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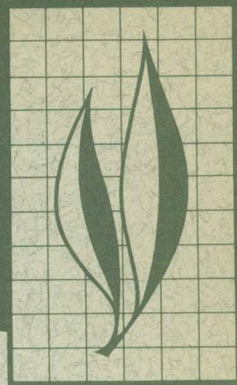
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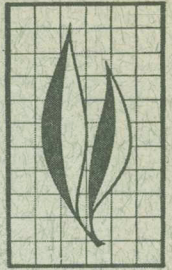
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Fifth Taxonomic Study of North American Mealybugs, with Revisional Notes on Seven Species (Homoptera: Coccoidea: Pseudococcidae)

Howard L. McKenzie and D. J. Williams

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This paper, the fifth in a series of related ones dealing with the taxonomy of mealybugs, presents the authors' careful studies on the reclassification of a series of ten specimens located in the British Museum and the United States National Museum. These slides contained eight North American species, as originally named, which have here been resolved into a series of seven species, as redescribed. The final result has usually been assignment to a different genus, sometimes with a different specific name. Full synonymy is presented, with its attendant bibliography. The species treated were omitted, or considered to be of dubious validity, by Ferris in his *Atlas of the Scale Insects of North America*.

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Fifth Taxonomic Study of North American Mealybugs, with Revisional Notes on Seven Species

(Homoptera: Coccoidea: Pseudococcidae)^{1, 2}

INTRODUCTION

SEVERAL YEARS AGO, the authors discovered in the British Museum five old slides (two slides of one of the species) of North American mealybugs which were omitted, or included only as dubious species, in the pseudococcid sections of Ferris' *Atlas of the Scale Insects of North America*, Series V (1950) and Volume VI (1953). Two of these slides were types. An additional five types of obscure species were discovered in the collection of pseudococcids in the United States National Museum. One of these named species (*Pseudococcus neomexicanus* var. *utahensis* Cockerell) was never listed in the *Zoological Record*, although Morrison and Renk (1957) included its name in their *Selected Bibliography of the Coccoidea*. (See Cockerell, 1916.)

The original name, "type" status, and museum of deposition of each species re-described in this paper are indicated below, together with references to Literature Cited.

British Museum (Natural History)

Ripersia viridula Cockerell. Slide material identified by Cockerell. (No type stated.) Cockerell (1901b).

Ripersia trivittata Cockerell. Immature specimens only. Slide material identified by Cockerell. (No type stated.) Cockerell (1901b).

Ripersia cockerellae King. Holotype. King (1902).

Trionymus geraniae Rau. Paratype. Rau (1938).

United States National Museum

Dactylopius neomexicanus var. *indecisus* Cockerell. Holotype. Cockerell (1901a).

Phenacoccus wilmattae Cockerell. Holotype. Cockerell (1901a).

Pseudococcus neomexicanus var. *utahensis* Cockerell. Holotype. Cockerell (1916).

Ripersia trivittata Cockerell. Syntype. Cockerell (1901b).

Trionymus nanus Cockerell. Lectotype. Cockerell (1905).

TAXONOMIC ACCOUNTS OF SPECIES

The purpose of this paper is to re-describe these species. Their taxonomic status, corrected generic assignments,

and relationships with other pseudococcids are here considered. This is especially desirable, because many species

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² National Science Foundation Grant No. GB-1911 provided funds for technical assistance and for a number of the illustrations.

of mealybugs have been and are now being described from California and bordering states. The present study may help to obviate confusion.

***Chnaurococcus trifolii* (Forbes)**

(Figure 1)

Coccus trifolii Forbes. Forbes (1885), p. 71.

Dactylopius trifolii Davis (not Forbes). Davis (1894), p. 172.

Dactylopius trifolii (Forbes). Osborn (1898), pp. 224–231.

Dactylopius trifolii (Forbes). Pettit (1899), pp. 279–280.

Ripersia confusella Cockerell. Cockerell (1901b), pp. 52–53 (at least in part as a misidentification).

Ripersia tenuipes Cockerell. Cockerell (1901b), p. 54.

Ripersia trivittata Cockerell. Cockerell (1901b), p. 55. (New synonymy.)

Ripersia cockerellae King. King (1902), pp. 42–43. (New synonymy.)

Pseudococcus trifolii (Forbes). Fernald (1903), p. 111.

Trionymus trifolii (Forbes). MacGillivray (1921), p. 139.

Trionymus grindeliae Ferris. Ferris (1918), p. 71.

Chnaurococcus trifolii (Forbes). Ferris (1950), pp. 41–42.

Chnaurococcus trivittatus (Cockerell). Ferris (1953), p. 303. (Synonymy with *C. trifolii* is doubtful because of unsatisfactory study material.)

Ripersia cockerellae Cockerell. Ferris (1953), p. 496. (Suggests possible synonymy with *Chnaurococcus trifolii*; credits Cockerell as describer of species.)

Recognition characters. The description of *Chnaurococcus trifolii*, as presented by Ferris (1950), is basically adequate. In addition to his description and illustration of the species, the present authors have observed numerous minute circular pores on both body surfaces, and translucent pores evident on the hind coxae.

Notes. A single syntype adult female and several immature paratypes of

Ripersia trivittata Cockerell, as well as a holotype adult female of *R. cockerellae* Cockerell (see Fig. 1) have been examined by the authors. These species seem to represent *Chnaurococcus trifolii* as currently recognized.

***Chorizococcus indecisus* (Cockerell)**

(Figure 2)

Dactylopius neomexicanus var. *indecisus* Cockerell. Cockerell (1901a), p. 209.

Pseudococcus neomexicanus var. *indecisus* (Cockerell). Fernald (1903), p. 106.

Trionymus indecisus Hall. Ezzat (1962), pp. 61–65. (New homonym.)

