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Mealybugs of the genera *Eumyrmococcus* Silvestri and *Xenococcus* Silvestri associated with the ant genus *Acropyga* Roger and a review of the subfamily Rhizoecinae (Hemiptera, Coccoidea, Pseudococcidae)

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CONTENTS

Synopsis. The hypogeic mealybug genera *Eumyrmococcus* Silvestri and *Xenococcus* Silvestri, their distribution throughout southern Asia and Australasia, and their association with the ant genus *Acropyga* Roger are discussed. *Eumyrmococcus* is also discussed from Europe and South Africa. Descriptions or redescriptions of 17 species of *Eumyrmococcus* are presented and illustrated, including *E. corinthiacus* Williams, *E. falciculosus* sp. n., *E. kolombangarae* sp. n., *E. kruiensis* sp. n., *E. kusiacus* sp. n., *E. lamondicus* sp. n., *E. lanuginosus* sp. n., *E. maninjauensis* sp. n., *E. neoguineensis* sp. n., *E. nipponensis* Terayama, *E. queenslandicus* sp. n., *E. recalvus* sp. n., *E. sarawakensis* sp. n., *E. scorpioides* (De Lotto), *E. smithii* Silvestri, *E. sulawesicus* sp. n. and *E. taylori* sp. n. The genus *Xenococcus* includes two species, *X. acropygae* sp. n. and *X. annandalei* Silvestri. It is now known that *X. annandalei* is a local species from a small area in India. The female pupal instar, already known in *Xenococcus*, is also discussed in *Eumyrmococcus*. Full page illustrations for each species and keys to species of *Eumyrmococcus* and *Xenococcus* are provided.

The position of *Eumyrmococcus* and *Xenococcus* within the subfamily Rhizoecinae is discussed and a review of all the genera included in the subfamily is provided. A new genus and species, *Leptorhizoecus deharvengi*, is described from Sumatra and the generic name *Radicoccus* Hambleton is synonymised with *Rhizoecus*.

INTRODUCTION

In a list of family-group names of the Coccoidea, Williams (1969a) erected the tribe Rhizoecini, within the mealybug family Pseudococcidae, for *Rhizoecus* Künckel d'Herculais and a few related genera, all inhabiting soil, leaf litter, rotting logs or feeding on roots. Some of these genera are now known to be identical with others and some other genera have been added since. After a comprehensive study of the labium of the Coccoidea, Koteja (1974a, 1974b) accepted the group as the subfamily Rhizoecinae, mainly on the basis that the labium is very narrow. This group also lacks cerarii and the antennae are usually strongly geniculate, with never more than 6 antennal segments, the terminal segment always tapering and pointed. The subfamily status has been accepted by most workers. The other subfamilies Trabutininae, Pseudococcinae and Sphaerococcinae, discussed by Koteja, have also been accepted by many students of the Coccoidea although the status of each subfamily is still ill-defined.

The purpose of this work is to revise the genera *Eumyrmococcus* and *Xenococcus*. A few species of *Eumyrmococcus* had been studied already for the author's current work on the mealybugs of southern Asia. Some interesting collections, however, sent by Dr R.W. Taylor, CSIRO, Canberra, from Australasia, associated with the ant genus *Acropyga*, have revealed some remarkable species. Any attempt to publish on southern Asian species without a knowledge of all the others would be undesirable. It is for this reason that a study is presented here of all the known species of *Eumyrmococcus*, now totalling 17.

It is clear that most of the records of the related genus *Xenococcus* have been based on a misconception. The type species *X. annandalei* Silvestri, appears to be a local species, at present living only on Barkuda I., Orissa Province, India. Another species, previously identified as *X. annandalei* from India, most of southern Asia and Australasia, is different, and is here described as new.

Eumyrmococcus and *Xenococcus* were also included in the subfamily Rhizoecinae by Tang (1992) who erected the tribe Xenococcini for them. According to Tang, this tribe differs from the Rhizoecini, the only other tribe, in lacking ostioles. The distinction may hold for Chinese and neighbouring species but not in the subfamily as a whole as known worldwide. It is difficult to separate *Eumyrmococcus* and *Xenococcus*, for instance, without reference to *Neochavesia* Williams & Granara de Willink, a South American genus. This study of *Eumyrmococcus* and *Xenococcus* is followed, therefore, by a discussion of all genera of the subfamily Rhizoecinae. Included genera accepted here are *Rhizoecus*, *Capitisetella* Hambleton, *Pseudorhizoecus* Green, *Geococcus* Green, *Leptorhizoecus* gen. nov., *Pygmaeococcus* McKenzie, *Neochavesia*, *Eumyrmococcus* and *Xenococcus*. A key to these genera is also included.

Few specimens of *Eumyrmococcus* have been available for this study. Collecting these mealybugs is not easy and acknowledgement is always due to the collectors who have searched for them in ants' nests or have taken the trouble to extract them from soil samples. Species records represent isolated collections over a wide area. All the species are minute and their preparation on to microscope slides is often tedious. Distinguishing adults from immatures preserved in vials is almost impossible and it is often disappointing to find only one or two adult females in any sample. Even more disappointing is the complete absence of adults.

The present study of *Eumyrmococcus* and *Xenococcus* must be recognized as a preliminary identification guide and not a phylogenetic study. Some possible species-groups can be distinguished and these are discussed in the introduction to the section on 'Species and Genera' (p. 7). It is hoped that the present study of these mealybugs and their ant relationships will form the basis for a future cladistic study. Such a study could also be extended to the other rhizoecine genera discussed here, at least to some of the monotypic genera which need further investigation.

MATERIAL AND METHODS

The slide-mounting techniques and the methods of illustration described by Williams & Watson (1988) and Williams & Granara de Willink (1992) are followed. The terminology in these works is adopted here except for the terms bitubular and tritubular pores. In the present work they are referred to as bitubular cerores and tritubular cerores, terms that were widely used by Hambleton (1976) and adopted from MacGillivray (1921).

Measurements of the body length and width are in millimetres but all other measurements, even if larger than the body length, are given in microns.

ABBREVIATIONS OF INSTITUTIONS

The following acronyms are used throughout for the depositories of specimens.

ANIC Australian National Insect Collection, Canberra, Australia.
BMNH The Natural History Museum, London, UK.
IEAUN Istituto di Entomologia Agraria dell'Università di Napoli, Portici, Italy.
MNHN Muséum National d'Histoire Naturelle, Paris, France.
NIAES National Institute of Agro-Environmental Science, Tsukuba-shi, Japan.
QM Queensland Museum, South Brisbane, Queensland, Australia.
SANC National Collection of Insects, Pretoria, South Africa.
USNM National Museum of Natural History [Scale insect Collection], Beltsville, Maryland, USA.

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Dr Penny J. Gullan, Australian National University, Canberra, Australia, read the entire draft manuscript, suggested improvements and offered perceptive criticism, which I have heeded throughout. I am much indebted to Dr Gullan for spending her time and showing keen interest in this work.

HABIT AND ECONOMIC IMPORTANCE

It has been been postulated by Koteja (1984, 1985) and well summarised by Gullan & Kosztarab (1997) that the ancestors of present-day Coccoidea lived on the leaf-litter layer, feeding on dead and decaying matter, or even on associated fungi and bacteria. Some soil-inhabiting coccoids are, apparently, secondarily inhabitants but Koteja suggests that *Margarodes* Guilding (Margarodidae) and *Rhizoecus* (Pseudococcidae) might have spent all of their phylogeny in soil or litter. The underground habit of *Rhizoecus* could not have been acquired secondarily from an aerial habit on stems, twigs and leaves (Koteja, 1985).

Endosymbionts of scale insects are diverse and may have been acquired via the alimentary canal during the original leaf-litter habit. Mealybugs may have even changed their feeding behaviour by living a symbiotic relationship with ants (Tremblay, 1989) but the endosymbionts of most mealybugs, although different, are nevertheless related (Buchner, 1969). The symbionts of *Puto* Signoret and *Macrocerococcus* Leonardi are different from others in the Pseudococcidae and those of *Rastrococcus* Ferris are so distinct that *Rastrococcus* should be separated from the Pseudococcidae (Buchner, 1957, 1969). Tremblay (1977) recognizes two main symbiotic adaptations among the pseudococcids, the *Pseudococcus* Westwood type and the *Puto* type. No symbionts of *Rhizoecus* and its close relatives have been studied but Silvestri (1924) showed that *Xenococcus* has a pseudococcid type of endosymbiosis. Buchner (1957, 1969) apparently studied symbionts of *Eumyrmococcus* (without mentioning the species) and commented that these are a pseudococcid type, near those of *Phenacoccus* Cockerell.

Rhizoecinae live underground, mostly feeding on rootlets. Many species have only been collected from Berlese funnel apparatus but many are known from leaf litter and rotting logs. The only aerial habit reported is that of *Rhizoecus mexicanus* (Hambleton) on leaves of *Zygocactus truncatus*; otherwise this mealybug normally feeds on cactus roots (Hambleton, 1979).

Species of many genera of Rhizoecinae are associated with ants of the genus *Acropyga* Roger which attend the mealybugs and feed on their excreted honeydew. The association may be an old one because some of these ant species are known to be obligate coccidophiles and many of the mealybug species are probably obligate myrmecophiles, although some mealybug species reported with ants are capable of living without them. *Rhizoecus coffeae* Laing is a pest of coffee in Brazil where it lives on the roots in association with *Acropyga (Rhizomyrma) paramibensis* Borgmeier (Bünzli, 1935). The mealybug is well protected from excessive change in dryness and wetness caused by the weather because the nests are well drained and the mealybugs are capable of moving to suitable feeding sites. According to Bünzli, the situation is different from that of the ant-free mealybugs. Flanders (1957) reported that the myrmecophilous mealybug *Eumyrmococcus (= Neochavesia)* sp. only feeds on roots exposed by the ant *A. (Rhizomyrma) fuhrmanni* Forel and that the number of mealybugs feeding at any one time is regulated by the ant.

Ants associated with *Eumyrmococcus* and *Xenococcus* are also species of *Acropyga* and these mealybugs have been collected within the ants' nests, in ant tunnels, or from the mandibles of flying queens. A few *Eumyrmococcus* species described here as new, have been collected without ant data or simply labelled 'with ants' but it is reasonable to suggest that all these mealybugs may be associated with *Acropyga* (see list of *Acropyga*-Rhizoecinae associations p. 30).

When carrying mealybugs in the mandibles, ants grip species of *Rhizoecus* and *Geococcus* at a point near the metathorax (Bünzli, 1935). Ants apparently grasp individuals of *Eumyrmococcus* at the dilated cephalothorax (Roepke 1930; Prins 1982; Buschinger *et al.*, 1987).

Ants of the genus *Acropyga* are discussed here in the four subgenera listed by Bolton (1995a). Some of the unidentified species of Australasian *Acropyga* may be undescribed if not discussed by Taylor and Brown (1985) or Taylor (1992). Of the 56 species of *Acropyga*, about half occur in the Neotropical Region and the remainder are distributed mainly in the Indo-Australasian Region, with a few described from the Palaearctic, Afrotropical and Oriental Regions (Bolton, 1995b). This ant distribution appears to be correlated with the number of mealybug species found in these regions. A few non-rhizoecine mealybugs may be associated with *Acropyga* in South America (Bünzli, 1935), and it seems unlikely that species of *Acropyga* in other regions will not exploit mealybug trophobionts in other subfamilies.

Bünzli (1935) has listed *R. coffeae, R. caladii* Green, *R. moruliferus* Green (= *R. falcifer* Künckel d'Herculais), *Geococcus coffeae* Green, *Pseudorhizoecus proximus* Green and *Capitisetella migrans* (Green) as attacking coffee roots in Brazil. All the indigenous host plants of these mealybugs are grasses, and Bünzli has shown that the mealybugs have migrated to the new host plant *Coffea liberica*.

Other rhizoecine mealybugs associated with *Acropyga* in South America, attacking economic plants, are *Neochavesia caldasiae* (Balachowsky) on roots of coffee in Colombia, *N. eversi* (Beardsley) on roots of banana in Panama, and *N. trinidadensis* (Beardsley) on roots of cacao in Trinidad.

In India, Dr C.A. Viraktamath, University of Agricultural Sciences, Bangalore, has sent specimens of *X. acropygae* sp. n., that were feeding on the rootlets of grape, causing a severe reduction in yield. The mealybug also attacked many weed species in the vicinity of the vines.

LIFE CYCLES

In the family Pseudococcidae, there are usually four instars in the female and five in the male. Normally the female is regarded as neotenic and all instars feed. In the male, feeding is restricted to the first two instars followed by the non-feeding prepupa, pupa and adult. Koteja (1985) suggests that loss of wings in the female occurred only once and was an adaptation to the original leaf-litter or hypogeic habitat. Normally adult males are much smaller than the adult female. Koteja (1985) hypothesizes that in the original leaf litter, small males were able to crawl among soil particles to reach the females. This small size could be realized only by a cessation of feeding, i.e. at the end of the second instar. In order for the males and females to emerge simultaneously, the last male instars became resting and non-feeding instars known as the prepupa and pupa.

The life cycles of *Rhizoecus* and near relatives are virtually unknown. Bünzli (1935) discusses four female instars in *R. coffeae* and three male instars but he may have overlooked the pupal instars. Schmutterer (1952) discusses four female instars in *R. albidus* Goux in Germany and mentions nymphs and adults in the male without further details.

The adult males in some of the *Rhizoecus* group are wingless and morphologically degenerate but in other species they are winged (Schmutterer, 1952; Beardsley, 1962). Surprisingly, winged males in slide collections of *Rhizoecus* are not uncommon (D.R. Miller, personal communication).

The first record of a female pupal instar was described by Williams (1988) for the genus *Xenococcus*. This instar replaces the normal third or feeding instar and probably acts as a resting stage for the female to develop in the presence of attending ants. A similar type of pupa has now been found and is discussed here in at least five species of *Eumyrmococcus*.

Unfortunately, no first-instar nymphs of *Eumyrmococcus* are known from any of the material at hand except for a single specimen still within the egg membrane. This first-instar nymph is densely covered in short setae and shows unusual developmemt of many characters as in the first instar of *Xenococcus* (Fig. 24). Second-instar nymphs are available in 11 species of *Eumyrmococcus* but these remain unsexed. Normally second-instar mealybugs show strong dimorphism, with the second-instar male usually possessing more tubular ducts and pores to form a waxy covering for the prepupa and pupa. These characters are usually absent or fewer in the second-instar female. In *Eumyrmococcus*, the female pupal instar and the male prepupal and pupal instars are without any coverings and any sexual differences in the second instar are not apparent.

Female pupae show a well developed labium and this is evidenced by at least four species of female pupae with the developing adult female still inside (Fig. 1B). It is thus easy to separate female pupae from male prepupae and pupae which lack the well developed labium (Figs 21, 25). Male prepupae are available with the developing pupae still inside and pupae are at hand with the developing adult male inside just before the final moult (Fig. 1A). All female pupae, and male prepupae and pupae, lack dermal structures such as pores and setae. Unlike most male pupae in the Pseudococcidae, which usually possess longer limbs and antennae than those of the prepupae, these characters in the pupa of *Xenococcus* are shorter, presumably in preparation for the adult male which possesses minute tubercle-like antennae and short legs.

Studies of the adult male of *Rhizoecus* are remarkably few. Beardsley (1962) described the adult male of *R. falcifer* in detail and showed that the head bears only two pairs of eyes and lacks the normal lateral ocelli. Furthermore, the head is not separated from the thorax by a constricted neck. The penial sheath, according to Beardsley, is related to that of *Phenacoccus* Cockerell. Similar features are present in the male of *R. albidus* as shown by Schmutterer (1952).

The adult male of *Neochavesia eversi* (Beardsley) is morphologically degenerate, without wings, eyes or thoracic sclerotization, and the penial sheath and aedeagus resemble those of *Puto* (Beardsley, 1970). Adult males of three species of *Eumyrmococcus* are available, one of which is not described here because no adult females were collected. The males are disparate. All are without eyes, wings and thoracic sclerotization and possibly resemble males of *Neochavesia*. The genital capsule in the Australian species studied, possesses a long dorsal style and a long pointed aedeagus. It is not clear why there should be such development when the tip of the female abdomen is normally curled dorsally, presenting easy access. Adult males of *E. sarawakensis* sp. n. are elongate, curled ventrally, with most of the genital capsule internal. Both the male and female in any one species of *Eumyrmococcus* are about the same size.

Peculiar development in the adult male of *Xenococcus* is described on p. 24. The legs are placed at the anterior end of the body and the claws have the strangest development known in any scale insect, with apparent digitules larger and stouter than the actual claw.

PARASITISM

Of about 160 species described in the subfamily Rhizoecinae, only a single record of a parasitoid has been published. Schmutterer (1952) reported a very effective chalcid parasitising *R. albidus* Goux in Germany. The parasitoid was recorded later as *Anomalicornis tenuicornia* Mercet (Hymenoptera: Encyrtidae) by Ferrière (1956), a fairly common Old World species.

The Encyrtidae have successively parasitised the other three mealybug subfamilies Trabutininae, Pseudococcinae and Sphaerococcinae recognized by Koteja (1974a, 1974b) as evidenced by the host parasitoid index of encyrtid parasitoids of mealybugs in Noyes and Hayat (1994). The views of Koteja (1984, 1985) that *Rhizoecus*, which we may substitute as the Rhizoecinae, could have spent the whole of their phylogeny underground, may be a reason for the lack of parasitism. Many of the mealybugs in the other three subfamilies live underground or are concealed and are known to be parasitised. The hypogeic habit is, therefore, not a barrier. Many Rhizoecinae have a symbiotic relationship with ants which could successfully exclude parasitoids but conversely many Rhizoecinae are not associated with ants. Parasitoids may not recognize rhizoecine mealybugs as suitable hosts. J.W. Beardsley (personal communication) has commented that the Rhizoecinae may have branched off from the main mealybug lineage before the evolution of the Encyrtidae and may not be recognized as normal encyrtid hosts. It is possible, however, that parasitoids have simply not been collected from the Rhizoecinae.

MORPHOLOGY OF *EUMYRMOCOCCUS* AND *XENOCOCCUS* (ADULT FEMALES)

BODY. All descriptions of the adult female in life indicate that the cephalothorax is strongly dilated, or shows some sign of dilation, with a narrow tapering abdomen which curls dorsally. When prepared on microscope slides, the anal lobes are poorly developed and are recognizable by infolding on both the dorsum and venter with the apex of each lobe bearing three long setae, collectively referred to here as anal lobe setae. In *E. neoguineensis* sp. n., each lobe has 8 anal lobe setae and in *E. lanuginosus* sp. n., the anal lobe setae are not differentiated from other setae on the anal lobes. Usually there are 3 anal lobe setae that are long and stout at the bases with wide setal collars. They are similar to those in many other genera of the Rhizoecinae. In *Eumyrmococcus* and *Xenococcus*, there are usually one ventral and two dorsal setae on each anal lobe but occasionally two are placed ventrally and one dorsally.

ANAL RING. The anal opening projects slightly between the anal lobes and the anal ring is normally simple with a crescentic sclerotized band without cells. Three pairs of anal ring setae appear to be usual but occasionally there are 4–7 pairs. The anal ring setae are normally detached from the anal ring, lying just anterior to it except in *E. corinthiacus* Williams, which possesses 4 pairs, apparently attached to the outer edge of the ring. In all species the anterior pair of setae are short and slender, the second pair either the same length as the anterior pair or longer, and the posterior pair often long and stout, sometimes as long as the anal lobe setae.

ANTENNAE. The antennae are 2–4-segmented and differ in shape and position. In *E. lanuginosus*, they are 2-segmented, short and tubercle-like. In most species of *Eumyrmococcus* the antennae are 2-segmented, with a short basal segment and a long tapering second segment. They are placed fairly wide apart on either the ventral or dorsal margin of the head. In *E. sarawakensis* sp. n. and *E. sulawesicus* sp. n., the antennae are situated well on the dorsum of the swollen cephalothorax. The 4-segmented antennae of *E. neoguineensis* are unusual in possessing spine-like setae on the leading edge. *Xenococcus* has 4-segmented antennae that are long, sometimes as long as the body, with strong articulation between the first and second segments. The second segment is provided with small points at the proximal end which fit into grooves at the distal end of the first segment. This articulation allows the antennae to fold against the dorsum of the body. A pair of peg-like setae are present at the tip of each fourth segment.

LEGS. The legs are always well developed with few setae. The setae are stout and flagellate but sometimes a few on the outer edge of the femur in *Eumyrmococcus* are blunt and sensory. In *Xenococcus*, the leg setae may be unusually long on the distal end of the femur, almost as long as the femur. In most species the tibia is swollen distally before narrowing towards the tarsus. The tarsus is usually swollen near the base then tapers gradually, sometimes for nearly half its length. In one species of *Xenococcus*, the tibia and proximal end of the tarsus are straight. The claw in *E. scorpioides* (De Lotto) is broad but in all other species it is long, pointed and slender with a pair of short setose digitules. These digitules are difficult to discern in some species except for the bases. A campaniform sensillum is present at the base of all tarsi.

EYES. These are completely absent in all species of *Eumyrmococcus* and *Xenococcus*.

LABIUM. In most species the labium is narrow with 3 segments, often longer than the clypeolabral shield. The setae on the anterior surface of the apical segment are often widely spaced and the subapical setae are sometimes reduced to 3 pairs. A few species possess 2 pairs of setae on the clypeolabral shield.

CEPHALIC PLATE. This sclerotized area on the frons in many species of *Rhizoecus* is not apparent in any species of *Eumyrmococcus* or *Xenococcus*.

CIRCULI. The type species of *Eumyrmococcus, E. smithii* Silvestri, is the only species studied without a circulus. In other species the circuli number 1–3, situated within the borders of the segments. When only a single circulus is present it is situated either on abdominal segment II or III. When 2 are present they lie on abdominal segments II and III, and a third in *Eumyrmococcus* is sometimes present on the metathorax. In *Xenococcus*, when a third is present, it lies on abdominal segment IV. Each circulus is round and may be small (the smallest studied only 8.75 µm in diameter) or unusually large (up to 85.0 µm in diameter). The outer edge of each circulus may be flat or raised slightly from the surrounding derm. In one species the circulus is almost conical but the centre in all circuli is cupped, sometimes deeply in *Eumyrmococcus*, or shallowly in *Xenococcus*, so that the circulus resembles a crater. A similar type of circulus is present in *Neochavesia*, and Beardsley (1970) has cautiously termed these 'circulus-like projections'. The form of the circulus in all these genera is different from that of other genera in the Rhizoecinae which possess circuli that are usually truncate-conical with the centre part flat and often reticulate or faveolate.

A function of the circulus as an adhesive organ has been demonstrated for *Pseudococcus adonidum* (L.) (=*P. longispinus* (Targioni Tozzetti)) and *Planococcus citri* (Risso) by Pesson (1939) and in other species by Lloyd and Martini (1957). Ferris & Murdock (1936), from histological sections, discussed the circulus in *Pseudococcus maritimus* (Ehrhorn) as a secretory organ. Pesson (1939), in a detailed study, found that the circulus of *Pseudococcus* is an exsertile organ, lacking secretory pores between the organ and the cuticle and that the epithelium is only a part of the hypoderm. The epithelium is responsible for the formation of the peripheral chitin, which protects it, and of a mucin which hardens after secretion. In the circulus, the substance secreted appears to be a chitin which remains soft longer with the gluey properties of a mucin and hence gives the circulus adhesive properties. It is easy to see the exsertile action of the circulus, according to Pesson, by placing the mealybug on a microscope slide so that it has difficulty in taking hold with its claws. The mealybug can then hold on to the surface by the circulus.

It is not clear if the circulus of *Eumyrmococcus* and *Xenococcus* has the same function as those studied above. Silvestri (1924) studied histological sections of the circulus of *X. annandalei* and concluded that there are numerous elongate-pyriform cells directly under the shallow central cup. Silvestri thought that the circulus secretes some kind of liquid which may be attractive to the ants attending the mealybugs. Any exsertile properties of the circulus in *Eumyrmococcus* and *Xenococcus*, or even in any Rhizoecinae, remain unproved. The term circulus is retained for the species under discussion.

OSTIOLES. These structures are always absent in *Eumyrmococcus, Xenococcus* and *Neochavesia* but are usually well defined in some other genera of the Rhizoecinae.

SETAE. One of the striking characters of *Eumyrmococcus* and *Xenococcus* is the abundance of short setae on the dorsum of the abdomen. They extend to the venter of the abdomen in *Eumyrmococcus* and may be present on the head and thorax of both surfaces. In *Xenococcus*, they extend to the head and thorax of the dorsum and to the ventral lateral margins of the head and thorax. They lie in well defined bands across the segments leaving clear areas on the intersegmental lines. Normally these setae are flagellate, often slightly curved, but in *E. falciculosus* sp. n., they are mostly sickle-shaped, and in *Xenococcus*, there are patches of sickle-shaped setae among the flagellate setae on the dorsum of the thorax.

Stout and longer flagellate setae are usually present on the mid-venter of the thorax. In *Xenococcus*, these extend to the entire venter of the abdomen also. Sensory setae are sometimes present in *Eumyrmococcus*. These are slightly swollen at the apices and may be the only setae present on the head and thorax in some species. In other species, they are either long or short and sometimes mingle with the short, flagellate setae. The sensory setae may also be lanceolate or extremely minute and can be detected with certainty only by oil-immersion studies. Some short setae in *E. neoguineensis* are set in dermal pockets, forming clusters on the venter of the thorax.

MICROTRICHIA. Elongate microtrichia, resembling setae, are so abundant in some species that they almost completely cover the insect so that the setae are obscured. The setae in these species are only recognizable by the presence of setal collars. At present, species with dense microtrichia are only known from the more equatorial areas, Sumatra, Sarawak and Sulawesi.

PORES AND DUCTS. Some genera of Rhizoecinae contain species possessing trilocular pores, multilocular disc pores and tubular ducts. Normally, trilocular pores secrete fine wax to protect the surface from contamination by the insect's own honeydew. Excreted honeydew balls are often coated with this wax. Multilocular disc pores secrete wax to help in the production of ovisacs or to protect eggs. They are sometimes present in second-instar males to secrete wax in the formation of the cocoon (Cox and Pearce, 1983).

Tubular ducts in the Rhizoecinae are usually small, often narrower than the trilocular pores. Normally, tubular ducts in the adult female secrete wax to form the ovisac, or in the second-instar male, to help form a cocoon.

Pores and ducts are completely absent in *Eumyrmococcus* and *Xenococcus*. Honeydew excreted is probably taken entirely by the ants without need for the mealybugs to secrete wax as an anti-contaminent. Apparently the species are ovoviviparous and first-instar nymphs would be protected and transported by ants along with any other instars. Second instars lack pores and ducts and succeeding male prepupae and pupae are not enclosed in cocoons. The dense covering of short setae on the abdomen of all species and the complete covering of microtrichia in some species may help to protect the mealybugs from any possible contamination of honeydew and from excessive humidity in the nests and tunnels formed by the ants.

In *Neochavesia*, trilocular pores are found in the type species only but these pores are unlike any other trilocular pores in possessing a minute filament at the centre. Normal trilocular pores and tubular ducts are present in *Leptorhizoecus* gen. nov. (Fig. 28).

GENERA AND SPECIES

Eumyrmococcus and *Xenococcus* are closely related and it could be argued that *Xenococcus* is a subordinate clade within *Eumyrmococcus*. Both genera occupy similar geographical areas in southern Asia and Australasia (Figs 29, 30) and the species in both genera are mostly associated with specific ants of the same genus (p. 30). *Xenococcus* possesses unusual 4-segmented antennae, almost as long as the body, with remarkable articulationn between the first and second segments. In *Eumyrmococcus*, the antennae are much shorter and lack this special articulation. Furthermore, all species of *Eumyrmococcus* have a dense covering of short setae on both the dorsum and venter of the abdomen. In *Xenococcus*, short setae are restricted to the dorsum of the abdomen only and any ventral abdominal setae on the abdomen are long and stout. Although both genera have many shared characters, the genera are regarded here as distinct, in the interests of nomenclatural stability, pending future cladistic studies. A key to separate both genera is included in the general key on p. 30.

Some species of *Eumyrmococcus* share a large type of circulus, others a small type, and two species lack any type. Although it may be possible to recognise species-groups based on the type of circulus, the circulus is not a stable character in some other genera of Rhizoecinae when any single species may possess 0–2 (Williams, 1996).

Species-groups could be recognised on other characters. The *E. smithii*-group contains species with abundant short flagellate setae covering the dorsum and venter and lacking any sensory setae. In addition to the type species, *E. smithii*, this group also contains *E. kolombangarae* and *E. kusiacus*. Another group, found near the equator, comprises *E. kruiensis, E. lanuginosus, E. maninjauensis, E. sarawakensis* and *E. sulawesicus*. All are densely covered in elongate microtrichia. In possessing similar 4-segmented antennae, *E. corinthiacus* in Europe, is probably related to *E. scorpioides* from South Africa even though the claws in *E. scorpioides* are stout and different from the long slender claws in any other species. The Australian species, *E. lamondicus, E. queenslandicus, E. recalvus* and *E. taylori* appear to be related to the Japanese species, *E. nipponensis*. All possess similar 2-segmented antennae, with the second segment elongate and tapering, and with elongate posterior setae on the anal ring.

Most of the abundant abdominal setae in *E. falciculosus* are sickle-shaped, unlike the setae in any other species, although similar setae are present in small numbers in both species of *Xenococcus*. A final species, *E. neoguineensis*, has an unusual combination of characters. The 4-segmented antennae are the longest of any species and, although the articulation between the first and second segments is normal, these antennae possibly come nearest in structure to those of *Xenococcus*. Furthermore, the anal lobes in *E. neoguineensis* contain numerous setae and the body shape is unusual, without such a marked dilated cephalothorax. This species may form a distinct group.

The two adult males described here in *Eumyrmococcus* are so disparate that if discovered without accompanying adult females, it would be difficult to place them in the same genus. The difference between these adult males is as great as the difference between either and the adult male of *Xenococcus acropygae*. Similar differences in male morphology are expected among the different species-groups of *Eumyrmococcus* discussed here.

Eumyrmococcus Silvestri

Eumyrmococcus Silvestri, 1926: 271.

Type species *Eumyrmococcus smithii* Silvestri, by original designation.

Description

Adult female. Body pyriform, broadly pyriform, or elongate-pyriform, with cephalothorax usually strongly dilated, often constricted between second and third abdominal segments, then abdomen tapering to narrow abdominal segment VIII. In life, tip of abdomen curled dorsally. Posterior end rounded, anal lobes not developed but recognizable by inner edges slightly grooved, each lobe usually terminating in long, stout flagellate setae forming a group of 3, sometimes nearly as long as body, sometimes stout and short or in groups of numerous slender flagellate setae. Antennae each with 2–4 segments, placed fairly wide apart on venter of head margin or displaced to dorsum of head when prepared on microscope slides; terminal segment usually tapering, sometimes tubercle-like or long and slender. Legs well developed, tibia and tarsus subequal in length, tarsus swollen from joint with tibia then tapering to narrow distal end, all segments with fairly stout flagellate setae, set well apart; occasionally with sensory setae on outer edges of femur and tibia. Claw normally long and slender, pointed, except in one species with claw relatively stout at base; each with a pair of short, slender setose digitules but these difficult to recognise in some species. Labium longer than wide, often with 3 pairs of subapical setae, widely spaced. Clypeolabral shield with 1 or 2 pairs of setae. Anal ring dorsal, sclerotized, usually crescentic except in one species when circular; simple, without cells; with normally 3 pairs of setae; first 2 pairs usually detached, lying just anterior to ring, second pair sometimes longer than anterior pair, posterior pair sometimes stout and as long as anal lobe setae; sometimes ring with 4–7 pairs of setae, variously placed. Circuli present or absent; when present numbering 1–3, all round, small to unusually large and conspicuous, always deeply cupped.

Body setae short and abundant, at least on abdomen, sometimes present on entire body, usually flagellate but sometimes most abdominal setae replaced by sickle-shaped setae.

