



**United States  
Department of  
Agriculture**

Agricultural  
Research  
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and

**United States  
Department of  
Health and  
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Public Health  
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Food and Drug  
Administration

Agriculture  
Handbook No. 655

# **Insect and Mite Pests in Food**

## **An Illustrated Key Volume 2**

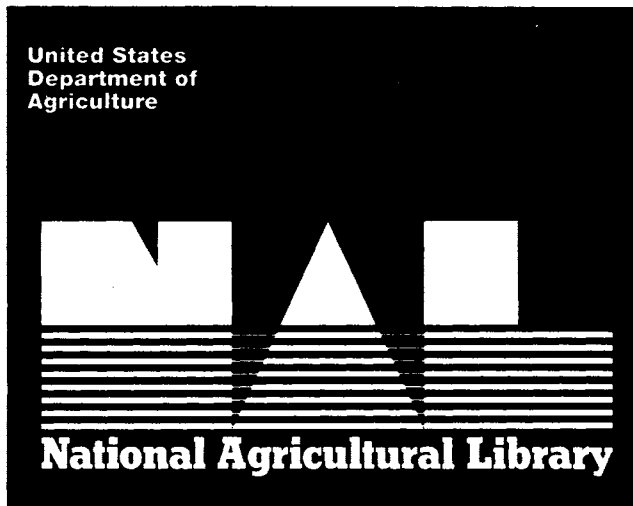


Plate 2. Some **moths** (Lepidoptera) associated with the food industry (body lengths for each species are shown in millimeters in parentheses): A, **webbing clothes moth**, *Tineola bisselliella* (5-7.5) (Tineidae); B, **brown house moth**, *Hofmannophila pseudospretella* (7.5-10) (Oecophoridae); C, **lesser wax moth**, *Achroia grisella* (♂7-9; ♀9.5-12) (Pyralidae); D, **Monopis crocicapitella** (5-7) (Tineidae); E, **Angoumois grain moth**, *Sitotroga cerealella* (6-9) (Gelechiidae); F, G, **Indianmeal moth**, *Plodia interpunctella* (6-8.5) (Pyralidae); H, **rice moth**, *Corcyra cephalonica* (♂7.5-9; ♀8.5-11) (Pyralidae); I, **Mediterranean flour moth**, *Anagasta kuehniella* (9-11) (Pyralidae); J, **tobacco moth**, *Ephestia elutella* (7-9) (Pyralidae); K, **European grain moth**, *Nemapogon granella* (5-7) (Tineidae); L, **stored nut moth**, *Paralipsa gularis* (♂8.5-12; ♀8.5-13.5) (Pyralidae); M, **greater wax moth**, *Galleria mellonella* (♂9.5-11.5; ♀13-16) (Pyralidae); N, **whiteshouldered house moth**, *Endrosis sarcitrella* (7-9.5) (Oecophoridae); O, **meal moth**, *Pyralis farinalis* (♂7.5-11.5; ♀13-15) (Pyralidae).





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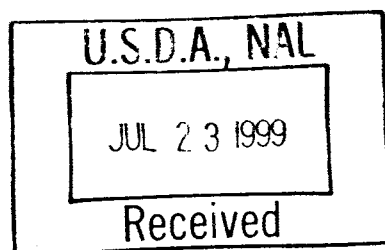
Food and Drug  
Administration

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# **Insect and Mite Pests in Food**

## **An Illustrated Key**

J. Richard Gorham  
Editor



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## Part 2

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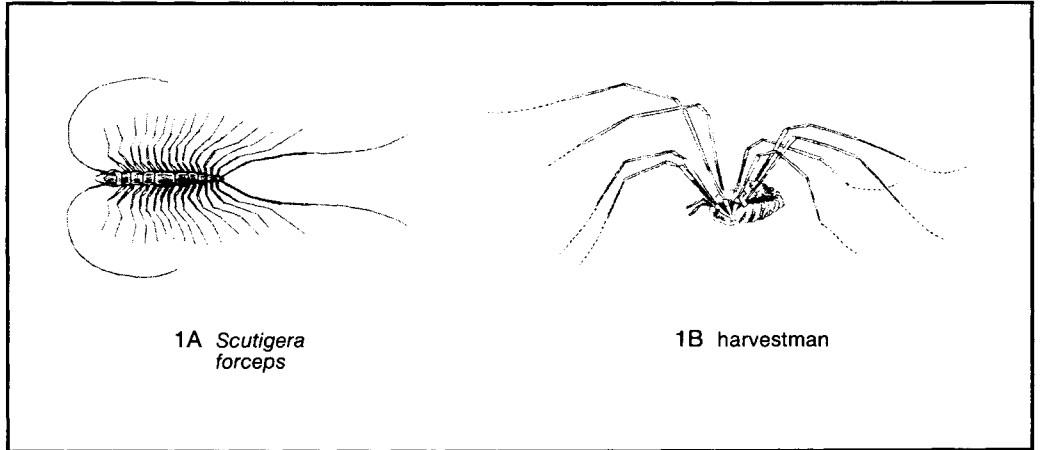
**George T. Okumura**

Okumura Biological Institute  
6669 Fourteenth Street  
Sacramento CA 95831

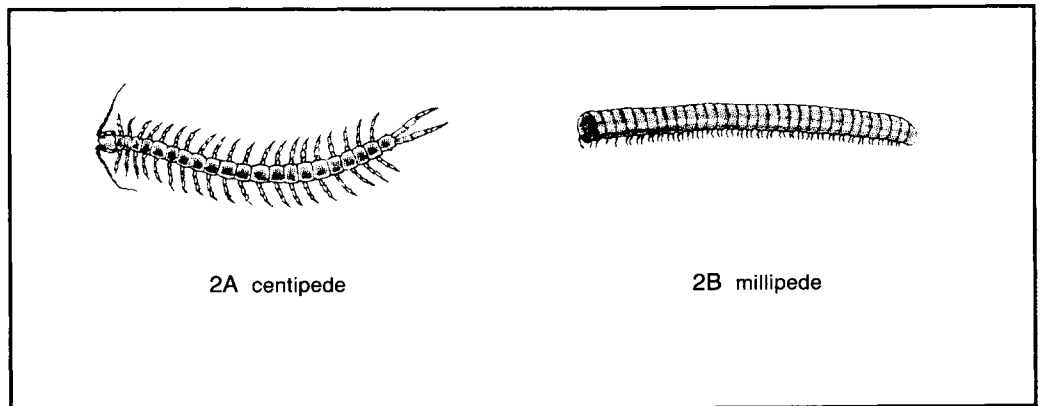
**KEY TO ADULTS**

Drawings by C.S. Papp  
unless otherwise noted.<sup>1</sup>

- 1 With more than 10 pairs of legs; body usually elongate (1A)----- 2  
With less than 10 pairs of legs; body usually not elongate (1B)----- 3

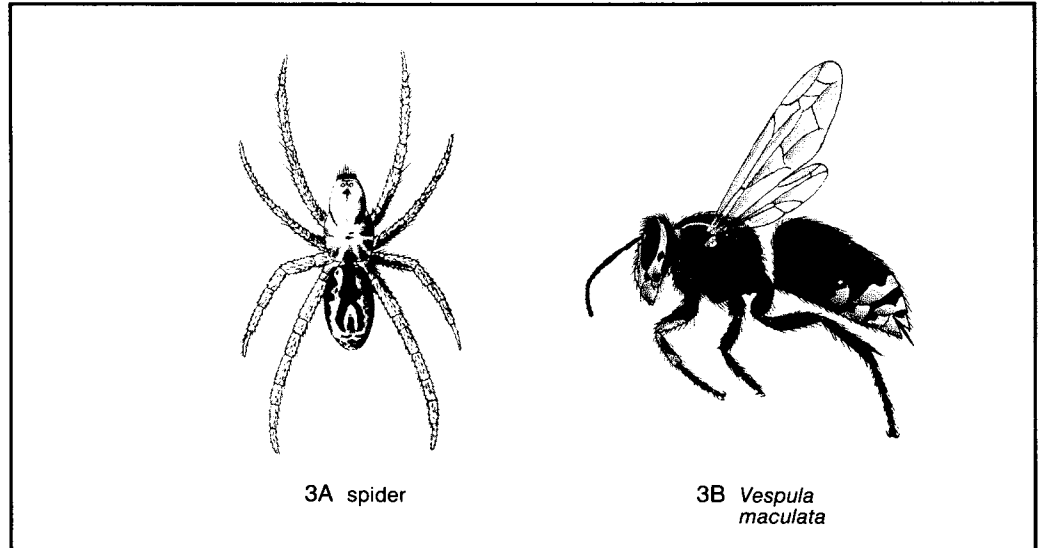


- 2 Most body segments with 1 pair of legs (2A)-----centipedes, Chilopoda  
Most body segments with 2 pairs of legs (2B)-----millipedes, Diplopoda



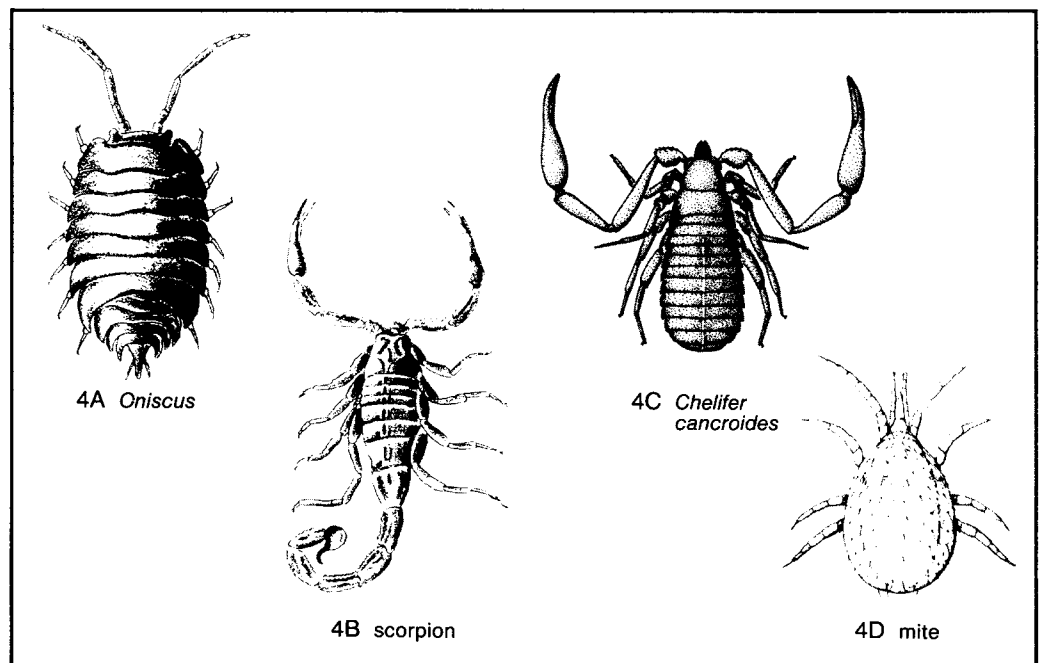
<sup>1</sup>Drawings 1B, 4A, 4B, 8B, 10A, 14B, 15A, 21A, 21B, 24A, 29A, 29B, and 30B from *The Common Insects of North America* by Lester A. Swan and Charles S. Papp. Reprinted by permission of Harper & Row, Publishers, Inc.; copyright 1972 by Lester A. Swan and Charles S. Papp.

- 3 With 4 or more pairs of legs, 1 or 2 body regions, and either 2 pairs of antennae or none; wings absent (3A)----- 4  
 With 3 pairs of thoracic legs, 3 major body regions, and 1 pair of antennae; often with 1 or 2 pairs of wings (3B). Insecta (**insects**)----- 5



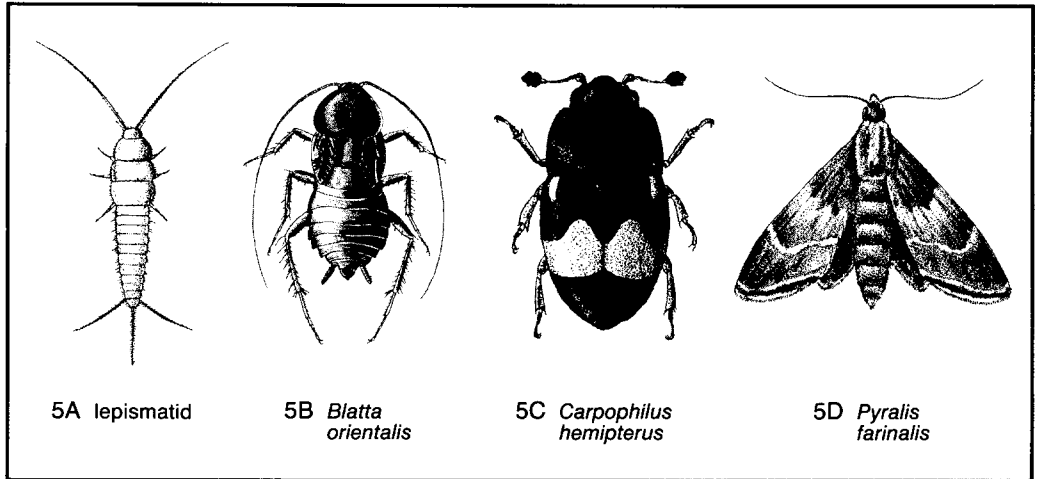
- 4 With 5 or more pairs of legs and 2 pairs of antennae (one pair may be difficult to see) (4A)-----crustaceans, Crustacea  
 With 4 pairs of legs; antennae absent (4B-D) -----**arachnids**, Arachnida  
 FOR KEY TO MITES, SEE CHAPTER 1

Drawing 4C by C. Feller

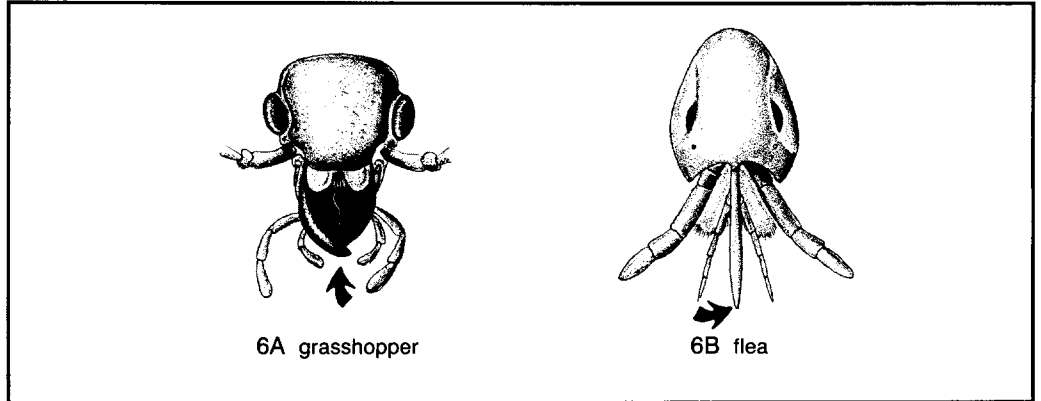


**Insecta**

5 Wings absent (5A) or rudimentary (5B)----- 6  
 Wings present (5C, 5D) (but may be nonfunctional)----- 21

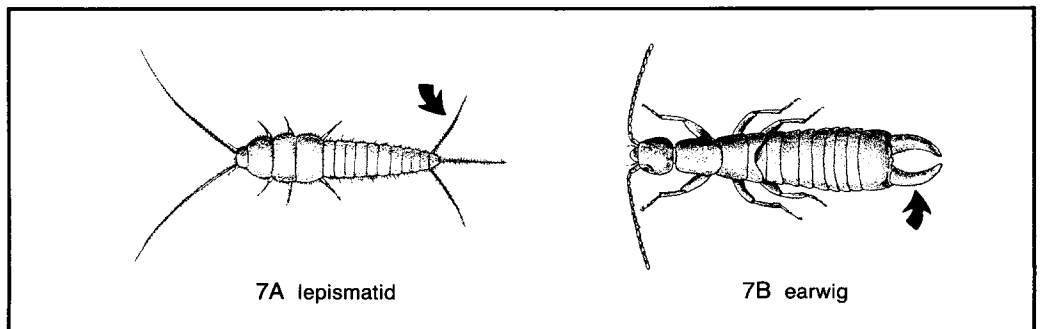


6 With jaws (chewing mouthparts) (6A)----- 7  
 With a long beak or stylets (sucking mouthparts) (6B)----- 15



7 With 3 long filaments at tip of abdomen (7A)-----silverfish, Thysanura  
 FOR KEY TO SILVERFISH, SEE CHAPTER 21

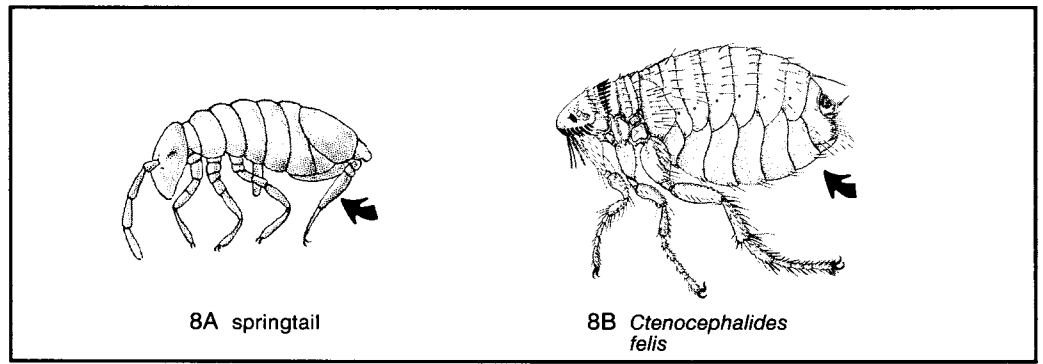
Without 3 caudal filaments (7B)----- 8



8 Abdomen with no more than 6 segments; springlike appendage usually present on posteroventral surface of abdomen (8A) ----- **springtails**, Collembola  
 FOR KEY TO SPRINGTAILS, SEE CHAPTER 20

Abdomen with more than 6 segments; springlike appendage absent (8B)----- 9

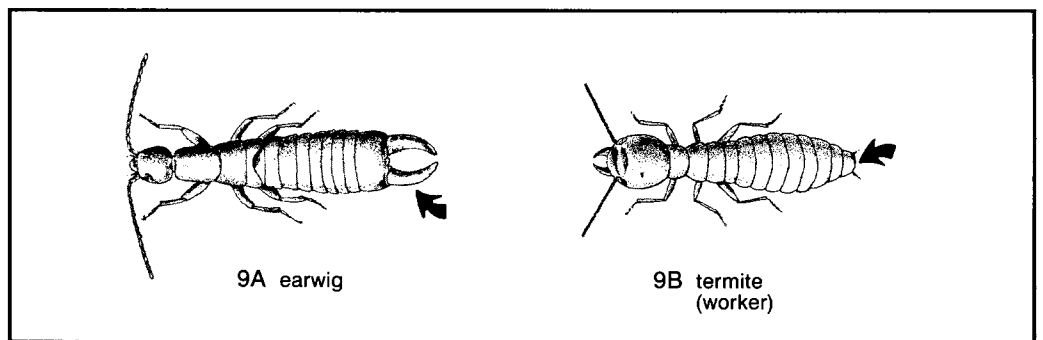
Segmentation is usually readily apparent (see 11A-D) in the abdomens of the Hymenoptera included in this Handbook, but it is often very difficult to see all of the segments that may be present. Therefore, when the abdomen consists of a propodeum, petiole, and gaster (as in 11A-D), the reader may assume that more than 6 segments are present.