Ezzat (1962) transferred *Trionymus indecisus* Hall (1923), an Egyptian species, to the genus *Spilococcus* Ferris. His illustration of this species, prepared by Professor G. F. Ferris, clearly demonstrates that it is a genuine component of *Chorizococcus* McKenzie, thus creating a homonym of Hall's *indecisus*. The present authors propose a new name, *Chorizococcus halli* McKenzie and Williams, for this species, since it is entirely different from Cockerell's (1901a) *indecisus*.

Recognition characters. Adult female, mounted, approximately 1.75 mm. long, 1.20 mm. wide; body form broadly oval.

Dorsum with 2 or 3 pairs of abdominal cerarii, and 1 pair of frontal cerarii. Anal lobe cerarius without sclerotization, with a pair of stout conical setae, 4 or 5 slender auxiliary setae, and surrounded by a cluster of trilocular pores. Penultimate and antepenultimate cerarii each with 2 smaller conical setae; these may be widely separated, no slender auxiliary setae, and very slight concentration of trilocular pores. Ocular cerarii noted with the same general features as penultimate and antepenultimate cerarii.

Trilocular pores evenly distributed on dorsum. Oral-collar ducts absent. Oral-rim ducts present in clusters along the lateral margins of the abdomen, and in

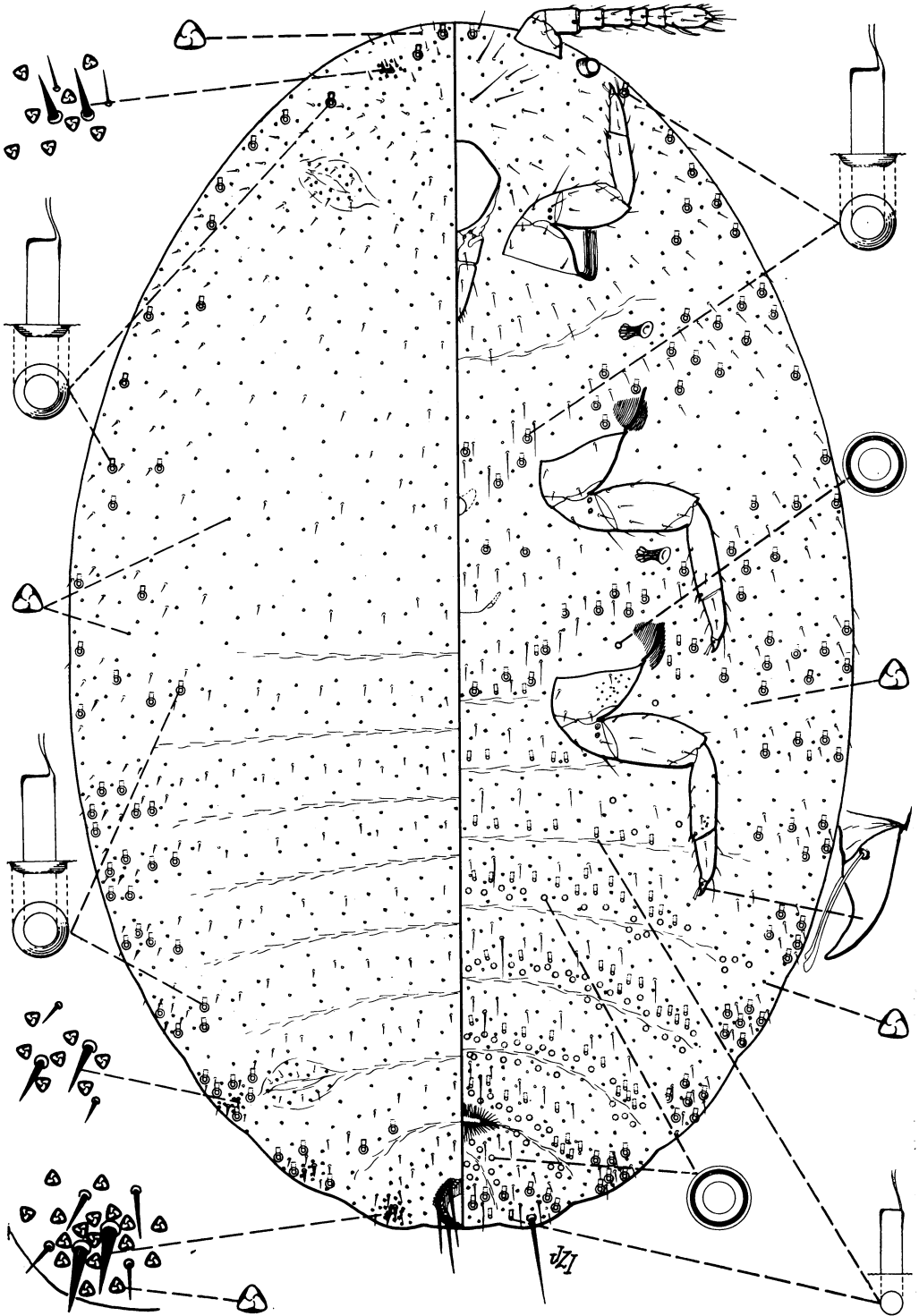


Fig. 2. *Chorizococcus indecisus* (Cockerell), in nests of *Lasius americanus*, Las Vegas, San Miguel County, New Mexico, April 22, 1901. W. P. Cockerell, collector. (Holotype.)

a submarginal series as far forward as head. Body setae short and slender. Anal ring apical, with no unusual characters; each of its 6 setae approximately twice as long as greatest diameter of ring.

Venter with multilocular disk pores in considerable numbers in the mid-region of the abdomen as far forward as the fifth segment, and occasionally in small numbers on the third and fourth segments. Trilocular pores evenly dispersed. Oral-collar ducts small, all essentially of one size, fairly numerous, in transverse bands on abdominal segments, these apparently absent on thorax and head. Oral-rim ducts of the same size as those on dorsum occur in the lateral areas from the last abdominal segment as far forward as the prothorax; 1 or 2 oral-rim ducts on head; and in small numbers on sternal areas of thoracic segments. Body setae slender, slightly longer than those on dorsum.