Setae on head and thorax often longer and stouter. Sensory setae, either lanceolate or with slightly swollen blunt tip, sometimes distributed over entire body with the flagellate setae, or situated at anterior end of body only: occasionally minute bulbous setae present. Microtrichia sometimes present, covering entire body, these often nearly as long as setae giving the insect a woolly appearance and often masking the short body setae. Ostioles absent. Tubular ducts, multilocular disc pores and trilocular pores absent.

First instar. Well clothed in short setae as evidenced by single specimen still within egg membrane.

Second instar. Similar to adult female but with fewer setae and usually shorter antennae and legs.

Female pupa. Recognizable by elongate labium, antennae showing segmentation, legs well developed.

Male prepupa and pupa. Similar to female pupa but with shorter limbs and antennae. Labium not developed.

Adult male. Wingless and morphologically degenerate, of diverse appearance. Genital capsule well developed, either exposed or mostly enclosed within abdomen; when exposed, with conspicuous anal opening and dorsal style, penial sheath rounded apically, ventral slit rounded near base then widening apically, basal ridge of penial sheath well defined ventrally, aedeagus long and pointed. Posterior edge of abdominal segment VIII forming possible anal ring as in female, with 3 pairs of setae. Legs well developed, slender. Body setae numerous. Antennae 2-segmented. Eyes absent. When genital capsule mostly enclosed within abdomen then ventral slit almost square, anal opening oval at posterior end of abdomen at base of sclerotized extension, possibly representing a short style. Legs squat. Antennae short, 2-segmented. Body almost naked except for a few minute setae.

COMMENTS. The description of the adult male is based on two species and another still within the pupal instar. The wide disparity in shape and form may indicate a much wider range of variation.

Key to Species of *Eumyrmococcus* (Adult Females)

1 Antennae 4-segmented 2

– Antennae 2-segmented 4

2 Anal lobe setae in groups of 3. Anal ring with 6–8 pairs of setae 3

– Anal lobe setae in groups of 8 or 9. Anal ring with 10 pairs of setae (Fig. 10) .... *neoguineensis* (p. 14)

3 All setae on head, thorax and abdomen, minute and flagellate. Claw elongate, slender (Fig. 2) .... *corinthiacus* (p. 10)

– Most setae on head and thorax sensory, blunt, expanded apically, only abdominal setae flagellate. Claw stout and short (Fig. 16) .... *scorpioides* (p. 19)

4 Surface of body densely covered in minute hair-like microtrichia in addition to abundant slender setae 5

– Surface of body not densely covered in minute hair-like microtrichia. Abundant setae present only, although there may be a few stout microtrichia present in some areas 9

5 Anal lobe setae not differentiated from other setae on anal lobes. Antennae each with segment 2 short, scarcely longer than segment 1 (Fig. 8) .... *lanuginosus* (p. 13)

– Anal lobe setae in groups of 3 on each anal lobe. Antennae each with second segment noticeably longer than first segment 6

6 Anal lobe setae and posterior anal ring setae short, about 70–75 µm long. All setae flagellate, blunt sensory setae absent (Fig. 5) .... *kruiensis* (p. 11)

– Anal lobe setae and posterior anal ring setae much longer, each 220–525 µm long. Blunt sensory setae present, at least on head, thorax and outer edges of legs 7

7 Antennae distinctly placed dorsally on microscope preparations. Blunt sensory setae present on dorsum of head and thorax in addition to short minute flagellate setae 8

– Antennae distinctly placed ventrally on microscope preparations. Blunt sensory setae absent from dorsum of head and thorax, only short minute flagellate setae present (Fig. 9) .... *maninjauensis* (p. 14)

8 Long, blunt sensory setae, at least 17.5–22.5 µm long, present on dorsum anterior to antennae only, near to head margin. Shorter blunt setae present on dorsum posterior to antennae on thorax and abdominal segment I (Fig. 14) .... *sarawakensis* (p. 18)

– Long blunt sensory setae, at least 45–50 µm long, more numerous on dorsum, present anterior and posterior to antennae. Shorter blunt setae absent from dorsum on thorax and abdominal segment I (Fig. 18) .... *sulawesicus* (p. 20)

9 Most setae on abdomen short, stout and sickle-shaped (Fig. 3) .... *falciculosus* (p. 10)

– Most setae on abdomen short and flagellate, sickle-shaped setae absent 10

10 Blunt sensory setae present, in addition to dense, short flagellate setae 13

– Blunt sensory setae absent, dense, short flagellate setae present only 11

11 Circuli absent. Anal lobe setae and posterior anal ring setae long, at least 500 µm long (Fig. 17) .... *smithii* (p. 19)

– Circuli present, small, on abdominal segments II and III. Anal lobe setae and posterior anal ring setae much shorter, at most 65–100 µm long 12

12 Long, stout flagellate setae, at least 80–90 µm long, present in rows at posterior edges of dorsal and ventral abdominal segments, these in addition to abundant minute flagellate setae (Fig. 6) .... *kusiacus* (p. 12)

– Long, stout flagellate setae shorter, at most 35 µm long, present medially on venter of abdomen only, in addition to abundant minute flagellate setae (Fig. 4) .... *kolombangarae* (p. 11)

13 Most sensory setae lanceolate 14

– All sensory setae blunt and expanded apically 15

14 A single circulus present only, on abdominal segment III, wide and conspicuous, at least 52–60 µm wide. Slender, blunt sensory setae present on dorsum and venter of abdominal segment II (Fig. 12) .... *queenslandicus* (p. 16)

– Two circuli present, these on abdominal segments II and III, small, at most 11.0–12.5 µm wide. Slender, blunt sensory setae absent from abdominal segment II (Fig. 7) .... *lamondicus* (p. 12)

15 Short slender setae abundant on head and thorax. Obanal setae stout and long, about as long as anal lobe setae. A single circulus present, this on abdominal segment III (Fig. 11) .... *nipponensis* (p. 15)

– Short slender setae sparse on head and thorax. Obanal setae short and slender. Two circuli present, these on abdominal segments II and III 16

SPECIES DESCRIPTIONS

Eumyrmococcus corinthiacus Williams

(Fig. 2)

Eumyrmococcus corinthiacus Williams, 1993: 218. Holotype adult♀, Greece, Corinth (BMNH) [examined].

DISTRIBUTION

Greece: Corinth, Perachora, near Lautraki, carried by swarming ant *Acropyga* sp., 7.x.1985 *(A. Buschinger)*; without locality, carried by queens of *Acropyga* sp. during mating flight, x. 1992 *(W.H.O. Dorow)*.

COMMENTS. This species was described recently by Williams (1993). Important characters are the 4-segmented antennae and thick setae in groups of 3 on the anal lobes, 2 in each group distinctly longer and stouter than the other. The dorsal and ventral setae are abundant, all flagellate, becoming less numerous on the thorax and head. As in other species, the circulus is concave and cup-shaped when viewed laterally.

The original material, the first known from Europe, was sent for identification by Professor A. Buschinger, Institut für Zoologie Technische Hochschule, Darmstadt, Germany. When discussing the habit, Buschinger *et al.*, (1987) recorded the ant as *Plagiolepis* sp. and this name was used by Williams (1993). Professor Buschinger (personal communication) has since indicated that the ant is actually a species of *Acropyga*. The most likely species is *A.(Rhizomyrma) paleartica* Mennozzi, the only species known in Greece.

The accompanying figure first appeared in the Entomologist's Gazette and is reproduced here from the original illustration with slight modification.

Eumyrmococcus falciculosus sp. n.

(Fig. 3)

DESCRIPTION

Adult female on microscope slide membranous, elongate, largest specimen 1.15 mm long, 0.50 mm wide, widest at about mesothorax; head and thorax rounded, constricted slightly between abdominal segments II and III, abdomen tapering and narrowing between abdominal segments VII and VIII, posterior end of body rounded, abdominal segment VIII 200 µm wide at base. Positions of each anal lobe with 2 stout dorsal setae, each about 188µm long, and 1 ventral seta about 125µm long, forming a group of 3. Antennae situated on ventral head margin, each 65–77 µm long, with 2 segments; basal segment wide, second segment tapering. Legs well developed, slender; hind trochanter + femur 115–118 µm long, hind tibia + tarsus about 100µm long, claw slender, about 20 µm long. Ratio of lengths of hind tibia + tarsus to hind trochanter + femur 0.84–0.86. Ratio of lengths of hind tibia to tarsus 0.73–0.81. Tibiae swollen then tapering, tarsi widening near base then narrowly tapering. Leg setae pointed. Labium about 117–125 µm long, as long as clypeolabral shield, 77–80 µm wide; ratio of length to width 1.51–1.56. Circulus present, distorted in available specimens but at least 50 µm wide, situated near middle of abdominal segment III. Anal ring about 75 µm wide, with 6 slender setae, the anterior pair each about 32.5 µm long, the second and posterior pairs longer but not complete in available material.

Dorsal surface with unusual sickle-shaped setae, fairly crowded, present as far forward as abdominal segment III, those posteriorly on abdominal segment VIII each about 20 µm long, others on abdomen mostly 12.5 µm long. A few flagellate setae each 12.5 µm long, present among the sickle-shaped setae. Setae on head, thorax and abdominal segments I and II, curved but fairly stiff and pointed, mostly about 15 µm long, moderately numerous. Thicker sensory setae, each bluntly tipped and with large setal collars, few, distributed mainly around margins.

Ventral surface with a similar distribution of sickle-shaped setae, pointed setae and thick sensory setae, to those on dorsum. A few long, stout sensory setae present in medial area of thorax.

MATERIAL

HOLOTYPE. Adult ♀, **Indonesia: Sumatra**, Krui, Kubu Prau, among primary forest litter, 800 m, 29.v.1991 *(L. Deharveng & A. Bedos)* (MNHN).

PARATYPE. **Indonesia: Sumatra**, same data as holotype. 1 adult ♀ (BMNH).

Non-type material, **Indonesia**: Sumatra, Jambi Province, Rantau Pandan, in soil in *Hevea* plantation, 9.vi.1991 *(L. Deharveng & A. Bedos)*.

COMMENTS. This is a curious species with peculiar sickle-shaped setae on the abdomen and short 2-segmented antennae. It has no close relatives thus far discussed here. The antennae are similar to those of *E. lanuginosus* sp. n., also described from Sumatra, but *E. lanuginosus* is extensively clothed in long microtrichia whereas in *E. falciculosus* any microtrichia are short and barely perceptible.

The specimen recorded from Rantau Pandan is extremely poor but is recognisable as this species by the sickle-shaped setae.

The epithet '*falciculosus*' is based on the Latin word '*falcicula*' meaning small sickle, and the Latin suffix '*-osus*' meaning 'abundance of', referring to the numerous setae of this shape.

Eumyrmococcus kolombangarae sp. n.

(Fig. 4)

Description

Adult female on microscope slide broadly oval, about 0.90 mm long, 0.60 mm wide, widest at mesothorax, tapering to a constriction between abdominal segments VII and VIII, base of abdominal segment VIII 180 µm wide. Posterior end of body rounded; positions of each anal lobe with 2 ventral setae and 1 dorsal seta forming a group of 3, each seta about 80 µm long. Antennae lying on ventral head margin, each about 110 µm long, with two segments, the second tapering. Legs well developed; hind trochanter + femur about 168 µm long, hind tibia + tarsus 142 µm long, claw slender, unusually long, about 45 µm long. Ratio of lengths of hind tibia + tarsus to hind trochanter + femur 0.84. Ratio of lengths of hind tibia to tarsus 1.84. Tarsi each swollen near base then tapering to narrow distal end. All leg setae stout and flagellate. Labium distorted in available specimen but at least 100 µm long and fairly wide, about as long as clypeolabral shield. Circuli numbering 2, each about 15 µm wide, situated near posterior edges of abdominal segments II and III but within borders of segments. Anal ring about 75 µm wide, with 6 setae, each about 65 µm long.

Dorsal surface with crowded flagellate setae occupying most of surface except for well marked intersegmental areas; setae on abdominal segment VIII mostly 15 µm long, anteriorly about 12.5 µm long; a few setae on any segment with larger setal collars.

Ventral surface with crowded setae as on dorsum except in medial area of thorax where they are longer and not numerous. Long stout setae, each about 35 µm long, present in pairs near mid-line of abdominal segments II–VII.

Material

Holotype. Adult ♀, **Solomon Islands**: New Georgia Group, Kolombangara, E. Kusi, 600 m, associated with *Acropyga lauta* in log, 30.viii.1965 *(Isiah)* (ANIC).

Paratypes. **Solomon Islands**: same data as holotype, 1 2nd instar (ANIC), 1 ♀ pupa (ANIC), 1 ♀ pupa (BMNH).

Comments

This species is related to the type species *E. smithii* in the arrangement of the densely crowded flagellate setae, at least on the dorsum, but differs in possessing two small circuli. *E. smithii* lacks circuli completely. Furthermore, in *E. kolombangarae*, the anal lobe setae are at most only 80 µm long and the posterior anal ring setae are about 65 µm long, whereas in *E. smithii*, these setae are noticeably much longer, at least 500 µm long.

E. kolombangarae is very close to *E. kusiacus*, herein described, differing mainly in lacking long stout setae in rows at the posterior edges of the dorsal and ventral abdominal segments. In *E. kolombangarae*, long stout setae are present in pairs only near the midline of the venter of abdomen.

The description of this species has also been based on an almost perfect adult female still within the pupal instar. A single second instar is also available. This is similar to the adult female, differing mainly in having shorter limbs, a single circulus present on abdominal segment III, and in the body setae which are not so dense.

The epithet is based on the Latin genitive of the place name meaning 'of' or 'from'.

Eumyrmococcus kruiensis sp. n.

(Fig. 6)

Description

Adult female on microscope slide, elongate, membranous 0.81mm long, 0.38 mm wide, widest at mesothorax, abdomen gradually tapering, slightly constricted between abdominal segments VII and VIII, base of abdominal segment VIII 120 µm wide, posterior end of body fairly straight. Positions of each anal lobe with 2 stout dorsal setae and 1 ventral seta, each about 70 µm long, forming a group of three. Antennae placed on ventral head margin, each 82.5 µm long, with 2 segments, the second segment 60 µm long, tapering. Legs well developed; hind trochanter + femur about 117.5 µm long, hind tibia + tarsus 95 µm long, claw slender, about 27.5 µm long, 5 µm wide at base. Ratio of lengths of hind tibia + tarsus to hind trochanter + femur 0.80. Ratio of lengths of hind tibia to tarsus 1.11. Tibiae swollen then tapering to narrow distal ends. All legs with stout flagellate setae. Labium about 92.5 µm long, same length as clypeolabral shield, 65 µm wide; ratio of length to width 1.42. Circulus large, about 45 µm wide, situated near posterior end of abdominal segment III but within borders of segment. Anal ring about 70 µm wide, with 6 setae; anterior and middle pairs slender, each 25–37 µm long, posterior pair stout, each about 75 µm long, similar to anal lobe setae.

Dorsal surface densely covered in hair-like microtrichia and slender flagellate setae except for intersegmental areas. Most setae on abdominal segment VIII about 15 µm long, those on anterior abdominal segments 10.0–12.5 µm long, most on head and thorax 5.0–12.5 µm long.

Ventral surface with similar microtrichia and setae to those on dorsum; on abdominal segment VIII, some setae as long as 40 µm, most other setae on abdomen about 25 µm long, marginal areas of head and thorax with short slender setae each about 12.5 µm long. Long, stout flagellate setae, each 25–30 µm long, with large setal collars, present on head and submarginal and medial areas of thorax.

MATERIAL

HOLOTYPE. Adult ♀, **Indonesia, Sumatra**, Krui, Pahmungan, in soil of dammar plantation, 23.v.1991 *(L. Deharveng & A. Bedos)* (MNHN).

PARATYPES. **Indonesia, Sumatra**, same data as holotype, 3 2nd instars (MNHN), 2 2nd instars (BMNH).

COMMENTS. This is a distinctive species within the group extensively clothed in hair-like microtrichia. The stout setae in groups of three on the anal lobes and the posterior pair on the anal ring are much shorter than those in *E. maninjauensis*, *E. sarawakensis* and *E. sulawesicus*. *E. kruiensis* also differs from these three species in lacking any sensory setae with swollen tips.

There are also available five second instars. These are similar to the adult female in the dense covering of microtrichia but the limbs are shorter and the body setae are fewer.

The epithet is based on the place name 'Krui' and the Latin suffix *'-ensis'* denoting origin.

Eumyrmococcus kusiacus sp. n.

(Fig. 6)

DESCRIPTION

Adult female on microscope slide broadly oval, 1.12 mm long, 0.65 mm wide, widest at mesothorax, abdomen tapering, abdominal segment VIII 220 µm wide at base. Positions of each anal lobe with 2 stout dorsal setae and 1 ventral seta forming a group of 3, each about 100 µm long. Antennae placed near ventral head margin, each 112–120 µm long, with 2 segments, the second tapering, both segments with long stout setae. Legs well developed, slender; hind trochanter + femur about 200 µm long, hind tibia + tarsus 158–162 µm long, claw slender, about 58 µm long. Ratio of lengths of hind tibia + tarsus to hind trochanter + femur 0.79–0.81. Ratio of lengths of hind tibia to tarsus 1.02–1.16. Tarsi each swollen near base then tapering to narrow distal end. All legs with stout flagellate setae. Labium 150–162 µm long, about same length as clypeolabral shield, 75–80 µm wide; ratio of length to width 1.50–1.62. Circuli numbering 2 situated near posterior edges of abdominal segments II and III but within borders of segments, diameter on abdominal segment II about 10 µm, on abdominal segment III about 17.5 µm, each deeply cupped. Anal ring about 100 µm wide with 6 setae; anterior and second pairs each 75 µm long, posterior pair each about 87 µm long, the anterior pair with setal collars touching.

Dorsal surface with crowded flagellate setae; on abdominal segment VIII mostly about 40 µm long, anteriorly on abdomen and remainder of body mostly about 15 µm long except towards posterior edges of abdominal segments, mostly about 25 µm long. Setae on abdomen in fairly narrow bands leaving extensive intersegmental bare areas. Setae on head and thorax much more crowded than on abdomen. Long stout setae, each 80–90 µm long, present in rows at posterior edges of abdominal segments II–VII.

Ventral surface with similar setae to those on dorsum, sparse on venter of thorax. Long stout setae as on dorsum, present at posterior edges of abdominal segments I–VII.

MATERIAL

HOLOTYPE. Adult ♀, **Solomon Islands**: New Georgia Group, Kolombangara, Kusi, 1220 m, associated with *Acropyga lauta*, in log, 29.viii.1965 *(Isiah)* (ANIC).

PARATYPE. **Solomon Islands**: same data as holotype, 1 adult ♀ (BMNH).

COMMENTS. *E.kusiacus* is related to *E. smithii* but differs in possessing two small circuli, and short stout setae on the anal lobes. These setae are scarcely longer than the width of the anal ring. In *E. smithii*, the circuli are absent and the setae on the anal lobes are conspicuously longer than the width of the anal ring. *E. kusiacus* is very close to *E. kolombangarae*, differing mainly in possessing long stout setae on the dorsum and venter at the posterior edges of the abdominal segments. In *E. kolombangarae*, there are long stout setae in the medial areas of the ventral abdominal segments only.

The name is based on 'Kusi', the place of origin, and the Latin suffix *'-acus'* meaning 'belonging to'.

Eurmyrmococcus lamondicus sp. n.

(Fig. 7)

DESCRIPTION

Adult female on microscope slide elongate, slender, largest specimen 1.28 mm long, 0.53 mm wide (holotype 1.40 mm long, 0.40 mm wide), widest at about mesothorax, head and thorax rounded, narrowing at abdominal segment III then narrowly tapering to small constriction between abdominal segments VII andVIII, base of abdominal segmentVIII about 100 µm wide. Positions of each anal lobe with 2 stout dorsal setae and 1 ventral seta, each about 325 µm long, forming a group of 3. Antennae placed on dorsal head margin, each 330–340 µm long, with 2 segments, the second 260–280 μm long, tapering. Legs well developed, slender; hind trochanter + femur 193–218 μm long, hind tibia + tarsus 112–122 μm long, claw slender, about 27.50 μm long, 6.25 μm wide at base. Ratio of lengths of hind tibia + tarsus to hind trochanter + femur 0.91–1.00. Ratio of lengths of hind tibia to tarsus 1.38–1.43. Tibiae swollen then tapering abruptly to narrow distal ends. All legs with stout pointed setae. Labium 127.5–137.5 μm long, slightly longer than clypeolabral shield, 80–105 μm wide; ratio of length to width 1.21–1.66. Circuli numbering 2, situated near middle of abdominal segments II and III, cup-shaped, about as deep as wide; on abdominal segment II about 12.5 μm wide, on abdominal segment III about 11.0 μm wide. Anal ring about 45 μm wide, with 6 setae; anterior pair slender, each about 72 μm long, second and posterior pairs stouter, each about 187 μm long, resembling anal lobe setae.

Dorsal surface with short crowded setae in bands across segments as far forward as prothorax; setae at posterior end of abdominal segment VIII each about 30 μm long, most on abdominal segment VII about 12.5 μm long, anteriorly mostly 7.5–10.0 μm long; a few on most segments with larger setal collars; on prothorax and mesothorax setae occupying medial areas except for marginal band, absent from head and in noticeable intersegmental areas. Stout flagellate setae, 32.5–37.5 μm long, present in medial area of head, interspersed with a few smaller setae. Short lanceolate sensory setae, each about 10 μm long, not numerous, mingled with the slender setae posteriorly to abdominal segment VI. Slender sensory setae, each about 10 μm long, and bluntly tipped, represented by a few on abdominal segment II only, these in addition to lanceolate setae.

Ventral surface with similar slender setae to those on dorsum, those on venter of thorax in deep marginal bands. Lanceolate sensory setae as on dorsum, few, present on most segments. Slender sensory setae occurring on abdominal segment II only. Stout flagellate setae present on head and medial area of thorax.

MATERIAL

HOLOTYPE. Adult ♀, **Australia**: Queensland, Mt Lamond, 12°44′S 143°18′E, associated with *Acropyga* sp., in rotting wood, 9–15.vi.1971 *(R.W. Taylor & G.J. Feehan)* (ANIC).

PARATYPES. **Australia**: Queensland, same data as holotype, 3 adult ♀♀ (ANIC), 2 adult ♀♀ (BMNH), 4 2nd instars (ANIC), 3 2nd instars (BMNH).

COMMENTS. The distribution of the dorsal and ventral slender setae and the shape of the antennae, place this species near *E. nipponensis*. *E. lamondicus*, however, comes closest to *E. queenslandicus* sp. n. in possessing minute lanceolate sensory setae, whereas those of *E. nipponensis* are blunt and swollen apically. *E. lamondicus* differs from *E. queenslandicus* in possessing also some slender blunt sensory setae on abdominal segment II and having two small circuli. In *E. queenslandicus* the blunt sensory setae are absent and there is only a single but large circulus. The slender setae on the venter of the thorax in *E. lamondicus* are also in much deeper marginal bands than in *E. queenslandicus*.

The epithet '*lamondicus*' is based on the place name Mt Lamond and the Latin suffix '*-icus*' meaning 'belonging to'.

Eumyrmococcus lanuginosus sp. n.

(Fig. 8)

DESCRIPTION

Adult female on microscope slide elongate-oval, membranous, largest specimen 1.00 mm long, 0.50 mm wide, widest at mesothorax then gently tapering to abdominal segment VII, with a constriction between abdominal segments VII and VIII, posterior end of body rounded. Positions of each anal lobe with numerous long stout setae, mostly about 75 μm long. Antennae placed on ventral margin of head, short, each 35.0–37.5 μm long, with 2 segments, second segment tapering, almost conical. Legs well developed, robust, hind trochanter + femur 145–150 μm long, hind tibia + tarsus 97.5–110.0 μm long, claw slender, 10.0–12.5 μm long, 7.5 μm wide at base. Ratio of lengths of hind tibia + tarsus to hind trochanter + femur 0.67–0.73. Ratio of lengths of hind tibia to tarsus 1.00–1.09. Tibiae each swollen near base then tapering to narrow distal end. All legs with stout flagellate setae. Labium 95–100 μm long, 50.0–62.5 μm wide, ratio of length to width 1.6–1.9. Circuli numbering 2 or 3, when 3 then situated near middle of mesothorax and abdominal segments II and III. When only 2 then absent from mesothorax; each circulus about 12.5 μm in diameter except on abdominal segment III when about 10 μm in diameter, truncate-conical but deeply cupped from apex. Anal ring 70–74 μm wide, with 6 setae; anterior pair slender, each about 30 μm long, second pair each about 50 μm long, posterior pair stouter, each about 80 μm long; anal ring setae difficult to discern because of surrounding setae.

Dorsal surface extensively covered in fine hair-like microtrichia and short fine setae except for bare intersegmental areas. Short setae on abdominal segment VIII mostly about 15 μm long, those anteriorly mostly about 7.5 μm long except for a few about 12.5 μm long with slightly larger setal collars. Long stout setae present towards posterior edges of abdominal segments IV–VIII, those on abdominal segment VIII numerous, 55–75 μm long; anteriorly mostly 55 μm long, distributed across the segments except on abdominal segment IV where they are sparse.

Ventral surface with similar microtrichia and setae to those on dorsum, covering most of surface; the short setae fine in medial area of thorax. Long flagellate setae, much more numerous than on dorsum, present towards posterior edges of abdominal segments and in medial areas of head and thorax. A few stout sensory setae, each with swollen tip, present laterally on thorax.

MATERIAL

HOLOTYPE. Adult ♀, **Indonesia: Sumatra**, Si Antar [2°40′N 98°43′E], with ants (Smithsonian Expedition), 1937 *(W.M. Mann)* (USNM). The holotype is the middle specimen of five, all mounted in a row on the same slide and is clearly marked.

PARATYPES. **Indonesia: Sumatra**, same data as holotype, 3 adult ♀♀, clearly marked in row with holotype, 1 2nd instar to right of other specimens (USNM).

COMMENTS. *E. lanuginosus* belongs to the group of species extensively covered in minute hair-like microtrichia. It differs from all the other species in possessing only short, almost conical antennae, and numerous stout setae on the positions of each anal lobe, not differentiated into groups of three.

The specimens were first studied by Harold Morrison who noted on the envelope that the species had been discussed by Roepke (1930). Although Roepke's illustration of the mealybug is rather simple, it does show the small tubercle-like antennae. The ant species was provisionally identified as *Cladomyrma* sp. but the equally simple illustration of the ant with the mealybug held in the mandibles, may be a species of *Acropyga*.

The epithet *'lanuginosus'* is a Latin adjective meaning downy or woolly, referring to the dense covering of microtrichia.

Eumyrmococcus maninjauensis sp. n.

(Fig. 9)

DESCRIPTION

Adult female on microscope slide, membranous, pyriform, about 0.83 mm long, 0.48 mm wide, widest at mesothorax, narrowing abruptly at about abdominal segment II, then gently tapering to rounded posterior end; abdominal segment VIII 150 µm wide at base. Positions of each anal lobe with 2 stout dorsal setae and 1 ventral seta, each about 275 µm long, forming a group of 3. Antennae situated on ventral head margin, each 95 µm long, with 2 segments, the second segment about 62.5 µm long, tapering, 1 antenna partly divided on 1 side only. Legs well developed, slender, hind trochanter + femur about 107.5 µm long, hind tibia + tarsus about 105 µm long, claw, slender, about 25 µm long, 5.0 µm wide at base. Ratio of lengths of hind tibia + tarsus to hind trochanter + femur 0.97. Ratio of lengths of hind tibia to tarsus 1.0. Tibiae each narrow at base, widening, then tapering abruptly to narrow distal end. All legs with outer setae sensory, each with slightly swollen tip, inner setae flagellate. Labium fairly wide, difficult to measure in available specimen, about same length as clypeolabral shield. Circulus large, about 32.5 µm wide, placed near middle of abdominal segment III. Anal ring about 75 µm wide, with 6 setae; anterior pair slender, each 67.5 µm long, second pair similar, each about 70 µm long, posterior pair stout and long, about 220 µm long, resembling anal lobe setae.

Dorsal surface densely covered in hair-like microtrichia and short, fine setae, except for intersegmental areas. Setae on abdominal segment VIII flagellate, mostly about 20 µm long; similar setae 10–20 µm long, present towards posterior edges of abdominal segments IV–VII; anteriorly, setae much more slender, 6.25–12.00 long, sometimes difficult to discern amongst the dense microtrichia.

Ventral surface with similar microtrichia and setae to those on dorsum. Obanal and cisanal setae present, each about 50 µm long; stout flagellate setae present on abdominal segment VIII, as long as 67 µm but most at posterior edge of abdominal segments about 50 µm long, mixed with others about 20 µm long. Minute slender setae distributed around margins of thorax. Medial area of thorax with stout flagellate setae; medial area of head and lateral area of thorax with a few stout sensory setae, each 15–20 µm long, with slightly expanded tips and with wide thick setal collars.

MATERIAL

HOLOTYPE. Adult ♀, **Indonesia: Sumatra**, Barat Province, Kotomalintang, nr Lake Maninjau, in soil, extracted by Berlese funnel apparatus, 19.xii.1994 *(L. Deharveng & A. Bedos)* (MNHN).

COMMENTS. Among the group of species with a dense covering of hair-like microtrichia, *E. maninjauensis* seems to be related to *E. sarawakensis* and *E. sulawesicus* in possessing long stout setae in groups of three on the positions of each anal lobe, and a pair of similar posterior setae on the anal ring. The antennae of *E. sarawakensis* and *E. sulawesicus*, however, are placed well on the dorsum of the cephalothorax, whereas in *E. maninjauensis* they are placed on the ventral head margin. Furthermore, any stout sensory setae with swollen tips in *E. maninjauensis* are distributed on the venter only, whereas in the other two species they occur on the dorsum also.

The epithet is based on the place name 'Lake Maninjau' and the Latin suffix *'-ensis'* denoting locality.

Eumyrmococcus neoguineensis sp. n.

(Fig. 10)

DESCRIPTION

Adult female on microscope slide membranous except for abdominal segment VIII lightly sclerotized; elongate-oval, largest specimen 1.15 mm long, 0.57 mm wide, widest at about abdominal segments II and III; head and thorax rounded, anterior margin of head sometimes straight, constricted slightly at mesothorax, then widening to anterior abdominal segments, remainder of abdomen tapering, base of abdominal segment VIII about 230 μm wide, apparent anal lobes set well apart, apex of abdomen protruding. Position of each anal lobe with 3 or 4 dorsal setae and usually 5 ventral setae forming a group of 8 or 9; inner ventral setae slender, each about 150 μm long, others increasing in length distally, outer ventral and dorsal setae stout, 550–600 μm long. Antennae situated on dorsal head margin, each 420–440 μm long, with 4 segments, second segment longest with a row of short conical setae on anterior edge, increasing in length distally; setae on third and fourth segments long, longest on third segment, about 325 μm long. Legs well developed; hind trochanter + femur 188–232 μm long, hind tibia + tarsus 180–220 μm long, claw slender, about 34 μm long, 7.5 μm wide. Ratio of lengths of hind tibia + tarsus to hind trochanter + femur 0.93–0.95. Ratio of lengths of hind tibia to tarsus 1.20–1.29. First legs with noticeably larger coxae than in other legs and longer trochanter + femur, 232–245 μm long, and longer tibia + tarsus, 260–272 μm long. Tibiae of all legs swollen near bases and narrowly tapering distally. All legs with long slender setae, except for some stout setae on posterior surface of femur of each first leg. Labium 162–175 μm long, 87–100 μm wide, longer than clypeolabral shield; ratio of length to width 1.62–1.86. Circulus present near anterior end of abdominal segment II but placed well within borders of segment, 20–25 μm in diameter, deeply cupped, about as deep as wide or slightly deeper. Anal ring about 90 μm wide, with 14 slender setae, each about 110 μm long.

