Memoirs of the Museum of Victoria 51: 65–82 (1990)
https://doi.org/10.24199/j.mmv.1990.51.03

31 October 1990
ISSN 0814-1827

REDESCRIPTION OF *CRYPTES BACCATUS* (MASKELL) (COCCOIDEA: COCCIDAE), AN AUSTRALIAN SPECIES OF SOFT SCALE

By Grant S. Farrell

Department of Zoology, La Trobe University, Bundoora, Victoria 3083, Australia

Abstract

Farrell, G.S., 1990. Redescription of *Cryptes baccatus* (Maskell) (Coccoidea: Coccidae), an Australian species of soft scale. *Memoirs of the Museum of Victoria* 51(1): 65–82.

All instars of the male and female of *Cryptes baccatus* (Maskell) are described and illustrated. Characteristic features of each instar are discussed. Morphology of the adult male is examined in detail and compared with that of other coccid species. The status of the genus is examined with regard to the morphology of the adult male and female.

Introduction

The Coccidae are difficult to classify and there are few keys to species. Little has been written on the family (Williams and Kosztarab, 1972) although a large number of species are economically important (De Lotto, 1965). For most species the few diagnostic characters used in the past are either unreliable or of minor taxonomic importance (De Lotto, 1965).

There has been little recent study on endemic soft scales in Australia. Froggatt's (1921) work, the most recent treatment, was not systematic and was little better then a catalogue. One endemic Australian genus of interest is *Cryptes* Cockerell and Parrott. This genus is monotypic and *Cryptes baccatus* (Maskell) is restricted to *Acacia* Willd. (Mimosaceae) Although distinctively a coccid, its relationship within the family is uncertain (Steinweden, 1929). No modern descriptions of the species exist and while work was being carried out on its ecology the opportunity was taken to describe all stages of both the male and female of this unusual species.

The scale occurs in large aggregations, the sexes either occurring together or in separate, but proximate aggregations. The species has been found along the east coast of Australia, although the northern limits of its distribution are unknown. To the south its range extends into South Australia and it has also been found in the Perth region of Western Australia (Farrell, 1985).

Materials and methods

Material was collected and prepared as described by Farrell (1990). The development of the adult female is characterised by an extended period of allometric growth, with the female becoming heavily sclerotized and convex towards the end of this period (Farrell, 1985). This renders mature females useless for distinguishing morphological characters. Descriptions of adult females presented here are restricted to young individuals prior to this stage. All measurements of morphological characters are in micrometers and are given as either ranges or means followed by ranges in parentheses. Unless stated otherwise a minimum of ten replicates were used for each character. Terminology for female instars is based on Ray and Williams (1980) and for male instars on Giliomee (1967) and Ray and Williams (1980). Illustrations (except for adult male) include a central drawing of the insect with the left half representing the dorsal aspect and the right half the ventral aspect. Enlargements of important details are placed around the perimeter of the figure. These enlargements are not to the same scale in each illustration, nor are the dermal structures and enlargements in direct proportion to each other. Scale lines are for the central drawing only, the exception to this being the illustration of the adult male. Details of the adult male illustration are provided in the figure legend. Voucher specimens of all stages have been lodged in the Australian National Insect Collection, Canberra.

Cryptes Cockerell and Parrot

Cryptes Cockerell and Parrott, 1899: 161. — 1901: 58. — Froggatt, 1921: 42. — Morrison and Morrison, 1922: 80. — Steinweden, 1929: 233.

Type species. Lecanium baccatum Maskell, 1891.

Remarks. This monotypic genus was erected by Cockerell and Parrott for a species of *Lecanium* Bouche described by Maskell (1891) from a specimen collected on *Acacia paradoxa* Br. Cockerell and Parrott (1899), upon examining material sent to them by J. Lidgett believed that the species was more closely related to *Kermes* Latreille than to *Lecanium*. However, as the species showed a mixture of features common to both genera they decided, based on the male test, that it warranted a distinct genus.

Morrison and Morrison (1922) showed that Cockerell and Parrott were the first to use *Cryptes* as a genus, despite some earlier confusion in the literature. Steinweden (1929) concluded that the following features diagnose the genus: the long, curved, blunt-tipped marginal setae and body setae; the stout, very short, blunt stigmatic setae of the first instar; and the completely fused anal cleft of the adult female. As the last feature is absent in young specimens of adult females, it is not entirely satisfactory as a diagnostic character. Fusion of the anal cleft occurs as a result of allometric growth of the scale dorsum and can take up to a month to be completed (Farrell, 1985). This character should be considered of secondary importance in defining the genus.

Cryptes baccatus (Maskell)

Lecanium baccatum Maskell, 1891: 20. — 1893: 217. — 1897: 311.

Lecanium baccatum var. *marmoreum* Fuller, 1899: 458.

Cryptes baccatus Cockerell and Parrott, 1899: 161. — Froggatt, 1921: 42. — Morrison and Morrison, 1922: 80.

Egg. Ellipsoidal, 253 (228 — 266) long, 118 (95–133) wide (n = 20). Covered with a light dusting of white wax, probably secreted by the ventral abdominal pores of the female during oviposition; orange when laid, but gradually become lighter in colour, yellowish shortly before hatching.

First instar (Fig. 1). General Appearance: Body flattened, elongate-ovoid, tan to mustard in colour. Slide-mounted specimens 749 (589–961) long, 433 (310–589) wide.

Dorsum: Derm membranous. Marginal setae (Fig. 1A), 26 (18–40) long, blunt ended, often bent posteriorly, distributed as follows: 13–19 between anterior spiracular furrows, 2–3 between anterior and posterior spiracular furrows of each side, 22–30 on remainder of body. Body setae (Fig. 1B), 34 (26–46) long, blunt ended and often bent posteriorly; 18–20 on derm arranged in 2 longitudinal rows. Two spiracular setae (Fig. 1C), in anterior spiracular furrow, 1 in posterior spiracular furrow; 8.0 (6.6–9.6) long, 3.7 (3.0–4.8) wide. Eyes on margin. No pores, tubular ducts or tubercles on derm.

Anal Plates: Each plate triangular with rounded angles; 75 (69–81) long, 22 (18–27) wide, cephalolateral margin 43 (39–53) long, caudolateral margin 42 (33–48) long. Each plate (Fig. 1D), with 3 apical setae, 1 discal seta, 1 subapical seta. Anal fold with 1 pair of fringe setae. Median apical setae (Fig. 1E), approximately half body length. Anal ring (Fig. 1F), with 6 hairs and no pores.

Venter: Segmentation faintly delineated on abdomen. Submarginal setae (Fig. 1G), in longitudinal row on each side of body arranged as follows: 7 setae on abdomen, 1 seta between spiracular furrows, 1 seta medially on head, between antennae. Body setae (Fig. 1H), shorter and stouter than submarginal setae, arranged on each side of abdomen in row of 6–7 setae parallel to submarginal setae. One pair of long setae anterior to anal cleft. One pair of interantennal setae. Antennae (Fig. 1I), well developed, 6 segmented, 138 (120–147) long. Legs well developed, without tibiotarsal sclerosis; 2 tarsal digitules, proximal 1 with knobbed apex, distal 1 with plate-like apex; 2 claw digitules with knobbed apex. Length of hind femur: 90 (84–91, n = 20). Spiracular furrows with quinquelocular pores (Fig. 1J); anterior band with 2 pores, posterior band with 3 pores. No other pores on venter. Tubular ducts and microducts absent.

Second instar (*Female*) (Fig. 2). Body elliptical to slightly pyriform, with white seta-like wax fringe. Yellow-white in colour. Slide-mounted specimens 1166 (1054–1314) long, 783 (651–930) wide.

Dorsum: Derm membranous. Marginal setae (Fig. 2A), 17.6 (14.4–28.2) long, blunt ended, distributed as follows: 17 (14–19) between anterior spiracular furrows, 3 (3–4) between anterior and posterior spiracular furrows of each side, 30 (27–32) on remainder of body. Two spiracular setae (Fig. 2B), in anterior spiracular furrow, 1 in posterior spiracular furrow; 7.0 (4.8–9.0) long, 7.0 (5.4–9.0) wide. Body setae, tubular ducts, tubercles, eyes and pores absent on derm.

