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AUSTRALIAN JOURNAL OF ZOOLOGY

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A REVISION OF THE
AUSTRALASIAN BOOPIIDAE (INSECTA: PHTHIRAPTERA),
WITH NOTES ON THE TRIMENOPONIDAE

S. von Kéler

31 July 1971

A REVISION OF THE AUSTRALASIAN BOOPIIDAE (INSECTA: PHTHIRAPTERA):
WITH NOTES ON THE TRIMENOPONIDAE

By the late S. VON KÉLER*

[Manuscript received 21 March 1968; revised manuscript received 23 November 1970]†

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Abstract

The louse family Boopiidae, parasitic on marsupials in Australia and New Guinea, is revised on the basis of much new material from wild hosts. Important morphological features, particularly the genitalia, and their taxonomic value, are reviewed.

A key is given to the genera of Boopiidae and those of the most closely related family, the Trimenoponidae, which occurs on Neotropical marsupials and caviomorph rodents. Seven genera (*Boopia*, *Phacogalia*, *Heterodoxus*, *Paraboopia*, *Macropophila*, *Paraheterodoxus*, *Latumcephalum*) and 35 species of Boopiidae are recognized. Keys are given to the species, and all species are described and figured. Fourteen species are described as new, two in *Boopia*, seven in *Heterodoxus*, three in *Macropophila*, and two in *Paraheterodoxus*.

The majority of boopiids are parasites of Macropodidae but a few species are found on members of the families Dasyuridae, Peramelidae, and Vombatidae. One species, *Heterodoxus spiniger*, has an anomalous host distribution: it is found on domestic and wild Canidae in many parts of the world, but there are occasional records from wallabies.

* Formerly of Berlin.

† Shortly after Dr. von Kéler died, the original manuscript was received for publication in the *Australian Journal of Zoology*. The Editor-in-Chief is indebted to Mr. M. D. Murray, Division of Animal Health, CSIRO, for accepting responsibility for the redrafting of the entire manuscript. Also, the valuable contribution of Dr. Theresa Clay, of the British Museum (Natural History), who reconstructed the keys and established the details of types is gratefully acknowledged. Mr. J. H. Calaby kindly clarified problems of host identity.

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INTRODUCTION

The Boopiidae of Australasian marsupials have been treated in many papers, chiefly by S. A. Le Souëf* alone and with H. Bullen, L. Harrison alone and with T. H. Johnston, and recently in an exhaustive and excellently illustrated monograph by F. L. Werneck (1948) reviewing a number of contributions by that author alone and in collaboration with G. B. Thompson.

Dr. Theresa Clay, Department of Entomology, British Museum (Natural History), kindly proposed some years ago that I should determine the Australasian Boopiidae in the British Museum and the Division of Entomology Museum, Canberra.† The material sent to me has proved to be very extensive and its elaboration grew in course of time to a revision of the whole group.

The bulk of the material before me has been collected by Mr. J. H. Calaby, Division of Wildlife Research, CSIRO, and by Mr. R. Domrow, Queensland Institute of Medical Research, Brisbane. I have also been able to examine type material and specimens determined and published by Werneck and Thompson.

I am grateful to Dr. Clay for the loan of the named material as well as for much information concerning it and for supplying some photocopies of literature not available to me. I am indebted also to Dr. K. C. Emerson for loan of some Boopiidae from New Guinea. Dr. Clay has included in the manuscript information on *Heterodoxus maai*, a species not seen by me.

GENERAL REMARKS ON THE BOOPIIDAE

The Boopiidae represent a small group of Mallophaga parasitizing marsupials. In his monograph Werneck (1948) treated 10 genera (four South American and six Australasian) and 27 species (eight South American and nineteen Australasian) of Boopiidae and Trimenoponidae; all the South American species belong to the Trimenoponidae. To date, no boopiid species is known as native in South or Central America. The fifth genus‡ and ninth species of Trimenopodae was recently described by K. C. Emerson as *Chinchillophaga clayae*. Fourteen new species are described in the Boopiidae in the present paper, two in *Boopia*, seven in *Heterodoxus*, three in *Macropophila*, and two in *Paraheterodoxus*. Two species regarded in Werneck's monograph as probably conspecific but treated provisionally as distinct (*B. bettongia* and *phanerocerata*) must be definitely synonymized and two others synonymized by Werneck (*B. spinosa* and *brevispinosa*) must be validated, so that the present status of Australasian Boopiidae amounts to 35 species (see List of Recognized Species).

In the Boopiidae every genus is in some respects a chapter of evolution, and it is impossible in the present paper to deal with all the characters of interest from the standpoint of comparative morphology. This may be a future task of a younger specialist.

* The correct order of the initials of Le Souëf is A. S., as is found on labelled slides in the British Museum (Natural History). The order was reversed in his publications.

† Now part of the Australian National Insect Collection, Canberra, which for the present is being cared for by the Division of Entomology, CSIRO.

‡ Since this paper was written a sixth genus, *Hoplomyophilus* Méndez, 1967, has been described. T. C.

The general shape of the body of Boopiidae may be represented by that of *Boopia biseriata*, sp. nov. (Fig. 81) and *Heterodoxus spiniger* (Fig. 82) and by the photographs (Figs. 1-80). The outline of the *head* and *pronotum* is characteristic for each genus, with the one exception of *spinosa*, which in spite of its boopiid head has been placed in *Phacogalia*, a genus which in some details is transitional between *Boopia* and *Heterodoxus*, as has been pointed out by Harrison. The position and character of all setae are very constant, partly as generic, partly as specific or species-group characters. The characters of chaetotaxy have been used in the present paper as far as the material has allowed, but future statistical investigations of larger numbers of specimens will surely bring some further details of the diagnostic value and constancy or variation limits of some groups of setae not dealt with here, as, for example, postnodal, clypeal, frontal, and ventral setae of head and thorax, and pleural setae of abdomen. It may be emphasized that all setae in the figures of the present paper are exact in natural position and character. Some insight into the individual variation of the chaetotaxy is shown in Figures 91 and 104.

The *legs* are relatively uniform in Boopiidae, and highly interesting in the family Trimenoponidae and the boopiid genus *Latumcephalum*, in which they are much shorter than in all other genera of Boopiidae; the tarsi especially are more or less reduced. In this respect *Latumcephalum* is transitional between Boopiidae and Trimenoponidae. No trimenoponid species possesses such long tarsi as *Boopia* or *Heterodoxus*. It may be noted here that *Boopia* often anchors its tarsi in the saddle between the coxa and femur (e.g. *B. tarsata* Slide No. 1505/36). The tarsus of *Latumcephalum lesouefi* (Fig. 132) shows some similarity to that of Ischnocera, especially of some Trichodectidae (see von Kéler 1938).

The *mouthparts*, except maxillary palpi, have not been treated as diagnostic characters, but their comparative study may clear up some questions of relationships. The mouthparts of *Cummingsia* are particularly interesting (Fig. 83) as they possess a chitinized groove in the labium, perhaps corresponding to part of that in the Corrodentia (von Kéler 1966).

The most important diagnostic characters lie in the *genital organs* of Boopiidae and these have been treated with particular attention. The male copulatory organ seems to possess characters of more diagnostic than evolutionary value. The Boopiidae are specialized for insemination with the help of the spermatophore, while in Trimenoponidae and all other Mallophaga insemination is conducted without spermatophores. The female genital characters are more constant, less progressive, and offer less valuable diagnostic differences, but are highly interesting in the evolutionary respect. Gonapophyses are, among the Mallophaga, present in Boopiidae, some Gyropidae, and Trichodectidae. Their presence in Anoplura may be emphasized. Undoubtedly the presence of gonapophyses represents a primitive character of Mallophaga and it should be interesting to trace their fate within all remaining groups of these insects. The progressive reduction of the gonapophyses may be studied in the Boopiidae and Trimenoponidae. In the Boopiidae they are partly highly developed, in Trimenoponidae highly reduced.

(a) The Male Copulatory Organ

The male copulatory organ, or phallus, of Boopiidae is composed of a basal plate, of one pair of parameres, one mesosome, and one preputial sac or vesica (Figs. 84 and 118).

The *basal plate* shows but little specific or generic variation. It is tongue-shaped in all genera of Boopiidae, more or less narrowed in or before the middle, wider at its posterior, narrower at its anterior end. Its lateral margins are well chitinized and brown coloured, while the median portion is colourless, endocuticular, but rather leathern than membranous. The posterior ventral corners of the basal plate are provided with a ventral articulation for the parameres and the dorsal corners with a large dorsal articulation process for the mesosome arch and clasps.

The *parameres* show but little specific or generic differentiation. Their variable position, due to the state of repose or erection as well as to the technical effects of mounting, rarely admits of their incontestable comparison among different species. The end of each paramere is always provided with an apical sensory seta and sometimes with one or two subapical setae.

The *mesosome* is membranous, stiffened dorsally by a chitinous mesosome arch and laterally by one pair of mesosome clasps. Both mesosome arch and clasps articulate on the ends of the dorsal articulation process of the basal plate. The mesosome arch retains the same position in rest and erection, but the mesosome clasps at rest are folded within the mesosome (Fig. 122), and their ends may reach far forward to the posterior ends of the lateral sclerites of the vesica.

The *vesica* is for the most part membranous, clothed with denticles of specifically different shape and density, and with a number of chitinous plates, two median, two to four lateral, and sometimes two accessory lateral ones. The two median plates are movably joined like two covers of a book and retain their connection in repose and erection (Figs. 97 and 122). In this paper they will be referred to as the anterior and the posterior median plates, according to their position in repose. The median plates of the vesica suffer less under the technical effects of mounting than the lateral sclerites, but the lateral sclerites are diagnostically more important than the posterior median plate, because they vary more specifically. While the posterior median plate is nearly constant in all species of a genus, the lateral sclerites differ in every species. More differentiation shows in the anterior median plate, especially its lateral wings, but the latter are often indistinctly outlined except for the anterior handle. All useful details of the plates and sclerites of the vesica have been utilized in the keys to genera and species.

The vesica is in repose invaginated into the posterior end of the mesosome, involving the posterior part of it and folding the posterior halves of the mesosome clasps inside it, while the mesosome arch remains still in position (Fig. 122). The mesosome arch and clasps do not show any essential generic or specific differentiation.

The *ejaculatory duct* (*ductus ejaculatorius*) opens into the vesica in the middle of its ventral side between this and the basal plate (Fig. 84). Its mouth lies between the anterior and posterior median plates (Figs. 84, 109, 110), the function of which is to hold fast the stalk of the spermatophore and to carry it backwards during evagination of the vesica. The function of the lateral vesical sclerites (Fig. 90) is probably to support the corners of the mouth of the genital chamber (vulva), which is stiffened by the posterior projections of the genital sternite. Some distance before its mouth the ejaculatory duct is provided with a large muscular dilatation and its distal part, between this dilatation and the mouth, is provided with a layer of muscle fibres and is folded, so that the distal part comes to the mouth back to front. The purpose of this

fold may be understood if we consider that the distal part of the ejaculatory duct is drawn into the vesica during its evagination, the mouth of it coming into the position of insemination together with both the median plates on the ventral side of the evaginated vesica (Fig. 98). In this way the distal part of the ejaculatory duct must be forced inside out during the invagination of the vesica. In the fully evaginated state the end of the spermatophore, or its stalk, held fast by both the median vesical plates, comes out of the mouth of the duct on the ventral side of the vesica (Figs. 109 and 110). In subfeminal copulation the ventral side of the erected vesica comes into contact with the dorsal wall of the genital chamber and the stalk of the spermatophore can contact the genital papilla of the female. Figure 98 shows an extracted penis with the distal part of the ejaculatory duct hanging out of its opening, probably having been broken during mounting and pressed out.

Some species of *Heterodoxus* possess one or two pairs of long weakly chitinized spines between the denticulation of the ventral wall of the vesica, turning out in the erected state and directed with their ends anteriorly (Fig. 122). The function of these spines is not quite clear to me. In *Heterodoxus alatus* there are, indeed, in the dorsal wall of the genital chamber three pairs of longish sclerotizations anterior to the genital papilla, corresponding approximately to the point where the vesical spines must lie during copulation. But in *Heterodoxus spiniger* there are no such sclerotizations. In *H. macropus* there is a small brown sclerite anterior to the genital papilla with a sharply outlined anterior margin. It is, of course, not certain whether or not these structures are correlated with the vesical spines of the males.

On the posterior margin of the vesical anterior median plate is inserted a long and strong tendon, probably belonging to the retractor muscle of the vesica, originating on the anterior end of the basal plate. According to Blagoveshtchensky (1956) a retractor muscle is inserted on the anterior part of the vesica, but the exact point of insertion has not been ascertained. According to that author the evagination of the vesica is caused by the pressure of blood only. He has, indeed, not studied the genital organs of Boopiidae and has therefore not seen the way of the spermatophore. It seems to me that evagination of the vesica in Boopiidae begins when the spermatophore is pushed into the vesica by means of compression of its anterior end (Fig. 109) within the muscular ampulla of the ejaculatory duct. The pressure of the spermatophore causes the handle of the anterior vesical plate to bend anteriorly and the surrounding part of the vesica wall to form a deep fold; this takes the pressure of blood and thus terminates the process of evagination.

The ventral articulation of the parameres helps to turn the mesosome upwards and to bring the mouth of the invaginated vesica into contact with the vulva. The dorsal basal corners of the parameres are provided with strong levator muscles, which turn the parameres upwards [von Kéler (1960), Fig. 6]. As soon as the mouth of the invaginated vesica (i.e. the posterior end of the mesosome) faces the mouth of the genital chamber, the vesica can be fully evaginated and pressed into the genital chamber.

Spermatophores are very often present in the abdomen of males of Boopiidae. They are generally broken into many pieces distributed within the abdomen, but in many cases only their stalk is broken off. Only in two males has the spermatophore been found in the position shown in Figures 109 and 110, with the stalk squeezed between both the median plates of the vesica.

(b) *The Female Genital Region*

The female genital region of Boopiidae occupies the abdominal segments VII–IX or VIII–IX. Segments X–XII constitute the anal region concealed between the gonapophyses of segment IX. It is in most cases difficult to be sure, in whole mounts, of the real form of sternites VII and VIII because they are often not sharply outlined and are, besides, obscured by other translucent sclerites. These sternites, although they may have diagnostic value, can hardly be utilized for practical purposes of determination. In general, it is also not easy to show with certainty the outlines of all other abdominal sternites and tergites except in some favourable mounts not excessively cleared in caustic potash. In *Heterodoxus longitarsus*, for example, sternites VII and VIII are fused together (Fig. 120) and in *H. spiniger* they are separated (Fig. 119). In some species sternite VII differs in no way from VI, in some others it shows different outlines, as for example in *Boopia biseriata* (Fig. 105). Sternum VII is counted in the genital region if it shows a different outline from that of VI. Consequently the *subgenital plate* or *hypogynium* is sometimes represented by sternum VIII alone and sometimes by the differentiated or fused sterna VII and VIII. This character is certainly of diagnostic value, but can seldom be utilized. Abdominal tergite VII is generally the same as VI in outline and chaetotaxy, but differs in some species. In comparing the chaetotaxy of the pregenital abdominal segments of different species or specimens, it appears, at any rate, advisable to use only segments II–VI or III–VI.

Abdominal sternum VIII is in all genera larger than tergum VIII. It is posteriorly elongated into a broad, rounded, sometimes slightly or deeply emarginated lobe, the *subgenital lobe*, covering the broad mouth of the genital chamber or vulva. Its posterior margin represents the ventral margin of the *genital chamber* and is here simply termed “*vulva*” although this term is not quite correct, because it should refer to the mouth of the genital chamber. It is, in all Boopiidae, provided with a marginal row of vulvar setae. The sternite of the subgenital plate usually reaches to the margin of the subgenital lobe, but sometimes it is emarginated, leaving the median part of the vulvar margin membranous and sometimes hardly perceptible. The number, location, distribution, and strength of the vulvar setae are individually variable within limits; nevertheless they furnish, in most cases, reliable diagnostic characters.

The dorsal wall of the genital chamber is represented by sternum IX. Its sternite, the *genital sternite*, is covered for the most part by the subgenital sternum and lobe; only its posterior corners projecting beyond the vulvar margin are freely visible and reach, in most species, to the sides of the postgenital sternum or to the lateral gonapophyses. The genital sternite is usually more or less deeply emarginate anteriorly forming a *lumula*. Within this emargination lies the genital papilla of the spermathecal duct (see below). Behind and usually on both sides of the genital papilla, the genital sternite is provided with a microsculpture of denticles of specific constancy. That this sculpture belongs to the genital and not the subgenital sternites is evident in cases where the subgenital lobe is pushed forward and the sculpture, being free, is perceptible on the posterior part of the genital sternite.

Behind the vulvar margin there is, in all species of Boopiidae known to me, a transverse, generally sharply outlined, and more or less distinctly brownish chitinized *postgenital sternum*, provided on its posterior margin with a row of postgenital setae. It may be partly covered by the subgenital lobe. The length, density, distribution, and

character of these postgenital setae are within some limits individually variable; nevertheless they furnish a character of some diagnostic value. On both sides of this sternite, the marginal setae are much stronger and longer than in the middle. The fact that the posterior projections of the genital sternite reach to the sides of the postgenital sternite, or are fused with them, suggests that the postgenital sternum represents the *inner gonapophyses* of segment IX of Corrodentia fused with the posterior part of this sternite.

On both sides of the postgenital sternum there are, in all Boopiidae known to me, sickle-shaped bluntly or sharply pointed appendages known in the literature of Mallophaga as *gonapophyses*. They probably* represent the outer gonapophyses of segment IX of Corrodentia. The basal ventral side of each gonapophysis is provided with a row of strong setae, which generally cut obliquely the setae of the lateral brushes of the postgenital segment. In some species of *Boopia* and in *Paraheterodoxus* some of the gonapophysal setae are located on an enlargement of its external margin. In *Paraheterodoxus calcaratus* the innermost gonapophysal seta is developed as a strong spine located on a large lateral projection of the gonapophysis, which is remarkably reduced. In *Pa. erinaceus* the gonapophysis is reduced to a small appendage, much smaller than its lateral projection, bearing a large and strong spine (Fig. 129). In *Boopia* the gonapophyses are dorsally fused with the lateral plates of tergum IX which, on the other side, stand in syndetic connection with the narrowly pointed posterior edges of tergite VIII. Pleurite IX is wanting in *Boopia* or fused as a tergopleurite. In *Heterodoxus* and *Paraheterodoxus* the gonapophyses are separated from segment IX by a distinct suture. The dorsal sclerite of the gonapophysis is, in these genera, prolonged toward the posterior angles of the ninth median tergal plate (see below) sometimes building a syndetic connection with it. In some species of *Heterodoxus* this basal dorsal prolongation of the gonapophysal sclerite is partly or totally separated from its body by a suture or deep incision (Fig. 119). The gonapophyses end with a more or less strongly developed gonapophysal spur. In *Boopia tarsata* and *B. dubia* the gonapophyses are not at all pointed, but rounded at the end and provided with a subapical seta instead of an apical spur.

Tergite IX is divided into three plates, both the lateral plates apparently representing the tergopleurites and the median plate the rest of the divided tergum. As may be seen from Figure 116, this median plate is in some limits individually variable but possesses some constancy within the species and consequently is of some limited diagnostic value. The beginning of a corresponding median plate is observed within the posterior emargination of tergite VIII in *Heterodoxus longitarsus*, *spiniger*, *ualabati*, *ancoratus*, *macropus*, and *octoseriatus*. In the remaining species of *Heterodoxus* (*ampullatus*,

* My recent investigations of the genito-anal region of the female abdomen of Corrodentia make it more probable that the “gonapophyses” of Boopiidae correspond either to paraprocts or to a fusion of them with the outer gonapophyses of these insects. In Corrodentia the paraprocts articulate dorsally with tergite IX (X and XI being absent). The gonapophyses of Boopiidae show this articulation (or fusion). The fact that the posterior arms of tergite IX in Boopiidae reach in some species to the sides of the postgenital sternite and in others to the lateral margins of the “gonapophyses” speaks rather for the bivalent nature of the “gonapophyses” of Boopiidae. The apical spur of the “gonapophyses” of Boopiidae is thus probably homologous with the anal spines of trogiomorph Corrodentia.

calabyi, *biarcuatus*, *alatus*, and *quadriseriatus*) the posterior margin of tergite VIII is flatly emarginated and provided with a small, slightly projecting lobe generally limited on both sides by more or less deep and narrow incisions. The median tergal plate of tergite VIII has probably been overlooked by Werneck in his figure of the female of *Heterodoxus* "*longitarsus*" [Werneck (1936), Fig. 126], because it is present in all specimens of *longitarsus* and *spiniger* before me. In *Macropophila* there is neither a lobe nor emargination of the posterior margin of tergite VIII. The intersegmental suture between tergites VIII and IX is very distinct in all species of *Heterodoxus*, *Boopia*, and *Macropophila*. In *Boopia* the ninth median tergal plate is present, the eighth always absent. In all species of *Heterodoxus*, *Boopia*, *Macropophila*, *Phacogalia*, and *Latumcephalum*, the ninth median tergal plate bears on both sides a group of sensilia basiconica, sometimes located on lighter sclerotized lateral wings of this plate. In *Heterodoxus* the syndetic connection of the posterior corners of this plate with the dorsal gonapophysal sclerites cannot be understood otherwise than as a secondary feature.

The *anal segment* is, in all Boopiidae except *Paraheterodoxus*, membranous. Its posterior wall is concave, forming a small *anal pocket*, into which the rectum opens. Theoretically, the anal pocket represents segment XI + telson. In *Paraheterodoxus* there is a distinctly sclerotized tenth tergite extending between the basal halves of the gonapophyses and separated from them by a narrow colourless suture. The posterior *supraanal margin* of tergum X extends on both sides into the membranous inner wall of the gonapophyses and is, in some species of *Heterodoxus*, provided with more or less dense standing sensory ampullae which ascend to the base of the gonapophysal spur. The sensory equipment of the supraanal margin undoubtedly possesses a diagnostic value but its fineness and variable location in mounts make this character difficult for practical use. The ventral *subanal margin* of the anal segment is still perceptible a small distance below the supraanal margin and sometimes anterior to it. It is still provided with a more or less dense row of short sensory setae. It must be added that the supraanal and subanal margins are optical illusions of vertical aspect. Really there are no margins, but perpendicular standing walls of the anal segment. Accordingly the corresponding setae are not to be understood as "marginal" setae but as setae of the supra- and subanal walls.

The *genital papilla* of the spermathecal duct is present in all species of Boopiidae, but it is not always perceptible. Its shape and size are specifically variable, but its diagnostic value is, in practice, small on account of the difficulty of seeing it and its varying position in different slides. The outlines of the genital papillae of some species are represented in Figure 115. The spermathecal duct is in many specimens very distinct, reaches the length of 0.5 mm, and in many specimens is provided with a small pear-shaped dilatation a short distance from the papilla; from this dilatation forward it is twice as thick as behind it, measuring 2 μ m.

In the descriptions and keys which follow, "sternites" and "tergites" refer to those of the abdomen unless otherwise stated; "intercalaries" are shorter setae inserted between the longer ones in a row of setae; "discal" setae are those arising towards the middle of a structure, the discal setae of the sternites and tergites being equivalent to the median anterior setae as used by Price and Beer (1963) and others.

HOST NOMENCLATURE

In the present paper the term "type host" has been replaced by the neutral term "nominal host". "Types" and "typical" mean something fundamental and unique, like the type species of a genus or type specimens or holotype of a species, while the host named in the original description of a mallophagan species contains absolutely nothing which can be called typical. Very often this host is even erroneous. The word "nominal host" (Nennwirt) implies no prejudice as to the subsequent host records, meaning only that the described mallophagan species was first discovered on that host species. It must be decided from subsequent records whether the nominal host is correct or due to contamination, and whether it is the chief host or an additional natural host of a polyphagous or oligophagous mallophagan species.

ABBREVIATIONS

In lists of *material examined*, the format adopted is initials of determiner, specimens, host (skin number if any), geographical locality, date of collection, full name of collector, museum, accession number, and slide number (in parentheses). The specimens are classified by the host name that is presently accepted. The exact museum location is given for type specimens only.

The abbreviations used for *determiners* are: L.H., L. Harrison; T.H.J., T. H. Johnston; N.J.B.P., N. J. B. Plomley; G.B.T., G. B. Thompson; F.L.W., F. L. Werneck.

The abbreviations for *museums* are ANIC, Australian National Insect Collection, Canberra; BMNH, British Museum (Natural History); LM, Leiden Museum; MZH, Museum of Zoology, Hamburg; UC, California Insect Survey Collection, Division of Entomology, University of California, Berkeley; USNM, United States National Museum, Washington; KCE and GBT, collections of K. C. Emerson and G. B. Thompson respectively.

All *measurements* have been made in millimetres, and the following abbreviations have been used: HL, head length; HB, head breadth; HI, head index; Poc, postocular angle; PrB, prothorax breadth; MsB, mesothorax breadth; MtB, metathorax breadth; AB, abdomen breadth; SL, length of head spine; SD, distance of head spine; STh, thickness of head spine; TL, total length.

KEY TO GENERA OF TRIMENOPONIDAE AND BOOPIIDAE*

- | | | | |
|-------|---|-----------------------|---|
| 1. | Spiracles absent on abdominal segment VIII† (5 pairs)..... | TRIMENOPONIDAE | 2 |
| | Spiracles present on abdominal segment VIII (6 pairs) | BOOPIIDAE | 7 |
| 2(1). | Head without dorsal or ventral hooks or processes of the cuticle | | 3 |
| | Head with hooks or processes of the cuticle | | 5 |
| 3(2). | With definite prosternal plate with many setae | | 4 |
| | Without definite prosternal plate; prosternum without many setae | <i>Hoplomyophilus</i> | |
| 4(3). | Maxillary palpus with small 5th basal joint (Fig. 86) | <i>Trimenopon</i> | |
| | Maxillary palpus 4-jointed | <i>Philandesia</i> | |
| 5(2). | Head nearly twice as broad as long with strongly projecting postnodal lobes; with a pair of large sharply pointed nodal hooks directed posteriorly on ventral side; end of temporal lobe bent backwards to form short serrated hook | <i>Harrisonia</i> | |
| | Head not as above | | 6 |

- 6(5). Head ventrally with 1 blunt nodal process and 1 longer and sharply pointed maxillary process (Fig. 87D); without process from ventral margin of antennal groove *Cummingsia*
 Head without ventral nodal and maxillary processes but with pointed process from ventral margin of antennal groove (Fig. 87C) *Chinchillophaga*
- 7(1). Postspiracular setae on segments II-IV modified as trichobothria; maxillary palpus 4-jointed 8
 Postspiracular setae on segments II-IV unmodified; maxillary palpus 2- or 3-jointed 12
- 8(7). Spinous process arising near base of each maxillary palpus (Fig. 117); spiracles on central tergal plates 9
 Head without such spinous processes; spiracles not on central tergal plates 10
- 9(8). Abdominal lateral plates of VII and VIII broad and darkly pigmented (Fig. 7).....*Macropophila*
 Abdominal lateral plates of VII and VIII not as above *Heterodoxus*
- 10(9). Pair of short, stout spiniform gular setae; segments I-VIII each with pair of stout spiniform setae on tergites and sternites; abdominal lateral plates partly divided by suture
 *Paraheterodoxus*
 Without such gular setae; segments I-VIII without such spiniform setae; lateral plates not so divided 11
11. Head with sinus occipitalis forming dorsal horizontal line across head immediately caudad to occipital (frontal) setae (Fig. 111); plantar pulvillus of tarsal claws with freely projecting point *Phacogalia*
 Head without sinus occipitalis; plantar pulvillus without projecting point *Boopia*
- 12(7). Maxillary palpus 2-jointed; ocular seta on process *Latumcephalum*
 Maxillary palpus 3-jointed; ocular seta not on process *Paraboopia*

* This key is partly based on Clay (1970, p. 96). T.C.

† The numbers refer to the primary segments, e.g. in the Boopiidae the apparent first segment is II.

Family TRIMENOPONIDAE

Description

Maxillary palp 4- or 5-jointed, projecting or not beyond margin of head. Mesothorax fused with pro- or metathorax or free; if mesonotum fused with pronotum or free, it has pair of minute setulae, not on elevated warts; if fused with metanotum it bears several normal setae. If mesothorax fused with pro- or metathorax, mesosternum and 2nd coxae are located beneath posterior half of pronotum or anterior half of metanotum; if free, it has small but separated notum sometimes partly concealed beneath pro- and metanotum, 2nd coxae located between pro- and metathorax. Legs very short and thick, tarsi usually not longer than half tibia, in one species two-thirds of tibia. Abdomen with 5 pairs of spiracles on segments III-VIII, pleurae II-IV without trichobothrial setae.

Hosts

Marsupials and rodents in South and Central America.

Genus TRIMENOPON Cummings

Trimenopon Cummings, 1913b, pp. 39-40.

Description

Head rounded, triangular (Fig. 87E), without hooks or thorn-like projections of cuticle, dorsally or ventrally. Maxillary palp with small 5th basal joint (Fig. 86), near margin of head and projecting with 3 joints beyond.

Mesonotum fused with pronotum, posteriorly with recognizable separate sclerotizations. Mesosternum beneath pronotum, separated from prosternum by distinct suture.

Abdominal segment I shorter than II but complete, its pleura concealed beneath sides of metanotum.

Species

T. hispidum (Burmeister, 1838) [syn. *Menopon jenningsi* Kellogg & Paine, 1910; *M. extraneum* Galliard, 1934; *Trimenopon echinoderma* Cummings, 1913; *T. rozeboomi* Emerson, 1940]; ♂ 1.85 mm (Figs. 85, 86, 87E), ♀ 2.05 mm (Fig. 88); from *Cavia porcellus* (Linnaeus, 1758) [syn. *C. cobaya* Pallas, 1766; *C. cutleri* Bennett, 1836; *C. anolaimae* Allen, 1916], *C. aperea* Erxleben, 1717 [syn. *C. azarae* Lichtenstein 1823], *C. fulgida* Wagler, 1831 [syn. *C. rufescens* Lund, 1841]; South America, and from captive guinea-pigs all over the world.

Genus PHILANDESIA Kellogg & Nakayama

Philandesia Kellogg & Nakayama, 1914, pp. 198-9.
Philandria Kellogg, 1914, p. 257.

Description

Head without hooks or thorn-like projections of cuticle, dorsally or ventrally. Head with specifically different outlines; in *Ph. townsendi* (Fig. 87A) and *chinchillae* (Fig. 87B) as in *Boopia*; in *Ph. mazzai* as in *Trimenopon*. Maxillary palp 4-jointed, short, projecting beyond margin of head with 2-3 joints.

Mesothorax fused with prothorax. Mesonotum situated between pro- and metanotum; mesosternum beneath posterior half of pronotum, separated from pro- and metasternum.

Male genital organ of uniform type with the mesosomal arch forming a median plate of different outlines, with the mesosome clasps forming on both sides of it a pair of appendages similar to a second pair of parameres.

Female genitalia more differentiated; in *townsendi*, a broad postgenital sternum with a comb of strong spines each side with a short row of setae on the rudimentary gonapophyses and with a continuous row of marginal setae on tergite IX; anal segment ribbed longitudinally. In *Ph. chinchillae*, only a brush of setae both sides of the postgenital sternum and a short row of gonapophysal setae beneath them, the gonapophyses wanting as in *townsendi*. In *Ph. mazzai*, postgenital sternum with 1 postgenital and 1 gonapophysal brush of setae each side and with 3 strong setae medially to these. The

vulva bears in *mazzai* a continuous row of 14 setae, in *chinchillae* a median group of 6 setae, and in *townsendi* 14 very short setulae widely scattered, situated not on margin but more anteriorly.

Species

Ph. townsendi Kellogg and Nakayama, 1914; ♂ 1.96 mm (Fig. 87A), ♀ 2.07 mm; from *Lagidium peruanum* Meyen, 1833 [syn. *L. inca* (Thomas, 1907)], *L. viscacia* (Molina, 1782) [syn. *L. pallipes* (Bennett, 1835)], *Chinchilla lanigera* (Molina, 1782) [syn. *Ch. laniger* (Molina)]; South America.

Ph. mazzai Werneck, 1933; ♂ 1.47 mm, ♀ 1.32 mm; from *Ch. lanigera*, *L. peruanum* [syn. *L. saturatum* = *L. saturata* (Thomas, 1907)].

Ph. chinchillae Werneck, 1935; ♂ 1.16 mm, ♀ 1.11 mm (Fig. 87B); from *Ch. lanigera*, *L. peruanum*.

Genus HARRISONIA Ferris

Harrisonia Ferris, 1922b, pp. 80–81.
Acanthomenopon Harrison, 1922, p. 156.

Description

Head nearly twice as broad as long with strongly projecting postnodal lobes and triangularly projecting temporal lobes, with a pair of large, sharply pointed nodal hooks directed posteriorly on the ventral side of head; end of temporal lobe bent backwards forming a short serrated hook. Maxillary palp projecting with 2 joints beyond margin of head.

Mesonotum fused with metanotum, both nota with some normal alveolar spines or strong setae, no trace of notal suture; mesosternum fused with prosternum, without suture.

First abdominal segment smaller than 2nd, but complete, with small tergite and strong pleurae. Female postgenital sternite very broad with short comb of setae each side. Gonapophyses absent, but 4 strong setae on a projecting lobe each side of postgenital sternite.

Species

H. uncinata Ferris, 1922; ♀ 0.8–0.9 mm, from *Hoplomys gymnurus* (Thomas, 1897), *Proechimys guyannensis* (Geoffroy, 1803) [syn. *P. cayennensis* (Desmarest, 1817), *P. mincae* (Allen, 1899), *P. oris* Thomas, 1904, *P. trinitatis* (Allen and Chapman, 1893)], *P. semispinosus* (Tomes, 1858); South America and Trinidad.

Genus CUMMINGSIA Ferris

Cummingsia Ferris, 1922b, p. 83.

Description

Head bell-shaped (Fig. 87D), broadly rounded anteriorly, with projecting temporal lobes, their postocular margin closing an angle of about 150° with the ocular margin. Ventral side of head with one strong and blunt nodal thorn and one longer and sharply pointed maxillary thorn, both directed posteriorly. Both sides of labrum with a small tooth on the edges of the clypeus (Fig. 83). Maxillary palp very short, one-fourth longer than broad on base, not reaching to the margin of head.

Mesonotum fused with pronotum and concealed beneath it; mesosternum situated totally beneath pronotum but independent from pro- and metasternum, forming a strong sclerotized plate with many strong spines.

First abdominal segment strongly reduced, consisting of a crescent-shaped tergite between the 2nd pleurae and a small sternite between the 3rd coxae. Mesosomal arch Y-shaped forming a "pseudopenis". Female postgenital sternite with a complete row of strong marginal setae, on the sides very indistinctly separated from the gonapophyses, which seem to be fused with anal sternum and are provided with a row of very strong setae on their external margins (Fig. 89). It is noteworthy that the setae of the gonapophyses and of the postgenital sternum seem to constitute one uninterrupted circular anal corona of setae as in many Menoponidae.

Species

C. maculata Ferris, 1922; ♂, ♀ 1.22 mm; from *Lestoros inca* (Thomas, 1917) [syn. *Caenolestes inca* Thomas]; Peru.

C. peramydis Ferris, 1922; ♂ 1.2 mm, ♀ 1.4 mm (Figs. 83, 87D, 89); from *Monodelphis domestica* (Wagner, 1842) [syn. *Peramys domesticus*]; Brazil.

C. intermedia Werneck, 1937; ♂ 1.25 mm, ♀ 1.47 mm; from *Marmosa incana* (Lund, 1841) [syn. *Marmosa incana paulensis* Tate, 1931]; Brazil.

Genus CHINCHILLOPHAGA Emerson

Chinchillophaga Emerson, 1964, pp. 383–4.

Description

Head rounded, triangular. Maxillary palp long, projecting with 3 joints beyond the margin of head. Anterior half of the ventral cover of the antennal groove prolonged into a long, sharply pointed tooth directed posteriorly (Fig. 87C). Pre-ocular nodi poorly developed without notch but with a small emargination. Postnodal lobes of head slightly broadened.

Mesonotum fused with pronotum, situated between pro- and metanotum; mesosternum between pro- and metathorax.

Species

Ch. clayae Emerson, 1964; ♂ 1.06 mm, ♀ 1.55 mm (Fig. 87C); from *Dolichotis patagonum* (Zimmermann, 1780) in London Zoo; South America.

Genus HOPLYMYOPHILUS* Méndez

Hoplomyophilus Méndez, 1967, pp. 287–91.

Description

"Head without spinelike processes on ventral region; with lateral and posterior margins sinuate; posterior margin with central sinus; with two dorsal, submarginal spiniform setae at the antennal level; clypeal region moderately produced, not limited by distinct suture; eyes absent; maxillary palpi 4-segmented, exposed; antennae 4-

* This genus was described since the manuscript was submitted for publication and has been included to complete the descriptions of the genera of the family Trimenoponidae. The description and details given are those of Méndez, 1967. M.D.M.

vulva bears in *mazzai* a continuous row of 14 setae, in *chinchillae* a median group of 6 setae, and in *townsendi* 14 very short setulae widely scattered, situated not on margin but more anteriorly.

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segmented, exposed; not protected ventrally by a flap; antennal fossae deep; temporal lobes slightly prominent, truncate. Prothorax and pterothorax fused, both subquadrate; anterior thoracic stigmata conspicuous; posterior thoracic stigmata reduced; sternal plates fused into a single plate. Legs short, stout, with distinct pulvilli on the 1st tarsal segment of all legs. Abdomen subovate, with 5 pairs of abdominal stigmata; male genitalia of simple type."

Species

H. nativus Méndez, 1967; ♂ 1.27 mm, ♀ 1.46 mm; from *Hoplomys gymnurus* (Thomas, 1897); Panama.

Family BOOPIIDAE Mjöberg

Boopiidae Mjöberg, 1910, p. 21; Harrison and Johnston, 1916, pp. 337, 340 (two sub-families: Latumcephalinae, Boopinae); Eichler, 1941, p. 385 (two subfamilies: Boopinae, Heterodoxinae).

Boopiidae Ewing, 1929, p. 96.

Ricinidae Werneck, 1948, pp. 5-7.

Type genus *Boopia* Piaget, 1880.

Genera

Boopia Piaget, 1880; *Paraboopia* Werneck & Thompson, 1940; *Phacogalia* Mjöberg, 1919; *Macropophila* Mjöberg, 1919; *Heterodoxus* Le Souéf & Bullen, 1902; *Paraheterodoxus* Harrison & Johnston, 1916; *Latumcephalum* Le Souéf, 1902.

Description

Maxillary palp 2- to 4-jointed. Mesothorax free, usually smaller than pro- or metathorax, well sclerotized, its notum with a pair of spines on elevated warts bordered anteriorly by a sclerotized arc. Mesosternum well sclerotized with spines or setae, situated beneath mesonotum; 2nd coxae always between pro- and metathorax. Pleurae II-IV with or without trichobothrial setae. Abdomen with 6 pairs of spiracles on segments III-VIII.

Discussion

Harrison and Johnston (1916) have found as the chief character of the family "the presence of a large accessory sac of unknown function in connection with the male genitalia". Their figure 1 makes it clear that the "accessory sac" represents the spermatophore squeezed with its stalk in the vesica, just as shown in my Figure 109. I do not know whether the Boopiidae is the only family of Mallophaga producing spermatophores to inseminate females, but Blagoveshchensky (1956) who has closely investigated the genital organs of 29 genera (64 species) of Amblycera, not including the Boopiidae, and 50 genera (141 species) of Ischnocera, did not find spermatophores, but only spermatodotes in females of some Ischnocera. I have not found spermatophores or debris of them in Trimenoponidae, but I have so far seen only 12 males of this family. Trimenoponidae do not possess a vesica armed with chitinous plates like the Boopiidae, and I must conclude that they do not produce spermatophores. As I have explained in the Introduction, spermatophores and in- and evaginable vesica with clasping chitinous plates belong together functionally. I cannot explain the chitinous structures in the genital organ of males of *Trimenopon hispidum*, having examined only

one male of this species, but it is certain that its posterior large parts are homologous with the mesosome arch and clasps of the Boopiidae (Fig. 85).

Unlike the Trimenoponidae, the Boopiidae, except *Latumcephalum*, have long tarsi. In *Heterodoxus* the tibio-tarsal ratio varies from 0.66 to 0.90 in males and from 0.70 to 1.00 in females. The shortest legs are found in *Heterodoxus ampullatus*, 0.66 in males and 0.70 in females, and the longest in *H. pygidialis* with 0.91 in males and 1.00 in females. In *Boopia* the tibio-tarsal ratio varies from 0.52 to 0.90 in males and from 0.62 to 0.90 in females. The shortest tarsi are found in *B. biseriata* (0.68 ♂ and 0.67 ♀) and *grandis* (0.70 ♂ and 0.62 ♀). *Paraboopia* has relatively long tarsi with ratio 0.75 in males and 0.63 in females. The shortest tarsi are found in both the species of *Phacogalia*; *brevispinosa* has 0.52 in males and 0.63 in females, and *spinosa* 0.65 in males and females. The length of the tarsi and their more or less strongly arched form in Boopiidae are very interesting evolutionally, but possess no diagnostic value. As I have already said in the Introduction, the Boopiidae are inclined to anchor their hind tarsi in the saddle between the coxae and femora of the hind legs, a condition which has been highly developed in the Gyropidae.

The differentiation of gonapophyses in Boopiidae has been mentioned in the Introduction and need only be emphasized here. The male copulatory organs of *Boopia*, *Phacogalia*, *Paraboopia*, and *Latumcephalum* are shown in Figure 90.

Hosts

Marsupials of Australia and New Guinea. One species, *Heterodoxus spiniger*, is found on Canidae throughout much of the world.

Genus BOOPIA Piaget

Boopia Piaget, 1880, pp. 599-600; Harrison and Johnston 1916, pp. 345-7; Werneck, 1948, p. 7.

Keleriella Eichler, 1940, p. 161.

Type species *Boopia tarsata* Piaget, 1880.

Species

B. bettongia Le Souéf, *biseriata*, sp. nov., *doriana*, sp. nov., *dubia* Werneck & Thompson, *grandis* Piaget, *minuta* Le Souéf, *mjöbergi* Werneck & Thompson, *notafusca* Le Souéf, *tarsata* Piaget, *uncinata* Harrison & Johnston.

Description

Boopiidae with body length of 1.30-3.14 mm.

