

A TAXONOMIC ANALYSIS OF THE *ERIOCOCCIDAE* OF CHILE

DOUGLAS R. MILLER*
AND
ROBERTO H. GONZÁLEZ**

ABSTRACT

Two species of Eriococcidae (Homoptera), *Eriococcus araucariae* Maskell and *E. navarinoensis* Hoy, were hitherto known in Chile. This paper adds four new genera and ten new species to the eriococcid fauna of Chile and provides keys and illustrations for the identification of this group of scale insect pests. Primary emphasis was placed on the eriococcids that feed on the southern beech (*Nothofagus*), because of this plant's significance to studies of zoogeography. The new species described include *Chilecoccus browni*, *Ch. spinosus*, *Eriococcus chilensis*, *E. eurythrix*, *E. rhadinothrix*, *E. tholothrix*, *Exallococcus laureliae*, *Icelococcus charlini*, *I. nothofagi* and *Stibococcus cerinus*.

RESUMEN

Dos especies de Eriococcidae (Homoptera), *Eriococcus araucariae* Maskell y *E. navarinoensis* Hoy eran conocidas hasta el momento en Chile. En este trabajo se describen cuatro géneros y diez especies nuevas y se proveen claves e ilustraciones para la identificación de este grupo de insectos. Con especial énfasis se tratan las especies de eriococcidos que se alimentan de Fagáceas endémicas del género *Nothofagus*, debido a su especial significancia con relación a estudios zoogeográficos. Las nuevas especies descritas son: *Chilecoccus browni*, *Ch. spinosus*, *Eriococcus chilensis*, *E. eurythrix*, *E. rhadinothrix*, *E. tholothrix*, *Exallococcus laureliae*, *Icelococcus charlini*, *I. nothofagi* y *Stibococcus cerinus*.

In 1962, J. M. Hoy published a comprehensive paper on the Eriococcidae of New Zealand and concluded that the center of origin of the family was in Antarctica. He hypothesized that similar eriococcid faunas should occur in New Zealand and southern South America because of their past close proximity to the proposed center of origin and because of the similar composition of the floras of these areas, especially in regard to *Nothofagus* (Philippi 1872, Edwards 1929, Couper 1960, Darlington 1965). In support of his hypothesis Hoy undertook a study of herbarium specimens of Chilean *Nothofagus* and discovered two eriococcids which were strikingly similar to the species in New Zealand. He had adequate material of only one species which he described as *Eriococcus navarinoensis* (Hoy, 1962b).

With Hoy's findings in mind, the junior author former Professor of Entomology, Uni-

versity of Chile* and Dr. Spencer Brown, University of California, set out to find additional eriococcids in Chile. Because of the large numbers of eriococcid species on *Nothofagus* in New Zealand, and because of the interest in *Nothofagus* by zoogeographers, particular emphasis was placed on the eriococcid fauna of that host.

In Chile *Nothofagus* ranges from 33°30'S latitude to the tip of Cape Horn and includes ten endemic species which are mainly distributed between 34° and 54°S latitude. Apart from *E. navarinoensis*, which represents the southernmost collection of an eriococcid (54° 55'S latitude), only three other scale insects have been reported on *Nothofagus* in the country—namely *Fagisuga triloba* Lindinger, *Pseudoparlatoria chilina* Lindinger, and *Llaveia* sp. (González and Charlin, 1968).

Until now only two eriococcid species have been reported from Chile - *Eriococcus arauca-*

*Systematic Entomology Laboratory, HBIII, Agr. Res. Serv., USDA, Beltsville, Maryland.

**Plant Protection Service, Plant Production & Protection Division, FAO, United Nations, Rome, Italy.

*Project carried out jointly with Prof. R. Charlin, Faculty of Agronomy, University of Chile, Santiago.

riae Maskell (Olalquiaga, 1945) and *E. navarinoensis* Hoy. The present paper adds 4 genera and 10 species, making a total Chilean eriococcid fauna of 5 genera and 12 species. This study has proven to be particularly informative about the past distribution and evolution of the family Eriococcidae. Although data are inadequate to form definitive conclusions, it is evident that the study of southern areas of South America will be highly significant in establishing a basic understanding of eriococcid evolution and distribution.

METHODS

In the descriptive portions of the text a roman numeral following the word "segment" is used as an abdominal segment designation: e. g. segment VIII = abdominal segment 8. Measurements and numbers are given as follows: (range) small number-large number (average). Ranges and averages are taken from 10 specimens when available and are normally rounded off to the nearest whole number.

All illustrations of adult females are representations of the holotype. Inmature instars and/or adult males were available for only 2 species.

The depositories of specimens are as follows: British Museum (Natural History), London (BM); Department of Scientific and Industrial Research, New Zealand (DSIR); Museum National d'Histoire Naturelle, Paris (MNHN); University of Chile, College of Agriculture, Santiago (UCH); University of California, Davis (UCD); U.S. National Museum (Natural History), Washington, D.C. (USNM); Virginia Polytechnic Institute and State University, Blacksburg (VPI); Zoological Institute, Academy of Sciences of U.S.S.R., Leningrad (ZAS).

KEY TO THE CHILEAN GENERA OF THE ERIOCOCCIDAE

- 1. Macrotubular ducts absent from dorsum
 *Icelococcus* Miller and González, n. gen.
 — Macrotubular ducts present on dorsum 2
- 2(1). Macrotubular ducts on dorsum with conspicuous rim surrounding dermal orifice 3
 — Macrotubular ducts on dorsum without conspicuous rim surrounding dermal orifice 4
- 3(2). Venter with large clusters of tubular ducts on abdomen; dorsum without simple pores; without cruciform pores
 *Stibococcus* Miller and González, n. gen.
 — Venter without tubular ducts; dorsum with numerous simple pores; cruciform pores present on venter near body margin

- *Exallococcus* Miller and González, n. gen.
- 4(2). Enlarged setae unusually abundant, present ventrally on all areas of abdomen; anal lobes modified into platelike structures
 *Chilecoccus* Miller and González, n. gen.
 — Enlarged setae not abundant on venter of abdomen, when present, restricted to lateral areas; anal lobes unmodified, not platelike
 *Eriococcus* Targioni-Tozzetti

Chilecoccus Miller and González, n. gen.

Type-species. Chilecoccus browni n. sp.

Diagnosis. Enlarged setae on medial areas of both surfaces. Anal lobes modified into flattened plates, surrounding anal opening. Anal ring unusually large for eriococcid, with many pores and 4 pairs of setae. Hind coxae and femora with many pores. Labium 3-segmented; proximal segment unsclerotized, indicated by one or 2 pairs of setae.

Notes. The unusual structure of the anal lobes and anal ring, combined with the numerous, ventral, enlarged setae set *Chilecoccus* apart from all other eriococcid genera known to us.

The generic name is masculine and is derived from the name of the country in which members of the genus were collected. The suffix *coccus* is Greek meaning "seed" or "scale" insect and is used in all of the generic names proposed here.

KEY TO SPECIES OF *CHILECOCCUS* IN CHILE

- 1. Multilocular pores absent from dorsum, restricted to narrow, longitudinal band on mediolateral areas of venter; with 65-120 pores on dorsal surface of each hind coxa *browni* Miller and González, n. sp.
 — Multilocular pores abundant on dorsum, present on mediolateral and lateral areas of venter; with 35-65 pores on dorsal surface of each hind coxa
 *spinus* Miller and González, n. sp.

Chilecoccus browni new species

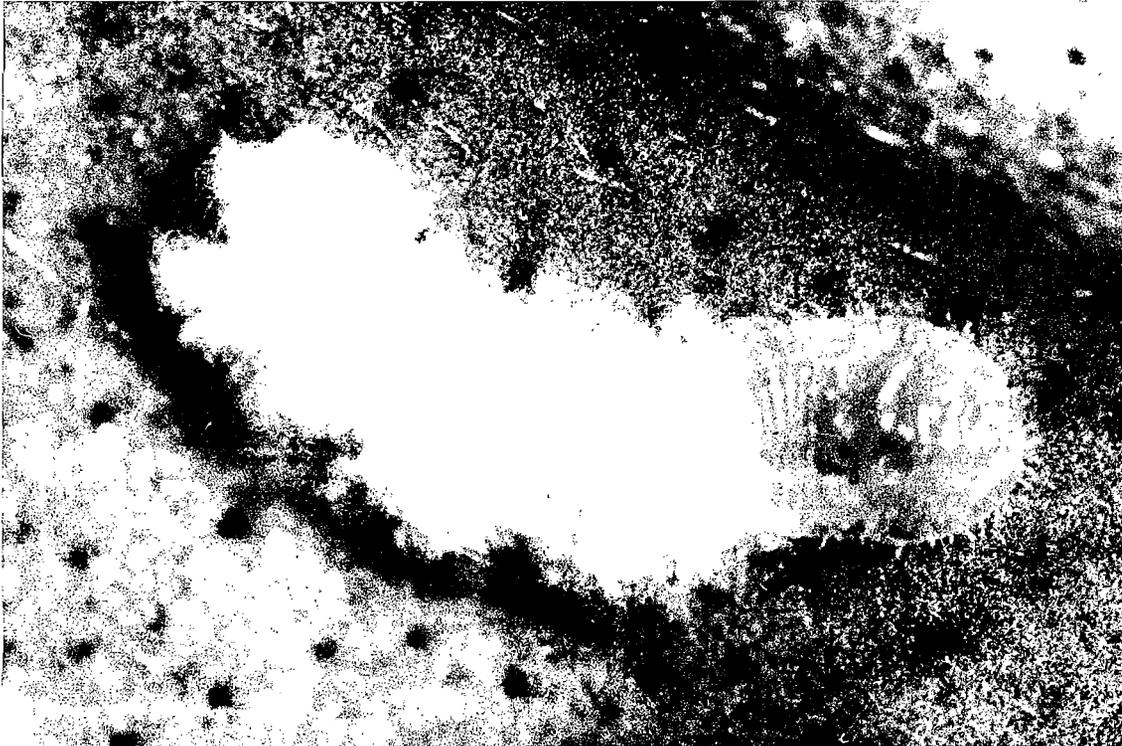
Brown's eriococcin
 (Fig. 1, Photo 1)

Type Material. Adult female holotype (specimen on right side of slide) with right label "Chilecoccus browni Miller and González Paratype Holotype", left label "on Nothofagus dombeyi, Camino a Villarrica, Cautín, Chile 26-XI-1968 R. González" (deposited in UCH). Ten paratypes are deposited in BM, UCD, UCH, USNM, ZAS.

Field Features. Adult females occur on the undersides of leaves of *N. dombeyi*. The ovisac is pinkish white and is partially divided into



Chilecoccus browni Miller & González. Adult female and male sac on *Nothofagus dombeyi*



Stibococcus cerinus Miller & González. Adult female with ovisac on *Myrceugenia bridgessi*

sections reflecting the segmental areas on the abdomen. At the time of collection adult males were emerging from felted, white male sacs.

Recognition Characters. Adult female holotype as illustrated except as follows. Mounted, 1.9 mm long, 1.7 mm long, 1.7 mm wide (paratypes 1.2-1.9 mm long, 1.1-1.7 mm wide). Posterior anal-lobe setae 33 and 38 u long (paratypes 20-45 (34) u).

Dorsum with enlarged setae of one basic size, those near posterior margin largest. Segment VIII with largest setae about 25 u long (paratypes 21-28 (24) u). Abdominal segment V with 70 (paratypes 55-82 (68)) dorsal setae. Macrotubular ducts about 20 u long (paratypes 18-23 (21) u). Microtubular ducts about 8 u long (paratypes 8-10 (9) u). Multilocular pores absent.

Anal-ring sclerotized areas unusually broad, with large number of pores, similar in appearance to coccid ring, ventral, not invaginated.

Venter with most body setae represented by enlarged setae except in medial areas of thorax and head; longest seta on segment VIII about 21 u long (paratypes 18-23 (21) u). Macrotubular ducts of one size, same as on dorsum. Microtubular ducts present in mediolateral and lateral areas. Multilocular pores distributed in a characteristic pattern, pores of 2 kinds: quinqueloculars most abundant, triloculars rare.

Hind coxae each dorsally with 101 and 105 pores (paratypes with 65-117 (97)), ventrally with 16 and 28 (paratypes with 15-28 (22)); hind femora each dorsally with 51 and 53 pores (paratypes with 38-49 (46)), absent ventrally; each femur with 5 setae; each tibia with 4 setae; hind tibia/tarsus ratio 0.9 and 1.0 (paratypes 0.9-1.0 (1.0)); tibia + tarsus length 168 u (paratypes 158-183 (170) u); tarsal and claw digitules with expanded, variable-sized apices; claw with small subapical denticle. Labium 3-segmented, basal segment unsclerotized, represented only by ventral seta; crumena broken off (paratypes 232-287 (262) u long). Antennae 6-segmented, 185 and 188 u long (paratypes 170-190 (183) u).

Variation. Two paratypes have the anal ring and anal lobes present on the dorsum.

Notes. The above description is based on 11 specimens from one locality.

This species is most closely related to *Chilecoccus spinosus*, herein described as new, but differs in lacking dorsal quinquelocular pores, in having ventral quinqueloculares restricted

to a pair of longitudinal bands in the submedial areas of the abdomen, and in having 65-117 (97) pores on the dorsal surfaces of each hind coxa. *C. spinosus* has quinquelocular pores scattered over the dorsum, has ventral quinqueloculares in submedial sublateral, and lateral areas, and has 35-65 (45) pores on the dorsal surface of each hind coxa.

We take great pleasure in naming this species in honor of Dr. Spencer W. Brown who has made many significant contributions in the genetics of scale insect.

Specimens Examined. CHILE, Cautín, Road to Villarrica, XI-26-68, R. H. González and S. W. Brown, on *Nothofagus dombeyi* (BM, UCD, UCH, USNM, ZAS).

Chilecoccus spinosus new species

Spinose eriococcin.
(Fig. 2)

Type Material. Adult female holotype (single specimen on slide) with right label "5 mi. W. Termas de Chillán, CHILE 23-XI-1968, ex *Nothofagus dombeyi*, Coll. R. González", left label "*Chilecoccus spinosus* Miller & González Holotype", (deposited in UCH). Five paratypes are deposited in: BM, UCD, UCH, USNM.

Field Features. Collected with *Eriococcus tholothri*: Miller and González on the undersides of leaves of *N. dombeyi*.

Recognition Characters. Adult female holotype as illustrated except as follows. Mounted, 2.1 mm long, 1.8 mm wide (paratypes 1.8-2.0 mm long, 1.3-1.6 mm wide). Posterior anal-lobe setae 33 and 38 u long (paratypes 33-38 (35) u).

Dorsum with enlarged setae of one basic size, those near posterior margin largest. Segment VIII with largest seta about 28 u long (paratypes 18-30 (24) u). Abdominal segment V with 78 (paratypes 63-89 (73)) dorsal setae. Macrotubular ducts about 19 u long (paratypes 18-22 (20) u). Microtubular ducts about 8 u long (paratypes 7-8 (8) u). Multilocular pores of 2 or 3 kinds: Quinqueloculars most abundant, of one size: quadriloculars and triloculars rare.

Anal ring as in *C. browni*.

