

## MALLOPHAGA FROM MARSUPIALS. I.

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(With 14 Text-figures.)

THIS communication is the first of a series dealing with Mallophaga from Australian marsupials. We had hoped to prepare a single monographic work on the Family Boopidae, but the carrying out of this plan has been prevented by a variety of causes, and we think it advisable to publish piecemeal the notes and descriptions that we have accumulated during the last six years. There has of late years been a recrudescence of interest in the Mallophaga, and a considerable number of students are now investigating the group. Little has been published upon the very distinct family which is characteristic of Australian marsupials, and it is important that students of the group should have diagnoses of the family, sub-families, and genera, based upon an ample material, which includes all the known species, with a single exception, and more than an equal number of undescribed new forms. Such a material is at our disposal. Apart from our own collections, Mr A. S. Le Souëf has very kindly transferred to us all his Mallophaga from marsupials, including his types.

Some structural features, of which use is made in the diagnoses of the family and its lesser groups, but which are not enlarged upon in the descriptions of species, will be dealt with more fully in a forthcoming morphological work by one of us (L. H.). Host-lists, and complete keys to the species of *Boopia* and *Heterodoxus*, will be included in the last paper of the series.

## Family BOOPIDAE Mjöberg (1910, p. 21).

Mjöberg (*loc. cit.*) has given a diagnosis of this family, based upon his own species, *B. peregrina*, from an otter, *Lutra pruneri*, and upon Piaget's descriptions of *B. tarsata* (1880, p. 599) and *B. grandis* (1885, p. 154). The chief character upon which we rely to separate the family from all other Mallophaga is the presence of a large accessory sac of unknown function in connection with the ♂ genitalia. This sac is not figured by Mjöberg for *B. peregrina*, and Dr Mjöberg, who has seen our preparations of all other genera of Boopidae, assures us that it is not present. There is thus some doubt as to whether *B. peregrina* should

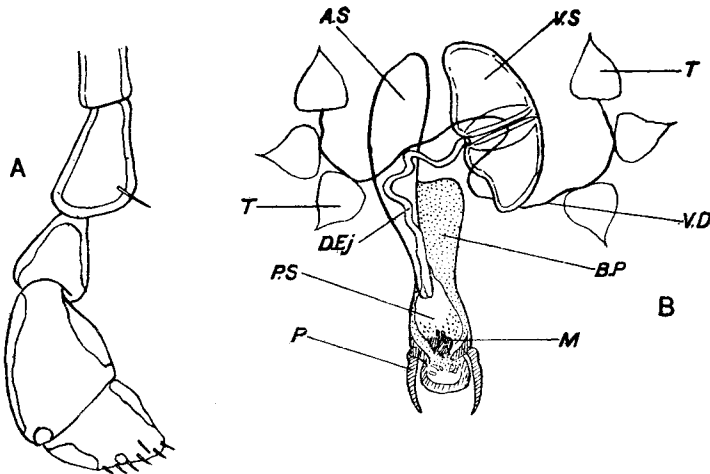


Fig. 1. Family Boopidae. (A) Antenna of *Paraheterodoxus insignis*, (B) ♂ genitalia of Boopidae, schematic. A.S. Accessory sac, B.P. Basal plate, D.E.j. Ejaculatory duct, M. Mesosome, P. Paramere, P.S. Preputial sac, T. Testes, V.D. Vasa deferentia, V.S. Vesicula seminalis. (L. H. del.)

be included in *Boopia* at all, although in every other respect it appears to conform.

The family may be briefly diagnosed as follows: Amblycera with head broader than long; antennae definitely five-jointed; thorax relatively long; prothorax transversely ellipsoid, with lateral expansions; mesothorax distinct, with a pair of dorsal prominences, each bearing a spine, or a long hair; hairs generally stouter, and of a more spinous character than in bird-frequenting Amblycera; abdominal stigmata on segments 2-7, not 3-8; ♂ genitalia with vesicula very broad in

proportion to its length, and with a large accessory sac without homologue in other Mallophaga. Characteristic of marsupials.

This family we divide into two sub-families, Latumcephalinae, and Boopinae, which are easily separable by the following key.

*Key to Sub-families.*

- A. Palpi two-jointed LATUMCEPHALINAE.
- AA. Palpi four-jointed BOOPINAE.

Sub-family LATUMCEPHALINAE n.

*Characters of sub-family.* Boopidae with head twice as broad as long; antennary fossa covered dorsally by a thin membranous plate; a tubercle with a movable spine protecting eye; palpi two-jointed; tarsi short and two-jointed; mesothoracic prominences with hairs, not spines. A single genus, *Latumcephalum* Le Souëf.

Genus *Latumcephalum* Le Souëf.

Le Souëf (1902, p. 51) has given a brief diagnosis of this genus, in which he states, *inter alia*, that the palpi are "apparently two-jointed, but in reality four-jointed." We find that the palps have only two articles. The characters we give for the sub-family hold equally for the genus. We may, in addition, draw attention to the extreme lateral production of the anterior temporal angle; to the unusual position of the eye, which is not marginal, but situated dorsal to the innermost part of the antennary fossa; to the development of the prothoracic wings at the expense of the median portion; and to the lateral incisions which divide the metathorax into two unequal parts. *Latumcephalum* is also devoid of the three pairs of special sensory organs (Fig. 4) which appear upon the first three abdominal segments of all other Boopidae. Two species are known, *L. macropus* Le Souëf, and *L. lesouëfi*, a new species which we describe below.

*Latumcephalum macropus* Le Souëf. Figs. 2-3.

Le Souëf (*loc. cit.*) has recorded this species from "wallabies," and has given a summary description and a poor figure (Fig. 4) of the ♀. He did not distinguish between the two species. We find the correct host of the type to be *Macropus dorsalis* (a Queensland species) in the Melbourne Zoological Gardens. The description and figures are from Le Souëf's types in our possession.

