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A Systematic Study of *Ovaticoccus* Kloet and its Relatives, with a Key to North American Genera of Eriococcidae (Homoptera: Coccoidea: Eriococcidae)[1,2]

INTRODUCTION

THIS IS A preliminary study of four small genera of the family Eriococcidae Fernald, namely, *Cornoculus* Ferris, *Oregmopyga* Hoy, *Ovaticoccus* Kloet, and *Spiroporococcus* Miller. A fifth genus, *Eriococcus* Targioni-Tozzetti, not investigated in detail, is included in this presentation only because *Oregmopyga nudula* (Ferris) seems to belong there. At first we believed that the group constituted one genus, *Ovaticoccus*, but after much study we concluded, as had Ferris (1955) and Boratynski (1958), that the group is extremely heterogeneous. Both of those authors believed that the relationships could be understood only when more species were discovered. Now the addition of 10 species to the group—two described by McKenzie in 1964 and eight described in the present paper—permits a more definitive classification.

The senior author has done most of the systematic work in this study and is wholly responsible for the descriptions of the eight new species and the new genus. His name will appear alone as their author.

To make a natural generic classification it was necessary to describe the new genus *Spiroporococcus* to hold three species previously in *Ovaticoccus*. Also it was necessary to transfer one species from *Ovaticoccus* to *Oregmopyga* and another from *Oregmopyga* to *Eriococcus*. The characters used to separate these genera may seem insignificant, but we feel that the generic designations are justified because biological differences such as host and position on the host conform with these subtle key characters. Future workers may find important taxonomic aid in the physiological characters revealed by chromatography. Study of the males, so often ignored in work on Coccoidea, is another area that may be of much future importance.

The four genera that we concentrated on show so many characters in common that they may constitute a tribe or some other suprageneric category. Although we do not feel sufficiently familiar with the family as a whole to propose such a designation, we are using ovaticoccin as a common name, to show some relationship among these genera. This com-

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mon name can apply to either a tribe or a subfamily, if one of these categories is designated at a later time. *Eriococcus* is not included in the ovaticoccins.

Insects of this group are rare in collections—not because they are uncommon, but because they are small and are hidden under the bark of their host plants. After we became aware of this concealment we made 30 ovaticoccin collections on one two-week collecting trip. These collections yielded 10 species, five of them new, and gave evidence that the ovaticoccin fauna in the southwestern United States is extremely large and that undoubtedly there are still many undescribed species.

Type specimens and other slides are in the following depositories: British Museum (Natural History) (BM); Collection of the California State Department of Agriculture (CDA); Florida State Collection of Arthropods (FCA); Collection of Coccoidea, University of California at Davis (UCD); and Collection of Coccoidea, United States National Museum (USNM). The collection of Coccoidea made by the late Professor G. F. Ferris of Stanford University is now housed at Davis.

EXTERNAL MORPHOLOGY OF THE OVATICOCCIN GROUP

Field Features

Adult female

Gross external characters. The body is usually some shade of red, but at least one species is yellow. In some species all or part of the intersegmental area is clear brown, which gives the body a spotted appearance. The legs and the antennae are cream-colored or dark yellow; in most species they are small and are not visible to the naked eye. A characteristic feature of living specimens is the smooth and shiny derm. The body segments are only rarely discernible and are seen dorsally if at all. Some species have one dorsal longitudinal ridge, some have none, and some have three.

Waxy secretions are of two main types—mealy and filamentous. In ovaticoccins the mealy secretion familiar on mealybugs is usually produced ventrally but not in large quantities. It appears as a fine white powder, and even in the few species where it is produced dorsally it rarely hides the body color. The filamentous secretions, also white, have two distinct areas of origin, which correspond to their hypothesized functions. (1) The ovisac is produced ventrally and also from the last two or more segments of the dorsal surface. (2) The nestlike structure is produced from the ventral margins. Eggs and newly hatched nymphs are found in the ovisac, which presumably protects them from the environment. At least two species lay eggs, but we suspect that some species produce living young. If so, it might be that in such species no ovisac is formed. We have seen fully formed first-instar nymphs inside mounted adult females, but it is possible that the egg shells had been broken during the mounting procedure. A nestlike structure is produced laterally by many female ovaticoccins.

Body form. Females of the species that infest Gramineae and Agavaceae are usually elongate and slender and flattened dorsoventrally; those infesting other plants are oval and rotund. In mounted specimens the total body length varies from 1.00 to 4.10 mm, the width from 0.60 to 2.10 mm.

Habitat. These insects are strongly specific to particular hosts. Moreover, each species is confined to a particular part of the selected plant. Females and nymphs are found mostly on the roots and crowns of the host plant and sometimes on aerial stems. If on a leaf, they are hidden at the base of the sheath.

Adult male

Adult males are rarely found. We believe that they are winged in most species. Male sacs found so far have been on the upper parts of the plant. These sacs are composed of the waxy secretions of male nymphs.

Structures Seen on Mounted Specimens

Adult female

Setae are found over most of the body surface. Presumably all types of setae have some sensory function. We recognize that the commonly used names are arbitrary, but they are useful in the species descriptions and we will continue to use these names for two of the four major types of setae found on the ovaticoccins.

LANCEOLATE BODY SETAE are always present on both surfaces. They are more or less slender. Normally they are longer on the ventral surface than on the dorsal, and the posterior anal-lobe setae are always the longest. This pair of setae is present on all species—even where anal lobes are lacking. A specialized kind of body seta, more robust than the lanceolate body seta, is found on the tibia of a few species. There may be two of these setae on each tibia.

ENLARGED SETAE are usually somewhat dome-shaped. Each seta is greatly thickened at the base and narrowed either more or less abruptly to an apical projection. Its form is distinctive for most species. It is always heavily sclerotized and associated with an enlarged setal base. Frequently the structure is partially or entirely recessed into a pocket in the derm. These setae occur mainly on the dorsum. Although they are not exactly alike in any two species, their size and shape are constant on the adult females of any one species—with the single exception of *Ovaticoccus agavium* (Douglas), which has enlarged setae of one shape but of two or three sizes. We believe that in many instances enlarged setae are transformed into lanceolate body setae during ecdysis, because enlarged setae are present on the nymphs of most of the species that lack them in the adult stage. *O. agavium* is again an exception, in that the direction of the transformation appears to be reversed. The adult females of this species have fewer lanceolate body setae than the nymphs and a greater number of enlarged setae. Enlarged setae are present on the adult females of 11 of the ovaticoccin species treated in this paper and on nymphs of most of the other species. Their function is probably protective, but it is not known why some are recessed into the derm.

INTERMEDIATE SETAE presumably represent a transitional form between the enlarged setae and the lanceolate body setae. They appear to be very small forms of the enlarged setae. They are most numerous along the dorsal body margin and do not occur ventrally. They have been found on only three species—*Oregmopyga neglecta* (Cockerell), *Ovaticoccus adoxus* (Ferris), and *O. californicus* McKenzie.

SENSORY SETAE are much thicker than lanceolate body setae of the same length, and their surfaces appear coarser. On adult females and on nymphs they are present only on the antennae, on the last two or three segments. It is possible that their distribution on adult males is somewhat less restricted. They are of different sizes on the different segments of the same antenna, and the size relationships seem to be of minor specific significance. These setae may have a special sensory function.

Tubular ducts are of two major types, but all have the same basic structure—a dermal orifice, a tube or duct, and a sclerotized vestibule.

THE MACROTUBULAR DUCT has a circular, unsclerotized orifice and an ex-

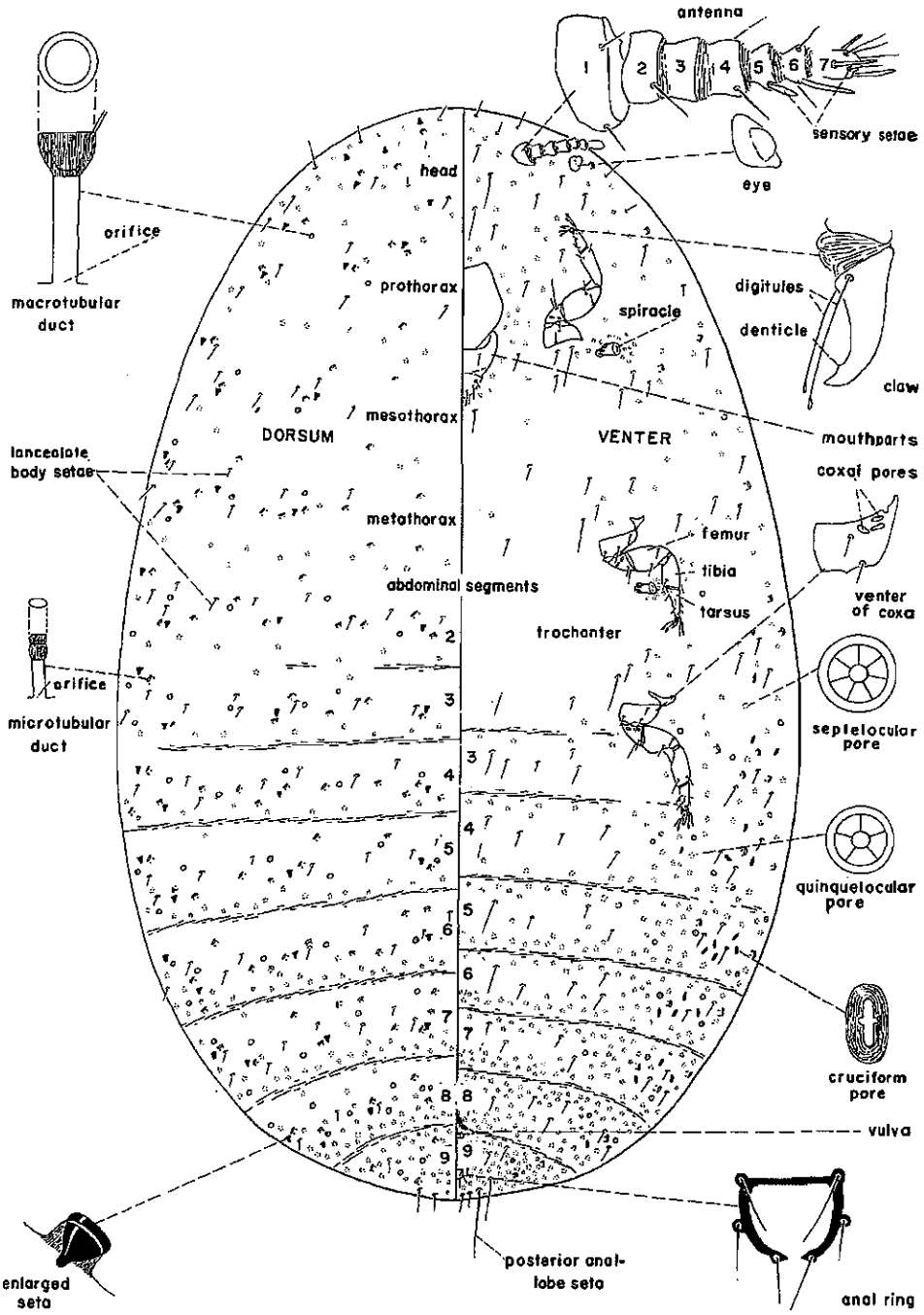

Fig. 1. Composite diagram of adult female ovaticoccin, showing the principal characters and their typical distribution patterns. Dorsal aspect at left, ventral at right—for all figures.

panded cup-shaped vestibule. One small tubule is usually visible, attached to the rim of the cup. Presumably it comes from the reservoir of a wax gland, as in the mealybugs (Ezzat, 1956), but histological preparations would be needed to make sure of this. Usually the macrotubular ducts of one species are all of one size, but the size may vary from one species to another. Several species of *Oregmopyga* have macrotubular ducts of two sizes, with the smaller ducts on the medioventral surface of the abdomen and the larger ducts on both body surfaces. Macrotubular ducts have been found on all known ovaticoccin species except *Ovaticoccus parkerorum* Miller. From comparison of field records on the distribution of the filamentous ovisac secretion on a given species with laboratory records and drawings of the distribution of macrotubular ducts on the same species, it appears that these ducts extrude the ovisac secretions.

THE MICROTUBULAR DUCT has an oval, sometimes sclerotized orifice. The vestibule is in two parts; both parts are sclerotized but are only slightly expanded. The microtubular ducts on one species are always of one size, but the size may vary from one species to another. These ducts have been found on all known ovaticoccin species except *Ovaticoccus californicus*. Their exact function is unknown, but we suppose that they extrude some part of the filamentous ovisac secretion.

Sessile pores are of two major types. Multilocular sessile pores are usually the most common glandular structures on the ovaticoccin derm and are more abundant than cruciform sessile pores.

MULTILOCULAR SESSILE PORES (fig. 1) are circular and are composed of concentric rings. Usually a trilocular pore is slightly larger than the orifice of a large macrotubular duct, and the overall size of a multilocular pore increases with the number of loculi. In nearly all species the multilocular pore has a central sclerotized hub. A ring of three to seven loculi surrounds the hub. Five is the most common number of loculi on adult ovaticoccins and three the most common on nymphs. Around the loculi there may be an intermediate ring, in which a larger number of partitions can sometimes be seen. This occurs in some septelocular pores and less often in quinqueloculars. In every multilocular pore an outermost ring, wide and heavily sclerotized, surrounds the entire structure. However, it is important to realize that the kind of microscope and the amount of magnification directly influence the appearance of these pores, so that the detailed structure of the various rings is not necessarily of taxonomic significance. We believe that most of the trilocular pores of the early instars develop into quinquelocular pores on later instars and that, in the final molt, some of the quinqueloculars may develop into septelocular pores on the adult. Multilocular pores are present on all known ovaticoccins. From comparison of field records on the distribution of the white mealy secretions on a given species with laboratory records and drawings of the distribution of multilocular pores on the same species, it appears that these pores extrude the white mealy secretions so common on the venter of the ovaticoccins.

CRUCIFORM SESSILE PORES are always oval and retain the same size and shape in all instars. Each pore appears to have only one loculus, but critical examination sometimes discloses four parts—two large and two small (fig. 1). The surrounding band is heavily sclerotized—sometimes so heavily that the loculi cannot be found. Pores of this type are present on all known ovaticoccins except *Oregmopyga neglecta*. Their exact function is unknown, but because they are usually lateral we think that they may extrude the filamentous secretions that form the nest-like structure.

Derm granulations occur commonly on the ovaticoccin venter. They are of

taxonomic significance only on the ventral surface of the hind coxa of *Cornoculus cornutus* Ferris.

Characteristic patterns of setae, ducts, and pores. The arrangement patterns of these dermal structures have some features that are constant on most of the species of ovaticoccins.

Lanceolate body setae are arranged segmentally in transverse rows. On the dorsal surface of the abdomen each segment usually has a single row of setae. On the dorsal surfaces of the thorax and head there are two or more rows per segment. On the venter each abdominal segment has a single row of setae, with one medial pair in each row noticeably longer than the others. Moreover, on the venter of abdominal segments 8 through 4, the segmental rows of setae are interrupted in a definite pattern, which gives the effect of either three or five longitudinal lines, each composed of only a few setae per segment. On the ventral thorax the setae occur mostly in clusters—just anterior to the legs, just lateral to the spiracles, and slightly posterior to the mouthparts. On the ventral surface of the head these setae occur in the medial areas and along the extreme body margin.

Enlarged setae are normally dorsal and are usually concentrated along the body margin. They are less numerous than lanceolate body setae, but they show the same segmental patterns. Typically there are eight enlarged setae per segment on the abdomen, but the numbers vary from 4 to 14 in different species. Often these setae are arranged in longitudinal lines from the eighth abdominal segment through the mesothoracic or the prothoracic segment, each line made up of one or more setae per segment. On the head and often on the anterior thorax these setae are randomly distributed and may be quite numerous.

Macrotubular ducts are scattered over the entire dorsum of the typical ovaticoccin, but in several species they may be restricted to the posterior one or two abdominal segments. On the venter they are most numerous along the lateral margins.

Microtubular ducts show the same distribution patterns as the macrotubular ducts. On the dorsum, a microtubular duct often occurs in association with each enlarged seta.

Multilocular sessile pores are quite variable in their distribution patterns on the dorsum, but on the venter the patterns are relatively constant. Ventrally these pores are most numerous on the posterior abdominal segments and progressively less numerous anteriorly. Usually there are a few pores around the spiracles; also there are some on the lateral margins of the thorax and some scattered on the head. The medial regions of the anterior abdominal segments and of the thorax are nearly bare of pores. Each abdominal segment has an anterior and a posterior row of pores with a bare area between, but in each segment a longitudinal submarginal line of pores joins the two rows.

Cruciform sessile pores are relatively common along the ventral body margins, and in several species they may extend across the dorsum also. In many species of *Ovaticoccus* they occur in clusters on the margins of the abdominal segments. In *Ovaticoccus adoxus* and in *Spiroporococcus yuccae* (Ferris) the cluster arrangements are distinctive for the particular species.

Abdomen. The segmentation of the abdomen is a major subject of controversy. We have not been able to study this aspect of morphology in the Coccoidea. Since Ferris (1955) has done the most complete work on the ovaticoccins, it seems logical to follow his interpretation. Thus we have numbered the posteriormost segment 9 and the anteriormost segment 2. In many species the ninth segment seems to be divided into two.

Two anal lobes occur on the posterior margin and may be conspicuous. The ex-

tent of their development seems to be of major taxonomic importance at the generic level. In *Oregmopyga* and *Spiroporococcus* they are definite but variable; in *Cornoculus* they may be present or absent; and in *Ovaticoccus* they are lacking. The setal pattern on the anal lobes is an important character, which varies from species to species in the ovaticoccins. On the other hand, all species in the genus *Eriococcus* normally have three setae on the dorsum and three on the venter of each anal lobe.

The anal ring is located on the ninth abdominal segment. It may be either dorsal or ventral, and often it is apical. Its shape is nearly always characteristic for both a genus and a species. It is always sclerotized. It may be either a complete ring or abortive, i.e., divided once or several times. There are three pairs of lanceolate body setae on the sclerotized area and often there is an additional pair of setae in association. In occasional species, some or all of these setae may be vestigial in the adult. Whether the ring is of "cellular" or "noncellular" appearance is an important character at both the specific level and the generic level and is much more constant than the degree of abortiveness, which Ferris (1955) considered of paramount importance in separating *Ovaticoccus* (at that time called *Gymnococcus*) from the other eriococcid genera. It has since been found that the amount of abortiveness of the anal ring is highly variable. Although the waste which is eliminated through the anal ring is undoubtedly in the form of honeydew, it is rarely found near the bodies of ovaticoccins, even where infestations are heavy. Moreover, this freedom from honeydew and its sooty mold contaminants is apparently not due to ant associations, as it is in many pseudococcids. Possibly it is due to the highly porous condition of the substrates in the ovaticoccin habitat.

The vulva is located medioventrally on the line between segments 9 and 8. It is present only in adult females and is the single constant character used to distinguish the final instar from the nymphs. Structurally it is merely a hole through the derm, surrounded by a multitude of wrinkles. Functionally it is the female genital opening.

Thorax. The thorax is composed of three segments and bears three pairs of legs and two pairs of spiracles. There is a very small and inconspicuous sternal apophysis on the mesothorax (Ferris, 1950). We mention it only to indicate its presence, which is usually ignored.

The leg segments (fig. 2) are coxa, trochanter, femur, tibia, tarsus, and claw. The coxa is usually the broadest part of the leg. Its shape and size are of minor taxonomic significance at the generic level. Most species of *Oregmopyga* have enlarged hind coxae with many small, oddly shaped holes in the derm. The holes, called coxal pores, occur most frequently on the dorsal surface of the coxa, but they are numerous on the ventral surface also in *Cornoculus densus* Miller and in four species of *Oregmopyga*. In *Oregmopyga neglecta, Ovaticoccus salviae* Miller, and *O. senarius* McKenzie, there are many microcruciform pores on the derm around the hind coxae. There is a very small but definite opening through each of these pores. Their exact function is unknown, but they appear to be coxal pores that have become dissociated from the proximal part of the coxa. The trochanter is a small, triangular segment. On each surface it has two small, circular pores, which Ferris (1950) considered sensory in function and called sensoria. In ovaticoccins these are normally near the proximal part of the trochanter, whereas in pseudococcids they are normally near the distal part. Although there are several lanceolate body setae on the trochanter, only the distalmost seta on the dorsal surface bears special mention. It is much longer than any of the other leg setae. The

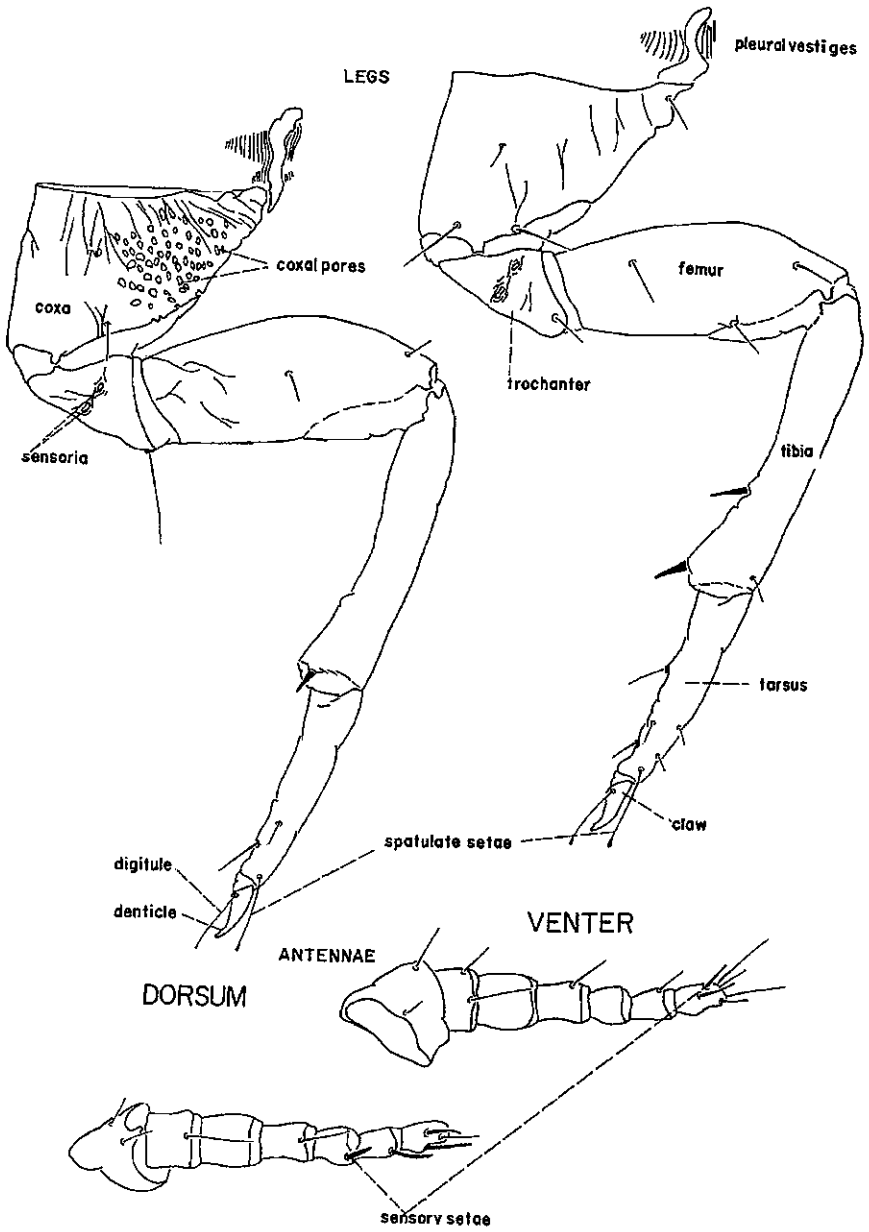

Fig. 2. Hind leg and antenna of *Cornoculus densus* Miller, adult female, showing principal parts and setal patterns. Dorsal aspect at left, ventral at right.

femur and the tibia have no unusual characters. The hind tarsus may show some very small and obscure pores, apparently of the same nature as the coxal pores. The outer distal margin of each tarsus has a pair of spatulate setae that extend to the tip of the claw or beyond. The claws have a characteristic shape

for each species—slender in some species, robust in others. The inner margin of each claw has a pair of spatulate setae, called digitules, and a tooth, called the denticle. Apparently the digitules function in grasping the substrate, in conjunction with the spatulate setae of the tarsi. The denticle is conspicuous in most species. It is never absent, though in some species it is difficult to see. The size of the legs varies considerably—large in a few species but extremely small in several other species. The setal patterns of the leg segments are relatively constant.

There are two pairs of spiracles, located slightly laterad to the first two pairs of legs. In most species the spiracles are small and inconspicuous. They offer few characters of taxonomic significance except in the three species of *Spiroporococcus,* where they are exceptionally large and have many quinquelocular pores in the atria.

Head. It is difficult to demarcate the head from the thorax, because there is rarely a segmental line to separate them. The head contains the mouthparts, the antennae, and the eyes.

The mouthparts are not of taxonomic importance, because their size and shape are often variable within a species. The clypeus is the proximal half and the labium is distal to it. The labium usually appears two-segmented, but rudiments of an additional segment can often be seen proximally. Usually the stylets can be seen protruding from the labium, but during ecdysis they are curled in two rolls within the head.

The antennae are either 6-segmented or 7-segmented. The number of segments is of some importance in separating species. The patterns of the lanceolate body setae on the antennae (fig. 2) seem to be similar in all four genera. Sensory setae are normally present on the distal three segments. Their numbers, shapes, and relative sizes are of minor taxonomic importance.

The eyes, located more or less posteriorly on the head, appear to be reduced compound eyes. In his discussion on pseudococcids, Ferris (1950) said: "The compound eyes are reduced to the equivalent of a single facet, which is borne upon a sclerotized base." In ovaticoccins, the eyes are of taxonomic importance only in *Cornoculus cornutus,* which has eyes so large and protruding that they look like horns. They are nearly the size of the first antennal segment.

Nymphal female

Nymphal females normally differ from adult females as follows: They have fewer lanceolate body setae, and those on the venter are only occasionally in clusters. Enlarged setae may be of different sizes on one individual, and they are more numerous on nymphal females than on adult females, except in *Ovaticoccus agavium.* Moreover, enlarged setae are present on nymphal females in very nearly all species, even though they are lacking on the adult females. Nymphal females usually have no macrotubular ducts. They have fewer multilocular sessile pores, and these have fewer loculi than the adult females. Nymphs usually have fewer cruciform pores. The hind coxae are not enlarged and have at most only a few coxal pores. The antenna has fewer segments, and the third segment is usually the largest. There is no vulva.

Adult male

There is only one conclusive record of an adult male ovaticoccin—that of *Ovaticoccus agavium.* Boratynski (1958) gave the following description: "They are dark red, robust insects, about 1115μ long from tip of head to end of genital organs, about 375μ wide at level of mesothorax, and the wing span 1770μ. External genital organs at end of abdomen broadly conical, about 150μ long. Head with two pairs of simple eyes and 10-segmented antennae, the apical segments of which are globular. . . ." We

have found evidence of males in our collecting but have been unable to recover an adult specimen in good condition.

Nymphal male

Nymphal males are not common, and their specific identification is not entirely certain in every case. They differ from nymphal females in the following characters: a larger number of lanceolate body setae on the dorsum; no enlarged setae; many macrotubular ducts, arranged in longitudinal lines; and more antennal segments.

FAMILY ERIOCOCCIDAE Fernald

The status of this family has always been a matter of some controversy. Works by Ferris (1957) and by Hoy (1962; 1963) have clarified it considerably; but unless some lost types are located, illustrated, and redescribed, the taxonomic boundaries of the family cannot be defined completely.

The family includes approximately 57 genera and 481 species (Hoy, 1963). It is worldwide in distribution, with the possible exception of some parts of Africa. The type genus, *Eriococcus,* is the most widespread of the genera, as it occurs on all of the continents and on many islands.