Head with rounded quadrangular temporal lobes, their postocular angle varying from 110° to 150°. Antennae clavate, 5-jointed, the 4th and 5th joints forming a club. Maxillary palpi 4-jointed, situated near the outer margin of the head and with 3 joints projecting beyond it, the last joint provided with 2 sensory rods of unequal length on its hind dorsal side. Ventral side of head without horn-shaped projections or heavy spines.

Prothorax with sides bluntly angulated in or slightly anterior to the middle of its length. Chaetotaxy of pronotum rather uniform, consisting of 3 marginal setae, 1 near the anterior angle, and 2 long on the posterior margin and 1 or (in 5 species) 2 discal setae both sides of the pronotum. Before the anterior marginal seta 1, and

behind it 2 more or less strong spines, the 3rd always the strongest, but in some species all 3 setaceous. One minute or short setula behind the marginal spine, wanting in some species. Prosternum with an elevated sternite of oval, rectangular, or triangular outline, with specifically varying chaetotaxy but apparently without diagnostic reliability due to some individual variability (Figs. 91 and 104).

Mesonotum with 2 large colourless warts bordered anteriorly by a chitinous arc and bearing 1 more or less strong spine. Chaetotaxy of mesosternum practically the same in all species (Figs. 91 and 104).

Metanotum separated from mesonotum by a narrow membranous suture, with very uniform chaetotaxy consisting of 1-2 setae on the posterior margin, and in some species with 1-2 spines on the posterior end of the metapleura, 1 discal transversal row of 2 setae both sides of the midline, the external being the longest, and 2 short setae anterior to the external discal one, standing one after the other. Metasternum in all species with same shape and chaetotaxy, 2 pairs of setae before and 1 pair behind it (Figs. 91 and 104).

Legs strong and long, tarsi nearly as long as the tibia, the tibio-tarsal ratio of the hind legs varying from 0.52 to 0.90, tibia somewhat shorter than the femur. Second tarsal joint 4-5 times the length of the basal, with smooth or transversely denticulated planta. Claws long and sharp with colourless pulvinus not projecting anteriorly into a point (Figs. 94 and 101).

First segment of abdomen rudimentary, without pleurae, with strongly chitinized tergite and strongly chitinized sternites divided in the middle. Segments II-IX normal and complete, X and XI concealed in the female between the gonapophyses, in male not visible externally. Six abdominal spiracles on pleurites III-VIII, 3 pairs of trichobothrial hairs on pleurites II-IV (Fig. 81). Tergites and sternites II-VI in female or II-VII in male narrow, generally well chitinized, brown, VII and VIII varying specifically.

Male genital organ with vesica of different lengths, more or less densely and strongly denticulated and provided with 2 median plates and 1 pair of lateral sclerites, sometimes with a pair of small additional plates before the lateral sclerites, without long paired spines or accumulation of denticles before the median plates.

Vulva of the female with 1 row of marginal setae, the number and distribution of which are of diagnostic value. Postgenital sternum with marginal row of setae which may be characteristic for each species. Gonapophyses rounded with subapical seta or triangular, sharply or bluntly pointed with 1 more or less strong apical spur and with a row of strong setae near the base, situated in some species partly on a projecting dilatation of its outer margin. Genital papilla generally slender conical, in some species of particular shape.

Hosts

The species of this genus are found on representatives of all families of Australasian marsupials from which Boopiidae have been collected.

KEY TO THE SPECIES OF BOOPIA

1. Abdominal sterna III-V (at least) with 1 row of long setae 2
- Abdominal sterna III-V (at least) with shorter setae anterior to the row of long setae (Fig. 81) 5

- 2(1). Prosternum with anterior macrochaeta only; gonapophysis with submarginal seta on outer margin (Fig. 95) 3
- Prosternum with at least 1 pair of posterior macrochaetae; gonapophysis with apical seta (Fig. 99) 4
- 3(2). Second joint of hind tarsus with long plantar process, sclerotized on posterior wall (Fig. 94); prosternite with 2 pairs of macrochaetae *dubia*
- Second joint of hind tarsus with small membranous plantar process without sclerotization (Fig. 101); prosternite with 1 pair of macrochaetae *tarsata*
- 4(2). Postocular notch present; ocular seta not strongly spiniform *mjobergi*
- Postocular notch absent; ocular seta strongly spiniform *bettongia*
- 5(1). Abdominal terga III-VI (at least) with 1 row of 2:4:2 long setae 6
- Abdominal terga III-VI with chaetotaxy otherwise 7
- 6(5). Postocular seta anterior to postocular notch; 2nd frontal setae not strongly spiniform (Fig. 103) *uncinata*
- Postocular seta posterior to notch; 2nd frontal setae strongly spiniform *grandis*
- 7(5). Ocular seta strongly spiniform (Fig. 103) 8
- Ocular seta not strongly spiniform (Fig. 93) 9
- 8(7). 2nd frontal setae strongly spiniform; prosternal plate with spiniform setae posteriorly *biseriata*
- 2nd frontal setae not strongly spiniform; prosternal plate with macrochaeta only *doriana*
- 9(7). Abdominal terga with 2 rows of setae, separated from each other by narrow sclerites *notafusca*
- Abdominal terga with 1 irregular row of setae *minuta*

BOOPIA BETTONGIA Le Souéf

(Figs. 90E, 92)

Boopia bettongia Le Souéf, 1902, p. 50, fig. 2 (♂ from *Bettongia rufescens*, Victoria); Werneck and Thompson, 1940, pp. 432-3 (1♀ "paratype", BMNH); Werneck, 1948, pp. 14-15, figs. 2 and 3 (♂, ♀ "type" and "paratype", BMNH).

Boopia phanerozerata Harrison and Johnston, 1916, pp. 348-9, fig. 7 (♂♂, ♀♀, from *Perameles nasuta*, Woolloomooloo, N.S.W.); Thompson, 1939, pp. 604-6 (♂, ♀ types and 1♂, 4♀ paratypes in GBT coll.); Werneck and Thompson, 1940, pp. 429-32, figs. 28-34 (2♂, 5♀ "cotypes", in GBT coll.; ♂ from *P. nasuta*, New South Wales; det. L.H., 2♀, Mackay, Qld., R. E. Turner, BMNH); Werneck, 1948, pp. 13-14; Hopkins, 1949, pp. 440-2 (from *P. nasuta* and *Thylacis torosus*); Hopkins and Clay, 1952, p. 52 (syn. with *B. bettongia*); von Kéler, 1957, figs. 3A, 20B, 34C, 34E.

Types

Lectotype of *B. bettongia* here designated: ♂, in BMNH (Slide No. B.M. 743, 1508/4), from *Bettongia rufescens*, Victoria, 1902-173, with pencil note by Harrison "Type, L.H., differs from any of mine."

Paralectotype: ♀, in BMNH (Slide No. 1508/5), data as lectotype.

Lectotype of *B. phanerozerata* here designated: ♂, in BMNH (Slide No. B.M. 725, 1527/8), det. G.B.T. 1939, from *Perameles nasuta*, Sydney, June 1911, L. Harrison.

Paralectotype: 5♀, in BMNH: 1♀ (Slide No. 1505/32) 4♀ (Slide Nos. 726-729), data as lectotype.

Material examined

Aepyprymnus rufescens.*-syn. *Bettongia rufescens*: 1♂, 1♀ syntypes now lectotype and paralectotype, Victoria, BMNH (1508/4 and 5) [identified as *B. bettongia*].

**Aepyprymnus rufescens* was once found in northern Victoria but appears to have disappeared from that State over a century ago. It is virtually certain that Le Souéf's host animal was a zoo captive. J.H.C.

Perameles nasuta.—1♂ lectotype, 1♀ paralectotype, BMNH (1527/8, 1505/32); det. L.H., 1♀, Mackay, Qld., Aug. 1893 (1505/33); 1♀, Mackay, Qld., Aug. 1893, R. E. Turner (1505/34); det. ?, 1♀, Queensland, 1930, F. V. Collins (1496/24); det. ?, 1♀, south Queensland, 1930, F. V. Collins (1496/25). [All identified as *B. phaneroceata*.] 1♂, New South Wales, 1962–67 (1505/35); 9♂, 8♀, 9 nymphs, Hornsby, N.S.W., 9.xii.1957, B. McMillan (1512/1–11).

Isodon macrourus.—det. F.L.W.?, 2♂, 1♀, Innisfail, Qld., 27.iv.1959, H.B. 47 (1505/86–87) [identified as *B. phaneroceata*]; 1♀, Mundoo, Innisfail, Qld., 3.vii.1958, NF IOH (1496/26); 5♂, 3♀, Innisfail, Qld., 27.iv.1959, H.B. 47 (1496/27–31); 5♂, 6♀, Tootloom, N.S.W., J. H. Calaby, 5.xii.1961 (1496/32–37).

Isodon obesulus.—syn. *I. obesula*: det. ?, 2♂, 1 nymph, Tamborine,* Qld., R. Riek, 27.x.1953, BMNH 1953–331 (1505/88); det. F.L.W., 1♂, 1♀, Stoneville, W.A., 441 (1505/89). [All identified as *B. phaneroceata*.]

Description

Ocular seta strongly spiniform; postocular notch wanting; postocular seta just posterior to posterior omma, not on papilla. Prosternite not rectangular, with 1–2 anterolateral macrochaetae and with 1 pair of posterior discal setae. Sternites III–VII with 8 setae in the row, tergites with 2 : 4 : 2 setae; tergite VIII sclerotized only in the posterior corners.

Male.—Second femur with a pair of strong spines near end of trochanter. Median anterior plate of vesica with a short (60 μm) anterior handle varying from slender triangular to rodlike with triangular base (Fig. 90E); lateral sclerites broadly band-shaped with a broader anterior lobe which may in some positions roll itself up suggesting a pocket-shaped structure; anterior to the lateral sclerites there is a pair of small triangular sclerites each with a sharp tooth.

Measurements (in mm) lectotype with range of 21♂ (9♂ from *P. nasuta*, 12♂ from *I. macrourus*): HL 0.29 (0.26–0.31); HB 0.42 (0.40–0.45); HI 1.45 (1.38–1.48); Poc 130° (115°–143°); PB 0.36 (0.34–0.39); MsB 0.36 (0.29–0.36); MtB 0.41 (0.35–0.46); AB 0.80 (0.70–0.87); TL 1.71 (1.57–1.87).

Female.—Genital sternite similar to that of *mjobergi*, but with broadened anterior corners and with the posterior arms reaching to the external sclerotizations of the gonapophyses (as in *mjobergi*). Genital papilla slender conical, 30 by 45 μm, bluntly pointed, colourless. Vulva with 2–4 : 1–4 strong setae, the end or 1st external the longest. Postgenital sternum colourless except for the median crescent-shaped sternite and with 4 weak lateral and 2 : 2 : 2 short (30 μm) median setae. Gonapophyses triangular, well sclerotized with external wall coloured brown, internal wall membranous, sharp. Apically with a spur as long as the inner margin and with 4 strong setae along the external margin; the inner margin is provided with a scanty row of hairless sensory ampullae, not reaching to the supraanal margin, which is furnished with a row of short (15 μm) hairs.

Measurements (in mm) paralectotype with range of 24♀ (11♀ from *P. nasuta*, 12♀ from *I. macrourus*, 1♀ from *I. obesulus*): HL 0.30 (0.28–0.33); HB 0.42 (0.41–0.47); HI 1.38 (1.38–1.58); Poc 134° (112°–132°); PrB 0.37 (0.35–0.41); MsB 0.35 (0.28–0.39); MtB 0.41 (0.38–0.46); AB 0.87 (0.77–1.00); TL 1.74 (1.48–2.00).

Discussion

I could not find any diagnostic difference between the type male and the paratype female of *Boopia bettongia* on the one hand and the type male and paratype

* Because of locality this host must be a misidentified *I. macrourus*. J.H.C.

female of *B. phaneroceata*, and males and females collected subsequently off *Perameles nasuta*, *Isodon macrourus*, and *I. obesulus*, on the other. The differences in the outline of the male antenna (see Werneck 1948, p. 15 and fig. 2) have no diagnostic value, being caused by the different position of the insect in the mounts and other technical effects. The median posterior plate of the vesica in the type male of *B. bettongia* (see Werneck 1948, p. 15 and fig. 3) agrees exactly with that of all other males before me, but it has in *Boopia* no diagnostic value, showing in all species approximately the same outline. The median piece of the transverse bar of this plate is not lacking in the type male as stated by Werneck; it is always present, but sometimes pale-coloured.

Boopia bettongia is the only species of the genus having no postocular notches and no postocular tubercle. The outlines of the thoracic sternites of the type male and the paratype female of *B. bettongia* are somewhat indistinct but are still recognizable enough to allow their identification with those of all other specimens. Some of the variations of these sternites and of their chaetotaxy are shown in Figure 91.

The measurements of *B. bettongia* from *P. nasuta* were consistently less than those from *I. macrourus*.

The figures of the whole male of *B. bettongia* and the original description of this species do not admit the identification of the species. According to Le Souëf the ocular spine is the only spine on the dorsal surface of the head, but the eighth postnodal seta is, in the "type" and "paratype" of *B. bettongia* as well as in the "paratypes" of *B. phaneroceata* and all other specimens of the series, a short and thick sharply pointed seta, which may appear as spine-like. In all other species of *Boopia* the eighth postnodal is a normal slender seta. Le Souëf gives the total length of *B. bettongia* (no designation of sex) as 1.60 mm. The male "type" before me is 1.71 mm and the female paratype 1.74 mm long. Werneck and Thompson (1940) did not give measurements of the paratype female they examined.

The description and figure of *B. phaneroceata* Harrison & Johnston are much better. The figure of the whole male is recognizable as this species by the postnodal and ocular spines, which are characteristic of this species. Both the spines are also mentioned in the original description. The difference between the outlines of the prothorax of *B. phaneroceata* and *B. notafusca* is exaggerated. The planta of the second tarsal joint is correctly described as "without the minutely spinous ridges", but this is also the case in *B. minuta*, *tarsata*, *uncinata*, and *dubia*, while all other species have more or less distinctly serrate plantae. The pair of spines on the median femora in males of *B. phaneroceata* are also present in *B. notafusca*, *B. uncinata*, *Paraboopia flava*, and both species of *Phacogalia*. The male genital organ is not "of the same general form as in *Boopia notafusca*"; it differs as described. The very characteristic feature mentioned in the original description of *B. phaneroceata* is "that the eye is not bounded posteriorly by a cleft". As I have mentioned above, *B. bettongia* is the only species of this genus having no postocular cleft. The measurements given by Harrison and Johnston lie nearly exactly within the ranges given. The total length of the male is given as 1.529 mm and that of the female as 1.66 mm, but the breadth of the female mesothorax, given as 0.07 mm, may be a misprint.

Werneck and Thompson (1940) have supplied a detailed description of *B. phaneroceata*, containing some errors and contradictions. The postocular temporal margin is correctly described "sans aucun sillon derrière les yeux" but this character

is not "comme chez *grandis* et *notafusca*"; both possess a small but distinct and constant postocular notch as figured by these authors in figures 14 and 22. The chaetotaxy of the head does not "rappelle celle de la dernière" (*notafusca*), because *notafusca* has no spines on the dorsal surface of the head at all, while *phanerocerata* possesses "deux paires de forts piquants" "au niveau des lobes preoculaires" (eighth and ninth postnodal) "les soies oculaires de vrais épines". The ninth postnodal seta is in all specimens before me a normal short seta. The marginal setae of the prothorax "se rapprochant de ceux de *tarsata* par leur nombre et leur distribution" is incorrect; actually these setae are quite different in both species, although individually variable within limits and sometimes slightly different on each side in one and the same specimen. The figures of the prothorax of *B. phanerocerata* and *B. tarsata* (Werneck and Thompson figs. 30 and 4) illustrate the chaetotaxy of the prothorax correctly, contradicting the text. The male "armature genitale (fig. 33) du typ commun à toute les espèces de la même famille" lacks any diagnostic value. The figure of the male copulatory organ is, in general, correct and shows the specific characters distinctly enough for the identification of the species. The total length of the male is given as 1.74 mm and that of the female as 1.78 mm, both lying within the variation limits of the series before me.

Characters common to both sexes and showing specific differences are numerous in all species of *Boopia*. Only the most striking of them may be given here.

B. bettongia is the smallest species of the genus, probably not greater than *minuta*. It is in both sexes distinguished by the chaetotaxy of the head and the prosternite (Fig. 91), the ocular seta being a strong spine, the eighth postnodal seta strong and short, the second frontal a strong and long seta. The sides of the pronotum have three spines, the third the strongest, behind it a fine and short seta elsewhere present only in *biseriata*, *grandis*, and *uncinata*. Similar chaetotaxy of head and prothorax is found only in *biseriata* and *grandis*, but the end frontal is short in both these species, not reaching the transverse pronotal bar, while in *bettongia* it reaches to the level of the third lateral spine. *B. grandis* and *biseriata* possess two pairs of pronotal discal setae, *bettongia* but one, the anterior. The prosternal chaetotaxy of *B. bettongia* can be only confused with that of *B. uncinata* (Figs. 91 and 104). No other species of *Boopia* possesses so many discal setae on the prosternite. The median abdominal segments have 2 : 4 : 2 tergal and eight sternal setae in one row each. Similar distribution of setae is present only in *B. mjobergi* and *tarsata*.

Hosts

Aepyprymnus rufescens (Gray 1837) has not been confirmed as a host but *Perameles nasuta* Geoffroy has by three collections: 1496/24-5, 1505/35, and 1512/1-11. *Isoodon macrourus torosus* (Ramsay 1877), recorded by Hopkins (1949), is confirmed as a host as all *I. macrourus* from which new material was collected belong to this subspecies because of their locality. *Isoodon obesulus* (Shaw 1797) is recorded as a new host by 1505/89.

BOOPIA BISERIATA, sp. nov.

(Figs. 1-4, 81, 90C, 105)

Types

Holotype: ♂, in ANIC (Slide No. 1505/67), from *Macropus antilopinus*, Nourlangie Camp, S. Alligator R., N.T., 19.viii.1962, J. H. Calaby.

Paratypes: 4♂, 4♀, in ANIC, BMNH (Slide Nos. 1505/67-71), data as holotype.

Material examined

Macropus antilopinus.—holotype and 4♂, 4♀, paratypes.

M. robustus.—subspecies *M. robustus cervinus*: 5♂, 4♀, Woodstock Field Station, W.A., E. H. M. Ealey, 1958-207 (1496/66, 67; 1497/12, 13; 1505/85).

Description

Temples rounded with short, stout spine on anterolateral corners. Ocular seta strongly spiniform. Second frontal seta thick spiniform, not reaching pronotal transverse bar. Sides of pronotum with 2 spines; prosternite with 2 long setae near each anterior corner, median pair as long as the lateral, reaching to the inner margin of the anterior coxae; and a pair of medium strong and long sharp spines in the posterior half. Metapleurum with 2 spines on its posterior end, the external shorter than the internal. Abdominal sternites with 2 rows of setae. Tergites with 2 rows, the anterior with 6 short and posterior with 2 : 6 : 2 longer and shorter setae.

Male.—Anterior median plate of vesica with weakly chitinized, long (90 μm) and narrow handle, with a posterior spur; lateral sclerites long, with roundly broadened and nearly touching median margins (Fig. 90C).

Measurements (in mm) 10♂ including holotype and 4 paratypes, mean and range: HL 0.40 (0.37-0.41); HB 0.52 (0.50-0.54); HI 1.31 (1.24-1.36); PrB 0.48 (0.46-0.49); MsB 0.44 (0.39-0.46); MtB 0.53 (0.46-0.61); AB 0.97 (0.94-1.04); TL 2.34 (2.26-2.52).

Female.—Tergite VIII large, strongly chitinized, with colourless areas around the 8 setae which are arranged in 2 rows.

Genital sternite 2-winged, its triangular wings connected by a short bridge not forming a more strongly chitinized lunula; its posterior arms confluent with the lateral sclerites of the postgenital sternum. Genital papilla conical, very fine, colourless, only in few specimens recognizable, 20 by 30 μm. Vulva with a continuous row of 11-15 strong setae, generally the 2nd, rarely the 3rd, on both sides the longest. Postgenital sternum with a row of strong lateral setae situated on warts and with a row of 4 strong but short setae situated on small warts each side of the midline; its sternite narrowly arched in the middle, broadening toward the sides and to the lateral marginal setae, and confluent with the posterior arms of the genital sternite. The posterior margin of the postgenital sternite sends narrow bridges to the alveoli of the lateral and median setae. Gonapophyses large, strong, bluntly pointed, with apical alveolar seta instead of spur and with a row of short sensilli along their inner margin; about 7 strong gonapophysal setae are situated partly on strong lateral dilatations of the outer margin.

Measurements (in mm) 8♀ including 4 paratypes, mean and range: HL 0.40 (0.35-0.42); HB 0.55 (0.52-0.57); HI 1.37 (1.29-1.62); PrB 0.50 (0.48-0.54); MsB 0.45 (0.41-0.48); MtB 0.55 (0.54-0.57); AB 1.09 (1.04-1.13); TL 2.63 (2.54-2.71).

Discussion

Boopia biseriata is very similar to *B. grandis* but the ocular and second frontal spines are shorter and stronger, the latter never reaching to the transverse pronotal bar. The metapleurum has two spines on its posterior end, the external shorter than the internal; in *B. grandis* the former is replaced by one fine and short seta. The abdominal tergites have two rows of setae, the anterior with six short and the posterior with 2 : 6 : 2 longer and stronger ones; the external seta in the median group is not minute as in *grandis* but strong, half or more the length of the other.

Hosts

The nominal host is *Macropus antilopinus* (Gould, 1842), and *M. robustus* Gould, 1841 (subspecies *M. robustus cervinus* Thomas, 1900) is a second host.

BOOPIA DORIANA, sp. nov.

Types

Holotype: ♂, in Bernice P. Bishop Museum, Honolulu (Bishop 9340, 1526/0/4), from *Dendrolagus dorianus*, Bulldog Rd., Morobe District, New Guinea, 11.viii.1963, H. Clissold, BBM-NG 28901.

Paratypes: 8♂, 6♀, in Bernice P. Bishop Museum (Slide Nos. 1526/0/4, 7, 9-12); 1♂, 1♀, in BMNH (Slide Nos. 1526/0/2); 2♂, 2♀, in KCE coll. (Slide Nos. 1526/0/1, 5); data of all as holotype.

Material examined

Dendrolagus dorianus.—holotype, 11♂, 9♀, paratypes; 5 nymphs, same data as holotype.

Description

Close to *B. notafusca*. Sides of temporal lobes nearly parallel, without short spine on anterolateral corners, their anterior edges more rounded, the posterior projecting beyond the occipital margin and provided with a nearly membranous, triangular, bluntly pointed lobe, bearing dorsally a short seta. Postocular notch in the form of a narrow slit. Eyes with a strong spine. Ocular setae spiniform. Postocular seta long, reaching slightly beyond the temporal lateral margin.

Second frontal setae normal, reaching beyond pronotal transverse bar to the posterior distal setae of the pronotum.

Pronotum with 1 lateral spine and 3-4 setae before it, with 2 discal setae, the anterior strong, spinous. Prosternite with 2 lateral setae near the anterior corners, with 2 anterior and 2 posterior discal setae; spines absent.

Abdominal segments II-VI in female or II-VII in male with 2 rows of sternal and tergal setae, those of the posterior row long and strong; those of the anterior short and, especially on the sternites, may be scattered to form 2 irregular rows. The external seta in the tergal median posterior row minute.

Male.—Second femora with 2 strong or 1 strong and 1 weak spine near the end of the trochanter. Anterior median plate of vesica with long (200 μm) narrow handle and with a spur on its posterior margin. Lateral sclerites bent anteriorly toward the midline, their ends denticulated on the margin.

Measurements (in mm) 12♂, holotype and paratypes, mean and range: HL 0.39 (0.38-0.41); HB 0.53 (0.52-0.55); HI 1.38 (1.35-1.42); PrB 0.41 (0.39-0.42); MsB 0.38 (0.35-0.41); MtB 0.49 (0.46-0.51); AB 1.00 (0.93-1.06); TL 2.23 (2.15-2.33).

Female.—Abdominal tergite VIII frame-shaped, narrowly bordered on the anterior and lateral sides with brown margin, the lateral frames broadened posteriorly. Genital sternite frame-shaped, with slightly arched lunula, its posterior arms touching but not fused with the lateral sclerites of postgenital sternum. Genital papilla colourless, sharply outlined, slender conical, 65 μm long. Vulva with 3-4 : 5-10 : 3-4 setae, 2nd external the longest and anterior to the row, the median group short, sometimes divided into 2 or 3 groups. Postgenital sternum with strong lateral and 4-7 (generally

6) short median setae. Postgenital sternite strongly arched in the middle, indistinct on the sides, recognizably dilated and reaching to the lateral setae and to the side margins. Gonapophyses triangular, bluntly pointed, with a strong but short apical spur, median margin with a row of short setae and circular hairless sensilli, both ascending along the supraanal margin. About 7 strong gonapophysal setae, 1 or 2 of them situated on a slightly projecting lateral dilatation of the outer basal margin.

Measurements (in mm) 9♀ paratypes, mean and range: HL 0.39 (0.38-0.41); HB 0.54 (0.54-0.55); HI 1.40 (1.35-1.46); PrB 0.42 (0.41-0.44); MsB 0.40 (0.38-0.42); MtB 0.52 (0.49-0.54); AB 1.11 (1.06-1.16); TL 2.40 (2.32-2.54).

Host

The nominal host is *Dendrolagus dorianus* Ramsay, 1883.

BOOPIA DUBIA Werneck & Thompson

(Figs. 90B, 93-95)

Boopia dubia Werneck and Thompson, 1940, pp.419-20, figs. 9-12 (12♂, 6♀, from *Lasiorhinus latifrons*, Blanchtown, S.A., in GBT coll.); Werneck, 1948, pp. 9-10.

Types

Lectotype here designated: ♂, in BMNH (Slide No. 718) from *L. latifrons*, Blanchtown, S.A.

Paralectotypes: 10♂, 5♀, in BMNH, ANIC (including Slide Nos. 1505/41-46), data as lectotype.

Material examined

Lasiorhinus latifrons.—Lectotype and 3♂, 2♀ paralectotypes; det. ?, 1♂, 1♀, Portee Station near Blanchtown, S.A., 23.viii.1958, J. H. Calaby, BMNH 1959-667 (1496/23).

Vombatus hirsutus.—syn. *Phascolomis* (V.) *hirsutus*: det. F.L.W., 1♂, 1♀, Swan Beach,* S.A., 18.iv.1953, BMNH 1954-723 (1496/38, 39).

Description

Prosternite rounded rectangular, longer than broad, with 2 pairs of macrochaetae. Abdominal sternites II-VI with 1 row of long setae, 3 : 4 : 3. Tergites II-V with 1 row of long setae, 4 : 4 : 4. Second joint of hind tarsus in both sexes with a strong and long plantar process, sclerotized on its posterior wall (Fig. 94).

Male.—Anterior median plate of vesica with a narrow, rod-like, long (90 μm), moderately sclerotized handle, with a short spur on its posterior margin. Lateral sclerites of vesica anteriorly bifurcated with 1 short external and 1 long internal arm, with a large triangular tooth behind the median plates (Fig. 90B).

Measurements (in mm) lectotype and 3 paralectotypes, mean and range: HL 0.47 (0.46-0.49); HB 0.58 (0.56-0.60); HI 1.23 (1.21-1.25); PrB 0.49 (0.47-0.51); MsB 0.44; MtB 0.50 (0.49-0.51); AB 1.06 (1.01-1.16); TL 2.8 (2.7-2.9).

* *V. hirsutus* has a limited range in South Australia and no "Swan Beach" can be found within it. It seems likely that the recorded locality name is an error for Swan Reach, a place on the Murray River within the range of *L. latifrons* but outside that of *V. hirsutus*, and that the host was a misidentified *L. latifrons*. J.H.C.

Female.—Eighth tergite large, with colourless areas around the setal alveolae, with weakly sclerotized anterior half, and deeply emarginated posteriorly. Supraanal margin with a round projecting papilla in the middle and with 2:4:2 short setae. Genital sternite butterfly-shaped with flatly arched lunula. Genital papilla slender, conical, sharply pointed, 20 by 36 μm . Vulva with 4-5:2-4:4-5 strong setae, the median group equally thick but shorter than the outer groups. Gonapophysis nearly colourless, broadly rounded, with 1 subapical seta on outer margin (Fig. 95). Post-genital sternum with 5 strong lateral setae, large median gap with 2 minute hairs each side near the median lateral seta, which is some distance away from the remaining laterals (Fig. 95).

Measurements (in mm) 3♀ including 2 paralectotypes, mean and range: HL 0.47 (0.45–0.49); HB 0.56 (0.55–0.59); HI 1.20 (1.15–1.26); PrB 0.48 (0.46–0.49); MsB 0.42 (0.42–0.44); MtB 0.49 (0.48–0.52); AB 1.16 (1.09–1.25); TL 2.70 (2.58–2.78).

Discussion

The two long temporal setae are not longer than in *tarsata*, as stated by Werneck and Thompson, but are of the same length, reaching in both sexes to the middle of the mesothorax (Fig. 93). Their absolute length varies in both species from 0.43 to 0.48 mm. The narrow abdominal tergites are not wanting; in two specimens they are light brown, in others colourless but sharply outlined.

The males and females from the doubtful host, *V. hirsutus*,* do not differ in any way from those off *L. latifrons*. Their measurable characters are within the limits of the other specimens, except for the breadth of the male prothorax (0.46 mm).

A very striking character, absent in all other species of *Boopia*, is the long, strongly chitinized process on the second joint of the posterior tarsi of both sexes (Fig. 94). In *B. tarsata* this process is represented by a small membranous tubercle (Fig. 101).

Hosts

The nominal host, *Lasiiorhinus latifrons* (Owen, 1845), the hairy-nosed wombat, is confirmed. The new host, *Vombatus hirsutus* (Perry, 1810), is in doubt.*

BOOPIA GRANDIS Piaget

(Figs. 90D, 96–99)

Boopia grandis Piaget, 1885, pp. 154–5, pl. 16, fig. 8 (♂, ♀, from *Macropus rufus*, Zoo, Rotterdam); Thompson, 1937, p. 23 (types 1♂, 7♀, 1 nymph); Werneck and Thompson, 1940, pp. 420–4, figs. 13–20 (1♀, 1 nymph "cotypes"; 1♂, 1♀, from *Megaleia rufa*, Zoo, Sydney; 2♀, from *M. rufa*; ♂♂, ♀♀, nymphs, from *Macropus* sp., Broken Hill, N.S.W., R. N. McCulloch; 2♀, from *M. major*, Coonamble, N.S.W.; 2♀ "cotypes", of *B. peregrina*); Werneck, 1948, pp. 10–11.

Boopia peregrina Mjöberg, 1910, pp. 21–6 and 240, 241, figs. 10–18, pl. 4 (♂, ♀, from *Lutra pruneri*, India, MZH); Thompson, 1939, p. 605 (2 paratypes, in GBT coll.); Werneck and Thompson, 1940, p. 421 (syn. *B. grandis*); Werneck, 1948, p. 10.

Types

Lectotype here designated.—♀, in Piaget Coll., BMNH (Slide No. 1482), from *Macropus rufus*, Zoo, Rotterdam.

* See footnote, p. 25.

Paralectotypes.—4♀, in Piaget Coll., BMNH (Slide Nos. 1483, 1484), data as for lectotype.

Material examined

Megaleia rufa.—det. ?, 1♂, Zoo, Sydney, 1962–667 (1505/90). Syn. *Macropus rufus*: det. ?, 2♂, 1 nymph, Woodstock, W.A., E. H. M. Ealey, 1958–207 (1496/68, 69); det. ?, 3♀, Wilcannia, N.S.W., 15.viii.1961, R. Mykytowycz, 1962–186 (1491/71). [All identified as *B. grandis*.]
Macropus giganteus.—syn. *M. major*: det. ?, 2♀, Coonamble, N.S.W., 1962–677 (1505/75, 76) [identified as *B. grandis*]. 9♂, 8♀, Victoria, 12.ii.1962, R. M. Warneke (1512/34–41). Syn. *M. canguru*: 1♂, 3♀, Yan Yean, Vic., 7.viii.1962, R. M. Warneke (1509/5, 6); 4♀, Yan Yean, Vic., 21.ix.1962, R. M. Warneke (1505/77, 78); 6♀, Victoria, 13.viii.1962 (1509/7, 8; 1512/42).
Macropus fuliginosus.—syn. *M. canguru (melanops)*: 5♂, 4♀, 6 nymphs, Raak Crossing, Vic., 19.v.1964, R. M. Warneke (1513/15–20).

Description

Ocular setae strong but not spinous. Postocular seta long and posterior to post-ocular notch, 2nd frontal seta a very strong spine usually reaching to or just beyond the pronotal transverse bar, but may be shorter. Prosternite oval with broadly rounded posterior end, with 1 pair of setae in each anterior corner and with 2 discal spines in the posterior half.

Abdominal sterna and terga with 1 row of discal setae behind the narrow sclerite, the dorsals reaching to the next alveoli, the sternals only to the alveoli of the next anterior discal row of setae, this standing just before the narrow sternite and intercalating half its length with the posterior row. Sterna III–VII each with a scanty anterior row of 1–2 fine setae each side of midline, with 10 in posterior row. Terga with 2 rows of setae, III–VI with 2:4:2 long setae.

Male.—Second femora without spines near end of trochanter. Median anterior plate of vesica with a long (120 μm) rod-like, dark brown chitinous handle which in some positions appears slender, leaf-shaped; the lateral wings are anteriorly confluent with a heart-shaped broad plate extending into the handle. Lateral sclerites channel-shaped (Figs. 90D, 96–98).

Measurements (in mm) 18♂ (mean of 10♂ from *M. giganteus* and 5♂ from *M. fuliginosus*, range includes 3♂ from *M. rufa*): HL 0.40 (0.39–0.42); HB 0.50 (0.48–0.54); HI 1.24 (1.20–1.28); Poc 140° (124°–153°); PrB 0.41 (0.39–0.45); MsB 0.37 (0.33–0.39); MtB 0.47 (0.43–0.56); AB 0.94 (0.87–1.13); TL 2.26 (2.09–2.55).

Female.—Sternite VIII not exactly definable. Tergite VIII large with broad dark brown border (Fig. 99) except in the middle of the posterior margin. Genital sternite 2-winged with strong and straight lunula, smooth, except for extremely fine denticles on the sides. Its posterior arms very narrow, confluent with the sides of the post-genital sternite. Genital papilla slender conical, sharply pointed, membranous, colourless, with a sclerotized basal ring, 27 by 42 μm . Vulva with a continuous or discontinuous row of 10–13 or 5–6:6–7 strong marginal setae, the 2nd, rarely the 1st, external the longest. Postgenital sternum posteriorly deeply emarginate with a complete row of marginal setae, the stronger and longer laterals standing in alveolar papillae; divided into 3 sclerites, the median broadly crescent-shaped and the lateral small, and continuous with the posterior projections of the genital sternite forming narrow bridges to the alveoli of about 7 of the strong lateral marginal setae. Gonapophyses strong, with a strongly sclerotized apical spur, which is generally nearly as

long as the gonapophysis itself. Its inner margin with about 2-3 short alveolar setae (Fig. 99) which follow in equal length and distribution the supraanal margin, this being also provided with extremely fine sharp denticles. The ventral row of strong setae on the base of the gonapophyses is partly located on a dilatation of its external margin, as in *biseriata*, *notafusca*, *minuta*, and *mjobergi*.

Measurements (in mm) 30♀ (mean of 23♀ from *M. giganteus* and 4♀ from *M. fuliginosus*, range includes 3♀ from *M. rufa*): HL 0.42 (0.38-0.45); HB 0.52 (0.49-0.57); HI 1.23 (1.19-1.27); Poc 143° (122°-159°); PrB 0.44 (0.42-0.48); MsB 0.40 (0.36-0.46); MtB 0.49 (0.45-0.57); AB 1.07 (0.94-1.25); TL 2.45 (2.03-2.68).

Discussion

To the revised description by Werneck and Thompson may be added only that the sensory rods on the end joint of the maxillary palpi are present in all Boopiidae and absent in all Trimenoponidae.

B. grandis belongs, with its head index 1.20-1.28 in males and 1.19-1.27 in females, to the species with slender heads like *dubia*, *minuta*, *notafusca*, *tarsata*, and *mjobergi*. A head with one pair of spines, the 2nd frontals, which never reach the pronotal transverse bar, is one of the exclusive characters of *B. grandis*. The ocular seta is strong but not spinous. The pronotum is as in *biseriata* with two pairs of lateral spines, the posterior much stronger, and with two pairs of lateral discal setae. The metathorax is as in *biseriata* and *uncinata*, with one spine on the posterior upper edges of the metapleura associated laterally with a short seta, wanting in *uncinata* and replaced by a shorter, weaker spine in *biseriata*.

The tergal setae are in distribution 2:4:2 as in *bettongia*, *mjobergi*, *tarsata*, *uncinata*, and *Phacogalia spinosa*, as well as in the posterior tergal row of *B. notafusca* and *Paraboopia flava*. The sternal setae have a distribution 2:2 for the anterior and 10 for the posterior row; this occurs in no other species with a similar distribution of setae, e.g. 2:4 and 8 in *notafusca*, 2:9 and 8 in *uncinata*, etc. The second tarsal planta of all legs are serrate with transverse rows of minute (5 μm) spicules as in *biseriata*, *mjobergi*, *minuta*, and *notafusca*.

Hosts

The nominal host, *Megaleia rufa* (Demarest, 1822), has been reconfirmed. *Macropus giganteus* Shaw, 1790, the eastern grey kangaroo, is confirmed as another host, and *M. fuliginosus* (Desmarest, 1817), the western grey kangaroo, is a new host.

BOOPIA MINUTA Le Souéf

(Fig. 90G)

Boopia minuta Le Souéf, 1902, p. 51, fig. 3 (♀, from *Macropus dorsalis**); Werneck and Thompson, 1940, p. 428 (1♀ paratype = *notafusca*?); Werneck, 1948, pp. 12-13, fig. 1 (♂ and same ♀ paratype = *notafusca*?).

Types

Lectotype here designated: ♂, in BMNH (Slide No. 1508/3), from *Macropus dorsalis**, Victoria, 1902.

**M. dorsalis* is not native to Victoria and the type and only known material of *B. minuta* must have come from a zoo specimen. J.H.C.

Paralectotypes: 2♀, in BMNH (Slide No. 1508/2 B.M. 370), data as lectotype.

Material examined

Wallabia dorsalis.—syn. *Macropus dorsalis*: "types" now lectotype and paralectotypes.

Description

Ocular seta fine, reaching to end of the antennal club. Second frontal seta long, reaching nearly to the posterior margin of pronotum. Prosternite rounded triangular with 2 macrochaetae in the anterior angles and with 1 pair of setae in the posterior half.

Abdominal sterna with 2 rows of setae, anterior short, posterior long. Terga with 2-3:6-7:2-3 setae in the posterior and 2-3 shorter, weaker setae in the anterior row nearly intercalating with the posterior ones, so that it may appear as one row only.

Male.—Vesica small, pear-shaped, roughly and coarsely denticulated with broad, sharply pointed scales; anterior median vesical plate with very indistinct, triangular handle, without spur (Fig. 90G).

Measurements (in mm): TL 1.42.

Female.—Abdominal tergite VIII of paratype (1508/2) not recognizable. Genital sternite indistinct in paratype ♀, frame-shaped as in *mjobergi*, *notafusca*, or *bettongia*, with weakly arched lunula, its posterior arms reaching to the lateral margin of the gonapophyses. Genital papilla in the paratype obliquely erect, located just anteriorly to the lunula, seems to be conical, bluntly pointed. Vulva with 8 fine setae, the 2nd external the longest. Postgenital sternite with 4 long and strong lateral and 8 short and weak median setae. Gonapophyses with a short and weak apical spur and with a triple row of densely standing circular sensory ampullae without setae. The strong gonapophysal setae (about 5) are concentrated on a strong lateral projection as in *mjobergi*, *grandis*, *notafusca*, and *biseriata*.

Measurements (in mm): TL 1.30.

Discussion

I find the male type in very good condition, with complete chaetotaxy, without any trace of distortion of the body, with somewhat shrunken posterior femora, and with all details of the genital organ clearly visible. One of the female paratypes is, as stated by Werneck and Thompson, not treated with caustic potash and consequently the abdominal segments are contracted. The shape of the male antennae has, as in other cases (see *B. bettongia*), no diagnostic value due to their variable position in mounts. The second femora possess no spines near the end of the trochanter, they are not at all shrunken, and their ventral side is seen perfectly, as the male lies with the ventral side up.

This species seems to be the smallest of all *Boopia*. It is similar to *B. notafusca* but differs in the following details. The total length of the male is 1.42 mm (*notafusca* 1.80-1.94 mm), and that of the female 1.30 mm (1.41 in Werneck and Thompson), but as stated above the abdomen is contracted and consequently the total length of the female paratype is not comparable with that of *notafusca* (1.64-2.12 mm). There is no difference between the two species in the shape of the head, except that the eyes of *notafusca* are much more prominent and the second temporal seta is much

longer. The prothorax in *notafusca* has more rounded lateral edges and the lateral setae are different. The setae of the anterior tergal rows on the abdominal segments in *minuta* are nearly intercalating with the posterior row while in *notafusca* they are distinctly separated. The external seta of the posterior median and lateral rows is minute in *notafusca* and much longer in *minuta* (10 μm in *notafusca*, 36 and 70 μm in *minuta*). The sternal rows of the setae are distinctly separated in both species. The setae of the sternal and tergal posterior rows of the female are distinctly spindle-shaped in *minuta* and normal in *notafusca*, although inclining in some specimens here and there to a slight spindle-shaped form. To summarize: both species are, apart from the total length, very similar in monomorphic characters. The differences in dimorphic characters are much more marked. The second femora of males of *notafusca* possess a pair of spines which are wanting in *minuta*. The male genital organ is different in both species. In *B. minuta* the posterior median plate of the vesica is present and distinctly visible although the type is rather strongly cleared with caustic potash, while in all four males of *notafusca* it could not be discovered, although the vesical sclerites are perfectly chitinized. This statement must, in any case, be confirmed with further material, because the absence of the posterior vesical plate is hardly credible. The lateral vesical sclerites are similar in both species, but smaller and weaker in *minuta* and longer and stronger in *notafusca* (Figs. 90G and 90H). The genital papilla and genital sternite are apparently the same in both species, the latter being frame-shaped. The vulva in *minuta* has eight long marginal setae equally spaced, the second external the longest; in *notafusca* the distribution is: 2-4 : 1-3 : 2-3 setae, the second external is as generally the longest. The postgenital sternite in *notafusca* has 9-10 very strong lateral setae standing on warts, in *minuta* has five weaker setae both sides. In *B. notafusca* these lateral setae ascend farther toward the midline, leaving but a small median gap occupied by three strong but short setae separated from each other by the diameter of one alveolus. In *B. minuta* this median gap is much longer, containing a continuous row of eight fine setae equally separated by four to five alveolar diameters. The posterior margin of the postgenital sternum is very flat in *minuta*, but in *notafusca* nearly as deeply emarginated as in *biseriata* (Fig. 105).

