

Two new gall-inducing genera and species of Eriococcidae (Hemiptera) on Malvaceae and Anacardiaceae from the Neotropics

Chris Hodgson¹, Thiago A. Magalhães² & Douglass Miller³

¹ Department of Biodiversity and Biological Systematics, The National Museum of Wales, Cathays Park, Cardiff, CF10 3NP, UK. Email: hodgsoncj@cardiff.ac.uk.

² Departamento de Botânica, Universidade Federal de Minas Gerais, Av. Antonio Carlos 6627, Belo Horizonte, Minas Geras, Brazil.

³ Systematic Entomology Laboratory, Beltsville Agricultural Research Center, U.S. Department of Agriculture, Beltsville, Maryland 20705, USA. Email: douglass.miller@ars.usda.gov

Abstract

This paper describes two new genera and species of gall-inducing Eriococcidae from the Neotropics: *Eriogallococcus isaias* Hodgson & Magalhães **gen. & sp. nov.** from Brazil, which forms tall conical galls on the leaflets of *Pseudobombax grandiflorum* (Malvaceae), and *Dromedaricoccus hansonii* Hodgson & Miller **gen. & sp. nov.** from Costa Rica, in bulbous swellings on the young stems, petioles and underside of the mid-veins of leaflets of *Astronium graveolens* (Anacardiaceae). The adult female, adult male, pupa, 2nd-instar male and crawler of *E. isaias* are described and illustrated but only the adult female and adult male of *D. hansonii* are described and illustrated. Keys are provided for the identification of (i) all eriococcid genera now known from the Neotropics as recognised by Hodgson & Miller (2010) based on the morphology of the adult female and (ii) all Neotropical genera based on adult males for which this stage is known.

Keywords: **Sternorrhyncha, Coccoidea, taxonomy, identification, immatures, host-plants.**

Introduction

The family Eriococcidae or felt scales is the fourth largest family of scale insects (Hemiptera: Sternorrhyncha: Coccoidea) (Ben-Dov et al. 2010). It is most abundant in the Southern hemisphere, particularly in New Zealand and Australia but is almost certainly as abundant in South America which is less well studied. The status of the family in South America has been recently reviewed by Kozár (2009) and Hodgson & Miller (2010), although they used slightly different generic concepts. Kozár (2009) concluded that 67 species of Eriococcidae in 27 genera were known from the Neotropical Region whilst Hodgson & Miller (2010) considered that there were 72 recognisable species in 24 genera known from South America (i.e., minus Central America and the rest of the Caribbean). However, Kozár's placement of some of the species differed from that of Hodgson & Miller and further species have been described since Kozár's paper was published.

There is mounting evidence that the family Eriococcidae is non-monophyletic – indeed, molecular analyses by Cook et al.

(2002) and Cook & Gullan (2004) suggest that there are three major lineages in the Eriococcidae *sensu lato*. The fauna currently known from the Neotropics falls into two of these lineages, that which is basically Gondwanan in origin (encompassing Australia, New Zealand and South America) and the more widespread acanthococcid clade (Cook & Gullan, 2004; Kondo et al., 2006). Clearly, therefore there are likely to be major changes in the classification of this family in the near future.

For a recent history of the study of this family in South America, see Hodgson & Miller (2010). What is striking about the eriococcid genera currently known from the Neotropics is the high percentage of species that induce galls. The present paper describes two further gall-inducing genera and species from the Neotropics, one from Costa Rica which induces bulbous swellings on the twigs, petioles and main leaf veins of *Astronium graveolens* (Anacardiaceae), and the other from Brazil where it induces tall conical galls on the upper leaf surface of *Pseudobombax grandiflorum* (Malvaceae).

Materials and methods

Recently collected specimens were slide mounted in the usual way (see Henderson & Hodgson (2000)) except that all specimens were left in cold KOH (about 20°C) for 3-4 days

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rather than being gently heated in warm KOH. Terminology in the descriptions follows that of Hodgson & Miller (2010) and Hodgson et al. (2004). Material examined is shown as (for example) 2/5 adff (= 2 slides with a total of 5 adult females). Depository abbreviations are: Taxonomic

collections of UFMG, Belo Horizonte, Brazil; USNM – The National Museum of Natural History, Beltsville, Maryland, USA, and BMNH- The Natural History Museum, London, UK; BME – Bohart Museum of Entomology, University of California, Davis, USA.

Key to the Eriococcidae of the Neotropical Region based on the morphology of adult females

- | | | |
|--------|--|---------------------------------|
| 1. | Legs present, sometimes greatly reduced or located near anal opening | 5 |
| – | Legs absent | 2 |
| 2(1) | Conspicuously enlarged setae (excluding marginal setae) absent from dorsum | 3 |
| – | Conspicuously enlarged setae present on dorsum, either enlarged and narrow and restricted to posterior abdominal segments or cupulate-shaped and robust, scattered over thorax and abdomen | 4 |
| 3(2) | Antennae segmented; quinquelocular pores restricted to mostly near thoracic spiracles, absent from dorsum | <i>Pseudocapulinia</i> |
| – | Antennae each represented by an unsegmented knob; quinquelocular pores present on both body surfaces | <i>Carpochloroides</i> |
| 4(2) | Enlarged setae of 2 types present, cupulate-shaped setae on anterior abdomen, thorax, and head, and elongate setae on posterior abdominal segments | <i>Macracanthopyga</i> |
| – | Only enlarged cupulate-shaped setae present, scattered over dorsum | <i>Apiococcus</i> |
| 5(1) | Antennae with 6 or more segments | 12 |
| – | Antennae with 5 or fewer segments | 6 |
| 6(5) | Dorsum of mature adult with a large sclerotised area over thorax or abdomen; without conical spinose setae on dorsum | 7 |
| – | Dorsum of mature adult without a large sclerotised area over thorax or abdomen; with conical spinose setae somewhere on dorsum | 8 |
| 7(6) | Legs poorly developed; abdomen attenuated; mature adult female with large sclerotised hump on about metathorax | <i>Dromedaricoccus</i> |
| – | Legs fairly-well developed; abdomen not attenuated, body almost round; mature adult female with large area of sclerotisation on abdomen | <i>Eriogallococcus</i> |
| 8(6) | Without ring of tubular ducts surrounding apex of abdomen | 9 |
| – | With ring of tubular ducts surrounding apex of abdomen | <i>Capulinia</i> |
| 9(8) | Legs large, well developed; dorsum of abdomen membranous | 10 |
| – | Legs small, abortive; dorsum of abdomen sclerotised | <i>Aculeococcus</i> |
| 10(9) | Enlarged setae not grouped in circular area on thorax and head | 11 |
| – | Enlarged setae grouped in circular area on thorax and head | <i>Neotectococcus</i> (in part) |
| 11(10) | Anal lobes protruding, heavily sclerotized | <i>Pseudotectococcus</i> |
| – | Anal lobes absent or very small, unsclerotized | <i>Tectococcus</i> (in part) |
| 12(5) | Anal lobes absent or, if present (sclerotised or not), not protruding noticeably past posterior apex of abdomen | 24 |
| – | Anal lobes present, clearly protruding from posterior apex of abdomen | 13 |
| 13(12) | Macrotubular ducts present on dorsum | 17 |
| – | Macrotubular ducts absent from dorsum | 14 |
| 14(13) | Antennae 6 segmented; without a cluster of spinose setae ventrally between meso- and prothoracic legs | 15 |
| – | Antennae 8 segmented; with a cluster of spinose setae ventrally between meso- and prothoracic legs | <i>Eriobalachowskya</i> |
| 15(14) | Loculate pores absent from spiracular atria; anal ring with 8 setae and with a double row of pores | 16 |
| – | Loculate pores present in spiracular atria; anal ring with 10 setae and with a single row of pores | <i>Poliloculus</i> |

16(15) Dorsal setae large, conspicuously spiniform; translucent pores on hind coxa represented by large openings	<i>Icelococcus</i>
– Dorsal setae small, slightly spiniform; translucent pores on hind coxa represented by small dots	<i>Intectococcus</i>
17(13) At least some macrotubular ducts on dorsum with a conspicuous rim surrounding dermal orifice	22
– Macrotubular ducts on dorsum without a conspicuous rim surrounding dermal orifice	18
18(17) Without groups of microducts on dorsum of thorax and anterior abdominal segments ..	19
– With conspicuous groups of microducts on dorsum of thorax and anterior abdominal segments	<i>Hempelicoccus</i>
19(18) Setae in medial areas of ventral abdomen with acute apices; translucent pores present on some, but not all, of the following hind leg segments: coxa, femur and tibia	20
– Some setae in medial areas of ventral abdomen slightly capitate; translucent pores present on all of the following hind leg segments: coxa, femur and tibia	<i>Coxicoccus</i>
20(19) Anal lobes conspicuous and sclerotized	21
– Anal lobes small and unsclerotized	<i>Oregmopyga</i> (in part)
21(20) Anal lobes plate-like, not protruding strongly	<i>Chilecoccus</i> (in part)
– Anal lobes not plate-like, protruding strongly	<i>Acanthococcus</i> and <i>Madarococcus</i>
22(17) Venter with tubular ducts; dorsum without simple pores; cruciform pores absent	23
– Venter without tubular ducts; dorsum with numerous simple pores; cruciform pores present on venter near body margin	<i>Exallococcus</i>
23(22) Venter with large clusters of tubular ducts; posterior abdomen without sclerotised nodules; anal lobes unsclerotised	<i>Stibococcus</i> (in part)
– Venter with scattered tubular ducts; posterior abdomen with sclerotised nodules; anal lobes heavily sclerotised	<i>Orafortis</i>
24(12) Anal lobes without conspicuous sclerotisation	26
– Anal lobes conspicuously sclerotised	25
25(24) Enlarged setae forming conspicuous band around body margin	<i>Chilechiton</i>
– Enlarged setae not forming conspicuous band around body margin	<i>Chilecoccus</i> (in part)
26(24) Enlarged setae absent or, if present, not grouped in circular area on dorsum of thorax and head	27
– Enlarged setae grouped in circular area on dorsum of thorax and head	<i>Neotectococcus</i> (in part)
27(26) Venter without large clusters of tubular ducts on abdomen	28
– Venter with large clusters of tubular ducts on abdomen	<i>Stibococcus</i> (in part)
28(27) Largest dorsal macroducts without associated setae	29
– Largest dorsal macroducts with 1–3 associated setae	<i>Melzeria</i>
29(28) Some dorsal setae cupolate; without winglike apodemes arising from mouthparts	30
– Dorsal setae not cupolate; with large wing-like apodemes attached to mouthparts	<i>Tectococcus</i> (in part)
30(29) Anal lobes absent; anal ring non-cellular; ducts and pores sparse	<i>Ovaticoccus</i>
– Anal lobes present; anal ring cellular; ducts and pores numerous	<i>Oregmopyga</i> (in part)

Notes: based on the evidence provided by Cook & Gullan (2004), Hodgson & Miller (2010) transferred all species in the Neotropics which were still assigned to *Eriococcus* Targioni Tozzetti to either *Acanthococcus* Signoret or to *Hempelicoccus* Kozár, and provided an appendix which listed the current placement of all South America eriococcid species. However, it was considered that many of these placements would change in the near future. In addition, *Opisthoscelis prosopidis* Kieffer & Jorgensen was considered to be unrecognisable at the present

time but was considered unlikely to belong to the genus *Opisthoscelis*. Thus neither *Eriococcus* nor *Opisthoscelis* is included in the above key. *Ovaticoccus* Kloet is included in the above key because of *Ovaticoccus amplicoxae* Williams & Martin, from Belize. *Ovaticoccus lahillei* (Leonardi) was transferred to *Eriococcus* by González and then to *Acanthococcus* by Hodgson & Miller (2010). Recently, the genus *Madarococcus* Hoy was revised by Hardy et al. (2008) based on nucleotide sequence data and morphology. As part of

this revision, Hardy et al. transferred several species previously included in *Eriococcus* to *Madarococcus*. One effect of this transfer was to make the generic diagnosis of *Madarococcus* difficult due to the lack of diagnostic characters, which is why *Madarococcus* keys out with *Acanthococcus* above.