Circulus absent. Legs comparatively large and stout; a few translucent pores on hind coxae, with a few similar pores distributed on distal one-fourth of hind tibiae; claw without noticeable denticle. Mouthparts comparatively broad. Antennae 7-segmented. Eyes present.

Notes. The authors have assigned this species to the genus *Chorizococcus* McKenzie mainly on the basis of a reduced number of cerarii, there being not more than 2 or 3 pairs on the abdomen and 1 pair of ocular cerarii on the head. The presence of ocular cerarii is distinctive. It resembles *C. californicus* McKenzie in the distribution of the ventral submarginal band of oral-rim tubular ducts. The ocular pair of cerarii and the submarginal band of dorsal oral-rim tubulars in *C. indecisus* preclude confusion with *C. californicus*.

Phenacoccus wilmattae Cockerell
(Figure 3)

Phenacoccus wilmattae Cockerell. Cockerell (1901b), p. 57.

Phenacoccus wilmattae Cockerell. Ferris (1953), p. 403. (Misidentification; places *P. wilmattae* as synonym of *P. solani* Ferris.)

Phenacoccus wilmattae Cockerell. Bueker (1930), pp. 93-94.

Recognition characters. Adult females (2 specimens), mounted, 2.60 to 2.70 mm. long, 1.20 to 2.00 mm. wide, body form broadly oval.

Dorsum with cerarii variable, 14 to, at most, 17 pairs, some of these at times with only a single seta, those along thoracic margin most likely to be absent. Anal-lobe cerarius with 2 moderately stout, slightly lanceolate setae, 1 to 3 or 4 smaller setae of similar shape, slight concentration of trilocular pores. Remaining cerarii each with usually 2 setae (occasionally only 1), these considerably smaller, no auxiliary setae, not more than 4 or 5 associated trilocular pores.

Trilocular pores rather sparsely beset on dorsum. Tubular ducts absent. Body setae somewhat lanceolate, sparsely beset on dorsum, largest of these scarcely as large as lateral cerarian setae, most of them smaller. Anal ring apical, no unusual features; each of its 6 setae about twice as long as diameter of ring itself.

Venter with multilocular disk pores in relatively small numbers, situated from apical segment of abdomen forward to posterior margin of segment 5, absent elsewhere on venter. Quinquelocular pores are absent. Trilocular pores sparsely scattered on venter. Oral-collar tubular ducts small, few, present mostly in midregion of abdominal segments. Body setae slender, variable in size, some noticeably longer than those on dorsum.

Circulus quite small, circular or slightly oval in shape, situated slightly above intersegmental line, usually not involved in same. Legs well developed, moderately stout; hind femora and tibiae swollen; translucent pores on hind tibiae conspicuous, numerous.

