Farina. 16 ounces.

Fig. 36. Artipena Water, Martin's Well.

PEBBLE IMPLEMENTS.

Fig. 37 to 79 are all trimmed pebble implements with the exception of fig. 65 which is a flake.

Fig. 37 to 39. Derived from smooth angular pebbles and retaining the horsehoof shape along the trimmed edge; flat base.

Fig. 37. Made from a smooth triangular pebble of light brown quartzite. Trimmed at broad end of base only. Sellick's Beach. 31 ounces.

Fig. 38. Worked on front and both side margins, producing a very effective implement. A flat, bluish quartzite pebble. Muston, Kangaroo Island.

Fig. 39. Working edge on one margin only and showing evidence of removal of material by use and subsequent re-trimming. Matthewson Springs, 4 miles south of Martin's Well.

Fig. 40 to 43. Made from both angular and partly rounded pebbles of no defined shape. These differ from preceding horsehoof types in that working face shows as an acute angle.

Fig. 40. Neatly trimmed and efficient implement with symmetrical working edge. Balcoracana Springs, Wirrealpa. 20 ounces.

Fig. 41. Fishery, 3 miles east of Cape Jervis.

Fig. 42. Artipena Water, Martin's Well. 10 ounces.

Fig. 43. Blanche Point, 1 mile north of Port Willunga.

Fig. 44 to 47. Derived from smooth rounded pebbles, almost invariably of quartzite, having as the apex one pre-existing corner of the stone. The trimmed working edge, which is rounded is therefore, a diagonal cross section of the pebble.

Fig. 44. Artipena Water, Martin's Well. 39 ounces.

Fig. 45. Hog Bay River, Kangaroo Island.

Fig. 46. Boorloo Creek, Callanna, 5 miles west of Marree.

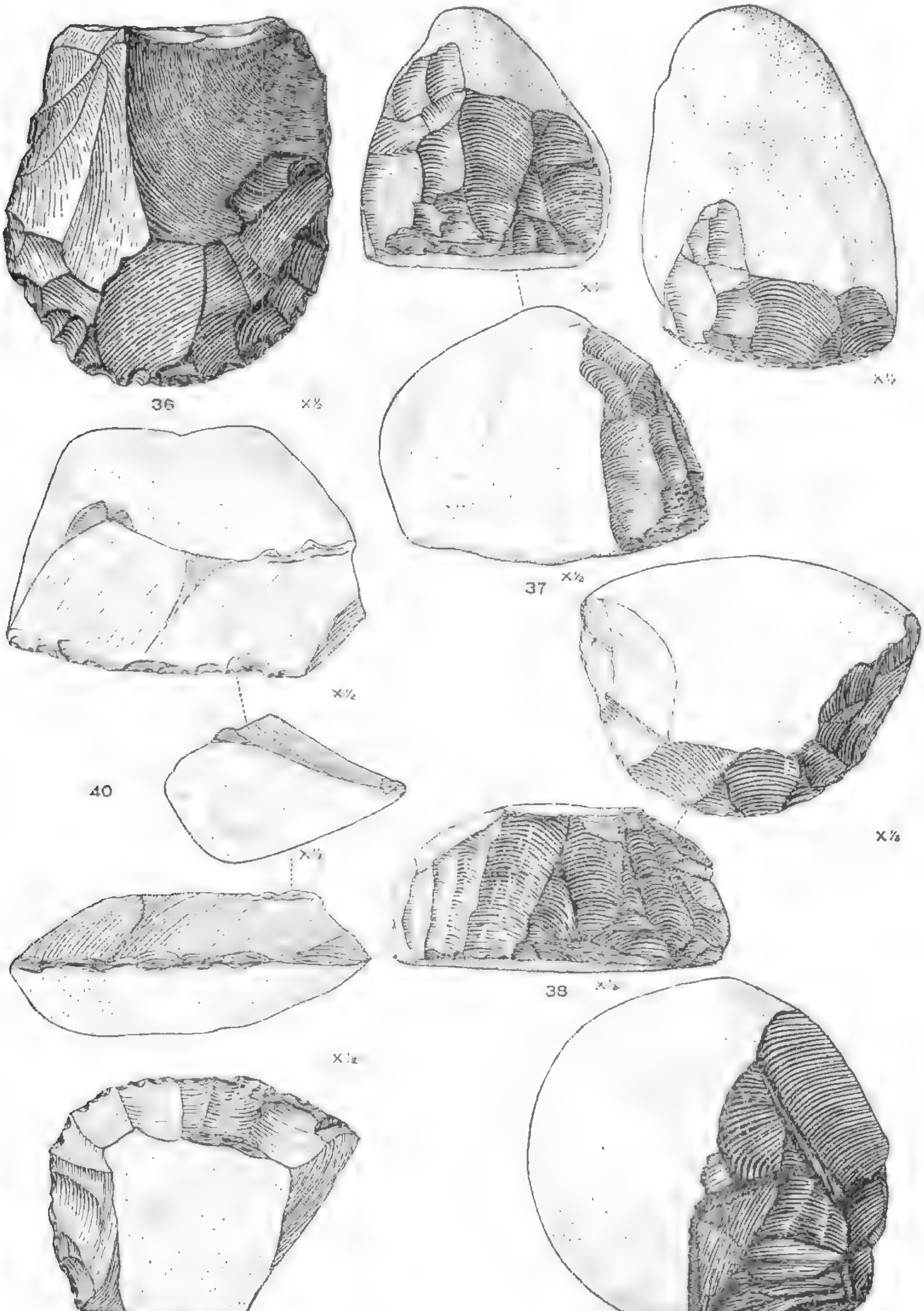
Fig. 47. Discovery Lagoon, Kangaroo Island.

Fig. 47A and 47B. Rather similar to fig. 44 to 47 except that portion of the working edge is trimmed to a point.

Fig. 47A. Sellick's Beach.

Fig. 47B. Mount Chambers Gorge, Wirrealpa. 44 ounces.

Fig. 48 to 54. This series of semi-uniface pebble choppers may be regarded as representative of many hundreds of Kangaroo Island specimens from which they have been selected. Derived from symmetrical elongate oval pebbles, the lower or working edge is neatly trimmed whilst the upper is roughly shaped, forming an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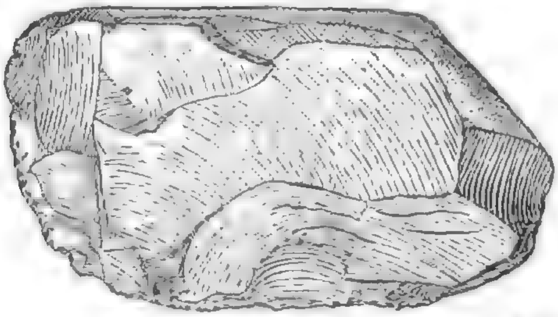

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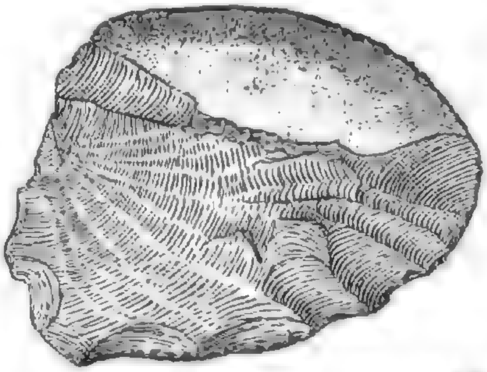
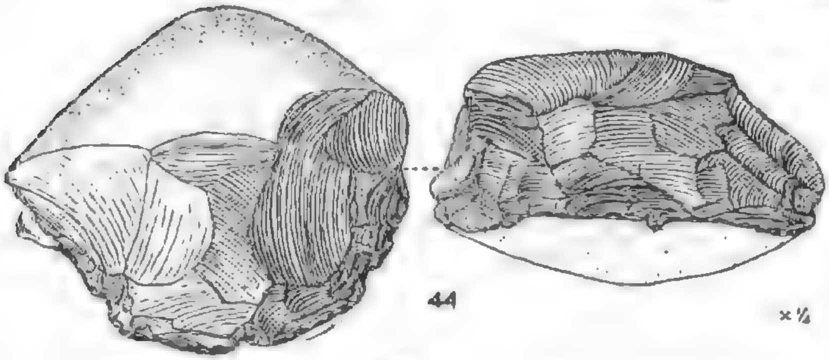
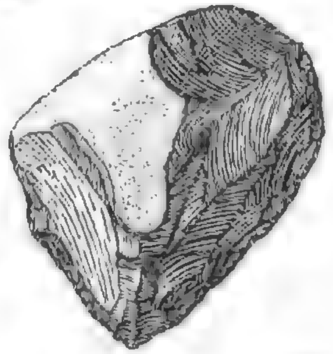


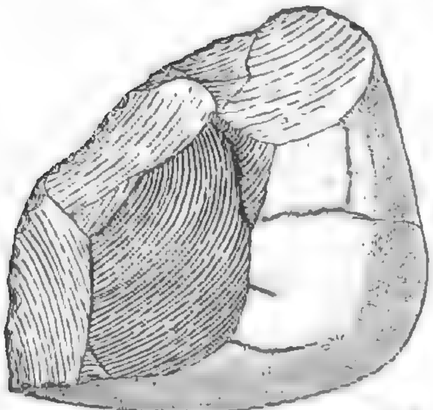
43 × ⅔



44 × ½ × ½



47A × ½



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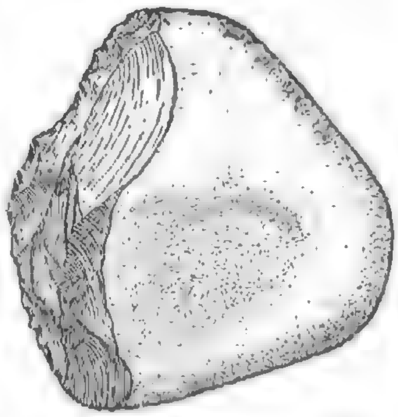
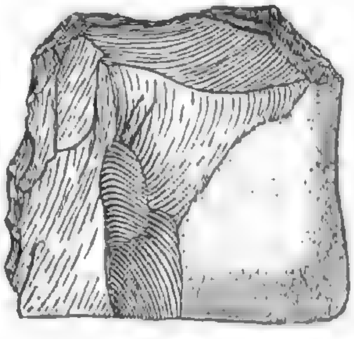
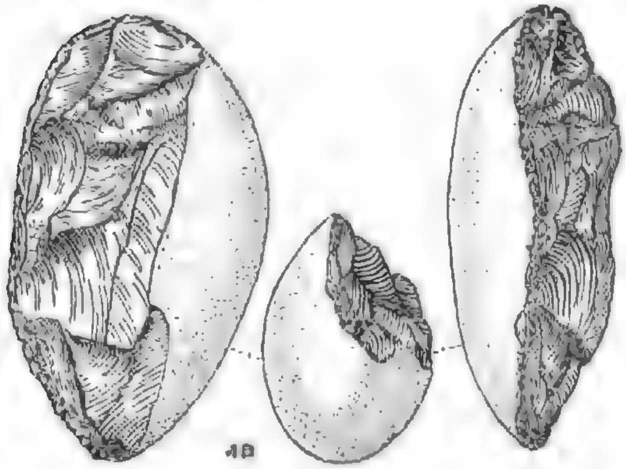


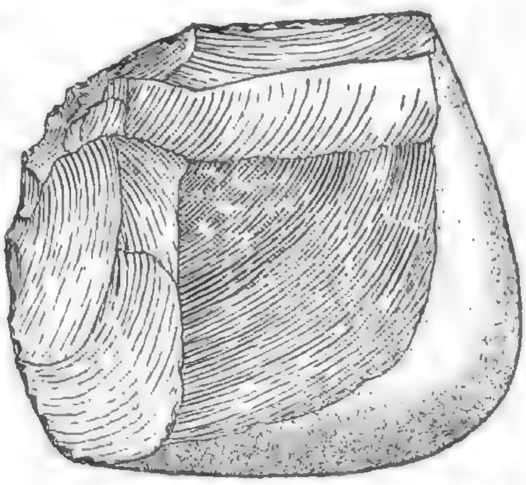
46 × ½



47B × ½



48 × ½ × ½ × ½



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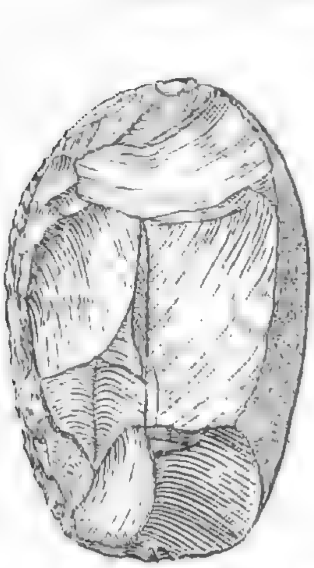

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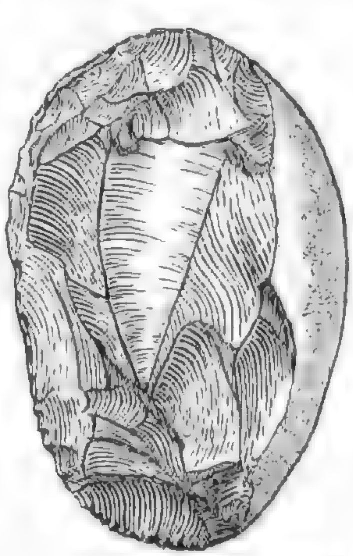

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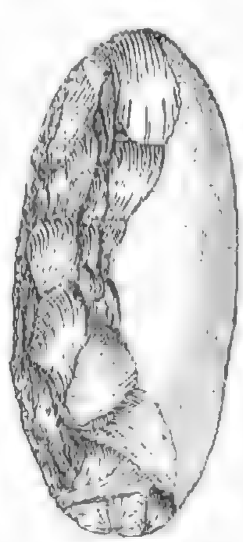

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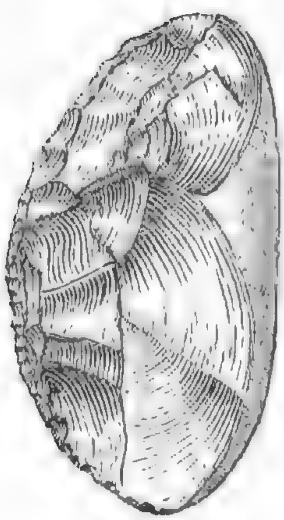

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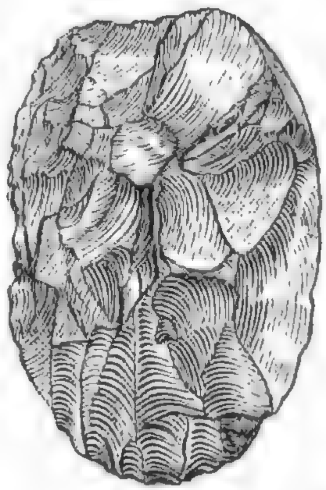

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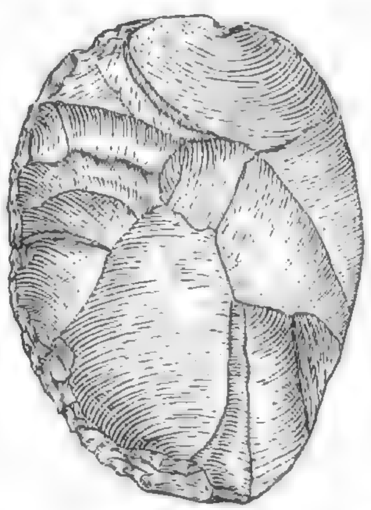

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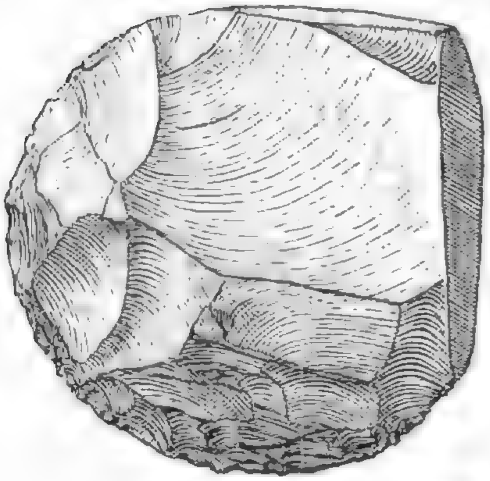

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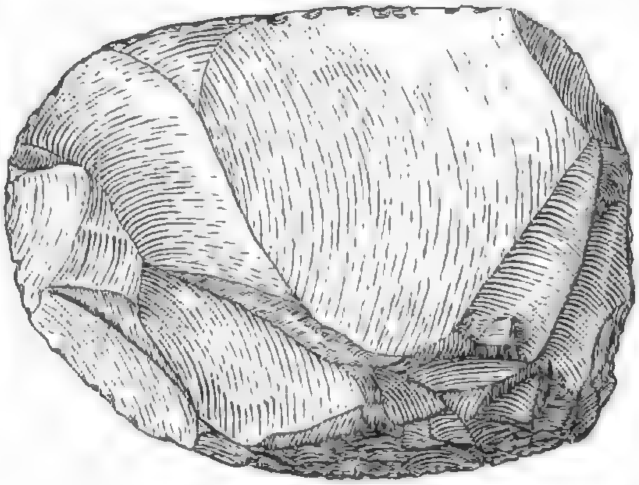


56 x ⅔

acute angle in relation to the former. This angle gradually becomes obtuse with wear and consequent re-trimming of the base, the worker having thus anticipated his continued requirements by correct design. These implements may be termed semi-uniface.

