

A Redescription of *Phenacoccus dearnessi* (Homoptera: Coccoidea: Pseudococcidae)¹

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ABSTRACT

The 4 instars of the female and the 5 instars of the male of *Phenacoccus dearnessi* King are described and illustrated. A key for the separation of all the instars of this species and *P. aceris* (Signoret), a close relative, is included. An attempt is made to correlate the char-

acters of the adult females of the "*Phenacoccus* group" with the characters of the adult males of the "*Ceroplasto* group." Comments are made on the taxonomic significance of the lateral plates on the pupa.

In 1965, a hawthorn tree heavily infested with mealybugs was found at Urbana, Ill. L. J. Stannard, Taxonomist, Illinois Natural History Survey, identified the pseudococcids as *Phenacoccus dearnessi* King. During 1966-69, this species was very abundant in nursery plantings of *Crataegus* and *Cotoneaster apiculata* in northern and central Illinois.

Adult females feeding on the outer branchlets of the host produce large amounts of honeydew which collect on the upper surfaces of the leaves and branches. A sooty mold grows on the honeydew causing blackened leaves and branches and early leaf drop. In some nurseries, the unsightly appearance of infested host plants causes them to be unsaleable. Because *P. dearnessi* is economically important and because there was a paucity of information about its identity and life history, 2 separate studies were initiated. This paper deals solely with the description of the different life stages. A paper on the life history will be published later.

Terminology employed in the description of the adult male is taken mainly from Afifi (1968) and Beardsley (1960).

Measurements are based on 10 specimens.

Phenacoccus dearnessi King

Two-circuli mealybug

Phenacoccus dearnessi King, 1901: 180; 1902: 159. Fernald 1903: 91. Cooley 1904: 128 (misidentification). Jarvis 1911: 69. Ferris 1919: 68. MacGillivray 1921: 144. Essig 1926: 286. Felt and Morrison 1928: 195. McDaniel 1930: 15. Gillett 1935: 161 (possibly same as *P. aceris* (Signoret)). Herrick 1935: 102 (misidentification). Lindinger 1936: 286. Kaston 1938: 236 (misidentification). Ferris 1950: 135; 1953: 397. McKenzie 1960: 713; 1961: 26; 1964: 238; 1967: 231. *Eriococcus dearnessi* (King), Fernald 1903: 73. *Phenacoccus cockerelli* King, 1903: 195. Sanders 1906: 4. Cockerell 1910: 426. MacGillivray 1921: 142. Essig 1926: 286. Ferris 1950: 135. McKenzie 1967: 231. *Phenacoccus betheli* Cockerell, 1912: 301; 1913: 14. Ferris 1919: 20. Essig 1926: 286. Ferris 1950: 135. McKenzie 1967: 231. *Nidularia dearnessi* (King), Lindinger 1933: 108.

Through the courtesy of J. G. Rosen, Jr., American Museum of Natural History, it has been possible to examine part of the type series of *P. dearnessi*. Because a holotype was not designated, we have chosen a slide containing a syntype and labeled it as the lectotype. The original label on the slide is written in King's handwriting as follows: "Phenacoccus dearnessi King Type." Although additional information is not available, it is evident that this specimen is part of the type series. In addition, we have examined 2 vials of unmounted specimens and a single mounted 2nd instar of a male from the same lot of material. We have also examined syntypes of *P. betheli* and *P. cockerelli* in the collection of the U.S. National Museum and we agree that they are synonyms of *P. dearnessi*.

Ferris (1953) and McKenzie (1967) considered *Phenacoccus regnillhoi* Hollinger to be a junior synonym of *P. dearnessi* and examination of the original description of *P. regnillhoi* (Hollinger 1923) reveals that synonymy is a possibility. However, neither Ferris nor McKenzie saw type material. In fact, the whereabouts of the types is unknown; a search of the entomology collected at the University of Missouri, Columbia, where Hollinger worked, was unsuccessful. Because *P. regnillhoi* was collected on *Ostrya virginiana* (Betulaceae) and because *P. dearnessi* is known only from rosaceous hosts, we do not feel justified in considering these species to be synonymous.

Adult Female (4th Instar)

(Fig. 1)

Field Features.—Body convex, dark salmon red, covered with a thin, white, mealy secretion. Body fluid and ostiole secretion salmon red. Found most commonly in crotches of twigs and at base of bud scales, occasionally on lower leaf surfaces. Heavily infested branches appear speckled in white. Upper surfaces of lower branches and leaves often covered with sooty mold growing on honeydew excretions of mealybugs.

Recognition Characters.—Mounted, 2.4-3.9 mm long, 1.7-3.6 mm wide. Body rotund, with slightly protruding anal lobes.

Dorsum with cerarii unusually variable and indefinite, exact number difficult to determine. Anal lobe-cerarii each with 6-11 conical setae, cluster of trilocular pores, 2 or 3 small discoidal pores, and large

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area of basal sclerotization. Remaining cerarii each with 2-13 conical setae; abdominal segments VIII through III or II each with 2 or 3 cerarian setae larger than others and surrounded by small area of basal sclerotization; smaller cerarian setae in loose clusters along body margins, with no basal sclerotization or aggregation of trilobular pores. Frontal and ocular cerarii frequently heavily sclerotized. Rarely anterior abdominal, thoracic, and head cerarii reduced to 2 or 3 conical setae. Trilobular and small discoidal pores scattered over surface. Multilobular disk pores and oral-collar tubular ducts absent. Dorsal body setae conical, of 2 sizes: larger setae about equal in length to cerarian setae, arranged in 3 or 4 pairs of longitudinal lines; smaller setae scattered over surface. Both pairs of ostioles present.

Anal ring dorsal, touching apical margin of abdomen, with 2 rows of conspicuous pores; each of its 6 setae ca. $1\frac{1}{2}$ times longer than greatest diameter of ring.

Venter with multilobular disk pores normally restricted to posterior margins of abdominal segments, rarely with 1 or 2 such pores on anterior margin of abdominal segment VIII; multilobulars present in small numbers on medial areas of abdominal segments IX through VII, rarely with 1 or 2 present on segments VI and V or restricted to segments IX and VIII. Quinquelobular pores normally present on medial areas of thorax between hind 2 pairs of legs, also present near mouthparts, at times present on anterior abdominal segments, rarely with only 1 or 2 such pores on entire venter. Trilobular pores uncommon, nearly absent on medial areas of anterior abdominal segments and thorax, most abundant along body margin. Discoidal pores scattered over surface in small numbers. Oral-collar tubular ducts of 2 indistinct sizes: larger size most abundant, present on medial areas of abdominal segments VIII or VII through segments VI or V, unusually numerous on medial areas of mesothorax, prothorax, and head, also present along body margin; smaller size present on lateral and sublateral areas of abdomen. Anal lobes each with cluster of elongate body setae, several small conical setae, and elongate sclerotized area. Lateral areas of posterior 4 or 5 abdominal segments each with cluster of elongate setae and 1-8 conical setae.

Circuli variable in number, normally with 2, rarely with 1 or 3; largest circulus present between abdominal segments V and IV, remaining circuli either equal in size, or circulus between segments VI and V, when present, smallest. Legs unusually robust for genus; tibiae dorsally with ca. 20 translucent pores; tarsal digitules acute, not extending to tip of claw; claw digitules capitate, extending beyond tip of claw; claws with large denticle on plantar surface near tip. Antennae 9-segmented.

Notes.—This species has been confused with *P. aceris* (Cooley 1904, Herrick 1935). Although both *P. dearnessi* and *P. aceris* normally possess 2 circuli and more than 2 conical setae on each anal lobe cerarius, they are quite different. *P. dearnessi* com-

pletely lacks dorsal oral-collar tubular ducts, normally has multilobular disk pores on abdominal segments IX through VII or VI (rarely 1 or 2 on segments VI and V), possesses 5-13 conical setae in each penultimate cerarius, and does not form a dorsal ovisac. *P. aceris*, on the other hand, possesses large numbers of dorsal oral-collar tubular ducts, normally has multilobulars on abdominal segments IX through IV, possesses only 2-4 conical setae on each penultimate cerarius, and produces a large ovisac which covers the entire dorsum except the head.

