

A new genus and two new species of soft scale insect (Sternorrhyncha, Coccoidea, Coccidae) from Africa

Chris Hodgson

Department of Biodiversity and Biological Systematics, The National Museum of Wales, Cardiff, Wales

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Corresponding author: *Chris Hodgson* (hodgsoncj@cardiff.ac.uk)

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Abstract

A new soft scale insect genus, *Sterculicoccus* Hodgson, **gen. n.**, is introduced to take a new species, *Sterculicoccus tafoensis* Hodgson, **sp. n.**, off *Triplochiton* from Ghana. *Sterculicoccus* belongs to the Myzolecaniinae and is close to *Alecanium* Morrison. In addition, a new species of *Hemilecanium* Newstead, *H. cedrelus* Hodgson, **sp. n.**, is also described off *Cedrela toona* from Zambia. *Hemilecanium cedrelus* is close to *H. coriaceum* Hall and *H. uesato* Kondo & Hardy (Saissetiinae). The adult females of these two species are described, along with the 1st-instar and the 2nd- and 3rd-instar females of *H. cedrelus*.

Keywords

Sternorrhyncha, Coccoidea, Coccidae, Africa, Zambia, Ghana, new species, new genus, Sterculiaceae, Meliaceae

Introduction

Whilst the Coccidae of some areas of Africa are quite well known [e.g. South Africa and Zimbabwe – both with more than 80 species (Scalenet, 2008)], others have had very little attention. Two such countries are Ghana (with 24 known species of Coccidae) and Zambia (with 16 species). The present paper describes a new species from each of the latter two countries, one of them in a new genus.

Materials, methods, and conventions

Several specimens were already mounted but others were mounted especially for this study in the usual way (Hodgson and Henderson, 2000), using acid fuchsin stain, except that the specimens were left in unheated KOH for about 72 h for clearing. The figures are typical scale insect diagrams, with the dorsal surface forming the left of the main drawing and the ventral surface forming the right; important structures within these central drawings are enlarged around the margins; these are not drawn to the same scale. Terminology follows that of Hodgson (1994). Specimens of both species will be deposited in The Natural History Museum, Cromwell Road, London (BMNH) and in the Coccoidea Collection of the Smithsonian Museum, Washington (USNM), kept in the US Department of Agriculture, Beltsville, Maryland.

Sterculicoccus Hodgson, gen. n.

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Type species: *Sterculicoccus tafoensis* Hodgson, sp. n.

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Generic diagnosis. Body broadly oval. Anal cleft deep, about $1/3^{\text{rd}}$ - $1/4^{\text{th}}$ total-body length, with parallel margins; with a narrow sclerotisation around anterior margin of cleft and sclerotisations ventrally in each stigmatic cleft. Dorsal derm otherwise membranous with numerous areolations, those anterior to anal plates and dorsal to mouthparts much larger than elsewhere. Dorsal setae mainly short, but with a few long. Anal plates together oval, with polygonal reticulations on dorsal surface. Outer anal opening with an O-shaped sclerotised band. Marginal setae apparently ventral, short and spinose, in a band 2-3 setae wide; stigmatic clefts absent but with stigmatic sclerotisations in each stigmatic area. Venter with a marginal band of large tubular ducts plus a broad submarginal band of much smaller tubular ducts. Pregenital disc-pores each with mainly 5 loculi, in a small group beneath posterior end of anal plates. Antennae small, 6 segmented. Clypeolabral shield proportionately large. Spiracles very large. Legs much reduced.

Relationships. *Sterculicoccus*, gen. n., is clearly a member of the subfamily Myzolecaniinae as defined by Hodgson (1994) – absence of dorsal tubular ducts; absence of eyespots; rather large spiracles; pregenital setae represented by bands of setae rather than pairs of larger setae; legs and antennae reduced in size, and anal tube short. However, it is unusual within this group in having (i) 2 types of ventral tubular ducts (usually only of one type) and (ii) each anal plate with only 4 setae, all near the apex (typically with many setae). In the Key to Myzolecaniinae in Hodgson (1994, p. 91), *Sterculicoccus* keys out at *Alecanium* Morrison. *Alecanium* and *Sterculicoccus* are clearly closely related and share the following character states: (i) stigmatic clefts very shallow or absent, without stigmatic spines; (ii) each stigmatic area with a small sclerotisation enclosing some spiracular disc-pores; (iii) marginal setae spinose, in a marginal band several setae wide;

(iv) some dorsal setae long and flagellate; (v) anal plates elongate oval; (vi) pregenital disc-pores with mainly 5 loculi; (vi) legs very reduced; (vii) antennae reduced; (viii) spiracles large; (ix) ventral tubular ducts in a wide submarginal band and in transverse bands medially on meso- and metathorax; (x) ventral setae with a similar distribution (i.e. with a band across metathorax), and (xi) outer end of anal tube with an O-shaped sclerotisation. *Sterculicoccus* differs from *Alecanium* in having (character-states on *Alecanium* in brackets): (i) two types of ventral tubular ducts (only 1 type); (ii) only one type of marginal seta (two types); (iii) dorsal surface of anal plates with a polygonal reticulate pattern of microridges (absent); (iv) anal plates each with only four setae near apex (each with many setae distributed over most of dorsal surface), and (v) long dorsal setae restricted to dorsad to mouthparts (throughout dorsal surface).

The key in Hodgson (1994) can be modified to accommodate *Sterculicoccus* as follows:

3. Stigmatic spines present; pregenital disc-pores each with 10 loculi
 *Richardiella* Matile-Ferrero & Le Ruyet
- Stigmatic spines absent; pregenital disc-pores each mainly with 5 loculi..... 3a
- 3a. Dorsal surface of anal plates with a reticulate pattern of micro-ridges; ventral tubular ducts of two types, a larger type along margin and a smaller type submarginally; marginal setae of one type only*Sterculicoccus* gen. n.
- Dorsal surface of anal plates without a reticulate pattern of micro-ridges; ventral tubular ducts of one type; marginal setae of two types, one spinose and the other flagellate.....*Alecanium* Morrison

Etymology. The name *Sterculicoccus* is composed of the main part of the plant family (Sterculiaceae) on which this species was collected, plus *coccus*, from the Latin *Coccum*, a word commonly used to describe scale insects.

Distribution. *Sterculicoccus* is a monotypic genus currently only known from West Africa.

***Sterculicoccus tafoensis* Hodgson, sp. n.**

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Material studied. **Holotype female: Ghana (Gold Coast),** Tafo, on *Triplochiton scleroxylon* K. Schum. (Sterculiaceae), 5.XI.1945, E.O. Boafo (BMNH): 1/1 ad♀ in good condition.

Paratype ♀. As for holotype: 5/5 ad♀ in fair to good condition (BMNH, USNM).

Adult female (Fig. 1)

Unmounted material. Not seen.

Mounted material. Broadly oval, body length 2.4–5.4 mm; width 2.0–4.5 mm. Basic structure as in generic diagnosis.