Fig. 48. Lashmar's Lagoon, Antechamber Bay, K.I.(1) 20 ounces.

Fig. 49. A beautiful example of craftsmanship in pale blue quartzite and probably two handed. Red Banks near Point Morison, K.I. 80 ounces.

Fig. 50. Hog Bay River, K.I. 43 ounces.

Fig. 51. Discovery Lagoon, K.I. 30 ounces.

Fig. 52. A clever example of pebble trimming. Discovery Lagoon, K.I. 34 ounces.

Fig. 53. Hawk's Nest, K.I. 18 ounces.

Fig. 54. Red Banks near Point Morison, K.I. 6 ounces.

Fig. 55. Many Kangaroo Island pebble implements are noted in a broken condition due apparently to heavy requirements. The breakage generally occurs at right angles to the trimmed edge as shown in this specimen from Hog Bay River.

Fig. 56. Broken similarly to fig. 55, but rounding and re-trimming the broken edge has extended its life. Hog Bay River, K.I.

Fig. 57 to 58. Usage and re-trimming gradually reduce the length of the pebble-implement working edge, and also make it obtuse.

To prolong its usefulness and increase the length of that working edge, it appears that the ends were trimmed subsequently. Specimens similar to fig. 57 and 58 are common on the larger camp sites and apparently represent a stage that is similarly reached with worn horsehoof implements. (See amongst fig. 3 to 27).

Fig. 57. Discovery Lagoon, K.I.

Fig. 58. 2 miles south of Antechamber Bay, K.I.

Fig. 59. Similar to the elongate oval pebble implements, fig. 48 to 54 but fashioned from a flattened block. Muston, K.I. 50 ounces.

Fig. 60. Made from a large pebble of blue quartzite but trimmed across its short cross section and possibly a two handed implement. Represents the largest pebble artefact yet reported from the Island. 2 miles south of Antechamber Bay, K.I. 115 ounces.

Fig. 61. Derived from a flattened discoidal pebble and showing an effective working edge. Boorloo Creek, Callanna, 5 miles west of Marree. 37 ounces.

Fig. 62 to 64A. Implements made from round pebbles occur on Kangaroo Island, also sparingly on the mainland at Artipena, Sellick's Beach and other isolated localities.

Fig. 62. Artipena Water, Martin's Well. 18 ounces.

Fig. 63. Artipena Water, Martin's Well.

Fig. 64. McLaren Vale. 9 ounces.

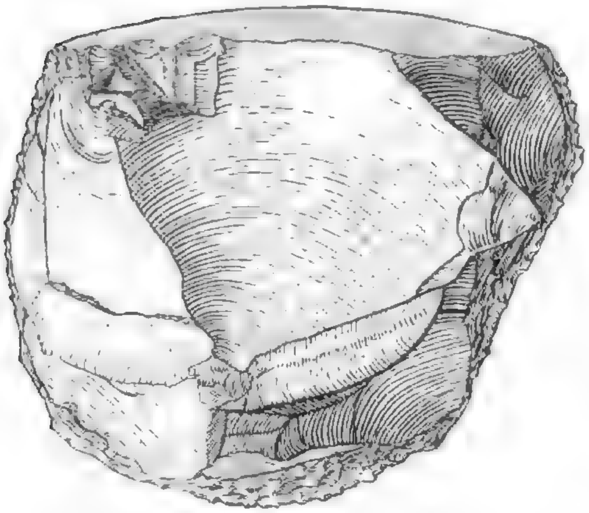
Fig. 64A. Hog Bay, K.I.

Fig. 65. *Pebble implement made from a flake.* The writer has found this type most uncommon and all specimens were collected on Kangaroo Island. It is, therefore, a flake implement. Discovery Lagoon, K.I. 42 ounces.

Fig. 66 to 75. Pebble implements which are trimmed around the whole of one margin and are, therefore, uniface in technique. Occurrence apparently chiefly confined to Kangaroo Island where it is comparatively rare. Workmanship is generally of a high order and the shape usually an elongate oval. They may be classed as double edged choppers.

Fig. 66. Perfect in symmetry, highly patinated quartzite pebble. Probably two handed. The largest uniface yet reported in South Australia. Muston, K.I. 78 ounces.

(1) Kangaroo Island has generally been abbreviated to K.I.



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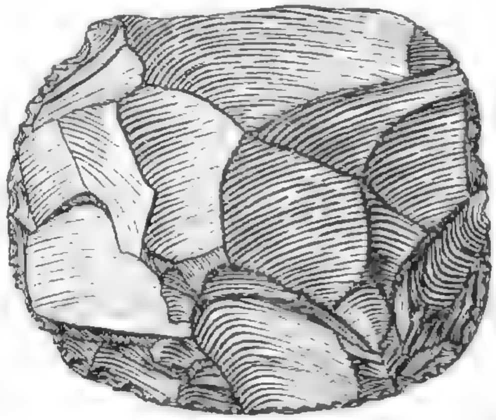
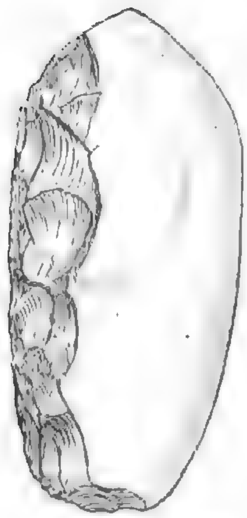
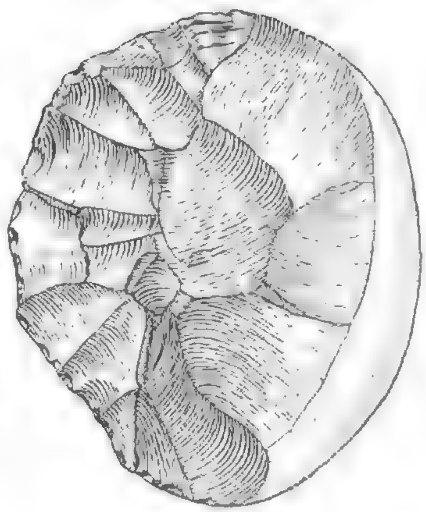


58 × 2/3



59 × 1/4

60 × 1/4



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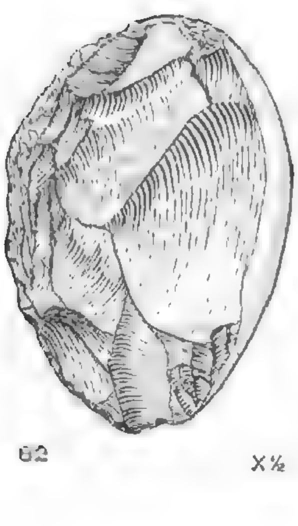

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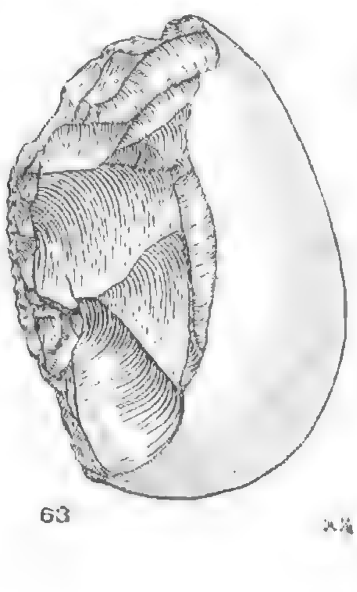

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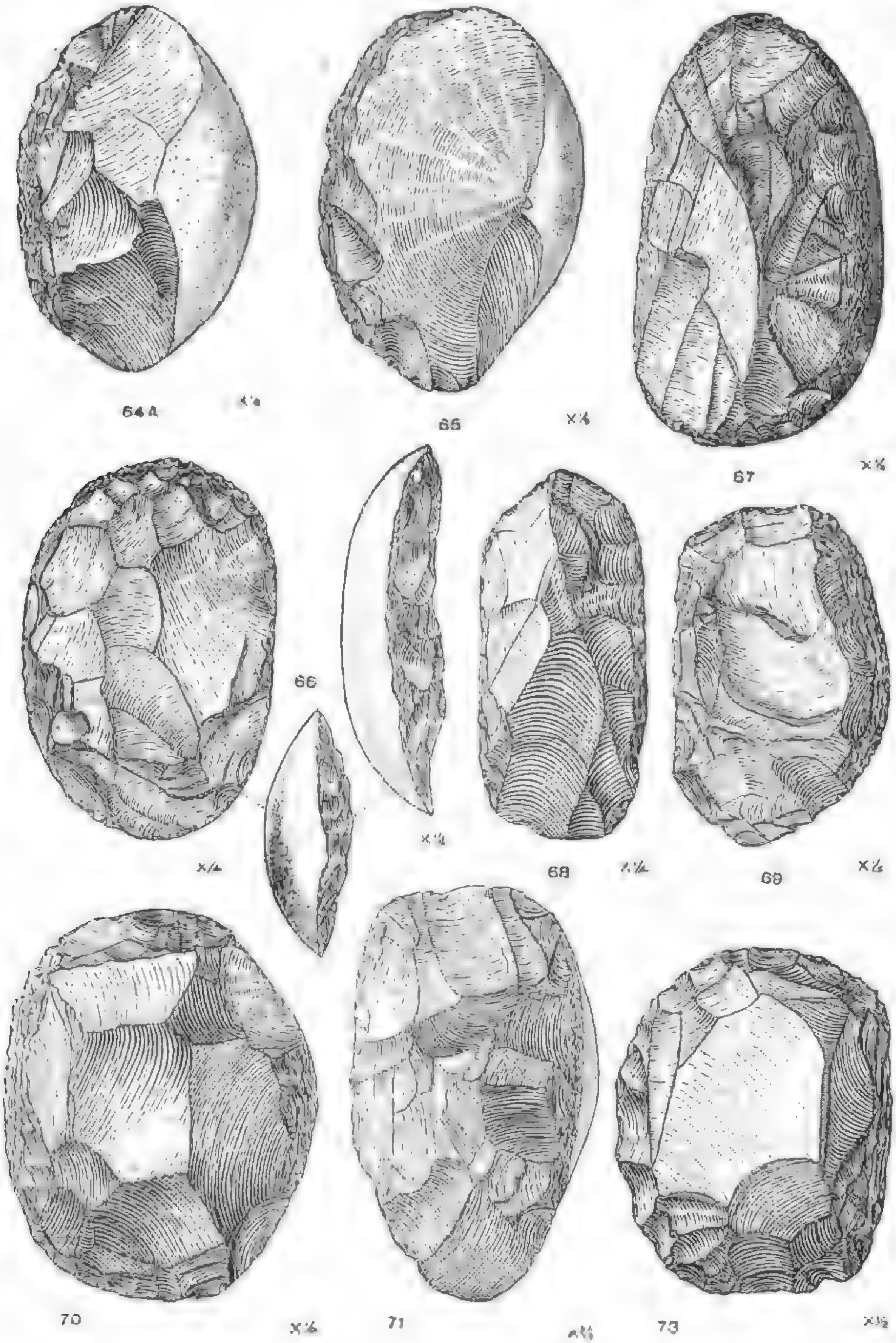
64 × 2/5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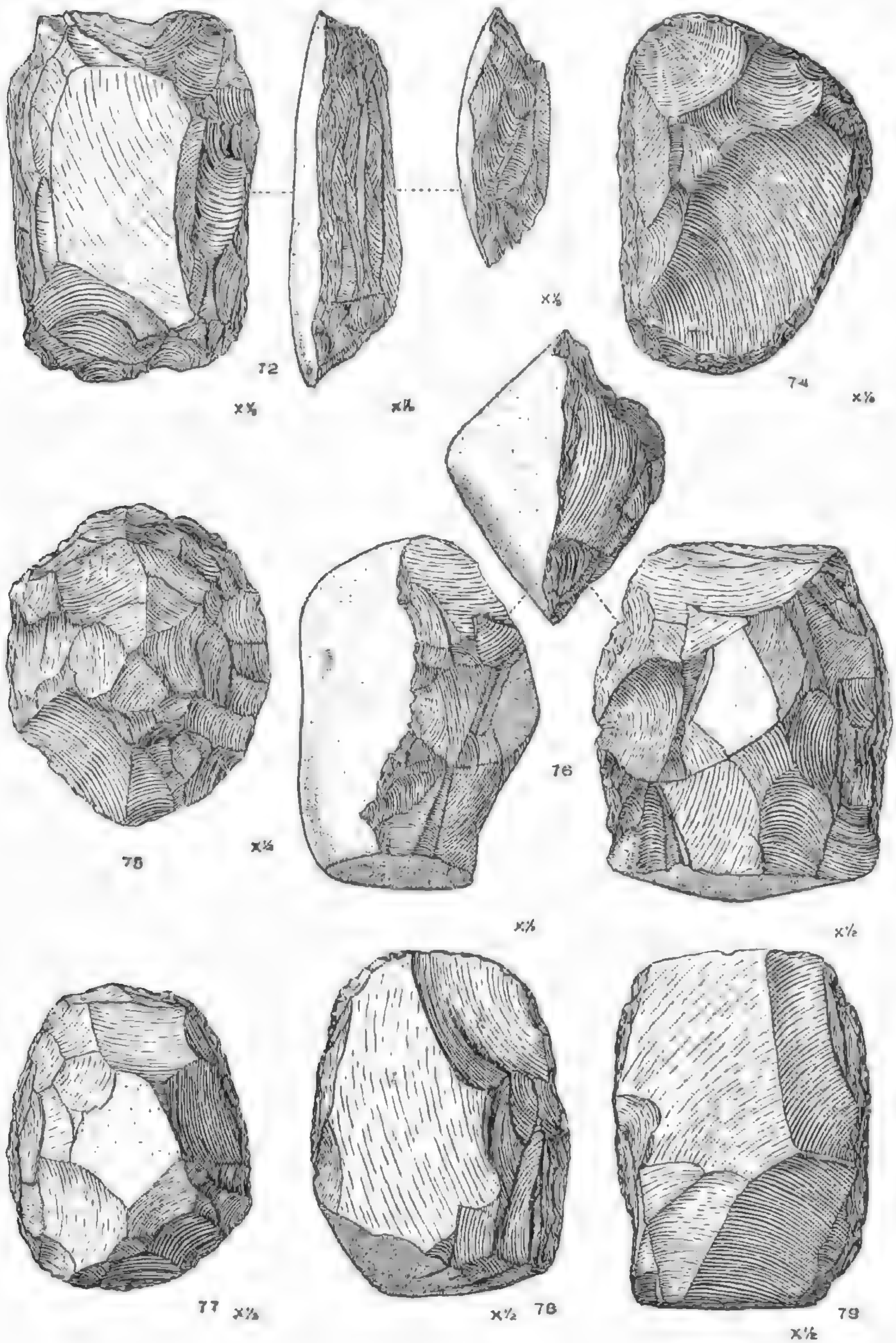
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Fig. 67. Hog Bay River, K.I.
Fig. 68. Hog Bay River, K.I.
Fig. 69. Discovery Lagoon, K.I. 53 ounces.
Fig. 70. Hog Bay River, K.I.
Fig. 71. Discovery Lagoon, K.I. 6 ounces.
Fig. 72. Carefully trimmed to produce a rectangular block. The type occurs sparingly. Hog Bay River, K.I. 26 ounces.
Fig. 73. Fine working edge on whole of margin. Hog Bay River, K.I.
Fig. 74. Triangular in shape with all three margins trimmed. Hog Bay River, K.I. 33 ounces.
Fig. 75. Uniface implement from Yappala Lagoon. 5 miles south-west of Hawker.
Fig. 76 to 79. Derived from smooth rectangular pebbles which are trimmed on at least two of the longer margins.
Fig. 76. Sellick's Beach. 35 ounces.
Fig. 77. Trimmed around most of margin. Fishery, 3 miles east of Cape Jervis.
Fig. 78. Hog Bay River, K.I.
Fig. 79. Artipena Water, Martin's Well.

OTHER IMPLEMENTS.