Venter with most body setae on abdomen replaced by short enlarged setae; slender body setae most abundant in medial areas of thorax and head; longest seta on segment VIII about 30 u long (paratypes 25-33 (29) u). Macrotubular ducts of one size, same as on dorsum. Microtubular ducts present in mediolateral and lat-

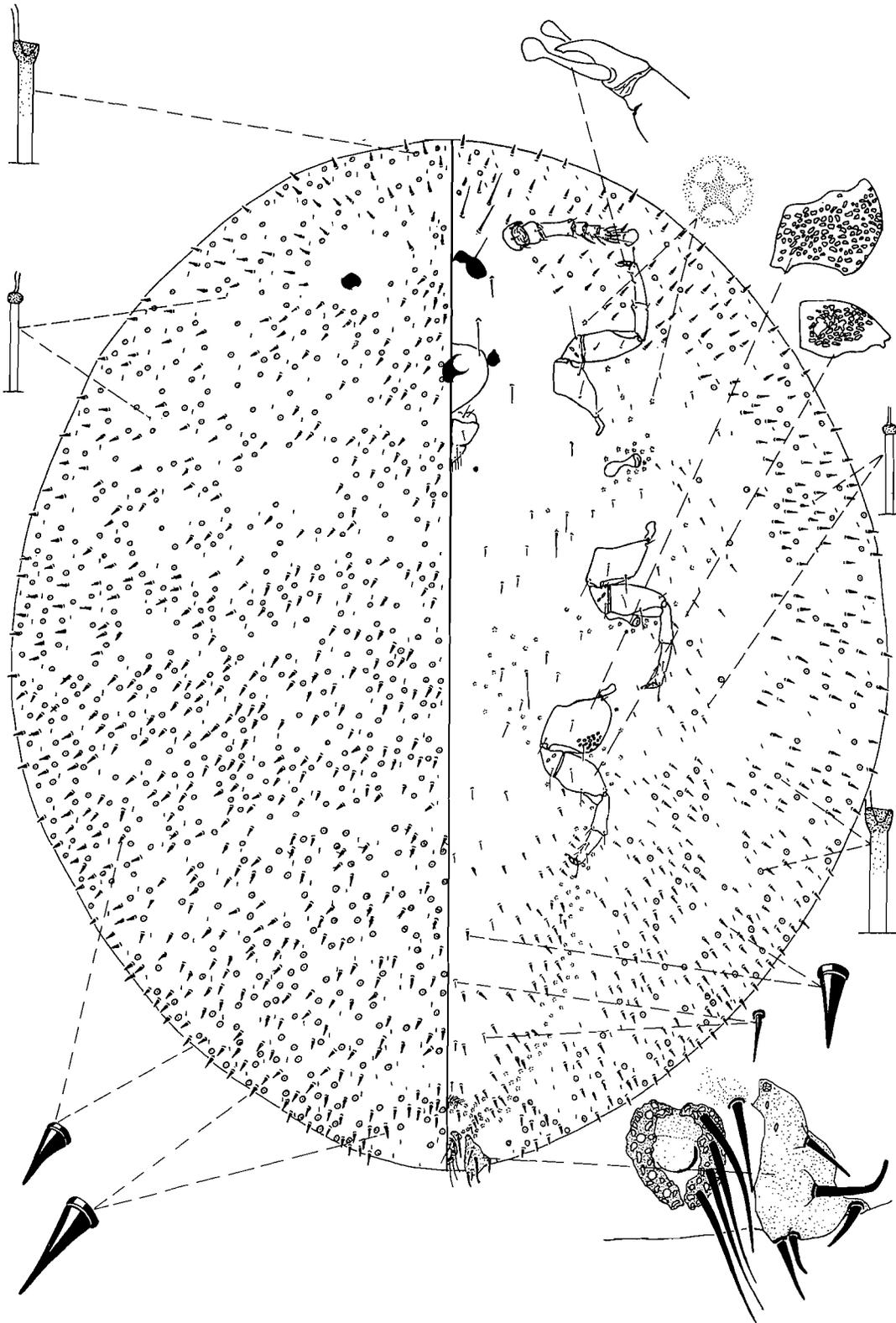


Fig. 1. *Chilecoccus browni* Miller and González, Camino a Villarrica, Cautín, Chile, x1-26-68, R. H. González and S. W. Brown. On *Nothofagus dombeyi*.

eral-areas. Multilocular pores of same kinds and relative numbers as on dorsum.

Hind coxae each dorsally with 47 and 56 pores (paratypes with 37-63 (45)), ventrally with 4 and 3 pores (paratypes with 0-7 (4)); hind femora each dorsally with 17 and 26 pores (paratypes with 13-22 (19)), absent ventrally; each femur with 5 setae; each tibia with 4 setae; hind tibia/tarsus ratio 0.9 (paratypes 0.9-1.0 (1.0)); hind tibia + tarsus length 190 and 198 μ long (paratypes 198-203 (200) μ); tarsal digitules with large, expanded, equal-sized apices; claw digitules with expanded, unequal-sized apices, larger digitule about same size as tarsal digitules; claw with small denticle. Labium 3-segmented, crumena broken off (paratypes 357-400 (380) μ long). Antennae 6-segmented, 200 μ long (paratypes 170-213 (195) μ).

Variation. One paratype has apices of all tarsal and claw digitules nearly equal in size.

Notes. The above description is based on 6 specimens from 2 localities.

This species is most closely related to *Chilococcus browni*, herein described as new. For a comparison of these species see "Notes" in the description of *C. browni*.

The name *spinus* is from the Latin meaning "thorny" or "spiny" and refers to the numerous enlarged setae on the venter of the abdomen.

Specimens Examined. CHILE, Chiloé: Road between Chaco and Ancud, Chiloé Island, XI-28-68, R. H. González and S. W. Brown, on *Eucryphia cordifolia*, "ulmo" (Eucryphiaceae) (UCH, USNM). Ñuble: 5 mi. W. Termas Chillán, XI-23-68, R. H. González and S. W. Brown, on *Nothofagus dombeyi* (BM, UCD, UCH, USNM).

Genus *Eriococcus* Targioni-Tozzetti

Eriococcus Targioni-Tozzetti, 1867:726.

Type-species. *Coccus crispus* Fonscolombe, 1834:204 by subsequent designation of Fernald 1903:70.

Acanthococcus Signoret, 1875:34.

Type-species. *Acanthococcus aceris* Signoret 1875:35, by monotypy.

Rhizococcus Signoret, 1875:36.

Type-species. *Rhizococcus gnidii* Signoret 1875:37, by monotypy.

Uhleria Cooke, 1881:41.

Type-species. *Uhleria araucariae* (Maskell) 1879:218, by monotypy.

Eriococcus was first proposed by Targioni-

Tozzetti (1867) and included 5 species previously in *Coccus* Linnaeus (*festucae* (Fonscolombe), *rorismarinis* (Fonscolombe), *buxi* (Fonscolombe), *crispus* (Fonscolombe), *fimbriatus* (Fonscolombe); no type-species was designated. Signoret (1870) removed one species and stated that he was reserving *Eriococcus* for *festucae* Fonscolombe. However, in 1872 he stated that he was reserving *C. buxi* Fonscolombe for *Eriococcus*. Based on the International Code of Zoological Nomenclature, Article 69(a) (iii), neither *festucae* nor *buxi* was designated the type-species of *Eriococcus* as a consequence of Signoret's reservations, because he did not state that either of them was the type or type-species. The next work concerning the status of *Eriococcus* was presented by Fernald (1903). She definitely designated as the type-species *Coccus crispus* Fonscolombe. Because this species was one of the five listed by Targioni-Tozzetti (1867), and because Fernald's type-species designation is in compliance with the Code, *C. crispus* in here considered the type-species of *Eriococcus*.

The generally accepted type-species of *eriococcus* has been *Coccus buxi* (Borchsenius, 1949; Hoy, 1962a., 1963; Morrison and Morrison, 1966), but *C. crispus* was used by Ferris (1955). Even if Signoret's reservations were considered as valid type-species designations, *C. festucae*, presently assigned to the genus *Eriopeltis* Signoret, family Coccidae, would have priority over *Coccus buxi*.

The past use of *C. buxi* as the type-species of *Eriococcus* has caused other problems. Borchsenius (1948) considered *Eriococcus* to be monotypic, containing only *C. buxi*. The remaining species were placed under the next available name, *Acanthococcus*. Although some workers have continued to use *Acanthococcus* in place of *Eriococcus*, other coccidologists have rejected Borchsenius' opinion (Ferris, 1955; Hoy, 1962a, 1963; McDaniel, 1964). With *Coccus crispus* as the type-species, *Eriococcus* will no longer be considered monotypic and *Acanthococcus* will again be placed as a junior synonym of *Eriococcus*. If *Coccus buxi* is radically different from the normal concept of *Eriococcus*, then a new genus should be proposed for it.

If the *Eriococcus* confusion ended here, the problem of its nomenclatorial position would be settled, but unfortunately this is not the case. Careful examination of the original description of the type-species, *Coccus crispus*, reveals

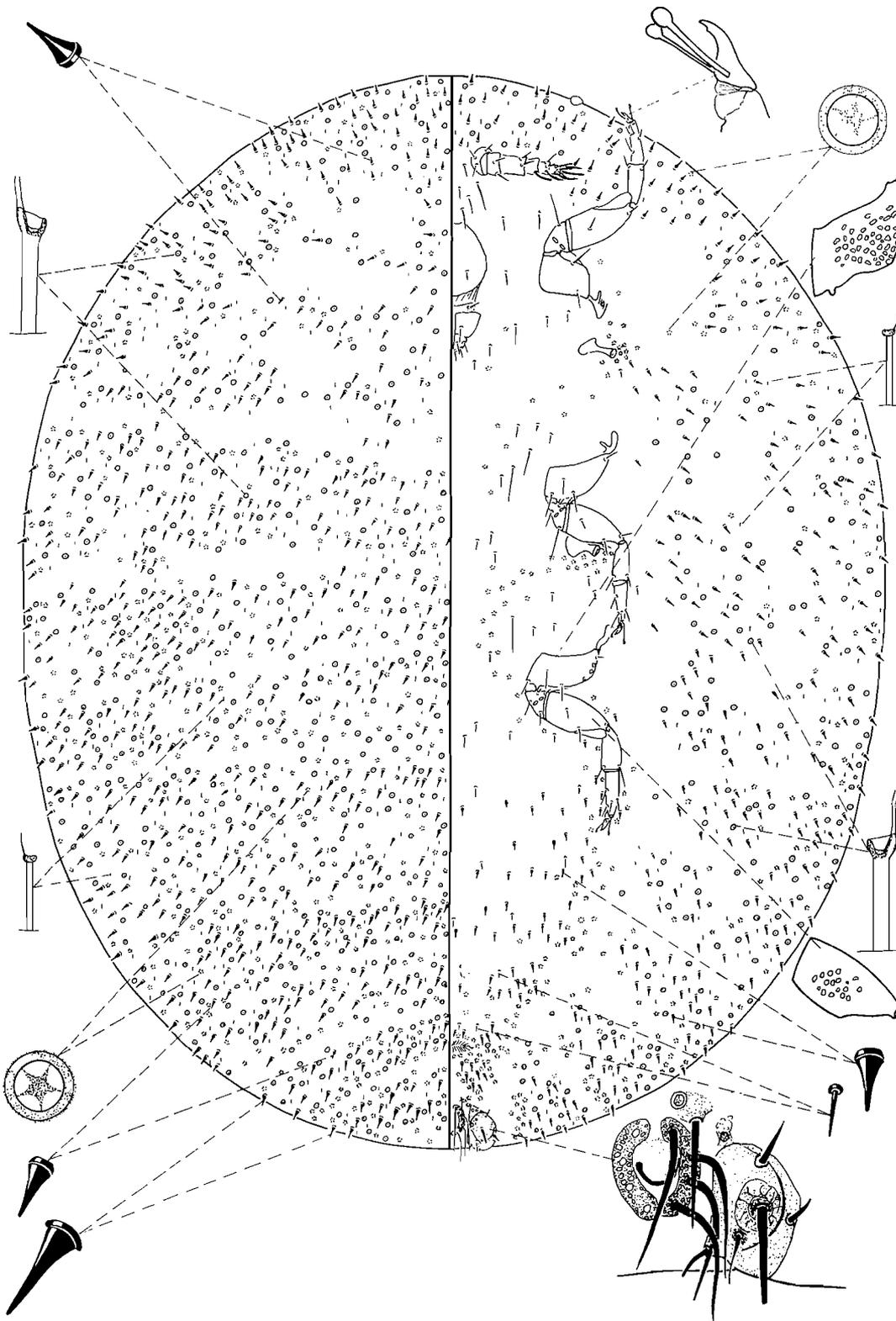


Fig. 2. *Chilecoccus spinosus* Miller and González. 5 mi. W. Termas de Chillán, Ñuble, Chile, xi-28-68, R. H. González and S. W. Brown. On *Nothofagus dombeyi*.

that this species is not an eriococcid at all. It is unclear exactly where *C. crispus* belongs; Lindinger (1933) believed that it was a synonym of the margarodid *Guerniniella serratulae* (Fabricius). However, because *G. serratulae* is found on *Cistus*, *Daucus*, *Erica*, and olive, and *C. crispus* was described from "copals ou figuers d'Inde", which probably is *Opuntia ficus-indica*, the likelihood of *G. serratulae* and *C. crispus* being the same is remote.

For the purposes of this study we have retained the concept of *Eriococcus* as presented by Ferris (1957), Hoy (1962a., 1963), and Miller and McKenzie (1967). The senior author is presently formulating a petition to be submitted to the International Commission on Zoological Nomenclature to clarify the nomenclatorial position of *Eriococcus*.

Diagnosis. Anal lobes protruding, normally sclerotized. Enlarged setae usually present somewhere on body; anal lobes typically each with 3 enlarged setae. Macro- and microtubular ducts present on both body surfaces. Multilocular sessile pores restricted to venter. Cruciform pores normally present. Claws with small denticle.

Notes. *Eriococcus* is closely related to *Gossyparia* Signoret, *Greenisca* Borchsenius, and *Oregmomyga* Hoy.

Gossyparia differs in having an ovisac which does not cover the entire dorsal surface and no dorsomedial macrotubular ducts. *Eriococcus* has an ovisac which encloses the entire adult female and at least a few dorsomedial macrotubular ducts.

Greenisca differs in having dorsal multilocular sessile pores, whereas *Eriococcus* lacks these pores on the dorsum.

Oregmomyga differs in having inconspicuous anal lobes, many dorsal multilocular sessile pores, and enlarged setae which are about as wide as long when present. *Eriococcus* normally has conspicuous anal lobes, no multilocular sessile pores on dorsum, and enlarged setae which are longer than wide.

KEY TO SPECIES OF *ERIOCOCCUS* IN CHILE

1. Dorsal setae dome shaped; hind femora each with 4 setae *tholothrix* Miller and González, n. sp.
— Dorsal setae not dome shaped; hind femora each with 5 setae 2
- 2(1). Suranal setae spatulate; femora of front legs each with 6 setae
..... *eurythrix* Miller and González, n. sp.
— Suranal setae bristle shaped; femora of front legs each with less than 6 setae 3

- 3(2). Dorsomedial enlarged setae truncate apically; ventral multilocular pores on thorax predominantly with 3 loculi; tibiae of front legs each with 5 setae *araucariae* Maskell
— Dorsomedial enlarged setae with acute or rounded apices; ventral multilocular pores on thorax predominantly with 5 loculi; tibiae of front legs each with 4 setae 4
- 4(3). Dorsomedial setae on abdomen about equal in length to largest lateral setae
..... *chilensis* Miller and González, n. sp.
— Dorsomedial setae on abdomen noticeably smaller than largest lateral setae 5
- 5(4). Antennae 6-segmented; abdominal segment V with 9-14 (10) enlarged setae; hind tibia/tarsus ratio 0.7-0.8 (0.7); enlarged setae on dorsomedial areas of thorax and head about same size as those along margin of abdomen
..... *rhadinothrix* Miller and González, n. sp.
— Antennae 7-segmented; abdominal segment V with 19-31 (24) enlarged setae; hind tibia/tarsus ratio 0.9-1.1 (1.0); enlarged setae on dorsomedial areas of thorax and head noticeably smaller and more slender than those along margin of abdomen *navarinoensis* Hoy

Eriococcus araucariae Maskell

Norfolk Island pine eriococcin

(Fig. 3)

Eriococcus araucariae Maskell, 1879:218.

Uhleria araucariae (Maskell), Cooke, 1881:41.

Rhizococcus araucariae (Maskell), Comstock, 1881:339.

Criccoccus (sic) *araucariae* Maskell, Rutherford, 1915:110.

Nidularia araucariae (Maskell), Lindinger, 1933:108.

Type Material. Specimens of the type series have not been examined. However, two second instar nymphs from the Maskell collection have been examined and agree with our concept of the species.

Field Features. Females occur on the undersides of leaves on the terminal twigs and in twig axils of *Araucaria*. Newly mature adult females are brownish yellow with a pair of light purple, longitudinal, sublateral, stripes on the dorsum. Mature adult females are purple. Crystalline rods are noticeable along the body margin. Up to 207 yellow eggs are laid in the white ovisac.

Recognition Characters. As illustrated except as follows. Adult female mounted, 1.7-2.6 mm long, 0.8-1.4 mm wide. Posterior anal-lobe setae 155-220 (196) μ long.

