A MORPHOLOGICAL AND SYSTEMATIC STUDY OF THE FIRST AND SECOND INSTARS OF THE KERMESIDAE IN THE NEARCTIC REGION (HOMOPTERA: COCCOIDEA)

by

Ronald George Baer

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APPROVED:

M. Kosztarab, Chairman

J. A. Fox

W. H Robinson

J. L. Eaton

H. J. Heikkenen

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This dissertation is dedicated to my parents and brothers

for their love, patience and encouragement

throughout this endeavor.

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INTRODUCTION AND LITERATURE REVIEW

Introduction

The Coccoidea or scale insects are among the most important pests of sylvicultural, ornamental, agricultural and greenhouse plantings throughout the world. There are 21 families comprising 6,000 species. Direct injury occurs from the withdrawal of sap while feeding and from the production of galls. Some scale insects are host specific while others are polyphagous. They feed on many different parts of plants including the roots, trunk, stems, leaves, buds and fruit.

The Kermesidae or gall-like scale insects are found throughout the northern hemisphere. There are four genera in the family: Kermes Boitard (1828), Olliffiella Cockerell (1896a), Fulbrightia Ferris (1950) and Physeriococcus Borchsenius (1959). Of the sixty-two described species in the genus Kermes, twenty-nine occur in the Nearctic Region. The genus Olliffiella consists of two species found in the southwestern United States and Mexico. The genera Fulbrightia and Physeriococcus are monotypic and both are known from the Palearctic Region in the Hunan Province of China. Species belonging to all four genera are from hosts in the genera Quercus L. (oaks) and Chrysolepis Hjelmquvist (chinquapins).

Ferris (1955) stated "The genus Kermes presents to the student an almost impossible situation." The difficulty alluded by Ferris, stems from the fact that the mature females are extremely sclerotized. Early descriptions were based only on the external appearance because

it was almost impossible to prepare slide mounts suitable for microscopic examination. Color, shape and size of adult females are so variable that one may think that ten to fifteen different species could be collected on the same host and at the same locality.

The original descriptions were based primarily on the adult female. If the description included the morphology of the first instar, it gave general information such as: elongate oval, more than twice as long as broad; antenna small, six-segmented with a segment ratio; yellow, brown or red in color; anal setae large; stout bristles along body margin; rostral loop extending half way between base of third pair of legs and the anal ring; legs large with claws curved and long. The characters overlap in each species description and thus are of no value for species identification. Numerical data were needed for these morphological characters to assist species recognition. Only four descriptions or redescriptions (Ferris 1919, 1920, McConnell and Davidson 1959, Sternlicht 1974, Hamon et al. 1976) of first instars in the Nearctic Region provided adequate morphological characters. The validity of using first instars has been shown by studies on species of the Palearctic Region, (Kuwana 1931, Balachowsky 1950a).

There has been no comprehensive systematic study of the first and second instars of the species found in the Nearctic Region. This study provides keys, descriptions, and illustrations of the known first and second instars based on their external morphology and should reduce the nomenclatural and systematic problems within the family Kermesidae.

Taxonomy of the Kermesidae

Family Kermesidae Signoret 1875. Kermesites (Signoret 1875) was considered the first family-group name (Williams 1969). This designation was based on the genus Kermes Boitard (1828). Since the original designation of the family, the genus Kermes has been placed in various other families including the Coccidae (Maskell 1894, Cockerell 1896b, 1899a,b, Fernald 1903), the Kermidae (Ferris 1937), the Lecanidae (Balachoswky 1948, 1950a,b), the Dactylopiidae (Ferris 1955) and the Kermococcidae (Borchsenius 1960).

Lobdell (1929) first designated the name Kermesidae in place of the Eriococcidae based on the Law of Priority citation with the type-genera. However, the name Kermesidae was never accepted as a replacement for the Eriococcidae. Williams (1969) stated the family name should be Kermesidae based on the type-genus Kermes Boitard.

Genus Kermes Boitard 1828. Latreille (1798) suggested the name Kermes as a common or group name in the Coccoidea, but Boitard (1828) first designated Kermes as a generic name for some scale insects resembling galls. Some of the synonyms for the genus Kermes include Kermococcus Silvestri (1911), and Talla von Heyden 1860 (Lindinger 1933). Although workers have argued over the name Kermes, the group's generic status has never been challenged. The type-species of the genus is Kermes roboris (Fourcroy, 1785).

Balachowsky (1942, 1948) placed the genus Kermes with the eriococcids and the pseudococcids. Ferris (1955) linked the genus Kermes with the eriococcids.

Genus Olliffiella Cockerell 1896. Cockerell (1896a) described O. cristicola and placed it in the Coccidae. Ferris (1955) stated that Olliffiella is essentially a species of Kermes that has adapted a gall-making habit. Ferris (1955) and Hoy (1963) placed this genus in the Eriococcidae. The type-species is Olliffiella cristicola Cockerell, 1896.

Genus Fulbrightia Ferris 1950. Ferris (1950) stated that the monotypic genus Fulbrightia does not resemble Olliffiella, although both have gall-making habits. However, he does mention that they both may be derived from Kermes. Ferris placed this genus in the Eriococcidae and later, Hoy (1963) confirmed its placement. The type-species is Fulbrightia gallicola Ferris, 1950.

Genus Physeriococcus Borchsenius 1959. Borchsenius (1959) allied this monotypic genus close to the genus Kermococcus, a synonym of Kermes. Hoy (1963) confirmed its placement in the family. The type-species is Physeriococcus cellulosus Borchsenius, 1959.

Remarks on the Genera of Kermesidae. The adult females of the above four genera included in the Kermesidae have their derm highly sclerotized unlike the species in the closely related family Eriococcidae which have an unsclerotized derm. Borchsenius (1960) and the findings of this study indicate that the first instars belong to two distinct groups. Beardsley (unpublished, 1975) believes that the adult males of species in the family Kermesidae are not closely related to the Eriococcidae.

Biology and Economic Importance of the Kermesidae

Genus Kermes Boitard 1828. Hamon et al. (1976) presented the biology of the Nearctic species, K. kingi, found on red and black oaks. Each female deposits an average of 2820 eggs on trees during late July and early August. The eggs hatch between September and November. The first instars migrate and overwinter in crevices on the limbs and trunk. They molt in April of the following year. Second instar males may migrate to a lower area of the trunk or to debris under the tree where they transform into prepupae, pupae and adult males. The second instar females migrate to the new growth and usually settle at the base of the leaf petioles. They molt into third instars in early June. These then transform into adults in mid-June. After mating, the females develop into highly sclerotized, gall-like individuals. The shape of the females are correlated with habitat: usually spherical on a twig, wedge-shaped on a twig between a bud or asymmetrical in a cluster of buds. Color varies from patterned to uniform and light tan to dark brown. Size may vary from 5-7 mm in diameter and 4-6 mm in height. "Flagging" or browning of the terminal leaves can occur when even a single female is present at the base of a leaf petiole.

The partial biology of Kermes pubescens has been discussed by Garman (1905), Houser (1918), McDaniel (1930), Baerg (1955) and McConnell and Davidson (1959). The following is a summary from these sources.

The eggs of K. pubescens develop inside the female during June. In July, first instars exit from under the female, migrate to the trunk

and limbs of the host, where they feed and overwinter. Their color changes from lemon yellow at hatching to an orange color as winter approaches. They molt in May of the next year. Second instar males remain on the trunk or limbs and transform into prepupae, pupae and adult males. The second instar females migrate to the new growth. They either settle near the bud or on a petiole or midvein on the upper surface of the leaf. They molt to the third instar in mid-May, and to adults in late May. They become smooth, globular, heavily sclerotized and red brown in color during the first week of June. Although only ca. 2.5 mm in length, a few adult females feeding on a young leaf petiole or midvein can cause serious distortion due to unequal development of the leaf. If several specimens were found feeding in one area, "flagging" or death of the leaf or twig may result. The tree as a whole apparently is not seriously injured.

The biology of Kermes quercus L., a bark inhabitating Palearctic species, is discussed in detail by Nassanov (1910) and Saakyan-Baranova and Muzafarov (1972). Each female deposits between 120-1,200 eggs during mid-June. The first instars settle in bark crevices near the old females. The nymphs then molt at the end of August. The overwintering stage of both sexes is the second instar. At the beginning of spring, the second instar males migrate to the bark surface where they transform into prepupae, pupae and adult males. The second instar females remain in the fissures of the bark and molt in the spring. The third instar females molt to young females in mid-May. At this time, mating takes place and the female rapidly increases in size and becomes globular. In Hungary, Kozar (1974) reported K. quercus as

damaging young forest trees.

Genus Olliffiella Cockerell 1896. Genus Olliffiella includes two species, O. cristicola and O. secunda. Both are gall-formers on oaks, the former in the southwestern United States and the later in Mexico. Observations on the biology of O. cristicola are given by Cockerell (1896a) and Ferris (1919).

The galls, located on the undersurface of the leaf are 10-15 mm in height and are compressed laterally and taper into a sharp point. The gall opening is an elongate slit parallel to the midrib on the upper surface of the leaf. There may be two to four galls on a single leaf. Dry galls are hard and woody and are 8-10 mm thick at their base. The female fills the lower or pointed end of the cavity of the gall and lies with its dorsum toward the opening. The overall shape of the female is conical conforming to the shape of the cavity with a heavily sclerotized, flat, circular dorsum and a membranous or slightly sclerotized venter. It remains questionable how the first instars escape from under the female and through the opening of the gall. Nymphs that were found inside the gall on the leaves or near bud regions were used for this study. No other information is available as to the overwintering stage, the instar starting the gall or on the males.

Ferris (1955) stated that the females of O. secunda form galls on leaves similar to O. cristicola.

Genus Fulbrightia Ferris 1950. The biology of the Palearctic species, Fulbrightia gallicola was discussed by Ferris (1950). He assumed that the first or second instar female settled near a bud on the twig. While developing, it causes distortion of the entire twig.

All lateral twigs beyond this point are dwarfed. The leaves are reduced in size and each twig with its leaves forms a short cone. The female becomes buried among the swollen bases of several of these short cones. The external morphology of the female is described as oval or more or less circular with a membranous or slightly sclerotized derm.

Genus Physeriococcus Borchsenius 1959. Borchsenius (1959) mentioned very little on the biology of the Palearctic species, Physeriococcus cellulosus. The females develop on the branches or near the bud region. The body of the female is globular and the exoskeleton is highly sclerotized, with polygonal and oval clear areas.

MATERIAL AND METHODS

Materials

Dry or alcohol preserved and slide-mounted specimens were borrowed from institutions and private collections. Collected lots are listed alphabetically by host, locality (state, county or city, etc.), date of collection and collector(s). The number of slides, number of specimens (in parentheses) and repository follow. Repositories of specimens are given in the "Abbreviations" section.

Collecting and Preservation

Dry preserved first instars were collected from the brood chamber inside old sclerotized adult females of Kermes spp. (Plate 1 - First Instar Kermesidae Habitats, Fig. a) and from under females inside leaf galls of Olliffiella spp. (Plate 1, Fig. b). Dead dry and live first and second instars were also collected from under Kermes females (Plate 1, Fig. c), from crevices in the bark of the trunk or branches (Plate 1, Fig. d) and from bud regions (Plate 1, Figs. e,f). Twigs infested with egg-laying females were placed with their base in water and kept in glass cylinders covered with organdy cloth. Also, females on twigs were placed in cellophane bags sealed with paper clips. The emerging first instars were collected.

Specimens were preserved by drying them on the infested plant material. Dry old females usually contain first instars that can be mounted on slides. Some first instars that had been entrapped for 98

PLATE 1.- First Instar Kermesidae Habitats

Figure a. Cut open old sclerotized adult female of Kermes branigani, exposing: 1) empty egg shells and 2) few dry nymphs (4.5x)

Figure b. Cut open Olliffiella cristicola gall, exposing: 1) eggs and nymphs, 2) sclerotized female showing circular dorsum, and 3) the opening of the gall on upper surface of leaf (3.8x).

Figure c. Settled Kermes galliformis nymphs under old sclerotized adult female (31x).

Figure d. Settled Kermes rimarum nymphs in bark crevices (67x).

Figure e. Settled Kermes galliformis nymphs at base of leaf petiole (86x).

Figure f. Settled Kermes pubescens nymphs near bud region (79x).

Photographs for Figs. a and b were made with a Nikon F2 Photomic camera with a Micro-Nikkor 55/ 3.5 lens. Figures c thru f were made with a Zeiss Photomicroscope I using reflected light. Kodak Panatomic X film was used and the negatives were enlarged and printed on Kodak Kodabromide F 3 paper.

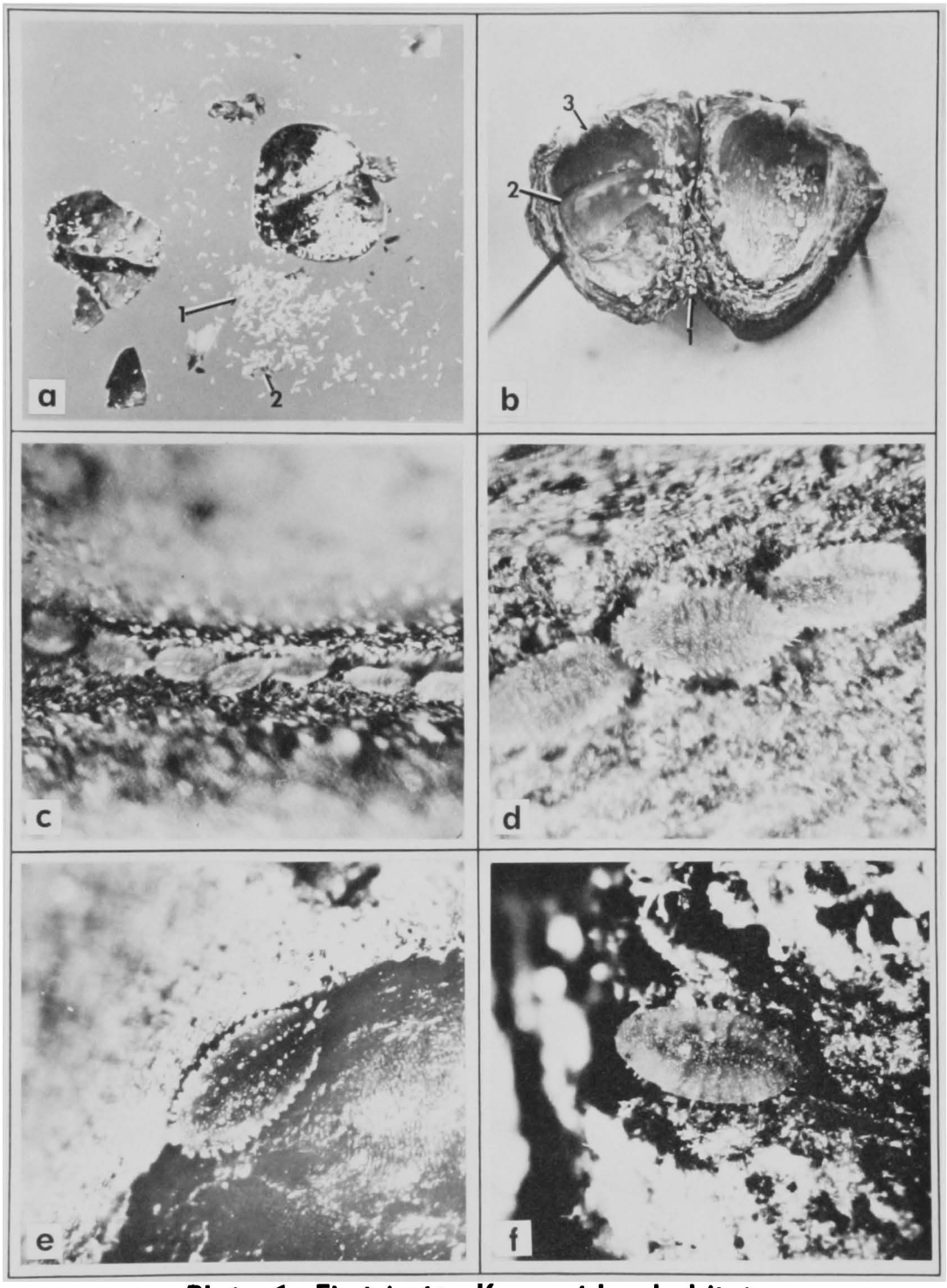

Plate 1. - First instar Kermesidae habitats

years inside females were mounted for this study and provided excellent specimens. Dry material can be stored in cellophane bags sealed with paper clips or in "pill" boxes. Live specimens were removed from the habitats mentioned in the "Collecting and Preservation" section and placed in hot 70% ethyl alcohol.

Clearing, Staining and Slide Mounting

The specimens were:

1. transferred into 10% KOH at room temperature for 24-48 hours;
2. pressed with a microspatula to remove body contents;
3. transferred to 70% ethyl alcohol for 15 minutes;
4. pressed again with the microspatula if some body contents still remained;
5. transferred to Essig's Aphid Fluid (Wilkey 1962), containing three drops of Wilkey's (1962) modified double stain for 24-48 hours;
6. dehydrated and fixed specimens in ethyl alcohols (70, 95, 100%) and clove oil for 15 minutes each;
7. mounted in Canada Balsam on microscope slides using 12 mm. coverslips and marked with a tungsten carbide pencil;
8. the slides were placed in a drying oven at 40° C for two weeks and labelled.

Poorly stained or cleared specimens already on slides were soaked in xylene for 3-5 days or until the coverslip could be removed. These specimens were passed through a series of decreasing ethyl alcohol concentrations (100, 95, 70, 50%) and rinsed in distilled water for

15 minutes each. The procedure from this point on has been previously given in the text (start with step 1).

Abbreviations

Collections and Collectors*

(Names of curators appear in parentheses)

ABH - A. B. Hamon

AFS - A. F. Satterwait

AHH - A. H. Hollinger

AK - A. Koebele

ALQ - A. L. Quaintance

AMNH - American Museum of Natural History; NY (R. T. Schuh)

AU - Auburn University; Auburn, AL (M. L. Williams)

CAES - Connecticut Agricultural Experimental Station; New Haven (M. McClure)

CAS - California Academy of Sciences; San Francisco (D. C. Rentz)

CDA - California Department of Agriculture; Sacramento (R. J. Gill)

CHR - C. H. Ray

CPG - C. P. Gillette

CSU - Colorado State University; Fort Collins (H. E. Evans)

DRM - D. R. Miller

DSIR - Department of Scientific and Industrial Research; Nelson, NEW ZEALAND (J. M. Hoy and L. L. Deitz)

EEB - E. E. Bogue

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*Collectors who have collected three or more lots of material.

EME - E. M. Ehrhorn

EOE - E. O. Essig

ERS - E. R. Sasscer

FDA - Florida Department of Agriculture; Gainesville (A. B. Hamon)

FMS - F. M. Schott

FMT - F. M. Trimble

GBK - G. B. King

GF - G. Frankie

GFF - G. F. Ferris

HFD - H. F. Dietz

HM - H. Morrison

IAE - Institute of Agricultural Entomology; Portici, ITALY (E. Tremblay and A. Tranfaglia)

IZ - Institute of Zoology of USSR; Leningrad (E. M. Danzig)

JBN - J. B. Norton

JGS - J. G. Sanders

JK - J. Kotinsky

JMA - J. M. Amos

JOH - J. O. Howell

JSH - J. S. Houser

JWB - Collection of John W. Beardsley; Honolulu, HI

KSU - Kansas State University; Manhattan (H. D. Blocker)

LH - L. Hanning

LPW - L. P. Wehrle

NMNH - U.S. National Museum of Natural History, Washington, DC and Beltsville, MD (D. R. Miller)

MK - M. Kosztarab

MLW - M. L. Williams

MMK - M. and M. Kosztarab

NMSU - New Mexico State University; Las Cruces (W. A. Iselin and J. Zimmerman)

NWC - N. W. Capron

OEB - O. E. Bremner

OHSU - Ohio State University; Columbus (C. Triplehorn)

ORSU - Oregon State University; Corvallis (J. D. Lattin)

PANS - Philadelphia Academy of Natural Sciences; PA (W. W. Moss)

RB - R. Beshear

RFW - R. F. Wilkey Collection, Arthropod Slide Mounting Service; Bluffton, IN

RGB - R. G. Baer

RJG - R. J. Gill

RLP - R. L. Penrose

RWD - R. W. Doane

SEM - Snow Entomological Museum, University of Kansas; Lawrence (G. W. Byers)

SWB - S. W. Bullington

SWRS - Southwest Research Station; Portal, AZ (V. Roth and R. Morse)

TDAC - T. D. A. Cockerell

UCD - University of California; Davis (R. O. Schuster)

UMN - University of Minnesota; St. Paul (P. J. Clausen)

VPI - Virginia Polytechnic Institute and State University; Blacksburg (M. Kosztarab)

WAI - W. A. Iselin

WJB - W. J. Baerg

Note: In cases where the abbreviated collector(s) name in the "Material Studied" sections appears in parentheses, proper identification could not be established.

States

AK	Alaska	MS	Mississippi
AL	Alabama	MT	Montana
AR	Arkansas	NB	Nebraska
AZ	Arizona	NC	North Carolina
CA	California	ND	North Dakota
CO	Colorado	NH	New Hampshire
CT	Connecticut	NJ	New Jersey
DC	District of Columbia	NM	New Mexico
DE	Delaware	NV	Nevada
FL	Florida	NY	New York
GA	Georgia	OH	Ohio
HI	Hawaii	OK	Oklahoma
IA	Iowa	OR	Oregon
ID	Idaho	PA	Pennsylvania
IL	Illinois	RI	Rhode Island
IN	Indiana	SC	South Carolina
KS	Kansas	TN	Tennessee
KY	Kentucky	TX	Texas
LA	Louisiana	UT	Utah
MA	Massachusetts	VA	Virginia
MD	Maryland	VT	Vermont
ME	Maine	WA	Washington
MI	Michigan	WI	Wisconsin
MN	Minnesota	WV	West Virginia
MO	Missouri	WY	Wyoming

Note. Names for countries other than the United States are spelled out completely with each letter capitalized.

Other Abbreviations

B+Z - Biology and Zoology
C - Centigrade
ca. - about
Co. - County
coll.(s). - collector(s)
dia. - diameter
E. - East
fig.(s). - figure(s)
Ft. - Fort
Hosp. - Hospital
Hwy. - Highway
KOH - Potassium hydroxide
mi. - miles
mm. - millimeters
Mt.(s). - Mount or Mountain(s)
N. - North
Natl. - National
NE. - northeast
no. - number
Pk. - Park
Rd. - Road
Rt. - Route
S. - South
St. - Saint
Str. - Street
Univ. - University
W. - West
Zool. - Zoological

Measurements and Illustrations

Measurements are rounded to the nearest micron unless otherwise stated. They were made with an ocular micrometer fitted to a Zeiss RA phase contrast microscope. Ocular micrometer units were calibrated using a stage micrometer. In each description, measurements include the average followed by the range in parentheses. New species have the holotype measurement first, followed by (in parentheses) the average and range of the other material. Length and width measurements were made at the longest and widest points of each morphological structure.

In each description, the measurements when possible were from 10 randomly selected specimens.

Figures were outlined using a Leitz Prado 500 microslide projector. The details and enlargements were illustrated using a Zeiss RA phase contrast microscope. For each species there is a central drawing for the entire body; with the left half representing the dorsal surface and the right half the ventral surface. Setae located on the legs and antennae are solid if on the ventral surface and dashed if on the dorsal surface. Enlargements are not in proportion to each other within each plate. When questions of size arise, the reader is urged to consult the measurements within the descriptions.

COMMENTS ON KEYS AND DESCRIPTIONS

Keys

The keys are designed to separate first and second instars of Kermesidae and to facilitate their identification based on their morphology.

Ten species of Kermes and one species of Olliffiella were included in the study of the first instars from the Nearctic Region. These are: Kermes branigani, K. cockerelli, K. concinnulus, K. galliformis, K. gillettei, K. iselini, K. kosztarabi, K. pubescens, K. rimarum, K. shastensis and Olliffiella cristicola. First instars of Olliffiella secunda were not available for study. The Palearctic species, Fulbrightia gallicola and Physeriococcus cellulosus were also studied. Sexual dimorphism was not apparent among the first instars.

The study of the second instars included only species of the Nearctic genera Kermes and Olliffiella. In some cases, second instars could not be correlated with species determined by the first instar study. Second instars could be sexed and determined. The following species were studied: eight Kermes second instar females, K. branigani, K. cockerelli, K. concinnulus, K. galliformis, K. gillettei, K. iselini, K. pubescens, K. rimarum; four Kermes second instar males, K. cockerelli, K. concinnulus, K. galliformis, K. rimarum; and the second instar female of Olliffiella secunda. Second instars of Olliffiella cristicola, Fulbrightia gallicola and Physeriococcus cellulosus were not available for this study.

Descriptions

The general morphological descriptions contain characters which overlap for species in the genus Kermes of the Nearctic Region. All other genera have the general morphological characters combined with the specific descriptions.

The original description reference of each species is provided at the beginning of the plate description. The morphological structures are listed for both dorsal and ventral surfaces along with their measurements. The "Etymology" section explains the derivation of new species names. The "Remarks" section includes the proposed synonyms, redescriptions and the references. However, some of the proposed synonym names were proven to belong to valid species on the basis of the adult female (Bullington, 1978). Future studies are needed on the adult males to clarify species in question. Notes on relationships, distribution and hosts are also included in the "Remarks" section of each species description.

KEYS

Key to the First and Second Instars of the Holarctic Kermesidae

1. Tubular ducts always absent on dorsal and ventral derm.....
.....first instar

   Tubular ducts always present on ventral derm, may or may not be present on dorsal derm..... 2

2. Antenna 6-segmented; dorsal tubular ducts usually absent but if present, ca. 9 wide and 19-33 long (only in two spp.).....second instar female

   Antenna 7-segmented; dorsal tubular ducts always present, 2-4 wide and 18-23 long.....second instar male

Key to the Genera of the Holarctic Kermesidae Based on First Instars

1. Three pairs of acorn-shaped setae along the dorsal margin of each abdominal segment; ventral submedial seta on each anal lobe ca. 2/3 the length of apical seta; venter without longitudinal rows of submedial pores.....
.....Fulbrightia Ferris, p. 167

   One or two pairs of conical or setaceous setae along the dorsal margin of each abdominal segment; ventral submedial seta on each anal lobe 1/4 or less the length of apical seta; venter with longitudinal rows of submedial pores..... 2

2. Dorsal submedial setae lacking on abdominal segments; 2 trilocular pores present anterior to each anterior spiracle.....Physeriococcus Borchsenius, p. 172

Dorsal submedial setae present on abdominal segments; trilocular pores anterior to each anterior spiracle absent..... 3

3. Twelve pairs of dorsal submedial setae; these parallel-sided on abdomen; dorsal marginal setae anterior to the anterior spiracles thinner than those posterior to it.....Olliffiella Cockerell, p. 157

Eleven pairs of dorsal submedial setae; if these parallel sided, then lacking on abdomen; dorsal marginal setae similar on entire body margin.....Kermes Boitard, p. 28

Key to the First Instars of Kermes and Olliffiella of the Nearctic Region

1. Twelve pairs of dorsal submedial setae; these parallel sided on abdomen; dorsal marginal setae anterior to the anterior spiracles thinner than those posterior to it.....Olliffiella cristicola Cockerell, p. 157

Eleven pairs of dorsal submedial setae; if these parallel sided, then lacking on abdomen; dorsal marginal setae similar on entire body margin..... 2

2. Two pairs of dorsal marginal setae on each abdominal segment; dorsal marginal setae conical..... 3

One pair of dorsal marginal setae on each abdominal segment; dorsal marginal setae not conical..... 4

3. Entire row of dorsal submedial setae similar to dorsal marginal setae; 2 or 3 quinquelocular pores laterad of each anterior spiracle.....
.....Kermes pubescens Bogue, species complex, p. 126

Only the first 4 pairs of dorsal submedial setae similar to dorsal marginal setae; 1 quinquelocular pore laterad of each anterior spiracle.....
.....Kermes iselini new species, p. 112

4(2). Pores in submedial longitudinal rows on venter trilocular; dorsal marginal setae short, 8-22 long..... 5

Pores in submedial longitudinal rows on venter quinquelocular; dorsal marginal setae 19-48 long, (except Kermes shastensis, 14-24, but setae parallel-sided and blunt)..... 8

5. Three quinquelocular pores laterad of each anterior spiracle; 2 or 3 ventral bilocular pores along each body margin..... 6

Two or 4 quinquelocular pores laterad of each anterior spiracle; 4-11 ventral bilocular pores along each body margin..... 7

6. Dorsal marginal setae 8-14 long; dorsal submedial setae on head, thorax and first abdominal segment thicker than those on abdomen.....Kermes kosztarabi Baer, p. 121

Dorsal marginal setae 16-21 long; dorsal submedial setae on head, thorax and first abdominal segment similar to those on rest of abdomen..... ..... Kermes galliformis Riley, species complex,p. 78

7(5). Two quinquelocular pores laterad of each anterior spiracle; 3 or 4 pairs of submedial trilocular pores on abdominal venter.....Kermes branigani King, p. 42

Usually four quinquelocular pores laterad of each anterior spiracle; usually 5 pairs of submedial trilocular pores on abdominal venter..... .....Kermes gillettei Cockerell, p. 103

8(4). Dorsal submedial setae on head, pro- and mesothorax thickened and similar to dorsal marginal setae; 1 pore laterad of each anterior spiracle..... 9

Dorsal submedial setae on head, pro- and mesothorax slender, small and different from dorsal marginal setae; 3 pores laterad of each anterior spiracle..... 10

9. Dorsal marginal setae parallel-sided; 1 7-locular pore laterad of each anterior spiracle..... .....Kermes shastensis Ehrhorn, p. 152

Dorsal marginal setae setaceous; 1 quinquelocular pore laterad of each anterior spiracle..... .....Kermes cockerelli Ehrhorn, p. 51

10(8). Four to 7 bilocular pores along each ventral body margin; terminal antennal segment 21-25 long..... .....Kermes concinnulus Cockerell, p. 64

Eight to 10 bilocular pores along each ventral body margin; terminal antennal segment 26-30 long..... .....Kermes rimarum Ferris, p. 139

Key to the Second Instar Males and Females of Kermes and Olliffiella of the Nearctic Region

1. With 12 pairs of dorsal submedial setae; dorsal submarginal row of quinquelocular pores present..... .....Olliffiella secunda Ferris, female, p. 163

With 11 pairs of dorsal submedial setae; dorsal submarginal row of quinquelocular pores absent..... 2

2. Antenna 6-segmented; dorsal tubular ducts usually absent but if present, ca. 9 wide and 19-33 long..... 6

Antenna 7-segmented; dorsal tubular ducts always present, 2-4 wide and 18-23 long..... 3

3. Quinquelocular pores scattered over entire dorsal and ventral derm; dorsal and ventral marginal setae thin, setaceous; no simple pores on dorsum..... 4

Quinquelocular pores absent from dorsal derm; dorsal and ventral marginal setae stout, spinelike; simple pores scattered on dorsum..... ....Kermes galliformis Riley, species complex, male, p. 93

4. Dorsal marginal setae 63-100 long..... 5

Dorsal marginal setae 30-59 long.....

.....Kermes cockerelli Ehrhorn, male, p. 56

5. Antenna ca. 135 long; anal ring setae ca. 30 long.....

.....Kermes concinnulus Cockerell, male, p. 70

Antenna 179-202 long; anal ring setae 38-47 long.....

.....Kermes rimarum Ferris, male, p. 139

6(2). Tubular ducts present on dorsum; abdominal venter without quinquelocular pores..... 7

Tubular ducts absent from dorsum; abdominal venter with quinquelocular pores..... 8

7. With 120-150 tubular ducts on dorsum; 3-4 quinquelocular pores laterad of anterior spiracle.....

.....Kermes iselini new species, female, p. 117

With 70-100 tubular ducts on dorsum; 4-7 quinquelocular pores laterad of anterior spiracle.....

.....Kermes pubescens Bogue, species complex, female,p. 135

8(6). Two pairs of dorsal marginal setae on each abdominal segment..... 11

One pair of dorsal marginal setae on each abdominal segment..... 9

9. One to 5 simple pores on dorsal derm; ventral quinquelocular pores on abdomen not arranged in definite rows.....Kermes gillettei Cockerell, female, p. 108

With many simple pores on dorsal derm; ventral quinquelocular pores on abdomen arranged in definite rows..... 10

10. Each anterior spiracle with 1 quinquelocular pore; 1 medial row of ventral quinquelocular pores on abdomen.....*Kermes branigani* King, female, p. 47

Each anterior spiracle with 5-13 quinquelocular pores; 3 rows of ventral quinquelocular pores on abdomen..... ....*Kermes galliformis* Riley, species complex, female p. 97

11(8). With few or no simple pores on dorsal derm; quinquelocular pores absent along ventral body margin..... 12

With many simple pores on dorsal derm; quinquelocular pores present along ventral body margin..... .....*Kermes concinnulus* Cockerell, female, p. 74

12. Dorsal submedial setae on head, pro- and mesothorax thickened and similar to dorsal marginal setae; ventral seta on inner margin of anal lobe 49-50 long..... .....*Kermes cockerelli* Ehrhorn, female, p. 60

Dorsal submedial setae on head, pro- and mesothorax reduced to small slender setae and these not similar to dorsal marginal setae; ventral seta on inner margin of anal lobe 30-33 long..... .....*Kermes rimarum* Ferris, female, p. 148

GENERAL MORPHOLOGICAL DESCRIPTIONS

Kermes spp., General Morphology, First Instar

Plate 2

Description. Body (fig. a) oblong, widest at mesothorax, tapering posteriorly. Antennae, legs, anal lobes and apical setae well developed.

DORSUM

Marginal setae (figs. b_{1-5}). Variable in size, shape and number. Long, conical setae (fig. b_1, K. iselini); short, conical setae (fig. b_2, K. pubescens); short, thickened setae (fig. b_3, K. kosztarabi); parallel sided setae (fig. b_4, K. shastensis); setaceous setae (fig. b_5, K. galliformis and K. rimarum). Each abdominal segment with 1 pair of dorsal marginal setae (K. galliformis) or each abdominal segment with 2 pairs of dorsal marginal setae (K. pubescens).

Marginal setae on anal lobe (figs. c_{1-4}). Variable, but longer and thicker than other marginal setae.

Submedial setae on head and thorax (figs. d_{1-6}). Variable in size and shape. Long, conical setae (fig. d_1, K. iselini); short, conical setae (fig. d_2, K. pubescens); parallel sided setae (fig. d_3, K. shastensis); thick, setaceous setae (fig. d_4, K. cockerelli); fusiform setae (fig. d_5, K. kosztarabi); slender, setaceous setae (fig. d_6, K. concinnulus).

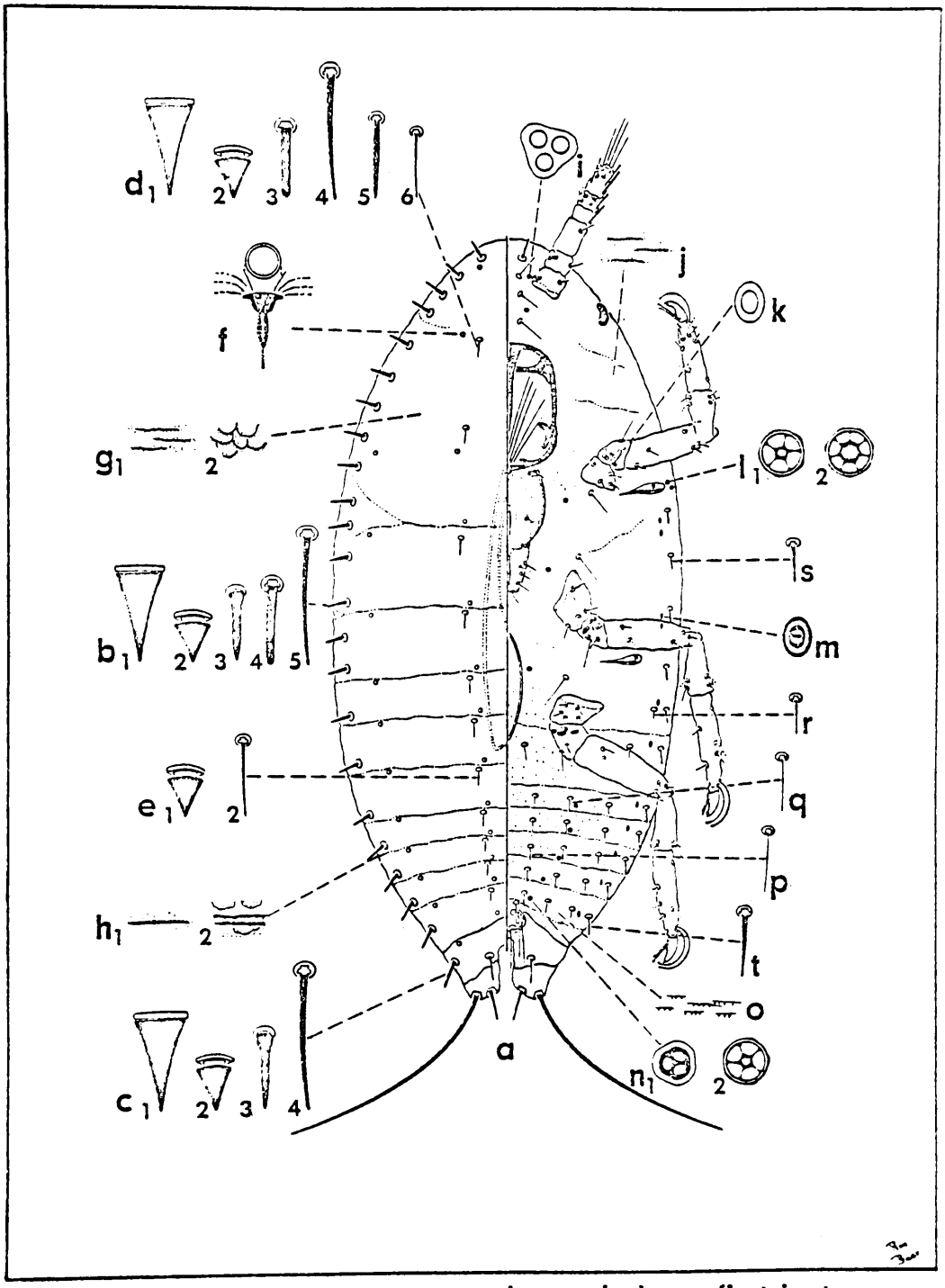

Plate 2. - Kermes spp., general morphology, first instar

Submedial setae on abdomen (figs. e_{1-2}). Short, conical setae (fig. e_1, K. pubescens); or slender, setaceous setae (fig. e_2, K. galliformis).

Simple pores (fig. f). Composed of a sclerotized ring, with a membranous duct. All arranged in longitudinal rows on body, dia. ca. 2.

Derm (figs. g_{1-2}). Membranous. Simple (fig. g_1, K. galliformis); composed of overlapping platelike areas (fig. g_2, K. pubescens).

Intersegmental membrane (figs. h_{1-2}). Apparent (fig. h_1, K. galliformis); pronounced (fig. h_2, K. pubescens).

Anal lobes (fig. a). Partially or fully sclerotized, with numerous setae.

VENTER

Antennae. Six segmented. Segment I with 2 slender setae, II with 2 slender setae and 1 sensory pore, III with 1 slender seta, IV with 1 fleshy seta, V with 3 or 4 slender setae and 1 fleshy seta, VI with 4 to 6 slender setae and 3 fleshy setae. See enlargement. One trilocular pore near antennal base (fig. i).

Clypeolabral shield. Sclerotized, tentorium-like structure containing the pharyngeal pump and the stylets which are looped and extend to the second or third abdominal segments, enclosed in a crumena.

Labium. Sclerotized, triangular shaped, composed of 3 distinct parts. The anteriormost part with 2 pairs of setae, the middle part with 1 pair of setae and the posteriormost part with 5 pairs of setae. Labial setae 14 (5-23) long.

Derm (fig. j). Simple membranous.

Legs. Sclerotized. Numerous, slender setaceous setae on each segment. Sensory pore on proximal lateral margin of each tarsus. Four sensory pores on each trochanter. Tarsal and claw digitules extending beyond apex of claw. Claws with a denticle.

Pores anterior to anterior spiracle. Absent.

Pores laterad of spiracle (figs. 1_{1-2}). Varying in numbers of pairs and locules. Quinquelocular pore (fig. 1_1, K. galliformis), 7-locular pore (fig. 1_2, K. shastensis); 1 pair (K. shastensis), 2 pairs (K. branigani), 3 pairs (K. kosztarabi), 4 pairs (K. gillettei), dia. ca. 5. Anterior spiracle 19 (12-22) long, 5 (5-9) wide, atrium ca. 2 wide. Posterior spiracle 18 (15-23) long, 6 (5-8) wide, atrium ca. 2 wide.

