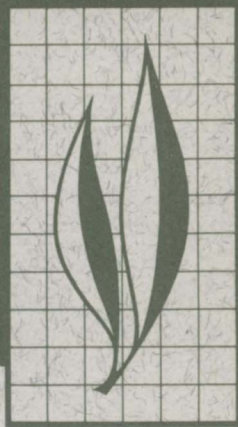


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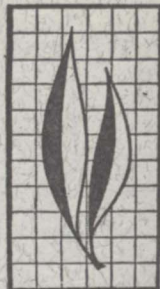
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Seventh Taxonomic Study of North American Mealybugs (Homoptera: Coccoidea: Pseudococcidae)

Douglass R. Miller and Howard L. McKenzie

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Seventh Taxonomic Study of North American Mealybugs (Homoptera: Coccoidea: Pseudococcidae)^{1, 2}

ABSTRACT

In this paper we redescribe 16 previously poorly known species of pseudococcids. Their taxonomic status, generic assignments, and relationships to other mealybugs are given. The species treated are: *Cataenococcus formicarii* (Ehrhorn); *C. guatemalensis* (Ferris); *C. phoradendri* (Cockerell); *Cryptoripersia arizonensis* (Ehrhorn); *C. trichura* (Cockerell); *Dysmicoccus aurantius* (Cockerell); *D. lasii* (Cockerell); *D. morrisoni* (Hollinger); *D. roseotinctus* (Cockerell and Cockerell); *Puto lasiorum* (Cockerell); *P. sandini* (Washburn); *Spilococcus juniperi* (Ehrhorn); *Tridiscus sporoboli* (Cockerell); *Trionymus cariois* McConnell; *T. magnus* (Cockerell and Cockerell); and *T. violascens* Cockerell.

New synonymy is as follows: *Cryptoripersia trichura* (= *Trionymus hypolithus* Shotwell); *Trionymus violascens* (= *T. furvus* McKenzie). *Dysmicoccus formicarii* (Ehrhorn) is transferred to *Cataenococcus*. Revised keys to the following genera are also presented: *Cataenococcus*, *Cryptoripersia*, *Dysmicoccus*, *Spilococcus*, *Tridiscus*, *Trionymus*.

FOREWORD

THIS IS THE LAST in a series of papers on the taxonomy of North American mealybugs initiated by Howard L. McKenzie in 1960. At the inception of these studies, Mr. McKenzie's goal was to complete a comprehensive study of the mealybugs of the United States. As a first step, he published a book, *Mealybugs of California with Taxonomy, Biology and Control of North American Species* (1967). In 1966, following completion of the book, we began work

on the second step. This was to be a revision of the pseudococcids of the western United States. Although ill with cancer, Mr. McKenzie continued to work whenever possible, and together we began to make progress. Unfortunately, on October 17, 1968, Howard Lester McKenzie, Jr., died at the age of 58. (See the tribute to Mr. McKenzie by Miller, Bohart, and Wilkey, 1969.) His untimely death left unfinished his much needed study.

INTRODUCTION

This paper and the sixth study (Miller and McKenzie, 1971) include the information gathered during our inves-

tigations on the mealybugs of the western United States. Included here are redescrptions of 16 species, with lecto-

¹ Submitted for publication November 9, 1971.

² National Science Foundation Grant No. GB-5847 to the junior author provided part of the funds necessary for the completion of this paper.

type designations for nine of them. We have attempted to give complete synonymies, including not only synonyms, homonyms, and generic transfers, but also citations for each mention of the species in the literature. When our information required extensive revision of McKenzie's (1967) keys, we have included new keys.

Depositories are hereafter abbreviated as follows: Collection of Coccoidea, University of California at Davis (UCD); Coccoidea Collection, University of Maryland, College Park (UM); National Collection of Coccoidea, United States National Museum, Washington, D.C. (USNM).

CHANGES IN TECHNIQUE

We have made two changes in the technique used in the first five studies in this series. (1) The enlargements of selected leg parts presented along the margin of each illustration are of the dorsal leg surface only. The ventral surface is shown on the main drawing. (2)

Discoidal and minute circular pores are no longer distinguished as separate entities since they often intergrade into each other. Therefore, we have called them all discoidal pores, and have indicated them as small or large where necessary.

KEYS AND DESCRIPTIONS

Genus *Cataenococcus* Ferris, 1955

Type species. *Dactylopius olivaceus* Cockerell, 1896*b* (by original designation).

Discussion. As pointed out by Williams (1960, 1969) and Miller and McKenzie (1971), this genus is extremely tentative. It is now separated from *Dysmicoccus* Ferris in that it has more than

4 conical setae in each anal-lobe cerarius. It is also very near to *Paraputo* Laing. When a revision of the New World mealybug fauna is undertaken, these genera will have to be reexamined and redefined.

Cataenococcus now includes seven species in North America.

KEY TO SPECIES OF *CATAENOCOCCUS* IN NORTH AMERICA: ADULT FEMALES

- 1. With fewer than 17 pairs of cerarii2
- With 17 or 18 pairs of cerarii or forming nearly continuous band along margins of body3
- 2(1). Multilocular disk pores absent; hind coxae without translucent pores
formicarii (Ehrhorn)
- Multilocular disk pores present near vulva; hind coxae with translucent pores *phoradendri* (Cockerell)
- 3(1). Cerarii arranged in a nearly continuous marginal band
olivaceus (Cockerell)
- Cerarii arranged in 17 or 18 distinct pairs4
- 4(3). Multilocular disk pores distorted, giving appearance of large discoidal pores; circulus absent; translucent pores absent on hind legs; oral-collar tubular ducts with unusually large dermal orifices (fig. 2)
guatemalensis (Ferris)

- Multilocular disk pores normal; circulus present; translucent pores present on hind legs; oral-collar tubular ducts normal for genus 5
- 5(4). Multilocular disk pores and oral-collar tubular ducts present on dorsum; ventral anal lobe unsclerotized *mexicanus* Miller and McKenzie
 Multilocular disk pores and oral-collar tubular ducts restricted to venter; ventral anal lobe sclerotized 6
- 6(5). Multilocular disk pores present on thorax *cualatensis* (Cockerell)
 Multilocular disk pores absent on thorax *larai* Williams

***Cataenococcus formicarii*
 (Ehrhorn) n. comb.**

(Figure 1)

Dactylopius formicarii Ehrhorn, 1899: 6; Ferris, 1953: 494.

Pseudococcus formicarii (Ehrhorn), Fernald, 1903: 102; Wheeler, 1912: 134; Ferris, 1918: 47; MacGillivray, 1921: 133.

The junior, primary homonym *Dactylopius formicarius* Newstead, 1900: 249 was renamed as *D. formiceticola* Newstead, 1901: 86.

The transfer of *Dactylopius formicarii* Ehrhorn to *Cataenococcus* complicates the nomenclature of *Tylococcus formicarii* Green, 1922: 368. Although the Green species has never been placed in *Cataenococcus*, the description indicates that it belongs in this genus. Until type material can be examined we shall leave the species as it is now placed—*Farinococcus formicarii* (Green). If it should become necessary to transfer it to *Cataenococcus*, however, it would be as a junior, secondary homonym of *Cataenococcus formicarii* (Ehrhorn).

Suggested common name. Ant mealybug.

Specimens examined. Adult females, apterous adult male, and immature nymphs on *Artemisia* sp. (Compositae) in ants' nest, collected at Camp Thurber, Grand Canyon, Coconino Co. (?), Arizona, June, 1898, by E. M. Ehrhorn.

Type material. From the syntypes, we have chosen and marked as lectotype an adult female with right label "Ant-hills Camp Thurber Grand Cañon Flag-

staff Arizona June 1898," left label, "Type *Dactylopius formicarii* Ehrh. Type"; deposited at UCD. Three specimens on one slide; middle specimen is the lectotype. Thirteen paralectotypes.

Gross external features. According to Ehrhorn (1899), "♀ small, broadly oval, lightly covered with powder. . . . Colour yellowish brown."

This species occurs in ants' nests on the roots of its host.

Recognition characters. Adult female, mounted, 2.1 to 2.3 mm long, 1.2 to 1.5 mm wide; body broadly oval.

Dorsum with 4 to 6 pairs of abdominal cerarii and 0 to 2 pairs on head. Anal-lobe cerarii each with 4 to 9 (av. 6.1) conical setae, 5 to 10 slender auxiliary setae, cluster of approximately 40 to 50 trilocular pores, several small discoidal pores, and light area of basal sclerotization. Penultimate pair of cerarii each with 3 to 5 (av. 3.9) conical setae, several elongate auxiliary setae, loose cluster of trilocular pores, no discoidal pores or basal sclerotization. Third cerarii from apex each with 1 to 5 (av. 2.3) conical setae, several auxiliary setae, small, loose cluster of trilocular pores. Fourth cerarii from abdominal apex each with 1 to 3 (av. 1.6) conical setae, several auxiliary setae, without cluster of trilocular pores. Fifth cerarii from apex with 0 to 3 (av. 0.5) conical setae and 1 or 2 auxiliary setae. Sixth cerarii represented on only 1 specimen. Conical cerarian setae become progressively more elongate anteriorly. Head cerarii sometimes

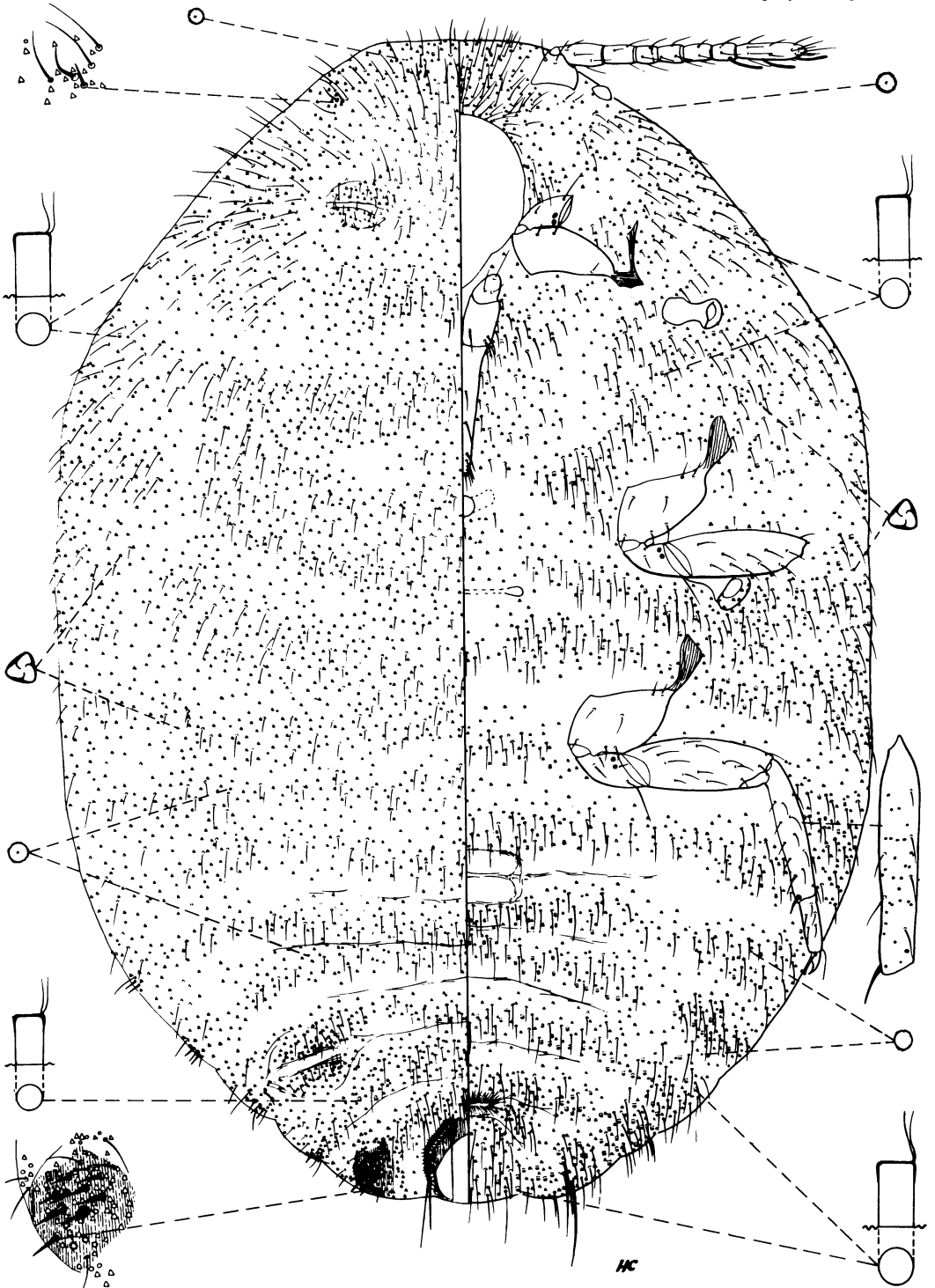


Fig. 1. *Cataenococcus formicarii* (Ehrhorn), collected at Camp Thurber, Grand Canyon, Coconino (¶) County, Arizona, June, 1898, in ants' nest.

present, represented by 2 or 3 elongate, conical setae and loose cluster of trilocular pores. Multilocular disk pores absent. Trilocular pores abundant. Discoidal pores rare. Oral-collar tubular ducts normally present in small numbers on abdominal segments 9 and 8, sometimes present in small numbers near body margin at juncture of thorax and head. Dorsal body setae elongate; body setae on medial areas of abdominal segments 9 and 8 and on head noticeably longer than on other parts of dorsum.

Anal ring unusually large, dorsal, normally touching abdominal apex, with 2 rows of small pores, both rows weakly developed; each of its 6 to 8 (av. 6.7) setae approximately equal in length to greatest diameter of ring.

Venter with multilocular disk pores absent. Trilocular pores abundant. Discoidal pores present in small numbers over surface. Oral-collar tubular ducts scattered over venter; most abundant on posterior abdominal segments, becoming increasingly less abundant anteriorly. Body setae more elongate than those on dorsum, with conspicuous clusters of elongate setae along body margin of posterior abdominal segments. Anal lobes without sclerotization.

Circulus large, divided by intersegmental line between abdominal segments 5 and 4. Translucent pores small, often difficult to see; hind tibiae with 20 to 41 pores dorsally, absent ventrally; tarsal digitules apically knobbed, not reaching tip of claw; claw digitules capitate, extending beyond tip of claw; claws without denticle. Antennae 8-segmented; one specimen with 7-segmented antenna on one side and 8-segmented antenna on other. Eyes often with associated discoidal pore. Rostrum unusually elongate.

Notes. In McKenzie's (1967) key to the mealybug genera of North America, this species will key to *Cataenococcus*. The placement of this species in *Catae-*

nococcus is extremely tentative. Although several characteristics of *C. formicarii* do not coincide with the features of the species of either *Cataenococcus* or the related genus *Dysmicoccus*, we feel that the designation of a new genus would only add to the confusion which now exists in defining these genera.

This species can be distinguished from all other North American mealybugs in having the following combination of characters: anal-lobe cerarii each with 4 to 9 conical setae; penultimate cerarii each with 3 to 5 conical setae, with 4 to 8 pairs of cerarii; anal ring unusually large and often with more than 6 setae; no multilocular disk pores; rostrum extremely elongate; body setae unusually long. For a further comparison see "Notes" under *C. phoradendri*.

Cataenococcus guatemalensis

(Ferris)

(Figure 2)

Farinococcus guatemalensis Ferris, 1953: 354.

Cataenococcus guatemalensis Ferris, Ferris, 1955: 3; McKenzie, 1967: 81.

Cataenococcus guatemalensis (Ferris), Williams, 1969: 103.

Suggested common name. Large-duct mealybug.

Specimens examined. This species is very common in Central and South America on orchids. We have examined specimens from the following countries: Bolivia, Brazil, Colombia, Costa Rica, Dutch Guiana, El Salvador, Guatemala, Mexico, Nicaragua, and Venezuela. Specimens are at hand from the following hosts: *Cattleya*, *Epidendrum*, *Mormodes*, *Odontoglossum*, *Oncidium*, and "bromeliad."

Type material. From the syntypes, we have chosen and marked as lectotype an adult female with right label "*Farinococcus guatemalensis* n. sp. On Odon-

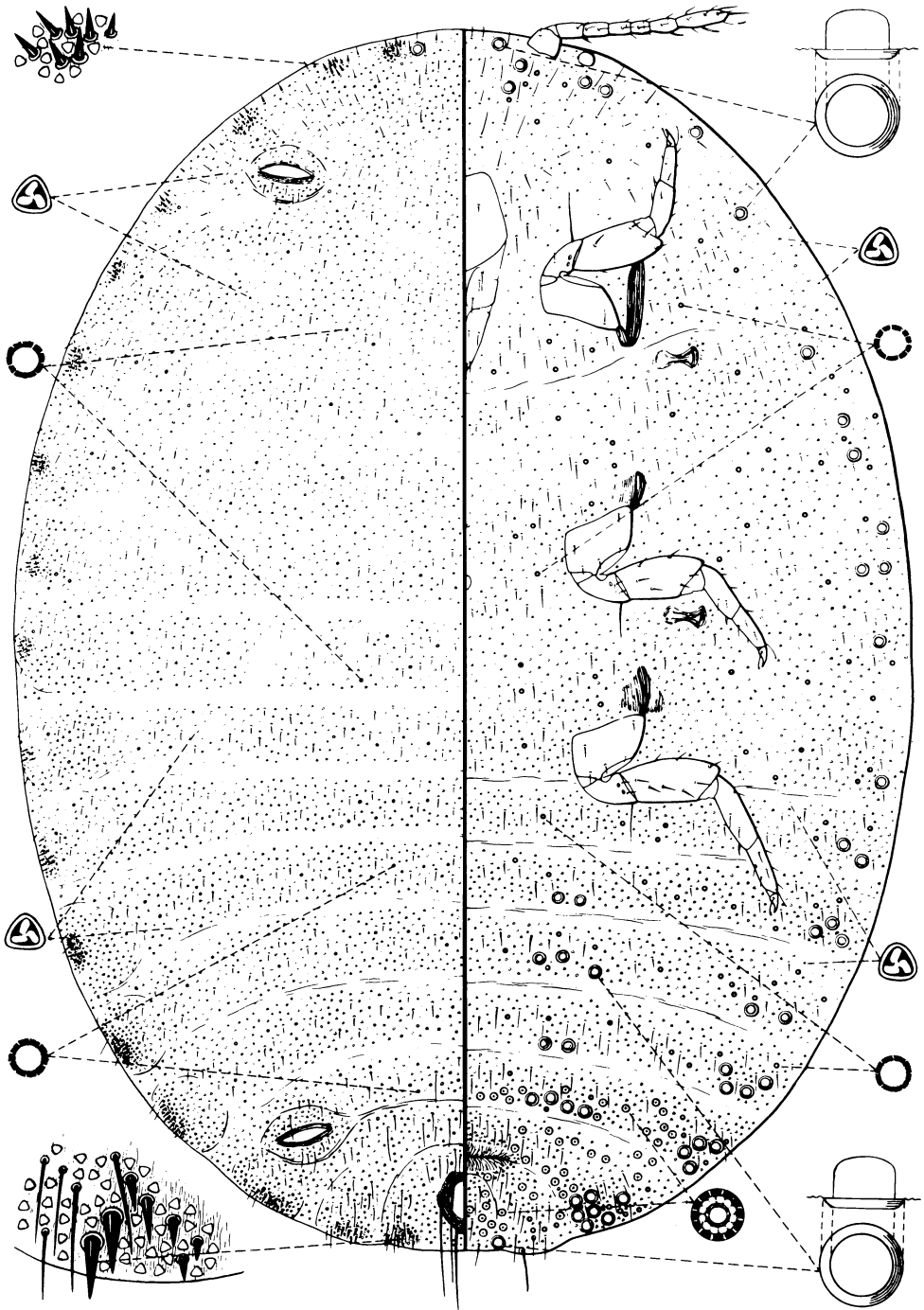


Fig. 2. *Cataenococcus guatemalensis* (Ferris), taken in quarantine at Hoboken from Brazil, July 22, 1947, on wild *Cattleya* sp. (Orchidaceae).

toglossum grande Type San Jose de Guatemala quar. S. F. III-24-47"; deposited at UCD. Two specimens on one slide; specimen on left is the lectotype. Six paralectotypes.

Gross external features. No information.

Recognition characters. Adult female, mounted, 1.6 to 2.5 mm long, 1.1 to 2.3 mm wide; body normally rotund, newly formed adult females oval.

Dorsum with 17 pairs of cerarii. Anal-lobe cerari each with 4 to 12 (av. 7.3) conical setae, 2 to 7 auxiliary setae, cluster of 40 to 73 trilocular pores, 0 to 3 small discoidal pores, and large area of basal sclerotization. Remaining cerarii from penultimate pair forward to frontal pair each with following number of conical setae: 10 to 16 (av. 12.7); 9 to 14 (11.8); 8 to 12 (10.0); 6 to 13 (8.7); 5 to 9 (6.8); 5 to 8 (5.9); 4 to 6 (5.0); 4 to 6 (4.9); 2 to 7 (4.9); 3 to 8 (5.0); 3 to 7 (4.2); 3 to 7 (5.2); 3 to 6 (4.8); 5 to 9 (6.2); 4 to 9 (6.1); 5 to 12 (7.7). Cerarii anterior to anal-lobe pair, in addition to above numbers of conical setae, each with 0 to 3 auxiliary setae, cluster of trilocular pores, 0 to 2 small discoidal pores, and normally with small area of basal sclerotization. Multilocular disk pores absent. Trilocular pores densely distributed over surface. Large discoidal pores scattered over surface, most abundant on medial areas of abdominal segments 9, 8, and 7. One pair of oral-collar tubular ducts normally present near anterior pair of cerarii, same size and shape as those on venter. Dorsal body setae short, slightly curved, and robust, except noticeably more elongate on medial areas of abdominal segments 9, 8, and 7.