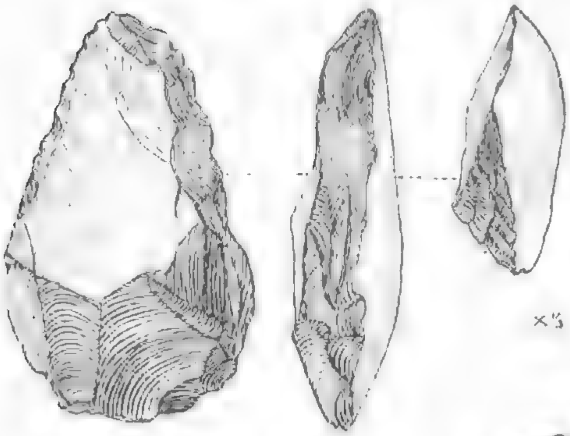
Fig. 80 to 82. Roughly pick form and triangular in shape with rounded apex, extremities usually bruised or polished. Occur on Kangaroo Island where marine shellfish abound. At least one possible use may have been the removal of these from the rocks. Similar implements are noted elsewhere in Australia, including some in the South Australian Museum from Mornington Island where they are used as oyster picks.
Fig. 80. Made from a quartzite pebble. Hog Bay River, K.I. 14 ounces.
Fig. 81. Discovery Lagoon, K.I.
Fig. 82. Blue quartzite pebble, Hog Bay River, K.I.
Fig. 83. Horsehoof type of implement trimmed from a block of poor material; discovered upon the rocky floor of Janarwing Cave, referred to elsewhere in this paper. 52 ounces.

CLEAVERS OR LARGE KNIFE-LIKE IMPLEMENTS.

Fig. 84 to 87. These occur sparingly and are fashioned from suitable thin, irregular blocks or flakes. No evidence was noted of any defined industry or of similarity in design, the native apparently, being concerned only with his requirements, that is, an efficient cutting edge.
Fig. 84. Flake of brown quartzite. Coast two miles north of Port Noarlunga. 26 ounces.
Fig. 85. Flake implement. Normanville.
Fig. 86. Angular block. Third Waters, Oratunga. 13 ounces.
Fig. 87. Angular block. Oratunga Old Station.

SITE AT CAPE CASSINI, KANGAROO ISLAND.

Fig. 88 to 92. In this paper a short reference is made to the site at Cape Cassini, Kangaroo Island, where material collected resembles crude implements obtained at Cape Jervis and other places on the mainland, rather than on the Island. These figures show the types from Cape Cassini.



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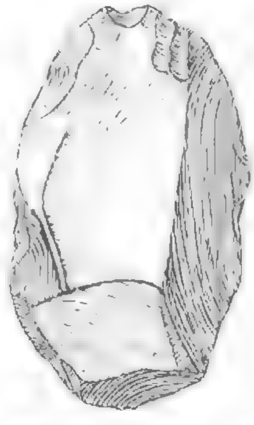

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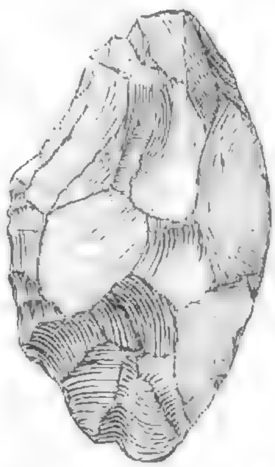

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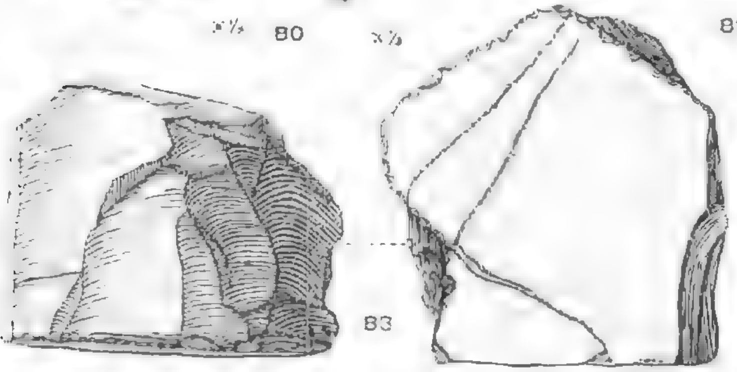

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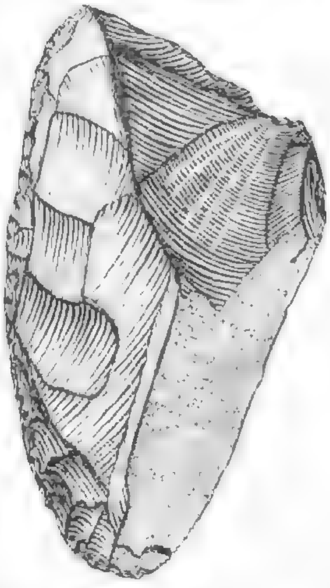

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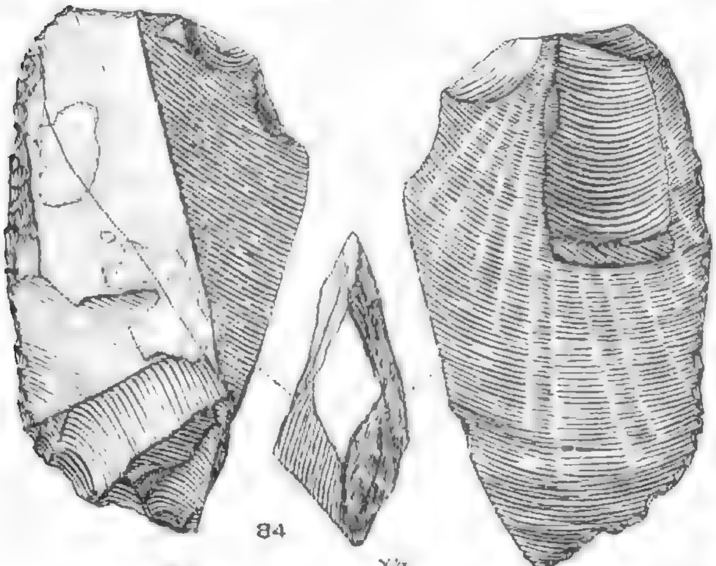
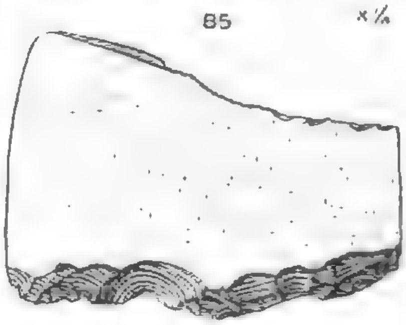


84 ×⅓ ×⅓ ×⅓



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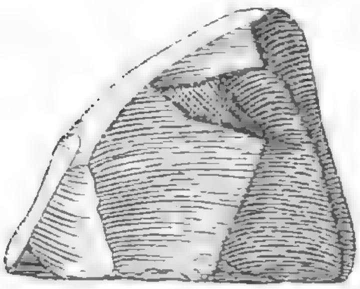

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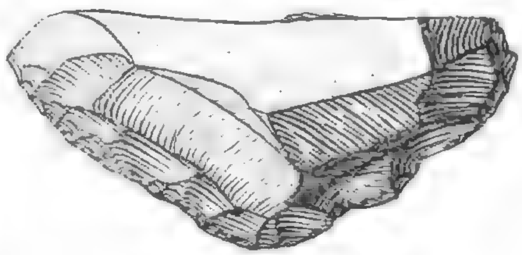
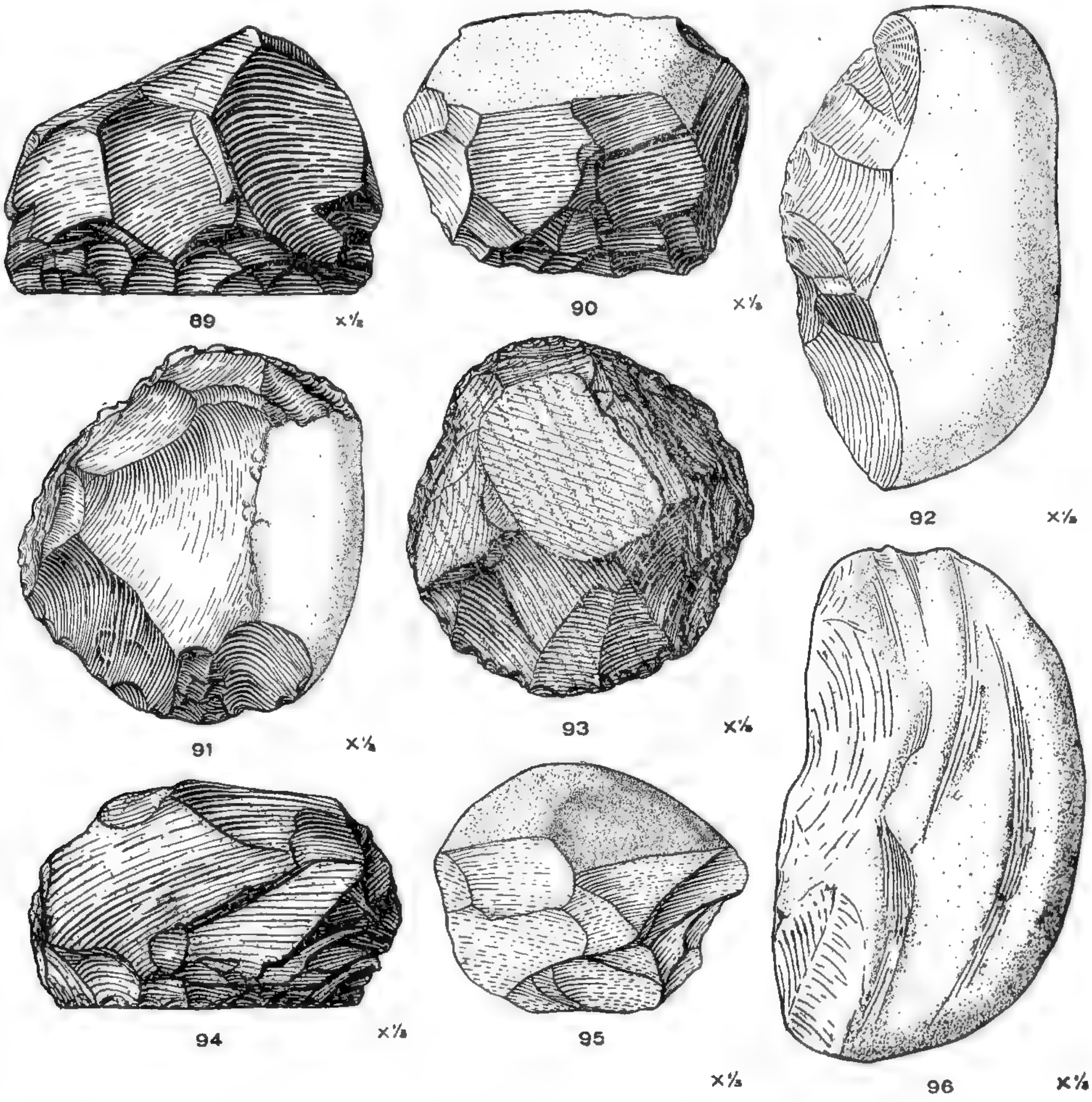


87 ×⅓

Fig. 88. Horsehoof type implement. 35 ounces.
Fig. 89. Horsehoof type showing wear.
Fig. 90. Similar design to fig. 15, but roughly worked.
Fig. 91. Made from irregularly shaped smooth pebble and poorly trimmed.
Fig. 92. Pebble implement, similar to the Kangaroo Island industry but showing indifferent workmanship. 58 ounces.



DETERIORATION AND WEATHERING.

The effect of local atmospheric conditions and/or soil content is discussed elsewhere in this paper. These drawings show the resulting effects of such causes.
Fig. 93. Horsehoof core implement. Hallett's Cove.
Fig. 94. Similar to fig. 15. Hog Bay River, Kangaroo Island.
Fig. 95. Angular pebble implement somewhat similar to fig. 41. Wonoka Creek, 4 miles north of Hawker.
Fig. 96. Characteristic Kangaroo Island oval pebble implement showing partial disappearance of evidence of original trimming. Coastal sand dunes, Pennington Bay, Kangaroo Island.

SUMMARY.

This paper is an introductory survey of approximately 2,000 specimens of some of the larger stone implements from South Australia.

A tentative classification, based on a study of those implements from three specified regions of the State, is given.

Horsehoof and pebble types have been subdivided insofar as seems appropriate at the present stage.

Some comparative figures show the relative frequency of the characteristic Kangaroo Island types compared with similar large implements of the mainland.

Emphasis is placed on the distinctive culture exhibited by the implements of Kangaroo Island, the main feature of which is the great predominance of the ellipsoidal, semi-uniface pebble chopper. The unexplained disappearance of its former inhabitants is referred to briefly.

Short descriptions of the more important features accompany drawings of selected representative specimens. Attention is drawn to the relatively frequent re-trimming and re-edging of the pieces so that they can be reduced to almost a different tool.

Probable uses, weights, age, also patination, weathering and deterioration, are briefly discussed.

Experimental study was made by attempting to simulate aboriginal uses of these large implements for chopping, scraping, etc. Their efficiency was readily demonstrated.

ACKNOWLEDGMENTS.

The writer desires to thank Mr. H. M. Hale, Museum Director, and Dr. T. D. Campbell, for their assistance, Mr. R. M. Peake for five years' co-operation in the field, Flight-Lt. N. B. Tindale, Museum Ethnologist, now on service with the R.A.A.F., and Miss G. M. Bishop, the librarian. He is also deeply indebted to Mr. H. V. V. Noone for the benefit of his valued experience, and to Miss Gwen Walsh for the excellent series of drawings which accompany this paper and their arrangement therein.

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SOME ABORIGINAL CAMP SITES IN THE WOAKWINE RANGE REGION OF THE SOUTH EAST OF SOUTH AUSTRALIA

BY T. D. CAMPBELL, D.D.SC., AND H. V. V. NOONE, F.R.A.I.

Summary

Little has been written on the life of the aborigines who in modern times occupied the South-East of this State. One of the present writers has, in two previous papers (1933, 1939) briefly recorded published and other collected data; his survey showed that our knowledge of the social and material culture of the Buandik people–who occupied most of the South-East–is exceedingly scant.

Some ABORIGINAL CAMP SITES in the WOAKWINE RANGE REGION of the SOUTH EAST of SOUTH AUSTRALIA[1]

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Fig. 1–157.

INTRODUCTION

Little has been written on the life of the aborigines who in modern times occupied the South-East of this State. One of the present writers has, in two previous papers (1933, 1939) briefly recorded published and other collected data; his survey showed that our knowledge of the social and material culture of the Buandik people—who occupied most of the South-East—is exceedingly scant.

The present notes give an account of a brief visit to this southernmost part of the State in April of this year. The main objects were the examination of some already known camp sites in the Millicent district, and an attempt to add to our knowledge of the southerly occurrence of microlithic and other special types of implements such as the South Australian pirri, the eastern Bondi point and the Gambierian biface implements. A preliminary investigation of a number of sites was carried out and useful data and many implements were collected.

The *South-East* is generally defined by the geographer as a natural region lying south of a line approximately from Kingston across to Naracoorte. It was probably the lower two-thirds of this area which formed the territory of the Buandik people—who become extinct with the close of last century. Some of their camp sites known to collectors occur in the coastal strip of this country and are mainly associated with the coastal dunes and the Woakwine Range. This latter is a consolidated sand-dune range lying about three to five miles inland from, and parallel to, the coastline. It is also one of the series of similar, more or less parallel ridges, which constitute a striking geographical feature of the South East. As stated by Wade (1915) these ridges are mostly covered with a hard crust of travertine; and "under the hard cover the consolidation is very imperfect and the sands very loose".

On weathered or "blown out" sand areas in or near the Woakwine, relics of native occupation almost invariably occur; the position and nature of these camp sites, their relation to the surrounding features, water and stone sources, all form facets of an interesting study. The whole South-East presents an important story in recent geology; and the bearing of this on the age of the camp sites and relics is an intriguing problem, for students of paleontology, paleobotany and geophysics.

Sites examined. For convenience, Millicent was made our headquarters, as a number of known camp sites were readily accessible in that district. The following notes give a brief description and fairly precise data of their location.

A. Near Mt. Muirhead, at a cutting on the main road to Penola and Kalangadoo. Situated at the junction of Sections 406–110–108 in the Hundred of Mt. Muirhead. Here a limestone rise, sectioned by the main road cutting, is covered by

(1) A short account of the collection of stone implements made and the sites concerned was given at the meeting of the Anthropological Society of South Australia of 27th May, 1943.

now drifting sand. The native relics in the form of worked material were rather sparse; nevertheless, they afforded some specimens of interest.

B. At the north-west extremity of a low sandy ridge on which the settlement of Hatherleigh is located about two to three miles to the south-east. The camp site is not far from the main highway and lies in Section 18 in the Hundred of Symon. For introduction to this rich and striking site, we are indebted to Mr. David Schulz of Rendelsham. The sand ridge is not many feet above the present plain level and does not seem to have been originally much higher. The obvious camp exposure occupies probably at least two acres and is divided into two portions; separated by a low subsidiary overgrown ridge. On most of this camp area, wind denudation has exposed rounded masses of rock, which may have been the source of implement material. Between and about these outcrops, the stone implements occur in fairly considerable quantity. Many lie clearly exposed; some partly buried in loose sand drift. One interesting feature on the western area of the site, is a spur of the less disturbed part of the main sand ridge which juts out on to the flat eroded area. The north-west face of this spur has collapsed and exposes a section of a smallish hearth, lying some eight to ten feet below the crest of the ridge. In the time available a large and varied collection was made from this site—one which merits further and intensive study, of the various features of interest it presents.

