

THE SCALE INSECTS OF CALIFORNIA

PART 3

THE ARMORED SCALES

(Homoptera: Diaspididae)

by:

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(HOMOPTERA:COCCOIDEA:DIASPIDIDAE)

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The color photograph on the front cover is of the San José scale, *Quadraspidiotus perniciosus* (Comstock), on almond, reared indoors at Riverside, Riverside County, California.

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DEPARTMENT OF FOOD AND AGRICULTURE
DIVISION OF PLANT INDUSTRY**

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Dedicated to

Richard F. Wilkey

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PREFACE

The **Scale Insects** are a group of animals in the insect superfamily Coccoidea, which are in turn included in the suborder Sternorrhyncha. The Sternorrhyncha, which also includes the psyllids, aphids and whiteflies, was previously in the now defunct order Homoptera, but now is included in the Hemiptera. The Sternorrhyncha are separated from other groups of insects, except for the suborders composed of the cicada and planthopper groups, primarily because of piercing-sucking types of mouth parts situated near the posterior ventral part of the head. All of the Sternorrhyncha are plant feeders. Many are of economic concern to Agriculture in California and throughout the World. Scale insects are encountered daily by Field Entomologists, County Agricultural and Extension Personnel, University Researchers, Nurserymen, Quarantine Inspectors, Pest Control Advisors and many others. Unfortunately, comprehensive books on the habits and economic importance of these creatures are in short supply. Further, few if any of the scale insects are studied in University and College classes. Hopefully this book will fill some of these gaps.

This book is designed to be both a **field guide** and a **laboratory manual** for the armored scale insect family Diaspididae of California. It is the third part of what is hoped will be a five volume set covering all of the Coccoidea and the Aleyrodidae (whiteflies) of California. The five volumes will be divided as follows: Part 1, "**The Soft Scales**" or Coccidae (already published); Part 2, "**The Minor Families**" (already published); Part 3, "**The Armored Scales**" or Diaspididae (covered here); Part 4, "**The Mealybugs**" or Pseudococcidae and Putoidae; and Part 5, "**The Whiteflies**" or Aleyrodidae. The volumes are not being produced in any particular phylogenetic order, but rather in the order of need by those field personnel and scientists dealing with scale insects on a day to day basis. The author's reasoning is that two of the three major families of the Coccoidea, the Diaspididae and the Pseudococcidae, have already been thoroughly treated in the two excellent works by Howard McKenzie. The first two volumes have been completed, and it is now time to move on to those two families that McKenzie has already treated for California. This volume will cover the armored scales, first completed by McKenzie in 1965. That work is now out of print, and numerous changes have been made to the California fauna and to the systematics of the Diaspididae since then.

While the whiteflies are not part of the same superfamily as the scale insects, their appearance and economic status are similar and they will be included in the fifth volume. Like the soft scales and the minor families, the whiteflies have never been treated comprehensively in the State. There has been much demand for such a treatise. However, the author wishes to postpone publication on the whiteflies of California, at least for a time, because there may be some important changes taking place in California and North American whitefly taxonomy and nomenclature in the next several years.

All of the proposed volumes are essentially written. All that remains is to find the necessary funds for publication and time for the physical typesetting and layout.

This volume is designed with the Field Entomologist and Agriculturalist in mind. Every California scale species is listed along with its approved or suggested common name, other

historical common names, field characteristics, species which are similar and which are likely to be confused with it in the field, lists of common hosts, general distribution, and summaries of its biology and economic importance. Selected references are provided at the end of each species treatise. Color photographs of all of the more economic species as well as photographs of some of the less important native or uncommon species are included.

The author has not attempted to give complete host and distributional records for several reasons. Primarily, the Entomology Laboratory Unit, Plant Pest Diagnostics Branch, of the California Department of Food and Agriculture, has not kept records of any insect collections or interceptions in any manner except chronological order. With the advent of new and superior computer equipment, it may now be possible to rectify that problem and to get complete host and distributional data for the scale insects. However, data entry will still require years of work and it was deemed more important to publish the volumes without this data in the interests of both time and expense.

Control measures are not included even though they are probably the first concern of the Field Entomologist. With the drastic changes in Pesticide Use Enforcement Regulations that have occurred over the last 10-15 years, the author is really not qualified to dispense such information. Also, several other very useful publications by other authors on the biologies and economic importance of horticultural pests have been removed from circulation because of changes in the legality of use of certain pesticides. It would be an obvious disaster to see this volume follow the same path. However, Biological Control, as it relates to Integrated Pest Management, is not affected by the same restrictions, and references to pertinent literature on natural enemies is included whenever available or appropriate.

For the Laboratory Scientist and Taxonomist, this volume represents a complete checklist and taxonomic treatment of the armored scales known to occur in California as well as those species recorded from the state which are not now considered part of the fauna here. Complete, full scale taxonomic illustrations and keys to the genera and species are provided as well as a nearly complete list of synonymies. The book is not, however, meant to be a taxonomic review or revision. There are no species descriptions or changes in synonymies included; they were deemed beyond the scope and general purpose of this book.

This book is meant to be complimentary to the Color and Host Identification Field Keys which are available through this author or the Environmental Monitoring and Pest Management Branch of the Department of Pesticide Regulations, Sacramento.

LIST OF COLOR PHOTOGRAPHS

1. cyanophyllumscale, *Abgrallaspiscyanophylli* (Signoret).
2. cyanophyllumscale, *Abgrallaspiscyanophylli* (Signoret).
3. degenerate scale, *Abgrallaspis degenerata* (Leonardi).
4. California red scale, *Aonidiella aurantii* (Maskell).
5. California red scale, *Aonidiella aurantii* (Maskell).
6. California red scale, *Aonidiella aurantii* (Maskell).
7. California red scale, *Aonidiella aurantii* (Maskell).
8. California red scale, *Aonidiella aurantii* (Maskell) (adult female and adult male).
9. yellow scale, *Aonidiella citrina* (Coquillett).
10. yellow scale, *Aonidiella citrina* (Coquillett).
11. ceanothus scale, *Aonidomytilus ceanothi* (Ferris).
12. ceanothus scale, *Aonidomytilus ceanothi* (Ferris).
13. concolor scale, *Aonidomytilus concolor* (Cockerell).
14. arctostaphylos scale, *Aspidaspisarctostaphyli* (Cockerell & Robbins).
15. arctostaphylos scale, *Aspidaspisarctostaphyli* (Cockerell & Robbins).
16. oleander scale, *Aspidiotus nerii* Bouché.
17. oleander scale, *Aspidiotus nerii* Bouché.
18. oleander scale, *Aspidiotus nerii* Bouché (adult male).
19. rose scale, *Aulacaspis rosae* (Bouché).
20. rose scale, *Aulacaspis rosae* (Bouché).
21. rose scale, *Aulacaspis rosae* (Bouché) (scale cover removed, showing scale body color).
22. juniper scale, *Carulaspis juniperi* (Bouché).
23. juniper scale, *Carulaspis juniperi* (Bouché).
24. minute cypress scale, *Carulaspis minima* (Targioni-Tozzetti).
25. tamarix scale, *Chionaspis etrusca* Leonardi.
26. tamarix scale, *Chionaspis etrusca* Leonardi.
27. cottonwood scale, *Chionaspis ortholobis* (Comstock).
28. cottonwood scale, *Chionaspis ortholobis* (Comstock).
29. pine needle scale, *Chionaspis pinifoliae* (Fitch) (uniparental strain).
30. pine needle scale, *Chionaspis pinifoliae* (Fitch) (uniparental strain).
31. pine needle scale, *Chionaspis pinifoliae* (Fitch) (biparental strain).
32. Sasscer scale, *Chionaspis sassceri* Cockerell & Robbins.
33. wistaria scale, *Chionaspis wistariae* Cooley.
34. Florida red scale, *Chrysomphalus aonidum* (Linnaeus).
35. Florida red scale, *Chrysomphalus aonidum* (Linnaeus).
36. bifasciculate scale, *Chrysomphalus bifasciculatus* Ferris.
37. dictyospermum scale, *Chrysomphalus dictyospermi* (Morgan).
38. elm clavaspis scale, *Clavaspis ulmi* (Johnson).
39. palmetto scale, *Comstockiella sabalis* (Comstock).
40. palmetto scale, *Comstockiella sabalis* (Comstock).
41. palmetto scale, *Comstockiella sabalis* (Comstock).
42. Beshear scale, *Cupidaspis beshearae* Howell & Tippins.
43. Beshear scale, *Cupidaspis beshearae* Howell & Tippins.
44. California lineaspis scale, *Cupidaspis cupressi* (Coleman).
45. redwood scale, *Cupressaspis shastae* (Coleman).
46. redwood scale, *Cupressaspis shastae* (Coleman).
47. redwood scale, *Cupressaspis shastae* (Coleman).
48. buckeye scale, *Diaspidiotus aesculi* (Johnson).
49. buckeye scale, *Diaspidiotus aesculi* (Johnson).
50. buckeye scale, *Diaspidiotus aesculi* (Johnson).
51. conifer scale, *Diaspidiotus coniferarum* (Cockerell).
52. conifer scale, *Diaspidiotus coniferarum* (Cockerell).
53. Ehrhorn scale, *Diaspidiotus ehrhorni* (Coleman).
54. Ehrhorn scale, *Diaspidiotus ehrhorni* (Coleman) (scale cover removed on two individuals, showing scale body color).
55. sweet gum scale, *Diaspidiotus liquidambaris* (Kotinsky) (top of leaf only showing domed galls).
56. sweet gum scale, *Diaspidiotus liquidambaris* (Kotinsky) (bottom of leaf showing scales and gall openings).
57. Boisduval scale, *Diaspis boisduvalii* Signoret.
58. Boisduval scale, *Diaspis boisduvalii* Signoret.
60. pineapple scale, *Diaspis bromeliae* (Kerner).
61. cactus scale, *Diaspis echinocacti* (Bouché).
62. cactus scale, *Diaspis echinocacti* (Bouché).
63. manzanita scale, *Diaspis manzanitae* (Whitney).
64. manzanita scale, *Diaspis manzanitae* (Whitney).
65. mistletoe scale, *Diaspis parasiti* McKenzie.
66. holly scale, *Dynaspidotus britannicus* (Newstead).
67. holly scale, *Dynaspidotus britannicus* (Newstead).
68. Italian pear scale, *Epidiaspis leperii* (Signoret).
69. Italian pear scale, *Epidiaspis leperii* (Signoret).
70. Italian pear scale, *Epidiaspis leperii* (Signoret) (scale cover removed, showing scale body color; a small external parasitoid larva present on lower edge of the scale body).
71. magna scale, *Ferrisidea magna* (Ferris).
72. palm fiorinia scale, *Fiorinia fioriniae* (Targioni-Tozzetti).
73. palm fiorinia scale, *Fiorinia fioriniae* (Targioni-Tozzetti).
74. juniper fiorinia scale, *Fiorinia pinicola* Maskell.

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75. juniper fiorinia scale, *Fiorinia pinicola* Maskell.
76. penicillate scale, *Froggattiella penicillata* (Green) (G.M. Buxton photograph).
77. penicillate scale, *Froggattiella penicillata* (Green) (G.M. Buxton photograph).
78. cycad scale, *Furchadaspis zamiae* (Morgan).
79. cycad scale, *Furchadaspis zamiae* (Morgan) (scale cover turned over on one specimen, showing ventral scale and scale body color).
80. cord grass scale, *Haliaspis spartinae* (Comstock).
81. latania scale, *Hemiberlesia lataniae* (Signoret).
82. latania scale, *Hemiberlesia lataniae* (Signoret).
83. tropical palm scale, *Hemiberlesia palmae* (Cockerell).
84. tropical palm scale, *Hemiberlesia palmae* (Cockerell).
85. greedy scale, *Hemiberlesia rapax* (Comstock).
86. greedy scale, *Hemiberlesia rapax* (Comstock).
87. bamboo diaspidid scale, *Kuwanaspis pseudo-leucaspis* (Kuwana).
88. bamboo diaspidid scale, *Kuwanaspis pseudo-leucaspis* (Kuwana).
89. purple scale, *Lepidosaphes beckii* (Newman).
90. purple scale, *Lepidosaphes beckii* (Newman).
91. fig scale, *Lepidosaphes conchiformis* (Gmelin) (leaf form).
92. fig scale, *Lepidosaphes conchiformis* (Gmelin) (twig form).
93. DeStefan scale, *Lepidosaphes destefanii* Leonardi (scale covers removed from three individuals, showing scale body color; undisturbed individuals are cryptic).
94. Glover scale, *Lepidosaphes gloverii* (Packard).
95. Glover scale, *Lepidosaphes gloverii* (Packard).
96. cymbidium scale, *Lepidosaphes machili* (Maskell).
97. oystershell scale, *Lepidosaphes ulmi* (Linnaeus).
98. oystershell scale, *Lepidosaphes ulmi* (Linnaeus).
99. podocarpus leucaspis scale, *Leucaspis portaeureae* Ferris (G.M. Buxton photograph).
100. podocarpus leucaspis scale, *Leucaspis portaeureae* Ferris (G.M. Buxton photograph).
101. black araucaria scale, *Lindingaspis rossi* (Maskell).
102. black araucaria scale, *Lindingaspis rossi* (Maskell).
103. brown pineapple scale, *Melanaspis bromeliae* (Leonardi).
104. obscure scale, *Melanaspis obscura* (Comstock) (colony of females with one adult male).
105. obscure scale, *Melanaspis obscura* (Comstock) (G.M. Buxton photograph).
106. Hall scale, *Nilotaspis halli* (Green) (G.M. Buxton photograph).
107. Hall scale, *Nilotaspis halli* (Green) (G.M. Buxton photograph).
108. black pineleaf scale, *Nuculaspis californica* (Coleman).

LIST OF COLOR PHOTOGRAPHS

109. black pineleaf scale, *Nuculaspis californica* (Coleman).
110. Bermuda grass scale, *Odonaspis ruthae* Kotinsky.
111. Bermuda grass scale, *Odonaspis ruthae* Kotinsky.
112. ephedra scale, *Pallulaspis ephedrae* Ferris.
113. ephedra scale, *Pallulaspis ephedrae* Ferris.
114. milky conifer scale, *Paracupidaspis wilkeyi* Howell & Tippins.
115. milky conifer scale, *Paracupidaspis wilkeyi* Howell & Tippins.
116. camellia parlatoria scale, *Parlatoria camelliae* Comstock.
117. olive scale, *Parlatoria oleae* (Colvée).
118. olive scale, *Parlatoria oleae* (Colvée).
119. olive scale, *Parlatoria oleae* (Colvée) (scale cover turned over on one specimen, showing scale body color).
120. chaff scale, *Parlatoria pergandii* Comstock.
121. chaff scale, *Parlatoria pergandii* Comstock.
122. pittosporum scale, *Parlatoria pittospori* Maskell.
123. fern scale, *Pinnaaspis aspidistrae* (Signoret).
124. fern scale, *Pinnaaspis aspidistrae* (Signoret).
125. boxwood scale, *Pinnaaspis buxi* (Bouché).
126. cycad poliaspis scale, *Poliaspis cycadis* Comstock.
127. oak protodiaspis scale, *Protodiaspis agrifoliae* Essig.
128. magnolia white scale, *Pseudaulacaspis cockerelli* (Cooley) (note stylet tracks).
129. white peach scale, *Pseudaulacaspis pentagona* (Targioni-Tozzetti).
130. false parlatoria scale, *Pseudoparlatoria parlatorioides* (Comstock).
131. walnut scale, *Quadraspidiotus juglans-regiae* (Comstock).
132. walnut scale, *Quadraspidiotus juglans-regiae* (Comstock).
133. walnut scale, *Quadraspidiotus juglans-regiae* (Comstock) (scale cover removed showing body color and lateral indentations typical of this species).
134. San José scale, *Quadraspidiotus perniciosus* (Comstock).
135. oak scale, *Quernaspis quercus* (Comstock).
136. oak scale, *Quernaspis quercus* (Comstock).
137. Dearness scale, *Rhizaspidiotus dearnessi* (Cockerell).
138. white euphorbia scale, *Selenaspis albus* McKenzie.
139. mistletoe situlaspis scale, *Situlaspis multipora* (Ferris).
140. yucca scale, *Situlaspis yuccae* (Cockerell).
141. Kellogg scale, *Stramenaspis kelloggi* (Coleman).
142. euonymus scale, *Unaspis euonymi* (Comstock).
143. mesquite scale, *Xerophilaspis prosopidis* (Cockerell).
144. mesquite scale, *Xerophilaspis prosopidis* (Cockerell).

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And last but not least, thanks for the money, Dennis.

Family Diaspididae
armored scales or diaspidids
Colored Plates 1-144

The armored scales are the largest family of scale insects, with nearly 2,000 species in about 400 genera. There are 300 species in the United States in about 90 genera. McKenzie (1956) thoroughly covered the systematics, host plants and distribution of the California species. Ferris, in his four volumes of the "Atlas of the Scale Insects of North America," covered much the same thing. All California species are treated in detail in this work, including species which have been found in the State after McKenzie's work, and much information on biology, economic importance and distribution are added. For an excellent account of the biology and ecology of armored scales in general see Beardsley and Gonzalez (1973), Miller and Kosztarab, (1979) and the very intensive two volume treatise entitled "Armored Scale Insects. Their Biology, Natural Enemies and Control" edited by D. Rosen, 1990.

Field Characteristics: Very small scales, 1 to 2 mm long or in diameter, enclosed (except possibly in *Protodiaspis*) within a covering consisting of wax and proteinaceous, materials specifically enzymatically polymerized tyrosine (Beardsley and Gonzalez, 1973) and the cast skins of previous instars. This cover is produced and added to throughout most of the life cycle. After the crawlers hatch and begin feeding, they secrete materials which eventually completely cover the individual; after molting the first cast skin is incorporated into the cover and, in females, the cast skin from the second molt is also incorporated. In males, only the first cast skin is incorporated into the cover. Each cast skin thus incorporated is called an exuvium (plural = exuviae). During scale cover formation many armored scales also incorporate parts of the plant into the cover or mine beneath loosened plant tissues. This is seen in many species which inhabit either the bark or leaves of hosts such as bromeliads which have many loose stellate hairs. The ability to incorporate plant parts into the scale cover makes the scales cryptic. Most species also lay down a ventral armor which separates the body from the host surface, aids in enclosing the scale and seals it off from the outside, protecting the scale and its eggs and young. This ventral scale is normally very thin and white, but thickness varies with species and age. If the dorsal scale is turned over, the body of those species with a thin ventral armor will be left on the host, while those with a tough, thick, ventral scale usually remain enclosed in the dorsal cover. Scales in the tribe Odonaspidini have exceptionally well developed ventral armor. In most species, after the female dies, the dorsal scale cover usually weathers and eventually falls from the host, leaving the white circular impression of the ventral armor. This white impression left on the host is called a "flag" and is a useful detection tool for the field entomologist. For an excellent account of scale cover formation see Dickson (1951), Beardsley and Gonzalez (1975), Stoetzel (1976), and Foldi (1982, 1983).

The shape of the scale cover, its color and the position of the exuviae are relatively constant in a given species, and these three characteristics can be valuable in field recognition. Adult females have two basic shapes, circular or elongate (oystershell-shaped). In scales with a circular cover, the exuviae may be on the outer margin of the cover, or in a more central location. In scales with an elongate cover, the exuviae are always at the end (terminal). In males, the one exuvium is either at the end of an elongate cover, or the center of an oval cover. Most species are legless except in the crawler stage and in the adult male, although some have rudimentary spine-like legs which remain through the adult female stage. Most species feed

on aerial plant parts including leaves, twigs, branches, trunks, crowns and fruit. Very few species have been collected on roots, but when they are, the root is usually exposed. The majority are egg-layers, although a few such as California red scale give birth to active crawlers. The scale cover encloses and protects eggs and crawlers, which often settle permanently under the cover of the parent female. There may be one to several generations per year depending on species and climates. Females usually undergo four life stages; egg, first stage nymph (crawler), second stage nymph and adult. Males develop through the egg, crawler, second instar, prepupal, pupal and adult stage. Armored scales are either parthenogenetic or, more commonly, obligately biparental. However, in a number of species both parthenogenetic and biparental races are known, and in some cases this has resulted in the naming of separate species even though morphological differences between the females cannot be found. For more information on parthenogenetic and biparental strains see DeBach and Fisher (1956), Beardsley and Gonzalez (1975) and Gerson and Hazan (1979).

Similar Species: Armored scales should not be confused with any other group of scale insects in the field. Size, shape, color and the presence of exuviae in the scale cover are characteristics which aid in their recognition. One family of scale insects, the Conchaspidae, form a scale cover similar in size and shape to the armored scale cover. However, this group of scales does not incorporate exuviae into the cover and does not occur in California. Other non-arthropod structures can be confused with armored scale insects, such as raised bark lenticels, fungal spore bodies, mycelial mats, *Oxalis* seeds, etc. A most interesting similarity occurs in the soil fungus genus *Sphaerobolus* (*Ophiobolus*). These fungi inhabit soil, especially that of pot-grown indoor ornamental plants and nursery stock. The spore bodies of these fungi are imbedded in a soft, pliable matrix which is propelled from the surface of the soil with some force. When this matrix strikes an object such as the leaves of a plant, it sticks and is flattened against the leaf in a small conical mass very similar in appearance, size and color to armored scale covers. The similarity works both ways, since the modified scale cover of the bromeliad-infesting species *Gymnaspis aechmeae* Newstead resembles these spore masses.

Hosts: There are no patterns of host preferences in the family. While some species are narrowly host specific, most feed on a number of different hosts and many are highly polyphagous. Many host lists are available for various species or groups of species. The Borchsenius (1966) catalogue has a host list of the world species. Dekle (1976) provides very complete lists for many of the North American species.

Economic Importance: Many species are serious plant pests, causing host debilitation and dieback, leaving the host more susceptible to attack by other organisms, and often killing the host. Some species are particularly serious on perennial agricultural crops although many more species are pests of nursery stock and ornamental plants. Unlike most other scale insects, armored scales do not produce honeydew. For an excellent review of the injury to plants caused by armored scales see Beardsley and Gonzalez (1975).

Distribution: Found in most life zones except for Arctic habitats, although most species are probably native to the tropics. Many species have been moved about by man and are now cosmopolitan. There are a number of native California species, the majority found in the more arid, southern portions of the State.

Diagnosis: The Diaspididae are recognized by: The armored scale cover consisting in part of the cast skins or exuviae of past instars; the development of the pygidium which is the coalesced portion of the last 5 or 6 abdominal segments; and the absence of legs. In the family Conchaspidae, there is also a scale cover, but without exuviae incorporated into it; there is a pygidium-like sclerotization of the posterior abdominal segments, but the legs and antennae are well developed. The family Phoenicococcidae was at one time included with the Diaspididae, and while they also produce a scale cover, it is generally composed of loose waxy fibers and does not contain incorporated exuviae. Also, the Phoenicococcidae lack pygidial development. The armored scales have been catalogued by Borchsenius (1966). There are a number of regional works including McKenzie (1956) for California species, Ferris (1937-1942) for North America, Kosztarab (1963) for Ohio and Dekle (1976) for Florida, as well as many other works for other parts of the world. Keys to the genera and species are available for California here and in Ferris (1937-1942) and McKenzie (1956).

Taxonomic studies and species identifications of armored scales are based primarily on the morphology of the adult female, although the 1st instar nymphs and occasionally adult males have been useful in solving some systematic issues, especially in regards to phylogenies. Tribal, generic and specific identifications require that the specimens be cleared, stained, and slide mounted (these procedures are explained in the chapter on 'Collection and Preservation Techniques'). Species separations are based mostly on pygidial characters such as number and shape of median lobes; presence or absence, placement of, and types of macroducts; presence or absence of perivulvar pores; presence or absence, numbers and placement of gland spines and fringed plates; and other morphological structures depending on the species complexes involved. Figures 1 and 2, taken from McKenzie (1956), illustrate and explain the basic armored scale morphology. Shape and color of the armored scale cover in males and females, along with host associations, can be developed to aid in tentative but rapid field identifications of armored scales in small geographic areas. One such key for the common armored scales of California (Gill, 1982) is available through the Department of Pesticide Regulations, Environmental Monitoring and Pest Management Branch, Sacramento, or through this author.

For the purposes of this book, there are four separate tribes within the Diaspididae based on morphological characteristics and partly on habits and external features of the scale covers. Some authors break the Aspidiotini and the Diaspidini into other tribes such as the Comstockiellini, Chionaspidini, Fioriniini, Lepidosaphidini and the Parlatoriini. These concepts are beyond the scope of this book, and only the tribes listed below will be used; the others will be left as subtribes. The taxonomic keys to the genera will make it obvious where most of the species belong in the more complicated set of tribes. The tribe **Aspidiotini** is considered to be the most evolutionarily advanced of the armored scales. The tribe also contains some of the most serious agricultural pests. It is recognized by the following characteristics: one-barred, usually elongated, pygidial macroducts; second lobe if present with a single lobe only; gland tubercles usually absent; antennae usually with only one seta; anterior spiracles without disk pores. Externally, members of the tribe are easily recognized because the exuviae of both males and females are always central or subcentral, and they are, therefore, never situated on the margin or at the end of the scale cover. Also, the male scale covers are usually similar to the female covers in color and shape, although the male covers are usually more oval than those of the females. Male covers are never elongate and never have carinae. The tribe **Diaspidini** is recognized by the following characteristics: Two-barred, usually short, pygidial macroducts;

second lobe if present usually bilobed, gland tubercles usually present; antennae usually with more than one seta; and anterior spiracles usually with associated disk pores. Externally the tribe is easily recognized because the male scale covers are always elongated with the exuvium at one end. Females often have the exuviae on the margin or at one end although they are definitely central in some genera, such as *Diaspis*. The male scale cover is white in most species irrespective of the color of the female cover, often with 1 to 3 raised longitudinal carinae. The tribe **Odonaspidini** is small, with only five genera world wide; its species generally restricted to graminaceous hosts. It is recognized by the following characteristics: Complete absence of pygidial plates, gland spines and paired pygidial lobes; macroducts small, short, numerous, usually on both dorsal and ventral surfaces and usually not arranged in rows. Female scale covers are the bivalve type, that is, with the ventral scale as thick and strong as the dorsal scale cover and the terminal second exuvium incorporated into the cover both dorsally and ventrally, so that the scale body is completely enclosed by the cover except for a small area near the mouth parts. Male scale covers light colored, elongate, with a terminal exuvium and lacking longitudinal carinae. The tribe **Rugaspidiotini** is also small, containing four genera.

Some armored scale species are affected morphologically by the part of the host that they feed on, specimens on leaves being distinct morphologically from those feeding on twigs. For further information see the review by Beardsley and Gonzalez (1975), the study of *Chionaspis nyssae* by Knipscher et al (1976), the various studies of *Chionaspis* and *Pseudalacaspis* by Takahashi and by Takagi, and in this text under the genus *Chionaspis*.

Adult male morphology has been studied by several authors, especially Bustshik (1958) and Ghauri (1962). Several publications including Boratynski and Davies (1971), Davies and Boratynski (1979) and Davies (1981) deal with numerical taxonomy as it relates to male morphology. Identifications of the males is generally not much value below the tribal level. Adult males are seldom collected since they are so tiny and difficult to see in the field. Males are not known for a good many species, and some species races are parthenogenetic. Published descriptions of the males of California species are referenced under each species treatise. A provisional key to and illustrations of some of the more commonly encountered California males are included here after the individual species treatments.

Immature stages are usually of little value for specific determinations, but they have been useful in solving certain difficult species complexes. The various works of Howell and Takagi should be consulted for more information on these stages. References to descriptions and illustrations of immatures of California species are listed with each species.

The California genera and species are listed on the following pages. Those considered economically important are covered in more detail, as are those not covered by McKenzie (1956). For information concerning the morphology, distribution, host plants and other data including keys to the species, consult McKenzie. The number of world species and United States species mentioned under each genus is approximate, since the generic placement is questionable in some cases, and synonymies may be involved in others.

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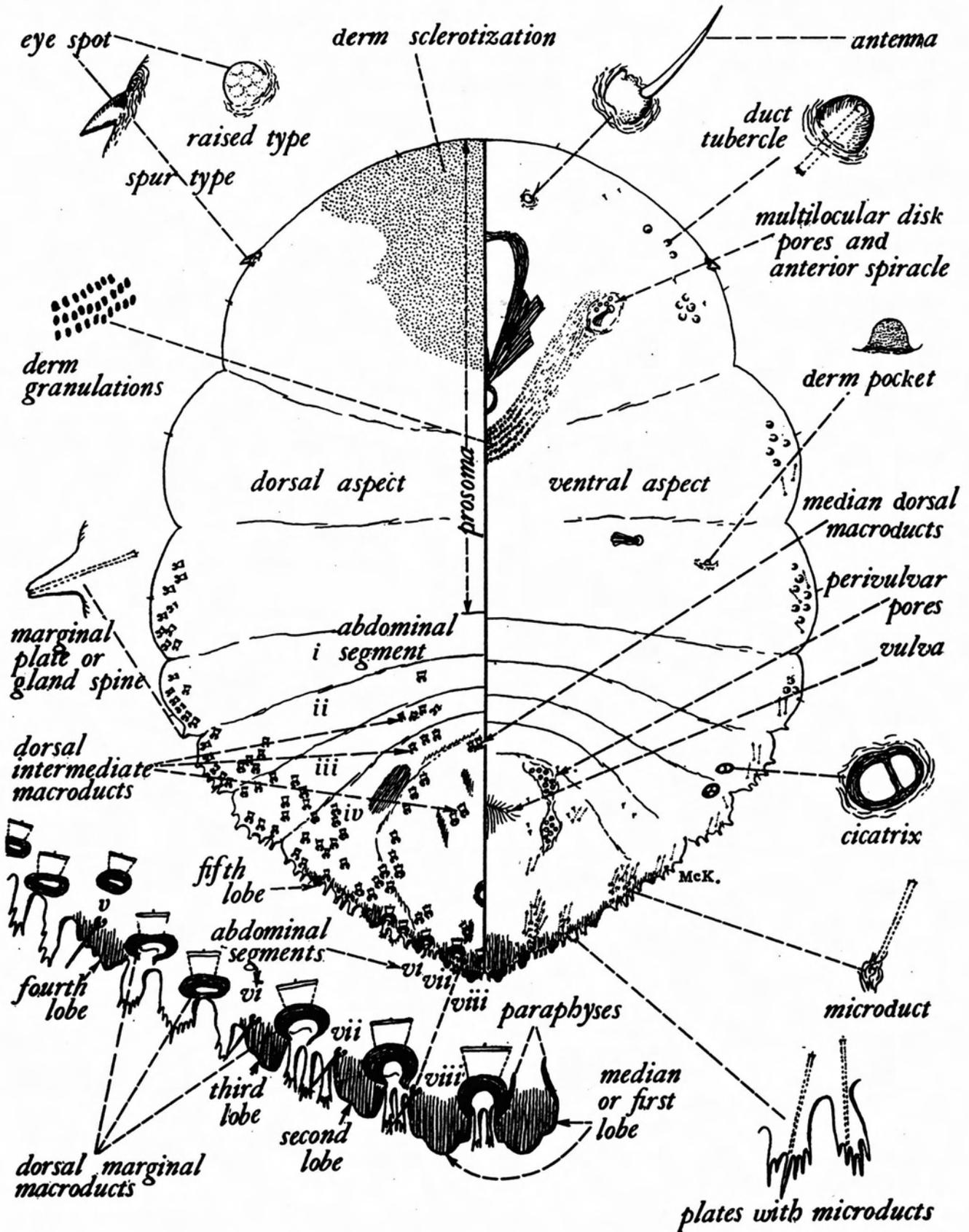


Fig. 1. Generalized and semidiagrammatic drawing representing the genus *Parlatoria*. Morphological structures of typical Diaspididae. (From McKenzie, 1956).

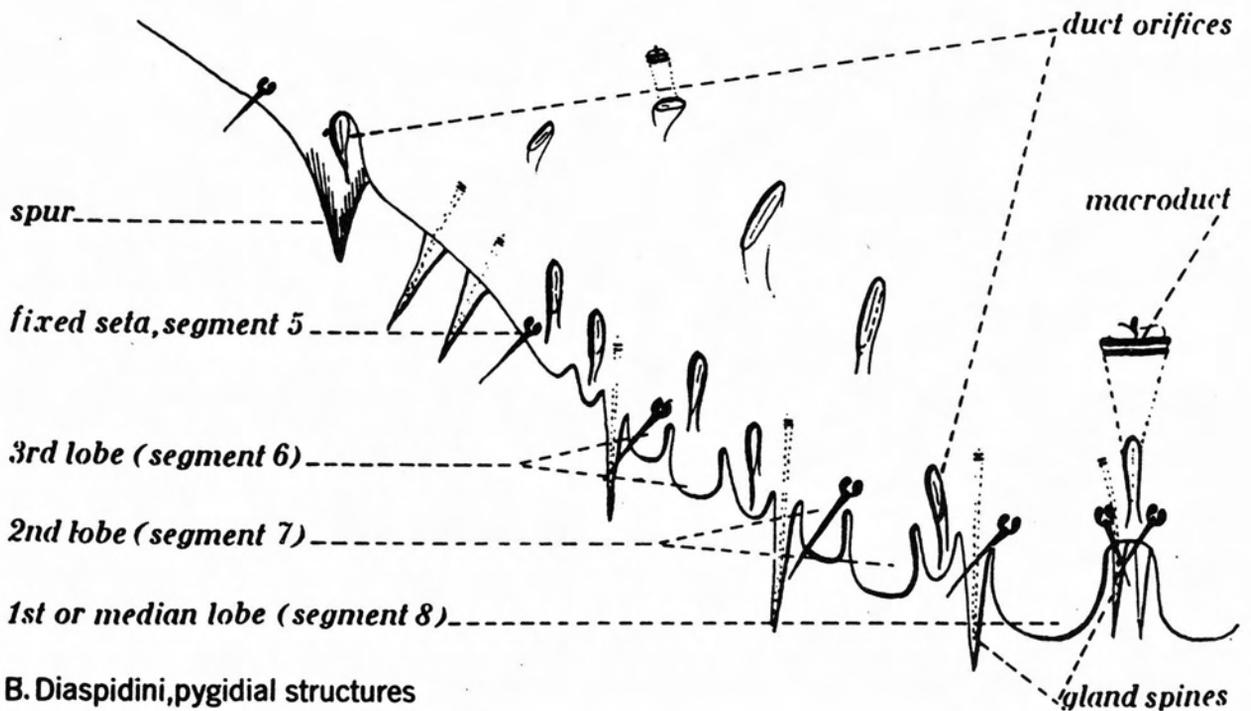
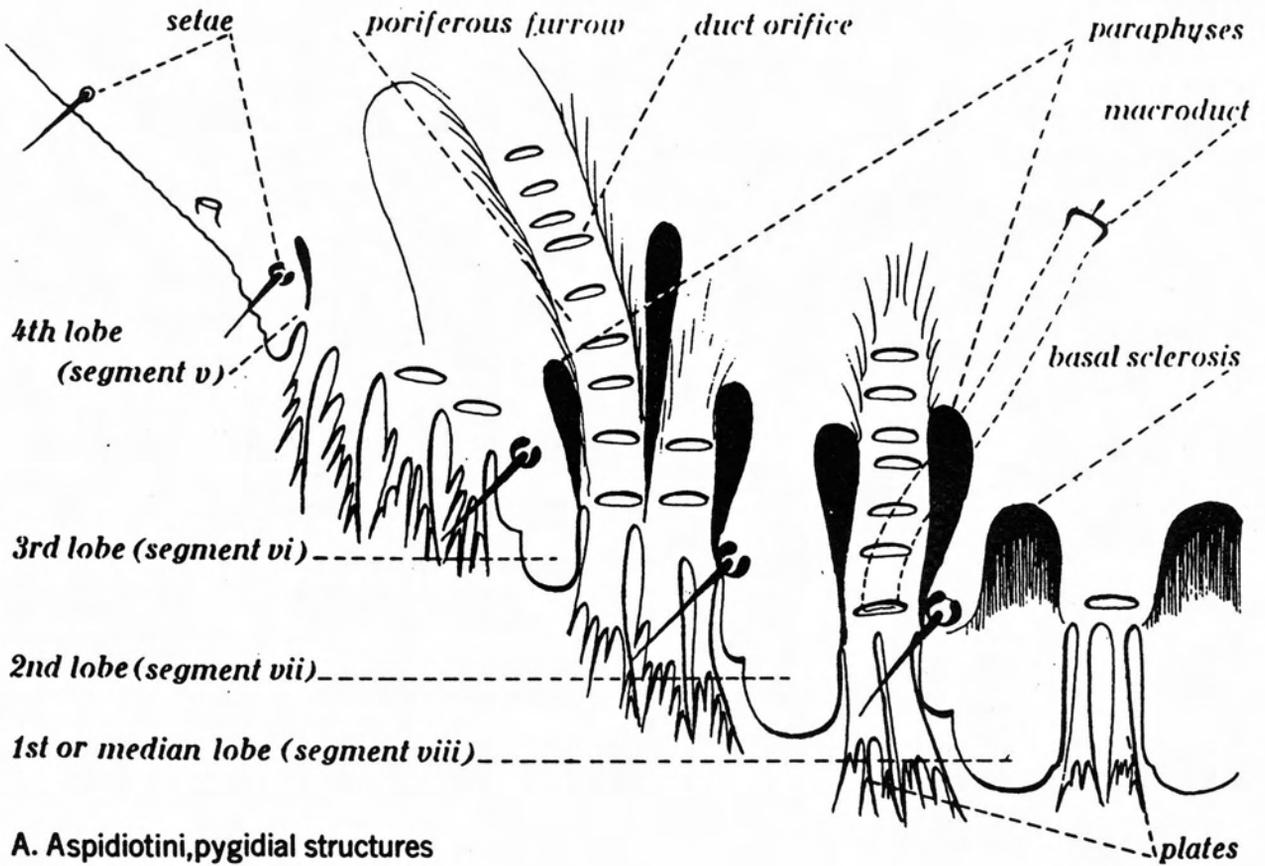


Fig. 2. (A) Pygidial structures of Aspidiotini; (B) Pygidial structures of Diaspidini (From McKenzie, 1956).



1. *Abgrallaspis cyanophylli*



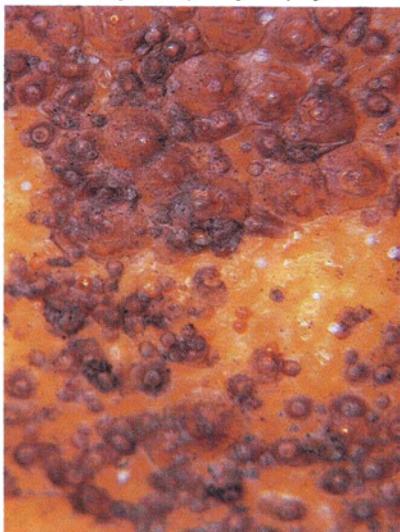
2. *Abgrallaspis cyanophylli*



3. *Abgrallaspis degenerata*



4. *Aonidiella aurantii* ♀ and ♂



5. *Aonidiella aurantii*



6. *Aonidiella aurantii*



7. *Aonidiella aurantii*



8. *Aonidiella aurantii* ♀ and ♂



9. *Aonidiella citrina*



10. *Aonidiella citrina*



11. *Aonidomytilus ceanothi*



12. *Aonidomytilus ceanothi*



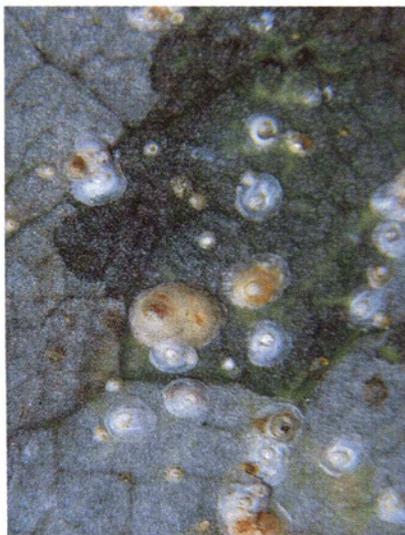
13. *Aonidomytilus concolor*



14. *Aspidaspis arctostaphyli*



15. *Aspidaspis arctostaphyli*



16. *Aspidiotus nerii*



17. *Aspidiotus nerii*



18. *Aspidiotus nerii* ♂ adult



19. *Aulacaspis rosae*



20. *Aulacaspis rosae*



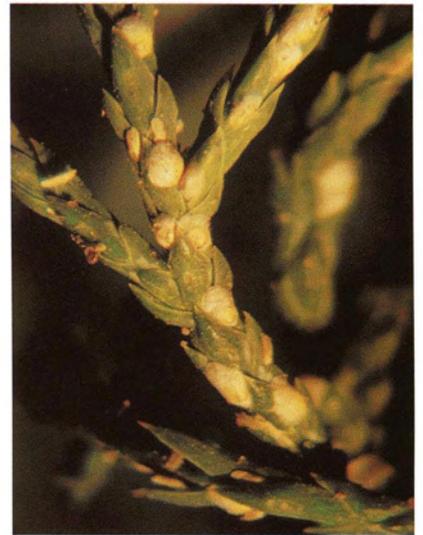
21. *Aulacaspis rosae*



22. *Carulaspis juniperi*



23. *Carulaspis juniperi*



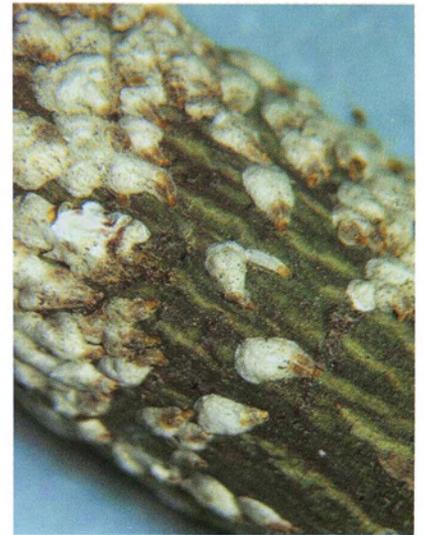
24. *Carulaspis minima*



25. *Chionaspis etrusca*



26. *Chionaspis etrusca*



27. *Chionaspis ortholobis*



28. *Chionaspis ortholobis*



29. *Chionaspis pinifoliae*



30. *Chionaspis pinifoliae*



31. *Chionaspis pinifoliae*



32. *Chionaspis sassceri*



33. *Chionaspis wistariae*



34. *Chrysomphalus aonidum*



35. *Chrysomphalus aonidum*



36. *Chrysomphalus bifasciculatus*



37. *Chrysomphalus dictyospermi*



38. *Clavaspis ulmi*



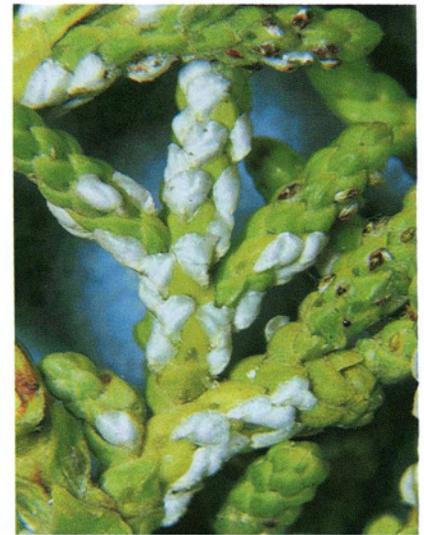
39. *Comstockiella sabalis*



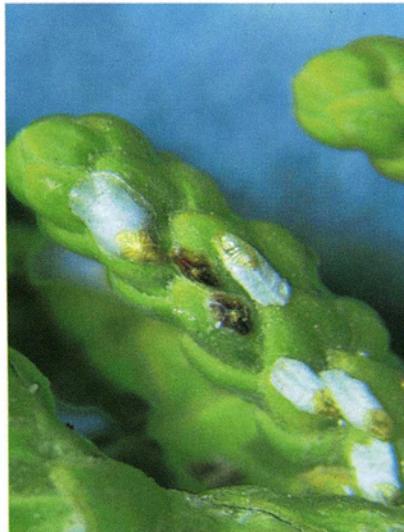
40. *Comstockiella sabalis*



41. *Comstockiella sabalis*



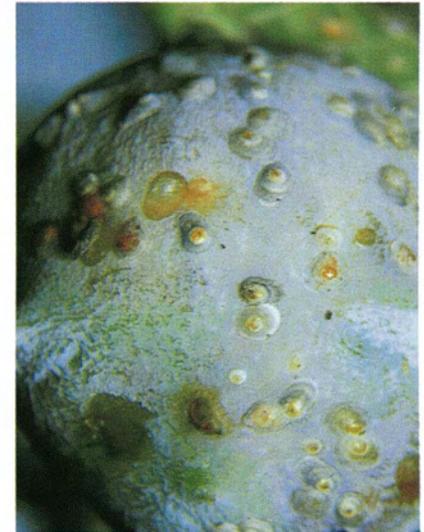
42. *Cupidaspis beshearae*



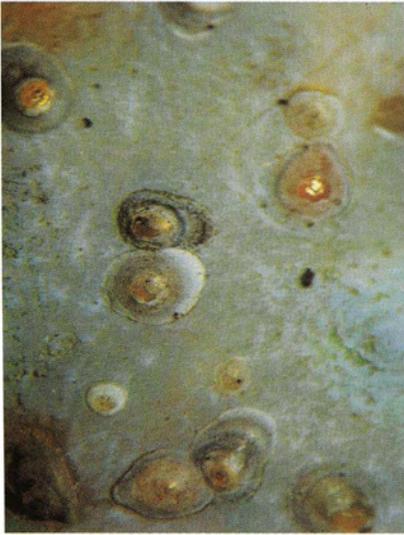
43. *Cupidaspis beshearae*



44. *Cupidaspis cupressi*



45. *Cupressaspis shastae*



46. *Cupressaspis shastae*



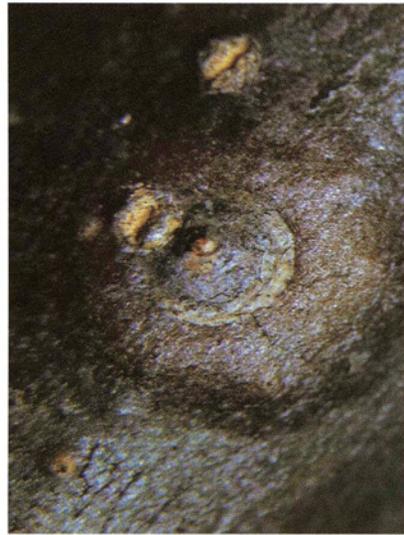
47. *Cupressaspis shastae*



48. *Diaspidiotus aesculi*



49. *Diaspidiotus aesculi*



50. *Diaspidiotus aesculi*



51. *Diaspidiotus coniferarum*



52. *Diaspidiotus coniferarum*



53. *Diaspidiotus ehrhorni*



54. *Diaspidiotus ehrhorni*



55. *Diaspidiotus liquidambaris*



56. *Diaspidiotus liquidambaris*



57. *Diaspis boisduvalii*



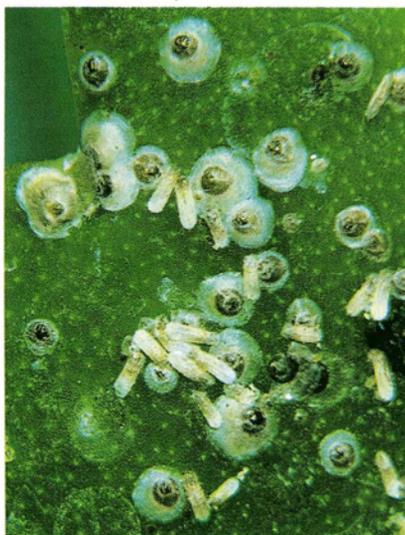
58. *Diaspis boisduvalii*



59. *Diaspis bromeliae*



60. *Diaspis bromeliae*



61. *Diaspis echinocacti*



62. *Diaspis echinocacti*



63. *Diaspis manzanitae*



64. *Diaspis manzanitae*



65. *Diaspis parasiti*



66. *Dynaspidiotus britannicus*



67. *Dynaspidiotus britannicus*



68. *Epidiaspis leperii*



69. *Epidiaspis leperii*



70. *Epidiaspis leperii*



71. *Ferrisidea magna*



72. *Fiorinia fioriniae*



73. *Fiorinia fioriniae*



74. *Fiorinia pinicola*



75. *Fiorinia pinicola*



76. *Froggattiella penicillata*



77. *Froggattiella penicillata*



78. *Furchadaspis zamiae*



79. *Furchadaspis zamiae*



80. *Haliaspis spartinae*



81. *Hemiberlesia lataniae*



82. *Hemiberlesia lataniae*



83. *Hemiberlesia palmae*



84. *Hemiberlesia palmae*



85. *Hemiberlesia rapax*



86. *Hemiberlesia rapax*



87. *Kuwanaspis pseudoleucaspis*



88. *Kuwanaspis pseudoleucaspis*



89. *Lepidosaphes beckii*



90. *Lepidosaphes beckii*



91. *Lepidosaphes conchiformes*



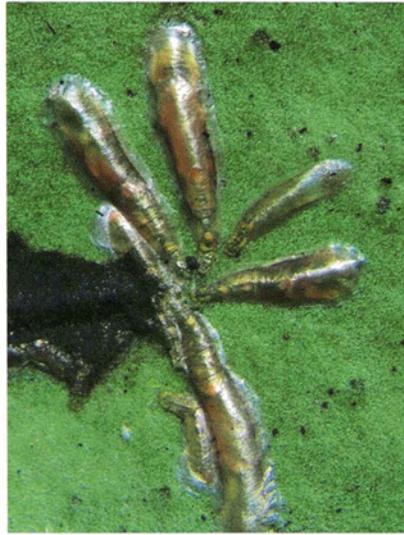
92. *Lepidosaphes conchiformes*



93. *Lepidosaphes destefanii*



94. *Lepidosaphes gloverii*



95. *Lepidosaphes gloverii*



96. *Lepidosaphes machili*



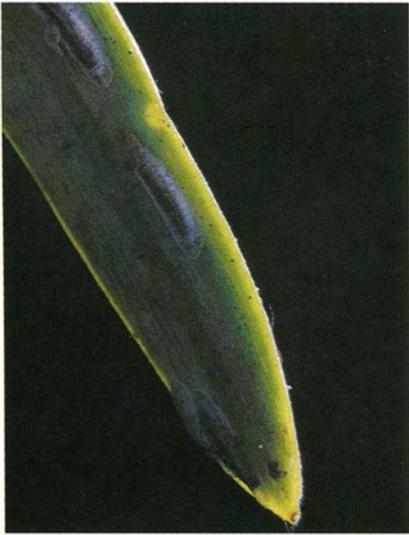
97. *Lepidosaphes ulmi*



98. *Lepidosaphes ulmi*



99. *Leucaspis portaeureae*



100. *Leucaspis portaeareae*



101. *Lindingaspis rossi*



102. *Lindingaspis rossi*



103. *Melanaspis bromeliae*



104. *Melanaspis obscura* ♀ and ♂



105. *Melanaspis obscura*



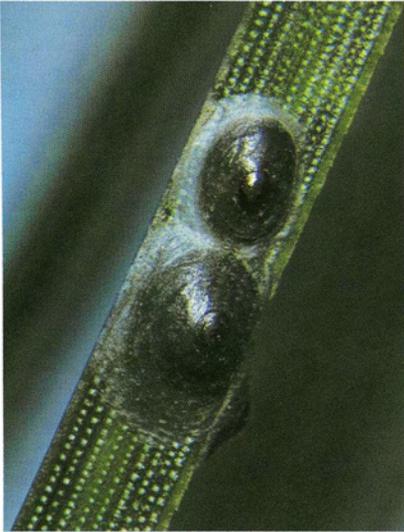
106. *Nilotaspis halli*



107. *Nilotaspis halli*



108. *Nuculaspis californica*



109. *Nuculaspis californica*



110. *Odonaspis ruthae*



111. *Odonaspis ruthae*



112. *Pallulaspis ephedrae*



113. *Pallulaspis ephedrae*



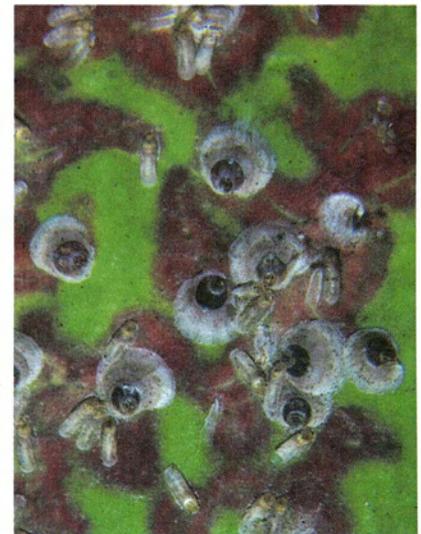
114. *Paracupidaspis wilkeyi*



115. *Paracupidaspis wilkeyi*



116. *Parlatoria camelliae*



117. *Parlatoria oleae*



118. *Parlatoria oleae*



119. *Parlatoria oleae*



120. *Parlatoria pergandii*



121. *Parlatoria pergandii*



122. *Parlatoria pittospori*



123. *Pinnaspis aspidistrae*



124. *Pinnaspis aspidistrae*



125. *Pinnaspis buxi*



126. *Poliaspis cycadis*



127. *Protodiaspis agrifoliae*



128. *Pseudaulacaspis cockerelli*



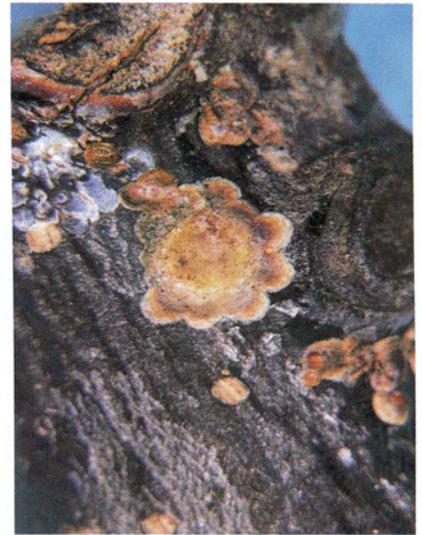
129. *Pseudaulacaspis pentagona*



130. *Pseudoparlatoria parlatorioides*



131. *Quadraspidiotus juglans-regiae*



132. *Quadraspidiotus juglans-regiae*



133. *Quadraspidiotus juglans-regiae*



134. *Quadraspidiotus perniciosus*



135. *Quernaspis quercus*



136. *Quernaspis quercus*



137. *Rhizaspidotus dearnessi*



138. *Selenaspis albus*



139. *Situlaspis multipora*



140. *Situlaspis yuccae*



141. *Stramenaspis kelloggi*



142. *Unaspis euonymi*



143. *Xerophilaspis prosopidis*



144. *Xerophilaspis prosopidis*

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The following keys to the adult females will separate the tribes and genera of the Diaspididae. Keys to the species are incorporated with each genus. The tribal and generic keys are modified from Ferris (The Atlas of the Scale Insects of North America), McKenzie (The Armored Scale Insects of California), and others. The species keys are modified from the same authors unless otherwise noted.

SYSTEMATICS

Key to the Tribes of the Subfamily Diaspidinae (Modified from Ferris, Ben-Dov and others)

1. Adult female normally with plates or gland spines, or second stage presenting them; macroducts commonly showing some evidence of arrangement in segmental rows or series; pygidial lobes usually present, median lobes rarely united into single lobe, otherwise various. 2
- Adult female without plates or segmentally arranged gland spines, without paired lobes but commonly with single median lobe; macroducts usually small and short, numerous, never in segmentally arranged rows, usually abundant on ventral side of pygidium as well as on dorsum; second exuvia bivalve. 3
- 2(1). Macroducts of one-barred type, second pygidial lobes never bilobulate; fringed plates normally present; gland tubercles rarely or never present; anterior spiracles

normally without associated disc pores; antennae of adult female rarely with more than one seta. **Aspidiotini**

Macroducts of two-barred type; second pygidial lobes usually showing some evidence of being bilobulate; gland spines normally present, although in some forms replaced by fringed plates, in latter case usually with gland tubercles; anterior spiracles commonly with associated disc pores; antennae of adult female commonly with two or more setae **Diaspidini**

- 3(1). Pygidium at least one pair and usually with two pairs of marginal scleroses which indicate the intersegmental junctures of the eighth and seventh and sixth abdominal segments; dorsum of the fifth and preceding abdominal segments commonly with well-delimited paratergal areas; characteristically infesting grasses **Odonaspidiini**
- Pygidium entirely without such intersegmental scleroses; dorsum of the fifth and preceding abdominal segments with paratergal areas weakly or not at all indicated; not infesting grasses. (genus *Rugaspidiotus*) **Rugaspidiotini**

**Key to Genera
of the Tribe Aspidiotini
(Modified from Ferris)**

- 1. Adult female with six groups of perivulvar pores; without plates, lobes or paraphyses; associated with palms. **Comstockiella**
- Adult female with never more than five groups of perivulvar pores; lobes and plates normally present, if lacking, paraphyses are present. **2**
- 2(1). Second exuvia larger than and enveloping, although not entirely enclosing, the adult female stage, the latter with lobes and plates very much reduced. **3**
- Second exuvia smaller than and not at all enveloping adult female. **4**
- 3(2). Adult female with plates present; dorsal macroducts quite large and long; associated with *Juniperus*, *Sequoia* and other coniferous hosts in the western half of the United States. **Cupressaspis** (Coleman)
- Adult female without plates; dorsal macroducts very small and slender; associated with *Laurus*. **Aonidia**
- 4(2). Pygidium with paraphyses arising from bases of lobes or at site of obsolete lobes (other than a mere prolongation of base of median lobes, and other than a mere sclerotization of folds about a pore or pore furrow), these sometimes small but usually clearly recognizable. **5**
- Pygidium without such paraphyses or scleroses (other than modifications noted above). **15**
- 5(4). Paraphyses arising only from basal angles of lobes, never from within space between the lobes, thus forming merely paired supports for lateral margins of intersegmental poriferous furrows. **6**
- With at least one paraphysis arising from about the center of at least one interlobular

space, ordinarily that between second and third lobes, frequently with paraphyses along margin beyond third lobe. 10

6(5). Anal opening large, the space between the opening and the posterior edge of the pygidium not more than twice the diameter of the opening; second and third pygidial lobes reduced to small points; paraphyses wide, robust. *Hemiberlesia*
Anal opening small, or if large, then pygidial-anal space more than twice the diameter of the opening; second and often third lobes well developed; paraphyses slender, small. 7

7(6). Second and third lobes well developed; plates usually well developed and at times quite extravagantly so *Abgrallaspis*
Third lobes not developed, second lobes developed but often only as small points; plates usually small, poorly developed and unfimbriated. 8

8(7). Mesal paraphysis of first space, in its most typical form, elongate, slender, and terminating apically in a heavily sclerotized knob, some other paraphyses at times showing a similar character; in less typical form first paraphysis may be short and merely apically swollen, the swelling asymmetrical and directed toward the meson *Clavaspis*
Mesal paraphysis of first space without apical knob, although increasing in size toward apex. 9

9(8). Median and second lobes well developed, sclerotized, apically rounded, their axes somewhat diagonal, so that lobes seem to converge slightly. . . . *Quadraspidiotus*
Median lobes, and second lobes when present, with their axes parallel. *Diaspidiotus*

10(5). Prosoma of mature adult female much swollen and strongly sclerotized, varying in form from slightly reniform to markedly so, lateral prosomatic lobes more or less enclosing pygidium. *Aonidiella*
Prosoma of mature adult female if sclerotized or swollen, not reniform. 11

11(10). Pygidium broad at base, elongate and tapering to quite an acute apex, lateral margins tending to be slightly concave; three pairs of very small lobes present; plates confined to interlobular spaces, all extremely small; margin for some distance beyond site of fourth lobe slightly sclerotized and with small paraphyses. *Acutaspis*
Pygidium usually rather short and broad, not tapering to an acute apex; pygidial lobes and plates usually well developed. 12

12(11). Pygidium with conspicuous, branched plates between third and fourth lobes, these exceeding the lobes in length; fourth lobe present as a sclerotized point; margin beyond fourth lobe tending to be slightly sclerotized but without paraphyses *Chrysomphalus*
Pygidial plates extremely small or mere points, not exceeding the lobes in length, or even lacking. 13

13(12). Pygidium apically rounded; with three pairs of very small pygidial lobes and with

- fourth lobe indicated as a mere point; margin beyond fourth lobe with extended series of well-developed, quite long, closely set paraphyses. *Lindingaspis*
 Pygidium variously shaped, not apically rounded; paraphyses beyond fourth lobe usually rather few, at times lacking or weakly developed. 14
- 14(13). Entirely without plates; entirely without paraphyses beyond third lobe; dorsal ducts of pygidium with their orifices for the most part arranged in distinct furrows; dorsum of pygidium without sclerotization pattern. *Targionia*
 With at least a few plates, these at times mere points; usually with at least a few paraphyses beyond third lobe; dorsal sclerotization of pygidium arranged in definite pattern. *Melanaspis*
- 15(4). Body at maturity swollen and strongly sclerotized, pygidium retracted into apex of this sclerotization; associated with conifers. *Nuculaspis*
 Body at maturity not swollen, sclerotization various; pygidium always exerted; usually never associated with conifers. 16
- 16(15). Third pygidial lobe in form of acute, elongate, sclerotized spine; body with some degree of constriction between mesothorax and metathorax *Selenaspis*
 Third pygidial lobe variously shaped, not acute; without constriction between mesothorax and metathorax. 17
- 17(16). Pygidium with median and second lobes fused, forming a produced median lobe. *Chortinaspis*
 Pygidium with median and second lobes distinct. 18
- 18(17). Median pygidial lobes present and distinctly differentiated; remainder of pygidial margin crenulate; second and third lobes represented at most by slightly more prominent crenulations; ducts numerous on dorsum and marginal ventral areas of pygidium, all small and slender. *Rhizaspidiotus*
 Second and third pygidial lobes distinctly differentiated from other processes, if present at all. 19
- 19(18). With but two pairs of pygidial lobes, the third indicated at most merely by slight point. *Aspidaspis*
 Three pairs of pygidial lobes definitely developed. 20
- 20(19). Fourth pygidial lobe indicated by definite, sclerotized point. . . . *Dynaspidiotus*
 Fourth pygidial lobe not in slightest degree developed 21
- 20(19). Dorsal setae associated with outer corners of the abdominal lobes thickened, swollen basally. *Oceanaspidiotus*
 Dorsal setae associated with outer corners of the abdominal lobes not swollen, usually thin *Aspidiotus*

**Key to Genera
of the Tribe Diaspidini
(Modified from Ferris)**

- 1. Adult female entirely enclosed within the exuvia of the preceding stage. 2
 Adult female not enclosed within the exuvia of the preceding stage, in a few forms this exuvia is unusually large and may more or less envelop the female but does not enclose it. 6

- 2 (1). Adult female with disc pores present on at least one segment anterior to and in addition to the usual perivulvar pores; form elongate and slender; second stage with well-developed lobes and large macroducts. 3
 Adult female with no disc pores other than the usual perivulvar groups or a transverse row anterior to the vulva or with all such pores lacking. 4

- 3 (2) Margins of thorax and abdomen with a row of gland tubercles; pygidial macroducts, though few, randomly scattered across dorsum. *Lopholeucaspis*
 Margins of body without gland tubercles; pygidial macroducts confined to the marginal and submarginal areas. *Leucaspis*

- 4 (3). Adult female with the median lobes forming a notch in the apex of the pygidium and yoked together basally; antennae tending to be elongate conical and close together at the apex of the head, at times with a membranous process between; gland spines present. *Fiorinia*
 Adult female with the median lobes not thus forming a notch in the apex of the pygidium, variously developed, at times lacking; gland spines lacking. 5

- 5 (4). Adult female with the median lobes alone present, restricted to *Encelia* in southern California. *Exuviaspis*
 Adult female with two pairs of short, apically rounded lobes, restricted to *Prosopis* in southern California. *Xerophilaspis*

- 6 (1). Pygidium with a single median lobe which shows no trace of division; marginal macroducts each with a swollen, sclerotic rim about the orifice; as now known occurring only on oaks. *Quernaspis*
 Median lobes, if present, sometimes fused at the base but always with some indication of their paired character; at times lacking. 7

- 7 (6). Median lobes present, yoked basally by an internal sclerosis. 8
 Median lobes present or absent; if present not yoked basally by an internal sclerosis (their separation is sometimes obscured by crowding or by secondary sclerotization but is definitely determinable by careful examination). 12

- 8 (7). Prosoma swollen, more or less quadrate, wider than the postsoma, the sides of the latter roughly parallel; pygidial lobes forming a distinct notch in the apex of the pygidium. *Aulacaspis*
 Body not thus formed, turbinate or elongate. 9

- 9 (8). Body broadly turbinate; median lobes large and prominent, or if fusiform and without prominent median lobes then first instar with a **pair of cephalic macroducts** *Pseudaulacaspis*
 Body fusiform, the prosoma tapering anteriorly; first instars **without cephalic macroducts**; median lobes various. 10
- 10 (9). Median lobes actually separate, but their mesal margins very tightly appressed; pygidial and prepygidial macroducts confined to the margin and to a few in submarginal series. *Pinnaspis*
 Median lobes usually distinctly separate or divergent for at least a part of their length, although at times fused basally and with merely an apical notch; if appressed mesally the dorsal macroducts are abundant in both submarginal and submedian series on the fifth and preceding segments. 11
- 11 (10). Median lobes with the free outer margin usually as long as or even longer than the free inner margin, the lobes tending to project from the body for their whole length and thus not forming a median apical notch in the pygidium. *Chionaspis*
 Median lobes with the free inner margin longer than the free outer margin, an inverted V- or U-shaped notch being formed in the apex of the pygidium; usually the lobes are strongly divergent. *Poliaspis*
- 12 (7). Median lobes very small and obscure, much exceeded in size by the second lobes; as known, occurring on Cupressaceae. 13
 Median lobes present or absent, if present always larger than or at least equal to the second lobes. 14
- 13 (12). Dorsal macroducts present in definite rows on at least one prepygidial segment; second lobes not bilobed. *Cupidaspis*
 Dorsal macroducts few, not in definite rows, usually absent on segment 4; second lobes bilobed. *Paracupidaspis*
- 14 (12). Marginal pygidial macroducts with the axis of their orifices set transversely or essentially so, each with the orifice surrounded by a transversely oval, sclerotized rim 15
 Marginal pygidial macroducts with the axis of their orifices set longitudinally or diagonally, the sclerotized rim, if present, similarly disposed. 16
- 15 (14). At least three pairs of pygidial lobes present; gland spines broad, apically fimbriate or laterally serrate. *Parlatoria*
 With but two pairs of pygidial lobes present; gland spines few, small, not fimbriate or serrate; oral scleroses of the first two pairs of marginal pygidial macroducts asymmetrically swollen. *Parlatoreopsis*
- 16 (14). Pygidium tapering abruptly, acute; mesal margins of median pygidial lobes contiguous but not fused. *Neopinnaspis*

- Pygidium broad; median lobes various but without mesal margins contiguous. 17
- 17 (16). Median lobes well separated, with a "fishtail-shaped" structure formed by a furcate gland spine between them. *Pseudoparlatoria*
Median lobes various, but the gland spines between them, if present at all, separate to their bases and not giving such an appearance. 18
- 18 (17). Dorsum of the pygidium with the sclerotization forming a coarse reticulum or "lattice work" pattern. *Ischnaspis*
Dorsum of the pygidium without such reticulum. 19
- 19 (18). With an elongate, club-shaped, internal, sclerotized process arising from the base of each median lobe; body large, broadly turbinate, multilobate laterally, heavily sclerotized at maturity; perivulvar pores lacking *Howardia*
Without median club-like structures; body small, pyriform or slenderly fusiform and membranous at maturity; perivulvar pores present or absent 20
- 20 (19). Margin of the pygidium with membranous, low, broad, apically serrate processes in addition to lobes and gland spines; occurring as known, only on bamboos; marginal ducts subequal to dorsal ducts. *Kuwanaspis*
Without the above combination of characters. 21
- 21 (20). Median lobes normally with inner margin shorter than outer margin; pygidial apex strongly acute. *Andaspis*
Median lobes normally subequal in length on inner and outer margin; pygidial apex rounded. 22
- 22 (21). Body elongate and fusiform or elongate oval, not widening anteriorly, the length normally at least twice the greatest breadth and the greatest breadth not across the head or prothoracic region. 23
Body turbinate or pyriform or with the prosoma laterally expanded, length not likely to be more than twice the greatest breadth across the head or the prothoracic region. 30
- 23 (22). Perivulvar pores present, although at times very few. 23
Perivulvar pores lacking. 27
- 24 (23). Three pairs of pygidial lobes present, the third pair distinct, flattened, in size and form resembling the second pair; dorsal pygidial ducts scattered irregularly, present to the seventh or perhaps the eighth segment. *Unaspis*
Third lobes represented at the most merely by a variously shaped, sclerotized point or points, at times lacking. 25
- 25 (24). Median lobes apically rounded, tending to be elongate and narrow, never laterally

notched; gland spines never present between them; dorsal ducts tending to be only slightly smaller than the marginal and to be arranged in distinct segmental rows submarginal setae on the ventral side of the pygidium tending to be enlarged; all the species now known are grass-infesting. *Haliaspis*
 Median lobes usually quite broad and heavy, but even if narrow they are notched laterally and are apically truncate or irregular and usually there is a pair of gland spines between them; dorsal ducts various. 26

26 (25). Dorsal pygidial ducts, even if few, arranged in definite segmental rows or series, none present posterior to the sixth segment (except in one species a single duct on seventh and eighth); neither eyes nor antennae ever with any unusual developments; second pygidial lobes always present, well developed, flattened and bilobulate. *Lepidosaphes*

Dorsal pygidial ducts, distributed irregularly, frequently present to the seventh or even the eighth segment; eyes or antennae at times with some unusual feature; second pygidial lobe various, at times reduced to a mere point or heavily sclerotized and but slightly bilobulate. part of *Aonidomytilus*

27 (23). Three pairs of well-developed pygidial lobes present, the third pair deeply bilobulate and resembling the second pair in shape and size. *Stramenaspis*
 Third pygidial lobes, if recognizable at all, not bilobed. 28

28 (27). Third pygidial lobe present, flattened, resembling the first lobule of the second lobe in size and form; no marginal macroducts in; restricted to *Ephedra* in desert areas *Pallulaspis*
 Third pygidial lobe, if recognizable at all, merely a sclerotized point; some of the marginal macroducts arranged in pairs; not on *Ephedra*. 29

29 (28). Dorsal pygidial ducts, although few, arranged in definite segmental rows; median lobes alone present. *Nilotaspis*
 Dorsal pygidial ducts scattered or in broad bands, not in segmental rows; median lobes various. Part of *Aonidomytilus*

30 (22). Perivulvar pores present. 31
 Perivulvar pores lacking (in one species occasionally present). 35

31 (30). Pygidium entirely without large marginal macroducts and none of the marginal ducts arranged in the normal fixed positions. *Protodiaspis*
 Pygidium with large marginal macroducts in the normal fixed positions. 32

32 (31). Dorsal pygidial ducts arranged in definite, segmental rows, not present posterior to the fifth segment except for a single submarginal duct anterior to the second lobe; known in North America only from conifers of the family Cupressaceae *Carulaspis*
 Dorsal pygidial ducts at times exceedingly few or almost lacking, but when in sufficient numbers to define any arrangement, not in definite segmental rows, usually scattered or in clusters except for rows on the prepygidial segments, present to the

- sixth or seventh segment. 33
- 33 (32). Basal scleroses of these setae not enlarged; median lobes well separated or in many species apically divergent and forming an apical notch in the pygidium; second lobes tending to be well developed and even the third lobe at times present. *Diaspis*
 Basal scleroses of the dorsal marginal setae of at least segments six and seven (second and third lobes) definitely enlarged, usually quite strikingly so, median lobes usually close together or even basally approximate or fused, never apically divergent; second lobes tending to be reduced, sometimes almost obsolete; third lobe never developed as more than a minute point. 34
- 34 (33). Perivulvar pores in four or five well-developed groups. *Epidiaspis*
 Perivulvar pores occasionally vestigial, or if definitely present with not more than four or five on either side. One species, in which the perivulvar pores may be either present or absent. part of *Situlaspis*
- 35 (30). Median lobes forming a notch in the apex of the pygidium, widely separated and with a pair of apically fimbriate gland spines between; known only from Cycads *Furchadaspis*
 Median lobes, if present at all, not thus forming an apical notch in the pygidium 36
- 36 (35). Pygidial gland spines unusually stout, apically truncate and with a bundle of very long, slender microducts discharging through each. *Pseudodiaspis*
 Pygidial gland spines of normal character, with usually one and never more than two microducts discharging through each. 37
- 37 (36). Marginal macroducts, if present at all, not differentiated from the dorsal ducts by size or occupation of the normal fixed positions. *Protodiaspis*
 Marginal macroducts of the pygidium distinctly differentiated from the dorsal ducts by larger size or by occupation of some of the normal fixed positions. part of *Situlaspis*

**Key to Genera
of the Tribe Odonaspidini
(Modified from Ferris)**

1. Adult female with two pairs of long pygidial scleroses; pygidium with an apical cluster of seta-like gland spines *Froggattiella*
 Adult female with one pair of short pygidial scleroses; pygidium without an apical cluster of seta-like gland spines. *Odonaspis*

THE CALIFORNIA SPECIES OF ARMORED SCALES

Genus *Abgrallaspis* Balachowsky, 1948

Includes many species formerly in the genus *Hemiberlesia* but with two or three pairs of well developed median lobes and a small anal ring not situated near the pygidial margin.

Number of World Species: 31

Number of United States Species: 10. Includes one recently described United States species, *Abgrallaspis liriodendri* Miller and Howard, 1981, Ann. Ent. Soc. Amer. 74(2):164-166.

Key to World Species: Komosinska, H., 1969: Acta Zool. Cracov. 14(3):43-85.

Key to United States Species: Davidson, J.A., 1964: Ann. Entomol. Soc. Am. 57:638-643.

Key to California Species: See below or McKenzie, H.L., 1956: The Armored Scale Insects of California. Univ. Calif. Press, Berkeley. 209 pp. (the California species are listed in the genus *Hemiberlesia*).

KEY TO CALIFORNIA SPECIES OF *ABGRALLASPIS*

1. Perivulvar pores absent; median lobes not rounded, apically truncate, dorsal macroducts present on abdominal segments 2 and 3; lobe 3 not represented; plates usually present only between the median lobes. *quercicola*
— Perivulvar pores present; without the other above characteristics. 2
2. Two or 3 submedian dorsal macroducts present on segments 1, 2, 3, and 4. . . . *fraxini*
— Submedian dorsal macroducts absent. 3
3. Submarginal dorsal macroducts always present in definite series on abdominal segments 3 and 4; usually more than 20 dorsal macroducts present; third lobe represented by a sclerotized prominence often bearing lateral serrations; second lobes subapically notched on both lateral and mesal aspects, known from camellia and ornamentals. . . . *degenerata*
— Dorsal macroducts normally confined to pygidial segments 5 and 6; 1 or 2 submarginal ducts occasionally present on segment 4; usually less than 20 dorsal macroducts present. 4
4. Eyespots well developed, sclerotized; usually less than 10 dorsal macroducts present; female scales elongate oval, lobe 3 a narrow, sclerotized point; median lobes not convergent. *cyanophylli*
— Eyespots short, lightly sclerotized, blunt, usually more than 10 dorsal macroducts present; female scale circular, lobe 3 replaced by a hyaline point or represented by a low, broad, sclerotized process; median lobes tending to be convergent, longer than wide, closely apposed, often obscuring the median pair of plates; known mainly from the West on members of the genus *Prunus*; placed here because of possible confusion when using the key, this is considered to be a leaf feeding form of *Diaspidiotus ancylus* — see comments under that species. *howardi*

Abgrallaspis cyanophylli (Signoret), 1869
cyanophyllum scale

Fig. 3, Color Plates 1, 2

Tribe: Aspidiotini.

Synonymy: *Aspidiotus cyanophylli* Signoret, *Evaspidiotus cyanophylli* Signoret, *Furcaspis cyanophylli* (Signoret), *Hemiberlesia cyanophylli* (Signoret).

Field Characteristics: Adult female cover 1 to 2 mm long, ovoid to oblong, somewhat convex, slightly transparent yellowish-white or tan, with darker yellow or tan exuviae. Exuviae subcentral to subterminal; body yellow. Male scale covers oblong, smaller and lighter colored than females.

Similar Species: Oleander, latania and greedy scales are similar but not as oblong. Tropical palm scale, *Hemiberlesia palmae* (Cockerell), not presently known from California, is also similar as is *Abgrallaspis gliwicensis* Komosinska from Brazil.

Biology: Little known, but apparently has several generations per year.

Hosts: Polyphagous. Prefers cactus and palms in California. For host lists see Borchsenius (1966) and Dekle (1976).

Economic Importance: Not common in California, but infestations in nurseries may occasionally require treatment. Listed by Dekle (1976) as a pest of palms in Florida and by Silva (1950) as a pest of cocoa.

Distribution: Cosmopolitan. Generally distributed in California on nursery stock, par-

ticularly on cactus, but uncommon. Does not do well out-of-doors outside the nursery situation.

Diagnosis: Best recognized by color and shape of scale cover and the well developed eye spine. The genus *Abgrallaspis* is a difficult one to work with, however, and the keys by Davidson (1964) and Komosinska (1969) should be consulted when working with quarantine specimens in this group. *Abgrallaspis gliwicensis* Komosinska from Brazil is nearly identical to *cyanophylli* but has fewer perivulvar pores and fewer (3 versus 4 or more) plates anterior to lobe 3.

Borchsenius, N.S., 1966: A Catalogue of the Armored Scale Insects of the World. Zool. Inst. U.S.S.R. Acad. Sci., Moscow and Leningrad. 449 pp.

Davidson, J.A., 1964: Ann. Entomol. Soc. Am. 57:638-643.

Dekle, G.W., 1976: Florida Armored Scale Insects. Fla. Dept. Agric. Cons. Serv., Div. Plant Ind. Gainesville. 345 pp.

Komosinska, H., 1969: Acta Zool. Cracov. 14(3):43-85:

McKenzie, H.L., 1956: The Armored Scale Insects of California. Univ. Calif. Press, Berkeley. 209 pp.

Silva, P., 1950: Bull. Entomol. Res. 41:119-120.

Abgrallaspis degenerata (Leonardi), 1896
degenerate scale

Fig. 4, Color Plate 3

Tribe: Aspidiotini.

Synonymy: *Chrysomphalus degeneratus* Leonardi, *Aspidiotus degeneratus* (Leonardi), *Hemiberlesia degeneratus* (Leonardi), *Diaspidiotus degeneratus* (Leonardi), *Dynaspidiotus degeneratus* (Leonardi).

Field Characteristics: Adult females 1.5 to 2.5 mm in diameter, circular, moderately convex, opaque yellow with a central to subcentral

exuvium. Male scales oblong, typical of other males in this group.

Similar Species: Yellow scale is similar but flatter and the scale cover is more transparent.

Biology: Unknown.

Hosts: Prefers camellia. For a host list see McKenzie (1956).

Economic Importance: McKenzie (1956) lists it as a common nursery pest. Rare in recent

years; not found recently in nurseries. It apparently has not been able to successfully move onto other hosts from the original camellia plants introduced into California in the 1930's and 1940's. For more information on the early history and economics of this species in California, see Mackie (1933).

Distribution: Restricted to the San Joaquin and Sacramento Valleys, rare. Also occurs in Europe and Japan.

Diagnosis: Host preference, geographic range

and scale cover color aid in recognition. The only California *Abgrallaspis* with macroducts on the prepygidial segments and reduced numbers of multilocular pores. Closest morphologically to *A. fraxini*.

McKenzie, H.L., 1956: The Armored Scale Insects of California. Univ. Calif. Press, Berkeley. 209 pp.

Mackie, D.B., 1933: Calif. Dep. Agric. Mon. Bull. 22(12):457-472.

Abgrallaspis fraxini (McKenzie), 1944

ash scale

Fig. 5

Tribe: Aspidiotini.

Synonymy: *Hemiberlesia fraxini* McKenzie.

Field Characteristics: Scale cover 1.5 to 2.0 mm in diameter, circular, flat, yellow or tan with lighter yellow exuviae. Males oval, colored like the females, with a subterminal exuvium. Occurs on the leaves of the host.

Similar Species: Nearly identical in external appearance to oleander scale, but the males of oleander scale when present are transparent white, different from the color of the female. In ash scale, male and female covers are nearly

identical in color.

Biology: Unknown.

Distribution: A rare species restricted to ash and willow in the Coachella Valley, Riverside County; has been collected only at La Quinta and Thermal.

Economic Importance: None.

McKenzie, H.L. 1956: The Armored Scale Insects of California. Univ. Calif. Press, Berkeley. 209 pp.

Abgrallaspis howardi (Cockerell), 1895

Howard scale

Fig. 6

Tribe: Aspidiotini.

Synonymy: *Aspidiotus howardi* Cockerell, *Aspidiotus townsendi* Cockerell, *Aspidiotus pseudospinosus* Woglum, *Aspidiotus epigaeae* Marlatt, *Hemiberlesia howardi* (Cockerell), *Gonaspidotus howardi* (Cockerell). Considered a dimorphic form of Putnam scale (*Diaspidiotus ancylus*). See comments under that species.

Abgrallaspis quercicola (Ferris), 1941

irregular oak scale

Fig. 7

Tribe: Aspidiotini.

Synonymy: *Hemiberlesia quercicola* Ferris.

Field Characteristics: Adult females 1.5 to 2.0 mm in diameter, circular, fairly convex, tan,

with yellow or gold subcentral exuviae. Males unknown. Occurs under bark.

Hosts: Oaks (*Quercus*). Has also been found on volunteer almond seedlings (*Prunus*

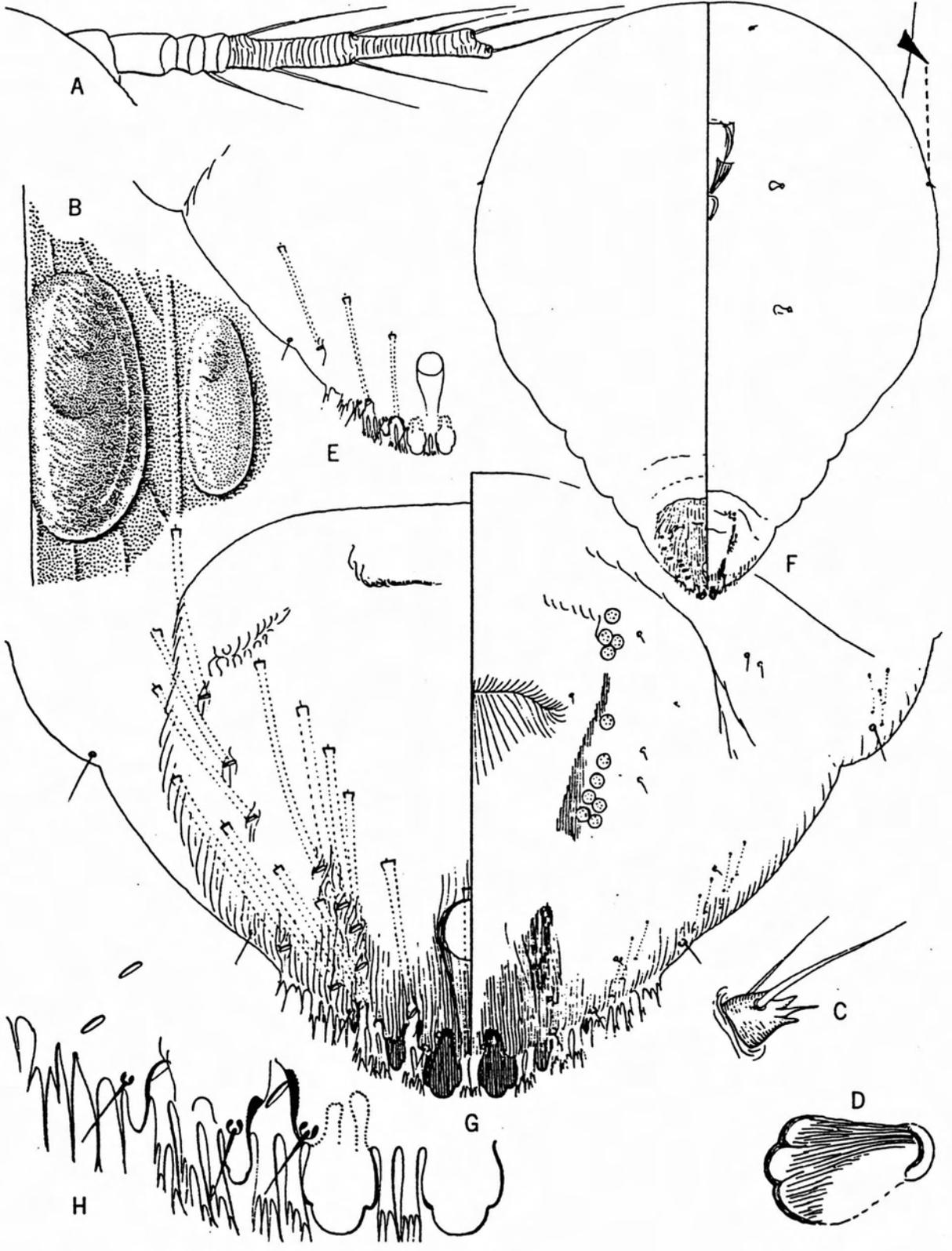


Fig. 3. *Abgrallaspis cyanophylli* (Signoret).

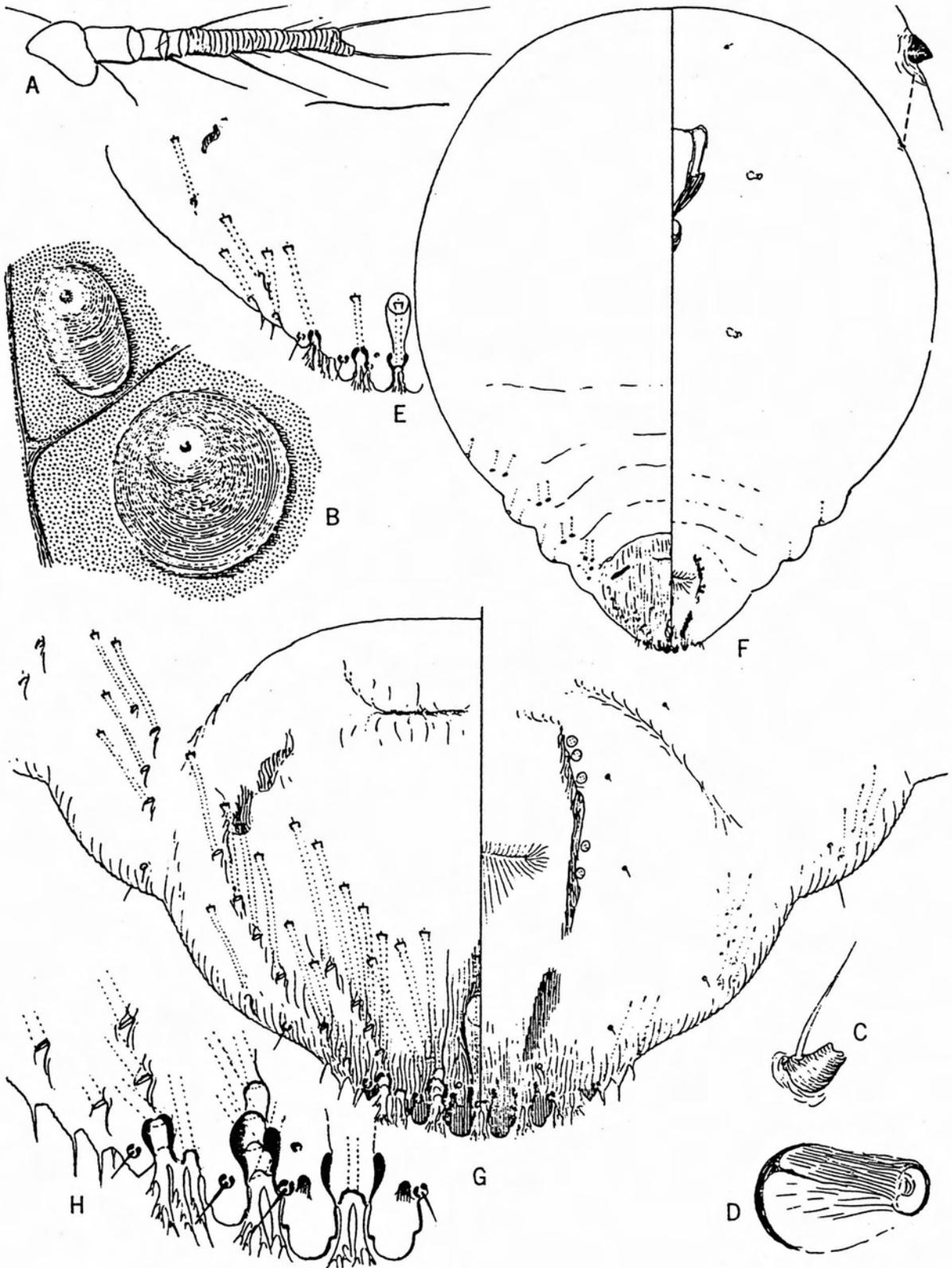


Fig. 4. *Abgrallaspis degenerata* (Leonardi).

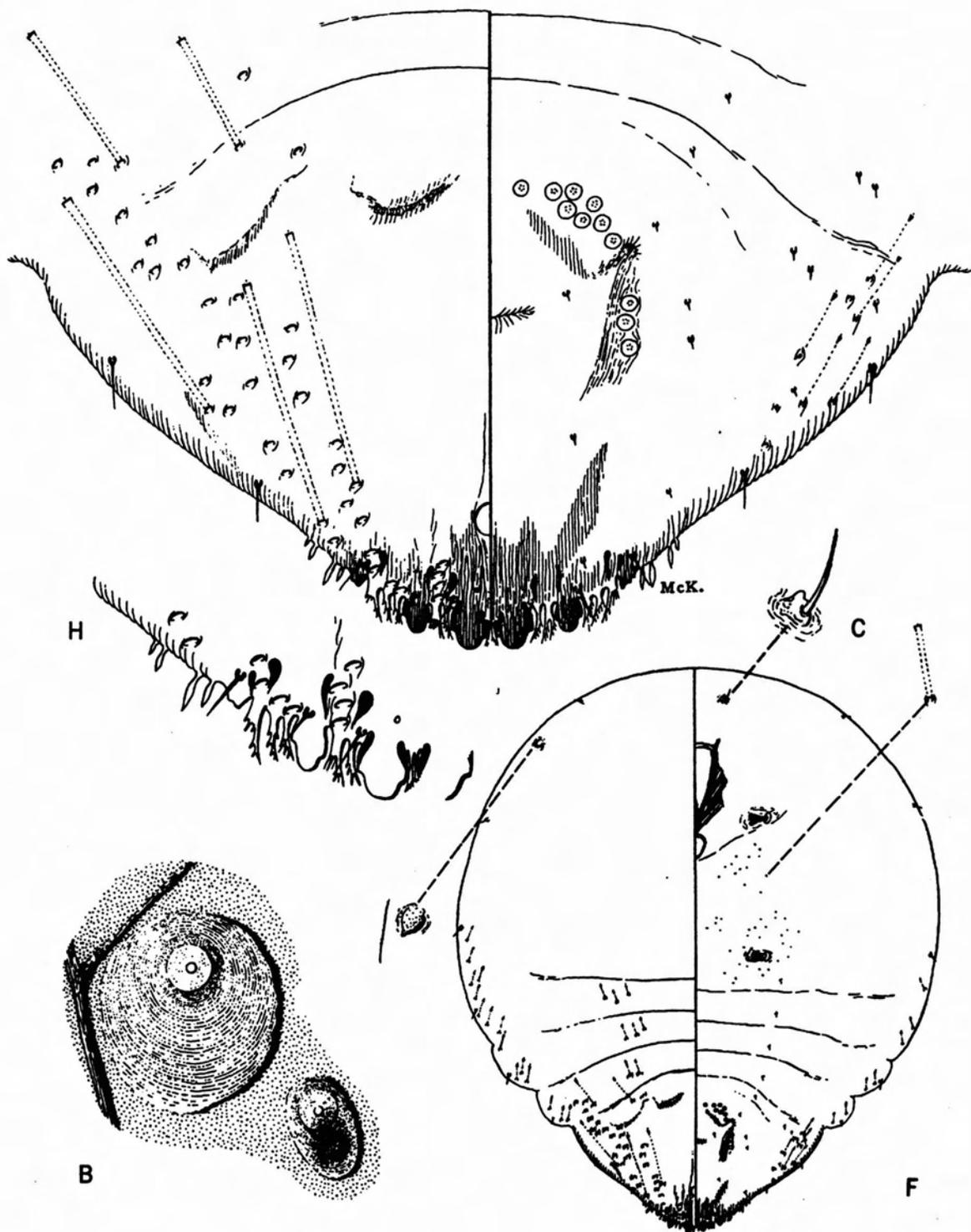


Fig. 5. *Abgrallaspis fraxini* McKenzie.

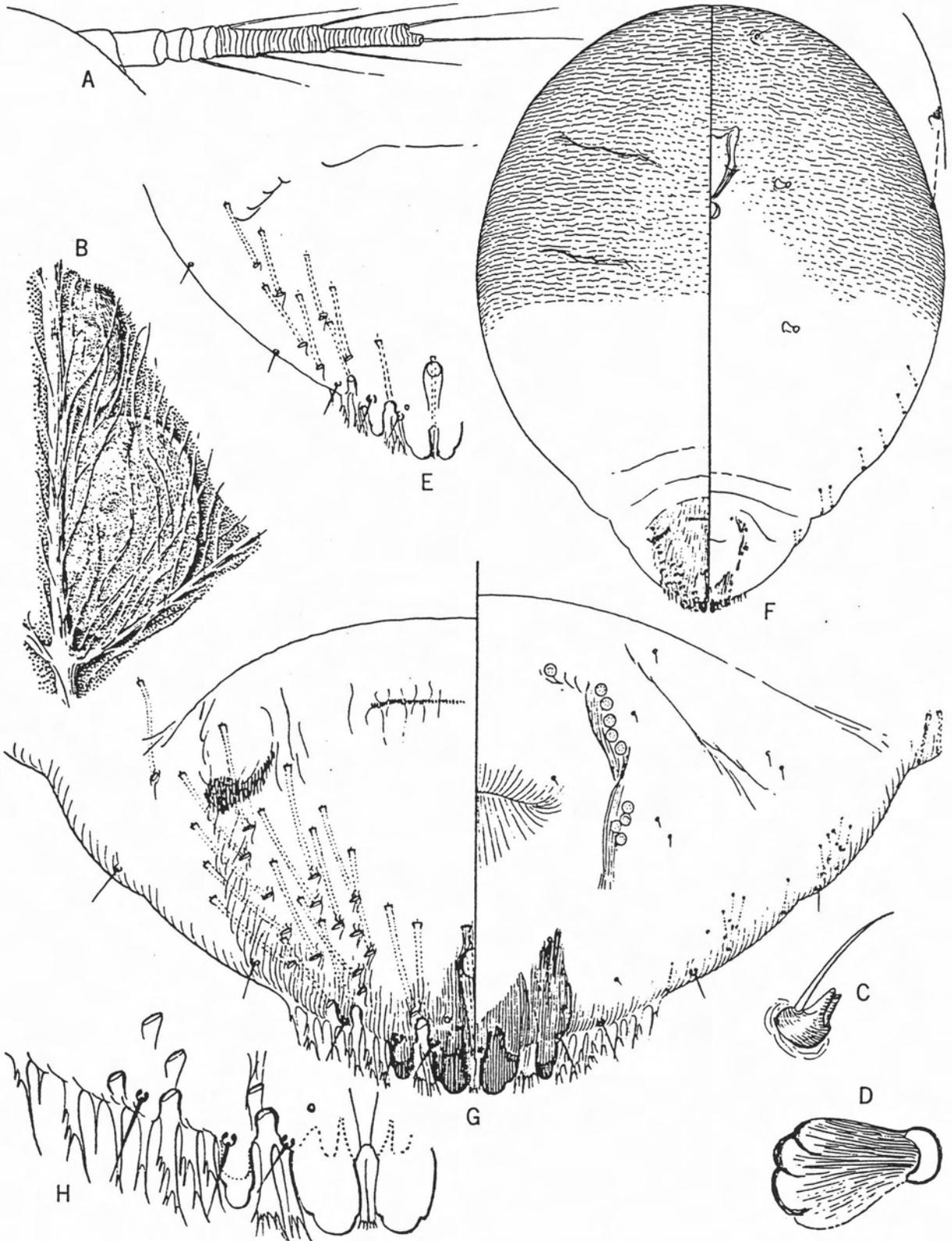


Fig. 6. *Abgrallaspis howardi* (Cockerell).

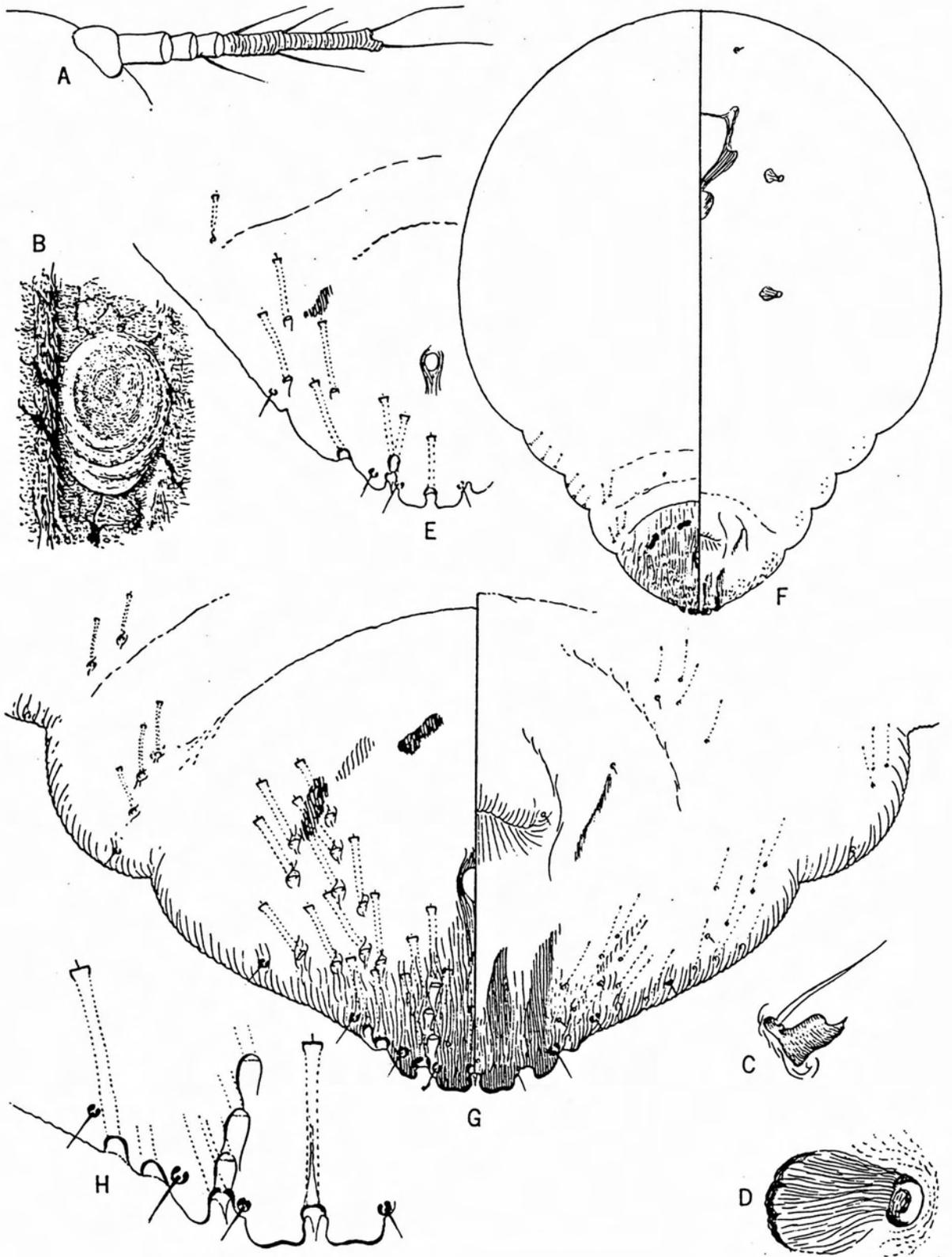


Fig. 7. *Abgrallaspis quercicola* (Ferris).

amygdalis) in Riverside County.

Distribution: San Diego, Inyo and Riverside Counties; New Mexico. Probably also occurs in adjacent areas. Common but rarely collected; native.

Diagnosis: Morphologically unlike other scales in *Abgrallaspis* and *Hemiberlesia*. Prob-

ably belongs in its own genus. The only scale on oak with well developed second lobes and greatly reduced pygidial plates.

McKenzie, H.L., 1956: The Armored Scale Insects of California. Univ. Calif. Press, Berkeley. 209 pp.

Genus *Acutaspis* Ferris, 1941

A small genus containing mostly New World species, some of which have questionable taxonomic status. Difficult to key to species.

Number of World species: 16

Number of United States species: 4

Keys to species: None current. See Ferris, G.F., 1937-1942: Atlas of the Scale Insects of North America, Ser. I-IV. Stanford Univ. Press, Stanford.

Acutaspis albopicta (Cockerell), 1898

albopicta scale

Fig. 8

Tribe: Aspidiotini.

Synonymy: *Aspidiotus albopictus* Cockerell, *Aspidiotus albopictus* var. *leonis* Townsend and Cockerell, *Aspidiotus koebelei* Townsend and Cockerell, *Chrysomphalus koebelei* (Townsend & Cockerell), *Insaspidiotus albopictus* (Cockerell), *Chrysomphalus albopictus* (Cockerell).

Collected on *Philodendron* and *Tillandsia* in several California nursery locations prior to 1960. Occasionally seen on *Aglaonema* shipments from Puerto Rico. Apparently never became established in the State.

McKenzie, H.L., 1956: The Armored Scale Insects of California. Univ. Calif. Press, Berkeley. 209 pp.

Genus *Andaspis* MacGillivray, 1921

The genus *Andaspis* contains several species formerly in the genus *Lepidosaphes*.

Number of World species: 22

Number of United States species: 2

Key to World species: Williams, D.J., 1963: Bull. Br. Mus. (Nat. Hist.), Entomol. 15(1):1-31.

Andaspis mackieana (McKenzie), 1943

Mackie scale

Fig. 9

Tribe: Diaspidini.

Synonymy: *Lepidosaphes mackieana* McKenzie.

Collected several times on dendrobium orchids in nurseries in Los Angeles County. Not collected since 1944. Not considered part of the California fauna.

McKenzie, H.L., 1956: The Armored Scale Insects of California. Univ. Calif. Press, Berkeley. 209 pp.

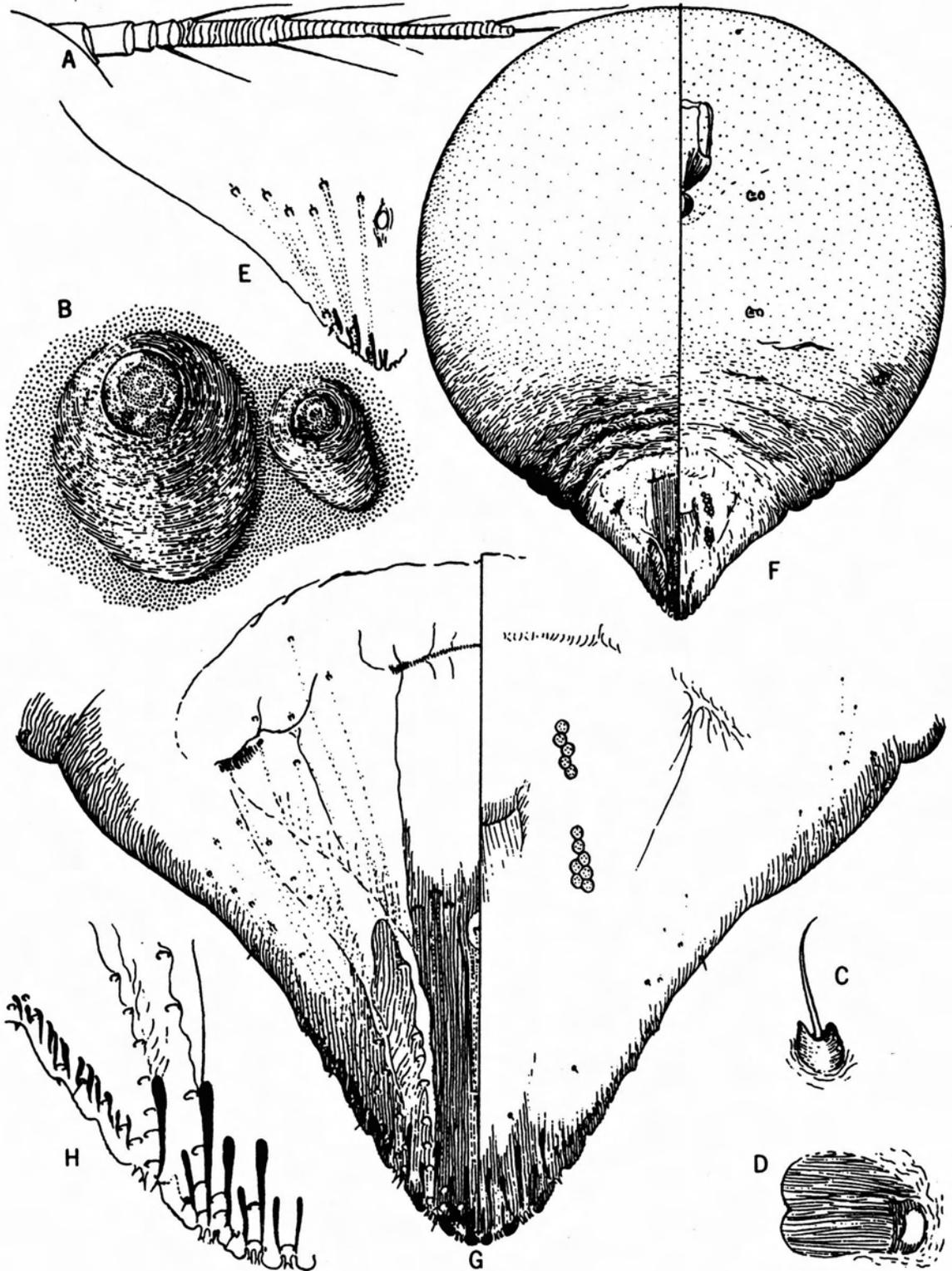


Fig. 8. *Acutaspis albopicta* (Cockerell).

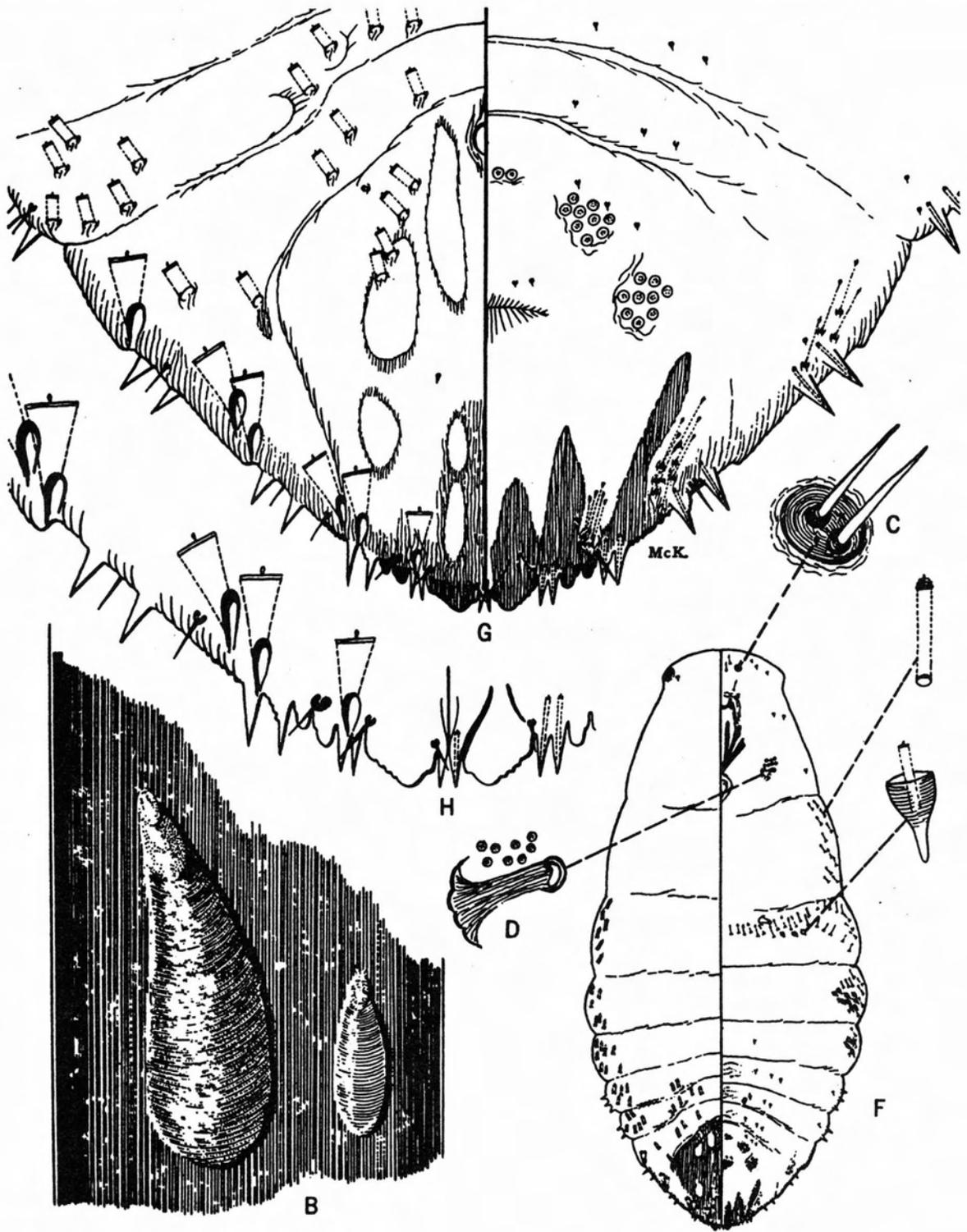


Fig. 9. *Andaspis mackieana* (McKenzie).

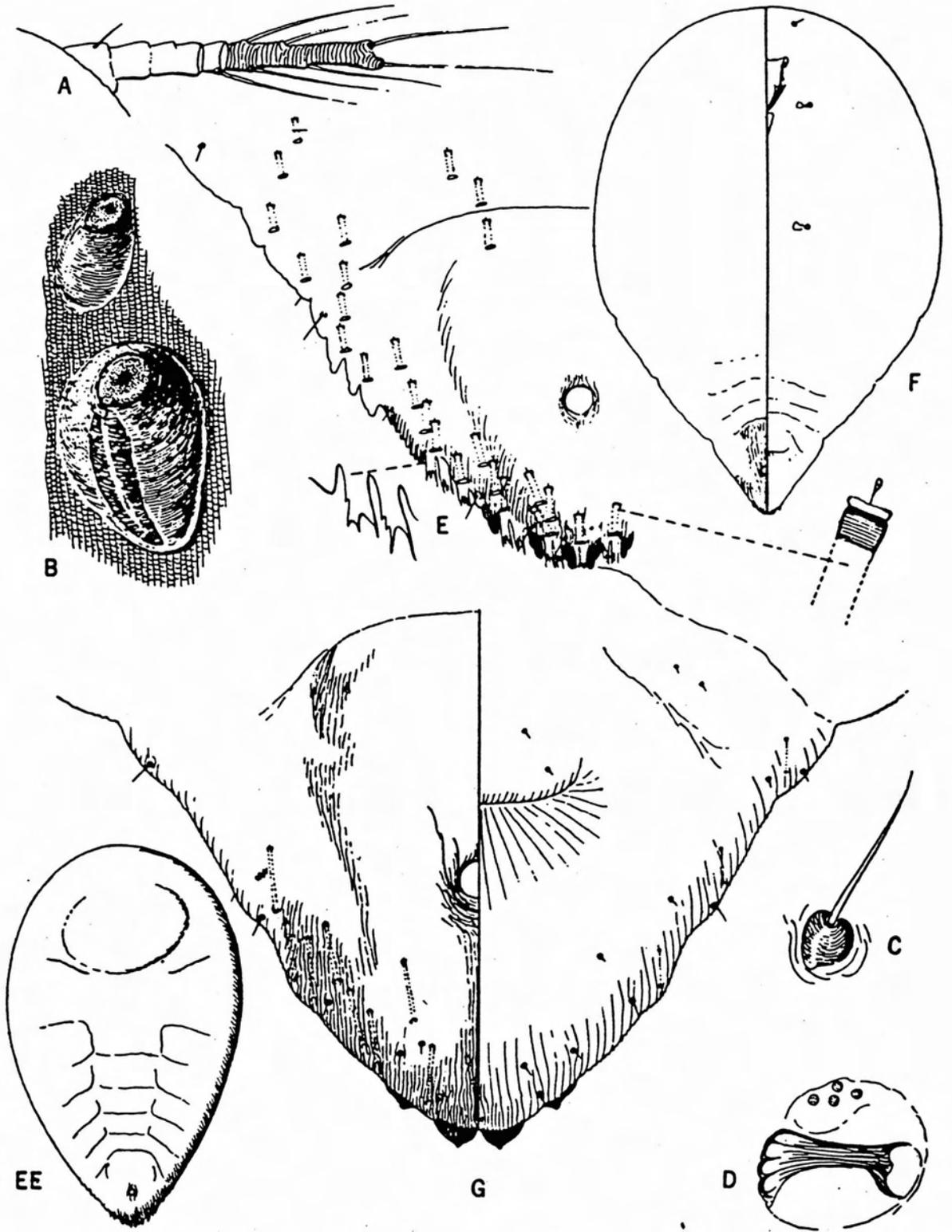


Fig. 10. *Aonidia lauri* (Bouché).

Genus *Aonidia* Targioni-Tozzetti, 1868

An Old World genus, several North American forms previously assigned here have been removed to *Cupressaspis* by Borchsenius.

Number of World Species: 31

Number of United States Species: None currently.

***Aonidia lauri* (Bouché), 1833**

laurel scale

Fig. 10

Tribe: Aspidiotini.

According to McKenzie this species has been collected from *Laurus nobilis* in single locations in Los Angeles and Santa Clara Counties. Currently not present in California although it may occasionally be seen on bay leaves imported from the Mediterranean area.

McKenzie, H.L., 1956: The Armored Scale Insects of California. Univ. Calif. Press, Berkeley. 209 pp.

Genus *Aonidiella* Berlese and Leonardi, 1896

Number of World Species: 30

Number of United States species: 4

Keys to World species: McKenzie, H.L., 1946: Microentomol. 11(1):29-36, and McKenzie, H.L., 1939: Microentomol. 3(1):1-36.

KEY TO CALIFORNIA SPECIES OF AONIDIELLA

1. With at least one pair of small scleroses in the membrane just anterior to the vulva. . . 2
Without such prevulvar scleroses. *taxus*
2. Usually only a single pair of prevulvar scleroses present, these in the form of an inverted, somewhat V-shaped apophysis. *citrina*
With two pairs of little, sclerotized spots in addition to the pair of apophyses
. *aurantii*

***Aonidiella aurantii* (Maskell), 1878**

California red scale (ESA approved)

Fig. 11, Color Plates 4-8

Tribe: Aspidiotini.

Other Common Names: orange scale, red orange scale, red scale.

Synonymy: *Aspidiotus aurantii* Maskell, *A. citri* Comstock, *A. coccineus* Gennadius, *Aonidia gennadii* Targioni, *Chrysomphalus aurantii* (Maskell).

Field Characteristics: Adults 1.5 to 2.0 mm in diameter, nearly round, fairly flat, reddish to reddish-grey or brown with central exuviae. Male scale covers smaller, oblong, reddish or yellow-grey, with a subterminal exuvium. Female body yellow but normally not visible when the scale cover is turned over because a

ventral scale is secreted which binds the female closely to the upper cover. Between the nymphal-adult molt and the time that fertilization takes place the adult female is not protected by the ventral scale and will be left on the host if the scale cover is removed. During the time between the last molt and fertilization the scale is called the grey adult because grey colored "wax" materials are added to the scale cover. Before fertilization the adult female body is typical of many scales in that its shape is rounded anteriorly and tapered at the pygidial or posterior end. However, after fertilization takes place the pygidium is drawn forward and the sides of the abdomen expand posteriorly so that the body becomes "horse-shoe" or "kidney" shaped. The kidney-shaped female body can often be seen through the semi-transparent scale cover with a good hand lens or dissecting scope, and is a good field diagnostic character.

Similar Species: Yellow scale is similar and if the two species occur together it may be extremely difficult to distinguish them. Living adult females of yellow scale are normally bright lemon-yellow as contrasted with the reddish-brown red scale. However, dead yellow scale females are darker (more brownish) than living scales and in this situation field identification is difficult. On citrus, red scale heavily infests twigs and branches, while yellow scale does not, and this difference can be useful in field identification.

