TAXONOMY OF THE SCALE INSECTS OF OKLAHOMA

(HOMOPTERA: COCCOIDEA)

By

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PREFACE

Scale insects constitute an important group of phytophagous parasites. Unfortunately, the average entomologist shuns them because of their small size and the difficulty in identification. Considering the wide range of plants attacked in the state and the difficulty in obtaining adequate chemical control, a taxonomic study of the species found in Oklahoma appeared to be basic to control investigations.

The purpose of this study is to present in one paper, keys, descriptions, and host plant relationships of scale insects found in Oklahoma.

Most of the species identifications were verified by Dr. Harold Morrison, of the U.S. National Museum in Washington, D. C.; and Howard L. McKenzie or Richard L. Wilkey, of the California State Department of Agriculture, Sacramento, Calif.

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A. C. A.

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CHAPTER I

INTRODUCTION

Scale insects constitute an important group of plant parasites and are of considerable economic importance in Oklahoma. The amount of authentic information on this group of insects in Oklahoma is limited. Various individuals and agricultural agencies have been sending samples of scale insect infested material to the Oklahoma State University Entomology department for identification. Reliable diagnosis was difficult and time consuming, thus the need for a taxonomic study of scale insects was deemed necessary. The writer became interested in this group during the summer of 1957 when he collected and mounted insect specimens for the department collection. Because of the needs expressed above, a taxonomic study of representatives of the superfamily in the state was undertaken as a doctoral dissertation.

This study is based on specimens examined by the writer from collections made in Oklahoma during a two-year period from June 1957 to June 1959. They were taken from greenhouses, fruit markets, nurseries, orchards, and perennial outdoor plants.

The writer followed the taxonomy and nomenclature system as proposed by G. F. Ferris. An attempt was also made to use a standard in referring to the wide ranges of colors in order to make the descriptions of the various species more reliable. The "Dictionary of Color" (Maerz and Paul, 1930) was used as a source of color terminology.

CHAPTER II

EARLY RECORDS OF SCALE INSECTS IN OKLAHOMA

The early records of scale insects refer almost entirely to the San Jose scale, Quadraspidiotus perniciosus (Comstock). There appears to be confusion as to when the above species was first officially reported.

Bogue (1898) stated that this species was first found in Oklahoma in June 1897, in an apple and peach orchard owned by W. T. Harness in Lexington.

Wilcox (1901) mentioned that a few fruit growers reported finding the San Jose scale in various counties in 1901.

Marlatt (1906) stated that the Bureau of Entomology was sent the first specimens of this insect taken from a Japanese plum collected from Mulhall in 1904. More were collected from peach at Stillwater and El Reno in 1905.

The first record concerning this insect in Oklahoma, according to Painter (1916), was on a Japanese plum at Mulhall on March 29, 1904.

Lovett (1907-1908) proclaimed that the San Jose scale and the new peach scale, ? Diaspis perniciosus (Cockerell), were injurious.

Nicholson (1908) found the San Jose scale in the following localities: Shawnee, Yukon, McLoud, El Reno, Mulhall, Warwick, Norman, and Wagoner.

Sanborn (1912) considered the San Jose scale to be the most injurious fruit-tree insect in the state.

The earliest record of another species, Kermes boguei Cockerell on Quercus alba, was collected by Bogue ten miles from Stillwater, and was

described by Cockerell (1897).

From 1916 to 1940 scale insects were mentioned only in publications where general insect control recommendations were given.

Fenton (1940) published a paper which dealt with the description and control of the European fruit lecanium, Lecanium corni Bouché.

At the present time, there are two major sources of information relative to the distribution of scale insects in the state. One is a limited check list at the United States National Museum which records the distribution based on specimens sent to Washington for identification and on literature citations. The other concerns records and specimens in the Department of Entomology, Oklahoma State University.

CHAPTER III

HISTORICAL RELATIONS OF SCALE INSECTS TO MAN

Ferris (1957) stated that insects first attracted the attention of mankind long before they were specifically recognized as enemies of vegetation.

Clausen (1954) stated that the ancient Phoenicians (1600 B. C.) were probably the first to discover that certain scale insects could be used as a basic ingredient of dyes. In Palestine these were first known as "Zehori." The Arabs learned of these insects from Persia and Armenia under the name of "Kermes" or "Alkermes." Leggett (1944), in discussing the etymology of the name, "Kermes," arrived at the following synonomy: "Krimija" from the Sanskrit, "Qirmiz" from the Arabic, and "Krmi" from the ancient Persians. The aforementioned names mean "worm-begotten."

Bruce (1958) gave an interesting account regarding the discussion in the New Testament relating to the use of scale insects for use in dyes. Rollin (1834) described the use of dyes from the time of Pliny the Elder (23-79 A. D.) through the time of Pausanias, a Greek traveler and geographer of the second century A. D. The dye produced from cochineal scale insects in Mexico and South American countries was discussed in detail by Bühler (1948) and Skinner (1949). The importance of the dye to the Spanish Empire was well illustrated in a book, published in 1588 by a Jesuit father, Joseph de Acosta, called "Natural and Moral History of the Indies." Weiss (1936) reviewed this book which dealt with the political and economic importance of the cochineal insect to Spain. With the appearance of synthetic dyes, dyes from a biological source have practically disappeared.

Borror and De Long (1957) stated that females of the tamarisk scale, Trabutina mannipara (Ehrenberg) which feeds on plants of the genus Tararix, excrete large quantities of honeydew. In arid regions the honeydew solidifies on the leaves and accumulates in thick layers to form a sweet, sugar-like material called manna. The tamarisk manna scale may have supplied the food for the Israelites in their trip through the wilderness about 1100 B. C. Bruce (1958) gave an interesting account of the use of manna during Old Testament days. Mann (1948) stated that in some parts of the world scale insects infest sugar cane and excrete the exudation in such copious quantities that bees use it for honey. One of our Pure Food and Drug laws requires that confections made of this product be labeled, "Made from honeydew," whereas confections made from honey are labeled, "Made from honey."

Essig (1931), in his discussion of some of the uses to which scale insects have been employed, mentions the oak wax scale, Cerococcus quercus Comstock, which secretes thick globular masses of bright yellow wax, which he claims to have been used as chewing gum by Indians. This insect occurs in the semi-arid regions of southern California and in Arizona.

Apparently the earliest known useful species was the lac insect and it remains today as the only one whose secretions are still used in industry. Comstock (1947) stated that the lac insect is Tachardia lacca. The word, lac, is derived from the Sanskrit "laksha" and is the same as the Hindu "lakh" meaning "one hundred thousand," a descriptive term denoting the countless numbers of insects (Encyclopædia Britannica 1956). It is a product of the East Indies, Bengal, Siam, and Assam, and is produced by the insect on a number of trees, particularly Ficus religiosa Linnaeus, a fig. The stick-lac of commerce, from which shell-lac or shellac is prepared, is a resinous substance secreted by this scale insect, which lives on the young branches of numerous tropical trees. Most of the trees belong

to the genus Ficus. Lac is the basic ingredient of an amazing list of articles: stiffening agents in the toes and soles of shoes, and in felt, fur, and composition hats; shoe polishes; artificial fruits and flowers; lithographic ink; electric insulation; protective coverings for wood, paper, metal, fabric, wax emulsions, wood fillers, sealing wax and buttons; glazes on confections; coffee bean burnishing; paints; cements and adhesives; phonographic records; playing card finishes; dental plates; pyrotechnics; foundry work and hair dyes, and enteric coated tablets used in medicine (Clausen 1954). India and Burma produce over 90 per cent of the world's supply of lac. The annual crop of lac in these two countries is about 64,000,000 pounds valued in excess of $20,000,000.

Scale insects are also of great economic importance because of the injuries produced on growing plants. They subsist upon the sap which they obtain by means of their piercing-sucking mouth parts. In addition to devitalizing the plant, McKenzie (1956) stated that injury is often aggravated by toxic enzymes in the saliva of certain species which are introduced into the plant. These enzymes are at times responsible for chlorophyll removal resulting in the discoloration of leaves as well as malformations and other growth abnormalities of plant tissue.

Slingerland and Crosby (1924) stated that orchard fruits are lowered in market value by the San Jose scale because the insect is often clustered around the stem and blossom end of the fruit. At times a pitted appearance is caused by the lesions produced by the insect on the fruit. Their presence may also cause defoliation. Premature leaf fall interferes with food manufacture and the normal physiology of the host. Various factors determine the severity of the pathogenicity: the relative number of parasites, the insect species involved, the vigor of the host, and other factors.

The San Jose scale was first recorded in this country at San Jose, California, in 1870. At the turn of the century, the mere mention of such species as the San Jose scale and the oystershell scale to most growers was enough to cause extreme alarm since trees and shrubs were severely injured and even killed by them (Dietz and Morrison, 1916). The importance of the San Jose scale was vividly illustrated by the fact that a total of 214 papers was written on the species up to 1903 (Fernald, 1903).

Rhodes-grass, Chloris gayana Kunth, the chief pasture grass in the South Texas area, was literally destroyed by the Rhodes-grass scale, Antonina graminis (Maskell) in 1949 according to Wood (1955). He stated that the problem was considered serious enough for the Entomology Research Division of the United States Department of Agriculture to initiate an extensive research program into the life history and control of the insect in 1949.

Quayle (1938) stressed the role of scale insects in the citrus industry by ranking them first in the list of serious pests in the major citrus-growing areas of the world.

Certain "soft" scale insects excrete honeydew which in turn encourages the occurrence of other insects and molds on the host. The presence of honeydew on a fruit lowers its market quality.

The California red scale, Aonidiella aurantii (Maskell), is one of the most important pests of citrus fruits throughout the world according to McKeown (1942). In Australia the annual loss to citrus growers by this insect amounts to many thousands of pounds in monetary value. In California it caused an estimated crop loss of $3,400,000 in 1956 to citrus in seven counties of California (Osborn, 1957). Infestations of the San Jose scale in commercial plantings for nine counties of California caused an estimated crop loss of $700,387. The olive scale caused an estimated crop loss of $450,000 to deciduous fruits and olives in six counties. Much of the

damage done is of a gradual and insidious nature and cannot be measured as in many other cases of parasitism, causing the total losses due to scale insects to be greater than the usual loss estimates.

CHAPTER IV

METHODS

Collection

Scale insects occur on perennial plants, including grasses. They may attack any part of the plant, including the leaves, twigs, fruit, branches, crown, and roots. The writer collected from outdoor plants as well as from plants in greenhouses, nurseries, and various other indoor localities. In the initial phase of this project, area sampling was attempted and scale insects regardless of the species of host plants were collected. The method appeared to be somewhat erratic and time consuming, for the benefits derived, and was therefore abandoned.

A satisfactory method was to become familiar with the host-plant associations. After familiarization with the insect species involved, their appearance, and their preferred hosts, collecting proceeded in a more satisfactory manner.

Collecting equipment consisted of a sharp knife, pruning shears, a hand lens, and paper bags. In most cases the outside of the bag was marked to indicate host, locality, date, and collector. In some cases the data were recorded on a slip of paper and inserted in the bag.

In some cases collecting was aided by "indicators," such as the presence of ants on plants. At times, a scabby appearance of a twig enabled the writer to determine where there was a heavily infested area of scale insects. Sometimes, an abnormal coloration could be used as indication of the presence of scale insects, particularly where there were white areas on leaves.

The specimens, when collected, were allowed to remain on their hosts and kept under dry conditions. In most cases they were transferred to envelopes and assigned a number. In a few cases the insects, in situ, were placed directly in riker mounts. In no case were specimens placed in liquid preservatives, because of resulting distortion and "clouding" of the insects.

Mounting Methods

The technique involved in mounting these insects is quite intricate and similar to that required for histological preparations. Only the sclerotized parts of the body are required in the completed mount; therefore, it is essential to eliminate the external secretions as well as the internal organs and tissues.

The steps in the process were as follows:

1. Transferred the specimens into a 10 per cent solution of KOH for 24 hours.
2. Transferred the specimens into distilled water for 24 hours, after puncturing the anterior end of the insect with a fine dissecting needle and gently pressing the body to remove all internal parts.
3. One to two changes of distilled water were used for cleaning, depending on the size of the specimen.
4. Transferred the insects into a 1 per cent solution of basic fuchsin alcoholic solution*, and left overnight or preferably for 24 hours.
5. Placed the specimens into a 50-50 mixture of creosote-xylol for clearing, where they remained until they were mounted.
6. Transferred to Canada balsam on a slide and covered with a slip.

* 1 gram basic fuchsin to 100 ml. of 95 per cent ethyl alcohol.

Actually, the size, shape, and color of the specimens determines the length of time the specimens remain in the respective solutions.

Rapid techniques may be employed for making temporary microscopic mounts, as follows:

1. Transfer specimens into a hot 10 per cent solution of KOH for 3 minutes, transfer to distilled water, add a drop of 3 per cent iodine solution and examine.
2. Place the specimen directly into a water medium, tease out the body contents, transfer to a slide, add Hoyer's medium and examine.
3. In some cases where it is desired to examine gross features, the insect may be placed directly into a drop of water on a slide and examined.

CHAPTER V

DISCUSSION OF DIAGNOSTIC CHARACTERS

DIASPIDIDAE

The writer has used the characters and terms as presented by Professor G. F. Ferris (1942, 1950) except where noted.

Scale Covering

The scale covering refers to the combined first and second exuviae and the secretion of the diaspidids which form the dorsal and ventral coverings of the insect. The shape of the scale covering, the relative position of the exuviae, and the color aid in diagnosis of the species.

Prosoma

The prosoma is the area comprising the head and thorax of the adult and immature female.

Segmentation of the Body

The degree of segmentation varies considerably; in some cases the fusion of the segments or lack of fusion aids in identification.

Antennae

The length of the antennae, the number and shape of the segments, and the setal number are used in identification. In the diaspidids the setal number on the rudimentary antennae are of value.

Setae

Apparently, setae have played a minor role in specific diagnosis, but they are of value in the composite of characters for diagnosis. The number, size, and position assume a significant role.

Perivulvar Pores

The pores are part of the basic structure of the diaspidids. They are named according to their relative position to the vulva. The median pores are just anterior to the vulva. The anterior lateral pores are just posterior and lateral to the median group. The posterior laterals are posterior to the anterior laterals and closest to the apex of the pygidium. The presence or absence of the pores, the relative number in a group, and their position all are of value in the composite of characters of the species. Green (1896-1922), in a study of the coccids of Ceylon, stated that all the species he studied which possessed perivulvar pores were oviparous. This has been verified by the writer with the one exception of a single specimen of the Florida red scale which had embryos within the body cavity. This single exception in this series, however, would not influence the rule, since the other specimens of the series were oviparous. This is the only record in the literature of a viviparous specimen of the Florida red scale.

Types of Ducts

The wax which is secreted passes through tubular ducts. The outer end of the duct is open, through which the wax is discharged. The inner ends are closed but have minute extensions which apparently lead to gland cells. The size, the number, the arrangement, and the location of tubular ducts are determinant characters. The ducts are further classified into one-barred ducts which have a horizontal, heavily sclerotized band at the

inner end; and two-barred ducts which have two horizontal bands at the inner end.

Pygidial Lobes

The pygidial lobes are on the lateral margins of the pygidium; the lobes are flattened and are sclerotized processes. The number, size, shape, and indentures form one of the most valuable specific diagnostic features.

Plates

Plates are marginal pygidial structures that usually appear as hyaline processes. When the plates are conical and elongated, they are called gland spines, but when the gland spines are short, swollen basally, and sclerotized, they are called gland tubercles. The plates form a useful character in identification.

Paraphyses

Paraphyses are conspicuous sclerotic structures along the margin of the pygidium and enter strongly into the very important pygidial fringe diagnostic structures. At times, paraphyses are found in the pygidial region but not on the fringe.

Dorsal Pygidial Scars

Dorsal pygidial scars consist of a series of sclerotized areas which are surface indications of phragmata for the attachment of muscles, and are of secondary importance.

Anus

The anus is always located on the dorsum of the pygidium. At times, there is a sclerotized ring around it. In the armored scale insects, the ring is never septate.

Anus to Vulva Relationship

Very few specialists stress the importance of the relative position of the anus to the vulva. Green (1896-1922) considered it important enough to use in his keys. The writer considers this relationship important particularly in separating two closely related species.

SOFT SCALE INSECTS

Anal Ring

The anal ring is septate in soft scale insects and bears relatively long setae. The length and number of anal setae aid in identification but lose significance in closely related species.

Dorsal Ostioles

Dorsal ostioles are slit-like openings which sometimes have a raised area around each opening. The presence or the absence of a dorsal ostiole is a very important character in this group. The anterior pair is on the head, and the posterior pair is on the seventh abdominal segment. Zimmerman (1948) suggested that the substance extruded through these openings is the body fluid itself, and not a specialized secretion.

Circulus

The circulus is a sclerotized ring on the ventral side of the abdomen, between the third and fourth segment. The structure is a good specific character.

Setae

The dorsal setae are of some generic significance and at times are specifically distinct.

Ducts and Pores

As many as five or six types of ducts and pores may appear in a single species. The nature and distribution of these are exceedingly specific.

Triocular Pores

The triocular pores vary considerably in location and in form and are more prevalent in mealybugs. Despite the variation, this type of pore aids in a composite diagnosis only.

Multilocular Disc Pores

Multilocular disc pores occur chiefly on the ventral part of the abdomen and anterior to the vulva. In some cases the pores are on the dorsum. The arrangement and distribution are frequently used in taxonomy.

Quinquelocular Pores

The quinquelocular pores are frequently found on the ventral part of the thorax and also on the head. They may aid in identification of species.

Cerarii

The cerarii consist of clusters of pores and setae along the lateral margins of the body. The number and character of these structures are among the most important taxonomically.

CHAPTER VI

BIOLOGY

In the case of the Coccoidea, MacGillivray (1921) stated that the sexual dimorphism was greater in many of the species of insects than of other families or orders.

Armored Scale Insects--Diaspididae

The armored scale insects possess a scale covering which can be separated from the body. The newly hatched, first instar (crawler) insect is usually oval in outline, much flattened, has six legs, a pair of antennae, and a well developed piercing-sucking apparatus. After wandering about for a time, this stage inserts its beak into the plant from which it draws nourishment. McKenzie (1956) stated that, if a suitable feeding place is not found within a few hours, they perish during this stage. If they succeed in attaching themselves, fine, cottony, threads of wax are secreted. The secretion process continues until the insect is completely enclosed. Later the crawler secretes a pellicle which is very thin but dense and firm in texture.

The first molt soon follows in which the legs, antennae, and anal filaments are lost, and the resulting second instar assumes a stationary position. The mouth parts, however, remain in a highly developed condition. Not only do the stylets serve to draw nourishment from the plant, but they also provide a means of attachment to the plant. Ebeling (1949)

stated that after the first molt there is a degree of distinction between the sexes, since immature males are more elongated than the females. Later the females molt a second time to become adults. The males, however, undergo further metamorphosis involving five instars, to develop into two-winged adults. Shortly after emerging, the adult males mate with the females and die. After fertilization the adult females increase in size very rapidly and either begin to lay eggs or bear living young.

The number of generations in different species may vary from one to six depending on the climate or locality. The winter is spent in either the egg, immature or adult stages, or in all three stages. During the warmer seasons much overlapping of the broods appears, and all stages may be evident at one time.

Unarmored Scale Insects--Soft Scale Insects

The soft scale insects do not possess a scale covering which is deciduous and can be separated from the body of the insect. The bodies of the earlier instars are relatively soft; but the mature females may possess a derm which, together with its waxy secretions, may be quite rigid. Antennae and legs are usually retained after the first instar as contrasted with female armored insects, in which antennae and legs are absent. Most soft scale insects are active in all stages; a few are sessile as adults.

The remainder of the life cycle is similar to that of the armored group.

Feeding

Males have non-functional vestigial mouth parts and are unable to feed during the few days of their adult existence. Among the females, a few species have the faculty of withdrawing the beak at will and moving

around on the plant. The majority of females, however, become so securely anchored that they remain sessile for the remainder of their existence.

Parasites

Parasites, at times, are quite effective in controlling local outbreaks of various species of scale insects. Certain species are quite susceptible to parasitism.

Ebeling (1950) listed over 80 hymenopterous parasites of the black scale, Saissetia oleae (Bernard). The genus Coccophagus is the most prevalent of the parasites.

Quayle (1938) listed about 84 species of hymenopterous parasites which parasitize scale insects of citrus and subtropical fruits.

Predators

Predators are also quite important in control of scale insects and at times have saved an entire crop from being eliminated.

Balachowsky (1932) listed three species of lepidopterous larvae belonging to the family Noctuidae, which are oophagous on certain soft scale insects. Quayle (1938) stated that as early as 1906 it was known that at least 64 species of birds eat scale insects. Quayle also listed 15 species of coccinellids, which are predacious on scale insects attacking citrus and other subtropical fruits.

A classical example of biological control using a coccinellid was the importation from Australia of Rodolia cardinalis (Mulsant), to control the cottony cushion scale, Icerya purchasi Maskell, a pest of citrus in California.

Dissemination

Merrill (1953) stated that the movement of infested nursery stock is largely responsible for the widespread dissemination of scale insects.

To a lesser extent the insects may be disseminated in the crawler stage by man, animals, birds, ants, and even wind currents. All stages of scale insects may be widely scattered by means of infested host plants carried by flood waters.

CHAPTER VII

THE SYSTEMATIC POSITION OF THE COCCOIDEA

The scale insects were placed by Linnaeus (1758) in the order Hemiptera. He listed 17 Coccus species. Fabricius (1776) listed six coccids. From the time of Linnaeus to the appearance of Signoret's and Targioni-Tozzetti's publications in 1868, practically no work was done on the classification of scale insects. Fallén in 1814 erected the term "Coccides" to refer to scale insects. Leach in 1815 also used the term "Coccides." In 1819 Stephens established the family name of Coccidae. Handlirsch in 1903 first proposed the superfamily Coccoidea. Targioni-Tozzetti (1868) recognized four groups in the Coccides: Orthezites, Coccites, Lecanites, and Diaspites. Signoret (1868) recognized four sections: Diaspites, Brachyscelides, Lecanides, and Coccides. Comstock (1881) accepted Signoret's sections, but he ranked the sections as subfamilies. Maskell (1887) divided the Coccidae into four subfamilies as Comstock had done, but he substituted Hemicoccidinae for Brachyscelidinae.

Cockerell (1896) revised the family and designated ten subfamilies as follows: Monophlebinae, Porphyrophorinae, Coccinae, Hemicoccinae, Orthezinae, Asterolecaniinae, Brachyscelinae, Idiococcinae, Lecaniinae, and Diaspinae. Berlese and Leonardi (1898) recognized eight tribes but gave them subfamily suffixes. They discarded Cockerell's subfamilies, Brachyscelinae and Idiococcinae. Green (1896) arranged the Ceylonese coccids into 11

subfamilies somewhat similar to the arrangement of Cockerell, but he deleted Porphyrophorinae, Asterolecaniinae, and added Conchaspinae, Dactylopiinae, and Tachardiinae. In a later work Green (1909) added the subfamily Asterolecaniinae and placed it between Dactylopiinae and Tachardiinae. Cockerell (1899) revised his ten subfamilies of 1896 to a total of eight. This list deleted Porphyropherinae, Hemicoccinae, Asterolecaniinae, Brachyscelinae, and Idiococcinae. He added Margarodinae, Conchaspinae, and Tachardiinae. Newstead (1901) adopted the subfamilies of Green, but added Margarodinae. Mrs. Fernald (1903), in her "Catalogue of the Coccidae of the World," listed nine subfamilies which were similar to that of Cockerell except that the following subfamilies were included: Phenacoleachiinae and Dactylopiinae. The subfamily Lecaniinae of Cockerell was not used.

MacGillivray (1921) divided the Coccidae into a striking array of 17 subfamilies as follows: Monophlebinae, Kuwaniinae, Xylococcinae, Margarodinae, Callapappinae, Coccinae, Ortheziinae, Phenacoleachiinae, Briococcinae, Tachardiinae, Lecaniinae, Kermesiinae, Asterolecaniinae, Apiomorphinae, Cylindrococcinae, Conchaspinae, and Diaspidini. Ferris (1937-1955), in his Atlas of scale insects, used the superfamily Coccoidea and divided the superfamily into 11 families as follows: Margarodidae, Ortheziidae, Lacciferidae, Kermidae, Dactylopiidae, Pseudococcidae, Acleridae, Asterolecaniidae, Coccidae, Conchaspidae, and Diaspididae. The classification of Ferris is used in the present work. Silvestri (1939) separated the Coccoidea into two large subfamilies: Ortheziinae and Coccinae. Balachowski (1942) startled his fellow workers by proposing that the Coccoidea be divided into three large "phyla" based on the adult males. Figueroa (1956) stated that a concensus of the workers has accepted, although some of them with reservations, the following 15 families which follow the Ferris system but with the following exceptions: Kermidae is changed to read Kermesidae and Stictococcidae,

Phenacoleachidae, Apiomorphidae, and Cylindrococcidae are added.

In addition to these, certain workers have specialized in the taxonomy of certain groups. Chamberlin (1923) published a monograph on the Tachardinae. Stickney (1934) made a detailed study on the Ortheziidae and Margarodidae. McConnell (1953) and McKenzie (1956) published comprehensive contributions on the coccid family Acleridae, and the Diaspididae of California, respectively. Ezzat and McConnell (1956) made an exhaustive study of the tribe Planococcini of the Pseudococcidae.

CHAPTER VIII

KEY TO THE OKLAHOMA FAMILIES OF THE SUPERFAMILY COCCOIDEA

1 Adult female without a pygidium or a waxy scale covering 2

Abdomen of adult female terminating in a compound segment, the pygidium; all stages except the newly hatched young hidden and and protected by a waxy scale covering readily separated from the insect; adult female flat, small, antennae and legs wanting . . . . . .Diaspididae (p. 25)

2 (1) Dorsal ostioles present or absent; cerarii; internally truncated dorsal ducts present . . . . . .Pseudococcidae (p. 78)

Dorsal ostioles absent; dorsal ducts not internally truncate. . . . 3

3 (2) Anal opening covered by a pair of plates which form an operculum . . . . . .Coccidae (p.64)

Anal opening without such plates 4

4 (3) Lateral margin of body with numerous 8-shaped wax gland pores . . . . . .Asterolecaniidae (p. 62)

Lateral margin of body without well-developed, 8-shaped pores; anal opening without a setigerous ring; minute ducts, each arising from the center of a cluster of sessile pores . . . . Dactylopiidae (p. 74)

CHAPTER IX

FAMILY DIASPIDIDAE MASKELL, 1878.

The diaspidids are also called the armored scale insects. The antennae, in all stages except the first instar, consists of an unsegmented tubercle. Legs in all stages but the first instar are lacking. Terminal segments of the pygidium are fused to form a compound structure, the pygidium. No setal-bearing ring surrounding the anus. Body of adult female covered by a scale covering composed of secreted wax and of exuviae.

This family is represented in Oklahoma by nineteen genera and thirty-two species.

Key to the Diaspididae (Armored scale insects)

Genera from Oklahoma

1 Without branched plates on the margins of any of the segments anterior to the pygidium 2

With branched plates on some of the segments anterior to the pygidium; two-barred ducts; median lobes not basally yoked. . Parlatoria (p. 53)

2 (1) Without plates between the median lobes; perivulvar pores present except in Rhizaspidiotus. 3

With plates between the median lobes; perivulvar pores present or absent. 12

3 (2) Median lobes appearing to be sunken in the body, strongly divergent, leaving distinct notch on median line. . Phenacaspis (p. 54)

Median lobes not sunken into the body, not strongly divergent . . . 4

4 (3) Median lobes with their inner margins touching throughout their length; outer margin thrice notched. . . . . .Pinnaspis (p. 55)

Median lobes with their inner margins not touching throughout their length 5

5 (4)Median lobes project from body for their whole length . . . . . .Chionaspis (p. 34)

Median lobes do not project from their body for their whole length 6

6 (5) Macroducts one-barred; median and second lobes well developed, apically rounded, converge slightly. . . . . Quadraspidiotus (p. 56)

Median and second lobes, with their axes parallel. 7

7 (6) Second lobe never developed more than a mere point; anal opening well toward apex of pygidium . . . . . .Diaspidiotus (p. 39)

Second lobe well developed 8

8 (7) Paraphyses of pygidial fringe present beyond the third lobe. . . . . .Melanaspis (p. 52)

Paraphyses of pygidial fringe not present beyond the third lobe. . 9

9 (8) Prosoma swollen, quadrate, sides of postsoma roughly parallel. . . . . .Aulacaspis (p. 31)

Prosoma not swollen, not quadrate, sides of postsoma not parallel 10

10 (9) Antennae conical and close together at apex of head . . . . . .Fiorinia (p. 43)

Antennae not conical or close together, not located at apex of head. 11

11 (10) Three pairs of pygidial lobes present, third pair resembles second pair; dorsal pygidial ducts scattered irregularly; anus

anterior to vulva. . . . . .Unaspis (p. 60)

As above, but anus posterior to vulva. . . . . .Diaspis (p. 41)

12 (2) Perivulvar pores absent; host is Juniper . . . . .Aonidia (p. 29)

Perivulvar pores present except in

. . . . . Quadraspidiotus perniciosus (p. 57) 13

13 (12) Pygidium broad at base; elongate and tapering to an acute apex; three pairs of small lobes present; small plates; small paraphyses . . . . . Acutaspis (p. 28)

Pygidium short and broad not tapering to an acute apex; pygidial lobes and plates well developed 14

14 (13) Body at least as wide as long; dorsal ducts do not extend caphalad beyond pygidial base 15

Body distinctly longer than broad; in some the dorsal ducts extend cephalad beyond pygidial base . . . . . Chrysomphalus (p. 37)

15 (14) Median group of perivulvar pores absent; multilocular disc pores absent. . . . . .Aspidiotus (p. 30)

Median group of perivulvar pores present; multilocular disc pores present 16

16 (15) Antennae two-bristled; dorsal ducts arranged in definite rows; body elongate. . . . . .Lepidosaphes (p. 48)

Antennae not two-bristled; dorsal ducts arranged in definite rows 17

17 (16) Just one multilocular disc pore present . . .Carulaspis (p. 32)

More than one multilocular disc pore present 18

18 (17) Diameter of anal opening about equal to length of a median lobe. . . . . .Hemiberlesia (p. 46)

Genus Acutaspis Ferris, 1941.

Genotype: Aspidiotus perseae Comstock, 1881. U. S. Dept. Agr. Commr. Agr. Rpt. p. 276, 349.

This genus is represented by one species which serves as a basis for the description.

Acutaspis albopicta (Cockerell)

Plate II

Albopicta scale

Aspidiotus albopictus Cockerell, 1898. Ann. Mag. Nat. Hist. 7 (1): 433.

Aspidiotus koebelei Townsend and Cockerell, 1898. Jour. N. Y. Ent. Soc., 6: 179.

Chrysomphalus albopictus (Cockerell, 1898). Fernald, 1903, Cat. of Coccidae, p. 285.

Chrysomphalus koebelei (Townsend and Cockerell, 1898), Fernald, 1903, Cat. of Coccidae, p. 291.

Insaspidiotus albopictus (Cockerell, 1898). McKenzie, 1939, Microentomology, 4 (2): 53.

Acutaspis albopicta (Cockerell, 1898). Ferris, 1941, Atlas of Scale Insects, Ser. III: 330.

Microscopic characters: Pygidium long acute-shaped pygidium; long narrow paraphyses; median group of pores absent; multilocular disc pores absent.

Field characters: Adult female scale covering circular to slightly oval; color spanish raison to slag (dark brown); exuviae toward one end.

The male scale covering is smaller, more elongate, and similar in color to the female.

Hosts and distribution: The specimens were taken from the foliage of Magnolia sp. indoors, in Oklahoma County.

Genus Aonidia Targioni, 1868.

Genotype: Aonidia purpurea Targioni, 1868. Soc. Ital. Di Sci. Nat. Atti. II: 694-738.

The genus is represented by one species, and the description is given under the species.

Aonidia shastae (Coleman)

Plate III

Redwood scale

Aspidiotus coniferarum shastae Coleman, 1903. Jour. N. Y. Ent. Soc. 11: 67.

Aonidia juniperi Marlatt, 1908. U. S. Dept. Agr. Tech. Ser. 16 (2): 24.

Cryptaspidiotus shastae (Coleman, 1903). Ferris, 1920. Stanford Univ. Publ. Biol. Sci., 1 (1): 55.

Gonaspidiotus shastae (Coleman, 1903). MacGillivray, 1921, The Coccidae, p. 432.

Aonidia shastae(Coleman, 1903). Ferris, 1938. Atlas of Scale Insects, Ser. 11: 177.

Microscopic characters: Perivulvar pores lacking; multilocular disc pores absent; very little evidence of body segmentation.

Field characters: On juniper; adult female scale covering is broadly oval outline and slightly convex; color slate gray in unrubbed coverings

and in rubbed specimens the exuviae is ponce de leon to rufous in color (yellow-orange). The male covering is oval, smaller in size, and similar in color to the female.

Hosts and distribution: Foliage of Juniperus virginiana (Red cedar) from Murray, Oklahoma, and Payne Counties.

Genus Aspidiotus Bouché, 1833.

Genotype: Aspidiotus nerii Bouché, 1833. Naturgeschichteder Schadlichen und Nutzlichen Garteninsekten. Berlin, Cinolai, p. 176.

The genus is represented in the state by one species, and this serves as the hosts for the description.

Aspidiotus spinosus Comstock, 1883.

Plate IV

Spinose scale

Aspidiotus spinosus Comstock, 1883. 2d Rpt. Dept. Ent. Cornell Univ., 2, p. 70.

Aspidistus (typographical error) persearum Cockerell, 1898. Entomologist, 31: 340.

Aspidiotus persearum (Cockerell, 1898). MacGillivray, 1921, The Coccidae, p. 403.

Microscopic characters: Median group of perivulvar pores absent; no multilocular disc pores; long, slender dorsal ducts; anal opening small and located near the bases of the median lobes.

Field characters: Adult female scale covering circular and slightly convex; color varies from seabird (gray) to whippet (light brown); exuviae central. Male scale covering smaller, oval, similar in color to female.

Hosts and distribution: The specimens were obtained from the foliage of Ilex sp. (Holly) in a nursery in Tulsa County.

Genus Aulacaspis Cockerell, 1896.

Genotype: Aspidiotus rosae Bouché, 1834. Naturgeschichte des Insecten: 14.

The genus is represented by one species in the state.

Aulacaspis rosae (Bouché)

Plate V

Rose scale

Aspidiotus rosae Bouché, 1834. Naturgeschichte des Inseckten, p. 14.

Diaspis rosae (Bouché, 1849). Signoret, 1869, Ann. Soc. Ent. Fr., Ser. 4: 9, 44.

Aulacaspis rosae (Bouché, 1834). Cockerell, 1896, Bul. Bot. Dept. Jamaica, 3, p. 259.

Microscopic characters: Prosoma swollen and exceeds postsoma in width; prosoma angular in form; dorsal ducts arranged in orderly rows; large cluster of multilocular disc pores on outer margin of anterior spiracle.

Field characters: The specimens were obtained from slide mounts in the O. S. U. department collection. The field characters are from Lawson (1917): female scale covering circular to oval, rather thin, and slightly convex; exuviae marginal or submarginal; color white, sometimes dirty white; exuviae dull yellow brown. Male scale covering elongate, narrow, parallel-sided, distinctly tricarinate; exuvia terminal; color brown.

Hosts and distribution: Rosa sp. (Rose), from a twig in Payne County.

Genus Carulaspis MacGillivray, 1921.

Genotype: Aspidiotus juniperi Bouché, 1851. Stettin Ent. Ztg. 12: 110-112.

Microscopic characters: Five groups of perivulvar pores; one multilocular disc pore present; two-barred wax ducts; one pair of small gland spines between the median lobes; two prominent pairs of median lobes.

Field characters: Female scale covering parchment white (white) in color; exuviae subcentral. Male scale covering similar in color to the female; elongate; felted; exuvia terminal; host is Juniperus sp.

Notes: This genus is represented by two species in Oklahoma. They may be separated by the following key:

Key to the Species of Carulaspis from Oklahoma

1 Marginal pygidial macroduct present between median lobes . . . . . .visci (p. 33)

Margin pygidial macroduct not present between median lobes . . . . . minima (p. 32)

Carulaspis minima (Targioni)

Plate VI

Minute cypress scale

Diaspis minima Targioni, 1869. Cat. cocc. Ital., p. 43.

Carulaspis minima (Targioni, 1869). Balachowsky, 1954, Mem. Sci. L'Inst. Past.: 210-212.

Microscopic characters: Median lobes well separated; five groups of perivulvar pores; one multilocular disc; two spines between median lobes;

one prominent spine between median and second lobes; macroduct absent between median lobes.

Field characters: Adult female scale cover oval to circular; color slate gray (gray) to oyster white (white); exuviae close to center. Male scale cover elongate; parchment white (white) in color; occurs on red cedar.

Hosts and distribution: Twigs and foliage from Juniperus virginiana (Red cedar) in Oklahoma and Stevens Counties.

Notes: The species can be distinguished from C. visci in that the latter has a macroduct present between the median lobes.

Carulaspis visci (Schrank)

Plate VII

Juniper scale

Coccus visci Schrank, 1781. Enumeratic insectorum Austriae, p. 296 and p. 588.

Aspidiotus juniperi Bouché, 1851. Stettin Ent. Ztg., 12: 112.

Diaspis carueli Targioni, 1869. Cat. p. 43.

Carulaspis visci (Schrank, 1781). Ferris, 1937, Atlas of Scale Insects, Ser. I: 12.

Microscopic characters: This species may be separated from C. minima by the presence of a marginal macroduct between the median lobes in C. visci and its absence in C. minima. The other microscopic characters are similar to C. minima.

Field characters: The adult female scale covering is circular with central exuviae; color oyster white (white) to marguerite (gray). The male scale covering is elongate with terminal exuvia and of the same color as the female; occurs on Juniperus spp.

Hosts and distribution: From the foliage and twigs of Juniperus spp. (Juniper) in Comanche, Oklahoma, and Payne Counties.

Genus Chionaspis Signoret, 1869.

Genotype: Coccus salicis, Linnaeus, 1758. Sys. Nat. Ed. 10. 1: 455-457.

Microscopic characters: Two-barred ducts; multilocular disc pores present; five groups of perivulvar pores present; body elongate; anus anterior to vulva; gland spines prominent.

Field characters: The female scale covering elongate with terminal exuviae; broadening posteriorly; and of a white color. The male scale coverings are elongate; felted; terminal exuvia; white in color.

Note: This genus is represented by three species in Oklahoma.

Key to the Species of Chionaspis from Oklahoma

1 Median lobes fused anteriorly but separated posteriorly; outer margin of median lobes twice notched. . . . . .americana (p. 34)
Median lobes not fused anteriorly but separated along its entire length; outer margin of median lobes not notched 2

2 (1) Each median lobe has a basal sclerotic bar . . . furfura (p. 35)
Each median lobe lacks a badal sclerotic bar; two distinct sizes of wax ducts in pygidial area. . . . . .salicis-nigrae (p. 36)

Chionaspis americana Johnson, 1896.

Plate VIII

Elm scurfy scale

Chionaspis americana Johnson, 1896. Ent. News, 7: 150.

Fundaspis americana (Johnson, 1896). MacGillivray, 1921, The Coccidae.

Microscopic characters: Three multilocular disc pores present; median lobe fused anteriorly but diverging posteriorly; outer margin of median lobes distinctly notched twice; second lobe outer margin notched once.

Field characters: The female scale covering is elongate and broadened posteriorly; exuviae terminal; color parchment white (white). The male scale covering is similar to that of the female but much smaller.

Hosts and distribution: From twigs on Ulmus americana (American elm) and Ulmus pumila (Siberian elm) in Beckham, Garvin, Kingfisher, Oklahoma, Payne, and Washita Counties.

Notes: According to Ferris (1937), the specimens differ from the typical by not having small microducts, and also the number of macroducts is reduced.

Chionaspis furfura (Fitch)

Plate IX

Scurfy scale

Aspidiotus furfurus Fitch, 1856. Trans. N. Y. State Agr. Soc. 16, p. 352.

Aspidiotus cerasi Fitch, 1856. Trans. N. Y. State Agr. Soc. 16, p. 368.

Aspidiotus harisii (Fitch, 1856). Walsh, 1866, Practical Ent., p. 119.

Chionaspis furfurus fulvus King, 1899. Psyche, 8: 344.

Chionaspis furfura (Fitch, 1856). Ferris, 1937, Atlas of Scale Insects, Ser. I: 18.

Microscopic characters: Multilocular pores present; median lobes set

close together, low, and apically rounded; median yoke elongate and sclerotic; base of each median lobe has a sclerotic bar.

Field characters: Scale covering of adult female elongate and broadened posteriorly; terminal exuviae; color oyster white (white). Male scale covering similar to female but more slender and smaller.

Hosts and distribution: From twigs of Malus sp. (Apple) and Ulmus sp. (Elm) in Payne and Seminole Counties.

Chionaspis salicis-nigrae (Walsh)

Plate X

Black willow scale

Aspidiotus salicis-nigrae Walsh, 1868. 1st Rpt. on Noxious and Beneficial Insects of Ill. p. 40.

Multilaspis salicis LeBaron, 1871. Trans. Iowa Hort. Soc. p. 140.

Chionaspis salicis (Linnaeus, 1758). Comstock, 1881, Rpt. U. S. Dept. Agr. for 1880, p. 320.

Chionaspis ortholobis bruneri Cockerell, 1898. Canad. Ent. 30: 133.

Chionaspis salicis-nigrae (Walsh, 1868). Ferris, 1937, Atlas of Scale Insects, Ser. I: 24.

Microscopic characters: Two distinct sizes of wax ducts in pygidial region.

Field characters: Scale covering of adult female elongated and broadened posteriorly; exuviae terminal; color oyster white to greystone (light gray). Scale covering of male similar to female but smaller and narrower; longitudinal ridge present.

Hosts and distribution: From twigs of Salix nigra (Black willow) in Blaine County.

Genus Chrysomphalus Ashmead, 1880.

Genotype: Chrysomphalus ficus Ashmead, 1880. Amer. Ent. 3: 267-269.

Microscopic characters: One-barred ducts; three pairs of well-developed lobes; pygidial plates fringed.

Field characters: Adult female scale covering circular; flat; exuviae central or subcentral; color variable. Adult male scale covering oval; exuvia toward one end.

Notes: This genus is represented by three species in Oklahoma.