***Eriogallococcus* gen. nov. Hodgson & Magalhães**

Type species: *Eriogallococcus isaias* sp. nov. Hodgson & Magalhães

Generic diagnosis: Adult female. Unmounted material.

Inducing sharply conical galls on upper surfaces of leaves of host plant but with gall orifice on the lower surface. Gall chamber quite elongate. Body of scale globose, almost round to oval, perhaps broadest across metathorax. Youngest specimens in alcohol pale pink but deep pink when mature. **Mounted material.** Body almost round to slightly egg-shaped. Anal lobes absent. **Dorsum.** Derm membranous on young specimens, but developing a large circular sclerotised area on dorsum of abdomen on mature specimens. Dorsal setae rather few, most abundant posteriorly. Microtubular ducts with a distinctly sclerotised dermal rim, sparse across head, thorax and anterior abdominal segments; absent more posteriorly. Macrotubular ducts absent. Loculate pores, each mainly with 5 loculi; frequent over most of dorsum but few or absent posteriorly. Anal lobes absent. **Margin.** Margin undefined, without differentiated setae. **Venter.** Setae similar to those on dorsum, sparse. Microtubular ducts absent medially but present very sparsely along margin of head; structure similar to those on dorsum. Macrotubular ducts and cruciform pores absent. Loculate pores extending onto venter between spiracles. Antennae appearing to be 3 segmented but setal distribution suggesting perhaps 5 segmented. Clypeolabral shield with a pair of large broad, paddle-like apodemes extending antero-laterally; number of segments in labium uncertain, probably 2, with 3 pairs of setae. Eyespot distinct, laterad to antennae. Spiracles set in a cavity, entire spiracle surrounded by a sclerotised area in oldest specimen. Legs short but moderately well-developed but tibia and tarsus often appearing fused; hind coxae not enlarged and without translucent pores; each trochanter with 1 long and 1 shorter seta on ventral surface; all tibia with 1 seta; tarsi slightly longer than tibiae, each with 2 setae; tarsal campaniform pore present; tarsal digitules capitate; claw digitules capitate, with one significantly broader than other; claws long and slender, each with a small denticle near apex. Anus possibly located on ventral surface, U-shaped, without pores or an anal ring. With a pair of long setae posteriorly. Vulva placed between segments VII and VIII, surrounded by a group of flagellate setae.

Comment. This new genus, *Eriogallococcus*, is immediately separable from all other eriococcid genera known from the Neotropics in that the dorsum of the adult female has abundant loculate pores and develops a large area of sclerotisation on the dorsum of the abdomen when mature. It is currently only known off *Pseudobombax* (Malvaceae) from Minas Gerais, Brazil.

Name derivation. *Eriogallococcus* is composed of the Latin name for the felt scales, namely *Eriococcus*, with “gall” inserted

into the middle. The latter word is derived from the Latin *galla*, f, which refers to a swelling or excrescence on a plant. The name is treated as masculine.

***Eriogallococcus isaias* sp. nov. Hodgson & Magalhães**

Material studied. Holotype ad♀: Brazil, State Park of Sumidouro, Lagoa Santa Municipality, Minas Gerais, on *Pseudobombax grandiflorum* (Malvaceae), 23.ix.2009, Thiago A. Magalhães (UFMG): 1/2 ad♀♀, holotype a young adult specimen before sclerotisation has set in; clearly labelled and nearest to species name label.

Paratypes. Remaining specimen on holotype slide (UFMG) plus 25/10 ad♀♀ (good to poor), 3 ?3rd-instar ♀♀ nymphs (fair to poor), 2 ?2nd-instar ♀♀ nymphs (good/poor), 11 1st-instar nymphs (mainly fair to poor), 9 2nd-instar ♂♂ nymphs (mainly fair), pupa 3 (fair to poor) and 9 adult ♂♂ (fair to good) – all with the same collection data as holotype but collected on various dates in 2009 (BMNH, USNM, UFMG).

Galls. Male and female galls similar in shape and size. Galls green and formed on dorsal surface of leaf. Actual gall rather like a wizard’s hat, tall and narrow, pointed and, when mature, generally bent, 8-12 mm long and 3-5 mm wide at base, generally fattest about half-way along length. Gall orifice on ventral leaf surface in middle of a strongly-developed rounded cone about 2-3 mm wide and 1-1.5 mm tall. Inner chamber quite broad, about 1.5-2 mm wide, with a narrow passage about 2 mm long opening through the outer orifice. Walls of gall quite thick.

Adult female (Fig. 1)

Described from 8 specimens in good to fair condition.

Unmounted material. As for generic diagnosis. Body 1.0-3.0 mm long.

Mounted material. As for generic diagnosis. Body 1.0-2.0 mm long, 0.8-1.65 mm wide. Mature specimens with a large, almost circular, area of sclerotisation on dorsal surface of abdomen.

Dorsum. Derm of youngest specimens entirely membranous but with a large circular sclerotised area developing on dorsum of abdomen in older specimens; sclerotised area 0.83-1.5 mm long and 0.88-1.25 mm wide; intersegmental folds of some older specimens with a line of sclerotisations, perhaps apodemes, between posterior abdominal segments. Dorsal setae rather few, most abundant posteriorly on abdomen and perhaps anteriorly on head but otherwise sparse; most setae fairly short and flagellate, 8-18 µm long but a few longer posteriorly – up to 25-30 µm long. Microtubular ducts, each with a distinctly sclerotised rim on derm, each about 10 µm long, with a central dark line down outer duct; sparse across head, thorax and anterior abdominal segments becoming scarce or absent posteriorly. Macrotubular ducts absent. Loculate pores, each convex and 6-8 µm wide and mainly with 5 loculi; frequent over most of dorsum, perhaps in sparse segmental rows, but absent anteriorly on head and posteriorly on abdomen.

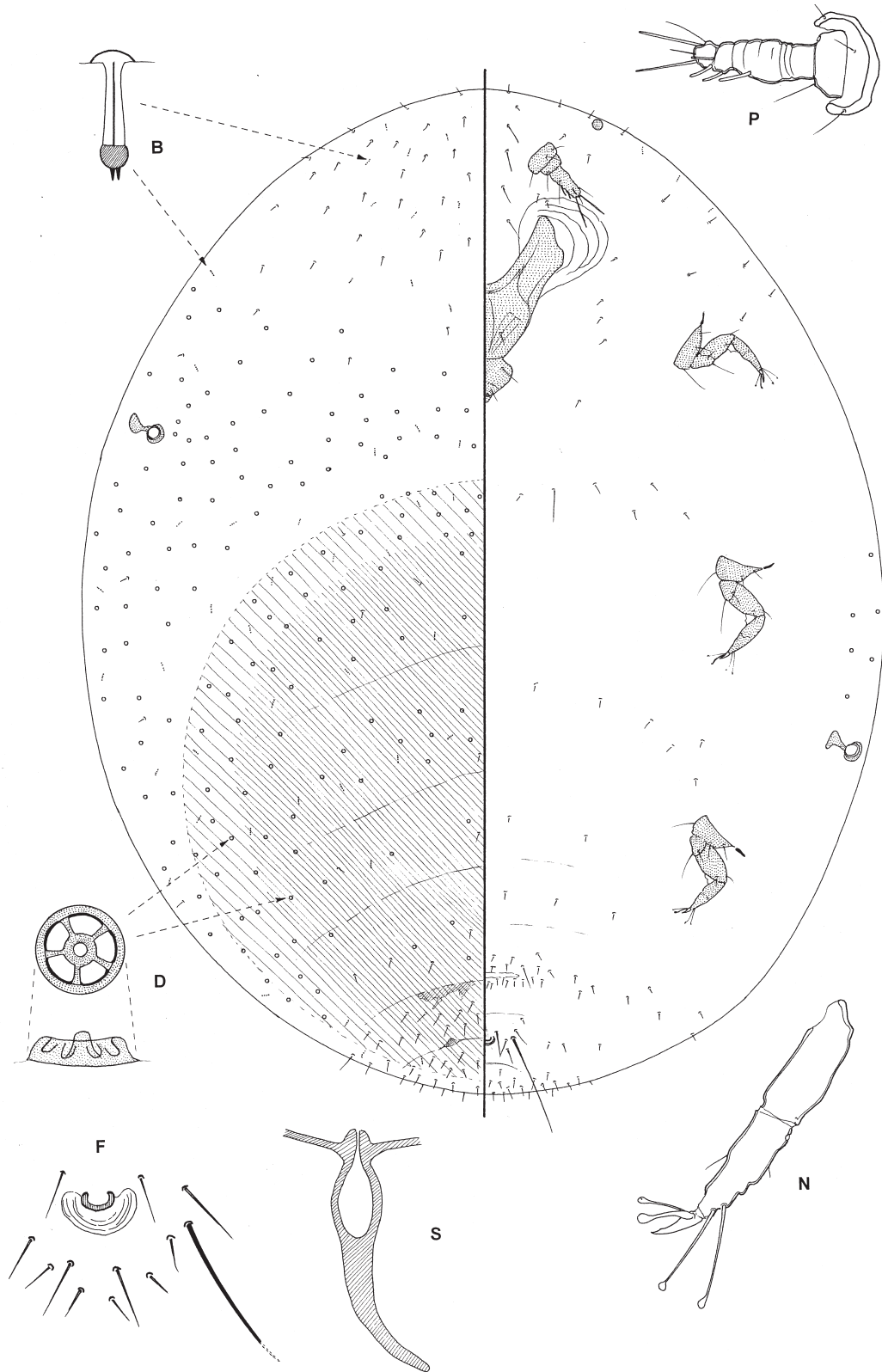


Figure 1 - Adult female of *Eriogallococcus isaias* Hodgson & Magalhães. Where B = dorsal microtubular duct; D = dorsal loculate pore; F = anal area; N = tibia + tarsus of metathoracic leg, P = antenna, and S = section through gall.

Margin. Margin undefined; without differentiated marginal setae. Eyespot distinct, more or less round, 20-22 μm wide on margin laterad to antennae.

Venter. Setae mainly similar to those on dorsum but some longer, up to 65 or 70 μm long; mainly sparse, most abundant anteriorly on head and posteriorly on abdomen; with 4 (or rarely 5) pairs of longer setae in 2 longitudinal lines between antennae. Microtubular ducts absent medially but present very sparsely along margin of head; structure similar to those on dorsum. Macrotubular ducts and cruciform pores absent. Loculate pores, similar to those on dorsum, present near margin, mainly between spiracles.