Biology: Gives birth to active crawlers (ovoviparous). Produces 2 to 3 crawlers per day for about two months, eventually producing about 150 crawlers. Young crawlers remain under the female scale covering a day or so before they emerge. They usually emerge before noon and crawl actively about looking for a place to settle and feed. The majority settle within 6 to 24 hours; only about 5 percent remain active for a longer time. During this period the crawlers are often carried great distances by farming equipment, birds or wind currents. Within a few hours to several days after settling, the scale forms a waxy, protec-

tive cover called a "white cap." After the white cap phase, more wax is laid down in the shape of a central prominence or nipple, and the scale is then in the "nipple stage." The scale passes through two growth stages requiring 10 to 15 days each. They usually take on their distinctive red coloration after the first molt. Between molts the scales feed, add to and enlarge the scale cover. The female scale rotates in a full circle around her fixed location (point of mouth-part insertion) as material is added to the cover, resulting in its circular shape. The male scale does not rotate as much and adds material mostly at one end, forming an oblong cover. About three generations of red scale occur per year in California, although broods overlap so much that they are not readily recognizable. Average generation length is about 75 days in summer. The above information on biology summarized from Quayle (1911b, 1938), Bliss et al., (1931), Dickson and Lindgren (1947), Ebeling (1957), Tashiro and Beavers (1968), Tashiro and Moffitt (1968), Willard (1972), Grout and Richards (1989), Grout et al (1989 and Washington and Walker (1990). California red scale has apparently been out-competing the similar yellow scale, and as a result, yellow scale is becoming very scarce in California (DeBach, et al, 1978). **Hosts:** Prefers *Citrus*, otherwise polyphagous. Other than citrus, it is usually found on ornamental evergreen shrubs. For a host list see McKenzie (1956), Quayle (1911b), and Borchsenius (1966).

Economic Importance: A serious pest of citrus. Causes leaf discoloration and premature drop, branch dieback, reduced fruit quality, and if left unchecked, eventual death of the tree. Difficult to control, particularly since it has widely overlapping generations. Had been controlled to some extent by various natural enemies, in coastal localities, but not in many inland citrus growing areas, but now most of these are also under some form of biological or integrated control. Much has been presented on biocontrol of red scale; it has been adequately summarized by Rosen

and DeBach (1978), but see Compere (1961), and see Samways (1985) for more recent information. For more information about economic importance see Quayle (1911a, 1911b, 1936), Ebeling (1959), Carman (1981) and Elmer and Brawner (1982). In addition to the economics of injury to the host trees and the cost of control, quarantine regulations restricting the movement of infested nursery stock have added to the damage caused by red scale. Various red scale control districts have been organized in California over the years to eradicate red scale from commercial citrus growing areas. One such district is still operating in the Coachella Valley of Riverside County. Those control districts presently operating are using the male-attracting pheromone traps developed by Shaw et al. (1971) as a detection tool. These traps are also being used in Arizona. For more information on male trapping and male scale identification see Gardner et al., (1983) and the included section on male scale identification. For more information on red scale control districts, see Ervin et al., 1986.

Distribution: Occurs in most citrus growing areas of the world. See Ebeling (1959) for data on its worldwide distribution. Introduced into the Los Angeles area from Australia prior to 1875. Thought to be native to Southeast Asia. Presently found in California almost everywhere that citrus can be grown. Due to quarantine restrictions and the relative success of the red scale control districts, it is found in low numbers or is absent from some citrus growing areas of the Sacramento Valley and the desert valleys of Riverside and Imperial Counties.

Diagnosis: In California, should not be confused with anything except yellow scale. Red scale is separated from yellow scale by the presence of two sclerotized areas called sclerites, "eyebrows," occurring ventrally anterior to the sclerotized ventral apophyses. See McKenzie (1937, 1956), Ferris (1938) and Ebeling (1959). Many other species of *Aonidiella* can also be separated using the keys provided by McKenzie (1938). Adult male identifica-

tion is also possible. See the chapter on male scales.

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- Dep. Agric. Handb. 480:1-545.
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 Washington, J.R. and G.P. Walker, 1990: Ann. Entomol. Soc. Am. 83(5):939-948.
 Willard, J.R., 1972: Aust. J. Zool. 20:37-47.

Aonidiella citrina (Coquillett), 1891
 yellow scale (ESA approved)
 Fig. 12, Color Plates 9, 10

Tribe: Aspidiotini.

Synonymy: *Aspidiotus citrinus* Coquillett, *Aspidiotus aurantii* var. *citrinus* Coquillett, *Chrysomphalus aurantii* var. *citrinus* (Coquillett), *Chrysomphalus citrinus* (Coquillett).

Field Characteristics: Adults 1.5 to 2.0 mm in diameter, nearly circular, flat transparent lemon-yellow, with central exuviae. Male scales smaller, more oblong, with a subterminal exuvium.

Similar Species: California red scale, but living adults of yellow scale are lighter colored than red scale, and are usually easy to separate in the field. However, dead specimens of yellow scale are darker and harder to distinguish from red scale. Also, on citrus, yellow scale is not found on the branches whereas red scale is commonly found on the wood. Degenerate scale (*Abgrallaspis degenerata*) is similar in color to yellow scale, but the scale cover of *degenerata* is more convex and less transparent than that of yellow scale.

Biology: Similar to that of California red scale (Ebeling, 1959). According to Nel (1933), generation time averages about 5 days longer in yellow scale than in red scale.

Hosts: Prefers *Citrus*, but has a long host list. Usually found on ornamental evergreen shrubs. For a host list see McKenzie (1956) and Borchsenius (1966).

Economic Importance: A minor pest of citrus. Causes defoliation, die-back and fruit drop. Since it does not occur on the wood, overall damage is not as severe as with red scale.

Because the scale is on the leaves and fruit, any defoliation resulting from heavy populations automatically reduces the scale population. For more on the economic importance of this species see Ebeling (1959) and Quayle (1911a, 1938). Natural enemies have effectively reduced populations, especially in Southern California. This, plus the competitive nature of red scale, has led to the disappearance of yellow scale from many California locations. For more information on biocontrol of yellow scale see the excellent summary by Rosen and DeBach (1978).

Distribution: Once widespread in California, but becoming rare. Still occurs in the Ventura-Santa Barbara County area, the southern San Joaquin Valley, and the Sacramento Valley; fairly common in the citrus growing areas in Sutter and Butte counties. Recently (1996) collected from citrus at Redding, Shasta County. Also known from Florida, Texas, Australia, Japan, India and the Mediterranean. Native to the Orient.

Diagnosis: Nearly identical to California red scale but lacks scleroses "eyebrows" ventrally. See comments under California red scale. Care should be taken in using this criterion, however, since old or poorly mounted specimens of yellow scale show considerable thickening of the derm in the "eyebrows" area, in which case separation of the two species is difficult.

Borchsenius, N.S., 1966: A Catalogue of the Armored Scale Insects of the World. Zool. Inst. U.S.S.R. Acad. Sci., Moscow, Leningrad. 449 pp.

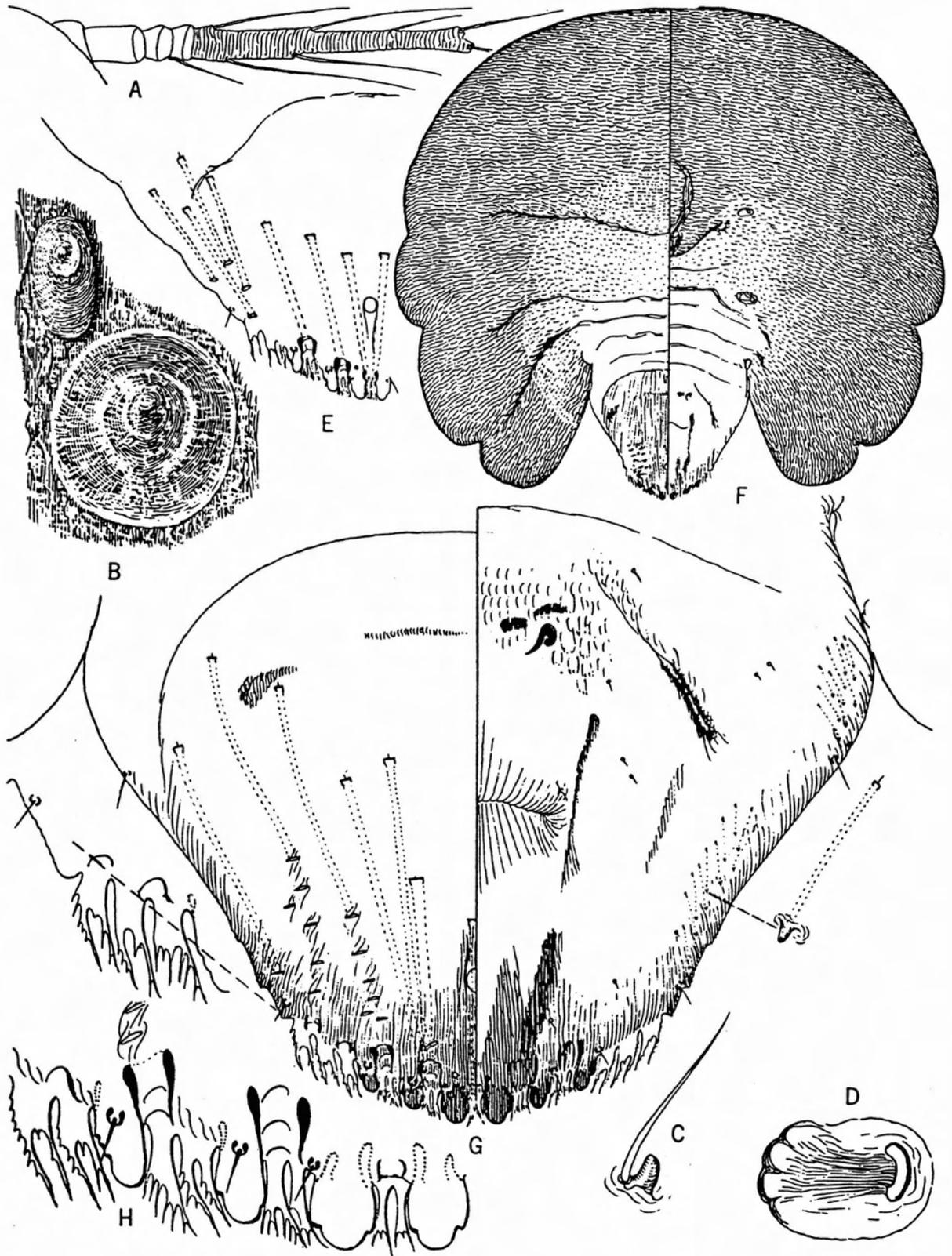


Fig. 11. *Aonidiella aurantii* (Maskell).

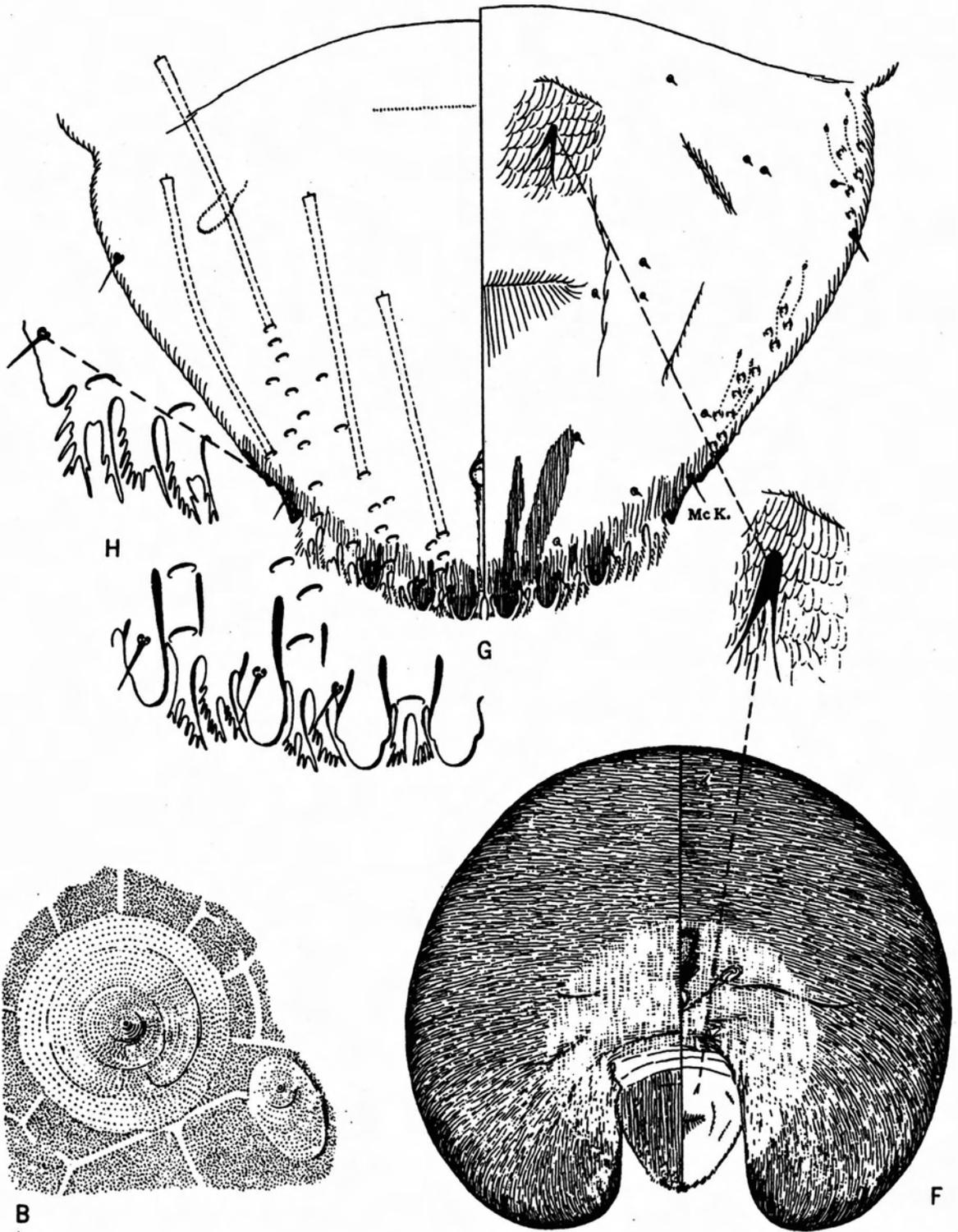


Fig. 12. *Aonidiella citrina* (Coquillett).

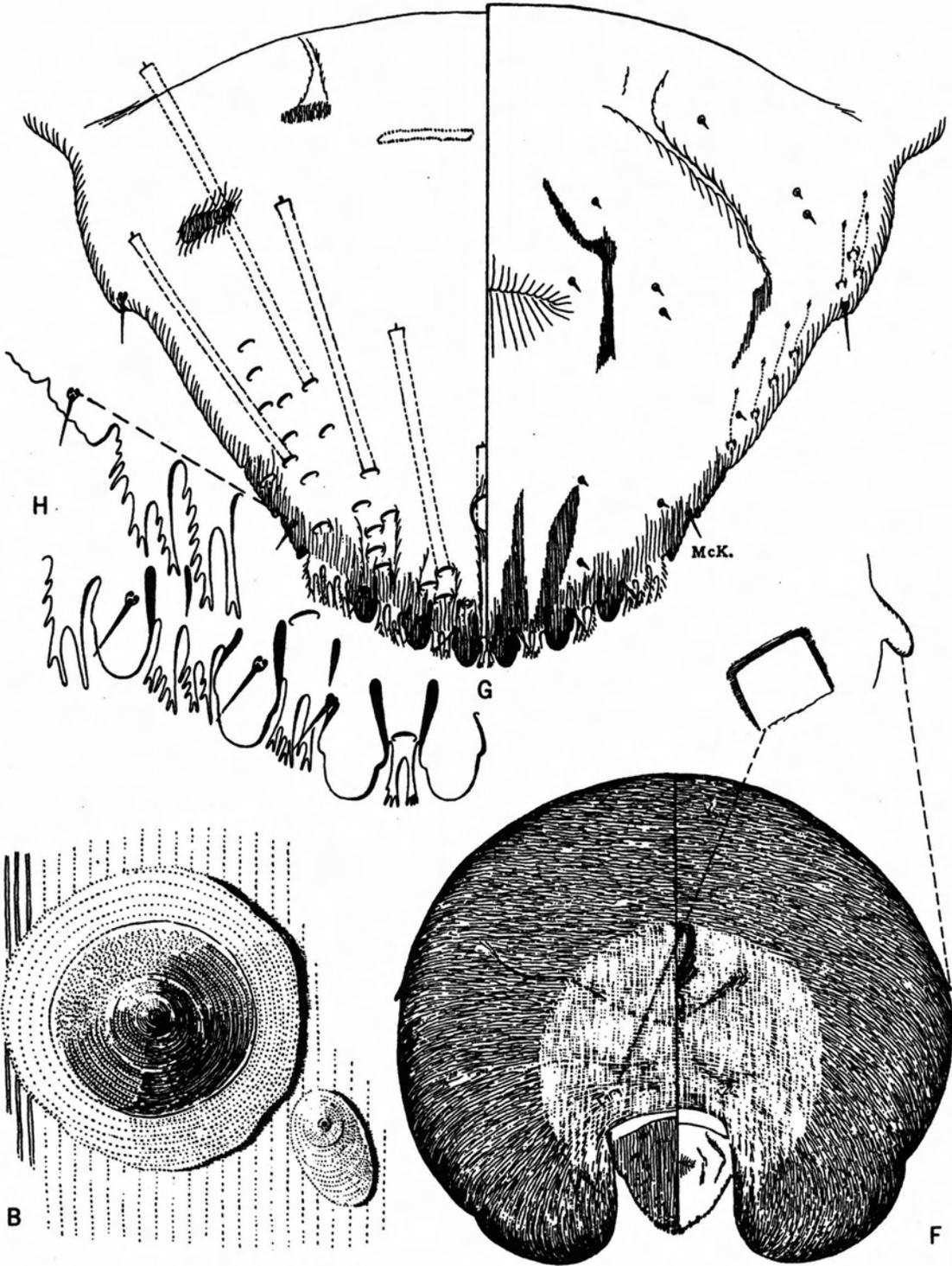


Fig. 13. *Aonidiella taxus* Leonardi.

ARMORED SCALE INSECTS OF CALIFORNIA

AONIDIELLA to AONIDOMYTILUS

Ebeling, W., 1959: Subtropical Fruit Pests. Univ. Cal. Div. Agric. Sci. Bull., Los Angeles. 436 pp.
 McKenzie, H.L., 1956: The Armored Scale Insects of California. Univ. Calif. Press, Berkeley. 209 pp.
 Nel, R.G., 1933: Hilgardia 7(11):417-466.
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 Quayle, H.J., 1938: Insects of Citrus and Other Subtropical Fruits. Comstock Publ. Co., Ithaca.
 Rosen, D., and P. DeBach in C.P. Clausen, ed., 1978: U.S. Dept. Agric. Agric. Handb. 480: 1-545.

Aonidiella taxus Leonardi, 1906
 asiatic red scale
 Fig. 13

Tribe: Aspidiotini.

Collected in single locations on English yew in Los Angeles and San Bernardino counties in 1939 and 1949. Eradicated.

McKenzie, H.L., 1956: The Armored Scale Insects of California. Univ. Calif. Press, Berkeley. 209 pp.

Genus *Aonidomytilus* Leonardi, 1903

Number of World species: 13

Number of United States species: 7

Key to California species: McKenzie, H.L., 1956: Scale Insects of California. U. C. Press, Berkeley. 209 pp.

Key to North American species: Ferris, G.F., 1938-42: Atlas of the Scale Insects of North America. Stanford Univ. Press. See Tippins (1968) for a new species from eastern U. S.

Tippins, H.H., 1969: J. Ga. Entomol. Soc. 3(4):167-169.

KEY TO CALIFORNIA SPECIES OF AONIDOMYTILUS

1. Perivulvar pores present, although at times very few. 2
- Perivulvar pores lacking. 4

2. Perivulvar pores extremely few, there being not more than three or four on each side and some of these apparently being on the second segment anterior to the vulva; dorsal pygidial ducts numerous, of various sizes, for the most part with a sclerotized area around the orifice; median lobes short, apically almost truncate, second lobes mere points; occurring as far as known only on hosts in the genera *Sambucus* and *Catalpa*. *variabilis*
- Perivulvar pores in the usual four or five groups. 3

3. All gland spines exceedingly minute, third lobes lacking; second and median lobes very short; at present known only from *Ceanothus* in California. *ceanothi*
- Gland spines of the pygidium well developed; the median lobes large and prominent, deeply notched on each side, at times almost trifoliate in form, both these and the second lobes heavily sclerotic; occurring throughout the southwestern United States and Lower

California on numerous hosts, but especially the chenopodiaceous genus *Atriplex*
. *concolor*

- 4. Marginal macroducts lacking; associated with *Lycium*. *durus*
- With marginal macroducts, associated with Chenopodiaceae. *bilobis*

***Aonidomytilus bilobis* Ferris, 1941**
bilobed scale

Fig. 14

Tribe: Diaspidini. **Diagnosis:** Recognized by host preference and lack of perivulvar pores.

Field Characteristics: Scale cover dirty-white, narrow, elongate, with terminal exuvium.

Hosts: *Atriplex*.

Economic Importance: None. A rare native species. McKenzie, H.L., 1956: The Armored Scale Insects of California. Univ. Calif. Press, Berkeley. 209 pp.

Distribution: Fresno and Inyo counties.

***Aonidomytilus ceanothi* (Ferris), 1919**
ceanothus scale

Fig. 15, Color Plates 11, 12

Tribe: Diaspidini. **Distribution:** Throughout the State. Probably native.

Synonymy: *Lepidosaphes ceanothi* Ferris, *Mytilaspis concolor* Cockerell [misidentification], *Chionaspis ceanothi* (Ferris). **Diagnosis:** Recognized by host preference, presence of perivulvar pores and poorly developed gland spines.

Field Characteristics: Scale cover dirty-white, elongate, narrow, with yellow terminal exuviae. Female body dark red.

Hosts: *Ceanothus*. McKenzie, H.L., 1956: The Armored Scale Insects of California. Univ. Calif. Press, Berkeley. 209 pp.

Economic Importance: None. Common but rarely collected.

***Aonidomytilus concolor* (Cockerell) 1893.**
concolor scale

Fig. 16, Color Plate 13

Tribe: Diaspidini. **Distribution:** Fresno County south and east to New Mexico.

Synonymy: *Mytilaspis albus* var. *concolor* Cockerell, *Mytilaspis concolor* var. *viridissima* Cockerell and Parrott, *Lepidosaphes concolor* (Cockerell), *Chionaspis concolor* (Cockerell). **Diagnosis:** Recognized by the presence of perivulvar pores and well developed gland spines.

Field Characteristics: Scale cover dirty-white, narrow, elongate, exuviae terminal.

Hosts: Native composite and chenopodiaceous plants such as *Franseria*, *Aplopappus*, *Atriplex* and *Suaeda*. McKenzie, H.L., 1956: The Armored Scale Insects of California. Univ. Calif. Press, Berkeley. 209 pp.

Economic Importance: None. A rare native species.

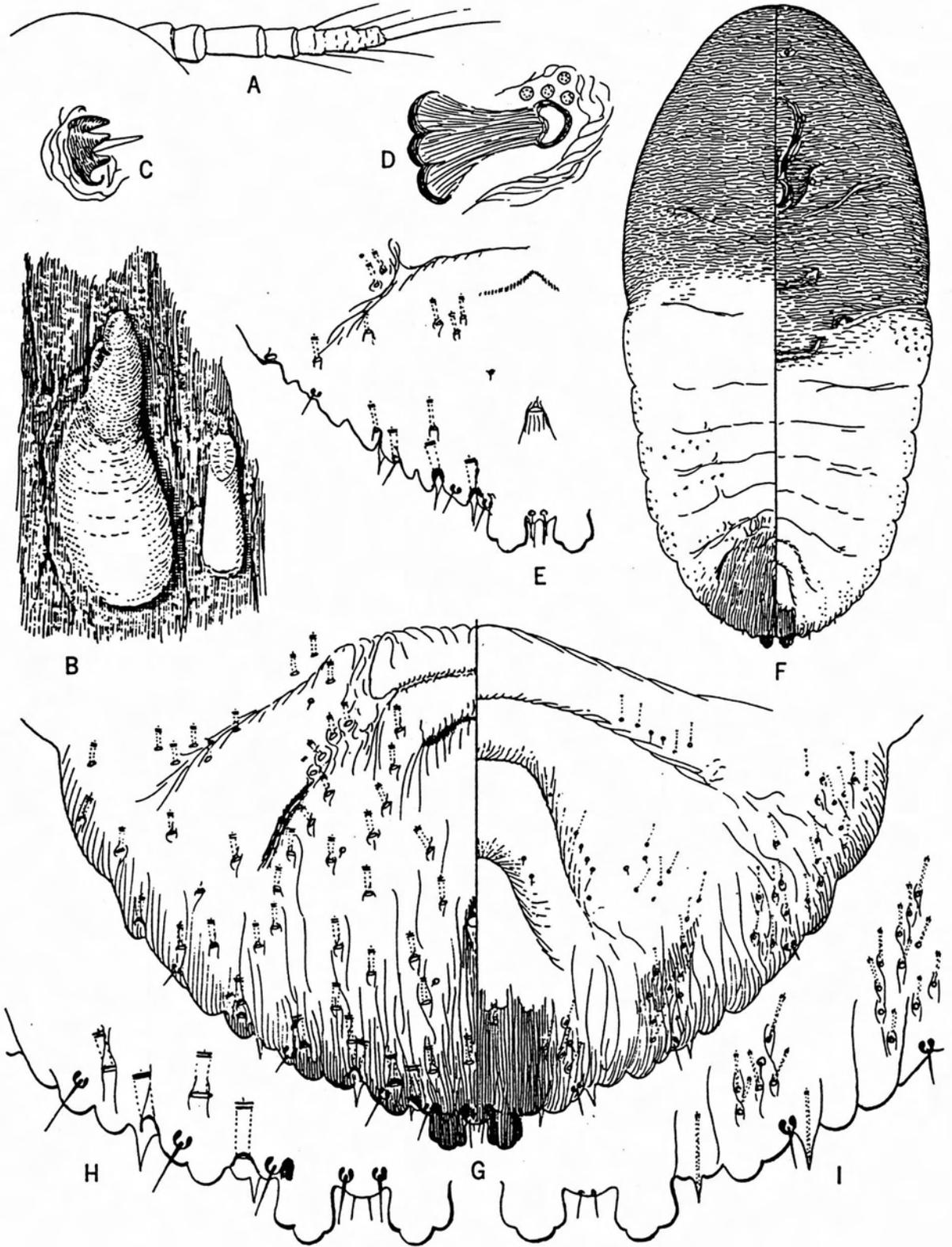


Fig. 14. *Aonidomytilus bilobis* Ferris.

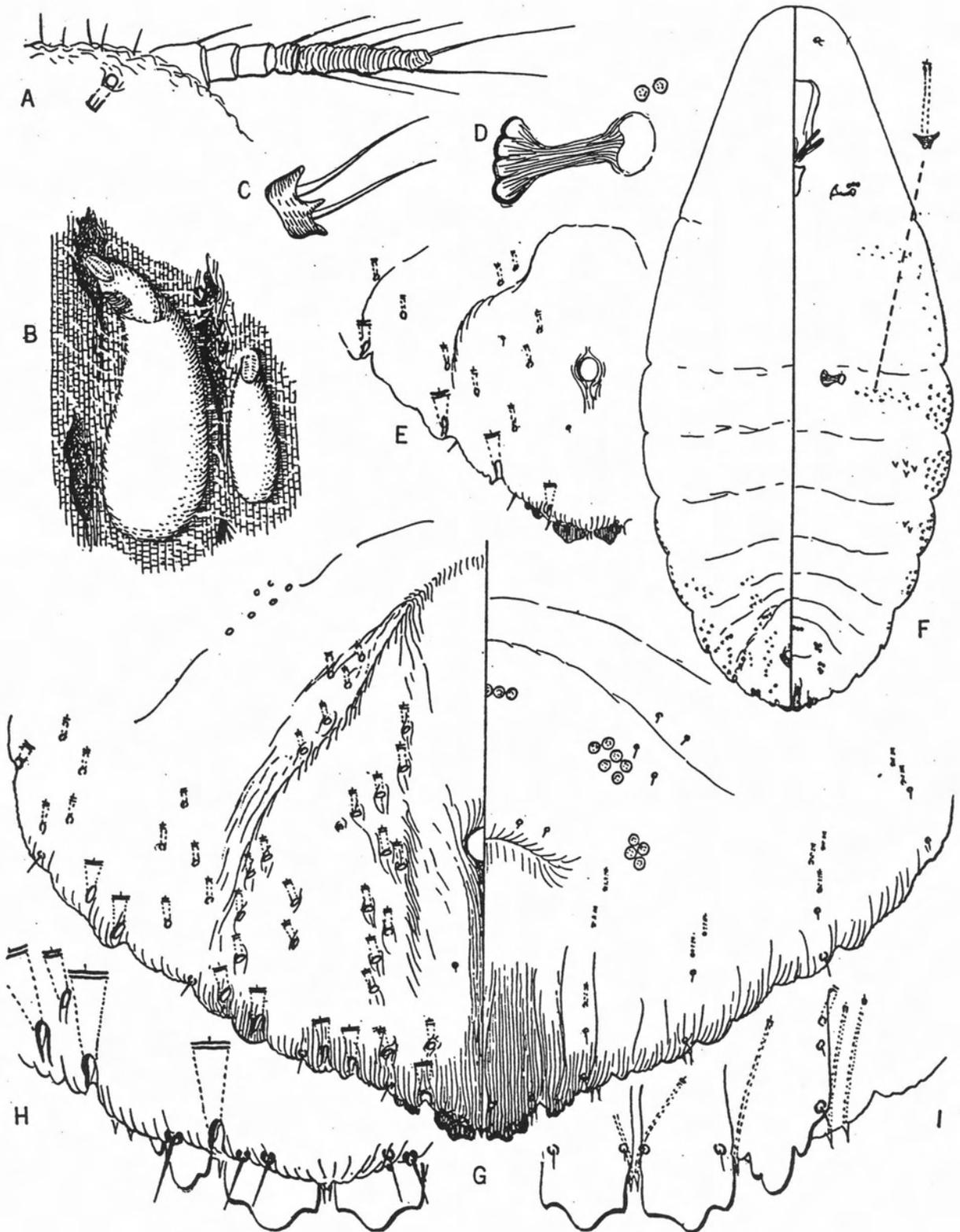


Fig. 15. *Aonidomytilus ceanothi* (Ferris).

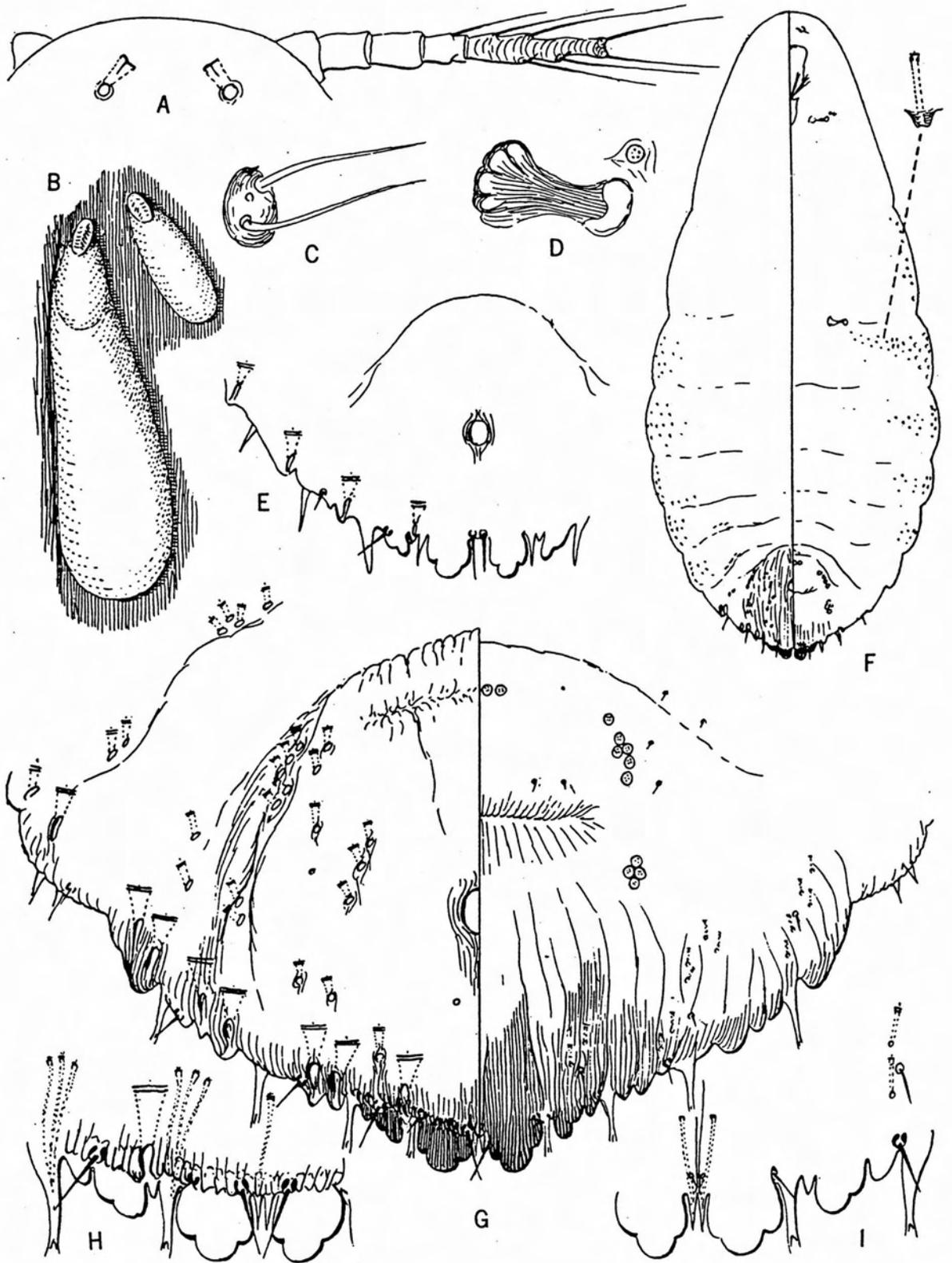


Fig. 16. *Aonidomytilus concolor* (Cockerell).

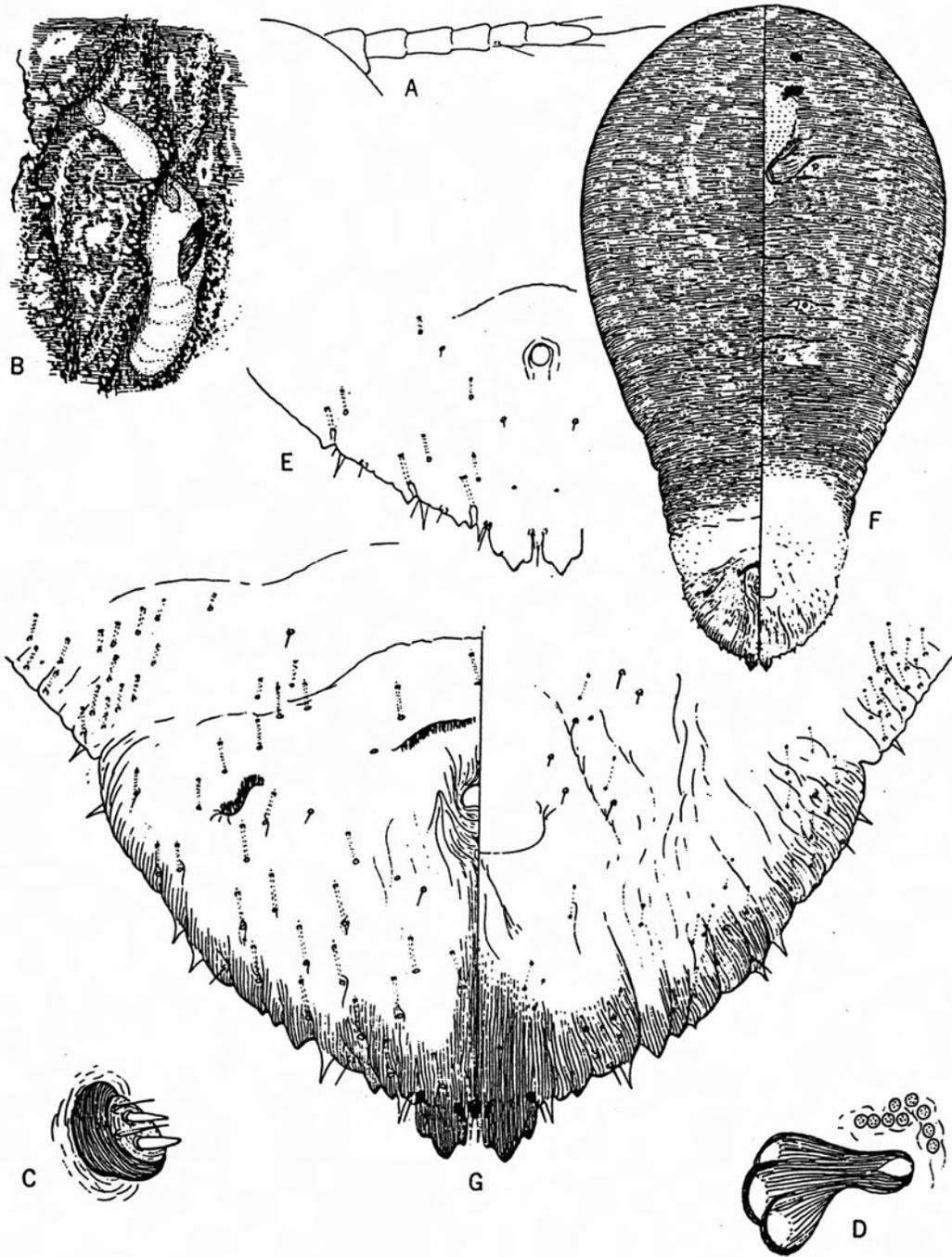


Fig. 17. *Aonidomytilus durus* Ferris.

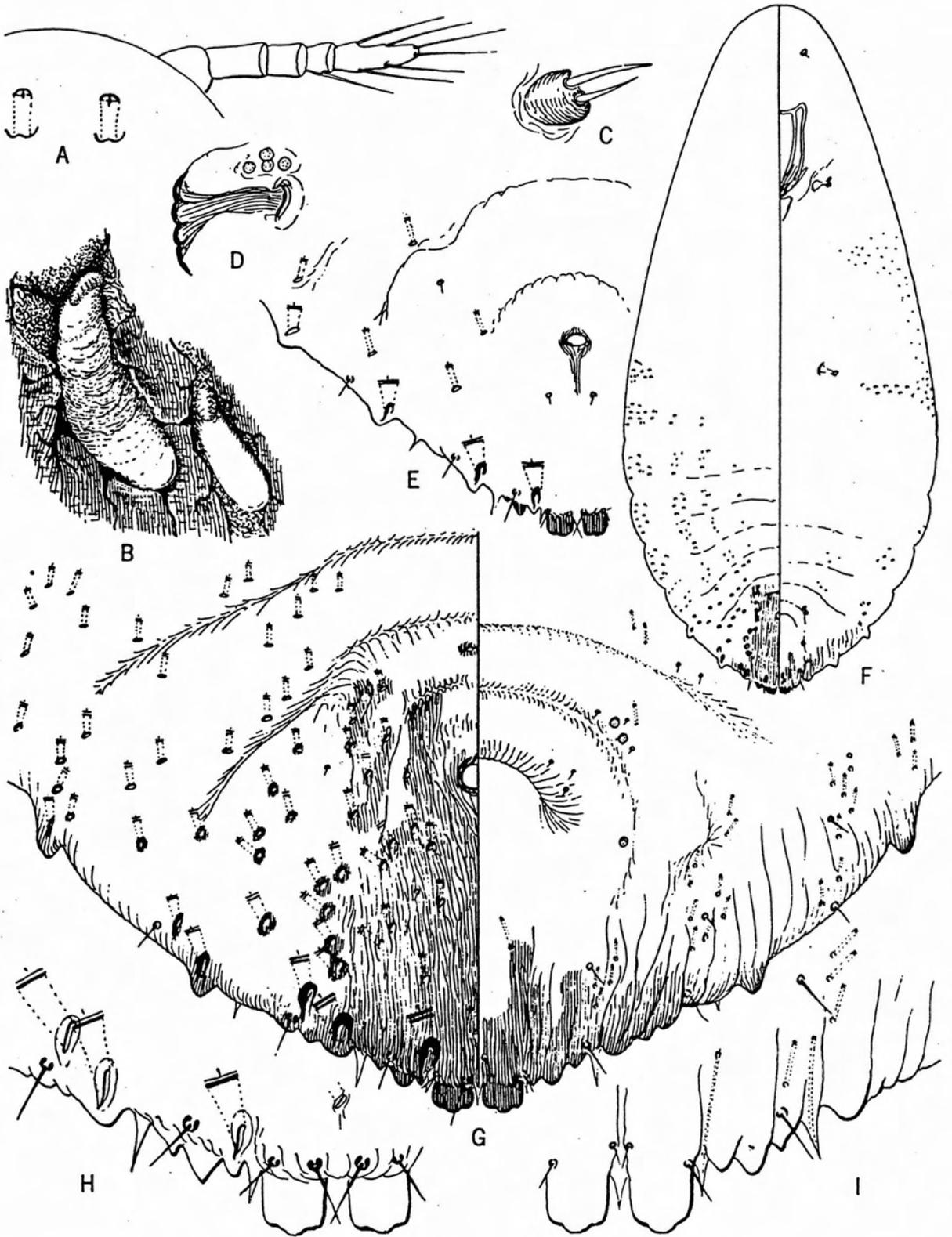


Fig. 18. *Aonidomytilus variabilis* Ferris.

Aonidomytilus durus Ferris, 1943

durus scale

Fig. 17

Tribe: Diaspidini.

Field Characteristics: Scale cover dirty-white, narrow, elongate, exuviae terminal, irregular in form. Male scale similar but smaller. Occurs on the twigs of the host, especially associated with the twig axils and with roughnesses of the bark surface.

Hosts: Known only from Cooper's desert thorn, *Lycium cooperi*.

Economic Importance: None. A rare native

species.

Distribution: Known only from the type locality, Cedar Canyon, Providence Mountains, San Bernardino County.

Diagnosis: Recognized by the host association and the lack of marginal macroducts. Apparently the 1st instars also vary from other *Aonidomytilus* (See Ferris, 1943).

Ferris, G.F., 1943: Microentomol. 8(2):58-79

Aonidomytilus variabilis Ferris, 1938.

variable scale

Fig. 18

Tribe: Diaspidini.

Field Characteristics: Scale cover dirty-white, narrow, elongate, exuviae terminal. Occurs on the branches and stems of the host, usually buried in bark crevices.

Hosts: *Encelia*, *Sambucus* (elderberry).

Economic Importance: None. A rare native species.

Distribution: Southern California.

Diagnosis: Very similar to *bilobis*. Occasionally some specimens in the same lot may lack perivulvar pores. Whether it is distinct from *bilobis* is questionable.

McKenzie, H.L., 1956: The Armored Scale Insects of California. Univ. Calif. Press, Berkeley. 209 pp.

Genus *Aspidaspis* Ferris, 1938

Number of World Species: 7

Number of United States species: 4

Key to United States species: McKenzie, H.L., 1956: The Armored Scale Insects of California. Univ. Calif. Press, 209 pp.

KEY TO CALIFORNIA SPECIES OF ASPIDASPIS

1. With many macroducts present in a submarginal zone from the pygidium to the first abdominal segment; associated with *Arctostaphylos* in California. . . . *arctostaphyli*
- With few macroducts present anterior to the pygidium, these either confined to the fourth segment or to a marginal row. 2
2. Prosoma sclerotized at maturity; associated with pines in western and south-western United States. *florenciae*
- Prosoma remaining membranous at maturity. 3

- 3. Pygidial margin beyond the site of the third lobe irregular, with numerous small points; at present associated only with cultivated fig in California. *braunschvigi*
- Pygidial margin without such irregularities; associated with oak in California *densiflorae*

Aspidaspis arctostaphyli (Cockerell and Robbins), 1909

arctostaphylos scale

Fig. 19, Color Plates 14, 15

Tribe: Aspidiotini.

Synonymy: *Aspidiotus arctostaphyli* Cockerell and Robbins, *Aspidiella arctostaphyli* (Cockerell and Robbins).

Field Characteristics: Females white or grey with yellow central exuviae and yellow body; male covers dark grey with a subcentral exuvium and usually a pale posterior margin.

Hosts: Prefers manzanita (*Arctostaphylos*). Occasionally found on other native hosts such as siltkassel (*Garrya*) and choke cherry (*Prunus*

virginiana). Specimens from Joshua tree (*Yucca brevifolia*) from three or four different California locations are different enough that they may be an undescribed species.

Distribution: Found throughout the State on manzanita.

McKenzie, H.L., 1956: The Armored Scale Insects of California. Univ. Calif. Press, Berkeley. 209 pp.

Aspidaspis braunschvigi (Rungs), 1936.

Braunschvigi scale

Fig. 20

Tribe: Aspidiotini.

Synonymy: *Aspidiotus braunschvigi* Rungs

Apparently imported from the Middle East onto the D'Orrigo Ranch in San José, Santa Clara County, where it was collected on common fig in 1939. Probably no longer present in California.

McKenzie, H.L., 1956: The Armored Scale Insects of California. Univ. Calif. Press, Berkeley. 209 pp.

Aspidaspis densiflorae (Bremner), 1907

tan oak scale

Fig. 21

Tribe: Aspidiotini.

Synonymy: *Aspidiotus densiflorae* Bremner, *Aspidiella densiflorae* (Bremner).

Field Characteristics: Female cover white or light tan, with tan or yellow central exuviae; second exuvium often obscure. Body yellow. Male scale covers grey, with a yellow subcentral exuvium, posterior edges may be

lighter.

Hosts: Prefers oaks, particularly coast live oak and tanbark oak. Also recorded from *Rhus* and *Mahonia*.

Economic Importance: None. A native species.

Distribution: Throughout the State.

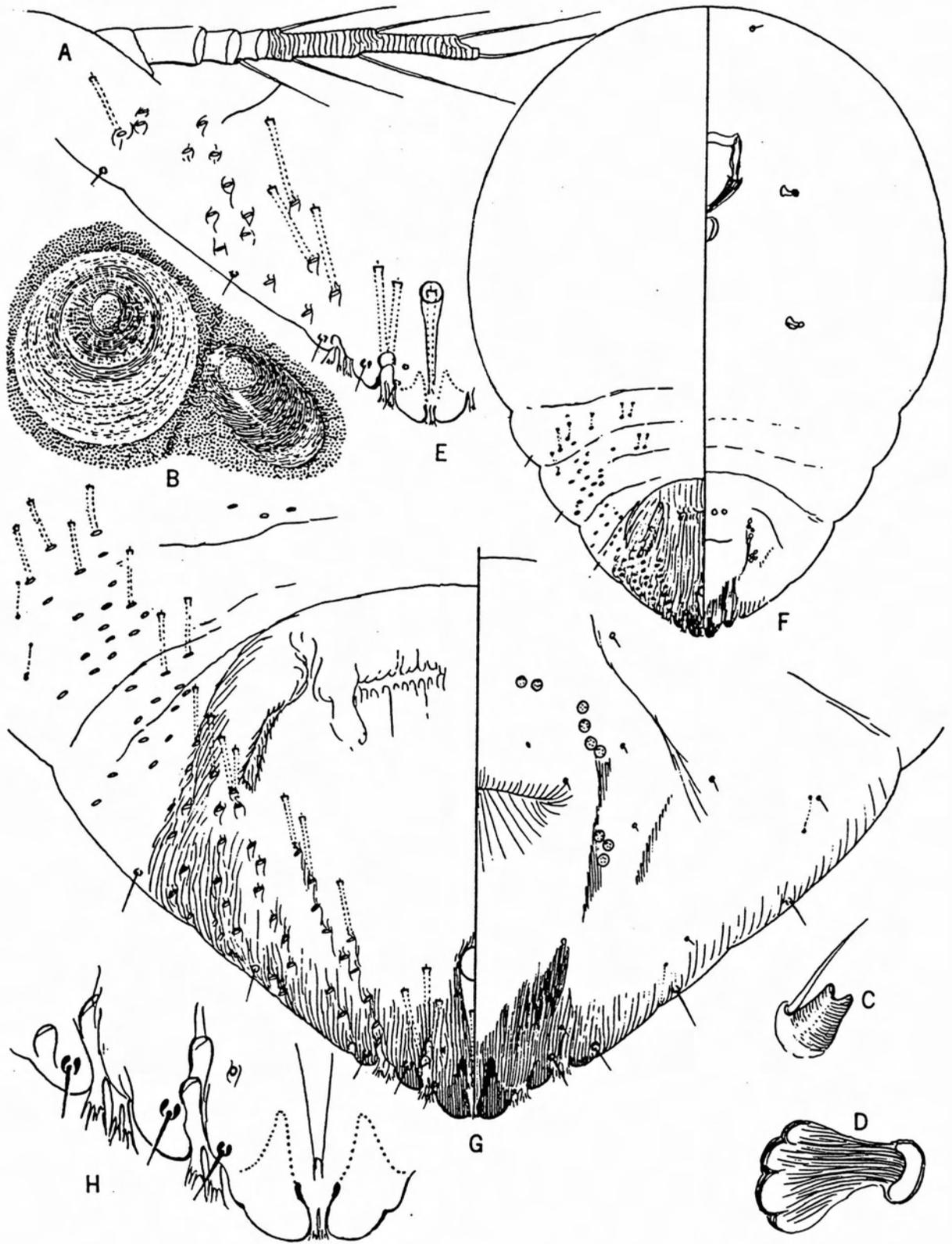


Fig. 19. *Aspidaspis arctostaphyli* (Cockerell and Robbins).

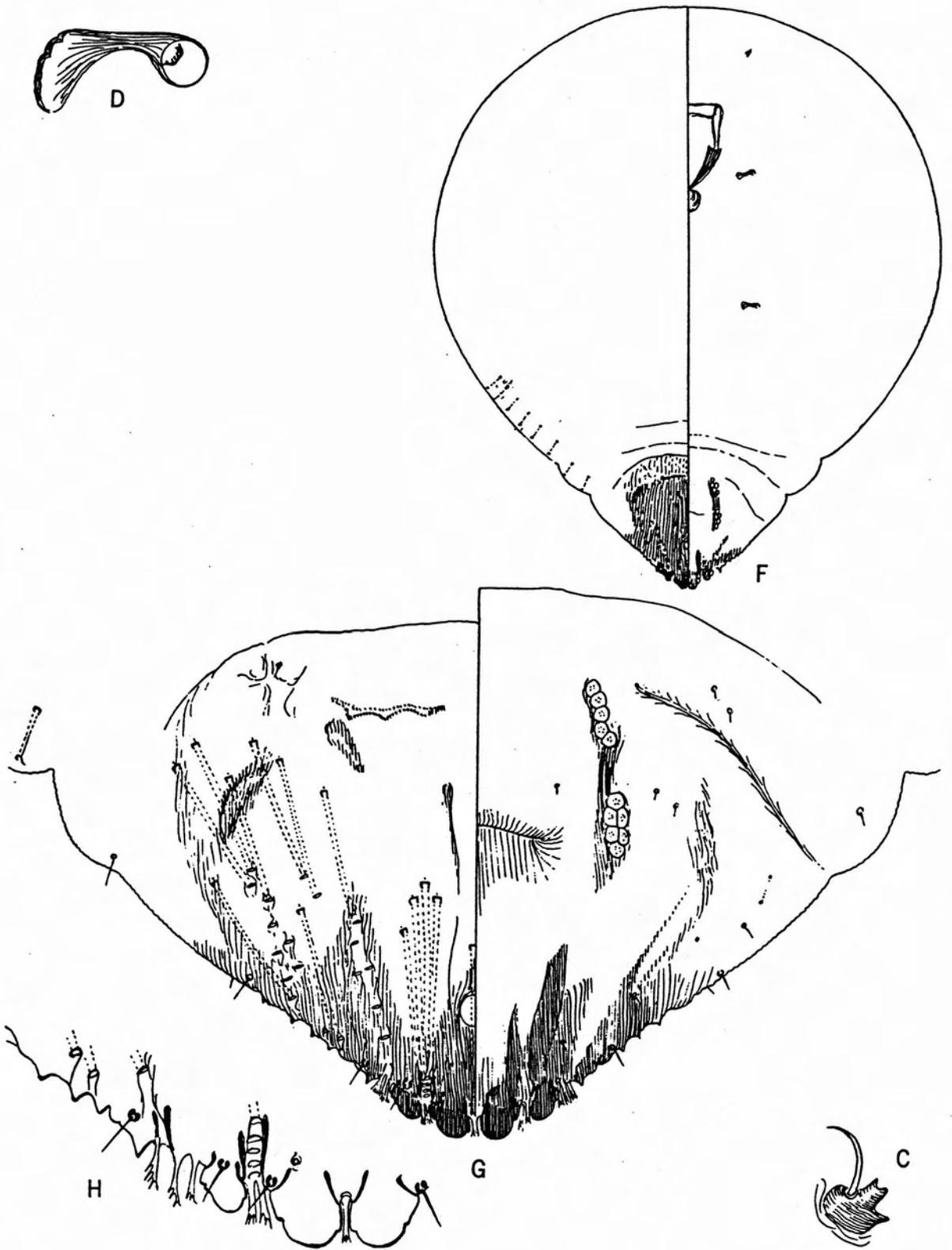


Fig. 20. *Aspidaspis braunschvigi* (Rungs).

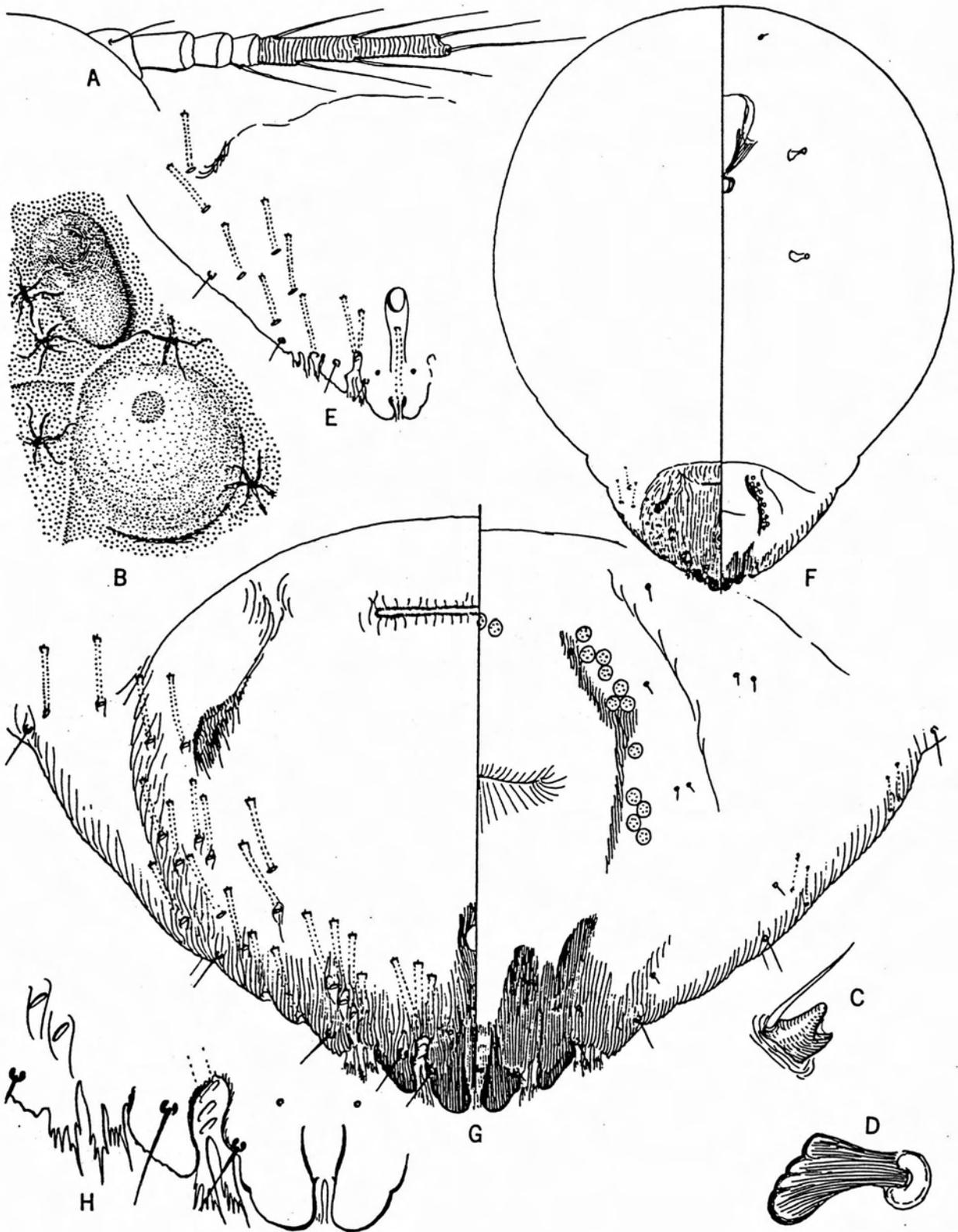


Fig. 21. *Aspidaspis densiflorae* (Bremner).

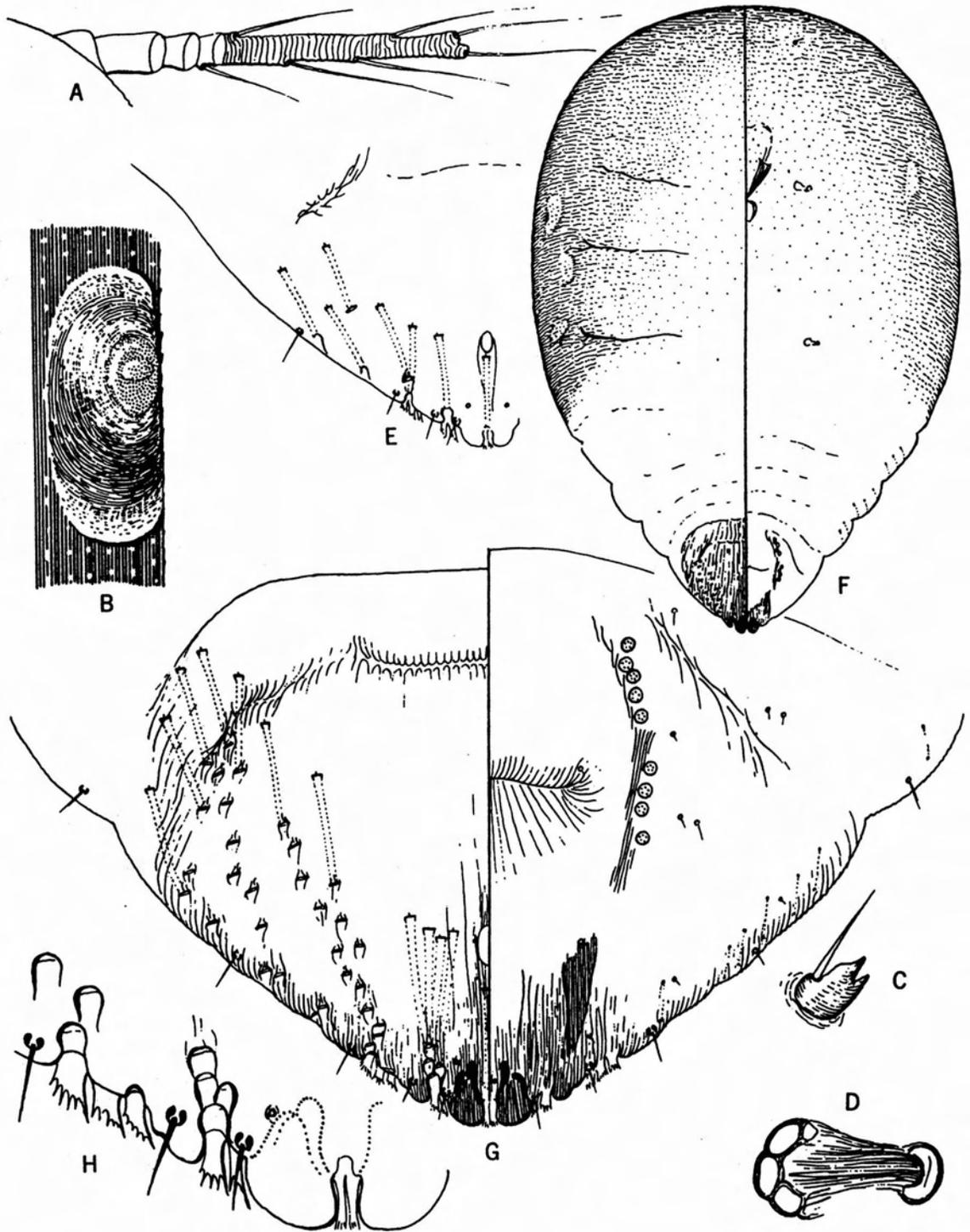


Fig. 22. *Aspidaspis florenciae* (Coleman).

Aspidaspis florenciae (Coleman), 1903

Florence scale

Fig. 22

Tribe: Aspidiotini.

same hosts.

Synonymy: *Aspidiotus florenciae* Coleman.**Distribution:** Mt. Hamilton and Pine Ridge, Santa Clara County, and Cuyamaca State Park, San Diego County.**Field Characteristics:** Identical in appearance to *Nuculaspis californica* in the field.**Hosts:** Known only from *Pinus ponderosa* and *Pinus coulteri*.**Economic Importance:** None. Either very rare or overlooked because of the more common occurrence of *Nuculaspis californica* on the

McKenzie, H.L., 1956: The Armored Scale Insects of California. Univ. Calif. Press, Berkeley. 209 pp.

Genus *Aspidiotus* Bouché, 1833

This generic name was one of the first available to the early scale workers, so it was used for many species which have since been placed in other, newer genera.

Number of World species: 35.

Number of United States species: 5

Keys to World species: Ferris, G.F., 1941: Microentomol. 6(2):33-70, and Ferris, G.F., 1946: Microentomol. 11(1):37-49.

KEY TO CALIFORNIA SPECIES OF ASPIDIOTUS

1. Ducts long and broad, concentrated toward the apex of the pygidium; plates beyond the third lobe forming a very regular series. *destructor*
- Ducts short and broad, present in a submarginal zone that extends to the anterior margin of the pygidium or beyond; plates various *nerii*

***Aspidiotus destructor* Signoret, 1869**

coconut scale (ESA approved)

Fig. 23

Tribe: Aspidiotini.**Synonymy:** *Aspidiotus transparens* Green, *Aspidiotus fallax* Cockerell, *Aspidiotus cocotis* Newstead, *Aspidiotus simillimus* var. *translucens* Cockerell, *Aspidiotus oppugnatus* Silvestri.**Other Common Names:** transparent scale.

Collected from several California nurseries prior to 1955, but has not become established in the State. Frequently encountered in quarantine on palms and coconut husks. Similar to oleander scale but is more white in color and the scale cover excluding the exuviae is transparent. For an indepth study on the biology, economics and natural control of this scale see Taylor (1935). For information on biological control see Chazeau (1981).

Chazeau, J., 1981: Cah. ORSTOM, Ser. Biol., no. 44:11-22.

McKenzie, H.L., 1956: The Armored Scale Insects of California. Univ. Calif. Press, Berkeley. 209 pp.

Rosen, D., and P. DeBach, in C.P. Clausen, Ed., 1978: U.S. Dept. Agric. Agric. Handb. 480:1-545.

Taylor, T.H.C., 1936: Bull. Entomol. Res. 26:1-102.

***Aspidiotus nerii* Bouché, 1833**
oleander scale (ESA approved)
Fig. 24, Color Plates 16-18

Tribe: Aspidiotini.

Other Common Names: ivy scale, white olive scale, white scale.

Synonymy: *Aspidiotus hederæ* (Vallot), *Chermes nerii* Bouché, *Aspidiotus vagabundus* Cockerell, plus many other synonyms too numerous to mention here. See Borchsenius (1966).

Field Characteristics: Adult females 1.5 to 2.0 mm in diameter, nearly circular, very flat. Some individuals occasionally settle on stems rather than on leaves, in which case they are much more convex. Adult cover yellowish-white to light tan, body bright yellow; exuviae yellow or golden, central to subcentral. Ventral scale poorly developed, body remains on host if cover is removed. Male scale covers pure white, oblong, transparent.

Similar Species: Coconut scale, *Aspidiotus destructor* Signoret, not known to occur in California, is similar but has a more transparent scale cover. In California, latania scale and greedy scale resemble *nerii* but are usually more convex, with darker exuviae. Cycad scale on sago palms is similar but lighter colored, more convex, usually oblong. *Aspidiotus excisus* Green, on *Aglaonema* in Florida and the Caribbean, is also similar. Tropical palm scale, *Hemiberlesia palmarum* (Cockerell), not found in California; is similar but more convex.

Biology: May have two to four greatly overlapping generations per year. In California, Ebeling (1959) lists two generations on avocado and states that adult females overwinter. Some populations are parthenogenetic. The above biological information also summarized from Essig (1917), Schrader (1929), Bodenheimer (1951), DeBach and Fisher (1956), Avidov and Harpaz (1969), Argyriou (1976) and Gerson and Hazan (1979).

Hosts: Polyphagous. Prefers *Aucuba*, olive, oleander, cycad, palm and ivy. Commonly found on *Citrus* in coastal areas, particularly on lemons; an occasional pest of commercial

kiwi plants. For a host list see Essig (1958), Borchsenius (1966) and Dekle (1976).

Economic Importance: The most common scale insect in California. A troublesome pest of many ornamental plants, in the dooryard, on nursery stock and in greenhouses. Not usually a pest of food crops, although it often develops large populations on olives, infested fruit is discolored, deformed and culled. Occasionally a minor pest of commercial lemons and kiwi. Can be a pest of citrus, carob and olives in other countries. Infested olives grown for olive oil are often low in oil content. For more information see Essig (1917), White (1933), Pritchard (1949), Bodenheimer (1951), Avidov and Harpaz (1969) and Argyriou (1976). For information on natural enemies see Essig (1917), Bodenheimer (1951), Avidov and Harpaz (1969), and Argyriou (1976).

Distribution: Throughout the State at lower elevations and on indoor plants in many other locations. Generally distributed in the United States although restricted to indoor plants in the north. Worldwide. Origin unknown.

Diagnosis: Recognized by the three pairs of well-developed lobes and shortened macroducts. One of the few Aspidiotine species with shortened macroducts except for *Aspidiotus excisus* Green, in which the median lobes are inset or shorter than the second pair. First instars were described and illustrated by Howell and Tippins (1977).

As with many other scale insects, a parthenogenetic and biparental race both occur in California. DeBach and Fisher (1956) suggested that the two forms were separate species. Recently, Gerson and Hazan (1979) suggested that at least six different uniparental strains exist in various parts of the world. They described an Israel strain as a new species, *Aspidiotus paranerii*, and also stated that the life cycle of *paranerii* is different from the Cali-

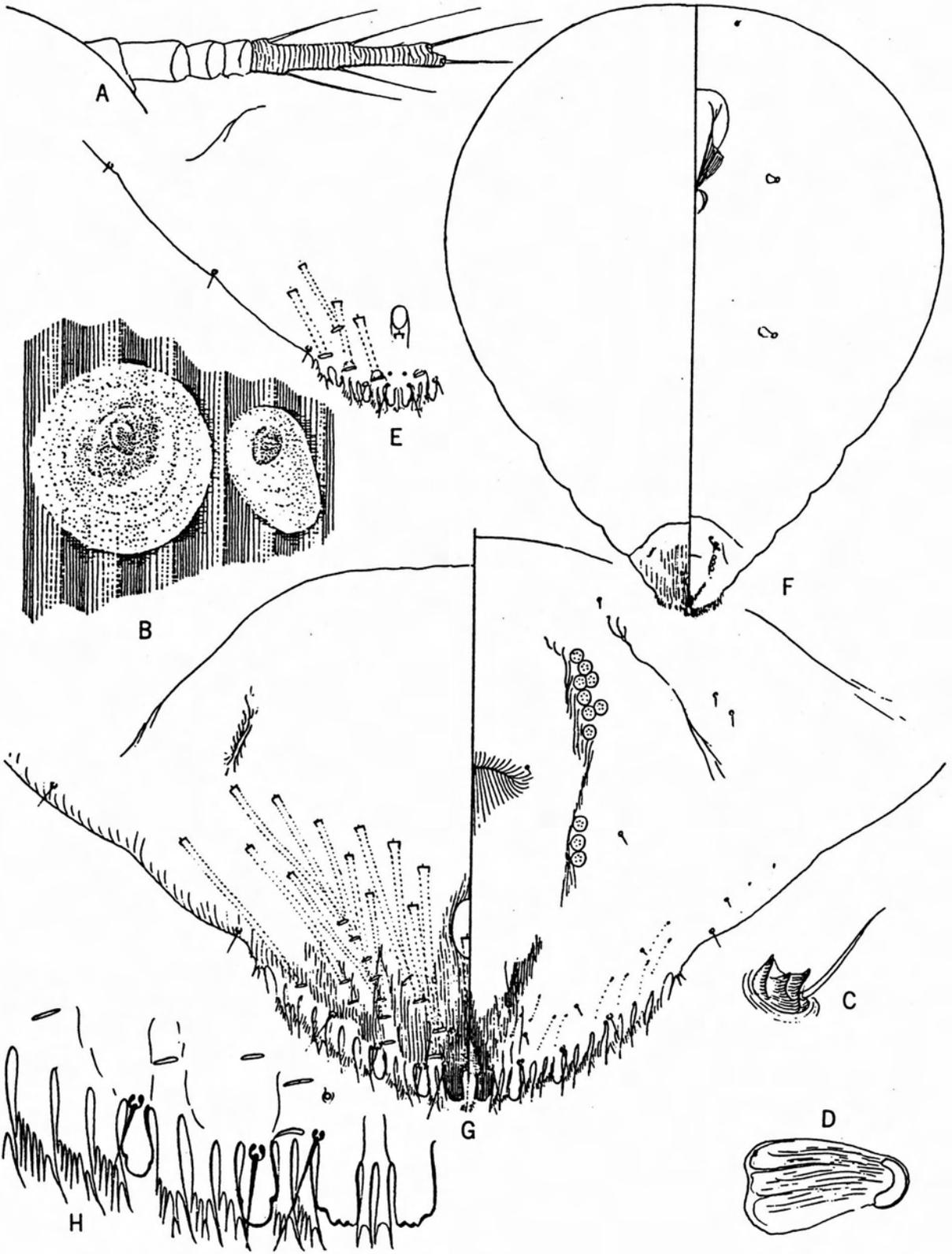


Fig. 23. *Aspidiotus destructor* Signoret.

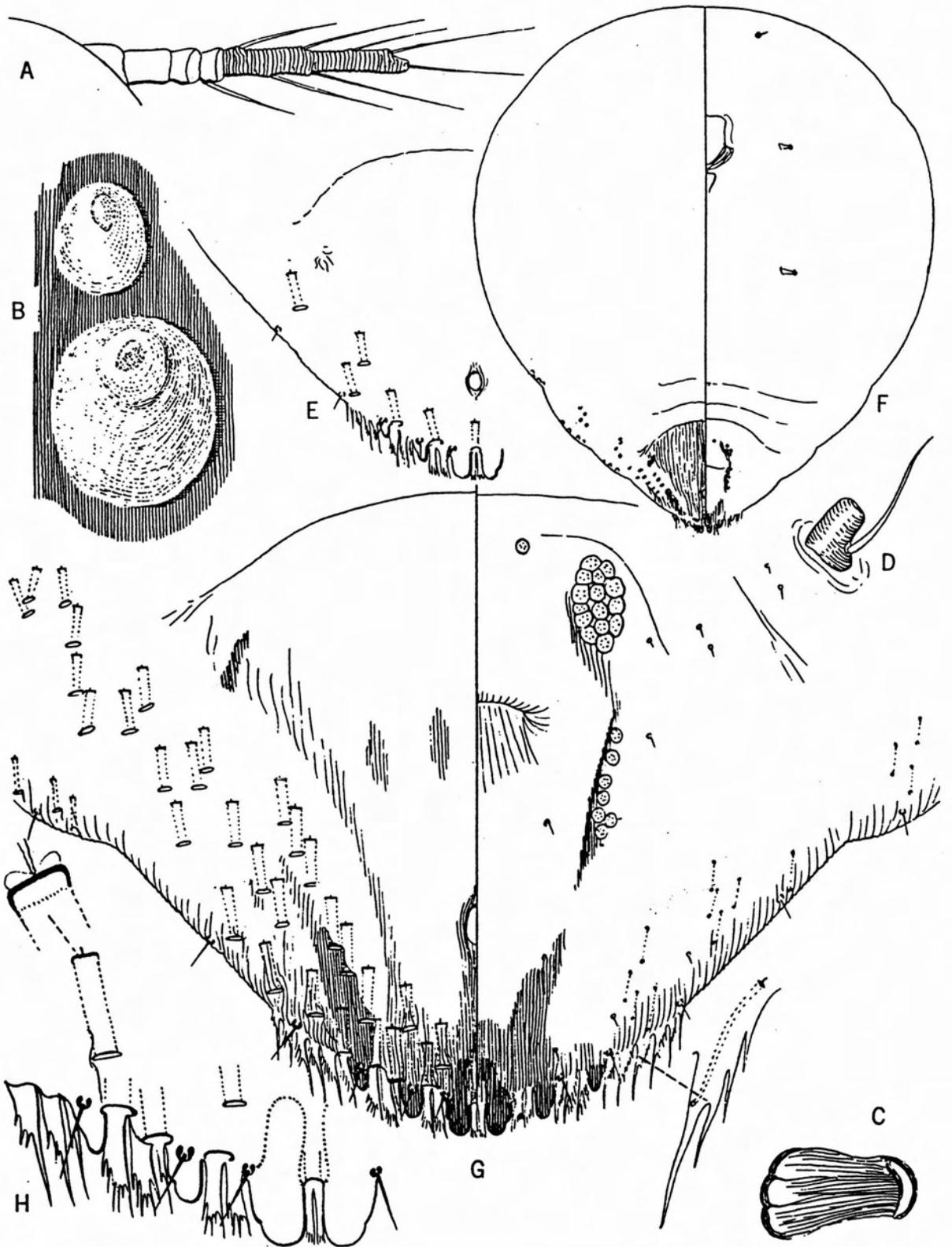


Fig. 24. *Aspidiotus nerii* Bouché.

fornia strain studied by DeBach and Fisher. Unfortunately, these various uniparental and biparental strains appear identical taxonomically, and identifications at this point require a detailed life history study.

Argyriou, L.C., 1976: Ann. Inst. Phytopathol. Benaki (n.s.) 11(3):209-218.

Avidov, Z., and I. Harpaz, 1969: Plant Pests of Israel. Isr. Univ. Press, Jerusalem. 549 pp.

Bodenheimer, F.S., 1951: Citrus Entomology in the Middle East. Dr. W. Junk, The Hague. 663 pp.

Borchsenius, N.S., 1966: A Catalogue of the Armored Scale Insects of the World. Zool. Inst. U.S.S.R. Acad. Sci., Moscow, Leningrad. 449 pp.

DeBach, P., and T.W. Fisher, 1956: Ann. Entomol. Soc. Amer. 49:235-239.

Dekle, G.W., 1976: Florida Armored Scale Insects. Arthropods of Florida V. Fla. State Plant Board, Gainesville. 345 pp.

Ebeling, W., 1959: Subtropical Fruit Pests. Univ. Calif. Div. Agric. Sci. Bull., Los Angeles. 436 pp.

Essig, E.O., 1917: Calif. Agric. Exp. Stn. Bull. 283:1-64.

Essig, E.O., 1958: Insects and Mites of Western North America. The Macmillan Co., New York. 1050 pp.

Gerson, U., and A. Hazan, 1979: J. Nat. Hist. 13:275-284.

Howell, J.O. and H.H. Tippins, 1977b: Ann. Entomol. Soc. Am. 70(1):119-135.

Pritchard, A.E., 1949: Calif. Agric. Exp. Stn. Bull. 713:1-71.

Schrader, F., 1929: Psyche 36:232-236.

White, R.P., 1933: J. Econ. Entomol. 26:631-640.

Genus *Aulacaspis* Cockerell, 1893

Number of World Species: About 50.

Number of United States Species: 2, including 1 in Hawaii only.

Keys to the World species: (partial only) Scott, C.L., 1952: Microentomol. 17(2):33-60. See also several recent works by Takagi.

Aulacaspis rosae (Bouché), 1834 rose scale (ESA approved) Fig. 25, Color Plates 19-21

Tribe: Diaspidini.

Other Common Names: Rosa scale.

Synonymy: *Aspidiotus rosae* Bouché, *Diaspis rosae* (Bouché).

Field Characteristics: Adult females 1 to 2 mm in diameter, nearly circular, flat, white, with yellow or gold exuviae. Exuviae marginal, giving the cover an elliptical or out-of-round appearance. Body orange or dark red, usually mottled with both colors. Male scale covers elongate, white, tricarinate (three longitudinal ridges).

Biology: There are conflicting reports on the biology of this species. Schuh and Mote (1948) list one generation per year in Oregon, over-

wintering as eggs. Smith (1902) suggests up to three overlapping generations per year in New Jersey, with all stages overwintering. Kosztarab (1963) lists crawler and male emergence at widely variable dates, indicating more than one yearly generation in some situations. Murakami (1970) indicates two annual generations in Japan. Apparently several overlapping generations occur in Northern California.

Similar Species: *Aulacaspis rosarum* Borchsenius, known from Europe and the Hawaiian Islands, is identical in the field. White peach scale, *Pseudaulacaspis pentagona* (Targioni-Tozzetti), is also similar, may be

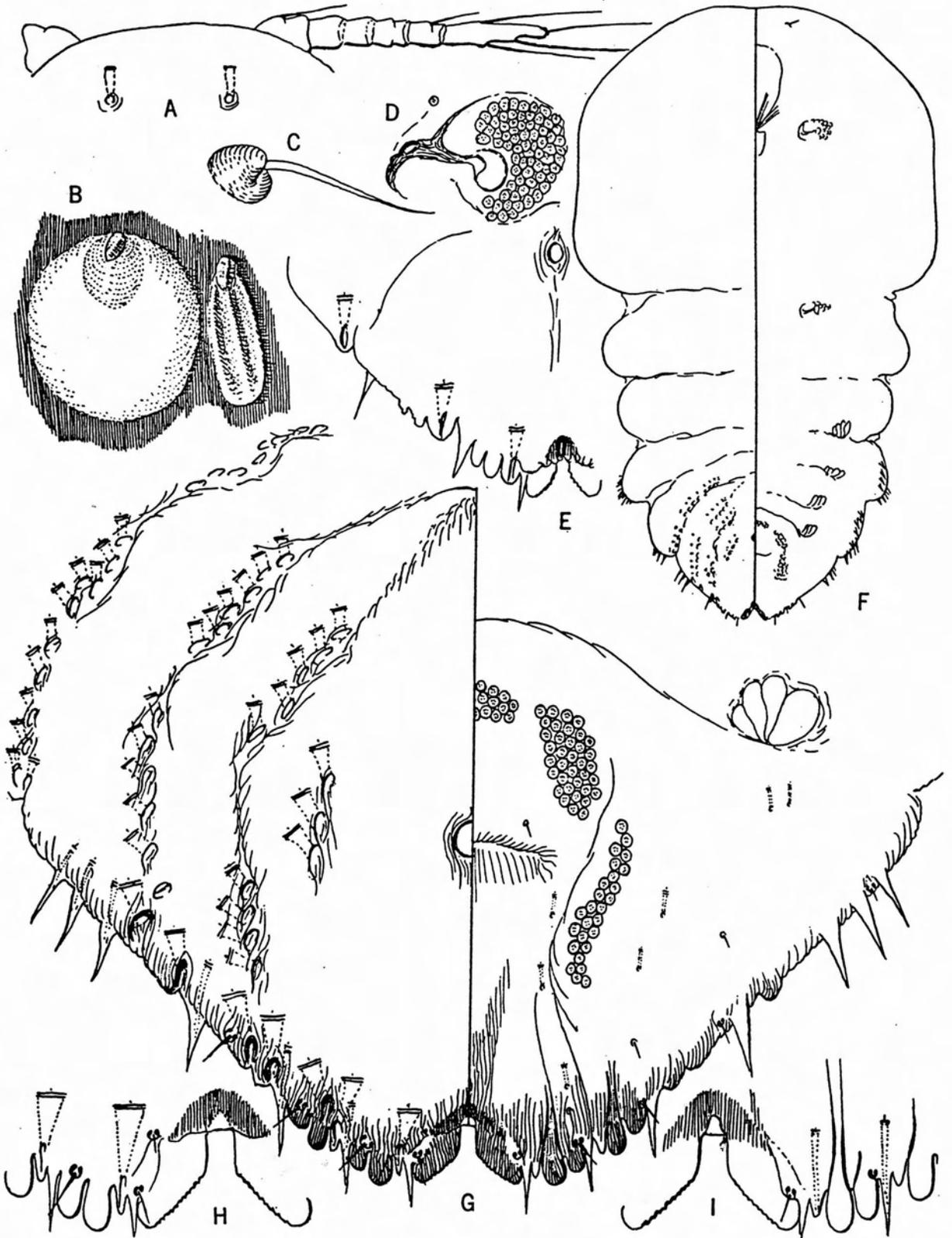


Fig. 25. *Aulacaspis rosae* (Bouché).

found on the same hosts, and may be confused with this species in the field, except that the exuviae are not marginal as in rose scale.

Hosts: In California, normally found on caneberries (*Rubus*), particularly on wild blackberries. Only occasionally found on roses although it is sometimes a pest of roses in other states. Also reported on strawberry, dewberry, thimbleberry and related plants in the rose family.

Economic Importance: Can be a pest of roses and caneberries, particularly in damp, shaded locations. Heavy infestations can occur, especially near the crown of the host, and infested plants may be weakened or killed. Not generally a pest in California although it has been a problem on roses in a commercial rose nursery in Northern California. The nursery was next to a riverbank overgrown with wild blackberries. For more information on the economic importance of this species see Smith (1902), Essig (1915), Schuh and Mote (1948) and Ellis et al (1991).

Distribution: Throughout California. Most common in Northern California.

Diagnosis: The elongate shape, notched sides, quadrate cephalothoracic area and host preference distinguish this species. The very similar *Aulacaspis rosarum* Borchsenius differs from rose scale by having an extra subdorsal row of macroducts.

Ellis, M.A., R.H. Converse, R.N. Williams and B. Williamson editors, 1991: Compendium of Raspberry and Blackberry Diseases and Insects. American Pathological Society, APS press, St. Paul, Minn. 100pp.

Essig, E.O., 1915: Injurious and Beneficial Insects of California. Calif. Dep. Agric. Mon. Bull. Suppl. 4(4):1-541.

Kosztarab, M., 1963: Bull. Ohio Biol. Surv. (n.s.) 2(2):1-120.

Murakami, Y., 1970: Mushi 43(7):65-114.

Nakayama, S. 1915: J. Entomol. Zool. 7(1):45-54.

Schuh, J., and D.C. Mote, 1948: Oreg. State Coll. Stn. Bull. 449:1-164.

Smith, J.B., 1902: N.J. Agric. Exp. Stn. Bull. 159:1-14.

Genus *Carulaspis* MacGillivray, 1921.

Number of World species: 6.

Number of United States species: 2.

Key to the World species: Nakahara, S. (unpublished).

Key to the United States species: McKenzie, H.L., 1956: The armored scale insects of California, Univ. Calif. Press, Berkeley. 209 pp.

KEY TO CALIFORNIA SPECIES OF *CARULASPIS*

- 1. With a macroduct and gland spines between the median lobes. *juniperi*
- Without a median macroduct and gland spines. *minima*

***Carulaspis juniperi* (Bouché), 1851
juniper scale (ESA approved)
Fig 26, Color Plates 22, 23**

Tribe: Diaspidini.

Synonymy: *Aspidiotus juniperi* Bouché, *Diaspis visci* (Schrank) (misidentification), *Diaspis caruelii* (Targioni-Tozzetti) (misidentification), *Carulaspis visci* (Schrank) (misidentification).

Listed as *Carulaspis visci* (Schrank) in McKenzie.

Field Characteristics: Adult females 1 to 2 mm in diameter, circular to oval, moderately convex, white with yellow subcentral to sub-

terminal exuviae. Body yellow, often with greenish mottling. Male cover elongate, white with a yellow terminal exuvium and a slightly elevated median carina. Found on leaves.

Similar Species: Minute cypress scale is identical in the field.

Biology: Unknown in California partly because of previous misidentifications. However, in other parts of the United States it has one generation per year. Overwinters as mature females; crawlers hatch in late spring. The above information summarized from Schuh and Mote (1948), Kosztarab (1963), Stimmel (1977, 1979), Boratynski (1957), and Furniss and Caroline (1977). Goidanich (1960), compared the the ecology of several species of *Carulaspis*, including *juniperi*.

Hosts: Restricted to conifers; prefers junipers and incense cedar, but also found on redwood, big tree, spruce, pine, cypress, arborvitae and *Chamaecyparis*.

Economic Importance: Not a pest in California, due possibly to its restricted distribution. Causes chlorosis in needles and sometimes death of host branches. For more information on the economic importance of this species see Schuh and Mote (1948), Kosztarab (1963), Pirone (1970), Furniss and Carolin (1977), and Stimmel (1977). For information on natural enemies see Kosztarab (1963) and Deitz (1979). Probably does not produce honeydew and sooty mold as mentioned by Schuh and Mote (1948) and Furniss and Carolin (1977).

Distribution: Found in most areas of the State but rare except at certain higher elevations or more northerly locations. Seems to prefer cooler habitats than does the more widely

distributed minute cypress scale. Generally distributed in the United States; native to Europe.

Diagnosis: According to Nakahara (personal communication) this species is recognized by having a macroduct and gland spines between the median lobes and submarginal dorsal macroducts absent from the sixth abdominal segment. The macroduct between the median lobes is the major difference between this species and *C. minima*. Both this species and *C. minima* belong to a complex of about 5 species native to Europe. In the past the genus was poorly understood, much confusion existed and many misidentifications made. The genus is now better understood and keys to the known species have been developed by Nakahara (unpublished).

Boratynski, K., 1957: Entomol. Mon. Mag. 93:246-251.

Dietz, L.L., 1979: N.Z. J. Zool. 6:459-460.

Furniss, R.L., and V.M. Carolin, 1977: U.S. Dep. Agric. Misc. Publ. 1339:1-654.

Goidanich, A., 1960: Boll. dell' Inst. Entomol. della Univ. Bologna. 24:1-38.

Kosztarab, M., 1963: Bull. Ohio Biol. Surv. (n.s.) 2(2):1-120.

Pirone, P.P., 1970: Diseases and Pests of Ornamental Plants. The Roland Press Co., New York. 546 pp.

Schuh, J., and D.C. Mote, 1948: Oreg. State Coll. Stn. Bull. 449:1-16.

Stimmel, J.F., 1977: Pa. Dep. Agric. Reg. Hort. Entomol. Circ. 22:19-20.

Stimmel, J.F., 1979: Proc. Entomol. Soc. Wash. 81(2):222-229.

***Carulaspis minima* (Targioni-Tozzetti), 1869**
minute cypress scale
Fig 27, Color Plate 24

Tribe: Diaspidini.

Other Common Names: Bermuda cedar scale.

Synonymy: *Diaspis minima* Targioni-Tozzetti,
Carulaspis carueli (Targioni-Tozzetti).

Field Characteristics: Adult females 0.5 to 2.0

mm in diameter, circular, moderately convex, white with yellow central or subcentral exuviae. Body yellow with green mottling. Male cover elongate, white, with a terminal yellow exuvium and a slightly elevated median ca-

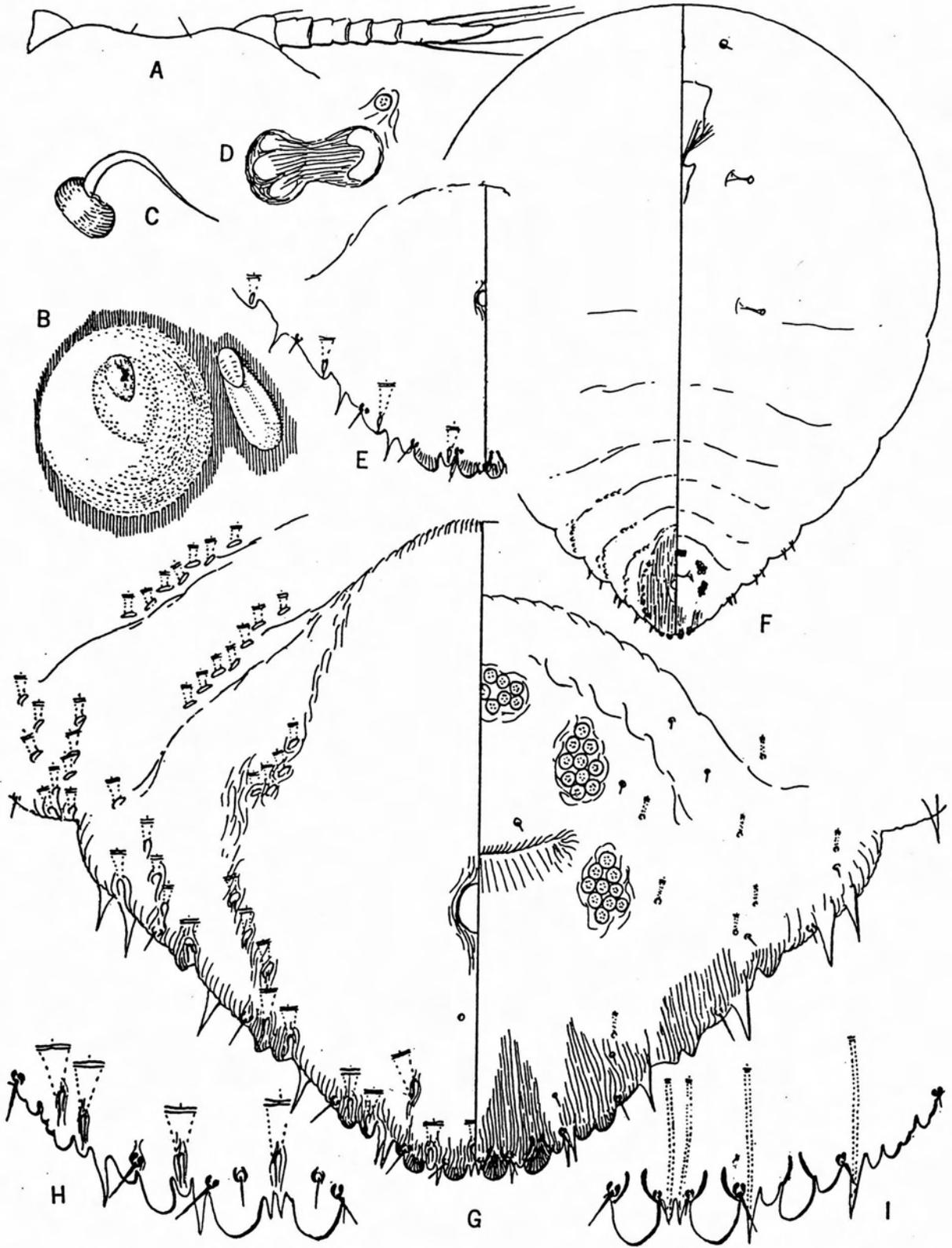


Fig. 26. *Carulaspis juniperi* (Bouché).

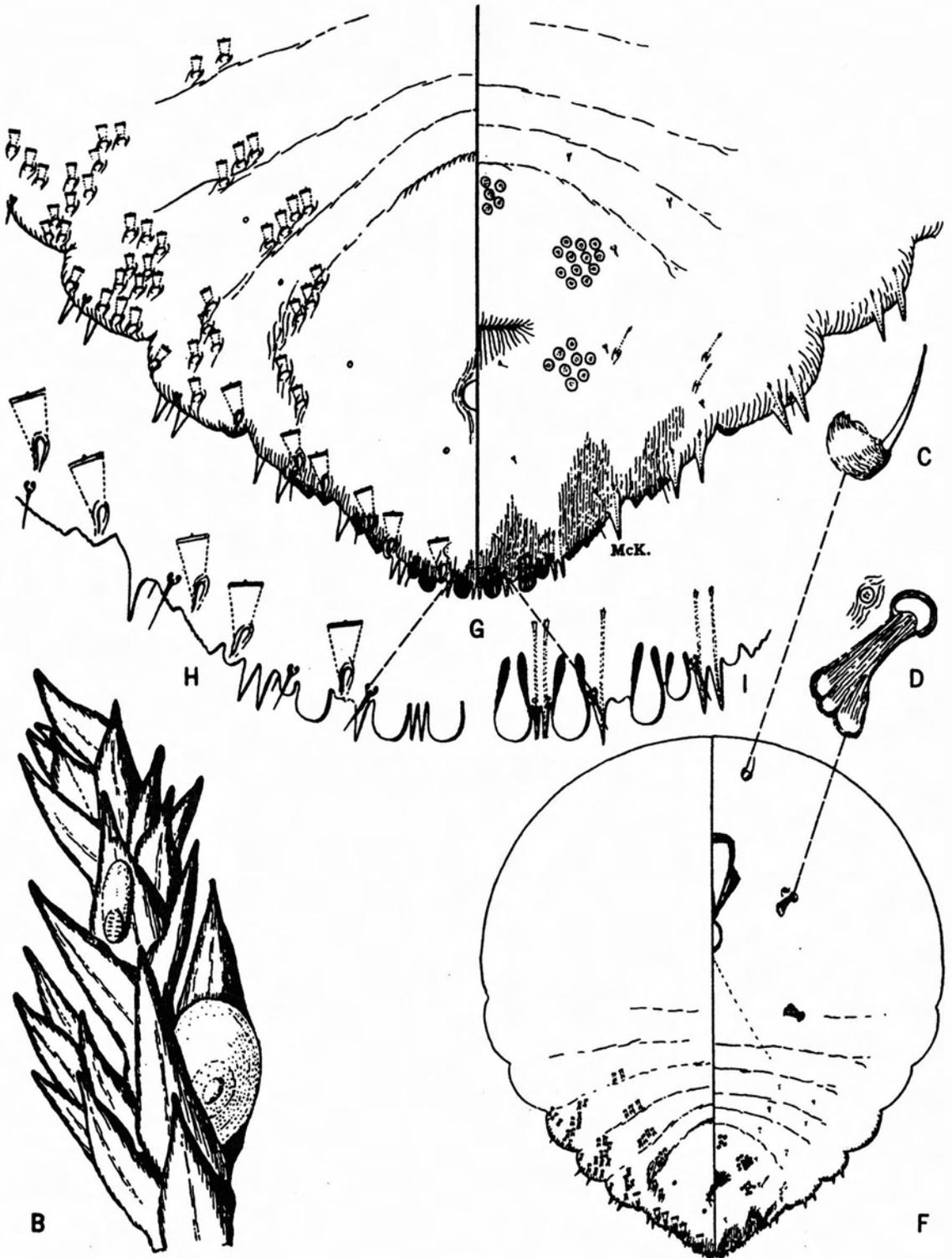


Fig. 27. *Carulaspis minima* (Targioni-Tozzetti).

rina. Prefers leaves (needles).

Similar Species: Juniper scale is identical in the field.

Biology: One generation per year in Pennsylvania, (Stimmel 1979). Overwinters as adult females. However, more than one generation per year is recorded in some European countries and in Bermuda (Bennett and Hughes 1959).

Hosts: Prefers cypress and juniper, but otherwise found on same hosts as *juniperi*.

Economic Importance: Causes yellowing of needles; may cause branch dieback. Although widespread in California, it is not a serious pest, except in some wholesale nursery situations. The economic effects and biological studies in California in the paper by Brown and Eads (1965) probably refer to this species. Does not seem to attack our native junipers, but was considered a serious pest of the native cedar, *Juniperus bermudiana* on the Island of Bermuda, causing the death of many trees and adversely affecting the tourist business. Attempts at biological control in Bermuda were

unsuccessful. The above information on the economic importance of this species is summarized from Bennett and Hughes (1959), Brown and Eads (1967) (under *Carulaspis visci*), Rosen and DeBach (1978) and Stimmel (1979).

Distribution: Found on practically every ornamental juniper in the State. Widespread in California, the United States and Europe. Palearctic in origin.

Diagnosis: The two California species of *Carulaspis* can be separated by the morphological characteristics listed under *Carulaspis juniperi*. *C. minima* differs from *C. juniperi* in its absence of the macroduct between the median lobes.

Bennett, F.D., and I.W. Hughes, 1959: Bul. Entomol. Res. 50:423-436.

Brown, L.R., and C.O. Eads, 1967: Calif. Agric. Exp. Stn. Bull. 834:1-72.

Rosen, D., and P. DeBach, in C.P. Clausen, ed., 1978: Agric. Handb. 480:1-545.

Stimmel, J.F., 1979: Proc. Entomol. Soc. Wash. 81(2):222-229.

Genus *Chionaspis* Signoret, 1869

This genus is an old one, and many species have since been removed to other genera. Those remaining in the genus are mostly Holarctic in origin. Also, several species previously in the genus *Phenacaspis* are actually the leaf-feeding forms of wood-infesting scales which belong in *Chionaspis*. In these species two distinctly different morphological forms occur depending on the part of the host where feeding takes place. Although this phenomenon occurs in a few species in other genera, it is present in many of the species in this genus. Takahashi (1952, 1953) discovered this phenomenon when he noticed that specimens from leaf petioles and small green twigs were often morphologically intermediate between *Chionaspis* and *Phenacaspis*. This discovery was followed up by careful transfer studies which proved beyond doubt that dimorphism actually occurs. Because of these findings, all the North American and Japanese species of *Phenacaspis* have been placed in the genus *Chionaspis* or in the genus *Pseudaulacaspis*, even though dimorphism has not been proven to exist in all of the species. The genera *Chionaspis* and *Pseudaulacaspis* are separated by the presence of a pair of marginal setae between median lobes in *Pseudaulacaspis*, which are absent in *Chionaspis*, and by different arrangements and types of tubular ducts in the 2nd stage males. For information on the problem of dimorphism in *Chionaspis* see Takahashi (1952, 1953) and Takagi and Kawai (1967). For a list of United States species of *Chionaspis* and their *Phenacaspis* synonyms see Nakahara (1975).

Number of World species: Currently unknown.

Number of United States species: 23.

Number of United States species of *Phenacaspis* now placed in *Chionaspis*: 7

Key to United States species: Liu et al (1989). Also Ferris (1938), but note that some species may be listed in *Phenacaspis* and other species have been described since. There are six recently described United States species: *C. floridensis* Takagi (1969), *C. triformis* Tippins and Beshear (1974), *C. kosztarabi* Takagi (1967), *C. hamoni* Liu et al (1987), *C. gilli* Liu et al (1987) and *C. styracis* Liu and Kosztarab (1989).

Key to California species: McKenzie (1956). Species are under both *Chionaspis* and *Phenacaspis*. Adult males of numerous species in the genus have been described and illustrated by Bullington et al (1989).

Bullington, S.W., M. Kosztarab and G. Jiang, 1989: Studies on the morphology and systematics of scale insects No. 15. Va. Agric. Exp. Stn. Bull 88-2:127-198.

Ferris, G.F., 1937-1942: Atlas of the Scale Insects of North America, Ser. I-IV. Stanford Univ. Press, Stanford.

Liu, T., M. Kosztarab and M. Rhoades, 1989: Studies on the morphology and systematics of scale insects No. 15. Va. Agric. Exp. Stn. Bull 88-2:127-198.

Nakahara, S., 1975: U.S. Dept. Agric. Coop. Econ. Insect Rpt. 25(11):201-203.

Takagi, S., 1969: Kontyu 37(3):269-271.

Takagi, S., and S. Kawai, 1967: Insecta Matsumurana 30(1):29-43.

Takahashi, R., 1952: Msc. Rep. Res. Inst. Nat. Resour. Tokyo, 27:7-15.

Takahashi, R., 1953: Bol. Lab. Zool. Gen. Agric. Filippo Silvestri. 33:48-56.

Tippins, H.H., and R.J. Beshear, 1974: J. Ga. Entomol. Soc. 8(3):146.

KEY TO CALIFORNIA SPECIES OF *CHIONASPIS*

- 1. Median lobes separated for more than half of their length. 2
- Median lobes fused for half of their length; common on *Ulmus* but polyphagous *americana*

- 2(1). Median lobes more or less elongate, their width less than half their length; usually completely separated and strongly divergent; on needles or leaf petioles of trees. 3
- Median lobes usually broad, wider than half their length; often close together at base, and not strongly divergent (except *gilli* which has 2 spines and 1 seta overlapping each median lobe). 5

- 3(2). Inner margins of median lobes with fine serrations; distance between outer margin of median lobes and inner lobule of second pair of lobes much less than width of inner lobule. 4
- Inner margins of median lobes without serrations; distance between median lobes and inner lobule of second pair of lobes as wide or wider than width of inner lobule; on needles of conifers. *pinifoliae*

- 4(3). Inner lobule of second pair of lobes protruding beyond apex of median lobe; on *Gleditsia* leaf form, *gleditsiae*
- Inner lobule of second pair of lobes shorter than median lobes, not protruding beyond the apex of median lobe; on *Wistaria* leaf. leaf form, *wistariae*

- 5(2). About one-half or more of dorsal submedian duct groups of abdominal segments II-V very small; dorsal submedian group of ducts on abdominal segment VI entirely or mostly of small ducts, seldom mixed with macroducts; sometimes 3 dorsal marginal macroducts present on abdominal segments VI, or sometimes I pair of toothlike projections present between bases of median lobes; associated chiefly with *Salix* and *Populus*. *salicis-nigrae*
- Only a few of the dorsal submedian duct groups on abdominal segments II-V very small; so small ducts or only a few in submedian groups on abdominal segment VI; never with 3 dorsal marginal macroducts on abdominal segment VI, or with toothlike projections between bases of median lobes; on a variety of hosts. 6

- 6(5). Distance from posterior margin of anus to base of median lobes much less than distance from anterior margin of anus to midpoint between abdominal segments V and VI; associated with *Tamarix* in southwestern U.S. and Mexico. 7
- Distance from posterior margin of anus to base of median lobes much less than distance from anterior margin of anus to midpoint between abdominal segments V and VI; not known from *Tamarix* (except *ortholobis*). 8

- 7(6). Median lobes relatively long and semicircular at apex, not notched, strongly divergent and poorly sclerotized; with 2 gland spines and 1 long seta overlapping median lobes, and protruding beyond apex of median lobe. *gilli*
- Median lobes short and broad, notched on both sides, well sclerotized basally, close to each other; gland spines and setae only laterad of median lobes. *etrusca*

- 8(6). No dorsal submedian macroducts or rarely 1 on abdominal segment III and VI on each side of body. 9
- One, but normally more than 1, dorsal submedian macroduct on each side of abdominal segments III and VI. 10

- 9(8). Median lobes distinctly broad, wider than long, semicircular, without notches or serrations on margins, close to each other; a distinct sclerotized horizontal bar at base of medianlobes; common on apples and other Rosaceae. *furfura*
- Median lobes not wider than long, not semicircular, with notches or serrations on margin, well separated; without horizontal bar at base of median lobes; commonly on *Gleditsiae*. bark form, *gleditsiae*

- 10(8). Divergent inner margins of triangular median lobes much longer than outer margins; commonly on *Cornus*. *corni*
- Median lobes not matching above characters, on a variety of host plants. 11

- 11(10). Both mesal and lateral margins of median lobes with fine serrations or irregular notches. 12
- Both mesal and lateral margins of median lobes without serrations or notches; in western U.S. only. 13

- 12(11). Several dorsal submedian macroducts on abdominal segment II; on a variety of hosts in the eastern U.S. to Texas. *lintneri*

- No dorsal submedian macroducts on abdominal segment II; on *Wistaria* only *wistariae*
- 13(11). Median lobes distinctly broad and rounded, widely separated basally; margin of 3rd lobes usually smooth; found in west coast area of U.S. *sassceri*
- Median lobes rounded apically but close to each other with a very narrow separation; 3rd pair of lobes distinct, margins usually finely serrate. *ortholobis*

***Chionaspis americana* Johnson, 1896**
elm scurfy scale (ESA approved)
Fig. 28

Tribe: Diaspidini.
Synonymy: *Fundaspis americana* (Johnson).
Field Characteristics: Female scale cover pure white, with terminal exuviae; oystershell shaped. Males white with a terminal exuvium. Occurs on bark.
Biology: According to Willoughby and Kosztarab (1974), has nearly two yearly generations in Virginia. Overwinters mostly in the egg stage; hatching commences in April. Biology unknown in California.
Hosts: Elm, mulberry, hackberry.
Economic Importance: A "B"-rated pest in California.
Distribution: Los Angeles, Orange and San

Diego counties; also collected in San Mateo County in 1967. Introduced. Rarely collected; current status unknown.
Diagnosis: Recognized by the nearly fused median lobes. The adult male was described and illustrated by Bullington et al (1989).
 Bullington, S.W., M. Kosztarab and G. Jiang, 1989: Studies on the morphology and systematics of scale insects No. 15. Va. Agric. Exp. Stn. Bull 88-2:127-198.
 Kosztarab, M., 1963: Bull. Ohio Biol. Surv. (n.s.) 2(2):1-120.
 Willoughby, P.A., and M. Kosztarab, 1974: Polytech. Inst. State Univ. Res. Div., Bull. 92:1-43.

***Chionaspis corni* Cooley, 1899**
dogwood scale (ESA approved)
Fig. 29

Tribe: Diaspidini.
Field Characteristics: Females white, with terminal yellow exuviae; oystershell-shaped. Males elongate, white, with a terminal exuvium.
Biology: Unknown.
Hosts: Prefers dogwood (*Cornus*) but also known from *Ribes*.
Economic Importance: None.
Distribution: Found in a number of locations throughout the State, usually in mountainous country. The only known record other than those listed by McKenzie is from Woodfords, Alpine County, in 1960. Current status in California unknown. Probably introduced

from the East Coast.
Diagnosis: For distinguishing morphological characteristics, see McKenzie (1956). The adult male was described and illustrated by Bullington et al (1989).
 Bullington, S.W., M. Kosztarab and G. Jiang, 1989: Studies on the morphology and systematics of scale insects No. 15. Va. Agric. Exp. Stn. Bull 88-2:127-198.
 Kosztarab, M., 1963: Bull. Ohio Biol. Surv. (n.s.) 2(2):1-120.
 McKenzie, H.L., 1956: The Armored Scale Insects of California. Univ. Calif. Press, Berkeley. 209 pp.

Chionaspis etrusca Leonardi, 1908
tamarix scale

Fig. 30, Color Plates 25, 26

Tribe: Diaspidini.

Other Common Names: Tamarisk scale.

Field Characteristics: A typical *Chionaspis* with a white oystershell scale cover.

Similar Species: *Chionaspis gilli*.

Biology: Unknown.

Hosts: Occurs only on the introduced tamarisk or salt cedar (*Tamarix*), which occurs in waste places and is occasionally used as windbreaks in the desert.

Economic Importance: None.

Distribution: Very common in desert valleys of southeastern California and the San Joaquin Valley. Also known from Arizona and Mexico.

Native to the Mediterranean.

Diagnosis: For distinguishing morphological characters in the key. Host restriction is usually adequate for identification. The adult male was described and illustrated by Bullington et al (1989).

Bullington, S.W., M. Kosztarab and G. Jiang, 1989: Studies on the morphology and systematics of scale insects No. 15. Va. Agric. Exp. Stn. Bull 88-2:127-198.

McKenzie, H.L., 1956: The Armored Scale Insects of California. Univ. Calif. Press, Berkeley. 209 pp.

Chionaspis furfura (Fitch), 1856
scurfy scale (ESA approved)

Fig. 31

Tribe: Diaspidini.

Synonymy: *Aspidiotus furfurus* Fitch, *Aspidiotus cerasi* Fitch, *Aspidiotus harrisii* Walsh, *Chionaspis furfurus* var. *fulvus* King.

Has been collected several times in nurseries but eradicated. Apparently does not occur in California at this time. Attacks birch, cotoneaster, hawthorne and deciduous fruit trees. For more information on this scale see the following references:

Hammer, O.H., 1938: J. Econ. Entomol. 31(2):244-249.

Kosztarab, M., 1963: Bull. Ohio Biol. Surv. (n.s.) 2(2):1-120.

McKenzie, H.L., 1956: The Armored Scale Insects of California. Univ. Calif. Press, Berkeley. 209 pp.

Quaintance, A.L., and E.R. Sasser, 1916: U.S. Dept. Agric. Farmers' Bull. 723:1-14.

Chionaspis gilli Liu and Kosztarab, 1992
Gill's tamarix scale

Fig. 32

Tribe: Diaspidini.

Field Characteristics: Oystershell-shaped, dirty white with yellowish terminal exuvium as is typical of *Chionaspis*. Indistinguishable from *C. etrusca* in the field, with which it is often associated.

Hosts: Restricted to salt cedar, (*Tamarix*).

Economic Importance: None.

Distribution: Known only from Imperial County, California, Arizona, New Mexico and Mexico along the United States border.

Diagnosis: Similar to *etrusca* but the characters enumerated in the key will separate the two.

Chionaspis gleditsiae Sanders, 1902
honey locust scale

Fig. 33

Tribe: Diaspidini.

Synonymy: *Phenacaspis spinicola* Dietz and Morrison is the leaf-inhabiting form of this species. See comments under "Genus *Chionaspis*."

Field Characteristics: A typical *Chionaspis* in shape and color.

Hosts: Honey locust (*Gleditsia triacanthos*).

Economic Importance: None.

Distribution: Known in California from one collection in a Los Angeles nursery in 1954. Probably no longer present in California.

Diagnosis: Host restriction is characteristic.

The adult male was described and illustrated by Bullington et al (1989).

Bullington, S.W., M. Kosztarab and G. Jiang, 1989: Studies on the morphology and systematics of scale insects No. 15. Va. Agric. Exp. Stn. Bull 88-2:127-198.

Kosztarab, M., 1963: Bull. Ohio Biol. Surv., (n.s.) 2(2):1-120.

McKenzie, H.L., 1956: The Armored Scale Insects of California. Univ. Calif. Press, Berkeley. 209 pp.

Chionaspis lintneri Comstock, 1883
Lintner's scale

Fig. 34

Tribe: Diaspidini.

Synonymy: *Chionaspis lintneri betulae* Cooley.

Listed as occurring in central California by Essig (1915). This is based on a misidentification and the species is not considered to be part of the California fauna.

Essig, E.O., 1915: Calif. Dept. Agric. Mon. Bull. Suppl. 4(4):1-541.

Ferris, G.F., 1937: Atlas of the Scale Insects of North America, Stanford Univ. Press, Stanford.

Chionaspis ortholobis Comstock, 1881
cottonwood scale

Fig. 35, Color Plate 27

Tribe: Diaspidini.

Field Characteristics: A typical *Chionaspis*, with a white scale cover and oystershell shape.

Similar Species: Cannot be separated in the field from black willow scale on willow, and from sasscer scale on ceanothus.

Hosts: Willow (*Salix*); also occurs on *Ceanothus*.

Distribution: Common throughout California. Also common everywhere in the United States west of the Rocky Mountains.

Diagnosis: This species and *C. sassceri* are difficult to separate morphologically and whether they are separate species is questionable. McKenzie's choice of cottonwood scale for the common name is unfortunate since it

has never been recorded from it. However, there is a possibility that *C. ortholobis* is a synonym of *C. platani* Cooley from the eastern United States and it is best not to change the common name at this time. The adult male was described and illustrated by Bullington et al (1989).

Bullington, S.W., M. Kosztarab and G. Jiang, 1989: Studies on the morphology and systematics of scale insects No. 15. Va. Agric. Exp. Stn. Bull 88-2:127-198.

McKenzie, H. L., 1956: The Armored Scale Insects of California. Univ. Calif. Press, Berkeley. 209 pp.

***Chionaspis pinifoliae* (Fitch), 1855**
pine needle scale (ESA approved)
Fig. 36, Color Plates 28-31

Tribe: Diaspidini.

Other Common Names: Pine leaf scale, white pine needle scale.

Synonymy: *Aspidiotus pinifoliae* Fitch, *Mytilaspis pinifoliae* (Fitch), *Phenacaspis pinifoliae* (Fitch). See comments under "Genus *Chionaspis*" concerning the reasons for changing the name from *Phenacaspis* to *Chionaspis*.

Field Characteristics: Adult females 1.5 to 2.5 mm long. Oystershell-shaped or elongate, fairly flat, pure white with yellow terminal exuviae. Body dark orange, eggs red or orange. Male scale cover, if present, elongate, white with a terminal exuvium. Primarily infests needles of host.

Similar Species: The only similar species in California on the same hosts is Kellogg scale, but its scale cover is tan or brown, not pure white as in pine needle scale. Beshear scale, *Cupidaspis beshearae*, is similar but pine needle scale is not known from juniper. The pine scale, *Chionaspis heterophyllae* (Cooley), from the southeastern United States and the Caribbean, cannot be separated from this species in the field.

Biology: Apparently two races; one parthenogenetic and the other biparental. The parthenogenetic race has one generation per year and overwinters as eggs. The biparental race has two generations per year and overwinters as mature gravid adult females. The biology of this species is thoroughly covered by Luck and Dahlsten (1974) and Nielsen and Johnson (1973). See also Cumming (1953) and Brown (1958, 1959).

Hosts: Common on most pine species. Also known from *Abies*, *Cedrus*, *Picea*, *Taxus*, *Torreya*, and *Tsuga*.

Economic Importance: Injures conifers by reducing host vitality, weakening and killing branches and sometimes the whole tree. Also ruins the aesthetic appearance of the tree in

cases of heavy infestations, since large populations cause a frosted appearance. While not generally an important pest, serious outbreaks do occur, such as the one covering about 1200 acres in the Tahoe Basin after insecticides were applied for mosquitoes. The above information on economic importance summarized from Brown and Eads (1967), Luck and Dahlsten (1974), Furniss and Carolin (1977), Stimmel (1978), and Burden and Hart (1989). For information on natural enemies see Kosztarab (1963), Nielsen and Johnson (1973), Luck and Dahlsten (1974), and Burden and Hart (1990).

Distribution: Common in most of California, the United States and Canada, wherever native or ornamental pines are found.

Diagnosis: Host plant preference and field appearance are generally adequate for recognition. The only California *Chionaspis* with inset median lobes, so that the outer free margins are much shorter than the inner margins. *C. heterophyllae* Cooley, occurring on pines in the southeastern United States, differs by its acutely pointed and strongly divergent median lobes, as compared to the broadly rounded median lobes of *pinifoliae*. The adult male was described and illustrated by Bullington et al (1989).

- Brown, C.E., 1958: Can. Entomol. 90(11):685-690.
 Brown, C.E., 1959: Can. Entomol. 91(9):529-535.
 Brown, L.R., and C.O. Eads, 1967: Calif. Agric. Exp. Stn. Bull. 834:1-72.
 Bullington, S.W., M. Kosztarab and G. Jiang, 1989: Studies on the morphology and systematics of scale insects No. 15. Va. Agric. Exp. Stn. Bull. 88-2:127-198.
 Burden, D.J. and E.R. Hart, 1989: Envir. Entomol. 18(2):223-227.
 Burden, D.J. and E.R. Hart, 1990: The Great Lakes Entomol. 23:93-97.

- Cumming, M.E.P., 1953: Can. Entomol. 85(9):347-352.
- Furniss, R.L., and V.M. Carolin, 1977: U.S. Dep. Agric. Misc. Publ. 1339:1-654.
- Kosztarab, M., 1963: Bull. Ohio Biol. Surv. (n.s.) 2(2):1-120.
- Luck, R.F., and D.L. Dahlsten, 1974: Ann. Entomol. Soc. Am. 67(3):309-316.
- Nielsen, D.G., and N.E. Johnson, 1973: Ann. Entomol. Soc. Am. 66(1):34-43.
- Stimmel, J.F., 1978: Pa. Dep. Agric. Reg. Hort. Entomol. Circ. 32, Vol. 4(2):15-16.

Chionaspis salicis-nigrae (Walsh), 1868
black willow scale

Fig. 37

Tribe: Diaspidini.

Synonymy: *Aspidiotus salicis-nigrae* Walsh,
Mytilaspis salicis LeBaron.

Field Characteristics: A typical *Chionaspis* with a white oystershell scale cover; the common name is derived from the host, black willow.

Similar Species: Cannot be separated from cottonwood scale in the field.

Biology: According to Lambdin (1990), there are three generations in Tennessee with the winter spent in the egg stage. Nothing is known about the species in California.

Hosts: Primarily black willow (*Salix nigra*). Known also from *Populus*, *Cornus* and

Liriodendron.

Distribution: Apparently rather rare. Collections are known from Lassen, Modoc and Ventura Counties.

Diagnosis: Differs from *ortholobis*, the only other *Chionaspis* on willow, by many small ducts in the dorsal submedial duct groups on abdominal segments 3 to 6. In *ortholobis*, all of these ducts are full size.

Kosztarab, M., 1963: Bull. Ohio Biol. Surv. (n.s.), 2(2):1-120.

Lambdin, P.L., 1990: Entomol. News 101(5): 288-292.

Chionaspis sassceri Cockerell and Robbins, 1909
Sasscer scale

Fig. 38, Color Plate 32

Tribe: Diaspidini.

Field Characteristics: Typical of the other members of the genus.

Similar Species: Cottonwood scale, *Chionaspis ortholobis*, and ceanothus scale, *Aonidomytilus ceanothi* are both similar and occur on the same genus of plants.

Biology: Unknown.

Hosts: Prefers *Ceanothus*, but originally described from *Citrus* in Fallbrook, San Diego County.

Distribution: Common on *Ceanothus* in Southern California, particularly at higher elevations, although occasionally collected in northern California. Known only from California.

Diagnosis: Similar morphologically to *C. ortholobis*; whether it is distinct from that species is open to question.

McKenzie, H.L., 1956: The Armored Scale Insects of California. Univ. Calif. Press, Berkeley. 209 pp.

Chionaspis wistariae Cooley, 1897
wistaria scale

Fig. 39, Color Plate 33

Tribe: Diaspidini.

Other Common Names: Fujicola scale.

Synonymy: *Phenacaspis fujicola* Kuwana, is

actually the leaf-infesting form of this scale. See comments under "Genus *Chionaspis*."