*Description of the ♂.* Head twice as wide as long, roughly parabolic in front, with squared temporal lobes and slightly concave occipital margin; anterior portion, in front of palps, sharply marked off from remainder by a pair of distinct indentations; antennary fossa very deep, with projecting anterior angles; and covered dorsally by a fine hyaline ridged plate, with its free edge serrated; the lateral margin of this plate completely bridges the fossa, giving an apparently continuous outline to the margin of the head, but there is a deep, narrow indentation before and behind it; temporal lobes truncated; palpi two-jointed, not four-

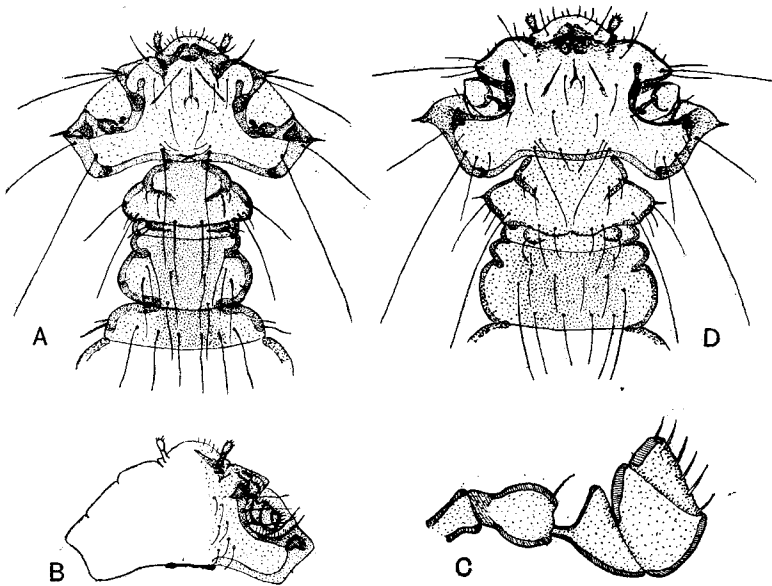


Fig. 2. *Latumcephalum macropus*. (A) Head and thorax, (B) Under side of head, (C) Antenna. *L. lesouëfi*. (D) Head and thorax. (L. H. del.)

jointed, as stated in the original description; the proximal joint cylindrical, the distal somewhat swollen, with rounded extremity bearing a few short hairs; the two segments of equal length; antennae capable of free projection beyond the margins of the head, of five segments; first short, second with cylindrical base and almost spherical distal portion, with a few slight projections on the distal border; third pedunculated, conical, with a concave extremity for reception of the fourth; fourth segment rounded and swollen, inverted distally to receive the irregularly conical fifth, which bears a fringe of bristles; eye dorsal, in

posterior angle of fossa, small, with a double pigment spot; protected dorsally by a chitinous tubercle set just behind it, which bears in a socket on its summit a stout skittle-shaped spine; general colour pale yellowish, with strong chitinisations round the greater part of its margin, the relations of which are best seen in the figure; at the base of the palps is a strong chitinous support, which ends ventrally in a prominent tooth-like structure; immediately in front of the clypeal suture is a small rounded dorsal prominence; from the suture a strong chitinous band extends laterally, following the inner margin of the antennary fossa, thence round the temporal lobes and along the occiput; chitinisation very strong at the posterior lateral angles, with strong, tooth-like ventral projection; a similar, but weaker projection ventrally behind the insertion of the antenna; chitin band narrower along occiput; delicate hairs scattered round anterior part of head; a strong pustulated hair, and two shorter ones, at the anterior angle of the antennary fossa; lateral temporal angle with a stout short spine and a long hair; a long pustulated hair immediately in front of the posterior temporal angle, behind which is a tooth-like spine projecting inward and upward dorsally; in the mid-region of the dorsal surface, a few fine hairs, two longer ones, near the occipital margin, reaching to the metathorax; numerous small hairs on the ventral surface, and a stronger fringe along the inner border of the antennary fossa, which is not covered ventrally.

Prothorax about half as long and half as wide as head, transversely elliptical, with lateral expansions and obtusely rounded hind margin; strongly coloured on the antero-lateral borders, with oblique bands converging toward the mid-line posteriorly; four long and some short hairs along posterior margin, and a hair in lateral angles; a few scattered hairs on dorsal, and two pairs of long hairs on ventral surface. Mesothorax short, with rounded lateral borders, narrower than prothorax, with distinct suture; on dorsal surface two rounded prominences laterally, each bearing a couple of hairs; two pairs of long hairs on ventral surface. Metathorax of irregular shape, narrower anteriorly, and bilobed laterally; posterior margin flatly rounded, with crenated edge; practically uncoloured, save for narrow lateral bands; six pairs of long and some short hairs dorsally; two pairs on ventral surface; sternal markings distinct, comprising a roughly rectangular presternite, a papilionaceous mesosternite, and a rounded metasternite, with four internal chitinous spots, two in front and two behind the insertions of the metathoracic legs.

Abdomen of nine segments, elongate elliptical; widest at segments four and five; angles rounded and somewhat projecting; cuticle in general thrown into delicate ridges; lateral blotches yellow, with uncoloured space between them and margins of segments; transverse blotches also yellowish, and confined to the centre of the abdomen, leaving wide uncoloured spaces on either side; a hair in each lateral angle; six hairs dorsally on segment one; two rows, of about four and eight respectively, on the next seven; posterior extremity rounded, with several hairs; chitinous genitalia complex, and of same general form as in *Heterodoxus* and *Boopia*; ventral surface has hairs distributed in much the same manner as the dorsal; legs weak, uniformly coloured pale yellow, with stout hairs at the distal end of the tibia; tarsi short, two-jointed, with first joint a little shorter and stouter than second.