Key to the Species of Chrysomphalus from Oklahoma

1 Perivulvar pores lacking . . . . . tenebricosus (p. 38)
Perivulvar pores present 2

2 (1) Median group of perivulvar pores lacking . . . . . ficus (p. 38)
All five groups of perivulvar pores present. .bifasciculatus (p.37)

Chrysomphalus bifasciculatus Ferris, 1938.

Plate XI

Bifasciculate scale

Chrysomphalus ficus Ashmead, 1880. Amer. Ent. 3: 267-269.

Chrysomphalus bifasciculatus Ferris, 1938. Atlas of Scale Insects, Ser. II: 199.

Microscopic characters: Enlarged spur opposite posterior spiracle; five groups of perivulvar pores present; multilocular disc pores lacking; wax ducts long and narrow; sclerotized bars on pygidium.

Field characters: Adult female scale covering circular with subcentral exuviae; color raison to rubient (brown).

Male scale covering oval with exuvia toward one end; similar in color to female.

Hosts and distribution: From the foliage of the following greenhouse plants: Rhododendron sp. (Azalea), Ficus spp., Ilex sp. (Holly), and Philodendron spp. in the counties of Creek, Pottawatomie, Pushmataha, Seminole, Tulsa, and Washington.

Chrysomphalus ficus Ashmead, 1880.

Plate XII

Florida red scale

Chrysomphalus ficus Ashmead, 1880. Amer. Ent., 3: 267.

Chrysomphalus aonidum (Linnaeus, 1758). Cockerell, 1899. Proc. Acad. Nat. Sci. Phila.: 273.

Chrysomphalus ficus (Ashmead, 1880). Ferris, 1937, Microentomology, 3: 105.

Microscopic characters: Median group of perivulvar pores absent; anterior spiracle stubby; multilocular disc pores lacking; wax ducts one-barred, long, and slender; conspicuous clusters of submarginal and dorsal ducts on the abdominal segments.

Field characters: Adult female scale cover circular; flat; exuviae central; color spanish raison (dark brown) to egg plant (brownish-purple). Male scale cover similar in color to female; oval; exuvia near one end.

Hosts and distribution: Citrus sinensis (orange) from a store in Pawnee County and plam foliage from a greenhouse in Pontotoc County.

Notes: Although this species is known to be oviparous, the writer found one specimen containing embryos.

Chrysomphalus tenebricosus Comstock, 1881.

Plate XIII

Gloomy scale

Microscopic characters: Perivulvar pores absent; median and second lobes distinctly bilobed at the apex.

Field characters: Adult female scale covering convex and circular; exuviae between the center and one side; color gull (gray). Male scale covering oval; color similar to female. Comstock (1881) found this species on the bark and limbs of red maple.

Hosts and distribution: From a "fruit" tree in Seminole County.

Genus Diaspidiotus Berlese and Leonardi, 1896.

Genotype: Diaspis ancylus Putnam, 1877. Iowa State Hort. Soc. Ann. Rpt. 12: 317-324.

Microscopic characters: Median group of perivulvar pores absent; anterior and posterior lateral clusters of perivulvar pores almost continuous; multilocular disc pores lacking; only median lobes well developed.

Field characters: Occurs on bark of the host; female scale covering circular; male scale covering oval with exuvia toward one end.

Notes: This genus is represented by two species in Oklahoma.

Key to the Species of Diaspidiotus from Oklahoma

1 Anterior spiracle short and stubby; pair of gland spines between the median and second lobes. . . . . aesculi (p. 39)
Anterior spiracle elongate and slender; fringed plates between the median and second lobes. . . . . ancylus (p. 40)

Diaspidiotus aesculi (Johnson)

Plate XIV

Buckeye scale

Aspidiotus aesculi Johnson, 1896. Bul. Ill. Lab. Nat. Hist. 4: 386.

Diaspidiotus aesculi (Johnson, 1896). Ferris, 1938, Atlas of Scale Insects, Ser. II: 215.

Microscopic characters: Wax ducts occur in clusters in the pygidial region; pair of gland spines between the median and second lobes; spines lacking between median lobes; median group of perivulvar pores lacking; anterior spiracle short and stubby.

Field characters: Adult female scale covering circular and flat; exuviae subcentral; color gull (gray). Scale covering of male elongate; exuvia near one end; color similar to female. Habitat on the bark, and this species causes bark pitting.

Hosts and distribution: Twigs of Quercus borealis (Northern red oak) from a nursery in Oklahoma County.

Diaspidiotus ancylus (Putnam)

Plate XV

Putnam scale

Diaspis ancylus Putnam, 1877. Trans. Iowa Hort. Soc., 12: 321.

Aspidiotus ancylus Putnam, 1879. Proc. Davenport Acad. Nat. Sci., 2: 346.

Aspidiotus ancylus serratus Newell and Cockerell, 1898, Iowa Acad. Sci., 5: 229.

Aspidiotus ancylus latilobis Newell, 1899. Contr. Dept. Ent. Iowa Agr. Col., 3: 9.

Aspidiotus aesculi solus Hunter, 1899. Kans. Univ. Quart., 8: 12.

Aspidiotus (Diaspidiotus) ohioensis York, 1905. Ohio Nat., 5: 325.

Diaspidiotus solus (Hunter, 1899). MacGillivray, 1921, The Coccidae,: 414.

Aspidiotus oxycrataegi Hollinger, 1923. Bul. Miss. Agr. Expt. Sta. 58: 15.

Diaspidiotus ancylus (Putnam, 1877). Ferris, 1938, Atlas of Scale Insects, Ser. II: 216.

Microscopic characters: Wax ducts occur in rows rather than clusters in the pygidial region; fringed plates between median and second pair of lobes; spines lacking between median lobes; median group of perivulvar pores lacking; anterior spiracle elongate and slender.

Field characters: Adult female scale covering circular and convex; exuviae near one end; color bonito to rose gray (dark gray). Adult male scale covering elongate; exuvia toward one end; color similar to the female.

Hosts and distribution: Twigs of Bumelia lanuginosa (Chittam wood) in Blaine County.

Genus Diaspis Costa, 1835.

Genotype: Diaspis calyptroides Costa, 1835. Fauna del Regno di Napoli, 23 pp.

Microscopic characters: All five groups of perivulvar pores present; paired spines and a wax duct located between median lobes; median lobes separated throughout the entire length; multilocular disc pores present.

Field characters: According to Dietz and Morrison (1916), the adult female scale covering is circular or subcircular; color dirty white or pale yellow; exuviae subcentral but not marginal. The male scale covering is small, elongate, and parallel sided; color white, felted, and tricarivate; exuvia terminal.

Notes: Two species are represented in this genus for Oklahoma.

Key to the Species of Diaspis from Oklahoma

1 Inner margin of median lobes serrate. . . . . .*boisduvalii* (p. 42)

Inner margin of median lobes not serrate. . . . *echinocacti* (p. 42)

Diaspis boisduvalii Signoret, 1869

Plate XVI

Boisduval scale

Diaspis boisduvalii Signoret, 1869. Ann. Soc. Ent. Fr., 4 (9): 432.

Aulacaspis boisduvalii (Signoret, 1869). Cockerell, 1893, Gard. Chron., 3 (8): 548.

Aulacaspis cattleyae (Cockerell, 1893). Cockerell, 1899, Biol. Cent-Amer., 2 (2): 30.

Diaspis cattleyae (Cockerell, 1899). Cockerell, 1902, Entomologist, 35: 59.

Diaspis boisduvalii (Signoret, 1869). Ferris, 1937, Atlas of Scale Insects, Ser. I: 32.

Microscopic characters: Five groups of perivulvar pores present; usually a pair of conspicuous lateral lobes on prosoma; some have only one lateral lobe and other specimens may have lobes absent; multilocular disc pores present; inner margin of median serrated, outer margin smooth.

Field characters: Adult female scale covering circular, flat, exuviae subcentral; color from an oyster white to woodash (white) and translucent. Male scale covering elongate; tricarinate; paper white in color. Host is orchid.

Hosts and distribution: Foliage and stems of orchids in greenhouses located in Oklahoma and Tulsa Counties.

Diaspis echinocacti (Bouché)

Plate XVII

Cactus scale

Aspidiotus echinocacti Bouché, 1883. Naturge schichte der Schadlichen Garten Insecten, p. 53.

Diaspis calyptroides Costa, 1835. Fauna del Regnodi Napoli, Cocciniglie, p. 20.

Diaspis cacti Comstock, 1883. 2d Rpt. Dept. Ent. Cornell Univ., p. 91.

Diaspis calyptroides opuntiae Cockerell, 1893. Jour. Inst. Jamaica, 1: 256.

Diaspis echinocacti (Bouché, 1883). Ferris, 1937, Atlas of Scale Insects, Ser. I: 36.

Microscopic characters: Five groups of perivulvar pores present; multilocular pores present; apodeme of anterior spiracle three-lobed; margins of median lobes smooth; median lobes separated along their entire length.

Field characters: Adult female scale covering circular and flat; exuviae approximately central; color gull (gray) to a parchment white with the exuviae color raison brown (dark brown). The male scale cover is elongate; felted; exuvia terminal; color a parchment white; host is cactus.

Hosts and distribution: Foliage and stems of cactus from greenhouses in Greer and Oklahoma Counties.

Genus Fiorinia Targioni, 1869.

Genotype: Fiorinia pellucida Targioni, 1869. Soc. Ent. Ital. Bul. 1: 257-267.

Microscopic characters: Two-barred ducts; antennae prominent and located on or close to cephalic margin; five groups of perivulvar pores; body slender; multilocular pores present; median lobes prominent and fusing at the base.

Field characters: Female scale covering appears to have one terminal exuvia since the second exuvia forms the major part of the covering; elongate; male scale covering elongate and parchment white in color; exuvia terminal. This genus has only been recorded on camellia and holly hosts.

Notes: This genus is represented by two species in Oklahoma.

Key to the Species of Fiorinia from Oklahoma

1 Base of antennae situated on cephalic margin; lacking fleshy tubercle between antennae . . . . . fioriniae (p. 44)
Base of antennae situated caudad of the cephalic margin; fleshy tubercle present between antennae. . . . . theae (p. 45)

Fiorinia fioriniae (Targioni)

Plate XVIII

Palm fiorinia scale

Fiorinia pellucida Targioni, 1869. Introduzione alla seconda memoria per gli studi Salle cocciniglie, e cat. dei gen. e sp. della famiglia, p. 42.

Fiorinia camelliae Comstock, 1881. Rpt. U. S. Dept. Agr. for 1880, p. 329.

Uhleria fioriniae (Targioni, 1869). Comstock, 1883, 2d Rpt. Dept. Ent. Cornell Univ., P. 111.

Uhleria camelliae (Comstock, 1881). Comstock, 1883, 2d Rpt. Dept. Ent. Cornell Univ., p. 111.

Fiorinia palmae Green, 1896. Ind. Mus. Notes, 4: 5.

Fiorinia fioriniae (Targioni, 1869). Ferris, 1937, Atlas of Scale Insects, Ser. I: 55.

Microscopic characters: Adult female scale covering elongated; exuvia terminal (only one exuvia is visible because the second exuvia composes the rest of the scale covering); color varies from daffodil (yellow) to a spanish raison (brown); and is translucent. Male scale covering elongated; parchment white; felted terminal exuvia. Habitat is on the foliage.

Hosts and distrubution: Foliage of Camellia spp. in greenhouses from Tulsa County.

Fiorinia theae Green, 1900.

Plate XIX

Tea scale

Fiorinia theae Green, 1900. Ind. Mus. Notes, 5: 3.

Microscopic characters: Prominent tubular process located between antennae; five groups of perivulvar pores; anus confluent with vulva; anterior spiracular apodeme quite slender and stalk-like.

Field characters: The adult female scale covering appears to have just one terminal exuvia as in F. fioriniae; posterior end is pointed; longitudinal ridge is sometimes evident; color spanish raison (dark brown). Male scale covering elongated terminal exuvia; color parchment white. This species is a foliage feeder.

Hosts and distribution: Camellia japonica (Camellia) and Ilex spp. (Holly) from the foliage of nursery and greenhouse plants in Oklahoma,

Payne, Pontotoc, and Tulsa Counties.

Genus Hemiberlesia Cockerell, 1895.

Genotype: Aspidiotus rapax, Comstock, 1881. Rpt. U. S. Dept. Agr. 1880, p. 307.

Microscopic characters: One-barred ducts; fringed plates; median group of perivulvar pores absent; multilocular disc pores lacking.

Field characters: It is difficult to list field characters that are characteristic for the genus because of the variations between species. About all that can be said for the Oklahoma representatives is that the female and male scale coverings are of a gull (gray) color, and they are on Amaranthus sp. and Euonymus sp. (Strawberry bush, Burning bush).

Notes: This genus is represented by two species in Oklahoma.

Key to the Species of Hemiberlesia from Oklahoma

1 Exuviae of female scale covering tilted to one side giving the scale covering the appearance of leaning toward one side . . . . . .lataniae (p. 47)

Exuviae of female scale covering normal in appearance.howardi (p. 46)

Hemiberlesia howardi (Cockerell)

Plate XX

Howard scale

Aspidiotus howardi Cockerell, 1895. Canad. Ent., 27: 16.

Aspidiotus townsendi Cockerell, 1896. Psyche, 7(1): 20.

Aspidiotus pseudospinosus Woglum, 1906. Canad. Ent., 38: 75.

Aspidiotus epigaeae Marlatt, 1908. U. S. Dept. Agr. Bur. Ent., Tech.

Ser. 16 (2): 21-22.

Hemiberlesia howardi (Cockerell, 1895). Ferris, 1938, Atlas of Scale Insects, Ser. II: 240.

Microscopic characters: Median group of perivulvar pores lacking; wax ducts single-barred, long, and slender.

Field characters: Adult female scale covering circular; slightly convex and thin; color gull (gray); exuviae toward one end; male scale covering is similar to female but oval in shape.

Hosts and distribution: Foliage and twigs of indoor and field grown Amaranthus sp. and Euonymus sp. (Strawberry bush, Burning bush) in Oklahoma and Tulsa Counties.

Hemiberlesia lataniae (Signoret)

Plate XXI

Latania scale

Aspidiotus lataniae Signoret, 1869. Ann. Soc. Ent. Fr., 4 (9): 124.

Aspidiotus cydoniae Comstock, 1881. Rpt. U. S. Dept. Agr. for 1880, p. 295.

Aspidiotus punicae Cockerell, 1893. Jour. Inst. Jamaica, 1: 225.

Aspidiotus implicatus Maskell, 1897. Ent. Monthly Mag., 33: 241.

Aspidiotus diffinis lateralis Cockerell, 1897. Div. Ent., Bul. 6, Tech. Ser., U. S. Dept. Agr., p. 23.

Aspidiotus (Hemiberlesia) crawii Cockerell, 1897. Div. Ent., Bul. 6, Tech. Ser., U. S. Dept. Agr., p. 5 and p. 23.

Aspidiotus greenii Cockerell, 1898. Ent. Monthly Mag., 34: 184.

Hemiberlesia lataniae (Signoret, 1869). Ferris, 1938. Atlas of Scale Insects, Ser. II: 241.

Microscopic characters: Median group of perivulvar pores lacking; multilocular disc pores lacking; many striations in pygidial region; anus close to apex of pygidium.

Field characters: Adult female scale covering strongly convex and circular; color gull (gray); covering appears tilted due to the angle of the exuviae; color of exuviae bonita to rose gray (dark gray). No males observed. Occurs on the twigs.

Hosts and distribution: Twigs of nursery and greenhouse grown Euonymus sp. (Strawberry bush, Burning bush) and Schefflera sp. located in Craig, Okmulgee, and Tulsa Counties.

Genus Lepidosaphes Shimer, 1868.

Genotype: Coccus conchiformis Gmelin, 1766. Onomatologia Hist. Nat. Completa, v. 3, 1,004 columns.

Microscopic characters: Antennae two-bristled; ducts two-barred; body elongate; median lobes separated; body distinctly segmented.

Field characters: Adult female scale covering elongate; color varying from a gray to purple color; exuviae terminal; male when present similar in form and color to female.

Notes: This genus is represented by four species in Oklahoma.

Key to the Species of Lepidosaphes from Oklahoma

1 Male insect not present; scale covering annulated. . . .ulmi (p. 51)

Male insects present; scale covering not annulated 2

2 (1) Dorsum at maturity sclerotized . . . . . .gloverii (p. 50)

Dorsum at maturity membranous. 3

3 (2) Median lobes notched once on inner and outer margins

. . . . . camelliae (p. 49)

Median lobes notched more than once on inner and outer margins . . . . . beckii (p. 49)

Lepidosaphes beckii (Newman)

Plate XXII

Purple scale

Coccus beckii Newman, 1869. Entomologist, 4: 217.

Aspidiotus citricola Packard, 1869. Guide to Study of Insects, p. 527.

Lepidosaphes beckii (Newman, 1869). Ferris, 1937, Atlas of Scale Insects, Ser. I: 71.

Microscopic characters: Antennae two-bristled; posterior part of body considerably broader than anterior portion; abdominal lobes quite conspicuous and bluntly pointed at apex; three pairs of prominent cutucular bosses on abdominal lobes; five groups of perivulvar pores; anus cephalad to vulva; median lobes having an undulating margin.

Field characters: Adult female scale covering oyster-shell shaped; moderately convex; color toga to eminence (dark purple to purple brown); exuviae terminal. Male scale covering similar to female, but shorter and straighter. Habitat on fruit.

Hosts and distribution: Fruit of Citrus deliciosa (Tangerine) and Citrus sinensis (Orange) from stores in Payne and Tulsa Counties.

Lepidosaphes camelliae Hoke, 1922.

Plate XXIII

Camellia scale

Lepidosaphes camelliae Hoke, 1922. Ann. Ent. Soc. Amer., 14: 339.

Lepidosaphes camelliae Hoke, 1922. Ann. Ent. Soc. Amer., 14: 339.

Microscopic characters: Antennae two-bristled; distal end of anterior spiracular apodeme distinctly five-lobed; multilocular pores present; wax ducts quite large; wax duct lacking between median lobes; anus anterior to vulva; inner and outer margin of each median lobe bears one notch which is not very distinct.

Field characters: Adult female scale covering oyster-shell shaped; moderately convex; posterior part considerably broader than the anterior forming a trumpet-shaped covering; color spanish raison (dark brown). Male scale covering similar to female but narrower and shorter; habitat on foliage.

Hosts and distribution: Foliage from greenhouse and nursery grown Camellia spp. and Ilex spp. (Holly) in Carter, Comanche, and Tulsa Counties.

Lepidosaphes gloverii (Packard)

Plate XXIV

Glover scale

Coccus gloverii Packard, 1869. Guide to Study of Insect, 527 pp.

Aspidiotus gloverii (Packard, 1869). Packard, 1880, 7th Rpt. Mass. Bd. Agr., (1869), p. 259.

Mytilaspis gloverii (Packard, 1869). Comstock, 1881, Rpt. U. S. Dept. Agr. for 1880, p. 323.

Mutilella sexspina Hoke, 1922. Ann. Ent. Soc. Amer., 14: 341.

Lepidosaphes gloverii (Packard, 1869). Ferris, 1937, Atlas of Scale Insects, Ser. I: 74.

Microscopic characters (McKenzie, 1956): Dorsum of the thoracic and

first abdominal segment heavily sclerotized; abdominal segments two to four with well-developed lateral lobes each of which has a distinct sclerotized, small, sharp, marginal thorn-like spur.

Field characters: Female scale covering long and narrow; sides nearly parallel; usually curved; color spanish raison (dark brown); exuviae terminal and of a saffron to Florida gold (orange yellow) color. Male scale covering similar to female but smaller. Habitat on fruit.

Hosts and distribution: Fruit in a store of Citrus sinensis (Orange) in Payne County.

Notes: Only a few specimens were available; and in the process of verification, none were sent back to the writer.

Lepidosaphes ulmi (Linnaeus)

Plate XXV

Oystershell scale

Coccus ulmi Linnaeus, 1758. Sys. Nat., 10th Ed., p. 455.

Aspidiotus pomorum Bouché, 1851. Stettin Ent. Ztg., 12: 110.

Lepidosaphes ulmi (Linnaeus, 1758). Ferris, 1937, Atlas of Scale Insects, Ser. I: 76.

Microscopic characters: Antennae two-bristled; five groups of perivulvar pores; anus anterior to vulva; each median lobe has a distinct notch on the outer and inner margin; multilocular disc pores present.

Field characters: Adult female scale covering oystershell shaped; spanish raison (dark brown) in color; exuviae terminal; curved transverse ridges on dorsum of scale covering. No male has been observed.

Hosts and distribution: Twigs of Betula sp. (Birch) and Malus sp. (Apple) in Cherokee and Payne Counties.

Notes: This species can readily be distinguished from the other three because no males are present; transverse curved ridges on the dorsum of the scale covering.

Genus Melanaspis Cockerell, 1897.

Genotype: Aspidiotus obscurus Comstock, 1881. Rpt. U. S. Dept. Agr. for 1880, p. 303.

This genus is represented by one species, thus the description is based on the species.

Melanaspis obscura (Comstock)

Plate XXVI

Obscure scale

Aspidiotus obscurus Comstock, 1881. Rpt U. S. Dept. Agr. for 1880, p. 303.

Chrysomphalus obscurus (Comstock, 1881). Leonardi, 1899, Riv. Patol. Veg., 7: 206.

Melanaspis obscura (Comstock, 1881). Leonardi, 1899, Riv. Patol. Veg., 7: 206.

Melanaspis obscura (Comstock, 1881). Keifer, 1941, Calif. Dept. Agr. mimeo. Fol. No. 12.

Microscopic characters: Contrary to the literature, some of my specimens lacked the median group of perivulvar pores. The literature states that five groups of perivulvar pores are present; wax ducts long and slender; anus median between vulva and the caudal end of the body; multilocular pores lacking.

Field characters: Adult female scale covering circular and flattened;

color gull (gray); exuviae not central and cruiser (dark gray) in color. Male scale covering similar to female but smaller and oval in shape. Habitat on bark of burr oak.

Hosts and distribution: Twigs of Quercus macrocarpa (Burr oak) in Payne County.

Genus Parlatoria Targioni, 1868.

Genotype: Parlatoria lucasii Targioni, 1868. Soc. Ital. di Sci. Nat. Atti. 11: 694-738.

Notes: This genus is represented by one species, thus the description is based on the species.

Parlatoria pergandii Comstock, 1881.

Plate XXVII

Chaff scale

Parlatoria pergandii Comstock, 1881. Rpt. U. S. Dept. Agr. for 1880, p. 327.

Parlatoria sinensis Maskell, 1897. Ent. Monthly Mag., 32: 241.

Syngenaspis pergandii (Comstock, 1881). Borkhsenius, 1937, U.S.S.R. Peoples' Comissariat for Agr. Pl. Quar. Admin., Pl. Insp. of Georgia, Div. of Sci. Lit., p. 88.

Parlatoria pergandei (Comstock, 1881). Zimmerman, 1948, Insects of Hawaii, 5: 396.

Microscopic characters: Median group of perivulvar pores lacking; pygidium broadly rounded; three pairs of well-developed pygidial lobes; margin of the pygidium deeply indented; apodeme of anterior spiracle uniform in width and curved caudad; multilocular pores present.

Field characters: Adult female scale covering broadly oval; flat; exuviae toward one end; color varies from lotus to magnolia (straw) and translucent. Male similar to female but smaller and more of an elongate oval shape. Habitat fruit of grapefruit, orange, and tangerine.

Hosts and distribution: Fruit in stores in Payne County consisting of Citrus deliciosa (Tangerine), Citrus paradisi (Grapefruit), and Citrus sinensis (Orange).

Genus Phenacaspis Cooley and Cockerell, 1899.

Genotype: Chionaspis nyssae Comstock, 1881. Rpt. U. S. Dept. Agr. for 1880, p. 316.

Notes: This genus is represented by one species, thus the description is based on the species.

Phenacaspis pinifoliae (Fitch)

Plate XXVIII

Pine needle scale

Aspidiotus pinifoliae Fitch, 1855. 2nd. Rpt. on the Insects of New York, 488 pp.

Mytilaspis pinifoliae (Fitch, 1855). Le Baron, 1871, 1st. Rpt. on the Noxious and Beneficial Insects of Ill., p. 83.

Chionaspis pinifoliae (Fitch, 1855). Comstock, 1881, Rpt. U. S. Dept. Agr. for 1880, p. 318.

Chionaspis pinifolii (Fitch, 1855). Riley, 1882, Amer. Nat., 16: 514.

Chionaspis pinifoliae semiaurea Cockerell, 1895. Amer. Nat., 29: 731.

Phenacaspis pinifoliae (Fitch, 1855). Ferris, 1937, Atlas of Scale Insects, Ser., 1: 93.

Microscopic characters: Taken from McKenzie (1956) because my two specimens were inadvertently lost. Five groups of perivulvar pores; multilocular disc pores present; anus anterior to vulva; median lobes separated and with smooth margins; spines lacking between median lobes.

Field characters: Adult female scale covering elongate; almost parallel-sided; color parchment white; terminal exuviae of a grapefruit (yellow) color. Male scale covering similar to female but tricarinated. Habitat on pine needles.

Hosts and distribution: Foliage of Pinus nigra (Austrian pine) in Oklahoma County.

Genus Pinnaspis Cockerell, 1893.

Genotype: Mytilaspis pandani Comstock, 1881. Rpt. U. S. Dept. Agr. for 1880, p. 324.

Notes: This genus is represented by one species, therefore, the description is based on the species.

Pinnaspis aspidistrae (Signoret)

Plate XXIX

Fern scale

Chionaspis aspidistrae Signoret, 1869. Ann. Soc. Ent. Fr., 4 (9): 443.

Chionaspis brasiliensis Signoret, 1869. Ann. Soc. Ent. Fr., 4 (9): 444.

Chionaspis latus Cockerell, 1896. Psyche, 7, Suppl.: 53.

Hemichionaspis aspidistrae (Signoret, 1869). Cockerell, 1897, Amer. Nat., 31: 592.

Pinnaspis aspidistrae (Signoret, 1869). Lindinger, 1912, Die Schildlause, p. 79.

Microscopic characters: Five groups of perivulvar pores; multilocular disc pores present; distal part of anterior spiracular apodeme has the appearance of "spread fingers"; anus and vulva confluent; inner margins of median lobes fused along their entire length.

Field characters: Adult female scale covering oystershell shaped with caudal end broader than anterior; flat; color from a mauve castor to wineberry (light reddish brown); exuviae terminal. Male scale covering elongate; almost parallel-sided; parchment white; felted; tricarinate; habitat on foliage and stems of fern.

Hosts and distribution: Foliage and stems of indoor and greenhouse grown fern plants in Payne and Washington Counties.

Genus Quadraspidiotus MacGillivray, 1921.

Genotype: Aspidiotus ostraeformis Curtis, 1843. Gard. Chron. No. 46: 805.

Microscopic characters: Second pygidial lobe well developed and sclerotized; axes of the second lobes are oblique, appearing to converge toward apex of pygidium.

Field characters: The adult female scale coverings are usually gray in color; moderately convex; circular to slightly oval; exuviae central or subcentral. The male scale covering is similar to the female with the exuvia near one end.

Notes: This genus is represented by two species in Oklahoma.

Key to the Species of Quadraspidiotus from Oklahoma

1 Perivulvar pores lacking . . . . . perniciosus (p. 57)

Five groups of perivulvar pores present. . . . . forbesi (p. 57)

Quadraspidiotus forbesi (Johnson)

Plate XXX

Forbes scale

Aspidiotus forbesi Johnson, 1896. Ent. News, 7: 151.

Aspidiotus fernaldi hesperius Cockerell, 1902. Ann. Mag. Nat. Hist., (7): 450.

Quadraspidiotus forbesi (Johnson, 1896). Ferris, 1938, Atlas of Scale Insects, Ser. II: 256.

Microscopic characters: Five groups of perivulvar pores; multilocular disc pores lacking; anus close to base of pygidium and small enough to be almost inconspicuous; wax ducts long and slightly curved.

Field characters: Adult female scale covering elongate; oval; slightly convex; color gull (gray); exuviae toward one end. Male scale covering similar to female but smaller. Habitat on bark.

Hosts and distribution: Twigs and trunk of Malus sp. (Apple) and Pyracantha sp. (Firethorn) in Payne and Pushmataha Counties.

Quadraspidiotus perniciosus (Comstock)

Plate XXXI

San Jose scale

Aspidiotus perniciosus Comstock, 1881. Rpt. U. S. Dept. Agr. for 1880, p. 304.

Aonidiella perniciosa (Comstock, 1881). Berlese and Leonardi, 1898, Chermotheca Italica, 3: 53.

Comstockaspis perniciosa (Comstock, 1881). MacGillivray, 1921, The Coccidae, p. 438.

Quadraspidiotus perniciosus (Comstock, 1881). Ferris, 1938, Atlas of Scale Insects, Ser. II: 259.

Microscopic characters: Similar to Quadraspidiotus forbesi (Johnson) but the prime difference is the absence of perivulvar pores.

Field characters: Adult female scale covering circular; slightly convex; color variable from asphalt (black) to oyster white (white); exuviae central to off center; color varies considerably as in the rest of the scale covering. One of the important field characters of this species is that the first exuvia appears as a nipple-like structure. Surrounding the first exuvia is a circular depression. It is this distinct circular depression surrounding the nipple that differentiates this species from closely related species. Male scale covering similar to female but more elongate. Habitat primarily on the bark.

Hosts and distribution: This species has been found on a large number of plants on the foliage and twigs in the field, nurseries, indoor plants, and greenhouses. Carya sp. (Pecan), Cydonia sp. (Quince), Euphorbia sp. (Poinsettia), Ficus spp. (Rubber plant, etc.), Hedera spp. (Ivy), Mahonia aquifolium (Oregon holly), Malus sp. (Apple), Poncirus sp. (Trifoliate orange), Prunus sp. (Plum), Pyracantha sp. (Firethorn), Pyrus sp. (Pear), Spiraea sp. (Spirea). The counties represented were Garfield, Garvin, Haskell, McCurtain, Oklahoma, Payne, Pushmataha, Tillman, and Tulsa.

Genus Rhizaspidiotus MacGillivray, 1921.

Genotype: Aspidiotus helianthi Parrott, 1899. Canad. Ent. 31: 176.

Notes: This genus is represented by one species, therefore, the description is based on the species.

Rhizaspidiotus dearnessi (Cockerell).

Plate XXXII

Dearness scale

Aspidiotus dearnessi Cockerell, 1898. Canad. Ent., 30: 226.

Targionia dearnessi (Cockerell, 1898). Leonardi, 1901, Riv. Patol. veg., 8: 343.

Remotaspidiotus dearnessi (Cockerell, 1898). MacGillivray, 1921, The Coccidae, p. 434.

Aspidiotus gutierreziae Cockerell and Parrott, 1899. Industrialist 25: 159-165.

Targionia gutierreziae (Cockerell and Parrott, 1899). Leonardi, 1901, Riv. Patol. veg., 8: 343-344.

Chorizaspidiotus gutierreziae (Cockerell and Parrott, 1899). MacGillivray, 1921, The Coccidae, p. 432.

Aspidiotus helianthi Parrott, 1899. Canad. Ent., 31: 176.

Rhizaspidiotus helianthi (Parrott, 1899). MacGillivray, 1921, The Coccidae, p. 431.

Rhizaspidiotus dearnessi (Cockerell, 1898). Ferris, 1938, Atlas of Scale Insects, Ser. II: 263.

Microscopic characters: Perivulvar pores lacking; multilocular disc pores absent; anterior spiracle short and stubby; prominent crenulations along pygidial margin.

Field characters: Adult female scale covering gull (gray) in color; circular; convex; exuviae central. Male scale covering similar to female but smaller with exuvia terminal.

Hosts and distribution: Stem of Xanthocephalus dracunculoides (Broom weed) in Payne County.

Genus Unaspis MacGillivray, 1921.

Genotype: Chionaspis acuminata Green, 1899. Coccidae of Ceylon, Part II: 105-169.

Notes: One species is known to occur in Oklahoma, and the description is based on the species.

Unaspis euonymi (Comstock)

Plate XXXIII

Euonymus scale

Chionaspis euonymi Comstock, 1881. Rpt. U. S. Dept. Agr. for 1880, p. 313.

Unaspis euonymi (Comstock, 1881). Ferris, 1937, Atlas of Scale Insects, Ser. I: 130.

Unaspis nakayamai Takahashi and Kanda, 1939. Annot. Zool. Jap., 18: 185.

Microscopic characters: Body elongate, broader posteriorly; five groups of perivulvar pores; multilocular pores present; anus anterior to vulva; median lobes widely separated.

Field characters: Adult female scale covering elongate; exuviae terminal; body narrow at anterior end, broader at posterior end; color cyclamen to dante (brown). Male scale covering elongate; felted; sides parallel;

tricarinated; exuvia terminal; color parchment white; habitat foliage and twigs of euonymus and holly.

Hosts and distribution: Specimens collected from foliage and twigs of Euonymus sp. and Ilex spp. (Holly) in the field, greenhouses, nurseries, and twigs located in Comanche, Garvin, Grady, Haskell, Jackson, McCurtain, McLain, Oklahoma, Payne, Tillman, and Tulsa Counties.

CHAPTER X

FAMILY ASTEROLECANIIDAE (BERLESE)

Anal lobes not fused; no operculum over anal opening; few marginal setae; numerous 8-shaped dermal gland pores.

Key to the Genera of *Asterolecaniidae* from Oklahoma

1 Antennae nine segmented. . . . . .*Lecaniodiaspis* (p. 63)

Antennae reduced to one segmented tubercle . . . .*Cerococcus* (p. 62)

Genus *Cerococcus* Comstock, 1882.

Genotype: *Cerococcus quercus* Comstock, 1882. Cornell Univ. Agr. Exp. Sta. Bul. 372: 501-506.

Notes: Since this genus has only one species occurring in Oklahoma, the generic description is transferred to the discussion of the species.

Cerococcus koebelei (Cockerell)

Plate XXXV

Solenophora koebelei Cockerell, 1898. Psyche 8: 262-263.

Cerococcus koebelei (Cockerell, 1898). Ferris, 1955, Atlas of Scale Insects, 7: 233.

Microscopic characters: Antennae one segmented; legs lacking; no visible segmentation of body; cribriform plates in pairs; members of each

pair lying one behind the other; anal lobes strongly developed; geminate pores uniform in size.

Field characters: Body oval; strongly convex; slight median ridge; color rose ebony to briarwood (dark brown).

Hosts and distribution: Mahonia aquifolium (Oregon holly) on twigs from Oklahoma and Payne Counties.

Genus Lecaniodiaspis Targioni-Tozzetti, 1868.

Genotype: Lecaniodiaspis sarda Targioni-Tozzetti, 1869. Sec. Ent. Ital. Bul. 1: 257-267.

Notes: Since this genus has only one species occurring in Oklahoma, the generic description is transferred to the discussion of the species.

Lecaniodiaspis celtidis Cockerell, 1897.

Plate XXXVI

Lecaniodiaspis celtidis Cockerell, 1897. The Entomologist, XXX: 12.

Microscopic characters: Antennae nine segmented; legs present but vestigial; enlarged setae present on the periphery of the dorsal aspect of the body; body segmented.

Field characters: Body circular and slightly convex; color titian to gold pheasant (orange-brown).

Hosts and distribution: Celtis sp. (Hackberry) on twigs from Oklahoma and Tulsa Counties.

CHAPTER XI

FAMILY COCCIDAE, 1829.

Adult female with an anal cleft, the base of which is covered by an operculum formed of two plates; anal opening surrounded by a setigerous anal ring; prominent stigmatic setae present.

Key to the Genera of *Coccidae* from Oklahoma

1 Female body strongly convex at maturity. 2

Female body flat or slightly convex at maturity; no ovisac formed . . . . . .*Coccus* (p. 66)

2 (1) Stigmatic depressions bearing numerous (more than three) tubercle-like setae. . . . . *Ceroplastes* (p. 65)

Stigmatic depressions not bearing numerous setae 3

3 (2) Anal ring with 10 hairs; antennae and legs rudimentary . . . . . .*Toumeyella* (p. 72)

Anal ring not with 10 hairs; antennae and legs well developed. . . 4

4 (3) Anal ring with eight hairs; antennae and legs well developed. . . . . .*Lecanium* (p. 67)

Stigmatic depression bearing three setae, two stubby and short and one elongate seta. . . . . *Saissetia* (p. 70)

Genus Ceroplastes Gray, 1828.

Genotype: Ceroplastes janeirensis Gray, 1828. Spicilegia Zool. Pt. I: 12 pp.

Notes: Since this genus has but one species occurring in the state, the generic description is based on the species.

Ceroplastes floridensis (?) Comstock, 1881.

Plate XXXVII

Florida wax scale

Microscopic characters: Antennae six segmented; numerous cone shaped marginal setae in the stigmatic clefts; a raised sclerotized area surrounding the anal operculum.

Field characters: (Merrill, 1953) Scale covering very convex, thick, and waxy. The color ranges from dirty white to pink. A few black spots may be present. The adult female fits closely into the under surface of the scale covering.

Hosts and distribution: Gardenia sp. (Gardenia) associated part of host plant unknown because the insects were received in a vial. Collected from a greenhouse in Ellis County.

Notes: Comstock (1881) states that this species can readily be separated from other species by the small size of the central plate on the scale covering, compared to the other eight plates.

Genus Coccus Linnaeus, 1758.

Genotype: Coccus hesperidum Linnaeus, 1758. Sys. Nat. Ed. 10, p. 455.

Notes: The genus is represented by only one species in the state.

Accordingly, the generic description is based on the species.

Coccus hesperidum Linnaeus, 1758.

Plate XXXVIII

Soft scale

Coccus hesperidum Linnaeus, 1758, Syst. Nat. Ed. 10, p. 455

Lecanium hesperidum (Linnaeus, 1758). Comstock, 1881. Rpt. U. S. Dept. Agr. for 1880, p. 358.

Microscopic characters: Antennae seven segmented; marginal setae in a single row, all small and slender; stigmatic depression with one long and two short stout setae; tubular ducts lacking; anal plates slightly longer than their combined width.

Field characters: Shape oval, but broader posteriorly; relatively flat; color ranges from palmleaf (light green) to old gold (greenish brown).

Hosts and distribution: The specimens were collected from the foliage and stems of plants in greenhouses, nurseries, and indoor plants as follows: Acacia sp., Begonia sp., Castilleja sp. (Indian paintbrush), Chrysanthemum sp., Citrus limonia (Lemon), Citrus sinensis (Orange), Cyprus alternifolus (Umbrella plant), Dieffenbachia sp. (Seguin tuftroot), Euonymus spp. (Strawberry bush, Burning bush), Euphorbia sp. (Poinsettia), Ficus spp., Ilex spp. (Holly), Philodendron spp., and Pyracantha sp. (Firethorn). The counties represented were: Cherokee, Comanche, Grady, Jackson, Lincoln, Muskogee, Noble, Oklahoma, Okmulgee, Osage, Payne, Pontotoc, Tulsa, Washington, and Woodward.

Notes: It has been observed that in parasitized specimens, the flat appearance as mentioned under field characters does not hold true since the insect becomes quite convex.

Genus Lecanium Burmeister, 1835.

Genotype: Coccus coryli Linnaeus, 1758. Sys. Nat. Ed. 10, p. 456.

Microscopic characters: Antennae six to eight segmented; legs well developed; middle spiracular spine less than twice as long as the outer two (except nigrofasciatum); anal ring with eight setae.

Field characters: Outdoor species; body naked or only a few tufts of a white waxy secretion; before maturity the body is boat shaped (Comstock, 1881).

Notes: Four species of this genus have been found in the state.

Key to the Species of Lecanium from Oklahoma

1 Dorsum of adult female with a row of about thirty tiny spines running cephalad from the anal plates; middle spiracular spine more than twice as long as the outer ones (Dietz and Morrison, 1916). . . . . .nigrofasciatum (p. 69)

2 (1) Occurring on conifers; derm smooth . . . . . fletcheri (p. 68)

Not occurring on conifers; derm roughened. 3

3 (2) Derm pores in irregular rows radiating from the center of the body . . . . . corni (p. 67)

Derm pores not in any definite pattern, but scattered throughout the body. . . . . quercifex (p. 69)

Lecanium corni Bouché, 1844.

Plate XXXIX

European fruit lecanium

Lecanium corni, Bouché, 1844. Stettin Ent. Ztg., 5: 298.

Eulecanium corni (Bouché, 1844). Douglass, 1911, 4th Rpt. Ind. St.

Ent., p. 172.

Microscopic characters: Antennae seven segmented; legs well developed; median spiracular spine not twice as long as the outer ones; anal ring has eight setae.

Field characters: The shape is usually oval and is strongly convex at maturity; color varies from a beach tan to rubient (brown); dorsum fairly smooth, but the margins of the body are quite wrinkled; longitudinal dorsal ridge may be evident; sides of body may appear to be frosted.

Hosts and distribution: The following specimens were taken from twigs and leaves in nurseries and in the field from Carya spp. (Pecan), Celtis sp. (Hackberry), Cercis canadensis (Red bud), Juglans nigra (Black walnut), Morus sp. (Mulberry), Quercus palustris (Pin oak), Sapindus sp. (Soapberry) Ulmus americana (American elm), Ulmus pumila (Siberian elm). The counties represented were: Adair, Blaine, Greer, Kay, Noble, Oklahoma, Payne, and Tulsa.

Lecanium fletcheri Cockerell, 1893.

Plate XL

Fletcher scale

Lecanium fletcheri Cockerell, 1893. Canad. Ent. 25: 221.

Eulecanium fletcheri (Cockerell, 1893). Fernald, 1903, Cat. Cocc. Mass. Hatch Exp. Sta. Bul. 88, p. 187.

Microscopic characters: Antennae eight segmented; middle spiracular spine less than twice the length of the outer ones.

Field characters: The shape is globular, and the color is from rhubarb to fawn sandalwood (yellow brown).

Hosts and distribution: The specimens were taken on the twigs of

Juniperus virginiana (Red cedar) in Oklahoma and Tulsa Counties.

Notes: This species occurs on conifers. In Oklahoma it has been found on red cedar; Dietz and Morrison (1916) found this species occurring on arbor vitae.

Lecanium nigrofasciatum Pergande, 1898.

Plate XLI

Terrapin scale

Lecanium nigrofasciatum Pergande, 1898. U. S. Dept. Agr. Bur. Ent. Bul. 18, p. 26.

Eulecanium nigrofasciatum (Pergande, 1898). Fernald, 1903, Cat. Cocc. Mass. Hatch Exp.Sta. Bul. 88, p. 191.