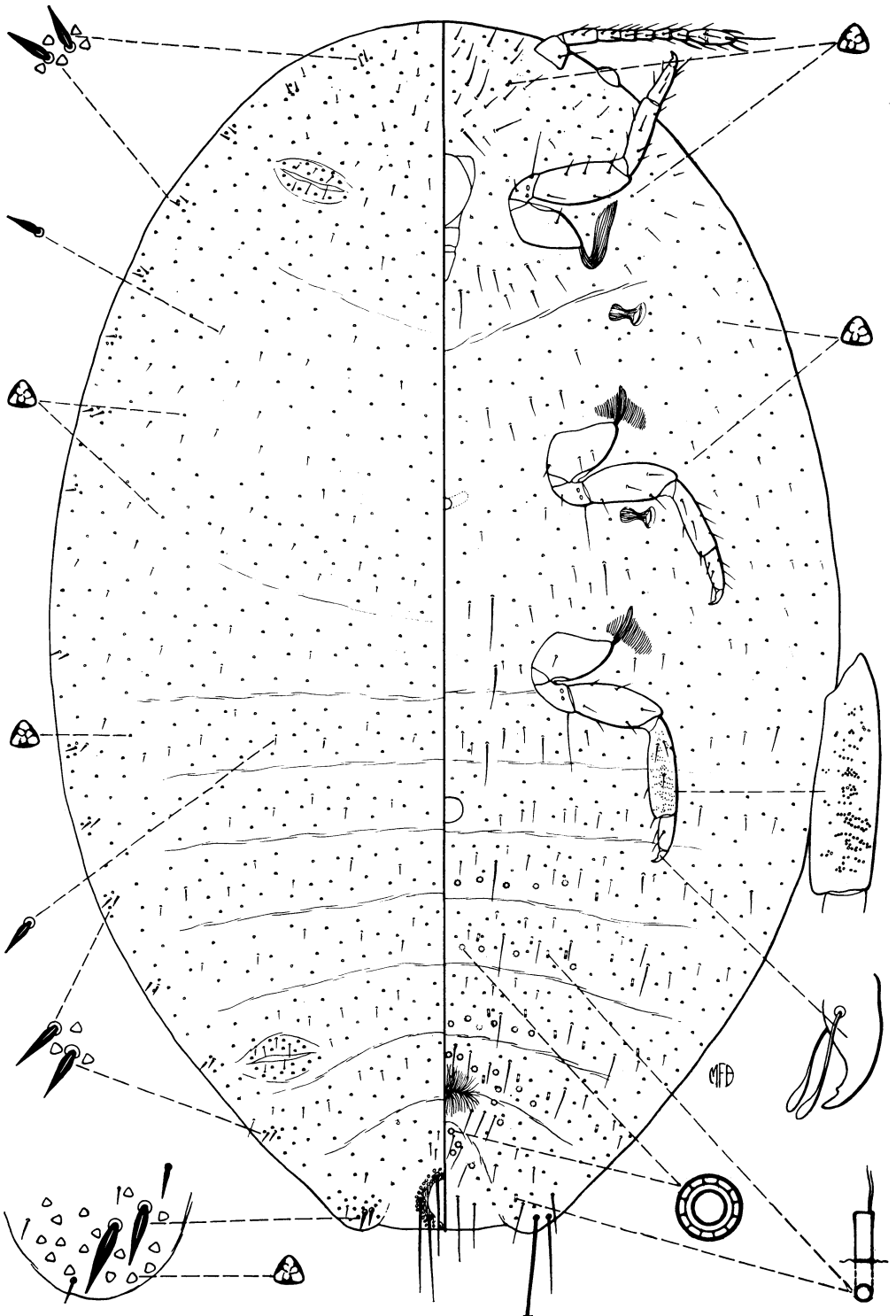


Fig. 3. *Phenacoccus wilmattae* Cockerell, on *Viola pedatifida* (Violaceae), Beulah, San Miguel County, New Mexico (altitude 8,000 feet), May 11, 1901. W. P. Cockerell, collector. (Holotype.)

tending to be arranged in bands or clusters over most of segment, ranging from 118 to 135 (average 125.6); claw with denticle near tip on plantar surface. Antennae 8-segmented, with tendency for apical segment, at times, to show some signs of slight division.

Notes. Through the courtesy of Miss Louise M. Russell, U.S.D.A., Washington, D.C., it has been possible for the authors to examine holotype and cotype slide mounts containing 4 adult females of *Phenacoccus wilmattae* Cockerell deposited in the United States National Museum. Ferris examined the cotype slide mount in 1952, and later, in Volume VI of his *Atlas* (1953), placed this species as a synonym of *P. solani* Ferris. A discrepancy was noted immediately, for *P. wilmattae* was described in 1901, thus reversing the synonymy, provided the species were actually alike, while *P. solani* was named in 1918—a difference of 17 years. Furthermore, a letter from Dr. Harold Morrison to Professor Ferris, dated December 31, 1947, indicated that the two species were quite different.

Re-examination of the type slide of *P. wilmattae* reveals that it is very closely related to *P. solani* Ferris, but differs mainly in the stout, robust legs, with swollen femora and tibiae; translucent pores conspicuous and numerous on hind tibiae, tending to be arranged in bands or clusters over most of segment, ranging in number from 118 to 135 (average 125.6); and with cerarian pairs variable, with 14 to, at most, 17 pairs. *P. solani*, on the other hand, has comparatively slender to slightly swollen hind femora and tibiae; translucent pores on hind tibiae quite small and inconspicuous, scattered over segment, count on 21 tibial segments in type series ranging from 44 to 71 (average 57.4); cerarii basically complete, normally 18 pairs present, infrequently 17.

The authors believe *P. wilmattae* Cockerell to be quite distinct from *P. solani* Ferris.

Spilococcus geraniae (Rau)

(Figure 4)

Trionymus geraniae Rau. Rau (1938), pp. 162–165.

Recognition characters. Adult female, mounted, approximately 2.50 mm. long, 1.40 mm. wide.

Dorsum with 6 or 7 pairs of abdominal, and possibly 1 or 2 pairs of frontal, cerarii. Anal lobe cerarius without sclerotization, with a pair of stout conical setae, 3 or 4 slender auxiliary setae, and surrounded by a cluster of trilocular pores. Remaining abdominal cerarii each with 2 conical setae (progressively smaller with distance from anal lobes), without auxiliary setae, but with a few trilocular pores. Cerarii on head, if correctly interpreted, with 2 or 3 slender conical setae and a few trilocular pores.

Trilocular pores evenly distributed on dorsum. Oral-collar ducts present along lateral margin from anal lobes forward to fourth abdominal segment; absent elsewhere on dorsum. Oral-rim ducts in transverse bands of from 6 to 14 on each abdominal segment except the last, also scattered over thorax and head. Body setae short and slender. Anal ring apical, with no unusual characters; each of its 6 setae about twice as long as diameter of ring.

Venter with multilocular disk pores abundant, in transverse, double-row bands from apex to posterior margin of fifth abdominal segment, a few submarginal ones present along posterior margin of fourth segment; and often with 1 or 2 pores in prothoracic region between anterior coxa and body margin. Trilocular pores evenly distributed. Oral-collar ducts small, all essentially the same size, fairly numerous, in transverse bands on abdominal segments, and a conspicuous cluster on prothorax between anterior coxa and body margin. A few oral-rim ducts of the same size as those on dorsum occur between anterior and posterior spiracles and body mar-

