Pacific Insects 13 (3-4): 519-529 5 December 1971

A NEW GENUS AND TWO NEW SPECIES OF BOOPIDAE (Phthiraptera : Amblycera)

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Abstract: A new genus of Boopidae is described based on specimens taken from a *Casuarius* (Cassowary) in New Guinea and reasons given to support the view that these were from an established population. Some implications of this atypical host association, in a family previously known only from mammals, are discussed. A new species of *Heterodoxus* from a New Guinea marsupial is described. A note on the thoracic sterna and the pronotal setae of the Boopidae is included.

Through the kindness of Dr I. L. Owen I have received some specimens belonging to the Boopidae* taken from a Cassowary in circumstances precluding direct contamination from a marsupial. In the British Museum (Natural History) collections there is a single nymph taken from a skin of *Casuarius bennetti* which resembles these specimens and like them differs from all known Boopidae. The Old World marsupials are the only known hosts of this family with the exception of one species, *Heterodoxus spiniger* (Enderlein), found on domestic dogs ; however, as this species is also parasitic on a kangeroo, *Wallabia agilis* (see Kéler 1971), its occurrence on dogs is obviously a case of relatively recent secondary establishment. The 2 separate records of the cassowary louse and the fact that it is generically separable from all the known marsupial Boopidae suggest that it is an established parasite of the Cassowary.

Genus **Therodoxus** Clay, new genus

This genus is a typical member of the Boopidae as defined by Clay 1970 : 88. It belongs to the group characterized by the modification of the post-spiracular setae of abdominal segments II-IV as trichobothria, the 4-segmented maxillary palpus and the contiguous alveoli of 2 of the dorsal temple setae (26 and 27). It is separable from other genera in the group by the absence of a slit in the ventrolateral margin of the head and by the combination of characters given below. Those characters found throughout the Boopidae are not included in the following description.

Description. Dorsolateral margin of head of characteristic form (fig. 1), ventrolateral margin without slit (fig. 2). Dorsal head sensilla b., c. and d. present, e. absent. Spinous process at base of each maxillary palpus ; antenna 5-segmented ; maxillary palpus 4-segmented. Pronotum with long anterior pronotal seta (fig. 1, a.) and minute

1. British Museum (Natural History).

* There is a difference of opinion in the spelling of this name. The original spelling in Mjöberg, 1910 : 21 was Boopiidae but Hopkins and Werneck throughout their published work used Boopidae. The genus name, *Boopia* was based by Piaget on the Greek name *Boopis* and it can be presumed that Hopkins, who would have checked the name before using it, took *Boop-* as the stem, thus forming the family name Boopidae.

inner seta (b.), the posterior seta (fig. 12, g.) not apparent; mesonotal seta (c.) with posterior ridge of thickening. Prosternal plate without thickened rim and with 2 macrochaetae placed anteriorly in addition to the 2 small anterior prosternal setae (fig. 3, e.); metasternite separated from the first abdominal sternite. Abdomen with post-spiracular setae II-IV modified as trichobothria; spiracles and post-spiracular setal complex on central tergal plates; sternite I with setae; gonapophyses without ampullae.

Type-species: *Therodoxus oweni* n. sp.

DISTRIBUTION: Known only from *Casuarius* (Casuariiformes), New Guinea.

The name is masculine and is used to suggest the affinities of this genus with *Heterodoxus*.

Therodoxus oweni Clay, new species Fig. 1-5, 11, 15.

Type-host: *Casuarius casuarius sclaterii* Salvadori.

♀. Head as in fig. 1-2, dorsolateral margin with broad pre-ocular slit; labial palpus with 5 distal setae and with seta at base (Clay 1962, fig. 23-24) short and fine (fig. 2, d.). Antenna 5-segmented, 2 terminal segments elongated; the 2 sensory setae on the last segment of the maxillary palpus do not show clearly in any of the specimens, but the shorter pointed one appears to be rather more than 1/2 the length of the longer blunt-ended one. Dorsal head setae show the typical Menoponidae pattern (Clay 1969, fig. 1-3), setae 8 and 9 being identified by sensillum b., 15 by c. and 16 by d. which is somewhat removed from the base of the seta. No seta representing temple seta 24 could be found in the available specimens. Thorax as in fig. 1, 3; mesosternum with the mesosternal seta (see below) each side of the indistinct central sternite; the plate formed by fused ridges of the anterior edge of the mesothoracic episternum and ventral ridge (see below) with only one seta (2 on one side of one specimen) each side on the lateral ridge (Le. Mayer 1954); metasternal plate with 3 + 3 setae. Metanotum with 2 anterior lateral setae each side and posterior margin with one long, stout seta each end and one minute more central seta; each metapleurite with a stout spiniform seta. Tergum I of abdomen fused with metanotum as in other Boopidae; terga II-VIII with tergites continuous across segments; anterior margin of tergite II concave, with band of thickening; IX with patch of circular sensilla and minute setae each side, not distinctly divided into 3 plates as in *Heterodoxus*. Each gonapophysis with a fine terminal seta (fig. 4). Sternite I not fused to metasternite; sternite II with heavy anterior bridge-like thickening. Subgenital plate (subgenital lobe, sens. Kéler) covering most of anal margin, its posterior margin (vulva) flattened with one medium, one long and 3-5 fine setae each side of mid line (fig. 5). Genital papilla indistinct, elongate conical, opening of duct terminal (fig. 11).