Dorsal surface densely covered in slender flagellate setae except around antennal bases and intersegmental areas; some setae at posterior end of abdominal segment VIII each about 87 μm long, those at anterior end of segment about 25 μm long. Anteriorly on abdomen, as far forward as abdominal segment V, mostly 17–25 μm long; in medial area of abdominal segment VI, medial and anterior areas of abdominal segment V, and all anterior segments of abdomen, thorax and head, extensively covered in minute setae 10.0–12.5 μm long. Posterior edges of abdominal segments each with a row of stout setae, each about 100 μm long, a few at lateral edges of abdominal segments each about 125 μm long.

Ventral surface with a similar distribution of setae to that on dorsum but mainly bare on medial areas of head and thorax except for a few short setae. A bunch of invaginated setae present lateral to each first and second coxa, these lightly sclerotized when prepared on slides.

MATERIAL

HOLOTYPE. Adult♀, **Papua New Guinea**, East Sepik Province, Yawasora [Yauwasoru], near Wewak, associated with *Acropyga (Atopodon) ambigua* Emery, in rotting log, 4–6.vii.1972 *(R.W. Taylor)* (ANIC).

PARATYPES. **Papua New Guinea**, same data as holotype, 3 adult♀♀ (ANIC), 2 adult♀♀ (BMNH); same data but in mountain log, 1 adult ♀ (BMNH); Morobe Province, 16 km NW Lae, 'Timber Track', in rotting wood, with *A. (Atopodon) ambigua*, 12.vi.1976 *(R.W. Taylor)*, 1 adult ♀ (ANIC).

COMMENTS. This species shares with *E. corinthiacus* and *E. scorpioides* the character of 4-segmented antennae but the antennae of *E. neoguineensis* are much longer, with long setae on the third and fourth segments, and conical setae on the anterior edge of the second segment. Furthermore, the long stout setae on each anal lobe number eight or nine, whereas those in the other two species are in groups of three. The affinities of *E. neoguineensis* are obscure but *Xenococcus annandalei* also possesses large groups of long stout setae on the anal lobes and the antennae are also 4-segmented with long setae on the third and fourth segments. In *Xenococcus*, however, the antennae are much longer, about as long as the body, and there is well developed articulation between the first and second segments. The bunches of invaginated setae in *E. neoguineensis* have not been seen in any other species. Despite the unusual characters, the true affinities of this spectacular species appear to be with the genus *Eumyrmococcus* to which it is here assigned.

The epithet is a Latinized word for New Guinea with the Latin suffix *'-ensis'* meaning 'belonging or pertaining to'.

Eumyrmococcus nipponensis Terayama

(Fig. 11)

Eumyrmococcus nipponensis Terayama, 1986: 509; 1988: 645; Ben-Dov, 1994: 152. HOLOTYPE ♀, Japan, Noboritachi, Mikura-jima Is, Tokyo, on rootlets of plants in nests of *Acropyga [Atopodon] nipponensis* Terayama, 30.viii.1980 *(K. Masuko)* (NIAES).

DESCRIPTION

Adult female on microscope slide pyriform, largest specimen 1.40 mm long, 0.60 mm wide, widest at mesothorax, abdomen tapering, constricted slightly between abdominal segments VII and VIII, base of abdominal segment VIII about 180 μm wide. Position of each anal lobe with 2 long, stout ventral setae and 1 dorsal seta, forming a group of 3, each seta about

450 µm long. Antennae situated on ventral head margin, each 2-segmented, 260–270 µm long, second segment tapering, 210–215 µm long. Legs well developed, slender; hind trochanter + femur 180–200 µm long, hind tibia + tarsus 182–195 µm long, claw slender, about 30 µm long. Ratio of lengths of hind tibia + tarsus to hind trochanter + femur 0.95–1.01. Ratio of lengths of hind tibia to tarsus 1.05–1.21. Tibiae swollen near middle then narrowly tapering. All legs with outer setae stout, sensory, swollen apically; inner setae flagellate. Labium 138–150µm long, 75.0–77.5 µm wide, slightly longer than clypeolabral shield; ratio of length to width 1.84–1.93. Circulus present, round to slightly elliptical, 20–30 µm wide, deeply cupped, about as deep as wide, situated near middle of abdominal segment III. Anal ring 68–75 µm wide, with 6 setae; anterior pair slender, each about 27 µm long, second pair stouter, each about 62 µm long, posterior pair stout and long, each about 450 µm long, resembling anal lobe setae.

Dorsal surface extensively covered with short slender flagellate setae, sparse near head margin and absent in wide intersegmental areas; at posterior end of body each seta about 15 µm long, anteriorly on abdominal segment VIII mostly 12.5 µm long, elsewhere mostly about 7.5 µm long. Short stout sensory setae, each with noticeable swollen tip, fairly numerous across segments and mixed with the short flagellate setae; at posterior end of body, each about 11 µm long but most anteriorly each about 7.5 µm long. Head with longer stout sensory setae 12.5–25.0 µm long. Most setae with setal collars probably slightly raised from surrounding derm so that setae appear to be surrounded by halos.

Ventral surface with similar short setae as on dorsum but not so dense; absent from medial area of thorax. Long sensory setae, each about 35 µm long, present at posterior edge of abdominal segment VII; similar setae, each about 25 µm long, present on head. Other sensory setae shorter, those around margins, each 7.5 µm long as on dorsum, others 12–28 µm long, distributed across segments. Long, stout flagellate setae present in medial area of thorax. Three very slender sensory setae sometimes present on each side of circulus. Obanal setae stout and long, about as long as anal lobe setae. Many flagellate setae at posterior end of body with thick setal collars.

MATERIAL

Japan: Yakushima Is, Amboh, on rootlets of plants in nests of *Acropyga (Atopodon) nipponensis* Terayama, 17.x.1984 *(M. Terayama)*; Tokunoshima Is, Tampatsuyama, same data but 8.viii.1984 (all labelled paratypes).

COMMENTS. *E. nipponensis* differs from *E. smithii*, the only other species known from Japan, in possessing a circulus and sensory setae with expanded tips. In *E. smithii*, the circulus is absent and all setae are flagellate. *E. nipponensis* seems to have affinities with two Australian species, *E. lamondicus* and *E. recalvus*, in possessing similar 2-segmented antennae, each with the second segment long and tapering; also with minute flagellate setae on the dorsum distributed at least as far forward as the prothorax. Most of the sensory setae in the two Australian species, however, are lanceolate, whereas those in *E. nipponensis* are blunt and widely expanded distally.

The ant attending this mealybug was described originally by Terayama (1985), from material collected at the same time.

The accompanying illustration has been prepared from paratypes kindly made available by Dr M. Terayama.

Eumyrmococcus queenslandicus sp. n.

(Fig. 12)

DESCRIPTION

Adult female on microscope slide elongate, largest specimen 1.30 long, 0.65 mm wide, widest at mesothorax, head and thorax rounded, abdomen tapering to rounded posterior end, constricted between abdominal segments VII and VIII, segment VIII about 150 µm wide at base; positions of each anal lobe with 2 dorsal setae and 1 ventral seta, each about 300 µm long, forming a group of 3. Antennae situated on dorsal head margin, each 270–300 µm long, with 2 segments, the second tapering, 220–240 µm long. Legs well developed, slender; hind trochanter + femur 190–192 µm long, hind tibia + tarsus 110–117 µm long, claw slender, about 27.5 µm long, 5.0 µm wide at base. Ratio of lengths of hind tibia + tarsus to hind trochanter + femur 0.97–1.02. Ratio of lengths of hind tibia to tarsus 1.37–1.41. Tibiae swollen then tapering towards narrow distal ends. All legs with stout pointed setae. Labium 130–138 µm long, slightly longer than clypeolabral shield, 75–100 µm wide; ratio of length to width 1.38–1.70. Circulus present near middle of abdominal segment II, large and conspicuous, 52–60 µm in diameter, deeply cupped with almost parallel sides but wider than deep. Anal ring 52.5–60.0 µm wide, with 6 setae; anterior pair slender, each about 100 µm long, second pair thicker, each about 220 µm long, posterior pair each about 250 µm long, almost as thick and as long as anal lobe setae.

Dorsal surface with crowded slender flagellate setae as far forward as thorax, those on prothorax represented by a medial band, absent laterally on mesothorax leaving bare areas on head and laterally on prothorax, mesothorax and intersegmentally. Setae towards posterior end of abdominal segment VIII each about 37.5 µm long, anteriorly on next few segments mostly 10–20 µm long, on thorax and anterior abdominal segments mostly 10 µm long; some setae on any segment with larger setal collars than others. A few sensory lanceolate setae, each about 10 µm long, present on thorax and abdominal segments I–V. Setae on head sparse, mostly stout and flagellate, 35–42 µm long.

Ventral surface with similar setae to those on dorsum. Short slender setae present around margins only of thorax and first abdominal segment, few. Long stout setae, 35–42 µm long, not numerous, present on head and medial area of thorax. Sensory lanceolate setae, same as on dorsum, few, distributed on abdominal segments II–V.

MATERIAL

HOLOTYPE. Adult ♀, **Australia**: Queensland, Kirrama Range, NE slope of Mt Pershouse, 700 m, associated with *Acropyga* sp., 5.v.1969 *(E. Kennedy & R.W. Taylor)* (ANIC).

PARATYPES. **Australia**: Queensland, same data as holotype, 7 adult ♀♀ (ANIC), 5 adult ♀♀ (BMNH), 1 adult♀ (USNM), 1 2nd instar (ANIC), 1 2nd instar (BMNH); 4.5 km W of Cape Tribulation, 760 m, taken in the mandibles of *Acropyga* sp. in flight, 20–23.iv.1983 *G.B. Monteith & D.K. Yeates)*, 1 adult ♀ (QM).

COMMENTS. Among the species already described, *E. queenslandicus* comes nearest to *E. nipponensis* in possessing similar antennae, each with a long second segment, and with the thorax and abdomen densely covered in slender setae. In *E. nipponensis*, the sensory setae are blunt and expanded apically, whereas in *E. queenslandicus* they are lanceolate. *E. queenslandicus* comes closest to *E. lamondicus* sp. n. Both species have short lanceolate sensory setae but in *E. queenslandicus* there is a large single circulus only, present on abdominal segment III. In *E. lamondicus* there are two small circuli present on each of abdominal segments II and III. Furthermore, *E. lamondicus* possesses some short, blunt sensory setae on abdominal segment II in addition to lanceolate sensory setae. These blunt setae are absent from *E. queenslandicus*.

Two second instars are also available. These have a similar appearance to the adult females but the short flagellate setae are present only as far forward as abdominal segment IV.

The epithet is based on the locality 'Queensland' and the Latin suffix '*-icus*' meaning 'belonging to'.

Eumyrmococcus recalvus sp. n.

(Fig. 13)

DESCRIPTION

Adult female on microscope slide, narrow, elongate, 1.40 mm long, 0.65 mm wide, widest at about metathorax; head and thorax rounded, constricted slightly between abdominal segments III and IV, then tapering to posterior end of body, sharply narrowing between abdominal segments VII and VIII; abdominal segment VIII 162 µm wide at base before tapering abruptly, projecting beyond positions of anal lobes. Each anal lobe with a group of 3 long stout setae, 2 on dorsum and 1 on venter, each seta at least 240 µm long but difficult to measure in available specimen. Antennae each about 270 µm long, with 2 segments, the second segment curved, 205 µm long. Legs well developed, slender; hind trochanter + femur about 170 µm long, hind tibia + tarsus about 140 µm long, claw slender, about 28 µm long. Ratio of lengths of hind tibia + tarsus to hind trochanter + femur 0.82. Ratio of lengths of hind tibia to tarsus 1.8. Inner leg setae flagellate, outer setae sensory, with slightly swollen tips. Tibiae swollen towards distal ends then narrowing, tarsi expanding then tapering to narrow distal ends, no thicker than bases of claws. Labium about 112 µm long, 82.5 µm wide, about same length as clypeolabral shield; ratio of length to width 1.35; all labial setae flagellate. Circuli numbering 2, each about 10 µm wide, situated near middle of each of abdominal segments II and III, deeply cupped. Anal ring about 48 µm wide with 6 setae; 2 anterior pairs slender, curled in available specimen but about twice length of diameter of anal ring, posterior pair thicker, almost as long as apical setae.

Dorsal surface with crowded slender setae as far forward as abdominal segment II; those on abdominal segment VIII each about 25 µm long, on abdominal segments V–VII mostly 17.5 µm long, anteriorly about 12.5 µm long; some on any segment with larger setal collars. Setae on head, thorax and abdominal segment I, all sensory with only minutely swollen tips, not numerous; many on head and medially on thorax each up to 37.5 µm long; others on thorax and abdominal segment I 12.5 µm long, mingled with minute and slightly swollen setae each about 3.7 µm long.

Ventral surface with similar setae to those on dorsum as far forward as abdominal segment II; anteriorly not numerous; metathorax and abdominal segment I with short sensory setae as on dorsum, on margins of head and thorax mostly long and sensory, up to 37.5 µm long; others on medial areas of thorax, long and flagellate.

MATERIAL

HOLOTYPE. Adult ♀, **Australia**, Queensland, Byfield, 22°51′S, 150°39′E, associated with *Acropyga* sp., 26.x.1976 *(R.W. Taylor, T.A. Weir)* (ANIC).

PARATYPES. **Australia**, same data as holotype, 4 2nd instars (ANIC), 2 2nd instars (BMNH).

COMMENTS. This species is very close to *E. taylori* sp. n., differing mainly in the shape of the setae anterior to abdominal segment II. In *E. reclavus*, these setae on the dorsum and around the ventral margins are all sensory and slightly expanded apically, the only flagellate setae are those situated medially on the venter of the thorax. In *E. taylori*, all setae in these positions are flagellate.

Material at hand also contains six second instars. These resemble the adult female but the minute flagellate setae are not so crowded and the appendages are slightly smaller.

The epithet *'recalvus'* is the Latin adjective meaning 'bald in front', referring to the paucity of setae at the anterior end of the body.

Eumyrmococcus sarawakensis sp. n.

(Figs. 14, 15)

DESCRIPTION

Adult female on microscope slide extremely slender, largest specimen 1.35 mm long, 0.52 mm wide, widest at about prothorax, then gently tapering, abdominal segment VIII about 115 µm wide at base. Position of each anal lobe with 1 stout dorsal seta and 2 ventral setae forming a group of 3, each 430–488 µm long. Antennae placed well on dorsum of cephalothorax, each 260–267 µm long, with 2 segments, second tapering, 210–215 µm long. Legs well developed, slender; hind trochanter + femur 162.5–182.0µm long, hind tibia + tarsus 160–185 µm long, claw slender, about 22.5 µm long, 6.25 µm wide at base. Ratio of lengths of hind tibia + tarsus to hind trochanter + femur 0.97–1.01. Ratio of lengths of hind tibia to tarsus 1.00–1.05. Outer setae on legs sensory, with swollen tips, inner setae flagellate. Labium about 137 µm long, longer than clypeolabral shield, 70.0–82.5 µm wide, ratio of length to width 1.66–1.96. Circulus large, round to slightly elliptical, 75–85 µm wide, situated in middle of abdominal segment III, cupped or bowl-shaped, not so deep as wide. Anal ring 65–70 µm wide, with 6 setae; anterior pair each about 32.5 µm long, second pair each about 62.5 µm long, posterior pair about 390 µm long, similar to anal lobe setae.

Dorsal surface with minute setae and hair-like microtrichia covering entire surface except for intersegmental areas. Setae on abdominal segment VIII each about 10.0–12.5µm long, others anteriorly mostly about 5 µm long, difficult to discern among microtrichia. Stout sensory setae with swollen tips, present on head, each 17.5– 22.5 µm long, not numerous. A few sensory setae, each about 12.5 µm long, present on thorax and abdominal segment I.

Ventral surface with similar setae and microtrichia to those on dorsum. Stout sensory setae present on head and thorax, not numerous; short sensory setae, 10–15 µm long, few, distributed across abdominal segments II–VI.

Second instar

Similar in shape to adult female. Legs and antennae shorter. Hair-like microtrichia present on abdomen only. Short sensory setae extending to abdominal segment VII. Circulus large as in adult female.

Adult Male (Fig. 15).

Body of adult male degenerate, elongate, slender, largest specimen 1.35 mm long, 0.50 mm wide, widest at mesothorax, head and thorax rounded, then gently tapering to rounded posterior end, base of abdominal segment VIII about 150 mm wide. Area between antennae on venter tessellated. Antennae short, almost conical, 2-segmented, 37.5–45.0 mm long, situated near ventral head margin. Legs squat, coxae wide; trochanter + femur fused, unsegmented, stout, about 67.5 mm long; tibia + tarsus slender, 50–57 mm long, sometimes with indistinct segmentation; claw distorted, stout and almost triangular, about 12.5 mm long. Genital capsule retracted inside abdomen, ventral slit almost square. Aedeagus about 100 mm long, stout, almost trumpet-shaped at apex. Anus oval, situated at posterior end of abdomen at base of sclerotized extension to abdominal segment VIII, this extension about 1.5 mm wide and long, hook-shaped in profile, equivalent to long style in male of *E. taylori*.

Dorsal and ventral surfaces practically naked except for some minute setae, each with setal length considerably smaller than width of collar, except on dorsum of thorax where setae slightly longer.

COMMENTS. There is available also a single male pupa with an adult male inside. Also available are some female pupae, one of which shows the developing adult female inside.

MATERIAL

HOLOTYPE. Adult ♀, **Malaysia, Sarawak**, 1°38′N 113°35′E, associated with *Acropyga* sp., 25.ii.1963 *(A. Emerson)* (ANIC).

PARATYPES. ♀, **Malaysia, Sarawak**, same data as holotype, 1 adult ♀, 7 adult ♂♂ (ANIC), 2 adult ♀♀, 7 adult ♂♂ (BMNH), 2 2nd instars (ANIC), 2 2nd instars (BMNH), 5 pupae ♀♀ (ANIC), 3 pupae ♀♀ (BMNH), 3 pupae ♂♂ (ANIC), 2 pupae ♂♂ (BMNH).

COMMENTS. This singular species has an unusual shape, evenly tapering posteriorly from the prothorax. It belongs to a group collected within the tropics and is extensively clothed in hair-like microtrichia and minute setae. *E. sarawakensis* comes closest to *E. sulawesicus* from which it differs mainly in possessing shorter and fewer stout sensory setae on the cephalothorax, mostly 17.5–22.5 µm long. In *E. sulawesicus*, these setae are noticeably longer, 45–50 µm long and more numerous.

Most of the differences are small but both species are known from widely isolated localities and at present this separation is justified.

The epithet is based on the name of the locality and the Latin suffix *'-ensis'* indicating origin.

Eumyrmococcus scorpioides (De Lotto)

(Fig. 16)

Xenococcus scorpioides De Lotto, 1977: 33. HOLOTYPE♀, South Africa, Cape Province, Jacobs Bay (SANC) [examined].

Eumyrmococcus scorpioides (De Lotto), Williams, 1993: 217; Ben-Dov, 1994: 152.

DESCRIPTION

Appearance in life not recorded. Adult female on microscope slide elongate, body membranous except for moderately sclerotized abdominal segment VIII, largest specimen 1.55 mm long, 0.77 mm wide, widest at mesothorax, head and thorax rounded, with a constriction between abdominal segments III and IV, narrowing abruptly, remainder of abdomen tapering with a further constriction between abdominal segments VII and VIII; segment VIII about 170 µm wide at base, posterior end rounded. Positions of each anal lobe with 2 stout ventral setae and 1 dorsal seta, each about 800 µm long, forming a group of 3. Antennae slender, 4-segmented, each 175–190 µm long. Legs well developed; hind trochanter + femur 170–180 µm long, hind tibia + tarsus 150–162 µm long, claw about 27.5 µm long, stout, 12.5 µm wide at base. Ratio of lengths of hind tibia + tarsus to hind trochanter + femur 0.87–0.92. Ratio of lengths of hind tibia to tarsus 1.41–1.61. Outer setae on legs sensory, slightly swollen at tips; inner setae flagellate. Labium 147–150 µm long, about as long as clypeolabral shield, 50–65 µm wide; ratio of length to width 2.26–3.00. Circuli numbering 2, situated anteriorly on abdominal segments II and III but within borders of segments; circulus on abdominal segment II about 25 µm in diameter, on segment III about 15 µm in diameter, both cup-shaped. Anal ring 57–60 µm wide, with 6 slender setae; posterior pair each about 87 µm long, anterior 2 pairs shorter but curled in available specimens.

Dorsal surface with crowded flagellate setae on abdomen, those at posterior end of abdominal segment VIII each about 75 µm long, on abdominal segment VII mostly about 37 µm long, anteriorly about 25 µm long. Head and thoracic setae mostly sensory, with slightly swollen tips, 12.5–25.0 µm long but some flagellate setae present mingled with the sensory setae.

Ventral surface with similar setae to those on dorsum, crowded and flagellate as far forward as abdominal segment III but a few sensory setae also present on abdominal segment III. Anteriorly, setae mostly sensory with swollen tips except in medial area of thorax where they are mostly flagellate but a few sensory setae also present.

MATERIAL

South Africa: Cape Province, Jacobs Bay, in nests of *Acropyga (Malacomyrma) arnoldi* Sanschi, 7.viii.1969 *(A.J. Prins)*.

COMMENTS. In possessing 4-segmented antennae and in the general distribution of body setae, this species is related to *E. corinthiacus*. Most dorsal and ventral setae on the head and thorax of *E. scorpioides*, however, are sensory with slightly swollen tips, whereas in *E. corinthiacus* they are all flagellate. Moreover, the long setae on the anal lobes of *E. scorpioides* are each over 800 µm long and those of *E. corinthiacus* are thicker but at most only about 200–230 µm long. *E. scorpioides* differs from all other known species of *Eumyrmococcus* in possessing stout claws, those in other species being much more slender.

The accompanying illustration is based on the holotype and two paratypes kindly made available for this work by Ian Millar, Plant Protection Research Institute, Pretoria, South Africa.

Eumyrmococcus smithii Silvestri

(Fig. 17)

Eumyrmococcus smithii Silvestri, 1926: 273; Williams, 1970: 138; 1978: 63; Ben-Dov. 1994: 152. LECTOTYPE♀, **China:** Macao, [on roots of plants, attended by the ant *Acropyga (Rhizomyrma) sautori* Forel], designated by Williams, 1978: 63 (IEAUN) [examined].

COMMENTS. This species was described and illustrated in detail by Williams (1970) from material collected in various localities in China and Japan. Dr M. Terayama has kindly made available some fresh material collected in Okinawa and a new illustration is presented here based on this material.

The most important characters are the 2-segmented antennae, the absence of a circulus, long stout setae in groups of three on each apparent anal lobe, each seta about 500 µm long in the species illustrated but up to 700 µm long in other specimens. The anal ring possesses 6 setae, the 2 anterior pairs short and slender and the posterior pair stout, about as long as the anal setae. All the body setae are short, slender and flagellate, occupying all the dorsal surface except for intersegmental areas. A striking character, not seen in any other species, is a long wide extension on each hind coxal process.

In lacking any sensory setae with blunt or swollen tips, *E. smithii* is related to *E. kolombangarae* and *E. kusiacus*, described here from the Solomon Islands. It differs from both of these species in lacking a circulus.

MATERIAL

China: Macao, in nest of *Acropyga (Rhizomyrma) sauteri*. **Taiwan**: Taichu, on sugarcane, 24.ii.1933 *(M. Yanagihara)*. **Japan**: Ryukyu Is, Okinawa Is, in nest of *A. (Rhizomyrma) sauteri*, 15.viii.1984 *(M. Terayama)*; without locality, ex coll. R. Takahashi.

The species was also recorded from Shanghai by

Silvestri (1926, 1927) and from Taiwan by Takahashi (1934).

Eumyrmococcus sulawesicus sp. n.

(Fig. 18)

DESCRIPTION

Adult female on microscope slide narrowly elongate, membranous, largest specimen 1.50 mm long, 0.60 wide, widest at mesothorax; head and thorax rounded then constricting slightly between abdominal segments VII and VIII, abdominal segment VIII 162 µm wide at base. Position of each anal lobe with 2 stout dorsal setae and 1 ventral seta, forming a group of 3, each 510–525 µm long. Antennae placed well on to dorsum, each 275–295 µm long, with 2 segments, second tapering, 215–232 µm long. Legs well developed, slender; hind trochanter + femur 200–205 µm long, hind tibia + tarsus 182.5–205.0 µm long, claw slender, about 27.5 µm long, 7.5 µm wide at base. Ratio of lengths of hind tibia + tarsus to hind trochanter + femur 0.90–1.02. Ratio of lengths of hind tibia to tarsus 0.87–0.95. Leg setae short and sensory on outer edges, each with swollen tip, flagellate on inner edges. Labium about 142.5 µm long, longer than clypeolabral shield, 95 µm wide, ratio of length to width 1.5. Circulus large, round to slightly elliptical. Anal ring 72–78 µm wide with 6 setae; anterior pair slender, each about 45 µm long, second pair each about 75 µm long, posterior pair stout, each about 475 µm long, resembling anal lobe setae with which they are sometimes intertwined.

Dorsal surface entirely covered with minute slender setae and fine microtrichia. Setae on abdominal segment VIII mostly about 15 µm long, anteriorly about 6–10 µm long, many of longer setae with larger setal collars, density less towards head and thorax. Long sensory setae, each with swollen tip, 45–50 µm long, present on head and thorax. Microtrichia dense, hair-like, short and stouter on abdominal segment VIII, very slender anteriorly. Setae and microtrichia absent from intersegmental areas.

Ventral surface with similar setae and microtrichia to those on dorsum, covering entire surface except for intersegmental areas. Long, stout sensory setae, as on dorsum, present on head and thorax, fairly numerous, becoming shorter, 17.5–25.0 µm long, towards anterior abdominal segments except for one or two, each about 32 µm long near circulus. Sensory setae towards abdominal segment V mostly about 15 µm long, sometimes blunt, without swollen tips. Setae stout and flagellate on medial area of thorax.

MATERIAL

HOLOTYPE. Adult ♀, **Indonesia, Sulawesi**, Sulawesi Utara, Toraut forest, Dumoga-Bone National Park, with *Acropyga (Atopodon)* sp., 15.iii.1985 *(R.H.L. Disney)* (BMNH).

PARATYPES. **Indonesia, Sulawesi**, same data as holotype, 3 adult ♀♀ (BMNH), 6 2nd instars (BMNH).

COMMENTS. This species, covered in hair-like microtrichia, is noticeably elongate with the antennae placed well on the dorsum of the cephalothorax. It is closely related to *E. sarawakensis* in most characters but the stout sensory setae on the head and thorax are longer, up to 50 µm long, and more numerous. In *E. sulawesicus* these setae are at most about 22.5 µm long.

A few second instars are also available. They differ from the adult female in having much fewer minute setae and microtrichia, but the stout sensory setae are more numerous, extending posteriorly as far as abdominal segment VII.

The epithet is based on the country of origin, Sulawesi, and the Latin suffix *'-icus'* meaning 'pertaining to'.

Eumyrmococcus taylori sp. n.

(Figs 19–22)

DESCRIPTION

Appearance in life not recorded. Adult female (Fig. 19) on microscope slide elongate, narrow, membranous except for posterior end of body moderately sclerotized; longest specimen 1.30 mm long, 0.50 mm wide, widest at mesothorax; constricting between abdominal segments IV and V, widening at abdominal segment VI, then narrowly tapering between abdominal segments VII and VIII, base of abdominal segment VIII 117–125 µm wide; posterior end of body rounded, projecting beyond actual anal lobes, these each with 2 ventral setae and 1 long stout seta forming a group of 3, each seta about 315 µm long. Antennae each situated on dorsal margin when flattened on slide, 310–390 µm long, with 2 segments, second segment long, about 290–330 µm long, curved and tapering. Legs well developed, slender, hind trochanter + femur 170–210 µm long, hind tibia + tarsus 150–190 µm long, claw slender, about 27 µm long. Ratio of lengths of hind tibia + tarsus to hind trochanter + femur 0.88–0.90. Ratio of lengths of hind tibia to tarsus 1.14–1.25. Tibia swollen towards distal end then tapering. Tarsus swollen then tapering to narrow distal end, about as wide as base of claw. Leg setae all flagellate. Labium about as long as clypeolabral shield, 117–120 µm long, 77.5–82.5 µm wide; ratio of length to width 1.41–1.51. Circuli numbering 1 or 2, situated within borders of abdominal segments II and III; if only 1 circulus then present on abdominal segment III; circulus on abdominal segment II about 8.75 µm wide, on abdominal segment III about 11.25 µm wide, each circulus deeply cup-shaped. Anal ring 53–57 µm wide, with 6 setae; anterior pair each about 67 µm long, second pair each about 112 µm long, posterior pair thicker, each about 275 µm long, resembling the apical setae.

Dorsal surface with crowded flagellate setae as far forward as abdominal segment II, mostly about 17.5–25.0 µm long on abdominal segment VIII, those on anterior segments each about 15 µm long, very slender. Minute swollen setae present, each about 3.75 µm long, sparse, mingled with the flagellate setae on abdominal segments II–IV. Setae anterior to abdominal segment II mostly thick and flagellate, 25–50 µm long, not numerous. A few minute swollen setae present on head, each about 3.5 µm long, slightly narrower than those on abdomen.

Ventral surface with similar setae to those on dorsum, crowded as far forward as abdominal segment II, with a few minute swollen setae on abdominal segments II–VI. Anteriorly a few thicker flagellate setae present as on dorsum, and a few minute swollen setae also present on head and around anterior spiracles.

Second instar (Fig. 20)
Body pyriform, 1.05–1.10 mm long, 0.45–0.58 mm wide, widest at about mesothorax, tapering abruptly to abdominal segment IV then gradually to posterior end of body; base of abdominal segment VIII 75–92 µm wide; posterior end of body projecting beyond actual anal lobes, each lobe with 1 dorsal and 2 stout ventral setae each 375–470 µm long. Antennae each 290–350 µm long, with 2 segments; first 40–50 µm long, second curved, with setae of various lengths, longest at distal end about 100 µm long. Legs well developed; hind trochanter + femur 155–195 µm long, hind tibia + tarsus 157.5–185.0 µm long, claw slender, about 22.5 µm long. Ratio of lengths of hind tibia + tarsus to hind trochanter + femur 0.94–1.04. Ratio of lengths of hind tibia to tarsus 1.03–1.25. First pair of legs longer, trochanter + femur 170–200 µm long, tibia + tarsus 185–207 µm long. Labium broad, 105–115 µm long, longer than clypeolabral shield. Circulus present within borders of abdominal segment III, 7.50–11.25 µm in diameter, deeply cupped. Anal ring 35–40 µm wide, with 6 setae; 2 anterior pairs slender, each about 75 µm long, posterior pair stout but not so stout as anal lobe setae, each about 350 µm long.

Dorsal surface with long stout setae 95–120 µm long at posterior edges of abdominal segments III–VII: other abdominal setae, each about 25 µm long, present on abdominal segment VIII, and others, each about 20 µm long, at anterior edges of abdominal segments IV–VII; slenderer setae on these segments mostly about 15 µm long. Other setae on head, thorax and abdominal segments I–III, each 20–55 µm long, not numerous. Minute clavate setae present on abdominal segments II–IV, and others, about same size but with smaller collars, present on head and lateral area of metathorax.

Ventral surface with similar setae to those on dorsum. Abdominal segments V and VI each with a few elongate sensory setae; abdominal segments III and IV each with a few shorter sensory setae. Minute clavate setae present anterior to each spiracle and posterior to each second spiracle.

COMMENTS. Material from Baroalba Spring possesses legs and antennae slightly longer than that from Sawcut Gorge but the proportions of the segments are about the same. At present, specimens from both areas are treated here as conspecific.

Female pupa (Figs 1B, 21A)
Body membranous, elongate-pyriform, 0.90–0.99 mm long, 0.38–0.43 mm wide, widest at mesothorax, abdomen gently tapering, posterior end projecting only slightly, segmentation distinct on abdomen. Antennae situated on dorsal margin, 2-segmented, curved, 262–270 µm long, apex rounded. Legs tapering to pointed developing claws, 325–390 µm long, with faint segmentation. Labium distinct, 100–120 µm long, longer than clypeolabral shield. Anal ring dorsal, at apex of abdomen. Spiracles present.