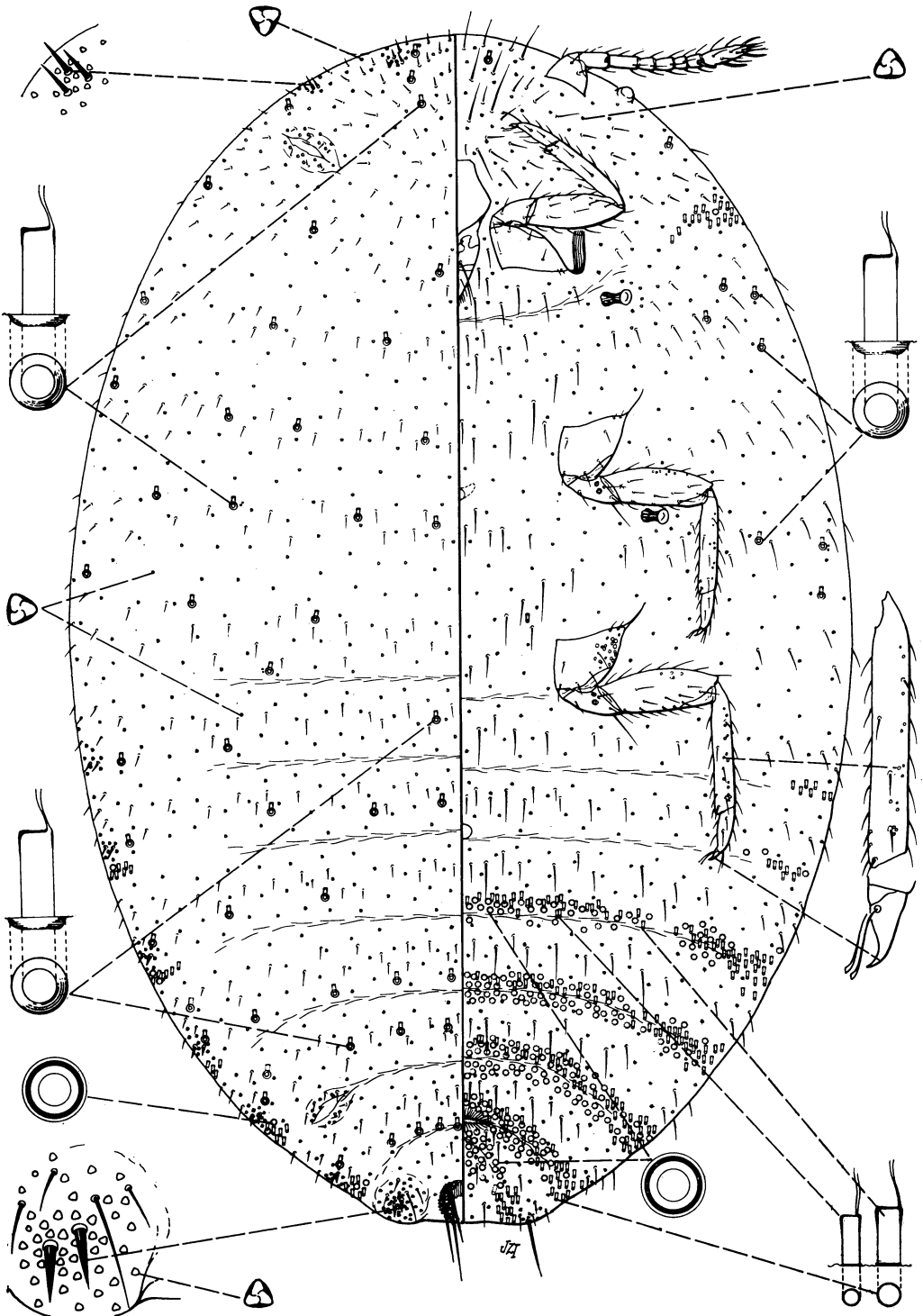


Fig. 4. *Spilococcus geraniae* (Rau), on *Geranium robertianum* (Geraniaceae), Saratoga Springs, Saratoga County, New York, September 6, 1937. Collector not indicated. (Paratype.)

gin, 1 or 2 on head. Body setae slender, slightly longer than those on dorsum.

Circulus small, transversely oval, not divided by segmental line. Legs well developed, comparatively large; a few rather indistinct translucent pores on hind coxa; a few similar pores distributed on femora and tibiae of middle and hind legs; claw without denticle. Mouthparts comparatively broad. Antennae 8-segmented. Eyes present.

Notes. The authors concur that this species is closely related to *Spilococcus parvicirculus* McKenzie. *S. geraniae* differs in these respects: very numerous ventral multilocular disk pores in double rows on the abdomen (approximately 500); a conspicuous cluster of ventral oral-collar ducts occurs between the anterior coxa and the body margin; and the ventral oral-rim tubular ducts are absent on the abdomen. On the other hand, *S. parvicirculus* has fewer ventral multiloculars in single rows on the abdomen (approximately 140); the oral-collar ducts are absent on the thorax; and the ventral oral-rim tubular ducts are present along the submargin of the abdomen.

Spilococcus viridula (Cockerell)

(Figure 5)

Ripersia viridula Cockerell. Cockerell (1901b), p. 56.

Ripersia viridula Cockerell. Ferris (1953), p. 496.

Recognition characters. Adult female, mounted, approximately 1.75 mm. long, 1.00 mm. wide.

Dorsum with apparently 11 or 12 pairs of cerarii; some reduction usual for thoracic and head areas. Anal-lobe cerarius without sclerotization, with a pair of stout, conical setae, 1 or 2 slender auxiliary setae, and surrounded by a cluster of trilocular pores. Remaining abdominal cerarii each with 2 conical setae (progressively smaller with distance from anal lobes), without auxiliary setae, but with a few trilocular pores. Cerarii on head and thorax, if

correctly observed, similar to those on abdomen, exclusive of anal lobes.

Trilocular pores evenly distributed on dorsum. Oral-collar ducts absent. Oral-rim ducts in a median longitudinal single band from eighth abdominal segment to head; in a submarginal band, mostly double, from apical segment to head; scattered elsewhere on thorax. Body setae short and slender. Anal ring apical, with no unusual characters; each of its 6 setae about twice as long as diameter of ring.

Venter with multilocular disk pores present in transverse single bands on all abdominal segments; in sternal region of meso- and metathorax; between posterior coxa and body margin. Trilocular pores evenly distributed. Oral-collar ducts, all essentially the same size, fairly numerous, in transverse bands and along submargin of abdominal segments; 1 or 2 between posterior coxae of hind legs; absent elsewhere on thorax. A few oral-rim ducts of the same size as those on dorsum are present in sternal area and elsewhere on meso- and metathorax, 1 or 2 on head. Body setae slender, slightly longer than those on dorsum.

Circulus absent. Legs large and stout, well developed; a few translucent pores on hind coxae; a few similar pores, though possibly less distinct, are lightly scattered on tibiae of middle and hind legs; claw with slight denticle. Mouthparts moderately broad. Antennae 7-segmented. Eyes present.