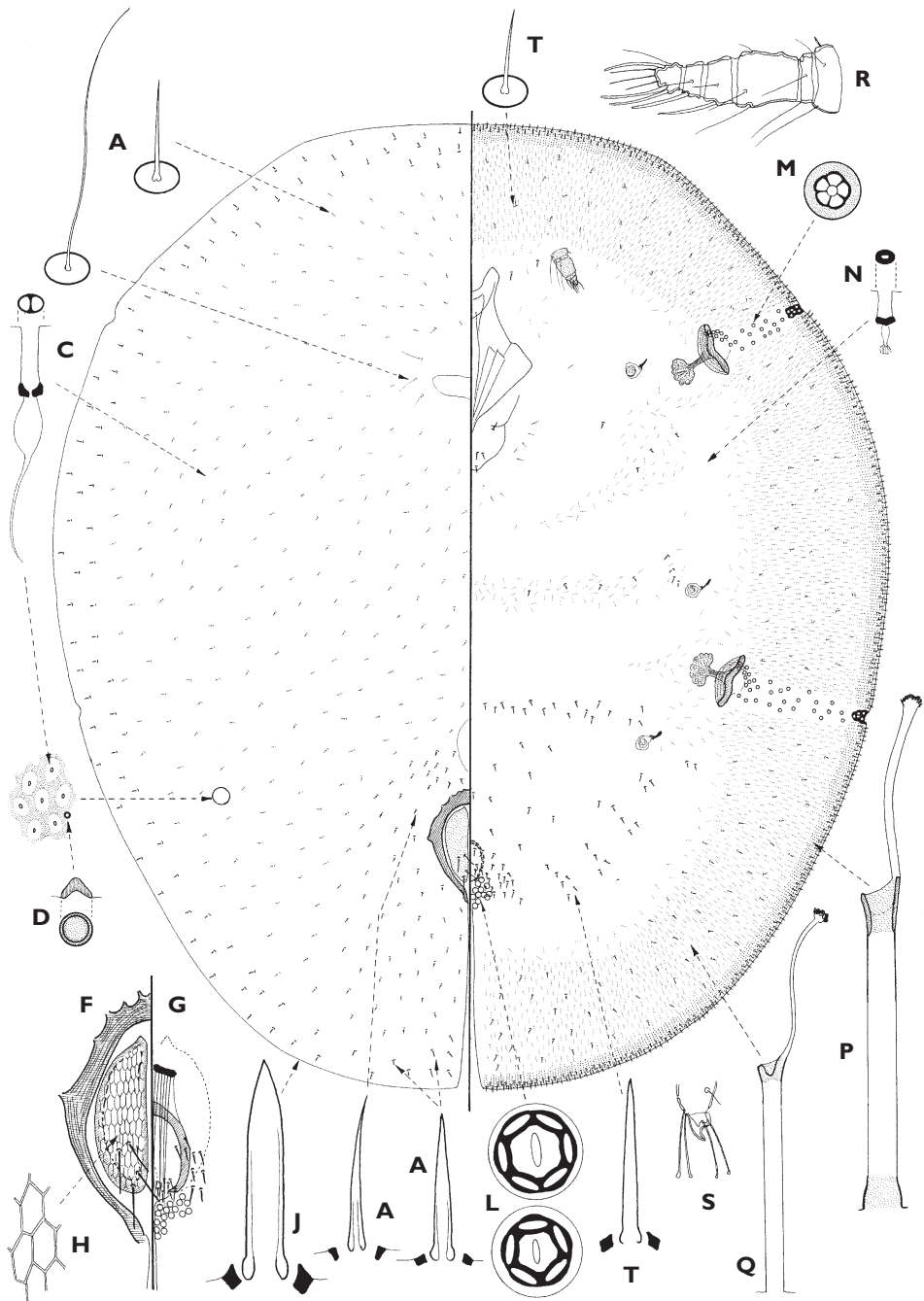


Fig. 1. *Sterculicoccus tafoensis* Hodgson, sp. n., adult female. Where: A = dorsal setae; C = dorsal microduct; D = dorsal simple pore; F = dorsal view of anal plates; G = ventral view of anal plates; H = micro-ridges on dorsal surface of anal plate; J = marginal seta; L = pregenital disc-pore; M = spiracular disc-pore; N = ventral microduct; P = larger ventral tubular duct; Q = smaller ventral tubular duct; R = antenna; S = claw, and T = ventral setae.

Dorsum. Derm membranous, apart from a narrow crescentic sclerotisation around anterior margin of anal cleft. Derm with abundant small areolations, each polygonal in shape, with a central dorsal microductule. Dorsal setae variable: (i) a larger slightly spinose seta with a sharp apex and well-developed basal socket; each 16–18 μm long; apparently restricted to a broad submarginal band, plus a few occasionally up margins of anal cleft; (ii) a slightly smaller, more setose seta, each 12–16 μm long, in a broad area around anal plates, and (iii) a short, fine seta, each about 8–15 μm long, frequent throughout rest of dorsum, but also with 0–3 setae up to 100 μm long on either side of large areolation dorsad to mouthparts. Dorsal pores of 2 types: (i) a small convex, closed pore, each about 3 μm wide, frequent throughout; and (ii) a small microductule with a narrow outer ductule about 5 μm long, with sclerotised pore about 1.0–1.5 μm wide and an inner ductule quite long and swollen at proximal end; abundant throughout with one in each areolation. Dorsal tubular ducts, dorsal tubercles and preopercular pores absent. Anal plates together approximately oval, each plate with a rounded outer angle and with dorsal surface covered in micro-ridges arranged in a polygonal pattern; without a small additional triangular anal plate between lateral plates anteriorly; each plate 185–210 μm long, combined width 140–165 μm ; each plate with 4 setae; 2 along inner margin, 1 near apex (each 33–38 μm long) and one dorso-laterally 45–50 μm long. Ano-genital fold possibly absent; posterior opening of anal tube apparently with a sclerotised O-shaped margin, with a group of 10–18 short setae, each 25–35 μm long, medially between ventral arms of anal ring posteriorly. Anal plates without strong inner apodemes. Anal ring with 3 pairs of anal ring setae, each about 125 μm long, all setae attached to ventral half of anal ring; anal ring apparently without anal ring pores; anal tube quite short, anal ring lying beneath anal plates. Eyespots not detected.

Margin. Marginal setae all short and spinose with parallel margins, each 11–17 μm long, in a marginal band 2–3 setae wide; basal socket broad; with several hundred around margin, appearing to be on ventral surface; setae on margins of anal lobe not differentiated. Stigmatic clefts absent or extremely shallow, each with a small area of sclerotisation on venter which encloses outermost spiracular disc-pores; without stigmatic spines.

Venter. Derm entirely membranous. Pregenital disc-pores quite large, each 8–10 μm wide, with mainly 5 or 6 loculi; restricted to a small group of 18–30 (total) apparently posterior to anal opening, probably with 8–20 on each side. Spiracular disc-pores each mainly with 5 loculi, present in a wide band between spiracles and margin, with perhaps 45–55 in anterior band and 50–70 in posterior band. Ventral microducts, each with ductule about 5 μm long and pore perhaps 2 μm widest; abundant throughout but perhaps least frequent medially on abdomen. Other ventral pores, including pre-antennal pores, absent. Ventral tubular ducts of 2 types: (i) ducts with a long, narrow outer ductule (each about 25 μm long and 2 μm wide), with a narrow, much shorter inner ductule about 14 μm long, and with a fairly small glandular end; in a fairly broad submarginal band, which extends medially past spiracles; also with a few on either side of mouthparts; absent medially on thorax and abdomen; (ii) much larger ducts, each with a long, narrow outer ductule about 33–40 μm long and 3 μm wide, with a sclerotised outer orifice, and a narrow, much shorter inner ductule about 20–28 μm long, and

a fairly small glandular end; present in a dense marginal band about 2-3 ducts wide, intermingled with marginal setae. Ventral setae abundant, particularly submarginally, where quite fine, each 7-9 μm long, with a wide basal socket; some medially rather longer, longest about 27 μm long; pregenital setae not differentiated; with 2 pairs of interantennal setae, these similar to ventral submarginal setae, each 16-28 μm long.

Antennae greatly reduced, each about 80-105 μm long; with 6 ring-like segments; scape with 3 setae, 1 long and flagellate (about 40 μm long); pedicel with 2 setae, both long and flagellate + a campaniform sensilla; segment III with 3 setae, IV & V with 1 fleshy seta + 1 hair-like seta, and VI with 3 fleshy setae, 2 hair-like setae and 3 stiff setae. Mouthparts proportionately rather large; clypeolabral shield about 365-410 μm long; labium with 4 pairs of setae. Spiracles large, each with a large apodeme; each anterior peritreme 130-150 μm wide, posterior peritreme 140-165 μm wide; length of apodemes about 88-100 μm . Legs extremely reduced but with large coxal apodemes; segmentation difficult to discern but each coxa with long, flagellate setae (each 58-65 μm long), trochanter + femur with 1 long flagellate seta and, on each side, 2 campaniform sensilla; tibia + tarsus very short, with one short seta; tarsal digitules parallel-sided and about 33 μm long; claw digitules similar but shorter, each 26-28 μm long; claw about 13 μm long, without a denticle. Vulva probably located between segments VII and VIII.