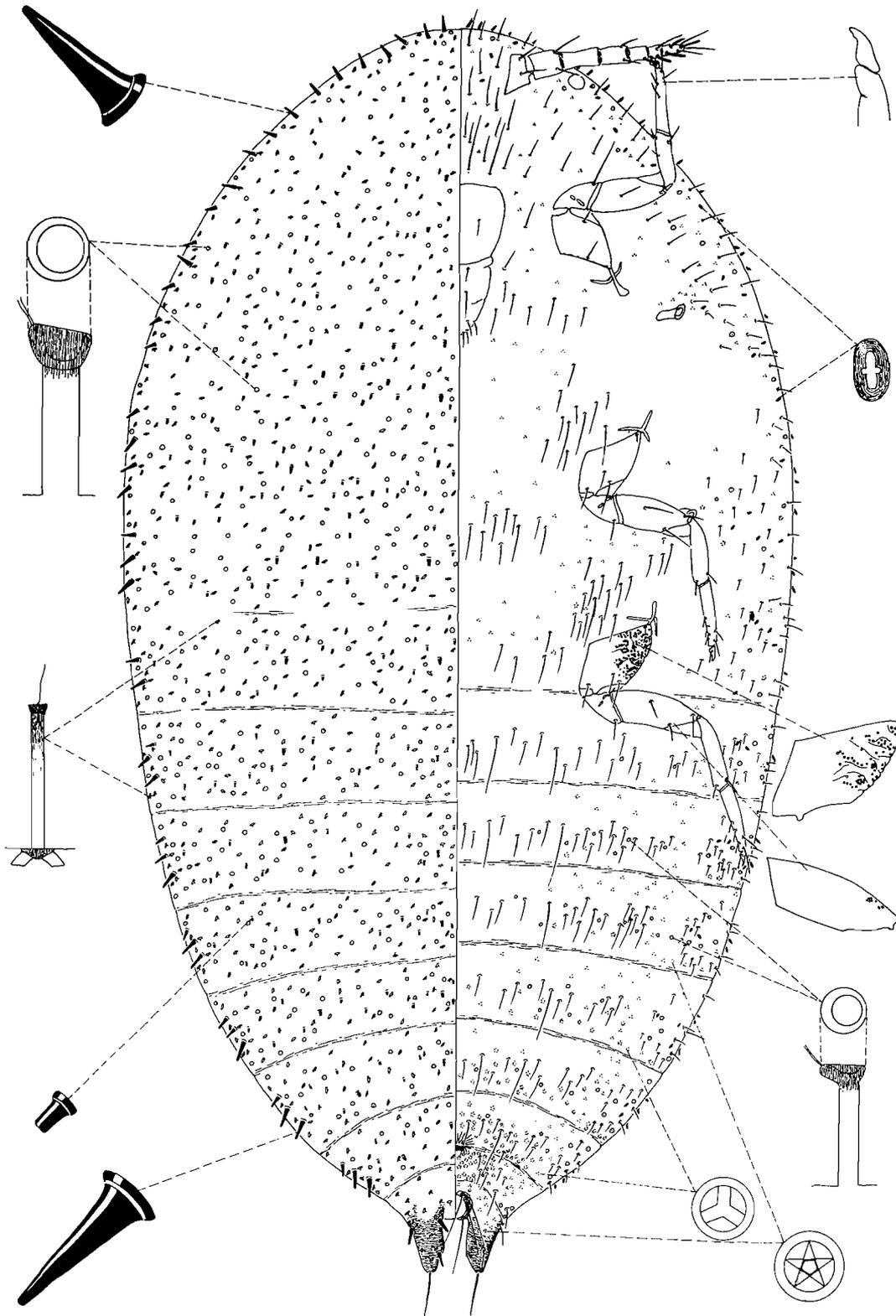


Fig. 3. *Eriococcus araucariae* Maskell. San Francisco, Golden Gate Park, San Francisco Co., California, xi-26-67, D. R. Miller and J. W. Beardsley. On *Araucaria excelsa*.

Notes. The above description is based on 235 specimens from 75 localities.

This species can be separated from all other *Eriococcus* species known to occur in Chile by the presence of the large-sized setae which are restricted to the body margin, truncate dorsomedial enlarged setae, and numerous trilocular pores.

Specimens Examined. CHILE, *Coquimbo*: La Serena, x-1-66, R. Charlin, *Araucaria brasiliensis* (Araucariaceae) (USNM). *Santiago*: Santiago, III-6-(?), C. E. Porter, *Araucaria* sp. (USNM); III-16-68, R. H. González, *A. excelsa* (UCH).

In addition, material has also been examined from the following: Argentine, Australia, the Azores, Bermuda, Brazil, Canary Islands, Ceylon, Costa Rica, Cuba, Egypt, Guatemala, Italy, Mexico, New Zealand, Nicaragua, Panama, Puerto Rico, Republic of South Africa, Spain, Uruguay, United States, (California, Connecticut, District of Columbia, Florida, Hawaii, Massachusetts, Mississippi, New York, Pennsylvania, Texas), and Venezuela.

Eriococcus chilensis new species

Chile eriococcin

(Fig. 4)

Type Material. Adult female holotype (right specimen on slide) with right label "*Eriococcus chilensis* Miller & González, Holotype, Paratype", left label "On *Nothofagus betuloides* 'coigue de Magallanes', Puerto del Hambre, Magallanes, Chile, Dec. 18 '71 R. González", (deposited in UCH.) Eight paratypes are deposited in: EM, UCH, USNM.

Field Features. Females are enclosed in a dirty white ovisac which is attached to the undersides of leaves. Normally there is only one female per leaf.

Recognition Characters. Adult female holotype as illustrated except as follows. Mounted, 1.7 mm long, 1.1 mm wide (paratypes 1.5-1.9 mm long, 0.9-1.3 mm wide). Posterior anal-lobe seta 90 and 100 u long (paratypes 100-113 (105) u).

Dorsum with enlarged setae of 2 basic sizes: Larger size present on abdomen in medial and lateral areas, scattered over thorax and head; smaller size restricted to anterior abdominal segments and to thorax and head. Segment VIII with largest marginal seta about 51 u long (paratypes 45-58 (49) u); segment

VIII with largest medial seta about 65 u long (paratypes 53-63 (57) u); longest lateral seta 0.8 times longer than longest medial seta (paratypes 0.8-1.0 (0.9) times). Medial setae distributed as follows: IX with 0, VIII with 2, VII with 0, VI with one, V with one, IV with 2, III with 2, II with 3 (paratypes IX with 0, VIII with 0,2 (2), VII with 0, VI with 0-2 (1), V with 0-2 (1), IV with 0-2 (2), III with 2-4 (3), II with 2-4 (3)). Abdominal segment V with 5 (paratypes 5-8 (7) dorsal setae. Macrotubular ducts about 28 u long (paratypes 24-31 (28) u). Microtubular ducts about 7 u long (paratypes 7-8 (7) u).

Anal ring dorsal, touching apex of abdomen, not invaginated.

Venter with most body setae short and robust on abdomen, becoming longer and more slender on thorax and head; largest seta on segment VIII about 40 u long (paratypes 33-40 (35) u). Macrotubular ducts of 2 sizes: Large ducts of same size as on dorsum; small ducts about 20 u long (paratypes 19-23 (21) u). Microtubular ducts in small numbers along body margin. Multilocular pores of one to 3 kinds: Quinqueloculars of 2 sizes; quadriloculars and trilocular rare.

Hind coxae each dorsally with 24 and 38 pores (paratypes with 20-37 (29), ventrally with 5 and 9 (paratypes with 3-20 (8))); hind femora each dorsally with 6 and 14 pores (paratypes with 3-15 (12), absent ventrally; each femur with 5 setae; each tibia with 4 setae; hind tibia/tarsus ratio 0.8 (paratypes 0.8-0.9 (0.8)); hind tibia + tarsus length 178 and 183 u (paratypes 173-193 (183) u); tarsal digitules with large, expanded, equal-sized apices; claw digitules with large, expanded, unequal-sized apices, larger digitule bigger than tarsal digitules; claw with denticle. Labium 2-segmented, apical segment faintly divided into 3rd segment; crumena 301 u long (paratypes 275-303 (288) u). Antennae 7-segmented, 168 and 165 u long (paratypes 145-180 (160) u).

Variation. Sometimes with microtubular ducts more numerous on dorsum; antennae sometimes with 3rd and 4th segments partially fused.

Notes. The above description is based on 9 specimens from 2 localities.

This species differs from all other species of *Eriococcus* in Chile in possessing dorsomedial enlarged setae on the abdomen which are approximately equal in size to the enlarged

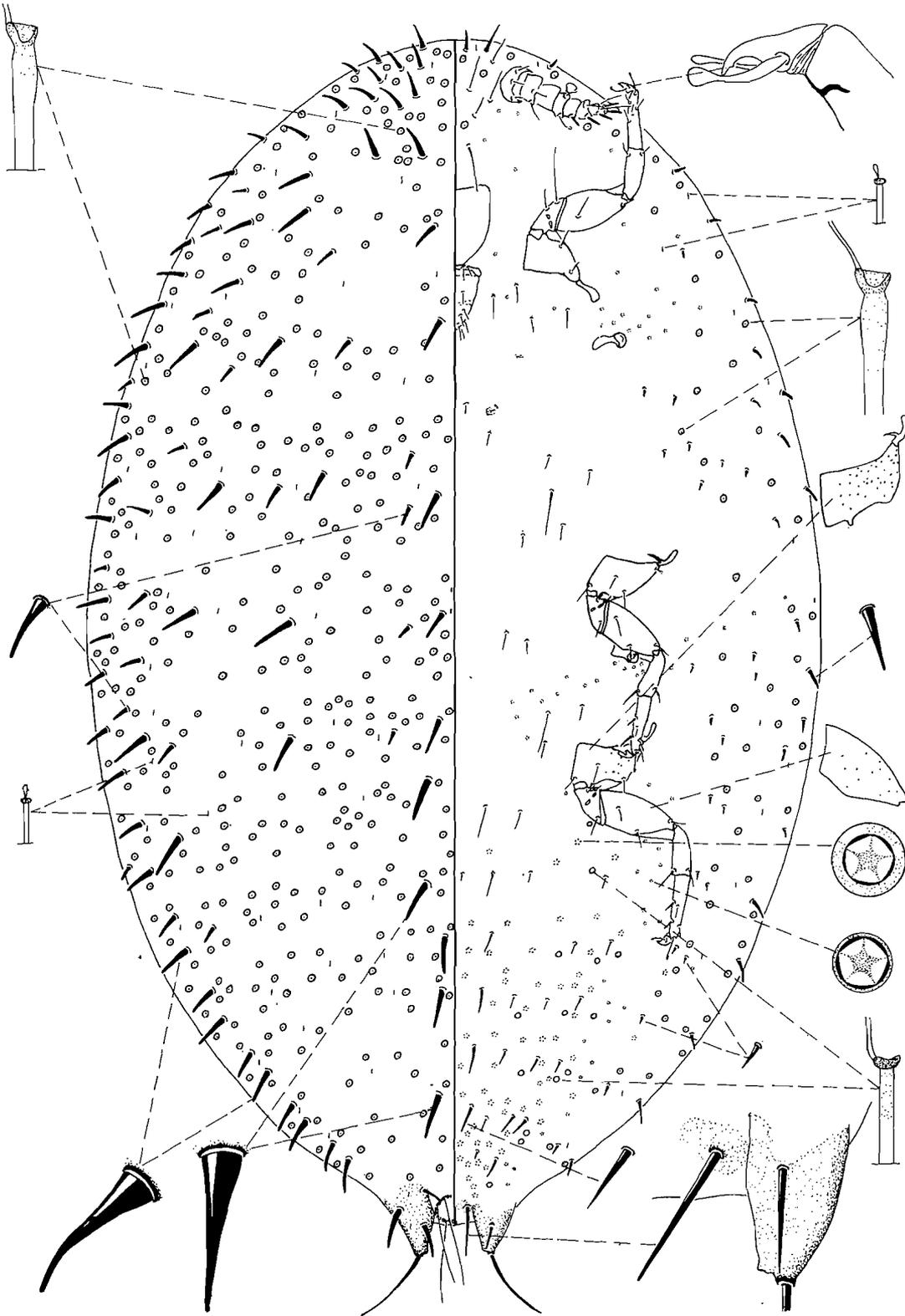


Fig. 4. *Eriococcus chilensis* Miller and González. Puerto del Hambre, Magallanes, Chile, XII-18-71, R. H. González. On *Nothofagus betuloides*.

setae on the body margin of the abdomen and are not dome shaped.

The name *chilensis* is the Latinized form of the country in which this species was collected.

Specimens Examined. CHILE, *Cautín*: Pucón, XI-26-68, R. H. González and S. W. Brown, on *Nothofagus obliqua* (UCD). *Maggallanes*: Puerto del Hambre, XII-18-71, R. H. González, on *N. betuloides* (BM, UCH, USNM); near Rio Verde, on road to Seno de Otway, XII-20-71, R. H. González, on *N. antarctica* (USNM).

Eriococcus eurythrix new species

Spatulate seta eriococcin

(Fig. 5)

Type Material. Adult female holotype (single specimen on slide) with right label "nr. Villa Portales, CHILE-25-XI-1968, ex *Nothofagus "nirre"*" Col. R. González "*Nothofagus antarctica*", left label "*Eriococcus eurythrix* Miller and González Holotype" (deposited in UCH). Twenty six paratypes are deposited in: BM, DSIR, MNHM, UCD, USNM, VPI, ZAS.

Field Features. This species occurs on the undersides of leaves and twigs of its *Nothofagus* host. The body of the adult female is light brown, with a single, white, longitudinal stripe on the medial area of the dorsum. No ovisac was observed.

Recognition Characters. Adult female holotype as illustrated except as follows. Mounted, 1.9 mm long, 1.6 mm wide (paratypes 1.5-2.6 mm long, 0.8-2.2 mm wide). Posterior anal-lobe setae broken (paratypes 105-130 (120) u long). Suranal setae spatulate.

Dorsum with enlarged setae of 2 basic sizes: Larger size present along body margin, normally with 2 large and one small setae present on each lateral margin of each abdominal segment; smaller size present on rest of dorsum. Segment VIII with largest marginal seta about 59 u long (paratypes 48-63 (56) u); segment VIII with largest medial seta about 15 u long (paratypes 15-25 (20) u); longest marginal seta about 3.8 times longer than longest medial seta (paratypes 2.2-3.6 (2.8) times). Abdominal segment V with 17 (paratypes with 15-27 (20)) dorsal setae. Macrotubular ducts about 23 u long (paratypes 18-25 (21) u). Microtubular ducts about 8 u long (paratypes 8-9 (8) u).

Anal ring touching apex of abdomen, slightly invaginated.

Venter with body setae of abdomen only slightly enlarged, largest seta on segment VIII 28 u long (paratypes 23-38 (31) u). Macrotubular ducts of one size, same as on dorsum. Microtubular ducts present along body margin. Multilocular pores of 4 kinds: Septeloculars, quadriloculars, and triloculars rare; quinqueloculars numerous, of one variable size.

Hind coxae with small pores, dorsally with 32 and 18 pores (paratypes with 20-41 (29)), ventrally with 10 and 13 (paratypes with 9-26 (20)); hind femora dorsally with 30 and 37 pores (paratypes with 7-42 (22)), ventrally with 3 and 0 (paratypes with 0-7 (2)); femora of posterior 2 pairs of legs each with 5 setae, anterior femora each with 6; tibiae of posterior 2 pairs of legs each with 4 setae, anterior tibiae each with 5; hind tibia/tarsus ratio 0.9 and 1.0 (paratypes 1.0); hind tibia + tarsus length about 185 u (paratypes 205-223 (212) u); tarsal digitules with expanded, variable-sized apices; claw digitules with expanded apices, with one apex noticeably larger than the other. Labium 2-segmented, basal segment small, lightly sclerotized, apical segment showing signs of weak division; crumena about 350 u long (paratypes 338-413 (368) u). Antennae 6-segmented, 195 and 205 u long (paratypes 207-235 (225) u).

Variation. The anal ring is not always invaginated, although on those specimens not showing invagination, the derm around the anal ring is conspicuously wrinkled indicating possible evagination. The anal lobes on some paratypes have several poorly developed teeth on their medial margin.

Notes. The above description is based on 25 specimens from 3 localities.

This species can easily be separated from all other species of *Eriococcus* in Chile by the presence of the spatulate suranal setae and 6 setae on each front femur.

At the time of collection most of the females were gravid. Neonate larvae show a conspicuous fringe of strong, marginal, enlarged setae.

The name *eurythrix* is derived from the Greek work *eury*s meaning "broad" and *thrix* meaning "hair". The name applies to the broad or spatulate suranal setae which are characteristic of this species.

Specimens Examined. CHILE, *Cautín*: 12.3 km. N. Loncoche, Jct. Pan-American Highway, XI-10-66, M. E. Irwin and E. I. Schlinger, on

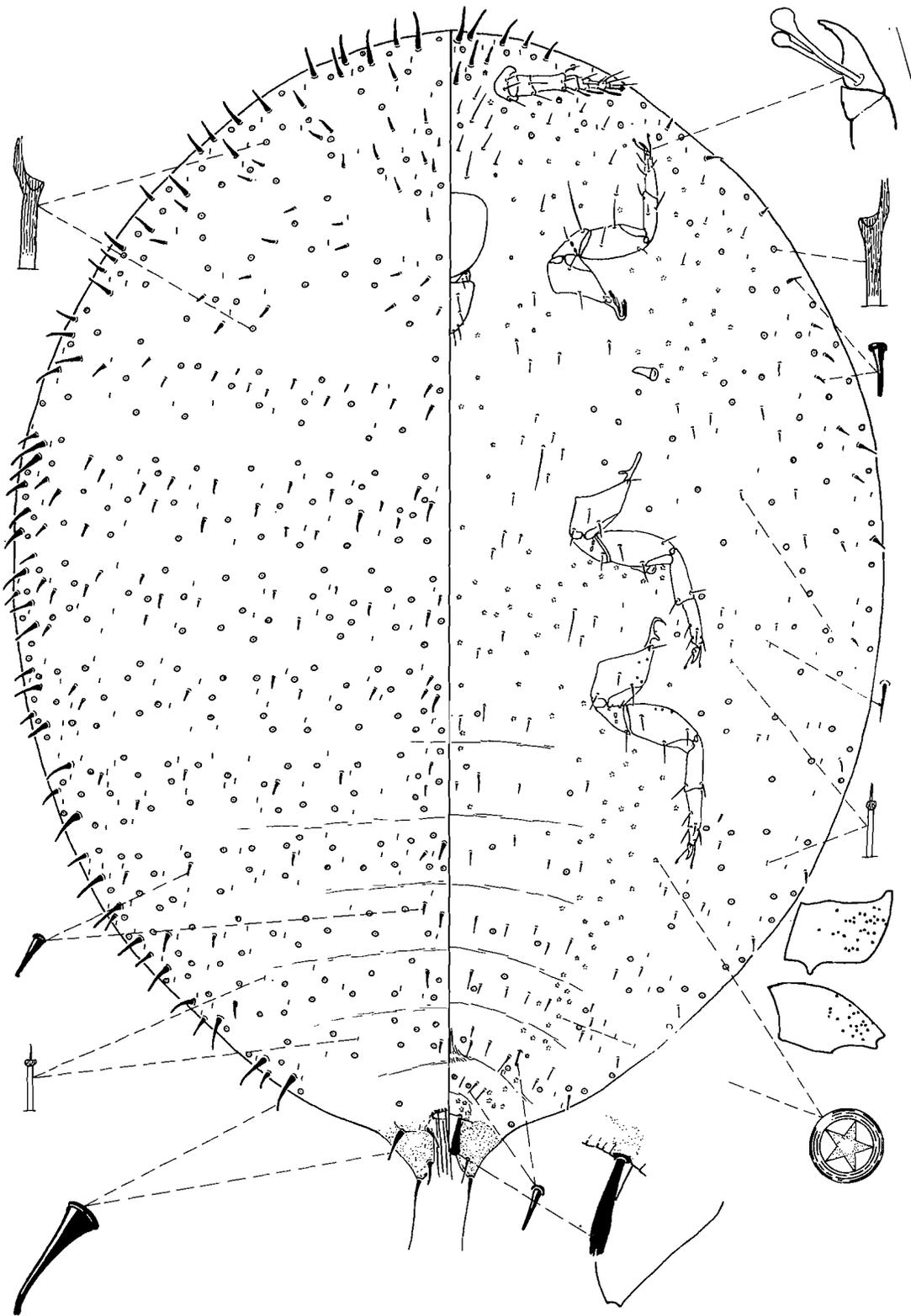


Fig. 5. *Eriococcus eurythrix* Miller and González. Near Villa Portales, Cautín, Chile, xi-25-68, R. H. González and S. W. Brown. On *Nothofagus antarctica*.