The situation of this camp area is interesting in that it is in a somewhat isolated position between both the Woakwine and Mt. Muirhead-Mt. Burr Ranges. It occurs on a low sandy ridge which on all sides—excepting the south-easterly extension of the ridge—is surrounded by broad flat plains which, before the days of the artificial drainage system, must have been extremely wet and probably water-covered for quite a portion of the year. The food production possibilities of the immediate environment could not have been so favourable—unless the aquatic life of the wet season helped—as the higher range country. The outcropping stone material on the site may have been a strong determining factor in its occupation.

C and D. These occur in the Woakwine Range between Millicent and the north end of Lake Bonney in the Hundred of Mayurra. Both are on open roadways: the former near Sections 225 and 360, the latter about a mile further east, near Sections 227-229. They are not typical "blown-out" sand areas, but occur on rises which have been "loosened" somewhat by road traffic. The implements here were sparse and scattered; mostly of the medium to large sized flakes or pieces, with but little variety of interest.

E. This extensive interesting camp area occurs on the inland slopes of a series of large, partly-consolidated, but now disintegrating sand-dunes which lie about three miles to the west of Rendelsham. It is not far from Bevilaque's Ford which lies in a depression between the Woakwine and the big sand-dunes in the Hundred of Rivoli Bay. Sections have not been established in this part of the Hundred; but the site lies to the south-west of Sections 6 and 7. These prominent dunes show obvious evidence of previous partial induration and consolidation; but they are now undergoing active disintegration, so that a continuous series of camp areas is almost completely buried beneath the loose sand which is making an inland drift. The implement covered areas are obviously widespread, but it is only on the occasional harder, bared patches that the relics are now exposed for collection. This site produced a moderately useful assortment of pieces.

F. This site occurs on a sandy outcrop in a low elevation called Jacob's Range; this latter, however, is merely an outlying part of the main Woakwine Range and lies on the edge of the broad flat country lying north of that range. The camp site is in Section 9W, Hundred of Rivoli Bay. Much material is probably buried below loose sand which has drifted or been washed down on to lower levels; but the exposed, firm patches yielded many interesting specimens and the site could be termed moderately rich.

G. This camp area is situated a mile or two west of site F and lies partly over a roadway in the Woakwine Range about one mile north of Mt. Hope, in Section 8E, Hundred of Rivoli Bay. Here again, the loosened sand from higher levels of the site has drifted and been washed down, possibly covering archaeological material. However, careful search provided an interesting and varied collection of specimens which were sufficient in quantity to style the site as moderately rich. One of the writers (T.D.C.) had previously worked on this site, and F also, some years ago.

H. Mt. Gambier. The roadway immediately above the Valley Lake, on its south side, cuts over this small site, which in spite of years of intense disturbance by the wheels of traffic, still produces on careful search a few odd pieces of interest.

I. Cape Northumberland, near Pt. Macdonnell in the Hundred of Macdonnell. A cursory examination of this region was made possible through the opportunity of a brief visit to Mt. Gambier. This area has been examined by collectors for many years past; but scattered material still occurs on the flat cliff tops immediately above the sea and on some inland slopes of the sand-dunes adjacent to the cliffs. The majority of the pieces found were of the large size. In the Howchin collection we have found an exceptionally large pointed blade from this area which is included in our illustrations.

J. The camp area here, like E, also consists of quite a number of camp sites extending along an inland sand-dune ridge. This latter appears to be a south-easterly portion of the partly consolidated sandhills constituting site E. Both these sand ridges have the same relation to the Woakwine and to the coast. Site J is in the Hundred of Mayurra, but this coastal portion is not sectioned and is locally known as the Commonage. The camp areas examined extended over about a mile of this sand ridge in a region lying a little west of the north-west corner of Lake Bonney. It proved a fairly productive site, in spite of the fact that here again the loose drift sand probably covered much good material.

The above described sites, most of them associated with the Woakwine Range, were all of the usual class such as are now found near the sea board; the implements being levelled down to a hard surface and thus exposed by wind erosion. Most of the camp areas occur on the inland or northern faces of the ridges, thus being somewhat sheltered from the prevailing winds—westerly and south-westerly—from the ocean. While they showed the general characteristics of camp areas, namely, on an elevated, sheltered portion of a sand-hill or sand outcrop, well drained, with the recoverable implements on the harder, eroded portions of the area, there were also other local features affecting them. For example, on some areas desirable collecting conditions had been disturbed by rabbit burrowing having loosened the sand and causing drift, or allowing it to become overgrown with vegetation. Also, in some places, local weather conditions had caused considerable washing down of loose material from higher parts of the slope thus probably covering what might otherwise have been good eroded collecting patches. Sites E and J, on the extensive inland sandhill ridge situated inland between the Woakwine and the coastal dunes, were much affected by drift. This striking ridge had obviously undergone, at some previous period, a partial induration and consolidation; but is now unfortunately rapidly disintegrating. This breaking up process has definitely produced a fairly recent and copious inland drift of loosened sand, which in places has almost completely covered extensive camping areas.

MATERIALS USED.

Very little quartz or quartzite has been utilized. While the authors had insufficient time thoroughly to study the material used and its sources of supply, there are some pieces of evidence which are interesting.

The main material upon which the implements were made though classable geologically as flint, for the purposes of prehistoric stone implement study is usually distinguished as a cherty material. In discussing the considerable limestone formations which are frequent in the South-East, Wade mentions the occurrence of flints, which, he says "are indistinguishable from the flints in the English chalk. In some places near Port Macdonnell and south of Cape Banks the formation becomes practically a mass of flints interbedded with layers of chert. Where the travertine rests upon it the upper formation contains derived water-worn flints associated with fossils of recent types". One of us (H.V.V.N.), however, is unable to reconcile this statement with the flint that has been used by the so-called Gambierian culture as shown by the specimens now in the Museum. In other places the outcropping calcareous boulders—conspicuous on Site B—contain highly silicified material which was eminently suitable for working. Although these materials at times vary in quality, the aboriginals showed obvious appreciation of the better texture and used it to good purpose.

Mr. P. S. Hossfeld, M.Sc., has kindly examined our collected material and supplied the following notes.

"The implements with few exceptions consist of the mineral known as flint. Flint is a cryptocrystalline variety of silica which in its fresh or unweathered condition is dark in colour, commonly greyish black, and practically opaque.

The special characteristics of flint which are advantageous for toolmaking are its toughness and ability to take a fine edge, the marked conchoidal fracture, smoothness of fractured surfaces and absence of grain or cleavage.

The source of supply in the South-East appears to have been twofold; one being the plentiful flint nodules occurring in some of the Tertiary Age limestones of the region, and the other being accumulations of beach pebbles derived by wave action on these limestones where they are, or were, exposed on the coast.

Although, as stated above, flints are dark in colour, if obtained in an unweathered condition, only few of the implements collected exhibited this colour. Nearly all the specimens appear to consist of a hard white material, marked in many instances by a slight yellowish stain. This white material is derived from the original dark flint, as can be seen by the presence in it of similar organic remains, and also by the existence, in those specimens which were fractured for examination, of a central core of unaltered flint. The change has been produced by atmospheric weathering resulting in a bleaching of the dark colouring matter, the removal by solution of any calcium carbonate and possibly alterations in the texture of the material, which is, however, still a form of silica. That this atmospheric weathering took place after the implements had been manufactured from the fresh material, is shown conclusively by the fact that the central cores of unbleached flint reflect in their outlines the outer faces of the implements, faces which were given to them by the aboriginal craftsman. The time that may have elapsed since any particular implement was manufactured cannot be determined at present by the study of the depth to which atmospheric weathering has penetrated. Such reactions vary so much with climatic and other factors, that special determinations are necessary for any given set of conditions.

The planned exposure of a large number of freshly chipped flints in this area, and their examination from time to time over a period of years together with measurements of the depths to which alteration will have gone, would be an interesting and valuable experiment.

Many of the specimens bear slight yellow stains. These apparently consist of hydrated iron oxide and probably were produced by chemical deposition from water in which the implements were immersed during wet periods, or from wet sands in which they were buried."

TECHNIQUE OF MANUFACTURE.

Details in regard to some of the terms used herein will be found in Tindale and Noone (1941). Except for the points and microliths, a definite blade knapping technique was not practised. What few prismatic nuclei were found are small. Most of the implements are made from flakes, which though in many cases appearing thick and clumsy, may be for that reason more fitted to the work required of them. Several pieces show that some craftsmen were capable of deft knapping and skilful trimming.

A roomy striking platform was frequently detached with the flake, accompanied by a salient bulb. The inner-angle ranges from 110° to 130°, with an average of about 122°, which is high for the ordinary size of implement. In contrast to this the microliths collected show a majority of diffused bulbs and a platform-cum-inner-face angle of about 107° to 122°, but most of them are knapped at around 112°. The inner-angle of the Eucla heard of flint flakes was found to be 100° to 125° with an average of about 110°. It would seem that the lighter the fragment to be detached the less the slope necessary on the nucleus platform, for the same material. Within a certain range, however, the more sloped the platform on a large nucleus the greater number of pieces can be detached before the prohibiting high angle is reached, the detached pieces usually being thinner at the end than the butt.

Multiple bulbs and eraillures were infrequent.

The trimming was often done by detaching long regular small chips, or scales, and finishing off by carefully evening the edge, removing the horns between the scars in the process. Considerable skill was shown in producing a fine acute edge on the somewhat stout implements. Occasionally the vicinity of the outer surface edge of the piece, where it adjoins the striking platform, is treated by the removal of small thin bladelets so as to thin the butt. A reason for this may be to make the implement more suitable for hafting. On the other hand it may be to enable more accurate striking to be done when knapping. Another noticeable feature is a readiness to resort to inverse trimming, in using the outer face of the flake as the base or platform, for the removal of trimming scales from the inner face. This was in order to make use of part of the implement where it was difficult to remove the trimming scales in the orthodox way, i.e. by detaching them from the outer face. The Woakwine stone workers would seem to have depended more on their trimming than their knapping skill, in making their ordinary size of implement.

In forming the microliths, besides practising the knapping technique of carefully preparing a suitable form of prismatic nucleus which would enable the production of suitable bladelets, a form of abrupt, or more or less vertical, trimming was employed to complete the implement. The consistent form of the 98 Woakwine points collected, which piece is abrupt-trimmed almost invariably on the left hand margin (i.e. when the pointed end of the piece is held upwards and the inner face out of sight) shows that it must have been the product of a specialized technique. As a quantity of scrap and untrimmed pieces were also collected these were examined in the hope of finding some indications of the procedure. Some 24 specimens of a similar point-like shape were sorted out, and then found to have a steep angled margin on the body as also on the oblique that formed the point. In the case of 10 of the specimens the steep margin was on the right. In all cases the pieces were left unfinished and untrimmed and the conclusion was that they were "blanks" which for one reason or another had been discarded. They revealed, however, that the blades intended for the fashioning of Woakwine points were the product of a special form of nucleus. It would be perhaps narrow with a longish corner at one side connecting the slightly sloped platform at top with another similar face at the bottom but this last would be placed transversely sloping up towards the corner.

The rule of trimming on the left hand margin of the piece is also strictly observed in the making of the geometrical microlith types such as the trapeze as also in the fashioning of the South-East Bondi points. It would seem to be a fixed tradition of the Woakwine microlithic workmen. We submit the suggestion that on the assumption that these workers were right-handed this habit was found the most convenient for trimming. When a piece is to be trimmed to a point by shaping one margin it is, we find, more convenient if the piece is held so as to lie with that margin between the holding hand and the trimming hand, so that the work is done from left to right towards the point or vice versa from point to butt. Following the orthodox manner of trimming with the inner face as base the left hand margin of the piece would thus be the one trimmed.

There is another feature to be found on the Woakwine point which is suggestive of a special procedure during knapping. The practice of trimming the Bondi point along the left hand margin from both inner and outer faces is followed on many of the Woakwine type, by trimming the outer face along part of the oblique in the vicinity of the pointed tip. In the case of the South-East Bondi point this trimming, which is worked from the outer face, we conclude, was done prior to the "blank" being detached from the nucleus. This conclusion was arrived at because amongst the similar pieces collected are 20 abrupt trimmed bladelets, of somewhat irregular form, which were not pointed at the end nor finished off by trimming from the inner face. In fact they appear to be failures in an attempt to knap off an asymmetrical bladelet suitable for the fashioning of a Bondi point. They, however, show trimming done from the outer face, and this trimming was done apparently while the piece was still part of the nucleus. Such primary trimming on the nucleus would serve the purpose of forming a ridge and on account of the guiding control of such a ridge, when that part of the nucleus was detached, the bladelet should be of the required size and shape. This would seem to have been the object of such trimming done from the outer face. In addition to the 20 abrupt trimmed failures, showing such preparatory trimming, there were similarly found 12 pieces of a clumsy Woakwine point shape which lacked the finish and final trimming to the orthodox sharp point. They bore, like the abrupt trimmed bladelets, some trimming done from the outer face; not, however, for the full length of the margin but only along part of the oblique shaped end. These also have every appearance of being discards in this case in an attempt to form a Woakwine point. If this is correct the Woakwine point would appear to be the product of an improvement in the technique of making the Bondi point. The obliquely trimmed ridge on the nucleus would ensure the obtaining of an asymmetrical blank with more certainty, and incidentally, could produce a more outcurved point. Supporting this inference is the fact that amongst the 52 examples of the South-East Bondi point there are six specimens which have been trimmed to form a sort of oblique form of tip to the point; in fact they are a kind of intermediate stage between the Bondi and the Woakwine types.

If the Woakwine workers' methods have been correctly interpreted then they differ from those thought to have been in vogue amongst the Mesolithic stone workers of Europe and Africa who are said to have obtained their trapeze shaped implements also of asymmetrical form, by trimming an ordinary, more or less symmetrical blade, by a somewhat roundabout method involving the production of what is called a micro-burin as a by-product.

The Woakwine technique, which is outlined above as that possibly followed in order to produce a pointed implement is not the same as that practised by the stone workers farther north to produce the South Australian pirri. They used a plain controlling ridge and a somewhat flat faced nucleus so as to get a leaf shaped symmetrical blade with a ridge approximately equi-distant from both margins, all three of which meet and end in the pointed tip.

As at other sites some of the geometrical pieces and Woakwine points were found in groups which would suggest they were caches of an expert worker though another explanation is that they are the stone components of a decayed composite implement, or the isolated remains of a very small group of people only using small stone implements.

CLASSIFICATION.

The implements found on the sites being of much the same facies are treated as one collection, and as so many types are found in both ordinary and micro sizes, it is convenient, except for the geometrical microliths, to classify them also together. This does not mean, however, that we wish it thought that all the pieces are contemporaneous and of one and the same culture.

Based to some extent on the system of classification by technique and the terms employed in our general survey of the South Australian microliths and points, we have found the following types and varieties. Some of these have already been described by us, so in several cases we shall confine ourselves to little more than enumeration. On the other hand, as we find it necessary to record several types and varieties hitherto not differentiated or described, we shall deal with them more fully. As is our practice the report is accompanied by simple line drawings detailing only the more characteristic features of the specimens.

BIFACE WORKED COROID IMPLEMENTS:

Semi-biface.
Discoid.
Semi-discoid.

FLAKE AND BLADE IMPLEMENTS:

Knives and saws.
Cleavers.
Abrupt trimmed bladelets.
Points—asymmetrical—Woakwine. South-East Bondi. Oblique.
Piercers.
Burinate pieces.
Scrapers—ordinary, ogival, discoid, squat, casual, butt-end, nosed, side-scrapers, concave, carinate, slugs, semi-discoidal.
Elouera.
Irregular edge pieces.
Battered pieces.
Sundry flakes and blades.
Scrap.

GEOMETRICAL MICROLITHS:

Segments—crescentic, ordinary, narrow, half-moon, rudder, cocked, semi-segment.
Discoidal—micro-scraper.
Triangles—equilateral, obtuse, scalene, isosceles, bracket.
Trapezes—symmetrical, asymmetrical.

POLYHEDRAL IMPLEMENTS:

Percuters and trimmers—pebble, nucleiform, trimmers.
Nuclei—polygonal, discoidal, conical-prismatic, prismatic, semi-cylindrical.
Sundry—slabs and milling stones.
Pounders.
Sundry implements.

BIFACE WORKED IMPLEMENTS (22).

One *semi-biface* implement, which shows the chipping restricted to the formation of the edge, like some of those that have been called Gambierian, was found on the Cape Northumberland site. It is much weathered.

A few (8) *discoid* pieces, biface worked, including an oval form made from a thickish flake, were collected, as also one small specimen showing a pyramidal form on one face. (Fig. 114, Micro, C. & N.).

There are also some (15) of *semi-discoidal* shape, a few of which are much like the stones used in the Western Australian flaked hatchet (Fig. 28, "Some Aboriginal Stone Implements of Western Australia", and Fig. 116, "South Australian Microlithic Stone Implements"). Two of these specimens are of micro dimensions.