Anal ring dorsal, removed from abdominal apex by approximately one-fourth to one-half diameter of ring, with 2 rows of pores; each of its 6 setae about one and one-half times as long as greatest diameter of ring.

Venter with multilocular disk pores of distorted type, usually appearing as abnormally large discoidal pores, occasionally showing locular structure, normally restricted to abdominal segments 9, 8, and 7, rarely present on segments 6 and 5. Trilocular pores abundant. Large discoidal pores scattered over surface. Oral-collar tubular ducts unusually short, with large orifices, extremely variable in number and distribution, normally present in submedial clusters on abdominal segments 7 through 5, rarely also present on segment 4, some specimens without submedial clusters. When present, each cluster with following number of oral-collar tubular ducts: abdominal segment 7 with 0 to 4 ducts (av. 1.6); segment 6 with 0 to 3 (1.5); 5 with 0 to 3 (1.2); 4 with 0 to 2 (0.1). Lateral clusters of oral-collar tubular ducts associated with cerarii, each cluster with the following number of ducts beginning with anal-lobe cerarius and moving forward to frontal cerarius: anal-lobe cerarius with 0 to 1 duct (av. 0.2); penultimate cerarius, 3 to 8 (av. 5.8); 3 to 8 (5.2); 1 to 7 (3.6); 1 to 4 (2.6); 0 to 5 (2.4); 1 to 6 (2.2); 0 to 1 (0.8); 0 to 4 (1.7); 1 to 5 (2.2); 0 to 3 (1.5); 0 to 1 (0.4); 0 to 1 (0.8); 0 to 1 (0.9); frontal cerarius with 1 to 4 ducts (av. 1.7). Body setae longer than those on dorsum, unusually short for pseudococcid; longest posterior anal-lobe seta conspicuously short. Anal lobe unsclerotized.

Circulus absent. Translucent pores absent; tarsal digitules apically enlarged, not extending to tip of claw; claws with capitate digitules, extending beyond tip of claw; claws without denticles. Antennae normally 7-segmented, sometimes 6-segmented. Eyes without associated discoidals. Rostrum elongate.

Notes. Unfortunately the original description of this species was based on specimens which possessed abnormally small numbers of oral-collar tubular

ducts. As the preceding description shows, these ducts vary widely in number. Only one of the specimens examined (the lectotype) has 8-segmented antennae, and then only on one side, with 7 on the other.

When the genera related to *Cataenococcus* are reexamined, it is quite likely that *C. guatemalensis* will be placed in *Paraputo*.

This species can be separated from all other species of *Cataenococcus* in having the following combination of characters: large-diameter, short oral-collar tubular ducts; 17 pairs of cerarii; no translucent pores on legs; distorted multilocular disk pores near vulva; no circulus; and elongate dorsal body setae on medial area of abdominal segments 9, 8, and 7.

Cataenococcus phoradendri
(Cockerell)

(Figure 3)

Pseudococcus phoradendri Cockerell, 1912: 133; Wheeler, 1912: 130; Sasser, 1915: 30; Schumacher, 1918: 228; Bequaert, 1922: 496.

Lachnodioides salicis Ferris, 1919a: 23.

Lachnodioides phoradendri (Cockerell), Ferris, 1919b: 298; Costa Lima, 1934: 132.

Farinococcus phoradendri (Cockerell), Ferris, 1953: 358.

Cataenococcus phoradendri (Cockerell), Ferris, 1955: 4; McKenzie, 1967: 81; Williams, 1969: 103.

Suggested common name. Mistletoe mealybug.

Specimens examined. Adult females in tunnels of *Phoradendron flavescens* var. *villosum* (Loranthaceae) associated with ants (*Crematogaster arizonensis* Wheeler), collected in Miller Canyon (4,500 ft.), Huachuca Mountains, Cochise Co., Arizona, November 17, 1910, by W. M. Wheeler. Adult females also on "willow," collected in Sabino Can-

yon, Pima Co., Arizona, June 26, 1918, by G. F. Ferris.

Type material. From the syntypes, we have selected and marked as lectotype an adult female labeled "*Pseudococcus phoradendri* (Ckll.) Cotype Miller Canyon, Huachuca Mts. Ariz. W. M. Wheeler, Coll. Nov 17, 1910. In stems of *Phoradendron flavescens* var. *villosum*"; deposited at USNM. Single specimen on slide. Seven paralectotypes.

We have also seen four syntypes of *Lachnodioides salicis* Ferris, and we agree that it is a junior synonym of *Cataenococcus phoradendri*. These specimens are deposited at UCD.

Gross external features. According to Wheeler (1912), this species is "broad, plump, reddish, mealy, strongly segmented . . . legs and antennae . . . clear yellowish ferruginous." The waxy secretion is apparently very light and does not conceal the body color.

This species was first discovered in the hollowed-out stems of mistletoe on *Quercus emoryi*. The mealybugs were closely associated with the ant *Crematogaster arizonensis* (Formicidae). Ferris re-collected the species in cracks of willow bark in carton tents constructed by ants.

Recognition characters. Adult female, mounted, 2.6 to 3.5 mm long, 2.0 to 2.4 mm wide; body broadly oval.

Dorsum with 6 or 7 pairs of cerarii. Anal-lobe cerarii each with 11 to 19 conical setae (av. 16.1), 4 or 5 auxiliary setae, cluster of approximately 70 trilocular pores, 0 or 1 large discoidal pore, area of light basal sclerotization. Remaining abdominal cerarii beginning with penultimate pair and progressing forward, with following numbers of conical setae: 18 to 25 (av. 21.4); 18 to 25 (21.7); 14 to 22 (19.6); 7 to 15 (11.2); 0 to 5 (1.5); each abdominal cerarius also with large cluster of trilocular pores, sometimes basally sclerotized; anterior cerarii often divided

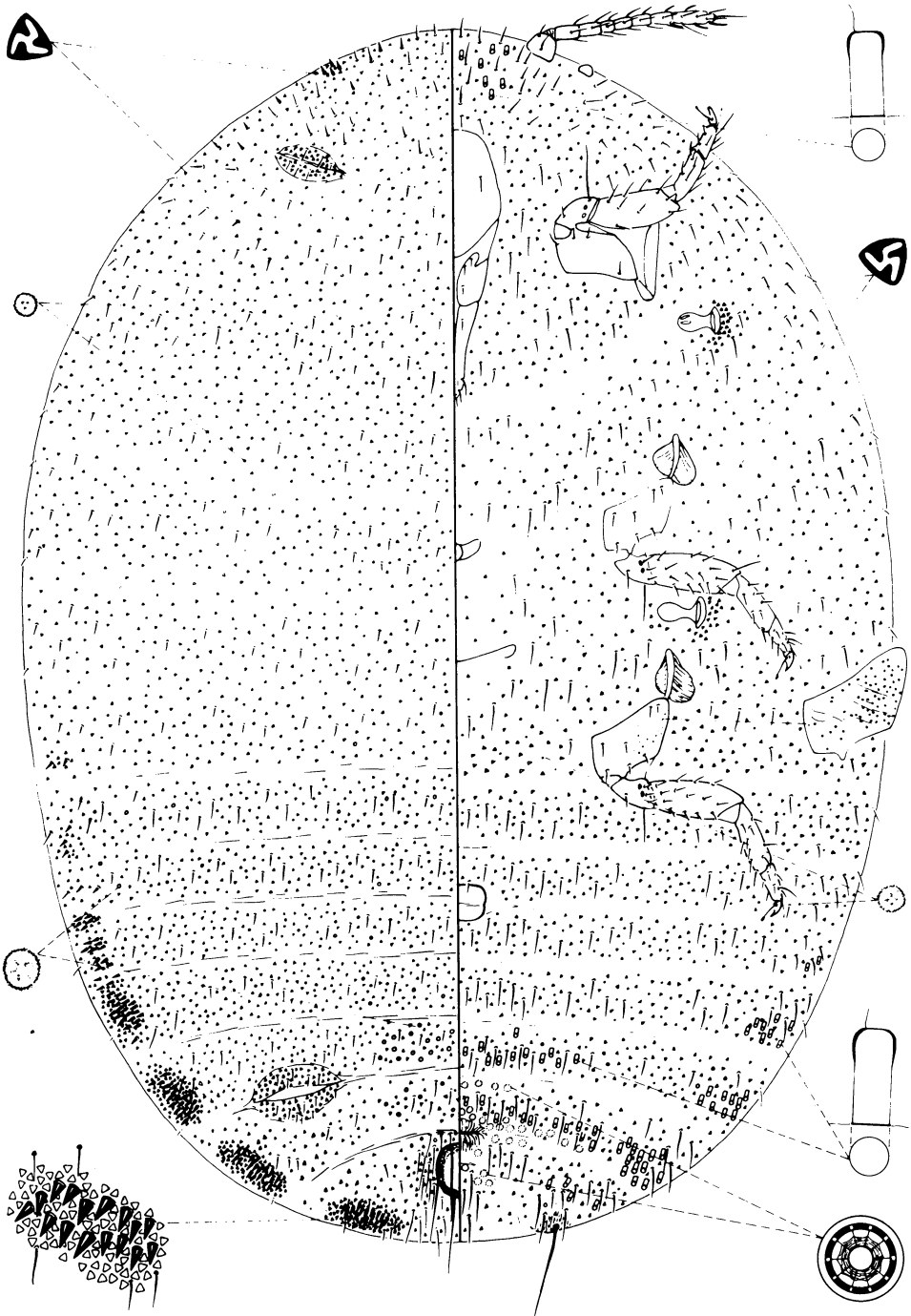


Fig. 3. *Cataenococcus phoradendri* (Cockerell), collected in Miller Canyon, Huachuca Mountains, Cochise County, Arizona, November 17, 1910, in stems of *Phoradendron flavescens* var. *villosum* (Loranthaceae), associated with the ant *Crematogaster arizonensis* Wheeler.

into 2 or 3 clusters. Head with 1 pair of cerarii in frontal position, each with 3 to 6 (av. 4.5) conical setae and small cluster trilocular pores. Multilocular disk pores absent. Trilocular pores densely scattered over surface. Discoidal pores of two sizes which intergrade into each other; noticeable cluster of large discoidals on medial areas of abdominal segments 8 and 7, irregularly scattered over rest of surface. Oral-collar tubular ducts absent. Dorsal body setae short, all of approximately same length except near anal ring.

Anal ring dorsal, surrounded by large cluster of body setae, situated approximately diameter of ring from apex of abdomen, with 2 rows of pores, outer row weakly developed; each of its 6 setae approximately same length as greatest diameter of ring.

Venter with multilocular disk pores present on abdominal segments 9 and 8. Trilocular and discoidal pores densely scattered over surface. Oral-collar tubular ducts of two intergrading sizes, present in clusters near cerarii on abdominal segments 9 through 6 or 5; also present medially on segments 8, 7, and sometimes 6, and present in cluster near frontal cerarii. Body setae unusually

short for pseudococcid, noticeably longer than those on dorsum; longest posterior anal-lobe setae short. Anal lobes with small area of sclerotization.

Circulus divided by intersegmental line of segments 5 and 4. Legs short, robust; hind coxae dorsally with 72 to 135 translucent pores, ventrally with 45 to 84 pores; tarsal digitules apically clubbed, not reaching tip of claw; claw digitules capitate, extending beyond claw apex; claws without denticle. Antennae normally 8-segmented, occasionally with 7. Eyes sometimes with 1 discoidal pore in association. Rostrum unusually elongate.

Notes. This species is most closely related to *Cataenococcus formicarii* (Ehrhorn), but differs in that it has multilocular disk pores near the vulva; translucent pores on hind coxae; no translucent pores on hind tibiae; oral-collar tubular ducts restricted to posterior 5 abdominal segments and to head; dorsal body setae short; normal-sized anal ring. *C. formicarii*, on the other hand, has no multilocular disk pores; translucent pores on hind tibiae only; oral-collar tubular ducts over entire venter; long dorsal body setae; unusually large anal ring.

Genus *Cryptoripersia* Cockerell, 1899b

Type species. *Ripersia arizonensis* Ehrhorn, 1899 (by monotypy).

Discussion. This genus may be separated from all North American genera of the Pseudococcidae in having 1 pair of cerarii with elongate setae only; 6-segmented antennae; numerous dorsal oral-collar tubular ducts; rotund body form when fully gravid; no circulus.

Trionymus Berg is closest to *Cryptoripersia*, but differs in that it has 1 to 5 pairs of cerarii with some conical setae; antennae 6- to 8-segmented; body normally elongate; circulus present or ab-

sent. Species such as *T. magnus* (Cockerell and Cockerell) and *T. strongylus* Miller and McKenzie may well belong in *Cryptoripersia*. These species have a rotund body shape and only 1 pair of cerarii; they differ, however, in that they have a small circulus and conical cerarian setae. When more species are described we may be better able to reassess the limits of this genus.

With the new synonymy included herein, there are now three North American species of *Cryptoripersia*.

KEY TO SPECIES OF *CRYPTORIPERSIA* IN NORTH AMERICA:
ADULT FEMALES

1. With dorsal multilocular disk pores *trichura* (Cockerell)
Without dorsal multilocular disk pores 2
- 2(1). Oral-rim tubular ducts absent; conspicuously large discoidal pores present on dorsum *arizonensis* (Ehrhorn)
Oral-rim tubular ducts present; discoidal pores of small type only
tubulata McKenzie

Cryptoripersia arizonensis
(Ehrhorn)

(Not illustrated)

Ripersia arizonensis Ehrhorn, 1899: 5; Cockerell, 1899a: 5; 1899b: 392; Ferris, 1903: 116; MacGillivray, 1921: 141.

Eriococcus salinus Ehrhorn, 1911: 276.

Cryptoripersia salinus (Ehrhorn), Ferris, 1918: 74; MacGillivray, 1921: 141; Ferris, 1953: 308.

Cryptoripersia arizonensis (Ehrhorn), Ferris, 1919a: 34; 1919b: 298; 1920: 9; Lindinger, 1937: 183; DeLotto, 1964: 348.

Cryptoripersia salina Ferris, Lindinger, 1932: 197.

Cryptoripersia salina (Ehrhorn), McKenzie, 1964: 228; 1967: 130; Miller and McKenzie, 1971: 600.

Cryptoripersia arizonensis was previously considered a senior synonym of *C. salina* (Ferris, 1919a). In the *Atlas of the Scale Insects of North America* (1953), Ferris decided that because of a misidentification of *C. arizonensis*, this synonymy was incorrect, and he therefore returned to *C. salina*. He further concluded that *C. arizonensis* was actually a synonym of *Cryptoripersia trichura* (Cockerell). Although *C. arizonensis* had seniority, Ferris continued to use *C. trichura*.

We have been able to examine type material of both *Cryptoripersia arizonensis* and *C. salina*, and it is evident that these species are synonymous. Because of this, it will be necessary to use the oldest name—*C. arizonensis*.

Suggested common name. Felt-sac mealybug.

Specimens examined. Adult females in ants' nests, collected near Grand Canyon (Flagstaff), Coconino Co., Arizona, June, 1898, by E. M. Ehrhorn. Adult females and first instar nymphs on "bunchgrass," collected at Alameda Shore, Alameda, Alameda Co., California, July 25, 1906, by E. M. Ehrhorn. Adult females on *Stipa* sp. (Gramineae), collected at Monitor Pass, Alpine Co., California, August 2, 1964, by D. R. Miller and J. A. Froebe. Adult female on "bunchgrass," collected at Stevens Creek, Santa Clara Co., California, August 26, 1917, by G. F. Ferris. Adult female associated with ants, collected in Dunn Co., North Dakota, June 30, 1955, by G. and J. Wheeler.

Type material. From the syntypes, we have chosen and marked as lectotype an adult female with the left label "Type *Ripersia arizonensis* Ehrh. June 1898"; right label, "*Ripersia arizonensis* Ehr. ants nests Grand Cañon Colorado Arizona"; deposited at USNM. Two specimens on slide; specimen on right is the lectotype. Three paralectotypes. We also have mounted 26 specimens from the Ehrhorn dry material that were apparently collected at the same time as the type series. They are labeled "*Ripersia Cryptoripersia arizonensis* Camp Thurber, Grand Cañon Flagstaff Ariz. June 1898a"; deposited at USNM.

We also examined two slides from the type series of *Cryptoripersia salina*.

They are labeled "Eriococcus salinus n. sp. on Bunchgrass Alameda shore Alameda Cal 7/25/06 Type. 2229"; deposited at USNM. One slide contains 4 adult females; the other, 19 first-instar nymphs.

Notes. We believe that the descriptions and illustration of the junior synonym *Cryptoripersia salina* presented by McKenzie (1967) adequately characterize *C. arizonensis*. Therefore we refer the reader to that study for detailed information on the morphology used to diagnose *C. arizonensis*.

There is now indication that *Cryptoripersia arizonensis* and *C. trichura* may be the same. Because inadequate numbers of specimens are available, however, we have decided to continue to consider those specimens lacking dorsal multilocular disk pores (*C. arizonensis*) as distinct from those having such structures (*C. trichura*). We have at hand specimens that have a reduced number of dorsal multiloculars. We believe further collecting will show a geographic gradient from numerous dorsal multiloculars, in specimens from eastern areas, to few or no dorsal multiloculars in specimens from the far west. In any event, *C. arizonensis* has seniority.

Cryptoripersia trichura
(Cockerell)

(Figure 4)

Ripersia trichura Cockerell, 1901a: 55; Fernald, 1903: 119; Cockerell and Robinson, 1915: 106; Ferris, 1919b: 298; MacGillivray, 1921: 141; Bueker, 1931: 159.

Cryptoripersia arizonensis (Ehrhorn), Ferris, 1919a: 34; 1953: 310; McKenzie, 1967: 129 (all based on a misidentification).

Trionymus hypolithus Shotwell, 1924: 353; Ferris, 1950: 267; 1953: 483 (new synonymy).

Ripersia hypolithus (Shotwell), Bueker, 1931: 157 (new synonymy).

Cryptoripersia trichura (Cockerell), Ferris, 1953: 310; McKenzie, 1964: 227; 1967: 130; DeLotto, 1964: 348.

Erium hypolithus (Shotwell), Lindinger, 1957: 551 (new synonymy).

Cryptoripersia hypolithus (Shotwell), McKenzie, 1960: 706; 1964: 227; 1967: 130 (new synonymy).

The differences in body shape and multilocular disk pore distribution patterns have not proved significant in distinguishing *C. trichura* from *C. hypolithus*. The narrow body shape, supposedly characteristic of *C. hypolithus*, is due not to species differences, but rather to the stage of development of the adult female.

Two syntypes of *hypolithus* (deposited at USNM) have been examined.

Cryptoripersia arizonensis (Ehrhorn) has been considered a synonym of *C. trichura* by both Ferris and McKenzie. We have been able to examine the types of *C. arizonensis*, and it is apparent that this species is not synonymous with *C. trichura*, but is instead a synonym of *C. salina* Ehrhorn. For further information see the treatment of *C. arizonensis*.

Suggested common name. Anal-seta mealybug.

