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Scale insects from Dutch New Guinea*)

by

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New Guinea is next to Greenland the largest island in the world; its area is about 785000 sq. kilometers (with adjacent islands ca. 806000 sq.kms). It lies within the tropics, quite near the equator, and is largely covered by a luxuriant vegetation, so that a rich fauna of scale insects may be expected, though extremely little has been published on this subject.

In FERNALD's catalogue with supplements (1903—1915), and in the Zoological Record for the years 1915—1957, only 4 new species are reported from New Guinea, viz. *Myxolecanium kibarae* BECCARI (FERNALD No. 1005), *Aulacaspis major* RUTHERFORD, *Ceroplastes murrayi* FROGGATT, and *Steatococcus samaraius* MORRISON (Zool. Rec. 1916, 1919, and 1927).

In the Review of applied Entomology (Series A, 1913—1954) the following scale insects are mentioned as occurring in New Guinea: *Aspidiotus destructor* SIGN., *Coccus viridis* (GREEN), and *Ferrisiana virgata* (CKLL.); see vols. 12, 25, and 26.

Dr. HAROLD MORRISON of the Entomology Research Division of the U.S.Dept of Agriculture at Washington has kindly sent me the following list of species from New Guinea, recorded in literature or identified at Washington (indicated by *l.* and *w.* respectively). *Andaspis* sp., apparently new (w.), *Aonidiella inornata* McK. (l.), *Aspidiotus destructor* SIGN. (l., w.), *Aspidiotus lataniae* SIGN. (w.), *Aspidiotus palmae* CKLL. (l.), *Aspidiotus* sp. (l., w.), *Aulacaspis madiunensis* ZEHNT. = *A. major* RUTHERFORD = *A. rutherfordi* MORR. (w.), *Ceroplastes murrayi* FROGGATT (l.), *Chionaspis simulatrix* GREEN, nom. nud. (l.), *Chionaspis* sp. (l.), *Chrysomphalus dictyospermi* (MORG.) (w.), *Coccus mangiferae* (GREEN) (l.), *Coccus viridis* (GREEN) (l.), *Coccus* sp. (w.), *Dinaspis veitchii* GREEN et LAING (l.) *Ferrisiana virgata* (CKLL.) (l.), *Icerya seychellarum* (WESTW.) (w.), *Ischnaspis longirostris* (SIGN.) (l.), *Lecanium* sp. (l.), *Lepidosaphes gloverii* (PACK.) (l.), *Lepidosaphes pinnaeformis* (BOUCHé) (l.), *Lepidosaphes* sp. (w.), *Mytilaspis* sp. (l.), *Myxolecanium kibarae* BECCARI (l.), *Odonaspis* sp., perhaps new (w.), *Odonaspis saccharicaulis* ZEHNT. (l.), *Parlatoria citri* McK. (w.), *Parlatoria pergandii*

*) Received July 26, 1960

COMST. (l.), *Parlatoria* sp. (w.), *Phenacaspis* sp. (w.), *Pinnaspis aspidistrae* (SIGN.) (1.), *Pinnaspis buxi* (BOUCHÉ) (w.), *Pinnaspis pseudaspidiotus* GREEN Ms. (1.), *Pinnaspis* sp. (1), *Platylecanium* sp. (w.), *Protopulvinaria* sp. (l.), *Pseudaulacaspis pentagona* (TARG.) (w., l.), *Pseudococcus adonidum* L., larval stage only (w.), *Pseudococcus* sp. (l.), *Pseudococcus* sp., perhaps *Ps. lilacinus* CKLL. (l.), *Pseudococcus* sp. (w.), *Saissetia nigra* (NIETN.) (l.), *Selenaspidus* sp. (w.), *Targionia sacchari* (CKLL.) (w.), and *Trionymus* sp., close to *T. diminutus* LEON. (w.).

Dr. MORRISON informed me that no effort has been made to review or recheck the material on which this list has been based.

Dr. D. J. WILLIAMS of the Commonwealth Institute of Entomology in London called my attention to a paper by DUMBLETON (1954), not available in Holland, in which the following species are mentioned from British and Dutch New Guinea: *Aspidiotus destructor* SIGN., *Coccus viridis* (GREEN), *Diaspis rutherfordi* MORR., *Dysmicoccus brevipes* (CKLL.), *Ferrisiana virgata* (CKLL.), *Hemiberlesia cyanophylli* (SIGN.), *Lepidosaphes beckii* (NEWMAN), *Parlatoria ziziphi* (LUC.), *Planococcus citri* (RISSO), *Pseudococcus filamentosus* (CKLL.) = *Nipaecoccus vastator* (MASK.)*), *Farinococcus simmondsi* LAING, *Saccharicoccus sacchari* (CKLL.), and *Saissetia nigra* (NIETN.).

From the names mentioned above it is clear that about 50 species of scale insects are known from New Guinea. This is a very small number, considering that from a tropical island like Ceylon whose area is only 1/12 of that of New Guinea, GREEN (1937) has recorded 327 species.

In recent years I have received some scale insects from Dutch New Guinea, the western part of this island. Some of these insects were collected on the north coast or adjacent islands by Dr. L. D. BRONGERSMA of the Natural History Museum at Leiden, Mr. F. W. RAPPARD, chief of the Forestry Division in Dutch New Guinea, and Mr. R. T. SIMON THOMAS, entomologist of the Agricultural Division. Further I am greatly indebted to Jhr. E. W. VAN HEURN, advisory agricultural expert of the government at Merauke, who collected about 70 samples of coccids on the south coast, largely taken from cultivated and ornamental plants at Merauke and its environments.

Dr. BRONGERSMA collected *Ceroplastodes chiton* GREEN from a papaw tree (*Carica papaya* L.) on Biak, one of the Schouten Islands, 22.IV. 1952. For a description and figures of this insect see GREEN (1909). The insect is at present known from India, Ceylon, the Andamans, Thailand, Java, Formosa, and Dutch New Guinea. According to TAKAHASHI (1928) it is common in Formosa.

Mr. RAPPARD collected *Antonina graminis* (MASKELL), which was afterwards described by GREEN (1922) as *A. indica*, from the roots and root collar of a coarse grass near Hollandia, 4.III.1955. The insects were assiduously frequented by ants. This scale insect is known from India, Ceylon, Malaya, Sumatra, Java, Formosa, China, Mauritius and East Africa, and also from Hawaii and Texas. In 1959 I have received this species from Mr. P. H. VAN DOESBURG Jr. in Surinam (Sth America). He reported that this insect during the dry season did considerable damage

*) According to FERRIS (Atlas V, p. 107) *filamentosus* (CKLL.) and *vastator* (MASK.) are different species which have been often confused.

to Pangola-grass (*Digitaria decumbens*) on the meadows of the Government Farm; other grasses like *Cynodon dactylon* and *Paspalum conjugatum* were also infested. Sometimes it infests sugar cane. A detailed description with excellent figures was already published by ZEHNTER (1901) under the name of *Planchonia* (?) sp. ZEHNTER found it on the subterranean nodes of sugar cane in Java. GREEN (1930) reports the insect from grasses in Sumatra. For a description and figures of this scale insect see GREEN (1922), and FERRIS (1948).

Mr. RAPPARD has also collected two interesting scale insects from the coconut and the sago palm which are described in the following pages as types of new genera of the Pseudococcidae and Eriococcidae. This description is mainly based on the abundant material, containing all stages of development, which Jhr. VAN HEURN has afterwards collected on the south coast, where he found the same insects without difficulty, after I had called his attention to them. Further Mr. RAPPARD collected a Pseudococcid from a large rattan (*Calamus* sp.) in a locality on the north coast near Humboldt Bay. As the insects could not be identified with certainty they were put aside. It was only after my MS. was finished that they were examined again. Then it became clear that the rattan-insects belonged to the same species as *Eurycoccus vanheurni* n.sp., described in the following pages, where RAPPARD's notes are inserted.

Mr. SIMON THOMAS sent me 3 species of *Asterolecanium* from New Guinea, a genus hitherto not reported from this island. One species was found on cacao in an experimental garden near Manokwari. It occurred on the smaller twigs and leafveins, on which it caused slight deformations A second species was taken from small *Citrus*-twigs near Sentani (40 km west of Hollandia); no deformation was seen. A third species was collected from *Leucaena glauca;* it caused deep circumvallated pits on the twigs. The species were submitted to Miss L. M. RUSSELL for indentification. She placed the species as follows: (a) on cacao, near *A. javae* RUSSELL, but distinct, (b) on Citrus, *A. striatum* RUSSELL, (c) on *Leucaena, A. pustulans* (CKLL.). For description and figures of these species see her monograph of *Asterolecanium* (1941, U. S. Dept. of Agric., Miscell. Publ., 424: 1—322).

Quite recently I have received from Mr. SIMON THOMAS *Dysmicoccus brevipes* (CKLL.), collected from the root collar of celery in an experimental garden near Hollandia. The insect has already been reported from celery in Hawaii (FERRIS, 1948). DUMBLETON (1954) mentions its occurrence in New Guinea.

Further I received from the district of Hollandia a *Ceroplastes* sp. which in habit and structure seems to be identical with, or very similar to *C. rusci* (L.), well-known from Southern Europe, but seldom reported from the tropics (e.g. from Townsville in Australia; identification by E. E. GREEN). The species from Hollandia was found on the leaves of *Mangifera indica,* and also observed on *Annona muricata. Fiorinia theae* GREEN (syn. *F. proboscidaria* GREEN) was recently found on Citrus-leaves at Hollandia-Binnen; for figure and description of this species see FERRIS' Atlas IV, p. 395. (see addendum page 167).

Among the material collected by Jhr. E. W. VAN HEURN along the south coast, at Merauke and environments, the following species were identified.

1) *Icerya seychellarum* (WESTWOOD). On *Rosa* and *Citrus*, parasitized by a fly (*Cryptochaetum* sp., fam. Agromyzidae), and unparasitized on *Zinnia*.

2) *Saissetia nigra* (NIETNER). On *Hibiscus rosa-sinensis*, and *Solanum melongenum*.

3) *Anomalococcus multipora* MORRISON. On the coconut palm. This insect has been found on different food plants, at Singapore (MORRISON, 1921), in Sumatra (GREEN, 1930), the Riouw Islands (TAKAHASHI, 1950), and Formosa (TAKAHASHI, 1928).

4) *Vinsonia stellifera* (WESTWOOD). On the coconut palm.

5) *Coccus acuminatus* (SIGN.). On *Citrus* (lime). This species was recently chosen as type of a new genus *Platycoccus* by R. TAKAHASHI (1959, Kontyu, vol. 27, pp. 75—76). I am indebted to Dr. D. J. WILLIAMS (London) for this information; the periodical Kontyu is not available in Holland.

6) *Coccus viridis* (GREEN). On *Coffea*, *Citrus* (lime), and on an unknown plant belonging to the fam. Malvaceae. Mr. SIMON THOMAS has recently collected this insect from coffee in an experimental garden near Hollandia.

7) *Coccus mangiferae* (GREEN), or closely allied species. On *Mangifera indica*, *Ficus* sp., and *Derris* sp. I have compared my slides with 2 preparations of *C. mangiferae*, kindly sent me on loan by Dr. HAROLD MORRISON (Washigton). One specimen came from Ceylon, and had been prepared by GREEN in 1902; the other specimens came from the Philippines (1945); all these insects had been collected from *Mangifera indica*. Not any of my specimens was wholly like GREEN's specimen from Ceylon, but this applies also to the specimens of the Philippines. Sometimes the submarginal tubercles were lacking, or much reduced and obscure (my specimens from *Mangifera*, and those of the Philippines). Sometimes the dermpores were much reduced (my specimens from *Derris*; also less numerous in the Philippine specimens). In other cases the margin of the body was sclerotized (my specimens from *Mangifera*, also those of the Philippines); in my specimens from *Ficus* even the whole dorsum was sclerotized. It is not clear whether my specimens are merely varieties of *C. mangiferae* or closely allied species; habit and biology are not known. In some of the Philippine specimens I have observed many tubular ducts (about 80—100), medioventrally between the legs. These tubular ducts are also present in my specimens from New Guinea, and very faintly visible in GREEN's specimen from Ceylon. This is in contradiction with FERRIS' statement that there seem to be no tubular ducts (FERRIS, 1948, p. 308). In *Coccus acuminatus* (SIGN.) I failed to find these tubular ducts, but only one well-cleared specimen was available. Further this species differs from *C. mangiferae* by the enlarged coxae of the middle- and hind legs, the marginal setae, and the shorter length of the anal valves (180 μ in 3 specimens of *C. acuminatus;* in *C. mangiferae* from Ceylon, the Philippines, and New Guinea length at least 200 μ, usually about 250 μ).

Afterwards I could examine 9 other slides with *C. mangiferae* by the courtesy of Dr. D. J. WILLIAMS, namely one from Ceylon and one from India (prepared by E. E. GREEN), further 7 slides with specimens from the Solomon Islands. The latter specimens are not wholly alike those of

Ceylon and India. Dr. WILLIAMS' opinion is that they seem more allied to *Lecanium psidii* GREEN than to *C. mangiferae*. Dr. HAROLD MORRISON, who examined two of my slides with specimens from *Ficus*, stated that these specimens from New Guinea, in which the dorsal cuticle is wholly sclerotized, seem to be closest to *Lecanium psidii* GREEN, and when not identical with this species that they might be an undescribed one. After having examined several specimens from New Guinea, the Philippines, and the Solomon Islands, my conclusion is that no specimens have been observed which are certainly identical with *Coccus mangiferae*, as represented in GREEN's slides from Ceylon and India. It is possible that *C. mangiferae* is a very variable species, though this is not shown by GREEN's specimens (examined 3 from India, and 4 from Ceylon); it seems likely that one or more closely allied species have been confused with it. Perhaps their biology, which can only be studied on the spot, may help to solve this problem.

8) *Coccus* sp. One species from *Artocarpus* was examined by Dr. HAROLD MORRISON, who thought that it was an undescribed species, identical or closely allied to a species from *Artocarpus* in Micronesia, represented in his collection. Further I have received one (possibly two) species from *Citrus* (lime) in New Guinea which could not be idenfied.

9) *Pulvinaria urbicola* CKLL. from *Capsicum* sp. Compared with a topotype from Jamaica, collected by COCKERELL in 1894, one year after his description of the species, and specimens from Puerto Rico (1956). I could examine these specimens by the courtesy of Dr. HAROLD MORRISON. At present the species seems to be only known from the Antilles, Trinidad, Florida, and Hawaii. Among the material from New Guinea an ovisac was found which agrees with the figure given by FERRIS (1948, p. 340).

10) *Saissetia coffeae* (WALKER), syn. S. *hemisphaerica* (TARG.). On *Citrus* (lime). I have received this species and *S. nigra* (NIETNER) also from Hollandia, where they were collected by Mr. G. DEN HOED on *Hibiscus* (May, 1958).

11) *Pulvinaria psidii* MASKELL (?). On *Citrus* (lime). Dr. HAROLD MORRISON, who examined this elongate specimen (with derm pores, and submarginal tubercles), suspects that it is this species, though the sclerotizations encircling the spiracles, a typical feature according to FERRIS (1948), are lacking.

12) *Ferrisiana virgata* (CKLL.). On *Annona muricata, Quamoclit pennata, Acalypha* sp., *Morus alba, Helianthus,* and an unknown plant.

13) *Planococcus citri* (RISSO). On *Annona squamosa* and *Theobroma cacao*.

14) *Planococcus lilacinus* (CKLL.). On *Solanum melongenum, Ficus* sp., *Citrus* (orange), and *Annona muricata*.

15) *Pseudococcus maritimus* (EHRH.). On *Capsicum, Zinnia,* and an unknown plant.

16) *Maconellicoccus hirsutus* (GREEN), syn. *Phenacoccus hirsutus* GREEN. On teak (*Tectona grandis*), *Annona muricata, A. squamosa,* and on an unknown plant.

17) *Nipaecoccus vastator* (MASKELL). On *Tamarindus* and *Citrus*.

18) *Rastrococcus spinosus* (ROBINSON); formerly placed in the genus *Phenacoccus* or *Puto*. On *Theobroma cacao*, and an unknown plant.

19) *Leptococcus metroxyli.* On the leaves of the sago palm. This new genus and species is described in the following pages.

20) *Eurycoccus vanheurni* sp. nov. This new species is described in the following pages. Nos. 19 and 20 belong to the fam. Pseudococcidae.

21) *Haematococcus obtusispinus.* On the leaves of the coconut palm. This new genus and species of the fam. Eriococcidae is described in the following pages.

22) *Lepidosaphes gloverii* (PACK.). On *Citrus* (pomelo).

23) *Parlatoria ziziphi* (LUCAS). On *Citrus* (pomelo).

24) *Pseudaulacaspis pentagona* (TARG.). On *Morus alba, Lochnera rosea,* and *Cocos nucifera.*

25) *Aspidiotus destructor* SIGN. On the coconut palm.

26) *Hemiberlesia palmae* (CKLL.). On the coconut palm. This species was recently chosen as type of a new genus, *Borchseniaspis,* by J. ZAHRADNIK (1959, Acta faun. ent. Mus. Nat. Pragae, vol. 5, pp. 65—67). The species is common on coconut palm in Indonesia, and was already known from New Guinea.

27) *Hemiberlesia lataniae* (SIGN.). On *Artocarpus.*

Some samples contained aphids which have been sent to Mr. D. HILLE RIS LAMBERS who studies the aphids from Indonesia and New Guinea. In one sample from the coconut palm *Aleurodicus destructor* MASK, was present. Some samples contained larvae of Coccinellidae with wax excrescences, apparently taken for mealy bugs; further a Psyllid and 2 unidentified Homoptera were found among the material from Merauke and environments.

Detailed figures of the above-mentioned species Nos. 2, 5—7, 9, 10, 12, 13, 15, 22 and 23 are given by FERRIS (1948), and of Nos. 17, and 24—27 in his Atlas of the scale insects of North America. For Nos. 1, 4, 14 and 18 see MORRISON (1920), for Nos. 3 and 16 MORRISON (1921), and for No. 16 EZZAT (1958).