FLAKE AND BLADE IMPLEMENTS.

KNIVES AND SAWS (61).

We have included in this class the ordinary acute edge knife form and also several pieces somewhat like the side scrapers, which have been trimmed to a sharper angle acute enough to be quite effective for stout cutting work. They appear to be made either for this purpose, or are re-edged cutting implements. We have here in quantity a carefully prepared form of tool unusual for Australia.

There are some (15) pieces with *Saw* margins, a few of small size.

CLEAVERS (8).

Like large size knives these heavy specimens have more or less acute work ing edges and may be conveniently separated into a *cleaver* type by themselves.

ABRUPT TRIMMED BLADELETS (20).

None of these bear any evidence of being broken Bondi points. As mentioned above under the discussion on technique, we look upon them as failures in attempts to knap off a bladelet suitable for the formation of a Bondi point. Being found unsuitable they were not finished off by further trimming from the inner face. In conformity with the technique followed in making their small implements, they are, with the exception of two specimens, all abruptly trimmed on the left margin and whilst still part of the nucleus. There is, of course, a possibility that they may have been found useful for odd work.

POINTS.

Symmetrical (9). As this was not a form of point favoured by the Woakwine people it is possible these specimens, being untrimmed, are of no more significance than knapping blades.

Asymmetrical. This is the type of point, with an abrupt trimming, that was preferred in the locality. One of these is of the well known Bondi type and the other which is more numerous is of a new type that has not hitherto been differentiated. This latter is so characteristic of the region that we have given it the name of the Woakwine point. About 70 per cent. of the 98 examples collected were found on site B, but E, J, G, F and A respectively all contributed a few. The form of this new point is that of an asymmetric trapeze elongated to a fine oblique point. Ordinary trapezes of usual microlithic size and proportions were also found but the Woakwine point reaches as long as 5 cm. and is frequently over 3 cm. in length. It appears to have been especially produced to serve a particular purpose such as say a spear barb. The extended shape of the body, as well as the abrupt trimmed oblique margin which forms the pointed end are the main characteristics of its type. Usually it has one or more ridges on the outer face whilst it is most often made of a comparatively thick bladelet. Most examples are trapezoidal in transverse section but towards the pointed end this changes to a stronger triangular section. With two exceptions none of the specimens show any marks of rough contact on the thin margin. The other margin, the thicker, is almost invariably (96 per cent.) on the left (i.e. when the pointed end of the piece is held upwards and the inner face out of sight) and is partly abrupt-trimmed, but this trimming very seldom extends beyond the oblique margin on to the body. To some extent the trimming of the oblique is done from both faces. A few specimens show trimming the full length of the left hand edge, suggestive of an affinity with the South-East Bondi point. The butt is quite frequently (75 per cent.) found trimmed so as to remove the platform and bulb-top and also to shape the base to a (1) straight, (2) rounded, (3) short oblique or (4) slightly incurved outline. A few of the points (20 per cent.) are left untrimmed at the butt, and are, therefore, like the ordinary obliquely pointed bladelet. These particular specimens show a majority of diffused bulbs centred about the middle of the base whilst the platform inner angle is about 107°.

A census of the microlithic pieces and points collected by us gives an idea of the predominant position of the Woakwine point: Triangles 36, Trapezes 35, Segments 34, Thumbnail scrapers 33, South-East Bondi point 53, Woakwine points 98.

It may be noted here that figs. 30 and 104 of our "South Australian Microlithic Stone Implements" can now be classed as varieties of the Woakwine point, they having been found in that area.

South-East Bondi Point (53). These were mostly found on sites B, E and J. Not many are well made; a few are broken off tips. The South-East Bondi differs from the Woakwine point in usually being trimmed the full length of the margin and from both faces; also ridges on the outer face are not found on the former so that its transverse section is in shape like an isosceles triangle. Like the Woakwine the abrupt-trimming, with very few exceptions (4), appears on the left hand margin. Not many (18) have trimmed butts, the outline being short oblique, rounded or straight. The range of length is from 1·5 to 4·5 cm. Some (9) of indifferent workmanship are not fully trimmed along the margin. Six of the specimens show a special trimming near the tip giving them a more oblique shape to the point. They are of some interest in that they seem to be intermediate between the Bondi and the Woakwine just as are the fully trimmed Woakwine specimens.

Oblique Point. In view of the locality in which found, the similarity and proportions of those oblique abrupt trimmed bladelets collected have been taken to indicate they are really varieties of the Woakwine point.

PIERCERS (19).

The few examples were all from sites B and G. One of micro dimensions is an unusual form of double with unfortunately one of the points fractured. Another, though carefully trimmed, one margin showing the small nibble trimming, and bearing a fine point, for some reason has been left with the contex on down to the tip. We know of two other similar examples from this locality. A third specimen is similar to that shown as Fig. 34 in our "South Australian Microlithic Stone Implements".

BURINATE PIECES (32).

A varied assortment of these was collected showing to some extent a rough idea of specialization in form. Of the spalled order there are six somewhat like the *Nucleiform* type, and three like the *Central* type. Four examples were found of the "twin", and six of the single, *Scaled rectangular* type, as also four of the *Scaled oblique*, one of which, a large piece, is a double. There are nine examples of the *Counterscaled*.

Eight fragments like *Spalls* were found, one showing wear on the outer edge of the striking platform.

SCRAPERS (482).

This class of tool, in its many varieties, seems to be the major production of the industry. The common use of the term "scraper" to designate these tools, although followed by us, does not mean we consider them all to be only, or even mainly, used for scraping work.

End (37). Of the *ordinary* type, formed on the end of a longish flake or blade, not many examples were found. Except for six of micro size they are mostly heavy tools, some showing usage also along one or both margins. A few are of *ogival* working edge shape.

The true "duck bill" shape is absent but there are ten made on short flat flakes.

There are no examples of doubles.

Six specimens of *discoid* form in ordinary macrolothic size were found.

An abundant variety (92) is of somewhat semi-discoid form made on a stout more or less *Squat* flake, several specimens being like the "tula" form of adze-flake, with which there would seem to be some sort of relationship. Many have been trimmed to a more or less acute cutting edge and some show a stouter working edge which has the appearance of being the outcome of re-edging. Some of this squat variety rise to a sort of peak behind the working end; a few are nearly straight edged. A kind of tool like this variety used nowadays in Australia, fixed in gum to a wooden handle, is utilized mainly for cutting, chopping with a regular jerky movement much as that in which an adze is used, and engraving. Only very occasionally is it used as a scraper. Much worn adze-flakes such as are found further north are not in evidence in the Woakwine area, possibly because of the seemingly abundant supply of suitable material. One of us (T.D.C.), however, found one such worn tula in the Woakwine area some years ago which, because of the material of which it was made, must be considered as having originated in some northerly region.

Several (35) stoutish pieces of various shapes show that a small area of a usable edge has been utilized in a casual way for rough hacking or scraping, as if, being opportunely near at hand, they had been temporarily pressed into service. Judging by the quantity of material, at site B for instance, such an occurrence could be a commonplace event.

Some somewhat similar pieces with signs of more drastic use we look upon as probably used for trimming.

Only a few (13) *Butt-end* scrapers were found, several of which are microlith size.

There is a large number (96) of *Nosed* scrapers, some having the nose narrow and ending in almost a point, others show a miniature nose. A special variety has a kind of twin nosed form, the noses being at the two corners of the splayed end of a squat flake. In many cases there would seem to be more attention given to the formation of the nose than of the concave wings. On the other hand some specimens show more wear of the concaves. It is not impossible that this tool was fabricated for use as a small hand adze for delicate work on wood, or as Miss Alison Harvey has suggested in skin preparing. The nosed working edge is usually part of a comparatively large piece, such as would afford gripping surface. The nose is not always accompanied by two concaves and sometimes more than one nose occurs on a specimen. It would not seem to be a common form of tool in other parts of Australia though some examples have been found in the Adelaide zone.

A form of edge which is usually classed as that of a scraper occurs on the side margins or margins of quite a number (74) of pieces which we therefore differentiate as *Side-scrapers*. Several of them are of small size and a number of others are trimmed on both side margins. Of these latter some are trimmed on one margin from the inner face in the orthodox manner but on the other margin from the outer face (inverse trimming). A few specimens are even more unorthodox in showing on one side margin part trimmed in the orthodox and the remainder of the same margin in the inverse manner. The side scraper is another uncommon tool for Australia when, as in most of the above mentioned examples, it is in a form not particularly suitable for hafting to make a flake-adze.

Another large series (62) of the scraper class is the *Concave scraper*, for which presumably a lot of use was found, possibly in shaping wooden shields, clubs, etc. The range in width of the concave is from 1 to 4 cm. Several of the examples are heavy tools. There are four doubles. The existence of the single concave in quantity like this would seem to emphasize the primary importance of the nose in the much more abundant nosed scraper.

A type of tool which is usually included in the scraper class is the *Carinate*. Examples are not very plentiful (34). Besides the ordinary crested form some have flat tops and one or two are strikingly like miniature "horsehoofs". Two specimens show at the other end a pointed working edge much like pieces found further north in the State and identified by us in "South Australian Microlithic Stone Implements". This pointed Carinate appears to be a well standardized variety. A fine example has been found as far afield as Eucla and nearer at hand at Morphett Vale. Another interesting variety is found in three examples which have three working edges, a form found by one of us in the Upper Paleolithic deposits in France. A few miniature examples of the carinate were found.

We include in the scraper class some pieces which we call *slugs*. They are long, stout ridged specimens of rough slug-like form. Some tend to have a pointed end. As differentiated by us, under the description of the carinate scraper, in "South Australian Microlithic Stone Implements" this piece should not be confused with the worn tula adze-flake which is described in "Some Aboriginal Stone Implements of Western Australia" (Noone).

A not particularly well made variety of scraper is the small *semi-discoidal*, also called the thumbnail. Of those (33) found most are the large size for this type. One shows inverse trimming. There are six doubles, one an exceptionally good little specimen worthy of the Moonta craftsmen. Another double shows a twin combination. Two show inverse trimming, one combined with the orthodox.

ELOUERA (8).

No regular examples of these were found, only some pieces of somewhat similar form. Of these four also show trimming and use on the thin margin, some bearing the edge serrated. A fine example of the typical elouera was found on another occasion by one of us (T.D.C.) in this Woakwine Area. It is possible this type of tool was produced in much the same way as we have outlined for the knapping off of the Bondi point.

IRREGULAR EDGE PIECES (17).

A few variously shaped pieces with more or less irregular edges, mainly due to coarse trimming, are perhaps tools in preparation that have been left in their preliminary stage.

BATTERED PIECES (4).

There are a few stout blades showing a crevassed ridge, but no example of the *pièces esquillées* such as is shown by Fig. 47 of our paper on South Australian microliths.

SUNDRY FLAKES (1), BLADES (2) AND SOME UTILIZED (27).

Twelve pieces have already been mentioned in dealing with technique. There are also 15 other pieces, but of small size, which bear signs of trimming or use, of which some appear to be snapped off working edges.

SCRAP (137).

Some of these pieces have been referred to under other headings.

GEOMETRIC MICROLITHS.

SEGMENTS (34).

Crescentic (1). Only one of a somewhat crescent moon shape was found.
Ordinary (11). Most of the examples are fairly well made.
Narrow (3). Very few and not well made. One is a large example.
Half-moon (7). Some well made.
Rudder (4). All are good examples.
Cocked or Cupid's-bow (3). Specimens have one tip retroussé or cocked.
Semi-segment (5). Most are poor examples.

DISCOIDAL MICRO-SCRAPER.

No examples found.

TRIANGLES (36).

Equilateral (5). These are all small examples.
Obtuse (5). Not well made.
Scalene (8). These are a little longer than the other triangles, a feature noted by one of us when recording the microliths of Ceylon.
Isosceles (10). All but one are trimmed at butt and all are trimmed on left margin in accordance with the Woakwine tradition.
Bracket (8). All poor examples; one is a large specimen.

TRAPEZES (35).

On the whole the trapeze is fairly well made.

Symmetrical (21). An unusually large specimen was found. Both the partly trimmed and fully trimmed occur.

Asymmetrical (14). Both the partly trimmed and fully trimmed were found.

POLYHEDRAL IMPLEMENTS.

PERCUTERS AND TRIMMERS (36).

Except for four fragments of which two are of flint the *Pebble* form was not found. The *Nucleiform* type with prominent points and edges is more in evidence (13). One is of milky quartz and is a fine example. Sizes range from a walnut to a tennis ball size.

Certain (19) blocky flakes and some small pieces showing use of a percussive nature on portions of their prominent parts may have been used as *trimmers*.

NUCLEI (18).

These are not abundant although site B especially had all the appearance of a stone-working camp. Three specimens of *polygonal* shape are small and appear to be residual nuclear butts, which may mean that the Woakwine workman's habit was to work for long periods and make full use of a nucleus of good material. There are only three of the *discoidal* type and one a small example of the *conical*. Two medium and six small *prismatic* types were probably used for the production of microlithic implements. Three pieces of peculiar form being rather of *semi-cylindrical* shape may also be of this type but on the other hand they seem to bear some relationship to the twin form of scaled burinate. There are a few instances of a blocky flake being used as a nucleus for production of flakes.

PUNCHES (6).

Including two small pieces these are characterized by a terminal edge formed by the meeting of two flaked converging faces, the edge showing signs of forcible contact.

GRINDING SLABS AND MILLING STONES (4).

A *slab* and three fragments of *milling stones* were found. The slab is $7\frac{1}{2} \times 6$ inches and of a D-shape. It is made of silicified sandstone (?) and the greater portion of one face is evenly worn into a slight depression. There are no ruddle stains on the slab. The lack of these grinding slabs suggests that seeds did not bulk largely in the diet.

POUNDERS (1).

Only a fragment of what appears to have been a thick discoidal flint *pounder* was found. This may have been used also as a percuter.

SUNDRY IMPLEMENTS (8).

One large flake has been carefully adzed at the thick butt end, so as to give it a slightly incurved steep cutting edge like a *gouge*.

While in the district we received the following on behalf of the South Australian Museum. Three edge-ground axe-heads of basalt (?), shaped by flaking, and found in the vicinity of Lake Leake, were presented by Mr. R. N. Campbell of Mt. Gambier. From Mr. Stewart of Rendelsham, an oval flattish pitted stone of tufa or basalt (?) found near Mt. Graham. It was said to have been used for the cracking of bones for the marrow. An ornamented boomerang, non-returning, was presented by the Clerk to the Millicent District Council. This has an interesting design in the form of an intertwined, double-lined engraving like a snake with a tail at each end, and suggestive of agonized death writhings. A Lionile Club of usual Victorian form with worn out grooves at the bend was presented by Mr. G. Willshire.

COMPARISON.

The absence of certain stone implements found on similar sites but mainly to the West of the Lower Murray, allocated to the Pirrian, Murundian and Kangaroo Is. or Kartan Cultures by N. B. Tindale, is noticeable, especially the South Australian pirri and Adelaide type of abrupt trimmed point, and the discoidal micro scrapers, the Adelaide variety of adze-flake, the large pebble implements and coroids like the horsehoof, and the kidney-shaped slate implement. Some of these, however, may come to light when more intensive collecting is undertaken. Little is known, unfortunately, of the stone implements to be found on the stretch of territory between the Lower Murray and the Woakwine area.

The abrupt-trimmed South-Eastern Bondi point and varied geometrical microliths show some relationship between the Victorian and Woakwine industries but lack of available records of the nature of the West Victorian stone culture limits further comparison.

The large proportion of "scraper" tools in various forms, especially the nosed and concave varieties, the knapping technique which favoured a well-sloped, roomy, striking platform, giving a high angled platform, inner-angle, the frequency of a salient bulb, the mediocre class of blade technique (except for the microliths), the long facetted form of trimming and the habit at times of using inverse trimming, are all features that the Woakwine industry has in common with that of the extinct Tasmanians. In view of the contention sometimes emphasized that the stone industry of the near Australian mainland shows no affinities whatever with that of Tasmania, the above facts have a special significance. On the other hand, N. B. Tindale (1937) has told us that certain distinctive stone implements of the Kangaroo Island culture, i.e. the karta, the horsehoof and "Sumatra-like" types (the latter in the form of a sort of semi-uniface worked pebble) may be found in the Tasmanian deposits. As far as our search went, we found no such pieces in the Woakwine industry.

ANTIQUITY.

The problem of assessing the age of these camp sites and their material relics is obviously a difficult one, nevertheless all the more intriguing because certain peculiarly local factors provide some tantalizing pieces of evidence. The nature of these sites, occuring as they do on moving sand areas, almost completely rules out stratigraphical assistance. From information gained from persons whose memory took them back to the days of still persisting aboriginal occupation, we know that the Woakwine and Mt. Burr Ranges definitely were the camping haunts of the Buandik people. Thus some of the material collected was possibly made and used at the very latest about a century ago. Lack of food debris which is very noticeable deprives us of another possible means of arriving at some idea of the age of the culture or cultures. As to the implements and the material upon which they were made practically all the evidence of value left to us, the factor of patination is one on which the present writers place no reliance. Observations have shown that patination varies so much with material and with local environmental factors, that it serves no reliable guide. An interesting point is raised by Mr. Hossfeld in his remarks on the chemical changes undergone by the particular South-Eastern material used for most of the implements. If this line of study can be followed up and proved we should be provided with some valuable data as to the period when the Culture flourished in the Woakwine area.