The following redefinition of the family, based on the 13 genera now known in North America, is presented for further clarification. Since it is not possible to define this family on the basis of a few outstanding characters, it is important to consider as a group all of the characters listed.

Definition of the Family Eriococcidae: Adult Females

Positive characters. Tubular ducts of at least one type. Macrotubular duct with lightly sclerotized, cup-shaped vestibule. Microtubular duct smaller, with its vestibule lightly sclerotized and only slightly expanded. Multilocular sessile pores with three to nine loculi. Cruciform pores frequently present. Anal ring normally with three pairs of lanceolate body setae on the sclerotized area. Legs present in most genera. Two pairs of spiracles. Antennae normally 6- or 7-segmented, rarely 1- to 5-segmented. Anal lobes present or represented by anal-lobe setae. Enlarged setae usually present.

A new and important character is the arrangement of the lanceolate body setae—both on the legs, when legs are normal, and on the antennae (fig. 2). The patterns seem to be relatively constant for the North American genera of Eriococcidae and are remarkably different from the patterns found in the Pseudococcidae.

Negative characters. Ostioles, cerarii, and circuli all lacking. Trilocular sessile pores, if present, distinct from pseudococcid type. Abdomen never flattened into a posterior pygidium.

KEY TO NORTH AMERICAN GENERA OF ERIOCOCCIDAE

ADULT FEMALES

1. Legs absent or, rarely, as small vestiges 2
   Legs present 4
2(1). Anal lobes large, heavily sclerotized; anal ring noncellular
   Xerococcus Ferris
   Anal lobes absent; anal ring cellular 3
3(2). Macrotubular ducts present ..... *Cryptococcus* Douglas
   Macrotubular ducts absent ..... *Apezococcus* Ferris
4(1). Macrotubular ducts in large clusters on ventral margins of abdomen
   Cornoculus Ferris (p. 484)
   Not as above 5
5(4). Anal lobes present 6
   Anal lobes absent 10
6(5). Quinquelocular pores present in spiracular atrium
   Spiroporococcus Miller (p. 428)
   Quinquelocular pores absent from spiracular atrium 7
7(6). Anal ring deeply invaginated between anal lobes; body rotund; derm heavily sclerotized; macrotubular ducts concentrated in single band along ventral body margin ..... *Kermes* Boitard
   Not as above 8
8(7). Dorsal quinquelocular pores present 9
   Dorsal quinquelocular pores absent
   Eriococcus Targioni-Tozzetti (p. 481)
9(8). Anal lobes sclerotized, apically pointed, strongly produced
   Atriplicia Cockerell and Rohwer
   Anal lobes unsclerotized, rounded, weakly produced
   Oregmopyga Hoy (p. 489)
10(5). Figure-eight-shaped pores numerous on dorsum; all species found in galls on *Quercus* ..... *Olliffiella* Cockerell
   Figure-eight-shaped pores absent; insects never forming galls, unknown on *Quercus* 11
11(10). Derm granulations conspicuous over much of body; macrotubular ducts absent; sessile pores with seven or more loculi
   Hypericicoccus Williams
   Derm granulations absent or restricted to medioventral areas; macrotubular ducts present except on one species; sessile pores rarely with seven loculi, never with more 12
12(11). Quinquelocular pores arranged in clusters; microtubular ducts absent; anal ring a transverse slit ..... *Dactylopius* Costa
   Quinquelocular pores arranged singly; microtubular ducts present except on one species; anal ring circular ..... *Ovaticoccus* Kloet (p. 507)

KEY TO NORTH AMERICAN SPECIES OF *ERIOCOCCUS*

ADULT FEMALES

Eriococcus nudulus fits into Ferris's key (1955) as follows:

16(15). Dorsal setae of anal lobes long, slender, and filiform ..... A
   Dorsal setae of anal lobes short, not filiform 17
A(16). All anal-lobe setae lanceolate ..... *paucispinus* Ferris
   Two of dorsal anal-lobe setae lanceolate, one robust ..... *nudulus* (Ferris)

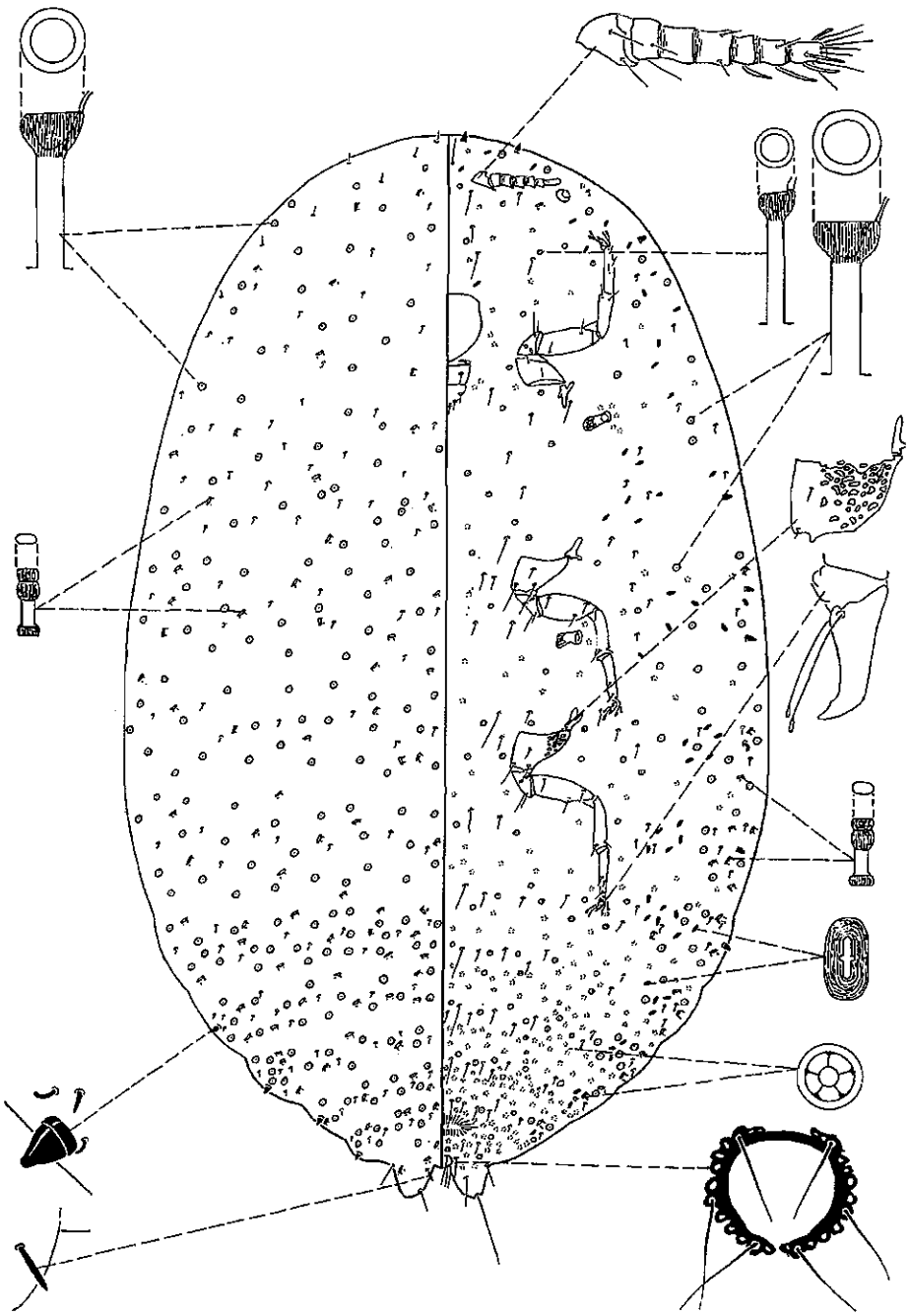

Fig. 3. *Eriococcus nudulus* (Ferris), adult female. Found in northern Texas on *Boutelova* sp. (Gramineae).

Eriococcus nudulus (Ferris)

Bare eriococcin

(Figure 3)

Onceropyga nudula Ferris, 1955.

Oregmopyga nudula (Ferris) Hoy, 1963.

Type material. Ferris did not designate a holotype specimen in his description of this species, so I here designate as lectotype the specimen which Ferris marked "type" (1 female on 1 slide). Also I designate the remaining two females from Ferris's original type series as lectoparatypes.

Field features. Host a grass, *Bouteloua* sp.; infestation probably in crown of plant.

Recognition characters: Adult females, mounted, 2.00 to 2.40 mm long, 0.60 to 1.20 mm wide. Body oval; anal lobes prominent, protruding, lightly sclerotized.

Dorsum with lanceolate body setae extremely short, robust, often slightly curved; two pairs of dorsal anal-lobe setae typically elongate, the anterior medial pair robust. Enlarged setae present along body margins, seen on either dorsal or ventral aspect; tapering to blunt apexes; variable in number. Macrotubular ducts numerous, present over entire surface. Microtubular ducts present over entire surface, nearly lacking in head region. Sessile pores absent.

Anal ring apical, seen on either dorsal or ventral aspect; circular, incomplete, cellular; with three pairs of very elongate setae and a single additional pair in association.

Venter with lanceolate body setae of two sizes—short and robust on lateral and sublateral areas, longer and more typically lanceolate on medial areas—in five longitudinal lines on abdominal segments 8 through 3; posterior anal-lobe setae elongate. Enlarged setae marginal, sometimes seen on ventral aspect. Macrotubular ducts of two sizes: those in lateral areas of same size as those on dorsum, those in medial areas smaller. Microtubular ducts still smaller, with sclerotized orifices; present along body margins, few on anterior thorax and head. Multilocular pores of two kinds: septeloculars very rare, often absent; quinqueloculars present over entire surface, most numerous on posterior abdomen, in very slight concentrations around spiracles. Cruciform pores numerous along body margin and submargin, most numerous on anterior abdomen.

Legs of medium size; hind coxae not enlarged, with many pores on both dorsal and ventral surfaces; very inconspicuous denticle on each claw. Mouthparts normal. Eyes normal. Antenna 7-segmented; three sensory setae on segment 7; only one on segment 6—long and very slender, slightly longer than the one on segment 5.

Recognition characters: Nymph (first instar, inside body of female lectoparatype). Lanceolate body setae short and robust on both dorsum and venter. Single marginal band of enlarged setae seen. Anal lobes and anal-lobe setae as in adult female. Anal ring as in adult female but relatively large. Claws without denticles. Antennae 6-segmented.

Notes. I am transferring this species from *Oregmopyga* to *Eriococcus*. It is most closely related to *Eriococcus calvus* Ferris, *E. larreae* Parrott and Cockerell, and *E. paucispinus* Ferris. I believe that it belongs in this genus because the adult female has the following characters, which occur in most species of *Eriococcus* but usually are not found in ovaticoccins: Anal lobes very prominent, lightly sclerotized, protruding; with three dorsal and three ventral setae on each lobe, one dorsal pair robust. Enlarged setae of abdomen restricted to body margins. Dorsal sessile pores absent. Lanceolate body setae of dorsum and of ventral submargin short, robust, often slightly curved. Hind coxae not enlarged.

Specimens examined. TEXAS, HARDEMAN COUNTY: Between Vernon and Quanah, 1921, on *Bouteloua* sp. (Gramineae), G. F. Ferris (1 adult female lectotype on 1 slide; 2 adult female lectoparatyes on 2 slides) UCD.

Genus *Cornoculus* Ferris

Cornoculus Ferris, 1955.

History. In the original description of this genus Ferris designated the type of the genus as *Cornoculus oculatus* and stated that it was the only species included. He then described this species under the name of *C. cornutus*. It is apparent that he changed his mind about the name of this species after writing the generic description and that the name *oculatus* should be considered a lapsus. Evidence of his intent to use the name *cornutus* rather than *oculatus* is the fact that in a later paper Ferris (1957) listed *C. cornutus* as the "generic type." Therefore I agree with Hoy (1963) that the type of the genus should be considered to be *C. cornutus*.

Type of genus. *Cornoculus cornutus* Ferris, 1955.

Field features. Adult females elongate. Both species red.

Found in grass-blade sheaths.

Generic diagnosis: Adult females with large clusters of macrotubular ducts on ventrolateral areas of abdomen. Distal inner margin of each tibia with two robust setae. Anal ring large, heavily sclerotized.

Anal lobes, if present, small. Enlarged setae always present on venter, sometimes also on dorsum; each seta with a very broad base and a low-dome shape, with or without a small apical projection. Macrotubular ducts all of one size, present on dorsum and venter. Microtubular ducts small, with sclerotized orifices, present in numbers over dorsum, absent from venter or restricted to its margin. Multilocular pores with five or seven loculi; present on both surfaces. Cruciform pores present dorsally on anterior abdomen and posterior thorax, ventrally along body margin.

Anal ring cellular or noncellular; with or without setae. Legs large or of moderate size; hind coxae not enlarged, with a few dorsal pores—one species with many ventral pores; small denticle on each claw. Spiracle without pores in atrium. Antennae 7-segmented; sensory setae of last three segments relatively slender. Eyes enlarged, especially in one species.

Notes. This genus is very distinct—characterized in adult females by ventrolateral clusters of macrotubular ducts, robust setae on distal margins of tibiae, large and heavily sclerotized anal ring, and low-dome-shaped enlarged setae.

There are only two species in the genus, including the new species described here.

KEY TO NORTH AMERICAN SPECIES OF *CORNOCULUS*

ADULT FEMALES

1. Eyes larger than first antennal segment, horn-shaped; anal ring cellular; enlarged setae with apical projections..... *cornutus* Ferris
   Eyes smaller than first antennal segment, not horn-shaped; anal ring noncellular; enlarged setae without apical projections..... *densus* Miller

Cornoculus cornutus Ferris

Big-eyed ovaticoccin

(Figure 4)

Cornoculus cornutus Ferris, 1955. (Ferris, 1957; Hoy, 1962, 1963.)

Cornoculus oculatus Ferris, 1955 (lapsus for *C. cornutus*). (Morrison and Morrison, 1966.)

Type material. Ferris did not designate a holotype in his original description, so I here designate as lectotype the adult female which Ferris marked "type" (1 specimen on 1 slide). Also I here designate 5 adult female lectoparatypes and 10 nymphal female lectoparatypes.

Field features. Ferris (1955) reported: "Occurring beneath the enveloping leaf sheaths of its host, surrounded by a small amount of amorphous wax."

Host an undetermined grass.

Recognition characters: Adult females, mounted, 1.60 to 1.90 mm long, approximately 0.40 mm wide. Body exceptionally elongate; small anal lobes evident.

DORSUM with lanceolate body setae smaller than those on venter. Enlarged setae absent. Macrotubular ducts present in small numbers on abdominal segments 9 and 8. Microtubular ducts small, with sclerotized orifices; present over surface. Multilocular pores of two kinds: septeloculars and quinqueloculars in approximately equal numbers; present on abdomen and posterior thorax. Cruciform pores in small numbers from abdominal segment 7 through posterior part of thorax.

Anal ring ventral; bow-shaped with a connecting band, complete, cellular; heavily sclerotized, with three pairs of setae plus an additional pair present but not in close association.

VENTER with lanceolate body setae in five longitudinal lines on abdominal segments 8 through 3; posterior anal-lobe setae elongate. Enlarged setae with broad base and small apical projection; usually present on one or more of the last three abdominal segments. Macrotubular ducts numerous; arranged in large square clusters on submargins of abdominal segments 8 through 2 and of metathorax; few in medial areas of abdominal segments 8 and 7, few on lateral margins of mesothorax and of prothorax; absent from head. Microtubular ducts absent. Multilocular pores of two kinds: septeloculars and quinqueloculars in equal numbers; most common over abdominal segments 9 through 7, restricted to lateral margins on the rest of venter, in large concentrations around spiracles. Cruciform pores few on abdomen, most common on lateral margins of anterior thorax and of head.

Legs large; hind coxae not enlarged, with a few dorsal pores and with many conspicuous derm granulations on ventral surfaces; robust setae on distal margins of tibiae; small denticle on each claw. Mouthparts apically blunt. Eyes abnormally large, horn-shaped. Antenna 7-segmented, robust; first (basal) segment enlarged; seventh segment with two sensory setae, both very slender; segment 6 with only one, of same length and width as the one on segment 5.

Recognition characters: Nymphal female (late instar) of same shape and size as adult female.

DORSUM with few lanceolate body setae. Enlarged setae present from eighth abdominal segment through head; largest on eighth segment and progressively smaller anteriorly; arranged in three pairs of longitudinal lines—medial, mediolateral, and lateral—from abdominal segment 8 through prothorax, in no particular pattern on head. Macrotubular ducts absent. Microtubular ducts scattered over entire surface. Multilocular pores absent. Cruciform pores present from abdominal segment 7 through prothorax; more numerous than on adult female.

Anal ring as in adult female.

VENTER with lanceolate body setae not clustered; posterior anal-lobe setae

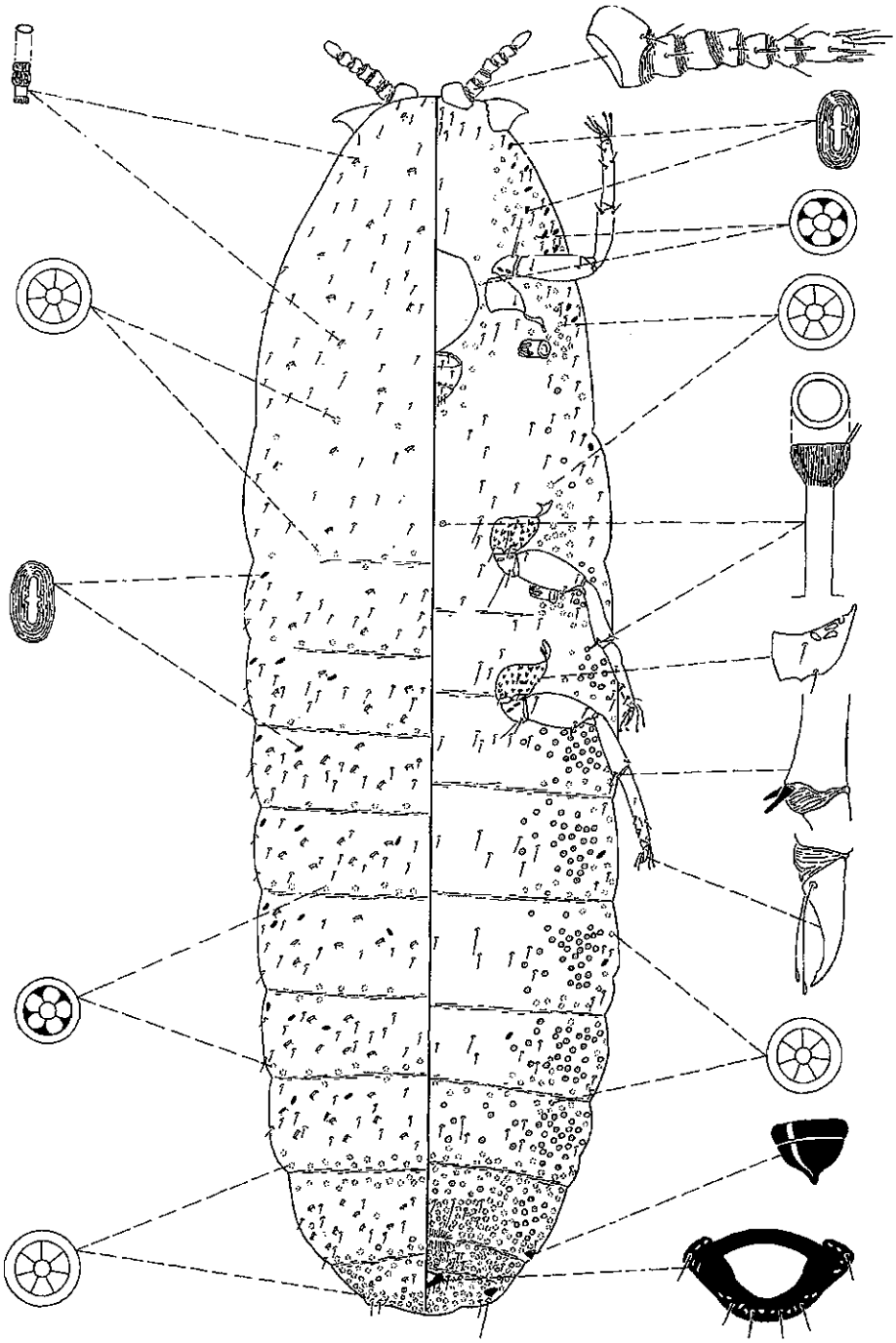

Fig. 4. *Cornoculus cornutus* Ferris, adult female. Found in southern Texas on undetermined grass (Gramineae).

elongate. Enlarged setae in two pairs of longitudinal lines, along margins and submargins of abdominal segments only; relatively large on posterior segments and progressively smaller anteriorly. Tubular ducts absent. Multilocular pores of two kinds: septeloculars and quinqueloculars in equal numbers; present from seventh abdominal segment through head, increasing in numbers anteriorly. Cruciform pores absent.

Legs as in adult female but lacking coxal pores and robust tibial setae. Mouthparts apically blunt. Eyes not abnormally large. Antenna 6-segmented; basal segment not enlarged.

Notes. This species is quite distinct. The adult female differs from that of *Cornoculus densus* by the presence of the following characters: greatly enlarged eyes, enlarged first antennal segment, bare areas on medial part of venter, large numbers of septelocular pores, and ventral enlarged setae on one or more of the last three abdominal segments. It resembles that of *C. densus* in the following characters: presence of enlarged setae on venter, distribution of cruciform pores, large clusters of macrotubular ducts on ventral body margins, robust tibial setae, large and heavily sclerotized anal ring, and hosts of the same plant family.

Specimens examined. TEXAS, BREWSTER COUNTY: Chisos Mountains, 1921, on undetermined grass (Gramineae), G. F. Ferris (1 adult female lectotype on 1 slide; 1 adult female lectoparatype on 1 slide; 4 adult female lectoparatypes and 4 nymphal female lectoparatypes on 4 slides; 6 nymphal female lectoparatypes on 2 slides) UCD.

Cornoculus densus Miller, new species

Dense-character ovaticoccin

(Figure 5)

Type material. Adult female holotype (1 specimen on 1 slide), 3 adult female paratypes.

Field features. Found on the grass *Hilaria rigida*, probably in grass-blade sheaths.

Recognition characters: Adult female holotype, mounted, 4.10 mm long, 2.00 mm wide. (Range 3.20 to 4.10 mm long, 1.70 to 2.00 mm wide.) Body elongate; no trace of anal lobes.

DORSUM with lanceolate body setae numerous, elongate but still noticeably smaller than those on venter. Enlarged setae of low-rounded-dome shape, with large and heavily sclerotized setal bases; rare on abdomen and distributed at infrequent intervals along margins of thorax and of head. Macrotubular ducts numerous; present over entire dorsum, especially numerous in areas devoid of quinquelocular pores. Microtubular ducts numerous; unusually small, with short tubes and heavily sclerotized orifices; present primarily in areas with setae. Multilocular pores of one kind: quinqueloculars, some with the intermediate ring; numerous; present over entire dorsum except on ninth and eighth abdominal segments, where they occur only on anterior margins. Cruciform pores uncommon; present erratically from seventh abdominal segment through mesothorax.

Anal ring ventral; U-shaped, incomplete, noncellular; heavily sclerotized, with no setae either on ring or associated with it.

VENTER with lanceolate body setae unusually long, numerous, not arranged in clusters; posterior anal-lobe setae only slightly longer than other ventral body setae. Enlarged setae present on margins of thorax and of head, most numerous in eye region. Macrotubular ducts present over venter; most numerous along margin of abdomen. Microtubular ducts as on dorsum. Multilocular pores of one kind: quinqueloculars, as on dorsum; extremely numerous, but infrequent on area anterior to legs and on head; no noticeable concentration around spiracles. Cruciform pores un-

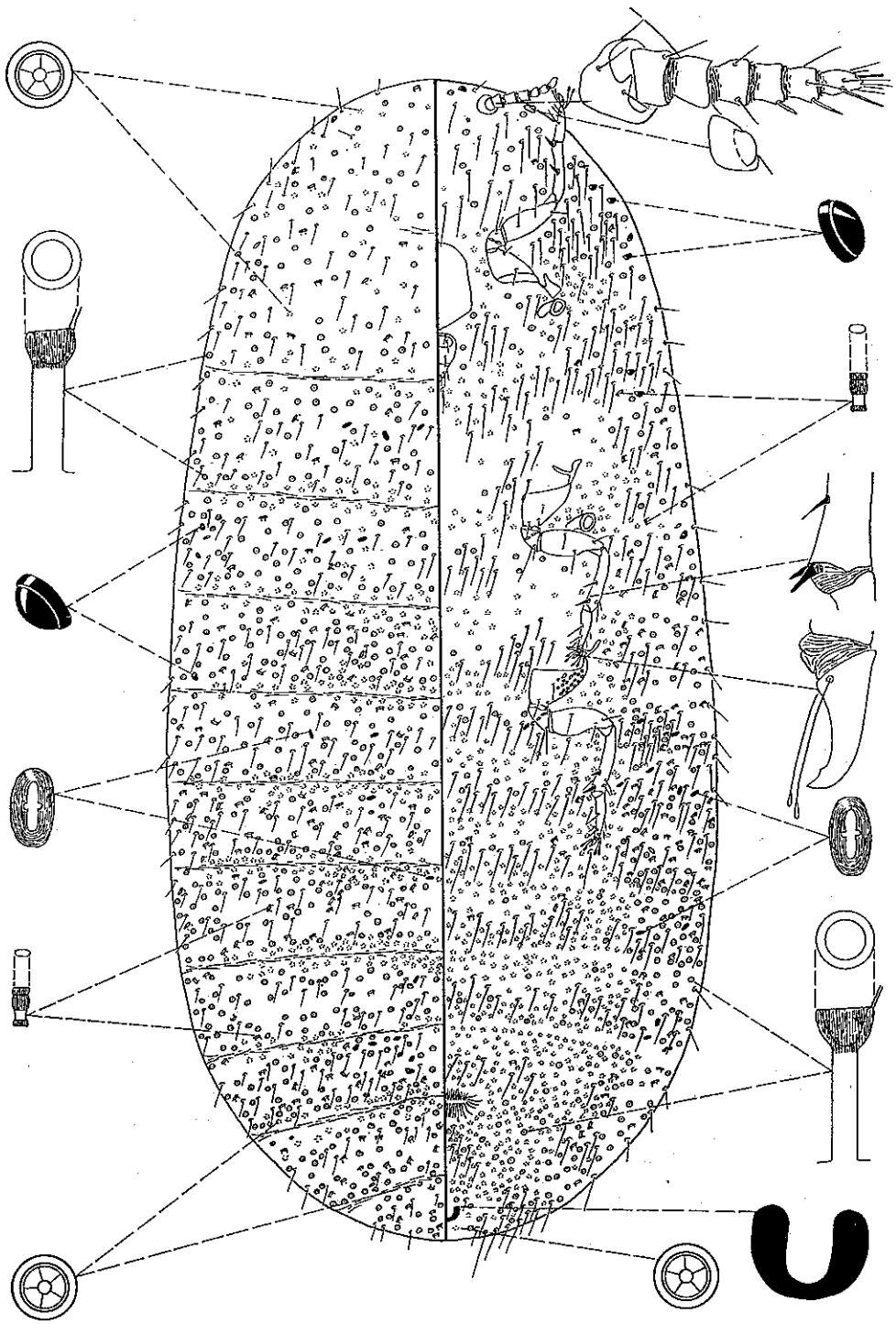

Fig. 5. *Cornoculus densus* Miller, new species, adult female. Found in southern California on *Hilaria rigida* (Gramineae).

common; restricted to margins of abdominal segments 7 through 4.