COMMENTS. Specimens are available showing the adult female inside, almost ready to emerge (Fig. 1B).

Adult Male (Fig. 22)
Body of adult male elongate-pyriform, 104 µm long, 40 µm wide, widest at mesothorax, head and thorax rounded, tapering abruptly to anterior end of abdominal segment IV, remainder of abdomen narrow, tapering gradually, base of abdominal segment VII 90 µm wide. Apparent anal lobes each with 1 stout dorsal seta and 2 ventral setae, each 200–250 µm long, forming a group of 3. Antennae 2-segmented, 310–400 µm long; second segment curved, 270–350 µm long, longest setae about 90 µm long. Legs well developed, slender; hind trochanter + femur 155–175 µm long; hind tibia + tarsus 147.5– 175.0 µm long; claw slender, 25 µm long, 5 µm wide at base. Ratio of lengths of hind tibia + femur to trochanter + femur 0.94–1.01. Ratio of lengths of hind tibia to tarsus 1.03–1.33. First legs longer; trochanter + femur 180–210 µm long, tibia + tarsus 180–200 µm long. Mouthparts represented by tentorium, remains of clypeolabral shield with a few setae, and a small vestigial labium. Genital capsule almost triangular, 65 µm wide, length about the same, venter of penial sheath rounded apically, ventral slit rounded near base then widening slightly apically; basal ridge of penial sheath well defined ventrally; aedeagus long and pointed, 250–262 µm long. Dorsal aspect with an apparent anal ring and anal ring setae at posterior edge of abdominal segment VIII; 2 anterior pairs of setae each about 45 µm long, posterior pair thicker, each about 58 µm long, situated near curved ends of anal ring and lateral to large, almost triangular anus, about 30 µm wide. Dorsal part of capsule extending from anus as a slender elongate style, about 125 µm long, shorter than aedeagus, slightly expanded

apically then pointed, tip bearing a few spicule-like extensions; base of style with 2 pairs of short setae.

Dorsal surface of body with short, flagellate setae, each about 12.5–15.0 µm long, on abdominal segment VIII. Anteriorly on all segments including head, with transverse rows of long, slender flagellate setae 62–70 µm long, these sometimes absent; posterior abdominal segments also with a few short flagellate setae. Minute sensory setae, each with slightly swollen tip and scarcely longer than a setal collar, present in moderate numbers across segments anterior to abdominal segment VIII.

Ventral surface with similar distribution of setae to those on dorsum, the long flagellate setae sometimes absent. Minute sensory setae present as on dorsum but fewer on thorax.

Male prepupa (Fig. 21B)
Body elongate-pyriform, about 0.90 mm long, 0.40 mm wide at mesothorax; abdomen with distinct segmentation, tapering to rounded apex. Antennae situated on dorsal margin, 2-segmented, tapering, apex rounded, 220–240 µm long. Legs 305–330 µm long, segmented, developing claws pointed. Anal ring present at apex of abdomen. Mouthparts represented by remains of clypeolabral shield and small lobes of labium. Spiracles distinct.

COMMENTS. Specimens are available showing the developing pupa inside.

Male pupa (Fig. 21C)
Body narrowly pyriform, 1.00–1.27 mm long, 0.40–0.43 mm wide, widest at mesothorax, narrowing to abdominal segment V then tapering to developing genital capsule, posterior end elongate, pointed; segments distinct on abdomen. Antennae tapering to pointed distal end, 285–300 µm long, situated on dorsal head margin. Legs tapering to pointed claws, 320–360 µm long. Mouthparts represented by indistinct clypeolabral shield. Spiracles present. Anal ring situated dorsally towards anterior end of abdominal segment VIII.

COMMENTS. Some specimens available show the adult male complete, almost ready to emerge (Fig. 1A).

MATERIAL

HOLOTYPE. Adult ♀, **Australia**: Northern Territory, Sawcut Gorge, 12°55′S, 132°56'E, associated with *Acropyga* sp., 19.xi.1972 *(R.W. Taylor)* (ANIC).

PARATYPES. **Australia**: same data as holotype, 1 adult ♀, 2 adult ♂♂ (ANIC), 1 2nd instar, 2 ♂♂ pupae, 1 ♀ pupa (ANIC), 1 adult ♀, 3 adult ♂♂, 1 ♂ pupa (BMNH): same data but 13.vi.1973, 1 adult ♂, 4 2nd instars, 2 prepupae ♂♂, 1 pupa ♂, 2 pupae ♀♀ (ANIC); 2 2nd instars, 1 prepupa ♂ (BMNH). Baroalba Spring, 12°47′S, 132°51′E, with *Acropyga* sp., 17.xi.1972 *(R.W. Taylor)*, 1 adult ♂, 7 2nd instars, 7 pupae ♀♀ (ANIC), 1 2nd instar, 3 pupae ♀♀ (BMNH); same data but 17.xi.1971, 1 adult ♂ (ANIC).

COMMENTS. In possessing a general distribution of short crowded setae in the adult female, only as far forward as abdominal segment II, this species closely resembles *E. recalvus* sp. n. In *E. taylori*, however, all the dorsal setae on the head, thorax and first abdominal segment are flagellate except for a few minute swollen sensory setae. In *E. recalvus*, all the dorsal setae at the anterior end of the body are sensory and bluntly tipped or slightly swollen. Furthermore, the outer setae on the legs of *E. taylori* are flagellate, whereas those of *E. recalvus* are sensory.

There are available some second instars from all localities. These differ from the adult female in lacking the wide bands of dense setae across the segments and instead there are long slender setae, similar to those of the adult male.

Adult males appear to be of two forms, with or without long flagellate body setae. Most of the adult males from Sawcut Gorge possess the long setae except in one specimen. One of the adult males from Baroalba Spring also lacks these long setae as does the specimen still enclosed within the pupal instar. All specimens are here regarded as representing the same species. Such wide differences occur also in adult females of *Molluscococcus fibrillae* Hall, redescribed by Miller and Williams (1995). This species normally possesses extremely long setae, 812–928 µm long over most of the dorsum, but there are also specimens with short setae only, 44–61 µm long.

The only adult females available for study from Baroalba Spring are still within the pupal instar and they appear to be identical with adult females from Sawcut Gorge. If there is evidence in future that the two forms of adult male discussed here, represent two distinct species, then the matter can easily be corrected.

The species is named after the collector, R.W. Taylor, CSIRO, Canberra, Australia, who sent many of the mealybugs discussed in this work.

Xenococcus Silvestri

Xenococcus Silvestri, 1924: 312; Williams, 1978: 63.

TYPE SPECIES. *Xenococcus annandalei* Silvestri, by original designation and monotypy.

DESCRIPTION
Body of adult female broadly oval, membranous, abdomen tapering abruptly to narrow sclerotized apical segment. Anal lobes not developed, recognizable by inner ventral grooves, position of each lobe with a group of 3 long, stout setae, 2 ventral and 1 dorsal.

Anal ring protruding between anal lobes, represented by crescentic dorsal band without cells, with 8 anal ring setae, the 2 anterior pairs of setae slender, the third pair thicker and longer, detached from ring, the fourth pair ventral in position, about as long as anal lobe setae. Antennae 4-segmented, placed on dorsal margin, tapering, about as long as body with strong articulation between first and second segments. Legs well developed, long and slender; claw elongate, slender. Labium elongate, longer than wide, setae on upper surface well spaced. Circuli present, round and shallowly cupped. Dorsal body setae minute and abundant, extending to lateral ventral margins on thorax. Ventral setae mostly long and stouter. Sickle-shaped setae usually present on thorax. Eyes absent. Ostioles absent. Pores and ducts absent.

COMMENTS. In life, the abdomen of *Xenococcus* curls slightly to the dorsum as in *Eumyrmococcus*. The genus differs from *Eumyrmococcus* in possessing very long antennae with well developed articulation between the first and second segments. Although the abdomen tapers, it narrows abruptly to a narrow abdominal segment VIII and the body is widest at about the metathorax. In *Eumyrmococcus*, the whole cephalothorax is dilated and the abdomen tapers gradually. Furthermore, only the dorsal abdominal setae in *Xenococcus* are short and crowded, those on the venter of the abdomen, although numerous, are long and stouter, similar to the medial ventral setae on the head and thorax. The ventral abdominal setae in *Eumyrmococcus* are always short and crowded, similar to the dorsal abdominal setae.

At present, two species are recognized, always associated with the ant genus *Acropyga*. The female possesses a pupal instar and the adult male of one of the species is described on p. 24.

Key to Species of *Xenococcus* (Adult Females)

1 Legs with tibia shorter than tarsus. Antennae each about 860–1090 µm long .... *acropygae* (p. 23)

– Legs with tibia about twice as long as tarsus. Antennae about 1480–1550 µm long .... *annandalei* (p. 25)

Xenococcus acropygae sp. n.

(Figs 23–26)

Xenococcus annandalei Silvestri, Williams, 1985: 390; Williams and Watson, 1988: 221 (mis-identifications).

DESCRIPTION

Adult female (Fig. 23) on microscope slide pyriform, narrowing at abdominal segment VII; 1.27–1.65 mm long, 0.74–1.08 mm wide, widest at about metathorax; body membranous except for sclerotized abdominal segment VIII, posterior end of body projecting beyond anal lobes; base of abdominal segment VIII 180–220 µm wide; anal lobes each with 1 dorsal and 2 ventral setae, all stout, forming a group of 3, each 875–920 µm long. Antennae conspicuous, each 860–1090 µm long, with 4 segments; segment 1 170–230 µm long (type series 90–120), segment 2 280–300 µm long (type series 330–360), segment 3 90–130 µm long (type series 90–120), segment 4 200–300 µm long (type series 240–300); segment 1 170–230 µm wide, segments progressively narrowerer to segment 4 60–100 µm wide, segment 4 tapering. All antennal segments with long stout setae, segment 2 with about 30 setae on ventral surface; longest setae on segment 4 400 µm long, setal bases 3–5 µm wide with correspondingly wide setal collars. Segments 1 and 2 strongly articulated with grooves at distal end of segment 1 and minute projections at proximal end of segment 2. Tip of segment 4 with a pair of peg-like setae each 10.0–12.5 µm long. Legs well developed; hind trochanter + femur 270–380 µm long (type series 290–340), hind tibia + tarsus 280–415 µm long (type series 310–360), claw slender about 35–45 µm long. Ratio of lengths of hind tibia + tarsus to hind trochanter + femur 1.01–1.13. Ratio of lengths of hind tibia to tarsus 0.66–0.95; tarsus always longer than tibia. Hind tarsus swollen then narrowing distally. All legs with long stout setae, the longest at distal end of femur, 250–300 µm long. Labium 165–220 µm long, longer than clypeolabral shield, setae well separated. Circuli normally numbering 2 within borders of abdominal segments II and III, each 27.5–47.0 µm in diameter, with rim projecting from surrounding derm, inner part cup-shaped, shallow. Occasionally a small third circulus present on abdominal segment IV. Anal ring 77.5–85.0 µm wide with 8 setae; 2 anterior pairs slender, each about 130 µm long, 2 posterior pairs stout, each about as long as anal lobe setae, 1 pair on dorsum and the posteriormost pair usually placed on venter.

Dorsal surface densely covered with slender setae except in intersegmental areas and on head, mostly curved, each about 15 µm long towards anterior edges of segments, and about 20 µm long towards posterior edges of segments; a few longer setae, each about 25 µm long with larger collars, present across all segments; abdominal segment VIII with fewer but longer setae. Sickle-shaped setae usually present on thorax and anterior abdominal segments but sometimes absent entirely, each with slender tip. Setae near each antennal base slender, stouter on head margin.

Ventral surface with stout setae on abdomen and medial areas of head and thorax, 40–165 µm long except for some on margins of abdominal segment VIII, each about 300 µm long. Short slender setae as on dorsum, present around margins of anterior abdominal segments and thorax. A few sickle-shaped setae usually present near margin of thorax.

COMMENTS. This species differs from *X, annandalei* mainly in the lengths and ratios of the tibiae and tarsi. In *X. acropygae*, the tarsus is longer than the tibia but in *X. annandalei*, the tibia is about twice as long as the tarsus. Furthermore, the setal bases on the antennae of *A. acropygae* are mostly narrower than those of *X. annandalei*. Moreover, the antennae and legs of *A. acropygae* are shorter than those of *A. annandalei*.

First instar (sex not determined) (Fig. 24)

COMMENTS. This instar was described by Williams (1978) from specimens collected in India, Mysore, on coconut roots under the name *X. annandalei*. Specimens from southern Asia and Australasia agree with these first instars but show wider variation. The body varies from 0.70–1.05 mm long and 0.27–0.58 mm wide. Antennae 4-segmented, 740–880 µm long, with long stout setae, the longest on segment 4 about 250 µm long. Hind trochanter + femur 175–250 µm long, hind tibia + tarsus 215–270 µm long. Ratio of lengths of hind tibia + tarsus to trochanter + femur 1.08–1.27. Ratio of lengths of hind tibia to tarsus 0.58–0.74, tarsus always noticeably longer than tibia. All segments with long stout setae, longest at distal end of femur about 160 µm long. Anal ring with 4 pairs of setae; 2 anterior pairs slender, each about 60–110 µm long, third pair stouter, 295–360 µm long, fourth pair stoutest, 535–750 µm long, resembling the anal lobe setae. Anal lobe setae, stout, usually curled when prepared on slides, 675–700 µm long, forming a group of 3 on each anal lobe, 1 on venter and 2 on dorsum. Body setae short and curved on head and thorax, each 12–15 µm long, accompanied by a few sickle-shaped setae on dorsum. Other body setae 40–88 µm long except on margins where they are 100–120 µm long.

A new illustration has been prepared for this work based on specimens collected at the type locality, Sulawesi.

Third-instar female (pupa) (Fig. 25A)
Body broadly oval, 0.84–0.90 mm long, 0.55–0.67 mm wide, membranous, with only faint signs of segmentation at posterior end of abdomen. Antennae dorsal, 660–760 µm long, tapering. Legs tapering, 425–530 µm long, segmentation faint. Labium distinct, 135–145 µm long, longer than clypeolabral shield. Spiracles distinct.

COMMENTS. The female pupal instar is always recognizable by the well developed labium and the long dorsal antennae. Some specimens available have the developing adult female still within the pupal instar.

Adult male (Fig. 26)
Body normally curved ventrally and distorted when prepared on microscope slides. When flattened, broadly oval, about 1.0 mm long, 0.70 mm wide, sides sub-parallel, widest at about abdominal segments II and V. Head and abdominal segment I sclerotized dorsally except at anterior end surrounding antennae; ventrally, sclerotized laterally on thorax. Antennae situated on dorsal membranous area, each 1-segmented, tubercle-like, with 6 stout setae, each 30–35 µm long. Legs placed well anterior on body, of an unusual shape, squat and robust. Coxae large. Trochanter + femur stout, about 70 µm long, fused except for faint line apparent in some specimens, trochanter with the usual 2 pairs of sensory pores. Tibia + tarsus much narrower, tapering, about 75 µm long. Claw about 20 µm long, unusual, with well developed wide base, actual claw pointed and slender with apparently a pair of stout blunt digitules. Genital capsule about 290 µm long, 110 µm wide, mostly internal, the external venter of penial sheath about 170 µm long; ventral slit indistinct, at distal end of sheath; tip of sheath with a few minute setae. Aedeagus strongly sclerotized, elongate. Base of genital capsule dorsally with a pair of lobes, each with a group of 3 stout setae, 30–37 µm long, and usually 4 short setae, the lobes situated on each side of a minute projecting plate; anus, when viewed laterally, opening under the plate; entire area normally lying between the genital capsule and dorsal surface of abdomen when flattened on slide.

Body setae of 2 types. A band of setae present across anterior edges of venter of abdominal segments II and III, each seta minute and shorter than diameter of heavily sclerotized collar. A minute type of seta with membranous collar, present across dorsal and ventral segments; setae in a row near ventral edge of abdominal segment IV either with membranous or sclerotized collars.

Third-instar male (prepupa) (Fig. 25B)
Body almost rotund, 0.78–0.86 mm long, 0.66–0.70 mm wide. Segmentation discernible on dorsum and venter of abdomen. Antennae dorsal, tapering to blunt apex, 185–260 µm long. Legs 180–240 µm long, tapering, with faint segmentation. Remains of clypeolabral shield and labium present. Spiracles well developed.

COMMENTS. The prepupal instar is recognizable by the dorsal developing antennae, only about one-third the length of those of the female pupa. There are faint signs of the labium and clypeolabral shield.

Fourth-instar male (pupa) (Fig. 25C)
Body broadly oval, 0.86–0.98 mm long, 0.65–0.75 mm wide, with signs of segmentation on abdomen. Anten-

nae reduced to small triangular flaps on venter of head, 25–30 µm long, 50–65 µm wide. Legs 155–200 µm long, stout and tapering to sclerotized points or developing claws, segmentation not discernible. Small area of clypeolabral shield present only. Spiracles distinct.

COMMENTS. In the male pupa the legs are usually shorter than those of the prepupa but the lengths sometimes overlap. The most distinctive pupal character is the shape of the antennae which are short, triangular and present on the anterior edge of the head to contain the short developing antennae which in the adult male lie dorsally.

MATERIAL

HOLOTYPE. Adult ♀, **Indonesia, Sulawesi**, Sulawesi Utara, Dumoga-Bone National Park, Toraut forest, with *Acropyga (Acropyga) acutiventris* Roger, 19.iii. 1985 *(R.H. Disney)* (BMNH).

PARATYPES. **Indonesia, Sulawesi**, same data as holotype but *(R.H. Disney* or *R.H. Disney & J.H. Martin)*, 3 adult ♀♀ (BMNH), 10 adult ♂♂ (BMNH), 1 adult♂ (ANIC), 1 adult♂ (MNHN), 1 adult♂ (USNM), 18 1st instars, 24 pupae ♀♀, 4 prepupae ♂♂, 3 pupae ♂♂ (BMNH).

Non-type material (all ♀♀). **Indonesia**, Krakatau, Anak Krakatau, Rakata (in mandibles of *A. acutiventris*). **India**, Mysore, on roots of *Cocos nucifera*, 21.vi.1937 *(T.V. Subramanian)* (first instar); Karnataka, Bangalore, on roots of *Vitis vinifera*, 18.i.1996 *(A. Virakramath & B.K. Rajagopal)*. **Singapore**; Botanical Gardens, in soil under wood, with *A. acutiventris*, 21.v.1968. **Philippine Islands**, Palawan (spirit material). **Malaysia, Sabah**, Tawau, Quoin Hill, with *A. acutiventris*, 10.vi.1968. **Papua New Guinea**, Morobe Province, 16 km N.W. Lae, in soil under wood, with *A. acutiventris*, 12.vi.1972 *(R.W. Taylor)*; Wau, McAdam Park, in rotting log, with *A. acutiventris*, 14.vi.1972 *(R.W. Taylor)*; Bulolo (spirit material, with *A. acutiventris* and *A. (Atopodon) ambigua*): East Sepik Province, Angoram, from rotting log, 2.vi.1972 *(R.W. Taylor)*; Yawasora, nr Wewak, from rotting log, 4–6.vii.1972 *(R.W. Taylor)*; Hayfield, nr Maprik, in soil under wood (all with *A. acutiventris)*: West Sepik Province, Pes, nr Aitape, in soil under wood with *A. acutiventris*, 8–9.vii.1972: Northern Province, Kokoda, associated with dying *Theobroma cacao*, ix.1990 *(G. Lockwood)*; nr Kokoda, in soil under wood, with *A. acutiventris*, 1.vi.1972 *(R.W. Taylor)*. **Solomon Islands**, San Cristobal, Guadalcanal, Nggela (spirit material), with *A. acutiventris* and *A. (Rhizomyrma) lauta* Mann. **Australia, Queensland**, Iron Range, 12°42′S 143°18′E, 9–15.vi.1971 *(R.W. Taylor & J. Feehan)*; Waugh, from rotten log, 11.vi.1962 *(R.W. Taylor)*; Cape York Peninsular, Bemaga, from mandibles, xii.1983 *(J. Sedlack)*; Finch Hatton Gorge, 21°05′S 148°38′E, 11.xi.1976 *(R.W. Taylor & T.A. Weir)*; Josephine Falls (spirit material): **Northern Territory**, Baroalba Spring, 12°47′S 132°51′E, in soil under wood, 16, 17, 20.xi.1972, 13.vi.1973 (all with *A. acutiventris*).

COMMENTS. Specimens recorded under the name *X. annandalei* from Hong Kong, Vietnam and Penang by Williams (1978) are probably this species and await verification.

Xenococcus annandalei Silvestri

(Fig. 27)

Xenococcus annandalei Silvestri, 1924: 312; 1926: 275; 1927: 253. LECTOTYPE ♀, INDIA: Barkuda I. [Chilka (Chilika) Lake, Madras District (now Orissa Province), on roots of *Ficus obtusa*, with ants *Acropyga acutiventris* Roger] (IEAUN, Portici) designated by Williams 1978: 66 [examined].

COMMENTS. Williams (1978) described the adult female in detail and the illustration is reproduced here with slight modification. Some further notes are now added to distinguish the species from *X. acropygae*.

The antennae are 1480–1550 µm long, longer than in any specimen of *X. acropygae* so far studied. In *X. acropygae*, the range is 860–1090 µm long. Furthermore, although the distribution of the antennal setae are about the same in the two species, there are many more shorter and more slender setae in *X. annandalei*. The bases of the setae in the antennae of *X. annandalei* vary in width from 2.5 µm to 7.5 µm with a corresponding difference in size of the setal collars, whereas in *X. acropygae* there is less variation, with the width of the setal bases 3–5 µm. The legs of *X. annandalei* differ from those of *X. acropygae*. In *X. annandalei*, they are longer, with the hind trochanter + femur 440–480 µm long and the hind tibia + tarsus 530–560 µm long. The ratio of lengths of hind tibia + tarsus to those of the hind trochanter + femur is 1.16–1.18 and the most striking difference is the ratio of the hind tibia to tarsus, with the tibia always about twice as long as the tarsus. Besides, the tibiae and tarsi are fairly uniform in width for most of their lengths, although the tarsi narrow and taper distally. In *X. acropygae*, the tarsus is always longer than the tibia and the tibia is swollen before narrowing abruptly to a long slender distal end.

The short flat setae on the dorsum discussed by Williams (1978) are, in fact, sickle-shaped in profile, similar to those of *X. acropygae*.

The third instar discussed by Williams (1978) is now known to be the second instar (Williams, 1988). It is also evident that the first instar discussed by Williams (1978) from Mysore, on coconut roots, is the first instar of *X. acropygae*.

MATERIAL
At present the species is only known from India, Orissa Province, Barkuda I., on roots of *Ficus obtusa* and *F. religiosa*.

REVIEW OF GENERA IN THE RHIZOECINAE

In addition to *Eumyrmococcus* and *Xenococcus*, already discussed, the following genera have been included in the subfamily at one time or another and their current status is discussed.

Tang (1992) erected the subtribes Rhizoecina, Prorhizoecina and Pseudorhizoecina for some of the genera, but this action seems unnecessary. These names, nevertheless, remain available.

The opportunity is taken to describe a new genus from southern Asia because it resembles *Eumyrmococcus* superficially but is clearly more related to *Rhizoecus*.

Brevicoccus Hambleton

Brevicoccus Hambleton, 1946a: 10; Williams & Granara de Willink, 1992: 68. Type species: *Brevicoccus clavisetosus* Hambleton, by original designation and monotypy.

DIAGNOSIS. Body broadly oval, anal lobes poorly developed, each without any development of long setae. Antennae placed close together, strongly geniculate, 4-segmented, last segment triangular. Legs well developed; claws long and narrow, Anal ring fairly simple, with a few cells and 8–16 short knobbed setae. Ostioles present. Eyes absent. Cephalic plate present. Body setae short, clavate. Trilocular pores present. Multilocular disc pores present on venter. Minute oval disc pores present.

COMMENTS. The characters of the anal ring and antennae are distinct and the genus is recognized by most workers as belonging to the Rhizoecinae. This is a monotypic genus, known only from Brazil, and the single species is reported to live on roots of Gramineae and Cyperaceae in ant tunnels.

Capitisetella Hambleton

Capitisetella Hambleton, 1977: 40; Williams & Granara de Willink, 1992: 71. Type species: *Pseudorhizoecus migrans* Green, by original designation and monotypy.

DIAGNOSIS. Body almost pyriform, abdomen constricted slightly near posterior end. Anal lobes not developed, without differentiated anal lobe setae. Antennae placed fairly wide apart, 3-segmented, the third segment tapering, antennal setae clavate. Legs stout, with capitate setae, claws elongate. Anal ring heavily sclerotized, with a few elongate cells and 6 setae. Ostioles absent. Cephalic plate absent. Eyes absent. Body setae all capitate. Trilocular pores present. Multilocular pores absent. Large granular discoidal pores present at posterior end of body.

COMMENTS. The combination of a constriction at the posterior end of the body, reduction of antennal segments to three, the capitate body setae and the absence of ostioles, link this South American genus with *Eumyrmococcus*. In *Capitisetella*, there are a few elongate cells on the anal ring and these are absent in *Eumyrmococcus*. Furthermore, *Capitisetella* lacks the abundant setae on the abdomen, present in *Eumyrmococcus* or even in *Neochavesia*, also possibly related to *Capitisetella*. The single species lives in association with *Acropyga (Rhizomyrma) paramaribensis* (Bünzli, 1935). At present, the genus is accepted in the Rhizoecinae.

Geococcus Green

Geococcus Green, 1902: 262; Williams, 1969b: 508. Type species: *Geococcus radicum* Green, by original designation.

DIAGNOSIS. Body elongate to oval, anal lobes well developed, sclerotized, each terminating in a stout, spine-like seta. Antennae geniculate, 6-segmented. Legs well developed, inner edges of tibia and tarsus with stout setae, claws long and slender. Anal ring with large cells and 6 setae. Ostioles present. Circuli present, raised. Cephalic plate present. Multilocular disc pores present. Trilocular pores present. Large trilocular pores present, usually much larger than the normal trilocular pores. Body setae fairly abundant, short and flagellate.

COMMENTS. The genus is widely accepted in the Rhizoecinae. At present six species are assigned to the genus from South-East Asia, southern Asia and the Indo-Australian Region but there are many species awaiting to be described. The genus is well known for the spread of *G. coffeae* throughout much of the tropics. Although this species was described from Surinam, where it is associated with *Acropyga (Rhizomyrma) paramaribensis* on coffee roots and other plants, it is undoubtedly native to southern Asia.

The peculiar large trilocular pores, always present, may be modified tritubular cerores. It is often difficult to study the anal ring because it is concealed between the sclerotized anal lobes.

Leptorhizoecus gen. nov.

TYPE SPECIES. *Leptorhizoecus deharvengi* sp. n.

DESCRIPTION
Body membranous, elongate, with dilated cephalothorax, abdomen narrow, subparallel, narrowing abruptly to abdominal segment VIII; posterior end of body sclerotized, rounded. Anal lobes not developed; setae on positions of anal lobes not differentiated from other setae on abdominal segment VIII. Anal ring ventral, crescentic, with a single row of minute elongate cells and 6 spine-like setae. Antennae placed close together on venter of head margin, 6-segmented. Legs well developed; with thick pointed setae on inner edge of tibia and tarsus. Claw elongate and slender. Labium narrow, longer than wide. Ostioles and circulus present. Body setae flagellate, mostly short and fairly numerous. Trilocular pores present on dorsum and venter. Quadrilocular pores present next to circulus. Tubular ducts absent.

COMMENTS. This genus is typically rhizoecine but the body shape resembles species of *Eumyrmococcus* in exhibiting a dilated cephalothorax. It differs from *Eumyrmococcus* in possessing 6-segmented antennae, placed close together, and in having ostioles and trilocular pores. The ventral anal ring is unlike any so far described in the Rhizoecinae.

Leptorhizoecus is probably intermediate between the *Rhizoecus* and *Eumyrmococcus* groups and the shape suggests it is possibly attended by ants.

The name *Leptorhizoecus* is based on the Greek word 'Leptos', meaning fine and delicate, combined with the extant genus name *Rhizoecus*.

Leptorhizoecus deharvengi sp. n.

Fig. 28.

DESCRIPTION
Appearance in life not recorded. Adult female on microscope slide elongate, cephalothorax dilated, abdomen subparallel, widening slightly to abdominal segment VII, narrowing abruptly to rounded posterior end, body membranous except for rounded posterior half of apical segment of abdomen; 0.80–0.92 mm long, 0.27–0.36 mm wide; anal lobes not developed, anal lobe setae not differentiated from others on apical segment. Antennae placed close together on ventral head margin, each 115–135 µm long, with 6 segments; falcate setae well developed on segments 5 and 6. Legs well developed; hind trochanter + femur about 92.5 µm long, hind tibia + tarsus 97.5–100.0 µm long, claw slender, elongate and slightly curved, about 27.5 µm long. Ratio of lengths of hind tibia + tarsus to hind trochanter + femur 1.05–1.08. Ratio of lengths of hind tibia to tarsus 0.97–1.00. Leg setae flagellate, placed well apart, inner edges of tibia and tarsus with thicker setae. Labium 77.5–82.0 µm long, about 37.5 µm wide, ratio of length to width 2.06–2.18; longer than clypeolabral shield. Clypeolabral shield with 2 pairs of setae. Circulus slightly oval, about 17.5 µm wide, situated within borders of abdominal segment II; structure difficult to determine in available material. Ostioles present, posterior pair fairly well developed but without associated setae; anterior pair represented by indistinct slits. Anal ring ventral in position, oval to triangular, 25–30 µm wide, with a single row of minute elongate cells in posterior arc, accompanied by 6 stout, elongate-conical setae, each 17.5 µm long (cells and setae actually anterior if ring transferred to dorsum). Eyes present.

Dorsal surface with long setae, each about 60 µm long, on sclerotized apical segment of abdomen; shorter setae, each about 25 µm long, situated at anterior end of apical segment. Anteriorly on abdomen, setae all about 25 µm long, in moderate numbers in well defined bands across middle of segments leaving bare intersegmental areas. Shorter setae, each 12.5–18.0 µm long, present on head and thorax. All setae flagellate. Trilocular pores present, not numerous, evenly distributed among the setae.

Ventral surface with similar distribution of setae to those on dorsum. Multilocular disc pores represented by a few quadrilocular pores, near circulus, each about 5 µm in diameter. Trilocular pores scattered, not so numerous as on dorsum.

MATERIAL

HOLOTYPE. Adult ♀, **Indonesia, Sumatra**, Rantau Pandan, in soil of *Hevea* sp., 9.vi.1991 *(L. Deharveng & A. Bedos)* (MNHN).

PARATYPE. **Indonesia, Sumatra**, same data as holotype. 1 adult ♀ (BMNH).

COMMENTS. The species is named after Louis Deharveng, Université Paul Sabatier, Toulouse, one of the collectors. Dr Deharveng has sent interesting samples from southern Asia collected from Berlese funnel apparatus.

Neochavesia Williams & Granara de Willink

Chavesia Balachowsky, 1957: 158; Beardsley, 1970: . [Preoccupied by *Chavesia* Dollfus, 1889, Isopoda].
Neochavesia Williams & Granara de Willink, 1992: 232 [replacement name]. Type species *Chavesia caldasiae* Balachowsky, by original designation.

DIAGNOSIS. Body in life with tip of abdomen curled to dorsum, scorpion-like. Slide-mounted specimens with cephalothorax dilated, abdomen narrowing to a pair of protuberant, rounded anal lobes bearing many long flagellate setae. Anal ring situated at base of anal lobes, simple, with 6 or a few setae around anterior sclerotized half, without cells. Antennae each with 4 or 5 segments. Legs well developed, tarsi tapering, claws long and slender. Ostioles absent. Circuli conical, each with centre cupped. Labium with 3 pairs of subapical setae. Eyes absent. Body setae short and abundant on cephalothorax, longer and in bands across abdominal segments. Trilocular pores present in type species only, each with a minute internal filament arising from centre of pore. Multilocular disc pores and tubular ducts absent.