Microscopic characters: Antennae six segmented; middle spiracular spine more than twice the length of the outer ones; a row of tiny spines extending cephalad from the anterior margin of the anal plates.

Field characters: The shape is oval to hemispherical; the background color ranges from carmine to loganberry (reddish brown) with a longitudinal median stripe of armaranth to hollyhock (red).

Hosts and distribution: The specimens were collected from the twigs of Bumelia languinosa (Chittam wood) in Blaine County.

Notes: The conspicuous longitudinal median stripe of red is quite characteristic of this species.

Lecanium quercifex Fitch, 1858.

Plate XLII

Oak lecanium

Lecanium quercifex Fitch, 1858. Rpt. Ins. N. Y. 5: 194.

Eulecanium quercifex (Fitch, 1858). Fernald, 1903, Cat. Cocc. Mass. Hatch Exp. Sta. Bul. 88, p. 194.

Microscopic characters: Antennae seven segmented; marginal setae short and blunt; middle spiracular spine less than twice the length of the outer ones; derm pores not in a definite pattern but scattered.

Field characters: The body is strongly convex and tapers gradually at both ends; color varies from burgundy to spanish raison (light to a dark brown); occurs mainly on black jack oak, but has also been collected from pyracantha.

Hosts and distribution: Collected from twigs of Pyracantha sp. (Fire-thorn) and Quercus marlandica (Black jack oak) in Payne County.

Genus Saissetia Deplanche, 1858.

Genotype: Lecanium hemisphaerica Targioni, 1867. Soc. Ital. di. Sci. Nat. Mem. 3(3): 1-87.

Microscopic characters: Antennae eight segmented; middle spiracular spine more than twice as long as the outer ones; anal ring with eight setae.

Field characters: Adult female hemispherical and strongly convex; in temperate regions confined to greenhouse plants; derm strongly sclerotized at maturity and has numerous pores.

Notes: Two species of this genus have been found in Oklahoma in greenhouses.

Key to the Species of Saissetia from Oklahoma

1 Derm smooth, glistening, and light in color; no longitudinal and transverse ridges. . . . . hemisphaerica (p. 71)

Derm with small tubercles, dull and dark in color; two transverse and one longitudinal ridges form an H-shaped figure on the dorsum . . . . . oleae (p. 71)

Saissetia hemisphaerica (Targioni)

Plate XLIII

Hemispherical scale

Lecanium hemisphaerica Targioni, 1867. Studii sul Cocc.: 26.

Saissetia hemisphaerica (Targioni, 1867). Fernald, 1903, Cat. Cocc., Mass. Hatch Exp. Sta. Bul. 88, p. 202.

Microscopic characters: The few specimens that I had were inadvertently lost, and as a result, the following description was taken from Zimmerman (1948). Antennae eight segmented; dorsum with numerous minute pores; minute tubercles in region anterior to anal plates; large numbers of tubular ducts of two distinct sizes; legs with movable tibia-tarsal articulation; tibia with an articulatory sclerosis.

Field characters: Adult female hemispherical and strongly convex; color from heather to punjab (light brown) and with a glossy appearance; under a hand lens scattered oval spots may be seen on the dorsum.

Hosts and distribution: The specimens were taken from a leaf of Arthesia sp. from a greenhouse in Oklahoma County.

Saissetia oleae (Bernard)

Plate XLIV

Lecanium oleae Bernard, 1782. Mem. d'Hist. Nat. Acad. Marseille.

Coccus oleae (Bernard, 1782). Kirkaldy, 1902, Fauna Hawaiiensis 3, p. 106.

Saissetia oleae (Bernard, 1782). Fernald, 1903, Cat. Cocc. Mass. Hatch Exp. Sta. Bul. 88, p. 205.

Microscopic characters: Antennae eight segmented; tubular ducts are of one size and have a narrow apical filament; polygon derm markings.

Field characters: The adult female is hemispherical, and the derm is roughened and very dark in color. The color varies from burgundy (dark brown) to mulberry (black). The major field character is the presence of two transverse ridges and one short longitudinal ridge to form an H-figure on the dorsum.

Hosts and distribution: The specimens were taken from the foliage and stems of the following greenhouse plants: Euphorbia pulcherrima (Poinsettia), Ficus spp., Gardenia sp., Gossypium sp. (Cotton), Mums, Philodendron sp. The counties represented were: Oklahoma, Payne, Tulsa, and Woods.

Notes: This species is closely related to S. hemisphaerica, but S. hemisphaerica has two sizes of tubular ducts. The larger ducts have apical filaments almost as wide as the basal portion; S. oleae has polygon markings on the derm, while S. hemisphaerica has minute pores on the dorsum.

Toumeyella parvicorne ? (Cockerell)

Plate XLV

Genotype: Lecanium mirabilis Cockerell, 1895. Psyche 7: 1-4.

Microscopic characters: Antennae six segmented and small; legs reduced in size; anal ring with ten setae; setae around anal plates of two sizes.

Field characters: The female body is oval and strongly convex; conspicuous pits are on dorsum, two longitudinal rows on each side of dorsum; color colonial to canary (light yellow).

Hosts and distribution: The specimens were obtained from the twigs and leaves of Pinus echinata (Shortleaf pine) from a nursery in Tulsa County.

Notes: The specimen was verified to the genus but not to the species. In view of this situation, only the generic description is given. Dr. Morrison indicated that the specimens varied a bit from T. parvicorne, but there was not enough variation to warrant a new species.

CHAPTER XII

FAMILY DACTYLOPIIDAE FERNALD, 1903.

The morphology of the species of the family varies markedly according to (Ferris, 1955). The one common character is in the duct which has the inner extremity formed into a cup, from the rim of which arises a delicate, filamentous process.

Key to the Genera of Dactylopiidae from Oklahoma

1 Adult female with body becoming strongly sclerotized and globular . . . . . .Kermes (p. 75)
Adult female with body not becoming strongly sclerotized and globular 2

2 (1) Anal lobes, cylindrical, not fused at base . .Eriococcus (p. 74)
Anal lobes globular, not fused at base . . . . . .Onceropyga (p. 77)

Genus Eriococcus Targioni-Tozzetti, 1868.

Genotype: Eriococcus crispus Fonscolombe, 1834. Soc. Ent. de France Ann. 3: 201-218.

Notes: Since this genus has only one species occurring in Oklahoma, the generic description is transferred to the discussion of the species.

Eriococcus quercus (Comstock, 1881)

Plate XLVI

Oak eriococcus

Rhizococcus quercus Comstock, 1881. Rpt. U. S. Dept. Agr. for 1880, 276-349.

Eriococcus howardi Ehrhorn, 1906. Canad.Ent. 38: 329-335.

Eriococcus quercus gilensis Cockerell, 1909. Ent. Soc. Wash. Proc. 10: 167-168.

Microscopic characters: Antennae seven segmented; dorsum beset with variable-sized setae; marginal setae present; tarsal claw with a tooth; anal lobes sclerotic; mesal margins toothed, cylindrical in shape.

Field characters: The female enclosed in an oval-shaped, parchment white (white), felt-like sac. Male similar to female but smaller.

Hosts and distribution: On foliage of Quercus stellata (Post oak) in Oklahoma County.

Genus Kermes Boitard, 1828.

Genotype: Coccus variegatus Gemelin, 1766, a synonym of Chermes roboris Fourcroy, 1785. Entomologia Parisiensis: 544 pp.

Kermococcus Silvestri, 1911, proposed as a name to replace Kermes because of the similarity of pronunciation of Kermes to Chermes, an aphid; invalid.

Field characters: The adult female is globular in form, strongly convex, and sclerotized; antennae and legs present; host plant apparently restricted to the genus Quercus (Oak).

Notes: According to Ferris (1955), this genus is in a deplorable situation because species' descriptions have been based on the gross

features, not on the microscopical characters. Relatively few good microscopic mounts have been made of representatives of this genus, and certainly not enough to form the basis for an adequate description based on microscopic characters. There appears to be some justification for describing species from gross appearances; since after molting to the adult stage, growth is very rapid and suitable specimens can only be found within perhaps fifteen days after reaching the adult stage.

Ferris originally had the genus in the family Kermidae; but in the seventh volume of his Atlas (1955), he placed it in the family Dactylopiidae based on the first instar forms which are of the dactylopiid type.

Two species have been found in Oklahoma.

Key to the Species of Kermes from Oklahoma

1 Mature female globular; on Quercus; pubescent. . . pubescens (p. 76)

Mature female globular; not pubescent. . . . . .boguei (p. 76)

Kermes boguei Cockerell, 1897.

Kermes boguei Cockerell, 1897. Ent. News 8: 94.

Type host and locality: Quercus alba, ten miles from Stillwater, Oklahoma.

Field characters: Adult female globular; color whippet to coffee (light brown); mottled with dahlia to lilium (red), gargoyle to smoke brown (black), and polar bear to cream (ivory).

Hosts and distribution: Quercus palustris (Pin oak) on twigs from Oklahoma County.

Kermes pubescens Bogue, 1898.

Kermes pubescens Bogue, 1898. Canad. Ent. 30: 172.

Field characters: Adult female globular; color spanish raison (dark brown); body covered with an iris to oyster white (white) pubescence; body glossy.

Hosts and distribution: Quercus stellata (Post oak) on twigs and foliage from Bryan, Choctaw, LeFlore, and Pittsburg Counties. Reports in June, 1959, indicate that the species occurs along the eastern tier of counties, from the Kansas border south to the Texas border.

Notes: Apparently this species is restricted to Quercus stellata.

Genus Onceropyga Ferris, 1955.

Genotype: Eriococcus neglectus Cockerell, 1895. Garden and Forest No. 382: 244.

Notes: Since this genus has only one species in Oklahoma, the generic description is transferred to the species description.

Onceropyga nudula Ferris, 1955.

Plate XLVII

Onceropyga nudula Ferris, 1955. Atlas of Scale Insects, VII, p. 211.

Microscopic characters: Antennae seven segmented; tarsal claw with a tooth; tubular ducts with a deep asymmetrical cup; anal lobes membranous.

Field characters: The adult female is enclosed in an oval, parchment white (white) sac which has an aperture over the anal opening; a grass infesting species.

Hosts and distribution: Buchloe dactyloides (Buffalo grass) from Payne County.

CHAPTER XIII

FAMILY PSEUDOCOCCIDAE HEYMONDS

The Pseudococcidae is a large and complicated group, which includes other soft scale insects, as well as the mealybugs. The legs may be fully developed or lacking at maturity; one or two pairs of dorsal ostioles may be present or absent. If two pairs are present, the anterior ones are located on the prothorax and the posterior pair on the seventh abdominal segment. Triocular pores are present. The dorsal ducts are internally truncated. Cerarii are present. The circulus may or may not be present. The anal ring is cellular.

Key to the Genera of Pseudococcidae from Oklahoma

1 Two pairs of dorsal ostioles present
. . . . . .Pseudococcidae (Mealybugs only) 2

One pair of dorsal ostioles present or dorsal ostioles lacking. . . . . Pseudococcidae (exclusive of mealybugs) 6

2 (1) Tarsal claws dentate on inner margins. . . . <u>Phenacoccus</u> (p. 82)

Tarsal claws not dentate 3

3 (2) Enlarged dorsal ducts having their orifice surrounded by a sclerotized area bearing setae . . . . . .<u>Ferrisiana</u> (p. 80)

Not as above 4

4 (3) With eighteen pairs of cerarii . . . . . <u>Planococcus</u> (p. 83)

With not more than seventeen pairs of cerarii. 5

5 (4) With seventeen pairs of cerarii having slender auxiliary setae along with the conical setae in the cerarii. Pseudococcus (p. 85)

6 (1) Antennae reduced to tubercles, two segmented; legs absent . . . . . .Antonina (p. 79)

Antennae five segmented; legs present although reduced in size; one pair of dorsal ostioles present . .Antoninoides (p. 80)

Genus Antonina Signoret, 1875.

Chaetococcus Maskell, 1898. New Zeal. Inst. Trans. and Proc. 30: 219-252.

Genotype: Antonina purpurea Signoret.

Notes: Since this genus is represented by just one species in Oklahoma, the generic description is based on the species.

Antonina nortoni Parrott, 1899.

Plate XLVIII

Microscopic characters: Antennae two segmented; mouth parts quite close to anterior end; legs lacking; spiracles with very large apodemes; a cluster of pores on outer margin of spiracular opening.

Field characters: Adult female is oval in shape and enclosed in a parchment white (white) cottony sac. Occurs on the crown and roots of grasses.

Hosts and distribution: The specimens were collected from the crown and roots of Aristida purpurea (Purple aristida) in Beaver and Texas Counties.

Notes: This species can be separated from Antoninoides parrotti (Cockerell) by the fact that A. parrotti has five segmented antennae. Legs are present.

Genus Antoninoides Ferris, 1953.

Genotype: Antonina parrotti Cockerell, 1916. Jour. Econ. Ent. 9: 312-313.

Notes: Since only one species of the genus is represented in the state, the description will be based on the species.

Antoninoides parrotti (Cockerell)

Plate XLIX

Antonina graminis Parrott, 1900 (not Maskell, 1897), Kans. Agr. Expt. Sta. Bul. 98: 137-146.

Antonina parrotti Cockerell, 1916. Jour. Econ. Ent. 9: 312-313.

Antoninoides parrotti (Cockerell, 1916) Ferris, 1953, Atlas of Scale Insects, V. 6, p. 301.

Microscopic characters: Antennae five segmented; legs present but small; spiracles have large apodemes; cluster of pores on outer margin of spiracular opening.

Field characters: Occurs on grasses; adult female is oval in shape and enclosed in a parchment white (white) cottony sac.

Hosts and distribution: On the roots and crown of Andropogon scoparius (Little bluestem) from Ellis County.

Notes: Antonina graminis Parrott, 1899, is a homonym according to Ferris, (1953).

Genus Ferrisiana Takahashi, 1929.

Ferrisia Fullaway, 1923. Hawaii Ent. Soc. Proc. 5: 305-321.

Genotype: Dactylopius virgatus Cockerell, 1893.

Notes: One species of this genus has been found in the state, and

the usual generic description will be replaced by the description of the species.

Ferrisiana virgata (Cockerell)

Plate L

Striped mealybug

Dactylopius virgatus Cockerell, 1893. Entomologist 26: 177-179: 266-268.

Dactylopius ceriferus Newstead, 1898. Ent. Monthly Mag. 34: 92-99.

Pseudococcus virgatus (Cockerell), Ferris, 1919. Jour. Econ. Ent. 12: 292-299.

Ferrisis virgatus (Cockerell), Fullaway, 1923. Hawaii Ent. Soc. Proc. 5: 305, 321.

Ferrisiana virgata (Cockerell). Takahashi, 1929. Formosa Nat. Hist. Soc. Trans. 19(104): 425, 431.

Microscopic characters: Eight segmented antennae; large ducts present; one cerarius is present on each anal lobe; dorsal ostioles present.

Field characters: Since the specimens, mounted on slides, were obtained from R. G. Price and he, in turn, received the specimens in a vial of preservative, the field description is taken from Merrill (1953). Long, slender body and dark purple in color; body covered with a fine, white powdery secretion composed of delicate, silken, waxy threads; two narrow dark bands extending lengthwise on the body; last pair of caudal filaments about one-half the length of the body; legs and antennae brown.

Hosts and distribution: The specimens were obtained from Aglaonema simplex (Chinese evergreen) in Stevens County.

Genus Phenacoccus Cockerell, 1893.

Genotype: Pseudococcus aceris Signoret, 1868. Soc. Ent. de France Ann. (ser. 4) 8: 503-528.

Notes: Two species have been found in the state.

Field characters: The field characterization for the genus is practically non-existent, since the generic characters are all microscopic. The body is oval in shape.

Microscopic characters: Antennae nine segmented; dorsal ostioles present; eighteen pairs of cerarii present.

Key to the Species of Phenacoccus from Oklahoma

1 Circulus large and produced into a narrow lateral arm on each side; tarsal claw without a tooth . . . . . .gossypii (p. 82)

1 Circulus without lateral arms; tarsal claw with a tooth . . . . . .solenopsis (p. 83)

Phenacoccus gossypii (Townsend and Cockerell)

Plate LI

Mexican mealybug

Phenacoccus gossypii Townsend and Cockerell, 1898. N. Y. Ent. Soc. Jour. 6: 165-180.

Microscopic characters: Antennae nine segmented; multilocular disc pores along posterior margins of most of segments; circulus large and produced into a narrow, lateral arm on each side.

Field characters: The original specimens were received in a vial containing preservative. Only the slide mounts of the specimens were studied, thus the field description is taken from Merrill (1953). Oval in shape and

of a light yellow to bluish gray color; body covered with a thin, powdery coating; anal filaments about one-fourth the body length; marginal filaments short; egg sac consists of a compact, rectangular mass of white, cottony material.

Hosts and distribution: The specimens were obtained from Chrysanthemum sp., Lantana sp., and Verbena sp. in greenhouses located in Comanche, Noble, and Payne Counties.

Phenacoccus solenopsis (Tinsley)

Plate LII

Phenacoccus solenopsis Tinsley, 1898. Canad. Ent. 30: 47-48.

Microscopic characters: Claws with a small tooth; cerarii with two setae, except the cerarius on the anal lobe which has three setae.

Field characters: Adult female oval; covered lightly with a powdery wax which is of a parchment white (white) color; found on roots and crown of Ambrosia sp. Ferris (1950) found the specimens on the above ground portions of the plant.

Hosts and distribution: Collected from the roots of Ambrosia sp. (Ragweed) in Dewey County.

Genus Planococcus Ferris, 1950.

Genotype: Pseudococcus citri Risso, 1813. Mus. d'Hist. Nat. Ann. 20: 169-212, 401-431.

Notes: This genus is represented by one species in Oklahoma.

Dorthesia cirri Risso, 1813, Mus. d'Hist. Nat. Ann. 20: 169-212, 401-431.

Coccus citri Boisduval, 1867. Essai Sur L'Ent. Hort. Paris, Donnaud, p. 648.

Dactylopius destructor Comstock, 1881. U. S. Dept. Agr. Rpt. for 1880, pp. 276-349.

Dactylopius brevispinus Targioni-Tozzetti, 1888. Min. di Agr. Indus. E Com. Ann. di Agr., 1888 (Nos. 145-146): 415-436.

Lecanium phyllococcus Ashmead, 1891. Amer. Ent. Soc. Trans. 18: 92-102.

Planococcus citri (Risso, 1813). Ferris, 1950, Atlas of Scale Insects, v. 5: 165.

Planococcus citri (Risso)

Plate LIII

Citrus mealybug

Microscopic characters: Antennae eight segmented; eighteen pairs of cerarii; all cerarii with only two slender conical setae with no accessory setae; area around cerarii not sclerotized; dorsal ducts very distinct.

Field characters: The writer has examined only slides furnished by R. G. Price and is, therefore, using the field description as presented by Merrill (1953). Adult female oval, light amber in color and covered with a white, powdery wax-like secretion; caudal filaments about one-fourth the length of the insect; legs and antennae brownish; eggs deposited in large, irregular masses of cottony secretion.

Hosts and distribution: The specimens were received in vials and collected from greenhouses from the following plants: Amaryllis sp., Anthurium sp., Aralia sp., Chrysanthemum sp., Coleus sp., Croton sp., Euonymus sp., Geranium sp., Ilex spp., Kalanchoe sp., Nephilyis sp., and Philodendron sp. The greenhouses were located in Choctaw, Grady, Oklahoma, Payne, and Tulsa Counties.

Genus Pseudococcus Westwood, 1840.

Genotype: Coccus adonidum Linnaeus, 1758. Sys. Nat. Ed. 10: 455-457.

Notes: This genus contains two species in Oklahoma.

Field characters: According to Ferris (1950), the genus contains over 200 species which are heterogeneous. This unwieldy genus makes classification very difficult and differentiating field characters non-uniform except to say that the body is oval and covered with a white, waxy, powdery secretion.

Microscopic characters: Antennae eight segmented; body oval; anal lobes not strongly developed; tarsal claws without a tooth; seventeen pairs of cerarii present.

Key to the Species of Pseudococcus from Oklahoma

1 Seventeen pairs of cerarii present; usually occurring on plants in greenhouses or indoors; caudal pair of anal filaments as long or longer than body. . . . . .adonidum (p. 85)
Seventeen pairs of cerarii present; not usually occurring on plants in greenhouses or indoors; caudal pair of anal filaments not as long as body. 2

2 (1) Usually present on grasses . . . . . sorghiellus (p. 86)

Pseudococcus adonidum Linnaeus, 1758.

Plate LIV

Long-tailed mealybug

Coccus adonidum Linnaeus, 1758. Syst. Nat. Ed. 10: 455-457.

Dactylopius adonidum (Linnaeus, 1758). Comstock, 1881, Rpt. U. S.

Dept. Agr. for 1880, p. 341.

Dactylopius longispinus Osborne, 1898. Contr. Ia. Agr. Coll., p. 2.

Dactylopius longifilis Newell, 1899. Bul. 43, Ia. Sta., p. 172.

Pseudococcus longispinus (Osborne, 1898). Fernald, 1903, Cat. Cocc. Hatch Exp. Sta., Bul. 88, p. 104.

Pseudococcus adonidum (Comstock, 1881). Sanders, 1909, Jour. Econ. Ent. 2: 431.

Microscopic characters: Antennae eight segmented; presence of two or three tubular ducts close to each cerarius; sclerotized triangular area on ventral part of anal lobe.

Field characters: (Merrill, 1953) Oval in shape; grayish to light yellow in color; covered with a fine, powdery, waxy, white secretion; caudal pair of anal filaments often much longer than the body; the other filaments around the margin of the body are about one-half the width of the body.

Hosts and distribution: The specimens were received in vials and represent the following greenhouse plants: Euonymus sp., Philodendron sp., and Pothos sp. The greenhouses were in Comanche, Oklahoma, and Tulsa Counties.

Pseudococcus sorghiellus Forbes, 1885.

Plate LV

Coccus sorghiellus Forbes, 1885. Ill. State Ent. Ann. Rpt. 14, p. 71.

Dactylopius sorghiellus Forbes, 1894. Ill. State Ent.Ann. Rpt. 18, 106-108.

Microscopic characters: Antennae eight segmented; seventeen pairs of cerarii present; anal lobe cerarii surrounded by a concentrated cluster

of numerous pores; well defined sclerotized area on ventral part of anal lobe.

Field characters: Occurs on grasses; attended by ants (Forbes, 1894); the specimens were obtained from the "washings" of a Berlese funnel in the process of sorting samples from a recent chinch bug survey, thus an adequate field description is not offered.

Hosts and distribution: Collected from culms and leaves of Andropogon scoparius (Little bluestem) in Kay and Murray Counties.

CHAPTER XIV

FIELD GUIDE

The following guide is based on host plant association and field appearance of the species. It is in no way intended to serve as an accurate determination of the species but to form a tentative diagnosis.

A. Body of adult female usually small, flat, covered by a detachable waxy scale covering; lacking legs and antennae; prominent circular or oval area raised or flat on scale covering. Diaspididae (armored scales).

B. Found on citrus fruits in groceries, markets, and other food establishments; Chaff scale (*Parlatoria pergandii*), Florida red scale (*Chrysomphalus ficus*), Glover scale (*Lepidosaphes gloverii*), Purple scale (*Lepidosaphes beckii*).

BB. Found under greenhouse conditions and in nurseries:

1. On Azalea (*Rhododendron* sp.): Bifasciculate scale (*Chrysomphalus bifasciculatus*).
2. On Cactus (*Cactus* spp.): Cactus scale (*Diaspis echinocacti*).
3. On Camellia (*Camellia* sp.): Camellia scale (*Lepidosaphes camelliae*), Palm fiorinia scale (*Fiorinia fioriniae*), Tea scale (*Fiorinia theae*).
4. On Euonymus (*Euonymus* spp.): Euonymus scale (*Unaspis euonymi*), Howard scale (*Hemiberlesia howardi*), Latania

scale (Hemiberlesia lataniae).

5. On Fern (Filices sp.): Fern scale (Pinnaspis aspidistrae).

6. On Holly (Ilex spp.): Bifasciculate scale (Chrysomphalus bifasciculatus), Camellia scale (Lepidosaphes camellia), Euonymus scale (Unaspis euonymi), Spinose scale (Aspidiotus spinosus), Tea scale (Fiorinia theae).

7. On Jacobs coat (Amaranthus sp.): Howard scale (Hemiberlesia howardi).

8. On Magnolia (Magnolia sp.): Albopicta scale (Acutaspis albopicta).

9. On Orchid (Orchid sp.): Boisduval scale (Diaspis boisduvalii).

10. On Palm (Dictyosperma sp.): Florida red scale (Chrysomphalus ficus).

11. On Philodendron (Philodendron spp.): Bifasciculate scale (Chrysomphalus bifasciculatus).

12. On "Rubber plants" (Ficus spp.): Bifasciculate scale (Chrysomphalus bifasciculatus).

13. On Schefflera (Schefflera sp.): Latania scale (Hemiberlesia lataniae).

BBB. Found on conifers.

1. On Austrian pine (Pinus nigra): Pine needle scale (Phenacaspis pinifoliae).

2. On Juniper (Juniperus spp.): Juniper scale (Carulaspis visci), Minute cypress scale (Carulaspis minima), Redwood scale (Aonidia shastae).

BBBB. Found on fruit and nut-bearing trees.

1. On Apple (*Malus* sp.): Forbes scale (*Quadraspidiotus forbesi*), San Jose scale (*Quadraspidiotus perniciosus*), Scurfy scale (*Chionaspis furfura*).
2. On "Fruit" tree: Gloomy scale (*Chrysomphalus tenebricosus*).
3. On Pear (*Pyrus* sp.): San Jose scale (*Quadraspidiotus perniciosus*).
4. On Pecan (*Carya* sp.): San Jose scale (*Quadraspidiotus perniciosus*).
5. On Plum (*Prunus* sp.): San Jose scale (*Quadraspidiotus perniciosus*).

BBBBB. Found on other deciduous trees.

1. On American elm (*Ulmus americana*): Elm scurfy scale (*Chionaspis americana*).
2. On Black willow (*Salix nigra*): Black willow scale (*Chionaspis salicis-nigrae*).
3. On Burr oak (*Quercus macrocarpa*): Obscure scale (*Melanaspis obscura*).
4. On Chittam wood (*Bumelia lanuginosa*): Putnam scale (*Diaspidiotus ancylus*).
5. On Elm (*Ulmus* sp.): Scurfy scale (*Chionaspis furfura*).
6. On Northern red oak (*Quercus borealis*): Buckeye scale (*Diaspidiotus aesculi*).
7. On Siberian elm (*Ulmus pumila*): Elm scurfy scale (*Chionaspis americana*).

BBBBBB. Found on shrubs and weeds.

1. On Broonweed (*Xanthocephalus dracunculoides*): Dearness scale (*Rhizaspidiotus dearnessi*).

2. On Euonymus (Euonymus spp.): Euonymus scale (Unaspis euonymi).

3. On Firethorn (Pyracantha sp.): Forbes scale (Quadraspidiotus forbesi), San Jose scale (Quadraspidiotus perniciosus).

4. On Ivy (Hedera spp.): San Jose scale (Quadraspidiotus perniciosus).

5. On Oregon Holly (Mahonia aquifolium): San Jose scale (Quadraspidiotus perniciosus).

6. On Spirea (Spiraea sp.): San Jose scale (Quadraspidiotus perniciosus).

7. On Trifoliate orange (Poncirus sp.): San Jose scale (Quadraspidiotus perniciosus).

AA. Body of adult female sac-like, gall-like, not flat and not covered by a detachable scale covering as are the Diaspididae; sometimes enclosed in a sac or covered with waxy or powdery secretion. Unarmored (soft) scale insects.

B. Body covered with a mealy secretion: margins with projecting white waxy filaments; not enclosed in a sac. Mealybugs: Citrus mealybug (Planococcus citri), Long-tailed mealybug (Pseudococcus adonidum), Mexican mealybug (Phenacoccus gossypii), Phenacoccus solenopsis, Pseudococcus sorghiellus, Striped mealybug (Ferrisiana virgata).

BB. Body covered with a mealy secretion; marginal waxy filaments lacking; enclosed in a sac.

1. Occurring on the crown and roots of grasses: Antonina nortoni, Antoninoides parrotti, Onceropyga nudula.

2. Occurring on Post oak (Quercus stellata): Oak eriococcus

(Eriococcus quercus).

BBB. Out-of-door species, body naked; not covered with a mealy secretion.

C. Found on conifers.

1. On Red cedar (Juniperus virginiana): Fletcher scale (Lecanium fletcheri).

2. On Shortleaf pine (Pinus echinata): Toumeyella parvicorne (?).

CC. Not found on conifers.

1. On Chittam wood (Bumelia lanuginosa): Terrapin scale (Lecanium nigrofasciatum).

2. On Oak (Quercus spp.): Kermes boguei, Kermes pubescens, Oak eriococcus (Eriococcus quercus), Oak lecanium (Lecanium quercifex).

3. On Oregon holly (Mahonia aquifolium): Cerococcus koebelei.

4. On Hackberry (Celtis sp.): Lecaniodiaspis celtidis, European fruit lecanium (Lecanium corni).

5. On other trees: European fruit lecanium (Lecanium corni).

BBBB. Greenhouse species.

C. On Gardenia (Gardenia sp.): Florida ceroplastes (Ceroplastes floridensis).

CC. Body strongly convex; nearly hemispherical.

D. Dorsum with a distinct H-shaped figure formed by two transverse ridges and one longitudinal ridge; color dark brown to almost black. Black scale (Saissetia oleae).

DD. Dorsum smooth, hemispherical, color lighter. Hemispherical scale (Saissetia hemisphaerica).

CCC. Body almost flat; oval shaped; anal cleft short; soft scale (Coccus hesperidum).

CHAPTER XV

HOST PLANT INDEX

This host list is restricted to plants that have been found infested with scale insects within the state of Oklahoma during the two year period of this study.

ACACIA SP. (Popinac)

Coccus hesperidum (L.)

AGLAONEMA SIMPLEX (Chinese evergreen)

Ferrisiana virgata (Ckll.)

AMARANTHUS SP.

Hemiberlesia howardi (Ckll.)

AMARYLLIS SP.

Planococcus citri (Risso)

AMBROSIA SP. (Ragweed)

Phenacoccus solenopsis Tinsl.

ANDROPOGON - See grass

ANTHURIUM SP.

Planococcus citri (Risso)

APPLE - See MALUS

ARALIA SP.

Planococcus citri (Risso)

ARISTIDA - See grass

ARTHESIA SP.

Saissetia hemisphaerica (Targ.)

AUSTRIAN PINE - See PINUS NIGRA

AZALEA - See RHODODENDRON

BEGONIA SP.

Coccus hesperidum (L.)

BETULA (Birch)

Lepidosaphes ulmi (L.)

BIRCH - See BETULA

BLACK JACK OAK - See QUERCUS MARLANDICA

BLACK WALNUT - See JUGLANS NIGRA

BLACK WILLOW - See SALIX NIGRA

BROOMWEED - See XANTHOCEPHALUS DRACUNCULOIDES

BUCHLOE - See GRASS

BUMELIA LANGUINOSA (Chittam wood)

Diaspidiotus ancylus Putn.

Lecanium nigrofasciatum (Perg.)

BURR OAK - See QUERCUS MACROCARPA

CACTUS

Diaspis echinocacti (Bouché)

CAMELLIA

Fiorinia fioniniae (Targ.)

Fiorinia theae Green

Lepidosaphes cameliae Hoke

CAPE JASMINE - See GARDENIA

CARYA PECAN (Pecan)

Aspidiotus perniciosus Comst.

Lecanium corni (Bouché)

CASTILLEJA

Coccus hesperidum (L.)

CELTIS SP. (Hackberry)

Lecanium celtidis Ckll.

Lecanium corni (Bouché)

CHINABERRY - See MELIA AZADIRACHTA

CHINESE EVERGREEN - See AGLAONEMA SIMPLEX

CHITTAM WOOD - See BUMELIA SP.

CHRYSANTHEMUM

Coccus hesperidum (L.)

Phenacoccus gossypii T. & C.

Planococcus citri (Risso)

Saissetia oleae (Bern.)

CITRUS SPP.

Chrysomphalus ficus Ashm.

Coccus hesperidum (L.)

Lepidosaphes beckii (Newm.)

Lepidosaphes gloverii (Pack.)

Parlatoria pergandii Comst.

CITRUS, PONCIRUS TRIFOLIATA (Trifoliate orange)

Quadraspidiotus perniciosus (Comst.)

CODIAEUM (Croton)

Planococcus citri (Risso)

COLEUS

Phenacoccus gossypii T. & C.

Planococcus citri (Risso)

COTTON - See GOSSYPIUM

CROTON - See CODIAEUM

CYDONIA OBLONGA (Quince)

Quadraspidiotus perniciosus (Comst.)

CYPRUS ALTERNIFOLIUS

Coccus hesperidum (L.)

DIFFENBACHIA SP.

Coccus hesperidum (L.)

ELM - See ULMUS

EUONYMUS (Strawberry bush, Burning bush)

Coccus hesperidum (L.)

Hemiberlesia howardi (Ckll.)

Hemiberlesia lataniae (Sign.)

Planococcus citri (Risso)

Pseudococcus adonidum (Targ.)

Unaspis euonymi (Comst.)

EUPHORBIA PULCHERRIMA (Poinsettia)

Coccus hesperidum (L.)

Quadraspidiotus perniciosus (Comst.)

Saissetia oleae (Bern.)

FERNS

Pinnaspis aspidistrae (Sign.)

FICUS SPP.

Chrysomphalus bifasciculatus Ferris

Coccus hesperidum (L.)

Quadraspidiotus perniciosus (Comst.)

Saissetia oleae (Bern.)

FIRETHORN - See PYRACANTHA

"FRUIT" TREE

Chrysomphalus tenebricocus Comst.

GARDENIA (Cape jasmine)

Ceroplastes floridensis (?) Comst.

Saissetia oleae (Bern.)

GERANIUM

Planococcus citri (Risso)

GOSSYPIUM (Cotton)

Saissetia oleae (Bern)

GRASS: ANDROPOGON SCOPARIUS (Little bluestem)

Antoninoides parrotti (Ckll.)

Pseudococcus sorghiellus (Forbes)

GRASS: ARISTIDA PURPUREA (Purple aristida)

Antonina nortoni Parr.

GRASS: ARISTIDA SP.

Antonina nortoni Parr.

GRASS: BUCHLOE DACTYLOIDES (Buffalo grass)

Onceropyga nudula Ferris

HACKBERRY - See CELTIS

HEDERA SPP. (Ivy)

Quadraspidiotus perniciosus (Comst.)

HOLLY - See ILEX

ILEX SPP. (Holly)

Aspidiotus spinosus Comst.

Chrysomphalus bifasciculatus Ferris

Coccus hesperidum (L.)

Fiorinia theae Green

Lepidosaphes camelliae Hoke

Planococcus citri (Risso)

Unaspis eyonymi (Comst.)

IVY - See HEDERA SPP.

JUGLANS NIGRA (Black walnut)

Lecanium corni (Bouché)

JUNIPER - See JUNIPERUS

JUNIPERUS SPP.

Carulaspis visci (Shrank)

JUNIPERUS VIRGINIANA (Red cedar)

Aonidia shastae (Cole.)

Carulaspis minima (Targ.)

Lecanium fletcheri Ckll.

KALANCHOE

Planococcus citri (Risso)

LANTANA

Phenacoccus gossypii T. & C.

MAGNOLIA

Acutaspis albopicta (Ckll.)

MAHONIA AQUIFOLIUM (Oregon holly)

Cerococcus koebelei (Ckll.)

Quadraspidiotus perniciosus (Comst.)

MALUS (Apple)

Chionaspis furfura (Fitch)

Lepidosaphes ulmi (L.)

Quadraspidiotus forbesi (Johns.)

Quadraspidiotus perniciosus (Comst.)

MELIA AZADIRACHTA (Chinaberry)

Lecanium corni (Bouché)

MORUS SP. (Mulberry)

Lecanium corni (Bouché)

MULBERRY - See MORUS

NEPHILYIS

Planococcus citri (Risso)

NORTHERN RED OAK - See QUERCUS BOREALIS

ORCHID

Diaspis boisduvalii Sign.

OREGON HOLLY - See MAHONIA AQUIFOLIUM

PALMS (unnamed)

Chrysomphalus ficus Ashm.

PEAR - See PYRUS SPP.

PECAN - See CARYA PECAN

PHILODENDRON

Chrysomphalus bifasciculatus Ferris

Coccus hesperidum (L.)

Planococcus citri (Risso)

Pseudococcus adonidum (Targ.)

Saissetia oleae (Bern.)

PIN OAK - See QUERCUS PALUSTRIS

PINUS ECHINATA (Short leaf pine)

Toumeyella parvicorne ? (Ckll.)

PINUS NIGRA (Austrian pine)

Phenacaspis pinifoliae (Fitch)

PLUM - See PRUNUS

POINSETTIA - See EUPHORBIA PULCHERRIMA

PONCIRUS TRIFOLIATA - See CITRUS, PONCIRUS TRIFOLIATA

POPINAC - See ACACIA

POST OAK - See QUERCUS STELLATA

POTHOS

Pseudococcus adonidum (Targ.)

PRUNUS SP. (Peach)

Quadraspidiotus perniciosus (Comst.)

PYRACANTHA (Firethorn)

Coccus hesperidum (L.)

Lecanium quercifex Fitch

Quadraspidiotus forbesi (Johns.)

Quadraspidiotus perniciosus (Comst.)

PYRUS SPP. (Pear)

Quadraspidiotus perniciosus (Comst.)

QUERCUS BOREALIS (Northern red oak)

Diaspidiotus aesculi (Johns.)

QUERCUS MACROCARPA (Burr oak)

Melanaspis obscura (Comst.)

QUERCUS MARLANDICA (Black jack oak)

Lecanium quercifex Fitch

QUERCUS PALUSTRIS (Pin oak)

Coccus hesperidum (L.)

Kermes boguei Ckll.

QUERCUS STELLATA (Post oak)

Eriococcus quercus (Comst.)

Kermes pubescens Bogue

RED CEDAR - See JUNIPERUS VIRGINIANA

RHODODENDRON (Azalea)

Chrysomphalus bifasciculatus Ferris

ROSA (Rose)

Aulacaspis rosae (Bouché)

ROSE - See ROSA

SALIX NIGRA (Black willow)

Chionaspis salicis - nigrae (Walsh)

SCHEFFLERA

Hemiberlesia lataniae (Sign.)

SHORT LEAF PINE - See PINUS ECHINATA

SPIRAEA (Spirea, Bridalwreath)

Quadraspidiotus perniciosus (Comst.)

ULMUS AMERICANA (American elm)

Chionaspis americana (Johns.)

Lecanium corni (Bouché)

ULMUS PUMILA (Siberian elm)

Chionaspis americana (Johns.)

Lecanium corni (Bouché)

ULMUS SPP. (Elm)

Chionaspis furfura (Fitch)

VERBENA

Phenacoccus gossypii T. & C.

XANTHOCEPHALUS DRACUNCULOIDES

Rhizaspidiotus dearnessi (Ckll.)

CHAPTER XVI

NEW RECORDS OF SCALE INSECTS IN OKLAHOMA

During the course of the study the following twenty-seven species were recorded for the first time from the state of Oklahoma:

Antoninoides parrotti (Cockerell)

Aspidiotus spinosus Comstock

Aulacaspis rosae (Bouché)

Carulaspis minima (Targioni)

Carulaspis visci (Shrank)

Cerococcus koebelei (Cockerell)

Ceroplastes floridensis (?) Comstock

Chionaspis furfura (Fitch)

Diaspis boisduvalii Signoret

Eriococcus quercus (Comstock)

Ferrisis virgata (Cockerell)

Hemiberlesia howardi (Cockerell)

Lecanium fletcheri Cockerell

Lecanium nigrofasciatum Pergande

Lecanium quercifex Fitch

Lepidosaphes beckii (Newman)

Onceropyga nudula Ferris

Parlatoria pergandii Comstock

Phenacaspis pinifoliae (Fitch)

Phenacoccus gossypii Townsend and Cockerell

Phenacoccus solenopsis Tinsley

Pinnaspis aspidistrae (Signoret)

Pseudococcus adonidum Linnaeus

Pseudococcus sorghiellus (Forbes)

Pulvinaria sp.

Rhizaspidiotus dearnessi (Cockerell)

Toumeyella parvicorne (?) (Cockerell)

CHAPTER XVII

SUMMARY

The period of time spent in this study was from June 1957 to June 1959.

Approximately two hundred and thirty samples of scale insect infested plant material involving approximately seventy plant species was examined.

Forty-seven counties were represented out of a possible seventy-seven.

A total of five families, thirty-five genera, and fifty-six species was obtained during the study of the scale insects of Oklahoma. Twenty-seven species were first official records for the state.

Keys to the families, genera, and species are given for all the species found during the investigation period with appropriate illustrations to aid in their determination.

A single specimen of the Florida red scale, Chrysomphalus ficus Ashmead, contained embryos within the body cavity. This is the only record of the Florida red scale being viviparous.

This preliminary study should be continued with emphasis on more intensive collecting in all counties of the state.