Bilocular pores (fig. m). Located near the bases of the submarginal or marginal setae. Two to 11 along each margin, dia. ca. 2.

Submedial pores on derm (figs. n_{1-2}). Varying in numbers of pairs and locules on head, thoracic and abdominal regions. Either triloculars (fig. n_1, K. galliformis), dia. ca. 4 or quinqueloculars (fig. n_2, K. cockerelli), dia. ca. 5.

Microspines on derm (fig. o). Small spinelike projections of the derm, varying in size and number. These are found on abdominal segments and between the coxae.

Body setae (figs. p-t). In 6 to 8 longitudinal rows on abdomen and partly on thorax: medial row with 6 pairs (fig. p); submedial row with 5 pairs (fig. q); submarginal row with 7 pairs (fig. r); marginal row if present with 11 pairs (fig. s). Usually posteriormost seta in marginal row thicker than rest in row (fig. t). Other longer setaceous setae near coxae and antennal scape bases. One pair of setae similar

to dorsal marginal setae near scape base.

Anal lobes and anal ring (fig. a). Partial or fully sclerotized. Anal ring with 18-23 translucent cells and 6 anal ring setae. See enlargement of anal ring.

Remarks. The Nearctic species in the genus Kermes have 11 pairs of dorsal submedial setae. Also, the dorsal marginal setae are similar morphologically to each other.

Kermes spp., General Morphology, Second Instar Male

Plate 3

Description. Body (fig. a) oblong to elliptical, derm membranous, tubular ducts present on both dorsum and venter. Antennae, legs, and anal lobes well developed; latter with long apical setae.

DORSUM

Marginal setae (figs. b_{1-3}). Variable in size, shape, and number of pairs. Long, thin setaceous (fig. b_1, K. concinnulus and fig. b_2, K. cockerelli) or stout, spinelike setaceous (fig. b_3, K. galliformis).

Submedial setae (figs. c_{1-2}). Variable in size and number of pairs. Long, setaceous (fig. c_1, K. rimarum) or short, setaceous (fig. c_2, K. galliformis).

Quinquelocular pores (figs. d_{1-2}). Absent, or if present, variable morphologically.

Simple pores (fig. e). Absent, or if present, composed of a sclerotized ring, with a membranous duct, scattered over derm, dia. ca. 2.

Tubular ducts (fig. f). Numerous, distributed throughout derm. Cylindrical membranous portion with deep invaginated cup and filament; each 19 (18-23) long, 3 (2-4) wide. (Note: Length measurements include filament.)

Anal lobes (fig. a). Sclerotized. With numerous setae.

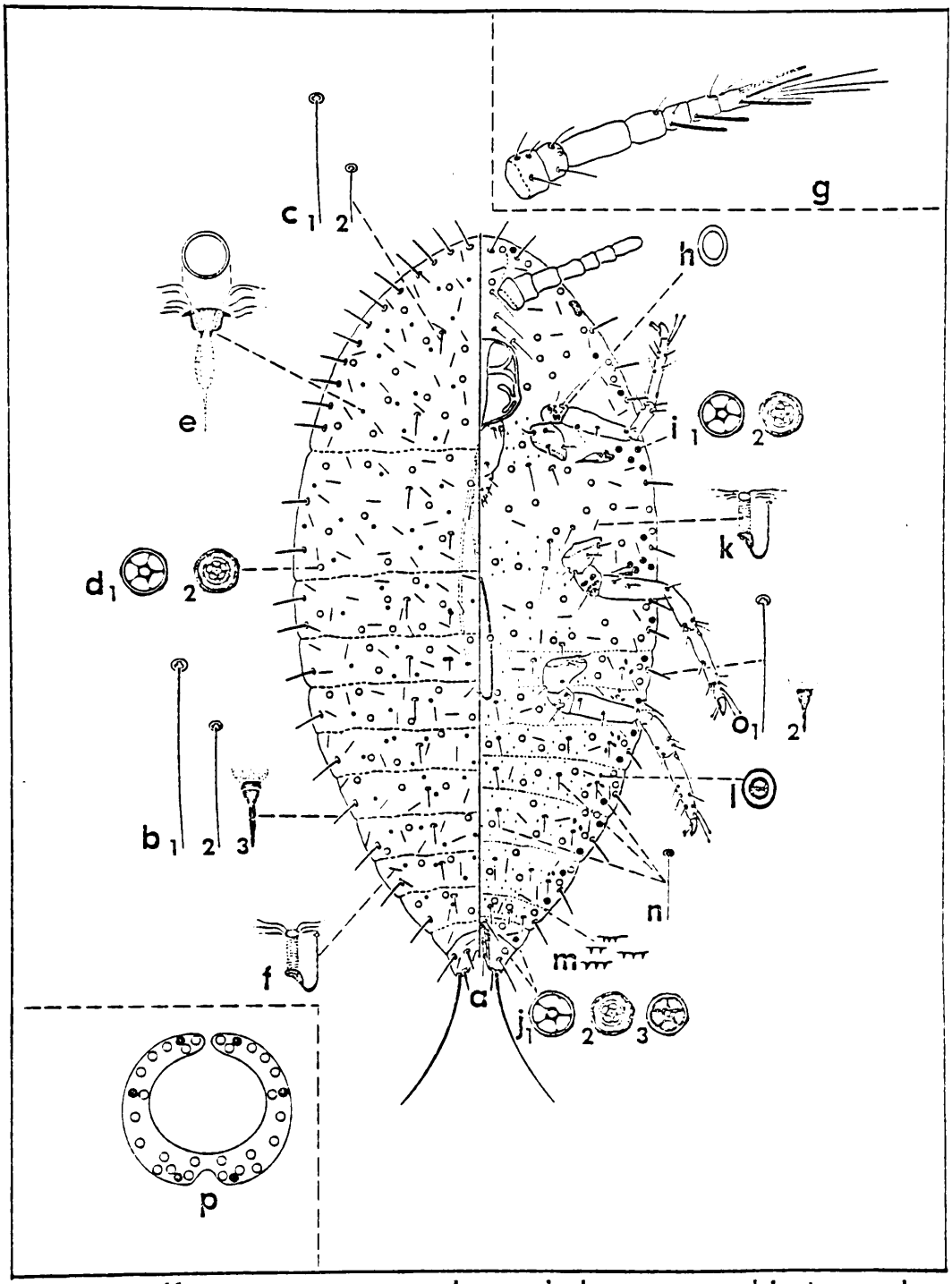

Plate 3.-Kermes spp., general morphology, second instar male

VENTER

Antennae (fig. g). Seven segmented. Segment I with 2 or 3 slender setae, II with 2 slender setae and 1 sensory pore, III with setae, IV with 1 slender seta, V with 1 slender and 1 fleshy seta, VI with 2 or 3 slender and 1 fleshy seta, VII with three fleshy and 4 or 5 slender setae.

Clypeolabral shield. A tentorium-like structure containing the pharyngeal pump and the stylets which are looped and extend to the second or third abdominal segments, enclosed in a crumena.

Labium. Triangular shaped, composed of three segments. The anteriormost part with 2 pairs of setae, the middle parts with 1 pair of setae, and the posteriormost or apical part with 5 pairs of setae. Labial setae 25 (21-30) long.

Legs. With numerous slender setae on each segment. Sensory pore on proximal lateral margin of tarsus. Four sensory pores on each trochanter (fig. h). Tarsal and claw digitules extending beyond apex of claw. Claws with a denticle.

Pores laterad of spiracle (figs. i_{1-2}). Variable morphologically but always quinquelocular (fig. i_1, K. cockerelli and fig. i_2, K. rimarum); from 2 to 7 in each anterior spiracular furrow and 1 to 7 in each posterior spiracular furrow. Anterior spiracle 34 (28-48) long, 12 (11-16) wide, atrium ca. 6 wide. Posterior spiracle 32 (30-38) long, 14 (12-19) wide, atrium ca. 6 wide.

Quinquelocular pores on derm (figs. j_{1-3}). Variable morphologically but always quinquelocular. Sometimes scattered over entire venter

(fig. j_1, K. concinnulus and fig. j_2, K. rimarum) or restricted to margins (fig. j_3, K. galliformis), (represented by solid circles), dia. ca. 5.

Tubular ducts (fig. k). Less numerous but similar morphologically to those on dorsum. Each 19 (20-23) long, 3 (2-4) wide. (Note: length measurement includes filament.)

Bilocular pores (fig. l). Located near the bases of the sub- and marginal setae, dia. ca. 2.

Microspines on derm (fig. m). Small spinelike projections of the derm, varying in size and number, these are found on the abdominal segments and between the coxae.

Body setae (figs. n,o_{1-2}). In 8 longitudinal rows on abdomen and partly on head and thorax: medial row with 5 or 6 pairs (fig. n); submedial row with 5 pairs (fig. n); submarginal row with 6 or 7 pairs (fig. n); marginal row with 13-19 pairs, similar morphologically to the dorsal marginal setae (fig. o_1, K. concinnulus and fig. o_2, K. galliformis).

Anal lobes and ring (figs. a,p). Partially or fully sclerotized. Anal ring with 24-28 transparent cells (represented by empty circles) and 6 anal ring setae (setal bases represented by solid circles).

Remarks. The presence of a 7 segmented antenna and tubular ducts on the dorsum which are similar morphologically to those on the venter distinguishes the second instar males of the genus Kermes from Kermes second instar females. No males of the genera Olliffiella, Fulbrightia or Physericoccus were available for this study.

Kermes spp., General Morphology, Second Instar Female

Plate 4

Description. Body (fig. a) oblong to oval depending on time of collection, derm membranous. If tubular ducts present on dorsum, these larger than those on venter. Antennae, legs, and anal lobes well developed; latter with long apical setae.

DORSUM

Marginal setae (figs. b_{1-5}). Variable in size, shape, and number of pairs. Some species have one pair on each abdominal segment (K. gillettei), but most have two pairs (K. cockerelli). Long, thick setaceous (fig. b_1, K. rimarum and fig. b_2, K. galliformis), thick setaceous (fig. b_3, K. concinnulus), thin, curved setaceous (fig. b_4, K. pubescens), and spinelike (fig. b_5, K. branigani).

Submedial setae (figs. c_{1-4},d_{1-2}). Variable in size and shape. Head and thorax with thick, long setaceous (fig. c_1, K. cockerelli), thick, short setaceous (fig. c_2, K. pubescens), short setaceous (fig. c_3, K. rimarum), or short, rounded setae (fig. c_4, K. branigani). Setae on abdomen either short setaceous (fig. d_1, K. gillettei) or short rounded (fig. d_2, K. concinnulus).

Quinquelocular pores. Absent.

Simple pores (figs. e_{1-2}). Absent or if present, composed of a sclerotized ring either being unilocular (fig. e_1, K. concinnulus) or bilocular (fig. e_2, K. pubescens), with a membranous duct, dia. ca. 2.

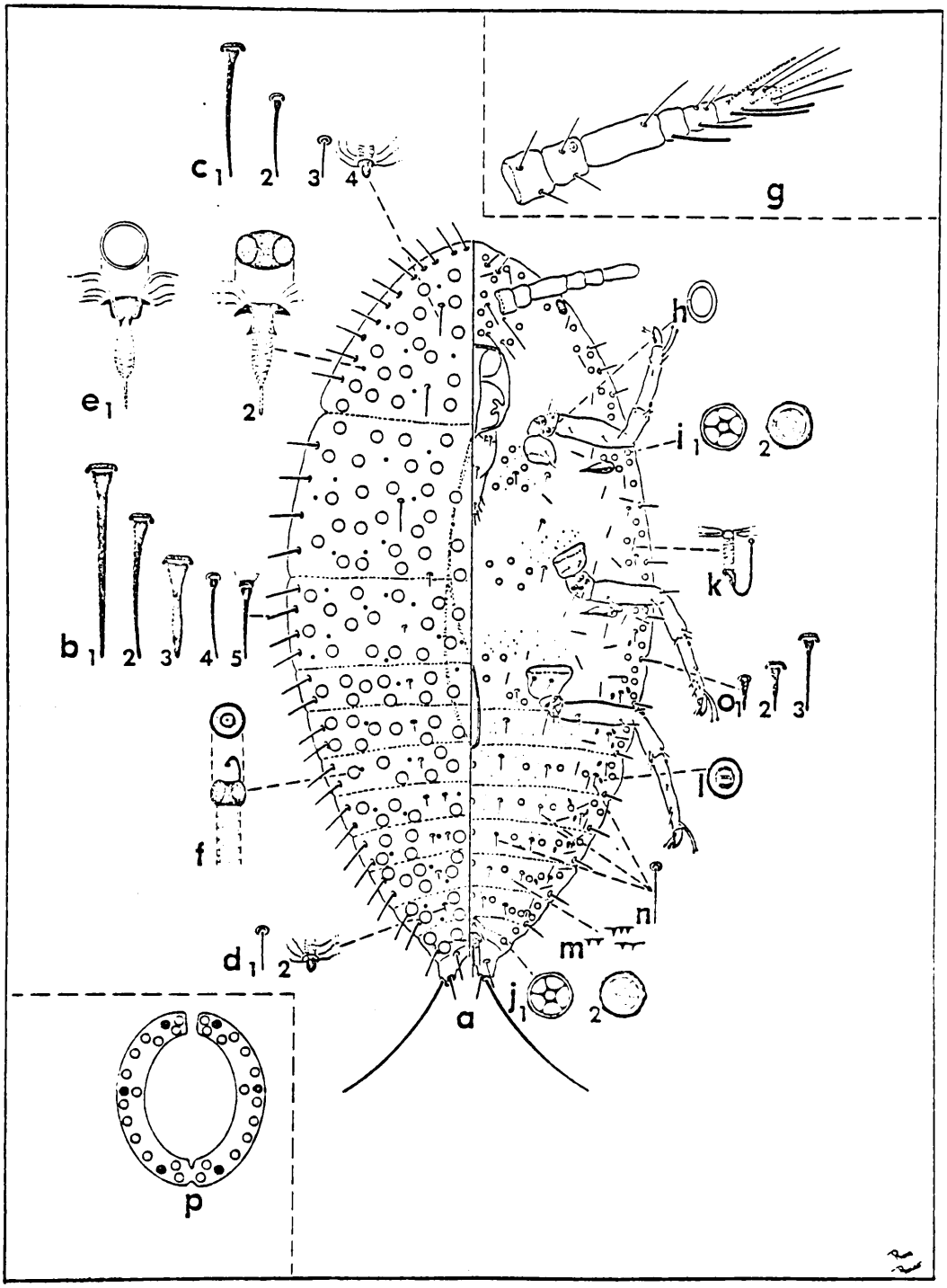

Plate 4. - Kermes spp., general morphology, second instar female

Tubular ducts (fig. f). If present, distributed throughout derm, larger than those on venter, cylindrical membranous portion with shallow invaginated cup and filament. (Note: length measurements in descriptions include filament.)

Anal lobes (fig. a). Sclerotized. With numerous setae.

VENTER

Antennae (fig. g). Six segmented. Segment I with 2 or 3 slender setae, II with 1 or 2 slender setae and 1 sensory pore, III with 1 slender seta, IV with 1 fleshy seta, V with 2 to 4 slender setae and 1 fleshy seta, VI with 3 to 6 slender setae and 3 fleshy setae.

Clypeolabral shield. A tentorium-like structure containing the pharngeal pump and the stylets which are looped and extend to the second or third abdominal segments, enclosed in a crumena.

Labium. Triangular shaped, composed of 3 distinct parts. The anteriormost part with 2 pairs of setae, the middle part with 1 pair of setae, and the posteriormost or apical part with 5 pairs of setae. Labial setae 23 (20-29) long.

Legs. Numerous slender setae on each segment. Sensory pore on proximal lateral margin of tarsus. Four sensory pores on each trochanter (fig. h). Tarsal and claw digitules extending beyond apex of claw. Claws with a denticle.

Pores laterad of spiracle (figs. i_{1-2}). Variable morphologically and always quinquelocular (fig. i_1, K. rimarum and fig. i_2, K. gillettei); from 1 to 13 in each anterior spiraclar furrow with 1 to 3 in each posterior spiracular furrow. Anterior spiracle 30 (27-41)

long, 11 (9-14) wide, atrium ca. 6 wide. Posterior spiracle 29 (26-39) long, 10 (9-15) wide, atrium ca. 6 wide.

Quinquelocular pores on derm (figs. j_{1-2}). Absent or if present, variable morphologically, sometimes scattered over entire venter (fig. j_1, K. concinnulus), or in definite rows on abdomen and near coxal and antennal bases (fig. j_2, K. rimarum), dia. ca. 5.

Tubular ducts (fig. k). Always present, smaller than those on dorsum, cylindrical membranous portion with deep invaginated cup and filament. Each 19 (20-23) long, 3 (2-4) wide. (Note: length measurement includes filament.)

Bilocular pores (fig. 1). Absent or if present located near the bases of the sub- and marginal setae, dia. ca. 2.

Microspines on derm (fig. m). Small, spinelike projections of the derm, varying in size and number, these are found on the abdominal segments and between the coxae.

Body setae (figs. n,o_{1-3}). In 8 longitudinal rows on abdomen and partly on thorax and head: medial row with 6 pairs (fig. n); submedial row with 5 pairs (fig. n); submarginal row with 7 to 11 pairs (fig. n); marginal row with 8 to 29 pairs (fig. o_{1-3}), variable morphologically. Several setae near coxae and antennal scape bases.

Anal lobes and ring (figs. a,p). Sclerotized. Anal ring with 24-28 transparent cells (represented by empty circles) and 6 anal ring setae (setal bases represented by solid circles).

Remarks. Second instar females of the genus Kermes can be distinguished from the second instar males by the presence of a 6 segmented antenna. Also, if tubular ducts are present on the dorsum

they are larger and more numerous than those on the venter.

Second instar females of Kermes spp. can be separated from the second instars of Olliffiella secunda by the presence of 11 pairs of dorsal submedial setae and the absence of dorsal submarginal rows of quinquelocular pores.

No second instar females of the genera Fulbrightia and Physeriococcus were available for study.

DESCRIPTIONS OF FIRST AND SECOND INSTARS BY SPECIES

Kermes branigani King, first instar

Plate 5

Kermes branigani King, 1914a:100.

Type material studied. Paralectotypes on Quercus chrysolepis, CA, Placer Co., Bath, Jul. 11, 1975, coll. RJG, 11(59), VPI.

Description. Body (fig. a) length 519 (483-547), width 257 (242-287).

DORSUM

Marginal setae (fig. b). Thick, setaceous, ca. 44-50, 12 (9-16) long, 2 (2-3) wide.

Marginal setae on anal lobe (fig. c). Thicker than other marginal setae, 15 (9-19) long.

Submedial setae on head and thorax (fig. d). Thin, setaceous, similar to abdominal submedial setae but longer, 4 pairs, 12 (9-14) long, 2 (1-3) wide.

Submedial setae on abdomen (fig. e). Thin, setaceous, 7 pairs, 7 (5-9) long, 2 (1-3) wide.

Simple pores (fig. f). In 4 longitudinal rows, some pores sometimes missing in each row, ca. 40-48 pores.

Derm (fig. g). Composed of overlapping platelike areas.

Intersegmental membrane (fig. h). Pronounced due to type of derm.

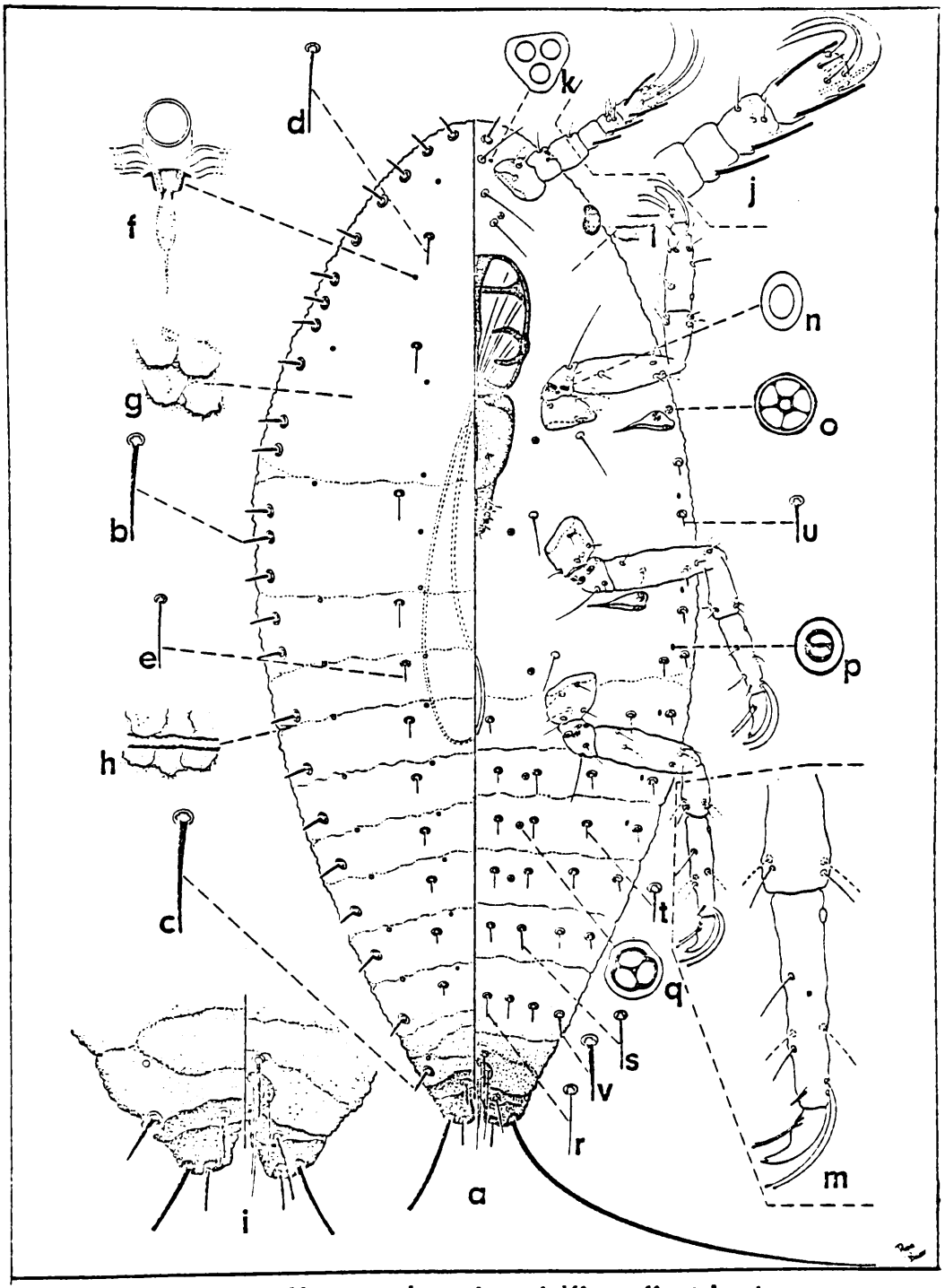

Plate 5.- Kermes branigani King, first instar

Anal lobes (figs. a,i). Sclerotized. One thick seta on inner margin of each lobe, 12 (10-16) long. Another at posterior end 14 (10-19) long; apical seta 168 (136-196) long.

VENTER

Antennae (fig. j). Total length 97 (88-104). Scape 14 (12-16) long, and 29 (23-35) wide. Segments II to IV: 14 (12-16), 21 (19-23), 12 (11-13), 12 (12-15), 23 (21-26) long respectively. Trilocular pore at scape base (fig. k).

Clypeolabral shield. Length 83 (79-91), width 64 (60-70).

Labium. Length 81 (72-91), width 64 (60-70).

Derm (fig. 1). Membranous.

Legs. See enlargement of tibia, tarsus and claw of metathoracic leg (fig. m). Four sensory pores on each trochanter (fig. n).

Leg Segments and Claw	Lengths Prothoracic	Lengths Mesothoracic	Lengths Metathoracic
Coxa	25 (20-30)	25 (23-28)	23 (19-23)
Trocanter	28 (26-30)	26 (23-30)	27 (23-30)
Femur	57 (53-60)	57 (51-63)	57 (53-63)
Tibia	32 (28-35)	34 (30-39)	35 (32-39)
Tarsus	51 (49-56)	56 (53-60)	59 (58-60)
Claw	19 (16-21)	20 (19-22)	21 (16-23)
Entire leg	212 (195-232)	218 (202-234)	222 (209-234)

Pores laterad of spiracle (fig. o). Anterior spiracle usually with quinquelocular pores, occasionally with a 3-, 4-, or 7-locular pore, usually 2, rarely 3 associated with each spiracle. Each posterior spiracle with 1 quinquelocular pore.

Bilocular pores (fig. p). Located near the bases of the marginal setae, usually associated with the 9 anteriormost setae. Usually 4-7 pores along each margin.

Submedial pores on derm (fig. q). In 2 submedial longitudinal rows. Four pairs on head and thorax; mostly 3 pairs, sometimes 4 pairs, and rarely 5 pairs on abdomen; usually triloculars, but occasionally several quinquelocular pores.

Body setae (figs. r-v). In 8 longitudinal rows on abdomen and partly on thorax: medial 10 (7-12) long, ca. 1 wide (fig. r); submedial 8 (5-12) long, ca. 1 wide (fig. s); submarginal 5 (4-9) long, ca. 1 wide (fig. t); marginal 6 (5-7) long, ca. 2 wide (fig. u). Posteriormost seta in marginal row thicker than the rest in the row 9 (7-10) long (fig. v).

Anal lobes and ring (figs. a,i). Sclerotized. With a submedial seta on each lobe, 17 (13-20) long. Ring oval, 18 (12-19) long, 26 (22-33) wide; anal ring setae 39 (37-44) long; a pari of thick setae at the anterior margin of anal ring, each 16 (14-21) long.

Additional material studied. On Quercus chrysolepis, CA, Confidence, Jul. 31, 1919, coll. R. D. Hartman, 4(9) and May 1920, coll. H. E. Burke, 2(4), UCD; Forest Hills, Nov. 22, 1913, coll. EOE, 2(7), CAS; Groveland, Jul. 1, 1976, colls, MMK, 2(5), VPI; 0.5 mi. before Groveland, Rt. 120, Jul. 1, 1976, colls. MMK, 4(9), VPI; Shasta Co., May 21,

1914, coll. L. Childs, 2(2), UCD; Shasta Springs, coll. EME, 1(2); near Shasta Springs, Dunsmuir City Pk., Jul. 7, 1976, colls. MMK, 2(5), VPI; On Quercus sp., CA, Sacramento Co., American River, Carmichael, Mar. 18, 1967, coll. RFW, 1(1), CDA; Tulare Co., Jul. 1976, coll. RJG, CDA.

Remarks. King (1914a) placed K. branigani in close affinity with K. galliformis on the basis of the adult female. The original description contained no first instar information. It is believed K. branigani closely allied with species in the K. galliformis group. This group of species has relatively short dorsal marginal setae and rows of trilocular pores on the venter.

Kermes branigani can be distinguished by the following characters: 1) one pair of dorsal marginal setae on each abdominal segment; 2) setaceous dorsal marginal setae 9-22 long; 3) two quinquelocular pores laterad of each anterior spiracle; and 4) 3 or 4 pairs of submedial trilocular pores on abdominal venter.

This species is found only on Quercus chrysolepis in California.

Kermes branigani King, second instar female

Plate 6

Kermes branigani King, 1914a:100.

Material studied. On Quercus chrysolepis, CA, Confidence, May 1920, coll. H. E. Burke, 2(3), UCD.

Description. Body (fig. a) length 780 (679-845), width 403 (287-468).

DORSUM

Marginal setae (fig. b). Short, spinelike, ca. 44, these 25 (18-35) long, 4 (3-5) wide.

Submedial setae (fig. c,d). In 2 longitudinal rows, 11 pairs, all reduced to small rounded setae, ca. 2 wide.

Simple pores (fig. e). Randomly distributed over derm, ca. 65 total.

Tubular ducts. Absent.

Anal lobes. Sclerotized. One seta on inner margin of each lobe 16 (12-19) long, another at posterior end 16 long; apical seta 97 (89-105) long.

VENTER

Antennae. Total length 107 (104-109). Scape 12 (12-14) long, 25 (23-26) wide. Segments II to VI: 13 (12-14), 28 (26-30), 13 (12-14), 15 (13-16), 26 (24-30) long respectively.

Clypeolabral shield. Length 110 (100-118) width 83.

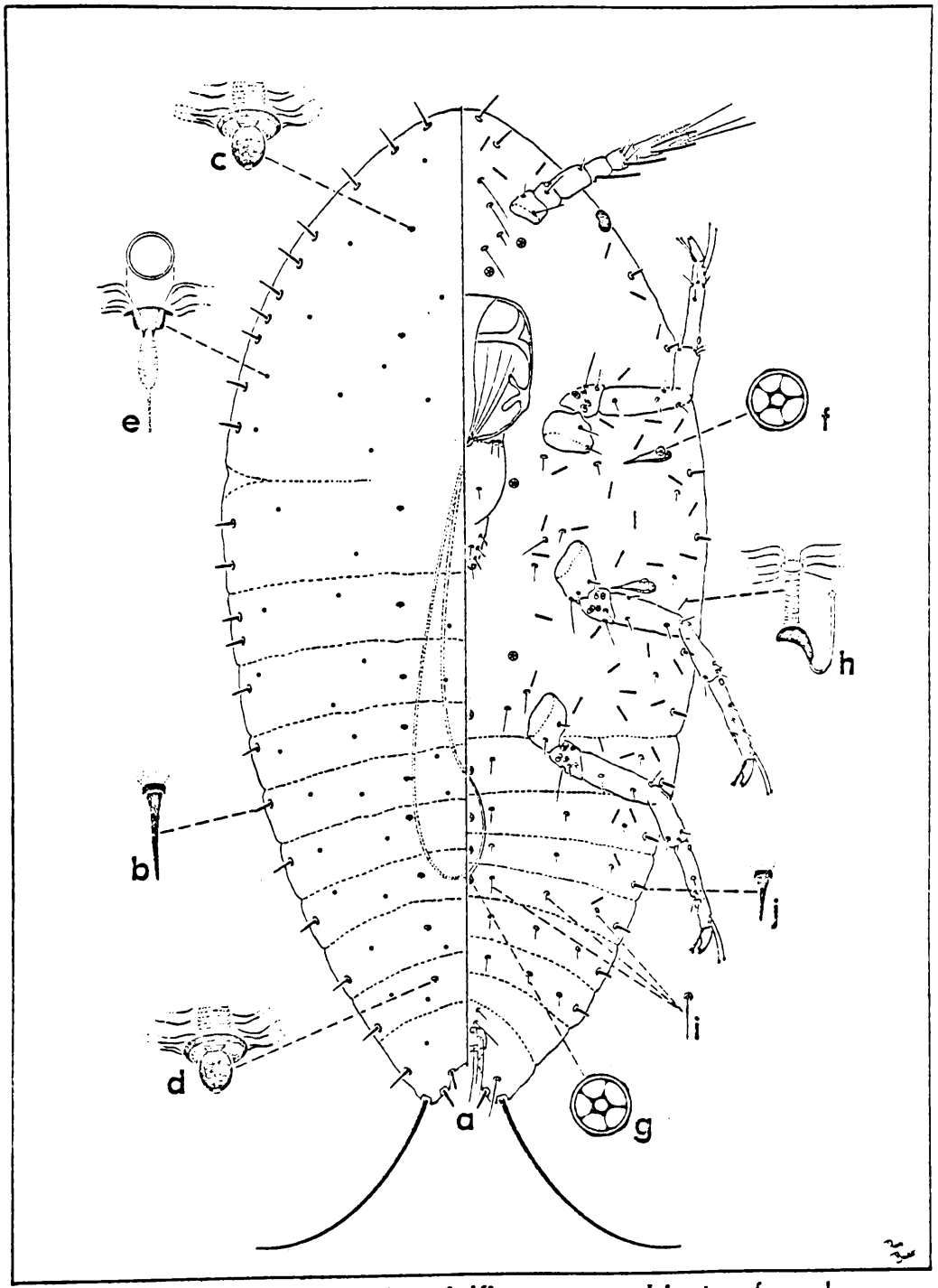

Plate 6. -Kermes branigani King, second instar female

Labium. Length 85 (77-89), width 59.

Legs. See chart below.

Leg Segments and Claw	Lengths Prothoracic	Lengths Mesothoracic	Lengths Metathoracic
Coxa	29 (28-30)	29 (28-30)	28 (28-30)
Trochanter	30 (30-33)	31 (30-33)	31 (30-33)
Femur	72 (70-74)	67 (65-70)	68 (65-71)
Tibia	38 (37-39)	44 (41-46)	39 (35-41)
Tarsus	68 (67-70)	69 (68-70)	74 (72-77)
Claw	ca.16	ca.16	ca.16
Entire leg	ca.251	257 (255-259)	257 (250-264)

Pores laterad of spiracle (fig. f). Each anterior and posterior spiracles with 1 quinquelocular pore.

Quinquelocular pores on derm (fig. g). In 1 medial longitudinal row on abdomen, also 1 or 2 pores associated with each coxa and antennal base.

Tubular ducts (fig. h). Distributed in derm mainly along submargin and coxal areas, ca. 80 total.

Bilocular pores. Absent.

Body setae (figs. i,j). In 8 longitudinal rows on abdomen and partly on thorax and head: medial 15 (12-19) long, ca. 1 wide (fig. i); submedial 9 (7-12) long, ca. 1 wide (fig. i); submarginal 4 (4-5) long, ca. 1 wide (fig. i); marginal, similar morphologically to dorsal

marginal setae 5 (5-7) long, 3 (2-4) wide (fig. j).

Anal lobes and ring. Sclerotized. With a single submedial seta on each lobe, 21 (19-23) long. Ring oval, ca. 21 long, 26 (21-28) wide; anal ring setae 48 (46-51) long.

Remarks. Kermes branigani second instar females can be distinguished from other Kermes spp. by the following characters: 1) tubular ducts absent from dorsum; 2) abdominal venter with quinquelocular pores arranged in one definite row; 3) one pair of dorsal marginal setae on each abdominal segment; 4) many simple pores on dorsal derm; and 5) each anterior spiracle with one quinquelocular pore.

Kermes cockerelli Ehrhorn, first instar

Plate 7

Kermes cockerelli Ehrhorn, 1898:8.

Type material studied. Paralectotypes on Quercus lobata, CA, Mountain View, (no date or collector mentioned), 15(81), NMNH.

Description. Body (fig. a) length 530 (438-589), width 233 (196-257).

DORSUM

Marginal setae (fig. b). Long, thick, setaceous, ca. 40-48, 25 (19-37) long, 4 (2-7) wide.

Marginal setae on anal lobe (fig. c). Longer and thicker than other marginal setae, 35 (26-46) long.

Submedial setae on head and thorax (fig. d). Thick, setaceous, on head, pro- and mesothorax, similar to dorsal marginal setae, 3 pairs, 22 (19-26) long, 2 (1-3) wide. Metathoracic setae thin, setaceous, similar to submedial setae on abdomen, 1 pair, 11 (10-13) long.

Submedial setae on abdomen (fig. e). Thin, setaceous, 7 pairs, 7 (5-12) long, ca. 1 wide.

Simple pores (fig. f). In 4 longitudinal rows, ca. 44-50.

Derm (fig. g). Simple, membranous.

Intersegmental membrane (fig. h). Apparent due to type of derm.

Anal lobes (figs. a,i). Sclerotized. One thick seta on inner margin of each lobe, 29 (23-31) long. Another at posterior end, 31 (26-42) long; apical seta 146 (76-211) long.

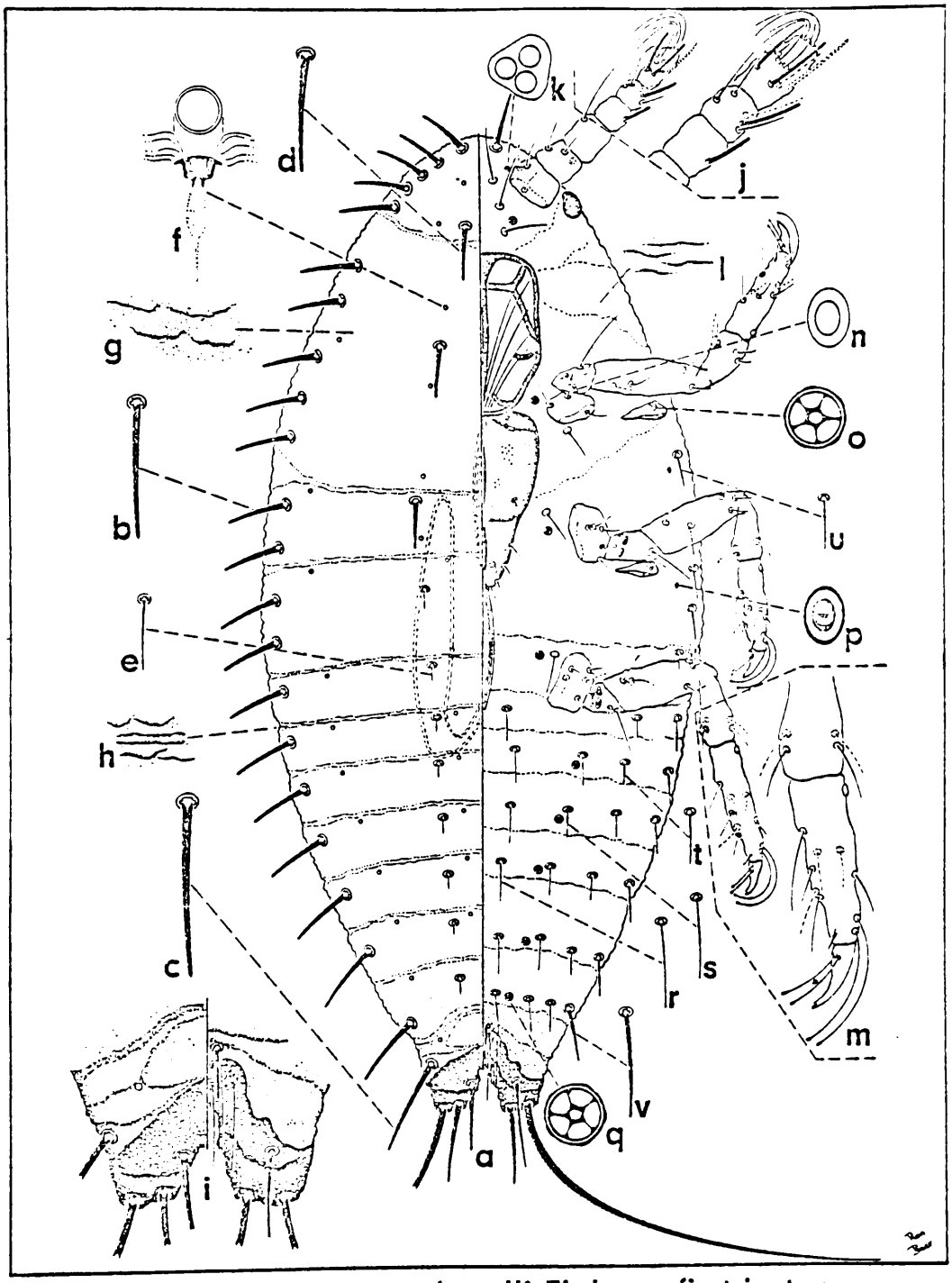

Plate 7.- Kermes cockerelli Ehrhorn, first instar

VENTER

Antennae (fig. j). Total length 111 (103-117). Scape 18 (14-23) long and 30 (28-33) wide. Segments II to VI: 16 (14-19), 25 (23-28), 12 (9-14), 12 (11-14), 25 (23-33) long respectively. Trilocular pore at scape base (fig. k).

Clypeolabral shield. Length 90 (81-97), width 70 (63-81).

Labium. Length 86 (79-97), width 53 (46-60).

Derm (fig. l). Membranous.

Legs (fig. m). See enlargement of tibia, tarsus and claw of metathoracic leg. Four sensory pores on each trochanter (fig. n).

Leg Segments and Claw	Lengths Prothoracic	Lengths Mesothoracic	Lengths Metathoracic
Coxa	25 (21-28)	25 (23-28)	25 (23-28)
Trochanter	33 (30-35)	28 (23-30)	29 (26-33)
Femur	66 (58-72)	65 (56-74)	68 (60-72)
Tibia	36 (33-39)	38 (30-42)	40 (28-46)
Tarsus	52 (51-56)	56 (51-65)	62 (56-65)
Claw	20 (16-21)	21 (16-23)	22 (21-23)
Entire leg	226 (206-234)	235 (207-253)	246 (218-260)

Pores laterad of spiracle (fig. o). Each anterior and posterior spiracle with 1 quinquelocular pore.

Bilocular pores (fig. p). Located near the bases of the marginal setae, usually associated with the 5 anteriormost setae. Usually 2-3

along each margin.