Nos. 3—5, 9—10, 15—16, and 18 are for the first time recorded from New Guinea; the same is the case with *Ceroplastodes chiton* GREEN, *Antonina graminis* (MASKELL), and the three species of *Asterolecanium. Pulvinaria psidii* GREEN could not be identified with certainty; this applies also to some *Coccus* sp. The species mentioned under Nos. 19—21 are described as new species; for two of them a new genus is proposed.

HAEMATOCOCCUS, A NEW GENUS OF SCALE INSECTS FROM THE COCONUT PALM

In the years 1927—30, when I was charged with the study of coconut pests in Celebes and the Moluccas, I have often observed a peculiar mealy bug on the leaves of the coconut palm. Its body fluid was crimson-red. Some natives called this insect "blood-louse", because their hands looked as if they were blood-stained after handling leaves infested by these insects.

As there were no complaints about any damage done by these mealy bugs, very little attention was paid to them. A few notes from my diary are inserted in the description of *H. truncatispinus* in the following pages. The insects were submitted in 1927 to Dr. HAROLD MORRISON (Washington) for identification. Dr. MORRISON answered that it was not a true mealy bug, but a relative of the genus *Eriococcus*. As far as he knew, it was an undescribed species which quite possibly could represent an undescribed genus.

In 1955 Mr. F. W. RAPPARD collected an insect from a coconut palm on an island in the Geelvink Bay (Dutch New Guinea) which I thought to be the same species as the „blood-louse" from North Celebes. By comparison with the specimens from Nth Celebes, prepared by Dr. MORRISON, and kindly given me on loan, it became evident that the insects from New Guinea belonged to another species, but that both species are certainly congeneric. After having examined the specimens collected by Mr. RAPPARD on the north coast of New Guinea I asked Jhr. E. W. VAN HEURN, who lived at Merauke on the south coast, to look out for this insect on coconut palms. He found it without difficulty in the environment of Merauke, and provided me with abundant material, so that it has been possible to describe all stages of development of the New Guinea-species which I have called *H. obtusispinus*. This species has been chosen as the type species of the genus *Haematococcus*, as from *H. truncatispinus* only adult females were avaible.

Of the species *H. truncatispinus* I could only examine 3 slides with adult females which I had collected at Taroena on the island of Sangi (Nth Celebes) in Sept. 1927. They had been prepared by Dr. MORRISON who has kindly lent me his slides. Further I have examined 5 adult females of this species from the Territory of New Guinea, collected by J. L. FROGGATT in January 1937. I am indebted to Dr. D. J. WILLIAMS (London) for the opportunity offered to examine the slides with these specimens which he had found in the collections of the British Museum (Nat. Hist.).

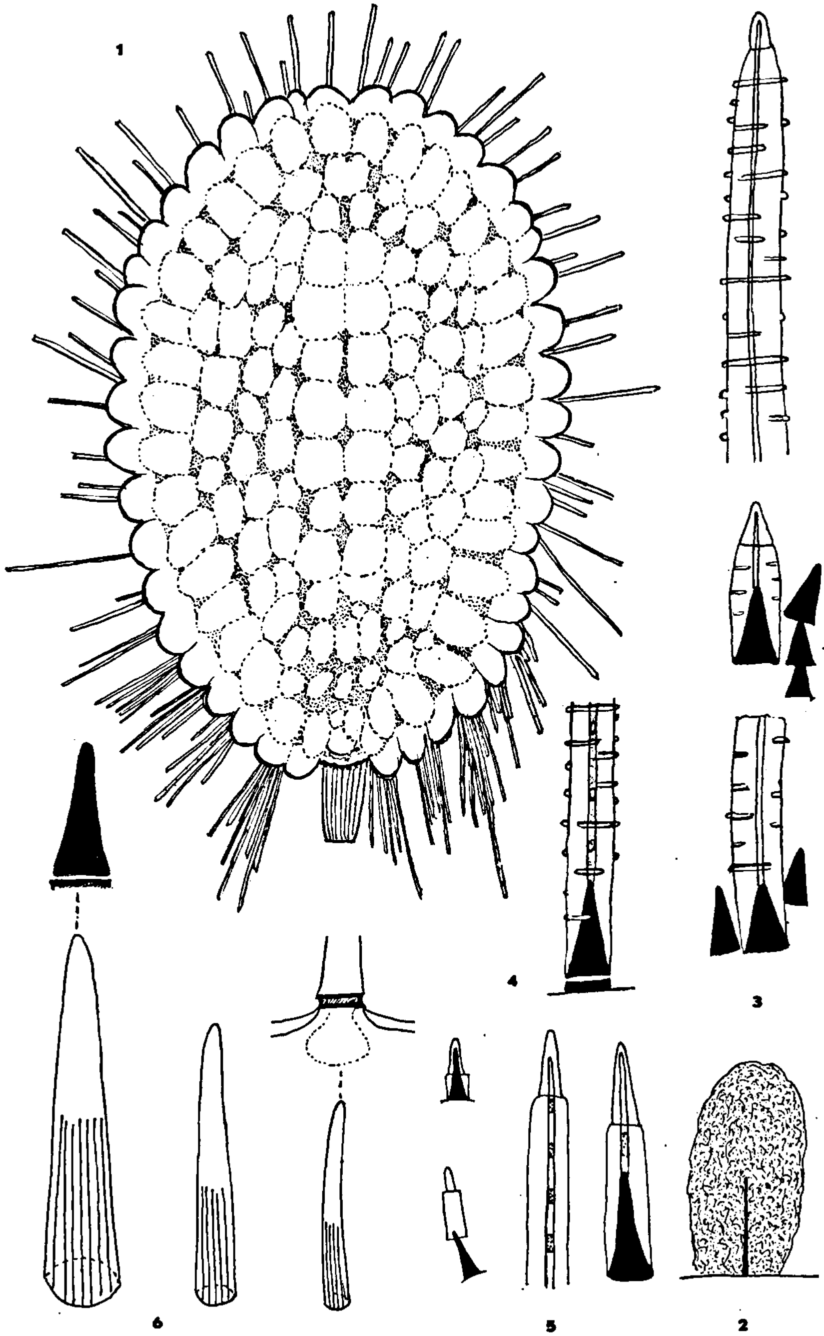
It seems that only few species of Eriococcidae are known from tropical Asia. In examining the literature, though rather hastily, I found mentioned about a dozen species from tropical Asia, but no less than ca. 50 from Australia. Further I failed to find any mention of the occurrence of Eriococcidae on the coconut palm.

Haematococcus, gen. nov.

Eriococcidae (as defined by FERRIS, 1957) in which the spines along the margin of the body of the adult female have another shape than those on the dorsum, and are arranged in clusters, either along the whole margin of the body or only along the margin of the abdomen. Legs and antennae reduced. Labium one-segmented, with only a few minute setae at its tip. The anal lobes are unsclerotized flaps which in some species are movable like the anal valves of the Lecaniidae. Ovoviviparous: no ovisac. The wax covering resembles that of the Pseudococcidae, as the marginal spines produce wax filaments along the margin of the body, while the dorsum is covered by small wax tubercles formed by the dorsal spines. The marginal spine clusters seem to take the place of the cerarii in the Pseudococcidae. Body and body fluid are crimson.

First stage larva with 3 double rows of spines, one row on mid-dorsum and one on each side of the body; these spines form 3 longitudinal strips of wax on the dorsal side.

Type species: *H. obtusispinus*, spec. nov.



FIGURES 1—6. Explanation on opposite page.

H. obtusispinus, spec. nov.

Adult female (♀ ad.)

Habit. Outline almost circular. Length 1.7—1.9, width 1.4—1.8 mm in mature females with fully developed embryos. The smallest adult specimen measured only 1.0 × 0.6 mm. All measurements refer to specimens in microscopical preparations.

Dorsum with white wax tubercles, more or less arranged in longitudinal rows; the medio-dorsal tubercles are usually somewhat larger than the other ones. Several fine wax filaments of 12—20 μ diameter are observed along the margin of the body. Their number and length is variable, as the fragile filaments easily break off. Sometimes 50 or more were counted on each side, but often much less. The length of these filaments is usually ¼—½ of the body width, when undamaged (figs. 1—3).

Found on the under-side of the leaves of the coconut palm; attended by ants; sooty mould present.

Antennae short, about 70 μ, with only 3 segments (fig. 12). The second segment is sometimes fused with the third one; the usual sensorium is absent. The third segment is much longer than the first and second one; it seems to have been formed by the fusion of 2 or more segments. Comparison with the larval antenna (cf. fig. 16), where the sensorium on the second segment is present, shows that the 2 basal segments correspond with those of normal antennae. At the top of the antenna usually 4 sensory setae are observed, and 3 ordinary ones (fig. 12). Sometimes 4 ordinary setae are present, but in other cases only 2. The number of lower setae is rather constant, 2 on segments I and II, and 2 on the middle of the third segment or somewhat higher.

FIGURES 1—6. *Haematococcus obtusispinus* gen. et sp. nov.; **1.** Old adult female (x 65). Wax covering, seen from the dorsal side. Dorsum covered by wax tubercles (cf. fig. 2); wax filaments along the margin of the body (cf. fig. 3). The wax plug at the apex of the abdomen is produced by the gland pores of the anal ring; **2.** Adult female. Wax tubercle formed by a dorsal spine and the adjacent tubular ducts (x 200); **3.** Adult female. Marginal wax filaments, formed by the short, unstriated spines along the margin of the body (x 430). Above: Top of a detached filament. Two lower figs.: filaments in connection with the marginal spines; **4.** Second stage larva. Though only 2—3 short, unstriated marginal spines are present on both sides of the anal opening, they form the same wax filaments as in the adult female (x 630). In this case, however, small wax pellets are obser- in the central canal (cf. fig. 5); **5.** Wax filaments of the dorsal spines, *Eriococcus devoniensis* (GREEN), shown for comparison with *Haematococcus obtusispinus.* The 2 left figs. refer to the first stage larva (x 630), the 2 right figs. to the adult female (x 430). The ovisac or cocoon in this species consists of a dense mass of thin wax filaments (produced by numerous tubular ducts), intertwined between the straight wax filaments of the dorsal spines; the tips of these straight filaments are still visible in a newly formed cocoon; **6.** Adult female. Three of the larger striated dorsal spines (x 630). Above the largest spine an unstriated short marginal spine is figured (x 630). Above the smallest spine the base of a dorsal spine is shown in longitudinal section, stained with azo-carmine. The secretion zone is stained bright red, the cuticle blue with its uppermost layer red; the spine itself remained unstained. A part of the wax gland is indicated by a dotted line (x 630). The striated dorsal spines form wax tubercles (cf. fig. 2), the unstriated marginal spines wax filaments (cf. fig. 3).

Legs reduced like the antennae, with only 3—4 segments; length of hind leg about 0.12 mm (fig. 18). The 3 segments represent the coxa, the femur fused with the trochanter (recognizable by its sensoria, 2 on each side), and a fused segment of tibia and tarsus. Sometimes a faint partition can be observed between tibia and tarsus, or a constriction which indicates the division between the 2 segments. The sensorium, present at the proximal end of the tarsus in the larval leg, is wanting in the reduced legs of the adult female. The coxa is only slightly sclerotized, so that its outline is sometimes more or less irregular in the preparations. Occasionally minute specks are present on the hind coxa and -femur. Tarsal and ungual digitules longer than the claw, and slightly knobbed. At the base of the claw 2 small outgrowths are observed which are already present in the newly born larva (cf. fig. 20).

Labium short, one-segmented, semi-circular, with only a few minute setae at its tip. Rostral loop short, about as long as the labium.

Eyes present, but difficult to find, as they are usually covered by the marginal spines.

Dorsal surface with bluntly pointed, striated, glandular spines, of which about 20 on the middle of the dorsum, and some sublateral ones are larger than the other spines (fig. 7). Several smaller spines are distributed over the whole dorsum. The striation on the larger spines (fig. 6) is caused by 8—14 external ribs, as is clearly visible when the base of a spine is observed in the direction of its axis. The smallest spines show no striation in lateral view. The large mediodorsal and sublateral spines probably correspond with those of the first stage larva (cf. fig. 15), though they are irregularly arranged.

Along the margin of the body short, stout, conical spines are present, without any striation (figs. 8—11). These marginal spines are arranged in clusters of 6—10 spines on the 5 last abdominal segments (figs. 7—9); the 3 posterior spine clusters are usually placed on more or less sclerotized plates.

Sometimes 6—8 pairs of spine clusters could be recognized, but the separation of the foremost clusters was not distinct. Further forward, up to the frons, the short marginal spines are not, or very indistinctly, arranged in separate groups, and somewhat smaller (fig. 10). The short marginal spines are only present in the adult female, but in the preceding stage usually 1—3 of such spines are observed next to the anal ring (which applies also to larva II ♂); see fig. 4.

The wax filaments produced by the short marginal spines are opaque, and have an irregular, knobbed outline (figs. 3—4) which is probably caused by intermittant wax secretion, as is observed in the glandular spines of *Eriococcus devoniensis* GREEN (fig. 5)*). In both cases there

*) In *Eriococcus devoniensis* the outline of the wax filaments is smooth, but small pellets are seen in the central canal at regular intervals, which seem to indicate intermittant wax secretion. The cocoon (ovisac) of *E. devoniensis* is mainly formed by the numerous tubular ducts, whose wax filaments are intertwined between and around the straight filaments produced by the glandular spines. In a newly formed cocoon the points of the straight wax filaments can still be observed.

In *Haematococcus obtusispinus* the appearence of the wax covering is quite different, as the straight filaments of the marginal spines remain separate, while the dorsal spines in cooperation with the surrounding tubular ducts form the dorsal wax tubercles.

is a central canal in the wax filament, as is seen after immersion in alcohol or glycerin.

The dorsal wax tubercles of *H. obtusispinus* (diameter usually 50—100 μ; length 100—200 μ) consist of a woolly wax, in which it is difficult to detect any structure (fig. 2). The tubercles are produced by the dorsal spines, and the surrounding tubular ducts. After treatment with boiling benzene or xylene a distinct network of fine filaments (1—2 μ) remains which is apparently the product of the tubular ducts; the wax solved in benzene was probably formed by the spines themselves. It appears that the fluid wax is secreted at the base of the spine where the cuticle is very thin; this applies to the dorsal spines as well as to the marginal spines. If the dorsal wax tubercles are removed from the body, it appears that a meshwork of fine filaments is also present between the tubercles.

I am indebted to Prof. Dr. J. LEVER and Dr. A. P. VAN OVERBEEKE for 4 series of sections made in their laboratory. As far as could observed the glands of the marginal and dorsal gland spines are of the same structure. In sections stained with azo-carmine the secretion zone at the base of the dorsal spines was clearly shown by the red stain (fig. 6): in the marginal spines this zone is already visible in unstained chitin-preparations.

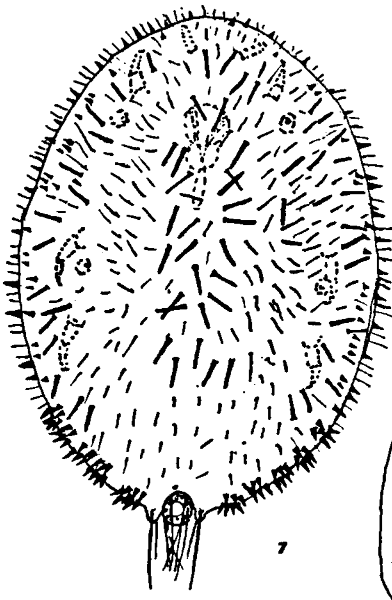
Anal ring with 6 setae (85—110 μ), and one row of pores (fig. 14).

Anal lobes with 2 long apical setae (100—130, and 85—110 μ), and 2 glandular spines on the dorsal surface (fig. 14). These lobes are perhaps movable flaps, as observed in *H. truncatispinus*; the structure is quite the same.

Wax pores on the dorsal surface comprise 2 types of tubular ducts, distributed over the whole dorsum, and disk pores which are only found on the abdomen.

Small tubular ducts (ca. 4 × 1.5 μ) are numerous; it seems that they are especially associated with the spines. Around the larger dorsal spines they are arranged in circles of 6—10 ducts. In the marginal spine clusters usually 10—12 of these minute tubes are present, more forward they are irregularly spread along the margin of the body. These minute tubes have a longitudinal partition, a small filament at the inner end, and a double opening at the surface of the body (cf. fig. 21).