Notes. The authors believe that even though *Spilococcus viridula* keys to *S. eriogoni* (Ehrhorn) in McKenzie's (1962) key to *Spilococcus* of North America, it shows several differences: the antennae have 7 segments; ventral multilocular disk pores are present on all abdominal segments, on the meso- and metathorax; and there are fewer ventral oral-rim ducts on the head and thorax. *S. eriogoni*, on the other hand, has 8-segmented antennae, on which the eighth segment at times appears to be

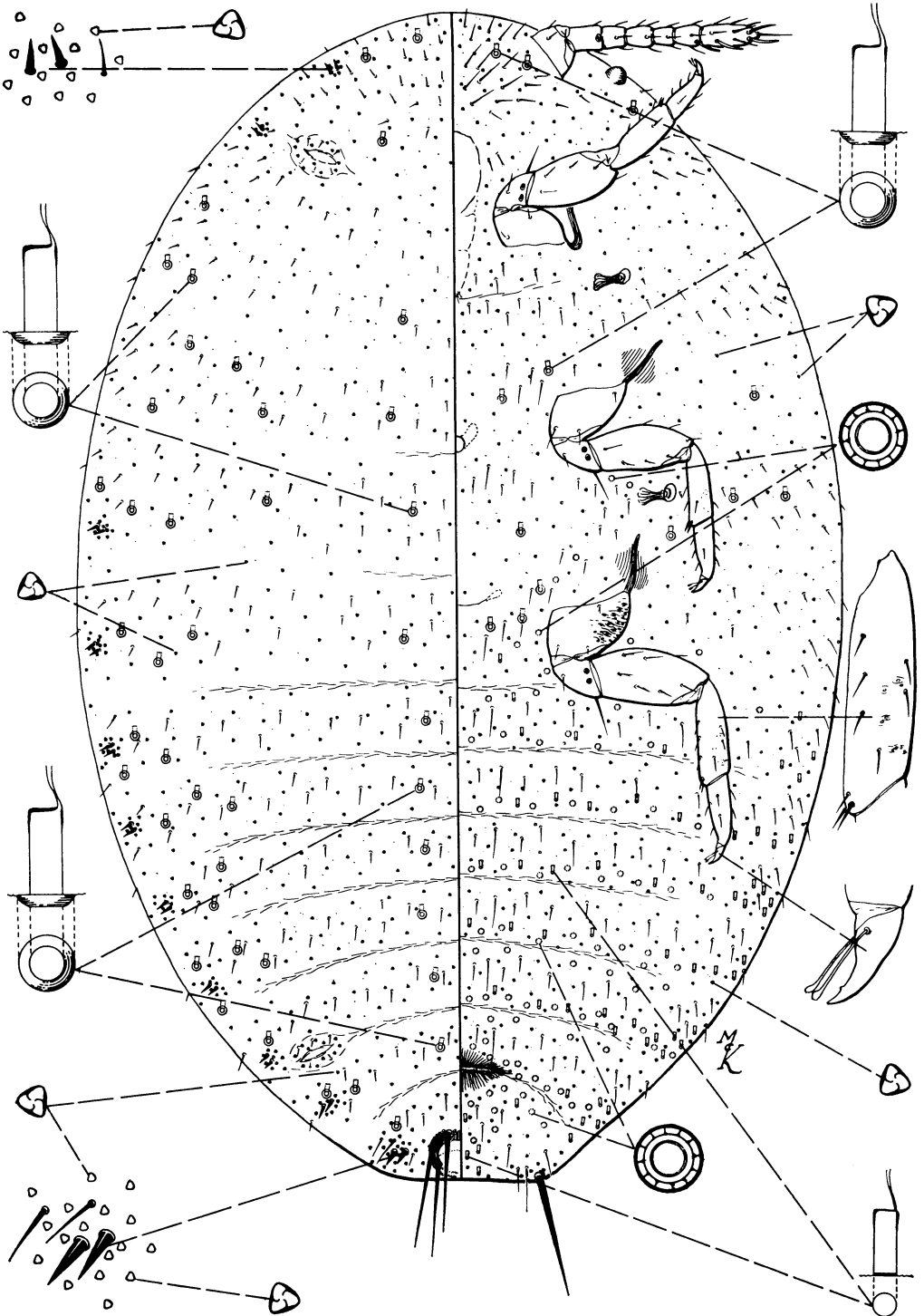


Fig. 5. *Spilococcus viridula* (Cockerell), in nests of *Lasius americanus*, near Green's Lake, San Miguel County (probably), New Mexico, April 26, 1920. T. D. A. Cockerell, collector. (Identified by Cockerell.) (No type stated.)

divided; the ventral multilocular disk pores are present from the apex of the abdomen to the posterior margin of the fifth segment; and there are numerous ventral oral-rim tubulars on the head and thorax.

The specimens from which the accompanying illustration was made were identified by T. D. A. Cockerell; there seems good reason to believe that they represent *S. viridula*. All the specimens examined are badly twisted and mutilated, and the illustration may be deficient in certain structural details.

Trionymus nanus Cockerell

(Figure 6)

Trionymus nanus Cockerell. Cockerell (1905), p. 136.

Recognition characters. Adult female, mounted, approximately 1.00 mm. long, 0.50 mm. wide; body form elongate, with nearly parallel sides.

Dorsum with cerarii represented only on anal lobes, each of these without sclerotization, with a pair of rather small, conical setae; a very small group of less than 10 trilocular pores about the bases of setae, and no closely associated, slender, auxiliary setae.

Trilocular pores evenly arranged on dorsum. Numerous small, circular, discoidal pores with poriferous centers, these with their diameter about equaling that of a trilocular pore, scattered over entire dorsum. A few multilocular disk pores, if correctly observed, appear on seventh abdominal segment. A few oral-collar ducts occur, mostly along posterior margin of abdominal segments, except the last; a few scattered on meso- and metathorax. Body setae short and slender. Anal ring apical, with no unusual characters; each of its 6 setae about twice as long as diameter of ring.