Submedial pores on derm (fig. q). In 2 submedial longitudinal rows. Four pairs on head and thorax; mostly 5 pairs on abdomen, usually quinquelocular pores but sometimes triloculars.

Body setae (figs. r-v). In 8 longitudinal rows on abdomen and thorax: medial 18 (12-30) long, ca. 0.95 wide (fig. r); submedial 14 (12-35) long, ca. 0.95 wide (fig. s); submarginal 8 (7-9) long, ca. 0.95 wide (fig. t); marginal 13 (7-28) long, ca. 1.3 wide (fig. u). Posteriormost seta in marginal row thicker than the rest in the row 22 (16-26) long (fig. v).

Anal lobes and ring (figs. a,i). Sclerotized. With a single submedial seta on each lobe, 39 (19-53) long. Ring oval, 15 (12-17) long, 24 (23-26) wide; anal ring setae 28 (19-44) long; a pair of thick setae at the anterior margin of anal ring, each 22 (16-28) long.

Additional material studied. On Quercus chrysolepis, CA, Mammoth Lakes, Jun. 29, 1976, coll. MK, 1(2), VPI; on Q. douglasii, Tulare Co., E. Orange Cove, Apr. 28, 1964, coll. HM, 4(16), CDA; On Q. durata, Napa Co., Mt. St. Helena, Oct. 12, 1967, coll. JWB, 2(6), JWB; On Q. garryana, OR, Jackson Co., 9.2 mi. E. of Ashland, Jun. 1-5, 1977, coll. R. L. Parsons, 2(3), VPI; On Q. kelloggii, CA, Yolo, 1910, 1(2), AMNH; On Q. lobata, CA, near Escalon, Sep. 19, 1967, coll. JWB, 1(3), JWB; Sacramento Co., American River, "Governors Mansion," Oct. 19, 1977, coll. RJG, 1(2), VPI; Stanford University, Apr. 1914, coll. GFF, 2(8), UCD and Oct. 28, 1914, coll. A. F. Swain, 3(5), NMNH; Walnut Creek, Aug. 20, 1911, coll. (JCB), 4(41), UCD; On Quercus sp., CA, Trinity Natl. Forest, Feb. 25, 1918, coll. R. Headley, 2(7), NMNH.

Remarks. The original description included no useful information on the first instar. However, Ferris (1920) redescribed and illustrated the first instar and mentioned it as having 2 or 3 large setae on the cephalothorax. This character is important in species recognition. Kermes cockerelli is closely allied with species in the Kermes concinnulus group. All species in this group have relatively long setaceous or parallel sided setae and quinquelocular pores in rows on the venter.

Kermes cockerelli can be distinguished by the following characters: 1) one pair of dorsal marginal setae on each abdominal segment; 2) setaceous dorsal marginal setae 19-48 long; 3) dorsal submedial setae on head, pro- and mesothorax thickened and similar to the dorsal marginal setae; and 4) one quinquelocular pore laterad of each anterior spiracle.

Kermes cockerelli is found in California and Oregon on Quercus lobata, Q. douglasii, Q. durata, Q. garryana and Q. kelloggii.

Kermes cockerelli Ehrhorn, second instar male

Plate 8

Kermes cockerelli Ehrhorn, 1898:8.

Material studied. On Quercus douglasii, CA, 3 mi. E. of Monticello Dam, Putah Creek, Dec. 6, 1967, coll. JWB, 1(3), JWB; Quercus lobata, CA, Seursville Lake, Mar. 4, 1937, 1(1), UCD.

Description. Body (fig. a) length 1351 (1117-1827), width 532 (438-604).

DORSUM

Marginal setae (fig. b). Very thin, setaceous, ca. 52, these 46 (30-59) long, ca. 2 wide.

Submedial setae (fig. c). In 4 longitudinal rows, 3 or 4 pairs in medial row, 11 pairs in submedial row, these 28 (18-41) long, ca. 2 wide.

Quinquelocular pores (fig. d). Numerous, scattered over derm.

Simple pores. Absent.

Tubular ducts (fig. e). Numerous, distributed throughout derm, 20 (19-21) long.

Anal lobes. Sclerotized. One seta on inner margin of each lobe, 25 (21-28) long, another at posterior end, 23 (21-28) long; apical seta 144 (106-166) long.

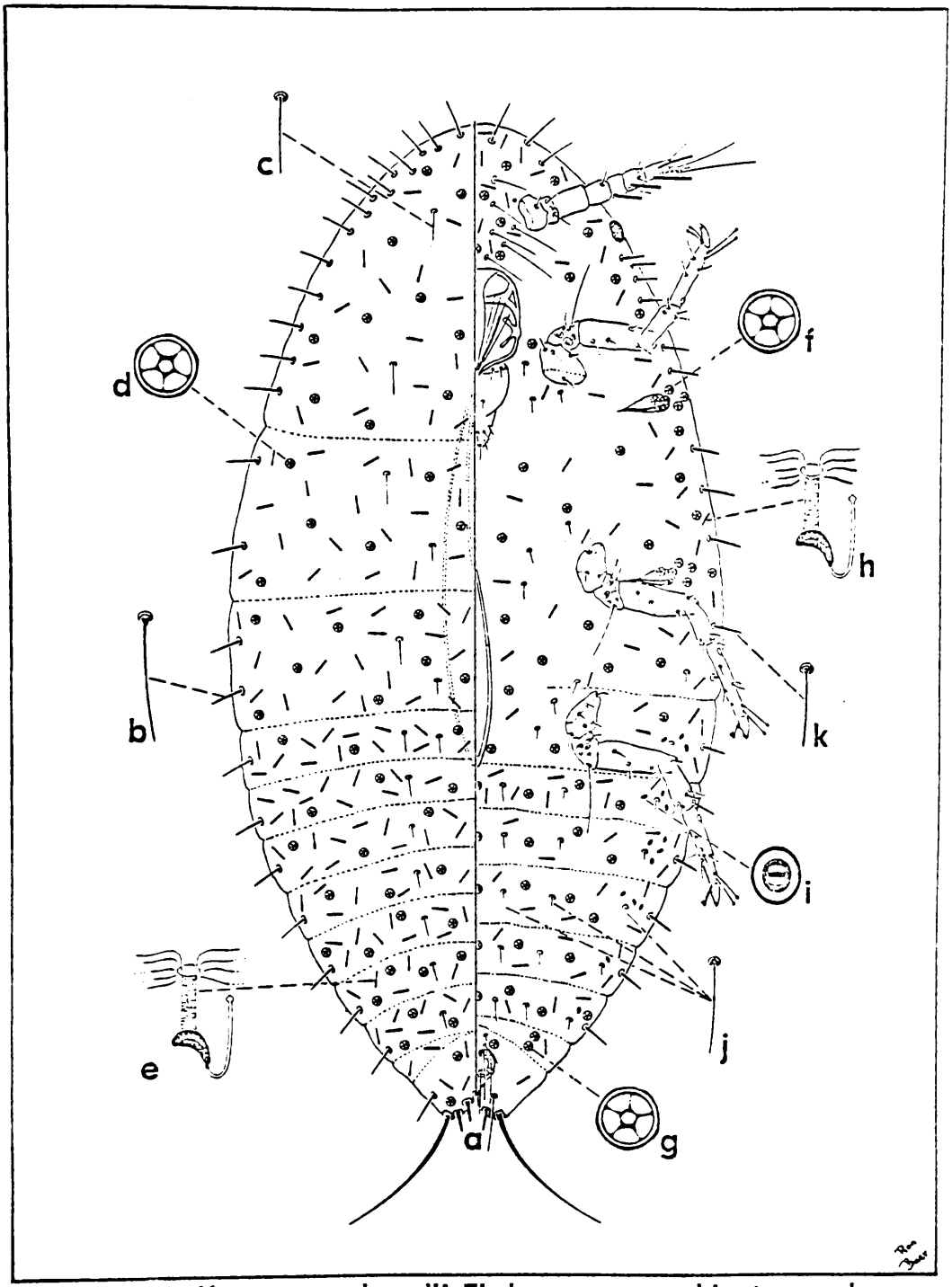

Plate 8.- Kermes cockerelli Ehrhorn, second instar male

VENTER

Antennae. Total length 175 (166-186). Scape 21 (18-26) long, 46 (42-51) wide. Segments II to VII: 18 (16-19), 36 (36-37), 28 (26-30), 20 (18-23), 21 (18-26), 32 (30-35) long respectively.

Clypeolabral shield. Length 124 (118-130), width ca. 123.

Labium. Length 85 (77-94), width 75 (71-77).

Legs. See chart below.

Leg Segments and Claw	Lengths Prothoracic	Lengths Mesothoracic	Lengths Metathoracic
Coxa	41 (30-47)	49 (41-53)	49 (47-51)
Trochanter	48 (46-51)	43 (35-47)	49 (47-53)
Femur	89 (86-94)	85 (81-89)	91 (88-94)
Tibia	59 (58-60)	68 (65-71)	69 (65-71)
Tarsus	86 (82-89)	88 (82-94)	93 (88-97)
Claw	22 (14-26)	21 (14-23)	22 (14-26)
Entire leg	344 (341-360)	354 (328-371)	372 (363-385)

Pores laterad of spiracle (fig. f). Each anterior and posterior spiracle with 4-6 quinquelocular pores.

Quinquelocular pores on derm (fig. g). Numerous, scattered over derm.

Tubular ducts (fig. h). Less numerous than on dorsum, distributed throughout the derm, about the same size and shape as those on dorsum.

Bilocular pores (fig. i). Located near the bases of the submarginal and marginal setae, about 15 along each margin.

Body setae (figs. j,k). In 8 longitudinal rows on abdomen and partly on head and thorax: medial 63 (51-77) long, ca. 2 wide (fig. j); submedial 39 (35-46) long, ca. 2 wide (fig. j); submarginal 21 (14-26) long, ca. 2 wide (fig. j); marginals, similar to dorsal marginals, 44 (37-51) long, ca. 3 wide (fig. k).

Anal lobes and ring. Sclerotized. With a single submedial seta on each lobe, 48 (30-65) long. Ring oval, 31 (28-35) long, 35 (33-37) wide; anal ring setae 41 (26-53) long.

Remarks. The first instars of Kermes cockerelli were placed in the K. concinnulus group. Also, the second instar males were found to be morphologically similar to other second instar males of different species in the Kermes concinnulus group. All species in this group have long, thin dorsal marginal setae and quinquelocular pores on the dorsum.

Kermes cockerelli second instar males can be distinguished by the following characters: 1) quinquelocular pores scattered over entire dorsal and ventral derm; 2) dorsal and ventral marginal setae thin, setaceous; 3) no simple pores on dorsum; and 4) dorsal marginal setae 30-59 long.

Kermes cockerelli Ehrhorn, second instar female

Plate 9

Kermes cockerelli Ehrhorn, 1898:8.

Material studied. On Quercus lobata, CA, Stanford University, Mar. 1, 1918, coll. GFF, 5(5), UCD.

Description. Body (fig. a) length 1505 (1419-1640), width 717 (604-830).

DORSUM

Marginal setae (fig. b). Thick, slightly curved at middle, 2 pairs on each abdominal segment, ca. 68, 63 (58-71) long, ca. 4 wide.

Submedial setae (figs. c,d). In 2 longitudinal rows, usually head, pro- and mesothoracic regions with 1 pair of setae each which are similar morphologically to marginal setae 45 (44-47) long, ca. 4 wide (fig. c), 7 other pairs on metathorax and abdomen short, ca. 5 long, ca. 1 wide (fig. d), several other pairs located medially to these rows, ca. 5 long.

Simple pores (fig. e). One or 2 distributed over derm.

Tubular ducts. Absent.

Anal lobes. Sclerotized. One seta on inner margin of each lobe, 33 (30-35) long, another at posterior end 26 (23-30) long; apical seta 170 (151-181) long.

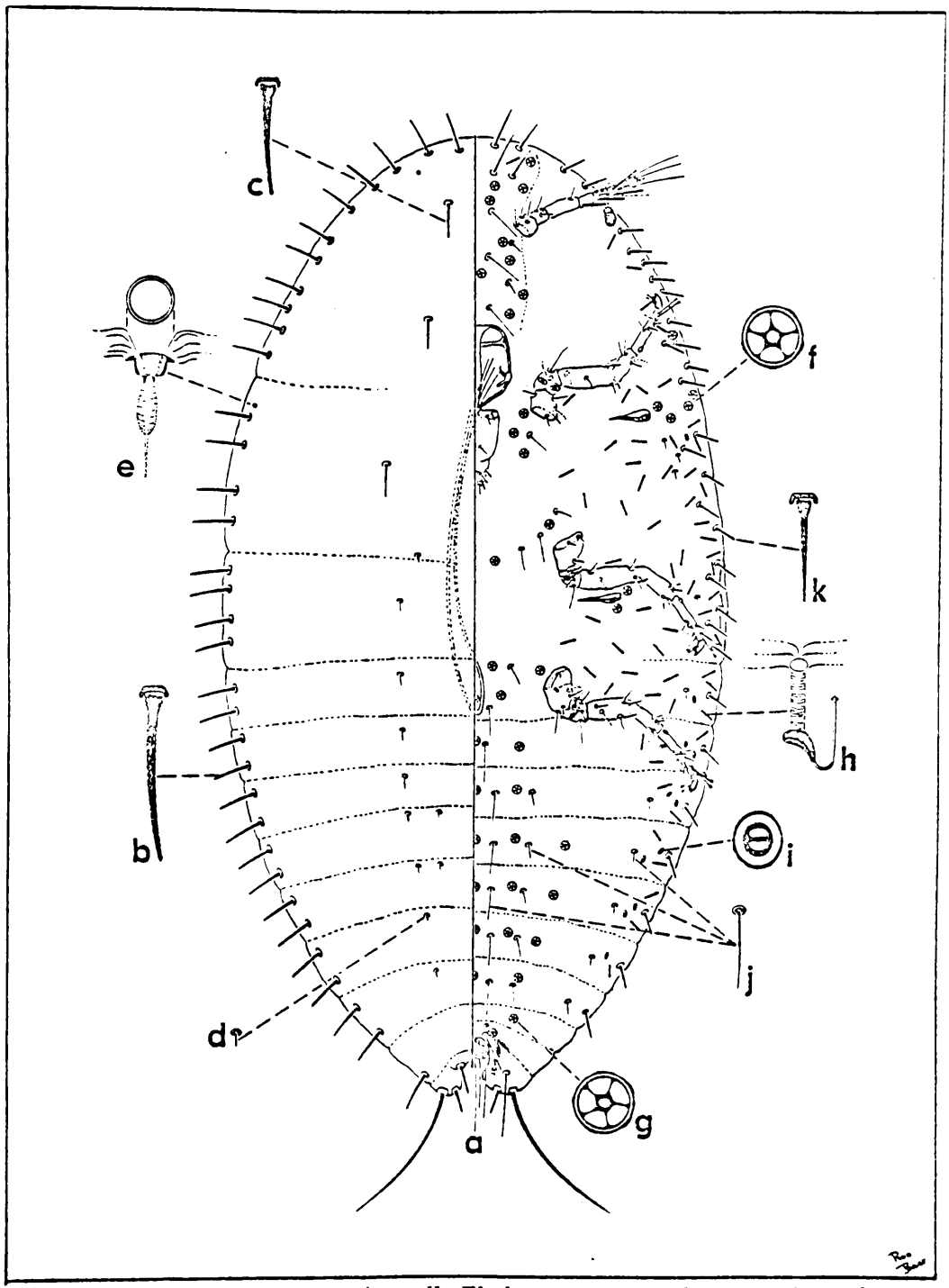

Plate 9. -Kermes cockerelli Ehrhorn, second instar female

VENTER

Antennae. Total length 172 (166-177). Scape ca. 24 long, 43 (40-46) wide. Segments II to VI: 21 (18-24), 50 (48-53), ca. 24, ca. 24, 30 (29-33) long respectively.

Clypeolabral shield. Length 138 (123-147), width 112 (106-118).

Labium. Length 118 (112-123), width 85 (83-89).

Legs. See chart below.

Leg Segments and Claw	Lengths Prothoracic	Lengths Mesothoracic	Lengths Metathoracic
Coxa	50 (48-53)	51 (49-53)	52 (48-53)
Trochanter	46 (44-49)	45 (41-49)	45 (41-49)
Femur	95 (93-97)	98 (95-100)	98 (95-100)
Tibia	64 (62-67)	64 (62-67)	70 (67-72)
Tarsus	86 (83-91)	94 (93-95)	96 (95-100)
Claw	20 (18-24)	21 (17-24)	21 (17-24)
Entire leg	362 (359-366)	373 (365-378)	381 (375-384)

Pores laterad of spiracle (fig. f). Each anterior spiracle with 3 or 4 quinquelocular pores. Each posterior spiracle with 2 quinquelocular pores.

Quinquelocular pores on derm (fig. g). In 5 longitudinal rows on abdomen, also several near coxae and antennal scape bases.

Tubular ducts (fig. h). Numerous, mainly along submargin and coxal areas, ca. 120 total.

Bilocular pores (fig. i). Located near the bases of the submarginal setae, ca. 5 to 10.

Body setae (figs. j,k). In 8 longitudinal rows on abdomen and partly on thorax and head: medial 56 (47-65) long, ca. 2 wide (fig. j); submedial 25 (23-30) long, ca. 2 wide (fig. j); submarginal 5 (4-7) long, ca. 1 wide (fig. j); marginal, similar morphologically to dorsal marginal setae 13 (12-14) long, ca. 2 wide (fig. k).

Anal lobes and ring. Sclerotized. With a single submedial seta on each lobe, 54 (49-58) long. Ring oval 31 (30-33) long, ca. 41 wide; anal ring setae 64 (58-67) long.

Additional material studied. On Quercus douglasii, CA, Putah Creek, 3 mi. E. Monticello Dam, Dec. 6, 1967, coll. JWB, 2(3), JWB; On Q. garryana, OR, Jackson Co., 9.2 mi. NE. Ashland, Apr. 26, 1977, coll. RLP, 1(4), Jackson Co., 1 mi. NE. Central Point, Apr. 26, 1977, coll. RLP, 2(3), VPI: On Quercus sp., CA, Danville, Mar. 28, 1958, colls. Seeley and Danielson, 1(1), CDA; San Mateo, 1(1), UCD.

Remarks. Ferris (1920) illustrated and briefly described the second instar female. The description lacked the important morphological characters needed for species recognition.

Kermes cockerelli second instar females can be distinguished by the following characters: 1) tubular ducts absent from dorsum; 2) abdominal venter with quinquelocular pores but absent along body margin; 3) two pairs of dorsal marginal setae on each abdominal segment; 4) with few or no simple pores on dorsal derm; 5) dorsal submedial setae on head, pro- and mesothorax thickened and similar to dorsal marginal setae; and 6) ventral seta on inner margin of anal lobe 49-58 long.

Kermes concinnulus Cockerell, first instar

Plate 10

Kermes concinnulus Cockerell, in Bogue 1898:172.

Type material studied. Paralectotypes on Quercus macrocarpa, KS, Manhattan, (no date mentioned), coll. JBN, 2(2), NMNH.

Description. Body (fig. a) length 521 (438-604), width 227 (211-242).

DORSUM

Marginal setae (fig. b). Long, thick, setaceous, ca. 42-48, 27 (26-28) long, 3 (2-4) wide.

Marginal setae on anal lobe (fig. c). Longer and thicker than other marginal setae, ca. 33 long.

Submedial setae on head and thorax (fig. d). Thin, setaceous, similar to abdominal submedial setae, 4 pairs, 10 (9-11) long, ca. 1 wide.

Submedial setae on abdomen (fig. e). Thin, setaceous, 7 pairs 8 (6-10) long, ca. 1 wide.

Simple pores (fig. f). In 4 longitudinal rows, ca. 40-46 pores.

Derm (fig. g). Simple, membranous.

Intersegmental membrane (fig. h). Apparent due to type of derm.

Anal lobes (figs. a,i). Sclerotized. One thick seta on inner margin of each lobe, 31 (30-33) long. Another at posterior end, 34 (33-35) long; apical seta ca. 166 long.

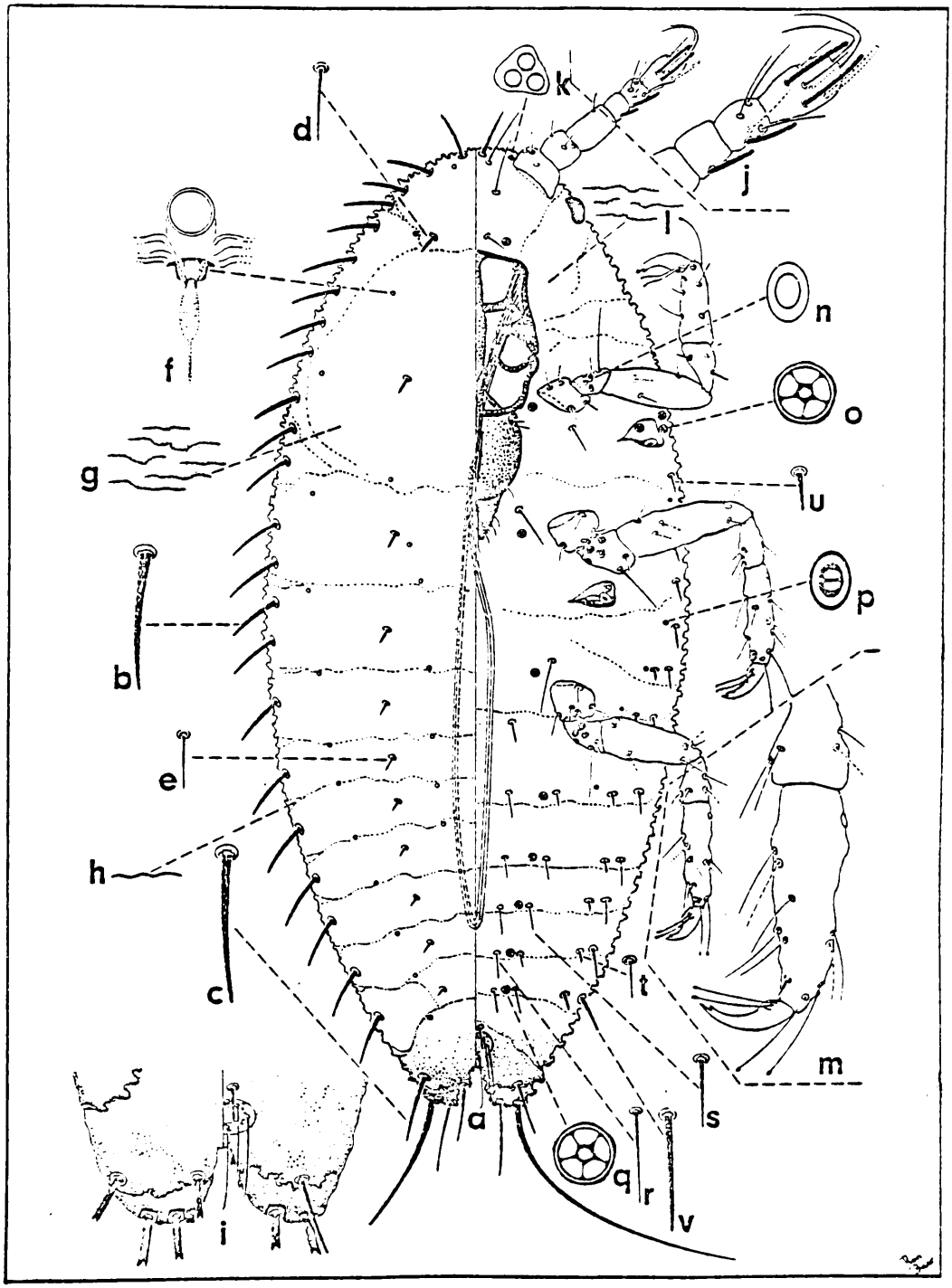

Plate 10.- Kermes concinnulus Cockerell, first instar

VENTER

Antennae (fig. j). Total length 107 (104-109). Scape 20 (19-21) long, ca. 26 wide. Segments II to VI: 17 (16-19), 24 (23-26), 10 (9-12), ca. 12, ca. 23, long respectively. Trilocular pore at scape base (fig. k).

Clypeolabral shield. Length 91 (88-93), width 68 (65-72).

Labium. Length 63 (60-65), width 44 (42-46).

Derm (fig. l). Membranous.

Legs (fig. m). See enlargement of tibia, tarsus and claw of metathoracic leg. Four sensory pores on each trochanter (fig. n).

Leg Segments and Claw	Lengths Prothoracic	Lengths Mesothoracic	Lengths Metathoracic
Coxa	ca. 23	23 (21-26)	20 (19-21)
Trochanter	28 (26-30)	ca. 26	27 (26-28)
Femur	60 (58-63)	ca. 58	60 (58-63)
Tibia	30 (28-33)	ca. 33	34 (33-35)
Tarsus	45 (44-46)	ca. 49	ca. 51
Claw	20 (19-21)	ca. 19	ca. 21
Entire leg	207 (202-211)	ca. 205	212 (211-213)

Pores laterad of spiracle (fig. o). Anterior spiracle, mostly with quinquelocular pores, occasionally a 7-locular pore, usually 3 associated with each spiracle. Each posterior spiracle with 1 pore, usually a quinquelocular but sometimes a 7-locular.

Bilocular pores (fig. p). Located near the bases of the submarginal and marginal setae. Usually associated with the anterior setae. Between 4-7 along each margin.

Submedial pores on derm (fig. q). In 2 submedial longitudinal rows. Four pairs on head and thorax, 5 pairs on abdomen, usually quinquelocular pores, sometimes triloculars.

Body setae (figs. r-v). In 8 longitudinal rows on abdomen and partly on thorax: medial 15 (14-16) long, ca. 0.95 wide (fig. r); submedial 8 (7-9) long, ca. 0.95 wide (fig. s); submarginal 9 (7-12) long, ca. 0.95 wide, (fig. t); marginal 15 (7-23) long, ca. 1.43 wide (fig. u). Posteriormost seta in marginal row thicker than rest in the row, 21 (19-23) long (fig. v).

Anal lobes and ring (figs. a,i). Sclerotized. With a single submedial seta on each lobe, 24 (23-26) long. Ring oval, 12 (9-14) long, ca. 23 wide; anal ring setae ca. 24 long; a pair of thick setae at the anterior margin of anal ring, each ca. 12 long.

Additional material studied. On Quercus alba, AL, Madison Co., Huntsville, Jun. 7, 1975, coll. CHR, 2(6), AU; IN, Vincennes, Jul. 13, 1913, coll. HFD, 1(1), NMNH; MA, Lawrence, Sep. 9, 1899, 4(23), AMNH; MD, Hagerstown, Greenhill Gardens, Jun. 7, 1972, coll. MLW, 2(6), AU; PA, Trappe, Jun. 12, 1946, coll. G. B. Sleesman, 2(6), NMNH; VA, Montgomery Co., Becky Thompson's Riding Academy, Jun. 20, 1975, colls. RGB and ABH, 6(38), VPI; Christiansburg, May 22, 1963, colls. D. Carl and J. Holcomb, 2(6), VPI; On Q. borealis, MA, Lawrence, Sep. 9, 1899, 4(23), AMNH; Lawrence, coll. GBK, 2(4), CAS; On Q. lyrata, AL, Auburn University, Comer Hall area, Jun. 6, 1976, colls. MLW and MK,

2(5), AU; On Q. macrocarpa, OH, Plain City, Jul. 9, 1960, coll. MK, 2(8), VPI; On Q. nigra, OK, Stillwater, Jun. 23, 1897, coll. EEB, 1(1), NMNH; On Q. prinus, OH, Columbus, coll. JGS, 2(9), AMNH; VA, Craig Co., S. of Newcastle, Rt. 42, Overlook, Jun. 4, 1977, colls. MMK, 3(19), VPI: On Q. stellata, GA, Experiment, Jun. 8, 1976, colls. JOH, RB and MK, 2(5), VPI; On Quercus sp., AL, Birmingham, May 12, 1925, coll. E. E. Ellis, 2(5), NMNH; AZ, near Flagstaff, Walnut Creek Canyon, coll. EME, 4(4), NMNH; GA, Atlanta, coll. W. M. Scott, 13(78), NMNH; IN, Noglesville, May 22, 1916, coll. HM, 9(85), NMNH.

Remarks. The first instars of Kermes concinnulus Cockerell cannot be differentiated from Kermes andrei (King 1900a) and K. ceriferus (Ehrhorn 1899a). The type descriptions contained no useful morphological characters in species recognition. K. concinnulus is designated here to represent a group of species including K. cockerelli, K. rimarum and K. shastensis. All these species have relatively long or parallel sided dorsal marginal setae and quinquelocular pores in rows on the venter.

Kermes concinnulus can be distinguished by the following characters: 1) one pair of dorsal marginal setae on each abdominal segment; 2) setaceous dorsal marginal setae 19-48 long; 3) dorsal submedial setae on head, pro- and mesothorax slender, small and different from the dorsal marginal setae; 4) 3 pores laterad of each anterior spiracle; 5) 4 to 7 bilocular pores along each ventral body margin; 6) terminal antennal segment 21-25 long.

Kermes concinnulus is found in central and eastern U.S. on Quercus alba, Q. borealis, Q. lyrata, Q. macrocarpa, Q. nigra, Q. prinus

and Q. stellata.

Kermes concinnulus Cockerell, second instar male

Plate 11

Kermes concinnulus Cockerell, in Bogue 1898:172.

Material studied. On Quercus alba, VA, Montgomery Co., Radford, Dec. 12, 1970, coll. MK, 1(1), NMNH.

Description. Body (fig. a) length 1148, width 606.

DORSUM

Marginal setae (fig. b). Very long thin, setaceous, ca. 52, these 83 long, ca. 2 wide.

Submedial setae (fig. c). In 4 longitudinal rows, 2 to 4 pairs in medial row, 11 pairs in submedial row, these 47 long, 2 wide.

Quinquelocular pores (fig. d). Numerous, scattered over derm.

Simple pores. Absent.

Tubular ducts (fig. e). Numerous, distributed throughout derm, ca. 22 long.

Anal lobes. Sclerotized. One seta on inner margin of each lobe, 33 long, another at posterior end, 28 long; apical seta 123 long.

VENTER

Antennae. Total length 135. Scape 23 long, 49 wide. Segments II to VII: ca. 19, 28, 12, 16, 14, 23 long respectively.

Clypeolabral shield. Length 144, width 116.

Labium. Length 102, width 90.

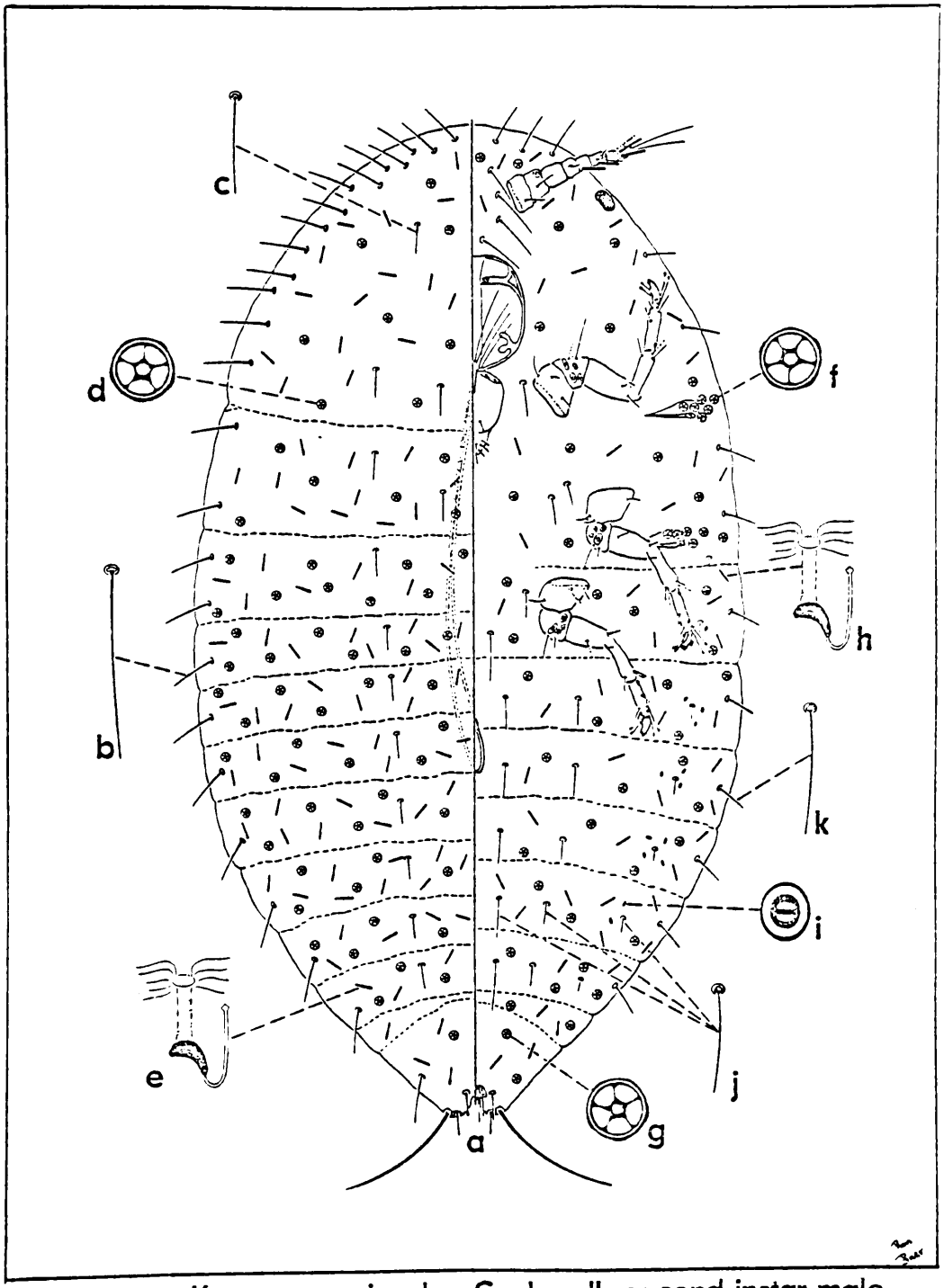

Plate II. -Kermes concinnulus Cockerell, second instar male

Legs. See chart below.

Leg Segments and Claw	Lengths Prothoracic	Lengths Mesothoracic	Lengths Metathoracic
Coxa	ca. 47	ca. 47	ca. 47
Trochanter	ca. 53	ca. 47	ca. 47
Femur	ca. 77	ca. 77	ca. 83
Tibia	ca. 71	ca. 65	ca. 71
Tarsus	ca. 65	ca. 70	ca. 71
Claw	ca. 20	ca. 20	ca. 20
Entire leg	ca. 333	ca. 326	ca. 339

Pores laterad of spiracle (fig. f). Each anterior and posterior spiracle with 5-7 quinquelocular pores.

Quinquelocular pores on derm (fig. g). Numerous, scattered over derm.

Tubular ducts (fig. h). Less numerous than on dorsum, distributed throughout derm, about the same size and shape as those on dorsum.

Bilocular pores (fig. i). Located near the bases of the submarginal and marginal setae, about 15 along each margin.

Body setae (figs. j,k). In 8 longitudinal rows on abdomen and partly on head and thorax: medial 71 long (fig. j); submedial 35 long (fig. j); marginal 20 long (fig. j); marginal 70 long (fig. k). All 2 wide.

Anal lobes and ring. Sclerotized. With a single submedial seta on each lobe, 42 long. Ring oval, 21 long, 35 wide; anal ring setae 30 long.

Remarks. The first instars of K. concinnulus were designated to represent a group of species allied to K. cockerelli and K. rimarum. Their second instar males are also similar in morphology. All have long, thin dorsal marginal setae and quinquelocular pores on the dorsum.

Kermes concinnulus second instar males can be distinguished from other Kermes spp. by the following characters: 1) quinquelocular pores scattered over entire dorsal and ventral derm; 2) dorsal and ventral marginal setae thin, setaceous; 3) no simple pores on the dorsum; 4) dorsal marginal setae 63-100 long; 5) antenna ca. 135 long; and 5) anal ring setae ca. 30 long.

Kermes concinnulus Cockerell, second instar female

Plate 12

Kermes concinnulus Cockerell, in Bogue 1898:172.

Material studied. On Quercus prinus, CN, Portland, Portland Country Club, Nov. 21, 1975, colls. M. Mclure and K. Welch, 4(17), CAES; On Q. stellata, VA, Radford, Becky Thompson's Riding Academy, Jan. 13, 1976, colls, RGB, ABH and MK, 1(1), VPI.

Description. Body (fig. a) length 941 (755-1223), width 434 (317-498).

DORSUM

Marginal setae (fig. b). Thickened, 2 pairs on each abdominal segment, ca. 68-72 total, these 35 (30-47) long, 6 (5-7) wide.

Submedial setae (fig. c). In 2 longitudinal rows, 11 pairs, reduced to small rounded setae, ca. 2 long, 1 wide.

Simple pores (fig. d). Randomly distributed on derm, dia. ca. 2.

Tubular ducts. Absent.

Anal lobes. Sclerotized. One seta on inner margin of each lobe, 23 (18-29) long, another at posterior end 22 (18-23) long; apical seta 123 (105-151) long.

VENTER

Antennae. Total length 157 (140-177). Scape 18 (16-24) long, 44 (40-53) wide. Segments II to VI: 17 (16-19), 53 (47-71), 17 (16-19), 17 (16-19), 34 (28-37) long respectively.

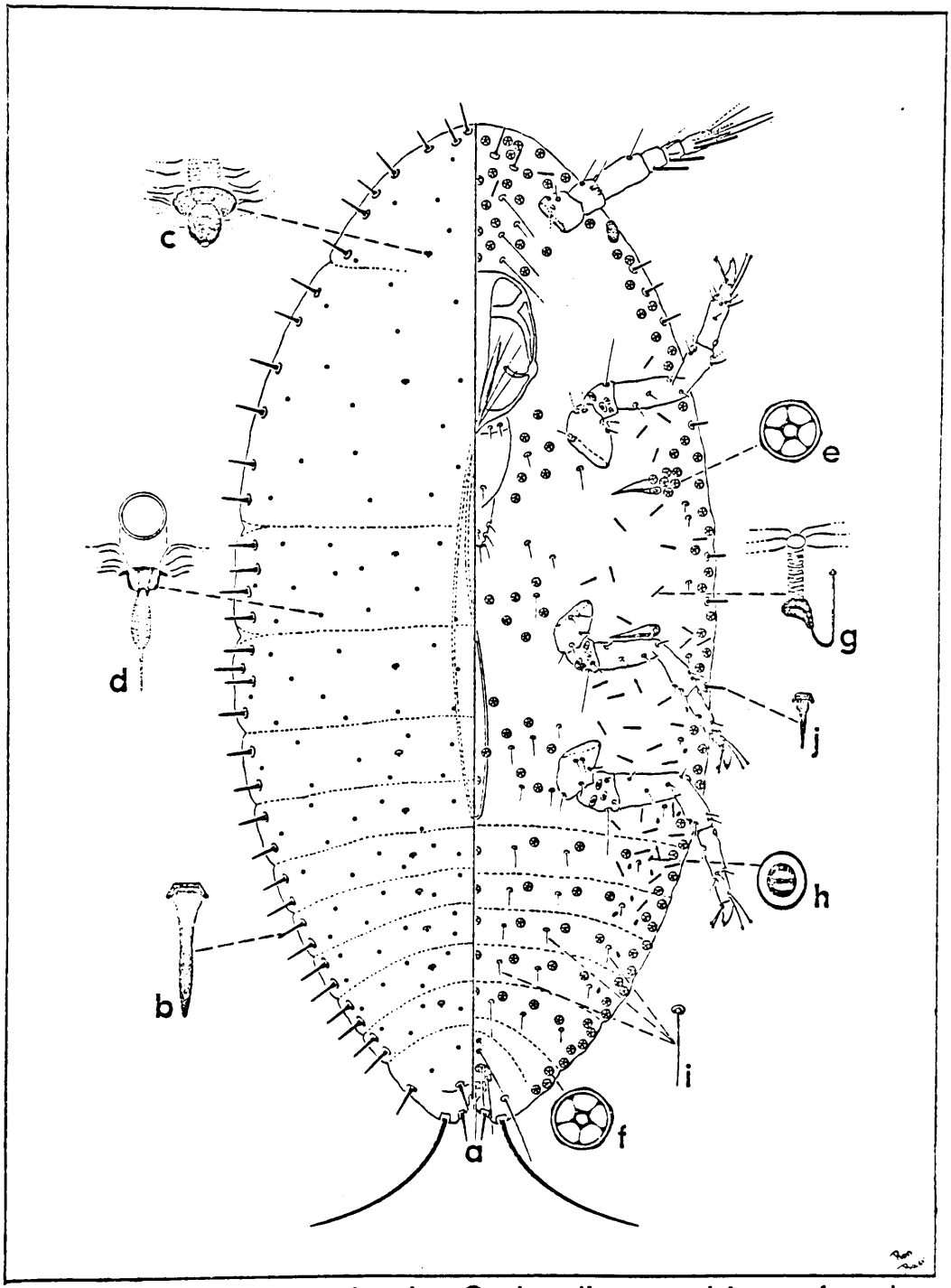

Plate 12. - Kermes concinnulus Cockerell, second instar female

Clypeolabral shield. Length 138 (120-166), width 123 (91-151).