Specimens examined. Adult females in ants' nest (*Lasius* sp.), collected at Boulder (near Chautauqua grounds), Boulder Co., Colorado, May 19, 1924, by R. I. Shotwell. Adult females were also examined from the following localities: in ants' nests, collected at Boulder (Geneva Park), Boulder Co., Colorado, April 9, 1929, by E. D. Bueker; in berlese sample, collected 1.5 mi. S. S.W. Winnett, Petroleum Co., Montana, July 28, 1970, by W. H. Burleson; collected at Las Vegas, San Miguel Co., New Mexico, April 12 and 29, 1901, by W. P. Cockerell; on grass, collected at Trout Springs, San Miguel

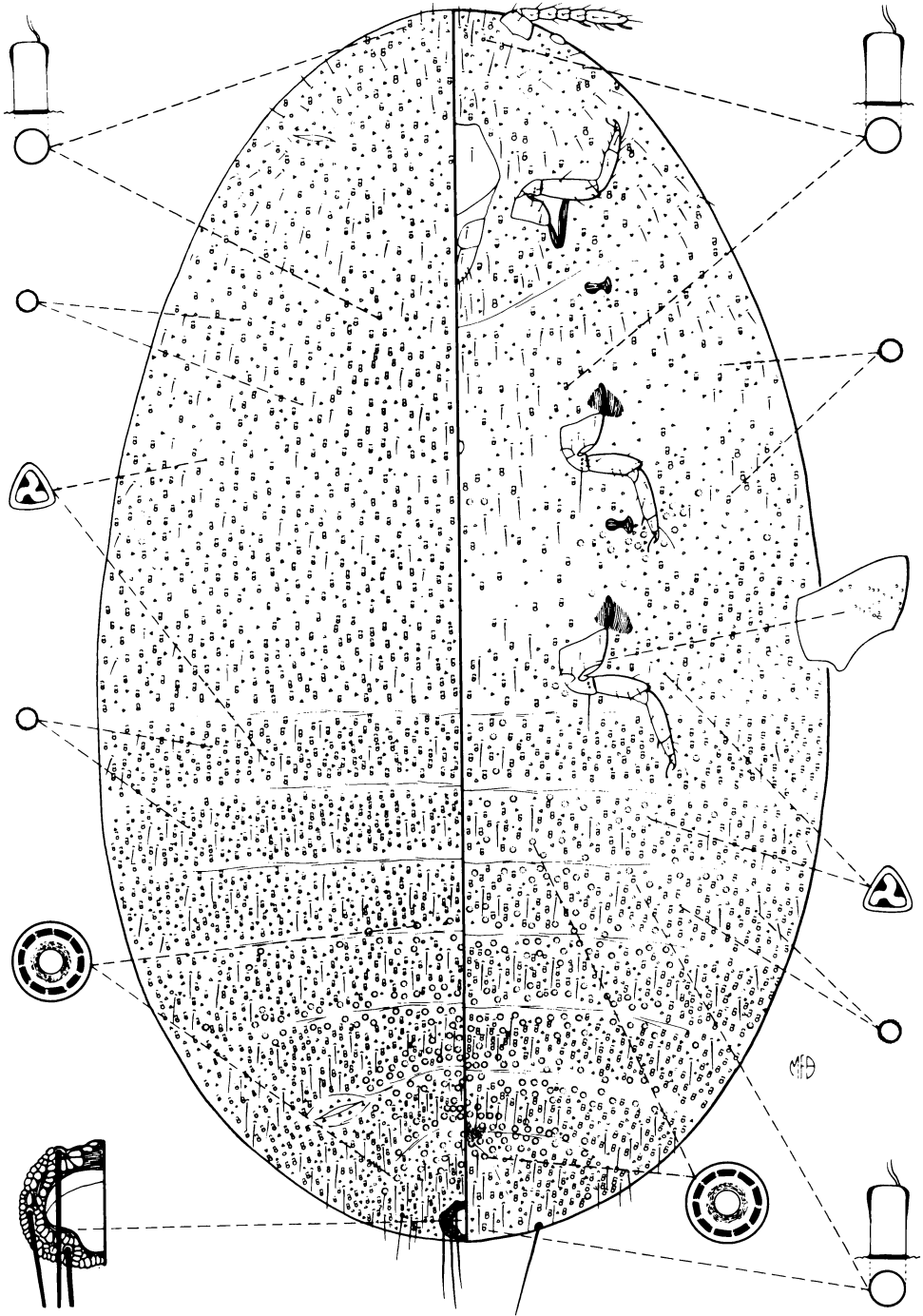


Fig. 4. *Cryptoripersia trichura* (Cockerell), collected at Las Vegas, San Miguel County, New Mexico, April 29, 1901.

Co., New Mexico, May 24, 1901; and immature nymphs in association with *Lasius crypticus* Wilson, collected in Divide Co., North Dakota, July 31, 1956, by G. C. Wheeler; on aspen (?), collected at Noonan, Divide Co., North Dakota, July 1, 1935, by J. Davis; in association with ants, collected in Foster Co., North Dakota, July 10, 1956, by G. C. and J. N. Wheeler; in association with ants, collected in Hettinger Co., North Dakota, June 28, 1956, by G. C. and J. N. Wheeler; on Gramineae, collected 15 mi. S. Afton, Lincoln Co., Wyoming, August 3, 1967, by D. R. Miller and D. S. Horning.

Type material. Authentic type material of this species has not been examined; however, topotypes collected by W. P. Cockerell (collector of the type series) have been seen. These specimens agree with the original description; deposited at USNM.

Gross external features. Although the types were found without ovisacs, material has since been collected with thick-walled ovisacs much the same as those formed by *C. arizonensis* (Ehrhorn). It seems likely that the type specimens were newly molted adult females which had not yet formed ovisacs. The body of the adult female varies from pink to light purple.

This species occurs on the roots of its host. It has also been found under rocks in association with *Lasius* sp., *L. alienus* (Foerester) (= *L. americanus*), *L. crypticus*, and *Formica* sp. (Formicidae).

Recognition characters. Adult female, mounted, 1.3 to 3.7 mm long, 0.6 to 3.1 mm wide; body oval in newly formed adults, pyriform in fully mature females.

Dorsum with 1 pair of cerarii represented by 1 or 2 elongate body setae and without sclerotization or basal cluster of trilocular pores. Multilocular disk pores variable, normally pres-

ent on anterior and posterior margins of abdominal segments 9 through 5, with 1 or 2 present on segments 4 and 3. Dorsum with light scattering of trilocular and large discoidal pores. Oral-collar tubular ducts abundant over entire surface, variable in size, lateral ducts slightly larger than those on medial areas. Dorsal body setae either same size as or slightly shorter than those on venter.

Anal ring dorsal, removed from apex of abdomen by 2 or 3 times diameter of ring (in newly formed adults, ring touching abdomen apex); anal ring usually broad, with 3 rows of pores; each of its 6 setae approximately two and one-half times as long as greatest diameter of ring.

Venter with multilocular disk pores variable, normally present on posterior and anterior margins of abdominal segments 9 through 3, sometimes absent on anterior 2 or 3 segments; also present near spiracles. Trilocular and large discoidal pores scattered over surface. Oral-collar tubular ducts short, present in large numbers over entire venter. Body setae elongate. Anal-lobe sclerotization absent.

Circulus absent. Hind coxae dorsally with 7 to 20 translucent pores, ventrally with 0 to 6 pores; claws with digitules extending beyond tip; claws without denticle. Antennae 6-segmented.

Notes. Figure 4 is based on a newly emerged adult female and therefore is somewhat atypical of the normally collected representatives of this species. We have illustrated this specimen because it is similar to the type, which also was a newly formed adult.

This species is most closely related to *Cryptoripersia arizonensis* (Ehrhorn), which differs in that it has no dorsal multilocular disk pores; *C. trichura*, on the other hand, has these structures dorsally on most of the abdomen.

Genus *Dysmicoccus* Ferris, 1950

Type species. *Dactylopius brevipes* Cockerell, 1893 (by original designation).

Discussion. This genus is recognized by a combination of characters: more than 5 pairs of cerarii; anal-lobe cerarii each with fewer than 5 conical setae; no oral-rim tubular ducts.

As pointed out previously (Beardsley, 1966; Miller and McKenzie, 1971), this genus does not appear to be monophyletic. Until a careful revision of the genus can be undertaken, however, we shall use the generally accepted generic concept as herein presented.

Dysmicoccus patulae (Rau) (see Ferris, 1950) is not included in the following key. The presence of quinquelocular pores excludes this species from *Dysmicoccus*.

Dysmicoccus salmonaceus (Cockerell) is also excluded from the key because adult females have not been seen. Immature specimens from the type series have been examined, and apparently have fewer than 17 pairs of cerarii. The specimens described as *D. salmonaceus* by Ferris (1950) have a full complement of 17 pairs of cerarii and probably are not this species.

Dysmicoccus fimbriatulus (Cockerell and King) differs considerably from Ferris's (1953) concept of this species; therefore *D. fimbriatulus* keys out much differently in our key than in Ferris's.

Dysmicoccus now includes 30 species in North America.

KEY TO SPECIES OF *DYSMICOCCLUS* IN NORTH AMERICA:
ADULT FEMALES

- 1. Dorsal multilocular disk pores present 2
 Dorsal multilocular disk pores absent 4
- 2(1). Oral-collar tubular ducts absent; multilocular disk pores distorted,
 difficult to distinguish from large discoidals
 roseotinctus (Cockerell and Cockerell) (in part)
 Oral-collar tubular ducts present; multilocular disk pores normal for
 Pseudococcidae 3
- 3(2). Dorsal multilocular disk pores present on thorax and head; anal-lobe
 cerarii each with basal sclerotization limited to areas near conical
 setae *desertorum* McKenzie
 Dorsal multilocular disk pores absent on thorax and head; anal-lobe
 cerarii each with large circular area of basal sclerotization
 timberlakei (Cockerell)
- 4(1). Circulus absent 5
 Circulus present 10
- 5(4). At least half of abdominal cerarii with 3 or more conical setae
 obesus (Lobdell)
 More than half of abdominal cerarii with 2 conical setae 6
- 6(5). Tubular ducts few—scarcely more than 10 on venter of abdomen;
 anal-lobe cerarii with large area of basal sclerotization. *aciculus* Ferris
 Tubular ducts numerous—many more than 10 on venter of abdomen;
 anal-lobe cerarii either unsclerotized or sclerotization confined to
 area near bases of conical setae 7

- 7(6). Oral-collar tubular ducts present in large clusters along lateral margins of thorax *mcdanieli* (Hollinger)
 Oral-collar tubular ducts absent on thorax 8
- 8(7). Fewer than 15 pairs of cerarii *junceus* (McConnell)
 More than 15 pairs of cerarii 9
- 9(8). Oral-collar tubular ducts present in clusters near lateral margins of abdominal segments 9 through 6; oral-collar tubular ducts forming continuous row across medial area of abdominal segment 6
diodium (McConnell)
 Oral-collar tubular ducts present in clusters near lateral margins of abdominal segments 9 through 5 or 4; oral-collar tubular ducts on medial area of abdominal segment 6 either entirely absent or not forming continuous row *lasii* (Cockerell)
- 10(4). With fewer than 17 pairs of cerarii 11
 With 17 pairs of cerarii 17
- 11(10). Oral-collar tubular ducts abundant on dorsomedial areas of abdominal segments 6, 5, and 4 (each segment with more than 10) 12
 Oral-collar tubular ducts normally absent dorsomedially; if present, rare (with fewer than 7 on each of abdominal segments 6, 5, and 4) . . 13
- 12(11). Circulus small, circular, not divided by intersegmental line
merrilli Ferris
 Circulus large, oval, divided by intersegmental line . . *boninsis* (Kuwana)
- 13(11). Multilocular disk pores present on thorax and head; translucent pores present on hind coxae *racemus* McKenzie
 Multilocular disk pores absent on thorax and head; translucent pores absent on hind coxae 14
- 14(13). Anal-lobe cerarii each with 3 or more conical setae 15
 Anal-lobe cerarii each with 2 conical setae 16
- 15(14). Multilocular disk pores absent or poorly developed and distorted; translucent pores absent on hind femora; without discoidal pores near eyes *polymeris* Miller and McKenzie
 Multilocular disk pores present on abdominal segments 9, 8, and 7, normal for Pseudococcidae; translucent pores abundant on hind femora; normally with discoidal pores near eyes . . *difficilis* (Lobdell)
- 16(14). Oral-collar tubular ducts present on venter of meso- and prothorax; translucent pores present on hind femora; multilocular disk pores present on abdominal segment 6; discoidal pores not associated with eyes *ryani* (Coquillett)
 Oral-collar tubular ducts absent ventrally on anterior portion of thorax; translucent pores absent on hind femora; multilocular disk pores absent on abdominal segment 6; discoidal pores normally associated with eyes *morrisoni* (Hollinger) (in part)
- 17(10). Oral-collar tubular ducts abundant on dorsum, with 15 or more on abdomen *quercicolus* (Ferris)

- Oral-collar tubular ducts normally absent dorsally, if present, with
10 or fewer on abdomen18
- 18(17). Oral-collar tubular ducts absent ventrally
roseotinctus (Cockerell and Cockerell) (in part)
Oral-collar tubular ducts present on venter of abdomen19
- 19(18). Translucent pores present on hind coxae20
Translucent pores absent on hind coxae21
- 20(19). Ventral anal lobes with quadrate area of sclerotization; oral-collar
tubular ducts absent on anterior abdominal segments and on
thorax; eyes normally with associated discoidal pores
mackenziei Beardsley
Ventral anal lobes with narrow area of sclerotization; oral-collar
tubular ducts present along entire body margin; eyes without asso-
ciated discoidal pores*wistariae* (Green)
- 21(19). Hind legs without translucent pores*vacuatus* McKenzie
Hind legs with translucent pores present at least on tibiae22
- 22(21). Hind legs with translucent pores on tibiae only23
Hind legs with translucent pores on femora and tibiae24
- 23(22). Multilocular disk pores either absent or restricted to abdominal seg-
ments 9 and 8; eyes normally with 1 or 2 associated discoidal pores
pinicolus McKenzie
Multilocular disk pores present on abdominal segments 9 through 6
or 5; eyes without associated discoidal pores*hurdi* McKenzie
- 24(22). Multilocular disk pores absent; lateral margins of abdominal seg-
ments each with 0 to 2 oral-collar tubular ducts
fimbriatulus (Cockerell and King)
Multilocular disk pores present; lateral margins of at least posterior
3 abdominal segments each with clusters of 5 or more oral-collar
tubular ducts25
- 25(24). Body setae on dorsomedial area of abdominal segment 8 noticeably
longer than on other areas of dorsum, and with cluster of more
than 8 large discoidal pores in this area*brevipes* (Cockerell)
Body setae normally not more elongate on dorsomedial area of
abdominal segment 8; if longer, then with fewer than 6 large dis-
coidal pores in this area26
- 26(25). Abdominal cerarii, for most part, with 2 conical setae27
Abdominal cerarii, for most part, with more than 2 conical setae.....29
- 27(26). Oral-collar tubular ducts with dermal orifices noticeably larger in
diameter than trilocular pores; lateral abdominal clusters of oral-
collar tubular ducts each with fewer than 10 ducts
aurantius (Cockerell)
Oral-collar tubular ducts with dermal orifices smaller than or equal
to diameter of trilocular pores; lateral abdominal clusters of oral-
collar tubular ducts each with more than 10 ducts28

- 28(27). Multilocular disk pores present on abdominal segment 6; circulus wider than long *bispinosus* Beardsley
 Multilocular disk pores absent on abdominal segment 6; circulus longer than wide *texensis* (Tinsley)
- 29(26). Longest dorsomedial seta on abdominal segment 9 greater than 30 μ long; dorsal setae filiform; longest seta near vulva greater than 90 μ long; abdominal cerarii normally without small discoidal pores (excluding anal-lobe cerarii), rarely with 2 or 3 cerarii each with 1 or 2 such pores *morrisoni* (Hollinger) (in part)
 Longest dorsomedial seta on abdominal segment 9 less than 25 μ long; dorsal setae spinose; longest seta near vulva less than 75 μ long; most abdominal cerarii each with 2 or more small discoidal pores 30
- 30(29). Antennae 6- or 7-segmented *probrevipes* (Morrison)
 Antennae 8-segmented *ncobrevipes* Beardsley

***Dysmicoccus aurantius* (Cockerell)**
 (Figure 5)

Ripersia aurantia Cockerell, 1901a: 51;
 Fernald, 1903: 116; MacGillivray,
 1921: 141.

Pseudococcus aurantia (Cockerell),
 McConnell, 1941: 96.

Dysmicoccus aurantius (Cockerell),
 Ferris, 1953: 334; McKenzie, 1967:
 156.

Suggested common name. Orange-colored mealybug.

Specimens examined. Adult female apparently associated with ants, *Lasius* sp., collected at Las Valles (misspelling of Las Vegas?), San Miguel Co., New Mexico, April, 1901, by W. P. Cockerell.

Type material. We suspect (but are not certain) that the original description was based on more than one specimen. Because we have been able to locate only one, however, we shall consider that specimen the holotype rather than the lectotype. If more type material becomes available, it will be necessary to designate a lectotype at that time. A single adult female is labeled "*Ripersia aurantia* *Ckl* Las Valles. N.M. (Apr. 1901) (W. P. Cockerell) TYPE"; left label, "10580 T. D. A. Cockerell Postal Mar. 23, 1904"; deposited at USNM.

Gross external features. According to Cockerell (1901a), the body is "Bright orange, with very little mealy powder; very convex, almost hemispherical. . . . Legs and antennae reddish brown."

This species was apparently found in the nest of an ant of the genus *Lasius* (Formicidae).

Recognition characters. Adult female, mounted, 2.4 mm long, 1.8 mm wide; body rotund.

Dorsum with 17 pairs of cerarii. Anal-lobe cerarii each with 2 conical setae, 4 or 5 auxiliary setae, cluster of 52 to 58 trilocular pores, 1 or 2 discoidal pores, and no basal sclerotization. Remaining cerarii each with 2 conical setae, 0 to 7 auxiliary setae, large cluster of trilocular pores, 0 to 2 small discoidal pores, and no basal sclerotization. Multilocular disk pores absent. Trilocular and small discoidal pores lightly scattered over surface. Oral-collar tubular ducts absent. Body setae slightly shorter than those on venter; those present on segments 9 and 8 not elongate.

Anal ring apical, touching apex of abdomen, with 2 rows of pores, outer row weakly developed; each of its 6 setae slightly longer than greatest diameter of ring.

Venter with 8 multilocular disk pores

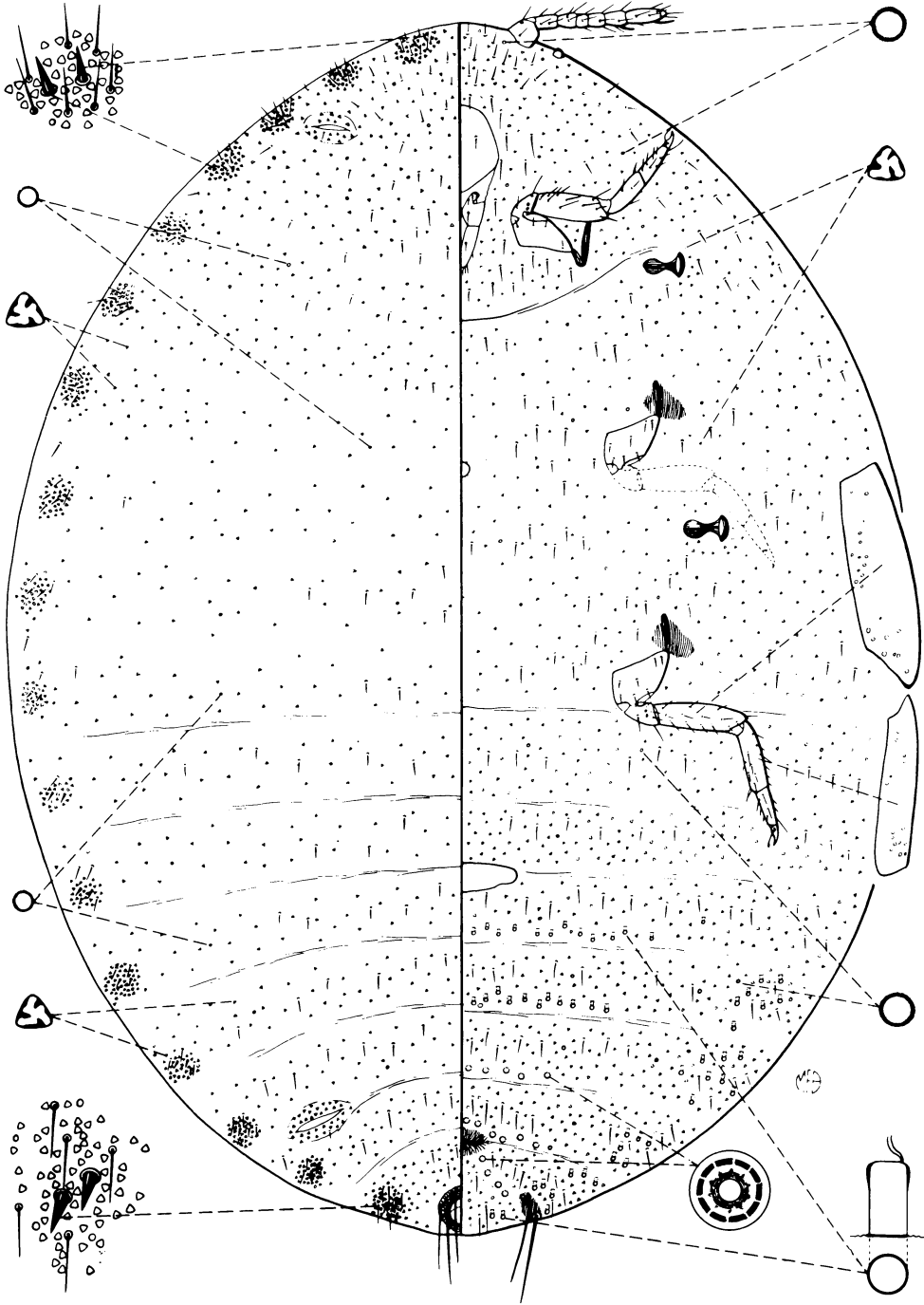


Fig. 5. *Dysmicoccus aurantius* (Cockerell), collected at Las Valles (Las Vegas ?), San Miguel County, New Mexico, April, 1901.

on abdominal segment 9, with 15 on segment 8, with 10 on 7, with 1 on 6, absent elsewhere. Trilocular and discoidal pores scattered over surface. Oral-collar tubular ducts short, with large orifices; present in lateral clusters from abdominal segments 9 through 6; each cluster near margin of segment 8 containing 5 or 6; also present in complete rows along posterior margin of abdominal segments 6 and 5. Body setae short for genus. Anal lobes each with small rectangular area of sclerotization.