Host

The nominal host, *Wallabia dorsalis* (Gray, 1837), awaits confirmation.

BOOPIA MJOBERGI Werneck & Thompson

Boopia mjobergi Werneck & Thompson, 1940, pp. 428-9, fig. 27 (3♀, 1 nymph, from *Macropus major*, Victoria, A. S. Le Souëf = *B. notafusca* from *M. giganteus*. det. L.H. and T.H.J.); Werneck, 1948, p. 13.

Types

Lectotype here designated: ♀, in BMNH (Slide No. 712), from *Macropus major*, Victoria, A. S. Le Souëf.

Paralectotypes: 2♀, in BMNH (Slide Nos. 714, 1505/74), data as lectotype.

Material examined

Macropus giganteus.—syn. *M. major*: 1♀ paralectotype, Victoria, A. S. Le Souëf (1505/74).

Description

Male.—Not known.

Female.—Ocular seta short; postocular notch present, postocular seta on papilla. Prosternite not rectangular with at least 1-2 anterolateral macrochaetae and a pair of posterior discal setae or spines. Abdominal sternites III-VI with 10 setae in a single row, the external being small. Tergites with 2 : 4 : 2 setae. Tergite VIII hardly recognizable, apparently similar to that of *tarsata* or *dubia*. Genital sternite rectangularly and narrowly frame-shaped with deeply emarginated anterior margin forming a weak lunula; its posterior arms reaching to the lateral sclerotizations of the gonapophyses.

Genital papilla conical, membranous, 10 by 20 μm . Vulva with 3 : 2 : 3 marginal setae, both median minute (4-6 μm), the innermost in the lateral groups very long (330 and 360 μm), the rest much shorter (80-100 μm). Vulva with 3 : 2 : 3 setae, the 2nd lateral the longest, both the median minute (6 μm). Postgenital sternum with about 6 lateral stronger setae reaching to the end of the gonapophysal spur and with a row of 5 : 5 minute setae (10 μm) each side of the midline.

Measurement (in mm): TL 1.57.

Discussion

The only paratype female before me, being one of the three females of the type series, belongs to the group of four species with one sternal and one tergal row of abdominal setae, including *mjobergi*, *tarsata*, *dubia*, and *bettongia*. The only character dealt with in the original description of *B. mjobergi* is the presence of but one row of setae on the abdominal sterna and terga. The genital sternite is narrowly frame-shaped as in *bettongia*, *minuta*, *notafusca*, and *biseriata*. The chaetotaxy of the postgenital sternum resembles those of *uncinata*, *minuta*, and *bettongia*.

It is impossible to decide, without having seen the original specimens, whether those determined by Harrison and Johnston as *notafusca* off *Macropus giganteus* (*major*) and *M. bicolor* (*ualabatus*) belong pro parte to *mjobergi* or not. I will return to this question in dealing with *B. notafusca*.

Host

The nominal host, *Macropus giganteus* Shaw, 1790, awaits confirmation.

BOOPIA NOTAFUSCA Le Souëf

(Fig. 90H)

Boopia notafusca Le Souëf, 1902, p. 50, fig. 1 (♂ from *Macropus ualabatus*); Harrison and Johnston, 1916, pp. 347-8, figs. 5 and 6 (♂ type, ♂♂, ♀♀, from *M. ualabatus* and *M. giganteus*, Victoria, A. S. Le Souëf); Thompson, 1939, p. 606 (♂, ♀ types, in GBT coll.); Werneck and Thompson, 1940, pp. 424-8, figs. 21-26 ("cotypes" 1♂, 2♀, 3 nymphs; det. L.H., 3♀, from *Osphranter robustus*, Belltrees, N.S.W., L. Harrison; ♂♂, ♀♀, nymphs, from "wallaby", Dargo, Vic., 15.vi.1911, Bruno Deck); Werneck, 1948, pp. 11-12.

Keleriella notafusca, Eichler, 1940, p. 161.

Types

Lectotype here designated: ♂, in BMNH (Slide No. B.M. 715, 1514/5), det. G.B.T., from *Wallabia bicolor*, Victoria, 1902, A. S. Le Souëf.

Paralectotypes: 2♀, in BMNH (1514/6, 7), data as lectotype.

Material examined

Wallabia bicolor.—Lectotype and 1♀ paralectotype (1514/6); 1 nymph, data as lectotype (1514/4). Syn. *Protamnodon bicolor*: 3♂, 3♀, 6 miles E. of Hoskinstown, N.S.W., 24.ii.1960, D. L. McIntosh (1512/23–25).

Macropus robustus.—syn. *Osphranter robustus*: 3♀, Belltrees, N.S.W., L. Harrison (1505/83, 84).

*Antechinus flavipes**: det. F.L.W.?, 1♀, Aug. 1911, A. S. Le Souëf, BMNH 1962–677 (1508/1) [identified as *Heterodoxus brevispinosus*].

Description

Temple rectangular, without short stout spine on anterolateral corner, posterior edge without triangular membranous lobe. Ocular seta not spiniform; posterior edge of temple without triangular membranous lobe. Second frontal seta strong, reaching just beyond pronotal transverse bar. Prosternite as in *biseriata* but the anterior median pair of setae much shorter, reaching only to the alveoli of the prosternal spines, which are weak and rather setaceous; pronotum without marginal spines. Abdominal sterna and terga III–VI with 2 rows of setae, 1 anterior and 1 posterior to the narrow sclerite.

Male.—Anterior median plate of vesica (Fig. 90H) with very indistinct, slender conical handle broadened at base and about 40 μm long, without spur on its posterior margin. Lateral sclerites bipartite, the inner lobe narrower than the outer, their bluntly pointed ends both posteriorly directed.

Measurements (in mm): TL 1.80–1.94.

Female.—Tergite VIII large, rectangular, with colourless round areas around the setae, sometimes united around the posterior row of setae, rarely also around the anterior ones and in this case similar to that of *B. grandis*. Genital sternite frame-shaped with long, dark brown, slightly arched lunula, its posterior arms fused with the lateral sclerotization of the postgenital sternum. Genital papilla distinct, although very fine, slender conical, with broadened base, 15 by 15 μm, very slightly sclerotized, sharply outlined. Vulva with 2–4 : 1–3 : 2–3 marginal setae, the lateral strong, the median much shorter and finer, the 2nd lateral the longest. Postgenital sternum with long row of strong lateral setae reaching to end of the gonapophysal spur and with 3 : 3 short but strong setae both sides of the midline. Postgenital sternite tripartite, the median part broad crescent-shaped, the lateral reduced to small plates with finger-like projections to the warts of the lateral setae. Gonapophyses slender triangular, sharply pointed, with a long apical spur of about half the length of the gonapophyses; median margin with a row of about 8–10 short (8 μm) alveolar sensory setae on the supraanal margin; about 5 gonapophysal setae on strong lateral projections of outer basal margin.

Measurements (in mm): TL 1.64–2.12.

Discussion

The suggestion of Werneck and Thompson that the specimens published by Harrison and Johnston (1916) as *Boopia notafusca* may in part (the specimens off *Macropus giganteus*) have been misdetermined and are probably *B. mjobergi* cannot

* Probably a misidentified *A. stuartii* (see note on *Phacogalia brevispinosa* in Appendix I). J.H.C.

definitely be considered without the original specimens. But both figures of *B. notafusca* published by Harrison and Johnston are explicitly said in the text to have been made from the type male, and the text contains nothing which could refer to *B. mjobergi*. This does not exclude the possibility that specimens off *Macropus giganteus* were considered in the original description. The fact that the drawing of the whole male shows but one row of setae on the abdominal tergites, while *notafusca* has two rows distinctly separated, is due to the loss of most of the abdominal setae from the type male, so that two rows of setae can only be recognized by the very indistinct alveoli. Werneck and Thompson very probably had some other species among their material, as they write "sur quelques spécimens les poils des deux séries sont très rapprochés, formant presque une rangée unique". This cannot occur in *B. notafusca*, because in this species the two tergal rows of setae are separated by the narrow sclerite. Figure 24 in Werneck and Thompson, which shows both tergal rows of setae before the narrow tergite, is incorrect.

Figure 5 of Harrison and Johnston, of the head and thorax of the type male of *B. notafusca*, agrees perfectly with the male type before me on slide 1514/5. The head and the segments of the thorax are extended exactly as in the figure and the metanotum shows the short transverse bar, just behind the pair of discal setae, representing a rudimentary metanotal sclerite, characteristic for *B. notafusca* and present in all males and females before me. There is no doubt that the male on slide 1514/5 is the type of *B. notafusca*.

Host

The nominal host, *Wallabia bicolor* (Desmarest, 1804), is confirmed. *Macropus giganteus* and *M. robustus* have not been confirmed as hosts nor has *Antechinus flavipes*. The latter record was probably due to contamination.

BOOPIA TARSATA Piaget

(Figs. 90A, 100–102)

Boopia tarsata Piaget, 1880, pp. 599–600, pl. 50, fig. 1 (♂, ♀, from *Phascolomys fossor*); Cummings, 1916, pp. 269–71, fig. 9 (22 specimens from *Phascolomis mitchelli*, Zoo, London); Thompson, 1937, p. 23 (1♂, 1♀, eggs, on 2 slides in Piaget Coll. BMNH); Werneck and Thompson, 1940, pp. 415–18, figs. 1–8 (♂♂, ♀♀, from *Vombatus ursinus*, Zoos, Melbourne and Sydney; ♂♂, ♀♀, from *V. hirsutus*, from Tasmania*, in Zoo, London; 1♀, from *Wallabia bicolor*, Victoria, Le Souëf); Werneck, 1948, pp. 8–9; von Kéler 1957, figs. 2 and 34.

Boopia longitarsata Piaget, 1880, pl. 50, explanation to fig. 1.

Types

Lectotype here designated: ♂, in Piaget Collection, BMNH (Slide No. 1485), from *Phascolomys fossor*.

Paralectotype: 1♀, in BMNH (Slide No. 1485), data as lectotype.

Material examined

Vombatus hirsutus.—det. G.B.T., 1♂, Zoo, Melbourne, BMNH 1962–677 (1505/38) [identified as *B. tarsata*]. Syn. *Phascolomis mitchelli*: det. G.B.T., 2♂, 1♀ (compared with types by G.B.T.), 6.iv.1914, Zoo, London, from Tasmania*, (1496/18–20); det. F.L.W., 3♂, 1♀, Fairbank, N.S.W., June 1960 (1505/36, 37). [All identified as *B. tarsata*.] 2♂, 2♀, Fairbank, N.S.W., June 1960 (1496/21, 22).

* If from Tasmania this host must have been *V. ursinus* and not *hirsutus*. J.H.C.

V. ursinus.—det. G.B.T., 1♂, Zoo, Sydney, 1962–677 (1505/39); det. G.B.T., 1♀, Zoo, Melbourne, 1962–677 (1505/40) [identified as *B. tarsata*]. Syn. *Phascolomis ursinus*: 6♂, 7♀, 7 nymphs, Green's Beach, Tas., 10.v.1965, R. H. Green (1512/14–20).

Description

Prosternite rounded rectangular, longer than broad with 1 pair of anterior macrochaetae. Abdominal sternites III–V with 1 row of 10 discal setae; tergites with 1 row of setae, 2 : 4 : 2. Second joint of hind tarsus with small membranous plantar process without sclerotization (Fig. 101).

Male.—Anterior median plate of vesica with a broad, tongue-shaped long (100 μm) handle and with a small spur on its posterior margin. Lateral sclerites forming triangular lobes with rounded posterior ends and converging anterior arms (Fig. 90A).

Measurements (in mm) 15♂ (8♂ from *V. hirsutus*, 7♂ from *V. ursinus*) mean and range: HL 0.48 (0.46–0.51); HB 0.56 (0.54–0.61); HI 1.16 (1.12–1.24); PrB 0.46 (0.44–0.49); MtB 0.55 (0.48–0.59); AB 1.14 (1.02–1.20); TL 2.77 (2.59–3.14).

Female.—Abdominal tergite VIII similar to that of *dubia* but with the colourless areas around the alveoli running into a large colourless excavation of the anterior half of the tergite. Supraanal margin without median papilla and with 3 : 3 longer (40–60 μm) setae.

Genital sternite bipartite composed of two longitudinal club-shaped sclerites reaching with their narrow posterior ends to the lateral margins of the postgenital sternite. Genital papilla slender conical, bluntly pointed, 30 by 40 μm. Vulva with 4–6 : 1–3 : 2–4 strong setae, the 2nd external the longest. Gonapophysis nearly colourless, broadly rounded, with 1 subapical seta on outer margin. Postgenital sternum with about 6 strong lateral setae, large median gap with 3 minute setae each side near the median lateral which is some distance away from the remaining lateral (Fig. 102).

Measurements (in mm) 12♀ (4♀ from *V. hirsutus*, 8♀ from *V. ursinus*) mean and range: HL 0.50 (0.47–0.52); HB 0.57 (0.55–0.62); HI 1.17 (1.13–1.23); PrB 0.49 (0.45–0.52); MtB 0.56 (0.51–0.58); AB 1.24 (1.17–1.38); TL 2.97 (2.67–3.21).

Discussion

B. tarsata is the largest species of the genus, the males being 2.6–3.1 mm and the females 2.9–3.2 mm. It is in general aspect, and especially in the outline of the head, similar to *grandis*, from which it may easily be distinguished by the lighter brown coloured apex of the female and the eighth tergite, which is broadly chitinized on lateral and posterior margins and appears as deeply excavated anteriorly. It may only be added that the second tarsus in *B. tarsata* is not 2.5 times longer than the first as Piaget writes. The lengths of the tarsi 1 : 2 : 3 are 0.550 : 0.630 : 0.745 mm and the ratios are 1 : 1.15 : 1.35.

Hosts

The nominal host, *Vombatus ursinus* (Shaw, 1800), and *V. hirsutus* (Perry, 1810) are confirmed as hosts. The record from *Wallabia bicolor*, which Hopkins (1949) considers may be due to contamination, requires confirmation.

BOOPIA UNCINATA Harrison & Johnston

(Figs. 90F, 103, 104)

Boopia uncinata Harrison & Johnston, 1916, pp. 349–50, fig. 8 (1♀, from *Dasyurus maculatus*, Sydney); Thompson, 1939, p. 604, fig. (♂♂, ♀♀, from *Dasyurinus geoffroyi*, Forest Grove and Serpentine, W.A., 1906); Werneck and Thompson, 1940, pp. 433–6, figs. 35–40 (1♂, 2♀, 1 nymph, from "*Dasyurus quoll*"*, Sydney; 6♂, 5♀, including ♂ allotype, from *Dasyurinus geoffroyi*, Forest Grove, W.A.); Werneck, 1940, pp. 15–16 (additional 3♂, 3♀, from *Dasyurus hallucatus*, Townsville, Qld., F. H. Taylor, Stanford University†; 2♂ from *Perameles macrura*, Townsville, Qld., F. H. Taylor, Stanford University†).

Type†

Lectotype: ♀ in BMNH (Slide No. 722), det. G.B.T., from *Dasyurus quoll** Zimmermann, Sydney, 7.iii.1910.

Material examined

Dasyurus hallucatus.—det. ?, 2♂, 4♀, Woodstock, W.A., 22.viii.1955, E. H. M. Ealey, 1958–207 (1496/15, 1505/27, 28); det. ?, 2♂, 2♀, Woodstock, W.A., 26.x.1955, 1958–207 (1496/16, 1505/29). [All identified as *B. uncinata*.] 6♂, 5♀, Smith Pt., Port Essington, N.T., 10.viii.65, J. H. Calaby (1522/1–6).

Dasyurus geoffroyi.—syn. *Dasyurinus geoffroyi*: det. ?, 2♂, 2♀, Forest Grove, W.A., 1906, 1962–677 (1505/23–26). Syn. *D. geoffroyi fortis*: det. ?, 1♂, Forest Grove, W.A., L. Glauert (1496/17).

*Dasyurus quoll**.—det. ?, 1♂, 1♀, Sydney, 7.vii.1910 (1505/30, 31).

Description

Ocular seta a stout spine; postocular seta short, anterior to postocular notch (Fig. 103). Second frontal seta a long strong bristle reaching to at least middle of pronotum. Prosternite semi-elliptical with narrowly rounded posterior end, with 2 or 3 macrochaetae near the anterior corners, the external one being stronger, with 1 or 2 pairs of short discal setae in the anterior and with 3–4 strong spines in the posterior half.

Abdominal sterna III–VII each with an anterior row of 10–12 setae. Terga III–VII with one row of 2 : 4 : 2 long setae, tergite VIII weakly sclerotized with colourless area around the setae.

* Identity of host doubtful (see Appendix I). J.H.C.

† These specimens are now in UC. M.D.M.

‡ Note on types. According to the original description this was described from 1 female, 1 nymph from *Dasyurus maculatus*, Sydney. Thompson (1939, p. 606) designated as type a female from *Dasyurus quoll*, Sydney, 7.vii.1910. In the British Museum (Natural History) there are two slides, with a female and a nymph, with this data, marked types by G.B.T. However, in addition there are two slides with a male and a female and the same data although Harrison states that he had only the female and nymph. The slide with the female has the word "Lectotype" written across the label.

Unfortunately all the Harrison and Johnston and Le Souëf material mentioned in Thompson (1939) has had the original labels removed and new labels attached; they do not in this case agree with the host data given in the original description.

It is apparent, however, from Thompson (1939, p. 604) that *Dasyurus quoll* is this author's interpretation of *Dasyurus maculatus* of the original description. We can conjecture that perhaps Harrison and Johnston obtained further material from the original host individual after their paper had gone to press. The female designated as type by Thompson (1939) must presumably be taken as the lectotype; the other female marked as lectotype having no standing. A male taken from a different host, *D. geoffroyi*, was referred to as "allotype" by Werneck and Thompson (1940, p. 433). T.C.

Male.—Second femora with a pair of strong spines near the end of the trochanter. Anterior median plate of vesica with short (30 μ m) light greyish brown coloured, slender conical handle, without spur on its posterior margin (Fig. 90F).

Measurements (in mm) 10♂ from *D. hallucatus*, mean and range: HL 0.28 (0.28–0.30); HB 0.40 (0.39–0.41); HI 1.42 (1.34–1.47); PrB 0.34 (0.33–0.36); MsB 0.30 (0.29–0.32); MtB 0.36 (0.35–0.39); AB 0.72 (0.70–0.80); TL 1.71 (1.64–1.91). The measurements of 2♂ (1505/23, 24) from *D. geoffroi* were in the same range except for PrB 0.37. The sole measurements of 1♂ (1505/30) from "*D. quoll*"* were HL 0.26; HB 0.38; HI 1.44.

Female.—Genital sternite rectangular, frame-shaped, broadened in the anterior corners, with an arched narrow lunula. Genital papilla very fine, slender conical, with bluntly pointed tip, 30 by 40 μ m. Vulva with 1 anteriorly remote lateral seta (discal in position) and with 2–3 short rows of setae with distribution 1 : 2–4 : 1–3 : 1 or 0–1 : 1–4 : 1–2 : 2–3 : 0–1, the 1st, 2nd, or 3rd external the longest. Postgenital sternum with a row of weak marginal setae, the 5 lateral long, the 5 : 5 median short. Gonapophyses with 1 short and weak apical spur, with 3 strong setae on its basal inner surface and with a threefold row of very densely standing circular sensory ampullae without setae.

Measurements (in mm) 10♀ from *D. hallucatus*, mean and range: HL 0.29 (0.27–0.30); HB 0.41 (0.39–0.42); HI 1.43 (1.37–1.50); PrB 0.35 (0.33–0.38); MsB 0.30 (0.26–0.33); MtB 0.38 (0.35–0.41); AB 0.78 (0.73–0.87); TL 1.75 (1.65–1.85). Those of 2♀ (1505/25, 26) from *D. geoffroi* were in the same range except for HB 0.43 (1505/26). Only AB 0.90 and TL 1.99 of 1♀ from "*D. quoll*"* were outside the range.

Discussion

Although no authenticated specimens have been seen from the nominal host, it is assumed that the series of specimens from "*Dasyurus quoll*",* *D. geoffroi*, and *D. hallucatus* belong to the species *uncinata*; these specimens are very uniform and differ only in individually variable details.

Hosts

The nominal host, *Dasyurus maculatus*, has not been confirmed; although the original labels were removed from the slide, it is probable that the host of the specimens examined by Werneck and Thompson, given as "*D. quoll*"*, was *D. maculatus* of Harrison and Johnston.

New material from *D. geoffroi* has not been seen but *Dasyurus hallucatus* Gould, 1842 has been confirmed as a host. Hopkins (1948) considers the record from *Isodon macrourus* (syn. *Perameles macrura*) to be due to contamination but this host record is possible.

Genus PARABOOPIA Werneck & Thompson

Parabooopia Werneck & Thompson, 1940, p. 441; Werneck, 1948, p. 18.

Type species *Parabooopia flava* Werneck & Thompson, 1940.

Description

Head without strong dilatations of margin; ocular seta never on a projecting wart. Head as in *Boopia* but with a spine-bearing wart on the anterior edges of the

*Identity of host doubtful (see Appendix I). J.H.C.

temporal lobes. Maxillary palp 3-jointed, with 2 joints reaching beyond the margin of head. Mesonotum smaller than metanotum, with 1 pair of large colourless warts bearing 1 strong spine, 1 small seta behind it and usually 1 minute setula near the margin of the alveolus of spine. Abdomen without trichobothrial hairs.

Discussion

The genus has been founded on the maxillary palpi, which are three-jointed in contrast to all other Boopiidae, and on the absence of the trichobothrial setae on abdominal pleurae II–IV, which are present in all Boopiidae except *Parabooopia* and *Latumcephalum*. In all other somatic and sexual details the single species of the genus is a typical *Boopia* of the group with two tergal and two sternal rows of abdominal setae. The male genital organ is poorly preserved in the only paratype specimen before me but is distinct enough to show that it is nearest to that of *Boopia notafusca*. The genital chaetotaxy of the vulva is similar to that of *Boopia mjobergi*, that of the postgenital sternum similar to that of *Boopia notafusca*. The narrow abdominal tergites II–VII are well recognizable but the sclerites of the apical segments of the female are not visible. The genital papilla is very distinct, sharply outlined, slender conical, 15 by 30 μ m; its apex is somewhat indistinct but seems to be blunt.

PARABOOPIA FLAVA Werneck & Thompson

(Figs. 90I, 106)

Parabooopia flava Werneck & Thompson, 1940, pp. 441–2, figs. 48–53 (3♂, 3♀, from *Osphranter robustus*, Scone, N.S.W.; 1♂ from *O. robustus*, Belltrees, N.S.W., L. Harrison); Werneck, 1948, pp. 18–19.

Types

Lectotype here designated: ♂, in BMNH (Slide No. 730), from *Osphranter robustus* Gould, Scone, N.S.W., 18.vii.1925.

Paralectotypes: 1♂, 2♀, in BMNH 1962–677 (Slide Nos. 1505/81, 82; 733), data as lectotype.

Material examined

Macropus robustus.—syn. *Osphranter robustus*: 1♂, 1♀ syntypes now paralectotypes (1505/81, 82).

Discussion

For some additional characters of the male, supplementing the very good original description of *P. flava*, see Figures 90I and 106.

Host

The nominal host, *Macropus robustus* Gould, 1841, has not been confirmed.

Genus PHACOGALIA Mjöberg

Phacogalia Mjöberg, 1919, p. 95–6; Werneck, 1948, p. 7 (syn. *Boopia*).

Type species *Phacogalia brevispinosa* Harrison & Johnston, 1916.

Species

Ph. brevispinosa Harrison & Johnston, *spinosa* Harrison & Johnston.

Description

Head without horn-shaped projection posterior to base of maxillary palp, and without strong dilatations of margin; preocular and ocular lobes not prominent, without notch; sides of head nearly straight, diverging posteriorly, postocular temporal margin forming at most an angle of 160° with the ocular margin; temporal lobes with but one rounded edge, the posterior; eyes not prominent. Ocular seta not on a projecting wart. Ventral side of head without spines behind the posterior tentorial pits, with or without a pair of such spines before the posterior tentorial pits. Maxillary palp 4-jointed with 3 joints reaching beyond the margin of head.

Pronotum usually slightly narrower than head, with broadly rounded sides, rarely slightly angulated posteriorly. Mesonotum smaller than metanotum, with 1 pair of large colourless warts bearing 1 strong spine, 1 small seta behind it, and usually 1 minute setula near the margin of the alveolus of spine.

Abdominal spiracles on pleurites. Abdomen with trichobothrial hairs on pleura II-IV (as in Fig. 81).

Discussion

Harrison and Johnston, in describing *Heterodoxus brevispinosus*, wrote: "we include it for the present time within the genus *Heterodoxus*, but its characters lie in some respects intermediate between that genus and *Boopia*, and it may later form the type of a distinct genus"; and further "head almost twice as wide as long, roughly hemispherical in shape, with temporal lobes showing a slight truncation with two rounded angles, a condition intermediate between *Heterodoxus* and *Boopia*". The two spines on the ventral side of the head "have been mainly instrumental in inducing us to include the species in the genus *Heterodoxus*....." The authors noted that the two spines "are not situated at the base of the palps as in the latter genus, but on the chitinous framework which supports the palps, at the level of the eyes". The prothorax is described as "almost as wide as the head, somewhat angulated", but in the specimens before me it is rounded, as in *Heterodoxus*, without any trace of an angle. This character is, indeed, not essential for the genus, because in *Ph. spinosa*, which in contrast to *brevispinosa* is more like *Boopia* than *Heterodoxus*, the sides of the prothorax are angulated as in *Heterodoxus alatus*, the only species of this genus with angulated prothorax, this angulation being quite different from all species of *Boopia*.

Boopia spinosa and *Heterodoxus brevispinosus* differ in appearance so far from *Boopia* on the one side and *Heterodoxus* on the other, and stand in some characters so near together, that they cannot be placed either in *Boopia* or in *Heterodoxus*.

An additional character common to both species, and found in no species of *Boopia* or *Heterodoxus*, is a sharp transverse margin just behind the frontal setae. This is no artificial product of pressure of the cover glass, as one is inclined to think at the first glance, but presents the sharp dorsal margin of the vertico-occipital gliding sinus for the anterior part of the pronotum. This gliding sinus is also present in most species of *Heterodoxus*, but here it is shallow and its dorsal margin is situated so far back that it escapes observation. In *Boopia* this sinus is still flatter and without a sharp dorsal margin at all. In both species of *Phacogalia* this *sinus occipitalis* runs on both sides into the membranous areas of the temporal lobes, reaching their margins. The temporal lobes appear therefore bifurcate, with sclerotized anterior and posterior

angles and with a colourless membranous median area. Some *Boopia* species show a slight inclination to this membranization of the median part of the temporal lobes, but in no species is this character so striking as in *Phacogalia*.

The keen observation of Harrison and Johnston revealed one more character of *Phacogalia brevispinosa*, neglected by subsequent authors and present also in *Ph. spinosa*. Harrison and Johnston found in both sexes on the inner face of the claws "a peculiar empodial modification, consisting of a transparent membranous expansion of the general shape of the claw itself, extending almost to the apex of the claw and projecting ventrally from it". This structure is perfectly clear in both species of *Phacogalia* and represents the plantar pulvinus, not the empodium, and, in contrast to the empodium, is not free but fused for the most part with the planta of the claw. A pulvinus is present in all Boopiidae (Figs. 94 and 101), gradually confluent with the sclerotized cuticle of the claws, while in both species of *Phacogalia* it forms an anteriorly projecting membranous point simulating a second subapical point of the claw itself, so that the end of the claw appears as asymmetrically split.

The spines on the ventral side of the head, present in *Ph. brevispinosa* but absent in *Ph. spinosa*, do not constitute a generic character. They are not homologous with either the maxillary hooks of *Heterodoxus* or the alveolar spines of *Paraheterodoxus*, although similar to the latter. The spines in *Phacogalia brevispinosa* are situated on the "framework supporting the palps", anterior to the posterior tentorial pits; in *Paraheterodoxus* they are situated on the anterior ends of the ventrally prolonged occipital sutures just behind the posterior tentorial pits.

I am, indeed, not absolutely convinced of the independent position of *Phacogalia* based on the characters discussed above. The two species pose an evolutionary rather than a diagnostic problem, and the chief motive for putting them both in a distinct genus was to prevent this interesting evolutionary problem, which may be solved by subsequent investigations, from being concealed in a "convenient" diagnostic hiding-place.

KEY TO THE SPECIES OF PHACOGALIA

1. Head ventrally with pair of stout spiniform setae (Fig. 107) *brevispinosa*
Head ventrally without pair of stout spiniform setae (Fig. 111) *spinosa*

PHACOGALIA BREVISPINOSA Harrison & Johnston

(Figs. 90K, 107-110)

Heterodoxus brevispinosa Harrison & Johnston, 1916, pp. 355-6, fig. 12 (1♀, from *Phascologale flavipes*,* Zoo, Sydney, A. S. Le Souéf).

Phacogalia brevispinosa, Mjöberg, 1919 (from *Phascologale* sp.); Thompson, 1939, p. 604 (1♀, from *Antechinus flavipes*,* Zoo, Sydney, Aug. 1911, A. S. Le Souéf, in GBT coll.); Werneck, 1948, p. 16 (syn. *Boopia spinosa* Harrison & Johnston).

Boopia brevispinosa, Hopkins and Clay, p. 51 (syn. *B. spinosa* Harrison & Johnston).

Type

The single female type has not been located and is apparently lost. A neotype has therefore been designated.

Neotype here designated: ♂, in ANIC (Slide No. 1505/10), from *Antechinus stuartii*, Victoria Range, Vic., 20.vii.1963, R. M. Warneke.

* See discussion on host identity in Appendix I.

Material examined

A. stuartii.—Neotype; 5♂, 5♀, data as for neotype (1505/10–15); 4♂, 6♀, 4 nymphs, Colo Vale, N.S.W., 9.ix.61, P. A. Woolley (1496/6–9, 14).

A. bellus.—2♂, 2♀, South Alligator R., N.T., 18.viii.1962, J. H. Calaby (1505/8–9).

*Antechinus flavipes**.—Syn. *Phacologale flavipes*: 2♂, 2♀, Palmerston, Johnston Shire, Qld., 8.vi.1960, NF 164S (1496/10, 13); 1♂, 3♀, Palmerston Highway, Johnston Shire, Qld., 9.viii.1960 (1496/11, 12).

A. minimus.—2♀, Waratah, Tas., June 1963, R. H. Green (1505/16, 17).

A. swainsonii.—6♂, 2♀, 12 miles E. of Marysville, Vic., 11–12.viii.1962, R. M. Warneke (1505/18–22).

Description and discussion

The head (Fig. 107) of most of the specimens before me shows a peculiar deformation of the clypeus consisting in a transverse shrinking to a sharp pointed triangle. A comparison of all the specimens with the most strongly deformed clypeus with those without any trace of such deformation, and a comparison of all possible deformations of the head in *Boopia* and *Heterodoxus*, have led me to the following explanation of this question.

The vertico-occipital gliding groove of *Ph. brevispinosa* passes through the whole posterior part of the head from one temporal margin to the other, rendering the anterior part of the head more flexible and more subject to shrivelling. The occipital carinae running on the ventral side of the head anteriorly, and the occipital nodi restricted to the ventral side of the head, make the dorsal wall of the head also more flexible. The dorsal margin of the gliding groove is easily pushed forward by pressure of the cover glass and this seems to be the chief reason for the deformation of the clypeus.

Measurements of specimens of *Ph. brevispinosa* are given in Table 1. The measurements of males have been taken from specimens with intact head capsules.

The head in both sexes of the *swainsonii* population is wider than in the specimens of the "*flavipes*" population. The population from *bellus* seems to trend more toward the broader head. The head index of all specimens before me, including both deformed and intact heads, is 1.47 : 1.59 : 1.77 in the males, and 1.40 : 1.56 : 1.71 in the females of the "*flavipes*" series, and the corresponding figures for the *swainsonii* population are 1.67 : 1.77 : 1.87 in the males and 1.71 and 1.84 in the two females. The difference in the head indices of both populations is, evidently, not essentially disturbed by the deformation of the clypeus. In the original description the head of the female is given as 0.206 mm long and 0.386 mm broad, this making an index of 1.87. The highest head indices in the genus *Boopia* are shown by the male of *B. bettongia* with 1.48 and the female of *B. biseriata* with 1.62.

The male genital organ (Figs. 90K, 108–110) is similar to that of *Boopia* and nearest to *B. bettongia*, but has a longer handle. Long handles also occur, indeed, in other species of *Boopia*, this character not being diagnostic for *Phacogalia*. In all specimens of the *swainsonii* population each of the anterior pair of vesical scales is not flat and broad as in the "*flavipes*" population, but more thorn-shaped and more strongly chitinized. The marginal row of vulva setae is as in *Boopia*, with the second external the longest, the 8–11 strong marginal setae being distributed continuously or in 2–4 more or less distinctly separated groups. The marginal row of postgenital

* See discussion on host identity in Appendix I.

setae is weakly developed, the 4–6 laterals and 2 : 2 small median setae are similar to those of *Boopia bettongia*. No difference in the female genital chaetotaxy has been found between the populations of different hosts. The gonapophyses are just as in *Boopia*, triangular, sharply pointed, with a short apical spur and dense accumulation of circular hairless sensilla on their inner margin. The gonapophyses

TABLE 1
MEASUREMENTS OF MALE AND FEMALE *PHACOGALIA BREVISPINOSA* FROM
ANTECHINUS SPP.

All values given in millimetres. When there are two specimens, measurements of both are given; when there are more than two, the mean is given with the range in parentheses

	<i>A. flavipes</i> * (5♂, 16♀)	<i>A. swainsonii</i> (5♂, 2♀)†	<i>A. bellus</i> (2♂, 2♀)‡	<i>A. minimus</i> (2♀)§
Males				
HL	0.23 (0.22–0.24)	0.24 (0.23–0.24)	0.22, 0.22	
HB	0.38 (0.38–0.40)	0.42 (0.41–0.44)	0.39, 0.39	
HI	1.65 (1.60–1.77)	1.79 (1.74–1.87)	1.77, 1.80	
PrB	0.36 (0.35–0.37)	0.39 (0.38–0.40)	0.39, 0.38	
MsB	0.30 (0.27–0.32)	0.30 (0.28–0.33)	0.28, 0.29	
MtB	0.39 (0.36–0.42)	0.38 (0.38–0.41)	–, 0.32	
AB	0.65 (0.61–0.70)	0.67 (0.65–0.70)	0.58, 0.62	
TL	1.42 (1.34–1.57)	1.47 (1.42–1.52)	1.31, 1.41	
Females				
HL	0.25 (0.23–0.26)	0.25, 0.23	0.23, 0.22	0.23, 0.25
HB	0.39 (0.36–0.41)	0.42, 0.43	0.39, 0.41	0.41, 0.42
HI	1.56 (1.40–1.71)	1.71, 1.84	1.68, 1.87	1.75, 1.71
PrB	0.38 (0.36–0.39)	0.39, 0.41	0.38, 0.38	0.40, 0.41
MsB	0.31 (0.28–0.34)	0.30, 0.36	–, 0.28	–, 0.33
MtB	0.41 (0.38–0.45)	0.41, 0.44	–, –	–, 0.44
AB	0.71 (0.64–0.77)	0.70, 0.73	–, 0.62	0.73, 0.75
TL	1.51 (1.44–1.65)	1.53, 1.51	1.38, 1.45	1.55, 1.67

* This must be a mixed series containing chiefly specimens from *A. stuartii*, and possibly *A. godmani* or *A. flavipes*. See Appendix I. J.H.C.

† Slide numbers of females 1505/18, 20.

‡ Slide numbers of males and females 1505/8, 9.

§ Slide numbers 1505/16, 17.

are provided with only 2–3 long and strong lateral setae, but no projecting edge of their external margin is present, as is also the case in some species of *Boopia*. The genital sternite is very indistinct, frame-shaped, not rectangular as in some *Boopia* but more circular, its posterior prolongations ending freely near the lateral border of the postgenital sternum. The abdominal sternites have two rows of setae, the posterior with 10, the externals of which are short weak spines, and the anterior with 10–13 short spinous setae; the tergites have but one row of 3 : 4 : 3 strong setae.

Hosts

The nominal host, *Antechinus flavipes* (Waterhouse), has not been confirmed. *Antechinus stuartii* Macleay, 1841, *A. bellus* (Thomas, 1904), *A. minimus* (Geoffroy, 1803), and *A. swainsonii* (Waterhouse, 1840) are new hosts.

PHACOGALIA SPINOSA Harrison & Johnston

(Figs. 90L, 111)

Boopia spinosa Harrison & Johnston, 1916, pp. 350-2, fig. 9 (♂, ♀, from *Macropus ualabatus*, Victoria, A. S. Le Souëf); Thompson, 1939, p. 604 (♂, ♀ types, in GBT coll.); Werneck and Thompson, 1940, pp. 436-9, figs. 42-47 (1♂, 1♀ types, in GBT coll.); Werneck, 1948, pp. 16-18 (1♂, 1♀ types; 1♂, 1♀, from *Antechinus penicillata* Shaw, no locality, BMNH; 1♂, 1♀, nymphs and eggs, from *A. tapoatafa*, New South Wales, leg Werneck from skin No. 8500 in USNM. Syn. *Heterodoxus brevispinosus* Harrison & Johnston).

Types

Lectotype: ♂, in BMNH (Slide No. 734), det. G.B.T., from *Macropus ualabatus* [relabelled as *Wallabia bicolor*], Victoria, A. S. Le Souëf [identified as *Boopia spinosa*].
Paralectotype: 1♀, in BMNH (Slide No. 735), data as lectotype.

Material examined

Phascogale tapoatafa.—F.L.W., 2♂, 3♀, 1 nymph, Western Australia, 35-1453/62, 1949-62, Ex. 2736 (1496/1, 1505/4) [identified as *Boopia spinosa*]. 6♂, 4♀, 7 nymphs, Buxton, Vic., I.iii.1962, R. M. Warneke (1503/3, 1513/1-5).

Description and discussion

Phacogalia spinosa is very well described and illustrated by Harrison and Johnston and subsequently by Werneck and Thompson, who revised the types. Werneck (1948) has, in a long but unconvincing argument, given his reasons for considering *Ph. spinosa* and *brevispinosa* identical, but without having seen the last-named species. The spines on the underside of the head of *brevispinosa* are no product of the imagination of Harrison and Johnston but exist in all specimens and in both sexes before me. These spines are wanting in *Ph. spinosa*. The "simples zonas espressadas que não se destacam de superficie do tegumento visiveis unicamente em boas preparações" indicated "em linha pontilhada" in figure 43 (Werneck and Thompson 1940) are, in all *Boopia* species, more or less distinctly visible and represent the posterior ends of the hypostomal rim or, perhaps, the rudiments of maxillary cardines, which normally articulate in insects on the posterior end of the hypostomal rim just anteriorly to the posterior tentorial pits (Fig. 111).

Male genital armature very distinct from that of *Ph. brevispinosa* (Fig. 90L). Vulva with a continuous row of 8-10 marginal setae, the 2nd external the longest, as in *Boopia*, generally divided by a small median gap into groups of 4 : 4, 5 : 5 or asymmetrically 4 : 5, 5 : 4, or 4 : 6 setae. Genital sternite in 1 female (1505/3) distinct, bipartite, consisting of 2 arched rims not connected anteriorly with one another. Their posterior ends run freely out near the lateral margins of the postgenital sternite. Postgenital marginal setae as in *brevispinosa*. Postgenital sternite in the above-mentioned female distinct, narrowly bow-like, reaching from one side of the postgenital sternum to the other. Gonapophyses triangular, with a short apical spur, 2-3 strong setae on the inner wall, but not on a projection of the external margin, and with an accumulation of circular hairless sensilla along their inner margin.

Abdominal sternites with 1 posterior row of 12 strong setae, both the externals being shorter, and with 1 anterior row of 5-6 short setae, tergites with 1 row of 2 : 4 : 2 strong spinous setae

Measurements (in mm) 8 males, mean and range: HL 0.27 (0.26-0.28); HB 0.41 (0.41-0.42); HI 1.65 (1.50-1.87); PrB 0.38 (0.36-0.41); MsB 0.30 (0.29-0.32); MtB 0.39 (0.36-0.44); TL 1.62 (1.60-1.71).

Measurements (in mm) 7 females, mean and range: HL 0.27 (0.26-0.29); HB 0.42 (0.41-0.44); HI 1.53 (1.42-1.66); PrB 0.40 (0.38-0.41); MsB 0.31 (0.25-0.33); MtB 0.40 (0.36-0.44); TL 1.66 (1.33-1.78).

Hosts

Phascogale tapoatafa (Meyer, 1793) is confirmed as a host. Specimens have not been seen from the nominal host, *Wallabia bicolor* (Desmarest, 1804) syn. *M. ualabatus*.

Genus MACROPOPHILA Mjöberg

Macropophila Mjöberg 1919, p. 95; Werneck and Thompson, 1940, p. 444 (syn. *Heterodoxus*).

Type species *Macropophila forcipata* Mjöberg, 1919.

Species

M. biarcuata, sp. nov., *breviarcuata*, sp. nov., *clayae*, sp. nov., *forcipata* Mjöberg.

Description

Head with a strong horn-shaped posteriorly-directed projection posterior to base of each maxillary palp, but without strong dilatations of margin. Preocular and ocular lobes not prominent, without notch; sides of head nearly straight, diverging posteriorly, postocular temporal margin forming at most an angle of 160° with the ocular margin; temporal lobes with but one rounded edge, the posterior; eyes not prominent. Maxillary palp 4-jointed with 3 joints reaching beyond the margin of head. Ocular seta not on a projecting wart. Third temporal seta nearer to the 2nd than to the posterior margin of the antennal groove or in equal distance.