It seems that these minute tubular ducts are a special feature of the Eriococcidae. They were first mentioned by SILVESTRI (1939) in his description of *Eriococcus araucariae* MASKELL as "dischi minimi biloculari, preceduti da uno tubicino commune". I have found such minute tubes in several *Eriococcus*-species, but no double opening was seen, only a slit or single opening. SCHMUTTERER (1952) calls these minute tubes with a diameter of 1—2 μ "Kleindrüsen". These small tubes are also figured by BORCHSENIUS (1949) in his figures 359, 371, and 376. FERRIS (1950) mentions the minute double pores for *Fulbrightia gallicola*, but not the tubes; in *Beesonia quercicola* (ibid.) tubes with a median partition, and a double pore at the surface are present, but FERRIS does not reckon this genus to the Eriococcidae. FERRIS (1955; Atlas VII: 74) mentions very minute pores, sometimes connected with minute and very delicate tubes, as occuring in some *Eriococcus-species*, but he does not mention double pores and the longitudinal partition of the tubes. Formerly, however, he had observed and figured the double pores of *Eriococcus araucariae*



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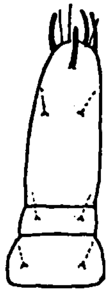

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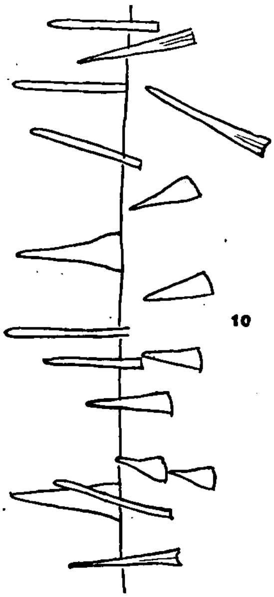

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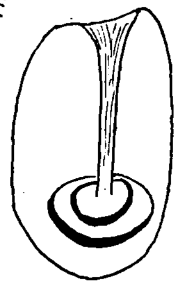

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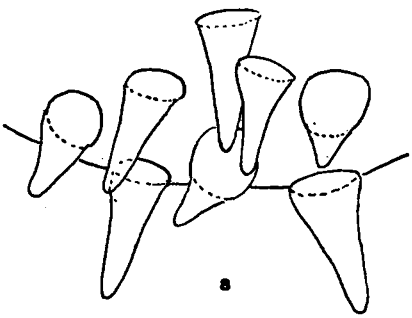

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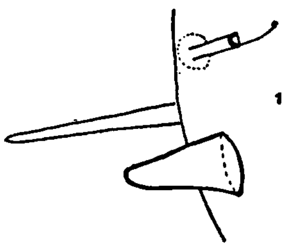

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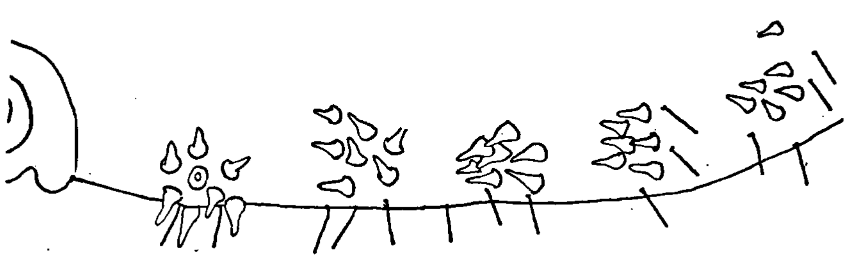

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FIGURES 7—13. Explanation on opposite page.

MASKELL (FERRIS 1948, pp. 283—286). Due to their minute size the structure of these small tubes is difficult to study, even with an oil-immersion objective (100 × 15).

The larger type of tubular ducts (ca. 10 × 2—3 μ), with a hollow cup at the proximal end, are also present, but only sparingly (fig. 11). About 10—12 are observed along each side of the body; they are also found on the dorsum near the larger spines, but only sporadically as compared with *Eriococcus*-species.

Disk pores are present dorsally on the 4—6 posterior segments, but only sparingly. They are arranged in transversal rows. The number of loculi is usually 7, but some pores with 5 loculi may be present.

Ventral surface. Only a few small setae are found on the venter (length ca. 10 μ). Disk pores with 7 loculi are numerous on the 4—5 last abdominal segments. Some pores with 9—10 loculi were also observed. and a few with 5—6 loculi. Further there is a group of 3—5 disk pores between the anterior spiracle and the body margin, and a similar group of 1—3, in the same position, opposite to the posterior spiracle. Occasionally 1—2 of these pores are also found between antenna and eye (observed in 4 of 25 specimens examined). The number of loculi is generally 7; in some pores which are somewhat smaller 5 loculi may be present. Disk pores with 9—10 loculi were only found on the last abdominal segment.

Minute tubular ducts, as described above, are sparingly distributed along the marginal spines; further there are a few (6—12) behind the anterior spiracle.

The spiracles show a central bar (fig. 13).

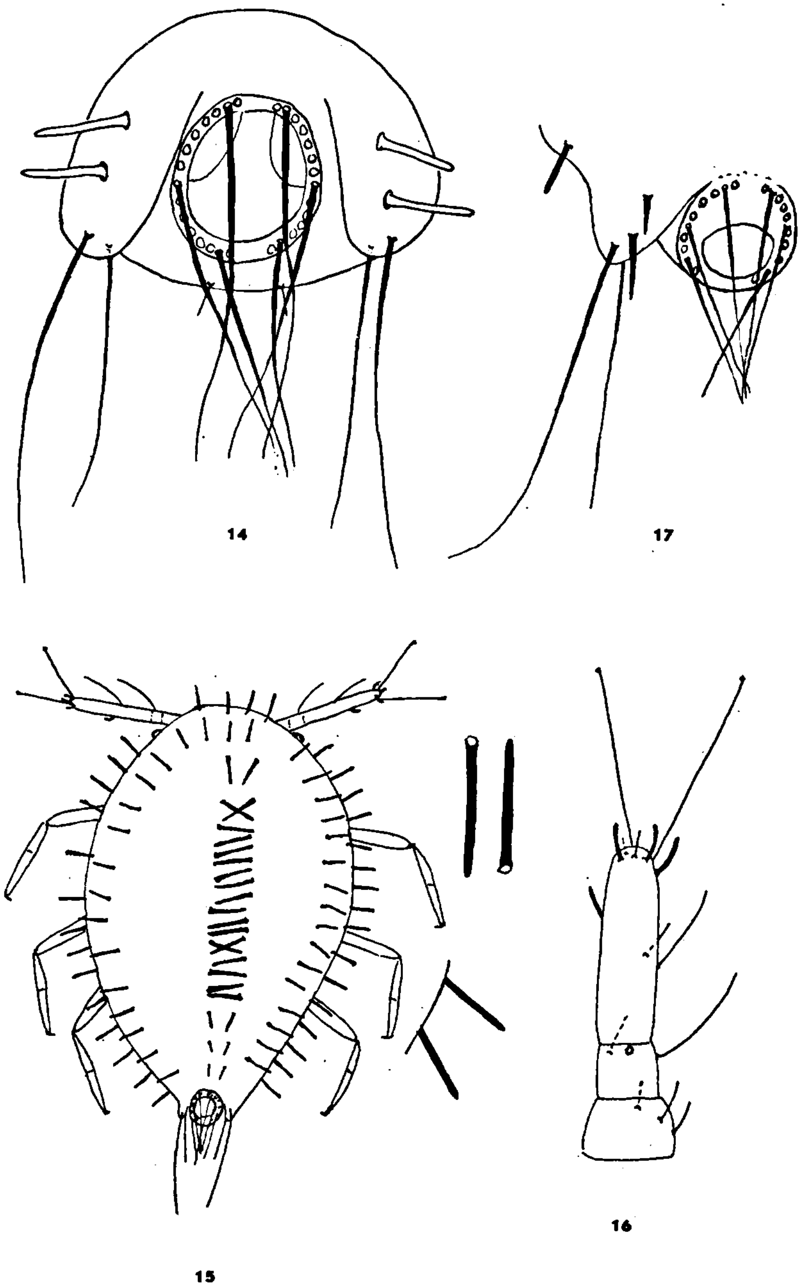
Adult male (♂ ad.)

Length 1.05—1.15 mm; colour of body red. Head with a pair of large eyes, surrounded by red pigment, on the dorsal and on the ventral side. The dorsal eyes are far apart, the ventral ones approached to the middle line. Further 2 much smaller eyes are present, without red pigment, one on each side of the head (fig. 23).

Antennae 9-segmented, length 0.45—0.50 mm (fig. 22). The 2 basal segments are often somewhat stouter than the other ones. Segments III—IX are provided with many short thick setae which are probably sensory setae. Some ordinary setae on the 2—3 last segments are rather long and slightly knobbed.

Legs normally developed; on the trochanter usually 4 sensoria on each

FIGURES 7—13. *Haematococcus obtusispinus* gen. et sp. nov.; **7.** Young adult female, after removal of the wax, seen from the dorsal side (x 65); antennae, legs, spiracles, and mouthparts on the ventral side are shown by dotted lines. On the abdomen 5 pairs of spine clusters are visible (cf. figs. 8 and 9). Adult female **8.** Marginal spine cluster next to the anal opening (x 630); **9.** 5 marginal spine clusters on the abdomen: to the left a part of the anal ring (x 200); **10.** Part of the body margin, opposite to the middle legs (x 465). The 8 short marginal spines form an indistinct group; only 2 of these spines are of normal size. The slender spines belong to the type found on the dorsum; only the larger ones show a striation., **11.** Part of frons with the 2 types of spines, and a tubular duct of the larger type (x 630); **12.** Antenna (x 465); **13.** Posterior spiracle (x 630).



FIGURES 14—17. *Haematococcus obtusispinus* gen. et sp. nov.; **14.** Adult female. Anal ring, and anal lobes, seen from the dorsal side (x 430); Larva I, **15.** seen from the dorsal side (x 140). The dorsum has 3 double rows of spines; in the separate fig. at right the mediodorsal and lateral spines are shown more enlarged (x 465); **16.** Antenna (x 465); **17.** Anal ring and left anal lobe, seen dorsally (x 465).

side (fig. 36). The claw is slender, its digitules are slightly knobbed which applies also to the tarsal digitules. Only few sensory setae are found on the legs; ordinary setae are numerous.

The copulatory apparatus has a bluntly pointed penis (figs. 24). Near the apex of the abdomen 2 shallows pits with wax pores, and a robust double seta, are present. Whether wax tails are formed by these glandular pits could not be made out, as the material had been preserved in alcohol.

The wings have a length of about 0.95 mm. Halteres could not be observed in any specimen, and are probably absent. I failed too to find them in pupae on the point of moulting to adult males.

Larval stages

First stage larva (larva I). Dimensions from 0.4 × 0.2 mm, in newly born larvae, to 0.6 × 0.3 mm in specimens which are on the point of moulting to the next stage. Full-grown embryos of this ovoviviparous species show the same features as the newly born larvae, and measure about 0.4 × 0.2 mm.

Eyes distinct. Antennae 3-segmented, ca 90 μ long; with 2—3 long knobbed hairs on their top, and a distinct sensorium on the second segment (fig. 16). Labium one-segmented, with 8 minute setae at its tip. The rostral loop reaches the line of the hind coxae.

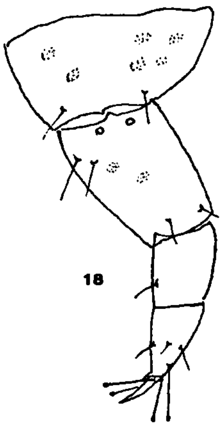
Legs normally developed, but trochanter fused with femur (fig. 19). Trochanter with 2 sensoria on both sides; sensorium at base of tarsus present. Tarsal and ungual digitules longer than the claw, and slightly knobbed. Two small outgrowths at the base of the claw are usually present. The top of the claw is obliquely truncated (fig. 20). Antennae and legs are slender, compared with those of the adult female (cf. figs. 16 and 19 with figs. 12 and 18).

Anal ring and *anal lobes* like those of the adult female, though much smaller (fig. 17). Anal lobes with 2 long apical setae (about 100 and 60—70 μ); the 2 spines on the dorsal surface of the lobes are pointed, and unequal in length.

The *dorsal surface* has a double row of glandular spines mediodorsally, and a double row of smaller spines on each side of the body (fig. 15). Among the mediodorsal spines about 10 pairs in the middle of the body are larger than those at the cephal and anal end. Some stray spines next to the lateral rows may be present on thorax and head. Small tubular ducts (ca. 4 × 2 μ) are found dorsally on the inner side of the lateral spine-rows, and on both sides of the mediodorsal spines; each of these 4 rows contains 10—12 ducts. The structure is like that of the small tubular ducts of the adult female (fig. 21).

The *ventral surface* shows some minute setae which are arranged in 4 longitudinal rows on the abdomen. Three groups of disk pores, with 7 loculi, are observed on both sides of the body, a group of 2—3 behind the eye, a group of 3—4 opposite to the anterior spiracle, and a group of 1—2 at the base of the anal lobe.

Second stage larva of female (larva II ♀). Dimensions 0.60 × 0.35—0.80 × 0.45 mm; a specimen on the point of moulting to adult female measured 0.82 × 0.55 mm. Legs and antennae already much reduced as in the adult female. The pattern of dorsal spines also resembles that of



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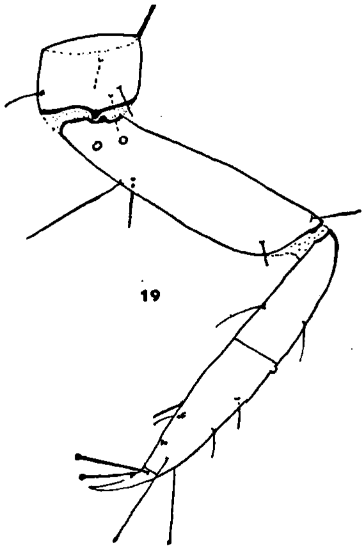

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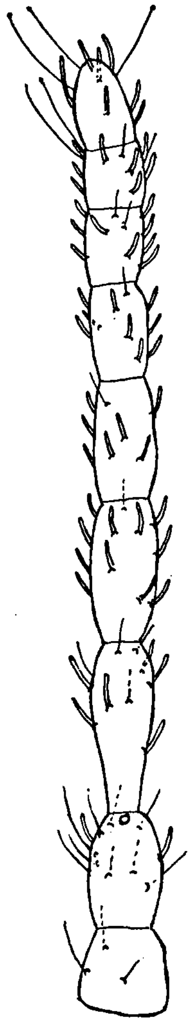

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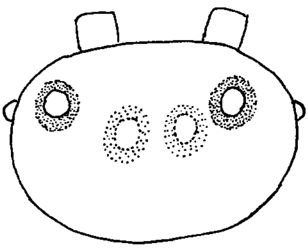

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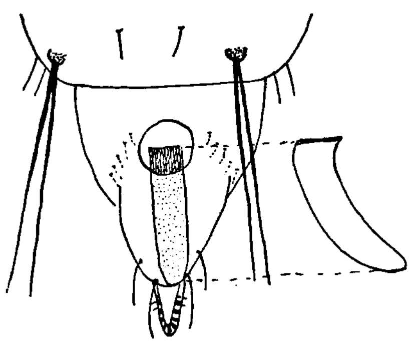

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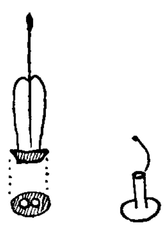

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FIGURES 18—24. Explanation on opposite page.

the adult. The larger sublateral and mediodorsal spines have a striated base, and are surrounded by small tubular ducts. The short conical, unstriated marginal spines, as found in the adult female, are still absent, except 1—3 separate spines next to the anal ring. This is clearly shown by female larvae II which are ready to moult to adult females. Besides the minute tubular ducts, mentioned above; very few of the larger type are present on the dorsum, at most 5—10 (cf. fig. 21).

On the ventral surface 10—12 quinquelocular pores are found along each side of the body; they are not concentrated in 3 groups as in larva I, but rather regularly spread, e.g. 5—6 on each side of the abdomen.

Second stage larva of the male (larva II ♂). Among the prepared larvae II several specimens were found in which the large tubular ducts (7—8 × 2 μ) were very numerous (fig. 21). From 150—190 were counted on the dorsal side, and 120—160 along the ventro-lateral sides (where they end in the line of the legs and spiracles), so that the total number of tubular ducts will be round about 300. Some specimens were found enclosed in a cocoon of fine filaments (2—4 μ in diameter) which, as mounts in alcohol showed, emerge from the tubular ducts. As far as seen, the other features are alike in male and female larvae II. Dimensions of male larvae from 0.70 × 0.45 to 0.90 × 0.45 mm; one specimen in cocoon measured 1.07 × 0.54 mm.

Prepupa (larva III ♂). This stage is provided with short wing-pads which are 200—250 μ long. The antennae are not or very indistinctly segmented ,and 150—200 μ long. Dimensions of body 0.9 × 0.4 and 1.1 × 0.5 mm in the two examined specimens.

Pupa (larva IV ♂). Wing-pads much longer than in the prepupa, reaching beyond the posterior coxae; length about 400 μ. Antennae indistinctly segmented.

On the ventral surface 4 groups of disk pores were found, 9—10 pores outside the fore legs, 13—17 pores behind the anterior spiracle, 10—12 pores inside the middle legs, and about 50 on the abdomen in a sublateral position. These disk pores have usually 9 loculi (rarely 7, 8 or 10). Near the apex of the abdomen some pores with 12 loculi were observed.

I failed to find these disk pores in the adult males, where wax pores were only observed in the two glandular pits at the end of the abdomen which produce the apical wax tails in male Eriococcidae. Dimensions of 7 pupae examined from 0.9 × 0.3 to 1.0 × 0.4 mm.

Prof. Dr. P. BUCHNER has examined on my request the symbionts of the adult female. His report reads as follows (in litt. 4.XII.1956).

FIGURES 18—24. *Haematococcus obtusispinus* gen. et sp. nov. Adult female. **18.** Hind leg (x 430); the division between tibia and tarsus is often indistinct, and sometimes seems to be wanting; Larva I. **19.** Hind leg (x 465); **20.** Claw with digitules, and 2 outgrowths at the base of the claw (x 630); separate figure: tip of claw, much enlarged; **21.** Tubular ducts of larvae. To the left minute tubular duct of larva I (enlarged about x 3000; examined with oil immersion 100 x 15). To the right large tubular duct of male larva II (x 630); Adult male. **22.** Antenna (x 300), **23.** Head, seen from dorsal side, with 3 pairs of eyes; the few setae are omitted (x 200), **24.** Posterior end of abdomen, seen from the dorsal side (x 300). The circle represents the anal opening. Detailfigure: outline of the penis in lateral view.

„Ich habe nun *Haematococcus* etwas genauer angesehen und festgestellt, dass er sich hinsichtlich seiner Symbiose sehr eng an die beiden bisher untersuchten Eriococcinen anschliesst.