Anal Plates: Each plate triangular, but with rounded angles and median edge concave; 105 (100–114) long, 38 (35–45) wide, cephalolateral

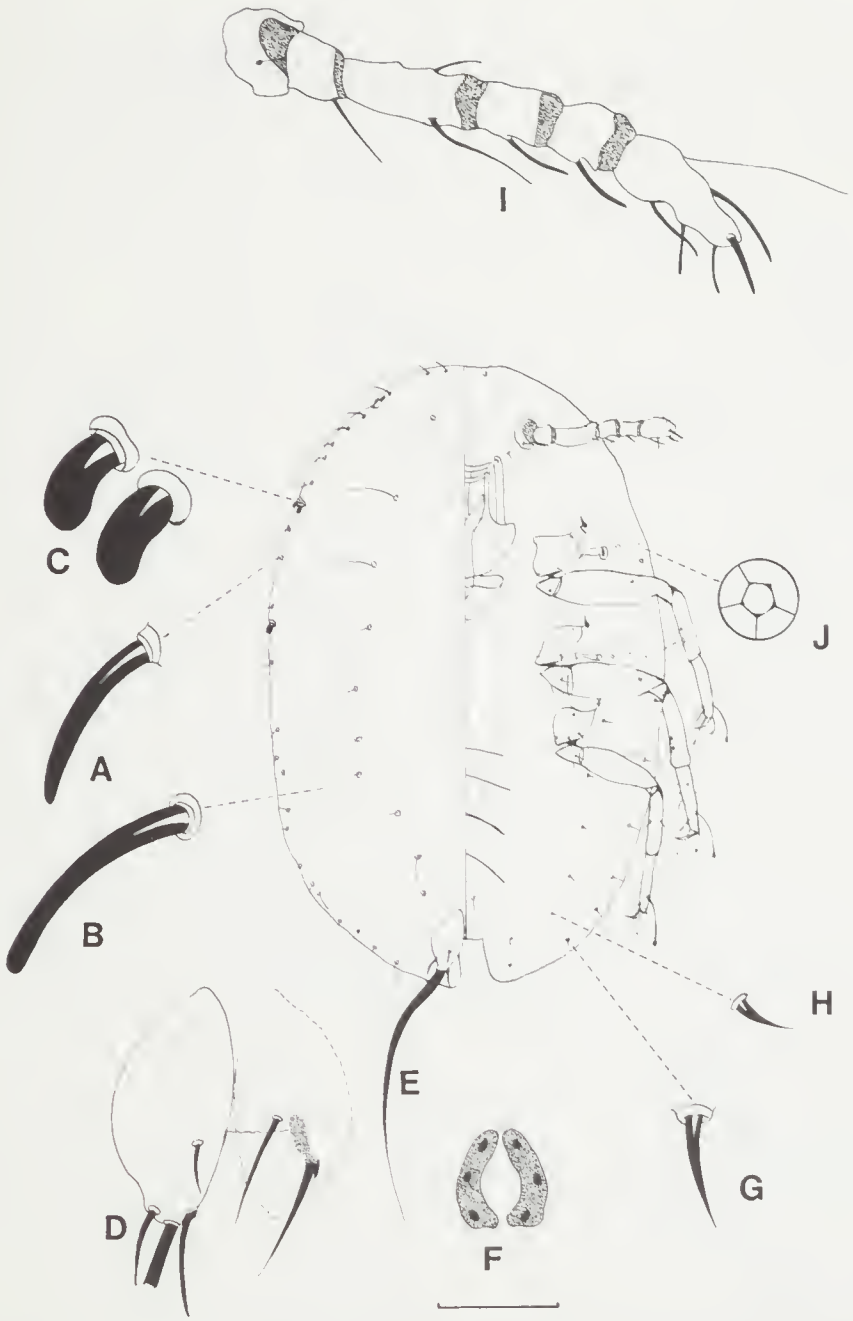

Figure 1. First instar *Cryptes baccatus*. (See Appendix for abbreviations in this and other figures. All scale lines 150 μm long).

margin 66 (60–72) long, caudolateral margin 63 (55–69) long. Each plate (Fig. 2C), with 2 apical setae, 1 discal seta, 1 subdiscal, 3 subapical seta. Anal fold with 1 pair of fringe setae (Fig. 2C). Anal ring (Fig. 2D), with 8 hairs and no pores.

Venter: Segmentation delineated on thorax and abdomen by membranous folds. Submarginal setae (Fig. 2E), long, pointed, 12.8 (8.4–18.0) long, arranged on each side of the body as follows: on abdomen in either 1 or 2 rows of 4 to

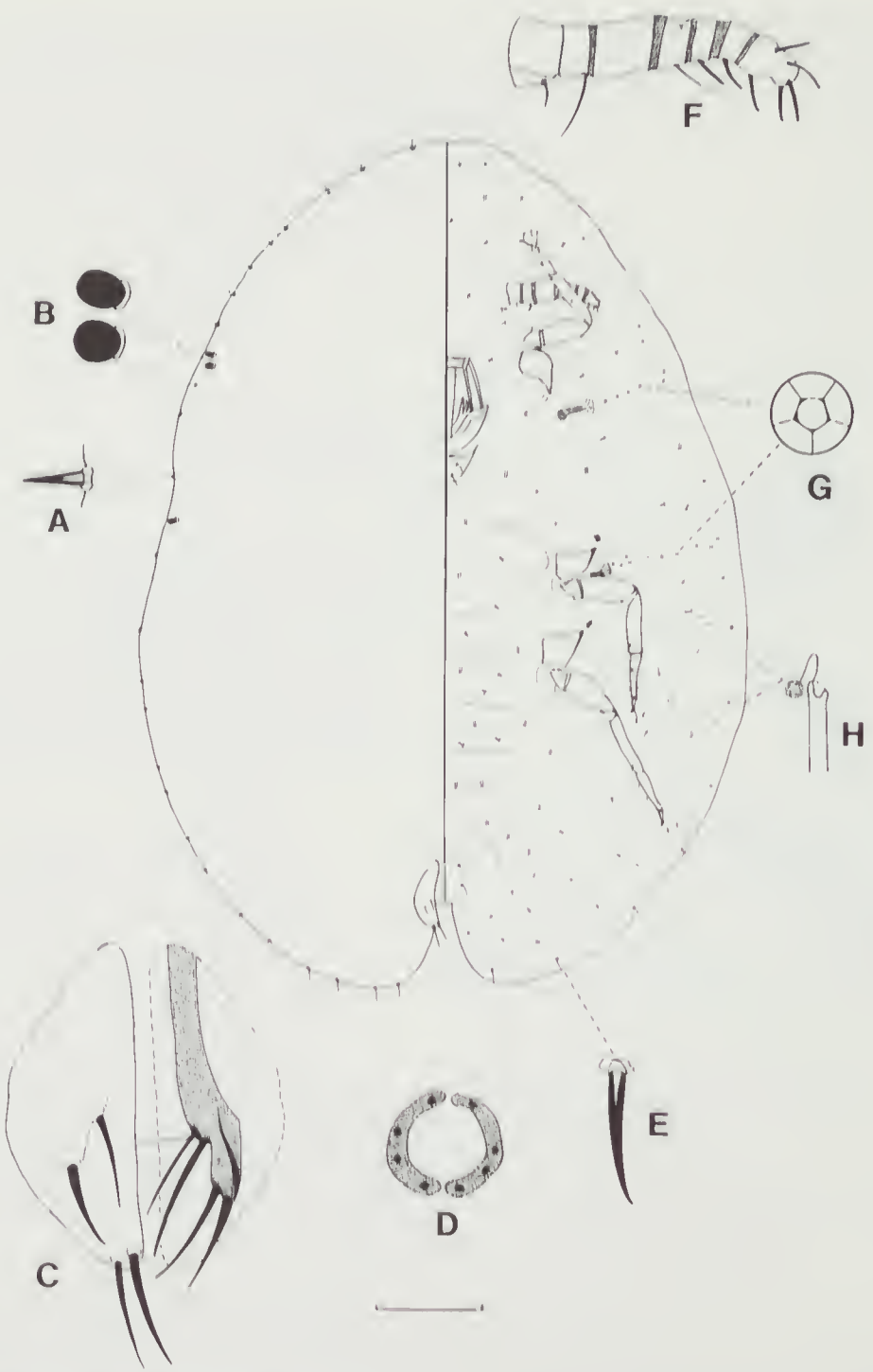

Figure 2. Second instar female *Cryptes baccatus*.

7 setae, posterior setae of outer row longest, 1–3 setae between spiracular furrows, 6–8 setae on whole head, between antennae. Body setae shorter and stouter than submarginal setae. Two pairs of long setae on abdominal segments VI and VII. Antennae (Fig. 2F), not well developed, 7 segmented, 118 (111–132) long. Two pairs of setae near antennal scape, 1 approximately twice

the length of other. Legs well developed, without tibiotarsal sclerosis, claw and tarsal digitules slender, knobbed. Length of hind femur 90 (81–102, n = 19). Spiracular pores quinquelocular (Fig. 2G), pore bands of variable width; anterior band with 6–10 pores, posterior band with 6–12 pores. Tubular ducts (Fig. 2H), scattered over venter. Microspines on abdomen, concentrated in anal cleft. Microducts absent.

Second instar (*Male*) (Fig. 3). Body elongate-oval, may be enclosed in a cottony wax test with a glassy operculum posteriorly. In life, tan in colour, test white. Slide-mounted specimens 1453 (1110–1860) long, 904 (775–1042) wide.