Antennae appearing to be 3 segmented but setal distribution suggesting perhaps 5 segmented and therefore with apical 3 segments more or less fused; length 85-105 μm ; with 3 setae on scape, 1 on pedicel + campaniform pore; apex of each antenna with 2 very long "stiff" setae, each 38-45 μm . Clypeolabral shield with a pair of large broad, paddle-like apodemes extending antero-laterally; actual shield 125-155 μm long; length of shield + apodemes 180-310 μm ; labium probably 2 segmented, with 3 pairs of setae. Spiracles: width of peritremes: 25-27 μm , set in a cavity 35-40 μm wide; entire spiracle surrounded by a sclerotised area in oldest specimen. Legs short but moderately well-developed but with tibia and tarsus often appearing fused; length of metathoracic leg (μm): coxa 70-90, trochanter + femur 90-105; tibia + tarsus 85-100, claw 16-20; hind coxae not enlarged, without translucent pores, but with 3 setae; each trochanter with 1 long and 1 shorter seta on ventral surface; femur with 2 setae; tibia with 1 seta; tarsi each with 3 setae; tarsal digitules capitate, subequal to length of claw digitules; claw digitules capitate, each claw with one digitule significantly broader than other; each claw long and slender, with a small denticle near apex. Anus possibly located on ventral surface, U-shaped, without an anal ring, width about 28-35 μm ; with, just anteriorly, a pair of longer setae, 25-30 μm long, plus a small group of 3 or 4 setae laterally on each side, each 20-50 μm long; also with one pair of very long setae laterad to anus, each about 130-180 μm . Vulva placed between segments VII and VIII, surrounded by a group of flagellate setae.

Comment. Mature adult females of *E. isaias* are immediately separable from those of all other South American eriococcids due to the presence of the large area of sclerotisation covering the dorsum. However, even young specimens are easily identified by the combination of: (i) moderately well-developed legs and antennae; (ii) dorsum with frequent loculate pores throughout; (iii) absence of macrotubular ducts and cruciform pores, and (iv) the reduced structure of the anus. The adult female of *Dromedaricoccus hansonii* Hodgson & Miller, described as new below, also has a heavily sclerotised area on the dorsum, but can be immediately separated by its elongate shape and absence of dorsal loculate pores.

Second/third-instar females (not illustrated)

Several nymphal specimens were available that were clearly neither 1st-instar nor 2nd-instar male nymphs. One specimen,

which had a non-sclerotised body (suggesting that it might have recently moulted as most nymphs had a clearly sclerotised derm) had single loculate pores laterad to each spiracle and no macrotubular pores. As loculate pores are entirely absent in 1st-instar nymphs, this specimen presumably represents a 2nd-instar female. However, several other specimens (which had a sclerotised derm), also lacked macrotubular ducts (and therefore could not be 2nd-instar males), but had more frequent loculate pores, with some along the margin of the abdomen and a pair of pores dorsally on the prothorax. One of these specimens contained a pharate adult female. This instar, therefore, clearly represents the pre-adult instar. Third-instar female nymphs are presently unknown in the Eriococcidae. It is therefore considered that further specimens should be studied before coming to any conclusion regarding the status of these specimens.

Second-instar male (Fig. 2)

Described from 5 specimens in fair to poor condition.

Unmounted material. Body egg-shaped, broadest across anterior abdomen; segmentation rather distinct, particularly on abdomen. Specimens in alcohol slightly pink to deep red.

Mounted material. Length 0.6-0.9, width 0.34-0.5 mm. Anal lobes absent.

Dorsum. Derm sclerotised in oldest specimens but maybe membranous when young; with numerous dermal nodulations, particularly on head and posterior part of abdomen. Dorsal setae rather few, possibly segmentally arranged; setae fairly short and flagellate, each about 10 μm long. Microtubular ducts absent. Macrotubular ducts present sparsely throughout, apparently segmentally arranged; each with a broad, sclerotised outer orifice, about 4.5 μm wide, a long outer ductule (8 μm long) with a cup-shaped inner end and an equally long inner ductule with a small terminal gland. Loculate pores, each convex, 6 μm wide with 5 loculi, frequent marginally and submarginally on abdomen but scarce marginally on thorax and absent on head.

Margin. Margin perhaps defined by a line of short curved setae near margin of dorsal sclerotisation, each about 8 μm long. Eyespot distinct, more or less round, 15-17 μm long on margin laterad to antennae.

Venter. Derm lightly sclerotised but without nodulations. Derm with small dermal spinules present almost throughout. Setae few, mainly similar to those on dorsum, most 13-15 μm long but longer near anus and mesad to meso- and metacoxae, where up to 35 μm long; mainly sparse, most abundant posteriorly on abdomen; also 3 pairs of longer setae in 2 longitudinal lines between antennae, each up to 40 μm long. Microtubular ducts absent. Macrotubular ducts, similar to those on dorsum, present sparsely throughout. Cruciform pores absent. Loculate pores mostly similar to those on dorsum but those nearest spiracles perhaps smaller (5 μm wide); present submarginally on posterior abdominal segments and near each spiracular peritreme.

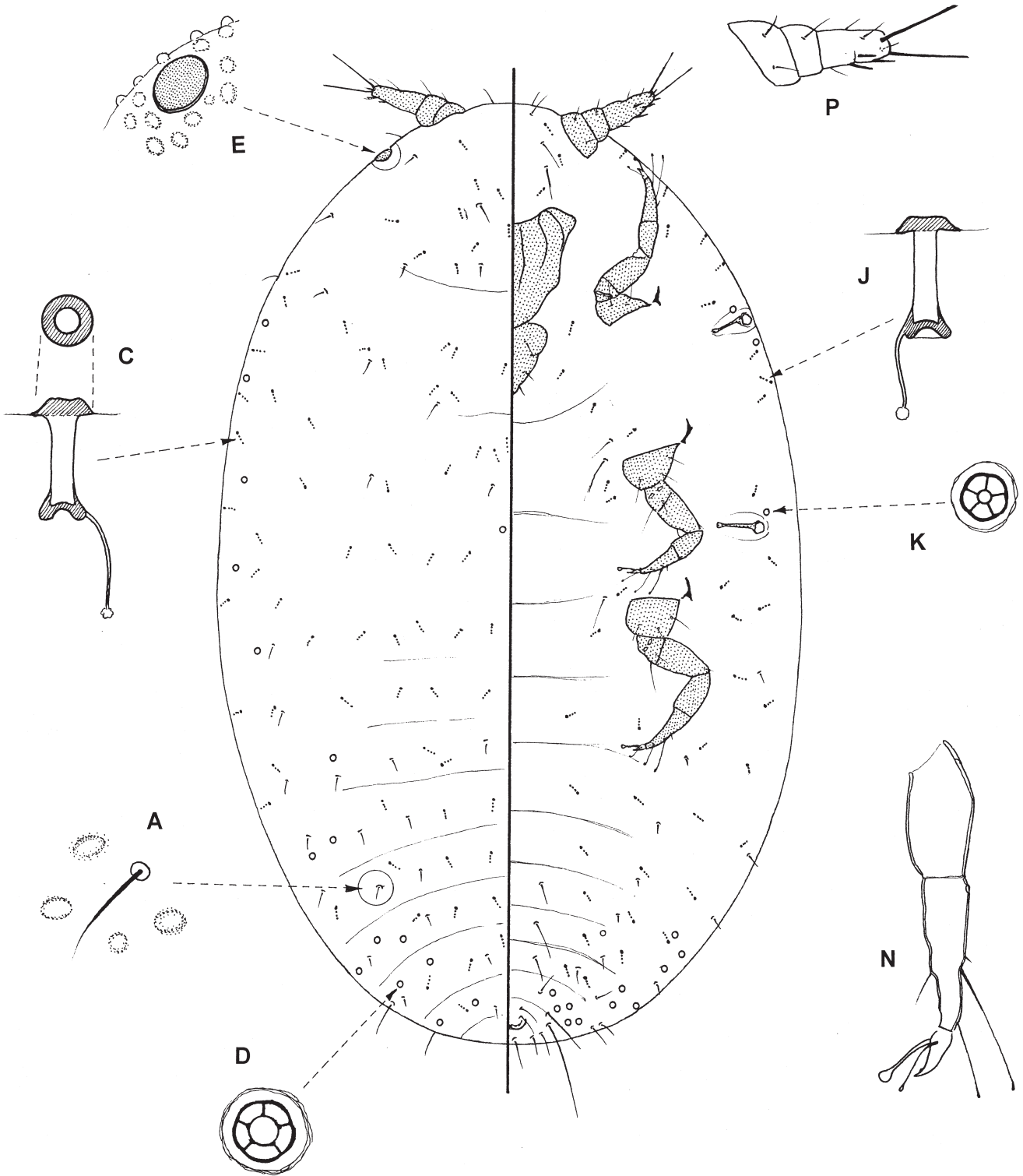


Figure 2 - Second-instar male of *Eriogallococcus isaias* Hodgson & Magalhães. Where A = dorsal seta + dermal nodulations; B = dorsal seta + dermal nodulations; C = dorsal macrotubular duct; D = dorsal loculate pore; E = eyespot with dermal nodulations; F = dorsal seta + dermal nodulations; G = dorsal seta + dermal nodulations; H = dorsal seta + dermal nodulations; I = dorsal seta + dermal nodulations; J = ventral macrotubular duct; K = ventral loculate pore; L = ventral seta + dermal nodulations; M = ventral seta + dermal nodulations; N = tibia + tarsus of metathoracic leg, and P = antenna.

Antennae appearing to be 3 segmented but setal distribution suggesting 5 segments, with apical three segments fused; length 63-66 μm ; with 3 setae on scape, 1 on pedicel + campaniform pore; apex of each antenna with 2 long "stiff" setae, each 28-35 μm . Clypeolabral shield with small antero-lateral apodemes; length of shield 100-125 μm ; labium 2 segmented, with 3 pairs of setae. Spiracles: width of peritremes: 10-12 μm , apodeme long, 20-30 μm long. Legs short but moderately well-developed; length of metathoracic leg (μm): coxa 55-57, trochanter + femur 65-73; tibia 35-43, tarsus (subequal in length to tibia) 36-43; claw 17; hind coxae not enlarged and without translucent pores but probably with 3 setae; each trochanter with 1 long and 1 shorter seta on ventral surface; femur with 2 setae; tibia with 0 or 1 seta; tarsi with 2 or 3 setae; tarsal campaniform pore present; tarsal digitules both capitate, offset, so that one much longer than other, apices subequal in length to those of claw digitules; claw fairly long and slender, each with one digitule significantly broader than other; each claw with a small denticle. Anus possibly located on ventral surface, with a U-shaped sclerotisation, width about 16-18 μm , width of outer sclerotisation 21-23 μm ; with 2 pairs of short setae just anterior to anus plus with a line of 4 setae more anteriorly to anus, most 20-35 μm long; plus further setae posteriorly; long posterior seta about 100-120 μm .

Comment. The 2nd-instar male of *E. isaias* differ from all other instars in having macrotubular ducts and no microtubular ducts; 2nd/3rd-instar and adult females have only microtubular ducts.

First-instar nymph (sex not determined) (Fig. 3)

Described from 4 specimens in fair to poor condition, 3 rather young and one much larger and pharate.

Unmounted material. Body oval; segmentation rather distinct, particularly on abdomen. Specimens in alcohol deep red.