Circulus large, apparently resting on intersegmental line between abdominal segments 5 and 4. Hind femora each dorsally with 23 translucent pores, absent ventrally; hind tibiae each dorsally with 15 pores, absent ventrally; tarsal digitules broken; claw digitules apically capitate, reaching tip of claw; claws without denticle. Antennae 6-segmented on 1 side, 7-segmented on the other. Eyes smaller than normal for genus, sometimes with discoidal pore near eye, but not considered in association. Rostrum unusually elongate for pseudococcid.

Notes. This species is most closely related to *Dysmicoccus lasii* (Cockerell), but differs in that it has a large circulus; cerarii all with 2 conical setae and with basal clusters of 25 to 60 trilocular pores. *D. lasii*, on the other hand, has no circulus; a few cerarii on thorax and head with 3 conical setae; cerarii with basal clusters of 7 to 25 trilocular pores.

Dysmicoccus lasii (Cockerell)

(Figure 6)

Ripersia lasii Cockerell, 1896a: 223; 1897: 240; King, 1897: 127; King and Cockerell, 1897: 93; Cockerell, 1899b: 391; King, 1899a: 110; 1899b: 254; 1899c: 312; 1899d: 299; 1900: 12; 1901: 193; Cockerell, 1901a: 57; King, 1902: 159; Fernald, 1903: 118; Jarvis, 1911: 69; MacGillivray, 1921: 141; Britton, 1923: 382; Green, 1931: 101; Rau, 1938: 161.

Dysmicoccus lasii (Cockerell), Ferris, 1953: 335; McKenzie, 1962: 644; 1964: 230; 1967: 157; Miller and McKenzie, 1971: 513.

Suggested common name. *Lasius* mealybug.

Specimens examined. Adult females collected at Leon Co., Florida, August 12, 1970, by H. H. Tippins. Adult females in nests of ants, *Lasius flavus* (Fabricius), collected in Massachusetts, April 4, 1897, by G. B. King. Adult females in nests of ants, *Acanthomyops claviger* (Roger), collected at Lawrence, Essex Co., Massachusetts, October 20, 1899, by G. B. King. Adult females and immature nymphs in nests of ants, *A. claviger*, collected at Methuen, Essex Co., Massachusetts, April 3 and 13, 1897, by G. B. King.

Type material. Authentic type material of this species has not been examined; however, topotypes collected by King (collector of the type series) have been seen; deposited at USNM. These specimens agree with the original description.

Gross external features. The light orange body of the adult female is lightly dusted with a white, waxy secretion.

This species has been collected on the roots of *Callistephus hortensis* and in the chambers of ant nests. *Acanthomyops claviger*, *Lasius alienus* (Foerster) (= *L. niger americanus*), and *L. flavus* (Formicidae) have been recorded as attendants.

Recognition characters. Adult female, mounted, 1.0 to 1.8 mm long, 0.8 to 1.4 mm wide; body rotund.

Dorsum with 17 pairs of cerarii. Anal-lobe cerarii each with 2 conical setae, 1 to 3 auxiliary setae, cluster of 15 to 25 trilocular pores, 1 or 2 small discoidal pores, and no basal sclerotization. Remaining cerarii each with 2 conical setae (except anterior 2 or 3 cerarii which may possess 3 conical

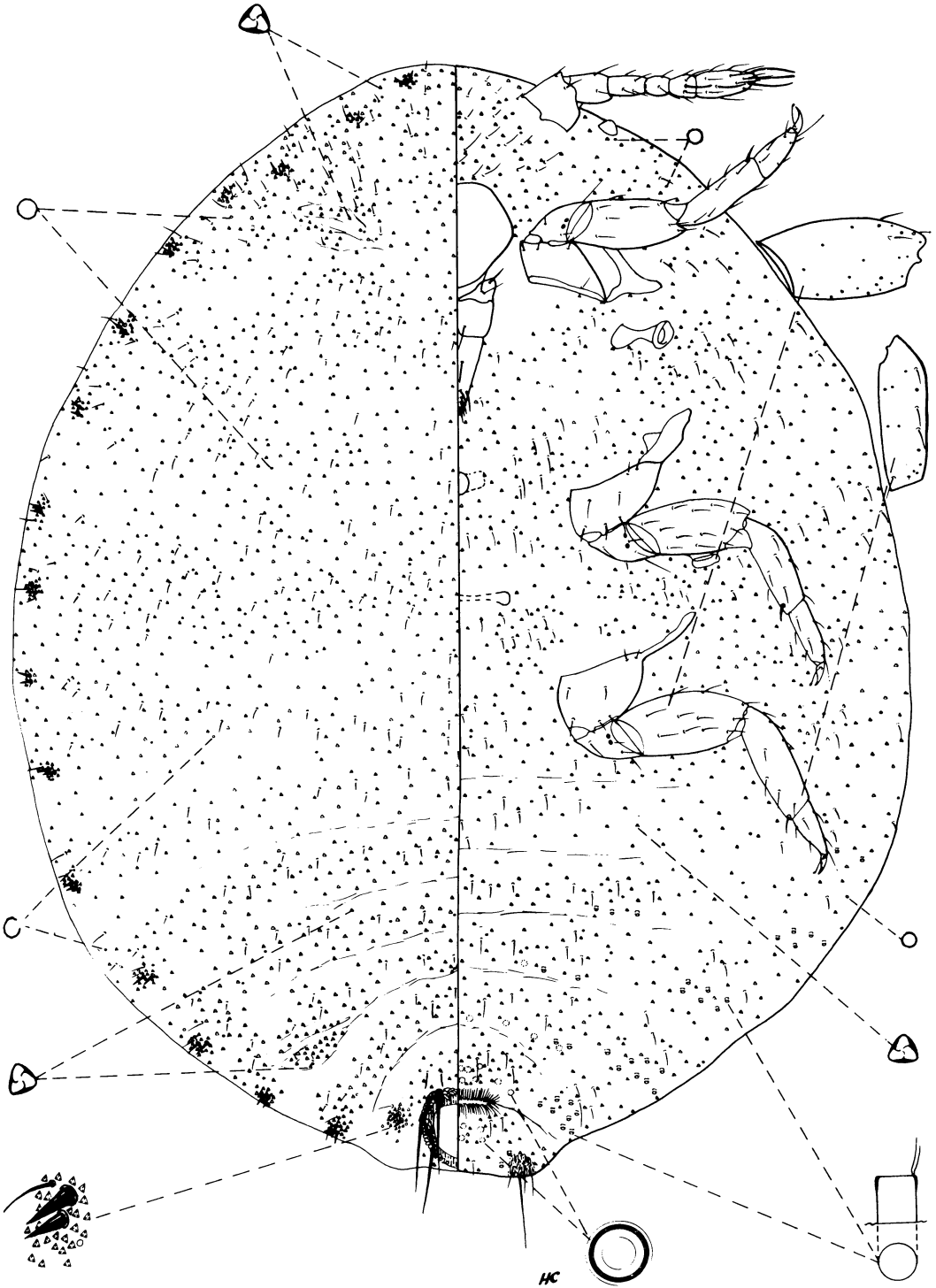


Fig. 6. *Dysmicoccus lasii* (Cockerell), collected at Methuen, Essex County, Massachusetts, April 13, 1897, associated with the ant *Acanthomyops claviger* (Roger).

setae), 0 to 3 auxiliary setae, cluster of 7 to 25 trilocular pores, 1 or 2 small discoidal pores, and no basal sclerotization. Multilocular disk pores absent. Dorsum with light scattering of trilocular and small discoidal pores. Oral-collar tubular ducts absent. Dorsal body setae short, except on medial areas of abdominal segments 9 and 8, where sometimes slightly longer than on rest of surface.

Anal ring dorsal, situated near abdominal apex, with 2 rows of pores, outer row weakly developed; each of its 6 setae slightly longer than greatest diameter of ring.

Venter with from 3 to 9 (av. 5.1) multilocular disk pores present on abdominal segment 9, with from 6 to 15 (av. 10.5) on segment 8, with 3 to 14 (av. 6.7) on 7, with 0 to 3 (av. 0.8) on 6, with 0 to 2 (av. 0.3) on 5, absent elsewhere. Trilocular and discoidal pores scattered over surface. Oral-collar tubular ducts short, with large orifices; present in lateral clusters from abdominal segments 9 through 5, 4, or 3; each cluster near margin of segment 8 containing 5 to 12; also present in complete or incomplete rows along posterior margin of abdominal segments 7, 6, and sometimes 5. Body setae noticeably longer than those on dorsum. Anal lobes each with large, quadrate area of sclerotization.

Circulus absent. Translucent pores small, sometimes difficult to see; rarely with a few such pores on trochanter, 9 to 30 pores on dorsal surface of femur, and 10 to 33 on dorsal surface of tibia; tarsal digitules apically enlarged, not reaching tip of claw; claws with digitules extending to tip of claw; claws without denticle. Antennae 6- or 7-segmented. Eyes normal in size for genus, often with discoidal pores near eye, but not considered in association. Rostrum unusually elongate for pseudococcid.

Notes. This species was previously

considered close to *Dysmicoccus fimbriatulus* (Cockerell and King) (Ferris, 1953), but it is actually quite distinctive. *D. lasii* differs in that it has no circulus; abdominal cerarii with 2 conical setae; clusters of 5 or more oral-collar tubular ducts along lateral margins of abdominal segments 8 and 7. *D. fimbriatulus*, however, has a small circulus; abdominal cerarii often with more than 2 conical setae; 0 to 2 oral-collar tubular ducts along lateral margins of abdominal segments 8 and 7. Ferris apparently did not notice the multiple seta cerarii or the circulus of *D. fimbriatulus*.

This species is most closely related to *Dysmicoccus diodium* (McConnell), which may prove to be a junior synonym when more specimens are available. *D. lasii* differs in that it has lateral clusters of oral-collar tubular ducts on abdominal segments 9 through 5 or 4; small number of ventral oral-collar tubular ducts on medial areas of abdominal segment 6, not forming a continuous row. *D. diodium*, on the other hand, has lateral clusters of oral-collar tubular ducts on abdominal segments 9 through 6; numerous ventral oral-collar tubular ducts on medial areas of abdominal segment 6.

Dysmicoccus lasii is also related to *D. brachydactylus* Miller and McKenzie, but differs in having 2 conical setae in each abdominal cerarius, and claw digitules extending to tip of claw. *D. brachydactylus*, however, has 3 or more conical setae in each abdominal cerarius (except on anal lobe); and claw digitules not extending to tip of claw.

For a further comparison see "Notes" under *Dysmicoccus aurantius*.

Dysmicoccus morrisoni (Hollinger) (Figure 7)

Pseudococcus morrisoni Hollinger, 1917: 270; 1923: 55; M. R. Smith, 1928: 277; Lohdell, 1930: 217.

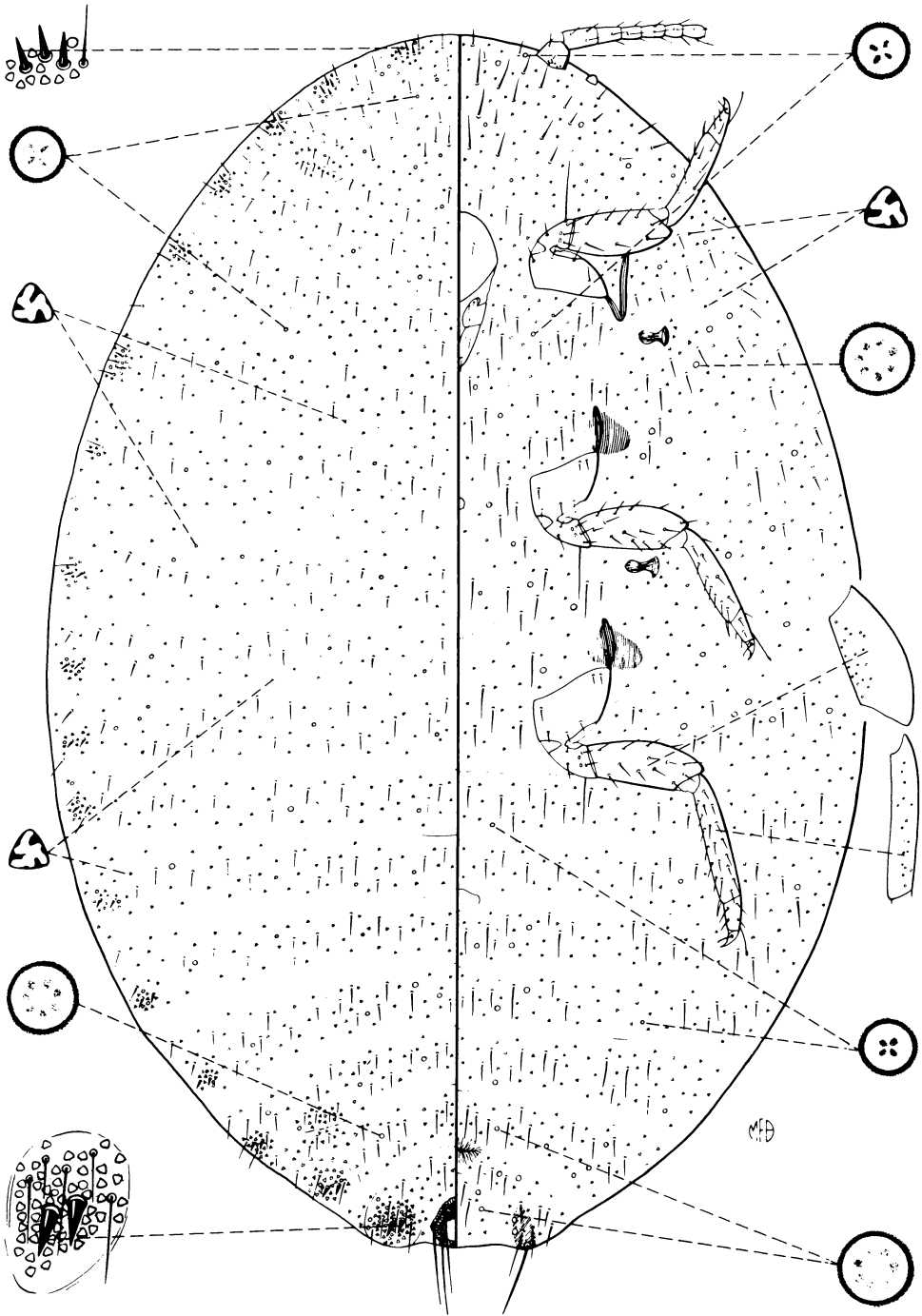


Fig. 7. *Dymicoccus morrisoni* (Hollinger), collected at Greenville, Butler County, Alabama, October 16, 1968, on *Carya illinoensis* (Juglandaceae).

Dysmicoccus morrisoni (Hollinger), Ferris, 1950: 67; 1953: 343; McKenzie, 1962: 644; 1964: 231; Beardsley, 1965: 57; McKenzie, 1967: 158.

Suggested common name. Pecan mealybug.

Specimens examined. Adult females on *Carya illinoensis* (Juglandaceae), collected at Greenville, Butler Co., Alabama, October 16, 1968, by P. Estes. Adult females on *C. illinoensis* have also been examined from the following localities: Richmond Hill, Bryan Co., Georgia, December 6, 1943, by Mallia; adult females and immature nymphs at Cordele, Crisp Co., Georgia, December 29, 1969, by J. A. Payne; Baton Rouge, East Baton Rouge Parish, Louisiana, October 30, 1947, by C. E. Smith; Shelby, Bolivar Co., Mississippi, May 3, 1929, by G. I. Worthington; Pascagoula, Jackson Co., Mississippi, May 25, 1927, by R. P. Colmer. Adult females on *Carya* (= *Hicoria*) *alba*, exact locality unknown but presumed to be Columbia, Boone Co., Missouri, by A. H. Hollinger. Adult females on *Carya* sp. have been examined from the following localities: Coytesville, Bergen Co., New Jersey, June, 1939, by G. Rau; Saratoga Springs, Saratoga Co., New York, August, 1938, by G. Rau.

Type material. We have seen three specimens apparently from the type series labeled "Pseudococcus morrisonii sp. novo. *Hicoria alba*"; deposited at USNM. For additional information about this material see Beardsley (1965).

Gross external features. Hollinger (1923) describes this species in the field as follows: "They were massed in a nearly closed callus which had been partially covered by a protecting carton built by the little black ants which were associated with them." The adult females were ". . . semi-globular in form; covered with a heavy, white, mealy, waxy secretion; . . . body var-

nish brown in color; . . . when boiled in 10% KOH the body contents turn a deep blood red. . . "

This species has since been found in association with the ant *Lasius neoniger* (Emery) (Formicidae), from pecan crown galls, and under a log, associated with *L. umbratus* (Nylander) (Formicidae).

Recognition characters. Adult females, mounted, 1.4 to 2.9 mm long, 0.8 to 2.6 mm wide; body oval to rotund.

Dorsum with cerarii extremely variable, with from 9 to 17 pairs (normally with 13 or 14), these often represented only by single, slightly enlarged body setae. Anal-lobe cerarii each with 2 robust, conical setae, 6 or 8 auxiliary setae, conspicuous cluster of approximately 35 trilocular pores, 1 or 2 discoidal pores, small area of light sclerotization. At least some of remaining abdominal cerarii with from 3 to 7 conical setae. Thoracic cerarii often absent or represented only by enlarged body setae. Head cerarii normally represented by frontal and ocular pairs. Multilocular disk pores absent. Trilocular pores abundant. Large discoidal pores with "sieve-like center" scattered over surface. Oral-collar tubular ducts normally absent; specimens from northern areas may possess a few inconspicuous ducts scattered over surface. Body setae often somewhat enlarged, similar in width to dorsal setae of *Dysmicoccus ryani* (Coquillett); body setae on median areas of abdominal segments 9 and 8 equal to or slightly longer than those on rest of dorsum (varying from 30 to 88 μ long).

Anal ring dorsal, normally touching posterior apex of abdomen, with 2 rows of pores, both rows slightly sclerotized; each of its 6 setae approximately one and one-half times as long as greatest diameter of ring.

Venter with multilocular disk pores present from abdominal segment 9

through posterior margin of segment 7; varying in number from 22 to 75. Trilocular pores abundant. Discoidal pores present in small numbers over surface. Oral-collar tubular ducts of 2 sizes: larger size, present on lateral areas of abdominal segments 9 through 6; smaller size present on medial areas of abdominal segments 9 through 3; sometimes with a few ducts present along lateral margins of thorax and head. Body setae noticeably more slender and elongate than those on dorsum, with conspicuous clusters of setae along body margin of posterior abdominal segments; longest body setae near vulva varying from 90 to 142 μ long. Anal lobes each with large area of sclerotization.

Circulus large, rectangular, divided by intersegmental line between abdominal segments 5 and 4. Legs normally robust; hind femora dorsally with 32 to 58 translucent pores, absent ventrally; hind tibiae dorsally with 25 to 41 pores, absent ventrally; tarsal and claw digitules capitate, extending beyond tip of claw; claws without denticle. Antennae 7- or 8-segmented. Eyes with 0 to 3 associated discoidal pores, at least 1 present on each specimen. Rostrum not unusually elongate.

Notes. This is probably the most variable North American species of *Dysmicoccus*. The variation seems to be geographically influenced. Material from Alabama, Georgia, Louisiana, and Mississippi has numerous robust, dorsal body setae; body setae on abdominal segments 9 and 8 only slightly longer than other dorsal body setae; no dorsal tubular ducts; reduced numbers of ventral tubular ducts, these almost entirely confined to abdomen; from 9 to 14 or 15 pairs of cerarii. Specimens from the type series (Missouri) are similar to the above except that they have from 14 to 16 pairs of cerarii and a few ventral tubular ducts on the thorax and head.

Specimens from New Jersey have robust dorsal body setae, which are noticeably longer on abdominal segments 9 and 8; dorsal oral-collar tubular ducts present or absent; ventral oral-collar ducts numerous; from 16 to 17 pairs of cerarii.

It is unfortunate that Ferris chose not to illustrate type material in his *Atlas* (1950). The specimen he drew was a variant quite different from the type series. The illustration presented herein is more typical of true *Dysmicoccus morrisoni*, although it has fewer cerarii.

Dysmicoccus roseotinctus
(Cockerell and Cockerell)

(Figure 8)

Dactylopius roseotinctus Cockerell and Cockerell, 1901: 336.

Pseudococcus roseotinctus (Cockerell and Cockerell), Cockerell, 1902b: 316; Fernald, 1903: 108; Cockerell, 1910 (misidentification); MacGillivray, 1921: 133.

Dysmicoccus roseotinctus (Cockerell and Cockerell), Ferris, 1953: 341; McKenzie, 1962: 644; 1964: 231; 1967: 157.

Suggested common name. Rose-colored mealybug.

Specimens examined. Adult female on "roots of grass," collected at Romeroville, San Miguel Co., New Mexico, November 9, 1901, by W. P. Cockerell.

Type material. A single specimen from the type series has been examined, with left label, "*Pseudococcus roseotinctus* (T. & W. Ckll.) Type (Roots of grass) Romeroville, N.M. (W. P. Cockerell) Nov. 9, 1901"; right label, "Dact. roseotinctus. Romeroville. on Nov. 9. 1901 (Ckll)"; deposited at USNM. Because only a single specimen from the type series is now available, we have considered this specimen the holotype. If more material becomes available, it will be necessary to designate a lectotype.