Nothofagus sp. (USNM); Pucón, XI-26-68, R. H. González and S. W. Brown, on *Nothofagus obliqua* (BM, DSIR, MNHM, USNM); near Villa Portales, XI-25-68, R. H. González and S. W. Brown, on *N. antarctica* (UCD, UCH, USNM, ZAS).

ARGENTINA, Neuquén: San Martín de los Andes, III-1-66, A. Burkart and N. Troncoso, on *N. nervosa* (USNM, VPI).

Eriococcus navarinoensis Hoy

Navarino eriococcin

(Fig. 6)

Eriococcus navarinoensis Hoy, 1962b:510.

Type Material. The type series includes 9 slides each with one specimen. The holotype and 2 paratypes have not been examined during this study. Through the courtesy of Dr. J. M. Hoy and Ms. J. A. DeBoer (formerly of DSIR, Entomology Division, Auckland, New Zealand, it has been possible to borrow 6 paratype slides. Each slide is labeled as follows: left label "Eriococcus, leaf, Nothofagus betuloides, Puerto Williams, Navarino Is., E. Godley 1958", right label "Eriococcus navarinoensis PARATYPE".

Field Features. Unknown.

Recognition Characters. As illustrated except as follows. Adult female, mounted, 1.2-2.2 mm long, 0.9-1.3 mm wide. Anal lobes with or without small medial teeth; posterior anal-lobe setae 77-91 (84) μ long.

Dorsum with enlarged setae of 2 basic sizes: Larger size present along body margin, with 2 or 3 such setae present on each lateral margin of each abdominal segment, marginal setae becoming thinner anteriorly; smaller size present in medial areas of abdomen, becoming longer and more slender anteriorly. Segment VIII with largest marginal seta 33-47 (40) μ long; segment VIII with largest medial seta 14-20 (17) μ ; longest marginal seta 2.0-3.0 (2.3) times longer than longest medial seta. Large marginal setae normally curved; small setae normally straight, rarely curved. Abdominal segment v with 19-31 (24) dorsal setae. Macrotubular ducts 23-28 (25) μ long. Microtubular ducts 8-10 (9) μ long.

Anal ring apical, not invaginated.

Venter with most body setae short and robust on abdomen, becoming longer and more slender on thorax and head; largest seta on segment VIII 18-28 (23) μ long. Macrotubular ducts of 2 kinds: Large ducts of same size as

on dorsum; small ducts 14-21 (16) μ long. Microtubular ducts present along body margin. Multilocular pores of 2 or 3 kinds: Septeloculars and triloculars rare or absent; quineloculars of 2 sizes.

Hind coxae each dorsally with 0-10 (5) pores, absent ventrally; hind femora each dorsally with 2-12 (6) pores, absent ventrally; hind tibiae each dorsally with one to 7 (5) pores, absent ventrally; each femur with 5 setae; each tibia with 4 setae; hind tibia/tarsus ratio 0.9-1.1 (1.0); hind tibia + tarsus length 168-210 (191) μ ; tarsal digitules with large, expanded, equal-sized apices; claw digitules with large, expanded, unequal-sized apices, larger digitule about same size as those on tarsi; claw with very small denticle, sometimes absent. Labium 2-segmented, apical segment faintly divided into 3rd segment; crumena 295-525 (412) μ long. Antennae 7-segmented, 182-225 (202) μ long.

Notes. The above description is based on 38 specimens from 5 localities.

This species is very similar to *Eriococcus eurythrix* and *E. rhadinotrix*. It differs from the former in lacking the spatulate suranal seta characteristic of *E. eurythrix*. *E. rhadinotrix* differs in possessing fewer enlarged setae on the posterior abdominal segments than *E. navarinoensis* and in having 9-14 (10) enlarged setae on segment v, enlarged setae on dorsomedial areas of thorax and head which are about the same size as those along body margin of abdomen, tibia/tarsus ratio 0.7-0.8 (0.7), 6-segmented antennae, large, conspicuous leg pores which are normally present on tibia, anal lobes which are larger, more slender, and more protuberant than on *E. navarinoensis*. *E. navarinoensis* possesses enlarged setae in transverse row across each posterior abdominal segment, 19-31 (24) enlarged setae on segment v, enlarged setae on dorsomedial areas of thorax and head which are noticeably more slender than those along body margin of abdomen, tibia/tarsus ratio 0.9-1.1 (1.0), 7-segmented antennae, small leg pores which are absent from tibia, anal lobes which are smaller, broader, and less protuberant than on *E. rhadinotrix*.

Specimens Examined. ARGENTINA. Neuquén: Volcán Lanín, I-31-(?), collector (?), on *Nothofagus alpina* (USNM). Tierra del Fuego: Near Harberton, Ushuaia Peninsula, XII-22-66, collector (?), on *N. betuloides* (USNM).

CHILE, Concepción: Near Concepción, 1885, P. Germain, on *N. dombeyi* (USNM). Magalla-

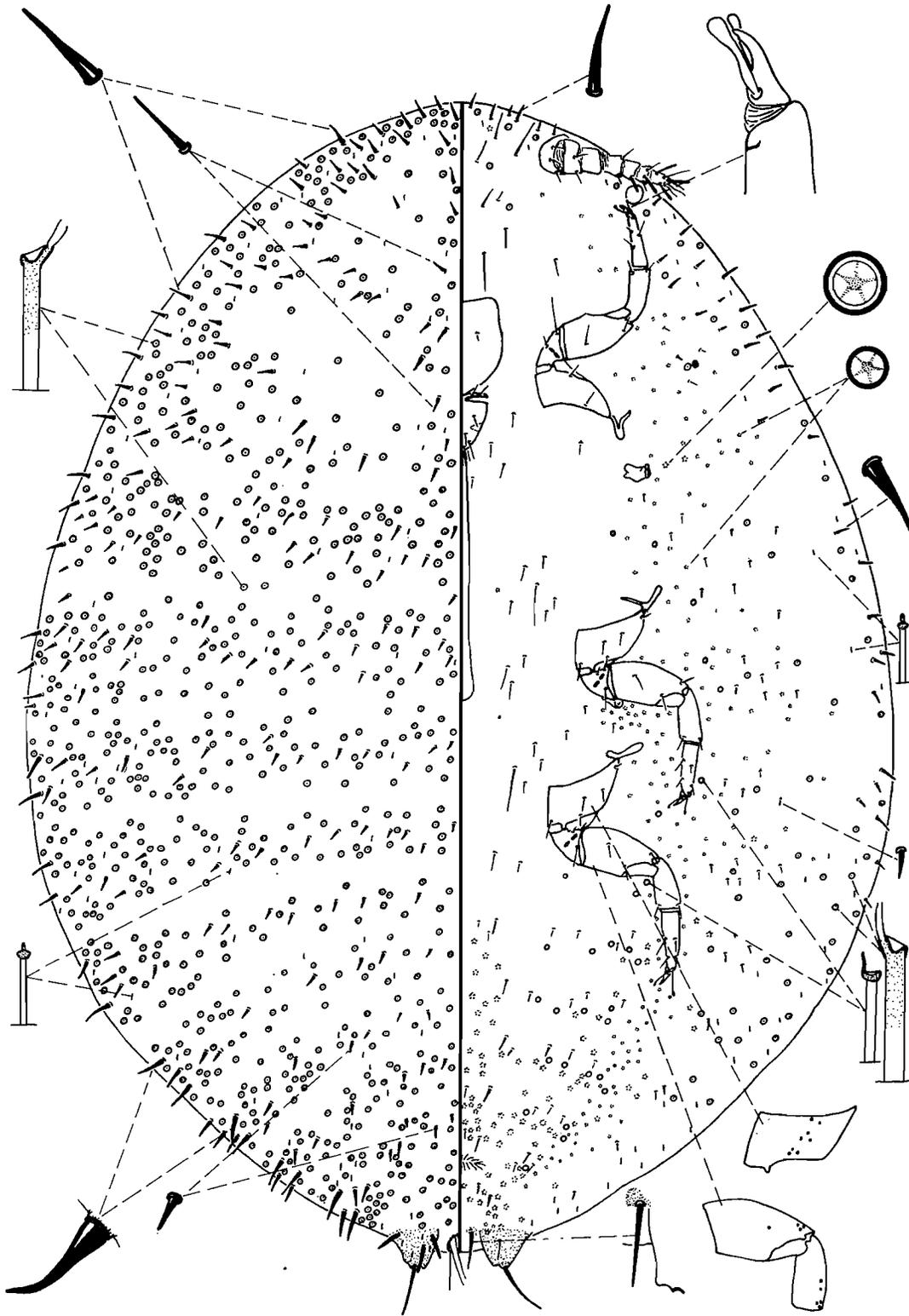


Fig. 6. *Eriococcus navarinoensis* Hoy. Puerto del Hambre, Magallanes, Chile, XII-18-71, R. H. González. On *Nothofagus dombeyi*.

nes: Puerto del Hambre, XII-18-71, R. H. González, on *N. dombeyi* (BM, UCH, USNM); Puerto Williams, Isla Navarino, 1958, E. Godley, on *N. betuloides* (DSIR).

***Eriococcus rhadinothrix* new species**

Slender seta eriococcin

(Fig. 7)

Type Material. Adult female holotype (single specimen on slide) with right label "nr. Pucón, CHILE, 26-XI-1968, ex *Nothofagus obliqua*, Coll. R. González, SWB # 667, C-9", left label "*Eriococcus rhadinothrix* Miller and González Holotype" (deposited in UCH). Four paratypes are deposited in: BM, UCD, USNM.

Field Features. Unknown.

Recognition Characters. Adult female holotype as illustrated except as follows. Mounted, 1.9 mm long, 1.3 mm wide (paratypes 2.0-2.2 mm long, 1.3-1.7 mm wide). Posterior anal-lobe setae broken (paratypes 60-88 (78) u long).

Dorsum with enlarged setae of 2 basic sizes: Larger size present over surface except for medial and mediolateral areas of abdominal segments VIII-V, normally with 2 setae on each lateral margin of each abdominal segment; smaller size present in medial areas of abdominal segments VIII-V. Segment VIII with largest marginal seta about 48 u long (paratypes 38-43 (41) u); segment VIII with largest medial seta about 10 u long (paratypes 8-13 (11) u); longest marginal seta about 4.8 times longer than longest medial seta (paratypes 3.0-5.7 (4.1) times).

Abdominal segment V with 11 (paratypes with 9-14 (10)) dorsal setae. Macrotubular ducts about 28 u long (paratypes 24-30 (27) u). Microtubular ducts about 8 u long (paratypes 8 u).

Anal ring apical, not invaginated.

Venter with body setae of abdomen only slightly enlarged, largest seta on segment VIII 23 u long (paratypes 25 u). Macrotubular ducts of 2 kinds: Large ducts of same size as on dorsum; small ducts about 20 u long. Microtubular ducts present along body margin. Multilocular pores of 3 kinds: Septeloculars and triloculars rare; quinqueloculars of 2 sizes, larger size present on medial areas of abdomen and near spiracles, smaller size present on mediolateral areas and on thorax.

Hind coxae with pores small, dorsally with 16 and 17 pores (paratypes with 18-33 (26)), ventrally with 2 and 11 pores (paratypes with one to 10 (5)); hind femora dorsally with 2 and 13 pores (paratypes with 3-14 (8)), absent ventrally; each femur with 5 setae; each tibia with 4 setae; hind tibia/tarsus ratio 0.7 and 0.8 (paratypes 0.7-0.8 (0.7)); hind tibia + tarsus length 195 and 188 u (paratypes 165-185 (175) u); tarsal digitules with expanded, equal-sized apices; claw digitules with expanded apices, with one apex noticeably larger than the other. Labium 2-segmented, basal segment small, lightly sclerotized, apical segment not divided; crumena about 200 u long. Antennae 6-segmented, 195 and 198 u long (paratypes 155-175 (170) u).

Variation. The only noticeable variation on the paratypes, not on the holotype, is the relative size of the dorsal enlarged setae. The medial and mediolateral setae on segment V are small on the paratypes.

Notes. The above description is based on 5 specimens from 3 localities.

This species is closely related to *E. eurythrix* and *E. navarinoensis*. For a comparison of these species see "Notes" under *E. eurythrix* and *E. navarinoensis*.

The name *rhadinothrix* is derived from the Greek words *rhadinos* meaning "slender" or "thin" and *thrix* meaning "hair". The name applies to the thin suranal setae on this species in contrast to the broad suranal setae of *eurythrix*.

Specimens Examined. CHILE. *Cautín*: Pucón, XI-26-68, R. H. González and S. W. Brown, on *Nothofagus obliqua* (BM, UCD, UCH, USNM); Volcán Llaima, II-1927, E. Werdermann, on *N. dombeyi* (USNM). *Concepción*: near Concepción, 1855, P. Germain, on *N. dombeyi* (USNM).

***Eriococcus tholothrix* new species**

Dome seta eriococcin

(Fig. 8)

Type Material. Adult female holotype (single specimen on slide) with right label "*Eriococcus tholothrix* Miller and González, Holotype", left label "En *Nothofagus dombeyi* 'Coigue', 5 km Termas de Chillán, Ñuble, CHILE, 22-XI-1968 Nov., Col. R. H. González. Lot. 52-68." (deposited in UCH). Two paratypes are deposited in: BM, USNM.