Venter with multilocular disk pores present in limited numbers from the ninth abdominal segment to the sixth, situated mainly in the midregion; none observed elsewhere. Trilocular pores

evenly distributed. Numerous small discoidal pores, similar to those on dorsum, occur over entire venter with possible exception of the head. Oral-collar ducts, all essentially the same size, fairly numerous, in transverse bands and along submargin of abdominal segments 3 to 9; a few in midregion of segment 2, and 1 or 2 near hind coxae. Body setae slender, slightly longer than those on dorsum.

Circulus absent. Legs comparatively short, though stout; a few rather indistinct translucent pores on hind coxae; claw without denticle. Mouthparts moderately broad. Antennae 7-segmented. Eyes present.

Notes. This species keys to *Trionymus smithii* (Essig) in McKenzie's (1961) key. However, *T. nanus* differs from *T. smithii* as follows: there are numerous discoidal pores having sievelike, poriferous centers; there are fewer dorsal multiloculars, and these are usually confined to the seventh abdominal segment; only a few trilocular pores occur near orifices of posterior spiracles; the posterior coxae are perceptibly larger than the coxae of the other legs; and the hind coxae have less conspicuous translucent pores. On the other hand, *T. smithii* lacks discoidal pores anywhere on the body; its ventral multiloculars are usually present only on the last 3 or 4 abdominal segments; the trilocular pores are numerous near orifices of posterior spiracles; the posterior coxae are definitely larger than those of the other legs, and are thickly beset with translucent pores. *T. smithii* is a much larger species than *T. nanus*.

Trionymus utahensis (Cockerell)

(Figure 7)

Pseudococcus neomexicanus var. *utahensis* Cockerell. Cockerell (1916), p. 313.

Trionymus bromi Ferris. Ferris (1950), pp. 255–256. (New synonymy.)

Recognition characters. Adult female, mounted, approximately 5.00 mm.

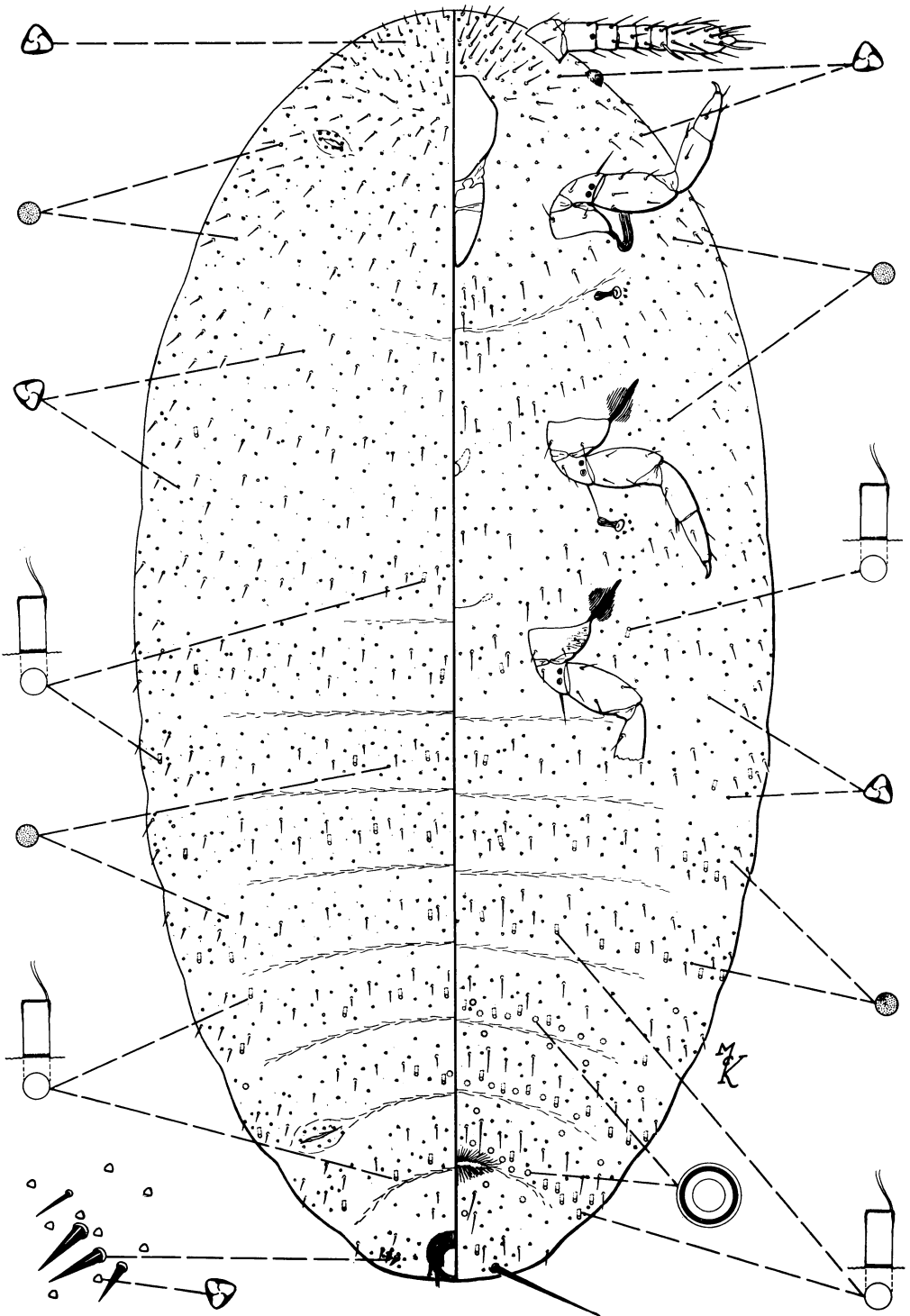


Fig. 6. *Trionymus nanus* Cockerell, on roots of grass under stone, Boulder, Boulder County, Colorado, November, 1904. T. D. A. Cockerell, collector. (Lectotype.)