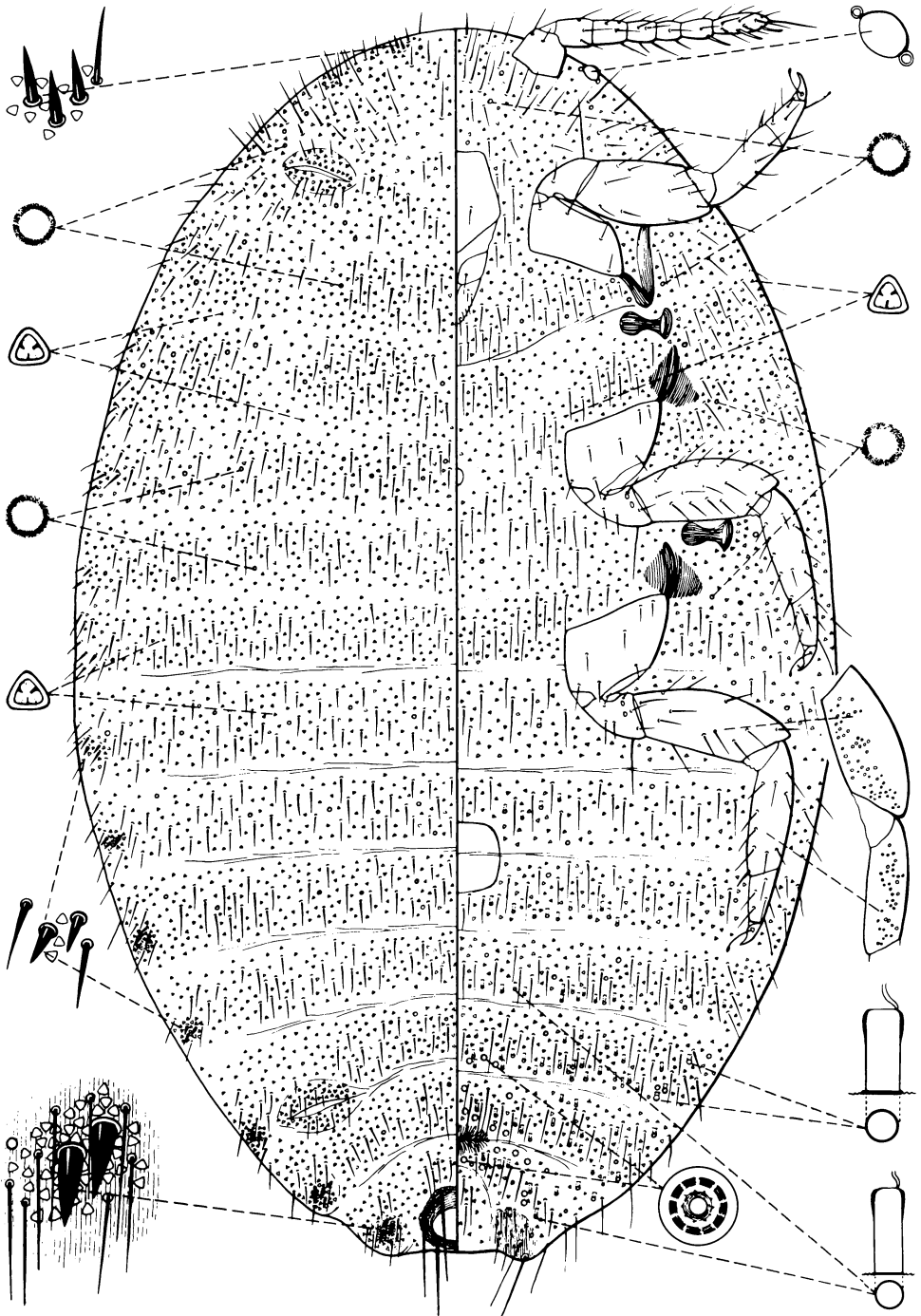


Fig. 8. *Dysmicoccus roseotinctus* (Cockerell and Cockerell), collected at Romeroville, San Miguel County, New Mexico, November 9, 1901, on "roots of grass."

Gross external features. According to Cockerell and Cockerell (1901), the species is "... pink, distinctly segmented, with a slight covering of mealy powder; caudal tassels short but well developed; lateral fringe of tassels very short, irregular, but plainly visible in fresh specimens. Females... show no signs of producing ovisacs."

Recognition characters. Adult female, mounted, 2.7 mm long, 1.7 mm wide; body oval.

Dorsum with 17 pairs of cerarii. Anal-lobe cerarii each with 2 conical setae, 3 to 5 auxiliary setae, cluster of 33 to 37 trilocular pores, 3 or 4 discoidal pores, and large area of light basal sclerotization. Remaining cerarii each with 2 conical setae (except for 1 pair on thorax and 3 pairs on head, which have 3 or 4 conical setae), 0 to 3 auxiliary setae, small cluster of trilocular pores, 1 to 3 discoidal pores, and basal sclerotization present only in posterior 2 or 3 pairs of cerarii. Pores either of multilocular type or of large discoidal type lightly scattered over entire surface. Trilocular pores scattered over surface. Oral-collar tubular ducts absent. Dorsal body setae noticeably shorter than those on venter; medial areas of abdominal segments 9 and 8 without elongate setae.

Anal ring apical (bent over abdomen apex), with 2 rows of pores; each of its 6 setae approximately twice as long as greatest diameter of ring.

Venter with "multilocular disk pores" of same type as on dorsum, decreasing in size anteriorly, scattered over entire surface, not clustered near spiracle. Discoidal pores absent. Trilocular pores present over surface. Oral-collar tubular ducts absent. Body setae

shorter than normal for genus. Anal lobes each with rectangular area of sclerotization.

Circulus present on intersegmental line between abdominal segments 5 and 4, showing no sign of division. Translucent pores small, difficult to see; hind femora with 18 to 23 pores dorsally, absent ventrally; hind tibiae with 17 pores dorsally, absent ventrally; tarsal digitules capitate, not extending beyond tip of claw; claw digitules broken on all legs; probably capitate and extending beyond tip of claw. Antennae broken, probably 8-segmented; with numerous small pores at antennal base. Eyes without associated discoidals. Rostrum slightly more elongate than normal for genus.

Notes. This species is most closely related to *Dysmicoccus pinicolus* McKenzie, but differs in that it has multilocular disk pores of abortive type or large discoidals on dorsum; translucent pores on hind femora; no tubular ducts or small discoidal pores. *D. pinicolus*, on the other hand, has no dorsal multilocular disk pores or large discoidal pores; no translucent pores on hind femora; ventral oral-collar tubular ducts present; small discoidal pores scattered over both body surfaces.

It is entirely possible that some specimens of this species will possess no multilocular disk pores. Therefore, in the revised key to the species of *Dysmicoccus*, *D. roseotinctus* is keyed out twice.

A specimen of the material described by Cockerell (1910) as *Dysmicoccus roseotinctus* has been examined. Although it is in poor condition, the presence of large numbers of tubular ducts clearly makes Cockerell's determination a misidentification.

Genus *Puto* Signoret, 1876

Type species. *Putonia antennata* Signoret, 1875 (by substitution of *Puto* for *Putonia* Signoret, 1875, which was

preoccupied by *Putonia* Stal, 1872; *P. antennata* is type of *Putonia* by monotypy).

Discussion. In North America this genus is quite distinctive morphologically. The adult females may be characterized as follows: cerarii heavily sclerotized, each having 6 or more conical setae; claws with large denticle; antennae normally 9-segmented; with or without quinquelocular pores; legs unusually large and heavily sclerotized.

A remarkable amount of similarity exists between *Puto* and *Phenacoccus* Cockerell. Both genera have species with cerarii having more than 6 conical setae, claws with a conspicuous denticle, 9-segmented antennae, and quinquelocular pores. *Puto* may be distinguished in that most of the cerarii have 6 or more conical setae, whereas in *Phenacoccus* species, most of the cerarii have fewer than 6 conical setae. Some species within these genera are very similar, including *Phenacoccus eriogoni* Ferris, *P. megaulus* McKenzie, *Puto mimicus* McKenzie, *P. nulliporus* McKenzie. Adult males of these genera are quite distinctive, and it will be interesting to examine males of the above species when available. It is entirely possible that such an examination will make several generic transfers necessary.

Because no major alterations to McKenzie's (1967) key to North American species of *Puto* seem necessary, we have excluded such a key in this study.

Puto now includes 24 species in North America.

Puto lasiorum (Cockerell)

(Figure 9)

Ceroputo lasiorum Cockerell, 1901b: 166; Fernald, 1903: 94.

Ceroputo lassiorum Cockerell, MacGillivray, 1921: 144.

Puto lasiorum (Cockerell), Essig, 1926: 286; Bueker, 1931: 153 (may belong in *Ceroputo*); Ferris, 1950: 206; Berry, 1959: 244 (probably a misidentification); McKenzie, 1960: 731; 1961: 33; Bibby, 1961: 330; McKenzie, 1967: 329.

Suggested common name. Dorsal-cerarius mealybug.

Specimens examined. Adult female associated with *Acanthomyops interjectus* (Mayr), collected at Las Vegas, San Miguel Co., New Mexico, April, 1901, by W. P. Cockerell.

Type material. A single specimen from the type series has been examined and is labeled "14568 *Ceroputo lasiorum* n. sp. nests of *Lasius interjectus* Las Vegas April. W. P. Ckll Adult. Apr. 1901"; deposited at USNM. Because only a single specimen from the type series is available, we have considered it the holotype; if more material becomes available, it will be necessary to designate a lectotype.

Gross external features. According to Cockerell (1910b) this species is "... broad, almost white, with a faint greenish tinge, covered with white secretion. The dense secretion covering the dorsum looks like wool, instead of having a chalky appearance... it is also not separable into distinct lamellae, nor are the hindmost lamellae at all prolonged... in young individuals the lateral tufts are distinct. Legs pale reddish brown..."

This species occurs on the roots of its hosts. It has frequently been collected under rocks in ants' nests, feeding on roots. It has been reported in association with *Acanthomyops interjectus* and *Lasius alienus* (Foerster) (= *niger americanus*) (Formicidae). It apparently overwinters as an adult.

Recognition characters. Adult female, mounted, 3.5 mm long, 2.2 mm wide; body broadly oval.

Dorsum with 17 or 18 pairs of definite cerarii and several accessory cerarii. Anal-lobe cerarii each with 17 and 20 conical setae, 1 or 2 oral-collar tubular ducts, 32 or 35 trilocular pores, large area of basal sclerotization. Remaining abdominal cerarii each with 13 to 21 (av. 16.6) conical setae, 1 to 5

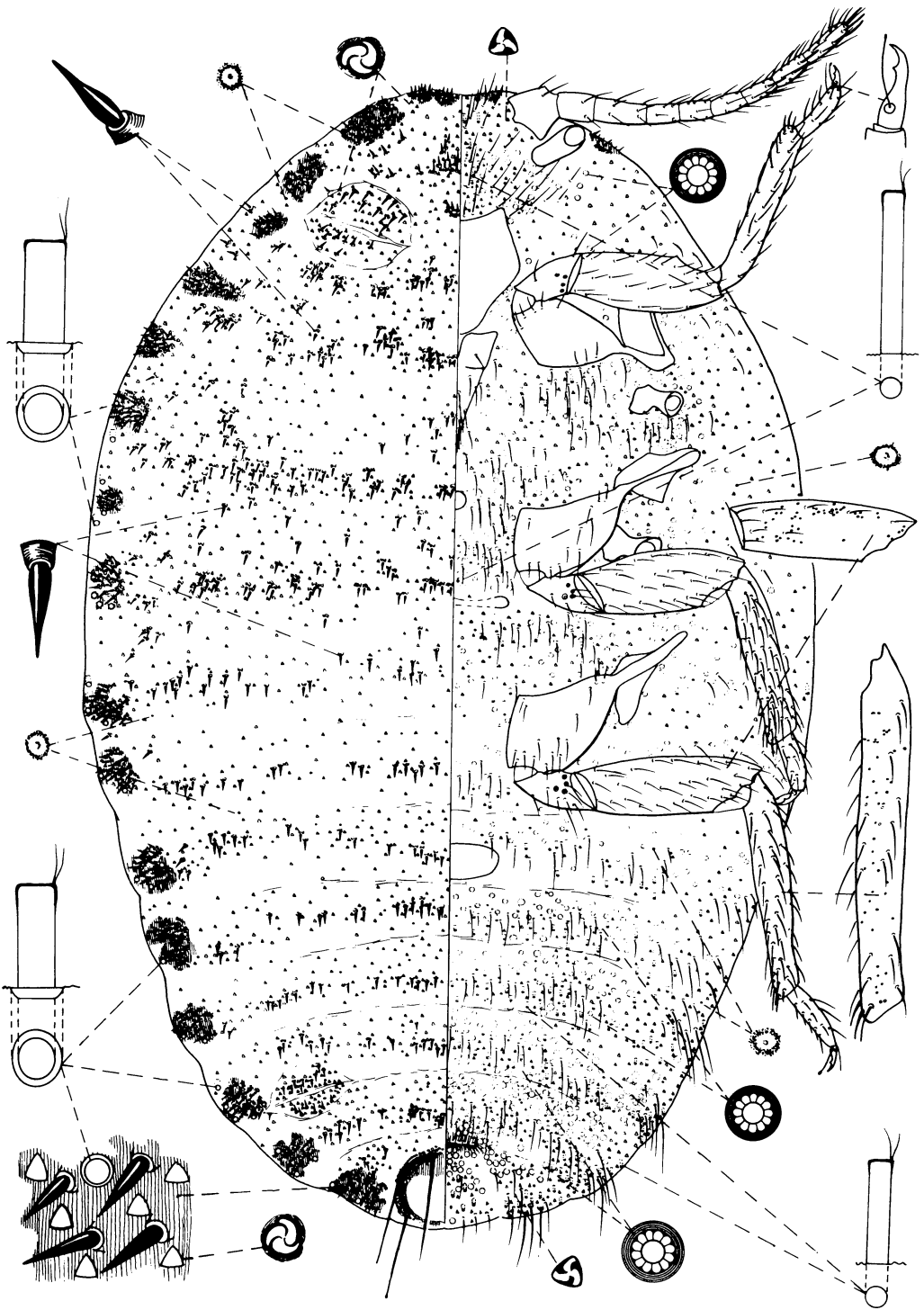


Fig. 9. *Puto lasiorum* (Cockerell), collected at Las Vegas, San Miguel County, New Mexico, April, 1901, associated with the ant *Acanthomyops interjectus* (Mayr).

(av. 2.4) oral-collar tubular ducts, cluster of trilocular pores, basal sclerotization. Thoracic and head cerarii each with 8 to 25 (av. 16.5) conical setae, 0 to 2 (av. 0.6) oral-collar tubular ducts, cluster of trilocular pores, basal sclerotization. Multilocular disk pores absent. Dorsum with trilocular and discoidal pores scattered over surface. Oral-collar tubular ducts larger than those on venter, present only on or near cerarii. Dorsal setae spinelike, approximately same size as cerarian setae, gathered into clusters on medial and mediolateral areas; clusters with small amount of basal sclerotization. Ostiole lips unsclerotized.

Anal ring apical, bent around apex of abdomen, with 3 or 4 rows of pores; 3 pairs of setae, approximately one and one-half times longer than greatest diameter of ring. Anal-ring setae of two types: 1 pair apically expanded; 2 pairs apically acute.

Venter with multilocular disk pores of two sizes, present over entire surface except along lateral margins of thorax and head, most abundant on posterior abdominal segments. Trilocular and discoidal pores scattered over surface. Oral-collar tubular ducts of two sizes: shorter ducts present over surface, becoming less numerous anteriorly; longer ducts present on medial area of head, with 1 such duct on thorax between mesothoracic legs. Body setae noticeably more elongate than dorsal setae, present in clusters laterally on posterior abdominal segments. Anal lobes unsclerotized.

Circulus elongate laterally, present on posterior margin of abdominal segment 4, anterior margin sometimes slightly crenulate. Translucent pores inconspicuous; hind femora dorsally with 38 and 47 pores, absent ventrally; hind tibiae dorsally with 38 and 50 pores, absent ventrally; tarsal digitules apically acute, not reaching tip of claw; claw digitules slightly capitate, extend-

ing beyond tip of claw; claws with conspicuous denticle. Antennae 9-segmented.

Notes. This species is very close to *Puto mexicanus* (Cockerell), but differs in having 1 or 2 oral-collar tubular ducts in each anal-lobe cerarius; dorsal setae of approximately same size as cerarian setae; dorsal setae present in clusters on medial areas, with basal sclerotization. *P. mexicanus*, however, has 5 to 15 oral-collar tubular ducts in each anal-lobe cerarius; dorsal setae smaller than cerarian setae, not gathered into large groups, and without basal sclerotization.

It is becoming increasingly apparent that these two species are very close. Although they are at present separable, it is likely that future collecting will reveal intermediate specimens.

Puto sandini Washburn

(Figure 10)

Puto sandini Washburn, 1965: 293; Miller, 1966: 112; McKenzie, 1967: 328.

Suggested common name. Spruce mealybug.

Specimens examined. Adult females on *Picea englemanni* (Pinaceae), collected near Panguitch, Dixie National Forest, Griffen Top, Garfield Co., Utah, August 22, 1955, by R. I. Washburn. Adult female on *P. englemanni*, collected near Escalante, Dixie National Forest, Griffen Mountain, Garfield Co., Utah, September 13, 1958, by R. I. Washburn. Adult females, adult males, and immature nymphs on *P. englemanni*, collected near Loa, Fish Lake National Forest, Thousand Lakes Mountain, Wayne Co., Utah, August 4, 1953, and July 24, 1955, by R. I. Washburn.

Type material. We have examined the adult female holotype with right label, "13 September 1958 Engelmann Spruce Griffen Mt. Dixie N. F. Utah Hopk. No. 39-706 Coll. R. I. Washburn

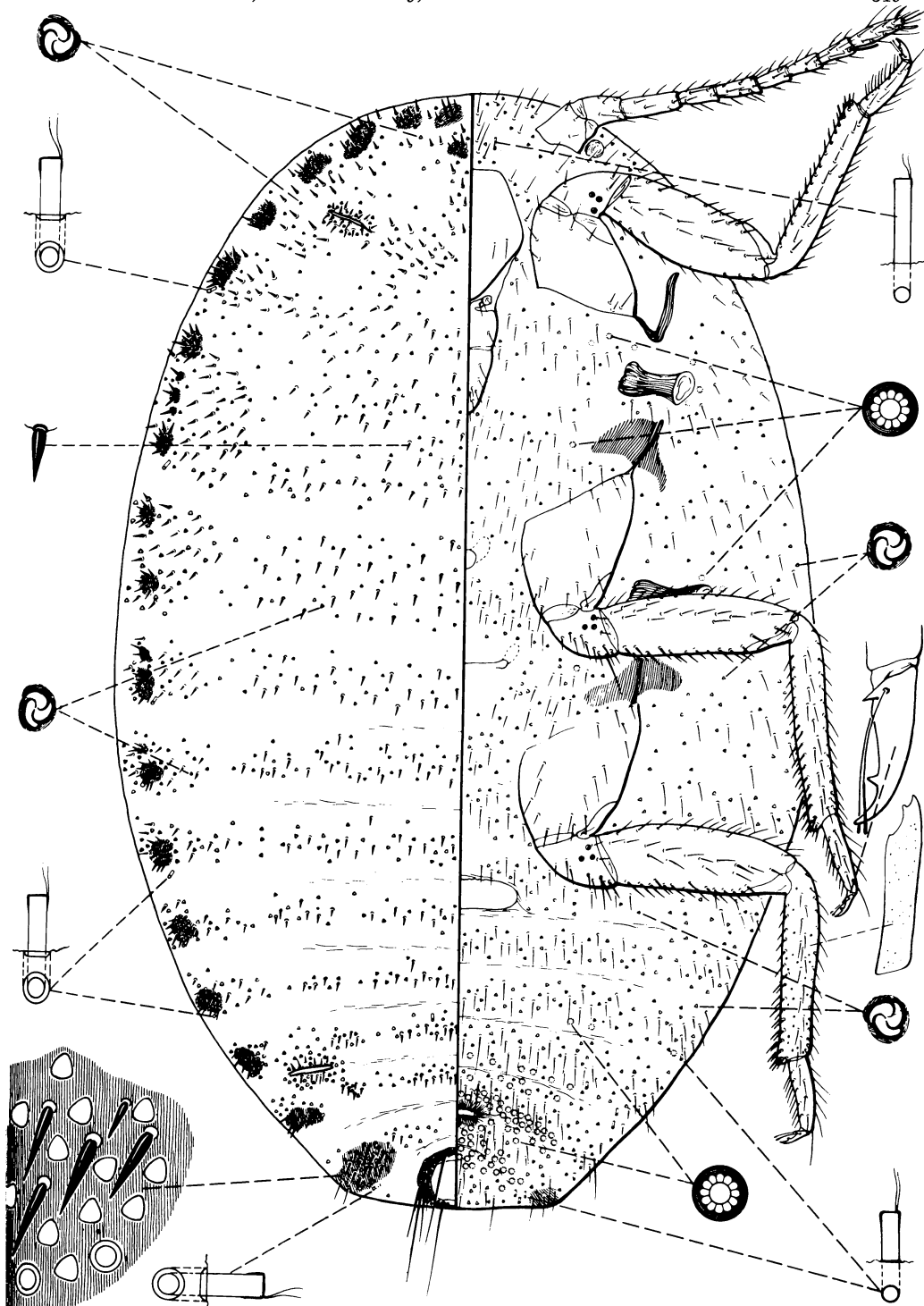


Fig. 10. *Puto sandini* Washburn, collected near Loa, Fish Lake National Forest, Thousand Lakes Mountain, Wayne County, Utah, August 4, 1953, on *Picea engelmanni* (Pinaceae).