Die Symbionten stellen zarte kurze Fädchen und Stäbchen dar, wie sie auch von WALCZUCH (1932) bereits bei *Cryptococcus fagi* und *Eriococcus spurius*, den einzigen bisher untersuchten Eriococcinen, gefunden wurden. Sie bewohnen zwischen den Fettzellen da und dort eingesprengte Zellen, kommen aber auch bei manchen Individuen, offenbar vor allem bei den jüngeren weiblichen Larven, in grosser Menge in den Fettzellen vor. Die Uebertragung geht zunächst in einer bei Cocciden bekanntlich weit verbreiteten Weise vor sich, wenn die Symbionten sich erst um den Ei und Nährzellen verbindenden Faserstrang sammeln und dann in eine terminale Grube der Oocyte sinken. Doch schliesst diese sich dann nicht, wie zumeist, hinter den Bakterien, sondern verflacht wieder, so dass die Symbionten eine sehr dünne Kappe über dem reifen Ei bilden. Erst im Verlaufe der Blastodermbildung treten sie dann zwischen und hinter die Blastodermzellen. In der Folge gesellen sich Dotterkerne zu den Symbionten und entstehen so die Mycetocyten, welche, wenn der Keimstreif das obere Ende erreicht, verstreut auf dessen Dorsalseite gleiten.

Von *Cryptococcus* wird ganz der gleiche Infektionsmodus und ein Uebertritt der Symbionten auf dem Blastodermstadium beschrieben, von *Eriococcus* ausserdem eine nicht stets zu konstatierende sekundäre Ueberschwemmung des Fettgewebes. Die Genese der Mycetocyten ist bei den beiden bisher studierten Eriococcinen die gleiche wie bei *Haematococcus*.

Alle drei Gattungen rücken damit deutlich von der überwältigenden Mehrzahl der Pseudococcinen ab, doch besteht eine überraschende Aehnlichkeit mit der Symbiose bei *Rastrococcus spinosus*. Auch hier kehrt eine extrazellulare dünne Bakterienkappe, ein Uebertritt der Symbionten auf dem Blastodermstadium und die Bildung verstreuter Mycetocyten wieder, und bei anderen *Rastrococcus*-Arten begegnet man einer ungezügelt anmutenden Invasion des Fettgewebes (BUCHNER-Endosymbiosestudien an Schildläusen V: Z.f. Morph. u. Oekol. *46*, 1957). Ein solches Verhalten und der Besitz von symbiontischen Hefen bei gewissen *Rastrococcus*-Arten steht aber in schroffem Gegensatz zu Allem, was bisher über die Symbiose der Pseudococcinen bekannt geworden ist.

H. obtusispinus is at present only known from Dutch New Guinea. The localities of collection are 1) on the north coast, on Mios Manggadi, an island in the Geelvink Bay (coll. F. W. RAPPARD, 10.V.1955), 2) on the south coast near Merauke: Experimental garden Mopa (24.VII.1956), Domandé (4.VIII.1956), and Boeti (III.1957), coll. Jhr. E. W. VAN HEURN. The insect has hitherto only been found on the leaves of the coconut palm. Both collectors reported that the insects were attended by ants, and that sooty mould was present.

Types in the Zoological Museum at Amsterdam. Slides with specimens from the south coast of New Guinea are present in the collections at Washington and London.

H. truncatispinus spec. nov.

The following description is based on specimens from Taroena on the island of Sangi (North Celebes), collected on leaves of the coconut palm by the present author in September 1927, and prepared by Dr. HAROLD MORRISON (Washington). I am indebted to Dr. MORRISON for the loan of 3 slides, one with 3, a second one with 6, and a third one with 2 adult females. The second slide is the best one. It contains 6 young adult females which have been chosen as types; this slide is in the collection of the U.S. Dept. of Agriculture at Washington. No material is available in Holland.

By the kindness of Dr. D. J. WILLIAMS (London) I could also examine 5 slides from the collections of the British Museum (Nat. Hist.), each with one specimen. These specimens had been collected from the coconut palm in the Territory of New Guinea by Mr. J. L. FROGGATT in January 1937; further particulars about the locality are not given. They belong to the same species as the specimens from the island of Sangi. The differences are so slight that it can be at most a variety of *H. truncatispinus*.

Adult female

Habit. According to my notes of 1927: with white wax on the dorsum, and with thin wax filaments along the margin of the body. A rough sketch in my notebook shows that these filaments are short on the frontal part of the body, and much longer on the posterior part of the abdomen, at least as long as the body of the insect. Dimensions (on MORRISON's slides) from 0.8 × 0.6 to 1.7 × 1.4 mm. Only in one specimen of 1.0 × 0.7 mm two half-developed embryos were visible. All available specimens seem to be young adult females. Found on the underside of the leaves of the coconut palm, with abundant sooty mould.

Antennae 3-segmented, with a few setae, like those of *H. obtusispinus* (fig. 28).

Legs also similar to those of *H. obtusispinus* (fig. 30). The trochanter, with 2 sensoria on each side, is fused with the femur. Tibia and tarsus are not fused. Tarsal and ungual digitules longer than the claw, and slightly knobbed. As in *H. obtusispinus* there are 2 small outgrowths at the base of the claw (fig. 31).

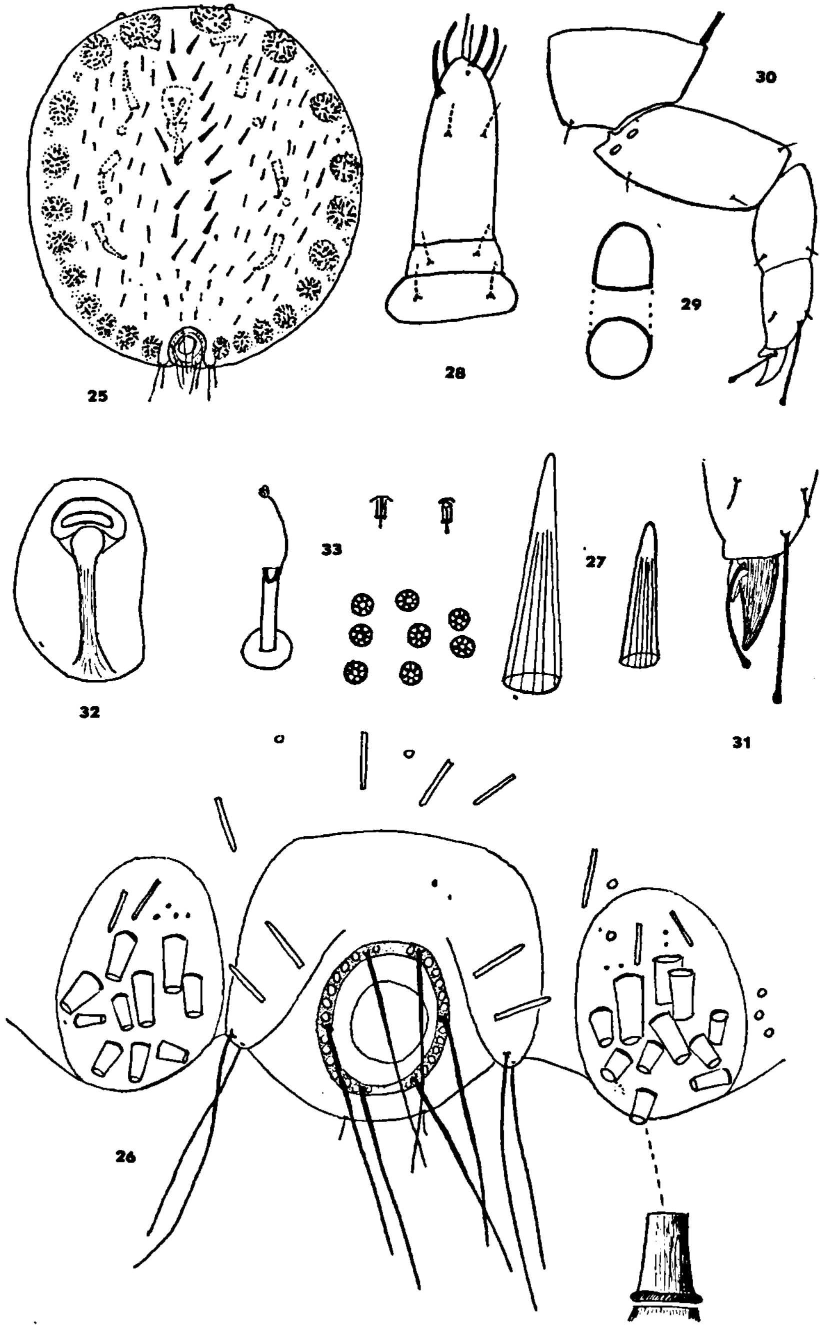
Labium one- segmented, with a few very small setae at the tip; length about 50 μ, width at base ca. 70 μ. Rostral loop short, about as long as the labium, judging from the length of the mouth setae.

Eyes present, on the outside of the first lateral spine-cluster (fig. 29).

Dorsal surface. With striated, bluntly pointed spines (fig. 27) like *H. obtusispinus.* Along the middle line there are 7—10 pairs of spines which are somewhat longer than the other ones. The marginal spines in this species are truncated, and arranged in 11 separate groups on each side of the body (figs. 25, 26, and 34). The number of marginal spines in each group is about 16—18 in the frontal clusters, and 10—12 in the posterior ones (fig. 26). The total number of truncated spines on each side varies from 100 to 125. The spine clusters are placed on more or less sclerotized plates.

The *anal ring* has one row of pores, and six anal setae which have a length of 90—110 μ (fig. 26).

The *anal lobes* are unsclerotized, movable flaps, provided with 2 long apical setae, and 2 much shorter glandular spines (fig. 26). When I collected the insect, the following interesting observation was made. The anal lobes, which cover the anal opening, are moved aside as soon as the lateral wax filaments are touched with a needle, and a clear drop of honey dew becomes visible on the exposed anal ring. As the glandular spines on the surface of the anal lobes are prolonged by white wax filaments, the movement of the lobes can be easily observed with a pocket lens (× 10). Jhr. VAN HEURN failed to observe this phenomenon in *H. obtusispinus*, but he had at his disposal only a lens of low magnification (× 2). As the structure of the anal lobes is the same as in *H. truncatispinus* I expected that *H. obtusispinus* would show the same reaction upon touch of the



Figures 25—33. Explanation on opposite page.

lateral wax filaments. A similar phenomenon has formerly been observed in *Coccus viridis* (GREEN); when the anal region is touched with a hair, the anal valves are opened, and a drop of honey dew becomes visible between the anal setae (REYNE, 1929). The same reactions of the anal valves or lobes are probably caused by the visiting ants which in this way can easily obtain the honey dew. Mr. P. H. VAN DOESBURG who sent me *Antonina graminis* (MASK.) from Surinam added the following remark: when the insect is touched, a clear drop appears at the end of the long wax-tube secreted by the anal ring. Ants were absent in this case. Mr. F. W. RAPPARD who collected the same insects in New Guinea stated, however, that they were assiduously visited by ants.

Wax pores are rather scanty on the dorsal surface. Some disk pores are found on the posterior abdominal segments, and a few on the head. Between, or at the outer side of, the marginal spine clusters groups of 2—10 disk pores are usually present (fig. 33).

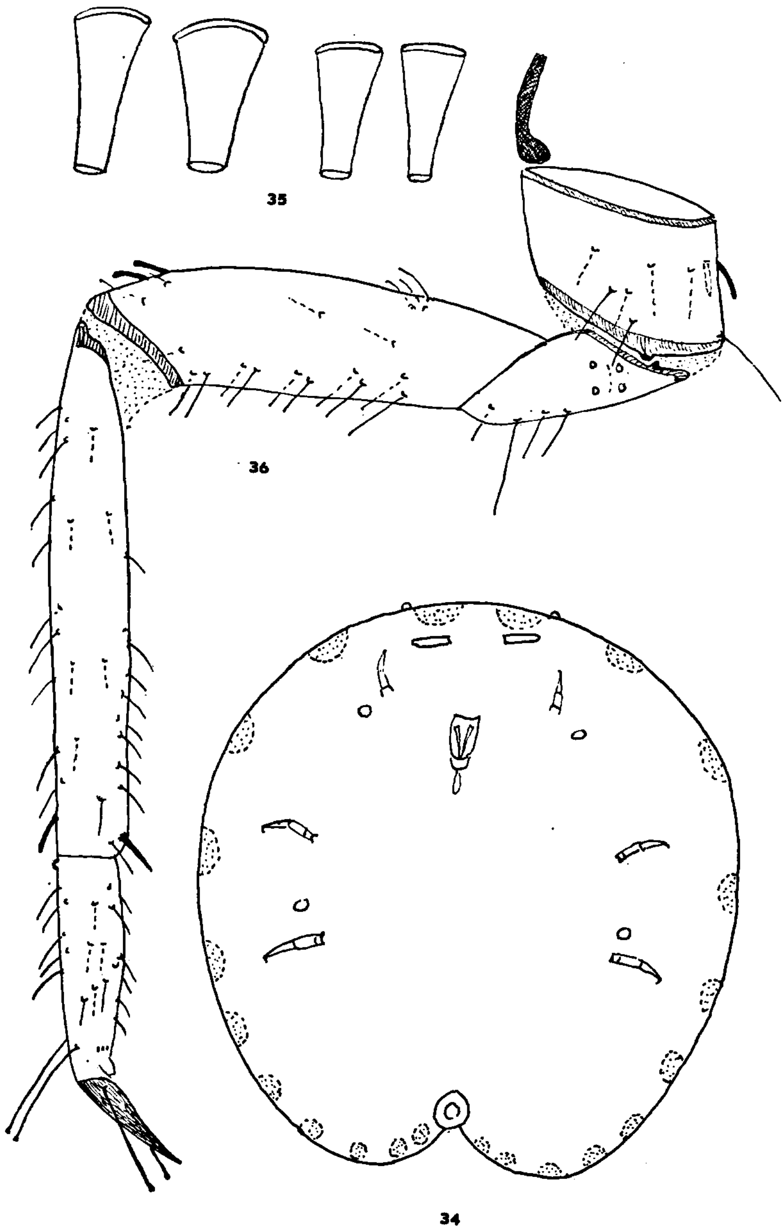
Minute tubular ducts (ca. 4 $\times$ 1.5 μ) are also present on the dorsum (fig. 33); they have probably the same structure as in *H. obtusispinus*. They have a double opening at the surface, a longitudinal partition, and a filament at the proximal end. Some of these minute tubes are also found on the marginal spine clusters (fig. 26).

The *ventral surface* shows only a few minute setae (length at most 35 μ), but no spines. The spiracles are like those of *H. obtusispinus* (fig. 32). Disk pores with 7 (sometimes 5) loculi*) are numerous on the abdomen, especially on the posterior segments. A few disk pores are also found along the margin of the body, e.g. 1—3 pores opposite to the spiracles, and one pore between antenna and fore leg. Large tubular ducts (12—20 $\times$ 2.5—3.0 μ), with a hollow cup and a filament at the proximal end (fig. 33), are found along the margin of the abdomen, and usually also of the thorax. They are arranged on the abdomen in small groups, sometimes of 4—7 ducts, opposite to the lateral spine clusters. On the innner side of these groups minute tubular ducts, as mentioned above, are observed in groups of 2—6. Some of these minute tubes are also present along the margin of the thorax, and near the rostrum.

Eggs with half-developed embryos, without spines, were only observed

*) I am indebted to Dr. MORRISON for these data. He examined the pores with an oil-immersion objective (Zeiss 90 $\times$ 15), but states that the material was not sufficient for a real critical study of these pores.

FIGURES 25—33. *Haematococcus truncatispinus* sp. nov.; Adult female **25**. after removal of the wax covering, seen from the dorsal side (x 40). The truncated, unstriated, marginal spines are arranged in 11 pairs of clusters along the margin of the body (see also fig. 34). The ventral parts, antennae, legs, spiracles, and mouthparts are shown by dotted lines; **26**. Posterior part of abdomen, seen dorsally, with anal ring, anal lobes, and the adjacent spine clusters (x 300). Small circles indicate disk pores, black dots minute tubular ducts. One of the truncated spines is shown more enlarged (x 630); **27**. Dorsal spines (x 430). In lateral view the larger spines are striated, but the smallest ones not: **28**. Antenna (x 465); **29**. Eye (x 630); **30**. Hind leg (x 430), **31**. Claw (x 800). **32**. Anterior spiracle (x 630), **33**. To the left: a tubular duct of the larger type (x 800); to the right: 2 tubular ducts of the minute type (x 800), and a group of 8 disk pores, lying between the marginal spine clusters (x 630).



FIGURES 34—36. *Haematococcus truncatispinus* sp. nov.; **34**. Adult female, wholly filled with embryos, seen from the ventral side (x 40). The eleven pairs of spine clusters on the dorsal margin are indicated. This fig. was drawn after a specimen from the Territory of New Guinea; **35**. Specimen of fig. 34. Marginal spines with slightly hollow sides (x 630). The 2 left spines are from the abdomen, the 2 right spines from the frons; **36**. Adult male of *H. obtusispinus*. Hind leg (x 465).

in one of the Sangi-specimens. From the specimens of the Territory of New Guinea it is evident that *H. truncatispinus* like *H. obtusispinus* is ovoviviparous. The fully developed embryos (larvae I) are alike those of *H. obtusispinus*, with a double row of spines along the middle line of the dorsum, and a double row along the margin of the body. The male stages cannot be described, as no material is available. Larvae and adult males were observed on Sangi in 1927, but I have only noted that their body colour is red, without further particulars.

Coconut palms infested by these scale insects are easily recognized by their blackened leaves. This phenomenon was very obvious when I visited Karakelong, one of the Talaud Islands ,in 1927. The trees in some villages along the coast were all blackened by sooty mould. The first blackened trees were seen on entering a village, and the last ones on leaving it (REYNE, 1948).

H. truncatispinus was common in the Sangi- and Talaud Islands in the years 1927—1930. It was also found in some villages of the district Minahassa which lies on the north point of Celebes. Further this insect was observed in the Moluccas on the islands of Halmahera. Morotai, Batjan, Obi (or Ombi), and on the Soela Islands. Only the specimens from Taroena (island of Sangi) have been examined in microscopical preparations, so that it is possible that *H. obtusispinus* or other species were present among the *Haematococcus* observed in the above mentioned islands.

Up till now *H. truncatispinus* has not been found in Dutch New Guinea, but may be expected there, as it occurs in the eastern part of this island.