The 4th instars of females of *P. dearnessi* and *P. aceris* can easily be separated from the other instars in possessing: 9-segmented antennae, a vulva, multilobular disk pores, and translucent pores on the hind tibia.

The preceding description is based on 122 specimens from 27 localities.

Third Instar of Female

(Fig. 2)

Field Features.—Body elongate oval, dark red-brown after molt; body covered with very thin, white, mealy secretion after feeding commences. Found at base of bud scales.

Recognition Characters.—Same as adult female except as follows. Mounted, 0.9-1.5 mm long, 0.5-1.0 mm wide. Body elongate oval.

Dorsum with 5-11 cerarii, with 5-9 on abdomen and posterior thorax and 0-2 on head. Anal lobe cerarii each with 3-6 conical setae, small cluster of trilobular pores, 0-1 small discoidal pores, area of basal sclerotization; penultimate cerarii each with 3-8 conical setae, small area of basal sclerotization; antepenultimate cerarii each with 3-7 conical setae, small area of basal sclerotization; counting forward from abdominal apex, 4th pair of cerarii each with 2-6 conical setae, no basal sclerotization; remaining cerarii each with 2 or 3 conical setae. Anterior ostioles often difficult to distinguish, but both pairs normally present.

Anal ring normally bent over abdominal apex, with largest portion on dorsum.

Venter with multilobular disk pores absent. Quinquelobular pores present on medial areas of abdominal segment VIII, VII, or VI through head. Oral-collar tubular ducts of 1 size only, present on medial areas of thorax and head, sometimes present on medial and lateral areas of abdominal segments VIII and VII.

Circuli variable in number, normally with 1, rarely with 2. Legs normal for genus; tibiae without translucent pores. Antennae 7-segmented, 7th segment sometimes partially divided.

Notes.—Third instars of females of *P. dearnessi* and *P. aceris* are similar. The most discrete difference is the number of cerarii; *P. dearnessi* possesses 5-11 pairs, whereas *P. aceris* has 15-18. In addition, the former species has fewer quinquelobular pores, more oral-collar tubular ducts, more conical setae in the last 3 pairs of cerarii, and only the pos-

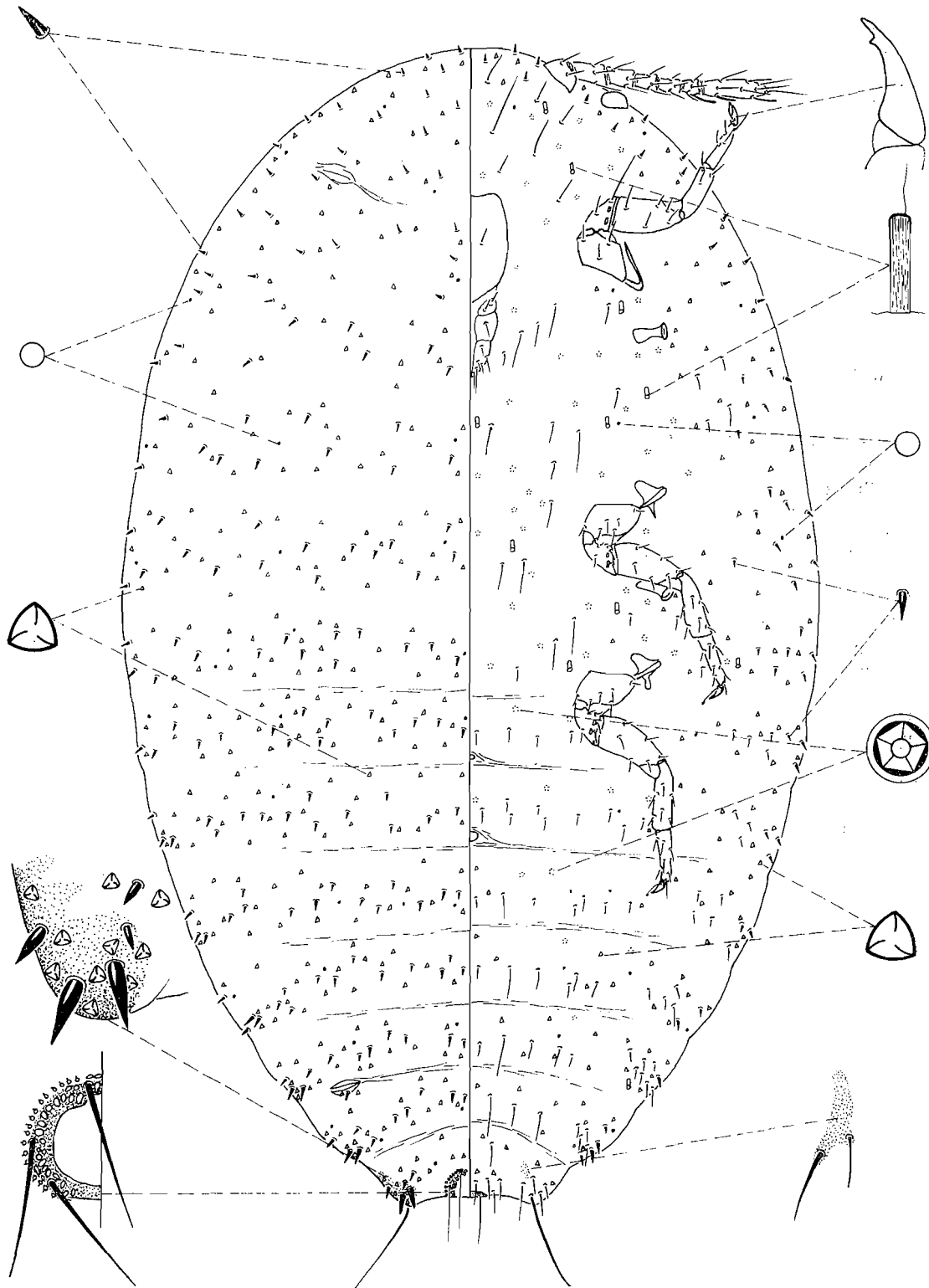


FIG. 2.—*P. dearnessi*. Third instar of female (specimen from Urbana, Ill., Apr. 29, 1969; on *Crataegus crus-galli* (Rosaceae).)

terior 2 or 3 cerarii possess basal sclerotization; in *P. aceris* normally all cerarii possess basal sclerotization.

The 3rd instars of females of *P. dearnessi* and *P. aceris* may be distinguished from the other instars in possessing: no dorsal oral-collar tubular ducts or multilocular disk pores, at least 1 circulus, and 7-segmented antennae.

The preceding description is based on 32 specimens from 3 localities.

Second Instar of Female

(Fig. 3)

Field Features.—Body elongate oval, dark salmon red after molt; body covered with thin, white, mealy secretion after feeding begins. Found on lower leaf surface generally along midvein. During winter, migrates to crevices, roughened areas, or loosened bark on branches or trunk of plant. After settling, nymph produces small amount of mealy secretion laterally on plant surface.

Recognition Characters.—Same as adult female except as follows. Mounted, 0.9–1.0 mm long, 0.5–0.6 mm wide. Body elongate oval.

Dorsum with 6–8 pairs of cerarii, restricted to abdomen and posterior portion of thorax. Anal lobe cerarii each with 2 conical setae, 2 or 3 trilocular pores, and large area of basal sclerotization. Remaining cerarii each with 2 conical setae, 1–3 trilocular pores, and no basal sclerotization. Oral-collar tubular ducts present in disrupted line along body margin, also present on medial and submedial areas of thorax and head; absent from medial areas of abdominal segments IX through IV (1 specimen with 1 oral-collar tubular duct on medial area of abdominal segment V). Ostioles small, rarely absent.

Anal ring bent over posterior apex of abdomen, largest portion normally on dorsum.

Venter without multilocular disk pores. Quinquelocular pores present on medial and sublateral areas of abdominal segments IX or VIII through head. Trilocular pores restricted to lateral areas near body margin. Discoidal pores present on sublateral areas forming 1 pair of longitudinal lines. Oral-collar tubular ducts of 2 sizes, normally present on medial areas of abdominal segment VII and/or segment VI, also forming sublateral line on abdomen, lightly scattered over thorax and head. Anal lobes with area of sclerotization, without clusters of elongate body setae and conical setae.