Comment. *S. tafoensis* new species is the only species currently known in this genus but is readily separated from other possibly similar species by the presence of: (i) a reticulate pattern of microridges on the dorsal surface of the anal plates, (ii) the presence of two types of ventral tubular ducts, the larger ducts forming a marginal band and the smaller ducts in a broad submarginal band, and (iii) marginal setae of one type only, all spinose, in a band 2 to 3 setae wide around the entire margin, and not differentiated into stigmatic spines at each stigmatic area.

Etymology. The specific name *tafoensis* is composed of *Tafo*, the name of the site in Ghana where this species was collected, and *-ensis* (Latin), a suffix denoting place or locality.

***Hemilecanium* Newstead**

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The genus *Hemilecanium* was introduced by Newstead (1908) to take *H. theobromae*, collected off cacao in Cameroon. Prior to 2005, *Hemilecanium* contained 4 species: *H. coriaceum* Hall, *H. imbricans* (Green), *H. recurvatum* Newstead and the type species. Since then however, there have been major changes in the species composition of *Hemilecanium*, most notably when Kondo and Hardy recently (2008) synonymised *Etiennea* Matile-Ferrero (type species *E. villiersi* Matile-Ferrero) with *Hemilecanium*, based on a comparative morphological study of the adult females, adult males and 1st-instar nymphs of 4 species of *Hemilecanium* and 6 species of *Etiennea*. The study also included a phylogenetic analysis based on adult female and 1st-instar nymphal characters. These changes brought the total number of species in *Hemilecanium* to 26. Earlier, Hodgson

(1994) had drawn attention to the morphological similarities of *Etiennaea* and *Hemilecanium* (both genera having dorsal tubular ducts with funnel-like apertures and both with two centres of sclerotisation on the dorsum) but had considered that they could be easily separated due to the presence of cribriform plates on *Hemilecanium* (absent on *Etiennaea* species). However, Kondo and Williams (2005) showed that 4 cribriform plates were present on the dorsum of the 1st-instar nymphs of several *Hemilecanium* species so that the 1st-instar nymphs of *E. villiersi* and *H. theobromae* were very similar.

Despite these changes, the species within the new concept of *Hemilecanium* can be divided into two groups based on the structure of the 1st-instar nymphs. These are referred to as the *petasus* and *theobromae* groups by Kondo and Hardy (2008). The 1st-instar nymphs are only known for nine of the species now included in *Hemilecanium* but these can be separated as follows: the *petasus* group is diagnosed by the presence of: (i) the dorsum without clusters of 4-locular pores; (ii) each spiracular pore band with 2-4 spiracular disc-pores; (iii) each femur with a very long seta near apex (only on the prothoracic leg of *H. uesatoi*), and (iv) each stigmatic cleft with 3 well-developed stigmatic spines. The *petasus* group includes *H. ferox* (Newstead), *H. montricardiae* (Newstead), *H. multituberculatum* (Hodgson), *H. petasus* (Hodgson), *H. sinetuberculum* (Hodgson) and *H. uesatoi* Kondo & Hardy. The *theobromae* group, on the other hand, has the following combination of characters: (i) dorsum with 4 clusters of 4-locular pores; (ii) each spiracular pore band with 1 spiracular disc-pore; (iii) very long setae absent from all femora, and (iv) stigmatic spines absent. It includes *H. imbricans*, *H. mangiferae* Kondo & Williams, *H. theobromae* and *H. villiersi*. As pointed out by Kondo and Hardy, these two groups are also supported by a single adult female character, with those in the *theobromae* group lacking stigmatic spines while those in the *petasus* group have well-developed stigmatic spines. This suggests that the present composition of *Hemilecanium* may be paraphyletic. This was understood by Kondo and Hardy who go on to say (2008, p. 212) “We need data on first-instar nymphs of additional species to determine whether these two crawler types and their associated adult females will correspond to reciprocally monophyletic groups”.

Below is described a further species which is here being tentatively placed in *Hemilecanium*. Although the 1st-instar nymphs fulfil the 4 character-states for the *petasus* group discussed above, they also have an apparently unique character – 1-4 cone-shaped or flap-like triangular structures medially on most segments.

***Hemilecanium cedrelus* Hodgson, sp. n.**

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Material studied. Holotype female: Zambia, Luanshya, 26.VII.1955, on *Cedrela toona* (spelt *tuna*), G.G. Robinson (BMNH): ad♀ in good condition.

Paratype ♀. Data as for holotype ♀: 14/14 ad♀ (fair to good) (BMNH, USNM); also 3/27 1st-instar nymphs (fair to good (BMNH, USNM)) plus 1/1 3rd-instar ♀ (good) + 1 2nd-instar ♀ (with pharate 3rd-instar ♀; fair, with inner hyphae (BMNH)).

Adult female (Fig. 2).

Described from 5 specimens in good condition, and with reference to the remaining 10 specimens.

Instar diagnosis. *Dried material* with many clear, round, brown-ochre-coloured spots present throughout dorsum indicating position of dorsal tubercles. *Mounted material* oval to almost round. *Dorsum* membranous apart from a narrow sclerotisation around anterior margin of anal cleft; derm with a reticulate pattern of areolations; also with about 150-200 randomly distributed dorsal tubercles, distributed over entire dorsum, each without satellite tubular ducts; also “scars” (see discussion below) in position of dorsal tubercles of 3rd-instar. Conical preopercular pores and dorsal setae present. Anal plates roughly quadrate with 4 setae near apex. *Margin* with a single line of sharply spinose setae; with 3 stigmatic spines each clearly differentiated from marginal spinose setae, median stigmatic spines much longer than lateral spines. *Venter* with abundant 10-locular disc-pores on all abdominal and thoracic segments. Ventral microducts abundant throughout. Tubular ducts of probably 1 type, present in a wide submarginal band. Antennae 6 segmented. Limbs fully developed but relatively small; tibio-tarsal articulation without a sclerosis; claw digitules different; claw with a small denticle. Spiracles proportionately very large, width of peritreme much wider than width of coxae. Mouthparts relatively large.

Unmounted material. Dried material quite dark brown; younger specimens with a distinct shallow longitudinal dorsal ridge and a clear, shelf-like margin; older specimens becoming strongly convex with two strong shoulders medially; venter becoming highly concave, forming an inner egg chamber. Positions of dorsal tubercles indicated by clear round areas of more brown-ochre-coloured derm scattered over dorsum.

Mounted material. Oval to almost round, 2.8-6.0 mm long and 2.25-5.00 mm wide; anal cleft about 1/4th-1/5th body length. Basic structure as for diagnosis.

Dorsum. Derm mainly membranous but with a heavy sclerotised band around anterior margin of anal cleft, which expands anteriorly with age. Derm of available specimens with polygonal reticulations throughout, each reticulation with an inner areolation and a dorsal microductule; perhaps becoming sclerotised at maturity. Dorsal setae all rather spinose, quite sharply pointed, with parallel sides; frequent laterally and anteriorly to anal plates, but absent submarginally; those anterior to anal plates each 33-36 μm long, those more anteriorly and laterally smaller, down to 16-24 μm long. Preopercular pores present in an elongate triangular group anterior to anal plates, each pore conical and 8-11 μm wide; each group with 85-140 pores, extending anteriorly to about metathorax. Dorsal microductules oval, appearing bilocular but with single inner ductule arising medially, each about 2.5-3.0 μm widest, most ductules swollen proximally; abundant, present in each dorsal reticulation. Other dorsal pores absent. Dorsal tubercles large and convex, but sunken into derm; each 16-26 μm wide, with a heavily sclerotised outer cone plus 2 inner chimney-like tubes (one inside other); outermost tube with a ring of about 10-12 vertical ridges (see Discussion below adult female); innermost tube long, extending some way above tubercle; dorsum with a total of about 140-200 tubercles, randomly distributed throughout; also with about 16 submarginal “scars” and 2 pairs of submedial “scars” (in approximate positions of dorsal tubercles of 3rd instar). Anal plates each about 275-330