8A springtail

8B *Ctenocephalides felis*

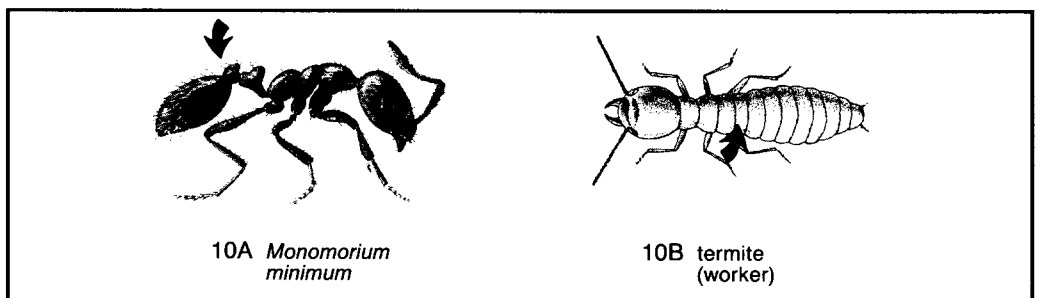
9 Forcepslike appendage present at tip of abdomen (9A)----- **earwigs**, Dermaptera (in part)  
 Forcepslike appendage absent (9B) ----- 10



9A earwig

9B termite (worker)

10 Abdomen strongly constricted at base (10A). Hymenoptera (ants, parasitic wasps) (in part) ----- 11  
 Abdomen not strongly constricted at base (10B) ----- 12



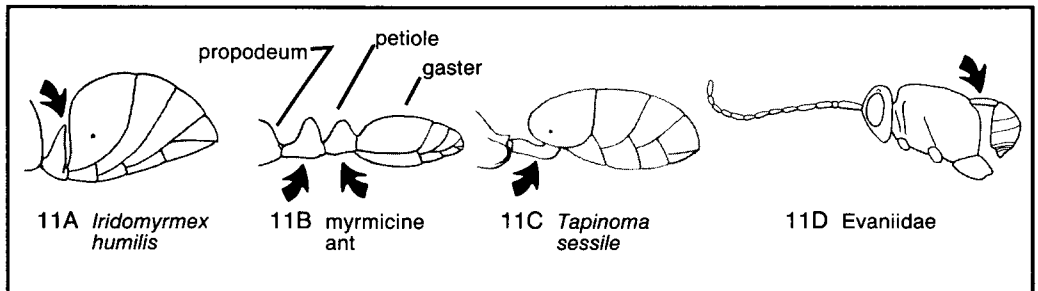
10A *Monomorium minimum*

10B termite (worker)

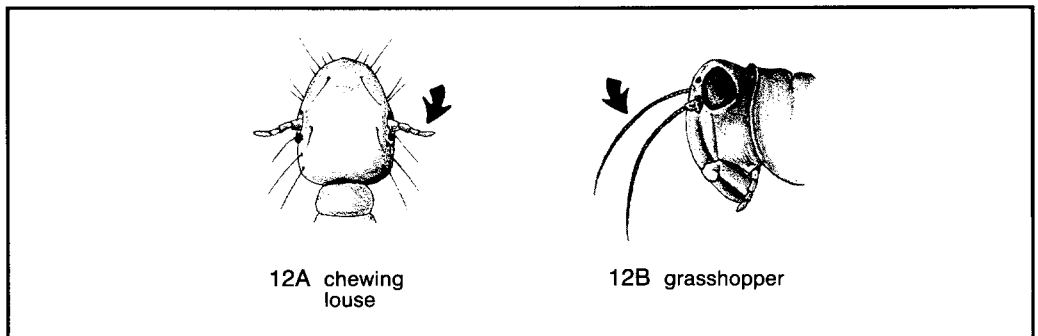
11 One (11A) or two (11B) petiolar nodes present-----ants, Formicidae  
 FOR KEY TO ANTS, SEE CHAPTER 17

Caution: The petiolar node is vestigial in the workers of  
*Tapinoma sessile* (11C) and *T. melanocephalum*.  
 Drawings 11A-C by A.D. Cushman; 11D by G. Gordh and P.  
 Mote.

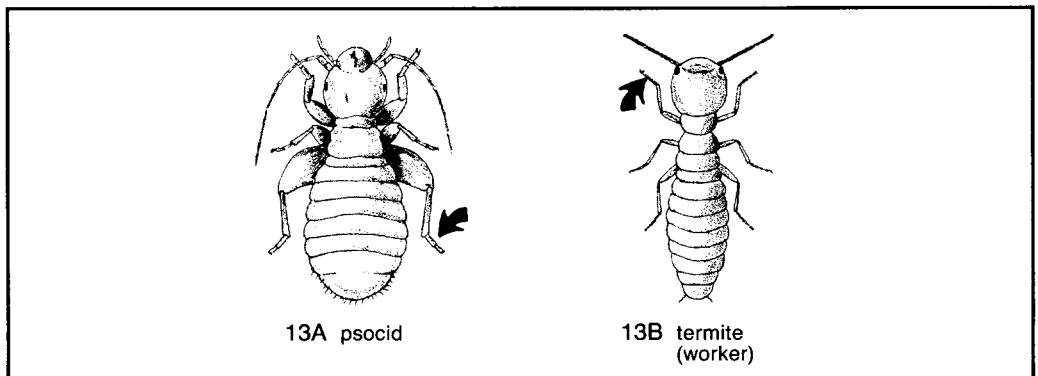
Petiolar node absent (11D) -----parasitic wasps  
 FOR KEY TO PARASITIC WASPS, SEE CHAPTER 26



12 Antenna with fewer than 8 segments (12A)-----chewing lice, Mallophaga  
 Antenna with more than 8 segments (12B)----- 13

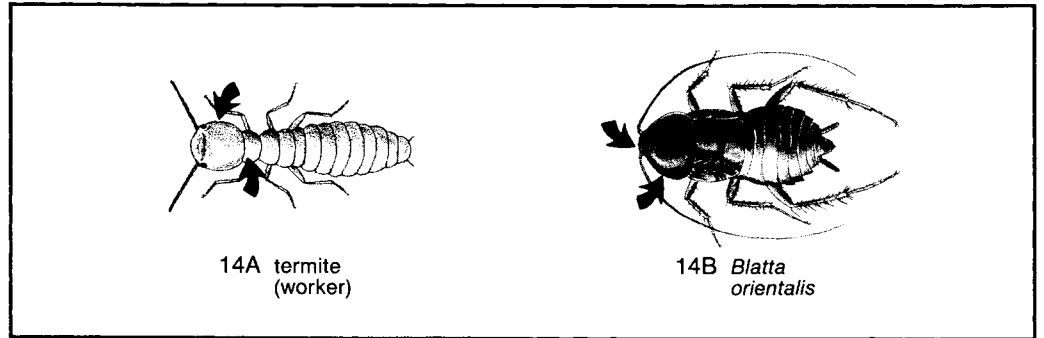


13 Tarsus with 1 to 3 segments (13A)-----psocids, Psocoptera  
 FOR KEY TO PSOCIDS, SEE CHAPTER 22  
 Tarsus with 4 or 5 segments (13B)----- 14

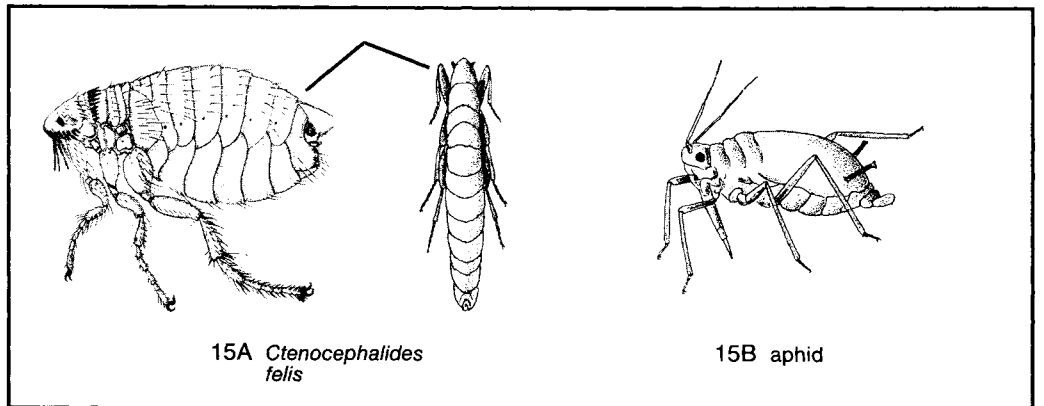




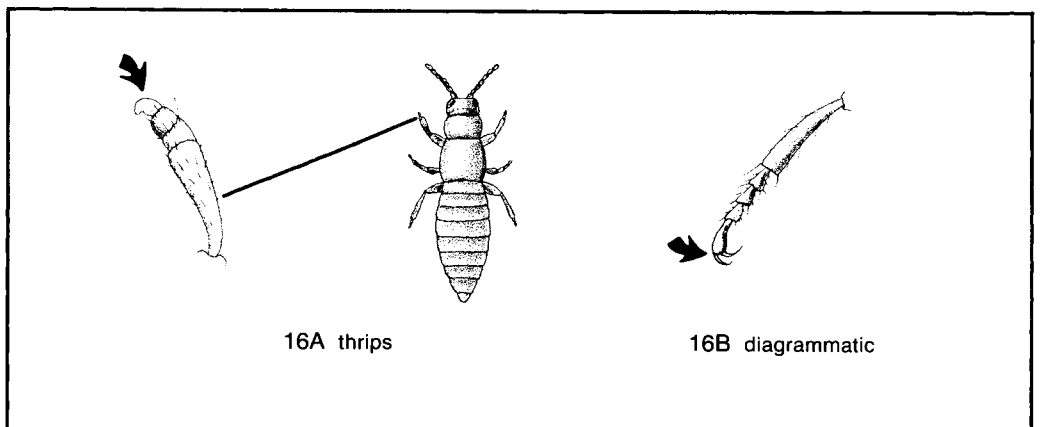
- 14 Width of pronotum less than length of head (14A)-----**termites**, Isoptera  
 Width of pronotum greater than length of head (14B) (pronotum covers head of some species)-----**crickets, cockroaches, etc.**, Orthoptera *s.l.* (in part)  
 FOR KEY TO COCKROACHES, SEE CHAPTER 2



- 15 Body extremely compressed (flattened from side to side) (15A)-----**fleas**, Siphonaptera  
 Body not compressed (may be depressed—flattened dorsoventrally—or roughly cylindrical) (15B)----- 16

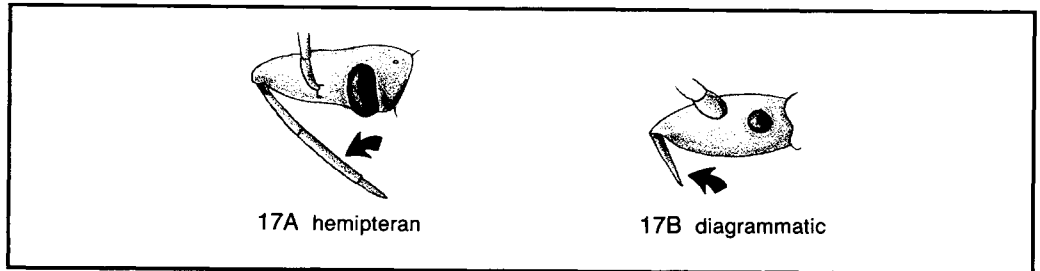


- 16 Tarsus terminating in a protrusible bladder (16A)-----**thrips**, Thysanoptera (in part)  
 FOR KEY TO THRIPS, SEE CHAPTER 23  
 Tarsus terminating in 1 or 2 claws (16B)----- 17



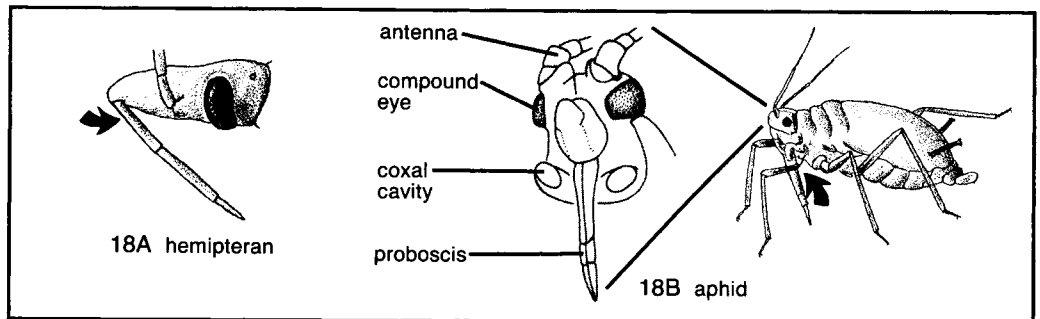
- 17 Beak jointed (17A)----- 18  
 Beak not jointed (17B)----- 20

If the mouthparts appear to be retracted into the head (thus difficult to observe) and the tarsi have only one segment, go to couplet 20.



- 18 Beak arising from front of head (18A)-----**true bugs**, Hemiptera (Heteroptera) (in part)  
 Beak arising from posteroventral part of head (18B). Hemiptera (Homoptera) (homopterans) (in part)----- 19

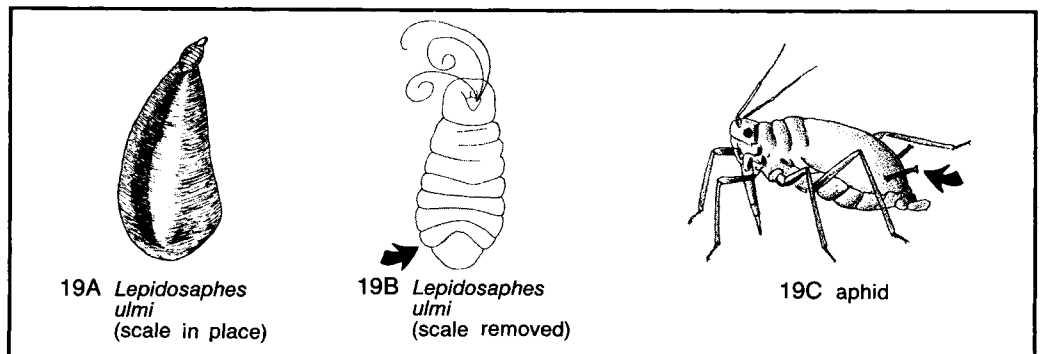
Drawing 18B-detail (head of *Myzus persicae*) by C. Feller.



- 19 Body of female covered by scalelike structure (19A); cornicles absent (19B)  
 -----females, **scale insects**, Coccoidea  
 FOR KEY TO SCALES, SEE CHAPTER 25

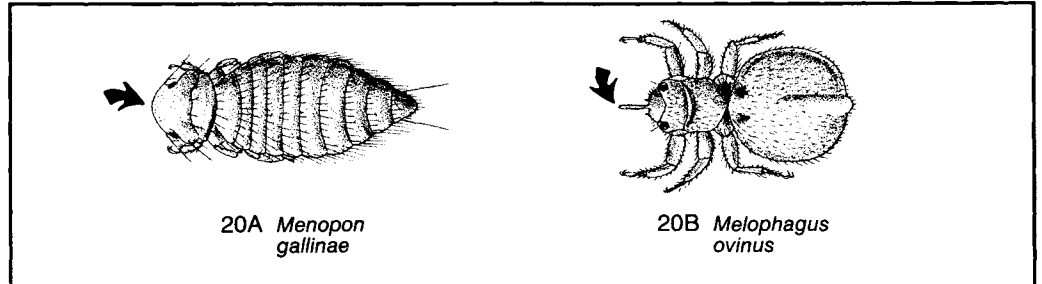
Drawings 19A&B from *Microscopic-Analytical Methods in Food and Drug Control*, 1960.

- Scalelike cover absent; cornicles present (19C)-----**aphids**, Aphididae  
 FOR KEY TO APHIDS, SEE CHAPTER 24

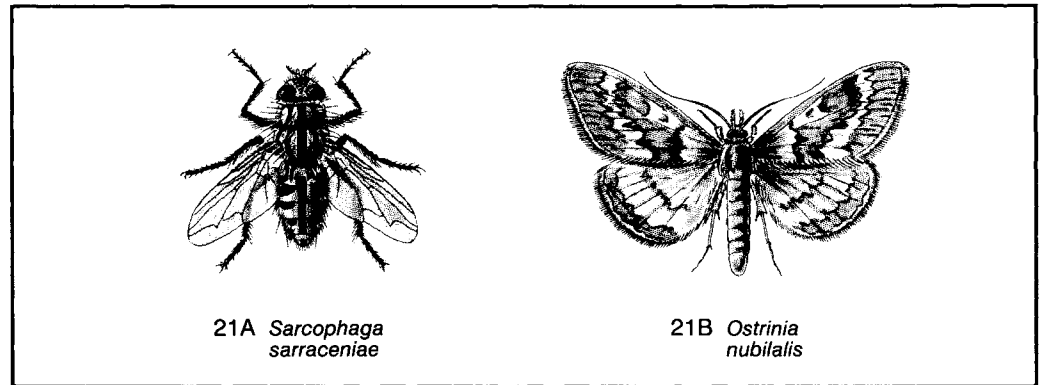


20 Mouthparts retracted into head (not protruding from front of head) (20A)  
 -----sucking lice, Anoplura

Mouthparts not retracted into head (20B). Diptera (flies) (in part)  
 -----sheep ked, *Melophagus ovinus*



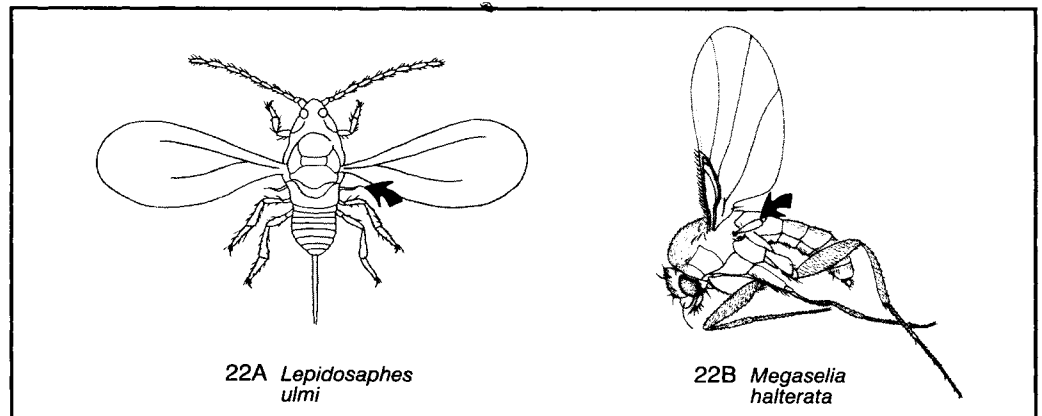
21 With 1 pair of wings (21A)----- 22  
 With 2 pairs of wings (21B)----- 23



22 Vestigial hind wings (hamulohalterae) lanceolate (22A); mouthparts absent  
 -----males, **scale insects**, Coccoidea

Drawing 22A from *Microscopic-Analytical Methods in Food and Drug Control*, 1960; 22B by C. Feller.

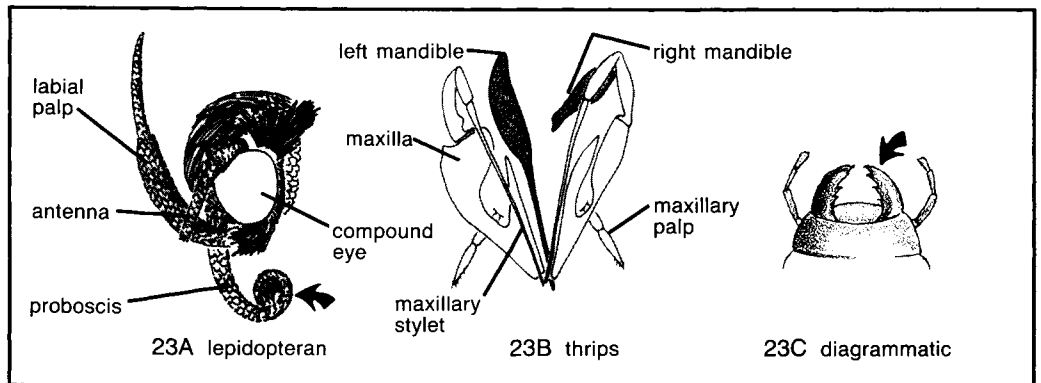
Vestigial hind wings (halteres) capitate (22B); mouthparts present  
 -----flies, Diptera (in part)



23 With sucking mouthparts (23A)----- 24

The mouthparts of thrips (23B) are minute, complex, and difficult to see, but the absence of prominent, chewing-type mandibles is readily apparent, at least.  
 Drawings 23A&B by C. Feller.