Marginal tergal setae (3 specimens): I, 6; II, 11; III, 16-17; IV, 18; V, 20-21; VI, 19-21; VII, 17-20; VIII, 9-12; on terga II-IV and VIII there is a central gap in the line of setae. These numbers do not include the setae of the post-spiracular complex (2 setae ± 2 minute each side). There are no anterior tergal setae except the single lateral one each side of tergum II. Marginal sternal setae (2): I, 2; II, 12; III-IV, 15 & 17; V-VI, 16 & 17; VII, 13 & 14. Anterior sternal setae: I, 0; II, 6; III, 9 & 12; IV, 13 & 9; V, 14 & 10; VI, 11 & 12; VII, 10. Setae of lateral plates (total of the 2 sides of 2 specimens): I, 4; II, 11 & 13; III, 14; IV, 18 & 16; V, 15; VI, 17 & 15; VII, 15 & 13; VIII, 7. Chaetotaxy of posterior segments as in fig. 4-5.

Dimensions (in mm): Preocular width, 0.49-0.50; temple width, 0.61-0.65; head length, 0.44-0.48; prothorax width, 0.53-0.55; tergite V breadth, 0.91-0.96; total length: 2.59-2.66.

♂. Unknown.

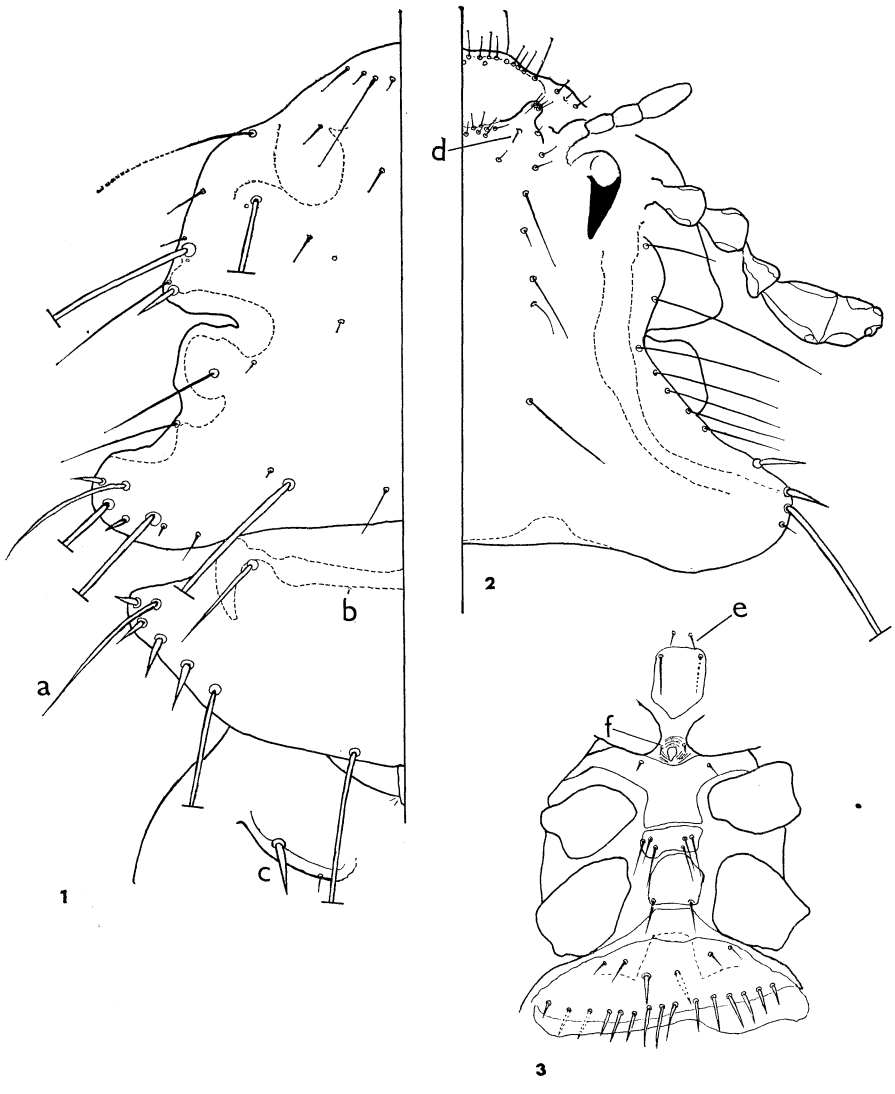


Fig. 1-3. *Therodoxus oweni* n. sp. : 1, head, pro- and meso-thorax, dorsal ; 2, head, ventral (setae of antenna and maxillary palpus omitted) ; 3, sternites of thorax and abdominal segments I-II.