COMMENTS. In the strong development of the cephalothorax, the simple anal ring without cells, the absence of ostioles, and the presence of cupped circuli, this South American genus comes closest to *Eumyrmococcus* and *Xenococcus*. Many species originally and provisionally identified as *Eumyrmococcus* in South America, associated with ants of the genus *Acropyga*, refer to *Neochavesia*. The genus is here accepted as belonging to the Rhizoecinae.

Prorhizoecus Miller & McKenzie

Prorhizoecus Miller & McKenzie, 1971: 583. Type species *Prorhizoecus atopoporus* Miller & McKenzie, by original designation and monotypy.

DIAGNOSIS. Body oval, anal lobes not developed; positions of each anal lobe with a single normal apical seta. Antennae each with 4 or 5 segments. Legs well developed, slender, hind coxae with translucent pores. Anal ring heavily sclerotized with thick rim, cells, and 6 setae. Cerarii present on anal lobes, each cerarius with 2 conical setae and a group of trilocular pores. Ostioles present. Eyes present. Body setae short and abundant. Trilocular pores present. Multilocular disc pores present, each with 12 loculi. Tubular ducts present, each with narrow oral rim and heavily sclerotized bulbous duct.

COMMENTS. Although the antennae resemble those of *Rhizoecus*, the other characters, cerarii, translucent pores on the hind coxae, an anal ring with a broad rim, and peculier oral rim ducts, exclude this genus from the Rhizoecinae. The single species is known only from Mexico and feeds on grass roots. The genus may be related to *Cryptoripersia* Cockerell or *Syrmococcus* Ferris.

Pseudorhizoecus Green

Pseudorhizoecus Green, 1933: 55; Hambleton, 1977: 38; Williams & Granara de Willink, 1992: 463. Type species *Pseudorhizoecus proximus* Green, by original designation.

DIAGNOSIS. Body rotund; anal lobes not developed, without differentiated anal lobe setae. Antennae placed close together, each with 5 segments, tapering. Legs well developed, tarsi tapering, claws long and slender. Anal ring terminal, wider than long, irregularly outlined, with 2–5 short setae, a few small cells, and numerous protuberances. Ostioles, eyes and cephalic plate absent. Body setae abundant, short and flagellate. Trilocular pores present.

COMMENTS. This unusual genus is probably related to *Capitisetella* but the anal ring possesses numerous protuberances and all the body setae are flagellate. The only included species has a fairly wide distribution in Central and South America and is associated with *Acropyga (Rhizomyrma) rutgersi* and *A. paramaribensis*.

The adult male is morphologically degenerate, without wings, resembling the adult female in body shape and possessing similar 5-segmented antennae. Beardsley (1970) remarked that the genitalia appeared to be similar to the genitalia of *Capitistella* and *Neochavesia*.

Pygmaeococcus McKenzie

Pygmaeococcus McKenzie, 1960: 741. Type species *Pygmaeococcus morrisoni* McKenzie, by original designation and monotypy.

DIAGNOSIS. Body of adult female minute, elongate, anal lobes not developed, position of each lobe with 1 long ventral and 2 long dorsal setae, forming a group of 3. Antennae each with 5 segments. Legs well developed, with stout, spinose setae present on inner edges of tibiae and tarsi; claw long and slender, digitules clavate, equalling or surpassing claw in length. Cephalic plate present. Anal ring terminal, with elongate-oval cells and 6 long setae. Ostioles present. Circulus present. Eyes present. Body setae short and sparse. Trilocular pores present. Tubular ducts present, each heavily sclerotized and slightly dome-shaped at inner end with, apparently, a septum. Bitubular and tritubular cerores absent.

COMMENTS. The only distinguishing characters separating this monotypic genus from *Rhizoecus* is the unusual type of duct. The genus, known from California, is accepted by most workers on scale insects but further related species may help to clarify its position.

Rhizoecus Künckel d'Herculais

Rhizoecus Künckel d'Herculais, 1878: 163. Type species *Rhizoecus falcifer* Künckel d'Herculais, by monotypy.

Ripersiella Tinsley, in Cockerell 1899:278. Type species *Ripersia rumicis* Maskell, by subsequent designation of Cockerell, 1901: 165. Synonymised by Hambleton, 1974: 147.

Pararhizoecus Goux, 1941: 197, as a subgenus of *Rhizoecus*. Type species *Rhizoecus (Pararhizoecus) petiti* Goux, by original designation and monotypy.

Synonymised with *Ripersiella* by Morrison & Morrison, 1966: 147, and with *Rhizoecus* by Ben-Dov, 1994: 286.

Morrisonella Hambleton, 1946a: 16. Type species *Morrisonella poensis* Hambleton, by original designation. Homonym of *Morrisonella* Bartsch, 1920. Synonymised by Ferris, 1953: 426.

Radicoccus Hambleton, 1946a: 47. Williams & Granara de Willink, 1992: 492. Type species *Rhizoecus globosus* James, by original designation. **Syn. nov.**

Coccidella Hambleton, 1946b: 177. Replacement name for *Morrisonella* Hambleton. Synonymised by Ferris, 1953: 426.

Neorhizoecus Hambleton, 1946a: 40. Type species *Rhizoecus coffeae* Laing, by original designation. Synonymised by Lindinger, 1957: 550.

DIAGNOSIS. Body normally small, elongate to rotund, anal lobes usually not developed, their positions each usually with 3 long anal lobe setae, or more rarely, with numerous setae. Antennae usually placed close together, short, strongly geniculate, each with 5 or 6 segments, these often wider than long, terminal segment tapering, almost triangular; with sensory falcate setae well developed on terminal and penultimate segments, these in addition to normal flagellate setae. Labium elongate, longer than wide. Anal ring with 6 setae, these usually flagellate or occasionally clavate; with fairly large elongate to triangular cells that can easily be counted to distinguish between species. Legs normally well developed; tarsus tapering to a long slender claw with short setose or dilated digitules, sometimes about as long as claw; without translucent pores but occasionally with large vacuolate pores; setae on inner edges of tibia and tarsus often elongate spine-like. Eyes present or absent. Circulus present or absent, when present usually truncate conical, distal surface often reticulate or faveolate, usually situated on abdominal segment III within borders of segment; sometimes as many as 6 circuli present distributed singly among other abdominal segments and occasionally present on metathorax. Ostioles present, placed well on dorsum, sometimes reduced to posterior pair only and occasionally barely perceptible. Frons often with sclerotized cephalic plate.

Body setae usually short and flagellate, often abundant, rarely very sparse. Bilocular or trilocular cerores present, never both types present together, rarely absent altogether. Trilocular pores present, often abundant, sometimes few. Tubular ducts present or absent, when present usually minute with parallel or subparallel sides. Multilocular disc pores present or absent. Medioventral pore groups sometimes present on abdomen. Mushroom bodies occasionally present on dorsum and venter.

COMMENTS. The above description should be adequate to separate the genus from all others discussed here. The tritubular and bitubular cerores are unique to the genus and some attempts have been made to distinguish between *Rhizoecus* with tritubular cerores and *Ripersiella* with bitubular cerores but there are many variations of the cerores. Sometimes the tubes of the bitubular cerores are so appressed as to appear unitubular and often their true structure can only be determined by the use of oil immersion. Besides, *R. andensis* (Hambleton) and *R. colombiensis* Hambleton, both South American species, and *R. cobelopus* Williams from Australia, are without either type but appear to be congeneric in other characters.

Emphasis on the presence or absence of eyes, the length and type of the claw digitules, and the shape of the bitubular and tritubular cerores to distinguish among genera has been challenged by Takagi & Kawai (1971) who commented on the variability of these characters.

The position of *Radicoccus* needs special mention. Hambleton (1946a) erected this genus for five species, each with a fairly stout body, the legs and antennae, although well developed, are minute for the size of body, and body setae are sparse. The species show widely diverse characters but these fall within the present concepts of *Rhizoecus*. These five species and another transferred since, are discussed as follows:

Rhizoecus globosus James. This African species, was illustrated by De Lotto (1957) and, considering the poor material on which the illustration was based, the illustration is fairly comprehensive. Some further notes are now added although a study of fresh material is needed. The species possesses 3 circuli and large tritubular cerores of two distinct sizes, each with short stout ducts giving the whole ceroris a flat appearance. Anterior and posterior ostioles are present although they are small and almost imperceptible.

Rhizoecus incrassatus James. This African species is similar to *R. globosus*, differing in possessing only 2 circuli and tritubular cerores of one size. Anterior and posterior ostioles are present. The species was illustrated by De Lotto (1957).

Rhizoecus kelloggi Ehrhorn & Cockerell. This North American species has sparse body setae, lacks bitubular or tritubular cerores but possesses distinctive tubular ducts, each with the orifice elliptical; nevertheless, the sides of each duct are parallel. Ostioles are present although they are represented by mere slits (D.R. Miller, personal communication). There are no good reasons to exclude this species from *Rhizoecus*.

Radicoccus hawaiiensis Hambleton. It was shown by Beardsley (1966) that this species possesses all the characters of *Rhizoecus* to which it was transferred.

Rhizoecus poltavae Laing. For some reason this species, described from Ukraine, has always been regarded as distinct in lacking bitubular or tritubular cerores but bitubular cerores are plainly discernible in the original material, a character noted by Matile-

Ferrero (1976) who included the species in *Ripersiella*. The species is here retained in *Rhizoecus*.

Rhizoecus cocois Williams. Although this species, described from India, was transferred to *Radicoccus* by Tang (1992) because of the globular body and paucity of body setae, the action was unnecessary. The species is related to *R. globosus* and *R. incrassatus* and should be retained in *Rhizoecus*.

All the species, therefore, that have been assigned to *Radicoccus* can be comfortably included in *Rhizoecus* and the name *Radicoccus*, as listed by Ben-Dov (1994), is here synonymised with *Rhizoecus*.

Key to Genera of the Subfamily Rhizoecinae (Adult Females)

1 Anal ring with protuberances; anal ring setae short, much shorter than diameter of anal ring, numbering 2–5, unevenly distributed .... ***Pseudorhizoecus*** (p. 28)

– Anal ring without protuberances, anal ring setae conspicuous, usually at least as long as diameter of anal ring or almost as long, numbering 6–16, distributed evenly on ring or detached from ring and lying in an arc anterior to ring (sometimes anal ring masked by heavily sclerotized anal lobes) 2

2 Anal ring distinctly ventral in position, with a single row of elongate cells and thick spine-like anal ring setae around posterior edge (actually anterior edge if transferred to dorsum) .... ***Leptorhizoecus*** (p. 27)

– Anal ring always dorsal in position, anal ring setae not spine-like, at least the 2 anterior pairs slender. Cells present or absent 3

3 Anal ring with large elongate to triangular cells, anal ring setae arising from surface of anal ring. Body rotund, elongate-oval or weakly pyriform, never with cephalothorax strongly dilated. Circulus, if present, never cupped in centre. Ostioles present or absent. Tubular ducts present or absent. 4

– Anal ring simple, without elongate cells, anal ring setae detached from ring or at edge of ring, usually lying in an arc anterior to ring, sometimes difficult to distinguish from dorsal setae of abdominal segment VIII. Cephalothorax dilated, abdomen narrow, tapering (in *E. neoguineensis*, the cephalothorax is dilated but the abdomen widens before tapering). Circulus, if present, cupped in centre, even if only shallowly. Ostioles always absent. Tubular ducts always absent 8

4 All body setae knobbed. Antennae each with 3 or 4 segments 5

– All body setae flagellate. Antennae each with 5 or 6 segments 6

5 Antennae each with 4 segments. Multilocular disc pores present. Anal ring with 8–16 short capitate setae .... ***Brevicoccus*** (p. 26)

– Antennae each with 3 segments. Multilocular disc pores absent. Anal ring with 6 pointed setae .... ***Capitisetella*** (p. 26)

6 Anal lobes well developed, protruding well beyond posterior end of body, each lobe terminating in a stout spine-like seta .... ***Geococcus*** (p. 26)

– Anal lobes barely perceptible or not developed. Any setae on anal lobes or on normal positions of anal lobes, flagellate, not spine-like 7

7 Body with conspicuous dome-shaped tubular ducts, each heavily sclerotized. Bitubular and tritubular cerores always absent .... ***Pygmaeococcus*** (p. 28)

– Body without conspicuous dome-shaped tubular ducts; if tubular ducts are present they are minute with parallel or subparallel sides. Bitubular or tritubular cerores often present. Body setae usually abundant, rarely sparse .... ***Rhizoecus*** (p. 28)

8 Anal lobes protruding, rounded, each with numerous flagellate setae. Antennae each with 4 or 5 segments. Anal opening situated at base of anal lobes. Trilocular pores present or absent. Circuli present .... ***Neochavesia*** (p. 27)

– Anal lobes not protruding, posterior end of body rounded, each lobe often with long setae, sometimes almost as long as body. Circuli present or absent. Antennae each with 1–4 segments. Trilocular pores always absent 9

9 Antennae short, each with 2–4 segments; any articulation between first and second segments poorly developed. Claws normally long and slender except in one species with stout claws. Minute setae abundant, always present on dorsum and venter of abdomen, most on abdomen sometimes replaced with short sickle-shaped setae. Clavate sensory setae present or absent on body ***Eumyrmococcus*** (p. 8)

– Antennae conspicuously long, always with 4 segments, almost as long as body, the first and second segments with well developed articulation, the proximal end of second segment with small points which fit into grooves at distal end of first segment. Claws long and slender. Minute setae abundant on dorsum of abdomen only, absent from venter of abdomen; ventral setae on abdomen mostly long and stout. If sickle-shaped setae are present they form small groups on thorax only. Clavate sensory setae always absent .... ***Xenococcus*** (p. 22)

LIST OF RHIZOECINAE ASSOCIATED WITH *ACROPYGA* WITH DISCUSSION OF SPECIFICITY OF THE MEALYBUG-ANT ASSOCIATIONS

Eumyrmococcus corinthiacus, Greece, with *Acropyga (Rhizomyrma) paleartica*, with queen in flight.

Eumyrmococcus falciculosus, Sumatra with ? ant, primary forest litter, *Hevea* soil.

Eumyrmococcus kolombangarae, Solomon Islands, with *Acropyga (Rhizomyrma) lauta* in log, queen in flight.

Eumyrmococcus kruiensis, Sumatra, with ? ant, in soil.

Eumyrmococcus kusiacus, Solomon Islands, with *Acropyga (Rhizomyrma) lauta* in log, queen in flight.

Eumyrmococcus lamondicus, Australia, with *Acropyga* sp. in rotting wood.

Eumyrmococcus lanuginosus, Sumatra, with 'ants'.

Eumyrmococcus maninjauensis, Sumatra, with ? ants, in soil.

Eumyrmococcus neoguineensis, Papua New Guinea, with *Acropyga (Atopodon) ambigua*, in rotting log.

Eumyrmococcus nipponensis, Japan, with *Acropyga (Atopodon) nipponensis*, on rootlets of plants or in rotten wood.

Eumyrmococcus recalvus, Australia, with *Acropyga* sp.

Eumyrmococcus sarawakensis, Sarawak, with *Acropyga* sp.

Eumyrmococcus scorpioides, South Africa, with *Acropyga (Malacomyrma) arnoldi*, in nests and mandibles.

Eumyrmococcus smithii, S.E. Asia, with *Acropyga (Rhizomyrma) sauteri*, in nests.

Eumyrmococcus sulawesicus, Sulawesi, with *Acropyga* sp., rain forest.

Eumyrmococcus taylori, Australia, *Acropyga* sp., in nests.

Eumyrmococcus sp., Papua New Guinea, with *Acropyga (Rhizomyrma) oceanica*, in log.

Eumyrmococcus sp., Papua New Guinea, with *Acropyga* sp., in rainforest.

Xenococcus acropygae, Southern Asia, Australasia, with *Acropyga (Acropyga) acutiventris*, *A. (Atopodon) ambigua*, *A. (Rhizomyrma) lauta*, in nests and mandibles of flying queens.

Xenococcus annandalei, India, with *Acropyga (Acropyga) acutiventris*, in nests and with flying queens.

Neochavesia caldasiae, Colombia, Trinidad, with *Acropyga (Rhizomyrma) robae*.

Neochavesia eversi, Colombia, Panama, with *Acropyga (Rhizomyrma) kathryna*.

Neochavesia trinidadensis, Colombia, Trinidad, with *Acropyga* sp.

Neochavesia weberi, Guyana, with *Acropyga (Rhizomyrma) paludis*.

Capitisetella migrans, Colombia, Guyana, Surinam, Trinidad, with *Acropyga (Rhizomyrma) rutgersi*.

Pseudorhizoecus proximus, Colombia, Costa Rica, Ecuador, Guatemala, Surinam, with *Acropyga (Rhizomyrma) rutgersi*, *A. (Rhizomyrma) paramibensis*.

Rhizoecus coffeae, Brazil, Costa Rica, Surinam, with *Acropyga (Rhizomyrma) paramibensis*.

Rhizoecus caladii, Brazil, Colombia, Guyana, Surinam, with *Acropyga (Rhizomyrma) paramibensis*.

Rhizoecus moruliferus (= R. flalcifer), Surinam, Trinidad, with *Acropyga (Rhizomyrma) paramibensis*.

Geococcus coffeae, South America, with *Acropyga (Rhizomyrma) paramibensis*.

Where possible the ant species are listed in the four subgenera of *Acropyga* presented by Bolton (1995a). Other Rhizoecinae associated with *Acropyga* species in South America have been recorded mentioning mealybug genera only. It is not certain if voucher specimens were kept and at present the species cannot be identified.

There is no doubt that *Xenococcus acropygae* and *X. annandalei* are always attented by *Acropyga (Acropyga) acutiventris* and the mealybug may be found eventually wherever the ant is located. The symbiotic association suggests that neither ant nor mealybug can live without the other. Taylor (1992) discusses the distribution of the ant in more detail with special reference to Australia. Records of *A. (Atopodon) ambigua* in Papua New Guinea and of *A. (Rhizomyrma) lauta* in the Solomon Islands, associated with *X. acropygae*, cannot be taken too seriously because they are listed from spirit material only. The type locality of *A. acutiventris* is Sri Lanka but so far no species of *Xenococcus* have been reported from there despite extensive collecting of mealybugs by E.E. Green at the beginning of this century.

A much better picture of ant-mealybug specificity would have emerged if some of the ants had been identified and recorded. Present records indicate that each species of *Eumyrmococcus* may be attended by a different ant species. The type species of *Eumyrmococcus*, *E. smithii*, has an apparent wider distribution than any other in the genus and it is always attended by *A. (Rhizomyrma) sauteri*. *E. kolombangarae* and *E. kusiacus*, two closely-related species, are attended by *A. (Rhizomyrma) lauta* in the Solomon Islands but the mealybugs are known from only a few specimens. *E. neoguineensis* is attended by *A. (Atopodon) ambigua* in Papua New Guinea and an interesting species of *Eumyrmococcus*, known from immatures only, is associated with *A. (Rhizomyrma) oceanica*. these mealybugs in the Solomon Islands and Papua New Guinea live close to colonies of *A. acutiventris* attending *X. acropygae*.

In Europe, *E. corinthiacus* is apparently associated with *A. (Rhizomyrma) paleartica* and *E. scorpioides* in South Africa is attended by *A. (Malacomyrma) arnoldi*.

Central and South American mealybug species in other genera are always associated with *Rhizomyrma*, the only subgenus in the area, and normally each mealybug species appears to be specific to a particular ant species.

The wide gap in records of *Eumyrmococcus* between Europe and South Africa in the west and southern Asia and Australasia in the east may be due to lack of collecting. Another possibility could be that species of *Eumyrmococcus* have been collected there but, at present, are lying in ant vials waiting to be sorted or are present in soil sample material extracted by students of Acari or Collembola.

There must be instances when ant species overlap and it seems difficult to believe that any species of *Acropyga* would reject a strange species of *Eumyrmococcus* if it were offered. *Geococcus coffeae* is readily attended by *A. (Rhizomyrma) paramaribensis* in Brazil although the mealybug originated in southern Asia.

These listed associations probably represent only a fraction of similar *Acropyga*-mealybug associations throughout southern Asia and Australasia. The associations may be widespread and just await further study.

The mealybug–ant system offers itself as an excellent future candidate for detailed coevolutionary studies based on independent cladistic analyses of the partner groups.

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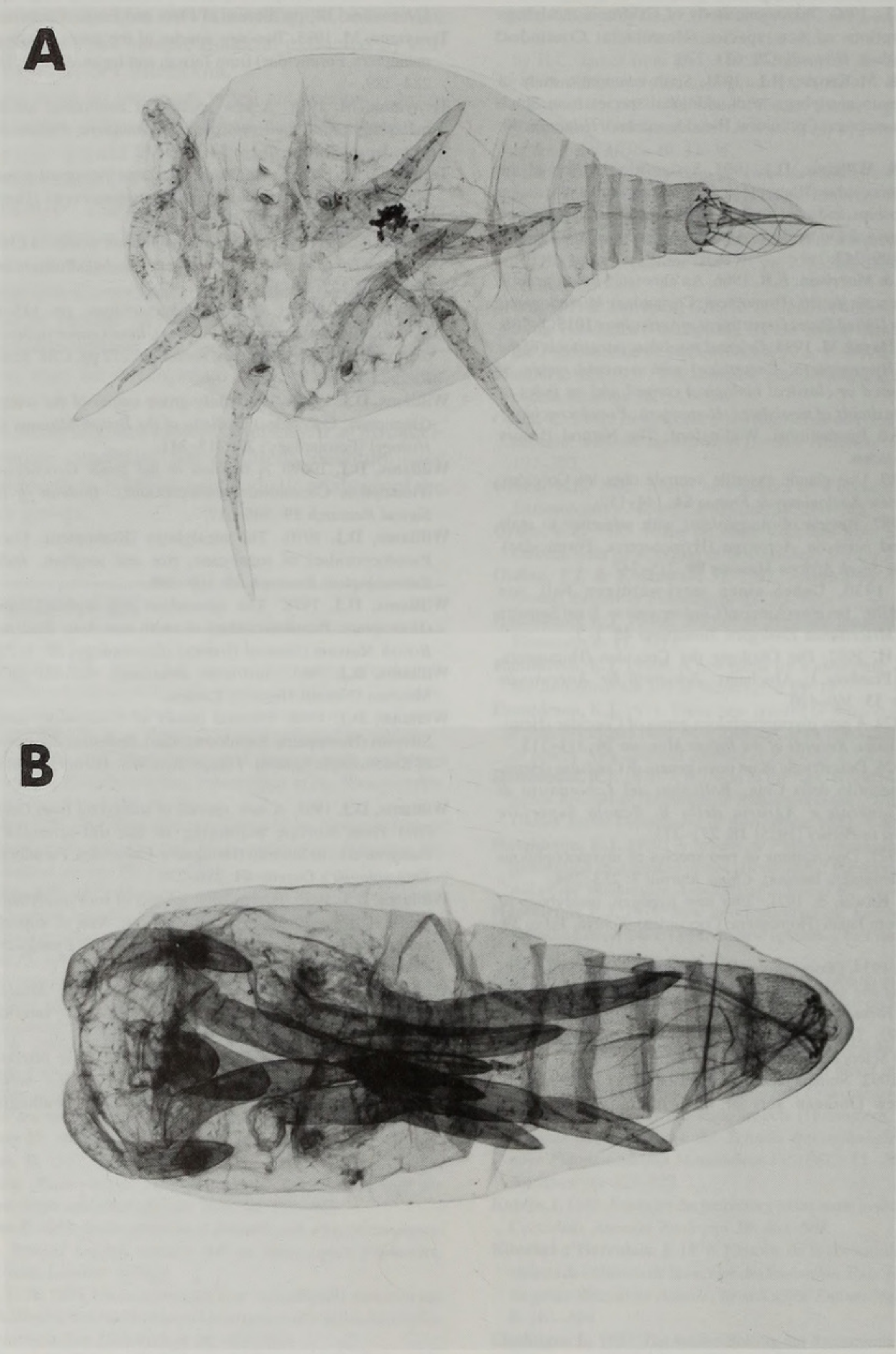

Fig. 1 *Eumyrmococcus taylori* sp. n. A. Male pupa enclosing adult male. B. Female pupa enclosing adult female.

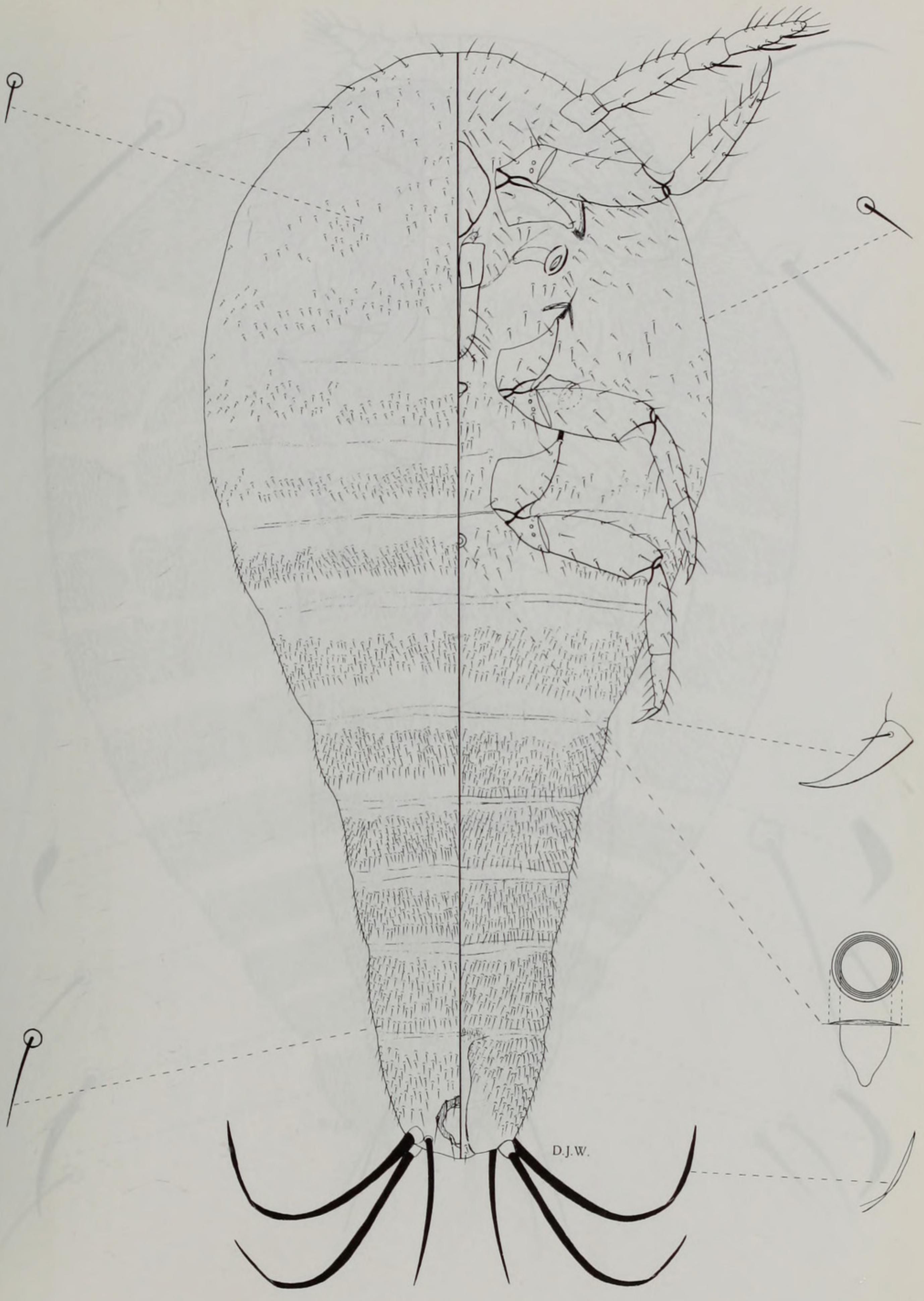

Fig. 2 *Eumyrmococcus corinthiacus* Williams. Adult female.

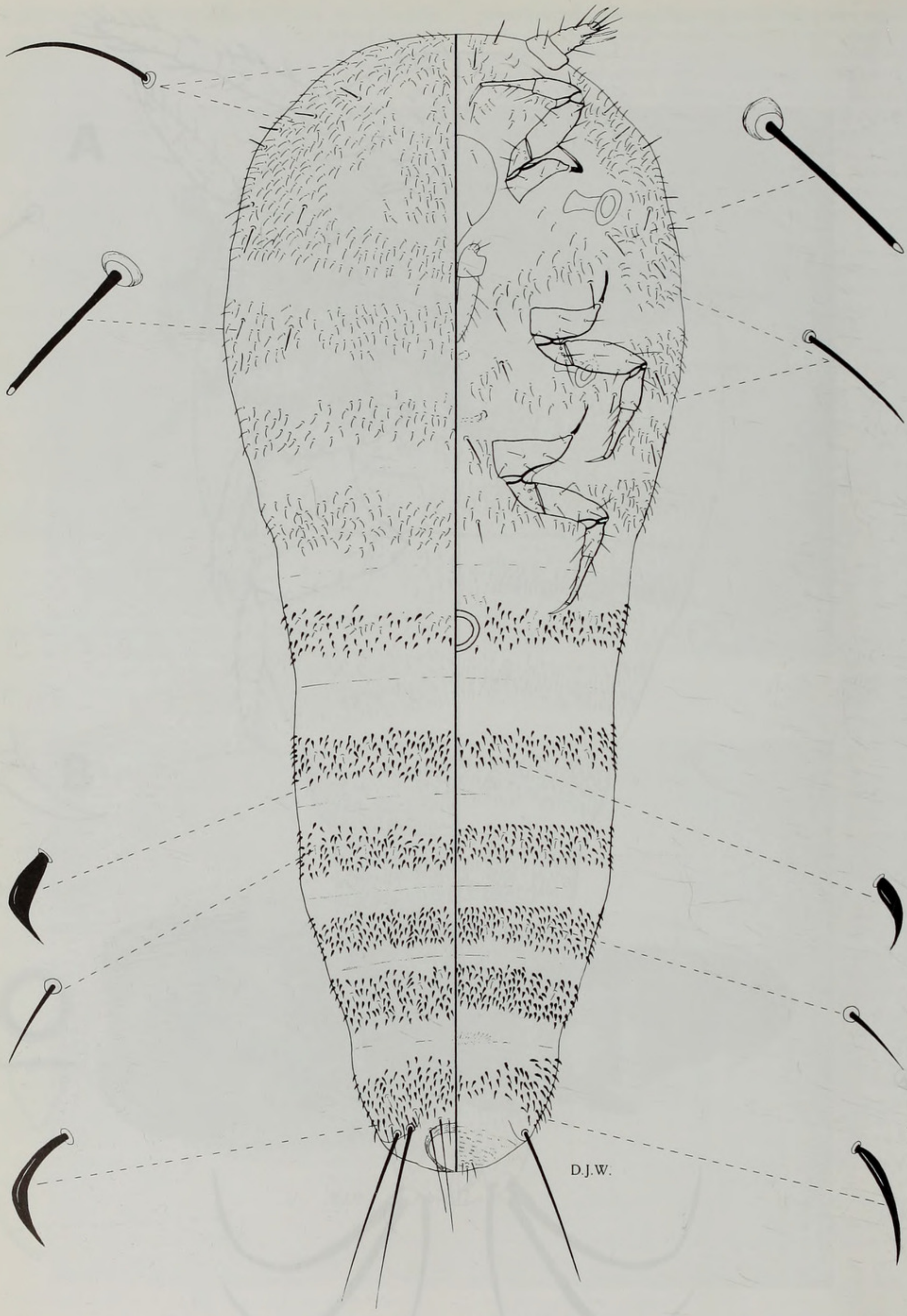

Fig. 3 *Eumyrmococcus falciculosus* sp. n. Adult female.