Field Characteristics: A typical *Chionaspis*,

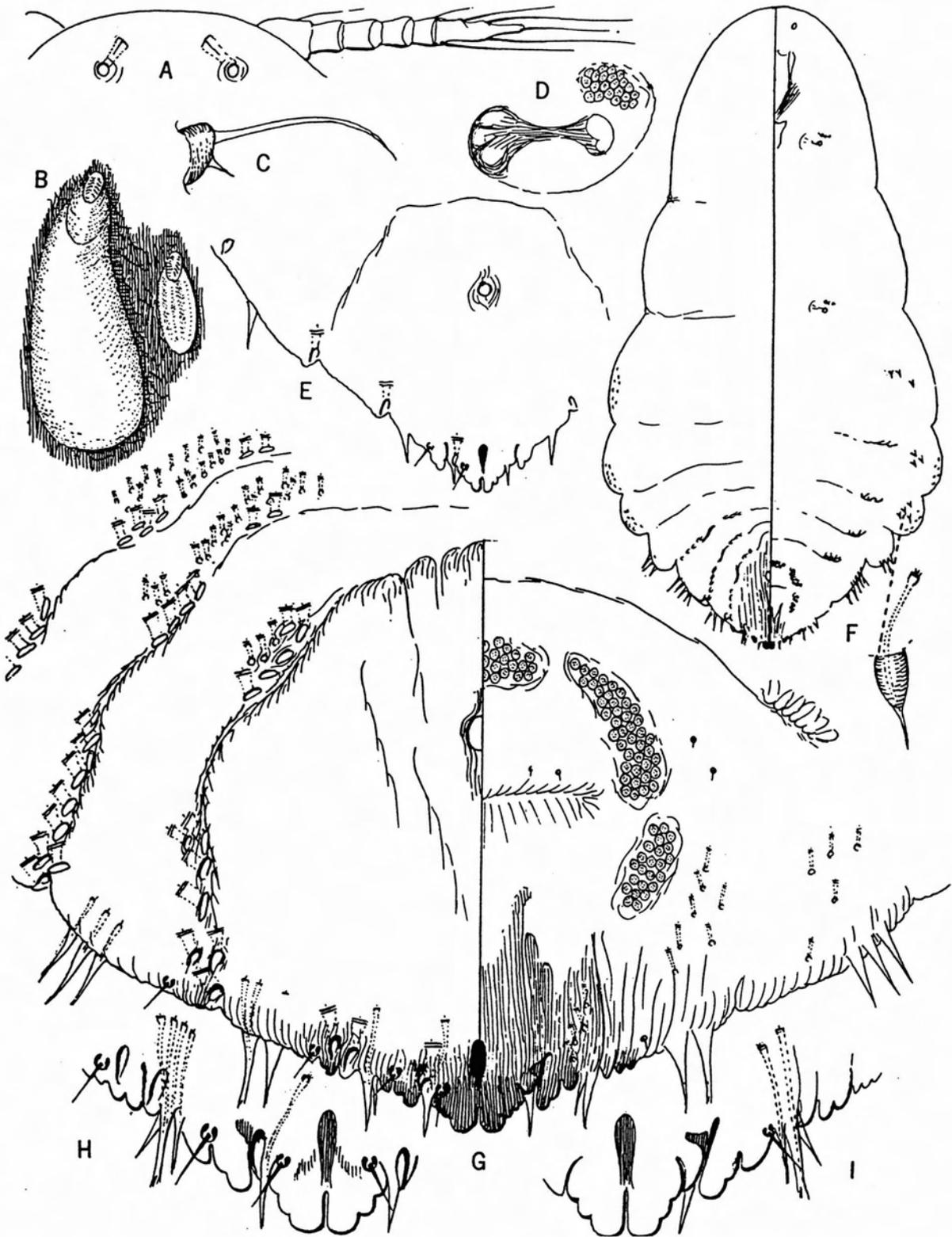


Fig. 28. *Chionaspis americana* Johnson.

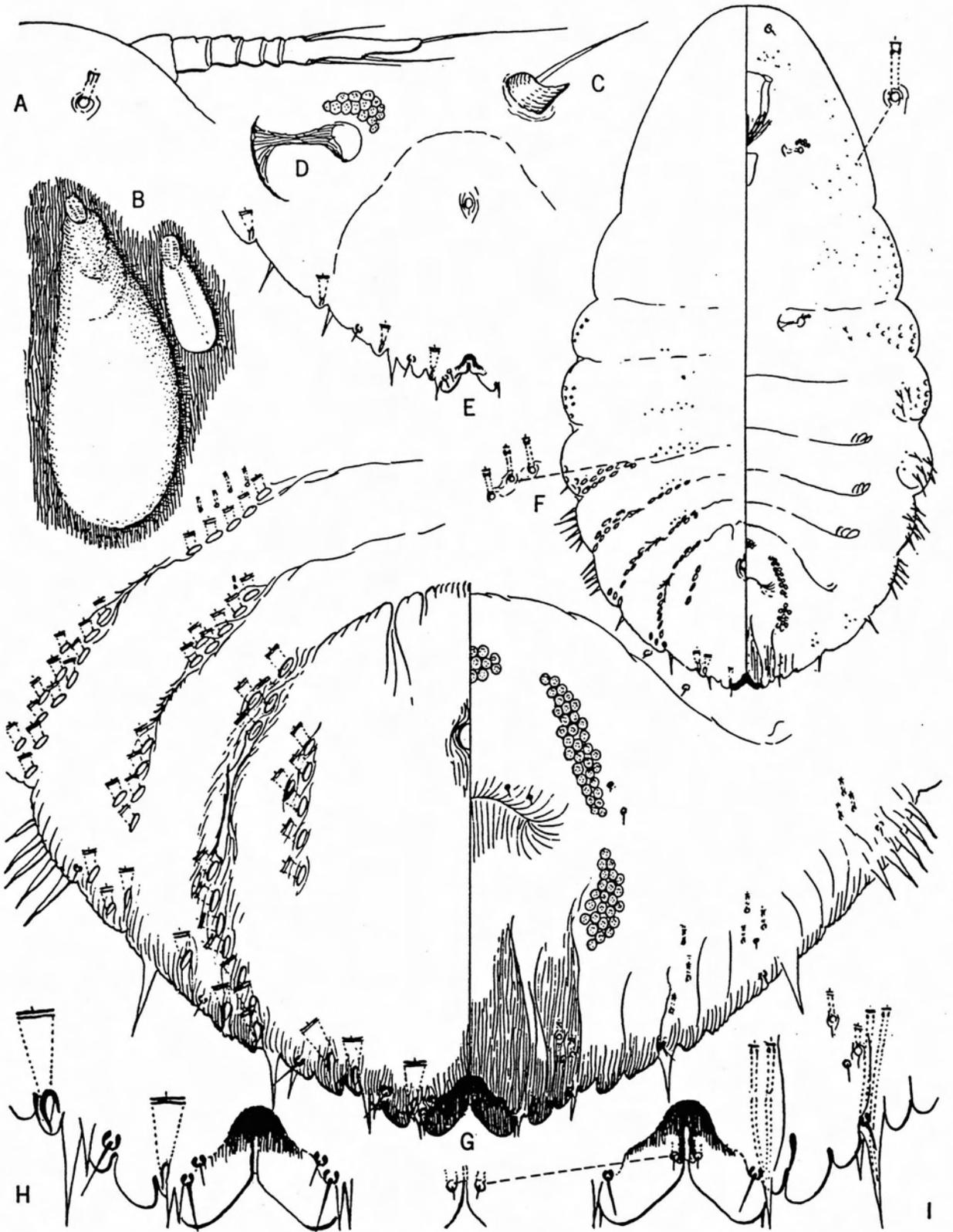


Fig. 29. *Chionaspis corni* Cooley.

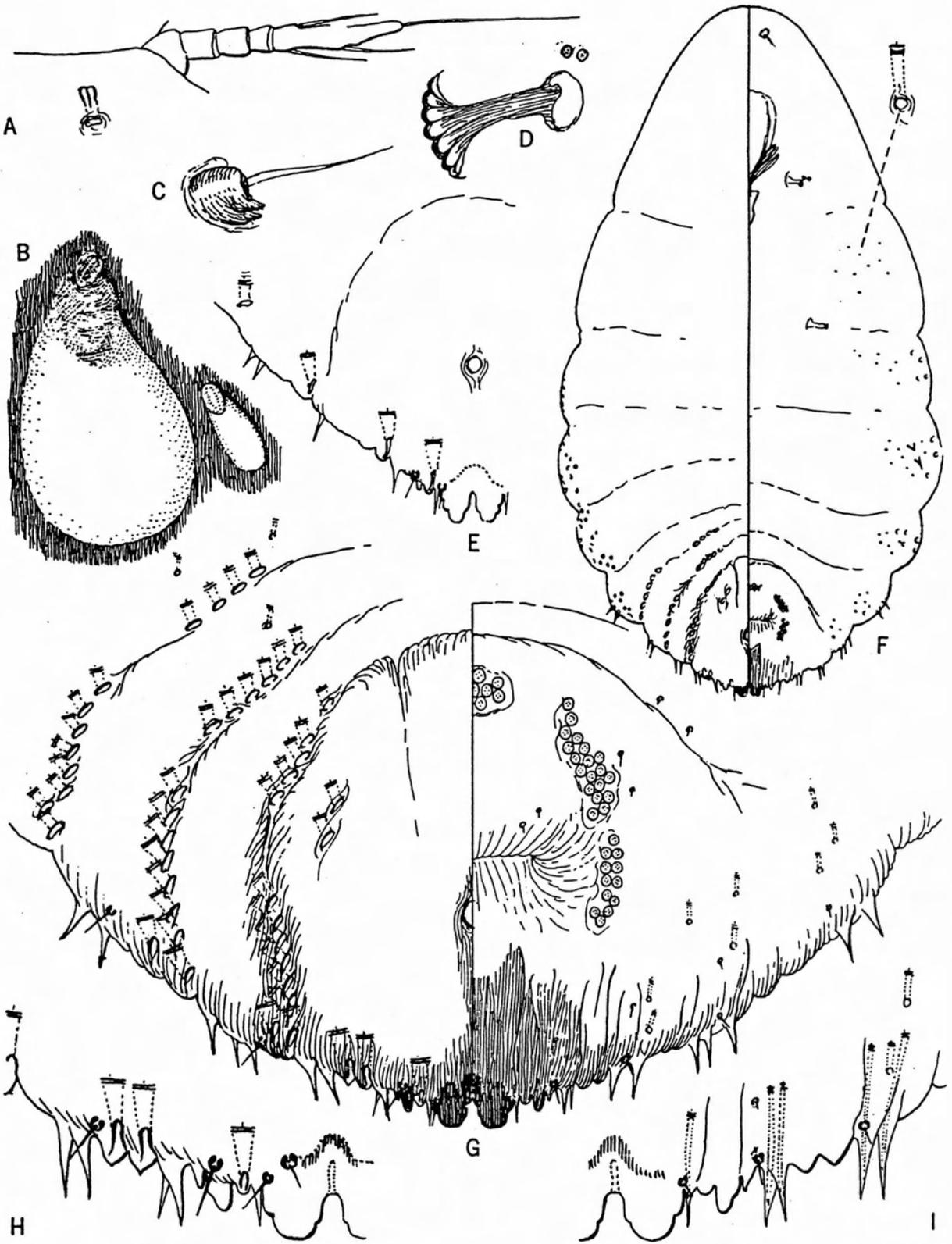


Fig. 30. *Chionaspis etrusca* Leonardi.

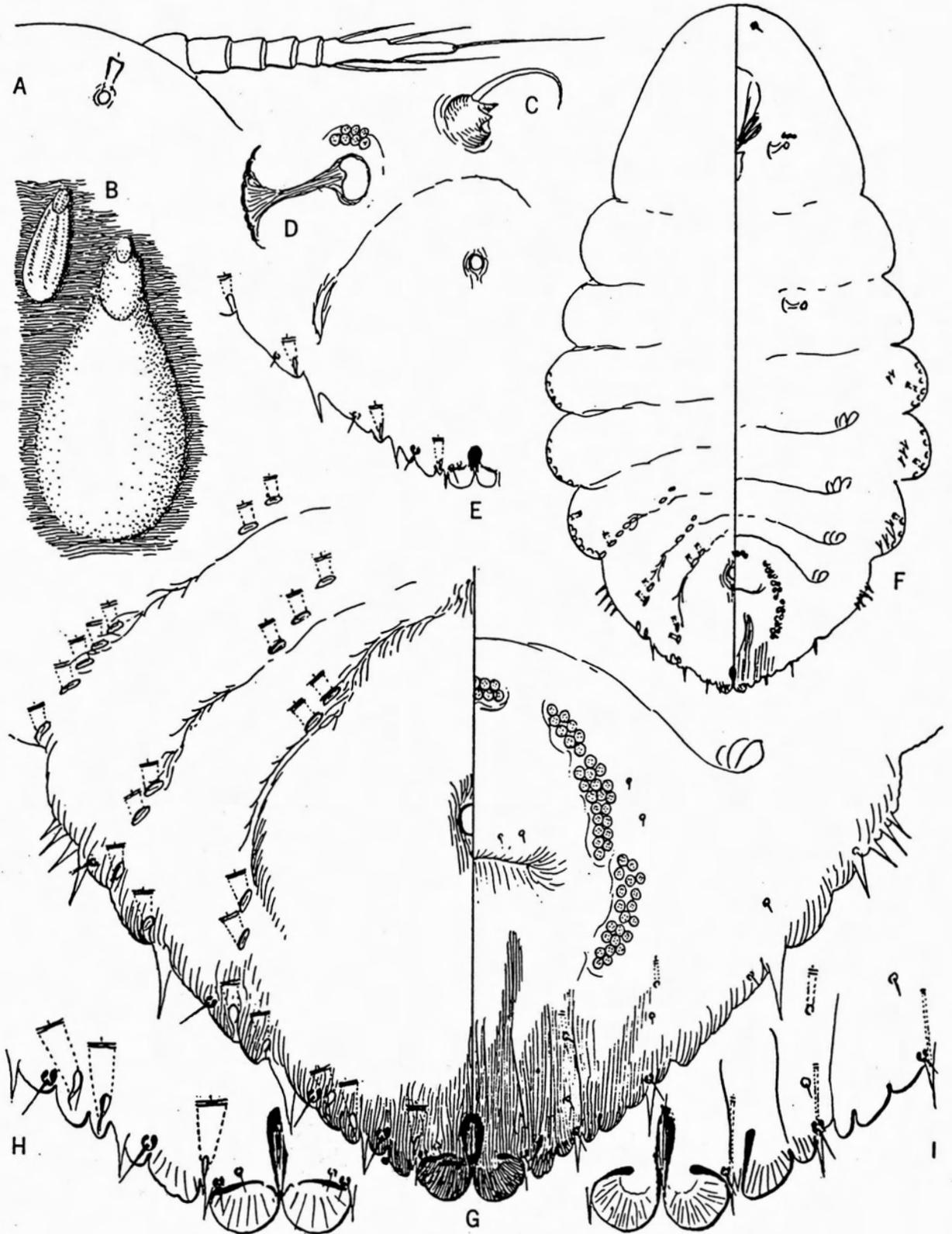


Fig. 31. *Chionaspis furfura* (Fitch).

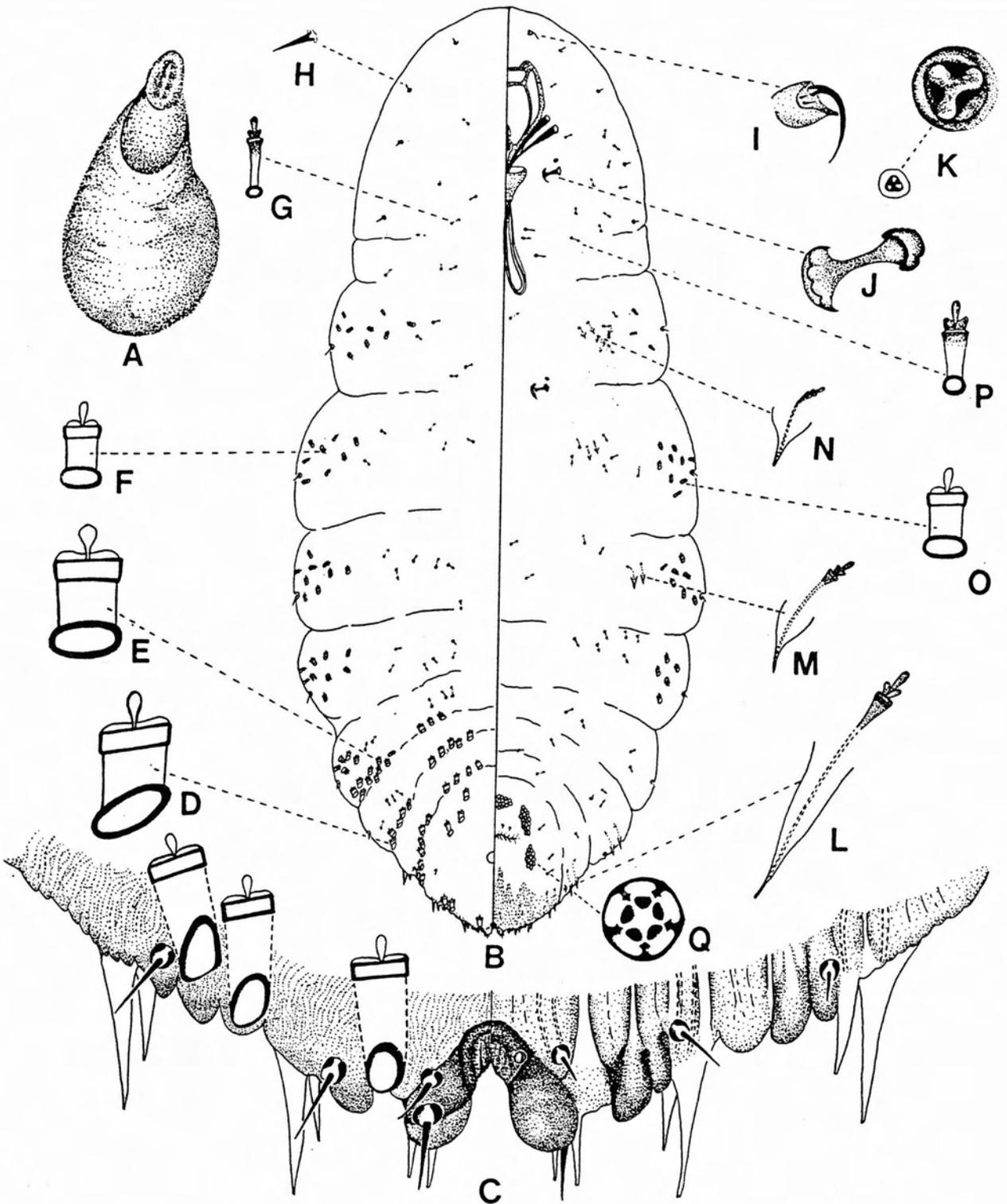


Fig. 32. *Chionaspis gilli* Liu and Kosztarab.

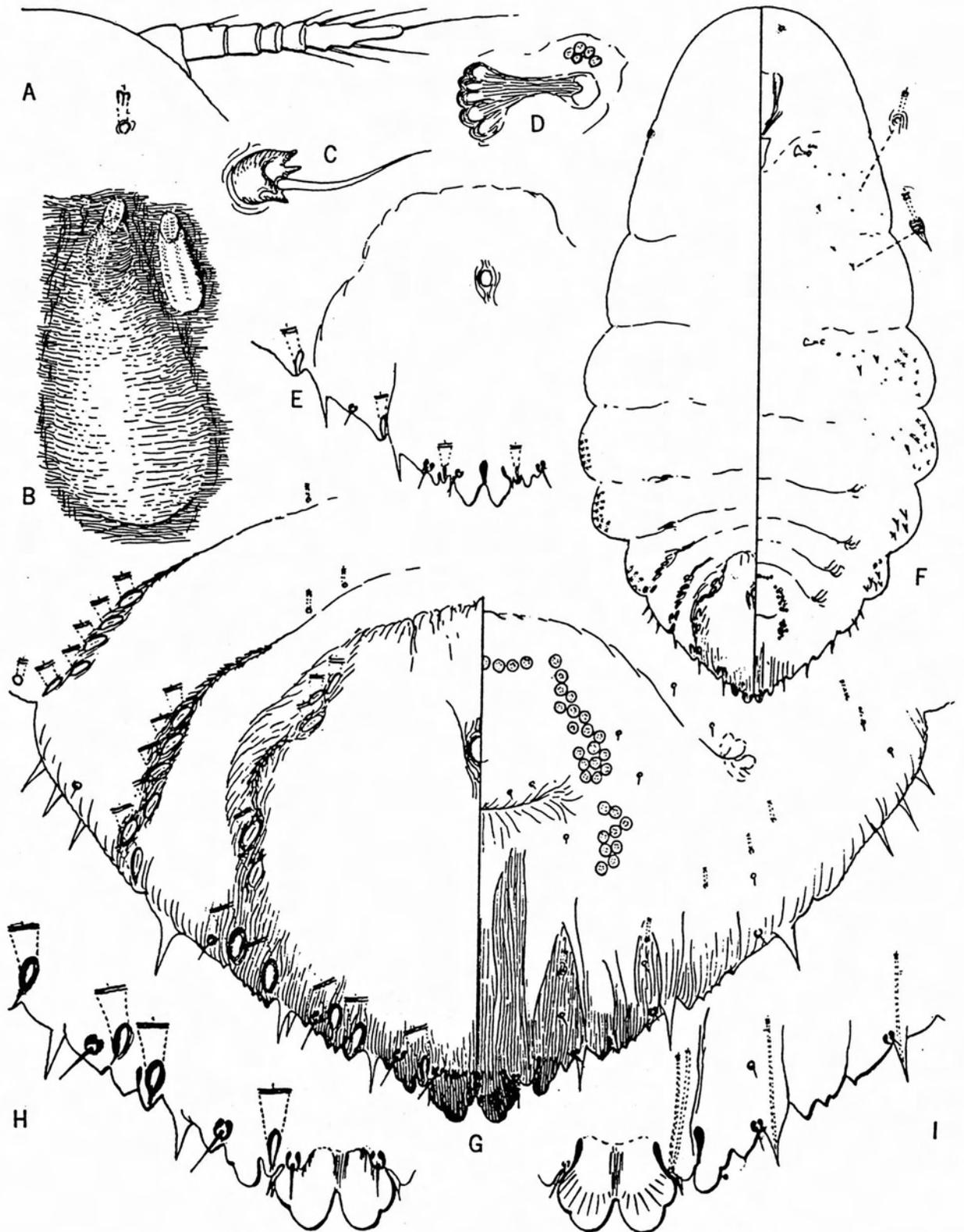


Fig. 33. *Chionaspis gleditsiae* Sanders.

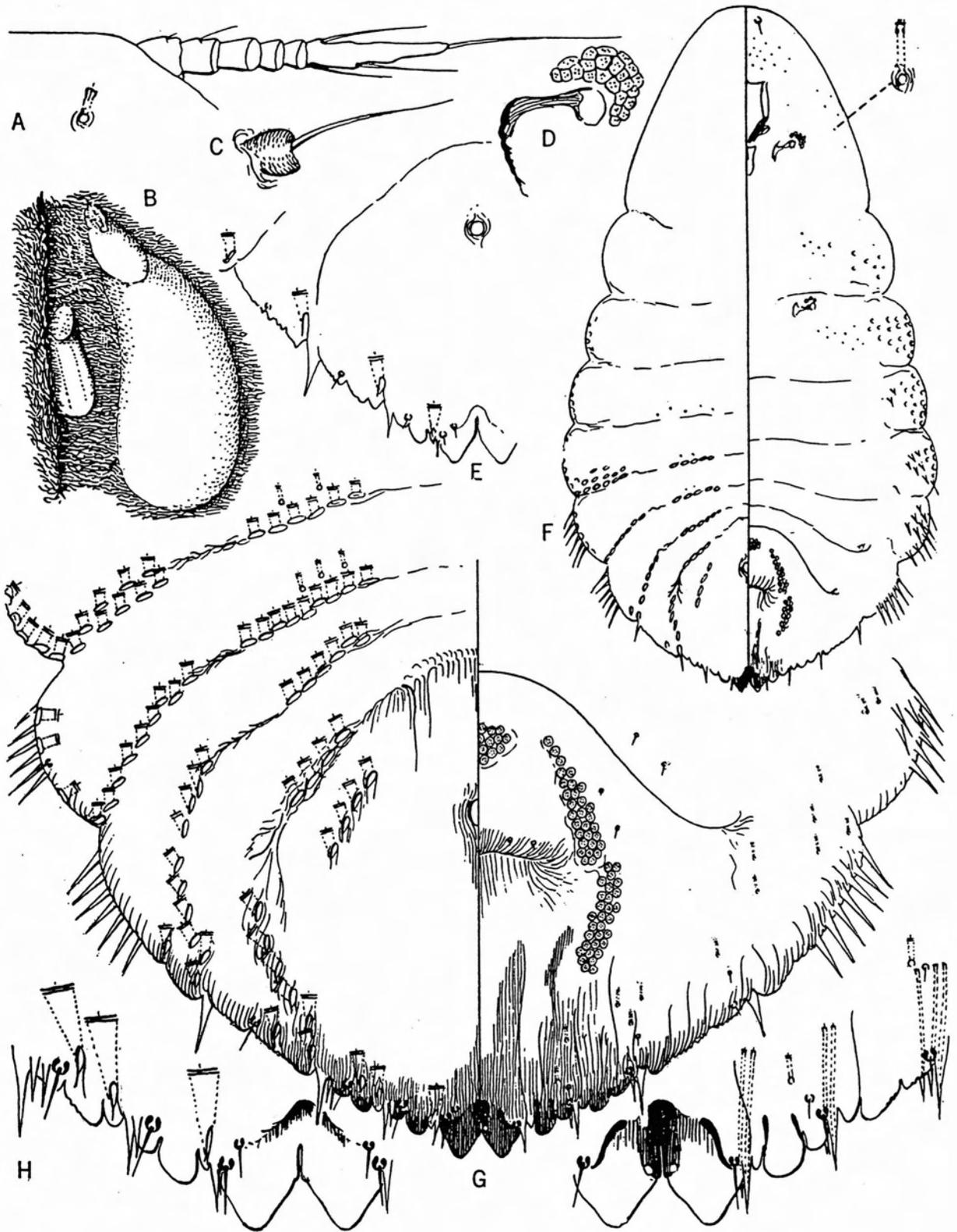


Fig. 34. *Chionaspis lintneri* Comstock.

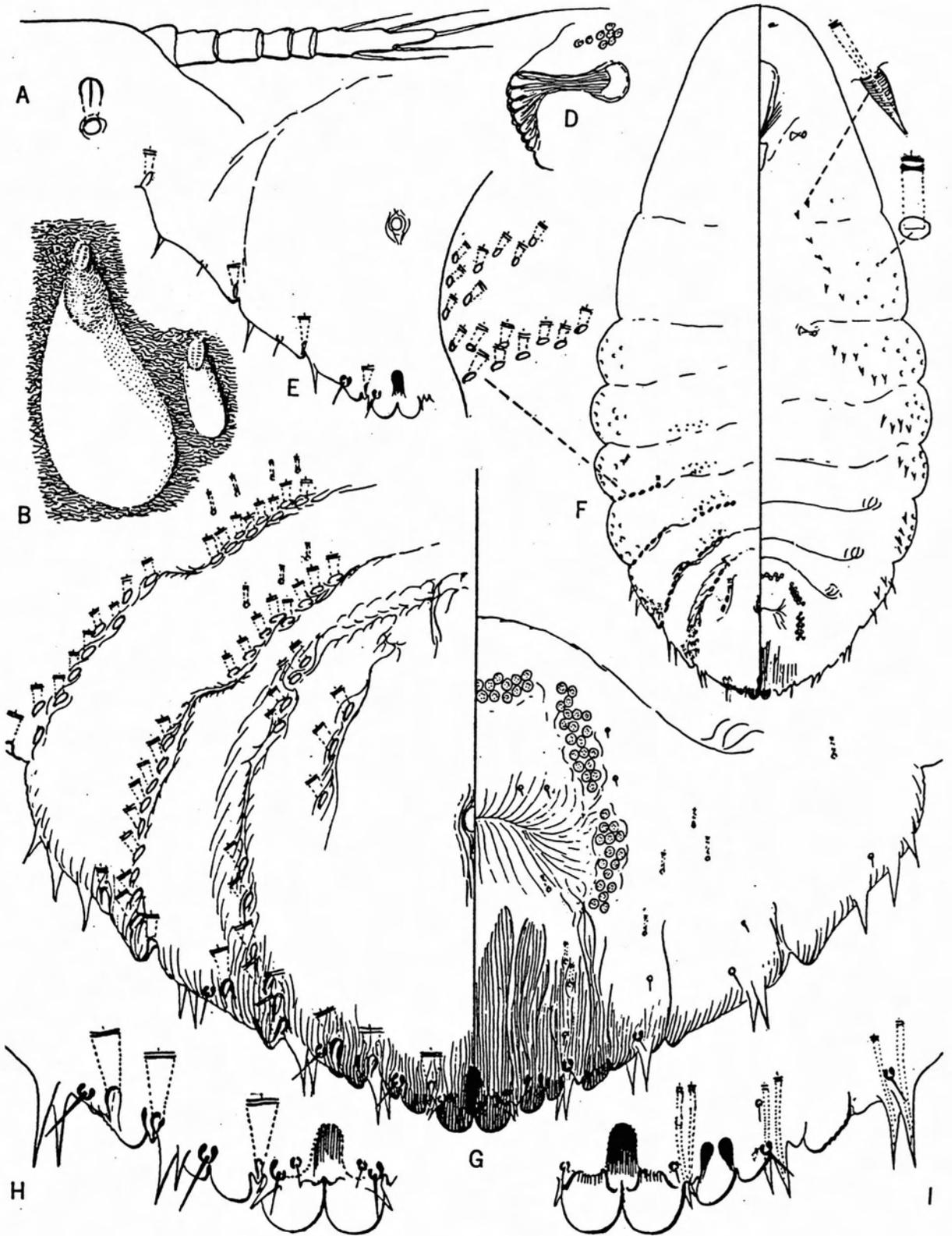


Fig. 35. *Chionaspis ortholobis* Comstock.

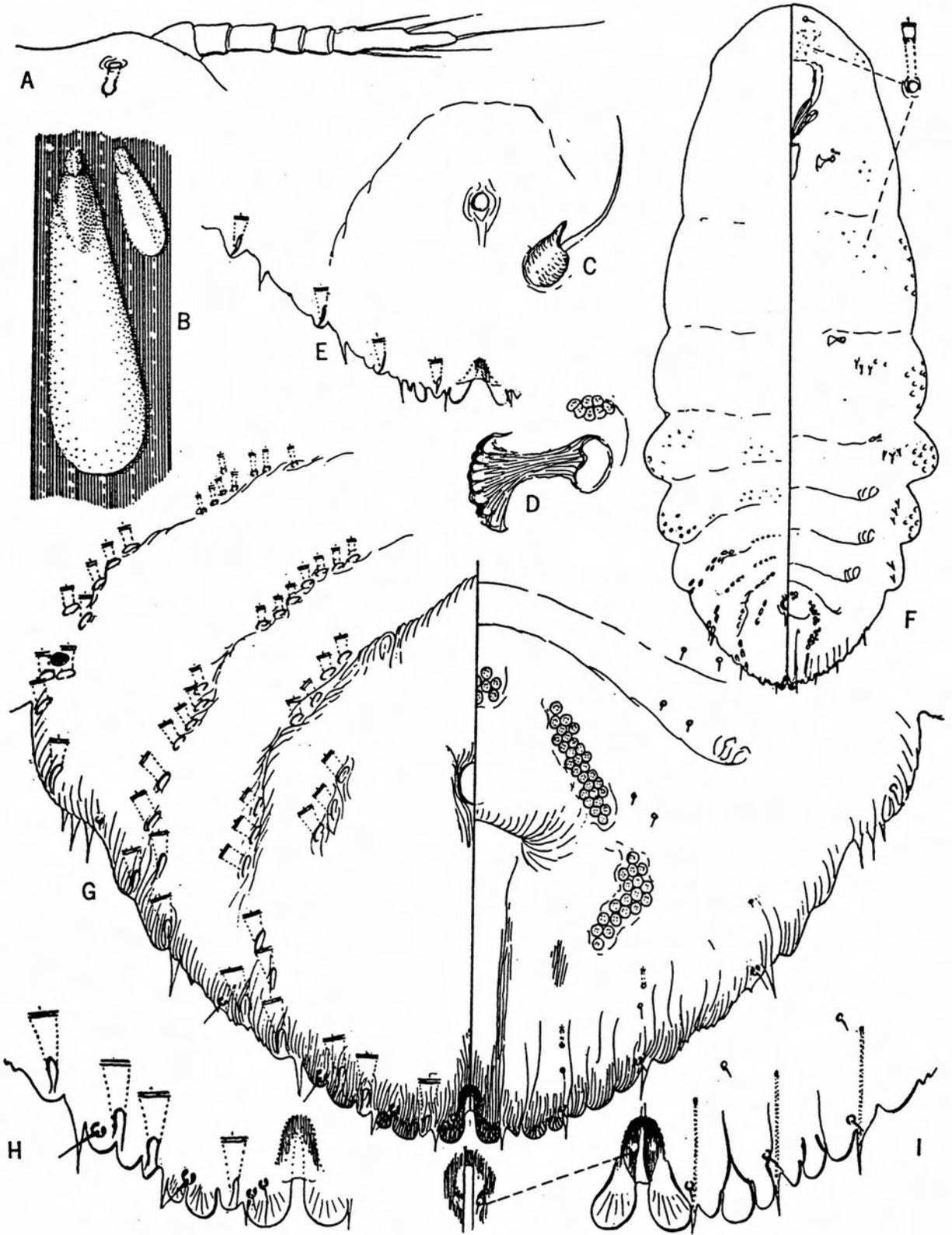


Fig. 36. *Chionaspis pinifoliae* (Fitch).

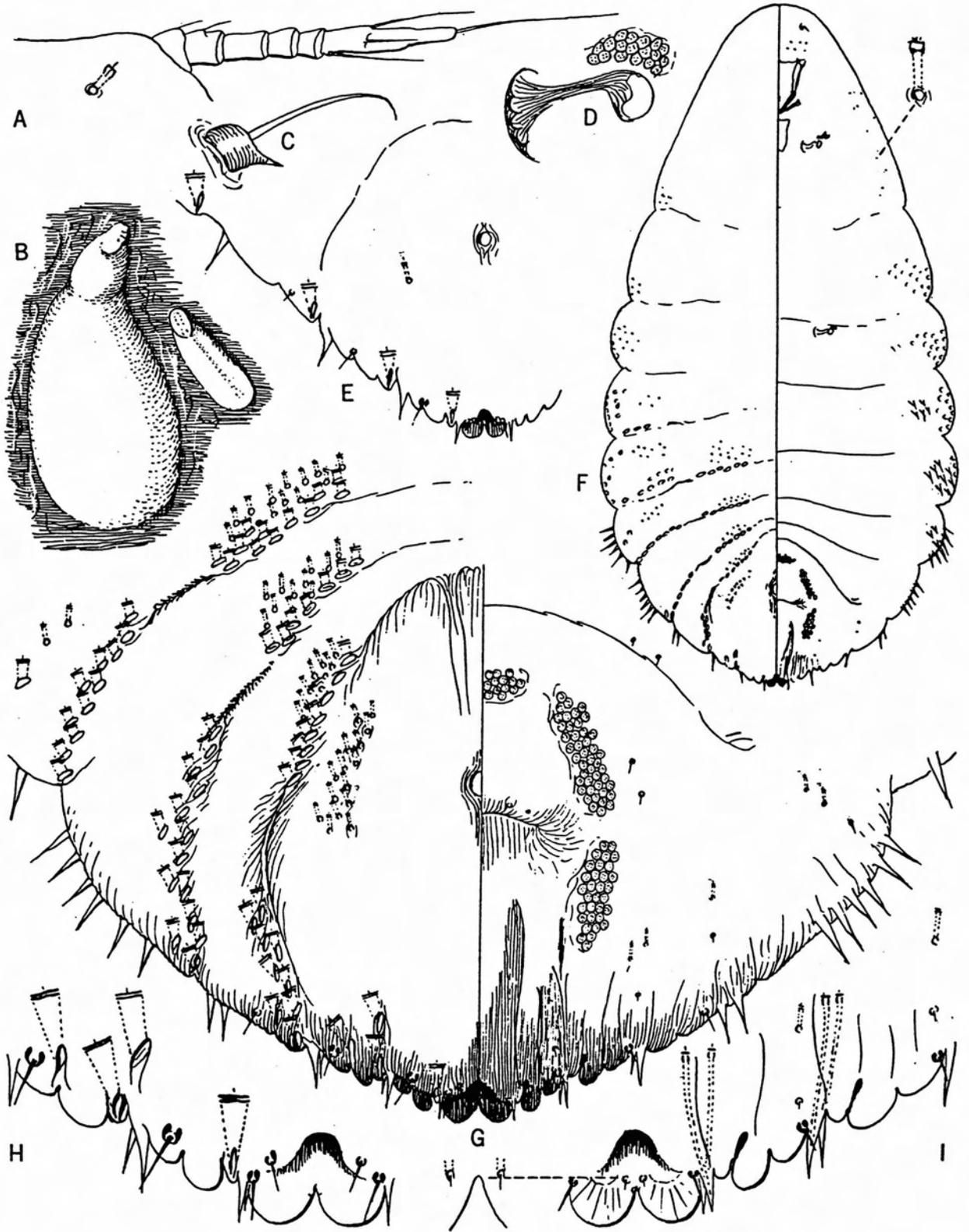


Fig. 37. *Chionaspis salicis-nigrae* (Walsh).

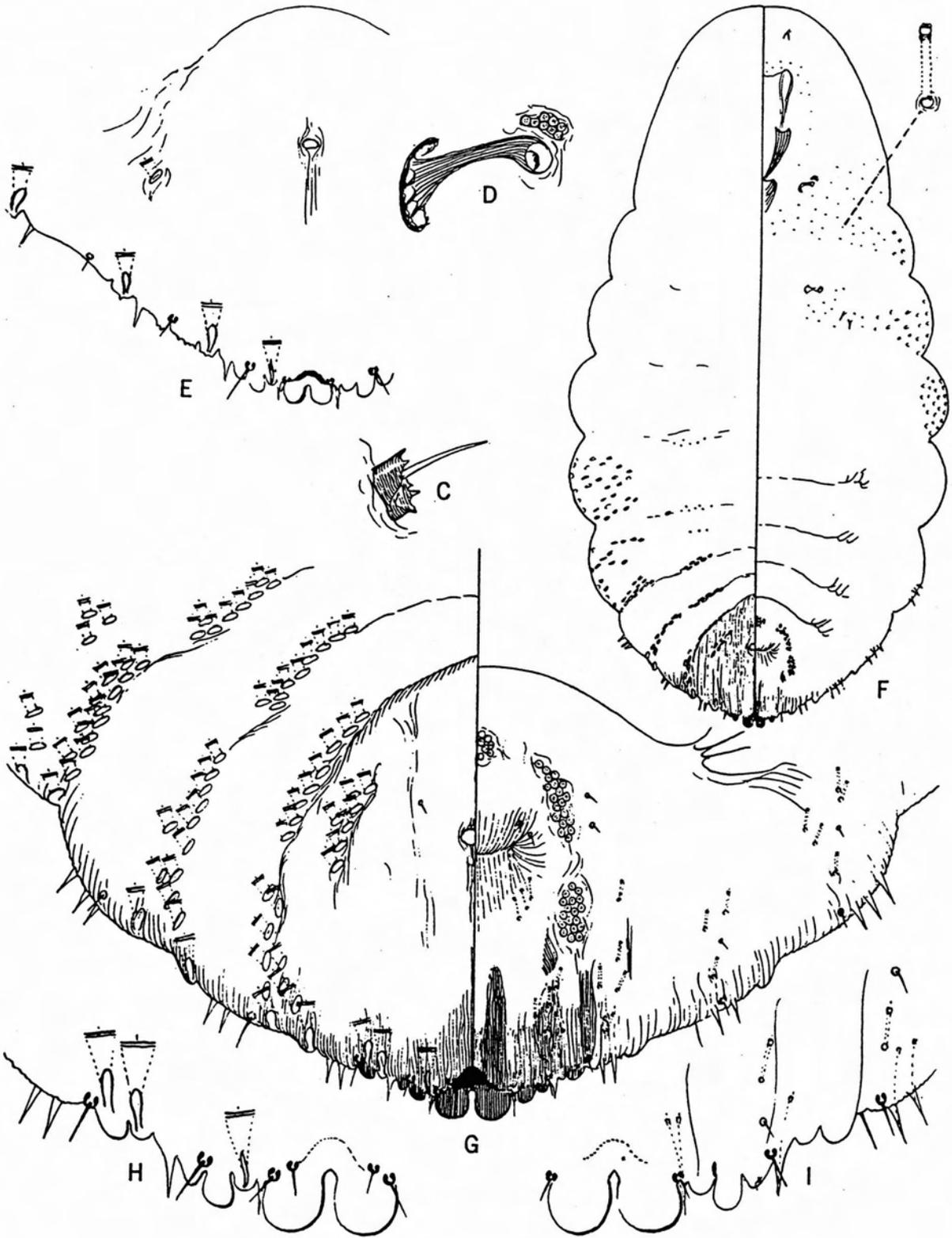


Fig. 38. *Chionaspis sassceri* Cockerell and Robbins.

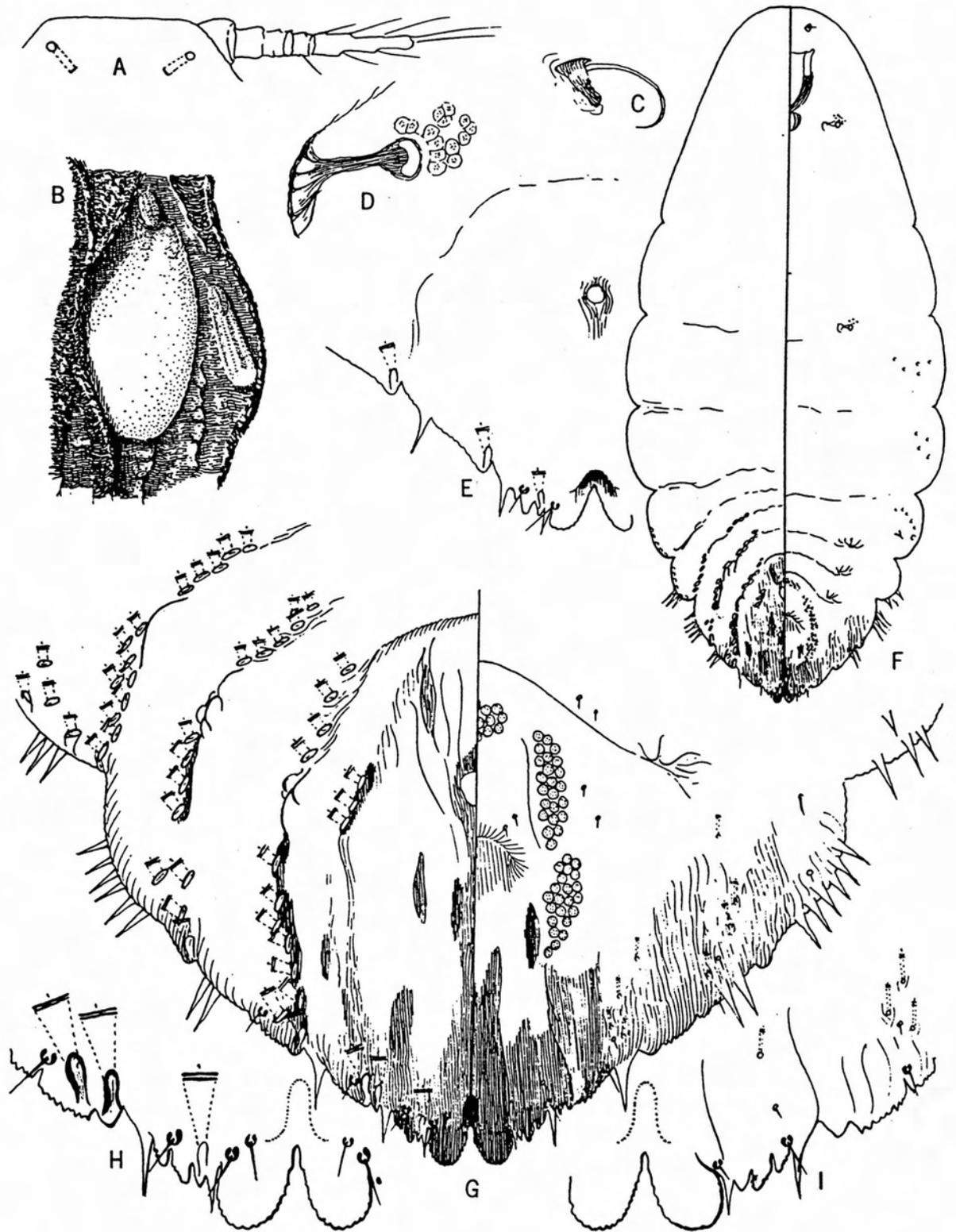


Fig. 39. *Chionaspis wistariae* Cooley.

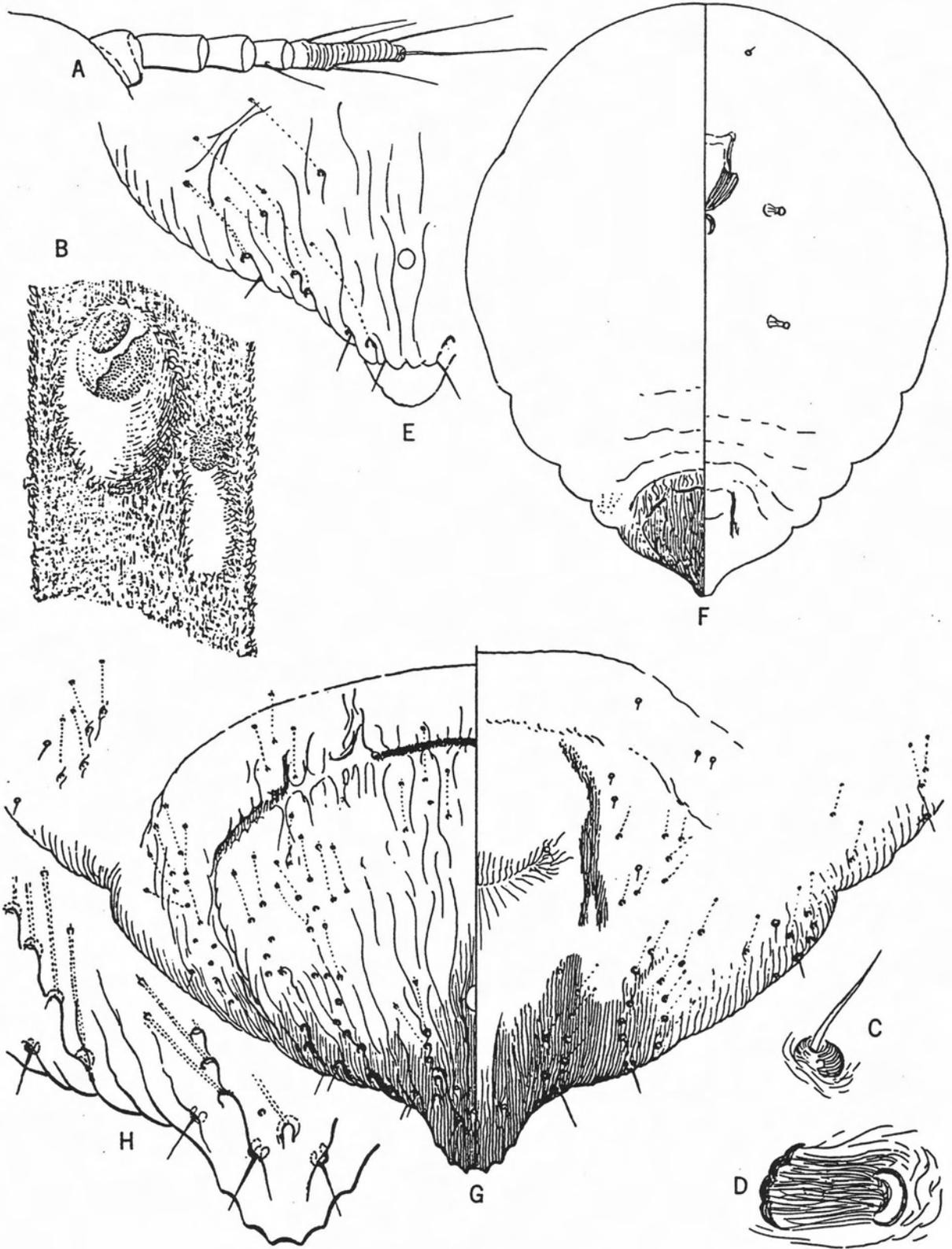


Fig. 40. *Chortinaspis consolidata* Ferris.

with a white oystershell scale cover. Adult females 1.5 to 2.0 mm long, elongate, usually narrow, somewhat convex, white, with yellowish-orange terminal exuviae. Body orange or reddish-orange; eggs orange. Male scales elongate, white, strongly tricarinate with a terminal exuvium. Found on stems, usually between bark cracks; occasionally found on leaves.

Biology: Unknown.

Hosts: Generally restricted to wistaria.

Economic Importance: None.

Distribution: Rare in California; collected only

occasionally from various locations in Southern California and on Treasure Island, Alameda County. Currently exists on wistaria in Huntington Gardens, San Marino, Los Angeles County. Native to Japan.

Diagnosis: Morphology of leaf-infesting forms differs from that of stem-infesting forms (see *Phenacaspis fujicola* in McKenzie, 1956). Best recognized by host preference.

Kosztarab, M., 1963: Bull. Ohio Biol. Surv. (n.s.) 2(2):1-120.

Genus *Chortinaspis* Ferris, 1938

Number of World Species: 14.

Number of United States Species: 3

Key to World Species: Ferris, G.F., 1946: Microentomol. 11(1):37-49.

Chortinaspis consolidata Ferris, 1941

grass scale

Fig. 40

Tribe: Aspidiotini?

Synonymy: Placed in the genus *Discodiaspis* by Munting (1968), but probably unjustifiably since *Discodiaspis* is restricted to the Old World.

Field Characteristics: Adult female scale covers 2 mm in diameter, circular, white, with terminal exuviae. Male scale cover elongate, white, with terminal exuvium. Occurs on stems, often partially concealed by host tomentum.

Hosts: Prefers *Hilaria rigida*. Occurs on native grasses.

Distribution: Rare; collected from Old Woman Springs, San Bernardino County; Ogilby, Im-

perial County; Yuma, Arizona.

Diagnosis: Included in the Aspidiotini but since both male and female scale covers have terminal exuviae, it may belong elsewhere. Studies of the earlier stages and adult males should clear up this problem. The only *Chortinaspis* species lacking well developed median lobes.

McKenzie, H.L., 1956: The Armored Scale Insects of California. Univ. Calif. Press, Berkeley. 209 pp.

Munting, J., 1968: J. Entomol. Soc. South Afr. 31(2):317-333.

Genus *Chrysomphalus* Ashmead, 1880

Number of World Species: 12.

Number of United States Species: 3.

Key to the World Species: McKenzie, H.L., 1943: Calif. Dep. Agric. Bull. 32(2):148-162.

Key to the United States species: McKenzie, H.L., 1956: The Armored Scale Insects of California, Univ. Calif. Press, Berkeley. 209 pp.

KEY TO CALIFORNIA SPECIES OF *CHRYSOMPHALUS*

- 1. With a crowded, submarginal cluster of macroducts on at least one prepygidial segment 2
- With not more than two or three marginal ducts on any prepygidial abdominal segment; plates beyond the third lobe conspicuously clubbed. *dictyospermi*
- 2. With such a cluster of ducts on but one segment. *aonidum*
- With such a cluster of ducts on two segments. *bifasciculatus*

Chrysomphalus aonidum (Linnaeus), 1758

Florida red scale (ESA approved)

Fig. 41, Color Plates 34, 35

Tribe: Aspidiotini.

Other Common Names: Black scale (used in some Mediterranean countries), circular black scale, circular scale, fig scale.

Synonymy: *Coccus aonidum* Linnaeus, *Aspidiotus ficus* Ashmead, *Chrysomphalus ficus* (Ashmead).

Field Characteristics: Adult females 1.5 to 2.5 mm in diameter, circular, flat, bluish-black with reddish brown central exuviae. Bodies yellow. Male scales similar in color but more oblong. Feeds primarily on host leaves.

Similar Species: Indistinguishable from bifasciculate scale (*C. bifasciculatus*) in the field. Similar to buckeye scale (*Diaspidiotus aesculi*), but that species usually feeds on the branches.

Biology: Has up to 5 or 6 annual generations. For a thorough study of the biology see Mathis (1947).

Hosts: Polyphagous. For host lists see Dekle (1976) and Mathis (1947).

Economic Importance: None in California. A pest of citrus in Florida, Texas and the Mediterranean. For more on economic importance see Ebeling (1959), Rosen and DeBach (1978), Mathis (1947) and Hafez et al. (1970).

Distribution: Collected frequently in quarantine and has been collected in a number of California nurseries, but there are currently no known infestations in California. Elsewhere occurs in most states and in most tropical and subtropical areas of the world. Apparently native to the Orient.

Diagnosis: The only commonly encountered species with a black scale cover and reddish exuviae except for bifasciculate scale. Morphologically separated from other *Chrysomphalus* species because it has only one pair of prepygidial macroduct clusters.

Dekle, G.W., 1976: Florida Armored Scale Insects. Fla. Dept. Agric. Cons. Serv., Div. Plant Ind., Gainesville. 345 pp.

Ebeling, W., 1959: Subtropical Fruit Pests. Univ. Calif. Div. Agric. Sci. Bull., Los Angeles. 436 pp.

Hafez, M., M.F.S. Tawfik and A. Raouf, 1970: U. A. R., Min. Agric. Tech. Bull. 2:1-97.

Rosen, D., and P. DeBach, in C.P. Clausen, Ed., 1978: U.S. Dep. Agric. Agric. Handb. 480: 1-545.

Mathis, W., 1947: Fla. Entomol. 29:13-35.

Chrysomphalus bifasciculatus Ferris, 1938

bifasciculate scale

Fig. 42, Color Plate 36

Tribe: Aspidiotini.

Other Common Names: False Florida red scale.

Field Characteristics: Adult females 1.5 to 2.5 mm in diameter, nearly circular, flat, dark grey to black with orange or reddish brown

central exuviae. Bodies yellow. Males similarly colored, oval with a subcentral exuvium. Found primarily on the leaves of the host.

Similar Species: Cannot be separated from Florida red scale in the field.

Biology: Little known. Murakami (1970) states that there are two yearly generations in Japan.

Hosts: Polyphagous.

Economic Importance: None.

Distribution: A tropical form occasionally seen

in quarantine samples. A small infestation on *Euonymus* at Lodi, San Joaquin County is the only known California infestation.

Diagnosis: Separated from the other species of *Chrysomphalus* because it has two pairs of prepygidial macroduct clusters.

McKenzie, H.L., 1956: The Armored Scale Insects of California. Univ. Calif. Press, Berkeley. 209 pp.

***Chrysomphalus dictyospermi* (Morgan), 1889**
dictyospermum scale (ESA approved)
Fig. 43, Color Plate 37

Tribe: Aspidiotini.

Other Common Names: Morgan's scale, Spanish red scale.

Synonymy: *Aspidiotus dictyospermi* Morgan, *Aspidiotus mangiferae* Cockerell, *Aspidiotus dictyospermi* var. *arecae* Newstead, *Aspidiotus dictyospermi* var. *jamaicensis* Cockerell, *Chrysomphalus minor* Berlese and Leonardi, *Aspidiotus agrumicola* Gregorio, *Chrysomphalus castigatus* Mamet.

Field Characteristics: Adult females 1.5 to 2.0 mm in diameter, flat, circular, greyish or reddish brown, often with a coppery tinge. Bodies yellow. Males similar in color, oval with subcentral exuviae. Prefers the host leaves.

Similar Species: Resembles California red scale in the field.

Biology: Has produced 3 to 4 overlapping yearly generations in California (Rosen and DeBach, 1978).

Hosts: Commonly encountered on palms and *Dracaena* in quarantine. Common on *Citrus* in some areas. Otherwise polyphagous.

Economic Importance: A serious pest of citrus in Florida and the western Mediterranean region, a minor citrus pest in Mexico and South America. Also a pest of palms and avocados. Infested citrus orchards in Ventura County in the 1950s and caused much con-

cern. However, these and populations also infesting palms have declined. The above economic information summarized from Chamberlin (1927), Dekle (1976), Ebeling (1959) and Mackie, (1931). For information on natural enemies see Rosen and DeBach (1978).

Distribution: Once common in southern California. Natural enemies were introduced for control and were so effective that no populations are now known to occur outdoors in California. Cosmopolitan in other tropical and subtropical areas of the world.

Diagnosis: The only California *Chrysomphalus* lacking prepygidial macroduct clusters.

Chamberlin, J.C., 1927: Calif. Dep. Agric. Mon. Bull. 16(9):484-491.

Dekle, G.W., 1976: Florida Armored Scale Insects. Fla Dep. Agric. Cons. Serv., Div. Plant Ind., Gainesville. 345 pp.

Ebeling, W., 1959: Subtropical Fruit Pests. Univ. Calif. Div. Agric. Sci. Bull., Los Angeles. 436 pp.

Mackie, D.B., 1931: Calif. Dep. Agric. U.S. Dep. Agric. Mon. Bull. 20(7):419-441.

Rosen, D., and P. DeBach, in C.P. Clausen, Ed., 1978: U.S. Dep. Agric. Agric. Handb. 480: 1-545.

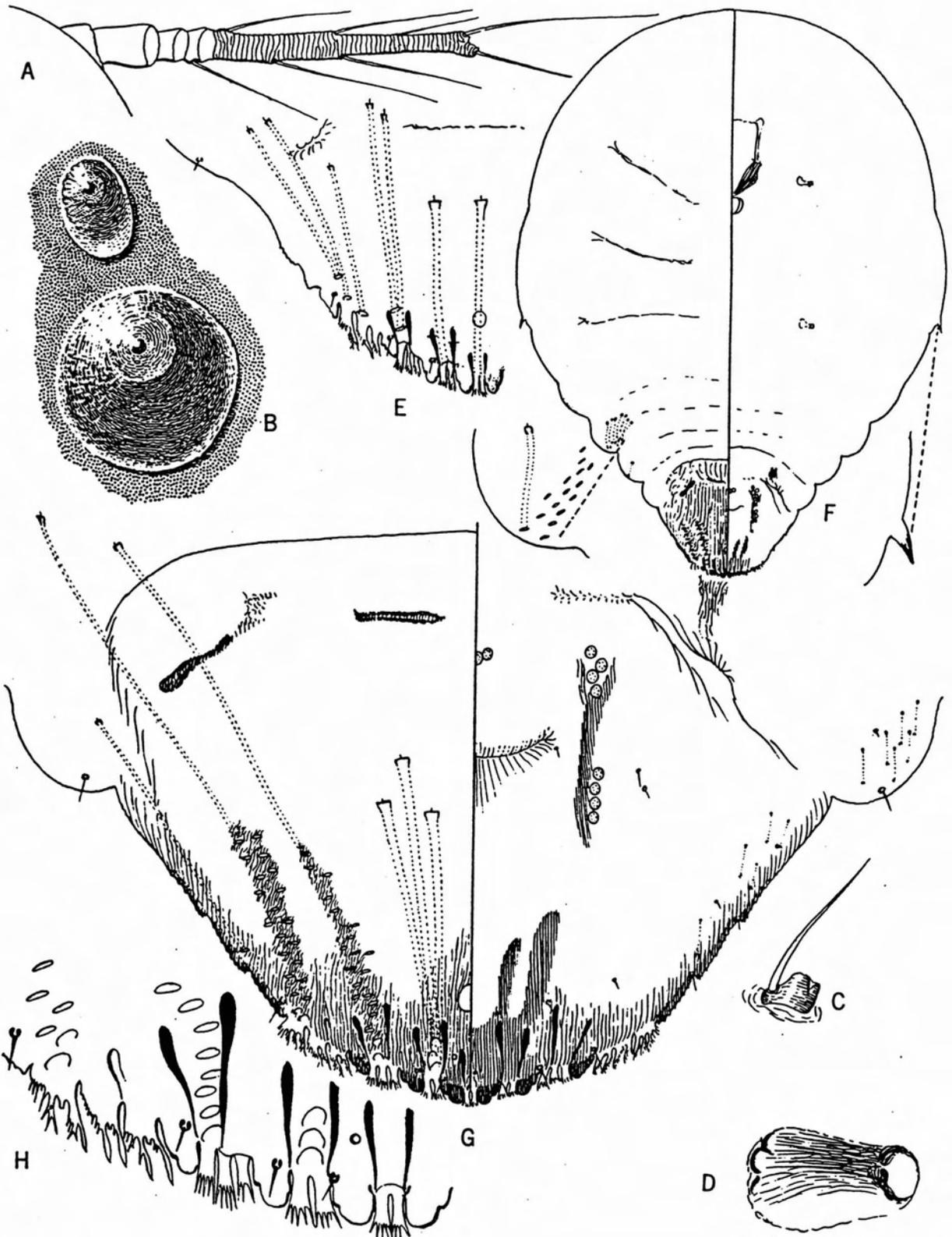


Fig. 41. *Chrysomphalus aonidum* (Linnaeus).

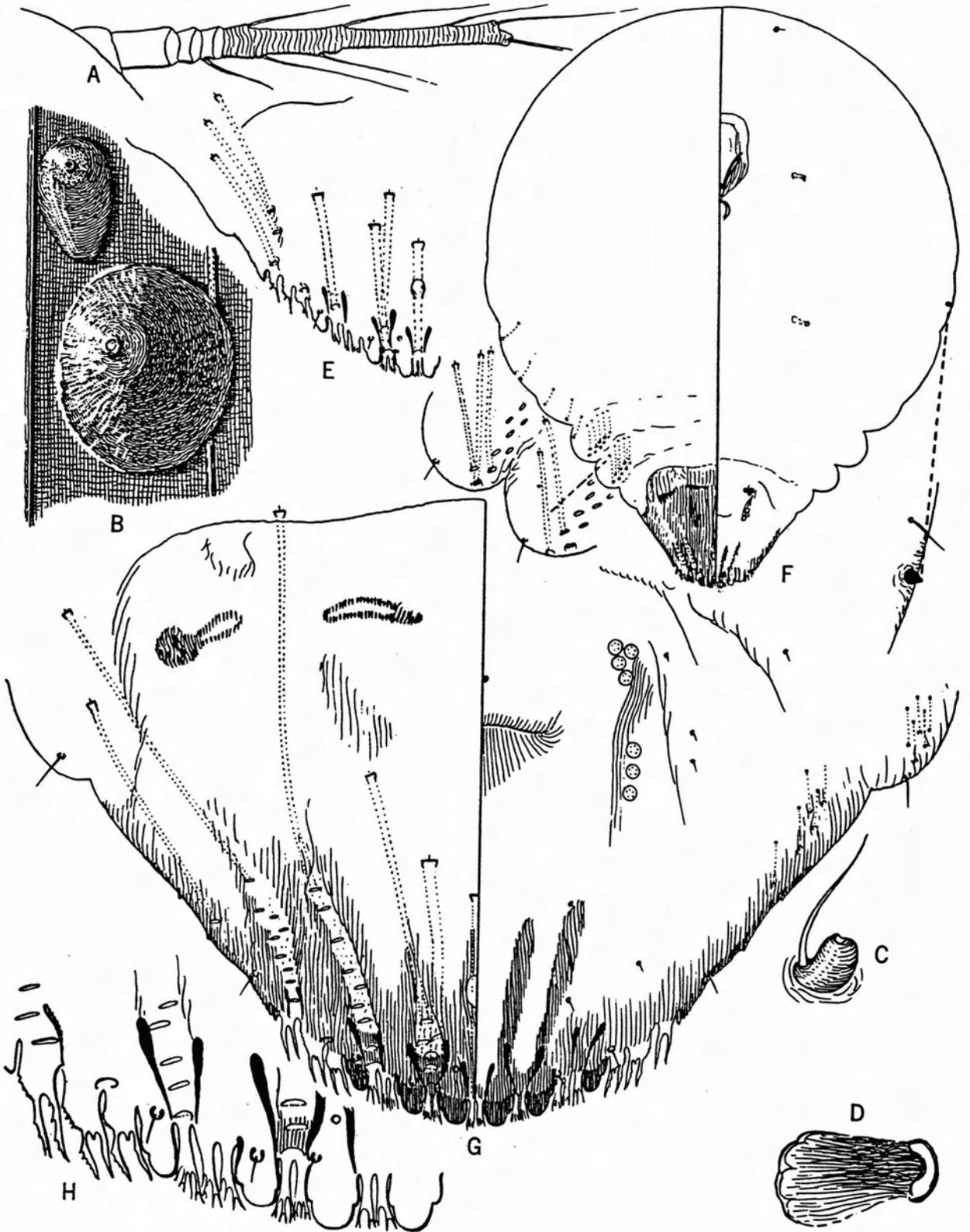


Fig. 42. *Chrysomphalus bifasciculatus* Ferris.

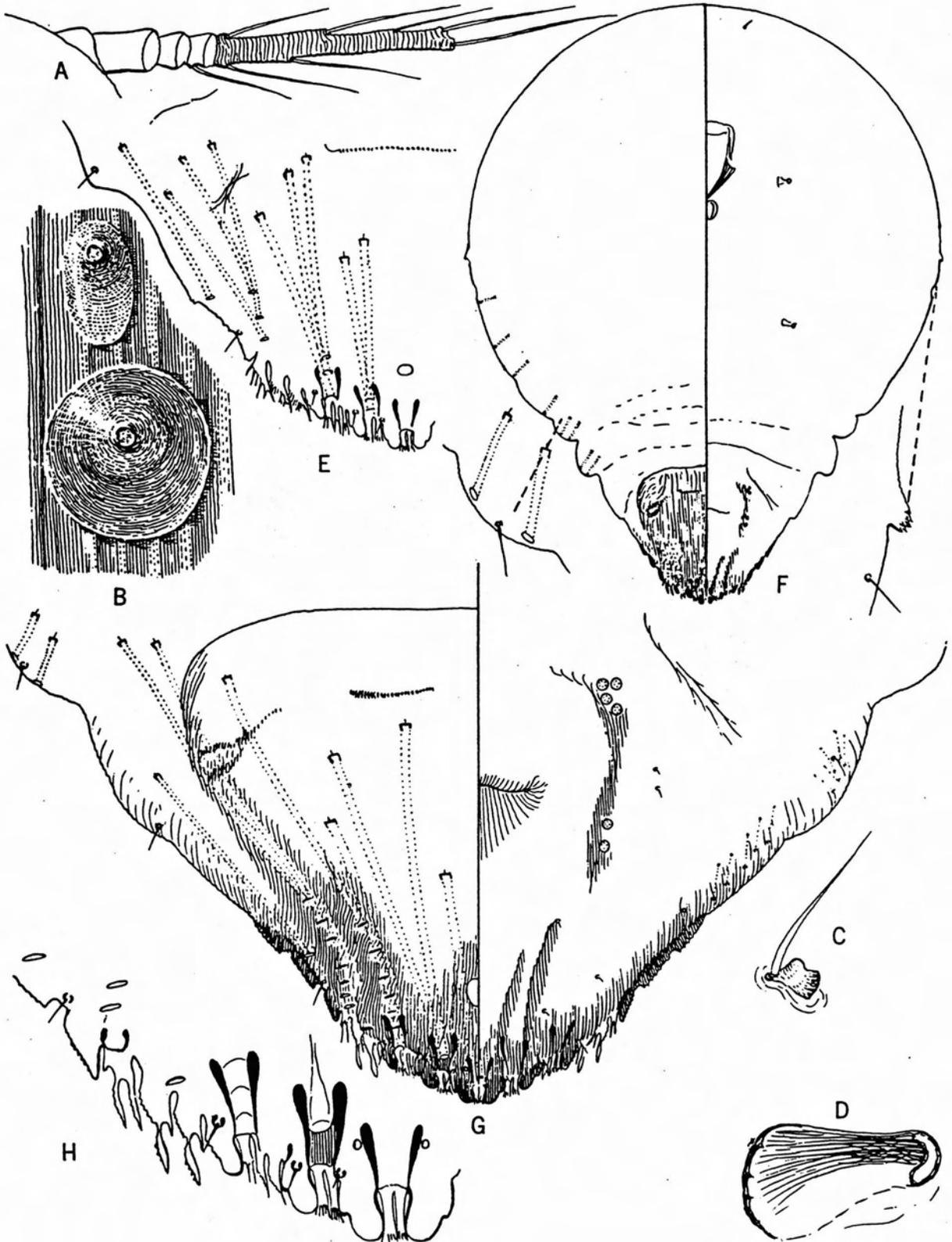


Fig. 43. *Chrysomphalus dictyospermi* (Morgan).

Genus *Clavaspis* MacGillivray, 1921

Number of World Species: 17.

Number of United States species: 9.

Keys to the World species: None.

Keys to the United States species: Ferris, G.F., 1937-1942: Atlas of Scale Insects of North America, Ser. I-IV, Stanford Univ. Press, Stanford, plus *C. barbiger*, Ferris, G.F., 1954: Microentomol. 19(2):41-50 and *C. crypta*, Howell and Tippins, 1975c: Ann. Entomol. Soc. Am. 68(2):338-340.

KEY TO CALIFORNIA SPECIES OF *CLAVASPI*

- 1. Perivulvar pores present, there being normally at least one or two in each of the four lateral groups. 2
- Perivulvar pores lacking; often associated with elm. *ulmi*
- 2. Perivulvar pore groups well developed, there being at least six pores in any one group *disclusa*
- Perivulvar pore groups very weakly developed, there being usually not more than two or three pores in any one group. *covilleae*

Clavaspis covilleae (Ferris), 1919

covillea scale

Fig. 44

Tribe: Aspidiotini.

Synonymy: *Aspidiotus covilleae* Ferris, *Ferrisaspis covilleae* (Ferris).

Field Characteristics: Scale cover light grey or tan, blending with color of host, circular, flat, exuviae central or subcentral. Males similarly colored, oval, with a subcentral exuvium. Usually found on twigs, crowns, and exposed roots, especially under loose bark.

Biology: Unknown.

Hosts: Prefers desert shrubs such as creosote bush (*Larrea*) and sage brush (*Purshia*), but has been found on a wide range of hosts including

olive, almond and pear.

Economic Importance: None.

Distribution: Native to eastern California from Imperial to Modoc counties west to eastern Kern and Los Angeles counties. Prefers desert habitats where it is apparently common but rarely collected.

Diagnosis: For distinguishing characters see McKenzie (1956).

McKenzie, H.L., 1956: The Armored Scale Insects of California. Univ. Calif. Press, Berkeley. 209 pp.

Clavaspis disclusa Ferris, 1938

discluse scale

Fig. 45

Tribe: Aspidiotini.

Other Common Names: Decluse scale (misspelling).

Field Characteristics: Adult female scale cover dark grey, flat, circular, exuviae central and

nearly concealed. Male scale unknown. Occurs on twigs and larger branches.

Similar Species: Resembles San José scale.

Biology: Unknown.

Hosts: Has a wide host range but prefers de-

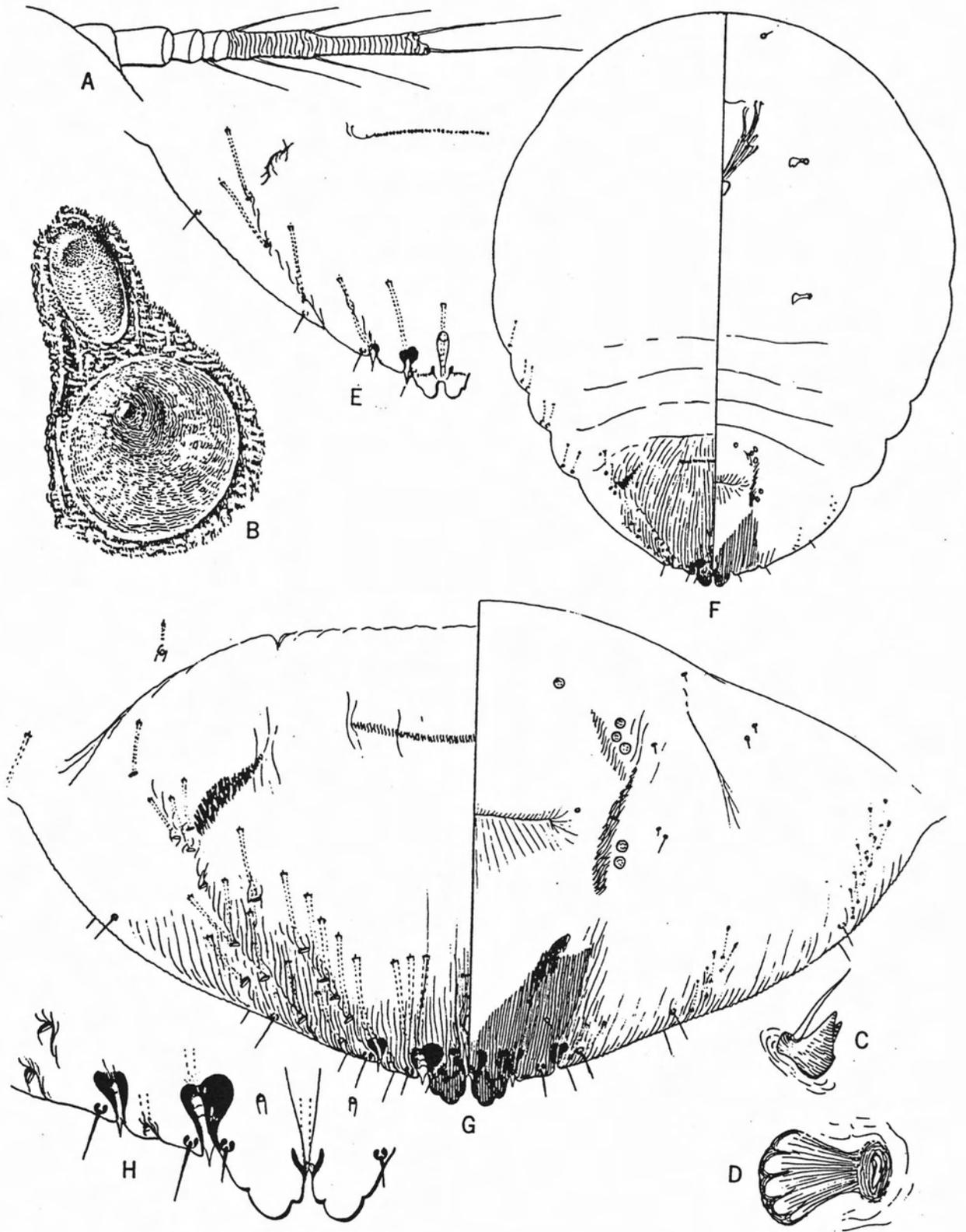


Fig. 44. *Clavaspis covilleae* (Ferris).

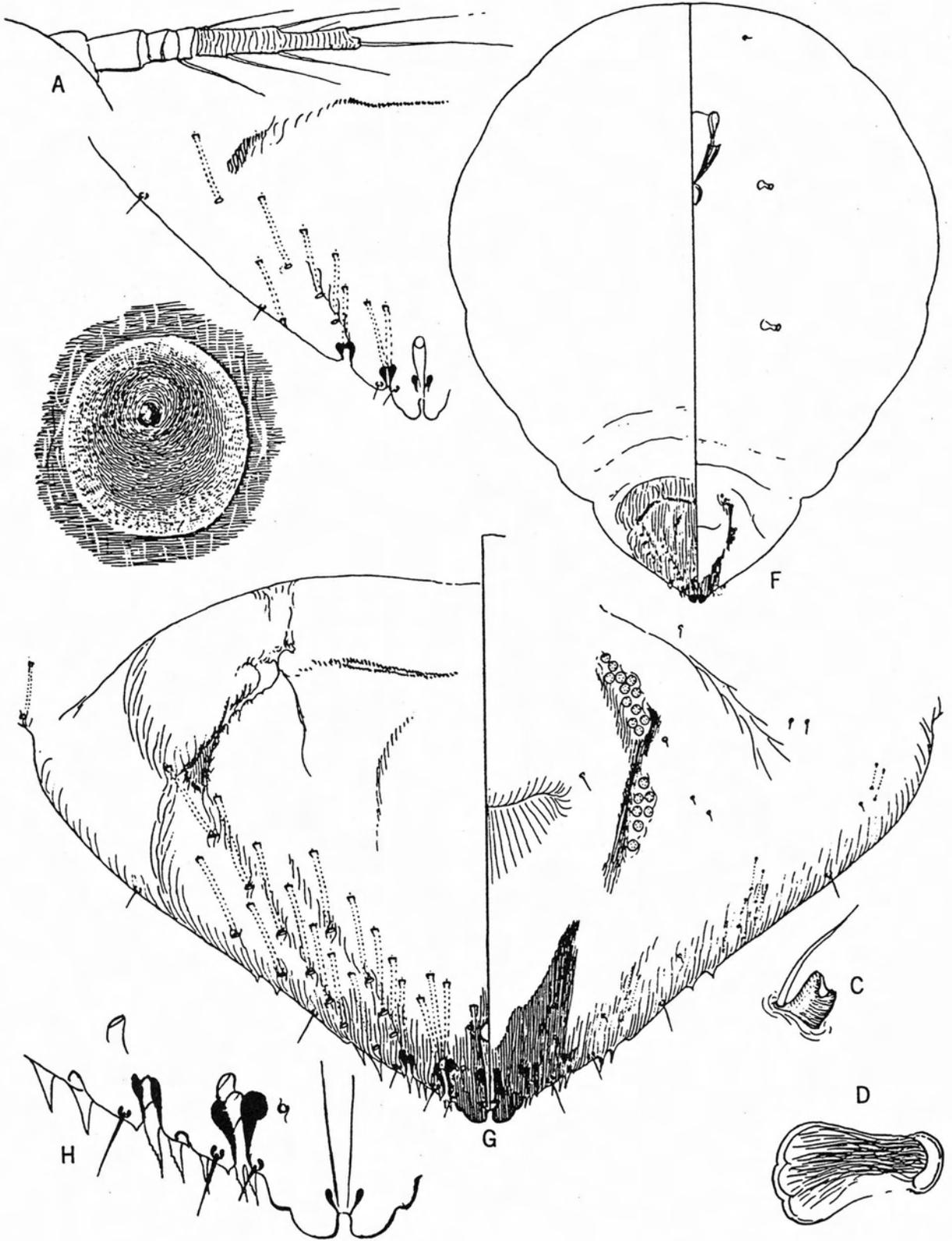


Fig. 45. *Clavaspis disclusa* Ferris.

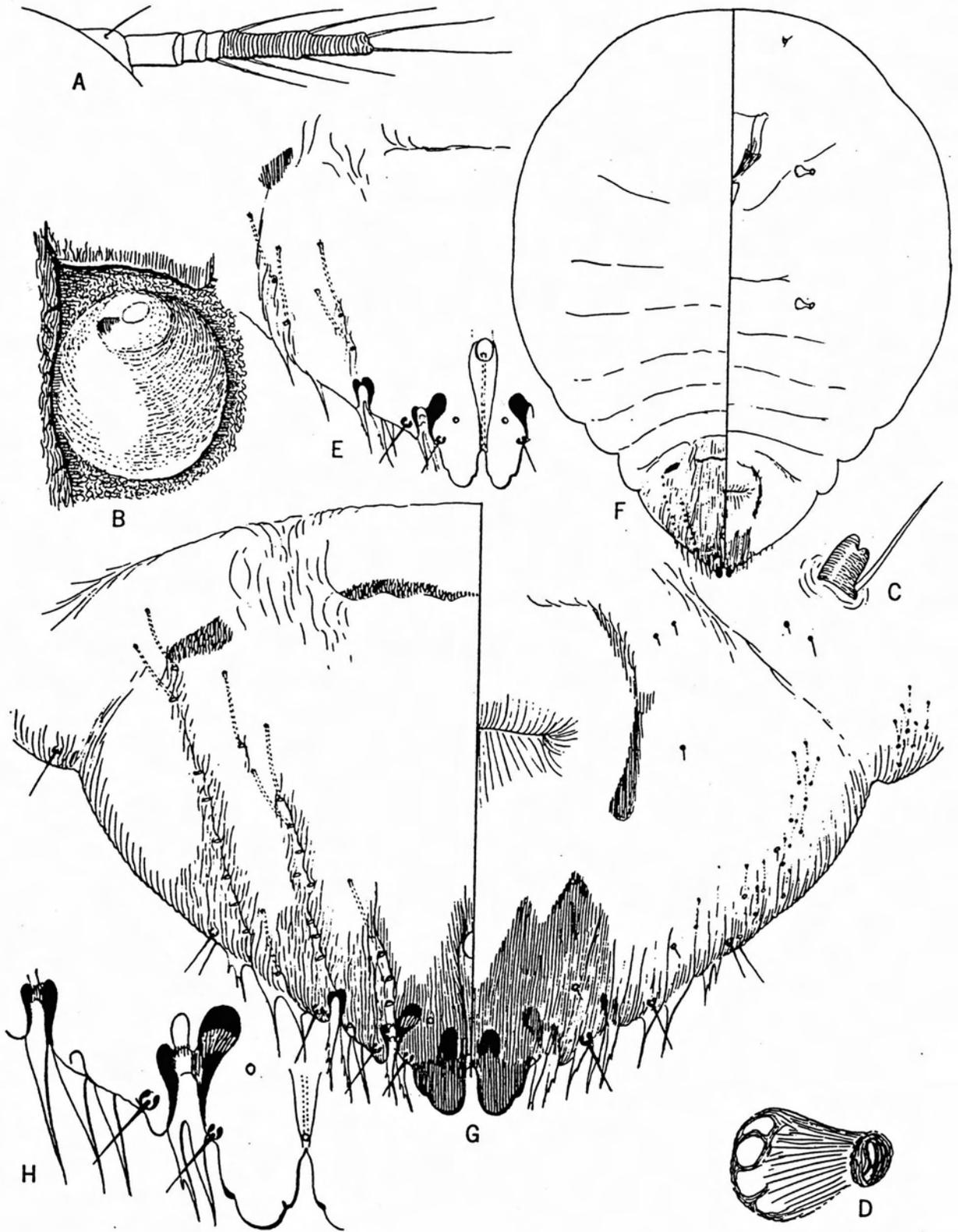


Fig. 46. *Clavaspis ulmi* (Johnson).

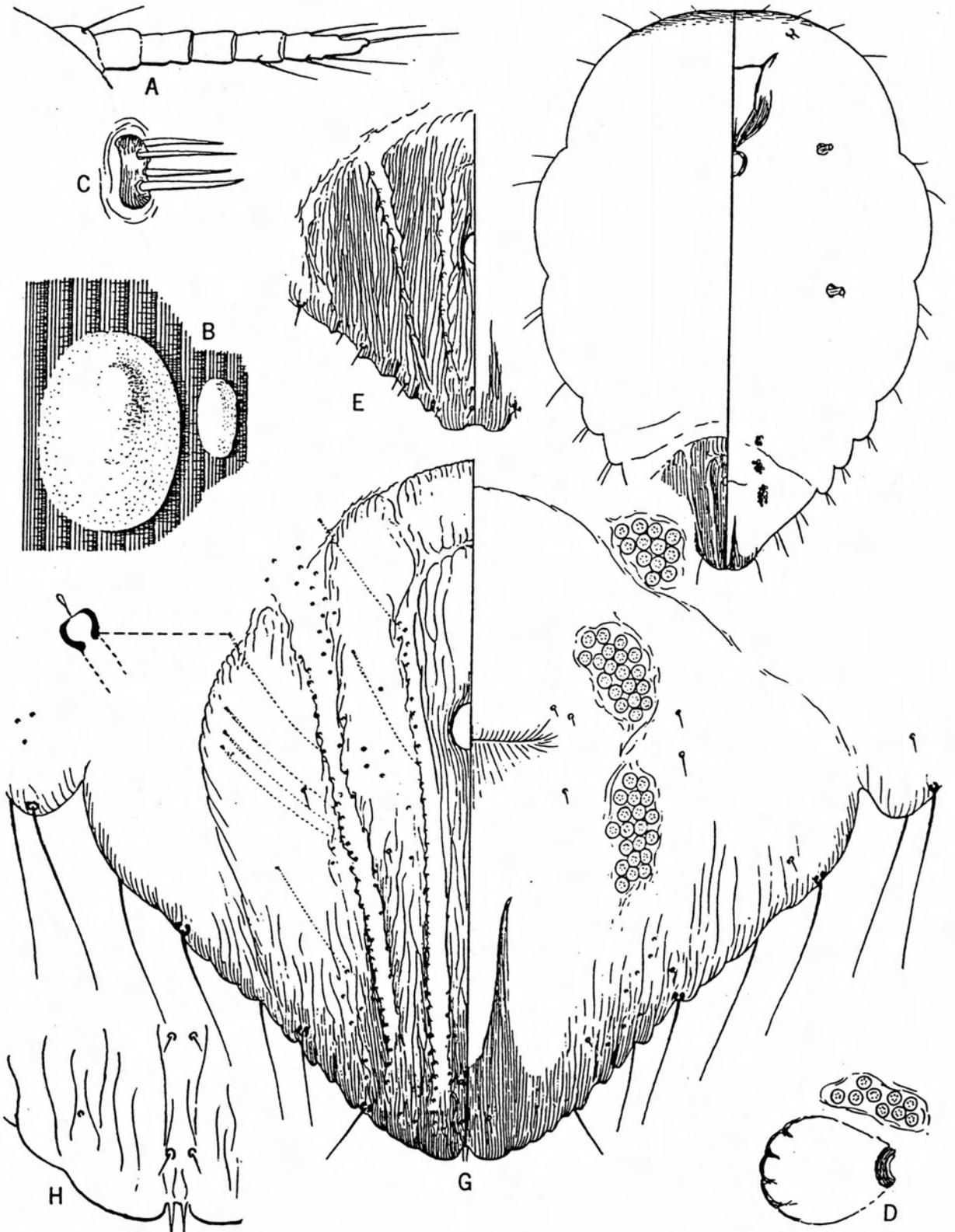


Fig. 47. *Comstockiella sabalis* (Comstock).

ARMORED SCALE INSECTS OF CALIFORNIA

ciduous trees such as walnut, pecan, ash, dogwood, peach and oak.

Economic Importance: None.

Distribution: Described from Camarillo, Ventura County on Persian walnut in 1936. Found in numerous localities in the State as far north as Tahoe City, Placer County between then and 1953. It has not been collected since

CLAVASPIS to COMSTOCKIELLA

and its current status is unknown. May well be a synonym of *Diaspidiotus osborni*.

Diagnosis: For distinguishing characteristics see McKenzie (1956).

McKenzie, H.L., 1956: The Armored Scale Insects of California. Univ. Calif. Press, Berkeley. 209 pp.

Clavaspis ulmi (Johnson), 1896

elm clavaspis scale

Fig. 46, Color Plate 38

Tribe: Aspidiotini.

Other Common Names: elm aspidiotus.

Synonymy: *Aspidiotus ulmi* Johnson, *Hendaspidiotus ulmi* (Johnson), *Aonidiella ulmi* (Johnson).

Field Characteristics: Adult female scale covers 1.0 to 1.5 mm in diameter, circular, flat, white, with yellow central exuviae. Male scales present but scale covers not described in the literature. Probably similar to the females in color. Found on trunk and branches of host, usually under loose outer bark and in bark cracks.

Similar Species: Latania scale is similar in the field, particularly since in long-established infestations on bark, scale covers of previous generations cling to the host and become lighter and flattened. However, host restriction and distribution in California should aid in recognizing *ulmi*.

Biology: Little known. Kosztarab (1963) states that it overwinters as second stage nymphs. Crawlers hatch in May.

Hosts: Prefers elm and catalpa. Also known

from maple, linden and buckeye.

Economic Importance: Has never caused any measurable or noticeable economic injury in California or elsewhere. For information on natural enemies see Kosztarab (1963).

Distribution: Collected in a 1/2-square mile area in Burlingame, San Mateo County in 1967. Infested primarily 30 to 45 year-old trees on which it was probably introduced. Current status of infestation unknown. Apparently native to the Midwest.

Diagnosis: The only species of *Clavaspis* which has well-developed, long pygidial plates, three sets of pygidial macroducts in definite rows, and few or no perivulvar pores (some California specimens have 2 or 3 pores on either side). Ferris' (1937) key to the genus lists no perivulvar pores in this species.

Ferris, G.F., 1937-1942: Atlas of the Scale Insects of North America, Ser. I-IV., Stanford Univ. Press, Stanford: Number SII:211

Kosztarab, M., 1963: Bull. Ohio Biol. Surv. (n.s.) 2(2):1-120.

Genus *Comstockiella* Cockerell, 1896

A monotypic genus.

Comstockiella sabalis (Comstock), 1883

palmetto scale

Fig. 47, Color Plates 39-41

Tribe: Aspidiotini.

Synonymy: *Aspidiotus sabalis* Comstock.

Field Characteristics: Adult female scale covers circular, flat, pure white, with central exu-

viae usually covered with white wax and not visible. Male scale covers oval, white, with a covered subterminal exuvium.

Hosts: Infests fronds and petioles of palms

and palmetto (*Sabal*).

Economic Importance: None in California.

Distribution: Several collections reported from Southern California but no active infestations known at the present time. Often encountered on palms from Florida.

Diagnosis: Resembles the Odonaspidines in that there are no median lobes, plates, or gland spines on the pygidial margin. It is placed in this tribe because it possesses long, slender macroducts in rows and because the scale cover is not of the bivalve type. Howell (1979) described and illustrated the adult male. First instars were described and illustrated by Howell and Tippins, (1977).

Dekle, G.W., 1976: Florida Armored Scale Insects. Fla. Dept. Agric. Cons. Serv., Div. Plant Ind., Gainesville. 345 pp.

Howell, J.O., 1979: Ann. Entomol. Soc. Am. 72(4):556-558.

Howell, J.O. and H.H. Tippins, 1977b: Ann. Entomol. Soc. Am. 70(1):119-135.

McKenzie, H.L., 1956: The Armored Scale Insects of California. Univ. Calif. Press, Berkeley. 209 pp.

Rosen, D., and P. DeBach, in C.P. Clausen, ed., 1978: U.S. Dept. Agric., Agric. Handb. 480:1-545.

Tippins, H.H., and R.J. Beshear, 1968: J. Ga. Entomol. Soc. 3(2):67-69.

Genus *Cupidaspis* MacGillivray, 1921

This genus was proposed by MacGillivray (1921) for *Leucaspis cupressi*. Ferris (1937) felt that this species was not different enough from species in the Old World genus *Lineaspis* to warrant this change, but Howell and Tippins (1977) found ample differentiating characters in North American material to justify the use of *Cupidaspis*.

Ferris, G.F., 1937-1942: Atlas of the Scale Insects of North America, Ser. I-IV. Stanford Univ. Press, Stanford.

MacGillivray, A.D., 1921: The Coccidae. Scarab Co., Urbana. 502 pp.

Howell, J.O., and H.H. Tippins, 1977: Ann. Entomol. Soc. Am. 70(6):898-900.

KEY TO CALIFORNIA SPECIES OF CUPIDASPIS
(Taken from Howell and Tippins, 1977)

- 1. With anal opening anterior to vulva; dorsal submarginal macroducts present on 6th abdominal segment; dorsal submedian microducts lacking from abdominal segments 3-4 *cupressi*
- With anal opening usually posterior to vulva; dorsal submarginal macroducts lacking from 6th abdominal segment; dorsal submedian microducts present on abdominal segments 3-4 *beshearae*

***Cupidaspis beshearae* Howell and Tippins, 1977**

Beshear scale

Fig. 48, Color Plates 42, 43

Tribe: Diaspidini.

Other Common Names: California lineaspis scale.

Synonymy: *Lineaspis cupressi* (Coleman)

(misidentification). This species has been frequently confused with what is now called *Cupidaspis cupressi*. Howell and Tippins (1977) made the distinction between the two species

and resurrected the genus *Cupidaspis*.

Field Characteristics: Adult female scale covers 1.0 to 1.5 mm long, oystershell-shaped, moderately convex, pure white, with yellow or whitish terminal exuviae. Body dark red. Scale covers often irregular and undulated, as a result of conforming with the irregularly shaped host needles. Usually gregarious; easily seen because of their broad shape and striking color. Males elongate, white, smaller than females, with a terminal yellow exuvium. Occurs on leaves (needle clusters) of host.

Biology: Unknown.

Similar Species: Pine needle scale is similar but does not occur on the same hosts. California lineaspis scale occurs on the same hosts, but is much smaller and less conspicuous.

Hosts: Prefers native juniper, but also known from cypress and incense cedar.

Economic Importance: None.

Distribution: Apparently occurs throughout the State wherever native juniper is found. Also occurs throughout the southwest. Native. According to Jim Howell (personal communication) some records for *beshearae* in the paper by Howell and Tippins (1977) actually refer to *C. cupressi*.

Diagnosis: Separated from *C. cupressi* by its lack of dorsal submarginal macroducts on the sixth abdominal segment (present in *cupressi*), smaller and thinner prepygidial macroducts than in *cupressi*, dorsal submedian microducts on segments 3 and 4 (absent in *cupressi*) and anal ring posterior to the vulva (anterior in *cupressi*). For more details see Howell and Tippins (1977).

Howell, J.O., and H.H. Tippins, 1977: Ann. Entomol. Soc. Am. 70(6):898-900.

Cupidaspis cupressi (Coleman), 1903
California lineaspis scale
Fig. 49, Color Plate 44

Tribe: Diaspidini.

Synonymy: *Leucaspis cupressi* Coleman, *Lineaspis cupressi* (Coleman), *Cupidaspis beshearae* Howell and Tippins (misidentification).

Field Characteristics: Very minute; scale cover 1.0 to 1.5 mm long, fairly convex, elongate, transparent white, with yellow terminal exuviae (the 2nd longer and wider than remaining part of scale cover in some specimens). The small size and transparent scale cover makes it extremely difficult to see. Infests needles.

Similar Species: Long confused with *C. beshearae*. In fact, the habitus sketch of *cupressi* in Ferris (1937) and McKenzie (1956) is probably *C. beshearae*, as are many of the distributional records listed by McKenzie. Also similar to *Paracupidaspis wilkeyi* in the field.

Hosts: Cypress, juniper, incense cedar.

Economic Importance: None.

Distribution: Known only from a few locations from Orange County north to Lake County in the Coast Ranges, and from several locations in the Sierra Nevada in Tuolumne, Merced, Shasta and Placer counties.

Diagnosis: See comments under *Cupidaspis beshearae*.

Ferris, G.F., 1937-1942: Atlas of the Scale Insects of North America, Ser. I-IV. Stanford Univ. Press, Stanford.

Howell, J.O., and H.H. Tippins, 1977: Ann. Entomol. Soc. Am. 70(6):898-900.

McKenzie, H.L., 1956: The Armored Scale Insects of California. Univ. Calif. Press, Berkeley. 209 pp.

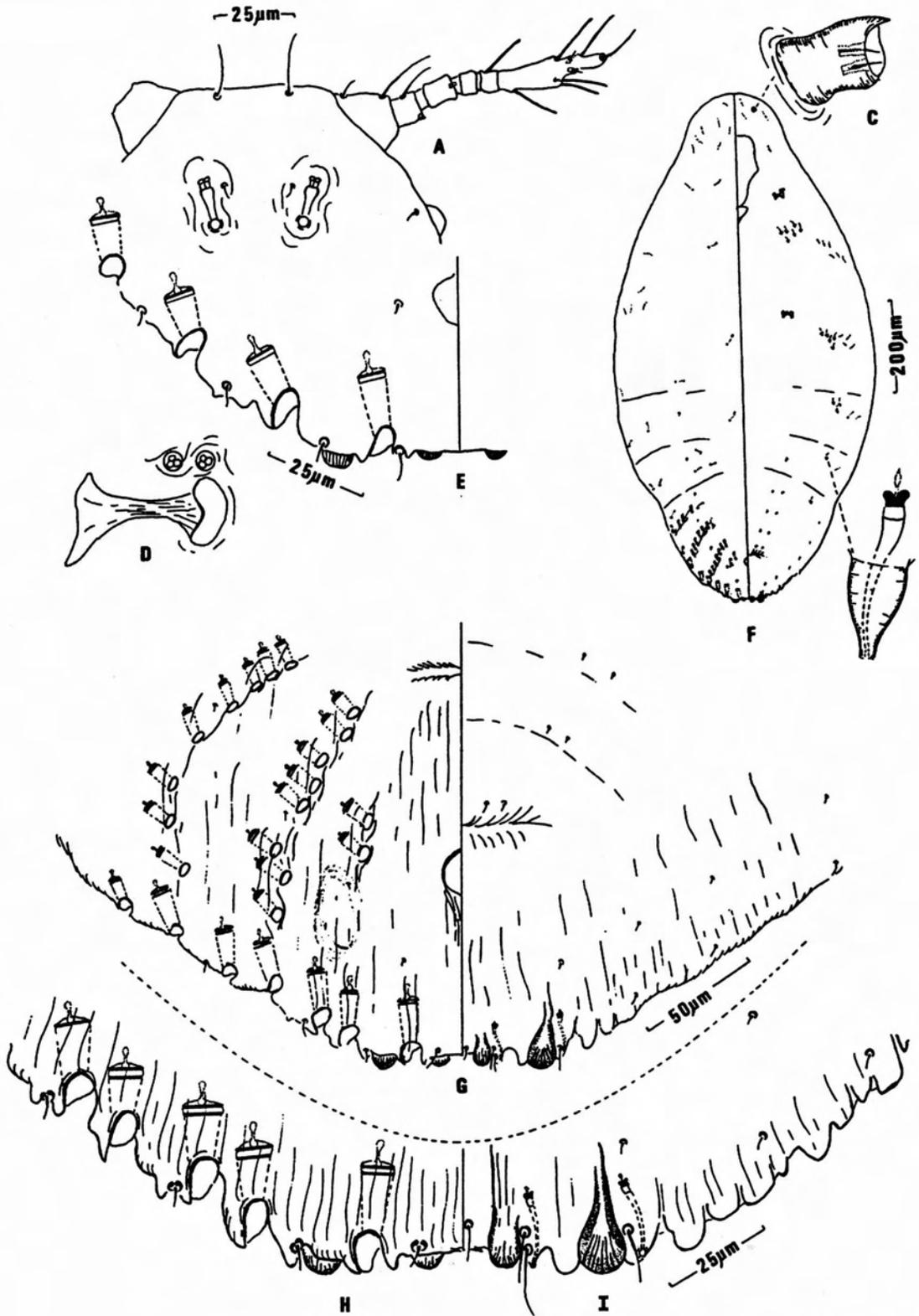


Fig. 48. *Cupidaspis beshearæ* Howell and Tippins.
Adapted from Howell and Tippins, 1977.

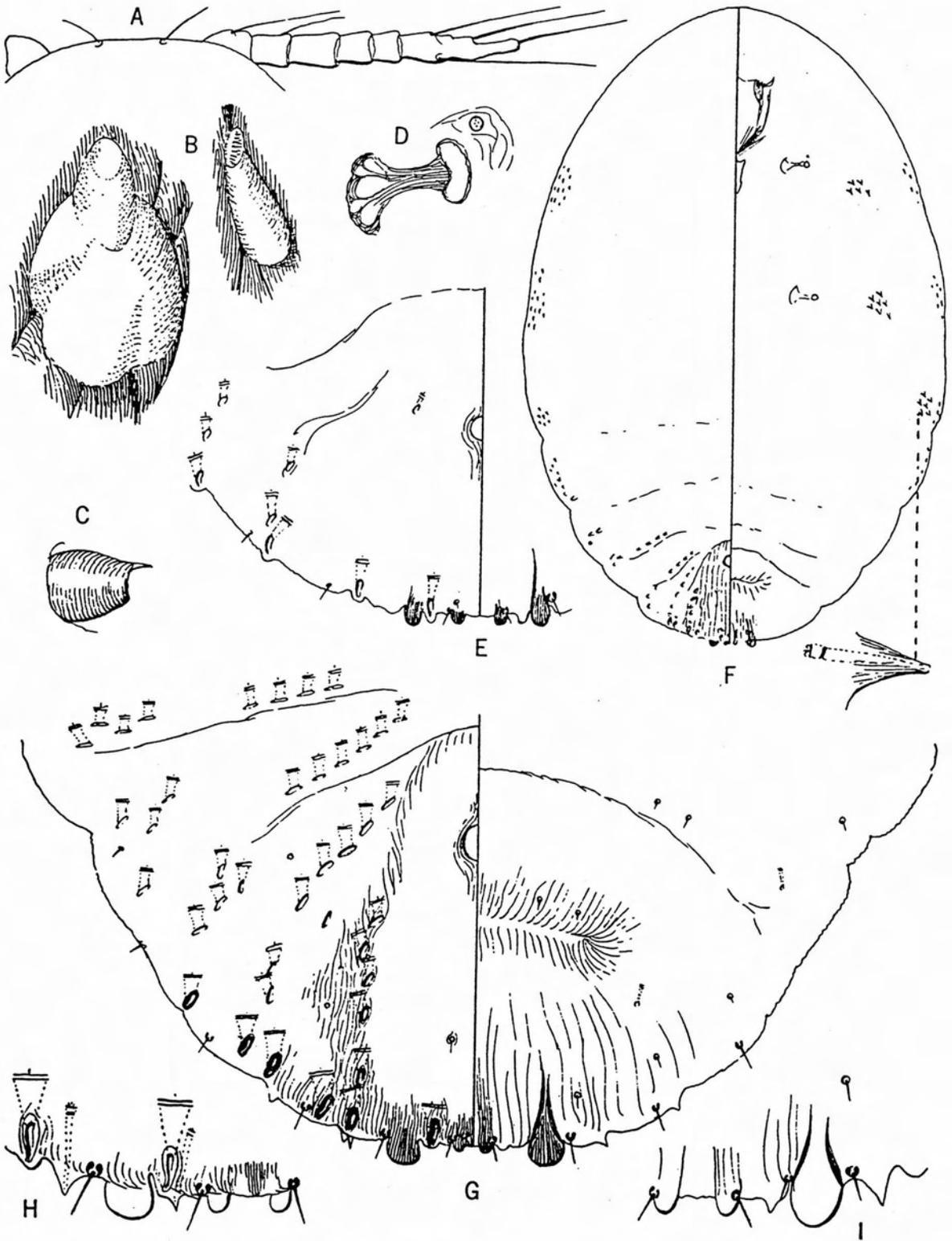


Fig. 49. *Cupidaspis cupressi* (Coleman).

Genus *Cupressaspis* Borchsenius, 1962

Number of World Species: 5.

Number of United States Species: 2.

Key to the World Species: Borchsenius, N.S., 1962: Entomol. Rev. 41:536-541.

Key to the United States species: Ferris, G.F., 1937-1942: Atlas of the Scale Insects of North America, Ser. I-IV. Stanford Univ. Press, Stanford.

***Cupressaspis shastae* (Coleman), 1903**

redwood scale

Fig. 50, Color Plates 45-47

Tribe: Aspidiotini.

Synonymy: *Aspidiotus coniferarum* var. *shastae* Coleman, *Aonidia juniperi* Marlatt, *Aspidiotus shastae* (Coleman), *Gonaspidotus shastae* (Coleman), *Aonidia shastae* (Coleman).

Field Characteristics: Adult females 1.0 to 1.5 mm in diameter; moderately convex; nearly circular; tan or grey; with a central yellow exuvium. Male cover oval, grey; darker than female; with a subterminal yellow exuvium. Females semi-pupillarial, entire adult life is spent inside hardened second instar cast skin. Since no additional material is added to the scale cover after the last nymphal stage, scale covers are small and never have a normal-appearing second exuvium.

Biology: Unknown, except that it is ovoviparous.

Similar Species: The only other similar conifer infesting armored scale in California is *Nuculaspis californica*, but it does not occur on the same hosts.

Hosts: Prefers native juniper but also found on cypress, incense cedar, redwood, giant sequoia and California nutmeg.

Economic Importance: None, although various authors list it as being very common at times, particularly on giant sequoia. For more on the economic importance of this species see Burke (1932), and Furniss and Carolin (1977).

Distribution: Found throughout most of California and the west. Apparently native.

Diagnosis: The reduced second and third pygidial lobes, lack of perivulvar pores, and pupillarial habit distinguish it from other conifer-infesting species in California. *Cupressaspis atlantica* (Ferris) from the east coast and three European species are similar morphologically. Borchsenius (1962) separated the conifer-infesting species from the genus *Aonidia* on the basis of the presence of well-developed gland spines and the well-separated median lobes.

Borchsenius, N.S., 1962: Entomol. Rev. 41:536-541.

Burke, H.E., 1932: Calif. Dep. Agric. Mon. Bull. 21:358-369.

Furniss, R.L., and V.M. Carolin, 1977: U.S. Dep. Agric. Misc. Publ. 1339:1-654.

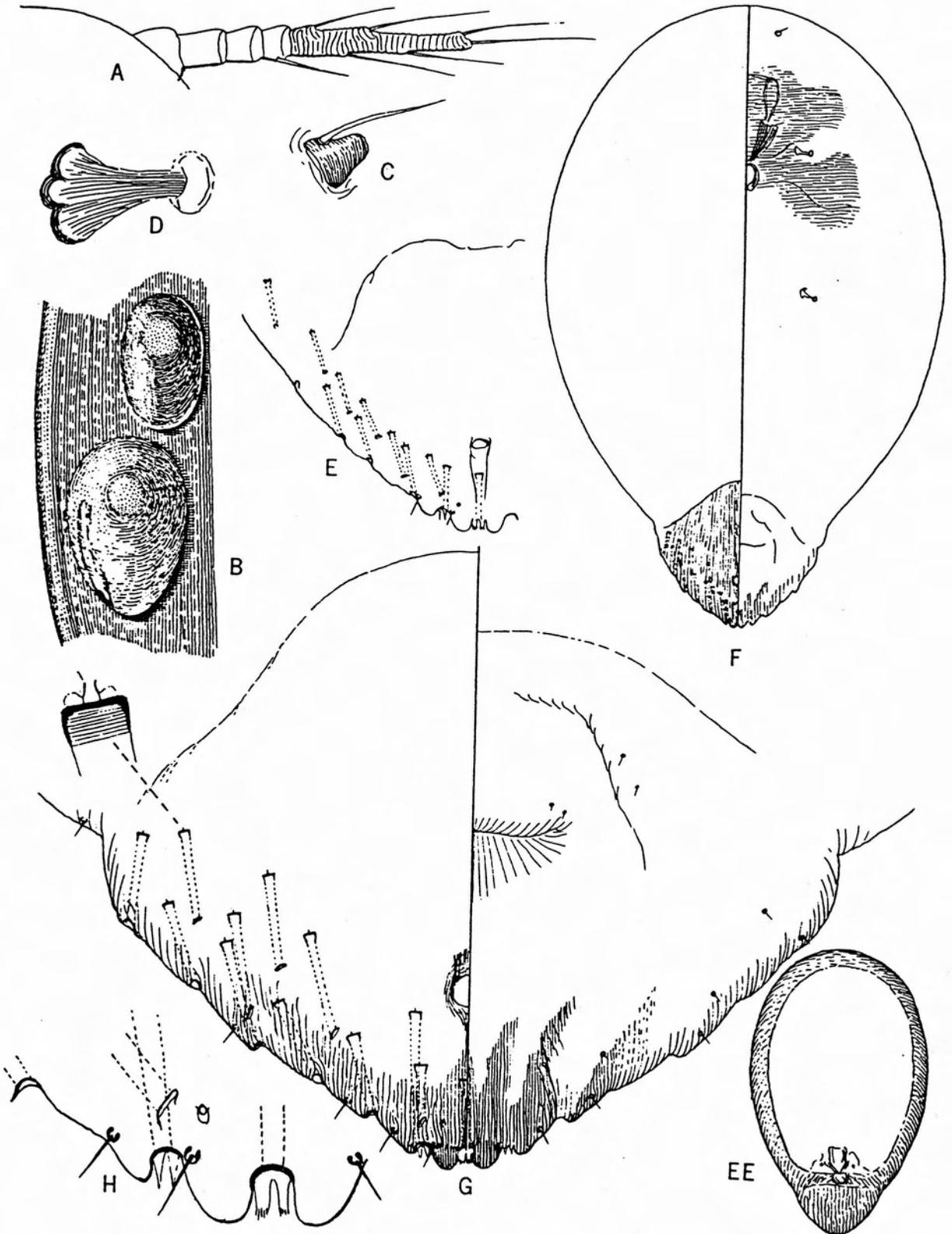


Fig. 50. *Cupressaspis shastae* (Coleman).

Genus *Diaspidiotus* Cockerell, 1897

Number of World species: 37.

Number of United States species: 12.

Key to the World species: None.

Key to the United States species: Ferris, G.F., 1937-1942: Atlas of the Scale Insects of North America, Ser. I-IV. Stanford Univ. Press, Stanford.

Key to the California species: McKenzie, H.L., 1956: The Armored Scale Insects of California. Univ. Calif. Press, Berkeley. 209 pp.

KEY TO CALIFORNIA SPECIES OF *DIASPIDIOTUS*

- 1. Perivulvar pores present. 2
- Perivulvar pores lacking. 6

- 2. With dorsal submedian clusters of ducts on the first pygidial and on prepygidial segments; submarginal ducts conspicuously numerous on the pygidium and prepygidial segments; associated especially with *Aesculus*, but occurring on *Populus* and other hosts in western United States. *aesculi*
- Entirely without dorsal, submedian ducts on any segment. 3

- 3. With definite submarginal rows or series of ducts in the anterior lateral angle of the pygidium, that is, on the fourth abdominal segment; associated with conifers in western United States. *ehrhorni*
- Without ducts in this position other than occasionally one or two. 4

- 4. Plates represented merely by minute, simple points; definitely associated with oaks throughout the United States. *osborni*
- Plates well developed and variously fringed. 5

- 5. Median lobes without a plate between; lobes somewhat elongate; associated especially with grape in eastern United States; rare in California. *uvae*
- Median lobes with a slender plate between; common on many hosts throughout California *ancylus*

- 6. Plates present merely as minute points in the interlobular spaces; associated with conifers throughout western States. *coniferarum*
- Plates well developed, long and laterally toothed, occurring laterad of the site of the third; associated with *Liquidambar*. *liquidambaris*

***Diaspidiotus aesculi* (Johnson), 1869**

buckeye scale

Fig. 51, Color Plates 48-50

Tribe: Aspidiotini.

Other Common Names: California buckeye scale.

Synonymy: *Aspidiotus aesculi* Johnson.

Field Characteristics: Femalescale cover dark grey; circular; flat; with reddish-brown exuviae. Body yellow. Male scale covers similar in color to female but oval. Males may form a

flower-like pattern around the edges of the old parent female scale cover as in walnut scale.

Similar Species: Resembles San José scale but somewhat darker and immatures are not blue-black. Putnam scale is also similar, and field separation is difficult. Florida red scale and bifasciculate scale are similar in color but they would not occur in the same habitats.

Hosts: Normally found on bark of poplar, willow, ash, alder and buckeye; occasionally on walnut in the Sacramento Valley. Does not

prefer same hosts as San José scale.

Economic Importance: None, although it does cause shallow pitting on twigs of some hosts.

Distribution: Throughout the State; apparently native to western United States.

Diagnosis: Easily recognized by the dorsal submedial abdominal duct clusters.

McKenzie, H.L., 1956: The Armored Scale Insects of California. Univ. Calif. Press, Berkeley. 209 pp.

Diaspidiotus ancylus (Putnam), 1877

Putnam scale (ESA approved)

Fig. 52

Tribe: Aspidiotini.

Synonymy: *Diaspis ancylus* Putnam, *Aspidiotus ancylus* (Putnam), *A. aesculi* var. *solus* Hunter, *Aspidiotus solus* (Hunter), *Aspidiotus ohioensis* (York), *A. oxycrataegi* Hollinger. This species is dimorphic (see Diagnosis) and Howard scale, *Abgrallaspis* [*Hemiberlesia*] *howardi* (Cockerell) is a leaf form of this species.

Field Characteristics: Adult females (twig form) 1.0 to 1.5 mm in diameter, convex; grey to dark grey; with a subcentral to subterminal reddish to brownish exuvium. Male scale cover oblong, grey, with a subterminal exuvium. Leaf form generally lighter in color with a more central exuvium.

Biology: One and possibly two generations per year in California. Apparently overwinters as late second stage nymphs or unmated adult females.

Similar Species: Similar to other species in the genera *Diaspidiotus*, *Quadraspidotus* and *Hemiberlesia*. Can be easily mistaken for San José scale, *Q. perniciosus*, but it has a darker scale cover than that species and the covers of the first instar nymphs are not blue-black as in San José scale.

Hosts: Most frequently found on walnut (*Juglans*), willow (*Salix*) and cottonwood (*Populus*). Has a wide host range, and particu-

larly attacks many ornamental trees. For host lists see Essig (1958), Kosztarab (1963) and Dekle (1978).

Economic Importance: According to Michelbacher and Ortega (1958) this species is normally controlled by natural enemies. However, pesticide-induced outbreaks have occurred occasionally on walnuts in California. A pest of elms and other ornamentals in the midwestern and northeastern states and on peaches in the south. Also recorded as a pest of cranberries and blueberries. For more information see McKenzie (1947) and English and Decker (1954).

Distribution: Generally distributed throughout most of the fruit growing areas of California at lower elevations, but not common. Widely distributed in the United States, probably native to North America. The leaf form was formerly common on apricots in the Hemet area of Riverside County (McKenzie, 1947), but is seldom if ever encountered now because those original groves are no longer in existence.

Diagnosis: The taxonomy of this species is somewhat confused, and care should be exercised when identifying it. It varies considerably in the number of dorsal pygidial tubular ducts and in the development of the plates and second lobes. The species *Diaspidiotus*

uvae, *Diaspidiotus osborni*, *Diaspidiotus hunteri* (Newell) and *Quadraspidotus gigas* (Thiem and Gerneck) are all similar morphologically. Stannard (1965) has shown that *Abgrallaspis howardi* (Cockerell) is the dimorphic leaf-infesting form of *Diaspidiotus ancylus*. The leaf form has three well-developed pygidial lobes as is typical of the genus *Abgrallaspis*. It keys out to *Hemiberlesia* in McKenzie's (1956) key and to *A. howardi* in Davidson's (1964) key.

Davidson, J.A., 1964: Ann. Entomol. Soc. Am. 57:638-643.

Dekle, G.W., 1976: Florida Armored Scale In-

sects. Fla. Dep. Agric. Cons. Serv., Div. Plant Ind., Gainesville. 345 pp.

English, L.L., and G.C. Decker, 1954: J. Econ. Entomol. 47(4):624-627.

Essig, E.O., 1958: Insects and Mites of Western North America. The MacMillan Co., New York. 1050 pp.

Kosztarab, M., 1963: Bull. Ohio Biol. Surv. (n.s.) 2(2):1-120.

McKenzie, H.L., 1947: Calif. Dep. Agric. Bull. 36(1):31-36.

Michelbacher, A.E., and J.C. Ortega, 1958: Calif. Agric. Exp. Stn. Bull. 764:1-87.

Stannard, L.J., 1965: Ann. Entomol. Soc. Am. 58(4):573-576.

Diaspidiotus coniferarum (Cockerell), 1898
conifer scale

Fig. 53, Color Plates 51, 52

Tribe: Aspidiotini.

Synonymy: *Aspidiotus coniferarum* Cockerell, *Comstockaspis coniferarum* (Cockerell).

Field Characteristics: Female scale cover grey, circular, flat, with darker central exuviae. Body yellow. Hides under loose bark of host.

Similar Species: Ehrhorn scale, but it generally prefers other species of conifers. However, both species occur on incense cedar, in which case they cannot be separated in the field.

Hosts: Prefers cypress, juniper and incense

cedar. Not usually found on pine or fir.

Economic Importance: None.

Distribution: Throughout the State. Common but rarely collected.

Diagnosis: The only *Diaspidiotus* on conifers in California except *D. ehrhorni*, which possesses perivulvar pores.

McKenzie, H.L., 1956: The Armored Scale Insects of California. Univ. Calif. Press, Berkeley. 209 pp.

Diaspidiotus ehrhorni (Coleman), 1903
Ehrhorn scale.

Fig. 54, Color Plates 53, 54

Tribe: Aspidiotini.

Synonymy: *Aspidiotus ehrhorni* Coleman.

Field Characteristics: Female scale cover grey, circular, flat, with subcentral exuviae. Body yellow. Males oval, grey, with a yellow subterminal exuvium. Occurs on bark.

Similar Species: Conifer scale, which may be found on the same hosts (see comments under that species).

Hosts: Foothill and Parry pines, Douglas and white fir, incense cedar.

Economic Importance: None.

Distribution: Throughout the State; probably native. Common but rarely collected.

Diagnosis: Differs from *D. coniferarum* by possessing perivulvar pores.

McKenzie, H.L., 1956: The Armored Scale Insects of California. Univ. Calif. Press, Berkeley. 209 pp.

Furniss, R.J., and V.M. Carolin, 1977: U.S. Dep. Agric. Misc. Publ. 1339:1-65.

Diaspidiotus liquidambaris (Kotinsky), 1903
sweet gum scale

Fig. 55, Color Plates 55, 56

Tribe: Aspidiotini.

Synonymy: *Cryptophyllaspis liquidambaris* Kotinsky, *Chemnaspidotus liquidambaris* (Kotinsky).

Field Characteristics: Adult female 0.75 to 1.50 mm in diameter, flat, circular, white, with central or subcentral yellow exuviae. Male scales white, oval, with subterminal yellow exuviae. This scale is distinctive in its ability to produce invaginated galls on the lower surfaces of the leaves of the preferred host, liquidambar. Young scales settle on the lower leaf surfaces and apparently inject material during feeding which causes the leaf surface to expand upward at the feeding point, forming a dome-like gall. As this gall is formed, the scale is pulled upward into the gall so that by maturity the scale is almost totally enclosed, often with only the exuviae visible at the gall opening on the lower surface. Occasionally male scales which have settled nearby may also be pulled into the gall as it is formed.

Similar Species: The gall-producing habit on liquidambar distinguishes this species.

Hosts: Apparently restricted to liquidambar although McKenzie (1956) records it from maple.

Biology: Two generations per year, a summer leaf form which causes galls, and a winter twig form. According to Stoetzel and Davidson (1974) it overwinters as mature fertilized adult

females, although Kosztarab (1963) states that both sexes overwinter.