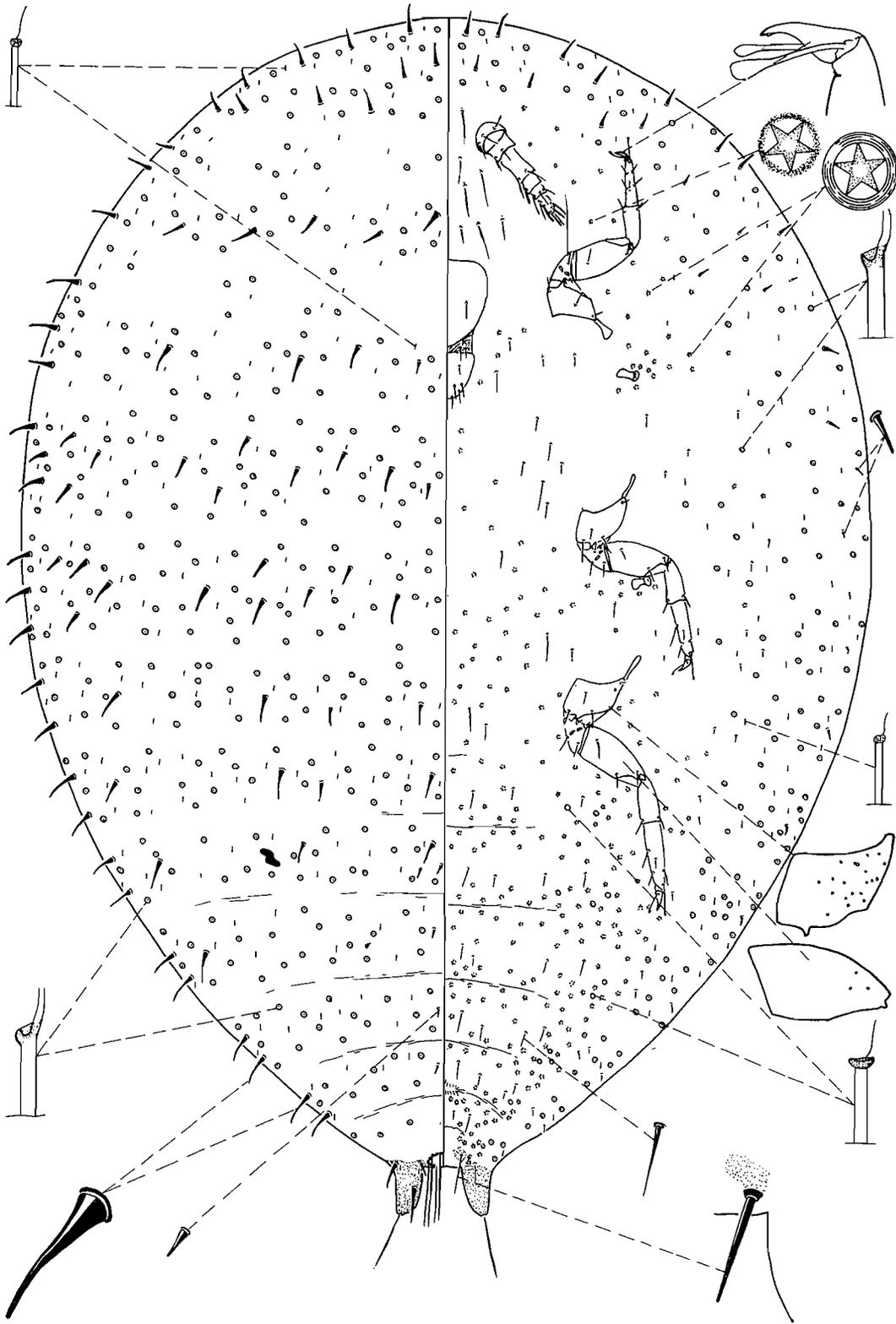


Fig. 7. *Eriococcus rhadinotrix* Miller and González. Pucón, Cautín, Chile, xi-26-68, R. H. González and S. W. Brown. On *Nothofagus obliqua*.

Field Features. The adult female produces a felted, gray ovisac on the undersides of the leaves of the host.

Recognition Characters. Adult female holotype as illustrated except as follows. Mounted, 1.4 mm long, 1.1 mm wide (paratypes 1.2 mm long, 0.8 mm wide). Posterior anal-lobe setae broken (paratypes about 115 u long). Anal lobes smooth.

Dorsum with enlarged setae of 3 basic sizes: Larger size forming 4 pairs of longitudinal lines on abdomen, scattered over thorax and head; intermediate size scattered over surface; smaller size restricted to lateral areas. Enlarged setae characteristically shaped, those of large and intermediate sizes dome shaped. Segment VIII with largest dome-shaped seta about 13 u long (paratypes about 15 u); segment VIII with largest lateral seta about 20 u long (paratypes about 25 u); longest lateral seta 1.6 times longer than longest dome-shaped seta (paratypes about 1.7 times). Slender body setae also present on segments VIII-VI. Abdominal segment V with 24 dorsal setae. Macrotubular ducts about 20 u long. Microtubular ducts about 8 u long.

Anal ring dorsal, touching apex of abdomen, not invaginated.

Venter with body setae on abdomen slightly enlarged, becoming more slender on thorax and head; largest seta on segment VIII about 23 u long (paratypes about 25 u). Macrotubular ducts of 2 sizes: Large ducts of same size as on dorsum; small ducts about 10 u long, restricted to mediolateral area of abdomen. Microtubular ducts present along body margin. Multilocular pores vary from triloculars to octoloculars, quinqueloculars most abundant type, of one size.

Hind coxae each dorsally with 40 and 27 pores (paratypes with 51 and 44); hind femora each with zero and one por dorsally, without pores ventrally (paratypes without femoral pores); hind 2 pairs of femora each with 4 setae, front pair each with 5 or 6; each tibia with 4 setae; hind tibia/tarsus ratio 1.0; hind tibia + tarsus length 205 u (paratypes 198 and 203 u); tarsal digitules with large, expanded, equal-sized apical; claw digitules with large, equal-sized apices about same size as tarsal digitules; with small denticle. Labium 2-segmented, segment nearest clypeus small, unsclerotized; crumena broken. Antennae 7-segmented, one antenna on holotype and one on paratype with 3rd and 4th

segments partially fused; antennae 233 and 216 u long (paratypes 210 and 225 u).

Notes. The above description is based on 3 specimens from one locality. A single poor specimen from Frutillar is tentatively placed as this species.

This species differs from all other species of *Eriococcus* in Chile in possessing characteristic dome-shaped setae and in having 4 setae, on each hind femur.

The name *tholothrix* is derived from the Greek words *tholos* meaning "dome" and *thrix* meaning "hair" or "seta". The name refers to the characteristic shape of the dorsal enlarged setae of this species.

Specimens Examined. CHILE, Llanquihue, Frutillar, 1-27-65, R. H. González and R. Charlin, on *Eucryphia cordifolia* (Eucryphiaceae) (UBNM). *Núcle:* 5 km W Termas de Chillán, XI-22-68, R. H. González and S. W. Brown, on *Nothofagus dombeyi* (UCH, USNM).

Exallococcus Miller and González, n. gen.

Type-species. *Exallococcus laureliae* n. sp.

Diagnosis. Anal lobes heavily sclerotized, with longitudinal fold. Enlarged setae and body setae present on dorsum. Macrotubular ducts with oral rims only slightly invaginated, present on dorsum only. Microtubular ducts present on dorsum only. Dorsomedial area of abdominal segment VIII sclerotized. Dorsum with many simple pores. Anal ring invaginated in apex of abdomen. Multilocular and cruciform pores present on venter only. Labium one-segmented. Antennal segments not constricted basally. Femora and tibiae with reduced numbers of setae. Claw and tarsal digitules with apices only slightly expanded. Claw with denticle.

Notes. This is an extremely unusual eriococcid. The shape of the antennal segments, the invaginated anal ring, the longitudinal fold on the anal lobes all suggest placement in a different family. However, the presence of typical microtubular ducts and cruciform pores immediately place it in the Eriococcidae.

The unusual macrotubular ducts and the simple pores on the dorsum separate this genus from all but a few known eriococcids. The same type of macrotubular duct is known to occur on "*Eriococcus*" *buxi* (Fonscolombe), and the simple pores occur on *Eriococcus serratilobis prominens* Green.

The generic name is masculine and is derived from the Greek word *exallos* meaning

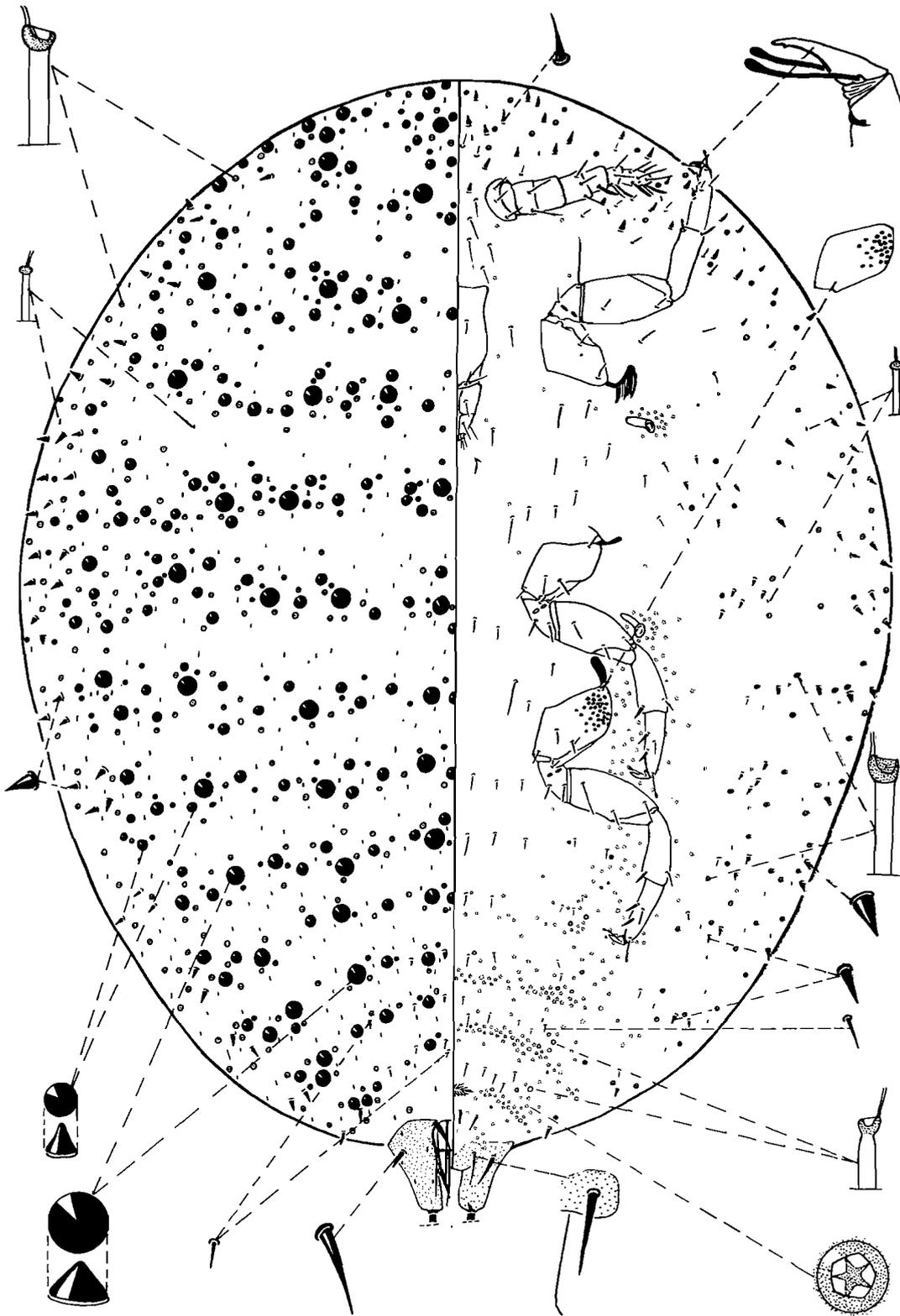


Fig. 8. *Eriococcus tholothrix* Miller and González. 5 mi. W. Termas de Chillán, Ñuble, Chile, XI-22-68, R. H. González and S. W. Brown. On *Nothofagus dombeyi*.

"different". The name refers to the very different morphological features exhibited by this unusual eriococcid.

Exallococcus laureliae new species

Laurel eriococcin
(Fig. 9)

Type Material. Adult female holotype (on slide with first instar nymph) with right label "Frutillar, Llanquihue, Chile 27-I-1965 ex *Laurelia sempervirens*, R. H. González & R. Charlin", left label "*Exallococcus laureliae* Miller and González Holotype Paratype" (deposited in UCH). Four paratypes are deposited in: BM, UCD, UCH, USNM.

ADULT FEMALE

Field Features. Females occur on the undersides of leaves of *Laurelia*.

Recognition Characters. Adult female holotype as illustrated except as follows. Mounted, 1.7 mm long, 1.3 mm wide (paratypes 1.2-1.8 mm long, 0.8-1.4 mm wide). Posterior anal-lobe seta broken (paratypes 75-130 (94) u long). Anal lobes each with a longitudinal fold. Dorsum of abdominal segment IX sclerotized medially.

Dorsum with enlarged setae on one size, with longitudinal lines in medial and lateral areas; mediolateral area with setae randomly scattered. Segment VIII with largest seta about 68 u long (paratypes 60-63 (63) u). Abdominal segment V with 7 (paratypes with 6-8 (7)) dorsal setae. With a few body setae. Macrotubular ducts of unusual size and shape for an eriococcid, with dermal ring similar to oral-rim tubular ducts of some pseudococcids, with slightly invaginated basal area, about 40 u long (paratypes 34-38 (36) u). Microtubular ducts about 18 u long (paratypes 11-15 (13) u). Simple pores scattered over medial and mediolateral areas.

Anal ring apical, slightly invaginated.

Venter with most body setae of abdomen definitely enlarged, largest seta on segment VIII 23 u long (paratypes 20-25 (23) u). Macro- and microtubular ducts absent. Multilocular pores of 2 kinds, arranged in longitudinal band in mediolateral area: Septeloculars rare; quinqueloculars abundant. Cruciform pores present in longitudinal band near body margin.

Hind coxae with large, indefinite pores on dorsal and ventral surfaces; hind femora without

pores; each femur with 3 setae; tibiae of posterior 2 pairs of legs each with 2 setae, anterior tibiae each with 3; hind tibia / tarsus ratio 0.6 and 0.7 (paratypes 0.6-0.7 (0.6)); hind tibia + tarsus length 155 and 165 u (paratypes 158-165 (161) u); tarsal digitules with only slightly expanded apices; claw digitules with slightly expanded, equal-sized apices, noticeably smaller than those on tarsus. Labium one-segmented; crumena about 366 u long (paratypes 335-445 (385) u). Antennae with individual segments not basally constricted as is typical of most eriococcids, 6 segmented, 220 and 240 u long (paratypes 208-220 (217) u).

Variation. There is a small amount of variation in the enlarged setae.

Notes. The above description is based on 4 specimens from 2 localities.

This species is separated from all other eriococcids in having unusual anal lobes, unusual macrotubular ducts, no ventral macro- or microtubular ducts, one-segmented labium, 3 setae on each femur, 3 setae on each front tibia, 2 tibiae on each hind tibia.

The name *laureliae* refers to the host plant *Laurelia*.

Specimens Examined. CHILE, Llanquihue: Frutillar, 1-27-65, R. H. González and R. Charlin, on *Laurelia sempervirens* (Monimiaceae) (UCH). Osorno, Purranque, VII-8-64, R. H. González, on *L. sempervirens* (BM, UCD, USNM).

FIRST INSTAR

(Fig. 10)

Recognition Characters. Mounted, 0.6 mm long, 0.3 mm wide. Posterior anal-lobe setae 80 and 83 u long. Anal lobes each with longitudinal fold. Small sclerotized area between anal lobes.

Dorsum with enlarged setae of one size, with longitudinal lines in medial and lateral areas, absent elsewhere. Segment VIII with largest seta about 45 u long. Abdominal segment V with 6 dorsal setae. Body setae present in small numbers. Macrotubular ducts absent. Microtubular ducts 10 u long. Simple pores weakly indicated, scattered over surface.

Anal ring apical, not invaginated.

Venter with body setae slightly enlarged, largest seta on segment VIII about 10 u long. Macrotubular ducts absent. Microtubular ducts restricted to body margin. Multiloculars of quinquelocular type only, present in longi-

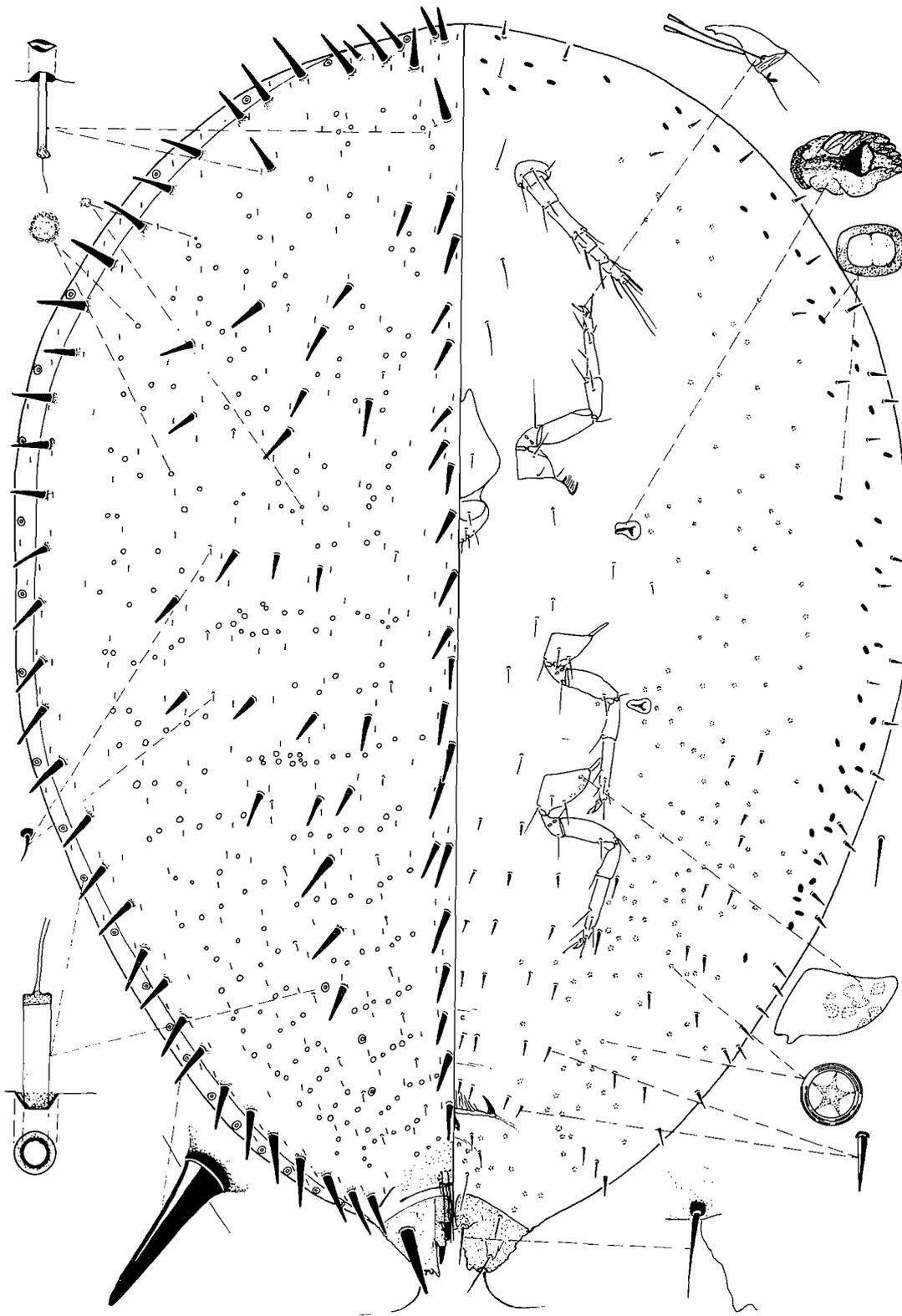


Fig. 9. *Exallococcus laureliae* Miller and González (adult female). Frutillar, Llanquihue, Chile, 1-27-65, R. H. González and R. Charlin. On *Laurelia sempervirens*.

tudinal band in mediolateral areas. Cruciform pores present near body margin on anterior abdominal segments and thorax.