Labium. Length 107 (91-123), width 81 (60-91). Labial setae 14 (11-18) long each.

Legs. See chart below.

Leg Segments and Claw	Lengths Prothoracic	Lengths Mesothoracic	Lengths Metathoracic
Coxa	38 (33-44)	40 (33-44)	40 (33-47)
Trochanter	40 (39-44)	41 (39-44)	44 (41-46)
Femur	82 (74-88)	84 (76-89)	89 (85-93)
Tibia	59 (56-63)	58 (53-63)	62 (56-65)
Tarsus	77 (74-79)	83 (76-88)	94 (90-97)
Claw	16 (14-19)	16 (14-19)	16 (13-19)
Entire leg	312 (300-318)	323 (298-338)	345 (334-359)

Pores laterad of spiracle (fig. e). Each anterior spiracle with 5 quinquelocular pores; each posterior spiracle with 1 quinquelocular pore.

Quinquelocular pores on derm (fig. f). Numerous, arranged in 7 longitudinal rows on abdomen, also near coxal areas and along margin and submargin.

Tubular ducts (fig. g). Numerous along submargin and near coxal areas, ca. 70 total.

Bilocular pores (fig. h). Located near the bases of the submarginal setae, ca. 12 along each margin.

Body setae (figs. i,j). In 6 longitudinal rows on abdomen and partly on thorax: medial 29 (21-44) long, ca. 2 wide (fig. i); submedial 14 (12-16) long, ca. 2 wide (fig. i); submarginal 9 (7-14) long, ca. 2 wide (fig. i). Several marginal setae from mesothorax to head region, ca. 8 pairs, similar morphologically to dorsal marginal setae, 20 (18-24) long, ca. 4 wide (fig. j).

Anal lobes and ring. Sclerotized. With a single submedial seta on each lobe, 51 (44-56) long. Ring oval 30 (23-37) long, 35 (28-41) wide; anal ring setae 49 (41-56) long each.

Remarks. Kermes concinnulus second instar females can be distinguished by the following characters: 1) tubular ducts absent from dorsum; 2) abdominal venter with quinquelocular pores; 3) two pairs of dorsal marginal setae on each abdominal segment; 4) with many simple pores on dorsal derm; and 5) quinquelocular pores present along ventral body margin.

Kermes galliformis Riley, first instar

Plate 13

Kermes galliformis Riley, 1881:482.

Type material studied. Paralectotypes on Quercus palustris, MO, Iron Mountain, (no date mentioned), coll. J. A. Warder, 8(66), NMNH.

Description. Body (fig. a) length 453 (408-498), width 223 (196-242).

DORSUM

Marginal setae (fig. b). Setaceous, ca. 44-46, 18 (16-21) long, 3 (2-4) wide.

Marginal setae on anal lobe (fig. c). Longer and thicker than other marginal setae, 20 (19-21) long.

Submedial setae on head and thorax (fig. d). Slightly longer and thicker than abdominal submedial setae, 4 pairs, 11 (9-18) long, ca. 2 wide.

Submedial setae on abdomen (fig. e). Thin, setaceous, 7 pairs, 6 (2-8) long, ca. 1 wide.

Simple pores (fig. f). In 4 longitudinal rows, ca. 40-46 pores.

Derm (fig. g). Simple, membranous.

Intersegmental membrane (fig. h). Apparent due to type of derm.

Anal lobes (figs. a,i). Sclerotized. One thick seta on inner margin of each lobe, 17 (14-19) long. Another at posterior end, 21 (19-23) long; apical seta 118 (89-136) long.

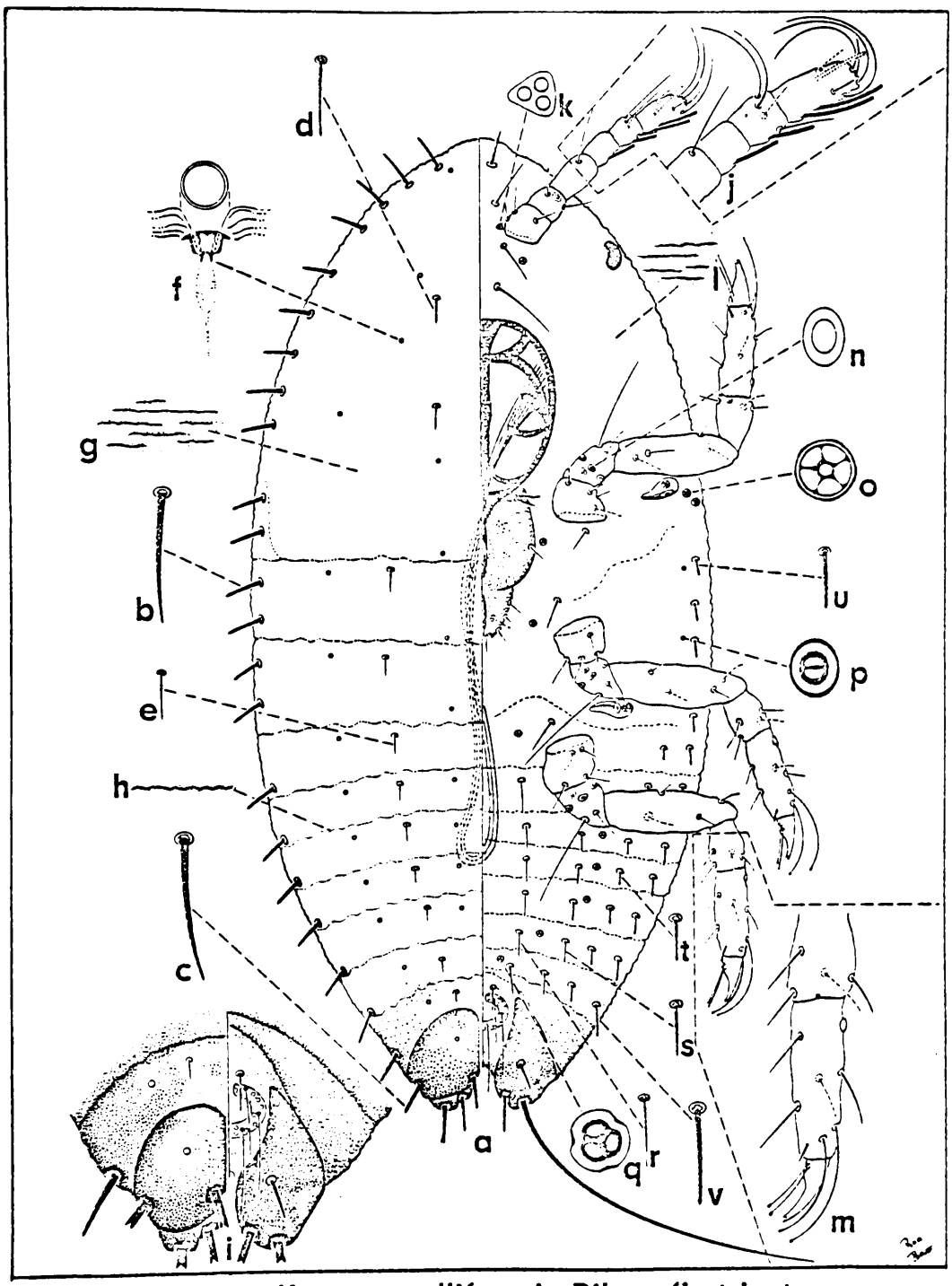

Plate 13.- Kermes galliformis Riley, first instar

VENTER

Antennae (fig. j). Total length 93 (84-99). Scape 14 (12-16) long, 24 (21-26) wide. Segements II to VI: 13 (12-14), 22 (21-23), 11 (9-12), 11 (9-14), 21 (19-25), long, respectively. Trilocular pore at scape base (fig. k).

Clypeolabral shield. Length 77 (72-81), width 57 (53-63).

Labium. Length 63 (60-65), width 45 (40-48).

Derm (fig. l). Membranous.

Legs (fig. m). See enlargement of tibia, tarsus and claw of metathoracic leg. Four sensory pores on each trochanter (fig. n).

Leg Segments and Claw	Lengths Prothoracic	Lengths Mesothoracic	Lengths Metathoracic
Coxa	23 (21-26)	22 (19-23)	22 (19-23)
Trochanter	28 (26-31)	26 (23-30)	26 (23-28)
Femur	61 (58-67)	57 (51-61)	61 (58-65)
Tibia	34 (30-37)	38 (37-39)	38 (35-39)
Tarsus	51 (49-52)	55 (53-58)	57 (51-65)
Claw	18 (16-19)	18 (17-19)	19 (18-21)
Entire leg	213 (209-220)	218 (214-227)	222 (206-234)

Pores laterad of spiracle (fig. o). Each anterior spiracle usually with 3 quinquelocular pores, rarely with 4 pores. Each posterior spiracle with 1 quniquelocular pore.

Bilocular pores (fig. p). Located near the bases of the marginal setae. Usually associated with the anterior setae. Two or 3 along each margin.

Submedial pores on derm (fig. q). In 2 submedial longitudinal rows. Four pairs on head and thorax, 5 pairs on abdomen, mostly triloculars.

Body setae (figs. r-v). In 8 longitudinal rows on abdomen and partly on thorax: medial 7 (5-8) long, 0.95 wide (fig. r); submedial 5 (4-7) long, 0.95 wide (fig. s); submarginal 5 (3-6) long, 0.95 wide (fig. t); marginal 7 (5-8) long, 1.11 (0.95-1.9) wide (fig. u). Posteriormost seta in marginal row thicker than rest in row 9 (7-12) long (fig. v).

Anal lobes and ring (figs. a,i). Sclerotized. With a single submedial seta on each lobe, 12 (10-14) long. Ring oval, 13 (11-16) long, 21 (18-23) wide; anal ring setae 33 (29-35) long; a pair of thick setae at the anterior margin of anal ring, 13 (11-16) long.

Additional material studied. On Chrysolepis sp., CA, near San Jose, Loma Prieta Mt., coll. GFF, 5(19), UCD; On Quercus agrifolia, CA, Los Angeles Co., 2(2), NMNH; Los Gatos, coll. A. H. Herbert, 2(5), UCD; Ontario, Nov. 10, 1913, 3(6), CAS; Pasadena, Jul. 19, 1911, coll. Timberlake, 2(5), NMNH; Santa Paula, Nov. 2, 1913, coll. EOE, 2(3), ORSU; Santa Rosa, Aug. 2 and Sep. 1905, coll. OEB, 4(15) and 2(6), UCD; Sonoma Co., Julupa Valley, Jul. 15, 1906, 1(3), NMNH; Ventura Co., Santa Paula Canyon, Nov. 2, 1913, coll. EOE, 4(34) UCD and coll. RSG and Rittobza, Aug. 14, 1975, 10(102), VPI; On Q. alba, DC, Aug. 15, 1916, coll. J. H. Payne, 2(8), NMNH; IN, Indianapolis, Feb. 22, 1914, coll. HFD, 3(8), UCD and 1443 N. Penn Str., June 17, 1921, coll.

HFD, 2(7), NMNH; MA, Lawrence, Sep. 9, 1899, 1(1), NMNH and 2(2) AMNH; Methuen, coll. GBK, 2(4), AMNH; Salem, coll. JGS, 2(4), AMNH; OK, Stillwater, Aug. 26, 1896, coll. EEB, 9(62), NMNH and Oct. 17, 1896, 7(30), NMNH; On Q. borealis, IN, Lafayette, Murdock Pk., Sep. 26, 1931, coll. JMA, 5(23), NMNH; W. Lafayette, Oct. 21, 1931, coll. JMA, 2(4), NMNH; Lafayette Country Club, Oct. 26, 1931, 1(1), VPI; KS, Lawrence, Aug. 25, 1908, coll. GBK, 1(2), NMNH; MA, Andover, coll. GBK, 4(28), AMNH; Lawrence, 1898, coll. GBK, 1(2), SEM; Sep. 9, 1899, 1(1), NMNH; Nov. 1912, coll. GBK, 14(72), NMNH; coll. BGK, 6(21), CAS; 10(39), AMNH; MN, Ramsey Co., coll. F. Pond, Oct. 17, 1922, coll. G. Hoke, 1(1), UMN; NY, Mt. Vernon, Nov. 1, 1918, coll. J. J. de Vyver, 4(16), CDA; Staten Island, coll. RWD, Sep. 4, 1917, 4(24), UCD; OH, Cincinnati, Oct. 5, 1916, coll. JSH, 2(6), OHSU; Cleveland, Mar. 6, 1912, coll. JSH, 1(1), OHSU; Columbus, Ohio State University, Across B + Z Bldg., Jul. 19, 1976, colls. MMK, 6(18) VPI; Maryville, Rt. 33, Rest area no. 63, Jul. 18, 1976, coll. MK, 2(5), VPI; Pomeroy, Aug. 28, 1903, coll. JGS, 2(3), NMNH; Wooster, Sep. 8, 1912, coll. JSH, 2(5), OHSU; PA, Chestnut Hill, Jan. 28, 1918, coll. FMT, 4(8), NMNH; Rockville, 1922, coll. FMT, 2(5), NMNH; On Q. chrysolepis, MEXICO, Baja Ca., Sierra San Pedro, Arroyo Copal, Aug. 24, 1968, 2(7), VPI; CA, Mountain View, Aug. 1899, coll. EME, 5(6), NMNH; San Jose, Loma Prieta Mt., coll. GFF, 4(22), UCD; Santa Clara Co., Stevens Creek, coll. GFF, 6(18), UCD; Shasta Springs, coll. EME, 1(3), IAE; Shasta Springs, Aug. 9, 1906, coll. EME, 4(21), NMNH; Shasta Springs, Dunsmuir City Pk., Jul. 7-8, 1976, colls. MMK, 4(9), VPI; Twin Peaks, July 20, 1930, coll. NWC, 2(5), NMNH; Yosemite Natl. Pk., Jul. 1,

1976, colls. MMK, 2(4), VPI; On Q. coccinea, IN, St. Joe Co., Nov. 18, 1976, coll. R. B. Cummins, 2(4), VPI; MA, Cape Cod, Sep. 15, 1977, coll. RGB and SWB, 2(4), VPI; On Q. douglasii, CA, Davis, Univ. of California, Jul. 5, 1976, colls. MMK, 2(4), VPI, Putah Creek, Monticello Dam, Dec. 6, 1967, coll. JWB, 3(7), JWB; On Q. emoryi, AZ, between Benson and Dragoon, Jun. 1918, coll. GFF, 2(8), UCD; S. of Flagstaff, Rock Creek Canyon, 1940, coll. GFF, 1(1), UCD; Huachucha Mts., Miller Canyon, 1940, coll. GFF, 2(2), UCD; 3 mi. E. of Oraoley, Jan. 7, 1940, coll. E. C. Marshall, 1(3), UCD; Portal, Jun. 22, 1976, coll. MK and I. Storks, 2(6), VPI; Prescott, Jul. 1921, coll. RWD, 4(31), UCD; Santa Cruz Co., Nogales, Aug. 28, 1975, coll. G. Ehni, 4(17), VPI; NM, Silver City, Dec. 17, 1880, coll. H. H. Rusby, 8(33), NMNH; On Q. falcata, AR, Paragould, Paragould Country Club, Jul. 1, 1968, coll. MLW, 2(5), AU; VA, Occoneechee St. Pk., near Clarksville, Sep. 24, 1976, colls. MMK and M. Rhoades, 2(6), VPI; On Q. gambellii, NM, Otero Co., Jun. 11, 1976, coll. WAI, 1(2), VPI; On Q. grisea, TX, Big Bend Natl. Pk., 1 mi. N. of Chisos Mt. Lodge, Jun. 15, 1976, colls. MMK, 2(6), VPI; On Q. havardii, TX, Comanche, Sep. 1, and 12, 1918, coll. Hollinger, 4(7), UCD; near Quitaque, escarpment of the Statseel Plains, 1921, coll. GFF, 2(4), UCD; On Q. hypoleucoides, AZ, Chiricahua Mts., Cave Creek, 1940, coll. GFF, 1(4), UCD, Cochise Co., Chiricahua Mts., Jun. 14, 1964, coll. MK, 2(6), SWRS; Madera Canyon, Jun. 25, 1976, coll. R. Lenczy and MK, 1(3), VPI; Santa Rita Mts., Jun. 24, 1943, coll. LPW, 2(6), UCD; On Q. ilicifolia, MA, Lawrence, 12(34), AMNH; PA, New Bloomfield, 1922, coll. T. L. Guyton, 2(6), NMNH; VA, Blacksburg, VPI&SU Campus, Oct. 18, 1968, coll.

MK, 3(11), VPI; On Q. imbricata, IN, W. Lafayette, Oct. 21, 1931, coll. JMA, 1(4), VPI; OH, Ohio State Univ., May 5 and Jul. 16, 1960, coll. MK, 4(14), VPI; On Q. incana, FL, Sopchoppy, Nov. 4, 1929, coll. L. H. Weld, 1(3), NMNH; On Q. kelloggii, CA, North Fork of Feather River, 1939, coll. GFF, 1(2), UCD; Santa Clara Co., Los Gatos, coll GFF, 2(5), UCD; Shasta Springs, Dunsmuir City Pk., Jul. 7, 1976, colls. MMK, 2(4), VPI; On Q. laurifolia, LA, New Orleans, Jun. 10, 1905, coll. R. S. Cooks, 2(6), NMNH; SC, Charleston, St. Phillip's Church, Cemetery Grounds, Jun. 16, 1971, coll. MK, 2(7), VPI; On Q. lobata, IN, Indianapolis, 4(8), UCD; VA, Blacksburg, VPI&SU Campus, Sep. 20, 1975, coll. RGB, 1(1), VPI; On Q. macrocarpa, IA, CPG, 7(19), NMNH; On Q. marilandica, TX, Goliad, 1921, coll. GFF, 2(5), UCD; VA, Amelia Co., Aug. 14, 1963, coll. MK and D. Vest, 2(4), VPI; On Q. neo-tharpii, TX, 27 mi. S. of Kingsville, Oct. 9, 1976, coll. GF, 2(6), VPI; On Q. nigra, GA, Atlanta, Dec. 30, 1913, coll. Cooley, 2(7), NMNH; Henry Co., Jun. 8, 1976, coll. RB, 1(2), VPI; LA, New Orleans, Dec. 1, 1924, coll. N. D. Blut, 1(3), NMNH; Roseland, Sep. 26, 1913, coll. E. S. Tucker, 2(7), NMNH; MS, Orange Grove, Jun. 18, 1906, coll. L. Rapp, 2(5), NMNH; OK, Stillwater, 12(74), NMNH; Stillwater, Nov. 2, 1896, coll. EEB, 4(26), NMNH; Stillwater, Oct. 1897, coll. S. E. Myers, 2(7), NMNH; Stillwater, Dec. 27, 1898, coll. EEB, 4(22), NMNH; SC, Charleston, Jul. 3, 1974, coll. D. Pollet, 4(13), VPI; VA, Virginia Beach, Seashore State Pk., Sep. 25, 1976, colls, RGB, SWB, and MMK, 4(11), VPI; On Q. oblongifolia, AZ, Superior, Craig Ranch, Apr. 16, 1928, coll. A. A. Nichols, 2(4), UCD; CA, San Diego Co., Escondido, coll. F. Austin, 7(15), NMNH; 8 mi. E. of Escondido, coll. F. Austin, 4(15), NMNH; On

Q. palustris, IN, Plymouth, Price Nursery, Sep. 16, 1977, coll. R. B. Cum, 2(4), VPI; LA, New Orleans, Jul. 8, 1921, coll. H. C. Land, 2(7), NMNH; MO, Sikeston, Mar. 18 and Apr. 9, 1976, coll. LRH, 2(4), VPI; NJ, Newark, Feb. 14, 1925, coll. FMS, 4(23), NMNH; NY, Manhattan, Feb. 17, 1932, coll. R. Sheehan, 4(14), NMNH; PA, Chestnut Hill, Jun. 28, 1918, coll. FMT, 3(5), NMNH; Philadelphia, Mar. 31, 1922, coll. A. J. Bonsall, 4(30), NMNH; VA, Roundhill, Sep. 1, 1909, coll. JGS, 2(8), NMNH; On Q. phellos, VA, Lynchburg, coll. D. Barnes, 1(2), VPI; On Q. prinus, NJ, Palisades, Dyckman Str. Ferry, May 30, 1930, coll. J. C. Bridwell, 2(6), NMNH; VA, Apr. 22, 1880, coll. T. Pergande, 2(12), NMNH; On Q. pungens, AZ, Camp Creek, Dec. 27, 1928, coll. NWC, 2(7), NMNH; On Q. robur, CA, Davis, Univ. of California, Jul. 5, 1976, colls. MMK, 1(2), VPI; On Q. stellata, AL, Auburn, Auburn Univ., Comer Hall area, Jun. 8, 1976, colls. MLW and MK, 1(2), AU; OH, sand dunes near Columbia, Sep. 4, 1960, coll. MK, 2(4), VPI; TX, Bryan, Apr. 19, 1919, 2(5), UCD; Corsicaus, Apr. 11, 1918, 1(1), UCD; Dallas, May 18, 1882, 2(6), NMNH; On Q. undulata, AZ, Camp Creek, Dec. 1928, coll. NWC, 2(6), NMNH; NM, Guadalupe Mts., Jun. 15, 1976, coll. WAI, 2(7), VPI; Otero Co., 2 mi. N. junction from Weed, Jun. 15, 1976, coll. WAI, 1(2), VPI; On Q. velutina, DC, near Washington Hilton, Aug. 27, 1976, colls. MK and SWB, 1(2), VPI; NY, Long Island, Melville, Jan. 3, 1926, colls. FMS, 1(2), NMNH; OH, Sandusky, Cedar Point, Aug. 27, 1906, coll. JGS, 3(9), NMNH; PA, Hershey, Hershey Hotel, Sep. 26, 1974, colls. RGB and ABH, 2(7), VPI; Shamokin, 1922, coll. FMT, 6(19), NMNH; West Chester, Nov. 5, 1908, coll. F. Windle, 2(7), NMNH; VA, Craig Co., Broad Run, Jul. 26, 1967, coll. MLW, 2(5), VPI; Montgomery Co., Blacksburg,

VPI&SU Campus, Apr. 22, 28, 29, 1975, coll. ABH, 5(68), VPI; On Q. virginiana, AL, Mobil, Aug. 11, 1918, coll. HM, 2(4), NMNH; CA, San Mateo, 2(8), UCD; Santa Rosa, Oct. 3, 7, 1880, coll. Comstock, 4(10), NMNH; FL, Cedar Key, Mar. 19, 1970, coll. MLW, 1(2), AU; Dade Co., Coral Gables, Jul. 1, 1976, coll. F. W. Howard, 1(4), VPI; Dixie Co., Aug. 4, 1977, colls. F. L. Carle and SWB, 5(15), VPI; Tampa, 5(28), NMNH; GA, Clinch Co., Hwy. 117E., May 10, 1977, coll. RB, 1(2), VPI; Savannah, Aug. 18, 1900, coll. P. D. Daffin, 2(4), NMNH; Savannah, Mar. 30, 1901, coll. W. F. Fiske, 2(5), DSIR; St. Marys, May 26, 1976, coll. RB, 2(3), VPI; LA, Baton Rouge, Aug. 26, 1976, coll. GF, 2(5), VPI; New Orleans, Jul. 13, 1911, coll. T. C. Barter, 1(8), NMNH; New Orleans, Jan. 12, 1932, coll. H. L. Dozier, 1(1), NMNH; New Orleans, Jul. 12, 1938, coll. H. A. Hetrick, 3(20), NMNH; New Orleans, Audubon Pk., Dec. 28, 1908, coll. F. N. Meyer, 1(2), NMNH; New Orleans, Audubon Pk., Dec. 2, 1975, coll. MK, 4(33), VPI; 43 mi. E. of Slidell, Aug. 26, 1976, coll. Hammond, 4(8), VPI; MS, Long Beach, Gulf View Motel, Jun. 9, 1976, colls. MMK, 5(26), VPI; Meridian, 1922, 3(13), UCD; SC, Branfort, Jul. 6, 1896, 2(5), NMNH; Charleston, Jul. 8, 1933, coll. P. U. Siggers, 4(44), NMNH; Charleston, Hampton Pk., Jun. 26, 1936, coll. Holcombe, 2(9), NMNH; Columbia, Aug. 24, 1976, coll. GF, 1(1), VPI; Fort Sumpter, Jul. 9, 1949, coll. J. H. Pruitt, 5(51), NMNH; TX, cuero, Jun. 12, 1976, coll. MK, 10(80), VPI; Cuero, Rt. 87, across from Cuero High School, Jun. 12, 1976, colls. MMK, 2(5), VPI; Dallas, Fair Grounds, Nov. 27, 1973, coll. MK, 1(3), VPI; La Grange, Haidusek Memorial Pk., Jun. 12, 1976, colls. MMK, 2(7), VPI; San Antonio, Nov. 27, 1895, 1(1), NMNH; Sinton, Welder Wildlife Foundation

Grounds, Aug. 6, 1976, coll. MK, 4(11), VPI; VA, Va. Beach, Seashore State Pk., Bay Zone, Mar. 20, 1969, colls. MLW and JOH, 2(6), VPI; On Q. virginiana var. fusiformis, MEXICO, Oct. 11, 1976, coll. GF, 1(3), VPI; TX, Austin, 1975, coll. GF, 1(3), VPI; Austin, Natural Area, Sep. 3, 1976, coll. GF, 1(2), VPI, Austin-urban, Sep. 3, 1976, coll. GF, 2(6), VPI; On Q. wislizenii, CA, Big Oak Flat, along Rt. 120, Jul. 1, 1976, coll. MK, 2(4), VPI; Folsom, Jul. 13, 1885, coll. AK, 4(21), NMNH; Kernville, Mar. 29, 1950, coll. GFF, 3(9), UCD; Santa Clara Co., Stevens Creek Canyon, Nov. 22, 1914, coll. A. F. Swain, 2(8), NMNH; Solano Co., Jul. 5, 1976, colls. MMK and D. V. Beres, 4(9), VPI; "Red Oak", AL, Farmsdale, Sep. 2, 1918, coll. J. H. Comstock, 2(3), NMNH; DC, near Washington Hilton, Aug. 20, 1976, coll. MK, 1(1), VPI; DE, Wilmington, May 21, 1920, coll. E. R. Mack, 2(6), NMNH; GA, Cassville, Oct. 30, 1929, coll. L. H. Weld, 1(2), NMNH; IN, Orange Co., Oct. 21, 1931, coll. JMA, 3(5), VPI; PA, Philadelphia, Mar. 6, 1915, coll. S. N. Baxter, 4(9), NMNH; TN, Memphis, Apr. 16, 1927, coll. E. F. Owens, 2(6), NMNH; VA, Blacksburg, VPI&SU Campus, Jun. 9, 1965, coll. MK, 2(4), VPI; Blacksburg, VPI&SU, Price Hall parking lot, Nov. 4, 1974, coll. ABH, 2(4), VPI; Elliston, Yagle Nursery, Sep. 8, 1977, coll. S. Winfrey, 2(5), VPI; On Quercus sp., CANADA, Toronto, Aug. 1891, coll. J. Brodie, 2(6), NMNH; AL, Auburn, Aug. 13, 1976, coll. MLW, 2(7), VPI; Jefferson Co., Dec. 5, 1975, coll. D. Bradford, 2(5), AU; AZ, Camp Creek, Nov. 20, 1928, coll. NWC, 2(7), NMNH; Chiricahua Mts., Jul. 14, 1938, coll. (RTS), 2(3), SEM; Empire Mts., Apr. 4, 1937, coll. LPW, 4(9), UCD; Nogales, Jul. 13, 1934, coll. EDB, 2(5), UCD; 10 mi. E. Nogales, Sep. 2, 1968, coll. T. R. Haig, 3(12), CDA;

Prescott, coll. TDAC, 10(80), UCD; E. of Superior, 1940, coll. GFF, 2(4), UCD; 7 mi. E. of Superior, Sep. 1, 1969, colls. P. F. Min and D. B. Carver, 4(13), CDA; Walnut Creek Canyon, 16(97), AMNH; CA, Butte Co., Oroville, Aug. 20, 1969, colls. B. Adkins and F. McCraken, 2(5), RFW; Fresno Co., coll. Clarke, 3(12), UCD; Los Angeles Co., Aug. 7, 1909, coll. Woods, 5(30), NMNH; Los Angeles, coll. A. Craw, 4(9), NMNH; Los Angeles, Mt. Lowe, Sep. 29, 1968, 2(7), IAE; Sacramento Co., American River, Carmichael, Mar. 18, 1967, coll. RFW, 3(3), RFW; San Anita Canyon, 1909, coll. F. Maskero, 2(4), NMNH; San Bernadino, Sep. 13, 1913, coll. S. A. Pease, 2(4), NMNH; San Diego, coll. A. Craw, 2(5), UCD; San Jacinto, Oct. 15, 1899, 4(31), NMNH; Tulare Co., Leavi Camp Ground, Jul. 8, 1976, coll. A. Kana, 2(6), VPI; CN, Hartford, Aug. 20, 1974, 2(7), USNM; Portland, Aug. 12, 1913, coll. B. H. Walden, 5(22), CAES; Stanford, Apr. 9, 1931, coll. E. P. Felt, 4(11), NMNH; CO, Moncos, Mesa Verde Natl. Pk., Oct. 3, 1928, coll. W. H. Weld, 2(5), NMNH; Trinidad, Ranton Pass, 1921, coll. GFF, 1(2), UCD; DC, USDA Grounds, Oct. 8, 1916, coll. HM, 2(6), NMNH; USDA Grounds, Sep. 4, 1918, coll. ERS, 2(6), NMNH; FL, Bradentown, Jun. 15, 1917, coll. F. Poos, Jr., 4(26), NMNH; Brooksville, Apr. 8, 1918, coll. ERS, 1(2), NMNH; Jacksonville, 1887, coll. Ashmead, 2(4), NMNH; Miami, Dec. 27, 1974, coll. CHR, 2(4), AU; Putnam Co., Mar. 17, 1968, 1(1), VPI; near Shady, on Hwy. 475A, Sep. 17, 1976, colls. CHR and L. R. Ray, 2(5), VPI; GA, Henry Co., Jun. 8, 1976, coll. RB, 2(5), VPI; Valdosta, Aug. 15, 1976, coll. GF, 2(7), VPI; IN, Elkart Co., Jul. 14, 1939, coll. A. Tripple, 4(21), NMNH; Indianapolis, 3(7), UCD; New London, coll. C. C. Beals, 2(9), NMNH; W. Lafayette, Feb. 27, 1932,

coll. G. Gould, 1(4), NMNH; KS, Manhattan, coll. JBN, 2(12), NMNH; LA, Baton Rouge, Oct. 11, 1921, coll. W. Bradley, 4(17), UCD; New Orleans, Nov. 22, 1903, 5(11), NMNH; MA, Cambridge, Apr. 1, 1885, 2(4), NMNH; Cape Cod, Sep. 15, 1977, colls. RGB and SWB, 2(6), VPI; Lawrence, 4(12), AMNH; Lawrence, coll. GBK, 4(40), UCD; Lawrence, Jun. 17, 1898, coll. GBK, 5(26), NMNH; Lawrence, Aug. 12, 1900, coll. GBK, 2(9), NMNH; MD, Beltsville, May 31, 1974; coll. MK, 1(3), VPI; LaPlata, Dec. 1914, coll. ERS, 2(6), NMNH; Plummers Sel., Jun. 7, 1914, coll. McAfee, 1(1), NMNH; St. Michaels, Nov. 10, 1971, coll. MLW, 1(3), AU; MI, Cheboygan Co., Vincent, Aug. 1927, coll. H. B. Hingafok, 2(6), SEM; MN, St. Paul Univ. Farm, Apr. 23, 1923, coll. G. Hoke, 2(4), UMN; MO, St. Louis, Aug. 12, 1876, 2(4), NMNH; MS, Cat. Island, Sep. 9, 1920, coll. J. E. Graf, 2(6), NMNH; Meridian, Sep. 4, 1927, coll. M. L. Grimes, 1(10), NMNH; NC, Aberdeen, Feb. 6, 1904, coll. F. Sherman, 3(5), NMNH; NH, Hoboken, Aug. 20, 1947, coll. Grayson, 2(9), NMNH; NJ, Bayonne, Aug. 18, 1908, coll. O. Farley, 4(37), NMNH; NY, Ithaca, 5(6), NMNH; Ithaca, 1893, 1(1), UCD; Ithaca, coll. LOH, 2(15), NMNH; Jaffrey, Sep. 1896, 2(2), NMNH; Long Island, Masbeth, Apr. 5, 1914, coll. C. E. Olsen, 2(9), CDA; Long Island, Riverhead, May 20, 1950, coll. L. H. Weld, 1(2), NMNH; New Rochelle, Oct. 19, 1921, coll. T. Ladenburger, 2(7), NMNH; OH, Cincinnati, Oct. 9, 1909, coll. N. Longsworth, 3(11), NMNH; Cincinnati, Aug. 3, 1916, coll. J. M. McCullough, 2(4), OHSU; Cincinnati, Dec. 30, 1921, coll. C. R. Crisby, 1(3), NMNH; Cleveland, Aug. 19, 1925, coll. A. D. Taylor, 2(5), OHSU; Rock Bridge, Apr. 23, 1916, coll. JSH, 1(3), OHSU; Wooster, Sep. 22, 1899, coll. W. Newell, 1(1), OHSU; PA, Narbeth, Oct. 31, 1917, coll.

A. R. Wohlert, 1(3), NMNH; Philadelphia, Aug. 16, 1919, coll. L. Morse, 2(8), NMNH; Philadelphia, Mt. Airy, Mar. 12, 1914, coll. W. Brooks, 2(5), NMNH; Wash. Co., Fredericktown, Aug. 29, 1944, coll. F. R. Smith, 1(13), NMNH; SC, Blufton, coll. J. H. Mellichamp, 2(3), NMNH; Charleston, Jun. 28, 1921, coll. D. L. Bissell, 1(2), NMNH; Charleston, Jul. 28, 1922, coll. W. M. Jennings, 2(4), NMNH; Charleston, Charleston Museum, Jul. 22, 1921, coll. L. M. Bragg, 2(4), NMNH; Clemson College, Mar. 1, 1916, coll. J. A. Berly, 1(5), NMNH; Wayside Pk., 2 mi. N. on US 21 from Fairfield Co., Mar. 16, 1968, coll. MK, 1(3), VPI; TN, 6.5 mi. E. of Maryville, Jun. 6, 1976, colls. MMK, 2(4), VPI; TX, Beaumont, Oct. 13, 1920, coll. L. R. Levy, 2(6), NMNH; Cloverdale, Apr. 8, 1918, 1(2), UCD; Cuero, coll. Townsend, 1(1), NMNH; Cuero, May 21, 1976, coll. DRM, 6(45), VPI; Dallas, Sep. 12, 1907, coll. R. Cushman, 4(13), UCD; Paris, Apr. 4, 1904, 8(50), NMNH; Tyler, Jul. 10, 1918, 1(3), UCD; VA, Blacksburg, VPI&SU Campus, Apr. 25, 1969, coll. R. C. Brachman, 3(8), VPI; Blacksburg, VPI&SU Campus, May 18, 1969, coll. A. Dascoli, 1(2), VPI; Blacksburg, VPI&SU Campus, near Seitz Hall, Jul. 22, 1974, coll. ABH, 2(7), VPI; Blacksburg, VPI&SU Campus, Mar. 6, 1975, 2(4), VPI; Craig Co., Broad Run, Jun. 24, 1974, coll. CHR, 1(1), AU; Leesburg, May 20, 1947, coll. F. Marr, 5(12), NMNH; Skyline, Oct. 20, 1958, coll. MK, 2(4), VPI; Skyline, Hazel Overlook, Jul. 29, 1958, coll. MK, 2(6), VPI; Virginia Beach, Seashore State Pk., Mar. 19, 1969, colls. MLW and JOH, 2(7), VPI; Virginia Beach, Seashore State Pk., Sep. 25, 1976, colls. MMK, 1(3), VPI; Winchester, Oct. 25, 1921, 2(4), VPI; WI, Madison, Apr. 4, 1965, 2(17), NMNH.

Remarks. The first instars of Kermes galliformis cannot be differentiated from Kermes arizonensis (King 1903), K. austini Ehrhorn (1899b), K. boguei (Cockerell 1897), K. cueronensis (Cockerell in King 1900b), K. ehrhorni (Cockerell manuscript species), K. emoryi (Ferris 1955), K. essigi (King 1913a), K. fuscata (King manuscript species), K. kingi (Cockerell 1898), K. mirabilis (King 1914b), K. niger (King manuscript species), K. nigropunctatus (Ehrhorn and Cockerell in Ehrhorn 1898), K. nivalis (King and Cockerell in Cockerell 1898a), K. occidentalis (King 1913b), K. perryi (King 1900b), K. pettiti (Ehrhorn 1899a), K. rattani (Ehrhorn 1906), K. sassceri (King 1914c), K. trinotatus (Bogue 1900) and K. waldeni (King 1914d).

The original description contained no information on the first instars. The description by Hamon et al. (1976), provided adequate morphological characters for species recognition. Based on the present study, I have designated K. galliformis to represent a group of species containing K. branigani, K. gillettei and K. kosztarabi. These four species have 2 rows of trilocular pores on the venter and relatively small, setaceous dorsal marginal setae.

Kermes galliformis can be distinguished from other Kermes spp. by the following characters: 1) one pair of dorsal marginal setae on each abdominal segment; 2) setaceous dorsal marginal setae 16-21 long; 3) 3 quinquelocular pores laterad of each anterior spiracle; and 4) dorsal submedial setae on head, thorax and first abdominal segment similar to those on rest of abdomen.

K. galliformis is widely distributed in the U.S. and occasionally is found in Canada and Mexico. It infests chinquapin and many

species of oaks.

Kermes galliformis is a species which apparently exhibits host-induced morphological variation. For example, in the samples studied there is variation in the morphology of the dorsal marginal setae. The shape ranged from slender to thickened and from sharp to relatively blunt at the apex of the setae. Therefore, I was not able to consistently separate all the first instar specimens from the paratype series of the species listed above. Earlier studies of these species were based solely on the external morphology of the adult female. These descriptions usually included an external morphological comparison of many of the closely related species that was unclear, overlapping and very generalized. Some of these species were considered synonyms by me, however, in the slide-mounted adult study (Bullington, 1978), some of these species were considered valid. Only additional studies on the adult males of the species in question can satisfactorily clarify their status. It is expected that such studies may reveal bonafide subspecific differences within the K. galliformis species complex.

Kermes galliformis Riley, second instar male

Plate 14

Kermes galliformis Riley, 1881:482.

Material studied. On Quercus velutina, VA, Blacksburg, VPI&SU Campus, near Chapel, May 26, 1975, coll. ABH, 10(26), VPI.

Description. Body (fig. a) length 753 (649-830), width 355 (332-392).

DORSUM

Marginal setae (fig. b). Stout, spinelike setae, ca. 48, these 21 (18-26) long, 4 (3-5) wide.

Submedial setae (fig. c). In 2 longitudinal rows, 11 pairs of similar slender setaceous setae on head, thorax and abdomen, these 9 (7-12) long, ca. 2 wide.

Quinquelocular pores. Absent except for simple pores.

Simple pores (fig. d). Randomly distributed over derm, ca. 2 wide.

Tubular ducts (fig. e). Numerous, distributed throughout derm, these 19 (18-21) long.

Anal lobes. Sclerotized. One seta on inner margin of each lobe 31 (23-35) long, another at posterior end, 23 (22-24) long; apical seta 153 (120-183) long.