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APPENDIX

Plate I

Morphology of an Armored Scale Insect

(After McKenzie)

1. Antenna
2. Duct tubercle
3. Multilocular disc pores and anterior spiracle
4. Derm pocket
5. Median dorsal macroducts
6. Perivulvar pores
7. Vulva
8. Cicatrix
9. Microduct
10. Plates with microducts
11. Median or first lobe
12. Second lobe
13. Dorsal marginal macroduct
14. Anus
15. Dorsal intermediate macroducts
16. Marginal plate or gland spine
17. Eye spot
18. Eye spot (Spur type)
19. Eye spot (Raised type)
20. Derm sclerotization

Plate I

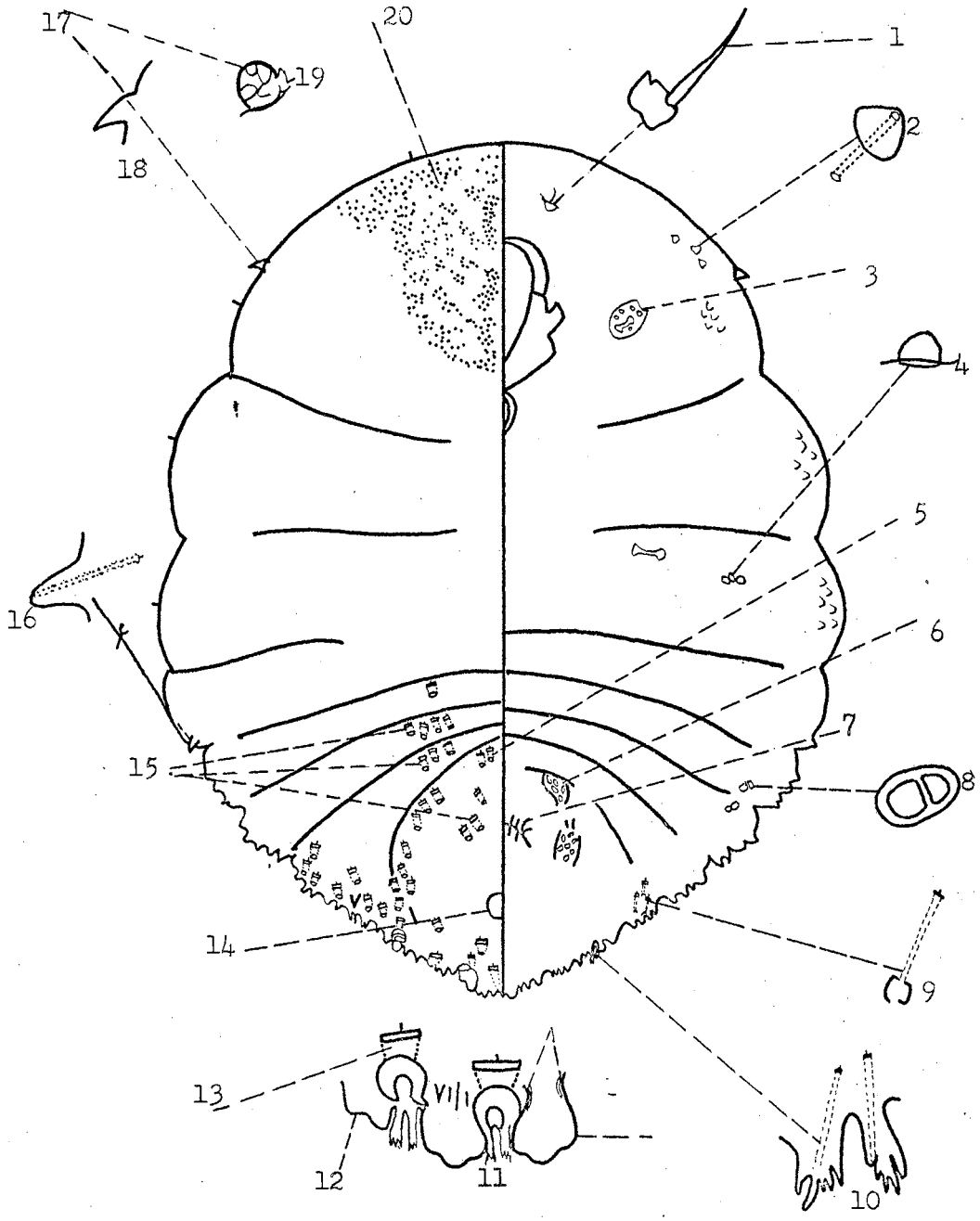


Plate II

Acutaspis albopicta (Cockerell)

Albopicta Scale

1. Adult female
2. Pygidium
3. Pygidial fringe
4. Anterior spiracle
5. Male scale covering
6. Female scale covering

Plate II

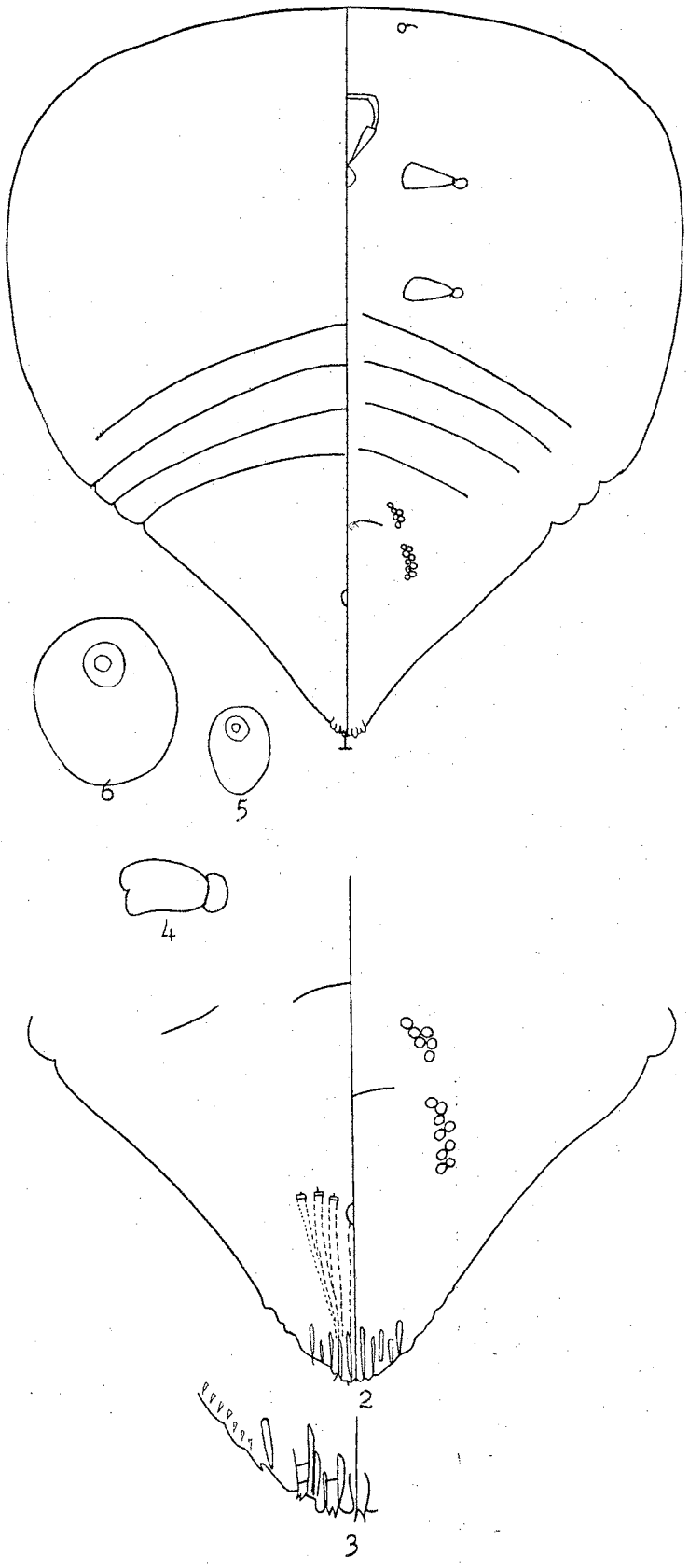


Plate III

Aonidia shastae (Coleman)

Redwood Scale

1. Adult female
2. Pygidium
3. Pygidial fringe
4. Anterior spiracle
5. Male scale covering
6. Female scale covering

Plate III

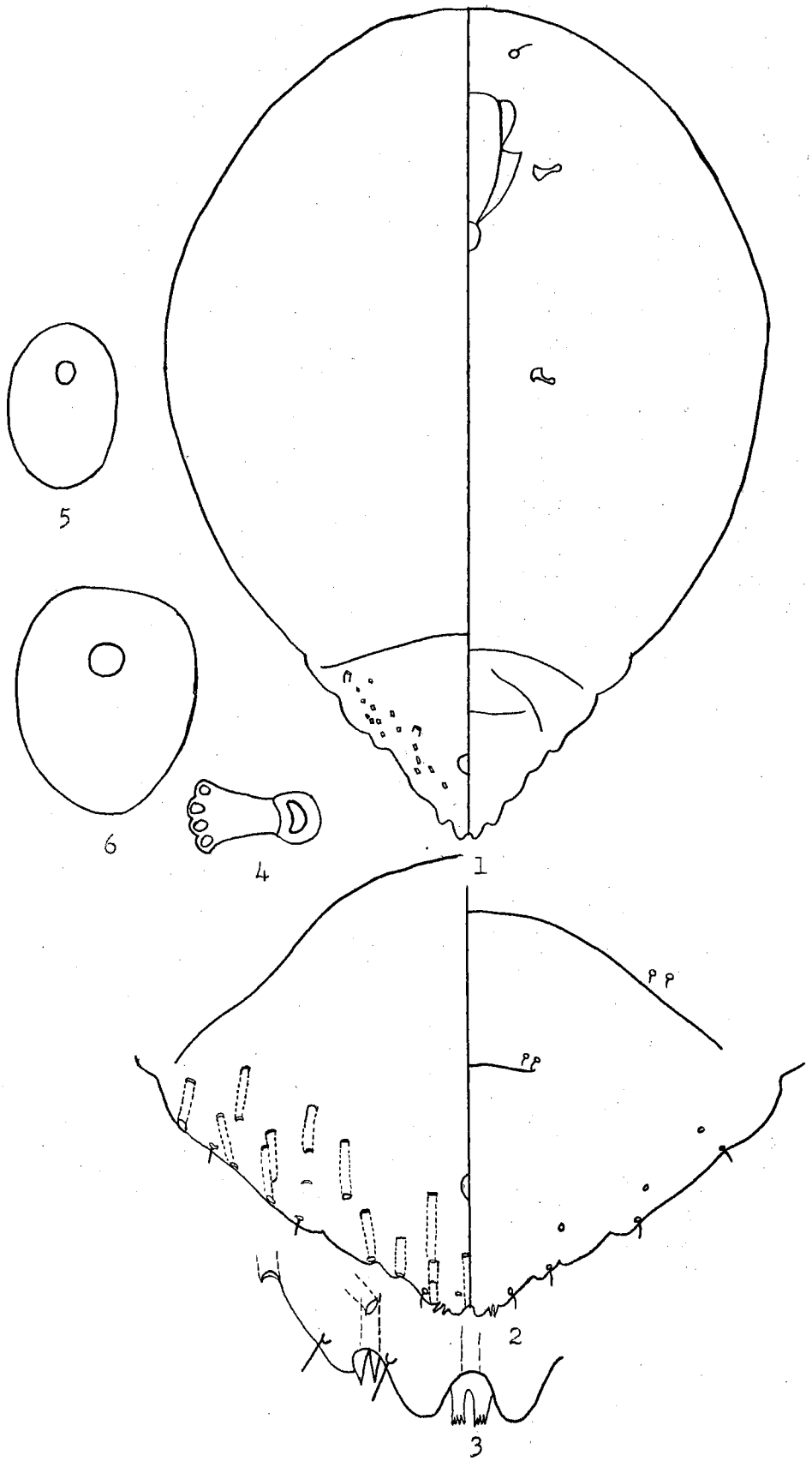


Plate IV

Aspidiotus spinosus Comstock

Spinose Scale

1. Adult female
2. Pygidium
3. Pygidial fringe
4. Anterior spiracle
5. Female scale covering

Plate IV

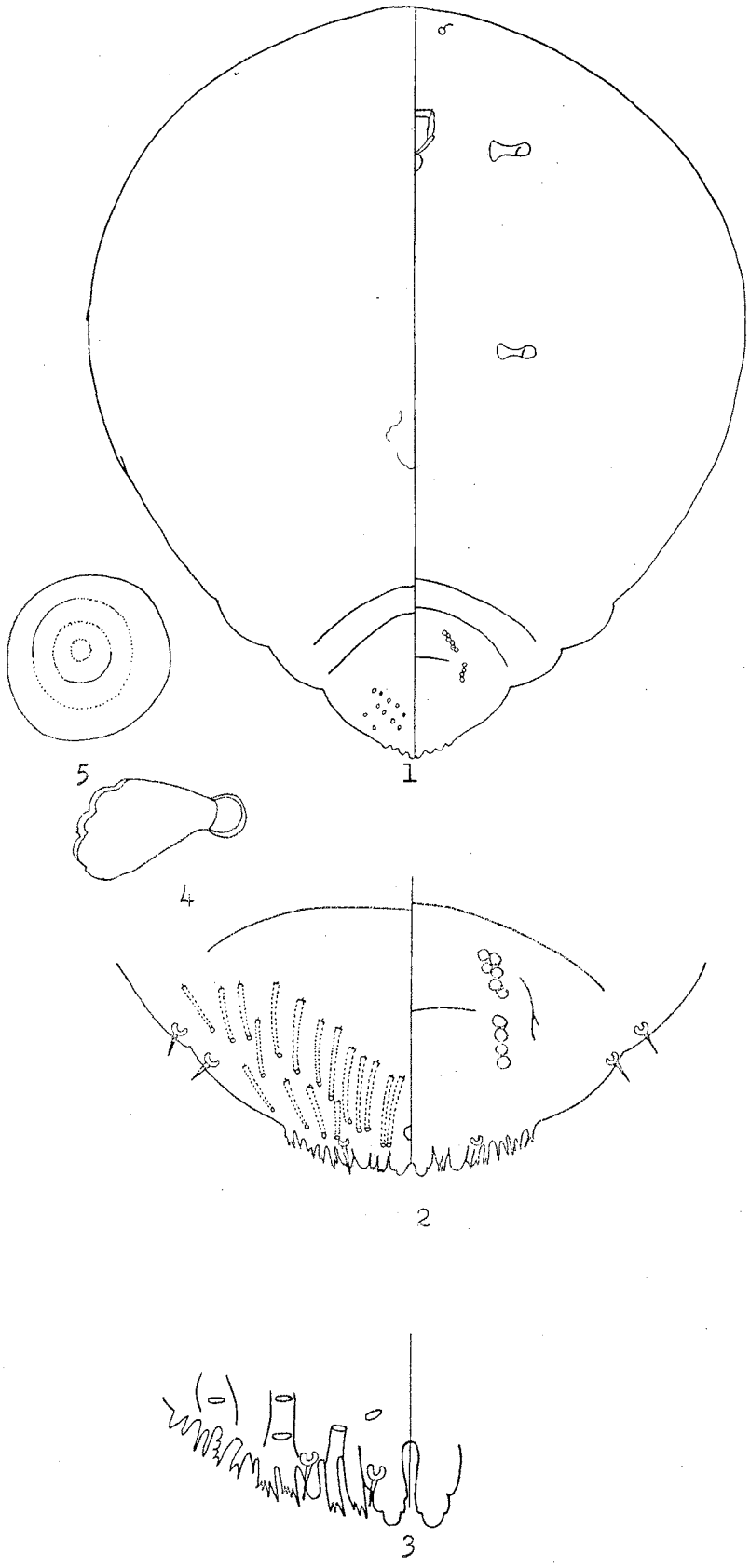


Plate V

Aulacaspis rosae (Bouché)

Rose Scale

1. Adult female
2. Pygidium
3. Pygidial fringe
4. Anterior spiracle
5. Male scale covering
6. Female scale covering

Plate V

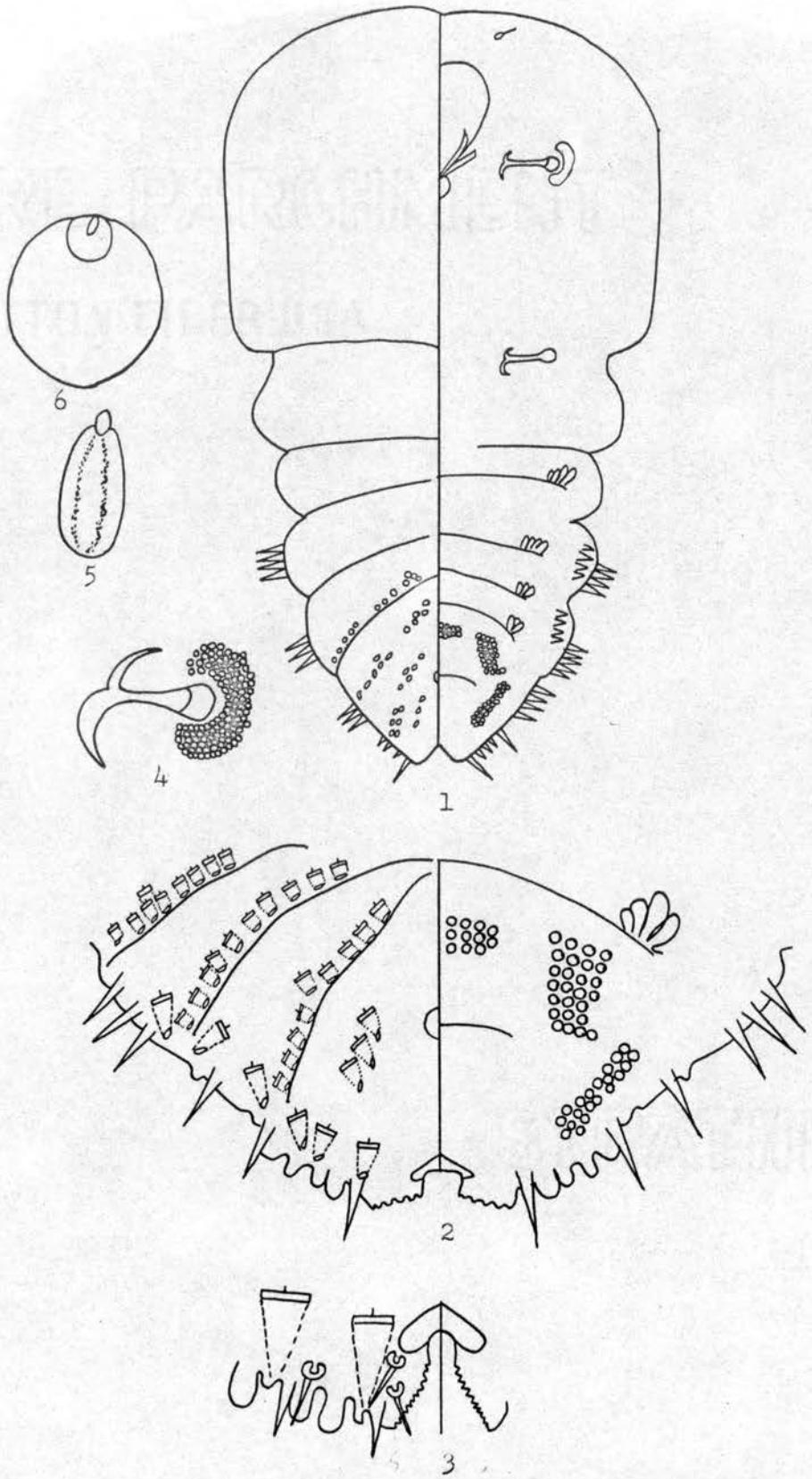


Plate VI

Carulaspis minima (Targioni)

Minute Cypress Scale

1. Adult female
2. Pygidium
3. Pygidial fringe
4. Anterior spiracle
5. Male scale covering
6. Female scale covering

Plate VI

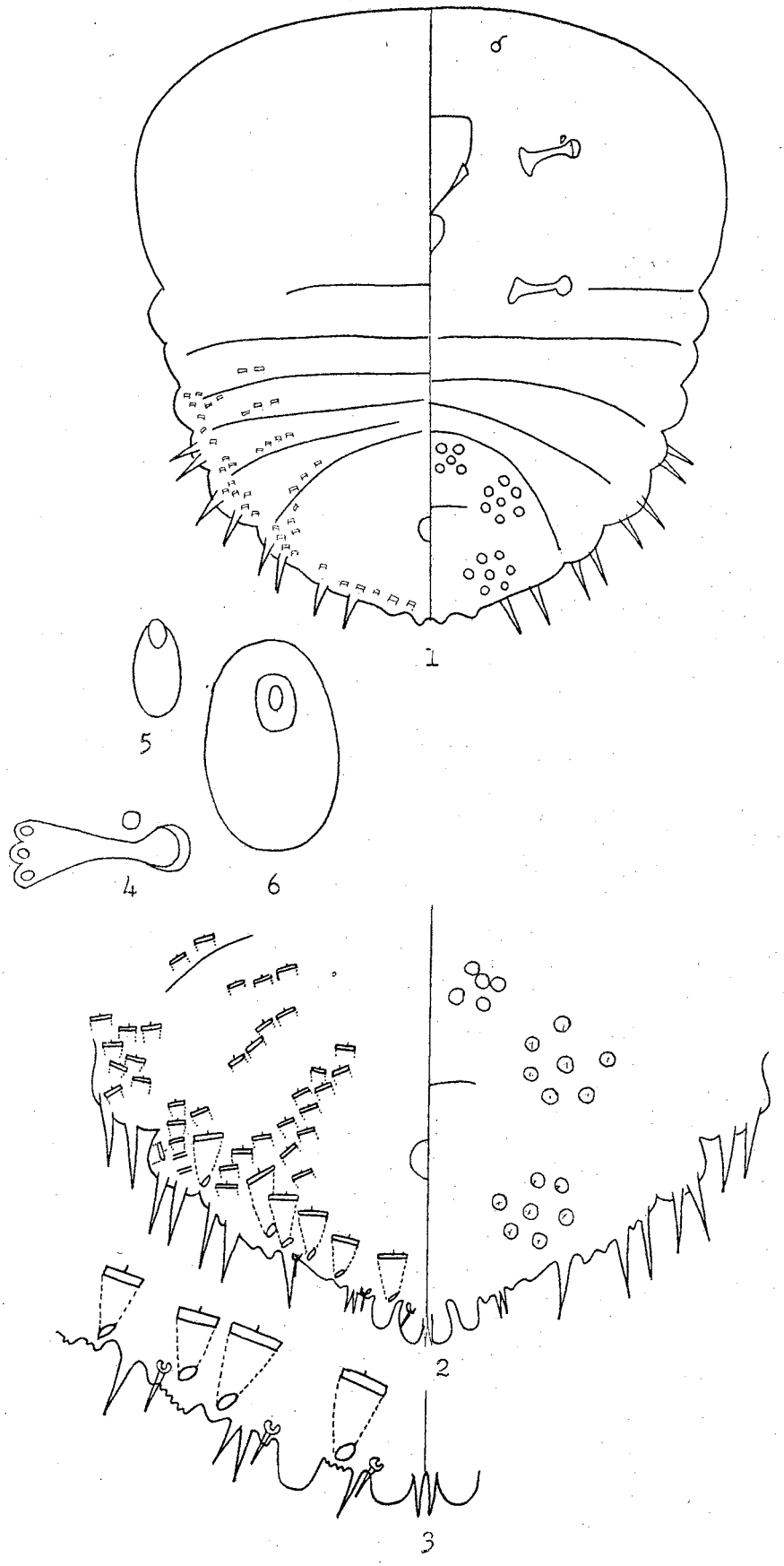


Plate VII

Carulaspis visci (Schrank)

Juniper Scale

1. Adult female
2. Pygidium
3. Pygidial fringe
4. Anterior spiracle
5. Male scale covering
6. Female scale covering

Plate VII

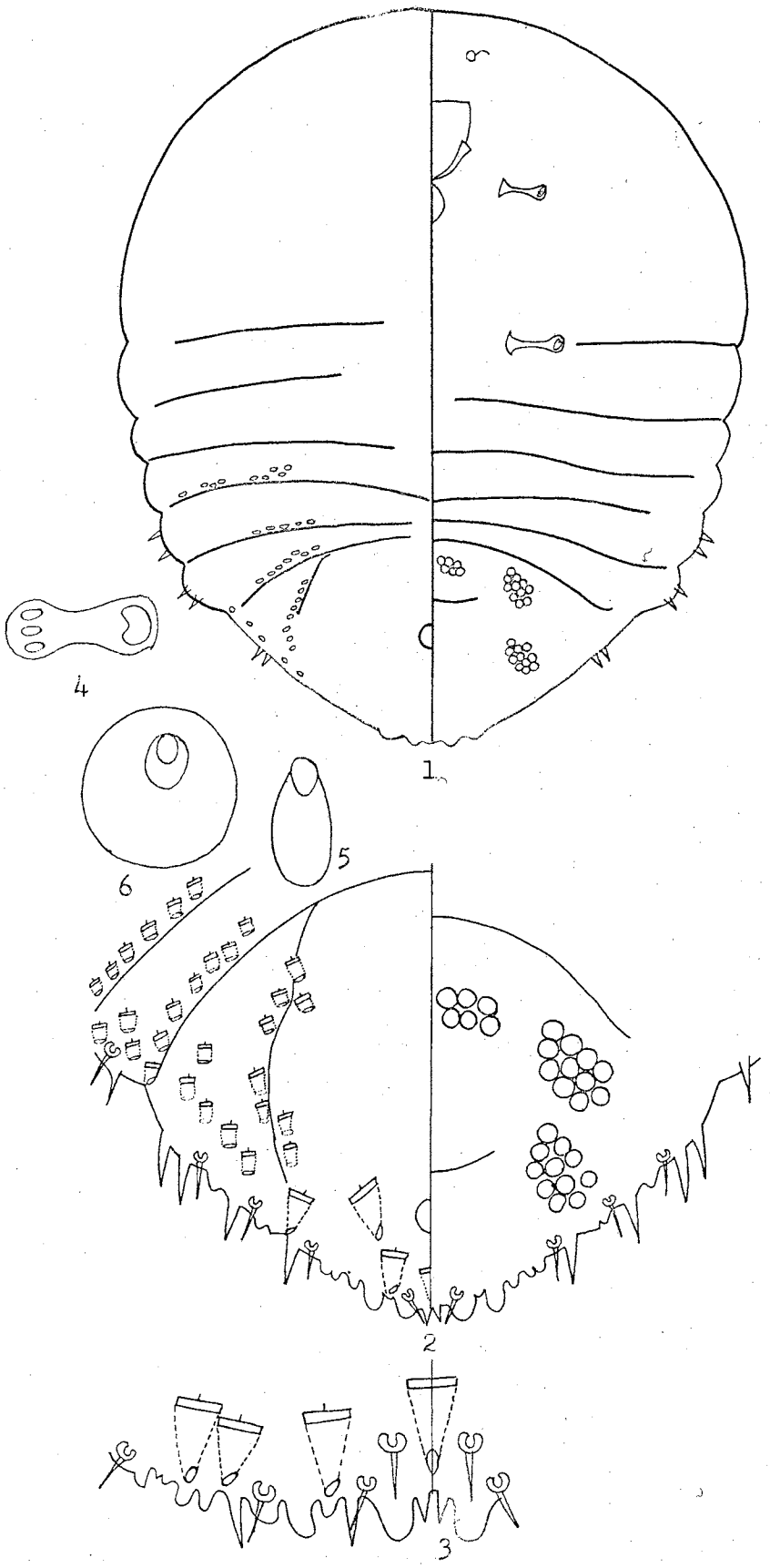


Plate VIII

Chionaspis americana Johnson

Elm Scurfy Scale

1. Adult female
2. Pygidium
3. Pygidial fringe
4. Anterior spiracle
5. Male scale covering
6. Female scale covering

Plate VIII

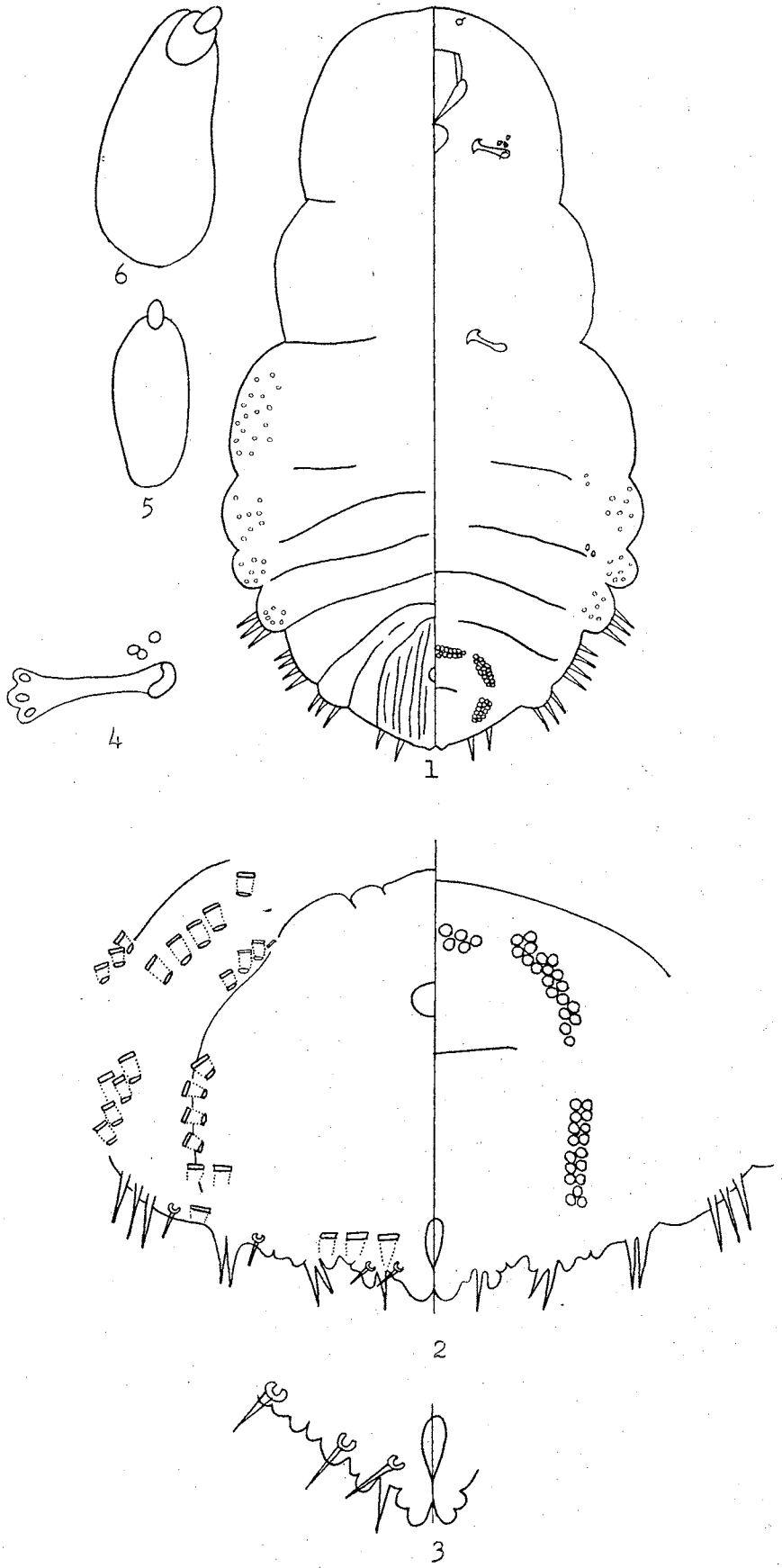


Plate IX

Chionaspis furfura (Fitch)

Scurfy Scale

1. Adult female
2. Pygidium
3. Pygidial fringe
4. Anterior spiracle
5. Male scale covering
6. Female scale covering

Plate IX

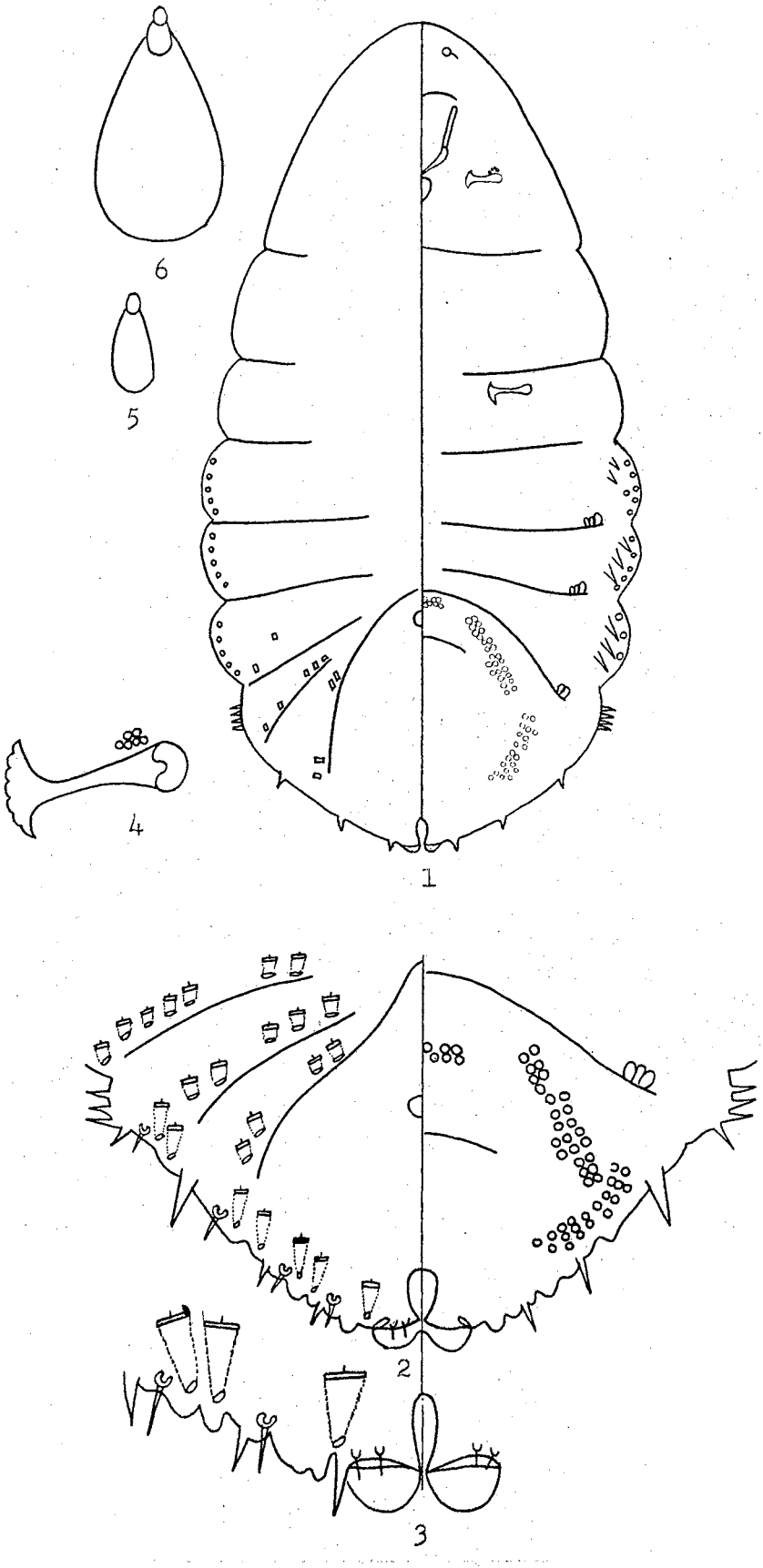


Plate X

Chionaspis salicis-nigrae (Walsh)