Holotype"; left label, "Puto sandini ♀"; deposited at USNM.

Gross external features. Washburn (1965) has given a detailed description of this species, both its external appearance and life history.

Recognition characters. Adult female, mounted, 3.3 to 3.8 mm long, 2.0 to 2.3 mm wide; body broadly oval.

Dorsum with 19 or 20 pairs of definite cerarii and several accessory cerarii which appear broken off from main cerarii. Anal-lobe cerarii each with 11 to 16 conical setae, 0 to 2 oral-collar tubular ducts, 32 to 41 trilocular pores, large area of basal sclerotization. Penultimate and antepenultimate cerarii each with 7 to 13 conical setae, 0 to 2 oral-collar tubular ducts, 12 to 19 trilocular pores, basal sclerotization. Remaining cerarii each with 6 to 15 conical setae, no oral-collar tubular ducts on basal sclerotization although often with 1 in close association, cluster of trilocular pores, basal sclerotization. Multilocular disk pores absent. Dorsum with light scattering of trilocular pores. Discoidal pores absent. Oral-collar tubular ducts sometimes with small rim, normally associated with cerarii, sometimes with 1 or 2 ducts present on medial or submedial areas of posterior abdominal segments. Dorsal setae spinelike, slightly smaller than cerarian setae. Ostioles with sclerotized lips.

Anal ring dorsal, touching apex of abdomen, with 3 or 4 rows of pores. Two sizes of anal-ring setae: larger size always present, numbering 3 pairs, approximately one and one-half times longer than greatest diameter of ring; smaller size variable, numbering from

0 to 5 pairs, normally shorter than ring diameter. Anal-ring setae apically acute.

Venter with multilocular disk pores present on abdominal segments 9, 8, 7, and sometimes 6; also present near spiracles. Trilocular pores lightly scattered over surface. Discoidal pores absent. Oral-collar tubular ducts of two sizes: smaller size restricted to abdomen, present on lateral areas of abdominal segments 9, 8, 7, and sometimes 6 and 5, also present on sublateral areas of segments 8, 7, and sometimes 6; larger size elongate; when present, restricted to medial area of head. Body setae noticeably more elongate than dorsal setae. Anal-lobe with quadrate area of sclerotization.

Circulus laterally elongate, situated on posterior margin of abdominal segment 4; anterior margin sometimes crenulate. Translucent pores inconspicuous; hind tibiae dorsally with 33 to 64 pores, ventrally with 3 to 28; tarsal digitules apically acute, not extending beyond tip of claw; claw digitules apically clubbed, extending beyond claw apex; claws with large denticle. Antennae 9-segmented.

Notes. This species is very closely related to *Puto profusus* McKenzie, but differs in having multilocular disk pores on abdominal segments 9, 8, 7, and sometimes 6; tubular ducts associated with about half of cerarii; no femoral translucent pores. *P. profusus*, on the other hand, has abdominal multilocular disk pores on segments 9 and 8 only; tubular ducts absent from dorsum, not associated with cerarii; translucent pores present on hind femora.

Genus *Spilococcus* Ferris, 1950

Type species. *Dactylopius gutierreziae* Cockerell, 1896c (by original designation).

Discussion. *Spilococcus* is recognized by oral-rim tubular ducts, 6 or more

pairs of cerarii, and cerarii without auxiliary setae, excluding anal-lobe pair.

In North America this genus is most closely related to *Chorizococcus* McKen-

zie, differing only in having 6 or more pairs of cerarii, in contrast to *Chorizococcus*, which has 4 or fewer. Unfortunately this character is not always satisfactory. For example, material is on hand that has 6 cerarii on one side of the specimen and 4 or 5 on the other. From this and other discrepancies, it is becoming increasingly apparent that *Chorizococcus* and *Spilococcus* should be considered synonyms.

The European genus *Atrococcus* Goux is also close to *Spilococcus*. *Atrococcus* is characterized by 1 to 7 pairs of cerarii, which are restricted to the abdomen; dorsal oral-rim tubular ducts; no circulus; a group of oral-collar tubular ducts near each anterior spiracle, these clusters often associated with multilocular disk pores; and black or blue-black body contents after death. Some North American species of both *Chorizococcus* and *Spilococcus* possess this combination of characters, including *Chorizococcus brevicurvis* McKenzie, *C. psoraleae* McKenzie, and *Spilococcus keiferi* McKenzie.

The African genus *Vryburgia* DeLotto is characterized in having cerarii on abdomen, and occasionally on head; oral-rim tubular ducts present or absent; and oral-collar tubular ducts present on dorsum, arranged either in segmental rows or in groups. Some North American species of both *Chorizococcus*

and *Spilococcus* possess this combination of characters, including *Chorizococcus fistulosus* McKenzie, *C. psoraleae* McKenzie, and *Spilococcus corticosus* McKenzie.

Until this group of genera can be carefully reexamined and revised, we believe that any changes in their status would only add to the present confusion. Therefore, we have chosen not to make changes even though obvious alterations may be suggested in some cases.

The classification of *Spilococcus* and *Chorizococcus* is by far the most confused among the North American pseudococcid genera. Many of the species are polyphagus, and as material from new hosts becomes available, we often observe more morphological variation than we had previously expected. Because of this, the key presented below must remain extremely tentative. For the most part it is the same as McKenzie's (1967) key, with inclusion of the two new species described in the previous study (Miller and McKenzie, 1971) and the additional variation noted in *Spilococcus juniperi* (Ehrhorn) in this paper. Small alterations have been added where obvious errors could easily be rectified.

Spilococcus now includes 24 species in North America.

KEY TO SPECIES OF *SPILOCOCCLUS* IN NORTH AMERICA:

ADULT FEMALES

(Modification of McKenzie, 1967)

- 1. Circulus present 2
 Circulus absent 17
- 2(1). Dorsum with oral-rim tubular ducts at least present over abdomen,
 at times over entire surface 3
 Dorsum with oral-rim tubular ducts absent or confined to single sub-
 marginal series 12
- 3(2). With 16 or 17 pairs of cerarii 4
 With 15 or fewer pairs of cerarii 6

- 4(3). Oral-collar tubular ducts present in cluster on venter between anterior spiracle and body margin *villanuevai* Miller and McKenzie
 Oral-collar tubular ducts absent on venter between anterior spiracle and body margin 5
- 5(4). Frontal cerarii definitely developed, each with 2 or 3 conical setae set close together *larreae* Ferris
 Frontal cerarii indefinite, each represented, at most, by group of 3 or more widely scattered conical setae . . . *steelii* (Cockerell and Townsend)
- 6(3) Oral-collar tubular ducts present in cluster on venter between anterior spiracle and body margin 7
 Oral-collar tubular ducts absent on venter between anterior spiracle and body margin 8
- 7(6). Oral-collar tubular ducts abundant on dorsomedial areas of abdomen
corticus McKenzie (in part)
 Oral-collar tubular ducts absent dorsally or restricted to lateral areas near cerarii *geraniae* (Rau)
- 8(6). From 6 to 10 dorsal oral-rim tubular ducts on each of abdominal segments 6, 5, and 4 9
 More than 12 dorsal oral-rim tubular ducts on each of abdominal segments 6, 5, and 4 10
- 9(8). Circulus large and divided by intersegmental line between abdominal segments 5 and 4 *cactearum* McKenzie
 Circulus small and undivided *parvicirculus* McKenzie
- 10(8). With no more than 6 pairs of cerarii *erigoni* (Ehrhorn) (in part)
 With 8 to 15 pairs of cerarii 11
- 11(10). Circulus undivided *parkeri* McKenzie
 Circulus divided *quercinus* McKenzie
- 12(2). Dorsal oral-rim tubular ducts absent 13
 Dorsal oral-rim tubular ducts present in broken or continuous submarginal series 15
- 13(12). Anal-lobe cerarii each with 3 to 5 moderately elongate, conical setae
ventralis McKenzie
 Anal-lobe cerarii each with 2 moderately stout, conical setae 14
- 14(13). Ventral oral-rim tubular ducts absent medially on meta- and mesothoracic segments; oral-collar tubular ducts scattered along body margin; occurring on juniper *juniperi* (Ehrhorn) (in part)
 Ventral oral-rim tubular ducts present medially on meta- and mesothoracic segments; oral-collar tubular ducts present in conspicuous clusters along body margin; occurring on *Fouquieria*
townsendi (Cockerell)
- 15(12). With 7 or fewer pairs of cerarii *prospodidis* (Cockerell)
 With more than 10 pairs of cerarii 16
- 16(15). Antennae 8-segmented; ventral submarginal oral-rim tubular ducts numerous on abdominal segment 3 through prothorax; occurring

- on Cupressaceae, Taxodiaceae, and Taxaceae*andersoni* (Coleman)
 Antennae 7-segmented; ventral submarginal oral-rim tubular ducts
 few, normally represented only by single row; occurring on
 Rhamnaceae*ceanothi* McKenzie
- 17(1) Ventrolateral areas of abdomen and thorax with conspicuous clusters
 of multilocular disk pores*sequoiae* (Coleman)
 Ventrolateral areas of body without clusters of multilocular disk
 pores 18
- 18(17). Oral-rim tubular ducts on thorax and head distinctly larger than
 those on abdomen*gutierreziae* (Cockerell)
 Oral-rim tubular ducts all approximately same size 19
- 19(18). Oral-collar tubular ducts present, at least in small numbers, on dor-
 somedial areas of abdomen 20
 Oral-collar tubular ducts absent on dorsomedial areas of abdomen,
 although often with a few ducts present laterally 21
- 20(19). With 6 or 7 pairs of cerarii; oral-collar tubular ducts lightly scattered
 over dorsum of abdomen*keiferi* McKenzie
 With more than 10 pairs of cerarii; oral-collar tubular ducts abun-
 dant over dorsum of abdomen*corticosis* McKenzie (in part)
- 21(19). Dorsal oral-rim tubular ducts absent or restricted to lateral areas
 near cerarii 22
 Dorsal oral-rim tubular ducts scattered over surface, often abundant . . 23
- 22(21). Tubular ducts forming thin, continuous line along sublateral areas
 of abdomen and thorax; body red in life*juniperi* (Ehrhorn) (in part)
 Tubular ducts forming broad line which is broken into clusters on
 thorax; body green in life*implicatus* Ferris
- 23(21). With cluster of oral-collar tubular ducts on venter between anterior
 spiracle and body margin; some dorsomedial setae noticeably more
 robust than remaining setae on this region
nototrichus Miller and McKenzie
 Without cluster of oral-collar tubular ducts near anterior spiracles;
 dorsal setae all approximately equal 24
- 24(23). Ventral multilocular disk pores present from abdominal segment 3
 through mesothorax; antennae normally 7-segmented
viridula (Cockerell)
 Ventral multilocular disk pores absent from abdominal segment 3
 through mesothorax; antennae 7- or 8-segmented 25
- 25(24). With 18 to 26 oral-rim tubular ducts on dorsum of abdominal seg-
 ments 6 and 5*erigoni* (Ehrhorn) (in part)
 With 6 to 14 oral-rim tubular ducts on dorsum of abdominal seg-
 ments 6 and 5 26
- 26(25). Ventral oral-rim tubular ducts present on prothorax and head; nor-
 mally with more than 14 pairs of cerarii*atriplicis* (Cockerell)
 Ventral oral-rim tubular ducts absent on prothorax and head; nor-
 mally with less than 14 pairs of cerarii*pressus* Ferris

***Spilococcus juniperi* (Ehrhorn)**

(Figure 11)

Pseudococcus juniperi Ehrhorn, 1906: 333; Cockerell and Robbins, 1909: 105; Sanders, 1909: 40; Lindinger, 1914: 116; Ferris, 1919a: 28; MacGillivray, 1921: 136; Merrill and Chaffin, 1923: 293; Smith and Kelly, 1943: 108; R. C. Smith, 1943: 198; Calkins, 1946: 66; 1948: 60; Merrill, 1953: 136; Riddick, 1955: 40.

Pseudococcus juniferi (Ehrhorn), Dean, 1944: 81.

Spilococcus juniperi Ehrhorn, Ferris, 1950: 231; Schuder, 1958: 148; Lindinger, 1958: 373 (= *Pseudococcus iuniperi* Ehrhorn, 1906).

Pseudococcus iuniperi Ehrhorn, Lindinger, 1958: 373.

Spilococcus juniperi (Ehrhorn), McKenzie, 1960: 757; 1962: 679; 1967: 412.

Suggested common name. Juniper mealybug.

Specimens examined. Adult females on *Juniperus virginiana* (Cupressaceae), collected at Ash Fork (Ashforks?), Yavapai Co., Arizona, June, 1898, by E. M. Ehrhorn. Adult females and first instar nymphs on *J. scopulorum*, collected at Colorado Springs, El Paso Co., Colorado, July 30, 1931, by S. C. McCambell. Adult females have also been seen from the following localities: on "juniper," collected at South Bend, Saint Joseph Co., Indiana, received at USNM July 16, 1954, collected by P. T. Ulman; on *J. virginiana*, collected at Council Bluffs, Pottawattamie Co., Iowa, October 4, 1930, by H. E. Guthrie; on "evergreen" collected at Lawrence, Douglas Co., Kansas, received at USNM June 1, 1942, collected by H. B. Hungerford; on "red cedar," collected at Hillsboro, Marion Co., Kansas, August 2, 1942; adult females and first-instar nymphs on "juniper," collected at Pratt, Pratt Co., Kansas, June 16, 1941, by H. B. Hungerford; on "juni-

per," collected at Lincoln, Lancaster Co., Nebraska, received at USNM June 24, 1933, collected by M. H. Swenk; on *Juniperus* sp., collected 20 mi. S. E. Santa Rosa, Guadalupe Co., New Mexico, July 2, 1970, by D. R. Miller; on "junipers," collected at Enid, Garfield Co., Oklahoma, received at USNM December 2, 1944, collected by C. A. Bower; on *Juniperus* sp., collected at Guthrie, Logan Co., Oklahoma, June 17, 1959, by A. Apt; on "cedar," collected at Stillwater (?), Payne Co., Oklahoma, received at USNM July 31, 1945, collected by C. F. Stiles; on *Juniperus* sp., collected at Enterprise, Wallowa Co., Oregon, August 5, 1970, by D. R. Miller; on *J. pinchoti*, collected at Dickens, Dickens Co., Texas, October 8, 1970, by D. R. Rummel; on *Juniperus* sp., collected near Sanderson, Terrell Co., Texas, June 16, 1947, by D. J. Smith; on *J. pinchoti*, collected 25 mi. S. W. Sheffield, Terrell Co., Texas, received at USNM April 21, 1936; on "*J. mahensis*" (?), collected at Springdale, Washington Co., Utah, September 9, 1953, by G. F. Knowlton.

Type material. From the syntypes, we have chosen and marked as lectotype an adult female labeled "*Pseudococcus juniperi* #514 Type On *juniperus virginiana* Ashforks, Arizona Summer 1898 Ehrhorn coll"; deposited at USNM. Single specimen on slide. Two paralectotypes.

Gross external features. Body round, dark purple; body contents bright red; lightly covered with smooth, gray wax; two elongate, bare areas on abdomen and thorax; short, partially fused lateral filaments present around entire body margin; ovisac produced ventrally only, nestlike structure similar to ovisac of most species of *Anisococcus* Ferris.

This species occurs on the foliage of its host.

In many areas this mealybug is a pest

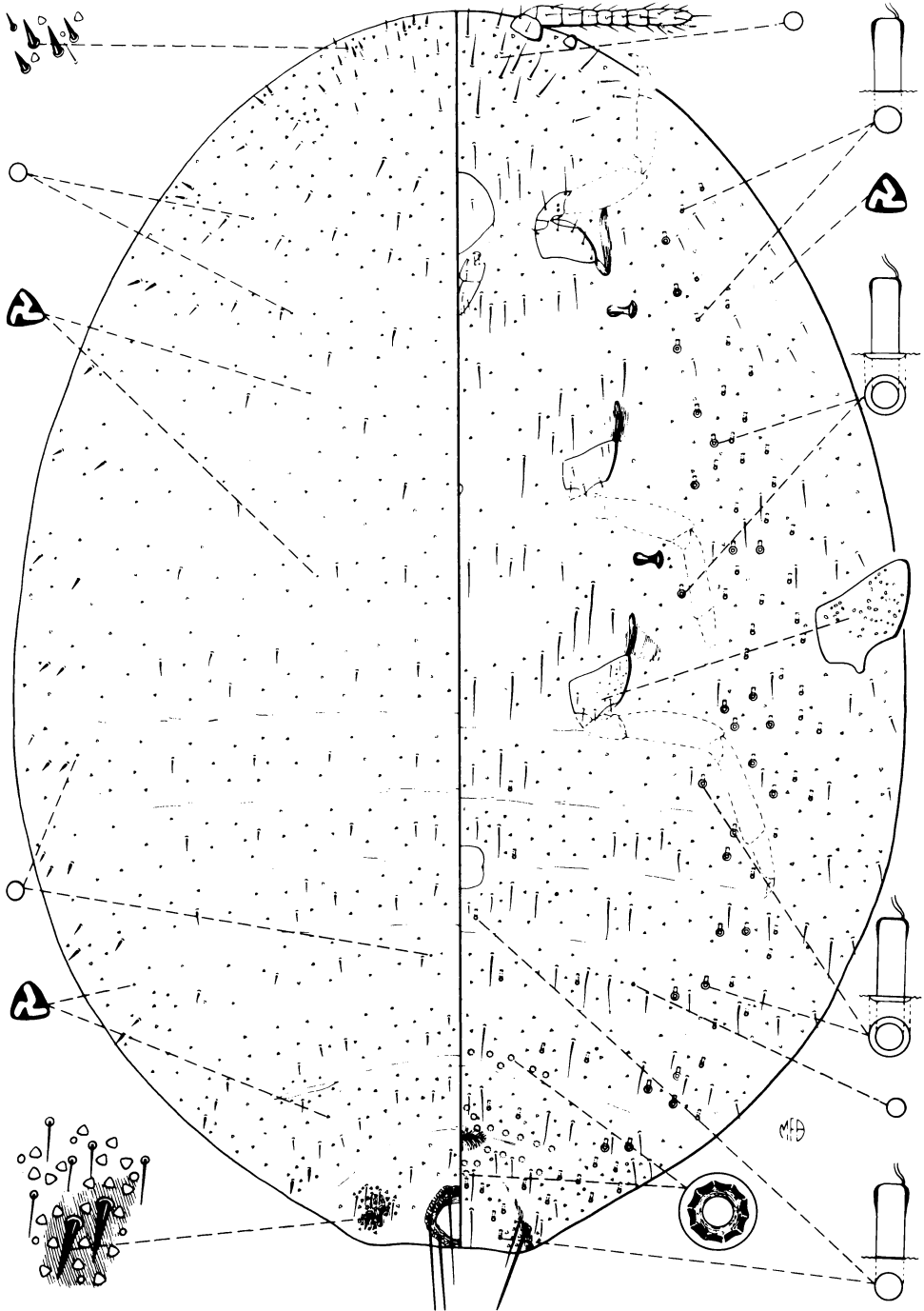


Fig. 11. *Spilococcus juniperi* (Ehrhorn), collected at Ash Fork (Ashforks ?), Yavapai County, Arizona, June, 1898, on *Juniperus virginiana* (Cupressaceae).

of ornamental junipers, particularly of *Juniperus virginiana* and *J. pinchoti*. Although trees are rarely killed, large branches die back, giving the tree an unsightly appearance.

Recognition characters. Adult female, mounted, 1.2 to 2.2 mm long, 0.8 to 1.7 mm wide; body varying from oval to "diamond-shaped."

Dorsum with from 5 to 17 pairs of cerarii. Anal-lobe cerarii each with 2 conical setae, 2 to 5 body setae, small cluster of trilocular pores, 1 to 7 discoidal pores, and small to large area of basal sclerotization. Remaining abdominal cerarii with 1 or 2 conical setae slightly larger than remaining dorsal setae, without basal cluster of trilocular pores and sclerotization, conical setae becoming progressively farther apart anteriorly, sometimes absent on anterior abdominal segments. Thoracic cerarii, when present, with 1 or 2 conical setae which are widely separated, becoming progressively closer together anteriorly, sometimes composed of 3 conical setae. Head cerarii, when present, with 2 to 5 conical setae, without basal clusters of pores or sclerotization. Multilocular disk pores absent. Dorsum with trilocular and discoidal pores scattered over surface. Oral-collar and oral-rim tubular ducts absent. Dorsal body setae noticeably shorter than those on venter.

Anal ring dorsal, normally touching posterior apex of abdomen, with 2 rows of pores; each of its 6 setae approximately one and one-half times as long as greatest diameter of ring.