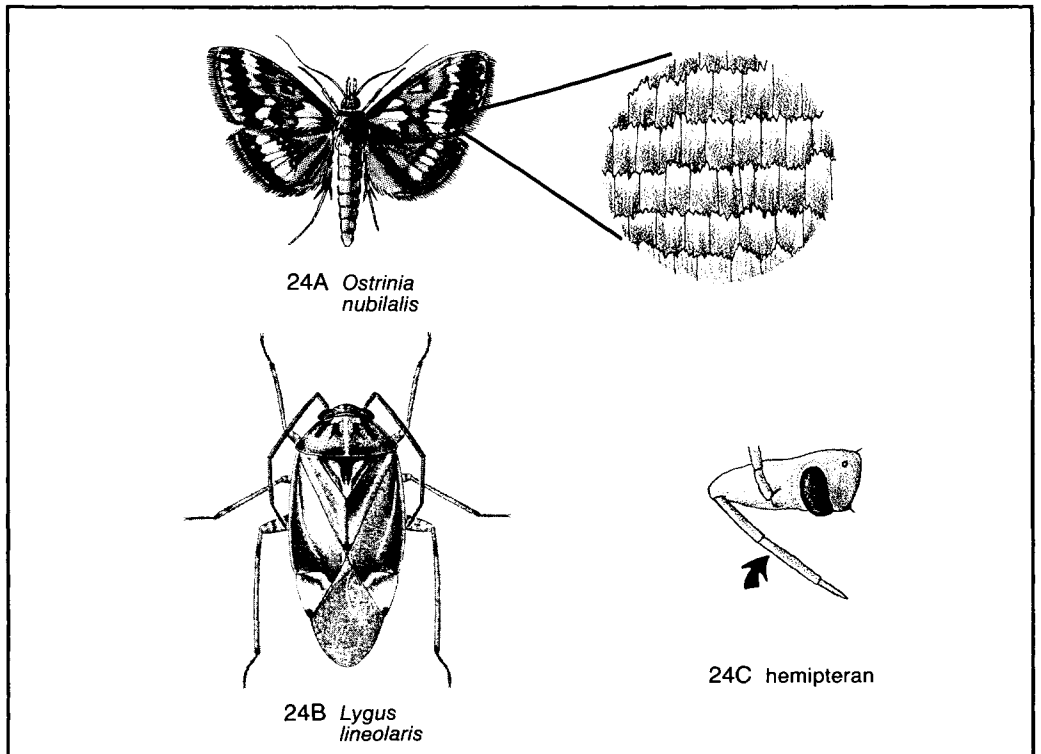
With chewing mouthparts (23C)----- 27



24 Wing densely covered with scales (24A); head with a coiled proboscis (see 23A)  
 -----moths, Lepidoptera  
 FOR KEY TO MOTHS, SEE CHAPTER 14

Wing not scaled (24B); proboscis not coiled (24C)----- 25

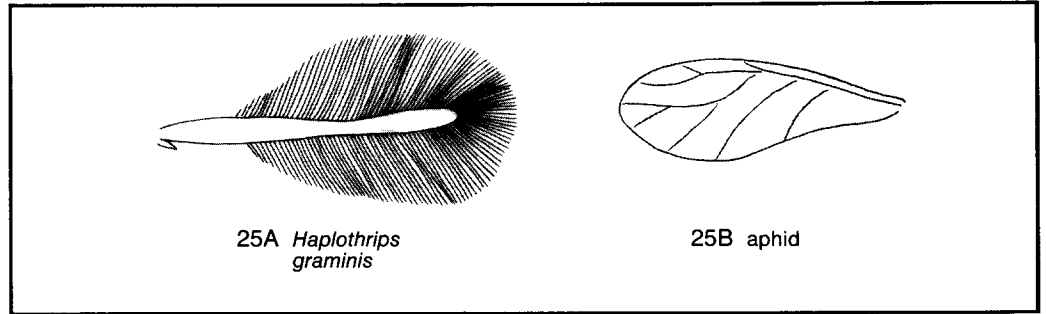
Drawing 24B by C. Feller.



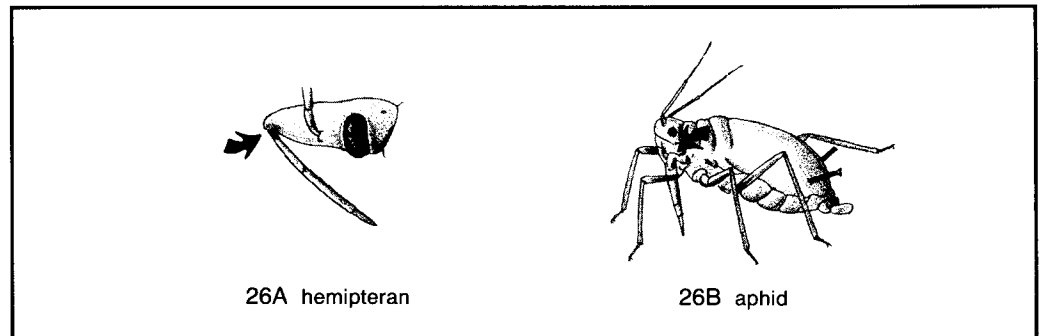
25 Wing with long fringe hairs (25A)-----**thrips**, Thysanoptera (in part)  
 FOR KEY TO THRIPS, SEE CHAPTER 23

Drawing 25A by C. Feller.

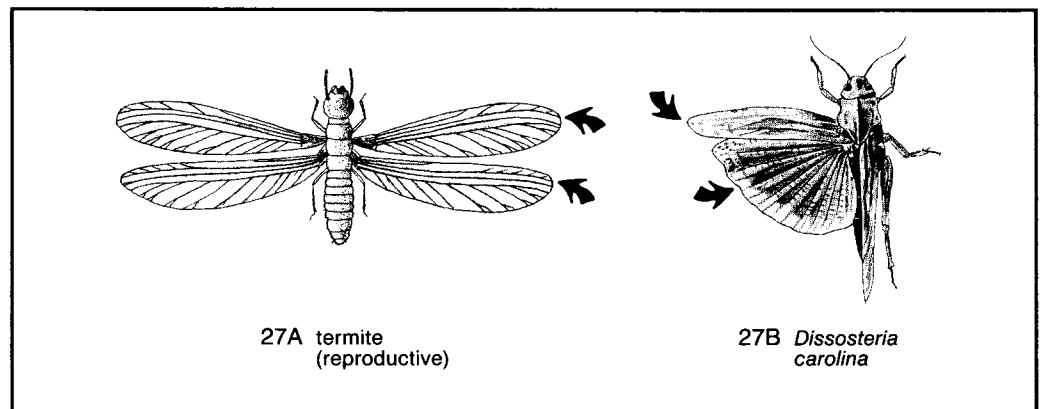
Long fringe hairs absent from wing (25B)----- 26



26 Beak arising from front of head (26A)-----**true bugs**, Hemiptera (Heteroptera) (in part)  
 Beak arising from posteroventral part of head (26B)  
 -----**leafhoppers, aphids, etc.**, Hemiptera (Homoptera) (in part)  
 FOR KEY TO APHIDS, SEE CHAPTER 24



27 Front and hind wings membranous and similar in texture (may or may not be similar in size) (27A)----- 28  
 Front and hind wings dissimilar in texture, the forewing leathery, horny, or paperlike, the hind wing membranous (27B)----- 29



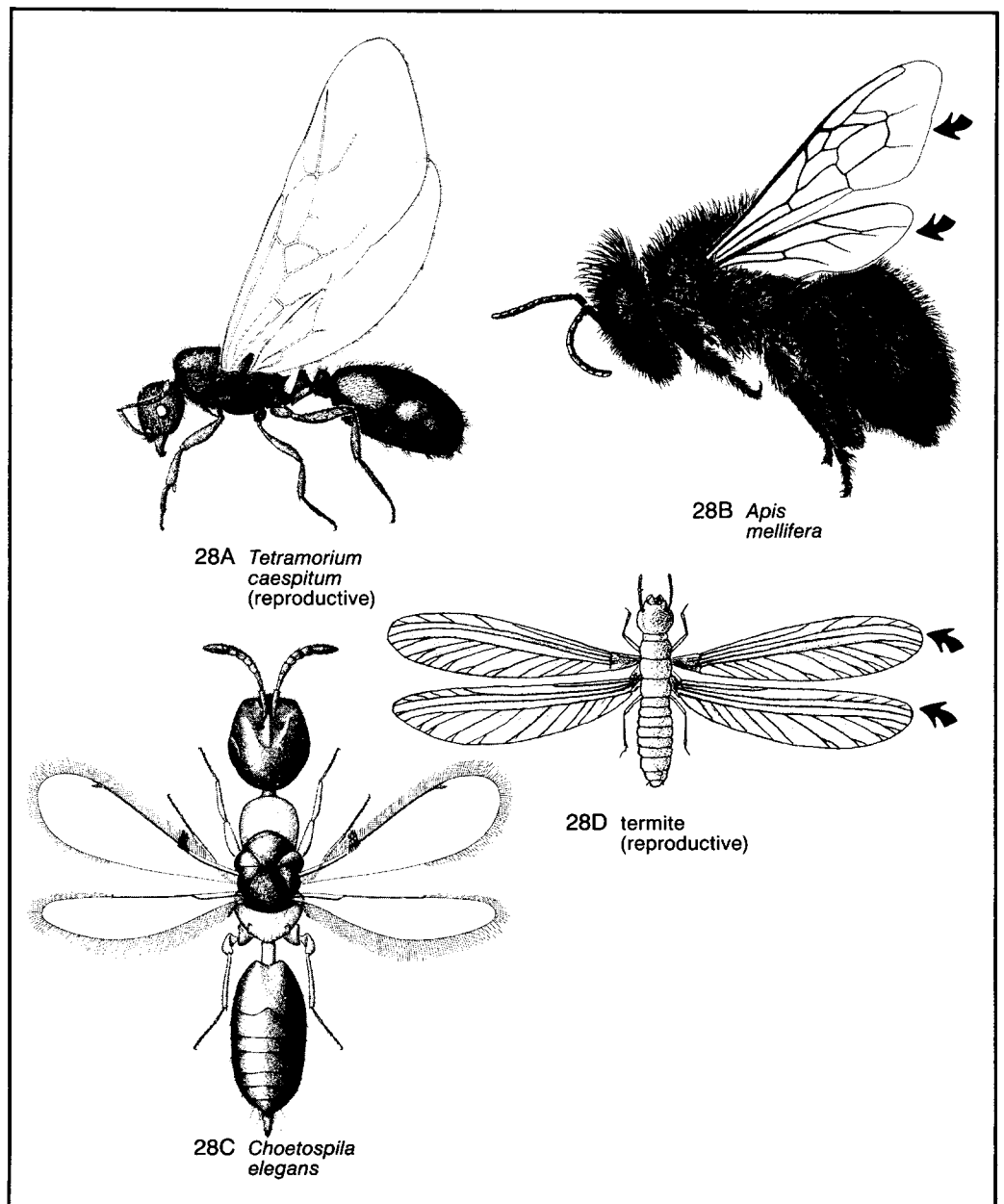
28 Hind wing much smaller than front wing (28A, 28B)

-----ants, bees, wasps, Hymenoptera (in part)  
FOR KEY TO ANTS, SEE CHAPTER 17  
FOR KEY TO PARASITIC WASPS, SEE CHAPTER 26

Hind wing usually shorter than front wing, but if front and hind wings are essentially similar in length (as in 28C), then the venation is greatly reduced. See also 3B, 10A, 11A-D.

Drawings 28A-C by C. Feller.

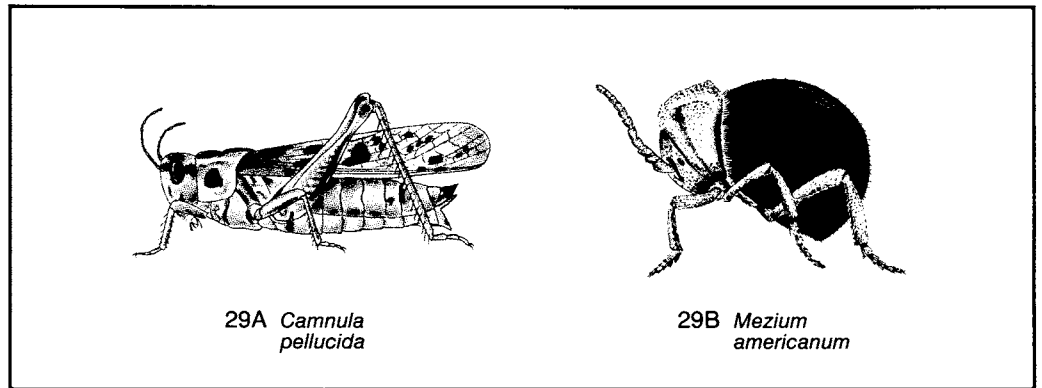
Front and hind wings similar in size (28D) -----termites, Isoptera (in part)



29 Front wing leathery or paperlike, with distinct veins (29A)

----- grasshoppers, cockroaches, etc., Orthoptera s.l. (in part)  
FOR KEY TO COCKROACHES, SEE CHAPTER 2

Front wing horny or leathery, without distinct veins (but may be ridged) (29B)----- 30

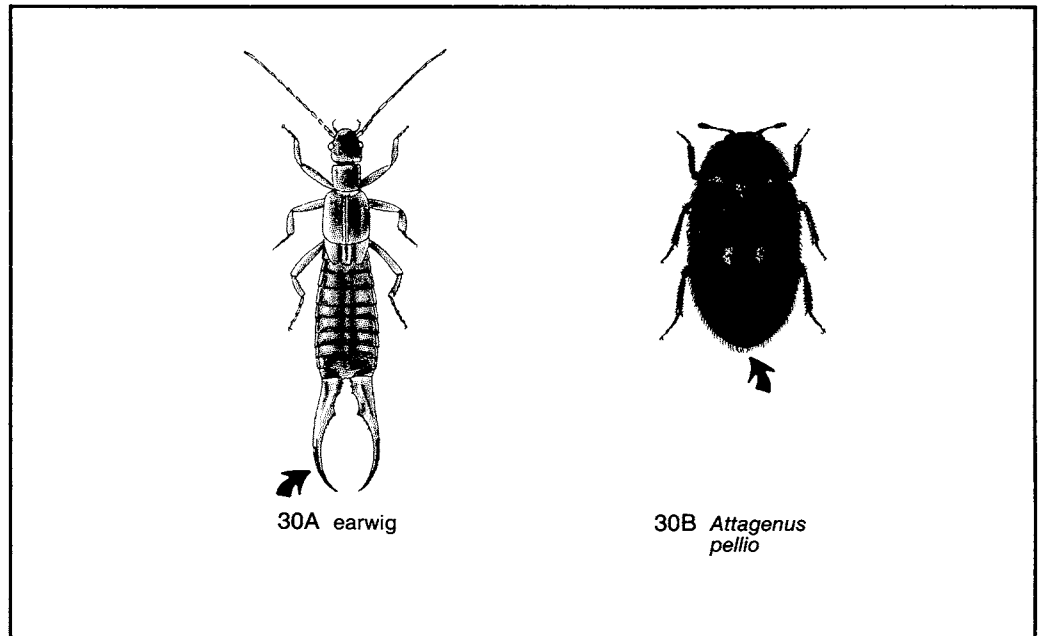


30 With forcepslike appendage at tip of abdomen -----**earwigs**, Dermaptera (in part)

Wings always very much shorter than abdomen.

Without forcepslike appendage (30B)-----**beetles**, Coleoptera  
FOR KEY TO BEETLES, SEE CHAPTER 3

If wings are abbreviated (as in Staphylinidae), then  
forceps are absent; wings commonly cover abdomen  
(30B) or nearly so (see 5C).



*Insect and Mite Pests in Food*

**Notes and Sketches**



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Identification of the larvae of the holometabolus insects is often more difficult than identification of the adults. Furthermore, when only incomplete or fragmentary specimens are available, the task is even more difficult and requires at the very least a considerable knowledge of insect morphology. Often, a knowledge of the life history of an insect lends credence to an identification based on an analytical key. Also, the overall habitus of a larva often identifies it as readily as one person recognizes another. Illustrations, keys, and descriptions in the existing literature, some of which is cited here (1-16), are often helpful aids to identification.

Certain morphological characters are a dead giveaway as to the identity of a larva, for example, the hastisetae of some dermestids or the three tarsal "claws" of blister beetle triungulins (Meloidae). Before advanced microscopic work was possible, these last structures were accepted as true claws (ungues) and from this feature the term "triungulin" was coined. Other larvae that resembled meloid triungulins, even though they had no claws or clawlike structures [for example, Strepsiptera and Rhipiphoridae (Coleoptera)], were also called triungulins (more properly, triungulinoids).

Larvae of the Holometabola are often divided into five or six types based on general body form. Thus, some are termed campodeiform (fig. 19.1A) because the form is basically that found in the genus *Campodea* (Campodeidae, order Diplura—formerly in Thysanura). Larvae of Meloidae (fig. 19.5) are good examples of the campodeiform habitus. Elateriform larvae (fig. 19.1B) resemble wireworms (Elateridae)—elongate, cylindrical, usually heavily sclerotized, with head capsule frequently somewhat flattened. Vermiform larvae (fig. 19.1C), as the name implies, are wormlike—elongate, often annulate, lacking legs, and usually having no distinct head. Flea larvae (Siphonaptera), even though they have a distinct head, and maggots (Diptera) are vermiform. Scarabaeiform larvae (fig. 19.1D) are C-shaped, usually stout-bodied (grublike), and resemble the white grubs of the beetle family Scarabaeidae. Eruciform larvae (fig. 19.1E; the term comes from the Latin stem *eruca* meaning caterpillar) are typical caterpillars with a distinct head, thoracic legs, and prolegs with crochets on some of the abdominal segments.

These terms for the various larval body types are also used to describe the successive larval stages of insects that undergo hypermetamorphosis (heteromorphosis). This is a remarkable process in which the larva assumes a different form at each succeeding molt. Hypermetamorphosis occurs primarily in parasitic insects of the orders Strepsiptera, Coleoptera (Meloidae, Rhipiphoridae), Diptera (Acroceridae, Bombyliidae, Nemestrinidae), Neuroptera (Mantispidae), and Hymenoptera (hypermetamorphosis in the last group is rather different from the kind summarized in the next few paragraphs).

Most hypermetamorphic insects start out as mobile, campodeiform larvae that actively seek out their hosts. Then they change into parasites at the first molt and often enter a scarabaeiform stage, a grublike form with legs, antennae, and other appendages greatly reduced. This is often followed by a coarctate stage somewhat like the dipteran puparium in being legless and covered by the heavily sclerotized cuticle of the larva. This stage is highly resistant to desiccation and other adverse environmental conditions. In the Meloidae there emerges from the coarctate form yet another larval stage that is brief and nonfeeding; this is followed by true pupation and eventual emergence of the adult.

Strepsipteran, rhipiphorid, and meloid triungulins are included here because they may become accidentally entrapped in honey or because they are associated with pollen or flowers that may be used as or used in human food. How they might come to be there may be deduced from their life histories. Strepsipteran triungulins apparently ride the host bee to its nest from whatever flowers it happens to visit. Meloid triungulins (except those that attack grasshopper eggs) and rhipiphorid triungulins hatch from eggs deposited on or near flower blossoms. When a bee visits the flower, the triungulins attach themselves to the bee and ride back to the nest where they dispose of the host's egg and any other competition, molt into a different stage and subsist on pollen and honey. Honeybees (*Apis mellifera*) are merely accidental, dead-end hosts. The life cycles of triungulins can be successfully completed only if the larvae find the right species of various flower-visiting, solitary or semisocial bees (Andrenidae, Anthophorinae, Colletinae, Halictidae, and Hylaeinae).

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<sup>2</sup>Excluding Neuroptera sens. lat., Mecoptera, and Trichoptera.