Dorsum: Derm initially membranous but becoming progressively sclerotized in older specimens. Marginal setae (Fig. 3A), 16.1 (12.0–23.0) long, blunt ended, distributed as follows: 14 (12–16) between anterior spiracular furrows, 3 (2–3) between anterior and posterior spiracular furrows of each side, 24 (16–29) on remainder of body. Two spiracular setae (Fig. 2B), in anterior spiracular furrow (occasionally 3), 1 in posterior spiracular furrow; 7.0 (4.8–9.0) long, 7.0 (5.4–9.0) wide. Tubular ducts (Fig. 3C1) scattered over derm, but absent from area corresponding to operculum of test. Sclerotization of area surrounding duct opening (Fig. 3C2) resulting in semicircular band corresponding to anterodorsal margin of operculum. Body setae, tubercles, eyes and pores absent on derm.

Anal Plates: Each plate triangular, but with rounded angles and median edge concave; 89 (78–96) long, 36 (27–51) wide, cephalolateral margin 58 (48–69) long, caudolateral margin 56 (48–62) long. Each plate (Fig. 3D), with 2 apical setae, 1 discal seta, 1 subdiscal, 3 subapical seta. Anal fold with 1 pair of fringe setae (Fig. 3D). Anal ring (Fig. 3E), with 8 hairs and no pores.

Venter: Segmentation on thorax and abdomen delineated by sclerotization medially. Submarginal setae (Fig. 3F), long, pointed, 12.8 (8.4–18.0) long, arranged on each side of the body as follows: on abdomen in either 1 or 2 rows of 4 to 7 setae, posterior setae of outer row longest, 1–2 setae between spiracular furrows, normally a pair of setae medially on head, between antennae, although 3 setae have been observed. Body setae (Fig. 3G) shorter and stouter than submarginal setae, scattered over body. Two pairs of long setae on abdominal segments VI and VII. Antennae (Fig. 3H), not well developed, 7 segmented, 105 (96–114) long. Two pairs of setae associated with each antennal scape, 1 approximately twice the length of other. Legs well developed, without tibiotarsal sclerosis, claw and tarsal digitules slender, knobbed. Length of hind femur: 79 (69–87, n = 19). Spiracular pores quinquelocular (Fig. 3I), pore bands of variable width; anterior band with 6–10 pores, posterior band with 6–12 pores. Tubular ducts (Fig. 3J), scattered over venter, more concentrated posteriorly. A submarginal row of tubular ducts also found. Microspines on abdomen, concentrated in anal cleft. Microducts absent.

Third instar (*Female*) (Fig. 4). Body subelliptical to pyriform, brown to tan in colour. Size of slide-mounted material 1277 (1178–1426) long, 1011 (930–1054) wide.

Dorsum: Derm membranous. Marginal setae (Fig. 4A), 18 (12–24) long, blunt ended, distributed as follows: 22–33 between anterior spiracular furrows, 5–7 between anterior and posterior spiracular furrows of each side, 44–58 on remainder of body. Body setae (Fig. 4B), as long or longer than marginal setae, spread in a semicircular ring anterior to anal plates, irregularly over rest of derm. Two spiracular setae (Fig. 4C), in anterior spiracular furrow (occasionally 3), 1 in posterior spiracular furrow; 8.0 (6.6–9.0) long, 8.0 (6.6–9.0) wide. Submarginal tubercles absent. Simple pores (Fig. 4D), restricted to semicircular ring anterior to anal plates.

Anal Plates: Each plate triangular, but with rounded angles and median edge concave; 118 (96–141) long, 45 (30–48) wide, cephalolateral margin 70 (54-87) long, caudolateral margin 74 (51–90) long. Each plate (Fig. 4E), with 2 apical setae, 1 discal seta, 1 subdiscal, 3 subapical seta. Anal fold with 1 pair of fringe setae (Fig. 4E). Anal ring (Fig. 4F), with 8 hairs and no pores.

Venter: Segmentation delineated on thorax and abdomen by membranous folds. Submarginal setae (Fig. 4G), long, pointed, arranged as follows: 16–23 around head, between anterior spiracular furrows, 3–6 setae between spiracular furrows, 48–50 setae on thorax and abdomen between posterior spiracular furrows. Body setae (Fig. 4H), shorter than submarginal setae and more bristle-like, scattered over venter. One pair of long setae medially on abdominal segment VII, flanked proximally by 2 pairs of shorter setae. Antennae not well developed, 7 segmented, 1332 (1080–1650) long. Legs well developed, without tibiotarsal sclerosis, claw and tarsal digitules slender, knobbed. Length of hind femur: 116 (109–153, n = 9). Spiracular pores quinquelocular (Fig.4I), pore bands of variable width; anterior band with 22–26 pores,

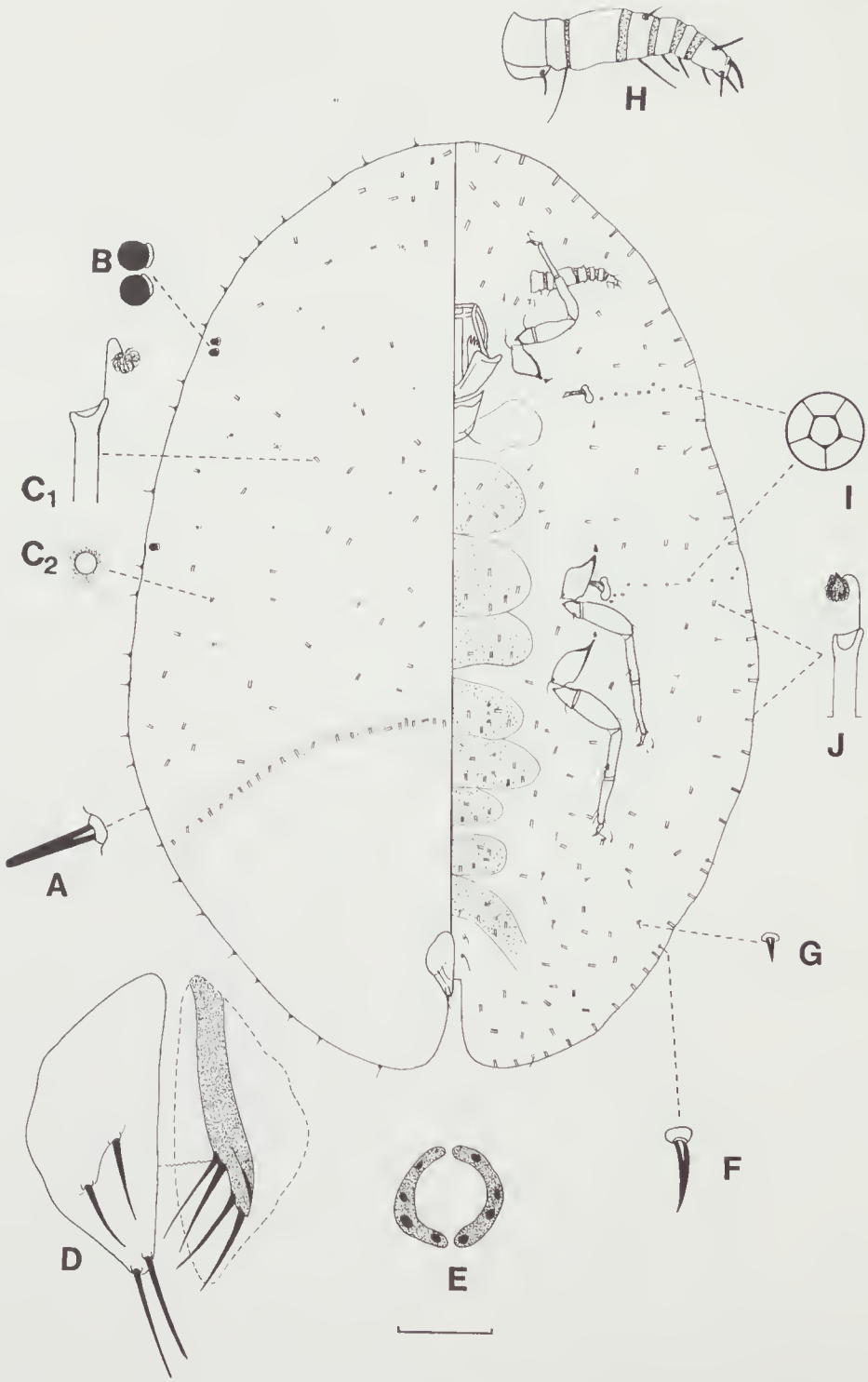

Figure 3. Second instar male *Cryptes baccatus*.