Venter with multilocular disk pores present on posterior margins of abdominal segments 8 through 7, 6, or 5, also present on segments 10 and 9. Trilocular and discoidal pores scattered over surface. Oral-rim tubular ducts at times entirely absent, normally with these ducts present, but with rims weakly developed, present in submarginal series from abdominal segments 9 or 8

through prothorax, rarely present on head and on medial areas of abdomen; oral-rim tubular ducts without associated discoidal pores. Oral-collar tubular ducts normally of same size and shape as oral-rims. Specimens from Midwest, Oregon, Utah, and northern Arizona have slightly smaller oral-collars; these specimens normally have many more oral-collars than illustrated, being most numerous in specimens collected the farthest east. Oral-collar tubular ducts most abundant lateral of oral-rims, normally with small number present on medial areas of abdomen. Body setae short for pseudococcid. Anal lobes sometimes with thin, sclerotized bar; often entirely unsclerotized.

Circulus normally large and rectangular, sometimes quite small, rarely absent; when present, resting on intersegmental line between abdominal segments 5 and 4. Hind coxae dorsally with 26 to 46 translucent pores, ventrally with 16 to 31; hind tibiae dorsally with 5 to 14 pores, absent ventrally; tarsal and claw digitules capitate, extending beyond tip of claw; claws without denticle. Antennae 7- or 8-segmented. Eyes and rostrum normal for genus.

Notes. This is an extremely variable species. For this reason, we have illustrated the lectotype even though it is a rather poor specimen. Within the description we have attempted to include all of the variation.

Texas, Oklahoma, and Kansas specimens of this species have only a small number of tubular ducts. Within this area *Spilococcus juniperi* is relatively homogeneous morphologically. Specimens from northern Arizona, New Mexico, Utah, and eastern Oregon have more oral-collar tubular ducts, which appear to increase in number as specimens originate from south to north. In specimens from Nebraska, Indiana, and Iowa, the number of oral-collars is still larger, apparently increasing in

specimens from west to east. The extremes in Texas and Indiana are different enough to be considered separate species, but the gradient described above shows this idea to be incorrect.

This species is quite similar to *Spilococcus implicatus* Ferris, especially in the East. *S. juniperi* can best be separated by its dark-red body contents and characteristic nestlike ovisac. When mounted, this species shows a continuous, thin, sublateral line of tubular ducts, whereas *S. implicatus* has a broad band of sublateral tubular ducts which becomes broken into large clusters on the thorax. *S. implicatus*, in life, is green in color, and produces an elongate ovisac.

This species is also similar to *Alloccoccus zealandicus* Ezzat and McCon-

nell, but differs in having a ventral sublateral series of oral-collars and in lacking transverse rows of oral-collars on the medial areas of the abdomen. *A. zealandicus*, on the other hand, lacks sublateral oral-collars and has 2 transverse rows of these structures on the ventromedial areas of abdominal segments 8 and 7.

The amount of variation within this species is an enigma. The presence or absence of generic characters such as oral-rim tubular ducts, 5 to 17 pairs of cerarii, and an anal bar is a taxonomic nightmare.

Although in the future someone may be able to distinguish two species within this group of specimens, at present we believe that it is a case of geographic variation.

Genus *Tridiscus* Ferris, 1950

Type species. *Trionymus distichlii* Ferris, 1918, (by original designation and monotypy).

Discussion. The taxonomic limits of *Tridiscus* have recently been considered unclear (DeLotto, 1964).

When originally described, this genus was characterized as having 2 or 3 circuli, 1 pair of cerarii, ostioles reduced, with anterior pair lacking; 7-segmented antennae.

In 1953, Ferris included two additional species that were somewhat different from the original species. He

redefined the genus to include species having 1 to 3 circuli, 1 pair of cerarii each of which is made up of 2 elongate setae, ostioles reduced, with anterior pair lacking; 6- or 7-segmented antennae.

We believe that Ferris's last diagnosis adequately characterizes the genus. The species treated by DeLotto (1964) do not fit this concept and should probably be included in a separate genus.

Tridiscus now includes three species in North America.

KEY TO SPECIES OF *TRIDISCUS* IN NORTH AMERICA: ADULT FEMALES

1. With 1 circulus *sporoboli* (Cockerell)
- With more than 1 circulus 2
- 2(1). Translucent pores present on hind coxae, absent on femora and tibiae;
 with 2 or 3 circuli; body elongate *distichlii* (Ferris)
- Translucent pores absent on coxae, present on hind femora and tibiae;
 with 4 or 5 circuli; body in fully gravid females broadly oval
 *multiorbis* Ferris

***Tridiscus sporoboli* (Cockerell)**

(Figure 12)

Ripersia sporoboli Cockerell, 1902a: 20; Fernald, 1903: 119; Ferris, 1919a: 33 (probably a misidentification); MacGillivray, 1921: 141; Lobdell, 1937: 78.

Tridiscus sporoboli (Cockerell), Ferris, 1953: 480; 1954: 53 (possibly another genus); McKenzie, 1967: 455.

Suggested common name. Dropseed mealybug.

Specimens examined. Adult females, adult male, and immature nymphs on *Sporobolus depauperatus* (Gramineae), collected at Las Vegas, San Miguel Co., New Mexico, October 5, 1901, by T. D. A. Cockerell.

Type material. From the syntypes, we have chosen and marked as lectotype an adult female labeled "*Ripersia sporoboli* Ckll. Type (On *Sporobolus depauperatus*) Las Vegas, N. Mex. Ckll., Coll. (Oct. 5), 1901"; deposited at USNM. Four specimens on slide; specimen second from left is the lectotype. Twelve paralectotypes.

Gross external features. According to Cockerell (1902a) ". . . much elongated, broad posteriorly, narrowing anteriorly, with the anterior end pointed, the head being the narrowest part of the whole insect; abdomen very distinctly segmented; colour very dark purple-grey; insect entirely covered by a white cottony secretion, in which are laid many pale pinkish eggs, . . ."

This species occurs on the stem of its host.

Recognition characters. Adult female, mounted, 1.9 to 3.7 mm long, 0.8 to 1.3 mm wide; body elongate.

Dorsum with 1 pair of cerarii represented by 1 or 2 elongate body setae and without basal sclerotization or cluster of trilocular pores. Multilocular disk pores normally present in complete transverse rows across abdominal

segments 9 through 7, restricted to lateral areas on remainder of body, becoming increasingly less numerous anteriorly; rarely, multiloculars present on medial areas of all abdominal segments. Trilocular pores in unusually small numbers, scattered over surface. Discoidal pores present over surface. Oral-collar tubular ducts of two sizes, present over entire dorsum, most abundant on posterior abdominal segments and along body margin. Dorsal body setae approximately same length as those on venter, forming clusters of elongate setae along margins of abdominal segments 9 through 6.

Anal ring dorsal, normally situated near abdominal apex; anal ring thin, with either 1 or 2 rows of pores; each of its 6 setae approximately twice as long as greatest diameter of ring.

Venter with multilocular disk pores of approximately same distribution pattern as on dorsum, more abundant, absent near spiracles. Oral-collar tubular ducts of same two sizes and of same distribution pattern as on dorsum. Trilocular and discoidal pores same as on dorsum. Body setae elongate, noticeably dense along body margins of posterior 3 or 4 abdominal segments. Anal-lobe sclerotization absent.

Circulus small and circular, located slightly anterior to intersegmental line 5 and 4; hind coxae dorsally with 17 to 32 translucent pores, ventrally with 22 to 41; some of pores appear to be on derm anterior to coxae; hind coxae slightly larger than meso- and prothoracic coxae; tarsal and claw digitules apically capitate; claw digitules extending beyond tip of claw; claws without denticle. Antennae 6-segmented.

Notes. This species is most closely related to *Tridiscus distichlii* (Ferris), but differs in having only 1 circulus, 6-segmented antennae, fewer dorsomedial

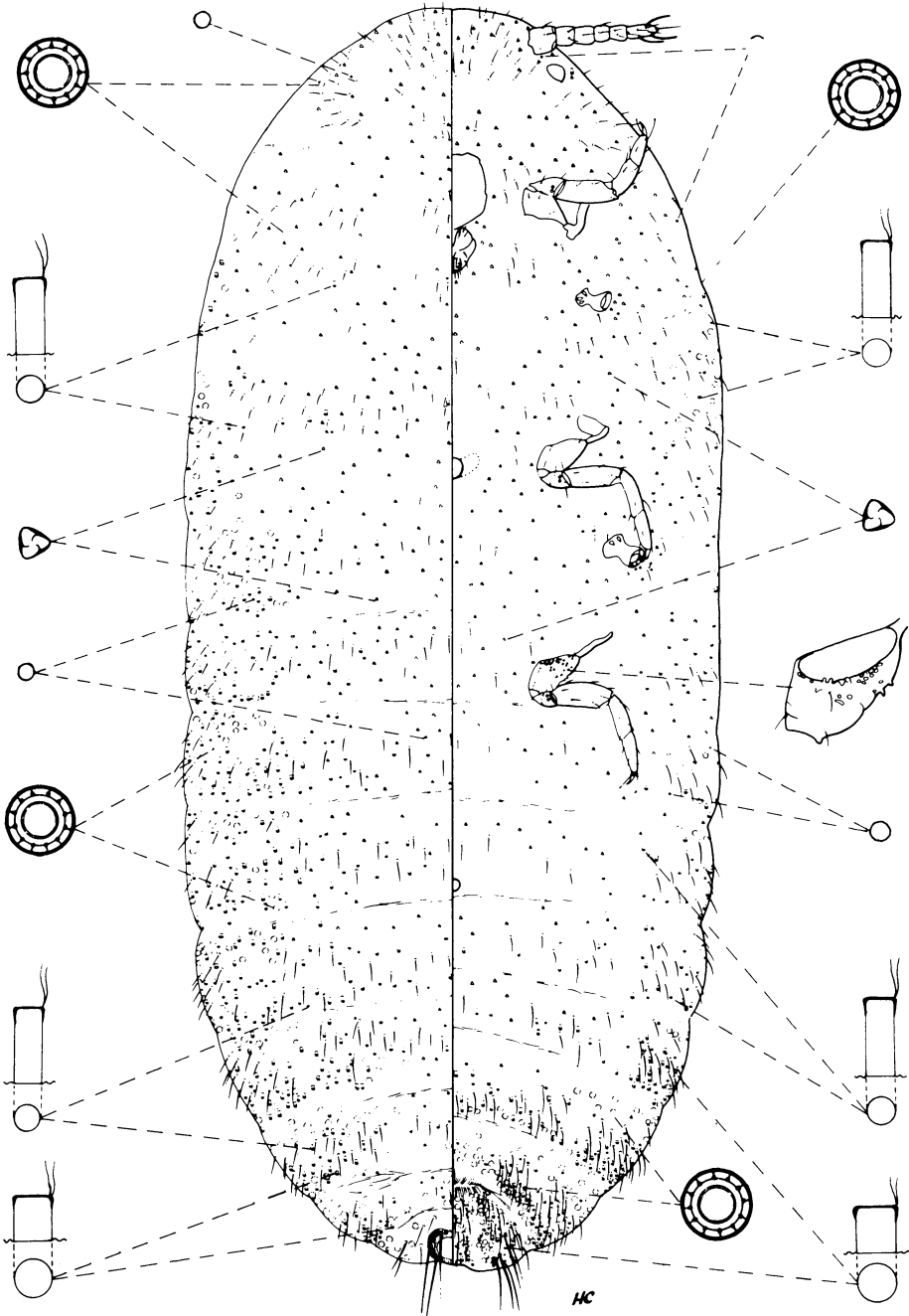


Fig. 12. *Tridiscus sporoboli* (Cockerell), collected at Las Vegas, San Miguel County, New Mexico, October 5, 1901, on *Sporobolus depauperatus* (Gramineae).

multilocular disk pores, clusters of elongate body setae along body margins of posterior abdominal segments. *T. distichlii*, on the other hand, has 2 or

3 circuli, 7-segmented antennae, numerous dorsomedial multilocular disk pores, no clusters of elongate body setae along body margin.

Genus *Trionymus* Berg, 1899

Type species. *Westwoodia perrisii* Signoret, 1875 (by substitution of *Trionymus* for junior homonym *Westwoodia* Signoret, 1875—type species of *Westwoodia* Signoret is *W. perrisii* by monotypy).

Discussion. This genus is recognized by a combination of characters: fewer than 6 pairs of cerarii; anal-lobe cerarii each with 2 conical setae; body shape

elongate; circulus small, undivided; occurring on grasses.

At present this genus contains a conglomeration of grass-infesting species. Included in *Trionymus* in North America are rotund species and species that have a large, divided circulus. Until a revision of the North American *Trionymus* can be undertaken, we believe that transfers of species to other genera and descriptions of new genera will only add to the present confusion.

**KEY TO SPECIES OF *TRIONYMUS* IN NORTH AMERICA:
ADULT FEMALES**

- 1. Body rotund, lateral body margins convex; normally occurring on grass crowns or roots 2
- Body elongate, lateral body margins parallel; normally occurring in grass sheaths 7
- 2(1). Cerarii present on at least last 2 abdominal segments 3
- Cerarii present only on anal lobes 4
- 3(2). Anal-lobe cerarii with large, circular area of basal sclerotization; circulus small, undivided *claviger* (King and Tinsley) (in part)
- Anal-lobe cerarii without basal sclerotization or with sclerotization restricted to areas near conical setae; circulus normally large; if small, then divided *quadricirculus* McKenzie (in part)
- 4(2). Dorsal multilocular disk pores absent; dorsal oral-collar tubular ducts absent except for 1 or 2 on abdominal segment 9; circulus absent *coronus* Miller and McKenzie
- Dorsal multilocular disk pores and dorsal oral-collar tubular ducts present over surface; circulus present 5
- 5(4). Multilocular disk pores concentrated around spiracles; two distinct sizes of oral-collar tubular ducts; often with 2 circuli
strongylus Miller and McKenzie
- Multilocular disk pores not concentrated around spiracles; one size of oral-collar tubular duct; 1 circulus 6
- 6(5). Circulus small, oval; antennae normally 7-segmented
magnus (Cockerell and Cockerell)
- Circulus large, quadrate; antennae normally 6-segmented
idahoensis Miller and McKenzie

- 7(1). Circulus absent 8
 Circulus present 12
- 8(7). Penultimate cerarii absent 9
 Penultimate cerarii present, sometimes represented only by single
 conical seta 11
- 9(8). Ventral multilocular disk pores present along submargin below eye
 and near spiracles *winnemucae* McKenzie
 Ventral multilocular disk pores absent along submargin below eye
 and near spiracles 10
- 10(9). Hind coxae definitely larger than coxae of other legs; discoidal pores
 of small type only *smithii* (Essig)
 Hind coxae approximately same size as coxae of other legs; discoidal
 pores of large type *nanus* Cockerell
- 11(8). Penultimate cerarii definite, with basal cluster of trilocular pores;
 hind coxae without translucent pores; hind femora with many
 small translucent pores *myersi* McKenzie
 Penultimate cerarii indefinite, without basal cluster of trilocular
 pores; hind coxae with translucent pores; hind femora without
 translucent pores *violascens* Cockerell
- 12(7). Cerarii present only on anal lobes 13
 Cerarii present at least on last 2 abdominal segments; second pair of
 cerarii sometimes represented only by single conical seta 15
- 13(12). Dorsal multilocular disk pores absent on mesothorax forward to
 head, sometimes with 1 or 2 pores in this area; antennae normally
 8-segmented, rarely with 7 segments *utahensis* (Cockerell)
 Dorsal multilocular disk pores present on mesothorax forward to
 head; antennae normally 7-segmented, rarely with 8 segments 14
- 14(13). Ventral multilocular disk pores on abdomen usually numerous, those
 of abdominal segments 7 to 5 medially arranged in broad bands of
 4 pores deep *clandestinus* McConnell
 Ventral multilocular disk pores on abdomen medially in bands of 1 or
 2 pores deep *caricis* McConnell (in part)
- 15(12). Anal-lobe cerarii with large, circular area of basal sclerotization 16
 Anal-lobe cerarii unsclerotized or with sclerotization only near base
 of conical setae 21
- 16(15). Multilocular disk pores absent on dorsum *modocensis* (Ferris)
 Multilocular disk pores present on dorsum at least on last 3 or 4
 abdominal segments 17
- 17(16). Ventral multilocular disk pores present on prothorax and head 18
 Ventral multilocular disk pores absent on prothorax and head, nor-
 mally absent from entire thorax 19

- 18(17). Dorsal multilocular disk pores present on thorax and head; circulus small, undivided; discoidal pores small and inconspicuous; frontal cerarii absent *claviger* (King and Tinsley) (in part)
Dorsal multilocular disk pores absent on thorax and head; circulus large, divided; discoidal pores large and conspicuous; frontal cerarii present or absent *frontalis* McKenzie
- 19(17). Discoidal pores absent; translucent pores absent on hind tibiae *americanus* (Cockerell)
Discoidal pores present; translucent pores present on hind tibiae 20
- 20(19). Circulus normally quadrate, divided; cerarii restricted to last 2 abdominal segments *haancheni* McKenzie
Circulus oval, undivided; cerarii present on last 3 or 4 abdominal segments *dolus* Ferris
- 21(15). Hind tibiae more than twice as long as hind tarsi .. *diminutus* (Leonardi)
Hind tibiae less than twice as long as hind tarsi 22
- 22(21). Multilocular disk pores absent on medial areas of thorax between legs *festucae* (Kuwana)
Multilocular disk pores present on medial areas of thorax between legs 23
- 23(22). Cerarii present on last 3 or 4 abdominal segments *mocus* Ferris
Cerarii present on last 2 abdominal segments 24
- 24(23). Tarsal digitules not extending to tip of claw; each tarsus with 1 capitate digitule and one apically acute digitule; translucent pores on hind coxae small, represented only by small dots; discoidal pores numerous, irregularly shaped, approximately same size as trilocular pores; antennae normally 8-segmented, rarely with 7 *quadricirculus* McKenzie (in part)
Tarsal digitules extending to tip of claw; each tarsus with 2 capitate digitules; translucent pores on hind coxae large (fig. 13); discoidal pores few, round, smaller than triloculars; antennae normally 7-segmented, rarely with 6 *caricis* McConnell (in part)

Trionymus caricis McConnell

(Figure 13)

Trionymus caricis McConnell, 1941: 97; Ferris, 1950: 257; 1953: 482; McKenzie, 1960: 765; 1961: 48; Nur, 1962: 181; Williams, 1962: 63; McKenzie, 1964: 270; 1967: 463; Miller and McKenzie, 1971: 598.

It is likely that *Trionymus mocus* Ferris is a junior synonym of this species. We have decided, however, to leave the species separate pending further study.

Suggested common name. *Carex* mealybug.

Specimens examined. Adult females on *Andropogon virginicus* (Gramineae), collected near Homestead on road to Card Sound, Dade Co., Florida, December 3, 1970, by S. Nakahara. Adult females on *Juncus* sp. (Gramineae), collected in Echols Co., Georgia, February 6, 1971, by R. Beshear. Adult females on *Carex tribuloides* (Gramineae), collected at Bowie, Patuxent River, Priests Bridge, Prince Georges Co., Maryland, August 4, 1940, by H. S. McConnell. Adult females on *Carex* sp., collected at Clements, Saint Marys Co., Maryland, November 15, 1941, by H. S. McConnell.

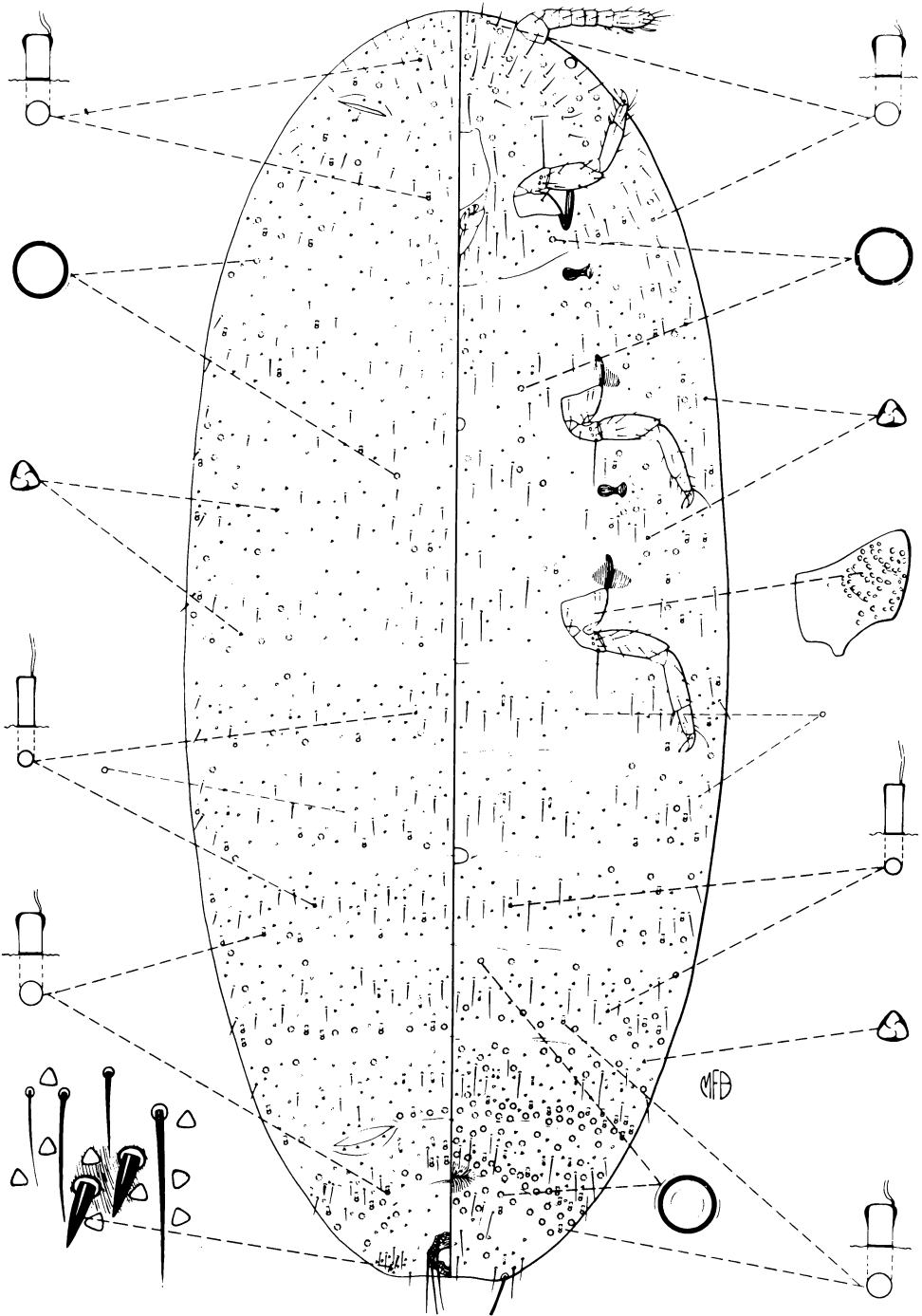


Fig. 13. *Trionymus caricis* McConnell, collected at Bowie, Patuxent River, Priests Bridge, Prince Georges County, Maryland, August 4, 1940, on *Carex tribuloides* (Gramineae).