Another feature bearing on the age problem lies in the fact that this particular part of the South-East is a fine example of post Pliocene geology. There is much evidence to indicate a general land uplift and ocean recession during comparatively recent geological times. Associated with this progressive land uplift and ocean recession, there probably have been also intervening periods of rest and oscillation and subsidiary ocean transgressions. These happenings have been naturally recorded by the series of stranded inland dunes which show varying stages of induration and solidification—fossil representatives of the coastal sandhills. In places, coastal erosion and disintegration of some of the inland ridges show the reverse process—a breaking down of previously built-up, hardened structures. Although it cannot be included here, there has been some discussion by Tindale (1933) and Ward (1941) on possible correlation between these ridge formations and Pleistocene ocean levels. More recently, Professor Cotton (McCarthy, 1943) in consideration of New South Wales shore-line changes, due to post-glacial conditions, has dated the formation of certain shell middens at between 5,000 and 11,000 years ago. It will be interesting to learn whether these eastern shore features can be correlated in any way with the interesting problems of the lower South Australian coast. Lack of intensive study of these interesting features of the South-East leaves us without any precise knowledge for dating such topographical happenings; it is likely, however, that as detailed investigation goes on, evidence will be produced to provide a solution to the problem concerning the early human occupation of these areas.

Another interesting point on the age problem is whether any time difference occurred between the distinct manipulative techniques revealed in the ordinary sized pieces and the geometrical microliths and abrupt trimming. Only continued intensive study, aided, we hope, by opportunities for excavation, will help to clarify such matters.

GENERAL.

In view of the possibility that no systematic collection has hitherto been undertaken at these particular sites, a census of the types for what it is worth is given. For want of full opportunity the collection made by us quite possibly does not embrace all types and varieties produced. When these are forthcoming statistics can be added to the census from time to time and so a true representation of the stone-implement evidence of the culture will be attained. The size in which the same type of tool is found show the considerable range on which we commented in our paper on Microliths. The employment of one class of material, i.e. flint or chert almost exclusively, is probably an environmental restriction. The stone working technique is not of high grade and generally speaking the Woakwine craftsman may be looked upon as a better trimmer than a knapper, and one who relied more on shaping his tool by secondary than primary working. Nevertheless, the microlithic pieces show that a fairly high degree of knapping skill was reached.

The proportion of "scraper" tools, some 482 out of the total of 1,175, is interesting, implying as it does, considerable occupation in the working at wood and animal skins. It further suggests, as far as site B is concerned, that it was popular for a happy combination of stone, wood and food supplies. There are so many utilized and finished tools on this site that it would not seem to be a stone working camp only, although the apparent ample supplies of material there, or in the vicinity, might favour one.

The similarity in several features to the Tasmanian stone industry has already been mentioned. Looked at as a whole, however, the Woakwine facies has reached a higher stage of development. Although there is a low proportion of blades we have a developed bladelet industry practised to produce microliths, a Bondi point and the distinctive Woakwine point.

A curious fact is that whereas the industry shows specimens comparable to the *tula* type of adze-flake so prominent in the Northern regions of the State, being in use even up to to-day, this kind of adze-flake is not much in evidence in the intervening territory and around Adelaide. This may, to some extent, be due to the lack there of such supplies of suitable material as the Woakwine and far northern regions enjoyed.

Here we would mention that in the Museum there is quite a number of interesting stone implements collected in and around the Woakwine area by Professors J. B Cleland and W. H. Howchin, Messrs. N. B. Tindale, H. Sheard, P. Stapleton, F. Secker, H. A. Lindsay and A. M. Morgan, to whose enthusiastic work we are indebted as this useful material has afforded us the opportunity of making a comparison with the implements collected by us. We are able to say they support the classification and interpretations of the industry, as outlined by us above.

Our limited time gave but little opportunity for investigating the question of the large biface-implements which have been termed Gambierian. A few largish pieces collected by us at Cape Northumberland had the familiar aspect of this particular class of South-Eastern implements, but unfortunately no definite camp site was discovered. It is very regrettable that much unscientific and unrecorded collecting of these interesting pieces has so far precluded their correlation with other data concerning South-Eastern bygone aboriginal stonecraft.

For valuable assistance which contributed so much towards making this brief trip so satisfactory to us, we are indebted to the following: Mr. H. M. Hale, Director of the South Australian Museum, Messrs. C. Willshire of Millicent, David Schulz of Rendelsham and R. N. Campbell of Mt. Gambier. Miss Gwen Walsh of the Museum staff has devoted earnest work to the illustrations, and Miss G. M. Bishop to the manuscript, whilst Mr. H. M. Cooper, as always, has been most helpful. Mr. Hossfeld has given assistance on many points.

SUMMARY.

Location and description of ten localities of the South-Eastern region of the State where old aboriginal camp sites are situated are supplied.

Some indication is given of the geological and geographical features of the environment and probable conditions of living of the stone workers.

An authoritative report is included dealing with the material utilized in the production of the stone implements.

A description of the technique practised in stone implement making is furnished, insofar as can be inferred by critical examination of those pieces collected, and deductions thereby reached.

A classification and description of the pieces collected (1,175) by sorting them into classes in accordance with their form and technique of manufacture, so far as practicable.

The illustrating of the various types and varieties to facilitate identification.

The recording of certain new types and varieties which hitherto have escaped definite differentiation.

The reporting and description of a new type of standardized point to which the name of Woakwine point is given.

The defining of an area with its own distinctive stone working facies which is named the Woakwine industry.

A comparison is made of the Woakwine stone-working technique with that of other industries.

The sparse evidence available in regard to the possible antiquity of the pieces is touched upon.

A census of the implements classified according to our system.

CENSUS.

Bifaces		22
Knives and Saws		61
Cleavers		8
Abrupt trimmed Blades		20
Symmetrical Point		9
Asymmetrical Point Woakwine		98
Asymmetrical Point South-East Bondi		53
Piercers		10
Burinate Pieces		32
Burinate Spalls		8
Scrapers, End		37
,,	Squat	92
,,	Discoid	6
,,	Semi	33
,,	Butt-end	13
,,	Casual	35
,,	Nosed	96
,,	Side	74
,,	Concave	62
,,	Carinate	34
Slugs		9
Elouera		8
Irregular edge Pieces		17
Battered Pieces		4
Sundry Flakes and Blades		27
Scrap		137
Segments		34
Triangles		36
Trapezes		35
Percuters and Trimmers		36
Nuclei		18
Punches		6
Grinding slabs, etc.		4
Pounder		1
		1,175

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Explanation of Figures 1–157.

1	Semi-uniface worked implement.
2–3	Biface worked discoids.
4–5	Biface worked semi-discoids.
6–9	Flake Knives, first is a double.
10–12	Trimmed Knives.
13–15	Saw-Knives.
16	Cleaver.
17–19	Bladelets.
20–1	Abrupt trimmed bladelets (failures).
22–3	South-Eastern Bondi points, rounded and straight butt.
24	South-Eastern Bondi point, oblique formed tip.
25	Symmetrical blade.
26–7	Blanks for Woakwine point.
28	Blank for Koakwine point, outer face trimmed on oblique.
29	Woakwine point, plain butt.
30–2	Woakwine points, straight trimmed butt.
33	Woakwine point, rounded butt.
34	Woakwine point, short oblique butt.
35	Woakwine point, incurved butt.
36	Woakwine point, margin fully trimmed.
37–8	Piercers.
39	Piercer on Bondi point (failure).
40	Double piercer, one tip fractured.
41–2	Spalled (Central) Burinate pieces.
43–4	Spalled (Nucleiform) Burinate pieces.
45	Scaled (Rectangular) Burinate piece in twin form.
46	Scaled (Rectangular) Burinate piece in twin form.
47	Scaled (Oblique) Burinate piece.
48–9	Counter-scaled Burinate pieces.
50–1	Spalls.
52–56	End-scrapers, with side trimming.
57–8	End-scrapers, ogival.
59–63	Squat end-scrapers like tula adze-flake, last showing repeated re-edging.
64	End-scraper, straight edge.
65–6	Flat end-scrapers.
67–8	Discoid scrapers, small one inversely trimmed.
69	Semi-discoidal or thumb nail scraper.
70	Double scraper inversely trimmed.
71	Butt-end scraper.
72	Casual scraper.
73–5	Ordinary nosed scrapers, last with much worn nose.
76–9	Small nosed scrapers, last shows more use of concaves.
80–1	Twin form nosed scrapers, last with one nose inversely trimmed.
82	Pointed nosed scraper.
83–6	Side-scrapers, last shows inverse abrupt trimming.
87	Side-scraper showing prolonged use.
88–9	Double side scrapers, last inversely trimmed.
90–1	Side scrapers with ordinary and inverse trimming.
92	Triple side scraper with nose and two sides inversely trimmed.
93–4	Side scrapers with ordinary and inverse trimming in line.
95–9	Concave scrapers.
100	Double concave scraper, inverse trimming.

101 Triple concave scraper with nose.
102–4 Carinate scrapers, last like miniature "horsehoof" with a burned crest.
105 Pointed carinate scraper.
106–8 Triple edged Carinate scrapers.
109–10 Pointed "slugs".
111–2 Elouera, last with plain butt end.
113–4 Irregular edged pieces.
115 Battered ridge piece.
116–7 Micro semi-discoidal scrapers, first inversely trimmed.
118 Micro double scraper.
119 Exceptionally large pointed blade from Cape Northumberland.
120 Crescent segment.
121–2 Ordinary segments.
123 Narrow segment.
124–5 Half-moon segments.
126–7 Rudder-form segments.
128 "Cupid's-bow" segment.
129–30 Semi-segments.
131–2 Equilateral triangles.
133–4 Obtuse triangles.
135–6 Scalene triangles.
137–8 Isosceles triangles.
139–40 "Brackets".
141–2 Asymmetrical trapezes.
143–4 Symmetrical trapezes.
145 Nucleiform quartz percuter.
146–7 Trimmers.
148 Conical nucleus.
149–51 Prismatic nuclei.
152 Flake nucleus.
153 Discoidal nucleus.
154–5 Semi-cylindrical form nuclei (?).
156 Punch made on flake.
157 Gouge made on large flake.

All illustrations are one-half natural size excepting numbers 116 to 118 and 120 to 140, which are shown natural size.

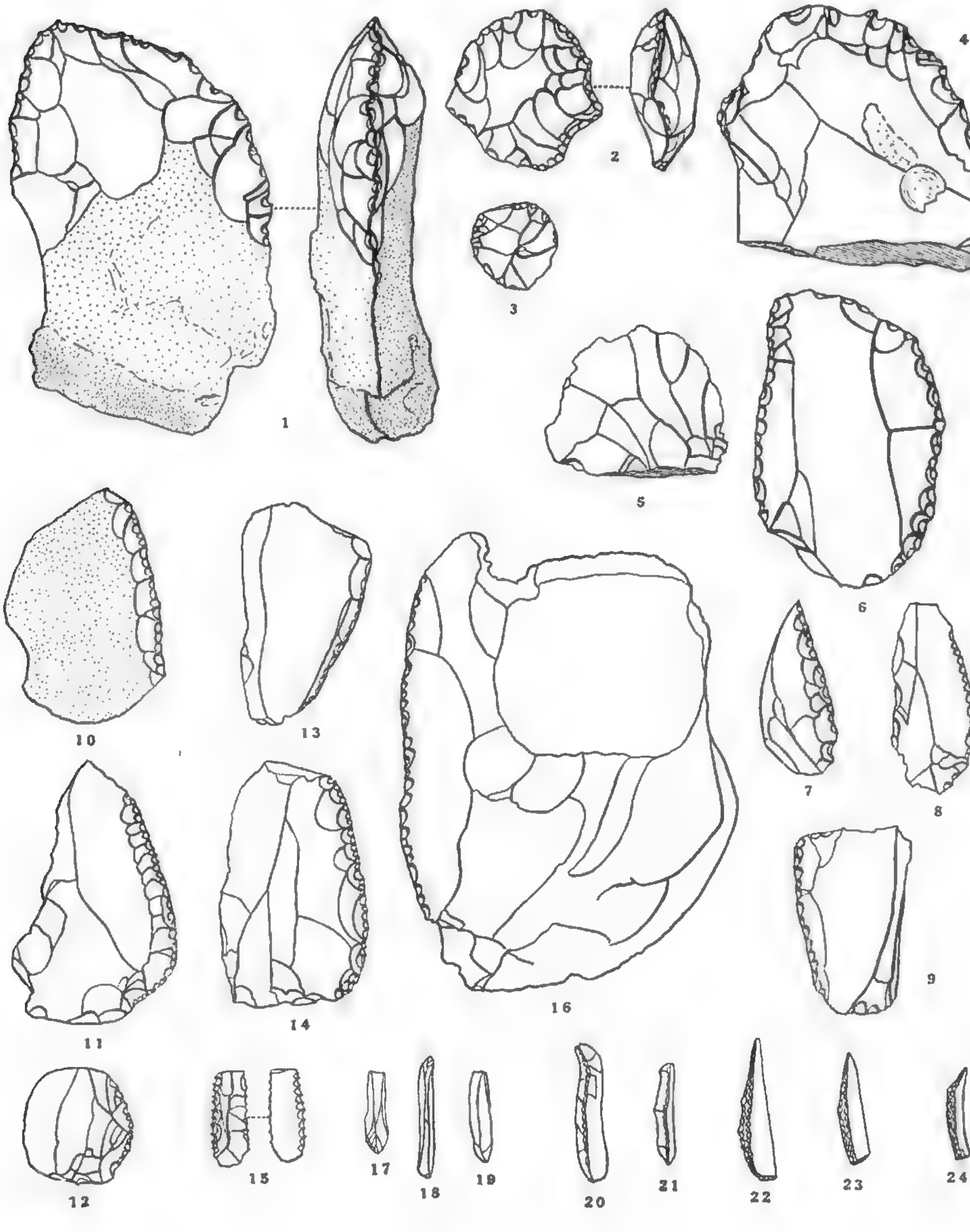

Fig. 1–24.

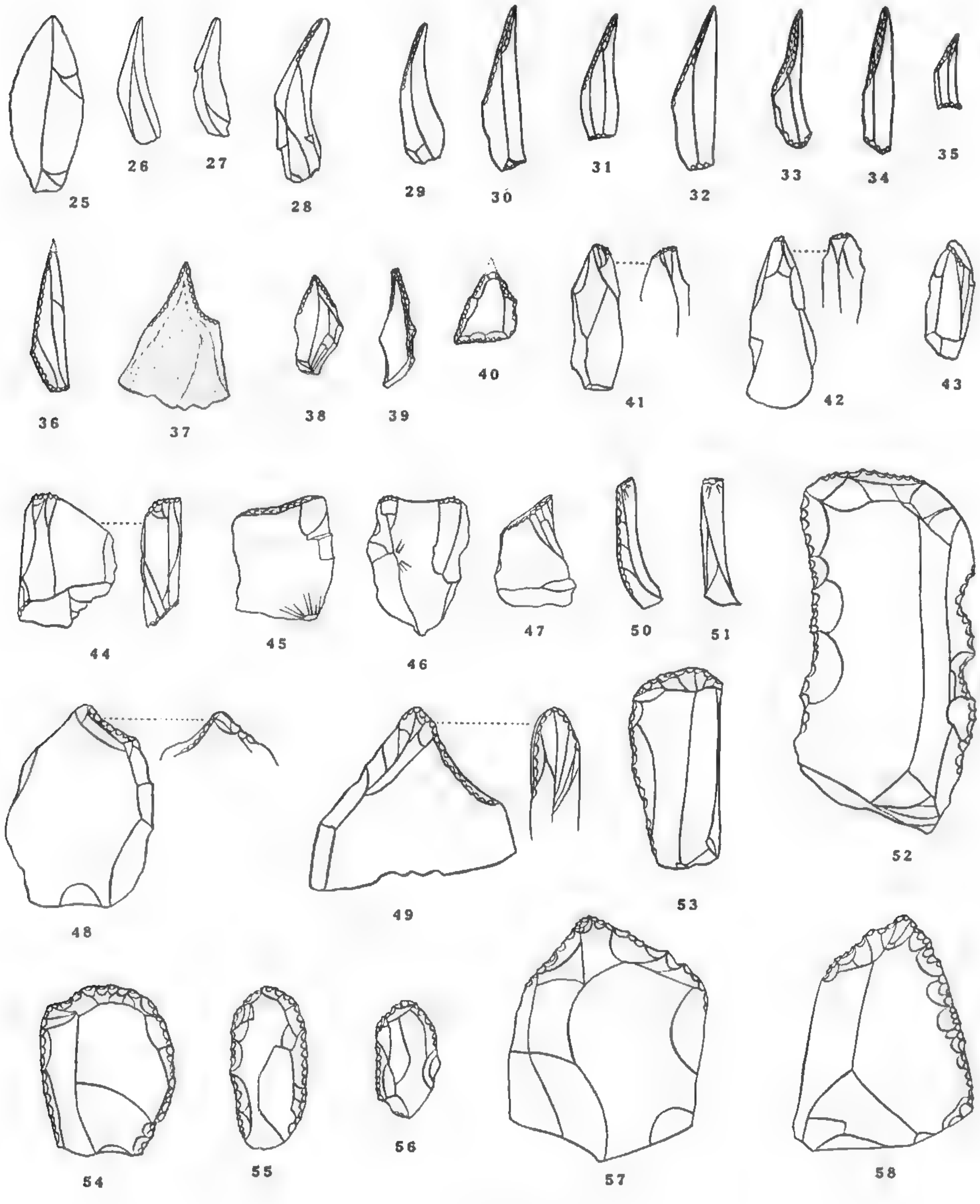
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Fig. 25–58.