Pronotum usually slightly narrower than head, with broadly rounded sides. Prosternite with 3 lateral macrochaetae, with 2 spines between the 1st and the 2nd, and with 2-6 anterior and 2-6 posterior discal spines (Fig. 112). Mesonotum smaller than metanotum, with 1 pair of large colourless warts bearing 1 strong spine, 1 small seta behind it and usually 1 minute setula near the margin of the alveolus of spine. Posterior margin of metanotum between the long seta and the posterior metapleural spine with 1-3 short spines and 2-3 very fine short setulae (Fig. 114).

Abdominal spiracles on tergites. Abdominal pleurae VII and VIII in both sexes thickened, brown coloured, VIII rounded and projecting posteriorly, trichobothrial hairs on II-IV (as in Fig. 81). Sternites with 1 marginal and 1 regular discal row of setae, tergites II-VI with 1 marginal seta, the tergal marginal rows with short intercalaries.

Dorsolateral sclerites of vesica hooked anteriorly towards the midline. Postgenital sternum of female with an oval, colourless area in the middle of its posterior margin, containing a group of 6-11 sensilla (Fig. 113).

Discussion

I have decided to exclude *Macropophila* with its four known species from the genus *Heterodoxus*. *Macropophila* differs much more and constantly, in a number of characters, from all other species of *Heterodoxus* than *Dendrolagia* Mjöberg, which I

have, in contrast to previous authors, synonymized with *Heterodoxus*. The four species of *Macropophila* differ from *Heterodoxus* in the following characters: (1) Enlarged and posteriorly prominent pleurae VII and VIII; (2) Third temporal seta situated near alveolus of second (shown in *Heterodoxus* only in *H. ampullatus*); (3) Two spines on the lateral margins of prosternite between the first and second macrochaetae, which do not occur in any species of *Heterodoxus*; (4) One to three strong spines on the posterior margin of the metanotum between the median macrochaeta and the metapleural spine; (5) A small, median, colourless semicircular area on the posterior margin of the wholly chitinized postgenital sternum of female, provided with a group of small setae, this area being absent in all *Heterodoxus*; (6) Lateral sclerites of the vesica hooked anteriorly medially, which does not occur in any species of *Heterodoxus*; (7) Gonapophyses elongated, much longer and more slender than in *Heterodoxus*.

Mjöberg has based his genus on the following characters: (1) Gemmal notches deeper; (2) Spines behind maxillary palpi smaller; (3) Mesothorax much reduced, with four strong spines between the coxae; (4) Metathorax with posterior angles produced into an obtuse process carrying a very long hair; (5) Abdomen with regular rows of 30-40 fine flattened chitinous setae and six longitudinal rows of much longer hairs; (6) Last segment in female ending in two forceps-like, sharply pointed movable processes; (7) Lateral sclerites of, especially, the preceding segment very strongly developed, dark brown, well set off and protruding backwards in both sexes. Of the above characters it must be noted that the gemmal notches are not deeper. The spines behind the maxillary palpi are smaller, their length varying in *Macropophila* (3 species) between 72 and 100 μm and in *Heterodoxus* between 87 and 174 μm . This character does not, therefore, possess any diagnostic value. The mesosternite has, in all species of *Heterodoxus* except *ualabati*, four spines on the posterior end; this character has consequently no diagnostic value. The posterior angles of the metathorax, i.e. the metapleurae, are, in intact specimens, not prolonged posteriorly but they suffer readily under the pressure of the cover glass, shifting more posteriorly. The setae on the abdominal segments are not flattened. The "movable processes" on the apex of the female abdomen are the gonapophyses. Pleurites VII and VIII are really enlarged and prolonged posteriorly, and this is the chief character of *Macropophila* absent in all *Heterodoxus*.

KEY TO THE SPECIES OF *MACROPOPHILA*

- | | | |
|-------|--|---------------------|
| 1. | Long marginal setae of sternites II-VI not regularly interspersed with shorter setae | <i>clayae</i> |
| | Long marginal setae of sternites II-VI regularly interspersed with shorter setae | 2 |
| 2(1). | Females | 3 |
| | Males | 5 |
| 3(2). | Sternite VIII with 18 setae | <i>forcipata</i> |
| | Sternite VIII with 14 or less setae | 4 |
| 4(3). | Anterior margin of genital sclerite deeply concave with lunula | <i>biarcuata</i> |
| | Anterior margin of genital plate flatly concave without lunula | <i>breviarcuata</i> |
| 5(2). | Anterior hooks of dorsal lateral plates of vesica with ear-like appendages on outer margin; ends of parameres straight (Fig. 11) | <i>biarcuata</i> |
| | Anterior hooks of dorsal lateral plates of vesica without ear-like appendages; ends of parameres bent inwards (Fig. 12) | <i>breviarcuata</i> |

MACROPOPHILA BIARCUATA, sp. nov.

(Figs. 9-11, 13, 112C, 112D, 114, 115B, 116E)

Heterodoxus forcipatus, Werneck, 1948, p. 24, fig. 6 (1♀, from *Thylogale thetidis*, Mt. Tamborine, Qld.)

Types

Holotype: ♂ in ANIC (Slide No. 1496/49), from *Thylogale thetis*, nr. Cougal, N.S.W., 9.xi.1961, J. H. Calaby.

Paratypes: 2♂, 13♀, in BMNH, ANIC. 1♂, 9♀, data as for holotype (1496/47-50); 1♀, from *T. thetis*, Mt. Tamborine, Qld. (1505/50); 1♂, 3♀, from *T. thetis* (C.M. 79), Mt. Tamborine, Qld., 7.v.1960, J. H. Calaby (1496/44-46).

Material examined

Thylogale thetis.—Holotype and 2♂, 13♀ paratypes; 2 nymphs (C.M. 79), Mt. Tamborine, Qld., 7.v.1960, J. H. Calaby (1496/4).

T. stigmatica.—1♀, Tooloom Scrub, N.S.W., 17.ii.62, J. H. Calaby (1496/43).

Description

Prosternite with 2-3 anterior and 1(?) - 3 apical discal spines. Marginal rows of sternal setae on abdominal segments II-VI with short intercalary setae.

Male.—Dorsal lateral plates of vesica with a pointed earlike appendage on the outer margin of their anterior hooks. Ends of parameres straight.

Measurements (mm) 3♂ holotype and 2 paratypes, mean and range: HL 0.39 (0.38-0.39); HB 0.60 (0.58-0.61); HI 1.54 (1.52-1.56); PrB 0.57 (0.57-0.58); MsB 0.42 (0.39-0.44); MtB 0.58 (0.55-0.59); AB 0.83 (0.82-0.84); SL 0.10; SD 0.22 (0.21-0.23); STh 0.02; TL 2.68 (2.57-2.76).

Female.—Anterior margin of genital sternite in female deeply concave with a weak but distinct lunula. Vulva with 6-9 marginal setae each side of the midline, its posterior margin flatly concave. Genital papilla as in *clayae*, sp. nov. (Fig. 115).

Measurements (mm) 14♀, including 13 paratypes, mean and range: HL 0.39 (0.36-0.42); HB 0.59 (0.57-0.62); HI 1.49 (1.39-1.63); PrB 0.56 (0.54-0.58); MsB 0.40 (0.36-0.44); MtB 0.57 (0.54-0.59); AB 0.84 (0.81-0.87); SL 0.09 (0.09-0.10); SD 0.20 (0.15-0.25); STh 0.02; TL 2.76 (2.71-2.87).

Discussion

M. biarcuata is very similar to *clayae*, on average smaller, differing in genital characters of male and female, and in the posterior ventral row of marginal setae having short intercalary setae.

Hosts

The nominal host is *Thylogale thetis* (Lesson, 1827); *T. stigmatica* Gould, 1860 is also recorded as a host.

MACROPOPHILA BREVIARCUATA, sp. nov.

(Figs. 14-16, 112E, 112F, 115C, 116F)

Werneck, 1941, p. 47 (1♂, 1♀, from *Thylogale stigmatica*).

Types

Holotype: ♂, in ANIC (Slide No. 1497/2), from *Thylogale stigmatica wilcoxi*, 19.ii.1960, Mt. Lindesay, N.S.W., J. H. Calaby.

Paratypes: 1♀, with holotype in ANIC (Slide No. 1497/2); 1♂, 1♀, from *Thylogale stigmatica*, 4 miles SW. of Atherton, Qld., 30.x.1963, K. Keith, in BMNH (Slide No. 1505/49).

Material examined

Thylogale stigmatica.—Holotype and paratypes.

Description

Prosternite with 2-3 anterior and 1(?)–3 apical discal spines. Marginal rows of sternal setae on abdominal segments II–VI with short intercalary setae.

Male.—Dorsal lateral plates of vesica without appendage on their hooked anterior ends. Ends of parameres bent inwardly.

Measurements (mm) 2♂, holotype (1497/2) followed by paratype 1505/9): HL 0.41, 0.39; HB 0.61, 0.61; HI 1.50, 1.56; PrB 0.55, 0.57; MsB 0.41, 0.41; MtB 0.54, 0.52; AB 0.80, 0.75; SL 0.19, 0.09; SD 0.24, 0.24; STh 0.02, 0.02; TL 2.58, 2.58.

Female.—Anterior margin of genital plate in female flatly concave, without lunula. Vulva with 5-7 marginal setae each side of the midline, its posterior margin more deeply excavated but not as deep as in *clayae*. Genital papilla slightly greater than in *biarcuata* and *forcipata* (Fig. 115).

Measurements (mm) 2♀, paratypes (1497/2, 1505/9): HL 0.39, 0.41; HB 0.61, 0.59; HI 1.56, 1.46; PrB 0.55, 0.55; MsB 0.41, 0.41; MtB 0.57, 0.54; AB 0.86, 0.80; SL 0.09, 0.09; SD 0.23, 0.24; STh 0.02, 0.02; TL 2.76, 2.70.

Discussion

M. breviaracuata is very similar to *clayae* and *biarcuata*, probably a little smaller than the latter, differing from it only in the sexual characters of both males and females, and from *clayae* by the presence of short intercalary setae in the marginal rows of pregenital abdominal sterna.

Host

The nominal host is *Thylogale stigmatica* Gould, 1860.

MACROPHILA CLAYAE, sp. nov.

(Figs. 5-8, 112A, 112B, 113, 115A, 116A-116D)

Heterodoxus forcipatus, Werneck, 1948, pp. 24-6, figs. 7, 10, 12 (♂, ♀, from *Thylogale billardieri*, Jan. 1913, Furneaux Is., Tas., R. N. Atkinson).

Types

Holotype: ♂, in ANIC (Slide No. 1496/40) from *Thylogale billardieri*, Maydena, Tas., 23.xii.1958, B. C. Mollison [identified as *H. forcipatus*].

Paratypes: 11♂, 13♀, in BMNH, ANIC. 1♂, 1♀, data as holotype, 1959-667 (1496/40, 41); F.L.W.?, 1♂, ♀, from *T. billardieri*, Maydena, Tas., 31.i.1960, T. Andersen (1505/54); det. F.L.W., 1♂, 2♀, from *Macropus billardieri*, Furneaux Is., Tas., R. N. Atkinson, 1913-450 (1505/51-53) [all identified as *H. forcipatus*]. 1♂, 1♀, from

T. billardieri, Maydena, Tas., 31.i.1960, T. Andersen (1496/42); 4♂, 5♀, from *T. billardieri*, Maydena, Tas., 25-27.viii.1960, B. C. Mollison (1518/4-6); 3♂, 3♀, from *T. billardieri*, Flinders I., Furneaux Group, Tas., 10.xii.1960, D. L. McIntosh (1518/1-3).

Material examined

Thylogale billardieri.—holotype and 10♂, 12♀ paratypes. Syn. *Macropus billardieri*: 1♂, 1♀ paratypes.

Description

Prosternite with 4-6 anterior and 3-6 apical discal spines. Marginal rows of sternal setae on abdominal segments II–VI without short intercalary setae.

Male.—Anterior hooks of dorsal lateral plates of vesica prolonged into denticulated plates projecting anteriorly and posteriorly (Fig. 7).

Measurements (mm) 12♂, holotype and paratype, mean and range: HL 0.42 (0.39-0.42); HB 0.62 (0.59-0.64); HI 1.47 (1.43-1.53); PB 0.60 (0.58-0.61); MsB 0.44 (0.42-0.45); MtB 0.58 (0.55-0.60); AB 0.80 (0.77-0.83); TL 2.88 (2.60-3.02).

Female.—Vulvar margin deeply concave with 4-5 setae of equal strength and 3-4 small and weak intercalary setae both sides of the median emargination. Genital sternite anteriorly flatly concave, without lunula. Genital papilla very fine, conical (Fig. 115).

Measurements (mm) 13♀, paratypes, mean and range: HL 0.43 (0.42-0.45); HB 0.63 (0.58-0.66); HI 1.46 (1.40-1.52); PB 0.61 (0.52-0.65); MsB 0.44 (0.41-0.46); MtB 0.59 (0.57-0.62); AB 0.89 (0.80-0.94); TL 3.02 (2.76-3.23).

Discussion

The description and especially the figures of this species published by Werneck (1948) under *M. forcipata* are sufficient for identification with the specimens of the type series before me. Figures 7 (male), 10 (female apex, ventral), and 12 (male genitalia) in Werneck's paper represent *clayae*, sp. nov.; figure 6 (female) is that of *M. biarcuata* off *Thylogale thetis*, but figures 8 (head of female), 9 (female apex, dorsal), and 11 (male apex, dorsal) are not identifiable with certainty.

Host

The only host known at present is *Thylogale billardieri* (Desmarest, 1822).

MACROPHILA FORCIPATA Mjöberg

(Figs. 78-80)

Macrophila forcipata Mjöberg, 1919, p. 95 (♂, ♀, from *Macropus coxeni*).

Type

Apparently missing from Mjöberg collection in Naturhistoriska Riksmuseet, Stockholm.

Material examined

Thylogale stigmatica.—syn. *Macropus coxeni*: ♀ within last nymph, from skin in Stockholm Museum collected by E. Mjöberg, Cedar Creek, Qld., 29.iii.1913, C. Moreby, Naturhistoriska Riksmuseet, Stockholm.

Description

Prosternite with 2-3 anterior and 1(?)–3 apical discal spines. Marginal rows of sternal setae on abdominal segments II–VI with short intercalary setae.

Male.—According to original description with the “apical ventral segment rounded, with 6 very long stiff hairs”.

Measurement (mm) TL 2.3 (after Mjöberg).

Female.—Vulva with 3 long stout setae each end and 1 + 2 finer setae.

Measurement (mm) TL 2.45 (after Mjöberg).

Discussion

The original description is insufficient to ensure the identification of the species. Mjöberg's statement that the males have “six long stiff hairs” on the rounded “apical ventral segment” and “the next last ventral segment in female deeply excised in the middle of the hind margin and armed with eight exceedingly long, stiff chitinous hairs, four on each side” together with his generic characters of *Macropophila* in which the “last segment in females ending in two forceps-like sharply pointed movable processes” and “the lateral sclerites of especially the preceding segment very strongly developed, dark brown, well set off and protruding backwards in both sexes” makes only the genus recognizable.

I have before me a female within the last nymph, which Mr. C. Moreby of the British Museum (Natural History) was successful in finding on the skin of *Macropus coxeni*, the only specimen of this kangaroo collected by Mjöberg (1916), and sent through kind cooperation of Dr. H. Stenram of the Zoological Institute, University of Lund, and Dr. C. Edlestam of the Naturhistoriska Riksmuseet, Stockholm, to Dr. Theresa Clay. This female is specifically not identifiable with the original description. Only two non-diagnostic facts, firstly that the specimen before me differs specifically from the three other species of this genus, and secondly that it comes from the only original skin of *Macropus coxeni* which supplied the type series, make it nearly sure that this specimen is conspecific with the type series of *M. forcipata* Mjöberg. This specimen cannot be designated as neotype, because we cannot exclude the possibility that *Macropus coxeni* may be the host of one or two other species of *Macropophila*.

The last nymph before me, 2.48 mm long, is in very good condition, with clearly visible, fully sclerotized, brown chaetotaxy of the female, very easily distinguished from the chaetotaxy of the nymph, which, where the setae are lost, is clearly recognizable by the alveoli. All the generic characters mentioned above in the discussion of the genus, except the position of the third temporal seta, could have been based on this specimen. The outline of the whole body of the nymph is in good condition, except that the thorax is somewhat distorted in breadth. The outline of the head is like that of *M. biarcuata*, sp. nov., and slightly different from that of the other two species, but not having studied the outlines of heads of boopiid nymphs, I am not able to say how far these coincide with the outlines of the imago. The ocular seta of the female (that of the nymphs is lost on each side) is minute, as in all other species of the genus. The gonapophyses are clearly visible with one thin and sharp apical spur 50 μ m long, and 8 strong seta directed mediad. The prosternite is distorted in breadth (s.a.), consequently not triangular, with three strong anterior

discal and one small posterior apical spine in the female. The anterior corners have one long seta each side in female and nymph. The lateral margins have two strong spines on both sides in female and nymph (generic character), and one short spine on both sides, laterally of the latter, in the nymph only. Curiously enough, the posterior pair of the long setae are represented by only one seta in the nymph. The genital papilla is distinct, bluntly conical, 20 by 20 μ m. The spermathecal duct is perceptible for about 100 μ m of its length. The maxillary hooks of the female are 80 μ m long, and those of the nymph 70 μ m long. Head 0.348 mm long, 0.609 mm broad. Head index 1.75.

Host

The only record of this species is the original, from the nominal host *Thylogale stigmatica* Gould, 1860, syn. *Macropus coxeni*.

Genus HETERODOXUS Le Souëf & Bullen

Heterodoxus Le Souëf and Bullen, 1902, p. 154; Paine, 1911, pp. 359–62; Kellogg and Ferris, 1915, p. 66; Harrison and Johnston, 1916, p. 352; Thompson, 1939, p. 605; Werneck and Thompson, 1940, pp. 444–5; Werneck, 1948, p. 20 (syn. *Macropophila*).

Dendrologia Mjöberg, 1919, p. 94; Thompson, 1939, p. 606; Werneck and Thompson, 1940, pp. 440–1.

Type species *Heterodoxus macropus* Le Souëf & Bullen, 1902.

Species

H. alatus, sp. nov., *ampullatus*, sp. nov., *ancoratus*, sp. nov., *calabyi*, sp. nov., *longitarsus* Piaget, *maai* Emerson, *macropus* Le Souëf & Bullen, *mitratus*, sp. nov., *octoseriatus*, sp. nov., *pygidialis* Mjöberg, *quadriseriatus*, sp. nov., *spiniger* Enderlein, *ualabati* Plomley.

Description

Head with a strong horn-shaped posteriorly-directed projection posterior to base of each maxillary palp, without strong dilatations of margin. Preocular and ocular lobes not prominent, without notch; sides of head nearly straight, diverging posteriorly, postocular temporal margin forming at most an angle of 160° with the ocular margin; temporal lobes with but one rounded edge, the posterior; eyes not prominent. Ocular seta not on a projecting wart. Third temporal seta located nearer to the posterior margin of the antennal groove than to the 2nd temporal, except in *H. ampullatus*. Maxillary palp 4-jointed with 3 joints reaching beyond the margin of head.

Pronotum usually slightly narrower than head, with broadly rounded sides, rarely slightly angulated posteriorly. Prosternite with 1 or 2 lateral macrochaetae, with or without 1 lateral spine. Apical discal spines wanting except in *H. mitratus* and *maai*. Posterior margin of metanotum without spines, with some small setulae only. Mesonotum smaller than metanotum, with 1 pair of large colourless warts bearing 1 strong spine, 1 small seta behind it, and usually 1 minute setula near the margin of the alveolus of spine.

Abdominal spiracles on tergites. Abdomen with trichobothrial hairs on pleurae II–IV (as in Fig. 81). Pleurae VII–VIII neither thickened nor projecting posteriorly. Sternites II–VI with one marginal row of setae without intercalaries except in

H. ampullatus, and with 1 or 2 more or less regular discal rows of setae. Tergites II–VI with 1 marginal row of setae and either with intercalaries or with more or less remote, but not intercalating, rather irregular rows of shorter setae.

Dorsolateral sclerites of vesica not hooked anteriorly towards the midline. Post-genital sternum in female without oval colourless sensorial area, except in *H. macropus*.

Discussion

The presence of one pair of cuticular spines behind the maxillary palpi, the absence of the postocular emarginations, and the acutely rounded temporal lobes as characters distinguishing *Heterodoxus* from *Boopia* have been noted by Harrison and Johnston (1916). My inclusion of *Dendrolagia pygidialis* in *Heterodoxus* does not influence the above diagnosis, the emargination of the lateral margins of head in this species being so shallow that it does not change the general outline of the head. Mjöberg's statement that the temporal lobes of the head of *Dendrolagia* are "well set off as in the genus *Boopia*" is much exaggerated.

Other important characters of the genus *Heterodoxus* are that it never possesses a handle on the anterior margin of the anterior median vesical plate, that the vesical posterior median plate is never lyrate, and that the gonapophyses are never fused with the ninth abdominal segment and never bear a projecting dilatation on their external margin. The last character occurs also in some species of *Boopia*.

KEY TO SPECIES OF *HETERODOXUS*

1. Prosternite quadrangular, corners rounded with 1 normal seta on the anterolateral and 1 spiniform on the posterolateral corner, without other lateral setae *pygidialis*
Prosternite triangular, laterally with 2–3 macrochaetae each side and 1 spiniform seta posterior to the 1st macrochaeta (Fig. 123B) 2
- 2(1). Prosternite with 3 lateral macrochaetae and 1 spiniform seta between the 1st and 2nd macrochaetae (Fig. 123B) *ampullatus*
Prosternite with 2 lateral macrochaetae and 1 spiniform seta between them (Fig. 124B) 3
- 3(2). Prosternite posteriorly with spiniform setae (Fig. 124B) 4
Prosternite posteriorly without spiniform setae 5
- 4(3). Male vesica strongly sclerotized, rigid, bottle-shaped with rounded anterior end, membranous posteriorly, uniformly denticulated all over (Fig. 54). Female genital papilla small, conical, rounded anteriorly (Fig. 115F); vulvar setae all stout, 12–13 in 3 groups, the 4–5 central ones shorter *mitratus*
Male vesica not as above; with patch of spines comprising 2 groups of 6–7 vertical rows of short stout overlapping spines separated by area of thorn-like spines (Figs. 74, 76). Female genital papilla elongate (Fig. 115P); vulvar margin with 4 long stout setae each side and 8 short fine setae in central emargination (Fig. 77) *maai*
- 5(3). Posterior margin of tergites IV–VI at least with a wide semicircular indentation each side (Fig. 22); sternite II with finger-like prolongations extending to base of marginal setae 6
Tergites without such indentations; sternite II without such prolongations 7
- 6(5). Dorsolateral vesical sclerites each prolonged anteriorly as a broad plate; vesica with semicircular thickening (Fig. 23). Female postgenital sternum with 4 median setae posterior to and distinct from marginal row (Fig. 120) *longitarsus*
Male genitalia not as above; vesica anteriorly with anchor-shaped sclerite. Setae of female postgenital sternum not as above *ancoratus*
- 7(5). Males 8
Females 14
- 8(7). Vesica with 2–4 long (over 46 μm) spines arranged in pairs 9
Vesica without spines or with shorter more numerous ones 11

- 9(8). Vesica without longitudinal rows of denticles (Fig. 118) *spiniger*
Vesica with longitudinal rows of denticles 10
- 10(9). Vesica with about 10 longitudinal rows of denticles, their bases confluent forming parallel ribs between the pairs of long spines; a large oval brush of strong dense spines between the posterior pair of spines and the median plate (Fig. 50) *macropus*
Vesica with 5 rows of short denticles, their bases not confluent; behind the posterior pair of spines a large oval area of dense scales denticulated on their margins (Fig. 122) *alatus*
- 11(8). Vesica anterior to the plates with longitudinal rows of long spines 12
Vesica anterior to the plates without longitudinal rows of long spines 13
- 12(11). Vesica anterior to the plates with less than 5 longitudinal rows of stout spines within an oval more finely denticulated area (Fig. 62) *quadriseriatus*
Vesica anterior to the plates with over 6 longitudinal rows of stout spines within a long brush of finer denticles (Fig. 58) *octoseriatus*
- 13(11). Vesica with 2 large conical brushes of dense strong spines lying just anterior to dorsolateral sclerites (Figs. 27, 28) *ualabati*
Vesica without such brushes. Dorsolateral sclerites of genitalia paddle-shaped (Fig. 45) *calabyi*
- 14(7). Genital papilla strongly sclerotized and situated within horseshoe-shaped sclerite (Fig. 115L) *macropus*
Genital papilla not as above 15
- 15(14). Genital papilla wider or as wide as long (anteroposteriorly) 16
Genital papilla longer (anteroposteriorly) than wide 17
- 16(15). Genital papilla broadly rounded anteriorly (Fig. 115E) *spiniger*
Genital papilla conical (Fig. 115O) *octoseriatus*
- 17(15). Genital papilla pointed anteriorly 18
Genital papilla rounded anteriorly 19
- 18(17). Vulva with 4–8 strong marginal setae each side of median group of 1–4 shorter ones *calabyi*
Vulva with continuous row of 20–23 strong marginal setae *ualabati*
- 19(17). Genital papilla bordered anteriorly by semicircular dark brown sclerite (Fig. 115K); vulva with continuous row of 16 strong marginal setae *alatus*
Genital papilla not bordered anteriorly by semicircular sclerite; vulva with 4–5 strong marginal setae each side of midline *quadriseriatus*

HETERODOXUS *ALATUS*, sp. nov.

(Figs. 30–33, 115K, 116T, 121, 122)

Types

Holotype: δ in Bernice P. Bishop Museum (Bishop 9341, 1503/3–2), from *Thylogale b. bruijini*, 5.ii.1960, Merauke R., west New Guinea, T.C. Maa, TMP 2206.
Paratypes: 1 δ , 1 η , in KCE coll. (Slide No. 1503/3–1, 2) data as holotype; 1 δ , 1 η , in Bernice P. Bishop Museum (Slide No. 1503/4–1), from *T. bruijini*, Mt. Kaindi, New Guinea, 5.x.1962, HC 20638, H. Clissold.

Material examined

Thylogale brunii.—syn. *T. bruijini bruijini*: holotype and 2 δ , 2 η paratypes.

Description

Temples behind eye straight. Third temporal seta near posterior margin of antennal groove (Fig. 117). Prothorax distinctly narrower than head. Prosternite triangular with 2 lateral macrochaetae and 1 spine between them, without apical (posterior) spines. Marginal rows of setae on sternites II–VI without intercalaries.

Male.—Vesica with patch of spines comprising two groups of 6–7 vertical rows of short stout overlapping spines separated by an area of thorn-like spines (Figs. 74 and 76).

Female.—Genital papilla elongated (Fig. 115P), surrounded by horseshoe-shaped area lightly pigmented posteriorly. Vulvar margin with 4 long stout setae each side and 8 short fine setae in central emargination (1♀).

Measurements (in mm) male and female, after Emerson (1962): TL 3.47, 3.45.

Host

The nominal host is *Dorcopsis veterum* (Lesson, 1827).

HETERODOXUS MACROPUS Le Souëf & Bullen

(Figs. 48–51, 115L, 116U)

Heterodoxus macropus Le Souëf & Bullen, 1902, p. 159, fig. 11 (♂, ♀, from “kangaroos, wallabies etc.”); Paine, 1912, p. 361, figs. E–G (2♂, 2♀, from “black wallaby”, Victoria, A. S. Le Souëf, syn. *spiniger*); Johnston and Harrison, 1912, p. 13 (types, syn. *H. longitarsus*); Hopkins, 1947, pp. 176–8; Hopkins, 1949, p. 441.
? *Heterodoxus longitarsus*, Harrison and Johnston, 1916, pp. 352–4, fig. 11 (from *Macropus giganteus* and *M. stigmaticus*); Werneck, 1941, p. 47 (1♂, 1♀, from *Thylogale stigmatica*, Queensland; 1♂, from *M. agilis*, Queensland).

Types

Lectotype here designated: ♂, in USNM, from “black wallaby”, Victoria, Le Souëf (remounted by E. W. Stafford, original label not preserved).

Paralectotypes: 1♂, 2♀, in USNM, data as lectotype.

Material examined

Macropus giganteus.—2♂, 2♀, Townsville, Qld., 1929, G. Dennes, BMNH (1496/65, 1497/9–11).
Thylogale stigmatica.—1♂, 1♀, Queensland, A. S. Le Souëf (1505/47, 48).
Wallabia agilis.—syn. *Protetnodon agilis*: 4♂, 9♀, Townsville, Qld., 26.x.63, K. Keith (1505/55–57; 1512/12–13).

Description

Temples behind eye straight, 3rd temporal seta near margin of antennal groove (Fig. 117). Prothorax distinctly narrower than head. Prosternite triangular with 2 lateral macrochaetae and 1 spine between them, without spiniform setae posteriorly. Marginal rows of setae on sternites II–IV without intercalaries.

Male.—Vesica with about 10 longitudinal rows of denticles between the pairs of long spines, their bases confluent forming parallel ribs; a large oval brush of strong dense spines between the posterior pair of spines and the median plate.

Measurements (in mm) 7♂ including holotype and paratype, mean and range: HL 0.44 (0.42–0.47); HB 0.64 (0.63–0.65); HI 1.46 (1.38–1.50); PrB 0.55 (0.53–0.57); MsB 0.43 (0.35–0.45); MtB 0.56 (0.54–0.57); AB 0.98 (0.94–1.02); SL 0.15 (0.15–0.16); SD 0.27 (0.26–0.28); STh 0.03 (0.03–0.04); TL 2.77 (2.61–2.90).

Female.—Genital papilla strongly sclerotized, conical and rounded at tip, and situated within a strongly sclerotized, horseshoe-shaped sclerite (Fig. 115L). Mouth of spermathecal duct opening apically on papilla. Vulvar margin straight, membranous in the median third and with 3–10 setae each side of the midline; subgenital sclerite deeply emarginate. Genital sternite flatly emarginate anteriorly, without lunula. Post-

genital sternite with a continuous row of marginal setae, about 12 of the median ones flanked each side by a long strong seta, nearly twice as long as the innermost of the lateral series. Just dorsal to the median series are 4 stronger supplementary setae with larger circular alveoli.

Measurements (in mm) 12♀ including 2 paratypes, mean and range: HL 0.44 (0.43–0.46); HB 0.65 (0.60–0.68); HI 1.45 (1.36–1.56); PrB 0.56 (0.52–0.60); MsB 0.45 (0.41–0.48); MtB 0.57 (0.49–0.61); AB 1.05 (1.00–1.12); SL 0.15 (0.14–0.16); SD 0.27 (0.25–0.28); STh 0.03 (0.03–0.04); TL 2.82 (2.67–3.03).

Discussion

H. macropus is similar to *alatus*, sp. nov., not only in having two pairs of vesical spines but also in the chaetotaxy of the abdominal segments, which is quite different from that of *spiniger*. The females of *macropus* are easily recognizable by their peculiar genital papilla.

Hosts*

The hosts are *Macropus giganteus* Shaw, 1790, *Wallabia agilis* (Gould, 1842), and *Thylogale stigmatica* Gould, 1860. The nominal host, the “black wallaby”, *Wallabia bicolor* (Desmarest, 1804) has not been confirmed.

The specimens from *Thylogale stigmatica* bear double red-bordered labels on the backs of both slides and are probably those seen by Werneck (1941). Those from *Wallabia agilis* were collected in 1963 and represent a confirmation of the record of Werneck (1941). The specimens from *Macropus giganteus* were collected in 1929 and cannot be those seen by Harrison and Johnston (1916).

HETERODOXUS MITRATUS, sp. nov.

(Figs. 52–55, 115I, 116R, 124)

Types

Holotype: ♂, in BMNH (Slide No. 1497/19), from *Dorcopsulus vanheurni*, 13.xii.1940, Mt. Mura, east Papua, Shaw Mayer, 968.

Paratypes: 1♂, 4♀, in BMNH (Slide Nos. 1497/18, 19), data as for holotype.

Material examined

Dorcopsulus vanheurni.—Holotype and 1♂, 4♀ paratypes.

* Hopkins (1946, p. 176) has discussed fully the action of various authors in relation to *macropus*. He concluded that Paine's redescription (1912, p. 361) of *macropus* from syntypes (2♂, 2♀) sent to Paine by Le Souëf, and including for the first time the name of the host, should be regarded as a restriction of the species. Hopkins (1946, p. 177), therefore, formally restricted the name *macropus* to the species represented by these syntypes from the black wallaby. Through the kindness of Dr. K. C. Emerson it has been possible to examine two males and two females now in the U.S. National Museum which are almost certainly those described by Paine and from which a lectotype has been designated. These prove to be the species described here; *Wallabia bicolor* has not been confirmed as the true host, but other specimens of *H. macropus* have been taken from *W. agilis*. Plomley (1940, p. 21) thought that two males in the Le Souëf collection from the black wallaby were those seen by Paine, presumably believing that they had been returned; he found that they were conspecific with his new species *ualabati*. Hopkins, misled by this statement, considered *ualabati* to be a synonym of *macropus*. It now seems most unlikely that these two males were seen by Paine, the four specimens belonging to another species having been found in the United States. T.C.

Male.—Vesica with 5 rows of short denticles between the 2 pairs of long spines, their bases not confluent (Fig. 122); behind the posterior pair of spines, a large oval area of dense scales denticulated on their margins.

Measurements (in mm) 3♂, holotype and paratypes, mean and range: HL 0.45; HB 0.67; HI 1.26; PrB 0.54 (0.51–0.54); MsB 0.40 (0.38–0.44); MtB 0.51 (0.48–0.52); AB 0.93 (0.87–0.97); SL 0.17 (0.16–0.17); SD 0.25 (0.20–0.25); STh 0.03; TL 2.80 (2.61–2.80). In the male 1503/4–1 the head is remarkably deformed, and the measurements of HL, HB, HI are not included.

Female.—Genital papilla bordered anteriorly by semicircular dark brown sclerotized ring (Fig. 115). Vulvar margin straight, membranous in its median third, with a continuous row of 16 (1♀) strong marginal setae; the subgenital sternite flatly emarginate posteriorly, genital sternite anteriorly deeply emarginate, the emargination bordered both sides by a clear fine line. Genital papilla short, conical, with rounded tip, well sclerotized. Postgenital marginal row of setae as in *macropus*, but with about 20 short median setae between the pair of strong ones.

Measurements (in mm) 1♀ paratype: SL 0.15; SD 0.16; STh 0.03; TL 2.55. The female is damaged and not measurable in all details.

Discussion

This species is a typical *Heterodoxus*, approaching *macropus*, with one dorsal row of abdominal setae intercalated by short ones, and with one sternal marginal row without intercalaries and two discal rows, the posterior more regular and dense, the anterior more scattered and irregular. The genitalia, especially the male copulatory organ, are similar to those of *macropus* and *spiniger*, with two pairs of long vesical spines, but with a very different armature of vesical plates.

Host

The nominal host is *Thylogale brunii* (Schreber, 1778).

HETERODOXUS AMPULLATUS, sp. nov.

(Figs. 34–38, 115G, 116P, 123)

Types

Holotype: ♂, in ANIC (Slide No. 1512/43), from *Petrogale penicillata*, 20.ii.1964, Jenolan, N.S.W., J. Bishop.

Paratypes: 3♀, in ANIC, BMNH (Slide Nos. 1512/43, 44), data as holotype.

Material examined

Petrogale penicillata: holotype and paratypes.

Description

Temples behind eye straight. Third temporal seta near 2nd (Fig. 123). Prosternite triangular with 3 lateral macrochaetae and 1 spine between 1st and 2nd (Fig. 123). Marginal rows of setae on sternites with intercalaries. Tergites II–VI with marginal row of setae only with intercalaries; sternites with 1 marginal and 1 discal row.

Male.—Dorsolateral vesical sclerites bent anteriorly at right angles towards midline and connected by the transverse base of a densely scaled area of the vesica, this area with an arched transverse row of darker, larger, contiguous brown scales.

Measurements (in mm) ♂, holotype: HL 0.46; HB 0.70; HI 1.50; PrB 0.64; MsB 0.51; MtB 0.67; AB 0.97; SL 0.10; SD 0.30; STh 0.02; TL 2.99.

Female.—Vulvar margin with 5–6 strong setae each side of the deep emargination; 4–5 short setae in the middle. Genital papilla (Fig. 115G) well sclerotized, situated within round colourless area bordered posteriorly by the semicircular lunula; genital sternite deeply emarginate anteriorly.

Measurements (in mm) 3♀ paratypes, mean and range: HL 0.46; HB 0.66 (0.65–0.67); HI 1.43 (1.40–1.44); PrB 0.63 (0.62–0.64); MsB 0.50 (0.48–0.49); MtB 0.67 (0.64–0.70); AB 0.98 (0.94–1.02); SL 0.11 (0.10–0.12); SD 0.29 (0.29–0.30); STh 0.02 (0.02–0.03); TL 2.97 (2.91–3.03).

Discussion

This species differs in two characters from all other species of *Heterodoxus*. The third temporal seta is situated, as in *Macropophila*, nearer to the second temporal than to the posterior margin of the antennal groove, and the posterior margin of the metanotum has four strong setae, two each side of the midline, with 6–7 minute setulae.

Host

The nominal host is *Petrogale penicillata* (Griffith, Smith, and Pidgeon, 1827).

HETERODOXUS ANCORATUS, sp. nov.

(Figs. 39–42, 115J, 116S)

Types

Holotype: ♂, in ANIC (Slide No. 1497/6), from *Protetmnodon parryi* (CM. 36), 23.iv.1960, Mt. Lindesay foothills, Qld., J. H. Calaby.

Paratypes: 11♂, 6♀, in BMNH, ANIC; 4♂, 4♀, data as for holotype (1496/57, 58; 1979/6, 7); 6♂, 2♀, from *P. parryi*, Mt. Lindesay foothills, Qld., 23.iv.1960, J. H. Calaby (1513/21–24); 1♂, from *P. parryi* (CM 56), Beaudesert, Qld., 2.v.1960, J. H. Calaby (1497/8).

Material examined

Wallabia parryi.—syn. *Protetmnodon parryi*: holotype and 11♂, 6♀ paratypes.

Description

Temples behind eyes straight, 3rd temporal seta near posterior margin of antennal groove (Fig. 117). Prothorax distinctly narrower than head. Prosternite triangular, with 2 lateral macrochaetae and 1 spiniform seta between them, without apical (posterior) spines. Marginal rows of setae on sternites II–VI without intercalaries. Sternite II with finger-like prolongations extending to base of marginal setae.

Male.—Posterior margin of tergites IV–VI, at least, with a wide semicircular indentation each side. Vesica without long spines, and without longitudinal rows of long spines anterior to plates. Dorsolateral sclerites of vesica with posterior ends knobbed, anteriorly bent towards the middle and prolonged into 2 parallel ledges joined at their ends to a long slender, triangular, finely granulated plate with a chitinized point and an anchor-shaped tip (probably representing the cup-shaped chitinization of the anterior end of the vesica).

Measurements (in mm) 12♂, holotype and paratypes, mean and range: HL 0.45 (0.41–0.46); HB 0.62 (0.60–0.65); HI 1.40 (1.37–1.45); PrB 0.55 (0.54–0.57); MsB 0.45 (0.41–0.46); MtB 0.54 (0.49–0.58); AB 0.96 (0.91–0.98); SL 0.15 (0.15–0.16); SD 0.25; STh 0.03 (0.02–0.03); TL 2.89 (2.68–2.94).

Female.—Vulvar margin slightly excavated and finely granulated with a continuous row of 17–20 strong setae; margin of subgenital sclerite excavated; genital sternite deeply excavated anteriorly, with well-sclerotized, slightly arched lunula. Genital papilla very fine, hardly visible, conical with rounded tip and with apical opening of spermathecal duct. Postgenital marginal row of setae as in *alatus*, but with about 15 short median setae.

Measurements (in mm) 5♀ paratypes, mean and range: HL 0.46 (0.45–0.47); HB 0.63 (0.62–0.65); HI 1.39 (1.37–1.42); PrB 0.56 (0.55–0.57); MsB 0.46 (0.45–0.46); MtB 0.56 (0.54–0.58); AB 1.01 (0.98–1.04); SL 0.15 (0.14–0.15); SD 0.26; STh 0.03 (0.02–0.03); TL 2.84 (2.76–2.94).

Discussion

This species is distinguished in both sexes by the second (first visible) abdominal sternite, in which four short finger-like projections extend from the posterior margin to each of the four marginal setae.

Host

The nominal host is *Wallabia parryi* (Bennett, 1835).

HETERODOXUS CALABYI, sp. nov.

(Figs. 43–47, 115H, 116Q)

? *Heterodoxus longitarsus*, Harrison and Johnston, 1916, p. 354 (from *Macropus ualabatus*, Victoria; *M. dorsalis*, New South Wales); Werneck, 1941, p. 47 (from *Wallabia bicolor*, Victoria).

Types

Holotype: ♂, in ANIC (Slide No. 1496/56), from *Protemnodon dorsalis*, Gorge Creek, Bonalbo, N.S.W., 20.ii.1960, J. H. Calaby.

Paratypes: 16♂, 17♀, in ANIC, BMNH, all from *P. dorsalis*. 7♂, 9♀, data as holotype (Slide Nos. 1509/9–11, 1496/55, 56, 1513/8–11); 2♂, 2♀, Mt. Lindesay foothills, Qld., 24.iv.1960, J. H. Calaby (1513/12–13); 4♂, 3♀ (from CM 73, 74, 86), Logan Village, Qld., 5–11.v.1960, J. H. Calaby (1518/7–9); 1♀, Tooloom Scrub, N.S.W., 25.ii.1962, J. H. Calaby (1518/10); 3♂, 2♀, Vinegar Hill, nr. Legume, N.S.W., 17.ii.1962, J. H. Calaby (1500/1: 1–4).

Material examined

Wallabia dorsalis.—syn. *Protemnodon dorsalis*: holotype and 16♂, 17♀ paratypes, 1 nymph, Mt. Lindesay foothills, Qld., 24.iv.1960, J. H. Calaby (1513/14).

W. eugenii.—syn. *Thylogale eugenii*: 4♂, 3♀, Snug Cove, Kangaroo I., S.A., Oct. 1964, J. H. Calaby and M. J. Clark (1509/1–4).