Holotype ♀, slide no. 750 in British Museum (N. H.) from *Casuarius casuarius sclaterii*, Wando, Western District, Papua, X.1969. Paratypes : 2 ♀ with same data as holotype.

Discussion. The genera of the group comprising *Heterodoxus*, *Macropophila*, *Therodoxus*, *Paraheterodoxus*, *Boopia* and *Phacogalia*, in which the maxillary palpus is 4-segmented and the post-spiracular setae of segments II-IV are modified as trichobothria, are separated from each other by the combination and permutation of a small number of

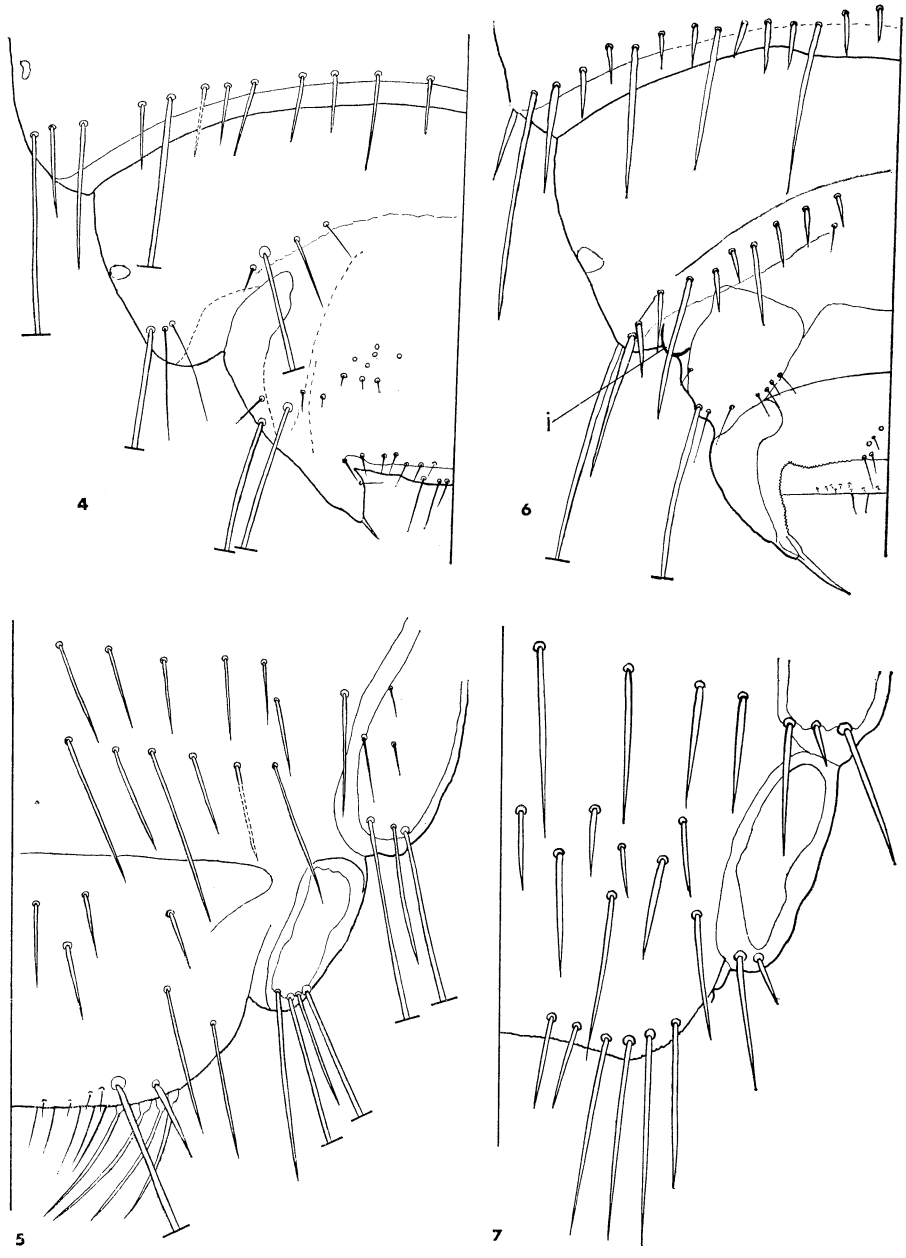


Fig. 4-7. Terminal segments of ♀ abdomen. 4-5. *Therodoxus oweni* n. sp.: 4, dorsal; 5, ventral. 6-7. *Heterodoxus keleri* n. sp.: 6, dorsal; 7, ventral.