Black Willow Scale

1. Adult female
2. Pygidium
3. Pygidial fringe
4. Anterior spiracle
5. Male scale covering
6. Female scale covering

Plate X

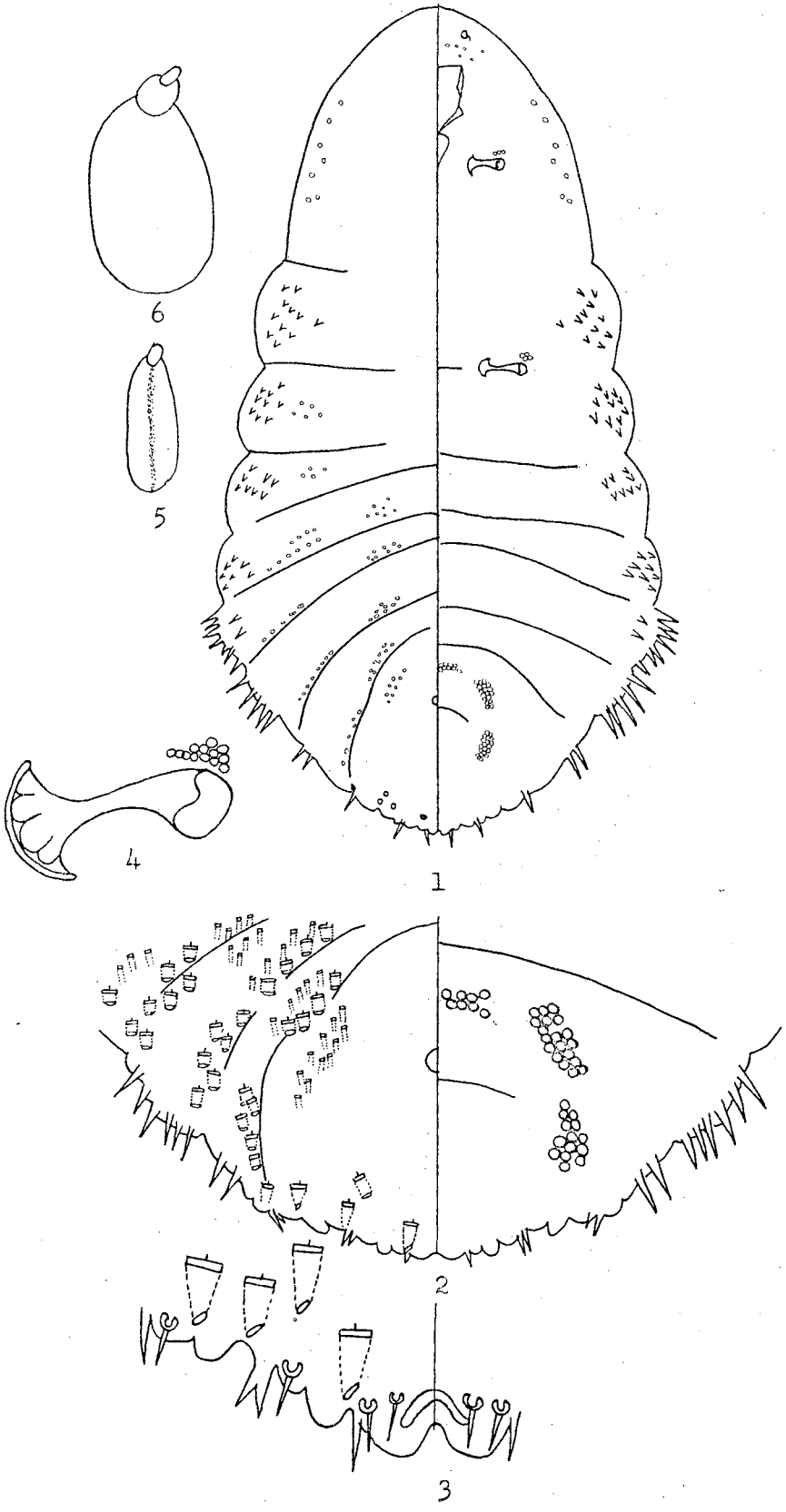


Plate XI

Chrysomphalus bifasciculatus Ferris

Bifasciculate Scale

1. Adult female
2. Pygidium
3. Pygidial fringe
4. Anterior spiracle
5. Male scale covering
6. Female scale covering

Plate XI

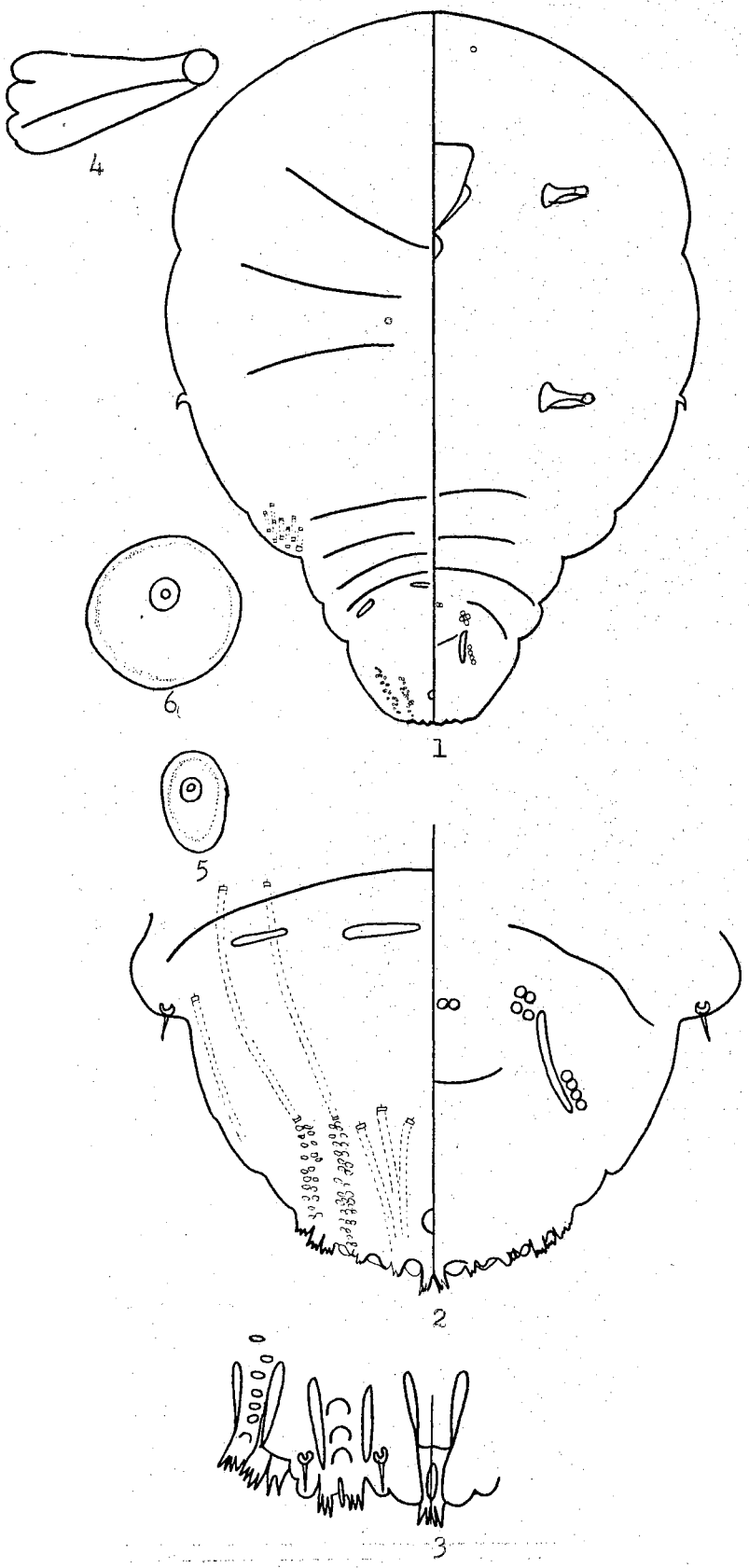


Plate XII

Chrysomphalus ficus Ashmead

Florida Red Scale

1. Adult female
2. Pygidium
3. Pygidial fringe
4. Anterior spiracle
5. Male scale covering
6. Female scale covering

Plate XII

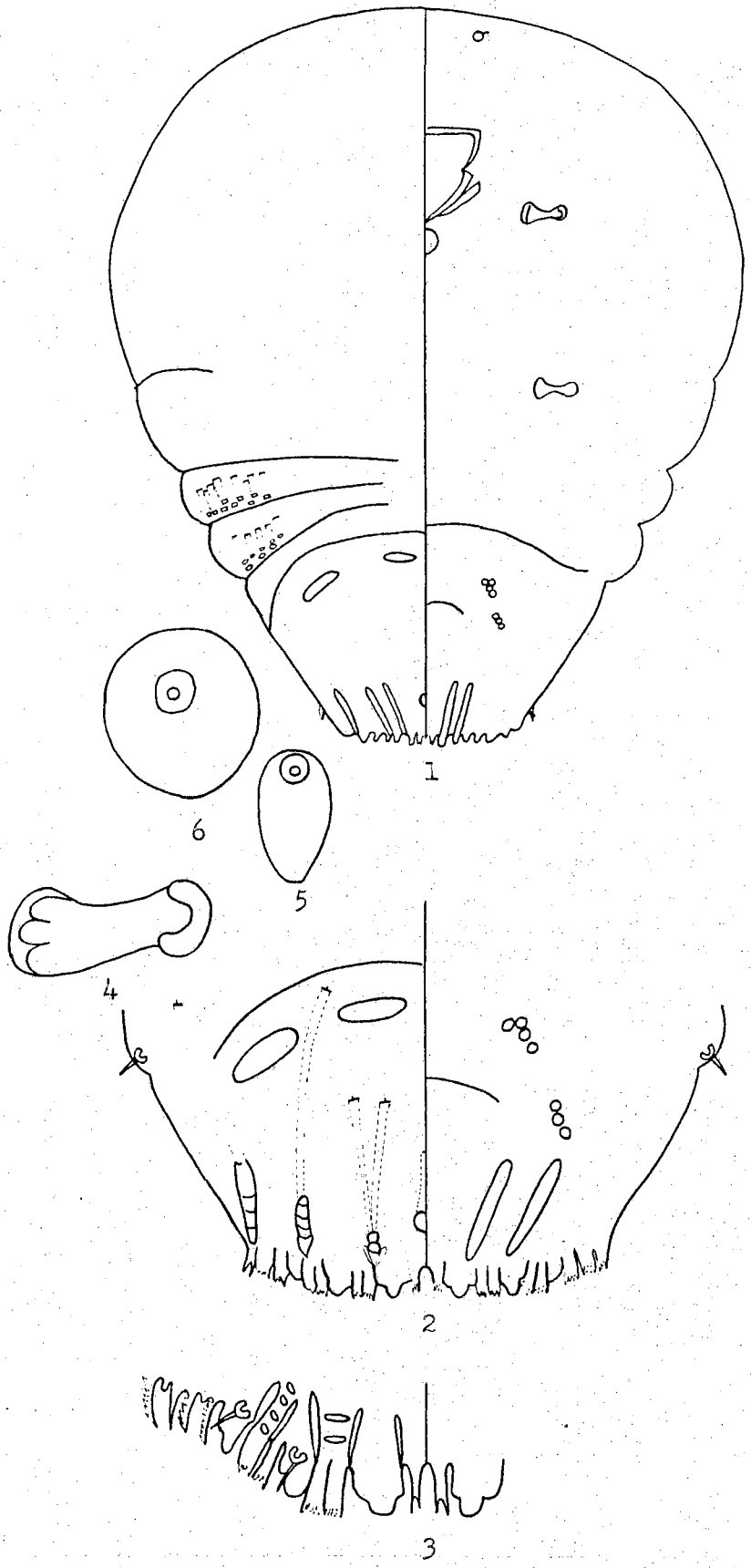


Plate XIII

Chrysomphalus tenebricosus Comstock

Gloomy Scale

1. Adult female
2. Pygidium
3. Pygidial fringe
4. Anterior spiracle
5. Male scale covering
6. Female scale covering

Plate XIII

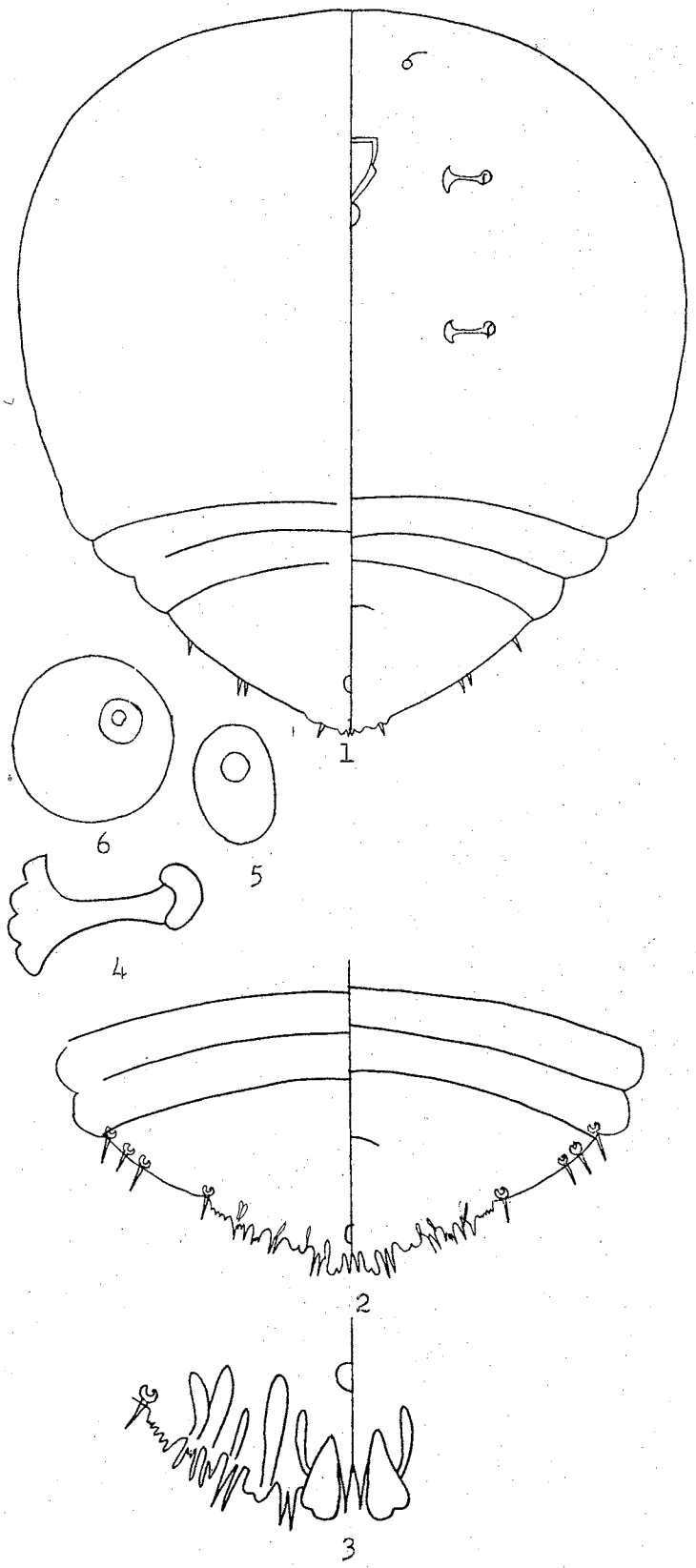


Plate XIV

Diaspidiotus aesculi (Johnson)

Buckeye Scale

(After McKenzie)

1. Adult female
2. Pygidium
3. Pygidial fringe
4. Anterior spiracle
5. Male scale covering
6. Female scale covering

Plate XIV

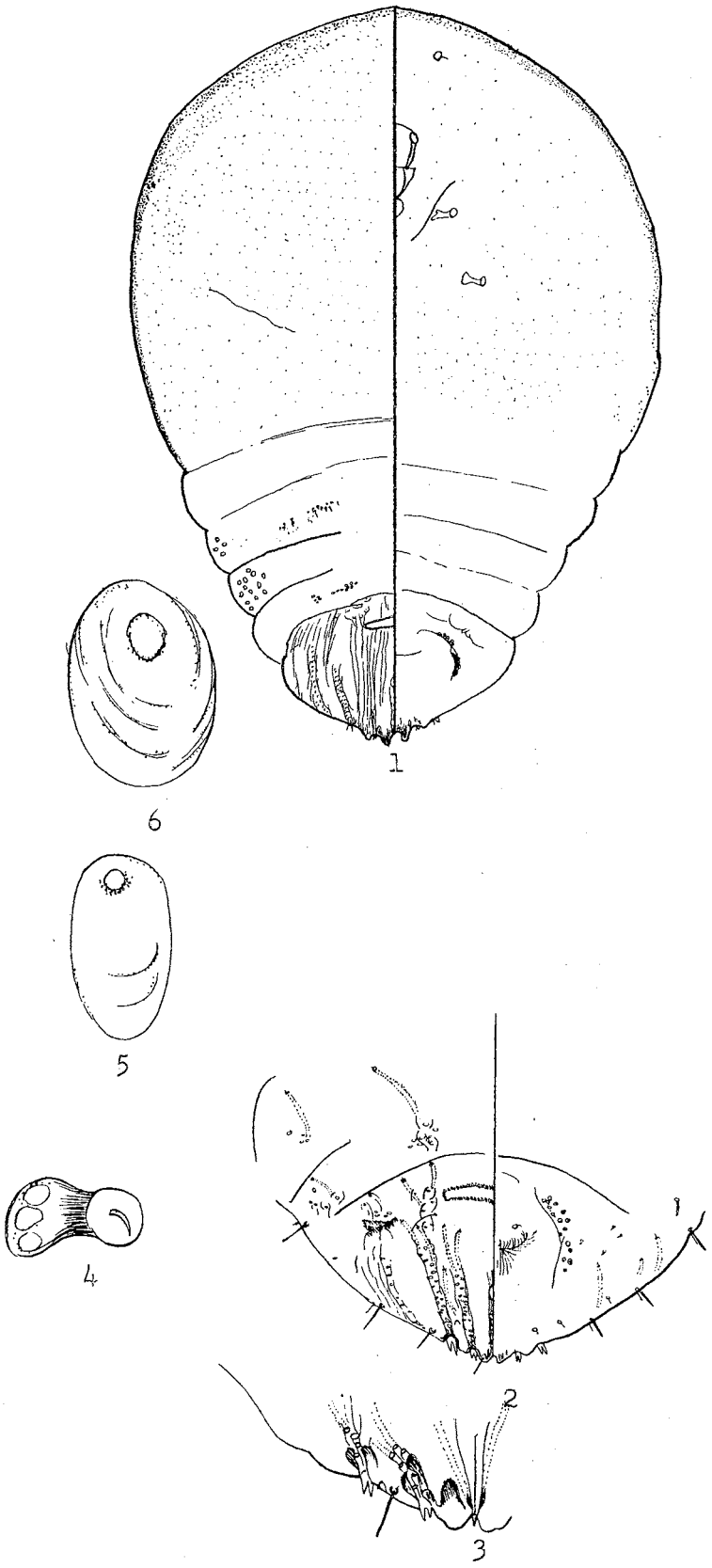


Plate XV

Diaspidiotus ancylus (Putnam)

Putnam Scale

1. Adult female
2. Pygidium
3. Pygidial fringe
4. Anterior spiracle
5. Male scale covering
6. Female scale covering

Plate XV

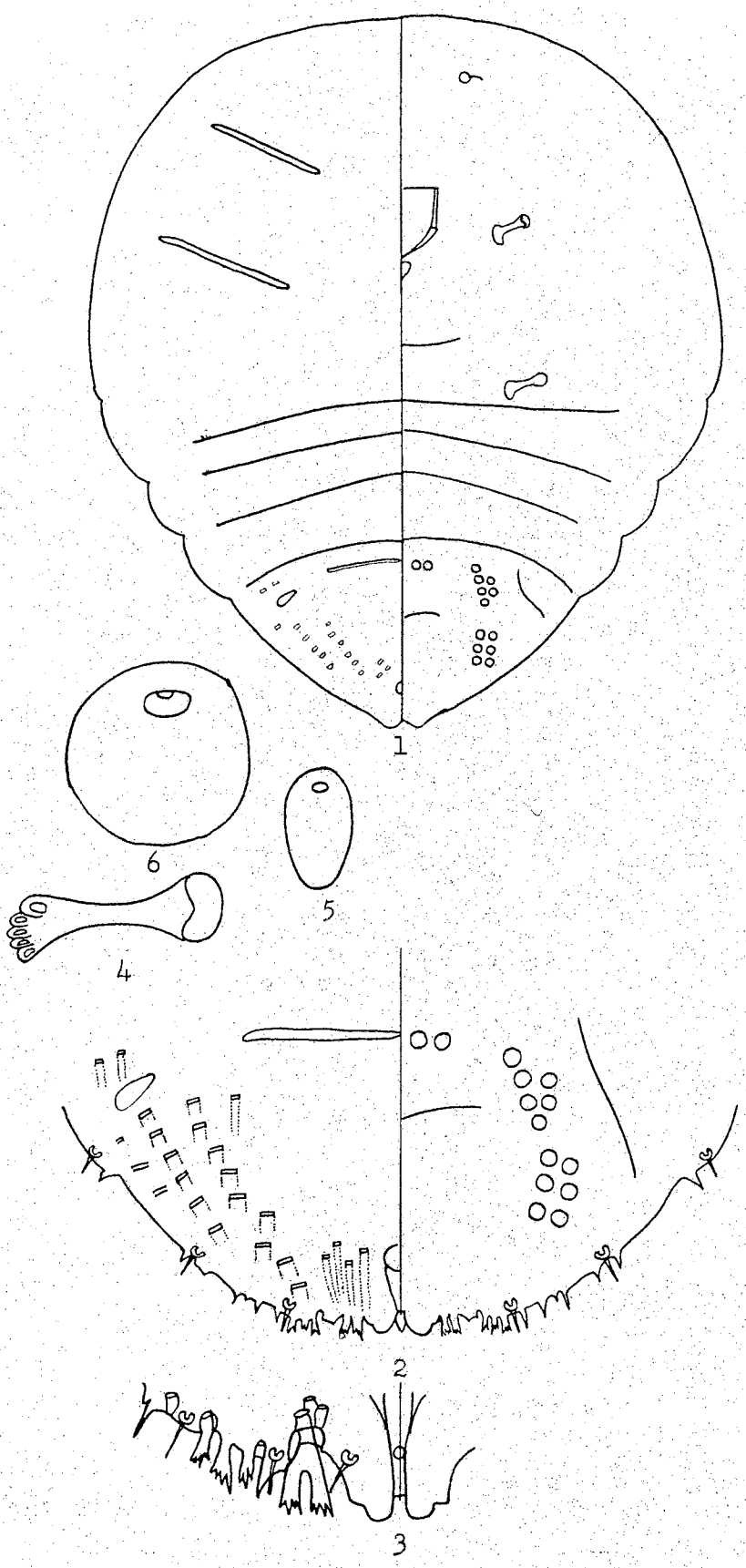


Plate XVI

Diaspis boisduvalii Signoret

Boisduval Scale

1. Adult female
2. Pygidium
3. Pygidial fringe
4. Anterior spiracle
5. Male scale covering
6. Female scale covering

Plate XVI

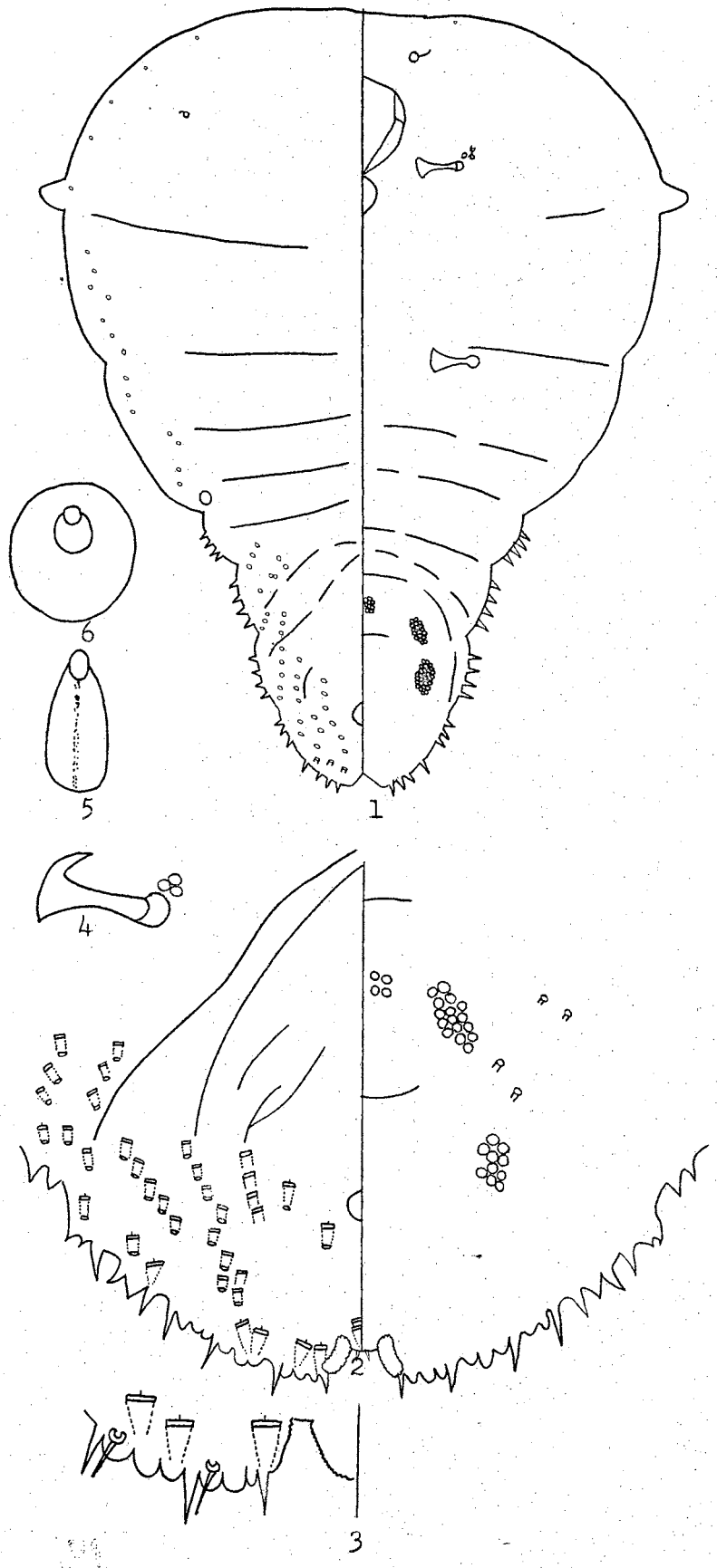


Plate XVII

Diaspis echinocacti (Bouché)

Cactus Scale

1. Adult female
2. Pygidium
3. Pygidial fringe
4. Anterior spiracle
5. Male scale covering
6. Female scale covering

Plate XVII

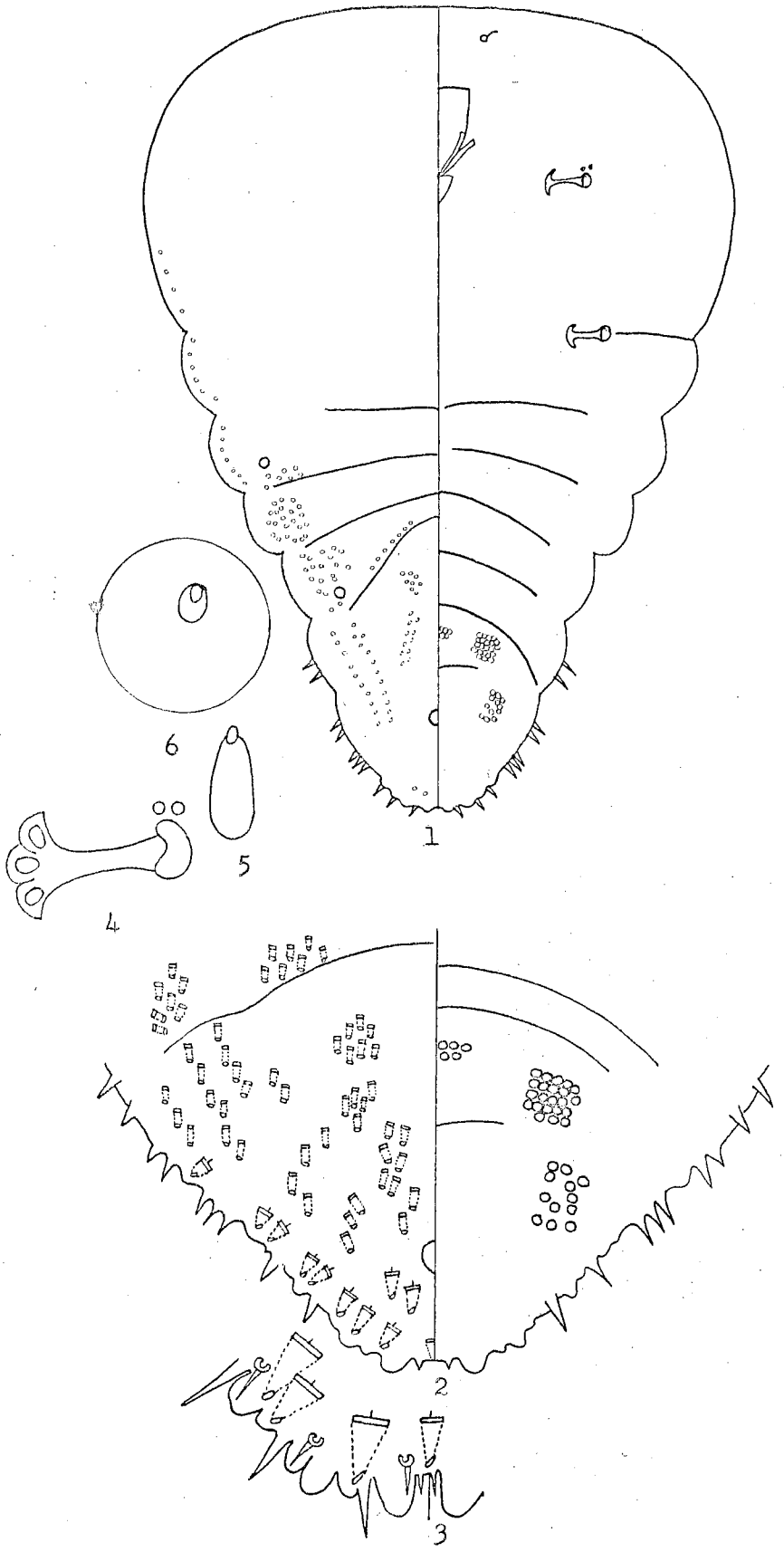


Plate XVIII

Fiorinia fioriniae (Targioni)

Palm Fiorinia Scale

1. Adult female
2. Pygidium
3. Pygidial fringe
4. Anterior spiracle
5. Male scale covering
6. Female scale covering

Plate XVIII

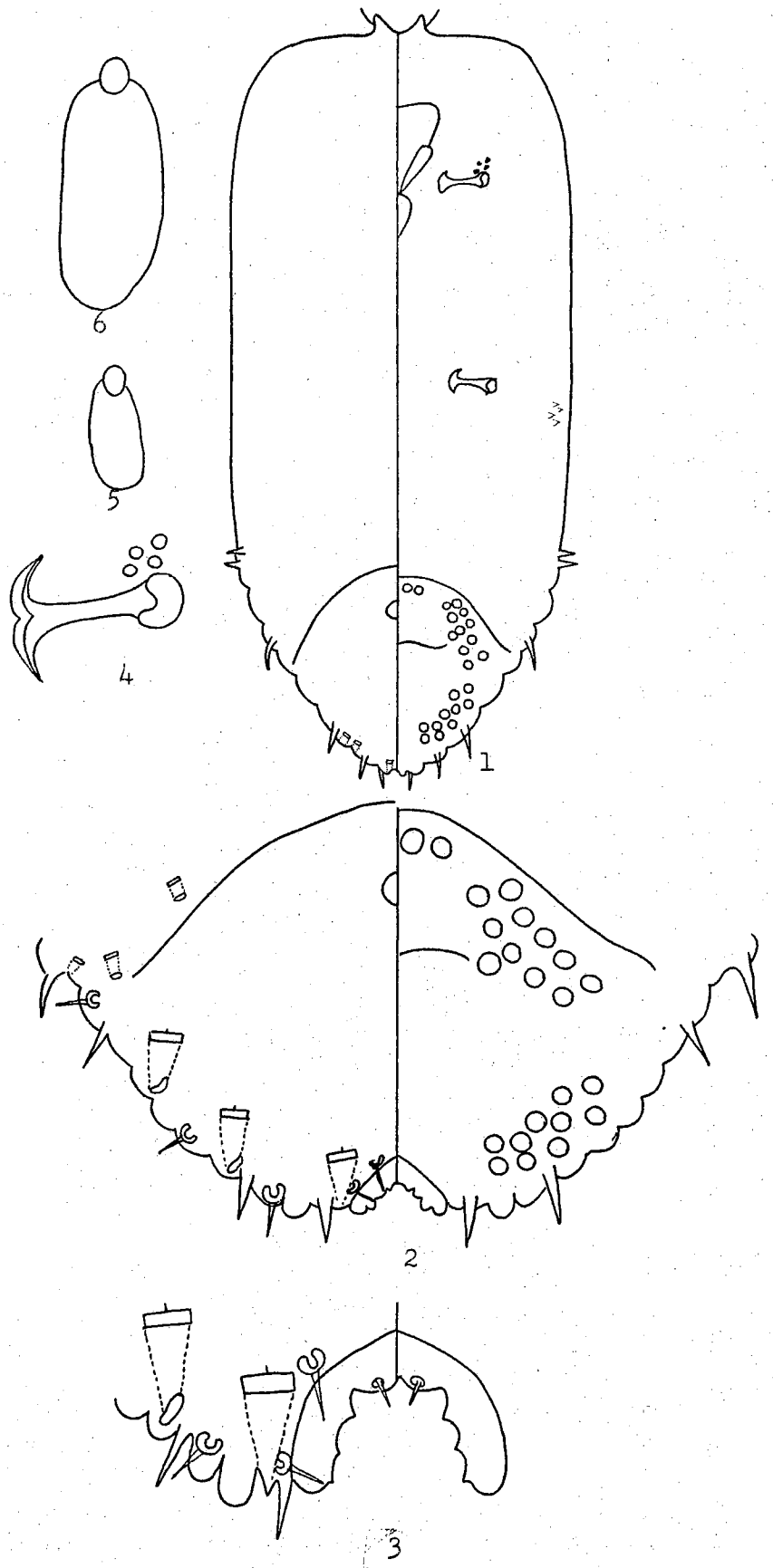


Plate XIX

Fiorinia theae Green

Tea Scale

1. Adult female
2. Pygidium
3. Pygidial fringe
4. Anterior spiracle
5. Male scale covering
6. Female scale covering
7. Microduct
8. Cephalic end showing fleshy tubercle and antenna

Plate XIX

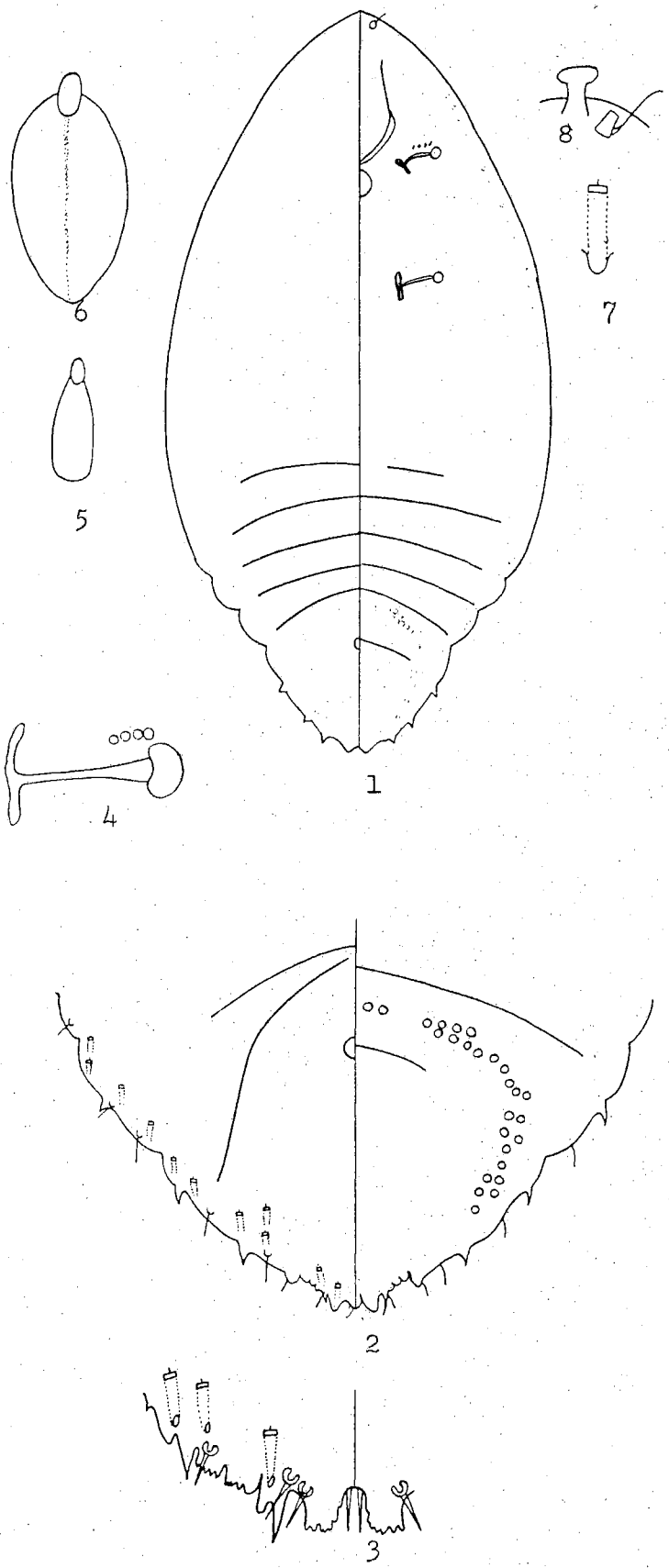


Plate XX

Hemiberlesia howardi (Cockerell)

Howard Scale

1. Adult female
2. Pygidium
3. Pygidial fringe
4. Anterior spiracle
5. Male scale covering
6. Female scale covering

Plate XX

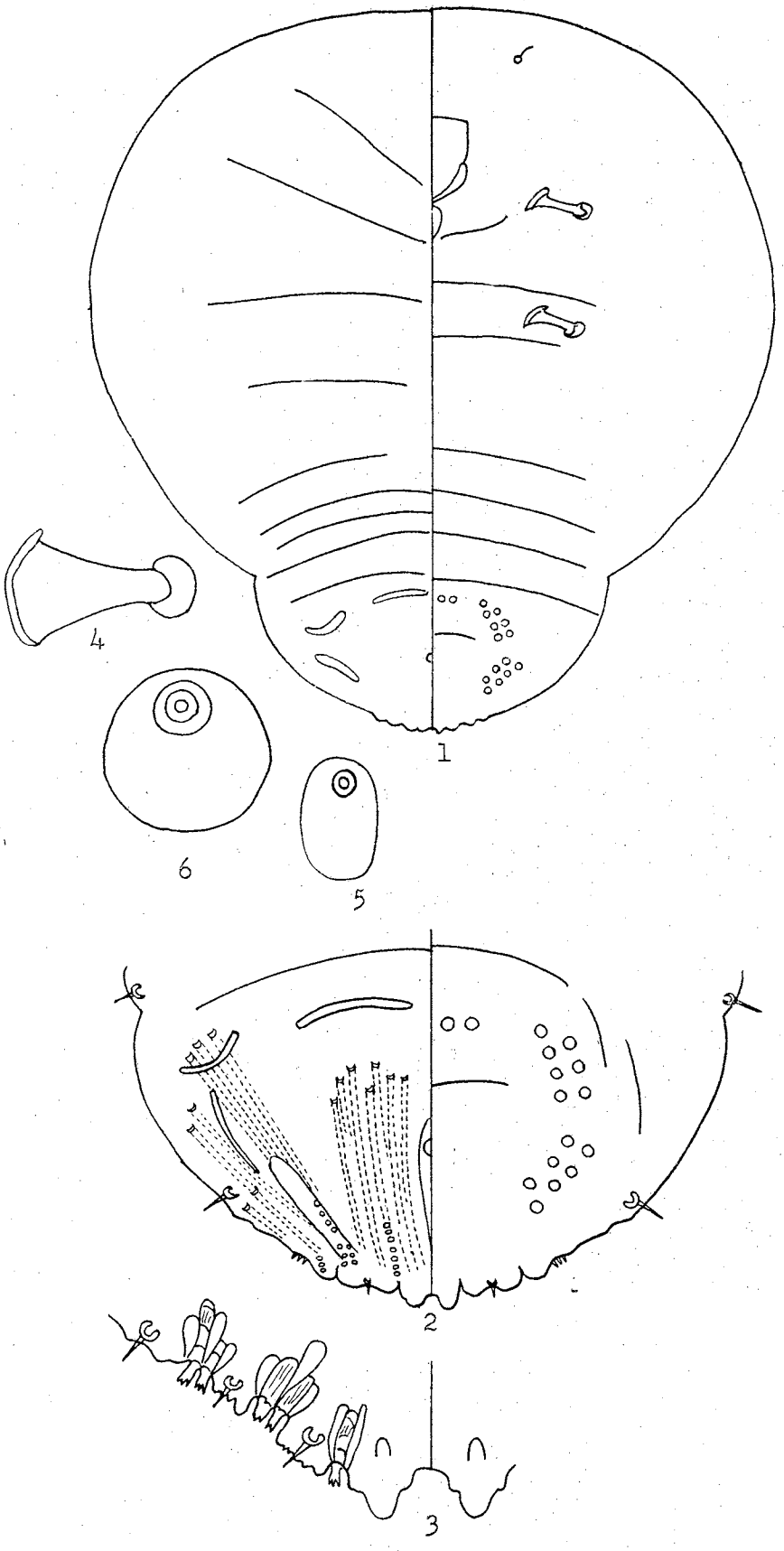


Plate XXI

Hemiberlesia lataniae (Signoret)

Latania Scale

1. Adult female
2. Pygidium
3. Pygidial fringe
4. Anterior spiracle
5. Female scale covering

Plate XXI

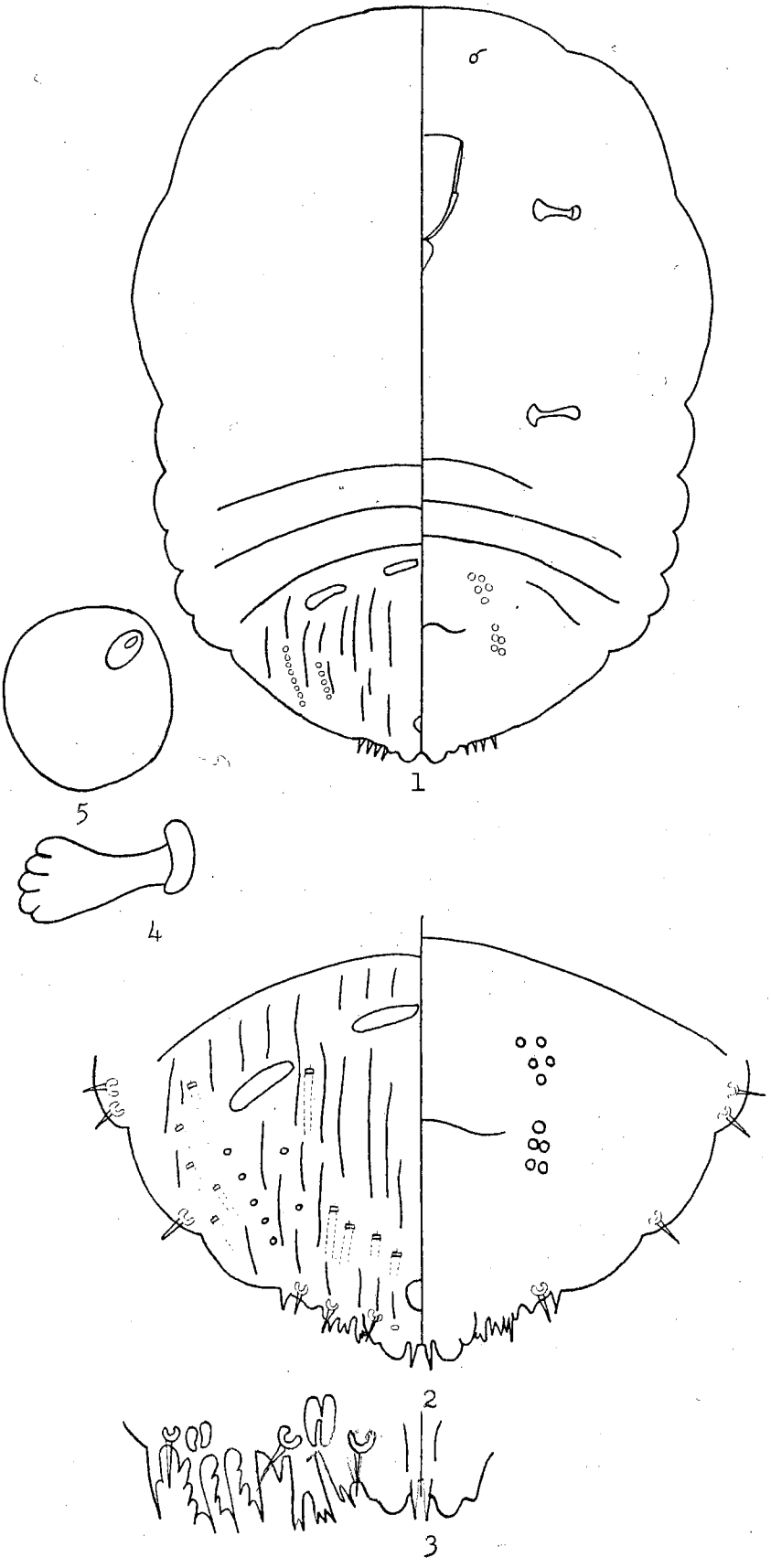


Plate XXII

Lepidosaphes beckii (Newman)

Purple Scale

1. Adult female
2. Pygidium
3. Pygidial fringe
4. Anterior spiracle
5. Male scale covering
6. Female scale covering
7. Microduct

Plate XXII

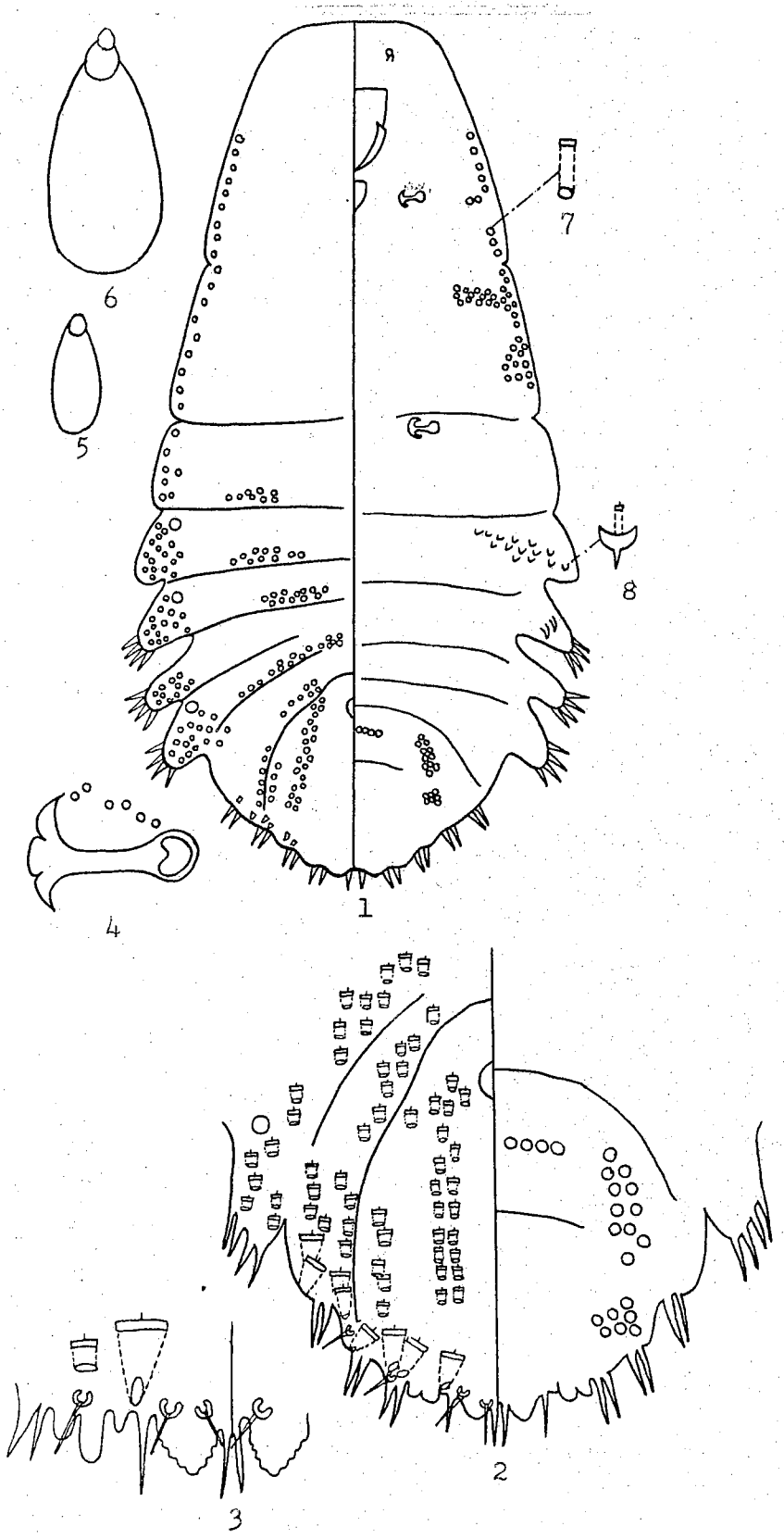


Plate XXIII

Lepidosaphes camelliae Hoke

Camellia Scale

1. Adult female
2. Pygidium
3. Pygidial fringe
4. Anterior spiracle
5. Male scale covering
6. Female scale covering

Plate XXIII

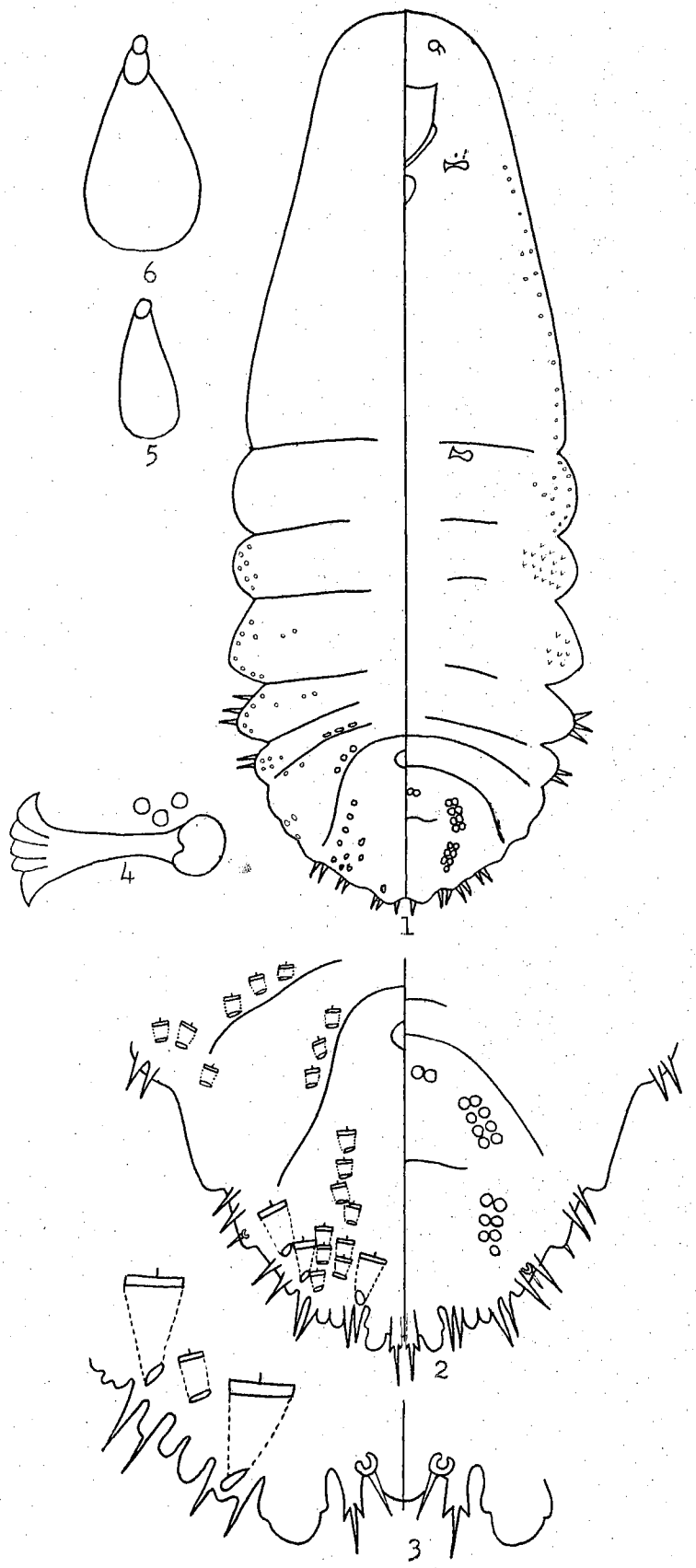


Plate XXIV

Lepidosaphes gloverii (Packard)