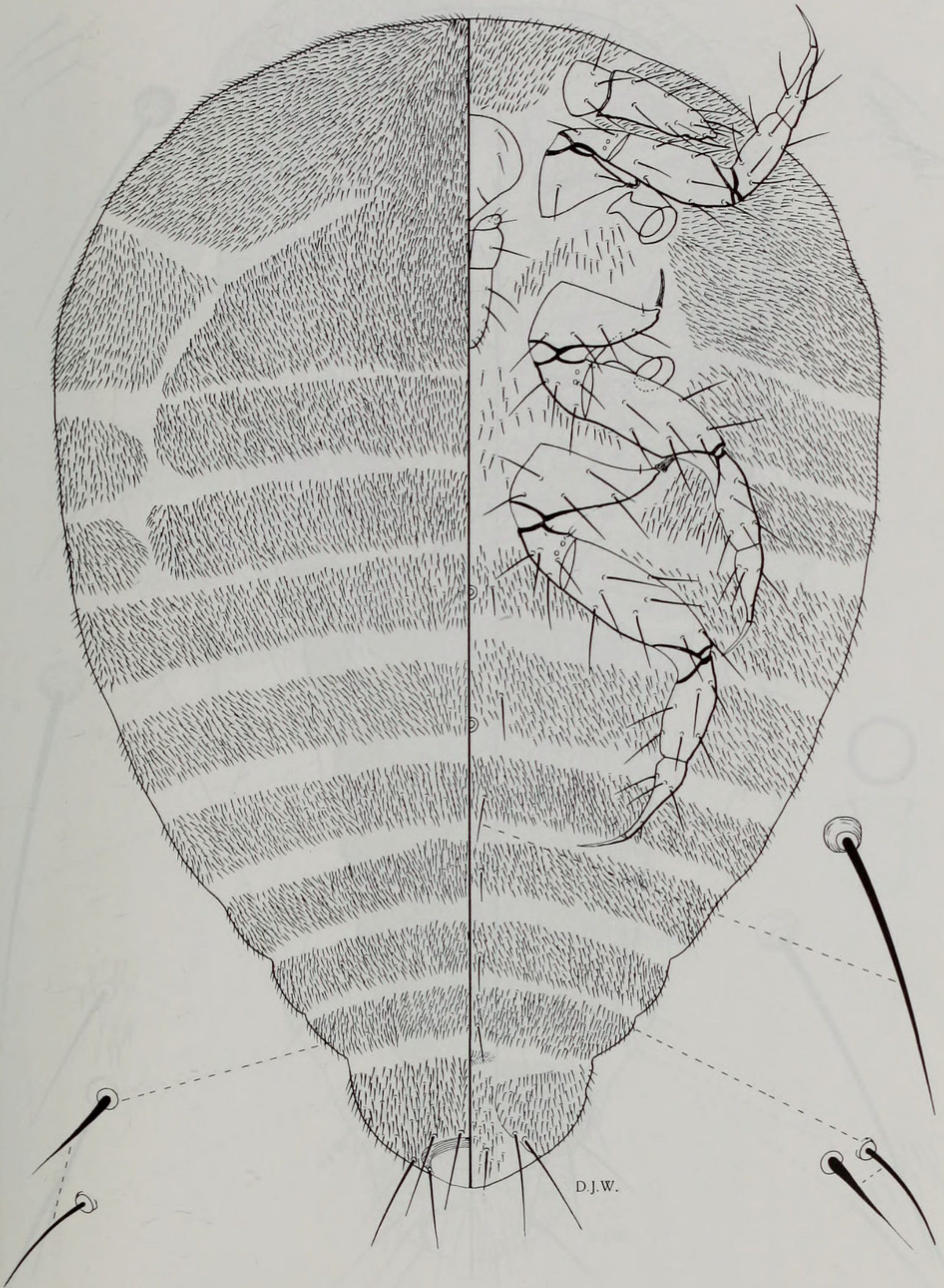

Fig. 4 *Eumyrmococcus kolombangarae* sp. n. Adult female.

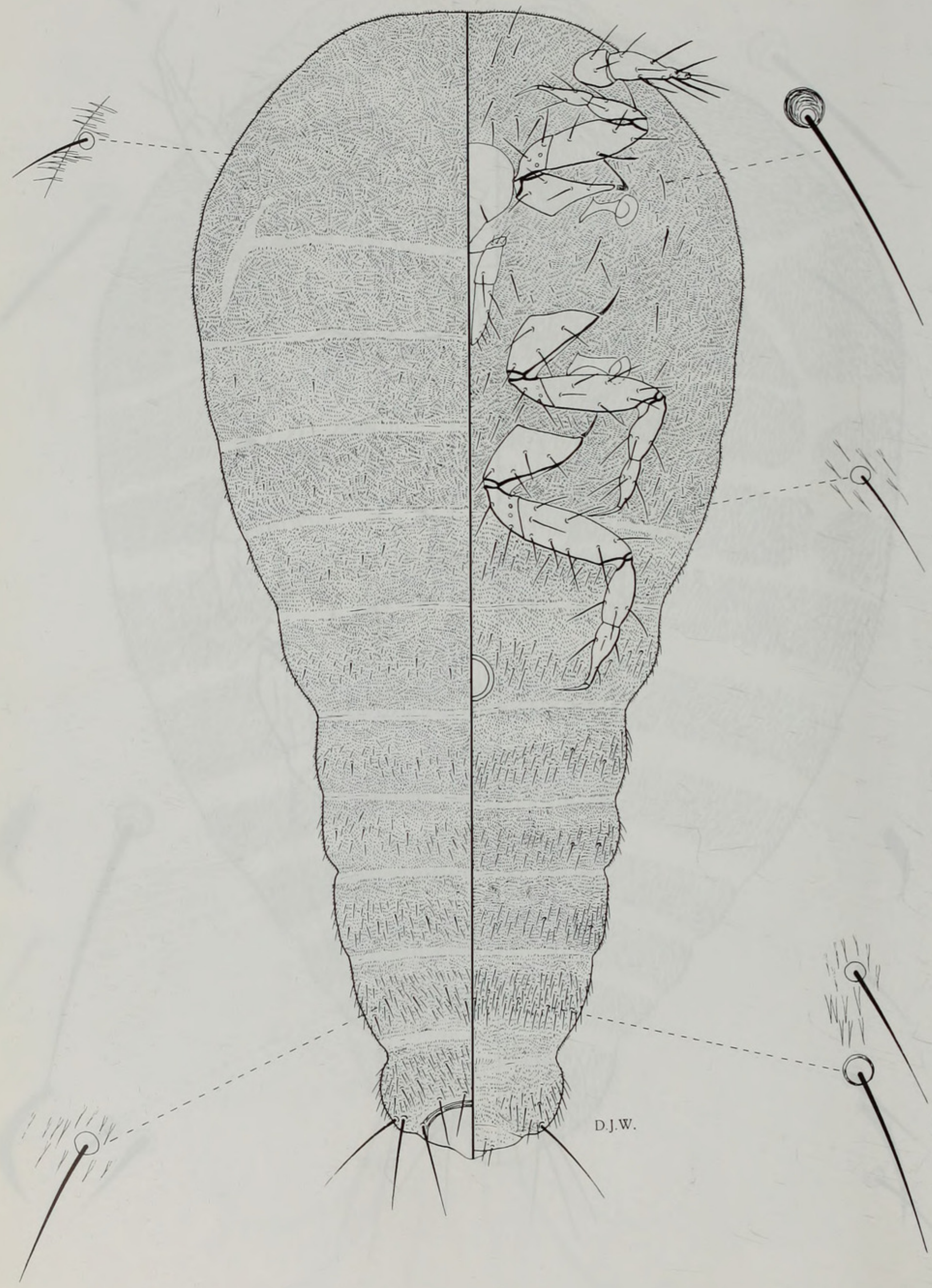

Fig. 5 *Eumyrmococcus kruiensis* sp. n. Adult female.

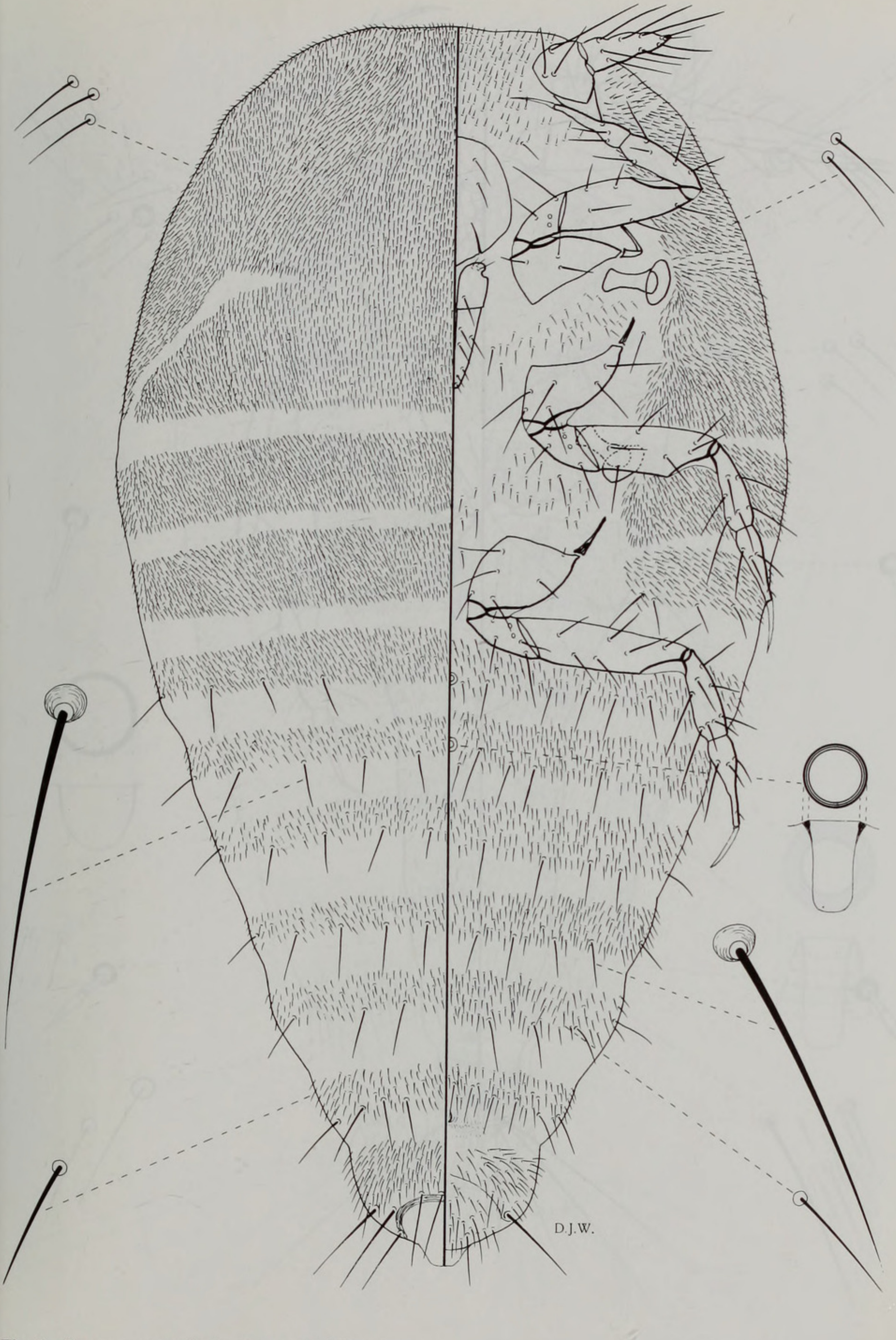

Fig. 6 *Eumyrmococcus kusiacus* sp. n. Adult female.

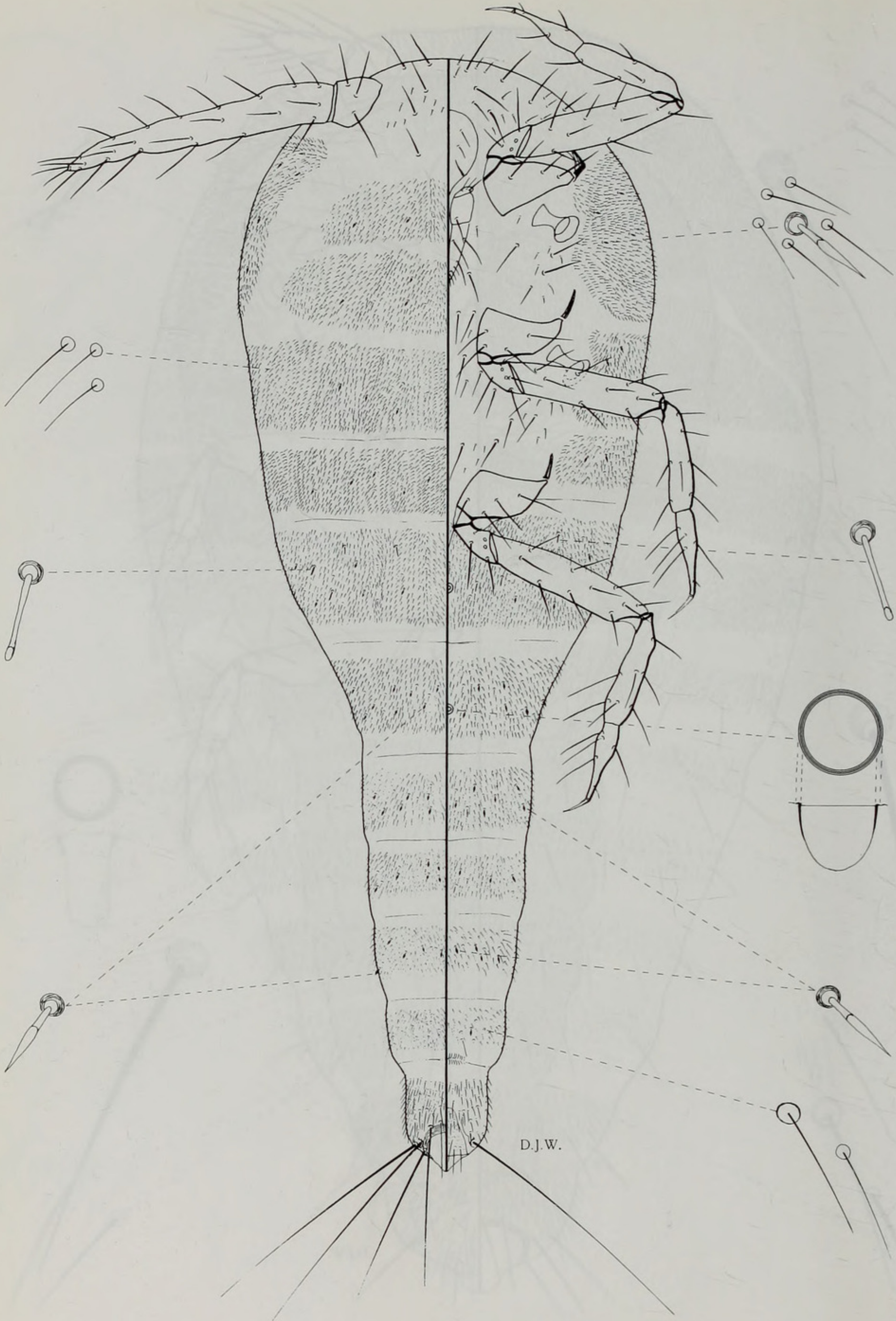

Fig. 7 *Eumyrmococcus lamondicus* sp. n. Adult female.

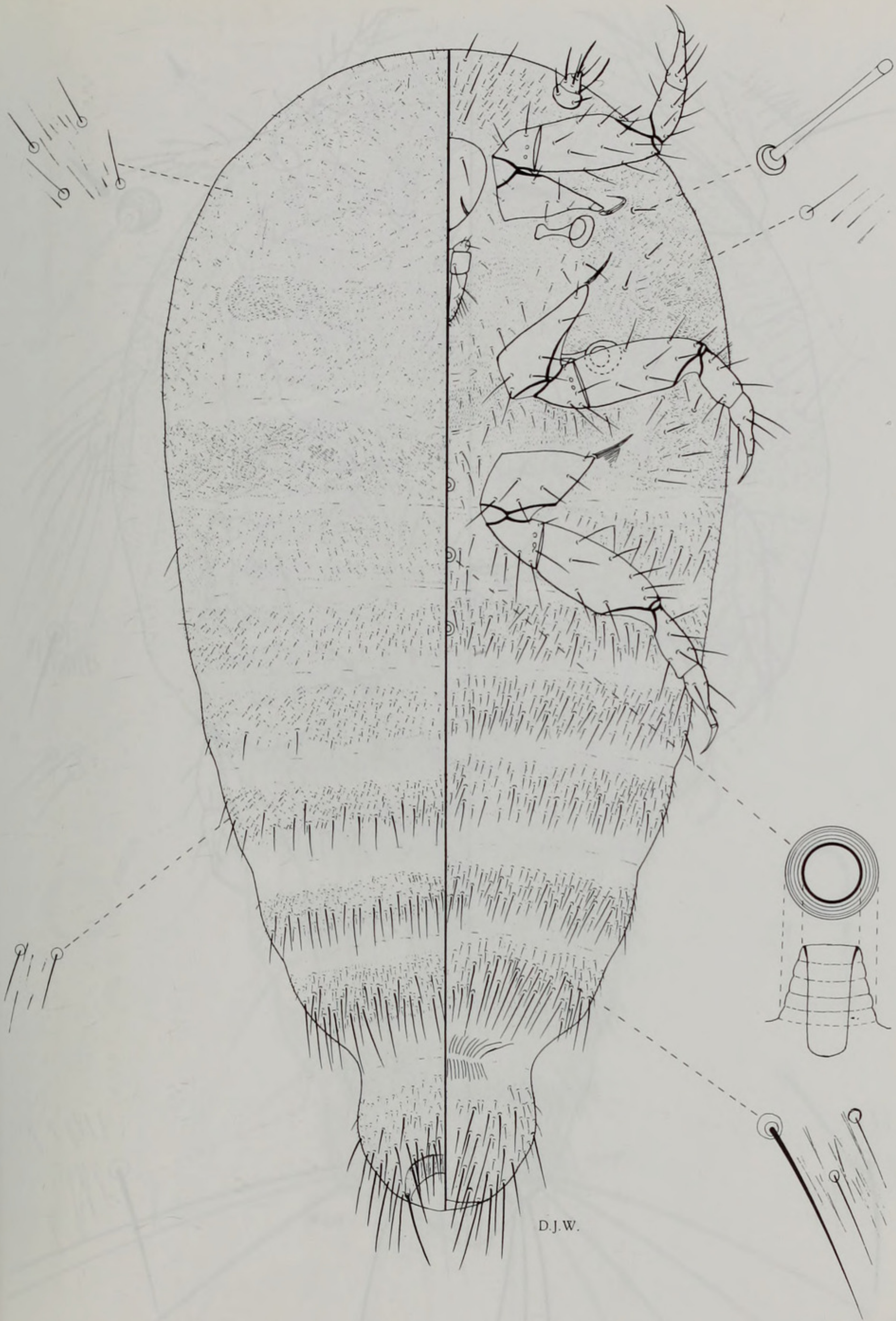

Fig. 8 *Eumyrmococcus lanuginosus* sp. n. Adult female.

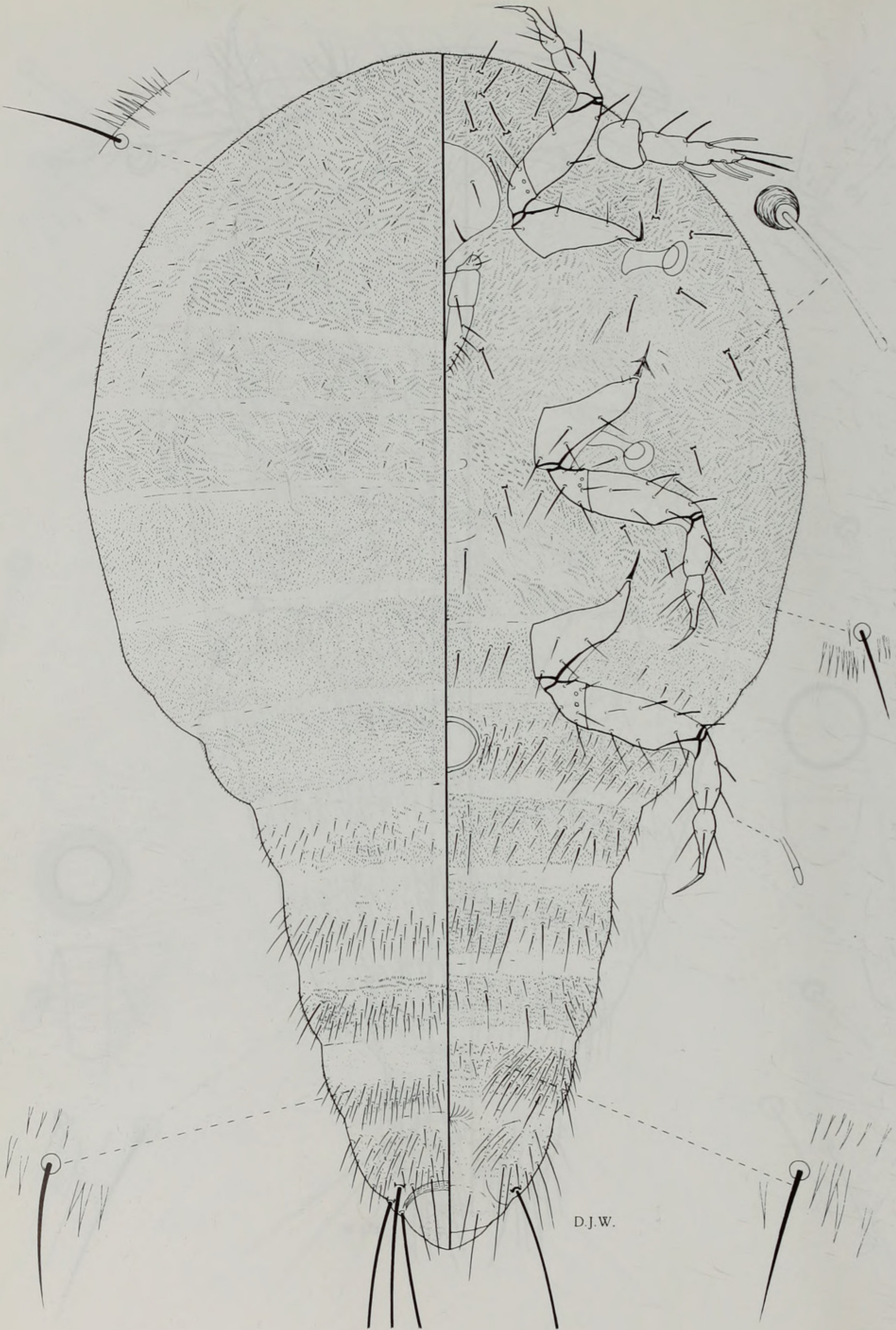

Fig. 9 *Eumyrmococcus maninjauensis* sp. n. Adult female.

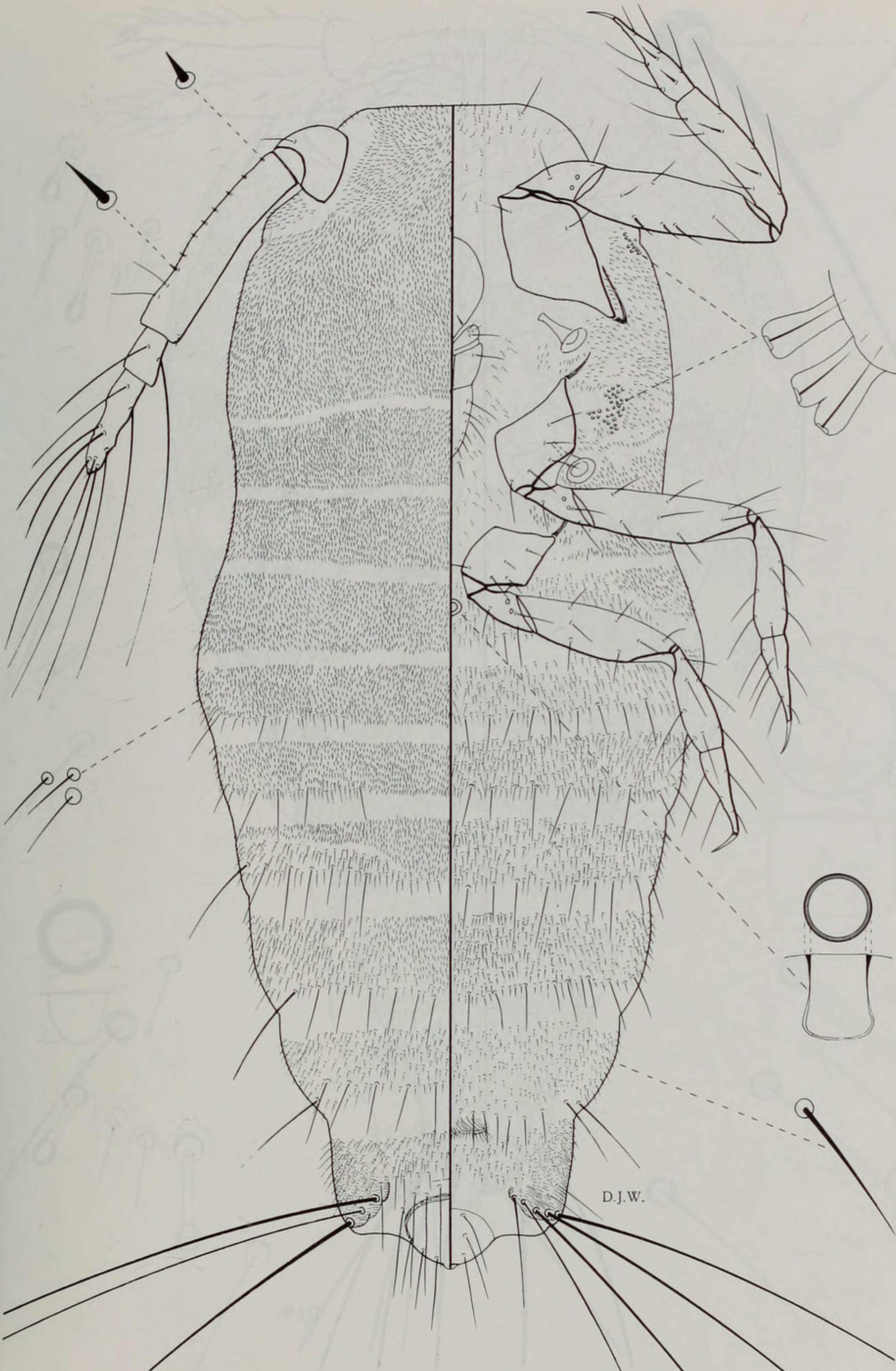

Fig. 10 *Eumyrmococcus neoguineensis* sp. n. Adult female.

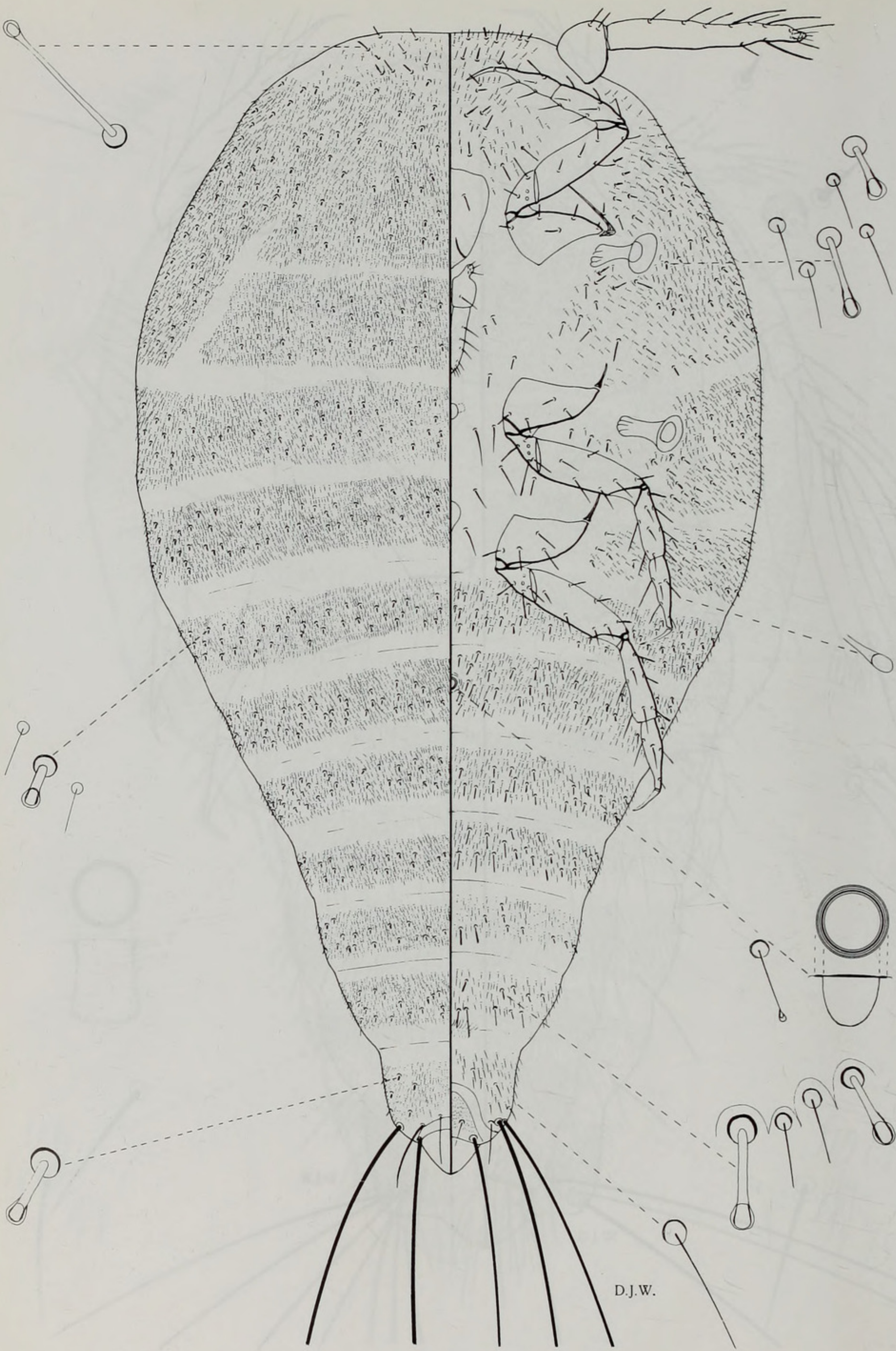

Fig. 11 *Eumyrmococcus nipponensis* Terayama. Adult female.