characters. In *Heterodoxus*, *Macropophila*, *Paraheterodoxus* and *Phacogalia brevispinosus* the dorsolateral margin of the head has no post-ocular slit or notch and the temporal lobe has one rounded edge ; in *Phacogalia spinosus*, *Boopia* and *Therodoxus* the dorsolateral margin has a post-ocular slit or notch and the temporal lobe is approximately quadrangular with both edges distinct. In *Heterodoxus*, *Macropophila*, *Therodoxus* and both species of *Phacogalia* the position of the 2 temple setae with contiguous alveoli (26 and 27) is marginal or just submarginal, while in *Boopia* they lie approximately in the middle of the temple. Ventral head processes are present in *Heterodoxus*, *Macropophila* and *Therodoxus*, and head sensillum e. is present in the first 2 of these genera and *Paraheterodoxus*. The thickening round the mesonotal seta is posterior in *Heterodoxus*, *Macropophila* and *Therodoxus* and anterior in *Boopia* ; in the 3 former genera the spiracles and post-spiracular setal complex are on the central tergal plates. In *Boopia*, *Phacogalia* and some species of *Paraheterodoxus* the anterior margin of the anterior median plate of the male genitalia has an anteriorly directed process which is absent in *Heterodoxus*.

The characters of the known species of *Heterodoxus* are less variable than those of the species of *Boopia*. In *Heterodoxus*, for example, there are 4 terminal setae on the labial palpus and 4 or 5 in *Boopia* ; the seta at the base of this palp in the former genus is always long and stout, but varies from long and stout to short and fine in *Boopia* ; the long anterior pronotal seta is absent in *Heterodoxus* and the inner and posterior pronotal setae are present, the latter always being minute ; in *Boopia* these setae may be present or absent, the posterior pronotal seta being long or minute. The prosternite in *Heterodoxus* has a thickened rim and posterior setae, in *Boopia* it may resemble this condition or lack the thickened rim or any posterior setae. The vulval setae in *Boopia* may be long and stout or short and fine, while in *Heterodoxus* some are always long and stout ; the gonapophyses of *Heterodoxus* always have ampullae, while in *Boopia* they may be present or absent.

Therodoxus agrees with *Heterodoxus* in the presence of ventral spinous head processes, in the position of the spiracles and post-spiracular setal complex and of the thickening associated with the mesonotal seta. However, in many features it resembles more closely some of the species of *Boopia* : the dorsolateral margin of the head, absence of sensillum e., 5 terminal setae on the labial palp (as in *B. biseriata*), the short and fine labial seta (*B. tarsata*), presence of the anterior pronotal seta and the absence of the posterior seta (*B. dubia*), prosternite without a thickened rim and with only 2 anterior macrochaetae (*B. dubia*), without row of stout vulval setae or ampullae on the gonapophyses (*B. tarsata*). Thus, to include this new species from *Casuarius* in *Heterodoxus* on the presence of head processes and the position of the spiracles, 2 characters which preclude its inclusion in *Boopia*, would mean widening the definition of a compact group in an unsatisfactory manner. There seems therefore no alternative to erecting a new genus to contain it.

Several explanations for the occurrence of this species of Boopidae on the cassowary can be postulated. It could have been recently acquired from a marsupial, the lice of which are at present unknown, and a population become established on the bird host ; or sometime in the past the cassowarys could have acquired marsupial lice which have become modified and are now different from any of the genera now found on marsu-

pial hosts. Or if the suggestion (see Clay 1970) is likely to be true that the marsupials acquired their lice comparatively recently from a bird, then this genus could be related to the ancestral stock which became established on the early marsupials and which spread throughout the greater part of the class.

Heterodoxus keleri Clay, new species Fig. 6-10, 12-14, 16-18.

Type-host : *Dorcopsis vanheurni rothschildi* Thomas.

General characters as in fig. 16-17; chaetotaxy of head and thorax as in fig. 8, 12, 13. Length of ventral spinous process (from outer base): 0.10-0.11 mm. Thorax and abdomen with arrangement of sclerites and spiracles typical for *Heterodoxus*; metanotum with 2 anterior lateral setae each side and 3 (occasionally 2 or 4) each end of the posterior margin. Sternite II with characteristic pigment pattern in the form of 4 finger-like processes (fig. 8).