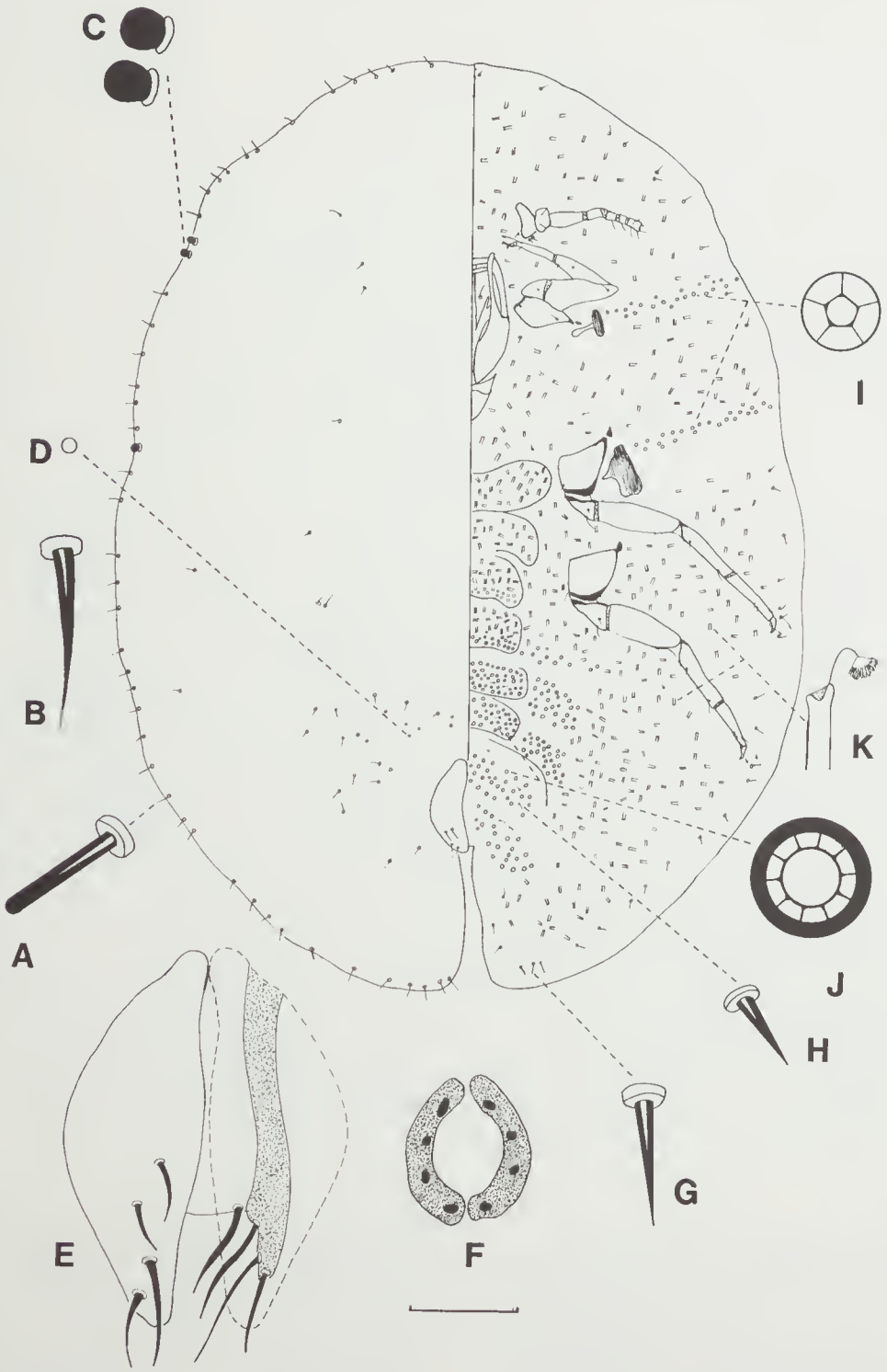

Figure 4. Third instar female *Cryptes baccatus*.

posterior band with 22–38 pores. Multilocular pores (Fig. 4J), restrieted to medial area of abdominal segments. Tubular duets (Fig. 4K), scattered over venter.

Third instar (*Male*) (Fig. 5). Enclosed within white eottony wax test with glassy operculum. Body elliptical. Slide-mounted speeimens 1760 (1628–1910) long, 970 (862–1102) wide.

Dorsum and Pleural Surface: Derm membranous. Pair of short peg-like setae (Fig. 5A), on head. No setae on thorax. A pair of peg-like setae (Fig. 5B) on eaeh of abdominal segments II to VII. Long and bristle-like dorsopleural setae (Fig. 5C) in groups of 1–3 on segments IV to VII. Shorter ventropleural setae (Fig. 5D) on abdominal segments IV to VII. Eyes present on margin above level of antennal scape. No spiracular setae, submarginal tubercles, pores or duets present. Wing buds 516 (475–550) long, 200 (173–238) wide.

Anal Plates: Plates reduced to an irregular bilobed membranous ring. Anal ring absent. Penial sheath lightly sclerotized, no setae: genital opening subapical. Sheath 107 (90–135) long, 114 (90–150) wide.

Venter: Pairs of peg-like setae between antennal bases. Oecasionally 1 or 2 longer bristle-like setae (Fig. 5E), at base of each hind coxa. Ventral abdominal setae: a pair on eaeh of abdominal segments II to VI (Fig. 5F); 3 pairs on segment VII. Antennae mainly membranous, 9 segmenteд, 341 (315–405) long. Legs mainly membranous, with poorly defined segmentation. Duets and spiraeular pores absent.

Fourth instar (*Adult Female*) (Fig. 6). Living scale varying in colour from brown in newly moulted, pre-sctttled females to grey in pre-oviposition females. Post-oviposition females dark brown. Shape varing from pyriform in newly moulted females to sub-spherical in reproduetive females. Distortion of shape due to aggregation may result in a "eorn on the eob" effect. Description based on pre-reproductive females. Size of slide-mounted material: immature, presettled individuals; 1795 (1430–2140) long, 1443 (1200–1710) wide, post-oviposition individuals: 6047 (4200–7150) long, 5572 (4620–6290) wide.

Dorsum: Derm membranous in pre-oviposition females, completely selerotized in post-oviposition females. Marginal setae (Fig. 6A), 34 (28–54) long, blunt ended, sometimes bent posteriorly, distributed as follows: 16–20 between anterior spiraeular furrows, 3–6 between anterior and posterior spiraeular furrows of eaeh side, 25–30 on remainder of body. Body setae (Fig. 6B), as long as marginal setae but more slender, pointed apieally, distributed over derm. Spiracular setae (Fig. 6C) sub-spherieal in shape, 19 (15–20) long, 17 (15–20) wide. Two spiraeular setae (oeeasionally 3), in anterior spiraeular furrow, 1 in posterior spiracular furrow. Submarginal tubereles and tubular duets absent. Simple pores (Fig. 6D), restricted to semieireular ring anterior to anal plates.

Anal Plates: Eaeh plate triangular, but with rounded angles and median edge eoneave; 167 (141–180) long, 66 (54–99) wide, eephalolateral margin 106 (93–120) long, caudolateral margin 100 (96–108) long. Eaeh plate (Fig. 6E), with 2 apieal setae, 1 discal seta, 1 subdiseal, 2 subapical seta. Anal fold with 2 pairs of fringe setae (Fig. 6E). Anal ring (Fig. 6F), with 16 setae and no pores. Anal eleft open initially, progressively fused as seale grows, with anal plates becoming eonvex and area around plates becoming heavily sclerotized.

Venter: Segmentation, when delineated, on abdomen medially. Submarginal setae (Fig. 6G), long, pointed, seattered along margin, more numerous posteriorly. Body setae (Fig. 6H), shorter than submarginal setae and more bristle-like, seattered irregularly over venter. Three setae near eaeh antenna. Pair of longer setae with nearby body setae on abdominal segment VII. Pair oeeasionally on abdominal segment VI. Antennae (Fig. 6I) well developed, 230 (200–250) long, usually 8 segmented, occasionally with ineomplete fourth segment (Fig. 6J). Legs well developed, with tibia and tarsus fused, elaw and tarsal digitules slender, knobbed. Length of hind femur: 155 (134–168, n = 22). Spiracular pores quinqueloeular (Fig. 6K), pore bands of 1–3 pores wide; anterior band with 22–34 pores, posterior band with 30–44 pores. Multilocular pores (Fig. 6L), on abdomen medially, body setae seattered amongst pores. Tubular ducts (Fig. 6M), seattered over venter. Mierospines in anal cleft. Small indistinguishable structures, possibly mieroduets seattered on head around mouthparts and between antennae.

Fourth instar (*Male*) (Fig. 7). Enelosed within white cottony wax test with glassy opereulum. Body elliptieal. Slide-mounted speeimens 1746 (1580–1868) long, 788 (671–958) wide.