W. bicolor.—1♂, 1♀, Victoria, A. S. Le Souëf, 1962–67 (1505/61, 62). Syn. *Macropus ualabatus*: det. ?, 1♂, 1♀, 1902–173 (1496/70) [identified as *H. longitarsus*].

Description

Temples behind eye straight. Prothorax distinctly narrower than head. Prosternite triangular with 2 lateral macrochaetae and 1 spiniform seta between them (Fig. 124B), without apical (posterior) spines.

Male.—Vesica without 2–4 long spines anterior to the plates, without longitudinal rows of long spines, without large brushes of dense strong spines lying just anterior to the dorsolateral sclerites which are paddle-shaped and converge gently anteriorly. Long setae of marginal row of tergites II–VI with definite intercalaries.

Measurements (in mm) 16♂ including holotype, mean and range: HL 0.43 (0.41–0.47); HB 0.64 (0.62–0.67); HI 1.48 (1.42–1.53); PrB 0.56 (0.54–0.58); MsB 0.46 (0.44–0.48); MtB 0.58 (0.55–0.61); AB 0.99 (0.94–1.02); SL 0.13 (0.13–0.15); SD 0.27 (0.24–0.28); STh 0.02 (0.02–0.03); TL 2.87 (2.77–3.03). The measurements of specimen 1505/61 from *W. bicolor* are within the range except HB 0.59; MsB 0.41; MtB 0.52.

Female.—Genital papilla bottle-shaped with a pencil-like apex (Fig. 115H). Vulva with almost straight, finely granulated margin with 4–8 strong marginal setae each side of the median group of 1–4 short ones; genital sclerite flatly emarginate anteriorly, with a round colourless area around the genital papilla and with a strong semilunar lunula; mouth of the spermathecal duct subapical. A short median row of 7–12 (21♀) weak, short postgenital marginal setae, bounded each end by 1 stronger and longer seta separated from the lateral row by a gap.

Measurements (in mm) 18♀, mean and range: HL 0.44 (0.43–0.46); HB 0.65 (0.62–0.70); HI 1.48 (1.40–1.60); PrB 0.56 (0.48–0.59); MsB 0.47 (0.45–0.49); MtB 0.59 (0.57–0.61); AB 1.01 (0.97–1.08); SL 0.14 (0.13–0.15); SD 0.28 (0.25–0.29); STh 0.03; TL 2.96 (2.83–3.09).

Discussion

H. calabyi is very similar to *macropus* but on average larger, the abdominal discal rows of setae less regular, and the setae less numerous. The male genital organ is quite distinctive, without analogy among the currently known species. The genital papilla of the female is also to some degree atypical, slender conical indeed, but in its apical third tubulose and with a short and bluntly conical tapering end; the duct is widened to its mouth, which is situated slightly subapically.

Hosts

The nominal host is *Wallabia dorsalis* (Gray, 1837); *W. eugenii* (Desmarest, 1817) is another host. The specimens described by Harrison and Johnston (1916) off *Wallabia dorsalis* were not among the present material.

The host record of *W. bicolor* (Desmarest, 1804) requires confirmation. The male and two females on Slide No. 1496/70 are probably those seen and described by Harrison and Johnston as *Heterodoxus longitarsus*, and the male and female from *Wallabia bicolor*, Victoria (Slides No. 1505/61, 62), are probably those described by Werneck (1941) as *H. longitarsus*.

HETERODOXUS LONGITARSUS (Piaget)

(Figs. 21–24, 115D, 116G, 116H, 120)

Menopon longitarsus Piaget, 1880, pp. 504–6, pl. 41, fig. 7 (♂, ♀, from *Halmaturus giganteus*, Zoo, Rotterdam).

Menopon (Menacanthus) longitarsus, Neumann, 1912, pp. 359–60, 367, fig. 5 (4♂, 4♀, from kangaroo, Jardin des Plantes, Paris; 1♂, 1♀, from wallaby, Hyslop).

Heterodoxus longitarsus, Johnston and Harrison, 1912, p. 13 (types of *H. macropus* conspecific); Cummings, 1913, p. 44 (types of *H. macropus* in BMNH conspecific with description; specimens from wallaby, north Queensland; from *Corone australis*, Victoria);

Neumann, 1913, p. 634 (syn. *H. spiniger*, *macropus*, *armiferus*); Harrison and Johnston, 1916, pp. 353-4, figs. 10-11 (specimens from *Macropus thetidis*, New South Wales; *M. ualabatus*, Victoria; *M. ruficollis*, Flinders I., Tas.; *M. bennetti*, Zoo, Melbourne; *M. dorsalis*, *M. robustus*, *M. giganteus*, *M. wilcoxi*, New South Wales; *M. stigmaticus*, Queensland; syn. *H. spiniger*, *macropus*, *armiferus*); Thompson 1937, p. 25 (Piaget types, 3♂, 3♀, 3 nymphs, in BMNH); Thompson 1939, p. 139 (Piaget types, 2♀, in LM); Plomley, 1940, p. 19 (not syn. *spiniger*, *ualabati*); Werneck, 1941, pp. 47-55, fig. 2 (1♂, 1♀ types, 1♀, from *Petrogale penicillata*, New South Wales; 1♀, from *Thylogale stigmatica*, Queensland; 1♀, from *Macropus agilis*, Queensland; 2♂, 2♀, from *Wallabia bicolor*, Victoria; 1♀, from wallaby, Western Australia); Werneck 1948, pp. 20-1 (syn. *H. spiniger*); Clay 1949, p. 836 (Piaget types, 3♂, 3♀, 3 nymphs in BMNH, 2♀, in LM); Hopkins, 1949, pp. 441-2 (hosts - *Thylogale stigmatica*, *Protemnodon agilis*, *P. dorsalis*, *P. rufogrisea*, *Macropus robustus*, *M. rufus*, *M. major*).

Types

Lectotype: ♂, in Piaget Collection, BMNH (Slide No. 426b), from *Macropus* (= *Halmaturus*) *giganteus*, Zoo, Rotterdam.

Paralectotypes: 2♂, 3♀, in Piaget Collection, in BMNH (Slide Nos. 425, 426a, 427), 2♀, in LM, data as lectotype.

Material examined

Wallabia rufogrisea.—det. ?, 2♂, 2♀, Tamborine, Qld., 20.x.1950, R. Riek, 1953-331 (1508/7, 8). Syn. *Protemnodon rufogrisea*: 4♂, 3♀, Logan Village, Qld., 5-11.v.1960, J. H. Calaby (1496/59-60, 1497/3, 1505/58); 4♂, 4♀, 2 nymphs, The Risk, N.S.W., 4.xi.1961, J. H. Calaby (1496/61-64); 2♂, 1 nymph, Mt. Lindesay foothills, Qld., 23.iv.1960 (1505/59). Syn. *Macropus bennetti*: det. ?, 3♀, Flinders I., Tas., 3.xi.1912, R. N. Atkinson (1505/79, 80; 1508/6).

Description

Temples behind eyes straight. Third temporal seta near posterior margin of antennal groove (Fig. 117).

Prothorax distinctly narrower than head. Prosternite triangular with 2 lateral macrochaetae and 1 spine between them, without apical (posterior) spines.

Sternite II with finger-like prolongations extending to base of marginal setae. Marginal rows of setae on sternites II-VI without intercalaries. Posterior margin of tergites IV-VI, at least, with a wide semicircular indentation on each side (Figs. 22, 120). Long setae of marginal row of tergites II-VI without intercalaries, discal row of shorter setae lies just anterior, but its setae never actually interspersed with the marginal ones.

Male.—Vesica without pairs of long spines, or longitudinal rows of long spines anterior to the plates. Dorsolateral vesical sclerites each prolonged anteriorly into a broad chitinous plate.

Measurements (in mm) 12♂, mean and range: HL 0.47 (0.45-0.49); HB 0.68 (0.64-0.70); HI 1.47 (1.40-1.60); PrB 0.59 (0.55-0.61); MsB 0.49 (0.46-0.52); MtB 0.61 (0.58-0.67); AB 1.10 (1.04-1.18); SL 0.16 (0.15-0.17); SD 0.27 (0.23-0.28); STh 0.03 (0.02-0.03); TL 3.04 (2.89-3.19).

Female.—Vulva straight, densely and roughly granulated with a continuous row of 18-25 long and strong setae; genital papilla conical, as long as broad, apex blunt, with mouth of spermathecal duct apical; genital sternite with 4 parallel arms, the outer pair longer than inner and a straight, horizontal, strongly sclerotized lunula; postgenital sternum with 4 median setae just behind marginal row (Fig. 120).

Measurements (in mm) 11♀, mean and range: HL 0.46 (0.44-0.48); HB 0.69 (0.65-0.71); HI 1.49 (1.46-1.54); PrB 0.59 (0.57-0.61); MsB 0.48 (0.44-0.52); MtB 0.61 (0.57-0.64); AB 1.11 (1.02-1.17); SL 0.16 (0.15-0.17); SD 0.27 (0.27-0.28); STh 0.03; TL 3.01 (2.73-3.16).

Discussion

After a long period of confusion of *H. longitarsus* with other described or undescribed species, male specimens of this species have been clearly defined by Werneck (1941) who has published excellent figures of the male genitalia of *H. spiniger* (Enderlein) and *H. longitarsus* (Piaget). The present investigation shows that both sexes of all species of *Heterodoxus* are perfectly distinguishable. Some of the material previously ascribed to this species is now considered to be *Macropophila biarcuata*, sp. nov., or *breviaruata*, sp. nov., *Heterodoxus macropus*, or *H. octoseriatus*, sp. nov.

Hosts

The nominal host, *Macropus giganteus* Shaw, has been subsequently recorded by Harrison and Johnston, but these specimens have probably been misidentified, the male copulatory organ in their figure 11 being that of *ualabati* and not *longitarsus*. Most other records of Harrison and Johnston are due to misdetermination. The same applies to records of Werneck. Three records of *Macropus rufus* recorded by Hopkins (1949) are probably independent, but lack data. Most of the host species recorded for *Heterodoxus longitarsus* are hosts of new species described in the present paper. The nominal host therefore has not been confirmed.

Wallabia rufogrisea (Desmarest, 1817) is a host.

HETERODOXUS MAAI* Emerson

(Figs. 74-77, 115P)

Heterodoxus maai Emerson, 1962, p. 240, figs. 1-3.

Types

Holotype: ♂, in Bernice P. Bishop Museum, Honolulu (Bishop 6585), from *Dorcopsis veterum* (Lesson, 1826) (American Museum of Natural History No. 193156), Eramboe, West Irian, 2.xi.1960, T. C. Maa.

Paratypes: ♀, with holotype; 1♂, in Bernice P. Bishop Museum, data as holotype; 1♂, 1♀, in KCE coll., data as holotype.

Material examined

Dorcopsis veterum: holotype and ♀ paratype (Bishop 6585).

Description

Temples behind eye straight, 3rd temporal seta near posterior margin of antennal groove. Prothorax as broad or nearly as broad as head (0.710-0.746: 0.725-0.760 mm). Prosternite triangular, with 2 lateral macrochaetae and 1 spiniform seta each side, 4-6 spiniform setae posteriorly. Marginal rows of setae on sternites II-VI without intercalaries. Sternites V-VI with two rows of discal setae.

* This description, with the accompanying figures, has been prepared by Dr. Theresa Clay. Dr. Nixon Wilson of the Bernice P. Bishop Museum, Honolulu, kindly made the holotype and paratype available for examination.

Description

Temples behind eye straight. Third temporal setae near posterior margin of antennal groove (Fig. 117). Prothorax as broad or nearly as broad as head (0.710–0.746: 0.725–0.760). Prosternite triangular, with 2 lateral macrochaetae and 1 spine between them; posteriorly 4–6 spiniform setae (Fig. 124B). Sternites V–VI with 2 rows of discal setae.

Male.—Vesica strongly sclerotized, rigid, bottle-shaped with rounded anterior end, membranous posteriorly, uniformly denticulated all over.

Measurements (in mm) 2♂, holotype followed by paratype: HL 0.49, 0.52; HB 0.75, 0.73; HI 1.51, 1.39; PrB 0.73, 0.71; MsB 0.52, 0.57; MtB 0.65, 0.70; AB 1.02, 0.99; SL 0.14, 0.12; SD 0.29, 0.26; STh 0.02, 0.02; TL 3.25, 3.26.

Female.—Genital papilla small, conical, rounded anteriorly (Fig. 115I). Vulvar setae all stout, 12–13 in 3 groups, the 4–5 central ones shorter. Gonapophyses long and straight, their apical spur nearly as long as the gonapophyses themselves. Genital sternite deeply excavated anteriorly with slightly sclerotized oval or rectangular lunula behind the genital papilla; small tubercle with pigmented margin present each side dorsal to subgenital lobe.

Measurements (in mm) 4♀ paratypes, mean and range: HL 0.51 (0.51–0.52); HB 0.75 (0.74–0.76); HI 1.47 (1.44–1.49); PrB 0.74 (0.71–0.75); MsB 0.54; MtB 0.69 (0.68–0.70); AB 1.07 (1.03–1.13); SL 0.13 (0.12–0.13); SD 0.29 (0.28–0.30); STh 0.03 (0.02–0.03); TL 3.39 (3.31–3.54).

Discussion

H. mitratus is of the general type of *Heterodoxus*, but with 4–6 spines on the posterior end of the prosternum, as in *Macropophila forcipata*. This species is nearest to *H. maai* Emerson in its chaetotaxy and in the breadth of the head, which is equal to the breadth of the prothorax while in all other *Heterodoxus* species known to me the prothorax is always distinctly narrower than the head. The antennal grooves in *H. mitratus*, as in all other *Heterodoxus* before me, are ventrally open, i.e. their ventral lobes do not reach to the margin of the head and consequently the antennal clubs are freely visible in the ventral aspect. The genital characters of male and female *maai** Emerson cannot be judged exactly from the original description, but the vesical plates seem to be quite different. In *mitratus* the prothorax is not rounded as in all other *Heterodoxus* species, but slightly angulated posteriorly.

Host

The nominal host is *Dorcopsulus vanheurni* (Thomas, 1922).

HETERODOXUS OCTOSERIATUS, sp. nov.

(Figs. 56–59, 115O, 116Y, 116Z, 125)

?*Heterodoxus longitarsus*, Werneck, 1941, p. 47 (1♂, 1♀, from *Petrogale penicillata*, New South Wales, in GBT coll.).

Types

Holotype: ♂, in ANIC (Slide No. 1496/4), from *Petrogale penicillata*, 5.viii.1960, Gorge Creek, Bonaibo, N.S.W., J. H. Calaby.

* See page 57.

Paratypes: 4♂, 8♀, in BMNH, ANIC; 2♀ (Slide No. 1496/4); 1♂, 2♀ (Slide No. 1496/5), data as holotype; 1♀, 1962–677 (Slide No. 1505/6), from *P. penicillata*, New South Wales; 2♂, 1♀ (Slide No. 1497/1), from *P. penicillata*, 10.viii.1960, Peacock Creek, Bonaibo, N.S.W., J. H. Calaby; 2♀ (Slide No. 1505/7), from *P. penicillata*, 27.ii.1962, Upper Clarence R., N.S.W., J. H. Calaby; 1♂, 1962–677 (Slide No. 1505/5), from *P. penicillata*.

Material examined

Petrogale penicillata.—Holotype and 4♂, 8♀ paratypes.

Description

Temples behind eye straight. Third temporal seta nearer to posterior margin of the antennal groove than to the 2nd temporal seta. Prothorax distinctly narrower than head. Prosternite triangular with 2 lateral macrochaetae and 1 spine between them, without apical discal spines. Abdominal tergites II–VI with 1 row of long setae and with intercalaries; sternites with 2 rows of setae, the posterior without intercalaries, the anterior not intercalating with the posterior one.

Male.—Vesica with long paired spines before the plates.

Measurements (in mm) holotype and 4 paratypes, mean and range: HL 0.43 (0.41–0.45); HB 0.63 (0.61–0.64); HI 1.46 (1.42–1.50); PrB 0.55 (0.54–0.57); MsB 0.46 (0.44–0.48); MtB 0.60 (0.56–0.62); AB 0.97 (0.94–1.02); SL 0.13; SD 0.26 (0.24–0.27); STh 0.02 (0.02–0.03); TL 2.88 (2.82–2.96).

Female.—No special features not covered by general description and measurements.

Measurements (in mm) 8 paratypes, mean and range: HL 0.44 (0.42–0.45); HB 0.63 (0.61–0.65); HI 1.44 (1.41–1.46); PrB 0.57 (0.54–0.59); MsB 0.46 (0.41–0.49); MtB 0.59 (0.58–0.62); AB 0.99 (0.94–1.03); SL 0.13 (0.10–0.15); SD 0.26 (0.23–0.28); STh 0.03 (0.02–0.03); TL 2.84 (2.78–2.93).

Host

The nominal host is *Petrogale penicillata* (Griffith, Smith, and Pidgeon, 1827).

HETERODOXUS PYGIDIALIS Mjöberg

(Figs. 65–68, 115N)

Dendrolagia pygidialis Mjöberg, 1919, p. 94 (from *Dendrolagus lumholtzi*, Malanda and Cedar Creek, Qld.).

Type

Enquiries from the Naturhistoriska Riksmuseet, Stockholm, show that the type material is apparently missing from the Mjöberg collection there. A neotype has therefore been designated.

Neotype here designated: ♂, in ANIC (Slide No. 1505/92), from *Dendrolagus lumholtzi*, Atherton, Qld., 2.xi.63, K. Keith.

Material examined

Dendrolagus lumholtzi.—Neotype; 4♂, 4♀, data as neotype (1505/92–96).

Description

Temples behind eye slightly concave. Prosternite quadrangular, corners rounded with 1 seta on the anterolateral and 1 spine on the posterolateral corner.

Male.—Dorsolateral vesical sclerites joined anteriorly forming a lyrate figure.

Measurements (in mm) 5♂ including neotype, mean and range: HL 0.41 (0.40–0.41); HB 0.56 (0.56–0.57); HI 1.37 (1.34–1.40); PrB 0.47 (0.46–0.48); MsB 0.41 (0.41–0.42); MtB 0.46 (0.46–0.48); AB 0.90 (0.90–0.91); SL 0.13 (0.13–0.14); SD 0.23 (0.22–0.25); STh 0.03; TL 2.45 (2.42–2.49).

Female.—Genital papilla broadly bell-shaped (Fig. 115N). Tergites and sternites each with a marginal and discal row of setae, without intercalaries; vulvar margin slightly concave with 3 long and 2–3 short setae each side of midline; gonapophysal spur as long as gonapophysis itself.

Measurements (in mm) 4♀, mean and range: HL 0.41; HB 0.57 (0.56–0.58); HI 1.38 (1.34–1.45); PrB 0.48 (0.46–0.49); MsB 0.42; MtB 0.47 (0.46–0.48); AB 0.95 (0.91–1.02); SL 0.13; SD 0.23 (0.22–0.23); STh 0.03; TL 2.46 (2.41–2.54).

Discussion

I do not find any generic difference between *Dendrolagia pygidialis* Mjöberg and all the species of *Heterodoxus* before me. The head is typical of *Heterodoxus*, having no similarity at all to *Boopia*. The postocular margins of the temples are slightly concave and not so straight as in *Heterodoxus*, but this is the only difference and does not change the typical triangular outline of the *Heterodoxus* head. The third temporal seta is typical in position for all *Heterodoxus*, before and somewhat median to the second. The male genital organ is, of course, different from all other *Heterodoxus*, but it is of the same general type with two median plates, the anterior quite similar to that of other *Heterodoxus* species, the posterior somewhat different; and a pair of lateral sclerites or chitin bands, complicated as in all *Heterodoxus*, anteriorly connected to an arched rim. Another somewhat atypical character, but with no generic rank, is the female genital papilla, which is not slender but broadly and shortly conical, being at its base broader than long, rather well sclerotized (Fig. 115). Much more "atypical" is the genital papilla of *Heterodoxus macropus*. The gonapophyses of *H. pygidialis* are slender triangular, provided with a long and strong apical spur as in *H. mitratus*, while all other species of *Heterodoxus* possess broadly triangular gonapophyses with a short or very short apical spur. In *pygidialis*, as in all other *Heterodoxus* species, they have no lateral lobe bearing the strong basal setae and are dorsally not fused with the ninth tergopleurite. The abdominal chaetotaxy is similar to that of *H. ualabati*, *longitarsus*, or *spiniger*, with both marginal rows without intercalaries and with tergal and sternal discal setae irregularly scattered in two rows. The prothorax is, as in all species of *Heterodoxus*, transversely elliptical with rounded sides; the lateral discal spine of *Heterodoxus* species is, indeed, replaced by a strong seta. It may be added that the tooth of the anterior coxae just before the trochanter is blunter than in other species of *Heterodoxus*.

Host

The nominal host, *Dendrolagus lumholtzi* Collett, 1884, is confirmed.

HETERODOXUS QUADRISERIATUS, sp. nov.

(Figs. 60–64, 115M, 116V–116X)

Types

Holotype: ♂, in ANIC (Slide No. 1496/72), from *Setonix brachyurus*, Bald I., W.A., 1954, G. B. Sharman.

Paratypes: 7♂, 6♀, in BMNH, ANIC. 1♀ (Slide No. 1496/72), data as holotype; 1♂, 1♀ (Slide No. 1505/91), 2♂, 1♀ (Slide Nos. 1497/14, 15), from *Setonix brachyurus*, 7.i.1955, Rottneest I., W.A., G. M. Dunnet; 4♂, 3♀, 1337 (Slide Nos. 1496/73–76), from *Setonix brachyurus*, Rottneest I., W.A.

Material examined

Setonix brachyurus.—holotype and 7♂, 6♀ paratypes.

Description

Temples behind eyes straight, 3rd temporal seta near posterior margin of antennal groove (Fig. 117). Prosternite triangular, with 2 lateral macrochaetae and 1 spine between them, without spiniform setae posteriorly. Abdominal terga II–VI with 1, the marginal, row of strong setae and with short intercalaries. Sterna with 1 marginal row of strong setae without intercalaries and with 1 discal row of short setae not intercalating with the posterior row.

Male.—Vesica with 4 longitudinal rows of long spines within an oval, more finely denticulated area anterior to the plates.

Measurements (in mm) 8♂, holotype and paratypes, mean and range: HL 0.37 (0.34–0.39); HB 0.54 (0.52–0.59); HI 1.49 (1.43–1.56); PrB 0.49 (0.46–0.52); MsB 0.39 (0.38–0.44); MtB 0.49 (0.47–0.54); AB 0.76 (0.72–0.80); SL 0.10 (0.10–0.11); SD 0.22 (0.21–0.24); STh 0.02; TL 2.48 (2.23–2.55).

Female.—Second sternite without finger-like projections. Vulvar margin emarginate, finely granulate, more strongly so at the sides, with 1 small (lateral) and 4–5 (mediad) strong setae each side of midline. Genital sternite anteriorly butterfly-shaped, posteriorly deeply emarginate with indistinct, light brown lunula. Postgenital sclerite as in *ancoratus*, but without the supplementary setae.

Measurements (in mm) 6♀ paratypes, mean and range: HL 0.38 (0.37–0.41); HB 0.56 (0.54–0.60); HI 1.47 (1.42–1.50); PrB 0.51 (0.49–0.54); MsB 0.40 (0.39–0.44); MtB 0.52 (0.49–0.57); AB 0.85 (0.83–0.87); SL 0.10; SD 0.22 (0.19–0.23); STh 0.02 (0.02–0.03); TL 2.60 (2.49–2.77).

Host

The nominal host is *Setonix brachyurus* (Quoy and Gaimard, 1830).

HETERODOXUS SPINIGER (Enderlein)

(Figs. 17–20, 82, 84, 115E, 116J, 116K–N, 117, 118, 119)

- Menopon spiniger* Enderlein, 1909, pp. 80–1, pl. 8, figs. 4 and 5 (♂, ♀, from house dog of a Bechuane, May 1904, Sekgoma, Kalahari).
Menacanthus spiniger, Howard, 1912, p. 213.
Menopon (Menacanthus) spinigerum Neumann, 1912, pp. 364–5, 367.
Heterodoxus spiniger, Plomley, 1940, pp. 19–20, pls. 3–6, Thompson, 1940, pp. 27–31; Werneck, 1941, pp. 47–55, fig. 1; Stafford, 1943, p. 36; Hopkins, 1947, pp. 181–2; Werneck, 1948, pp. 21–2, figs. 4 and 5; Hopkins, 1949, p. 441; von Kéler, 1952, p. 19; Ansari, 1952, p. 133; Tendeiro, 1953, pp. 501–14; Rocha, Campos, and Lenci, 1955, pp. 335–6.
Heterodoxus longitarsus, Neumann, 1913, pp. 631–4 (from dog, Formosa, Malay Peninsula); Cummings, 1913, p. 44; Kellogg and Ferris, 1915, p. 67 (syn. *H. macropus*, *H. spiniger*); Bedford, 1919, p. 718; Achida, 1926, p. 6; McCulloch, 1933, pp. 617–19, fig.; Ward, 1934, pp. 22–3, figs. 1–2; Roberts, 1936, p. 240; Werneck, 1936, pp. 492–5, figs.

126-129; Bhattacharjee, 1939, p. 438; Emerson, 1940, p. 104; Eichler, 1947, p. 14; Wolcott, 1948, p. 76; Eichler, 1953, p. 171.

Heterodoxus armiferus Paine, 1912, p. 362, figs. A-D (1♂, 3♀, from dog, Berkeley, California, U.S.A.); Harrison, 1916, p. 30 (syn. *H. longitarsus*); Werneck, 1941, p. 50 (syn. *H. spiniger*).

Types

*Lectotype here designated: ♂ in the Zoologisches Museum der Humboldt-Universität, Berlin (Slide No. 902, 1331/39-2), from house dog, Kalahari, Sekgoma, May 1904.

Paralectotypes: 4♀ in the Zoologisches Museum, Berlin (Slide Nos. 902, 1331/39-2, 1331/39-7), data as lectotype.

Material examined

Canis familiaris.—det. ?, 1♂, Ceylon, 1963 (1514/2); det. ?, 7♂, 7♀, Villarica, Paraguay, 19.viii.1938, F. H. Chade (1514/1). Syn. *Canis domesticus*: det. ?, 1♂, 1♀, Tel Aviv, Israel, Dec. 1938, 1595-56 (1514/3).

Canis adustus.—syn. *Thos adustus bweha*: det. ?, 2♂, 7♀, near Soroti, Uganda, May 1944, J. M. Watson (1496/84).

Wallabia agilis†.—syn. *Protetnodon agilis*: 2♂, 3♀, Iron Range, Qld., 31.vii.64, K. Keith (1518/11, 12).

Description

Temples behind eye straight. Third temporal seta near posterior margin of antennal groove (Fig. 117).

Prothorax distinctly narrower than head. Prosternite triangular with 2 lateral macrochaeta and 1 spine between them, without apical (posterior) spines.

Marginal rows of setae on sternites II-VI without intercalaries, 2 irregular discal rows, the most anterior with only a few setae. Long setae of marginal row of tergites II-VI without intercalaries, discal row of shorter setae lies just anterior, but its setae never actually interspersed with the marginal ones.

Male.—Vesica with pairs of long spines (Fig. 118), without longitudinal rows of denticles.

Measurements: see Table 2.

Female.—Genital papilla broadly rounded apically, as broad as long, without distinct lunula behind it and with sclerotized strip anteriorly (Fig. 115). Mouth of spermathecal duct wide, subapical; subgenital lobe deeply emarginate posteriorly; genital sclerite deeply emarginate anteriorly; postgenital sternum without 4 median setae behind marginal row (Fig. 119). Vulvar margin straight, smooth, membranous in the middle with 7-10 strong marginal setae each side.

Measurements: see Table 2.

Discussion

Plomley's statement that besides the sexual characters of males and females there is "no other character of absolute diagnostic value" is not quite right; see key to species of *Heterodoxus*.

* Although Dr. von Kéler must have seen this type material as it has his numbers on the slides, he omitted to mention it in his paper. Through the kindness of Dr. U. Göllner-Scheiding it has been possible to examine the specimens and a lectotype has been designated. T.C.

† From discussion with Mr. K. Keith there is no doubt that this is an authentic record from a wild animal. J.H.C.

Dr. Theresa Clay has kindly called my attention to the fact that the specimen from *Wallabia agilis* in Figure 118 shows but one pair of vesical spines, while in my original key to the species (now amended) two pairs are mentioned.* In fact, both the males examined from *W. agilis* possess but one pair of these spines and seven males examined from dogs possess either two pairs or in addition have one smaller fifth spine in one of the rows. Not having found any other differences between the males and females of the two populations, I am convinced that the number of vesical teeth is in some degree individually variable and that both the populations are conspecific.

TABLE 2

MEASUREMENTS OF MALE AND FEMALE *HETERODOXUS SPINIGER*

All values given in millimetres. When there are two specimens, measurements of both are given; when there are more than two, the mean is given with the range in parentheses

	<i>Canis familiaris</i>			<i>Canis adustus</i> (2♂, 7♀)	<i>Wallabia agilis</i> (2♂, 3♀)
	Paraguay (7♂, 7♀)	Ceylon (1♂)*	Israel (1♂, 1♀)†		
	Males				
HL	0.43 (0.42-0.44)	0.39	0.46	(0.45-0.46)	(0.43-0.44)
HB	0.62 (0.61-0.65)	0.61	0.66	(0.70-0.71)	(0.62-0.63)
HI	1.45 (1.43-1.48)	1.56	1.42	(1.53-1.55)	(1.45-1.46)
PrB	0.54 (0.53-0.57)	0.52	0.59	(0.61-0.62)	0.54
MsB	0.41 (0.38-0.44)	0.42	0.51	(0.48-0.51)	(0.41-0.42)
MtB	0.53 (0.49-0.55)	0.52	0.62	0.58	(0.49-0.51)
AB	0.96 (0.91-1.00)	0.93	1.04	(0.97-0.99)	(0.90-0.91)
SL	0.13 (0.12-0.15)	0.11	0.15	0.16	0.15
SD	0.25 (0.24-0.26)	0.24	0.24	(0.26-0.28)	(0.27-0.28)
STh	0.03 (0.02-0.03)	0.02	0.03	0.03	(0.03-0.04)
TL	2.75 (2.64-2.83)	2.62	3.07	(2.47-2.58)	(2.71-2.73)
	Females				
HL	0.43 (0.43-0.44)		0.46	0.45 (0.44-0.49)	0.45 (0.44-0.46)
HB	0.64 (0.61-0.67)		0.65	0.69 (0.67-0.71)	0.64 (0.64-0.65)
HI	1.48 (1.41-1.53)		1.40	1.49 (1.41-1.53)	1.42 (1.37-1.48)
PrB	0.56 (0.55-0.59)		0.59	0.61 (0.59-0.62)	0.56 (0.54-0.57)
MsB	0.46 (0.44-0.48)		0.51	0.50 (0.47-0.52)	0.45 (0.44-0.48)
MtB	0.57 (0.57-0.58)		0.62	0.63 (0.59-0.67)	0.55
AB	1.09 (1.03-1.13)		1.16	1.03 (0.97-1.09)	1.00 (0.97-1.02)
SL	0.14 (0.12-0.15)		0.15	0.16 (0.14-0.17)	0.13 (0.12-0.15)
SD	0.26 (0.23-0.28)		0.23	0.28 (0.26-0.29)	0.29 (0.28-0.29)
STh	0.03		0.03	0.03	0.03 (0.03-0.05)
TL	2.94 (2.94-3.07)		3.19	2.88 (2.32-3.20)	2.79 (2.77-2.83)

*Slide number 1514/2.

† Slide number of male and female 1514/3.

Hosts

The nominal host, *Canis familiaris* Linn., 1758, has been confirmed by many records from all continents except Europe and Antarctica. The other hosts which have been reported include *Canis aureus* Linn., 1758, common jackal (Cummings 1913; Hopkins 1947); *Canis cruesemanni* Matschie, 1900, syn. *C. ?aureus* Linn., 1758 (Eichler 1953); *Canis adustus* Sundevall, 1846, syn. *Thos adustus bweha* Heller, 1914, side-striped jackal (von Kéler 1952); *Canis latrans* Say, 1823, coyote (Plomley 1940);

*I now have specimens from *W. agilis* with two pairs of vesical spines. T.C.

Cuon alpinus (Pallas, 1811), syn. *C. javanicus* (Desmarest, 1820) (Eichler 1953); *Felis geoffroyi* D'Orbigny and Gervais, 1844, *Oncifelis salinarum* (Thomas, 1903) (Werneck 1936); *Wallabia bicolor* (Plomley 1940); man (Plomley, 1940); *Corvus coronoides* Vigors and Horsfield, 1827, syn. *Corone australis* Gould, 1865 (Cummings 1913). Only *Canis aureus* and *C. adustus* of the additional hosts have been confirmed. The record from *Wallabia agilis* makes probable the occurrence of *H. spiniger* on Australian marsupials. It is uncertain whether the specimens off *Corvus coronoides* and man belong to *spiniger* or *longitarsus*.

HETERODOXUS UALABATI Plomley

(Figs. 25-29, 115F, 116O)

Heterodoxus ualabati Plomley, 1940, pp. 21-6, pl. 3K, 4C, 4I, 5B, 5H, 6A (2♂, from "black wallaby", Victoria, A. S. Le Souëf; 5♂, from *Wallabia bicolor*, 10.v.1927, Zoo, Sydney; 4♂, from *W. bicolor*, Victoria); Werneck, 1948, p. 22 (syn. *H. macropus*); Hopkins, 1947: 176-8.

Types

Lectotype here designated: ♂, in SPHTM (Slide No. NJBP/1), det. N.J.B.P., from *Wallabia bicolor* Desmarest, Victoria.

Paralectotypes: 5♂, in SPHTM (Slide Nos. NJBP/2-5). 1♂, data as lectotype; det. N.J.B.P., 2♂, from *Wallabia bicolor*, Zoo, Sydney, 10.v.1927; det. N.J.B.P., 2♂, from "black wallaby", Victoria, A. S. Le Souëf.

Material examined

Wallabia bicolor.—1♂, San Remo, Vic., R. M. Warneke, 27.ix.1962 (1505/60). Syn. *Protemnodon bicolor*: det. ?, 2♂, 1♀, near Cougal, N.S.W., 28.x.1961, J. H. Calaby, 1962-186 (1496/53, 54); 3♂, 2♀, nymphs, Logan Village, Qld., 28.iv.1960, J. H. Calaby (1509/12-15); 4♂, 2♀, E. of Hoskinstown, N.S.W., 24.ii.1960 (1497/4, 5; 1505/66); 4♂, 4♀, 5 nymphs, 6 miles E. of Hoskinstown, N.S.W., 24.ii.1960, D. L. McIntosh (1512/27-33); 2♂, 1♀, 1 nymph, "Fairbank", N.S.W., 8.vi.1960, D. L. McIntosh (1513/6, 7).

Description

Temples behind eye straight. Third temporal seta near posterior margin of antennal groove.

Prothorax distinctly narrower than head. Prosternite triangular with 2 lateral macrochaetae with 1 spine between them, without apical (posterior) spines.

Marginal rows of setae on sternites II-VI without intercalaries. Long setae of marginal row of tergites II-VI without intercalaries, discal row of shorter setae lies just anterior, but its setae never actually interspersed with the marginal ones.

Male.—Vesica without 2-4 long spines or longitudinal rows of long spines anterior to the plates; 2 large conical brushes of dense strong spines lie just anterior to dorso-lateral sclerites.

*Measurement** (in mm): TL 2.9-3.5.

Female.—Genital papilla much longer than broad, slender conical, apex sharply pointed (Fig. 115). Mouth of spermathecal duct subapical. Vulvar margin broadly emarginate, densely but finely granulated, with a continuous row of 20-23 strong setae; postgenital sternum with 4 median setae just behind marginal row.

Measurement (in mm): TL 3.1-3.4.

* Measurements of lectotype (in mm): HL 0.44; HB 0.70; PrB 0.64; MsB 0.50; MtB 0.61; AB 1.09; SL 0.16; SD 0.18; STh 0.04; TL 3.00. M.D.M.

Discussion

The interpretation of this species is discussed under *H. macropus* (p. 59).

Host

Wallabia bicolor (Desmarest, 1804) is confirmed as host.

Genus PARAHETERODOXUS Harrison & Johnston

Paraheterodoxus Harrison & Johnston, 1916, pp. 356-7; Werneck and Thompson, 1940, p. 445; Werneck, 1948, p. 26.

Type species *Paraheterodoxus insignis* Harrison & Johnston, 1916.

Species

Pa. calcaratus, sp. nov., *erinaceus*, sp. nov., *insignis* Harrison & Johnston.

Description

Head without horn-shaped projection posterior to base of maxillary palp, without strong dilatations of margin. Preocular and ocular lobes not prominent, without notch; sides of head nearly straight, diverging posteriorly, postocular temporal margin forming at most an angle of 160° with the ocular margin; temporal lobes with but one rounded edge, the posterior; eyes not prominent. Ocular seta never on a projecting wart. Head on ventral side with a pair of strong alveolar spines behind the posterior tentorial pits. Maxillary palp 4-jointed with 3 joints reaching beyond the margin of head.

Pronotum usually slightly narrower than head, with broadly rounded sides, rarely slightly angulated posteriorly. Mesonotum smaller than metanotum, with 1 pair of large colourless warts bearing 1 strong spine, 1 small seta behind it and usually 1 minute setula near the margin of the alveolus of spine. Abdominal spiracles on pleurites, trichobothrial hairs on pleurae II-IV (as in Fig. 81).

Discussion

This genus is, like *Phacogalia*, transitional between *Boopia* and *Heterodoxus*. The head outline of *insignis* and *erinaceus*, sp. nov., is more like that of *Heterodoxus* than that of *calcaratus*, sp. nov., which is similar to *Phacogalia*. The prothorax in all three species is more like that of *Boopia*. The distribution of the temporal setae is not like that of *Boopia* or *Heterodoxus*, the third not arising before the second but before the first or in the middle before the first and second. The eyes are slightly prominent in *insignis* and *calcaratus*, not at all so in *erinaceus*. The margin of the pronotum has two short strong spines anterior to the external macrochaeta. The chaetotaxy of the abdomen differs from all *Boopia* and *Heterodoxus* in possessing one pair of lateral sternal and tergal spines. The anterior coxae are toothed just before the trochanter as in *Heterodoxus* and *Macropophila*. The maxillary thorn-shaped protuberance present in all *Heterodoxus* and *Macropophila* is wanting. Post-tentorial alveolar spines are placed on dilatations of the anterior ends of the occipital rims, being strong in *insignis* and *calcaratus*, weak and small in *erinaceus*. The occipital macrochaeta of the ventral side of the head is placed close to the spine in *insignis* and *calcaratus*, and is more posterior in *erinaceus*. The membranous papilla between the anterior coxae, flanked both sides by a minute seta, is more like that in *Boopia*. (I have not mentioned this papilla, which seems to be present in all Boopiidae, in the Introduction.)

The posterior median plate of the vesica is as in *Boopia*, lyrate and not, as in *Heterodoxus*, bilobed or quadrangular. The gonapophyses are like those in *Boopia*, provided with a projecting lateral lobe for the large basal setae. They are fused with the ninth pleurite as in *Boopia*, and not separated from it and articulated as in *Heterodoxus*. In *Pa. erinaceus* the gonapophyses are greatly reduced and their lateral lobes greatly enlarged (Fig. 129).

KEY TO SPECIES OF *PARAHETERODOXUS*

- Gula with pair of posteriorly diverging sclerites, each with a small spiniform seta in the middle and a long seta on the posterior end *erinaceus*
Gula with pair of roundish papillae, posteriorly each with a strong spiniform seta on the inner sclerotized end and a long seta on the outer membranous part (Fig. 126) 2
- Lateral wings of anterior median vesical plate each prolonged anteriorly as a narrow chitinous plate ending in a triangular tooth reaching nearly to anterior end of vesica; vesica cylindrical (Fig. 127). Setae of lateral projection of female gonapophysis not very strong and similar in form *insignis*
Lateral wings of anterior median vesical plate united to form a short plate which projects anteriorly as a short blunt or long slender style; vesica oval. Lateral projection of female gonapophysis with 1 strong apical setae and about 4 shorter and finer ones *calcaratus*

PARAHETERODOXUS *CALCARATUS*, sp. nov.

(Figs. 73, 128)

Paraheterodoxus insignis, Werneck and Thompson, 1940, p. 446 (2♀, 1 nymph, from *Wallabia bicolor*, Gippsland, Vic., June 1898, A. S. Le Souëf).

Types

Holotype: ♂, in ANIC (Slide No. 1496/2), from *Bettongia penicillata*, Dryandra, W.A., 13.ix.1954, G. M. Dunnet.
Paratypes: 1♀, in ANIC (Slide No. 1496/2), data as holotype; 1♂, 1♀, in BMNH (Slide No. 1496/3), data as holotype.

Material examined

Bettongia penicillata.—♂ holotype and 1♂, 2♀ paratypes.
Wallabia bicolor.—det. F.L.W. and G.B.T., 2♀, 1 nymph, Gippsland, Vic., June 1898, A. S. Le Souëf, BMNH, 1962-677 (1505/63, 1512/21, 22) [identified as *H. insignis*].

Description

Similar to *P. insignis* but the postocular temporal margins are not, or hardly visibly, concave. The chaetotaxy of the body without remarkable differences.

Male.—The wings of the anterior vesical median plates united anteriorly and produced into a short, bluntly rounded style in one male and a long and slender one in the other. The posterior margin of the anterior median plate with a short tooth as in most *Boopia*. The lateral sclerites of vesica long, with a blunt tooth-shaped edge in the middle of their median margin, similar to that of *Boopia bettongia*.

Measurements (in mm) 2♂ (1496/2 and 3): HL 0.40, 0.40; HB 0.68, 0.70; HI 1.72, 1.75; PrB 0.59, 0.62; MsB 0.48, 0.52; MtB 0.70, 0.70; TL 2.76, 2.77.

Female.—Vulva with 3 : 3 : 3 or 3 : 2 : 3 setae, the lateral ones longer and stronger than the median. Postgenital sternum with continuous row of weak marginal setae,

the lateral 7-8 stronger than about 10 median ones. Genital sternite without lunula; lateral projections reaching to base of the postgenital sternite. Gonapophysis slender with a long and strong apical spur; lateral projection strong but short, hardly reaching to middle of the gonapophysal cone. Genital papilla conical, colourless, and not always apparent.