Circulus absent. Legs normal for genus; tibiae without translucent pores. Antennae 6-segmented.

Notes.—Second instars of females of *P. dearnessi* and *P. aceris* are distinctive. The former species possesses 6–8 pairs of cerarii and abdominal and dorsal oral-collar tubular ducts. *P. aceris*, on the other hand, has 17 or 18 pairs of cerarii and no abdominal or dorsal oral-collar tubular ducts. (Because only a single specimen of this instar of *P. aceris* is available, it may be necessary to alter this comparison in the future.)

The 2nd instars of females of *P. dearnessi* and

P. aceris may be distinguished from all other instars in possessing: no medial or submedial trilocular pores on venter, no circulus, and 6-segmented antennae.

The preceding description is based on 12 specimens from 2 localities.

First Instar (Sexes not Distinguished)

(Fig. 4)

Field Features.—Body oval, light yellow, during diapause body light pink; body covered with very thin, white, mealy secretion after feeding begins. Found under body of parent, or on lower leaf surface. Found in crevices or under loose bark during diapause.

Recognition Characters.—Same as adult female except as follows. Mounted, 0.4–0.6 mm long, 0.2–0.3 mm wide. Body elongate oval.

Dorsum with 8–15 pairs of cerarii; cerarian setae becoming progressively smaller and farther apart anteriorly. Anal lobe cerarii each with 2 conical setae, 1 large trilocular pore, 1 small trilocular, and large area of basal sclerotization. Remaining cerarii same as those on anal lobes except nonsclerotized; anterior abdominal cerarii each with 1 large and 1 small conical seta; no cerarii on head. Trilocular pores of 2 sizes: larger size present between conical setae of each cerarius, forming 1 pair of longitudinal lines; smaller size scattered over remainder of dorsum, forming 4 pairs of longitudinal lines on abdomen, more randomly dispersed on thorax and head. Discoidal pores absent. Conical setae on medial, submedial, and sublateral areas slightly smaller than cerarian setae, forming 3 pairs of longitudinal lines. Ostioles, when present, indicated only by small slit in derm.

Anal ring normally bent over apex of abdomen.

Venter without multilocular disk pores. Quinquelocular pores normally present near spiracles, sometimes present near mouthparts, rarely entirely absent. Trilocular pores slightly smaller than smallest dorsal triloculars, forming 1 pair of longitudinal lines on submedial areas of abdomen, lightly scattered over thorax and head. Small discoidal pores present on abdomen and posterior thoracic segments, forming 1 pair of sublateral longitudinal lines. Oral-collar tubular ducts absent. Anal lobes each with small sclerotized area and without cluster of elongate or conical setae.

Circulus normally absent, rarely present. Legs normal for genus; tibiae without translucent pores. Antennae 6-segmented.

Notes.—First instars of *P. dearnessi* and *P. aceris* are similar. The former species differs in possessing no oral-collar tubular ducts; *P. aceris* has 2 such ducts near the antennae.

The 1st instars of *P. dearnessi* and *P. aceris* may be distinguished from all other instars in possessing: no tubular ducts, or if present, restricted to head; ventral trilocular pores on submedial areas of abdomen; no dorsal discoidal pores; normally no circulus; and 6-segmented antennae.

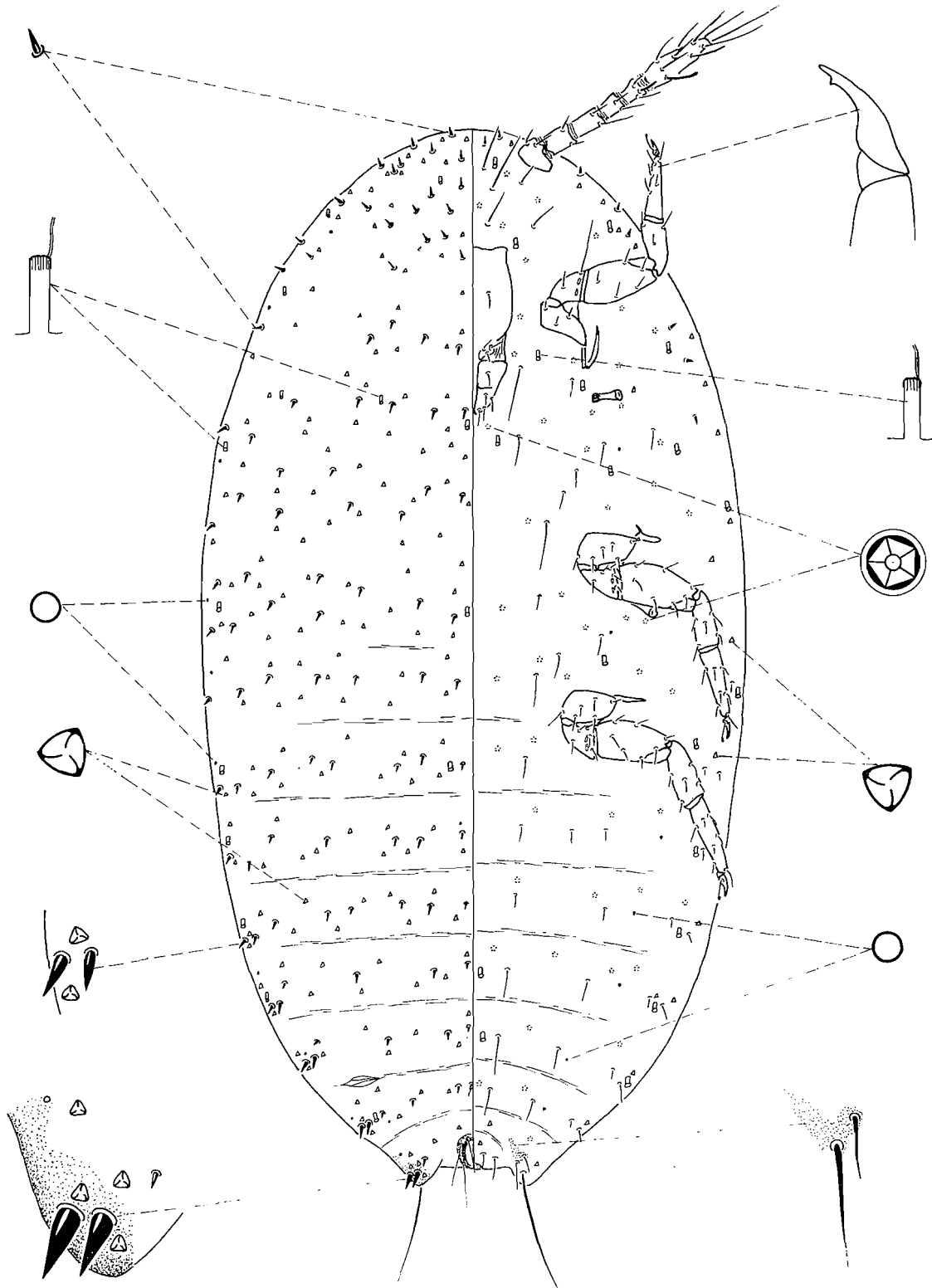


FIG. 3.—*P. dearnessi*. Second instar of female (specimen from Urbana, Ill., Jan. 8, 1970).