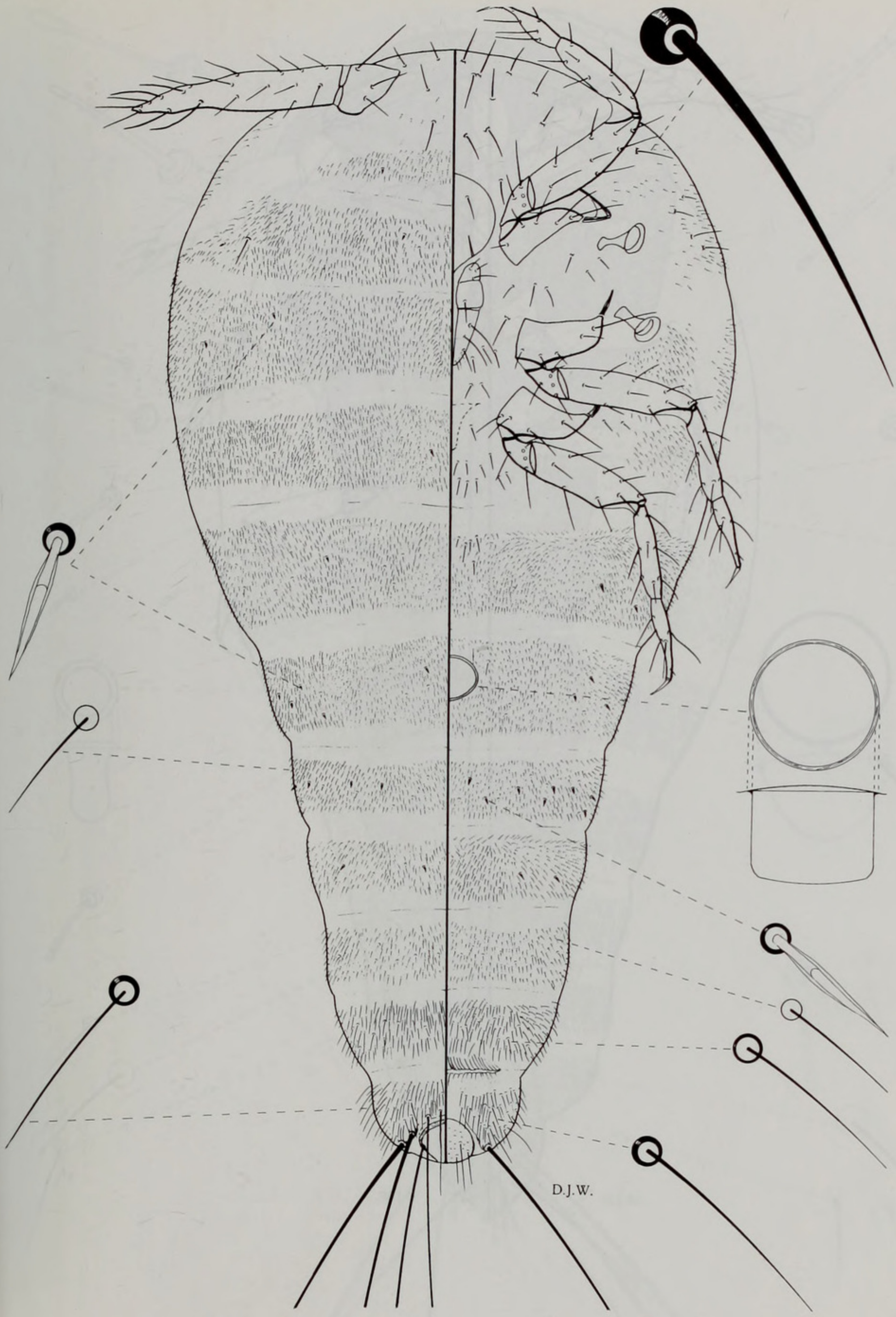

Fig. 12 *Eumyrmococcus queenslandicus* sp. n. Adult female.

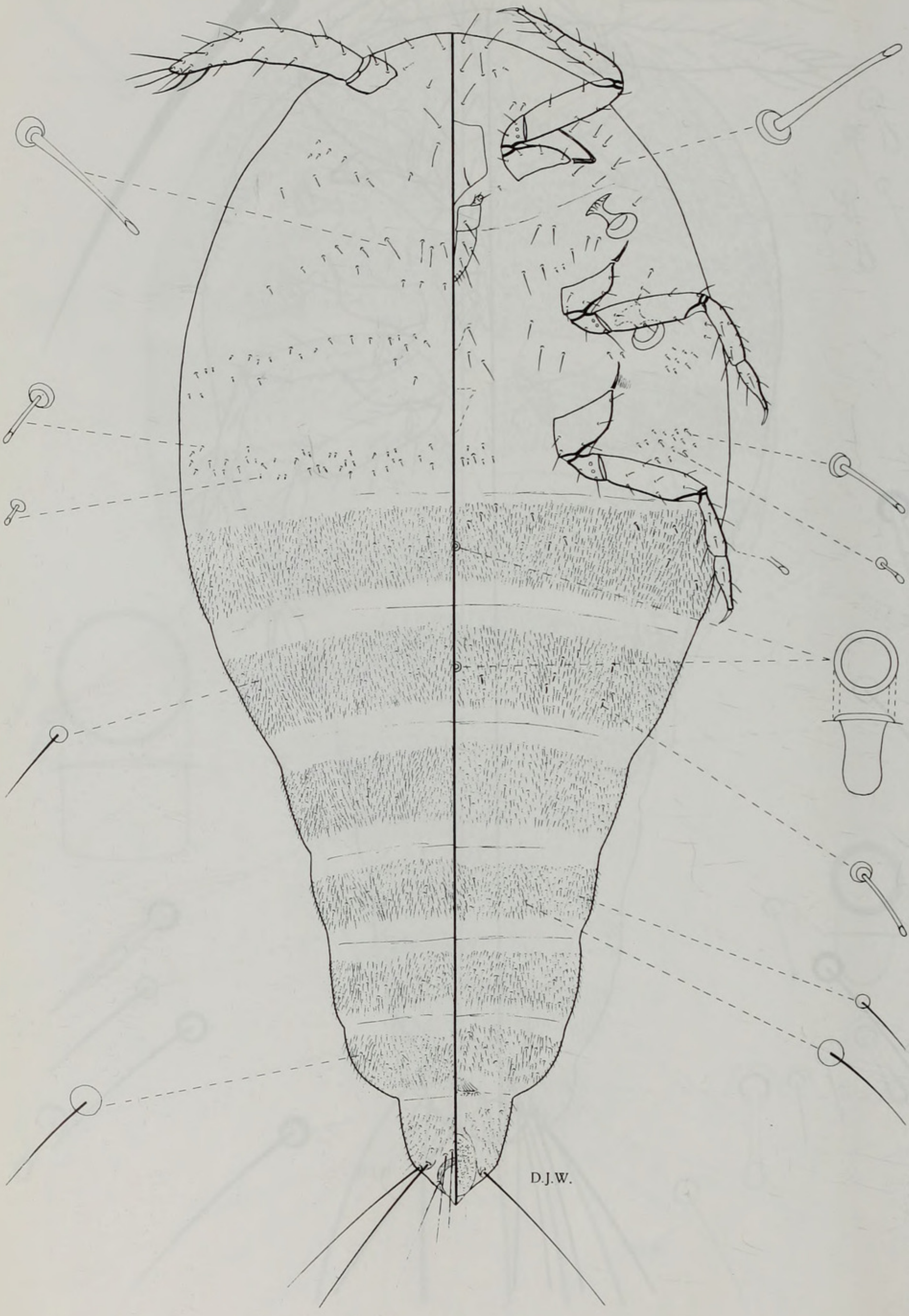

Fig. 13 *Eumyrmococcus recalvus* sp. n. Adult female.

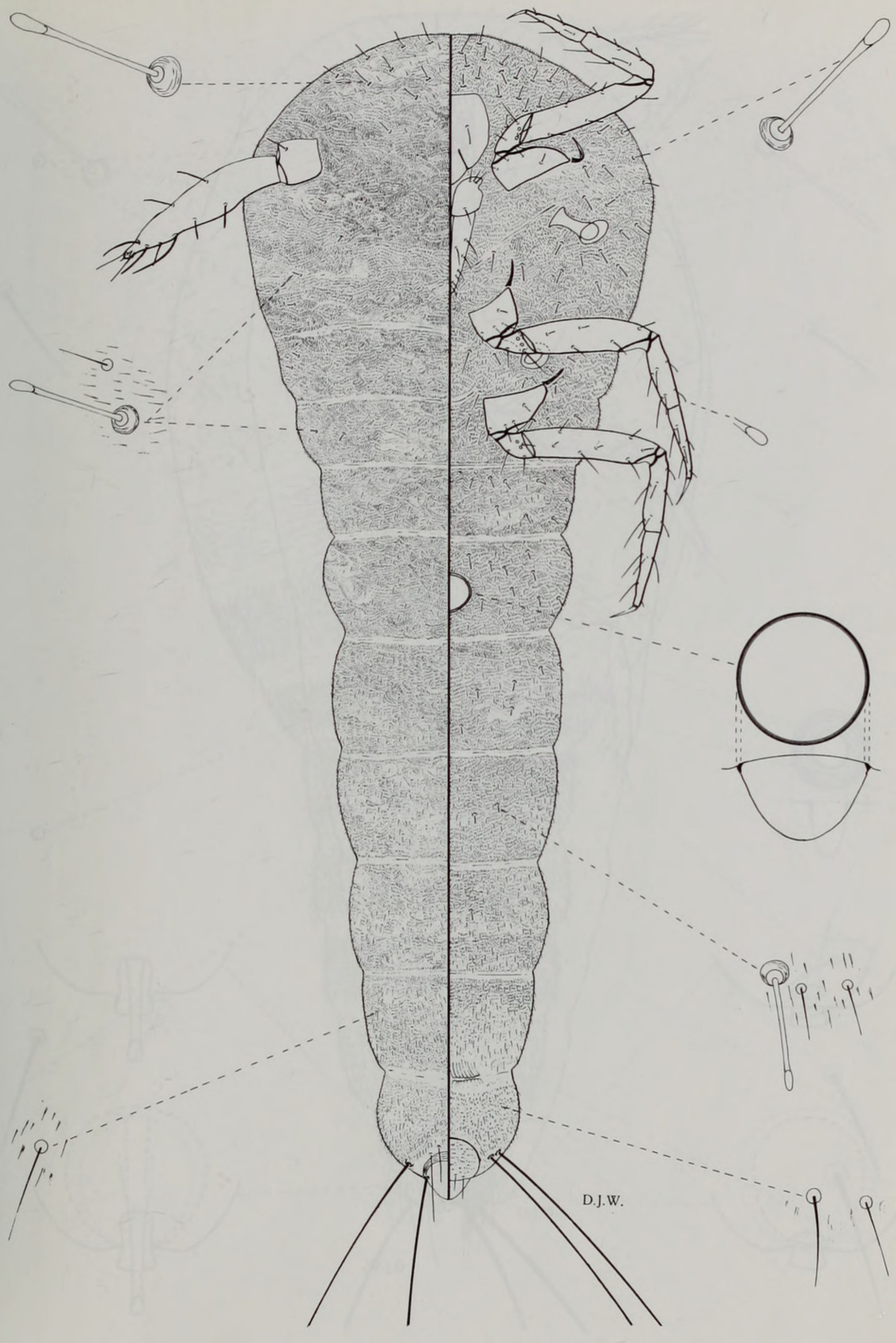

Fig. 14 *Eumyrmococcus sarawakensis* sp. n. Adult female.

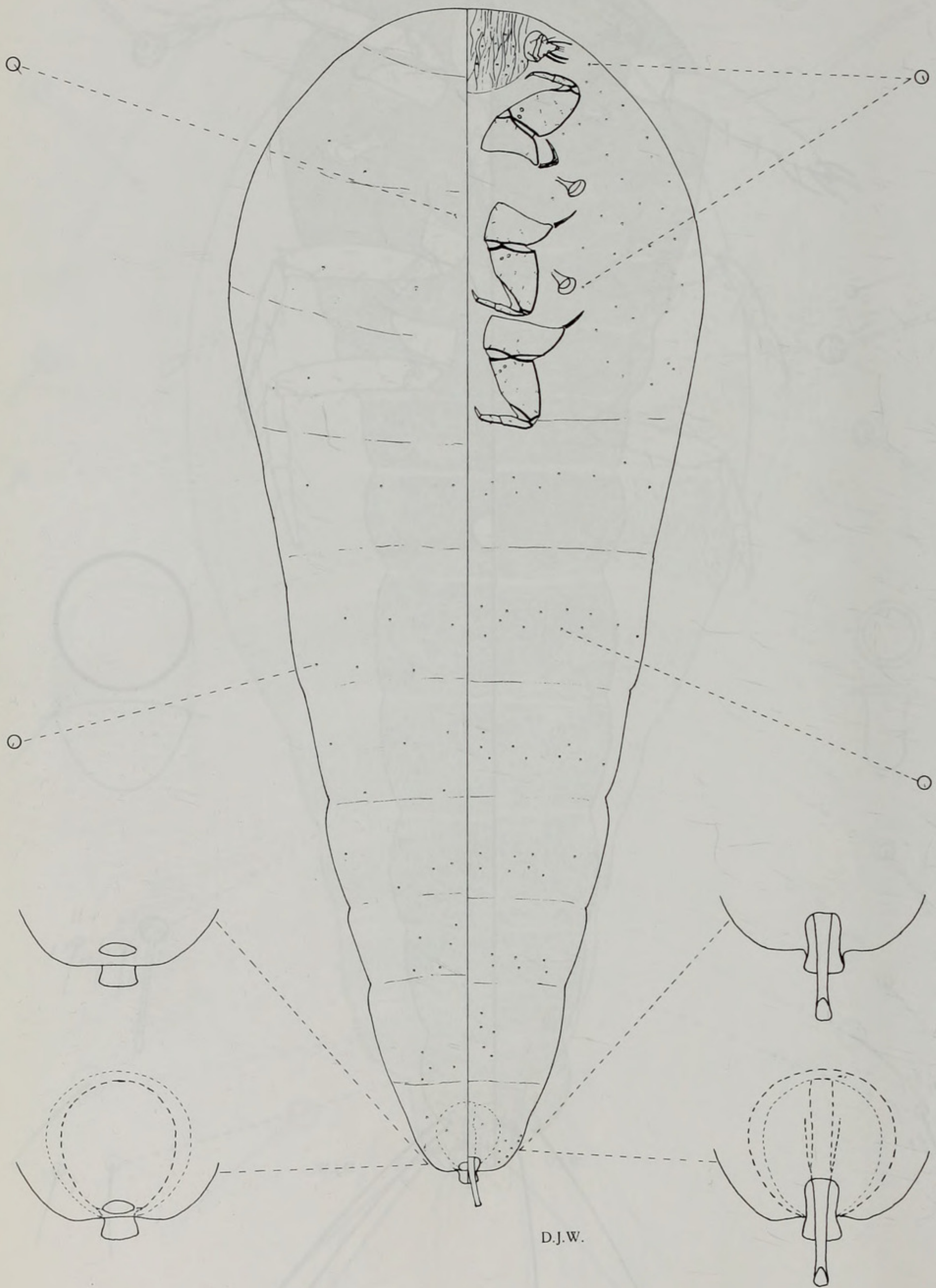

Fig. 15 *Eumyrmococcus sarawakensis* sp. n. Adult male.

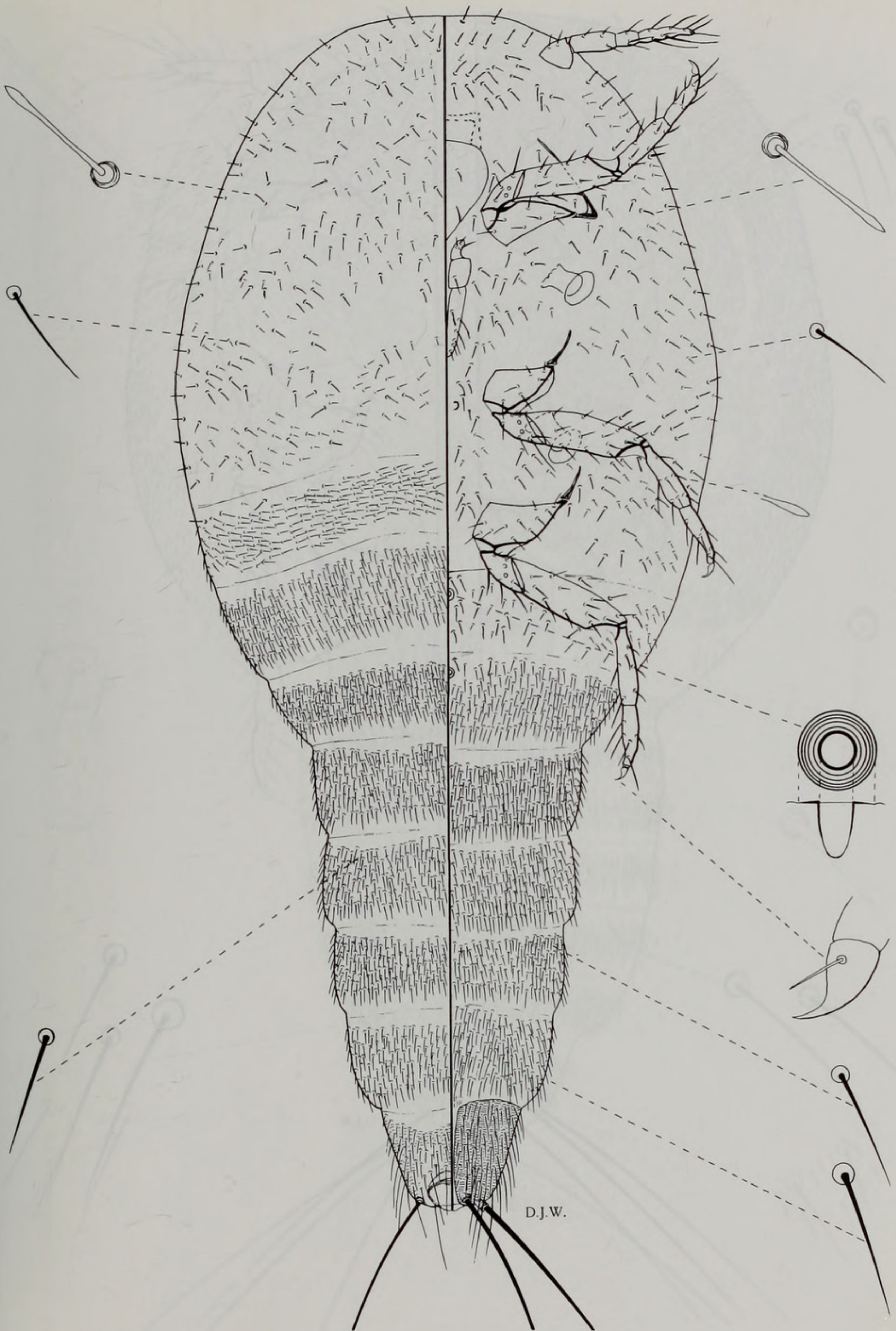

Fig. 16 *Eumyrmococcus scorpioides* (De Lotto). Adult female.

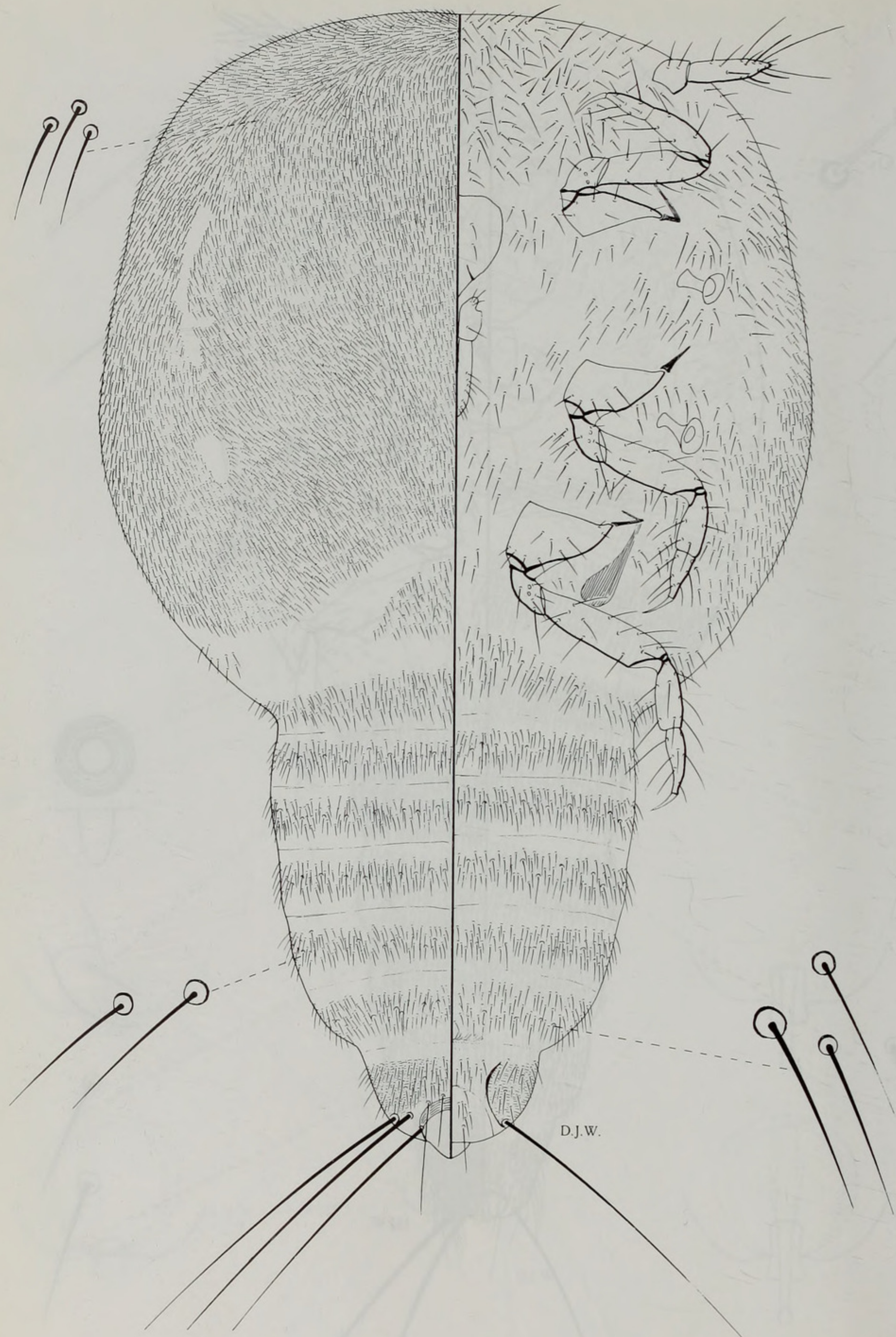

Fig. 17 *Eumyrmococcus smithii* Silvestri. Adult female.

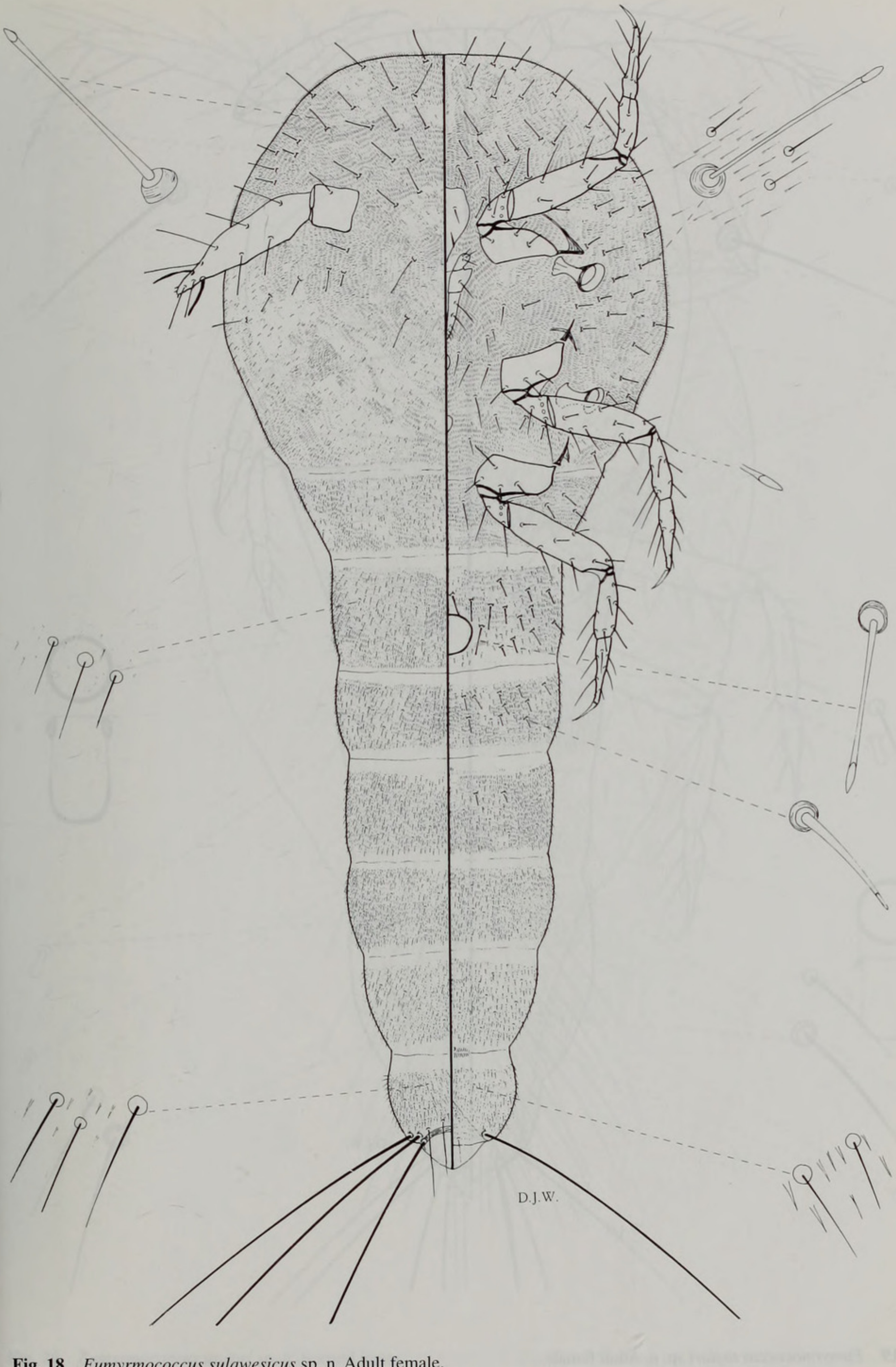

Fig. 18 *Eumyrmococcus sulawesicus* sp. n. Adult female.

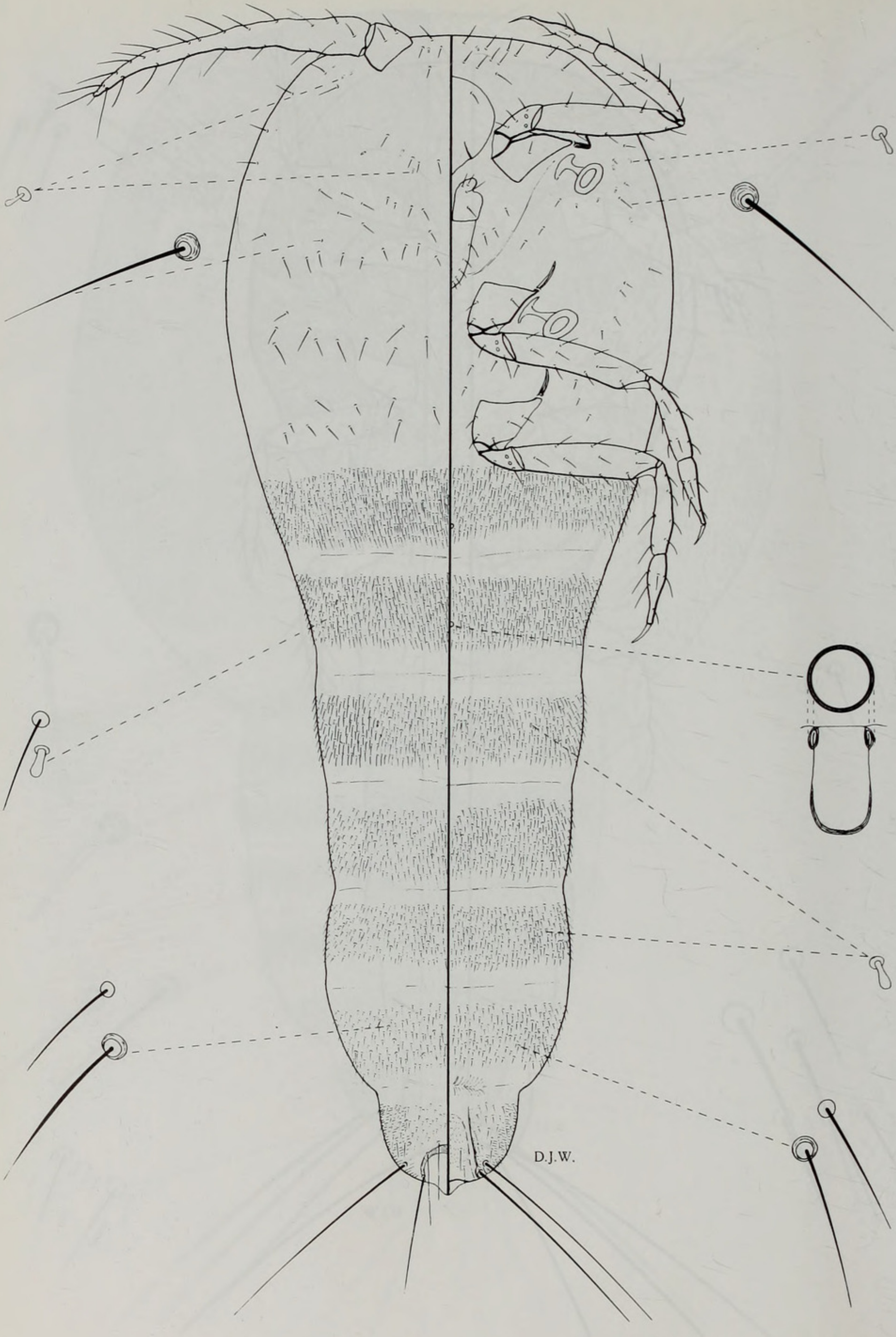

Fig. 19 *Eumyrmococcus taylori* sp. n. Adult female.

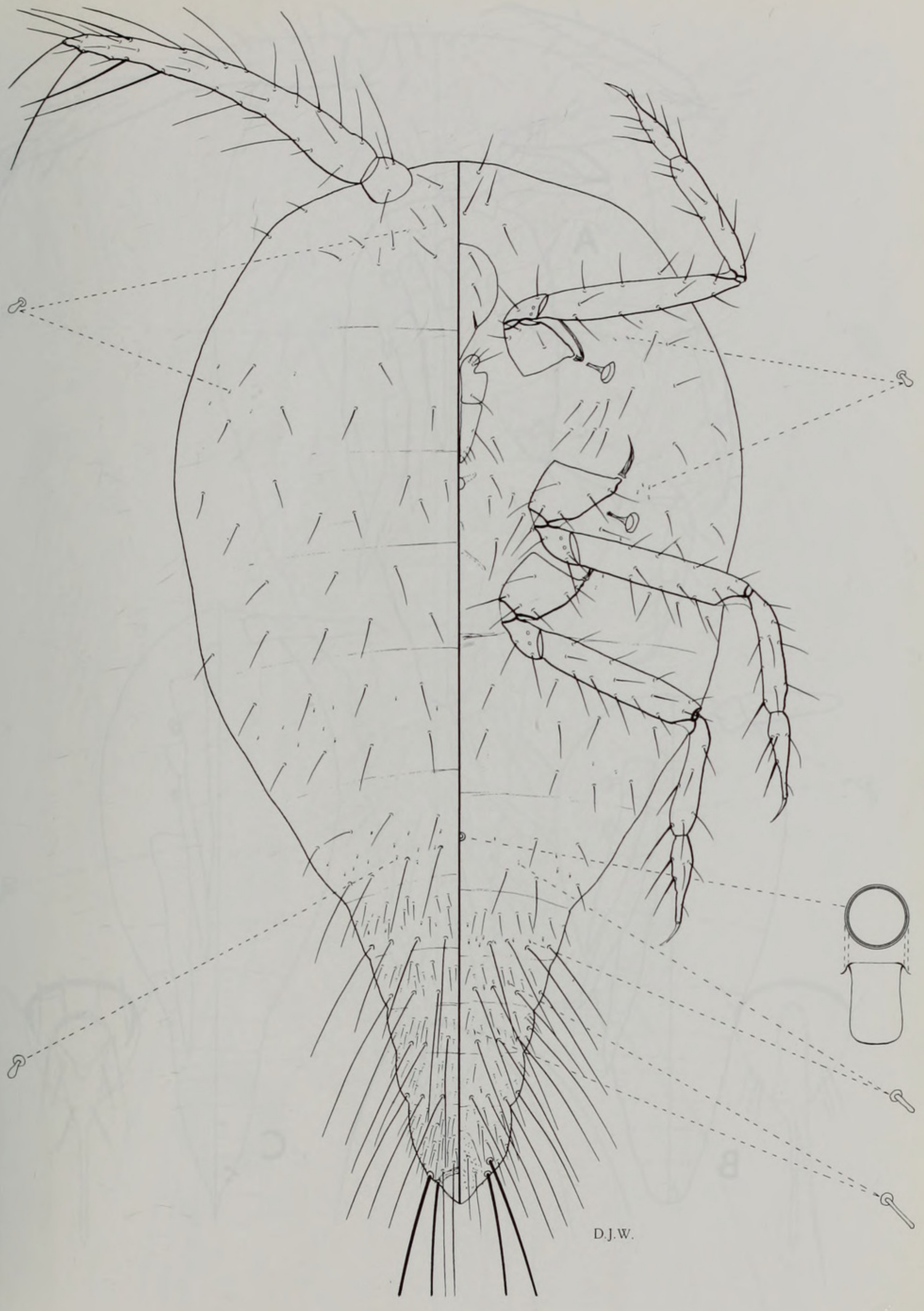

Fig. 20 *Eumyrmococcus taylori* sp. n. Second instar.