Dorsum and Pleural Surfaee: Derm membranous. Head and thorax without setae. A pair of short peg-like setae (Fig. 7A), on each of abdominal segments III to VII. Longer dorsopleural abdominal setae (Fig. 7B), in groups of

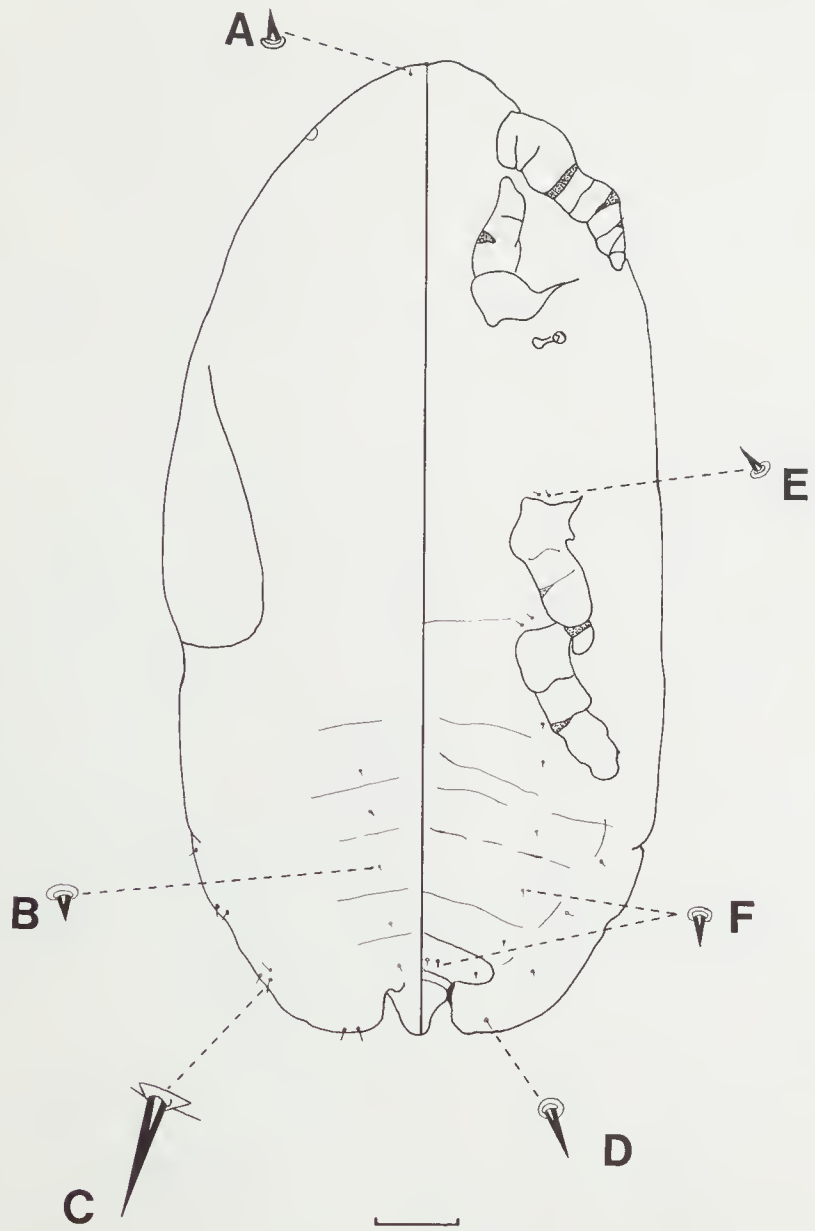

Figure 5. Third instar male *Cryptes baccatus*.

1–3 on segments IV to VII, usually becoming more numerous posteriorly. Shorter peg-like ventropleural setae (Fig. 7C), on segments V to VII. Eyes submarginal, posterior to scape. No spiracular setae, submarginal tubercles, pores or ducts present. Wing buds 749 (630–800) long, 254 (225–300) wide.

Anal Plates: Replaced by a membranous collar. Anal ring absent. A sclerotized penial sheath originates from membranous collar. Genital opening subapical.

Venter: No setae on head and thorax. Ventral abdominal setae (Fig. 7D), in pairs on each of abdominal segments II to VI, 3 pairs medially on

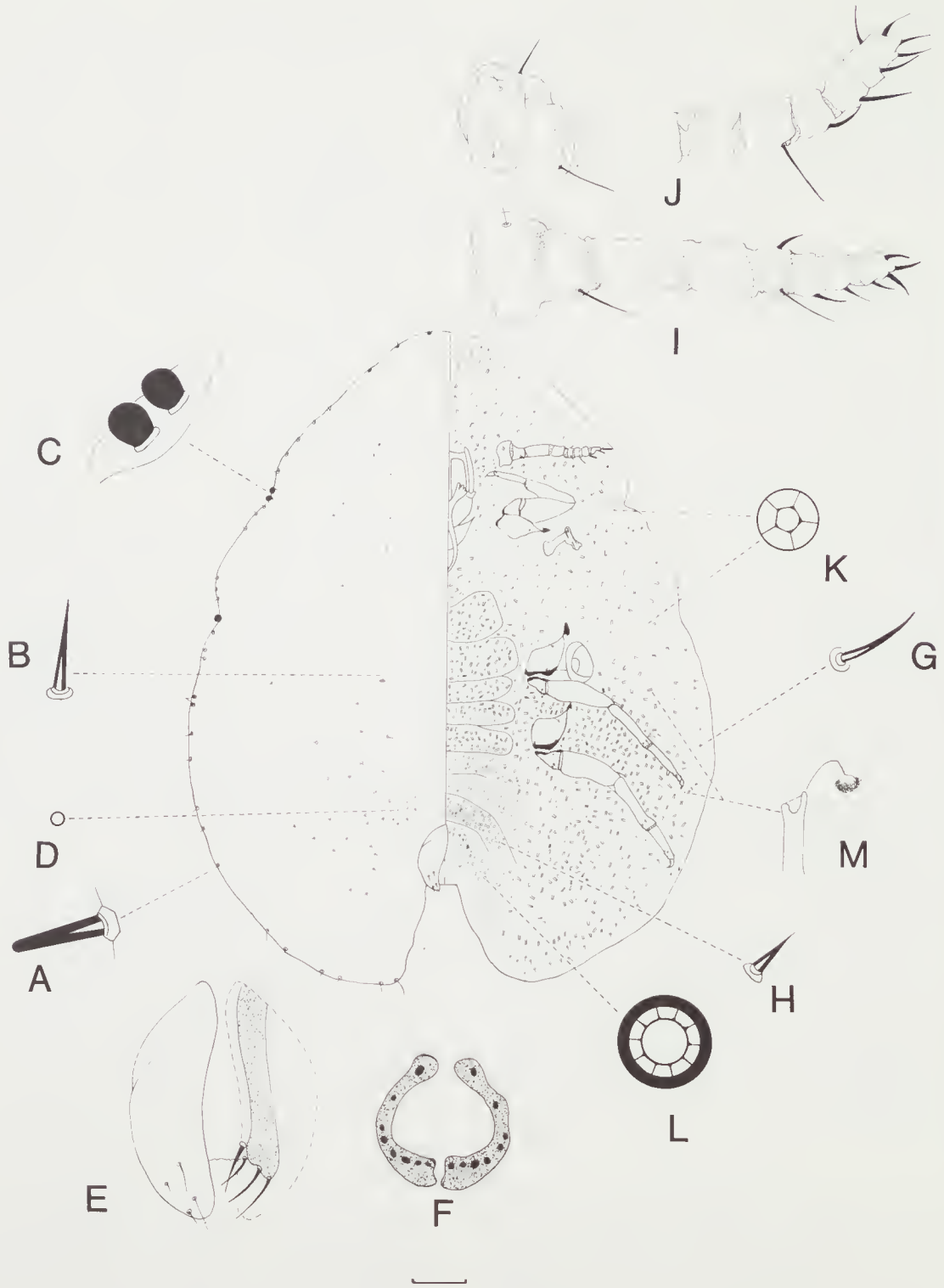

Figure 6. Fourth instar female (adult) *Cryptes baccatus*.

segment VII. Antennae elongate, largely membranous, 9–10 segmented, 717 (630–765) long. Legs mainly membranous, segmentation poorly defined, but apparent. Length of hind femur: 245 (216–276, n = 19). Ducts and spiracular pores absent.

Fifth instar (*Adult Male*) (Fig. 8). Living specimens red-brown with sclerotized areas dark brown-black, appendages yellowish-orange, wing with purplish tinge along radial vein; body robust; legs, antennae setose; abdomen with long wax filaments. Slide-mounted specimens, 2086 (1929–2367) long, 267 (237–312) wide; wing span 3263 (2989–3512).

Head: Typical coccid subconical shape in dorsal view (Fig. 8A); in lateral view (Fig. 8B), dorsoventrally elongated, anterodorsal bulge not pronounced. Length 304 (250–350), width 288 (275–300). Median crest sclerotized and weakly striated dorsally, but only weakly sclerotized anterodorsally to lateral arm of mid-cranial ridge (Fig. 8C); with 0–4 hair-like setae arranged in 2 groups of 0–2 setae, 1 group at level of, and other group anterior to, dorsal simple eyes. Dorsally midcranial ridge absent: posterior polygonal reticulation absent. Genae: moderate size, entirely membranous, without setae. Eyes: 2 pairs, subequal, corneae of dorsal eyes 50.8 (47.5–55.0) in diameter, corneae of ventral eyes 50.3 (45.0–57.5) in diameter. Ocellus small. Sclerotization of ocular sclerite apparent, although weakly in places; polygonal reticulation usually absent, if present weak and locally restricted; striation common, particularly between eyes. Preocular ridge moderately long with ventral part not extended far beyond articular process. Postocular ridge weak dorsally, definition increased lateroventrally but only well defined posteromedially; no apparent splitting to enclose ocellus. Dorsal ocular sclerite absent. Ventral head setae: restricted to 1 seta anterior to ocular sclerite, between articular process and midcranial ridge. Preoral ridge present. Tendon-like apodeme variable, usually absent. Cranial apophysis with apex truncated, extending to a level medial to ventral eyes. Anterior tentorial pits absent.