VENTER

Antennae. Total length 154 (138-165). Scape 18 (13-21) long, 17 (14-19) wide. Segments II to VII: 17 (14-19), 36 (37-37), 23 (14-30),

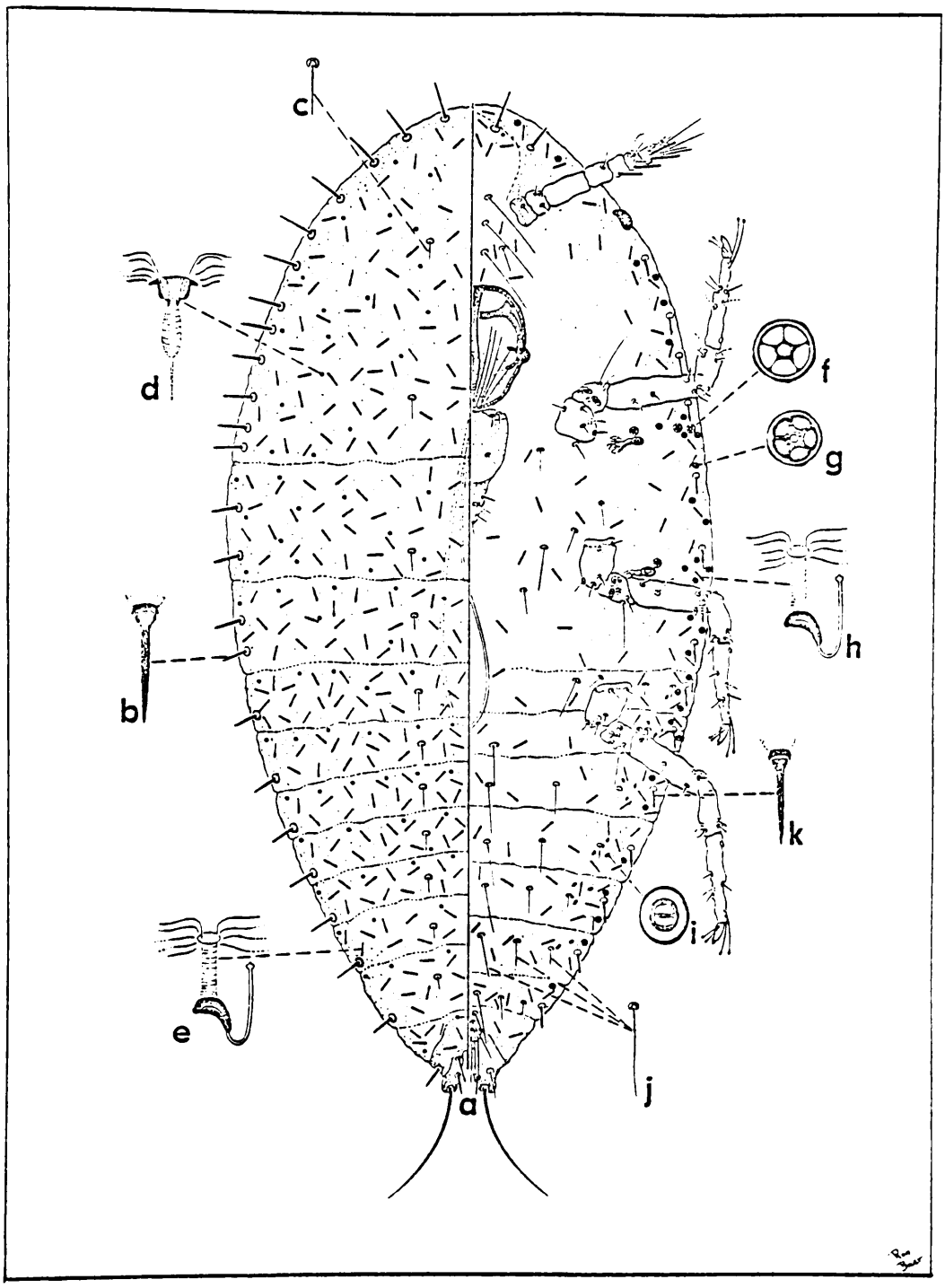

Plate 14.- Kermes galliformis Riley, second instar male

16 (14-18), 17 (15-19), 29 (28-30) long respectively.

Clypeolabral shield. Length 104 (83-123), width 88 (71-95).

Labium. Length 83 (70-91), width 76 (59-91).

Legs. See chart below.

Leg Segments and Claw	Lengths Prothoracic	Lengths Mesothoracic	Lengths Metathoracic
Coxa	32 (26-37)	41 (37-44)	44 (39-49)
Trochanter	42 (35-46)	45 (41-49)	43 (35-49)
Femur	94 (90-100)	95 (93-97)	96 (93-100)
Tibia	56 (51-60)	58 (55-60)	55 (53-58)
Tarsus	94 (90-97)	95 (91-97)	96 (93-100)
Claw	17 (14-21)	16 (14-19)	16 (14-19)
Entire leg	334 (319-335)	350 (340-361)	351 (334-364)

Pores laterad of spiracle (fig. f). Each anterior spiracle with 2-4 quinquelocular pores. Each posterior spiracle with 1 quinquelocular pore.

Quinquelocular pores on derm (fig. g). Along margin only, ca. 60 total.

Tubular ducts (fig. h). Less numerous than on dorsum, distributed throughout the derm, about the same shape and size as those on dorsum.

Bilocular pores (fig. i). Located near the bases of the submarginal and marginal setae, about 15 along each margin.

Body setae (figs. j,k). In 8 longitudinal rows on abdomen and partly on thorax and head: medial 42 (39-46) long, ca. 2 wide (fig. j); submedial 15 (14-19) long, ca. 2 wide (fig. j); submarginal 8 (5-14) long, ca. 2 wide (fig. j); marginal, similar to dorsal marginals, 15 (11-16) long, ca. 3 wide (fig. k).

Anal lobes and ring. Sclerotized. With a single submedial seta on each lobe, 23 (19-26) long. Ring oval, ca. 28 long, ca. 30 wide; anal ring setae 30 (28-33) long.

Additional material studied. On Quercus emoryi, AZ, Rock Creek Canyon, Jul. 1940, coll. GFF, 1(1), UCD; On Q. wislizenii, CA, 2.5 mi. below Monticello Dam, Putah Creek, Apr. 5, 1968, coll. JWB, 2(5), JWB; On Quercus sp., CA, Sacramento Co., American River, Carmichael, May 21, 1966, coll. RFW, 1(1), RFW; VA, Blacksburg, VPI&SU Campus, May 17, 1975, coll. ABH, 1(5), VPI.

Remarks. Hamon et al. (1976) described and illustrated the second instar male. The first instars of K. galliformis were designated to represent a group of species. Second instar males differ from those in the K. concinnulus group. The dorsal marginal setae are shorter and spinelike and the quinquelocular pores are absent on the dorsum. No other second instar males in the K. galliformis group were available for this study.

K. galliformis second instar males can be distinguished by the following characters: 1) quinquelocular pores absent from the dorsum; 2) dorsal and ventral marginal setae stout, spinelike; and 3) simple pores scattered on dorsum.

Kermes galliformis Riley, second instar female

Plate 15

Kermes galliformis Riley, 1881:482.

Material studied. On Quercus palustris, MO, Sikeston, May 17-June 15, 1976, coll. LH, 28(151), VPI.

Description. Body (fig. a) length 738 (604-966), width 361 (302-528).

DORSUM

Marginal setae (fig. b). Long, spinelike, ca. 46, these 35 (18-49) long, 3 (2-4) wide.

Submedial setae (fig. c,d). In 2 longitudinal rows, slender setaceous, 6-8 pairs restricted to head, thorax and first few abdominal segments, these ca. 4 long, 1 wide; posteriormost pair reduced to small rounded setae (fig. d).

Simple pores (fig. e). In 8 longitudinal rows on abdomen, randomly scattered over thorax and head, ca. 100 total.

Tubular ducts. Absent.

Anal lobes. Sclerotized. One seta on inner margin of each lobe, 21 (16-26) long, another at posterior end, 23 (18-26) long; apical seta 88 (76-106) long.

VENTER

Antennae. Total length 109 (102-115). Scape 12 (9-14) long, 25 (23-28) wide. Segments II to VI, 14 (11-16), 33 (30-25), 13 (11-14),

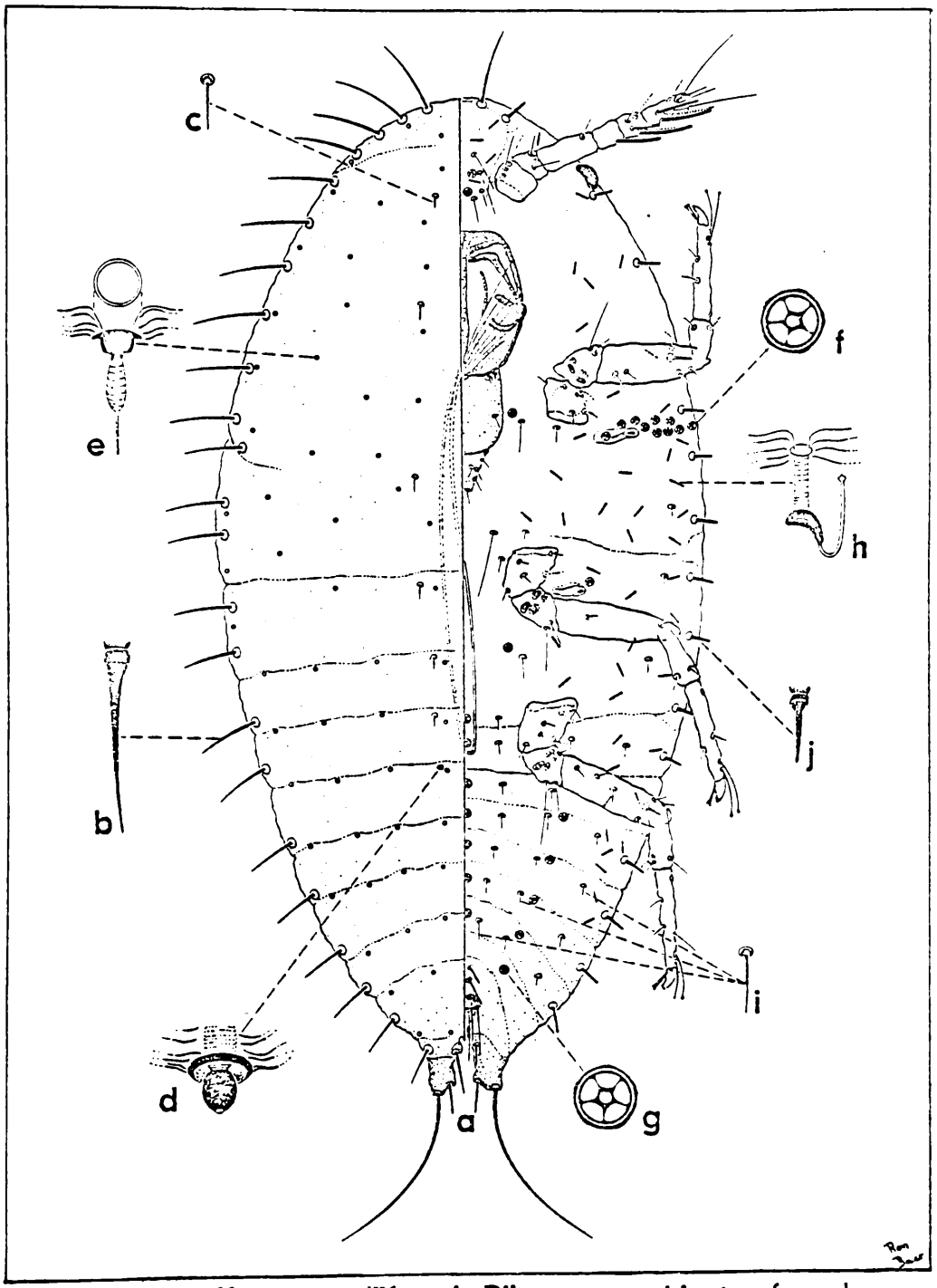

Plate 15. - Kermes galliformis Riley, second instar female

12 (12-14), 25 (23-28), long respectively.

Clypeolabral shield. Length 93 (88-100), width 82 (74-89).

Labium. Length 70 (65-83), width 59 (47-65). Labial setae 35 (31-41) long each.

Legs. See chart below.

Leg Segments and Claw	Lengths Prothoracic	Lengths Mesothoracic	Lengths Metathoracic
Coxa	32 (28-35)	33 (30-35)	35 (32-39)
Trochanter	36 (33-42)	34 (30-39)	37 (32-42)
Femur	76 (74-79)	71 (64-79)	78 (74-81)
Tibia	37 (34-42)	39 (37-42)	39 (35-42)
Tarsus	67 (64-70)	69 (67-72)	74 (70-79)
Claw	15 (12-19)	15 (12-16)	15 (12-19)
Entire leg	264 (256-274)	261 (249-266)	276 (266-283)

Pores laterad of spiracle (fig. f). Each anterior spiracle with 5-13 quinquelocular pores. Each posterior spiracle with 1 to 2 quinquelocular pores.

Quinquelocular pores on derm (fig. g). In 3 longitudinal rows on abdomen, also, 1 or 2 pores associated with each coxa and antennal base.

Tubular ducts (fig. h). Distributed in derm mainly along submargin and coxal areas, ca. 80 total.

Bilocular pores. Absent.

Body setae (figs. i,j). In 8 longitudinal rows on abdomen and partly on head and thorax: medial 8 (7-11) long, ca. 2 wide (fig. i); submedial 7 (7-9) long, ca. 2 wide (fig. i); submarginal 4 (4-7) long, ca. 2 wide (fig. i); marginal row similar morphologically to dorsal marginals, 12 (9-19) long, 3 (2-4) wide (fig. j).

Anal lobes and ring. Sclerotized. With a single submedial seta on each lobe, 14 (11-16) long. Ring oval, 22 (21-23) long, 23 (20-26) wide; anal ring setae 36 (30-39) long.

Additional material studied. On Chrysolepis sp., CA, Loma Prieta Mt., near San Jose, coll. GFF, 3(5), UCD; On Quercus agrifolia, CA, Sonoma Co., Julupa Valley, Jul. 15, 1906, coll. OEB, 1(1), NMNH; On Q. borealis, MA, Lawrence, off Rt. 114, Jun. 16, 1976, coll. SWB, 5(23), VPI; OH, Columbus, OHSU, Jul. 19, 1976, colls. MMK, 5(20), VPI; On Q. douglasii, CA, Tulare Co., E. of Orange Cove, Sandcreek Rd., Apr. 28, 1964, coll. HM, 1(3), CDA; Q. grisea, TX, Big Bend Natl. Pk., Jun. 15, 1976, colls. MMK, 1(1), VPI; On Q. kelloggii, CA, Yosemite Natl. Pk., Curry Village, Jun. 30, 1976, colls. MMK, 2(6), VPI; On Q. nigra, AL, Auburn, S. Gray Str., Jun. 8, 1976, colls. MLW and MK, 1(1), VPI; VA, Seashore State Pk., May 10, 1974, coll. MK, 4(27), VPI; On Q. palustris, NY, Brooklyn Botannical Garden, Jul. 1921, coll. G. L. Griffith, 1(2), NMNH; On Q. stellata, TX, Bryan, Apr. 6, 1918, 1(2), UCD; On Q. velutina, IA, Federal, Sep. 7, 1919, coll. RWD, 2(5), UCD; MA, N. Andover, Merrimack College Campus, Jun. 15, 1976, coll. SWB, 5(34), VPI; Lawrence, off Rt. 114, Jun. 16-18, 1976, coll. SWB, 19(93), VPI; VA, VPI&SU Campus, May 19-Jun. 5, 1975, coll. ABH, 14(68), VPI; On Q. virginiana, FL, Ft. Desoto Pk., Apr. 28, 1977, coll. K. Hickman,

3(3), FDA; GA, Emanuel Co., Feb. 15, 1976, coll. RB, 1(3), AU; On Q. wislizenii, CA, Putah Creek, Apr. 5, 1968, coll. JWB, 1(3), JWB; Putah Creek, 2.5 mi. below Monticello Dam, Apr. 5, 1968, coll. JWB, 1(3), JWB; Putah Creek, 7 mi. W. of Winters, May 17, 1968, coll. JWB, Sacramento Co., American River, Carmichael, Oct. 19, 1977, coll. RIG, 1(2), VPI; 1(2), JWB; "Red oak", VA, VPI&SU Campus, Price Hall, May 27, 1974, coll. P. Lambdin, 1(9), VPI; Price Hall, Jun. 3, 1974, coll. ABH, 1(4), VPI; Price Hall, May 28, 1976, coll. SWB, 1(2), VPI; On Quercus sp., AZ, Oak Creek Canyon, Indian Gardens, Jun. 26, 1976, colls. MMK, 1(2), VPI; 7 mi. E. of Superior, Sep. 1, 1969, colls. P. F. Mint and D. B. Carver, 1(1), CDA, CA, Sacramento Co., American Rivers, Carmichael, May 21, 1966, coll. RFW, 1(4), RFW; Siskiyou Co., Shasta Springs, May 20, 1976, 3(4), VPI; CN, Portland, Aug. 12, 1913, coll. B. H. Walden, 1(1), CAES; CO, Manitou, coll. CPG, 2(4), NMNH; FL, Miami, Sep. 8, 1973, coll. CHR, 4(7), AU; Miami, Dec. 27, 1974, coll. CHR, 1(1), AU; MD, Beltsville, May 25, 1976, coll. S. Nakahara, 1(1), NMNH; PA, Philadelphia, Aug. 16, 1919, coll. L. Morse, 1(1), NMNH; TX, Cuero, May 21, 1976, coll. DRM, 3(5), NMNH; VA, Blacksburg, VPI&SU Campus, Price Hall parking lot, May 14, June 16, 1975, coll. ABH, 3(11), VPI.

Remarks. Hamon et al. (1976) adequately described and illustrated the second instar female for species recognition.

K. galliformis second instar females can be distinguished from other Kermes spp. by the following characters: 1) tubular ducts absent from dorsum; 2) one pair of dorsal marginal setae on each abdominal segment; 3) with many simple pores on dorsal derm; 4) ventral

quinquelocular pores on abdomen arranged in 3 definite rows; and 5) each anterior spiracle with 5-13 quinquelocular pores.

Kermes gillettei Cockerell, first instar

Plate 16

Kermes gillettei Cockerell, 1895:101.

Type material studied. Paralectotypes on Quercus undulata, CO, Manitou, coll. CPG, 6(33), NMNH.

Description. Body (fig. a) length 483 (438-574), width 211 (196-242).

DORSUM

Marginal setae (fig. b). Thick, setaceous, ca. 46-50, 15 (12-22) long, ca. 2 wide.

Marginal setae on anal lobe (fig. c). Longer and thicker than other marginal setae, 21 (16-25) long.

Submedial setae on head and thorax (fig. d). Slightly thicker than abdominal submedial setae, four pairs, 10 (9-11) long, ca. 2 wide.

Submedial setae on abdomen (fig. e). Thin setaceous, 7 pairs, 5 (4-7) long, ca. 1 wide.

Simple pores (fig. f). In 4 longitudinal rows, ca. 42-48 pores.

Derm (fig. g). Simple, membranous.

Intersegmental membrane (fig. h). Apparent due to type of derm.

Anal lobes (figs. a,i). Sclerotized. One thick seta on inner margin of each lobe, 16 (14-19) long. Another at posterior end 19 (16-21) long; apical seta 166 (121-196) long.

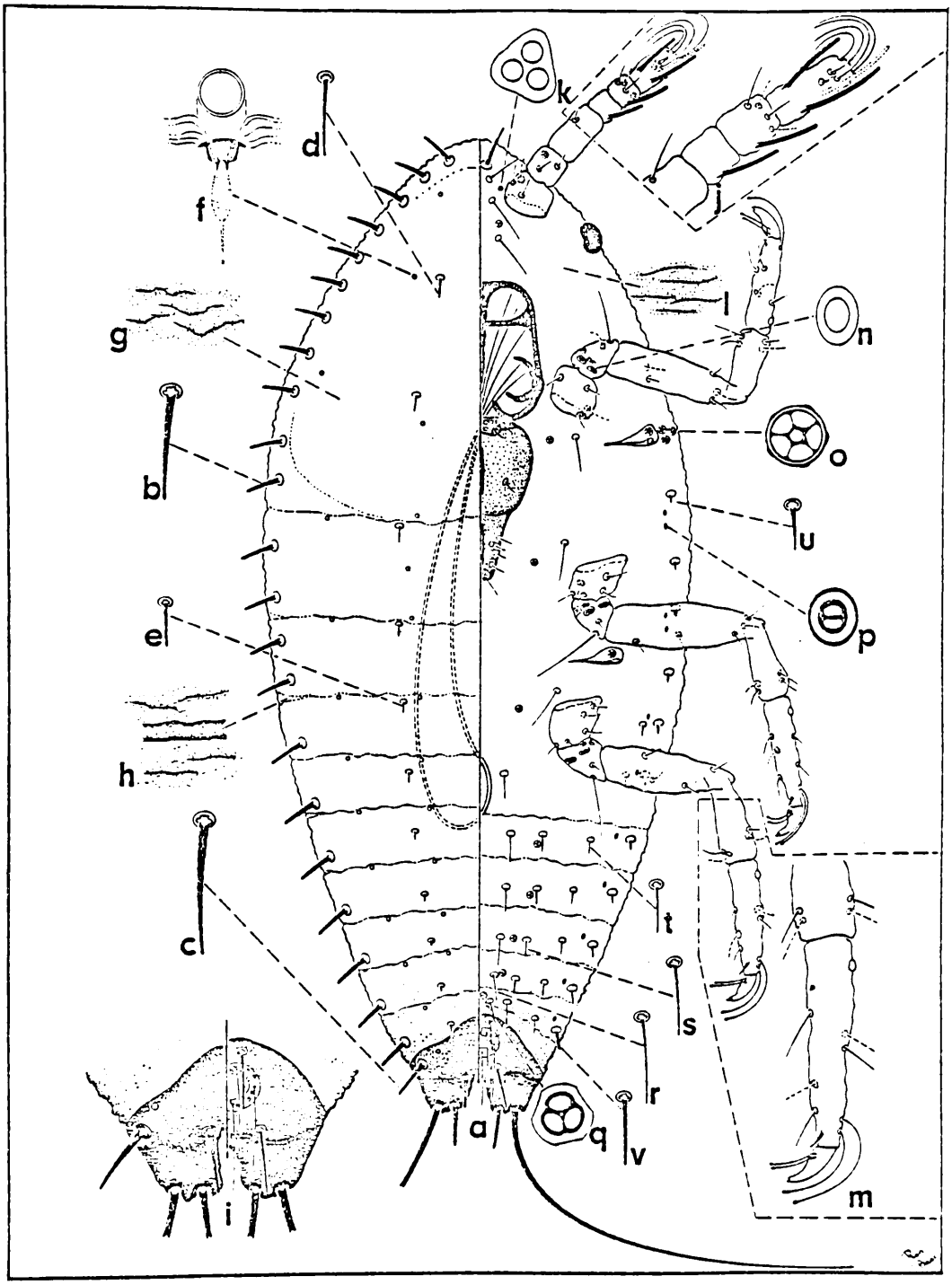

Plate 16.- Kermes gillettei Cockerell, first instar

VENTER

Antennae (fig. j). Total length 103 (95-116). Scape 13 (12-16) long, 28 (26-33) wide. Segments II to VI: 15 (12-19), 24 (21-28), 12 (11-14), 13 (12-16), 26 (23-28), long respectively. Trilocular pore at scape base (fig. k).

Clypeolabral shield. Length 81 (77-88), width 63 (58-67).

Labium. Length 78 (72-91), width 54 (46-60).

Derm (fig. l). Membranous.

Legs (fig. m). See enlargement of tibia, tarsus and claw of metathoracic leg. Four sensory pores on each trochanter (fig. n).

Leg Segments and Claw	Lengths Prothoracic	Lengths Mesothoracic	Lengths Metathoracic
Coxa	23 (21-26)	24 (21-26)	24 (21-28)
Trochanter	27 (23-33)	28 (26-33)	26 (25-30)
Femur	61 (53-65)	62 (51-67)	64 (53-70)
Tibia	36 (33-39)	39 (35-42)	40 (35-44)
Tarsus	55 (49-58)	59 (51-65)	64 (56-67)
Claw	18 (14-19)	19 (16-21)	20 (16-21)
Entire leg	223 (204-237)	229 (206-246)	238 (216-251)

Pores laterad of spiracle (fig. o). Each anterior spiracle with 4 quinquelocular pores, but sometimes with 3 pores. Each posterior spiracle with one quinquelocular pore.

Bilocular pores (fig. p). Located near the bases of the marginal setae. Seven to 11 along each margin.

Submedial pores on derm (fig. q). In 2 submedial longitudinal rows. Four pairs on head and thorax, 5 pairs on abdomen, mostly triloculars.

Body setae (figs. r-v). In 8 longitudinal rows on abdomen and partly on thorax: medial 11 (8-14) long, ca. 0.95 wide (fig. r); submedial 8 (7-10) long, ca. 0.95 wide (fig. s); submarginal 5 (4-7) long, ca. 0.95 wide (fig. t); marginal 8 (6-9) long, ca. 1.14 wide (fig. u). Posteriormost seta in marginal row thicker than rest in row 9 (7-11) long (fig. v).

Anal lobes and ring (figs. a,i). Sclerotized. With a single submedial seta on each lobe, 18 (14-25) long. Ring oval, 14 (11-16) long, 21 (19-23) wide; anal ring setae 36 (30-39) long; a pair of thick setae at the anterior margin of anal ring 16 (14-19) long.

Additional material studied. On Quercus alba, CO, Manitou, 3(6), NMNH; On Q. engelmannii, MEXICO, Amecameca, coll. AK, 3(13), NMNH; MEXICO, Amecameca, May 25, 1897, coll. AK, 17(110), NMNH; On Q. gambelii, CO, coll. TDAC, 6(44), UCD; On Quercus sp., MEXICO, Chivela, Claxaca, 1926, coll. GFF, 4(27), UCD; AZ, Young, Nov. 1, 1935, coll. NWC, 2(6), NMNH; CO, Colorado Mts., foothills, Jul. 1909, coll. E. Bethel, 2(4), CSU; Colorado Springs, Sep. 3, 1919, coll. J. H. Pollock, 4(32), UCD; Manitou, coll. TDAC, 4(24), PANS; Manitou, Apr. 13, 1904, coll. TDAC, 4(32), NMNH; Maintou, Oct. 10, 1923, coll. Beetrel, 4(6), UCD; Palmer Lake, 4(13), UCD; FL, Gainesville, Jan. 22, 1964, coll. JMA, 1(3), VPI; Jacksonville, Jul. 5, 1881, 2(4), NMNH; Miami, Dec. 27, 1974, coll. CHR, 5(13), AU; TX, Cuero, May 21, 1976, coll. DRM, 2(4),

VPI; Davis Mts., Mt. Livermore, Jul. 1921, coll. GFF, 1(2), UCD.

Remarks. The first instars of K. gillettei cannot be distinguished from Kermes grandis Cockerell (1898b) and Lecanium tubiliferum Cockerell (1898c). K. gillettei is closely allied with the K. galliformis group. All species in this group have two rows of trilocular pores on the venter and relatively small, setaceous dorsal marginal setae.

K. gillettei can be distinguished by the following characters: 1) 1 pair of dorsal marginal setae on each abdominal segment; 2) setaceous dorsal marginal setae 9-22 long; 3) usually 4 quinquelocular pores laterad of each anterior spiracle; 4) 4 to 11 ventral bilocular pores along each body margin; and 5) usually 5 pairs of submedial trilocular pores on the abdominal venter.

This species is found on Quercus alba, Q. engelmanni, Q. gambelii, and Q. undulata in Florida, Colorado, Texas and Mexico.

Kermes gillettei Cockerell, second instar female

Plate 17

Kermes gillettei Cockerell, 1895:101.

Type material studied. Paralectotypes on Quercus undulata, CO, Manitou, (no date mentioned), coll. CPG, 2(2), NMNH.

Description. Body (fig. a) length 974 (921-1026), width 559 (513-604).

DORSUM

Marginal setae (fig. b). Thick, slightly curved at middle, ca. 48, 49 (35-59) long, ca. 7 wide.

Submedial setae (fig. c). In two longitudinal rows, eight pairs, several other pairs located medially to these rows, ca. 5 long, 1 wide.

Simple pores (fig. d). One to 5 distributed over derm.

Tubular ducts. Absent.

Anal lobes. Sclerotized. One seta on inner margin of each lobe ca. 28 long, another at posterior end ca. 26 long; apical seta 171 long.

VENTER

Antennae. Total length 148 (144-153). Scape 15 (14-16) long, 34 (33-35) wide. Segments II to VI: 20 (19-21), 51 (49-53), ca, 16, 17 (16-19), 29 (28-31) long, respectively.

Clypeolabral shield. Length ca. 148, width 130 (106-153).

Labium. Length 109 (94-124), width 91 (77-106).

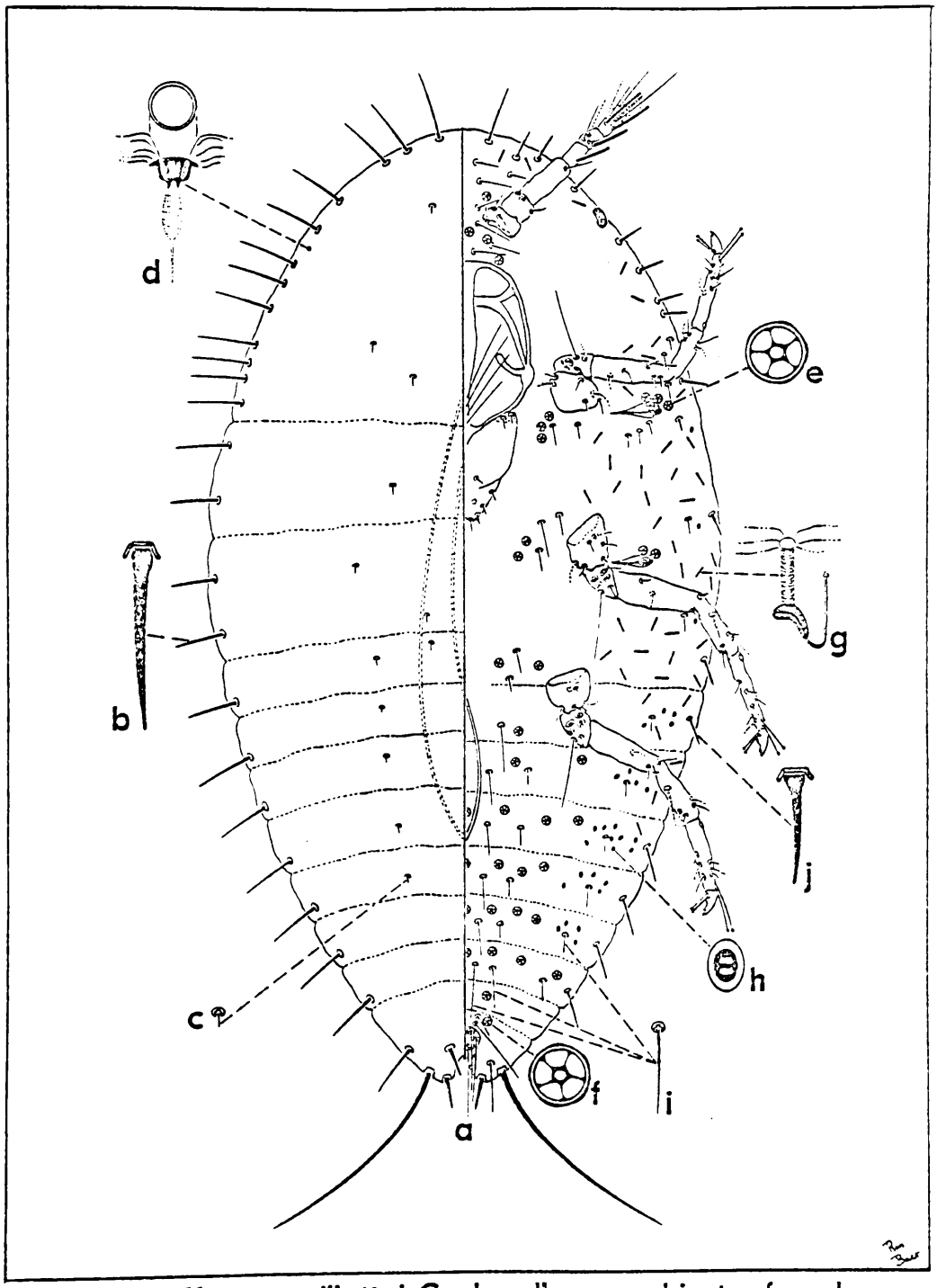

Plate 17.-Kermes gillettei Cockerell, second instar female

Legs. See chart below.

Leg Segments and Claw	Lengths Prothoracic	Lengths Mesothoracic	Lengths Metathoracic
Coxa	34 (33-35)	41 (35-46)	41 (35-46)
Trochanter	41 (39-42)	43 (42-44)	41 (37-44)
Femur	94 (93-95)	ca. 93	93 (91-95)
Tibia	65 (63-67)	60 (58-63)	65 (63-67)
Tarsus	87 (86-89)	87 (86-88)	89 (88-91)
Claw	17 (14-21)	17 (14-21)	ca. 21
Entire leg	337 (332-343)	341 (339-343)	349 (348-350)

Pores laterad of spiracle (fig. e). Each anterior spiracle with 4 quinquelocular pores. Each posterior spiracle with 2 quinquelocular pores.

Quinquelocular pores on derm (fig. f). Ca. 60 on abdomen, near each coxa and antennal base.

Tubular ducts (fig. g). Distributed in derm, mainly along submargin and coxal areas, ca. 86 total.

Bilocular pores (fig. h). Located near the bases of the submarginal setae, ca. 16-54.

Body setae (figs. i,j). In 8 longitudinal rows on abdomen and partly on thorax and head: medial 33 (21-44) long (fig. i); submedial 16 (12-21) long (fig. i); submarginal 12 (7-19) long (fig. i); marginal 25 (19-33) long (fig. j). All 2 wide.

Anal lobes and ring. Sclerotized. With a single submedial seta on each lobe, 46 (44-49) long. Ring oval, ca. 30 long, 43 (39-46) wide; anal ring setae 73 (70-77) long.

Remarks. K. gillettei second instar females can be distinguished from other Kermes spp. by the following characters: 1) tubular ducts absent from dorsum; 2) one pair of dorsal marginal setae on each abdominal segment; 3) one to 5 simple pores on dorsal derm; and 4) ventral quinquelocular pores on abdomen not arranged in definite rows.

Kermes iselini n. sp., first instar

Plate 18

Kermes iselini n. sp.

Type material studied. Holotype and paratype series on Quercus mohriana, NM, Otero Co., 15 mi. N. of El Paso Gap, Jun. 15, 1976, coll. WAI, 15(75), VPI.

Description. Body (fig. a) length 423 (483,408-544), width 181 (191,166-227).

DORSUM

Marginal setae (fig. b). Long, conical, ca. 66-70, 16 (16,12-23) long, 8 (8,5-9) wide.

Marginal setae on anal lobe (fig. c). Slightly longer and thicker than other marginal setae, 16 (18,16-24) long.

Submedial setae on head and thorax (fig. d). Long, conical, 4 pairs on head and thorax, similar to marginal setae. Length 14 (14, 12-16), width 9 (7,6-9).

Submedial setae on abdomen (fig. e). Thin, setaceous, 7 pairs, 4 (5,4-6) long, ca. 0.95 wide.

Simple pores (fig. f). In 2 longitudinal rows along submargin of body and 1 pore associated with each submedial seta on head and thorax, ca. 26-30 pores.

Derm (fig. g). Composed of overlapping platelike areas.

Intersegmental membrane (fig. h). Pronounced due to type of derm.

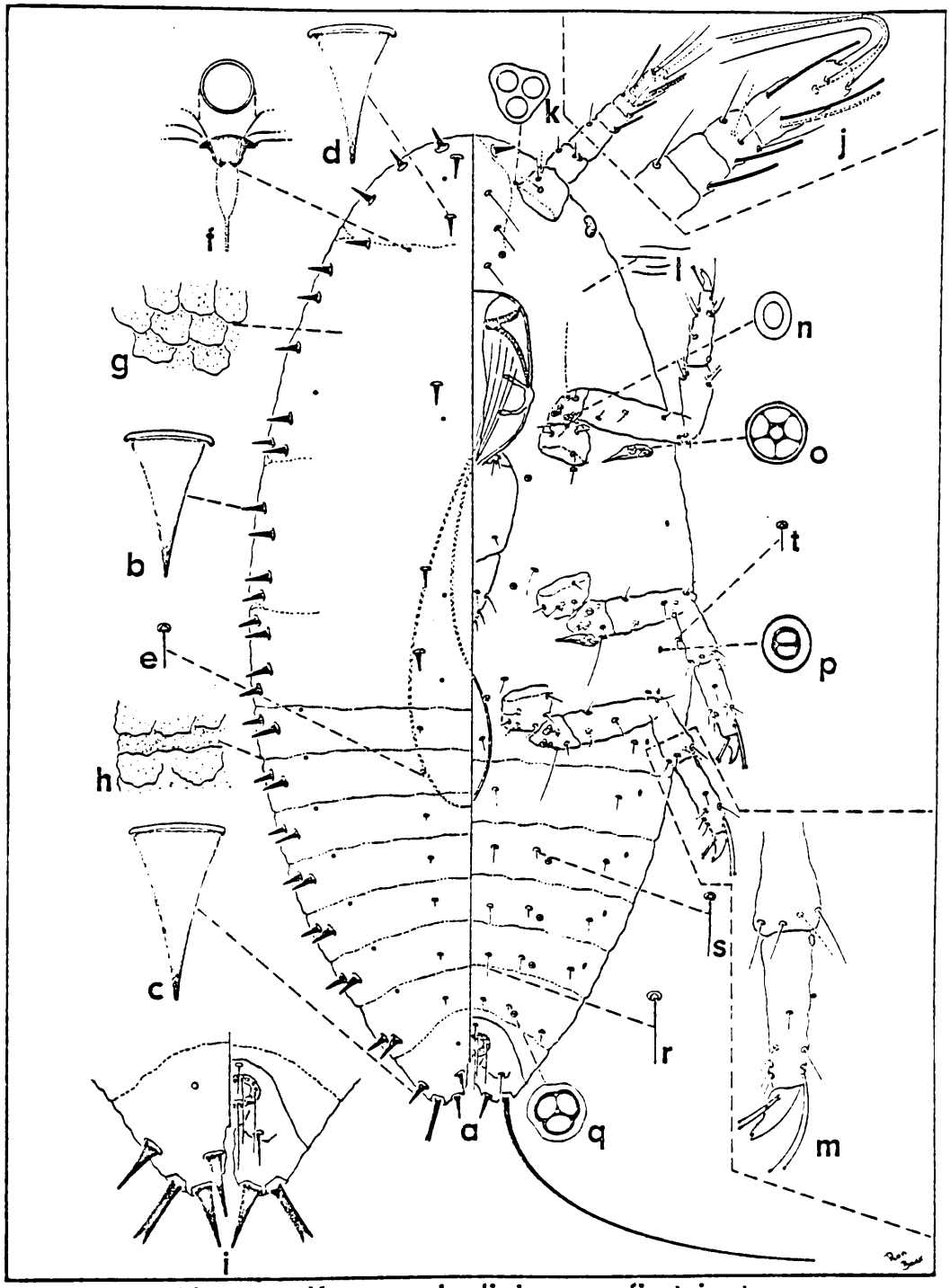

Plate 18.-Kermes iselini n. sp., first instar

Anal lobes (figs. a,i). Sclerotized. One thick seta on inner margin of each lobe 16 (21,16-23) long. Another at posterior end, 19 (19,16-21) long; apical seta 106 (124,91-196) long.

VENTER

Antennae (fig. j). Total length 84 (90,80,102). Scape 12 (13,12-14) long, 26 (26,23-33) wide. Segments II to VI: 16 (17,16-21), 16 (18,16-19), 9 (11,9-12), 12 (11,9-14), 19 (21,16-26) long respectively. Trilocular pore at scape base (fig. k).

Clypeolabral shield. Length 74 (84,74-95), width 58 (59,51-70).

Labium. Length 65 (73,58-86), width 46 (49,44-53).

Derm (fig. l). Membranous.

Legs (fig. m). See enlargement of tibia, tarsus and claw of metathoracic leg. Four sensory pores on each trochanter (fig. n).

Leg Segments and Claw	Lengths Prothoracic	Lengths Mesothoracic	Lengths Metathoracic
Coxa	19 (21,19-23)	19 (20,16-23)	19 (20,16-23)
Trochanter	19 (25,19-30)	23 (26,23-30)	23 (27,23-35)
Femur	44 (49,44-53)	44 (47,37-53)	46 (50,44-58)
Tibia	33 (30,23-35)	33 (33,26-35)	30 (33,26-37)
Tarsus	49 (42,35-49)	39 (45,39-46)	42 (48,42-53)
Claw	9 (14,9-19)	9 (15,9-21)	14 (15,9-21)
Entire leg	171 (182,160-200)	167 (189,162-202)	174 (193,167-218)

Pores laterad of spiracle (fig. o). Each anterior and posterior spiracle with 1 quinquelocular pore.

Bilocular pores (fig. p). Located near the bases of the submarginal setae. Seven to 10 along each margin.

Submedial pores on derm (fig. q). In 2 submedial longitudinal rows. Four pairs on head and thorax, 4 pairs on abdomen, mostly triloculars.