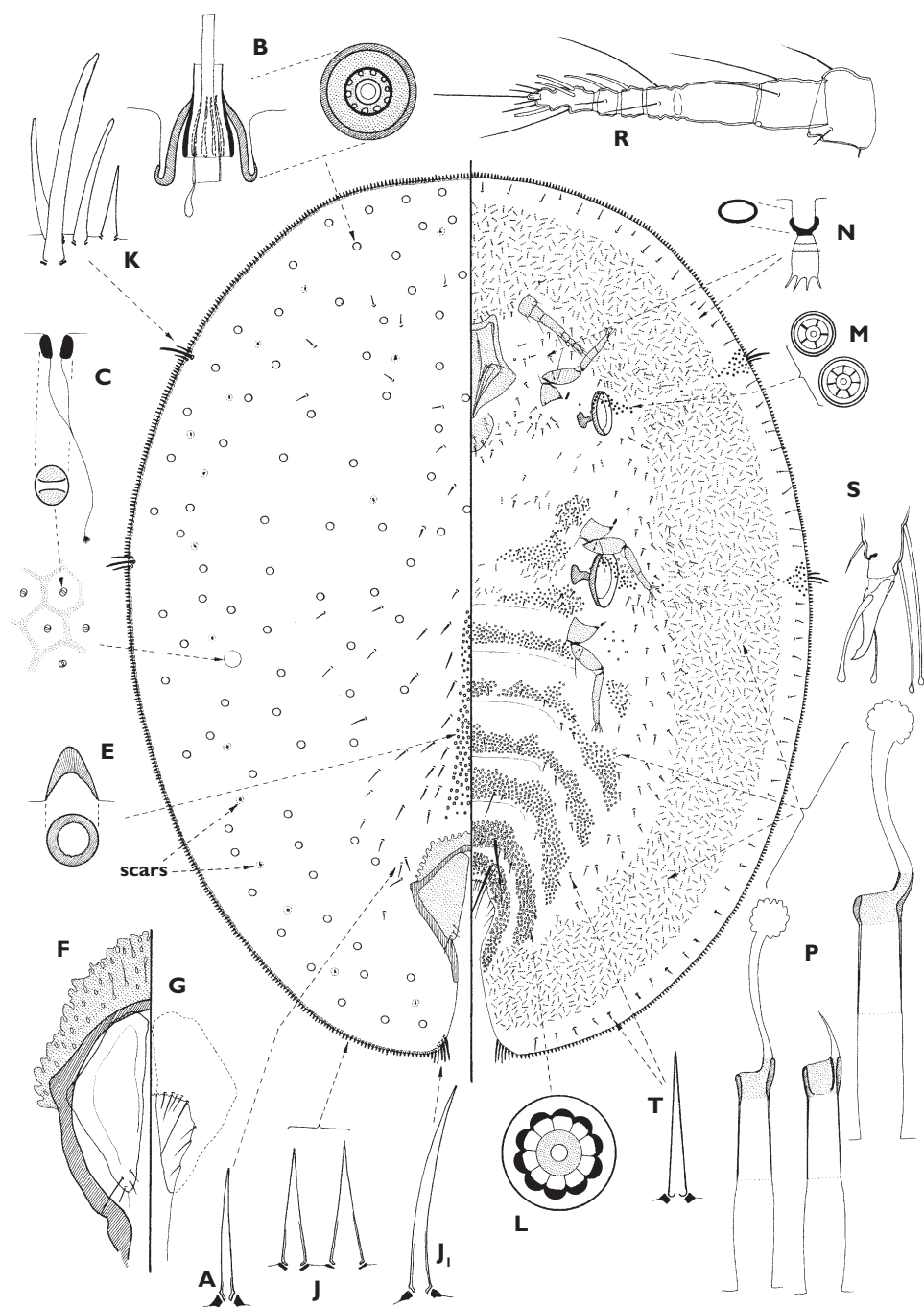


Fig. 2. *Hemilecanium cedreus* Hodgson, sp. n., adult female. For lettering, see Fig. 1, but also where B = dorsal tubercle; E = preopercular pore; J = marginal seta and J₁ = marginal seta on anal lobe; K = stigmatic spines; P = tubular ducts; and scars = scars showing position of dorsal tubercles of 3rd-instar nymph.

µm long, width of single plate 115-170 µm; each plate triangular, with 4 apical setae, both inner margin setae and subapical seta 25-30 µm long, other seta appearing dorsal, about 60-72 µm long. Anogenital fold with a line of 6-8 setae along anterior margin, each fairly short but with a long seta at each corner, latter about 60-75 µm long; each lateral margin with 3 setose setae. Anal ring well developed, with many pores and probably 5 pairs of setae, each 270-360 µm long; anal tube about as long as anal plates. Eyespots not detected.

Margin. Marginal setae all sharply spinose, each 16-45 µm long, with a broad base, straight sides and narrow basal sockets; abundant, with 175-240 anteriorly between anterior stigmatic areas, 54-62 laterally between stigmatic areas and 125-195 on each side of abdomen; each anal lobe with a group of 5 or 6 longer, slightly curved setae, longest 105-115 µm long. Stigmatic clefts absent. Stigmatic spines 3, clearly differentiated from marginal spines, slightly curved and with a less pointed apex than marginal setae; median spine longest, 75-85 µm long, each lateral spine 28-65 µm long.

Venter. Derm membranous. Spiracular disc-pores each mainly with 5 loculi, in broad groups near margin and each peritreme but very few or even sometimes absent in between; with about 45-50 in each anterior band and 60-85 in each posterior band, latter with a small group of multilocular pores near each spiracle. Multilocular disc-pores each about 8-10 µm wide, mainly with 10 loculi, abundant across all abdominal segments and across meso- and metathorax; scarce on prothorax and head. Ventral microducts each about 3 µm wide, abundant throughout, except marginally. Ventral tubular ducts slightly variable but probably all of one type, each with an outer ductule 17-30 µm long, inner ductule 13-20 µm long, with or without a glandular end; abundant in a broad submarginal band and rather less frequently in bands across each thoracic segment; with 1 or 2 present medially on abdomen among multilocular disc-pores. Other pores types absent. Ventral setae mainly rather spinose, most about 20-26 µm long, present across each abdominal and thoracic segment but most abundant in a submedial band just laterad to spiracles and legs; with about 5 pairs of rather short inter-antennal setae, longest 40 µm long; abdominal segments V, VI and VII each with a pair of longer setae, longest on VI and VII, each about 150 µm long; submarginal setae frequent, each about 25 µm long.

Antennae each 6 segmented, total length 250-350 µm; scape with 3 setae, pedicel with 2 setae, other segments: III with 2 setae, IV with 1 fleshy seta, V with 1 fleshy seta + 1 flagellate seta and VI with 3 fleshy setae, about 5 stiff apical setae + 1 flagellate seta; length of apical seta 66-90 µm long. Clypeolabral shield 270-350 µm long, labium probably with 4 pairs of setae. Spiracles large, width of peritremes: anterior 125-165 µm, posterior 155-210 µm; muscle plate much shorter than width of peritreme. Legs well developed but small; lengths (µm) of metathoracic legs: coxae 120-130 (width of coxal base 80-100 µm); trochanter + femur 145-153; tibia + tarsus 185-210; claw 28-31; tibio-tarsal articulation not always clear, with no sclerosis; longest coxal seta about 70 µm; longest trochanter seta about 85 µm; other setae very sparse; tarsal digitules about equal to length of claw digitules; claw digitules longer than claw, with one slightly narrower than other; claw with a small denticle. Vulva probably present between abdominal segments VII and VIII.