Antennae: Ten-segmented, filiform, 1173 (1047–1335) long. Ratio to: half body length 1:1.07–1.31 (average 1.14); posterior leg 1:0.87–1.34 (average 1.05); penial sheath 1:2.52–3.82 (average 3.14). Size of segments given in Table 1. All segments without polygonal reticulation, but striated. Scape with ventral sclerotization reduced; with hair-like setae only. Pedicel with

Table 1. Length and width of antennal segments of adult male *Cryptes baccatus*.

	Segment (µm)									
	I	II	III	IV	V	VI	VII	VIII	IX	X
Length										
range	56.9–68.2	64.4–72.0	83.4–117.5	136.4–181.9	121.3–181.9	155.4–227.4	128.9–174.3	94.8–136.4	72.0–94.8	68.2–87.2
mean	64.2	68.0	98.1	154.3	163.8	182.1	151.4	114.3	87.8	77.3
n	14	14	18	18	18	18	18	18	18	18
Width										
range	56.9–68.2	53.1–72.0	37.9–49.3	34.1–41.7	30.3–37.9	30.3–41.7	30.3–37.9	30.3–37.9	30.3–37.9	30.3–37.9
mean	63.2	60.6	42.9	35.8	35.0	34.3	34.3	34.5	33.7	32.8
n	14	14	18	18	18	18	18	18	18	18

dorsal sensillum. Segments II to IX predominantly with fleshy setae, but occasionally 1 hair-like seta and basiconica sensillum per segment Apical segment (Fig. 8D), with 2 subapical setae; 0–3 antennal bristles.

Thorax

Prothorax: Pronotal ridge uninterrupted medially, although narrow. Lateral pronotal sclerite variable, but usually absent. Post-tergites absent. Proepisternum and cervical sclerite and pleural ridge as normally for family except for pleural apophysis, which is vestigial. Prosternum variable, transverse ridge strong, but often with semicircular plate extending posteriorly; sclerite triangular to subtriangular, size variable; median ridge, if present, extending anteriorly beyond apex of sclerite, but not reaching transverse ridge posteriorly. Setae absent from prothorax.

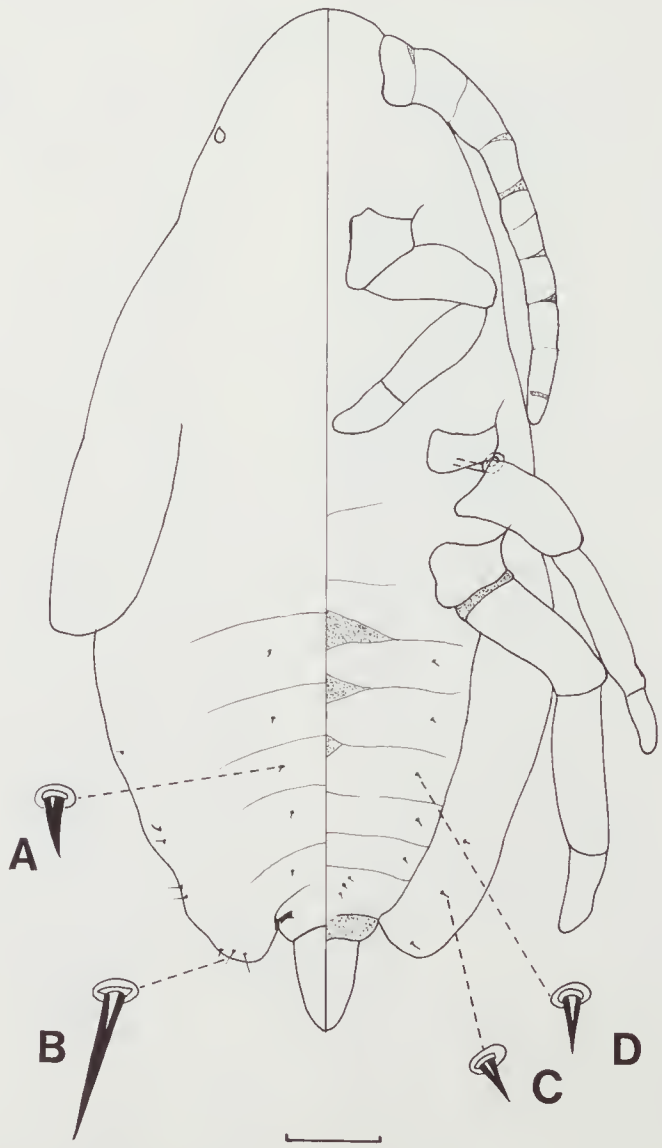

Figure 7. Fourth instar male *Cryptes baccatus*.

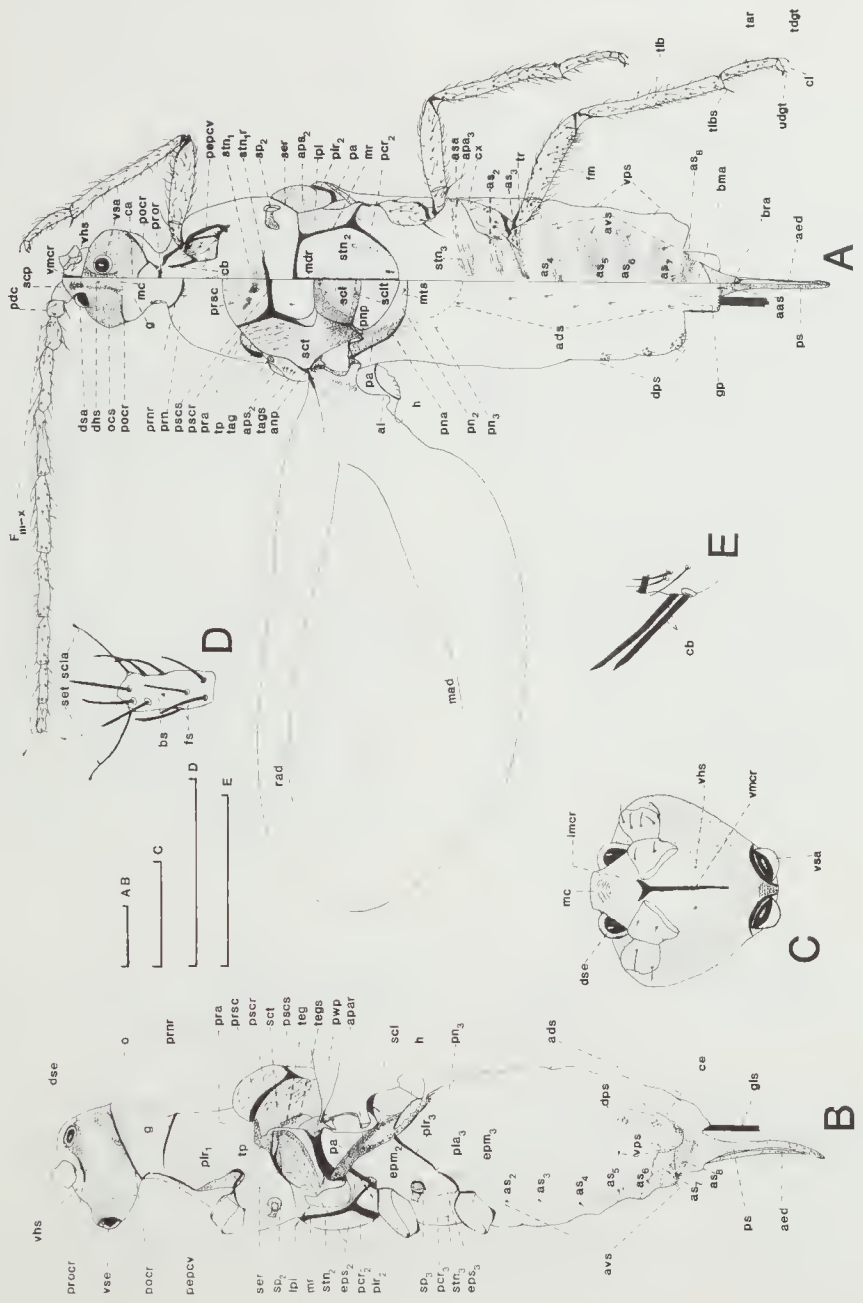

Figure 8. Fifth instar male (adult) *Cryptes baccatus*. A, dorsal and ventral aspect of body. B, lateral aspect of body. C, head, anterior view. D, 10th segment of antenna, dorsal view. E, distal edge of fore coxa, coxal bristle.