Glover Scale

(After Ferris)

1. Adult female
2. Pygidium
3. Pygidial fringe
4. Anterior spiracle
5. Male scale covering
6. Female scale covering

Plate XXIV

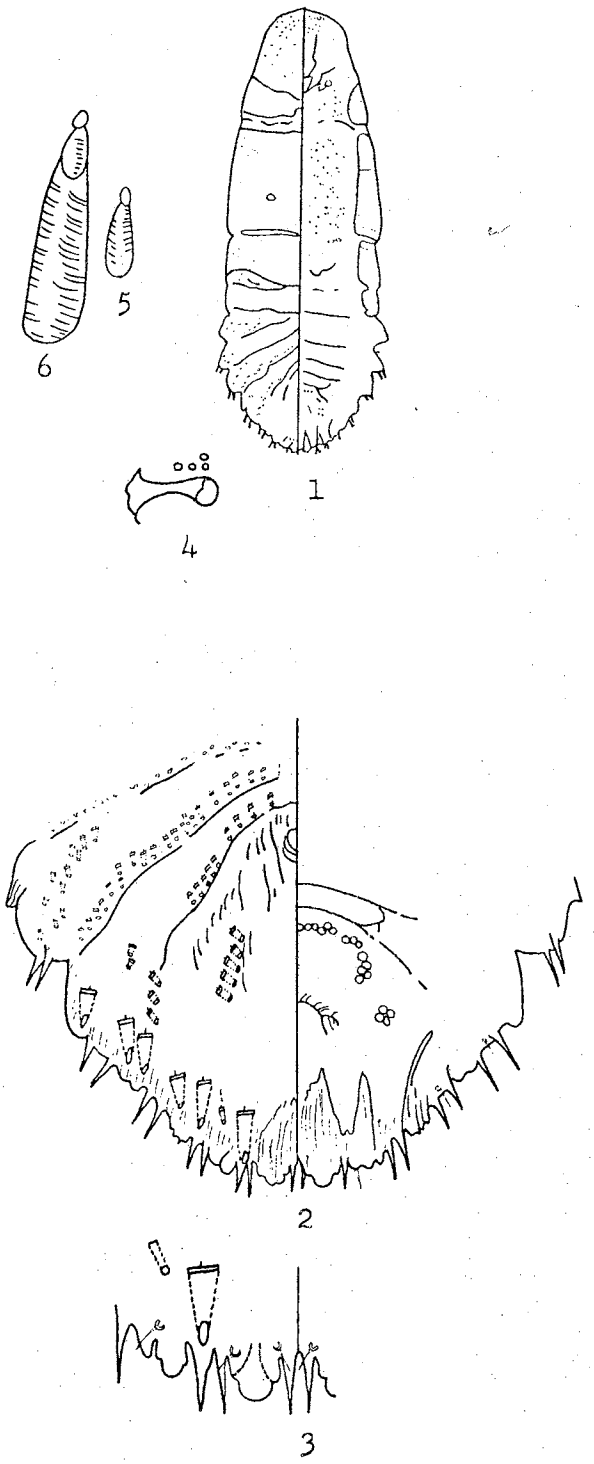


Plate XXV

Lepidosaphes ulmi (Linnaeus)

Oystershell Scale

1. Adult female
2. Pygidium
3. Pygidial fringe
4. Anterior spiracle
5. Female scale covering
6. Microduct

Plate XXV

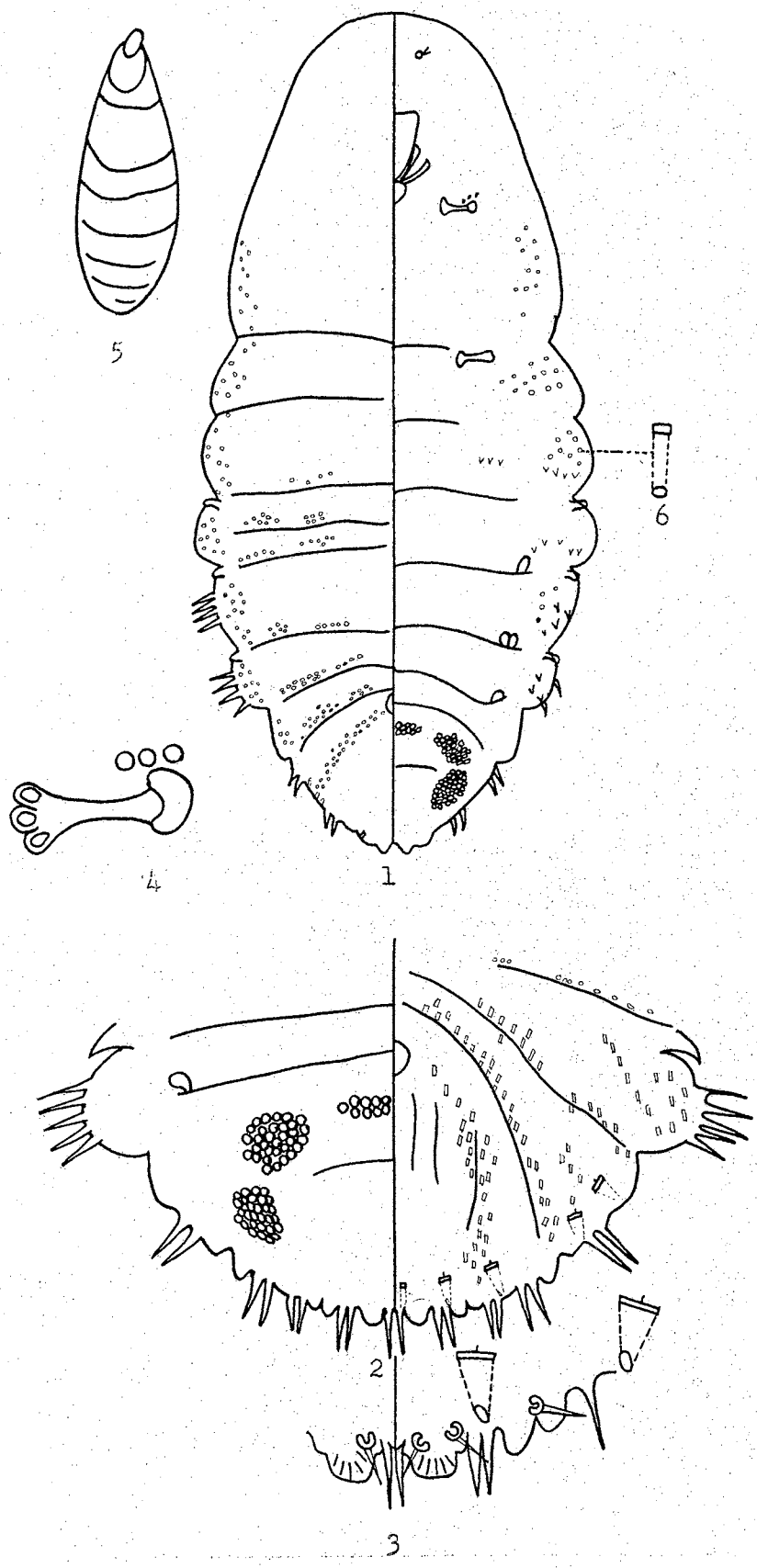


Plate XXVI

Melanaspis obscura (Comstock)

Obscure Scale

1. Adult female
2. Pygidium
3. Pygidial fringe
4. Anterior spiracle
5. Male scale covering
6. Female scale covering

Plate XXVI

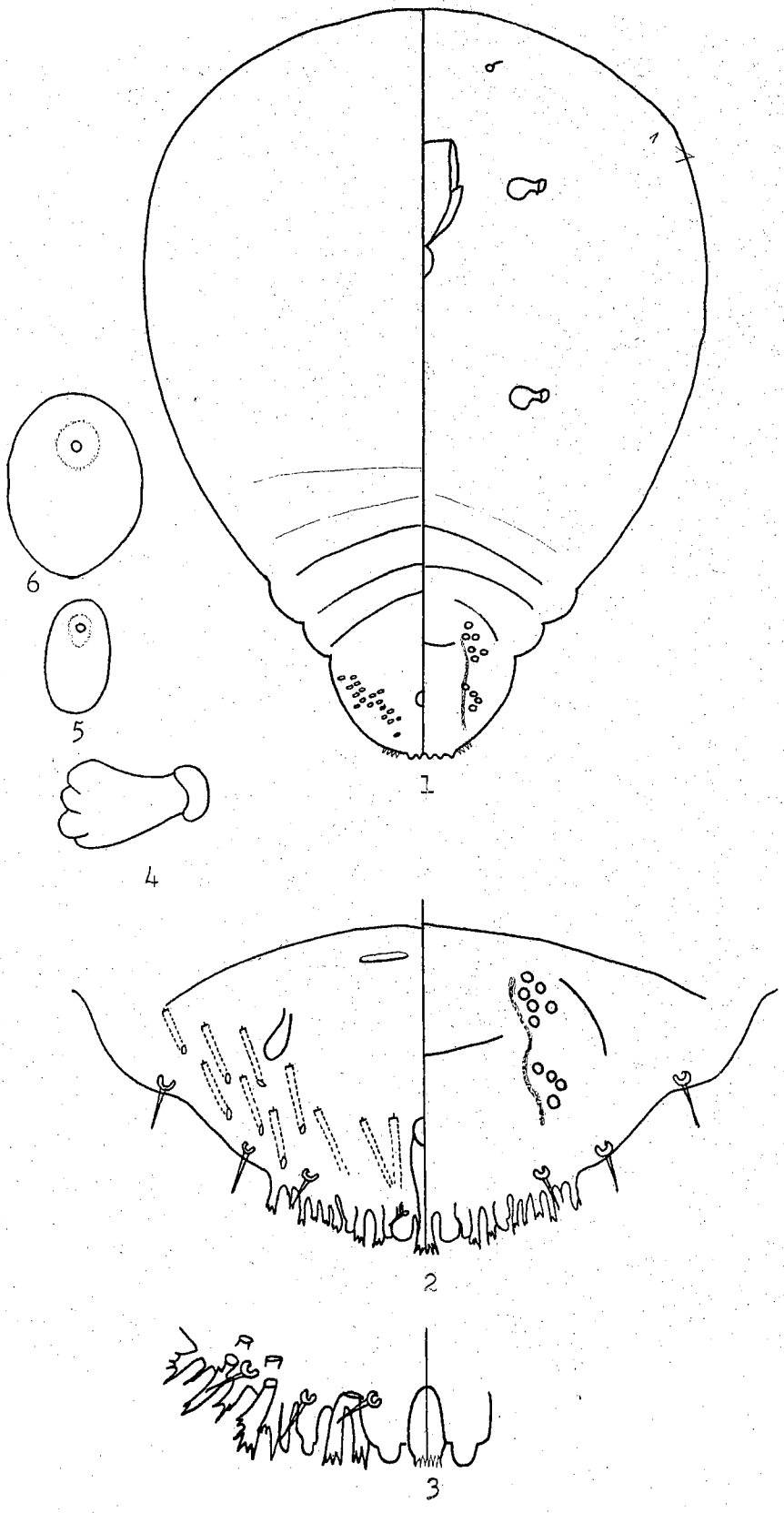


Plate XXVII

Parlatoria pergandii Comstock

Chaff Scale

1. Adult female
2. Pygidium
3. Pygidial fringe
4. Anterior spiracle
5. Male scale covering
6. Female scale covering

Plate XXVII

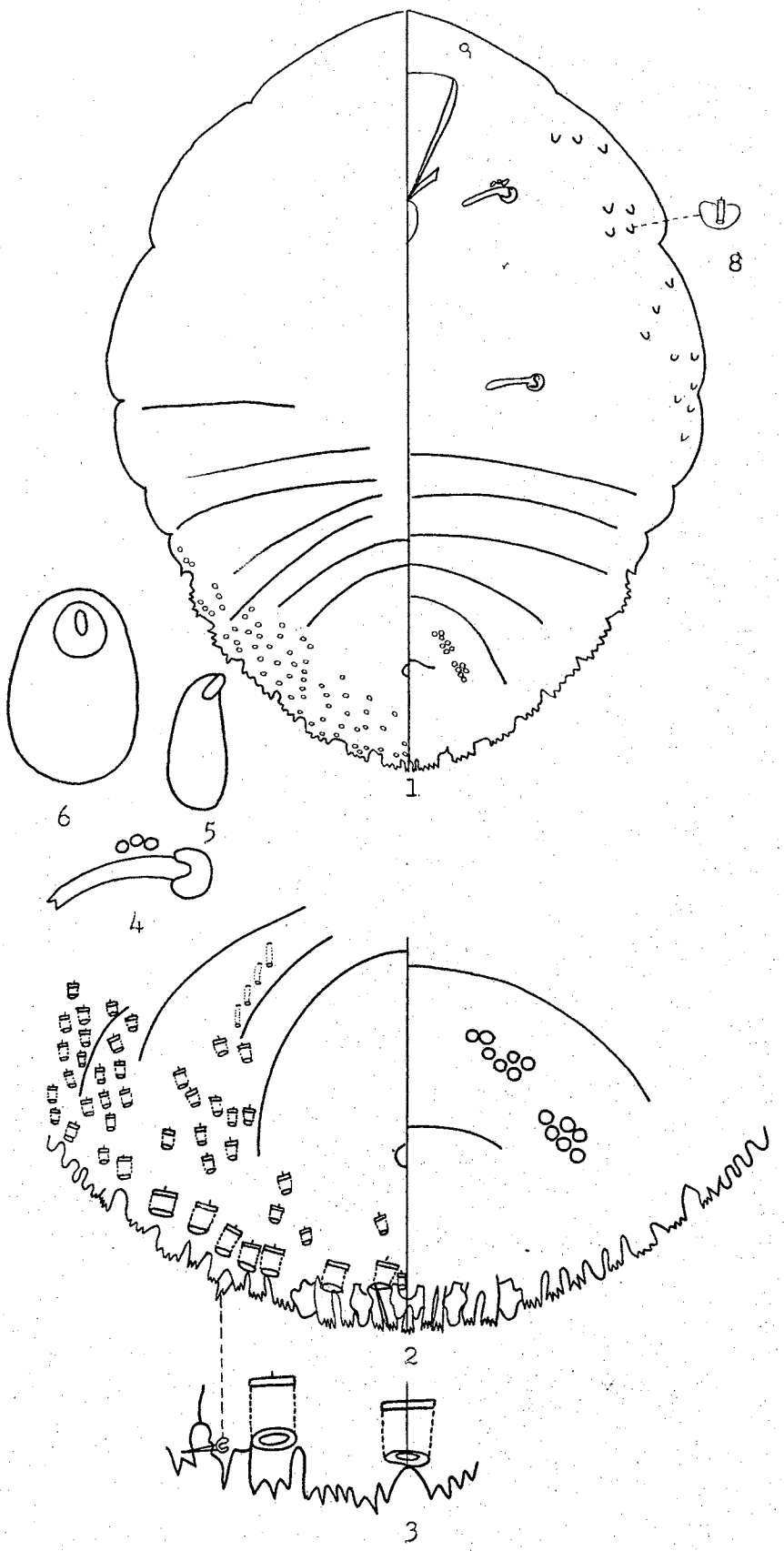


Plate XXVIII

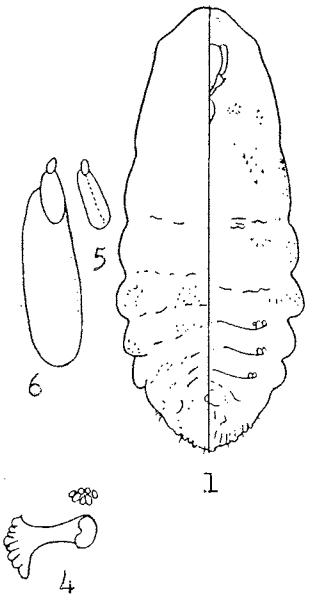
Phenacaspis pinifoliae (Fitch)

Pine Needle Scale

(After Ferris)

1. Adult female
2. Pygidium
3. Pygidial fringe
4. Anterior spiracle
5. Male scale covering
6. Female scale covering

Plate XXVIII



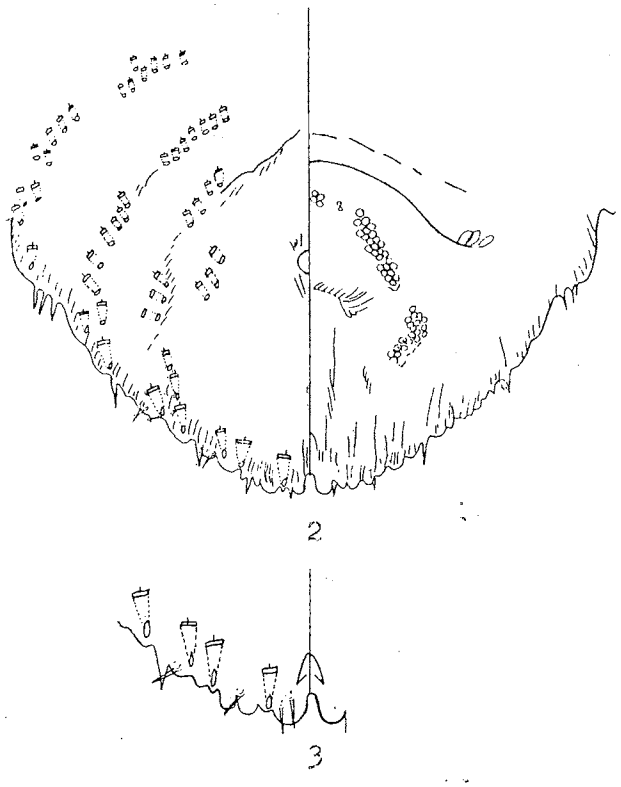


Plate XXIX

Pinnaspis aspidistrae (Signoret)

Fern Scale

1. Adult female
2. Pygidium
3. Pygidial fringe
4. Anterior spiracle
5. Male scale covering
6. Female scale covering

Plate XXIX

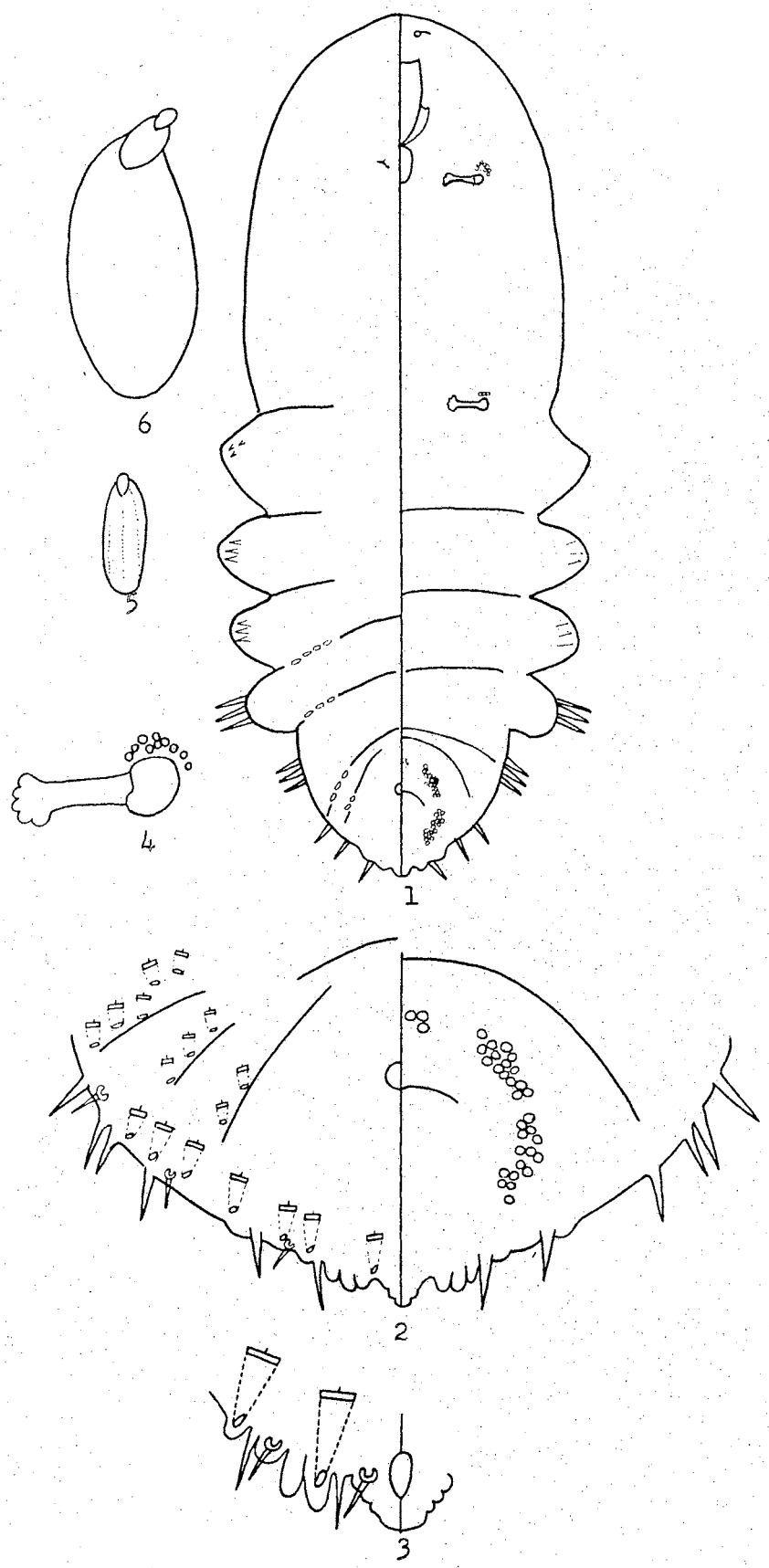


Plate XXX

Quadraspidiotus forbesi (Johnson)

Forbes Scale

1. Adult female
2. Pygidium
3. Pygidial fringe
4. Anterior spiracle
5. Male scale covering
6. Female scale covering

Plate XXX

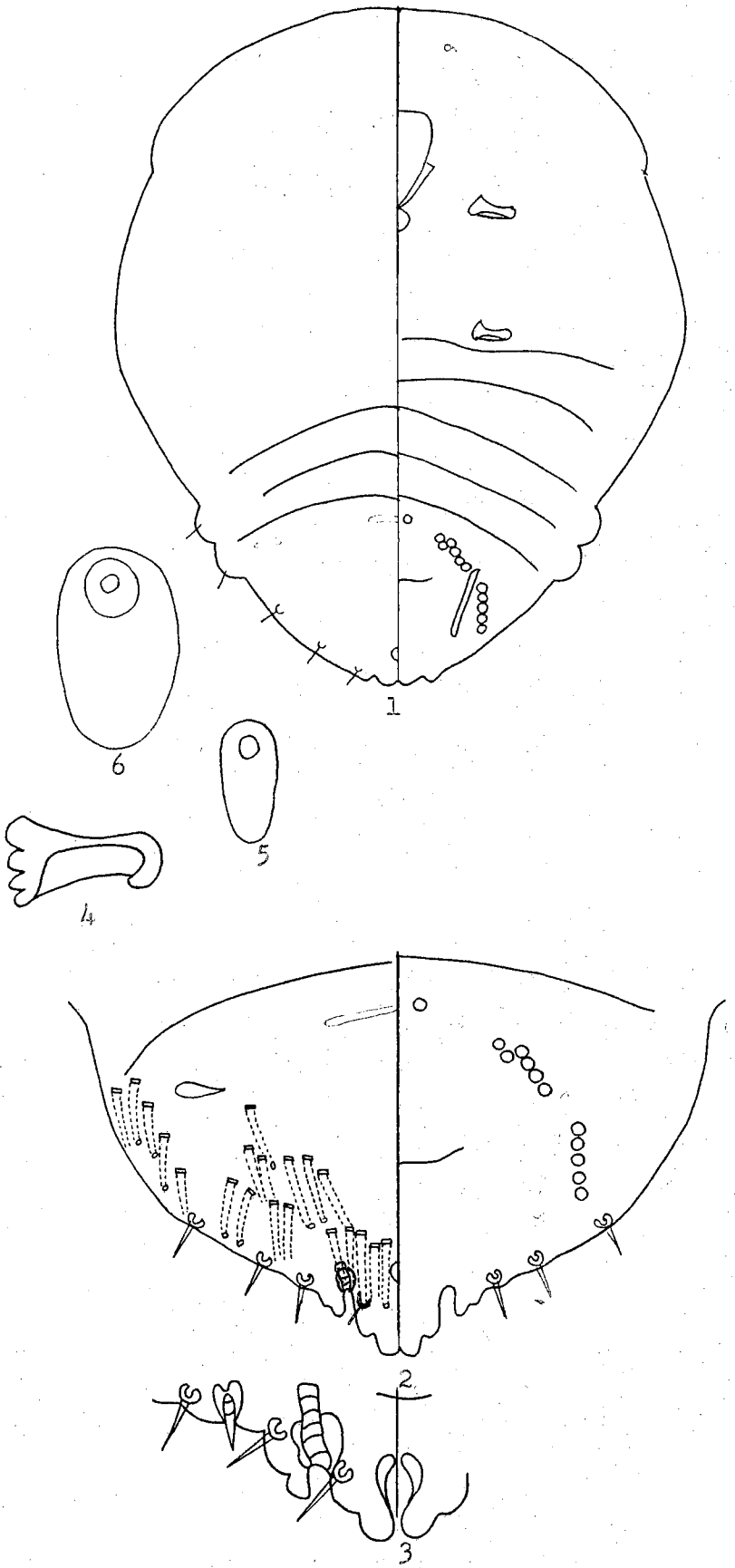


Plate XXXI

Quadraspidiotus perniciosus (Comstock)

San Jose Scale

1. Adult female
2. Pygidium
3. Pygidial fringe
4. Anterior spiracle
5. Male scale covering
6. Female scale covering

Plate XXXI

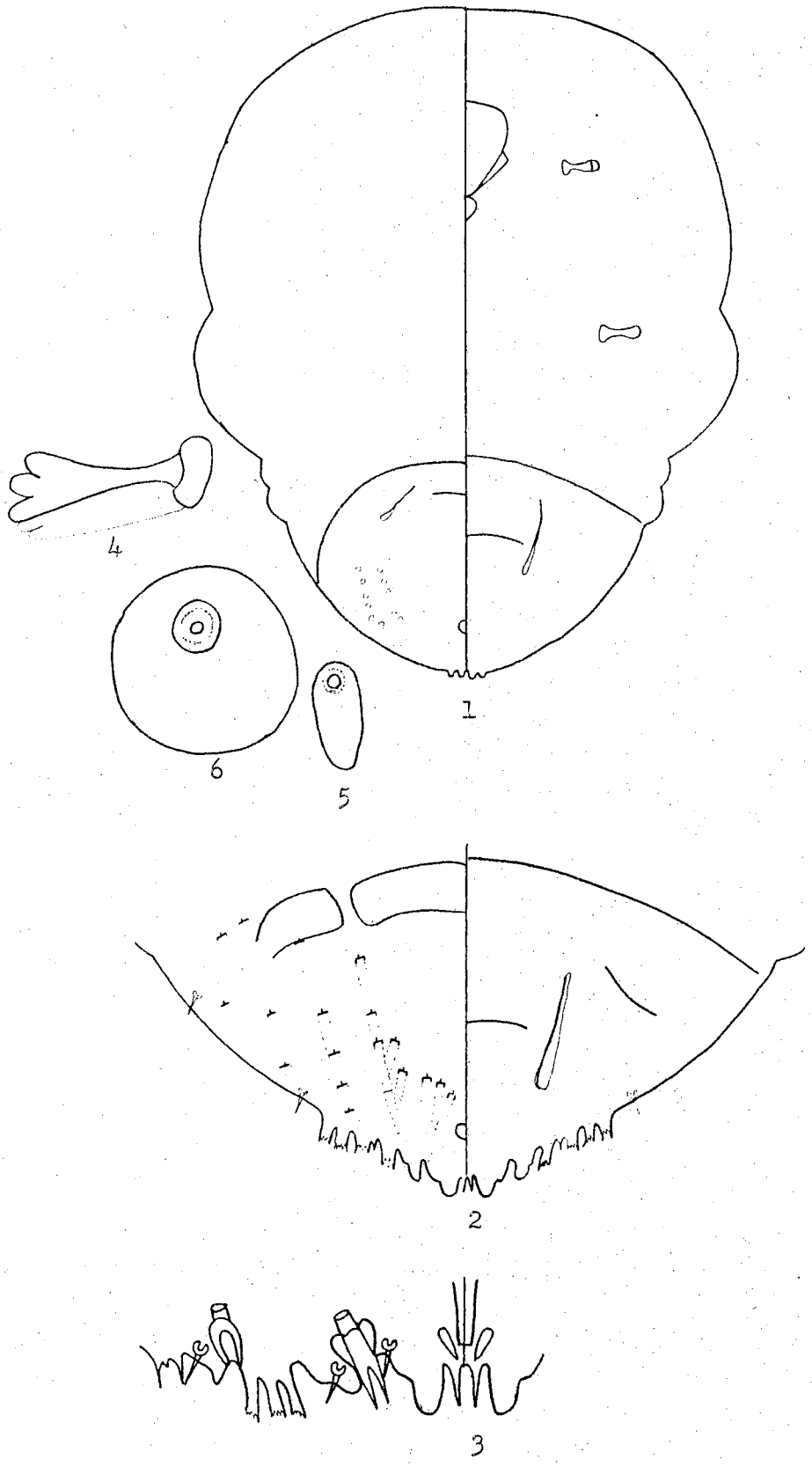


Plate XXXII

Rhizaspidiotus dearnessi (Cockerell)

Dearness Scale

1. Adult female
2. Pygidium
3. Pygidial fringe
4. Anterior spiracle
5. Male scale covering
6. Female scale covering

Plate XXXII

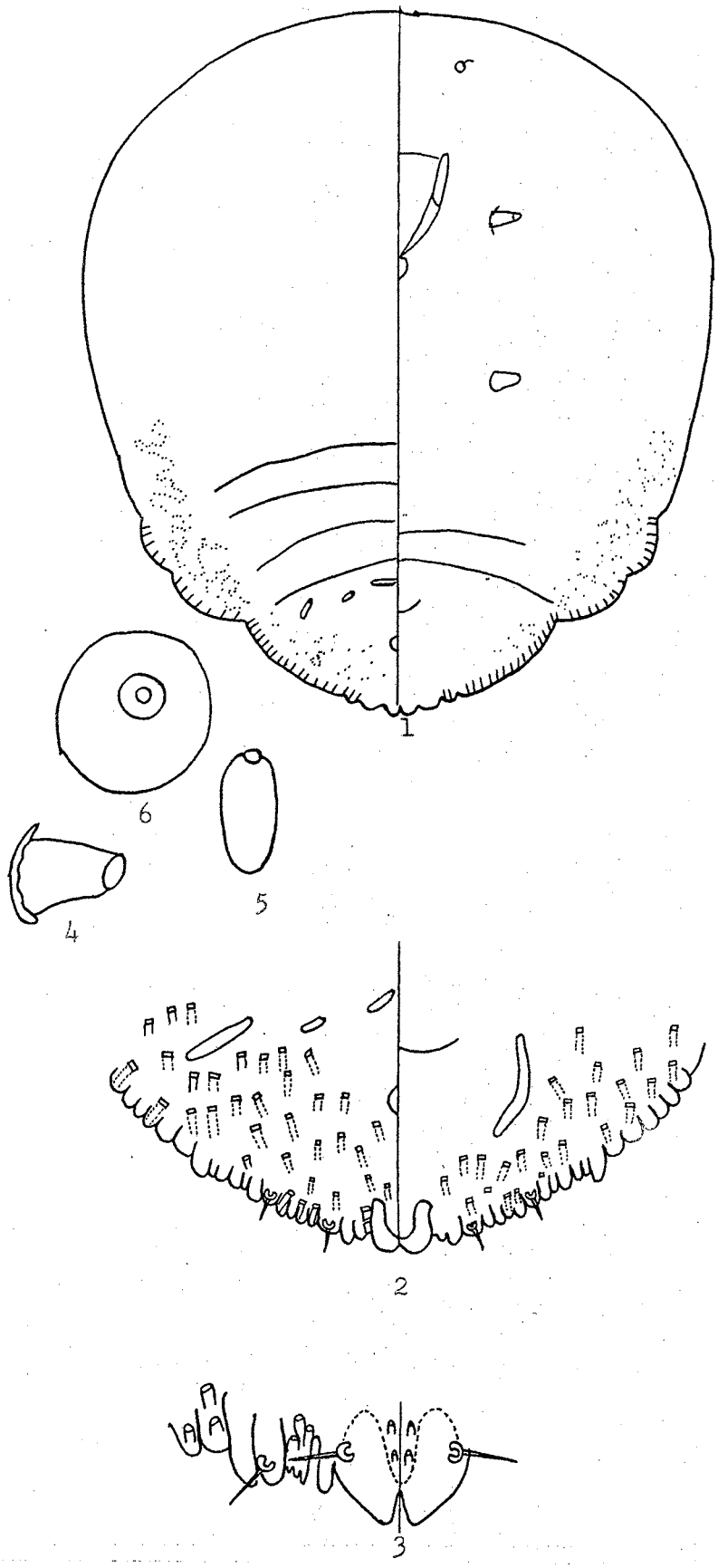


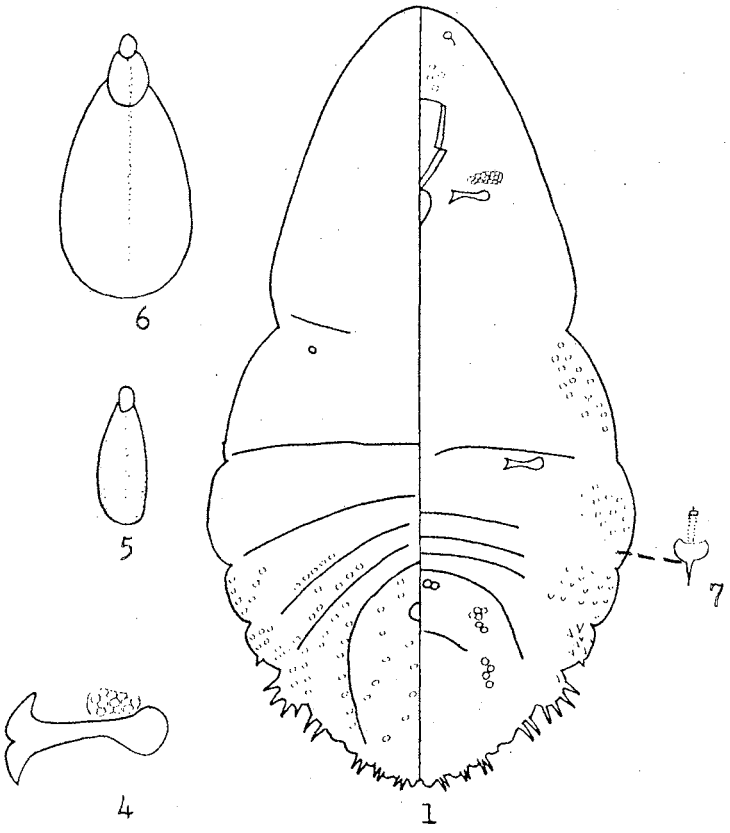
Plate XXXIII

Unaspis euonymi (Comstock)

Euonymus Scale

1. Adult female
2. Pygidium
3. Pygidial fringe
4. Anterior spiracle
5. Male scale covering
6. Female scale covering
7. Duct tubercle

Plate XXXIII



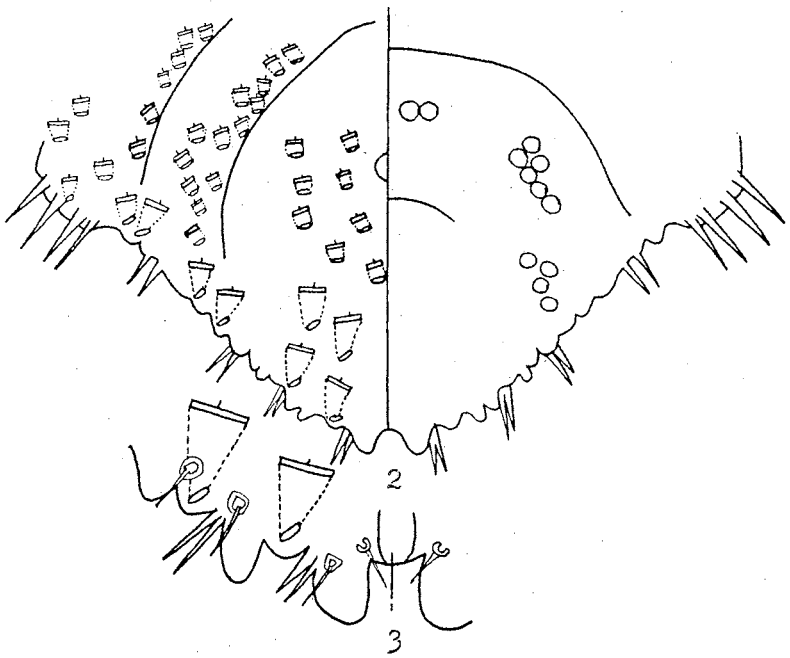


Plate XXXIV

Morphology of an Unarmored Scale Insect

(After Ezzat and McConnell)

1. Adult female
2. Leg
3. Spiracle
4. Multilocular pore
5. Triocular pore
6. Anal lobe (ventral)
7. Duct
8. Duct
9. Anal ring (dorsal half)
10. Anal lobe (dorsal)
11. Cerarius
12. Antenna
13. Ostiole
14. Antenna (scape)
15. Eye
16. Clypeus
17. Leg (Coxa)
18. Mesothoracic sternal apophysis
19. Metathoracic sternal apophysis
20. Circulus
21. Vulva