Body setae (figs. r-t). In 6 longitudinal rows on abdomen and partly on thorax: medial 6 (7,5-11) long, 0.95 wide (fig. r); submedial 7 (7,5-9) long, 0.95 wide (fig. s); submarginal 6 (7,5-9) long, 1.9 (1.1,0.95-1.9) wide (fig. t).

Anal lobes and ring (figs. a,i). Sclerotized. With a single submedial seta on each lobe, (10,9-12) long. Ring oval, 14 (12,9-19) long, 16 (18,16-21) wide, anal ring setae 16 (19,14-23) long; a pair of thick setae at the anterior margin of anal ring 7 (9,7-14) long.

Additional material studied. On Quercus grisea, AZ, Tex Canyon, about 18 mi. N. from Rt. 80, Jun. 20, 1976, colls. MMK, 1(3), VPI; On Q. rugosa, AZ, near Portal, 1.5 mi. upon S. Fork Rd., Jun. 19, 1976, colls. MK, D. Hanna, and I. Storks, 1(3), VPI; NM, Coronado Natl. Forest, Jun. 20, 1976, colls. MMK, 3(8), VPI.

Remarks. Kermes iselini is closely allied with the K. pubescens group. The species in this group have conical dorsal marginal setae and quinquelocular pores on the venter.

K. iselini can be distinguished by having the following characters: 1) two pairs of dorsal marginal setae on each abdominal segment; 2) conical shaped dorsal marginal setae; 3) only first 4 pairs of dorsal submedial setae similar to dorsal marginal setae; and 4) 1

quinquelocular pore laterad of each anterior spiracle.

This species is found on Quercus grisea, Q. mohriana and Q. rugosa on the leaves, petioles and buds in Arizona and New Mexico.

Etymology: Kermes iselini is named in honor of William A. Iselin who provided this study with many valuable specimens from the southwestern United States.

Kermes iselini n. sp., second instar female

Plate 19

Type material studied. Paratypes on Quercus mohriana, NM, Otero Co., 15 mi. N. of El Paso Gap, Jun. 15, 1976, coll. WAI, 1(3), VPI.

Description. Body (fig. a) length 901 (800-1087), width 503 (392-709).

DORSUM

Marginal setae (fig. b). Thick, slightly curved at middle, 2 pairs on each abdominal segment, ca. 74, 28 (14-42) long, ca. 5 wide.

Submedial setae (fig. c). In two longitudinal rows, 11 pairs, 22 (5-47) long, ca. 4.0 wide.

Simple pores (fig. d). Randomly distributed over derm, these bilocular, ca. 50 total.

Tubular ducts (fig. e). Numerous distributed through derm, wider than those on venter, ca. 120-150, ca. 33 long, ca. 9 wide.

Anal lobes. Sclerotized. One seta on inner margin of each lobe 13 (12-14) long, another at posterior end ca. 12 long; apical seta not able to be measured.

VENTER

Antennae. Total length 138 (130-146). Scape 21 (18-23) long, 40 (35-46) wide. Segments II to VI: 19 (18-21), 36 (33-39), 19 (18-21), 19 (18-21), 25 (24-26) long respectively.

Clypeolabral shield. Length 112 (104-118), width 88 (83-93).

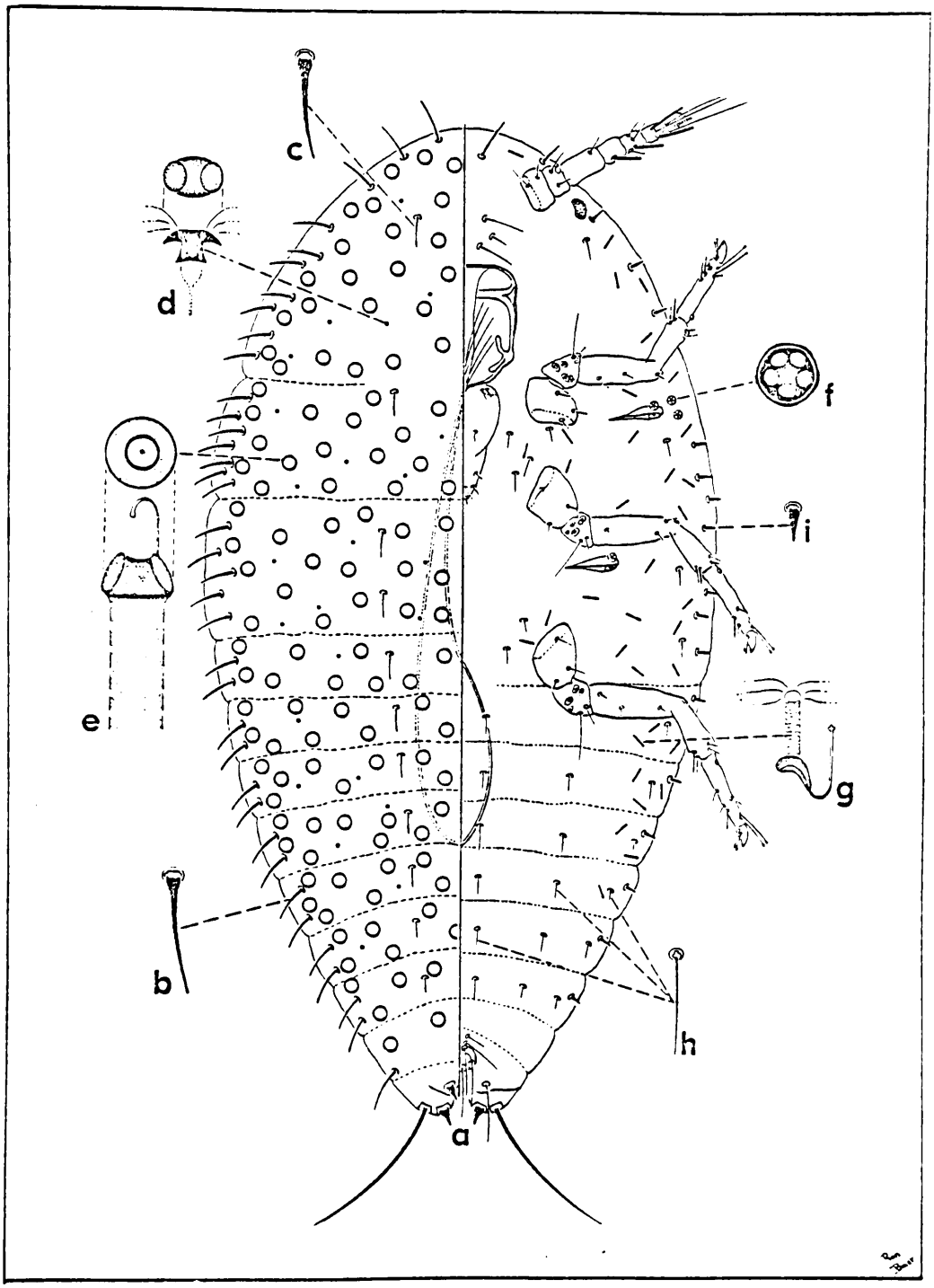

Plate 19. - Kermes iselini n. sp., second instar female

Labium. Length 77 (71-89), width 58 (47-65).

Legs. See chart below.

Leg Segments and Claw	Lengths Prothoracic	Lengths Mesothoracic	Lengths Metathoracic
Coxa	39 (37-41)	43 (39-47)	42 (37-47)
Trochanter	39 (37-41)	39 (37-41)	40 (39-41)
Femur	79 (77-83)	77 (74-83)	78 (74-84)
Tibia	51 (49-53)	52 (51-53)	57 (56-59)
Tarsus	65 (63-67)	69 (65-72)	74 (71-77)
Claw	20 (18-24)	20 (18-24)	20 (18-24)
Entire leg	293 (285-301)	300 (293-313)	310 (305-314)

Pores laterad of spiracle (fig. f). Each anterior spiracle with 3, sometimes 4 quinquelocular pores. Each posterior spiracle with one quinquelocular pore.

Quinquelocular pores on derm. Absent.

Tubular ducts (fig. g). Less numerous than on dorsum, mainly restricted to submargin, thinner than those on dorsum, ca. 60.

Bilocular pores. Absent.

Body setae (figs. h,i). In 8 longitudinal rows on abdomen and partly on thorax and head: medial 27 (19-35) long, ca. 2 wide (fig. h); submedial 16 (12-21) long, ca. 2 wide (fig. h); submarginal 15 (9-21) long, ca. 2 wide (fig. h); marginal 12 (9-14) long, ca. 4 wide (fig. i).

Anal lobes and ring. Sclerotized. With a single submedial seta on each lobe, 34 (33-35) long. Ring oval, 23 (21-26) long, 20 (19-21) wide; anal ring setae 52 (51-53) long.

Remarks. Kermes iselini second instar females can be separated by having: 1) 120-150 tubular ducts on the dorsum; and 2) 3-4 quinquelocular pores laterad of each anterior spiracle.

Kermes kosztarabi Baer, first instar

Plate 20

Kermes kosztarabi Baer, (1978, unpublished)

Type material studied. Holotype and paratype series on Quercus nigra, GA, Tifton, Nov. 22, 1899, colls. Scott and Quaintance, 15(58), VPI, NMNH and CSU.

Description. Body (fig. a) length 393 (420,347-531), width 166 (191,166-287).

DORSUM

Marginal setae (fig. b). Short and stout, ca. 44-48, these 12 (11, 8-14) long, 3 (3,2-5) wide.

Marginal setae on anal lobe (fig. c). Longer and thicker than other marginal setae, 14 (14,12-16) long.

Submedial setae on head and thorax (fig. d). Fusiform shaped setae on abdominal segments, 4 pairs, 10 (10,8-12) long, ca. 2 wide.

Submedial setae on abdomen (fig. e). First pair similar to those on head and thorax, ca. 8 long, 2 wide. Six remaining pairs, thin setaceous, 5 (5,2-8) long, ca. 0.95 wide.

Simple pores (fig. f). In 4 longitudinal rows, ca. 44-48 pores.

Derm (fig. g). Simple, membranous.

Intersegmental membrane (fig. h). Apparent due to type of derm.

Anal lobes (figs. a,i). Sclerotized. One thick seta on inner margin of each lobe, ca. 12 long. Another at posterior end, 14 (14,12-16) long; apical seta 136 (124,84-151) long.

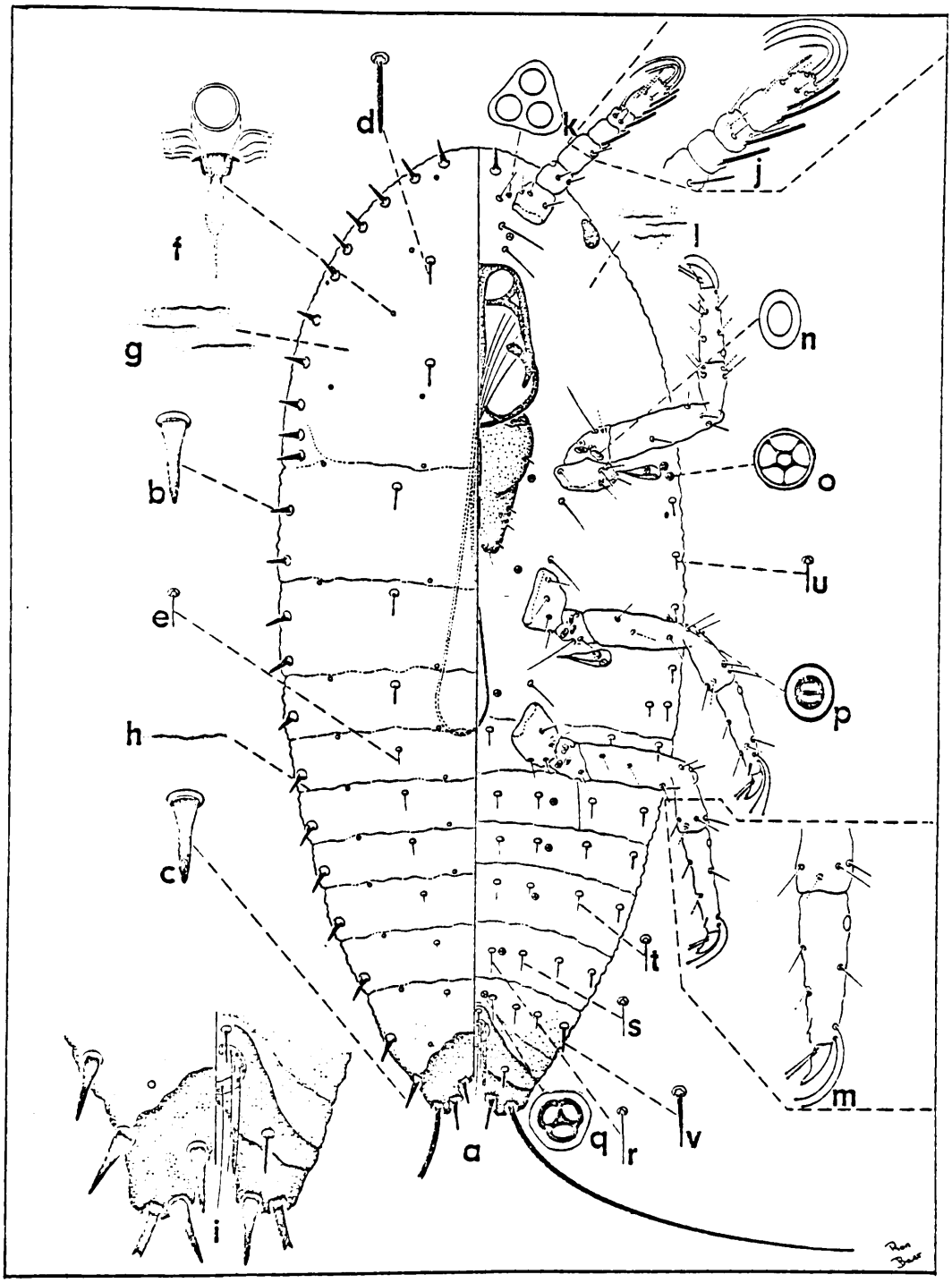

Plate 20.-Kermes kosztarabi n. sp., first instar

VENTER

Antennae (fig. j). Total length 86 (82,74-88). Scape 12 (12,9-14) long, 23 (22,21-23) wide. Segments II to VI: 14 (12,11-14), 19 (19, 16-21), 9 (9,7-12), 12 (11,7-12), 21 (20,19-23) long respectively. Trilocular pore at scape base (fig. k).

Clypeolabral shield. Length 67 (69,60-74), width 51 (54,49-63).

Labium. Length 53 (57,49-65), width 39 (39,35-44).

Derm (fig. 1). Membranous.

Legs (fig. m). See enlargement of tibia, tarsus and claw of metathoracic leg. Four sensory pores on each trochanter (fig. n).

Leg Segments and Claw	Lengths Prothoracic	Lengths Mesothoracic	Lengths Metathoracic
Coxa	19 (21,19-23)	21 (21,19-23)	23 (21,19-23)
Trochanter	26 (25,23-28)	23 (23,21-26)	26 (25,23-26)
Femur	51 (50,46-51)	46 (49,46-51)	51 (50,49-53)
Tibia	28 (28,26-30)	28 (28,23-30)	30 (31,28-35)
Tarsus	44 (45,42-49)	46 (48,44-51)	51 (49,44-51)
Claw	14 (14,12-16)	14 (14,12-16)	16 (15,12-19)
Entire leg	181 (184,179-188)	179 (183,174-197)	197 (191,179-202)

Pores laterad of spiracle (fig. o). Each anterior spiracle with 3 quinquelocular pores. Each posterior spiracle with 1 quinquelocular pore.

Bilocular pores (fig. p). Located near the bases of the marginal setae. Usually associated with the anterior setae. Two or 3 along each margin.

Submedial pores on derm (fig. q). In 2 submedial longitudinal rows. Four pairs on head and thorax, 5 pairs on abdomen, mostly triloculars.

Body setae (figs. r-v). In 8 longitudinal rows on abdomen and partly on thorax: medial 7 (7,5-10) long, ca. 0.95 wide (fig. r); submedial 5 (6,5-8) long, ca. 0.95 wide (fig. s); submarginal 4 (4,3-5) long, 0.95 (1.14,0.95-1.9) wide (fig. t); 5 (6,5-7) long, 0.95 (1.24, 0.95-1.9) wide (fig. u). Posteriormost seta in marginal row thicker than rest in row 9 (11,7-12) long (fig. v).

Anal lobes and ring (figs. a,i). Sclerotized. With a single submedial seta on each lobe, 9 (11,7-12) long. Ring oval, 19 (12,9-19) long, 19 (18,16-19) wide; anal ring setae 23 (29,23-33) long; a pair of thick setae at the anterior margin of anal ring 9 (11,9-12) long.

Additional material studied. On Q. laurifolia, AL, Auburn, Gay Str., Gay Manor, Jun. 8, 1976, colls. MLW and MK, 2(3), VPI; FL, Marion Co., Heagy Burry Pk., Sep. 17, 1976, colls. CHR and L. R. Ray, 2(7), VPI; On Q. myrtifolia, FL, Carabelle, Nov. 2, 1929, 1(3), NMNH; On Quercus sp., FL, Bradentown, Jun. 28, 1917, coll. F. Poos, Jr., 1(3), NMNH; Fort Pierce, Jul. 27, 1917, coll. F. F. Bibby, 2(4), NMNH; Levy Co., Rt. 24, Aug. 4, 1977, colls. SWB and F. L. Carle, 4(12), VPI; LA, New Orleans, Spanish Ft., Mar. 9, 1919, colls. HFD and ERS, 1(2), NMNH; SC, Charleston, Magnolia Cemetery, Jul. 10, 1923, colls. ERS and Rogers, 1(1), NMNH.

Remarks. This species is closely allied to the K. galliformis group. All species included in this group have relatively short setaceous dorsal marginal setae and trilocular pores on the venter.

K. kosztarabi can be distinguished by: 1) 1 pair of dorsal marginal setae on each abdominal segment; 2) setaceous dorsal marginal setae 8-14 long; 3) 3 quinquelocular pores laterad of each anterior spiracle; 4) 2 to 3 bilocular pores along each body margin; and 5) dorsal submedial setae on head, thorax and first abdominal segment thicker than those on rest of abdomen.

This species is found on Quercus laurifolia, Q. myrtifolia in South Carolina, Alabama, Louisiana and Florida.

Kermes pubescens Bogue, first instar

Plate 21

Kermes pubescens Bogue, 1898:172.

Type material studied. Paralectotypes on Quercus macrocarpa, KS, (no date mentioned), coll. JBN, 16(78), NMNH.

Description. Body (fig. a) length 477 (464-512), width 214 (197-228).

DORSUM

Marginal setae (fig. b). Short, conical, 2 pairs on each abdominal segment, ca. 73-75, 8 (6-12) long, 5 (4-6) wide.

Marginal setae on anal lobe (fig. c). Longer and thicker than other marginal setae, 11 (9-13) long.

Submedial setae on head and thorax (fig. d). Short, conical similar to marginal setae, 4 pairs on head and thorax, 8 (7-9) long, 5 (4-6) wide.

Submedial setae on abdomen (fig. b). Short, conical similar to submedial setae on head and thorax, 7 pairs, 7 (6-8) long, 5 (4-6) wide.

Simple pores (fig. e). In 4 longitudinal rows, ca. 38-42 pores.

Derm (fig. f). Composed of overlapping platelike areas.

Intersegmental membrane (fig. g). Pronounced due to type of derm.

Anal lobes (fig. a,h). Partially sclerotized. One conical seta on inner margin of each lobe 11 (10-14) long. Another at posterior end, 11 (10-12) long; apical seta 125 (110-134) long.

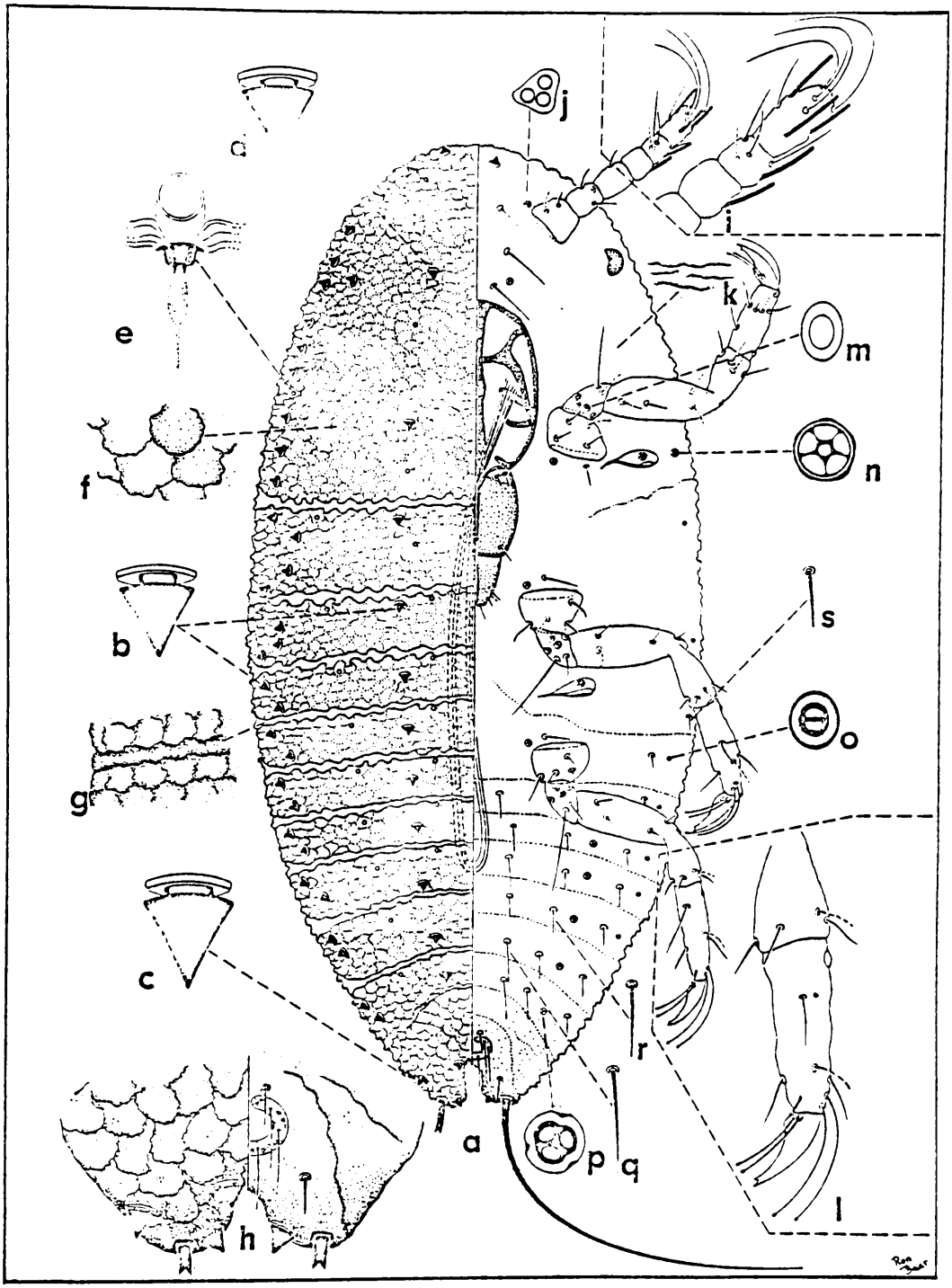

Plate 21. - Kermes pubescens Bogue, first instar

VENTER

Antennae (fig. i). Total length 106 (99-115). Scape 17 (12-21) long, 29 (25-33) wide. Segments II to VI: 17 (16-19), 20 (18-21), 14 (10-16), 16 (12-18), 23 (20-27) long respectively. Trilocular pore at scape base (fig. j).

Clypeolabral shield. Length 88 (80-95), width 66 (58-70).

Labium. Length 67 (58-76), width 43 (39-49).

Derm (fig. k). Membranous.

Legs (fig. l). See enlargement of tibia, tarsus and claw of metathoracic leg. Four sensory pores on each trochanter (fig. m).

Leg Segments and Claw	Lengths Prothoracic	Lengths Mesothoracic	Lengths Metathoracic
Coxa	25 (19-29)	24 (18-29)	24 (19-29)
Trochanter	29 (27-33)	28 (23-35)	27 (25-29)
Femur	51 (49-54)	49 (43-52)	51 (47-56)
Tibia	30 (25-33)	32 (31-35)	35 (33-39)
Tarsus	39 (35-41)	42 (39-45)	45 (41-47)
Claw	17 (13-19)	18 (14-19)	18 (14-19)
Entire leg	188 (181-198)	192 (181-208)	202 (196-212)

Pores laterad of spiracle (fig. n). Each anterior spiracle with usually 2, sometimes 3 quinquelocular pores. Each posterior spiracle with 1, sometimes with 2 quinquelocular pores. Rarely 2,4- or 7-locular pores.

Bilocular pores (fig. o). Located near the bases of the submarginal setae. Six to 8 along each margin.

Submedial pores on derm (fig. p). In 2 longitudinal rows. Four pairs on head and thorax, 5 pairs on abdomen, mostly triloculars, occasionally quinqueloculars.

Body setae (figs. q-s). In 6 longitudinal rows on abdomen and partly on thorax: medial 8 (6-12) long, ca. 1.24 wide (fig. q); submedial 7 (5-13) long, ca. 1.14 wide (fig. r); submarginal 5 (4-8) long, ca. 1.05 wide (fig. s).

Anal lobes and ring (figs. a,h). Partially sclerotized. With a single submedial seta on each lobe 8 (7-11) long. Ring oval, ca. 16 long, 19 (12-20) wide; anal ring setae 11 (8-12) long; a pair of thick setae at the anterior margin of anal ring 7 (6-10) long.

Additional material studied. On Quercus alba, AL, Vinemont, Jun. 16, 1904, coll. H. O. Sargent, 2(5), NMNH; DC, Jun. 30, 1906, coll. F. Baker, 1(2), DSIR; Jun. 17, 1916, coll. JK, 2(6), NMNH; Jun. 16, 1927, coll. P. Bissett, 2(6), NMNH; Jun. 10, 1938, coll. C. A. Bolgiano, 2(5), NMNH; Cleveland Pk., Feb. 18, 1917, coll. JK, 2(7), NMNH; St. Elizabeth Hosp., Jun. 8, 1918, coll. JK, 2(7), NMNH; U.S. Zool. Pk., Jun. 30, 1906, coll. F. Baker, 3(8), NMNH; DE, Wilmington, Jul. 3, 1927, coll. H. L. Dozier, 2(6), NMNH; GA, Experiment, Georiga Agricultural Experiment Station, Jun. 8, 1976, colls. MK, RB, JOH, 2(6), VPI; IL, Kankakee, Jun. 16, 1908, coll. S. A. Forbes, 2(6), NMNH; IN, Marion Co., Jul. 1, 1913, coll. HFD, 2(6), UCD; Noglesville, Jul. 4, 1913, coll. HM, 1(1), UCD; KS, Lawrence, Mar. 1898, coll. OEB, 4(13), UCD; MA, Lawrence, 1898, coll. GBK, 2(5), SEM; MD, Belaire,

213 Red Pump Rd., Jun. 18, 1971, coll. C. W. McCombs, 2(5), AU; College Park, Jun. 1, 1956, coll. H. S. McCounce, 1(3), VPI; College Park, Sep. 23, 1958, 1(3), VPI; College Park, Univ. of Maryland Campus, Jun. 18, 1974, coll. MLW, 2(8), AU; La Plata, Jul. 5, 1905, coll. ERS, 2(6), NMNH; MN, Alexandria, Jul. 9, 1941, coll. W. C. Hanson, 2(6), UMN; NC, Chapel Hill, Jun. 4, 1941, coll. J. N. Couch, 1(3), NMNH; NH, Concord, Jul. 29, 1940, coll. T. J. Parr, 2(8), NMNH; NJ, Holly Beach, Jul. 2, 1906, coll. C. F. Naegle, 2(6), NMNH; Madison, Jul. 7, 1925, coll. FMS, 2(5), NMNH; Red Bank, Jun. 12, 1919, coll. H. W. Lutz, 2(5), NMNH; PA, Cedar Grove, May 26, 1926, coll. S. F. Bailey, 2(7), NMNH; Norristown, Jun. 29, 1937, coll. M. C. VanHorn, 2(6), NMNH; Philadelphia, Sep. 27, 1919, coll. S. N. Baxter, 2(6), NMNH; SC, Clemson College, Jun. 18, 1917, coll. J. A. Berly, 3(8), NMNH; VA, Arlington, Aug. 1945, coll. S. B. Detweiler, 4(12), NMNH; Arlington, Jul. 22, 1963, coll. L. T. Froney, 2(8), VPI; Blacksburg, VPI&SU Campus, Jun. 20, 1977, coll. RGB, 2(8), VPI; Charlottesville, Univ. VA Campus, Oct. 5, 1973, coll. NK, 1(1), VPI; Fairfax, R. F. Kennedy Estate, May 28, 1975, coll. B. Zirrilli, 5(47), VPI; Radford, Becky Thompson's Riding Academy, Jan. 13, 1976, colls. RGB, MK, and ABH, 5(13), VPI; On Q. falcata, TN, Smoky Mts. Natl. Pk., Rt. 73, 3 mi. before Metcalf Bottom Picnic Ground, Jun. 6, 1976, colls. MMK, 2(4), VPI; On Q. lyrata, AR, near Helena, 1925, coll. WJB, 2(5), NMNH; LA, Tallulah, May 21, 1907, col-. A. H. Rosenfeld, 2(7), NMNH; On Q. macrocarpa, IL, Chicago, Sep. 22, 1903, 1(1), NMNH; IN, Indianapolis, Jun. 17, 1912, coll. H. H. Fall, 2(6), NMNH; Lafayette, Jun. 16, 1931, coll. J. J. Davis, 2(6), NMNH; Lafayette, Sep. 26,

1931, coll. JMA, 1(1), NMNH; W. Lafayette, 1931, coll. JMA, 1(2), VPI; KS, Iola, City Pk., Aug. 17, 1976, colls. MMK, 2(4), VPI; Manhattan, Aug. 6, 1976, colls. MMK, 2(7), VPI; Wichita, Aug. 3, 1976, coll. H. E. Thompson, 2(7), VPI; OH, Aug. 4, 1913, coll. JSH, 2(4), OHSU; Sharon Hill, Jul. 20, 1918, coll. FMT, 4(13), UCD; On Q. prinus, AR, near Helena, 1925, coll. JWB, 2(7), NMNH; DC, Cleveland Pk., Jul. 8, 1906, coll. JGS, 2(6), NMNH; On Q. stellata, AL, Baldwin Co., Jun. 15, 1975, coll. R. Self, 4(13), VPI; Fruitdale, May 3, 1905, coll. W. F. Fiske, 2(6), NMNH; AR, Ft. Smith, Jun. 8, 1937, coll. JWB, 2(4), NMNH; Texarkana, Jun. 7, 1919, coll. W. C. McCallister, 1(3), NMNH; GA, Atlanta, Jun. 17, 1911, coll. H. C. Lewis, 2(7), NMNH; Demorest, Rt. 441, Jun. 7- 1976, colls. MMK, 2(6), VPI; MO, St. Louis, Jul. 12, 1912, coll. C. W. Fullgraf, 2(7), NMNH; Webster Groves, Jun. 11, 1920, coll. AFS, 1(3), NMNH; Webster Groves, Jun. 18, 1928, coll. F. P. Westcott, 2(5), NMNH; Webster Groves, Jun. 27, 1931, coll. JSH, 2(5), NMNH; MS, Jackson, May 12, 1919, coll. S. M. Thomas, 2(5), NMNH; Jackson, May 23, 1919, coll. J. B. Harris, 2(4), NMNH; NC, Oteen, Jul. 10, 1941, coll. C. H. Hoffman, 1(3), NMNH; Quercus sp., AL, Birmingham, Jul. 17, 1914, coll. L. W. Weigh, 2(7), NMNH; Birmingham, Jun. 10, 1924, coll. S. Harris, 2(6), NMNH; Birmingham, May 12, 1925, coll. E. E. Ellis, 1(3), NMNH; AR, Russellville, May 23, 1938, coll. EJB, 2(6), NMNH; Texarkana, Jun. 25, 1919, coll. E. Holland, 2(6), NMNH; DC, Aug. 2, 1907, 1(1), UCD, Jul. 11, 1916, coll. N. P. Sedaley, 1(3), NMNH; Jun. 4, 1927, 2(11), NMNH; Capital Grounds, Jun. 6, 1910, coll. E. Woode, 2(6), NMNH; Cleveland Pk., Jul. 16, 1923, 2(4), NMNH; near Zool. Pk., May 28, 1918, coll. Kootz, 4(15), NMNH; GA, Spelman,

Oct. 31, 1934, coll. H. T. Albro, 1(2), NMNH; Kirkwood, May 11, 1919, coll. W. F. Turner, 2(3), NMNH; Augusta, Jun. 21, 1901, 2(4), NMNH; IA, Ames, Jun. 17, 1938, coll. C. J. Drake, 2(6), NMNH; Des Monies, Sep. 3, 1937, coll. C. H. Richardson, Jun. 13, 1938, 2(5), NMNH; Marshaltown, Jun. 28, 1923, coll. C. J. Drake, 2(7), NMNH; IL, Glenville, Jul. 6, 1915, coll. R. Redfield, Jr., 2(6), NMNH; Godfrey, Jun. 17, 1919, coll. RWD, 8(29), UCD; IN, Indianapolis, Oct. 18, 1911, coll. HM, 2(7), UCD; KS, Manhattan, 1(1), NMNH; Manhattan, coll. EEB, 2(5), NMNH; Manhattan, Apr. 23, 1906, coll. G. A. Dean, 2(7), NMNH; Manhattan, Jun. 1, 1915, 4(13), KSU; Riley Co., 1899, coll. P. J. Parrott, 5(27), SEM; Scandia, coll. S. Shivvers, Jun. 13, 1904, 2(7), KSU; MA, Lawrence, 4(15), UCD; MD, Chevy Chase, Jun. 14, 1912, coll. W. Law, 2(6), NMNH; College Park, Jun. 16, 1974, coll. CHR, 3(12), AU; College Park, Univ. of Maryland, Jun. 24, 1974, coll. CHR, 2(8), AU; Ellicott City, Jul. 11, 1958, coll. MK, 2(5), VPI; Waldorf, Jul. 9, 1926, coll. P. Simmons, 1(4), NMNH; MN, Bemidji, coll. E. J. Olin, 3(11), NMNH; MO, St. Louis, Aug. 16, 1920, coll. J. L. Wentworth, 2(4) NMNH; St. Louis, Jun. 23, 1913, coll. J. M. Greenman, Jun. 23, 1913, 1(3), NMNH; Webster Groves, Jun. 7, 1930, coll. J. W. Freudenberg, 2(4), NMNH; MS, Jackson, Elon Dairy Farm, Jun. 16, 1925, coll. H. H. Wedgworth, 2(7), NMNH; NJ, New Brunswick, Sep. 20, 1904, coll. J. B. Smith, 2(6), NMNH; Trenton, Jul. 7, 1926, coll. E. J. Matthews, 2(7), NMNH; NY, Pelham, Apr. 20, 1932, coll. E. P. Felt, 2(5), NMNH; Rochester, Jul. 30, 1931, coll. C. R. Crosby, 2(4), NMNH; OH, Cincinnati, Nov. 8, 1914, colls. JSH and GBK, 2(6), OHSU; Cincinnati, Jun. 22, 1916, coll. R. M. Lenise, 1(3), OHSU; Cincinnati, Nov. 1918,

coll. F. P. Atkins, 2(6), NMNH; Columbus, Jul. 8, 1931, coll. R. C. Hall, 2(6), NMNH; Oberlin, Jul. 1915, coll. E. A. Barrett, 2(4), OHSU; Toledo, Jul. 6, 1910, coll. W. M. Brooker, 2(6), NMNH; RI, Kingston, Jul. 3, 1915, coll. A. E. Stone, 2(7), NMNH; Providence, Apr. 7, 1883, coll. A. S. Packard, 2(5), NMNH; TN, Memphis, Jun. 11, 1924, coll. C. W. Herskell, 2(7), NMNH; Nashville, Jun. 6, 1925, coll. R. S. Maddox, 1(1), NMNH; TX, Dallas, May 8, 1916, coll. F. H. McGinnis, 2(6), NMNH; Gregg Co., Longview, May 7, 1938, coll. R. K. Fletcher, 2(4), NMNH; VA, Frys Springs, Jun. 24, 1910, coll. M. W. Minor, 2(5), NMNH; Lyon Farm, May 31, 1941, coll. F. Andre, 2(5), NMNH; Norfolk area, Newport News, Jul. 6, 1942, coll. H. G. Walker, 2(6), NMNH; Portsmouth, Pinecrest Baptist Church, Jun. 26, 1967, coll. W. F. Tate, 4(10), VPI.

Remarks. The original description contained no information on the first instar of Kermes pubescens. King (1900b) and Sanders (1904) mentioned that the first instars differ from other species by having 6 rows of short conical spines and short caudal setae. These characters undoubtedly refer to the conical-shaped dorsal marginal and dorsal submedial setae. The redescription and illustration by McConnell and Davidson (1959) provided some characters for species recognition, but according to Bullington (1978), the available material studied by them included a different (new) species based on an adult female study. I was not able to separate first instars of his new species from K. pubescens.

Kermes pubescens is designated to represent a group of species including K. pubescens and K. iselini. These two species have two rows

of trilocular pores on the venter and conical dorsal marginal setae.

K. pubescens can be distinguished by the following characters: 1) two pairs of dorsal marginal setae on each abdominal segment; 2) dorsal marginal setae conical; 3) entire row of dorsal submedial setae similar to the dorsal marginal setae; and 4) 2 or 3 quinquelocular pores laterad of each anterior spiracle.

This species is found on Quercus alba, Q. falcata, Q. lyrata, Q. macrocarpa, Q. prinus and Q. stellata in central and eastern U.S.

Kermes pubescens Bogue, second instar female

Plate 22

Kermes pubescens Bogue, 1898:172.

Material studied. On Quercus alba, MD, College Park, May 4, 1956, coll. H. S. McConnell, 1(3), NMNH.

Description. Body (fig. a) length 755 (664-830), width 448 (377-513).

DORSUM

Marginal setae (fig. b). Thick, slightly curved at middle, 2 pairs on each abdominal segment, ca. 64-68, these 28 (23-32) long, ca. 4 wide.

Submedial setae (figs. c,d). In 4 longitudinal rows, 8-9 pairs of slender setaceous setae in medial row, these 7 (6-7) long, ca. 2 wide; 11 pairs of setae, similar to dorsal marginal setae, 23 (21-26) long, 3 (2-4) wide.

Simple pores (fig. e). Randomly distributed throughout derm, usually bilocular, dia. ca. 2.

Tubular ducts (fig. f). Numerous, distributed throughout derm, wider than those on the venter, ca. 70-100, ca. 19 long, ca. 9 wide.

Anal lobes. Sclerotized. One seta on inner margin of each lobe, ca. 14 long, another at posterior end 15 (14-16) long; apical seta ca. 83 long.