The specimens of *H. truncatispinus* from the Territory of New Guinea are slightly different from those of Taroena in the island of Sangi; the distance between these localities is about 2000 kms or more. The truncated marginal spines have sometimes slightly hollow sides (fig. 35). The mediodorsal spines are more slender, and more alike the other dorsal spines. The number of disk pores in the groups between the lateral spine clusters is only 1—3 (in the Taroena-specimens 2—10). The minute tubular ducts have usually a distinct double opening. The number of spines in the lateral spine clusters of the abdomen is somewhat smaller than in the Taroena-specimens (6—8 against 10—12).

Types in the collection of the U.S. Department of Agriculture at Washington (holotype and paratypes on the slide with 6 specimens; see above).

Leptococcus metroxyli gen. nov., spec. nov.

This insect has been found on the underside of the leaves of the sago palm (*Metroxylon* sp.). It was collected by Mr. F. W. RAPPARD near lake Sentani, in the environments of Hollandia, the chief town on the north coast of Dutch New Guinea (4.IX.1954, and 30.V.1955). Afterwards I have received abundant material from the south coast of this island, collected by Jhr. E. W. VAN HEURN in different localities around Merauke (Domandé 5.VIII.1956, Merauke 25.VIII.1956, Boetie XII.1956, Kalilain and Jacobi on Frederik Hendrik Island IV.1957). By his kind assistance I could also examine the wax covering of fresh specimens which is largely destroyed in alcohol material. He has sent me by air mail

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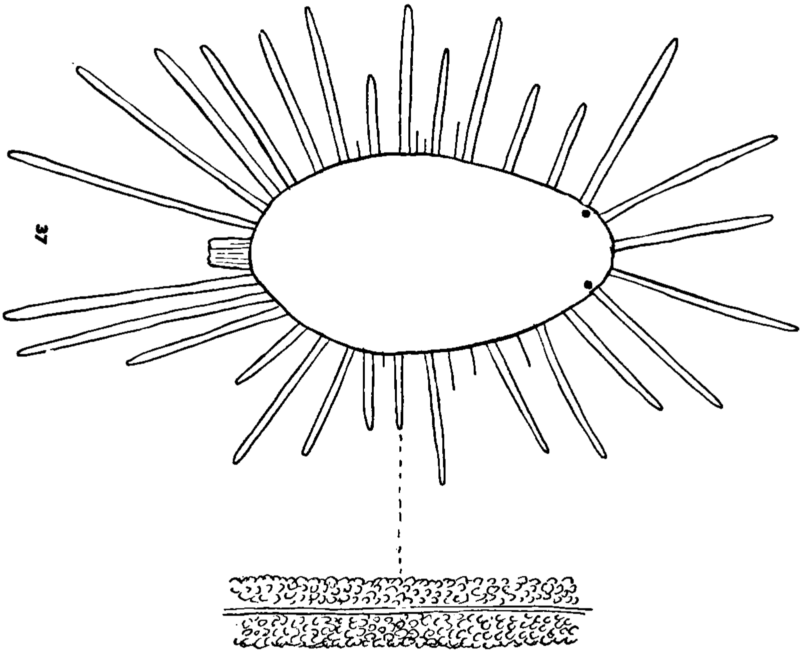

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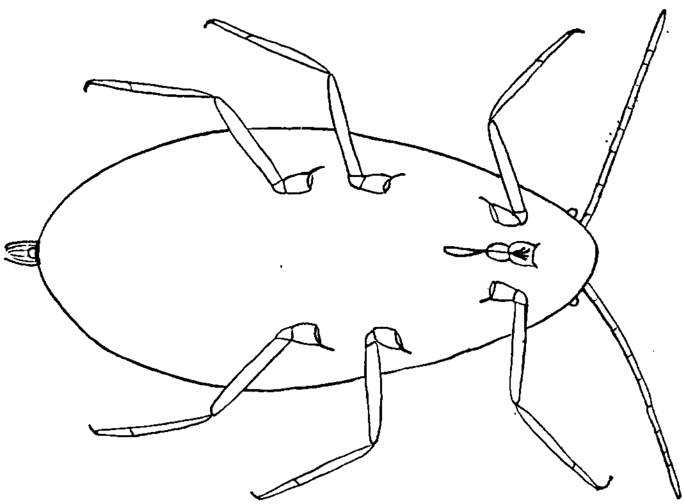


FIGURES 37—38. Explanation on opposite page.

several leaf pieces with these insects, of which some were still alive after their arrival in Holland; the last living specimens were observed 14—16 days after their dispatch from Merauke.

This scale insect belongs to the fam. Pseudococcidae, but it cannot be assigned to any genus described in the monographs of BORCHSENIUS (1949) and FERRIS (1937/55). Dr. D. J. WILLIAMS (London) informed me that he failed to find in the collections of the British Museum any Pseudococcid comparable with the present insect from New Guinea. Quite recently Dr. WILLIAMS informed me that he had received *Leptococcus metroxyli* from Br. New Guinea, where it had been found on pineapple in N.E. New Guinea, and on coconut in Papua (in litt. 23.I.1960). Dr. HAROLD MORRISON (Washington), who has examined some specimens of this coccid, called my attention to his description of *Macrocepicoccus loranthi* (1919). He thought that the species from New Guinea could be assigned to his genus *Macrocepicoccus*. Considering the localities of collection (Br. Guiana, and New Guinea), the food plants, and differences in structure, I have thought it better to assign the New Guinea-species to a new genus which is named *Leptococcus* in view of the slender antennae and legs. Dr. MORRISON also called my attention to *Heliococcus sakai* TAKAHASHI (1951) as allied to my *Leptococcus metroxyli* (see: *Discussion*).

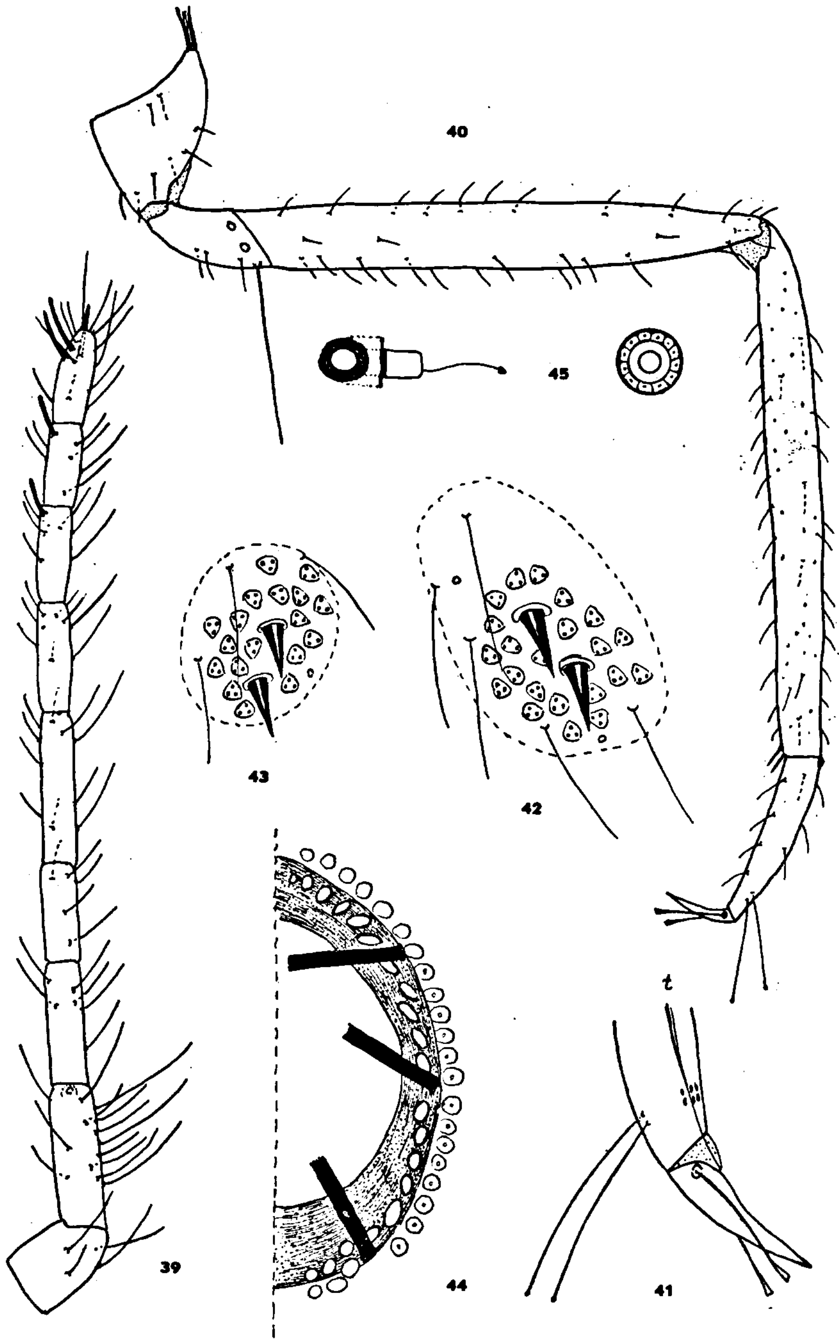
Leptococcus, gen. nov.

Pseudococcid with 9-segmented antennae in the adult female, but unlike *Phenacoccus*; no denticle on claw, no quinquelocular pores; setae on dorsum, no spines except in the cerarii. Antennae and legs very slender, and long in proportion to the body; claw slender and straight. Cerarii 14—16 pairs, with crowded trilocular pores, and usually some accessory setae in the larger cerarii. With a band of short, stout tubular ducts, and multilocular pores along the whole margin of the body; this band is already present in the second stage larva.

Adult male with 10-segmented antennae. Head with 3 pairs of eyes. Wings present, but halteres lacking. At the end of the abdomen 2 depressions with closely packed wax pores, and a large double seta. Copulatory apparatus with a curved spine-like penis.

Type species: *Leptococcus metroxyli*, spec. nov.

FIGURES 37—38. *Leptococcus metroxyli* gen. et sp. nov.; Adult female, **37**. Wax covering seen from the dorsal side; drawn from a living specimen (x 40). The wax plug at the end of the abdomen is produced by the gland pores of the anal ring. Separate figure: part of a wax filament more enlarged (x 300). In the axis 1—2 glassy threads are present, produced by the lateral tubular ducts; the surrounding wax curls are derived from the adjacent cerarii. Some of the glassy threads are not surrounded by wax curls; in the main figure these bare threads have been drawn by a simple line, the coated threads by a double line. **38**. Ventral view; drawn from a macerated specimen on slide (x 40). About 10 full-grown embryos were observed within the abdomen of this specimen.



FIGURES 39—45. Explanation on opposite page.

Leptococcus metroxyli spec. nov.

Adult female (♀ ad.)

Habit. Body flat; height only $^1/_3$—$^1/_2$ of width. The body is slightly dusted with wax, but old mature specimens from the alcohol material show a thin, dense wax coating. A fringe of about 15 long wax filaments is seen on both sides of the body; their length is usually about equal to the width of the insect, sometimes twice as long; their diameter is only 30—50 μ (fig. 37). These wax filaments have a peculiar structure. In their axis one, or usually two glassy threads are observed which are covered by a layer of small wax curls (fig. 37). The glassy threads are produced by the lateral tubular ducts, and the wax curls by the trilocular pores of the cerarii. It seems that the wax curls adhere to the glassy threads as soon as these threads emerge from the tubular ducts.

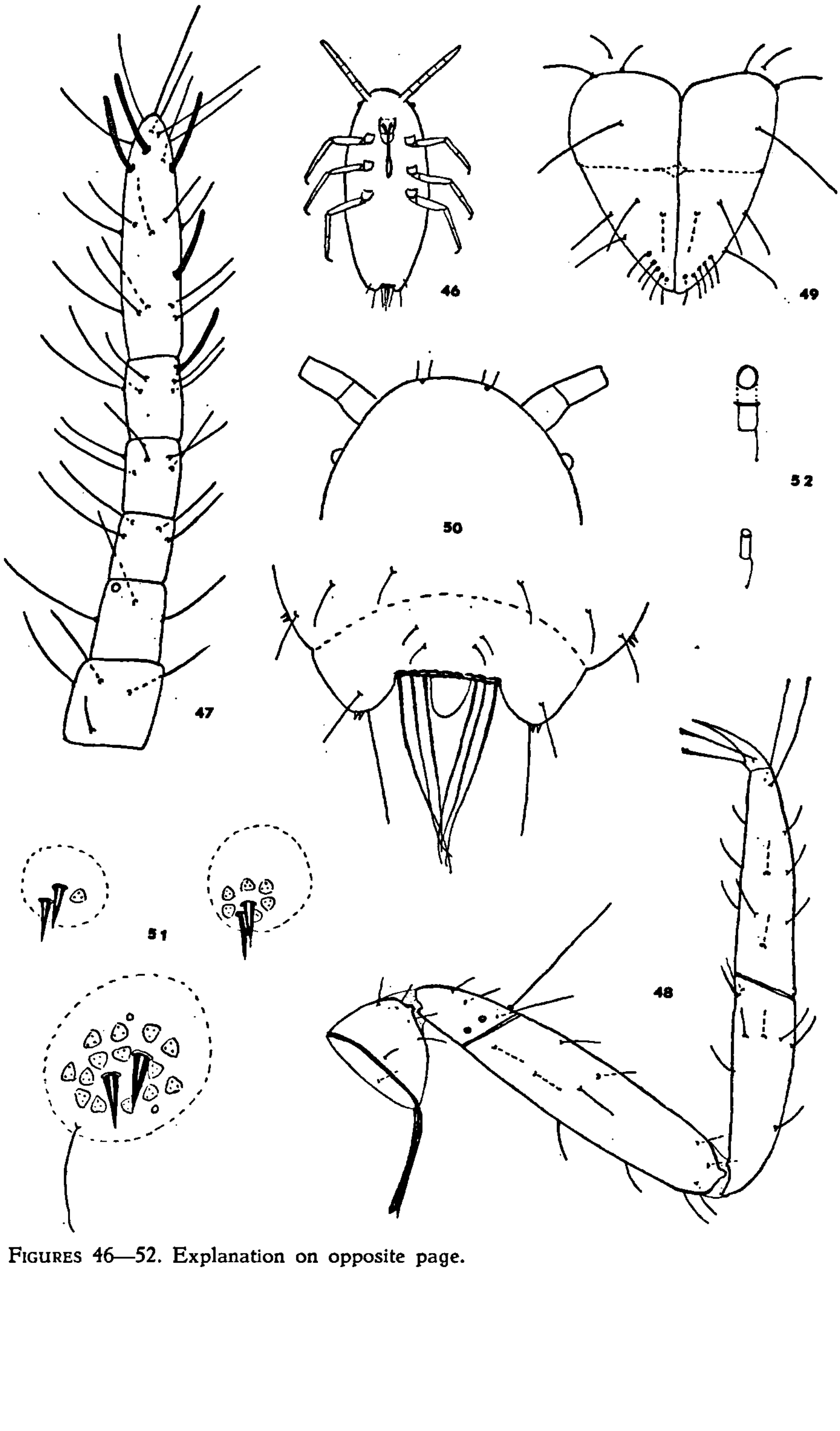
In crowded colonies, which sometimes cover $^3/_4$ of the lower surface of the separate pinnae of the palm leaf. Dimensions of body (on the slide) from 1.1 × 0.5 to 1.7 × 1.0 mm; mature females with many full-grown embryos sometimes measure 2.0 × 1.5 mm. Body, legs and antennae yellowish. According to Mr. RAPPARD and Jhr. VAN HEURN, who have collected the insects in New Guinea, they are not frequented by ants. Collected from the leaves of the sago palm (*Metroxylon*).

Antennae 9-segmented, length 600—700 μ (fig. 39). Width of segments II—IX only 20—30 μ. The basal segment has 4 setae, the second one 10—13, segments III—VIII 5—8 (V sometimes 10), and segment IX.12. In addition to these setae segments VII and VIII are provided with a sensory seta near their top, and segment IX with 3 such setae.

Legs like the antennae very slender (fig. 38 and 40). Length of hind leg about 900 μ femur ca. 300 × 40 μ, tibia 300 × 30 μ, tarsus (without claw) 110—120 μ, claw 35 μ. The ungual digitules are distinctly knobbed, the tarsal digitules very faintly (fig. 41). The trochanter has 2 sensoria on both sides, and the tarsus a sensorium near its base; these sensoria are also present in the larval stages of the female. The hind tibiae are usually provided with many translucent pores; the fore and middle legs are devoid of such pores. Sometimes 50 or more of these minute pores are present; in other cases only few or none at all could be found. The setae on the hind leg are shown in fig. 40.

Labium bluntly pointed. It is 2-segmented, but the division between the basal and the apical part (indicated by a dotted line in fig. 49) is often so faintly developed that it is scarcely visible in the microscopical prepara-

FIGURES 39—45. *Leptococcus metroxyli* gen. et sp. nov.; Adult female, **39.** Right antenna, seen from the ventral side (x 200). The sensory setae on the 3 last segments are drawn too thick to show their position clearly, **40.** Hind leg (x 200). The dots on the tibia indicate minute translucent pores, sometimes a few are also observed on the coxa. **41.** Claw with digitules (x 630); *t* is the tendon by which the claw is moved; the muscle of this tendon lies within the femur, **42.** Ultimate cerarius; with 5 accessory setae, 22 trilocular pores, and 2 micropores (x 630), **43.** Penultimate cerarius; with 3 accessory setae, 18 trilocular pores, and one micropore (x 630). For second cerarius on head see fig. 56, **44.** Half of anal ring, with basal part of anal setae (x 630), **45.** Tubular duct (x 630), and a multilocular pore (x 1000) from the margin of the body.



Figures 46—52. Explanation on opposite page.

tions. There are 9 pairs of setae on the apical segment, and 1 pair on the basal segment; further there are 2 groups of 3 setae at the base of the labium (cf. fig. 49). Rostral loop short, about twice as long as the labium.