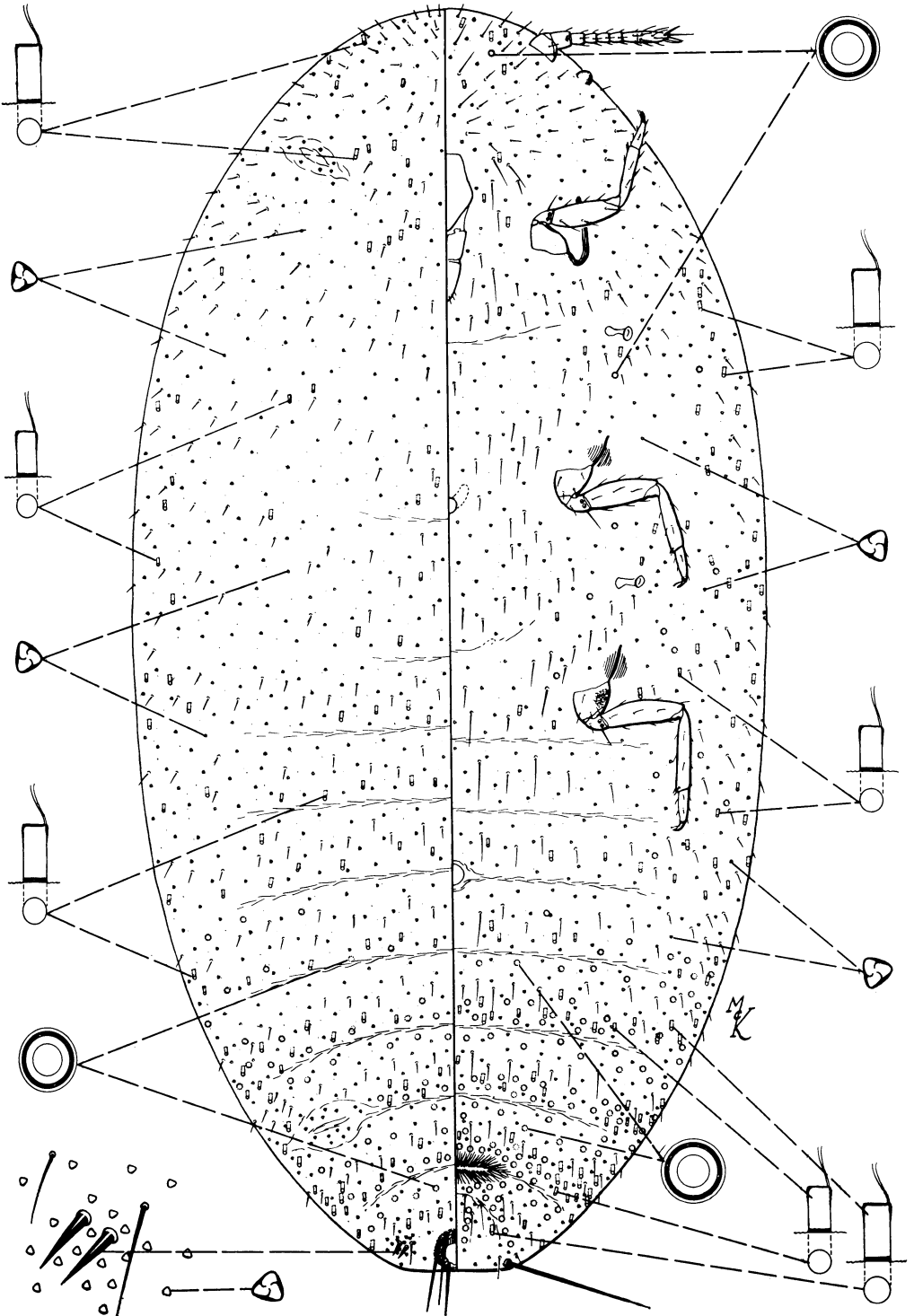


Fig. 7. *Trionymus utahensis* (Cockerell), on *Elymus* sp. (Gramineae), Salt Lake City, Salt Lake County, Utah, September 3, 1915. P. H. Timberlake, collector. (Holotype.)

long, 1.95 mm. wide; body form elongate, with nearly parallel sides.

Ferris' description and illustration of *Trionymus bromi* (considered by the authors to be a synonym of *T. utahensis*) are basically adequate for the species. Certain of the more variable structures are mentioned in detail below.

Notes. The present authors are illustrating the holotype of *T. utahensis*. This species keys to *T. bromi* in McKenzie's (1961) paper. It has been compared with the type slides of *T. bromi* in the University of California Coccoidea collection at Davis, and with

specimens from wheat taken near Salt Lake City, Utah, which were identified as *T. bromi* by Ferris.

T. utahensis has dorsal multilocular disk pores on the fifth abdominal segment, and its thorax has more submarginal multiloculars on the venter than are illustrated for *T. bromi* by Ferris. Also, the circulus is slightly larger, and the translucent pores on the hind coxae are more abundant than those shown in his drawing. Ferris mentioned a few of these deviations, especially in the examples collected on wheat near Salt Lake City.

SUMMARY

This paper redescribes seven pseudococcid species which were omitted or included only as species of dubious validity in Ferris' *Atlas*. Their taxonomic status, corrected generic assignments, and relationships with other pseudococcids are given. The species considered are: *Chnaurococcus trifolii* (Forbes) (= *Coccus trifolii* Forbes); *Chorizococcus indecisus* (Cockerell)

(= *Dactylopius neomexicanus* var. *indecisus* Cockerell); *Phenacoccus willmattae* Cockerell; *Spilococcus geraniae* (Rau) (= *Trionymus geraniae* Rau); *Spilococcus viridula* (Cockerell) (= *Ripersia viridula* Cockerell); *Trionymus nanus* Cockerell; and *Trionymus utahensis* (Cockerell) (= *Pseudococcus neomexicanus* var. *utahensis* Cockerell).

See new homonym, page 3.

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