Legs large; hind coxae not enlarged, with few dorsal and many ventral pores; robust setae on distomedial margins of tibiae; small denticle on each claw. Mouthparts apically acute. Eyes only slightly protruding, with large sclerotized base. Antenna 7-segmented; seventh segment with one or two sensory setae; sixth segment with only one—slightly longer than the one on segment 5.

Recognition characters: Nymphal female (second or third instar), mounted, 1.85 mm long, 0.70 mm wide. Body elongate; no sign of anal lobes.

DORSUM with lanceolate body setae restricted to medial areas from sixth abdominal segment through head; noticeably smaller than those on venter. Enlarged setae numerous; similar to those on adult female; present across abdominal segments 9 through 7. Macrotubular ducts absent. Microtubular ducts with enlarged and heavily sclerotized orifices; present only in areas with enlarged setae. Multilocular pores of three kinds: quinqueloculars, quadriloculars, and triloculars; scattered from third abdominal segment through head. Cruciform pores in transverse bands across abdominal segments 9 through 4.

Anal ring as in adult female, but with traces of a single pair of setae.

VENTER with lanceolate body setae long, present on all segments but restricted to medial regions, not arranged in clusters; posterior anal-lobe setae of specimen mutilated. Enlarged setae present laterally and sublaterally from prothorax through head. Macrotubular ducts absent. Microtubular ducts present in marginal and submarginal areas only; concentrated around spiracles. Multilocular pores of one kind: quinqueloculars, scattered; absent only from strictly lateral areas. Cruciform pores in clusters of four, restricted to lateral margins of abdomen.

Leg shape as in adult female; hind coxae with only a few ventral pores, none dorsal; tibial setae not robust; claws slender. Mouthparts normal. Eyes as in adult female. Antenna 6-segmented; third segment longest; all antennal setae of specimen mutilated.

Variations. The only variation noted is in the distribution of the enlarged setae. These are always present, at least around the eyes, but on some specimens no more than four can be found on the entire insect.

Notes. The adult females of this species are distinct. They can easily be separated from those of *Cornoculus cornutus* by the numerous pores and body setae, the exceptional length of the lanceolate body setae, the distinctive shapes of the enlarged setae and of the microtubular ducts, the lack of setae on anal ring, and the less conspicuous eyes.

Specimens examined. CALIFORNIA, IMPERIAL COUNTY: Seeley, March 25, 1965, on *Hilaria rigida* (Gramineae), R. A. Flock and L. Pineda (1 nymphal female on 1 slide; 1 adult female on 1 slide) UCD. SAN BERNARDINO COUNTY: 6.9 miles north of Lucerne Valley, October 19, 1961, on *H. rigida*, T. C. Fuller (1 adult female holotype on 1 slide; 3 adult female paratypes on 3 slides) CDA, UCD.

Genus *Oregmopyga* Hoy

Onceropyga Ferris, 1955. (Preocc. by *Onceropyga* Turner, 1906.)

Oregmopyga Hoy, 1963 (nom. nov. for *Onceropyga*). Type, by designation, *Eriococcus neglectus* Cockerell.

History. Ferris (1955) described the genus *Onceropyga* to include three species and designated *Eriococcus neglectus* Cockerell as the type. Hoy (1963) discovered that the generic name was preoccupied by *Onceropyga* Turner (1906) (Lepidoptera: Zygaenidae) and

proposed the new name *Oregmopyga*.

Type of genus. *Eriococcus neglectus* Cockerell, 1895*b*.

Significant publications. Ferris (1955) has given the only detailed discussion of the genus and its contained species. Hoy (1963) summarized the known publications.

Field features. Adult females oval; dorsal ridge usually absent. Body red or purple; legs and antennae cream-colored. Body covered with white mealy powder, most abundant on venter. Filamentous ovisac secretion present in large quantities, often covering entire dorsum; no nestlike structure produced ventrally. Eggs known in at least one species.

Females usually exposed, either on lower aerial branches or on crowns and roots; rarely found under bark.

Generic diagnosis: Adult females. Anal lobes present. Anal ring normally cellular and with three pairs of conspicuous setae. Tubular ducts and sessile pores numerous.

Enlarged setae normally present; recessed in some species; apexes differently shaped in each species. Macrotubular ducts often of two sizes; always present over entire dorsum, usually also along ventral body margin. Microtubular ducts of approximately same distribution as macrotubular ducts; often with sclerotized orifices. Multilocular pores with three, five, or seven loculi. Cruciform pores most common on venter in thoracic and head regions.

Legs of different sizes; hind coxae sometimes enlarged and with at least a few coxal pores present; denticle on each claw. Spiracle without pores in atrium. Antenna 6- or 7-segmented; sensory setae on last three segments often slender and elongate, almost indistinguishable from lanceolate body setae.

Notes. This genus is closely related to *Eriococcus*. The adult females are distinguished by the following characters: dorsal sessile pores; rounded, unsclerotized anal lobes; dorsal anal-lobe setae all slender, usually more than three on each lobe. Females of *Eriococcus,* on the other hand, have no dorsal sessile pores; they have protruding, sclerotized anal lobes and only three pairs of dorsal anal-lobe setae, usually with at least one pair robust. (See Notes on the genus *Ovaticoccus*.)

There are now six North American species in this genus. I have added three new species plus one species previously in *Ovaticoccus* and have extracted one species, which seems to belong in the genus *Eriococcus*.

KEY TO NORTH AMERICAN SPECIES OF *OREGMOPYGA*

ADULT FEMALES

1. Anal ring noncellular 2
   Anal ring cellular 3
2(1). Microtubular ducts absent from venter; anal ring dorsal, with three pairs of minute setae—usually only one pair of setae and their bases visible ..... *neglecta* (Cockerell)
   Microtubular ducts presents on venter; anal ring apical, with three pairs of long setae—their setal bases conspicuous..... *sanguinea* Miller
3(1). Hind coxae somewhat enlarged, with many pores on both surfaces 4
   Hind coxae with pores restricted to one surface 5
4(3). Antennae 6-segmented; enlarged setae and anal ring as in figure 6; found on *Eriogonum* ..... *eriogoni* Miller
   Antennae 7-segmented; enlarged setae recessed; anal ring as in figure 7; found on *Hymenoclea* ..... *johnsoni* Miller

5(3). Enlarged setae tapering to thick, blunt apexes, absent from medial regions of abdominal segments 9 through 5; cruciform pores confined to lateral margins of venter ..... *peninsularis* (Ferris)

Enlarged setae abruptly narrowed to slender apexes, absent from medial regions of abdominal segments 9 and 8; cruciform pores present on venter in medial regions of anterior abdomen, thorax, and head ..... *parvispina* (Chaffin)

Oregmopyga eriogoni Miller, new species

Eriogonum ovaticoccin

(Figure 6)

Type material. Adult female holotype (1 specimen on 1 slide), 6 adult female paratypes, and 2 nymphal paratypes.

Field features. Adult female small; elongate-oval, with dorsomedial ridge; pink. Eggs dark pink. Legs white. White mealy secretion covering venter lightly, not visible on dorsum. Ovisac secretion produced dorsally and ventrally, almost entirely covering body.

Found only on *Eriogonum* spp.; females on crowns and roots only, under bark.

Recognition characters: Adult female holotype, mounted, 1.90 mm long, 0.95 mm wide. (Range 1.20 to 2.20 mm long, 0.50 to 1.20 mm wide.) Body oval; small anal lobes evident.

DORSUM with lanceolate body setae smaller than those on venter. Enlarged setae numerous: from 5 to 7 pairs on each abdominal segment, from 5 to 11 pairs on each thoracic segment, and usually 10 pairs on head; of low, obtuse shape, partially recessed in derm. Macrotubular ducts of one size; present over entire dorsum; most numerous on abdomen, infrequent on head. Microtubular ducts present over dorsum; often associated with enlarged setae. Multilocular pores of two kinds: septeloculars rare; quinqueloculars in small numbers on posterior abdominal segments, rare on anterior thorax. Cruciform pores absent.

Anal ring apical, seen on either dorsal or ventral aspect; nearly circular, complete, cellular; with three pairs of elongate setae and an additional pair present but not closely associated.

VENTER with lanceolate body setae on abdominal segments 8 through 3 arranged in clusters, forming three longitudinal lines; posterior anal-lobe setae elongate. Macrotubular ducts of two sizes: the smaller on posterior abdomen, the larger present over entire venter but less frequent on thorax and head. Microtubular ducts restricted to body margins. Multilocular pores of three kinds: septeloculars scattered over entire venter; quinqueloculars present over venter, most numerous on posterior abdominal segments, in small concentrations around spiracles; triloculars uncommon, found on thorax. Cruciform pores along body margins, from anterior abdominal segments over thorax and posterior part of head; most numerous on anterior thorax and head.

Legs short, robust; hind coxae enlarged, with many pores on both dorsal and ventral surfaces; claws noticeably slender, with small denticle on each. Mouthparts and eyes normal. Antenna 6-segmented; sixth segment with four sensory setae; fifth segment with only one—noticeably longer and more slender than the one on segment 4.

Recognition characters: Nymph (second or third instar) differs from adult female as follows: On dorsum, fewer setae of both types; no macrotubular ducts; no sessile pores. On venter, lanceolate body setae arranged in six longitudinal lines—i.e., with three pairs of setae on each abdominal segment from 8 through 3; septelocular pores absent, four longitudinal lines of ventral quinqueloculars, triloculars more numerous than on adult female; ventral cruciform

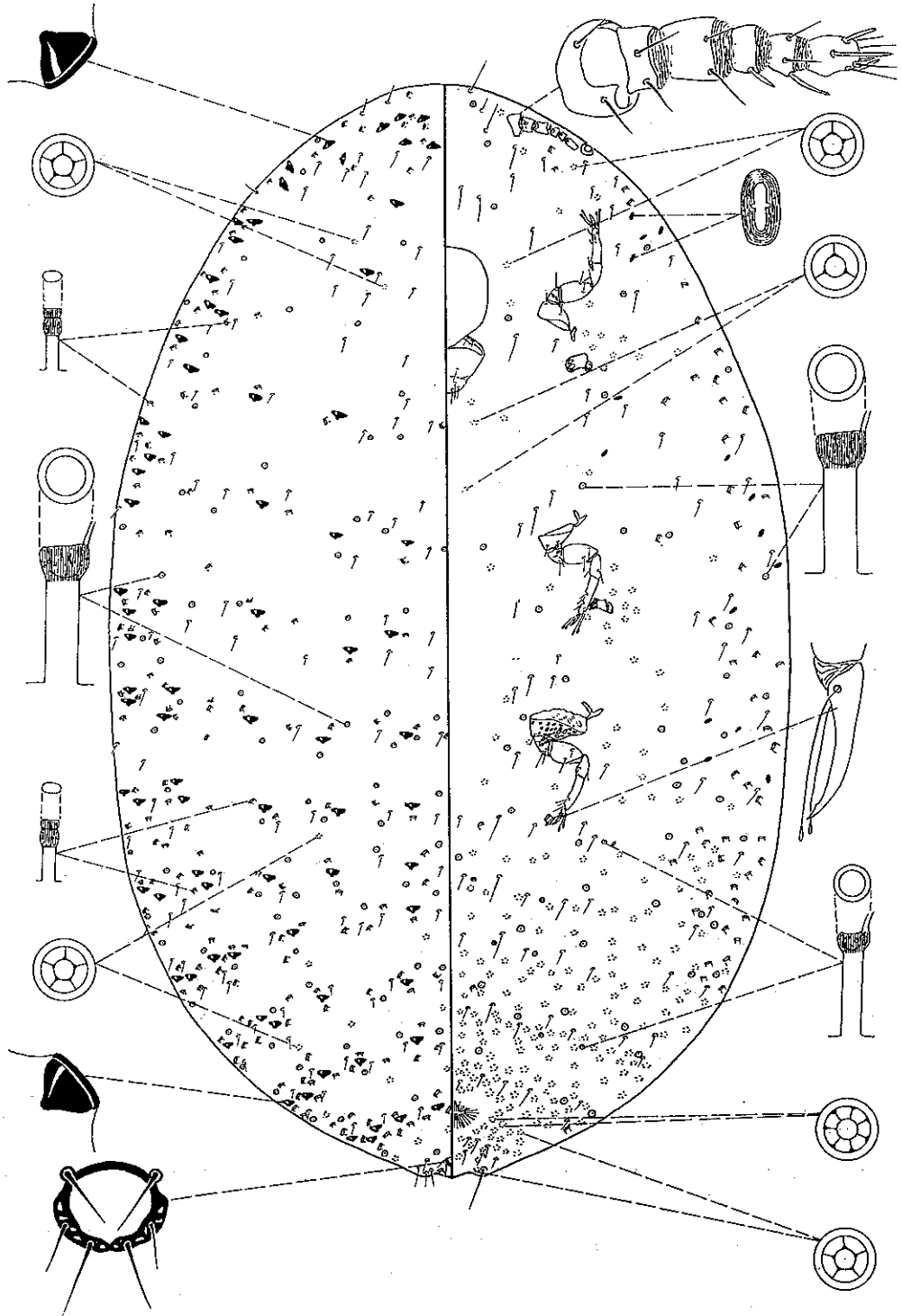

Fig. 6. *Oregmopyga eriogoni* Miller, new species, adult female. Found in southern California on *Eriogonum* spp. (Polygonaceae).

pores less frequent than on adult female; hind coxae not enlarged and with only a few ventral pores.

Variations. The only significant variations noted are in the total numbers of dorsal quinquelocular pores (from 5 to 30) and of ventral cruciform pores. However, the distribution patterns seem to be constant for each type of pore.

Notes. This species is closely related to *Oregmopyga johnsoni*. The adult females differ in having not more than 30 dorsal quinquelocular pores and only six antennal segments, whereas females of *O. johnsoni* have more than 30 dorsal quinquelocular pores and have seven antennal segments. *O. eriogoni* has been found only on *Eriogonum* sp. (Polygonaceae), *O. johnsoni* only on Compositae.

Specimens examined. CALIFORNIA, LOS ANGELES COUNTY: 3 miles north of Castaic, June 19, 1964, on *Eriogonum* sp. (Polygonaceae), D. R. Miller (1 adult female paratype on 1 slide; 2 nymphal paratypes on 2 slides) UCD. SAN BERNARDINO COUNTY: 3 miles north of Cajon Pass, April 17, 1965, on *Eriogonum* sp., D. R. Miller and J. F. Miller (1 adult female holotype on 1 slide; 5 adult female paratypes on 5 slides) BM, CDA, UCD, USNM. SAN DIEGO COUNTY: 5 miles southeast of Fallbrook, May 9, 1964, on *Eriogonum* sp., D. R. Miller (1 adult female on 1 slide; 4 nymphs on 1 slide) UCD.

Oregmopyga johnsoni Miller, new species

Johnson's ovaticoccin

(Figure 7)

Type material. Adult female holotype (1 specimen on 1 slide) and 9 adult female paratypes.

Field features. Adult female oval, rotund; with no sign of dorsal ridge. Body grayish purple, legs white. Small amounts of white mealy secretion on both surfaces. Large amounts of filamentous ovisac secretion produced along ventral body margins and completely covering dorsum.

Found on crowns of host plants, not under bark.

A male sac was found on *Hymenoclea salsola* (Compositae) in the 1963 collection in San Bernardino County.

Recognition characters: Adult female holotype, mounted, 2.00 mm long, 1.20 mm wide. (Range 1.50 to 2.20 mm long, 0.70 to 1.20 mm wide.) Body oval; anal lobes definite.

DORSUM with lanceolate body setae much smaller than those on venter. Enlarged setae numerous: from 4 to 7 pairs on each abdominal segment except the ninth, from 9 to 11 pairs on each thoracic segment, and usually 9 pairs on head; with short, thick, apical projections; deeply recessed into derm. Macrotubular ducts of one size; present over entire dorsum. Microtubular ducts numerous, present over dorsum. Multilocular pores of two kinds: quinqueloculars distributed over entire dorsum; triloculars uncommon. Cruciform pores absent.

Anal ring apical, may appear either dorsal or ventral; circular but incomplete, cellular; with three pairs of large setae and an additional pair present but not closely associated.

VENTER with lanceolate body setae long, arranged in clusters forming three longitudinal lines on abdominal segments 8 through 3; posterior anal-lobe setae long. Macrotubular ducts of two sizes: the smaller present on abdomen only, the larger present in small numbers on thorax and head, absent from abdomen. Microtubular ducts restricted to body margin. Multilocular pores of one kind: quinqueloculars, present over ventral surface; most numerous on posterior abdominal segments; with small concentrations around spiracles. Cruciform pores present along body margins of posterior abdominal segments, of thorax, and of head.

Legs of medium size; hind coxae enlarged, with many pores on both dorsal

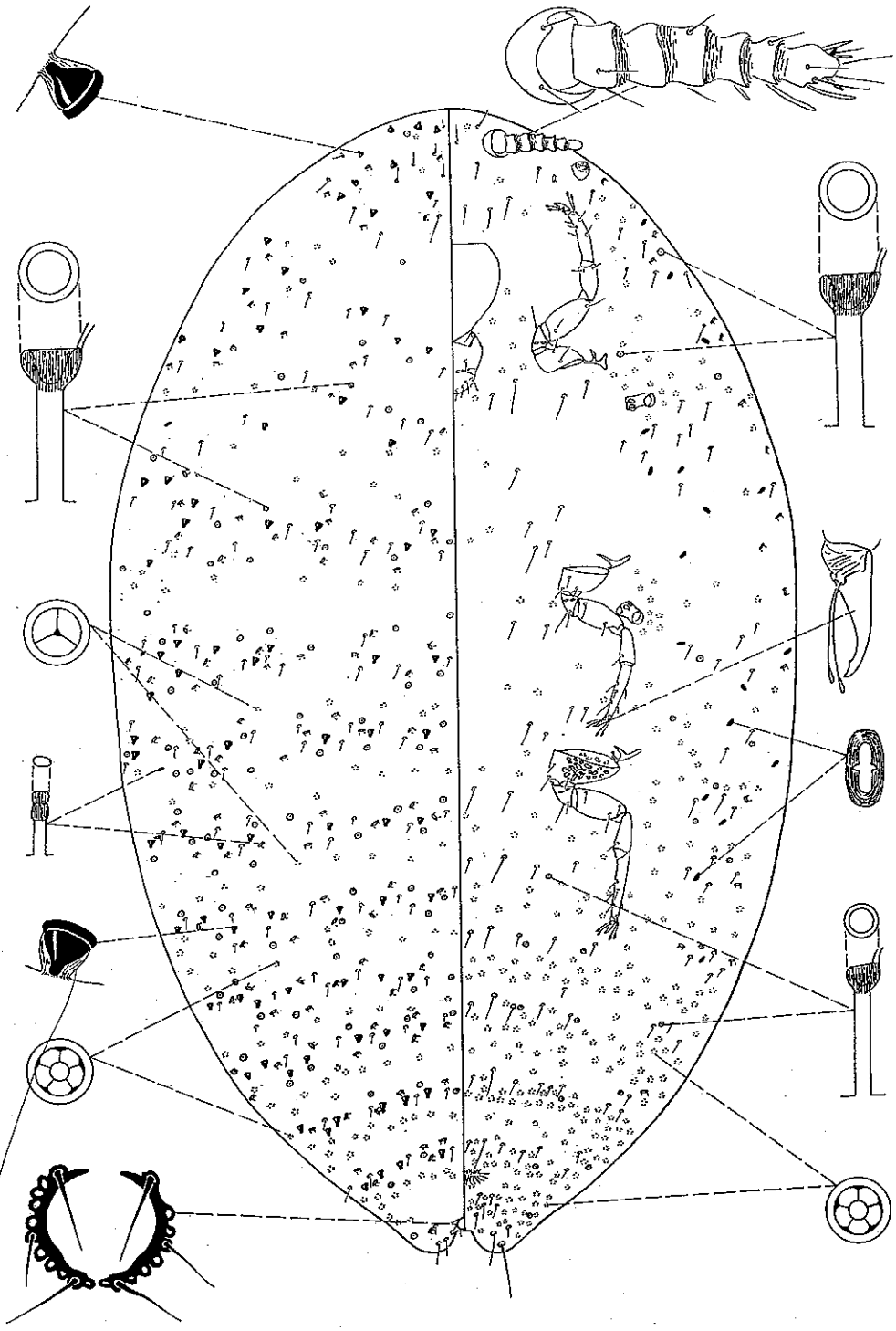

Fig. 7. *Oregmopyga johnsoni* Miller, new species, adult female. Found in southern and central California on *Hymenoclea* spp. (Compositae), in soil, and on another (undetermined) composite (Compositae).

and ventral surfaces; denticle on each claw. Mouthparts and eyes normal. Antenna 7-segmented; seventh segment with four sensory setae; sixth with only one—longer and more slender than the one on segment 5.

Recognition characters: Nymph (instar ?), mounted, 1.00 mm long, 0.20 mm wide. Body oval; anal lobes obvious.

DORSUM with lanceolate body setae smaller than those on venter; two pairs on each abdominal segment; more numerous on head. Enlarged body setae absent from ninth abdominal segment, prothorax, and head; with three pairs per segment on remaining abdominal and thoracic segments, arranged in six longitudinal lines—medial, mediolateral, and lateral. Macrotubular ducts present over entire dorsum. Microtubular ducts present; apparently associated with enlarged setae. Sessile pores absent.

Anal ring apical; incomplete, noncellular; with four pairs of setae.

VENTER with lanceolate body setae elongate, not arranged in clusters; posterior anal-lobe setae exceptionally elongate. Macrotubular ducts present on abdomen and thorax, smaller than those on dorsum. Microtubular ducts absent. Multilocular pores of two kinds: quinqueloculars distributed evenly over entire surface, with a slight concentration around spiracles; triloculars located on thorax, not common. Cruciform pores distributed as on adult female, but fewer.

Legs of medium size; hind coxae not enlarged, pores absent; small denticle on each claw. Mouthparts and eyes normal. Antennae as in adult female.

Notes. This species is most closely related to *Oregmopyga eriogoni*. Differences are that adult females of *O. johnsoni* have many dorsal quinquelocular pores and 7-segmented antennae, whereas those of *O. eriogoni* have few dorsal quinqueloculars and 6-segmented antennae. *O. johnsoni* is found only on Compositae and *O. eriogoni* only on Polygonaceae.

This species is named after John W. Johnson, to whom the senior author is deeply indebted. With his never-ending enthusiasm for nature, Mr. Johnson first aroused and encouraged this author's interest in entomology.

Specimens examined. CALIFORNIA, INYO COUNTY: 4 miles south of Lone Pine, January 30, 1965, on *Hymenoclea salsola* (Compositae), D. R. Miller (2 nymphs on 1 slide) UCD. KERN COUNTY: Near Mojave, April 26, 1963, on *Hymenoclea* sp., G. F. Ferris (1 adult female on 1 slide) UCD; 4 miles east of Monolith, November 17, 1966, on *Gutierrezia sarothrae* (Compositae), T. R. Haig (2 adult females on 1 slide) UCD. MONTEREY COUNTY: Salinas, April 17, 1962, in soil, L. Lanina (1 adult female paratype on 1 side) UCD. RIVERSIDE COUNTY: 10 miles west of Indio, January 29, 1965, on *H. salsola,* D. R. Miller (2 nymphs on 1 slide) UCD. SAN BERNARDINO COUNTY: 1 mile west of Joshua Tree, November 30, 1963, on *H. salsola,* D. R. Miller (7 nymphs on 5 slides) UCD (male sac collected on same plant); Morongo Valley, December 23, 1964, on *H. salsola,* D. R. Miller and J. F. Miller (1 adult female holotype on 1 slide, 1 adult female paratype on 1 slide) UCD. SAN DIEGO COUNTY: Scissors Crossing, January 26, 1965, on *H. salsola,* D. R. Miller (2 nymphs on 1 slide) UCD. YOLO COUNTY: 3 miles east of Guinda, December 25, 1961, on undetermined plant (Compositae), H. Court (7 adult female paratypes on 6 slides) BM, CDA, UCD, USNM.

Oregmopyga neglecta (Cockerell)

Neglected ovaticocein

(Figure 8)

Eriococcus neglectus Cockerell, 1895*b*. (Cockerell 1895*a*, 1896, 1900; Morrison and Morrison, 1966.)

Nidularia neglecta (Cockerell) Lindinger, 1933*a*.

Onceropyga neglecta (Cockerell) Ferris, 1955. (Ferris, 1957.)

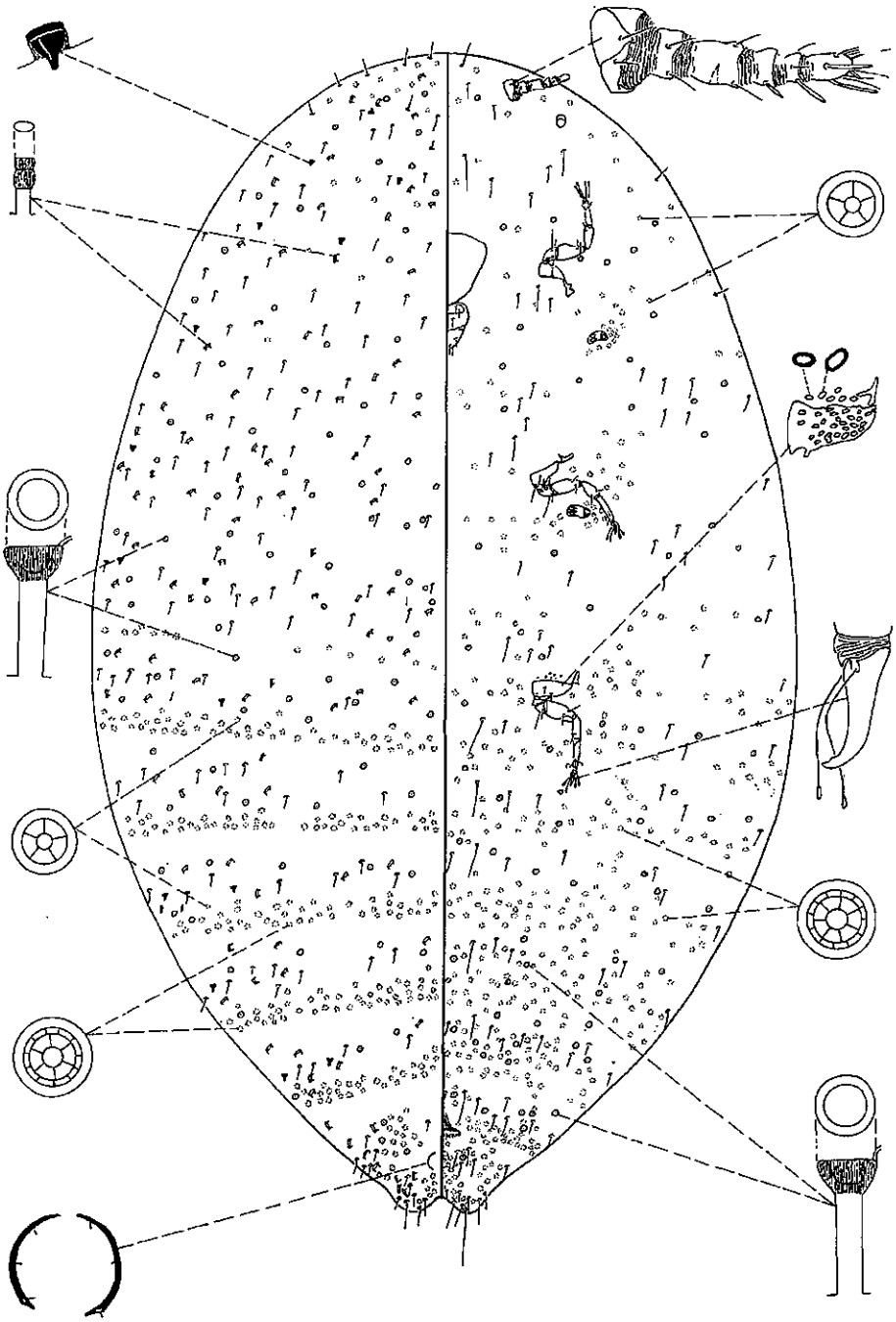

Fig. 8. *Oregmopyga neglecta* (Cockerell), adult female. Found in Arizona, central and southern California, southern New Mexico, and southwestern Texas on *Atriplex* spp. (Chenopodiaceae) and on *Allenrolfea occidentalis* (Chenopodiaceae).