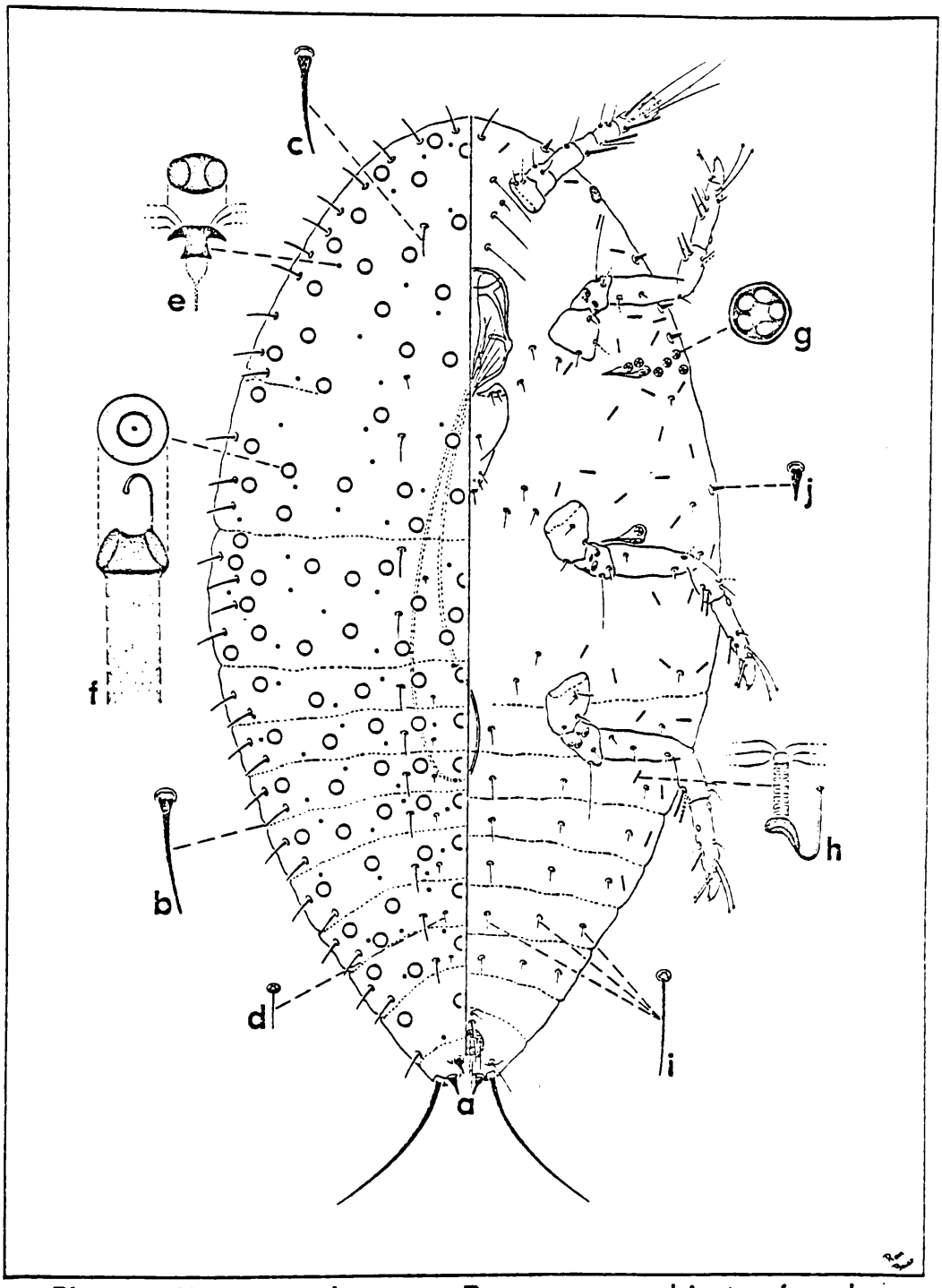

Plate 22.-Kermes pubescens Bogue, second instar female

VENTER

Antennae. Total length 131 (128-136). Scape 22 (19-24) long, 35 (33-37) long. Segments II to VI: 18 (17-19), 32 (33-35), 17 (16-18), 18 (17-19), 24 (23-25) long respectively.

Clypeolabral shield. Length 100 (94-106), width 87 (83-94).

Labium. Length 77 (71-83), width 61 (59-65).

Legs. See chart below.

Leg Segments and Claw	Lengths Prothoracic	Lengths Mesothoracic	Lengths Metathoracic
Coxa	37 (35-41)	37 (30-41)	40 (35-44)
Trochanter	40 (39-41)	38 (35-41)	42 (41-44)
Femur	76 (74-77)	75 (74-77)	78 (77-79)
Tibia	39 (35-44)	51 (49-53)	56 (53-58)
Tarsus	56 (53-56)	57 (56-59)	63 (62-65)
Claw	18 (17-19)	18 (17-19)	18 (17-19)
Entire leg	265 (261-269)	276 (271-280)	297 (289-302)

Pores laterad of spiracle (fig. g). Each anterior spiracle with 4-7 quinquelocular pores. Each posterior spiracle with 1 quinquelocular pore.

Quinquelocular pores on derm. Absent.

Tubular ducts (fig. h). Less numerous than on dorsum, mainly restricted to submargin, thinner than those on dorsum, ca. 20-30, ca. 25 long, ca. 5 wide.

Bilocular pores. Absent.

Body setae (figs. i.j). In 6 longitudinal rows on abdomen and partly on thorax: medial 29 (16-28) long, ca. 2 wide (fig. i); submedial 42 (35-53) long, ca. 2 wide (fig. i); submarginal 7 (6-8) long, ca. 2 wide (fig. i). Several pairs of short thickened setae (fig. j), between anterior and posterior spiracles and between anterior spiracle and apex of head, ca. 9 long.

Anal lobes and ring. Sclerotized. With a single submedial seta on each lobe, ca. 33 long. Ring oval, 22 (21-23) long, 26 (23-28) wide; anal ring setae 40 (37-41) long.

Remarks. McConnell and Davidson (1959) adequately described and illustrated the second instar female for species recongition. Their material included a different (new) species (Bullington 1978).

K. pubescens second instar females can be distinguished by the following characters: 1) 70-100 tubular ducts on the dorsum; and 2) 4-7 quinquelocular pores laterad of each anterior spiracle.

Kermes rimarum Ferris, first instar

Plate 23

Kermes rimarum Ferris, 1955:202.

Type material studied. Paralectotypes on Quercus gambelii, NM, 30 mi. from Las Vegas, Beulah, Jul. 17, 1947, coll. GFF, 17(44), UCD.

Description. Body (fig. a) length 538 (438-649), width 270 (227-317).

DORSUM

Marginal setae (fig. b). Long, thick, setaceous, ca. 46-48, 25 (19-35) long, 3 (2-5) wide.

Marginal setae on anal lobe (fig. c). Longer and thicker than other marginal setae, 37 (27-42) long.

Submedial setae on head and thorax (fig. d). Thin setaceous, similar to abdominal submedial setae, 4 pairs, 12 (10-14) long, ca. 1 wide.

Submedial setae on abdomen (fig. e). Thin setaceous, 7 pairs, 9 (7-12) long, ca. 1 wide.

Simple pores (fig. f). In 4 longitudinal rows, ca. 40-44 pores.

Derm (fig. g). Simple, membranous.

Intersegmental membrane (fig. h). Apparent due to type of derm.

Anal lobes (figs. a,i). Sclerotized. One thick seta on inner margin of each lobe 34 (30-37) long. Another at posterior end, 35 (30-39) long; apical seta 136 (100-166) long.

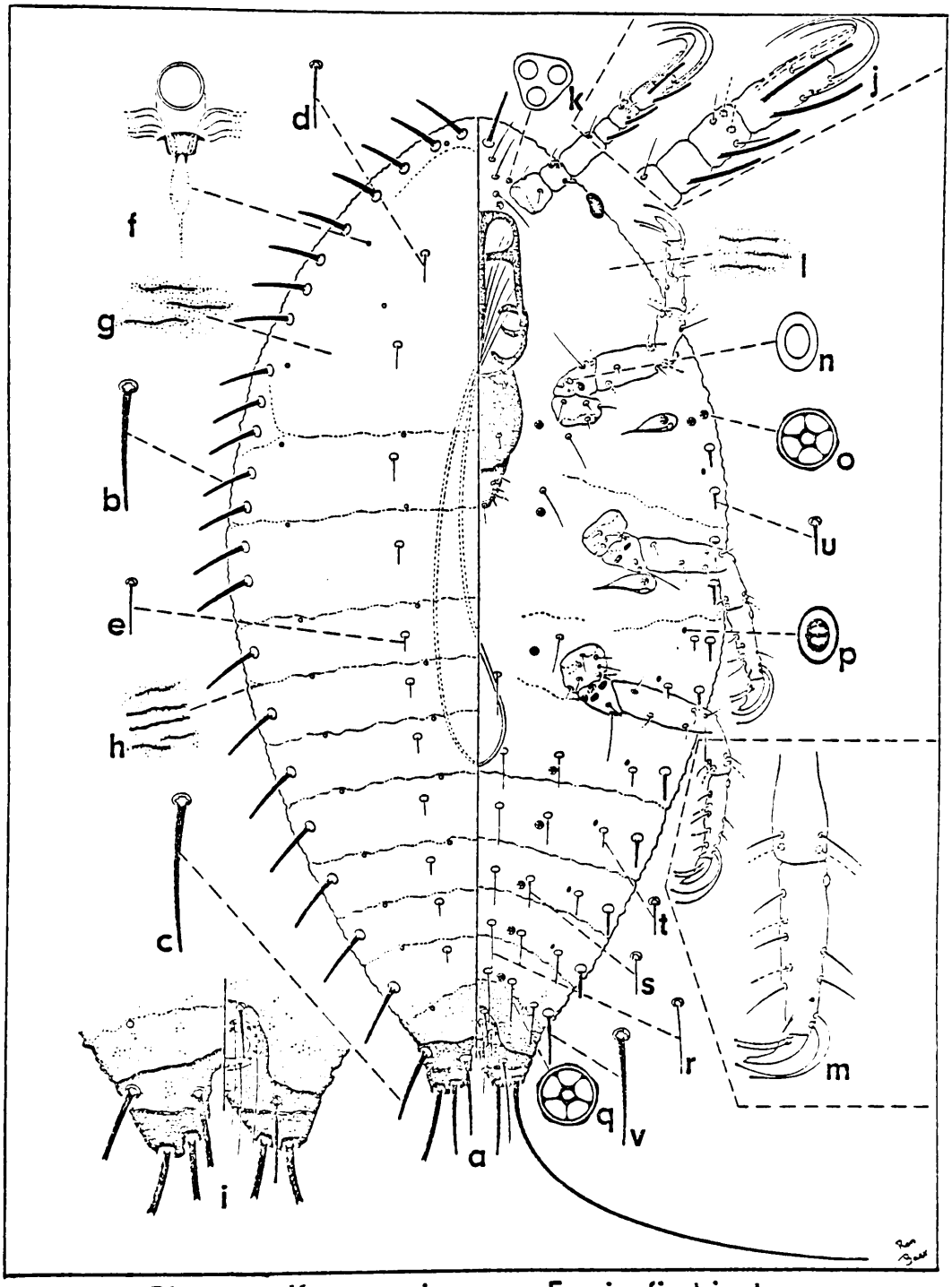

Plate 23- Kermes rimarum Ferris, first instar

VENTER

Antennae (fig. j). Total length 104 (107-121). Scape 17 (14-21) long, 29 (26-33) wide. Segments II to VI: 15 (14-16), 29 (26-33), 12 (9-16), 14 (12-16) 28 (26-30) long respectively. Trilocular pore at scape base (fig. k).

Clypeolabral shield. Length 102 (97-107), width 69 (63-74).

Labium. Length 78 (72-88), width 52 (42-70).

Derm (fig. l). Membranous.

Legs (fig. m). See enlargement of tibia, tarsus and claw of metathoracic leg. Four sensory pores on each trochanter (fig. n).

Leg Segments and Claw	Lengths Prothoracic	Lengths Mesothoracic	Lengths Metathoracic
Coxa	21 (19-23)	22 (21-23)	23 (18-28)
Trochanter	29 (28-35)	28 (23-33)	28 (26-33)
Femur	64 (60-67)	67 (63-67)	62 (67-72)
Tibia	35 (28-39)	35 (33-39)	37 (35-39)
Tarsus	53 (49-56)	57 (53-58)	61 (58-65)
Claw	18 (16-21)	20 (19-23)	21 (19-23)
Entire leg	221 (204-234)	230 (227-236)	237 (225-246)

Pores laterad of spiracle (fig. o). Each anterior spiracle usually with 3 quinquelocular pores. Each posterior spiracle with 1 quinquelocular pore.

Bilocular pores (fig. p). Located near the bases of the marginal and submarginal setae. Between 8 to 10 along each margin.

Submedial pores on derm (fig. q). In 2 submedial longitudinal rows. Four pairs on head and thorax, 5 pairs on abdomen, usually quinqueloculars, sometimes triloculars.

Body setae (figs. r-v). In 8 longitudinal rows on abdomen and partly on thorax: medial 15 (9-30) long, ca. 0.95 wide (fig. r); submedial 10 (7-16) long, ca. 1.05 wide (fig. s); submarginal 9 (5-12) long, ca. 1.33 wide (fig. t); marginal 13 (5-30) long, ca. 1.65 wide (fig. u). Posteriormost seta in marginal row thicker than rest in the row 27 (21-33) long (fig. v).

Anal lobes and ring (figs. a,i). Sclerotized. With a single submedial seta on each lobe, 33 (21-42) long. Ring oval, 18 (13-20) long, 26 (23-29) wide; anal ring setae 30 (26-33) long; a pair of thick setae at the anterior margin of anal ring, 18 (14-26) long.

Additional material studied. On Quercus gambellii, NM, San Miguel Co., 9 mi. W. of Sapello, Beulah, Jun. 2, 1976, coll. WAI, 1(4), VPI; On Quercus sp., CO, LaVeta Pass, Jul. 13, 1947, coll. GFF, 3(5), UCD.

Remarks. The original species description did not mention the first instar. K. rimarum is closely allied to the K. concinnulus group. Species included in this group have relatively long setaceous or parallel sided dorsal marginal setae and quinquelocular pores on the venter.

Kermes rimarum can be distinguished by the following characters: 1) one pair of dorsal marginal setae on each abdominal segment; 2) dorsal marginal setae 19-48 long; 3) dorsal submedial setae on head,

pro- and mesothorax slender, small and different from the dorsal marginal setae; 4) 8-10 bilocular pores along each ventral body margin; and 5) terminal antennal segment 26-30 long.

K. rimarum is a bark infesting species found in Colorado and New Mexico on Quercus gambellii.

Kermes rimarum Ferris, second instar male

Plate 24

Kermes rimarum Ferris, 1955:202.

Type material studied. Paralectotypes on Quercus gambelii, NM, 30 mi. from Las Vegas, Beulah, Jul. 15, 1947, coll. GFF, 18(37), UCD.

Description. Body (fig. a) length 1259 (906-1464), width 664 (558-785).

DORSUM

Marginal setae (fig. b). Thin setaceous, ca. 52, these 79 (65-100) long, ca. 2 wide.

Submedial setae (fig. c). In 4 longitudinal rows, 3 pairs in medial row, 11 pairs in submedial row, these 35 (29-43) long, ca. 2 wide.

Quinquelocular pores (fig. d). Numerous quinquelocular pores scattered over derm.

Simple pores. Absent.

Tubular ducts (fig. e). Numerous, distributed throughout derm, 19 (18-20) long.

Anal lobes. Sclerotized. One seta on inner margin of each lobe, 31 (23-35) long, another at posterior end 23 (22-24) long; apical seta 153 (120-183) long.

VENTER

Antennae. Total length 188 (179-201). Scape 27 (23-30) long, 41 (38-44) wide. Segments II to VII: 21 (18-24), 42 (35-47), 29 (26-30),

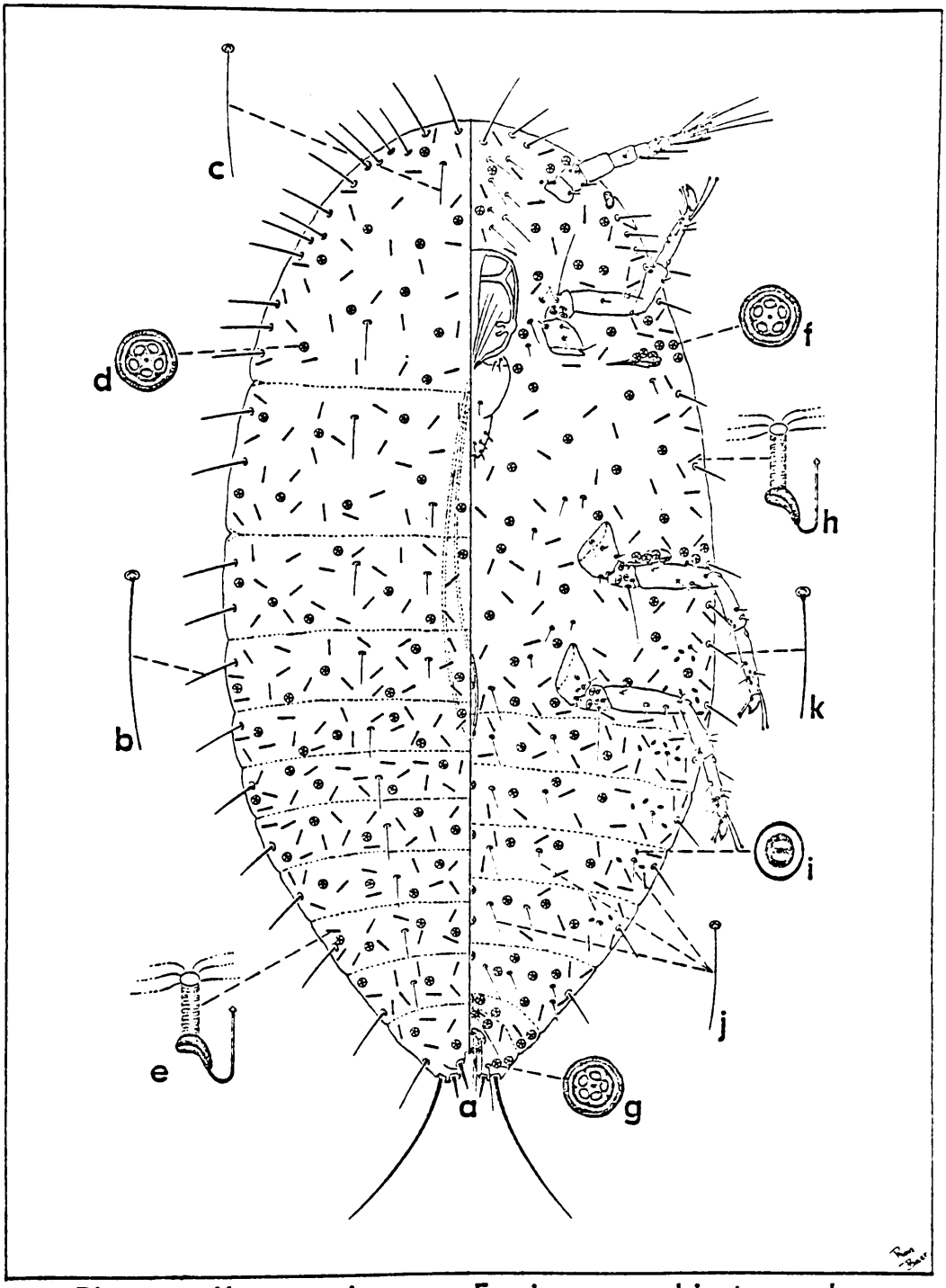

Plate 24.-Kermes rimarum Ferris, second instar male

Clypeolabral shield. Length 140 (120-149), width 123 (106-136).

Labium. Length 110 (90-136), width 89 (76-106).

Legs. See chart below.

Leg Segments and Claw	Lengths Prothoracic	Lengths Mesothoracic	Lengths Metathoracic
Coxa	47 (44-51)	48 (45-52)	49 (44-53)
Trochanter	52 (48-56)	51 (49-53)	46 (44-48)
Femur	93 (88-97)	92 (88-95)	91 (89-96)
Tibia	78 (72-84)	78 (74-86)	79 (74-84)
Tarsus	89 (86-93)	90 (86-93)	92 (88-97)
Claw	22 (19-26)	21 (19-24)	20 (19-24)
Entire leg	381 (364-388)	386 (374-396)	391 (378-401)

Pores laterad of spiracle (fig. f). Each anterior and posterior spiracle with 5-7 quinquelocular pores.

Quinquelocular pores on derm (fig. q). Numerous, scattered over derm.

Tubular ducts (fig. h). Less numerous than on dorsum, distributed throughout the derm, about the same size and shape as those on dorsum.

Bilocular pores (fig. i). Located near the bases of the submarginal and marginal setae, ca. 15 along each margin.

Body setae (figs. j,k). In 8 longitudinal rows on abdomen and partly on head and thorax: medial 66 (51-112) ca. 2 wide (fig. j); submedial 38 (35-41) long, ca. 2 wide (fig. j); submarginal 28 (22-30)

long, ca. 2 wide (fig. j); marginals, similar to dorsal marginals, 48 (41-59) long, ca. 2 wide (fig. k).

Anal lobes and ring. Sclerotized. With a single submedial seta on each lobe, 42 (37-46) long. Ring oval, 31 (28-35) long, 35 (33-37) wide; anal ring setae 44 (38-47) long.

Remarks. Second instar males were found along with second instar females and first instars in bark crevices.

Based on first instar morphology, Kermes rimarum was placed in the K. concinnulus group, which includes K. cockerelli, K. concinnulus and K. shastensis. The second instar males of K. rimarum were also morphologically similar to the included species (except K. shastensis where no male second instars were available). Second instar males in this group have long, thin dorsal marginal setae and quinquelocular pores on the dorsum.

Kermes rimarum second instar males can be distinguished from other Kermes spp. by the following characters: 1) quinquelocular pores scattered over entire dorsal and ventral derm; 2) dorsal and ventral marginal setae thin, setaceous; 3) no simple pores on the dorsum; 4) dorsal marginal setae 63-100 long; 5) antenna 179-202 long; and 6) anal ring setae 38-47 long.

Kermes rimarum Ferris, second instar female

Plate 25

Kermes rimarum Ferris, 1955:202.

Type material studied. Paralectotypes on Quercus gambelii, NM, 30 mi. from Las Vegas, Beulah, Jul. 15, 1947, coll. GFF, 6(7), UCD.

Description. Body (fig. a) length 1223 (1087-1434), width 722 (453-906).

DORSUM

Marginal setae (fig. b). Thick, straight, 2 pairs on each abdominal segment, ca. 70, 62 (53-71) long, 8 (7-9) wide.

Submedial setae (fig. c). In 2 longitudinal rows, 11 pairs, 3 (2-5) long, ca. 1.0 wide, occasionally a pair located medially to these on thorax.

Simple pores. Absent.

Tubular ducts. Absent.

Anal lobes. Sclerotized. One seta on inner margin of each lobe, 13 (12-14) long, another at posterior end 14 (12-15) long; apical seta 200 (181-226) long.

VENTER

Antennae. Total length 185 (178-191). Scape 30 (27-33) long, 40 (37-44) wide. Segments II to VI: 21 (19-24), 65 (62-70), 21 (18-24), 19 (18-21), 29 (26-33) long respectively.

Clypeolabral shield. Length 84 (59-147), width 61 (47-89).

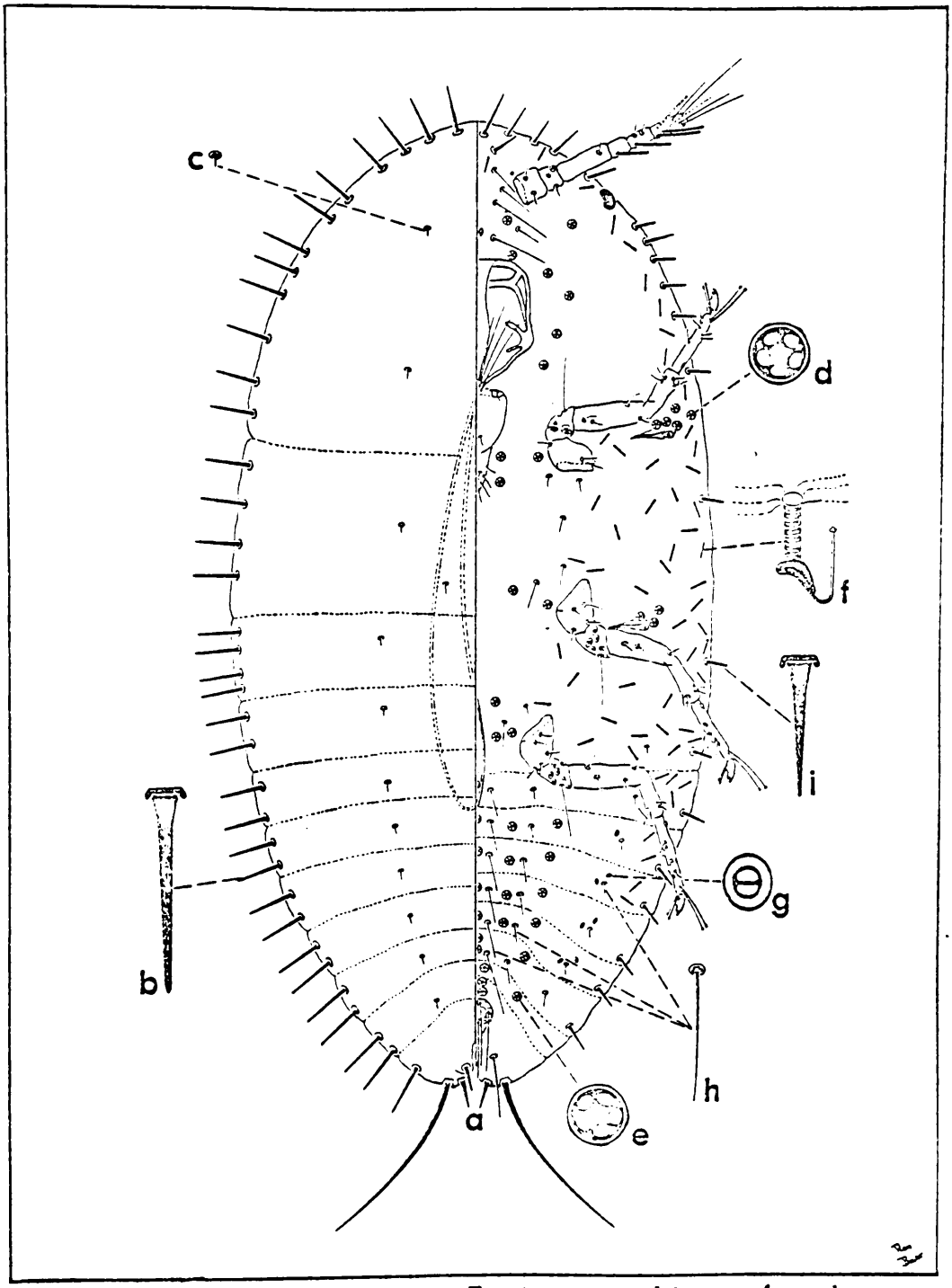

Plate 25. - Kermes rimarum Ferris, second instar female

Labium. Length 66 (53-118), width 50 (35-89).

Legs. See chart below.

Leg Segments and Claw	Lengths Prothoracic	Lengths Mesothoracic	Lengths Metathoracic
Coxa	40 (33-47)	46 (42-53)	46 (42-53)
Trochanter	44 (41-47)	53 (49-56)	50 (47-53)
Femur	95 (88-104)	95 (88-102)	96 (83-107)
Tibia	69 (65-74)	65 (60-67)	61 (53-67)
Tarsus	93 (88-95)	93 (89-102)	104 (89-124)
Claw	22 (19-24)	21 (19-24)	22 (19-24)
Entire leg	361 (355-369)	374 (359-386)	370 (334-425)

Pores laterad of spiracle (fig. d). Each anterior spiracle with 5 or 6 quinquelocular pores. Each posterior spiracle with 3 quinquelocular pores.

Quinquelocular pores on derm (fig. e). In 5 longitudinal rows on abdomen, also, several near coxae and antennal scape bases.

Tubular ducts (fig. f). Numerous, mainly along submargin and at coxal areas, ca. 100.

Bilocular pores (fig. g). Located near the bases of the submarginal setae, ca. 7 to 10.

Body setae (figs. h,i). In 8 longitudinal rows on abdomen and partly on thorax and head: medial 58 (41-77) long, ca. 2 wide (fig. h); submedial 26 (18-35) long, ca. 2 wide (fig. h); submarginal 16 (12-24)

long, ca. 2 wide (fig. h); marginal, similar morphologically to dorsal marginal setae, 35 (24-59) long, 7 (5-9) wide (fig. i).

Anal lobes and ring. Sclerotized. With a single submedial seta on each lobe, 31 (30-33) long. Ring oval, 20 (19-21) long, 19 (16-21) wide; anal ring setae 33 (30-35).

Remarks. K. rimarum second instar females can be distinguished by the following characters: 1) tubular ducts absent from dorsum; 2) abdominal venter with quinquelocular pores, but absent along body margin; 3) two pairs of dorsal marginal setae on each abdominal segment; 4) with few or no simple pores on dorsal derm; 5) dorsal submedial setae on head, pro- and mesothorax reduced to small slender setae and these not similar to dorsal marginal setae; and 6) ventral seta on inner margin of anal lobe 30-33 long.

Kermes shastensis Ehrhorn, first instar

Plate 26

Kermes shastensis Ehrhorn, 1911:275.

Type material studied. Topotypes on Quercus chrysolepsis, CA, Siskiyou Co., near Shasta Springs, colls. MMK, Jul. 7, 1976, 4(19), VPI; Quercus sp., Shasta Springs, May 20, 1976, coll. RJG, 11(57), CDA.

Description. Body (fig. a) length 492 (468-544), width 236 (227-242).

DORSUM

Marginal setae (fig. b). Parallel sided, blunt or slightly pointed at apex, ca. 42-48. Those anterior to anterior spiracles similar to those posterior to it. Length 17 (14-24), width 3 (2-5).

Marginal setae on anal lobe (fig. c). Longer and thinner at apex than other marginal setae, 30 (26-33) long.

Submedial setae on head and thorax (fig. d). Parallel sided, blunt at apex on head, pro- and mesothorax, similar to marginals, 3 pairs, 15 (12-16) long, ca. 2.5 wide. Metathorax with 1 pair, thin, setaceous, similar to submedial setae on abdomen, ca. 12 long.

Submedial setae on abdomen (fig. e). Thin setaceous, 7 pairs, 9 (7-11) long, ca. 1 wide.

Simple pores (fig. f). In 4 longitudinal rows, ca. 39-43.

Derm (fig. g). Simple, membranous.

Intersegmental membrane (fig. h). Apparent due to type of derm.

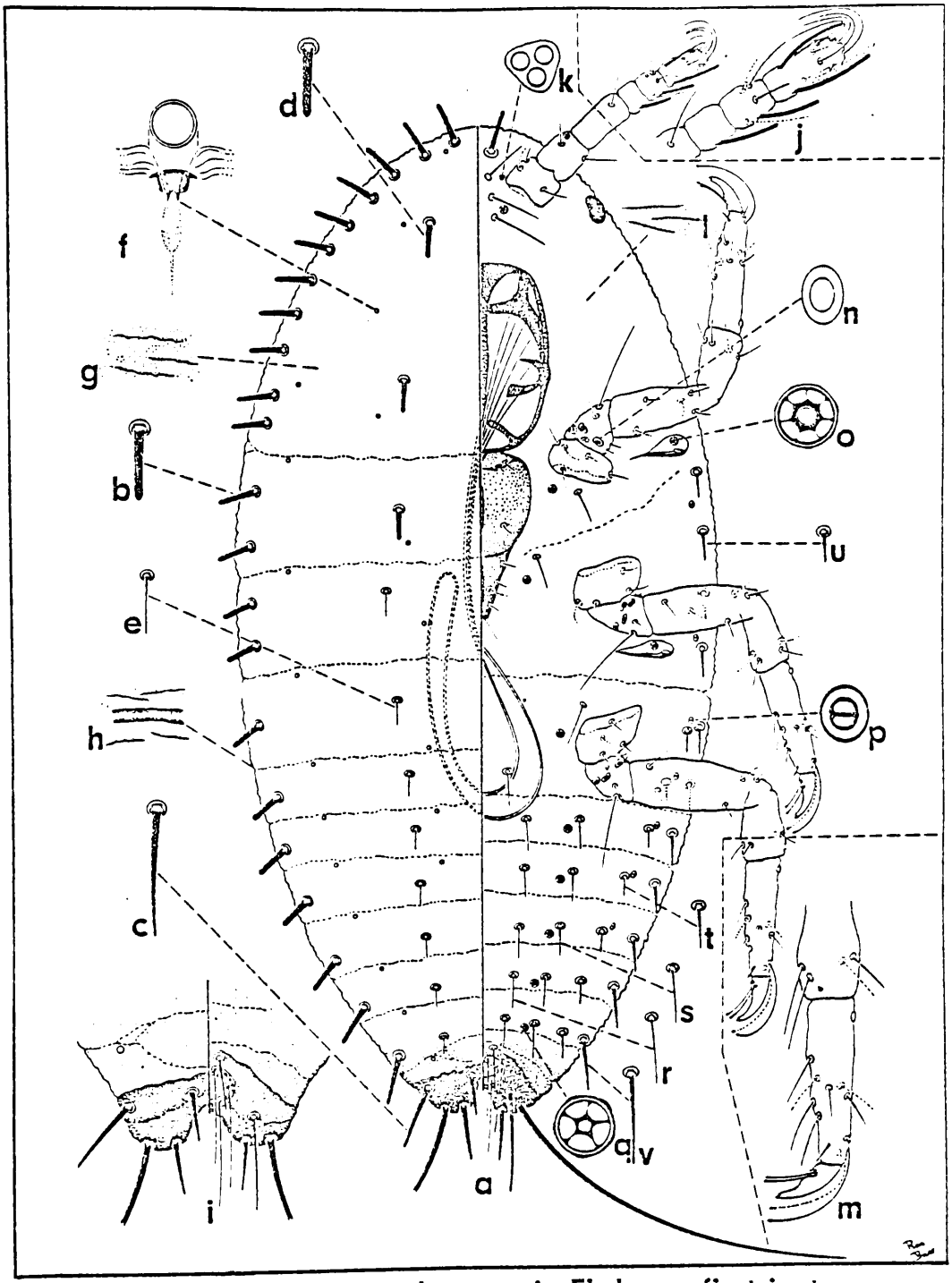

Plate 26. - Kermes shastensis Ehrhorn, first instar

Anal lobes (figs. a,i). Sclerotized. One thick seta on inner margin of each lobe, 23 (21-24) long. Another at posterior end, 23 (21-26) long; apical seta 127 (106-142) long.

VENTER

Antennae (fig. j). Total length 114 (107-121). Scape 16 (14-19) long, 32 (28-37) wide. Segments II to VI: 18 (14-21), 27 (23-30), 12 (11-14), 14 (12-15), 29 (28-33) long respectively. Trilocular pore at scape base (fig. k).

Clypeolabral shield. Length 97 (84-103), width 70 (67-74).

Labium: Length 85 (72-95), width 55 (51-63).

Derm (fig. l). Membranous.

Legs (fig. m). See enlargement of the tibia, tarsus and claw of metathoracic leg. Four sensory pores on each trochanter (fig. n).

Leg Segments and Claw	Lengths Prothoracic	Lengths Mesothoracic	Lengths Metathoracic
Coxa	23 (19-28)	25 (23-28)	24 (21-28)
Trochanter	32 (26-35)	27 (23-35)	31 (23-35)
Femur	68 (63-74)	65 (58-72)	69 (60-74)
Tibia	35 (28-39)	38 (33-39)	37 (30-42)
Tarsus	57 (53-60)	59 (53-63)	63 (53-70)
Claw	20 (19-23)	19 (18-21)	20 (19-23)
Entire leg	236 (223-246)	236 (209-248)	246 (216-269)

Pores of laterad of spiracle (fig. o). Each anterior and posterior spiracle usually with one 7-locular pore, occasionally a 5-, 6-, or 10-locular pore.

Bilocular pores (fig. p). Located near the bases of the submarginal and marginal setae. Between 6 to 8 along each margin.

Submedial pores on derm (fig. q). In 2 submedial longitudinal rows. Four pairs on head and thorax, 5 pairs on abdomen, mostly quinqueloculars, rarely a 7-locular pore.

Body setae (figs. r-v). In 8 longitudinal rows on abdomen and partly on thorax: medial 13 (8-24) long, ca. 1 wide, (fig. r); submedial 10 (8-17) long, ca. 1.14 wide (fig. s); submarginal 8 (5-12) long, ca. 1.43 wide (fig. t); marginal 11 (9-22) long, ca. 2 wide (fig. u). Posteriormost seta in marginal row thicker than rest in row, 20 (14-26) long.

Anal lobe and ring (figs. a,i). Sclerotized. With a single submedial seta on each lobe, 34 (16-44) long. Ring oval, 13 (9-16) long, 28 (26-30) wide; anal ring setae 39 (30-46) long; a pair of thick setae at the anterior margin of anal ring, each 17 (9-26) long.

Additional material studied. On Chrysolepis sempervirens, CA, Mono Co., Mammoth, Earthquake Fault, Jul. 4, 1976, colls. RJG and R. F. Gill, 5(30), CDA; Sierra Co., 6 mi. E. Independence Lake, Jul. 15, 1966, coll. DRM, 1(3), NMNH; On Quercus vaccinifolia, CA, Fallen Leaf Lake, Aug. 1920, coll. (JMC), 4(11), UCD; Lake Tahoe, 1916, coll. G. Bently, 5(12), UCD; On Q. wislizenii, CA, Kings Canyon, National Pk., Aug. 7, 1968, coll. JWB, 2(9), JWB.

Remarks. The original description contained no morphological characters on the first instars for species recognition.

Kermes shastensis is closely allied to the K. concinnulus group. Species included in this group have relatively long, setaceous or parallel sided dorsal marginal setae and quinquelocular pores on the venter.

Kermes shastensis can be distinguished by the following characters: 1) one pair of dorsal marginal setae on each abdominal segment; 2) parallel sided and blunt dorsal marginal setae; 3) dorsal submedial setae on head, pro- and mesothorax thickened and similar to the dorsal marginal setae; and 4) one 7-locular pore laterad of each anterior spiracle.

K. shastensis can be found on twigs near the bud region on Quercus chrysolepis, Q. vaccinifolia, Q. wislizenii and Chrysolepis sempervirens in California.

Olliffiella cristicola Cockerell, first instar

Plate 27

Olliffiella cristicola Cockerell, 1896a:299.

Material studied. On Quercus emoryi, AZ, Portal, Southwest Research Station, Jun. 24, 1976, coll. MK, 4(31), VPI.

Description. Body (fig. a) oblong, widest at mesothorax, tapering posteriorly, antennae, legs, and anal lobes well developed, with one apical seta on each lobe; body 525 (483-559) long, 208 (196-226) wide.

DORSUM

Marginal setae (fig. b). Parallel sided, blunt at apex, ca. 44-48. Those anterior to the anterior spiracles thinner than those posterior to it. Length 16 (12-17), width 3 (2-4).

Marginal setae on anal lobe (fig. c). Slightly longer and thicker than other marginal setae, ca. 17 long.

Submedial setae on head and thorax (fig. d). Parallel sided, similar to marginal setae, 2 pairs on head, 1 pair on each thoracic region, 16 (14-18) long, ca. 5 wide.

Submedial setae on abdomen (fig. e). Parallel sided, similar to submedial setae on head and thorax, 7 pairs, ca. 15 long, ca. 5 wide.

Simple pores (fig. f). Each with a sclerotized ring opening to a membranous duct, in 5 longitudinal rows, ca. 47-50, ca. 1 wide.

Derm (fig. g). Membranous, composed of overlapping plate-like areas.

Intersegmental membrane (fig. h). Pronounced due to type of derm.

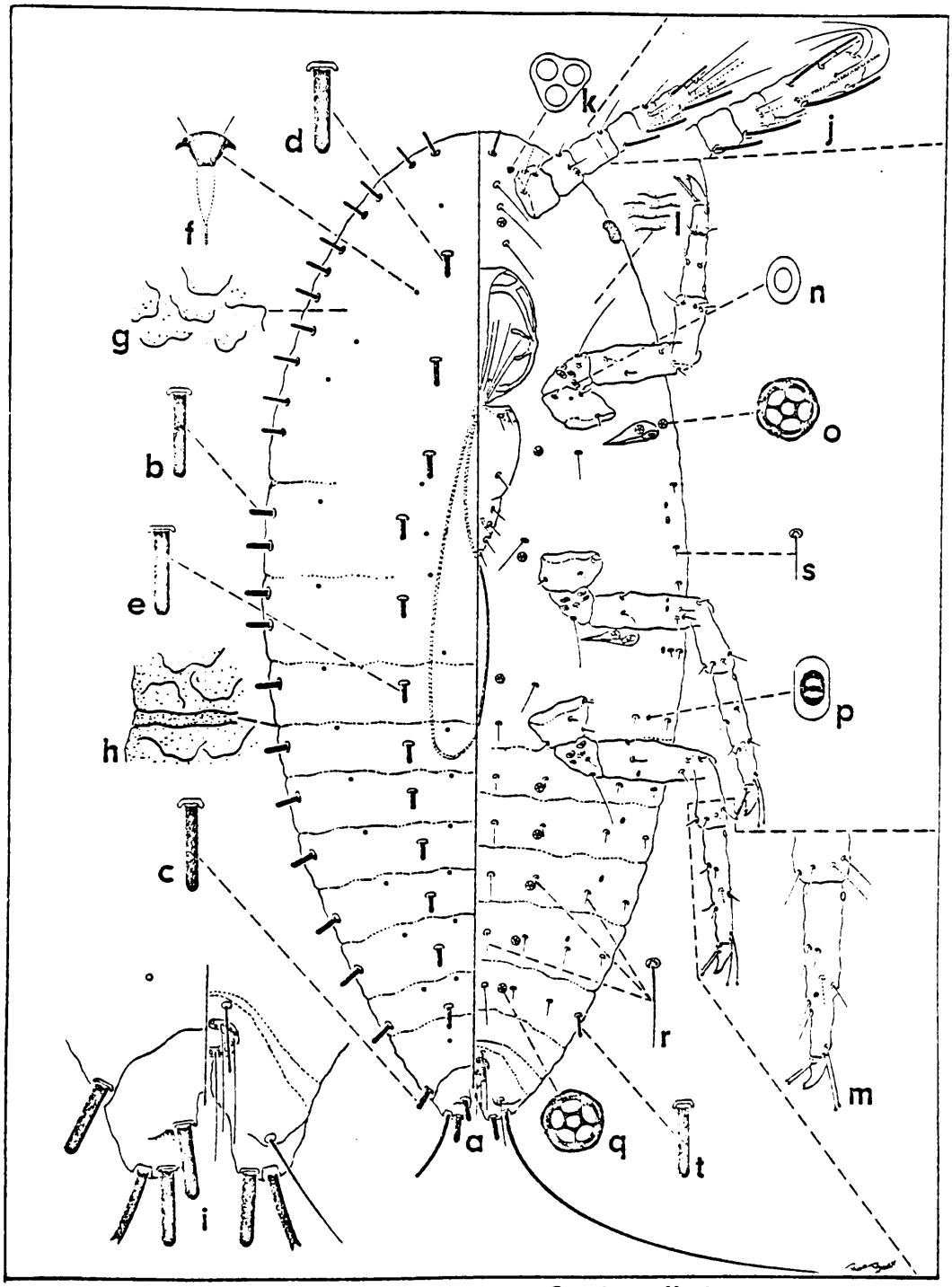

Plate 27. - Olliffiella cristicola Cockerell, first instar

Anal lobes (figs. a,i). Sclerotized. One parallel sided seta on inner margin of each lobe 19 (16-21) long. Another at posterior end, 19 (16-21) long; apical seta 187 (166-196) long.