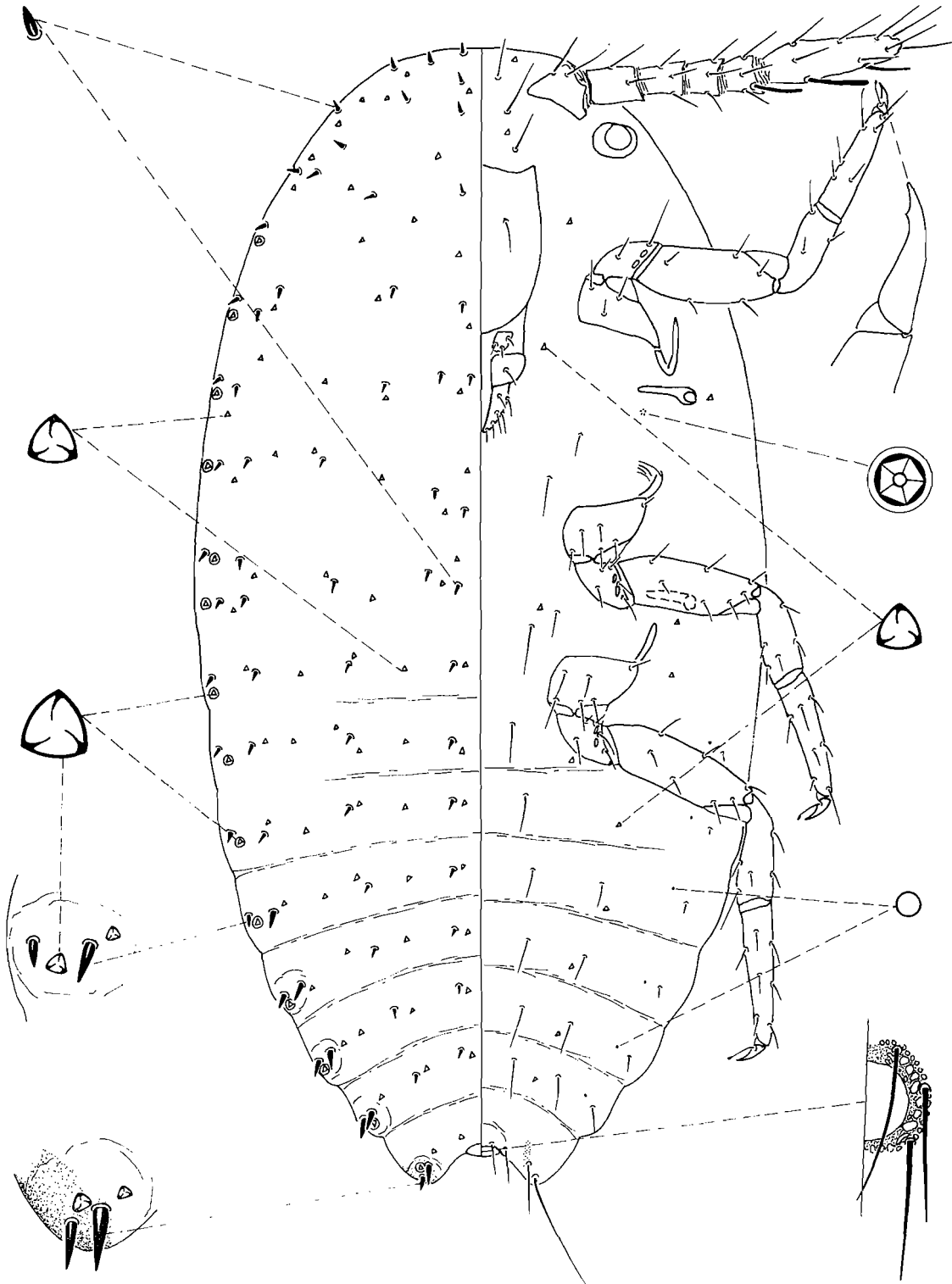


FIG. 4.—*P. dearnessi*. First instar (specimen from Urbana, Ill., July 7, 1968).

The preceding description is based on 170 specimens from 9 localities.

Adult Male (5th Instar)

(Fig. 5)

Field Features.—Body elongate, light tan-brown; wings nearly hyaline. With 2 pairs of waxy caudal filaments; just before emergence, filaments projecting from 1 end of overwintering "cocoon." Found crawling over bark near overwintering sites in search of newly molted adult female.

Recognition Characters.—Mounted, 1.3–1.5 mm long, ca. 0.4 mm wide. Body elongate.

Dorsum with 2 pairs of tail-forming pore clusters; 1 pair on abdominal segment IX (pc 9) and 1 on VIII (pc 8); each cluster on segment IX with 2 setae ca. 240 μ long, 1 seta about same length as other dorsal setae, 40–59 multilocular derm pores (mdp), and 1 or 2 discoidal pores (dp); each cluster on segment VIII with 2 setae ca. 235 μ long, 21–29 multilocular derm pores, and 1–3 discoidal pores. Multilocular derm pores with 3–5 loculi, present in clusters of 1–4 near each margin of abdominal segments VII through II, also present on submedial areas of segments VIII through III, with 1–3 pores near each prothoracic posttergite (ppt), and with at least 1 pore near lateral arms of midcranial ridge (lmr). Discoidal pores normally associated with multilocular derm pores. Body setae slender, clusters composed of 2 or 3 setae present near margins of each abdominal segment, present on meta- and mesothorax, absent on prothorax. Abdominal sclerotization normally on medial areas near anterior margins of abdominal segments IX, V, IV, III, and II. Metapostnotal ridge (mr) varying from strongly sclerotized to nearly absent. Lateral margin of abdominal segment IX sometimes with small projecting plate. Ostioles absent. Scutum (sc) sclerotized throughout. Prescutum (psc) somewhat triangular, with prescutal ridge (pscr) strongly developed. Hamulohaltera (h) each with single apical seta. Mesothoracic wings each with 2 or 3 circular sensoria (cs) near or attached to radius vein (r) and with 2 or 3 setae near wing base. Postocular (por) and preocular ridges (pr) separate; interocular ridge absent; broad ridge produced from anterior margin of postocular ridge dorsad from ocellus (o) which partially or entirely connects postocular and preocular ridges. Dorsal arm of midcranial ridge (dmr) elongate and slender, extending from posterior margin of lateral arms up to, but not touching, postoccipital ridge (poc). Dorsomedial sclerite (ds) lightly sclerotized. Dorsal eye (de) ca. 37 μ diam. Ocelli ca. 18 μ diam. Head setae normally distributed along midcranial ridge with 5–7 setae on dorsomedial sclerite and 2–4 slightly posterior to lateral arms; 2 or 3 setae present posterior to postocular ridge.

Penial sheath (ps) 125–145 μ long, width:length ratio varies from 0.49 to 0.64 (avg 0.56). Penial sheath divided into 2 parts; posterior portion ca. $\frac{1}{2}$ length of anterior portion. Posterior portion sclerotized on both surfaces; anterior portion sclerotized

only near sheath margins. Medial lobes absent. Ventral slit (vs) indefinite. Anal opening (a) conspicuous, completely surrounded by sclerotization. Basal rod (apodeme) absent.

Venter with multilocular derm pores most numerous on medial and submedial areas on abdominal segments VIII through III, rarely present along lateral margin of abdomen, 1 or 2 such pores near each posterior spiracle (not illustrated), 1–3 near each anterior spiracle, 1 or 2 posterior to each front leg, absent from head. Discoidal pores associated with multilocular derm pores, also present on head near ventral arms of midcranial ridge (vmr). Body setae slender, about same length as those on dorsum. Precoxal ridge on metathorax (pr 3) poorly developed. Proepisternum (pe) strongly sclerotized on dorsal and ventral margins. Prosternum (prs) narrow, often produced laterally just anterior to margin of prosternal ridge (psr). Ventral arm of midcranial ridge unusually broad, attached to lateral arms and extending to ocular sclerite (os) near level of ventral eye (ve). Ventral cavity (vc) conspicuous; cranial apophysis rarely visible. Mouth (m) small. Ventral eye about same size as dorsal eye. Head setae slender, present on midcranial ridge, on ocular sclerite anterior to ventral eye, and between ventral eyes; head setae absent posterior to eye.

Pro- and metathoracic legs about equal in length, mesothoracic legs shortest. Leg setae slender; apical portion of tarsal digitules either acute or capitate, apical portion apparently quite fragile and influenced by mounting treatments. Antennae ca. $\frac{1}{2}$ as long as total length of body; 10-segmented. Third antennal segment 1.4–1.7 times longer than apical segment. Antennal setae as follows: fleshy setae (digitiform setae) absent; hairlike setae (hs) present on all segments; subapical sensory setae (ss) present; capitate sensory setae (css) present on apical 3 segments (capitate apex small and fragile, similar to tarsal digitules); terminal 3 segments each with at least 1 antennal bristle (ab) not clearly differentiated from hairlike setae.