♂. In the genitalia, vesica rigid with rounded anterior end and without microtrichia centrally (fig. 18); mesosomal sclerites as in fig. 9. Marginal tergal setae (omitting the post-spiracular setal complex): I, 12 (5 minute and 1 long and stout each side of mid-line); II, 16 (3 minute, 9 short and stout, 4 long and stout); III, 24 (18 short, 6 medium or long); IV-V, 26 (20 short, 6 long); VI, 24 (18 long, 6 short); VII, 26 (18 short, 8 long); VIII, 17 (11 short, 6 long); IX, 6 + 5. Marginal sternal setae: I, 0; II, 4; III, 6; IV-VI 8; VII, 14; VIII, 8. Anterior sternal setae: I, 0; II, 6; III, 8; IV, 12; V, 17; VI, 21; VII, 17; VIII, 12; terminal segment, 12.

♀. Tergite VIII continuous across segment; small tubercle present lateral to tergite IX (fig. 6, i.); tergum IX (sens. Kéler) with a central and 2 lateral plates and a group of circular sensilla between the central and each lateral plate (hidden beneath the lateral plate in fig. 6); each gonapophysis with a long terminal spiniform seta, length: 84-88μ; inner margin of gonapophyses and supraanal margin with ampullae. Vulva with stout long and short setae each side of central emargination. Genital papilla conical with opening of spermathecal duct terminal (fig. 10); genital chamber with thorn-like and comb-like microthrichia. Marginal tergal setae: I as in ♂; II, 16 (4 minute, 8 short, 4 long); III, 21 (damaged); IV, 25 (19 short, 6 long); V, 26 (20 short, 6 long); VI, 25 (19 short, 6 long); VII, 25 (19 long, 6 short); VIII, 18. In both sexes tergum II has 2 small anterior setae each side. Marginal sternal setae: I, 0; II, 4; III-IV, 6; V-VII, 8. Anterior sternal setae: I, 0; II, 9; III, 5; IV, 16; V, 18; VI, 17; VII, 20; VIII, 16; vulval setae: 7+6; 4 median setae just posterior to row of postgenital setae (fig. 14).

Dimensions (in mm): Preocular width, ♂ (4) 0.49-0.53, $\bar{X}$ 0.51, ♀ 0.52; temple width, ♂ 0.64-0.67, $\bar{X}$ 0.66, ♀ 0.68; head length, ♂ 0.40-0.45, $\bar{X}$ 0.42, ♀ 0.45; prothorax width, ♂ 0.61-0.64, $\bar{X}$ 0.62, ♀ 0.61; tergite V breadth, ♂ 0.82-0.89, $\bar{X}$ 0.86, ♀ 0.86; total length, ♂ 2.77-2.89, $\bar{X}$ 2.82, ♀ 2.91.

Holotype ♂ (Bishop 9004), slide no. BBM-NG 52613 in the Bishop Museum, Honolulu from *Dorcopsis vanheurni rothschildi*, NE New Guinea, Huon Peninsula, Saruwaged Range, SW of Kabwum, 31.VII.1966 (O. Wilkes). Paratypes: 2 ♂, 2 ♀ with same data as holotype; 1 ♂ from Morobe District, NE New Guinea.

This species is named in honor of the late Dr S. von Kéler as a tribute to his work on the Phthiraptera and especially his present revision of the Boopidae which will form the basis of all future work on the family.

Discussion. This species resembles most closely *Heterodoxus mitratus* Kéler, 1971, parasitic on the related host *Dorcopsis v. vanheurni*. It is distinguished in both sexes by its smaller size: temple breadth of Kéler's species, ♂ 0.72-0.75, ♀ 0.74-0.76; head