Type material. We have examined the adult female holotype labeled "Trionymus caricis n. sp. Type on Carex tribuloides Bowie, Md. (Priests Bridge) Aug 4, 1940 H. S. McConnell"; deposited at USNM. Single specimen on slide. Seven paratypes.

Gross external features. McConnell (1941) describes this species as "long, narrow, egg laying individuals from 2 to 3 mm in length, between leaf sheaths of host; an ovisac formed, of indefinite character . . . usually long, narrow, flat; body of female pinkish to reddish in color, lightly dusted over with powdered wax."

Recognition characters. Adult female, mounted, approximately 2.5 mm long, 0.9 mm wide; body elongate.

Dorsum with 1 or 2 pairs of cerarii. Anal-lobe cerarii each with 2 conical setae, 1 to 3 auxiliary setae, 3 to 9 trilocular pores, small area of basal sclerotization. Penultimate cerarii, if present, variable, normally with 1 conical seta and 1 elongate seta, 1 or 2 trilocular pores, no basal sclerotization. Multilocular disk pores present over surface, most abundant on posterior margins of abdominal segments 8, 7, and 6, and along body margin; infrequent on medial areas of thorax. Discoidal pores small, inconspicuous, in reduced numbers over surface. Trilocular pores scattered over dorsum. Oral-collar tubular ducts distributed over surface, becoming less numerous anteriorly, of two distinct sizes: large, sometimes with weakly indicated rim, present on lateral and posterior margins of each segment, nearly absent from medial areas of thorax; small, present on medial areas of each segment, uncommon on thorax and head. Dorsal body setae all approximately same size, shorter than those on venter.

Anal ring dorsal, normally touching abdominal apex, with 2 rows of pores, both rows well developed; each of its 6

setae approximately one and one-half times as long as greatest diameter of ring.

Venter with multilocular disk pores present along entire body margin, also present on medial areas of abdominal segments 9 through 6 or 5, and on mesothorax through head. Oral-collar tubular ducts of same two sizes as on dorsum, present along entire body margin, also on medial areas of abdominal segments 9 through 5, 4, or 3, rarely present on medial areas of thorax, absent medially on head. Trilocular and discoidal pores of same distribution pattern as on dorsum. Body setae normal for genus. Anal-lobe sclerotization absent.

Circulus normally small and oval, rarely large and quadrate, present on intersegmental line between abdominal segments 5 and 4. Hind coxae with large translucent pores, dorsally with 20 to 32 pores, ventrally with 25 to 35; translucent pores rarely present on distal end of hind tibiae; tarsal and claw digitules apically expanded, extending to tip of claw; claws without denticles. Antennae 6- or 7-segmented.

Notes. Most of the specimens examined have a rather indefinite penultimate cerarius; this structure was overlooked by both Ferris (1950) and McKenzie (1967) even though it was illustrated in the original description. The species treated by McKenzie (1967) as *T. caricis* may not be this species.

Trionymus caricis is close to *T. utahensis* (Cockerell), but differs in having dorsal multilocular disk pores on thorax and head, 1 or 2 pairs of cerarii, 6- or 7-segmented antennae. *T. utahensis*, however, has dorsal multilocular disk pores on abdomen only, 1 pair of cerarii, 7- or 8-segmented antennae.

This species is also similar to *Trionymus quadricirculus* McKenzie, but differs as described in the key to species of *Trionymus*.

There is some relationship between *Trionymus caricis* and *T. diminutus* (Leonardi), but the former differs in having tibiae less than twice as long as tarsi, few dorsal multilocular disk pores 6- or 7-segmented antennae, and occurring on Gramineae. *T. diminutus*, on the other hand, has tibiae greater than twice as long as tarsi, numerous dorsal multilocular disk pores, 7- or 8-segmented antennae, and occurs on Agavaceae.

Trionymus magnus
(Cockerell and Cockerell)

(Figure 14)

Ripersia magna Cockerell and Cockerell
(In: Cockerell, 1901a: 56) Fernald,
1903: 118; MacGillivray, 1921: 141;
Bueker, 1931: 158.

Trionymus magnus (Cockerell and
Cockerell), Ferris, 1953: 486; Wil-
liams, 1958: 18; McKenzie, 1960: 765;
1961: 48; 1967: 461; Miller and Mc-
Kenzie, 1971: 598.

Suggested common name. Magnus mealybug.

Specimens examined. Adult females collected at Trout Springs, San Miguel Co (?), New Mexico, April 27, 1901, by T. D. A. Cockerell.

Type material. From the syntypes we have chosen and marked as lectotype an adult female labeled "*Ripersia cockerellae magna* Type 10577 Trout Spring, New Mexico Apr: 27, (1901) T. D. A. Cockerell Postal Mar. 23, '04"; deposited in USNM. Single specimen on slide. Four paralectotypes.

Gross external features. According to Cockerell and Cockerell (In: Cockerell, 1901a) "Dark pink, . . . sparsely mealy, no caudal or lateral tufts; legs and antennae pale brown; . . ."

This species probably occurs on the roots or subterranean crown of its host.

Recognition characters. Adult female, mounted, 2.7 to 3.4 mm long, 1.7 to 2.4 mm wide; body rotund.

Dorsum with 1 pair of cerarii; each cerarius with 2 conical setae and loose cluster of trilocular pores, but without basal sclerotization. Multilocular disk pores normally present over entire surface except on head, most numerous along posterior margins of abdominal segments 8, 7, and 6. Discoidal pores of two sizes, large size with unusually heavy dermal rims, present over surface. Trilocular pores abundant. Oral-collar tubular ducts generally of one size, but with those near margin somewhat larger, present over entire dorsum, least numerous on head. Dorsal body setae approximately same length as those on venter; setae on medial areas of abdominal segments 8 and 7 not unusually elongate.

Anal ring dorsal, situated near apex of abdomen, with 2 rows of pores; each of its 6 setae only slightly longer than greatest diameter of ring.

Venter with multilocular disk pores present on abdomen and thorax, most abundant along posterior margins of abdominal segments 8 and 7 and on segment 9, least abundant on medial areas of thorax, absent near spiracles. Oral-collar tubular ducts of one size, but slightly larger near body margin, scattered over entire surface, most abundant on posterior abdominal segments, becoming less numerous anteriorly. Trilocular and discoidal pores same as on dorsum. Body setae short. Anal-lobe sclerotization absent.

Circulus small, oval, located on intersegmental line between abdominal segments 5 and 4. Hind coxae larger than remaining coxae, dorsally with 43 to 53 translucent pores, ventrally with 17 to 28; tarsal digitules apically clubbed, not extending to tip of claw; claw digitules capitate extending beyond claw apex; claws without denticles. Antennae 7-segmented; one specimen with one antenna 6-segmented, with third segment partially divided.

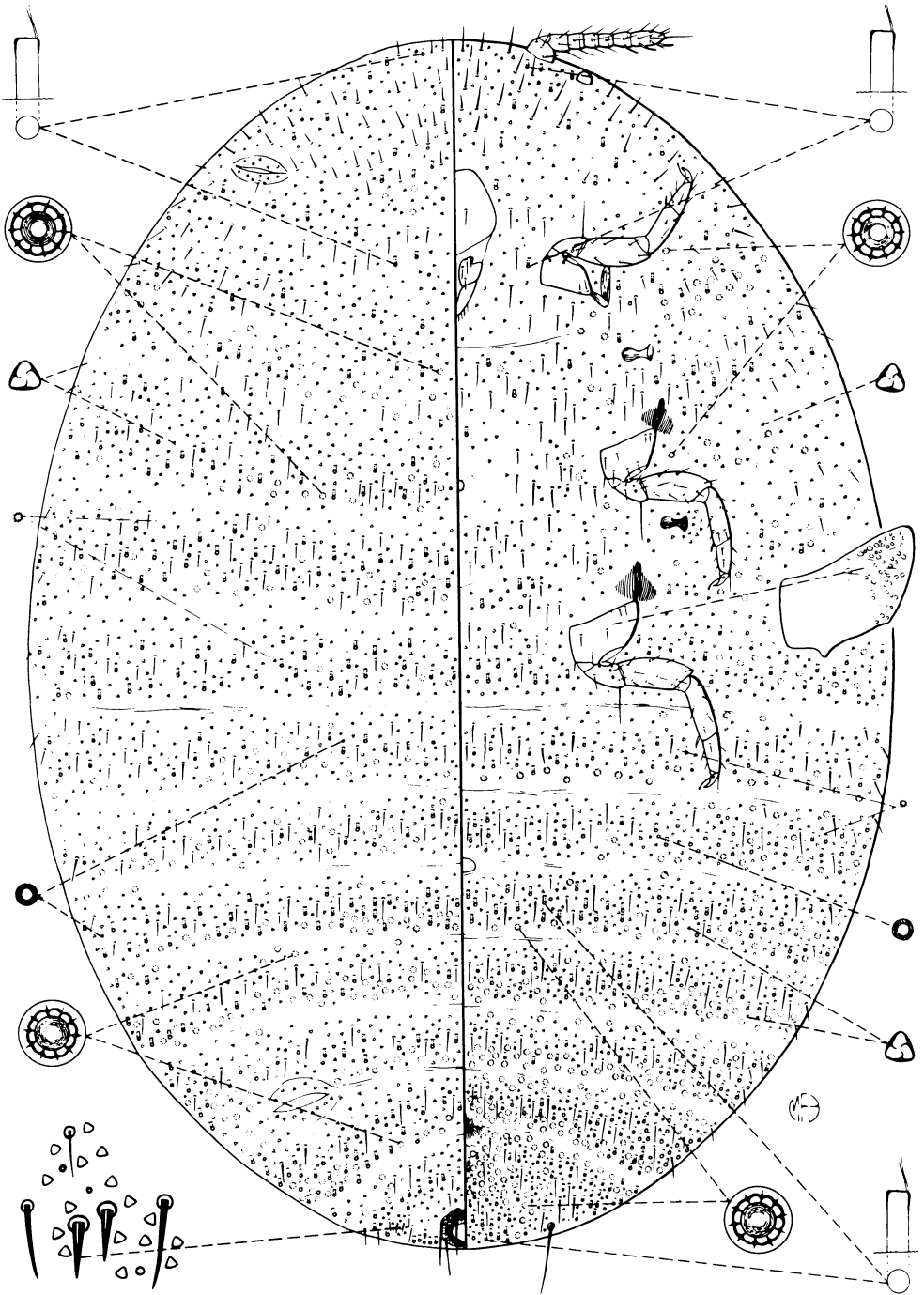


Fig. 14. *Trionymus magnus* (Cockerell and Cockerell), collected at Trout Springs, San Miguel County (?), New Mexico, April 27, 1901.

Notes. This species is extremely close to *Trionymus idahoensis* Miller and McKenzie, but differs in having 7-segmented antennae, small, oval circulus, two distinct sizes of discoidal pores. *T. idahoensis*, on the other hand, has 6-segmented antennae, large, square circulus, one size of discoidal pore.

Trionymus magnus is also similar to *T. strongylus* Miller and McKenzie, but is readily separated by the lack of clusters of multilocular disk pores near the spiracles.

***Trionymus violascens* Cockerell**
(Figure 15)

Trionymus violascens Cockerell, 1913: 143; Cockerell and Robinson, 1915: 105; Hartman, 1916: 96; Ferris, 1950: 277; 1953: 483; McKenzie, 1960: 765; 1961: 48; 1967: 461.

Trionymus furvus McKenzie, 1967: 474 (new synonymy).

Suggested common name. Violet-colored mealybug.

Specimens examined. Adult female on *Elymus triticooides* (Gramineae), collected 15 mi. N. Bishop, Inyo Co., California, July 17, 1963, by D. R. Miller. Adult females and immature nymphs on *Agropyron occidentale* (Gramineae), collected in Colorado, 1914, by G. E. Bethel. Adult females on *Agropyron* sp., collected at Glenwood Springs, Garfield Co., Colorado, by T. D. A. Cockerell and G. E. Bethel. Adult females on *A. occidentale*, collected at Walsenburg, Huerfano Co., Colorado, August 16, 1911, by G. E. Bethel.

Type material. From the syntypes, we have chosen and marked as lectotype an adult female with left label "*Trionymus violascens* Ckll Glenwood Springs. Colo. TYPE"; right label, "*Trionymus violascens* Ckll. Type No. 15693 U.S. N.M."; deposited at USNM. Two specimens on slides; specimen on left is the lectotype. One paralectotype.

We have also examined a paratype of the synonym *Trionymus furvus*.

Gross external features. The elongate body varies from dark purple to dark green, and is lightly covered with a gray wax secretion. One or two caudal filaments may be produced. A large ovisac is formed, which covers the abdomen and extends behind the body. Eggs are laid in the sac.

This species occurs either in the sheaths or on the stems and leaves of its host.

Recognition characters. Adult female, mounted, 1.9 to 2.8 mm long, 0.7 to 1.5 mm wide; body elongate.

Dorsum with 2 pairs of cerarii. Anal-lobe cerarii each with 2 conical setae, 1 or 2 auxiliary setae, 9 or 10 trilocular pores, small amount of basal sclerotization. Penultimate cerarii variable, each normally composed of 2 elongate conical setae (sometimes only 1) situated farther apart than setae of anal-lobe pair, usually without associated auxiliary setae (sometimes with 2), trilocular pores, or basal sclerotization. Multilocular disk pores present on abdominal segments 9 through 5, 4, or 3; also present on thorax, normally present in small numbers on medial or submedial areas, rarely with only 1 or 2 pores present on entire thorax; absent on head. Small discoidal pores inconspicuous, present in reduced numbers over surface. Trilocular pores present over surface. Oral-collar tubular ducts abundant over entire surface, of two sizes: larger most abundant around perimeter of each abdominal segment; smaller most abundant in middle of each segment; conspicuous clusters of oral-collars on posterolateral margin of last 3 or 4 abdominal segments, not always present. Dorsal body setae all approximately same size, slightly shorter than those on venter.

Anal ring dorsal, often touching apex of abdomen, with 2 or 3 rows of pores,

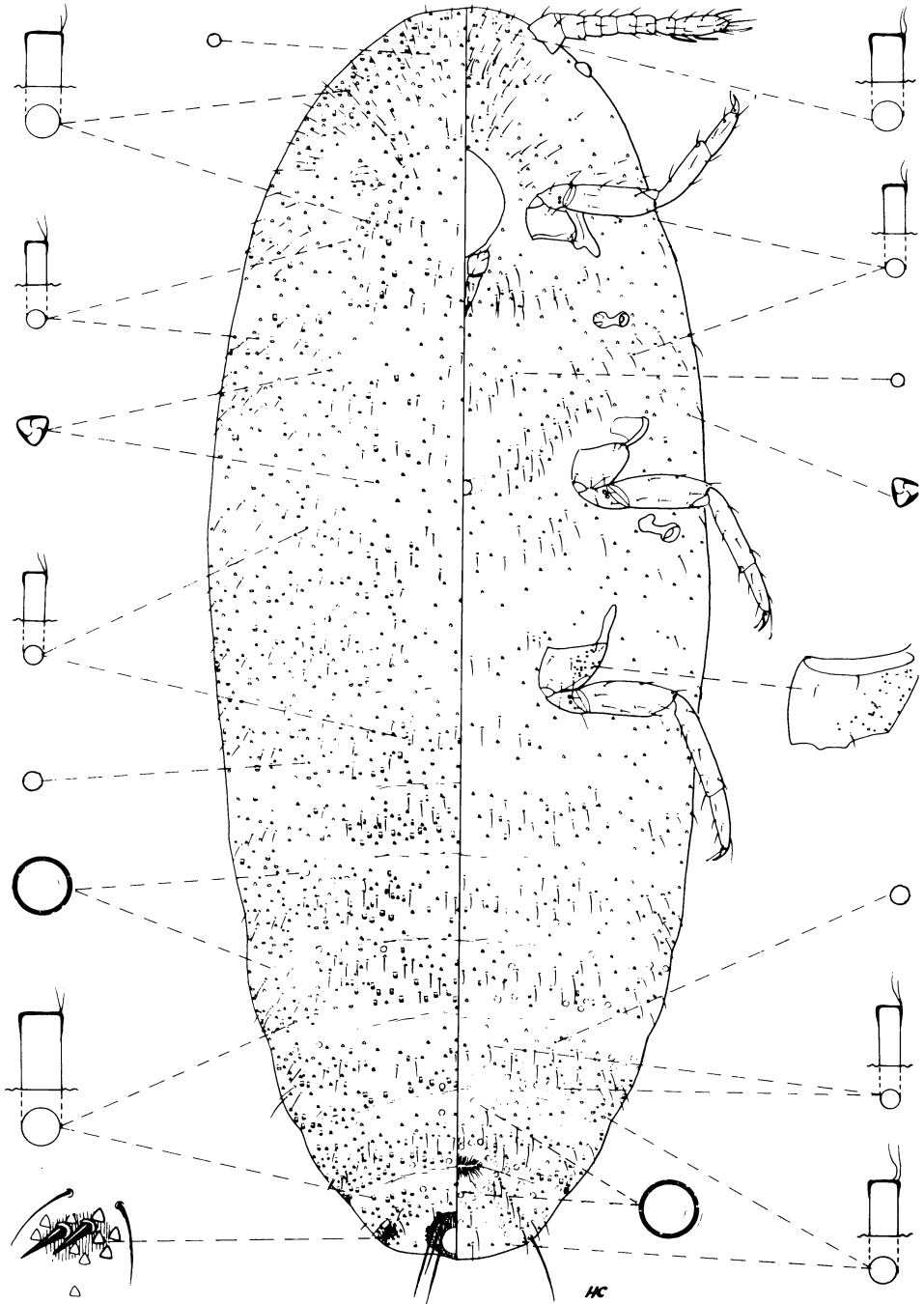


Fig. 15. *Trionymus violascens* Cockerell, collected at Glenwood Springs, Garfield County, Colorado, on *Agropyron* sp. (Gramineae).

outer row sometimes weakly developed; each of its 6 setae one and one-half to two times longer than greatest diameter of ring.

Venter with multilocular disk pores present on abdominal segments 9 through 5, 4, or 3, normally absent on thorax, often with 1 or 2 pores on head between antennae. Oral-collar tubular ducts scattered over surface, of two sizes: larger size most abundant along body margin; smaller size present on medial and mediolateral areas. Trilocular and discoidal pores of same distribution pattern as on dorsum. Body setae normal for genus. Anal-lobe sclerotization absent.

Circulus absent. Hind coxae each dorsally with 0 to 52 translucent pores, ventrally with 13 to 47 pores; tibiae with 5 to 7 translucent pores ventrally, absent dorsally; tarsal and claw digitules apically expanded, extending beyond claw apex; claws without denticles. Antennae 7- or 8-segmented.

Notes. Apparently none of the specimens examined has a circulus. One mutilated female may have this structure but the specimen is so badly distorted that it is difficult to be sure. The other

specimens definitely lack this structure. Both Ferris (1950) and McKenzie (1967) believed that this species had a circulus.

Trionymus violascens is most closely related to *T. myersi* McKenzie, but differs in having translucent pores present on hind coxae, absent on hind femora; 7- or 8-segmented antennae; rather indefinite penultimate cerarius; cerarii without basal clusters of trilocular pores, and occurring on Gramineae. *T. myersi*, however, has translucent pores present on hind femora, absent on hind coxae; 8- or 9-segmented antennae; definite penultimate cerarii with conspicuous cluster of trilocular pores, and occurs on Liliaceae (*Haworthia*).

This species is also related to *Trionymus nanus* (Cockerell), but differs in having 2 pairs of cerarii; dorsal multilocular disk pores present on abdomen and thorax; oral-collar tubular ducts present on anterior thorax and head. *T. nanus*, on the other hand, has 1 pair of cerarii; dorsal multilocular disk pores, when present, restricted to posterior abdominal segments; oral-collar tubular ducts absent on anterior thorax and head.

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