Anal lobes rather pronounced in younger specimens; apical seta about 80 μ, less robust than the setae of the anal ring (cf. fig. 50).

Dorsal surface. Eyes prominent (figs. 37, 38, and 56). Dorsum sparingly covered with setae; spines absent, except in the cerarii. Anterior and posterior ostioles well developed. The anal ring is provided with a double row of pores, almost equal in size, and with 6 anal setae (fig. 44). Diameter of ring 90—100 μ, length of anal setae 110—140 μ.

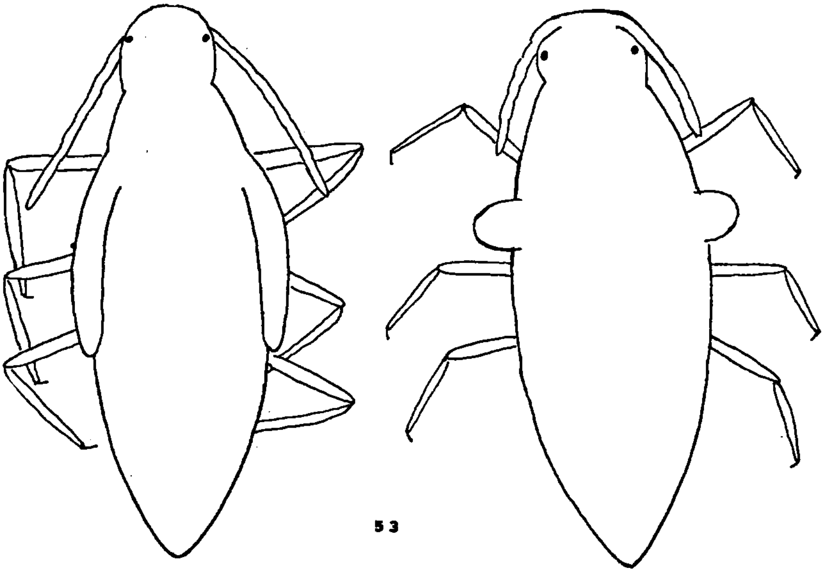
The number of cerarii is somewhat variable. As a rule there are 15 pairs, but specimens with 14 or 16 cerarii on one or both sides are also observed. The cerarii have short conical spines, a variable number of trilocular pores, and usually 1—5 accessory setae when there are 8 or more pores. Some cerarii on the thorax are often poorly developed, with 2 minute spines and only 1—3 trilocular pores; in one or two of these cerarii the spines may be replaced by a pair of setae. Only one pair of cerarii is present between the antennae; the next pair is found near the eyes. The 3 foremost pairs of cerarii have usually 3 spines, the other ones only 2 (figs. 56, 42, and 43).

The number of trilocular pores in the cerarii is very variable. The ultimate cerarius has usually 20—30 pores, the penultimate one 12—20, but, sometimes as many as 25—30. In the 2 frontal pairs of cerarii the number of pores may also be about 20, but sometimes only 6—8 are present. One or two cerarii at the base of the abdomen (the 6th and 7th, when the anal lobe-cerarius is taken as the first) are often provided with 12—18 pores.

The trilocular pores in the cerarii are crowded but usually do not touch each other ,though the distance between the pores is seldom more than their diameter. The trilocular pores outside the cerarii are of a somewhat smaller size; the distance between these pores is at least 6—8 times as large as their diameter.

A special feature of this insect is the presence of a band of wax pores around the whole margin of the body. This band consists of 70—80 stout tubular ducts (ca. 7 × 5 μ), and some 100 multilocular pores on each side; it encloses also the cerarii. The tubular ducts are without a distinct oral collar which is only visible in well-stained preparations; the filament is extremely thin, and only slightly dilated at the top (fig. 45). The

FIGURES 46—52. *Leptococcus metroxyli* gen. et sp. nov.; Larva I, **46.** Seen from the ventral side (x 40), **47.** Antenna (x 430), **48.** Hind leg (x 430), **49.** Labium, seen from the ventral side (x 630). The labium of the adult female is larger, but shows the same structure and setae, **50.** Upper figure: anterior end of body, seen from the dorsal side (x 200). The first pair of cerarii is represented by 2 double setae between the antennae; lower figure: Apex of abdomen, seen from the ventral side (x 430). The tips of the spines of the ultimate and penultimate cerarii are figured; **51.** Larvae I-III, ultimate cerarius (x 630). At left larva I, at right larva II of female, below larva III of female. The cerarius of larva III has 14 trilocular pores, 2 micropores, and one accessory seta; **52.** Larva II. Above: tubular duct of female larva II (x 630). Below: narrow tubular duct of male larva II, as found on the ventral side of the thorax between the legs (x 750).



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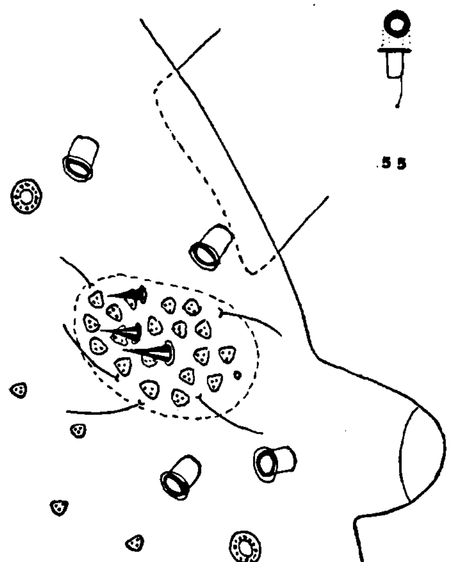

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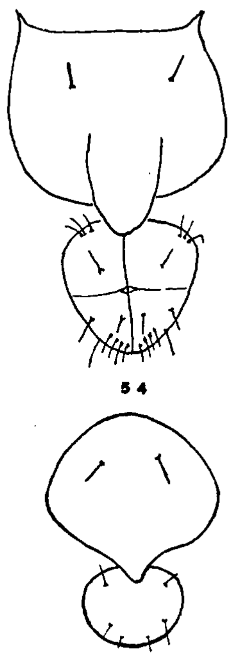

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FIGURES 53—56. *Leptococcus metroxyli* gen. et sp. nov.; **53**. Outline of pupa (at left), and prepupa (at right), seen from the dorsal side (x 65); **54**. Labium of male larva II (upper fig.), and of the following stage, the prepupa (lower fig.); (x 300); **55**. Prepupa. Tubular duct, with oral ring (x 630); **56**. Adult female. The second cerarius on the head, with eye, base of antenna, 4 adjacent tubular ducts, 2 multilocular pores, and 4 trilocular pores (x 630). The cerarius shows 3 spines, 5 accessory setae, 19 trilocular pores, and one micropore.

multilocular pores have a diameter of 6—8 μ, and as a rule 12 loculi (fig. 45). Outside the lateral band only a few multilocular pores are found on the dorsum (at most 10—12), and very few tubular ducts (1—5). The marginal band of tubular ducts and multilocular pores is already present in the second larval stage in which only the 2 anterior and 2 posterior pairs of cerarii are developed.

Ventral surface. No circulus. About 40—60 multilocular pores are observed on the abdomen, of which 20—30 are found on the segments bordering the genital fissure. On thorax and head sometimes a few stray wax pores are found, but they are usually absent. Setae are scarce on the venter; trilocular pores seem to be wanting, except very few on the abdomen. The spiracles show no special features except a group of about 6—10 multilocular pores in front of the opening; this group is formed by an extension of the lateral band of these pores.

The insect is ovoviviparous; mature females show full-grown embryos within their body, similar to the first stage larva.

First stage larva (larva I)

Dimensions from 0.5 × 0.2 to 0.7 × 0.25 mm; two specimens on the point of moulting to larva II measured 0.60 × 0.25 and 0.70 × 0.25 mm (fig. 46).

Antennae 6-segmented; length 200—270 μ (fig. 47). Number of setae on the different segments: I (basal segment) 4, II 3 (sometimes 4), III 4—5, IV 5, V 5, and VI 16—18. In addition to these setae segment V has a sensory seta near its top, and segment VI 4 such setae (one halfway the segment, and 3 near the top). Segment II is provided with the usual sensorium near its upper partition.

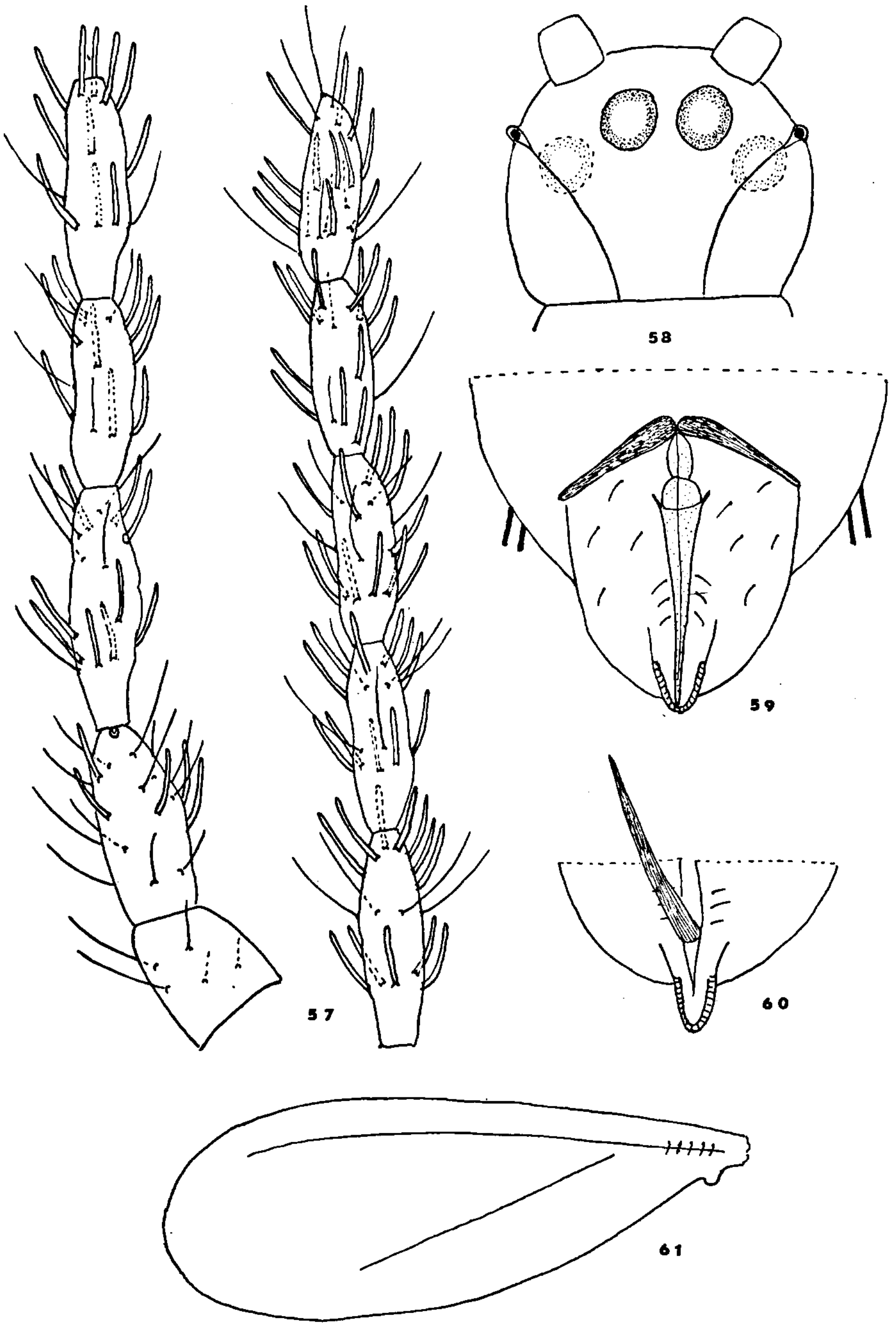
Legs. Hind leg about 300 μ long (fig. 48). The tarsus (without claw) and the tibia are about equal in length (70—80 μ); the femur is somewhat longer (100—110 μ). The claw has a length of ca. 25 μ. The ungual digitules are as long as the claw,and distinctly knobbed; the tarsal digitules are only very faintly dilated at their tips.

Labium bluntly pointed, about as long as wide (45—50 μ), with 10 pairs of setae, and at its base two groups of 3 setae (fig. 49). The labium is bipartite, but the division between the basal and the apical segment (indicated by a dotted line in fig. 49) is often so faintly developed that it is invisible in microscopical in preparations. The rostral loop is 2—3 times as long as the labium, and reaches the middle legs (fig. 46).

Anal lobes and *eyes* distinct (fig. 50); apical seta on anal lobe about 40 μ, accessory seta 20 μ; base of eye 10—15 μ. Both pairs of *ostioles* present; the posterior ones large and distinct.

Dorsal surface. Each segment has a transversal row of 6 setae; the marginal setae are often doubled, and probably represent initial cerarii. Only trilocular pores are present; their number is less than that of the setae.

The 2 posterior pairs of cerarii are present; they contain 2 short conical spines and 1—2 trilocular pores (figs. 50 and 51). The other cerarii, as far as recognizable, are represented by a pair of setae, similar to those on the dorsum. and sometimes provided with a single trilocular pore (e.g. in the cerarii between the antennae) (fig. 50).



FIGURES 57—61. Explanation on opposite page.

Anal ring with 2 rows of pores and 6 anal setae (length 60—80 μ); diameter of ring about 40 μ.

Ventral surface. With few setae in transversal rows. No trilocular pores except very few at the sides of the body. Spiracles without special features. No circulus.

Larva I can be easily distinguished from larva II by the absence of tubular ducts and multilocular pores, and by its cerarii as described above.

The mature female is ovoviviparous. Dimensions of full-grown embryos from 0.40 × 0.20 to 0.45 × 0.25; antennae, legs, labium, anal ring, and cerarian spines as described above for larva I.

Second stage larva of the female (larva II ♀)

Dimensions from 0.6 × 0.3 to 0.9 × 0.4 mm. A specimen which had just moulted to larva II measured only 0.55 × 0.25 mm, another specimen, on the point of moulting to larva III, 0.9 × 0.4 mm.

Larva II can be distinguished from larva I by the following characters.

1) A row of 17—20 short thick tubular ducts (about 6 × 4 μ) is observed on both sides of the body (fig. 52), interspersed with about the same number of multilocular pores (diameter ca. 5 μ; with 10—12 loculi). Some multilocular pores are usually present in the sublateral region of the abdomen, dorsally as well as ventrally, but their total number is at most 12—15.

2) The ultimate cerarius has 6—8 trilocular pores (fig. 51), and the penultimate one 4—6. An accessory seta is sometimes observed in these cerarii.

3) The 2 cerarii between the antennae, and usually also those near the eyes (the 2 foremost pairs) are provided with spines and 1—3 trilocular pores; in larva I the cerarii between the antennae are represented by a double seta with 0—1 trilocular pores. In one specimen of larva II 14 cerarii could be recognized, of which 6 had double spines, 5 single spines, and 3 double setae, but as a rule only the 2 foremost and 2 hindmost pairs of cerarii are well developed.

4) The third antennal segment is about 1.5 times as long as the second one; in larva I both segments are about equal in length.

Antennae 6-segmented; length 240—380 μ, average of 12 specimens 296 μ. Hind leg 360—400 μ femur ca. 130, tibia 100, tarsus (without claw) 90, and claw 30 μ. The number of setae observed on the different segments of the antennae and hind legs is about the same as in larva I. The number of setae and trilocular pores on the dorsum is somewhat larger. Labium and anal ring, apart from difference in size, are alike in all stages of the female.

FIGURES 57—61. *Leptococcus metroxyli* gen. et sp. nov.; Adult male, **57.** Right antenna, seen from the dorsal side (x 430). At left the 5 basal segments are figured, at right the 5 apical ones. **58.** Head with eyes, seen from the ventral side; setae are omitted (x 200), **59.** Apex of abdomen, seen from the ventral side, with genital valves closed, and penis (dotted) retracted (x 430), **60.** as in fig. 59, but with penis protruded (x 430), (see also fig. 62), **61.** Wing (x 65). Note the pocket at the wing base (though halteres are absent), and the small setae near the base of the vein.

Third stage larva of the female (larva III ♀)

Dimensions from 0.9 × 0.4 to 1.2 × 0.5 mm; a specimen on the point of moulting to adult female measured 1.2 × 0.5 mm.

This stage can be distinguished from larva I and II by its 7-segmented antenna; length 360—560 μ, average of 10 specimens 456 μ. In the hind legs the tarsus is rather constant in length, ca. 100 μ; femur 160—230 μ, average of 10 specimens 204 μ; tibia 140—200 μ, average of 10 specimens 166 μ.

As a rule 12—15 pairs of cerarii can be recognized. The 2 foremost pairs of cerarii have usually 3 spines and 4—8 trilocular pores. The remaining cerarii are provided with 2 spines, and 3—5 pores, but 2 pairs at the base of the abdomen have often 6—10 pores. Some cerarii are poorly developed, with only 1 spine or 2 setae, and 1—2 pores. The cerarii at the ends of the body, and near the base of the abdomen, are usually well developed, but the number of pores may be somewhat reduced. In the ultimate cerarius the number of pores is usually 10—14 (fig. 51), and in the penultimate one 8—10; these cerarii have often 1—2 accessory setae.

The principal differences between larva III and larva II of the female are as follows. Antenna 7-segmented (larva II 6-segmented). Number of tubular ducts and multilocular pores on each side of the body 30—40 (in larva II 17—20). The tibia is at least 1.5 times as long as the tarsus (without claw); in larva II the tibia is only slighter longer than the tarsus.

Adult male (♂ ad.)