Mounted material. Length 0.32-0.62, width 0.17-0.40 mm. Anal lobes short but distinct on youngest specimens but disappearing as body swells so that no lobes are apparent on oldest specimen.

Dorsum. Derm distinctly sclerotised even on young specimens; young specimens with numerous dermal nodulations throughout, nodulations largest and most distinct posteriorly and along margins; old specimen much swollen and nodulations absent although still indicated by darker oval areas on derm. Dorsal setae rather few, apparently segmentally arranged, each short with a blunt apex and about 4-5 μm long. Microtubular ducts, each about 7 μm long, present although distribution uncertain, but with 2 pairs on abdominal segment 1 and on meso- and metathorax, perhaps only 1 pair on prothorax and 2 pairs on head. Macrotubular ducts and loculate pores absent. Anal lobes present on either side of anus of youngest specimen, each about 15 μm long, each with a long anal lobe seta, 60-65 μm long.

Margin. Margin indicated by a major reduction in the size of the dermal nodulations and the presence of a sparse line of

marginal setae, each curved posteriorly and about 5 μm long. Eyespot more or less round, 12-14 μm wide on margin laterad to antennae.

Venter. Derm sclerotised but less so than dorsum and without nodulations except perhaps along margins. Derm with small dermal spinules present at least posteriorly. Setae few and setose, most about 10 μm long but with a few longer, those anterior to anus and mesad to metacoxae about 15 μm long, those mesad to mesocoxae longer, about 30 μm and 3 pairs of interantennal setae up to 30 μm long. Micro- and macrotubular ducts and loculate and cruciform pores absent.

Antennae appearing to be 3 segmented but setal distribution suggesting perhaps 5 segmented, with apical 3 segments semi-fused; length 45-52 μm ; with 3 setae on scape, 1 on pedicel + campaniform pore; apex of each antenna with 2 long "stiff" setae, each 35-50 μm long. Clypeolabral shield without antero-lateral apodemes; length of shield 105-125 μm ; labium apparently 2 segmented, with 3 pairs of setae. Spiracles: width of peritremes: 10-12 μm , apodeme possibly absent. Legs short but moderately well-developed; length of metathoracic leg (μm): coxa 30-35, trochanter + femur 43-50; tibia 19-20, tarsus (clearly much longer than tibia) 26-29; claw 13-14; coxa probably with 3 setae; each trochanter with possibly only 1 long seta on ventral surface; tibia with 0 or 1 seta; tarsi each with 2 setae; tarsal campaniform pore present; tarsal digitules offset, one much longer than other and extending past claw digitules, longer digitule capitate, other flagellate; claw fairly long and slender, each with one digitule significantly broader than other; each claw with a small denticle. Anus possibly located on ventral surface, U-shaped, without an anal ring, width about 5 μm ; setae around anus probably distributed as on adult female; each anal lobe with one long seta about 55 μm long.

Comment. First-instar *Eriogallococcus isaias* are unusual for 1st-instar nymphs of scale insects in having the derm of both surfaces somewhat sclerotised. Other significant characters are: (i) antennae reduced; (ii) dermal nodulations present throughout dorsum; (iii) presence of two long "stiff" setae on apex of each antenna; (iv) presence of microtubular ducts on dorsum (but absent from venter); (v) presence of a pair of short anal lobes on youngest specimens; (vi) anus reduced to a small U-shaped structure; (vii) tarsal digitules on all legs very different, with one very long and capitate, other much shorter and setose, and (viii) claw digitules dissimilar.

In the key to 1st-instar nymphs of South American eriococcids in Hodgson & Miller (2010), the nymphs of *E. isaias* key out (more or less!) to couplet 2 and to *Tectococcus Hempel*. However, the nymphs of these two genera are easily separable as follows (character-states on *T. ovatus* Hempel in brackets): (i) all dorsal and marginal setae setose (marginal and medial lines of dorsal setae all cupolate); (ii) loculate pores absent (loculate pores present on venter associated with spiracles); (iii) microtubular ducts absent from venter (present along ventral margins); (iv) claw digitules dissimilar (similar, both narrow); (v) tarsal digitules not both capitate (both capitate), and (vi) apex of antennae each with 2 very long "stiff" setae (setae all much shorter).

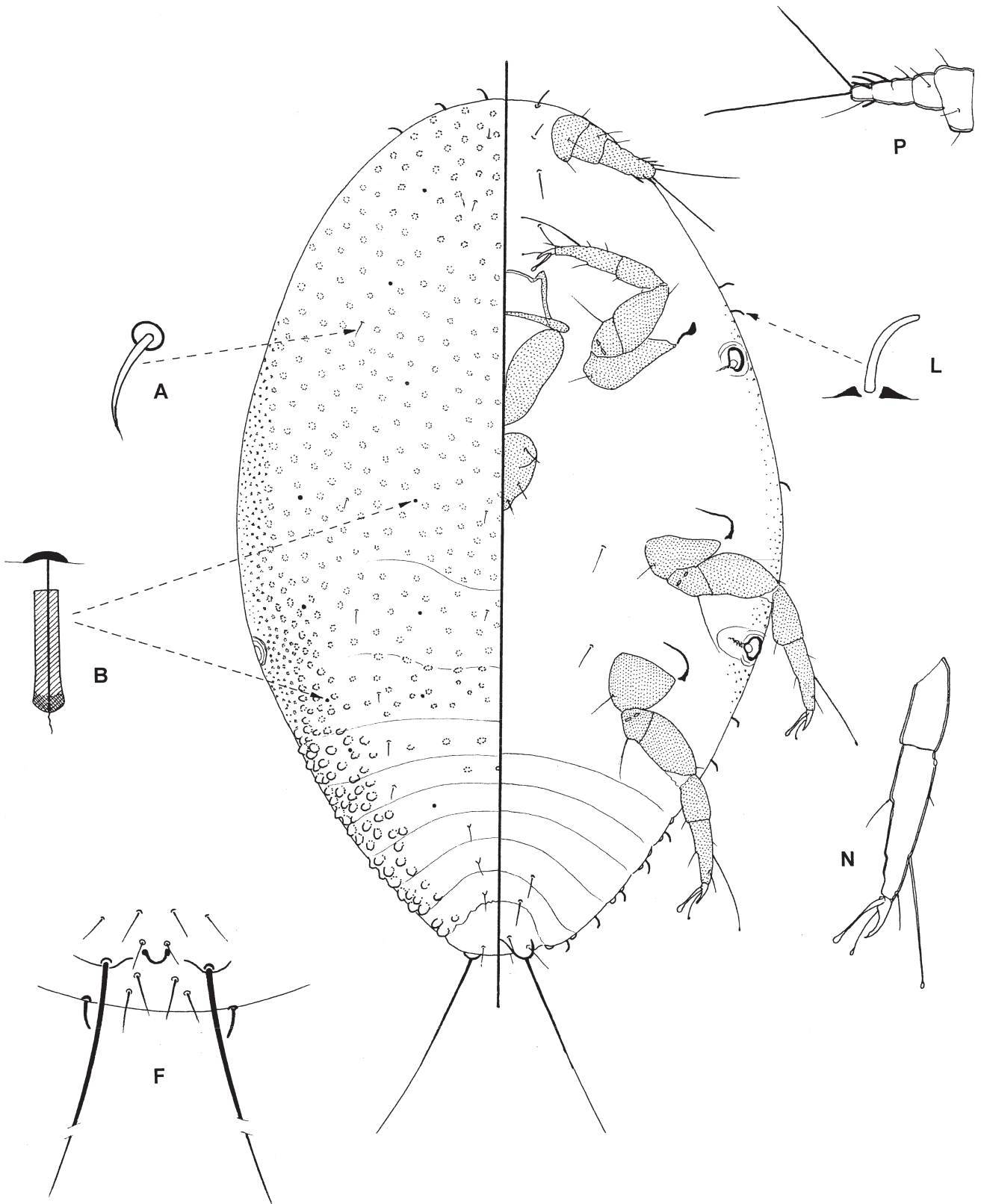


Figure 3 - First-instar nymph of *Eriogallococcus isaias* Hodgson & Magalhães. Where A = dorsal seta; B = dorsal microtubular duct; F = anal area; L = marginal seta; N = tibia + tarsus of metathoracic leg, and P = antenna.

Pupa (Fig. 4)

(Described from 3 specimens, 1 in fair condition, 2 poor, broken in half.)

Unmounted material: pupa (and adult male) covered in a rather sparse felt test, penial sheath extending posteriorly out of felt coat. Material in alcohol colourless to pale pink.

Mounted material: body rather elongate, 1.38 mm long. Derm membranous apart from lightly sclerotised penial sheath. Head fairly clearly demarcated but division between thorax and abdomen unclear. Penial sheath unusually long and blunt.

Head: about 235-270 μm widest; without eyes or mouthparts. Antennae obscurely 5 segmented, each about 290-320 μm long. With 3 pairs of small setae on ventral surface between antennae and 5 pairs dorsally plus 1 or 2 pairs laterally.

Thorax: legs short, anterior pair not reaching anterior margin of head; metathoracic legs each about 360-460 μm long; without setae. Mesothoracic wing buds well developed, each about 400 μm long and 135-155 μm wide; metathoracic wing buds absent. Spiracles small, width of anterior peritremes 18-21 μm wide; without spiracular loculate pores. Setae sparse on both surfaces.

Abdomen: caudal extensions on segment VII absent, those on segment VIII rounded, with a single longer seta about 25-28 μm long, plus a short seta 8-15 μm long. Each abdominal segment with a sparse band of about 4 short abdominal setae both dorsally and ventrally; also with 1 or 2 short dorsal pleural setae and 1 short ventral pleural seta on each side.

Segment IX fused to penial sheath, cylindrical and lightly sclerotised, with anus on dorsal surface. Penial sheath together with abdominal segment IX forming a nearly parallel-sided cylinder extending from posterior end of abdomen; total length about 190-200 μm and width 115-130 μm at base and 70-75 μm wide at apex. Penial sheath with 1 or 2 pairs of small setae on apex, each about 8-16 μm long, plus a sclerotised triangular structure about 30-35 μm long and 35-38 μm wide at base, slightly constricted apically, where possibly bifid, apex about 8 μm wide.

Comment. The homologies of the parts of the “penial sheath” are uncertain. The anterior part appears to relate to abdominal segment IX; the triangular structure *might* be the penial sheath proper – which leaves the intermediate part (more than half its length) uncertain. However, although the penial sheath of male eriococcids appears always to be composed of abdominal segment IX fused with the actual penial sheath, the structure of this penial sheath appears to be unique for an eriococcid pupa. In all other known eriococcid pupae, the penial sheath is more or less pointed quite unlike the rather cylindrical structure in *E. isaias*.

Adult male (Fig. 5)

(Described from 6 specimens, all fair to poor, several missing antennae).

Mounted material: of moderate size, total body length 1.5-1.8 mm; antennae short, 5-segmented, only about 1/4th

total body length; body fairly setose, fleshy setae (fs) difficult to separate from hair-like setae (hs) but generally longer and less finely pointed (fs 15-27 μm long; hs 10-15 μm long) - due to similarity, most setae not differentiated in text below; length of fs on antennae shorter than width of antennal segments. Wings about 0.65 total body length and about 0.4 as wide as long.