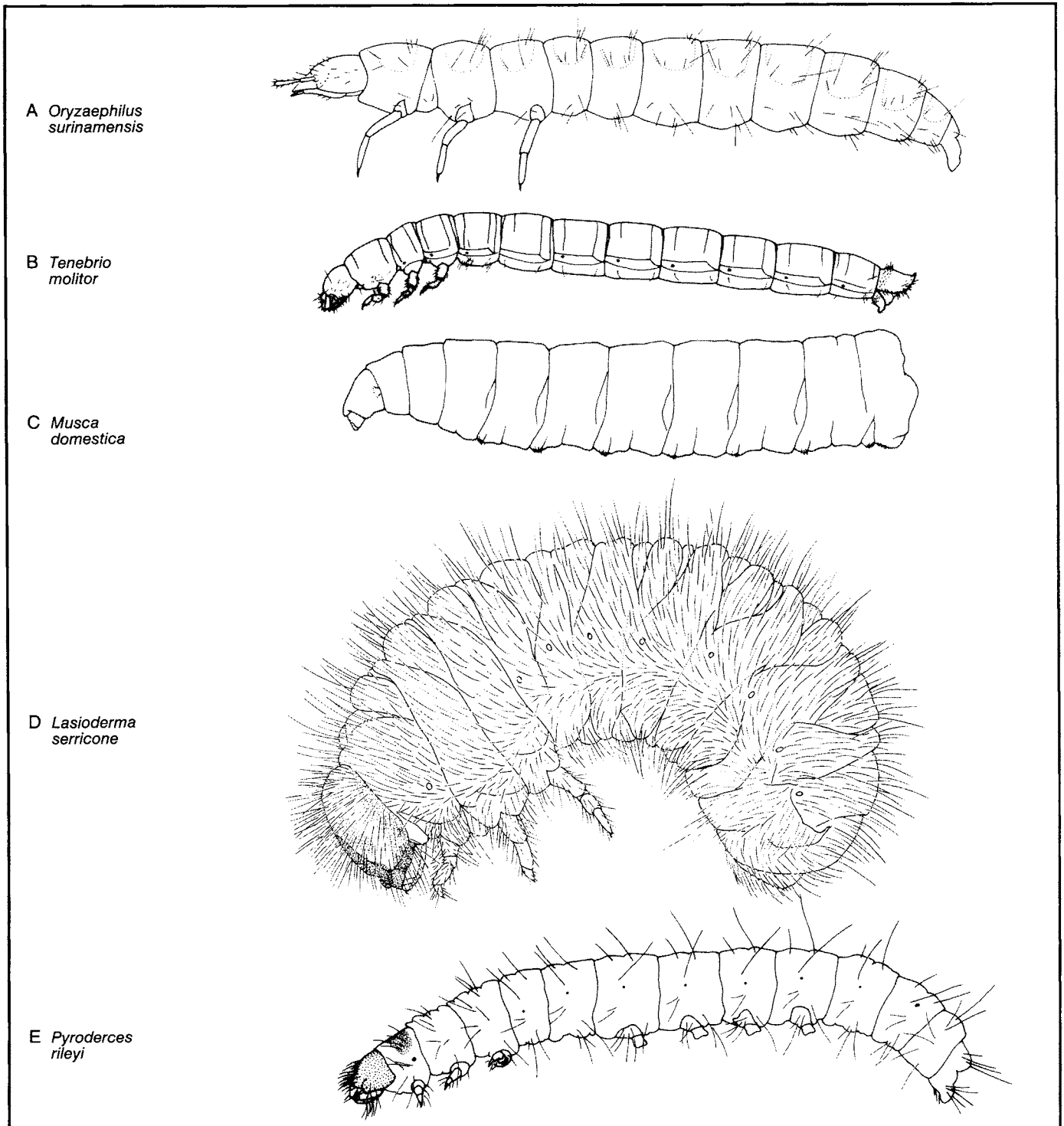


Figure 19.1. Types of insect larvae. A, campodeiform; B, elateriform; C, vermiform; D, scarabaeiform; E, eruciform. (Drawings by C. Feller.)

This is, of course, a most precarious way to make a living. Larval mortality in these groups is, therefore, exceedingly high. These insects have developed an effective way to overcome high mortality: The production of enormous numbers of eggs and larvae per female. For example, over 3,000 larvae have been recorded from a single female strepsipteran.

Any source of flower heads or pollen for use in studies such as on allergies, food fads, and flavorings could readily be contaminated by these larvae. The probability of finding them in food, however, remains extremely low.

The following key to selected orders of immature insects also includes certain infraordinal taxa (*Fannia*, *Eristalis*, Stratiomyidae, Rhipiphoridae, Meloidae) because the different members of a given order are so highly variable that it is impossible to bring them all out at the same point in the key. Only the first stage larvae (triungulins) of Strepsiptera, Meloidae, and Rhipiphoridae are included in this key. The characters of the other taxa treated here refer to the last larval instar. A further caution should be mentioned here, namely, that this is not a comprehensive key to the insect orders. It is distinctly biased toward those insects that are pests of stored food, are parasites of stored-food pests, or are in some other way associated with food.

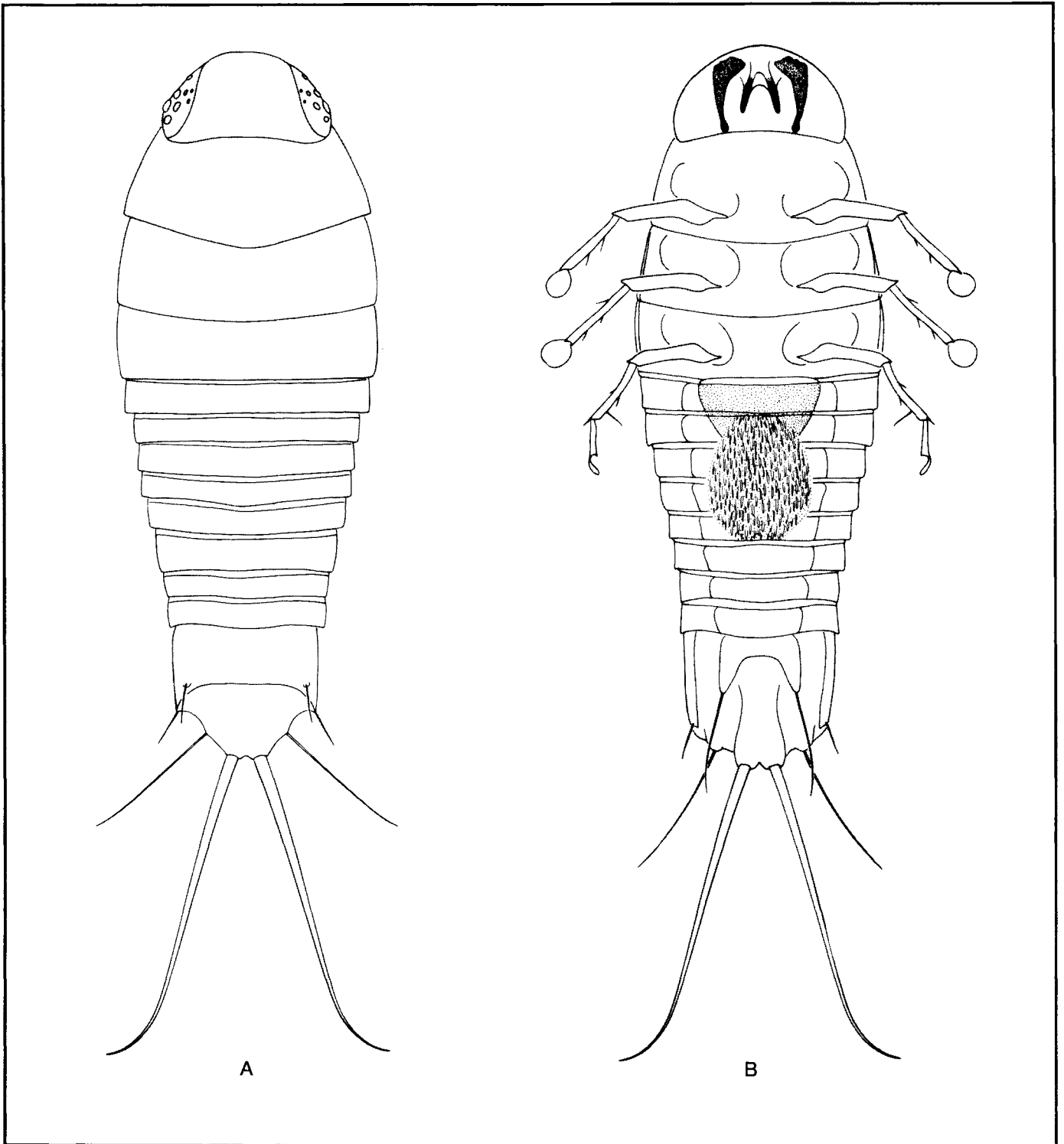


Figure 19.2. *Xenos peckii* Kirby (Stylopidae, Strepsiptera), triangulin: A, dorsal view; B, ventral view. (Drawings by C. Feller.)

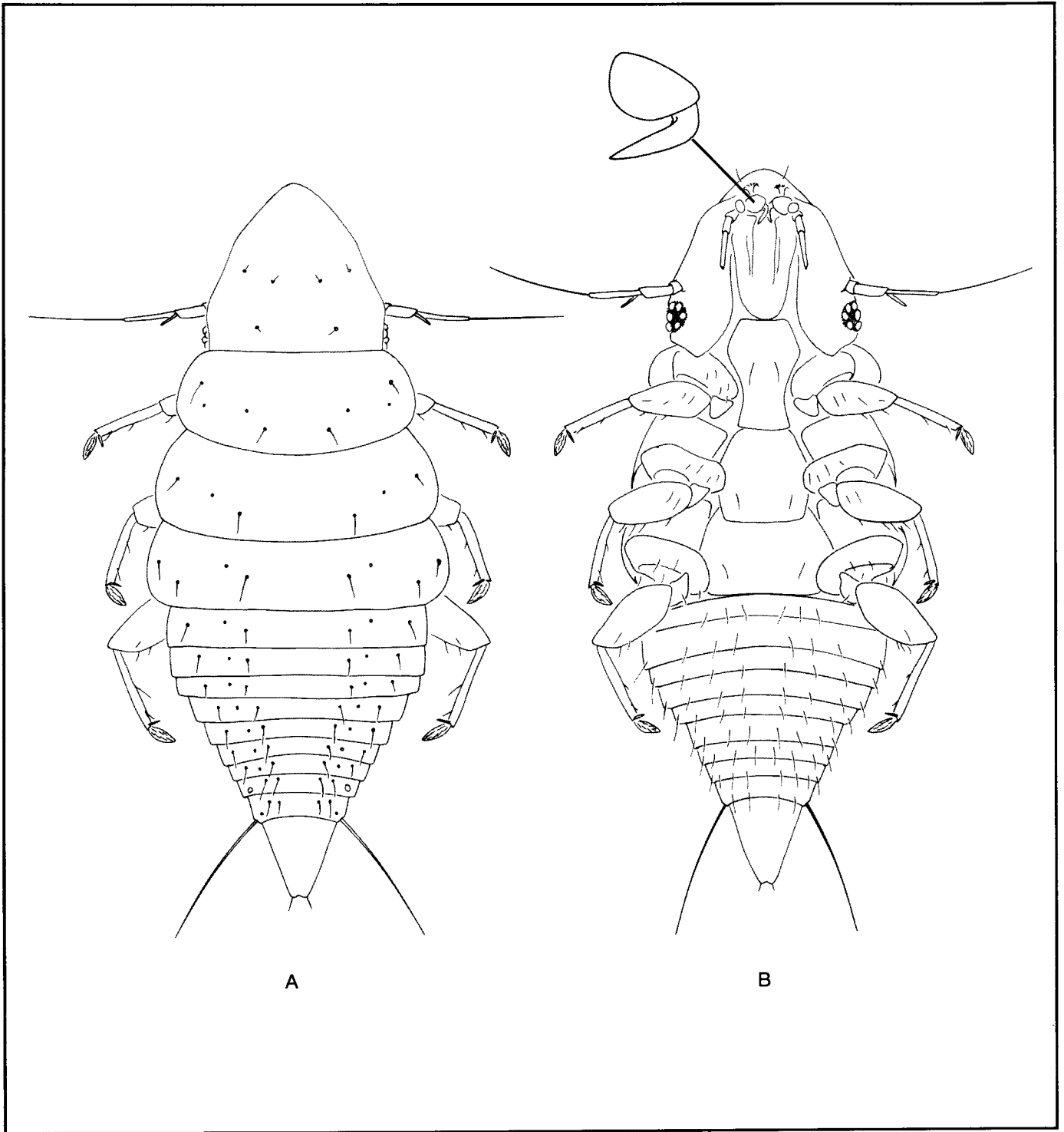


Figure 19.3. Triungulin larva of a wedge-shaped beetle (Rhipiphoridae): A, dorsal view; B, ventral view, with detail of right mandible. (Drawings by C. Feller.)

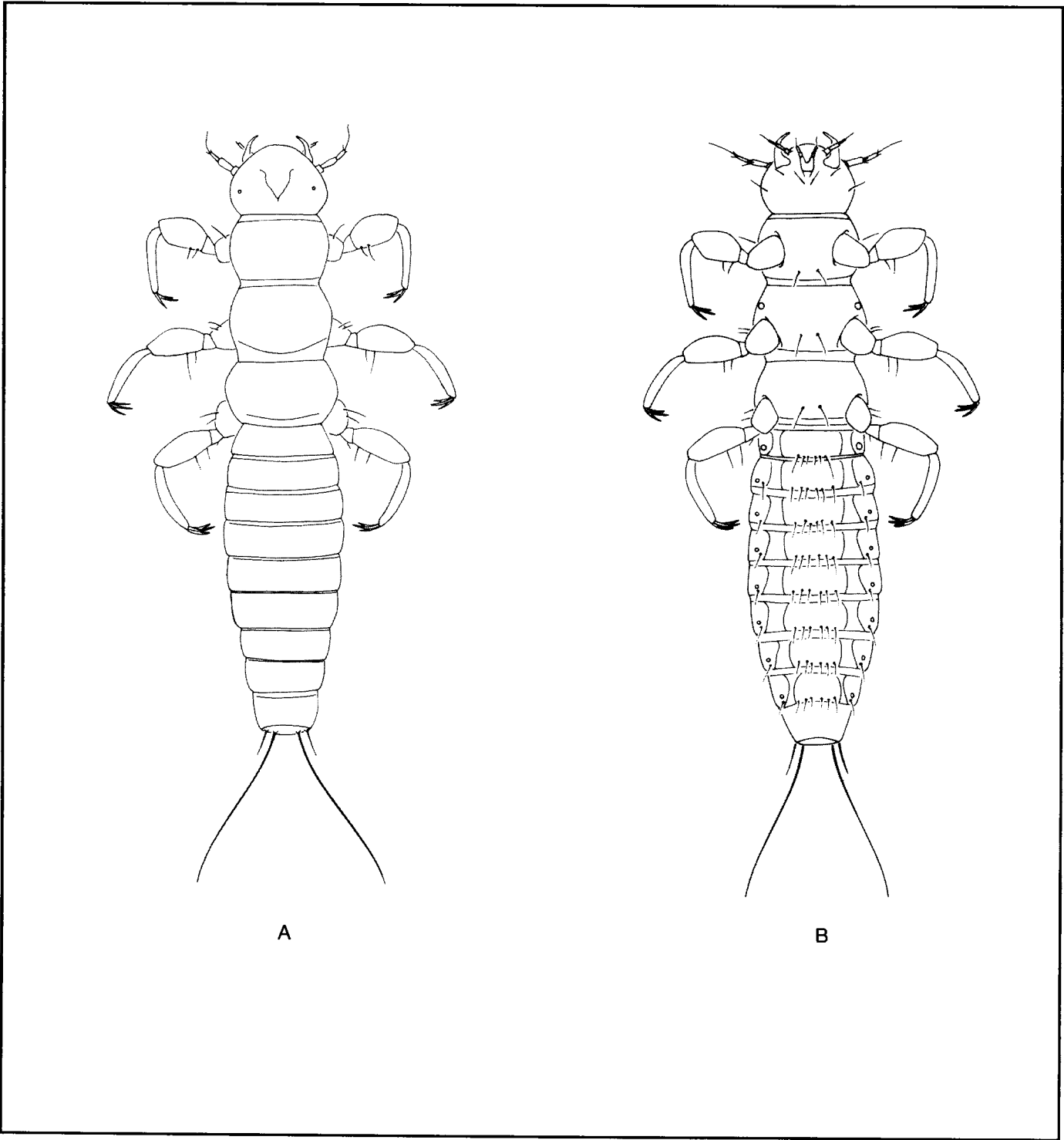


Figure 19.4. Triungulin larva of *Meloe* sp. (Meloinae, Meloidae): A, dorsal view; B, ventral view. (Drawings by C. Feller.)

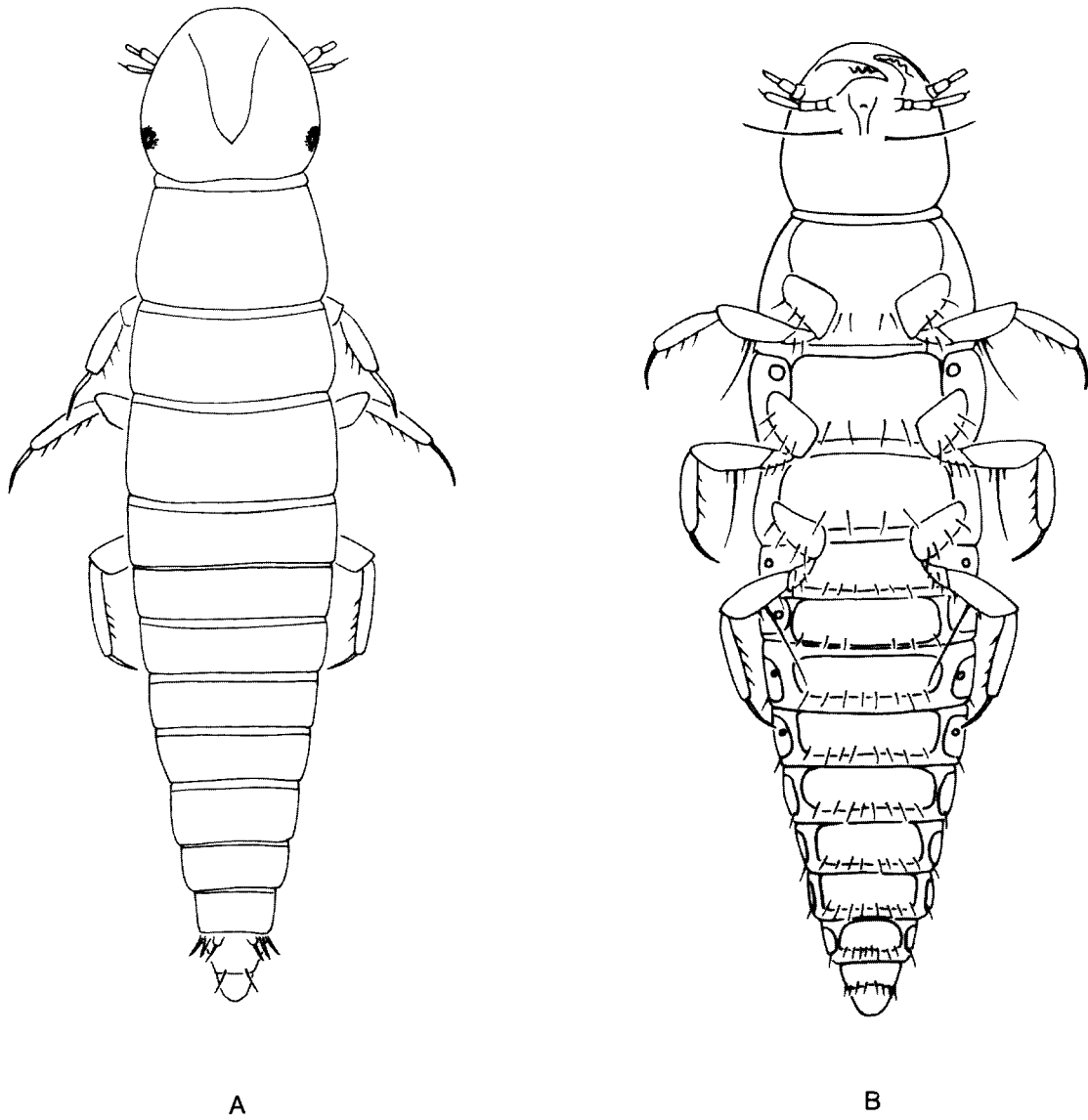


Figure 19.5. *Nemognathine triungulin*  
(Nemognathinae, Meloidae): A, dorsal view;  
B, ventral view. (Drawings by C. Feller.)



**KEY**

Drawings by C. Feller unless otherwise noted.