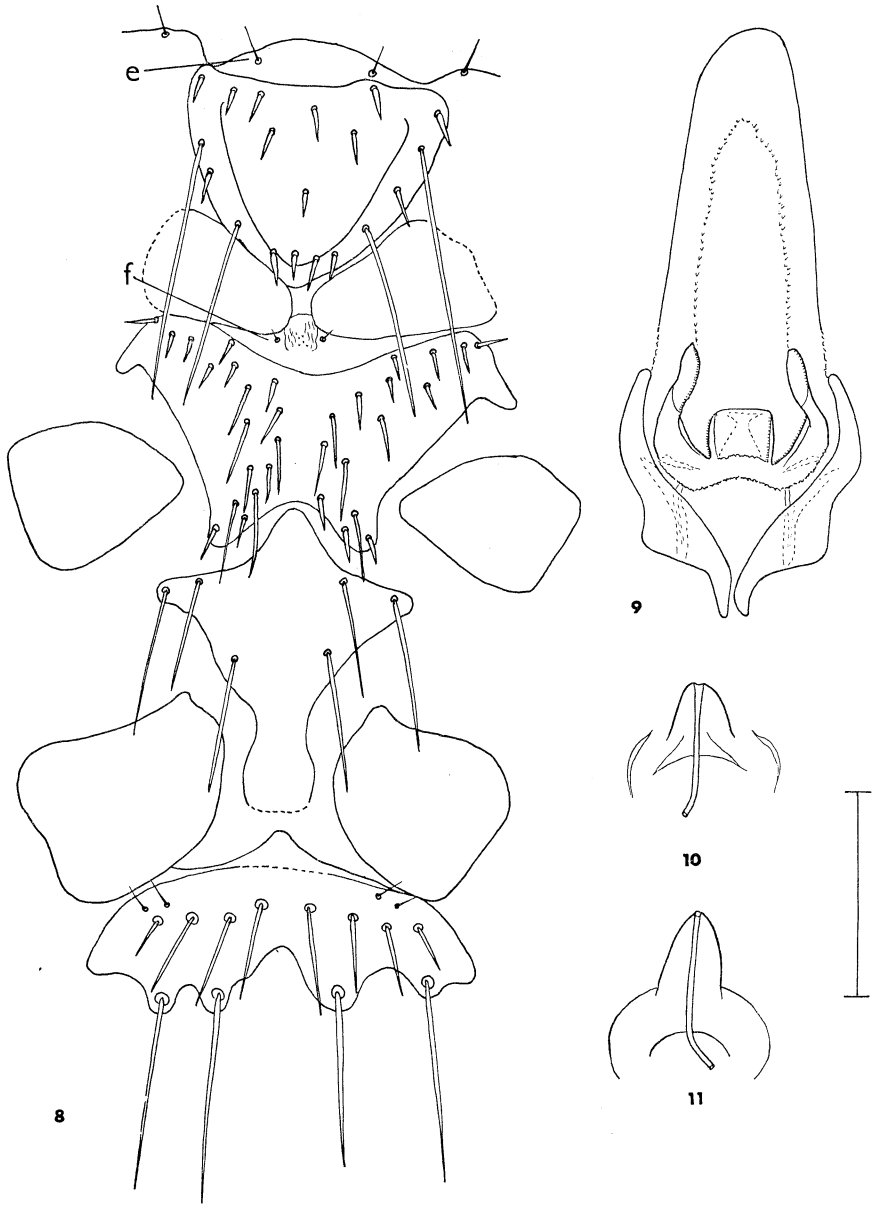


Fig. 8-11. 8-9, *Heterodoxus keleri* n. sp.: 8, sternites of thorax and abdominal segments I-II, ♀ (sternite II from ♂); 9, ♂, outline of vesica and mesosomal sclerites. 10-11. ♀ genital papilla, line 5 μ: 10, *Heterodoxus keleri*; 11, *Therodoxus oweni*.

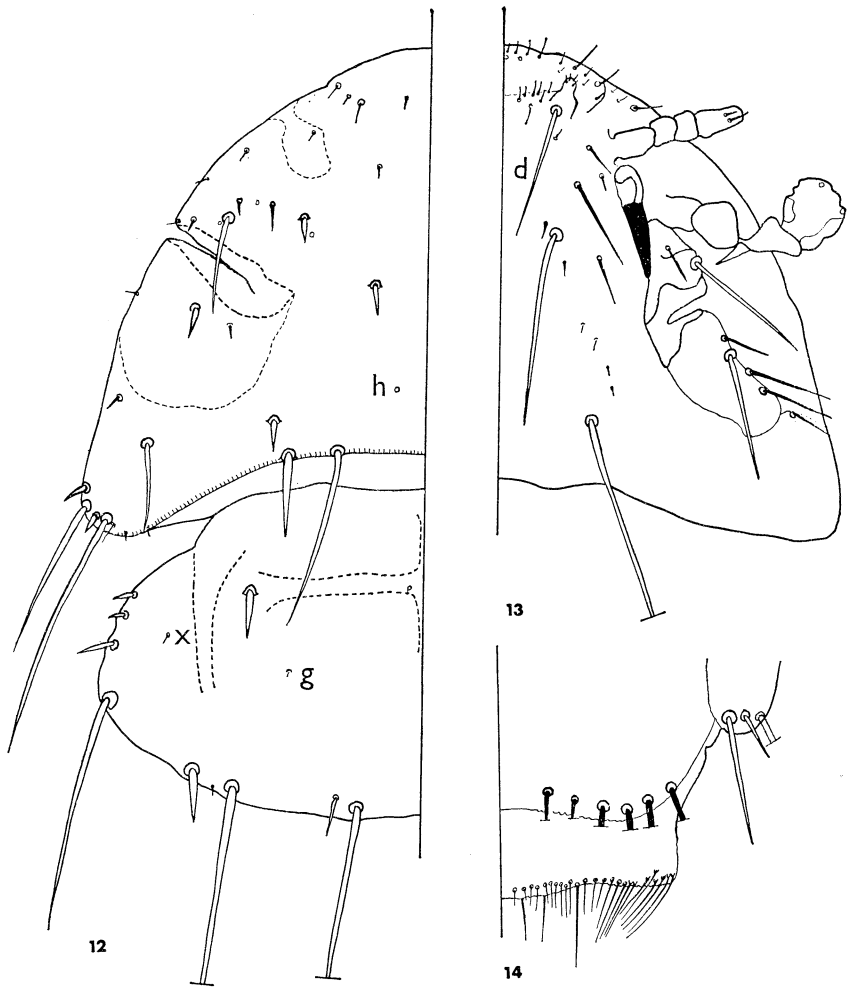
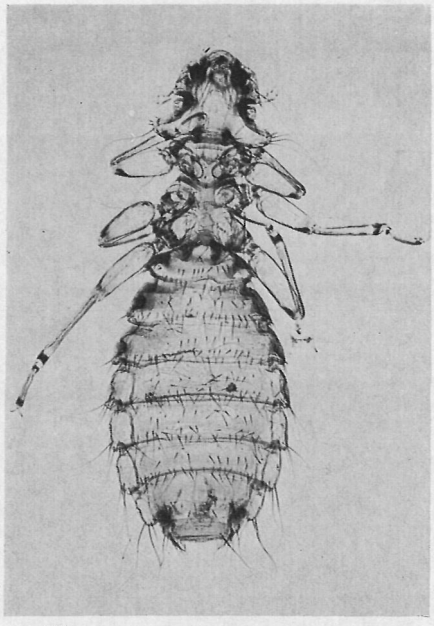