Economic Importance: Causes unsightly raised galls and otherwise distorted leaves. Since liquidambar is valued for its foliage, the disfigurement does have serious economic potential. Considered an economic pest in Florida by Dekle (1976). Currently "B"-rated in California.

Distribution: Although collected from Los Angeles and Merced Counties, it has apparently been eradicated from these localities. Has been found well established in Santa Clara County and very recently in San Diego County.

Diagnosis: The gall-forming habit on liquidambar, single lobes and lack of perivulvar pores identify this species. Another U. S. species, *Abgrallaspis liriodendri* Miller and Howard, also causes leaf galls, but only on tulip trees.

Dekle, G.W., 1976: Florida Armored Scale Insects. Fla. Dept. Agric. Cons. Serv., Div. Plant Ind., Gainesville. 345 pp.

Kosztarab, M., 1963: Bull. Ohio Biol. Surv. (n.s.) 2(2):1-120.

McKenzie, H.L., 1956: Armored Scale Insects of California. Univ. Calif. Press, Berkeley. 209 pp.

Stoetzel, M.B., and J.A. Davidson, 1974: Ann. Entomol. Soc. Am. 67(3):475-509.

Diaspidiotus osborni (Newell and Cockerell), 1898
osborn scale

Fig. 56

Tribe: Aspidiotini.

Synonymy: *Aspidiotus osborni* Newell and Cockerell, *Diaspis snowii* Hunter, *Aspidiotus yulupae* Bremner, *Neosignoretia yulupae* (Bremner).

Field Characteristics: Female scale cover circular, flat, grey, with yellow subterminal exu-

viae. Males oval, grey, with a subterminal exuviae. Occurs on bark.

Hosts: Many tree species, particularly oaks and walnuts.

Economic Importance: None.

Distribution: Collected from a number of locations throughout the State, but very rare,

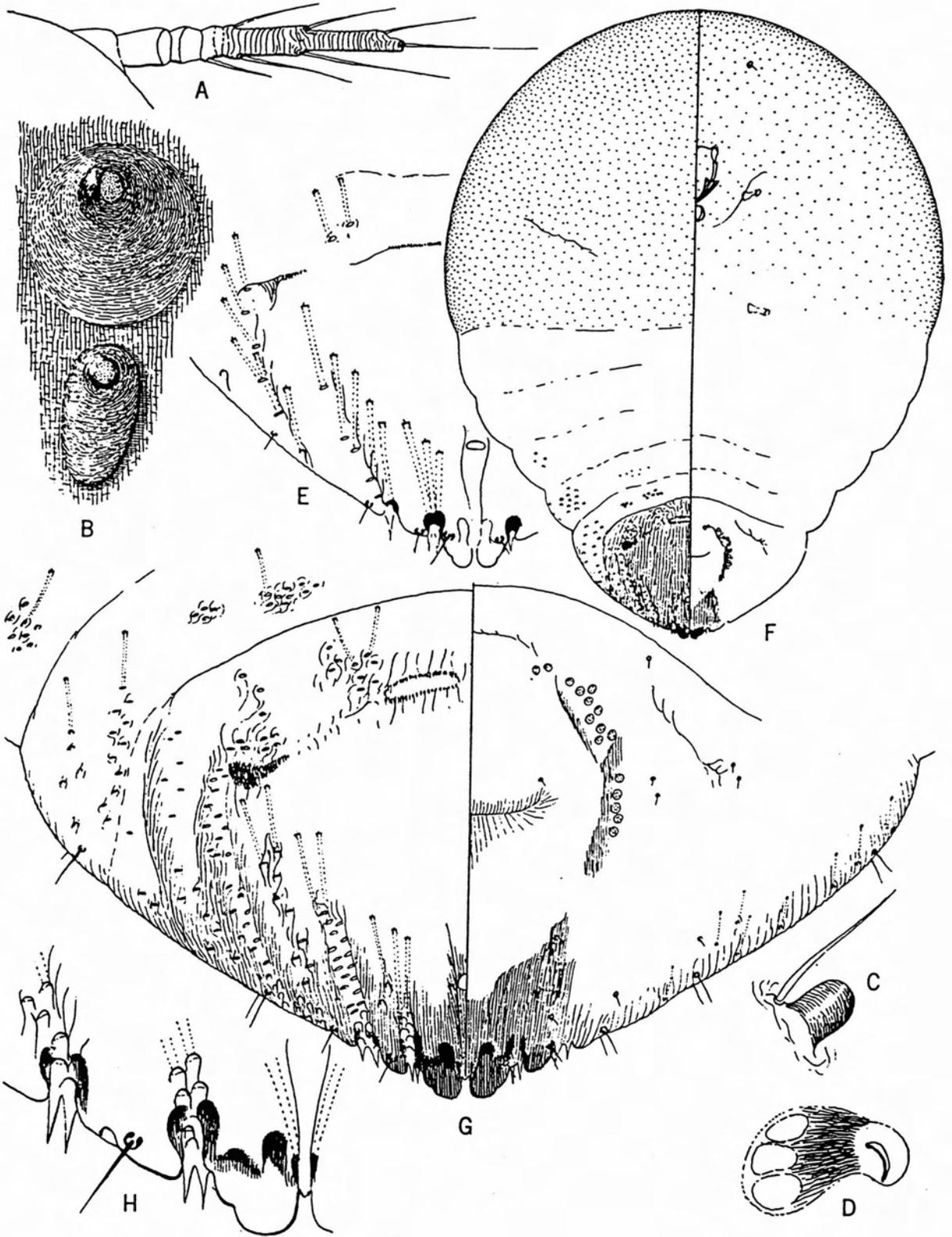


Fig. 51. *Diaspidiotus aesculi* (Johnson).

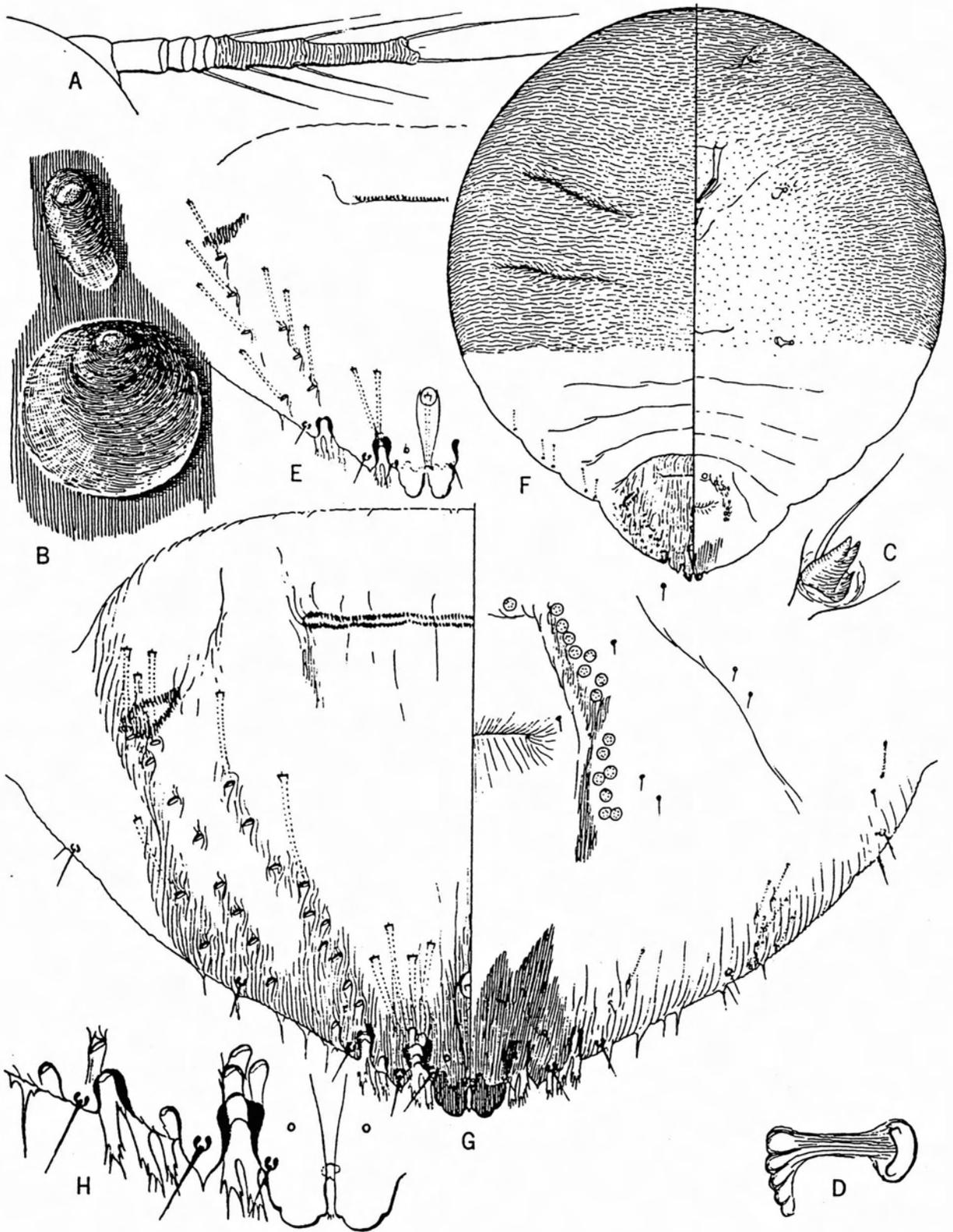


Fig. 52. *Diaspidiotus ancylus* (Putnam).

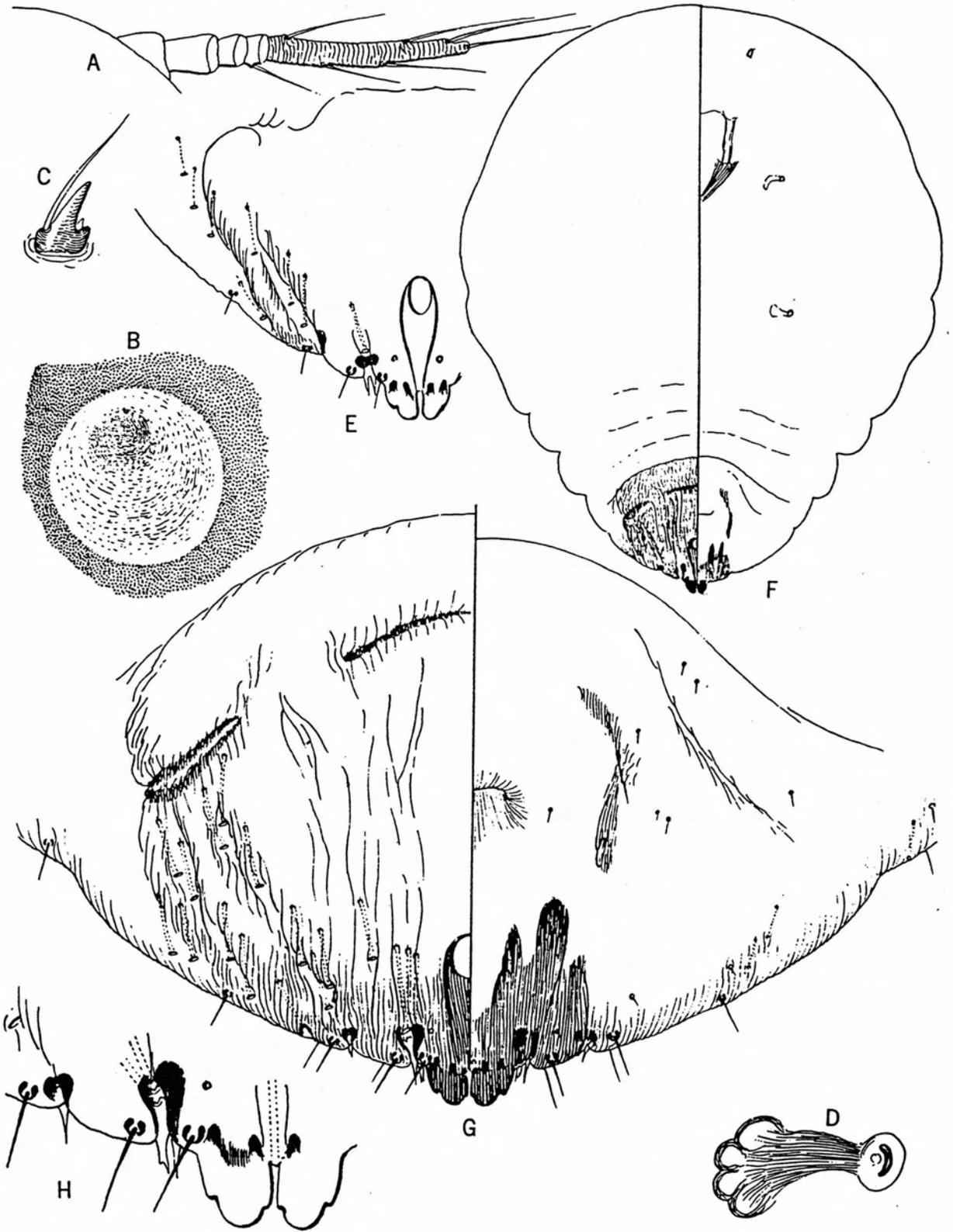


Fig. 53. *Diaspidiotus coniferarum* (Cockerell).

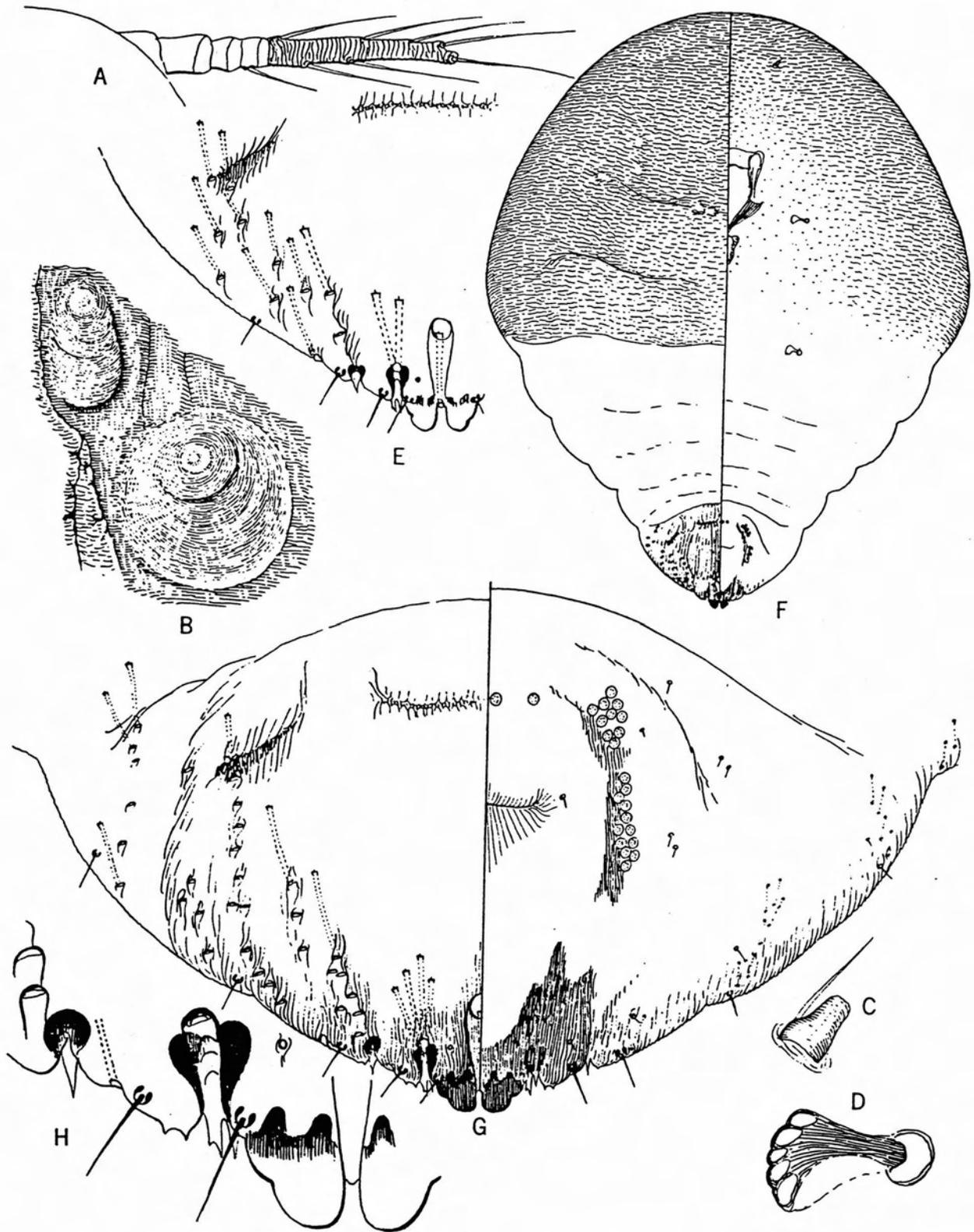


Fig. 54. *Diaspidiotus ehrhorni* (Coleman).

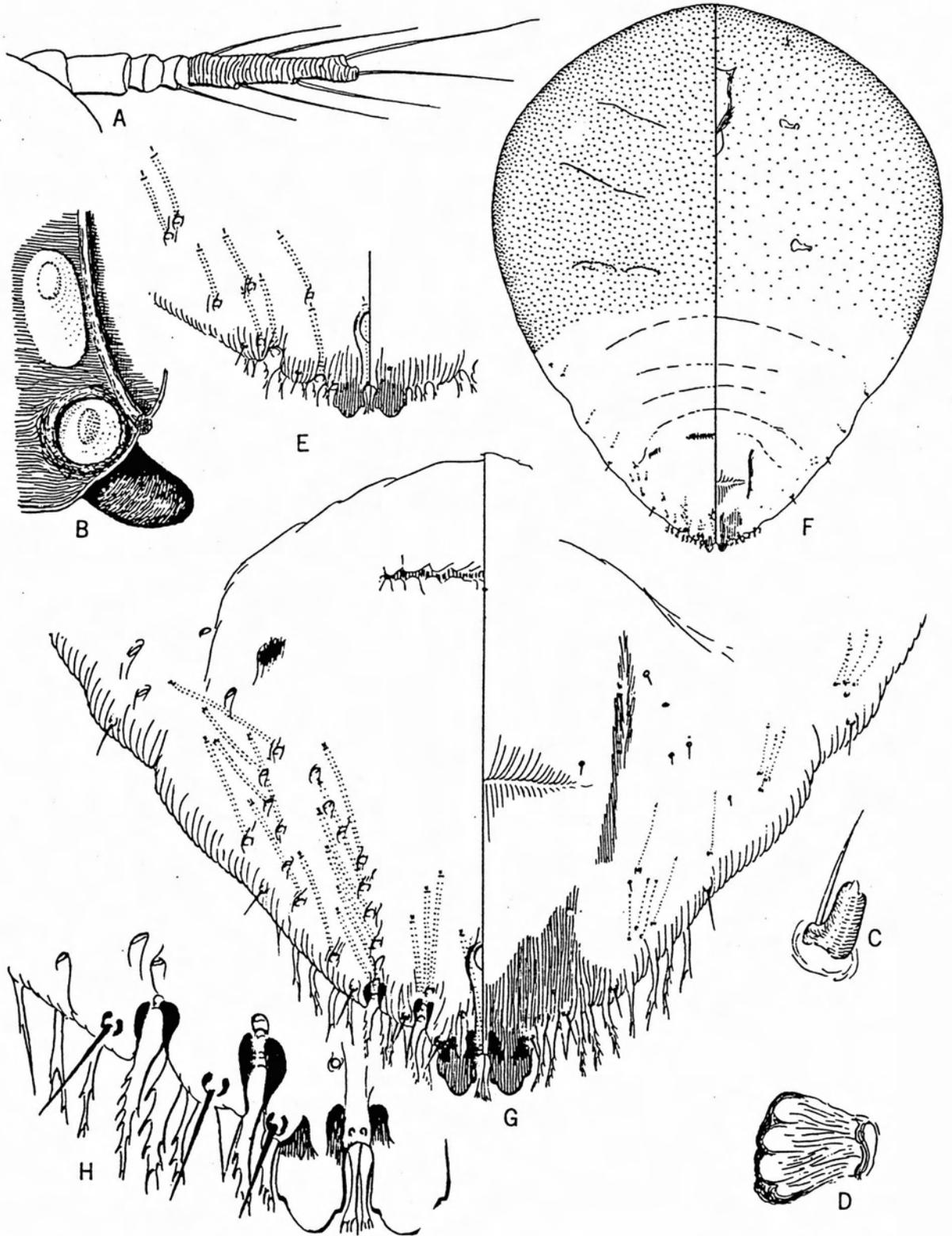


Fig. 55. *Diaspidiotus liquidambaris* (Kotinsky).

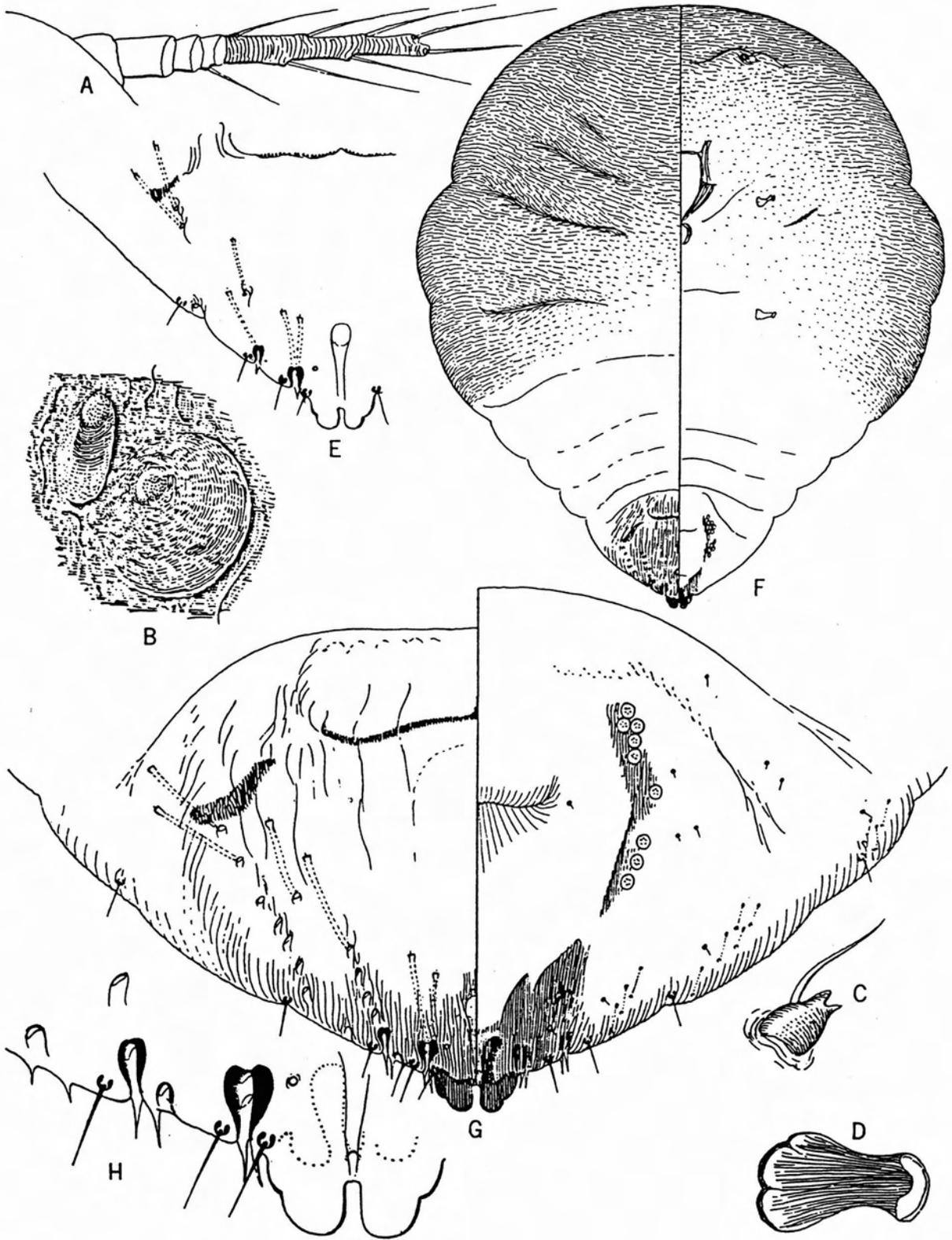


Fig. 56. *Diaspidiotus osborni* (Newell and Cockerell).

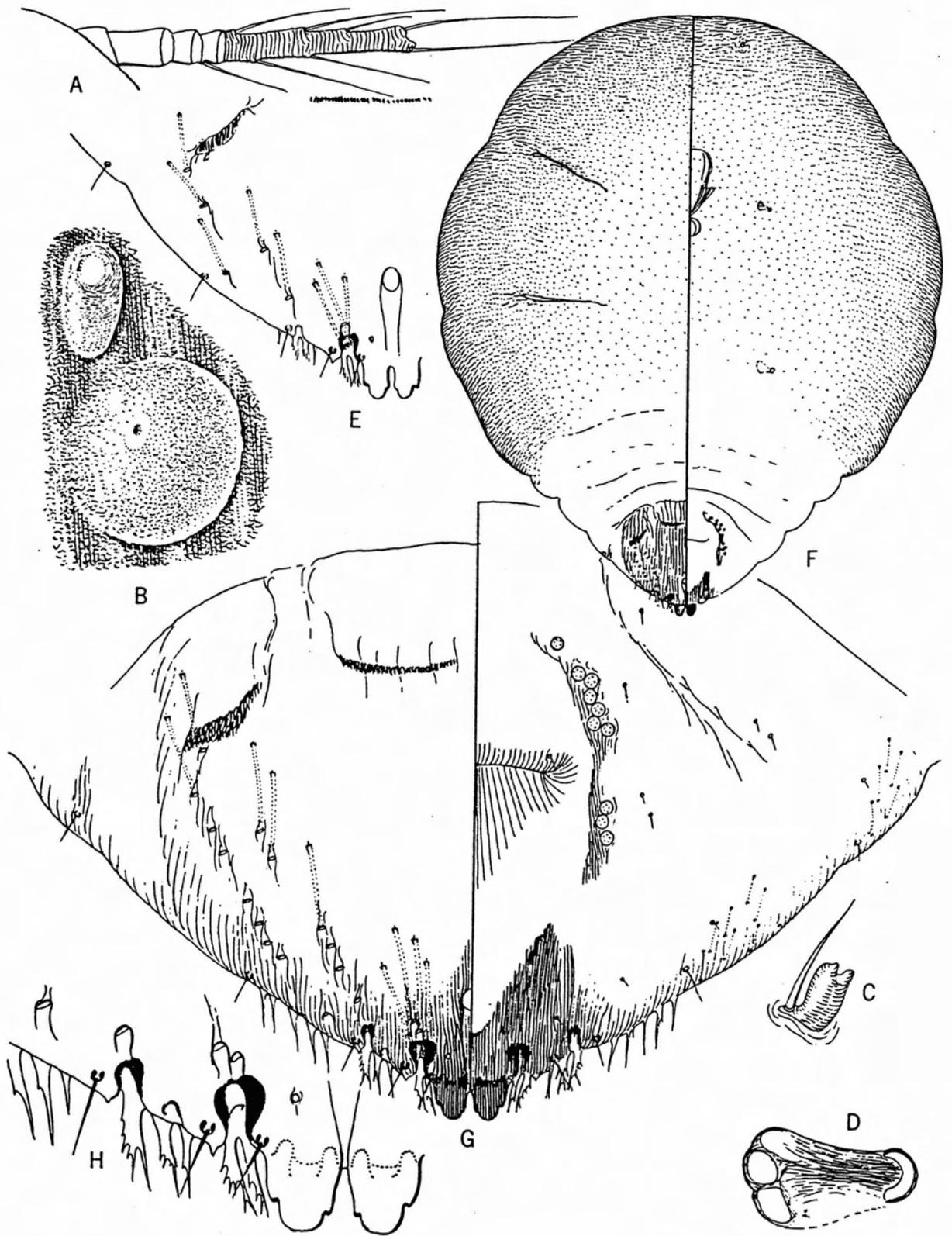


Fig. 57. *Diaspidiotus uvae* (Comstock).

perhaps because it is usually well camouflaged and closely resembles other more common species.

Diagnosis: The only *Diaspidiotus* occurring on deciduous trees which has the plates point-like, unfimbriated and which lacks submarginal, prepygidial macroducts.

Kosztarab, M., 1963: Bull. Ohio Biol. Surv. (n.s.), 2(2):1-120.

McKenzie, H.L., 1956: The Armored Scaled Insects of California. Univ. Calif. Press, Berkeley. 209 pp.

Stoetzel, M.B., and J.A. Davidson, 1974: Ann. Entomol. Soc. Am. 67(3):475-509.

Diaspidiotus uvae (Comstock), 1881

grape scale

Fig. 57

Tribe: Aspidiotini.

Synonymy: *Aspidiotus uvae* Comstock, *Aspidiotus uvaspis* Lindinger.

Field Characteristics: Scale cover white or light grey with yellowish exuviae, circular, flat. Male oval and somewhat darker. Difficult to detect because it is usually found beneath old loose bark of the trunk and older canes. Collectors should look for it particularly on very old vines.

Biology: According to Kostarab (1963), has one yearly generation; overwinters as mature females. Males active in spring. Females ovoviviparous.

Hosts: Prefers grapes (*Vitis*), but has a fairly wide host range among deciduous trees.

Distribution: Collected in San Diego County near El Cajon in 1946 and possibly in the San

Francisco Bay area. Not collected in many years; current status unknown. Primarily found in eastern U.S.

Economic Importance: None in California.

Diagnosis: Nearly identical to Putnam scale but differs in having narrower, more elongate and more widely separated median lobes, much thinner macroducts, and no macroduct between the median lobes.

Kosztarab, M., 1963: Bull. Ohio Biol. Surv. (n.s.) 2(2):1-120.

McKenzie, H.L., 1956: The Armored Scale Insects of California. Univ. Calif. Press, Berkeley. 209 pp.

Zimmer, J.F., 1912: U.S. Dep. Agric. Bur. Entomol. Bull. 97(pt VII):115-124.

Genus *Diaspis* Costa, 1828

Number of World species: About 50.

Number of United States species: 12.

Key to the World species: None.

Key to the United States species: Ferris, G. F., 1937-1942: Atlas of the Scale Insects of North America, Ser. I-IV. Stanford Univ. Press, Stanford.

KEY TO CALIFORNIA SPECIES OF *DIASPIS*

1. Median pygidial lobes with their mesal margin scarcely or not at all longer than their free margin, the lobes therefore projecting completely from apex of the pygidium and not forming a median emargination or notch. *echinocacti*
- Median pygidial lobes with mesal margin definitely longer than free lateral margin, frequently two or three times as long, lobes usually projecting but little from apex of pygidium and therefore forming a median notch or emargination. 2

- 2. Pygidium with three or more large ducts in submarginal series extending parallel to margin from just anterior to second lobe or further. *bromeliae*
- Pygidium without such a series of large ducts, there being ordinarily not more than two, one anterior to each of the second and third lobes. 3

- 3. Submedian dorsal groups of ducts present on at least one segment anterior to fifth abdominal segment. 4
- Submedian dorsal groups of ducts either entirely lacking or not present anterior to fifth abdominal segment. 5

- 4. Dorsal submedian groups of macroducts present from pygidium to thorax; associated with *Arctostaphylos* in California. *manzanitae*
- Dorsal submedian groups of macroducts lacking on metathorax, few microducts only in this area; known only from *Phoradendron* in California. *parasiti*

- 5. Prosoma normally with earlike lobe on each side, only occasionally lacking on one or both sides in some specimens; two pairs of submedian macroducts present on abdominal segment 5; sclerotized bosses present submarginally on abdominal segments 3-4 *boisduvalii*
- Without the above combination of characters. *cocois*

Diaspis boisduvalii Signoret, 1869

Boisduval scale (ESA approved)

Fig. 58, Color Plates 57, 58

Tribe: Diaspidini.

Synonymy: *Aulacaspis boisduvalii* (Signoret), *Aulacaspis cattleya* (Cockerell), *Diaspis cattleya* (Cockerell).

Field Characteristics: Adult female scale covers 1.5 to 2.5 mm in diameter, circular, slightly convex. Scale cover dirty white or light tan with yellowish or tan subcentral exuviae. Body bright yellow. If the scale cover is removed the female body usually displays horn-like lobed projections on either side of the cephalothoracic area which are usually not found in other related scale insects on orchids and palms and which aid in the recognition of this species. Male scale cover pure white, with three low, longitudinal carinae and a yellow, terminal exuvium. Male puparia often congregate in small groups of 10 or 20; a large amount of white woolly wax is usually associated with them. Prefers leaves, but also found on the pseudobulbs of orchid hosts.

Similar Species: Other species in the genus

Diaspis are similar. Cocos scale is indistinguishable on palms except that the female bodies of cocos scale lack the above-mentioned lobed cephalothoracic projections. Boisduval scale has very rarely been recorded from cactus where it might be confused with cactus scale.

Biology: Has multiple generations per year, with a single generation taking about 50 days under optimum conditions. Females produce about 200 offspring and in one experiment the total offspring produced by 7 original females was 10,000 scales after only 5 months. For more information see Bohart (1942) and Steinweden (1948).

Hosts: Prefers orchids, particularly *Cattleya* and *Cymbidium*. Also common on palms outdoors in Southern California. For a complete host list see Dekle (1976).

Economic Importance: A serious pest of orchids in greenhouses in California and in other parts of the world. Develops large, encrusted

populations on orchids and is difficult to control. Small numbers produce extensive discoloration and large populations usually kill the host. For more information see Bohart (1942), Steinweden (1948) and Pritchard (1949).

Distribution: Widespread and common on greenhouse orchids and outdoors on palms in Southern California. Found in most of the United States; generally worldwide in distribution. Probably a New World species.

Diagnosis: The prosomatic (cephalothoracic) lobes and the inset median lobes identify this species. On palms, cocos scale is similar but

lacks both the prosomatic lobes and the submedian macroducts on the fifth abdominal segment.

Bohart, R.M., 1942: J. Econ. Entomol. 35(3): 365-368.

Dekle, G.W., 1976: Florida Armored Scale Insects. Fl. Dep. Agric. Cons. Serv., Div. Plant Ind., Gainesville. 345 pp.

Pritchard, A.E., 1949: Calif. Agric. Exp. Stn. Bull. 713:1-71.

Steinweden, J. B., 1948: Orchid Dig. May-June: 105-111.

Diaspis bromeliae (Kerner), 1778

pineapple scale

Fig. 59, Color Plate 60

Tribe: Diaspidini.

Synonymy: *Coccus bromeliae* Kerner, *Chermes bromeliae* (Kerner), *Aulacaspis bromeliae* (Kerner), *Aspidiotus bromeliae* (Kerner).

Field Characteristics: Female scale cover dirty white or tan, circular (1.5 to 2.5 mm in diameter), slightly convex, with yellow or tan subcentral exuviae. Male scale cover white, tricarinate, with a terminal exuvium. Found on leaves and fruit.

Similar Species: Rarely recorded from orchids and cactus, in which case it could be confused with Boisduval and cactus scale in the field. Nothing is similar on the preferred host, pineapple.

Biology: Unknown. Probably has multiple annual generations.

Hosts: Commonly encountered on fresh pineapples in retail stores; does not occur outdoors in California; only occasionally found on bromeliads in greenhouses.

Economic Importance: A minor pest of pineapples in some tropical areas but not of economic concern in California.

Distribution: Probably occurs in greenhouses in California. No out-door infestations are known.

Diagnosis: Recognized by the four sets of enlarged submarginal macroducts. Immature stages have been described and illustrated by Howell (1975).

Brimblecombe, A.R., 1955: Queensl. J. Agric. Sci. 12(3):81-94.

Dekle, G.W., 1976: Florida Armored Scale Insects. Fla. Dep. Agric. Cons. Serv., Div. Plant Ind., Gainesville. 345 pp.

Howell, J.O., 1975: Ann. Entomol. Soc. Amer. 68(3):409-416.

Jarvis, H., 1944: Queensl. Agric. J. 59(1):26-29.

VanDine, D. L., 1904: Hawaii Agric. Exp. Stn. Press Bull. 10:1-6.

Diaspis cocois Lichtenstein, 1882

cocos scale

Fig. 60

Tribe: Diaspidini.

Synonymy: *Diaspis coccois* (Lichtenstein), *Diaspis tentaculatus* Morgan, *Aulacaspis coccois* (Lichtenstein).

Field Characteristics: Identical to Boisduval scale in the field, except that female Boisduval scales usually have fleshy (prosomatic) lobes on either side of the body (cephalothorax)

which are absent in cocos scale. These lobes can be seen with a hand lens if the scale cover is removed.

Hosts: Palms.

Economic Importance: None.

Distribution: Collected from a number of localities in Southern California; present status unknown.

Diagnosis: The taxonomic relationship between this species and Boisduval scale has been questioned. Because the type specimens of *cocois* have apparently been lost, the prob-

lem may never be solved. However, in the current concept *cocois* differs from *boisduvalii* in lacking the submedian macroducts on abdominal segment V (the submedian pores of Ferris and McKenzie), by lacking the sclerotized bosses on segments 3 and 4, and by lacking the prosomatic lobes, all of which are normally present in *boisduvalii*.

McKenzie, H.L., 1956: The Armored Scale Insects of California. Univ. Calif. Press, Berkeley. 209 pp.

***Diaspis echinocacti* (Bouché), 1883**
cactus scale (ESA approved)
Fig. 61, Color Plates 61, 62

Tribe: Diaspidini.

Other Common Names: prickly pear scale.

Synonymy: *Aspidiotus echinocacti* Bouché, *Diaspis calyptroides* Costa, *Diaspis cacti* Comstock, *Diaspis calyptroides* var. *opuntiae* Cockerell, *Diaspis opuntiae* Cockerell, *Diaspis opunticola* Newstead. Apparently the *Diplacaspis echinocacti* of Mann (1969) is the same species but other references to this name or to the generic name *Diplacaspis* Jacobson are unknown at this time.

Field Characteristics: Adult female scale covers 1.5 to 2.5 mm in diameter, circular, slightly convex. Scale cover tan with yellow or brown subcentral exuviae; body greenish-yellow. Male scale cover elongate, white, with a weak median longitudinal carina and yellow terminal exuvium. Found on stems, leaves (pads) and fruit.

Biology: Has multiple overlapping generations. Oetting (1982, 1984) found the length of development time from egg to adult to be 23 days, a generation about 50 days.

Similar Species: Other species in the genus *Diaspis* may be confused with cactus scale, but they are not likely to occur on cactus. Cyanophyllum scale is similar and occurs on cactus, but the scale cover is more oval and more transparent than in cactus scale, and the male scale covers are oval rather than elon-

gate.

Hosts: Mostly in the cactus family (Cactaceae). However, Dekle (1976) lists it from orchids and bromeliads. Oetting (1982) lists it from several succulent species, particularly *Portulaca grandiflora*.

Economic Importance: Generally none in California, but treatments are occasionally required on cactus nursery stock and on botanical garden specimens, not only in California but in other parts of the world. An occasional pest in South America on cactus grown for cattle feed. For more information see Mann (1969), Kozarzhevskaya and Reitzel (1975) and Oetting (1982).

Distribution: Widespread in California, the United States and much of the world. Apparently native to the New World.

Diagnosis: Recognized by its preference for cacti, and by the shape of the median lobes, which do not appear to be inset and notched as in most members of the genus. Occasionally populations exhibit prosomatic lobes similar to those of Boisduval scale. Immature stages have been described and illustrated by Howell (1975).

Dekle, G.W., 1976: Florida Armored Scale Insects. Fla. Dep. Agric., Cons. Serv., Div. Plant Ind., Gainesville, 345 pp.

- Howell, J.O., 1975: Ann.Entomol. Soc. Amer. 68(3):409-416.
- Kozarzhevskaya, E., and J. Reitzel, 1975: The Scale Insects of Denmark. Statens Fors. Plantekultur, Copenhagen. 40 pp.
- Mann, J., 1969: U. S. Nat. Mus. Bull. 156:1-158.
- Oetting, R.D., 1982: Orn. Plants Entomol. News. 13(1):7.
- Oetting, R.D., 1984: Ann. Entomol. Soc. Am. 77(1):88-92.

***Diaspis manzanitae* (Whitney), 1913**
manzanita scale
Fig. 62, Color Plates 63, 64

Tribe: Diaspidini.

Synonymy: *Aulacaspis manzanitae* Whitney.

Field Characteristics: Female scale cover 1.5 to 3.0 mm in diameter, tan, circular, slightly convex, with yellow or tan subcentral exuviae. Body greenish-yellow. Males not known except for one collection in Santa Barbara County in 1988. Occurs on leaves.

Similar Species: *Arctostaphylos* scale is similar but it has a white scale cover and males are usually common in the population.

Hosts: Manzanita (*Arctostaphylos*).

Distribution: Throughout California; native.

Diagnosis: Host restriction and the distribution of dorsal submedian macroducts from pygidium to metathorax immediately distinguish this species.

McKenzie, H.L., 1956: The Armored Scale Insects of California. Univ. Calif. Press, Berkeley. 209 pp.

***Diaspis parasiti* McKenzie, 1947**
mistletoe scale
Fig. 63, Color Plate 65

Tribe: Diaspidini.

Field Characteristics: Adult females light brown, with a darker central exuvium, 1.5 to 2.0 mm in diameter, slightly convex. Male scale covers dirty white, elongate, with a median longitudinal carina and a tan terminal exuvium. Males very common, distinguishing this species from all others on mistletoe except for mistletoe *situlaspis* scale and *salicicola* scale, which have lighter scale covers.

Hosts: Most common on mesquite mistletoe in desert valleys but also found on broadleaf mistletoe on sycamore trees elsewhere.

Distribution: Found in a number of locations in Imperial, Riverside, and San Bernardino counties; probably occurs in adjacent counties as well. Native.

Diagnosis: The only California *Diaspis* occurring on mistletoe. Also distinguished by the clusters of submedian macroducts on the prepygidial segments and the cluster of submedian microducts on the metathorax and first abdominal segments.

McKenzie, H.L., 1956: The Armored Scale Insects of California. Univ. Calif. Press, Berkeley. 209 pp.

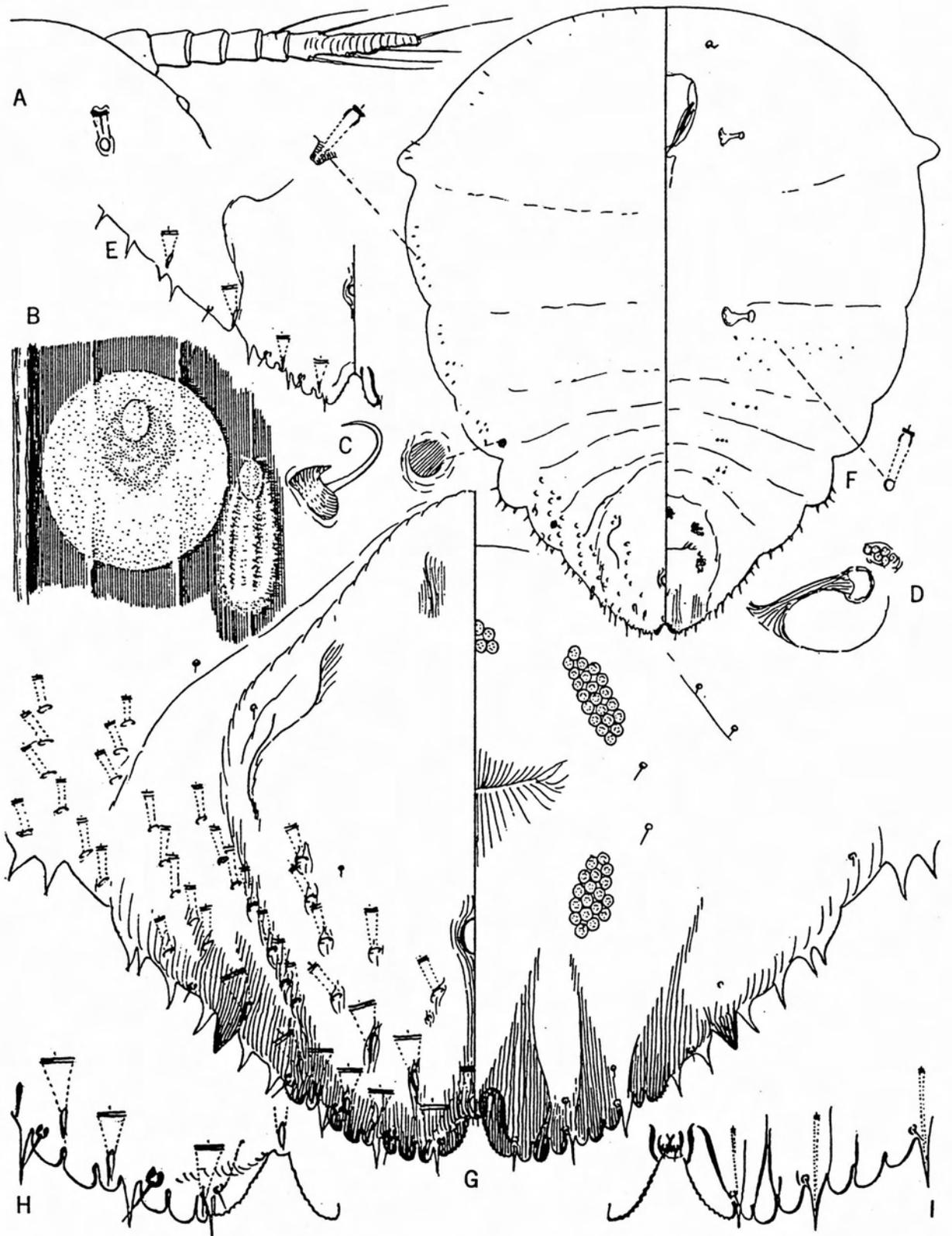


Fig. 58. *Diaspis boisduvalii* Signoret.

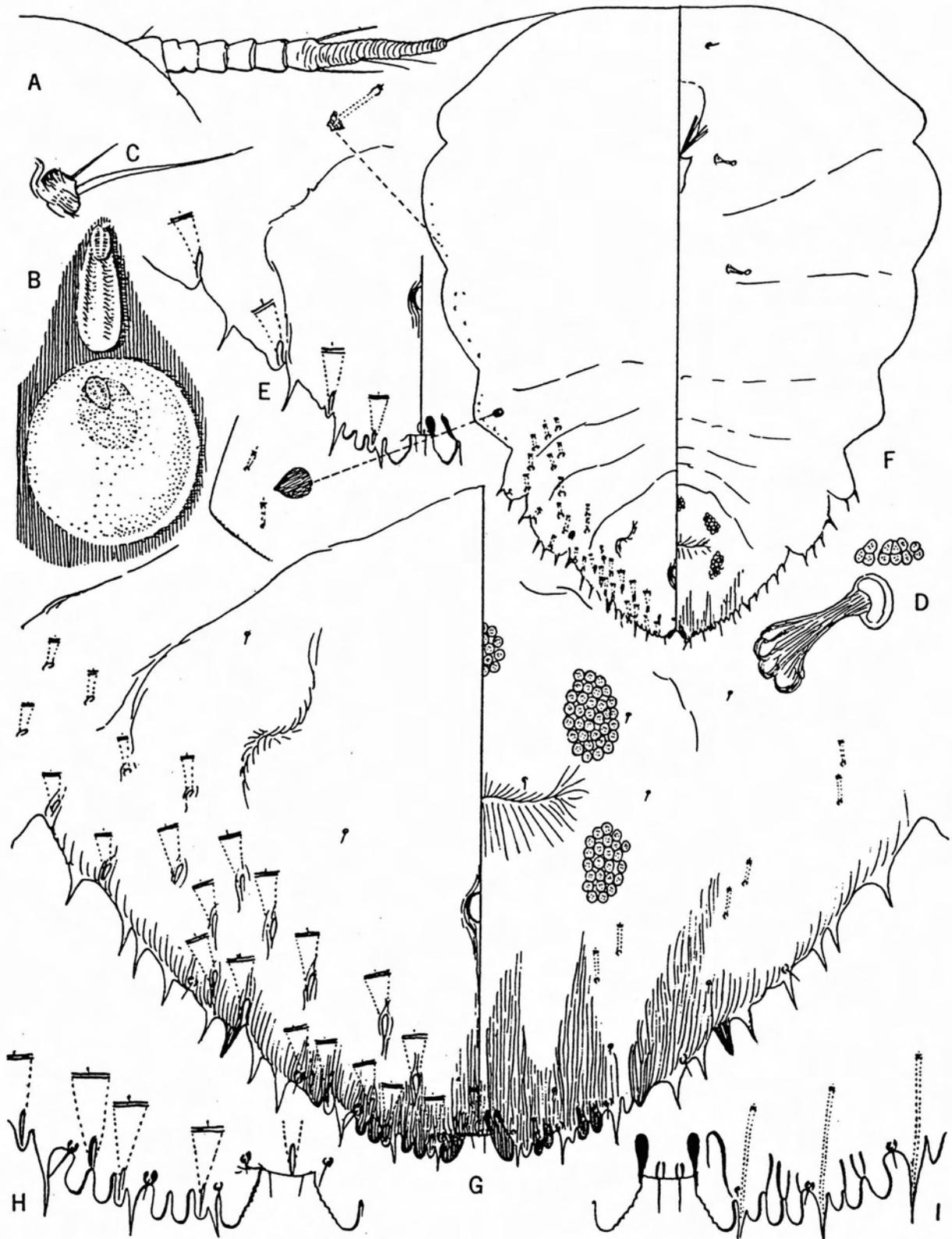


Fig. 59. *Diaspis bromeliae* (Kerner).

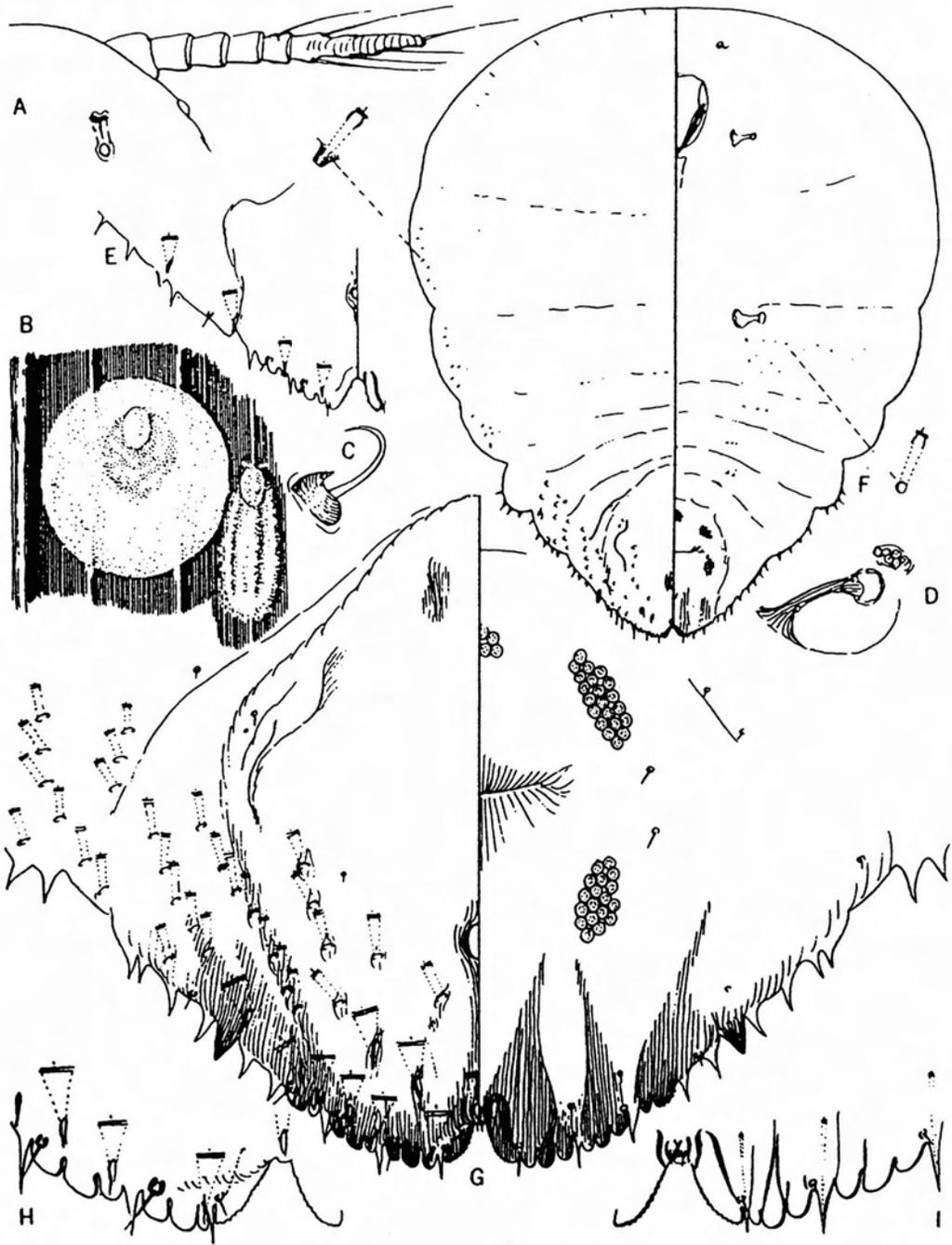


Fig. 60. *Diaspis cocois* Lichtenstein.

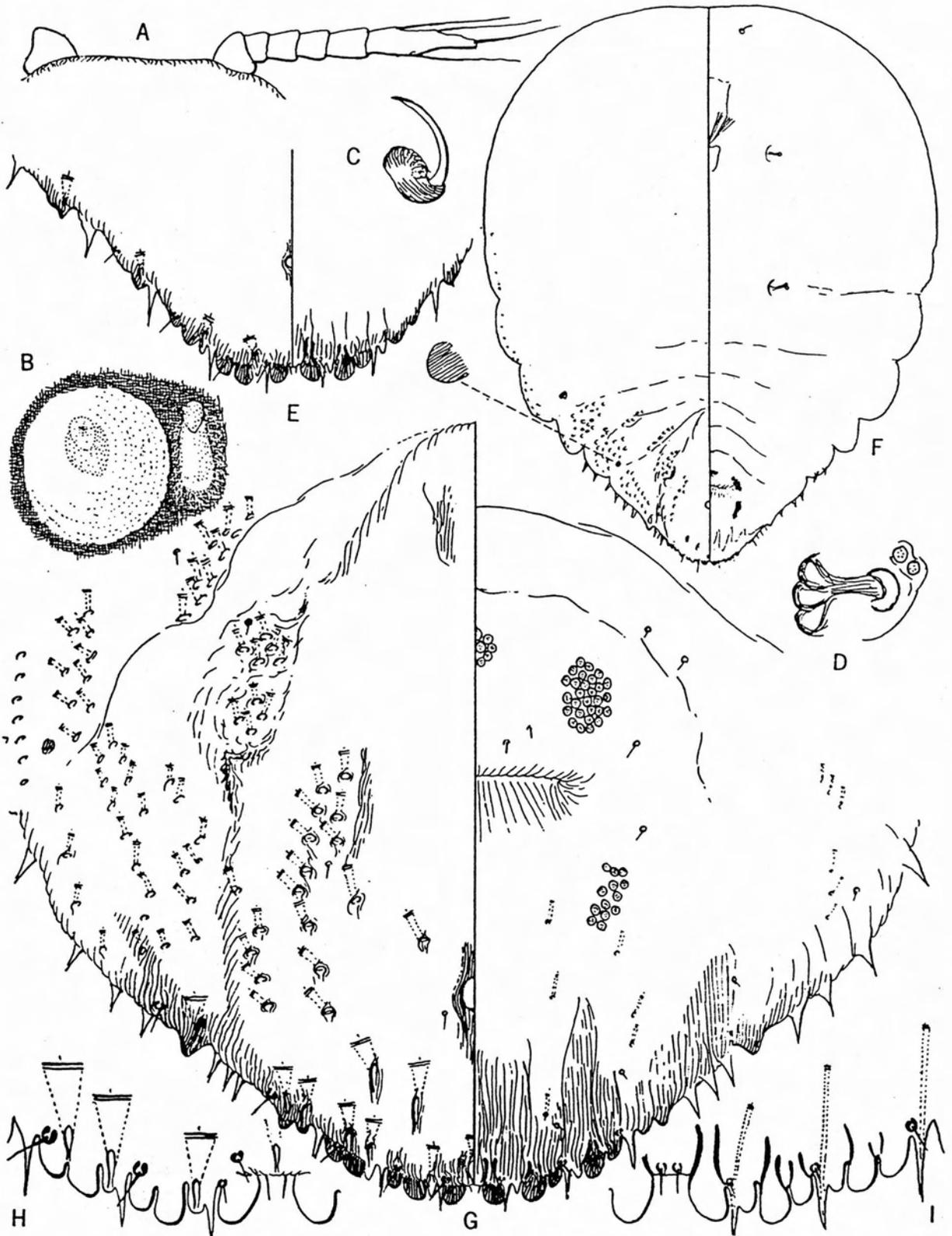


Fig. 61. *Diaspis echinocacti* (Bouché).

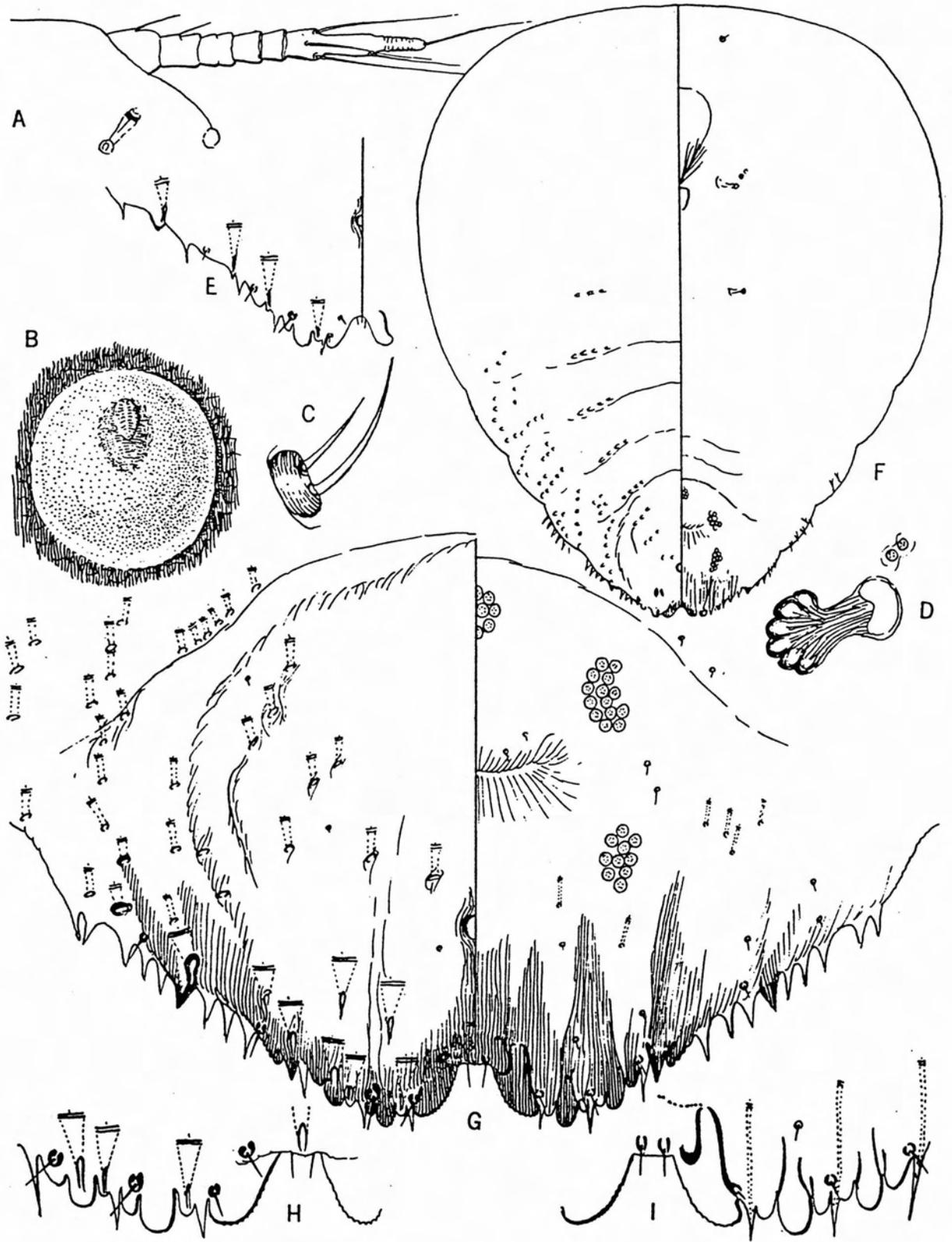


Fig. 62. *Diaspis manzanitae* (Whitney).

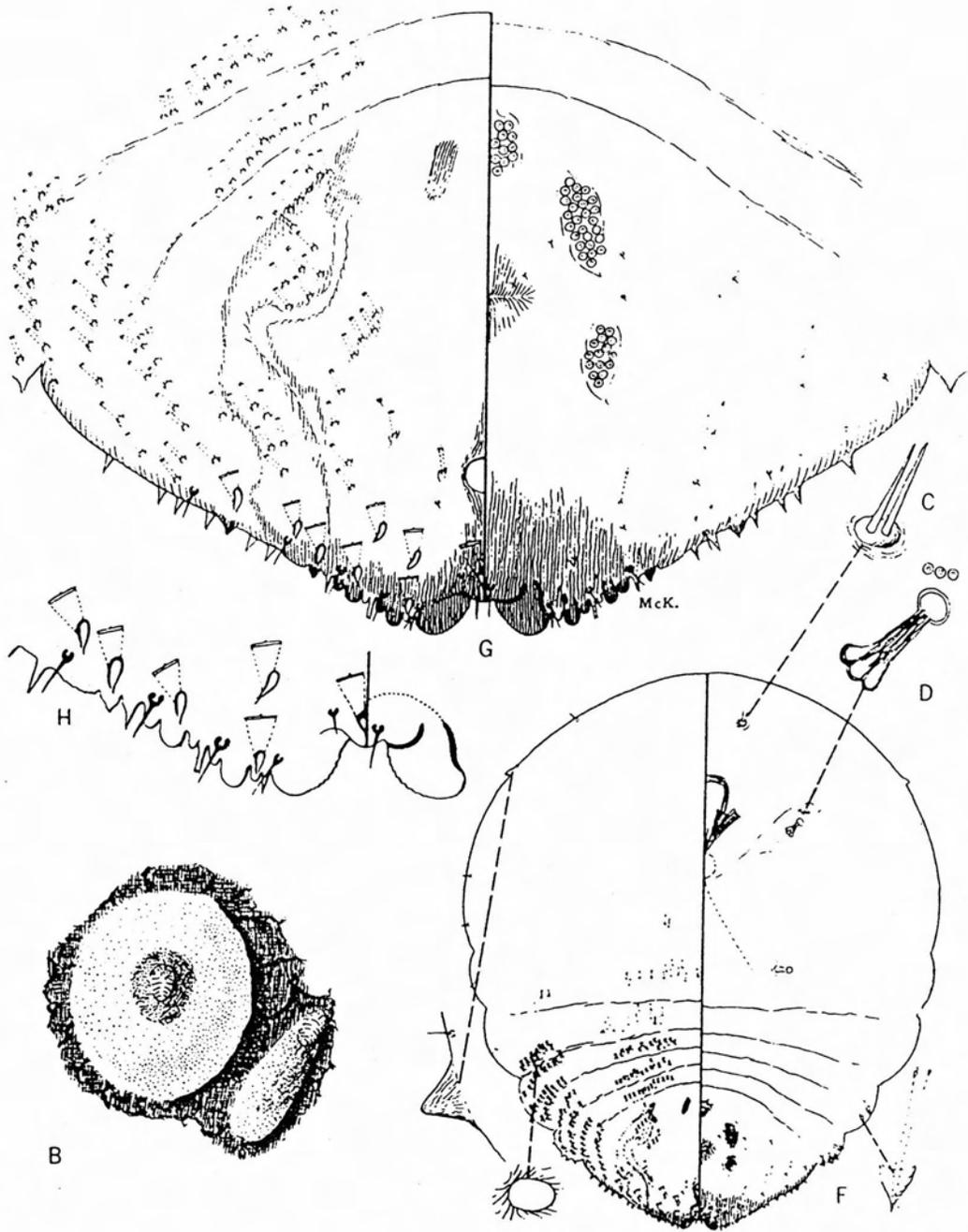


Fig. 63. *Diaspis parasiti* McKenzie.

Genus Dynaspidiotus Thiem and Gerneck, 1934

Number of World species: 11.

Number of United States species: 1.

Key to the World species: None.

Dynaspidiotus britannicus (Newstead), 1898
holly scale

Fig. 64, Color Plates 66, 67

Tribe: Aspidiotini.

Other Common Names: Laurel scale.

Synonymy: *Aspidiotus britannicus* Newstead,
Evaspidiotus britannicus (Newstead).

Field Characteristics: Adult female scales 1 to 2 mm in diameter, circular, flat, usually light brown (occasionally greyish-brown), yellow sub-central exuviae. Body yellow. Male scales oval with subterminal exuviae, colored as females. Found on leaves, twigs and berries.

Biology: One or two generations per year. Overwinters as second instar nymphs; eggs laid in June and July. For more information see Roaf and Mote (1935), Schuh and Mote (1948) and Del Bene (1984). The honeydew association with this scale mentioned in the Schuh and Mote paper is probably incorrect.

Similar Species: Oleander scale is similar, but the male scale covers are white (different colored than the females), whereas in holly scale males are the same color as females. Red and yellow scale are also similar but the scale covers of these are a distinctly different color.

Hosts: Prefers holly but also found on boxwood, ivy, privet, laurel and a number of other hosts. For a host list see McKenzie (1956), Roaf and Mote (1936), and Schuh and Mote (1948).

Economic Importance: Causes weakening of host plus spotting and stunting of leaves.

Currently a "B"-rated insect in California. For information on natural enemies see Battaglia(1988) and Battaglia and Viggiani (1986).

Distribution: Collected from many California locations, particularly in the San Francisco Bay area and the Sierra foothills. Eradicated from most locations; collected only once in the last 15 years. Common on Oregon and Washington and frequently intercepted on holly from these areas. Also known from the eastern United States and Europe.

Diagnosis: The lack of paraphyses at the bases of the pygidial lobes and the development of the fourth lobes differentiate this species from other California armored scales.

Battaglia, D., 1988: Boll. Lab. Entomol. Agraria, Filippo Silvestri. 45:145 - 165.

Battaglia, J. and G. Viggiani, 1986: Boll. Lab. Entomol. Agraria, Filippo Silvestri. 43:139-142.

Del Bene, G., 1984: Redia 67:323-336.

McKenzie, H.L., 1956: The Armored Scale Insects of California. Univ. Calif. Press, Berkeley. 209 pp.

Schuh, J., and D.C. Mote, 1948: Oreg. State Coll. Agric. Exp. Stn. Bull. 449:1-164.

Roaf, J.R. and D. C. Mote, 1935: Econ. Entomol. 28:1041-1049.

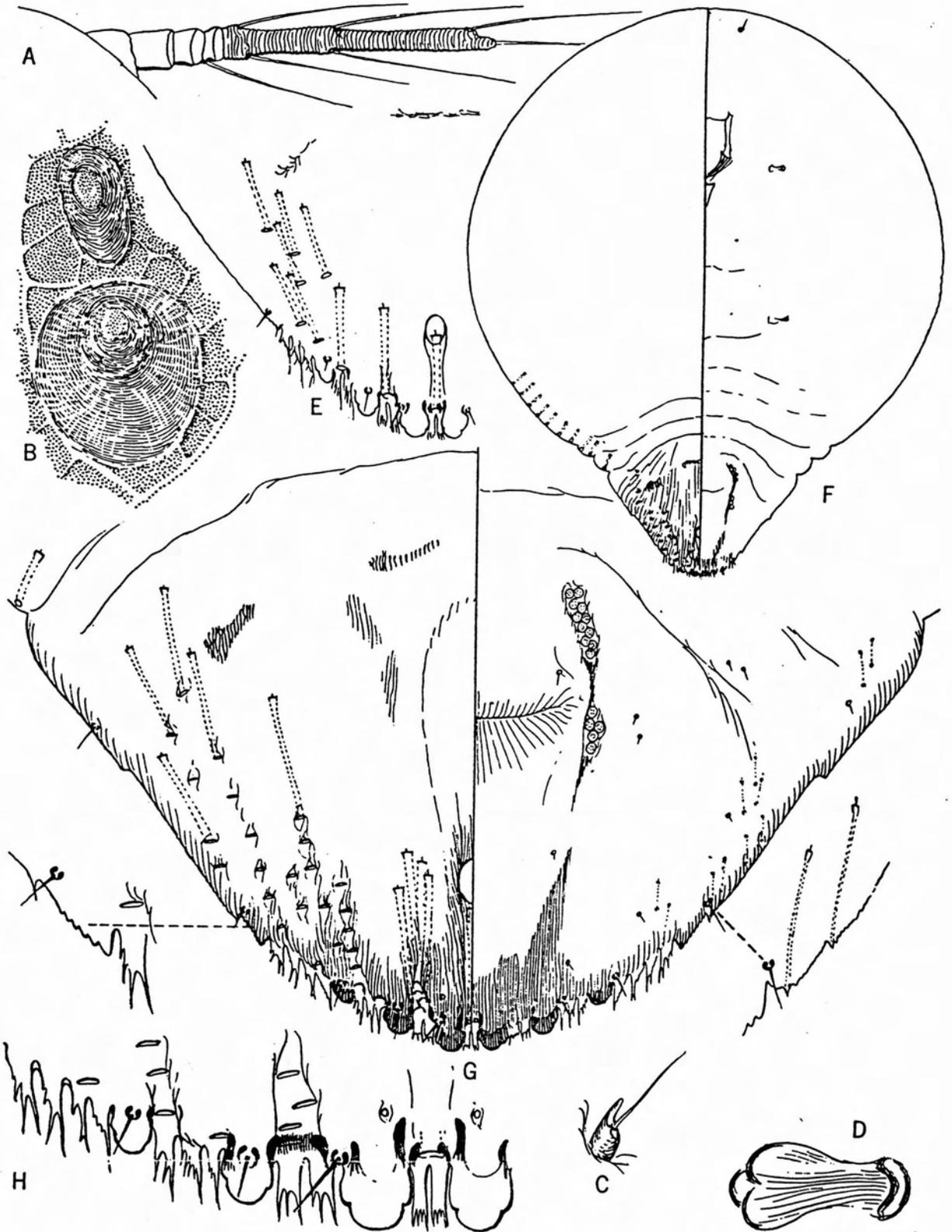


Fig. 64. *Dynaspidotus britannicus* (Newstead).

Genus *Epidiaspis* Cockerell, 1899

Number of World species: 12.

Number of United States species: 4.

Key to the World species: None.

Key to the United States species: Ferris, G.F., 1937-1942: Atlas of the Scale Insects of North America, Ser. I-IV, Stanford Univ. Press, Stanford. See also Takagi, S., and H. H. Tippins, 1972: Kontyu 40(3):180-186 for one new United States species (*E. tillandsiae*).

KEY TO CALIFORNIA SPECIES OF *EPIDIASPIS*

1. Second pygidial lobes at times small, but definitely present; associated so far only with native woody plants such as willow and poplar. *salicicola*
- Second pygidial lobes essentially lacking; associated with walnuts and Rosaceae *leperii*

Epidiaspis leperii (Signoret), 1869

Italian pear scale (ESA approved)

Fig. 65, Color Plates 68-70

Tribe: Diaspidini.

Other Common Names: Red pear scale, European pear scale.

Synonymy: *Diaspis leperii* Signoret, *Diaspis pyri* Colvee, *Aspidiotus piricola* Del Guercio, *Diaspis ostraeaformis* Signoret, *Diaspis fallax* Hovarth, *Diaspis piricola* (Del Guercio), *Epidiaspis piricola* (Del Guercio).

Field Characteristics: Adult female scale cover about 0.75 to 1.0 mm in diameter, light grey or white, with a yellow or brown central or subcentral exuvium. Body light pink, becoming dark red-brown toward the end of the egg-laying period. Male scale cover elongate, white or light grey, with a yellow terminal exuvium. Particularly common on hosts which support lichens, which apparently protect the scale from natural enemies and the elements; on hosts without lichens the scale does not do well. Found on twigs, branches and trunk; does not infest leaves or fruit.

Biology: Poorly understood in this country, although there are some current studies being made. Apparently has one generation per year; overwinters as adult females. Studies on the biology of this species in Europe include Abd El-Kareim et al (1988), Geier (1949), and

Kozár and Konstantinova (1981). Other information will be found in Essig (1920), Madsen and Barnes (1959), and Lockwood (1962).

Similar Species: Walnut scale is frequently found on the same trees, particularly on walnuts, but it has a larger, tan scale cover and an indented yellow scale body. San José scale and olive scale also occur on many of the same hosts as Italian pear scale. San José scale has a darker scale cover, yellow body and a subcentral exuvium on the male scale cover. Olive scale is very similar to Italian pear scale but the scale cover and exuviae are darker and the scale body is dark purple.

Hosts: Prefers walnuts, pome and stone fruits, and other trees or shrubs in the rose family. Commonly encountered in native habitats on toyon (*Heteromeles*).

Economic Importance: Not especially injurious in California except in walnut groves with heavy lichen growth. Large populations weaken trees and reduce nut size and tonnage. Causes pitting in the young stems of pear (Madsen and Barnes, 1959) and apple. For more information see Michelbacher and Ortega (1958) Barnes and Madsen (1961) and Kozár and Konstantinova (1981).

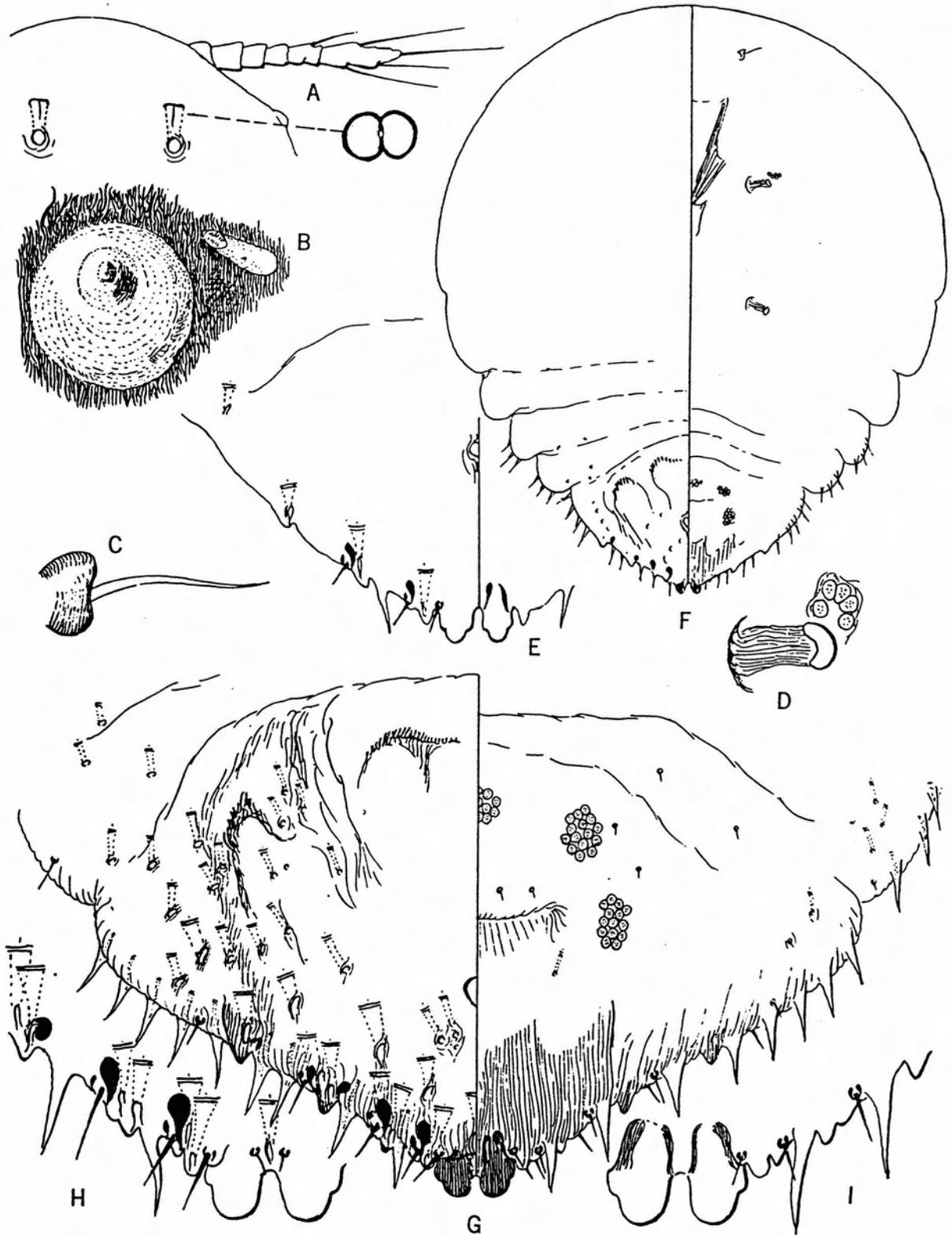


Fig. 65. *Epidiaspis leperii* (Signoret).

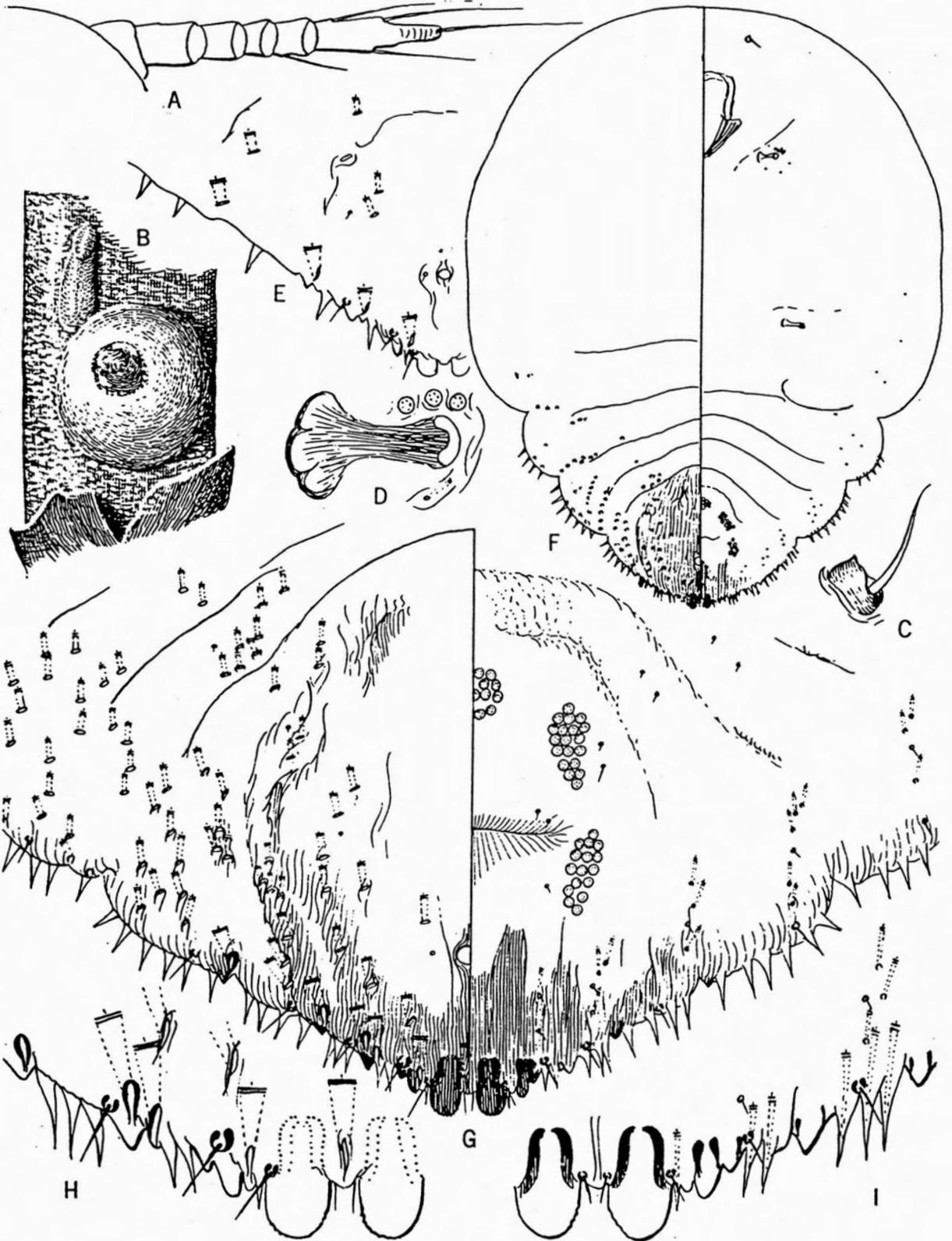


Fig. 66. *Epidiaspis salicicola* Ferris.

Distribution: Probably native to Europe. First found in California in 1882 at San Francisco; now common in the San Francisco Bay region, the Sacramento Valley and the northern San Joaquin Valley. Has also been found in several Southern California locations.

Diagnosis: Slide-mounted specimens are distinctive. They resemble scales in the genus *Diaspis*, but none of these occur on walnuts or rosaceous plants. *Epidiaspis salicicola* is similar morphologically, but is known only from poplar, mistletoe and the roots of willow.

Abd El-Kareim, A.I., B. Darvas and F. Kozár,

1988: J. Appl. Ent. 106:270-275.
 Barnes, M.M., and H.F. Madsen, 1961: Calif. Agric. Exp. Stn. Circ. 502:1-3.
 Essig, E.O., 1920: Calif. Agric. Exp. Stn. Circ. 224:1-11.
 Geier, P., 1949: Rev. Path. Veg. Entomol. Agric. Fr. 28:77-264.
 Kozár, F. and G.M. Konstantinova, 1981: Acta Phytopath. Acad. Sci. Hung. 16(1/2):211-222.
 Lockwood, S., 1962: Calif. Dep. Agric. Bur. Entomol. Loosel. Man.
 Madsen, H.F., and M.M. Barnes, 1959: Calif. Agric. Exp. Stn. Circ. 478:1-40.
 Michelbacher, A.E., and J.C. Ortega, 1958: Calif. Agric. Exp. Stn. Bull. 764:1-87.

Epidiaspis salicicola Ferris, 1938
 salicicola scale

Fig. 66

Tribe: Diaspidini.

Field Characteristics: Female scale cover 1.5 to 2.0 mm in diameter, circular, slightly convex, white, with a tan subcentral exuvium. Males elongate, white, with a tan terminal exuvium. Occurs on twigs, stems and exposed roots.

Similar Species: Mistletoe situlaspis scale (field separation is difficult); mistletoe scale, which is darker; and candidula scale, which has oval male scale covers and a subterminal exuvium.

Hosts: Most commonly willow (*Salix*) and cottonwood (*Platanus*), particularly on roots,

but has also been collected on mesquite mistletoe (*Phoradendron californicum*).

Economic Importance: None.

Distribution: A rare native species collected from Ventura and Kern counties south into Arizona.

Diagnosis: Similar to *Diaspis* but lacking a well developed marginal spur on the fifth abdominal segment. Has a more developed second pygidial lobe than does *E. leperii*.

McKenzie, H.L., 1956: The Armored Scale Insects of California. Univ. Calif. Press, Berkeley. 209 pp.

Genus Exuviaspis Ferris, 1941

Monotypic.

Exuviaspis enceliae Ferris, 1941
 encelia scale

Fig. 67

Tribe: Diaspidini.

Field Characteristics: Adult female scale covers 1.5 to 2.0 mm long, elongate, flat, pupillarial (like the similar genus *Fiorinia*), with only one apparent exuvium. Color actually white, of-

ten appears black because the hardened second exuvial skin can be seen through the thin, nearly transparent white wax covering. Wax cover is fragile and may be lost easily. Male scale cover elongate, white. Both male and

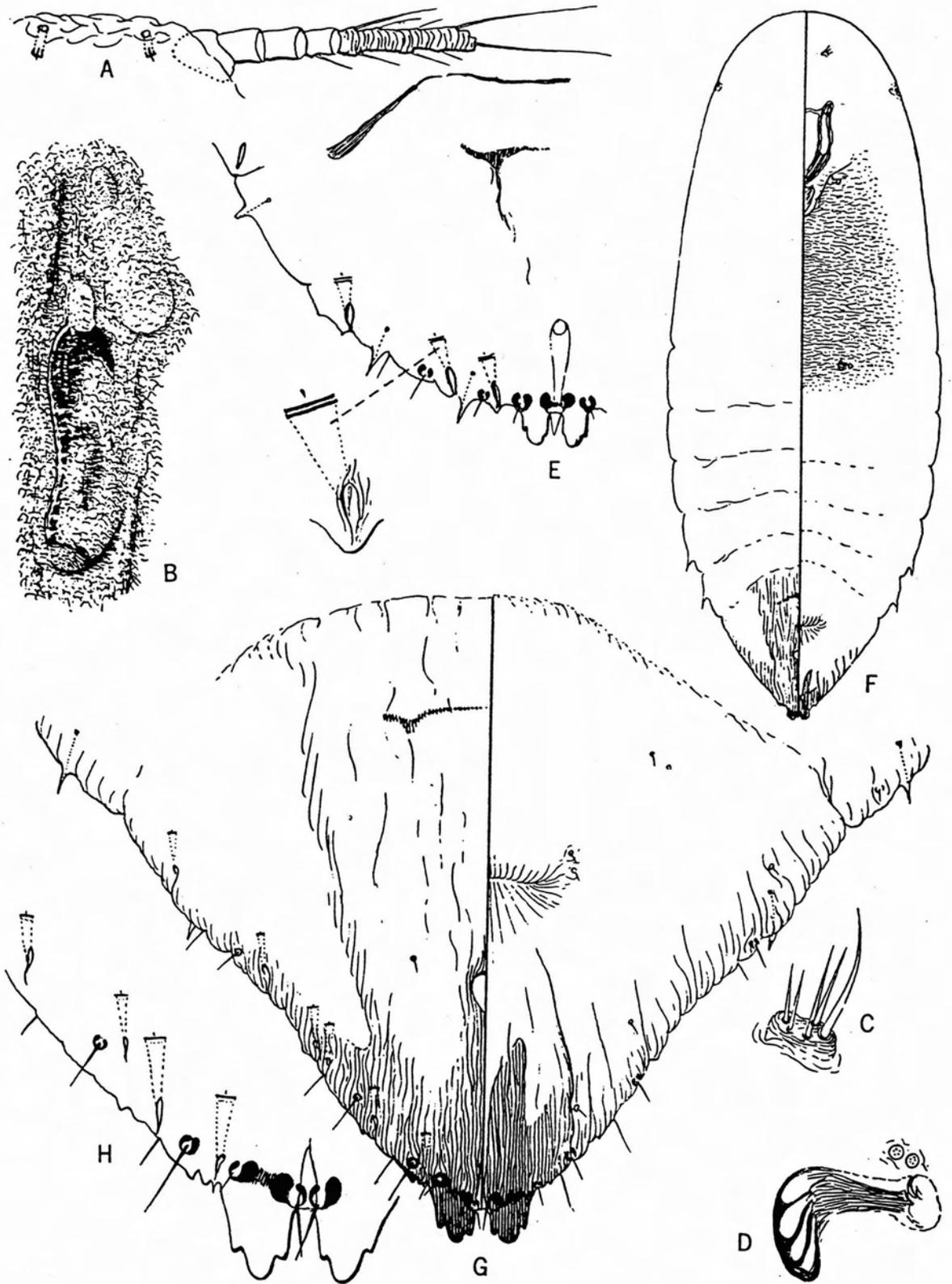


Fig. 67. *Exuviaspis enceliae* Ferris.

female scale covers have a terminal exuvium. Found under loose bark, under bud scales or buried in the soft cortex of the host; difficult to locate.

Biology: Unknown.

Similar Species: None.

Hosts: *Encelia palmeri*; other *Encelia* species.

Economic Importance: None. A rare native species.

Distribution: Previously known only from Todos Santos, Southern District, Baja California, Mexico. Collected from *Encelia* in Whitewater Canyon, Riverside County, Cali-

fornia in 1971 and recollected there in 1973. Probably occurs in adjacent counties to the south as well as in most of Baja California.

Diagnosis: Very similar to the *Fiorinia* group in overall appearance, but differs in having two protruding, indented median lobes. The *Fiorinia* group of scales has inset median lobes with only one free margin.

Ferris, G.F., 1937-1942: Atlas of the Scale Insects of North America, Ser. I-IV. Stanford Univ. Press, Stanford.

Genus *Ferrisidea* Borchsenius, 1965

This genus was erected by Borchsenius to include several species formerly in the genus *Pseudodiaspis*. All are native to Mexico and the southwestern United States. Recognized by the two pairs of lobes and the ventral clusters of very long, very thin tubular ducts on the pygidium.

Number of World species: 3

Number of California species: 1

Key to North American species: Ferris, G. F., 1937-1942: Atlas of the Scale Insects of North America, Ser. I-IV (included in *Pseudodiaspis*).

Ferrisidea magna (Ferris), 1921 magna scale

Fig. 68, Color Plate 71

Tribe: Diaspidini.

Synonymy: *Pseudodiaspis magna* Ferris.

Field Characteristics: Adult females 3.5 to 4.0 mm in diameter, circular, flat, white or grey, with submarginal exuviae. Second exuvium may be covered with a whitish secretion. Male scales white, oblong, with a terminal exuvium. Found on twigs and stems.

Biology: Unknown.

Hosts: Apparently restricted to boxwood plants in the genus *Lycium*, native to the southwestern United States and Mexico.

Economic Importance: None. A rare native species.

Distribution: Collected in California at

Palmdale, Los Angeles County in 1958, and in Mojave and Johannesburg, Kern County in 1981. Known from Baja California, Mexico and Texas; probably occurs in intervening areas wherever native stands of *Lycium* occur.

Diagnosis: Recognized by host preferences and by the clusters of long, thin, ventral microducts on the pygidium.

Ferris, G.F., 1921: Stanford Univ. Publ., Univ. Ser., Biol. Sci. 1(2):63-132.

Ferris, G.F., 1937-1942: Atlas of the Scale Insects of North America, Ser. I-IV. Stanford Univ. Press, Stanford.

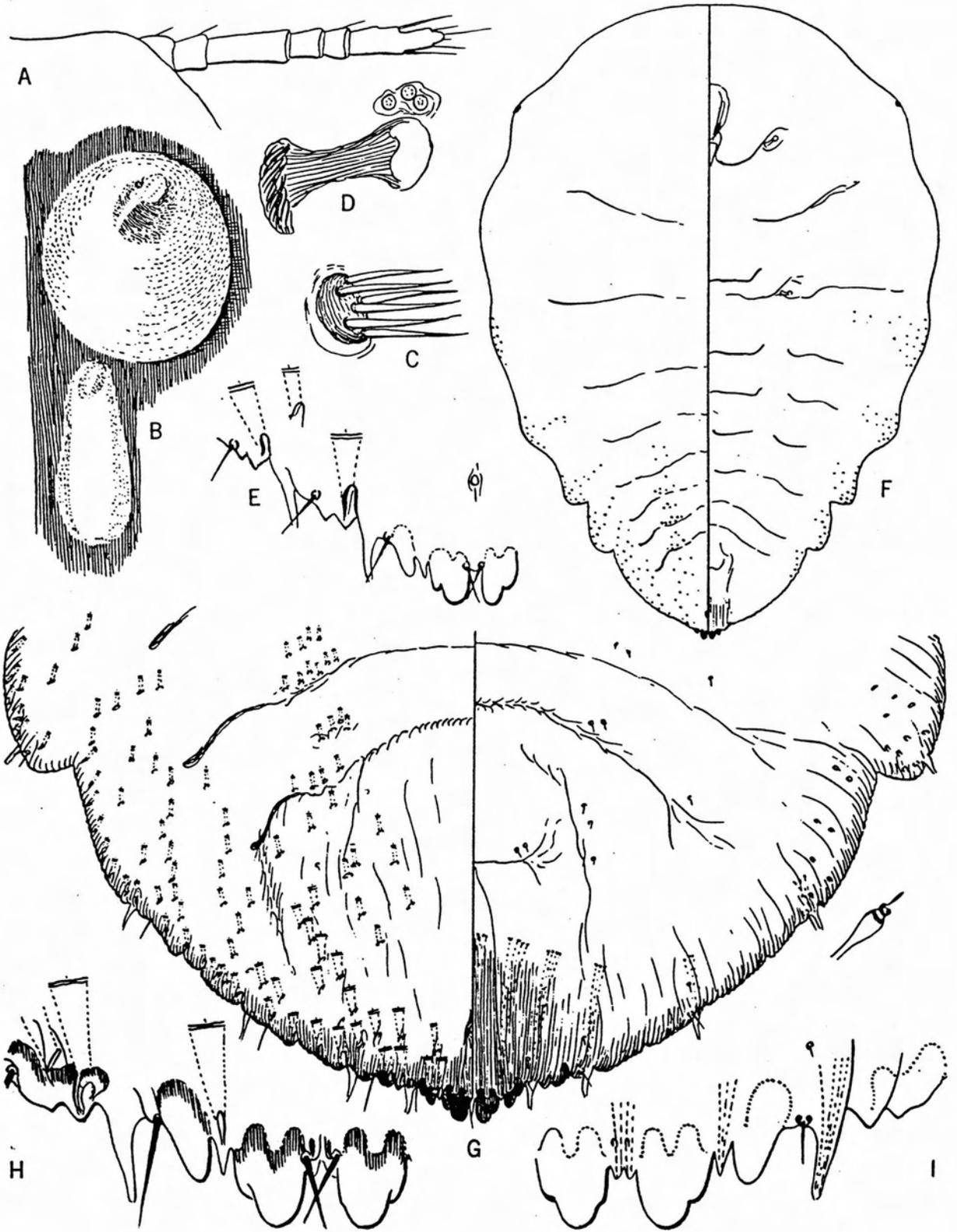


Fig. 68. *Ferrisidea magna* (Ferris).

Genus *Fiorinia* Targioni-Tozzetti, 1868

Number of World Species: 46.

Number of United States Species: 5.

Key to the World Species: None. The Japanese species have been keyed by Takagi, S., 1961: *Insecta Matsumurana* 24(1):4-42.

Key to the United States species: Ferris, G.F., 1937-1942: *Atlas of the Scale Insects of North America*, Ser. I-IV. Stanford Univ. Press, Stanford.

KEY TO CALIFORNIA SPECIES OF *FIORINIA*
(modified from McKenzie)

1. Pygidial margin with small macroducts only; with tubular process between antennae *theae*
- Pygidial margin with at least a few large macroducts; tubular process between antennae lacking. 2
2. Pygidial margin with from three to six large, and no small macroducts. 3
- Pygidial margin with four or five large macroducts followed by some small ducts; associated with conifers. *japonica*
3. Pygidial margin with but three or occasionally four large macroducts; infesting many hosts. *fioriniae*
- Pygidial margin with five to seven large macroducts; associated with *Podocarpus* *pinicola*

Fiorinia fioriniae (Targioni-Tozzetti), 1867

palm fiorinia scale

Fig. 69, Color Plate 72, 73

Tribe: Diaspidini.

Other Common Names: Fiorinia scale, ridged scale, European fiorinia scale, avocado scale.

Synonymy: *Diaspis fioriniae* Targioni-Tozzetti, *Fiorinia pellucida* Targioni-Tozzetti, *Fiorinia camelliae* (Comstock), *Chermes arecae* Boisduval, *Uhleria fioriniae* (Targioni-Tozzetti), *Uhleria camelliae* Comstock, *Fiorinia palmae* Green.

Field Characteristics: Adult female scale cover elongate oval, 1.0 to 1.5 mm long, transparent light brown, with only one yellowish terminal exuvium and a faint median longitudinal carina. The adult females are pupillarial, remaining inside the thickened, hardened second nymphal cast skin. Since little or no materials are added to the scale cover in the

adult state, no change in size takes place and the second exuvium is not readily apparent. Male scale covers, except for the exuvium, are dull white, nearly transparent, scarcely noticeable. The scales occur on the lower sides of the leaves; usually aligned along the leaf veins.

Biology: Little known in the United States. Murakami (1970) states that there are three generations annually in Japan.

Hosts: Prefers camellia in California but commonly encountered in quarantine on palms from Florida and from *Protea* from Hawaii.

Economic Importance: None.

Distribution: In California known only from southwestern San Diego County.

Diagnosis: The only California *Fiorinia*. Also

the only *Fiorinia* with enlarged antennal tubercles and fewer than four pairs of marginal macroducts. First instars have been described and illustrated by Howell (1977).

Dekle, G.W., 1976: Florida Armored Scale Insects. Fla. Dep. Agric. Cons. Serv., Div. Plant

Ind., Gainesville. 345 pp.

Howell, J.O., 1977: Ann. Entoml. Soc. Am. 70(6):829-836.

McKenzie, H.L., 1956: The Armored Scale Insects of California. Univ. Calif. Press, Berkeley. 209 pp.

Murakami, Y., 1970: Mushi 43(7):65-114.

Fiorinia japonica Kuwana, 1902

coniferous fiorinia scale

Fig. 70

Tribe: Diaspidini.

Found on juniper and *Podocarpus* in nurseries in Los Angeles and Alameda Counties. Apparently eradicated.

McKenzie, H.L., 1956: The Armored Scale Insects of California. Univ. Calif. Press, Berkeley. 209 pp.

Fiorinia pinicola Maskell, 1897

juniper fiorinia scale

Fig. 71, Color Plates 74, 75

Tribe: Diaspidini.

Synonymy: *Aspidiotus juniperi* Leonardi, *Diaspis juniperi* (Leonardi).

Found in several Los Angeles and Alameda Counties nurseries prior to 1945; thought to be eradicated. However, one of these was recently rediscovered from one of the originally infested nurseries in Alameda County in 1989.

McKenzie, H.L., 1956: The Armored Scale Insects of California. Univ. Calif. Press, Berkeley. 209 pp.

Fiorinia theae Green, 1900

tea scale (ESA approved)

Fig. 72

Tribe: Diaspidini.

Field Characteristics: Elongate oval, 1.0 to 1.5 mm long, dark chestnut brown, with a well-defined median longitudinal carina. Adult females pupillarial; only one terminal exuvium is apparent. Males very common, white, somewhat tricarinate with a terminal exuvium.

Hosts: Prefers camellias. Also known from citrus but otherwise polyphagous.

Economic Importance: An "A"-rated pest. A serious pest of camellias and other ornamental plants. Dekle (1976) considers it one of the 10 most important nursery plant pests. Com-

monly encountered in quarantine.

Distribution: Introduced into California a number of times, particularly in nurseries, but eradication attempts have been successful and it is presently not found in California.

Diagnosis: The only U. S. species of *Fiorinia* possessing small marginal macroducts. First instars have been described and illustrated by Howell (1977).

Dekle, G.W., 1976: Florida Armored Scale Insects. Fl. Dep. Agric., Cons. Serv., Div. Plant

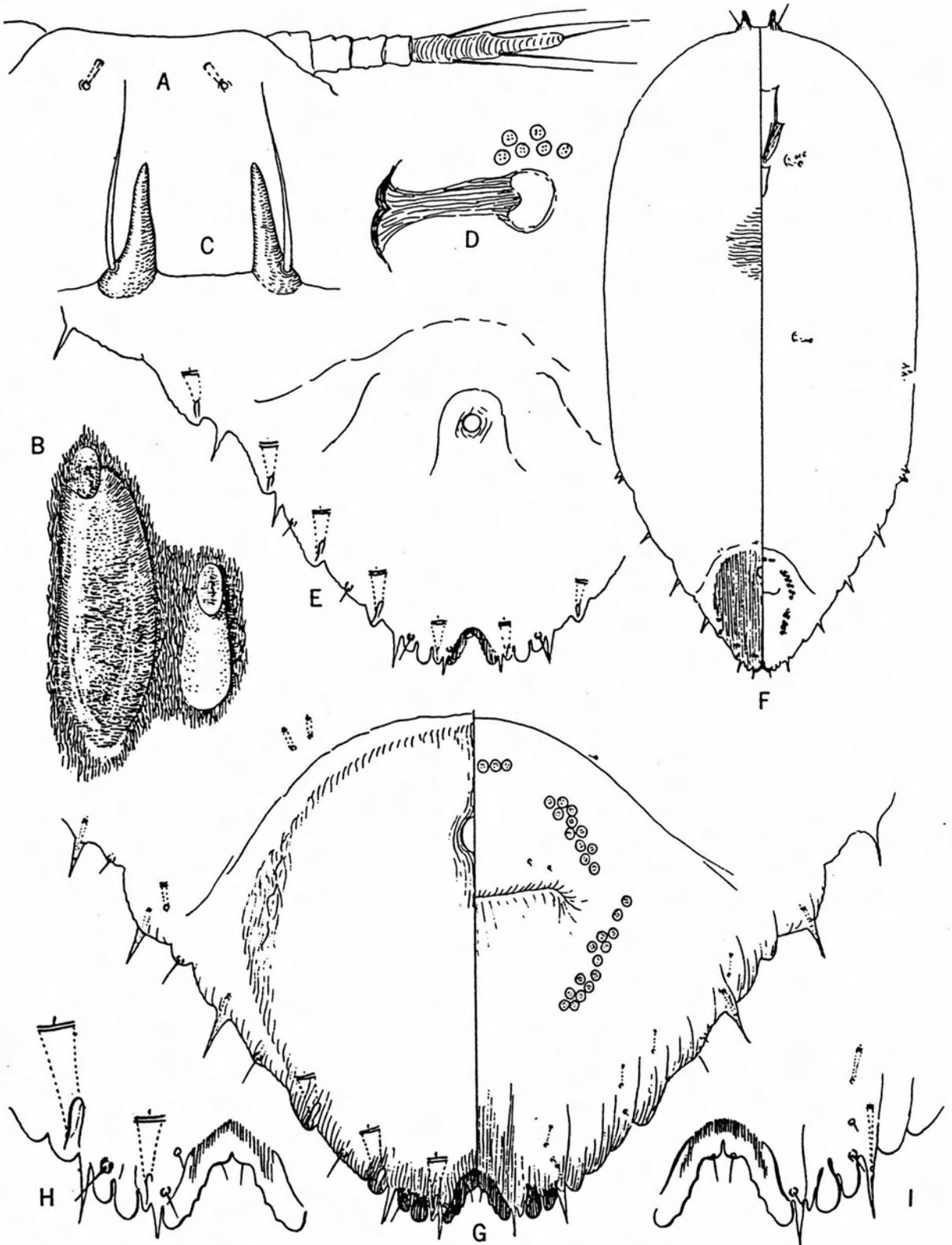


Fig. 69. *Fiorinia fioriniae* (Targioni-Tozzetti).

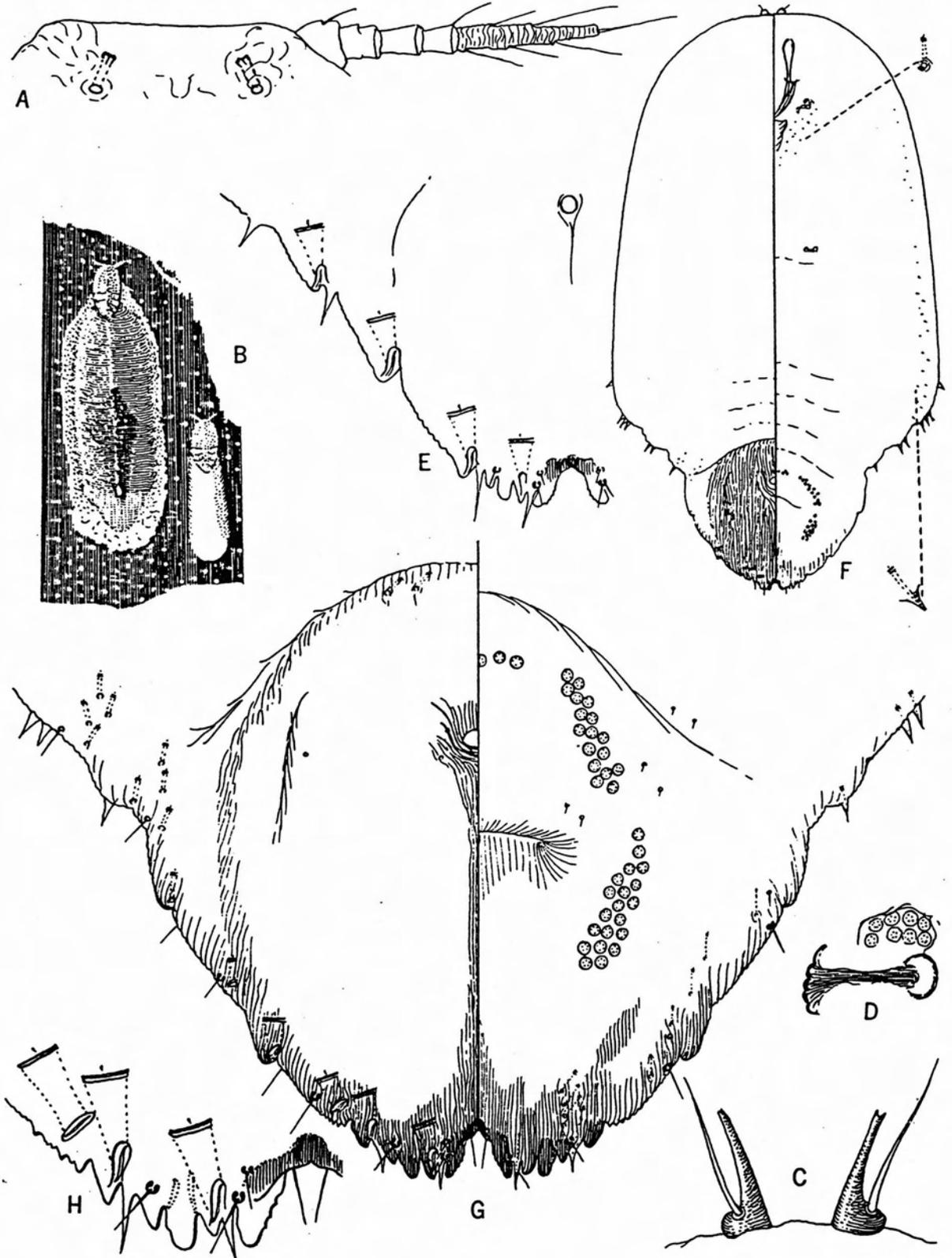


Fig. 70. *Fiorinia japonica* Kuwana.

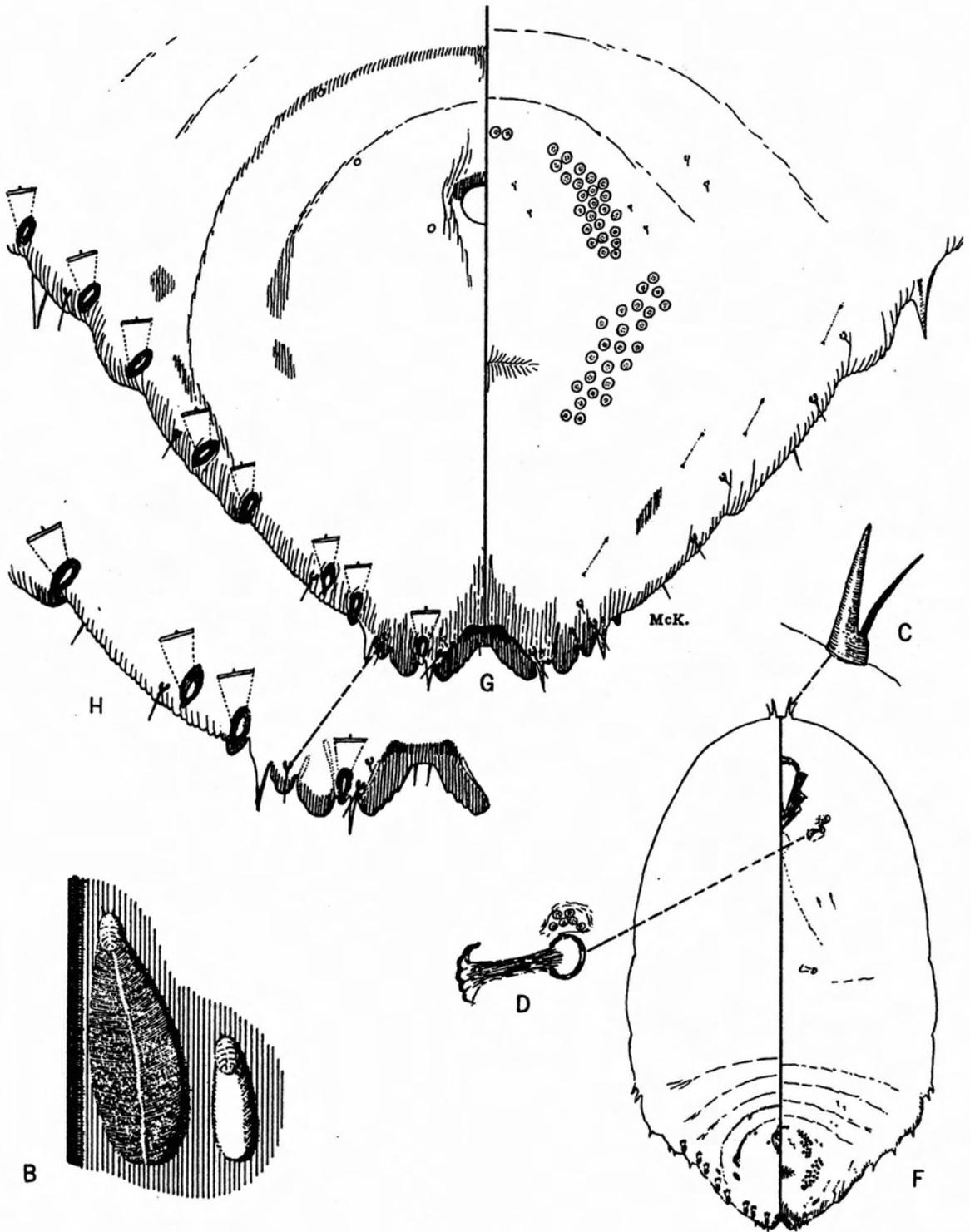


Fig. 71. *Fiorinia pinicola* Maskell.

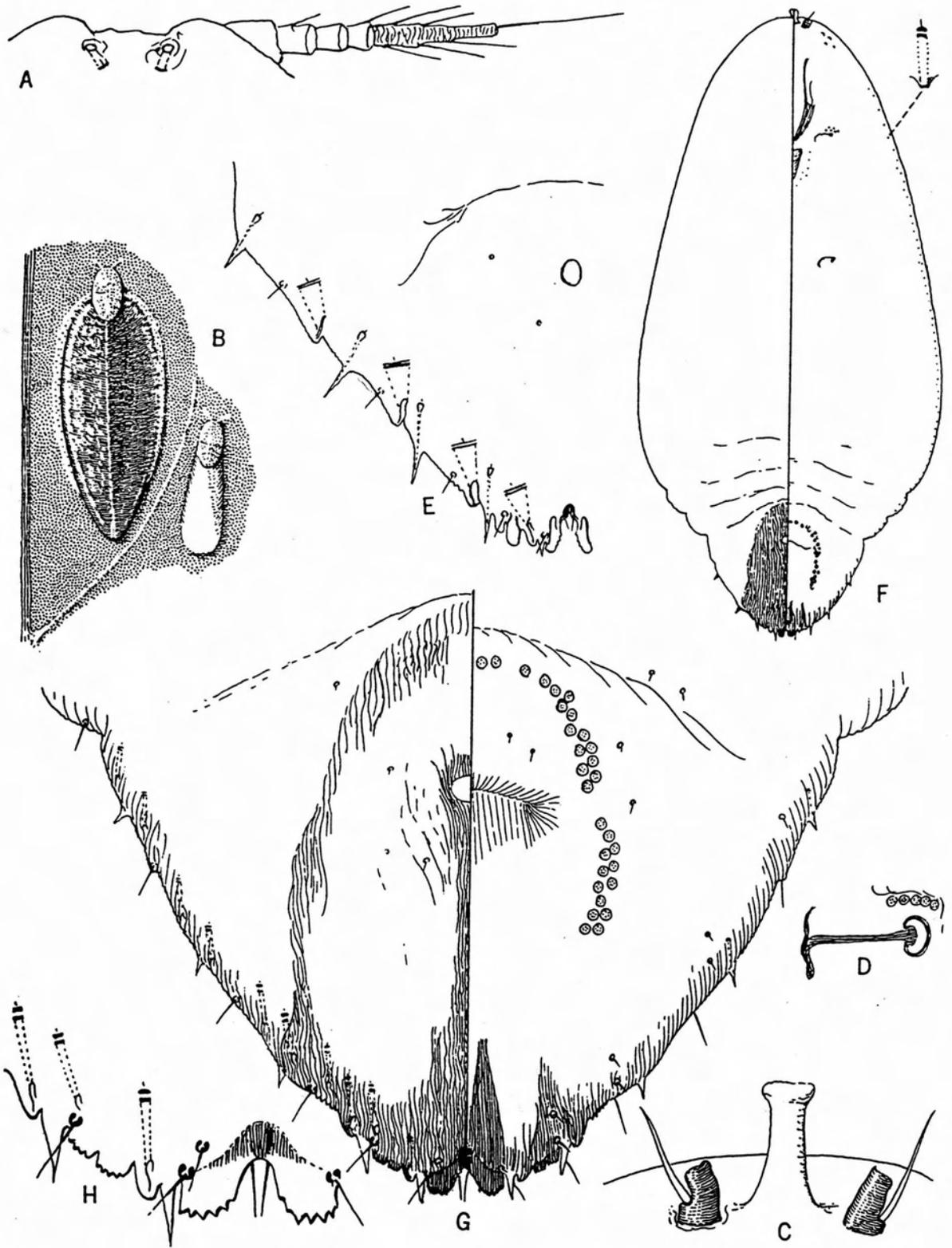


Fig. 72. *Fiorinia theae* Green.

Ind., Gainesville. 345 pp.

Howell, J.O., 1977: Ann. Entoml. Soc. Am. 70(6):829-836.

McKenzie, H.L., 1956: The Armored Scale Insects of California. Univ. Calif. Press, Berkeley. 209 pp.

Genus *Froggattiella* Leonardi, 1900

Number of World Species: 3.

Number of United States Species: 1.

Key to the World Species: Ben-Dov, Y., 1988: USDA Tech. Bull. 1723, 142 pp.

Froggattiella penicillata (Green), 1905

penicillate scale

Fig. 73, Color Plates 76, 77

Tribe: Odonaspidini.

Synonymy: *Aspidiotus inusitatus* Green (misidentification), *Anoplaspis penicillata* (Green), *Dycryptaspis penicillata* (Green), *Odonaspis penicillata* (Green).

Field Characteristics: Adult female scale covers 2.5 to 3.0 mm long, elongate oval, somewhat convex, tan or light brown with shiny yellow-brown terminal exuviae. Ventral scale of the female is of the bivalve type, well developed and including part of the exuviae, so that most of the scale body is separated from the host surface as is typical of the *Odonaspis* group. Male scales similar to the females but smaller. Occurs on the stems and nodes under the leaf sheaths.

Similar Species: *Odonaspis* species. A number of species occur on bamboo worldwide.

Biology: Unknown.

Hosts: Bamboo exclusively.

Economic Importance: Not serious, although nurserymen may wish to treat infested stock.

Distribution: Found in most areas where bamboo is grown or sold as nursery stock. Most common in Southern California.

Diagnosis: Placed by Ferris and McKenzie as a member of *Odonaspis*, it was recently placed back into *Froggattiella* by Ben-Dov (1988). The pygidial scleroses and apical cluster of seta-like gland spines are diagnostic and separate this species from California species of *Odonaspis*.

McKenzie, H.L., 1956: The Armored Scale Insects of California. Univ. Calif. Press, Berkeley. 209 pp.

Ben-Dov, Y., 1988: USDA Tech. Bull. 1723. 142 pp.

Genus *Furchadaspis* MacGillivray, 1921

Monotypic.

Furchadaspis zamiae (Morgan), 1890

cycad scale

Fig. 74, Color Plate 78, 79

Tribe: Diaspidini.

Other Common Names: Zamia scale.

Synonymy: *Diaspis zamiae* Morgan, *Howardia elegans* Berlese and Leonardi, *Aulacaspis*

elegans (Berlese and Leonardi), *Furchadiaspis zamiae* (Morgan) (note generic spelling), *Aulacaspis zamiae* (Morgan).

Field Characteristics: Adult females 1.0 to 2.5

mm long, oval to oblong, moderately to strongly convex, white with yellow or whitish marginal exuviae. Body yellow, usually well hidden by ventral scale armor. Often covered with woolly threads of white wax. Males unknown. Normally found on the ventral leaf surfaces, occasionally found on stems.

Similar Species: Oleander scale is often confused with this species on cycads, but it is light tan and males, if present, are white. Oleander scale females are normally flat on most hosts, but on the narrow, curled leaves of some cycads they are more convex like cycad scale. Another armored scale, *Aspidiotus tridentifer* Ferris, is similar and has been intercepted on sago palm in quarantine, but it is tan rather than white. Similar to *Poliaspis*, also on cycads in southern California, but that species has an oystershell type of scale cover.

Biology: Unknown.

Hosts: Prefers sago palms or cycads in the genera *Cycas*, *Zamia* and others. Found in recent years on a number of other plants in the

genera *Strelitzia*, *Musa*, *Maytenus*, *Thevetia*, *Aralia*, *Cussonia*, *Rhus*, and *Trachycarpus*.

Economic Importance: A serious pest of cycads, causing severe chlorosis of the leaves and greatly reducing the ornamental qualities of these expensive and slow growing plants. For more information see Brown and Eads (1967) and Kozarzhevskaya and Reitzel (1975).
Distribution: Found anywhere in the State where cycads are grown; most common in Southern California. Also occurs in subtropical United States, Africa, Asia, Australia and in European greenhouses.