Plate XXXIV

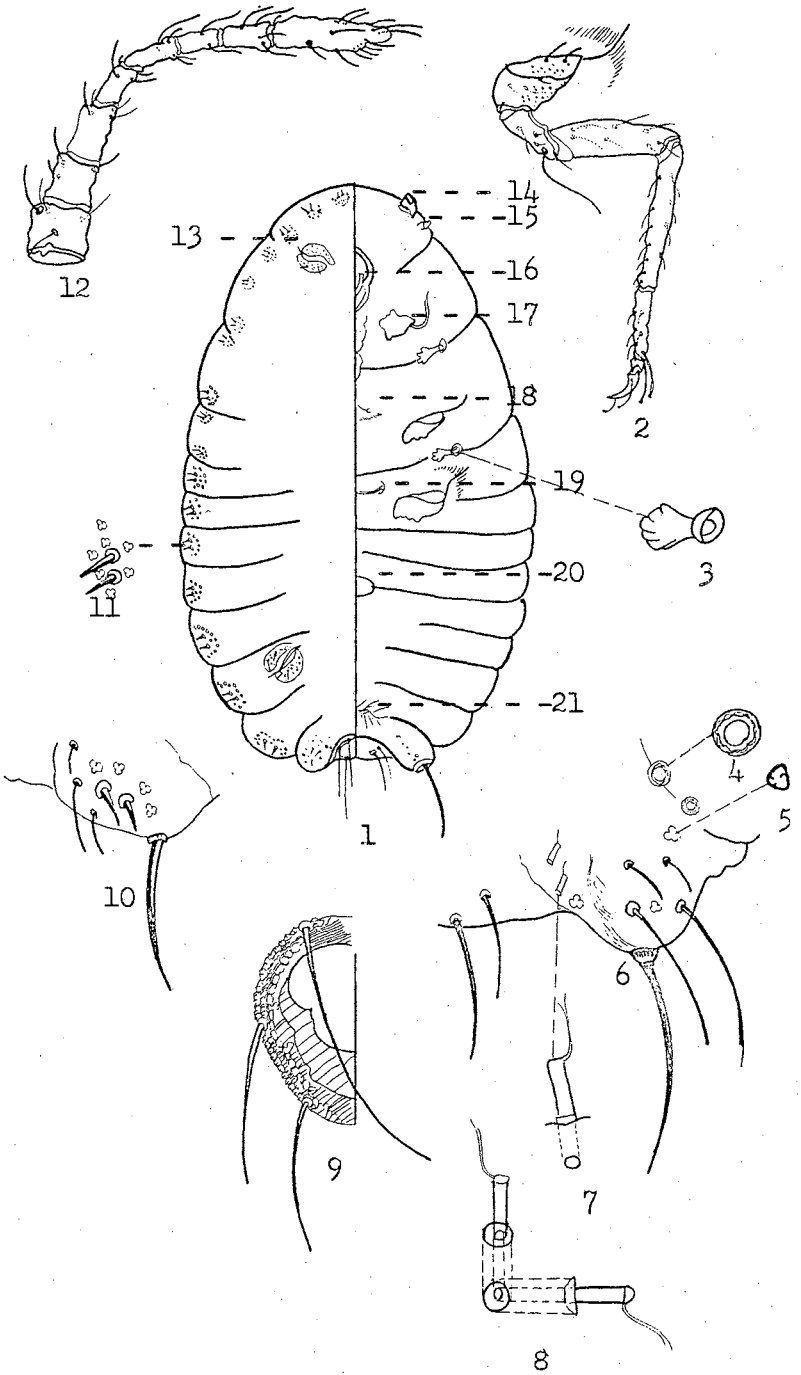


Plate XXXV

Cerococcus koebelei (Cockerell)

1. Adult female
2. Antenna
3. Anal lobes
4. Cribriform plate
5. Duct
6. 8-shaped pore

Plate XXXV

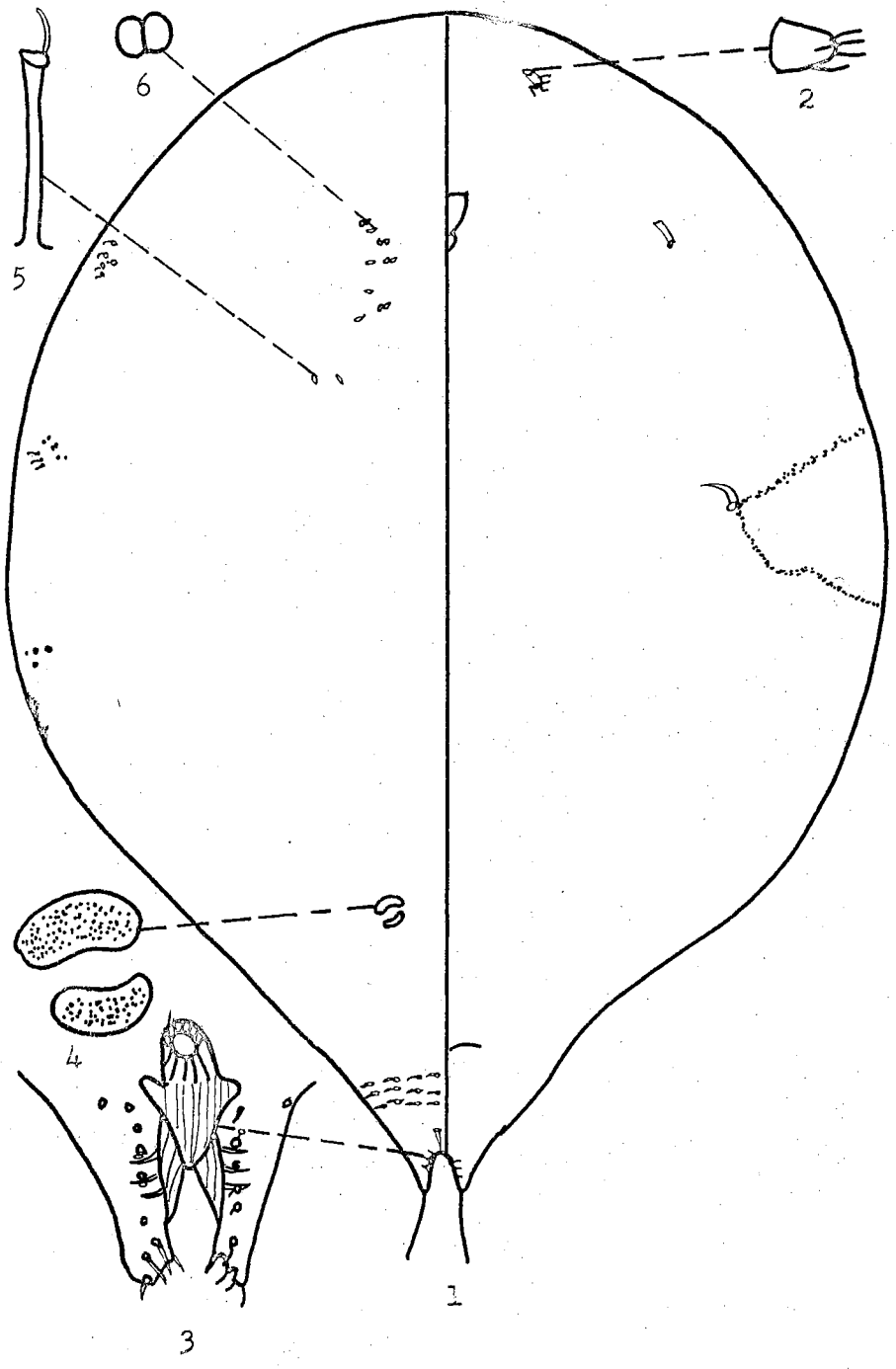


Plate XXXVI

Lecaniodiaspis celtidis Cockerell

1. Adult female
2. Antenna
3. Pore
4. Anal lobes
5. Multilocular pore
6. Duct
7. Seta
8. Duct

Plate XXXVI

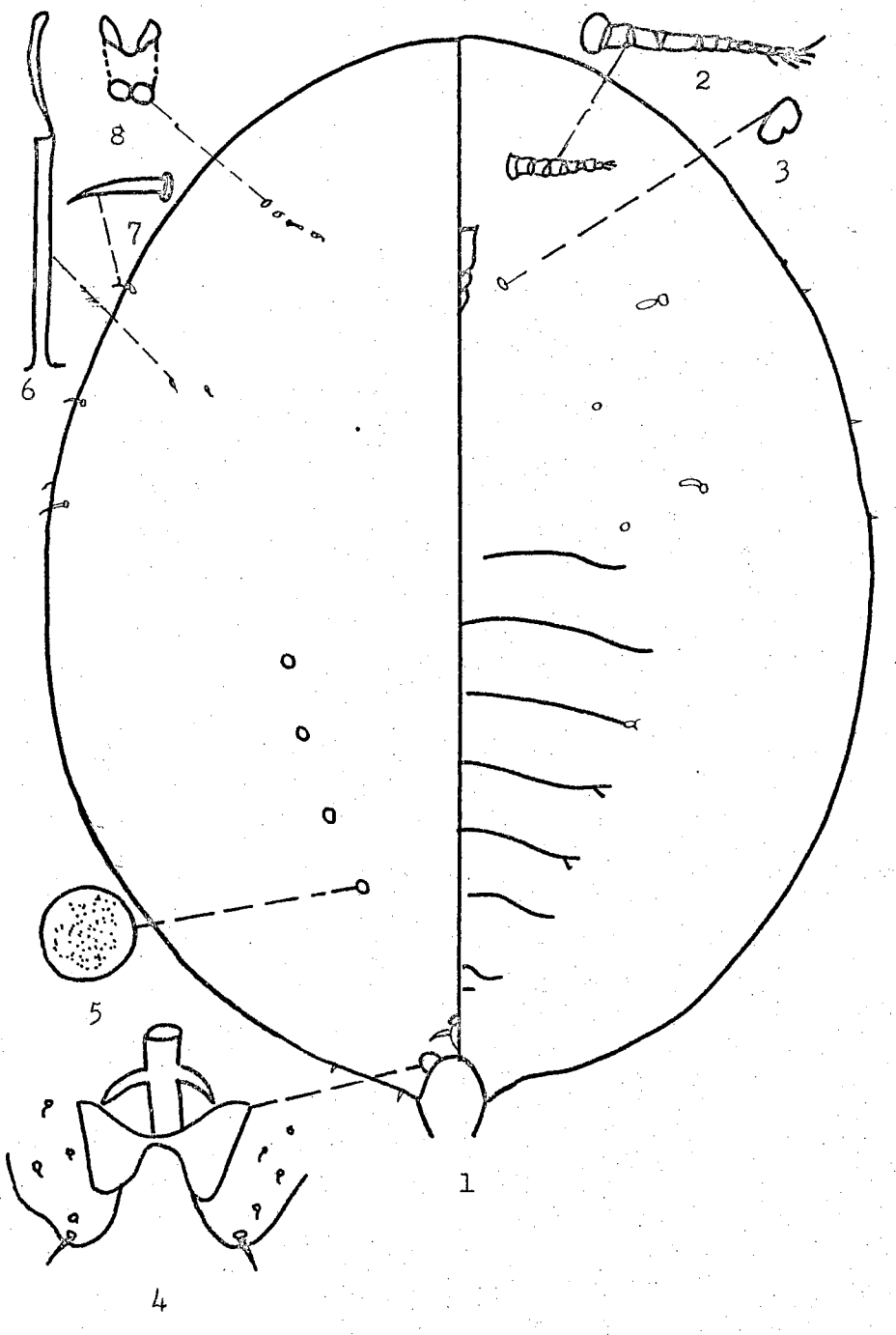


Plate XXXVII

Ceroplastes floridensis ? Comstock

Florida Wax Scale

1. Adult female
2. Antenna
3. Spiracular depression bearing setae
4. Metathoracic leg
5. Anal plate (ventral)
6. Anal plate (dorsal)

Plate XXXVII

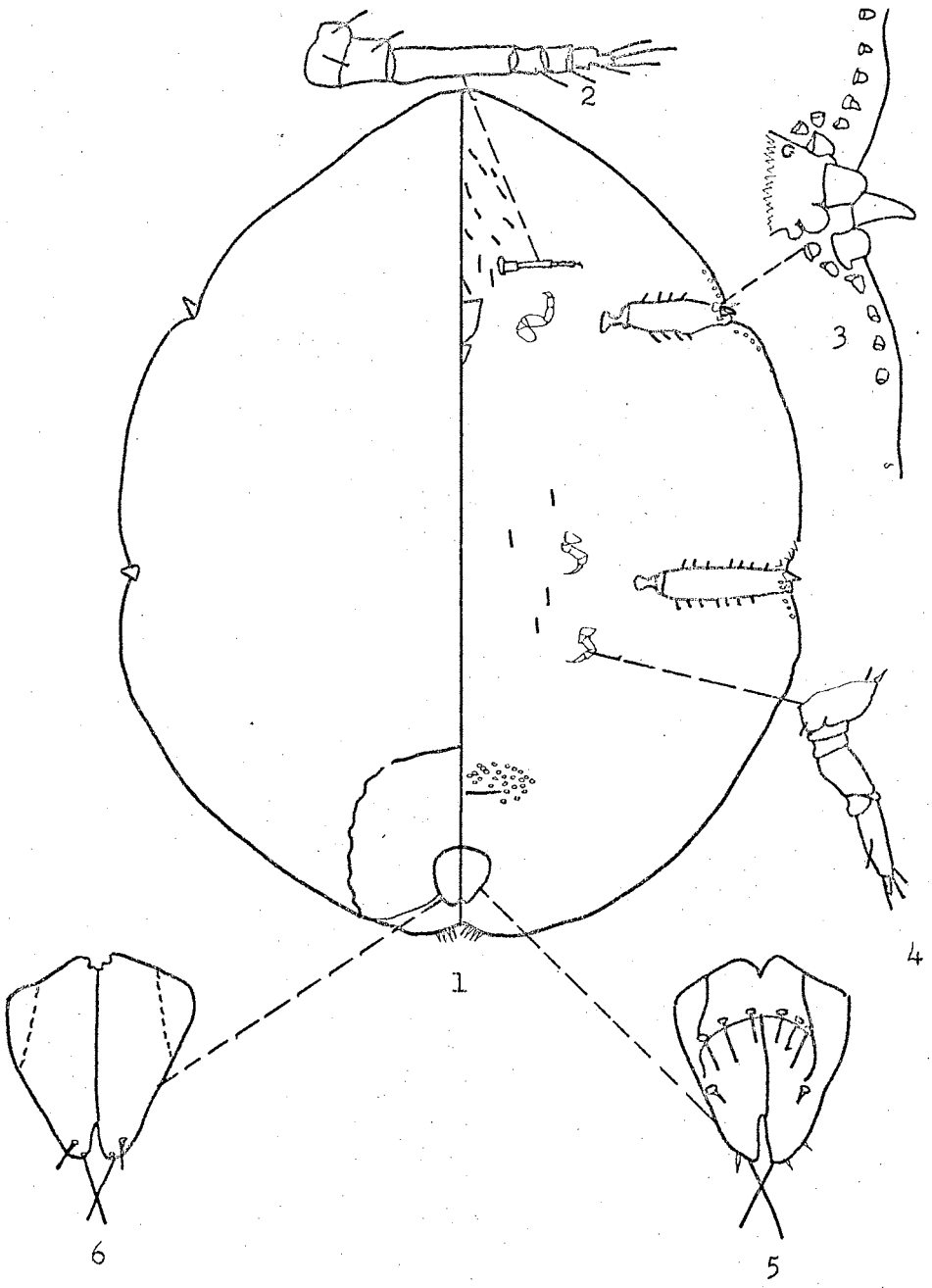


Plate XXXVIII

Coccus hesperidum Linnaeus

Soft Scale

1. Adult female
2. Antenna
3. Spiracular depression showing setae
4. Multilocular pore
5. Anal plate (ventral)
6. Anal plate (dorsal)
7. Duct
8. Habit sketch of adult female

Plate XXXVIII

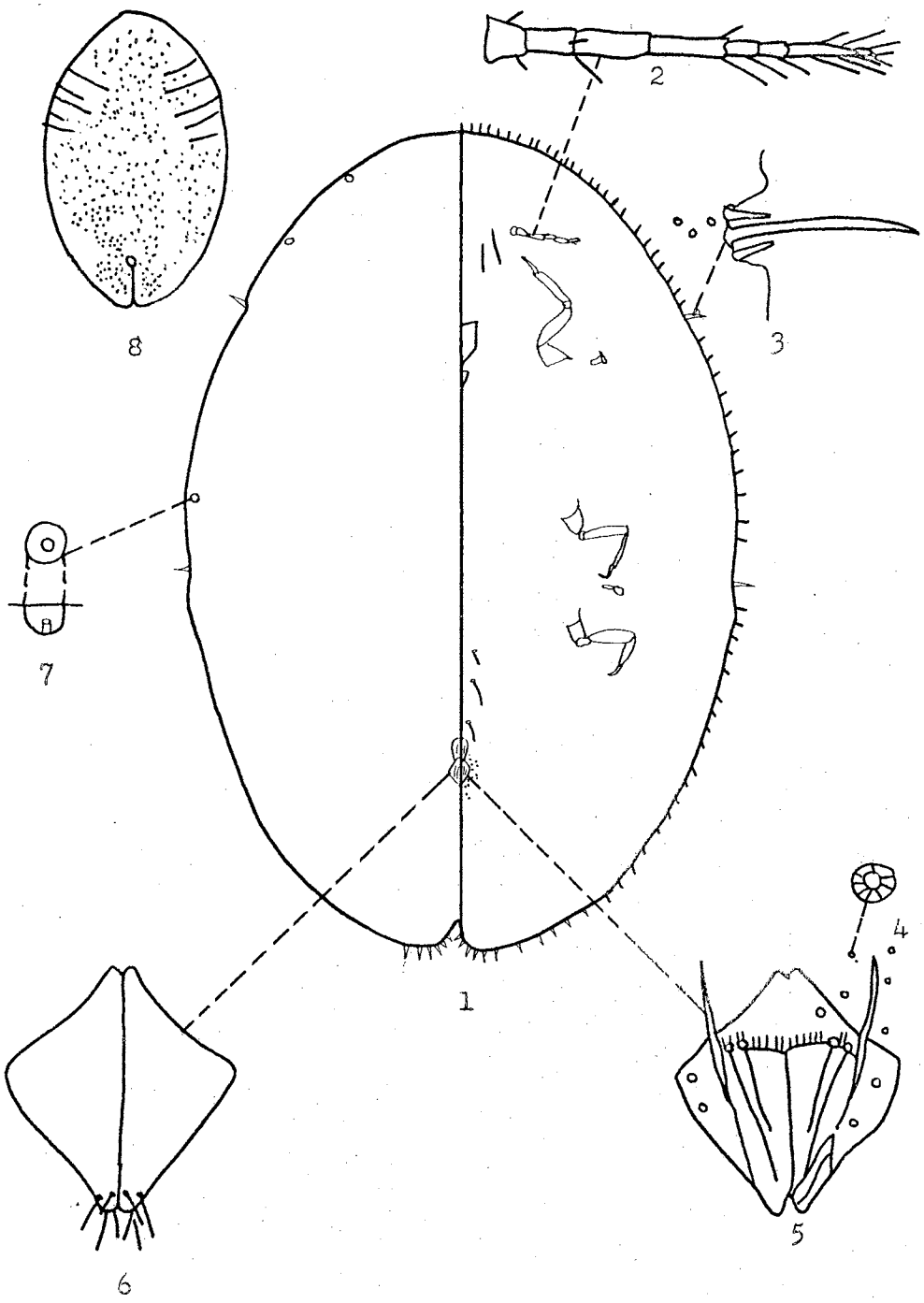


Plate XXXIX

Lecanium corni Bouché

European Fruit Lecanium

1. Adult female
2. Anal plate
3. Prothoracic leg
4. Anal ring
5. Antenna

Plate XXXIX

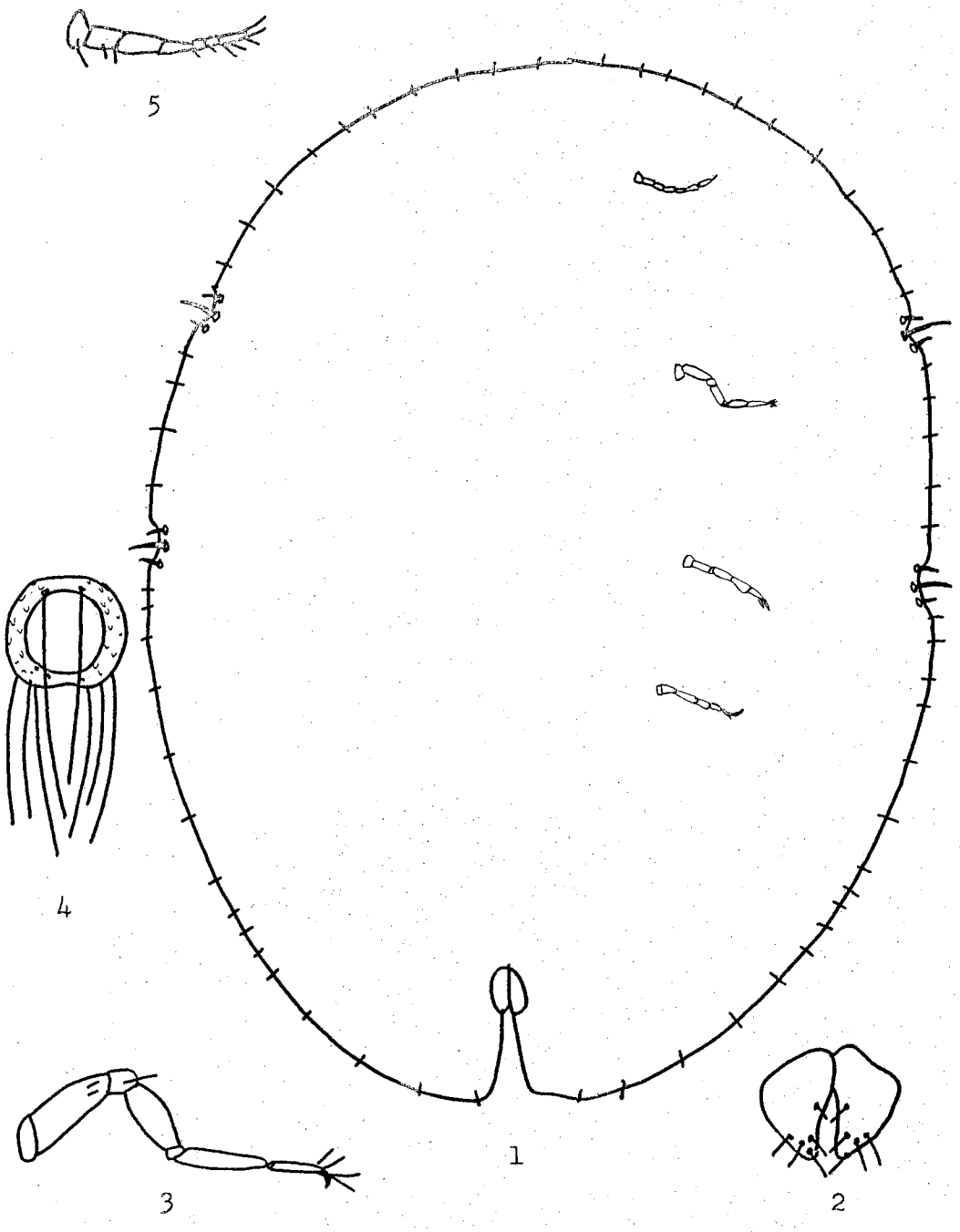


Plate XL

Lecanium fletcheri Cockerell

Fletcher Scale

1. Outline of adult female
2. Anal plate
3. Mesothoracic leg
4. Antenna

Plate XL

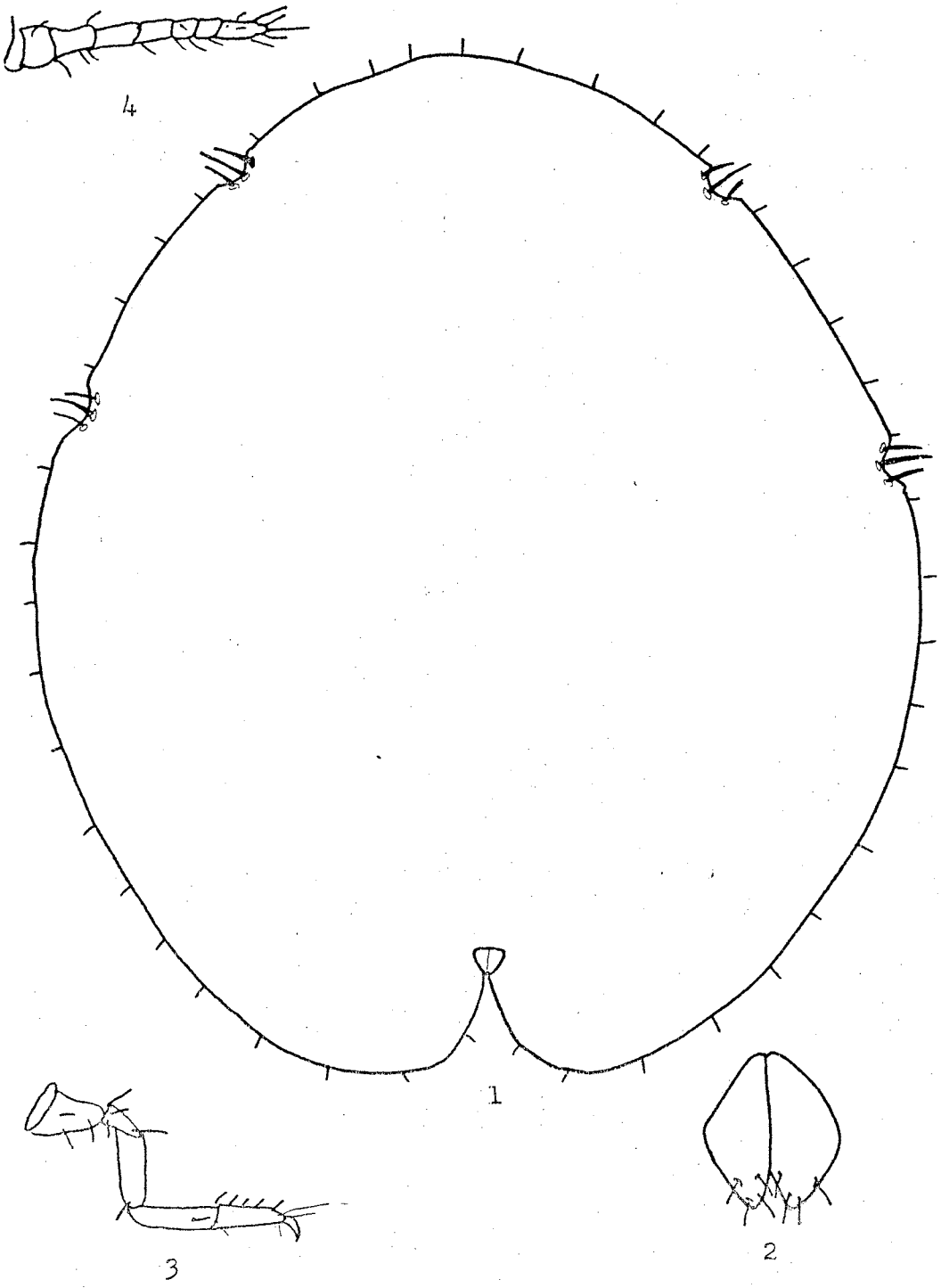


Plate XLI

Lecanium nigrofasciatum Pergande

Terrapin Scale

1. Outline of adult female
2. Anal plate
3. Metathoracic leg
4. Antenna

Plate XLI

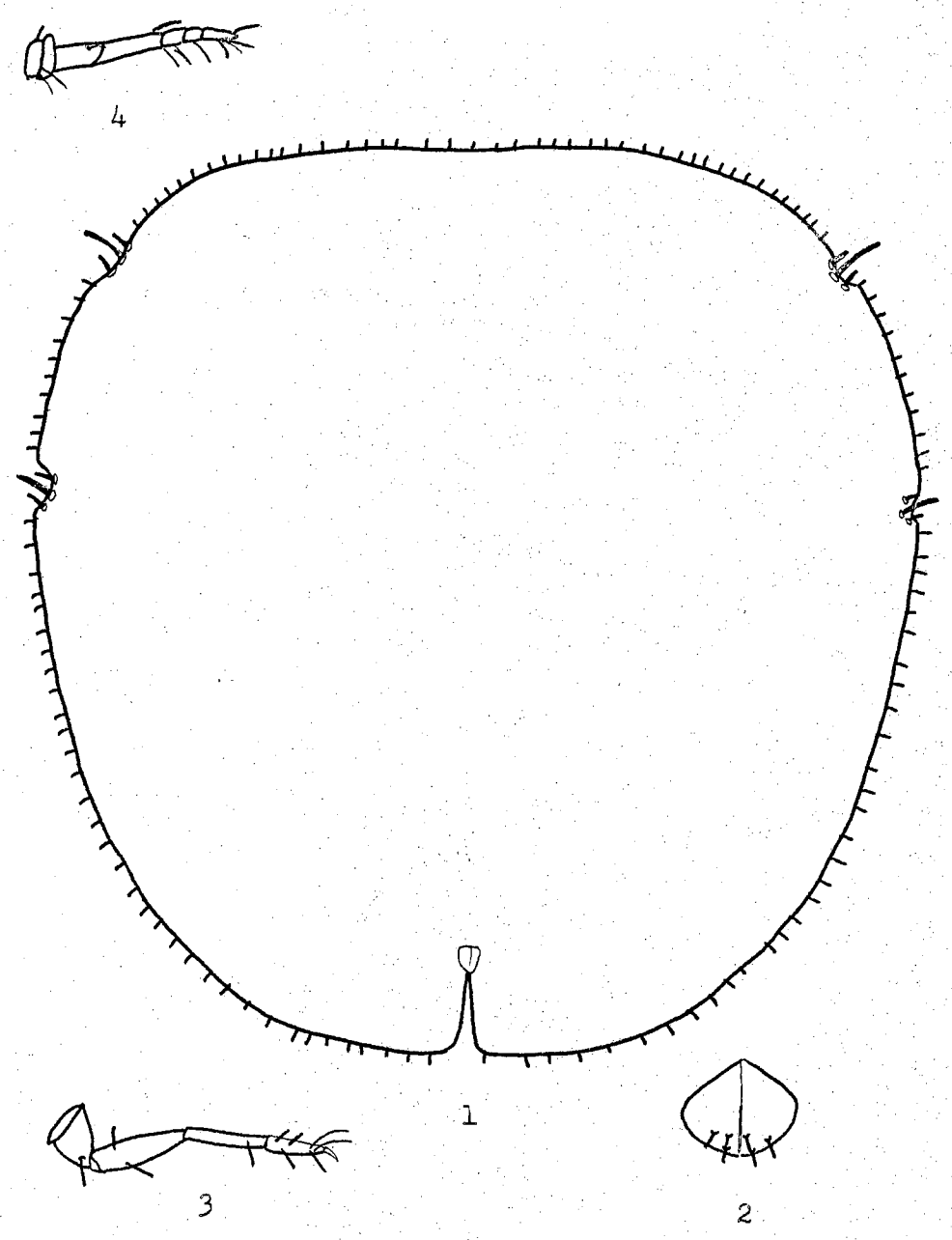


Plate XLII

Lecanium quercifex Fitch

Oak Lecanium

1. Outline of adult female
2. Anal plate
3. Mesothoracic leg
4. Antenna

Plate XLII

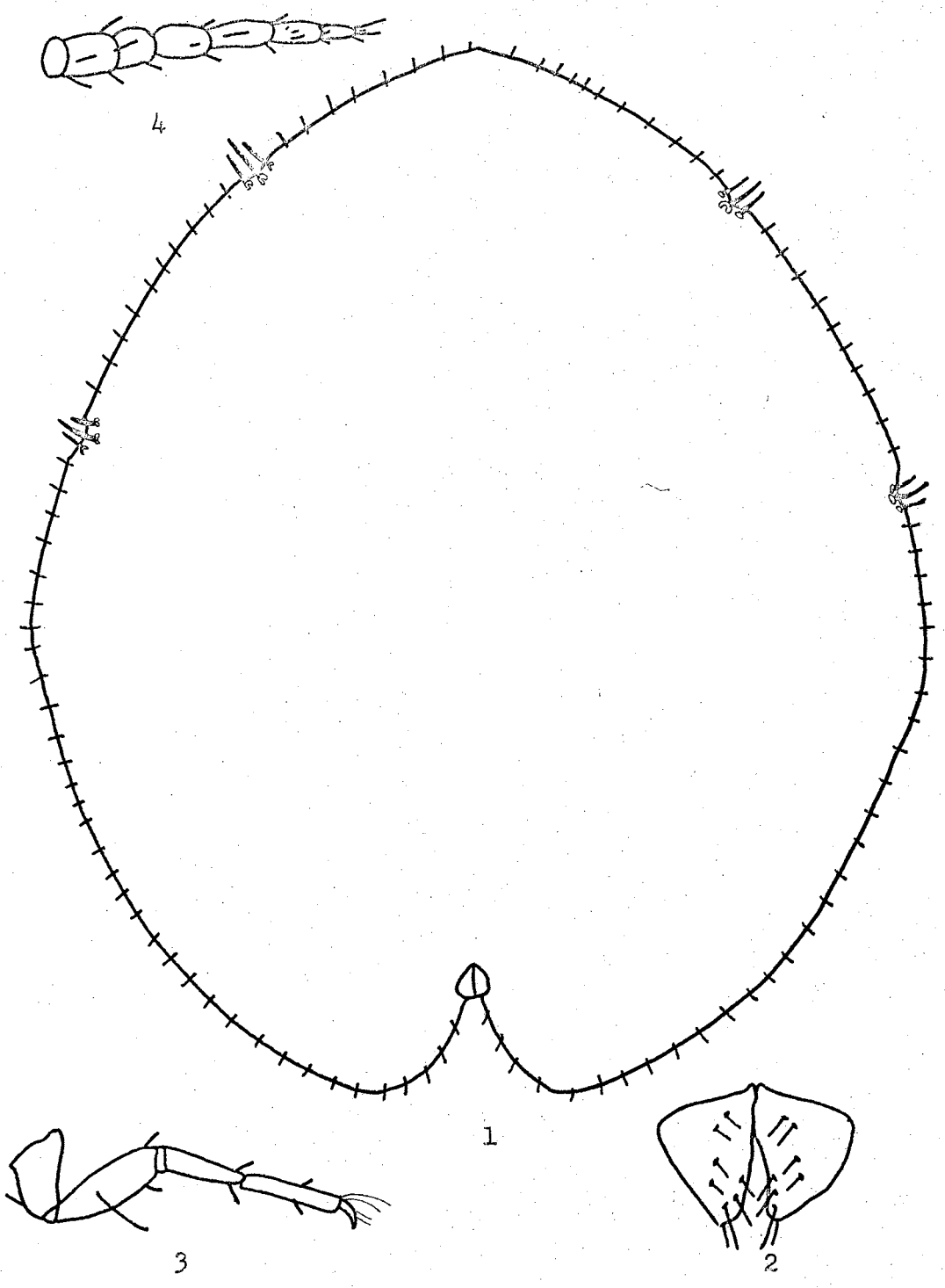


Plate XLIII

Saissetia hemisphaerica (Targioni)

Hemispherical Scale

1. Adult female
2. Spiracular depression bearing setae
3. Duct
4. Anal plate (ventral)
5. Anal plate (dorsal)
6. Duct
7. Duct
8. Habit sketch of adult female (lateral)
9. Antenna

Plate XLIII

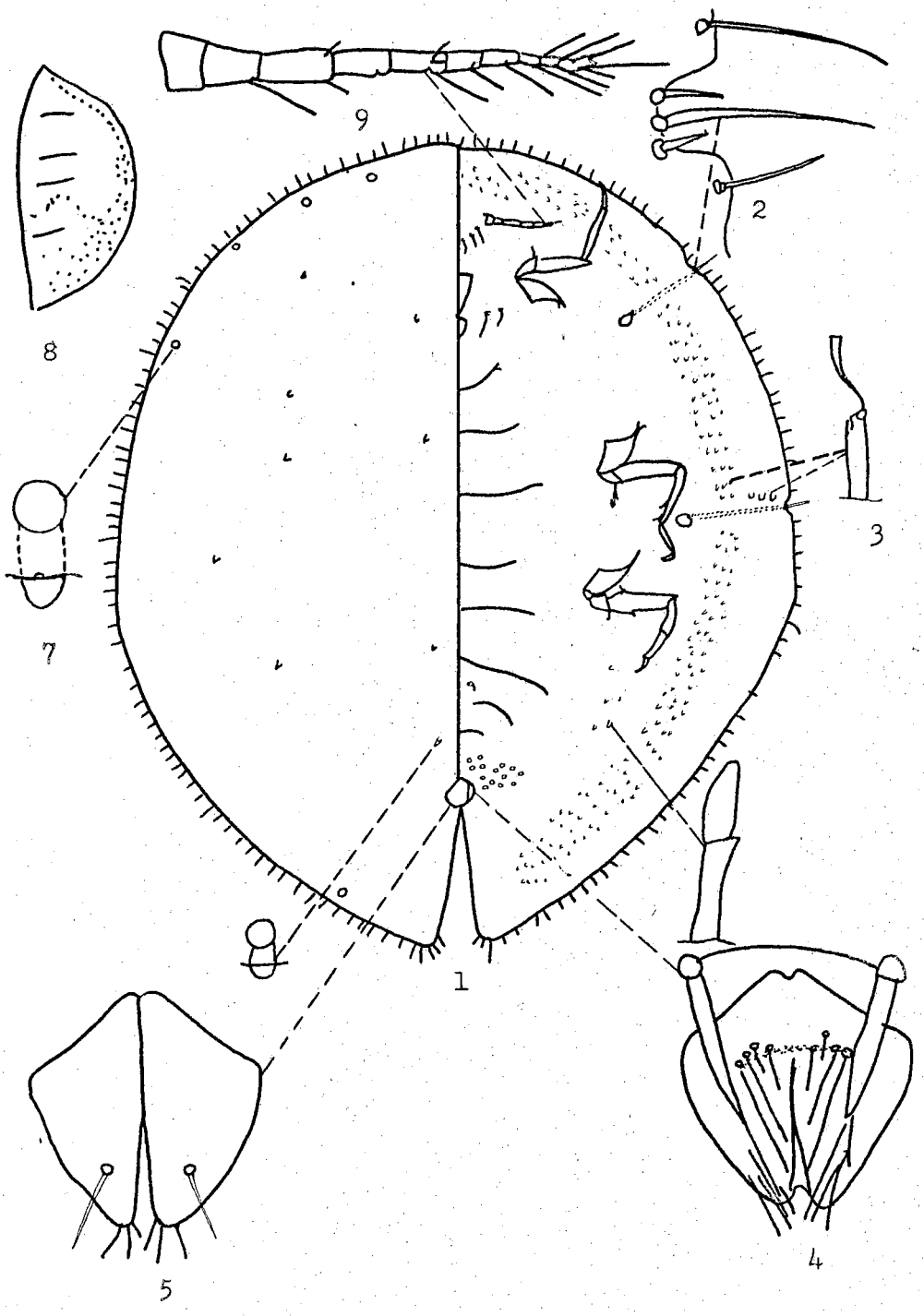


Plate XLIV

Saissetia oleae (Bernard)

Black Scale

1. Adult female
2. Spiracular depression bearing setae
3. Duct
4. Anal plate (ventral)
5. Anal plate (dorsal)
6. Duct
7. Habit sketch of adult female
8. Antenna

Plate XLIV

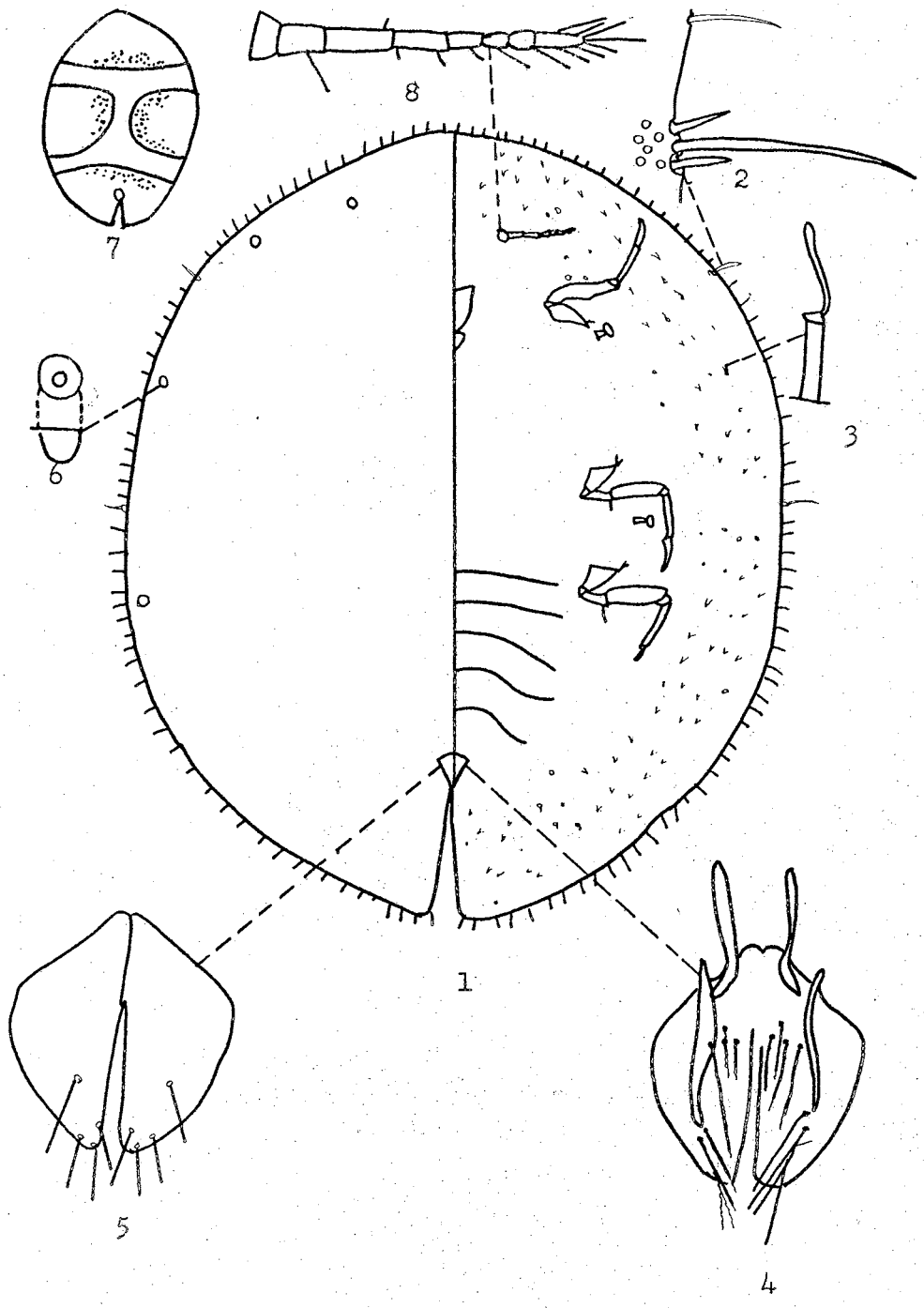


Plate XLV

Toumeyella parvicorne ? (Cockerell)