*Measurements in millimetres.*

	♂		♀	
	Length	Breadth	Length	Breadth
Head ... ..	0.210	0.403	0.218	0.412
Prothorax ... ..	0.090	0.202	0.111	0.218
Mesothorax ... ..	0.020	0.118	0.022	0.134
Metathorax ... ..	0.115	0.225	0.120	0.243
Abdomen ... ..	0.773	0.454	0.806	0.450
Total length and greatest breadth	1.210	0.454	1.277	0.450

The female differs from the male only in the posterior end of the abdomen, the final segment ending flatly with a fringe of hairs, and a pair of projecting gonopods, as in *Boopia*.

Found on *Macropus dorsalis* (a Queensland species) in the Melbourne Zoological Gardens, Le Souëf collection. The description and figures are from Le Souëf's type in our possession.

*Latumcephalum lesouëfi* n. sp. Figs. 2-3.

Amongst the mounted material in the Le Souëf collection was a slide containing three specimens of a *Latumcephalum* labelled *L. macropus*, from *Macropus ualabatus*, Victoria. We find, upon examination, that it is quite a distinct form, the main points of difference being in the shape and size of the plate covering the antennary fossa, the relatively broader abdomen, and distinctly wider thorax. We have named the species in compliment to Mr A. S. Le Souëf, who is both the author of the genus and the collector of the species.

*Description of ♂.* Like the last species, but with head and thorax proportionately larger; head with a more indented outline, due to the fact that the dorsal plate covering the antennary fossa is roughly triangular, instead of quadrangular; the apex projecting above the fossa, and giving an indentation in the outline on either side; the tubercle and spine protecting the eye are, in this species, borne upon this plate, and not on the chitinous framework of the fossa; posterior angles of temporal lobes projecting more prominently backwards behind the occiput; prothorax almost half as wide again, and has a more transversely elongate appearance; metathorax of same general character, but relatively wider, and a little longer; abdomen similar, but relatively broader; posterior extremity similar.

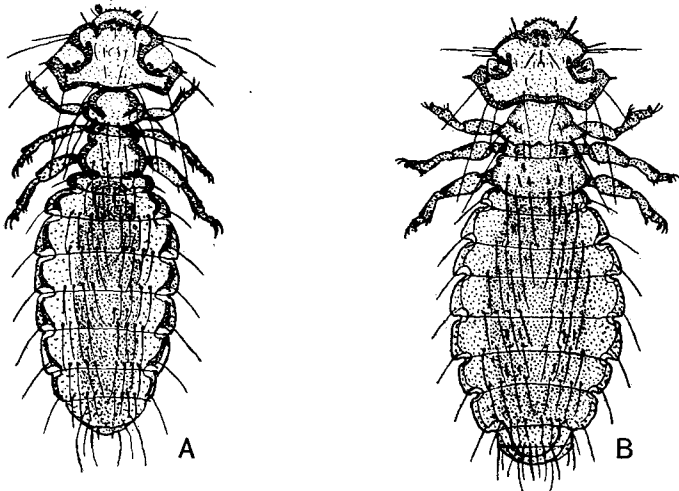


Fig. 3. (A) *Latumcephalum macropus*, ♂; (B) *L. lesouëfi*, ♂. (L. H. del.)

*Measurements in millimetres.*

	♂	
	Length	Breadth
Head ... ..	0.235	0.470
Prothorax ... ..	0.115	0.271
Mesothorax ... ..	0.020	0.138
Metathorax ... ..	0.140	0.295
Abdomen ... ..	0.800	0.538
Total length and greatest breadth	1.310	0.538

The only female at our disposal is immature, but indicates the same sexual dimorphism as in *L. macropus*.

On *Macropus ualabatus*, Victoria, Le Souëf collection.

## Sub-family BOOPINAE n.

*Characters of sub-family.* Boopidae with four-jointed palps, and long, two-jointed tarsus. Antennary fossa always bounded above and below by chitinous plate-like expansions of the sides of the head, both deeply cleft about the middle of their length. The eye is situated in the dorsal plate, just behind the cleft. Mesothoracic prominences always with stout spines. Three pairs of special sensory organs upon the first three abdominal segments.

Three genera are known, *Boopia* Piaget, *Heterodoxus* Le Souëf and Bullen, and *Paraheterodoxus* here described as new. The three may be easily distinguished by means of the following key.

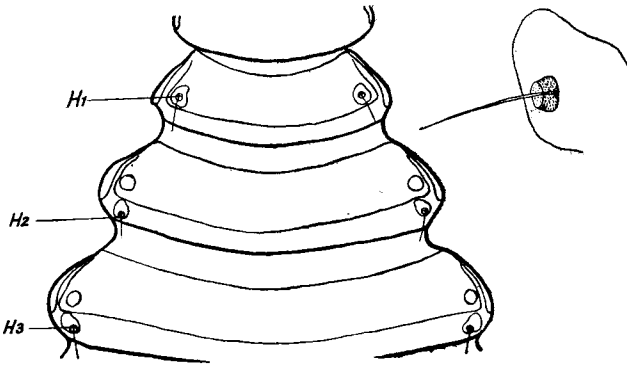


Fig. 4. First three abdominal segments of *Heterodoxus longitarsus*, to show special sensory hairs ( $H_1$ ,  $H_2$ ,  $H_3$ ). (L. H. del.)

## Key to the Genera of Boopinae.

- A. Without dagger-like spines beneath head *Boopia*.  
 AA. With dagger-like spines beneath head ... B.  
 B. Spines rising from base of palps ... *Heterodoxus*.  
 BB. Spines rising from throat beneath occiput *Paraheterodoxus*.

Genus *Boopia* Piaget.

The genus *Boopia* has been well enough characterised by Piaget (1880, p. 599), but we would emphasise the special features which distinguish this genus, which comprises more species than any other of the family, from the bird-frequenting forms. These features are possessed in common by the remaining genera of the family, but *Boopia* looks distinct to the ordinary systematist, while *Heterodoxus* has been



included in *Menopon* by Piaget, and only grudgingly allowed generic rank by Neumann (1913, p. 634), because of its superficial resemblance to the latter genus. We wish, therefore, to lay stress on the homogeneity of the Boopidae, and on the wide gulf which separates this family from the Menoponidae, and other bird-infesting Amblycera on the one side, and from the Trimenoponidae of rodents on the other.