Head: rather pointed anteriorly in dorsal view, but clearly bulbous ventrally; length 155-180 μm ; width across genae about 200-223 μm . Median crest (mc) poorly demarcated, not reticulated but slightly ridged; postoccipital ridge (por) distinct, with quite strong posterior ridges and weaker anterior ridges; with many dorsal head setae (dhs), perhaps mainly fs; pores absent. Mid-cranial ridge absent; ventrally derm with longitudinal microridges and with 2-4 ventral mid-cranial ridge setae (vmcrs) on each side. Genae (g) not reticulated but each with 1-4 hs genal setae (gs). Simple eyes (se): two pairs, each round and subequal in size, 40-50 μm wide. Ocelli (o) quite large, very convex and placed laterally, each 14-16 μm wide, situated just dorsad to where interocular ridge (ior) extends anteriorly. Ocular sclerite (ocs) sclerotised and dorsally lightly reticulated between ocelli and dorsal simple eyes. Preocular ridge (procr) short dorsally but with an interocular ridge (ior) extending posteriorly and fusing with postocular ridge (pocr) ventral to each ocellus. Postocular ridge (pocr) strongly developed, extending dorsally past posterior margin of each dorsal eye, almost reaching postoccipital ridge (por) medially. Dorsal ocular setae absent. Ventral head setae (vhs) numerous, perhaps mainly fs, present both between ventral simple eye (vse) and around anterior and lateral margins of each vse. Tentorial bridge absent. Cranial apophysis (ca) finger-like and blunt, about 45 μm long.

Antennae: 5-segmented and filiform; each 320-385 μm long (ratio of total body length to antennal length 1:0.21). Scape (scp): 35-39 μm long and 40-46 μm wide, with 2 or 3 hs ventrally and 1 hs dorsally. Pedicel (pdc): length 33-46 μm , width 33-40 μm , with distinct annular reticulations; with about 4 fs, 8 hs + (probably) 1 campaniform pore; fs about 11-24 μm long. Segment III 133-155 μm long, broadest distally (about 15 μm wide basally and up to 30 μm wide distally), with a short finger-like extension on apex; with about 23 setae + (possibly) 1 antennal bristle (ab) but latter very similar to fs; segment IV similar in shape to III but much shorter, about 48-85 μm long, with about 18 fs, 1 hs and perhaps an antennal bristle (ab) (very similar to fs); apical segment (V) rounded apically, about 95-108 μm long, with about 16 fs, 3 large and distinct ab + perhaps 2 or 3 smaller ab (similar to fs), 7-11 capitate setae (caps) + 1 sensilla basiconica.

Thorax. Prothorax: pronotal ridge (prnr) well developed and not fused dorsally; with a broad, slightly striated, triangular, lateral pronotal sclerite (prn); without lateral pronotal setae. With 1 pair of medial pronotal setae (mps). Post-tergital setae absent. Post-tergites not detected. Sternum (stn₁) not sclerotised but with slight, almost circular, striations; with a strong transverse ridge; median ridge short or absent; with 3-5 fs prosternal setae (stn₁s) + 1 or 2 anteprosternal setae (astn₁s). Antemesospiracular setae absent.

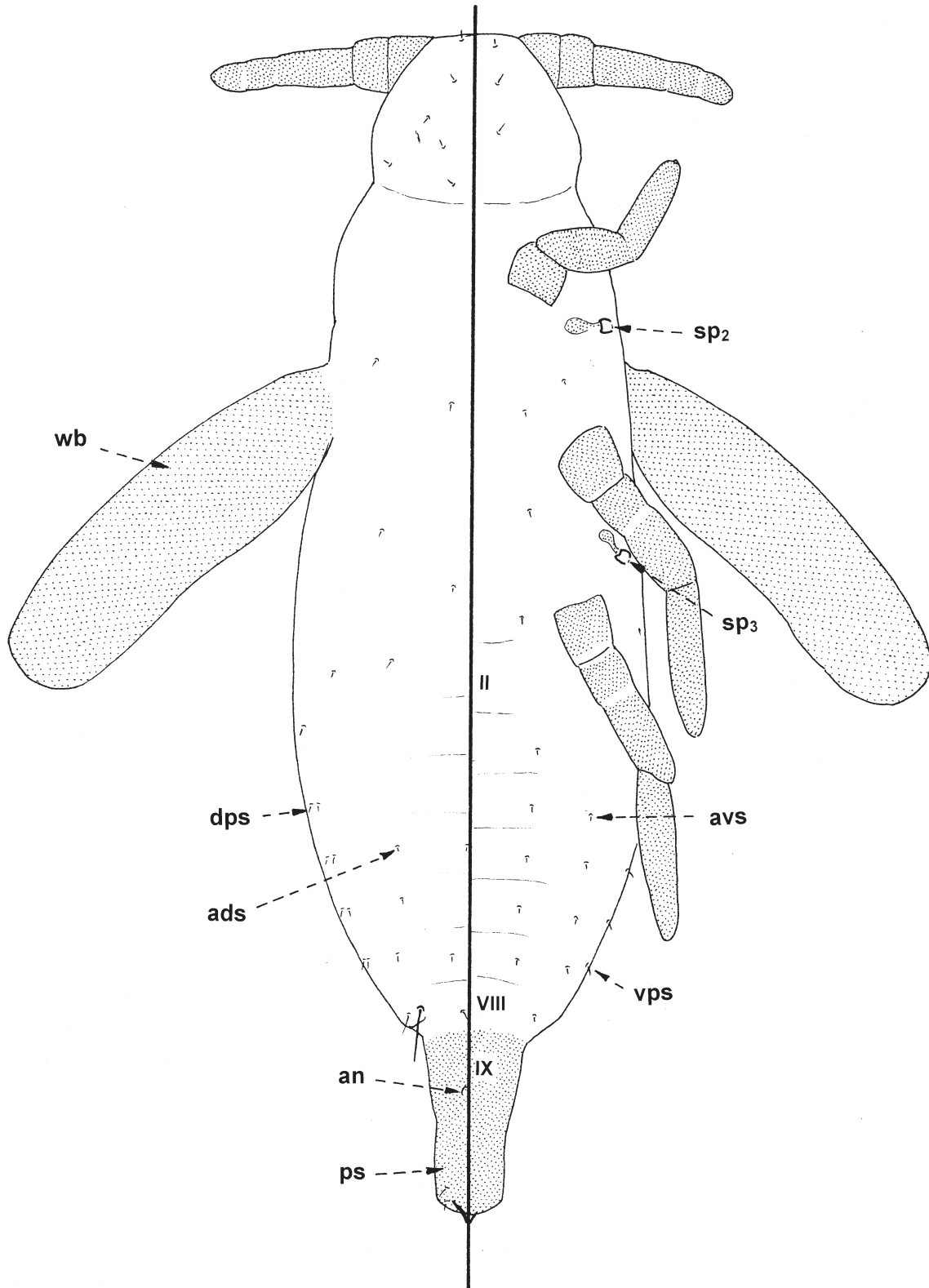


Figure 4 - Pupa of *Eriogallococcus isaias* Hodgson & Magalhães. Where an = anus, ads = dorsal abdominal setae; avs = ventral abdominal setae; dps = dorsal pleural setae; ps = penial sheath; sp₂, sp₃ = anterior and posterior spiracles; vps = ventral pleural setae, and II, VIII and IX = abdominal segments II, VIII and IX.

Mesothorax: prescutum (prsc) transversely oval, 95-125 µm long and 150-180 µm wide; sclerotised but not reticulated; with 5-7 prescutal setae (prscs); prescutal ridges (pscr) and prescutal suture (pscs) well developed. Scutum (sct): median area sclerotised but not reticulated, distance between prescutum and scutellum about 33-55 µm; scutal setae (scts) 0 or 1 pair; lateral margins sclerotised but not reticulated; prealar ridge (prar) weak. Scutellum (scl) 135-165 µm wide and 58-75 µm long; with an inverted U-shaped scutellar ridge (sclr); probably not tubular and lacking a foramen; scutellar setae (scls): 0 or 1 pair hs; posterior notal wing process (pnp) quite long and sclerotised. Basisternum (stn₂) 210-305 µm wide and 130-145 µm long; median ridge absent, but bounded anteriorly by a moderately strong marginal ridge (mr) and posteriorly by strong precoxal ridges (pcr₂); with many basisternal setae (stn₂s); lateropleurite (lpl) narrow, poorly defined and without an extension from marginal ridge along anterior margin; furca (f) well developed, narrow-waisted, arms very divergent and extending almost to anterior marginal ridge (much shorter on 1 specimen). Mesopostnotum (pn₂) well developed; postnotal apophysis (pna) well developed and opening quite large. Area bounded anteriorly by scutellum and laterally and posteriorly by mesopostnotum not sclerotised. Mesepisternum (eps₂) not reticulated; subepisternal ridge (ser) well developed. Postalare (pa) well developed; without postalare setae. Mesothoracic spiracle (sp₂): width of peritreme 22-27 µm. Postmesospiracular setae (pm₂s) abundant in an elongate group extending across segment between spiracles; perhaps mainly fs. Tegula (teg) present, rarely with 1 tegular setae.

Metathorax: with 1 or 2 pairs hs metatergal setae (mts). Dorsospiracular setae (dss): about 4 on each side. Metapostnotum absent or small, poorly sclerotised. Dorsal part of metapleural ridge absent, ventral part (plr₃) well developed; episternum unsclerotised, with 5-10 postmetaspiracular setae (eps₃) on each side; precoxal ridge (pcr₃) absent. Metepimeron (epm₃) quite long, without setae. Antemetaspiracular setae absent. Metathoracic spiracle (sp₃): width of peritreme about 23-25 µm. Metasternum membranous, with 3-10 anterior metasternal setae (amss) and 20-30 posterior metasternal setae (pmss).

Wings: hyaline, about 1.0-1.4 mm long and 425-475 µm wide (ratio of length to width 1:0.38; ratio of total body length to wing length 1:0.73); alar lobe, alar sensilla and alar setae absent. Hamulohalteres absent.

Legs: metathoracic leg marginally longest. Coxae (cx): I: 95-112; II: 82-100; III: 103-115 µm long; coxa III with about 10-15 fs + 3-6 hs. Trochanter (tr) + femur (fm): I: 185-210; II: 203-220; III: 220-245 µm long; trochanter III with 0-6 fs + 2 hs; long trochanter seta about 55-60 µm long; femur III with about 23-30 fs + 2 or 3 hs. Tibia (ti): I: 130-165; II: 140-180; III: 145-185 µm; tibia III with a total of about 25-30 setae, mainly hs, a few becoming spur-like on distal third of leg, plus 1 or 2 fs on dorsal surface distally; apical spurs (tibs) not differentiated but setae in this position 28-30 µm long. Tarsi (ta) 1 segmented: 60-88; II: 75-90; III: 86-108 µm long (ratio of length of tibia III to length of tarsus III 1:0.6); tarsus III with 18-25 setae, mainly spur-like, but some on dorsal surface fs; tarsal spurs barely

differentiated, each 30 µm long; tarsal campaniform pore (tcp) present; tarsal digitules (tdt) distinctly longer than claws, without apical knobs. Claws (c) quite long and rather straight, subequal to width of tarsi, with a distinct small denticle; length: III: 21-25 µm; claw digitules (cdt) longer than claw, dissimilar, one clearly broader than other, both with apical knobs.