Legs without pores; femora each with 3 setae; hind tibiae each with 2 setae, front tibiae absent; hind tibia / tarsus ratio 0.6 and 0.7; tibia + tarsus length 110 and 113 u; tarsal and claw digitules as in adult female. Labium one-segmented. Antennae 6 segmented, about 155 u long.

Notes. The above description is based on one specimen.

The presence of dorsal simple pores and the characteristic anal lobes distinguish the first instar of this genus from those of all other eriococcid genera.

Icelococcus Miller and González, n. gen.

Type-species. *Icelococcus nothofagi* n. sp.

Diagnosis. Anal lobes heavily sclerotized and rugose, with many medial teeth and 3 dorsal enlarged setae. Triangular plate present on dorsum anterior to lobes. Macrotubular ducts entirely absent, or absent from dorsum. Microtubular ducts scattered over dorsum. Cruciform pores present along submargin of venter. Multilocular pores primarily of quinquelocular type, restricted to venter. Labium distinctly 3-segmented.

Notes. This genus is remarkably similar to the New Zealand genus *Phloeococcus* Hoy. Both genera have large sclerotized anal lobes with many medial teeth, a dorsal triangular plate between the anal lobes, and few or no macrotubular ducts. *Icelococcus* differs in having: 3 enlarged setae on dorsum of each anal lobe, ventrolateral cruciform pores, multilocular pores primarily with 5 loculi. *Phloeococcus* has: 10 or 11 enlarged setae on dorsum of each anal lobe, no cruciform pores, multilocular pores primarily with 7 or 9 loculi.

Icelococcus is also similar to *Madarococcus* Hoy but differs in having a dorsal triangular plate between the anal lobes and a submarginal band of ventral cruciform pores; *Madarococcus* lacks both of these characters.

The generic name is masculine and is derived from the Greek work *ikelos* meaning "like". The name refers to the remarkable similarity of this genus to *Madarococcus* and *Phloeococcus*.

KEY TO SPECIES OF *ICELOCOCCUS* IN CHILE

1. Macrotubular ducts present on venter; hind coxae not greatly expanded
..... *charlini* Miller and González, n. sp.
- Macrotubular ducts absent on venter; hind coxae greatly expanded
..... *nothofagi* Miller and Gonzalez, n. sp.

Icelococcus charlini new species

Charlin eriococcin
(Fig. 11)

Type Material. Adult female holotype (single specimen on slide) with right label "*Icelococcus charlini* Miller & González Holotype", left label "En hojas de *Notophagus obliqua*, cerca de Pucón, Cautín, CHILE, 20-Nov.-1968 (Nov.) Col. R. H. González. (C-9) Lot. 53-68" (deposited in UCH).

Field Features. Unknown.

Recognition Characters. Adult female holotype as illustrated except as follows. Mounted, 2.3 mm long, 2.2 mm wide. Anal lobes very rugose. Posterior anal-lobe setae broken. Dorsal area between anal lobes with triangular plate.

Dorsum with enlarged setae of 2 basic sizes: Larger size present along body margin, with 3 or 4 setae on each lateral margin of each abdominal segment, and with large-sized setae also present in longitudinal line in medial area; smaller size present in small numbers over remainder of surface. Segment VIII with largest marginal seta about 35 u long; segment VIII with longest medial seta about 33 u long; longest marginal seta about same length as longest medial seta. Abdominal segment V with 12 dorsal setae. Macrotubular ducts absent. Microtubular ducts about 9 u long.

Anal ring apical, not invaginated, with 4 pairs of broad setae and numerous pores.

Venter with enlarged setae in transverse row from body margin to area just anterior of antennae; body setae slender, largest seta on segment VIII 40 u long. Macrotubular ducts present in mediolateral band, of one kind, about 25 u long. Microtubular ducts restricted to anterior portion of head. Multilocular pores of 2 kinds: Triloculars rare; quinqueloculars most abundant pore type, present submedially on abdomen and posterior thorax, present sublaterally near body margin except on head. Cruciform pores present in submarginal band.

Hind coxae dorsally with 12 and 7 pores, ventrally with one; hind femora each with

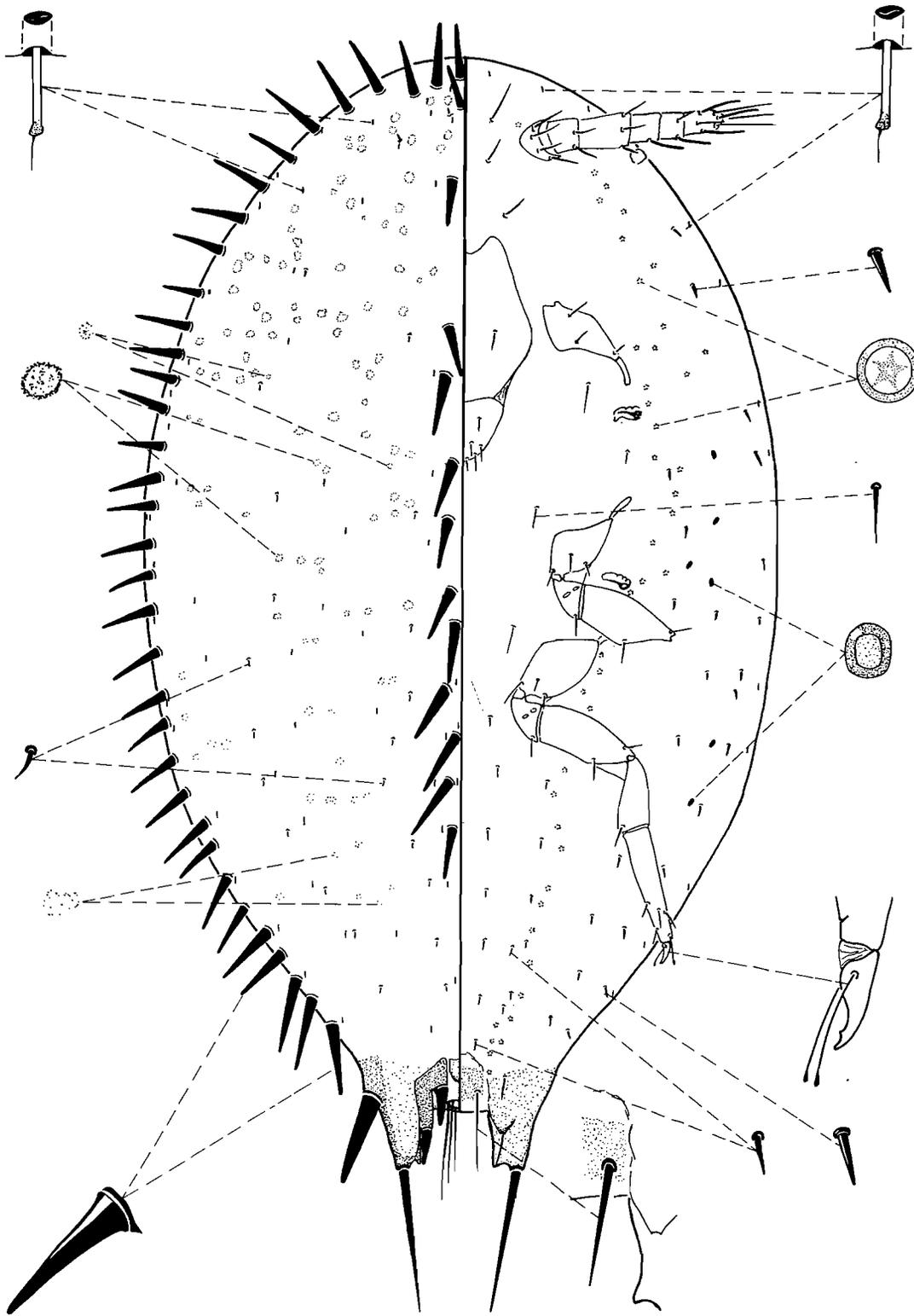


Fig. 10. *Exallococcus laureliae* Miller and González (first instar larva). Same data as for figure 9.

2 and 3 pores, absent ventrally; each femur with 5 setae; hind 2 pairs of tibiae each with 4 setae, front tibiae each with 5; tibia / tarsus ratio 0.6 and 0.7; hind tibia + tarsus length 124 and 135 u; tarsal digitules with expanded, equal-sized apices; claw digitules with small, expanded, equal-sized apices, smaller than apices of tarsal digitules; claw with small denticle. Labium with 3 conspicuous segments; crumena broken. Antennae 6-segmented, left antenna 163 u long, right antenna with apical segment broken.

Notes. The above description is based on one specimen.

This species differs from *I. nothofagi* in having ventral macrotubular ducts, fewer coxal and femoral pores, smaller legs, and 6-segmented antennae; *I. nothofagi* has no macrotubular ducts and normally has 7-segmented antennae.

This species is named in honor of Prof. Raimundo Charlin who has assisted the junior author in the survey of Chilean scale insects.

Specimens Examined. CHILE. *Cautín*: near Pucón, XI-26-68, R. H. González, on *Nothofagus obliqua* (UCH).

***Icelococcus nothofagi* new species**

Chile *Nothofagus eriococcin*
(Fig. 12)

Type Material. Adult female holotype (single specimen on slide) with right label "10 mi. W. Ancud, on Rd to Castro, Chiloé Prov., CHILE, 28-XI-1968 ex *Nothofagus dombeyi* Coll. R. González", left label "*Icelococcus nothofagi* Miller and González Holotype" (deposited in UCH). Six paratypes are deposited in: BM, DSIR, UCD, UCH, USNM, ZAS.

Field Features. The adult females occur in the twig axils of *Nothofagus*. The adult female is dark grey and does not form an ovisac.

Recognition Characters. Adult female holotype as illustrated except as follows. Mounted, 2.9 mm long, 1.6 wide (paratypes 2.8-3.0 mm long, 1.5-1.7 mm wide). Anal lobes very rugose. Posterior anal-lobe setae broken on all but 2 paratypes 128-150 u long. Dorsal area between anal lobes with triangular plate.

Dorsum with derm nodulose, especially on last two segments; en-larged setae of 2 basic sizes: Larger size present along body margin, with 3-5 setae present on each lateral margin of each abdominal segment; smaller size

present on rest of dorsum. Segment VIII with largest marginal seta about 83 u long (paratypes 76-80 (78) u); segment VIII with largest medial seta about 38 u long (paratypes 33-36 (35) u); longest marginal seta about 2.2 times longer than longest medial seta (paratypes 2.2-2.3 (2.3) times). Abdominal segment v with 32 (paratypes with 31-32 (31)) dorsal setae. Macrotubular ducts absent. Microtubular ducts 20 u long (paratypes 19-22 (21) u).

Anal ring apical, not invaginated, with 4 pairs of broad setae and numerous pores.

Venter with body setae slender, largest seta on segment VIII 85 u long (paratypes 75-85 (81) u). Macrotubular ducts absent. Microtubular ducts present along body margin. Multitubular pores of 3 kinds: Septeloculars and triloculars rare; quinqueloculars abundant. Cruciform pores present in submarginal band.

Hind coxae with numerous large granular pores on both surfaces; hind femora each dorsally with 9 and 16 pores (paratypes with 17-31 (25)), ventrally with 3 and 11 (paratypes with 5-16 (12)); each femur with 5 setae; hind 2 pairs of tibiae each with 4 setae, front tibiae each with 5; hind tibia / tarsus ratio 0.6 (paratypes 0.7); hind tibia + tarsus length about 263 u (paratypes 270-275 (273) u); tarsal digitules with large, expanded, equal-sized apices; claw digitules with small, expanded, equalsized apices, much smaller than apices of tarsal digitules; claw with small denticle. Labium with 3 conspicuous segments; crumena about 519 u long (paratypes 439-519 (482) u). Antennae 7-segmented, 323 and 311 u long (paratypes 305-329 (320) u).

Variation. Two paratypes have a 6-segmented antenna on one side and 7 on the other.

Notes. The above description is based on 7 specimens from one locality.

For a comparison of this species with *I. charlini* see "Notes" under that species.

The name *nothofagi* refers to the host *Nothofagus*.

Specimens Examined. CHILE, *Chiloé*: 10 mi. S. Ancud, road to Castro, XI-28-68, R. H. González, on *Nothofagus dombeyi* (BM, DSIR, UCD, UCH, USNM, ZAS).

***Stibococcus* Miller and González, n. gen.**

Type-species. *Stibococcus cerinus* n. sp.

Diagnosis. Adult female with anal lobes small, normally not protruding. Macrotubular

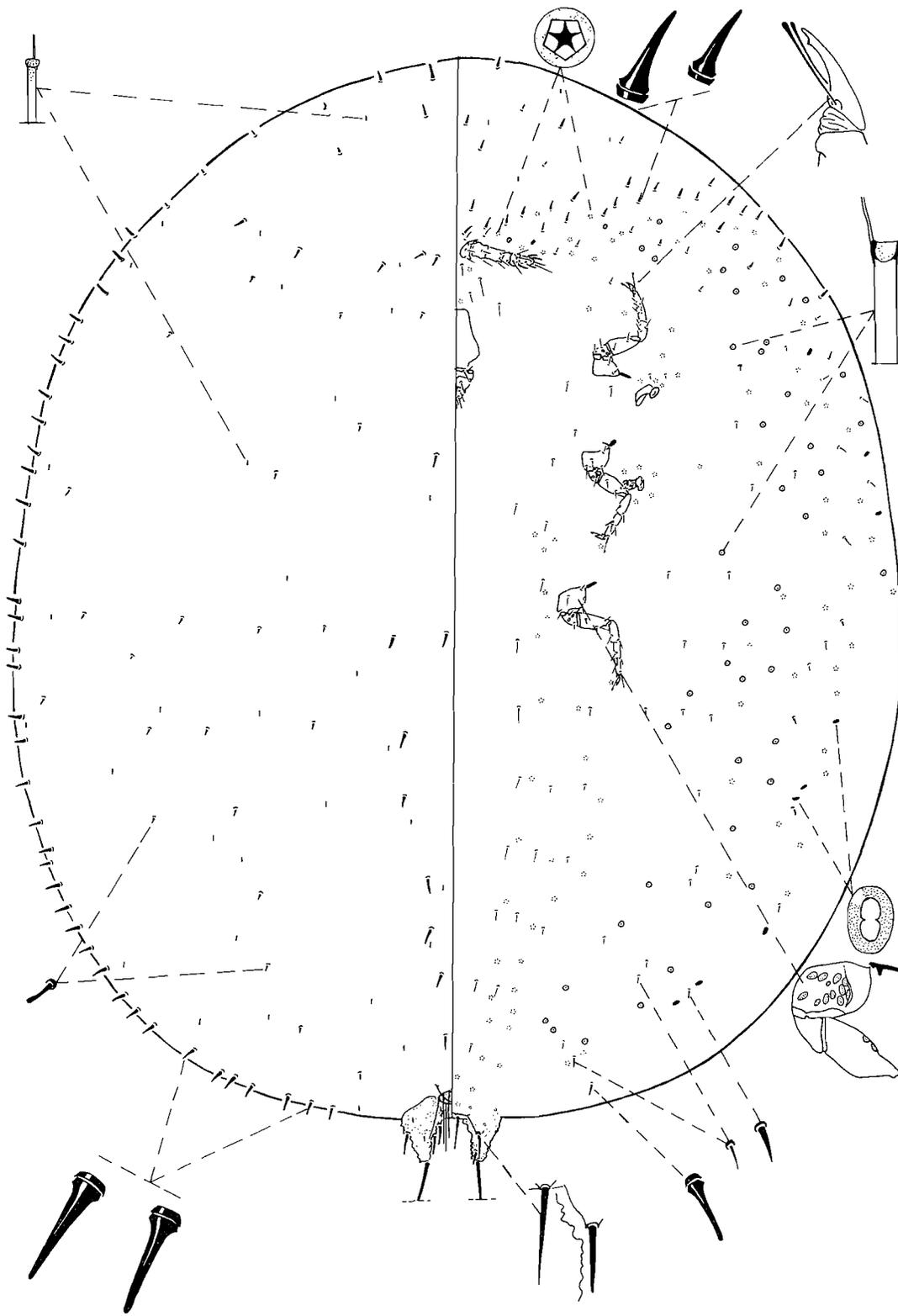


Fig. 11. *Icelococcus charlini* Miller and González. Near Pucón, Cautín, Chile, xi-26-68, R. H. González. On *Nothofagus obliqua*.

ducts with characteristic sclerotized dermal rim, those on dorsum unusually large, those on venter in large clusters. Labium one-segmented. Forming a characteristic ovisac beneath and behind the body of the adult female.