Notes.—Adult males of *P. dearnessi* and *P. aceris* are very similar. The former species differs in possessing a narrow penial sheath (width:length ratio varies from 0.49 to 0.64, avg 0.56) whereas, *P. aceris* possesses a much broader penial sheath (width:length ratio varies from 0.72 to 0.83, avg 0.78). In the limited amount of material available there also appears to be a difference in the ridge structure around the ocelli. None of the specimens of *P. dearnessi* possesses sclerotization on the ventral area, whereas most specimens of *P. aceris* possess ridges on both the dorsal and ventral sides of the ocellus. However, it is important to stress that the sclerotization in this region is quite variable. On *P. dearnessi*, although the dorsal ridge is always present, it may be very short and not exceed the level of the ocellus, or it may be very long and form a complete bridge between the post- and preocular ridges. On *P. aceris* the sclerotization is normally visible dorsally and ventrally, but it may be either an indefinite area of

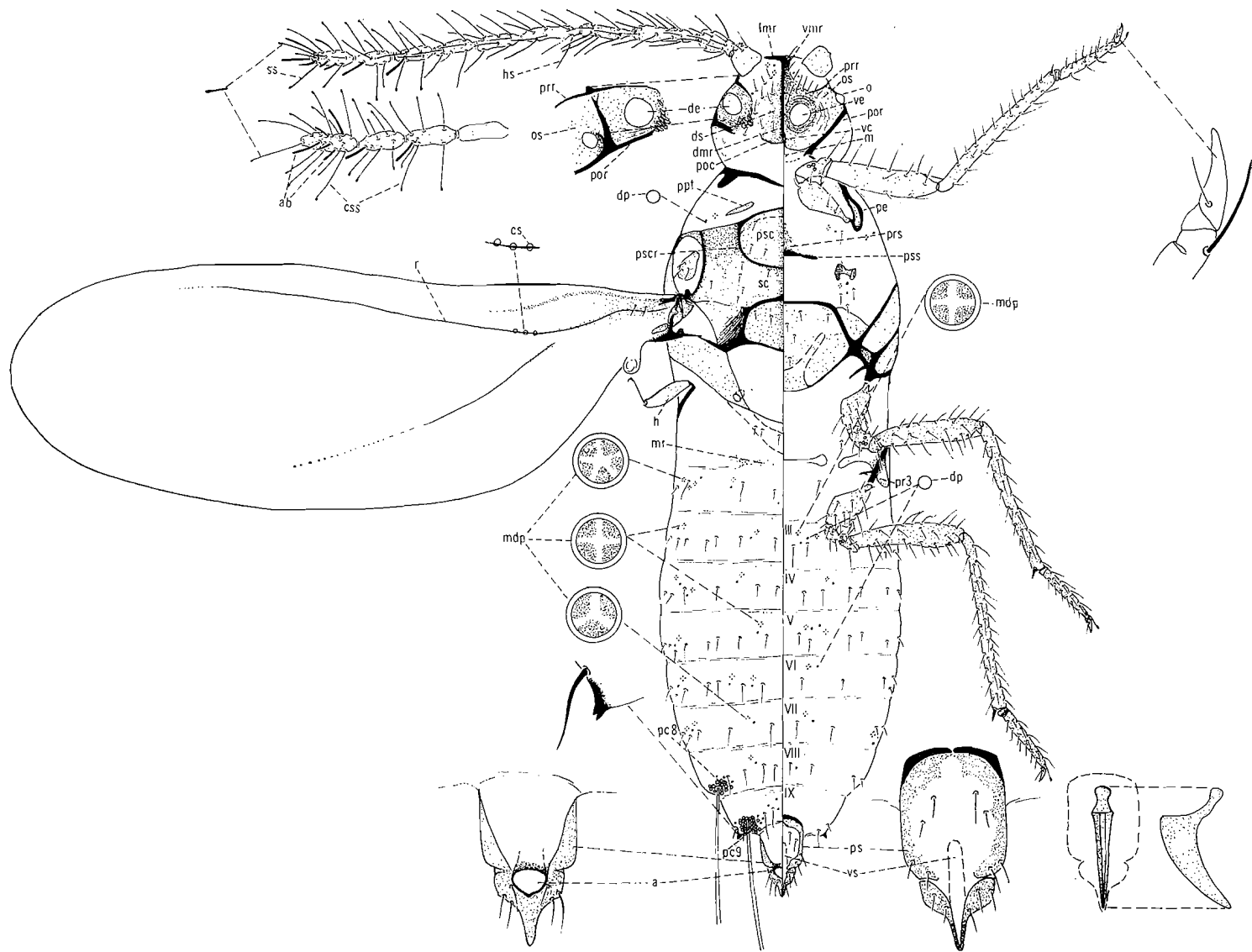


FIG. 5.—*P. dearnessi*. Adult male (5th instar) (specimen from Urbana, Ill., May 6, 1969). Lettering explained in text.

sclerotization which only partially encloses the ocellus, or it may be 2 definite dorsal and ventral ridges which entirely enclose this structure.

The adult male of *P. dearnessi* clearly falls in the "Ceroputo group" of Afifi (1968). The presence of tail-forming pore clusters on abdominal segments IX and VIII, the presence of the ridgelike sclerotization between the ocellus and the dorsal eye, the absence of fleshy setae on the antennae, the presence of only faintly capitate setae on the tarsi and antennae, the length of the 3rd antennal segment in relation to the apical segment, the heavily sclerotized dorsal and ventral margins of the proepisternum, the posteriorly continuous prescutal ridge, all suggest placement of this species in the "Ceroputo group."

The 5th instars of males of *P. dearnessi* and *P. aceris* may be easily distinguished from all other instars in possessing: fully developed forewings; hamulohaltera each with 1 apical seta; aedeagus; and 2 pairs of tail-forming pore clusters.

The preceding description is based on 23 specimens from 2 localities.

Fourth Instar of Male (Pupa)

(Fig. 6)

Field Features.—Body elongate, gray; wing pads well developed. Found within cocoon. Exuviae of this instar pushed outside through slit in posterior end of cocoon.

Recognition Characters.—Mounted, 1.3–1.4 mm long, 0.4–0.5 mm wide. Body elongate.

Dorsum with 2 robust setae near each margin of abdominal segments IX through VIII or VII, longest setae on segment IX. Multilocular disk pores with from 4 to 9 loculi, present on medial and submedial areas of abdomen and thorax, absent from mesothorax and head, most abundant on abdomen. Discoidal pores larger than on adult female, closely associated with multilocular disk pores. Body setae much more robust than on adult female, becoming progressively thinner anteriorly. Margins of abdominal segments IX through VII or VI each with heavily sclerotized plate which possesses posteriorly projecting tooth. Hamulohaltera present, wing shaped. Front wing buds ca. 0.45 mm long, partially sclerotized. Sclerotization present on medial areas of abdominal segment IX, in small patches on segments VIII and VII, and near mesothoracic wings. Ostioles absent. Postocular ridges present; dorsal portion of ocular sclerites weakly sclerotized.

Penial sheath sclerotized dorsally and ventrally; anal opening dorsal, surrounded by sclerotization. Genital slit weakly indicated. Width:length ratio of capsule ca. 0.72.

Venter with multilocular disk pores present on lateral and sublateral areas of abdomen, also present anterior to each leg, near each spiracle, and posterior to each antenna. Discoidal pores associated with multiloculars. Body setae slightly shorter than those on dorsum. Postocular ridges present. With 1 pair of small, weakly sclerotized areas between antennae. Mouth indicated by small opening.

Legs well developed, setae short. Antennae 10-segmented, short setae sometimes visible.

Notes.—Fourth instars of males of *P. dearnessi* and *P. aceris* are similar. The former species differs in possessing: 4 lateral sclerotized plates; sclerotization on dorsum of abdominal segment VIII absent or reduced, not continuous between lateral sclerotized plates; submedial longitudinal line of ventral multilocular disk pores from abdominal segment VIII forward. *P. aceris* possesses: 5 lateral sclerotized plates; continuous sclerotized band between lateral plates on abdominal segment VIII; submedial multilocular disk pores normally absent from venter of abdomen, if present, not occurring on abdominal segment VIII.