Measurements (in mm) 2♀ (1496/2 and 3): HL 0.42, 0.40; HB 0.65, 0.67; HI 1.55, 1.70; PrB 0.59, 0.59; MsB 0.46, 0.45; MtB 0.67, 0.62; TL 2.90, 2.83.

Hosts

The nominal host is *Bettongia penicillata* Gray, 1837. *Wallabia bicolor** (Desmarest, 1804) awaits confirmation as a host.

PARAHETERODOXUS *ERINACEUS*, sp. nov.

(Fig. 129)

Types

Holotype: ♂, in ANIC (Slide No. 1496/80), from *Potorous tridactylus*, Sandfly, Tas., 8.v.1962, B. C. Mollison.

Paratypes: 2♂, 2♀, in ANIC, BMNH (1496/80-83), data as holotype.

Material examined

Potorous tridactylus.—holotype and 2♂, 2♀ paratypes; 5 nymphs, data as holotype (1496/79).

Description

Head nearly as in *Heterodoxus*, but more flatly rounded anteriorly and with slightly convex postocular temporal margins. Gula with a pair of posteriorly diverging sclerites beginning on the tentorial pits, each with a small spine in the middle and with a long seta on its posterior end. Prosternal plate heart-shaped or oval. Second abdominal segment reduced, shorter than in *Pa. insignis* or *calcaratus*. Chaetotaxy of abdomen as in both the other species, with 1 spine both sides of sternites and tergites and with 2 rows of setae on sterna and terga, these being less numerous and more widely separated and not intercalated with shorter setae.

Male.—Lateral wings of the anterior median vesical plate united as a heart-shaped brown plate tapering anteriorly; posterior margin without tooth. Posterior median plate as in *Boopia*, lyrate. Lateral plates weakly developed, sharply pointed posteriorly, with a toothlike projection in the middle of their internal margins. Vesica oval, broadly bordered with minute spines, nearly smooth in the middle.

Measurements (in mm) 3♂ (1496/80, 81, 82), mean and range: HL 0.39 (0.37-0.42); HB 0.64 (0.64-0.65); HI 1.64 (1.52-1.72); PrB 0.61 (0.59-0.62); MsB 0.48 (0.46-0.49); MtB 0.55 (0.51-0.62); AB 0.94 (0.93-0.96); TL 2.74 (2.67-2.86).

Female.—Vulva with 4 : 1 : 1 : 4 or 4 : 1 : 2 : 4 strong setae, the median strong but much shorter. Genital sclerite in both females examined indistinct, its posterior projections long and narrow, connected with the sides of the postgenital sternite. Postgenital sternite narrow, arched, both sides enlarged with finger-like projections to the alveoli of the lateral marginal setae. The postgenital marginal row of setae con-

*Except for this record all other collections of *Paraheterodoxus* are from rat-kangaroos (subfamily Potoroinae). It is likely that this record is due to contamination (see Appendix II), M.D.M.

tinuous, with about 9–10 longer and stronger laterals and about 26 short and weak median setae. Gonapophyses reduced to short, strongly chitinized papillae provided with a strong but short apical spur. The lateral lobes of gonapophyses very strongly developed, much greater than the gonapophyses themselves, provided with 6–7 very strong, thick, long, brown spines. Genital papilla triangular, broad at base, colourless, and not always apparent.

Measurements (in mm) 2♀ (1496/80 and 81): HL 0.42, 0.41; HB 0.68, 0.70; HI 1.62, 1.71; PrB 0.67, 0.67; MsB 0.54, 0.51; MtB 0.65, 0.58; AB 1.13, 1.10; TL 3.29, 3.16.

Host

The nominal host is *Potorous tridactylus* (Kerr, 1792).

PARAHETERODOXUS INSIGNIS Harrison & Johnston

(Figs. 69–72, 126, 127)

Paraheterodoxus insignis Harrison & Johnston, 1916, pp. 357–9, figs. 1, 13, 14 (♂, ♀, from *Aepyprymnus rufescens*, New South Wales and Queensland); Thompson, 1939, p. 606 (♀ type, from *A. rufescens*, Zoo, Sydney, L. Harrison, in GBT coll.); Werneck and Thompson, 1940, pp. 445–7, figs. 54–56 (1♀ type, in GBT coll.; 1♀, in GBT coll.; 2♀, 1 nymph, from *Wallabia bicolor*, Gippsland, Vic., June 1898, A. S. Le Souëf); Werneck 1948, pp. 26–8 (addition ♀ paratype, UC); Hopkins, 1949, p. 442 (4 records from *A. rufescens*).

Types

Lectotype: ♀, in BMNH (Slide No. 736), det. G.B.T., from *Aepyprymnus rufescens*, Zoo, Sydney, L. Harrison.

Paralectotype: 1♀, in UC, data as lectotype.

Material examined

Aepyprymnus rufescens.—det. ?, 2♂, 2♀, Bonalbo, N.S.W., 8.viii.1960, J. H. Calaby, 1962–186 (1496/77, 78); 2♂, 1♀, Richmond Range State Forest, N.S.W., 15.viii.1960, J. H. Calaby (1497/16, 17); 3♂, 2♀, Tooloom, N.S.W., 7.v.1962, J. H. Calaby (1500/2: 1–3).

Description

Prosternal plate triangular with rounded anterior angles and straight lateral margins.

Male.—Lateral wings of the anterior median vesical plate each prolonged anteriorly into a long and narrow chitinous plate ending with a triangular tooth reaching nearly to the anterior end of the vesica. Vesica rounded cylindrical with flattened anterior margin, broadly bordered with finely denticulated area. Lateral plates nearly as broad as long, excavated on their posterior margin, forming 1 stronger median and 1 weaker outer tooth.

Measurements (in mm) 4♂ (1496/77, 78; 1497/16, 17), mean and range: HL 0.46 (0.45–0.46); HB 0.73 (0.72–0.74); HI 1.59 (1.57–1.61); PrB 0.66 (0.65–0.68); MsB 0.51 (0.49–0.52); MtB 0.66 (0.65–0.68); TL 3.03 (2.97–3.06).

Female.—Vulva with 2 : 4 : 2, 2 : 5 : 2, or 2 : 6 : 3 strong setae, the lateral groups being longer than the median. Gonapophyses broadly triangular and provided with a very thin and long apical spur, the 5 basal setae are situated on a strong external lobe. Postgenital sternite flatly emarginate, with a continuous row of marginal setae, the 7–8 lateral longer and stronger, about 10 of the median ones shorter and weaker. Genital

sternite H-shaped with a long and straight brown lunula, its posterior ends reaching to the external margin of the gonapophysal lobe. Genital papilla slender conical, bluntly pointed, with the mouth of the spermathecal duct just anterior to the middle of its length.

Measurements (in mm) 3♀ (1496/77, 78; 1497/17), mean and range: HL 0.47 (0.46–0.48); HB 0.75 (0.72–0.78); HI 1.53 (1.40–1.64); PrB 0.69 (0.65–0.71); MsB 0.54 (0.52–0.55); MtB 0.71 (0.68–0.73); TL 3.17 (2.94–3.25).

Discussion

The size and features of the head, the female gonapophyses, the slender conical genital papilla, and some other characters of this species are nearly typical of *Heterodoxus*, but its genital organ is more like that of *Boopia*. The strong alveolar spines on the ventral side of the head are neither homologous with the maxillary hooks of *Heterodoxus*, as has been correctly pointed out by Werneck (1948), nor with the alveolar spines of *Phacogalia*. The postocular margin of the temples is slightly concave, as in *H. pygidialis*; the prothorax is bluntly angulated before the middle, as in *Boopia*; the front coxa has a strong tooth before the trochanter, as in *Macropophila*. This tooth is much stronger than in *Heterodoxus*, except *H. calabyi* in which it is absent. The prosternum is triangular, as in most *Heterodoxus*, but its chaetotaxy is quite different from that in *Heterodoxus* or *Boopia*. The chaetotaxy of the mesonotum is as in *Boopia* and *Heterodoxus*, with one pair of alveolar spines situated on large warts; that of the metanotum is quite like that of *Heterodoxus*. The chaetotaxy of abdominal tergum I is again characteristic, being similar to that of the following five abdominal terga in the female and six in the male; these terga bear one strong spine each side of the marginal row of setae. This pair of spines is also present on the abdominal sterna, sternum I in the male bearing two spines each side. The chaetotaxy of sterna and terga is similar, being one marginal and one discal row of densely standing setae, the marginal rows interspersed with many shorter ones. The second femora of males have one pair of strong spines behind the middle of their length. This pair of spines is absent in all *Heterodoxus* and *Macropophila* and present in *Boopia bettongia*, *B. notafusca*, *B. uncinata*, *Paraboopia flava*, *Phacogalia spinosa*, and *Ph. brevispinosa*, but in all these species it is situated just behind the end of the trochanter.

Host

The nominal host, *Aepyprymnus rufescens* (Gray, 1837), is confirmed. The specimens from *Wallabia bicolor* (determined by Werneck and Thompson, 1940) are considered to be *Pa. calcaratus*, sp. nov.

Genus LATUMCEPHALUM Le Souëf

Latumcephalum Le Souëf, 1902, p. 51; Werneck and Thompson, 1940, pp. 448–9; Werneck, 1948, p. 28.

Laticephalum Tillyard, 1926 (emendation with consent of Le Souëf but unjustified).

Type species *Latumcephalum macropus* Le Souëf, 1902.

Species

L. lesouefi Harrison & Johnston, *macropus* Le Souëf.

Description

Head nearly twice as broad as long with large pointed postnodal lobes, large eye lobes, and pointed temporal lobes; ocular setae situated on a very large chitinous wart. Maxillary palp 2-jointed, 2nd joint clavate, reaching beyond margin of head.

Meso- and metanotum equal in size, separated by a distinct suture; mesonotum with 1 pair of conical sclerotized warts each bearing a weak spine and a small seta medially to it.

Abdomen without trichobothrial hairs.

Discussion

The peculiar shape of the head of this genus, with its broadened postnodal, ocular, and temporal lobes and large tubercles bearing the ocular setae, is less interesting than the formation of the legs, which do not have "l'aspect general commun a tous les mallophages des marsupiaux australiens" (Werneck and Thompson 1940), but, on the contrary, are more similar to those of ischnoceran Mallophaga. Their tarsi not only have "les derniers segments beaucoup plus courte" but the basal joint is also quite different from that of other Boopiidae, being cylindrical and having the euplantula reduced to a small tubercle bearing two setae. The second joint is a little longer than the basal and is provided on its planta with two long, membranous, sharply pointed, colourless hairlike projections similar to those which I have found (1938, fig. 49) on the plantae of the second tarsal joint in some Trichodectidae. Besides, the cibarium is provided with a strongly chitinized, brown, narrow clothes-peg-like larynx, very similar to that of many Menoponidae. The genital characters of male and female are of the same type as in *Boopia*. The two-jointed maxillary palpus and the absence of trichobothrial setae on the abdominal segments II-IV bring this genus into proximity with *Paraboopia flava*.

KEY TO THE SPECIES OF *LATUMCEPHALUM*

1. Area between preocular and postocular slit triangular and bluntly pointed *lesouefi*
Area between preocular and postocular slit large and rectangular (Fig. 130) *macropus*

LATUMCEPHALUM LESOUEFI Harrison & Johnston

(Figs. 90M, 132-135)

Latumcephalum lesouefi Harrison & Johnston, 1916, pp. 343-4, figs. 2 and 3 (♂, nymphal ♀, from *Macropus ualabatus*, Victoria, A. S. Le Souëf; Thompson, 1939, p. 607 (1♂ type, 2 nymphs, from *W. bicolor*, Victoria, 1902, A. S. Le Souëf, in GBT coll.); Werneck and Thompson, 1940, pp. 452-4, figs. 61-66 (1♂, 2 nymph types, in GBT coll.; 1♀, from *W. bicolor*, in GBT coll.; ♂♂, ♀♀, nymphs, from *W. bicolor* from New South Wales, Zoo, London, A. E. Hamerton).

Type

Lectotype here designated.—♂ in BMNH (Slide No. BM. 741), det. G.B.T., from *Wallabia bicolor*, Victoria, A. S. Le Souëf.

Material examined

Wallabia bicolor.—Lectotype. Syn. *Macropus ualabatus*: det. ?, 1♂, 1♀, from New South Wales, Zoo, London, 15.v.1929, A. E. Hamerton, 1929-225 (1505/72, 73). Syn. *Protetmnodon bicolor*: det. ?, 2♂, 1♀, from (CMS1), Logan Village, Qld., 28.iv.1960, J. H. Calaby, 1962-186 (1496/51, 52); 1♂, 6 mules E. of Hoskinstown, N.S.W., 24.ii.1960, D. L. McIntosh (1512/26); 6♂, 1♀, Logan Village, Qld., 28.iv.1960, J. H. Calaby (1509/16-21).

Description and Discussion

In addition to the diagnostic details used in the key to species of *Latumcephalum* and to the characters considered by Werneck and Thompson in text and figures, the following remarks may be made on this species. Lunula of the genital sternite arched exactly as in *L. macropus*. Genital papilla longer (30 μm) and more slender, and 10 μm diameter at its base. Vulva as in *L. macropus* with 2 : 7 : 2 or 2 : 6 : 2 setae, 2nd external the longest as in all species of *Boopia*, median group shorter and weaker, 1st external short, but nearly as long as the median setae. Subanal margin with 6 short alveolar spiculae. Inner margin of gonapophyses and supraanal margin with 13 short alveolar spiculae both sides of the midline. The copulatory organ very similar to that of *macropus*, but the details cannot be compared as they cannot all be seen in the single specimen of *macropus*. Posterior median plate of the vesica of *L. lesouefi* similar to that of *Boopia*, but its anterior arms fused with one another (Figs. 133 and 134).

Measurements (in mm) 11♂, mean and range: HL 0.26 (0.25-0.28); HB 0.46 (0.44-0.47); HI 1.71 (1.60-1.83); PrB 0.26 (0.25-0.28); MtB 0.28 (0.26-0.29); AB 0.54 (0.52-0.55); TL 1.34 (1.25-1.36). Those of 3 females fell within the male range except HB 0.46 (0.44-0.49) and AB 0.57.

Host

The nominal host, *Wallabia bicolor* (Desmarest, 1804), is reconfirmed.

LATUMCEPHALUM MACROPUS Le Souëf

(Figs. 130 and 131)

Latumcephalum macropus Le Souëf, 1902, p. 51, fig. 4 (from "skin of wallabies"); Harrison and Johnston, 1916, pp. 340-3, figs. 2 and 3 (5♀ types from *Macropus dorsalis*, Zoo, Melbourne, A. S. Le Souëf); Thompson, 1939, p. 607 (2♀ paratypes, from *Wallabia dorsalis*, Victoria, 1902, A. S. Le Souëf, in GBT coll.); Werneck and Thompson, 1940, pp. 449-51, figs. 57-60 (1♂, 3♀ cotypes, GBT; 2♀, from *Wallabia bicolor*, Victoria, A. S. Le Souëf, in G.B.T. coll.); Werneck, 1948, pp. 28-9.

Types

Lectotype here designated: ♂, in BMNH (Slide No. B.M. 737, 1518/13), det. G.B.T., from *Wallabia dorsalis*, Zoo, Melbourne, 1902, A. S. Le Souëf.

Paralectotypes: 3♀, in BMNH (Slide Nos. 738, 739, 740), data as lectotype.

Material examined

Wallabia dorsalis.—syn. *Macropus dorsalis*: syntypes now lectotype and 3♀ paralectotypes. *W. bicolor*.—det. F.L.W. & G.B.T. ?, 1♀, Victoria, Le Souëf, BMNH, 1962-677 (1505/65).

Description

Male.—Second femora are provided with only 1 strong spine near the end of the trochanter. Vesical plates similar to those of *Boopia*, the anterior median plate provided with a long and strongly chitinized handle. The posterior median plate in the single male not perceptible, the lateral sclerites short, posteriorly channel-shaped as in some species of *Boopia*.

Female.—Gonapophyses (Fig. 131) provided with a very thin and long apical spur and with 8 long and strong setae, 4 of them situated on the alveolar tubercles

of the outer margin, the others ascending on the base to the sides of the postgenital sternum, the last 2 or 3 situated just beneath its lateral margin. Genital sternite in female 1505/65 distinct, frame-shaped, with broadened anterior angles as in *Boopia bettongia* and some others, and with a distinct, slightly arched lunula. Its long and narrow posterior arms connected with the anterior edges of the more strongly chitinated sides of the postgenital sternum. Median margin of the gonapophyses and the supra-anal margin with a continuous row of short alveolar setae. Subanal margin with a row of hairless sensilli. Genital papilla slender conical, colourless; the spermathecal duct as in many *Boopia* very long, distinctly perceptible for a length of 0.5 mm, without forming a dilatation on this stretch. Vulva with 2 : 7 : 2 setae, the 1st external very short, 2nd very long, median group short but 2.5 times as long as the first external. Postgenital marginal row of setae discontinuous with 6 : 5 : 6 strong setae, all standing on small papillae. Subanal margin with 2 : 2 short alveolar spiculae. Inner margin of gonapophyses and supraanal margin with a row of 10–11 short alveolar spiculae both sides of the midline.

Measurements (in mm) ♂ (1518/13) followed by ♀ (1505/65): HL 0.22, 0.24; HB 0.41, 0.42; HI 1.81, 1.76; PrB 0.22, 0.23; MsB 0.20, 0.19; MtB 0.23, 0.23; AB 0.49, 0.47; TL 1.27, 1.27.

Hosts

The nominal host, "skin of wallabies", was restricted by Harrison and Johnston (1916) to *Wallabia dorsalis* (Gray, 1837). *W. dorsalis* and *W. bicolor* have not been confirmed as hosts in recent collections.

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APPENDIX I

By J. H. CALABY

NOTE ON THE NAMES OF AUSTRALASIAN MARSUPIAL HOSTS

In the literature of the systematics of parasites there are many problems of host identity. Perhaps most of these arise from misdeterminations of hosts by collectors or their advisors, and the failure to preserve specimens of hosts. In the absence of specimens, advances in host taxonomy make it impossible to be certain of the identities of some nominal hosts.

As Dr. von Kéler's paper is the first comprehensive review of an important group of parasites of Australian marsupials it is thought that a listing of host names and synonyms and a discussion of the doubtful hosts might be useful to parasitologists.

List of Hosts and Synonyms

There is no modern formal checklist of the Australian mammals, the most recent being that of Iredale and Troughton (1934). The authors of that work have a generally narrower view of generic limits than is accepted by the majority of present-day workers; and considerable systematic and nomenclatural research has taken place since it was published, resulting in a rearrangement of some forms, alterations to names, and additions to the fauna. Between 1935 and 1952 Tate published revisions of various groups of marsupials and improved the position somewhat, but some of his innovations are not accepted by other workers. Haltenorth's (1958) revision of the Marsupialia appears to be largely a personal interpretation of the literature and is little or no improvement on Tate's studies. Laurie and Hill (1954) have published a checklist of the mammals of New Guinea.

Species of marsupials from which Boopiidae have been recorded are given in the following list. The senior synonyms are the names most commonly used by present-day students of Australian mammals, and take account of recent systematic revisions and decisions of the International Commission for Zoological Nomenclature. They are followed by names for marsupials recorded in the literature by students of Mallophaga. Studies are in progress towards a new checklist of Australian mammals and will lead to further rearrangements. Of the species in the present list, the two wombats, *Vombatus ursinus* and *V. hirsutus*, are no more than subspecifically distinct, and all of the wallabies except *W. bicolor*, listed here in *Wallabia*, should perhaps be best placed in the genus *Macropus* for reasons given by Calaby (1966).

Family DASYURIDAE

Name of Marsupial	Synonym
<i>Antechinus flavipes</i> (Waterhouse, 1838)	<i>Phascologale flavipes</i>
<i>Antechinus stuartii</i> Macleay, 1841	
<i>Antechinus bellus</i> (Thomas, 1904)	

species commonly known as the eastern native cat. He presumably confused the name of the nominal host, *Dasyurus maculatus* (*Viverra maculata* Kerr, 1792), with *Didelphis maculata* Kerr, 1792, a junior synonym of "*Dasyurus quoll*". (The specific name *quoll* Zimmermann, 1777, has been ruled as unavailable by the International Commission for Zoological Nomenclature [*Bull. zool. Nomencl.* 4, 547 (1950)]. The valid name of the eastern native cat is *Dasyurus viverrinus* (Shaw, 1800).) All subsequent authors have followed Thompson and listed the nominal host of *B. uncinata* erroneously as "*Dasyurus quoll*".

Thompson stated that Harrison and Johnston's type material was in his care and that he had "remounted and labelled it all". The specimens of *B. uncinata* from Sydney (1 male, 2 females, 1 nymph) listed by Werneck and Thompson (1940) and labelled as from "*Dasyurus quoll*", may have originally stood under the name *Dasyurus maculatus*, but the original labels are lost. These specimens are unlikely to be type material as Harrison and Johnston in their original description saw only one female and one nymph. Thus there is no unequivocal record of *B. uncinata* from "*Dasyurus quoll*".

Nominal Host of *Phacogalia brevispinosa*

Phacogalia brevispinosa was described from a specimen taken from "a pouched mouse, *Phascologale flavipes* (= *Antechinus flavipes*), at the Sydney Zoological Gardens".

Wakefield and Warneke (1967) have shown that two species of *Antechinus*, *flavipes* and *stuartii*, have long been confused under the name *flavipes*. *A. stuartii* has been placed in subjective synonymy under *flavipes* for the past century. Only *A. stuartii* occurs in the coastal region of New South Wales and it is common around Sydney. It is probable that the animal from which the type of *Phacogalia brevispinosa* was collected was captured in the Sydney area and was a specimen of *A. stuartii*.

Von Kéler records *P. brevispinosa* from two specimens of "*Phascologale flavipes*" from Palmerston, Qld. In north Queensland there are three species of *Antechinus* which have been considered forms of *A. flavipes* and all of which may well occur around Palmerston. It is now known that one of these, *A. godmani* (Thomas, 1923), is a full species, and another, *A. s. adustus* (Thomas, 1923) is a subspecies of *stuartii*. The remaining form is true *flavipes* (Wakefield and Warneke 1967). Only one form, listed as *A. f. godmani*, has been recorded actually at Palmerston, by Harrison (1962). Harrison and his team from the Innisfail Field Station of the Queensland Institute of Medical Research labelled their specimens with serial numbers prefixed by "N.F.", and as one of the Palmerston series of *P. brevispinosa* from "*P. flavipes*" carries Harrison's number it seems certain that the lice were taken from host specimens he recorded as *A. f. godmani*. As the full complexity of the systematic situation in *Antechinus* in north Queensland was not realized at the time of Harrison's work and as he gives few descriptive details of his specimens it cannot be considered certain that they are *godmani*.

It thus appears that there are no unequivocal collections of *Phacogalia brevispinosa* from its recorded nominal host, *Antechinus flavipes*.

APPENDIX II

By M. D. MURRAY and J. H. CALABY

THE HOST RELATIONS OF THE BOOPIIDAE

Thirty-five species of Boopiidae have now been described from the Australasian marsupials and it is possible for the first time to review their host relationships critically. The collections upon which von Kéler's study is based fall clearly into two categories; the early collections made before 1960, from which the 20 species described previously were obtained, and the recent and extensive ones. The majority of the former were made from captive animals with some confusion of identity of the host, whereas the latter are field collections by persons competent in the modern concepts of identification of these mammals. These field collections have revealed clearly the danger of collecting ectoparasites from captive animals in zoological gardens. Of the 20 species of lice described from early collections, the types of 13 are known or can be presumed to have been collected from animals in zoological gardens or parks, and only five of these hosts have been confirmed even though many collections have been made from the supposed hosts.

It is customary in zoological gardens and parks, particularly in Australia, to have an enclosure in which several species of kangaroos feed and sleep together, so it is easy to understand how so many of the collections made by Le Souéf may have confused the issue, particularly with regard to the louse fauna of *Wallabia bicolor*. Von Kéler was well aware of this problem and wisely refers to the host of the type material as the nominal host, allowing the true hosts to be determined as more collections are made. However, the confusion will be perpetuated unless the problem is discussed and emphasized.

It seems advisable when discussing host relationships of Boopiidae to question all those collections from captive animals. Table 3 is a host-parasite list, arranged by family of host and genera of Boopiidae. Records which have been confirmed or have been collected reliably are given in italics, and those in need of confirmation, with a question mark. Records which appear to be due to contamination and which should be ignored are given in parentheses. The most striking feature is that no lice have been recorded from the Notoryctidae (marsupial-mole), Phascolarctidae (koala), Phalangeridae (possums), Petauridae (gliders), Burramyidae (pigmy possums), and Tarsipedidae (honey possum). In the case of the Notoryctidae and perhaps also the Burramyidae and Tarsipedidae, insufficient specimens have been examined for lice and no valid conclusions can be drawn. However considerable numbers of koalas and several species of possums in both the Phalangeridae and Petauridae have been searched for lice, and it is very probable that the members of these families do not harbour these parasites.

Phacogalia species appear to be lice of small dasyurids whereas *Boopia uncinata* is the louse of the large dasyurids. Other species of *Boopia* are found on all of the other groups of Australasian marsupials from which lice have been collected: *B. betongia* is the louse of typical bandicoots (Peramelidae); *B. tarsata* that of the two closely related species of common wombats, *Vombatus hirsutus* and *V. ursinus*; whereas *B. dubia* is the louse of the hairy-nosed wombat, *Lasiorchinus latifrons*. *Boopia* appear to be the typical lice of the large kangaroos, although one is found on the swamp

wallaby, *W. bicolor*, and another on a tree kangaroo, *Dendrolagus dorianus*, of New Guinea. Thus species of *Boopia* occur on members of all of the families Dasyuridae, Peramelidae, Vombatidae, and Macropodidae.

A distinct grouping may be seen of the lice found on Macropodidae. The genus *Paraheterodoxus* is confined to the rat-kangaroos (Potoroinae); the large kangaroos (red, eastern and western grey, euro, and antilopine) are infested by species of *Boopia* whereas the large and some of the smaller wallabies are infested by species of *Heterodoxus*; the genus *Macropophila* is confined to the small wallabies of the genus *Thylogale*. It is noteworthy that the remaining genera, *Paraboopia* and *Latumcephalum*, both of which have affinities with *Boopia*, infest those kangaroos which are parasitized by species of *Boopia*.

H. spiniger has now been definitely found on a marsupial, *W. agilis* (see p. 64), so it is highly probable that this louse did transfer from a macropidid host to dogs, perhaps via the dingo, and was transported around the world on domestic dogs.

Thus the extensive recent collections have considerably clarified the host relationships of lice of Australasian marsupials, and a definable pattern is emerging. However, it is equally clear that the need for collection to be continued remains, so as to confirm and clarify an emerging relationship before some of the hosts become extinct.

Clay (1970) casts doubt on the commonly held view that the Boopiidae are primary parasites of Australian marsupials, and suggests that infestation of these animals was comparatively late and arose from an avian menoponid ancestor. This might have become established on an ancestral phalangeroid stock [= Order Diprotodonta of Kirsch (1968)] and diversified on that group, the parasites now found on the other groups of marsupials being due to secondary infestations. A consideration of the known distribution of members of the Boopiidae among their marsupial hosts, including their absence from the possum families, leads us to go further and suggest that the ancestral boopiids became established in the first place on the family Macropodidae. Typical members of this family were in existence in the Miocene and probably Oligocene, and by the Pliocene the family had radiated widely (Stirton, Tedford, and Woodburne 1968). This seems to be early enough to allow sufficient time to elapse for the Boopiidae to reach its present diversity which, as pointed out by Clay, is not very great. There may of course be something peculiar about the arboreal possum-like marsupials that has discouraged an association of lice with them, but in the absence of any knowledge of the biology of these lice we can make no suggestions on this point. We agree also with Clay that the Boopiidae and Trimenoponidae are not closely related and almost certainly had different origins.

TABLE 3
HOST RELATIONS OF BOOPIIDAE OF MARSUPIALS

? Record requires confirmation; () Record due to contamination.

Marsupial Host	Genera and Species of Boopiidae				
	Phacogalia	Boopia	Paraheterodoxus	Heterodoxus	Macropophila
Family DASYURIDAE					
<i>Antechinus flavipes</i>		(notafusca)			
<i>A. stuartii</i>	brevispinosa ?				
<i>A. bellus</i>	brevispinosa				
<i>A. minimus</i>	brevispinosa				
<i>A. swainsonii</i>	brevispinosa				
<i>Phascogale tapoatafa</i>	spinosa				
<i>Dasyurus maculatus</i>		uncinata ?			
<i>D. geoffroyi</i>		uncinata			
<i>D. hallucatus</i>		uncinata			
Family PERAMELIDAE					
<i>Perameles nasuta</i>					
<i>Isoodon macrourus</i>					
<i>I. obesulus</i>					
Family VOMBATIDAE					
<i>Vombatus hirsutus</i>					
<i>V. ursinus</i>					
<i>Lasiorchinus latifrons</i>					
Family MACROPODIDAE					
Subfamily POTOROINAE					
<i>Bettongia penicillata</i>					calcaratus
<i>Aepyprymnus rufescens</i>					insignis
<i>Potorous tridactylus</i>					erhaceus
					(bettongia)

Subfamily MACROPODINAE

Megaléia rufa
Macropus giganteus

M. fuliginosus
M. robustus

M. antilopinus
Wallabia agilis

W. eugenii
W. dorsalis
W. parryi
W. rufogrisea
W. bicolor

Setonix brachyurus
Dendrolagus lumholtzi
D. dorianus
Dorcopsalus vanheurni
Dorcopsis veterum
Petrogale penicillata

Thylogale billardieri
T. brunii
T. stigmatica

T. thetis

grandis
grandis
mjobergi?
(notafusca)
grandis
biseriata
notafusca?
biseriata

(minuta)

notafusca
(tarsata)

(spinosa)

(calcaratus)

dortiana

longitarsus?
macropus?
(longitarsus)

flava

macropus
spinger?
calabyi
calabyi
ancoratus
longitarsus
ualabati
macropus?
spinger?
(calabyi)
quadriseiatus
pygidialis

macropus?

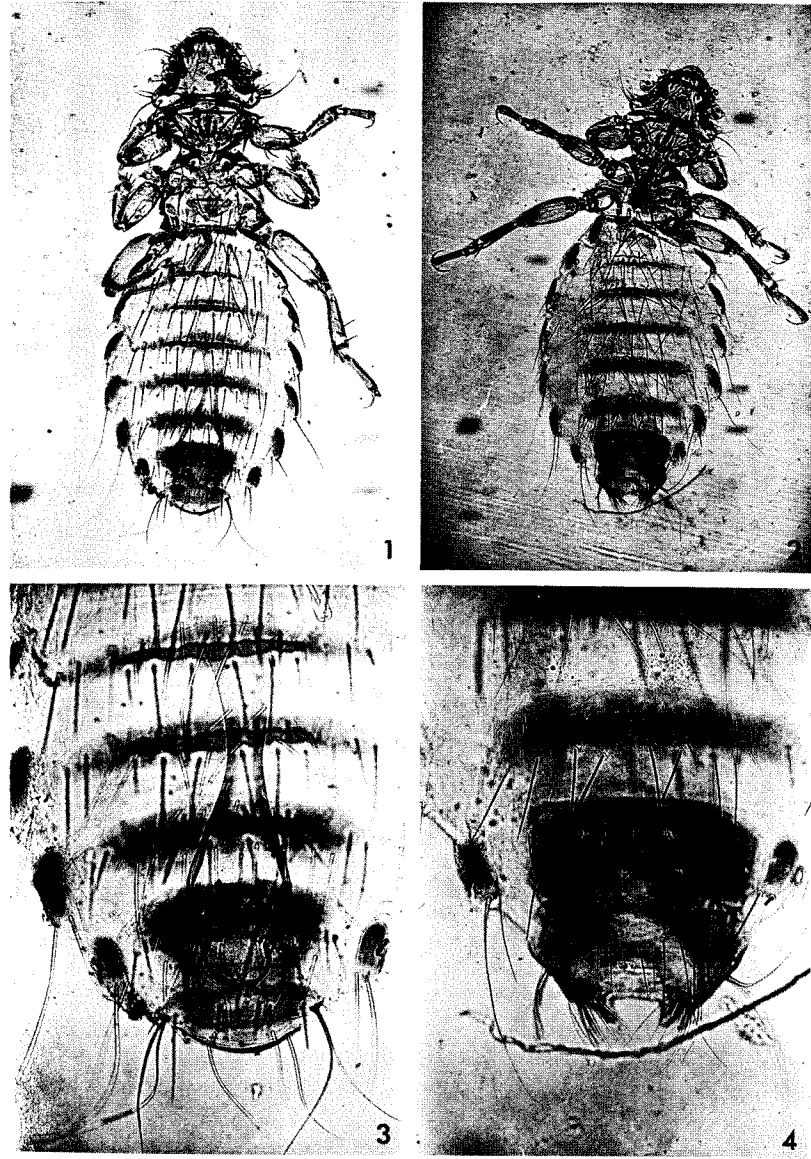
lesoueffi
macropus?

mitratus
maai
ampullatus
octoseriatus

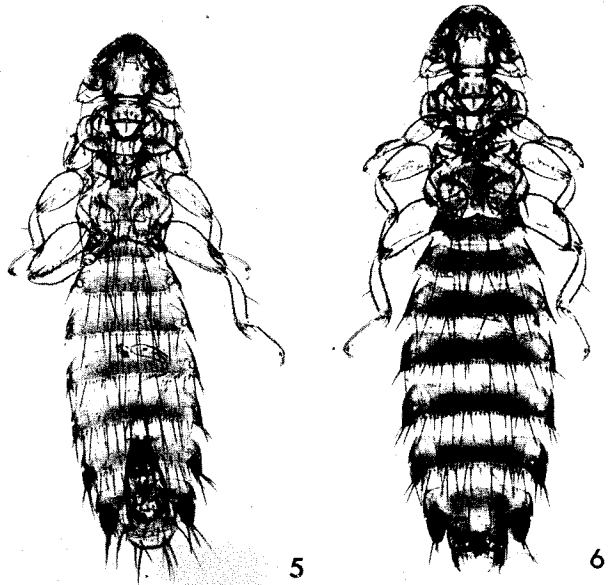
alatus
macropus?

clayae

breviarcuata
forcipata
biarcuata?
biarcuata

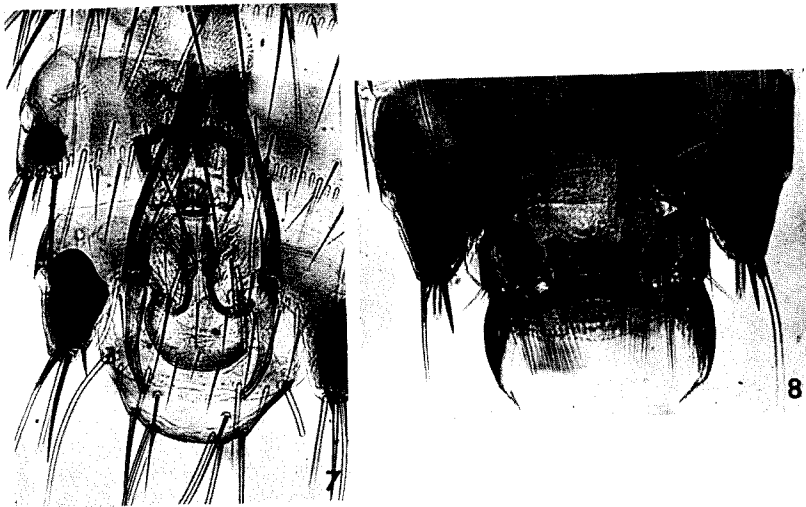


Figs. 1-4.—*Boopis biseriata*: 1, male; 2, female; 3 and 4, terminal abdominal segments of male and female respectively.



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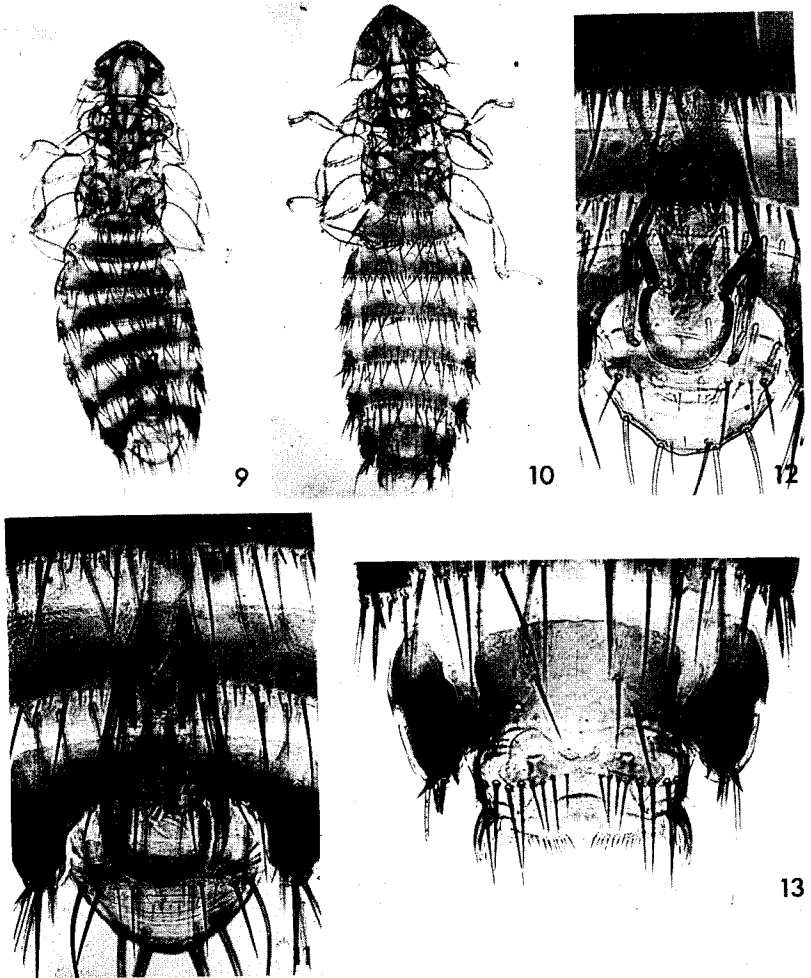
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Figs. 5-8.—*Macropophila clayae*: 5, male; 6, female; 7, male genitalia; 8, terminal abdominal segments of female.



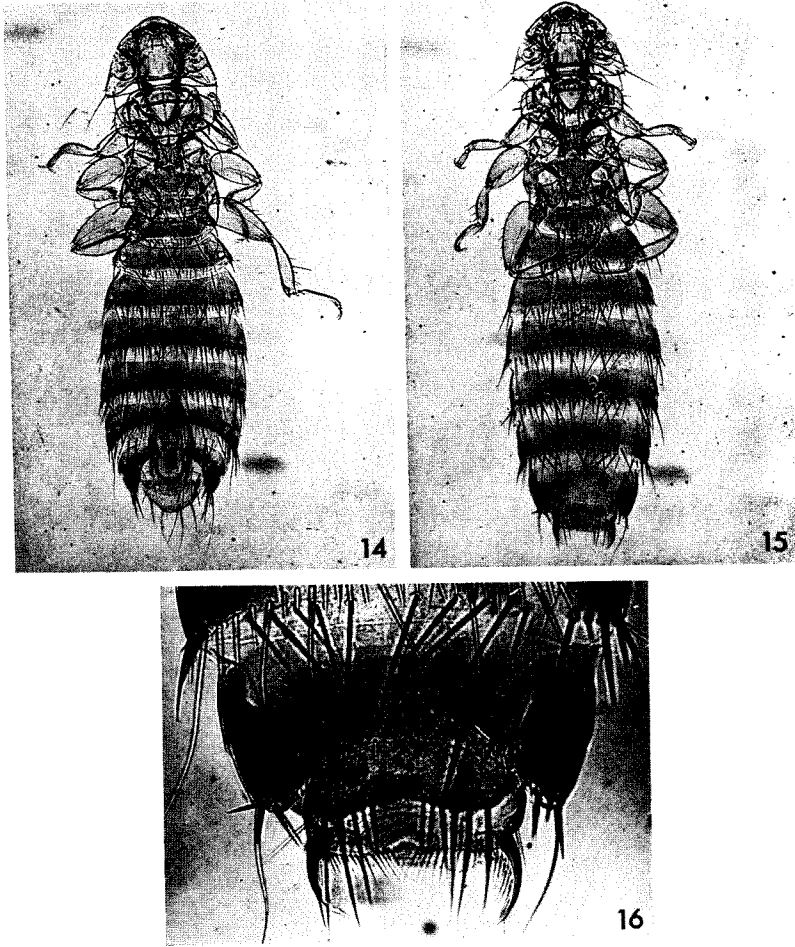
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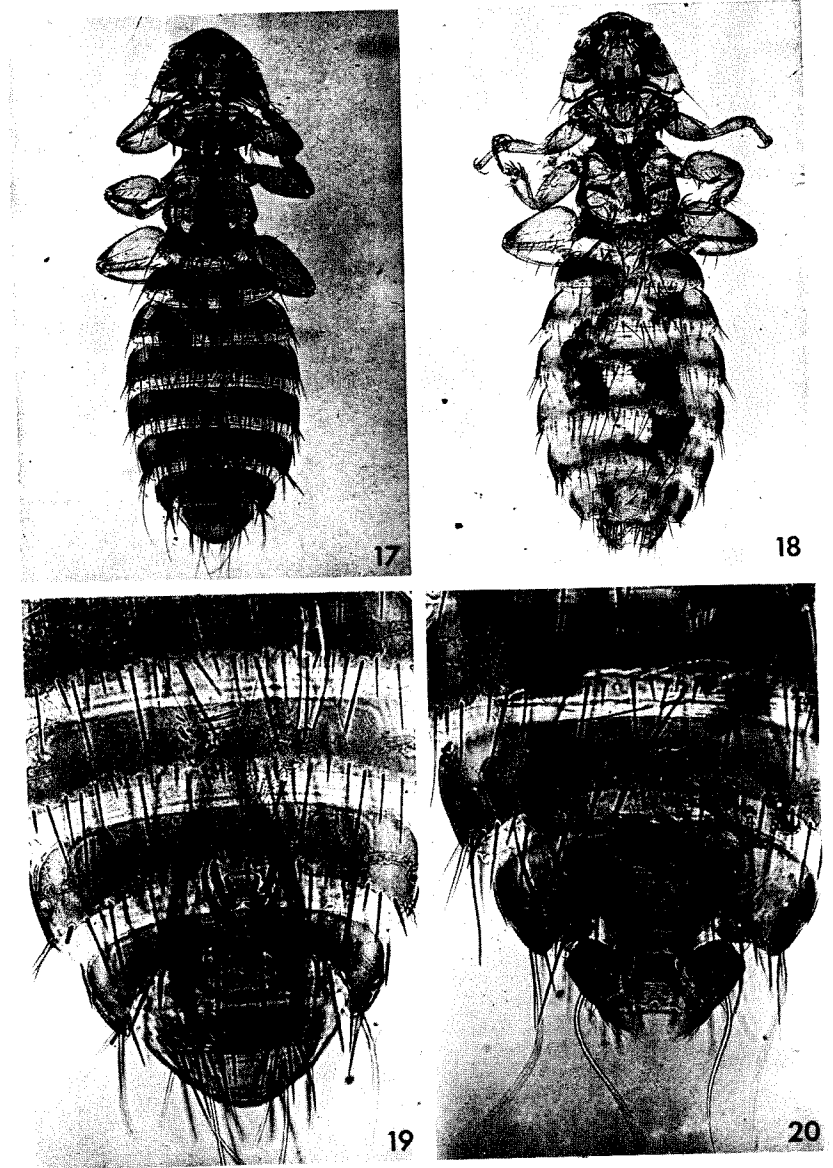
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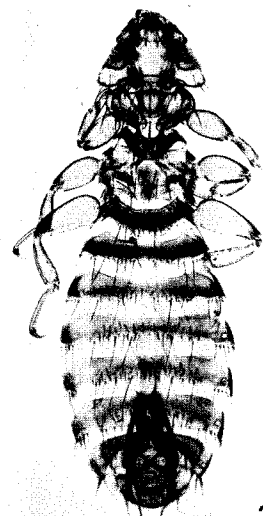
Figs. 9-13.—*Macropophila* spp. 9-11, *M. biarcuata*: 9, male; 10, female; 11, male genitalia. 12, *M. breviaracuata*, genitalia of male holotype. 13, *M. biarcuata*, terminal abdominal segments of female.