Oregmopyga neglecta (Cockerell) Hoy, 1963.

Type material. Since Cockerell did not designate a holotype, I selected one of the adult female specimens from the type series, which Miss Louise M. Russell of the U. S. National Museum kindly loaned to me, and marked it as the lectotype (1 specimen on 1 slide). Also I have designated as lectoparatypes 3 adult females on 2 other slides from the type series.

Field features. Adult female large, oval, rotund; without raised dorsal ridge. Body yellowish-red to pink; crushed body contents red; dorsal intersegmental lines demarked by clear brown areas. White mealy secretion restricted to venter. Specimens on foliage completely enclosed in filamentous sac; specimens on roots show little evidence of this secretion.

Found only on Chenopodiaceae; not hidden under bark.

Recognition characters: Adult females, mounted, 1.70 to 4.00 mm long, 1.15 to 2.00 mm wide. Body oval; anal lobes large.

DORSUM with lanceolate body setae noticeably smaller than those on venter. Intermediate setae of variable occurrence: lacking on rare individuals; usually present, in two pairs of longitudinal lines—submarginal and marginal; occasionally with a third—medial—pair of lines. Macrotubular ducts numerous; present over entire surface, most common on thorax. Microtubular ducts small; of same distribution pattern as macrotubulars. Multilocular pores of two kinds: septeloculars and quinqueloculars, sometimes distributed over entire surface in equal numbers; on other specimens quinqueloculars more numerous—from one to four pores deep in transverse rows on posterior parts of abdominal segments, progressively less numerous on thorax and head. Cruciform pores absent.

Anal ring dorsal; circular but incomplete—i.e., composed of two narrow half-moon-shaped bars—noncellular; with three pairs of minute setae present, usually only the posterior pair of setae and bases visible.

VENTER with lanceolate body setae in clusters, forming five longitudinal lines on abdominal segments 8 through 3; posterior anal-lobe setae elongate, robust. Macrotubular ducts present over venter. Microtubular ducts absent. Multilocular pores of two kinds: septeloculars and quinqueloculars, in same relative numbers as on dorsum; present over entire surface; most numerous on abdomen; scattered around spiracles. Cruciform pores absent.

Legs small; hind coxae enlarged, with many ventral pores; a few microcruciform pores on derm anterior to hind leg; denticle on each claw. Mouthparts and eyes normal. Antenna usually with six segments, rarely with seven; if six, segment 6 with three sensory setae (sometimes four); segment 5 with only one—of approximately same size as the one on segment 4.

Recognition characters: Nymphal female (late instar) similar to adult female. Enlarged setae (four pairs on each segment) arranged in six longitudinal lines from eighth abdominal segment through head: each medial and mediolateral line made up of one seta per segment and each lateral line made up of two closely associated setae per segment.

Recognition characters: Nymphal female (early instar), mounted, 1.00 mm long, 0.35 mm wide. Body oval; little or no evidence of anal lobes.

DORSUM with lanceolate body setae infrequent. With complete set of enlarged setae, as in late instar. Macrotubular ducts absent. Microtubular ducts present in small numbers over entire surface. Sessile pores absent.

Anal ring as in adult female.

VENTER with lanceolate body setae long, arranged in same cluster pattern as on adult female; posterior anal-lobe setae elongate. Tubular ducts absent.

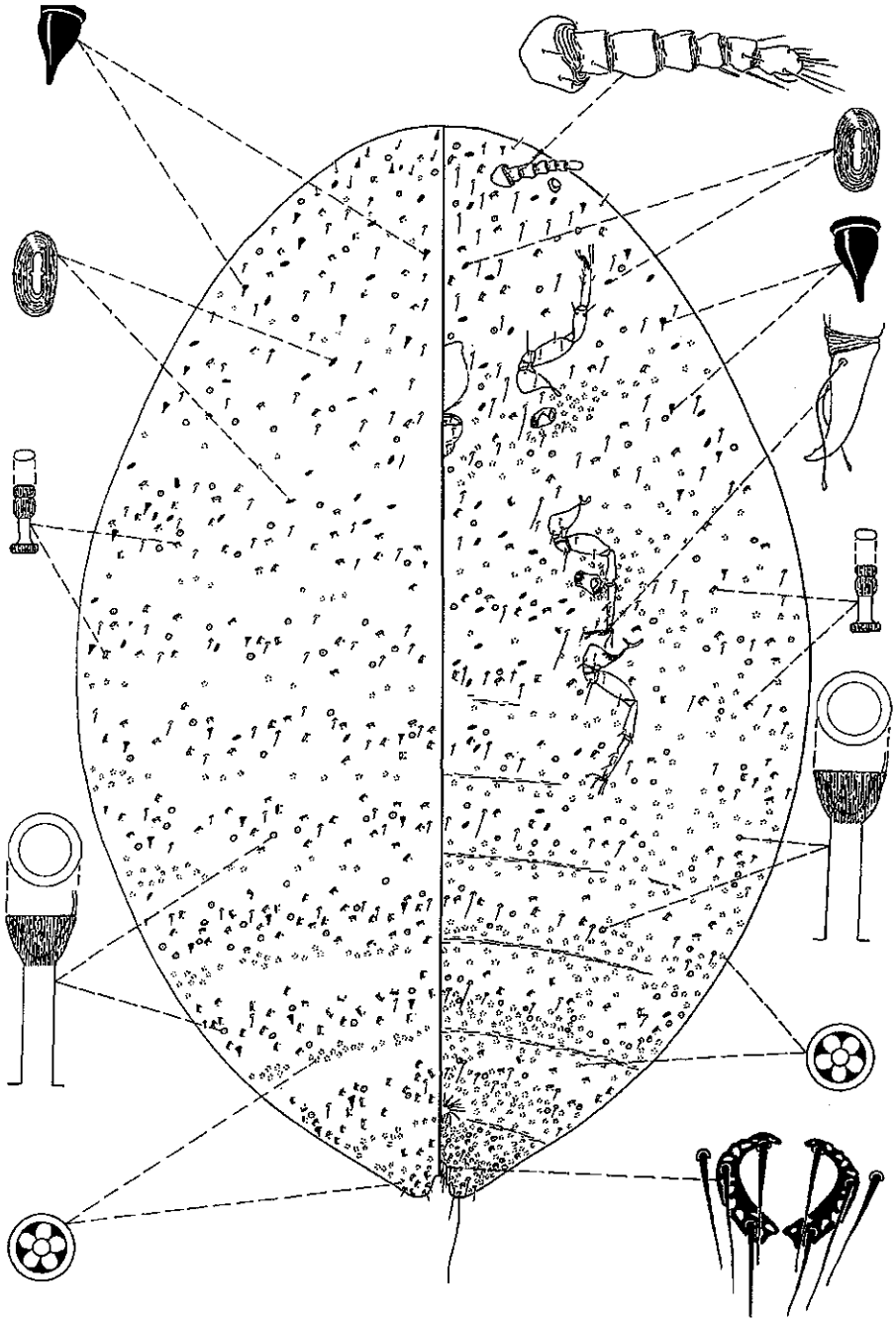

Fig. 9. *Oregmopyga parvispina* (Chaffiu), adult female. Found in central Florida on *Galactia volubilis* (Leguminosae) and in southern Texas on *Borrichia frutescens* (Compositae).

Multilocular pores of one kind: quinqueloculars, arranged in transverse rows over entire surface. Cruciform pores absent.

Legs small; hind coxae not enlarged, but with a few large ventral pores; small denticle on each claw. Mouthparts and eyes normal. Antenna 6-segmented; third segment longest; antennal setae as in adult female.

Recognition characters: Nymphal male (probably third instar), mounted, approximately 0.30 mm long. Body elongate; anal lobes present.

DORSUM with lanceolate body setae elongate; with four pairs per segment, arranged in six longitudinal lines of same pattern as enlarged setae of nymphal females. Enlarged setae minute and reduced in number. Macrotubular ducts numerous; arranged likewise in six longitudinal lines. Microtubular ducts present in small numbers over surface. Sessile pores absent.

Anal ring as in adult female.

VENTER with lanceolate body setae long, arranged in five longitudinal lines over surface; posterior anal-lobe setae exceptionally elongate. Tubular ducts absent. Multilocular pores of one kind: quinqueloculars, present over entire venter. Cruciform pores absent.

Legs of medium size; hind coxae not enlarged, pores absent; claws elongate—denticles small, digitules apically acute. Mouthparts elongate. Eyes normal. Antennae 7-segmented; otherwise as in adult female.

Notes. This species is quite distinct. The adult female differs from that of other members of the genus in having no cruciform pores, a narrow anal ring, large anal lobes with many stout setae, and 6-segmented antennae.

Specimens examined. CALIFORNIA, INYO COUNTY: Near Ballarat, 25 miles northeast of Trona, November 26, 1956, on *Allenrolfea occidentalis* (Chenopodiaceae), L. E. Myers (5 adult females on 5 slides) UCD; 4 miles south of Lone Pine, at edge of Owens Lake, January 30, 1965, on *Atriplex* sp. (Chenopodiaceae), D. R. Miller (1 adult female on 1 slide) UCD; Townes Pass, January 30, 1965, on *Atriplex* sp., D. R. Miller (2 adult females on 1 slide) UCD. RIVERSIDE COUNTY: 3 miles southwest of Palo Verde, April 3, 1966, on *Atriplex* sp., D. R. Miller (4 adult females on 4 slides) UCD. VENTURA COUNTY: Castaic (?), March 13, 1935, on *Atriplex* sp., E. T. Gammon (4 nymphs on 1 slide) UCD; 8 miles west of Castaic, April 23, 1935, on *Atriplex* sp., E. T. Gammon (3 adult females on 1 slide) UCD; Piru district, March 13, 1935, on *Atriplex* sp., E. T. Gammon (4 adult females and 1 nymphal female on 2 slides) UCD.

ARIZONA (COUNTY?): Road to Rough Rock, 1940, on *Atriplex* sp., G. F. Ferris (6 nymphal females on 2 slides) UCD.

NEW MEXICO, DOÑA ANA COUNTY: Las Cruces, no date, on *Atriplex canescens,* T. D. A. Cockerell (1 adult female lectotype on 1 slide; 3 adult female lectoparatypes on 2 slides) USNM. SAN JUAN COUNTY: North of Shiprock, July 20, 1946, on *Atriplex* sp., G. F. Ferris (3 nymphal females and 2 nymphal males on 3 slides) UCD.

TEXAS, EL PASO COUNTY: Near El Paso, June, 1921, on *Atriplex* sp., G. F. Ferris (8 adult females, 7 nymphal females, and 2 nymphal males on 8 slides) UCD.

Oregmopyga parvispina (Chaffin)

Chaffin's ovaticoccin

(Figure 9)

Eriococcus parvispinus Chaffin, 1923. (Merrill and Chaffin, 1923; Merrill, 1953; Riddick, 1955.)

Onceropyga parvispina (Chaffin) Ferris, 1955.

Oregmopyga parvispina (Chaffin) Hoy, 1963.

Field features. According to Chaffin (1923) the adult female is "Enclosed in smooth, light yellowish, flattened,

ovoid, feltlike sac. Female, when removed from sac, is dark wine colored and devoid of any cottony secretion. Abdominal segments very distinct; legs of a lighter color; body 2 mm. in length."

Hosts of at least two plant families. Insects apparently found on roots.

Chaffin (1923) described the male as a "small two-winged insect, body bright carmine in color, with four long, white, wax-like anal filaments. Legs and antennae yellowish red." He described the male sac as "similar to female but much smaller."

Recognition characters: Adult females, mounted, 1.50 to 2.20 mm long, 0.90 to 1.70 mm wide. Body rotund; with large, rounded, unsclerotized anal lobes.

DORSUM sparsely covered with short lanceolate body setae, smaller than those on venter. Enlarged setae in transverse rows, usually with eight setae on each abdominal segment except segments 9 and 8; arranged in six longitudinal lines from abdominal segment 6 through mesothorax: with one seta per segment in each of the medial and mediolateral lines and two closely associated setae per segment in each lateral line; scattered randomly on prothorax and head; not usually recessed into derm pockets; with narrow, slender apexes. Macrotubular ducts present over entire dorsum; distributed primarily in areas void of sessile pores. Microtubular ducts present over entire dorsum; orifices sclerotized. Multilocular pores of one kind: quinqueloculars, present over entire dorsum; primarily in transverse rows on one or both margins of abdominal and thoracic segments. Cruciform pores present in small numbers on anterior abdominal segments, progressively more numerous on thorax and head.

Anal ring apical; oval, incomplete, cellular; with three pairs of elongate setae and an additional pair near ring.

VENTER with lanceolate body setae noticeably long; posterior anal-lobe setae normally elongate. Enlarged setae sometimes present on lateral margins of thorax and head. Macrotubular and microtubular ducts distributed over entire venter. Multilocular pores of one kind: quinqueloculars, present over venter excluding head. Cruciform pores present on anterior abdominal segments, thorax, and head.

Legs medium in size; hind coxae with few pores on ventral surfaces; minute denticle on each claw. Mouthparts and eyes normal. Antenna 7-segmented; one or two robust sensory setae on seventh segment; sixth segment with only one sensory seta—noticeably more elongate and slender than that on segment 5.

Recognition characters: Nymph (late instar). Specimen differs from adult female in only two ways: (1) Sometimes there are fewer dorsal microtubular ducts, ventral macrotubular ducts, ventral quinquelocular pores. (2) Quinquelocular pores in occasional dorsolateral clusters on last three abdominal segments, otherwise restricted to venter.

Recognition characters: Nymph (first instar). Body elongate-oval; anal lobes rounded, well developed.

DORSUM with lanceolate body setae absent except on anal lobes. Enlarged setae present over dorsum excluding ninth abdominal segment; arranged in six longitudinal lines, with two setae per segment in each lateral line and one seta per segment in each medial and each mediolateral line; of same shape as on adult female. Macrotubular ducts absent. Microtubular ducts sparsely distributed over entire dorsum, often associated with enlarged setae; of same size and shape as on adult female. Multilocular pores of one kind: quinqueloculars, few; present only on ninth abdominal segment. Cruciform pores present on anterior abdominal segments, thorax, and head.

Anal ring as in adult female.

VENTER with lanceolate body setae

present. Single, poorly developed macrotubular duct in medial area of seventh abdominal segment. Microtubular ducts absent. Multilocular pores of one kind: quinqueloculars, present over entire venter. Cruciform pores absent.

Legs of normal size and shape; hind coxae not enlarged, with no pores; each claw with small, inconspicuous denticle. Mouthparts normal. Antennae 6-segmented; antennal setae of specimen mutilated.

Recognition characters: Adult male. The two pairs of anal filaments described by Chaffin (1923) would indicate that this male may have had two pairs of pore clusters instead of the single pair usually found on male scales.

Variations. The most significant variations in the adult females are as follows: The number of enlarged setae may vary from two to four pairs per abdominal segment; ventral quinqueloculer pores may be present on head or absent; dorsal cruciform pores are often more numerous than in the illustration; and the pores on ventral surfaces of hind coxae are often more widely distributed than in the illustration.

Notes. This species is very closely related to *Oregmopyga peninsularis* (Ferris). Differences are indicated in the notes on that species.

Specimens examined. FLORIDA, LAKE COUNTY: Lake Jem, August 17, 1922, February 12, 1923, and August 31, 1923, on *Galactia volubilis* (Leguminosae), H. W. Fogg (2 adult females on 1 slide: "original collection, compared with type"; 3 adult female "cotype" specimens on 2 slides; and 4 adult females on 2 slides) FCA.

TEXAS, CAMERON COUNTY: Beach at Port Isabel, 1921, on *Borrichia frutescens* (Compositae), G. F. Ferris (2 adult females on 2 slides; 1 adult female, 1 first-instar nymph, and 1 adult male on 1 slide; 1 third-instar nymph and 1 female shed skin on 1 slide) UCD.

Oregmopyga peninsularis (Ferris)

Peninsula ovaticoccin

(Figure 10)

Fonscolombia peninsularis Ferris, 1921*a*.

Pseudochermes peninsularis (Ferris) Lindinger, 1933*b*.

Gymnococcus peninsularis (Ferris) Ferris, 1955.

Ovaticoccus peninsularis (Ferris) Boratynski, 1958. (Hoy, 1963; McKenzie, 1964.)

Type material. Ferris never designated the type of this species in print, although slides which he prepared are marked "type" and "paratype." Therefore I here designate the adult female on his slide marked "type" as the lectotype (1 specimen on 1 slide) and the remaining 6 specimens on 6 slides marked "paratype" as lectoparatypes.

Specimens from La Paz, Baja California, on *"Franseria?"*, recorded by Ferris (1955) as of this species, are not included in this study because the preparations are too poor for critical examination. I believe they belong to a different species, because they lack enlarged setae.

Field features. Ferris (1955) stated: "Occurring on the crowns of the host, surrounded by a small amount of secretion." From the distribution of pores, it seems likely that this insect can cover itself completely with a filamentous ovisac secretion.

Recognition characters: Adult females, mounted, 1.25 to 3.00 mm long, 0.80 to 1.40 mm wide. Body elongate, oval; anal lobes present.

DORSUM with lanceolate body setae noticeably smaller than those on venter. Enlarged setae in transverse rows, with from no setae to six on each abdominal segment from 9 through 4 and with eight setae per segment—arranged in six longitudinal lines—from abdominal segment 3 through mesothorax: with one seta per segment in each of the medial and mediolateral lines and two closely

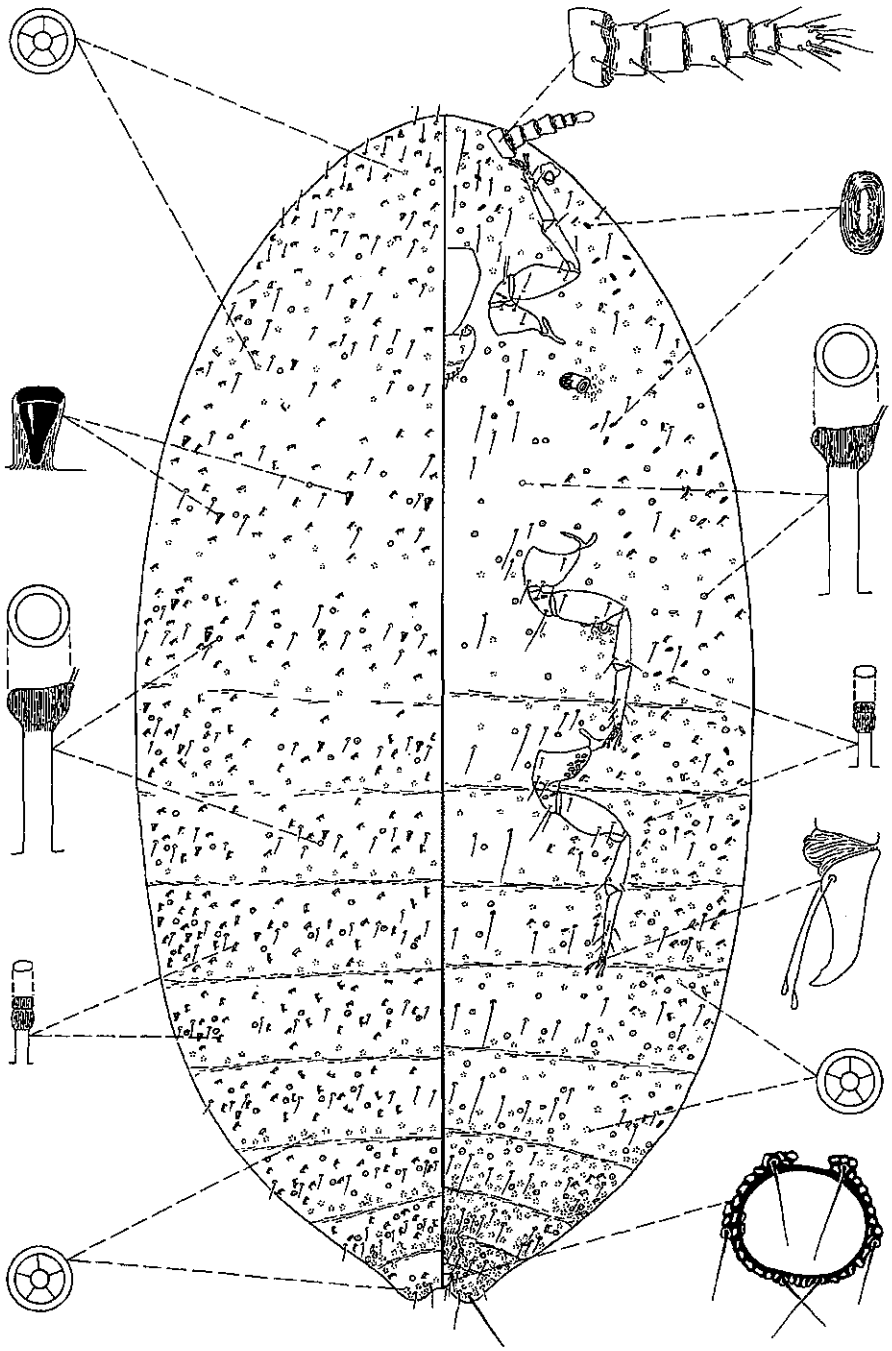

Fig. 10. *Oregmopyga peninsularis* (Ferris), adult female. Found in southern Baja California, Mexico, on *Asclepias subulata* (Asclepiadaceae).

associated setae per segment in each lateral line; scattered randomly on prothorax and head; usually recessed into derm pockets; each with a thick, blunt apex. Macrotubular ducts distributed over surface. Microtubular ducts numerous, present over entire surface. Multilocular pores of one kind: quinqueloculars, present over surface, particularly on posterior margins of abdominal and thoracic segments. Cruciform pores absent.

Anal ring apical; oval, complete, multicellular; with three pairs of large setae and an additional pair present but not associated with ring.

VENTER with lanceolate body setae long, arranged in clusters forming five longitudinal lines on abdominal segments 8 through 3; posterior anal-lobe setae elongate. Macrotubular ducts present over surface. Microtubular ducts restricted to body margins. Multilocular pores of one kind: quinqueloculars, present over surface; most numerous on posterior abdominal segments; small concentrations around spiracles. Cruciform pores always present along margins of thorax; inconsistently present on lateral margins of abdomen.

Legs large; hind coxae not enlarged, with many pores on ventral surfaces; inconspicuous denticle on each claw. Mouthparts variable, from apically acute to blunt. Eyes normal. Antenna 7-segmented; seventh segment with at most three sensory setae, all very slender; sixth segment with only one, which only slightly resembles a sensory seta; fifth segment with only one, unusually long and slender.

Notes. This species is very closely related to *Oregmopyga parvispina* (Chaffin). Adult females of *O. peninsularis* have enlarged setae with thick, blunt apexes; these setae are absent from the medial regions of abdominal segments 9 through 5. The cruciform pores of *O. peninsularis* are confined to the lateral margins of the venter. Adult females of *O. parvispina*, on the other hand, have enlarged setae which narrow abruptly to slender apexes and are absent from the medial regions only on abdominal segments 9 and 8. The cruciform pores of *O. parvispina* are present on both the dorsum and the venter: on the venter they are present in the medial regions of the anterior abdomen, thorax, and head.

Specimens examined. MEXICO, BAJA CALIFORNIA: San José del Cabo, August, 1919, on *Asclepias subulata* (Asclepiadaceae), G. F. Ferris (1 adult female lectotype on 1 slide; 6 adult female lectoparatypes on 6 slides) UCD.

Oregmopyga sanguinea Miller, new species

Bright-red ovaticoccin

(Figure 11)

Type material. Adult female holotype (1 specimen on 1 slide), 5 adult female paratypes, and 2 nymphal female paratypes.

Field features. Adult female oval, rotund; without dorsomedial ridge. Body grayish purple; crushed body contents bright red. Legs yellowish white. Eyes black. Dorsum covered with grayish bloom, venter with white mealy secretion. Many bright-red eggs laid in filamentous ovisac—covering dorsum completely though extruded only from ventrolateral margins.

Exposed on underground crown of host.

Recognition characters: Adult female holotype, mounted, 3.25 mm long, 1.70 mm wide. (Range 1.70 to 3.30 mm long, 1.00 to 2.00 mm wide.) Body oval; anal lobes definite.

DORSUM with lanceolate body setae noticeably smaller than those on venter. Enlarged setae absent. Macrotubular ducts present over entire dorsum. Microtubular ducts numerous; present over entire dorsum. Multilocular pores of one primary category: quinqueloculars, of two forms—the larger, with

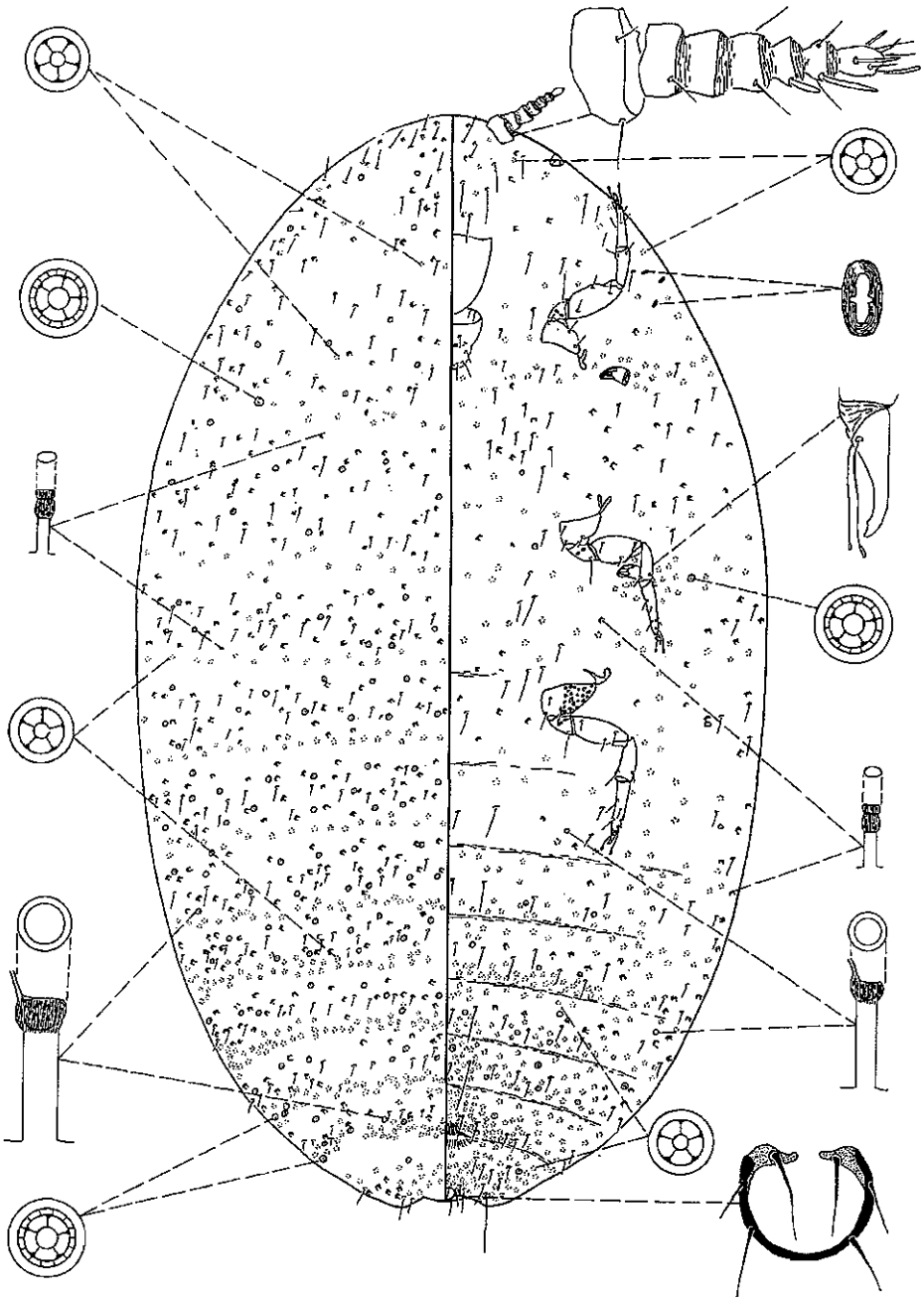

Fig. 11. *Oregmopyga sanguinea* Miller, new species, adult female. Found in southern California on *Haplopappus acradenius* (Compositae).

intermediate ring, distributed in small numbers over dorsum; the smaller, without this ring, present in larger numbers over dorsal surface, most common on posterior abdominal segments. Cruciform pores absent.