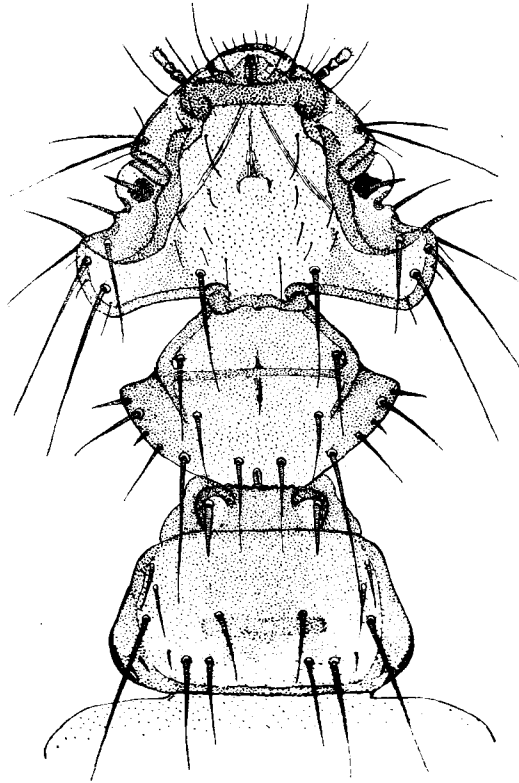


Fig. 5. *Boopia notafusca*, head and thorax. (L. H. del.)

These points of difference will be dealt with fully in a forthcoming morphological paper by one of us (L. H.). Here we simply repeat that they consist essentially in the structure of the ♂ internal genitalia, and in the structure, not the mere possession, of the distinct mesothorax. The close relation between *Boopia* and *Heterodoxus* is further emphasised by their possession in common of three pairs of sensory organs upon the first three abdominal segments.

*Boopia* is easily distinguished from *Heterodoxus* by the absence of the characteristic spines on the under side of the head, by the emargination of head outline posterior to the eye, and by the truncated temporal lobes. Twelve species are known to us at present, including the dubious *B. peregrina*; of which, in this communication, we redescribe *B. notafusca* of Le Souëf, and describe three new species.

*Boopia notafusca* Le Souëf. Figs. 5-6.

Le Souëf (1902, p. 50, Fig. 1) has given a summary description and a figure of no diagnostic value of this species. Our figures have been prepared from his type. Fig. 5 shows the character of the head and thorax, and serves to illustrate the genus as well as the species. Fig. 6 is an uncorrected camera drawing of the type ♂.

*Description of ♂.* Head broader than long, with very square temporal lobes, the posterior temporal angles, in specimens not subjected to compression, projecting behind the occiput. Eye large, simple. Prothorax two-thirds as long as wide, with lateral angles at about the middle of its length, narrow anteriorly and posteriorly. Mesothorax short, with lateral prominences bearing stout spines. Metathorax the width of the prothorax, widest close to its hind margin, shorter than the prothorax, with rounded angles. Abdomen broadly ovate, widest at the fourth segment, terminating in a narrower roundly conical last segment. Legs long, the second tarsal joint especially so. This joint exhibits a delicate transverse ridging upon its inner face, and is without an appendage. The general nature of the chaetotaxy will be apparent from the figures.

The ♀ differs from the ♂ only in being slightly larger, and in the posterior end of the abdomen, which shows two curved gonopodial processes.

*Measurements in millimetres.*

	♂		♀	
	Length	Breadth	Length	Breadth
Head ... ..	0.286	0.410	0.286	0.410
Prothorax ... ..	0.202	0.319	0.206	0.325
Mesothorax ... ..	0.050	0.202	0.050	0.218
Metathorax ... ..	0.218	0.370	0.225	0.385
Abdomen ... ..	1.092	0.790	1.273	0.807
Total length and greatest breadth	1.848	0.790	2.040	0.807

The species thus briefly characterised falls into that group within the genus which has hairs only, and no spines, upon the occiput. In

this group it is further distinguished by the backward production of the temporal angles behind the occiput (the figures, owing to pressure used in mounting the specimen drawn, do not sufficiently indicate this character), while the character of the inner face of the second tarsal joint finally distinguishes it from the one species with which it might be confused.

Our specimens are from *Macropus ualabatus* and *M. giganteus*, both from Victoria, Le Souëf collection. The former would seem to be the more characteristic host.

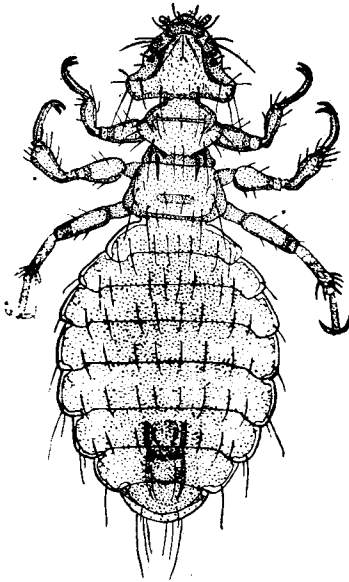


Fig. 6. *Boopis notafusca*, ♂.  
(L. H. del.)

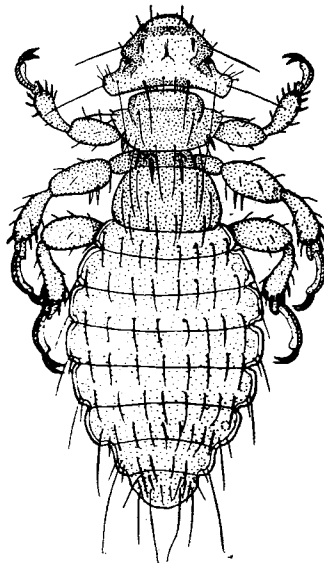


Fig. 7. *Boopis phaneroceata*, ♂.  
(L. H. del.)