Fig. 12-14. *Heterodoxus keleri* n. sp.: 12, head, dorsal and pronotum, ♂; 13, head, ventral (setae of antenna and maxillary palpus, except the sensory pair, omitted), ♂; 14, ♀ terminal segments to show vulvar and postgenital setae.

length, ♂ 0.49-0.52, ♀ 0.51-0.52; total length, ♂ 3.25-3.26, ♀ 3.31-3.36. The male genitalia of the two species are similar, especially in the form of the vesica but differ in the size and shape of some of the sclerites; in the female the gonapophyses of *H. keleri* are narrower, the genital papilla is narrower and more flattened anteriorly, and the tubercle on IX is smaller.

The thoracic sterna of the Boopidae

There are 2 pairs of setae, usually short or minute, which are present in all Meno-



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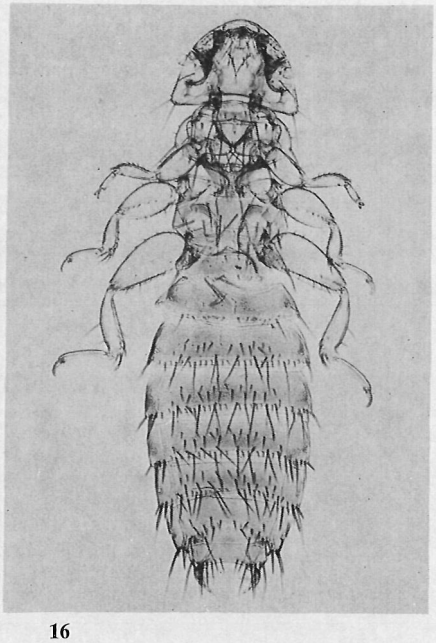

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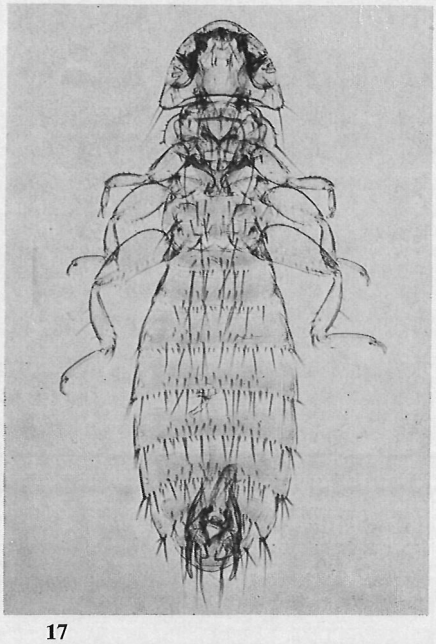

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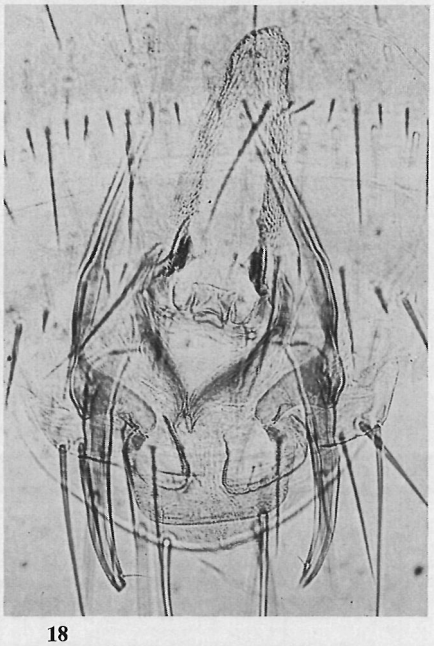