Mesothorax: Prescutum 129 (108–150) long, 260 (237–275) wide, curved anteriorly and bound laterally by prescutal ridge and posteriorly by prescutal suture; sclerotization even; polygonal reticulation variable, when present only faintly delineated; striations more normally present. Scutum: medium membranous area subrectangular 112 (90–127) long, 232 (217–250) wide, with 0–4 setae. Scutellum 136 (125–145) long 267 (237–312) wide, not tubular, without setae. Postnotum with anterior margin not overlapped by metathoracic fold; postnotal apophysis and postalare developed, the latter sclerotized such that it appears to bear a foramen lateromedially. Mesopleuron: mesopleural ridge strong, reaching coxal articulation; pleural apophysis well developed; pleural process developed, semicircular, not rounded. Basalare absent. Subalare small, difficult to detect. Episternum slightly striated, subepisternal ridge well developed, thicker medially; dorsal part of ridge split into two arms, ventrally ridge turns posteriorly, but stops well short of membranous cleft; sclerotized band joins episternum and lateral pleurite, closing membranous cleft anteriorly. Episternum small. Lateropleurite partly bound anteriorly by extension from marginal ridge. Basisternum 270 (250–312) long, 344 (330–395) wide, bounded by strong marginal ridge and precoxal ridges. Median ridge variable, when present may extend length of sclerite. Furca well developed. Setae absent. Mesothoracic spiracle with well developed peritreme; spiracular setae absent. Tegula small, 0–8 tegular setae. Axillary wing sclerites typical of family. Additional sclerites present.

Metathorax: Metanotum with posterior margin occasionally desclerotized medially, suspensorial sclerites small. Postnotum consisting of transverse sclerite on each side. Metatergal setae (1–3) usually present on each side of thorax. Pleural ridge well developed, may be interrupted anterior to episternum; with small wing process. Episternum extended ventrally, ridge not devel-

Table 2. Length and width of leg segments of adult male *Cryptes baccatus*.

	Segment (μm)				
	Coxa	Trochanter	Femur	Tibia	Tarsus
Leg I					
Length					
range	80–112	75–100	187–275	360–400	155–187
mean	97	87	247	374	176
n	12	13	12	13	13
Width					
range	75–105	42–55	50–75	27–37	22–32
mean	91	49	59	33	26
n	12	13	12	12	13
Leg II					
Length					
range	87–112	75–100	200–265	335–412	155–200
mean	96	86	231	374	167
n	14	14	15	15	16
Width					
range	80–100	45–62	50–75	25–37	22–32
mean	90	51	60	30	26
n	14	14	15	15	16
Leg III					
Length					
range	87–125	75–112	195–275	350–462	170–215
mean	108	97	252	422	195
n	14	21	21	21	21
Width					
range	100–137	47–75	62–90	32–50	25–37
mean	108	53	69	37	28
n	18	21	21	21	21

oped anteriorly; epimeron produced posteriorly. Metathoracic spiracle similar to mesothoracic one. Metasternal plate variable, sclerite often incomplete medially, irregularly shaped; metasternal setae absent.

Wings: Hyaline, 585 (538–625) long, 284 (237–325) wide, alar lobe and alar setae present. Hamulohalteres well developed, each with 1 apically hooked seta.

Legs: Moderately long, slender, hind pair longest, mid pair shortest; ratio hind leg to body length 1:1.53–2.03 (average 1.85). Length and width of segments given in Table 2. Each tibia with apical spur; each tarsus with 2 subequal digitules. Claws with 2 knobbed subequal digitules. Fore coxa with 2 large, distinctive coxal bristles (Fig. 8E). Mid and hind coxa with an elongate hair-like seta on proximal edge. Legs uniformly covered with fleshy setae.

Abdomen: Segments I–VII; tergites absent on all segments, sternites present on all segments; posterior sclerites present as transverse plates, anterior sclerites usually as 2 plates; sclerotization heaviest on posterior plates. Caudal extension of segment VII not sclerotized. Dorsal setae: hair-like only, segments I to VII with 1 seta on each side. Pleural setae represented by hair-like setae on segments V to VII only and associated with minute (1 simple) pores, arranged as follows: 2–3 dorsal pleural setae and 1 ventral pleural seta on segment V, 3-4 dorsal pleural setae and 1 ventral pleural seta on segment VI, 4 dorsal setae and 1 ventral pleural setae on segment VII, occasionally 1–2 dorsal pleural setae and 1 ventral pleural seta on segment IV. Ventral setae: hair-like only, arranged as follows: 1 seta each side of segments II to VII, segment VII also with 3–7 medial setae at posterior edge of sclerite.

Genital segment: Eighth segment expanded dorsally into subrectangular lobe overlaying base of penial sheath; containing glandular pouch. Penial sheath 380 long, 43 wide, lateral sclerotization not joined anteriorly to arms; basal rod short, sheath without setae, with small sensilla laterally over distal half.

Remarks. Maskell (1891) described the external features of the adult female and what appears to be the first instar, including details of the antennal segments. He also described the male test and figured the immature and adult female aggregation, details of adult females and male test, the first instar and antennae of the adult female and first instar. Fuller (1899) proposed a race for Western Australian specimens, *Lecanium baccatum* var. *marmoreum* Fuller, but its status is uncertain (Morrison and Morrison, 1922) although it is likely that, based on Fuller's description and illustrations, it should be synonymized with the nominal subspecies. Morrison and Morrison (1922) figured and described the first instar and adult females. Their illustration of the first instar nymph lacks the dorsal body setae found in this study and as there is no mention of them in the text, it must be assumed they were absent from the material examined (cf. Fig. 1 with Morrison and Morrison, 1922: 81, Fig. 27).

Key to instars of *Cryptes baccatus* (Maskell)

It was possible to separate instars on a number of morphological characters. These characters have been used to construct the key presented here. As the adult male is easily distinguished from other instars, it has not been included.

1. Without wing pads 2
— With wing pads 6
2. Dorsal body setae arranged into 2 longitudinal rows, with setae often bent posteriorly ..... 1st instar
— Dorsal body setae either absent or not as above 3
3. Dorsum naked ..... 2nd instar female
— Dorsum with tubular ducts, setae or minute circular pores 4
4. Dorsum with tubular ducts, but without setae or minute circular pores ..... 2nd instar male
— Dorsum without tubular ducts, but with setae and minute circular pores 5
5. Antennae with 7 segments; anal ring with 8 setae .. 3rd instar female
— Antennae with 8 segments, segments 3 and 4 occasionally only partly differentiated; anal ring with 16 setae ..... Adult female

6. Dorsal body setae on head and abdomen; legs and antennae: short, length much less than abdomen, with poorly defined segmentation .... 3rd instar male

— Dorsal body setae on abdomen only; legs and antennae: long, length subequal to abdomen, segmentation poor but apparent 4th instar male

Discussion

There are no authoritative revisionary treatments of the Australian Coccidae and the most recent world wide review of the family based on female morphology was by Steinweden (1929). Given that the generic classification of the family is in urgent need of revision (De Lotto, 1965), attempts to reclassify the family into natural or related groups have, not surprisingly, met with little success (Williams and Kosztarab, 1972). Speculation on the relationship of *Cryptes* to the rest of the family, based on female morphology, is mostly futile. Suffice to say that nothing in this redescription of the adult female questions the assertion of Morrison and Morrison (1922) or Steinweden (1929) as to the generic status of *Cryptes*. Whether this would remain so after a generic revision of the family is another matter.

The taxonomy of the Coccoidea is still firmly based on female morphology, but males are thought to represent ancestral affinities better, particularly at higher levels of classification (Boratynski, 1970), although they can be of use at an intrafamiial level (Boratynski and Davies, 1971; Davies and Boratynski, 1979; Davies, 1981). In the Coccidae the work by Giliomee (1967) provides a base line for the study of intrafamiial relationships using male morphology. Using 119 characters based on the study of 23 species he was able to separate the species examined into four subfamilies (Giliomee's groups of genera). By using the characters established by Giliomee, it was possible to examine the degree of affinity of *Cryptes* to these genera.

Cryptes shared most features (52–65) with the subfamily Eulecaniinae which includes: *Eulecanium* Cockerell, *Nemolecanium* Borchsenius, *Physokermes* Targioni Tozzetti, *Rhodococcus* Borchsenius, *Palaeolecanium* Sulc, *Phyllostroma* Sulc, *Filippia* Targioni Tozzetti, *Ctenochiton* Maskell, *Ericerus* Signoret, and an unidentified genus. It was the largest and most heterogeneous of the families and considered by Giliomee to be the most primitive.

To test the relationships between subfamilies, Giliomee used Ghauri's (1962) method of analysis to calculate the following:

(a) the number of character states shared by pairs of subfamilies;
(b) the number of character states exclusive to the pairs and;
(c) the number of character states by which the two subfamilies differ from each other.

A similar method was followed to examine the relationships of *Cryptes* to Giliomee's subfamilies (Table 3). These data confirm the affinity of *Cryptes* to Eulecaniinae. It shared more character states with this subfamily than any other, and it shared four exclusive character states with the Eulecaniinae compared with none or one shared with other subfamilies. However, *Cryptes* also shows two character states considered by Giliomee to be exclusive to other subfamilies. The postocular ridge does not fork in *C. baccatus*, a feature found only in the Eriopeltinae and *C. baccatus* has lost the basalare, a character state Giliomee considered to be diagnostic of the Coccinae.