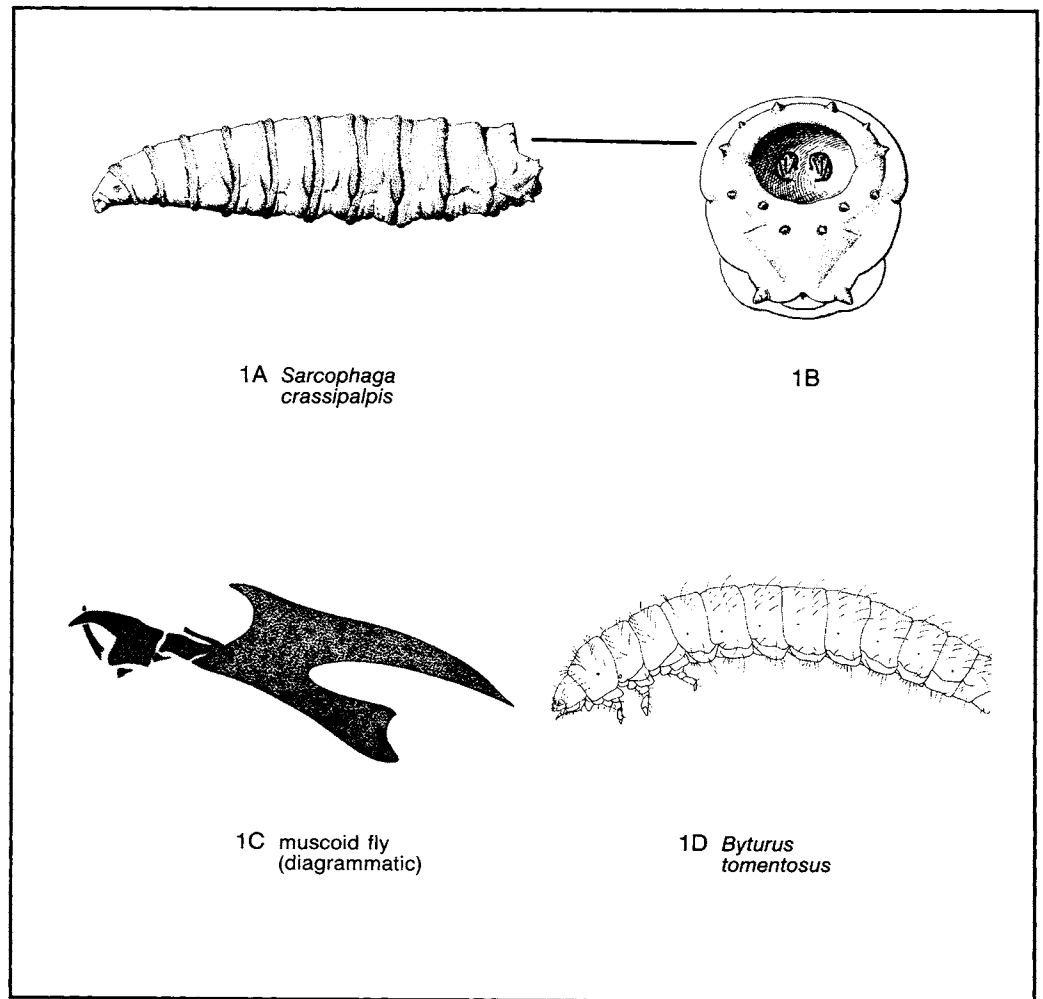
- 1 Typical maggots (1A); body tapering to a subacute head; posterior end somewhat truncate with 2 spiracles on posterior aspect (1B); mouthparts consisting of mouth hooks and internal pharyngeal sclerites (1C)-----flies, Diptera (in part)  
SEE CHAPTER 16

Body circular in cross section (1B); prolegs absent; head capsule unsclerotized (1A) or only weakly sclerotized.

Drawings 1A&B by A.D. Cushman.

- Not typical maggots (1D); body not tapered anteriorly; posterior end not truncated; spiracles not present on posterior aspect of posterior end; mouthparts not consisting of mouth hooks and internal pharyngeal sclerites----- 2

Body round, oval, or flattened in cross section; mouthparts may be absent or vestigial; prolegs may be present or absent.



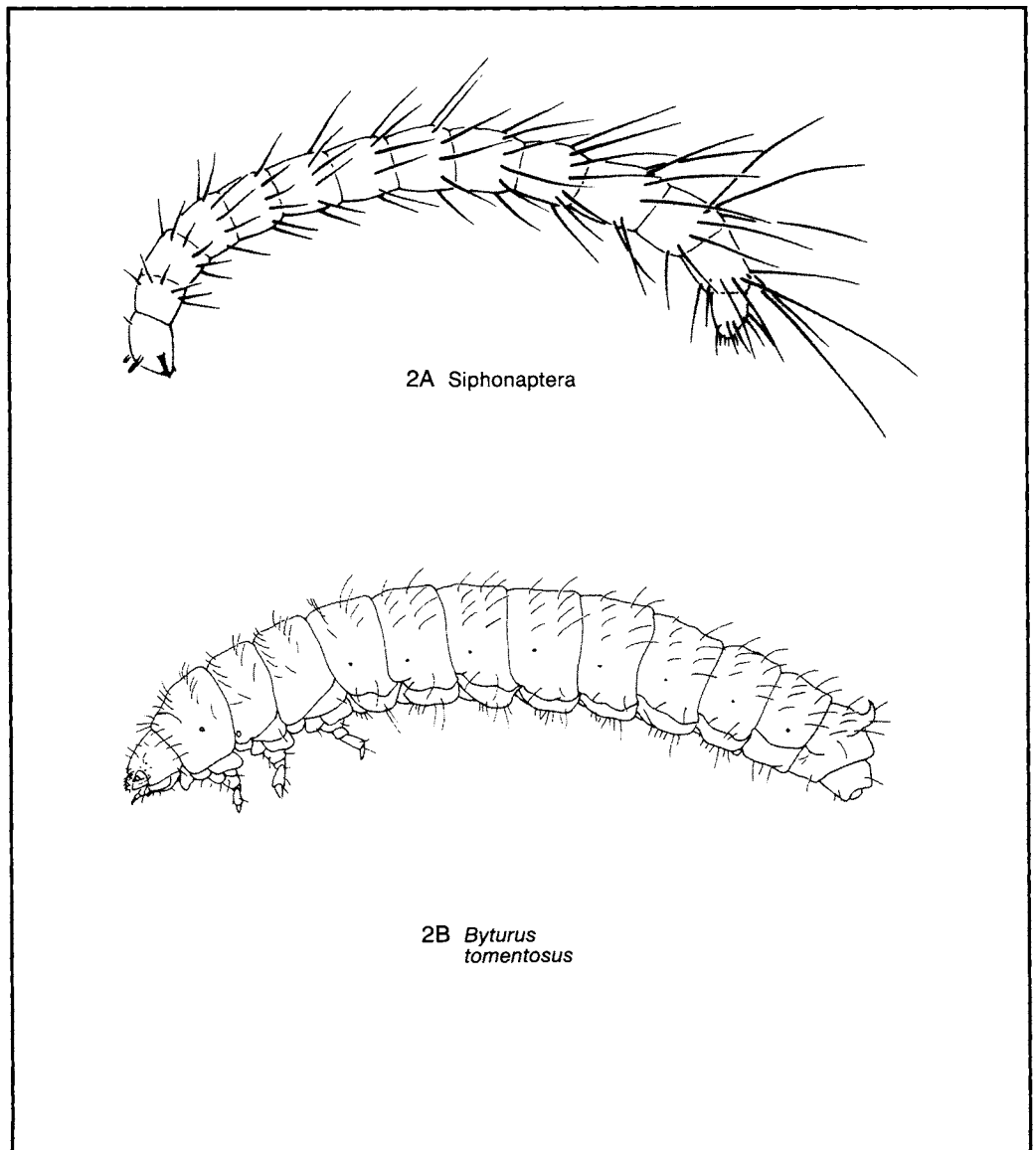
2 Each thoracic and abdominal segment with several long setae (2A); abdominal apex with a pair of short, subanal processes-----fleas, Siphonaptera

Body vermiform, very slender and elongate, usually less than 10 mm in length; antennae and mouthparts visible; legs and prolegs absent.

Long setae absent from some or all thoracic and abdominal segments (2B); abdominal apex without a pair of short, subanal processes-----

3

Body may or may not be vermiform, but if so, then it is not as slender as in 2A; length usually more than 10 mm; legs and prolegs usually present; if prolegs are absent, then body form is not vermiform.

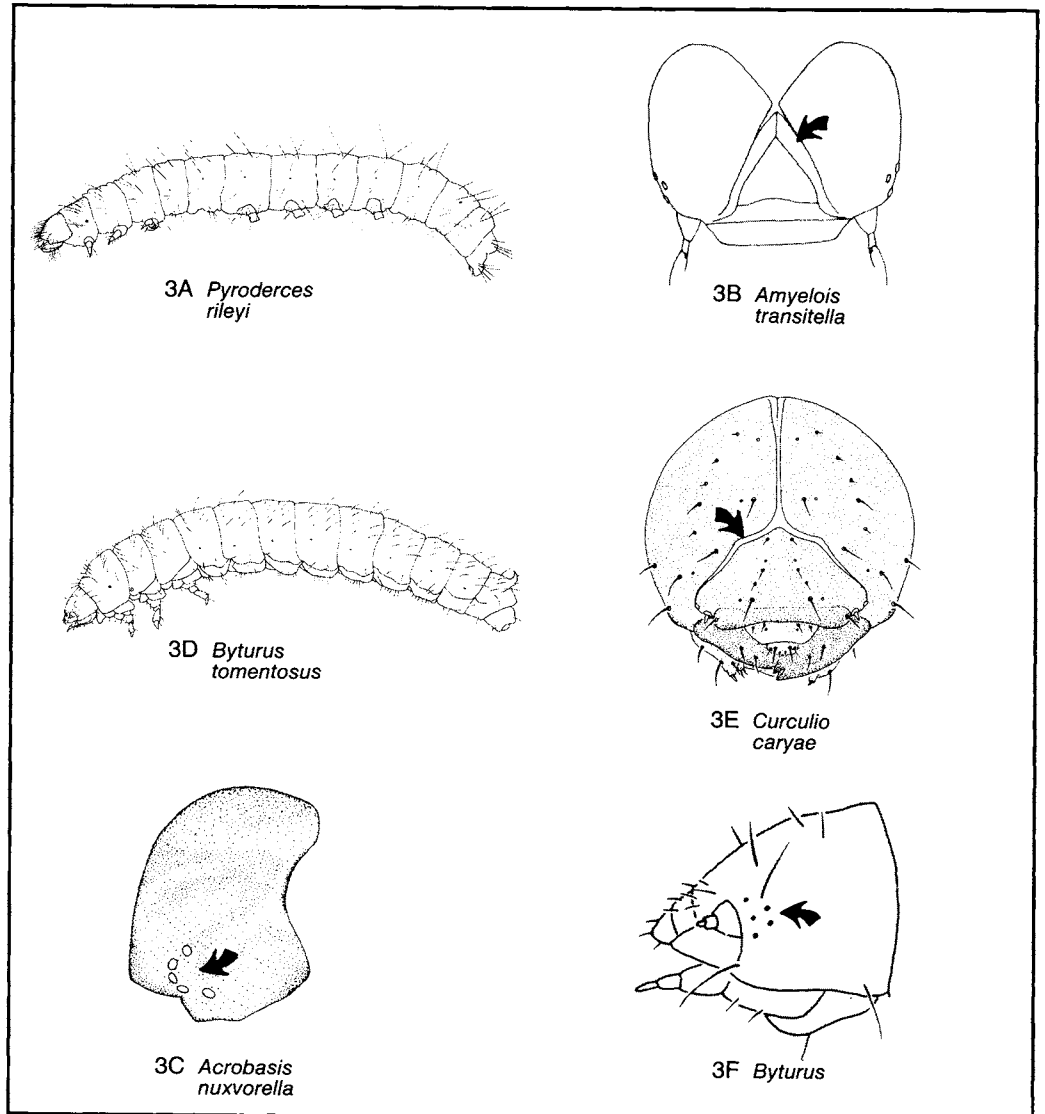


- 3 Larva eruciform (3A); adfrontal areas present (3B); prolegs and/or crochets on abdominal segments V and VI (3A); apical abdominal segments not comprising an elongate, contractile tube (3A)-----moths, Lepidoptera  
SEE CHAPTER 15

Simple eyes (ocelli or stemmata) present, often arranged in a semi circle (3C); typical mouthparts present and visible; prolegs or crochets may also be present on abdominal segments III, IV, and XI.

- Larva not eruciform (3D); adfrontal areas absent (3E); prolegs and/or crochets absent from abdominal segments V and VI, or if present on V and VI, then apical abdominal segments comprising a slender, elongate, contractile tube (see 6A)- 4

Simple eyes, if present, usually not arranged in a semicircle (3F); mouthparts variable.



4 Body surface rough, shagreened (4A). Diptera (flies) (in part)

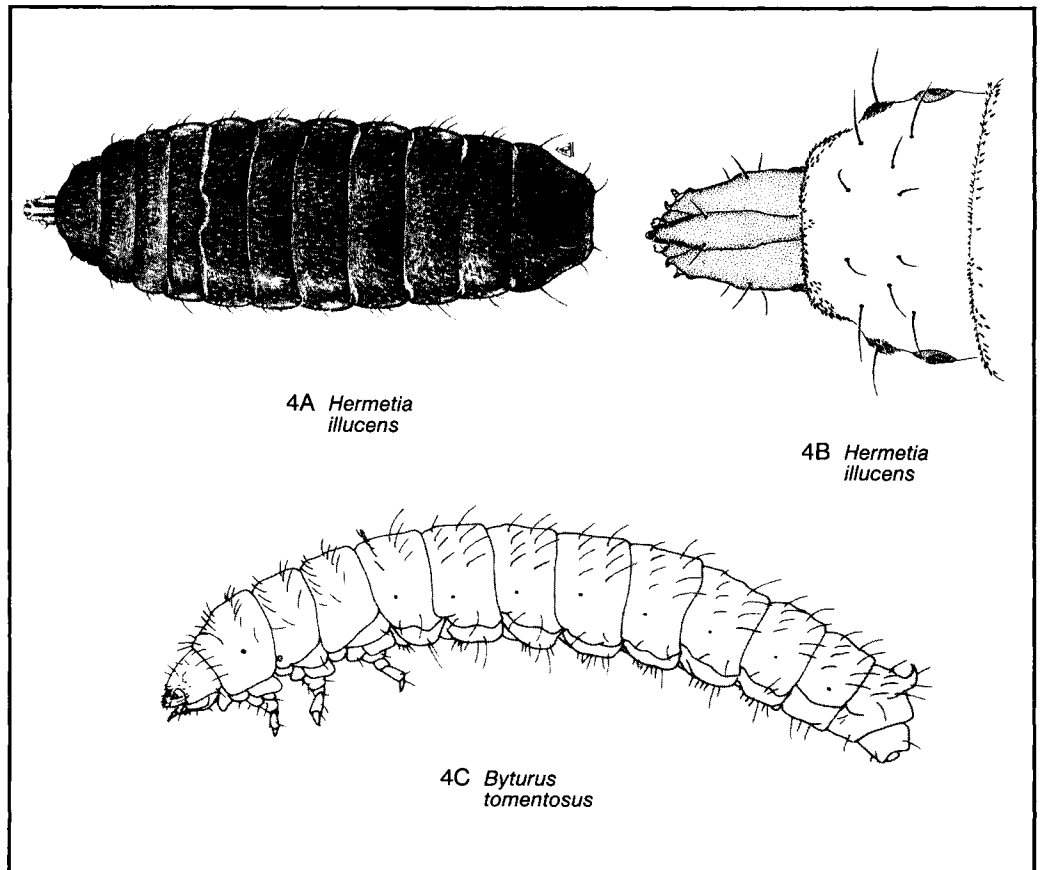
-----soldier flies, Stratiomyidae

Head capsule heavily sclerotized (4B); body depressed and elongate, without dorsal and lateral spinelike processes and without elongate and contractile posterior abdominal segments (4A); mandibles inconspicuous (vestigial or absent), but mouthparts in general not reduced to fleshy remnants; thoracic legs absent. CAUTION: Other fly larvae (all much smaller than *Hermetia illucens*) with definite head capsules (but without a rough, shagreened body surface)—Scatopsidae, Psychodidae, Sciariidae, Scenopinidae—should be taken out at this point and referred to Chapter 16.

Body surface not rough or shagreened (4C)-----

5

Head capsule may or may not be sclerotized (if sclerotized, then thoracic legs usually present); body not depressed; or body depressed but not elongate (as in *Murmidius ovalis*); or body elongate with dorsal and lateral spinelike processes (see 5A); or body elongate without dorsal and lateral spinelike processes but with posterior abdominal segments elongate and contractile (see 6A); thoracic legs present or absent (if absent, then mandibles either conspicuous or mouthparts in general reduced to fleshy remnants).



4A *Hermetia illucens*

4B *Hermetia illucens*

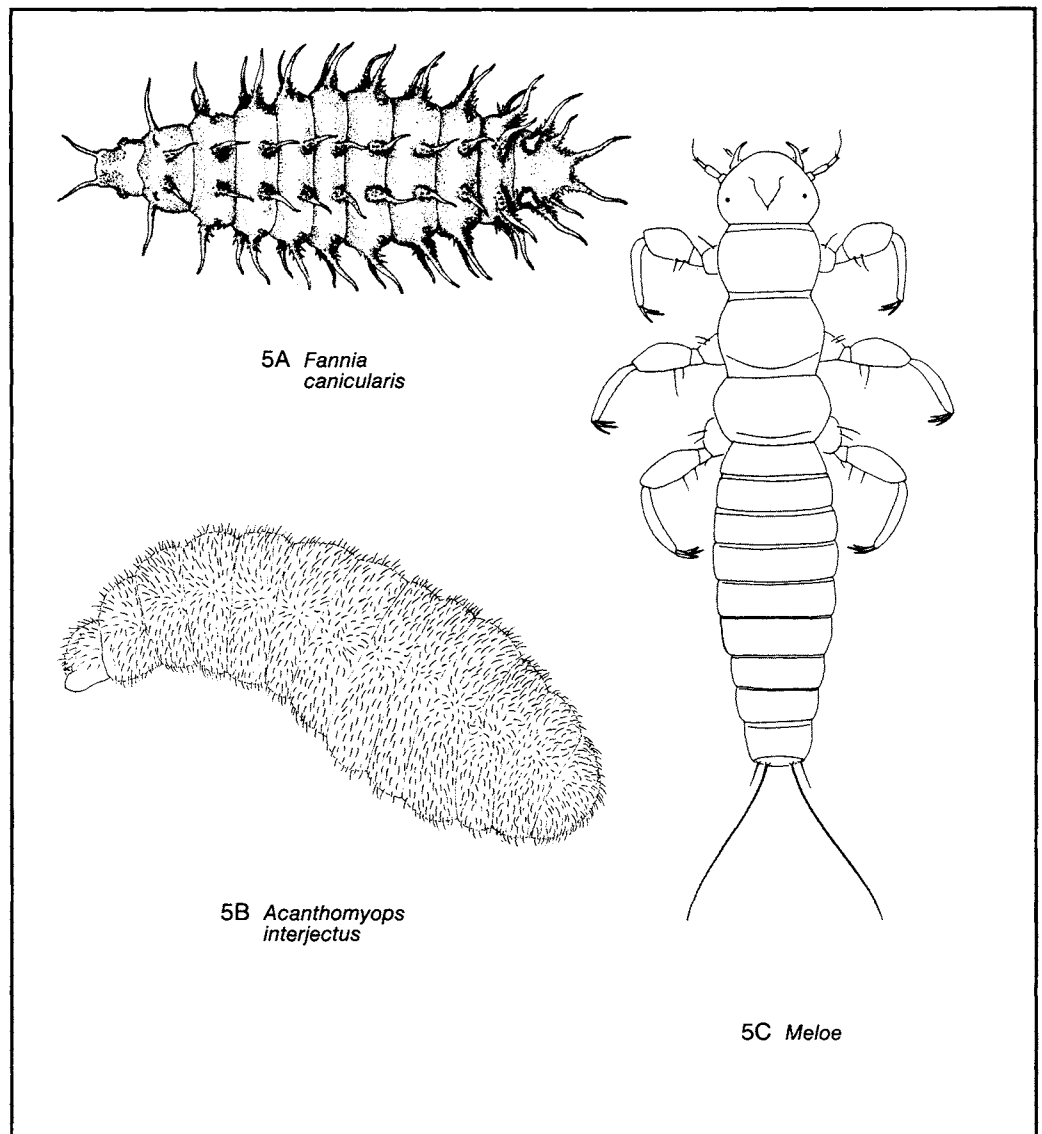
4C *Byturus tomentosus*

- 5 Body moderately depressed (not saclike, minute, or campodeiform; not round in cross section), bearing spiny or fleshy processes or tubercles dorsally and laterally (5A); apical abdominal segments not elongate and contractile. Diptera (**flies**) (in part) ---*Fannia*  
SEE CHAPTER 16

Head capsule minute, weakly developed. CAUTION:  
Some species of Phoridae also have dorsal and lateral  
lobes; see Chapter 16.  
Drawing 5A from 9.