*Boopis phaneroceata* n. sp. Fig. 7.

*Description of ♂.* Head of the same general shape and proportions as *B. notafusca*, but with temporal angles more rounded, and temporal lobes not so markedly produced backwards behind the occiput. The eye is not so prominent, the pigment spot being extremely small; and the eye is not bounded posteriorly by a cleft. The strong hair behind the eye in *B. notafusca* is here represented only by a minute prickle; and the head outline presents an even curve from eye to anterior-temporal angle. The ocular spine is short and very stout; and a similar

pair of short stout spines overlies the bases of the palps. The prothorax more resembles that of *Heterodoxus*, the expanded portion being semi-circular; while the central portion does not taper anteriorly as in *B. notafusca*. The second and third hairs from the lateral angle have the form of short stout curved spines. The meso- and metathorax have the same general form and chaetotaxy as in *B. notafusca*. The second tarsal joint is without the minutely spinous ridges on the inner face which characterise the last species. The femora of the second legs bear upon the post-axial surface, close to the trochanter, a pair of specialised spines similar to those of *Paraheterodoxus* mentioned below; and presumably having a clasping function. The abdomen and genitalia are of the same general form as in *B. notafusca*.

The ♀ exhibits the usual sexual dimorphism of the hind end of the abdomen, is without the spines upon the second femora, is slightly larger, and generally stouter in all measurements.

*Measurements in millimetres.*

	♂		♀	
	Length	Breadth	Length	Breadth
Head ... ..	0.252	0.420	0.252	0.438
Prothorax ... ..	0.168	0.353	0.185	0.370
Mesothorax ... ..	0.067	0.269	0.069	0.070
Metathorax ... ..	0.185	0.336	0.204	0.375
Abdomen ... ..	0.857	0.638	0.950	0.706
Total length and greatest breadth	1.529	0.638	1.660	0.706

This small form we obtained in enormous numbers upon a long-nosed bandicoot, *Perameles nasuta*, caught at Woolloomooloo, Sydney, which must have been the last survivor of its tribe in this now busy shipping centre. There must have been many thousands of this parasite upon it. We have named the species from the very active way in which it oscillates its antennae, and brings them into view, when alive. It belongs to a group which also includes *B. tarsata* Piaget, and *B. uncinata* next described, and which is distinguished from the *notafusca* group by the shape of the temporal lobes, which are not produced backwards behind the occiput. It is easily separated from the other two species of the group by the fact that the eye is not bounded posteriorly by a cleft.

*Boopia uncinata* n. sp. Fig. 8.

*Description of ♀.* Head short in proportion to its length, projecting strongly in front of eye; the latter prominent, with large pigment spot

and short thick curved spine, bounded posteriorly by a shallow cleft, from the bottom of which the anterior margin of the temporal lobe runs in a straight line to the angle. Both temporal angles rounded, the head at the posterior being decidedly narrower than at the anterior angles. Prothorax has the same general proportions as *B. phaneroerata*, but the semicircular hind margin is emarginate between the lateral hairs. The usual row of four hairs occurs upon the hind margin, but the wings carry only three heavy hook-like spines on each side. In the metathorax the outer pair of hairs of the posterior row is modified into a pair of short spines; and there is an indication of the inclusion of an abdominal tergite with the metathorax. The abdomen is narrow in proportion to its length, and ends dorsally in a single pair of gonopodial processes. The broadly rounded terminal sternite extends behind and laterally beyond the tergite.

Male unknown.

*Measurements in millimetres.*

	♀	
	Length	Breadth
Head ... ..	0.235	0.403
Prothorax ... ..	0.176	0.360
Mesothorax ... ..	0.060	0.202
Metathorax ... ..	0.202	0.353
Abdomen ... ..	1.092	0.806
Total length and greatest breadth	1.765	0.806

Described from one ♀ and one ♂ taken upon a "tiger cat," *Dasyurus maculatus*, at Sydney. The species differs from *B. phaneroerata* in having the eye bounded posteriorly by a cleft; and from *B. tarsata*, besides the marked difference in size, in having no appendage upon the second tarsal joint.

*Boopia spinosa* n. sp. Fig. 9.

*Description of ♀.* Head broad in proportion to its length, with square temporal lobes, large and prominent eye, bounded posteriorly by a shallow cleft, and broadly rounded anterior portion. A pair of stout spines upon the occipital margin, enclosing four hairs, the outer pair long, the inner short. Prothorax almost as wide as head, with obtusely rounded lateral angle, the wing carrying four stout curved spines, three marginal, and one internal at the angle. From the lateral angles the sides converge slightly backwards to the third marginal spine, at

which a slight angle is formed, and from this point the hind margin is broadly rounded. The metathorax is twice as broad as long, and has the outer hairs of the posterior row spinous. The abdomen is broadly ellipsoidal, widest at the fourth and fifth segments, with the dorsal gonopodial processes large and separated by a much wider interval than in the last species. The chaetotaxy conforms to the usual character in *Boopia*, each tergite carrying a single row of eight hairs, divided into a median row of four, and two lateral pairs; but in this species the median row is divided so as to give the appearance of four pairs. The sternites bear two rows of hairs, the anterior short, the posterior long. The first

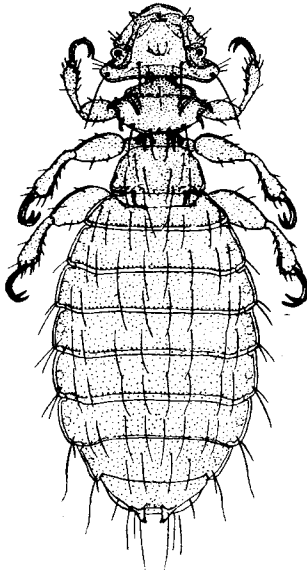


Fig. 8. *Boopia uncinata*, ♀.  
(L. H. del.)