The number of character states shared by *Cryptes* and the Eulecaniinae was greater than any other pair of subfamilies examined by Giliomee and similarly the number of differentiating character states was less then for any other pair (Giliomee, 1967: Table 2A). *Cryptes* can not be included in the Eulecaniinae, as defined by Giliomee because of attributes considered exclusive to other subfamilies. Giliomee stressed that his findings were provisional, given the limited number of species used in the analysis. In particular the Eulecaniinae was the most diverse and artificial, so it is hardly surprising given this, and considering that the work was based on European species, that while *Cryptes* showed close affinity to the subfamily, the genus could not be properly included within it.

Unique conditions during the evolution of the Australian phytofauna, particularly the (evolutionary) recent and extensive radiation of *Acacia* and *Eucalyptus* (Myrtaceae) (Gill, 1975), provided an ideal situation for diffuse coevolution (Fox, 1981) to occur (New, 1983). It has been postulated that this can lead to the evolution of many taxonomically difficult groups (New, 1983). Whether the situation with *Cryptes* is a reflection of this or more simply the poor

Table 3. Relationship between *Cryptes* and subfamilies of coccid genera based on Giliomee (1967). See text for explanation.

Pairing	Number of Character States		
	(a) Shared	(b) Exclusive	(c) Differentiating
Cryptes–Eulecaniinae	20	4	3
Cryptes–Eriopeltinae	18	1	10
Cryptes–*Inglisia**	13	0	20
Cryptes–Coccinae	10	1	21

* Only a single species was contained in Giliomee's (1967) *Inglisia*-group and so it has not been raised to subfamily status here.

state of our knowledge of the coccids is uncertain. The analysis of the male presented here, while giving a better indication of the affinities of the genus then possible from study of the female, still was inconclusive. The long term status of the genus depends very much on the extent of revisionary work to be done both on the Australian fauna and world wide. In a recent review Williams (1985) has predicted that many Australian mealybugs (Pseudococcidae) are yet to be discovered and described. It is not unreasonable to believe that a similar situation exits in the Coccidae. Until such revisionary work is done on the Coccidae, the status and position of *Cryptes* within the family will remain uncertain.

Acknowledgments

I thank Dr T. New (Department of Zoology, La Trobe University) for his help and advice during this project and for his critical reading of the manuscript. My thanks to Jenny Lawther for her help and good humour in preparing the illustrations through the early hours of many a cold winter's night. Comments on the manuscript by an anonymous referee are greatly appreciated. Part of this work was done while holding a Commonwealth Postgraduate Research Scholarship.

References

Boratynski, K., 1970. Advances in our knowledge of Coccoidea with reference to studies of males and the application of some numerical methods of classification. *Polish Congress of Contemporary Science and Culture in Exile* 1: 585–595.

Boratynski, K. and Davies, R.G., 1971. The taxonomic value of male Coccoidea with an evaluation of some numerical techniques. *Biological Journal of the Linnean Society* 3: 57–102.

Cockerell, T.D.A. and Parrott, P.J., 1899. Contributions to the knowledge of the Coccidae. *The Industrialist* 1899: 159–165.

Davies, R.G., 1981. Information theory and character selection in the numerical taxonomy of some male Diaspididae (Hemiptera: Coccoidea). *Systematic Entomology* 6: 49–178.

Davies, R.G. and Boratynski, K.L., 1979. Character selection in relation to the numerical taxonomy of some male Diaspididae (Homoptera: Coccoidea). *Biological Journal of the Linnean Society* 12: 95–165.

De Lotto, G., 1965. On some Coccidae (Homoptera), chiefly from Africa. *Bulletin of the British Museum (Natural History) Entomology* 16: 177–239.

Farrell, G.S., 1985. *The morphology, biology and ecology of two colonial scale insects (Coccoidea) on* Acacia *(Mimosaceae) in south-eastern Australia.* Unpublished PhD thesis, La Trobe University, Victoria, Australia.

Farrell, G.S., 1990. Description of the immature stages and adult male of an Australian mealybug, *Melanococcus albizziae* (Maskell) (Coccoidea: Pseudococcidae). *Memoirs of the Museum of Victoria* 51: 00–00.

Fox, L.R., 1981. Defence and dynamics in plant-herbivore systems. *American Zoologist* 21: 853–864.

Froggatt, W.W., 1921. A descriptive catalogue of the scale insects (Coccidae) of Australia. Part II. *Scientific Bulletin of the Department of Agriculture New South Wales* 18: 1–159.

Ghauri, M.S.K., 1962. *The morphology and taxonomy of male scale insects (Homoptera: Coccoidea).* British Museum (Natural History): London. 221 pp.

Giliomee, J.H., 1967. Morphology and taxonomy of adult males of the family Coccidae (Homoptera: Coccoidea). *Bulletin of the British Museum (Natural History) Entomology Supplement* 7: 168 pp.

Gill, E.D., 1975. Evolution of Australia's unique flora and fauna in relation to plate tectonics theory.

Proceedings of the Royal Society of Victoria 87: 215–234.

Maskell, W.M., 1892. Further coccid notes: with descriptions of new species and remarks on Coccidae from New Zealand, Australia and elsewhere. *Transactions of the New Zealand Institute* 24(1891): 1–64.

Morrison, H. and Morrison, E., 1922. A redescription of the type species of the genera of Coccidae based on species originally described by Maskell. *Proceedings of the United States National Museum* 60 art 12, No. 2407, 130 pp.

New, T.R., 1983. Systematics and ecology: reflections from the interface. Pp. 50–79 in Highley, E. and Taylor, R.W. (eds.) *Australian systematic entomology: a Bicentenary perspective*. CSIRO: Canberra.

Ray, C.H. and Williams, M.L., 1980. Description of the immature stages and adult male of *Pseudophillippia quaintancii* (Homoptera: Coccoidea: Coccidae). *Annals of the Entomological Society of America* 73: 437–447.

Steinweden, J.B., 1929. Bases for the generic classification of the coccoid family Coccidae. *Annals of the Entomological Society of America* 22: 197–243.

Williams, D.J., 1985. *Australian mealybugs*. British Museum (Natural History): London. 431 pp.

Williams, M.L. and Kosztarab, M., 1972. Morphology and systematics of the Coccidae of Virginia with notes on their biology (Homoptera: Coccoidea). *Virginia Polytechnic Institute and State University, Research Division Bulletin* 74: 215 pp.

Appendix

Abbreviations used in figures. aas, ante-anal setae. ads, abdominal dorsal setae. aed, aedeagus. al, alar lobe. anp, anterior notal wing process. apar, anterior postalar ridge. as, abdominal sternite. ase, differentiated apical setae. avs, abdominal ventral setae. bma, basal membranous area. bra, basal rod of aedeagus. bs, sensilla basiconica. ca, cranial apophysis. cb, coxal bristle(s). ce, caudal extention. cl, claw. cx, coxa. dhs, dorsal head setae. dps, dorsopleural setae. dse, dorsal simple eyes. epm2, mesepimeron. epm3, metepimeron. eps2, mesepisternum. eps3, metepisternum. f, furca. FIII–X, flagellum segments – 3rd to 10th. fm, femur. fs, fleshy setae. g, gena. gp, glandular pouch. h, hamulohaltere. lmcr, lateral arm of midcranial ridge. lpl, lateroplcurite. mc, median crest. mdr, median ridge. med, marginal ridge. mr, marginal ridge. mts, metatergal setae. o, ocellus. ocs, ocular sclerite. pa, postalare. pcr2, precoxal ridge of mesothorax. pcr3, precoxal ridge of metathorax. pdc, pedical. pepcv, proepisternum + cervical sclerite. pla3, metapleural apophysis. plr1, propleural ridge. plr2, mesopleural ridge. plr3, metapleural ridge. pn2, mesopostnotum. pn3, metapostnotum. pna, postnotal apophysis. pnp, posterior notal wing process. pocr, postocular ridge. pra, prealare. prnr, pronotal ridge. procr, preocular ridge. pror, preoral ridge. prsc, prescutum. ps, penial sheath. pscr, prescutal ridge. pscs, prescutal suture. pwp, mesopleural wing process. rad, radius. scl, scutellum. sclf, scutellar foramen. scp, scape. sct, scutum. ser, subepisternal ridge. set.scla, subapical sensory setae. sp2, mesothoracic spiracle. sp3, metathoracic spiracle. stn1, prosternum. stn2, mesosternum (basisternum). stn3, metasternum. stn1r, prosternal ridge. tar, tarsus. tdgt, tarsal digitules. teg, tegula. tegs, tegular setae. tib, tibia. tibs, tibial spur. tp, triangular plate. tr, trochanter. ts, tail setae. udgt, ungual digitules. vhs, ventral head setae. vmcr, ventral arm of midcranial ridge. vps, ventropleural setae. vse, ventral simple eyes.