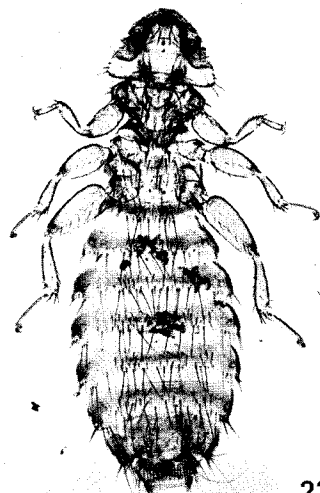
Figs. 14-16.—*Macropophila breviaricata*: 14, male; 15, female; 16, terminal abdominal segments of female.



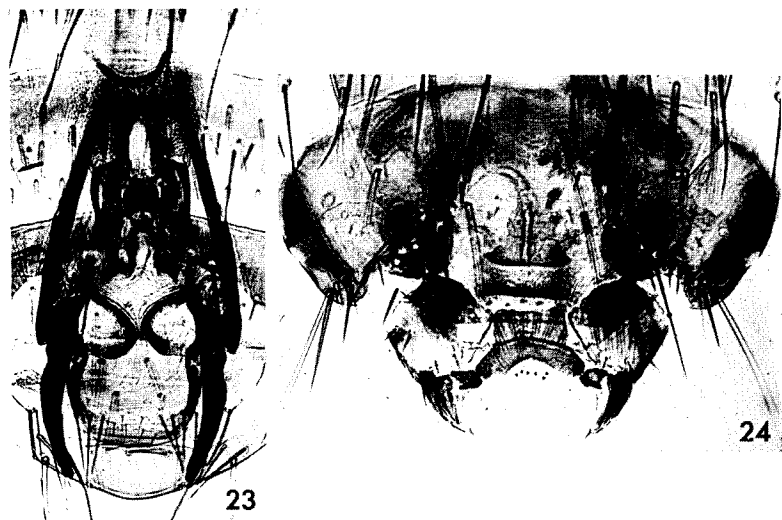
Figs. 17-20.—*Heterodoxus spiniger*: 17, male; 18, female; 19 and 20, terminal abdominal segments of male and female respectively.



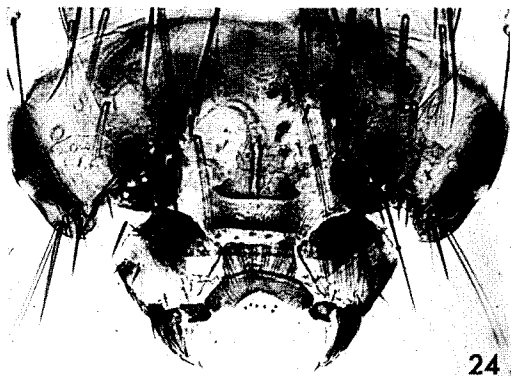
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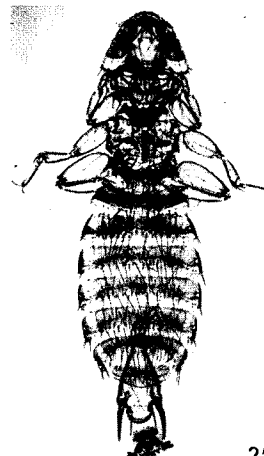


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Figs. 21-24.—*Heterodoxus longitarsus*: 21, male; 22, female; 23, male genitalia; 24, terminal abdominal segments of female.



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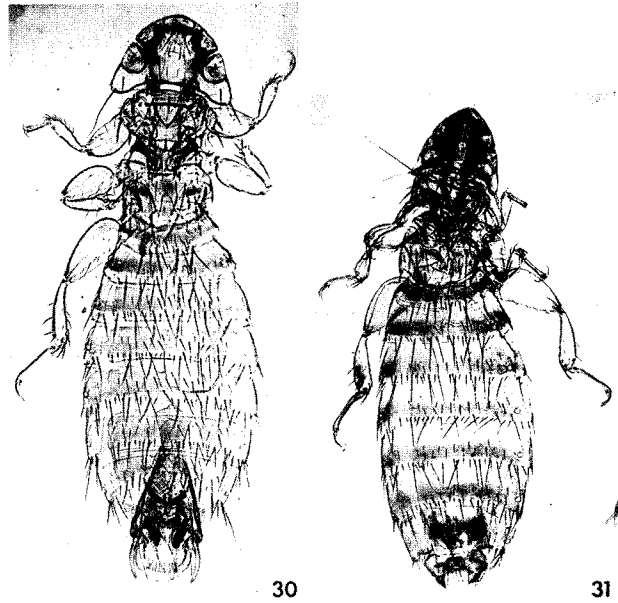


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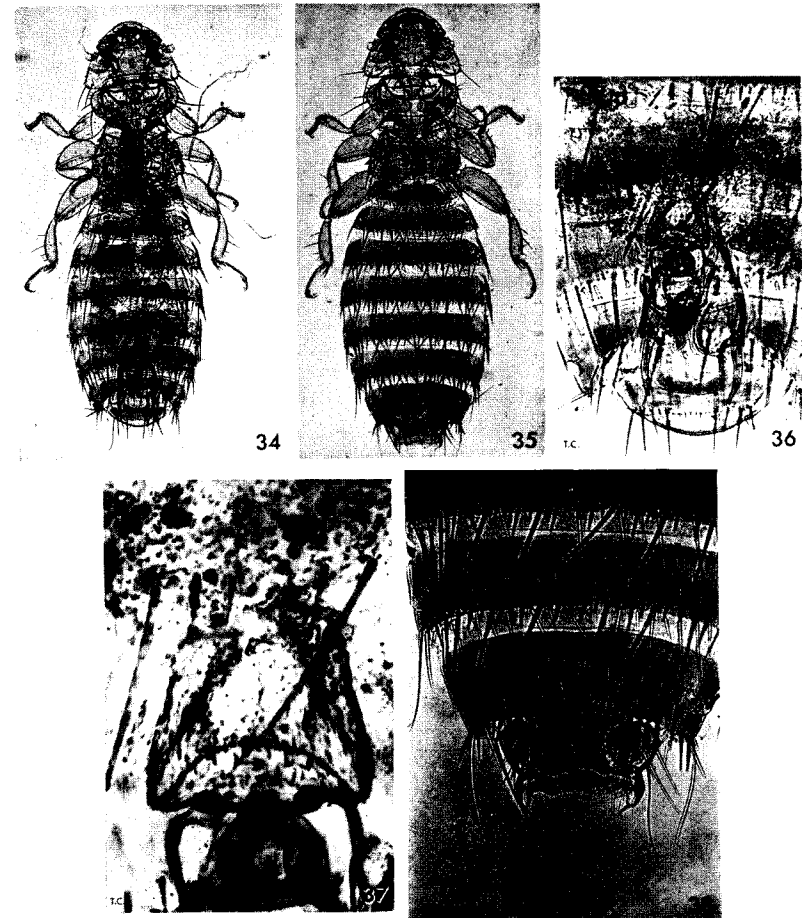


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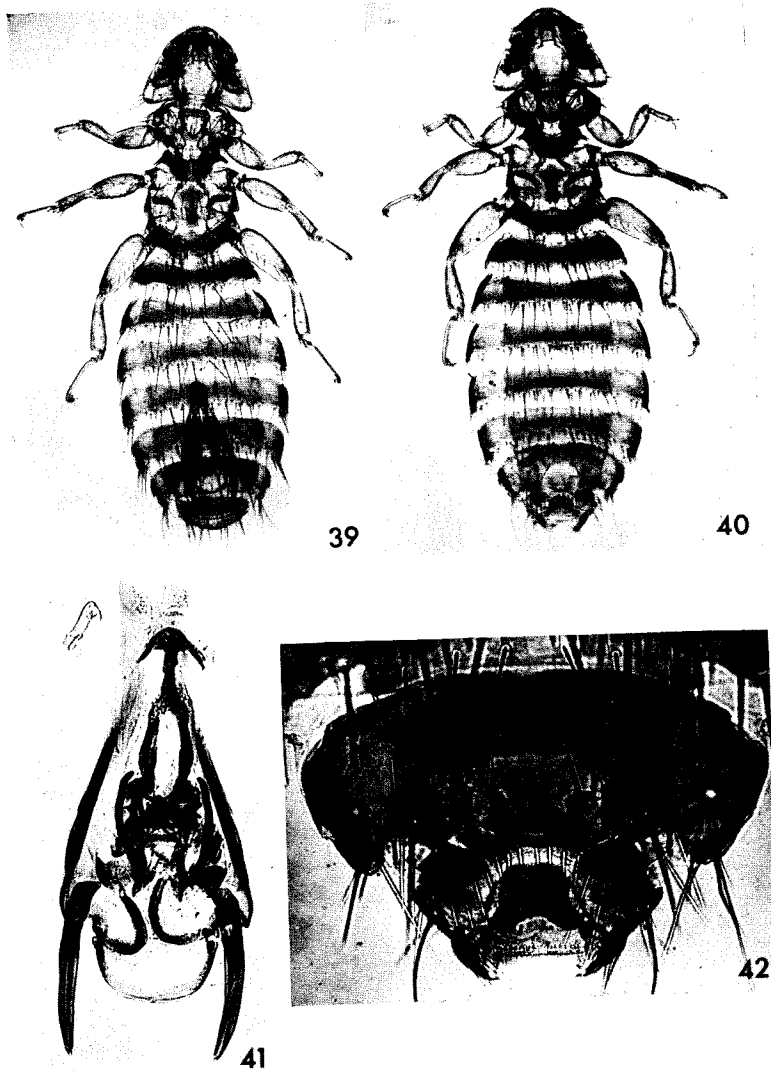
Figs. 25-29.—*Heterodoxus ualabati*: 25, male; 26, female; 27, male genitalia; 28, male genitalia—sac extended; 29, terminal abdominal segments of female.



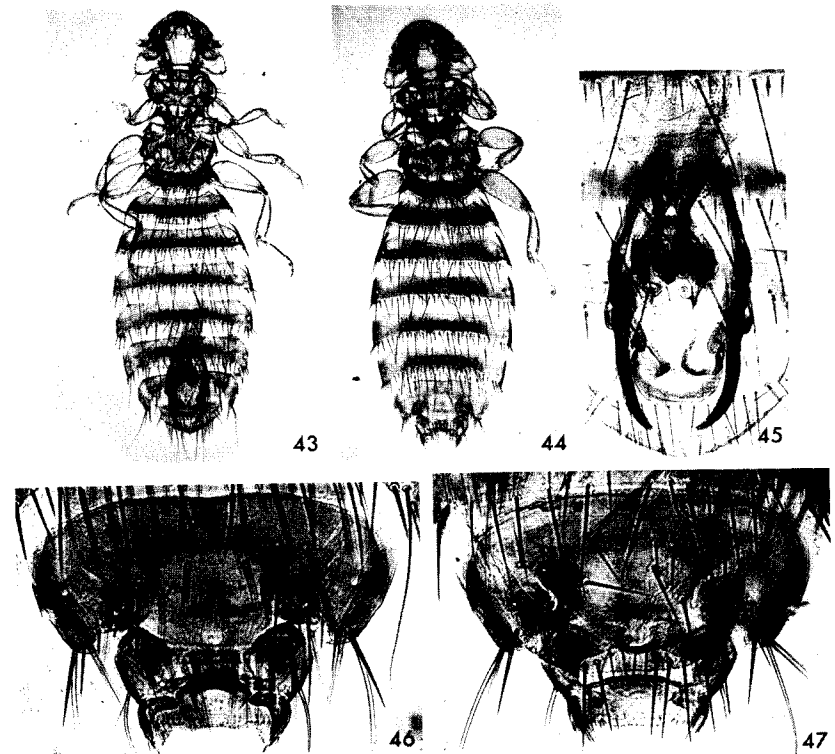
Figs. 30-33.—*Heterodoxus alatus*: 30, male; 31, female; 32, male genitalia; 33, terminal abdominal segments of female.



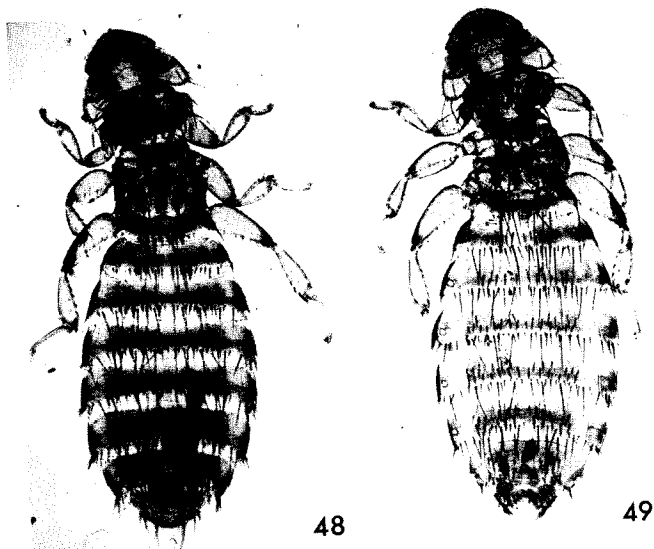
Figs. 34-38.—*Heterodoxus ampullatus*: 34, male; 35, female; 36, male genitalia; 37, part of vesica of male genitalia; 38, terminal abdominal segments of female.



Figs. 39-42.—*Heterodoxus ancoratus*: 39, male; 40, female; 41, male genitalia; 42, terminal abdominal segments of female.



Figs. 43-47.—*Heterodoxus calabyi*: 43, male; 44, female; 45, male genitalia; 46 and 47, dorsal and ventral view, respectively, of terminal abdominal segments of female.



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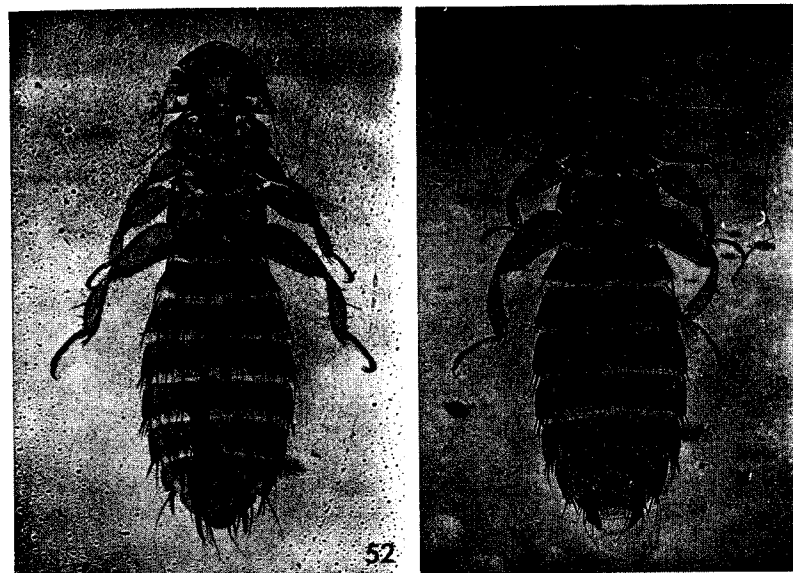


50



51

Figs. 48-51.—*Heterodoxus macropus*: 48, male; 49, female; 50, male genitalia; 51, terminal abdominal segments of female.



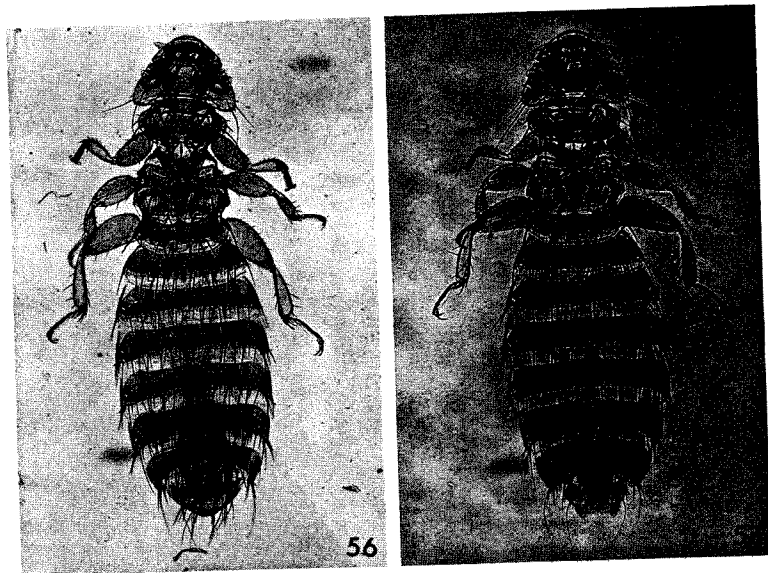
52



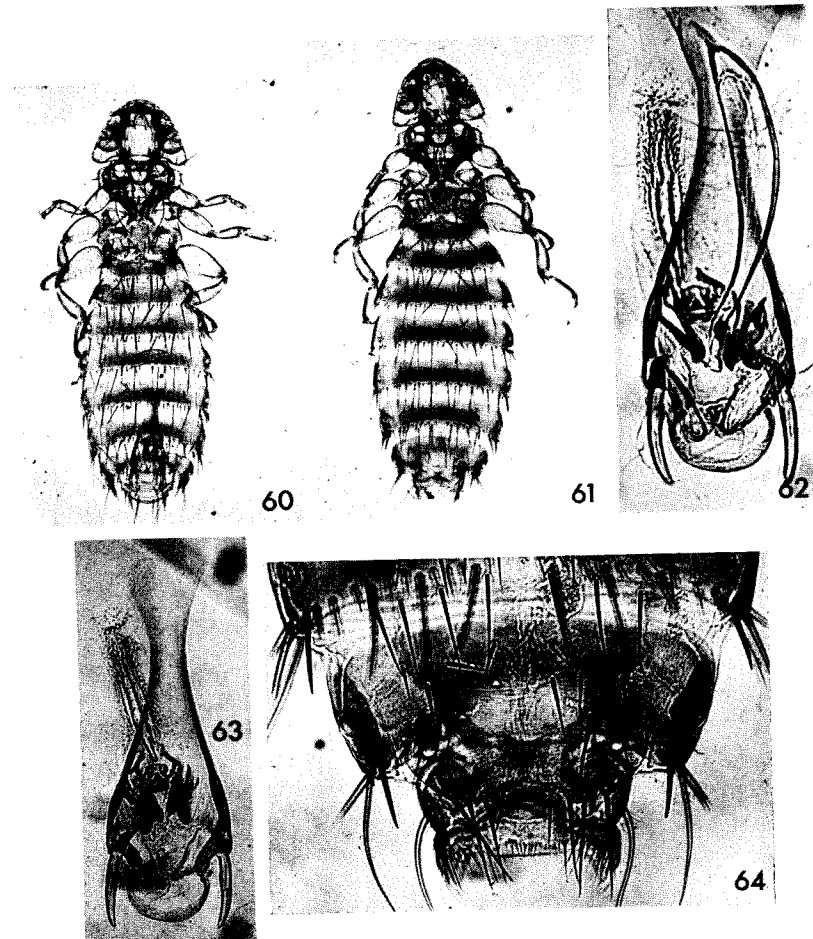
54



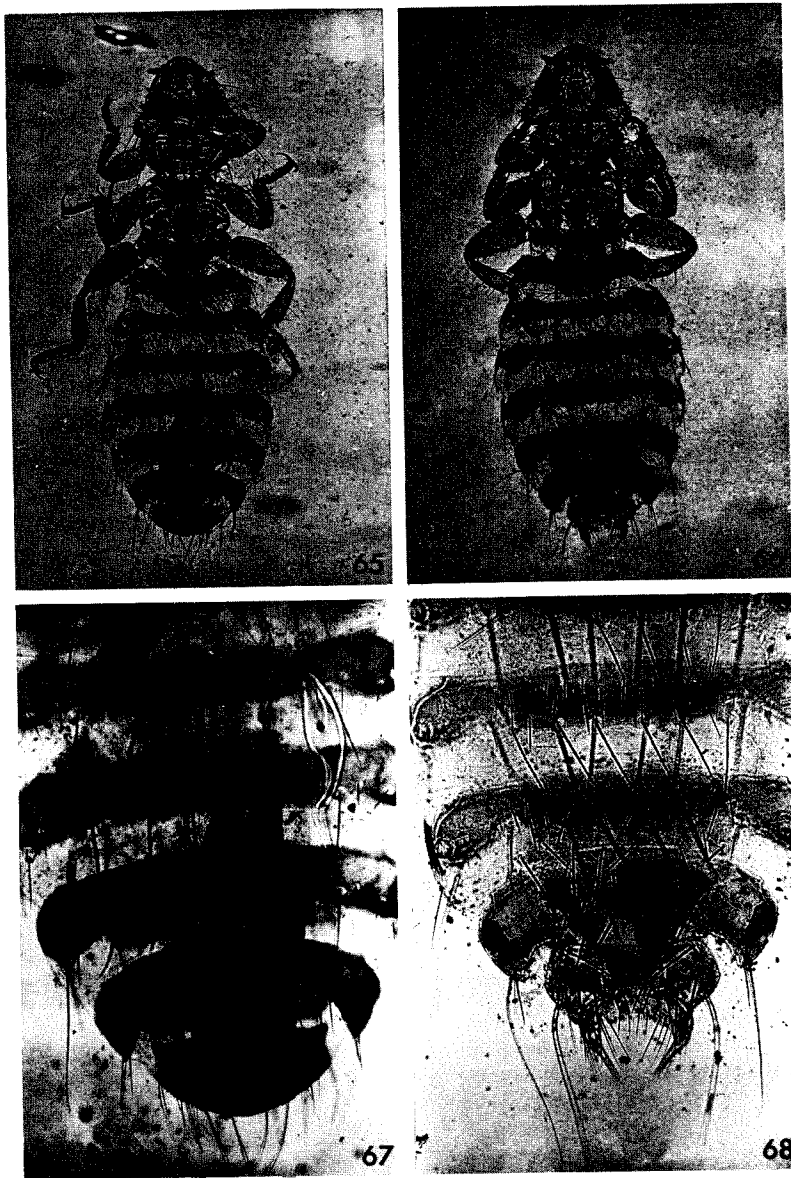
Figs. 52-55.—*Heterodoxus mitratus*: 52, male; 53, female; 54, male genitalia; 55, terminal abdominal segments of female.



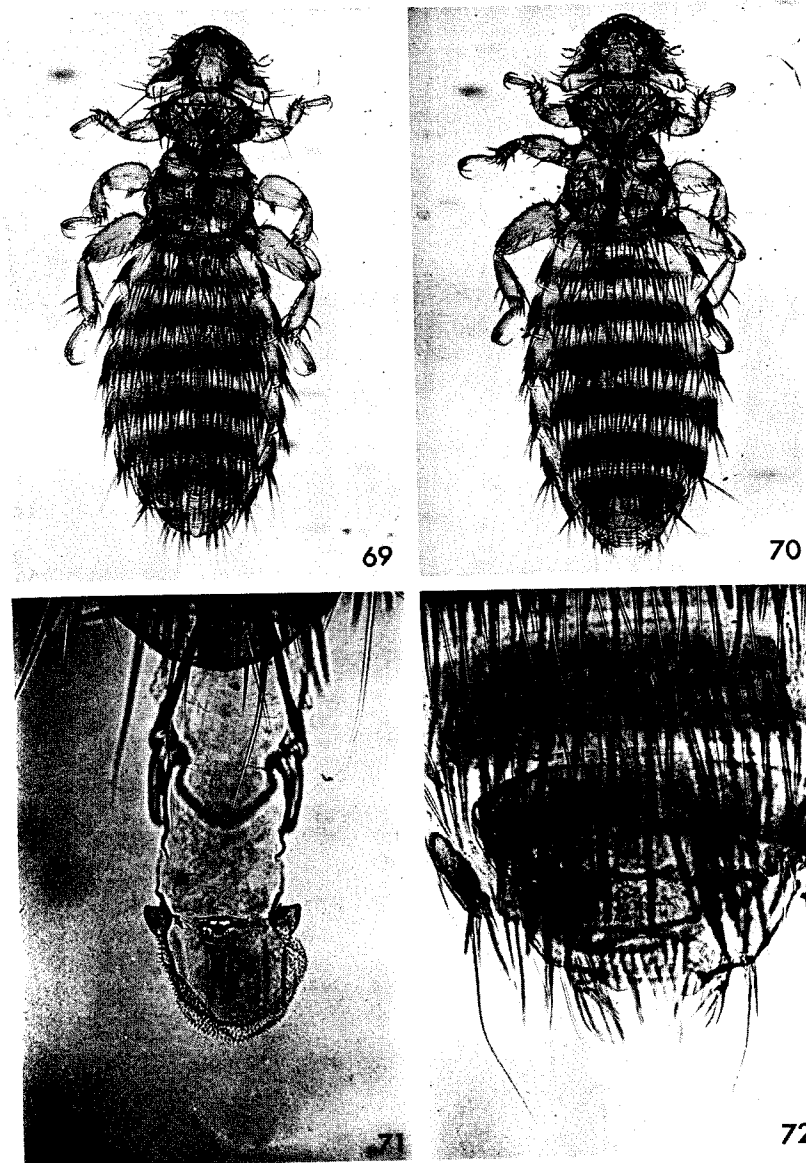
Figs. 56-59.—*Heterodoxus octoseriatus*: 56, male; 57, female; 58, male genitalia; 59, terminal abdominal segments of female.



Figs. 60-64.—*Heterodoxus quadriseriatus*: 60, male; 61, female; 62 and 63, male genitalia; 64, terminal abdominal segments of female.



Figs. 65-68.—*Heterodoxus pygidialis*: 65, male; 66, female; 67 and 68, terminal abdominal segments of male and female respectively.



Figs. 69-72.—*Paraheterodoxus insignis*: 69, male; 70, female; 71, male genitalia; 72, terminal abdominal segments of female.

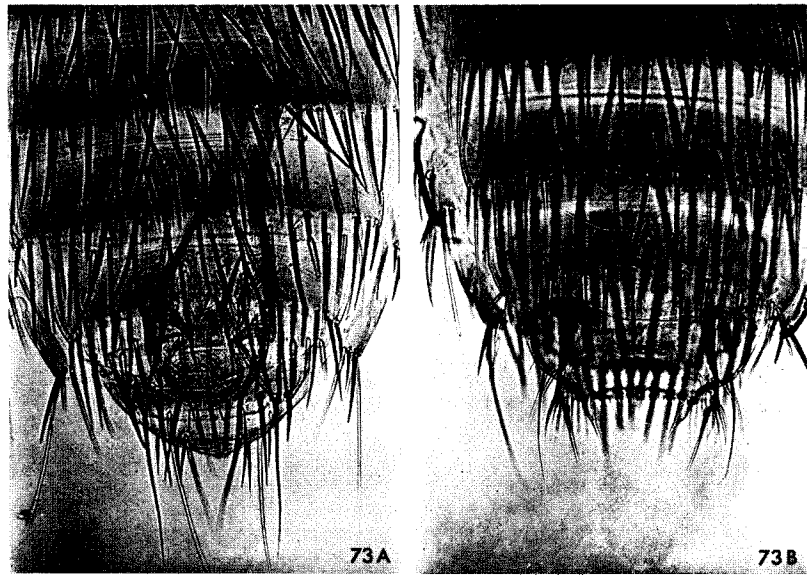
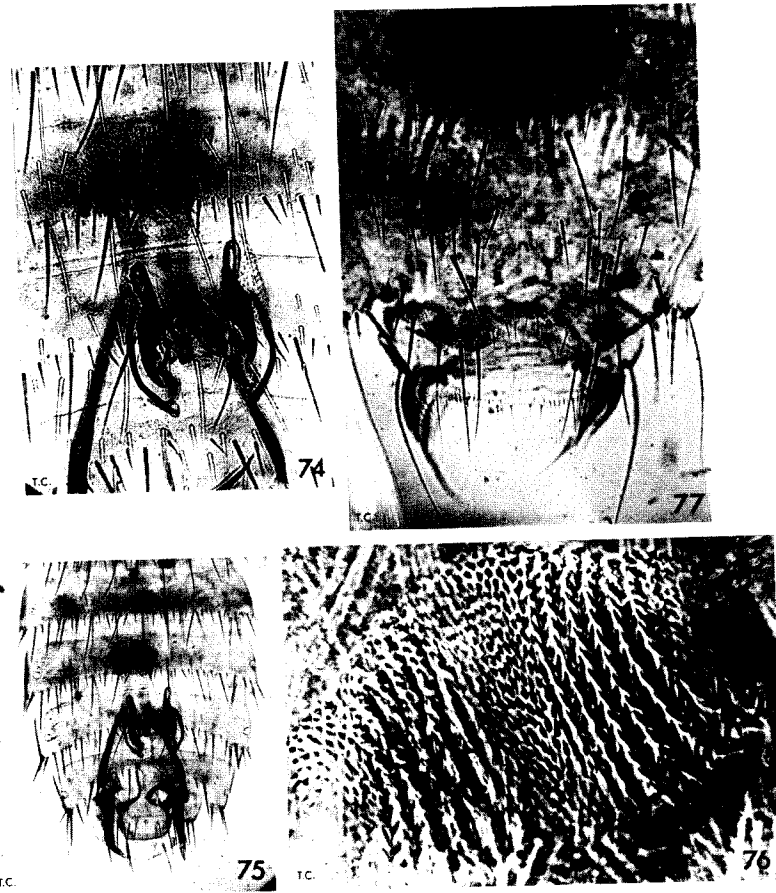
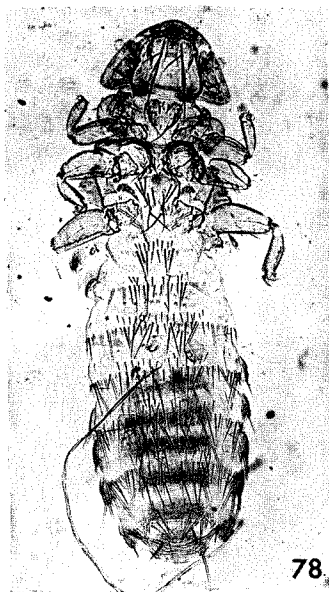


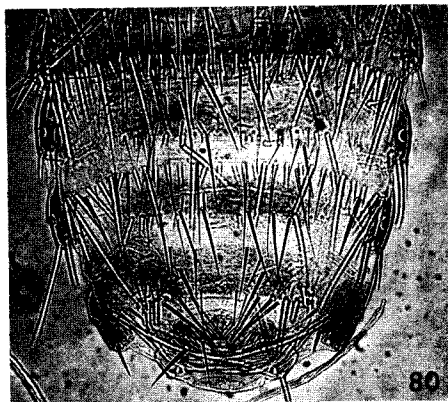
Fig. 73.—*Paraheterodoxus calcaratus*, terminal abdominal segments of male (A) and female (B).



Figs. 74-77.—*Heterodoxus maai*: 74 and 75, male genitalia; 76, male genitalia showing part of vesica; 77, terminal abdominal segments of female.

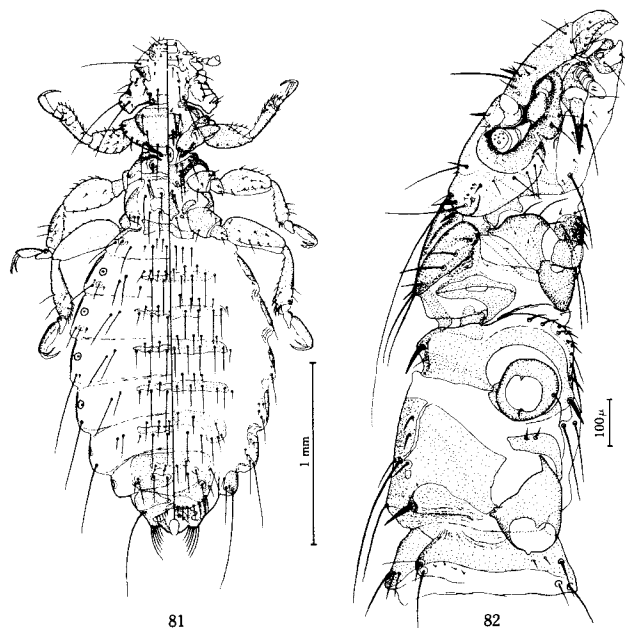


78



80

Figs. 78-80.—*Macropophila forcipata*: 78, female; 79, head and thorax of female; 80, terminal abdominal segments of female.

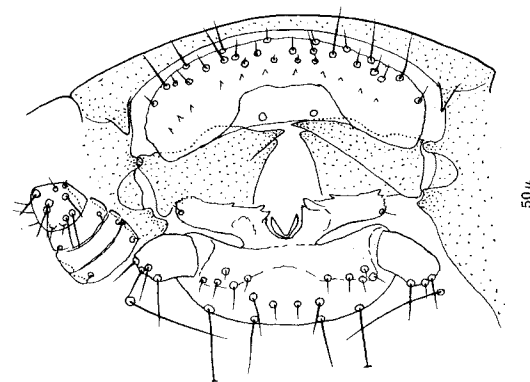


81

82

Fig. 81.—*Booplia biseriata*, female (1505/71).

Fig. 82.—Lateral aspect of head and thorax of *Heterodoxus spiniger* male (1521/7).



50 μ

Fig. 83.—Preantennal region, ventral, of *Cummingsia peramydis* female (1505/1).

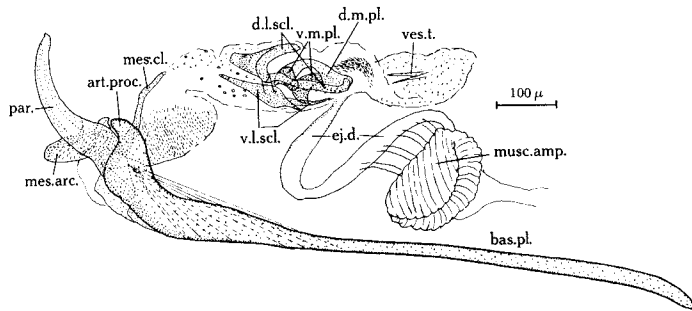
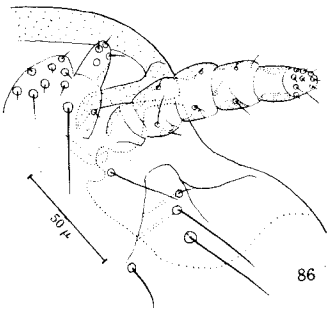
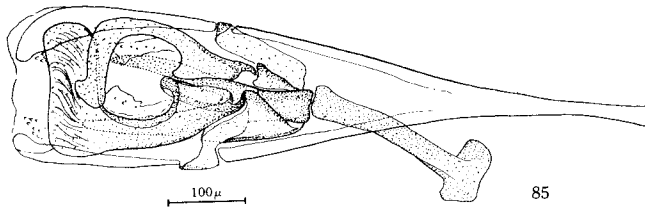


Fig. 84.—Male genitalia of *Heterodoxus spiniger* (1521/11). *mes. arc.*, mesosome arch; *par.*, paramere; *art. proc.*, articular process of basal plate; *mes. cl.*, mesosome clasp; *v. l. scl.*, venterolateral sclerite; *d. l. scl.*, dorsolateral sclerite; *v. m. pl.*, ventral median plate; *d. m. pl.*, dorsal median plate; *ej. d.*, ejaculatory duct; *ves. t.*, vesicular teeth; *musc. amp.*, muscular ampulla of ejaculatory duct; *bas. pl.*, basal plate.



Figs. 85 and 86.—*Trimenopon hispidum* (1525/1):
85, male genitalia;
86, maxillary palp.

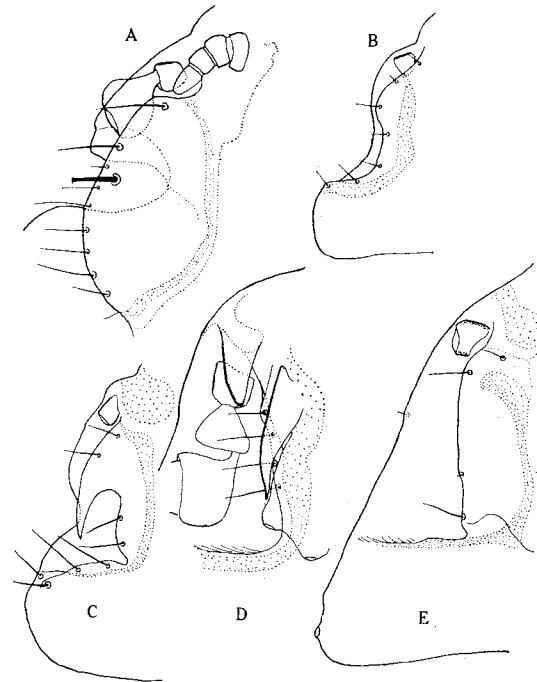
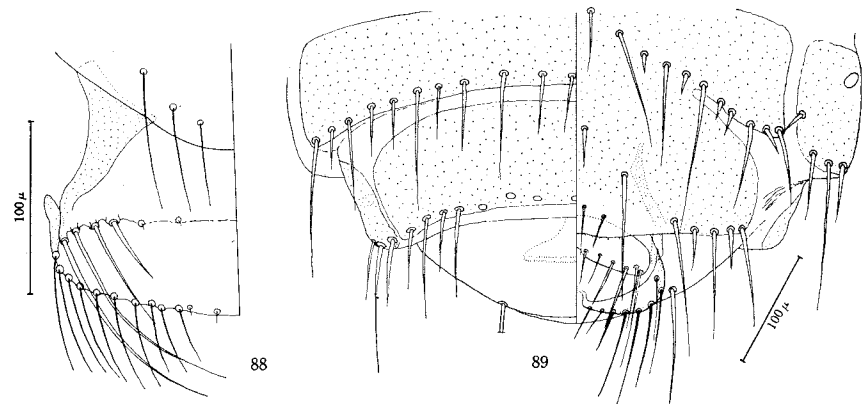


Fig. 87.—Lateral region of head of: A, *Philandesia townsendi* male (1525/5); B, *Philandesia chinchillae* female (1505/6); C, *Chinchillophaga clayae* female (1525/2); D, *Cummingsia peramydis* female (1505/1); E, *Trimenopon hispidum* male (1525/1).



Figs. 88 and 89.—Female end of abdomen of *Trimenopon hispidum* (1525/1) and *Cummingsia peramydis* (1505/2) respectively.

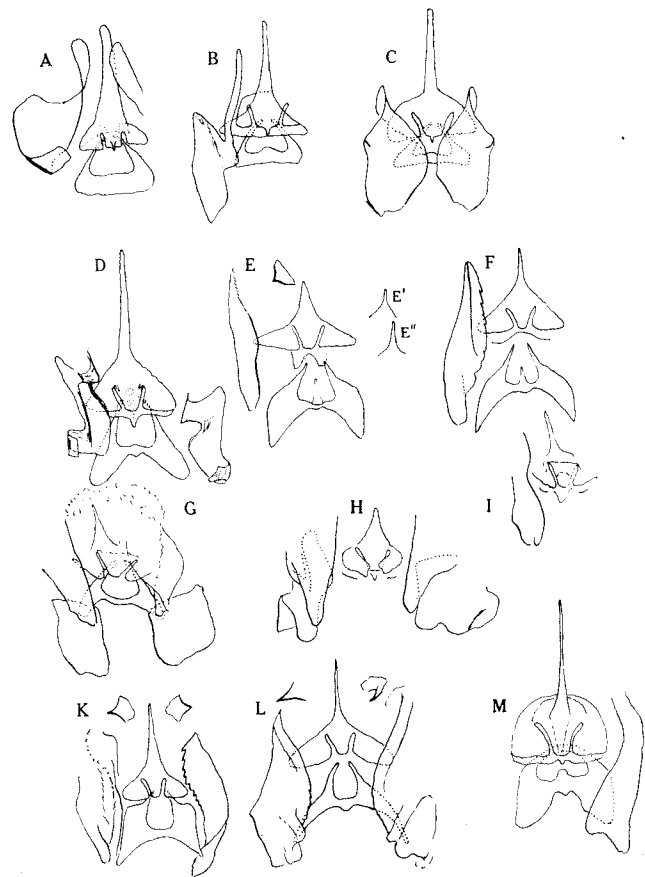


Fig. 90.—Sclerites of vesica, free-hand sketches: A, *Boopis tarsata* (1505/36); B, *B. dubia* (1496/23); C, *B. biseriata* (1505/67); D, *B. grandis* (1512/34, 1509/5); E, *B. bettongia* (1496/27) [E', 1496/28,34; E'', 1512/7]; F, *B. uncinata* (1505/27); G, *B. minuta* (1508/3, type); H, *B. notafusca* (1512/25); I, *Paraboopis flava* (1505/81); K, *Phacogalia brevispinosa* (1496/13,10); L, *Phacogalia spinosa* (1513/2); M, *Latumcephalum lesouefi* (1496/51).