Comment. The adult females of this species are superficially similar to those of *Hemilecanium coriaceum* Hall and *H. uesatoi* Kondo & Hardy, which also have dor-

sal tubercles randomly distributed throughout the dorsum,. However, *H. cedrelus* differs from *H. coriaceum* as follows (characters-states on *H. coriaceum* in brackets): (i) presence of 3 clearly differentiated stigmatic spines (absent or 1 barely differentiated); (ii) multilocular disc-pores abundant across all abdominal segments and also across meso- and metathorax (many fewer, restricted to abdomen); (iii) preopercular pores in an elongate group anterior to anal plates (in a broad group incorporating some dorsal tubercles anterior to anal plates); and (iv) large size of spiracular peritremes (small). Adult female *H. cedrelus* are also similar to the newly described *H. uesatoi* from the Ryukyu Archipelago, Japan, but the latter differs in having normal-sized spiracles; pocket-like sclerotisations restricted to the submargin, preopercular pores extending anteriorly onto head; 8-segmented antennae, and no denticle on the claw. In addition, the 1st-instar nymphs are rather different (see under that stage below).

Initially it was assumed that the ring of sclerotised spots on each dorsal tubercle, which are clearly visible in dorsal views of each tubercle, were satellite tubular ducts similar to those on some *Hemilecanium* species. However, true satellite ducts have the structure of a small tubular duct, i.e. with a long outer ductule, a small cup-shaped invagination and sometimes an inner ductule, each duct opening onto the surface of the tubercle through an aperture some distance from the funnel-like central cone (see *Etiennea halli*, *E. kellyi*, *E. petasus* and *E. villiersi* in Hodgson, 1991 (now all in *Hemilecanium*)). This is quite different from what we see on *H. cedrelus* where, when seen from the side, these “sclerotised spots” appear to refer to vertical sclerotised ridges on the outer funnel-shaped tube; none of which have either an associated ductule or an outer aperture. It is therefore considered that these structures are not satellite tubular ducts.

Distribution. *Hemilecanium cedrelus* is currently only known from Zambia.

Third-instar female (Fig. 3)

Described from 1 specimen in good condition. (Note: the data in brackets for the number of dorsal tubercles are from the pharate 3rd-instar nymph – see discussion under 2nd-instar nymph below.)

Instar diagnosis. Oval and rather flat. Dorsum with a submarginal ring of large dorsal tubercles plus 2/3 submedially on thorax. Margin with a single line of sharply spinose setae; with 3 stigmatic spines clearly differentiated from marginal spinose setae. Venter with a small group of 5-locular disc-pores posterior to anal opening; also with a sparse submarginal band of tubular ducts. Antennae 5 or 6 segmented. Legs fully developed; claw digitules dissimilar; claw with a small denticle. Spiracles of normal proportions, width of peritreme smaller than width of coxae. Mouthparts relatively large.

Unmounted material. Dried material pale brown; oval, rather flat, with a few shallow, radial ridges. No sign of a wax test.

Mounted material. As in instar diagnosis. Body 1.33 mm long and 0.9 mm wide; anal cleft about 1/5th body length. Dorsum with a submarginal ring of about 30 large dorsal tubercles plus 2(3) submedially on thorax, plus “scars” left by the 12 dorsal tubercles of 2nd-instar nymph.

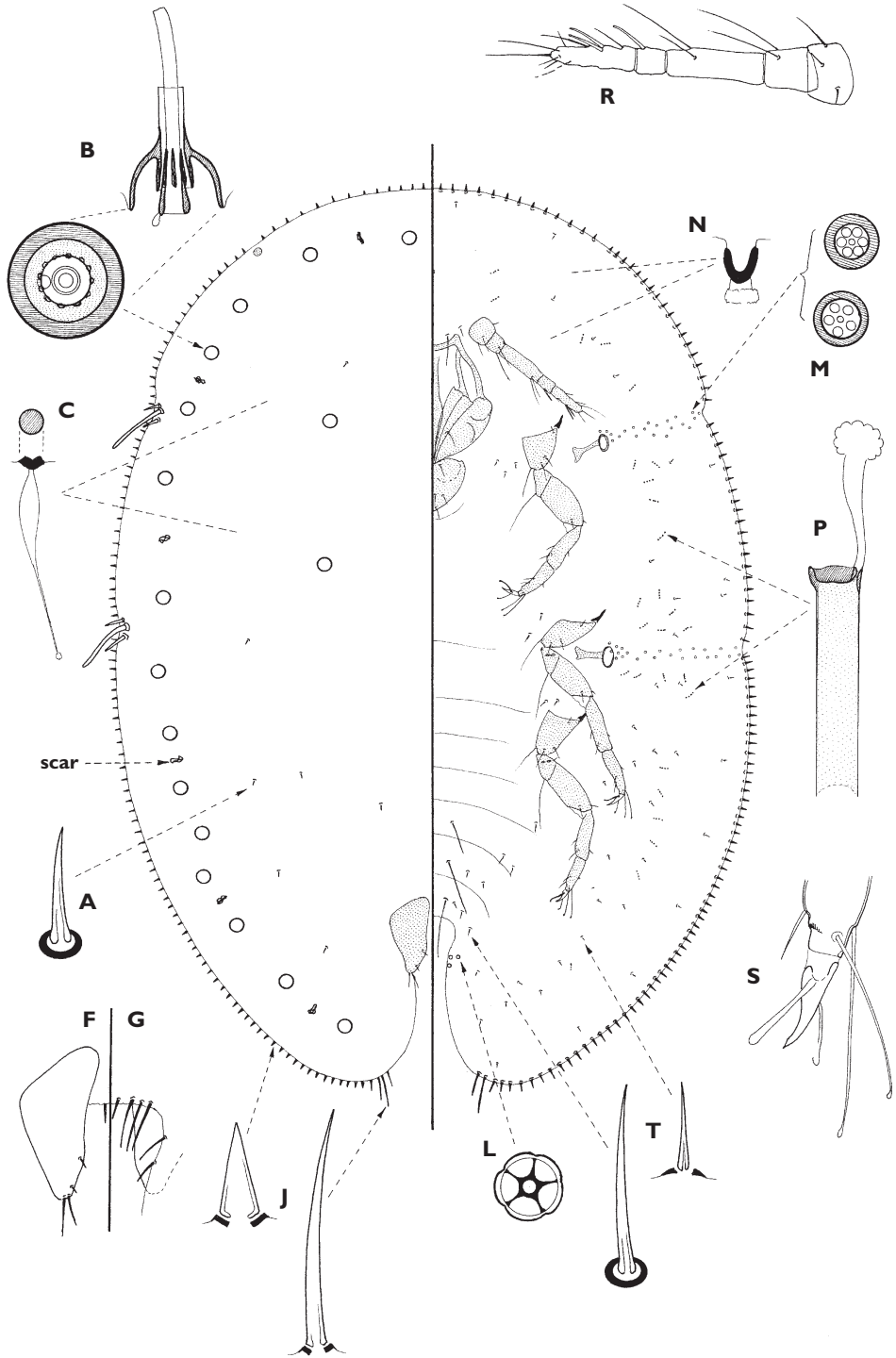


Fig. 3. *Hemilecanium cedrelus* Hodgson, sp. n., female 3rd-instar nymph. For lettering, see Figs 1 & 2, but where scar = position of scars left by dorsal tubercles of 2nd-instar nymph.

Dorsum. Derm mainly membranous, without a sclerotised band around anterior margin of anal cleft and without a reticulate pattern of areolations. Dorsal setae very few, each short and finely spinose, each about 10 μm long; distribution uncertain but very sparse. Preopercular pores absent. Dorsal microductules small, each about 1.5 μm wide, with an inner ductule about 8 μm long, most ductules swollen proximally; abundant. Other dorsal pores absent. Dorsal tubercles of more or less two types: (i) large and convex, each about 20–24 μm wide, basically similar to those on adult female; with (on each side in a submarginal ring) 5 (5–7) on abdomen; 2 (3) between stigmatic clefts, 2 (3) between anterior cleft and eyespot and 4 anteriorly between eyespots; and (ii) what are here considered to be remains of dorsal tubercles of 2nd-instar female, structure very unclear (but probably similar to “scars” on adult female); with 3 on each side of abdomen, 1 between stigmatic clefts, between anterior cleft and eyespot and 2 anteriorly between eyespots. Anal plates each about 110 μm long, width of single plate about 55 μm ; each plate triangular, with 4 setae: 2 inner margin setae, both short, and two other apical setae, positions uncertain, each possibly 16–23 μm long. Anogenital fold with a line of perhaps 8 setae along anterior margin, each about 28 μm long; each lateral margin with 2 setae. Anal ring well developed, with 4 pairs of setae, each about 100 μm long; anal tube about twice length of anal plates. Eyespots oval, 21–23 μm widest.