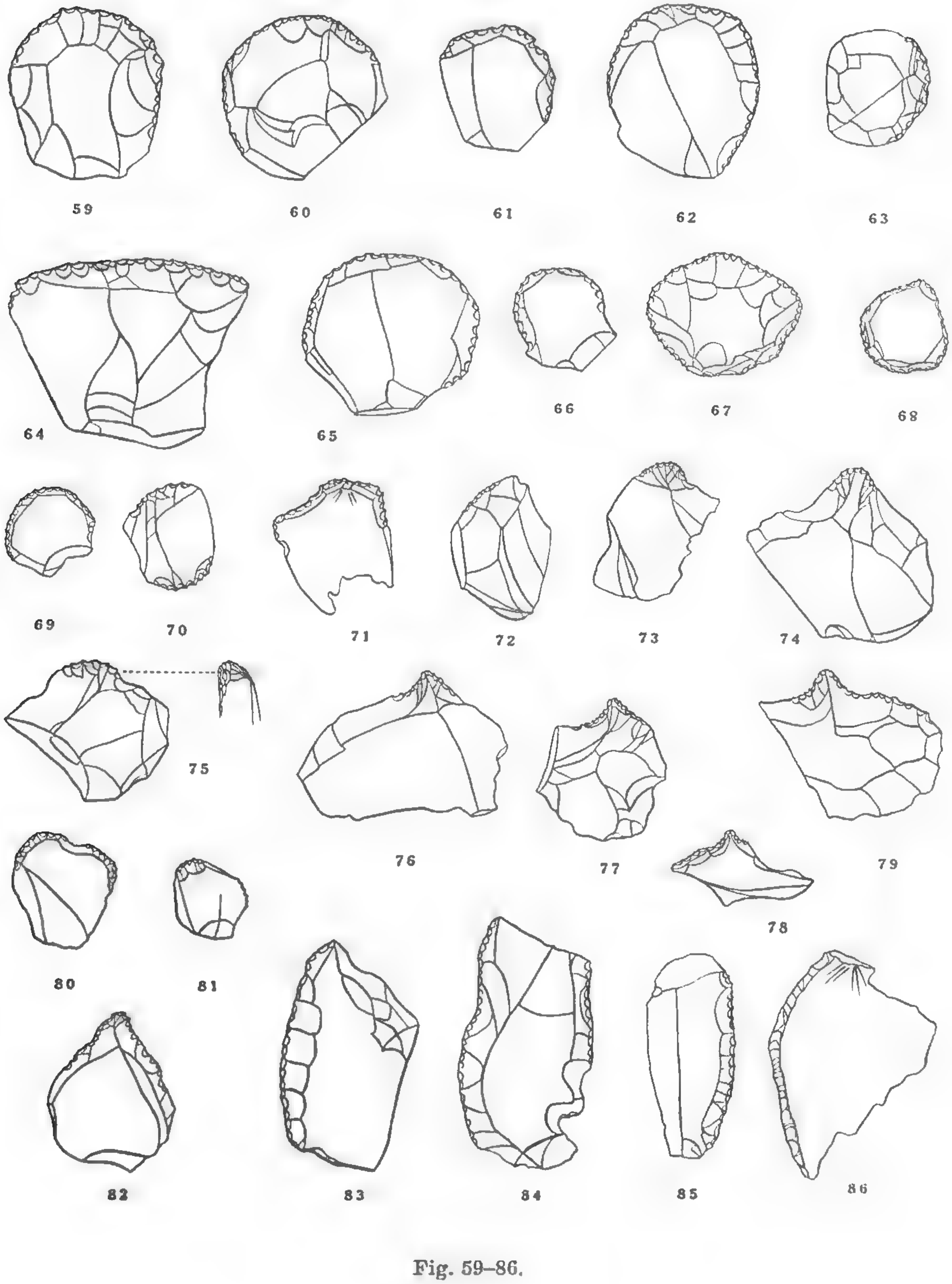
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Fig. 59–86.

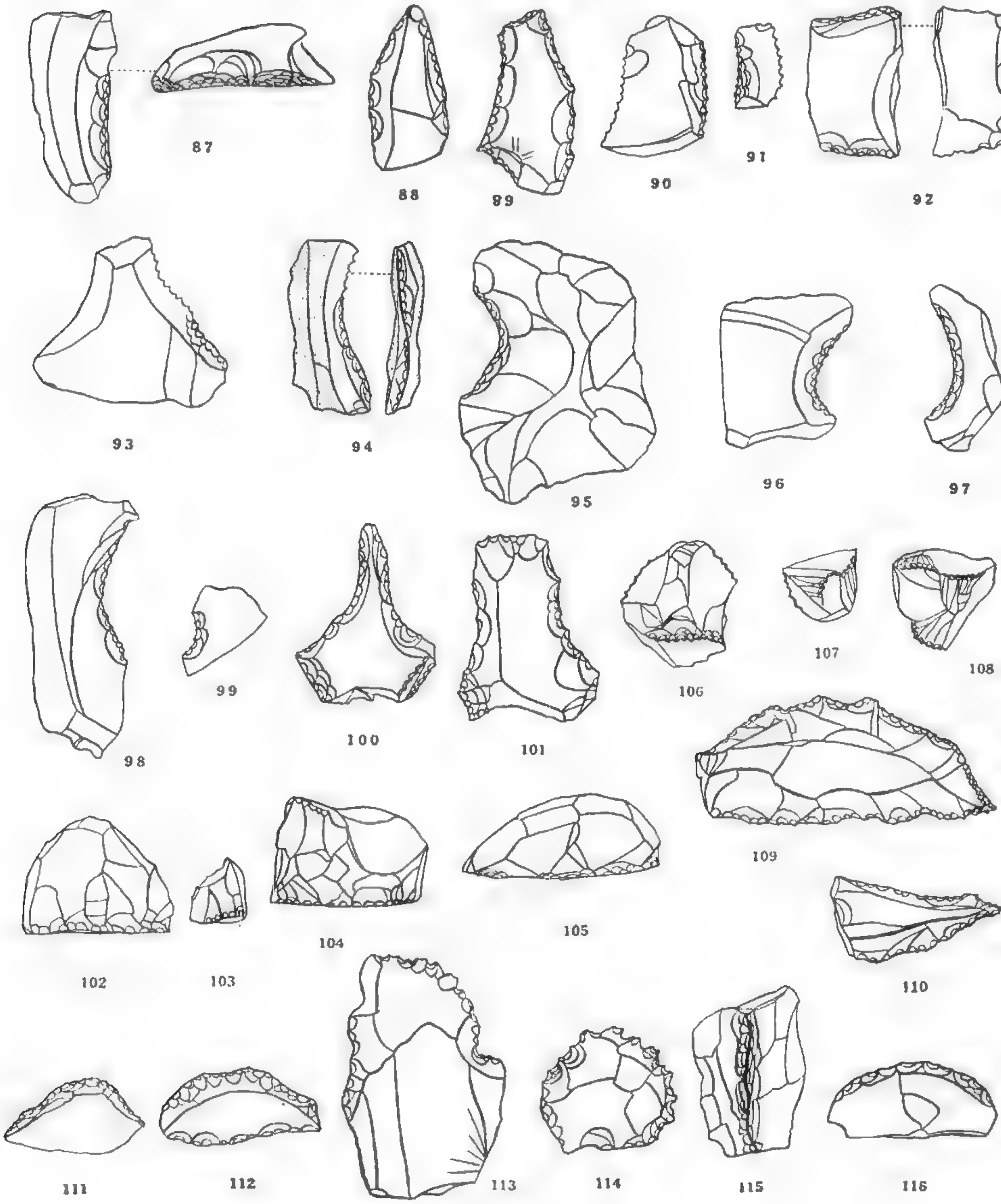
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Fig. 87–116.

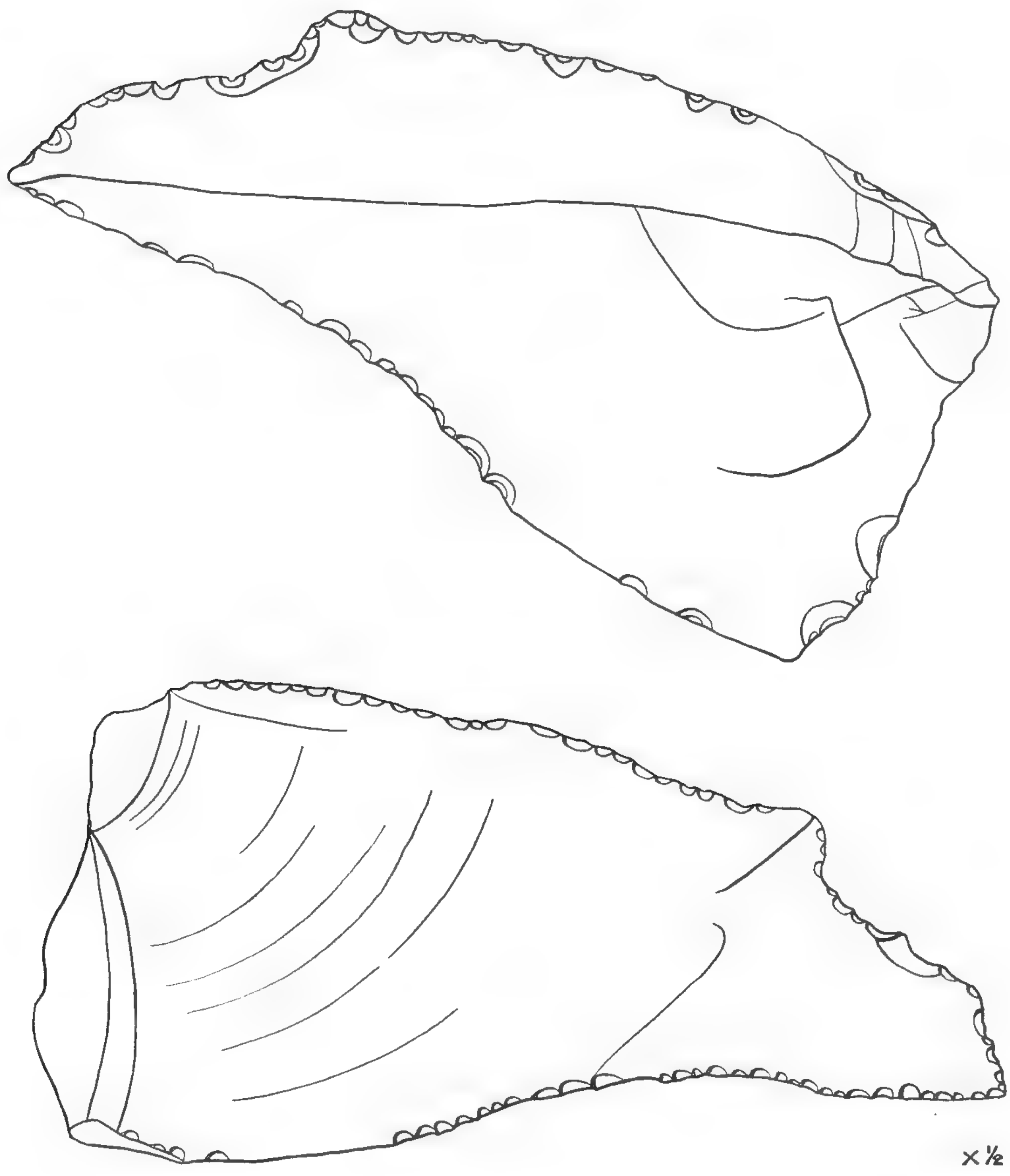

Fig. 119.

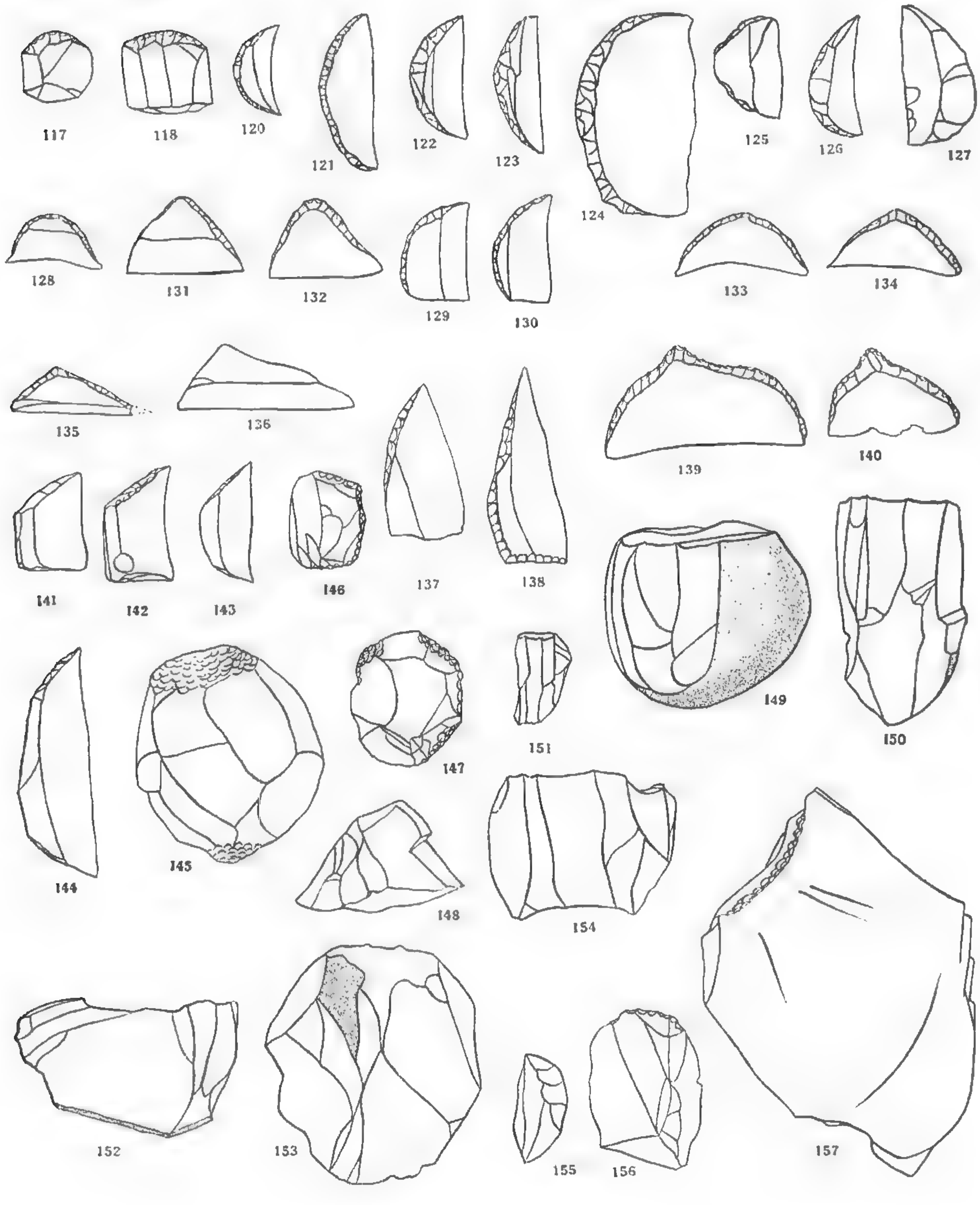

Fig. 117–118 and 120–157.

A NEW AUSTRALIAN SHARK

By Gilbert P. Whitley, F.R.Z.S.

Summary

Family **Triakidae**

Fur Whitley 1943.

Fur Whitley, Austr. Zool., x, 2, April 30, 1943, p. 167, Orthotype F. macki Whitley from Mordialloc, Victoria.
A new species of this genus has recently been found in Western and South Australia, which may be named and diagnosed as follows.

Fur Ventralis sp. nov.

Head. Snout bluntly rounded. Most of interorbital flat, sloping laterally over the dorso-laterally situated eyes which are elongate oval, with long horizontal pupils. Nictitating fold distinct from and slightly longer than orbit. Spiracles small, slit-like. Nostrils large, nearer mouth than tip of snout, each with a broad, long (16 mm.) cirrhus overlying a triangular lobe. No nasoral groove. Width of mouth nearly equals preoral length. Upper labial folds longer than lower.