The 4th instars of males of *P. dearnessi* and *P. aceris* differ from all other instars in possessing: wing buds; lateral sclerotized plates; and no tubular ducts.

The preceding description is based on 18 specimens from 2 localities.

Third Instar of Male (Prepupa)

(Fig. 7)

Field Features.—Body elongate, gray; wing pads small. Found within overwintering cocoon. Exuviae of this instar pushed outside through slit in posterior end of cocoon.

Recognition Characters.—Same as 4th instar of male except as follows. Mounted, 1.2–1.3 mm long, 0.5–0.6 mm wide.

Dorsum with lateral margins of abdominal segments IX through VII or VI produced posteriorly, each segment with 2 or 3 setae in cluster resembling cerarius. Anal lobes each with 1 hook-shaped seta and small area of lateral sclerotization. Multilocular disk pores with 5–9 loculi, scattered over surface from abdominal segment IX, VIII, or VII through head. Discoidal pores with sclerotized center, scattered over dorsum. Oral-collar tubular ducts short, heavily sclerotized, present on abdominal segment IX or VIII through metathorax, rarely with 1 or 2 such ducts on meso- or prothorax. Body setae on dorsum of abdomen moderately enlarged, not as noticeable as on pupa. Hamulohaltera inconspicuous, normally indicated by wrinkled area on derm. Front wing buds ca. 0.2 mm long, nonsclerotized. Postocular ridge absent; ocular area nonsclerotized. Dorsum of abdomen and thorax nonsclerotized (except in genital region).

Abdominal segment X sclerotized only around anal ring; anal opening dorsal.

Venter with multilocular disk pores lightly scattered over entire surface, most abundant near anterior spiracles. Discoidal pores of same type as on dorsum, lightly scattered over surface. Oral-collar tubular ducts present on submedial and lateral areas of abdominal segments VIII through II, also present on medial areas of abdominal segments VIII through VI or V, near anterior spiracles, and near antennae. Postocular ridges absent. Entire venter nonsclerotized.

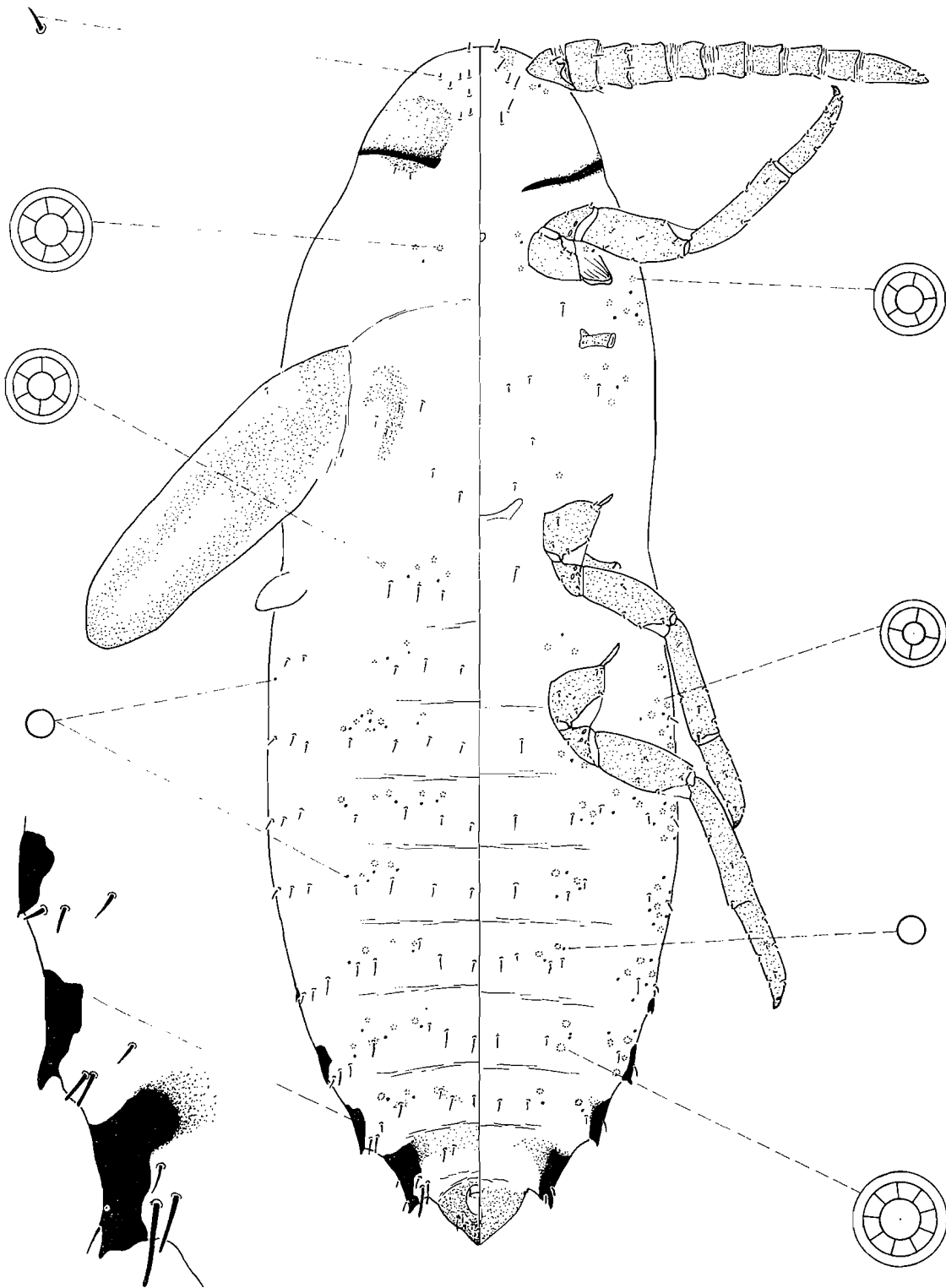


FIG. 6.—*P. dearnessi*. Pupa of male (4th instar) (specimen from Urbana, Ill., Apr. 22, 1969).