Diagnosis: Recognized by its field characteristics and by its *Diaspis*-like median lobes, lack of perivulvar pores and large number of dorsal ducts scattered on the abdominal segments.

Brown, L.R., and C.O. Eads, 1967: Calif. Agric. Exp. Stn. Bull. 834:1-72.

Kozarzhevskaya E., and J. Reitzel, 1975: The Scale Insects of Denmark. Statens Fors. Plantekultur, Copenhagen. 40 pp.

Genus *Haliaspis* Takagi, 1963

Number of World species: 8.

Number of United States species: 4.

Key to the World species: Howell, J.O., 1978: Ann. Entomol. Soc. Am. 71(3):401-407. Distribution of the U.S. species is given by Howell and Tippins (1975a).

Haliaspis spartinae (Comstock), 1883

cord grass scale

Fig. 75, Color Plate 80

Tribe: Diaspidini.

Other Common Names: saltmarshgrass scale.

Synonymy: *Chionaspis spartinae* Comstock, *Duplachionaspis spartinae* (Comstock).

Field Characteristics: Female scale cover elongate, oystershell-shaped, 2 to 3 mm long, white, with yellow or brown terminal exuviae. Males similar but smaller. Infests dorsal leaf surfaces.

Similar Species: Several similar related species occur in the eastern United States.

Hosts: Cord grass (*Spartina foliosa*), which grows primarily along the edges of the intertidal zones of bays and estuaries.

Distribution: A rare native species found along the coast from San Diego County to San Francisco Bay. Also occurs in the eastern States and along the Gulf of Mexico on cord grass and other related species.

Diagnosis: The only elongate white armored scale occurring on the leaves of grasses in California. Descriptions and illustrations of

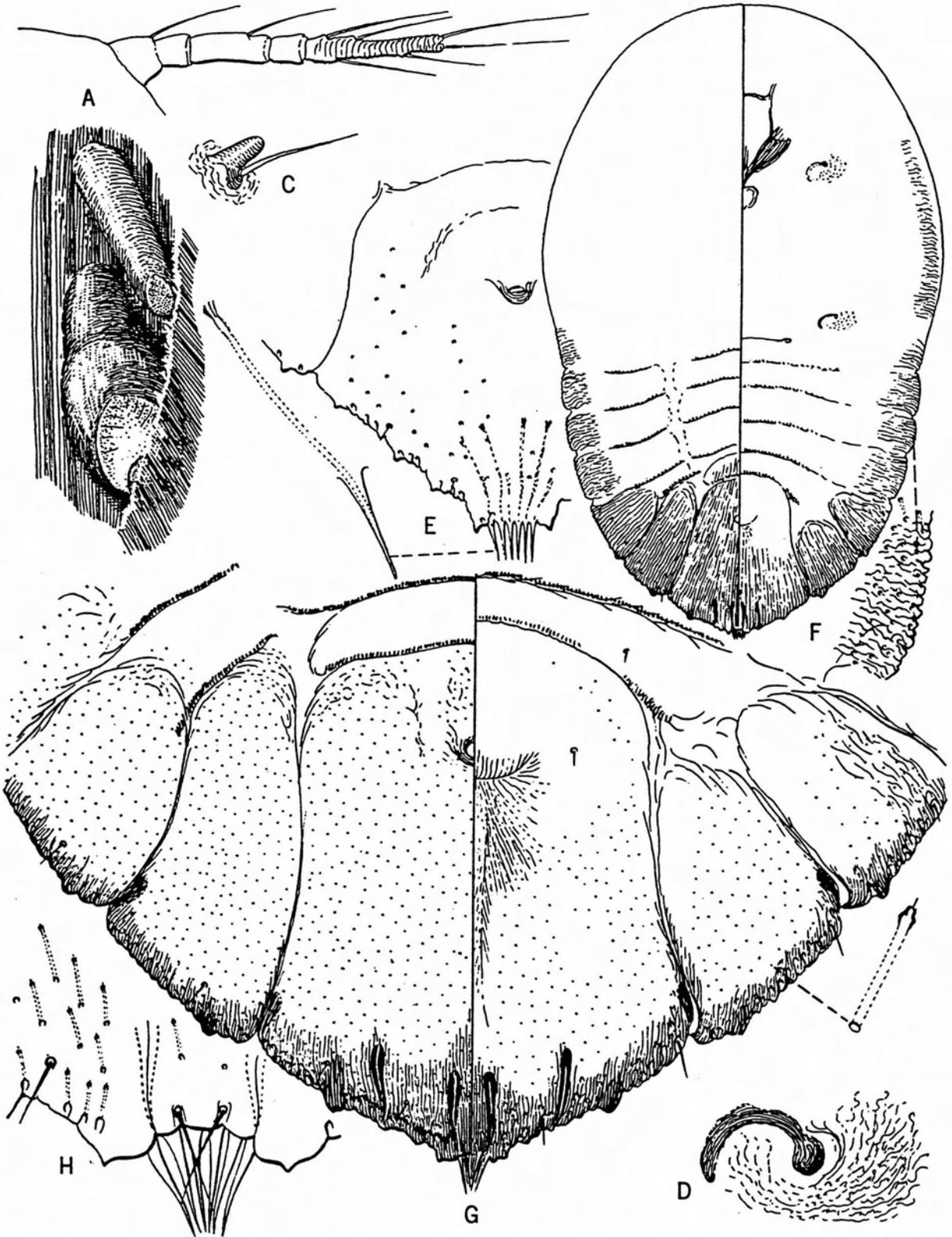


Fig. 73. *Froggattiella penicillata* (Green).

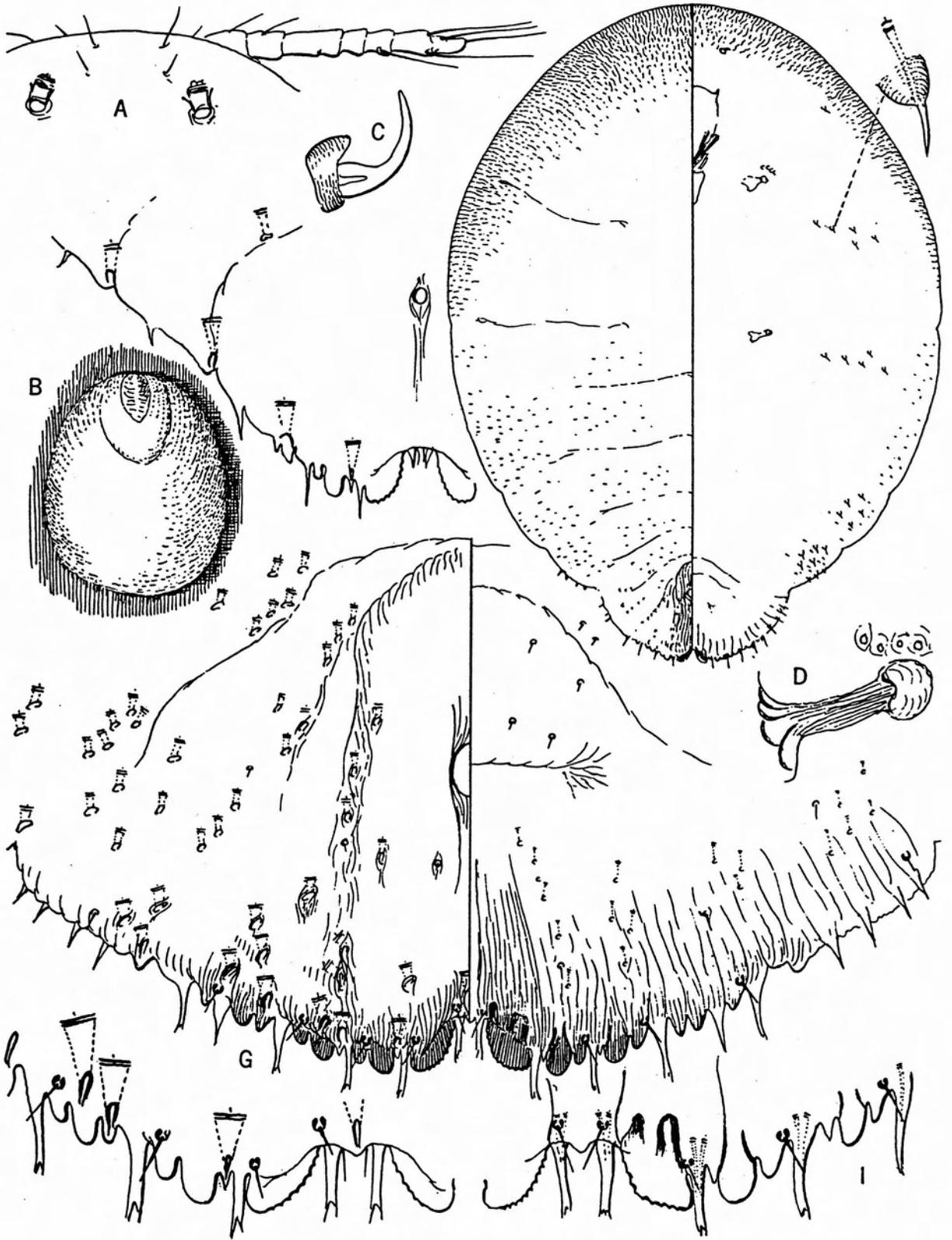


Fig. 74. *Furchadaspis zamiae* (Morgan).

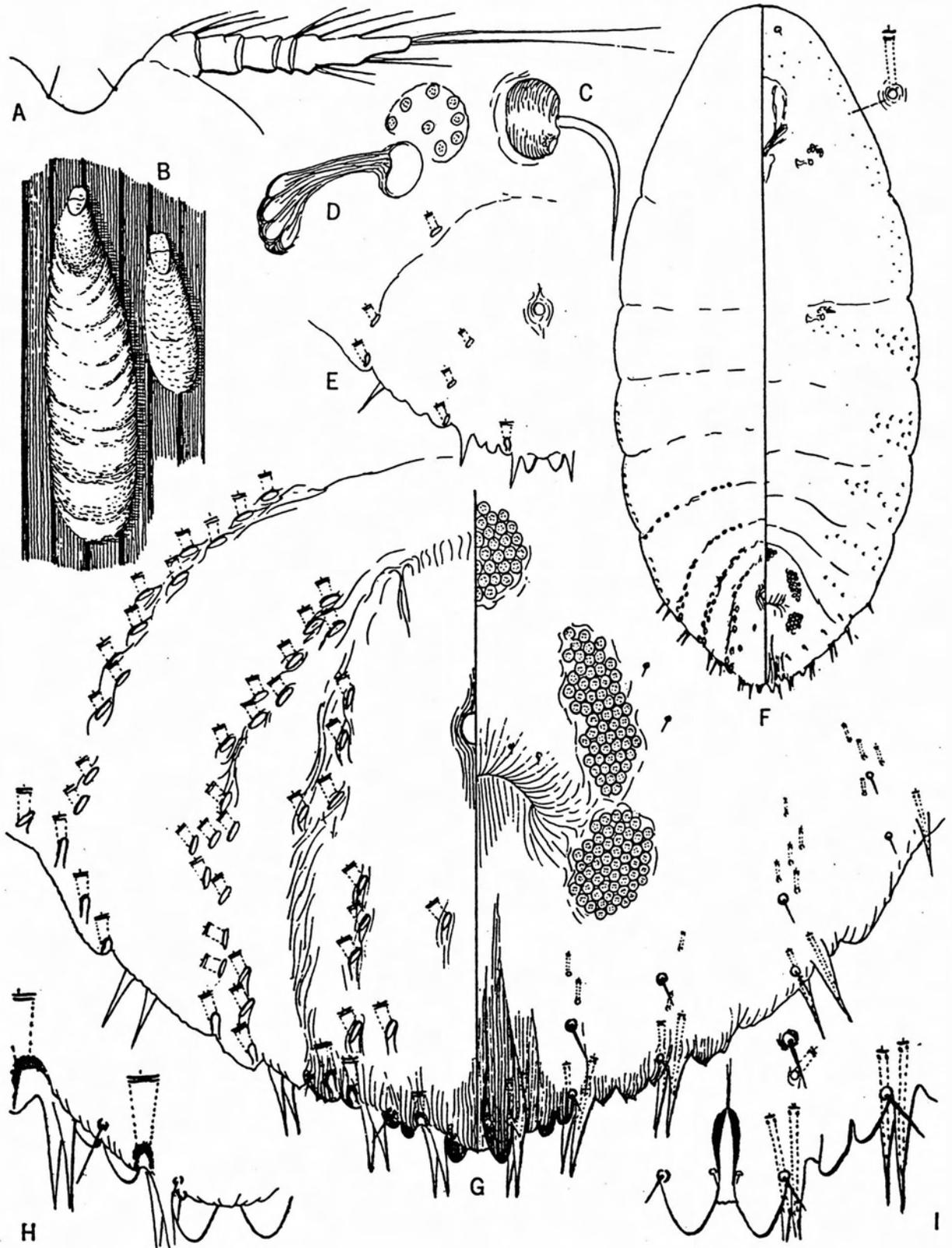


Fig. 75. *Haliaspis spartinae* (Comstock).

the first instars are given by Howell and Tippins (1975a) and of the second stage males by Howell and Tippins (1975b).
 Howell, J.O. and H.H. Tippins, 1975a: Ann. Entomol. Soc. Am. 68(3):429-433.
 Howell, J.O. and H.H. Tippins, 1975b: Ann. Entomol. Soc. Am. 69(2):175-180.
 McKenzie, H.L., 1956: The Armored Scale Insects of California. Univ. Calif. Press, Berkeley. 209 pp.
 Takagi, S., 1971: Kontyu 39(2):126-132.

Genus *Hemiberlesia* Cockerell, 1897

Number of World species: About 25.
 Number of United States species: 6.
 Key to the World species: None.
 Key to the United States species: Ferris, G.F., 1937-1942: Atlas of the Scale Insects of North America, Ser. I-IV. Stanford Univ. Press, Stanford. (Includes *Abgrallaspis*).

KEY TO CALIFORNIA SPECIES OF *HEMIBERLESIA*

- 1. Perivulvar pores present. **2**
 — Perivulvar pores lacking. *rapax*
- 2. Second and third lobes definitely developed, often sclerotized. *palmae*
 Second lobes and third lobes lacking or developed merely as an unsclerotized point. **3**
- 3. Plates small and inconspicuous, confined to the first and second interlobular spaces; dorsal ducts very numerous, in distinct furrows on the fifth and sixth segments, anal opening large and quite close to the apex of the pygidium; associated with willow and poplar *popularum*
 — Plates well developed, forming a quite conspicuous fringe, present laterad of the site of the third lobe; dorsal ducts relatively few. **4**
- 4. Dorsal ducts quite large and long, concentrated in short rows near the pygidial margin; plates but very slightly notched or divided; second and third lobes entirely obsolete; associated with *Prosopis*. *candidula*
 — Dorsal ducts very slender, not concentrated toward the pygidial margin; plates deeply and variously fringed and divided; first and second lobes indicated by mere points; one of the most frequently encountered species in collections from subtropical and tropical areas, occurring on many hosts. *lataniae*

***Hemiberlesia candidula* (Cockerell), 1900**
candidula scale

Fig. 76

Tribe: Aspidiotini. white or light tan; exuviae tan to brown, central or subcentral. Male scale covers white, oblong, with a subterminal exuvium.
Synonymy: *Aspidiotus candidulus* Cockerell, *Diaspidiotus candidulus* (Cockerell).
Field Characteristics: Adult females 1 to 2 mm in diameter, circular, somewhat convex, **Similar Species:** Oleander scale.
Hosts: Restricted to mesquite (*Prosopis*) and

mesquite mistletoe (*Phoradendron californicum*).

Economic Importance: None.

Distribution: Restricted to the desert areas of Riverside, Imperial and probably San Diego and San Bernardino Counties. Also occurs in Arizona.

Diagnosis: Not listed by McKenzie, since the first California material was collected in 1957. Normally only the median lobes are devel-

oped and thus, it is similar to *Hemiberlesia lataniae*, but the plates are different in shape and number, and the arrangement of the macroducts differs. See figure 76.

Ferris, G.F., 1937-1942: Atlas of the Scale Insects of North America, Ser. I-IV. Stanford Univ. Press, Stanford.

***Hemiberlesia lataniae* (Signoret), 1869**

latania scale (ESA approved)

Fig. 77, Color Plate 81, 82

Tribe: Aspidiotini.

Other Common Names: quince scale.

Synonymy: *Aspidiotus lataniae* Signoret, *Aspidiotus cydoniae* Comstock, *Aspidiotus diffinis* var. *lateralis* Cockerell, *Aspidiotus crawii* Cockerell, *Aspidiotus greenii* Cockerell, *Aspidiotus lataniae* Cockerell. For a more complete synonymical list see Borchsenius (1966).

Field Characteristics: Adult females 1 to 2 mm in diameter, circular, convex, usually tan, but may be darker or almost white. Exuvium usually yellow but may be much darker, particularly if the specimens occur on branches. Body bright yellow, exuvia subcentral. Males common in Florida and other tropical locations, but the species is nearly always parthenogenetic in California.

Similar Species: Cannot be separated in the field from greedy scale with any consistency although it usually has a less developed ventral scale than greedy scale. Oleander scale is similar but less convex. Tropical palm scale, *Hemiberlesia palmae* (Cockerell), not presently found in California, can be mistaken for this species on palms.

Biology: Biology not completely known, although generation time is about two months during the summer on avocados in California. Has four generations per year in Israel. The above information summarized from Ebeling and Pence (1953), Ebeling (1959) and Avidov and Harpaz (1969).

Hosts: Polyphagous. Prefers evergreen ornamental shrubs such as avocado, euonymus,

camellia, palms and *Aucuba*. Occasionally found on citrus fruit, walnuts and kiwi. For a host list see Mackie (1931) and Borchsenius (1966).

Economic Importance: An occasional pest of commercial avocados in California but natural enemies control it under most circumstances. Causes culling or grade reduction of avocados, and causes pits and other deformation of the outer flesh of thin-skinned varieties. Considered a serious pest of avocados in Israel. A serious pest of palms and other ornamentals in Florida and also a pest of many ornamental plantings in California. Recently found in heavy populations on commercial kiwi fruit in Kern County and it occurs on this fruit in other areas of California also. The above economic information summarized in part from Mackie (1931), McKenzie (1935), Ebeling and Pence (1953), Ebeling (1959), Avidov and Harpaz (1969), Dekle (1976), and Blank et al (1987). For information on natural enemies see Ebeling (1959).

Distribution: Found throughout the State at low elevations. Cosmopolitan. Origin unknown.

Diagnosis: Recognized by having second and third lobes represented by unsclerotized points and by having the large anal ring. Differs from *rapax* in possessing perivulvar pores.

Avidov, Z., and I. Harpaz, 1969: Plant Pests of Israel. Isr. Univ. Press, Jerusalem. 549 pp.
Blank, R.H., M.H. Olson and D.S. Bell, 1987:

- New Zealand Entomol. 10:127-130.
- Borchsenius, N.S., 1966: A Catalogue of the Armored Scale Insects of the World. Zool. Inst. U.S.S.R Acad. Sci., Moscow and Leningrad. 449 pp.
- Dekle, G.W., 1976: Florida Armored Scale Insects. Fla. Dep. Agric. Cons. Serv., Div. Plant Ind., Gainesville. 345 pp.
- Ebeling, W., 1959: Subtropical Fruit Pests. Univ. Calif. Div. Agric. Sci. Bull., 436 pp.
- Ebeling, W., and R. J. Pence, 1953: Calif. Agric. Exp. Stn. Circ. 428:1-35.
- Mackie, D.B., 1931: Calif. Dep. Agric. Mon. Bull. 20(7):419-441.
- McKenzie, H.L., 1935: Calif. Agric. Exp. Stn. Bull. 592:1-48.

***Hemiberlesia palmae* (Cockerell), 1893
tropical palm scale.**

Fig. 78, Color Plate 83, 84

Tribe: Aspidiotini.

Other Common Names: Dark spotted scale, coconut scale.

Synonymy: *Aspidiotus palmae* Cockerell, *Aspidiotus palmae* Morgan, *Furcaspis palmae* (Cockerell), *Aspidiotus unguiculatus* Leonardi, *Gonaspidotus unguilatus* MacGillivray, *Aspidiotus javanensis* Kuwana, *Abgrallaspis palmae* (Cockerell), *Borchseniaspis palmae* (Cockerell).

Found in several nurseries in Los Angeles County prior to 1945. Eradicated.

McKenzie, H.L., 1956: The Armored Scale Insects of California. Univ. Calif. Press, Berkeley. 209 pp.

***Hemiberlesia popularum* (Marlatt), 1908
poplar scale**

Fig. 79

Tribe: Aspidiotini.

Synonymy: *Aspidiotus popularum* Marlatt, *Diaspidiotus popularum* (Marlatt).

Field Characteristics: Female scale cover 1.5 to 2.5 mm in diameter, circular, very convex, dirty-white, with dark brown submarginal exuviae. Male scales oval, white, with a brown subterminal exuvium. Occurs on stems.

Similar Species: *Latania* and greedy scales, but poplar scale is lighter; also males, common in poplar scale, are not known in the other two species in California.

Biology: Unknown.

Hosts: Poplar, willow, ash, arrow-weed (*Pluchea*), and several other hosts.

Economic Importance: None.

Distribution: A rare species found from Ventura County south and east as far as Texas. Apparently native.

Diagnosis: Separated from other California *Hemiberlesia* by the reduced unfimbriated pygidial plates.

McKenzie, H.L., 1956: The Armored Scale Insects of California. Univ. Calif. Press, Berkeley. 209 pp.

***Hemiberlesia rapax* (Comstock), 1881
greedy scale (ESA approved)**

Fig. 80, Color Plate 85, 86

Tribe: Aspidiotini.

Synonymy: *Aspidiotus rapax* Comstock, *Aspidiotus camelliae* Signoret, *Aspidiotus convexus* Comstock (in part), *Aspidiotus tricolor* Cockerell, *Aspidiotus lucumae* Cockerell.

For a more complete synonymical list see Borchsenius (1966).

Field Characteristics: Adult females 1 to 2 mm in diameter, circular, convex, usually grey, with darker central or subcentral exuviae.

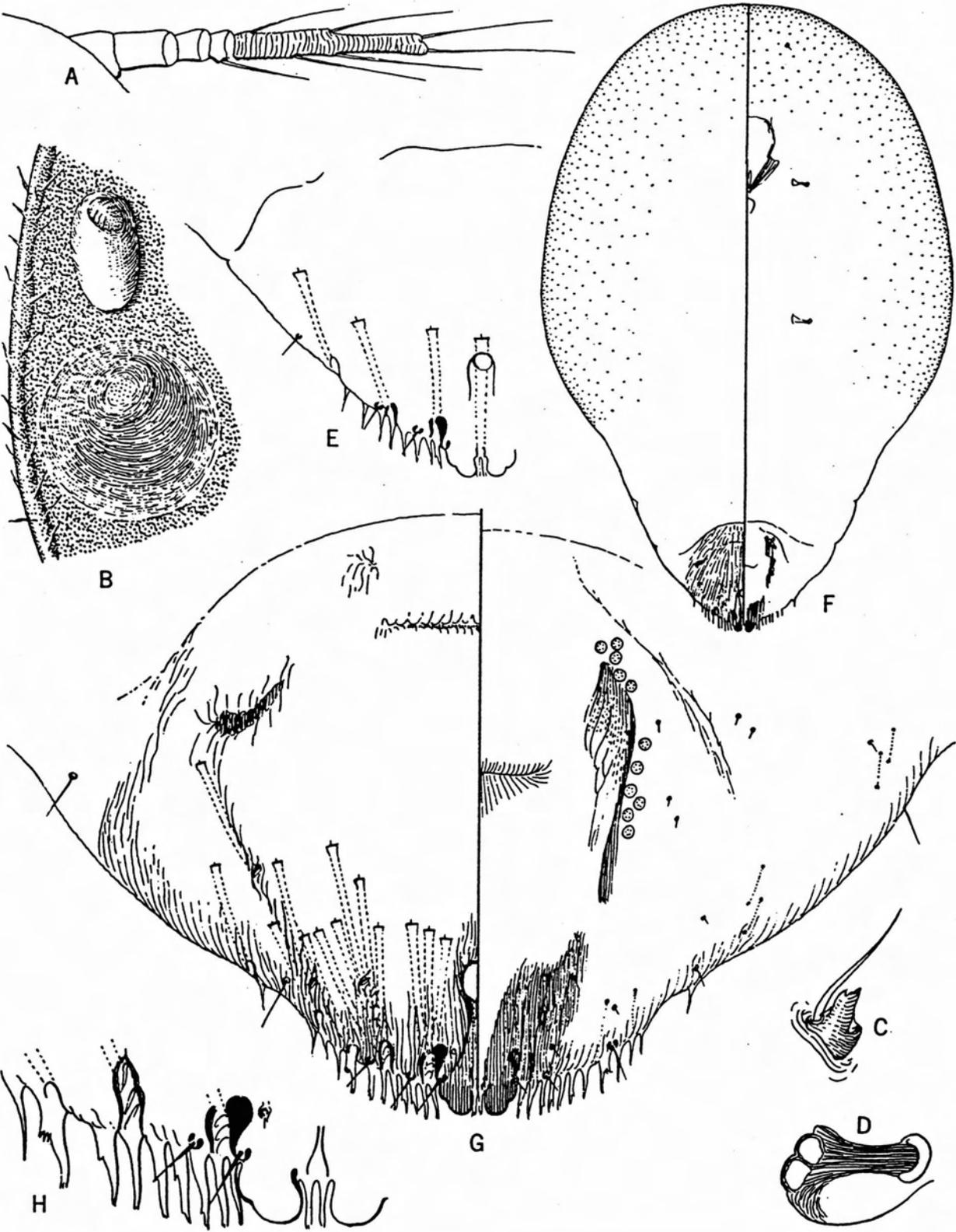


Fig. 76. *Hemiberlesia candidula* (Cockerell).

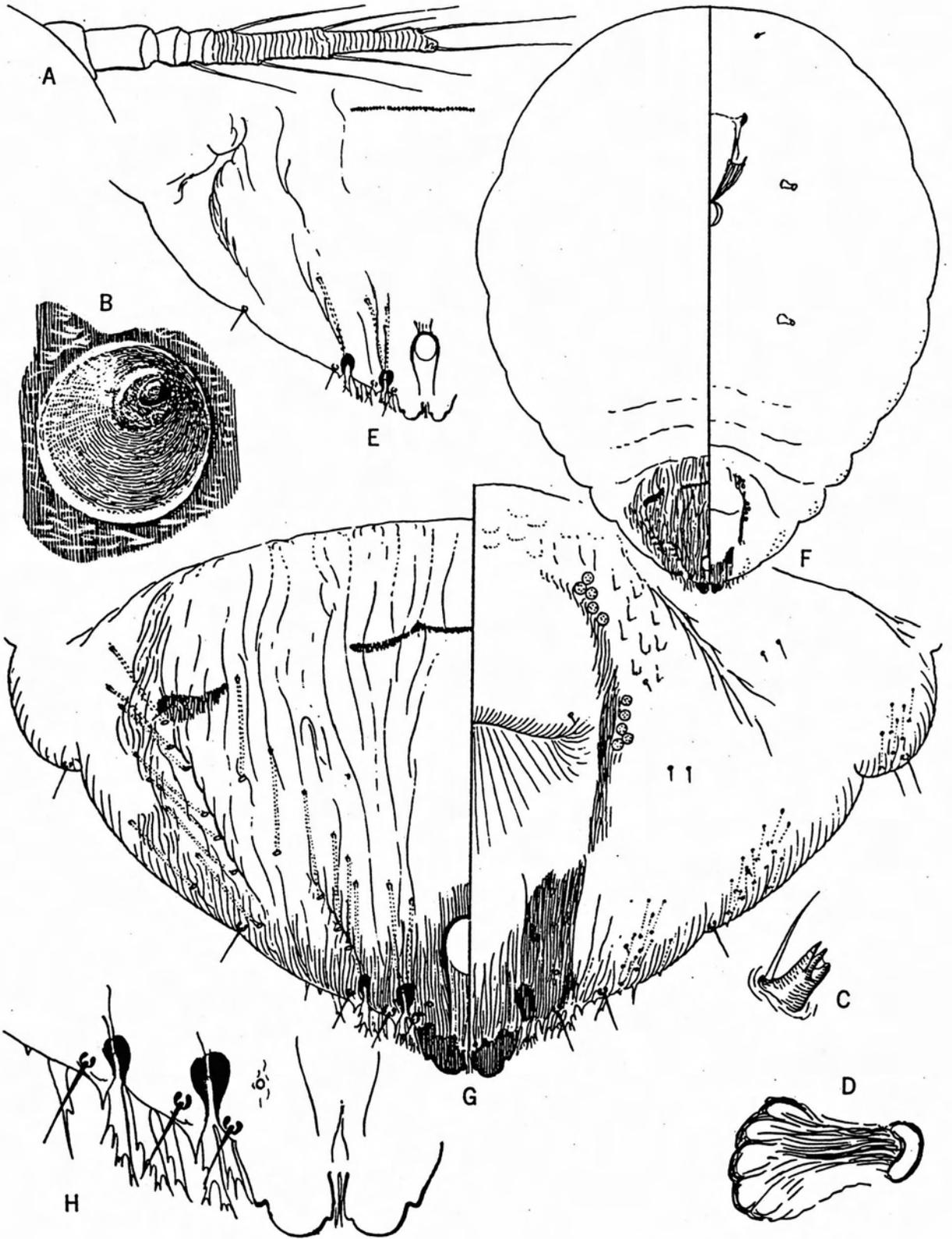


Fig. 77. *Hemiberlesia lataniae* (Signoret).

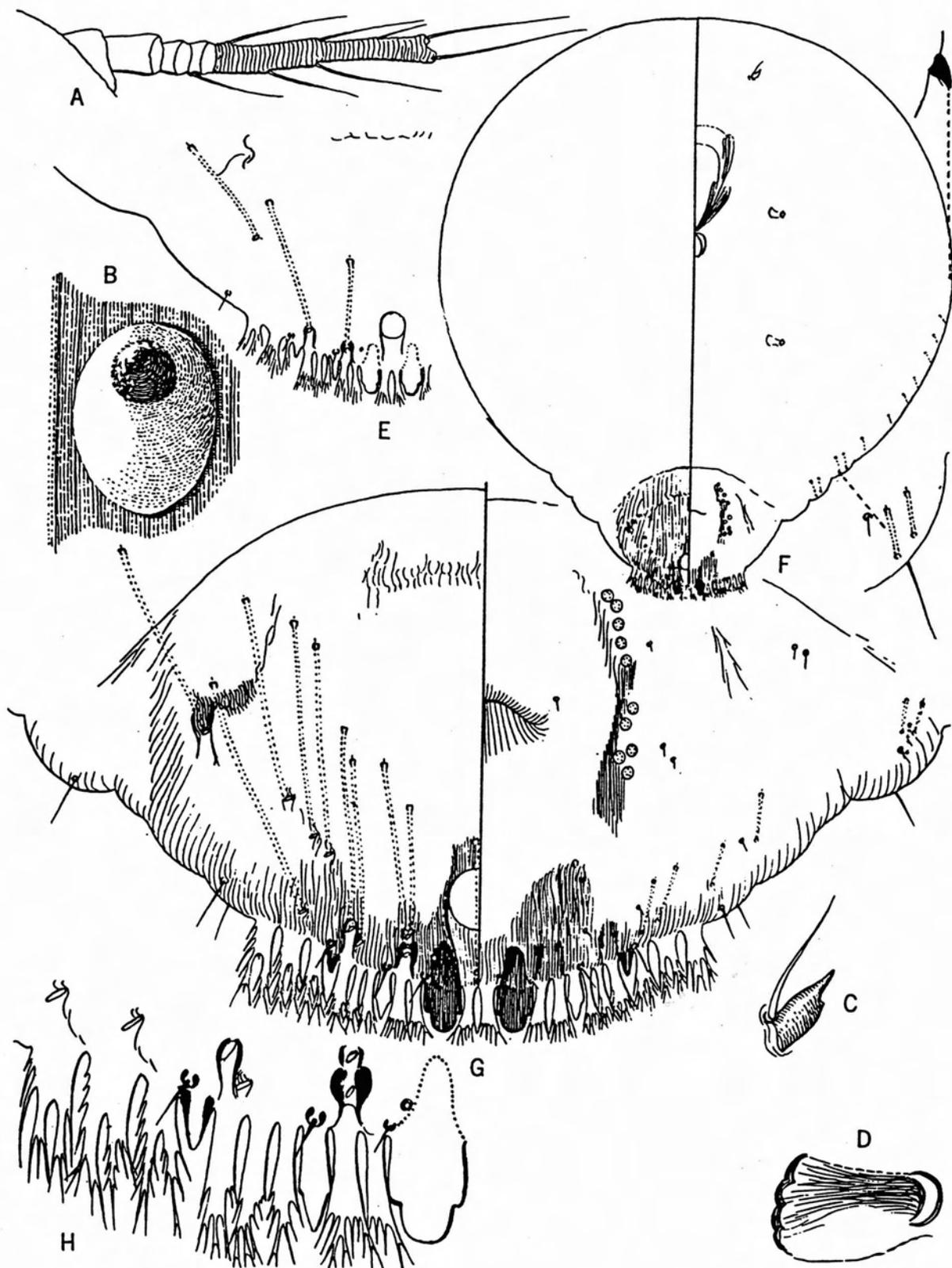


Fig. 78. *Hemiberlesia palmae* (Cockerell).

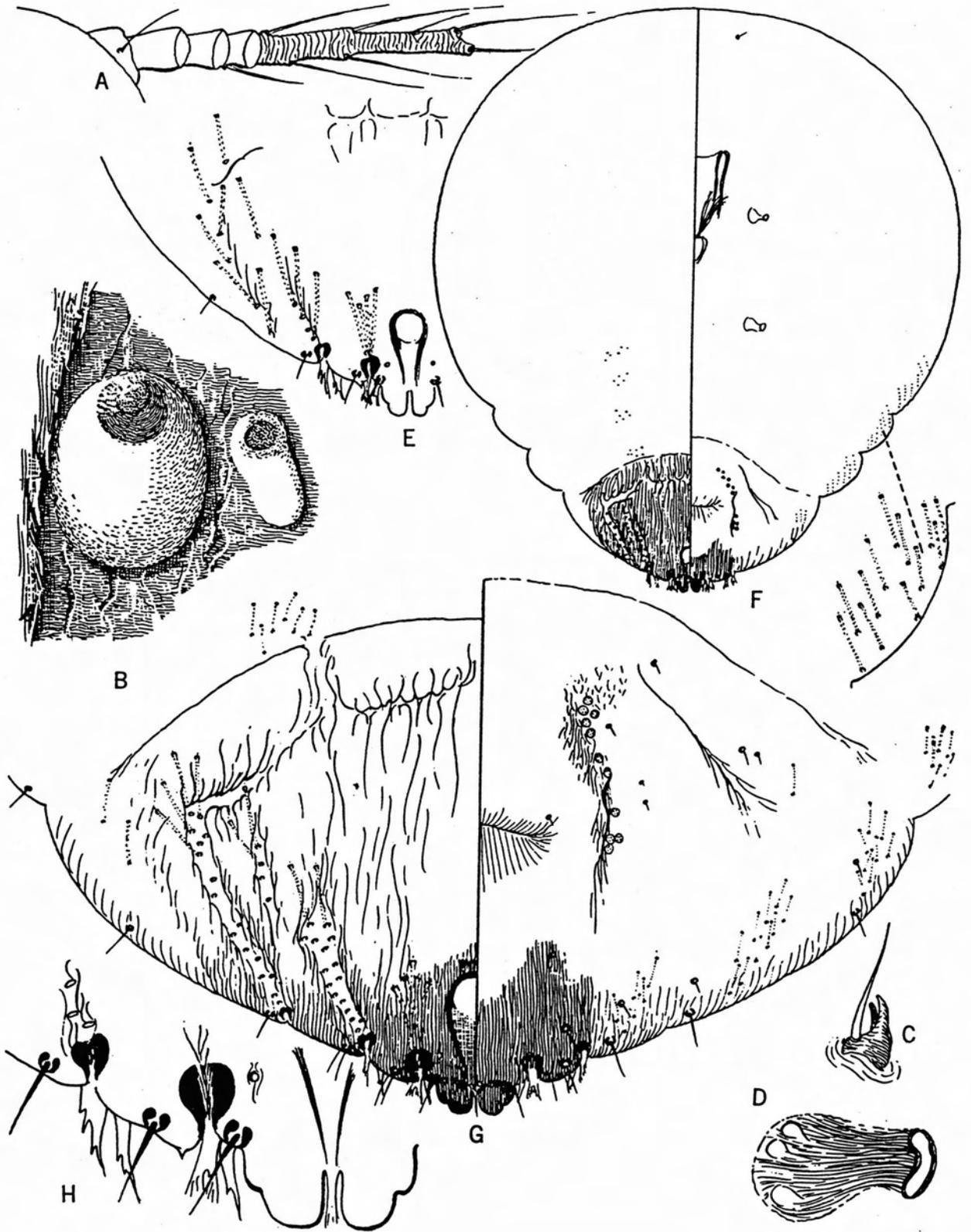


Fig. 79. *Hemiberlesia popularum* (Marlatt).

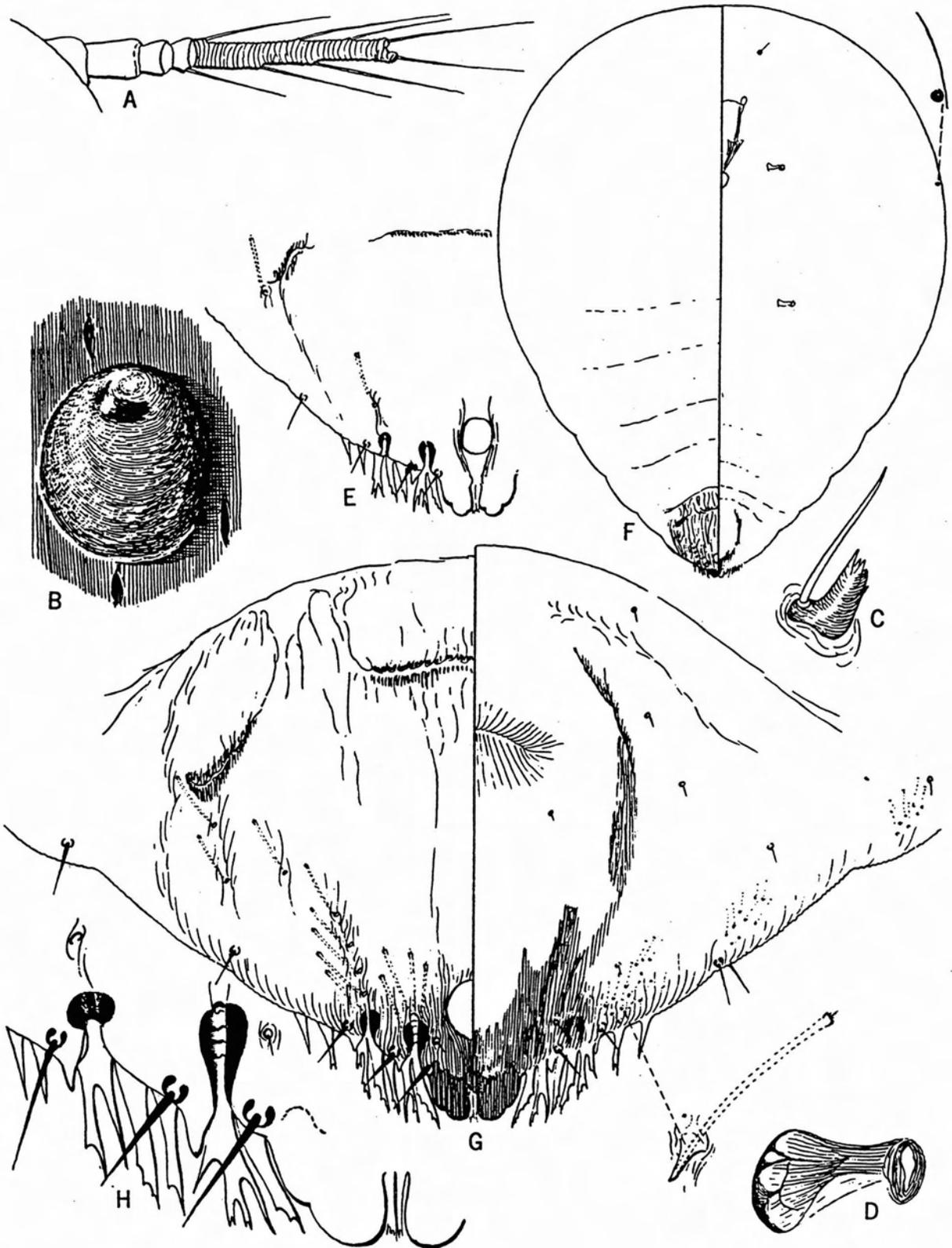


Fig. 80. *Hemiberlesia rapax* (Comstock).

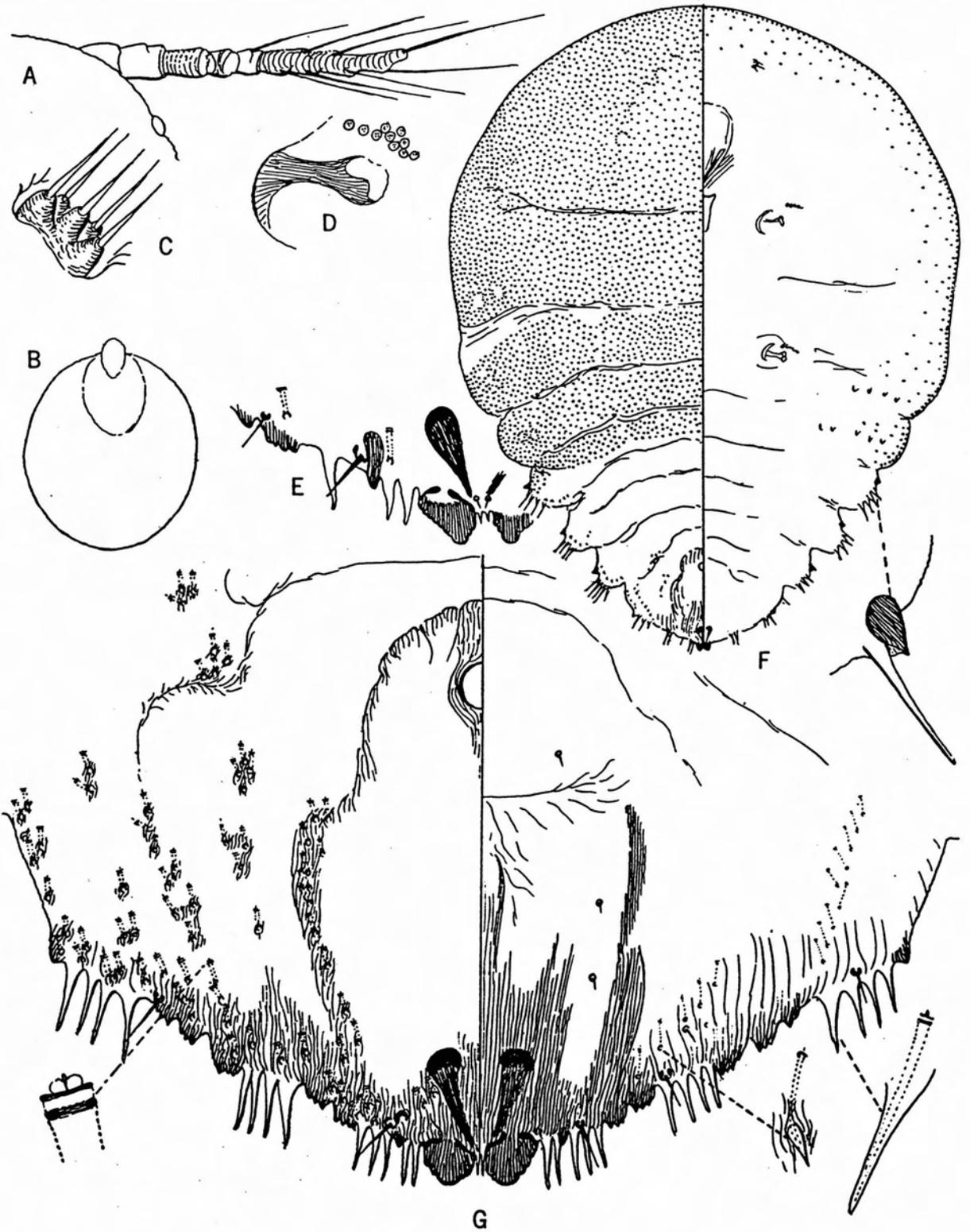


Fig. 81. *Howardia biclavis* (Comstock).

Body bright yellow. Ventral scale often well developed, partially or completely confining the body to the cover if it is removed from the host. Males unknown.

Similar Species: Cannot be separated from latania scale in the field. Oleander scale is similar but normally flatter and lighter. Tropical palm scale, *Hemiberlesia palmae* (Cockerell) is similar but does not occur in California.

Biology: Little known; may have two or more generations per year. Parthenogenetic, ovoviparous. For more information see Ferguson (1979).

Hosts: Polyphagous. Occasionally found on citrus and avocado. For a host list see Essig (1958), Borchsenius (1966) and Dekle (1976).

Economic Importance: Sometimes a serious pest of ornamental plants. Occasionally found in large numbers on citrus fruit, particularly on fruit covered by dirt and webbing. A pest of commercial kiwi fruit in New Zealand. For more information see Essig (1915), Ebeling (1959), Dekle (1976), and Love and Ferguson (1976). For information on natural enemies see DeBach (1958).

Distribution: Found primarily on ornamental plants throughout the State at low elevations. Generally distributed in the United States and the Northern Hemisphere. Thought

to be native to Europe. Usually not as common in California as latania scale.

Diagnosis: Recognized by the reduced second and third lobes, lack of perivulvar pores and large, sub-apically situated anal ring.

Borchsenius, N.S., 1966: A Catalogue of the Armored Scale Insects of the World. Zool. Inst. U.S.S.R. Acad. Sci., Moscow and Leningrad. 449 pp.

DeBach, P., C.E. Kennett, and R. J. Pence, 1958: J. Econ. Entomol. 51(1):114-115.

Dekle, G.W., 1976: Florida Armored Scale Insects. Fla. Dept. Agric. Cons. Serv., Div. Plant Ind., Gainesville. 345 pp.

Ebeling, W., 1959: Subtropical Fruit Pests. Univ. Calif. Div. Agric. Sci. Bull., Los Angeles, 436 pp.

Essig, E.O., 1915: Injurious and Beneficial Insects of California. Calif. Dept. Agric. Mon. Bull. Suppl. 4(4):1-541.

Essig, E.O., 1959: Insects and Mites of Western North America. The MacMillan Co., New York. 1050 pp.

Ferguson, A.M., 1979: N.Z. Dep. Sci. Ind. Res. Inf. Ser. No. 105/31.

Love, J.L. and A.M. Ferguson, 1976: N.Z. Agric. Res. 20:95-103.

Genus *Howardia* Berlese and Leonardi, 1896

Number of World species: 2.

Number of United States species: 1.

Keys to the species: None.

Howardia biclavis (Comstock) 1883 mining scale (ESA approved)

Fig. 81

Tribe: Diaspidini.

Found in a number of California nurseries prior to 1950, thus listed in McKenzie (1956). Eradicated. Frequently encountered in quarantine and is still found occasionally in nurseries. Eradicated whenever found.

Dekle, G.W., 1976: Florida Armored Scale Insects. Fla. Dep. Agric. Gainesville. 345 pp.

McKenzie, H.L., 1956: The Armored Scale Insects of California. Univ. Calif. Press, Berkeley. 209 pp.

Genus *Ischnaspis* Douglas, 1887

Number of World species: 5.

Number of United States species: 1.

Key to the World species: Matile-Ferrero, D., 1982: Rev. Fr. Entomol. (N.S.) 4(2):63-71.

***Ischnaspis longirostris* (Signoret), 1882
black thread scale (ESA approved)**

Fig. 82

Tribe: Diaspidini.

Other Common Names: Thread scale.

Synonymy: *Mytilaspis longirostris* Signoret, *Ischnaspis filiformis* Douglas, *Parischnaspis longirostris* (Signoret), *Ischnaspis spathulata* Lindinger.

Listed by Essig (1915) as occurring in San Francisco and in greenhouses throughout the State. Eradicated; no longer considered part of the California fauna.

Essig, E.O., 1915: Calif. Dep. Agric. Mon. Bull. Supple. 4(4):1-541.

Ferris, G.F., 1937-1942: Atlas of the Scale Insects of North America. Stanford Univ. Press, Stanford.

Genus *Kuwanaspis* MacGillivray, 1921

Number of World species: 14.

Number of United States species: 3.

Keys to the species: None, except for Ferris, G.F., 1937-1942: Atlas of the scale insects of North America, Ser. I-IV. Stanford Univ. Press, Stanford.

***Kuwanaspis pseudoleucaspis* (Kuwana), 1902
bamboo diaspidid**

Fig. 83, Color Plate 87, 88

Tribe: Diaspidini.

Synonymy: *Leucaspis bambusae* Kuwana, *Chionaspis bambusae* (Kuwana), *Lepidosaphes bambusae* (K.), *Mytilaspis bambusae* (K.), *Lepidosaphoides bambusae* (K.), *Kuwanaspis bambusae* (K.), *Tsukushiaspis bambusae* (K.), *Chionaspis pseudoleucaspis* K., *Tsukushiaspis pseudoleucaspis* (K.).

Field Characteristics: Females elongate, 2.5 to 3.0 mm long, slightly convex, tan or white with yellow or tan terminal exuviae. Males elongate, white, with a median keel and terminal exuvium. Usually found on stems or canes, particularly under bud scales at the nodes.

Hosts: Bamboo.

Distribution: Rare; occasionally collected on bamboo in Los Angeles, Orange, Santa Clara and Santa Barbara counties. Several other species in the same genus are known from bamboo in the southern United States and Hawaii. All are introduced from the Orient.

Diagnosis: The only elongate scale occurring on bamboo in California. Differs from other U.S. species in not having macroducts in the median area of abdominal segment I.

McKenzie, H.L., 1956: The Armored Scale Insects of California. Univ. Calif. Press, Berkeley. 209 pp.

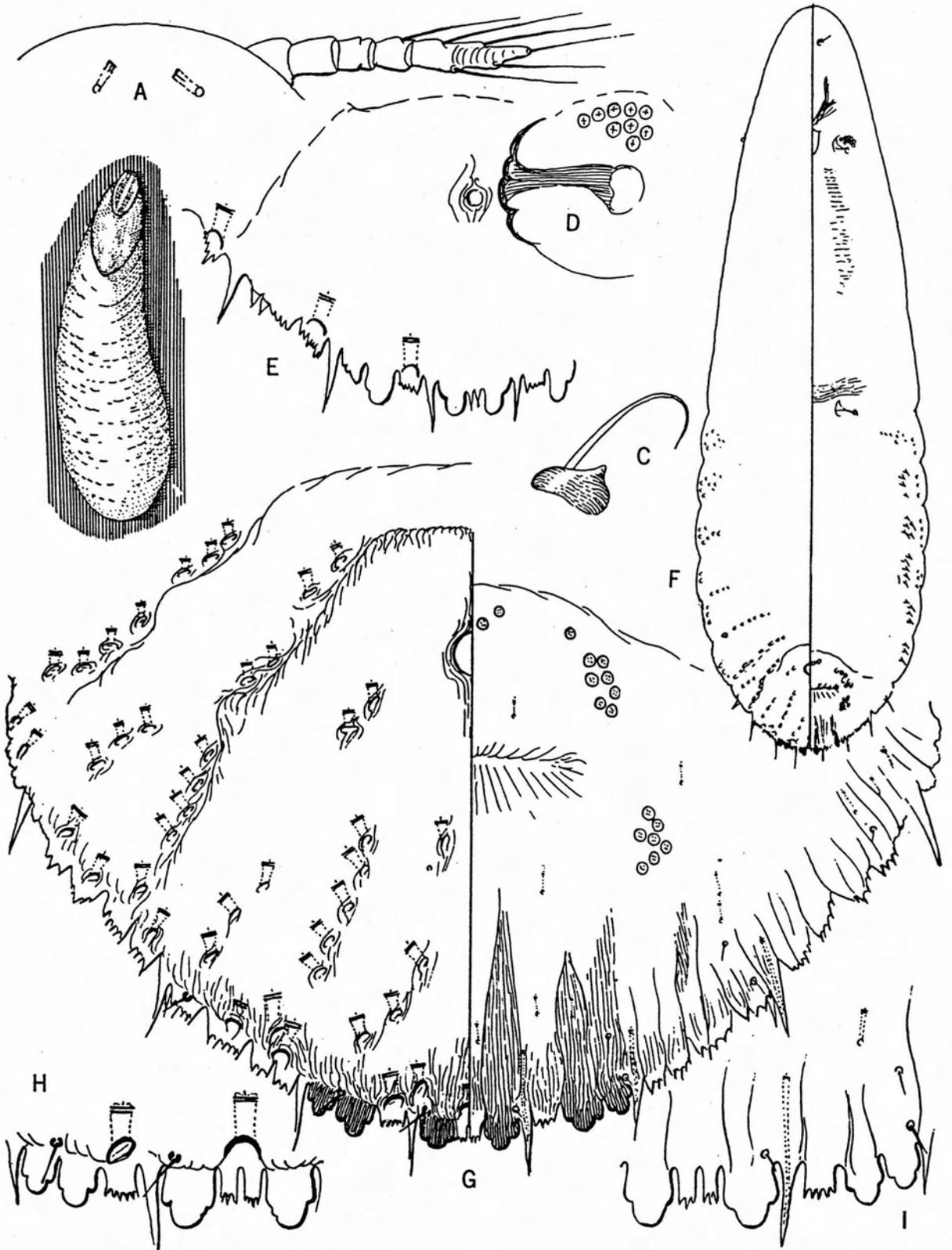


Fig. 83. *Kuwanaspis pseudoleucaspis* (Kuwana).

Genus *Lepidosaphes* Shimer, 1868.

Divided by Borchsenius (1963) and others into a number of genera including *Paralepidosaphes*, *Parainsulaspis*, *Pistachiaspis*, *Cornimytilus*, *Cornuaspis*, *Eucornaspis*, *Mytilaspis*, *Insulaspis*, and *Pinomytilus*. The Borchsenius concept of the genus is not generally accepted by American students of the Coccoidea, and will not be followed here.

Number of World species: About 100.

Number of United States species: 13.

Key to the United States species: Ferris, G.F., 1937-1942: Atlas of the Scale Insects of North America, Ser. I-IV. Stanford Univ. Press, Stanford.

KEY TO CALIFORNIA SPECIES OF *LEPIDOSAPHES*
(modified from McKenzie)

1. Prepygidial abdominal segments, some at least with distinct secondary lobe or sclerotized spur at each anterior lateral angle. **2**
— Prepygidial abdominal segments entirely without such lobes or spurs. **6**

2. Dorsum at maturity strongly sclerotized from pronotum to first abdominal segment, this sclerotization broken into plates by intersegmental furrows; marginal spurs small, thorn-like. *gloverii*
— Dorsum at maturity remaining membranous. **3**

3. Eyes forming sclerotized, thornlike spur that projects forward from the side of the head; associated with orchids. *machili*
— Eyes unmodified. **4**

4. Dorsal submedian macroduct group on sixth segment containing only one or two ducts; known only from umbrella pine, *Sciadopitys verticillata* in California *sciadopitysi*
— Dorsal submedian macroduct group on sixth segment numerous, containing usually as many as fifteen or twenty ducts. **5**

5. Mesal margin of median pygidial lobes twice-notched; prepygidial abdominal segments one to five with small, sclerotized spot or "boss" on dorsum slightly in from lateral margin on each side. *chinensis*
— Mesal margin of median pygidial lobes once-notched; sclerotized spots or bosses on prepygidial abdominal segments usually absent, if present, only three such structures on each side. *ulmi*

6. First, second, and fourth abdominal segments each with a little sclerotized area or boss on dorsum, slightly in from each lateral margin. *beckii*
— Entirely without such structures **7**

7. Head at full maturity tending to be slightly sclerotized and projecting laterally in form of a low rounded, posteriorly directed lobe on each side; associated with *Codiaeum* (croton). *tokionis*

- Head at full maturity membranous, evenly rounded but without posteriorly directed lobe on each side. 8
- 8. At least some of the pygidial gland spines bifid at tip and with two microducts discharging through them; median pygidial lobes somewhat unusually large and prominent, quite close together basally, with two notches on outer margin; second lobes somewhat reduced, forming small, bilobed points; dorsal ducts much smaller than marginal, series on sixth segment reaching from near anus almost to margin; associated with cultivated fig (occurring on twigs). *conchiformis*
- Pygidial gland spines simple, not bifid at tip, and with only one microduct discharging through them. 9
- 9. Dorsal pygidial macroducts of segment six confined to small row of two, three, or four on each side and quite close to anus. 10
- Dorsal pygidial macroducts of segment six in extended row, probably representing both submarginal and submedian groups. 13
- 10. Pygidium with small submarginal dorsal macroduct located slightly anterior to second lobe; associated with *Dendrobium* orchids. *noxia*
- Pygidium lacking small submarginal dorsal macroduct anterior to second lobe. 11
- 11. Median pygidial lobes with lateral margin serrate; antennae two-spined. 12
- Median pygidial lobes with lateral margin once-notched; antennae one-spined *pallida*
- 12. Dorsal pygidial macroducts of segment six confined to row of three or four quite close to anus; third pygidial lobe lacking although margin in this area serrate; associated with *Dendrobium* orchids. *Andaspis mackieana*
- Dorsal pygidial macroducts of segment six confined to either one or a small row of two quite close to anus; third pygidial lobe present, represented only as sclerotized point; associated with olive in California. *destefanii*
- 13. All dorsal ducts of pygidium much smaller than the marginal, none being more than about half the width of larger ducts as measured across apical bar; associated with cultivated fig (occurring on leaves); dimorphic form of. *conchiformis*
- Larger of dorsal ducts of pygidium about two-thirds the width of marginal ducts as measured across apical bar; associated with *Camellia* and *Thea*. *camelliae*

Lepidosaphes beckii (Newman), 1869

purple scale (ESA approved)

Fig. 84, Color Plates 89, 90

Tribe: Diaspidini.

Other Common Names: Mussel scale, citrus mussel scale, orange scale, comma scale.

Synonymy: *Coccus beckii* Newman, *Aspidiotus*

citricola Packard. This species has been called *Cornuaspis beckii* by Borchsenius (1963), and Williams (1971), but this name has not been officially accepted by Ameri-

can authors.

Field Characteristics: Adult female 2.0 to 3.0 mm long, oyster-shell shaped with exuviae at narrow end, curved or straight depending on roughness of host surface and population density of scales. Exuviae yellowish-brown; innermost tip of second exuvium usually with a distinctive reddish-brown spot. Scale cover dark brown, occasionally with light tan edges and a purplish cast. Body translucent white, as are eggs laid and stored under scale cover. Males similar but smaller and straighter. Occurs on leaves, bark and fruit.

Similar Species: In California, only Glover's scale (*Lepidosaphes gloverii*) is similar on citrus; it has a much narrower and longer scale cover. Also, several similar species of *Unaspis* occur on citrus in other areas of the world, but since they are not presently known in California, care should be taken before identifications are made. Citrus snow scale, *Unaspis citri* (Comstock), common on citrus in Florida and Texas, is similar, however, it is not found on fruit and the males have a white, carinated scale cover. The similar arrowhead scale, *Unaspis yanonensis* (Kuwana), is frequently encountered at quarantine stations along the California-Oregon border on citrus fruit imported from China and Japan.

Biology: Has three (and a partial fourth) overlapping generations per year in California. Found in all stages throughout winter. For more information see Quayle (1912), Bodenheimer (1951), Ebeling (1959), and Raul Rincones (1993).

Hosts: Prefers *Citrus*. Occasionally attacks evergreen ornamentals such as boxwood (*Buxus*) and holly (*Ilex*). For a host list see Dekle (1976).

Economic Importance: A very serious pest of citrus. According to Ebeling (1959) and others it is more important as a pest of citrus world wide than is California red scale, because it occurs in more citrus-growing areas. Injury consists of defoliation and dieback of branches, and discoloration of leaves and fruit. The major natural enemy of purple scale in Cali-

fornia is the wasp, *Aphytis lepidosaphes* Compere. The status of this parasite and other natural enemies of purple scale has been summarized by Ebeling (1959), DeBach and Landi (1961), and by Rosen and Debach (1978). For more information see Quayle (1938), Bodenheimer (1951) and Ebeling (1959).

Distribution: Probably native to the Orient. First found in the United States in 1859 in Florida, first introduced into California about 1899. Has since become a pest of commercial and dooryard citrus in coastal Southern California and as far north as Santa Barbara. An infestation has also occurred in Sacramento for many years. Has probably not moved inland because of its low tolerance to extreme temperatures and possibly because of stringent quarantine regulations against it.

Diagnosis: Identified by the presence of sclerotized bosses on one or more of abdominal segments 1, 2, and 4; no marginal spurs on the prepygidial segments. Glover scale has marginal spurs, no bosses and a sclerotized thoracic area.

Bodenheimer, F.S., 1951: Citrus Entomology in the Middle East. Dr. W. Junk, The Hague. 663 pp.

Borchsenius, H.C., 1963: Zool. Zh. 42(8):1161-1174.

DeBach, P., and J. Landi, 1961: Hilgardia 31(14):459-497.

Dekle, G.W., 1976: Florida Armored Scale Insects. Fla. Dep. Agric. Cons. Serv., Div. Plant Ind., Gainesville. 345 pp.

Ebeling, W., 1959: Subtropical Fruit Pests. Univ. Calif. Div. Agric. Sci. Bull, Los Angeles. 436 pp.

Quayle, H.J., 1912: Calif. Agric. Exp. Stn. Bull. 226:319-340.

Quayle, H.J., 1938: Insects of Citrus and Other Subtropical Fruits, Comstock, Publ. Co., Ithaca. 583 pp.

Raul Rincones, H., 1993: Rev. Peru Entomol. 15(2):356-363.

Rosen, D., and P. DeBach. In C.P. Clausen, ed. 1978: U.S. Dep. Agric. Agric Handb. 480:1-545.

Williams, D.J., 1971: Bull. Entomol. Res. 61:7-11.

Lepidosaphes camelliae Hoke, 1922
camellia scale (ESA approved)

Fig. 85

Tribe: Diaspidini.

Synonymy: *Insulaspis camelliae* (Hoke).

Field Characteristics: Light brown with an oystershell shape. Male scale covers nearly identical but smaller. Occurs on leaves.

Similar Species: Oystershell scale is basically identical in the field, but host preferences will aid in field separation.

Biology: Has four to five annual generations. For more information on biology see English and Turnipseed (1940) and Cooper and Oetting (1989).

Hosts: Prefers camellias, holly, but will attack other hosts such as magnolia, privet and raphiolepis.

Economic Importance: A "B"-rated pest of camellia and holly. Considered a serious pest of cuttings and small plants. For more information see Cooper and Oetting (1989).

Distribution: Once widespread in California nurseries but apparently eradicated; not presently known in the State.

Diagnosis: Recognized by host preference and few, relatively large dorsal macroducts. Immature stages are described and illustrated by Liu et al (1989).

Cooper, R.M. and R.D. Oetting, 1989: Ann. Entomol. Soc. Am. 82(6):730-736

English, L.L. and G.F. Turnipseed, 1940: Univ. Ala. Agric. Exp. Stn. Circ. 84: 1-18.

Liu, T., R.M. Cooper, R.D. Oetting and J.O. Howell, 1989: Ann. Entomol. Soc. Am. 82(1):9-13.

McKenzie, H.L., 1956: The Armored Scale Insects of California. Univ. Calif. Press, Berkeley. 209 pp.

Lepidosaphes chinensis Chamberlin, 1925
Chinese lepidosaphes scale

Fig. 86

Tribe: Diaspidini.

Collected twice in Los Angeles County on orchids in 1934 and 1935. Eradicated.

McKenzie, H. L., 1956: The Armored Scale Insects of California. Univ. Calif. Press, Berkeley. 209 pp.

Lepidosaphes conchiformis (Gmelin), 1789
fig scale (ESA approved)

Fig. 87, Color Plates 91, 92

Tribe: Diaspidini.

Synonymy: *Coccus conchiformis* Gmelin, *Mytilaspis ficus* Signoret, *Mytilaspis ficifoli* Berlese, *Mytilococcus ficifoliae* (Berlese), *Lepidosaphes ficifoliae* (Berlese), *Lepidosaphes ficus* (Signoret), *Mytilococcus conchiformis* (Gmelin).

Field Characteristics: Has two distinctly different forms which were once described as separate species. The twig form (*ficus* form) has a 2.0 mm long dark brown scale cover with

a terminal exuvium and elongate oystershell shape. The leaf form (*ficifoliae* form) has a 1.5 mm long, white, oystershell-shaped cover with a terminal exuvium. The leaf form may be of typical oystershell shape, particularly if the scale settles on the relatively smooth upper leaf surface, or it may have an S-shaped or otherwise distorted appearance if it settles on the lower leaf surface and develops around the stiff leaf hairs. Males of both forms, always found on the leaves, are light tan or white,

oblong, with a terminal exuvium.

Similar Species: Oystershell scale (*Lepidosaphes ulmi*) is similar but larger, and is not commonly found on fig.

Biology: Two (and a partial third) generations per year. Overwintering adult females are of the twig form; summer generations are found on the leaves. For more information see Roullard (1917), Stafford and Barnes (1948), Simmons et al. (1931), and Balali and Seyedoleslami (1986).

Hosts: Favors fig (*Ficus carica*). Also found on walnut and elm.

Economic Importance: Builds up extremely large populations on fig trees. Over 100 scales have been found on one leaf. Although heavy scale populations are thought to reduce fruit production and cause premature leaf drop, this has not been proven. However, it does reduce fruit grade due to discoloration and distortion of the fruit (see Stafford and Barnes, 1948). Biological control of this species has been attempted in California (see Flanders, 1957, and Rosen and DeBach, 1978).

Distribution: Probably introduced into the Fresno area in 1905 on fig cuttings from Alge-

ria. Now infests most of the fig growing areas of the San Joaquin Valley from Stockton south to Kern County, with satellite infestations in Orland, Glenn County, San José and Southern California.

Diagnosis: Readily identified by host restriction and other field characteristics. Specifically, small dorsal macroducts and lack of bosses or spurs are distinguishing characteristics.

Balali, G. and H. Seyedoleslami, (1986): Ent. Phyt. Appliq. 53(1-2):21-35

Flanders, S.E., 1957: J. Econ. Entomol. 50:171-172.

McKenzie, H.L., 1956: The Armored Scales Insects of California. Univ. Calif. Press, Berkeley.

Roullard, F.P., 1917: Calif. State Comm. Hort. 6(6):246-248.

Rosen, D., and P. DeBach in C.P. Clausen, ed., 1978: U.S. Dep. Agric., Agric. Handb. 480:1-545.

Simmons, P., W. D. Reed and E.A. McGregor, 1931: U.S. Dep. Agric. Circ. 157:1-71.

Stafford, E.M., and D.F. Barnes, 1948: Hilgardia 18(16):567-598.

Lepidosaphes destefanii Leonardi, 1907

DeStefan scale

Fig. 88, Color Plate 93

Tribe: Diaspidini.

Synonymy: *Mytilococcus destefanii* (Leonardi), *Lepidosaphes conchiformis-phillyreae* Koroneos, *Lepidosaphes palestiniensis* Bodenheimer. Borchsenius places this as a junior synonym of *Lepidosaphes flava* (Targioni-Tozzetti in his world catalogue). However, Ferris (1937) considers *flava* to be a nomen nudum (without a description and thus not useable) and this concept is followed here.

Field Characteristics: Adult female scale covers 1.0 to 1.5 mm long, oystershell-shaped, fairly flat, tan or grey-brown with reddish terminal exuviae. Body pale red. Males similar but smaller, lighter, with a terminal exuvium. Scale covers the same color as the bark of the host, often underneath the loose

outer layer of bark or covered by road dust. This, plus their very small size, makes them extremely difficult to locate.

Similar Species: Similar in size and coloration to fig scale.

Biology: Unknown, except that live adult females have been collected in October, which indicates that adults overwinter; eggs hatch in May and June.

Hosts: Only olives in California. In the Mediterranean area it is known from the closely related plant genus *Phillyrea*. Also may occur on privet.

Economic Importance: Unknown. Has existed in large numbers on the same trees in the Sonoma area for 30 years with no noticeable effect, but these are roadside trees; possible

effects on commercial trees are unknown. A "B"-rated pest in California.

Distribution: Sonoma County, where it was collected in 1952 at Cloverdale, Asti and Geyserville. The infestations in Cloverdale and Asti are still active. The scale may have spread from this area on transplanted ornamental olive trees, but it is so easily overlooked that this cannot be proven. Also known from the Eastern Mediterranean; probably

native to the Middle East.

Diagnosis: The host restriction and reduced number of dorsal macroducts on the sixth abdominal segment characterize this species.

Ferris, G.F., 1937: *Microentomol.* 2(1):1-45.

McKenzie, H.L., 1956: The armored scale insects of California. Univ. Calif. Press, Berkeley. 209 pp.

Lepidosaphes gloverii (Packard), 1869

Glover scale

Fig. 89, Color Plates 94, 95

Tribe: Diaspidini.

Other Common Names: Long scale, citrus long scale, escama.

Synonymy: *Coccus gloverii* (Packard), *Aspidiotus gloverii* (Packard), *Mytilaspis gloverii* (Packard), *Mytilella sexspina* Hoke, *Insulaspis gloverii* (Packard), (See Borchsenius 1963), *Mytilococcus gloverii* (Packard).

Field Characteristics: Narrow, elongate and parallel-sided, not strongly tapered toward the exuvial end as in purple scale. Scale covers 2.5 to 3.5 mm long, brown, with a reddish-brown spot on the inner (posterior) edge of the 2nd exuvium similar to that found on purple scale. Body white. Male covers similar to females, but smaller. Occurs on bark, leaves and fruit.

Similar species: In California the only similar species on citrus is purple scale, which is more oyster-shell-shaped. Several species of *Unaspis* resemble Glover scale and occur on citrus in other parts of the world, but they are also oyster-shell-shaped and the male scale covers are pure white with well-defined carinae. Two other common similar species which do not occur in California are black thread scale, *Ischnaspis longirostris* (Signoret) and *Velataspis dentata* (Hoke).

Biology: Three to four generations per year in California. For more information see Essig (1911), Quayle (1938), Bodenheimer (1951), Ebeling (1959) and Murakami (1970).

Hosts: Prefers citrus in California; occasionally attacks ornamentals such as camellia. In tropical countries it is apparently polyphous. For a host list see Bodenheimer (1951) and Dekle (1978).

Economic Importance: A minor pest of citrus. For more information see Quayle (1938), Ebeling (1959), and Griffiths and Thompson (1957). For information on natural enemies see Rosen and DeBach (1978).

Distribution: Uncommon in California; apparently restricted to the San Juan Capistrano Valley, Orange County, although it was collected in San Diego and Los Angeles Counties before 1935. Seems unable to survive hot, dry summers. Native to the Far East; introduced into the United States in Florida about 1838.

Diagnosis: Easily recognized by its host restrictions, prepygidial spurs and sclerotized thorax.

Bodenheimer, F.S., 1951: *Citrus Entomology in the Middle East*. Dr. W. Junk, The Hague. 663 pp.

Borchsenius, N.S., 1963: *Zool. Zh.* 42(8):1161-1174.

Dekle, G.W. 1976. Florida Armored Scale Insects. Fla. Dept. Agric. Cons. Serv., Div. Plant Ind., Gainesville.

Ebeling, W., 1959: *Subtropical Fruit Pests*, Univ. Calif. Div. Agric. Sci. Bull., Los Angeles. 436 pp.

Essig, E.O., 1911: *Pomona Coll. J. Entomol.*

3(1):404-411.

Griffiths, J.T., and W.L. Thompson, 1957: Univ.

Fla. Agric. Exp. Stn., Bull. 591:1-96.

Murakami, Y., 1970: Mushi 43(7):65-114.

Quayle, H.J., 1938: Insects of Citrus and Other

Subtropical Fruits. Comstock Publ. Co., Ithaca. 583 pp.

Rosen, D., and P. DeBach. In C.P. Clausen, ed., 1978: U.S. Dep. Agric. Agric. Handb. 480:1-545.

Lepidosaphes machili (Maskell), 1898

cymbidium scale

Fig. 90, Color Plate 96

Tribe: Diaspidini.**Synonymy:** *Mytilaspis machili* Maskell, *Lepidosaphes tuberculata* Malenotti, *Lepidosaphes cymbidicola* Kuwana, *Eucornaspis machili* (Maskell). Borchsenius in his world catalogue considers this species a synonym of *Eucornaspis pinnaeformis* (Bouché), but we agree with Ferris (1942) that this concept is incorrect.**Field Characteristics:** Adult females 2.5 to 3.5 mm long, oyster-shaped, fairly convex, brown, with orange or tan terminal exuviae. Males similar but smaller. Occurs on stems and leaves.**Hosts:** Cymbidium orchids, other orchid genera.**Economic Importance:** An occasional pest in

California. Large populations have developed on orchids, but they are easily controlled.

Distribution: Rare; found only in greenhouse situations. Current status unknown.**Diagnosis:** Readily recognized because of host preference and the ocular spurs.

Dekle, G.W., 1976: Florida Armored Scale Insects. Fla. Dep. Agric. Cons. Serv., Div. Plant. Ind., Gainesville. 345 pp.

Ferris, G.F., 1937-1942: Atlas of the Scale Insects of North America, Ser. I-IV. Stanford Univ. Press, Stanford.

McKenzie, H.L., 1956: The Armored Scale Insects of California. Univ. Calif. Press, Berkeley. 209 pp.

Lepidosaphes noxia McKenzie, 1946

noxious scale

Fig. 91

Tribe: Diaspidini.**Synonymy:** *Insulaspis noxia* (McKenzie). Described from specimens collected on *Dendrobium* orchids at San Leandro in 1944. Not collected since.

McKenzie, H. L., 1956: The Armored Scale Insects of California. Univ. Calif. Press, Berkeley. 209 pp.

Lepidosaphes pallida (Maskell), 1895

Maskell scale

Fig. 92

Tribe: Diaspidini.**Synonymy:** *Mytilaspis pallida* Green (var.?) Maskell; *Mytilaspis pallida* var. *maskelli* Cockerell; *Lepidosaphes maskelli* (Cockerell); *Insulaspis maskelli* (Cockerell); *Insulaspis**pallida* (Maskell); *Lepidosaphes newsteadi* (Sulc) of Ferris (misidentification).**Field Characteristics:** Scale cover narrow and elongate, light brown, with yellow or brown terminal exuviae.

Hosts: A wide variety of conifers.

Economic Importance: A "B"-rated pest in California.

Distribution: Found in several California locations before 1950 and once in 1966. Present status in California unknown.

Dekle, G.W., 1976: Florida Armored Scale Insects. Fla. Dep. Agric. Cons. Serv., Div. Plant. Ind., Gainesville. 345 pp.

McKenzie, H.L., 1956: The Armored Scale Insects of California. Univ. Calif. Press, Berkeley. 209 pp.

***Lepidosaphes sciadopitysi* McKenzie, 1955**
umbrella pine lepidosaphes
Fig. 93

Tribe: Diaspidini.

Synonymy: *Insulaspis sciadopitysi* (McKenzie).

Had persisted on several pines on the Huntington Library grounds in San Marino, Los Angeles County, but the infested trees have been removed and it is assumed that the scale no longer occurs in California.

McKenzie, H.L., 1956: The Armored Scale Insects of California. Univ. Calif. Press, Berkeley. 209 pp.

***Lepidosaphes tokionis* (Kuwana), 1902**
croton mussel scale (ESA approved)
Fig. 94

Tribe: Diaspidini.

Other Common Names: Croton scale.

Synonymy: *Mytilaspis newsteadi* var. *tokionis* Kuwana, *Mytilaspis auriculata* Green, *Lepidosaphes lasianthi* (Green) (as a misidentification), *Lepidosaphes auriculata* (Green), *Insulaspis tokionis* (Kuwana). Borchsenius placed this species in *Insulaspis*, but American authors do not agree with this concept.

Found in several California nurseries before 1952 but eradicated. Favors croton (*Codiaeum*) and *Anthurium*.

McKenzie, H.L., 1956: The Armored Scale Insects of California. Univ. Calif. Press, Berkeley. 209 pp.

***Lepidosaphes ulmi* (Linnaeus), 1758**
oystershell scale (ESA approved)
Fig. 95, Color Plates 97, 98

Tribe: Diaspidini.

Other Common Names: Mussel scale, apple comma scale, apple mussel scale.

Synonymy: The history of scientific names of this species is much confused. Many former names have been used as valid names for other species or have been dropped altogether. However, the following names probably refer to this species: *Coccus ulmi*

Linnaeus, *Aspidiotus pomorum* Bouché; *Mytilaspis pomorum* (Bouché) and *Mytilococcus ulmi* (Linnaeus).

Field Characteristics: The classic "oystershell" scale, since it resembles the shell of a mussel or oyster. Adult female cover about 3.0 mm long, elongate, rounded at one end and pointed at the exuvial end, straight or curved to conform to the host surface or as a response to crowd-

ing. Scale cover silver grey in immature and young adult females, becoming purplish or coppery brown with age. Scale covers often adhere to the host for several years and become quite bleached. Males unknown.

Similar Species: Fig scale is similar but smaller. Oystershell and fig scale may occur together on fig, elm, or walnut, but this is unlikely and usually the host restriction of fig scale distinguishes the species. Purple scale is also similar but is generally restricted to citrus.

Biology: Parthenogenetic in California, although a biparental race occurs on the East Coast. One, or occasionally two generations per year. Overwinters as eggs packed inside the scale cover of the parent female. For more information see Griswold (1925), Kosztarab (1963), Murakami, 1970, and the very thorough study by Samarasinghe and Leroux (1966).

Hosts: Prefers willows in California; found on native willow along practically every watercourse in the State. Also occurs on apple, walnut, ceanothus, almond, poplar, holly and about 150 other hosts. For further data see Quaintance and Sasser (1916), Griswold (1925) and McKenzie (1956).

Economic Importance: Can kill twigs, branches and young trees; if left unattended will seriously weaken and stunt mature plants. Has caused considerable losses of ornamental trees in the East and Midwest. Usually not a serious pest in California; seldom encountered on agricultural crops. It does cause occasional problems on deciduous fruit and nut crops, according to Michelbacher and Ortega (1958) and Barnes and Madsen (1961). Ebeling (1959) considered it second only to frosted scale as a pest on walnuts in Northern California. It is being considered as a biological control agent against unwanted brush species such as ceanothus in reforestation programs, since it can retard brush growth, al-

lowing young conifers to compete for light and nutrients. This could conceivably reduce the need for certain herbicides. Since this scale is not a serious pest in California, little recent work has been done on control. It does have natural enemies; see Griswold (1925), Kosztarab (1963), and Rosen and DeBach (1978) for more information.

Distribution: Throughout California and the United States. Cosmopolitan; probably native to Eurasia.

Diagnosis: Recognized by the many small macroducts on the dorsum of the pygidium and the lateral spurs between the prepygidial segments. Two or more forms of this scale are frequently discussed in the literature. Hosts and biologies of these forms are different, as well as the fact that parthenogenetic and biparental types of reproduction take place. There are, however, no morphological indications that there are two distinct species.

- Barnes, M.M., and H.F. Madsen, 1961: Calif. Agric. Exp. Stn. Circ. 502:1-31.
- Ebeling, W., 1959: Subtropical Fruit Pests. Univ. Calif. Div. Agric. Sci. Bull., Los Angeles. 436 pp.
- Griswold, G.H., 1925: Cornell Univ. Agric. Exp. Stn. Mem. 93:1-67.
- Kosztarab, M., 1963: Bull. Ohio Biol. Surv. (N.S.) 2(2):1-120.
- McKenzie, H.L., 1956: The Armored Scale Insects of California. Univ. Calif. Press, Berkeley. 209 pp.
- Michelbacher, A.E., and J.C. Ortega, 1958: Calif. Agric. Exp. Stn. Bull. 764:1-87.
- Quaintance, A.L., and E.R. Sasser, 1916: U.S. Dep. Agric. Farmers' Bull. 723:1-14.
- Rosen, D., and P. DeBach in C.P. Clausen, ed., 1978: U.S. Dep. Agric. Handb. 480:1-545.
- Murakami, Y., 1970: Mushi 43(7):65-114.
- Samarasinghe, S. and E.D. Leroux, 1966: Ann. Entomol. Soc. Quebec 11:206-292.

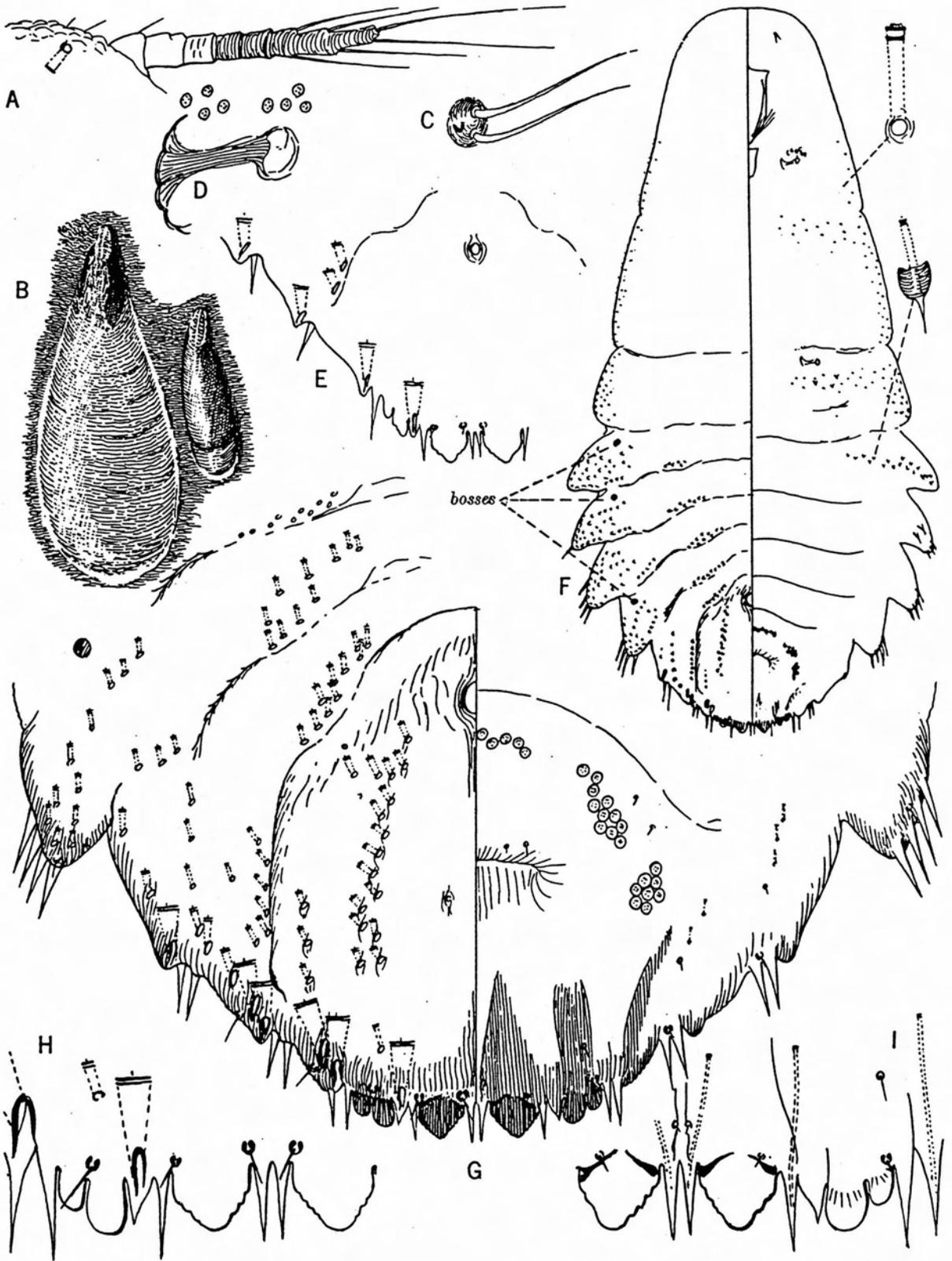


Fig. 84. *Lepidosaphes beckii* (Newman).

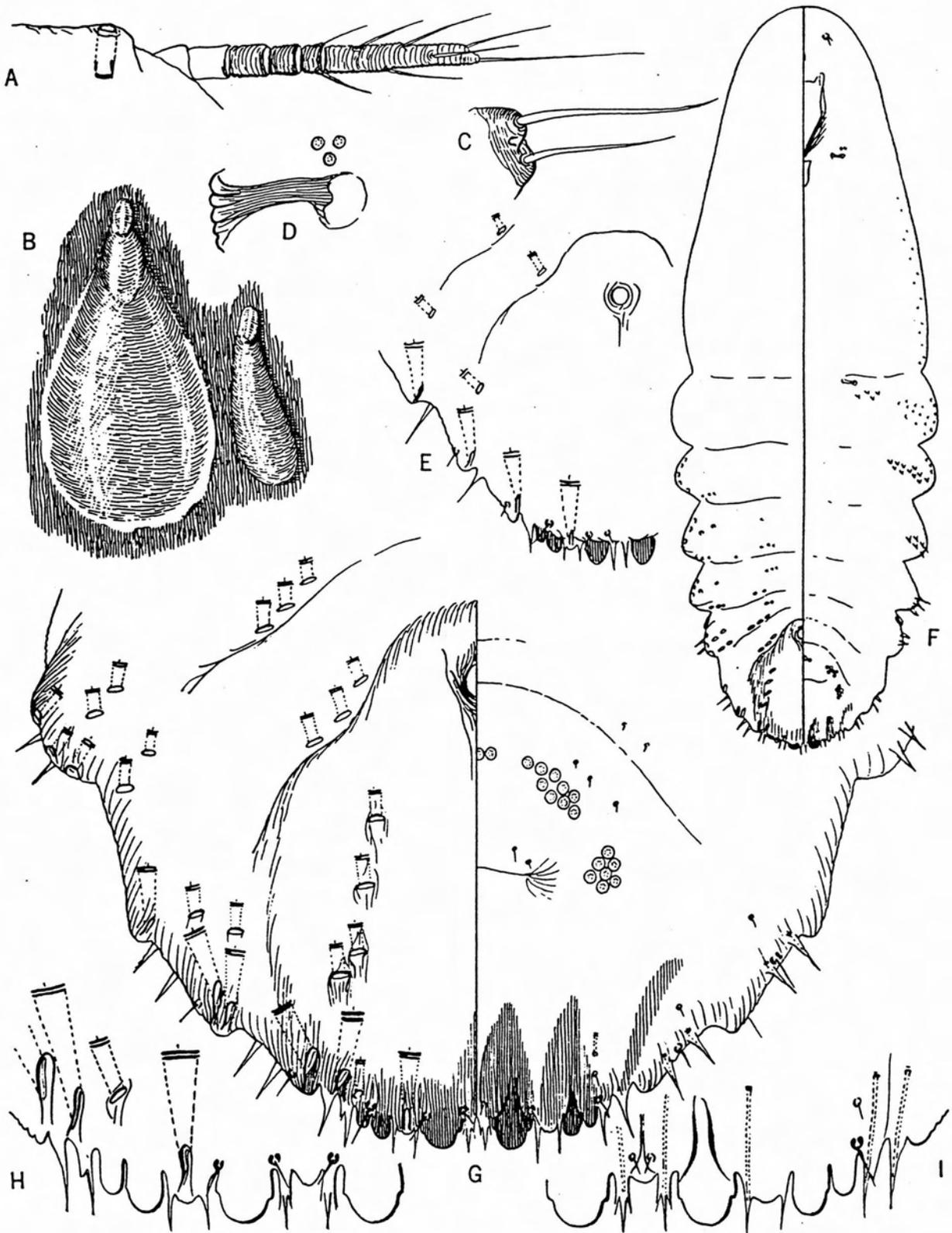


Fig. 85. *Lepidosaphes camelliae* Hoke.

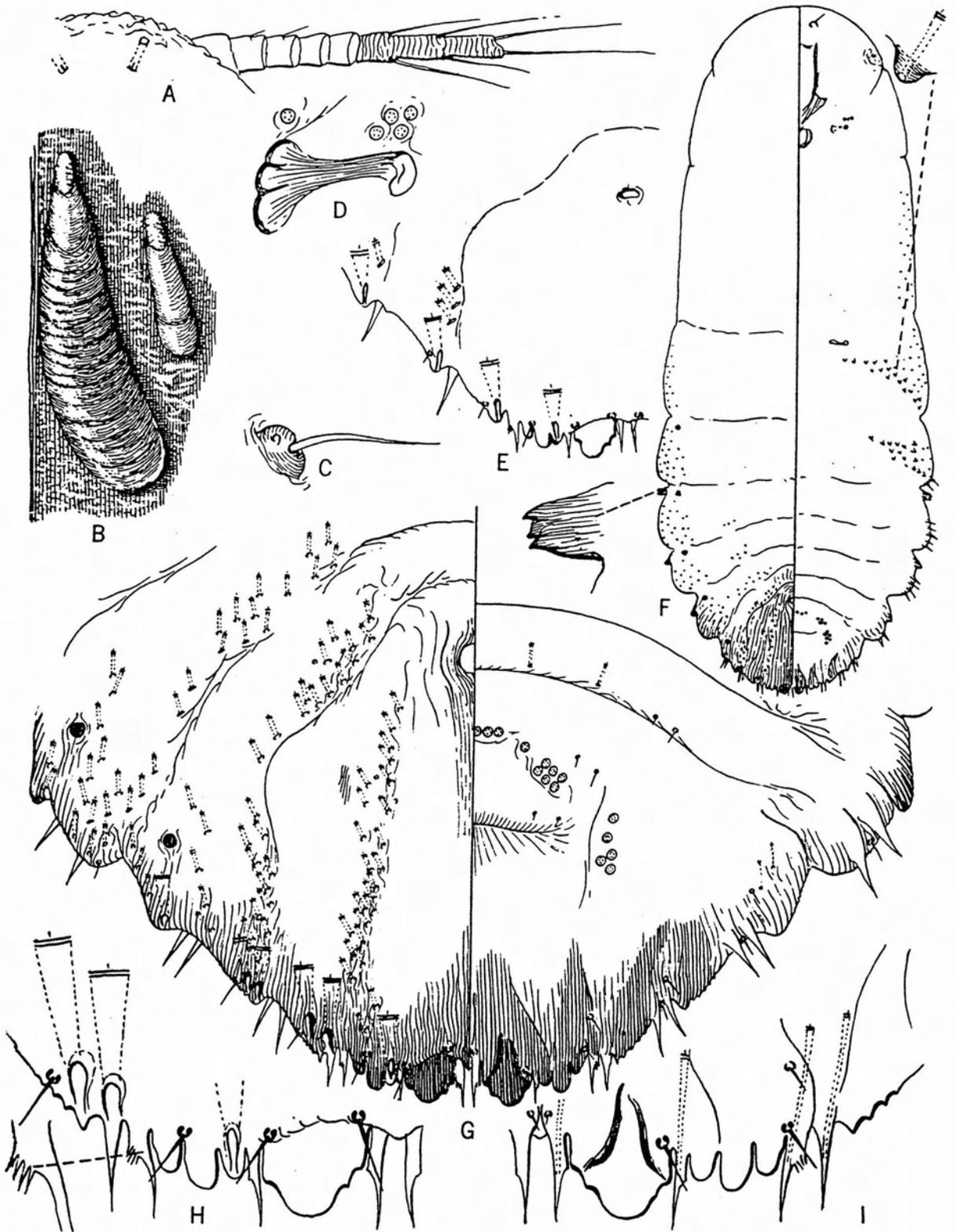


Fig. 86. *Lepidosaphes chinensis* Chamberlin.

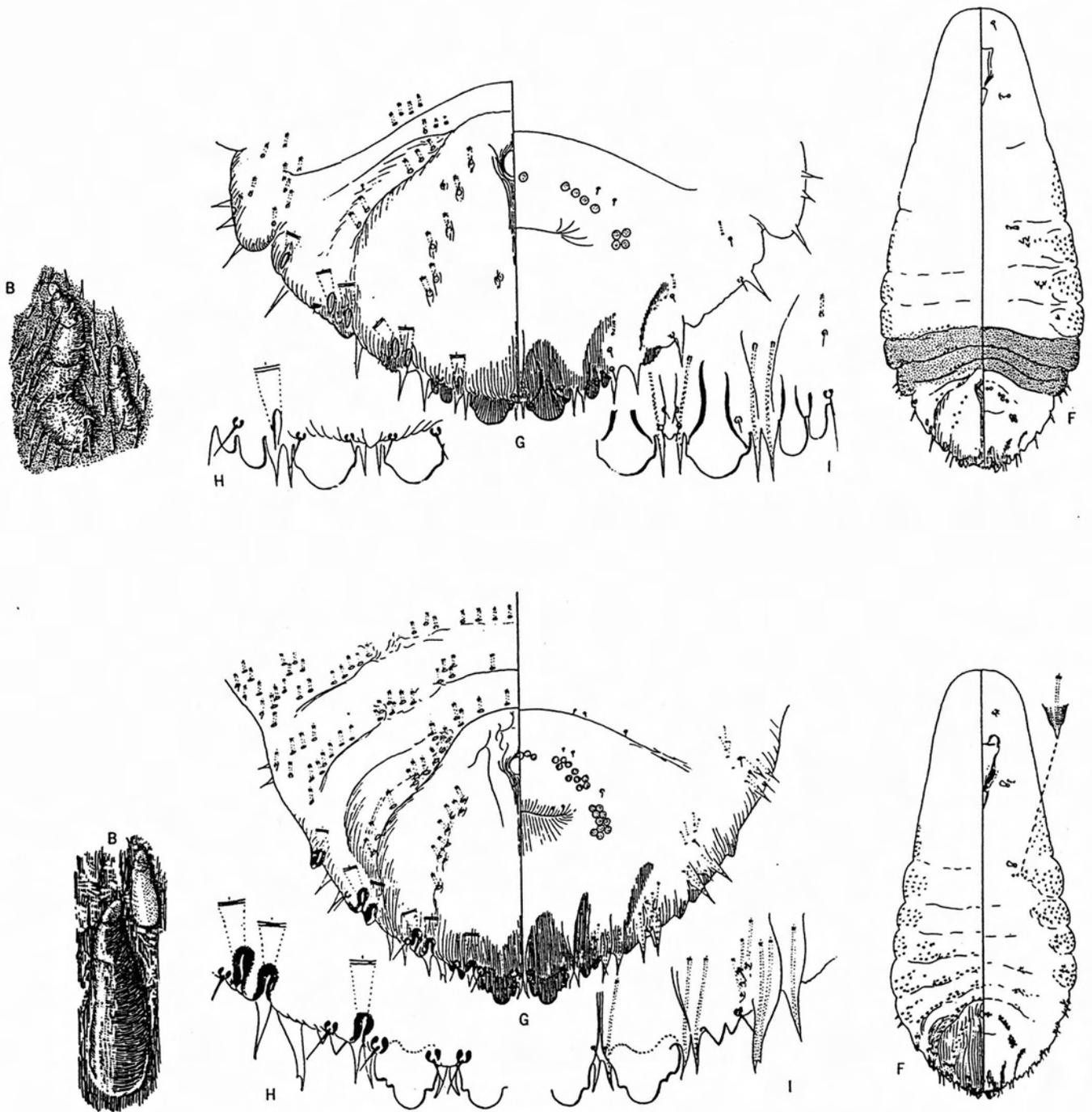


Fig. 87. *Lepidosaphes conchiformis* (Gmelin).
Upper figure shows the leaf form (*ficifoliae*); lower figure is the twig form (*ficus*).

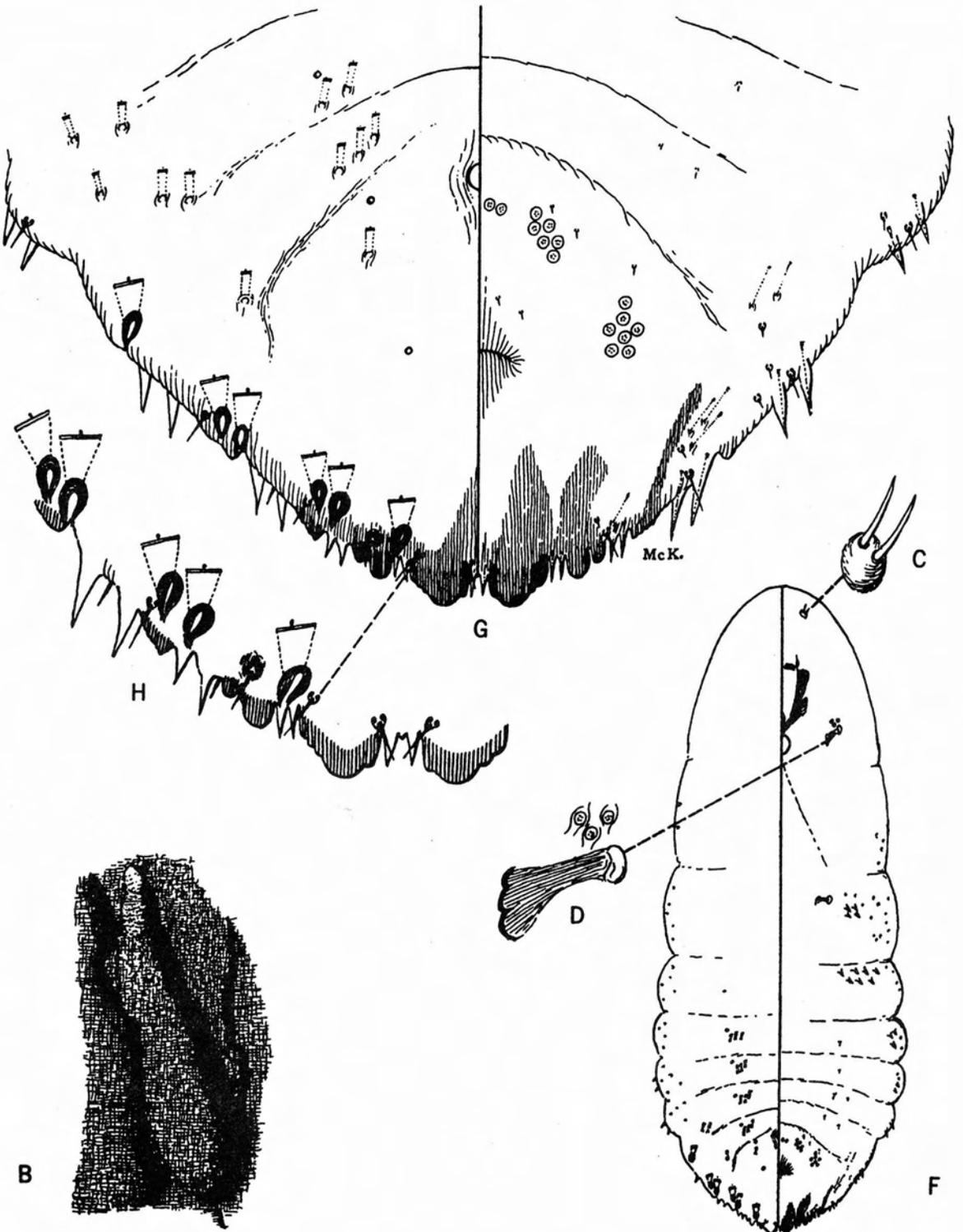


Fig. 88. *Lepidosaphes destefanii* Leonardi.

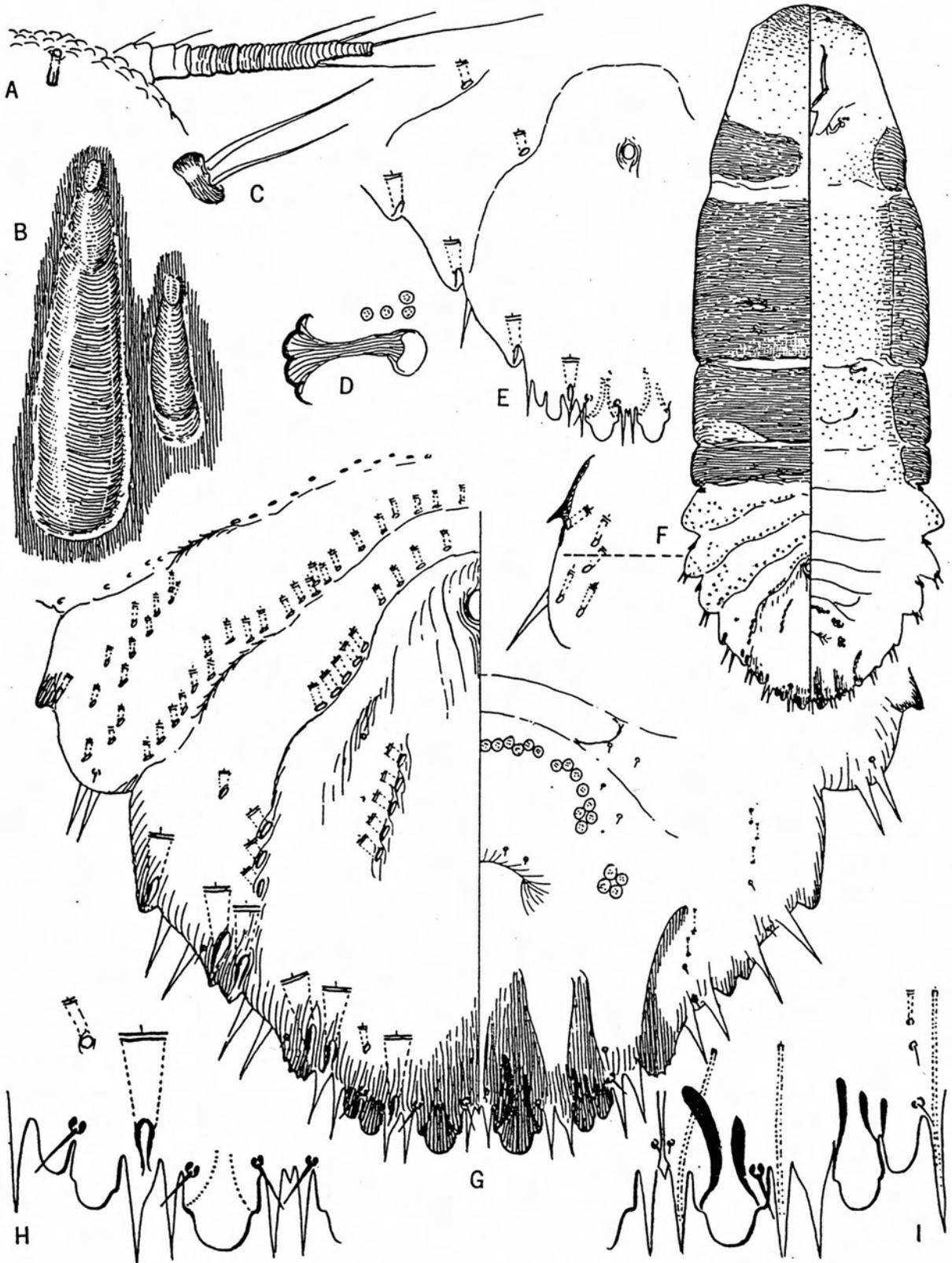


Fig. 89. *Lepidosaphes gloverii* (Packard).

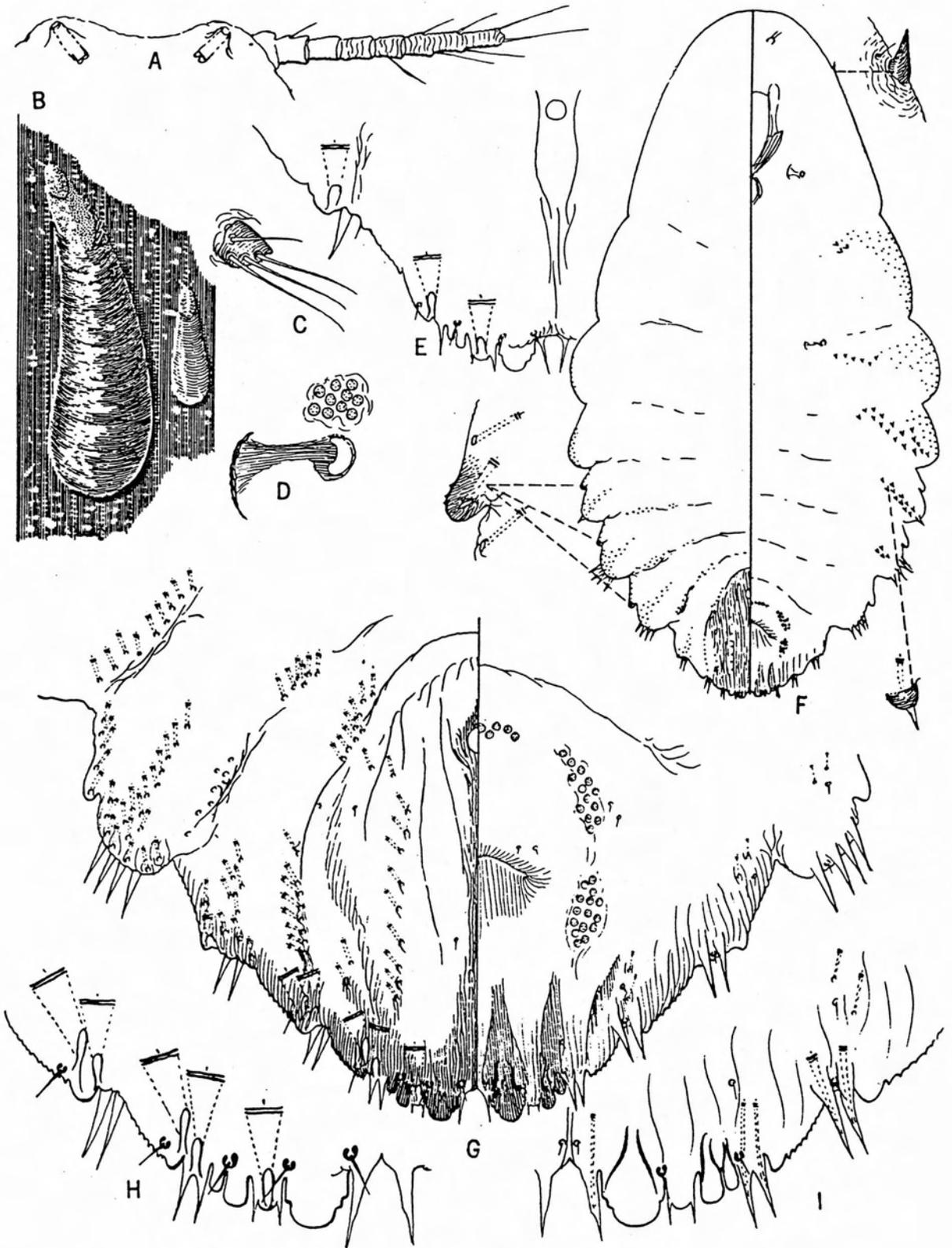


Fig. 90. *Lepidosaphes machili* (Maskell).

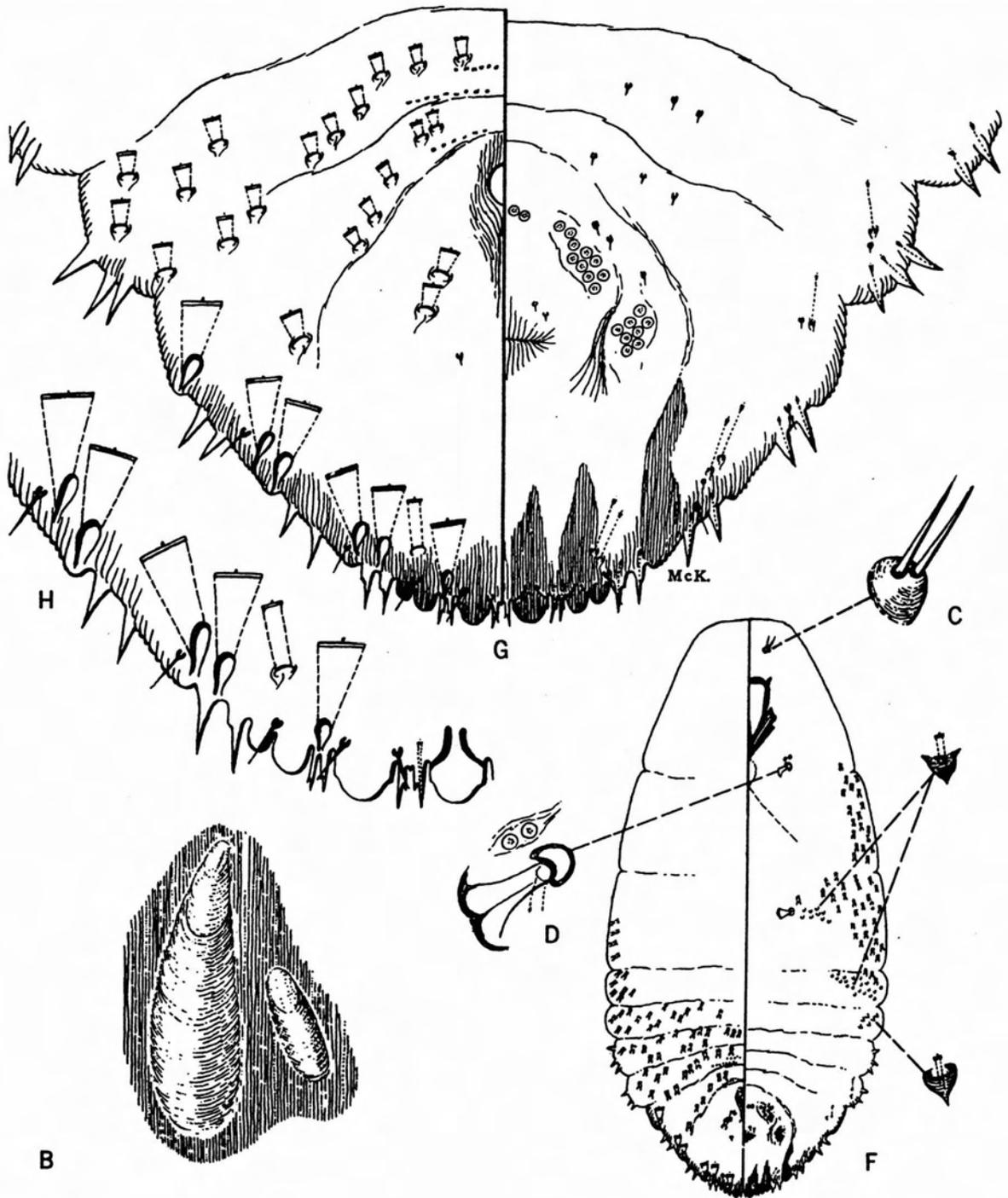


Fig. 91. *Lepidosaphes noxia* McKenzie.

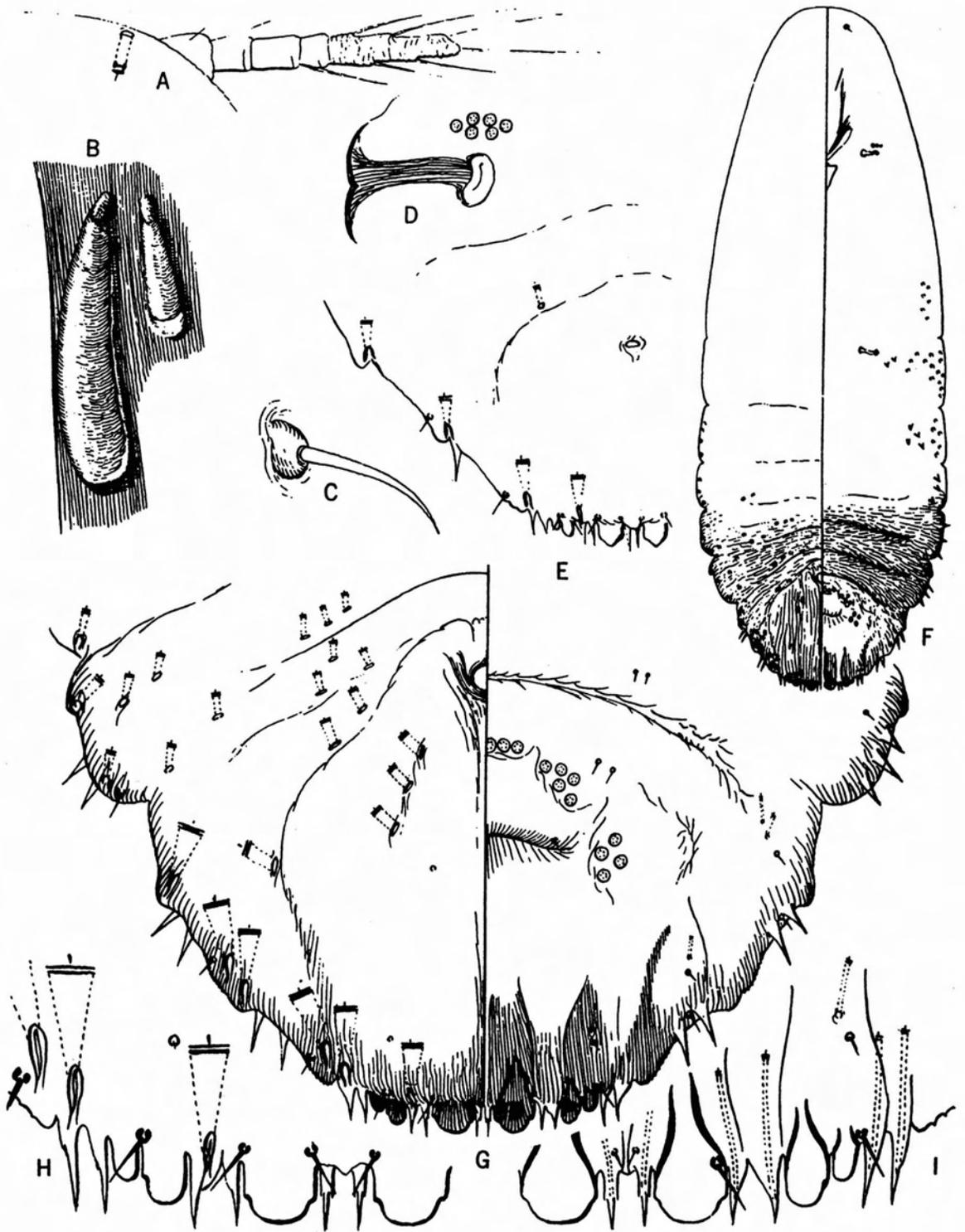


Fig. 92. *Lepidosaphes pallida* (Maskell).

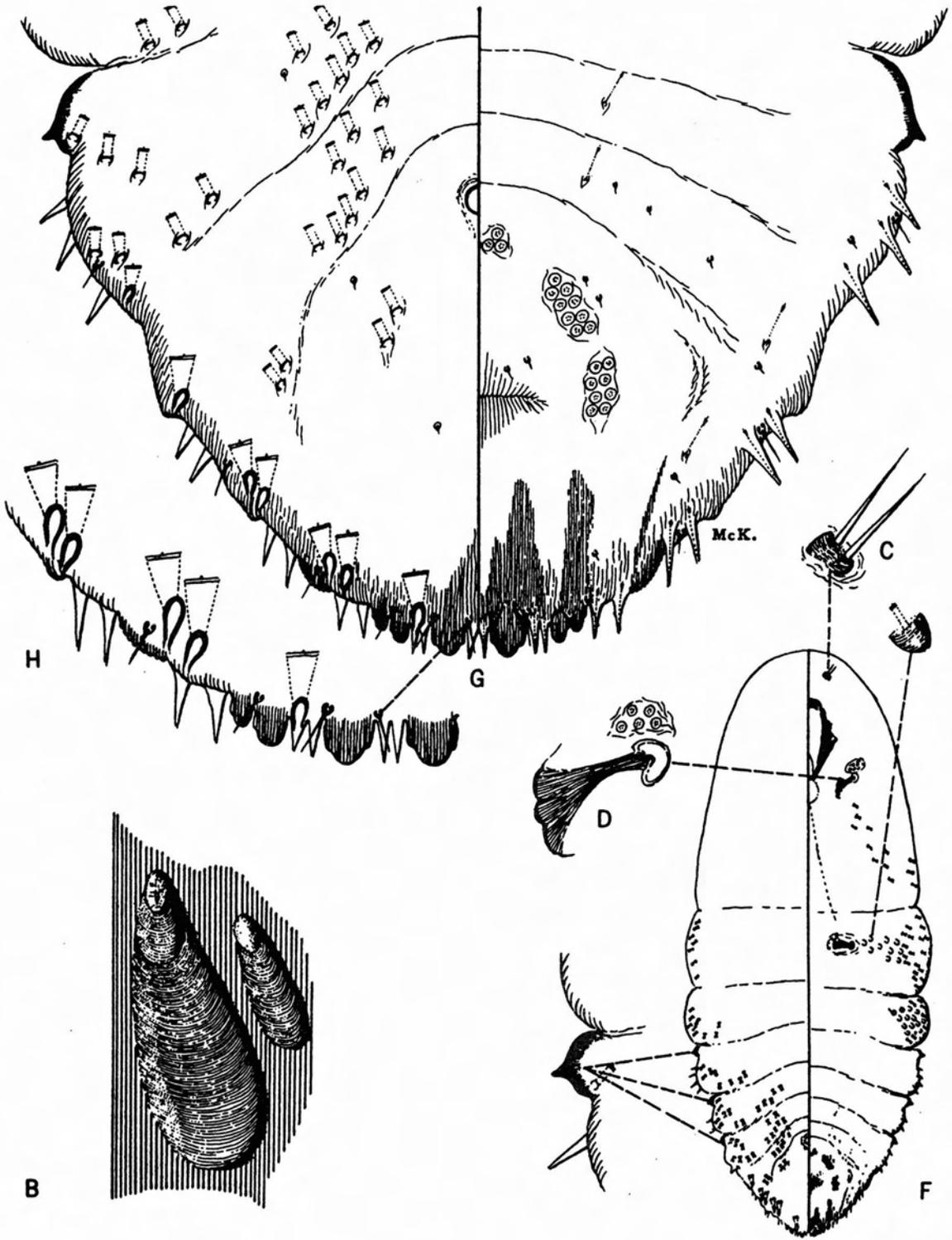


Fig. 93. *Lepidosaphes sciadopitysi* McKenzie.