A NEW AUSTRALIAN SHARK

By GILBERT P. WHITLEY, F.R.Z.S.

Family TRIAKIDAE.

Fur Whitley 1943.

Fur Whitley, Austr. Zool., x, 2, April 30, 1943, p. 167, Orthotype *F. macki* Whitley, from Mordialloc, Victoria.

A new species of this genus has recently been found in Western and South Australia, which may be named and diagnosed as follows.

Fur ventralis sp. nov.

Head. Snout bluntly rounded. Most of interorbital flat, sloping laterally over the dorso-laterally situated eyes which are elongate oval, with long horizontal pupils. Nictitating fold distinct from and slightly longer than orbit. Spiracles small, slit-like. Nostrils large, nearer mouth than tip of snout, each with a broad, long (16 mm.) cirrhus overlying a triangular lobe. No nasoral groove. Width of mouth nearly equals preoral length. Upper labial folds longer than lower.

Teeth compressed, subtriangular. Teeth of upper jaw all acute, with the centre fang inclined outwards, inner shoulders smooth, outer margin with four thick and rather blunt cusps. Symphysial pair of teeth in upper jaw entire, consisting of a solitary broad central fang with wide shoulders and no cusps. Teeth in middle of lower jaw also entire with broad triangular central fang, wide shoulders, and no cusps. Lateral teeth of lower jaw becoming less acute until the outermost are minute, flat, vestiges in pavement formation. No symphysial tooth differentiated in lower jaw.

Dental formula $\frac{14 \cdot 1 \cdot 1 \cdot 14}{c.42}$. Three functional rows of teeth in middle of upper jaw and five or six in middle of lower jaw.

Tongue rugose, broadly rounded. Ampullae of Lorenzini rather sparse. Endolymphatic openings inconspicuous.

First three gill-slits of equal length (27 mm.), fourth smaller (25 mm.), and the fifth, which opens over the pectoral, is notably the smallest (19 mm.); spaces between slits subequal.

Body. Form elongate, subcylindrical. Predorsal profile not markedly gibbous. Greatest depth little forward of origin of first dorsal. Greatest width of shark (150 mm.) just behind pectorals. Head and body subequal to rest of shark. Interdorsal and precaudal ridges present. No predorsal ridge. Shagreen consists of fine, close-set or imbricate, hard denticles, which vary from tricarinate on back to smooth on belly and over caudal where they are not notably enlarged. Lateral line system conspicuous; there is a downward dip, followed by an upward trend in the course of the lateral line between second dorsal and anal fins. Pit organs inconspicuous. Abdominal pores large. No caudal pits.

Fins. Dorsal fins both large, the first over the pectoral-ventral interspace, the second slightly smaller than the first. Anal fin smaller than second dorsal, its origin and end slightly behind levels of those of second dorsal. Pectorals moderate sized, reaching below anterior part of first dorsal when adpressed, their tips acutely rounded. Pectoral angle well before level of first dorsal. Ventrals smaller than dorsals and situated well behind level of first dorsal. Caudal fin with large terminal upper lobe and pointed lower subcaudal fin with large terminal upper lobe and pointed lower subcaudal lobe; its lower lobe originates slightly before level of origin of upper.

Dimensions. The detailed measurements in millimetres are as follows:

Length of head to first gill-slit, 179.
Length of head to fifth gill-slit, 220.
Tip of snout to anterior margin of eye, 71.
Breadth of snout immediately before eyes, 90.
Snout to origin of pectorals, 230.
Snout to origin of ventrals, 584.
Eye: horizontal diameter, 27.
Eye: vertical diameter, 11·5 (outside nictitating membrane).
Interorbital, 69.
Eye to spiracle, 13.
Length of nostril, 21.
Internarial, 32.
Preoral length, 65.
Width of mouth (distance between angles), 67.
Labial fold: upper, 26; lower, 15.
Height of first gill-opening, 27.
Height of last gill-opening, 19.
Length, snout to upper caudal root, 1,021.
Length of snout to vent (middle), 611.
Predorsal length, 380.
Depth at origin of first dorsal fin, 172.
Breadth below origin of first dorsal fin, 147.
Depth of caudal peduncle, 39; breadth, 30.
First dorsal fin: anterior margin, 129; base, 126; last ray, 52.
Interdorsal space, 312.
Second dorsal fin: anterior margin, 140; base, 114; last ray, 41.
Second dorsal fin to caudal base, 119.
Anal fin: anterior margin, 105; base, 90; last ray, 32.
Anal base to caudal base, 104.
Pectoral: length, 166; base, 60.
Origin of pectoral to that of ventral, 371.
Ventral fin: length of anterior margin, 80; base, 66; length of last ray, measured externally, 46.
Ventral origin to anal origin, 243.
Caudal: upper lobe, 228; lower lobe, 115.
End of upper caudal lobe, 80.
Upper edge of subcaudal notch, 49.

Colour, when fresh (frozen): Ashy grey above, with slight bronze tinge on back and sides, and shading to parchment white below. Eye grey, with the pupil dark grey-blue; iris surrounded by a smoky-grey ring. Inside of gill-slits milky white. Fins similar in colour to adjacent parts of body, without any light or dark marks at tips; axils of fins not much lighter than ground-colour. No conspicuous body-markings, such as spots or bars, but diffuse darker tones occur over eyes and gills, and here and there along flanks after thawing and preservation in formalin.

Described from the holotype, a female specimen, 1,250 mm. or 4 ft. 2 in. in total length; weight, 19 lb. Western Australian Museum, registered No. P2451.

Locality. Off Bunbury, Western Australia, hooked on long line in August, 1943, by Mr. Nicholas Soulos.

Affinities. The new species is distinguished from the only other one in the genus as follows:

A. Ventral origin below posterior lobe of first dorsal fin. A marked gibbosity predorsally. No interdorsal ridge. Coloration transversely barred and with light spots .. *F. macki*

AA. Ventrals behind level of first dorsal fin. Predorsal profile not markedly gibbous. Interdorsal ridge present. Coloration uniform .. .. *F. ventralis*

There are other minor differences in proportions, in size of anal fin, and outline of caudal.

In addition to the holotype from off Bunbury, other specimens have been examined or reported from various Western and South Australian localities, and it is evident that this species is the one which was regarded by Zietz, Waite and other Australian authors as the Japanese *Triakis scyllium*, which I (Fish. Austr. i, 1940, p. 115) removed from the Australian list. These extra (paratype) specimens have not all been preserved:

1. A mounted skin in the Western Australian Museum, from the Abrolhos Islands.
2. A male, 3 ft. 9 in. long, from off Second Valley, Rapid Bay, Fleurieu Peninsula, South Australia; January 2, 1942. Specimen not seen but a description and sketches by Mr. Keith Sheard, who obtained the shark, leave me no doubt as to the identification. He states that the species is common off the Fleurieu Peninsula in summer.
3. A cast of a South Australian example in the South Australian Museum at Adelaide.
4. The old skin recorded as "*Triakis scyllium*" by Zietz and Waite from South Australia, and housed in the South Australian Museum. Total length, 1,220 mm. Head, 220 mm. Interdorsal, 320 mm.
5. A head seen amongst shark offal at Bunbury, Western Australia, and caught by N. Soulos on long line, July 17, 1943.
6. A butchered carcase of a female from Fremantle in Perth market, August 26, 1943.

Range. The new species ranges from Fleurieu Peninsula, South Australia, to the Abrolhos Islands (Pelsart Island, December, 1913), Western Australia, and is of sufficient abundance to be of commercial value as food for man.

Vernacular Name. This species was at first called by the Bunbury fishermen the "Gummy with teeth", to distinguish it from the ordinary Gummy shark with blunt crowns (*Emissola*), from which it can also be separated by the nasal cirrhi. I therefore suggested Whiskery Shark as a vernacular name, and this has been adopted by the Fisheries Department, Perth, and the fishermen themselves.

ON ASTACOPSIPHAGUS PARASITICUS VIETZ 1931 (ACARINA-HALACARIDAE) PARASITIC IN THE GILL CHAMBERS OF EUASTACUS SULCATUS CLARK M.S.

By H. Womersley, F.R.E.S., A.L.S., South Australian Museum

Summary

In 1922 Haswell (Proc. Linn. Soc. N.S.W., 47 (3), 329) described a very interesting acarid, Astacocroton molle belonging to the family Hydrachnellae, from the gill chambers of the eastern Australian fresh water crayfish Euastacus serratus (Shaw). From Europe another species of mite, Lohmanella violacea (Kram.), belonging to the Halacaridae, is known to inhabit the gill chambers of the crayfish Potamobius astacus. In 1931 Vietz (Zool. Anz. 96. 115) described a second species of Halacarid, also from the gill chambers of the Queensland crayfish Euastacus serratus (Shaw) from Moran's Creek, Roberts Plateau, MacPherson Range, Queensland National Park, December, 1926 (A. Musgrave). For the species, parasiticus he erected the genus Astacopsiphagus and a new subfamily, Astacopsiphaginae. All his material, however, consisted of nymphs only, and consequently his generic and subfamily characters would be subject to modification upon discovery of the adult stages.

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Fig. 1.

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Through the kindness of Mr. E. F. Rick of the Biology Department, University of Brisbane, Queensland, I have received a number of nymphs of the third stage, labelled as from the gill chambers of *Euastacus sulcatus* Clarke m.s. from Lamington National Park, Queensland, January, 1943 (E. F. Rick).

A good many of these nymphs were so far advanced that the dark well chitinized adult stages were visible through the nymphal skin, and could easily be dissected out.

It is thus possible in this paper to describe the adult of both sexes, and to modify Vietz's specific, generic and subfamily diagnoses.

Subfamily Astacopsiphaginae Vietz 1931.

Palpi with two large distinct segments and two small globular segments apically; placed anterio-laterally on the maxillae. Maxillae short and massive, together forming a disc-like oral opening. Mandibles with recurved teeth. Adult with well developed antero-dorsal, ocular and post-dorsal plates; nymph III with two small antero-dorsal plates only. Legs of adult with normal fine setae; of nymphs on segments III–VI with a double row of short stout curved spines. Claws paired, long, and slender with a short hook-like empodium between; claws in nymphs combed or finely ciliated. Genital valves with area of many small acetabula.

Genus Astacopsiphagus Vietz 1931.

Large, over 2 mm. in length. Dorsally in adult with four large well chitinized plates, 1 antero-dorsal, 2 ocular and 1 post-dorsal; in nymph with only two small antero-dorsal plates. Eyes absent. Cuticle finely wrinkled between dorsal plates.

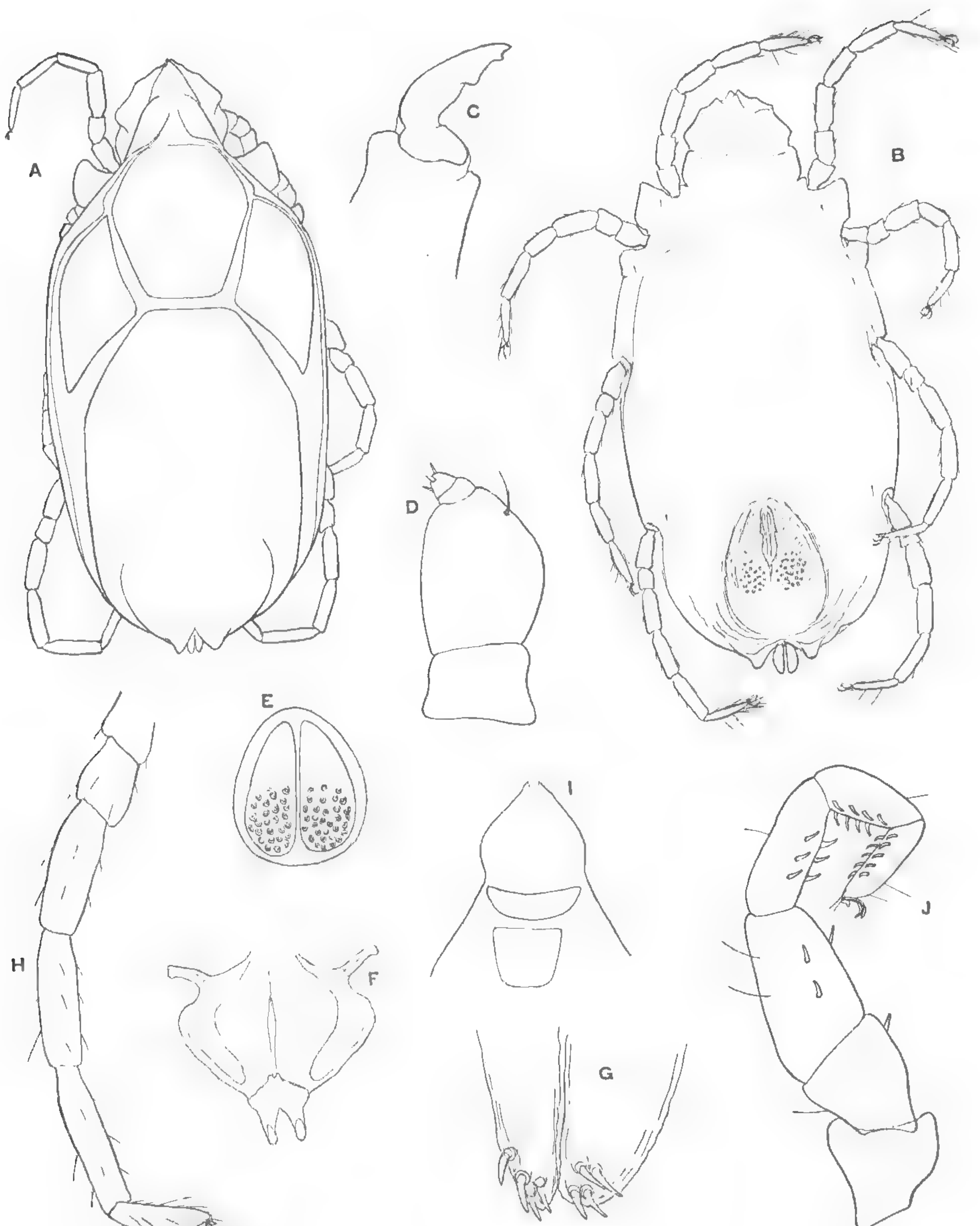

Fig. 1, A–J. *Astacopsiphagus parasiticus* Vietz 1931. A. dorsal view; B. ventral view: C. mandible: D. palp: E. male genital plate: F. female internal genitalia: G. male internal genitalia: H. leg I of female: I. dorsal plates of nymph III in relation to capitulum: J. leg I of nymph III.

Maxillae short and massive, anteriorly together forming a large disc-like oral opening. Mandibles with two strong, more or less recurved teeth. Palpi strongly reduced, placed in front of the maxillae near the upper dorsal edge of the oral opening; 4-segmented, I and II large, medio-laterally strongly flattened, III and IV small, globular and inconspicuous, IV with three stout short setae. Epimera I and II forming a single anterior plate in the nymph; III and IV in nymph large and separated; in adult, epimera I, II and III are united and form a single anterior plate posteriorly deeply excavated from III forwards to between I and II, between coxae I and II the plate is laterally expanded to form subquadrate and large expansions or tectopodia, a smaller similar expansion occurs behind coxae II; the epimera IV of adult is not differentiated. All coxae with one seta, which are very fine in the adult, stronger in nymph (cf. Veitz, fig. 4); the median posterior pair of setae on anterior ventral plate of the nymph and between epimera IV shown by Veitz could not be seen in the adult. Legs 5-segmented in nymph I, 6-segmented in nymphs II and III, and in adult; in adult with normal very fine setae, in nymphs with a double row of small stout hook-like spines. Tarsi with sessile paired curved long and slender claws, which in the nymphs are internally finely combed or ciliated; between the claws is a small stout curved hook-like empodium. Genital valves with many small acetabula. Sexes only differing in the internal genitalia.

ASTACOPSIPHAGUS PARASITICUS Vietz 1931.

Fig. 1, A–J.

Description of Adult. Length to 3,360μ, width to 1,640μ. Dark brown with the dorsal shields and capitulum well chitinized. Antero-dorsal plate roughly hexagonal, about $\frac{1}{3}$ length of body; ocular plates subtriagonal with the outer margin curved; posterior plate elongate (cf. fig. 1A). Eyes absent. Mandibles and palpi as in fig. 1C and D. Legs long and thin, I and II 1,200μ long, III and IV 1,440μ. Ventrally with the epimera I, II and III united to form a plate with deeply excavate posterior margin. All coxae with a single fine and minute seta. Female genital plate with the valves united posterior of the opening, with numerous acetabula; internal genitalia as in fig. 1F. Male genital plate with the valves entirely separated (cf. fig. 1E); internal genitalia as a pair of processes, each with four stout spines (fig. 1G).

Nymph. As described by Vietz, except that the antero-dorsal plates are two, not one, the anterior being somewhat crescent shape and wider and narrower than the posterior which is roughly quadrate. The nymph III containing fully developed adults measured up to 4,300μ in length and 2,100μ in width.

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