- Body round in cross section (posterior abdominal segments may be elongate and contractile) (see 6A); or body saclike (5B); or body minute and campodeiform (5C)---

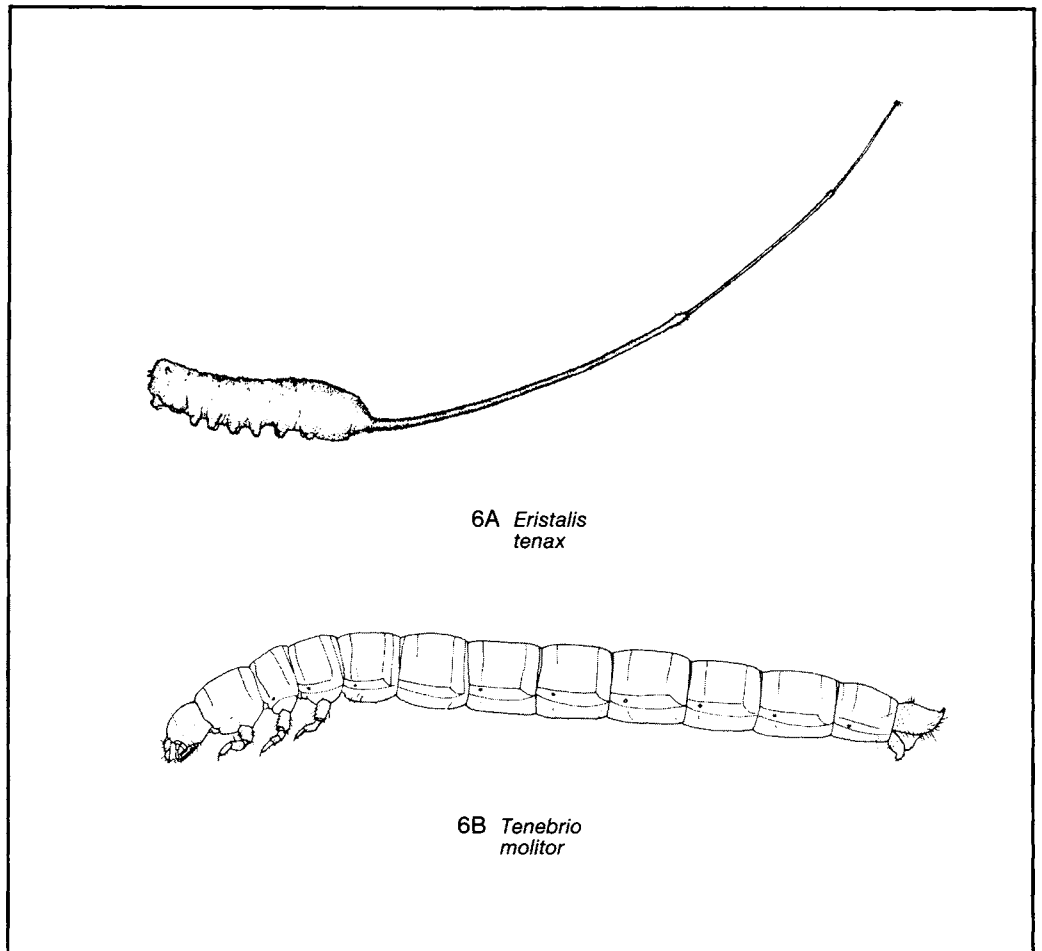
6



6 Posterior end of abdomen extended into a slender, 3-segmented, elongate, contractile breathing tube (6A). Diptera (**flies**) (in part). Syrphidae (**flower flies**)-----*Eristalis*  
SEE CHAPTER 16

CAUTION: Some fly larvae in the families Drosophilidae, Psychodidae, and Sepsidae have tubelike, posterior abdominal extensions; see Chapter 16.

Posterior end of abdomen not tubelike (6B)----- 7



7 Thoracic legs present (as in 6B)----- 8  
Thoracic legs absent (as in 12A) or vestigial (as in 12C)----- 12

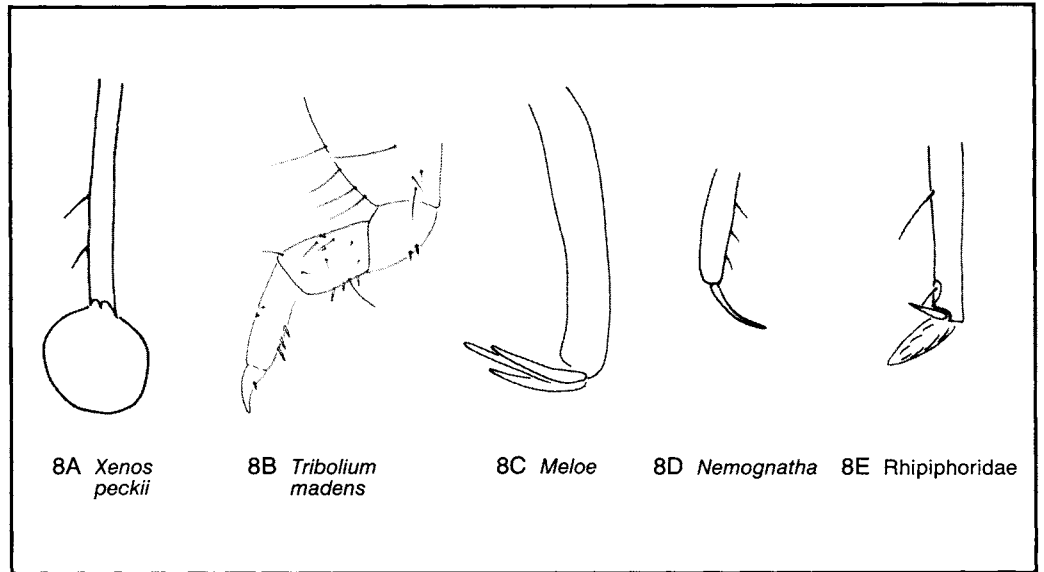
8 Tarsi I and II consisting of short or long bristles or of pulvilliform pads (8A)  
 -----twisted-wing parasites, Strepsiptera

Minute campodeiform larvae (fig. 19.2)—larval body straight, not hypognathous (length usually less than 1 mm, often less than 0.5 mm); antennae and mouthparts vestigial or absent (fig. 19.2B); trochanters absent (fig. 19.2B) (trochanters are absent in all stages that exhibit legs); one pair of very long caudal setae present (fig. 19.2).

Tarsi either appearing typically coleopteran in form (8B) or consisting only of clawlike structures (8C, 8D, 8E)-----

9

Larger larvae (length greater than 1 mm) of variable form (figs. 19.2-19.5)—campodeiform, scarabeiform, elateriform; mouthparts usually well developed and evident; trochanters usually present; long caudal setae present (fig. 19.4) or absent (fig. 19.5).



9 Tarsus distinct, with 1 or 2 claws evident (see 8B)-----**beetles**, Coleoptera (in part)  
 SEE CHAPTER 4

Body form variable; caudal tufts of setae sometimes present. See also 3E&F, 4C, 12C.

Tarsus highly modified (see 8C-E). Coleoptera (**beetles**) (in part)----- 10

Larva a campodeiform triangulin (larval body straight, not hypognathous); antennae and mouthparts well developed; caudal tufts absent; 1 or 2 pairs of caudal setae present; body length greater than 0.5 mm, ranging up to 3.5 mm.

- 10 With 3 or more pairs of ocelli (fig. 19.3B); labial palp absent (fig. 19.3B)  
-----wedge-shaped beetles, Rhipiphoridae

Gula extremely short (almost absent); tarsus with pulvillus and minute claw (claw much shorter than pulvillus) (see 8E).

- With 1 or 2 pairs of ocelli (fig. 19.4A); labial palp present (fig. 19.4B). Meloidae (**blister beetles**)----- 11

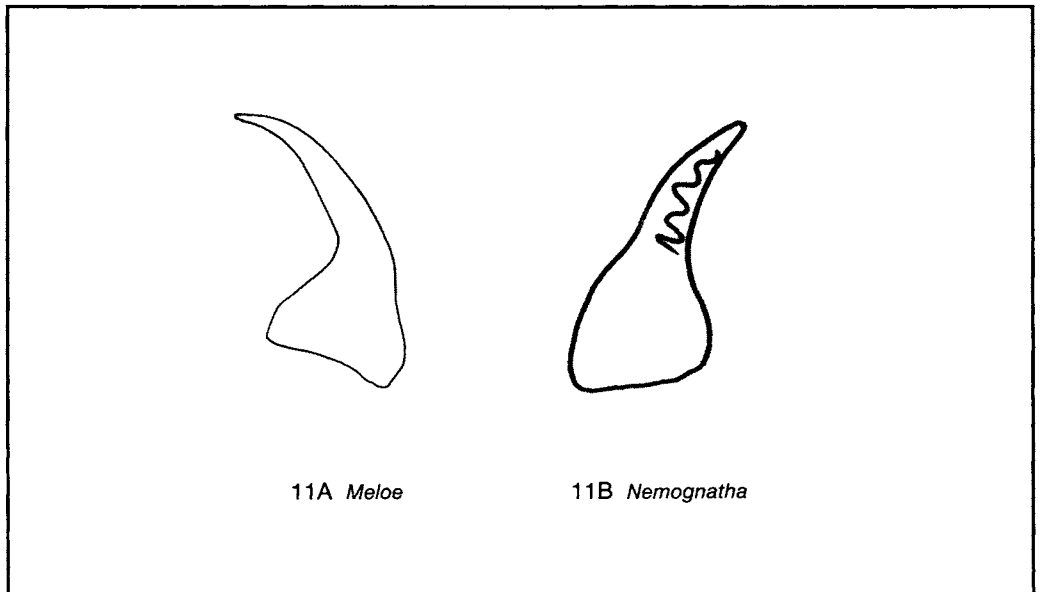
Gula well developed; labial palp 2-segmented; tarsus composed either of a single claw (see 8D) or of a strong claw bracketed by 2 strong setae, giving a 3-clawed appearance (see 8C).

- 11 Mandible entire (11A) or with toothlike emarginations. Meloinae (meloine blister beetles); fig. 19.4 -----*Meloe*

With 1 pair of ocelli (fig. 19.4A). See also 8C.

- Mandible with 2 or more prominent, toothlike ridges (11B); fig. 19.5  
-----nemognathine blister beetles, Nemognathinae

With 1 or 2 pairs of ocelli (fig. 19.5A). See also 8D.





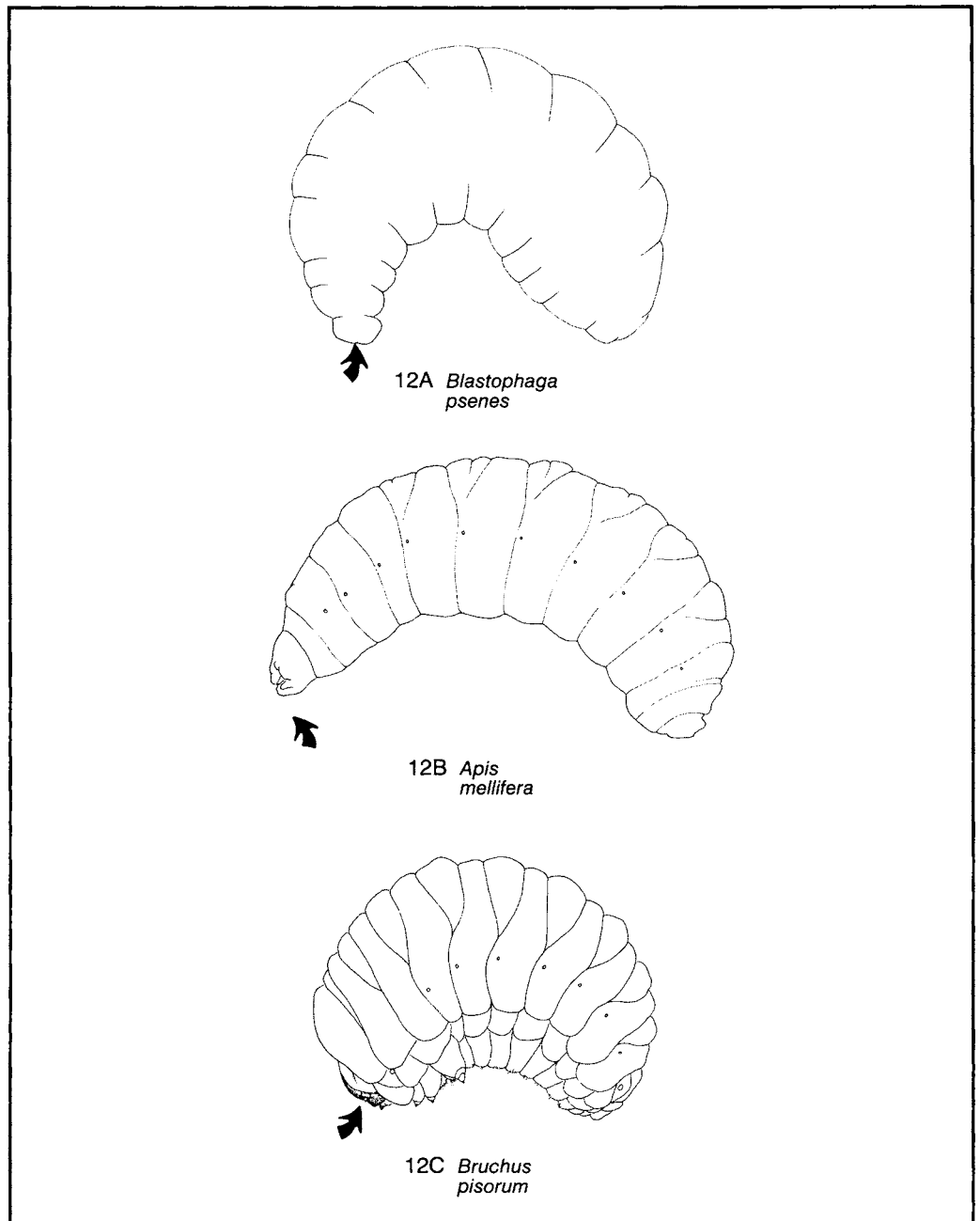
12 Head capsule unsclerotized or only weakly sclerotized (12A, 12B); mouthparts reduced to fleshy remnants or weakly sclerotized mandibles

-----ants, bees, wasps, Hymenoptera

See also 5B.

Head capsule well sclerotized, with distinct mouthparts (12C)

-----beetles, Coleoptera (in part)  
SEE CHAPTER 4



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1967. Pictorial key to common groups of household and stored-food pests. Larval stages. *In* Pictorial keys to arthropods, reptiles, birds and mammals of public health significance. National Communicable Disease Center, Atlanta.

**Harold George Scott**

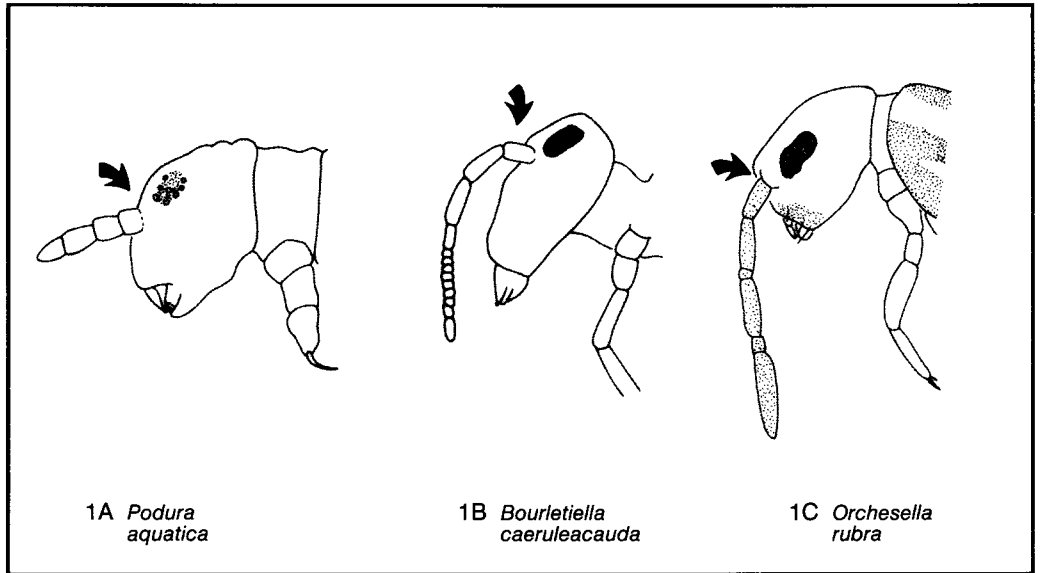
4 Pats Place  
Metairie LA 70001

**KEY**

Drawings by C.J. Stojanovich and  
C. Feller unless otherwise noted.

- 1 Antenna inserted at, just before (1A), or distinctly behind (1B) middle of head ---- 2  
 Antenna inserted well forward on anterior half of head (1C)----- 3

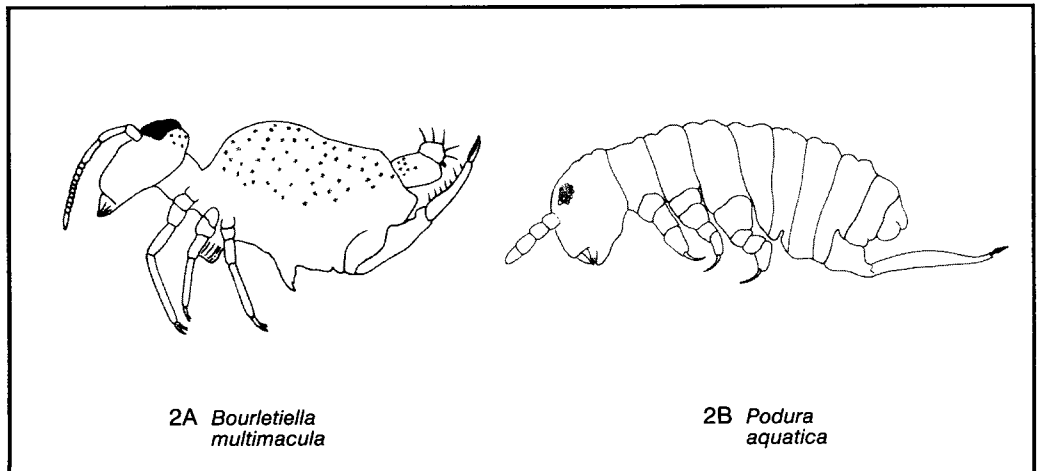
This key is based on 8 and 14. See couplet illustration  
11A for selected anatomical details.



- 2 Body globular (2A)-----Suborder Symphypleona

Species of this suborder have not been reported from  
stored foods.

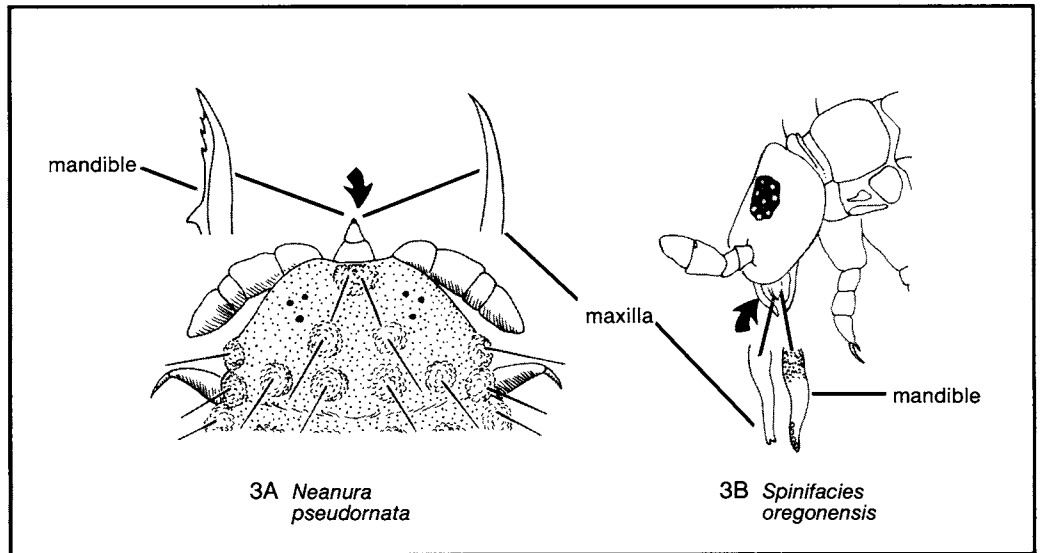
- Body elongate (2B). Suborder Metaxypleona----- 4



3 Mouthparts conelike (3A)-----Suborder Nearthropleona

Species of this suborder have not been reported from stored foods.

Mouthparts not conelike (3B). Suborder Arthropleona ----- 5



**Suborder Metaxyleona**

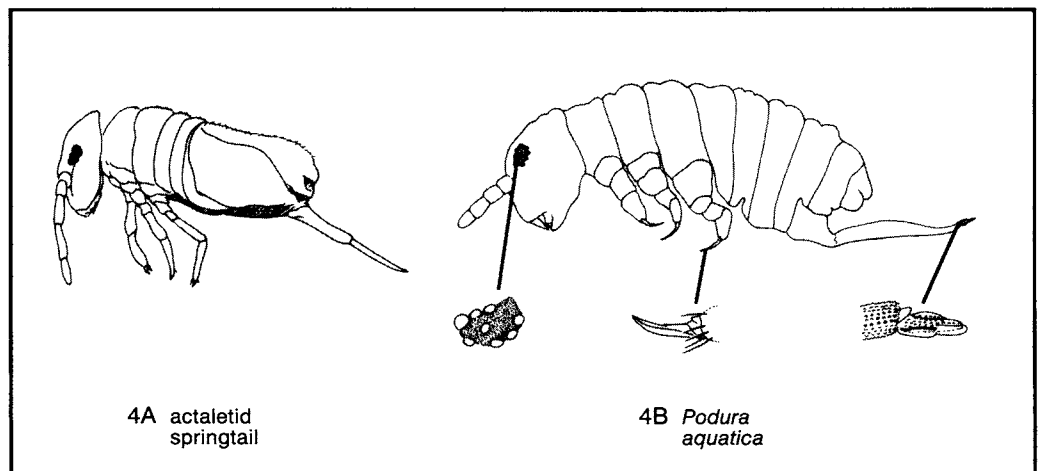
4 Abdomen with 4 or 5 apparent segments (4A)----- actaletid springtails, Actaletidae

Species of this family have not been reported from stored foods.