Margin. Marginal setae all sharply spinose, each 12–16 μm long, with a broad base, rather straight sides and narrow basal sockets; with a total of 26 anteriorly between eyespots, and (on each side) 15–19 between eyespots and anterior stigmatic areas, 20–22 laterally between stigmatic areas and 58–64 on each side of abdomen; each anal lobe with a group of 2 or 3 longer, slightly curved setae, longest 53–66 μm long. Stigmatic clefts shallow, each with 3 stigmatic spines, clearly differentiated from marginal spines, slightly curved and with a less pointed apex than marginal setae; median spine longest, 70–90 μm long, each lateral spine 20–40 μm long.

Venter. Derm membranous. Spiracular disc-pores, each with a broad sclerotised margin and perhaps mainly with 5 or 6 loculi, in broad bands between margin and each peritreme; with 20 or 21 in each anterior band and 24–26 in each posterior band. Preanal multilocular disc-pores each about 5 μm wide with 5 loculi, in a small group of 3 each side beneath anal plates. Ventral microducts each about 3 μm wide, abundant throughout apart from marginally, where absent. Ventral tubular ducts of one type, each with an outer ductule 15 μm long, inner ductule 10–12 μm long, with a glandular end; in a mainly narrow submarginal band but tending to be most concentrated on either side of spiracular disc-pore bands, with 3 anteriorly on head, 1–3 between eyespots and anterior stigmatic clefts, 11–12 on each side between stigmatic clefts and 11–18 on each side of abdomen. Other pore types absent. Ventral setae perhaps slightly larger medially than laterally, most about 10–12 μm long; with one longer pair and one shorter pair of inter-antennal setae, longest about 60 μm ; with long setae medially on abdominal segments V–VII, longest about 85 μm ; with 2 or 3 short setae associated with each coxa; other setae fairly frequent in a broad submarginal band, most abundant on abdomen, each about 6–7 μm long.

Antennae each either 5 segmented or slightly deformed (i.e. really 6 segmented), total length 200–215 μm ; scape with 3 setae, pedicel with 2 setae + campaniform sensil-

lum, setae on other segments uncertain. Clypeolabral shield 185 μm long; labium with 4 pairs of setae. Spiracles of normal size, width of peritremes: anterior 25 μm , posterior 30-32 μm . Legs well developed; lengths (μm) of metathoracic legs: coxae 80-85; trochanter + femur 100-110; tibia + tarsus 122-140; claw 23-26; tibio-tarsal articulation poorly defined; longest coxal seta about 58-60 μm ; longest trochanteral seta about 55 μm ; femur with 2 setae; tibia with 3 setae; tarsus with 3 setae; tarsal digitules perhaps extending further than claw digitules, each 28 μm long; claw digitules longer than claw, with one narrower than other, length 28-32 μm ; claw with a small denticle.

Comment. This is the only immature stage of any Coccidae known to the author with preanal multilocular disc-pores.

Second-instar female (Fig. 4)

Described from a single specimen containing a pharate 3rd-instar nymph.

Instar diagnosis. Oval. Similar to 3rd-instar but venter without disc-pores posterior to anal opening and without tubular ducts; marginal setae and spiracular disc-pores fewer.

Unmounted material. Dried material pale brown; oval, rather flat, with a few shallow, radial ridges. No sign of a wax test.

Mounted material. As for instar diagnosis. Body 1.5 mm long and 1.08 mm wide; anal cleft about 1/6th body length. Submarginal ring of 12 dorsal tubercles.

Dorsum. Derm mainly membranous, without a sclerotised band around anterior margin of anal cleft and without a reticulate pattern of areolations. Dorsal setae possibly absent. Dorsal microductules small, each about 1.5 μm wide, with or without an inner ductule, most ductules swollen proximally; sparse. Other dorsal pores absent. Dorsal tubercles of 1 type, each 11-15 μm wide; structure basically similar to those on adult female but smaller, each with about 6 vertical ridges on outer inner tube; with 1 pair of tubercles anteriorly, and (on each side) 1 between eyespots and anterior stigmatic cleft, 1 laterally between stigmatic clefts and 3 or 4 on abdomen (plus dorsal tubercles of pharate 3rd-instar nymph (as indicated in brackets in the description above). Anal plates each about 90 μm long, width of single plate about 42 μm ; each plate triangular, with 4 setae, all broken. Anogenital fold with 2 pairs of setae anteriorly, longest setae about 33 μm long; each lateral margin with 1 seta. Anal ring well developed, with 3 pairs of setae, each about 110 μm long; anal tube about twice length of anal plates. Eyespots oval, 15 μm widest.

Margin. Marginal setae all sharply spinose, each 8-20 μm long, with a broad base, slightly curved sides and narrow basal sockets; with 12 anteriorly between eyespots, and (on each side) 6 between eyespots and anterior stigmatic areas, 6 or 7 laterally between stigmatic areas and 19-22 on each side of abdomen; each anal lobe probably with a group of 2 or 3 longer setae but all broken. Stigmatic clefts shallow, each with 3 stigmatic spines, clearly differentiated from marginal spines, slightly curved and with a less pointed apex than marginal setae; median spine longest, 60 μm long (only one present), each lateral spine 15-18 μm long.

Venter. Derm membranous. Spiracular disc-pores each with a broad sclerotised margin and perhaps mainly with 5 loculi, in narrow bands between margin and each

peritreme; with 7 in each anterior band and 10-12 in each posterior band. Preanal multilocular disc-pores absent. Ventral microducts each about $3\text{ }\mu\text{m}$ wide, sparse in a broad submarginal band and also occasional medially on head, thorax and abdomen. Ventral tubular ducts absent. Other pores types absent. Ventral setae few, with two pairs of interantennal setae, longest $33+ \text{ }\mu\text{m}$; with long setae medially on abdominal segments V-VII, longest about $80+ \text{ }\mu\text{m}$; each coxa with 1 minute associated seta; other