Notes. The unusual macrotubular ducts, small anal lobes, one-segmented labium, and characteristic ovisac easily distinguish *Stibococcus* from all other eriococcid genera known to us.

The generic name is masculine and is derived from the Greek word *stibos* meaning "path" or "track" which refers to the long wax trail or ovisac produced by the adult female.

Stibococcus cerinus new species

Wax trail eriococcin
(Fig. 13, Photo. 2)

Type Material. Adult female holotype (specimen on lower right hand side of slide) with right label indicating position of holotype and stating "*Stibococcus cerinus* Miller & González Holotype Paratypes", left label "Underside leaves *Myrceugenia bridgesii* (Hook et Arn.) Berg 'petra' (Myrtaceae) Cajón Río Claro; 1,150 m., cordillera Curicó, CHILE, 9 October 1966, R. H. González, colr. Colección Universidad de Chile Lot 57-66" (deposited in UCH). Eight paratypes and an allotype are deposited in: UCH, USNM.

Field Features. The adult female is naked, shiny, and pale green. Eggs are laid in a elongate ovisac which may be as much as 7 or 8 times the length of the adult female body. The ovisac is produced from wax glands on the underside of the female in *Pulvinaria* fashion. Slender crystalline rods are visible around the margin of the body. Immatures feed on the undersides of leaves causing a gall-like distortion which is normally visible from above.

Recognition Characters. Adult female holotype as illustrated except as follows. Mounted, 1.5 mm long, 1.1 mm wide (paratypes 1.2-1.8 mm long, 0.9-1.5 mm wide). Posterior anal-lobe setae 120 and 125 u long (paratypes 88-153 (117) u). Anal lobes smooth, slightly protruding.

Dorsum with enlarged setae of 2 sizes: Larger size present along body margin and on dorsomedial area of abdomen; smaller size present elsewhere. Segment VIII with largest seta 43 u long (paratypes 38-43 (41) u). Abdominal segment V with 14 (paratypes 15-

18 (16)) dorsal setae. Macrotubular ducts with a raised, sclerotized, dermal rim, about 38 u long (paratypes 35-38 (36) u). Microtubular ducts about 6 u long (paratypes 6-8 (7) u).

Anal ring ventral, with 4 or 5 associated setae, not invaginated.

Venter with body setae slender, longest seta on segment VIII about 25 u long (paratypes 20-25 (23) u). Macrotubular ducts of 2 sizes noticeably smaller than those on dorsum: Larger size with small, sclerotized or unsclerotized dermal rim, restricted to anterior abdominal segments and to posterior thoracic segments; smaller size with sclerotized dermal orifice, abundant on abdomen. Microtubular ducts of same size as on dorsum. Multiloculars of 2 kinds: Triloculars rare; quinqueloculars common.

Hind coxae and femora with many pores on both surfaces; each femur with 5 setae; each tibia with 4 setae; hind tibia / tarsus ratio 1.3 and 1.4 (paratypes 1.3-1.6 (1.4)); tibia + tarsus length 180 and 183 u (paratypes 193-210 (201) u); tarsal digitules with large, expanded, equal-sized apices; claw digitules with enlarged, equal-sized apices, noticeably smaller than apices of tarsal digitules; claw with small, subapical denticle. Labium one-segmented, with no indication of small basal segment normally seen on eriococcids; crumena broken on holotype (paratypes 125-138 (133) u long). Antennae 213 and 230 u long (paratypes 218-273 (238) u).

Variation. Most paratypes have posterior anal-lobe setae with slightly expanded apices; the anal lobes normally do not protrude; the hind tibiae frequently have pores on the dorsal surface; the third antennal segment is sometimes partially divided indicating that some specimens, collected in the future, may have 7-segmented antennae.

Notes. The above description is based on 6 specimens from one locality.

This species differs from all other Chilean eriococcids as indicated under "Notes" of the generic treatment of *Stibococcus*. Characters which may be of importance at the species level are: 6-segmented antennae, one-segmented labium, hind tibia/tarsus ratio about 1.4.

The name *cerinus* is Greek meaning "waxen" and refers to the long wax ovisac of the adult female.

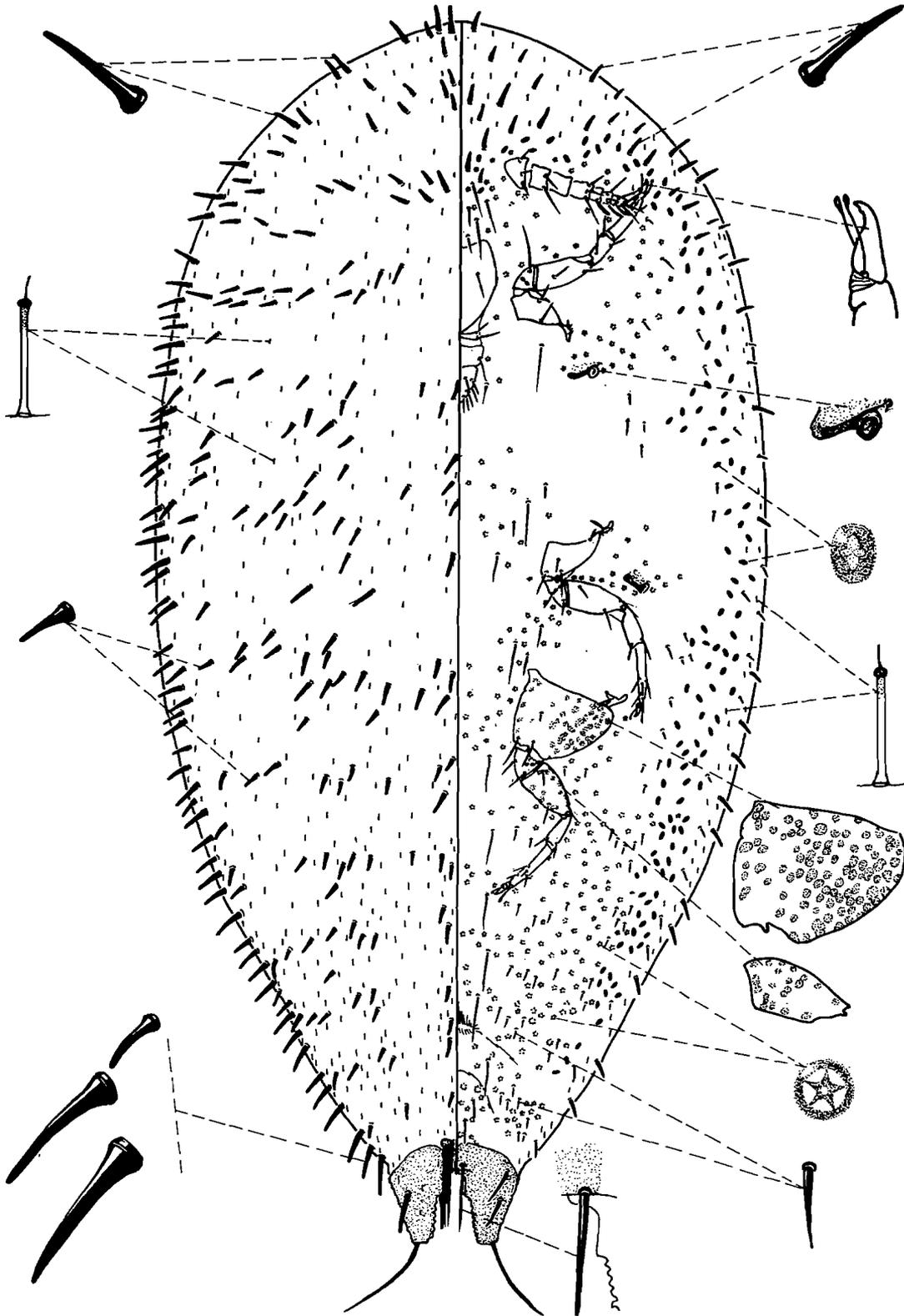


Fig. 12. *Icelococcus nothofagi* Miller and González. 10 μ m, S. Ancud, road to Castro, Chiloé, Chile, XI-28-68, R. H. González. On *Nothofagus dombeyi*.

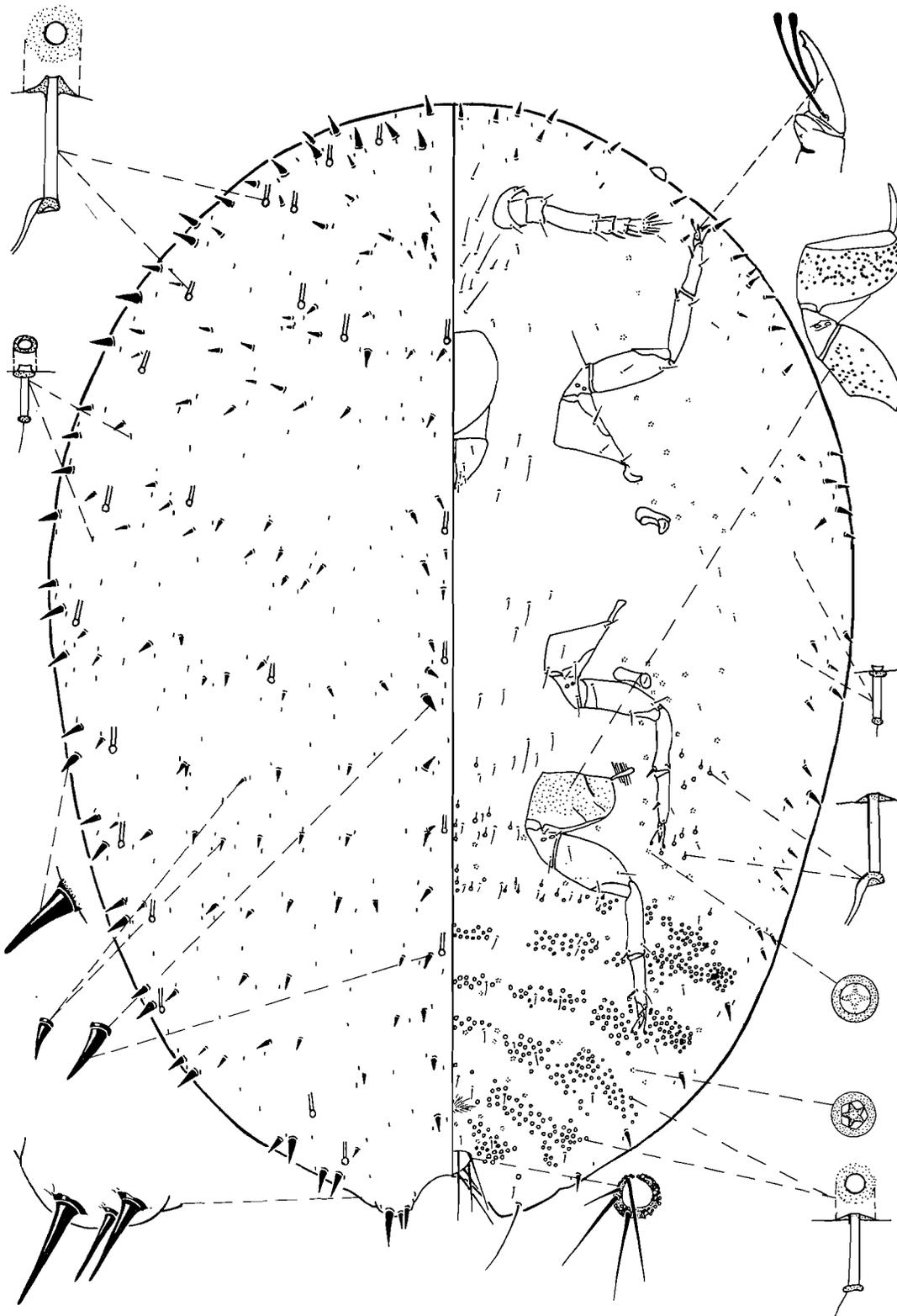


Fig. 13. *Stibococcus cerinus* Miller and González (adult female). Cajón Río Claro, cordillera Curicó, 1,150 m., Curicó, Chile, x-9-66, R. H. González. On *Myrceugenia bridgesii*.

Specimens Examined. CHILE, Curicó: Cañón Río Claro, cordillera Curicó, 1,150 m., x-9-66, R. H. González, on *Myrceugenia bridgesii* (Myrtaceae) (UCH, USNM).

FIFTH INSTAR MALE (ADULT) (Fig. 14)

Recognition Characters. Same as illustration except as follows. Mounted, 1.2-1.3 mm long, 0.4 mm wide. Segment ix slightly produced laterally giving lobular appearance. Alate form only.

Dorsum with one pair of tail-forming pore clusters, each cluster with 2 slightly capitate setae, 90-105 (95) μ long, and 75-102 (84) multilocular pores. Multilocular pores restricted to tail-forming pore clusters, with 3-7 loculi, quinqueloculars most abundant. X type pores present near apex of head near midcranial ridge. Body setae unusually numerous for an eriococcid, about same length as those on venter, in conspicuous clusters near body margin of abdomen. Hamulohalterae absent. Mesothoracic wings without setae near base of wing. Dorsal eye approximately 38 μ in diameter. Lateral ocellus about 18 μ in diameter, touching postocular ridge.

Penial sheath weak indication of division, 110-116 μ long. Width/length ratio of capsule 0.9. Aedeagus broken on both specimens, bulbous proximally.

Venter with body setae numerous. Ventral arm of midcranial ridge weakly indicated. Preocular ridge sometimes difficult to discern. Ocular sclerite lightly sclerotized or unsclerotized. Lateral areas of thorax badly damaged, unclear. Cranial apophysis bifurcate. Ventral eye about 40 μ in diameter.

Legs about same length; hind tibia/tarsus ratio 2.7-2.9 (2.9); tarsal and claw digitules capitate; claw denticle small or absent. Antennae 10-segmented, 769-811 μ long; third segment longest, 2.6 times longer than apical segment; apical segment rounded distally. Fleishy setae absent, capitate setae restricted to segment 10.

Notes. The above description is based on 2 specimens from one locality.

FOURTH INSTAR MALE (PUPA) (Fig. 15)

Field Features. Second instar males tend to aggregate in clusters on the leaves before forming the male sac. The second through fifth

instars occur in these sacs until the adult emerges and begins searching for adult females.

Recognition Characters. Same as illustration except as follows. Mounted, 1.2 mm long, 0.4 mm wide.

Dorsum with setae becoming increasingly less robust anteriorly; largest seta on segment ix about 20 μ long. Abdominal segment v with 12 dorsal setae. Lateral areas of segments x-vi or v lightly sclerotized. Hamulohalterae absent. Front wing buds 543-561 (553) μ long. Dorsal eyes and lateral ocellus weakly indicated.

Penial sheath with weak indication of lateral division, sclerotized dorsally and ventrally; anal opening dorsal. Genital opening indicated by small projection on venter. Width/length ratio of capsule 1.2-1.3.

Venter with lateral areas of segments x-viii sclerotized. Multilocular pores variable, with 3-8 loculi. Body setae slightly shorter than those on dorsum, robust setae restricted to posterolateral areas. Mouth and ventral eyes weakly discernible.

Legs with setae difficult to see; hind tibia/tarsus + claw ratio 1.6-1.9 (1.7); tibia + tarsus + claw length 235-255 (250) μ long. Antennal segmentation unclear, 500-519 (509) μ long.

Notes. The above description is based on 2 specimens from one locality.

DISCUSSION

It is obvious to us that this treatment encompasses only a small sample of the total eriococcid fauna of Chile. Furthermore, this sample is biased in that most collections were made from the host plant *Nothofagus*. In light of this, any statements presented in this section must be considered as tentative.