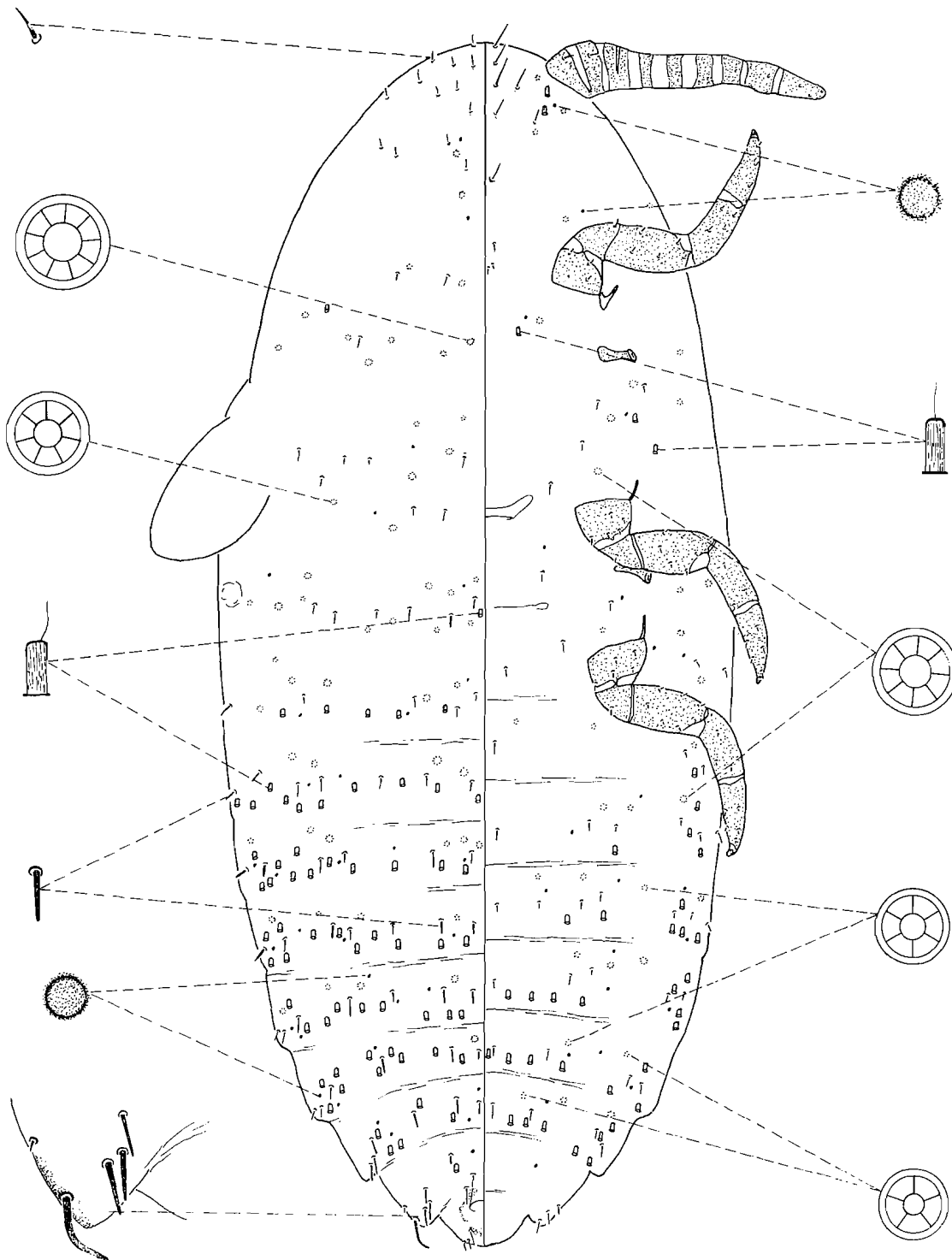


FIG. 7.—*P. dearnessi*. Prepupa of male (3rd instar) (specimen from Urbana, Ill., Apr. 12, 1969).

Antennal segments often partially fused and segmentation difficult to discern.

Notes.—Third instars of males of *P. dearnessi* and *P. aceris* can be separated as follows. The former species normally has 0–2 dorsal oral-collar tubular ducts on the mesothorax through the head, whereas *P. aceris* has more than 10 such ducts in this area.

The 3rd instars of males of the 2 species can be differentiated from all other instars in possessing: wing buds; oral-collar tubular ducts; and no lateral sclerotized plates.

The preceding description is based on 15 specimens from 2 localities.

Second Instar of Male

(Fig. 8)

Field Features.—Body elongate; body gray when in cocoon; wing pads absent; covered with thin, white, mealy secretion. Newly formed nymphs found on lower leaf surface along midvein, later migrating to crevices, roughened areas, or loosened bark of branches or trunk and forming white, elongate cocoons.

Recognition Characters.—Same as 2nd instar of female except as follows. Mounted, 0.7–1.2 mm long, 0.4–0.7 mm wide.

Dorsum with 6–9 pairs of cerarii, present on abdomen, posterior portions of thorax, and often with 1 ocular pair. Oral-collar tubular ducts scattered over surface, forming 3 pairs of longitudinal lines on abdomen.

Venter with oral-collar tubular ducts slightly more numerous than on 2nd instar of female.

Circulus present or absent. Antennae 7-segmented.

Notes.—Second instars of males of *P. dearnessi* and *P. aceris* are similar. The former species differs in possessing 6–9 pairs of cerarii, whereas *P. aceris* has 16–18 pairs.

The 2nd instars of males of *P. dearnessi* and *P. aceris* may be differentiated from all other instars in possessing: dorsal oral-collar tubular ducts on abdomen; 7-segmented antennae; and no ventral sub-medial or medial trilocular pores.

The preceding description is based on 39 specimens from 5 localities.

DISTRIBUTION

Specimens have been examined from the following localities. When a host is not indicated, it is *Craiaegus* sp. (Rosaceae).

ARIZONA, Coconino Co.: Grand Canyon, on *Amelanchier* sp. (Rosaceae). COLORADO, County (?): locality (?), on *A. steambarti* (?); Boulder Co.: Boulder, on *Prunus* sp. (Rosaceae). ILLINOIS, Champaign Co.: Urbana, on *Craiaegus* sp. and *C. crugalli*; Cook Co.: Brookfield, Chicago, Riverside, DuPage Co.: Lombard. INDIANA, Marion Co.: Indianapolis; Tippecanoe Co.: Lafayette. IOWA, Polk Co.: Des Moines, on *C. mollis*. KANSAS, Douglas Co.: Lawrence; Reno Co.: Hutchinson, on *Prunus* sp. MISSOURI, Wright Co.: Mountain Grove. NEW YORK, Cattaraugus Co.: Randolph; New York Co.: New York; Tompkins Co.: Ithaca, on *Cydonia* sp. (Rosaceae). NORTH DAKOTA, Grand Forks Co.: Inkster. OHIO, County (?); Andio, on *Prunus persica*, Wester-

ville (?); Franklin Co.: Columbus; Muskingum Co.: Duncan Falls, on *Crataegus* sp. and *Cydonia* sp. PENNSYLVANIA, Crawford Co.: Meadville, on *Crataegus phaenopyrum* (?). TEXAS, Montgomery Co.: Willis. WISCONSIN, Dane Co.: Madison; Rock Co.: Janesville.

DISCUSSION

The presence in the adult female of 9-segmented antennae, quinquelocular pores, a denticle on each claw, and apically acute tarsal digitules characterize *P. dearnessi* as a typical member of the group of genera termed by McKenzie (1967) as the "*Phenacoccus* group." In the adult male, the presence of 2 pairs of tail-forming pore clusters, the ridgelike sclerotization dorsad from the ocellus, the lack of fleshy setae on the antennae, the presence of heavily sclerotized ventral and dorsal margins of the proepisternum, the presence of a divided penial sheath, and the lack of complete ventral sclerotization of the penial sheath are characters which appear to be typical of the "*Phenacoccus* group." From a comparison of the males of that group with the males of the "*Ceroputo* group" of Afifi (1968), it is likely that these names apply to the same group of genera.

Another structure which may prove of importance in characterizing the "*Phenacoccus* group" is found on the pupa. Sclerotized, lateral plates apparently occur only in this group and in the genus *Puto*. It is somewhat surprising that *Puto* pupae possess these structures, because this genus is different enough from members of the Pseudococcidae that it was included in a separate family by Beardsley (1969). On the other hand, the presence of 9-segmented antennae and conspicuous claw denticles on the adult females of both *Puto* and the "*Phenacoccus* group" point out the fact that these genera do have several similarities. In fact, there are annectent species of *Phenacoccus* and *Puto* which do not clearly fall in either genus. However, the marked differences in the morphology of the adult males of *Puto* and *Phenacoccus* suggest that the inclusion of *Puto* in a separate family is warranted.

Pupae of the following species have been examined and possess lateral plates: *Coccidohystrix insolitus* (Green), *Phenacoccus acericola* King, *P. aceris*, *P. dearnessi*, *Puto arctostaphylii* Ferris, and *P. sandimi* Washburn. A single pupa of *Heterococcus nudus* (Green) has also been seen and possesses the same type of plates. Although McKenzie (1967) included this genus in a separate "*Heterococcus* group," it is becoming increasingly evident from both the adult males and females that it actually belongs with the "*Phenacoccus* group."

KEY TO THE STAGES OF *P. dearnessi* AND *P. aceris*

In view of the many similarities between *P. dearnessi* and *P. aceris* and in light of the fact that they are both commonly encountered pest species, we feel that it is important to include both species in the following key. For a detailed description of the various instars of *P. aceris* see Sulc (1943).