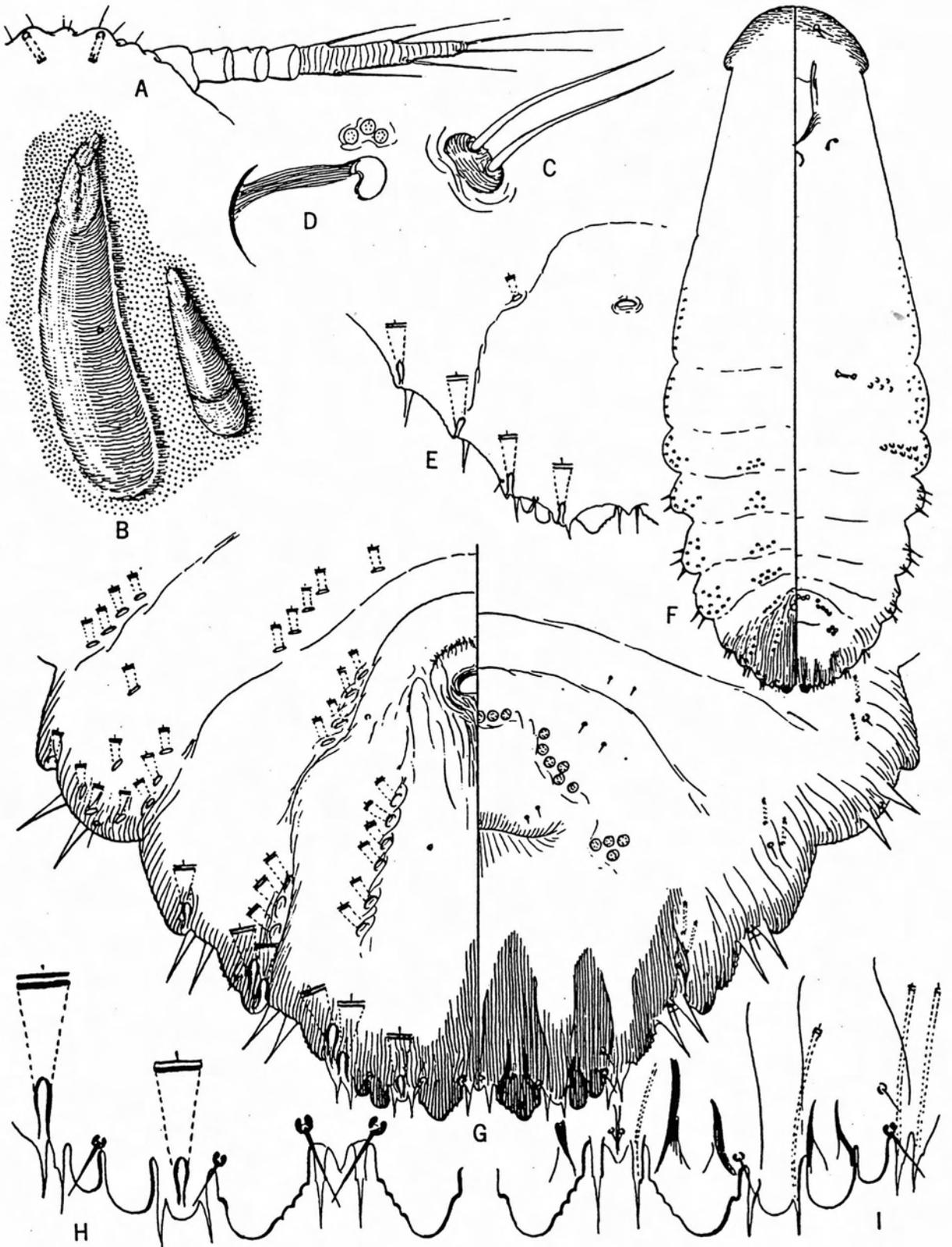


Fig. 94. *Lepidosaphes tokionis* (Kuwana).

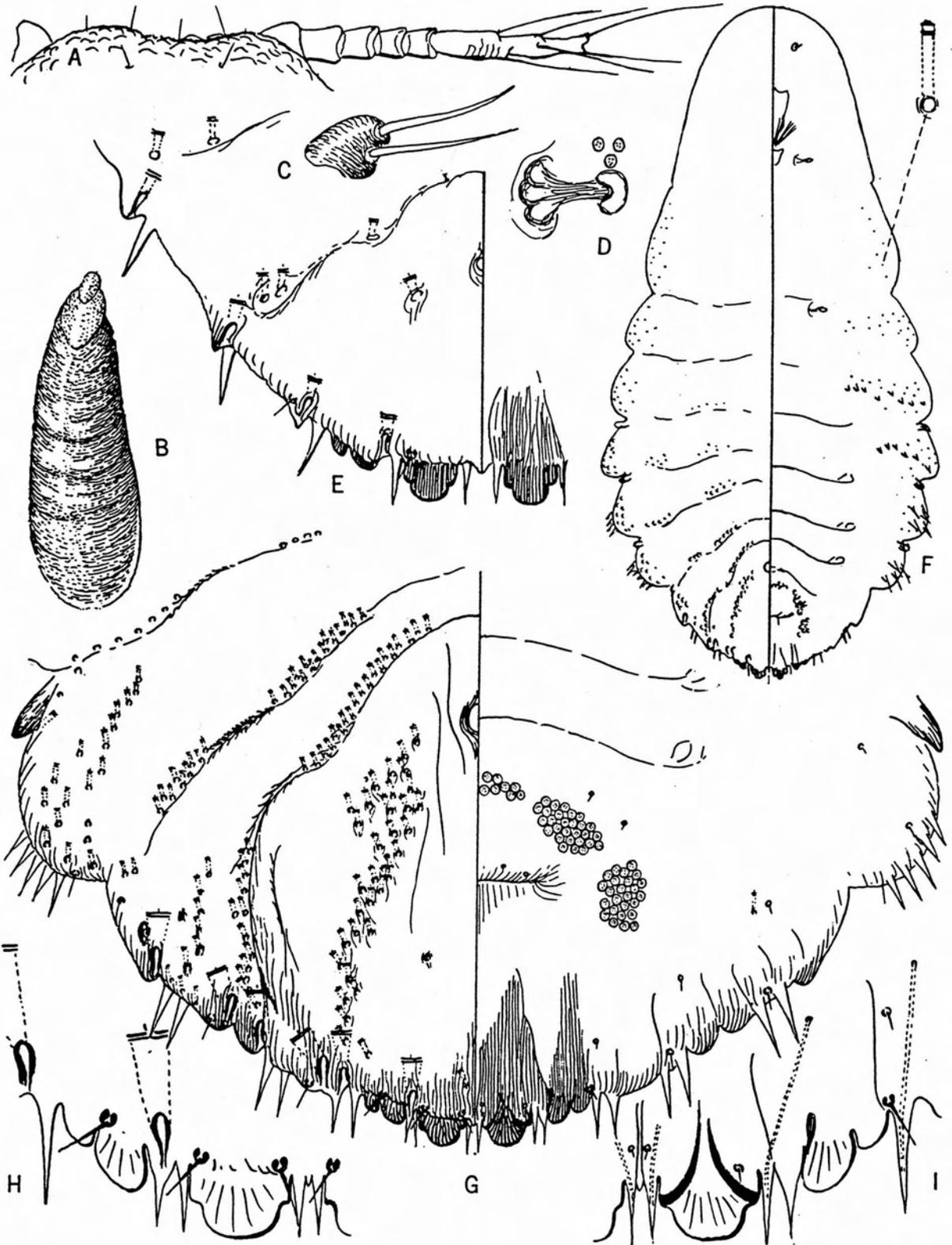


Fig. 95. *Lepidosaphes ulmi* (Linnaeus).

Genus *Leucaspis* Targioni-Tozzetti, 1868

Number of World species: About 22.

Number of United States species: 1.

Key to the World species: None.

Leucaspis portaeureae* Ferris, 1942*podocarpus leucaspis scale**

Fig. 96, Color Plates 99, 100

Tribe: Diaspidini.

Field Characteristics: Adult female scale cover 2.5 to 3.0 mm long, narrow and elongate, fairly convex; appears brown but may be grey with a white powdery wax covering. Females semi-pupillarial, hiding inside the hardened and darkened second stage cast skin, which causes the brown color of the cover. Only one yellow terminal exuvium apparent. Males unknown. Infests leaves.

Hosts: *Podocarpus*.

Economic Importance: None.

Distribution: Has persisted on *Podocarpus* trees in Golden Gate Park, San Francisco, from 1938 to the present. Apparently native to New Zealand.

McKenzie, H.L., 1956: The Armored Scale Insects of California. Univ. Calif. Press, Berkeley. 209 pp.

Genus *Lindingaspis* McGillivray, 1921

Number of World Species: 22.

Number of United States species: 2.

Key to the World species: Williams, D.J., 1963: Bull. Br. Mus. (Nat. Hist.) Entomol. 15(1):1-31.

Key to the United States species: Ferris, G.F., 1937-1942: Atlas of the Scale Insects of North America, Ser. I-IV. Stanford Univ. Press, Stanford.

Lindingaspis rossi* (Maskell) 1891*black araucaria scale**

Fig. 97, Color Plates 101, 102

Tribe: Aspidiotini.

Other Common Names: circular black scale, Ross' black scale, grey scale.

Synonymy: *Aspidiotus rossi* Maskell, *Chrysomphalus rossi* (Maskell), *Aonidiella subrossi* Laing.

Field Characteristics: Adult female scale covers 2.0 to 2.5 mm in diameter, circular, flat, dark brown to black, often with concentric rings of lighter brown, grey or white. Exuviae subcentral, dark brown, with concentric rings of white wax. First exuvium usually with a central button or nipple of white wax. Body colorless to pinkish; usually completely

encased between the scale cover and ventral armor. Males oval, similar in color to the females, with a subterminal exuvium. Occurs on leaves.

Biology: One generation per year on Monterey pine in New Zealand (Timlin, 1964), but up to 3 generations per year in Egypt (Swailam et al., 1976).

Similar Species: Easily confused in the field with a number of other scales in the genera *Lindingaspis*, *Melanaspis* and *Acutaspis* which are not known from California. However, these other scales would not likely be found on *Araucaria*. Florida red scale and bifasciculate

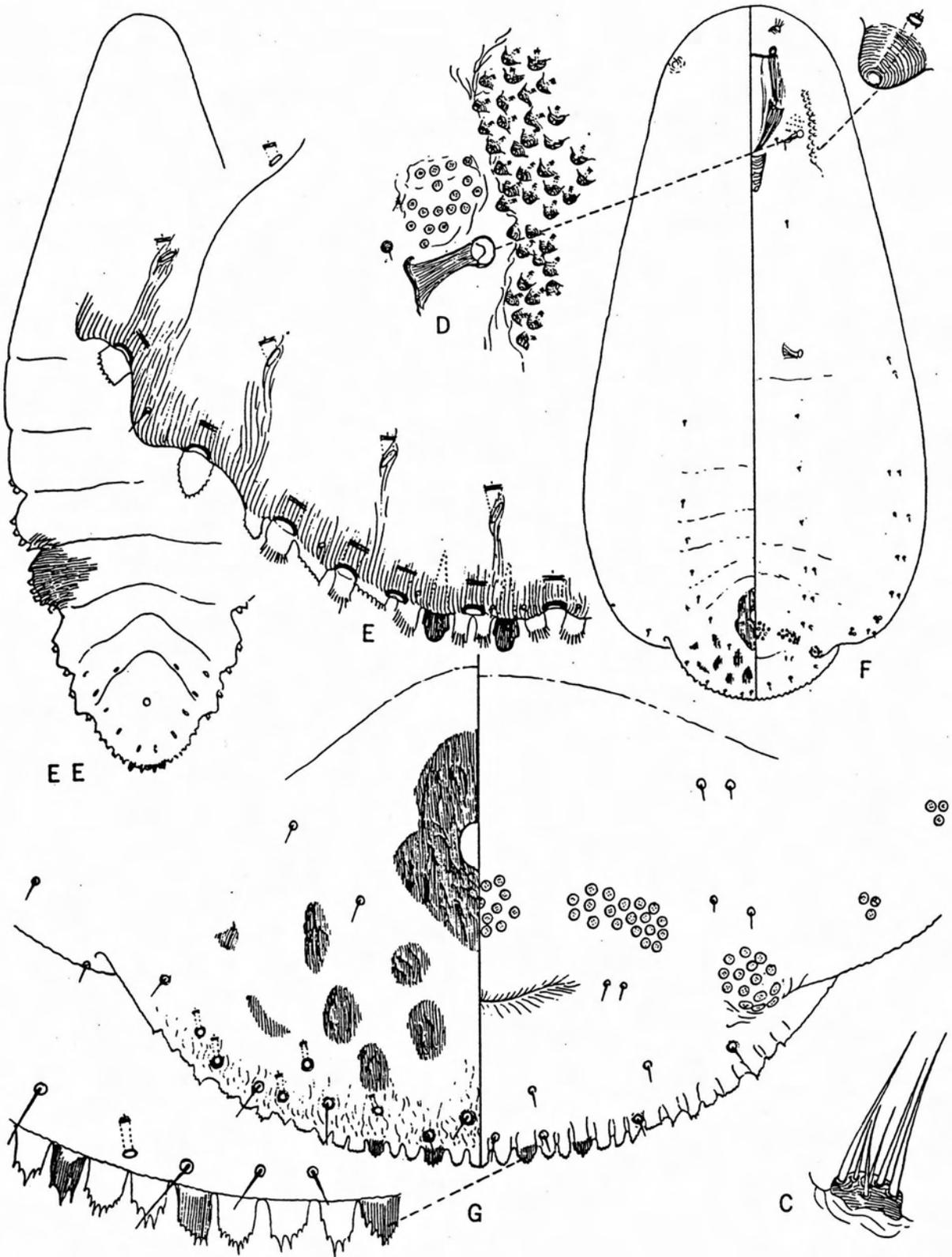


Fig. 96. *Leucaspis portae aureae* Ferris.

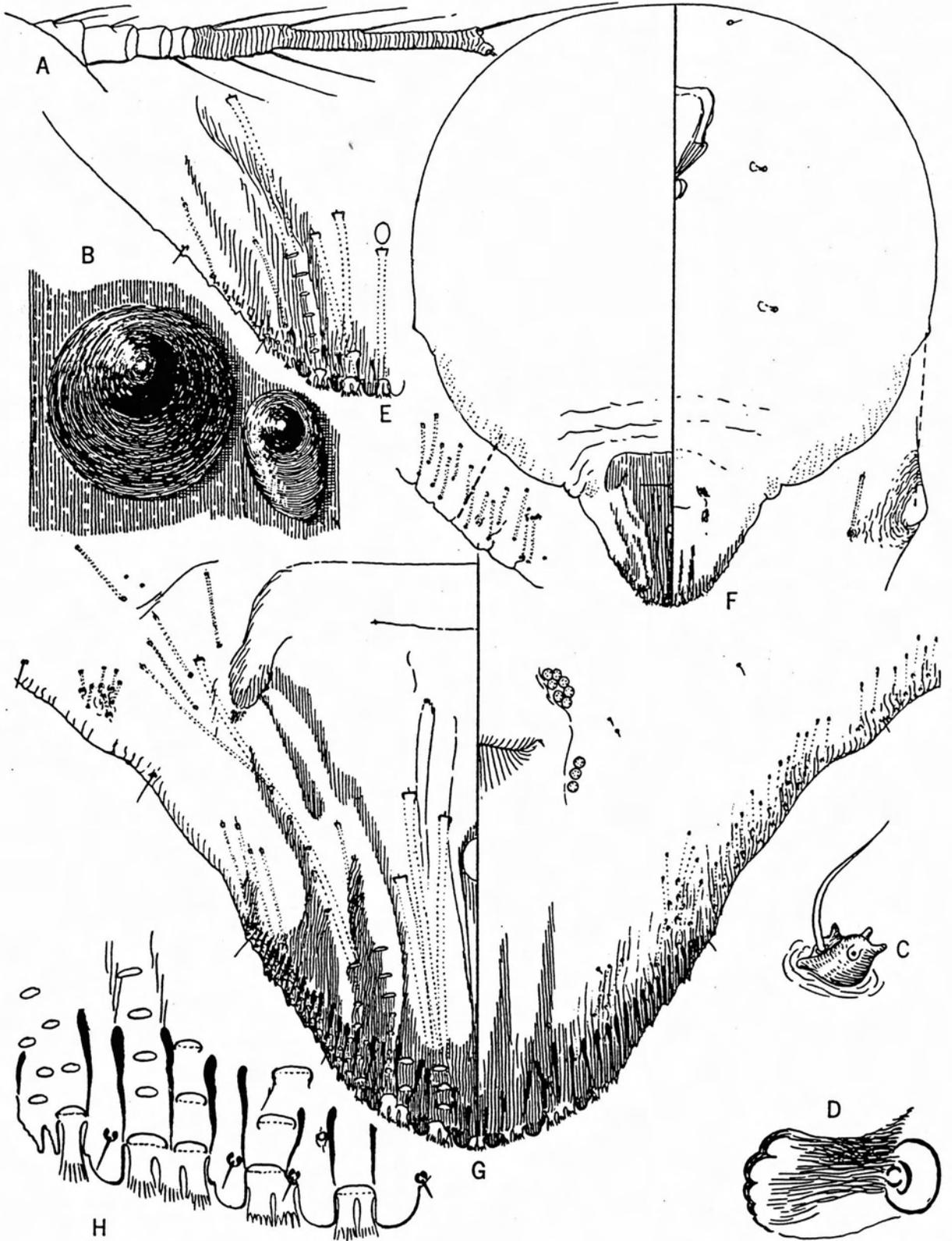


Fig. 97. *Lindingaspis rossi* (Maskell).

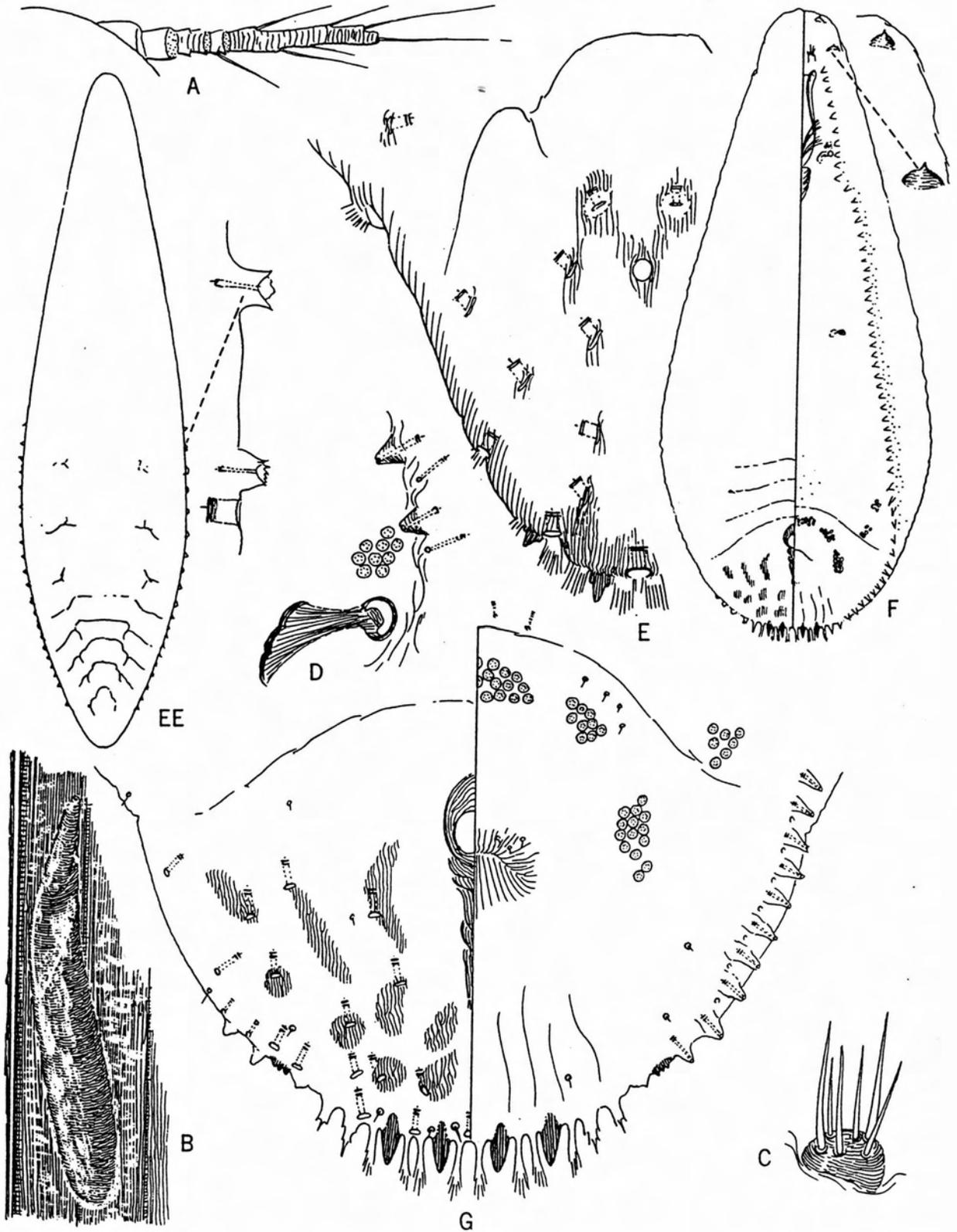


Fig. 98. *Lopholeucaspis cockerelli* (Grandpre and Charmoy).

ARMORED SCALE INSECTS OF CALIFORNIA

LINDINGASPIS to MELANASPIS

scale are similar but the exuviae in both of these species is red or reddish-brown.

Hosts: Prefers trees in the genus *Araucaria* such as monkey-puzzle tree and star pine in California. Attacks California redwood heavily; known from a wide range of hosts including *Citrus*. For a host list see McKenzie (1956) and Essig (1958).

Economic Importance: A serious pest of *Araucaria* species and California redwood, causing heavy chlorosis and general debilitation. For more information see Brown and Eads (1967).

Distribution: Coastal counties from San Luis Obispo south; most common in San Diego County. Also known from tropical and subtropical areas of the world. Originally described from Australia; may be native there.

Diagnosis: The elongated marginal paraphyses which occur anteriorly well beyond the 4th lobes, and the shortened plates between the third and fourth lobes separate this species from all others in California. However, there are over 20 species in the genus *Lindingaspis*

including *Lindingaspis floridana* Ferris in Florida. Special care should be taken with specimens of *Lindingaspis* from hosts other than *Araucaria*. Keys to the species are in McKenzie (1950) and Williams (1963).

Brown, L.R., and C.O. Eads, 1967: Calif. Agric. Exp. St. Bull. 834:1-72.

Essig, E.O., 1958: Insects and Mites of Western North America. The MacMillan Co., New York. 1050 pp.

McKenzie, H.L., 1950: Microentomol. 15(3):98-124.

McKenzie, H.L., 1956: The Armored Scale Insects of California. Univ. Calif. Press, Berkeley. 209 pp.

Swailen, S.M., K.T. Awadallah and A.A. Shaheen, 1976: Bull. Entomol. Soc. Egypte 60:257-263.

Timlin, J.S. 1964: N.Z. J. Agric. Res. 7(4):531-535.

Williams, D.J., 1963: Bull. Br. Mus. (Nat. Hist.) Entomol. 15(1):1-31.

Genus *Lopholeucaspis* Balachowsky 1953

Number of World species: 6.

Number of United States species: 2.

Key to the World species: None.

Key to the United States species: Ferris, G.F., 1937-1942: Atlas of the Scale Insects of North America, Ser. I-IV. Stanford Univ. Press, Stanford (under *Leucaspis*).

Lopholeucaspis cockerelli (Grandpre and Charmoy), 1899

Cockerell scale

Fig. 98

Tribe: Diaspidini.

Synonymy: *Fiorinia cockerelli* Grandpre and Charmoy, *Leucodiaspis cockerelli* (Grandpre and Charmoy), *Leucaspis cockerelli* (Grandpre and Charmoy).

Collected in several California nurseries on *Dendrobium* orchids. Eradicated. Also occurs on palms, citrus and other plants.

McKenzie, H.L., 1956: The Armored Scale Insects of California. Univ. Calif. Press, Berkeley. 209 pp.

Genus *Melanaspis* Cockerell, 1897.

Number of World species: About 60.

Number of United States species: 8.

Key to the World species: None.

Key to the North American species: Ferris, G.F., 1937-1942. Atlas of the Scale Insects of North America, Ser. I-IV. Stanford Univ. Press, Stanford.

Dietz, L.L. and J.A. Davidson, 1986: N. Carolina State Univ. Tech. Bull. 279:1-91.

KEY TO CALIFORNIA SPECIES OF *MELANASPIS*

1. Perivulvar pores present. *obscura*
— Perivulvar pores absent. 2
2. With one long paraphyses arising from each of the first to third spaces, these all of somewhat the same length, and with a paraphyses of less than half this length arising from and continuous with the mesal angle of the median to fourth lobes, all other paraphyses small; associated with oaks in the southwestern United States. *lilacina*
— Without the above combination of characters. 3
3. First interlobular space with a short paraphysis that is followed by a long paraphysis which is continuous with the mesal angle of the second lobe; second space with a short paraphysis, this followed by one that is much longer and by one arising from the mesal angle of the third lobe; third space with a quite long, stout paraphysis, followed by a shorter one that is continuous with the mesal angle of the fourth lobe; associated primarily with numerous deciduous hosts in southeastern and southern United States. *tenebricosa*
— Without the above combination of characters; usually associated with pineapple and other bromeliads. *bromeliae*

***Melanaspis bromeliae* (Leonardi), 1899**
brown pineapple scale (ESA approved)
Fig. 99, Color Plate 103

Tribe: Aspidiotini.

Other Common Names: Ananas scale.

Synonymy: *Aonidiella bromiliae* Leonardi, *Aspidiotus bromiliae* (Leonardi), *Chrysomphalus bromeliae* Leonardi, *Pseudischnaspis anassarum* Lindinger, *Melanaspis smilacis* Ferris (misidentification).

Field Characteristics: Scale cover 1.5 to 2.5 mm in diameter, circular, flat, brown with black central or subcentral exuviae.

Hosts: Pineapple.

Economic Importance: None.

Distribution: Occasionally encountered in retail stores on pineapple fruit. No established infestations have ever occurred in California.

Diagnosis: Recognized by host preference and the poorly developed pygidial paraphyses. See illustration.

Beardsley, J.W., 1966: Insects Micronesia 6(7):337-562.

Melanaspis lilacina (Cockerell), 1898

dark oak scale

Fig. 100

Tribe: Aspidiotini.**Synonymy:** *Aspidiotus lilacinus* Cockerell, *Chrysomphalus lilacinus* (Cockerell), *Pelomphala lilacina* (Cockerell).**Field Characteristics:** Female scale cover black or dark grey, with subcentral exuviae. Males similar but oval with a subterminal exuvium.

Occurs on bark.

Hosts: A number of species of oak.**Economic Importance:** Common and at times injurious on oaks in Arizona and New Mexico. Rare and non-economic in California.**Distribution:** Collected only twice in California, on Banner Grade and in Descanso, both in San Diego County. Probably is still present in similar semi-arid locations of San Diego County, as well as nearby Riverside County.**Diagnosis:** Similar to obscure scale but lacks perivulvar pores.

McKenzie, H.L., 1956: The Armored Scale Insects of California. Univ. Calif. Press, Berkeley. 209 pp.

Melanaspis obscura (Comstock), 1881

obscure scale (ESA approved)

Fig. 101, Color Plates 104, 105

Tribe: Aspidiotini.**Synonymy:** *Aspidiotus obscurus* Comstock, *Chrysomphalus obscurus* (Comstock).**Field Characteristics:** Adult female scale covers 2 to 3 mm in diameter, circular, flat to slightly convex, dark grey, with black subcentral exuviae. Body pale, often with a pinkish tinge. Male scale covers grey, circular or oval, with a subcentral exuvium. The common name refers to the fact that the scales are similar in color to, and often found under the loose outer bark of the host, making them obscure and hard to find.**Similar Species:** Cannot be separated in the field from various species in the genus *Melanaspis* such as *M. lilacina*, and *M. tenebricosa*.**Biology:** Variable depending on host species group. Crawlers hatch in August and overwinter as settled crawlers on white oaks; on red oaks, crawlers hatch in July and overwinter as second instars. There are still other differences depending on whether the host is in the red or white oak group. One generation per year in either case. The above biological information is summarized from Stoetzel and

Davidson (1971, 1973) and Hendricks and Williams (1992).

Hosts: Prefers oaks (*Quercus*) and pecan (*Carya*) but has been found on many deciduous trees. Collected on coast live oak in California. For host lists see Stoetzel (1971) and Dekle (1976).**Economic Importance:** A serious pest of oaks in the eastern United States. Stoetzel and Davidson (1971) consider it the most serious pest of shade trees in Maryland. A serious pest of pecan trees throughout the south, where it frequently kills branches less than 3 inches in diameter, and generally weakens the trees so that they become susceptible to woodborer attack. For more information see Stoetzel and Davidson (1971), Osburn et al., (1963), Payne et al., (1979), and Mackie (1934). An "A"-rated pest in California.**Distribution:** The only active infestation in California is in Capitol Park, Sacramento. This infestation was first found in 1962, but probably existed in the park since 1897, when oak trees from the major civil war battlefields were planted there. Other infestations occurred in San Diego and Los Angeles Counties before 1940, but these have been eradicated. Wide-

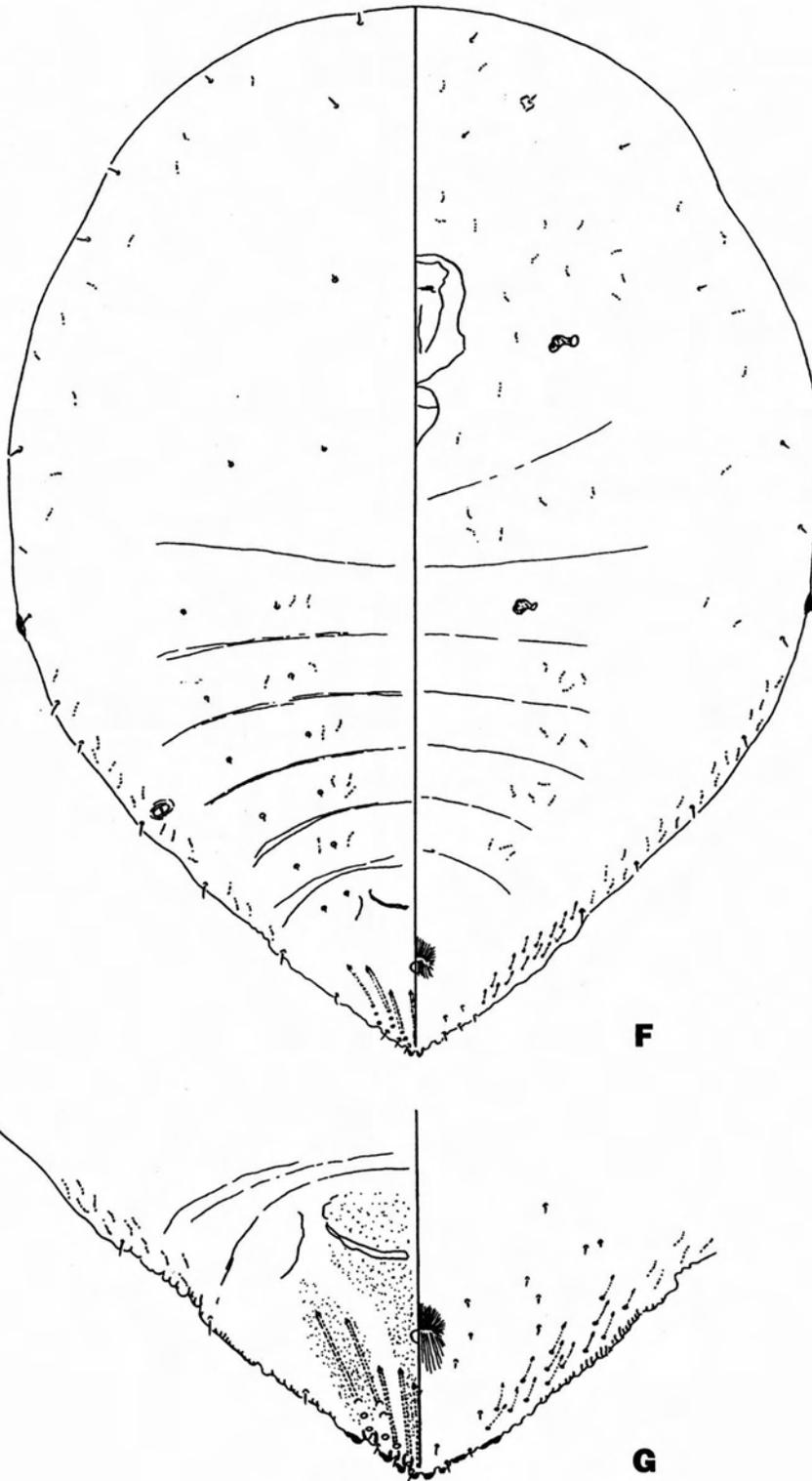


Fig. 99. *Melanaspis bromeliae* (Leonardi).

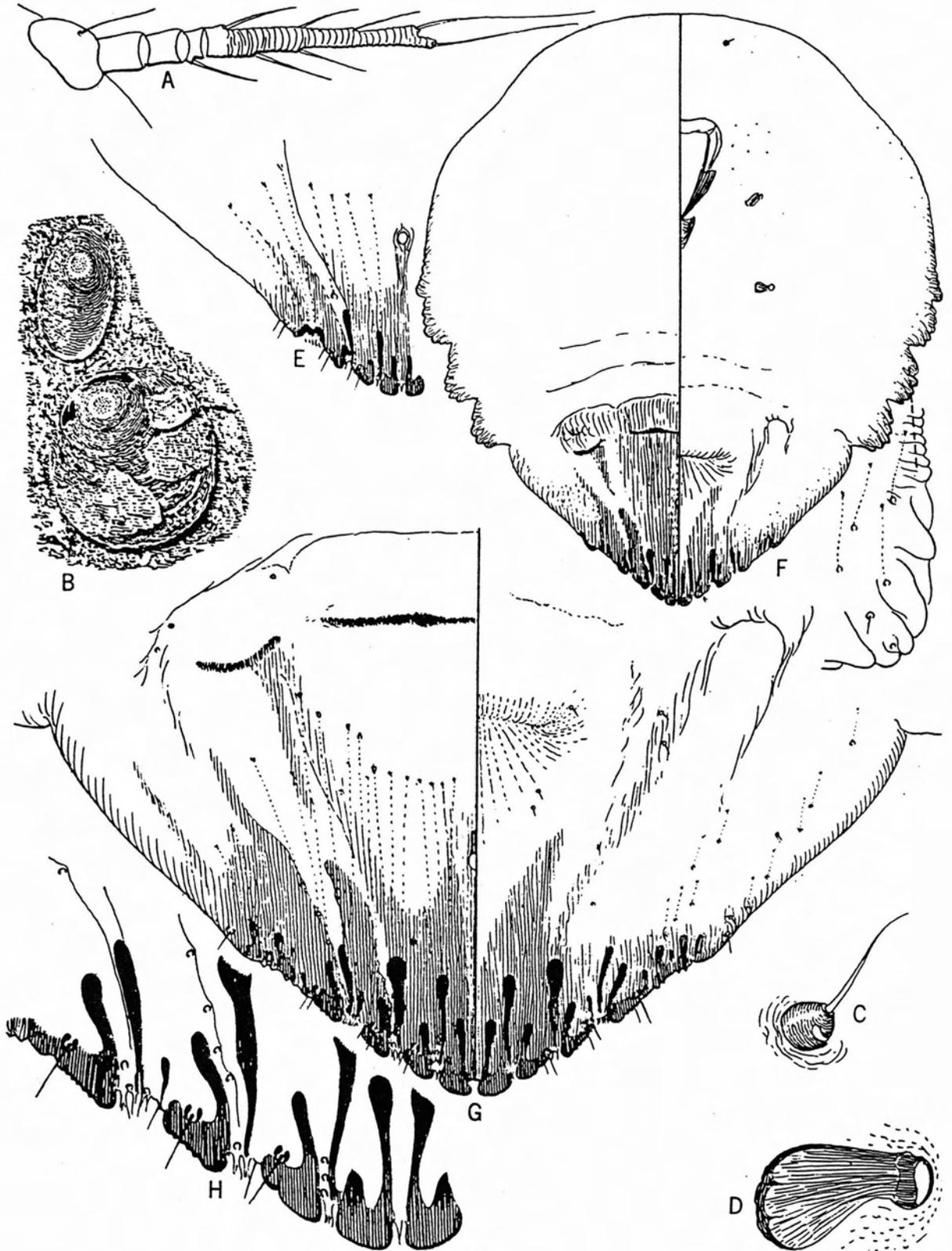


Fig. 100. *Melanaspis lilacina* (Cockerell).

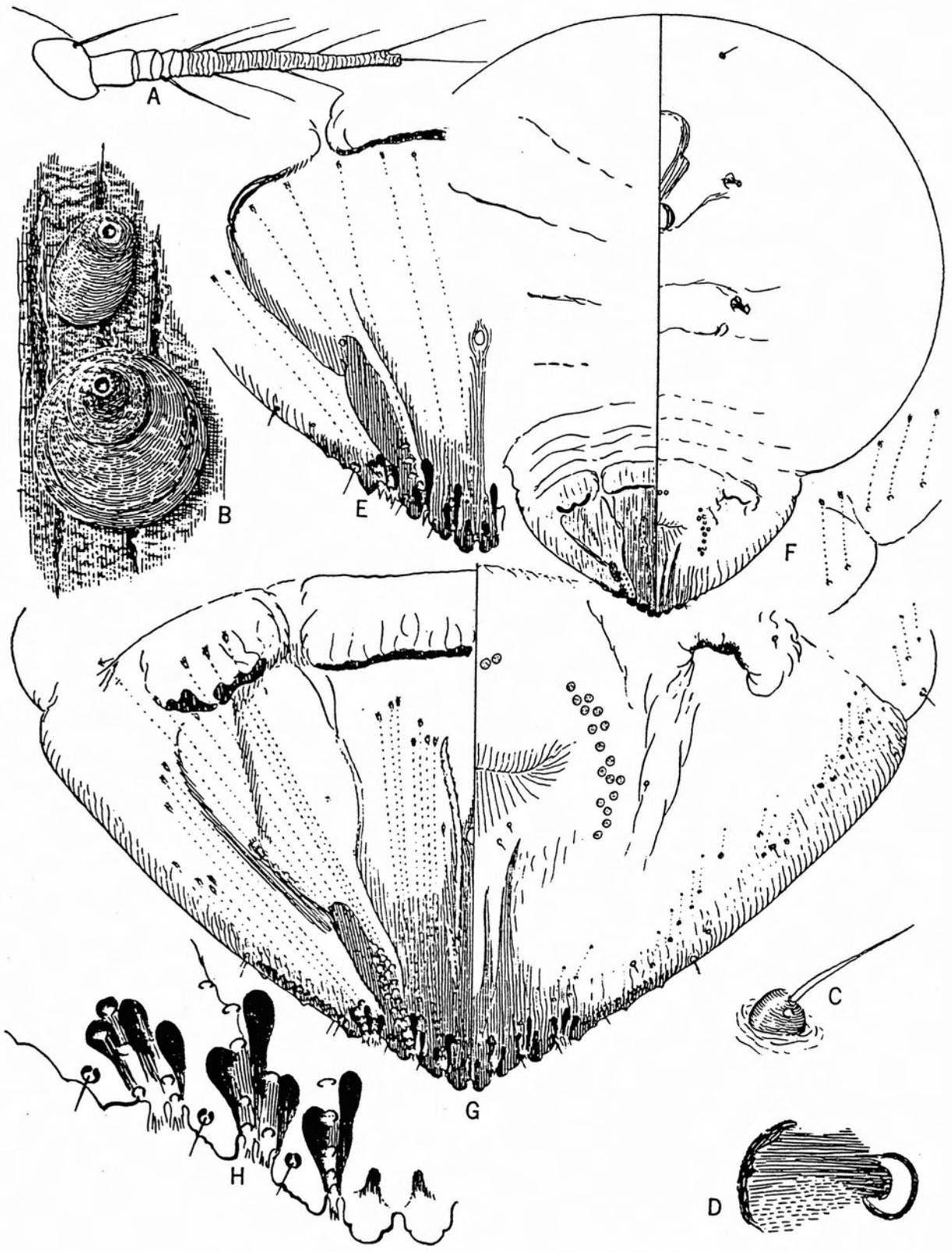


Fig. 101. *Melanaspis obscura* (Comstock).

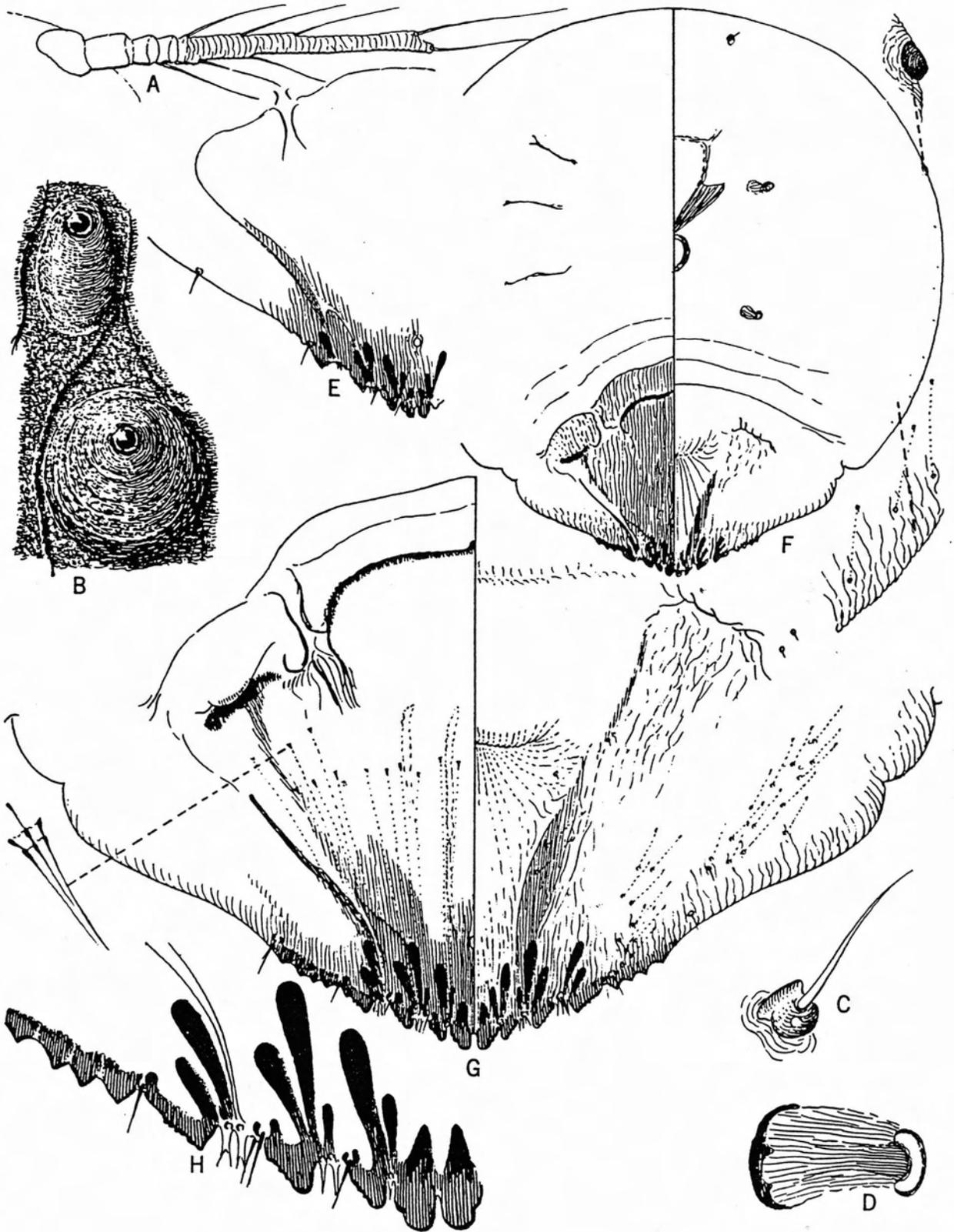


Fig. 102. *Melanaspis tenebricosa* (Comstock).

ARMORED SCALE INSECTS OF CALIFORNIA

MELANASPIS to NEOPINNASPIS

spread; apparently native to the eastern states south of the Great Lakes and east of Texas.

Diagnosis: The genus *Melanaspis* is recognized by the dark scale cover, broadly rounded pygidium, poorly developed plates and strongly developed paraphyses which occur at the bases of the lobes and extend as far as the fourth lobes. A number of similar genera occur throughout tropical America; care should be taken when identifying quarantine material. Obscure scale is the only California *Melanaspis* with perivulvar pores.

Dekle, G.W., 1976: Florida Armored Scale Insects. Fla. Dep. Agric. Cons. Serv., Div.

Plant Ind., Gainesville. 345 pp.
Hendricks, H.J. and M.L. Williams, 1992: Ann. Entomol. Soc. Am. 85(4):452-457.
Mackie, D.B., 1937: Calif. Dep. Agric. Mon. Bull. 25(4):455-481.
Osburn, M.R., W.C. Pierce and A.M. Phillips, 1963: U.S. Dep. Agric., Agric. Handb. 240:1-52.
Payne, J.A., H.L. Malstrom and G.E. KenKnight, 1979: U.S. Dep. Agric. Agric. Rev. Man. Arm-S-5:1-43.
Stoetzel, M.G., and J.A. Davidson, 1971: Ann. Entomol. Soc. Am. 64(1):45-50.
Stoetzel, M.B., and J.A. Davidson, 1973: Ann. Entomol. Soc. Am. 66(2):308-311.

Melanaspis tenebricosa (Comstock), 1881
gloomy scale (ESA approved)

Fig. 102

Tribe: Aspidiotini.

Synonymy: *Aspidiotus tenebricosa* Comstock, *Chrysomphalus tenebricosa* (Comstock), *Aonidiella tenebricosa* (Comstock).

Reported from the San Jose area in 1891 where it was injuring apple trees (Essig, 1915). The accuracy of the determination is questionable; if accurate, the scale has never been recollected.

Dekle, G.W., 1976: Florida Armored Scale Insects. Fla. Dep. Agric., Cons. Serv., Div. Plant Ind., Gainesville. 345 pp.

Essig, E.O., 1915: Injurious and Beneficial Insects. Calif. Dept. Agric. Mon. Bull. Suppl. 4(4): 1-541.

Kosztarab, J., 1963: Bull. Ohio Biol. Surv. (N.S.) 2(2): 1-120. Ferris, G.F., 1937: Atlas of the Scale Insects of North America. Stanford Univ. Press, Stanford.

Genus *Neopinaspis* McKenzie, 1949

Number of World species: 3.

Number of United States species: 1.

Key to the World species: None.

Neopinaspis harperi McKenzie, 1949

Harper scale

Fig. 103

Tribe: Diaspidini.

Synonymy: *Africaspis harperi* (McKenzie).

Field Characteristics: Adult females usually 1 mm long, occasionally 2 mm, narrow, irregu-

larly elongate, fairly flat, tan, with bronze or reddish-brown terminal exuviae. Body pink or red. Males unknown. Occurs on bark, especially in cracks. Because it is small and

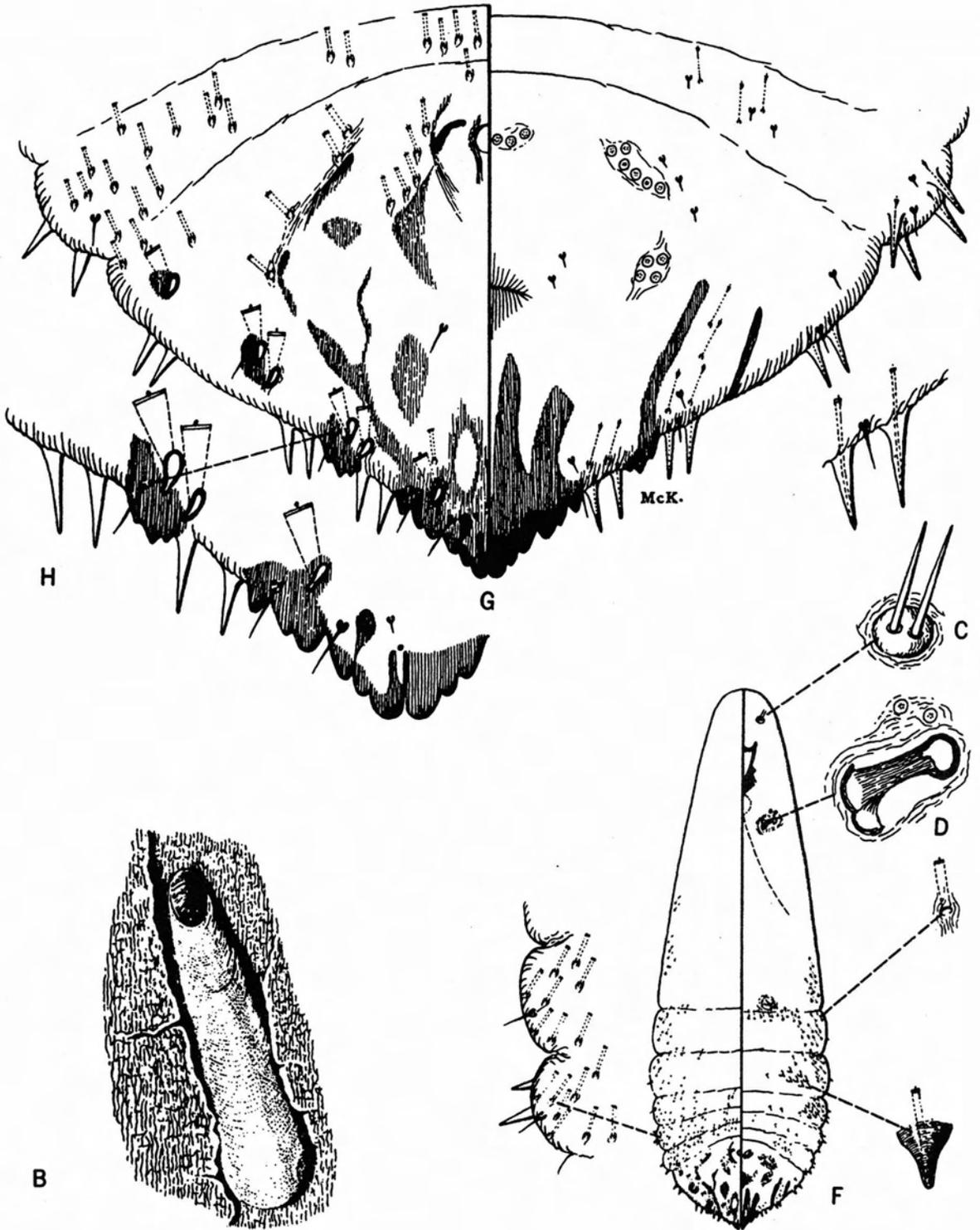


Fig. 103. *Neopinnaspis harperi* McKenzie.

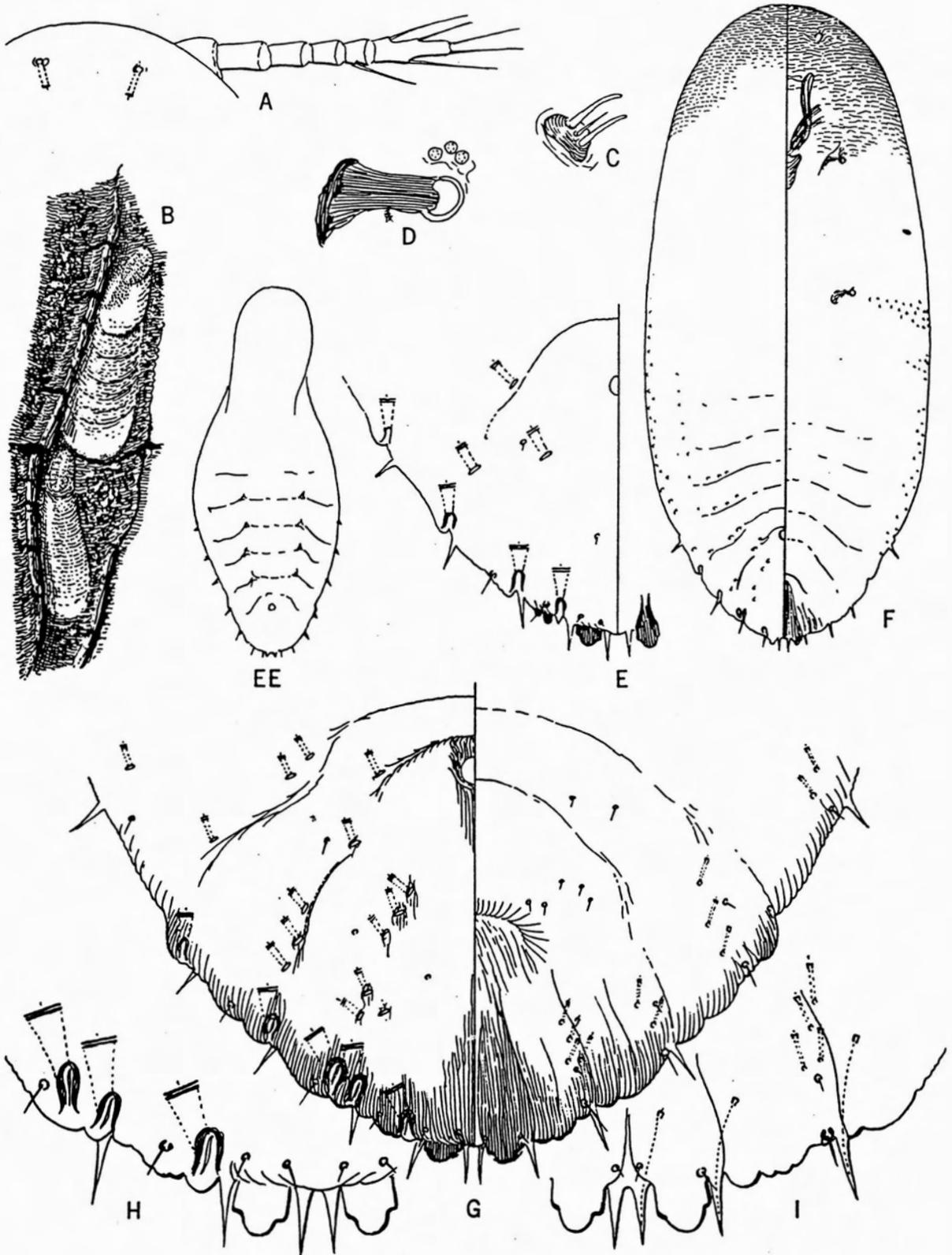


Fig. 104. *Nilotaspis halli* (Green).

blends in with its surroundings, heavy infestations can easily go unnoticed.

Similar Species: Fig scale and DeStephen scale.

Biology: Unknown.

Hosts: Has a wide host range among the ornamental perennial dicots, particularly those in the rose family. Some common hosts are Catalina cherry, chokecherry, cotoneaster, ceanothus, carob and macadamia. For more information see McKenzie (1949, 1956) and Dekle (1976).

Economic Importance: Status as a pest of ornamentals unknown. Has been in California at least since 1949 without measurable effects. Populations have declined from 1949 levels. A "B"-rated pest.

Distribution: Restricted to the cities of Santa Bar-

bara, Montecito and Los Alamos in Santa Barbara County, and Fountain Valley in Orange County. Also known from Florida, Georgia, Hawaii, Japan and Taiwan. Probably of Asian origin.

Diagnosis: The illustration of this scale provided here from McKenzie (1956) is adequate to identify this species. Nothing else in California resembles it.

Dekle, G.W., 1976: Florida Armored Scale Insects. Fla. Dep. Agric. Cons. Serv., Div. Plant Ind., Gainesville. 345 pp.

McKenzie, H.L., 1949: Calif. Dep. Agric. Mon. Bull. 38(3):123-126.

McKenzie, H.L., 1956: The Armored Scale Insects of California. Univ. Calif. Press, Berkeley, 209 pp.

Genus *Nilotaspis* Ferris, 1941

Number of World species: 8.

Number of United States species: Presently none.

Key to the World species: None.

Nilotaspis halli (Green), 1923

Hall scale (ESA approved)

Fig. 104, Color Plates 106, 107

Tribe: Diaspidini.

Synonymy: *Lepidosaphes halli* Green, *Coccomytilus halli* (Green), *Lepidosaphes zlocistii* Bodenheimer.

Field Characteristics: Adult female scale covers very small, 0.8 to 1.2 mm long, irregularly elongate, fairly flat, dirty white, with yellow or orange terminal exuviae, body yellowish. Male scale cover similar in appearance but smaller. Normally found on the wood, particularly in bark crevices, although if populations become heavy the scale will readily infest the fruit.

Similar Species: None.

Biology: According to Fosen et al., (1953), had one and a partial second generation in California. Overwinters as adult females.

Hosts: Prefers deciduous fruit and nut trees in the genus *Prunus*. Also known from plants in the genera *Cydonia* and *Spiraea*.

Economic Importance: A serious pest of fruit trees in other countries (Fosen et al., 1953).

Distribution: First found in California at the United States Plant Introduction Gardens at Chico, Butte County in 1934. Later found at Oroville, Butte County and Davis, Yolo County. Last collected in 1956; declared officially eradicated. For more information see Fosen et al., (1956).

Diagnosis: The only elongate, white scale ever recorded attacking *Prunus*. Morphologically similar to the genus *Cupidaspis* but these occur only on conifers.

Fosen, E.H., A.W. Cressman and H.M. Armitage, 1953: U.S. Dep. Agric. Circ. 920: 1-16.

McKenzie, H.L., 1956: The Armored Scale Insects of California. Univ. Calif. Press, Berkeley. 209 pp.

Genus *Nuculaspis* Ferris, 1938

Number of World species: 4.

Number of United States species: 2.

Key to the World species. None.

Key to the United States species: Ferris, G.F., 1937-1942: Atlas of the Scale Insects of North America, Ser. I-IV. Stanford Univ. Press, Stanford.

Nuculaspis californica (Coleman), 1903

black pineleaf scale (ESA approved)

Fig. 105, Color Plates 108, 109

Tribe: Aspidiotini.

Other Common Names: Hemlock scale, California pine scale, California pineleaf scale.

Synonymy: *Aspidiotus californicus* Coleman, *Aspidiotus abietis* (Schrank) as a misidentification), *Aspidiotus pini* Comstock (pre-occupied), *Chrysomphalus californicus* (Coleman).

Field Characteristics: Adult females 2.0 to 2.5 mm long, moderately convex, oblong or elongate, probably in response to the narrow surface of the host needles. Scale cover white or light grey but appearing black because of the very large, blue-black or grey-black second exuvium. The remainder of the scale cover appears as a narrow light grey ring around the second exuvium. First exuvium chestnut brown but may be obscured by a whitish waxy cover. Both exuviae centrally located. Female body bright yellow, becoming brown and sclerotized with age. Male scale cover colored as in female, oblong or oval, with a subterminal brown exuvium.

Biology: Found only on leaves (needles). One to 3 generations per year depending on climatic conditions, winter passed as second instar nymphs. For more information see Keen (1952), Struble and Johnson (1964), Brown and Eads (1967), Edmunds (1973) and Furniss and Carolin (1977). The paper by Edmunds is extremely detailed. Alstad and Corbin (1990) studied allelic frequencies and gene distributions.

Similar Species: The only similar species on conifer hosts in California are redwood scale and Florence scale, but they are lighter colored.

Pine needle scale is often found in association with this species, but the white oystershell-like cover of pine needle scale should not be confused with the black oblong cover of this species. Three species which occur on conifers in the eastern United States, *Acutaspis morrisonorum* Kosztarab, *Tsugaspidotus tsugae* (Marlatt) and *Diaspidiotus mcombi* McKenzie also appear similar in the field.

Hosts: Prefers pines; infests at least a dozen species. Also attacks Douglas fir and possibly spruce, cedar and hemlock.

Economic Importance: A serious pest of pines on the West Coast, particularly of ponderosa and other yellow pines. Causes severe discoloration of the needles, defoliation and reduced growth; young trees may be killed outright. Defoliation probably subjects the trees to sunburn, and the general debilitation caused by the scale undoubtedly makes the trees susceptible to bark beetle attack. For more information see Keen (1952), Struble and Johnson (1964), Brown and Eads (1967), Baker (1972), Edmunds (1973) and Furniss and Carolin (1977). For information on natural enemies see Struble and Johnson (1964) and Edmunds (1973).

Distribution: Found throughout the State both on native and ornamental conifers. Widespread in most of the United States and Northern Mexico. Apparently native to North America.

Diagnosis: Host restriction and field appearance aid in identification. The only conifer infesting species with four pairs of pygidial lobes except for *Nuculaspis apachea* Ferris, a

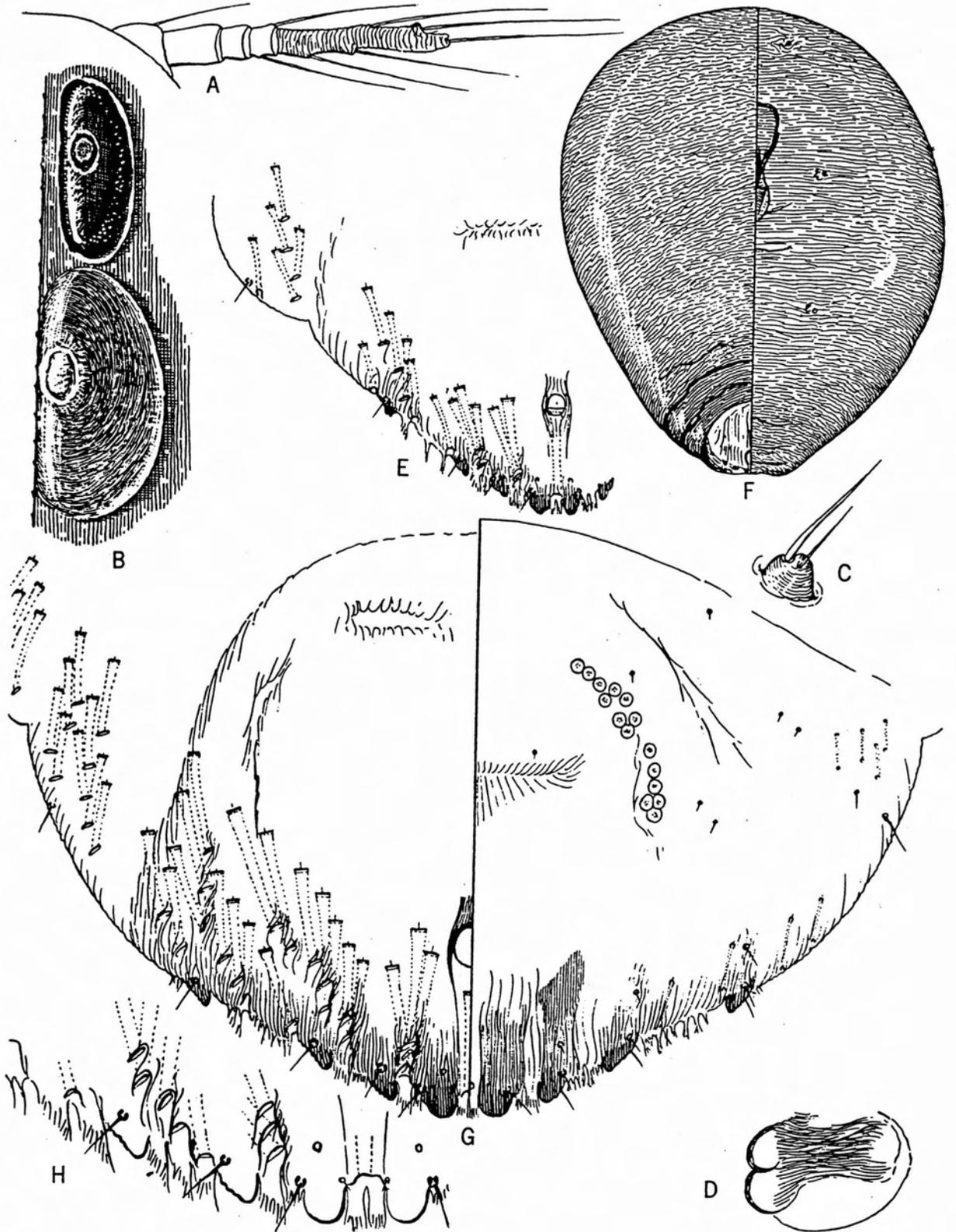


Fig. 105. *Nuculaspis californica* (Coleman).

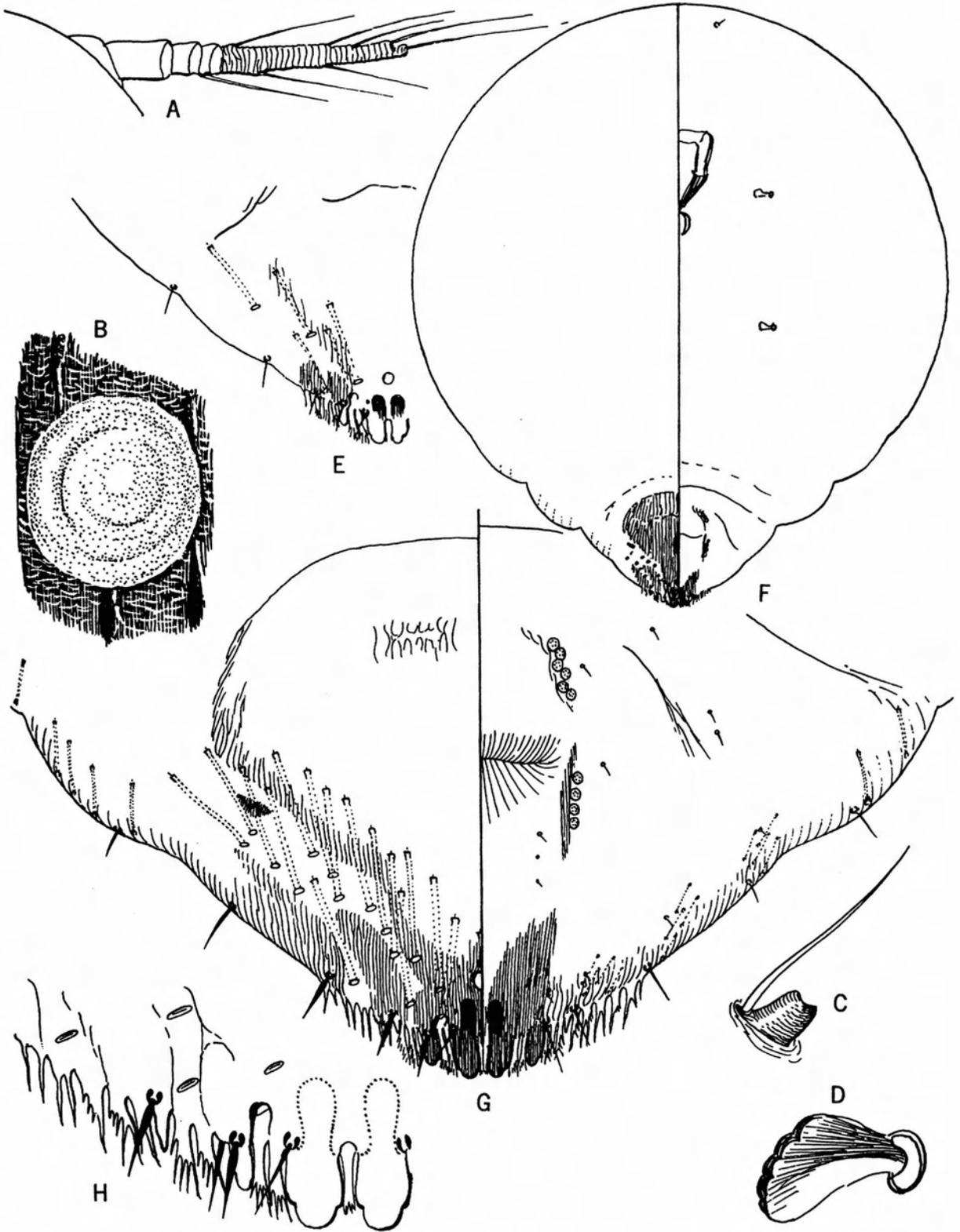


Fig. 106. *Oceanaspidiotus spinosus* (Comstock).

ARMORED SCALE INSECTS OF CALIFORNIA *OCEANASPIDIOTUS* to *ODONASPIS*

rare species known only from the type collection in the Chiricahua Mountains, Arizona. Several Eurasian species, *Tsugaspidotus tsugae* (Marlatt) and *Nuculaspis abietis* (Schrank), are very similar morphologically but lack the fourth pygidial lobe. *Tsugaspidotus tsugae*, the shortneedle evergreen scale, has been introduced into the eastern United States where it occurs on spruce, hemlock and other shortneedle conifers.

Ecol. 4:43-56.
Baker, W.L., 1972: U.S. For. Serv. Misc. Publ. 1175:1-642.
Brown, L.R., and C.O. Eads, 1967: Calif. Agric. Exp. Stn. Bull. 834:1-72.
Edmunds, G.F., 1973: Environ. Entomolo. 2(5):765-777.
Furniss, R.L., and V.M. Carolin, 1977: U.S. Dept. Agric. Misc. Publ. 1339:1-654.
Keen, F.P., 1952: U.S. Dep. Agric. Misc. Publ. 273:1-280.
Struble, G.R., and P.C. Johnson, 1964: U.S. Dep. Agric. For. Pest Leaflet. 91:1-6.

Alstad, D.N. and K.W. Corbin, 1990: Evol.

Genus *Oceanaspidotus* Takagi, 1984

Number of World species: 3.

Number of U. S. species: 1.

Key to the World species: Takagi, S., 1984: Insecta Matsumurana 28:1-68.

***Oceanaspidotus spinosus* (Comstock), 1883**

spinose scale

Fig. 106

Tribe: Aspidiotini.

Synonymy: *Aspidiotus persearum* Cockerell, *Aspidiotus spinosus* Comstock, *Acanthaspidotus borchsenii* Takagi and Kawai.

Field Characteristics: Similar in appearance to oleander and coconut scale.

Hosts: Prefers palms but otherwise polyphagous.

Economic Importance: None.

Distribution: Collected in several places in

Southern California; listed by McKenzie as common on Coronado Island in San Diego County. Not collected in California in many years. Occasionally collected in quarantine on palms.

McKenzie, H.L., 1956: The Armored Scale Insects of California. Univ. Calif. Press, Berkeley. 209 pp.

Genus *Odonaspis* Leonardi, 1897

Number of World species: 17.

Number of United States species: 9.

Key to the World species: Ben-Dov, Y., 1988: USDA, ARS, Tech. Bull. 1723.

Keys to the United States species: Ferris, G.F., 1937: Atlas of the Scale Insects of North America. Stanford Univ. Press, and Howell, J.O., and H.H. Tippins, 1978: Ann. Ent. Soc. Amer. 71(5): 762-766.

The scale covers of species in this genus are referred to in field keys as the bivalve type, constructed of both a tough dorsal and ventral scale cover. The female body is completely enclosed within the cover, except at the anterior end near the mouth parts. The mouth part is the only contact of the body with the host surface, and is often the only contact of the scale

cover with the host surface. In heavy infestations the posterior parts of the scale may be directed away from the host surface by as much as a 45° angle. The light color and somewhat elongate shape of the scale covers, along with their characteristic protrusion causes these scales to resemble the dead, whitened leaf sheaths of the hosts.

KEY TO CALIFORNIA SPECIES OF *ODONASPIS*

1. Perivulvar pores lacking. *graminis*
 — Perivulvar pores present; associated with *Cynodon dactylon* (Bermuda grass), and occasionally with certain succulents in California. *ruthae*

Odonaspis graminis Bremner, 1907

grass root scale

Fig. 107

Tribe: Odonaspidini.

Synonymy: *Rugaspidis* (= *Rugaspidiotus*) *graminis* (Bremner), *Dycryptaspis graminis* (Bremner).

Field Characteristics: Adult female scale cover 1.5 to 2.0 mm long, oval, brownish, yellowish exuviae terminal. Males unknown. Occurs beneath leaf sheaths and on the crowns and roots.

Similar Species: Other species in the genus *Odonaspis*.

Biology: Unknown.

Hosts: Perennial grasses and sedges (*Juncus*).

Economic Importance: None.

Distribution: A rare, probably native species

known from coastal California from Santa Clara to Mendocino Counties. One collection, on *Juncus*, is known from Michigan Bar, Sacramento County.

Diagnosis: Lack of pygidial scleroses and perivulvar pores distinguishes this species from other California *Odonaspis*.

Ferris, G F., 1938: Atlas of the Scale Insects of North America, Ser. I-IV. Stanford Univ. Press, Stanford.

McKenzie, H.L., 1956: The Armored Scale Insects of California. Univ. Calif. Press, Berkeley. 209 pp.

Odonaspis ruthae Kotinsky, 1915

Bermuda grass scale

Fig. 108, Color Plates 110, 111

Tribe: Odonaspidini.

Other Common Names: Hard grass scale, Ruth's scale, couch scale.

Synonymy: *Aonidia ruthae* (Kotinsky), *Dycryptaspis ruthae* (Kotinsky).

Field Characteristics: Adult female scale covers 1.5 to 2.0 mm long, ovoid, flat, white, with yellow or tan terminal exuviae. The white color and somewhat elongate shape, along with the characteristic protrusion of the scale cover, causes this scale to resemble the dead whitened leaf sheaths of the host (see comments under Genus *Odonaspis*). Parthenogenetic in California as far as is known. The

illustration of the male scale cover by Ferris (1938), later used by McKenzie (1956), indicates that there may be a biparental race.

Similar Species: *Odonaspis graminis* is similar but darker. *O. litorosa* Ferris identical in the field but is known only from lower Baja California, and Texas. *O. minima* Howell and Tippins from Georgia is also similar.

Biology: Usually found between leaf sheaths or bud scales and stems, usually around the lower nodes close to the ground. Little known except that there are multiple generations per year. For more information see Blair (1967).

Hosts: Most commonly collected on Bermuda

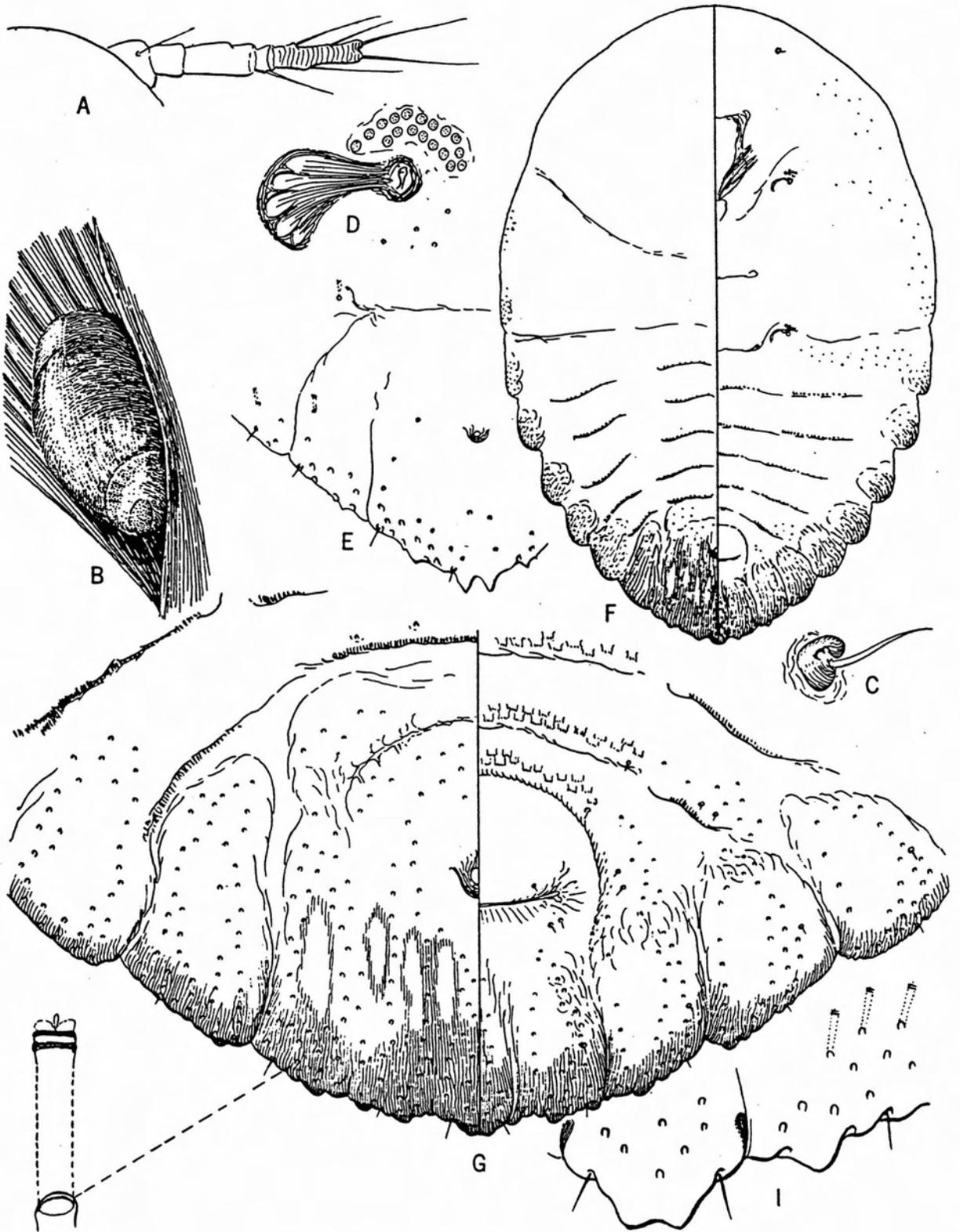


Fig. 107. *Odonaspis graminis* Bremner.

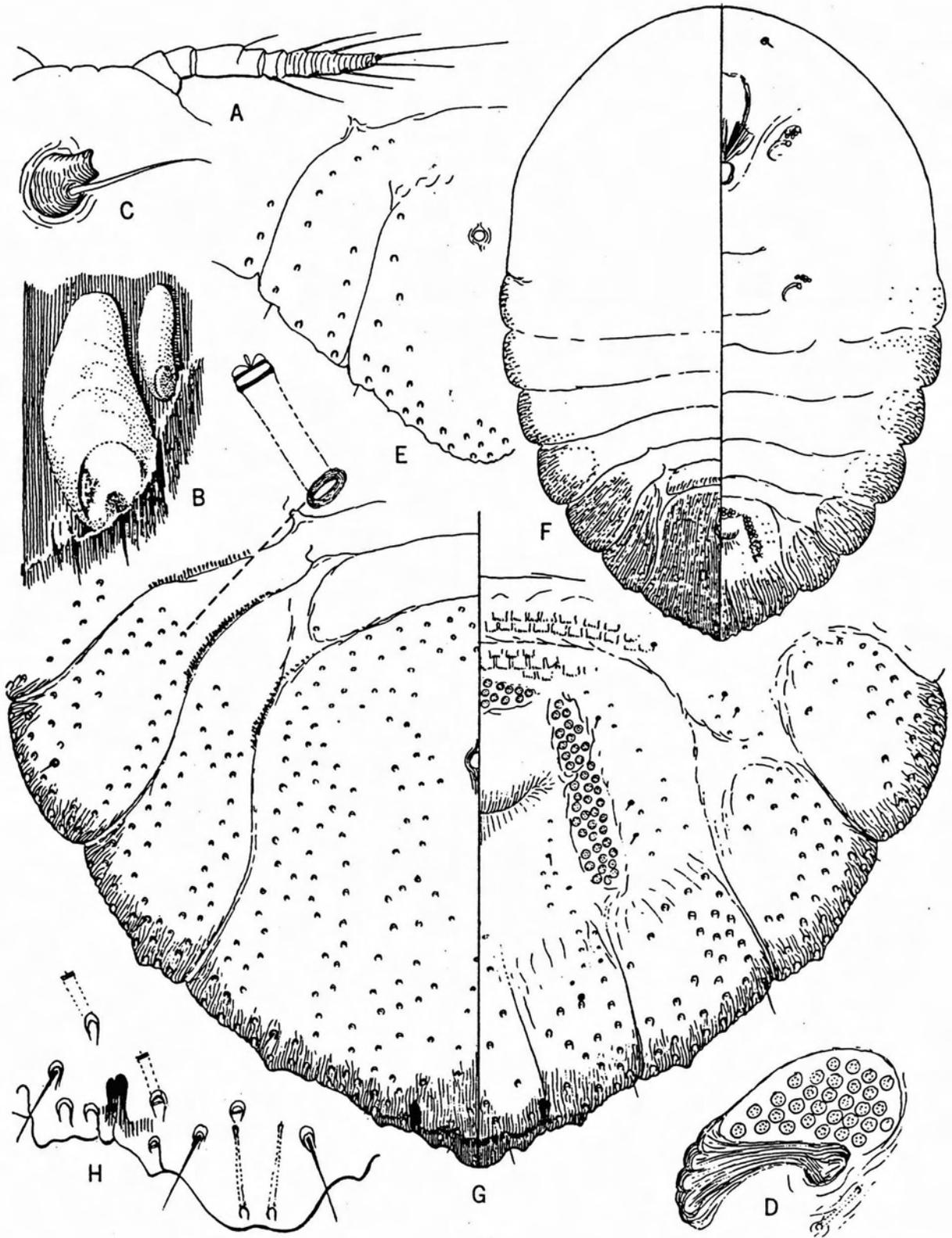


Fig. 108. *Odonaspis ruthae* Kotinsky.

grass, also found on many species of perennial grasses. For a host list see McKenzie (1956) and Dekle (1976).

Economic Importance: Causes browning and dieback of Bermuda grass, particularly in the southern United States. So easily overlooked that it doubtlessly causes more injury than is thought. For economic information see Vance (1956), Dale and McCoy (1964), Blair (1967), Tippins and Beshear (1968), and Tippins and Martin (1982).

Distribution: Very common in Southern California, particularly in San Diego, Imperial and Riverside Counties. Present in the San Joaquin Valley as far north as Sacramento; has been collected in the San Francisco Bay region. Widespread from California to Florida along the southern border of the United States. Also occurs in Europe and Africa.

Diagnosis: Host preferences and the presence of perivulvar pore groups separate *ruthae* from the other California species of *Odonaspis*.

Blair, B.W., 1967: Rhod. Agric. J. Bull. 2446:1-4.
Dale, J.L. and C.E. McCoy, 1964: Plant Dis. Rep. 48(3):228.

Dekle, G.W., 1976: Florida Armored Scale Insects. Fla. Dep. Agric. Cons. Serv., Div. Plant Ind., Gainesville. 345 pp.

Ferris, G.F., 1938: Atlas of the Scale Insects of North America, Ser. I-IV. Stanford Univ. Press, Stanford.

McKenzie, H.L., 1956: The Armored scale Insects of California. Univ. Calif. Press, Berkeley. 209 pp.

Shedley, D.G., 1963: West Aust. Dept. Agric. Bull. 3147:1-15; also in J. Agric. West. Aust. 4(8-9). 4th Ser.

Tippins, H.H., and R.J. Beshear, 1968: J. Ga. Entomol. Soc. 3(3):134-136.

Tippins, H.H., and P.B. Martin, 1982: J. Ga. Entomol. Soc. 17(3):319-321.

Vance, A.J., 1956: U.S. Dept. Agric. Home Garden Bull. 53: 1-24.

Genus *Pallulaspis* Ferris, 1937

Number of World species: 4.

Number of United States species: 1.

Key to the World species. None.

Pallulaspis ephedrae Ferris, 1937 ephedra scale

Fig. 109, Color Plates 112, 113

Tribe: Diaspidini.

Field Characteristics: Adult female scale covers 2.2 to 2.5 mm long, elongate with yellow terminal exuviae. Somewhat pupillarial, the second exuvium not readily apparent, covered with light-colored wax and appearing as a light brown patch in the center of the scale cover. Male scale covers similar but smaller. Occurs on the stems, particularly near nodes; closely resembles bits of loose epidermal tissue usually seen on the host.

Similar Species: None.

Biology: Unknown.

Hosts: Restricted to Mormon tea (*Ephedra*).

Economic Importance: None.

Distribution: Rare, native. Known only from Darwin Mesa, Inyo County and Quatal Canyon, Ventura County.

Diagnosis: Host restriction and field appearance are characteristic.

Ferris, G.F., 1937: Atlas of the Scale Insects of North America, Ser. I-IV. Stanford University Press, Stanford.

McKenzie, H.L., 1956: The Armored Scale Insects of California. Univ. Calif. Press, Berkeley. 209 pp.

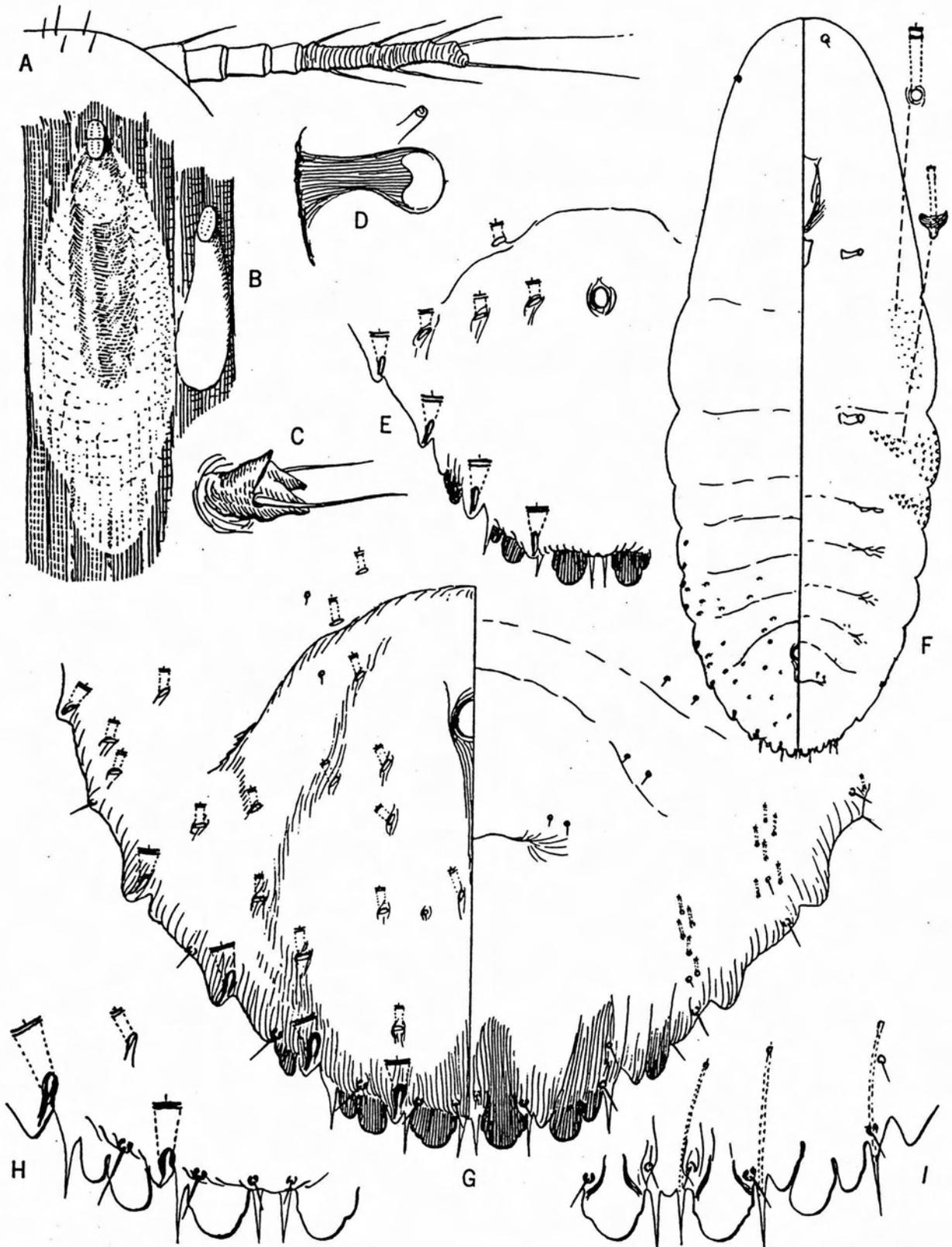


Fig. 109. *Pallulaspis ephedrae* Ferris.

Genus *Paracupidaspis* Howell and Tippins, 1981

Monotypic.

***Paracupidaspis wilkeyi* Howell and Tippins, 1981
milky conifer scale**

Fig. 110, Color Plates 114, 115

Tribe: Diaspidini.

Field Characteristics: Adult female scale covers 1 mm or less in length, elongate or often sigmoid, transparent white, with brown terminal exuviae. Because the second exuvium is large, the cover appears brown. Male scale cover snow white with a terminal yellow exuvium, elongate-oval. Male scales prevalent, usually seen more often than females. Found on leaves. Adult females usually found along seams in leaves or partially hidden under appressed needles. Male scales found in groups on all leaf surfaces.

Similar Species: *Cupidaspis cupressi* and *C. beshearae* are very similar and occur on the same hosts as this species. *C. beshearae* is much larger and snow white. However, *C. cupressi* cannot be distinguished in the field. The males of *Carulaspis*, juniper scale and minute cypress scale, resemble males of this species, and since the males of *Paracupidaspis*, *Cupidaspis* and *Carulaspis* are all similar in appearance and usually more easily seen than

the females, field identification may be difficult. However, female *Carulaspis* scales are distinctly circular with central exuviae, compared with the elongate scale covers of this species.

Biology: Little known, but crawlers have been observed in July and August.

Hosts: Incense cedar in California and Oregon; known from juniper in other states.

Economic Importance: None, rare. Probably a native species.

Distribution: In California, Butte, Colusa, El Dorado, Lassen, Placer, and Tuolumne Counties. Also occurs in Arizona, Kansas, New Mexico, and Oregon.

Diagnosis: Separated from the *Cupidaspis* species by lack of definite rows of dorsal macroducts, absence of macroducts on abdominal segment 4, and bilobular second lobes.

Howell, J.O., and H.H. Tippins, 1981: Ann. Entomol. Soc. Am. 74(4):419-421.

Genus *Parlatoreopsis* Lindinger, 1912

Number of World species: 3.

Number of United States species: 3 (all introduced).

Key to the World species: None.

***Parlatoreopsis chinensis* (Marlatt) 1908
Chinese obscure scale (ESA approved)**

Fig. 111

Tribe: Diaspidini.

Synonymy: *Parlatoria chinensis* Marlatt.

Field Characteristics: Adult female scale covers about 1 mm in diameter, circular, flat, grey, with darker marginal exuviae. Male scale

covers dark grey, elongate, with terminal exuviae. Occurs on the bark of twigs and branches.

Similar Species: Resembles San José scale in the field but has marginal or terminal exuviae.

Biology: Unknown.

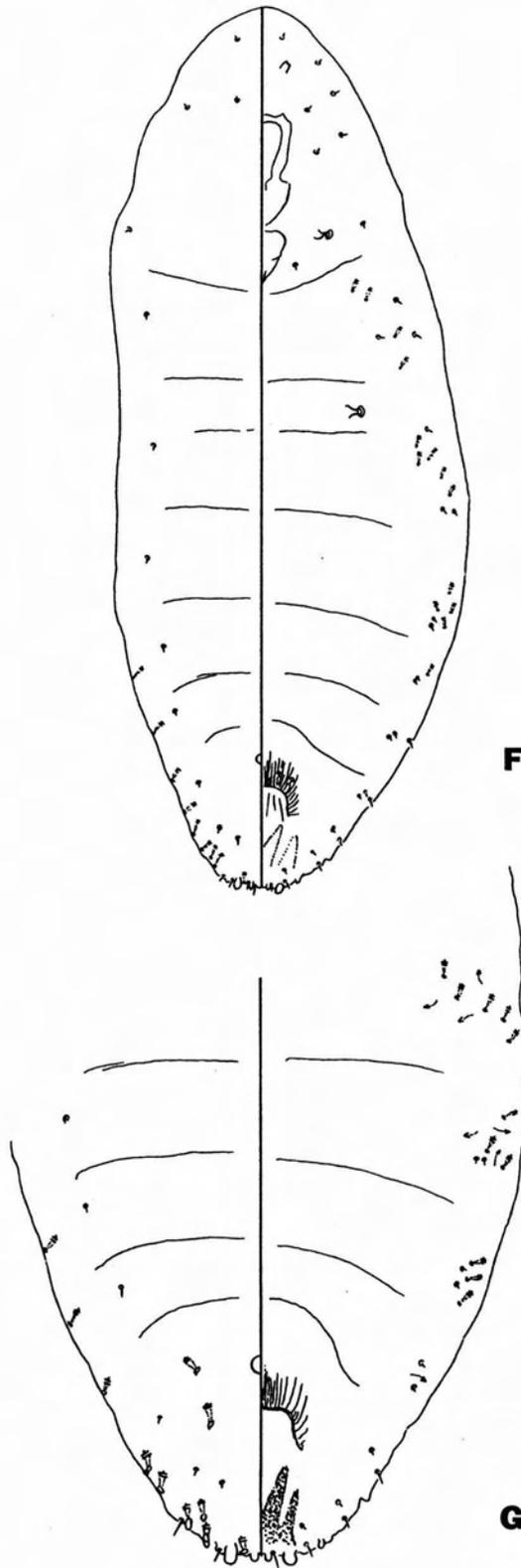


Fig. 110. *Paracupidaspis wilkeyi* Howell and Tippins.

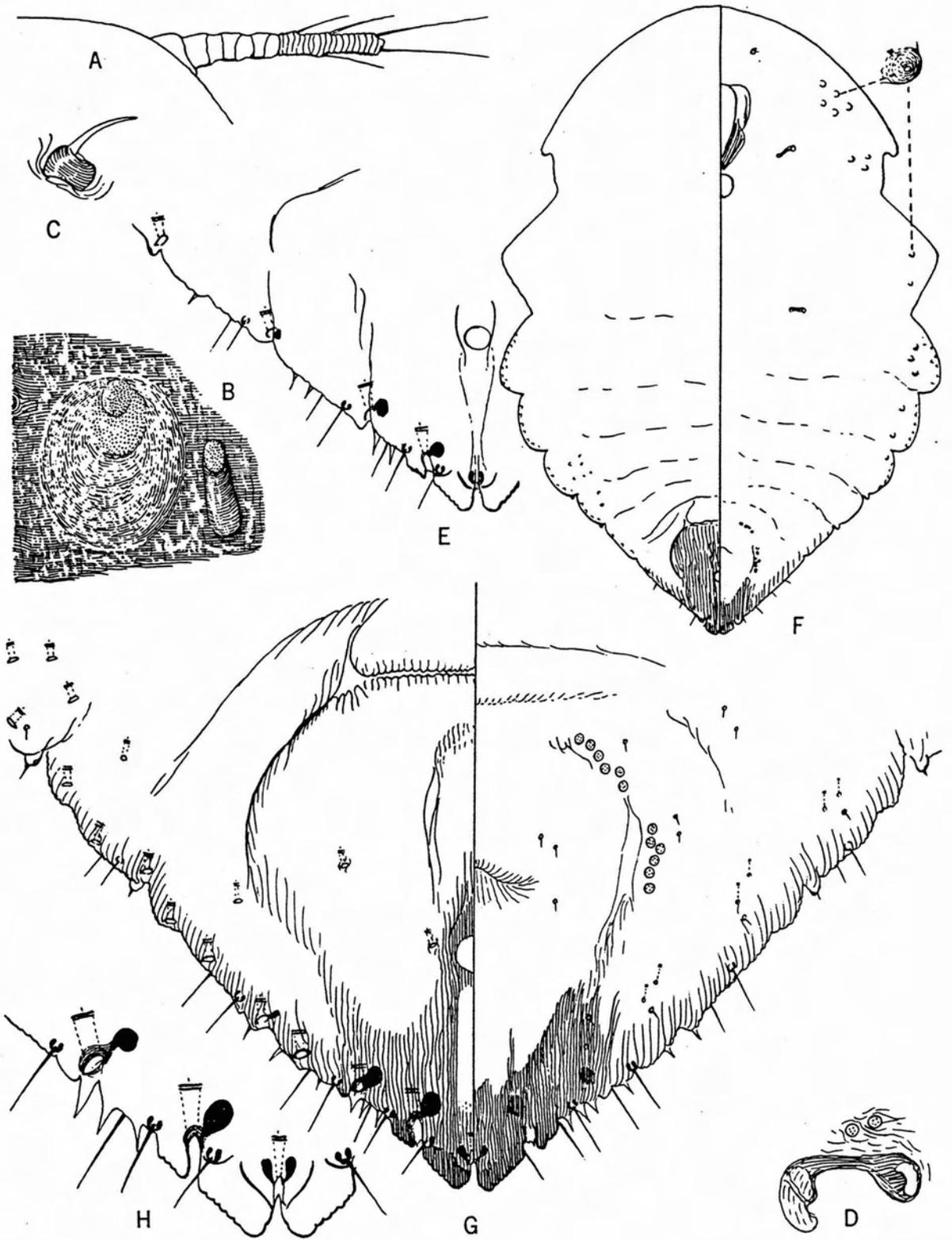


Fig. 111. *Parlatoreopsis chinensis* (Marlatt).

Hosts: Very polyphagous. Most commonly encountered on the Rosaceae.

Economic Importance: None.

Distribution: First collected in California in 1948 on the grounds of the Huntington Library at San Marino, Los Angeles County. Shortly thereafter collected on the California Institute of Technology campus in Pasadena and at several intervening locations. Not collected in later years until D. R. Miller and J. A. Davidson recollected it on street trees just

north of the Huntington Gardens in 1979. Apparently restricted to this small area. Occurs also in Missouri and Florida. Probably native to the Manchurian Region.

Diagnosis: Recognized by the lateral cephalothoracic indentations and the clavate pygidial scleroses.

McKenzie, H.L., 1956: The Armored Scale Insects of California. Univ. Calif. Press, Berkeley. 209 pp.

Genus *Parlatoria* Targioni-Tozzetti, 1868

Number of World species: About 60.

Number of United States species: 9 (including Hawaii).

Key to the World species: McKenzie, H.L., 1952a: Calif. Dep. Agric. Bull. 41(1):9-18, and Nakahara, S. (unpublished).

Key to the United States species: McKenzie, H.L., 1956: The Armored Scale Insects of California, Univ. Calif. Press, Berkeley. 209 pp.

KEY TO CALIFORNIA SPECIES OF *PARLATORIA*

1. With at least a few sclerotized duct tubercles present on anterior prosoma cephalad of abdominal segments. 2
- Without sclerotized duct tubercles on anterior prosoma. *blanchardii*

2. Pygidium normally with four plates between third lobes (sixth abdominal segment) and position of fourth lobes (fifth abdominal segment). *oleae*
- Pygidium with three plates between third and fourth lobes. 3

3. With small, but distinct, invaginated membranous derm pocket between posterior spiracle and body margin. 4
- Without invaginated membranous derm pocket between posterior spiracle and body margin. 7

4. Eyespot modified to form stout spur projecting from prosoma about opposite mouth parts 5
- Eyespot various, flat, irregular, sometimes almost hemispherical and often so obscure as to appear lacking. 6

5. Fourth pygidial lobe slender, definitely sclerotized, and almost spurlike. . . . *crotonis*
- Fourth pygidial lobe membranous and closely simulating adjacent plates in structure and appearance, although usually much smaller. *proteus*

6. Submarginal dorsal pygidial macroducts ranging in number from twenty to twenty-nine

- on each side of body; pygidial lobes almost equal in size; perivulvar pores few in number, total range nineteen to thirty-three, average about twenty-six. *camelliae*
- Submarginal dorsal pygidial macroducts ranging in number from twenty-six to ninety-five (average about fifty-one) on each side of body; pygidial lobes obviously graded, third pair definitely smaller than median pair; perivulvar pores numerous, total range twenty-five to eighty-four with an average of fifty-eight. *theae*
7. With dorsal intermediate macroducts present above anterior group of perivulvar pores and on abdominal segment anterior to these. *pittospori*
- Without dorsal intermediate macroducts above anterior group of perivulvar pores and on abdominal segment anterior to these. *pergandii*

***Parlatoria blanchardii* (Targioni-Tozzetti), 186**
parlatoria date scale (ESA approved)

Fig. 112

Tribe: Diaspidini.

Other Common Names: Date palm scale.

Synonymy: *Coccus blanchardii* Targioni-Tozzetti, *Aonidia blanchardii* (Targioni-Tozzetti), *Apteronidia blanchardi* (Targioni-Tozzetti), *Parlatoria victrix* Cockerell, *Parlatoria proteus* var. *palmae* Maskell, *Websteriella blanchardi* (Targioni-Tozzetti).

A pest of commercial dates and other palms. Introduced into California about 1905 at El Centro; later found in the Coachella Valley. There was an extensive and successful eradication program between 1928 and 1936. For information regarding the history of this species in California see Boyden (1941), Rosen and DeBach (1978), and for information about the biology see Stickney (1934) and Stickney et al., (1950). For information on economics and biology see Swaminathan and Verma (1991).

Boyden, B.L., 1941: U.S. Dep. Agric. Misc. Publ. 433:1-162.

McKenzie, H.L., 1956: The Armored Scale Insects of California. Univ. Calif. Press, Berkeley. 209 pp.

Rosen, D., and P. DeBach in C.P. Clausen, ed., 1978: U.S. Dep. Agric., Agric. Handb. 480:1-545.

Stickney, F.S., 1934: U.S. Dep. Agric. Tech. Bull. 421:1-67:

Stickney, F.S., D.F. Barnes and P. Simmons, 1950: U.S. Dep. Agric. Circ. 846:1-57.

Swaminathan, R. and S.K. Verma, 1991: Entomon 16(3):217-221.

***Parlatoria camelliae* Comstock, 1883**

camellia parlatoria scale

Fig. 113, Color Plate 116

Tribe: Diaspidini.

Synonymy: *Parlatoria pergandii* var. *camelliae* Comstock.

Field Characteristics: Adult females scale cover 1 to 2 mm long, oval, flat, tan or greyish-tan with yellow or golden marginal exuviae, the second of which usually has the broad median longitudinal greenish stripe typical of many

Parlatoria species. Male scale cover elongate, whitish or greyish with a yellow terminal exuvium with a median green stripe. Found almost exclusively on the leaves of the host.

Similar Species: Similar to latania and greedy scales which are the most common armored scales in California. However, these two species are more convex and on camellia are

usually found on twigs rather than leaves.

Biology: Unknown.

Hosts: California records are almost all on camellia. It is polyphagous, however. For a host list see Borchsenius (1966), Dekle (1976) and McKenzie (1956).

Economic Importance: Formerly considered a serious pest of camellia in California by McKenzie (1945); Westcott (1973) considered it the most common scale insect on camellia on the Pacific Coast. Not presently very common in California. Usually occurs in heavy, unsightly populations on the leaves.

Distribution: Found in most urban areas of California but most recent collections have been made in the San Francisco Bay area and the Sacramento Valley.

Diagnosis: Very similar morphologically to

P. theae. (see the keys by McKenzie, 1945 and 1956).

Borchsenius, N.S., 1966: A Catalogue of the Armored Scales of the World. Zool. Inst. U.S.S.R. Acad. Sci., Moscow and Leningrad. 449 pp.

Dekle, G.W., 1976: Florida Armored Scale Insects. Fla. Dep. Agric. Cons. Serv., Div. Plant Ind., Gainesville. 345 pp.

McKenzie, H.L., 1945: Microentomol. 10(2): 47-121.

McKenzie, H.L., 1956: The Armored Scale Insects of California. Univ. Calif. Press, Berkeley. 209 pp.

Westcott, C., 1973: The Gardener's Bug Book. Doubleday and Co., Inc., Garden City, New York. 625 pp.

Parlatoria crotonis Douglas, 1881

croton parlatoria scale.

Fig. 114

Tribe: Diaspidini.

Synonymy: *Parlatoria proteus* var. *crotonis* Douglas, *Parlatoria pergandii* var. *crotonis* Cockerell, *Parlatoria greeni* Banks.

Collected once in Los Angeles County in 1935. It has not been collected since that time.

McKenzie, H.L., 1956: The Armored Scale Insects of California. Univ. Calif. Press, Berkeley. 209 pp.

Parlatoria oleae (Colvée) 1880

olive scale (ESA approved)

Fig. 115, Color Plates 117-119

Tribe: Diaspidini.

Other Common Names: olive parlatoria scale.

Synonymy: *Diaspis oleae* Colvee, *Parlatoria calianthina* Berlese and Leonardi, *Parlatoria affinis* Newstead, *Syngenaspis oleae* (Colvee).

Field Characteristics: Adult female scale covers 1.0 to 2.0 mm in diameter, circular to elliptical, white to very light grey. Body deep purple. Exuviae terminal; appear dark brown (often dark green or marked with yellow). Male cover white, oblong, with a yellow terminal exuvium often marked with dark green.

Similar Species: San José scale is very similar

and occurs on many of the same hosts except olive. Other species of *Parlatoria* are also similar. Oleander scale is similar and is common on olive, but is tan with a central exuvium and yellow body.

Biology: Two generations per year in California; up to four generations per year in the Mediterranean region. Adult females overwinter. For more information see Nichol and Wehrle (1935), Ezzat (1957), and Huffaker et al., (1962).

Hosts: Prefers olive, *Olea europaea*, and most of the deciduous fruit and nut trees grown in

California. Like San José scale it is often common on rose. Known from at least 200 other species of plants. Does not occur on citrus. For a host list see McKenzie (1952).

Economic Importance: Formerly a very serious pest of olives and deciduous fruit crops in California, but now controlled by the two complementary Aphelinid parasites, *Aphytis maculicornis* (Masi) and *Coccophagoides utilis* Doutt. Injury consists of discolored and distorted fruit, reduced oil content in olives, and weakened or killed branches. Does not have the devastating effect on trees that San José scale does. For more information see McKenzie (1952) and Huffaker et al., (1962). Parasite information is available from Huffaker, et al., (1962), Kennett et al., (1966), Huffaker and Kennett (1966), Boardman (1977), Shoemaker et al., (1978), and Rosen and DeBach (1978). A "B"-rated pest in California.

Distribution: Generally distributed over most of California. First found in Fresno in 1934, although it had been in the area at least 4 or 5 years earlier. Most common in the San Joaquin and Sacramento Valleys, but has also been introduced into most of Southern California, the Owens Valley, and several coastal counties. For a chronological history of olive scale in California and the United States see McKenzie (1952b) and Allen (1963). Probably native to the area between the eastern Medi-

terranean and India.

Diagnosis: McKenzie (1945 and 1952a) provides a key to the world species of *Parlatoria*. *P. oleae* has four plates between the third and fourth lobes. Only two other species, *P. boycei* McKenzie and *P. multipora* McKenzie, have this character, but they have never been found in California.

Allen, R.P., 1963: Calif. Dept. Agric. Bull. 52(3):174-181.

Boardman, R.M., 1977: Calif. Agric. 31(10):8-11.

Ezzat, Y.M., 1957: Bull. Entomol. Soc. Egypte 41:351-363.

Huffaker, C.B., C.E. Kennett and G.L. Finney, 1962: Hilgardia 32(13):541-636.

Huffaker, C.B., and C.E. Kennett, 1966: Hilgardia 37(9):283-335.

Kennett, C.E., C.B. Huffaker and G.L. Finney, 1966: Hilgardia 37(9):255-282.

McKenzie, H.L., 1945: Microentomol. 10(2):47-121.

McKenzie, H.L., 1952a: Calif. Dep. Agric. Bull. 41(1):9-18.

McKenzie, H.L., 1952b: Calif. Dep. Agric. Bull. 41(3):127-138.

Nichol, A.A., and L.P. Wehrle, 1935: Ariz. Agric. Stn. Tech. Bull. 56:201-235.

Shoemaker, C.A., C.B. Huffaker and C.E. Kennett, 1978: Calif. Agric. 32(2):16-17.

Rosen, D., and P. DeBach in C.P. Clausen, ed., 1978: U.S. Dep. Agric. Agric. Handb. 480:1-545.

Parlatoria pergandii Comstock, 1881

chaff scale (ESA approved)

Fig. 116, Color Plates 120, 121

Tribe: Diaspidini.

Other Common Names: Pergande's scale.

Synonymy: *Parlatoria sinensis* Maskell, *Syngenaspis pergandii* (Comstock), *Parlatoria pergandei* Comstock.

Field Characteristics: Adult female scale covers 1 to 2 mm long, oval, slightly convex, light tan or grey-brown, with slightly darker yellow-brown marginal exuviae. Body purple. Male scale covers elongate, tan to light brown,

with a yellow-brown terminal exuvium which has the median greenish strip typical of the *Parlatoria* group. Found on bark, twigs, leaves, and fruit.

Similar Species: Should not be confused with any other California scale insect on citrus. On other hosts it is very similar to other *Parlatoria* species. It should be sent to the laboratory for positive identification in any case.

Hosts: Most frequently seen on citrus, but has

a wide host range, particularly in tropical climates. For more information see McKenzie (1956) and Dekle (1976).

Biology: Up to four generations per year. For more information see Bodenheimer (1951), Ebeling (1959), and Gerson (1967 and 1977).

Economic Importance: A minor pest of citrus in various parts of the world, although serious outbreaks may occur occasionally. For more information see Dean (1955), Ebeling (1959), Gerson (1967, 1977), and Rosen and DeBach (1978). For information on natural enemies see Dean (1955), DeBach (1969), and Rosen and DeBach (1978). A "B"-rated pest in California.

Distribution: Has a very limited distribution in California, but has been collected in the State from a number of locations as early as 1889. Probably the only current infestations are in San Diego and in the Escondido-Vista areas of San Diego County. Infestations have been known from Monrovia and Pomona, Los Angeles County; Santa Paula, Ventura County; and Nicolaus, Sutter County; but these have apparently been eradicated. Readily found in quarantine and in retail grocery stores on citrus fruit from Texas, Florida, and other citrus growing areas. Practically cosmopolitan.

Diagnosis: McKenzie's keys (1956) are ad-

equated for material collected in California, however, it would be wise to consult the key to the world species in McKenzie (1945). *Parlatoria citri* McKenzie and *Parlatoria cinerea* Hadden are similar species which are found particularly on citrus in other parts of the world.

Bodenheimer, F.S., 1951: Citrus Entomology in the Middle East. Dr. W. Junk, The Hague. 663 pp.

Dean, H.A., 1955: J. Econ. Entomol. 48(4):444-447.

DeBach, P., 1969: Proc. First Int. Citrus Symp. 2:801-815.

Dekle, G.W., 1976: Florida Armored Scale Insects. Fla. Dep. Agric. Cons. Serv., Div. Plant Ind., Gainesville. 345 pp.

Ebeling, W., 1959: Subtropical Fruit Pests. Univ. Calif. Div. Agric. Sci. Bull., Los Angeles 436 pp.

Gerson, U., 1967: J. Econ. Entomol. 60(4):1145-1151.

Gerson, U., 1977: Bol. Serv. Plagas. Madrid 3(1-2):1-53.

McKenzie, H.L., 1945: Microentomol. 10(2):47-121.

McKenzie, H.L., 1956: The Armored Scale Insects of California. Univ. Calif. Press, Berkeley. 209 pp.

Rosen, D., and P. DeBach in C.P. Clausen, ed., 1978: U.S. Dep. Agric. Agric. Handb. 480:1-545.

Parlatoria pittospori Maskell, 1890

pittosporum scale

Fig. 117, Color Plate 122

Tribe: Diaspidini.

Other Common Names: mauve pittosporum scale.

Synonymy: *Parlatoria myrtus* Maskell, *Parlatoria dryandrae* Fuller, *Parlatoria petrophilae* Fuller.

Field Characteristics: Adult female covers 1.5 to 2.5 mm, oval, slightly convex, tan or greyish-brown, with yellow or golden terminal exuviae which have a green median longitudinal patch. Male scales light grey, elongate, with a yellow terminal exuvium which usu-

ally has a green median stripe. Found on leaves and small stems.

Similar Species: A number of *Parlatoria* species on ornamental hosts are similar, including several "A" and "Q" rated pests. They cannot be identified in the field.

Biology: Has only one generation per year. For more information see Timlin (1964).

Hosts: Has a very wide host range, including conifers. In California, favors Australian tea tree, *Pittosporum*, *Leptospermum* and *Hakea*.

Economic Importance: A minor pest of orna-

mentals. Has been a minor pest of apple fruit in New Zealand wherever pines are used as windbreaks. The pines act as a reservoir for the populations. For more information see Timlin (1964). A "B" rated pest in California.

Distribution: Occurs primarily in San Diego County. Occasionally found in nurseries in other counties, but it is eradicated whenever it is found. Also occurs in Australia, New Zealand and Southern Africa.

Diagnosis: The keys in McKenzie (1945, 1956) should be consulted when identifying this species.

McKenzie, H.L., 1945: *Microentomol.* 10(2):47-121.

McKenzie, H.L., 1956: *The Armored Scale Insects of California*. Univ. Calif. Press, Berkeley. 209 pp.

Timlin, J.S., 1964b: *N.Z. J. Agric. Res.* 7(4):536-550.

Parlatoria proteus (Curtis), 1843

sansevieria scale

Fig. 118

Tribe: Diaspidini.

Other Common Names: proteus scale, common parlatoria scale, orchid parlatoria scale, small brown scale.

Synonymy: *Aspidiotus proteus* Curtis, *Diaspis parlatoris* Targioni-Tozzetti, *Parlatoria orbicularis* Targioni-Tozzetti, *Aspidiotus targionii* Del Guercio, *Syngenaspis proteus* (Curtis).

Field Characteristics: Adult female scale cover 1.5 to 2.0 mm long, oval, flat, tan to light yellowish-brown, semitransparent, with yellow-brown terminal exuviae. Male scale cover white to tan, with yellowish terminal exuvium. Found on bark, twigs, leaves and fruit.

Hosts: Prefers palms and orchids. Otherwise polyphagous.

Economic Importance: A pest of orchids in Florida (Dekle, 1976). An "A"-rated pest in California.

Distribution: Encountered frequently on nursery stock in California. Has been eradicated whenever found.

Diagnosis: The only commonly encountered *Parlatoria* with an invaginated derm pocket and a sclerotized eye spine.

Dekle, G.W., 1976: *Florida Armored Scale Insects*. Fla. Dep. Agric. Cons. Serv., Div. Plant Ind., Gainesville. 345 pp.

McKenzie, H.L., 1945: *Microentomol.* 10(2):47-121.

McKenzie, H.L., 1956: *The Armored Scale Insects of California*. Univ. Calif. Press, Berkeley. 209 pp.

Parlatoria theae Cockerell, 1896

tea parlatoria scale

Fig. 119

Tribe: Diaspidini.

Synonymy: *Parlatoria theae* var. *viridis* Cockerell, *Parlatoria theae* var. *euonymi* Cockerell, *Parlatoria dives* Bellio, *Syngenaspis theae* (Cockerell).

Collected in a number of California nurseries prior to 1950. Eradicated.

McKenzie, H.L., 1956: *The Armored Scale Insects of California*. Univ. Calif. Press, Berkeley. 209 pp.

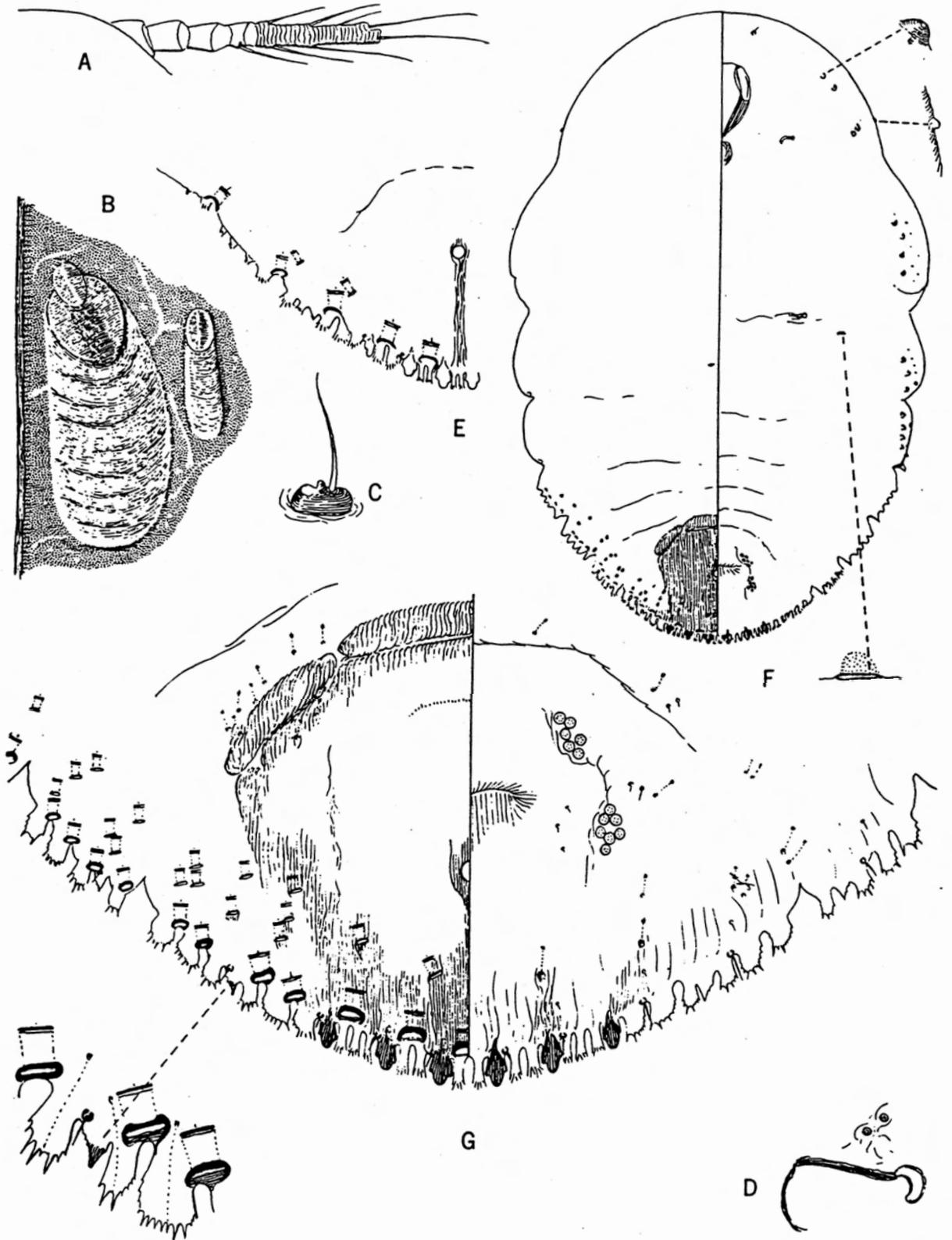


Fig. 113. *Parlatoria camelliae* (Comstock).