Abdomen: segments I-VII: tergites (at) and sternites unsclerotised; without obvious oval membranous areas in inter-segmental membranes. Caudal extension of segment VII absent. Dorsal setae (ads) (totals, mainly fs): segments I & II 2-4; III-VII 8-16, each about 25-27 µm long. Pleural setae: dorsopleural setae (dps): 1-3, mainly hs; ventropleural setae (vps) (on each side, mainly fs): III-VI 1; VII 0-5. Ventral setae (avs) (totals, mainly fs): II-VII 15-25, each up to 45 µm long. Segment VIII: with a lightly sclerotised tergite (at) but no sternite; with 8-12 ante-anal setae dorsally, mainly fs; sternite with 10-15 ventral abdominal setae (avs) on each side; caudal extension (ce) rounded, with 1 long hs pleural seta (length 35-40 µm) + 1 short seta (about 40 µm long). Glandular pouches (gp) present, rather deep; each without loculate pores around outer margin of pouch; glandular pouch setae (gts) each about 80-100 µm long.

Genital segment: total length of penial sheath (ps) 500-555 µm long (ratio of total body length to length of penial sheath + segment IX 1:0.33); divided into two parts: anterior section (segment IX?) sclerotised, broad (width at base 105-125 µm, approximate length 95-100 µm); anal opening posteriorly on dorsal surface; some specimens with a single long seta dorsally, about 35-40 µm long. Posterior part (penial sheath proper?) very long, 450-460 µm long and 50-55 µm wide at base, almost parallel sided with a pointed apex; sclerotised; with 4 or 5 long setae, each 40-60 µm long, near apex. Aedeagus (aed) long, almost as long as posterior part of penial sheath; length 400-460 µm, and narrow, 8-10 µm wide throughout most of length. Basal rod (bra) short, perhaps 25-28 µm long. Penial sheath with a few small sensilla (pss) near apex.

Comment: the adult male of *E. isaias* is immediately separable from the males of other eriococcid genera known from the Neotropics in having: (i) only 5-segmented antennae; (ii) an extremely long, fine penial sheath, and (iii) 0 or 1 tegular setae. Other significant characters are: (i) only one tarsal segment (otherwise only known in *Dromedaricoccus hansonii* Hodgson & Miller, described as new below); (ii) fleshy and hair-like setae very similar (otherwise known in *Capulinia sallei* Signoret); (iii) a denticle on the claw (otherwise known on *Tectococcus ovatus* Hempel and *D. hansonii*); (iv) capitate setae restricted to apical antennae segment only (as on *C. sallei* and *D. hansonii*); (v) no dermal pores (as on *Pseudotectococcus anonae* Hempel, *C. sallei* and *D. hansonii*); (vi) tibial spurs not differentiated from other spur-like setae on tibia (as on *D. hansonii*), and (vii) antennal setae shorter than width of segment (also on *D. hansonii*). From the above comparisons, *E. isaias* would appear to be most similar to *D. hansonii* but the latter has a very short penial sheath, 6-segmented antennae, extremely short and setose tarsal digitules, and several tegular setae.

General Biology. *Pseudobombax grandiflorum* is a deciduous plant and is totally free of leaves from March to

August. In the Gruta da Lapinha region in the State Park of Sumidouro, Minas Gerais State, Brazil, the galls start developing shortly after bud-burst in August and September when they become heavily infested with the galls of *E. isaias*, which are induced in the lower surface of the young leaflets. Their development is concomitant with leaf sprouting until maturation. The galls grow in about 30-40 days, are light green, glabrous, intralaminar, with an aciculate projection to the upper surface, and an open ostiole to the lower surface. No sexual dimorphism could be found in gall structure, and just one inducer occurs in each chamber. *E. isaias* is univoltine, and the

male insects emerge from the galls to copulate with the females which are sessile and stay inside the gall. The first-instar nymphs or crawlers hatch inside the galls, exit through the ostiole and disperse in November and December, but the site where they hibernate has not been determined. A new gall cycle coincides with bud-burst the following year.

Etymology. This species name *isaias* is in honour of Professor Rosy M.S. Isaias, Departamento de Botânica, Universidade Federal de Minas Gerais, who has now discovered two new species of gall-inducing Eriococcidae from Minas Gerais.

Key to instars of *Eriogallococcus isaias*

- | | | |
|----|---|------------------------|
| 1. | Wings or wing-buds present | 2 |
| – | Wings or wing-buds absent | 3 |
| 2. | Fully-developed wings present; head with 2 pairs of simple eyes | adult male |
| – | Wings only represented by wing buds; head without simple eyes | pupa & prepupa |
| 3. | Macrotubular ducts present; microtubular ducts absent | 2nd-instar male |
| – | Macrotubular ducts absent; microtubular ducts present | 4 |
| 4. | Loculate pores frequent over entire dorsum, with more than 30 pores | adult female |
| – | Loculate pores absent or with fewer than 30 pores | 5 |
| 5. | Loculate pores entirely absent | 1st-instar nymph |
| – | Loculate pores present at least near each spiracular peritreme | 2nd-/3rd-instar female |

Dromedaricoccus gen. nov. Hodgson & Miller.

Type species: *Dromedaricoccus hansonii* sp. nov. Hodgson & Miller

Generic diagnosis. Adult female (Fig. 6). An eriococcid inducing spherical galls on young stems, petioles and particularly leaflets of host plant. **Mounted material.** Adult female with head and thorax round and swollen, narrowing abruptly to a long narrow abdomen, posterior segments of which concertina into more anterior segments. Derm mainly membranous but with a heavily sclerotised boss or hump mediodorsally approximately on metathorax. **Dorsum.** Setae all rather small, often curved; frequent throughout on head and thorax (including dorsal boss) but scarce on narrow abdomen. Macro- and microtubular ducts absent. Loculate pores absent. With a group of sclerotised pores just anterior to anal ring. Anal lobes absent. Anus present just anterior to posterior apex of abdomen, without anal ring setae or pores. **Margin.** Not demarcated. **Venter.** Derm membranous apart from near spiracles and around mouthparts. Setae as on dorsum. Macrotubular ducts absent. Microtubular ducts present anteriorly on head and laterally on at least prothorax. Loculate pores each with mainly 5 loculi; most abundant in a broad line between anterior and posterior coxae, and extending a long way laterally; a few possibly present on head between procoxae and antennae. Antennae probably 6 segmented, segmentation weakly demarcated, all segments ring-like. Frontal lobes absent. Clypeolabral shield quite small but embedded in a strongly sclerotised area of unusual shape; labial segmentation unclear, perhaps 2 segmented, possibly with only 2 pairs of setae on

apex. Spiracles each with a large U-shaped area of sclerotisation around peritreme on margin side. Legs all short and distorted, but apparently with all segments; claw rather variable in size, sometimes with a small denticle; claw digitules capitate and longer than claw. Vulva not detected.

Generic name derivation: *Dromedaricoccus* is composed of *dromedarius* (m), Latin for one-humped camels, here referring to the sclerotised hump or boss on the dorsal surface, and *Coccus*, a word frequently used to describe scale insects. The name is treated as masculine.

Dromedaricoccus hansonii nov. sp. Hodgson & Miller

Material examined. Holotype ♀: **Costa Rica**, in galls on *Astronium graveolens* (Anacardiaceae) - .xi.1999, J. Lobo & Paul Hanson (USNM): 1/3 ad♀♀ (holotype ad♀ left specimen on slide along with 2 adult paratype ♀♀ in fair to good condition (USNM)). Also: Paratype ♀♀ with same collection data: 6/9 ad♀♀ (in fair to good condition but most somewhat twisted) + 8 ad♂♂ (in fair to good condition) (BMNH, BME, USNM).

Adult female (Fig. 6)

Unmounted material. Unknown.

Mounted material. Total length 3.0–4.5 mm, length of narrow abdomen 1.5–2.5 mm; greatest width 1.5–2.0 mm. Head and thorax round and swollen as in generic diagnosis. Derm

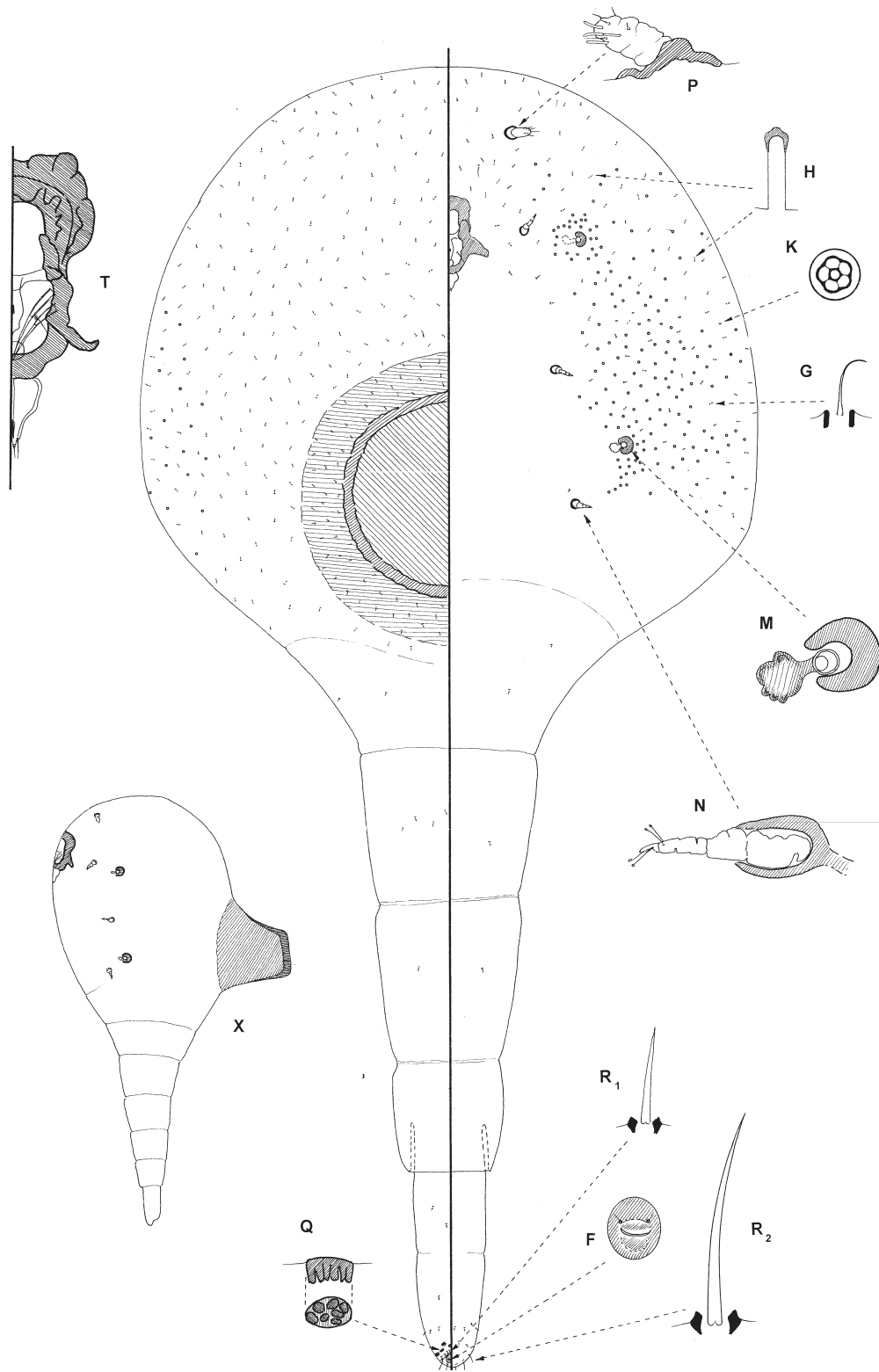


Figure 6 - Adult female of *Dromedaricoccus hansonii* Hodgson & Miller. Where F = anus; G = seta; H = ventral microtubular duct; K = ventral loculate pore; M = posterior spiracle; N = metathoracic leg; P = antenna; Q = pores near anus; R₁, R₂ = setae near anus; T = one side of mouthparts; X = side view of adult female, showing "hump".

mainly membranous but with a heavily sclerotised boss or hump mediadorsally approximately on metathorax, flattish on some (younger?) specimens and highly convex on others, basal width about 790–990 µm, greatest height about 670 µm and width of dorsal “plateau” about 445–480 µm.