1. Wings or wing buds present..... 2
- Wings and wing buds absent..... 7
- 2(1). Tail-forming pore clusters present on lateral

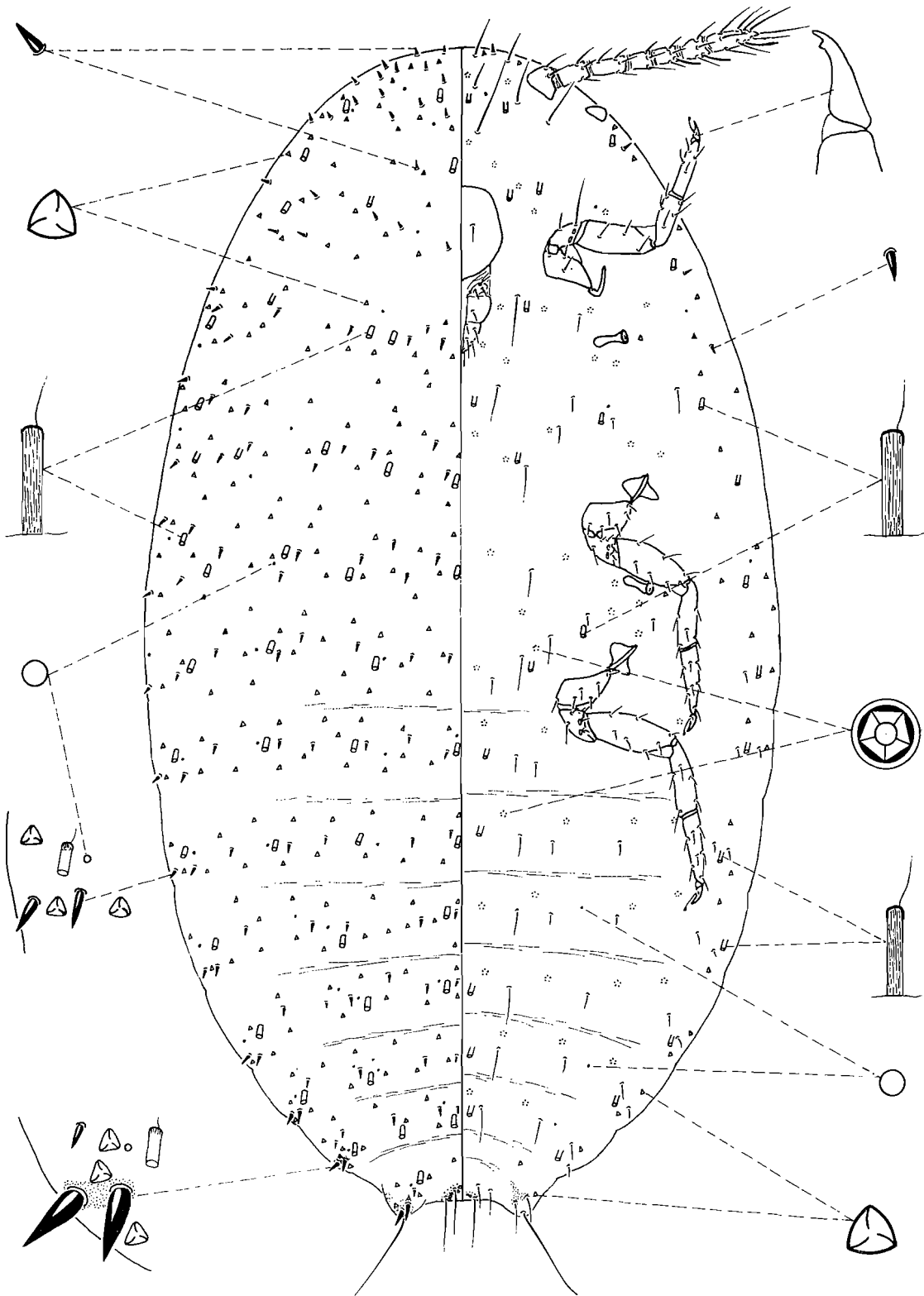


FIG. 8.—*P. dearnessi*. Second instar of male (specimen from Urbana, Ill., Feb. 18, 1969).

- margins of abdominal segments IX and VIII; wings fully developed; aedeagus present; thorax and head heavily sclerotized (Fig. 5)..... 3
- Tail-forming pore clusters absent; wings poorly developed; aedeagus absent; head and thorax with little or no sclerotization (Fig. 6, 7).. 4
- 3(2). Penial sheath narrow (width:length ratio 0.49-0.64 (avg 0.56))...adult male *P. dearnessi*
- Penial sheath broad (width:length ratio 0.72-0.83 (avg 0.78))adult male *P. aceris*
- 4(2). Oral-collar tubular ducts absent; margins of posterior abdominal segments with sclerotized plates; postocular ridges present (Fig. 6)..... 5
- Oral-collar tubular ducts numerous; margins of posterior abdominal segments without sclerotized plates; postocular ridges absent (Fig. 7)..... 6
- 5(4). Lateral, sclerotized plates present on abdominal segments IX through VI; sclerotization not continuous between plates on abdominal segment VIII.... 4th instar of male *P. dearnessi*
- Lateral, sclerotized plates present on abdominal segments IX through V; sclerotization continuous between plates on abdominal segment VIII..... 4th instar of male *P. aceris*
- 6(4). Mesothorax through head with 0-2 dorsal oral-collar tubular ducts..... 3rd instar of male *P. dearnessi*
- Mesothorax through head with more than 10 dorsal oral-collar tubular ducts..... 3rd instar of male *P. aceris*
- 7(1). Oral-collar tubular ducts absent from dorsum except strictly marginal ones..... 8
- Oral-collar tubular ducts present at least on dorsum of thorax..... 13
- 8(7). Multilocular disk pores present; antennae 9-segmented; vulva present; translucent pores on hind tibiae.....adult female *P. dearnessi*
- Multilocular disk pores absent; antennae 6- or 7-segmented; vulva absent; translucent pores absent..... 9
- 9(8). Dorsal discoidal pores absent; oral-collar tubular ducts absent from abdomen and thorax; antennae 6-segmented..... 10
- Dorsal discoidal pores present; oral-collar tubular ducts present at least on thorax; antennae 6- or 7-segmented..... 11
- 10(9). Oral-collar tubular ducts absent..... 1st instar *P. dearnessi*
- Oral-collar tubular ducts present near antennae..... 1st instar *P. aceris*
- 11(9). Antennae 6-segmented..... 2nd instar of female *P. aceris*
- Antennae 7-segmented..... 12
- 12(11). With 5-11 pairs of cerarii..... 3rd instar of female *P. dearnessi*
- With 15-18 pairs of cerarii..... 3rd instar of female *P. aceris*
- 13(7). Multilocular disk pores present; antennae 9-segmented; vulva present; translucent pores on hind tibiae.....adult female *P. aceris*
- Multilocular disk pores absent; antennae 6- or 7-segmented; vulva absent; translucent pores absent..... 14
- 14(13). Antennae 6-segmented; dorsal oral-collar tubular ducts absent on medial areas of last 6 abdominal segments..... 2nd instar of female *P. dearnessi*
- Antennae 7-segmented; dorsal oral-collar tubular ducts present on medial areas of at least 1 of last 6 abdominal segments 15
- 15(14). With 6-9 pairs of cerarii..... 2nd instar of male *P. dearnessi*

With 16-18 pairs of cerarii.....
.....2nd instar of male *P. aceris*

KEY TO ADULT FEMALES OF NORTH AMERICAN *Phenacoccus*

Because of variation not reported by McKenzie, part of his key to adult females of *Phenacoccus* of North America (1967) should be revised as follows:

- 2(1). Oral-collar tubular ducts absent from dorsum; penultimate cerarii each with 5-13 conical setae; multilocular disk pores present on abdominal segments IX through VIII or VII and rarely with 1 or 2 on segment VI or V*dearnessi* (in part)
- Oral-collar tubular ducts abundant on dorsum; penultimate cerarii each with 2-4 conical setae; multilocular disk pores present on abdominal segments IX through IV*aceris*
- and
- "21(20). Dorsum without tubular ducts except strictly marginal ones.....A
- "Dorsum with a considerable number of tubular ducts scattered over surface.....28"
- A(21). Anal lobe cerarii and penultimate cerarii each with 5-13 conical setae.....*dearnessi* (in part)
- Anal lobe cerarii and penultimate cerarii each with 2 or 3 conical setae22
- 22(A). "With 17 or 18 recognizable pairs of cerarii24"

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