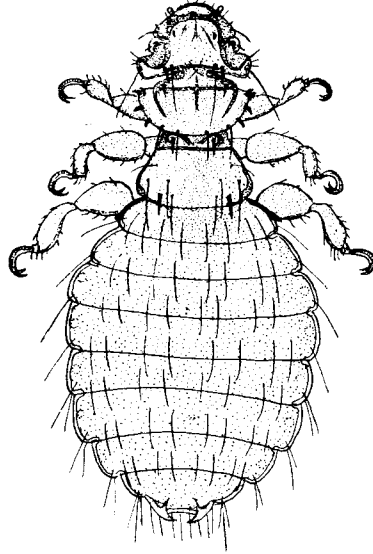


Fig. 9. *Boopia spinosa*, ♀.  
(L. H. del.)

abdominal segment bears upon its lateral margin, at about half its length, a short stout spine.

The ♂ differs from the ♀ in its generally smaller measurements, in the conically rounded character of the last abdominal segment, and in the presence of a pair of clasping spines at the junction of trochanter and femur on the inner side of the second pair of legs.

The inner face of the claws in both sexes shows 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.

*Measurements in millimetres.*

	♂		♀	
	Length	Breadth	Length	Breadth
Head ... ..	0.252	0.420	0.252	0.437
Prothorax ... ..	0.202	0.395	0.210	0.420
Mesothorax ... ..	0.040	0.269	0.050	0.302
Metathorax ... ..	0.185	0.386	0.200	0.420
Abdomen ... ..	1.001	0.790	1.126	0.890
Total length and greatest breadth	1.680	0.790	1.838	0.890

From a wallaby, *Macropus ualabatus*, Victoria, Le Souëf collection.

The species falls into a small group within the genus characterised by the occurrence of spines upon the dorsal occipital margin. From the two other species of this group with which we are acquainted, *B. grandis* Piaget and an undescribed form, the present species may be distinguished by the simple, not double, eye, and by the absence of a spine in the metathoracic angle.

Genus *Heterodoxus* Le Souëf and Bullen.

Le Souëf and Bullen (1902, p. 159) established this genus for a parasite of "kangaroos and wallabies." Their type species, *H. macropus*, was shown by us (1912, p. 13) to be identical with the *Menopon longitarsus* of Piaget, a fact subsequently pointed out independently by Cummings (1913, p. 44) and Paine (1912, p. 360). Neumann (1912, p. 359) included *H. longitarsus* in his sub-genus *Menacanthus*; but subsequently (1913, p. 634) acquiesced in the generic distinction of *Heterodoxus*.

*Heterodoxus* is distinguished from *Boopia* by the presence of spines on the under side of the head; by the absence of a post-ocular emargination, and by the acutely rounded temporal lobes.

Several species have been described, all of which must, for the present, be referred to *H. longitarsus*, under which species they are discussed below. In addition to these, we are acquainted with two new species, which will be described in a later communication, both from marsupials, and with a third, which is described below.

*Heterodoxus longitarsus* [Piaget] Johnston and Harrison.  
Figs. 10-11.

*Menopon longitarsus* Piaget, 1880, p. 504, Pl. 41, fig. 7.

*Menopon spiniger* Enderlein, 1909, p. 80.

*Menacanthus longitarsus* Neumann, 1912, p. 359, fig. 5.

*Menacanthus spinigerum* [Enderlein] Neumann, 1912, p. 364, fig. 12.

*Heterodoxus macropus* Le Souëf and Bullen, 1902, p. 159, fig. 11.

*Heterodoxus armiferus* Paine, 1912, p. 362.

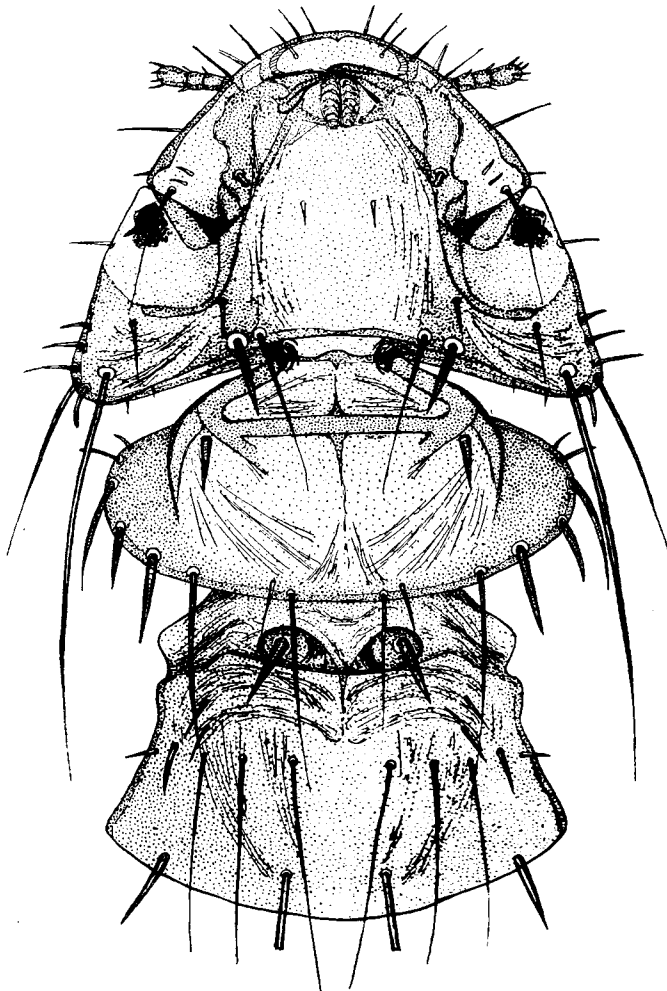


Fig. 10. *Heterodoxus longitarsus*, head and thorax. (L. H. del.)