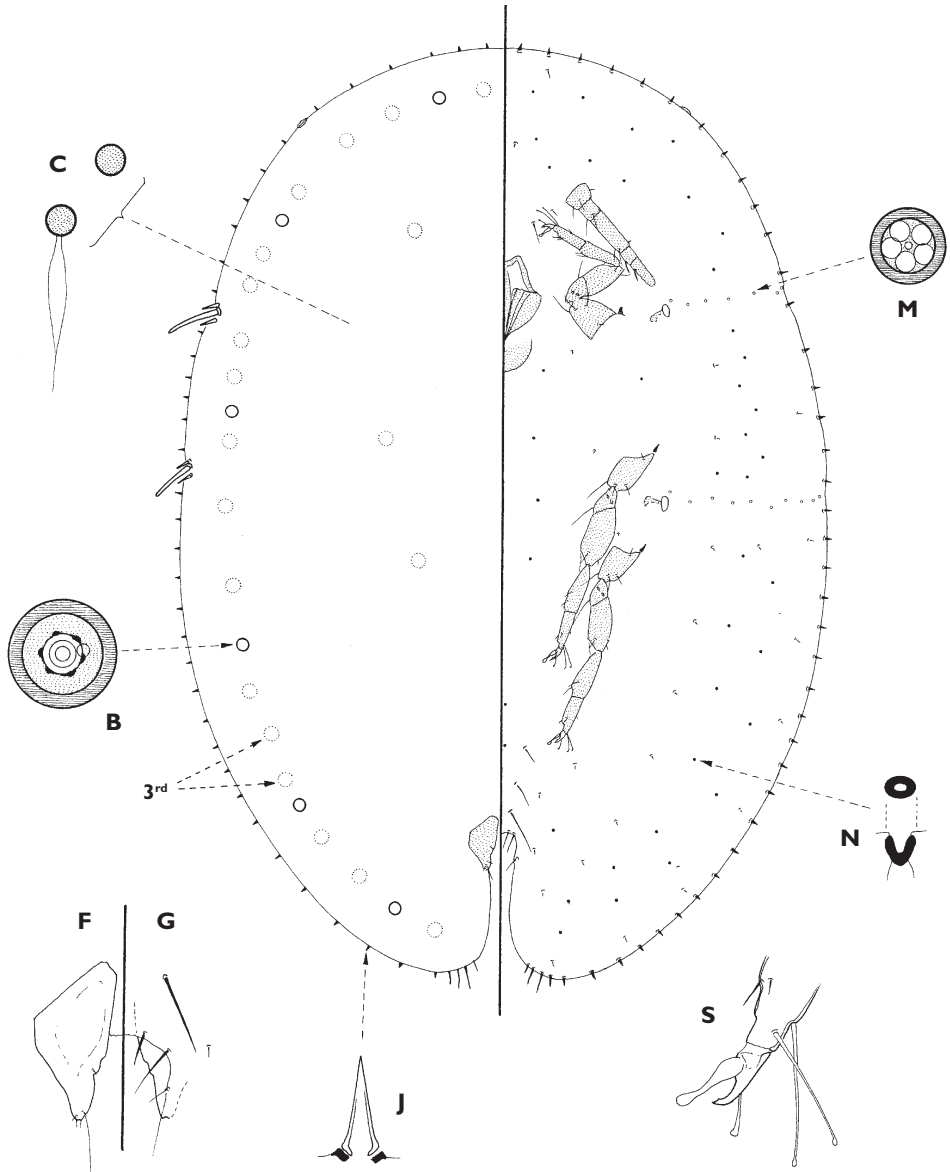


Fig. 4. *Hemilecanium cedrelus* Hodgson, sp. n., female 2nd-instar nymph. For lettering, see Figs 1 & 2, but also where 3rd = position of dorsal tubercles on parate 3rd-instar nymph.

setae in a submarginal line (1 laterally between stigmatic clefts), and an inner submarginal line on abdomen; each about 6-7 μm long.

Antennae both damaged but either 5 segmented or slightly deformed (i.e. really 6 segmented), total length perhaps 210 μm ; scape with 3 setae, pedicel with 2 setae + campaniform sensillum; number on other segments uncertain. Clypeolabral shield 132 μm long; labium with 4 pairs of setae. Spiracles of normal size, all peritremes 17-19 μm wide. Legs well developed; lengths (μm) of metathoracic legs: coxae 78-80; trochanter + femur 116-120; tibia 80-85; tarsus 65-70; claw 20-22; tibio-tarsal articulation fairly clear; longest coxal seta about 60-66 μm ; all long trochanter setae broken; femur 2 setae; tibia 3 setae; tarsus 3 setae; tarsal digitules perhaps extending further than claw digitules, each about 45 μm long; claw digitules longer than claw, with one clearly narrower than other, length 25-28 μm ; claw with a small denticle.

Comment. Despite having a slightly larger body size than the 3rd-instar nymph described above, this is clearly a female 2nd-instar nymph. This is shown not only by the smaller limbs etc, smaller number of spiracular disc-pores and absence of preanal disc-pores, but also by the presence of the pharate 3rd-instar and the distribution of the latter's dorsal tubercles, which are clearly visible inside its cuticle.

Because this specimen had a pharate 3rd-instar nymph within, it was possible to study the number and distribution of the dorsal tubercles, which were well developed and these data are given in brackets in the description of the 3rd-instar nymph above. The number and distribution of the "scars" on the derm of the 3rd-instar nymph agree with the number and positions of the dorsal tubercles on the 2nd-instar nymph and therefore clearly refer to these (see also the Discussion beneath description of 1st-instar nymph of *H. cedrelus*).

First-instar (Fig. 5)

Instar diagnosis. Oval. Dorsum membranous but with a series of 1-4 large, triangular or cone-shaped protuberances medially on most segments. Dorsal setae absent. Margin with small spinose setae. Each stigmatic cleft with 3 stigmatic spines, median spine long. Venter with three pairs of long preanal setae. Ventral microducts in a sparse submarginal line. Legs well developed; each femur with an exceptionally long seta on anterior margin; long setae also present on tibia and tarsus; claw digitules different; claw with a small denticle.

Mounted material. As for instar diagnosis. Body 0.5-0.53 mm long and 0.26-0.30 mm wide; anal cleft very short.

Dorsum. Derm mainly membranous, but with large triangular or cone-shaped protuberances medially, each margin of protuberance about 33-35 μm long and each 20-22 μm wide at base, distributed as follows: none on abdominal segments V-VII, pairs on abdominal segments III & IV, singles on abdominal segments I & II, each thoracic segment plus a pair posteriorly on head and 2 pairs together more anteriorly on head. Dorsal setae absent. Dorsal microductules small, each about 1.5 μm wide with a long inner ductule, most ductules swollen proximally; mainly in 2 pairs of longitudinal lines, one pair of lines medially (with 5 pores on abdomen, probably 3 on thorax and 1 on head) and other lines submarginal (with 7 pores on abdomen, 2