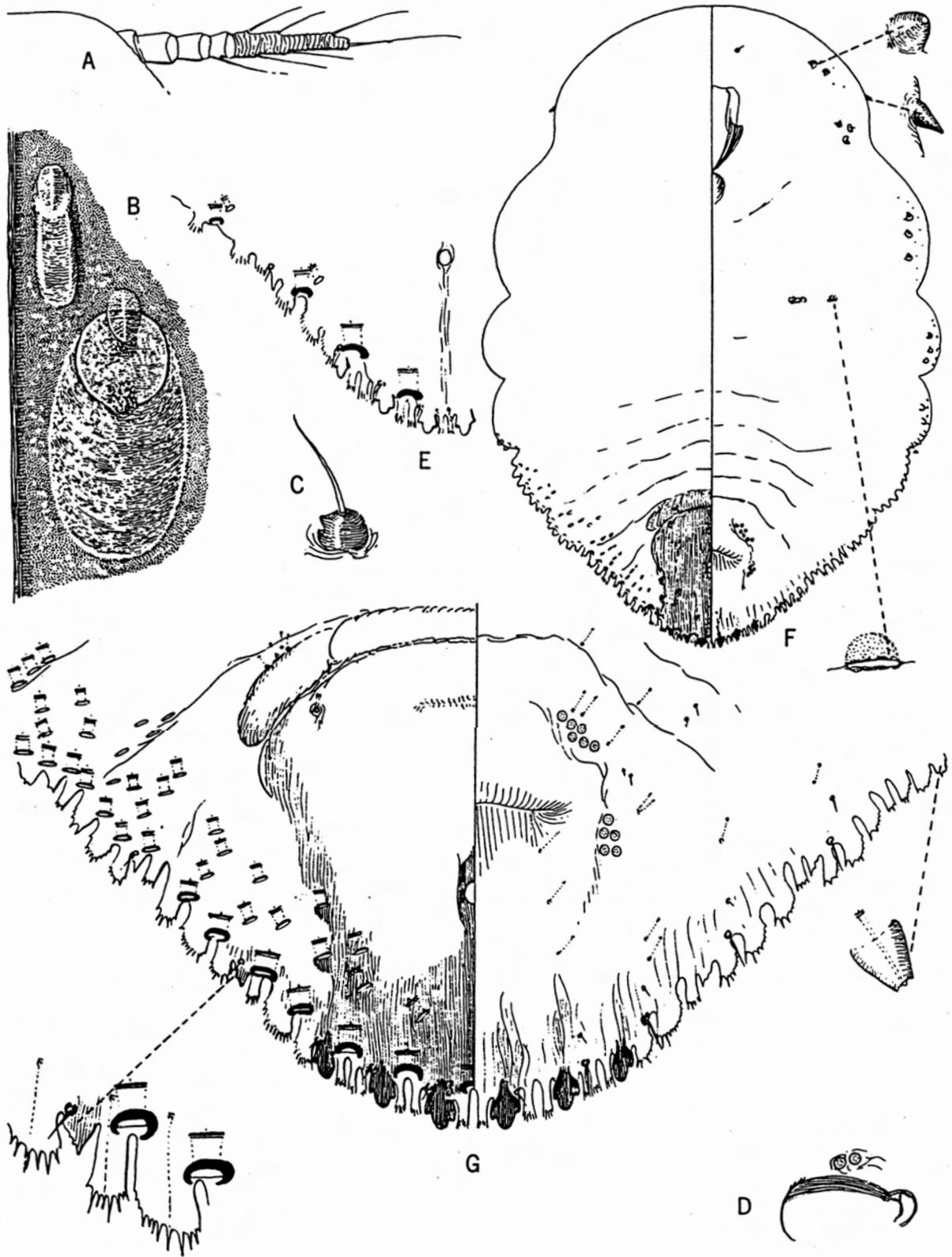


Fig. 114. *Parlatoria crotonis* Douglas.

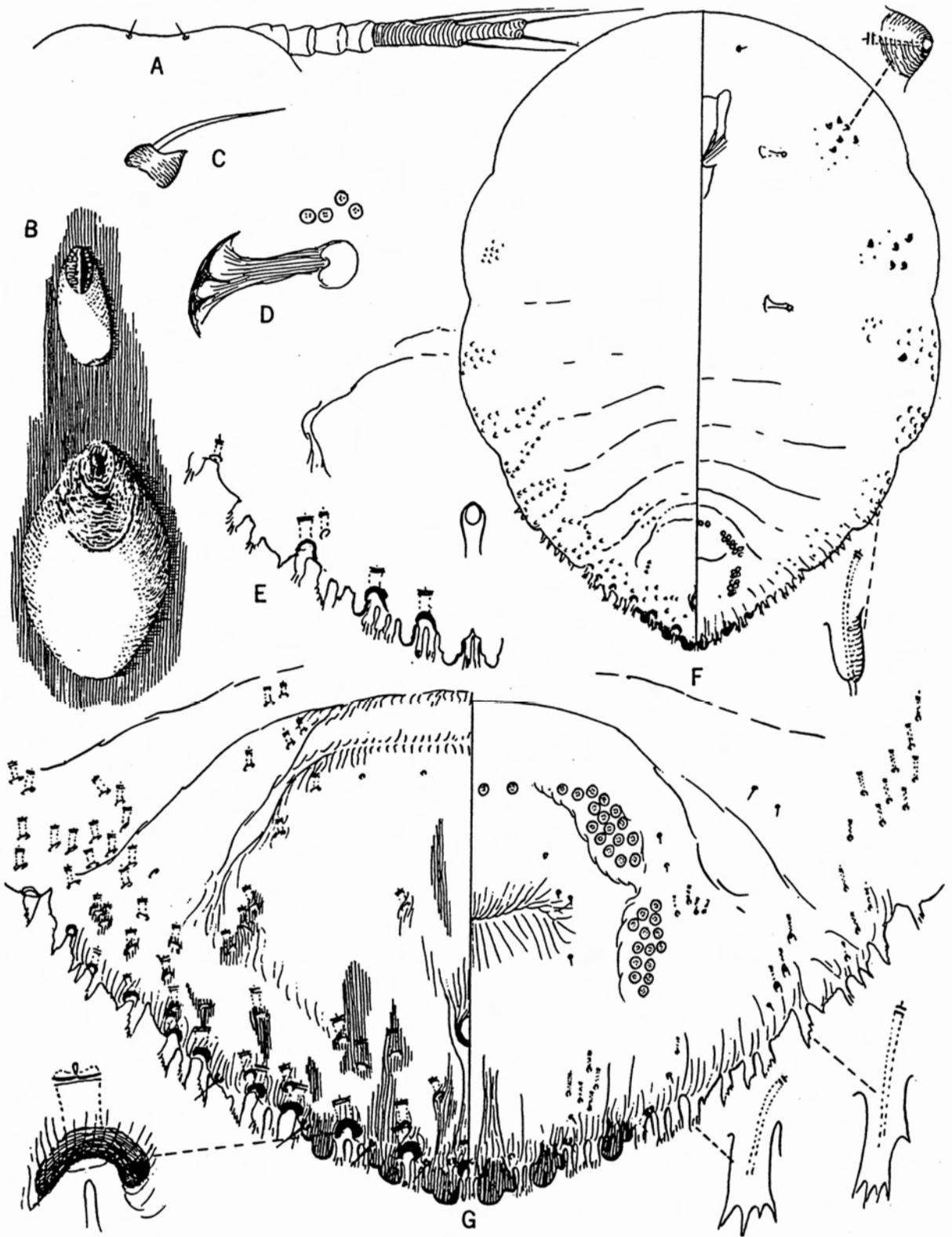


Fig. 115. *Parlatoria oleae* (Colvée).

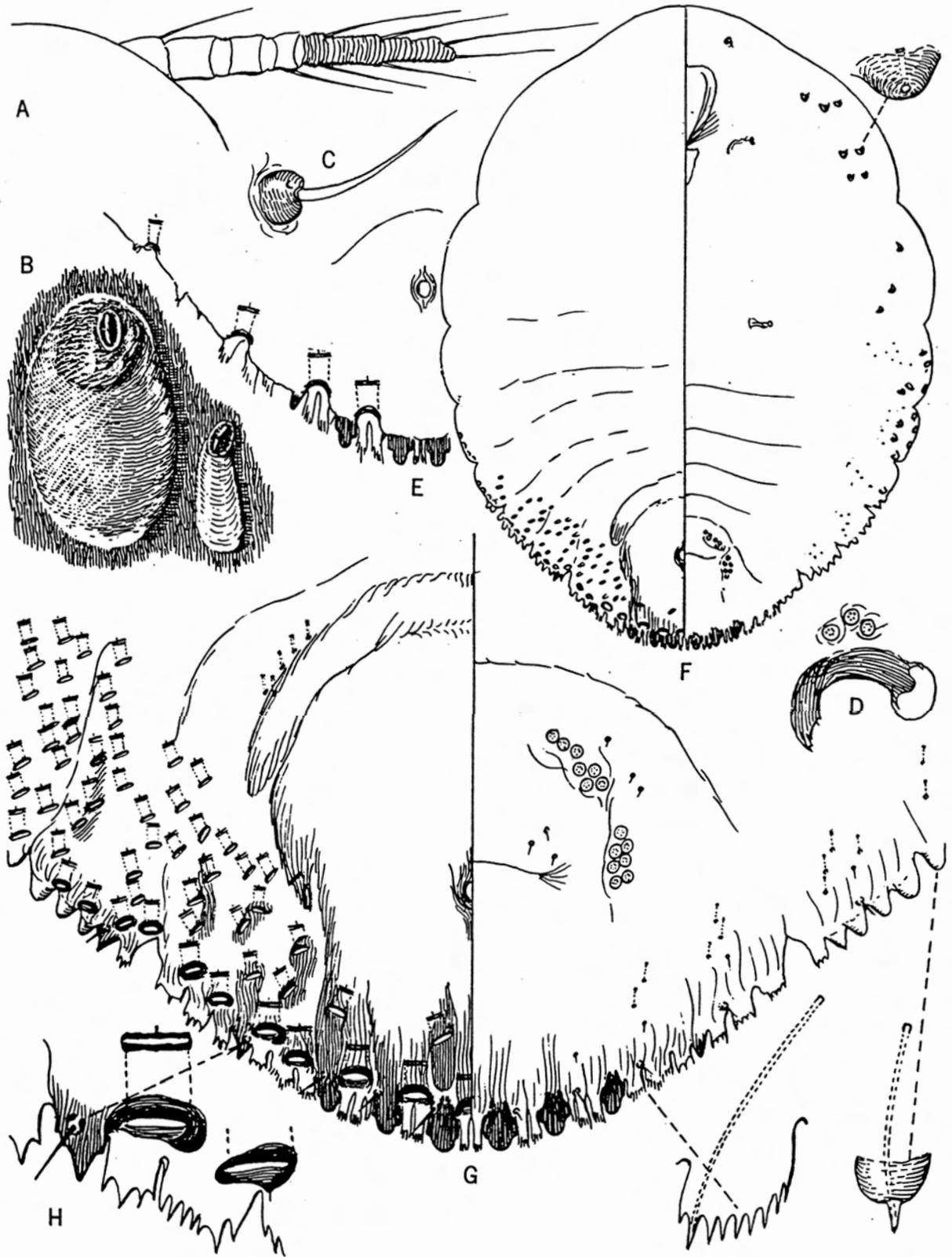


Fig. 116. *Parlatoria pergandii* Comstock.

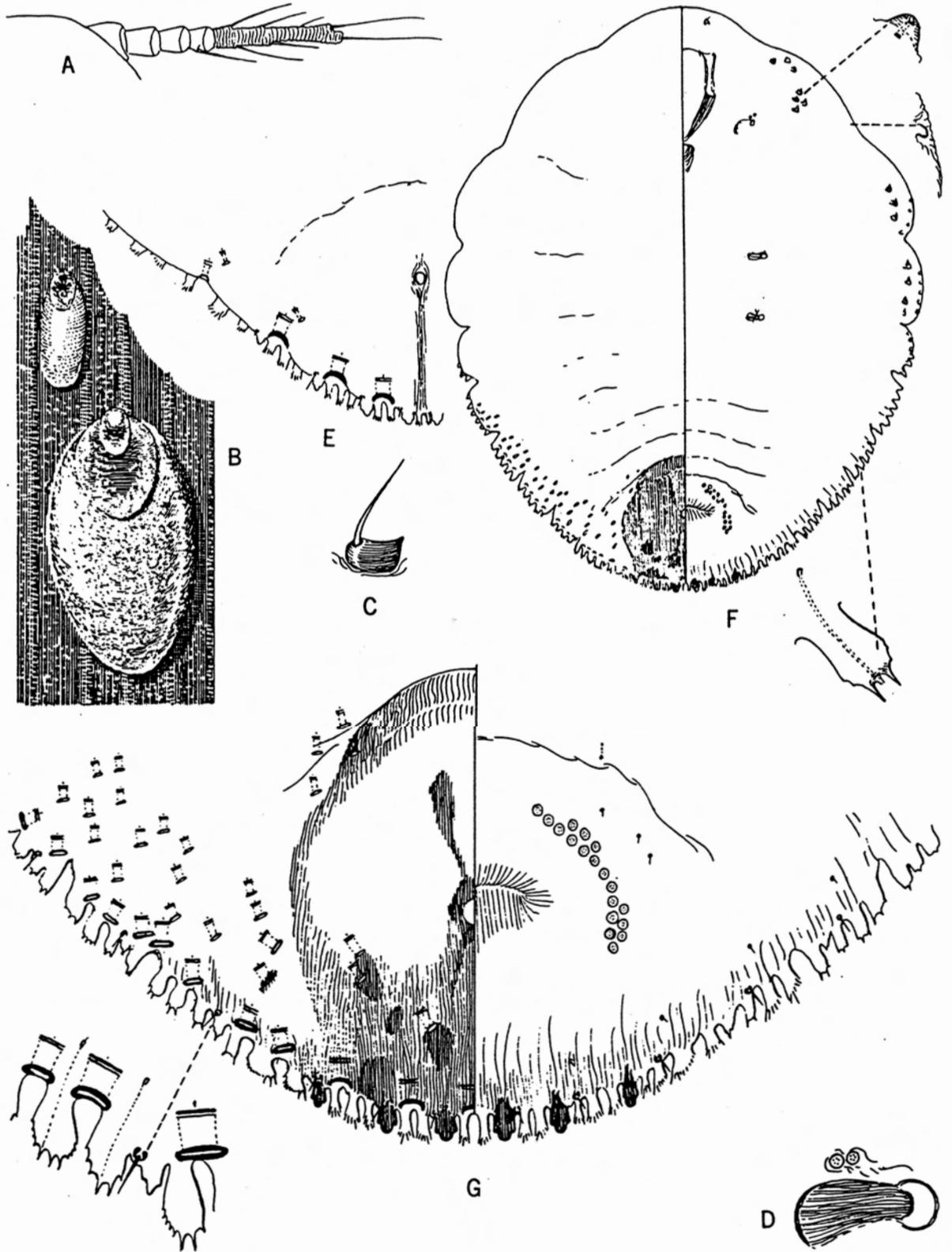


Fig. 117. *Parlatoria pittospori* Maskell.

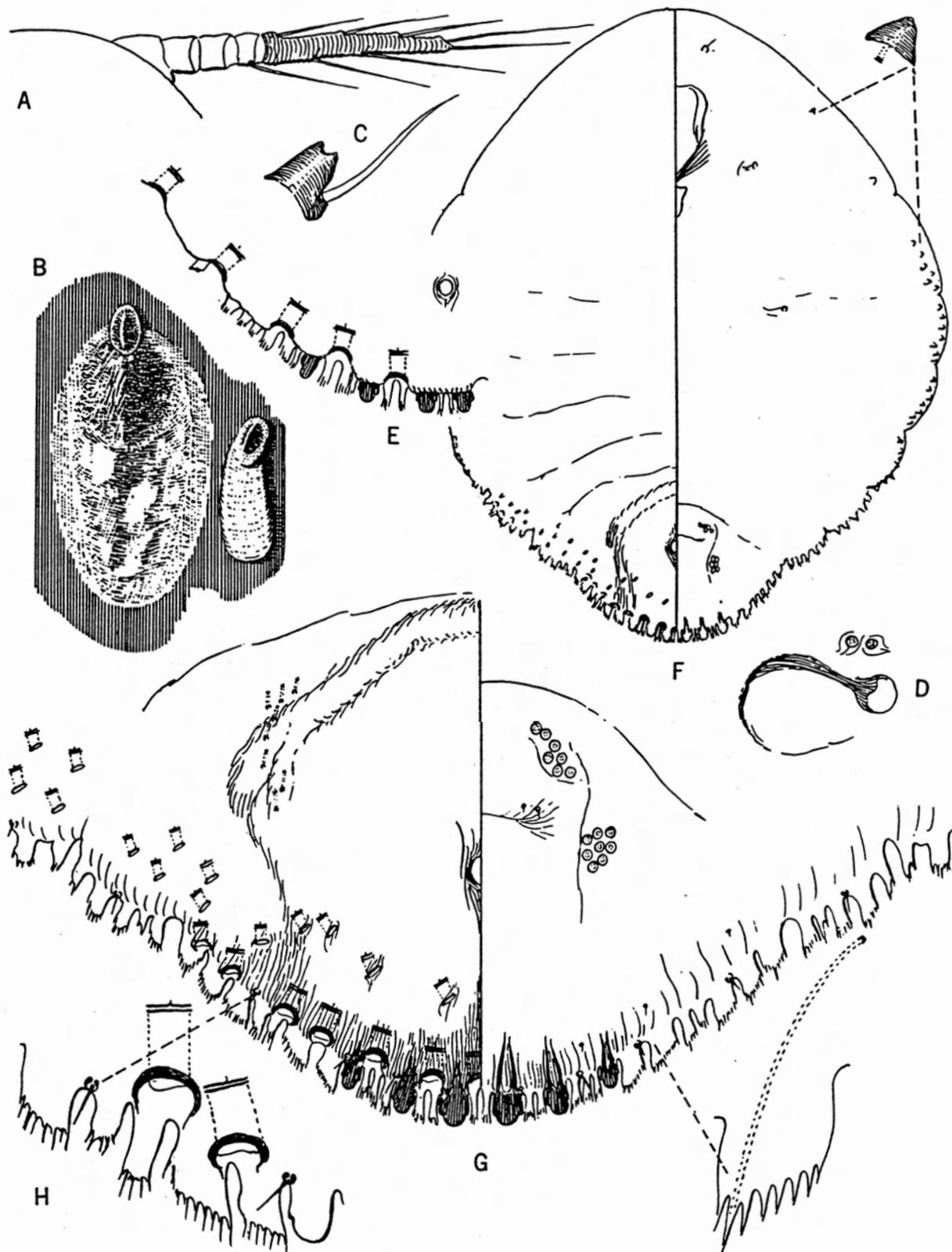


Fig. 118. *Parlatoria proteus* (Curtis).

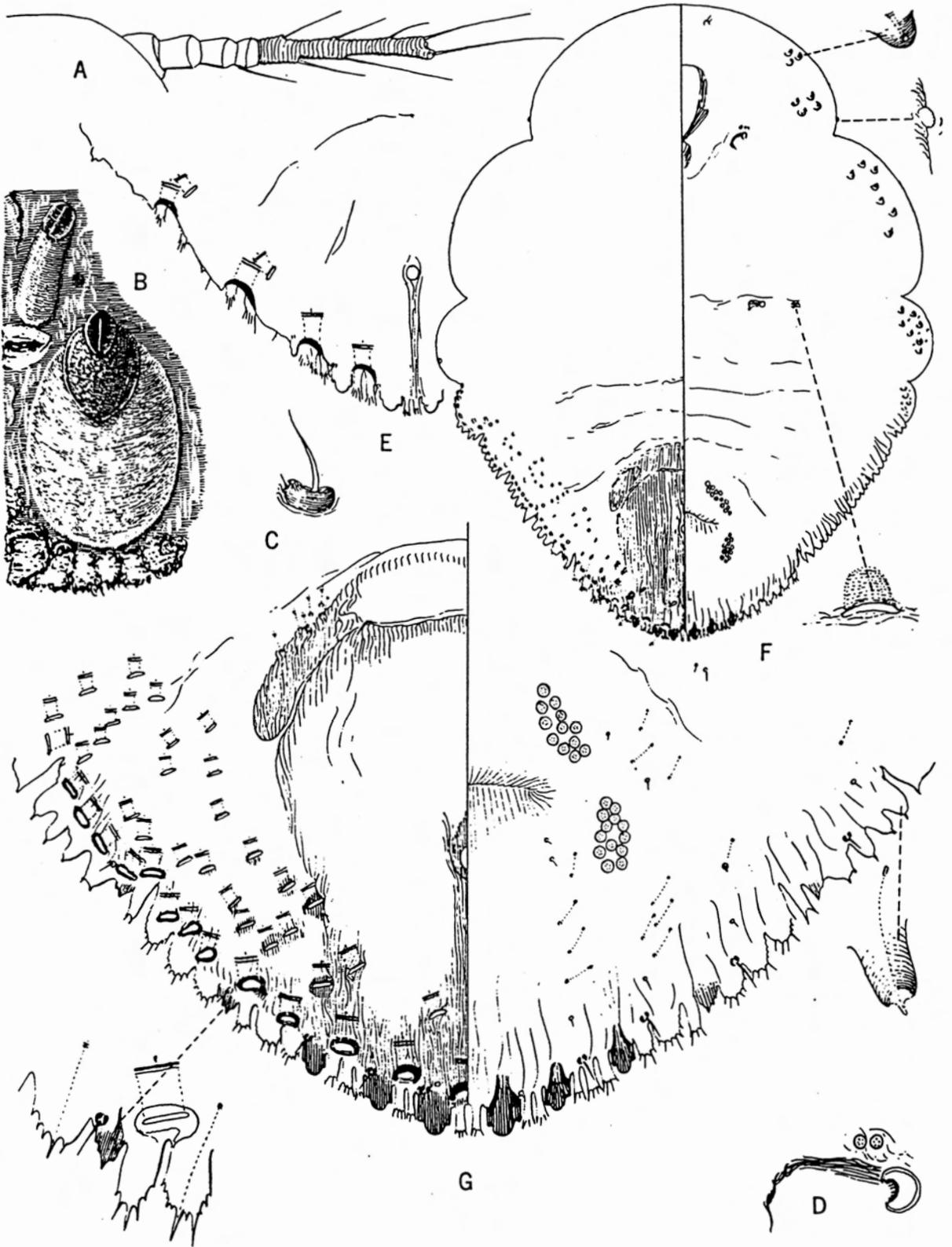


Fig. 119. *Parlatoria theae* Cockerell.

Genus *Pinnaspis* Cockerell, 1892

Number of World species: About 35.

Number of United States species: 3.

Key to the World species: Ferris, G.F., and V.P. Rao, 1947: Microentomol. 12(2):25-28 (outdated). See also Takagi, S. (Various papers 1961-1963).

KEY TO CALIFORNIA SPECIES OF *PINNASPIS*

1. Preanal scars of pygidium usually forming distinct, crescentic sclerotizations. 2
— Preanal scars of pygidium entirely lacking normally. 3
2. Scale of female white or gray. *strachani*
— Scale of female definitely brown. *aspidistrae*
3. Median pygidial lobes usually slightly but distinctly separated from each other; fifth abdominal segment normally without any submarginal macroducts; scale of female pale brown, yellow, or white; no males known; an apparently parthenogenetic species. *buxi*
— Median pygidial lobes always closely appressed together; fifth abdominal segment normally with at least one submarginal macroduct; female scale brown; males, when present, white-felted and tricarinate. *aspidistrae*

***Pinnaspis aspidistrae* (Signoret), 1869**
fern scale (ESA approved)
Fig. 120, Color Plates 123, 124

Tribe: Diaspidini.

Other Common Names: aspidistra scale, liriopie scale.

Synonymy: *Chionaspis aspidistrae* Signoret, *Chionaspis brasiliensis* Signoret, *Chionaspis latus* Cockerell, *Hemichionaspis aspidistrae* (Signoret), *Pinnaspis caricis* Ferris, *Pinnaspis ophiopogonis* Takahashi.

Field Characteristics: Scale cover 1.5 to 2.5 mm long, oystershell-shaped, light brown, with yellowish-brown terminal exuviae. Male scales, when present, snow white, elongate, strongly tricarinate, with a terminal exuvium. Occurs on host leaves.

Similar Species: Scale cover similar to that of purple scale, camellia scale and numerous other species in the genus *Lepidosaphes*, as well as other species in the genus *Pinnaspis*. Cannot be identified in the field on hosts other than mondo grass or lily-turf, except that *Pinnaspis* differs from *Lepidosaphes* by being flatter in profile. Cannot be field-separated

from boxwood scale (*Pinnaspis buxi*).

Biology: Little known. According to Werner (1930), has overlapping generations indoors.

Hosts: Occurs commonly on leaf bases inside clumps of mondo grass (*Mondo*) and lily-turf (*Ophiogon* and *Liriopie*), wherever these plants are used as ornamentals. Frequently seen on citrus in quarantine from Mexico but is not found on that host in California. Also seen commonly on palms.

Distribution: A common but rarely seen species in California. Occasionally infests leaves of palms in coastal Southern California.

Dekle, G.W., 1976: Florida Armored Scale Insects. Fla. Dep. Agric. Cons. Serv., Div. Plant Ind., Gainesville. 345 pp.

McKenzie, H.L., 1956: The Armored Scale Insects of California. Univ. Calif. Press, Berkeley. 209 pp.

Nakahara, S., 1979: Proc. Entomol. Soc. Wash. 81(1):31.

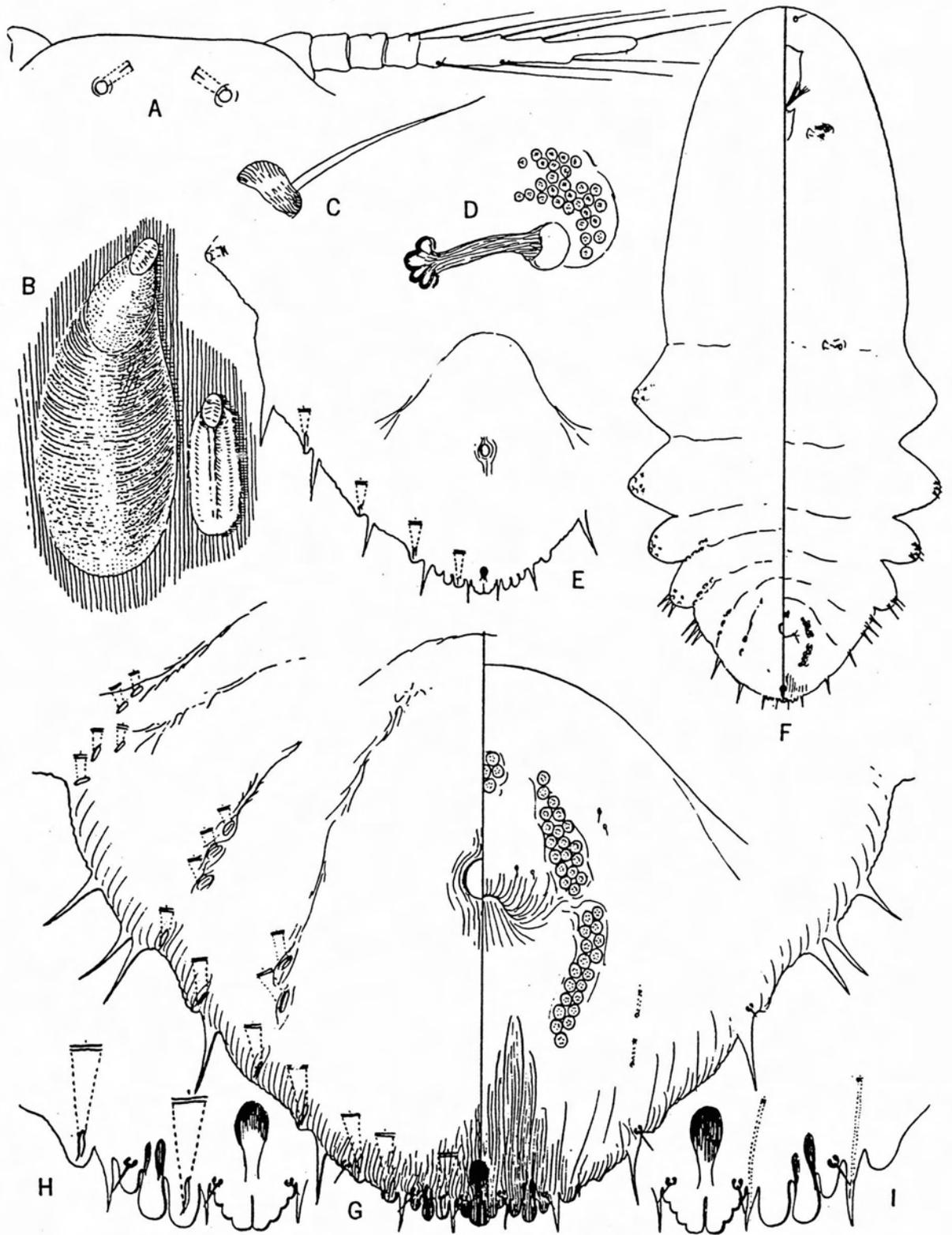


Fig. 120. *Pinnaspis aspidistrae* (Signoret).

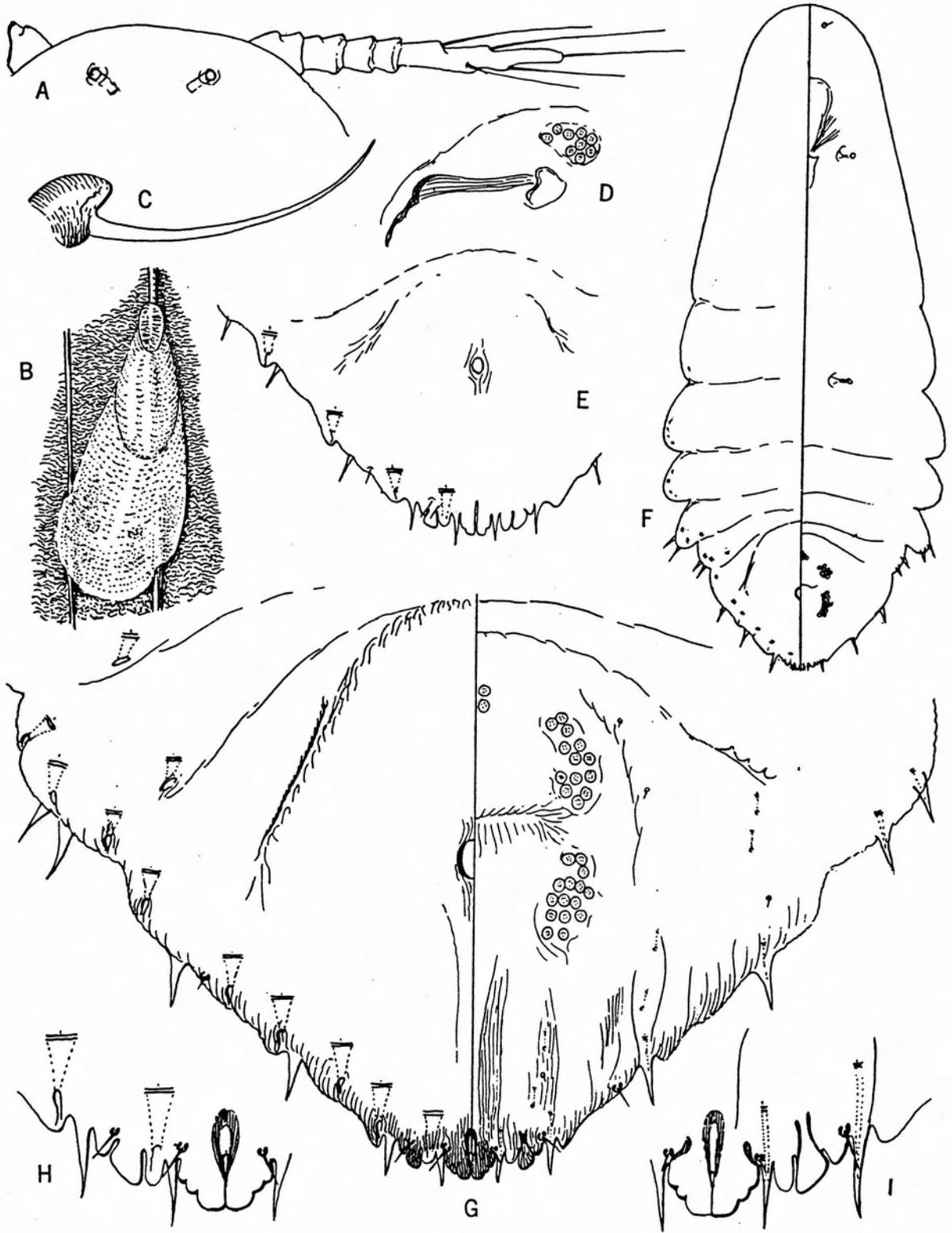


Fig. 121. *Pinnaaspis buxi* (Bouché).

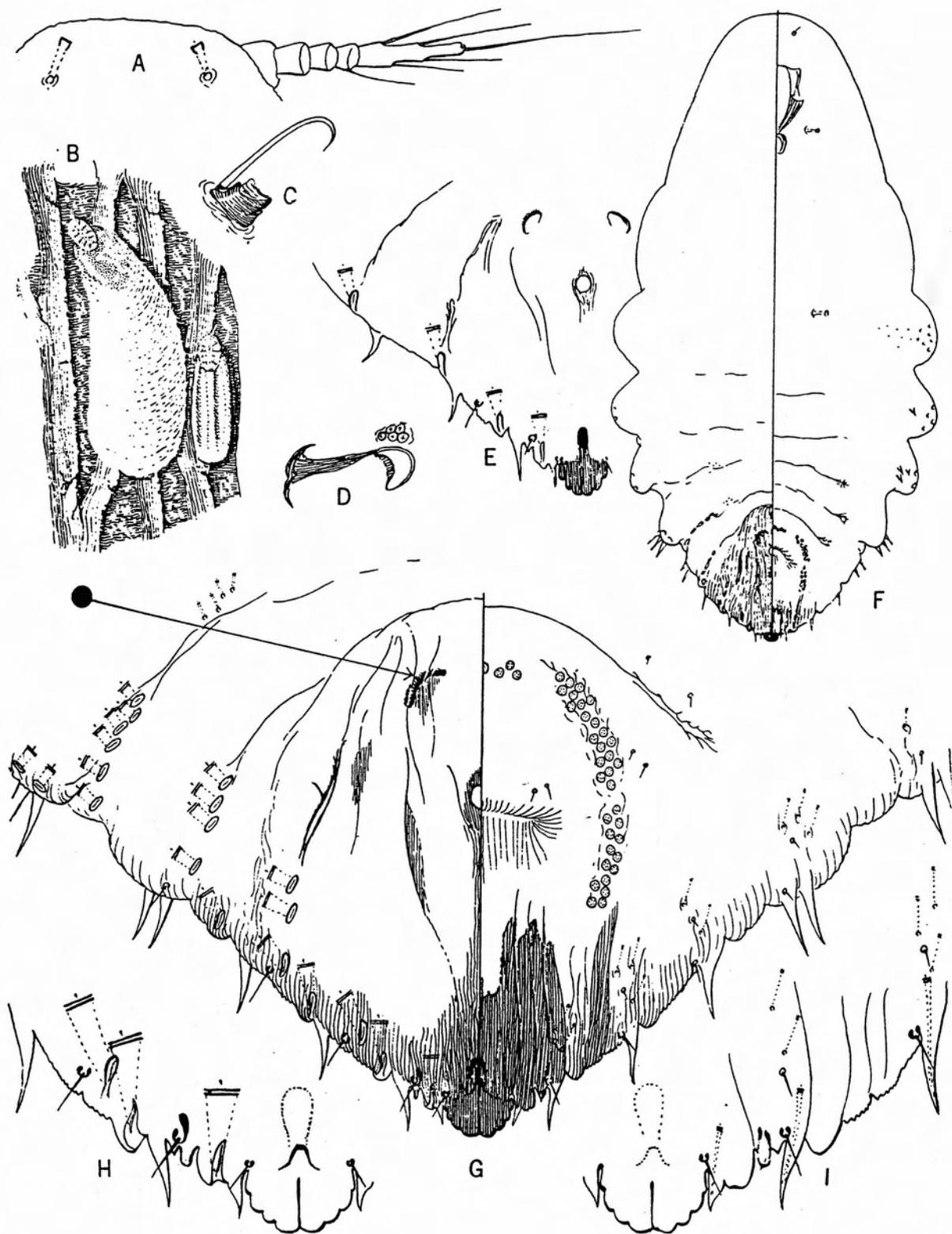


Fig. 122. *Pinnaspis strachani* (Cooley).

***Pinnaspis buxi* (Bouché), 1851**
boxwood scale
Fig. 121, Color Plate 125

Tribe: Diaspidini.

Synonymy: *Aspidiotus buxi* Bouché, *Mytilaspis buxi* (Bouché), *Mytilaspis pandani* Comstock, *Pinnaspis pandani* (Comstock), *Pinnaspis bambusae* Cockerell, *Pinnaspis siphonodontis* Cockerell and Robinson, *Hemichionaspis pseudaspidistrae* Green.

Collected in several Bay Area nurseries prior to 1950. Eradicated. Frequently seen on ti and ginger plants shipped from Hawaii. Usually cannot be separated easily from fern scale in the field, although it is not known to occur on mondo grass or lily turf, the preferred hosts of fern scale in California. Boxwood scale is usually smaller, flatter, and has a more transparent scale cover than does fern scale.

McKenzie, H.L., 1956: The Armored Scale Insects of California. Univ. Calif. Press, Berkeley. 209 pp.
 Rosen, D., and P. DeBach in C.P. Clausen, ed., 1978: U.S. Dep. Agric. Agric. Handb. 480:1-545.

***Pinnaspis strachani* (Cooley), 1899**
lesser snow scale
Fig. 122

Tribe: Diaspidini.

Other Common Names: cotton white scale.

Synonymy: *Hemichionaspis minor* var. *strachani* Cooley, *Hemichionaspis marchali* Cockerell, *Hemichionaspis townsendi* Cockerell, *Hemichionaspis aspidistrae* var. *gossypii* Newstead, *Pinnaspis gossypii* (Newstead), *Pinnaspis temporaria* Ferris, *Pinnaspis marchali* (Cockerell), *Pinnaspis minor* of authors.

Collected in a number of California nurseries, but eradicated. Commonly encountered on coconut husks and caps in quarantine. Similar to fern scale but has a white scale cover rather than a tan cover. Similar to magnolia white scale but does not have the dark exuviae usually found in that species.

McKenzie, H.L. 1956: The Armored Scale Insects of California. Univ. Calif. Press, Berkeley. 209 pp.
 Rosen, D., and P. DeBach in C.P. Clausen, ed., 1978: U.S. Dep. Agric., Agric. Handb. 480:1-545.

***Genus Poliaspis* Maskell, 1880**

Number of World Species: 9

Number of United States species: 1

Key to the species: None

***Poliaspis cycadis* Comstock 1883**
cycad poliaspis scale
Fig. 123, Color Plate 126

Tribe: Diaspidini.

Synonymy: *Poliaspis gaultheriae* Green, *Trichomytilus cycadis* Lindinger, *Poliaspis gauteriae* Lindinger.

Field Characteristics: Female scale cover 2.5 to 3.0 mm long, oystershell-shaped, shiny white except for a yellowish terminal exuvium. Male scale cover felt-like, elongate, white, with terminal exuvium and uncarinated.

Similar Species: Cycad scale is similar in color but is more convex and not oyster-like.

Biology: Unknown.

Hosts: Cycads, especially *Dioon* and *Microzamia*.

Economic Importance: Unknown.

Distribution: Was collected in 1993 at Brea,

Orange County from specimen cycads in a private collection. Current status of that infestation is unknown. Elsewhere known from Washington D.C. in greenhouses, and Europe, India and Asia.

Diagnosis: Unlike any other California armored scale on these hosts.

Ferris, G.F., 1937: Atlas of the Scale Insects of North America, Ser. I-IV. Stanford University Press, Stanford.

Genus *Protodiaspis* Cockerell, 1898

Number of World species: 16.

Number of United States species: 6.

Keys to the World species: Ferris, G.F., 1937-1942: Atlas of the Scale Insects of North America, Ser. I-IV. Stanford Univ. Press, Stanford. See also McKenzie, H.L., and W.A. Nelson-Rees, 1962: *Hilgardia* 33(4):133-139.

Protodiaspis agrifoliae Essig 1914

oak protodiaspis scale

Fig. 124, Color Plate 127

Tribe: Diaspidini.

Synonymy: *Essigaspis agrifoliae* (Essig).

Field Characteristics: Adult female scale covers less than 1 mm in diameter, circular, white or grey with reddish-brown marginal exuviae. Male scale cover elongate, white, with a brown terminal exuvium. Female scales are well camouflaged under the hair-like processes on the stems and ventral basal leaf surfaces of the host, and are nearly impossible to locate without the aid of a microscope. However, many of the male scale covers can be found exposed on the upper leaf surfaces, indicating that an infestation is present.

Similar Species: Male scales of *Chionaspis quercus* are similar. Since the females of both can be very cryptic, it is often difficult to determine which species is present.

Biology: Unknown.

Hosts: Prefers coast live oak, *Quercus agrifolia*.

Economic Importance: None. An uncommon native species.

Distribution: Apparently restricted to coastal California from San Luis Obispo County southward.

Diagnosis: A number of *Protodiaspis* species are known from oaks and some other hosts in the southwestern United States and Mexico. The keys by Ferris (1937) should be consulted.

McKenzie, H.L., 1956: The Armored Scale Insects of California. Univ. Calif. Press, Berkeley. 209 pp.

Ferris, G.F., 1937: Atlas of the Scale Insects of North America, Ser. I-IV. Stanford University Press, Stanford.

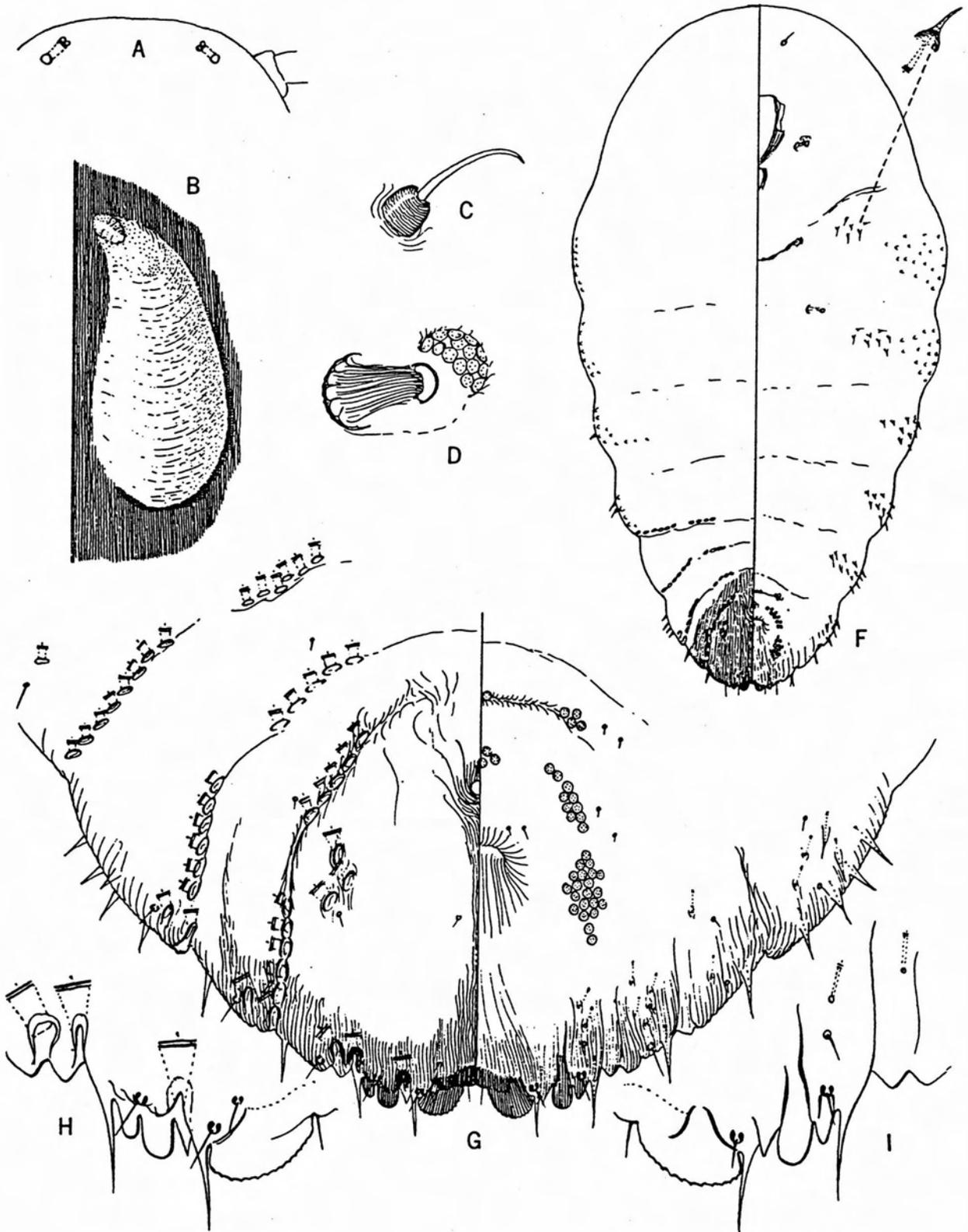


Fig. 123. *Poliaspis cycadis* Comstock.

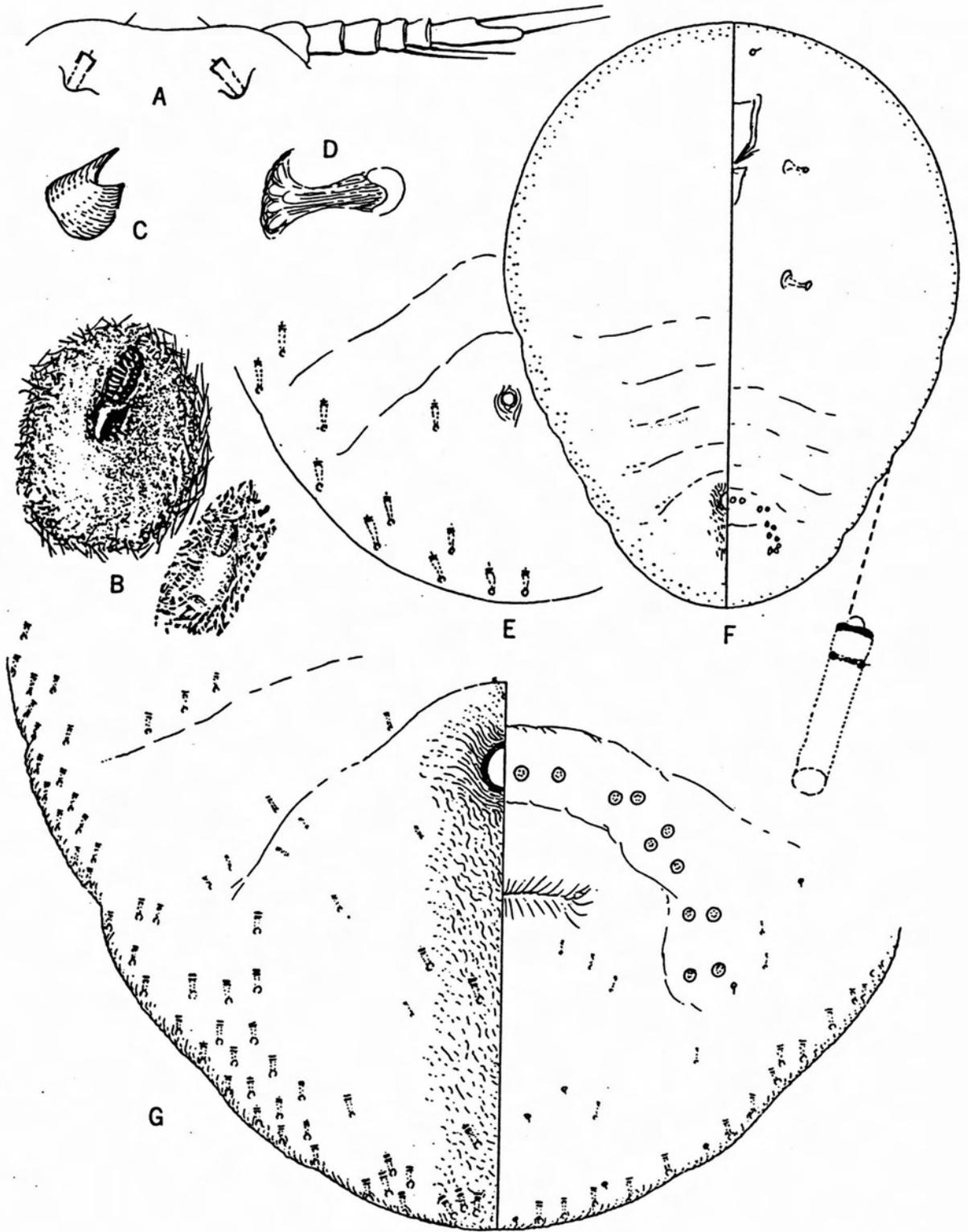


Fig. 124. *Protodiaspis agrifoliae* Essig.

Genus *Pseudaulacaspis* MacGillivray, 1921

Some species formerly in the genus *Phenacaspis* have been placed here. (See comments under genus *Chionaspis*).

Number of World species: 14.

Number of United States species: 4.

Number of California species: None currently.

Keys to United States species: Ferris, G.F., 1937-1942: Atlas of the Scale Insects of North America, Ser. I-IV. Stanford Univ. Press, Stanford.

Pseudaulacaspis cockerelli* (Cooley), 1897*magnolia white scale****Fig. 125, Color Plate 128**

Tribe: Diaspidini.

Other Common Names: oleander scale, false oleander scale (see comments under Diagnosis).

Synonymy: *Phenacaspis eugeniae* var. *sandwicensis* Fullaway, *Phenacaspis sandwicensis* Fullaway, *Chionaspis cockerelli* Cooley; *Chionaspis dilatata* Green; *Phenacaspis dilatata* (Green); *Phenacaspis natalensis* Cockerell; *Chionaspis aucubae* Cooley; *Phenacaspis aucubae* (Cooley); *Chionaspis syringae* Borchsenius; *Pseudaulacaspis bififormis* Takagi; *Phenacaspis ferrisi* Mamet, *Phenacaspis cockerelli* (Cooley).

Field Characteristics: Female scale cover 2 to 3 mm long, pure white, elongate or oystershell-shaped, flat, with distinctive reddish-brown terminal exuviae (may occasionally be yellow). Body yellow. Males elongate, white, tricarinate, with a terminal exuvium. Males tend to congregate in groups of 10 or more. Normally found on leaves. In some species of palms, the discolored areas of the leaves associated with the internal location of the feeding stylets is noticeable and serves as an aid in field recognition.

Similar Species: Lesser snow scale (*Pinnaspis strachani*) is similar but always has yellow or tan exuviae.

Biology: Has multiple overlapping yearly generations (Tippins, 1968).

Hosts: Prefers magnolia and palms, but has a wide host range.

Economic Importance: Considered by Dekle (1976) to be the most serious pest of ornamen-

tal plants in Florida. Commonly encountered in quarantine from Hawaii and Florida.

Distribution: First collected in California in a nursery in Alameda County in 1954. Although some of the infested plants were supposedly sold, the scale never became established in the State. Commonly encountered in plant quarantine situations and frequently in nurseries, probably more so than any other scale species. Eradicated whenever found.

Diagnosis: Best recognized by the white oyster-shaped scale cover with the usually reddish exuviae. Recognized morphologically by the fusiform body shape and the large, diverging median lobes which give the pygidium a notched appearance. The common names of this species are somewhat confusing. It was called oleander scale by McKenzie, but the common name oleander scale was given to *Aspidiotus nerii* by the ESA common names committee when the specific name of that species was changed from *Aspidiotus hederæ*. This change was unfortunate since *nerii* has been known as ivy scale for many years. However, the change was official and a new common name had to be found for *cockerelli*. Dekle (1976), has been calling it false oleander scale, but this name indicates affinities with oleander scale, which it does not have. The common name magnolia white scale will therefore continue to be used for this scale in California. Also, besides some problems with synonymy, the scientific name has been changed drastically because of the prob-

lems with the validity of the genus *Phenacaspis*, specimens of which have proven to be leaf forms of the genus *Chionaspis*. Based on studies of the early stages, Takagi and Kawai (1967) suggested that this particular species has more affinities with the genus *Pseudaulacaspis* than with the genus *Chionaspis*.

sects. Fla. Dep. Agric. Cons. Serv., Div. Plant Ind., Gainesville. 345 pp.

McKenzie, H.L., 1956: The Armored Scale Insects of California. Univ. Calif. Press, Berkeley. 209 pp.

Takagi, S., and S. Kawai, 1967: *Insecta Matsumurana* 30(1):29-43.

Tippins, H.H., 1968a: *J. Ga. Entomol. Soc.* 3(1):13-15.

Dekle, G.W., 1976: Florida Armored Scale In-

***Pseudaulacaspis pentagona* (Targioni-Tozzetti), 1886**
white peach scale (ESA approved)
Fig. 126, Color Plate 129

Tribe: Diaspidini.

Other Common Names: West Indian peach scale.

Synonymy: *Diaspis pentagona* Targioni-Tozzetti, *Diaspis amygdali* Tryon, *Diaspis lanatus* Morgan and Cockerell, *Diaspis patelliformis* Sasaki, *Chionaspis prunicola* Maskell, *Diaspis amygdali* var. *rubra* Maskell, *Aulacaspis pentagona* (Targioni-Tozzetti), *Sasakiaspis pentagona* (Targioni-Tozzetti). Davidson et al (1983) found evidence that the United States population actually consists of two species, *P. pentagona* and *P. prunicola* (Maskell).

Collected in Los Angeles and Sacramento Counties prior to 1920, but never recollected since. The following references deal with the bionomics of the species.

Ball, J.C., 1980: *Fla. Entomol.* 63(1):188-194.

Bennett, F.D., and S.W. Brown, 1958: *Can. Entomol.* 90(6):317-324.

Bobb, M.L., J.A. Weidhaas and L.F. Ponton, 1973: *J. Econ. Entomol.* 66(6):1290-1292.

Davidson, J.A., D.R. Miller and S. Naka-hara, 1983: *Proc. Entomol. Soc. Wash.* 85(4):753-761.

Dekle, G.W., 1976: Florida Armored Scale Insects. Fla. Dep. Agric., Cons. Serv., Div. Plant Ind., Gainesville. 345 pp.

Kozarzhevskaya, E.F., 1989: *Entomol. Rev.* 68(2):18-27.

McKenzie, H.L., 1956: The Armored Scale Insects of California. Univ. Calif. Press, Berkeley. 209 pp.

Pedata, P.A., M.S. Hunter, H.C.J. Godfray and G. Viggiani, 1995: *Bull. Entomol. Res.* 85:531-539.

Van Duyn, J. and M. Murphy, 1971: *Fla. Entomol.* 54(1):91-95.

Yonce, C.E. and S.W. Jacklin, 1974: *J. Georgia Entomol. Soc.* 9(4):213-216.

Genus *Pseudoparlatoria* Cockerell, 1892

Number of World species: 28.

Number of United States species: 1.

Key to the World species: None.

Key to the North American species: Ferris, G.F., 1937-1942: Atlas of the Scale Insects of North America, Ser. I-IV. Stanford Univ. Press, Stanford.

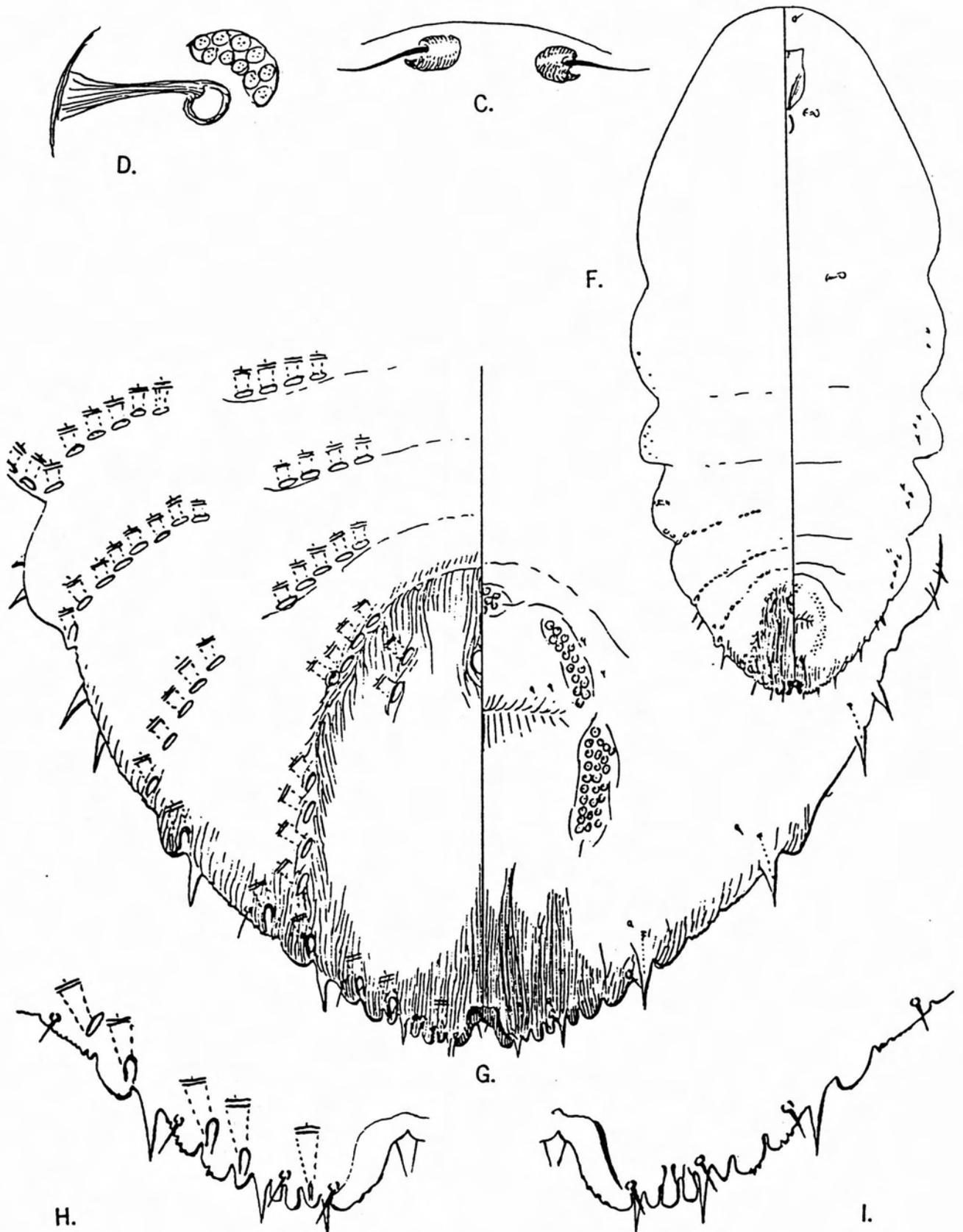


Fig. 125. *Pseudaulacaspis cockerelli* (Cooley).

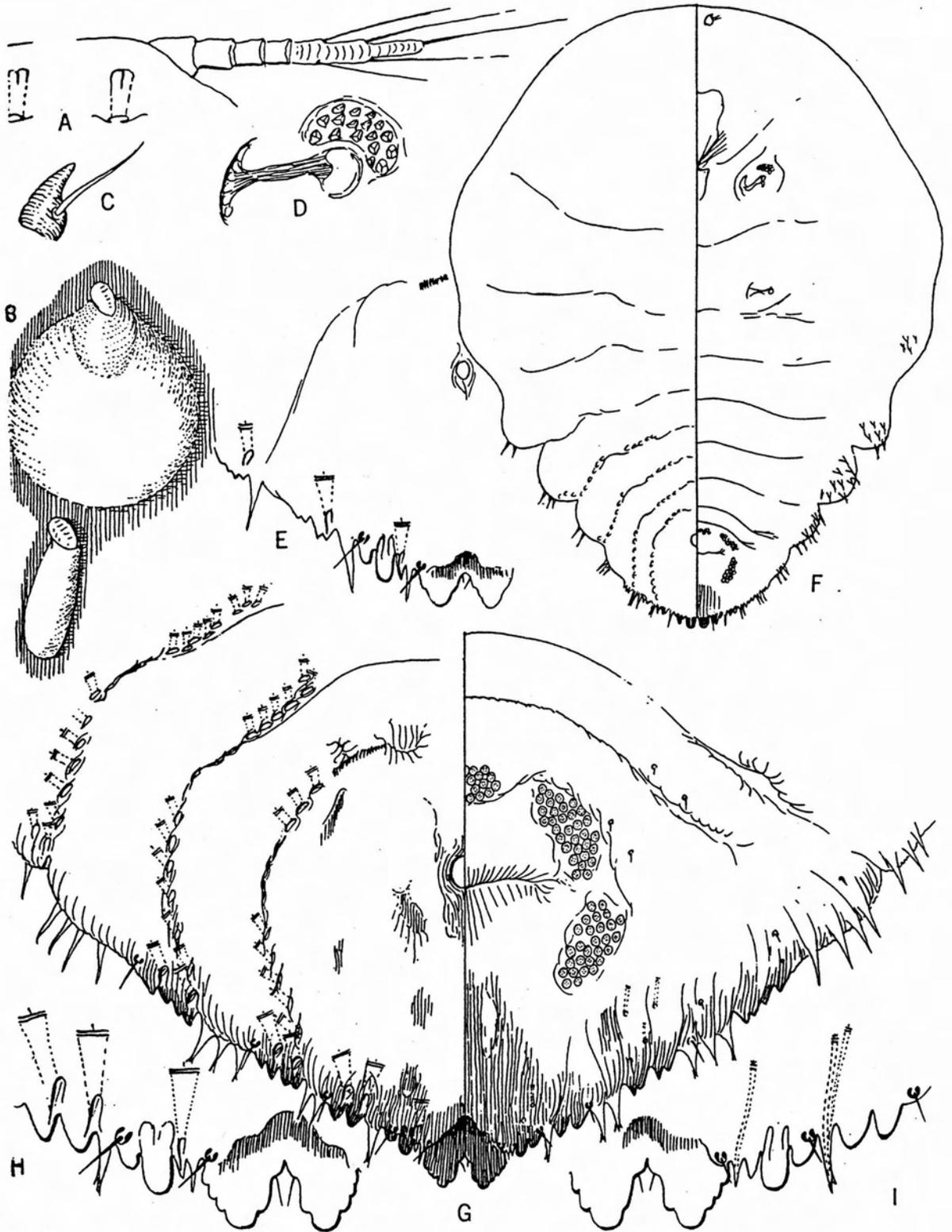


Fig. 126. *Pseudaulacaspis pentagona* (Targioni-Tozzetti).

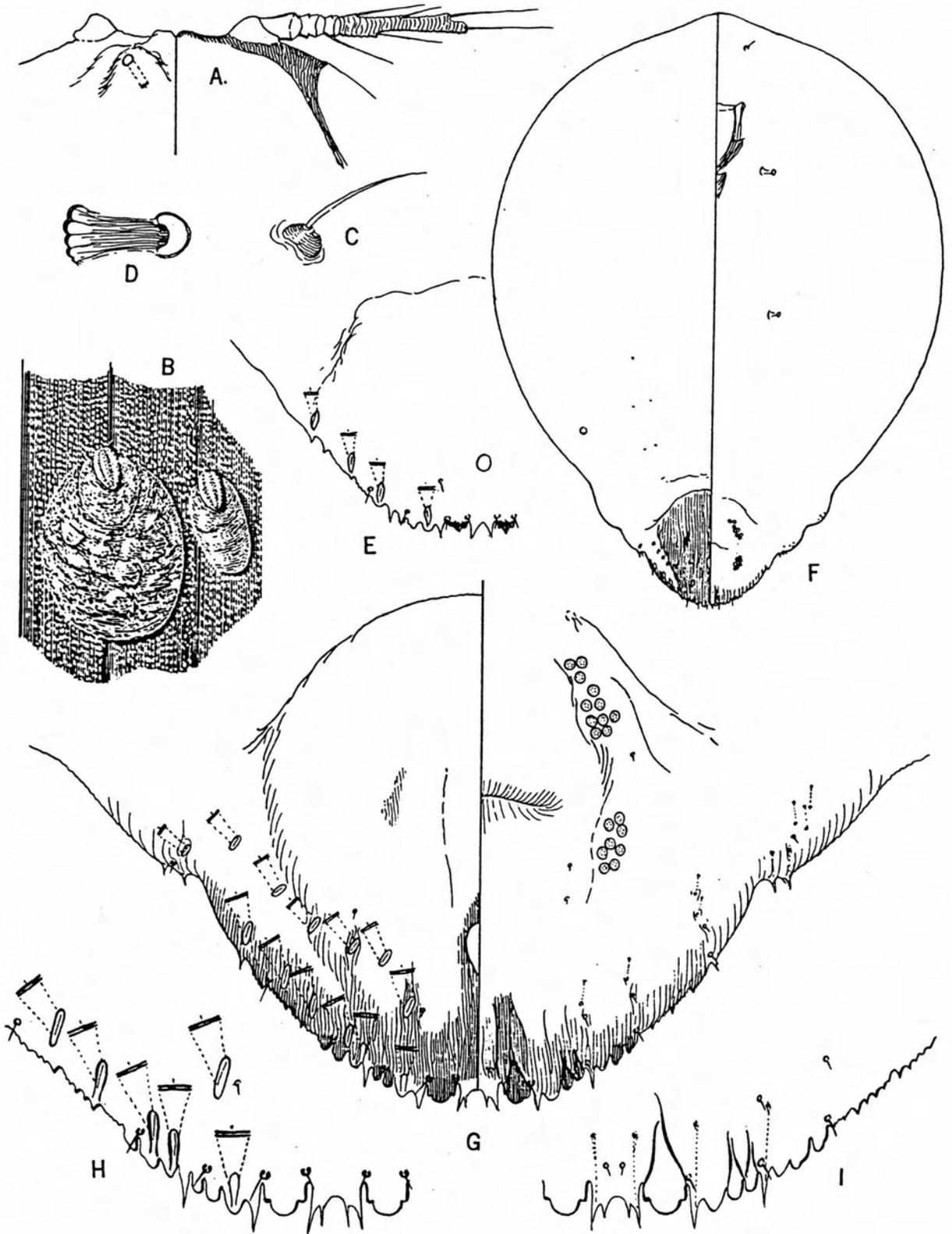


Fig. 127. *Pseudoparlatoria parlatorioides* (Comstock).

Pseudoparlatoria parlatoroides (Comstock), 1883
 false parlatoria scale
 Fig. 127, Color Plate 130

Tribe: Diaspidini.

Synonymy: *Aspidiotus parlatoroides* Comstock, *Pseudoparlatoria pusilla* Green.

Collected in nurseries in Los Angeles, Alameda and Marin Counties. Eradicated.

McKenzie, H.L., 1956: The Armored Scale Insects of California. Univ. Calif. Press, Berkeley. 209 pp.

Genus *Quadraspidotus* MacGillivray, 1921.

Number of World species: About 45.

Number of United States species: 8.

Key to the World species: None.

Key to the United States species: Ferris, G.F., 1937-1942: Atlas of the Scale Insects of North America, Ser. I-IV. Stanford Univ. Press, Stanford. See also Takagi, S., and H.H. Tippins, 1972: Kontyu 40(3):180-186, for one new United States species (*Q. tillandsiae*).

KEY TO CALIFORNIA SPECIES OF QUADRASPIDIOTUS

- 1. Perivulvar pores present. 2
- Perivulvar pores lacking. *perniciosus*

- 2. At full maturity with the derm of the entire dorsum quite heavily sclerotized; margins of the body deeply sculptured; third lobe indicated by at least a point. . . . *juglans-regiae*
- At full maturity with the derm of the entire dorsum remaining membranous; third lobe not indicated. *forbesi*

Quadraspidotus forbesi (Johnson), 1896
 Forbes scale (ESA approved)
 Fig. 128

Tribe: Aspidiotini.

Synonymy: *Aspidiotus forbesi* Johnson, *Aspidiotus fernaldi* var. *hesperius* Cockerell, *Forbesaspis forbesi* (Johnson).

Field Characteristics: Female scale cover 1.5 to 2.5 mm long, grey, oval, convex, with dark submarginal exuviae. Males similar but smaller, with a subterminal exuvium. Occurs on the bark.

Similar Species: San José scale, which occurs on many of the same hosts and is easily confused with Forbes scale.

Hosts: Found on many hosts, particularly in the rose family, such as *Crataegus* and *Prunus*.

Economic Importance: None.

Distribution: A rare species introduced into California from the midwest. Generally collected in the Sacramento and San Joaquin Valleys.

Diagnosis: The only California *Quadraspidotus* with perivulvar pores and no lateral constrictions.

Kosztarab, M., 1963: Bull. Ohio Biol. Surv. (n.s.) 2(2):1-120.

McKenzie, H.L., 1956: The Armored Scale Insects of California. Univ. Calif. Press, Berkeley. 209 pp.

Quadraspidotus juglans-regiae (Comstock), 1881

walnut scale (ESA approved)

Fig. 129, Color Plates 131-133

Tribe: Aspidiotini.**Other Common Names:** English walnut scale.**Synonymy:** *Aspidiotus juglans-regiae* Comstock, *Aspidiotus juglandis-regiae*, *Aspidiotus fernaldi* Cockerell, *Quadraspidotus fernaldi* (Cockerell), *Aspidiotus glanduliferus* Cockerell, *Quadraspidotus glanduliferus* (Cockerell), *Evaspidiotus juglans-regiae* (Comstock), *Furchaspis juglans-regiae* (Comstock). The species has also been listed under the varieties *pruni*, *albus*, *albiventer*, *kafkai*, and *cockerelli*.**Field Characteristics:** Adult females up to 3.0 mm in diameter, fairly flat, usually light tan, occasionally light grey, with an orange exuvium. Body bright yellow, deeply notched twice on each side in the thoracic area. No other similar scale insect presently in California on the same hosts has these lateral notches, which are easily seen with a hand lens if the scale cover is removed from a living adult female. These notches are also seen on flattened dead females, but a little practice is required in this case. Male scale covers usually the same color as females, but smaller and more oblong. Male crawlers often settle side-by-side just inside the edge of the parent female cover. The posterior end (exit hole) of the male cover is then formed so that it protrudes from under the old female cover, all of the male covers thus give the effect of petals on a flower. This is a characteristic habit of the males readily seen in infestations where the scales are not too heavily encrusted.**Similar Species:** Easily recognizable the field by its large size, light colored scale cover, and laterally indented body. Buckeye scale, *Diaspidiotus aesculi*, is similar in size and males often settle under the parent scale cover to form the same "flower" pattern found in walnut scale, but buckeye scale has a darker grey cover and the sides of the body are not indented. European fruit scale, *Quadraspidotus osteaeformis* (Curtis), not found in California,is similar but darker and has only one deep lateral notch on the body. Willow scale, *Q. gigas* (Thiem and Gerneck), is similar in size but darker and usually restricted to willow in the northern United States. Mining scale, *Howardia biclavis*, is very similar including the indented body margin, but it does not have a yellow body and is not generally found on deciduous hosts.**Biology:** One generation per year on the east Coast of North America, overwintering as second instars (Stoetzel, 1975), although Kosztarab (1963) and Gordon and Potter (1988) record two or more generations per year with adult females overwintering. No published accounts of the life cycle of this species in California.**Hosts:** Prefers walnut (*Juglans*) and ash (*Fraxinus*). Has a wide host range, particularly on deciduous trees. Occasionally found on conifers. For a host list see Dekle (1976) and Kosztarab (1963).**Economic Importance:** Several authors (Michelbacher and Ortega, 1958; Ebeling, 1959) consider it a minor pest of walnut orchards, particularly if the trees are well cared for. Can be a serious pest of some ornamental trees in California. Known to kill ornamental white birch trees (*Betula*) in Southern California and to kill or severely weaken ash trees (*Fraxinus*) in the Sacramento and San Joaquin Valleys. According to Ebeling (1959), it is normally held in check by the parasite *Aphycus californicus* Howard. For more information on natural enemies see Kosztarab (1963).**Distribution:** Generally distributed in California, probably having been introduced into most areas on fruit trees. Generally distributed in the United States; known from Europe. Origin unknown.**Diagnosis:** Readily identifiable by the constrictions between the meso- and meta-thorax. Placed in the genus *Quadraspidotus* because of the well developed, inwardly di-

rected second lobes, but in field characteristics and certain overall morphological characters this scale appears to have strong ancestral ties to several species in *Quadraspidotus* other than *perniciosus* and *forbesi*, as well as some species which are now in *Diaspidiotus* and *Hemiberlesia*, such as *D. aesculi*.

Dekle, G.W., 1976: Fla. Dep. Agric. Cons. Serv.,

Div. Plant Ind. Gainesville. 345 pp.
 Ebeling, W., 1959: Subtropical Fruit Pests. Univ. Calif. Div. Agric. Sci. Publ. Bull., Los Angeles. 436 pp.
 Kosztarab, M., 1963: Bull. Ohio Biol. Survey (n.s.) 2(2):1-120.
 Gordon, F.C. and D.A. Potter, 1988: J. Econ. Entomol. 81(4):1181-1185.
 Michelbacher, A.E., and J.C. Ortega, 1958: Calif. Agric. Exp. Stn. Bull. Stoetzel, M.B., 1975: Ann. Entomol. Soc. Am. 68(3):489-492.

Quadraspidotus perniciosus (Comstock), 1881

San José scale (ESA approved)

Fig. 130, Color Plates 134

Tribe: Aspidiotini.

Other Common Names: Chinese scale, pernicious scale, California scale. The common name San José scale was coined several years before this species was officially described as *Aspidiotus perniciosus* by Comstock, and almost 30 years before the native locality was discovered by C.L. Marlatt. Various people have attempted to change the name to pernicious scale (still used in some parts of Africa), and to Chinese scale, but without success. The city of San Jose is still known the world over for its rather dubious gift to the deciduous fruit industry.

Synonymy: *Aspidiotus perniciosus* Comstock, *Diaspidiotus perniciosus* (Comstock), *Aonidiella perniciosus* (Comstock), *Comstockaspis perniciosus* (Comstock).

Field Characteristics: Adult female scale covers 1.0 to 2.0 mm in diameter, grey or brownish grey, although they adhere to the plant after the insect is dead, and may become considerably lighter. Body bright yellow. Exuviae central or sub-central, orange or yellow-brown. If the scale covers are rubbed, the first larval cast skin is visible and appears as a small bead of burnished gold. Male scale covers oblong, grey, with the exuvium near one end. First instar scale cover blue-black (sooty black-cap phase), a good field identification character since no other species in California is this color in the first instar.

Similar Species: The only species commonly found on the same hosts is olive scale, which has a purple body and a lighter scale cover with a brown or dark green terminal exuvium in the female, and a white cover with a terminal exuvium in the male. Other similar California scales not commonly found on the same hosts, or which are otherwise rare, are Putnam scale (*Diaspidiotus ancyclus*), buckeye scale, (*Diaspidiotus aesculi*), Forbes scale (*Quadraspidotus forbesi*), latania scale (*Hemiberlesia lataniae*), and greedy scale (*Hemiberlesia rapax*). The European fruit scale, *Quadraspidotus ostreaeformis* (Curtis) of Europe and the northern United States is very similar.

Biology: Up to 4 or 5 generations per year depending on local climate. Overwinters primarily as first instar nymphs and has three overlapping generations in California. Ovoviparous. Found on all plant parts including roots. For more information, including natural enemies, see Gentile and Summers (1958). For information on biology, ecology and control in Chile see Gonzalez (1981), and for biology in Australia see Bower (1989).

Hosts: Prefers deciduous fruit and nut crops in the family Rosaceae, but attacks over 700 hosts. Often heavy on roses; has even been found on citrus. For host lists see Marlatt (1906) and Dekle (1976).

Economic Importance: The most serious scale

pest of deciduous tree crops throughout the world. Has noticeable affect on the host within 24 hours of infestation, and if left unchecked can kill mature trees in 2 to 3 years. Apparently injects a chemical toxin into the plant during the feeding process which severely disrupts normal tissue growth. Discoloration near the feeding sight is a common occurrence, particularly on first year wood and on fruit. Discolored fruit is reduced in grade and overall value. For an excellent account of the physiological effects on the host see Gentile and Summers (1958). Other important economic effects of San José scale are the government regulations regarding movement of infested fruit or nursery stock between various areas and particularly between countries. Many quarantine regulations have been developed over the years by most countries that have seriously hampered the movement of fruit. In many cases this has resulted in considerable loss of revenue. For more information see Marlatt (1906) and for information on economic importance in Australia see Ingram and Nimmo (1991). For information on natural enemies see Kosztarab (1963), Gulmahamad and DeBach (1978), and Rosen and DeBach (1978).

Distribution: Occurs in practically all of the pome and stonefruit growing areas of the world. Found in all states except Wyoming. For a distributional map of San José scale in the United States see Anonymous (1968). Found in most California counties. Native to an area including northern China, North Korea and Soviet East Asia (Marlatt 1902, 1906). Apparently introduced into the Santa Clara Valley at San Jose prior to 1870, when it was first noticed on the property of James Lick, a local orchardist and exotic plant fancier who

had obtained native flowering peach specimens from northern China.

Diagnosis: Field characteristics are useful in identification. Slide-mounted specimens are distinguished by the inwardly directed pygidial lobes, poorly developed plates, and most importantly by the lack of perivulvar pores. Male scale trapping programs have been initiated for this species; see Rice (1974) and Rice and Jones (1977). Males are easy to identify. See the section on male scale identification.

- Anonymous, 1969: U.S. Dep. Agric. Coop. Econ. Insect Rept. 19(22):390.
 Bower, C.C., 1989: J. Aust. Ent. Soc. 28:239-245.
 Dekle, G.W., 1976: Florida Armored Scale Insects. Fla. Dep. Agric. Cons. Serv., Div. Plant Ind., Gainesville. 345 pp.
 Gentile, A.G., and F.M. Summers, 1958: Hilgardia 27(10):269-285.
 Gonzalez, R.H., 1981: Univ. Chile Pub. Cienc. Agric. 9:1-64.
 Gulmahamad, H., and P. DeBach, 1978: Hilgardia 46(7):205-256.
 Ingram, B.F., and P.R. Nimmo, 1991: Gen. Appl. Ent. 23:53-8.
 Jorgensen, C.D., R.E. Rice, S.C. Hoyt, and P.H. Westigard, 1981: Can. Entomol. 113(2):149-159.
 Kosztarab, M., 1963: Bull. Ohio Biol. Surv. (n.s.) 2(2): 1-120.
 Marlatt, C.L., 1902: U.S. Dep. Agric. Agric. Yearb., 1902:155-174.
 Marlatt, C.L., 1906: U.S. Dep. Agric. Bur. Entomol. Bull. 62:1-89.
 Rice, R.E., 1974: J. Econ. Entomol. 67:561-562.
 Rice, R.E., and R.A. Jones, 1977: Can. Entomol. 109(10):1403-1404.
 Rosen, D., and P. DeBach in C.P. Clausen, ed., 1978: U.S. Dep. Agric. Handb. 480:1-545.

Genus *Quernaspis* Ferris, 1937

Number of World species: 3. Three other species now in *Neoquernaspis*.

Number of United States species: 3.

Key to the World species: None, but see the following reference for Asian species.

Key to the United States species: Takagi, S., and J.O. Howell, 1977: Insecta Matsumurana (n.s.) 11:31-59.

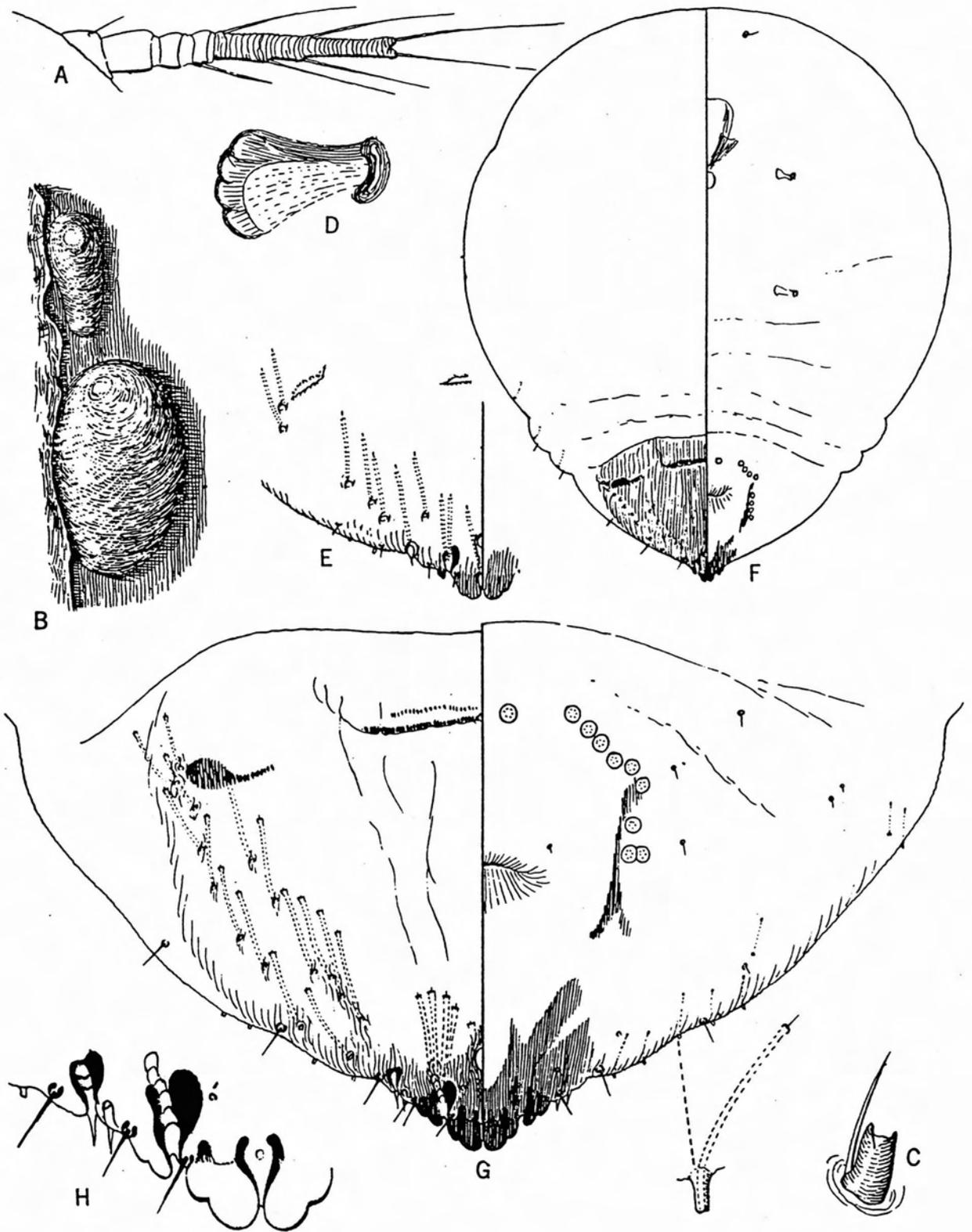


Fig. 128. *Quadraspidotus forbesi* (Johnson).

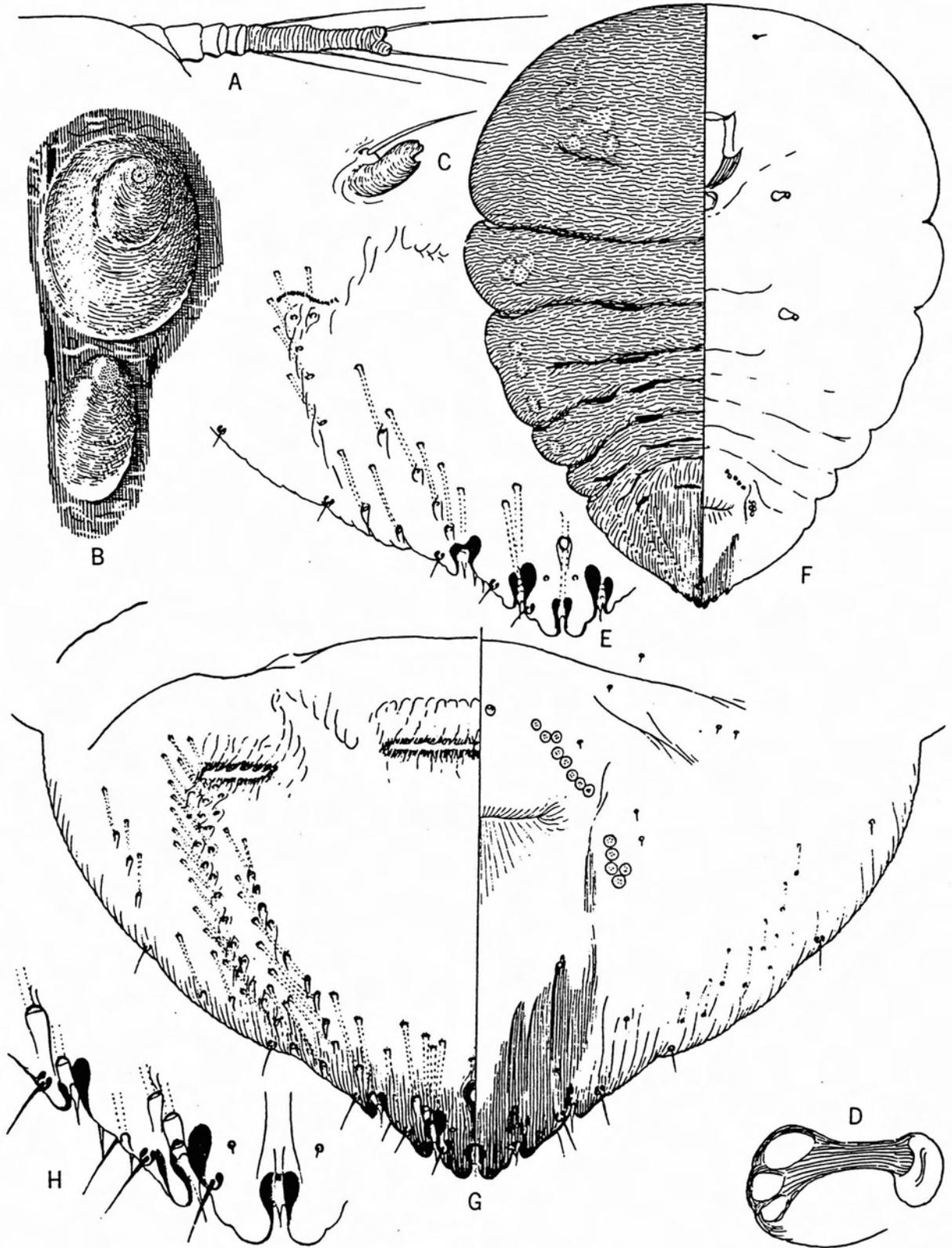


Fig. 129. *Quadraspidotus juglans-regiae* (Comstock).

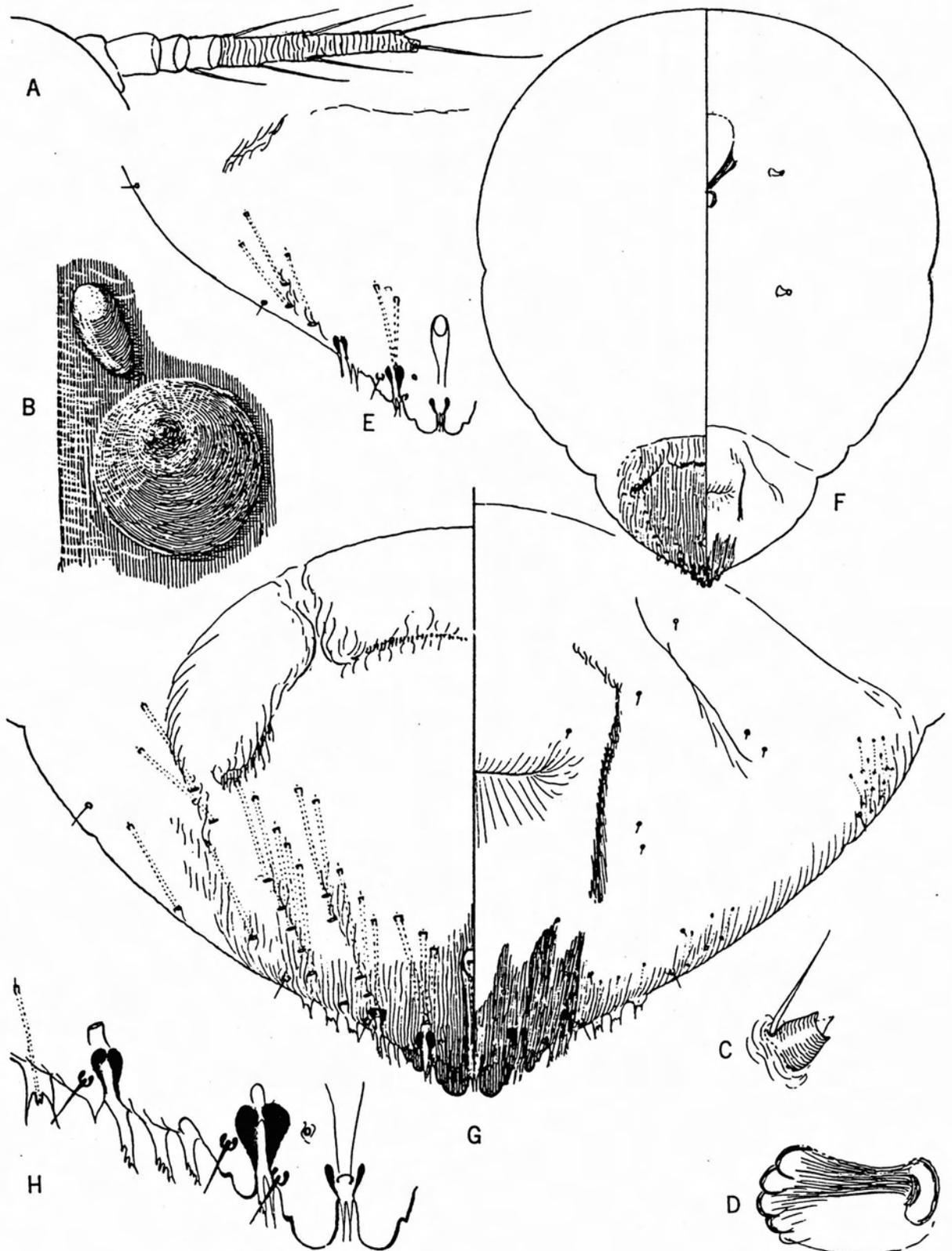


Fig. 130. *Quadraspidiotus perniciosus* (Comstock).

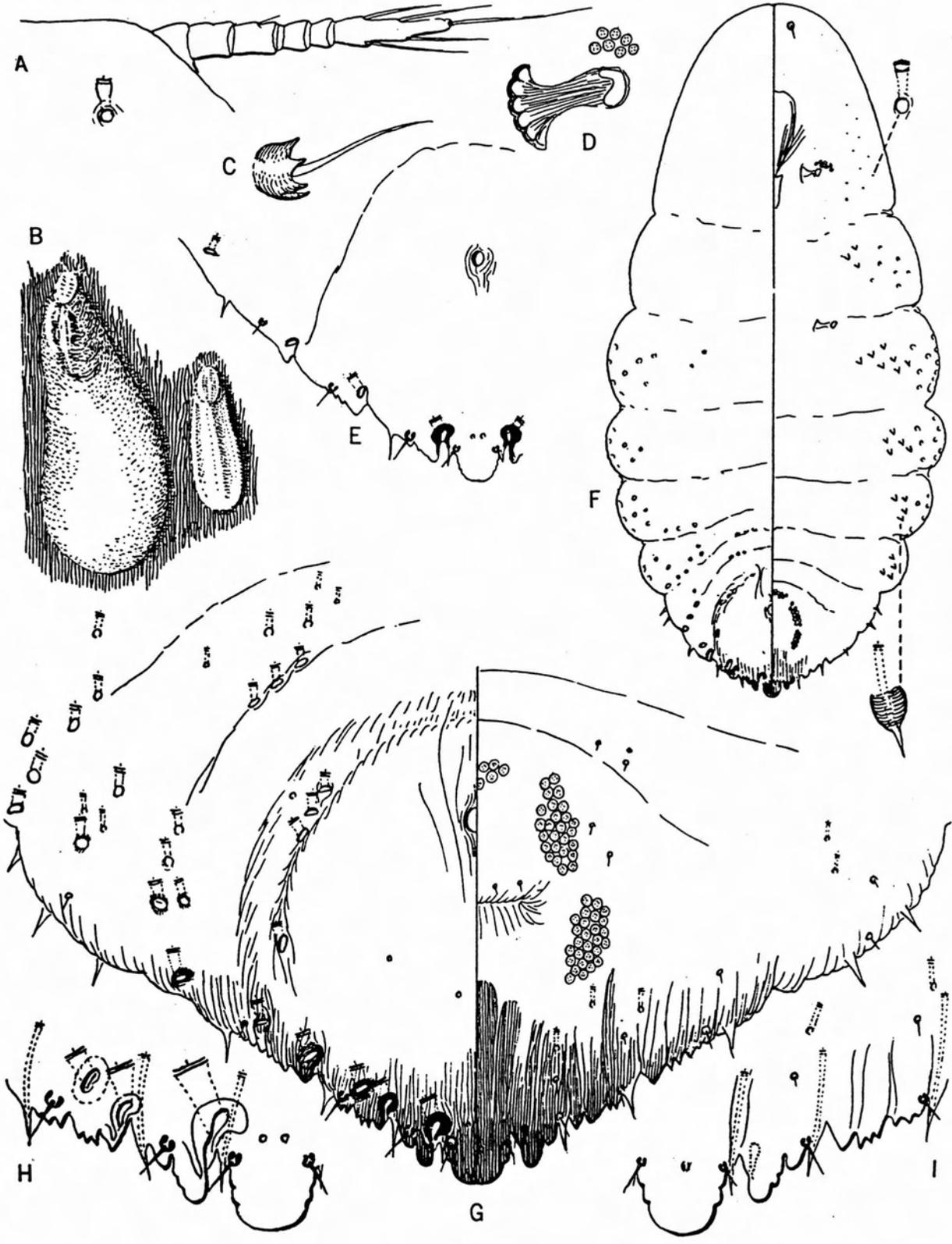


Fig. 131. *Quernaspis quercus* (Comstock).

Quernaspis quercus (Comstock), 1881
oak scale

Fig. 131, Color Plates 135, 136

Tribe: Diaspidini.

Synonymy: *Chionaspis quercus* Comstock,
Fundaspidis quercus (Comstock).

Field Characteristics: Adult female scale cover white, oystershell-shaped, 1.5 to 2.5 mm long with yellow or tan terminal exuviae. The body color is reddish-orange. Male scale covers white, elongate, feebly carinate with a terminal exuvium. Females normally found on bark and twigs, often concealed below the thin, loose epidermal layers. Male scales on bark but often found on leaves. Males exposed on leaves indicates that a cryptic infestation is present on nearby twigs.

Similar Species: Identical in the field to scales in the genera *Chionaspis* and *Aonidomytilus* but these have never been found on oak.

Biology: Unknown.

Hosts: Restricted to oaks (*Quercus*).

Economic Importance: None.

Distribution: A native species common

throughout California.

Diagnosis: Host restriction and the fused median lobes precludes confusion with any other California species. The closely related *Quernaspis quercicola* Tippins and Beshear and *Quernaspis insularis* Howell, occur on oaks in the southern United States; a number of closely related species in the genus *Neoquernaspis* occur in Asia. First instars were described and illustrated by Howell (1981).

Howell, J.O., 1981: Ann. Entomol. Soc. Am. 74:616-622.

McKenzie, H.L., 1956: The Armored Scale Insects of California. Univ. Calif. Press, Berkeley. 209 pp.

Takagi, S., and J.O. Howell, 1977: Insecta Matsumurana (n.s.) 11:31- 59.

Tippins, H.H., and R.J. Beshear, 1970: Ann. Entomol. Soc. Am. 63(3):808-809.

Genus *Rhizaspidotus* MacGillivray, 1921

Number of World species: 13.

Number of United States species: 1.

Rhizaspidotus dearnessi (Cockerell), 1898

Dearness scale

Fig. 132, Color Plate 137

Tribe: Aspidiotini.

Synonymy: *Aspidiotus dearnessi* Cockerell,
Targionia dearnessi (Cockerell), *Remotaspidiotus dearnessi* (Cockerell), *Aspidiotus gutierreziae* Cockerell and Parrott, *Targionia gutierreziae* (Cockerell and Parrott), *Chorizaspidotus gutierreziae* (Cockerell and Parrott), *Aspidiotus helianthi* Parrott, *Rhizaspidotus helianthi* (Parrott), *Targionia helianthi* (Parrott).

Field Characteristics: Female scale 1.5 to 2.5 mm in diameter, circular, fairly convex, tan or

grey, with tan subcentral or submarginal exuviae and a strongly developed ventral scale. Males white or tan, oval, with a subterminal exuvium. Occurs on stems, crowns, and even on roots. Usually well hidden except in heavy infestations.

Hosts: Has a wide range of native hosts, but found primarily on *Eriogonum* and various Compositae such as *Franseria*, *Ambrosia*, *Applopappus*, *Artemisia*, *Gutierrezia*, and *Helianthus*.

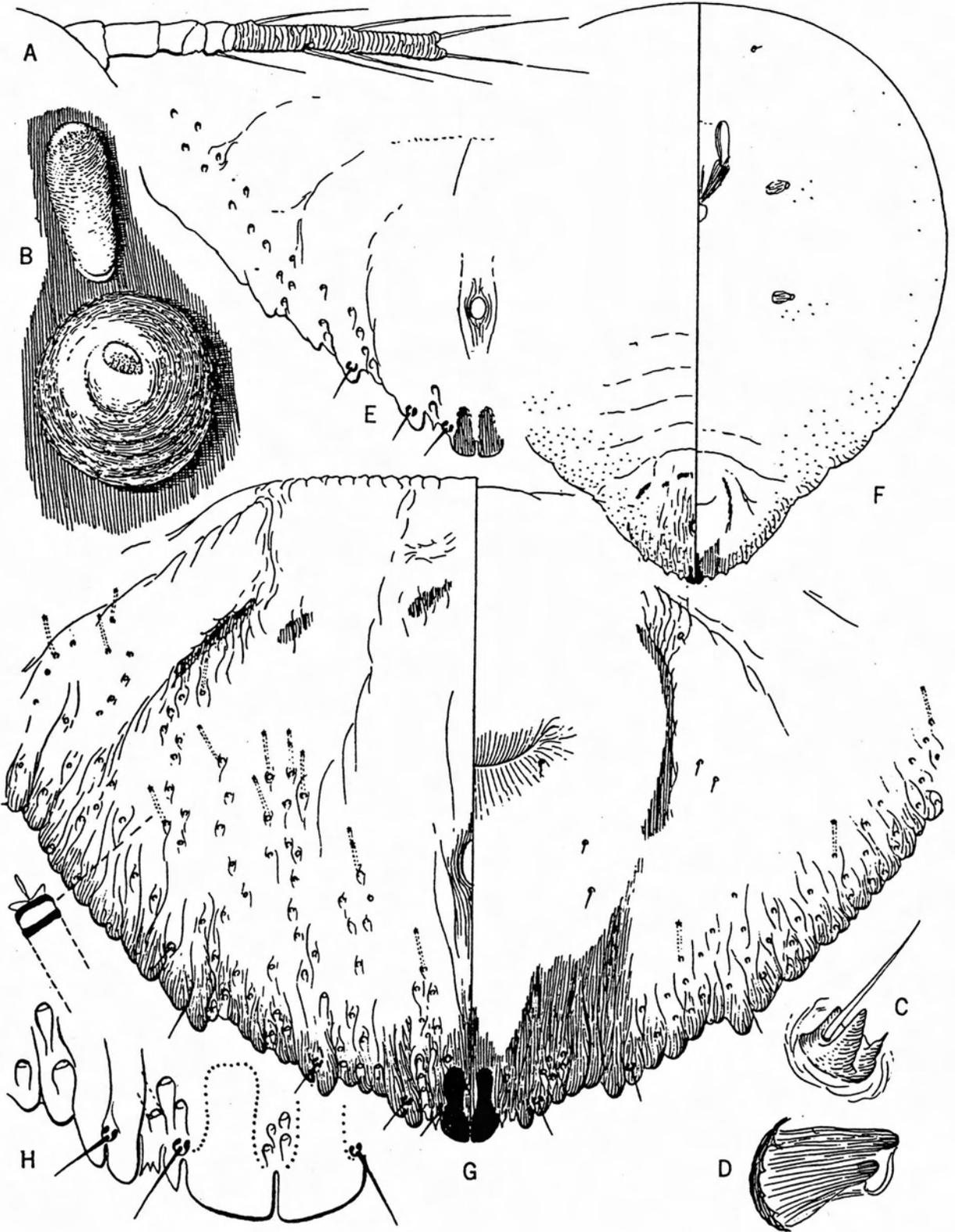


Fig. 132. *Rhizaspidotus dearnessi* (Cockerell).

Economic Importance: None.

Distribution: Common but rarely collected; native to western North America.

Diagnosis: Readily recognized by the poorly developed median lobes; short, minute pygidial macroducts; and lack of marginal plates.

Lacroix, D.S. 1926: Entomol. News. 37:249-251.
 McKenzie, H. L., 1956: The Armored Scales Insects of California. Univ. Calif. Press, Berkeley. 209 pp.

Genus *Rugaspidotus* MacGillivray, 1921

A small genus native to the southwestern United States and northwestern Mexico. The generic limits are currently in doubt; several of the species have been placed in the genus *Rugaspidotinus* by Balachowsky. These scales should be studied in much greater detail in order to solve some of the tribal and generic placement problems, but they are so rarely collected that this may be impossible for some time. Were formerly placed in the tribe Odonaspidini, but the concepts of Ben-Dov (1988) are followed here. Although they are rare in collections, this may be because they are very difficult to locate on the host. Best recognized by the lack of many of the normal structures found on other armored scales such as plates, gland spines, segmental lobes and segmental scleroses. Do not feed on grasses as do California species of Odonaspidini.

Number of World species: 5 (2 Mexican species have been placed in *Rugaspidotinus*).

Number of California species: 2.

Key to species: Ferris, G.F., 1937-42: Atlas of the Scale Insects of North America, Ser. I-IV. Stanford Univ. Press, Stanford.

KEY TO CALIFORNIA SPECIES OF *RUGASPIDIOTUS*

- 1. Body broadly pyriform with prosoma and pygidium deeply sclerotic; pygidial margin crenulate; associated with *Prosopis*, *Acacia*, and similar hosts. *arizonicus*
- Body oval or somewhat fusiform; sclerotization various; associated with *Eriogonum* in California. *nebulosus*

***Rugaspidotus arizonicus* (Cockerell), 1900**

Arizona *rugaspidotus* scale

Fig. 133

Tribe: Rugaspidotini

Synonymy: *Diaspis arizonicus* Cockerell.

Field Characteristics: Adult female scale covers elongate, white or tan, exuviae terminal, cover tapered posteriorly. Male covers white, elongate, smaller than female, exuvium terminal. Usually buried deep in bark cracks and under loose bark and bud scales.

Hosts: Apparently restricted to mesquite (*Prosopis*) and closely related desert legumes.

Distribution: Very rare. Has been collected at Andrada, Imperial County and from a number of locations in Arizona.

Diagnosis: Host restriction and pyriform body shape separate this species from *nebulosus*.

McKenzie, H.L., 1956: The Armored Scale Insects of California. Univ. Calif. Press, Berkeley. 209 pp.

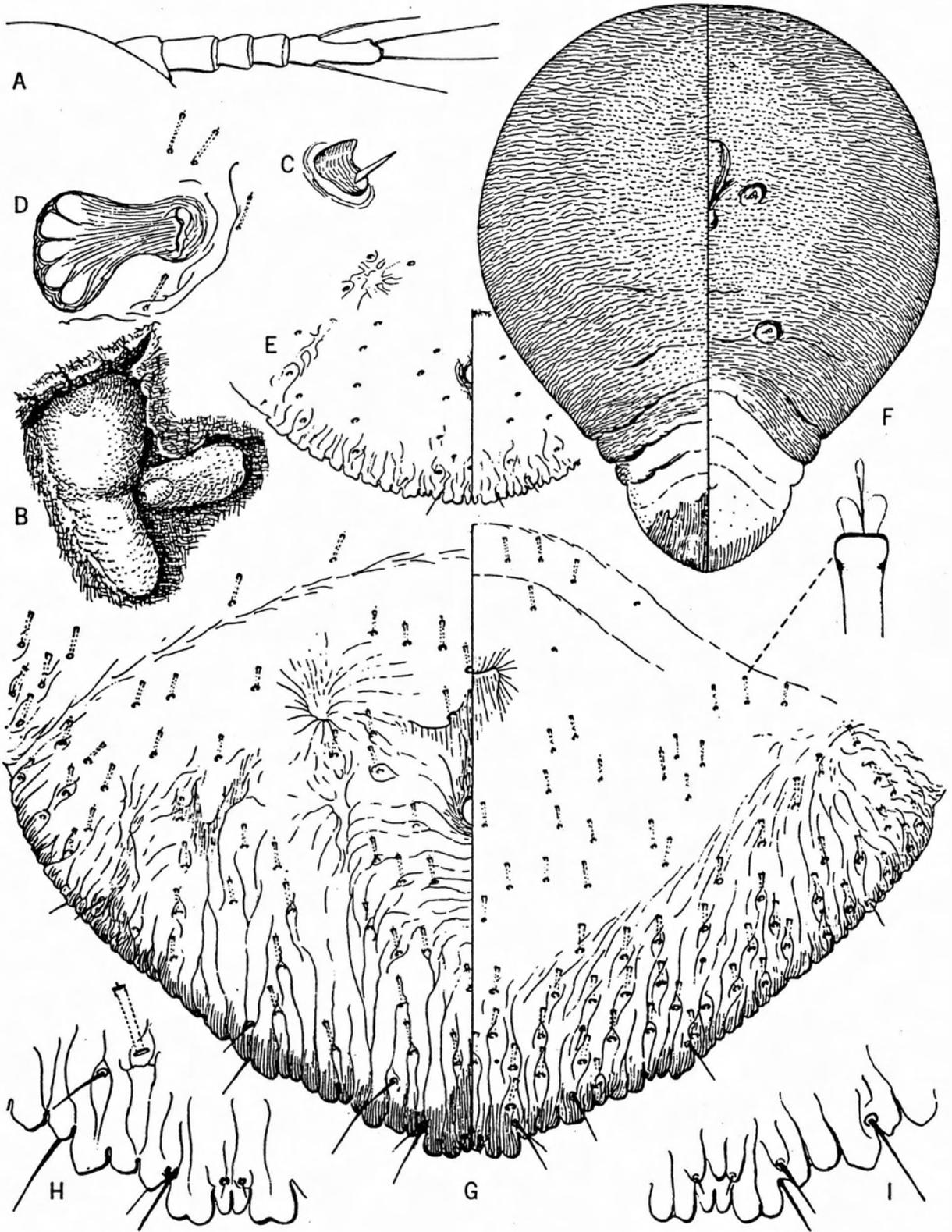


Fig. 133. *Rugaspidotus arizonicus* (Cockerell).

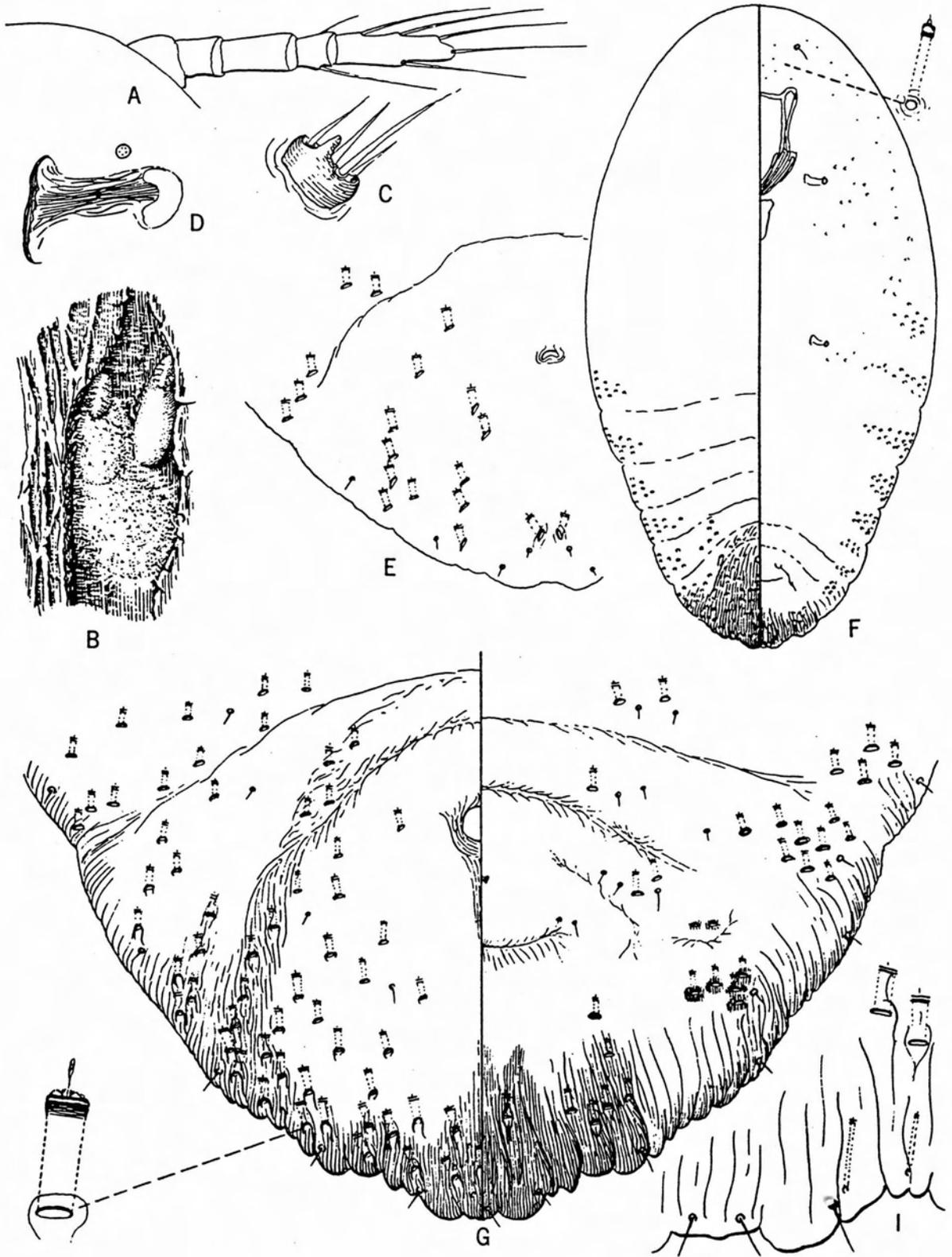


Fig. 134. *Rugaspidotus nebulosus* Ferris.

Rugaspidotus nebulosus Ferris, 1938
 nebulose scale
 Fig. 134

Tribe: Rugaspidotini

Field Characteristics: Adult female scale covers 2.0 to 2.5 mm long, elongate, flat, white with yellow terminal exuviae. Male scale covers similar to females but smaller. Scales usually produce white woolly wax secretions. Occur in bark cracks and deep beneath the loose outer ribbons of bark on larger branches near the crowns.

Similar Species: None.

Biology: Unknown.

Hosts: Buckwheat (*Eriogonum fasciculatum*).

Economic Importance: None; a rare native

species.

Distribution: Known only from Azusa, Los Angeles County; Whitewater Canyon, Riverside County and Kingman, Arizona. Probably can be found throughout southern California.

Diagnosis: Host restriction and oval body shape separate this species from *arizonicus*.

McKenzie, H.L., 1956: The Armored Scale Insects of California. Univ. Calif. Press, Berkeley. 209 pp.

Genus *Selenaspidus* Cockerell, 1897

Number of World species: 26.

Number of United States species: 3.

Key to the World species: Mamet, R., 1958: Mus. R. Congo Belge (Tervuren) Ann. (n.s.) Sci. Zool. 4:359-429.

Key to the United States species: McKenzie, H.L., 1956: The Armored Scale Insects of California. Univ. Calif. Press, Berkeley.

KEY TO CALIFORNIA SPECIES OF *Selenaspidus*

- 1. Perivulvar pores present. *articulatus*
- Perivulvar pores absent 2

- 2. Median and second pygidial lobes approximately same size and shape, smoothly rounded; ventral sclerotized prosomal spur present. *albus*
- Second pair of pygidial lobes noticeably smaller than median lobes, both pairs notched on either side; ventral sclerotized spur absent, submarginal sclerotized boss in this position *rubidus*

Selenaspidus albus McKenzie, 1953
 white euphorbia scale
 Fig. 135, Color Plate 138

Tribe: Aspidiotini.

Field Characteristics: Female scale cover 1.5 to 2.5 mm in diameter, circular, flat, white or yellowish-white with orange central exuviae.

Males have not been identified in the population. Found on all green surfaces of host.

Similar Species: *Selenaspidus rubidus*, which occurs on the same hosts.

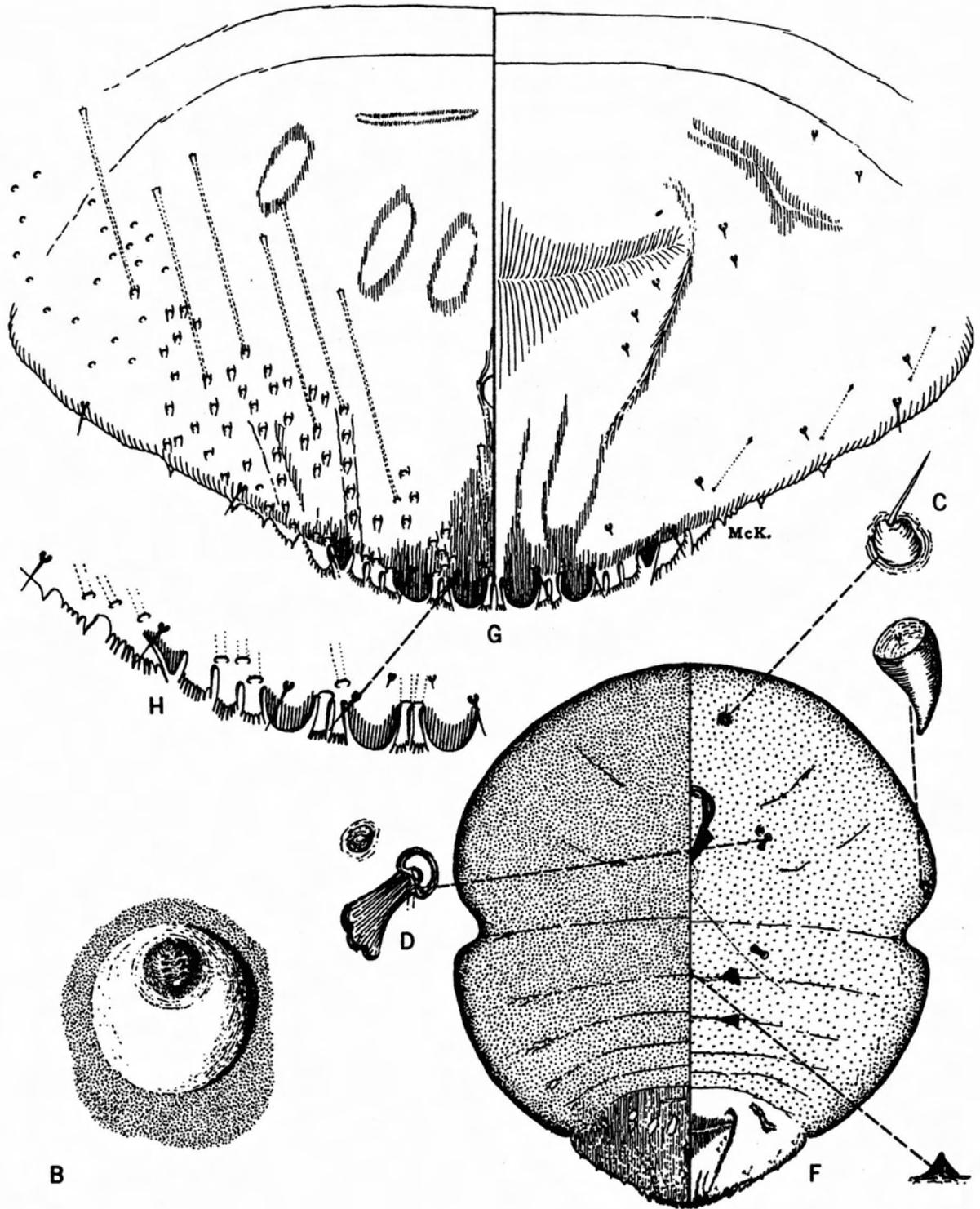


Fig. 135. *Selenaspidus albus* McKenzie.