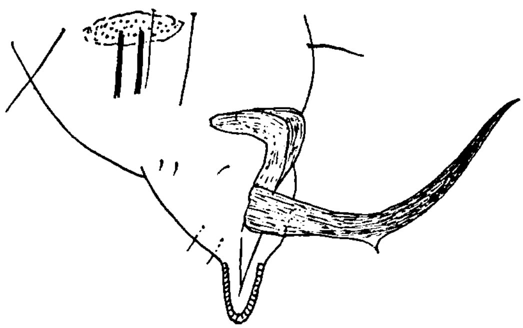
Dimensions of body (on slide) from 1.0 × 0.25 to 1.3 × 0.4 mm; the average length of 10 specimens was 1.18 mm.

The *antennae* have a length of about 600 μ, and are usually 10-segmented (fig. 57). Sometimes the 5th and 6th segments are fused, as was observed in 4 of 20 specimens examined; in one case the 4th and 5th segments had partly coalesced. The antennal segments are provided with many setae, among which there are several blunt ones that resemble the sensory setae of the antennae of the female stages.

The *legs* with their claws (fig. 64) are very slender, and provided with several blunt setae, similar to those on the antennae, in addition to common setae. There are 3 sensoria on both sides of the trochanter, and one near the base of the tarsus; in the female stages only 2 pairs of sensoria are present on the trochanter.

The *wings* (fig. 61) are about 1.0 mm long. They are provided with a pouch-like appendage on the hind margin, near their base. I failed, however, to find halteres with curved setae as a counterpart of this appendage, though 30 males, and several pupae on the point of moulting, were examined.

EZZAT (1956) has examined the thoracical sclerites of the adult males of a number of coccids, as it was supposed that these sclerites might furnish some features of taxonomic value. The thoracical sclerites of the adult male of *Leptococcus metroxyli* are shown in fig. 63. The round sclerites, marked with an asterisk in this figure, are not represented in EZZAT's fig. 4 of *Pseudococcus vitis* (NIED.). These sclerites are provided with 4—7 hairs, and a sclerotized eye at their sides.



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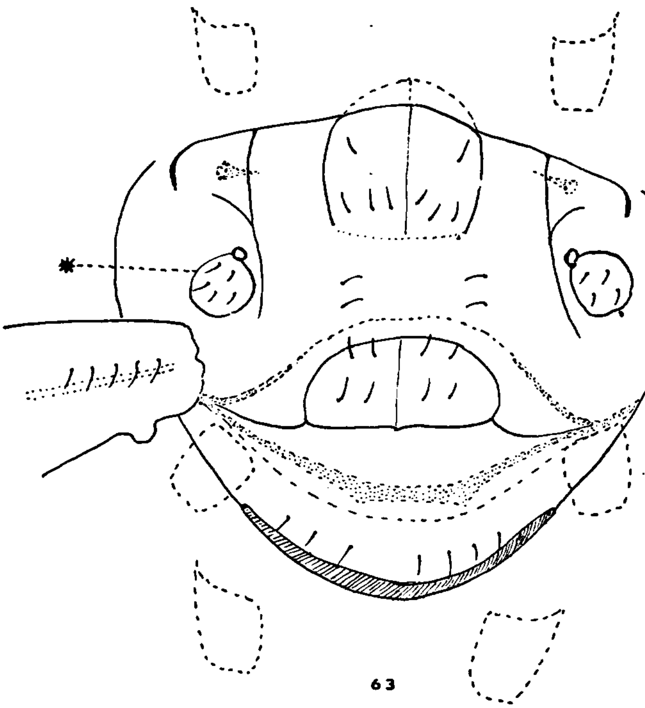

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FIGURES 62—63. *Leptococcus metroxyli* gen. et sp. nov.; Adult male, **62**. Lateral view of protruded penis (x 430). The glandular pit with the bases of 2 robust setae, which presumebly support caudal wax tails, is indicated (see also fig. 59). **63**. Thoracical sclerites, seen from the dorsal side (x 200). The minute sclerites near the wing base (shown to the left) are omitted. The round sclerites, marked with an asterisk, are wanting in EZZAT's figure of *Pseudococcus*. Parts from the ventral side, or below the dorsal surface, are shown dotted or by broken lines. The figure is somewhat diagrammatic; the number of setae is rather variable.

The head has one pair of large eyes on the dorsal side which are wide apart, and one pair of similar eyes on the ventral side which are placed close together; their diameter varies from 30 to 40 μ. These eyes are conspicuous, as they are surrounded by a bright red pigment which is visible with a hand lens ($\times$ 10). Further a small eye with dark pigment, probably the same as in the pupal stages, is found on each side of the head; its diameter is 15—20 μ. See fig. 58.

The copulatory apparatus has a spine-like penis which is curved upwards (figs. 59, 60, and 62).

I failed to find definite wax pores, except at the posterior end of the body, where 2 depressions are found with closely set quinquelocular pores and a robust double seta which is about 200 μ long. These double setae probably support wax tails which have been lost after submersion in alcohol. The body is sparingly covered with setae, among which there are some of the blunt type as described for the antennae and legs. These blunt setae seem to be always present on the abdomen and head.

Second stage larva of the male (larva II ♂)

Male stages were absent among the material collected by Mr. RAPPARD on the north coast. In the abundant material which Jhr. E. W. VAN HEURN has collected on the south coast they are sparingly represented; according to a rough estimate only 1—3 per cent of the specimens were males. Adult males and older pupae are easily recognized by the bright red pigment of the dorsal and ventral eyes; to detect the younger male stages it is necessary to examine a larger number of larvae in microscopical preparations. Seven specimens of male larvae have been found. One specimen was on the point of moulting to prepupa; dimensions of body 1.2 $\times$ 0.4 mm, antenna 390 μ, wing-pads of prepupa 140 μ long and 60 μ broad.

Larva II ♂ may be distinguished from larva II ♀ by the presence of about 60 narrow tubular ducts (6 $\times$ 2 μ), of which 25—30 are found on the ventral side of the thorax, between the legs (fig. 52), an area devoid of wax pores in larva II ♀. Only 15—30 per cent of these tubular ducts is found on the dorsum which is, however, well provided with trilocular pores, not found on the ventral side.

For the rest the male larva is like the female larva II. Wide tubular ducts (6 $\times$ 4 μ) and multilocular pores, as described for the female larva, are present, but their number is only half as much as in the female larva, or even less. Antennae 6-segmented; length 330—390 μ. Dimensions of body from 0.8 $\times$ 0.25 to 1.2 $\times$ 0.4 mm.

The narrow tubular ducts, in addition to the other wax pores, probably serve to construct a cocoon for pupation, but these cocoons have not been found in our material which had been scraped from the leaves and preserved in alcohol; all male stages found in the alcohol-material were without a covering of wax.

Prepupal stage of the male (larva III ♂)

The prepupa (fig. 53) can be recognized by the presence of initial wing-pads, and the absence of mouth setae and the anal ring with its 6 setae. The wing-pads, which are protrusions of the mesothorax, have a

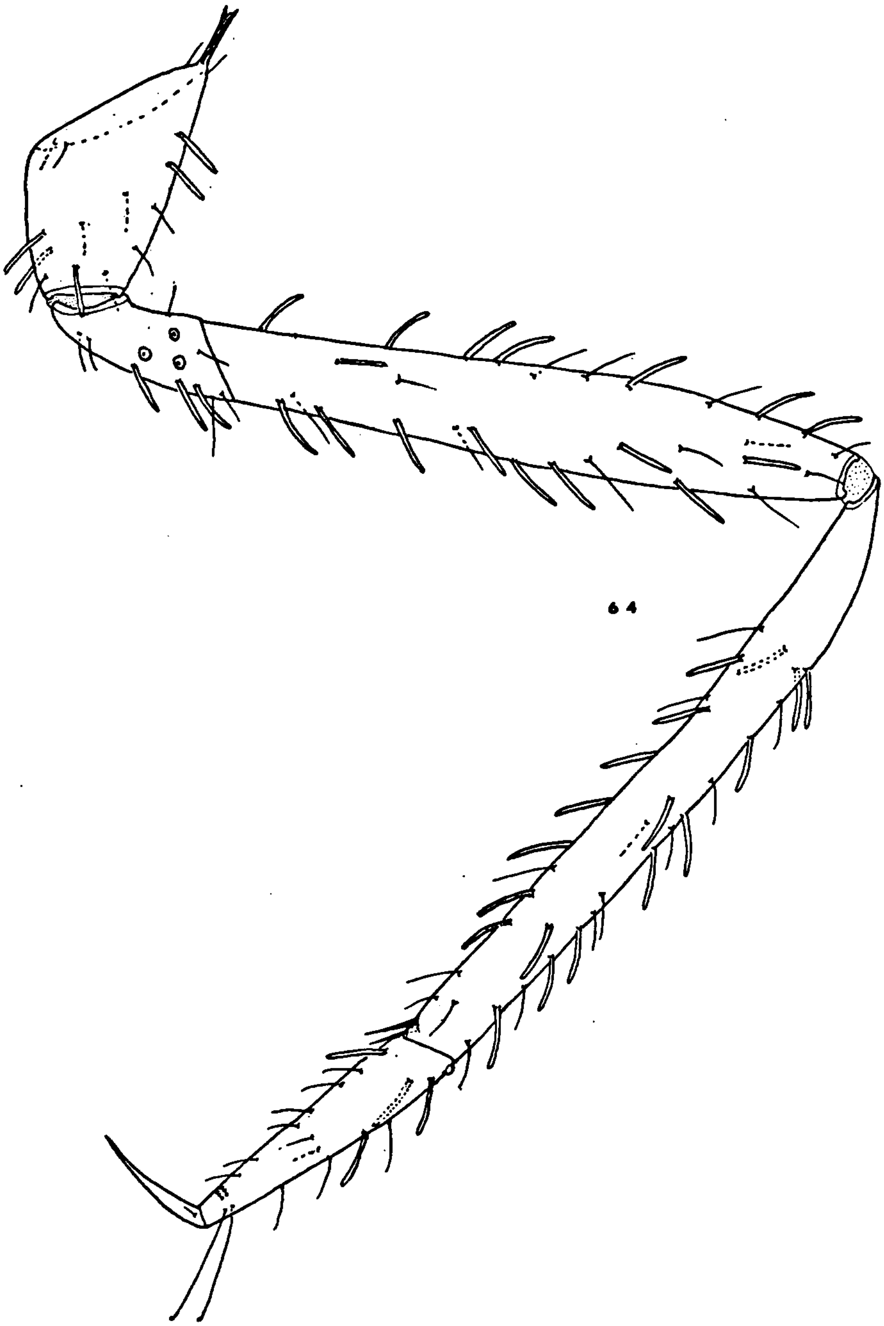


FIGURE 64. *Leptococcus metroxyli* gen. et sp. nov.; Adult male. Left hind leg, ventral view (x 430).

length of only 50—150 μ. Of the mouth-parts the rudimentary labium can still be recognized (fig. 54).

Dimensions of body from 1.0 × 0.3 to 1.2 × 0.4 mm. Antennae indistinctly segmented, probably with 7 segments; length 340—450 μ. The femur in the hind legs is about 160—180 μ long, the tibia 150—170 μ, and the tarsus (without claw) 80—90 μ.

On the dorsal surface trilocular pores are extremely scarce or wanting. The dorsum is, however, provided with 50—70 multilocular pores, and 20—40 narrow tubular ducts along the margin of the body. These tubular ducts have a more or less developed oral rim; dimensions of the tubes 5—6 × 2—3 μ, diameter of oral rim ca. 5 μ (fig. 55). On the ventral surface about 30 multilocular pores were observed.

Among the multilocular pores on the dorsum a number of minute unilocular pores are observed (diameter 1—2 μ); 1—3 of such pores are often found at the circumference of the larger cerarii of the female stages (figs. 42, 43, 51, and 56); they were also observed in the cerarii of a number of other Pseudococcidae.

The posterior ostioles are present, which is also the case in the pupa and the adult male, but they are less distinct than in the female stages. I failed to observe the anterior ostioles in the male stages, except in the male larva II, and in some prepupae.

It seems that the prepupal stage is of short duration; against more than 20 pupae only 9 prepupae were found, of which 2 were on the point of moulting to pupae.

Pupal stage of the male (larva IV ♂)

The wing-pads have a length of ca. 400 μ; their tips reach beyond the posterior coxae (fig. 53). Dimensions of body 1.1 × 0.3—1.3 × 0.4 mm. Antennae 400—500 μ. In the hind legs the femur is about 200 μ long, the tibia 170—180 μ, and the tarsus (without claw) 80—90 μ.

On the dorsum only 20—40 multilocular pores are present, on the venter at most 10; sometimes ventral pores seem to be wholly absent. Further 6—8 narrow tubular ducts (5 × 2—3 μ) are observed on both sides of the abdomen, and sometimes 1—2 near each fore leg.

Types of all stages in the Zoological Museum at Amsterdam.

Discussion

This species is allied to the genus *Pseudococcus* and not to *Phenacoccus,* though the antennae are 9-segmented. Denticle on claw, quinquelocular pores, and spines on dorsum absent; mycetome like that of *Pseudococcus citri,* and different from the mycetome of *Phenacoccus.*

The adult male of *Leptococcus metroxyli* has like that of *Pseudococcus* only 2 depressions with crowded wax pores at the end of the abdomen (to produce the waxy caudal tails), and not 4 as in *Phenacoccus aceris* Sign., the type-species of the genus *Phenacoccus.*

A special feature of *Leptococcus* is the presence of a continuous band of short tubular ducts and multilocular pores along the whole margin of the body. This band is already present in the second stage larva, in which only the 2 first and 2 last pairs of cerarii are developed. In the adult female few multilocular pores, and very few tubular ducts are found outside the lateral band, if we except the ventral side of the abdomen where some 40—60 multilocular pores are present.

Leptococcus metroxyli resembles *Macrocepicoccus loranthi* MORRISON, (1919) by its very slender antennae and legs. The principle difference between these insects is found in the cerarii which have a peculiar structure in *Macrocepicoccus*, as shown by fig. 10 of MORRISON's paper. In this genus multilocular pores are fairly numerous dorsally as well as ventrally, but not concentrated in a marginal band. The adult male of *Macrocepicoccus* has 4 eyes, that of *Leptococcus* 6. Unfortunately the microscopical structure of the larval stages of *Macrolepicoccus* is not known.

By the courtesy of Dr. D. J. WILLIAMS and Mr. J. P. DONISTHORPE I could examine a slide with *Heliococcus sakai* TAKAHASHI (1951) from the collections of the British Museum (numbered: Brit. Mus. 1955—812). This species has been found on the nipah palm in Malaya. Its antennae are 8-segmented. The marginal series of multilocular pores, as found in *Leptococcus*, is wanting; only few of these pores are present near the genital fissure, about 20 according to Dr. TAKAHASHI. Stout tubular ducts are present in the marginal area, and the cerarii resemble those of *Leptococcus*. I think, however, that this species is not congeneric with *Leptococcus*, which is also the opinion of Dr. WILLIAMS, as the marginal series of multilocular pores (already present in larva II of *Leptococcus*) is wholly wanting.

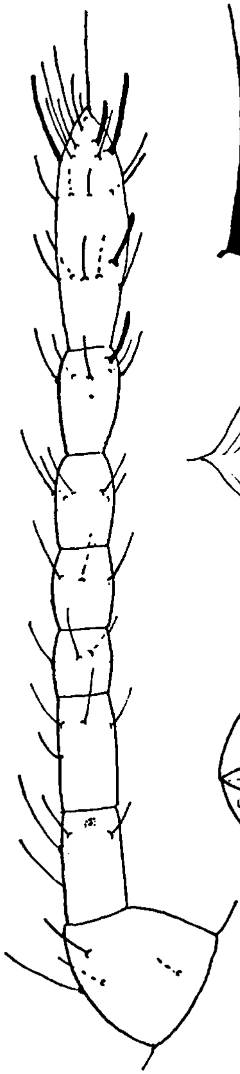
Both species, mentioned by Dr. MORRISON, are certainly allied to the genus *Pseudococcus* (type species *P. adonidum* L.) as defined by FERRIS (1950), since they have accessory setae in the cerarii, and tubular ducts with an oral rim; this applies also to *Leptococcus metroxyli*.

No trace of Hymenopterous parasites has been found, though more than 100 specimens were examined in microscopical preparations. Among the material from Merauke some larvae of Coccinellidae were found which, as I suppose, feed on the scale insects. Dr. F. I. VAN EMDEN (London), who examined a slide with 3 mounted specimens of these larvae, has identified them as *Cryptolaemus montrouzieri* MULS. (?). *C. montrouzieri* is indigenous in Australia, and has formerly been introduced into Java and Celebes for the control of different Pseudococcidae (cf. KALSHOVEN 1950/51). *C. affinis* CROTCH has formerly been found by the author in the Moluccas, on leaves infested by *Aspidiotus destructor* SIGN. (cf. REYNE, 1948).

Prof. Dr. P. BUCHNER has examined the symbionts of the adult female of *Leptococcus metroxyli* (and also of *Nipaecoccus nipae* MASK.) His report was as follows (in litt. 27.VII.1957): "Ich habe Ihre beiden Tiere sofort untersucht; beide folgen hinsichtlich der Symbiose ganz dem *Pseudococcus citri*-Typ, also unpaares Mycetom mit einkernigen Mycetocyten, in denen die schlauchförmigen Symbionten aufgeknäuelt in gallertigen Ballen liegen. Als solche Ballen treten sie auch in das Ei über".

Eurycoccus vanheurni spec. nov.