Anal ring apical, seen on either dorsal or ventral aspect; circular, incomplete, noncellular; with three pairs of long setae and an additional pair in close association.

VENTER with lanceolate body setae long, arranged in clusters forming three longitudinal lines on abdominal segments 8 through 3; posterior anal-lobe setae elongate, very robust. Macrotubular ducts smaller than those of dorsum; distributed in small numbers on abdomen and posterior thorax. Microtubular ducts numerous, especially in thoracic and head regions. Multilocular pores of one primary category: quinqueloculars, of two forms—the larger, with intermediate ring, uncommon; the smaller, without intermediate ring, numerous, distributed over entire surface. Cruciform pores uncommon; present only in marginal area between prothorax and head.

Legs of medium size; hind coxae not enlarged, with many dorsal and ventral pores; claws of medium size, all with denticles. Mouthparts apically blunt. Eyes normal. Antenna 7-segmented; seventh segment with three sensory setae at most; sixth segment with only one—longer and more slender than that on segment 5.

Recognition characters: Nymphal female (late instar), mounted, 1.20 mm long, 0.55 mm wide. Body oval; anal lobes conspicuous.

DORSUM with lanceolate body setae few and smaller than those of venter. Enlarged setae arranged in six longitudinal lines—medial, mediolateral, and lateral—with three pairs of setae on each segment from eighth abdominal segment through head. Macrotubular ducts absent. Microtubular ducts numerous over entire dorsum, many associated with enlarged setae. Quinqueloculars pores present over entire dorsum. Cruciform pores absent.

Anal ring as on adult female.

VENTER with lanceolate body setae long, arranged in clusters forming three longitudinal lines on abdominal segments 8 through 3. Macrotubular ducts absent. Microtubular ducts present along body margin. Multilocular and cruciform pores as on venter of adult female.

Legs of medium size; hind coxae with a few large ventral pores; small denticle on each claw. Mouthparts and eyes normal. Antenna 6-segmented; segment 3 largest; sixth segment with four sensory setae; fifth segment with only one—noticeably longer and more slender than that on segment 4.

Variations. The only noticeable variation is in the numbers of cruciform pores. Some specimens have three on each side of the head, others have only one.

Notes. Adult females of this species are quite distinct, with the following characters: dorsal enlarged setae absent, ventral macrotubular ducts restricted almost entirely to abdomen, and cruciform pores present only in prothoracic and head regions.

This species is named *sanguinea* because of its unusually bright red body. A specimen turns alcohol deep red, much as do specimens of *Dactylopius* Costa.

Specimens examined. CALIFORNIA, RIVERSIDE COUNTY: Thousand Palms Canyon, January 25, 1965, on *Haplopappus acradenius* (Compositae), D. R. Miller (2 nymphal female paratypes on 1 slide) UCD; Thousand Palms Canyon, April 16, 1965, on *H. acradenius*, D. R. Miller (1 adult female holotype on 1 slide; 5 adult female paratypes on 5 slides) BM, CDA, UCD, USNM.

Genus *Ovaticoccus* Kloet

Gymnococcus Cockerell, 1894. (Preocc. by *Gymnococcus* Zopf, 1887.)

Ovaticoccus Kloet, 1944 (nom. nov. for *Gymnococcus*).

Ovatococcus Lindinger, 1957 (misspelling of *Ovaticoccus*).

History. Douglas (1888) stated, in his description of *Coccus agavium:* "At one time I though it might constitute the type of a new genus, under the name of *Gymnococcus,* but in consideration of the important and leading characters of the antennae, I have concluded (for the present, at least) that it is better to regard all the others as specific, and to refer the species to Signoret's genus *Coccus.*" Cockerell (1894) designated *Gymnococcus* as a distinct genus and gave Douglas credit. Since Douglas did not actually use the name *Gymnococcus,* and since Cockerell was the first person to do so, Cockerell is here given credit for describing this genus. (See also Hoy, 1963.) Parrott (1900) considered *Gymnococcus* valid but credited it to Newstead (1897). However, *Gymnococcus* Douglas was considered valid until Kloet (1944) discovered that the name *Gymnococcus* was preoccupied by a genus of Myectozoa and introduced the new name *Ovaticoccus.* This name was disregarded until Ferris (1957) confirmed Kloet's designation.

Type of genus. *Coccus agavium* Douglas, 1888.

Significant publications. Ferris (1955) has done the most complete work on this genus. Boratynski (1958) presented a complete redescription of *Ovaticoccus agavium,* with descriptions of adults and nymphs of both sexes and a complete history of the taxonomy of the genus. Hoy (1963) has contributed tremendously to the clarification of this genus and of the entire family Eriococcidae. McKenzie (1964) contributed to a further understanding of the genus by presenting a revised key to the North American species and by describing two new species.

Field features. Adult females normally oval; several species with one or more dorsal longitudinal ridges. Body of various shades of red, pink, or purple. Legs and antennae white or light yellow. Body often covered with white mealy secretion, usually heaviest on venter, sometimes absent from dorsum. White filamentous ovisac secretions often present from tip of abdomen through posterior thorax; filamentous nest secretion most abundant in lateral regions. Eggs known in at least one species.

Species of this genus are normally host-specific. Found under bark of most hosts, but in basal sheaths when on Gramineae or Agavaceae; exposed only when infestations are heavy.

Males most often bright red, with a single pair of long, white, caudal filaments; winged, as far as known.

Generic diagnosis: Adult females. Anal lobes absent. Anal ring noncellular, usually a modified circle; with three pairs of setae—sometimes reduced. Tubular ducts and sessile pores sparse.

Enlarged setae present in some species, each with its characteristic shape. Macrotubular ducts of one size on each species; always present on dorsum, usually also on venter. Microtubular ducts variable in distribution; usually without sclerotized orifices. Multilocular pores with three, four, five, or seven loculi; always with one or more kinds on venter, sometimes also on dorsum. Cruciform pores usually in clusters on ventral body margins.

Legs small; hind coxae usually not enlarged, often with a small number of ventral pores; denticle on each claw. Spiracle without pores in atrium. Antennae 6- or 7-segmented; sensory setae

robust, present on last three segments.

Notes. This genus is most closely related to *Oregmopyga* but differs in that the adult female has no anal lobes, the anal ring is noncellular, and ducts and pores are sparse. On the other hand, the female of *Oregmopyga* always has anal lobes, the anal ring may often be cellular, and ducts and pores are numerous.

This genus now contains nine North American species. I have added four new species and have extracted four species previously included and placed them elsewhere. *Ovaticoccus nativus* (Parrott) is not included in the key; it is inadequately characterized because specimens were not available for examination. I have omitted *O. agenjoi* (Gómez-Menor Ortega) and *O. lahillei* (Leonardi) because neither occurs in North America. Specimens of *O. lahillei* have been examined and appear to belong to *Eriococcus* rather than to *Ovaticoccus*.

KEY TO NORTH AMERICAN SPECIES OF *OVATICOCCUS*

ADULT FEMALES

1. With at least 10 enlarged setae 2
   Without enlarged setae (except for perhaps one or two) 5
2(1). Dorsal quinquelocular pores present 3
   Dorsal quinquelocular pores absent (except for perhaps one or two on thorax) 4
3(2). Antennae 6-segmented; ventral cruciform pores restricted to lateral margins; microcruciform pores numerous in regions of hind coxae *salviae* Miller
   Antennae 7-segmented; ventral cruciform pores in transverse bands across most of abdominal segments; microcruciform pores absent *agavium* (Douglas)
4(2). Macrotubular ducts absent; abdomen with not more than two pairs of enlarged setae per segment ..... *parkerorum* Miller
   Macrotubular ducts present; abdomen with at least three pairs of enlarged setae per segment, usually with four pairs ..... *variabilis* Miller
5(1). Microtubular ducts absent ..... *californicus* McKenzie
   Microtubular ducts present 6
6(5). Dorsal quinquelocular pores absent; antennae 6-segmented *senarius* McKenzie
   Dorsal quinquelocular pores present; antennae usually 7-segmented 7
7(6). Cruciform pores numerous on dorsum, clustered on ninth abdominal segment; found on grass ..... *adoxus* (Ferris)
   Cruciform pores absent from dorsum; found on *Ephedra* sp. *mackenziei* Miller

Ovaticoccus adoxus (Ferris)

Obscure ovaticoccein

(Figure 12)

Gymnococcus adoxus Ferris, 1955.

Ovaticoccus adoxus (Ferris) Boratynski, 1958. (Hoy, 1963; McKenzie, 1964.)

Type material. Ferris (1955) stated: "Type from an undetermined grass at Fort Bliss, El Paso, . . . Texas." I have examined a single slide marked "type . . . *Gymnococcus adoxus* n. sp., from indet. grass, Mesa at El Paso, Texas, Ferris 1921." Since two specimens were on the slide and neither was specified as the holotype, the two specimens are to be

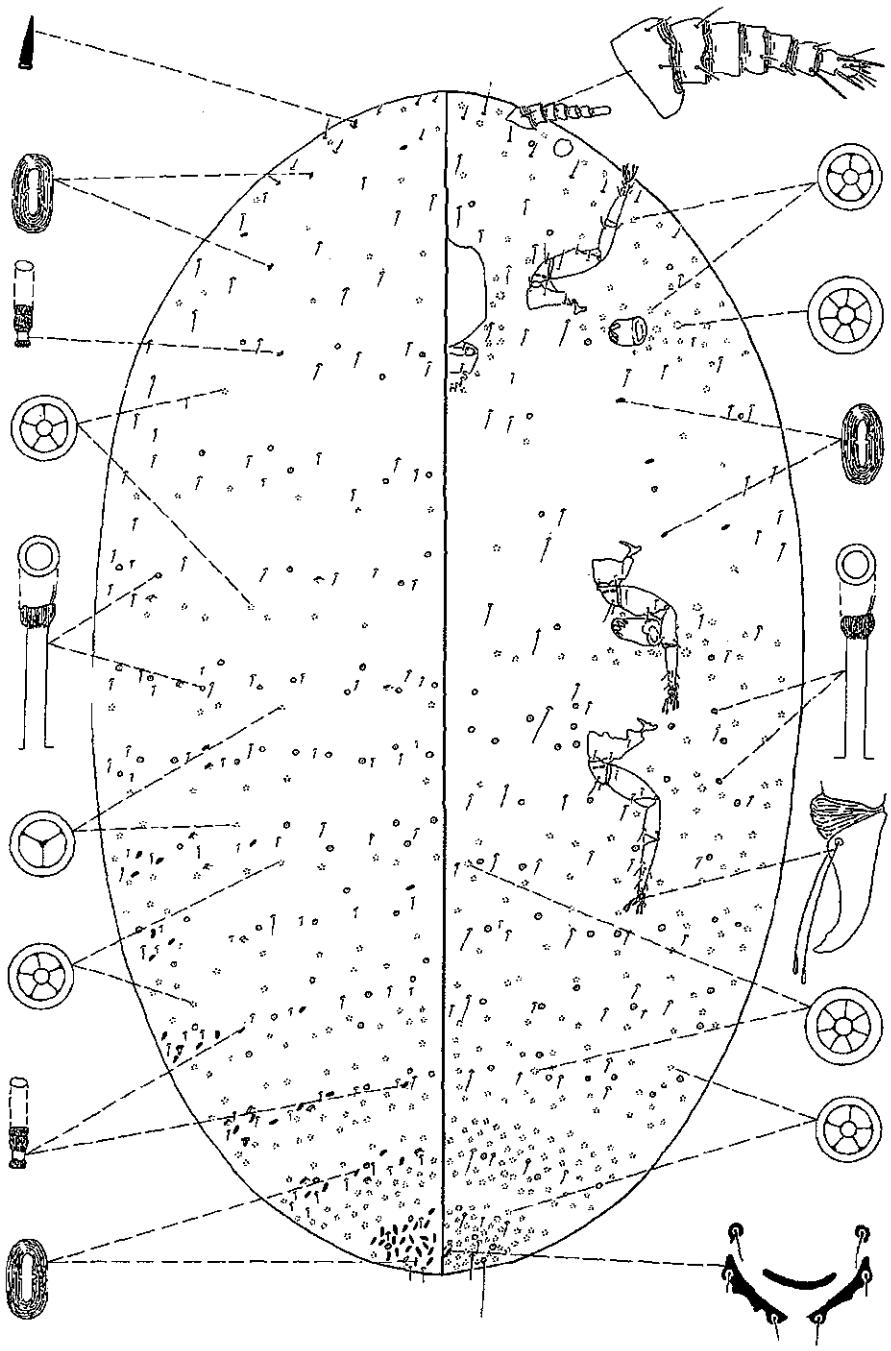

Fig. 12. *Ovaticoccus adoxus* (Ferris), adult female. Found in southwestern Texas on undetermined grass (Gramineae).

considered syntypes. I have soaked off one of them from the original slide and remounted it on a second slide. I here designate one specimen as the lectotype (1 specimen on 1 slide), and I have labeled the other as a lectoparatype. I have examined 15 additional adult females from the El Paso collection and marked them as lectoparatypes. I examined the specimens which Ferris discussed from "Fabens, a few miles from El Paso." These slides were not marked or indicated in the original description as part of the type series; therefore I have made no designation of this material.

Field features. Occurs on crowns of grass.

Recognition characters: Adult females, mounted, 2.00 to 3.00 mm long, 1.00 to 2.00 mm wide. Body oval; no sign of anal lobes.

DORSUM with lanceolate body setae of approximately same size as those on venter. Intermediate setae present along margin. Macrotubular ducts with elongate tubes; present over entire surface. Microtubular ducts small, with sclerotized orifices; distributed in small numbers on abdomen and posterior thorax, absent from head. Multilocular pores of two kinds: quinqueloculars present over dorsum; triloculars uncommon, found on anterior abdomen and on posterior thoracic segments. Cruciform pores clustered on ninth abdominal segment; present sublaterally on other abdominal segments; rarely present on thorax; in small numbers on lateral margins of head.

Anal ring apical; semicircular, incomplete, noncellular; with three pairs of small setae and an additional pair present but not in association.

VENTER with lanceolate body setae small, not noticeably clustered; posterior anal-lobe setae elongate. Macrotubular ducts as on dorsum; distributed over entire venter but more numerous on abdomen than on thorax or head. Microtubular ducts absent. Multilocular pores of two kinds, intermingled: septeloculars present in small numbers over surface; quinqueloculars present over surface, most numerous on abdomen, concentrated around mouthparts, with little or no concentration around spiracles. Cruciform pores present in small numbers on anterior thorax.

Legs of medium size; hind coxae slightly enlarged, irregularly shaped, with no pores; small denticle on each claw. Spiracles enlarged. Mouthparts apically blunt. Eyes normal. Antennae 6- or 7-segmented; when 7-segmented, segment 7 with three to five sensory setae; segment 6 with only one, which is longer and more slender than the one on segment 5.

Recognition character: Nymph. Enlarged setae present (Ferris, 1955).

Notes. This species is quite distinct in that the adult female has a dorsal cluster of cruciform pores on the ninth abdominal segment, enlarged spiracles, a peculiarly divided anal ring, and macrotubular ducts with elongate tubes.

Specimens examined. TEXAS, EL PASO COUNTY: Near Fabens, 1921, on undetermined grass (Gramineae), G. F. Ferris (8 adult females on 7 slides) UCD; El Paso, July, 1921, on undetermined grass, G. F. Ferris (3 adult females on 3 slides) UCD; mesa at El Paso, 1921, on undetermined grass, G. F. Ferris (1 adult female lectotype on 1 slide, 17 adult female lectoparatypes on 12 slides) UCD.

Ovaticoccus agavium (Douglas)

Agave ovaticoccin

(Figure 13)

Coccus agavium Douglas, 1888. (Cockerell, 1893; Newstead, 1897; Morrison and Morrison, 1966.)

Gymnococcus agavium (Douglas) Cockerell, 1894. (Cockerell, 1896; Parrott, 1900; Newstead, 1903; Trabut, 1910, 1911; Vayssière, 1914, 1915; Felt and Morrison, 1928; Lindinger, 1931; Walczuch, 1932; Lindinger, 1936,

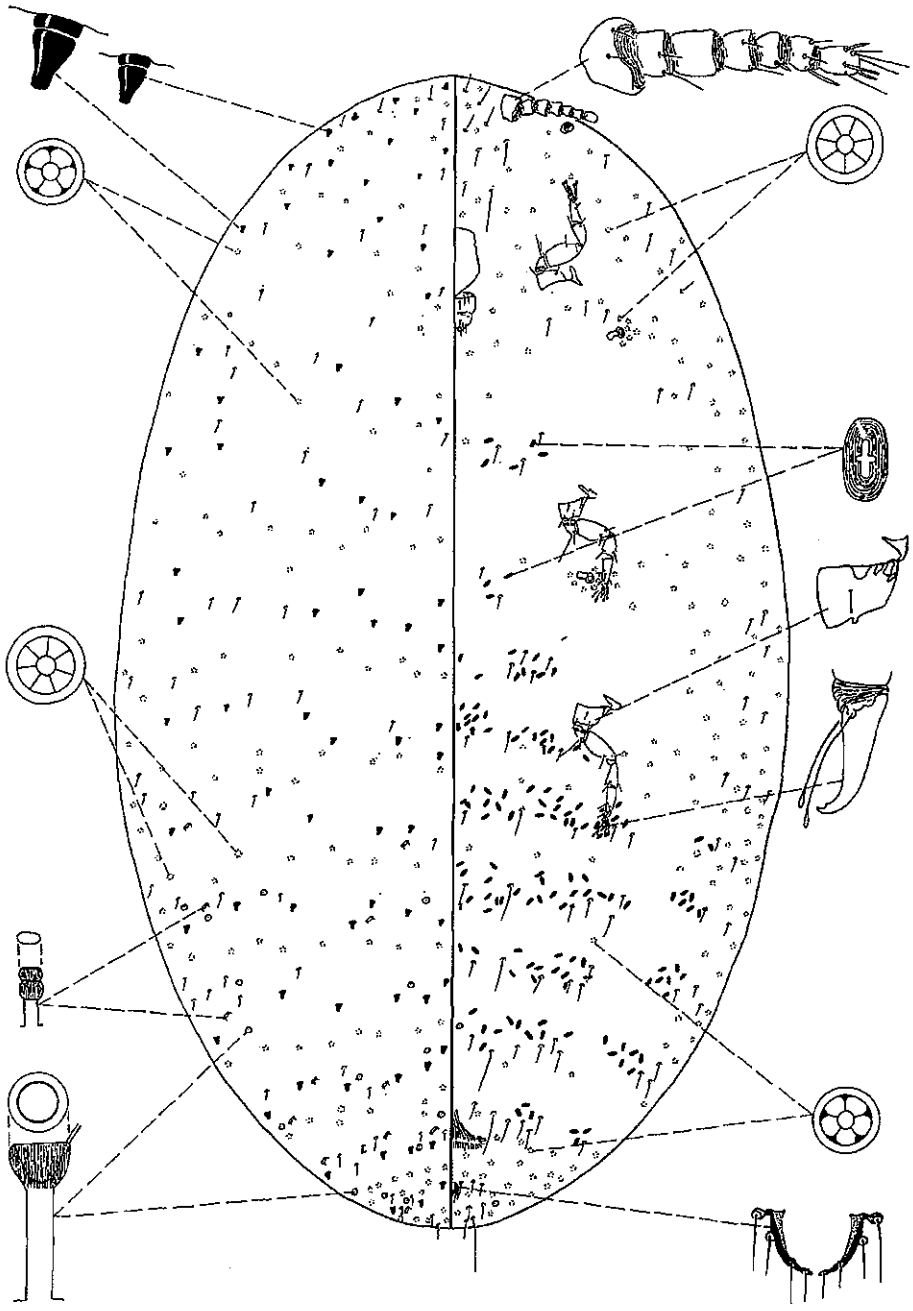

Fig. 13. *Ovaticoccus agavium* (Douglas), adult female. Found in England, France, Eritrea, United States, and U.S.S.R. on *Agave* spp. and *Yucca* spp. (Agavaceae) and on *Aloe* sp. (Liliaceae).

1937; Borkhsenius, 1949; Ferris, 1955.)

Ripersia agavium (Douglas) Newstead, 1897.

Pseudantonina agaves Chiaromonte, 1929. (Lindinger, 1958: prob. syn. *Ovaticoccus agavium;* Boratynski, 1958: jr. syn. *Coccus agavium.*)

Ovaticoccus agavium (Douglas) Kloet, 1944. (Ferris, 1957; Boratynski, 1958; Hoy, 1963; McKenzie, 1964.)

Ovatococcus agavium (Douglas) Lindinger, 1958 (misspelling of *Ovaticoccus agavium*).

Type material. The lectotype specimen of *Coccus agavium* Douglas from Kew, England, was designated by Boratynski (1958) and placed in the British Museum (Natural History). Boratynski also added *Pseudantonina agaves* Chiaromonte as a junior synonym of the above species.

Field features. Adult female elongate-oval, rotund. Body pinkish-yellow; with clear brown areas on dorsum between segments, arranged in two longitudinal lines. Segmentation clearly visible both dorsally and ventrally (Parrott, 1900). Both surfaces lightly dusted with white mealy secretion. Filamentous ovisac secretion often coalescing with ovisacs of other females (Boratynski, 1958).

Found on various species of Agavaceae and Liliaceae. Females completely hidden at bases of leaves. Males usually found on undersides of leaves, at any distance from base (Boratynski, 1958).

Recognition characters: Adult females, mounted, 2.10 to 4.00 mm long, 1.10 to 2.70 mm wide. Body oval; no trace of anal lobes.

DORSUM with lanceolate body setae infrequent; noticeably smaller than those of venter. Enlarged setae with truncated apexes; of several sizes; numerous over entire surface. Macrotubular ducts uncommon; present from tip of abdomen to fifth or fourth segment of abdomen. Microtubular ducts also uncommon; present on abdominal segments 9 through 4 or 9 through 3; rarely found on margin of thorax. Multilocular pores of one kind: quinqueloculars, common over entire surface. Cruciform pores absent.

Anal ring ventral; semicircular, incomplete, noncellular; with three pairs of setae and an additional pair often closely associated.

VENTER with lanceolate body setae long, arranged in clusters forming three longitudinal lines on abdominal segments 8 through 3; posterior anal-lobe setae elongate. Macrotubular ducts rare, varying from five to nine on entire surface. Microtubular ducts absent. Multilocular pores of one kind: quinqueloculars, primarily restricted to margin and submargin of body, in small numbers around spiracles. Cruciform pores numerous; in lateral clusters on abdominal segments 8 through 4, in medial clusters from segment 8 through mesothorax.

Legs small; hind coxae not enlarged, usually with a few pores on either surface; inconspicuous denticle on each claw. Mouthparts variable, from apically acute to blunt. Eyes normal. Antenna 7-segmented; seventh segment with three sensory setae; sixth segment with only one—noticeably longer and narrower than that on segment 5.

Note on nymphs. Boratynski (1958) suggested that there are only three female instars in this species. If this is true it is rather unusual, for in the Pseudococcidae, at least, there are four female instars. Because of this, I assume that this species, also, has four female instars, and I hope to look into the matter further in the future.

Recognition characters: Nymphal female (second or third instar), mounted, 0.67 to 0.97 mm long, 0.30 to 0.45 mm wide. Body oval; no sign of anal lobes.

DORSUM with enlarged setae of two sizes; arranged in eight to ten longitudinal lines.

VENTER with lanceolate body setae of several sizes, nearly as numerous as in

adult female. Macrotubular ducts absent. Microtubular ducts probably present. Quinquelocular pores less numerous than in adult female, present in lateral regions and in areas adjacent to each spiracle. Cruciform pores on segments 8 through 5 most often with two in each submarginal cluster, sometimes with more, also a few present medially. Antenna 6-segmented, with third segment relatively more elongate than in adult female.

Recognition characters: Nymph (first instar), mounted, 0.45 to 0.60 mm long, 0.19 to 0.28 mm wide. Body oval; no sign of anal lobes.

DORSUM with lanceolate body setae absent. Enlarged setae present; fewer than on late instar, above; with three pairs on each segment, forming six longitudinal lines on abdomen and thorax; distributed randomly on head. Macrotubular ducts apparently absent. Microtubular ducts probably present over abdomen, restricted to lateral areas of thorax. Sessile pores absent.

Anal ring as on adult female.

VENTER with lanceolate body setae present. Tubular ducts absent. Multilocular pores of one kind: quinquelocular, as follows (Boratynski, 1958): "First and second abdominal segments each with one quinquelocular pore on each side, situated somewhat nearer median line than the oval pores [cruciform pores]. Ventral side of thorax with 2 longitudinal rows of pores roughly in line with inner margin of base of antennae, each row composed of 4 pores, one each medially at base of each coxa, and one behind base of antenna.... One quinquelocular pore also present near opening of each spiracle." Cruciform pores arranged in submarginal band on abdominal segments 6 through 3; normally with one pore on each side of segment, but occasionally with two.

Legs as on adult female; probably without pores on hind coxae. Mouthparts and eyes as on adult female. Antennae 6-segmented; distribution of sensory setae unknown.

Recognition characters: Adult male, mounted, 1.11 mm long, 0.37 mm wide. Dark red. With one pair of long, waxy, caudal filaments. Two pairs of eyes. One pair of wings; wing spread 1.77 mm. Antennae 10-segmented; the apical segments globular. Genitalia apical, broadly conical. (Data from Boratynski, 1958.)

Recognition characters: Nymphal male (third or fourth instar).

DORSUM with long lanceolate body setae. Enlarged setae absent. Macrotubular ducts present over entire dorsum. Microtubular ducts absent. Quinquelocular pores present in small numbers on abdomen and posterior thorax. Cruciform pores absent.

Invagination just anterior to anal ring.

VENTER differing from that of second- or third-instar female as follows: Posterior anal-lobe setae more elongate. Cruciform pores slightly more numerous; arranged in segmental clusters. Antennae 7-segmented.

Notes. This species resembles *Ovaticoccus californicus* rather distantly, in the following characters of the adult female: few macrotubular ducts; similar distribution patterns of dorsal and ventral quinquelocular pores; cruciform pores in lateral clusters; pores on hind coxae; similar host plants. The adult females of the two species differ as follows: Those of *O. agavium* have many dorsal enlarged setae, a few dorsal microtubular ducts, and numerous medioventral cruciform pores. Those of *O. californicus* have no enlarged setae, no microtubular ducts, and no medioventral cruciform pores. However, some specimens of *O. californicus* have dorsal intermediate setae.