We find this species to be generally distributed upon the genus *Macropus*. Piaget originally described it from *Macropus giganteus* in the Rotterdam Zoo. We have it from the following hosts: *Macropus thetidis*, Queensland, N. S. Wales; *M. ualabatus*, Victoria; *M. ruficollis*, Flinders Island; *M. bennetti*, Melbourne Zoological Gardens; *M. dorsalis*, N. S. Wales; *M. rufus*, N. S. Wales; *M. robustus*, N. S. Wales; *M. giganteus*, N. S. Wales, Queensland; *M. wilcoxi*, N. S. Wales; and *M. stigmaticus*, Queensland. It has, in addition, been recorded from dogs from several localities in America and Africa, as well as from Japan; and from a jackal from Africa. This extraordinary host distribution has led Paine (*loc. cit.*) to claim that *Heterodoxus* is "characteristic of dogs." Such is certainly not the case. It is undoubtedly a marsupial parasite, and all occurrences on carnivora must be ascribed to straggling.

The species presents considerable difficulty for the systematic worker, as the range of variation is very considerable. Possibly at a later date characters may be found which will justify a splitting up, but we do not feel inclined to attempt this step at present; for, although forms from certain hosts seem quite distinct if examined alone, intermediate forms can be found upon other hosts, which connect them back with typical *longitarsus*. Curiously enough, the chaetotaxy of the dorsal surface shows a very remarkable uniformity. But we have found great variation, which we thought at first was going to give us characters of diagnostic value, in the chaetotaxy of the thoracic sternites. The variation here, however, finally baffled us. But we would draw attention to these plates, and to the ♂ genitalia, in which we have also observed differences, as likely to afford a solution.

*H. armiferus* Paine has been included as a synonym, because there is nothing in Paine's description or figures that we allow to have diagnostic value. It is quite possible, however, that this is really a distinct species, and we think it may even prove to be characteristic of some American marsupial host. We have examined the African and Yokohama specimens from dogs, and consider them to be indubitable stragglers from Australian marsupials.

Our figure of the head and thorax is drawn from a typical specimen from *Macropus ualabatus*. The proportions of the head and thorax vary somewhat according to the amount of pressure employed in mounting; a fact which accounts for the minor differences in various published figures.

*Heterodoxus brevispinosus* n. sp. Fig. 12.

This species is founded upon a single ♀ collected by Mr A. S. Le Souëf from a pouched mouse, *Phascologale flavipes*, at the Sydney Zoological Gardens. We include it for the present 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.

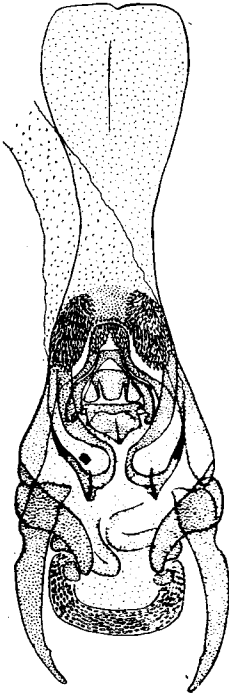


Fig. 11. ♂ genitalia of *Heterodoxus longitarsus* from *Macropus wilcoxi*.  
(L. H. del.)

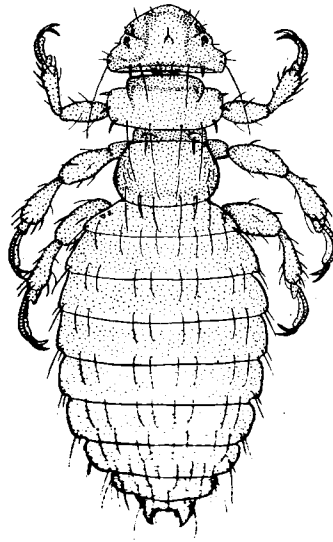


Fig. 12. *Heterodoxus brevispinosus*, ♀.  
(L. H. del.)

*Description of ♀.* 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 eye is prominent, with a large pigment fleck and a very short thick spine; and is followed by a very slight emargination, in the angle of which is a short prickle. The occiput carries a pair of stout spines externally, and between them two pairs of hairs, the outer

reaching to half the length of the prothorax, the inner very fine and short. The prothorax is almost as wide as the head, somewhat angulated, carrying three curved spines on each wing, and a row of four hairs of even length on the hind margin. The mesothorax is short and narrow, with the usual spines. The metathorax is narrow anteriorly, but widens considerably posteriorly, and is broadly rounded on the abdomen. It carries a few fine hairs in each antero-lateral area, a row of four longish hairs about the middle of its length, and a row of six close to the hind margin, of which the outer pair are long, the next short and spinous, and the median pair shorter, but stouter, than the outer pair. The abdomen is broadly ovate, and exhibits the characteristic form and chaetotaxy of *Boopia*.

The spines upon the under side of the head, which have been mainly instrumental in inducing us to include the species in the genus *Heterodoxus*, are very short, and 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.

*Measurements in millimetres.*

	♀	
	Length	Breadth
Head ... ..	0.206	0.386
Prothorax ... ..	0.170	0.375
Mesothorax ... ..	0.054	0.206
Metathorax ... ..	0.189	0.353
Abdomen ... ..	0.960	0.756
Total length and greatest breadth	1.579	0.756

Genus *Paraheterodoxus* n.