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Fig. 15-18. 15, *Therodoxus oweni* n. sp. ♀. 16-18. *Heterodoxus keleri*, n. sp.: 16, ♀; 17, ♂; 18, ♂ genitalia.

ponidae and Boopidae and form useful landmarks. These are the 2 setae on or just anterior to the prosternal plate (fig. 8, e.) and the setae lying anteriorly each side of the mesosternal plate (fig. 8, f.), if present, or just anterior to the level of the posterior margin of the first coxae. The mesosternum in the Menoponidae has a thickened ridge along the anterior margin of each episternum (Le. of Mayer 1954) which runs inwards from the lateral margin towards the middle line and turning posteriorly lies parallel to that of the other side (Ls, Mayer). Each anterior ridge usually has a small number of setae, under 4, but may have many more. Between the ridges may lie part of the mesosternal plate, with or without setae in addition to the 2 mesosternal setae. In *Myrsidea* the parallel ridges are fused to the mesosternal plate so that there is a sclerotized ring round the thorax, incorporating the mesosternal setae, formed from the tergum, pleura and sternum. In *Heterodoxus* and *Boopia* the ridges are enlarged centrally and fused (or perhaps in some species only approximated) so that a sclerotized ring may be formed round the thorax apparently similar to that of *Myrsidea*. However, the central sternal part of this ring does not incorporate the mesosternal setae as in *Myrsidea*, but these lie anteriorly each side of a faintly sclerotized area, presumably the mesosternal plate (fig. 8, f.). In the metasternum of *Heterodoxus* there is a setae-bearing plate similar to that found in many of the Menoponidae, but in *Heterodoxus* it seems probable that this plate is formed from the fused metasternite and sternite I ; in *Therodoxus* there are 2 distinct plates in this position as in some *Paraheterodoxus* and in the nymphs of *Phacogalia brevispinosus*.

Pronotal setae

The species of *Heterodoxus* have a number of marginal or slightly submarginal setae, some of which may be minute and difficult to see in specimens in poor condition ; the first 3 setae each side are short and spiniform and the first seta may be present or absent in different individuals of the same species. In *Boopia* there may be 5 or 6 of these marginal setae each side and in some species an extra long seta lying submarginal to the first seta (as in fig. 1, a.), giving a total of 6 or 7 setae ; the presence or absence of this seta, here called the anterior pronotal seta, is a useful taxonomic character. Three of the other pronotal setae also provide useful taxonomic characters, these are the inner and outer dorsal pronotal setae (d.p.s. 1 and 2 in Clay 1962, fig. 4) and a seta here called the posterior pronotal seta (fig. 12, g.) lying posterior or posterolateral to the outer dorsal prothoracic seta ; the outer seta may be short to medium, the inner short to minute and the posterior seta minute to medium or absent. On one side of the pronotum of 2 of the 4 males of *H. keleri* n. sp. there is an extra minute seta (fig. 12. x.).

ADDITIONS TO KEYS IN KÉLER (1971)

Key to genera of Boopidae

8a (8). Ventrolateral margin of head without slit ..... **Therodoxus**
Ventrolateral margin of head with well-marked slit 9

Key to Heterodoxus

4 (3). ♂ vesica with patch of spines comprising 2 groups of 6-7 vertical rows of short, stout overlapping spines separated by area of thorn-like spines. ♀ genital chamber with narrow wave-like strip of thickening..... **maai** Emerson

Vesica not as above, rigid with rounded anterior end, without denticulations centrally. ♀ genital chamber without strip of wave-like thickening 4a

4a (4). Breadth at temples over 0.70 mm ; ♂ mesosome with pair of centrally contiguous plates anterior to dorsal median plate ..... **mitratus** Kéler

Breadth at temples under 0.70 mm ; ♂ mesosome without such plates..... **keleri** n. sp.

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Explanation of Lettering

a. anterior pronotal seta.
b. inner dorsal seta.
c. mesonotal seta.
d. labial seta.
e. prosternal seta.
f. mesosternal seta.
g. posterior pronotal seta.
h. sensillum e.
i. abdominal tubercle.
x. seta sometimes present on one side of pronotum in *H. keleri*.

I am grateful to Miss C. J. Taute for fig. 1-8 and 12-14 and to the Photographic Studio, British Museum (Natural History) for fig. 15-18.