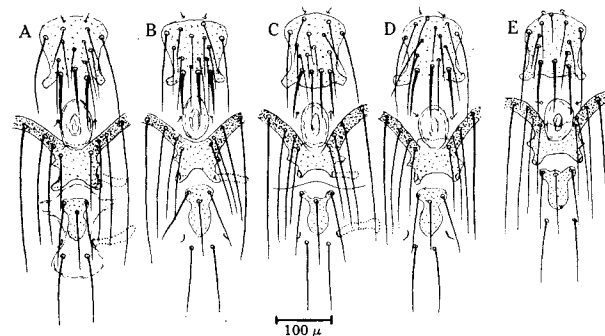


Fig. 91.—Thoracic sternites of one male and four females of *Boopis bettongia*: A, female (1508/5); B, male (1508/4); C, female (1512/3); D, female (1512/5); E, female (1496/25).

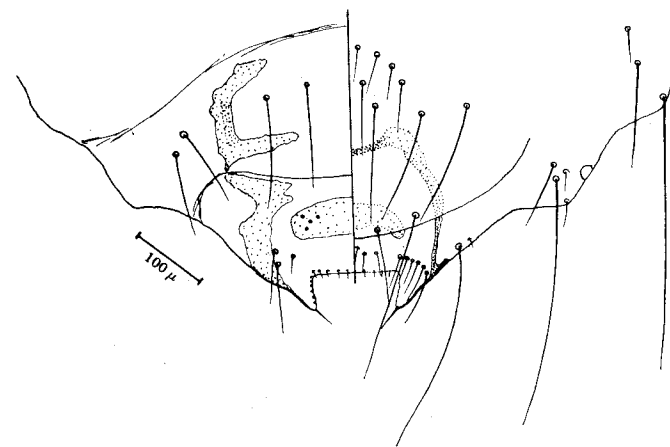
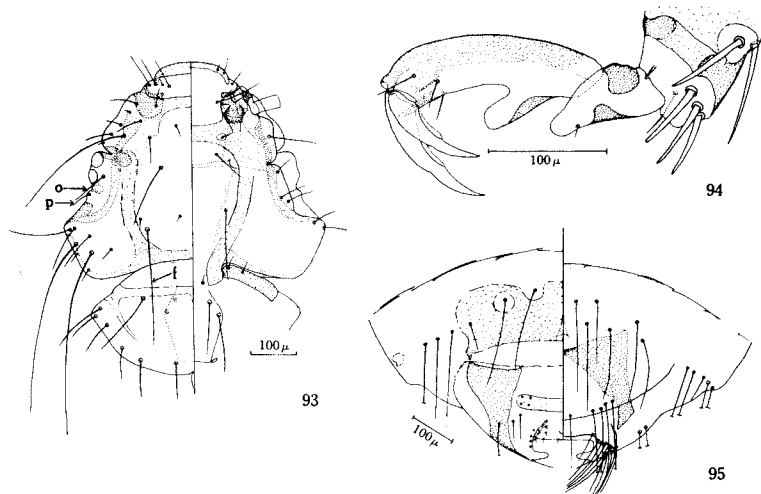
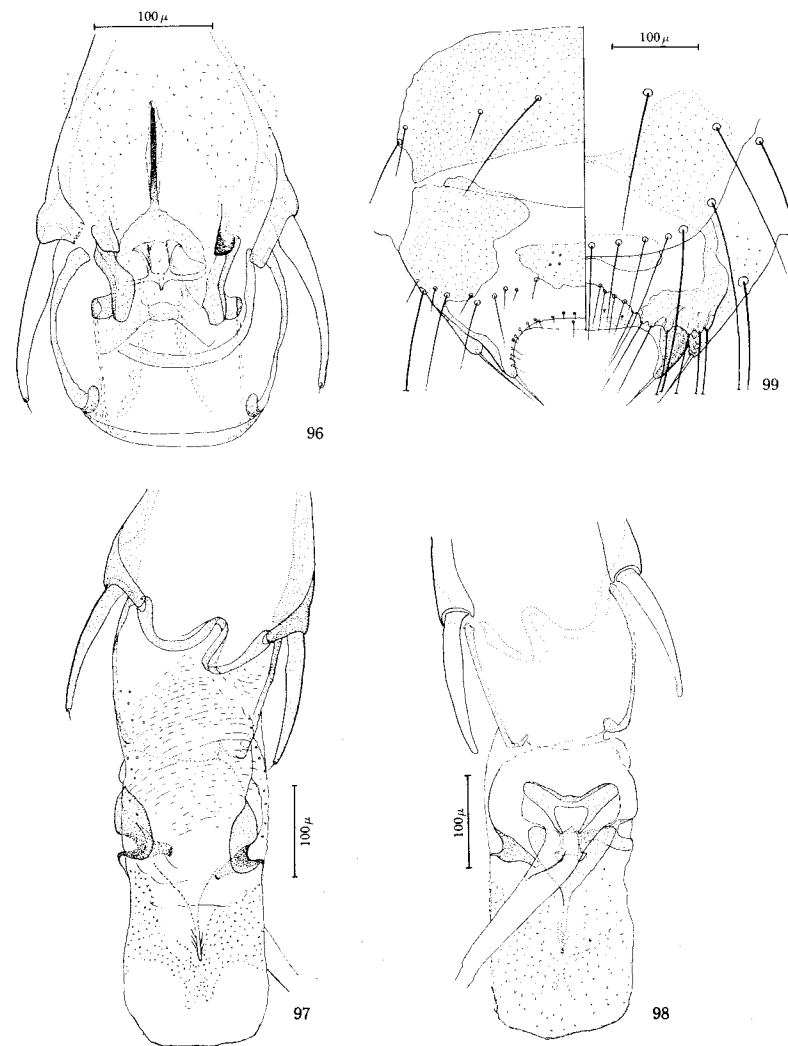


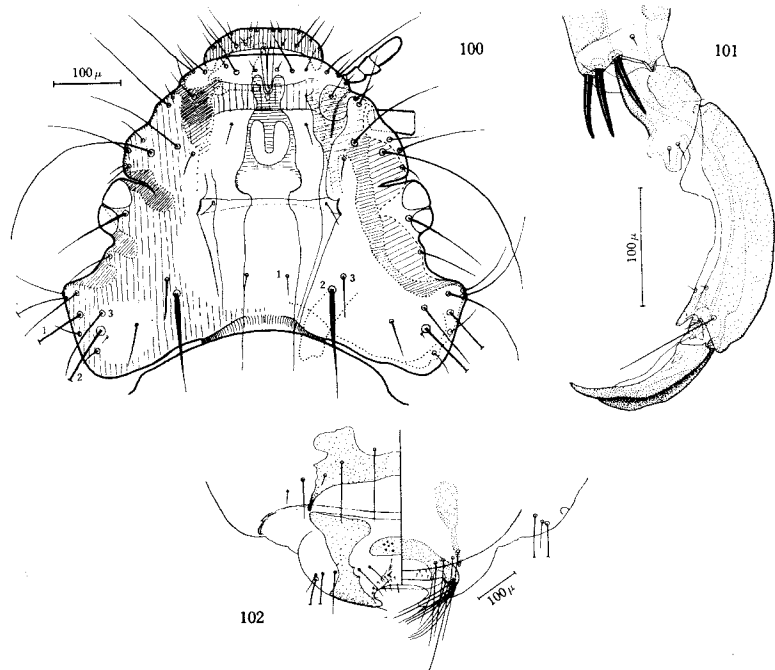
Fig. 92.—End of abdomen of *Boopis bettongia* female (1496/34).



Figs. 93-95.—*Boopia dubia*. 93, male (1496/38): *o*, ocular seta; *p*, postocular seta; *f*, second frontal seta; 94, hind tarsus (1496/23); 95, end of abdomen, female, of 1496/39 (left) and 1505/41 (right).



Figs. 96-99.—*Boopia grandis*: 96, male genitalia, ventral aspect (1512/34); 97, 98, erect phallus, dorsal and ventral aspect respectively; 99, end of abdomen of female (1512/34).



Figs. 100-102.—*Boopia tarsata*: 100, female head, dorsal (1496/18); 101, male left hind tarsus (1496/22); 102, end of abdomen of female (1512/18).

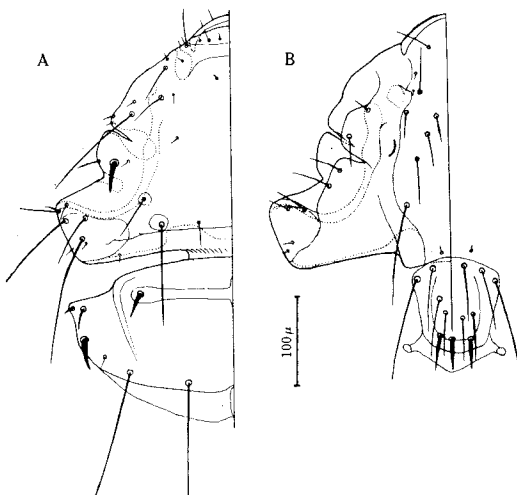


Fig. 103.—Male head and prothorax of *Boopia uncinata* (1505/24):

A, dorsal;
B, ventral.

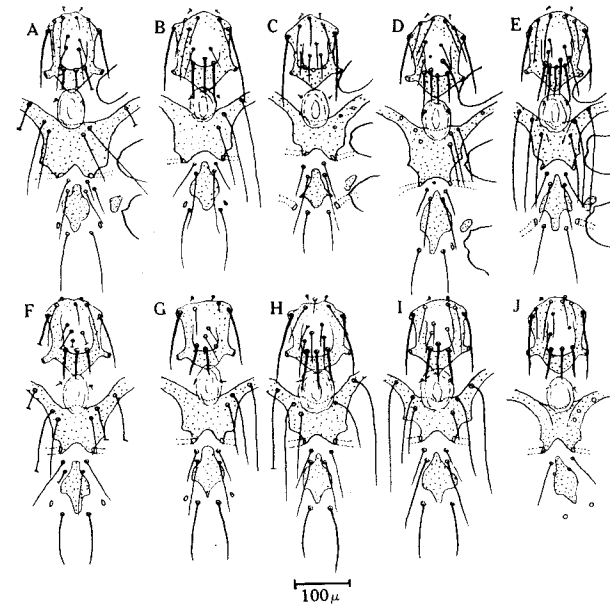


Fig. 104.—Thoracic sternites of *Boopia uncinata*: A-D and H, females off *Dasyurus hallucatus*; E, female off *Dasyurinus geoffroi*; F, G, I, males off *D. hallucatus*; J, male off *D. geoffroi fortis*. Slide identification numbers as follows: A, 1505/29; B, 1505/28; C, 1522/1; D, 1505/26; E, 1505/25; F, 1496/16; G, 1522/2; H, 1522/3; I, 1522/3; J, 1496/17.

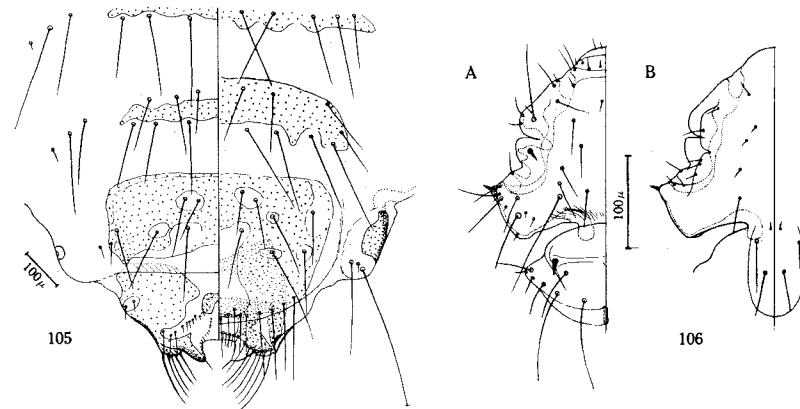
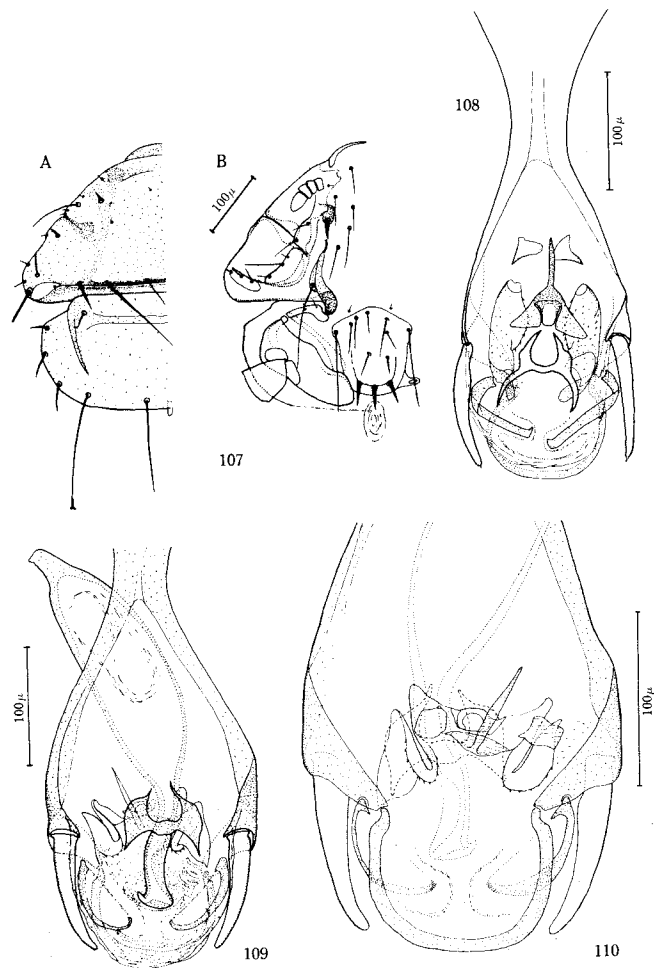


Fig. 105.—End of abdomen of *Boopia biseriata* female: 1496/67 (left); 1505/67 (right).

Fig. 106.—Head and prothorax of *Paraboopia flava* male (1505/81): A, dorsal; B, ventral.



Figs. 107-110.—*Phacogalia brevispinosa*. 107, dorsal (A) and ventral (B) view of head and prothorax; 108, male genitalia; 109, 110, phallus with spermatophore, ventral and dorsal aspects respectively.

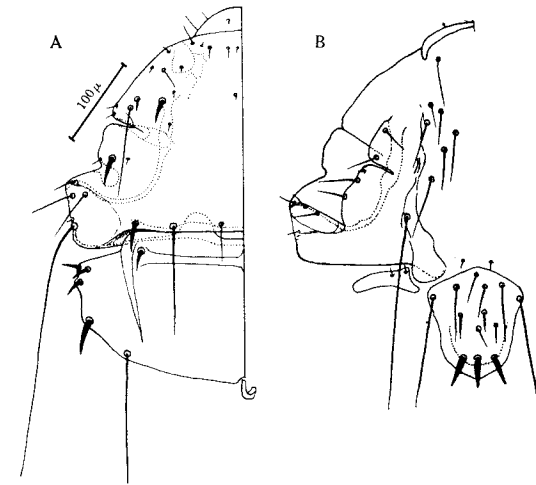
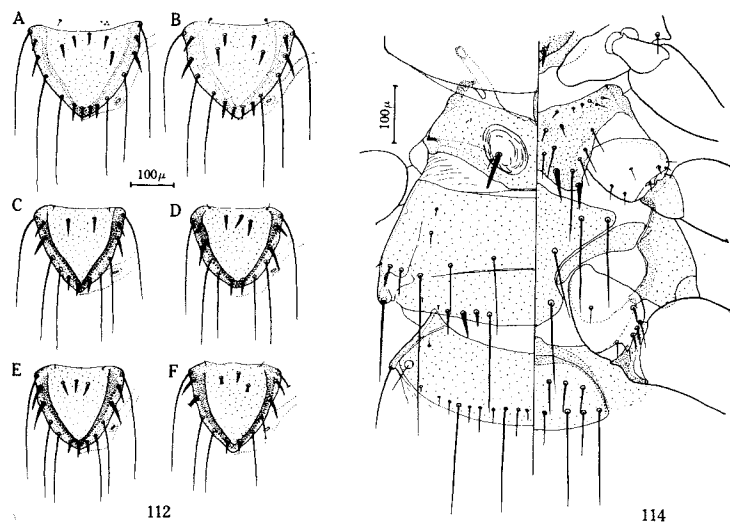
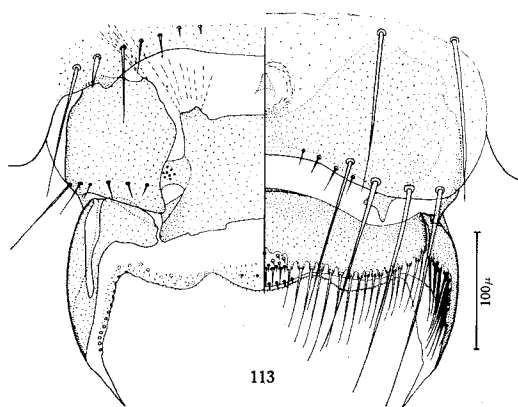


Fig. 111.—*Phacogalia spinosa*: A, female head and prothorax, dorsal (1513/1); B, male head and prothorax, ventral (1513/1).



112

114



113

Fig. 112.—Prosternites of *Macropophila clayae* (A, B), *M. biarcuata* (C, D), *M. breviarcuata* (E, F). Slide identification numbers are as follows: A, 1496/42; B, 1505/54; C, 1496/44; D, 1496/48; E, 1497/2; F, 1505/49.

Fig. 113.—End of abdomen of female *M. clayae* (1496/42).

Fig. 114.—Thoracic region of *M. biarcuata* (1496/49).

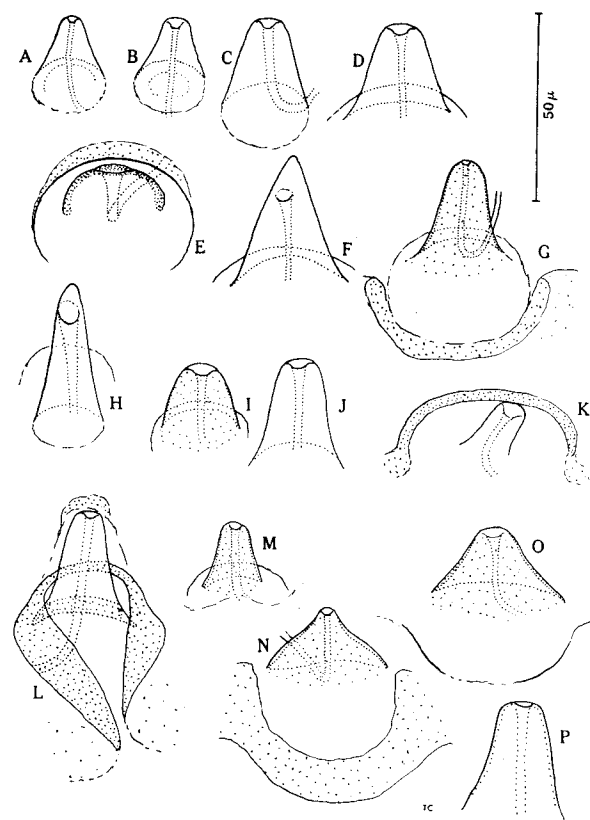


Fig. 115.—Genital papillae of species of *Macropophila* and *Heterodoxus*:

- | | | |
|-----------------------------|---------------------------|-------------------------------|
| A, <i>M. clayae</i> ; | G, <i>H. ampullatus</i> ; | L, <i>H. macropus</i> ; |
| B, <i>M. biarcuata</i> ; | H, <i>H. calabyi</i> ; | M, <i>H. quadriseriatus</i> ; |
| C, <i>M. breviarcuata</i> ; | I, <i>H. mitratus</i> ; | N, <i>H. pygidialis</i> ; |
| D, <i>H. longitarsus</i> ; | J, <i>H. ancoratus</i> ; | O, <i>H. octoseriatus</i> ; |
| E, <i>H. spiniger</i> ; | K, <i>H. alatus</i> ; | P, <i>H. maai</i> . |
| F, <i>H. ualabati</i> ; | | |

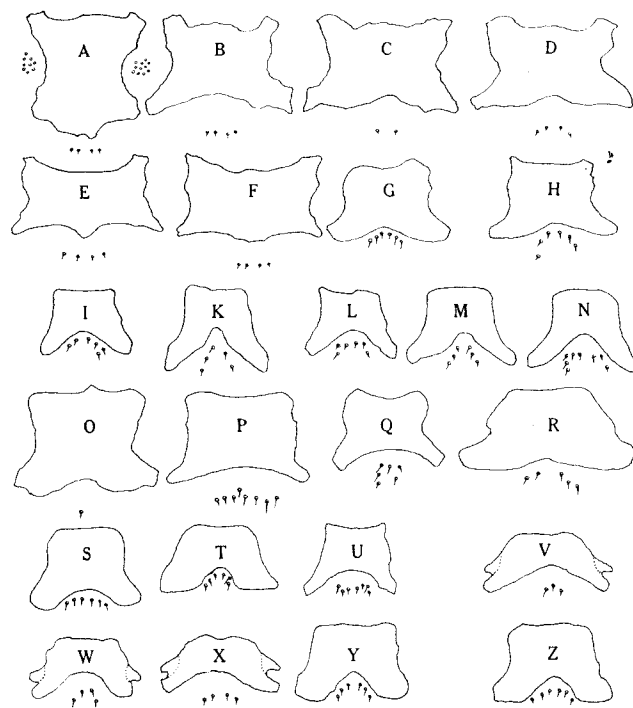


Fig. 116.—Ninth median tergal plates of females of *Macropophila* and *Heterodoxus* species. A–D, *M. clayae* (1496/40, 1496/42, 1505/54, 1518/5 respectively); E, *M. biarcuata* (1496/50); F, *M. breviarcurata* (1505/49); G, *H. longitarsus* (1496/60, 1496/61 respectively); I, K–N, *H. spiniger* (1518/12, 1514/3, 1518/11, 1514/1.2, 1514/1.4 respectively); O, *H. ualabati* (1497/5); P, *H. ampullatus* (1512/43); Q, *H. calabyi* (1496/55); R, *H. mitratus* (1497/18.1); S, *H. ancoratus* (1496/57); T, *H. alatus* (1503/41); U, *H. macropus* (1505/55); V–X, *H. quadriseriatus* (1496/72, 1496/75, 1505/91); Y, Z, *H. octoseriatus* (1496/4.2, 1496/4.1).

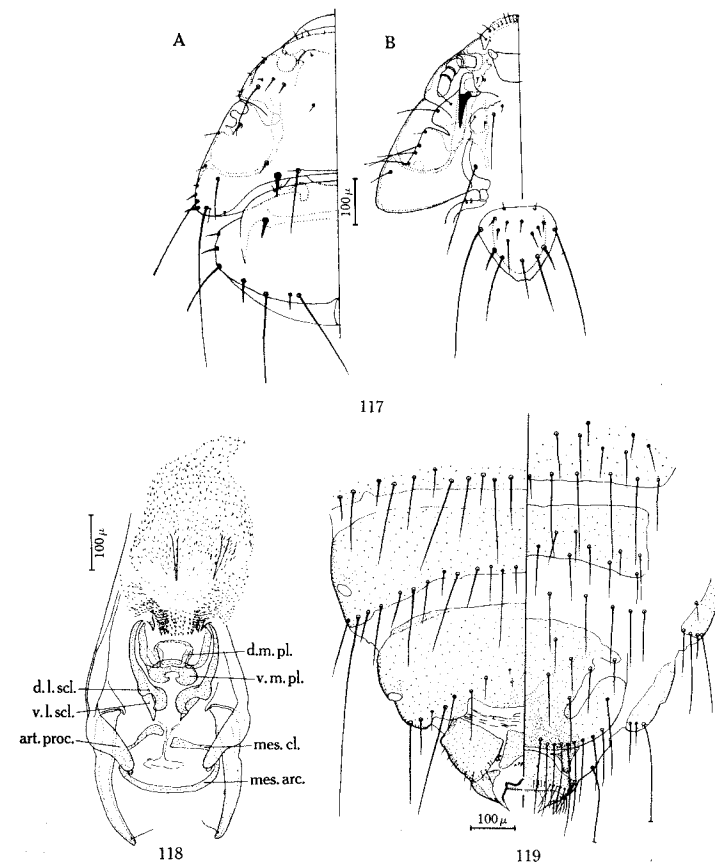


Fig. 117.—Male head and prothorax of *Heterodoxus spiniger* (1514/1): A, dorsal; B, ventral.

Fig. 118.—Male genitalia of *H. spiniger* (1518/12) from *Wallabia agilis*. Explanation of lettering as in Figure 84.

Fig. 119.—End of abdomen of female *H. spiniger* (1518/12) from *W. agilis*.

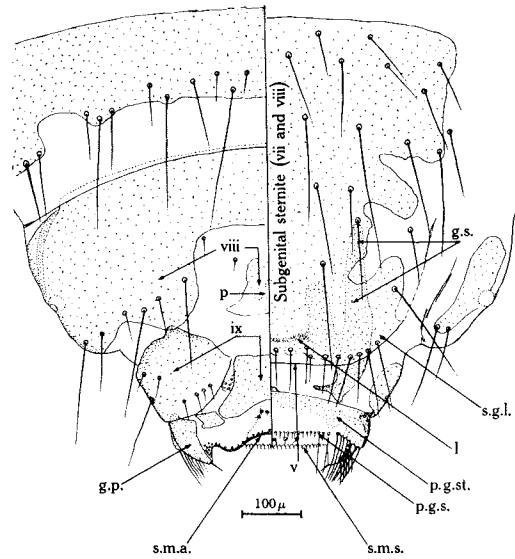


Fig. 120.—End of abdomen of female *Heterodoxus longitarsus*, left dorsal, right ventral. Slide identification numbers 1497/3 and 1496/62 respectively. viii, ix, tergites; *p*, genital papilla (internal); *g.p.*, gonapophysis; *s.m.a.*, supraanal margin and ampullae; *g.s.*, genital sclerite (internal); *s.g.l.*, subgenital lobe; *l*, lunula; *p.g.st.*, postgenital sternum; *p.g.s.*, postgenital setae; *s.m.s.*, subanal margin and setae; *v*, vulva.

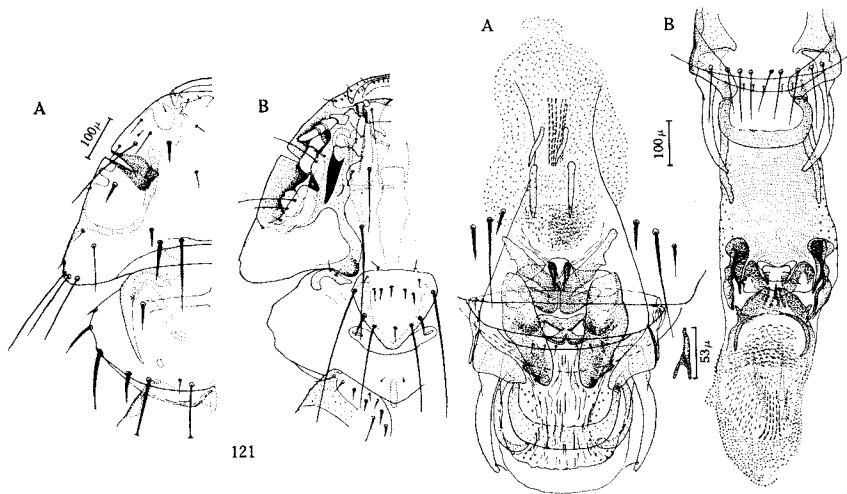


Fig. 121.—Male head and prothorax of *Heterodoxus alatus* (1503/3-2): *A*, dorsal; *B*, ventral.
Fig. 122.—Male genitalia of *H. alatus*: *A*, 1503/3-2; *B*, 1503/4-1.

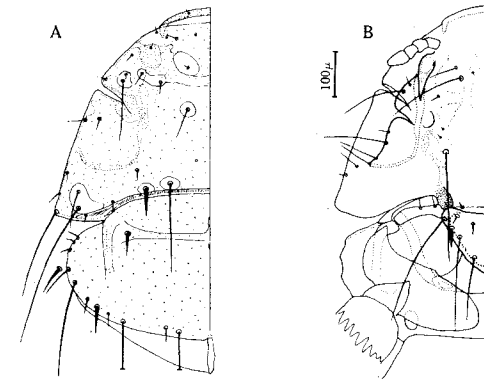


Fig. 123.—Male head and prothorax, dorsal and ventral views, of *Heterodoxus ampullatus* (1512/43).

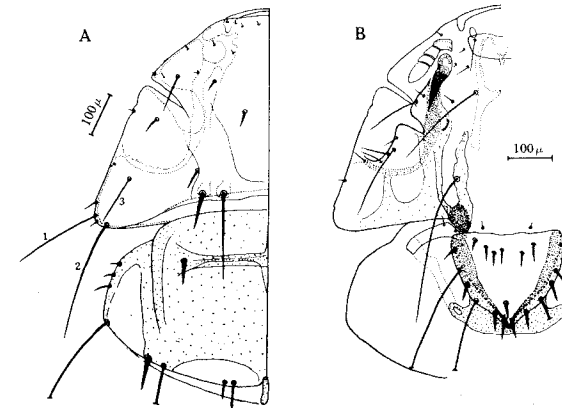


Fig. 124.—Male head and prothorax, dorsal and ventral views, of *H. mitratus* (1497/19). 1, 2, 3, temporal setae.

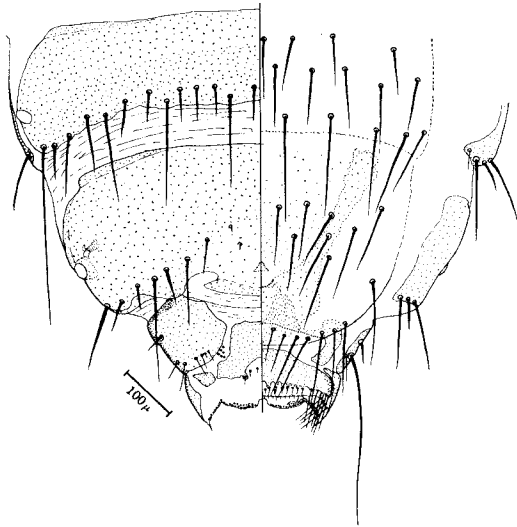
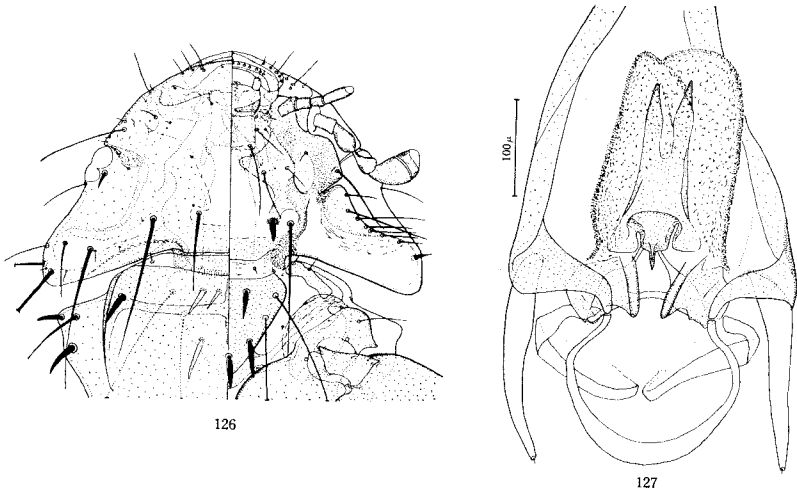
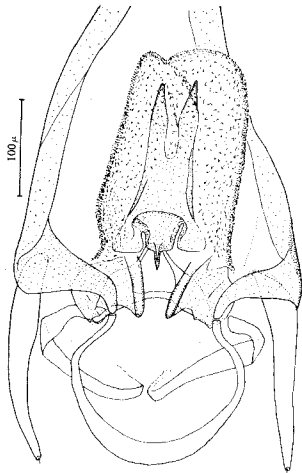


Fig. 125.—End of abdomen of female *Heterodoxus octoseriatus* (1496/4).



126



127

Figs. 126, 127.—Female head (1496/77) and male genitalia (1497/16) of *Paraheterodoxus insignis* respectively.

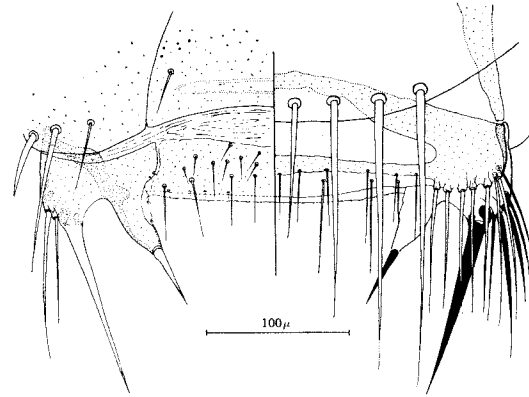


Fig. 128.—End of abdomen of female *Paraheterodoxus calcaratus* (1496/3).

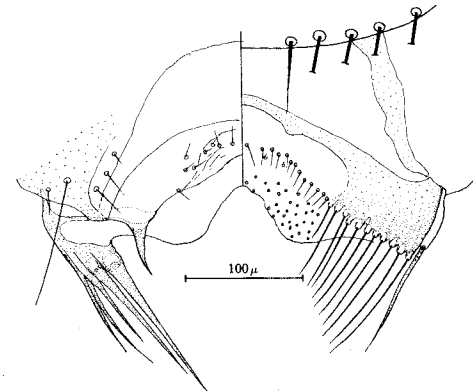
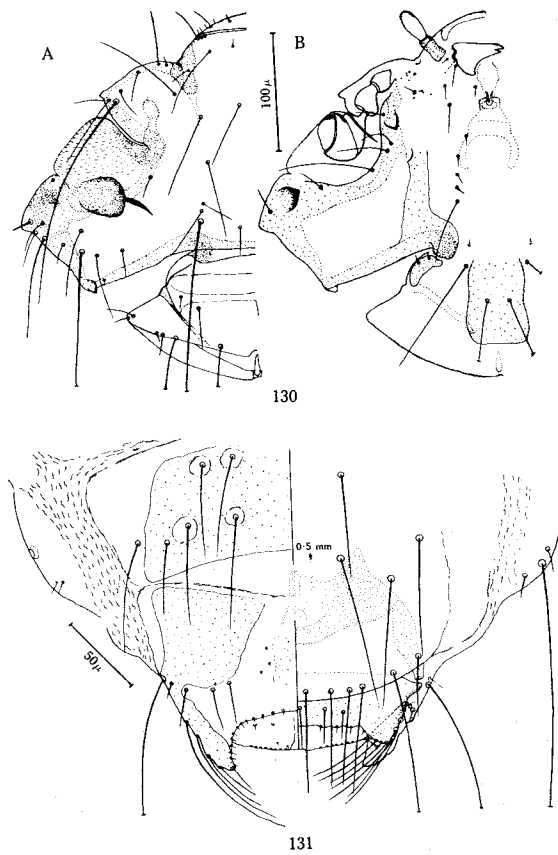
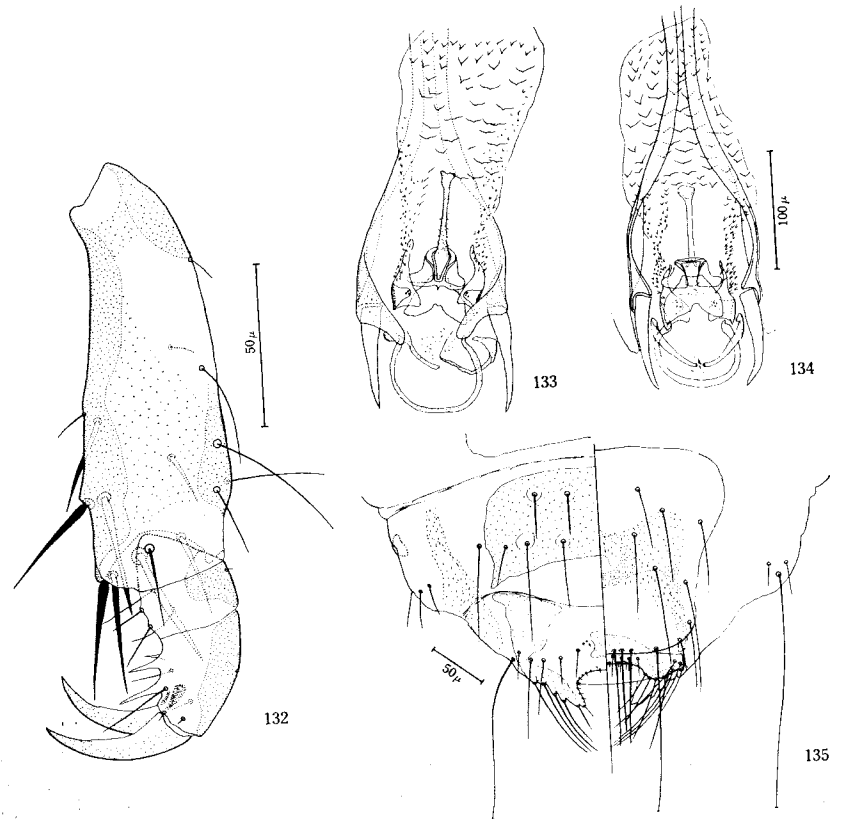


Fig. 129.—End of abdomen of female *P. erinaceus* (1496/80).



Figs. 130 and 131.—Female head and prothorax, dorsal and ventral views, and end of abdomen of female *Latumcephalum macropus* respectively (both 1505/65).



Figs. 132–135.—*Latumcephalum lesouefi*: 132, hind tarsus (1509/20); 133, dorsal aspect of male genitalia (1496/51); 134, ventral aspect of male genitalia (1496/52); 135, end of abdomen of female.

RECOGNIZED GENERA, SPECIES, AND SYNONYMS OF TRIMENOPONIDAE AND
BOOPIIDAE

Valid names in italics, synonyms in roman type

Family Trimenoponidae		<i>Heterodoxus</i> Le Souëf & Bullen 49
<i>Acanthomenopon</i> , syn. <i>Cummingsia</i> 14	<i>alatus</i> , sp. nov. 51	<i>ampullatus</i> , sp. nov. 52
<i>Chinchillophaga</i> Emerson 15	<i>ancoratus</i> , sp. nov. 53	<i>armiferus</i> , syn. <i>H. spiniger</i> 62
<i>clayae</i> Emerson 15	<i>brevispinosa</i> , syn. <i>Ph. brevispinosa</i> 39	<i>calabyi</i> , sp. nov. 54
<i>Cummingsia</i> Ferris 14	<i>longitarsus</i> (Piaget) 55	<i>maai</i> Emerson 57
<i>horrida</i> , syn. <i>C. peramydis</i> 15	<i>macropus</i> Le Souëf & Bullen 58	<i>mitratus</i> , sp. nov. 59
<i>intermedia</i> Werneck 15	<i>octoseriatus</i> , sp. nov. 60	<i>pygidialis</i> (Mjöberg) 61
<i>maculata</i> Ferris 15	<i>quadriseriatus</i> , sp. nov. 62	<i>spiniger</i> (Enderlein) 63
<i>peramydis</i> Ferris 15	<i>ualabati</i> Plomley 66	<i>Keleriella</i> , syn. <i>Boopia</i> 31
<i>Harrisonia</i> Ferris 14	<i>Laticephalum</i> , syn. <i>Latumcephalum</i> 71	<i>Latumcephalum</i> Le Souëf 71
<i>uncinata</i> Ferris 14	<i>lesouëfi</i> Harrison & Johnston 72	<i>macropus</i> Le Souëf 73
<i>Hoplomyophilus</i> Méndez 15	<i>Macropophila</i> Mjöberg 43	<i>biarcuata</i> , sp. nov. 45
<i>nativus</i> Méndez 15	<i>breviarcuata</i> , sp. nov. 45	<i>clayae</i> , sp. nov. 46
<i>Menopon jenningsi</i> , syn. <i>T. hispidum</i> 13	<i>forcipata</i> Mjöberg 47	<i>Menacanthus spiniger</i> , syn. <i>H. spiniger</i> 63
<i>Philandesia</i> Kellogg & Nakayama 13	<i>Menopon (Menacanthus) longitarsus</i> , syn. 55	<i>H. longitarsus</i> 55
<i>chinchillae</i> Werneck 14	<i>Menopon (Menacanthus) spiniger</i> , syn. 63	<i>H. spiniger</i> 63
<i>mazzai</i> Werneck 14	<i>Menopon longitarsus</i> , syn. <i>H. longitarsus</i> 55	<i>Menopon spiniger</i> , syn. <i>H. spiniger</i> 63
<i>townsendi</i> Kellogg & Nakayama 14	<i>Paraboopia</i> Werneck & Thompson 36	<i>flava</i> Werneck & Thompson 37
<i>Philandria</i> , syn. <i>Philandesia</i> 13	<i>Paraheterodoxus</i> Harrison & Johnston 67	<i>calcaratus</i> , sp. nov. 68
<i>Trimenopon</i> Cummings 13	<i>erinaceus</i> , sp. nov. 69	<i>insignis</i> Harrison & Johnston 70
<i>echinoderma</i> , syn. <i>T. hispidum</i> 13	<i>Phacogalia</i> Mjöberg 37	<i>brevispinosa</i> Harrison & Johnston 39
<i>hispidum</i> (Burmeister) 13	<i>spinosa</i> Harrison & Johnston 42	
<i>rozeboomi</i> , syn. <i>T. hispidum</i> 13		
Family Boopiidae		
<i>Boopia</i> Piaget 17		
<i>bettongia</i> Le Souëf 19		
<i>biseriata</i> , sp. nov. 22		
<i>brevispinosa</i> , syn. <i>Ph. brevispinosa</i> 39		
<i>doriana</i> , sp. nov. 24		
<i>dubia</i> Werneck & Thompson 25		
<i>grandis</i> Piaget 26		
<i>longitarsata</i> , syn. <i>B. tarsata</i> 33		
<i>minuta</i> Le Souëf 28		
<i>mjobergi</i> Werneck & Thompson 30		
<i>notafusca</i> Le Souëf 31		
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