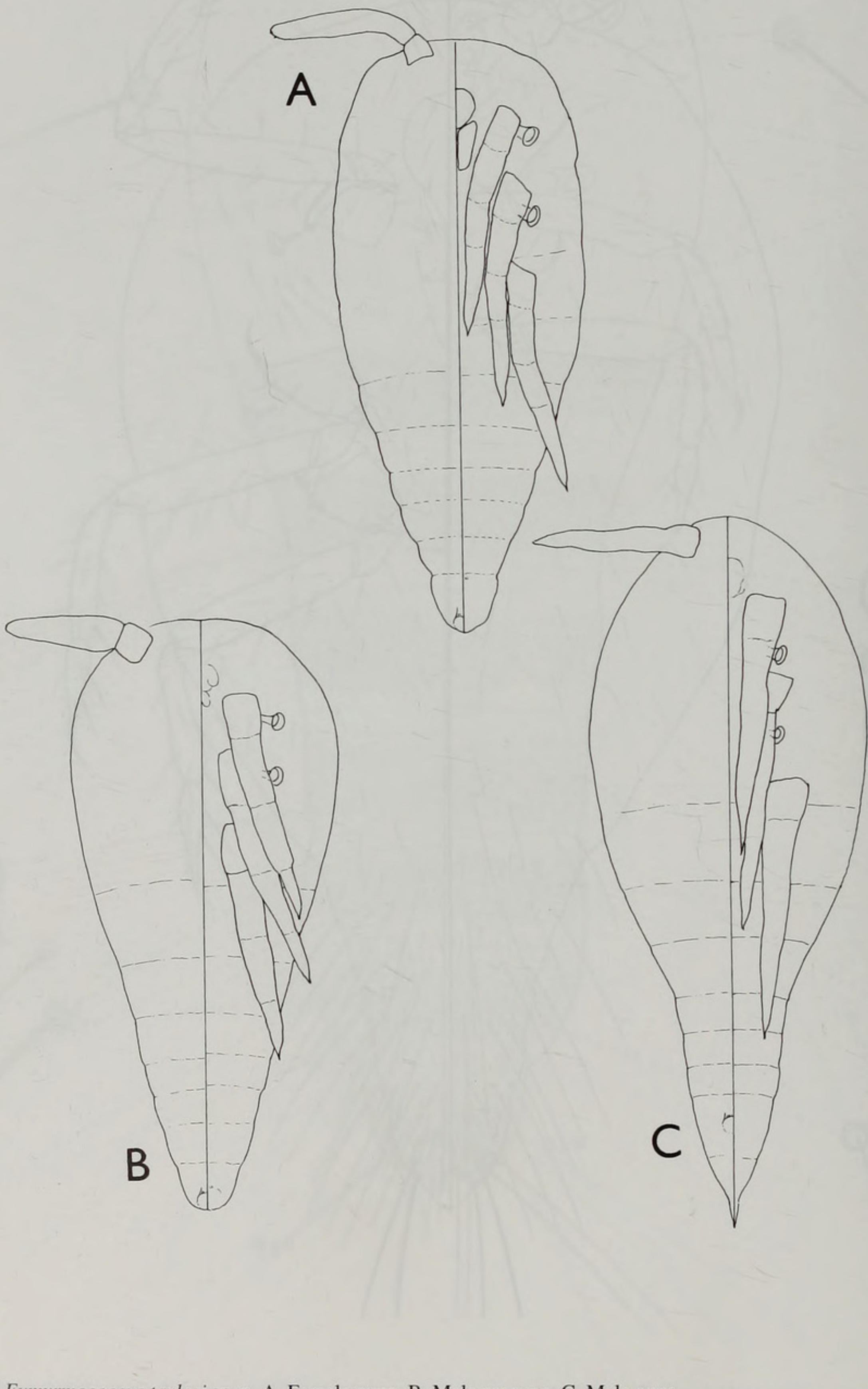

Fig. 21 *Eumyrmococcus taylori* sp. n. A. Female pupa. B. Male prepupa. C. Male pupa.

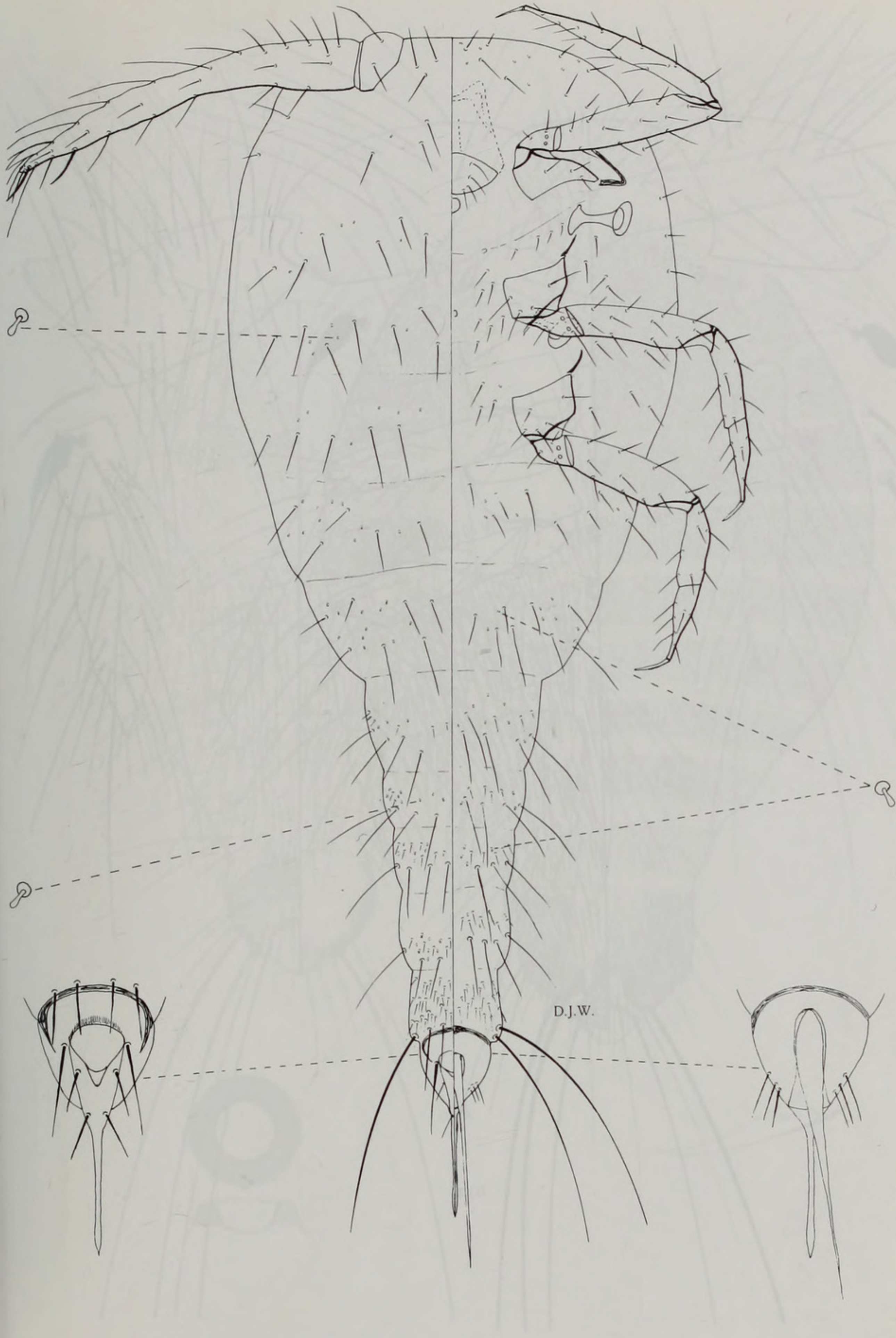

Fig. 22 *Eumyrmococcus taylori* sp. n. Adult male.

Fig. 23 *Xenococcus acropygae* sp. n. Adult female.

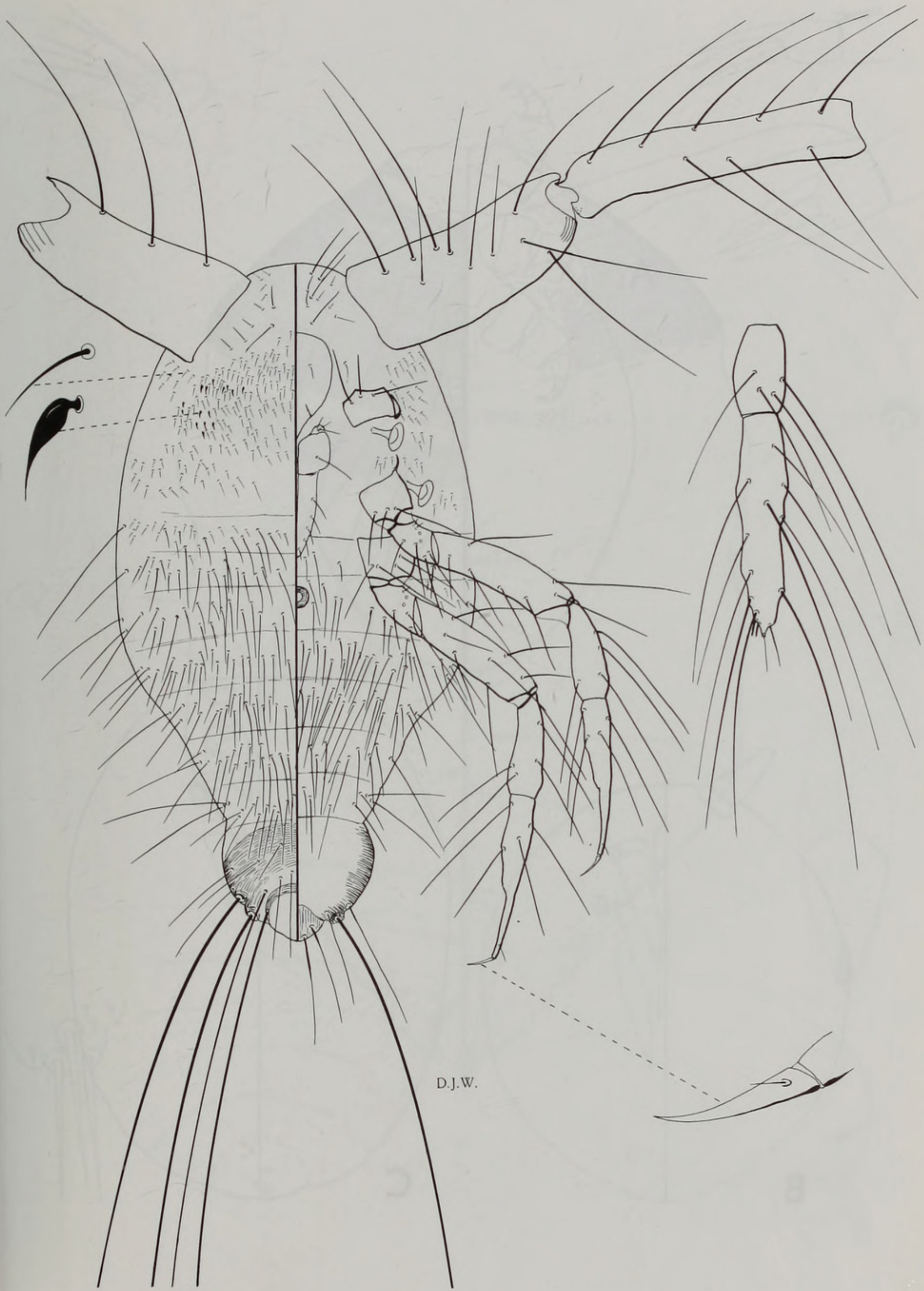

Fig. 24 *Xenococcus acropygae* sp. n. First instar.

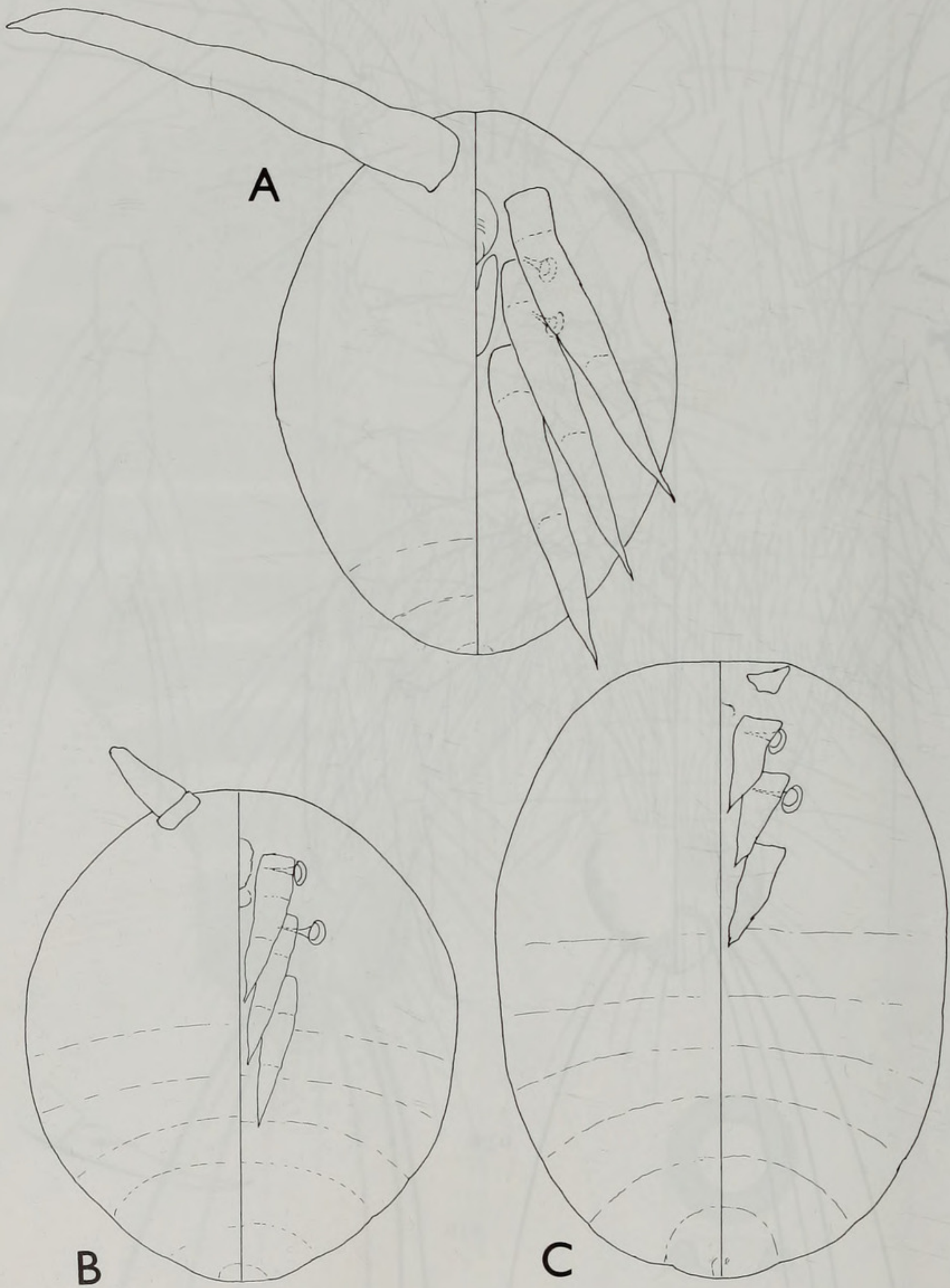

Fig. 25 *Xenococcus acropygae* sp. n. A. Female pupa. B. Male prepupa. C. Male pupa.

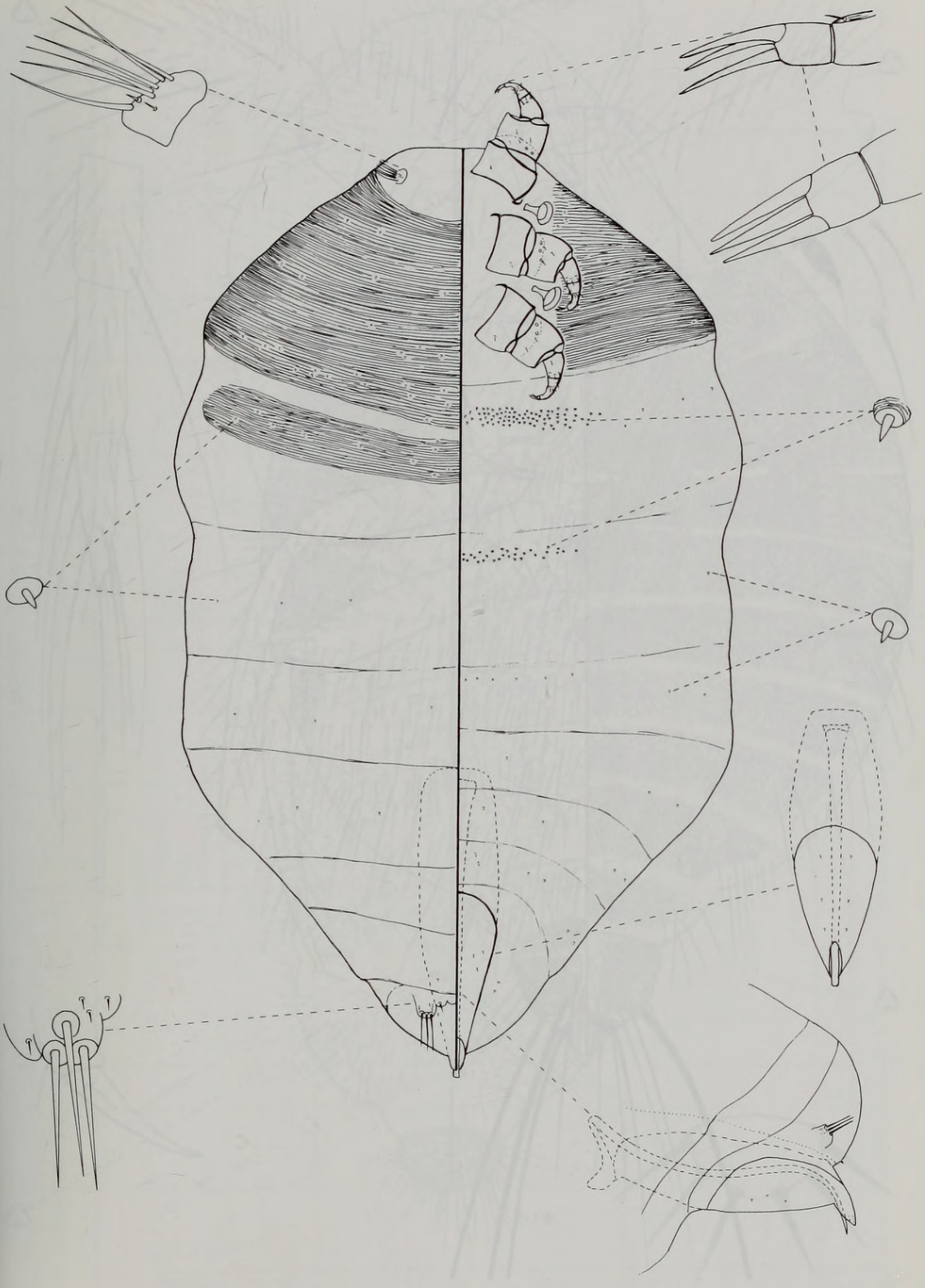

Fig. 26 *Xenococcus acropygae* sp. n. Adult male.

Fig. 27 *Xenococcus annandalei* Silvestri. Adult female.

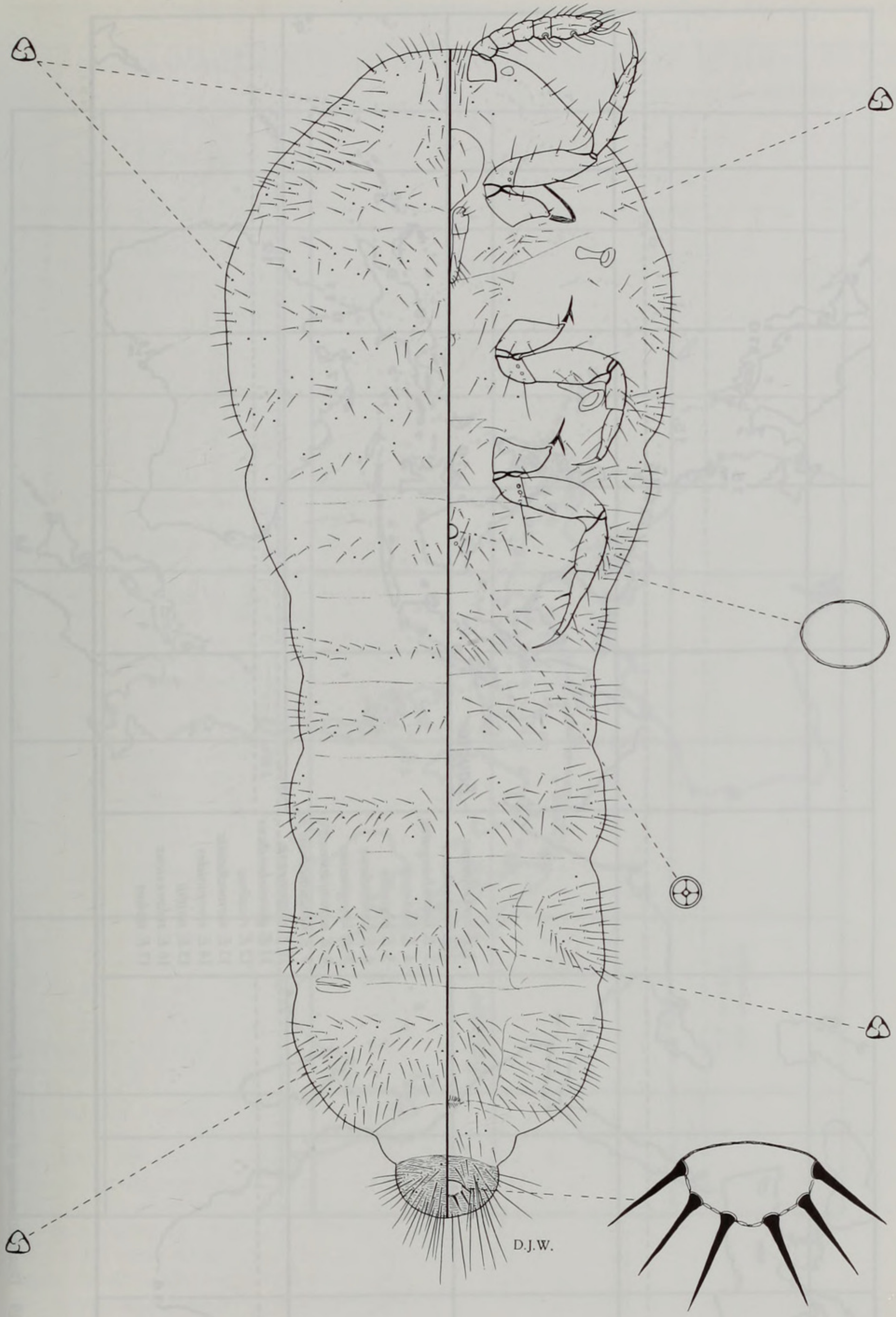

Fig. 28 *Leptorhizoecus deharvengi* sp. n. Adult female.

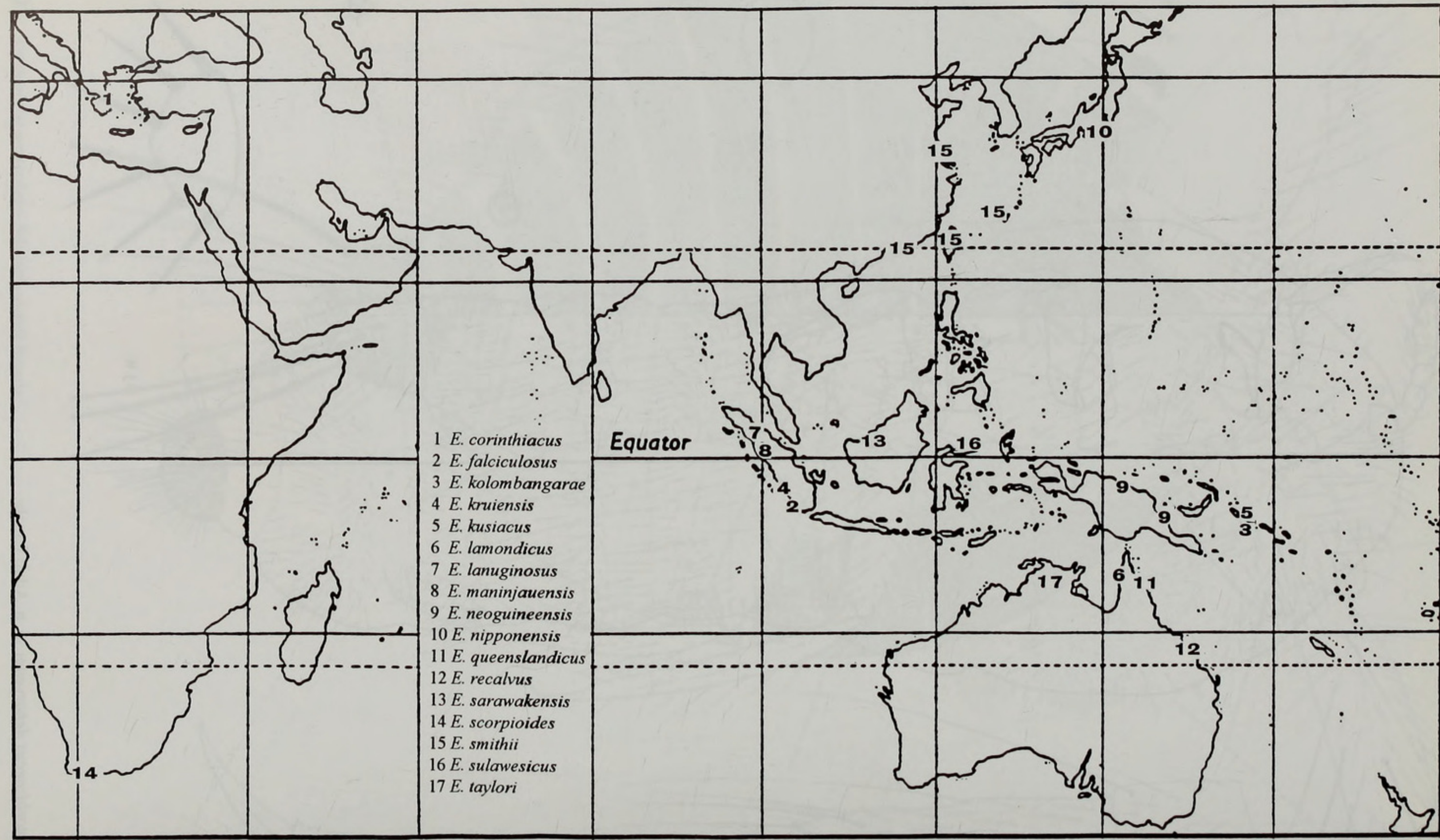

Fig. 29 Distribution map of species of *Eumyrmococcus*.

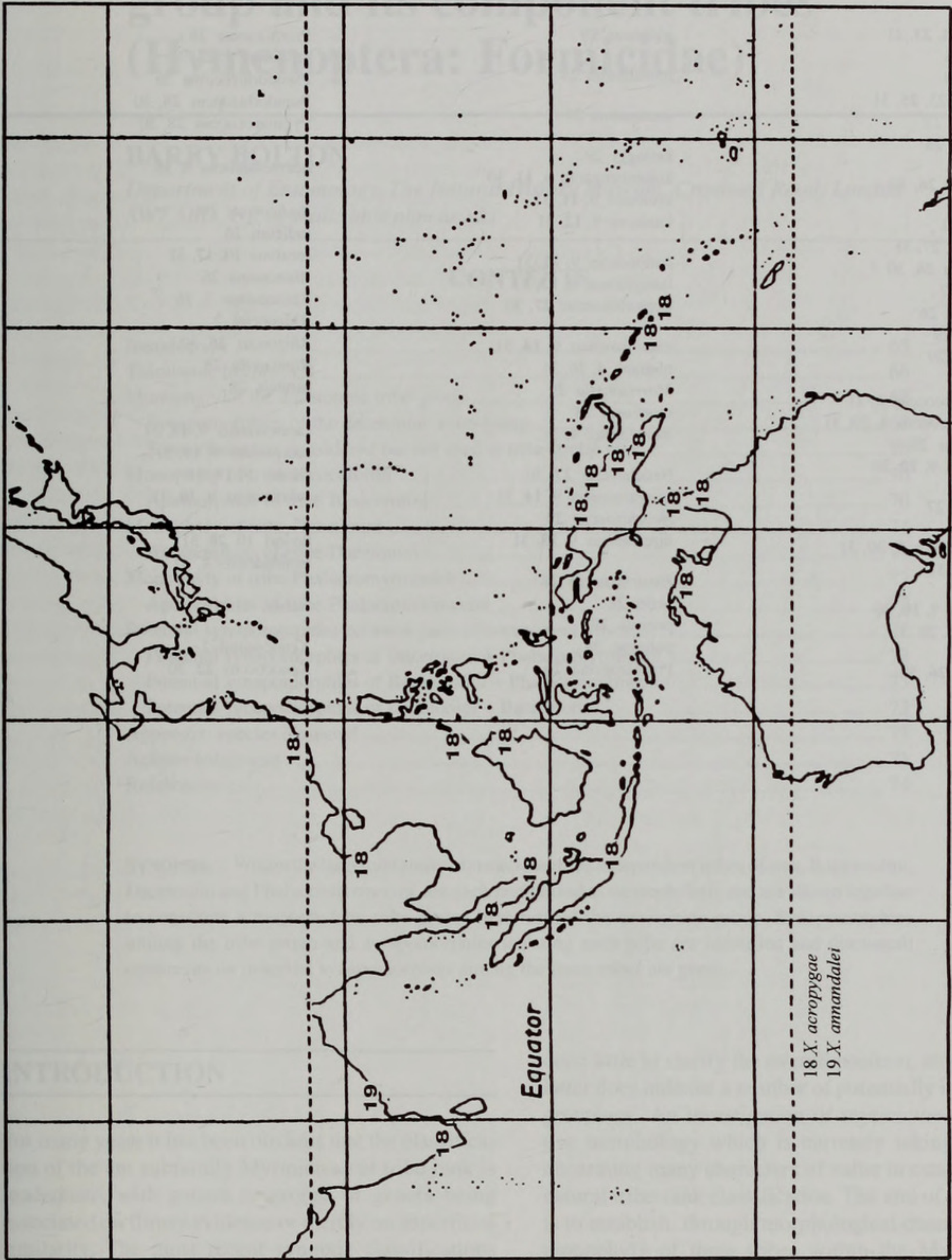

Fig. 30 Distribution map of species of *Xenococcus*.

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Synonyms and misidentifications are in *italics*; main citations in **bold**