Dorsum. Derm mostly membranous, segmentation obscure apart from on narrow abdominal region. A heavily sclerotised boss present medially, probably on metathorax, as described above. Dorsal setae small, often curved, each 9–10 µm long; frequent throughout on head and thorax (including dorsal boss) but scarce on narrow abdomen; setae immediately around anus rather larger, mainly 23–28 µm long but some up to 35 µm along posterior margin of abdomen. Macro- and microtubular ducts absent. Dorsal pores restricted to a group of 5–8 oval, sclerotised pores just anterior to anal ring, each 11–16 µm long and about 7 µm wide; other pores absent. Anal lobes absent. Anus present just anterior to posterior apex of abdomen, without anal ring setae or pores; appearing rather similar to anal ring of *Cryptococcus*; oval, about 40–42 µm long and 30–37 µm wide, appearing to have a transverse slit with a small seta on either side; presence of other setae perhaps variable but possibly with a small pair at posterior end.

Margin. Margin not demarcated and without marginal setae. Eyespots apparently absent.

Venter. Derm membranous apart from sclerotised areas near spiracles and around mouthparts. Setae as on dorsum; with 1 pair of interantennal setae, each about 21–30 µm long. Macrotubular ducts absent but microtubular ducts present anteriorly on head and laterally on at least prothorax; each small, about 6.5 µm long and about 1 µm wide, with a dark inner end; apparently without a dark, longitudinal inner line. Loculate pores each about 6.5 µm wide, with mainly 5 loculi (range 3–about 10) and a heavily sclerotised margin; most abundant in a broad band between anterior and posterior coxae, and extending a long way laterally; a few possibly present on head between procoxae and antennae.

Antennae probably 6 segmented, segmentation weakly demarcated, all segments ring-like, length 50–60 µm; scape perhaps quite wide; apex with at least 4 fleshy setae + some setose setae. Clypeolabral shield quite small, about 100–110 µm long, but apparently embedded in a strongly sclerotised area of unusual shape (see Fig. 7T), 250–285 long and 200–235 wide at anterior end; labial segmentation unclear, perhaps 2 segmented, possibly with only 2 pairs of setae on apex. Spiracles each with a large U-shaped area of sclerotisation around peritreme on margin side, each about 50 µm wide; inner peritreme 20–22 µm wide; muscle plate + peritreme each about 65–70 µm long. Legs all short and distorted, but apparently with all segments; claw rather variable in size, from 10–22 µm long, sometimes with a small denticle; tarsal digitules capitate but generally shorter than claw; claw digitules capitate and longer than claw; translucent pores absent. Vulva not detected on any specimen.

Comment. *Dromedaricoccus* is a monotypic genus only known from Costa Rica. The adult female of *D. hansonii* can be immediately recognised by the general shape of the body and the circular, dome-shaped sclerotisation medially on the dorsum of

the mesothorax. In addition, (i) the abdomen is drawn out into a narrow tube; (ii) the legs and antennae are much reduced; (iii) there are no anal lobes; (iv) the anal ring is a sclerotised area, perhaps with 2 small setae laterally; and (v) each spiracle has a C-shaped area of sclerotisation laterally around the spiracular opening. No other eriococcid genus has this combination of features in the adult female.

Adult male (Fig. 7)

Described from 8 specimens in mainly good condition. For abbreviations, see Fig. 5.

Mounted material: total body length about 0.95–1.05 mm; antennae short, about 1/4th total body length; body setose, particularly on head and venter; fleshy setae (fs) each about 16–18 µm long, often curved, not always easy to separate from fine hair-like setae (hs); hs mainly about 8–10 µm long but some as long as fs; short, stout fs absent. Loculate pores entirely absent. Wings without either alar setae or sensilla. Hamulohalteres absent. Tarsi 1 segmented; tarsal digitules setose. Glandular pouches and glandular pouch setae present.

Head: approximately oval to almost round in dorsal view; width across genae about 200–205 µm; length of head about 165–175 µm. Median crest (mc) represented by a faint ridge extending anteriorly from post-occipital ridge (por); not reticulated; por distinct, extending laterally and slightly posteriorly; anterolateral arms absent; dorsal head setae (dhs) abundant, mainly fs, but dhs absent between dorsal simple eyes (dse) and postocular ridge (pocr); head without pores. Mid-cranial ridge absent both dorsally and ventrally. Gena not reticulated, with 15 or 16 fs + 2–7 hs genal setae (gs). Eyes: with 2 pairs of round, simple eyes, subequal in size, each about 30 µm wide. Ocelli (o) each 16–18 µm wide, not touching postocular ridge (pocr). Ocular sclerite (ocs) barely sclerotised; reticulations barely visible, only obvious immediately around each simple eye. Preocular ridge (procr) extremely short, represented only by an articular sclerite laterad to each scape; but also with a faint line extending posteriorly over dorsal simple eye (dse) to por (possibly an interocular ridge). Postocular ridge (pocr) strongly developed, extending dorsally to about level with dorsal margin of each dse. Ventrally with abundant ventral head setae (vhs), mainly fs, extending anteriorly to head apex and also around and between ventral simple eyes (vse) posteriorly. Preoral ridge distinct. Cranial apophysis (ca) distinct, pointed, about 33 µm long. Mouth (mth) apparently present rather far posteriorly (almost between anterior coxae), with a pair of small lateral pores, perhaps tentorial pits.

Antennae: 6 segmented and filiform (occasionally apical 3 or 4 segments variously fused), segment III longest; length about 250 µm long (ratio of total body length to antennal length 1:0.25). Scape (scp): 28–32 µm long and 35–38 µm wide, with 3 hs setae on anterior and dorsal surface. Pedicel (pdc): length 37–45 µm, width 34–37 µm; with faint concentric microridges throughout; with 14–19 fs, 5 hs setae + 1 campaniform sensillum. Flagellar segments 24–28 µm widest, but segment III very narrow basally; fs short, 13–18 µm long; lengths of segments (µm): III 74–86; IV 20–24; V 20–24; VI 50;

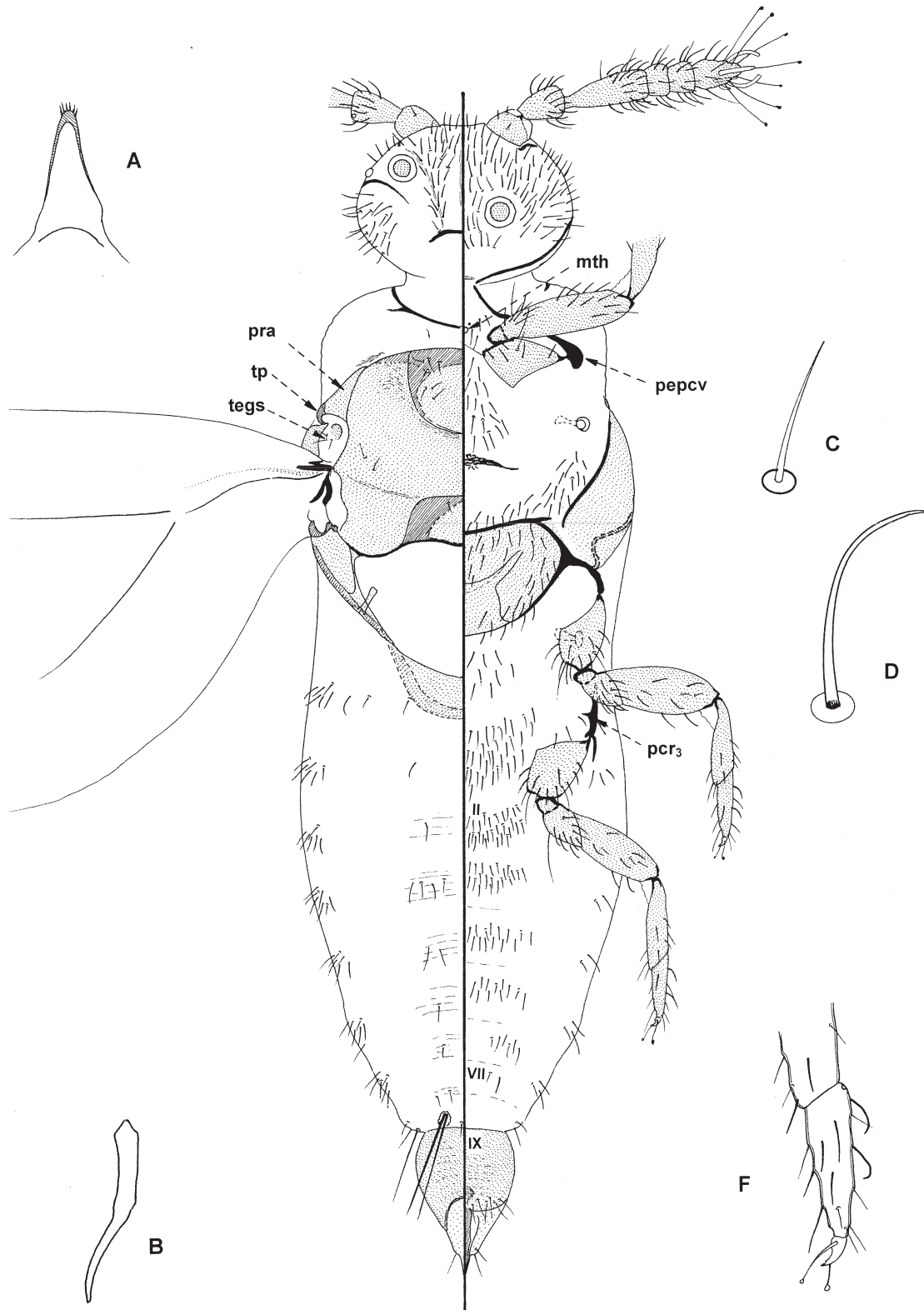


Figure 7 - Adult male of *Dromedaricoccus hansonii* Hodgson & Miller. Where A = cranial apophysis; B = side view of aedeagus; C = hair-like seta; D = fleshy seta; E = distal end of metathoracic leg; F = distal end of metathoracic leg; mth = mouth; pcr₃ = metaprecoxal ridge; pepcv = proepisternum + cervical sclerite; pra = prealare ridge; tegs = tegular setae, and tp = triangular plate.

approximate number of setae per segment: III 20–25 fs + 1 or 2 hs; IV & V 10–15 fs + 0–2 hs, and VI 7 or 8 fs, 4 large and 1 small antennal bristles (ab) + 7 or 8 capitate setae (caps); sensilla basiconica not detected.