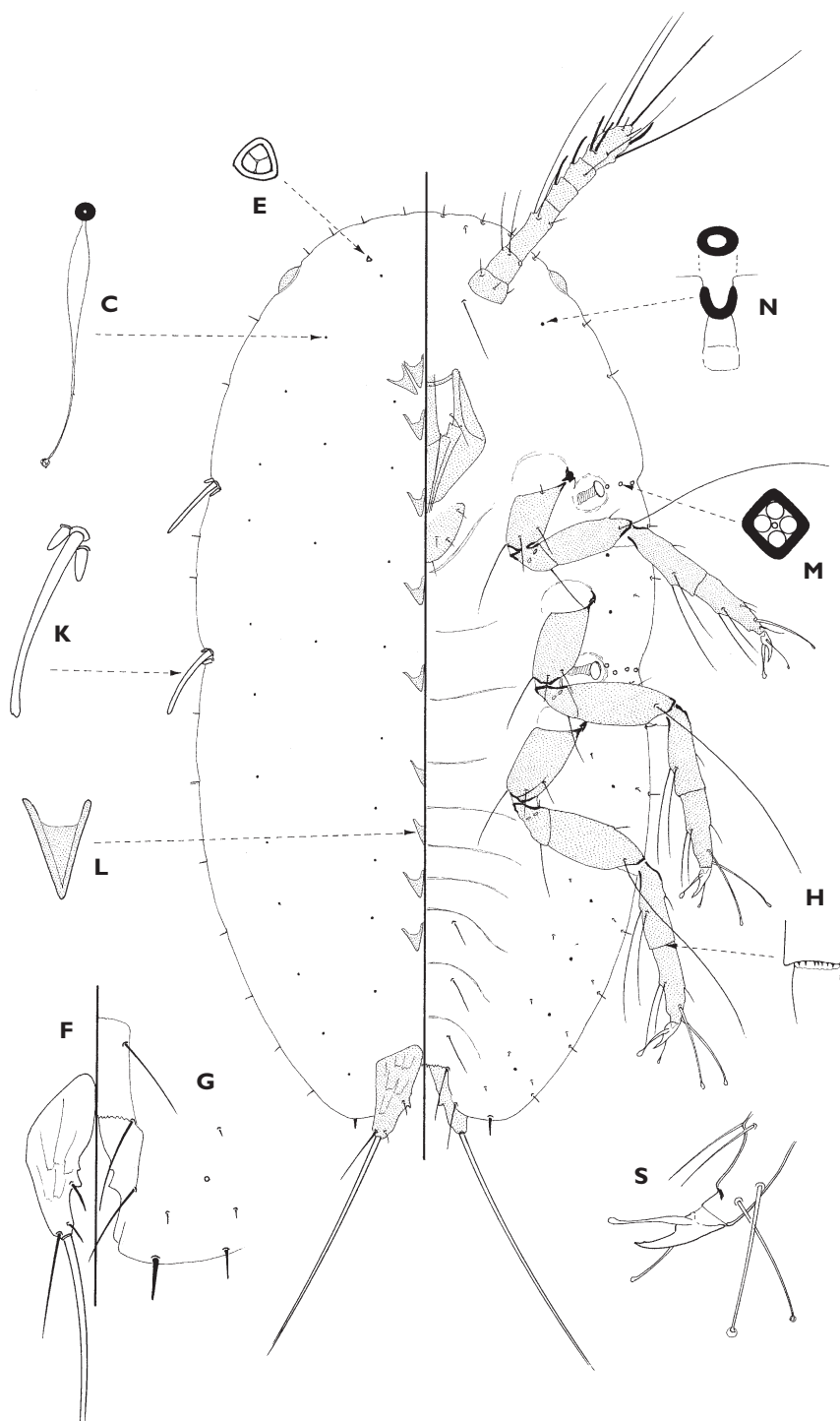


Fig. 5. *Hemilecanium cedrelus* Hodgson, sp. n., 1st-instar nymph (sex unknown). For lettering, see Figs 1 & 2, but where E = dorsal trilocular pore; L = dorsal protuberances, and H = tibio-tarsal articulation with microspines.

between stigmatic clefts and 4 anteriorly); also with single pores submedially in each thoracic segment. A pair of trilocular pores present on head some distance from anterior margin, each about 3.0 μm wide. Other dorsal pores absent. Anal plates each quite elongate, about 60-65 μm long, with a few shallow longitudinal ridges; each with a small spine on inner margin, 2 short setae along inner margin, each about 8 μm long; a very long apical seta, each 260-310 μm long, and a single seta on posterior margin, about 36 μm long. Anogenital fold with a single long seta at each corner, each 26-28 μm long, and a single similar seta on each lateral margin, 23-28 μm long. Anal ring with 2 rows of pores, each with 5-7 pores, plus 6 anal ring setae, each about 80-85 μm long; anal tube extending anterior to anal plates. Eyespots each 15-18 μm wide.

Margin. Marginal setae all finely spinose, most 6-8 μm long (that on each anal lobe 13-15 μm long), with well-developed socket, distributed as follows: with 8 anteriorly between eyespots, and (on each side) 2 between eyespots and anterior stigmatic cleft, 2 laterally between stigmatic clefts and 8 on abdomen. Stigmatic clefts shallow, each with 3 stigmatic spines clearly differentiated from marginal setae; median spinose seta very long, rather parallel sided and possibly with a slightly flattened apex, each 40-45 μm long, with a broad basal socket; anterior lateral spine shortest, about 5 μm long, posterior spine about 6.5 μm long.

Venter. Derm membranous. Spiracular disc-pores each with very thick margins and perhaps with mainly 3 or 4 loculi (occasionally 5?), with 3 pores in each anterior pore band and 4 in each posterior band. Ventral microducts each about 1.5 μm wide, present in a submarginal line, with (on each side) 1 on head, 2 on thorax and probably 6 on abdomen. Ventral setae few; with 1 pair of interantennal setae, each about 40 μm long, and with pairs of long setae medially in abdominal segments V-VII, longest about 40-45 μm long; short setae in a submarginal line, with (on each side) 7 on abdomen, 1 on thorax and 1 anteriorly on head; also with an inner submarginal line of 7 setae on abdomen.

Antennae each 6 segmented, total length 150-175 μm ; scape with 3 setae, pedicel with 2 quite long setae + campaniform sensillum segments: III with 3 setae, one very long, up to about 80-85 μm long, IV 1 fleshy seta, V 1 fleshy seta + 1 flagellate seta, and VI with 3 fleshy setae, about 4 stiff apical setae + 3 flagellate setae, longest at least 110 μm long; length of apical seta about 110 μm long. Clypeolabral shield 87-95 μm long; labium with 4 pairs of setae. Spiracles: all peritremes about 8 μm wide, in a shallow concavity. Legs well developed; lengths (μm) of metathoracic legs: coxae 60-66; trochanter + femur 83-85; tibia 55-60; tarsus 45-52; claw 20-23; longest coxal seta about 33-45 μm ; longest trochanter seta about 40 μm ; each femur with 3 setae, one exceptionally long seta on anterior margin, 140-150 μm long; tibia with 3 setae, 2 rather long, longest 75-80 μm long; tibia with a row of microspines along distal margin on each middle and hind leg; tarsus with 4 setae, 2 quite long, longest about 40 μm ; tarsal digitules both capitate, offset, extending to about equal with claw digitules, each about 50 μm long; claw digitules longer than claw, with one distinctly narrower than other, each about 28 μm long; claw with a small denticle.

Comment. The 1st-instar nymph of *H. cedrelus* is distinctive due to the presence of the triangular or cone-shaped protuberances medially on the dorsum of most seg-

ments, unknown on any other 1st-instar nymphs as far as the author is aware, including those of *H. uesatoi*. However, Hodgson (1993), when describing the dorsum of *Etiennaea (Hemilecanium) petasus* wrote “Derm entirely membranous, but thrown into small dermal nodules – in some specimens, these are rather pronounced and found throughout, in others they are few, but are always present around the margin and *in pairs medially*, probably one pair per segment” (my italics). It seems possible, therefore, that these “nodules” are just more pronounced on *H. cedrelus*. In addition, the presence of very long setae on each femoral segment of *H. cedrelus* is unusual, although similar setae are known on other species (Hodgson, 1993) in the *petasus* group as defined by Kondo and Hardy (2008). They are also known on *Protopulvinaria pyriformis* (Cockerell) (Ray & Williams, 1982) and *Kilifia* De Lotto (Ray & Williams, 1982). In addition to the triangular or cone-shaped protuberances medially, which are absent on the 1st-instar nymph of *H. uesatoi*, the 1st-instar nymphs of *H. cedrelus* differ from those of *H. uesatoi* in having (character-states on *H. uesatoi* (from Kondo & Hardy, 2008) in brackets): (i) long femoral setae on all femora (restricted to the metafemur only); and (ii) claw digitules dissimilar (similar).

Etymology. The specific name *cedrelus* is taken from the generic name of the host plant, *Cedrela toona* (Meliaceae).

A key to the adult females of *Hemilecanium* Newstead was included in Kondo and Hardy (2008, p. 195). This key can be modified to include *H. cedrelus* as follows:

- 6. Stigmatic spines not differentiated from marginal spines 7
- Stigmatic spines clearly differentiated from marginal setae 9a
- 9a Dorsum with dorsal tubercles present throughout dorsum; antennae 6-segmented; spiracles very large, posterior peritreme generally more than 1.7 times wider than basal width of metacoxa *H. cedrelus* new species
- Dorsum with dorsal tubercles generally restricted to a submarginal band (except *H. uesatoi*); antennae usually more than 6 segmented; spiracles smaller, width of peritremes of posterior spiracles usually less than basal width of metacoxa 9b (9b is original couplet 9)

General discussion

Boratynski (1970), when describing the immature stages of *Parthenolecanium persicae* (Fabricius), showed that the positions of the dorsal tubercles (which he called marginal bicylindrical ducts) on immature instars was indicated in the following instar (i.e. the positions of the tubercles of the 2nd-instar nymphs on the derm of the 3rd-instar nymph) by atrophied ducts. This is a fairly common phenomenon in the Coccidae, where the term “pocket-like sclerotisations” has been frequently used to describe the atrophied tubercles. In *H. cedrelus*, the atrophied tubercles do not look like the pocket-like sclerotisations found on other Coccidae, although their exact structure is hard to determine, and so are referred to here simply as “scars”. Thus, the position of the dorsal tubercles

on the 2nd-instar nymph is shown by “scars” on the dorsum of the 3rd-instar nymph, and those of the 3rd-instar nymph by “scars” on the dorsum of the adult female. It appears that the “scars” on the 3rd-instar nymph (left from the tubercles of the 2nd-instar nymph) disappear at the last moult into the adult female as none could be detected.

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