Abdomen with 6 apparent segments (4B). Poduridae (podurid springtails)

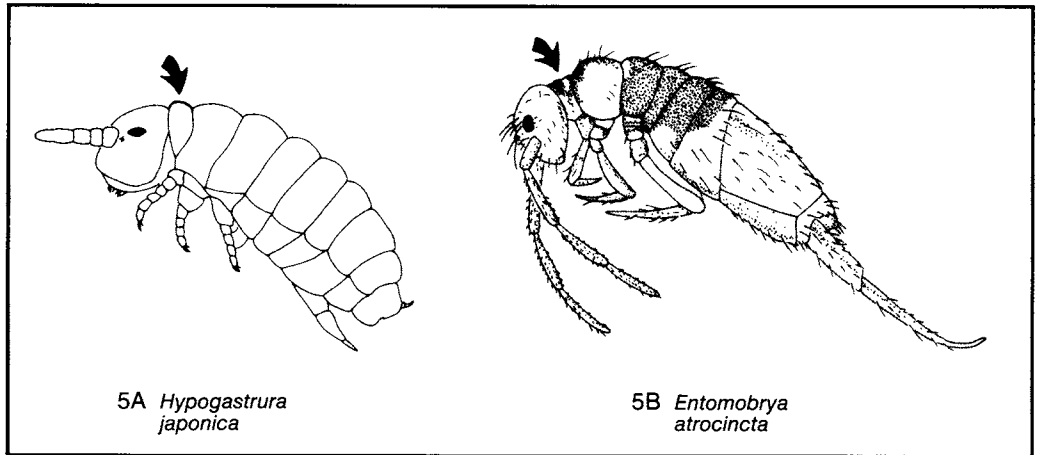
----- *Podura aquatica*

Distribution: cosmopolitan on freshwater surfaces; probably introduced to food with water from wells or ponds.



**Suborder Arthropleona**

- 5 Pronotum well developed (5A). Superfamily Hypogastruroidea (hypogastrurid springtails)----- 6
- Pronotum reduced (5B). Superfamily Entomobryoidea (entomobryoid springtails)----- 10

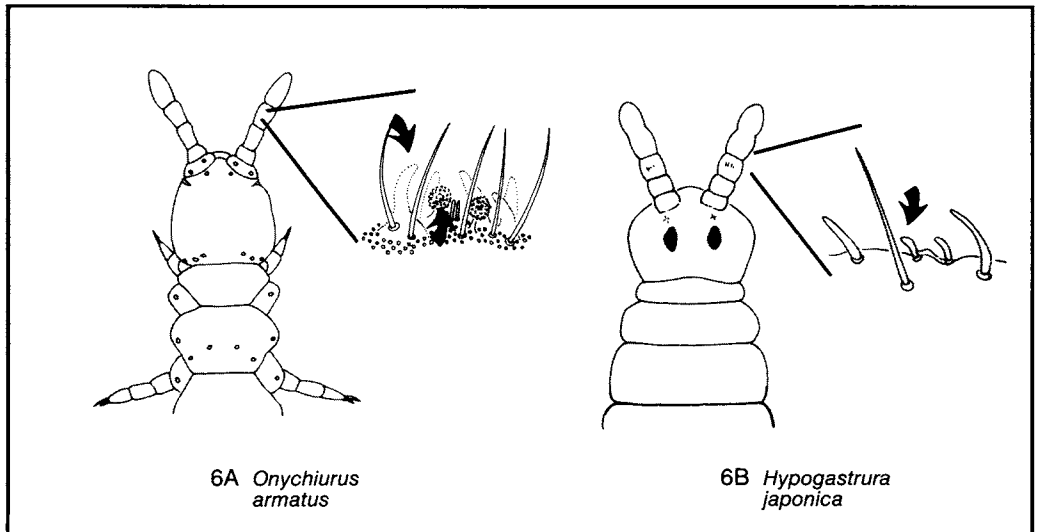


- 6 Sense organ on antennal segment III with rods and cones (6A). Onychiuridae (onychiid springtails) ----- 7

Eyes absent (6A).  
 Detail of sense organ redrawn by C. Feller from EB07 (see chapter 28).

- Sense organ on antennal segment III with rods only (6B). Hypogastruridae (hypogastrurid springtails) ----- 8

Eyes usually present (6B).

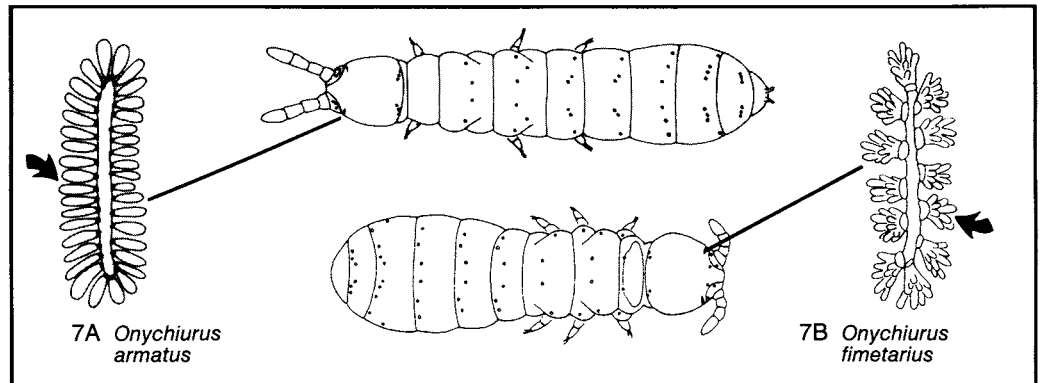


7 Postantennal organ with simple vesicles (7A)-----*Onychiurus armatus*

Distribution: cosmopolitan; reported from indoor flower pots (6) and as a common domestic species (18). See also 6A.

Postantennal organ with compound vesicles (7B)-----*Onychiurus fimetarius*

Distribution: cosmopolitan; reported from indoor flower boxes (6) and as a common domestic species (18).



8 Tarsal tenent hair capitate (8A)-----*Hypogastrura manubrialis*

Distribution: probably cosmopolitan; reported as a common domestic species (18).

Tarsal tenent hair not capitate (8B)----- 9

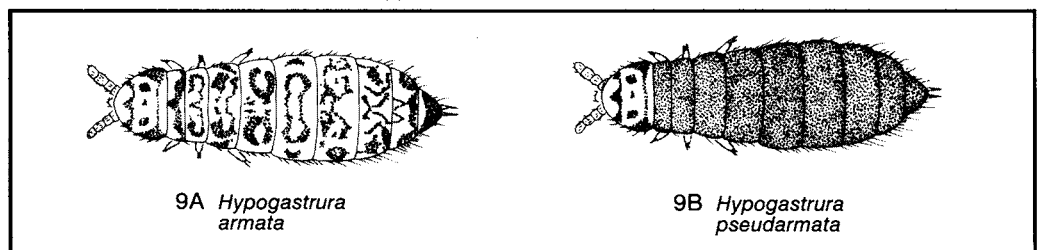


9 Body marbled (9A)-----*Hypogastrura armata*

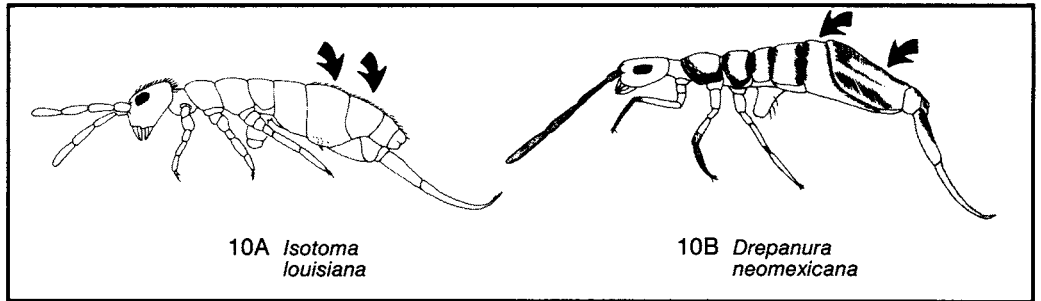
Distribution: cosmopolitan; reported invading houses (5); associated with domestic water supplies (6, 11).

Body not marbled (9B)-----*Hypogastrura pseudarmata*

Distribution: Nearctic; reported swarming on and in houses (6).



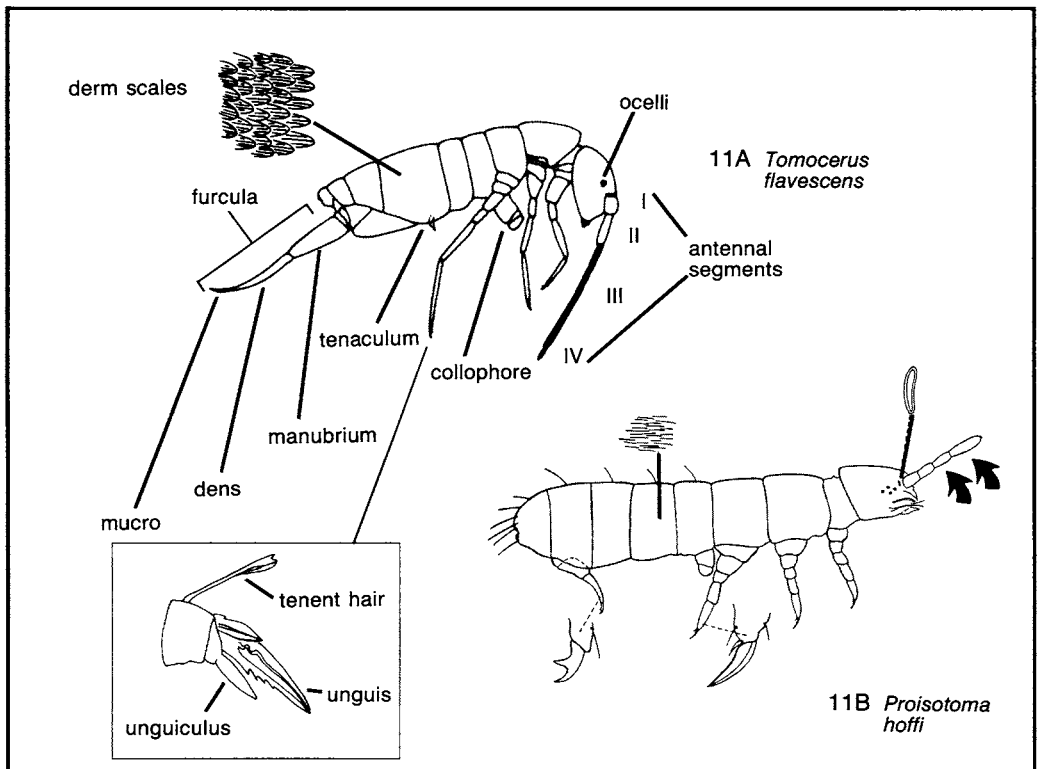
- 10 Abdominal segment IV less than twice as long as abdominal segment III (10A), or terminal abdominal segments fused----- 11  
 Abdominal segment IV at least twice as long as abdominal segment III (10B); terminal segments not fused. Entomobryidae (entomobryid springtails) ----- 12



- 11 Antennal segments III and IV subsegmented (11A). Tomoceridae (tomocerid springtails) ----- *Tomocerus*

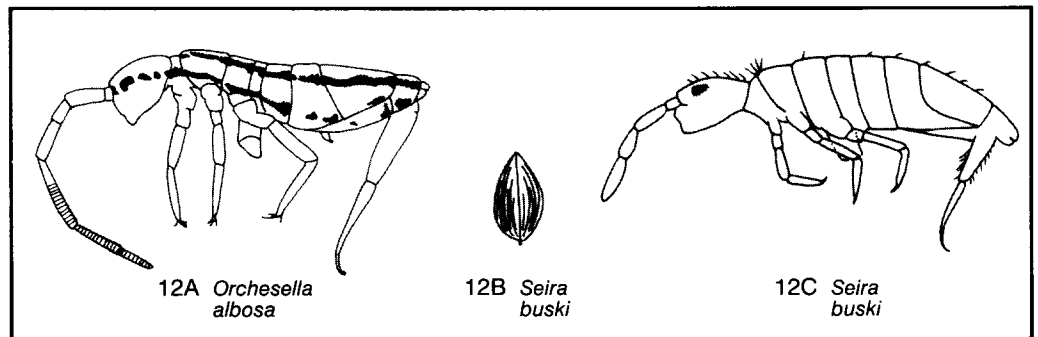
Distribution: cosmopolitan; common in houses. See 16 for a key to the Nearctic species.

- Antennal segments III and IV not subsegmented (11B). Isotomidae (isotomid springtails) ----- 22





- 12 Body scales absent (12A)----- 13  
 Body scales (12B) (see also derm scales of 11A) present (12C)----- 18

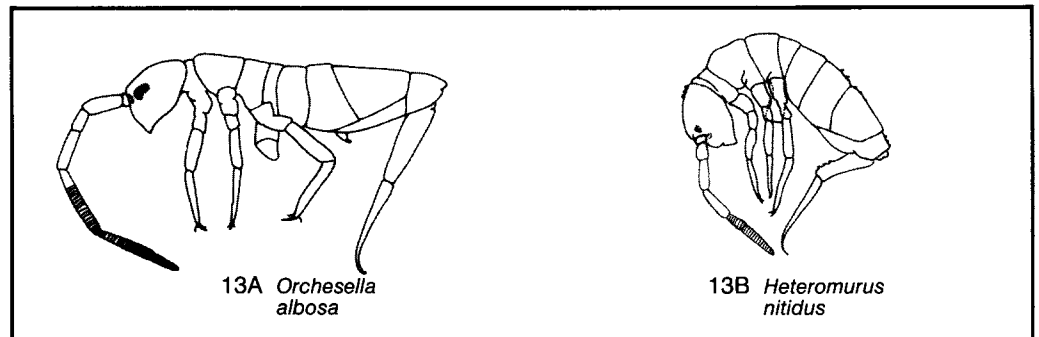


- 13 Antenna with 6 segments (13A)-----*Orchesella albosa*

Distribution: Holarctic. Reported infesting people in Texas; some moldy household item (perhaps bedding) was probably involved (18).

- Antenna with 4 or 5 segments (13B)----- 14

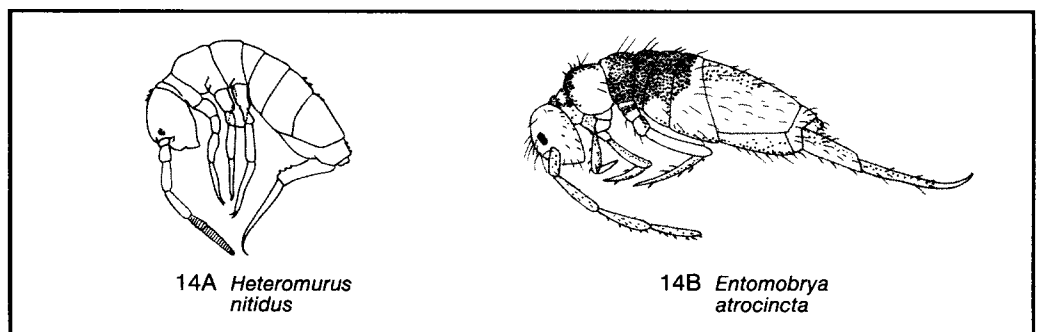
Antennal details of 13A&B by C. Feller.



- 14 Antenna with 5 segments (14A)-----*Heteromurus*

Distribution: cosmopolitan; common in houses.

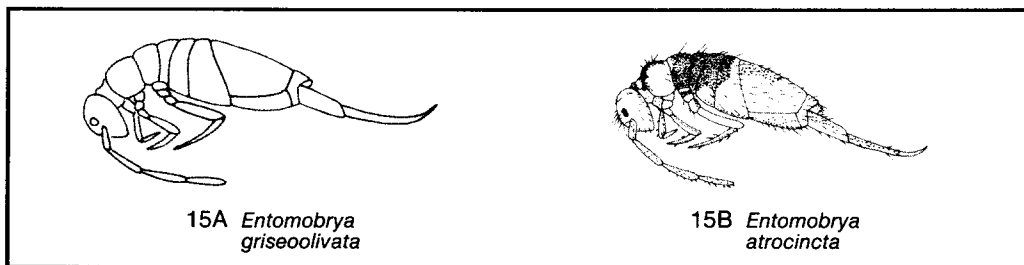
- Antenna with 4 segments (14B). Genus *Entomobrya*----- 15



15 Body without stripes (15A)-----*Entomobrya griseoolivata*

Distribution: cosmopolitan; reported as a common domestic species (18) and as infesting human hair (Richard W. Fay, 1958, personal communication).

Body with stripes (15B)----- 16

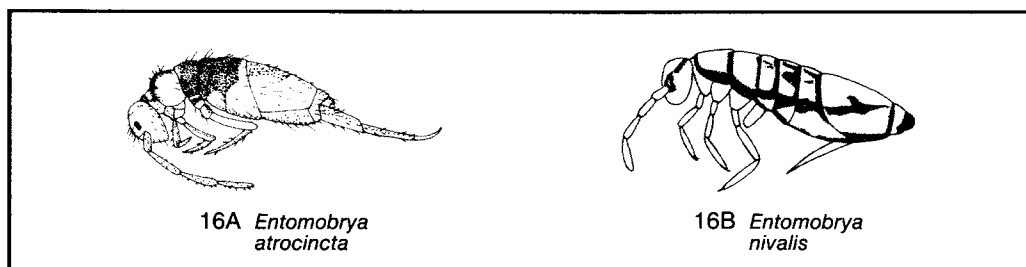


16 Some body segments striped (16A)-----*Entomobrya atrocincta*

Distribution: cosmopolitan; reported from indoor flower pots containing *Poinsettia pulcherrima* (13) and as infesting powdered milk (17).

All body segments striped (16B)----- 17

16B redrawn by C. Feller from EB07 (see chapter 28).

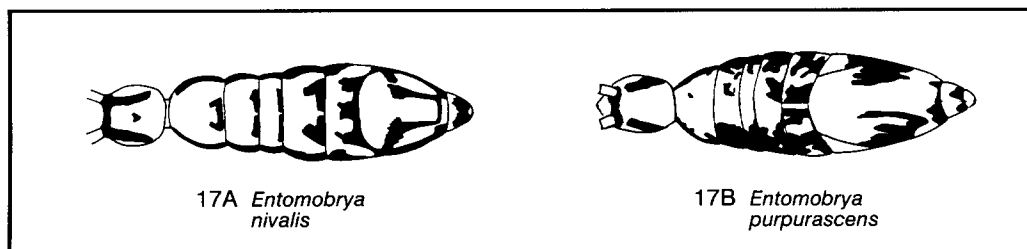


17 Head with a dorsal spot (17A)-----*Entomobrya nivalis*

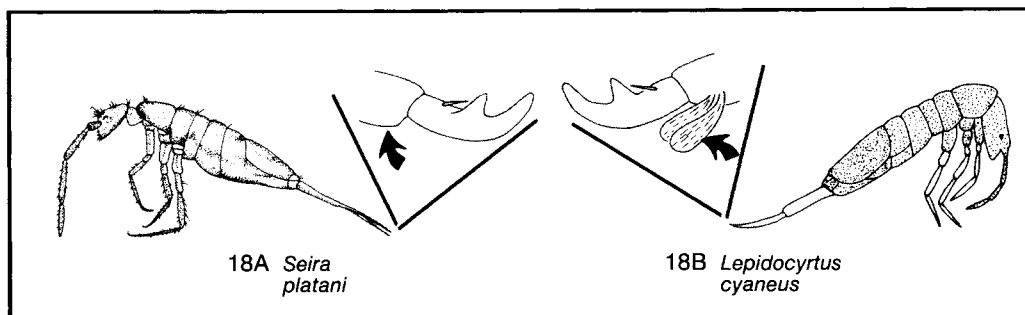
Distribution: cosmopolitan; a common domestic species (18); reported infesting the sack house of a flour mill (9, 11) and as causing dermatitis in man (3). See also 16B.