Specimens examined. CALIFORNIA, LOS ANGELES COUNTY: Los Angeles, May 28, 1940, on *Aloe* sp. (Liliaceae), F. R. Platt (10 adult females on 3 slides) UCD; Pasadena, May 12, 1938, on *Yucca* sp. (Agavaceae), Marsh (8 adult females on 4 slides) UCD. SAN BERNARDINO COUNTY: Ivanpah, 1912, on

Agave utahensis var. *nevadensis* (Agavaceae), collector unknown (3 adult females on 2 slides) UCD. SAN DIEGO COUNTY: Torrey Pines, April 6, 1965, on *Agave* sp., J. R. Carlin (1 adult female on 1 slide) UCD.

ARIZONA, MOHAVE COUNTY: Peach Springs, 1921, on *Agave* sp., G. F. Ferris (1 adult female on 1 slide) UCD.

NEW YORK, NEW YORK COUNTY: New York Botanical Gardens, March 29, 1937, on *Agave* sp., P. Rau (3 adult females on 3 slides) UCD.

TEXAS, EL PASO COUNTY: Mount Franklin, near El Paso, July, 1921, on *Agave lophantha* var. *poselgeri* (= *A. lecheguilla*), G. F. Ferris (9 adult females on 6 slides; 2 nymphal females and 1 nymphal male on 1 slide) UCD.

UTAH, WASHINGTON COUNTY: St. George, 1924, on *Yucca* sp., V. M. Tanner (3 adult females on 2 slides) UCD.

Ovaticoccus californicus McKenzie

California ovaticoccin

(Figure 14)

Ovaticoccus californicus McKenzie, 1964.

Field features. Adult female oval, rotund; with no trace of dorsomedial ridge; segmentation conspicuous. Body orange-red. White mealy secretion on dorsal and ventral surfaces. Filamentous ovisac secretion produced dorsally from posterior abdomen and ventrally from abdominal margin.

On *Agave* spp. and *Yucca* spp. these insects have been observed completely hidden at the bases of leaf sheaths, where they were tended by ants (*Crematogaster* sp.). This ovaticoccin has been found also feeding exposed on the crowns and roots of *Baccharis* sp.

Recognition characters: Adult females, mounted, 1.40 to 3.75 mm long, 0.50 to 2.75 mm wide. Body elongate to broadly oval; no trace of anal lobes.

DORSUM with lanceolate body setae exceptionally few and very short—of same length as the shortest on venter. Intermediate setae present on some specimens. Macrotubular ducts present on last three or four abdominal segments. Microtubular ducts absent. Multilocular pores of one kind: quinqueloculars, scattered over entire surface, most numerous on abdomen. Cruciform pores absent.

Anal ring ventral; transversely oval, incomplete, noncellular; with three pairs of small setae and an additional pair in association.

VENTER with lanceolate body setae small, arranged in clusters forming three longitudinal lines on abdominal segments 8 through 3; posterior anal-lobe setae elongate. Macrotubular ducts few; present along body margins of abdominal segments 9 through 5 or 9 through 4. Microtubular ducts absent. Multilocular pores of two kinds: septeloculars (not in illustration) present over entire venter, nearly as common as quinqueloculars and intermingled with them; quinqueloculars present over venter, most numerous on posterior abdominal segments, in slight concentration around spiracles. Cruciform pores usually numerous; arranged in lateral clusters on abdominal segments 9 through 4, sometimes through 3.

Legs very small; hind coxae not enlarged, with a few large pores on dorsal surfaces; minute denticle on each claw (not in illustration). Mouthparts apically acute. Eyes normal. Antenna 7-segmented; seventh segment with three or four sensory setae; sixth segment with only one—noticeably longer and more slender than the one on segment 5.

Notes. Nymph unknown. Although nymphs of "this" species were discussed in the original species description, it now appears that these are not specimens of *Ovaticoccus californicus* but rather of a species of *Oregmopyga*. Several specimens mounted just as they were shedding into the last instar but still inside the larval skins show the following characters, common to species of *Oregmopyga:* anal lobes, numerous

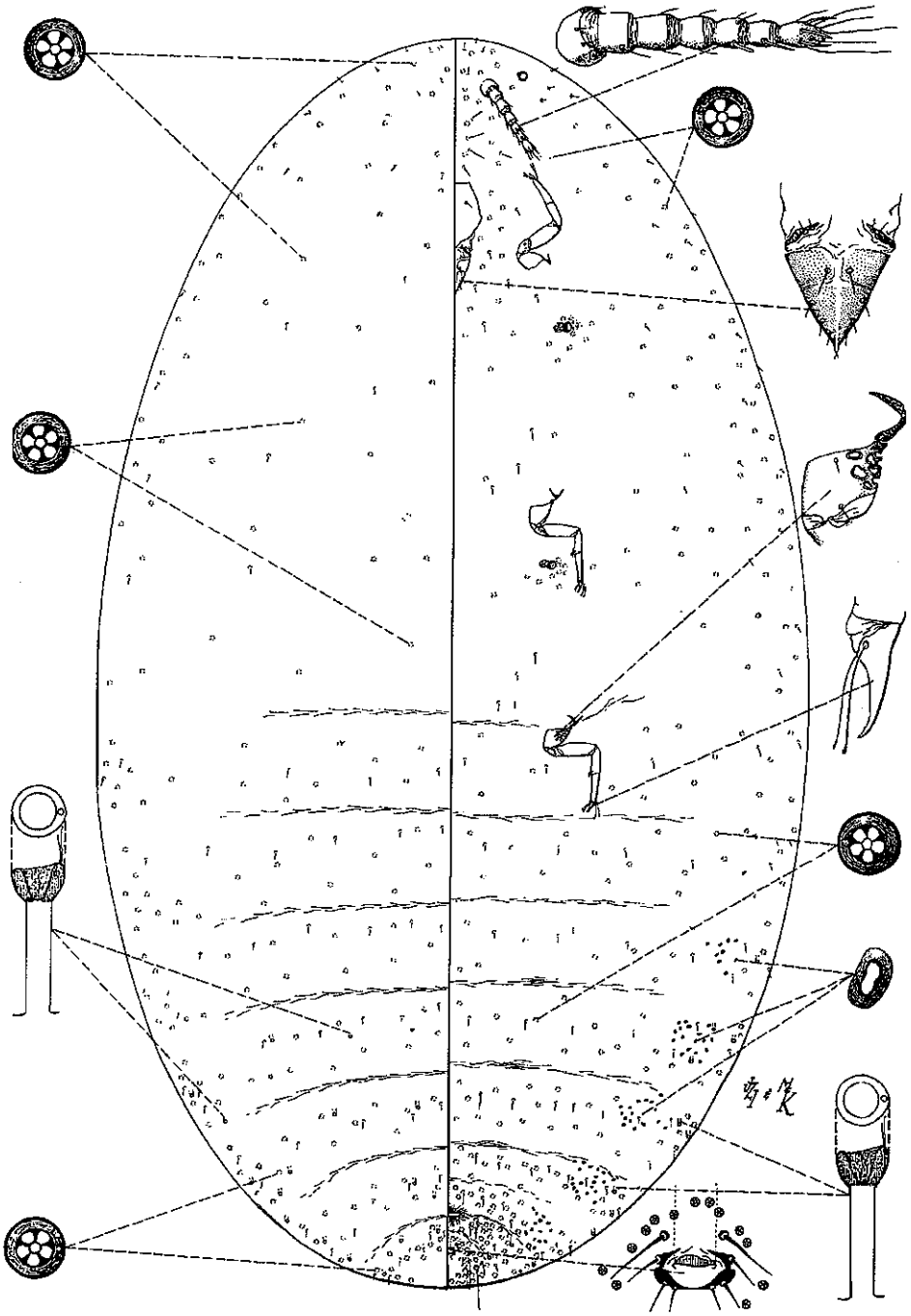

Fig. 14. *Ovaticoccus californicus* McKenzie, adult female. Found in southern California on *Baccharis sarothroides* (Compositae), *Yucca* spp. (Agavaceae), and *Agave* sp. (Agavaceae). (McKenzie, 1964.)

quinquelocular pores, enlarged setae, and enlarged hind coxae.

This species is distinct from all other members of its genus in lacking microtubular ducts.

Specimens examined. CALIFORNIA, LOS ANGELES COUNTY: Lancaster (taken in quarantine at San Diego), December 13, 1956, on *Yucca brevifolia* (Agavaceae), "J. D." (2 adult females and 1 nymphal female on 1 slide) CDA; Lancaster, April 2, 1963, on *Y. brevifolia*, A. Cravens (2 adult females on 2 slides) CDA; Lancaster (northern part), December 27, 1964, on *Y. brevifolia*, D. R. Miller and J. F. Miller (2 adult females on 1 slide) UCD; San Fernando, January 15, 1962, on *Yucca* sp., H. Whitmore (9 adult females on 7 slides) UCD. RIVERSIDE COUNTY: Deep Canyon (near Palm Desert), June 17, 1963, on *Agave* sp. (Agavaceae), E. I. Schlinger (9 adult females on 9 slides) UCD; Deep Canyon (near Palm Desert), January 26, 1965, on *Agave* sp., D. R. Miller (1 adult female on 1 slide) UCD. SAN BERNARDINO COUNTY: 3 miles south of Kramer Junction, December 28, 1964, on *Y. brevifolia*, D. R. Miller and J. L. Miller (2 adult females on 1 slide) UCD; 5 miles south of Kramer Junction, January 24, 1965, on *Y. brevifolia*, D. R. Miller (2 adult females on 1 slide) UCD. SAN DIEGO COUNTY: Borrego Springs, February 25, 1963, on *Baccharis sarothroides* (Compositae), H. L. McKenzie (1 adult female holotype on 1 slide; 6 adult female paratypes on 5 slides) UCD.

Ovaticoccus mackenziei Miller, new species

McKenzie's ovaticoccin

(Figure 15)

Type material. Adult female holotype (1 specimen on 1 slide), 26 adult female paratypes, and 2 nymphal paratypes.

Field features. Adult female elongate; no longitudinal dorsal ridge visible. Body pink or purple, with a few clear brown areas on venter. Legs light yellow. Both body surfaces dusted lightly with white mealy secretion, heaviest on venter. Dorsum producing many filamentous strands, often completely enclosing insect body. Extended stylets as long as total body length.

Restricted to subterranean portions of *Ephedra* sp.; found only under bark.

Adult male with pink body and two pairs of wings. Known only from one shriveled specimen found on *Ephedra* sp., in the material collected near Palm Desert, Riverside County. Found on root. Many empty male sacs observed.

Recognition characters: Adult female holotype, mounted, 2.20 mm long, 1.30 mm wide. (Range 1.70 to 2.70 mm long, 0.60 to 1.70 mm wide.) Body elongate; no sign of anal lobes.

DORSUM with lanceolate body setae short. Enlarged setae absent. Macrotubular ducts present over entire dorsum. Microtubular ducts sparsely distributed, most numerous on ninth abdominal segment. Multilocular pores of one kind: quinqueloculars, scantly distributed over dorsum; most numerous on abdomen, absent from anterior part of thorax, rarely present on head. Cruciform pores absent.

Anal ring ventral; abortive but complete, noncellular; sclerotization only around the three pairs of setae, with no additional setae in association.

VENTER with lanceolate body setae short—of same length as those on dorsum; arranged in clusters forming three longitudinal lines on abdominal segments 8 through 3; posterior anal-lobe setae elongate. Macrotubular ducts restricted to marginal or submarginal areas, absent from head. Microtubular ducts distributed in same areas but absent from one or two abdominal segments. Multilocular pores of one kind: quinqueloculars, most numerous on posterior abdominal segments, present over abdomen and thorax but almost lacking

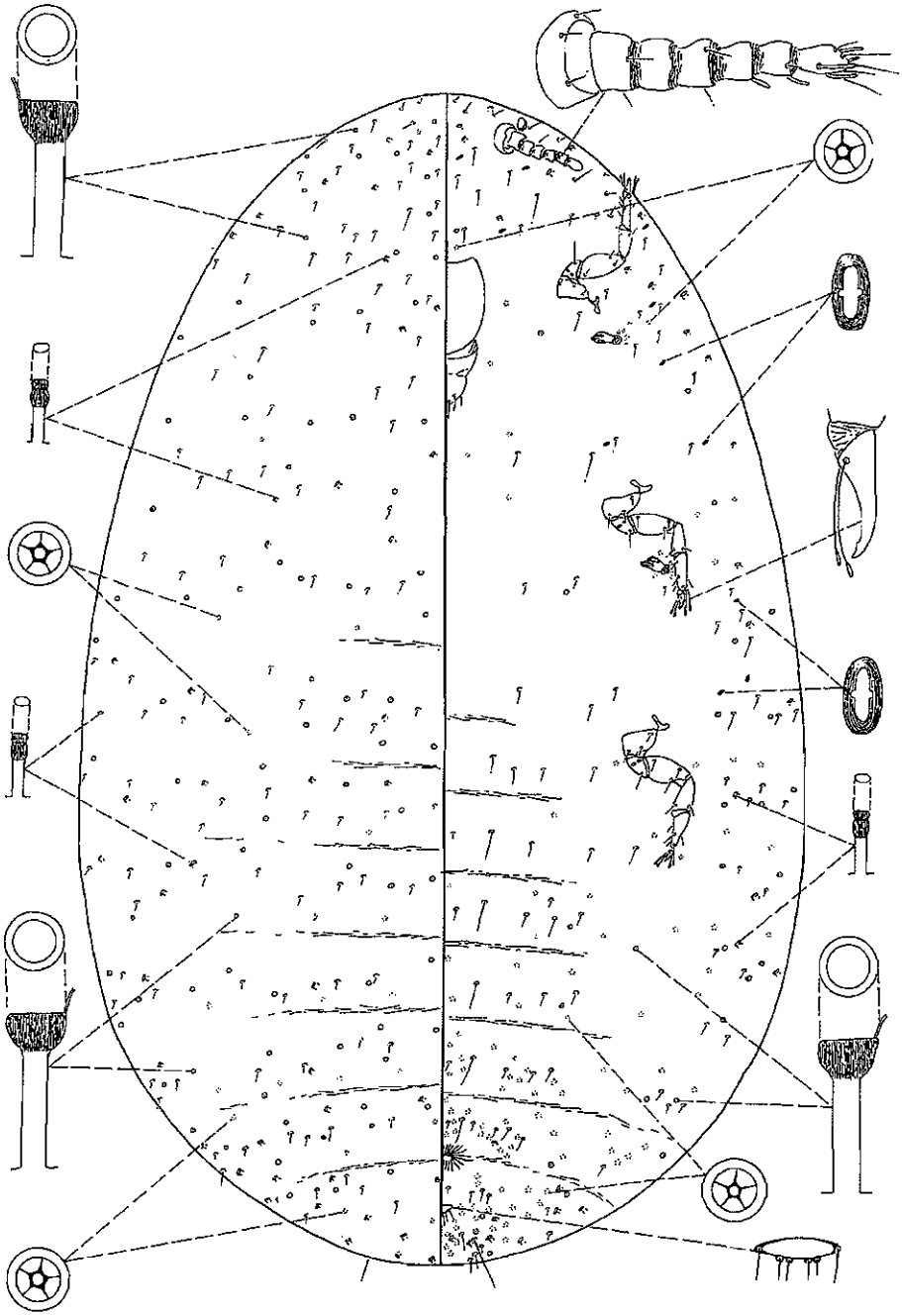

Fig. 15. *Ovaticoccus mackenziei* Miller, new species, adult female. Found in northern and southern California on *Ephedra* spp. (Ephedraceae).

in mediothoracic regions, in small concentrations around spiracles, absent from head. Cruciform pores small; present on lateral margins of thorax and head, medially on anterior thorax and head.

Legs short, robust; hind coxae not enlarged, with no pores; denticle on each claw. Mouthparts apically blunt. Eyes normal. Antenna 7-segmented; seventh segment with four sensory setae—three large and robust, one smaller; sixth segment with only one—of same size as the one on segment 5.

Recognition characters: Nymph (first or second instar), mounted, 0.80 mm long, 0.30 mm wide; no trace of anal lobes.

DORSUM with lanceolate body setae as long as those on venter, arranged in three pairs of longitudinal lines—medial, mediolateral, and lateral. Enlarged setae absent. Tubular ducts absent. Multilocular pores of one kind: triloculars, similar to those of pseudococcids in that the loculi are twisted and not joined centrally; associated with lanceolate body setae and arranged in same pattern. Cruciform pores absent.

Anal ring complete, cellular; with three pairs of setae.

VENTER with lanceolate body setae arranged as on dorsum; posterior anal-lobe setae elongate. Tubular ducts absent. Multilocular pores of one kind: triloculars, arranged in a single pair of sublateral longitudinal lines on abdomen; with two pores anterior to each metathoracic and mesothoracic leg, three pores around each front leg (one posterior, one mesad, and one anterior), one lateral to each spiracle, and one anterior to each antenna.

Legs as on adult female except that denticles on claws are very inconspicuous. Mouthparts apically acute. Antenna 6-segmented; apical segment large and with three sensory setae; fifth segment with only one—of same size and shape as the one on segment 4.

Variations. The principal variations noted are as follows: dorsal quinquelocular pores may be absent from abdominal segments 7 and 6 and from head; ventral quinqueloculars may be present on head and absent from medial regions of abdominal segments 4 and 3; microtubular ducts may be present on all body segments; in an occasional specimen the anal ring is incomplete; and the mouthparts may be apically acute.

Notes. This species is distinct. It is recognized easily by the frail and thinly sclerotized anal ring and by the distribution of cruciform pores on adult females.

The senior author is naming this ovaticoccin for Howard L. McKenzie, who collected this species and several others.

Specimens examined. CALIFORNIA, RIVERSIDE COUNTY: 1 mile north of White Water, January 25, 1965, on *Ephedra* sp. (Ephedraceae), D. R. Miller (1 adult female holotype on 1 slide; 3 adult female paratypes on 2 slides) UCD; 7 miles southwest of Palm Desert, January 25, 1965, on *Ephedra* sp., D. R. Miller (2 adult female paratypes on 2 slides) UCD (collection included also 1 shriveled adult male and many male sacs). SAN BENITO COUNTY: 5 miles east of Panoche Pass, January 23, 1965, on *Ephedra* sp., D. R. Miller and F. D. Parker (4 adult female paratypes on 3 slides) BM, UCD, USNM; Panoche Pass, March, 1939, on *Ephedra californica*, G. F. Ferris (4 adult female paratypes on 1 slide; 2 adult female paratypes and 2 nymphal paratypes on 1 slide) UCD. SAN BERNARDINO COUNTY: 10 miles southwest of Hesperia, April 17, 1965, on *Ephedra* sp., D. R. Miller and J. F. Miller (1 adult female and 1 nymph on 2 slides) UCD; Morongo Valley, February 26, 1963, on *E. californica*, H. L. McKenzie (5 adult female paratypes on 5 slides) CDA, UCD. SAN DIEGO COUNTY: Coyote Creek, January 27, 1965, on *Ephedra* sp., D. R. Miller (4 adult female paratypes on 3 slides) FCA, UCD.

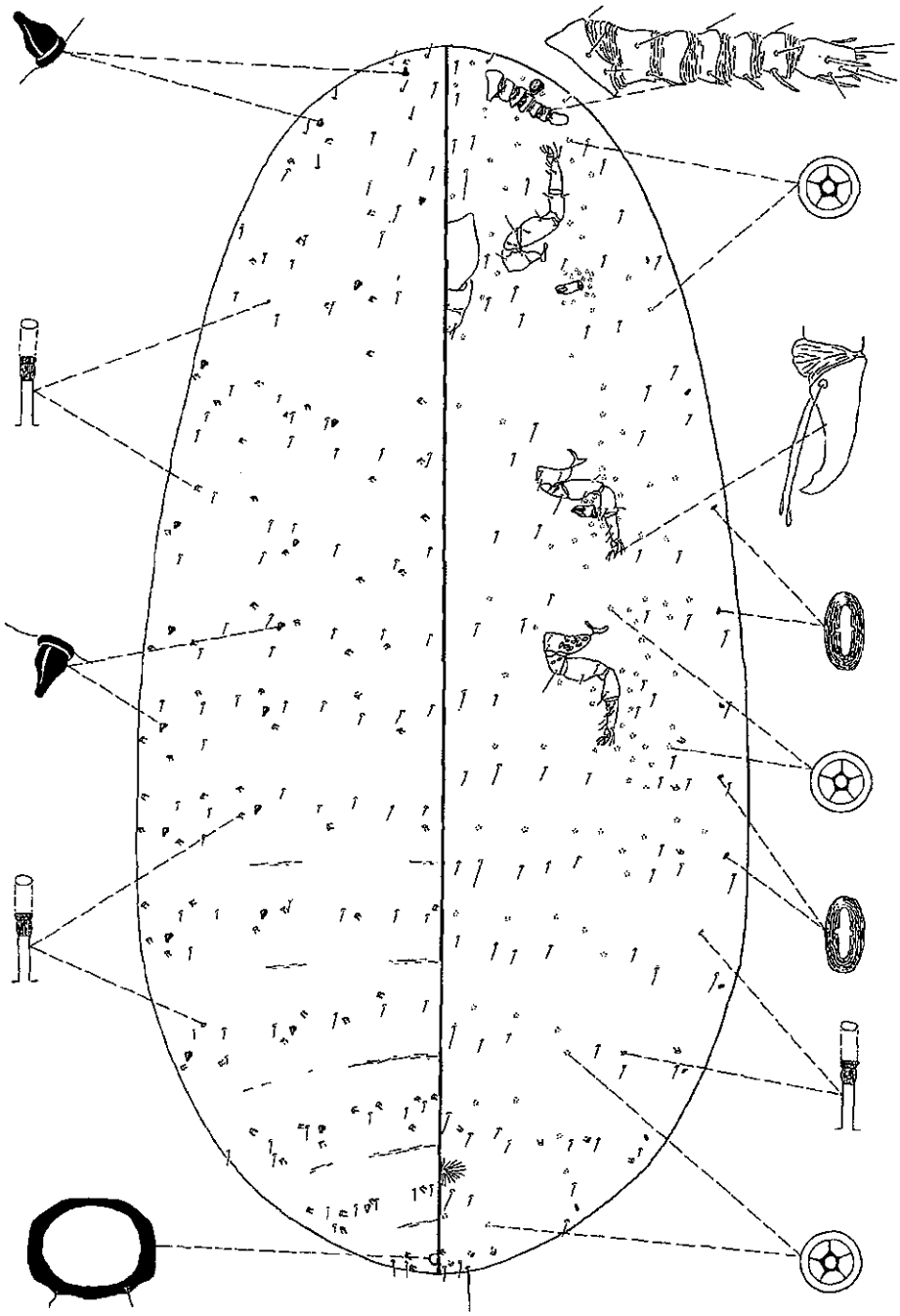

Fig. 16. *Ovaticoccus parkerorum* Miller, new species, adult female. Found in northern California on *Haplopappus linearifolius* (Compositae).

Ovaticoccus nativus (Parrott)

Native ovaticoccin

Gymnococcus nativus Parrott, 1900. (Hunter, 1902; Cockerell, 1905; Dean, 1909; Lawson, 1917; Ferris, 1955.)

Ovatococcus nativus (Parrott) Lindinger, 1957 (misspelling of *Ovaticoccus nativus*).

Ovaticoccus nativus (Parrott) Boratynski, 1958. (Hoy, 1963; McKenzie, 1964.)

Note. The following information is taken from Parrott's original description (1900).

Field features. Adult female rounded-oval to pyriform. Segmentation distinct, both dorsally and ventrally. Body red. No waxy secretions observed.

Found at bases of grass stems.

Recognition characters: Adult females, mounted, approximately 3.00 mm long, 2.00 mm wide.

Both surfaces with lanceolate body setae and macrotubular ducts. Sessile pores most numerous in caudal regions. Anal ring circular, complete; with three pairs of setae.

Legs stout. Spiracle with pores in or near atrium. Antennae 7-segmented.

Note. I am leaving this species in *Ovaticoccus* for the present, because I have seen no specimens. However, it is reasonable to believe that this species belongs in *Spiroporococcus*, because of the pores associated with the spiracular atrium. It is difficult to determine the location of these pores, because Parrott (1900) did not actually state that the pores were in the atrium, nor did he state otherwise. In the original description he said: "Exterior portion of spiracle circular, disk-like, surrounded on its outer margin by small round glands, from twelve to twenty in number, placed close together in a crescentic group." He presented a drawing of the spiracle, which shows the pores separate from the atrium. This is misleading, however, for he illustrated the spiracle of *Spiroporococcus ruber* (Parrott and Cockerell) in the same manner, and it is now known positively that *S. ruber* has pores in the spiracular atria.

Ovaticoccus parkerorum Miller, new species

Parker ovaticoccin

(Figure 16)

Type material. Adult female holotype (1 specimen on 1 slide) and 7 adult female paratypes.

Field features. Adult female oval, rotund; 12 body segments readily visible. Microscopic examination was needed to reveal the three dorsal longitudinal ridges, one medial and two mediolateral. Body pink, with clear brown areas over intersegmental lines. Legs short, yellow. White mealy secretion absent from dorsum; on venter not heavy enough to conceal body color. Filamentous ovisac secretion absent.

Located on roots of host, under bark.

Recognition characters: Adult female holotype, mounted, 1.40 mm long, 0.90 mm wide. (Range 1.40 to 1.90 mm long, 0.80 to 1.10 mm wide.) Body oval; no sign of anal lobes.

DORSUM with lanceolate body setae nearly as long as the smallest on venter. Enlarged setae present from eighth abdominal segment through head; usually with two pairs on each segment, arranged in marginal and submarginal longitudinal lines. Macrotubular ducts absent. Microtubular ducts present over entire dorsum; often associated with enlarged setae. Sessile pores absent.

Anal ring distinctly dorsal; circular, complete, noncellular; with one very distorted and inconspicuous pair of setae and no additional setae in association.

VENTER with lanceolate body setae arranged in clusters forming five longitudinal lines on abdominal segments 8 through 3; posterior anal-lobe setae elongate. Macrotubular ducts absent.