The sample examined suggests some interesting ideas relative to the origin of the Chilean eriococcid fauna and perhaps even to the origin of the family Eriococcidae. As a part of the New World fauna, the Chilean eriococcids are unique in resembling New Zealand species rather than those from the rest of the New World. Although the similarity of these geographically distant biotas has been reported on many other occasions (e.g., Philippi, 1872; Darlington, 1965), it has not been investigated in detail in relation to scale insects. Morphological features characteristic of Chilean and New Zealand eriococcid faunas, but not of the North American and northern South American

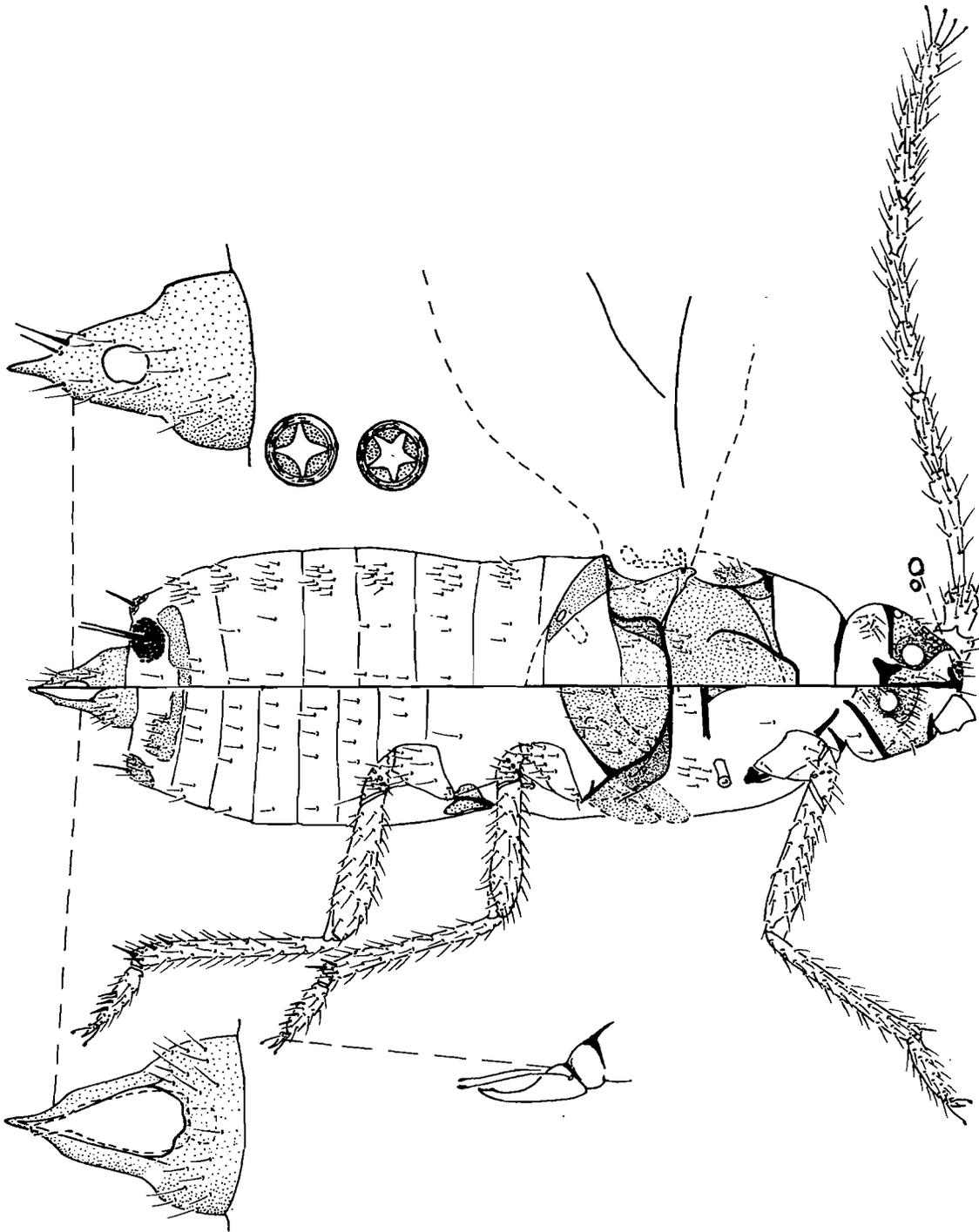


Fig. 14. *Stibococcus cerinus* Miller and González (adult male). Same data as for figure 13.

faunas, are as follows: The suranal setae are spatulate; the dermal area surrounding the base of the suranal seta is sclerotized; a sclerotized triangular plate is present on the dorso-medial area of abdominal segment ix; the anal lobes are large and heavily sclerotized on both surfaces and have medial teeth; the anal-ring setae are thick basally; the anal-ring sclerotization is broad the digitules have large, expanded apices similar to the digitules of some coccids; and the microtubular ducts are simple, without a double bar sclerotization at the apex.

In addition to similar morphology, other features of the eriococcids of Chile and New Zealand bear mention. (1) These faunas do not share Eriococcidae taxa except for the cosmopolitan genus *Eriococcus* and the pest species, *E. araucariae*. The latter was probably introduced into Chile by man; it does not occur in natural stands of *Araucaria araucana*, the only native *Araucaria* pine in Chile. (2) The faunas of both areas have concentrations of what we consider primitive forms. Hoy (1963) regarded both *Phloeococcus* Hoy and *Nothococcus* Hoy from New Zealand as primitive, and we believe that *Icelococcus* from Chile should be added to this group. (3) Several of the Chilean eriococcids have features normally found on members of the family Coccidae: Antenna segments of *Exallococcus laureliae* are not constricted proximally; the anal lobes of *E. laureliae* are divided longitudinally, a character present on *Malloccoccus sinensis* (Maskell) (Coccidae); ventral sclerotization on the lobes of *E. laureliae* and *Icelococcus charlini* is weakly indicated; the anal ring on *Eriococcus eurythrix* and *Exallococcus laureliae* is invaginated; the anal lobes on *Chilecoccus browni* and *C. spinosus* are plate like; the claw and/or tarsal digitules have large capitate apices on *Chilecoccus browni*, *C. spinosus*, *Eriococcus araucariae*, *E. chilensis*, *E. eurythrix*, *E. navarinoensis*, *E. rhadinotrix*, *E. tholothrix*, and *Stibococcus cerinus*. (4) Several Chilean eriococcids have a feature similar to a character diagnostic of the Lecanodiaspididae, i. e., the triangular plate on *Exallococcus laureliae*, *Icelococcus charlini*, and *I. nothofagi* which apparently is homologous to the arch plate of lecanodiaspidids.

The above discussion suggests several possibilities concerning eriococcid zoogeography and origin. (1) Based on the numerous morphological similarities of the primitive aggregation of Chilean eriococcids and the family Coccidae, we suggest that the families

Eriococcidae and Coccidae are closely related and probably had a common ancestor prior to the origin of the Eriococcidae. (2) The similarities between the eriococcids and lecanodiaspidids suggest that these families are also related. (3) The presence of similar eriococcid faunas in Chile and New Zealand suggests several possible theories of eriococcid origin and evolution; two of them are as follows: (a) The family may have originated in the southern temperate areas of Gondwanaland. When South America drifted from the supercontinent, it carried portions of the primitive Gondwanaland fauna. Southern Chile and New Zealand, in their more or less isolated position have retained relictual types of eriococcids, especially on more primitive hosts such as *Nothofagus*. The lack of shared taxa implies that these faunas have been separate for a long time. (b) The eriococcids of Chile and New Zealand may be distantly related, but because the habitats in both areas are similar, extensive convergent evolution has occurred. Based on evidence provided by Schlinger (1974), on the distribution of *Nothofagus* and some of its associated insect fauna, the former seems most likely.

It would be premature at this time to attempt a steadfast explanation of the origin of the unusual eriococcid fauna of Chile without more intensified and diversified collecting in southern South America. However, based on our study, it seems quite probable that more collecting in this area will give coccidologists a much more tenable theory of eriococcid origin and evolution.

ACKNOWLEDGMENTS

We extend special appreciation to Spencer W. Brown, Department of Genetics, University of California, Berkeley, for allowing us to use some of the specimens which he and the junior author collected in Chile in 1968. Without his efforts, much of the material used in this study would not have been available.

Field collections were possible thanks to a Rockefeller Foundation Research Grant extended to the junior author (Insect Survey in Chile, University of Chile - Institute of Agropecuarian Research, 1967-68). The assistance of Professor Raimundo Charlin in curating the Coccidological Collection of the Department of Plant Protection, Faculty of Agronomy, University of Chile, is gratefully acknowledged.

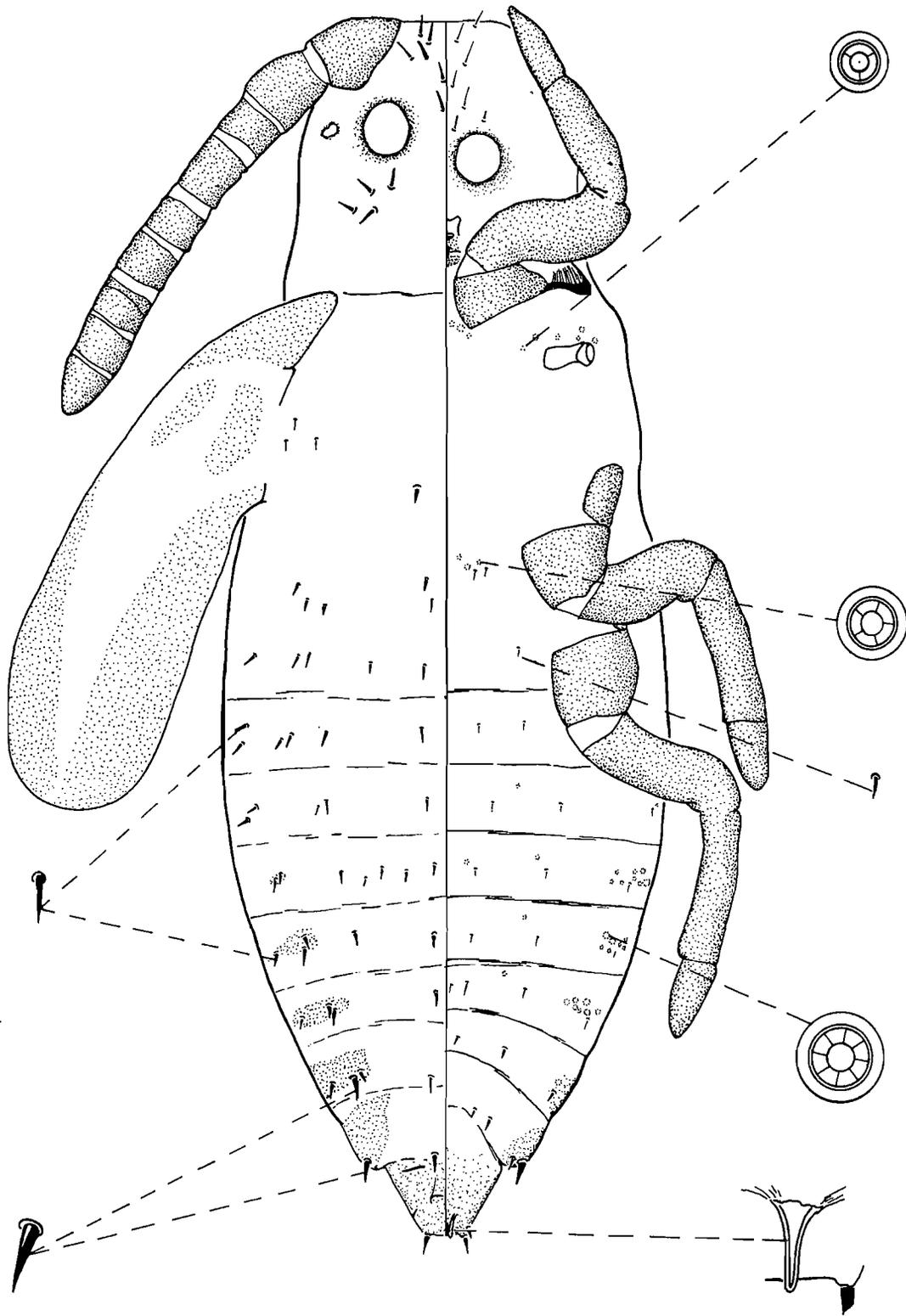


Fig. 15. *Stibococcus cerinus* Miller and González (4th instar male, pupa). Same data as for figure 13.

We wish to thank Dr. Dieter Wasshausen, Botany Department, Smithsonian Institution, Washington, D. C., for allowing the senior author to collect eriococcid specimens from the pressed *Nothofagus* plants stored in the Herbarium.

Appreciation is extended to L. M. Russell, R. W. Hodges, A. B. Gurney, L. V. Knutson, and D. R. Smith, Systematic Entomology Laboratory IBIII, Agr. Res. Serv., USDA, for their comments and criticism of this manuscript. We also extend thanks to Judy Miller for typing the manuscript.

LITERATURE CITED

- BORCHSENIUS, N. S. 1948. On the revision of the genus *Eriococcus* Sign. Akad. Nauk Dok. USSR 60:501-503 (in Russian).
- BORCHSENIUS, N. S. 1949. Coccoidea. Pseudococcidae Fauna of the USSR, vol. VII. Akad. Nauk, Zool. Inst. no. 38, 383 pp. (in Russian).
- COMSTOCK, J. H. 1881. Report of the entomologist of the United States Department of Agriculture for the year 1880. Ann. Rpt. Dep. Agric. 1880:236-350.
- COOKE, M. 1881. Scale insects injurious to fruit and other trees. *In his*. A treatise on the insects injurious to fruit and fruit trees of the state of California and remedies recommended for their extermination. Sacramento, State Office, Calif. 28-47 pp.
- COUPER, R. A. 1960. Southern hemisphere Mesozoic and Tertiary Podocarpaceae and Fagaceae and their palaeogeographic significance. Proc. Roy. Soc. London (B) 152:491-500.
- DARLINGTON, P. J. 1965. Biogeography of the southern end of the world; distribution and history of far-southern life and land, with an assessment of continental drift. Cambridge, Mass. Harvard Univ. Press. 236 pp.
- FERNALD, M. E. 1903. A catalogue of the Coccidae of the world. Mass. Agric. Exp. Stn. Spec. Bull. 88, 360 pp.
- FERRIS, G. F. 1955. Atlas of the scale insects of North America. Vol. VII. The families Aclerididae, Asterolecaniidae, Conchaspidae, Dactylopiidae, and Lacciferidae. Stanf. Univ. Press, Calif. 233 pp.
- FERRIS, G. F. 1957. A review of the family Eriococcidae. Microentomol. 22:81-89.
- FONSCOLOMBE, F. L. J. H. Boyer de 1834. Description des *Kermès* qu'on trouve aux environs d'Aix. Ann. Soc. Entomol. Fr. 3:201-218.
- GONZÁLEZ, R. H. and R. CHARLIN. 1968. Nota preliminar sobre los insectos coccoideos de Chile. Rev. Ghil. Entomol. 6:109-113.
- HOY, J. M. 1962a. Eriococcidae of New Zealand. N. Z. Dep. Sci. Ind. Res. Bull. 146, 219 pp.
- HOY, J. M. 1962b. A new species of *Eriococcus* from Navarino Island, Tierra del Fuego. N. Z. J. Sci. 5:510-512.
- HOY, J. M. 1963. A catalogue of the Eriococcidae of the world. N. Z. Dep. Sci. Ind. Res. Bull. 150, 260 pp.
- LINDINGER, L. 1933. Beiträge zur Kenntnis der Schildläuse. Entomol. Anz. 13:77-78, 107-108, 116-117, 143, 159-160, 165-166.
- MASKELL, W. M. 1879. On some Coccidae in New Zealand. Trans. Proc. N. Z. Inst. 11(1878):187-228.
- MCDANIEL, B. 1964. Key to Texas species of the genus *Eriococcus* and a description of a new species. Tex. J. Sci. 16:101-106.
- MILLER, D. R. AND MCKENZIE, H. L. 1967. A systematic study of *Ovaticoccus* Kloet and its relatives, with a key to North American genera of Eriococcidae. Hilgardia 33:471-539.
- MORRISON, H. AND E. R. MORRISON. 1966. An annotated list of generic names of the scale insects. U. S. Dep. Agric. Misc. Publ. N° 1015, 206 pp.
- OLALQUIAGA FAURE, G. 1945. Identificaciones y datos adicionales de algunos insectos y arácnidos de Chile. Rev. Chil. Hist. Nat. (1944):66-76.
- PHILIPPI, R. A. 1872. Sobre la flora de Nueva Zelanda comparada con la flora Chilena. An. Univ. Chile 41:170-189.
- RUTHERFORD, A. 1915. Notes on Ceylon Coccidae. Spolia Zool. 10:103-115.
- SCHLINGER, E. I. 1974. Continental drift. *Nothofagus*, and some ecologically associated insects. Ann. Rev. Entomol. 19:323-343.
- SIGNORET, V. 1870. Essai sur les cochenilles ou gallinsectes. 7^e partie (1). Ann. Soc. Entomol. Fr. (ser. 4) 10:268-286.
- SIGNORET, V. 1872. Essai sur les cochenilles ou gallinsectes. 8^e partie (1). Ann. Soc. Entomol. Fr. (ser. 5) 1:421-434.
- SIGNORET, V. 1875. Essai sur les cochenilles ou gallinsectes. 14^e partie (1). Ann. Soc. Entomol. Fr. (ser. 5) 5:15-10.
- TARGIONI-TOZZETTI, A. 1867. Introduzione alla seconda memoria per gli studi sulle cocciniglie, catalogo dei generi e delle specie delle famiglia del Coccidi. Mem. Soc. Ital. Sci. Nat. 3:694-738.