An undescribed species of the Pseudococcidae was collected by Jhr. E. W. VAN HEURN in September 1956 at Mindiptana, a locality about



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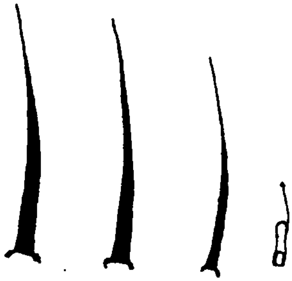

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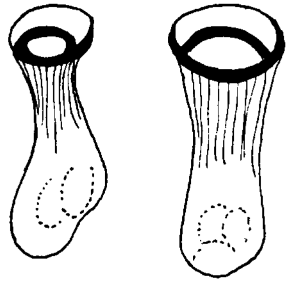

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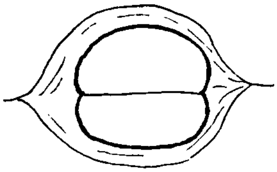

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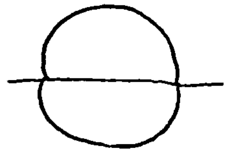

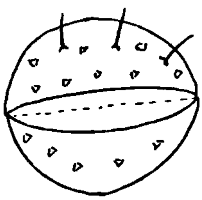

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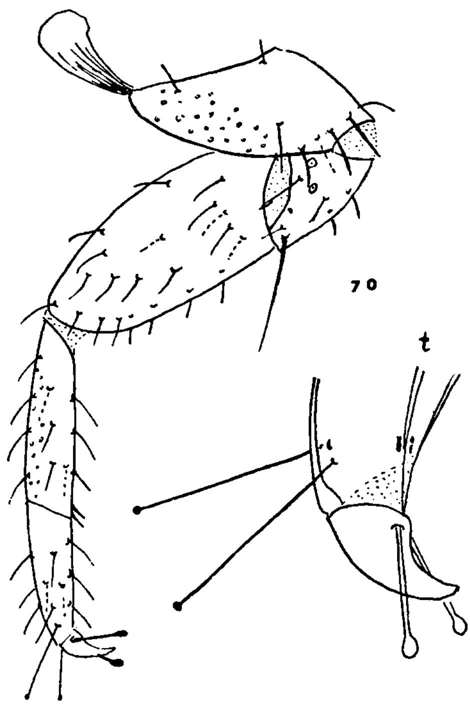

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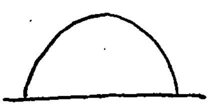

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FIGURES 65—71. Explanation on opposite page.

300 kms north of Merauke. It was found on the breadfruit-tree (*Artocarpus*), mainly on the leaf stalks. The species can be assigned to the genus *Eurycoccus* FERRIS (Atlas of the scale insects of North America, vol. V, p. 81). Some specimens were submitted to Dr. HAROLD MORRISON (Washington), who did not recognize them, but thought that they were allied to *Trionymus malaitensis* CKLL. (1929, The Entomologist. *62*: 90), a species found under ant galleries on the fruit spathes of the coconut palm in the Br. Solomon Islands. In my opinion the species fits the genus *Eurycoccus* FERRIS better than *Trionymus* BERG. It has a large folded circulus, a subrotund shape, and lives on a dicotyledonous tree, not on grasses.

After the MS. was finished some specimens were submitted to Dr. D. J. WILLIAMS in London. He suggested that my species could be assigned to his new genus *Mutabilicoccus* which is based on *Farinococcus simmondsi* LAING as type species (WILLIAMS, 1960). The species *vanheurni* is certainly closely allied to *Mutabilicoccus*, but the cerarii are different. In *E. vanheurni* only the anal lobe cerarius is developed, and represented by 2 distinct cerarian spines which are also present in the 3 larval stages. *Mutabilicoccus* has 18 pairs of cerarii (cf. figs. 11 and 12 of WILLIAMS' paper). For the present I have left the species *vanheurni* in the genus *Eurycoccus* untill the discovery of further species will clear up the relationship.

Adult female (♀ ad.)

Habit. The wax covering is scanty, as far as could be seen in the alcohol specimens. An ovisac is almost certainly lacking, as older females contain full-grown embryos. The shape of mature females is subrotund, the colour greyish. Some ants had been added to the alcohol sample, but as aphids and a *Coccus* sp. were also present it is not certain that these ants attended *Eurycoccus*. Male stages are not known at present. The smallest adult female, which was available, measured 1.3 × 0.8 mm, the largest one 2.1 × 1.8 mm (all measurements were taken from the slides).

Antennae 8-segmented (fig. 65), but the short 4th segment is often partly or wholly fused with the 5th or 3rd segment so that specimens with 7-segmented antennae are as common as those with 8 segments. In a few cases segments III, IV, and V were partly or wholly fused so that the antenna appeared to be 6-segmented (2 among 20 antennae examined), in

FIGURES 65—71. *Eurycoccus vanheurni* sp. nov.; Adult female, **65**. Left antenna, ventral view (x 300). The sensory setae are drawn too thick to bring them out clearly. The short 4th segment is often fused with the 5th or 3rd segment so that the antenna becomes 7-segmented; **66**. To the left 2 setae from the dorsal side of the metathorax, to the right 1 setae and a tubular duct from the ventral side of the abdomen (x 650), **67**. Spiracles; to the left the anterior, to the right the posterior one (x 465); **68**. Circuli of 2 specimens, in which the cuticle was well stretched; the anterior part lies on the second, the posterior part on the third abdominal segment (x 200); **69**. Posterior ostiole (x 300); **70**. Right hind leg, ventral view (x 200). Membranous parts are dotted; the translucent pores on coxa and tibia are indicated by small circlets. Separate figure: claw more enlarged (x 650); t is the tendon by which the claw is moved: **71**. Eye (x 650).

which case the third segment was very long. Fusion of segments can generally be recognized by the position of the setae or unsclerotized spots. Length 350—400 μ; average of 12 antennae 374 μ. The number of setae on the different segments is as follows: I (basal segment) 4, II 3—4, III 4—5, IV 3, V 3—4, VI 5, VII 5 and 1 sensory seta, VIII 17—18 and 4 sensory setae.

The *eyes* (fig. 71) and both pairs of *ostioles* are well developed. The posterior ostiole (fig. 69) has commonly 4—6 trilocular pores on the posterior lip, and 8—9 on the anterior lip; the anterior lip bears usually 2—3 setae which are absent on the posterior lip.

The anal lobes (figs. 72 and 73) are slightly protruding, and provided with 2 cerarian spines on the dorsal side, and one long apical seta (ca. 200 μ). Further 10—15 accessory setae (40—90 μ) are present, of which 3—5 are placed on the dorsal side of the lobe. A bar-like sclerotization is present on the ventromedial side of the lobe (fig. 72).

The *legs* (fig. 70) are rather stout. Tibia 1.3—1.5 times as long as the tarsus; in larvae II and III these segments are almost of the same length; in larva I the tarsus is about 1.3 times as long as the tibia. On the hind coxae and -tibiae a number of minute translucent pores are usually present. The claw is illustrated in fig. 70. The digitules are somewhat longer than the claw; the tarsal ones are slightly, the ungual ones distinctly knobbed. The average number of setae on the different segments of the hind leg was: coxa 8, trochanter 6, femur 20, tibia 12, tarsus (except digitules) 10.

The *labium* (fig. 74) seems to be 2-segmented, but the partition is rather indistinct; width at base 80—90 μ, length 120—130 μ. Rostral loop reaching beyond the hind legs.

The *anal ring* has a double row of pores and 6 anal setae (90—110 μ).

Dorsal surface. Provided with a large number of stout setae (fig. 66), and about an equal number of trilocular pores, or slightly more. Tubular ducts and multilocular pores are lacking. The dorsal setae are arranged in transversal bands on the abdominal and thoracical segments; on the first abdominal segment, and on the metathorax about 100 dorsal setae were observed in 10 examined specimens; the range of variation was rather wide, from 60—160, average 89 setae.

Only the posterior cerarius is developed; it has 2 conic cerarian spines (length 13—15 μ), and only a slight concentration of trilocular pores (fig. 73). There are usually 10—15 pores on the dorsal side of the anal lobe, and 5—10 on the ventral side; the average figures for 14 anal lobes were 12 pores dorsally, and 8 ventrally.

The ostioles are almost circular, and widely opened, especially the posterior one (fig. 69); the lips are sclerotized.

Ventral surface. The ventral setae are more slender than the dorsal ones (fig. 66); about an equal number of trilocular pores is present. Multilocular pores are only observed around the genital fissure. They are few in numbers; not more than 9—19 (average 14) were counted in 10 different specimens. As the insect is ovoviviparous, this scarcity might be expected. Tubular ducts are rather numerous along the margin of the body, especially in the abdomen, and also in the frontal part. Some tubular ducts are also present on the ventral side of the abdomen, mainly on the posterior segments; before the circulus they are usually lacking. From

50—70 tubular ducts were observed along each side of the body, and 25—30 on the ventral side of the abdomen; as these minute structures are easily overlooked, probably more were present. The tubular ducts measure about 8 × 2 μ; their distal part is thick-walled (fig. 66). A large folded circulus is present between the second and third segment of the abdomen (fig. 68); width 80—100 μ. The circulus has only a slightly sclerotized rim, and as is has a tendency to fold together in preparations, it is sometimes difficult to find. When the circulus is well-streched, its shape is quite different from the round or oval circulus of *Trionymus perrisii* SIGN. (the type species of *Trionymus*) which is never folded. The spiracles show no special features (fig. 67).

The stage of the adult female is preceded by 3 larval stages.

First stage larva (larva I)

Dimensions from 0.45 × 0.22 to 0.65 × 0.33 mm. Three specimens on the point of moulting to the following stage had a length of 0.63, 0.64, and 0.65 mm respectively, but one larva I of 0.64 × 0.33 mm was not yet ready to moult.

Antennae 6-segmented, length 180—190 μ. Number of setae on different segments: I (basal segment) 4, II 3, III 3, IV 5, V 5 and 1 sensory seta, VI 17 and 4 sensory setae. The position of the sensory setae on the two last segments is the same as in the adult female (see fig. 65).

Legs. The tarsus (70—80 μ) is slightly larger than the tibia (50—60μ). The claw is more slender than in the adult female; the tarsal digitules are faintly, the ungual ones distinctly knobbed.

Labium shaped as in the adult female; width at base ca 50 μ, length about 70 μ.

Anal lobes slightly or not pronounced. Apical seta about 100 μ; only one small accessory seta (20 μ) is present, on the ventral side of the lobe. On the dorsal side the 2 cerarian spines (length ca. 8 μ) are already developed, and usually accompanied by one trilocular pore.

The *dorsal surface* bears stout finely pointed setae (length about 30 μ; see fig. 75). On head and abdomen the setae are arranged in 4 longitudinal rows; on the thorax there are about 6 setae on each segment; further a row of stout setae is present along the whole body-margin. Most of these setae are accompanied by one trilocular pore. Anal ring with 2 rows of pores, and 6 anal setae (length 45—50 μ).

The *ventral surface* is provided with setae which are more slender than those on the dorsum. Trilocular pores are sporadically present, but tubular ducts and multilocular pores are lacking. The abdomen has a large folded circulus (fig. 76); width about 50 μ.

Second stage larva of the female (larva II ♀)

Dimensions from 0.6 × 0.3 to 0.9 × 0.5 mm; two specimens with a length of 0.8 and 0.9 mm were on the point of moulting to larva III.

The principal differences with larva I are as follows. The number of dorsal setae has about doubled; on the dorsal mesothorax 20 setae and 20 trilocular pores were counted; in larva I the number is at most half as large. On the ventral side of the anal lobe 2—3 acessory setae are

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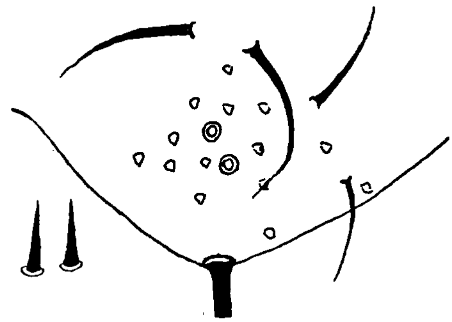

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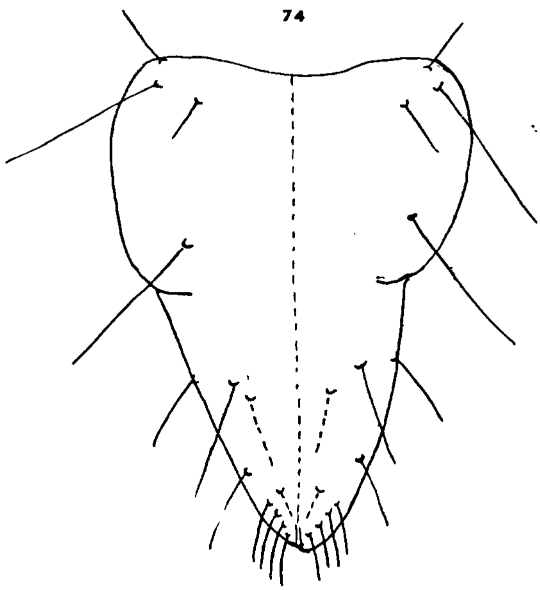

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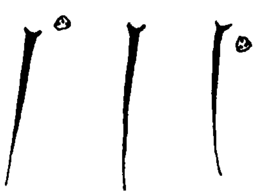

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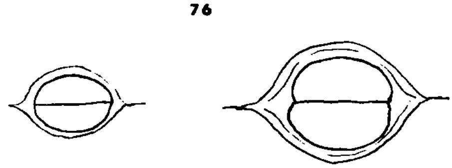

FIGURES 72—76. *Eurycoccus vanheurni:* sp. nov.; Adult female, **72**. Anal lobe; ventral view (x 465); the dotted part is a bar-like sclerotization on the ventro-medial side of the anal lobe. **73**. Anal lobe; dorsal view (x 465). Only the base of the apical seta is drawn. Separate figure: the 2 cerarian spines in lateral view (x 650); **74**. Labium, seen from the ventral side (x 465); **75**. Larva I. to the left 2 setae from the dorsum, to the right one from the venter (x 650), **76**. Circuli (x 200) from larva I (to the left), and larva III ♀ (to the right).

present, and also one on the dorsal side; the apical seta has a length of 125—140 μ. The 6-segmented antenna seems to be somewhat larger than in larva I (210 μ). Tibia and tarsus are about equal in length. The circulus has the same shape as in larva I; width about 60 μ.

Third stage larva of the female (larva III ♀)

Dimensions 1.35 × 0.8—1.5 × 0.9 mm. The number of dorsal setae is much larger than in larva II; from 40—50 were counted on the first abdominal segment and on the metathorax (in larva II at most 22). The anal lobe has 2—3 setae on its dorsal and 5—6 on its ventral side; length of apical seta 140—160 μ. The antennae are 7-segmented, but segments III and IV are partly fused; sometimes these segments are wholly fused so that the antenna becomes 6-segmented. In a few cases segment V also partakes in the fusion so that the antenna seems to be 5-segmented with a very long third segment. Length of antennae 275—300 μ. The circulus (fig. 76) has the same shape as in the other stages of the female; width about 70 μ. Some tubular ducts are already present, but multilocular pores are lacking. From 2—5 tubular ducts were observed on the margin of the last abdominal segments, and 1—2 between the antennae. The bar-like sclerotization on the ventral side of the anal lobe is already developed.

The 3 larval stages can be distinguished as follows. Larva I, length 0.45—0.65 mm; anal lobes with only 1 accessory seta (on the ventral side), length of apical seta ca. 100 μ. Larva II, length 0.65—0.90 mm; anal lobes with 3—4 accessory setae (1 dorsal, 2—3 ventral setae), length of apical seta 125—140 μ. Larva III, length 0.90—1.35 mm; anal lobes with 7—9 setae (2—3 dorsal, 5—6 ventral setae), length of apical seta 140—160 μ. Antennae indistinctly 7-segmented, segments III—IV partly fused; in larva I and II the antenna is usually distinctly 6-segmented. The adult female can be distinguished from larva III by the presence of some multilocular pores on the last abdominal sternites, an antenna which is distinctly 7- of 8-segmented, an anal lobe with 10—15 accessory setae, and an apical seta which has a length of ca. 200 μ.

The principal features by which the adult female and its larval stages can be recognized are the folded circulus between the second and third abdominal segment, the stout but finely pointed dorsal setae, and the cerarii of which only the posterior one is developed.

The species is named after Jhr. E. W. VAN HEURN, who collected this species and several other scale insects on the south coast of New Guinea, in the environments of Merauke. Types in the Zoological Museum at Amsterdam.

After the present MS. was finished I found that *E. vanheurni* had also been collected by Mr. F. W. RAPPARD on the north coast, in a locality near Humboldt Bay (2.X.1950). It was found there on a large rattan, identified by the Rijksherbarium at Leyden as *Calamus hollrungii* Becc. The insects had been put aside as *Farinococcus* (?) sp., but were examined again after completion of the MS. According to RAPPARD's notes these insects were found in great numbers in the leaf-sheaths, among the young fruits, and on the ovaries; they were assiduously visited by stinging ants. The insects were only slightly dusted with wax; their colour was olive-green or brown. According to my preparations the antennae in these specimens are usually 8-segmented, sometimes 7-segmented (segments III and IV fused). Mature females contain fully developed embryos. Male stages were not observed. Further all features of the rattan-insects agree with those of the species found on the breadfruit tree. About 50 tubular ducts were observed along each side of the body, and 50 on the abdominal sternites between vulva and circulus so that at least 150 tubular ducts were present. The maximum number of multilocular pores in these specimens was 20.

The ants found associated with *E. vanheurni* were identified by Mr. G. E. J. NIXON of the Commonwealth Institute of Entomology in London. The ants found on *Calamus* belonged to *Crematogaster* sp., and those on *Artocarpus* to *Dolichoderus* (*Hypoclinea*) *bituberculatus* MAYR.

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ADDENDUM

After the manuscript was submitted for printing I received the following species from Mr. SIMON THOMAS: (1) *Planococcus lilacinus* (CKLL.) from cacao, experimental garden at Amban Z. (Manokwari) 10.I.1960. *P. citri* (RISSO) was probably also present. (2) *Pinnaspis strachani* (COOLEY), type *townsendi*, as figured by FERRIS (1947, Microentomology, vol. 12). On *Portulaca* sp., Hollandia 3.II.1961. It seems that this species has often been reported as *P. minor* (MASKELL), e.g. from Java and Sumatra, Fiji, and Samoa. (3) *Aonidiella aurantii* (MASKELL) from *Cycas rumphii*, Hollandia, Nov. 1960.