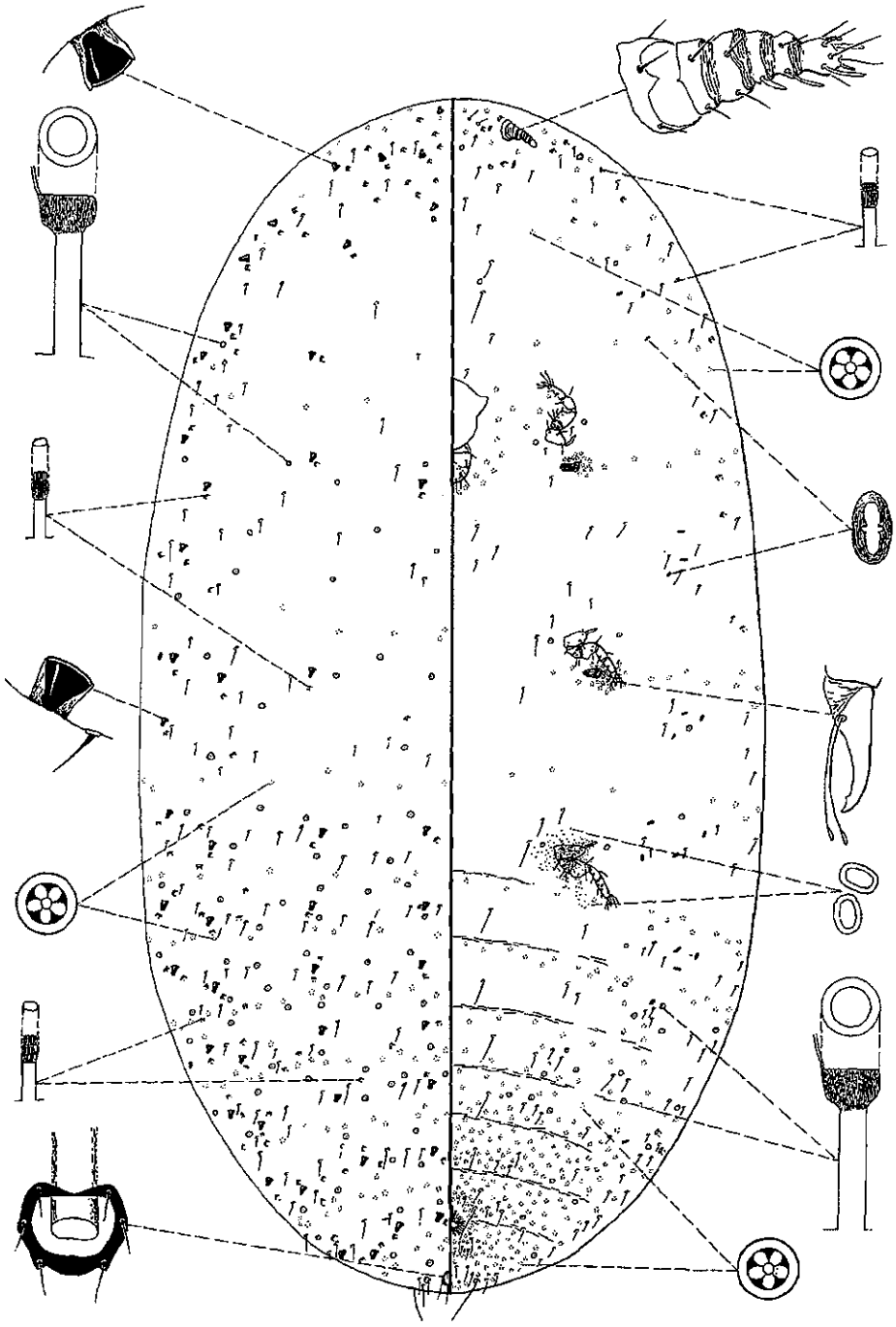

Fig. 17. *Ovaticoccus salviae* Miller, new species, adult female. Found in southern California on *Salvia* spp. (Labiatae).

Microtubular ducts present on segments 9 through 7. Multilocular pores of two kinds: quinqueloculars present from tip of abdomen through head—with some concentration around spiracles, on thorax, and on head; triloculars rare, present only in thoracic region. Cruciform pores arranged in marginal band from ninth abdominal segment through prothorax.

Legs short, robust; hind coxae not enlarged, with a few very faint dorsal pores; denticle on each claw. Mouthparts apically blunt. Eyes normal. Antenna robust, 7-segmented, with segments noticeably short; segment 7 with four or five sensory setae; segment 6 with only one—slightly larger than that on segment 5.

Variations. Significant variations include occasional absence of enlarged setae from some segments—interrupting the longitudinal lines—and a few more microtubular ducts on ventral abdomen.

Notes. This ovaticoccin is quite distinct from all other known species. The adult female is easily distinguished by the absence of macrotubular ducts; paired lines of enlarged setae; and a complete, circular, anal ring, with only one pair of setae.

The species is named after Frank and Ellen Parker, in recognition of their help in collecting specimens and preparing illustrations.

Specimens examined. CALIFORNIA, SAN BENITO COUNTY: Panoche Pass, January 23, 1965, on *Haplopappus linearifolius* (Compositae), D. R. Miller and F. D. Parker (1 adult female holotype on 1 slide; 7 adult female paratypes on 4 slides) CDA, UCD, USNM.

Ovaticoccus salviae Miller, new species

Salvia ovaticoccin

(Figure 17)

Type material. Adult female holotype (1 specimen on 1 slide) and 26 adult female paratypes.

Field features. Adult female elongate, rotund; with longitudinal mediodorsal ridge. Body pink; derm smooth and shiny; intersegmental areas demarked both dorsally and ventrally with clear brown; crushed body contents purple. Legs yellow. White mealy secretion present only on venter. Filamentous ovisac secretion produced on dorsum, enclosing posterior three quarters of body.

Known only from *Salvia* sp.; found under bark on roots, crown, or aerial stems—most commonly on stems.

Empty male sac found at Lake Mathews, Riverside County, on aerial stem of *Salvia mellifera.*

Recognition characters: Adult female holotype, mounted, 1.80 mm long, 1.10 mm wide. (Range 1.80 to 3.35 mm long, 0.80 to 1.80 mm wide.) Body elongate-oval; no indication of anal lobes.

DORSUM with lanceolate body setae only slightly shorter than those of venter. Enlarged setae present from eighth abdominal segment through head; arranged in three pairs of longitudinal lines, with one seta per segment in each medial and mediolateral line and two setae per segment in each lateral line—these lines occasionally interrupted; setae recessed into pockets in derm. Macrotubular ducts present from tip of abdomen through prothorax. Microtubular ducts present over entire dorsum; often associated with enlarged setae. Multilocular pores of one kind: quinqueloculars, absent only from medial areas of head; most numerous on posterior abdominal segments. Cruciform pores absent.

Anal ring apical or dorsal; complete, noncellular; with three pairs of setae and no additional associated setae.

VENTER with lanceolate body setae of normal length, arranged in clusters forming three longitudinal lines on segments 8 through 3; posterior anal-lobe setae elongate. Macrotubular ducts distributed sparsely over venter; located laterally and sublaterally except in leg

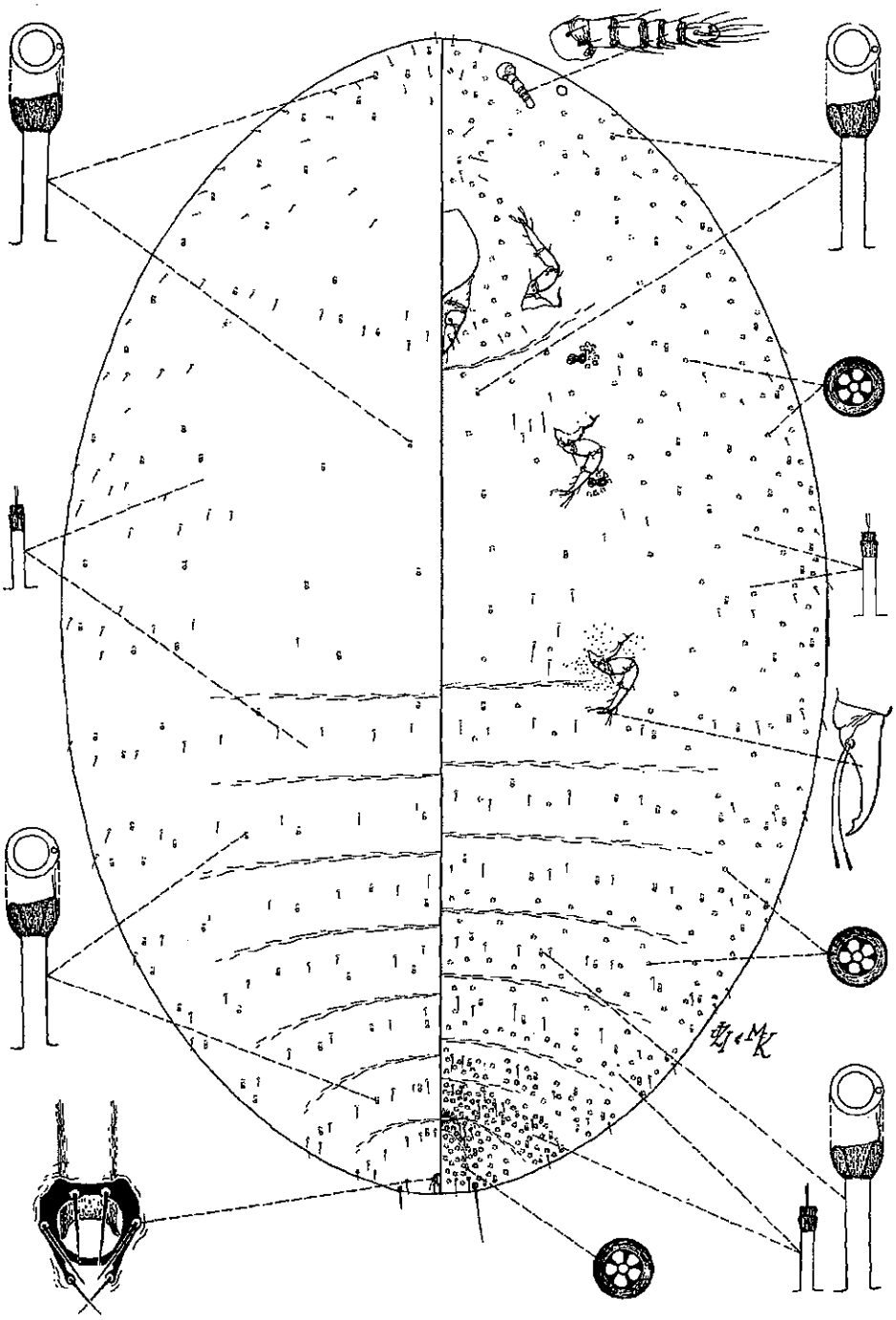

Fig. 18. *Ovaticoccus senarius* McKenzie, adult female. Found in southern California on *Franseria* spp. (Compositae). (McKenzie, 1964.)

and head regions. Microtubular ducts distributed sparsely along body margins. Multilocular pores of one kind: quinqueloculars, present over venter; most numerous on posterior abdominal segments; in heavy concentrations around spiracles and mouthparts; primarily lateral on head. Cruciform pores arranged in lateral clusters; present on abdominal segments 7 through 3, on thoracic segments, and on head.

Legs short, robust; hind coxae with few dorsal pores, but with heavy concentrations of microcruciform pores in association; small denticle on each claw. Mouthparts apically blunt. Eyes with little or no basal sclerotization. Antenna short, very thick; 6-segmented; sixth segment with four sensory setae; fifth segment with only one—slightly longer than the one on segment 4 but much more slender.

Variations. Occasionally on the adult female the dorsal enlarged setae or the ventral cruciform pores or both may be either more or less numerous than on the holotype specimen.

Notes. This species is most closely related to *Ovaticoccus senarius*. Similarities and differences are indicated in the Notes on that species.

Specimens examined. CALIFORNIA, ORANGE COUNTY: Trabuco Canyon, March 28, 1964, on *Salvia apiana* (Labiatae), D. R. Miller and J. A. Froebe (15 adult female paratypes on 15 slides) BM, CDA, FCA, UCD, USNM; Trabuco Canyon, December 26, 1964, on *S. apiana*, D. R. Miller and J. L. Bath (2 adult female paratypes on 1 slide) UCD. RIVERSIDE COUNTY: Corona, December 27, 1964, on *S. apiana*, D. R. Miller and J. F. Miller (2 adult female paratypes on 1 slide) UCD; Lake Mathews, December 22, 1964, on *S. mellifera*, D. R. Miller and J. F. Miller (4 adult female paratypes on 3 slides) UCD (empty male sac also found on aerial stem of this plant). SAN BERNARDINO COUNTY: 1 mile west of Cajon, January 24, 1965, on *S. apiana*, D. R. Miller (2 adult female paratypes on 1 slide) UCD; 11 miles southeast of Camp Angelus, July 30, 1964, on *S. apiana*, D. R. Miller and J. A. Froebe (1 adult female holotype on 1 slide; 1 adult female paratype on 1 slide) UCD.

Ovaticoccus senarius McKenzie

Franseria ovaticoccin

(Figure 18)

Ovaticoccus senarius McKenzie, 1964.

Field features. Adult female oval, rotund; without trace of mediodorsal ridge. Body light yellow; legs white. Small amount of white mealy secretion produced ventrally; small amount of filamentous ovisac secretion surrounding body.

Recorded on aerial roots of *Franseria* sp. when infestations are heavy. In time of stress embedded, cystlike, in crown of host plant—found only by dismembering the plant.

Recognition characters: Adult females, mounted, 1.30 to 3.20 mm long, 0.65 to 2.00 mm wide. Body oval; rarely with small indication of anal lobes.

DORSUM with lanceolate body setae smaller than those on venter. Enlarged setae absent. Macrotubular ducts present over surface; arranged in transverse bands. Microtubular ducts present over entire surface, most numerous on abdomen. Sessile pores absent.

Anal ring dorsal; circular, complete, noncellular; with three pairs of small setae and no additional setae in association.

VENTER with lanceolate body setae small, arranged in clusters forming three longitudinal lines on abdominal segments 8 through 3; posterior anal-lobe setae elongate. Macrotubular ducts present over abdomen; on thorax and head restricted primarily to lateral margins. Microtubular ducts present on lateral body margins. Multilocular pores of one kind: quinqueloculars, most common on posterior abdominal segments,

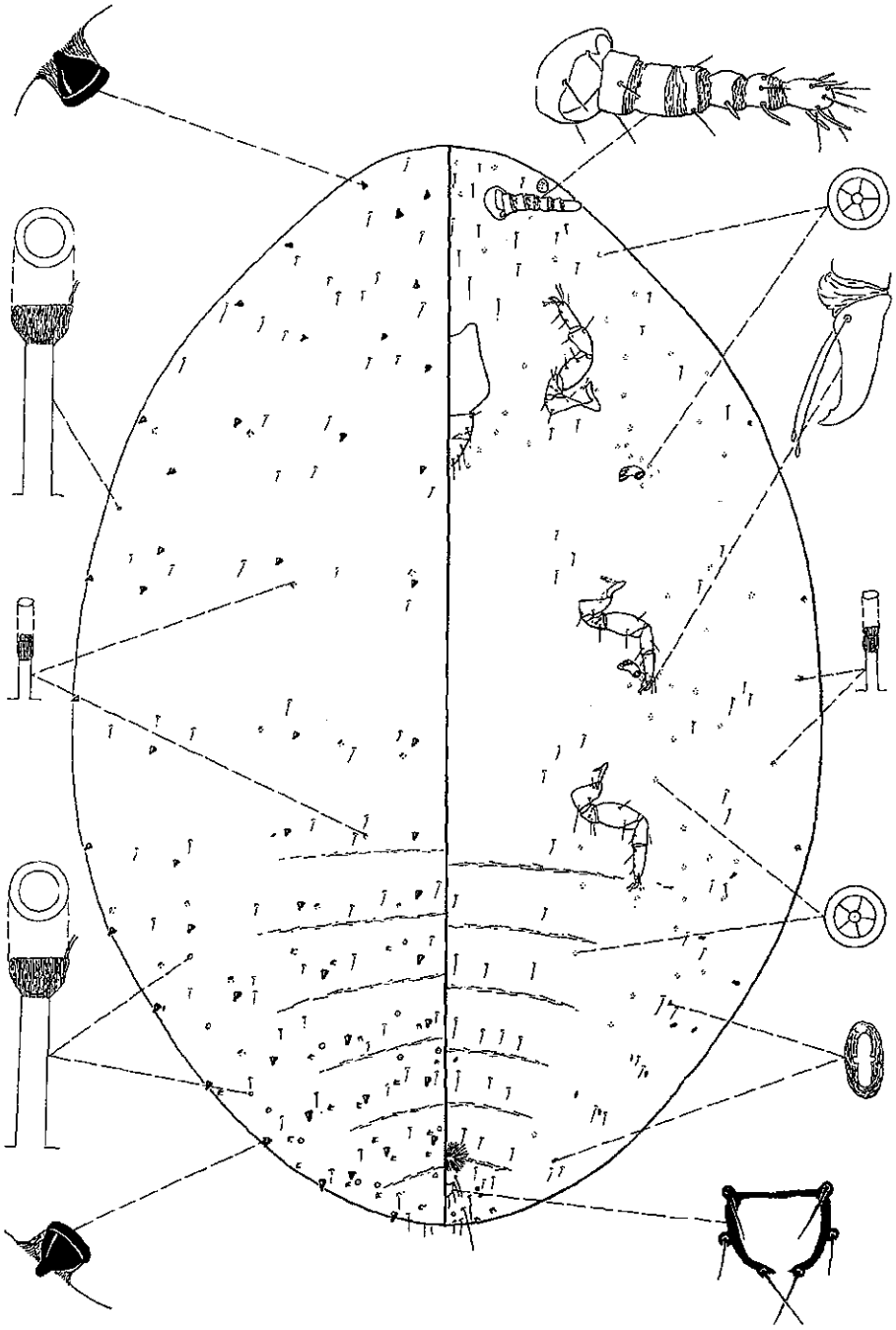

Fig. 19. *Ovaticoccus variabilis* Miller, new species, adult female. Found in northern and southern California on *Artemisia* spp. (Compositae) and *Eriogonum* (?) sp. (Polygonaceae), and in southeastern Montana and western Nevada on *Artemisia* spp. (Compare figure 20.)

progressively less numerous anteriorly; on thorax and head restricted primarily to lateral margins except where clustered around spiracles and mouthparts. Cruciform pores (not illustrated) present along lateral margins from abdominal segment 6 through mesothorax; usually with two or three pores clustered on each segment.

Legs short; hind coxae reduced, occasionally with a few pores on dorsal surfaces; large numbers of microcruciform pores on derm around hind coxae; claws slender, each with conspicuous denticle. Mouthparts normal. Eyes with abnormally small amount of basal sclerotization. Antenna 6-segmented; sixth segment with three sensory setae; fifth segment with only one—of approximately same length as the one on segment 4 but more slender.

Recognition character: Nymph. Enlarged setae the only known character.

Notes. This species is most closely related to *Ovaticoccus salviae*. Adult females of both species have 6-segmented antennae, microcruciform pores, ventrolateral cruciform pores, and anal rings of very similar shape. Adult females of *O. salviae* differ in having dorsal enlarged setae and dorsal quinquelocular pores present, and ventral macrotubular ducts restricted almost entirely to abdomen. Females of *O. senarius*, on the other hand, have no enlarged setae and no dorsal quinqueloculars but have ventral macrotubular ducts numerous over entire surface.

Specimens examined. CALIFORNIA, RIVERSIDE COUNTY: Desert Hot Springs, April 15, 1965, on *Franseria* sp. (Compositae), D. R. Miller and J. F. Miller (2 adult females on 1 slide) UCD. SAN BERNARDINO COUNTY: Twentynine Palms, February 26, 1963, on *F. dumosa*, H. L. McKenzie (3 adult female paratypes on 3 slides) UCD. SAN DIEGO COUNTY: Borrego Springs, January 25, 1963, on *F. dumosa*, H. L. McKenzie (1 adult female holotype on 1 slide; 20 adult female paratypes on 10 slides) UCD; Borrego Springs, January 27, 1965, on *F. dumosa*, D. R. Miller (2 adult females on 1 slide) UCD.

Ovaticoccus variabilis Miller, new species

Variable ovaticoccin

(Figures 19 and 20)

Type material. Adult female holotype (1 specimen on 1 slide) and 30 adult female paratypes. The specimen selected as the holotype is intermediate in several significant characters between the extremes of variation.

Field features. Adult female oval, dorsoventrally flattened; with three inconspicuous longitudinal ridges—one medial and two mediolateral. Body pink, with clear brown areas on intersegmental lines both dorsally and ventrally. Legs white. No white mealy secretion observed. Filamentous ovisac secretion covering less than half of dorsum. Stylets slightly longer than body.

Found under bark, on crowns and aboveground branches of *Artemisia* sp. and *Eriogonum* (?) sp.

Empty male sac found on *Artemisia californica*, on bark in the crown region, in the January, 1965, collection in Monterey County.

External parasitic fly larvae (*Hemeromyia* sp., Milichiidae[2]), found on this ovaticoccin at two different localities, have been reared to maturity. The larvae attack one host insect or sometimes two before pupating. Like their host, they are completely hidden under bark.

Recognition characters: Adult female holotype, mounted, 1.80 mm long, 1.00 mm wide. (Range 1.20 to 2.20 mm long, 0.65 to 1.40 mm wide.) Body oval; very slight indication of anal lobes.

DORSUM with lanceolate body setae slightly smaller than those on venter. Enlarged setae distributed over dorsum

[2] Identification by E. I. Schlinger, University of California, Riverside.

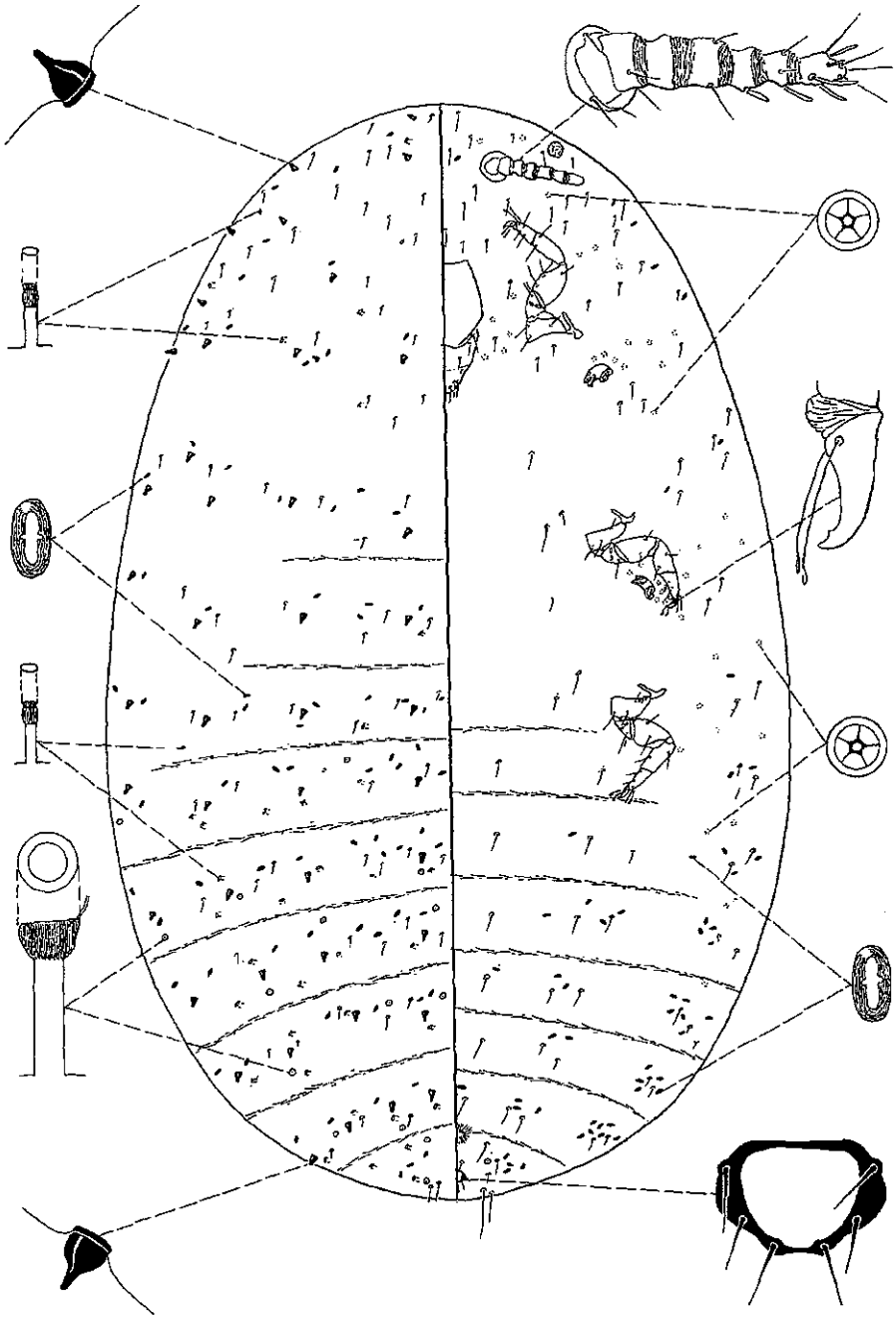

Fig. 20. *Ovaticoccus variabilis* Miller, new species, adult female. (Compare figure 19.)

in four pairs of longitudinal lines—medial, submedial, sublateral, and lateral; lines interrupted on prothorax and head. Macrotubular ducts usually restricted to abdomen. Microtubular ducts fairly numerous on abdomen, sparsely scattered on thorax and head. Multilocular pores of one kind: quinqueloculars, usually absent—occasionally present on metathoracic and mesothoracic areas. Cruciform pores arranged in transverse bands across abdominal and thoracic segments; absent from head.

Anal ring ventral; nearly circular, incomplete (rarely complete), noncellular; with three pairs of setae and an additional pair in association.

VENTER with lanceolate body setae short, arranged in clusters forming three longitudinal lines on abdominal segments 8 through 3; posterior anal-lobe setae slightly more elongate than normal. Macrotubular ducts confined to ninth abdominal segment. Microtubular ducts confined to lateral margins except on ninth abdominal segment. Multilocular pores of three kinds: septeloculars very uncommon, found on anterior abdominal segments and metathorax; quinqueloculars mainly in a sublateral line on abdomen and thorax, with weak concentrations around spiracles and mouthparts and on head; triloculars very uncommon, found on anterior abdominal segments and metathorax. Cruciform pores present in clusters along margins of abdominal segments 9 through 5, just lateral to the line of quinquelocular pores, and in bands across abdominal segments 9 through 6; absent from thorax and head.

Legs short, robust; hind coxae not enlarged, with a few small pores on dorsal surfaces; conspicuous denticle on each claw. Mouthparts and eyes normal. Antenna 7-segmented; seventh segment with four or five sensory setae; sixth segment with only one—slightly longer and more robust than the one on segment 5.

Recognition characters: Nymph (first instar). The following description is based on three mutilated specimens still inside body of holotype female.

DORSUM with lanceolate body setae absent. Enlarged setae present, of same form and arrangement as on adult female. Macrotubular ducts not seen. Microtubular ducts elongate; randomly distributed. Sessile pores not in evidence.

Anal ring as on adult female.

VENTER with three pairs of lanceolate body setae per abdominal segment, arranged in longitudinal lines; posterior anal-lobe setae very elongate. Tubular ducts and sessile pores absent.

Legs large; small denticle on each claw. Mouthparts normal. Eyes large. Antenna 6-segmented, with third segment largest; sixth segment with four sensory setae; fifth segment with only one—much longer and more robust than the one on segment 4.

Variations. The habitats of this species range from very near sea level to elevations of more than 7,000 feet. Because of this diversity of environment, individual specimens show a great amount of variation in some characters. The principal variation noted is in the distribution of cruciform pores. In some specimens (fig. 19) these pores are restricted to the lateral regions of the venter, whereas in other specimens (fig. 20) they are numerous over the entire dorsum also. If these were the only slides available, I would unhesitatingly classify the two insects in distinct species, but the rather long series of specimens available shows many gradations connecting these extremes. The other most variable characters are the form of the anal ring and the amount of derm recession of the enlarged setae. These likewise show a definite continuity over the series of slides, so that I cannot divide the series into separate species.

Notes. This species is most closely

related to *Ovaticoccus agavium* but differs in that the adult females have fewer quinquelocular pores, more tubular ducts on dorsum, and enlarged setae with narrowed apexes, whereas females of *O. agavium* have many quinquelocular pores, few dorsal tubular ducts, and enlarged setae with thick, truncated apexes. *O. agavium* has been found primarily on species of Agavaceae, whereas *O. variabilis* is usually found on *Artemisia* spp. (Compositae).

This species may be related to *O. agenjoi;* both species are found primarily on *Artemisia.* However, the description of *O. agenjoi* indicates that the adult female has definite anal lobes and a cellular anal ring with four pairs of setae. On the other hand, the adult female of *O. variabilis* has no anal lobes and has a noncellular anal ring with only three pairs of setae. Until I can study specimens of *O. agenjoi* I will not be able to determine even to what genus it should be assigned.

The name *variabilis* reflects the great amount of variation found in specimens from different habitats.