1. Outline of adult female

2. Anal plate

3. Antenna

4. Prothoracic leg

Plate XLV

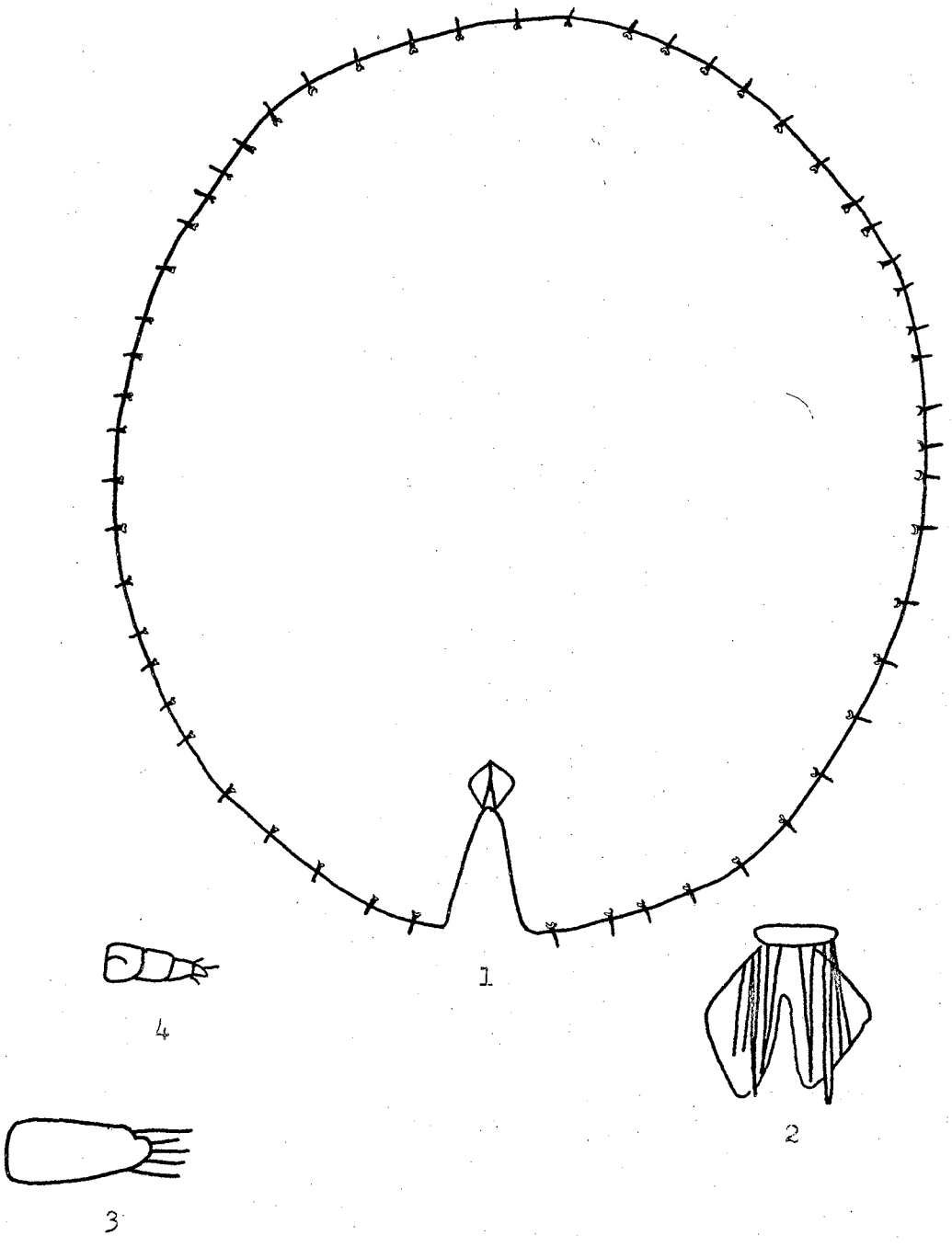


Plate XLVI

Eriococcus quercus (Comstock)

Oak Eriococcus

1. Adult female
2. Antenna
3. Tarsal claw
4. Anal lobe (dorsal)
5. Seta
6. Seta
7. Duct

Plate XLVI

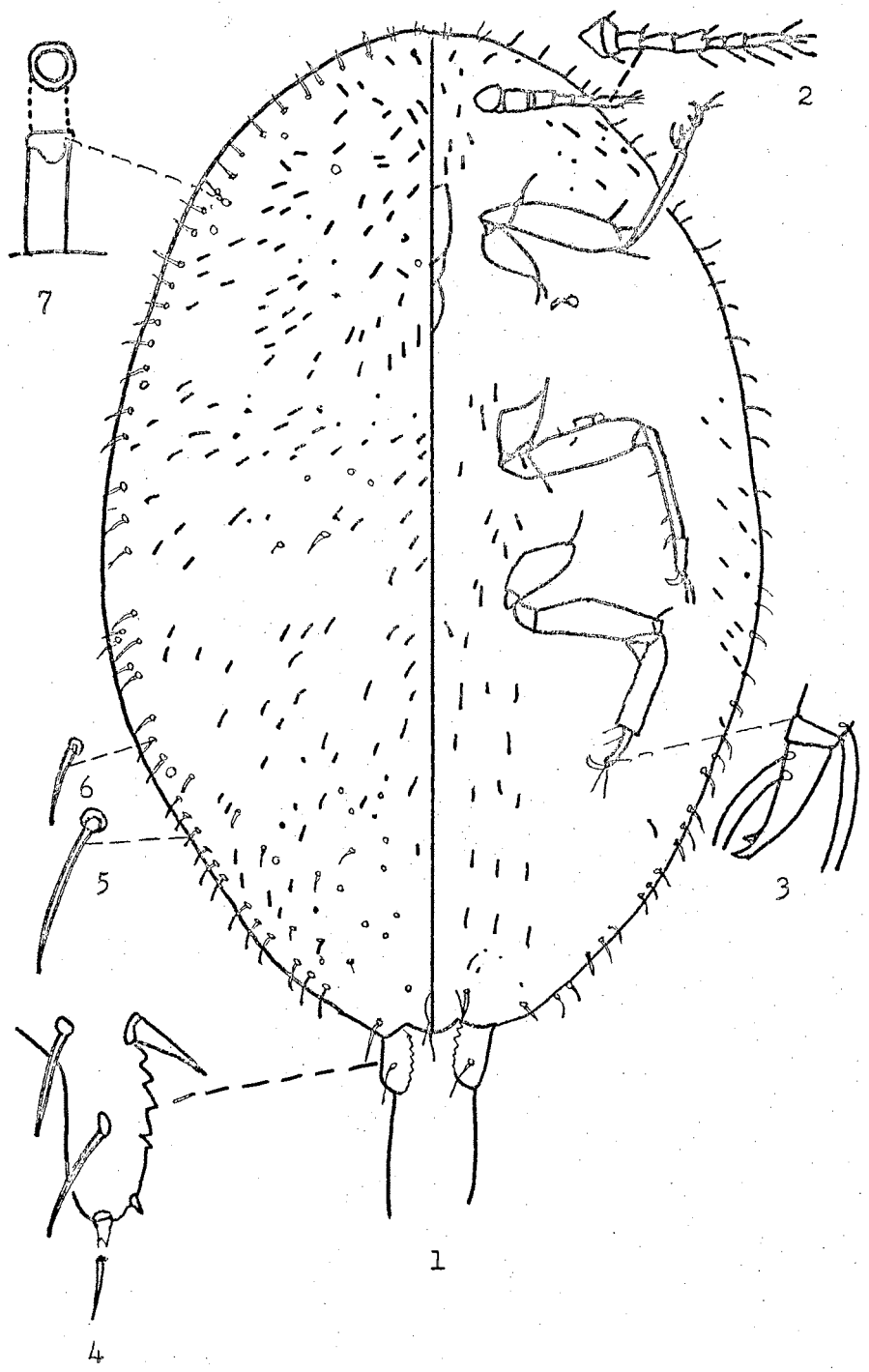


Plate XLVII

Onceropyga nudula Ferris

1. Adult female
2. Antenna
3. Tarsal claw
4. Seta
5. Seta
6. Duct

Plate XLVII

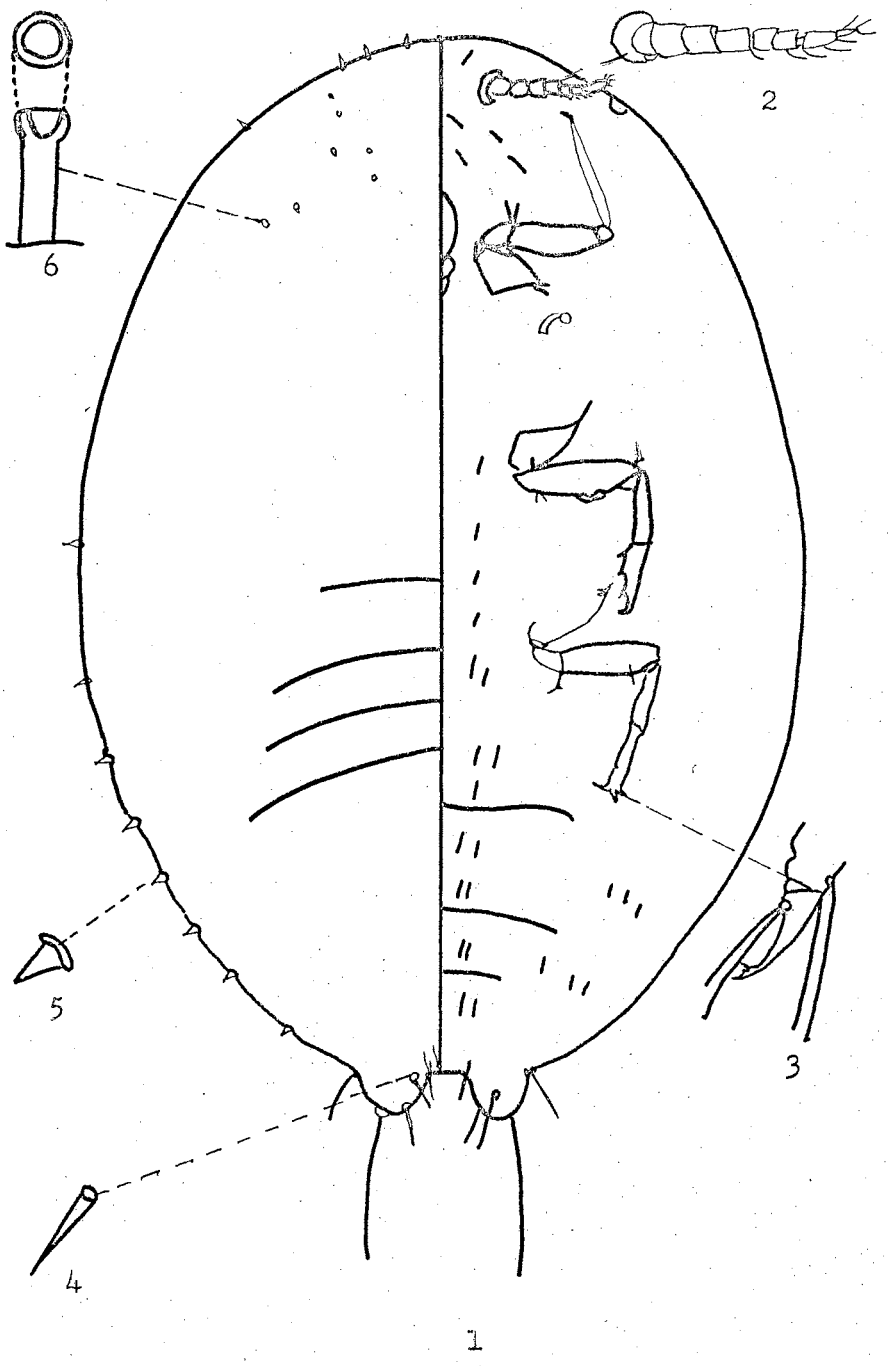


Plate XLVIII

Antonina nortoni Parrott

1. Adult female
2. Antenna
3. Tubular duct

Plate XLVIII

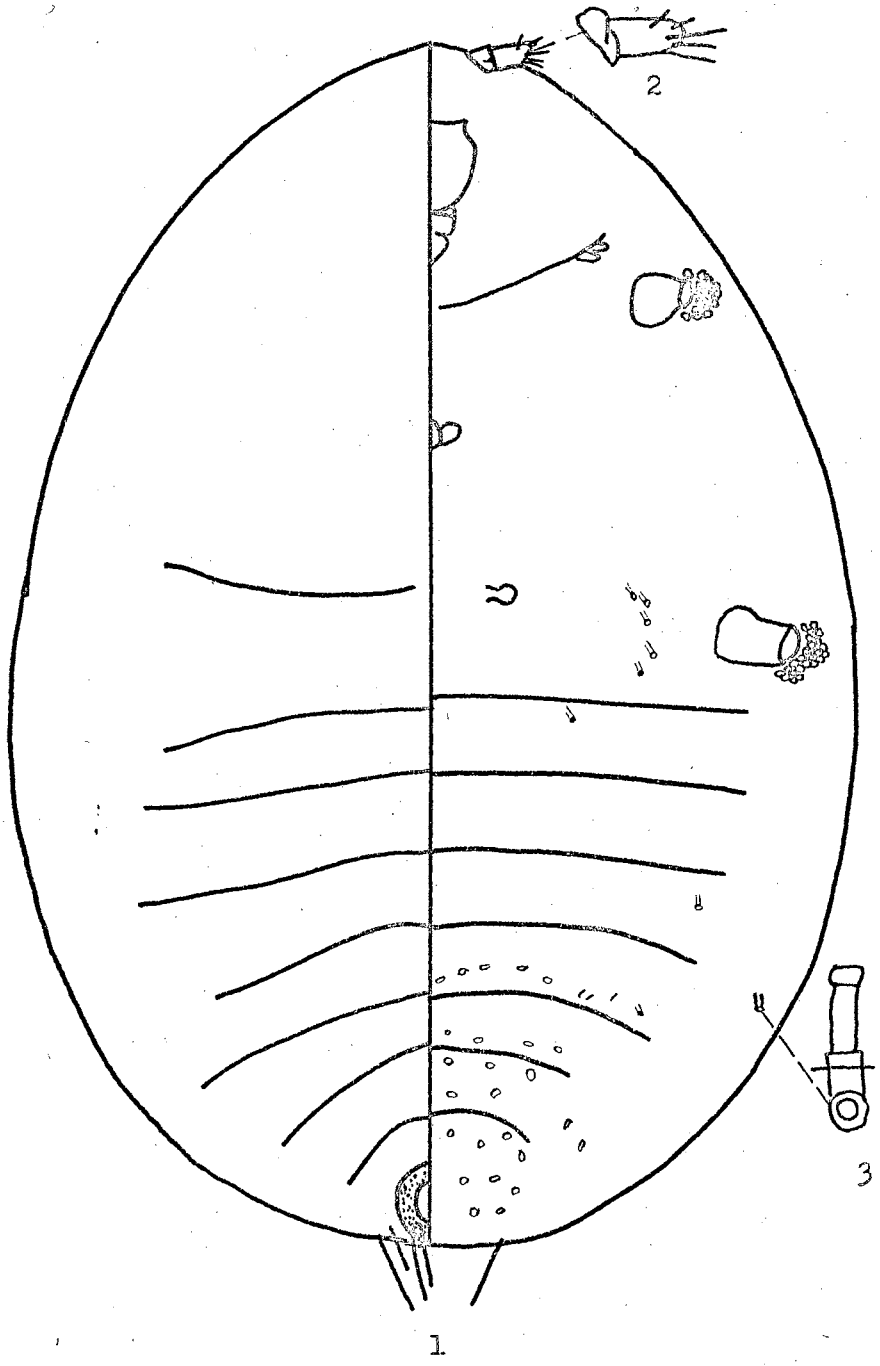


Plate XLIX

Antoninoides parrotti Cockerell

1. Adult female
2. Antenna
3. Duct

Plate XLIX

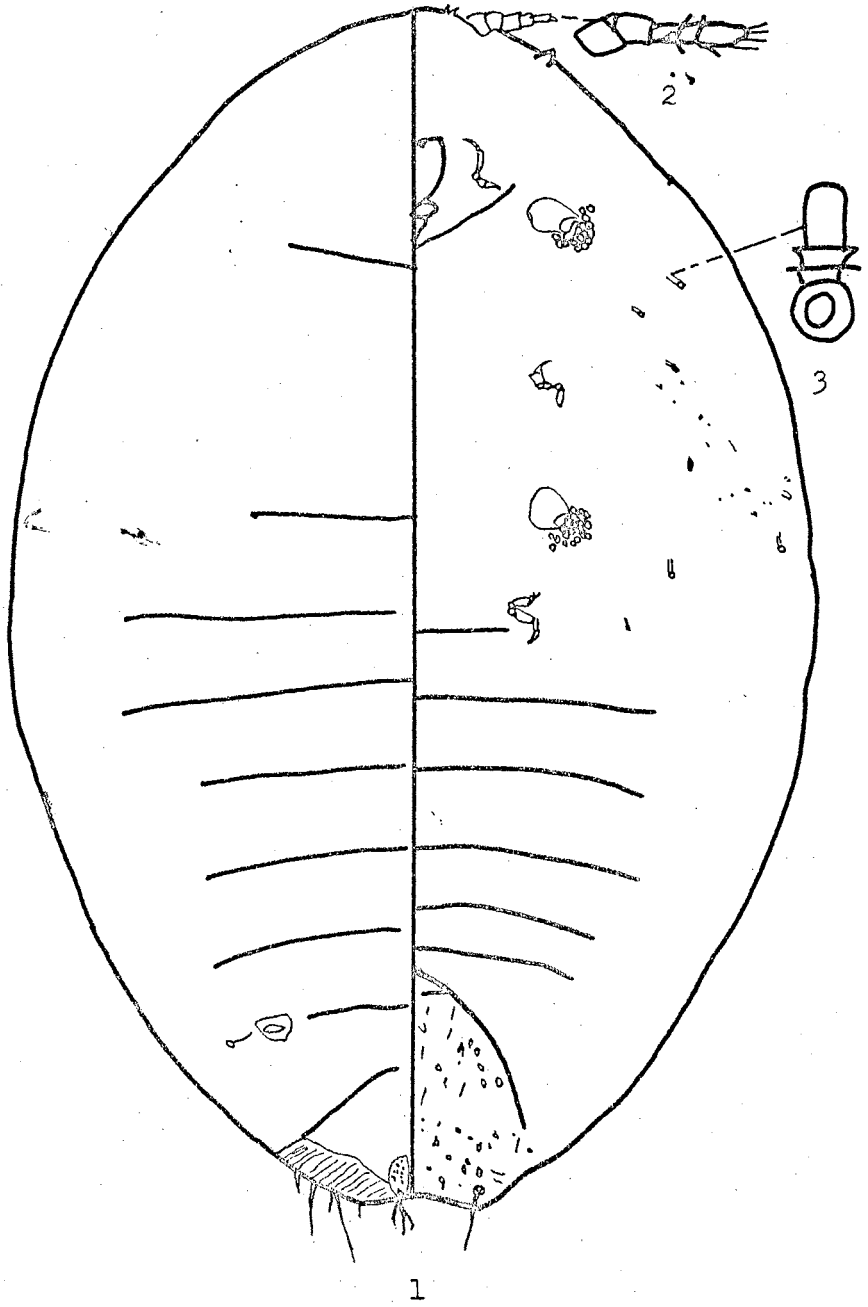


Plate L

Ferrisiana virgata Cockerell

Striped mealybug

1. Adult female

2. Duct

Plate L

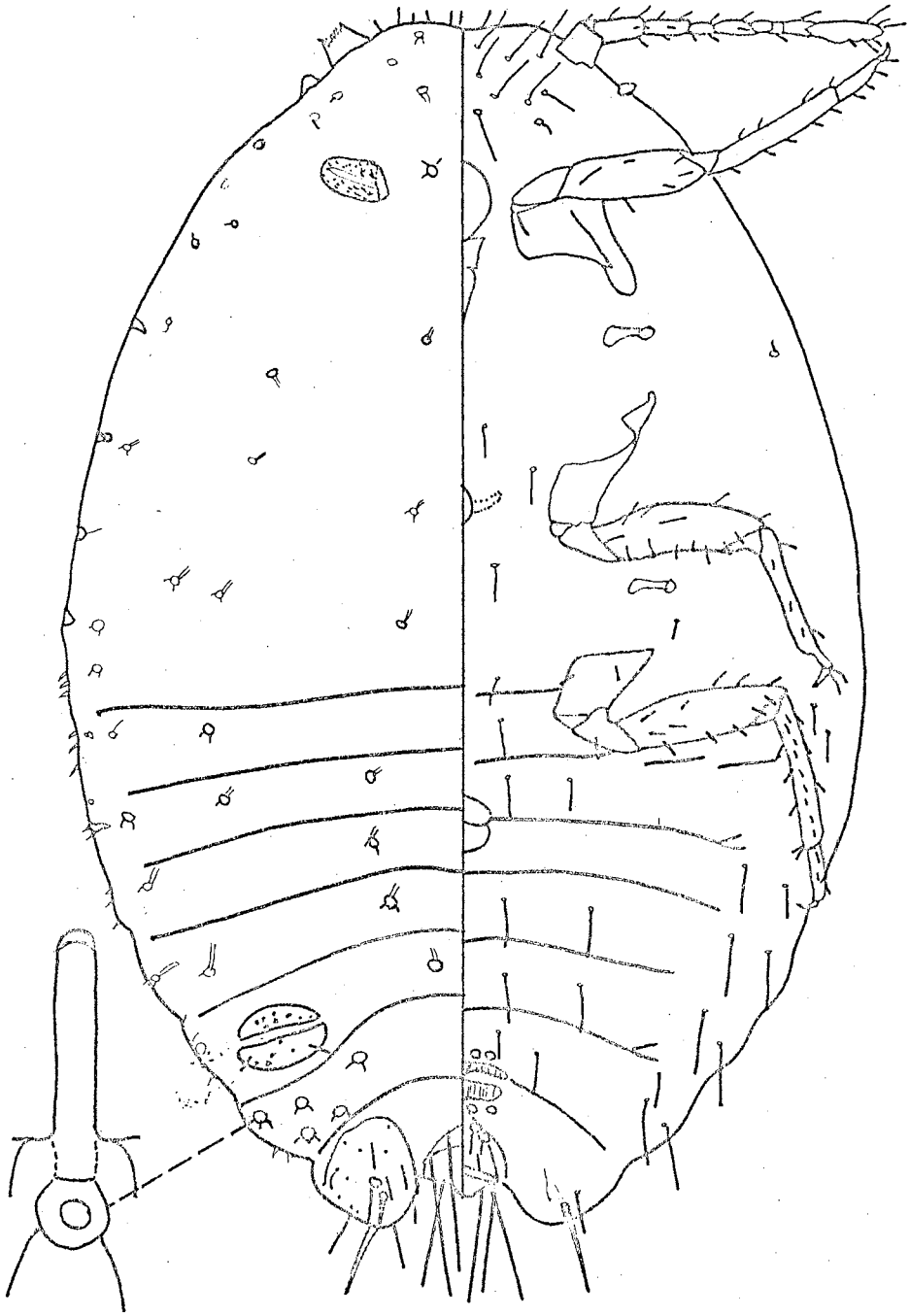


Plate LI

Phenacoccus gossypii Townsend and Cockerell

Mexican Mealybug

1. Adult female
2. Tarsal claw
3. Duct
4. Triocular pore
5. Anal lobe cerarius

Plate LI

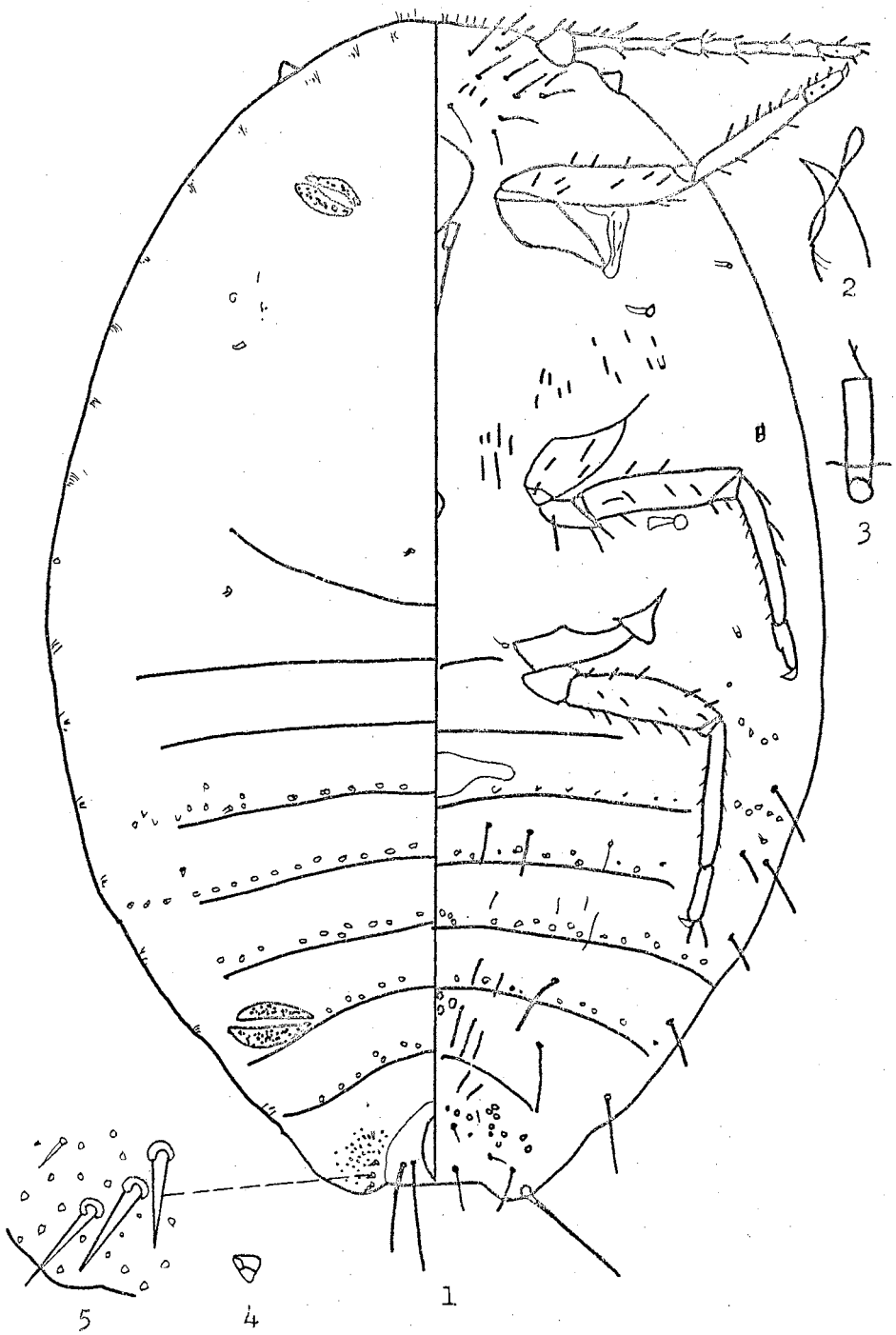


Plate LII

Phenacoccus solenopsis Tinsley

1. Adult female
2. Anal lobe cerarius
3. Duct
4. Seta
5. Cerarius

Plate LII

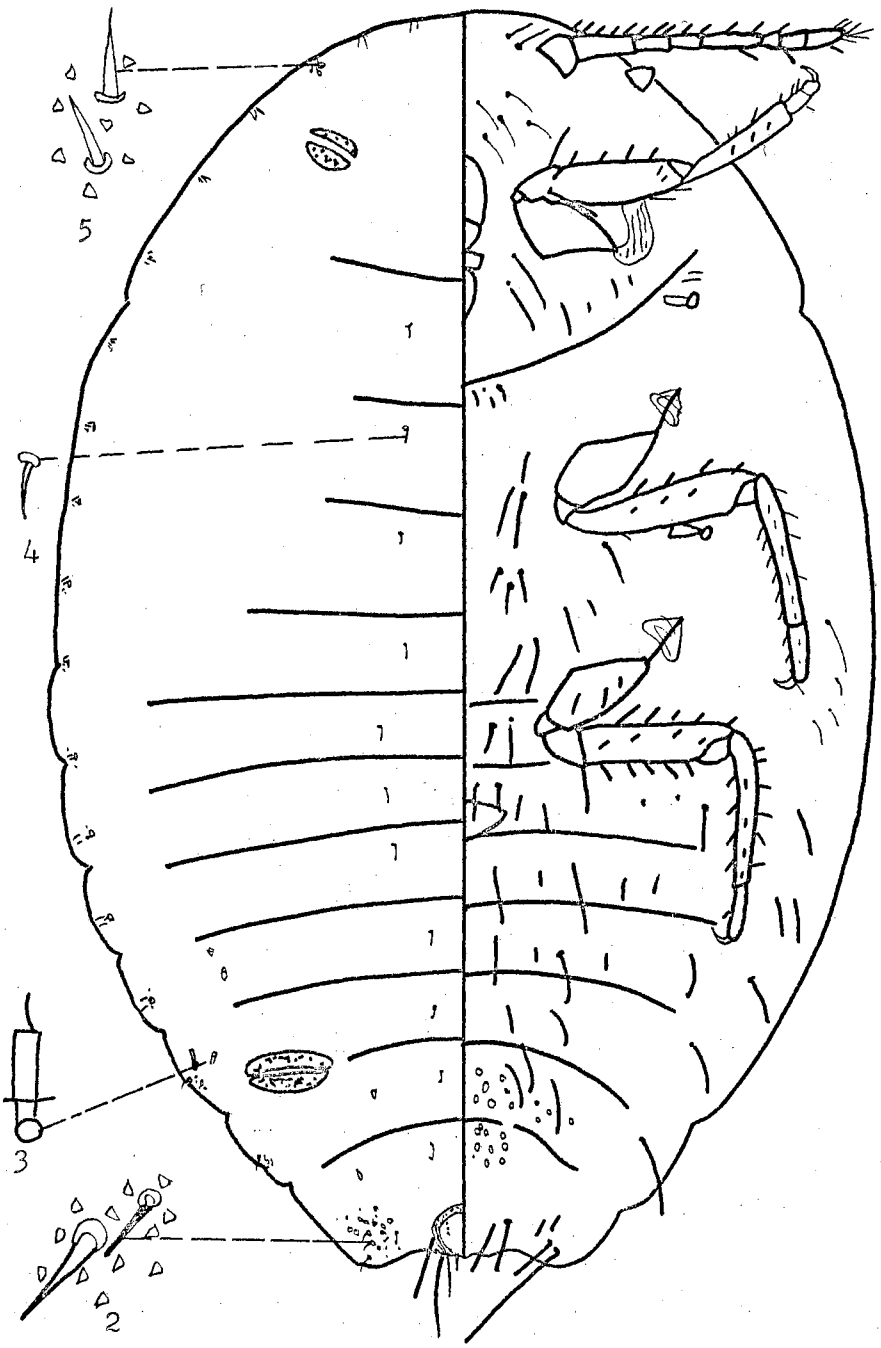


Plate LIII

Planococcus citri (Risso)

Citrus Mealybug

1. Adult female
2. Multilocular pore
3. Duct
4. Anal lobe (ventral)
5. Triocular pore
6. Anal lobe (dorsal)
7. Ducts
8. Cerarius

Plate LIII

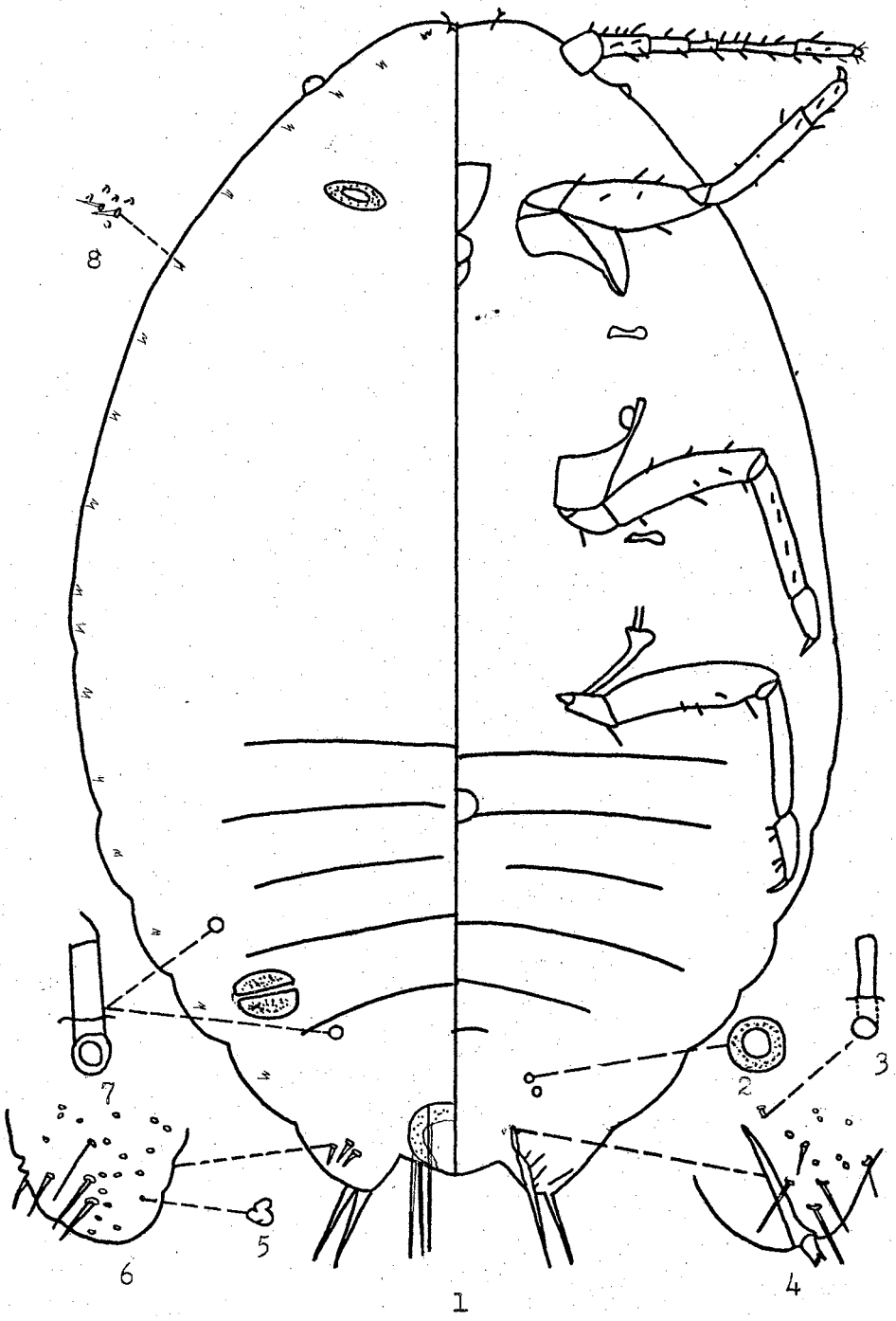


Plate LIV

Pseudococcus adonidum (Linnaeus)

Long-tailed Mealybug

1. Adult female

2. Anal lobe cerarius

3. Duct

Plate LIV

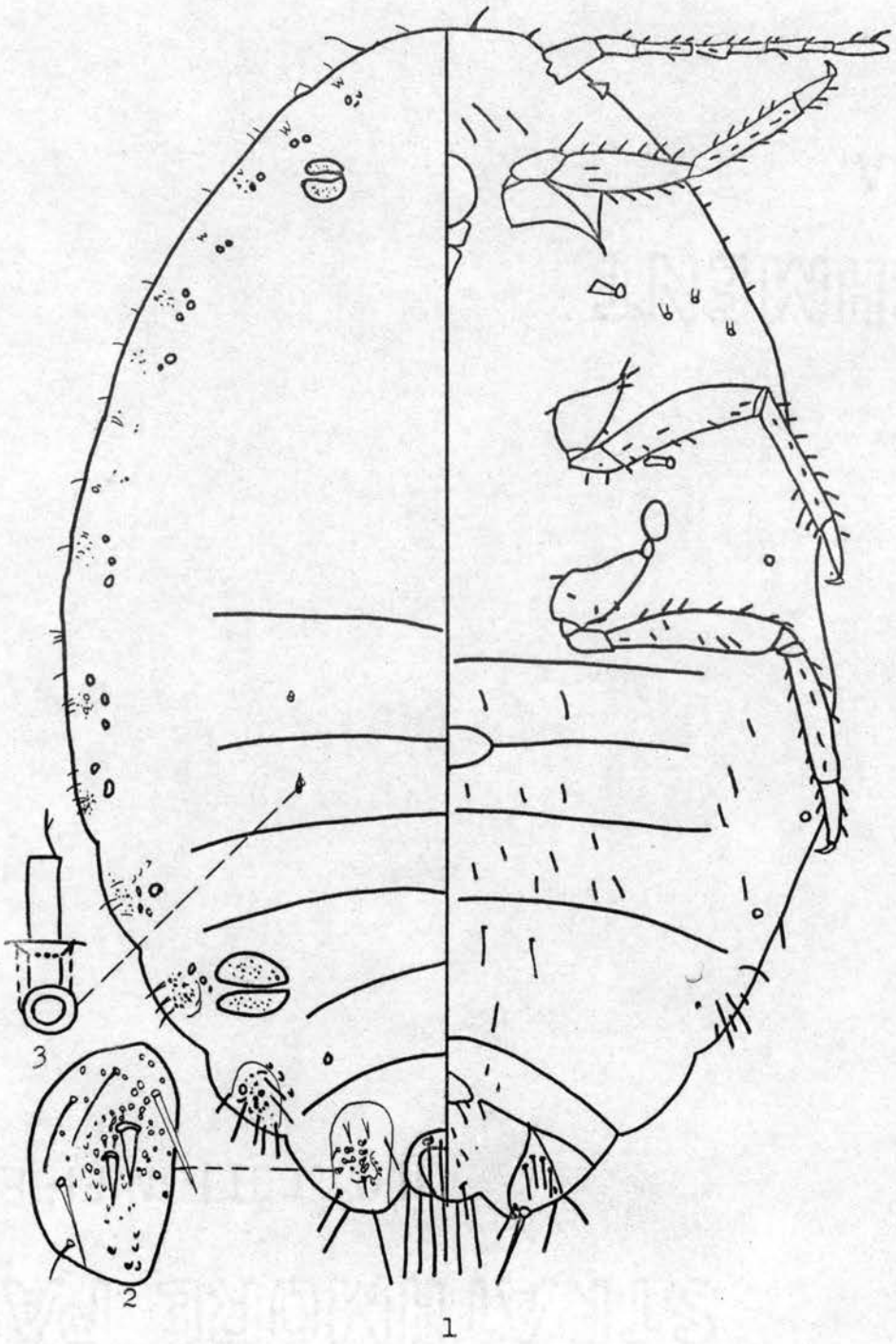
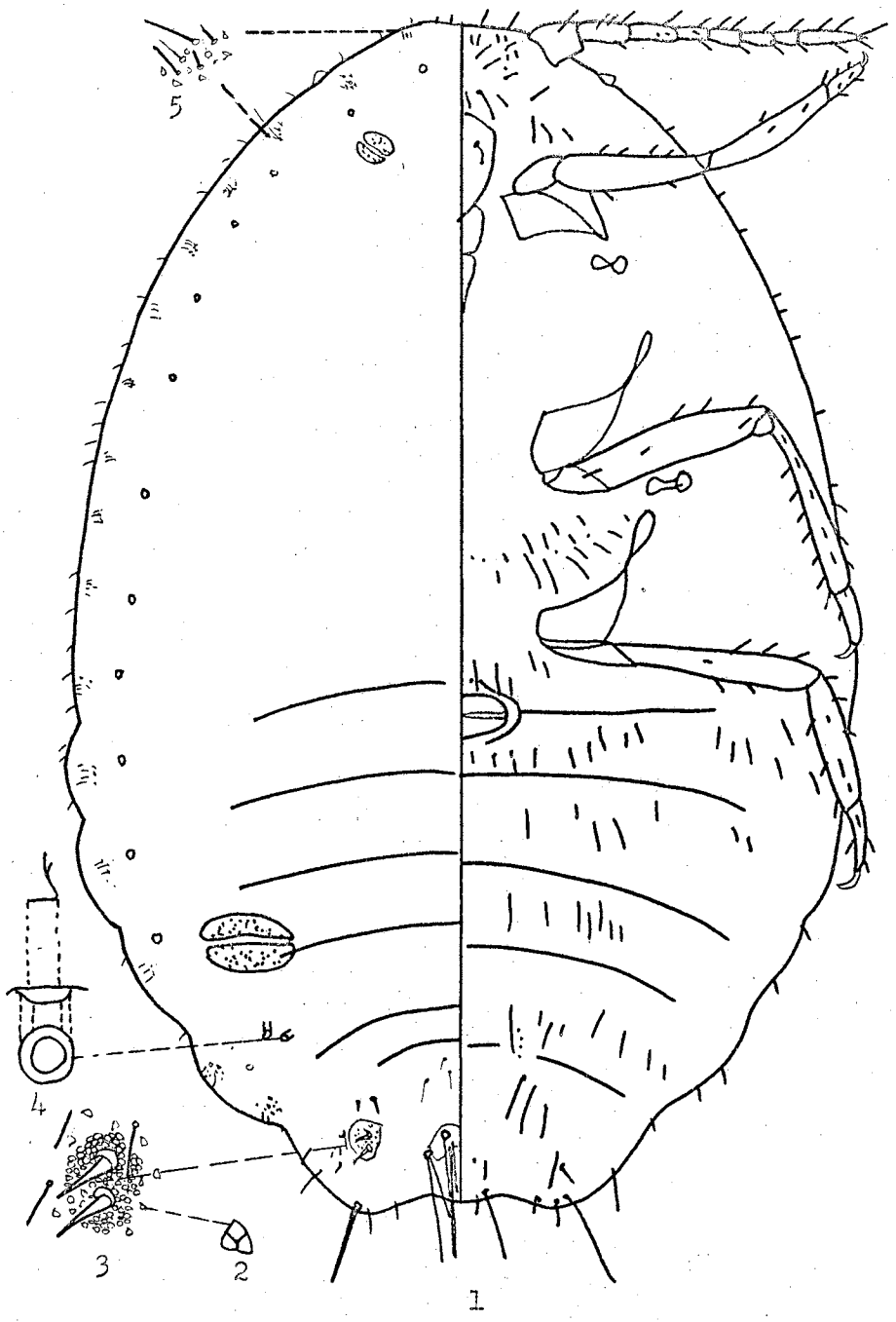


Plate LV

Pseudococcus sorghiellus Forbes

1. Adult female
2. Triocular pore
3. Anal lobe cerarius
4. Duct
5. Cerarius

Plate LV



VITA

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