*Characters of the genus.* In many respects intermediate between *Boopia* and *Heterodoxus*. General appearance that of *Heterodoxus*, with acutely rounded temporal angles, produced behind the occiput, and a very slight post-ocular emargination. A strong chitinous bar crosses the head dorsally, above the mandibles and bases of the palps, as in *Boopia*. On the under side of the head a pair of stout spines, not at the base of the palps, as in *Heterodoxus*, but posteriorly, on the gular margin. Thorax as in *Heterodoxus*, but with hind margin of prothorax angulated, not evenly rounded; and with sinuous lateral margins to the metathorax. Legs, especially the third pair, very strong, and beset with spines. The post-axial margin of the second femur of the ♂ exhibits

a special feature in the shape of two closely apposed strong spines, which probably subserve a clasping function. A large form, thickly clothed with spinous hairs. Characteristic of the rat-kangaroos, *Aepyprymnus* spp.

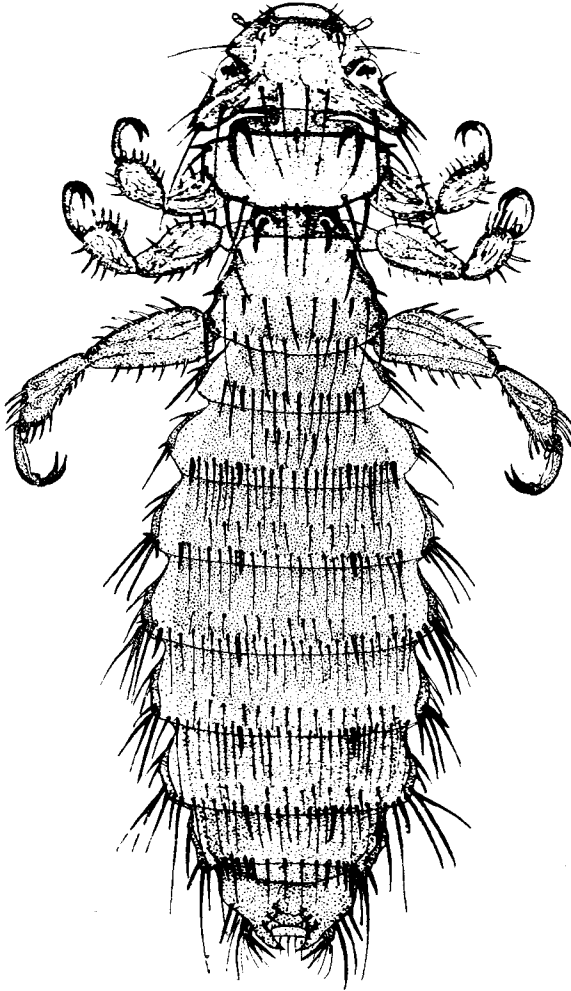


Fig. 13. *Paraheterodoxus insignis*, ♀. (L. H. del.)

*Paraheterodoxus insignis* n. sp. Figs. 13-14.

*Description of ♀.* Head about twice as broad as long, parabolic in front, slightly emarginate behind the eyes, which form flat projections,

and produced behind the occiput into acutely rounded temporal lobes. Prothorax resembling *Heterodoxus*, but angulated, not evenly rounded; equal in length to the head, but slightly narrower. Mesothorax a third as long as the prothorax, with the dorsal prominences widely separate. Metathorax a little longer than the prothorax, but narrower, with slight rounded projections from the lateral margins, carrying a spine, at a little more than half its length. Abdomen almost twice as long as head and thorax together, elongate ovate, widest at the fourth segment, deeply emarginate between segments. Terminal segment ending in two pairs of gonopodial processes, the ventral pair furnished with a couple of spines and some hairs, the dorsal terminating in a short bristle. Legs stout and spinous, with very short first tarsal joint. The hump on the third tibia is rather exaggerated in the figure.

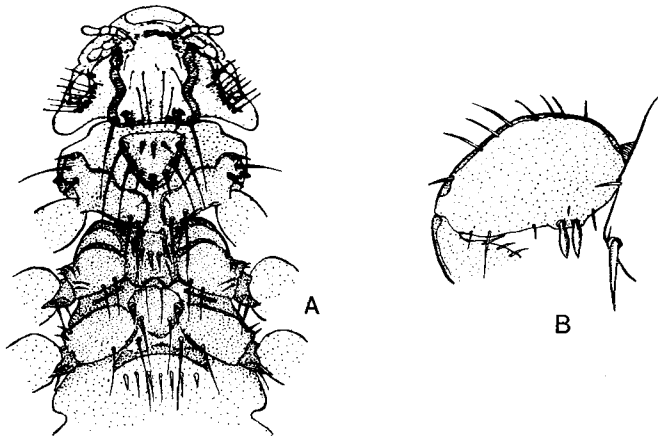


Fig. 14. *Paraheterodoxus insignis*. (A) Under side of head and thorax, ♀; (B) Second femur, ♂. (L. H. del.)

Chaetotaxy. A few short hairs on the clypeal margin, a long hair before and a short one behind the eye; a group of longish hairs on the temporal lobe, and four evenly spaced hairs, the outer longer, in front of occiput. The hairs of the thorax, both dorsal and ventral, are sufficiently indicated in the figures. Abdomen with a double row of hairs on segments 2-6, the marginal row of the first seven segments having a pair of spines interpolated at rather less than a third from the lateral margins.

The male differs only in its slightly smaller size, in the previously mentioned clasping spines upon the second femora, and in the posterior end of the abdomen, which is rounded.

*Measurements in millimetres.*

	♂		♀	
	Length	Breadth	Length	Breadth
Head ... ..	0.353	0.706	0.370	0.756
Prothorax ... ..	0.302	0.638	0.319	0.670
Mesothorax ... ..	0.100	0.454	0.134	0.538
Metathorax ... ..	0.365	0.645	0.370	0.706
Abdomen ... ..	1.636	1.042	2.083	1.193
Total length and greatest breadth	2.756	1.042	3.276	1.193

From *Aepyprymnus rufescens*, N. S. Wales and Queensland. The young differ from the adults in having a much deeper post-ocular emargination, and are likely to be taken for *Boopia*, from which genus, however, they are easily distinguished by the form of the temporal lobes.

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