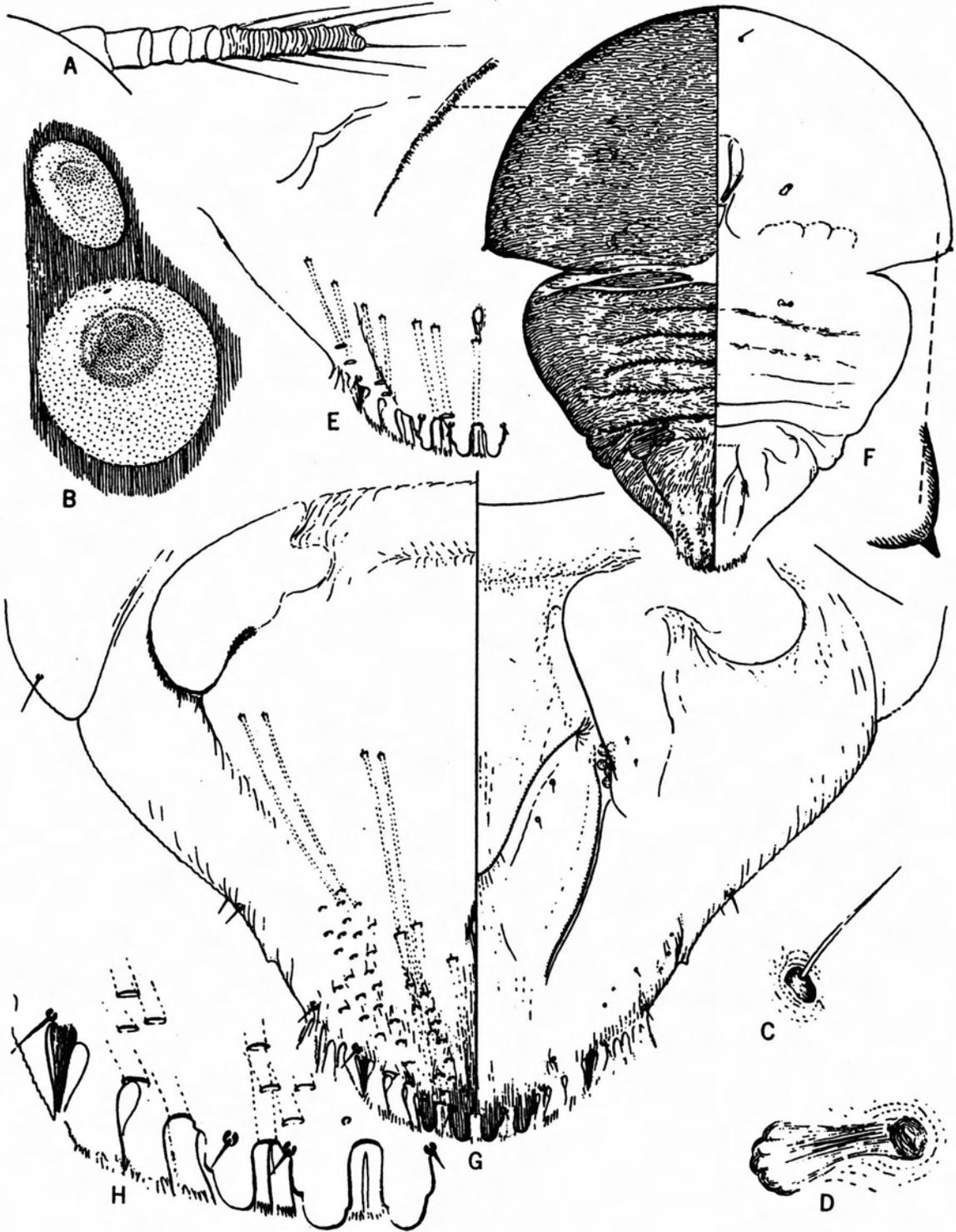


Fig. 136. *Selenaspidus articulatus* (Morgan).

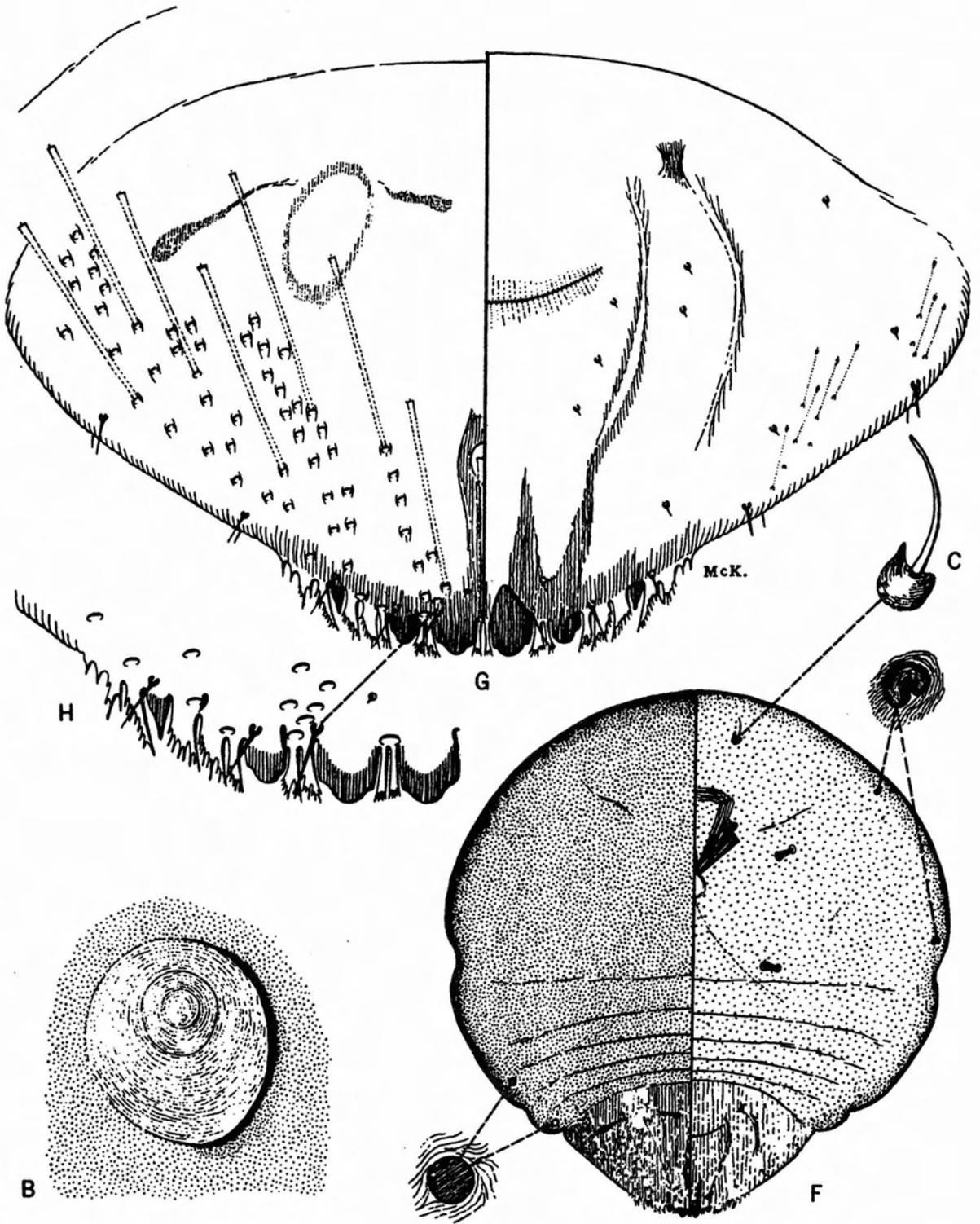


Fig. 137. *Selenaspidus rubidus* McKenzie.

Hosts: Euphorbias.

Economic Importance: Heavy populations develop on infested plants requiring either treatment or destruction of the plants.

Distribution: Very rare; found primarily on ornamental specimens in nurseries from San Luis Obispo south to San Diego. Probably native to Africa.

Diagnosis: Morphologically very similar to *Selenaspis rubidus*, so much so that some synonymy may be involved. Some collections

have indicated that there may be an intergradation of the characters which McKenzie used to separate the two species. However, both scales are so seldom collected that further conclusions cannot be drawn at this time.

McKenzie, H.L., 1953: Calif. Dep. Agric. Mon. Bull. 12:52-58.

McKenzie, H.L., 1956: The Armored Scale Insects of California. Univ. Calif. Press, Berkeley. 209 pp.

Selenaspis articulatus (Morgan), 1889

rufous scale

Fig. 136

Tribe: Aspidiotini.

Other Common Names: West Indian red scale.

Synonymy: *Aspidiotus articulatus* Morgan, *Pseudaonidia articulata* (Morgan).

Collected on croton plants in a nursery in Oakland, Alameda County in 1947. Eradicated. Frequently encountered on a wide range of tropical plants in quarantine. Many species in Africa have the unique indented shape of this species. The keys in Mamet (1958) are useful in separating this species from other *Selenaspis* forms. Information on biology can be obtained from Beingolea (1969) and Herrera (1964).

Beingolea, O., 1969: Rev. Peru Entomol. 12(1):119-129.

Herrera, J.M., 1964: Rev. Peru Entomol. 7(1):1-8.

Mamet, J.R., 1958: Mus. R. Congo Belge (Tervoren) Ann. (n.s.) Sci. Zool. 4:359-429. (?)

Selenaspis rubidus McKenzie, 1953

brownish euphorbia scale

Fig. 137

Tribe: Aspidiotini.

Collected from euphorbia plants in several nurseries in Los Angeles, San Diego, and Ventura Counties. Not collected in the State since 1948; probably not part of the California fauna. Very similar to *S. albus* morphologically, see comments under that species.

Genus *Situlaspis* MacGillivray, 1921

In the Borchsenius Catalogue (1966) one species, *multiplora*, was placed in the genus *Crassaspis*. The present author thinks that this move is not entirely justified, hence *multiplora* will be left in *Situlaspis* here.

Number of World species: 6.

Number of United States species: 5.

Key to the World species: Ferris, G.F., 1937-1942: Atlas of the Scale Insects of North America,

Ser. I-IV. Stanford Univ. Press, Stanford.

Key to the California species: McKenzie, H.L., 1956: The Armored Scale Insects of California. Univ. Calif. Press, Berkeley. 209 pp.

KEY TO CALIFORNIA SPECIES OF *SITULASPIS*

1. Second pygidial lobe present as distinct lobe or point. 2
 — Second pygidial lobe entirely obsolete; pygidium broadly rounded apically; associated with *Atriplex* in California. *atriplicis*
2. Pygidium and prepygidial segments with large numbers of dorsal macroducts. . . . 3
 — Pygidium with scarcely more than ten macroducts, including those of margin, on each side; prepygidial segments with but few small ducts on margins; perivulvar pores at times present; on numerous hosts. *yuccae*
3. Median pygidial lobes large and broad (each almost twice as large as anal opening circumference), well separated, and with three or four dorsal ducts between their bases; associated with mistletoe in California. *multipora*
 — Median pygidial lobes quite small (each approximately same size as anal opening circumference), and with only one large duct between their bases; associated with *Dalea* in southern California. *daleae*

Situlaspis atriplicis (Ferris), 1919
 atriplex scale
 Fig. 138

Tribe: Diaspidini.

Synonymy: *Pseudodiaspis atriplicis* Ferris.

Field Characteristics: Female scale cover 1 mm in diameter, circular, slightly convex, white, with reddish-brown subcentral exuviae. Male scale cover elongate, white, with a terminal exuvium. Occurs on leaves and twigs.

Similar Species: Identical in appearance to other *Situlaspis* scales, but can be field identified by host preference.

Hosts: *Atriplex*.

Distribution: A rare native species of the desert areas of Los Angeles County south into Arizona.

Diagnosis: Recognized by host restriction and the lack of the second pair of pygidial lobes.

McKenzie, H.L., 1956: The Armored Scale Insects of California. Univ. Calif. press, Berkeley. 209 pp.

Situlaspis daleae Ferris, 1941
 dalea scale
 Fig. 139

Tribe: Diaspidini.

Field Appearance: Scale cover 1 mm in diameter, circular, convex, white, with brown or black subcentral exuviae. Females occur on twigs, particularly in the axils and underneath

the bracts.

Hosts: Prefers indigo bush (*Dalea*); also collected from *Yucca*, *Cercocarpis* and *Prunus*.

Distribution: A rare native species of the desert areas of Riverside County; probably occurs in

adjacent counties as well.

Diagnosis: Similar morphologically to *yuccae*. Differs in having larger number of macroducts on the prepygidial abdominal segments.

McKenzie, H.L., 1956: The Armored Scale Insects of California. Univ. Calif. press, Berkeley. 209 pp.

***Situlaspis multipora* (Ferris), 1919**
mistletoe situlaspis scale
Fig. 140, Color Plate 139

Tribe: Diaspidini.

Synonymy: *Pseudodiaspis multipora* Ferris, *Crassaspis multipora* (Ferris).

Field Appearance: Female scale covers 1.0 to 1.5 mm in diameter, circular, fairly convex, white, with yellow or brown subcentral exuviae. Male scale covers elongate, white, with a terminal exuvium.

Similar Species: *Diaspis parasiti* and *Epidiaspis*

salicicola, but *parasiti* male covers have a carina which is lacking in *multipora* males. *E. salicicola* is difficult to separate in the field.

Hosts: Mistletoe (*Phoradendron*).

Distribution: Desert-montane transitional areas of San Diego, San Bernardino, Imperial, and Riverside Counties.

Diagnosis: Host preference and the enlarged, well-separated median lobes are distinctive.

***Situlaspis yuccae* (Cockerell), 1896**
yucca scale
Fig. 141, Color Plate 140

Tribe: Diaspidini.

Other Common Names: small situlaspis scale, celtis scale.

Synonymy: *Aspidiotus yuccae* Cockerell, *Xerophilaspis parkinsoniae* Cockerell, *Pseudodiaspis parkinsoniae* (Cockerell), *Targionia yuccae* (Cockerell), *Pseudodiaspis yuccae* (Cockerell), *Neosignoretia yuccae* (Cockerell).

Field Characteristics: Female scale cover 1.0 to 1.5 mm in diameter, circular, moderately convex, dirty white, with reddish-brown subcentral exuviae. Males elongate, dirty white, with a tan terminal exuvium. Found on leaves and stems.

Similar Species: Oleander scale, but males, if present, have a subterminal rather than a terminal exuvium.

Hosts: Native desert plants, but has a wide host range and has moved onto various introduced ornamental plants, especially ivy, in suburbanized desert communities.

Economic Importance: A troublesome pest of ornamental plants in Arizona.

Distribution: Common in desert areas of southern California and the southwestern United States. Has moved into the San Joaquin and Sacramento Valleys on nursery stock.

Diagnosis: Similar to *dalea* but has fewer macroducts.

McKenzie, H.L., 1956: The Armored Scale Insects of California. Univ. Calif. Press, Berkeley. 209 pp.

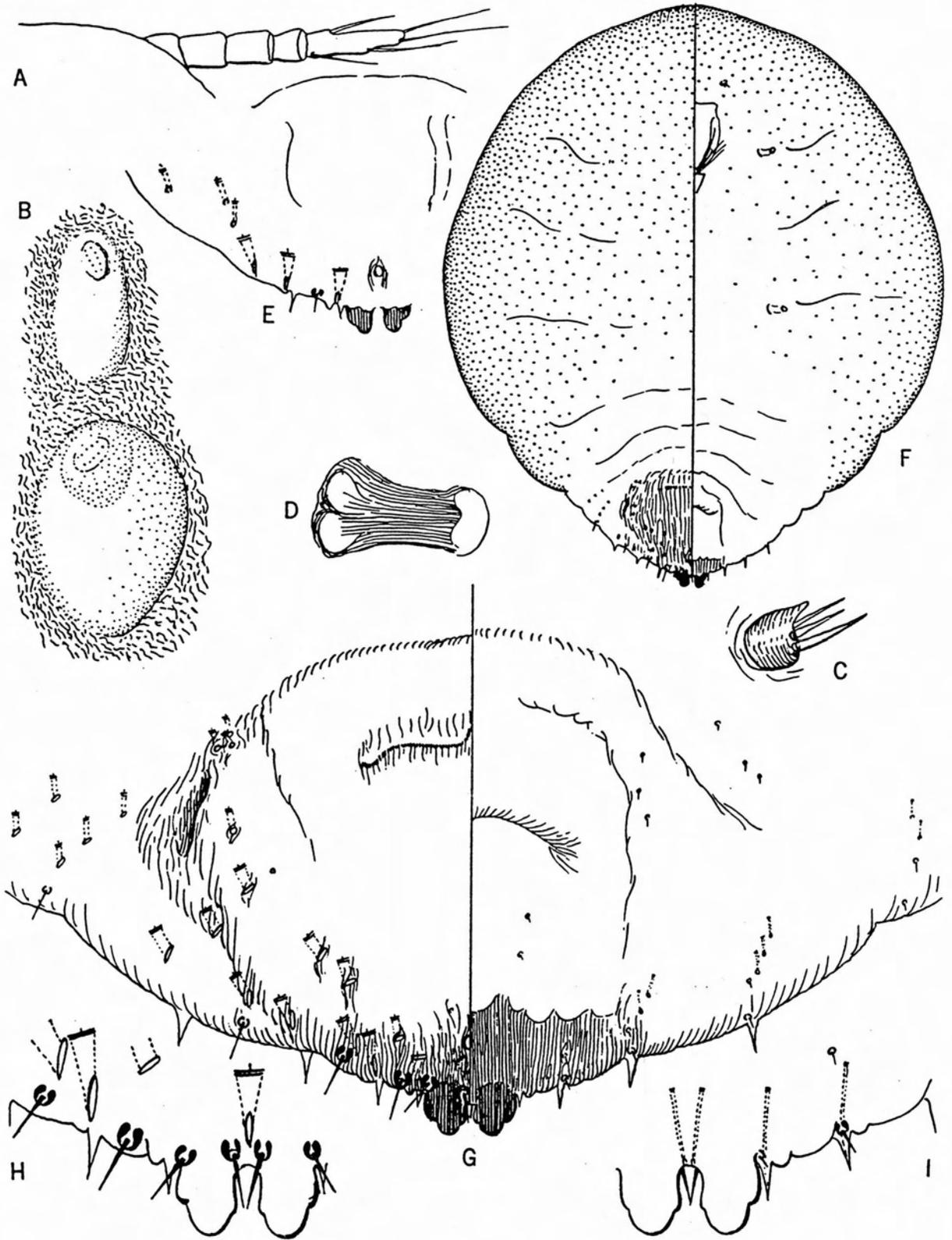


Fig. 138. *Situlaspis atriplicis* (Ferris).

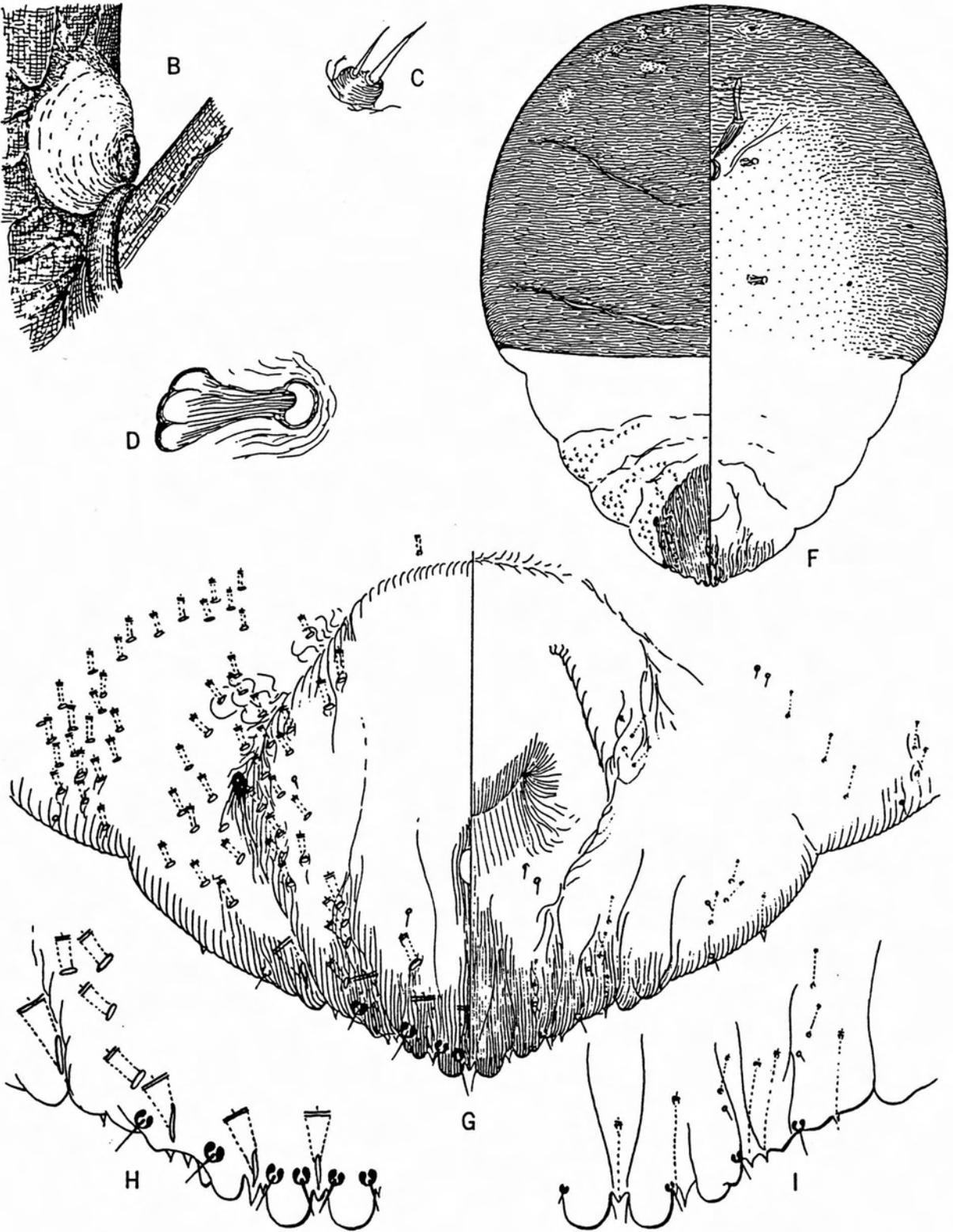


Fig. 139. *Situlaspis daleae* Ferris.

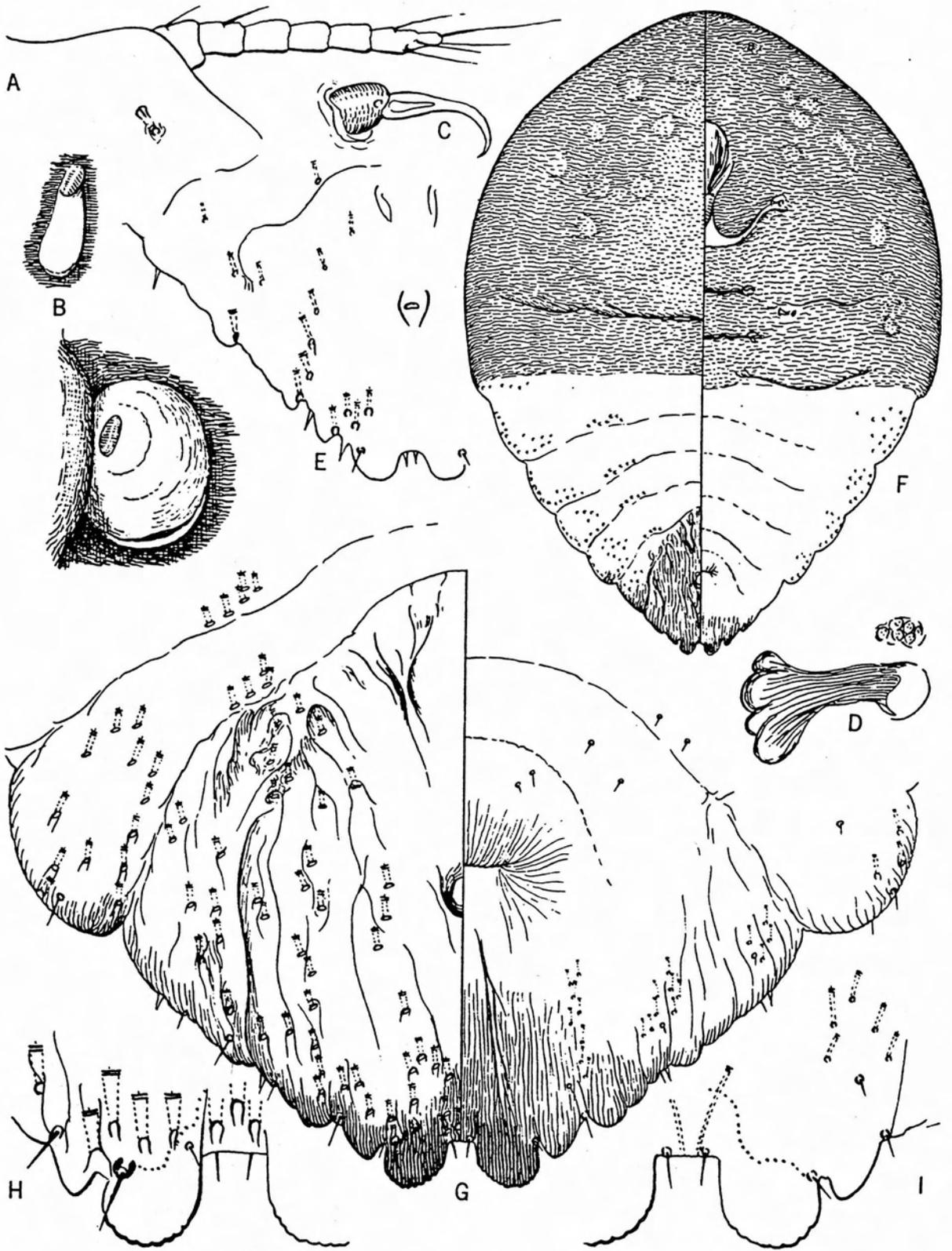


Fig. 140. *Situlaspis multipora* (Ferris).

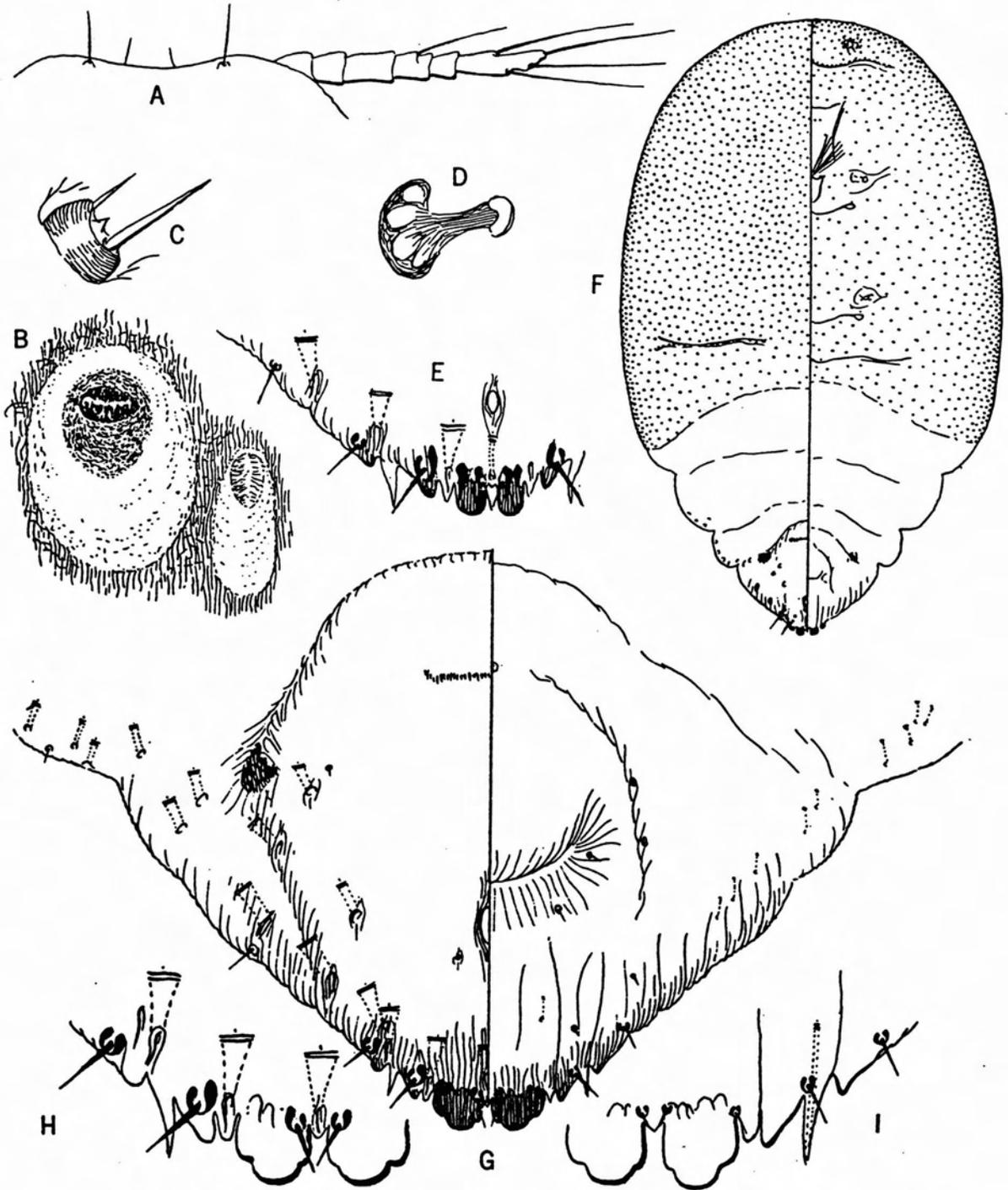


Fig. 141. *Situlaspis yuccae* (Cockerell).

Genus *Stramenaspis* Ferris, 1937

Monotypic.

Stramenaspis kelloggi (Coleman), 1903

Kellogg scale

Fig. 142, Color Plate 141

Tribe: Diaspidini.**Synonymy:** *Leucaspis kelloggi* Coleman, *Dinaspis kelloggi* (Coleman), *Suturaspis kelloggi* (Coleman), *Lepidosaphes kelloggi* (Coleman).**Field Characteristics:** Female scale cover 3 to 5 mm long, elongate, fairly convex, tan, with terminal yellow first instar and tan second instar exuviae. Males similar but smaller.

Occurs on needles.

Similar Species: Pine needle scale is similar but is snow-white rather than tan.**Hosts:** Pine, Douglas fir, white fir.**Distribution:** Rather uncommon, native; occurs throughout the State, usually on conifers in their native habitat.**Diagnosis:** Similar in shape to *Chionaspis pinifoliae*, but that species has perivulvar pores and contiguous median lobes; *kelloggi* lacks perivulvar pores and the median lobes are separated by a pair of gland spines.

McKenzie, H.L., 1956: The Armored Scale Insects of California. Univ. Calif. Press, Berkeley. 209 pp.

Genus *Targionia* Signoret, 1968

Two North American species which, in the Borchsenius Catalogue (1960), have been placed in the genus *Targaspidiotus*, a name that Ferris considered a synonym of *Targionia*. The change from *Targionia* to *Targaspidiotus* for the North American forms may be justified, but they will be left in *Targionia* here for convenience.

Key to the United States species: Ferris, G.F., 1937-1942: Atlas of the Scale Insects of North America, Ser. I-IV. Stanford Univ. Press, Stanford.

Targionia bigeloviae (Cockerell), 1897

bigelovia scale

Fig. 143

Tribe: Aspidiotini.**Synonymy:** *Aspidiotus bigeloviae* Cockerell, *Leonardiana bigeloviae* (Cockerell), *Targaspidiotus bigeloviae* (Cockerell), *Hemiberlesia bigeloviae* (Cockerell).**Field Characteristics:** Female scale cover 1.5 to 2.5 mm in diameter, circular, flat, dark reddish-brown, with whitish subcentral exuviae. Males elongate oval, reddish-brown, with a subterminal exuvium. Occurs on stems and crowns, as does Dearness scale.**Hosts:** Various native composites such as *Encelia*, *Bigelovia*, *Gutierrezia*, *Lepidospartum*, and also *Eriogonum*.**Distribution:** A rare native species known from Inyo, Los Angeles, Santa Barbara and Imperial Counties.

McKenzie, H.L., 1956: The Armored Scale Insects of California. Univ. Calif. Press, Berkeley. 209 pp.

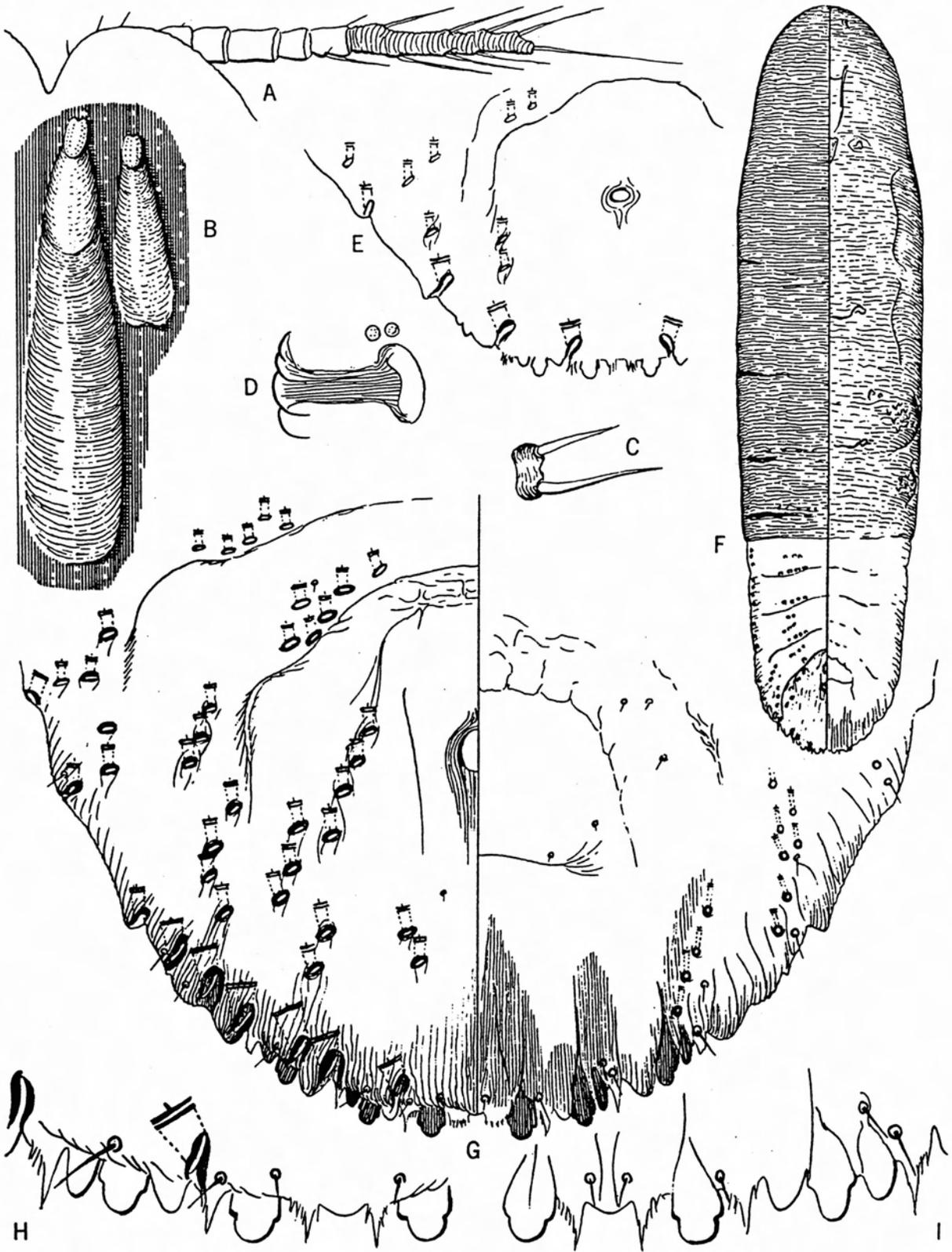


Fig. 142. *Stramenaspis kelloggi* (Coleman).

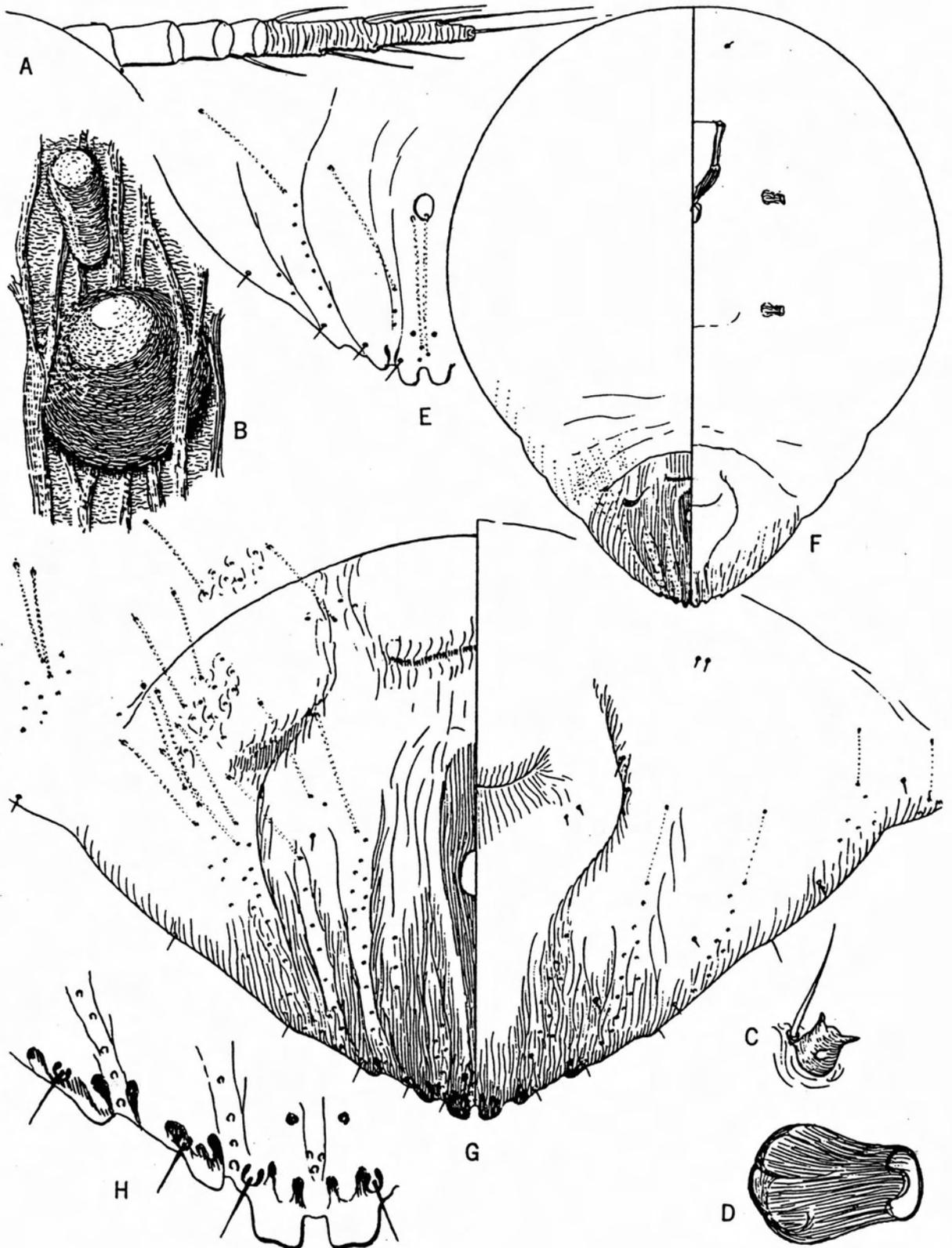


Fig. 143. *Targionia bigeloviae* (Cockerell).

Genus *Unaspis* MacGillivray, 1921

Number of World species: 12.

Number of United States species: 2.

Key to the World species: Rao, V.P., 1949: Microentomol. 14(2):59-72 (incomplete).

Key to the United States species: Ferris, G.F., 1937-1942: Atlas of the Scale Insects of North America, Ser. I-IV. Stanford Univ. Press, Stanford.

Unaspis euonymi* (Comstock), 1881*euonymus scale (ESA approved)****Fig. 144, Color Plate 142**

Tribe: Diaspidini.

Synonymy: *Chionaspis euonymi* Comstock,
Unaspis nakayamai Takahashi and Kanda.

Field Characteristics: Adult female scale covers 1.5 to 2.0 mm long, elongate or oystershell-shaped, slightly convex, dark brown, with yellowish-brown terminal exuviae. Males elongate, white, strongly tricarinate, with a terminal exuvium. Males very common and easily seen. Found on most aerial host parts.

Biology: Apparently has two or three generations per year; over-winters as adult females. For more information see Cantelo (1953), Kosztarab (1963), Stimmel (1979), and Gill et al., (1982).

Similar Species: On its preferred hosts should not be confused with any other species because of the dark brown oystershell scale cover and the large numbers of white tricarinate males. Yanagicola scale, *Lepidosaphes yanagicola* Kuwana, is similar in shape and occurs on the same hosts, but it is light tan, flatter, and lacks the white carinated male covers.

Hosts: Restricted to *Euonymus* and *Pachysandra* in California. Collected on other hosts in the eastern United States. For a host list see McKenzie (1956), Kosztarab (1963) and Dekle (1976).

Economic Importance: A "B"-rated pest in California. A serious pest of euonymus, causing severe chlorosis, stunting and eventual death of the plants. For more information see Sanders (1909), Neiswander (1954), Pirone (1970), Stimmel (1979), Gillet al (1982), Brewer

and Oliver (1987), Cockfield et al (1987), Cockfield and Potter (1990a, 1990b) and Sadof and Neal (1993). For information on natural enemies see Drea and Carlson (1987, 1988), and Hendrickson et al (1991).

Distribution: Collected in Los Angeles, Marin, Sacramento, San Mateo and Santa Clara Counties. The Sacramento infestations are still active, status of the others is unknown. Very common east of the Rocky Mountains; apparently cosmopolitan in the Northern Hemisphere. Introduced into the United States from the Orient prior to 1880, when it was first found in Virginia.

Diagnosis: Should not be confused with any other California scale insect. Citrus snow scale, *Unaspis citri* (Comstock), known from Florida and Louisiana, is similar but lacks the perivulvar pores present in *euonymi*. For detailed descriptions and illustrations of the taxonomy of all stages see Gill et al (1982).

Brewer, B.S. and A.D. Oliver, 1987: J. Entomol. Sci. 22(2):119-122.

Cantelo, W.W., 1953: Univ. Mass. Agric. Exp. Stn. Bull. 471:1-31.

Cockfield, S.D. and D.A. Potter, 1987: Environ. Entomol. 16:917-921.

Cockfield, S.D. and D.A. Potter, 1990a: Journal of Arboriculture 16(9):239-241.

Cockfield, S.D. and D.A. Potter, 1990b: J. Econ. Entomol. 83(3):995-1001.

Drea, J.J. and R.W. Carlson, 1987: Proc.

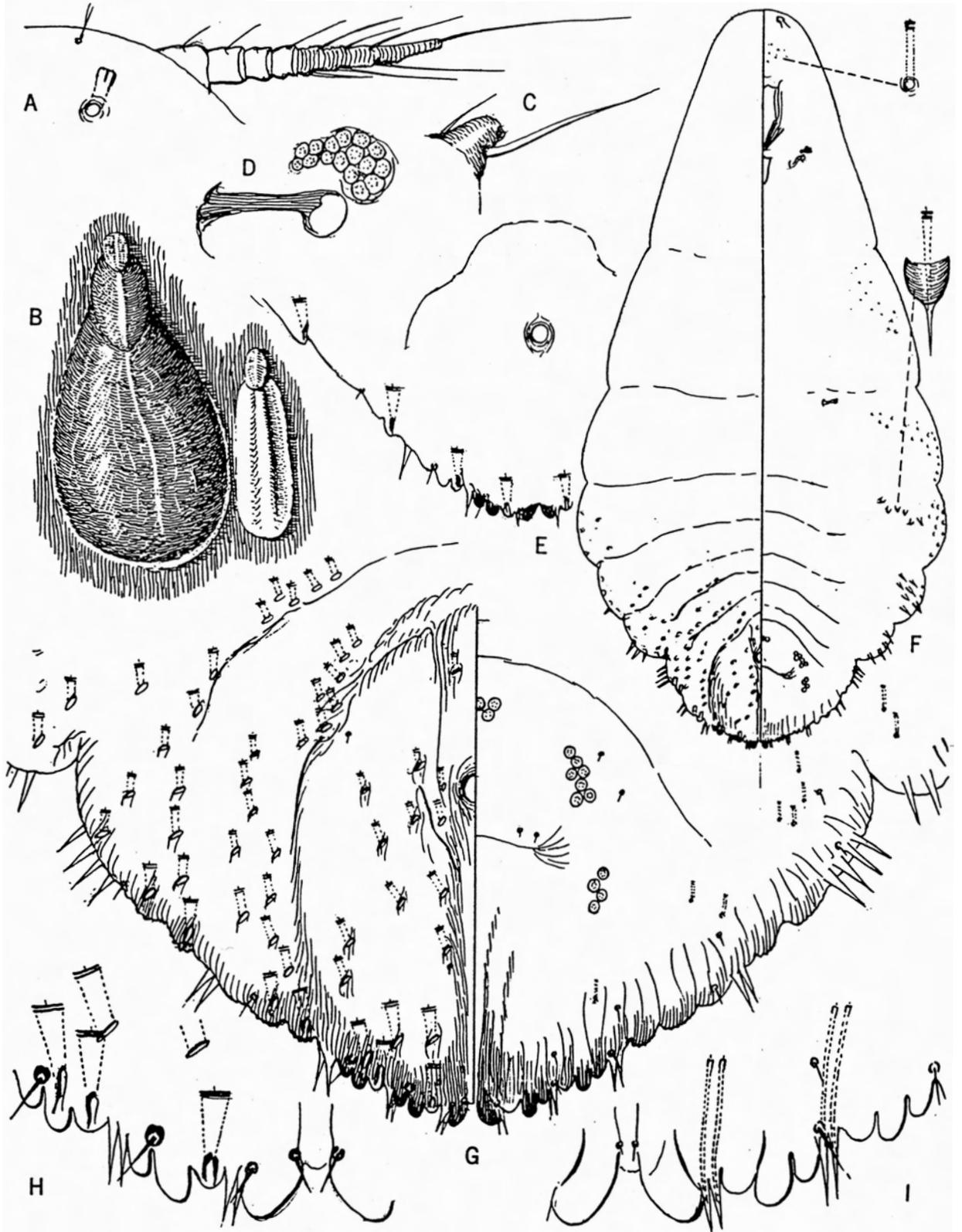


Fig. 144. *Unaspis euonymi* (Comstock).

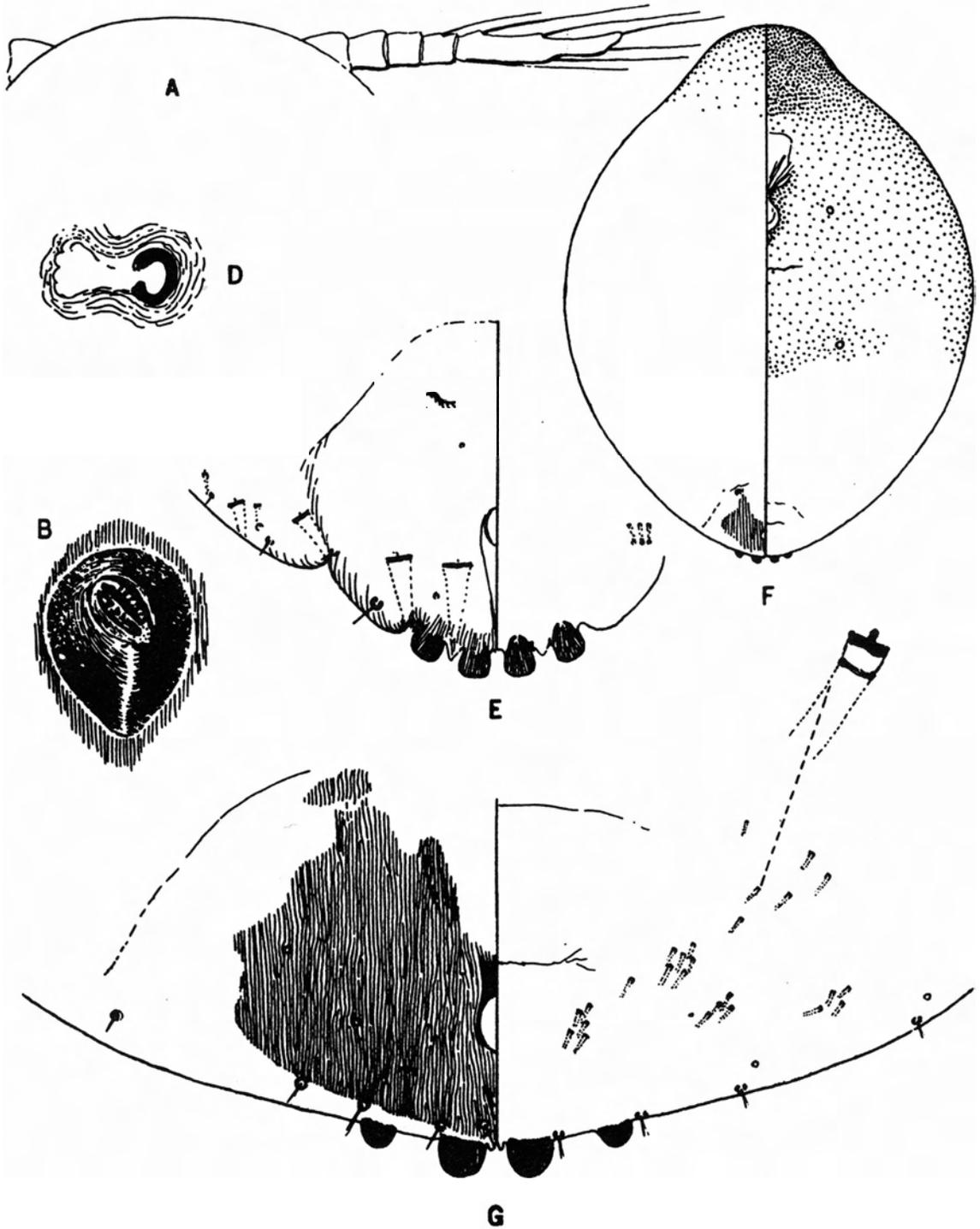


Fig. 145. *Xerophilaspis prosopidis* (Cockerell).

- Entomol. Soc. Wash. 89(4):197-200.
- Drea, J.J. and R.W. Carlson, 1988: Proc. Entomol. Soc. Wash. 90(3):307-309.
- Dekle, G.W., 1976: Florida Armored Scale Insects. Fla. Dept. Agric. Cons. Serv., Div. Plant Ind., Gainesville. 345 pp.
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- McKenzie, H.L., 1956: The Armored Scale Insects of California. Univ. Calif. Press, Berkeley. 209 pp.
- Neiswander, R.B., 1954: Ohio Farm Home Res. 43(313):54-55.
- Pirone, P.P., 1970: Diseases and Pests of Ornamental Plants. The Roland Press Co., New York. 546 pp.
- Sadof, C.S. and J.J. Neal, 1993: Ann. Entomol. Soc. Am. 86(5):614-620.
- Sanders, J.G., 1909: USDA Bur. Entomol. Circ. 114:1-5.
- Stimmel, J.F., 1979: Pa. Dep. Agric. Reg. Hort. Entomol. Circ. 41, Vol. 5(1):23-24.

Genus *Xerophilaspis* Cockerell, 1897

Monotypic.

Xerophilaspis prosopidis (Cockerell), 1895

mesquite scale

Fig. 145, Color Plates 143, 144

Tribe: Diaspidini.

Synonymy: *Aspidiotus prosopidis* Cockerell.

Field Characteristics: Female scale covers 0.5 to 1.0 mm in diameter, circular, flat, shiny black but may be covered with a thin, whitish waxy film. Adult females semi-pupillarial, remaining inside the black, sclerotized second exuvium, so that there appears to be only one subcentral exuvium. Males tan, oval, with a central exuvium, one of the few cases within the tribe Diaspidini where the exuviae are not

terminal. Occurs on twigs and leaves.

Hosts: Mesquite (*Prosopis*).

Distribution: Native to desert areas of California, Arizona, Texas and Mexico.

Diagnosis: Recognized by host restriction, color, and morphologically by the lack of gland spines and dorsal macroducts.

McKenzie, H.L., 1956: The Armored Scale Insects of California. Univ. Calif. Press, Berkeley. 209 pp.

Adult Male Morphology

Adult male morphology has been studied by several authors, especially Bustshik, 1958 and Ghauri, 1962. Several publications including Boratynski and Davies, 1971, Davies and Boratynski, 1979 and Davies, 1981 deal with numerical taxonomy as it relates to male morphology. Identifications of the males is generally not much value below the tribal level. Adult males are seldom collected since they are so tiny and difficult to see in the field. Males are not known for a good many species, and some species races are parthenogenetic. Published descriptions of the males of California species are referenced under each species treatise. A provisional key to and illustrations of some of the known California males are included here after the individual species treatments.

While not particularly useful for species identifications in general, there has been a need to take a cursory look at some of the males of armored scale species in California. Over the years, there have been several pest control districts set up for the localized eradication of California red scale in certain citrus growing areas. One such example, the Coachella Valley Red Scale Control District, is still active and is using the pheromone activated trap for adult males as a survey technique. A similar trapping program is also in use in Arizona. While these traps are theoretically specific to only California red scale, they do trap males of other species accidentally, and sometimes in large numbers. Because of the problem of non-target species in the trap, procedures had to be developed to make sure of the identity of the males in the traps, thus avoiding costly eradicated pesticide treatments for the wrong species. The following key to California male armored scales was developed to supply a tool to assess the males trapped in these situations. The illustrations show general male anatomy and the specific morphology for a number of common California male armored scales.

The armored scale species can be broken down into subtribal affinities which match very nicely with those tribal groups originally set up for the adult females. The dorsal submedian row of abdominal setae immediately separates out four of the six tribes. These tribes include *Situlaspis*, *Xerophilaspis* and several other genera which have been encountered in red scale traps previously. Prescutal setae separate the Parlatorines, and while they have not been seen in the traps, *Parlatoria oleae* does occur in the citrus growing areas of the Coachella Valley, California, and Arizona.

The major problem lies with the Aspidiotini. Except for two species, there seem to be no characters on the body of the males which will consistently separate one from another. The only significant and easily readable character appears to be the length of the setae on the antennae, but the reliability of even this character is presently open to question. Of the two differing species, *Aspidiotus nerii*, has some polygonal striations on the scutum and behind the scutellum; *Quadraspidotus perniciosus* has only a single row of ventral abdominal setae on each side and there is only one genal seta on each side of the head instead of the normal two. Antennal characters including setal lengths are shown for several common Aspidiotines in figure 163.

**PROVISIONAL KEY TO SOME SUBTRIBES
OF CALIFORNIA ARMORED SCALE MALES**

- 1. Dorsal submedial abdominal setae present on segments 1 to 7; prescutum quadrate (see Figs 148-150). **2**
- Dorsal submedial abdominal setae present on segments 1 to 2 or on 1 to 3 only; prescutum transversely elongate (see Figs 146, 155, 162). **4**

- 2. Prescutum, scutum and head with polygonal reticulations. **Chionaspiformes**
- Thorax and head without polygonal reticulations. **3**

- 3. With a posterior median process and basally contiguous anterior arms on postoccipital ridge (see Fig 148). **Lepidosaphidina**
- With a normal postoccipital ridge (see Figs 149-151), includes at least the genera *Situlaspis*, *Diaspis*, *Carulaspis*, and *Xerophilaspis*. **Diaspidiformes**

- 4. Prescutum triangularly produced anteriorly, prescutal setae present, and usually scutellar setae present. **Parlatorina**
- Prescutum rounded anteriorly; prescutal and scutellar setae absent, includes at least the genera *Aonidiella*, *Abgrallaspis*, *Aspidiotus*, *Diaspidiotus*, *Quadraspidotus* and *Hemiberlesia*. **Aspidiotini**

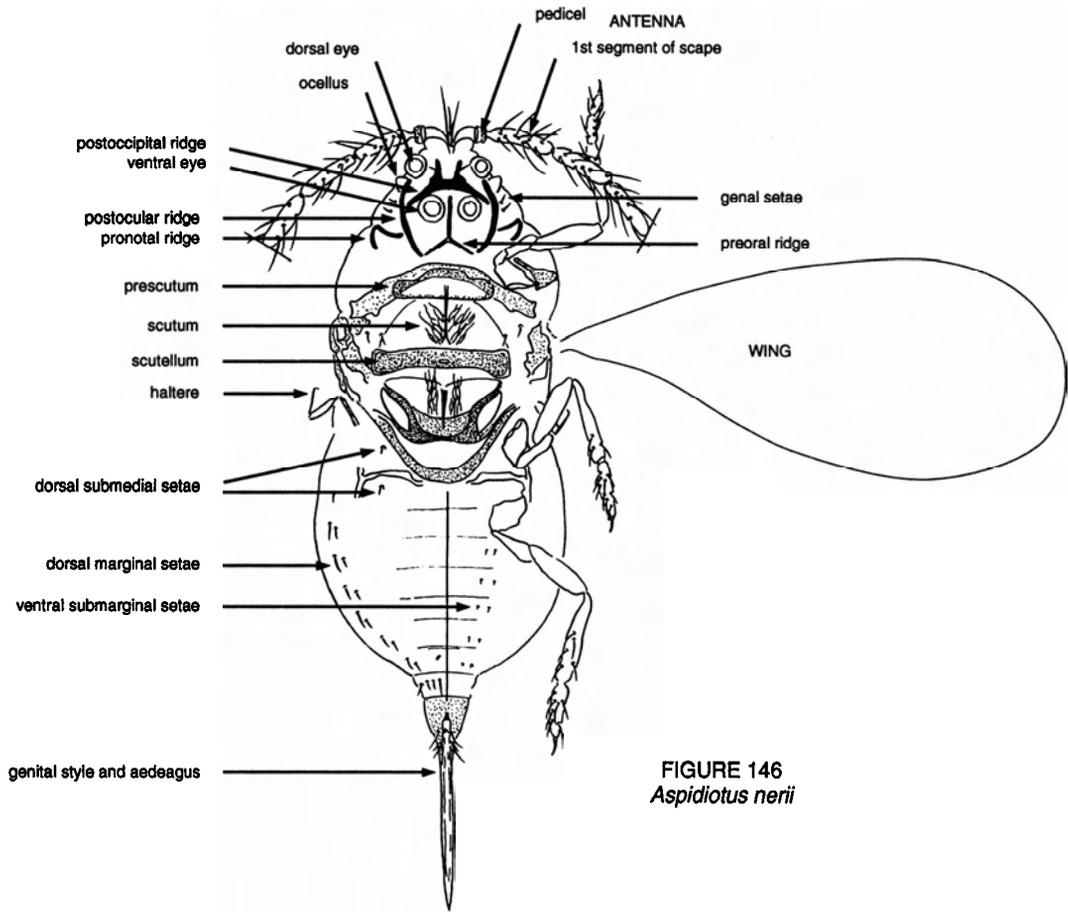


FIGURE 146
Aspidiotus nerii

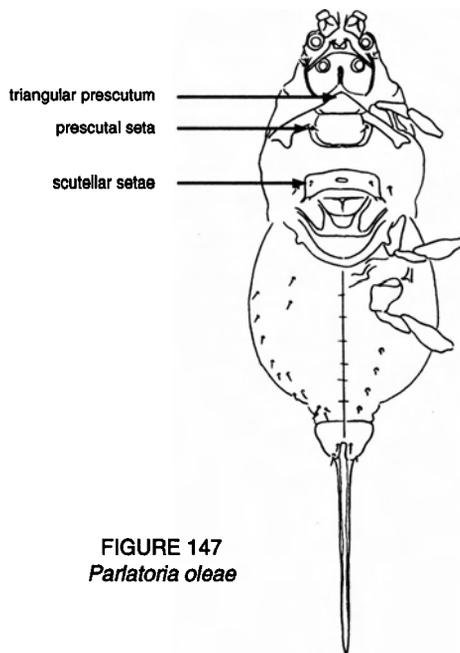


FIGURE 147
Parlatoria oleae

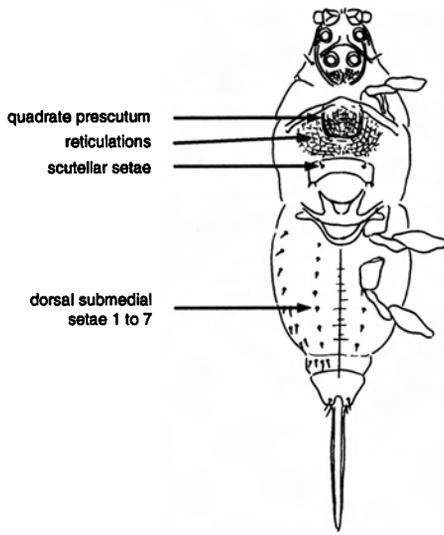


FIGURE 148
Chionaspis etrusca

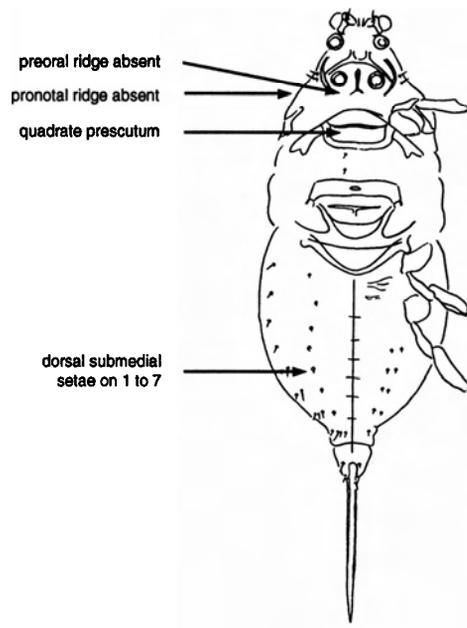


FIGURE 149
Xerophilaspis prosopidis

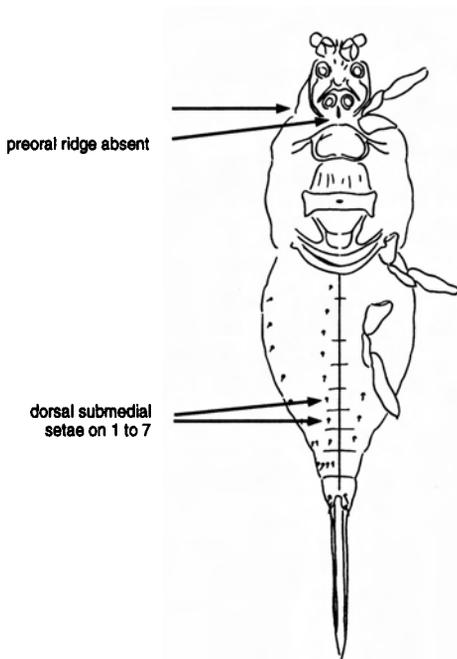


FIGURE 150
Situlaspis yuccae

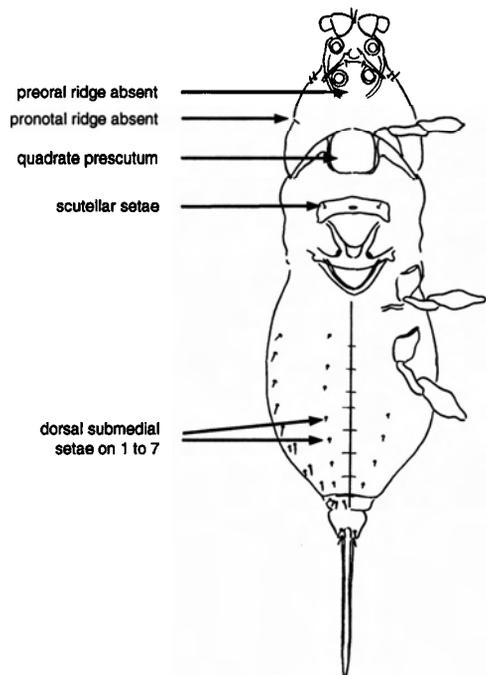


FIGURE 151
Diaspis echinocacti

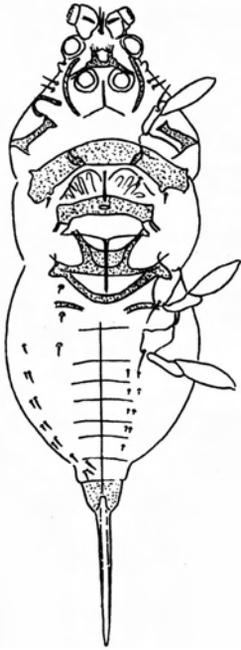


FIGURE 152
Aonidiella aurantii

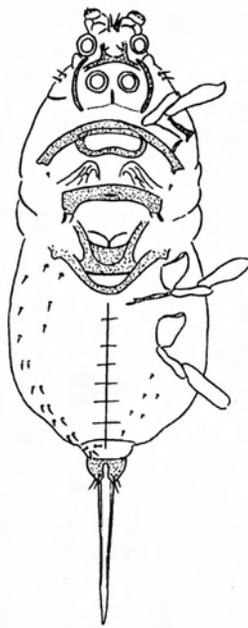


FIGURE 153
Hemiberlesia lantaniae

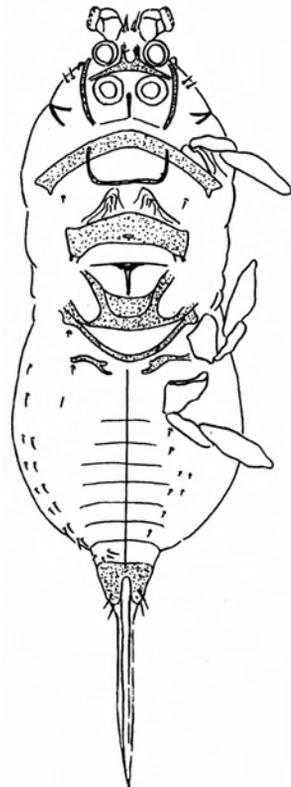


FIGURE 154
Hemiberlesia candidula



FIGURE 155
Abgrallaspis cyanophylli

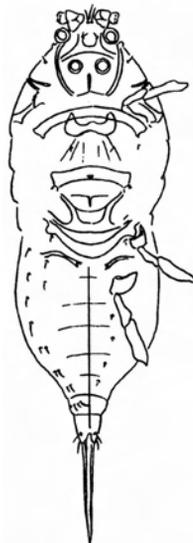


FIGURE 156
Quadraspidiotus perniciosus

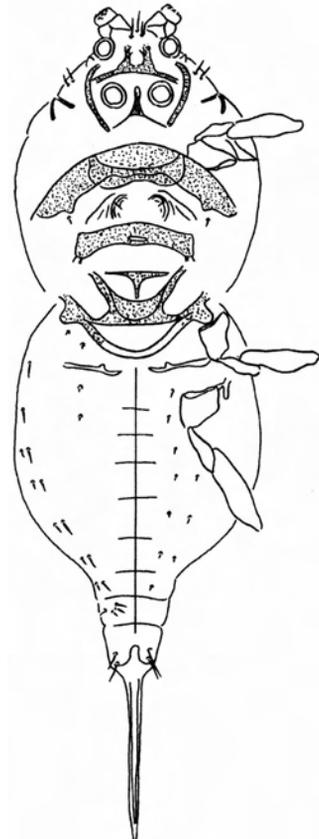


FIGURE 157
Quadraspidiotus juglans-regiae

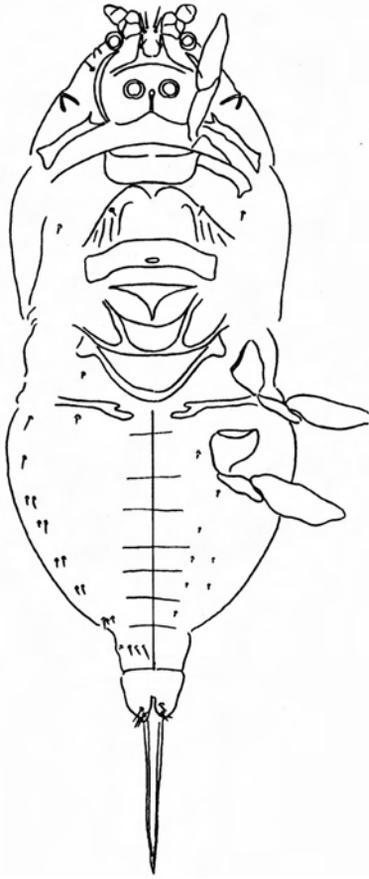


FIGURE 158
Diaspidiotus aesculi



FIGURE 159
Chortinaspis subchortina

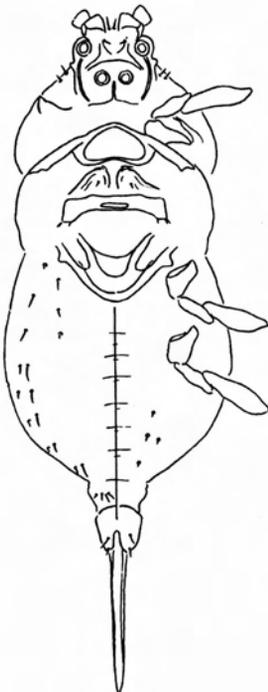


FIGURE 160
Aspidaspis arctostaphylli

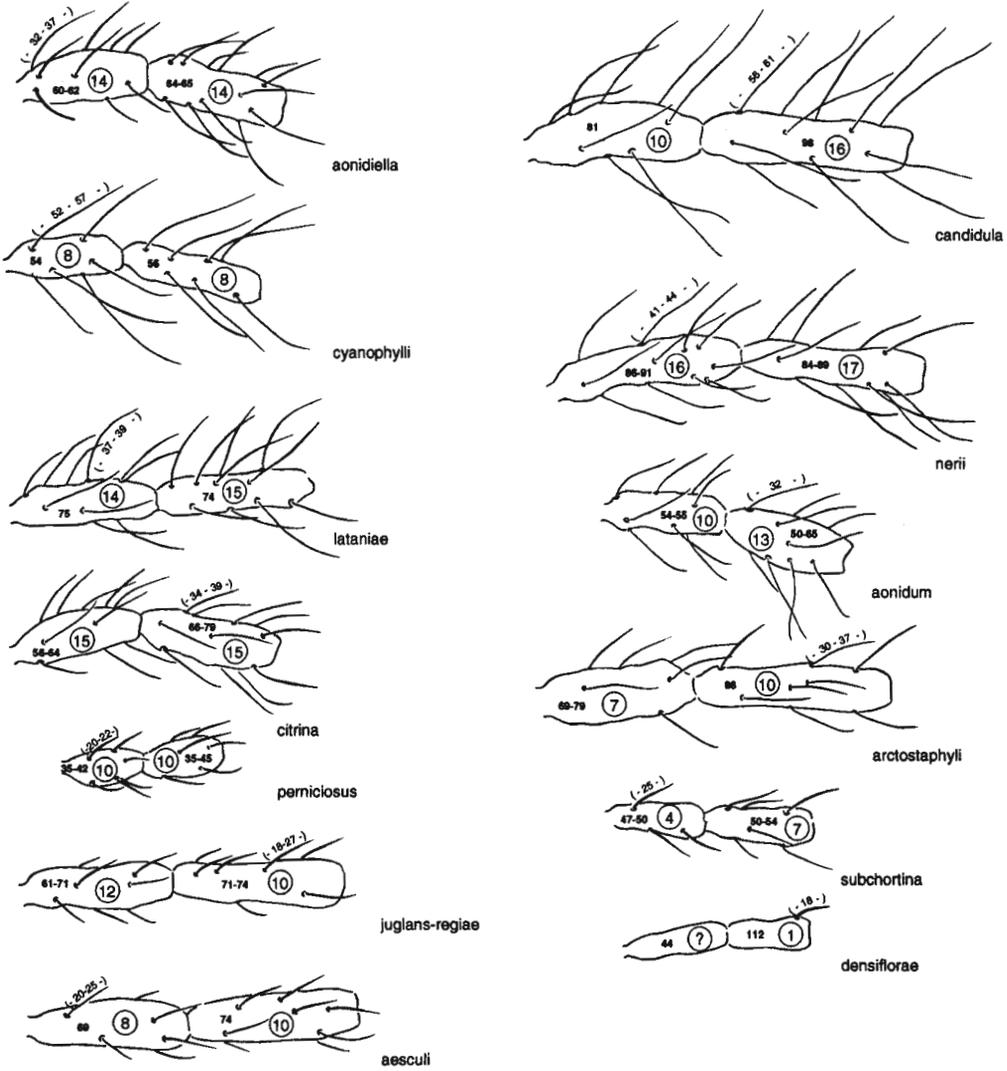


FIGURE 161
Aspidaspis densiflorae



FIGURE 162
Chrysomphalus bifasciculatus

1ST AND 2ND ANTENNAL SCAPE SEGMENTS
MALE ASPIDIOTINI
Figure 163



NUMBER IN CIRCLE: Approximate number of setae on that segment.
 NUMBER IN BOLD: Length of segment in microns.
 NUMBER ALONG SETAE: Length of setae in microns.

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COLLECTION DATA FOR COLOR PLATES

1. *Abgrallaspis cyanophylli*, Vista, San Diego County, California, 4/74, ex *Echinocactus* sp., Morgan coll.
2. *Abgrallaspis cyanophylli*, Fresno, Fresno County, California, 11/10/81, ex cactus, Dunnicliff/Rodriquez colls.
3. *Abgrallaspis degenerata*, Tulare, Tulare County, California, 8/9/74, ex camellia, J. Akana et al. colls.
4. *Aonidiella aurantii*, Sacramento, Sacramento County, California 7/21/77, ex citrus.
5. *Aonidiella aurantii*, ex. grapefruit.
6. *Aonidiella aurantii*, Elderwood, Tulare County, California, 9/23/81, ex olive, McIntyre/Gilley colls.
7. *Aonidiella aurantii*, Sacramento, Sacramento County, California, 7/21/77, ex citrus.
8. *Aonidiella aurantii*, Capitol Park, Sacramento, Sacramento County, California, 12/73, ex citrus, R.J. Gill coll.
9. *Aonidiella citrina*, Porterville, Tulare County, California, 10/7/86, ex navel orange, J. Steward coll.
10. *Aonidiella citrina*, Porterville, Tulare County, California, 10/7/86, ex navel orange, J. Steward coll.
11. *Aonidomytilus ceanothi*, Folsom, Sacramento County, California, 4/2/80, ex *Ceanothus* sp., Villegas/Bezark colls.
12. *Aonidomytilus ceanothi*, Folsom, Sacramento County, California, 4/2/80, ex *Ceanothus* sp., Villegas/Bezark colls.
13. *Aonidomytilus concolor*, Quatal Canyon, Ventura County, California, 5/24/77, ex *Atriplex* sp., Hobza/Gill colls.
14. *Aspidaspis arctostaphyli*, Del Puerto Canyon, Stanislaus County, California, 4/7/80, ex manzanita, R.J. Gill coll.
15. *Aspidaspis arctostaphyli*, Del Puerto Canyon, Stanislaus County, California, 4/7/80, ex manzanita, R.J. Gill coll.
16. *Aspidiotus nerii*, Hanford, Kings County, California, 7/18/77, ex *Hedera* sp., Dunnicliff/Katz colls.
17. *Aspidiotus nerii*, Hanford, Kings County, California, 7/18/77, ex *Hedera* sp., Dunnicliff/Katz colls.
18. *Aspidiotus nerii*, Eureka, Humboldt County, California, 2/24/75, ex *Aucuba* sp., P. Haggard coll.
19. *Aulacaspis rosae*, Sacramento, Sacramento County, California, 5/6/81, ex *Rubus* sp., R.J. Gill coll.
20. *Aulacaspis rosae*, Sacramento, Sacramento County, California, 5/6/81, ex *Rubus* sp., R.J. Gill coll.
21. *Aulacaspis rosae*, Sacramento, Sacramento County, California, 5/6/81, ex *Rubus* sp., R.J. Gill coll.
22. *Carulaspis juniperi*, Susanville, Lassen County, California, 8/1/63, ex *Calocedrus decurrens*, McCartney/Fix colls.
23. *Carulaspis juniperi*, Susanville, Lassen County, California, 8/1/63, ex *Calocedrus decurrens*, McCartney/Fix colls.
24. *Carulaspis minima*, Sacramento, Sacramento County, California, 12/73, ex juniper.
25. *Chionaspis etrusca*, Hinkley, San Bernardino County, California, 9/13/78, ex tamarisk, E. Paddock coll.
26. *Chionaspis etrusca*, Santa Paula, Ventura County, California, 2/27/91, ex tamarisk, S. Cooper-Smith coll.
27. *Chionaspis ortholobis*, Midpines, Mariposa County, California, 8/26/75, ex *Ceanothus* sp., Gilbert/Griffin colls.
28. *Chionaspis ortholobis*, Midpines, Mariposa County, California, 8/26/75, ex *Ceanothus* sp., Gilbert/Griffin colls.
29. *Chionaspis pinifoliae*, Sacramento, Sacramento County, California, 7/1/77, ex pine, R.J. Gill coll.
30. *Chionaspis pinifoliae*, Sacramento, Sacramento County, California, 7/1/77, ex

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- pine, R.J. Gill coll.
31. *Chionaspis pinifoliae*, Idyllwild Pines, Riverside County, California, 2/14/96, ex *Pinus jefferyi*, E. Spandler coll.
 32. *Chionaspis sassceri*, Frazier Park, Kern County, California, 5/12/76, ex *Fremontia* sp., Easley et al. colls.
 33. *Chionaspis wistariae*, San Marino, Los Angeles County, California, 6/2/80, ex *wistaria*, J. White coll.
 34. *Chrysomphalus aonidum*, Goleta, Santa Barbara County, California, 8/10/81, ex *Dracaena marginata*, S. Piper coll.
 35. *Chrysomphalus aonidum*, Goleta, Santa Barbara County, California, 8/10/81, ex *Dracaena marginata*, S. Piper coll.
 36. *Chrysomphalus bifasciculatus*, Sacramento, Sacramento County, California, 6/21/76, ex lily, Jones/Thompson colls.
 37. *Chrysomphalus dictyospermi*, from Hawaii, ex *Dracaena* sp.
 38. *Clavaspis ulmi*, adult, Burlingame, San Mateo County, California, 11/7/67, ex *Catalpa* sp., Davis/Haig colls.
 39. *Comstockiella sabalis*, ex palmetto.
 40. *Comstockiella sabalis*, Montecito, Santa Barbara County, California, 7/13/87, ex palm, J. Davidson coll.
 41. *Comstockiella sabalis*, Montecito, Santa Barbara County, California, 7/13/87, ex palm, J. Davidson coll.
 42. *Cupidaspis beshearae*, Onyx, Kern County, California, 7/30/75, ex juniper, Gilbert/Poore colls.
 43. *Cupidaspis beshearae*, Onyx, Kern County, California, 7/30/75, ex juniper, Gilbert/Poore colls.
 44. *Cupidaspis cupressi*, Del Puerto Canyon, Stanislaus County, California, 4/7/80, ex juniper, R.J. Gill coll.
 45. *Cupressaspis shastae*, Del Puerto Canyon, Stanislaus County, California, 4/7/80, ex juniper, R.J. Gill coll.
 46. *Cupressaspis shastae*, Del Puerto Canyon, Stanislaus County, California, 4/7/80, ex juniper, R.J. Gill coll.
 47. *Cupressaspis shastae*, Clough Cave, Tulare County, California, 7/2/75, ex nutmeg, Akana/Gilbert colls.
 48. *Diaspidiotus aesculi*, Del Puerto Canyon, Stanislaus County, California, 3/19/82, ex *Salix* sp., R.J. Gill coll.
 49. *Diaspidiotus aesculi*, Hornbrook, Siskiyou County California, 5/6/77, ex Oregon ash, D. Horn coll.
 50. *Diaspidiotus aesculi*, Hornbrook, Siskiyou County California, 5/6/77, ex Oregon ash, D. Horn coll.
 51. *Diaspidiotus coniferarum*, Williams, Glenn County, California, ex cypress, 5/27/77, F. Thomas coll.
 52. *Diaspidiotus coniferarum*, Williams, Glenn County, California, ex cypress, 5/27/77, F. Thomas coll.
 53. *Diaspidiotus ehrhorni*, Del Puerto Canyon, Stanislaus County, California, ex *Pinus sabiniana*, R.J. Gill coll.
 54. *Diaspidiotus ehrhorni*, Del Puerto Canyon, Stanislaus County, California, ex *Pinus sabiniana*, R.J. Gill coll.
 55. *Diaspidiotus liquidambaris*, Palo Alto, San Mateo County, California, 8/25/73, ex *Liquidambar* sp., Hill/Horst colls.
 56. *Diaspidiotus liquidambaris*, Palo Alto, San Mateo County, California, 8/25/73, ex *Liquidambar* sp., Hill/Horst colls.
 57. *Diaspis boisduvalii*, Sacramento, Sacramento County, California, 1/74, ex *Catteya* sp., J. Weller coll.
 58. *Diaspis boisduvalii*, Sacramento, Sacramento County, California, 1/74, ex *Catteya* sp., J. Weller coll.
 59. *Diaspis bromeliae*, El Cerrito, Contra Costa County, California, ex pineapple, 6/16/77, F. Ennik coll.
 60. *Diaspis bromeliae*, El Cerrito, Contra Costa County, California, ex pineapple, 6/16/77, F. Ennik coll.
 61. *Diaspis echinocacti*, Fresno, Fresno County California, 11/18/81, ex cactus, Dunningcliff/Rodriquez coll.

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62. *Diaspis echinocacti*, Santa Catalina Island, California, ex cactus, R.J. Gill coll.
63. *Diaspis manzanitae*, Shasta County, California, 1/77, ex manzanita, E. Paddock coll.
64. *Diaspis manzanitae*, Los Olivos, Santa Barbara County, California, 5/7/87, ex manzanita, J. Davidson coll.
65. *Diaspis parasiti*, Dawson Canyon, Riverside County, California, 3/29/73, ex *Phorodendron* sp. on *Platanus* sp., B. Engle coll.
66. *Dynaspidiotus britannicus*, Portland, Oregon, 2/12/87, ex boxwood, K. Sjoblom coll.
67. *Dynaspidiotus britannicus*, Portland, Oregon, 2/12/87, ex boxwood, K. Sjoblom coll.
68. *Epidiaspis leperii*, Dixon, Solano County, California, 9/22/75, ex walnut, DeMassa/Peterson colls.
69. *Epidiaspis leperii*, St. Helena, Napa County, California, 2/1/79, ex apple seedling, H. Stabo coll.
70. *Epidiaspis leperii*, Sacramento, Sacramento County, California, ex walnut, R.J. Gill coll.
71. *Ferrisidea magna*, Cameron, Kern County, California, 7/1/81, ex *Lycium cooperi*, D. Poore coll.
72. *Fiorinia fioriniae*, San Diego, San Diego County, California, 4/10/75, ex camellia, Brown/Gordon colls.
73. *Fiorinia fioriniae*, San Diego, San Diego County, California, 4/10/75, ex camellia, Brown/Gordon colls.
74. *Fiorinia pinicola*, Hayward, Alameda County, California, 9/20/89, ex *Podocarpus* sp., K. Peck coll.
75. *Fiorinia pinicola*, Hayward, Alameda County, California, 9/20/89, ex *Podocarpus* sp., K. Peck coll.
76. *Froggattiella penicillata*, ex bamboo.
77. *Froggattiella penicillata*, Encinitas, San Diego County, California, 3/3/88, ex bamboo, Kellum/Sims coll.
78. *Furchadaspis zamiae*, San Francisco, San Francisco County, California, 7/27/81, ex cycad, D. Katz coll.
79. *Furchadaspis zamiae*, Santa Barbara, Santa Barbara County, California, 1/30/74, ex African cycad, Dannenberg/Suskin colls.
80. *Haliaspis spartinae*, San Diego, San Diego County, California, 5/1/95, ex *Spartina* sp., K. Boyer coll.
81. *Hemiberlesia lataniae*, Sacramento, Sacramento County, California, 1/7/80, ex *Aucuba* sp., R. J. Gill coll.
82. *Hemiberlesia lataniae*, ex mulberry, no other data.
83. *Hemiberlesia palmae*, ex bromeliad, no other data.
84. *Hemiberlesia palmae*, ex bromeliad, no other data.
85. *Hemiberlesia rapax*, Vallejo, Solano County, California, 9/11/79, ex *Euonymus myrtifolia*, Dannenberg coll.
86. *Hemiberlesia rapax*, Vallejo, Solano County, California, 9/11/79, ex *Euonymus myrtifolia*, Dannenberg coll.
87. *Kuwanaspis pseudoleucaspis*, Japan quarantine at Encinitas, California, 3/11/88, ex bamboo, Kellum/Sims colls.
88. *Kuwanaspis pseudoleucaspis*, Japan quarantine at Encinitas, California, 3/11/88, ex bamboo, Kellum/Sims colls.
89. *Lepidosaphes beckii*, Orange County, California, 6/17/77, ex citrus, D. Byers coll.
90. *Lepidosaphes beckii*, Irvine Ranch, Orange County, California, 10/24/91, ex Valencia orange, Hand/Nisson coll.
91. *Lepidosaphes conchiformis*, Hanford, Kings County, California, 7/19/78, ex *Ficus carica*, Dunnicliff coll.
92. *Lepidosaphes conchiformis*, Visalia, Tulare County, California, 1/21/75, ex walnut, Thomas coll.
93. *Lepidosaphes destefanii*, Asti/Cloverdale, Sonoma County, California, 10/20/76, ex olive, Gill/Chesi colls.
94. *Lepidosaphes gloverii*, Orange County, California, 6/17/77, ex citrus, D. Byers coll.
95. *Lepidosaphes gloverii*, Davie, Broward County, Florida, 12/8/85, ex citrus, R. Dowell coll.

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96. *Lepidosaphes machili*, Republic of China quarantine at San Diego, California, 12/14/82, ex orchids, Ginsky coll.
97. *Lepidosaphes ulmi*, Auther, Calaveras County, California, 4/21/83, ex mistletoe in fir, D. Adams coll.
98. *Lepidosaphes ulmi*, Auther, Calaveras County, California, 4/21/83, ex mistletoe in fir, D. Adams coll.
99. *Leucaspis portueaureae*, San Francisco, San Francisco County, California, 9/18/63, ex *Podocarpus totara*, M. Stufflebeam coll.
100. *Leucaspis portueaureae*, San Francisco, San Francisco County, California, 9/18/63, ex *Podocarpus totara*, M. Stufflebeam coll.
101. *Lindingaspis rossi*, Berkeley, Alameda County, California, 8/77, ex *Araucaria* sp., C. Koehler coll.
102. *Lindingaspis rossi*, Santa Barbara, Santa Barbara County, California, 4/20/81, ex *Araucaria*, R. Douitt coll.
103. *Melanaspis bromeliae*, Irvine, Orange County, California, 1/3/77, ex bromeliad, Enns coll.
104. *Melanaspis obscura*, Sacramento, Sacramento County, California, 4/11/75, ex *Quercus* sp., R.J. Gill coll.
105. *Melanaspis obscura*, no other data
106. *Nilotaspis halli*, Stilson Canyon, Butte County, California, 5/3/63, ex flowering peach, Schaffer/Jensen colls.
107. *Nilotaspis halli*, Stilson Canyon, Butte County, California, 5/3/63, ex flowering peach, Schaffer/Jensen colls.
108. *Nuculaspis californica*, Livermore, Alameda County, California, 7/2/74, ex pine, R.J. Gill coll.
109. *Nuculaspis californica*, Del Puerto Canyon, Stanislaus County, California, 4/7/80, ex *Pinus sabiniana*, R.J. Gill coll.
110. *Odonaspis ruthae*, Toyon Canyon, Santa Catalina Island, California, 5/29/81, ex Bermuda grass, R.J. Gill coll.
111. *Odonaspis ruthae*, Calexico, Imperial County, California, 1/20/81, ex Bermuda grass, Flock/Pineda colls.
112. *Pallulaspis ephedrae*, Quatal Canyon, Ventura County, California, 3/18/76, ex ephedra, Hobza/Chase coll.
113. *Pallulaspis ephedrae*, Quatal Canyon, Ventura County, California, 3/18/76, ex ephedra, Hobza/Chase coll.
114. *Paracupidaspis wilkeyi*, Colusa, Colusa County, California, 7/7/81, ex incense cedar, D. Brown coll.
115. *Paracupidaspis wilkeyi*, Colusa, Colusa County, California, 7/7/81, ex incense cedar, D. Brown coll.
116. *Parlatoria camelliae*, Sacramento, Sacramento County, California, 2/74, ex *Viburnum* sp., J. Alden coll.
117. *Parlatoria oleae*, Yuba City, Sutter County, California, 1/29/80, ex *Mahonia* sp., D. Wilson coll.
118. *Parlatoria oleae*, Three Rivers, Tulare County, California, 4/7/75, ex *Mahonia* sp., Akana/Thomas colls.
119. *Parlatoria oleae*, Yuba City, Sutter County, California, 1/29/80, ex *Mahonia* sp., D. Wilson coll.
120. *Parlatoria pergandii*, P. R. China quarantine at California, 12/18/76, ex Mandarin orange, Immel coll.
121. *Parlatoria pergandii*, P. R. China quarantine at California, 12/18/76, ex Mandarin orange, Immel coll.
122. *Parlatoria pittospori*, San Diego, San Diego County, California, 7/8/74, ex *Leptospermum* sp., Beckett/Geising colls.
123. *Pinnaspis aspidistrae*, Santa Barbara, Santa Barbara County, California, 10/9/81, ex *Ophiopogon japonicum*, S. Piper coll.
124. *Pinnaspis aspidistrae*, Santa Barbara, Santa Barbara County, California, 10/9/81, ex *Ophiopogon japonicum*, S. Piper coll.
125. *Pinnaspis buxi*, from Hawaii at Palo Alto, Santa Clara County, California, 7/16/74, ex *Maranta variegata*, L. Buerer coll.
126. *Poliaspis cycadis*, Brea, Orange County, California, 2/23/93, ex *Cycas* sp., J. Wynn coll.

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127. *Protodiaspis agrifoliae*, Buellton, Santa Barbara County, California, 4/7/87, ex *Quercus agrifolia*, J. Davidson coll.
128. *Pseudaulacaspis cockerelli*, Hawaii quarantine at Lawndale, Los Angeles County, California, 8/17/77, ex *Areca* sp., Wood coll.
129. *Pseudaulacaspis pentagona*, ex *Prunus* sp., no other data.
130. *Pseudoparlatoria parlatorioides*, Costa Rica at Los Angeles, California, 9/14/82, ex *Dracaena tricolor*, D. Papilli coll.
131. *Quadraspidiotus juglans-regiae*, Dinuba, Tulare County, California, 6/19/75, ex ash, Akana/McIntire colls.
132. *Quadraspidiotus juglans-regiae*, Visalia, Tulare County, California, 1/21/75, ex walnut, C. Thomas coll.
133. *Quadraspidiotus juglans-regiae*, Corcoran, Kings County, California, 5/27/81, ex plum, J. Dunncliff coll.
134. *Quadraspidiotus perniciosus*, Yuba City, Sutter County, California, 1/23/75, ex almond, A. Melton coll.
135. *Quernaspis quercus*, Three Rivers, Tulare County, California, 10/31/75, ex oak, Thomas/Akana colls.
136. *Quernaspis quercus*, Green Valley, San Bernardino County, California, 10/29/79, ex *Quercus kelloggii*, Young/Esparza colls.
137. *Rhizaspidotus dearnessi*, Portal, Cochise County, Arizona, 9/18/86, ex *Gutierrezia microcephala*, N. Backus coll.
138. *Selenaspidus albus*, Sherman Oaks, Los Angeles County, California, 2/16/83, ex *Euphorbia flanaganii*, K. Shimoda coll.
139. *Situlaspis multipora*, Yucaipa, San Bernardino County, California, 3/1/61, ex *Phoradendron* on *Quercus velotina*, T. Pope coll.
140. *Situlaspis yuccae*, Mesa, Arizona, 1973, ex yucca, Kelly coll.
141. *Stramenaspis kelloggi*, Comptche, Mendocino County, California, 7/8/78, ex Douglas fir, T. Kono coll.
142. *Unaspis euonymi*, Sacramento, Sacramento County, California, 11/8/82, ex *Euonymus* sp., K. Casanave coll.
143. *Xerophilaspis prosopidis*, Bard, Imperial County, California, 5/1/81, ex mesquite, R. Flock coll.
144. *Xerophilaspis prosopidis*, Bard, Imperial County, California, 5/1/81, ex mesquite, R. Flock coll.

COLLECTION AND PRESERVATION TECHNIQUES

The common method of collecting scale insects is to place them in alcohol in the field. The California Department of Food and Agriculture uses 70% isopropyl alcohol for this purpose. However, some scales do not preserve well in alcohol and become very difficult or impossible to clear properly. They are best collected by removing an infested part of the host, which is then allowed to dry naturally. Steps should be taken to suppress mold growth.

In order to be preserved and identified properly, scale insects must be cleared completely by removing the internal body contents, leaving only the exo-skeleton and appendages intact. Specimens are then stained and placed on microscope slides for study under high magnifications. All of the slide mounted specimens used in producing the morphological illustrations used in this book are preserved in Canada balsam. Balsam is the current standard permanent mounting medium for scale insects. Euparal is another acceptable permanent medium. Temporary media such as Hoyer's or polyvinyl alcohol (PVA) are also used for less important specimens or when rapid determinations are required, but these media cannot be considered permanent.

Specimens should be cleared first in potassium hydroxide (10%) or a combination of potassium hydroxide and Essig's aphid fluid (20 parts 85% lactic acid; 2 parts liquified phenol; 4 parts glacial acetic acid; 1 part distilled water). The specimens are usually stained with either acid fuchsin, lignin pink or a combination of the two. The following clearing-staining procedure is currently used for scale insects in the California Department of Food and Agriculture Homoptera Laboratory. The procedure has been developed and modified over the years by numerous individuals including Harold Morrison, Richard Wilkey, Tokuwō Kono and the author. The procedure is not a rigid one and is often modified to suit conditions.

SLIDE MOUNTING PROCEDURE FOR SCALE INSECTS

1. Prepare several small tools from stainless steel insect pins by bending and flattening the ends at various angles to form spatulas. The spatula shapes allow easy pumping of the scale to remove the liquified body contents and allow easy transferring of the specimens from one reagent to another.
2. If not already in alcohol, remove specimens gently from the host substrate and place in clean 70% isopropyl alcohol. (Alcohol is necessary here because the body waxes of the soft scales would cause them to float in the surface tension of plain water.) Make a small midlateral incision on one side of the scale body. Remove immediately to potassium hydroxide (KOH).
3. Soak specimens in cold 10% KOH for 1 to 24 hours. DO NOT HEAT. Specimens may be pumped and teased lightly during this step to aid in the clearing process. Fresh specimens are usually cleared adequately in 1 to 2 hours, but a 24 hour time period may give better results in some cases.
4. Remove to isopropyl alcohol acidified with a 10% solution of hydrochloric acid to aid in neutralizing the KOH. Let stand for 15 minutes to 24 hours.
5. Place in Essig's aphid fluid (EAF) containing several drops of the preferred staining agent. Let stand for 10-15 minutes to further neutralize the KOH. Heat at 50° C. for 1 to 24 hours. Move to clean, new, unstained EAF. Tease and pump specimens until as clear as possible. Re-heat for 1 hour if necessary.
6. Place specimens in cellosolve (ethylene glycol monoethyl ether) for removal of all of the EAF and for dehydration of the specimens prior to placing in balsam.
7. Place specimens in tetrahydrofuran (THF), a wax solvent, for five minutes if necessary.
8. Place specimens in a drop of balsam on a microscope slide and add a cover glass.

PHOTOGRAPHIC TECHNIQUES

The color photographs included in this volume were produced primarily by the author. However, George Buxton supplied a number of the pictures of specimens collected prior to 1972. Those pictures were produced with standard 35 mm format single lens reflex cameras with close up lenses and bellows attachments.

Most of the author's pictures were produced in a different manner. The pictures were taken through a Wild M-5 stereo microscope with a Zeiss C-35 camera attachment. Illumination was by electronic strobe. Film is Kodachrome 25 color slide film. Magnifications of the author's photographs range from 1.5X to 12X magnification on the 35 by 24 mm film plane. The pictures were then enlarged to the 65 by 54 mm format used in this volume.

ILLUSTRATION AND PAGE LAYOUT TECHNIQUES

All of the morphological illustrations of the adult females in this volume were produced by conventional means using pen and ink by Ferris, McKenzie and others, and were used here with permission. Morphological illustrations of the males were drawn from actual slide mounted specimens. Specimens were chosen which had at least one half of the body intact and generally not noticeably distorted. The specimen slide was placed on a Bausch and Lomb bioscope slide projector. The image of the specimen was then projected onto the drawing surface. The typesetting and layout were produced by the author on a computer using typesetting software. Printing was done by the State Printing Plant.

EXPLANATION OF ABBREVIATIONS IN FIGURES

Figures 3-145 display a standard system of labeling the various morphological structures that was originally developed by Gordon Ferris. The explanations for the letter designations are as follows:

- A. Antenna and cephalic margin of first stage nymph (crawler).
- B. Habitat sketch.
- C. Antenna of adult female.
- D. Anterior spiracle of adult female. The anterior spiracle has been chosen for illustration because significant differences, such as pore arrangement, occur with these rather than in the posterior pair.
- E. Pygidium of second stage female
- EE. General outline of second stage in those forms which are pupillarial.
- F. General features of the adult female.
- G. Pygidium of adult female.
- H. Dorsal aspect of detail of pygidial margin of adult female.
- I. Ventral aspect of detail of pygidial margin of adult female.
- J. Outline of exuvium of first stage in a few forms.

Unlettered figures of details are usually connected with their points of origin by guide lines and should be readily identifiable.

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SCALE INSECTS OF CALIFORNIA

GENERA AND SPECIES

<i>cinerea</i> , <i>Parlatoria</i>	220	<i>cupressi</i> , <i>Leucaspis</i>	108	<i>elegans</i> , <i>Aulacaspis</i>	150
<i>citri</i> , <i>Aspidiotus</i>	44	<i>cupressi</i> , <i>Lineaspis</i>	108	<i>elegans</i> , <i>Howardia</i>	150
<i>citri</i> , <i>Parlatoria</i>	220	<i>cyanophylli</i> , <i>Abgrallaspis</i>		<i>enceliae</i> , <i>Exuviaspis</i>	140, 141f
<i>citri</i> , <i>Unaspis</i>	170		32, 33, 35f, 278m, 280m	<i>ephedrae</i> , <i>Pallulaspis</i>	211, 212f
<i>citricola</i> , <i>Aspidiotus</i>	169	<i>cyanophylli</i> , <i>Aspidiotus</i>	33	<i>Epidiaspis</i>	137
<i>citrina</i> , <i>Aonidiella</i>	44, 49f, 280m	<i>cyanophylli</i> , <i>Evanaspidotus</i>	33	<i>epigaeae</i> , <i>Aspidiotus</i>	34
<i>citrinus</i> , <i>Aspidiotus</i>	47	<i>cyanophylli</i> , <i>Furchaspis</i>	33	<i>etrusca</i> , <i>Chionaspis</i>	
<i>citrinus</i> , <i>Chrysomphalus</i>	47	<i>cyanophylli</i> , <i>Hemiberlesia</i>	33		76, 78, 84f, 277m
<i>Clavaspis</i>	101	<i>cycadis</i> , <i>Poliaspis</i>	235, 236f	<i>Eucornaspis</i>	168
<i>coccineus</i> , <i>Aspidiotus</i>	44	<i>cycadis</i> , <i>Trichomytilus</i>	235	<i>eugeniae</i> , <i>Phenacaspis</i>	238
<i>coccois</i> , <i>Aulacaspis</i>	126	<i>cydoniae</i> , <i>Aspidiotus</i>	156	<i>euonymi</i> , <i>Chionaspis</i>	270
<i>coccois</i> , <i>Diaspis</i>	126	<i>cymbidicola</i> , <i>Lepidosaphes</i>	174	<i>euonymi</i> , <i>Unaspis</i>	270, 271f
<i>Coccophagoides utilis</i>	219	<i>daleae</i> , <i>Situlaspis</i>	261, 264f	<i>Evanaspidotus</i>	244
<i>cockerelli</i> , <i>Chionaspis</i>	238	<i>dearnessi</i> , <i>Aspidiotus</i>	251	<i>excisus</i> , <i>Aspidiotus</i>	65
<i>cockerelli</i> , <i>Fiorinia</i>	193	<i>dearnessi</i> , <i>Remotaspis</i>	251	<i>Exuviaspis</i>	140
<i>cockerelli</i> , <i>Leucaspis</i>	193	<i>dearnessi</i> , <i>Rhizaspidotus</i>		<i>fallax</i> , <i>Aspidiotus</i>	64
<i>cockerelli</i> , <i>Leucodiaspis</i>	193		251, 252f	<i>fallax</i> , <i>Diaspis</i>	137
<i>cockerelli</i> , <i>Lopholeucaspis</i>		<i>dearnessi</i> , <i>Targionia</i>	251	<i>fernaldi</i> , <i>Aspidiotus</i>	244
	193, 192f	<i>degenerata</i> , <i>Abgrallaspis</i>		<i>fernaldi</i> , <i>Quadraspidotus</i>	243, 244
<i>cockerelli</i> , <i>Phenacaspis</i>	238		32, 33, 36f	<i>ferrisi</i> , <i>Phenacaspis</i>	238
<i>cockerelli</i> , <i>Pseudaulacaspis</i>		<i>degeneratus</i> , <i>Aspidiotus</i>	33	<i>Ferrisidea</i>	142
	238, 240	<i>degeneratus</i> , <i>Chrysomphalus</i>	33	<i>ficifoli</i> , <i>Mytilaspis</i>	171
<i>cocois</i> , <i>Diaspis</i>	124, 126, 131f	<i>degeneratus</i> , <i>Diaspidiotus</i>	33	<i>ficifoliae</i> , <i>Lepidosaphes</i>	171
<i>cocotis</i> , <i>Aspidiotus</i>	64	<i>degeneratus</i> , <i>Dynaspidotus</i>	33	<i>ficifoliae</i> , <i>Mytilococcus</i>	171
<i>Comstockiella</i>	106	<i>degeneratus</i> , <i>Hemiberlesia</i>	33	<i>ficus</i> , <i>Aspidiotus</i>	96
<i>conchiformis</i> , <i>Coccus</i>	171	<i>densiflorae</i> , <i>Aspidaspis</i>	59, 62f,	<i>ficus</i> , <i>Chrysomphalus</i>	96
<i>conchiformis</i> , <i>Lepidosaphes</i>			279m, 280m	<i>ficus</i> , <i>Lepidosaphes</i>	171
	169, 171, 180f	<i>densiflorae</i> , <i>Aspidiella</i>	59	<i>ficus</i> , <i>Mytilaspis</i>	171
<i>conchiformis</i> , <i>Mytilococcus</i>	171	<i>densiflorae</i> , <i>Aspidiotus</i>	59	<i>filiformis</i> , <i>Ischnaspis</i>	165
<i>conchiformis-phillyreae</i> , <i>Lepidosaphes</i>		<i>dentata</i> , <i>Velataspis</i>	173	<i>Fiorinia</i>	140, 142, 144
	172	<i>destefanii</i> , <i>Mytilococcus</i>	172	<i>fioriniae</i> , <i>Uhleria</i>	144
<i>concolor</i> , <i>Aonidomytilus</i>	52, 55f	<i>destephanii</i> , <i>Lepidosaphes</i>		<i>fioriniae</i> , <i>Diaspis</i>	144
<i>concolor</i> , <i>Chionaspis</i>	52		169, 172, 181f	<i>fioriniae</i> , <i>Fiorinia</i>	144, 146f
<i>concolor</i> , <i>Lepidosaphes</i>	52	<i>destructor</i> , <i>Aspidiotus</i>	64, 65, 66f	<i>flava</i> , <i>Lepidosaphes</i>	172
<i>concolor</i> , <i>Mytilaspis</i>	52	<i>Diaspidiotus</i>	113, 114, 245, 275m	<i>florentiae</i> , <i>Aspidaspis</i>	58, 63f, 64
<i>coniferarum</i> var. <i>shastae</i> , <i>Aspidiotus</i>		<i>Diaspis</i>	124, 275m	<i>florentiae</i> , <i>Aspidiotus</i>	64
	111	<i>dictyospermi</i> , <i>Aspidiotus</i>	97	<i>floridana</i> , <i>Lindingaspis</i>	193
<i>coniferarum</i> , <i>Aspidiotus</i>	115	<i>dictyospermi</i> , <i>Chrysomphalus</i>		<i>floridensis</i> , <i>Chionaspis</i>	75
<i>coniferarum</i> , <i>Comstockaspis</i>	115		96, 97, 100f	<i>forbesi</i> , <i>Aspidiotus</i>	243
<i>coniferarum</i> , <i>Diaspidiotus</i>	113,	<i>diffinis</i> var. <i>lateralis</i> , <i>Aspidiotus</i>	156	<i>forbesi</i> , <i>Forbesaspis</i>	243
	115, 119f	<i>dilatata</i> , <i>Chionaspis</i>	238	<i>forbesi</i> , <i>Quadraspidotus</i>	
<i>consolidata</i> , <i>Chortinaspis</i>	94f, 95b	<i>dilatata</i> , <i>Phenacaspis</i>	238		243, 245, 247f
<i>convexus</i> , <i>Aspidiotus</i>	157	<i>Diplacaspis</i>	127	<i>fraxini</i> , <i>Abgrallaspis</i>	32, 34, 37f
<i>corni</i> , <i>Chionaspis</i>	76, 77, 83f	<i>disclusa</i> , <i>Clavaspis</i>	101, 103f	<i>fraxini</i> , <i>Hemiberlesia</i>	34
<i>Cornimytilus</i>	168	<i>Discodiaspis</i>	95	<i>Froggattiella</i>	150
<i>Cornuaspis</i>	168	<i>dives</i> , <i>Parlatoria</i>	221	<i>fujicola</i> , <i>Phenacaspis</i>	81
<i>covilleae</i> , <i>Aspidiotus</i>	101, 102f	<i>dryandrae</i> , <i>Parlatoria</i>	220	<i>Furchadaspis</i>	150
<i>covilleae</i> , <i>Clavaspis</i>	101	<i>durus</i> , <i>Aonidomytilus</i>	56f, 58	<i>Furchaspis</i>	244
<i>covilleae</i> , <i>Ferrisaspis</i>	101	<i>Dynaspidotus</i>	135	<i>furfura</i> , <i>Chionaspis</i>	76, 78, 85f
<i>Crassaspis</i>	260	<i>echinocacti</i> , <i>Aspidiotus</i>	127	<i>furfurus</i> , <i>Aspidiotus</i>	78
<i>crawii</i> , <i>Aspidiotus</i>	156	<i>echinocacti</i> , <i>Diaspis</i>		<i>gaultheriae</i> , <i>Poliaspis</i>	235
<i>crotonis</i> , <i>Parlatoria</i>	216, 218, 224f		124, 127, 132f, 277m	<i>gauteriae</i> , <i>Poliaspis</i>	235
<i>Cupidaspis</i>	107, 203	<i>echinocacti</i> , <i>Diplacaspis</i>	127	<i>gennadii</i> , <i>Aonidia</i>	44
<i>Cupressaspis</i>	44, 111	<i>ehrhorni</i> , <i>Aspidiotus</i>	115	<i>gigas</i> , <i>Quadraspidotus</i>	115, 244
<i>cupressi</i> , <i>Cupidaspis</i>		<i>ehrhorni</i> , <i>Diaspidiotus</i>		<i>gilli</i> , <i>Chionaspis</i>	75, 76, 78, 86f
	107, 108, 110f, 213		113, 115, 120f	<i>glanduliferus</i> , <i>Aspidiotus</i>	244

<i>glanduliferus</i> , <i>Quadraspidotus</i>	244	<i>juniperi</i> , <i>Carulaspis</i>	70, 71, 72f, 74	<i>marchali</i> , <i>Pinnaspis</i>	234
<i>gleditsiae</i> , <i>Chionaspis</i>		<i>juniperi</i> , <i>Diaspis</i>	144	<i>maskelli</i> , <i>Insulaspis</i>	174
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<i>gliwicensis</i> , <i>Abgrallaspis</i>	33	kafkai var.	244	<i>mccombi</i> , <i>Diaspidiotus</i>	204
<i>gloverii</i> , <i>Aspidiotus</i>	173	<i>kelloggi</i> , <i>Diaspis</i>	267	<i>Melanaspis</i>	189, 194
<i>gloverii</i> , <i>Coccus</i>	173	<i>kelloggi</i> , <i>Lepidosaphes</i>	267	<i>minima</i> , <i>Carulaspis</i>	70, 71, 73f
<i>gloverii</i> , <i>Insulaspis</i>	173	<i>kelloggi</i> , <i>Leucaspis</i>	267	<i>minima</i> , <i>Diaspis</i>	71
<i>gloverii</i> , <i>Lepidosaphes</i>		<i>kelloggi</i> , <i>Stramenaspis</i>	267, 268f	<i>minima</i> , <i>Odonaspis</i>	208
	168, 170, 173, 182f	<i>kelloggi</i> , <i>Suturaspis</i>	267	<i>minor</i> , <i>Chrysomphalus</i>	97
<i>gloverii</i> , <i>Mytilaspis</i>	173	<i>koebeleri</i> , <i>Aspidiotus</i>	40	<i>minor</i> , <i>Hemichionaspis</i>	234
<i>gloverii</i> , <i>Mytilococcus</i>	173	<i>koebeleri</i> , <i>Chrysomphalus</i>	40	<i>minor</i> , <i>Pinnaspis</i>	234
<i>gossypi</i> , <i>Pinnaspis</i>	234	<i>kosztarabi</i> , <i>Chionaspis</i>	75	<i>morrisonorum</i> , <i>Acutaspis</i>	204
<i>graminis</i> , <i>Dycryptaspis</i>	208	<i>Kuwanaspis</i>	165	<i>multipora</i> , <i>Crassaspis</i>	260, 262
<i>graminis</i> , <i>Odonaspis</i>	208, 209f	<i>lanatus</i> , <i>Diaspis</i>	239	<i>multipora</i> , <i>Parlatoria</i>	219
<i>graminis</i> , <i>Rugaspidotus</i>	208	<i>lasianthi</i> , <i>Lepidosaphes</i>	175	<i>multipora</i> , <i>Pseudodiaspis</i>	262
<i>graminis</i> , <i>Rugaspidis</i>	208	<i>lataniae</i> , <i>Aspidiotus</i>	156	<i>multipora</i> , <i>Situlaspis</i>	
<i>greeni</i> , <i>Aspidiotus</i>	156	<i>lataniae</i> , <i>Hemiberlesia</i>	155,		260, 262, 265f
<i>greeni</i> , <i>Parlatoria</i>	218		156, 159f, 245, 278m, 280m	<i>myrtus</i> , <i>Parlatoria</i>	220
<i>gutierreziae</i> , <i>Aspidiotus</i>	251	<i>latus</i> , <i>Chionaspis</i>	230	<i>Mytilaspis</i>	168
<i>gutierreziae</i> , <i>Chorizaspidotus</i>	251	<i>lauri</i> , <i>Aonidia</i>	43f, 44	<i>nakayama</i> , <i>Unaspis</i>	270
<i>gutierreziae</i> , <i>Targionia</i>	251	<i>leperii</i> , <i>Diaspis</i>	137	<i>natalensis</i> , <i>Phenacaspis</i>	238
<i>Haliaspis</i>	151	<i>leperii</i> , <i>Epidiaspis</i>	137, 138f, 140	<i>nebulosus</i> , <i>Rugaspidotus</i>	
<i>halli</i> , <i>Coccomytilus</i>	203	<i>Lepidosaphes</i>	40, 168, 230		253, 255f, 256
<i>halli</i> , <i>Lepidosaphes</i>	203	<i>Leucaspis</i>	189	<i>Neopinnaspis</i>	200
<i>halli</i> , <i>Nilotaspis</i>	202f, 203	<i>lilacina</i> , <i>Melanaspis</i>		<i>Neoquernaspis</i>	245
<i>hamoni</i> , <i>Chionaspis</i>	75		194, 195, 197f	<i>nerii</i> , <i>Aspidiotus</i>	64, 65,
<i>harperi</i> , <i>Africaspis</i>	200	<i>lilacina</i> , <i>Pelomphala</i>	195		67f, 238, 274m, 276m, 280m
<i>harperi</i> , <i>Neopinnaspis</i>	200, 201f	<i>lilacinus</i> , <i>Aspidiotus</i>	195	<i>nerii</i> , <i>Chermes</i>	65
<i>harrisii</i> , <i>Aspidiotus</i>	78	<i>lilacinus</i> , <i>Chrysomphalus</i>	195	<i>newsteadi</i> , <i>Lepidosaphes</i>	174
<i>hederae</i> , <i>Aspidiotus</i>	65, 238	<i>Lindingaspis</i>	189	<i>Nilotaspis</i>	203
<i>helianthi</i> , <i>Aspidiotus</i>	251	<i>Lineaspis</i>	107	<i>noxia</i> , <i>Insulaspis</i>	174
<i>helianthi</i> , <i>Rhizaspidotus</i>	251	<i>lintneri</i> , <i>Chionaspis</i>	77, 79, 88f	<i>noxia</i> , <i>Lepidosaphes</i>	
<i>helianthi</i> , <i>Targionia</i>	251	<i>liquidambaris</i> , <i>Chemnasp-idiotus</i>	116		169, 174, 184f
<i>Hemiberlesia</i>		<i>liquidambaris</i> , <i>Cryptophyll-aspidiotus</i>	116	<i>Nuculaspis</i>	204
	40, 114, 155, 245, 275m	<i>liquidambaris</i> , <i>Diaspidiotus</i>		<i>obscura</i> , <i>Melanaspis</i>	
<i>heterophyllae</i> , <i>Chionaspis</i>	80		113, 116, 121f		194, 195, 198f
<i>howardi</i> , <i>Abgrallaspis</i>		<i>litorosa</i> , <i>Odonaspis</i>	208	<i>obscurus</i> , <i>Aspidiotus</i>	195
	32, 34, 38f, 114, 115	<i>longirostris</i> , <i>Ischnaspis</i>		<i>obscurus</i> , <i>Chrysomphalus</i>	195
<i>howardi</i> , <i>Gonaspidotus</i>	34		165, 173, 166f	<i>Oceanaspidotus</i>	207
<i>howardi</i> , <i>Hemiberlesia</i>	34, 114	<i>longirostris</i> , <i>Mytilaspis</i>	165	<i>Odonaspis</i>	150, 207, 208
<i>Howardia</i>	163	<i>longirostris</i> , <i>Parischnaspis</i>	165	<i>ohioensis</i> , <i>Aspidiotus</i>	114
<i>hunteri</i> , <i>Diaspidiotus</i>	115	<i>Lopholeucaspis</i>	193	<i>oleae</i> , <i>Diaspis</i>	218
<i>insularis</i> , <i>Quernaspis</i>	251	<i>lucumae</i> , <i>Aspidiotus</i>	157	<i>oleae</i> , <i>Parlatoria</i>	
<i>Insulaspis</i>	168	<i>machili</i> , <i>Eucornaspis</i>	174		216, 218, 225f, 274m, 276m
<i>inusitatus</i> , <i>Aspidiotus</i>	150	<i>machili</i> , <i>Lepidosaphes</i>		<i>oleae</i> , <i>Syngenaspis</i>	218
<i>Ischnaspis</i>	165		168, 174, 183f	<i>ophiopogonis</i> , <i>Pinnaspis</i>	230
<i>japonica</i> , <i>Fiorinia</i>	144, 145f	<i>machili</i> , <i>Mytilaspis</i>	174	<i>oppugnatus</i> , <i>Aspidiotus</i>	64
<i>javanensis</i> , <i>Aspidiotus</i>	157	<i>mackieana</i> , <i>Andaspis</i>	40, 42f, 169	<i>opuntiae</i> , <i>Diaspis</i>	127
<i>juglandis-regiae</i> , <i>Aspidiotus</i>	244	<i>mackieana</i> , <i>Lepidosaphes</i>	40	<i>opunticola</i> , <i>Diaspis</i>	127
<i>juglans-regiae</i> , <i>Aspidiotus</i>	244	<i>magna</i> , <i>Ferrisidea</i>	142, 143f	<i>orbicularis</i> , <i>Parlatoria</i>	221
<i>juglans-regiae</i> , <i>Evaspidotus</i>	244	<i>magna</i> , <i>Pseudodiaspis</i>	142	<i>ortholobis</i> , <i>Chionaspis</i>	
<i>juglans-regiae</i> , <i>Furchaspis</i>	244	<i>mangiferae</i> , <i>Aspidiotus</i>	97		77, 79, 81, 89f
<i>juglans-regiae</i> , <i>Quadraspidotus</i>		<i>manzanitae</i> , <i>Aulacaspis</i>	128	<i>osborni</i> , <i>Aspidiotus</i>	116
	243, 244, 248f, 278m, 280m	<i>manzanitae</i> , <i>Diaspis</i>		<i>osborni</i> , <i>Diaspidiotus</i>	
<i>juniperi</i> , <i>Aonidia</i>	111		125, 128, 133f		106, 113, 115, 116, 122f
<i>juniperi</i> , <i>Aspidiotus</i>	70, 144	<i>marchali</i> , <i>Hemichionaspis</i>	234	<i>ostaeiformis</i> , <i>Diaspis</i>	137

<i>ostreaeformis</i> , <i>Quadraspis</i> - <i>iotus</i>	<i>pinifoliae</i> , <i>Aspidiotus</i>	80	<i>rapax</i> , <i>Hemiberlesia</i>	
244, 245	<i>pinifoliae</i> , <i>Chionaspis</i>			155, 157, 162f, 245
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