Specimens examined. CALIFORNIA, ALPINE COUNTY: Winnemucca Lake, July 14, 1964, on *Eriogonum* (?) sp. (Polygonaceae), J. A. Froebe (4 adult female paratypes on 4 slides) UCD. LASSEN COUNTY: 8 miles west of Susanville, July 18, 1964, on *Artemisia* sp. (Compositae), D. R. Miller (1 adult female holotype on 1 slide; 3 adult female paratypes on 3 slides) UCD. MONO COUNTY: Paradise Camp, January 30, 1965, on *Artemisia* sp., D. R. Miller (2 adult female paratypes on 1 slide) UCD. MONTEREY COUNTY: 6 miles west of Greenfield, January 22, 1965, on *A. californica,* D. R. Miller and F. D. Parker (8 adult female paratypes on 5 slides) CDA, UCD (male sac collected on same plant). SAN BENITO COUNTY: Panoche Pass, January 23, 1965, on *Artemisia* sp., D. R. Miller and F. D. Parker (1 adult female paratype on 1 slide) UCD. SIERRA COUNTY: On Highway 89, 2 miles north of Sagehen Creek, July 6, 1964, on *Artemisia* sp., D. R. Miller (8 adult female paratypes on 8 slides) BM, FCA, UCD, USNM.

MONTANA, PARK COUNTY: Gardiner, August 30, 1964, on *Artemisia* sp., D. R. Miller and J. F. Miller (2 adult female paratypes on 2 slides) UCD.

NEVADA, WASHOE COUNTY: Verdi, June 18, 1964, on *Artemisia* sp., J. A. Froebe (2 adult female paratypes on 2 slides) UCD.

Genus *Spiroporococcus* Miller, new genus

Type of genus. *Fonscolombia yuccae* Ferris, 1919.

Field features. Apparently quite variable.

Generic diagnosis: Adult females. Spiracle with double band of quinquelocular pores in atrium.

Anal lobes small. Anal ring cellular, complete; with three pairs of inconspicuous setae. Enlarged setae absent. Macrotubular ducts present on abdomen and posterior thorax. Microtubular ducts without selerotized orifices; distribution patterns variable. Multilocular pores of only one kind: quinqueloculars, on dorsum in small numbers, restricted to posterior abdomen; on venter present medially on abdominal segments 9 through 7, laterally on abdomen and thorax. Cruciform pores absent from dorsum; present on venter over anterior abdomen, thorax, and head.

Legs medium to large; hind coxae not enlarged, with few or no pores; denticle on each claw. Antennae 7-segmented; slender sensory setae on last three segments.

Notes. This genus is distinct. It is characterized in adult females by the presence of pores in the spiracular atrium and by the distribution patterns of the sessile pores.

At present the genus contains three North American species, all previously included in *Ovaticoccus.* One of the

three—*Spiroporococcus braggi* (Cockerell and Robinson)—is placed here only until adult females can be found. This species is not included in the key because apparently it was described from immature specimens.

KEY TO NORTH AMERICAN SPECIES OF *SPIROPOROCOCCUS*

ADULT FEMALES

1. Cruciform pores in clusters anterior to midlegs and forelegs; microtubular ducts present over entire dorsum ..... *yuccae* (Ferris)
   Cruciform pores not in clusters; microtubular ducts present only on last few abdominal segments of dorsum ..... *ruber* (Parrott and Cockerell)

Spiroporococcus braggi (Cockerell and Robinson)

Bragg's ovaticoccin

(Figure 21)

Fonscolombia braggi Cockerell and Robinson, 1915. (Ferris, 1919, 1921*a*.)

Pseudochermes braggi (Cockerell and Robinson) Lindinger, 1933*b*.

Ripersia braggi (Cockerell and Robinson) Lindinger, 1937.

Tychea braggi (Cockerell and Robinson) Lindinger, 1943.

Gymnococcus braggi (Cockerell and Robinson) Ferris, 1955.

Ovaticoccus braggi (Cockerell and Robinson) Boratynski, 1958. (Hoy, 1963; McKenzie, 1964.)

Field features. Adult female unknown. Nymph bright red. Apparently the nymphs produce a filamentous sac, which does not cover entire body.

Found only on roots of *Berberis repens.*

Recognition characters: Nymph (third instar). Body elongate-oval; anal lobes small.

DORSUM with lanceolate body setae the size of smallest on venter. Enlarged setae absent. Macrotubular and microtubular ducts present over entire dorsum. Multilocular pores of only one kind: quinqueloculars, present only on ninth abdominal segment. Cruciform pores absent.

Anal ring apical; circular, complete, cellular; with three pairs of robust setae and no additional pair present.

VENTER with lanceolate body setae small, arranged in five longitudinal lines on abdominal segments 8 through 3; posterior anal-lobe setae very elongate. Macrotubular ducts present in small numbers over entire surface. Microtubular ducts present in small numbers. Multilocular pores of two kinds: quinqueloculars present in small numbers on abdomen and thorax, with two (sometimes three) found in faint indication of enlarged spiracular atrium; triloculars present on thorax and head in small numbers. Cruciform pores present only on lateral margins of abdomen, one pore per segment.

Legs very large; hind coxae not enlarged, with no pores; denticle on each claw. Mouthparts large, apically blunt. Eyes large. Antenna 7-segmented; seventh segment with two, perhaps three, sensory setae—all slender; sixth segment with only one—very long and slender and questionably of sensory type; segment 5 with single long sensory seta.

Recognition characters: Nymph (second [?] instar) similar to third instar, with the following differences: DORSUM with many enlarged setae, arranged in three pairs of longitudinal lines—medial, mediolateral, and lateral—with six enlarged setae on each segment from eighth abdominal segment through head. VENTER with marginal line of enlarged setae from ninth abdominal segment through head. Mac-

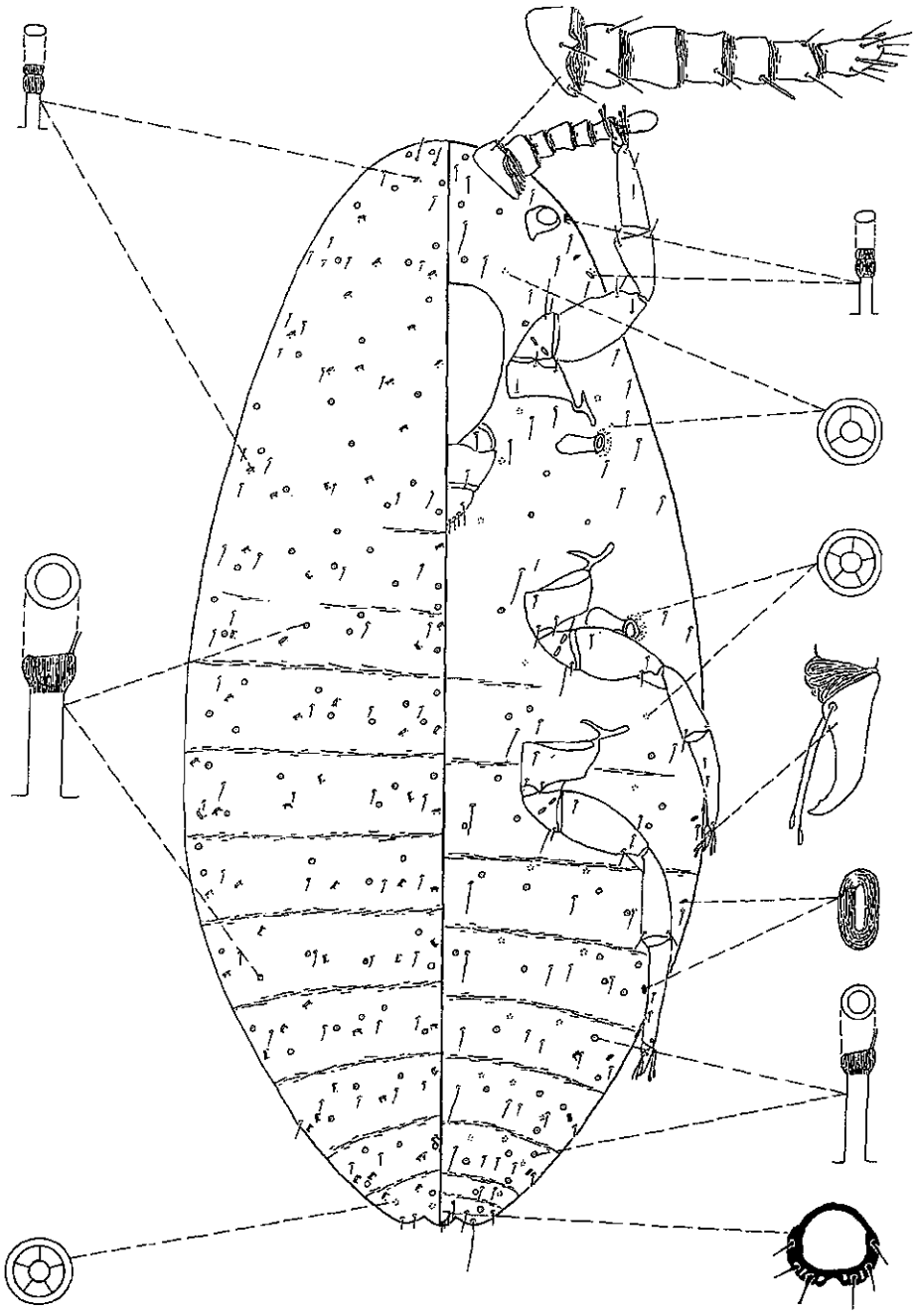

Fig. 21. *Spiroporococcus braggi* (Cockerell and Robinson), third (♀) instar nymphal female. Found in northern Colorado on *Berberis repens* (Berberidaceae).

rotubular ducts absent. Antennae 6-segmented.

Recognition characters: Nymph (first instar) similar to second instar, with the following differences: Dorsal lanceolate body setae absent. Tubular ducts few or absent; when present, arranged in longitudinal lines in same patterns as enlarged setae. Multilocular pores of two kinds: single quinquelocular pore present on thorax, no concentration around spiracles; trilocular pores present only on venter of abdomen, in one medial pair of lines.

Notes. There is no vulva on any of the specimens seen. Apparently this bothered Cockerell and Robinson, for in the original description they said: "Our examples, though adult, had not begun to produce eggs." They failed to state why they were positive that the specimens were adults.

Undoubtedly this species is related to *Spiroporococcus yuccae* and *S. ruber*, but I cannot make useful species comparisons because the information is so incomplete.

Specimens examined. COLORADO, BOULDER COUNTY: Boulder, May 31, 1911, on *Berberis repens* (Berberidaceae), Bragg (16 nymphal females on 6 slides, marked "type material") UCD.

Spiroporococcus ruber
(Parrott and Cockerell)

Red ovaticoccin

(Figure 22)

Gymnococcus ruber Parrott and Cockerell (*in* Cockerell and Parrott, 1899). (Parrott, 1900; Ferris, 1955.)

Ovaticoccus ruber (Parrott and Cockerell) Boratynski, 1958. (McKenzie, 1964.)

Ovaticoccus ruber (Cockerell and Parrott) Hoy, 1963.

Field features. Parrott (1900) said that females of this species were "more or less pyriform . . . soft, naked . . . with a very little white secretion on the under side; color dull terra-cotta red . . .Surface somewhat shining. . . . The eggs are deposited in a cottony mass, secreted by the female. Often one-half to three-quarters of the insect is covered by a loose mass of cottony threads." He observed that the eggs were "yellow to pinkish red" and that as many as 400 were laid in a single ovisac.

Apparently found in grass sheaths or between grass bundles.

Recognition characters: Adult females, mounted, 4.00 to 6.00 mm long, 3.50 to 4.50 mm wide. Body rotund; slight indication of anal lobes.

DORSUM sparsely covered with lanceolate body setae, noticeably smaller than those on venter. Enlarged setae absent. Macrotubular ducts apparently restricted to abdomen and posterior thorax. Microtubular ducts present on last few abdominal segments only. Multilocular pores of one kind: quinqueloculars, most numerous on last two abdominal segments, with only slight indication of sublateral line on remaining abdominal segments. Cruciform pores absent.

Anal ring apical; subcircular, complete, cellular; with three pairs of reduced and inconspicuous setae.

VENTER with lanceolate body setae not clustered; posterior anal-lobe setae very long. Macrotubular ducts restricted primarily to abdomen, most numerous on posterior part of each segment; a few scattered around legs and mouthparts. Microtubular ducts absent. Multilocular pores of one kind: quinqueloculars, clustered in double ring in spiracular atrium. Cruciform pores restricted primarily to thorax and head, not in clusters; an occasional pore present laterally on anteriormost abdominal segments.

Legs of medium size; hind coxae not enlarged, with no pores; all claws robust, slightly curved, with conspicuous denticles. Mouthparts pointed apically. Eyes normal. Antenna 7-segmented; seventh segment with one or two sen-

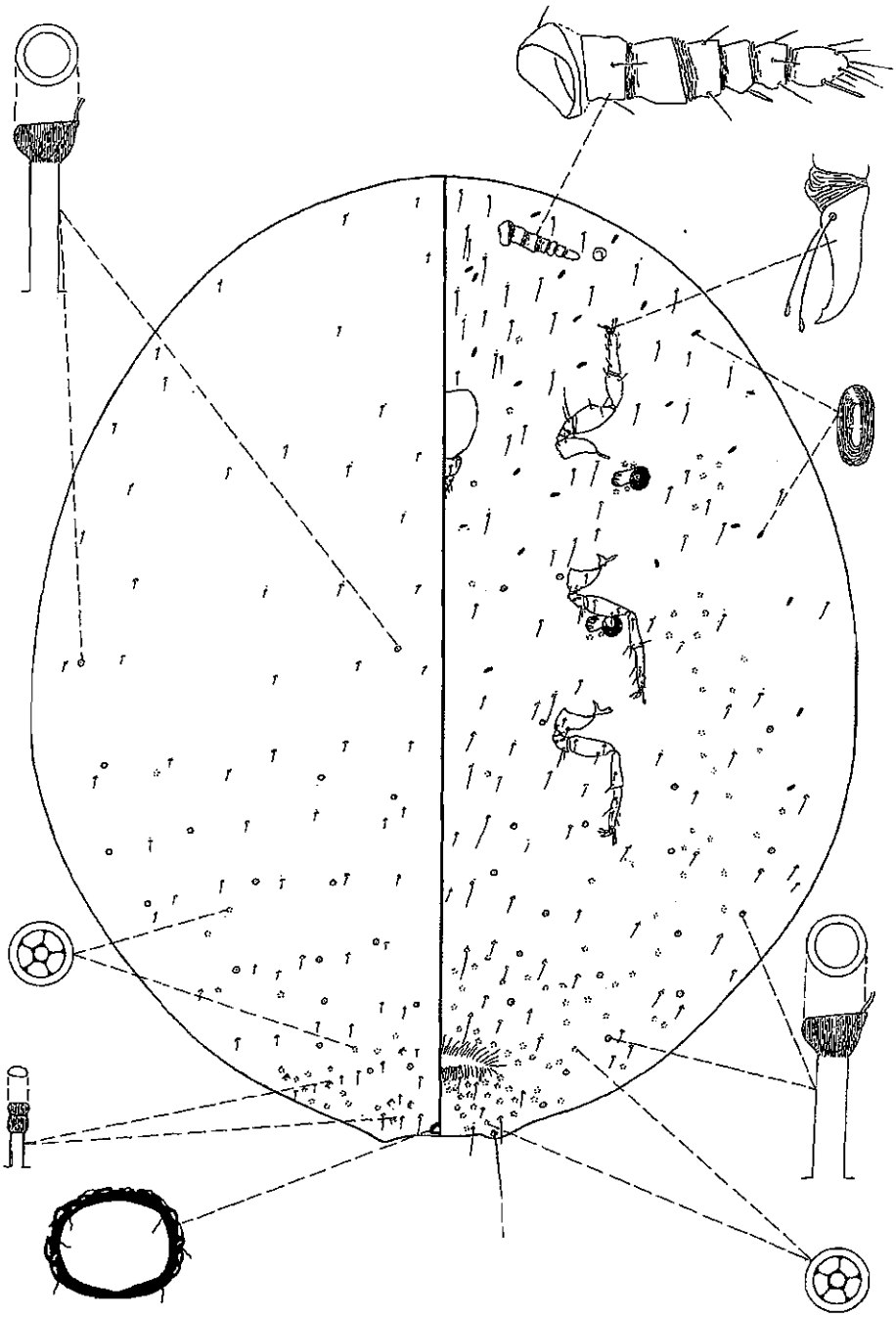

Fig. 22. *Spiroporococcus ruber* (Parrott and Cockerell), adult female. Found in southern New Mexico on *Bouteloua eriopoda* (Gramineae).

sory setae; sixth segment with only one—longer and more slender than the one on segment 5.

Recognition characters: Nymph (first instar, still in egg and inside body of adult female paratype). Body elongate; with no noticeable anal lobes.

DORSUM with enlarged setae apically pointed; in six lines—medial, mediolateral, and lateral—from eighth abdominal segment through head. Tubular ducts absent. Multilocular pores of one kind: quinqueloculars, found in four lines, in close association with medial and mediolateral lines of enlarged setae and on same segments. Cruciform pores absent.

Anal ring apical; complete, cellular; with three pairs of thickened setae.

VENTER with posterior anal-lobe setae unusually elongate. Intermediate setae present. Tubular ducts and sessile pores absent.

Legs and antennae not observed. Spiracle small, almost completely unsclerotized; no pores in atrium. Mouthparts large, apically acute.

Parrott (1900) said that nymphs had 6-segmented antennae, many truncate spines, produced anal lobes, and stout legs.

Notes. This species is most closely related to *Ovaticoccus nativus*, which has quinquelocular pores associated with the spiracular atrium. *Spiroporococcus yuccae* is similar, also, but differs in the following characters: Adult females of *S. yuccae* have oval clusters of cruciform pores in midleg and foreleg regions and microtubular ducts on both dorsum and venter; those of *S. ruber* have no oval clusters of cruciform pores and have only very few microtubular ducts on the dorsum, none on the venter.

Material used for the drawing was in very poor condition, and there may be minor inaccuracies.

Specimens examined. NEW MEXICO, DOÑA ANA COUNTY: Mesilla Park, January 17, 1899, on *Bouteloua eriopoda* (Gramineae) P. J. Parrott (1 adult female "type" on 1 slide; 1 adult female on 1 slide) USNM.

Spiroporococcus yuccae (Ferris)

Yucca ovaticoccin

(Figure 23)

Fonscolombia yuccae Ferris, 1919. (Ferris, 1921*a*.)

Pseudochermes yuccae (Ferris) Lindinger, 1933*b*.

Gymnococcus yuccae (Ferris) Ferris, 1955.

Ovaticoccus yuccae (Ferris) Boratynski, 1958. (Hoy, 1963; McKenzie, 1964.)

Type material. Since Ferris did not designate a holotype of this species in any publication, I here designate as lectotype one of the adult female specimens which he had marked "type" (1 specimen on 1 slide). I have marked as lectoparatypes the remaining 7 specimens of Ferris's type series.

Field features. Ferris (1919) wrote: "Occurring at the base of the leaves; covered with more or less white, woolly secretion; insect, when denuded of secretion, bright red."

Usually on members of family Agavaceae.

Recognition characters: Adult female, mounted, 1.25 mm long, 0.60 mm wide; all specimens of approximately same size. Body oval; small anal lobes evident.

DORSUM with lanceolate body setae noticeably robust; of approximately same length as those on venter. Macrotubular ducts present on abdomen and posterior thorax. Microtubular ducts numerous; present over entire dorsum. Multilocular pores of one kind: quinqueloculars, present on ninth abdominal segment only. Cruciform pores absent.

Anal ring apical; large and heavily sclerotized; of distinctive subcircular shape, complete, with a few inconspicu-

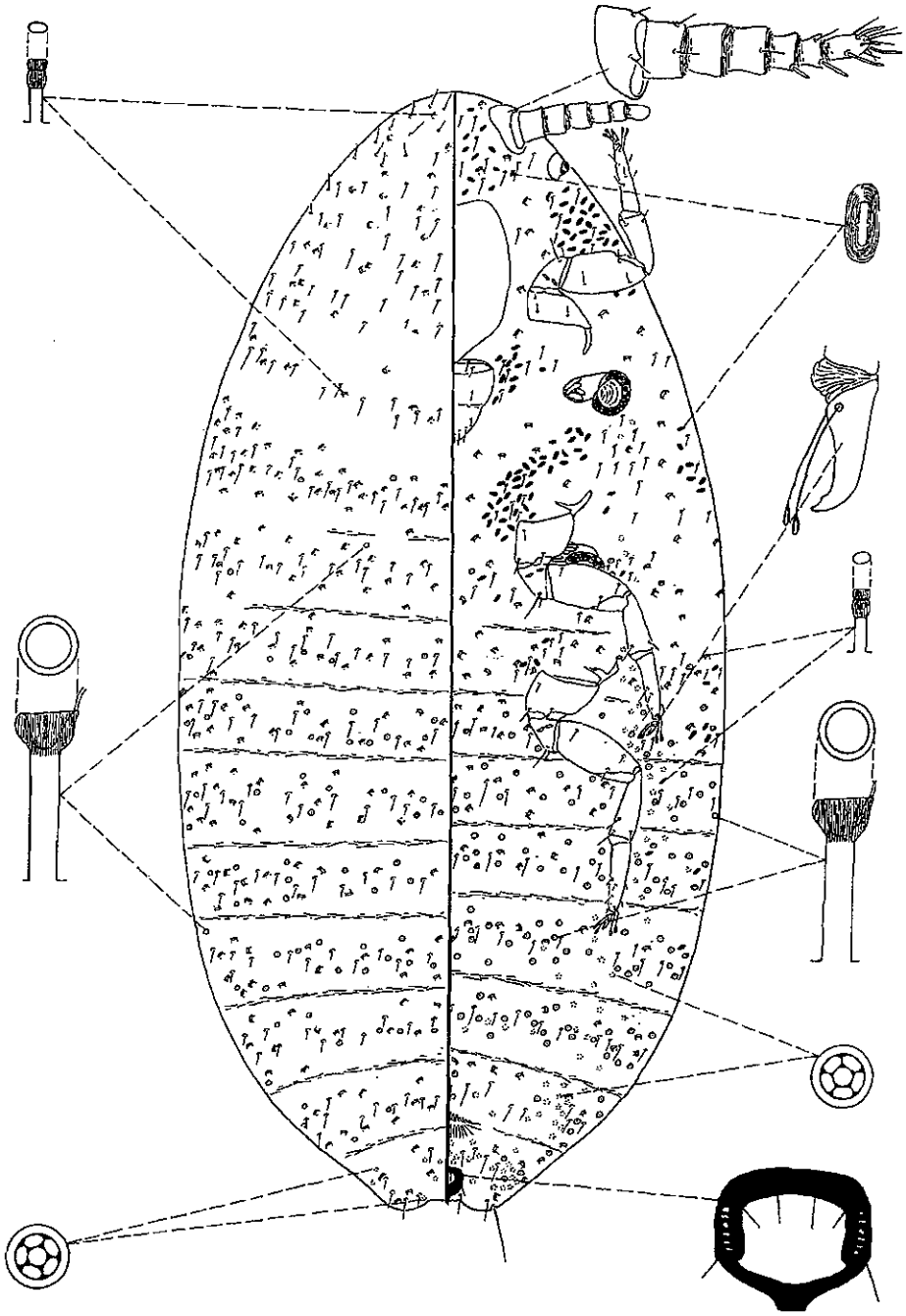

Fig. 23. *Spiroporococcus yuccae* (Ferris), adult female. Found in southeastern Arizona on undetermined grass (Gramineae), in central New Mexico on *Yucca* sp. (Agavaceae), and in southwestern Texas on *Agave lophantha* var. *poselgeri* (=*A. lecheguilla*) (Agavaceae).

ous "cells"; with three pairs of slender setae but no additional setae in evidence.

VENTER with lanceolate body setae small, arranged in clusters forming three longitudinal lines on abdominal segments 8 through 3; posterior anal-lobe setae very elongate. Macrotubular ducts present on abdomen and posterior thorax. Microtubular ducts present over entire surface. Multilocular pores of two kinds: septeloculars (not illustrated) predominant on thorax; quinqueloculars present over abdomen except in medial areas of segments 6 through 3, present in two rows in spiracular atrium. Cruciform pores present in small numbers on lateral margins of anterior abdominal segments; in small clusters anterior to hind leg, on lateral margins of metathorax and mesothorax, and near lateral margins of mouthparts; in large, oval clusters anterior to midlegs and forelegs and between mouthparts and antennae.

Legs very large; hind coxae not enlarged, with a few very minute pores present on ventral surfaces; large denticle on each claw. Spiracles enlarged. Mouthparts large. Eyes noticeably large. Antenna 7-segmented; seventh segment with two sensory setae, perhaps three, all thin; segment 6 with only one—noticeably longer and more slender than the one on segment 5.

Recognition characters: Nymphal female (late instar, probably third). Same size and shape as adult female; anal lobes sometimes absent.

DORSUM with lanceolate body setae infrequent, smaller than those on venter. Enlarged setae present in three pairs of longitudinal lines—medial, mediolateral, and lateral—from eighth abdominal segment through head. Macrotubular ducts absent. Microtubular ducts present over dorsum. Multilocular pores normally absent; rarely a single quinquelocular present on ninth abdominal segment. Cruciform pores absent.

Anal ring as on adult female.

VENTER with lanceolate body setae small, clustered in same patterns as on adult female; posterior anal-lobe setae very large. Macrotubular ducts absent. Microtubular ducts present over entire surface. Multilocular pores of one kind: quinqueloculars; those of abdomen as on adult female; present also in small numbers on thorax and head; only three or four pores found in spiracular atrium, which is indefinite.

Legs and mouthparts as on adult female. Eyes enlarged. Antenna 6-segmented, with third segment longest; setae as on adult female.

Notes. The adult female of this species is similar to that of *Spiroporococcus ruber* in the following characters: presence of quinquelocular pores in spiracular atrium, distribution of macrotubular ducts, small anal lobes, and 7-segmented antennae. That of *S. ruber* differs in having few microtubular ducts, a relatively frail anal ring, and no clusters of cruciform pores, whereas *S. yuccae* has many microtubular ducts, the anal ring large and heavily sclerotized, and many clusters of cruciform pores.

Specimens examined. ARIZONA, COCHISE COUNTY: Huachuca Mountains, July 13, 1940, on undetermined grass (Gramineae), G. F. Ferris (2 adult females and 2 nymphs on 1 slide) UCD.

NEW MEXICO, SOCORRO COUNTY: Blue Canyon, Socorro, July 2, 1918, on *Yucca* sp. (Agavaceae), G. F. Ferris (1 adult female lectotype on 1 slide; 2 adult female lectoparatypes and 5 nymphal female lectoparatypes on 6 slides) UCD.

TEXAS, EL PASO COUNTY: Mount Franklin, El Paso, July, 1921, on *Agave lophantha* var. *poselgeri* (= *A. lecheguilla*) (Agavaceae), G. F. Ferris (2 adult females on 2 slides) UCD.

SUMMARY

Four related genera of Eriococcidae—*Cornoculus* Ferris, *Oregmopyga* Hoy, *Ovaticoccus* Kloet, and *Spiroporococcus* Miller, new genus—are here grouped under the common name ovaticoccin. One genus and eight species are described as new and the remaining 13 species are redescribed in detail. Characters are given also for all available nymphal instars of both sexes, and the adult females of 20 species are shown in drawings.

This paper gives a revised key to North American genera of Eriococcidae and a slightly revised definition of the family; diagnoses of four previously recognized genera, including *Eriococcus* (not grouped in the ovaticoccins); and keys to the known North American species of the four ovaticoccin genera.

Some reorganization of previous classifications has been necessary. *Oregmopyga nudula* (Ferris) has been transferred to the genus *Eriococcus; Ovaticoccus peninsularis* (Ferris) to *Oregmopyga;* and three species of *Ovaticoccus—O. braggi* (Cockerell and Robinson), *O. ruber* (Parrott and Cockerell), and *O. yuccae* (Ferris)—to the new genus *Spiroporococcus.*

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