VENTER

Antennae (fig. j). Six segmented. Total length 98 (94-102). Scape 15 (14-16) long, 26 (23-33) wide. Segments II to VI: 15 (12-16), 21 (19-23), 12 (11-13), 12 (11-14), 24 (22-27) long respectively. Numerous slender setaceous setae on segments on antenna, fleshy setae on segments IV-VI. Sensory pore on segment II. Trilocular pore at scape base (fig. k).

Clypeolabral shield. Length 79 (71-89), width 58 (53-63).

Labium. Triangular, length 81 (71-89), width 42 (37-45). Eight labial setae, each ca. 14 long.

Derm (fig. l). Simple membranous.

Legs (fig. m). See enlargement of tibia, tarsus, and claw of metathoracic leg. Four sensory pores on each trochanter (fig. n). Also, a sensory pore on the proximal lateral margin of each tarsal segment. Numerous thin setaceous setae on the different segments of each leg. Tarsal and claw digitules extending beyond apex of claw. Claws with a denticle.

Leg Segments and Claw	Lengths Prothoracic	Lengths Mesothoracic	Lengths Metathoracic
Coxa	16 (14-19)	17 (14-23)	20 (19-23)
Trochanter	27 (26-33)	31 (30-33)	29 (23-33)
Femur	59 (56-63)	60 (58-63)	67 (65-70)
Tibia	36 (35-37)	36 (35-37)	39 (35-42)
Tarsus	55 (53-58)	56 (51-58)	63 (60-65)
Claw	18 (16-21)	18 (14-21)	19 (17-21)
Entire leg	205 (169-215)	218 (213-227)	237 (230-246)

Pores anterior to anterior spiracle. Absent.

Pores laterad of spiracle (fig. o). Each anterior spiracle with 2 quinquelocular pores. Each posterior spiracle with 1 quinquelocular pore. Anterior spiracle ca. 21 long, ca. 7 wide, atrium ca. 2 wide. Posterior spiracle ca. 21 long, ca. 7 wide, atrium 2 wide.

Bilocular pores (fig. p). Located near the bases of the submarginal and marginal setae. Nine to 11 along each margin, ca. 2 wide.

Submedial pores on derm (fig. q). In 2 longitudinal rows. Four pairs on head and thorax, 5 pairs on abdomen; mostly quinqueloculars, occasionally triloculars.

Body setae (figs. r-t). In 8 longitudinal rows on abdomen and partly on thorax: medial row with 6 pairs; submedial row with 5 pairs; submarginal row with 7 pairs; marginal row with 10 pairs. All setae in these rows are slender and setaceous, 9 (5-23) long, ca. 2 wide (figs. r-s). Posteriormost seta in marginal row similar to dorsal

marginals, ca. 16 long (fig. t). Other long setaceous setae near coxae and antennal scape bases. One pair of setae similar to dorsal marginal setae near scape base.

Anal lobe and ring (figs. a,i). Sclerotized. With a single submedial seta on each lobe, 30 (21-33) long. Ring oval, 13 (7-14) long, 22 (21-23) wide; with ca. 22 transparent cells and 6 anal ring setae, each 30 (26-31) long. A pair of setae on the anterior margin of anal ring, each 16 (14-17) long.

Additional material studied. On Quercus emoryi, AZ, Bisbee, Jul. 11, 1918, coll. L. H. Weld, 1(7), NMNH; Dragoon Pass, Jul. 6, 1940, coll. GFF, 1(16), NMNH; Pine, Oct. 1939, coll. NWC, 1(2), NMNH; near Portal, Southwest Research Station, Mar. 22, 1977, coll. R. Morse, 1(1), VPI; Wolf Creek, Sep. 26, 1945, coll. L. H. Weld, 1(8), NMNH; On Q. undulata var. pungens, NM, Pinos Altos, 1896, 1(5), PANS.

Remarks. The original description contained no morphological information useful for first instar recognition. Ferris (1919) mentioned that the first instars may be inseparable generically from the corresponding stages of certain species of Kermes. The redescriptions (Ferris 1919 and Sternlicht 1974) provided adequate morphological characters and illustrations.

The major distinguishing character of this North American species is the presence of parallel sided dorsal submedial setae on the abdominal segments. Also, the dorsal marginal setae anterior to the anterior spiracle are thinner than the rest of the setae along the margin.

This leaf gall-former is found in Arizona and New Mexico on Quercus emoryi and Q. undulata var. pungens.

Olliffiella secunda Ferris, second instar female

Plate 28

Olliffiella secunda Ferris, 1955:21.

Type material studied. Paralectotypes on Quercus sp., MEXICO, State of Guerro, 30 mi. E. of Acapulco, La Providencia, Mar. 15, 1926, coll. GFF, 4(7), NMNH.

Description. Body (fig. a) oblong, derm membranous, tubular ducts present on venter only, antennae, legs, and anal lobes well developed, body 906 (845-981) long, 480 (422-528) wide.

DORSUM

Marginal setae (fig. b). Setaceous, slightly curved at middle, ca. 45-47, these 33 (30-35) long, 3 (2-4) wide.

Submedial setae (figs. c,d). In 2 distinct longitudinal rows, 12 pairs, a few other pairs on thorax and several abdominal segments 28 (23-33) long, 3 (2-4) wide.

Quinquelocular pores (fig. e). In 2 submarginal longitudinal rows, ca. nine pairs, dia. ca. 5.

Simple pores (fig. f). In 2 submedial longitudinal rows, 11 pairs, each with a sclerotized margin and shaped like a campaniform sensillum, length ca. 2.

Tubular ducts. Absent.

Anal lobes. Sclerotized. One seta on inner margin of each lobe, 17 (16-19) long, another at posterior end 14 (12-16) long; apical seta 157 (135-166).

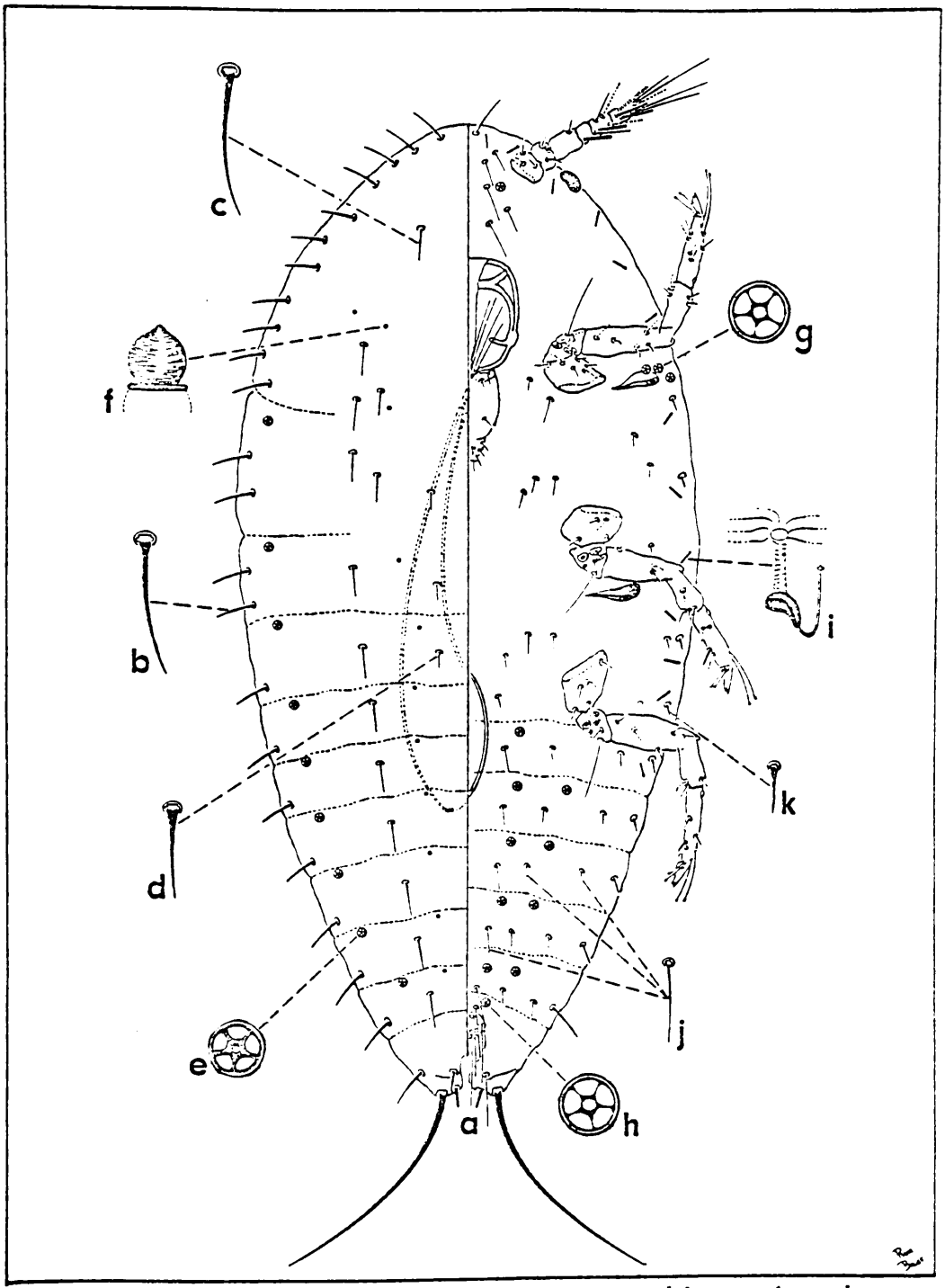

Plate 28.-Olliffiella secunda Ferris, second instar female

VENTER

Antennae. Six segmented. Total length 104 (95-109). Scape length 16 (14-19), width 38 (35-42). Segments II to VI: 14 (12-16), 26 (23-28), 11 (9-14), 11 (9-12), 26 (23-28) long respectively. Numerous slender setaceous setae on segments. Segments IV and V each with one fleshy seta, three fleshy setae on segment VI. Sensory pore on segment II.

Clypeolabral shield. Sclerotized, length 91 (77-106), width 88 (71-106).

Labium. Sclerotized, triangular, length 85 (71-94), width 66 (53-71); with 8 pairs of setae, each 11 (9-14) long.

Legs. Sclerotized, with numerous setaceous setae on each segment. Sensory pore on proximal lateral margin of each tarsus. Four sensory pores on each trochanter. Tarsal and claw digitules extending beyond apex of claw. Claws with a denticle.

Leg Segments and Claw	Lengths Prothoracic	Lengths Mesothoracic	Lengths Metathoracic
Coxa	31 (28-33)	31 (28-35)	31 (28-39)
Trochanter	30 (28-33)	33 (27-39)	39 (37-44)
Femur	81 (79-83)	81 (76-86)	81 (81-86)
Tibia	47 (41-51)	44 (39-49)	50 (48-53)
Tarsus	69 (67-72)	79 (72-83)	81 (78-86)
Claw	24 (19-28)	25 (19-28)	24 (23-28)
Entire leg	281 (273-288)	293 (282-300)	305 (294-322)

Pores laterad of spiracle (fig. g). Each anterior spiracle with 3 quinquelocular pores. Each posterior spiracle with 1 quinquelocular pore.

Quinquelocular pores on derm (fig. h). In 4 longitudinal rows on abdomen, 1 pore associated with each antennal scape, ca. 5 dia.

Tubular ducts (fig. i). Along submargin, ca. 30 totally, 20 (19-22) long.

Bilocular pores. Absent.

Body setae (figs. j,k). In 8 longitudinal rows on abdomen and partly on thorax: medial row with 6 pairs, each 33 (23-49) long, ca. 2 wide (fig. j); submedial row with 5 pairs, each 10 (7-19) long, ca. 2 wide (fig. j); submarginal row with 7 to 8 pairs, each 9 (7-14) long, ca. 2 wide (fig. j); marginal row with 10 to 11 pairs, each 12 (7-30) long, ca. 3 wide (fig. k). Other setae near coxae and antennal bases. One pair of setae similar to dorsal marginal setae near scape base.

Anal lobes and ring. Sclerotized. With a submedial seta on each lobe 37 (33-42) long, ring oval, ca. 30 long, 32 (30-33) wide; with 18 pairs of translucent rings and 6 anal ring setae, each 46 (42-51) long.

Remarks. The original description contained no information on the first or second instar. Ferris (1955) mentioned that O. secunda forms galls on oaks in Mexico, similar to O. cristicola.

This species can be separated from Kermes second instar females by having 12 pairs of dorsal submedial setae and the presence of dorsal submarginal rows on quinquelocular pores.

Fulbrightia gallicola Ferris, first instar

Plate 29

Fulbrightia gallicola Ferris, 1950:7.

Type material studied. Paralectotypes on Quercus delavayi, China, Yunnan Province, near Kunming, An-lin-wen-chian (Hot Springs), Apr. 28, 1949, GFF, 2(2), UCD.

Description. Body (fig. a) oblong, widest at mesothorax, tapering posteriorly, antennae, legs and anal lobes well developed, with 2 long apical setae on each lobe; body 612 (604-619) long, 192 (188-196) wide.

DORSUM

Marginal setae (fig. b). Acorn-shaped, 3 pairs on each abdominal segment, ca. 98-102, these 12 (9-14) long, 9 (7-12) wide.

Marginal setae on anal lobe (fig. c). Similar to other marginal setae.

Submedial setae on head and thorax (fig. d). Short, setaceous, 2 pairs on head, 1 pair on each thoracic region, 4 (2-5) long, ca. 1 wide.

Submedial setae on abdomen (fig. e). Short, setaceous, similar to submedial setae on head and thorax, 6 pairs, 3 (2-4) long, ca. 1 wide.

Simple pores (fig. f). Each with a sclerotized ring opening to a membranous duct, in 4 longitudinal rows, ca. 43-45, ca. 1 wide.

Derm (fig. g). Simple, membranous.

Intersegmental membrane (fig. h). Apparent due to type of derm.

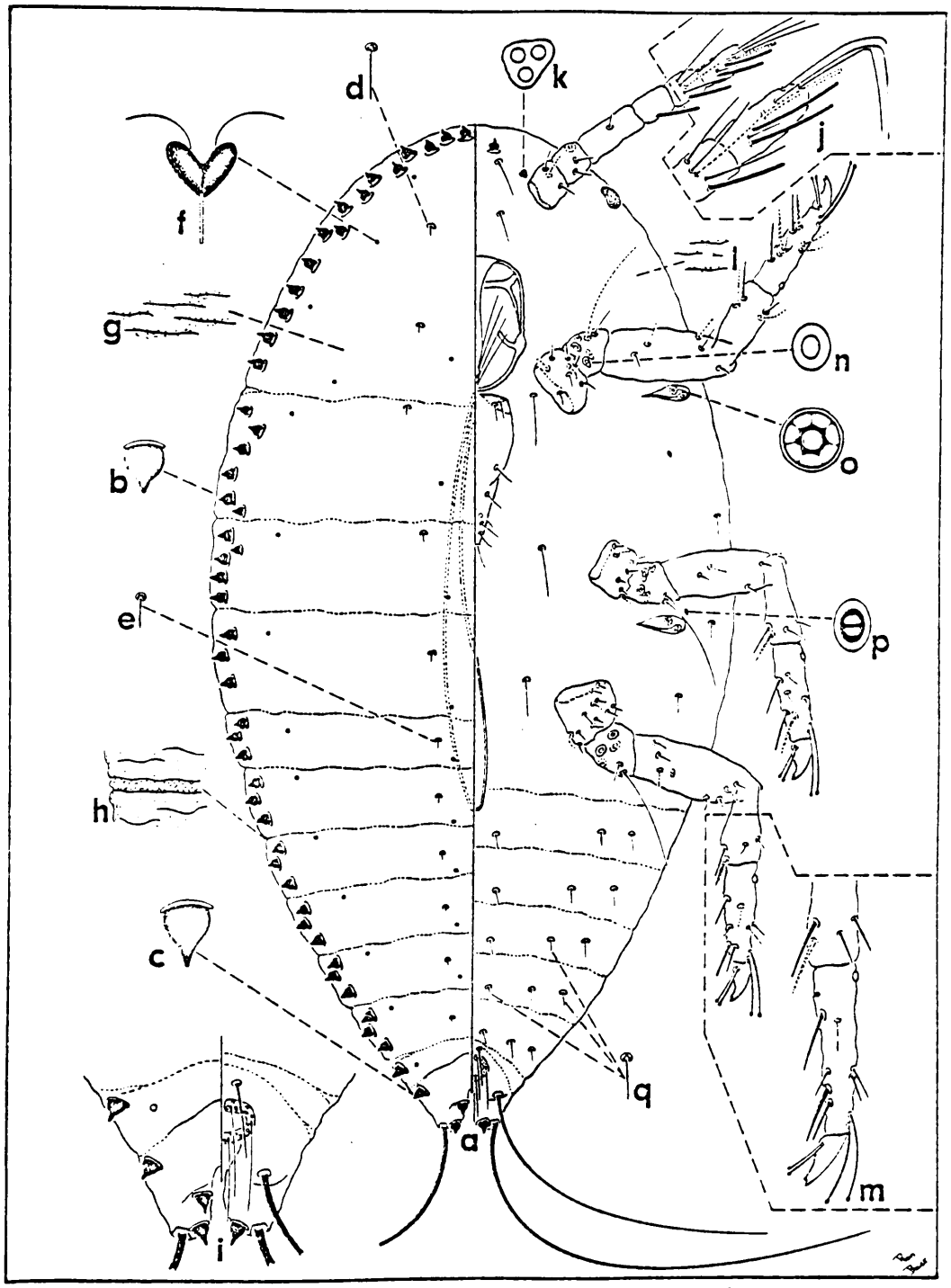

Plate29.-Fulbrightia gallicola Ferris, first instar

Anal lobes (figs. a,i). Sclerotized. One acorn-shaped seta on inner margin of each lobe 13 (12-14) long. Another at posterior end, 13 (12-14) long; apical seta 327 (325-330) long.

VENTER

Antennae (fig. j). Six segmented. Total length 153 (149-157). Scape 23 long, 34 (30-37) wide. Segments II to VI: 15 (14-16), 42 (39-44), 20 (19-21), 21 (19-23), 35 (30-39) long respectively. Numerous, slender setaceous setae on segments of antenna, fleshy setae on segments IV-VI. Sensory pore on antennal segment II. Trilocular pore at scape base (fig. k).

Clypeolabral shield. Measurements not available.

Labium. Long triangular, length 128 (116-139). Eight labial setae, 16 (14-27) long.

Derm (fig. l). Simple membranous.

Legs (fig. m). See enlargement of tibia, tarsus, and claw of metathoracic leg. Four sensory pores on each trochanter (fig. n). Also a sensory pore on the proximal lateral margin of each tarsal segment. Numerous thin, setaceous setae on the different segments of each leg. Numerous thick setae on the tibia and tarsus of each leg. Tarsal and claw digitules extending beyond apex of claw. Claws with a denticle.

Leg Segments and Claw	Lengths Prothoracic	Lengths Mesothoracic	Lengths Metathoracic
Coxa	36 (35-37)	32 (28-37)	33 (32-35)
Trochanter	39 (37-42)	38 (37-39)	39 (37-42)
Femur	61 (60-63)	61 (58-65)	60 (58-63)
Tibia	52 (46-58)	48 (46-49)	50 (46-53)
Tarsus	57 (56-58)	59 (51-67)	56 (53-58)
Claw	24 (23-26)	ca. 26	ca. 26
Entire leg	270 (267-274)	264 (260-269)	264 (253-276)

Pores anterior to anterior spiracle. Absent.

Pores laterad of spiracle (fig. o). Each anterior and posterior spiracle with one associated 7-locular pore. Anterior spiracle length ca. 21, width ca. 9, atrium 2. Posterior spiracle, length 21, width 7, atrium 2.

Bilocular pores (fig. p). Located between the anterior and posterior spiracles. Two along each margin, ca. 2 wide.

Submedial pores on derm. Absent.

Body setae (fig. q). In 6 longitudinal rows. Thin, setaceous on abdomen and partly on thorax: medial row with 5 pairs; submedial row with 5 pairs; submarginal row with 8 pairs. Each seta 12 (9-14) long, ca. 2 wide. Other longer setae near coxae and antennal scape bases. One pair of acorn-shaped setae near antennal scape base.

Anal lobes and ring (figs. a,i). Sclerotized. With a single submedial seta on each lobe 177 (171-183) long. Ring oval, ca. 23 long,

ca. 26 wide; with ca. 22 transparent cells and 6 setae, each 38 (37-39) long. A pair of thick setae at the anterior margin of the anal ring, each ca. 23 long.

Remarks. The type description provided adequate morphological characters and an illustration of the first instar for species recognition. The major distinguishing characters are: acorn-shaped dorsal marginal setae, three pairs of these on each abdominal segment, the ventral submedial seta on each lobe ca. 2/3 the length of the apical seta and the venter without longitudinal rows of pores.

Ferris (1950) also described the second instar female. However, according to our study, he actually described the second instar male. The 7-segmented antenna and numerous tubular ducts on the dorsum are important characters in distinguishing second instar males in the genus Kermes of the Nearctic Region. The presence of quinquelocular pores on the dorsum and venter may place this species in the Kermes concinnulus group.

However, conclusive relationships of this genus could not be established. Future studies are needed on other instars of this species. These need to be compared with corresponding stages of the genus Kermes from the Palearctic Region.

Physeriococcus cellulosus Borchsenius, first instar

Plate 30

Physeriococcus cellulosus Borchsenius, 1959:164.

Type material studied. Paralectotypes on Quercus sp., China, Yunnan Province, near Szemao and Kingtung, May 12, 1957, coll. N. S. Borchsenius, 6(51), IZ.

Description. Body (fig. a) oblong, widest at mesothorax, tapering posteriorly, antennae, legs, and anal lobes extremely well developed, with 1 long, thick apical seta; body 522 (483-634) long, 179 (166-196) wide.

DORSUM

Marginal setae (fig. b). Thick, slightly curved, ca. 45-47, these 13 (12-14) long, ca. 2 wide.

Marginal setae on anal lobe (fig. c). Slightly longer and straighter than other marginal setae, ca. 14 long.

Submedial setae on head and thorax (fig. d). Short, setaceous, 1 pair on head, pro- and mesothorax, 4 (2-5) long, ca. 1 wide.

Submedial setae on abdomen. Absent.

Simple pores (fig. e). Each comprised of a sclerotized ring opening into a membranous tubular duct, in 4 longitudinal rows, ca. 44-48, ca. 1 wide.

Derm (fig. f). Simple, membranous.

Intersegmental membrane (fig. g). Apparent due to type of derm.

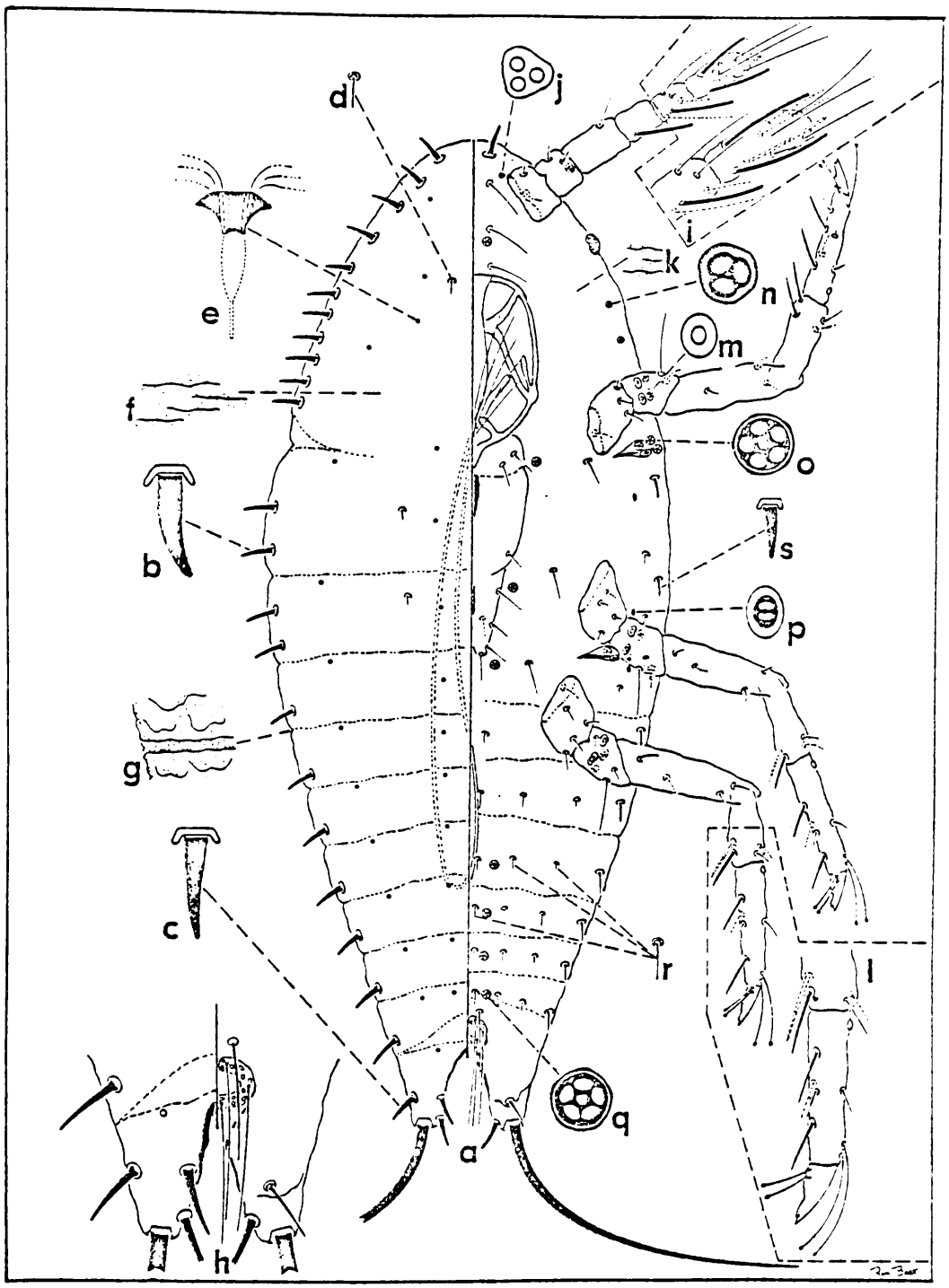

Plate 30: Physeriococcus cellulosus Borchs., first instar

Anal lobes (figs. a,h). Sclerotized. One strong seta on inner margin of each lobe 12 (11-14) long. Another at posterior end, 13 (12-14) long; apical seta 195 (166-211) long.

VENTER

Antennae (fig. i). Six segmented. Total length 124 (116-129). Scape 13 (12-14) long, 26 (23-28) wide. Segments II to VI: 17 (16-19), 33 (28-35), 15 (14-18), 19 (18-21), 27 (24-30) long respectively. Numerous slender setaceous setae on segments of antenna, fleshy setae on segments IV to VI. Sensory pore on segment II. Trilocular pore at scape base (fig. j).

Clypeolabral shield. Length 88 (81-94), width 68 (59-74).

Labium. Long, triangular, 104 (93-112) long, 49 (39-53) wide. Eight labial setae, each 14 (12-20) long.

Derm (fig. k). Simple membranous.

Legs (fig. l). See enlargement of tibia, tarsus, and claw of metathoracic leg. Four sensory pores on each trochanter (fig. n). Also a sensory pore on the proximal lateral margin of each tarsal segment. Numerous thin, setaceous setae on the different segments of each leg. Some thick setae on the tibia and tarsus of each leg. Tarsal and claw digitules extending beyond apex of claw. Claws with a denticle.

Leg Segments and Claw	Lengths Prothoracic	Lengths Mesothoracic	Lengths Metathoracic
Coxa	25 (23-28)	28 (26-33)	26 (23-28)
Trochanter	30 (23-35)	33 (30-35)	35 (31-37)
Femur	61 (58-65)	69 (67-70)	71 (70-72)
Tibia	40 (37-42)	41 (37-46)	46 (44-48)
Tarsus	59 (56-60)	62 (60-67)	68 (67-70)
Claw	15 (12-16)	15 (12-16)	14 (12-16)
Entire leg	230 (216-246)	248 (237-260)	259 (252-265)

Pores anterior to anterior spiracle (fig. n). Two triloculars along each margin.

Pores laterad of spiracle (fig. o). Each anterior spiracle with 3 quinquelocular pores. Each posterior spiracle with 1 quinquelocular pore. Anterior spiracle ca. 18 long, 9 wide, atrium 2 wide. Posterior spiracle ca. 23 long, 9 wide, atrium 2 wide.

Bilocular pores (fig. p). Located near the bases of the marginal setae. Two or 3 along each margin, ca. 2 wide.

Submedial pores on derm (fig. q). In 2 longitudinal rows. Four pairs on head and thorax, 4 pairs on abdomen, mostly quinqueloculars, occasionally triloculars.

Body setae (figs. r,s). In 8 longitudinal rows on abdomen and partly on thorax. Medial row with 6 pairs, each 11 (8-16) long; submedial row with 5 pairs, each 6 (5-12) long; submarginal row with 8 pairs, each 4 (3-7) long; marginal row with 9 pairs, similar to dorsal marginal

setae, 8 (7-12) long. All ca. 2 wide. Other longer setae near coxae and antennal scape bases. One pair of setae similar to dorsal marginal setae near scape base.

Anal lobes and ring (figs. a,h). Sclerotized. With a single submedial seta on each lobe 17 (16-19) long. Ring oval, ca. 19 long, ca. 23 wide; with ca. 22 translucent cells and 6 setae, with 30 (28-35) long. A pair setae at the anterior margin of the anal ring, each 12 (9-16) long.

Remarks. The original description contained no information on the first instar. The first instars of the Palearctic genus Physeriococcus can be separated from the 3 other genera in the Kermesidae by the absence of dorsal submedial setae on the abdominal segments and the presence of two trilocular pores anterior to each anterior spiracle.

Future studies are needed on other instars. These need to be compared with species in the genus Kermes of the Palearctic Region.

PHYLOGENY OF THE KERMESIDAE OF THE NEARCTIC REGION, BASED ON FIRST INSTARS

This phylogenetic systematic study of the Kermesidae is based on Hennig's (1965) method. Character states are designated as either plesiomorphic (ancestral) or apomorphic (derived). For a group of organisms to be considered monophyletic, its members must share certain apomorphic characters. In order for two groups of organisms to be distinct from one another, each must possess at least one apomorphic character that is plesiomorphic in the other. Both must share at least one apomorphic character.

A list of apomorphic and plesiomorphic characters is provided in Table 1. Inter-relationships were deduced and are presented in the form of a phylogenetic tree (Plate 31). The numbers between the branches, or clades, of the phylogenetic tree correspond to the numbers at the left in Table 1.

Character states that are widely distributed in the Eriococcidae and among the genera are considered plesiomorphic. Reductions in size or number of characters are considered apomorphic.

I concur with Borchsenius (1960) and Beardsley (1975) on the phylogeny of the Kermesidae. I feel that the Kermesidae in the Nearctic Region have evolved from an Eriococcid-like ancestor based on this first instar study. Four species or species groups are recognized. The Kermes pubescens group includes K. pubescens and K. iselini. The Kermes galliformis group contains K. branigani, K.

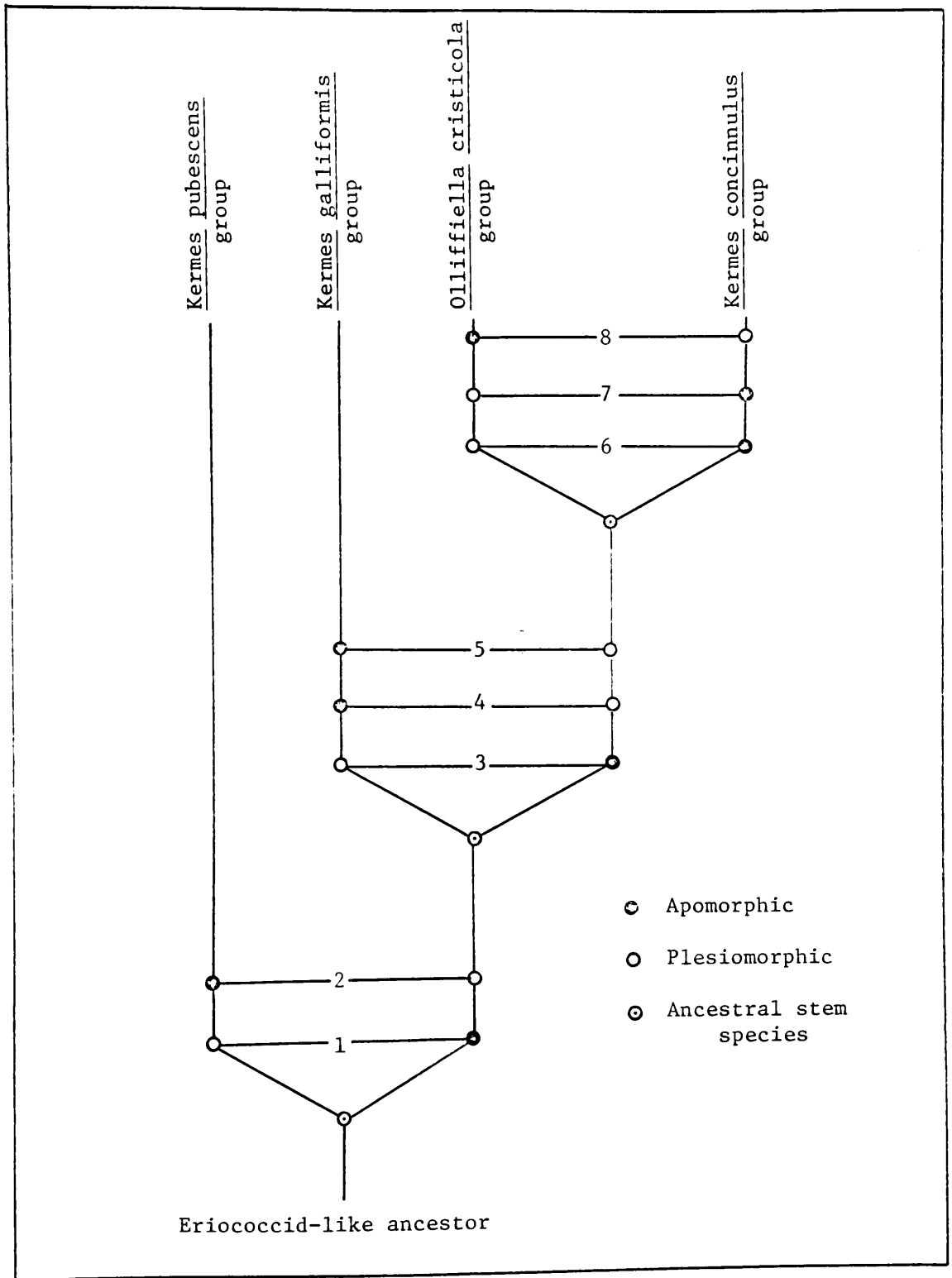

Plate 31. Phylogeny of the Kermesidae of the Nearctic Region, Based on First Instars.

Table 1. Plesiomorphic and apomorphic character states to the major groups of the Nearctic Kermesidae based on first instars.

Character	Plesiomorphic	Apomorphic
1. dorsal marginal setae	conical	setaceous
2. rows of setae on abdominal venter	8 rows	6 rows
3. type of pores on venter	trilocular	quinquelocular
4. ventral submedial seta on anal lobe	long (16-53)	short (7-25)
5. dorsal marginal setae	relatively long (19-48) or parallel sided	relatively short (8-22) and not parallel sided
6. dorsal submedial setae	undifferentiated	differentiated
7. number of pairs of setae in dorsal submedial row	12 pairs	11 pairs
8. dorsal marginal setae	undifferentiated	differentiated

galliformis, K. gillettei and K. kosztarabi. The Kermes concinnulus group includes K. cockerelli, K. concinnulus, K. shastensis and K. rimarum. The Olliffiella cristicola group is represented only by Olliffiella cristicola since material was not available for O. secunda. Balachowsky (1953), combined the morphological characters of ten first instar Kermes species from the Palearctic Region. He deduced that they belong to four clearly distinct types or groups.

Morphological groups of species can be established within the genus Kermes, indicating the possibility that new genera could be established. The type-species of the genus Kermes, Kermes roboris, a Palearctic species, has been placed in a group having long and slender dorsal marginal setae (Balachowsky, 1953). This group corresponds to the Nearctic K. concinnulus group found in this study. If new genera are proposed, they would be for the K. pubescens and K. galliformis groups and should be based on species groups found in studies on the adult males and females.

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INDEX TO HOST PLANTS

The scientific and common names and authors of many hosts were verified by Drs. John M. Tucker at the University of California, Davis, Duncan M. Porter and Leonard J. Uttal at Virginia Polytechnic Institute and State University, Blacksburg. The listing by Little (1953), was used as a secondary source. Synonym names are in quotation marks.

Fagaceae

VITA

The author was born on November 19, 1950 in Rockville Center, New York. He attended grammar school at New Hyde Park Road School and high school at New Hyde Park Memorial High School, New Hyde Park, New York. Upon graduation in 1968, he entered the State University of New York at Farmingdale and received his A.A.S. degree in Biological Science in 1970. He completed his B.S.A. degree in Entomology in 1972 and his M.S. degree in Entomology at the University of Georgia, Athens, Georgia in 1974, and began working for his Ph.D. degree in Entomology at Virginia Polytechnic Institute and State University.

A MORPHOLOGICAL AND SYSTEMATIC STUDY OF THE FIRST AND SECOND INSTARS OF THE KERMESIDAE IN THE NEARCTIC REGION (HOMOPTERA: COCCOIDEA)

by

Ronald George Baer

(ABSTRACT)

The genera Kermes Boitard and Olliffiella Cockerell are principally found on oak. Twenty-eight Nearctic Kermes species have been previously described, based primarily on the external characteristics of adult females. In addition there were three manuscript species names given by earlier authors of Kermes. The descriptions overlap considerably and no suitable keys have been prepared. These dry and old females are of little taxonomic value and cannot be slide-mounted because of their hard, sclerotized derm. First instars entrapped under or in the females, at the buds of twigs and in bark crevices were studied to determine the number of species which actually exist in the Nearctic Region.

The sex of Kermes first instars could not be determined. They were divided morphologically into three main species groups which subdivide into ten distinct species. The first group, the K. galliformis group, includes K. branigani King, K. galliformis Riley, K. gillettei Cockerell and K. kosztarabi Baer. The second group, the K. pubescens

group, contains K. iselini n. sp. and K. pubescens Bogue, while Kermes cockerelli Ehrhorn, K. concinnulus Cockerell, K. rimarum Ferris and K. shastensis Ehrhorn are included in the third or K. concinnulus group. Olliffiella cristicola Cockerell first instars can also be distinguished. The first instars of the Palearctic species Fulbrightia gallicola Ferris and Physeriococcus cellulosus Borchsenius were studied and described.

The sex of the second instars was determined. Of these, second instar females of eight Kermes species, K. branigani, K. cockerelli, K. concinnulus, K. galliformis, K. gillettei, K. iselini, K. pubescens, K. rimarum; second instar males of four species, K. cockerelli, K. concinnulus, K. galliformis and K. rimarum; and the second instar female of Olliffiella secunda Ferris were included in this study.

Materials and methods used, descriptions, illustrations, and keys are included for the available first and second instars based on their external morphology. Synonyms are listed under each species. Phylogenetic inter-relationships were determined using Hennig's (1965) method. An index to host plants by common and scientific names is included.