Thorax. Prothorax: pronotal ridge (prnr) present, not apparently fused medially on dorsum; pronotal sclerite (prn) distinct, each with faint ridging; without lateral pronotal, medial pronotal and post-tergite setae. Post-tergite (pt) lightly sclerotised. Prosternum (stn₁) with a distinct transverse ridge but median ridge only hinted at with faint ridges; possibly without apophyses laterally; with many fs + a few hs prosternal setae (stn₁s), extending anteriorly to area of ante-prosternal setae (astn₁s). Proepisternum + cervical sclerite (pepcv) showing nothing distinctive. Antemesospiracular setae absent.

Mesothorax: prescutum (prsc) oval, 78–95 µm long, 128–145 µm wide; sclerotised but not nodulated; with 4–6 prescutal setae (prscs) on each side; prescutal ridges (pscr) well developed; prescutal sclerites (pscs) only lightly sclerotised; prealare (pra) and triangular plates (tp) well developed. Scutum (sct): median area sclerotised, without nodulations; distance between prescutum and scutellum about 50–55 µm, with 1 or 2 scutal setae (scts) laterally on each side; setae absent medially; prealar ridge weak. Scutellum (scl) about 120 µm wide and 50 µm long; with an inverted U-shaped scutellar ridge; probably not tubular and lacking a foramen; scutellar setae (scls) 1 pair; postnotal wing process (pnp) quite long, more or less transverse and heavily sclerotised. Basisternum (stn₂) 185–190 µm wide and 120–125 µm long; median ridge absent; bounded anteriorly by a moderately strong marginal ridge (mr) and posteriorly by strong mesoprecoxal ridges (pcr₂); with many fs basisternal setae (stn₂s), mainly distributed nearer margins; lateropleurite (lpl) narrow, with a short ridge anteriorly; furca (f) well developed, narrow-waisted, arms divergent and extending about 2/3rds to anterior marginal ridge. Mesopostnotum (pn₂) well developed; mesopostnotal apophysis (pna) well developed, with round opening. Area bounded anteriorly by scutellum and laterally and posteriorly by mesopostnotum not sclerotised. Mesepisternum (eps₂) not reticulated; subepisternal ridge (ser) strongly sclerotised. Postalare (pa) well developed; without postalare setae. Anterior spiracle (sp₂) small, width of peritreme about 18 µm. Postmesospiracular setae (pm₂s) abundant, mainly fs, extending full width of segment. Tegular (teg) present, with 3 or 4 regular setae (tegs) on each side.

Metathorax: metatergal setae (mts): 1 or 2 fs + 1–3 hs on each side. Dorsospiracular setae (dss): 9–11 fs + 0 or 1 hs on each side. Dorsal part of metapleural ridge (plr₂) absent; ventral part short; metepisternum (eps₃) unsclerotised, with 0–2 fs + 0–1 hs postmetaspiracular setae (pm₃s) on each side; metaprecoxal ridges (pcr₃) extremely short. Metepimeron (epm₃) sclerotised but without setae. Antemetaspiracular setae absent. Posterior spiracle (sp₃) of moderate size: width of peritreme about 18 µm. Metasternum (stn₃) membranous and without metasternal apophyses; with a total of 5–14 fs + 0 hs anterior metasternal setae (amss) and many posterior metasternal setae (pmss), mainly fs.

Wings: hyaline, 750–800 µm long, 350–375 µm wide (ratio of total body length to wing length 1:0.78); alar lobe, alar sensoria and alar setae absent. Hamulohalteres absent.

Legs: subequal in length. Lengths (µm): coxa (cx) I 78–82; II 75; III 78–82; metacoxae with 6 or 7 fs + 3–5 hs. Trochanter

(tr) + femur (fm) I 125–145; II 140; III 140–145; metatrochanter with 8–12 setae, mainly fs; campaniform sensilla narrow, in a diagonal line; long trochanter seta differentiated, 43–60 µm long, placed much nearer proximal end of segment than normal; metafemur with about 6–8 fs + 5–7 hs. Tibia (ti) I 82–87; II 78–83; III 82–87; metatibia with a total of about 10 setae, mainly hs, a few becoming spur-like on distal third of leg; without fleshy setae on dorsal surface; with 1 poorly defined tibial spur, 23–25 µm long. Tarsus (tar) I 66–83; II 53–62; III 60–65 (ratio of length of tibia III to that of tarsus III 1:0.73); tar 1 segmented; metatarsi with 10–13 setae, mainly spur-like but a few fs; tarsal spurs poorly differentiated, length 20–22 µm; tarsal campaniform sensilla (cp) present; tarsal digitules (tdt) short and setose. Claw short, subequal to width of tarsi, with a distinct small denticle; length III: 15–18 µm; claw digitules (cdt) distinctly longer than claw, with minute apical knobs, 1 perhaps slightly larger than other.

Abdomen: segments I–VII: abdominal tergites (at) and sternites (as) membranous; without obvious oval membranous areas in inter-segmental membranes. Pleurites unsclerotised. Caudal extensions (ce) of segment VII absent. Abdominal dorsal setae (ads) few, segments I–VII each with 1–4 fs + 0–4 hs. Pleural setae: each segment with about 6 fs + 2 hs dorsopleural setae (dps) on each side, and usually with 2 fs + 1 hs ventropleural setae (vps) on each side. Abdominal ventral setae (avs) (on each side): II: abundant, mainly fs; III & IV many, mainly fs; V–VII few, both fs and hs.

Segment VIII: at and as unsclerotised; tergite with 2 hs ante-anal setae (aas); sternite with 0–2 setae; caudal extension (ce) small and rounded; with about 3 pleural setae, mainly fs but usually 1 much longer, up to 60 µm long. Glandular pouch (gp) present, placed perhaps slightly more medially than usual, with a fairly narrow and deep pouch, each with pores restricted to within pouch; each with 2 glandular pouch setae (gls) about 60–90 µm long.

Genital segment: penial sheath (ps) quite short, but broad anteriorly (segment IX?), rapidly narrowing to a sharp apex; total length 60–90 µm, greatest width 60–67 µm (ratio of total body length to length of penial sheath 1:0.08); anal opening medially on dorsal surface, 35–42 µm wide; with no setae on dorsal surface, but with a line of about 8 setae anterior to aedeagus (aed), each 25–32 µm long, plus 2 pairs of penial sheath setae (pss) near apex, each 21–25 µm long. Aedeagus (aed) tapering slightly, and extending to tip of penial sheath; length 58–70 µm, greatest width about 10 µm. Basal rod (bra) present anterior to aedeagus; short. Penial sheath apparently with a few small sensilla (psp) marginally near apex.

Comment. The adult male of *D. hansonii* can be separated from the other known Neotropical eriococcid males in having the following combination of characters: (i) 6 segmented antennae, with fleshy setae much shorter than width of antennal segments; (ii) capitate setae on the antennae restricted to apical segment; (iii) antennal bristles apparently restricted to apical segment (or similar to fleshy setae on previous 2 segments); (iv) penial sheath short, only slightly longer than basal width; (v) fleshy setae not easily separable from hair-like setae; (vi) legs relatively small; (vii) tarsal digitules unusually short; and (viii) head with many fleshy setae. The males of most gall-inducing eriococcids have elongate

abdomens or long penial sheaths so as to facilitate reaching the female inside the gall. The male of *D. hansonii* appears to have no such adaptations unless the reduced size of the legs is in some way related to access to within the gall. However, perhaps copulation is here facilitated by the elongation of the abdomen of the adult female rather than that of the adult male?

General biology. Little is known about the general biology of *D. hansonii*. The galls are found on the young stems, petioles and mid-veins of the leaflets of the host plant, producing spherical swellings mainly on the underside of the leaflets. Old galls are very hard and difficult to cut with a knife. Although Paul Hansen reared several other insects from these galls, he believes that the eriococcid is the main gall-inducer. The other insects are probably mainly parasitoids and predators of *D. hansonii*: Eulophidae (Tetrastichinae), Eupelmidae, Eurytomidae and a few Cecidomyiidae. The latter he considered to be an inquiline and he also reared Platygasteridae from the gall which he considered was probably a parasitoid of the cecidomyiid.

Etymology. This species is named in honour of Paul Hanson, who has collected several interesting gall-inducing scale insects in Costa Rica.

Key to the Genera of the Eriococcidae of the Neotropical Region based the morphology of the adult males

1	Antennae with 8 or fewer segments	5
–	Antennae with 10 segments	2
2(1)	Penial sheath less than half length of abdomen	3
–	Penial sheath more than half length of abdomen	<i>Capulinia</i>
3(2)	Antennae with long, narrow fleshy setae, similar to hair-like setae	4
–	Antennae with thicker fleshy setae, obviously different from hair-like setae	<i>Acanthococcus</i>
4(3)	Glandular pouch shallow, with pores spreading out of pouch onto dorsum; glandular pouch setae short, only extending to about half length of penial sheath; dorsal abdominal setae not as abundant as ventral abdominal setae	<i>Stibococcus</i>
–	Glandular pouch deep, with pores restricted to within pouch; glandular pouch setae long, extending to about level with tip of penial sheath; dorsal abdominal setae more abundant than ventral abdominal setae	<i>Carpochloroides</i>
5(1)	Glandular pouches absent; antennae 7 segmented; abdomen attenuated	<i>Tectococcus</i>
–	Glandular pouches present; antennae not 7 segmented; abdomen not attenuated	6
6(5)	Penial sheath very long, several times longer than basal width; antennae 5 segmented; genae each with few setae	<i>Eriogallococcus</i>
–	Penial sheath shorter, at most 3 times longer than basal width; antennae 6 or 8 segmented; genae each with many setae	7
7(6)	Fleshy setae clearly differentiated from hair-like setae, each short and blunt; antennae 8 segmented; tarsi each 2 segmented	<i>Pseudotectococcus</i>
–	Fleshy setae very similar in structure to hair-like setae, each long with a sharp apex; antennae 6 segmented; tarsi each 1 segmented	<i>Dromedaricoccus</i>

Discussion

Of the 27 genera of Eriococcidae now known from the Neotropics, these two new genera can be easily distinguished from the others by the presence of an area of moderate to heavy sclerotisation on the dorsum on the mature adult females. *Eriogallococcus isaias* is the first record of an eriococcid collected on Malvaceae in the Neotropical Region while *Dromedaricoccus hansonii* is only the second record on Anacardiaceae (the other is *Icelococcus lithrae* Miller & González from Chile). By far the most common host plant family in this region is Myrtaceae (26%), followed by Nothofagaceae (16%) and Fabaceae (14%). Of the 76 eriococcid species now known from the Neotropics, 12 (16%)

are known to induce galls in their host plants (Hodgson & Miller, 2010) (although the habit of several other species is not known). Of these, three induce galls on Myrtaceae, two on Annonaceae and one on Fabaceae (the host families of the remainder are unknown, including that of *Ovaticoccus amplicoxae*, which was not included in Hodgson & Miller's review as it is only known from Belize).

As pointed out in the Introduction, recent molecular analyses have strongly suggested that the family Eriococcidae is non-monophyletic and consists of three separate clades (Cook et al., 2002; Cook & Gullan, 2004). Looking at the morphological similarities between *Eriogallococcus* and *Dromedaricoccus* and the genera studied in the above papers, it seems clear that these two new genera fall within the Gondwanan clade.

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