Head without a dorsal spot (17B)-----*Entomobrya purpurascens*

Distribution: Holarctic; associated with human dwellings (1).



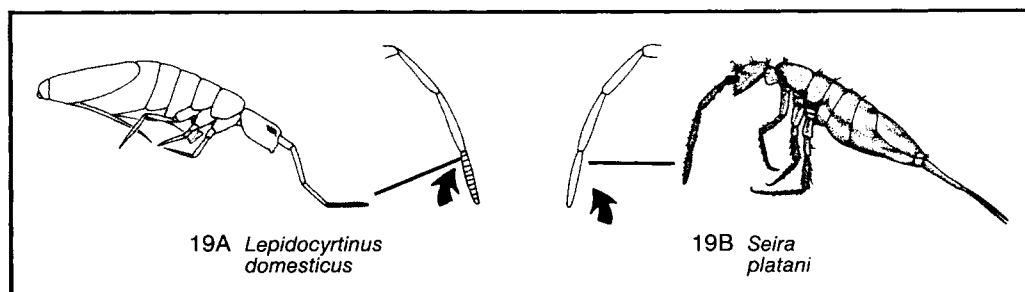
- 18 Dens without ventral scales (18A)----- 19  
 Dens with ventral scales (18B)----- 21



- 19 Segment IV of antenna annulate (19A)-----*Lepidocyrtinus domesticus*

Distribution: cosmopolitan; associated with houses (4).

- Segment IV of antenna not annulate (19B). Genus *Seira* ----- 20

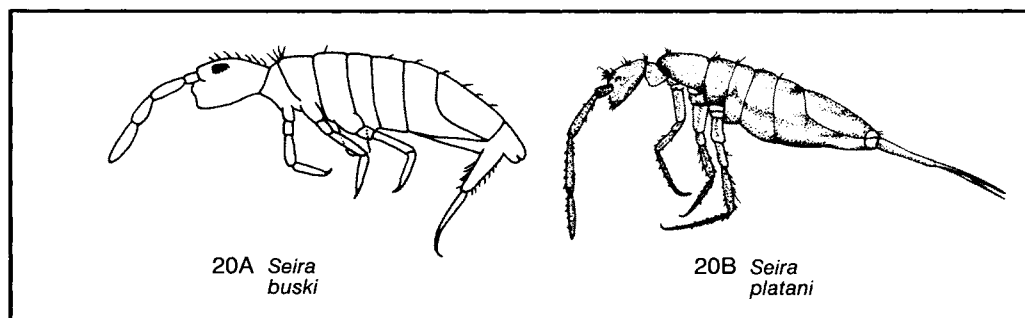


- 20 Body entirely blue (20A)-----*Seira buski*

Distribution: Holarctic; associated with houses (7, 18); reported as an accidental parasite of man (2).

- Body marked with blue (20B)-----*Seira platani*

Distribution: cosmopolitan; associated with houses (7) and stored food (17); reported infesting insulation in a refrigeration plant (10) and as infesting human hair (Richard W. Fay, 1958, personal communication).



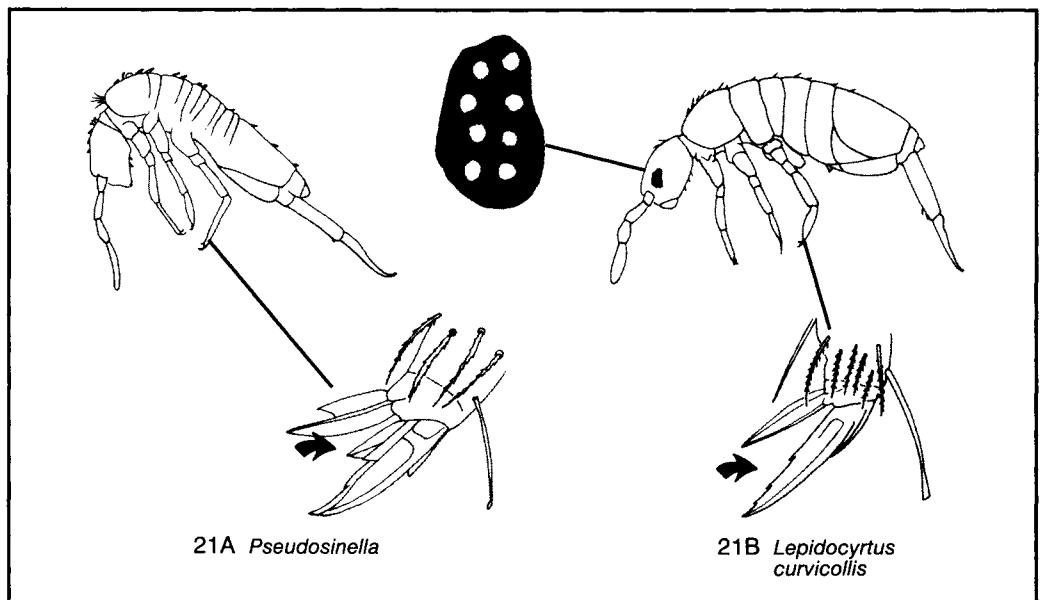
21 Basal teeth of unguis winglike (21A)-----*Pseudosinella*

Usually fewer than 8 ocelli; many species are white and blind. Distribution: cosmopolitan; associated with houses (5).

Detail of tarsus (21A) redrawn by C. Feller from *EB01* (see chapter 28).

Basal teeth of unguis not winglike (21B)-----*Lepidocyrtus curvicolis*

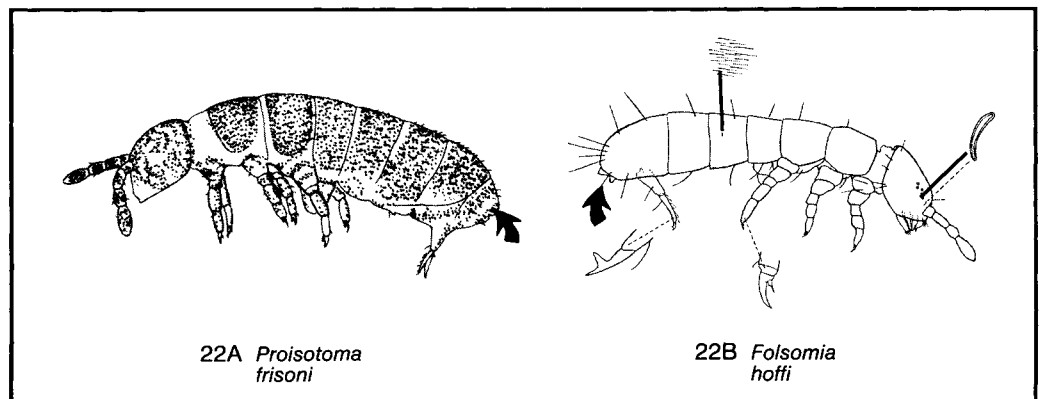
Eye with 8 ocelli. Distribution: cosmopolitan; associated with cellars (4) and houses (18).



22 Anus terminal (22A)-----*Proisotoma frisoni*

Distribution: Nearctic; a common domestic species (18); reported from potted *Ficus elasticus* (12).

Anus ventral (22B)----- 23

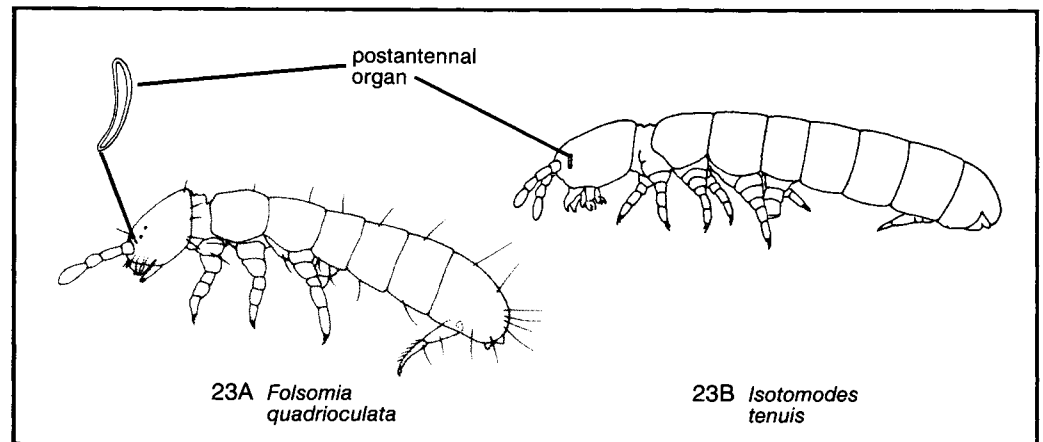


23 Ocelli present (23A)-----*Folsomia quadrioculata*

Distribution: Holarctic; a common domestic species (18); reported from indoor flower pots (6). Some *Folsomia* have an incomplete suture between abdominal segments IV and V.

Ocelli absent (23B)-----*Isotomodes tenuis*

Distribution: Nearctic; a common domestic species (18); reported from indoor flower pots (15).



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**Notes and Sketches**

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\*Deceased

Synanthropic species are found in two of the three families of Thysanura. *Nicoletia phytophila* (Nicoletiidae) occurs in greenhouses, under flowerpots and in soil, and may cause damage to cultivated plants. All other synanthropic species belong to the Lepismatidae (1). They are found in human habitations and in warehouses where they feed on starchy substances, such as paper, cardboard, and books, on various stored grains and their products (e.g., flour, oats, peanuts), and on certain fabrics. The most commonly encountered species are *Acrotelsa collaris*, *Ctenolepisma longicaudata*, *Thermobia domestica*, and *Lepisma saccharina*. The first is restricted to the tropics; the others occur most frequently in areas of temperate climate. The remaining species contained in the key are also, but less commonly, found associated with man. Since synanthropic Thysanura are dispersed by man, the original range of most species is not known. Because the actual range of most species is so large and so incompletely known, their recorded distribution is not indicated here.

Most characters used in the key are easily understood. Of special interest are the larger setae (macrochaetae), which are either glabrous (3A) or minutely spinulose (3C). On the thoracic nota and abdominal sternites and tergites, the macrochaetae are either single (4A) or arranged in one or several transverse series, the so-called bristlecombs (4B). The number and distribution of the bristlecombs furnishes generic and specific characters. The macrochaetae are caducous (easily dislodged); in preserved specimens frequently only the respective sockets can be seen. Care is thus required for a correct observation of the macrochaetal pattern.



**KEY**

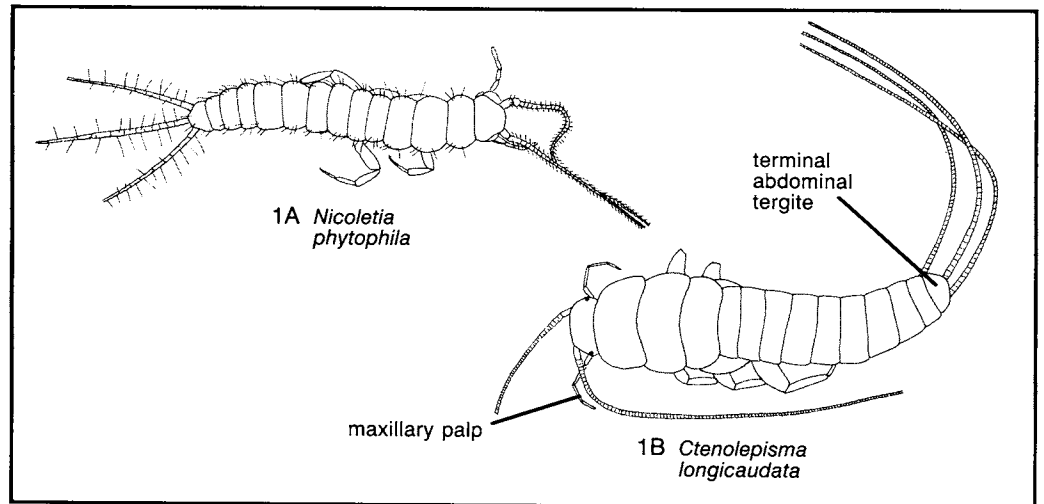
Drawings by P. Wygodzinsky.

1 Eyes absent (1A); scales absent in species mentioned here. Nicoletiidae (nicoletiid silverfish) ----- *Nicoletia phytophila*

Reference: 2.

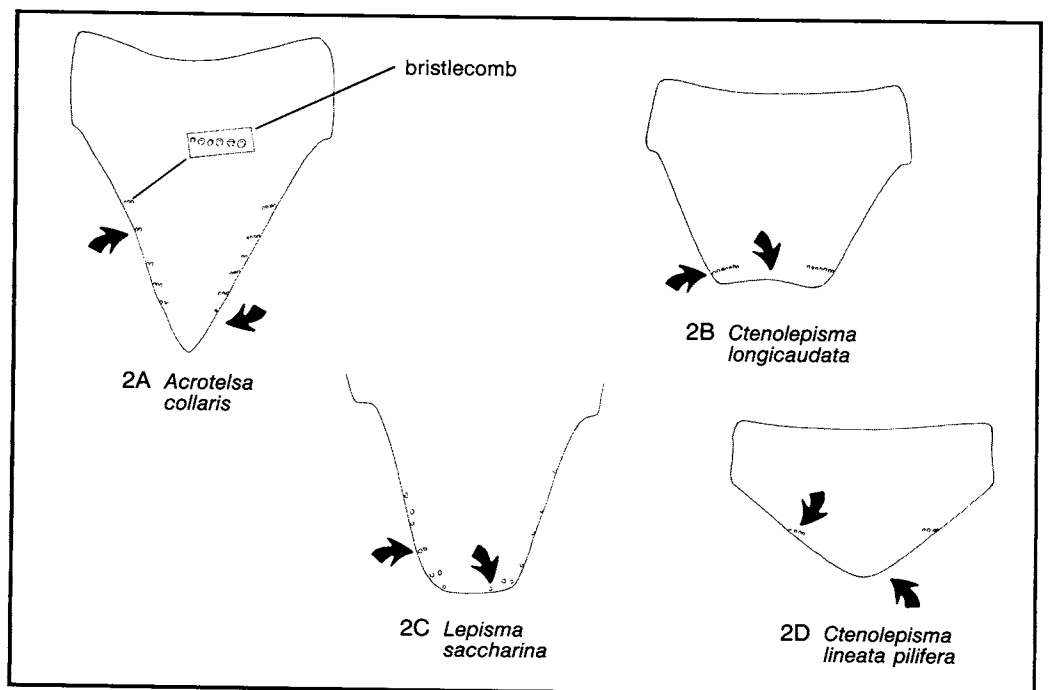
Eyes present (1B); scales present. Lepismatidae (**firebrats and silverfish**) ----- 2

Reference: 1.



2 Last abdominal tergite distinctly pointed, with several bristlecombs on each side (2A) ----- *Acrotelsa collaris*

Last abdominal tergite not distinctly pointed, usually with only 1 subapical bristlecomb on each side (but rarely with 1 or 2 supernumerary ones) (2B, 2C, 2D) ----- 3



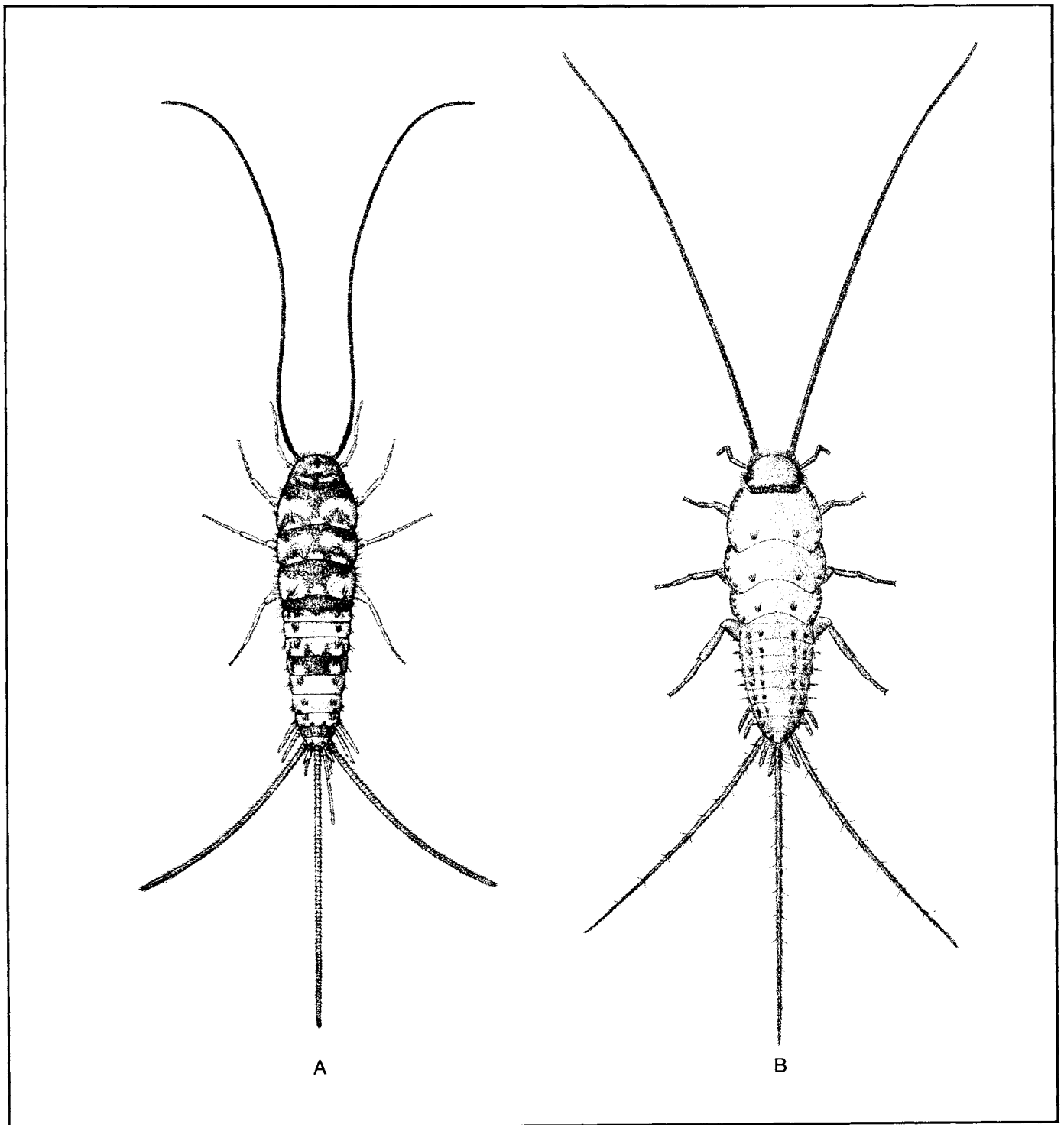


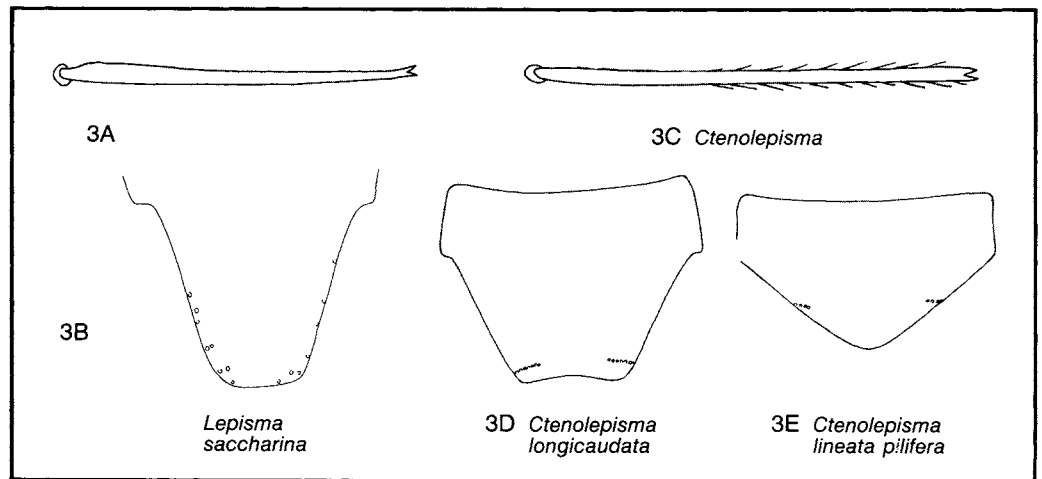
Figure 21.1. Silverfish (Lepismatidae). A, firebrat, *Thermobia domestica*; B, fourlined silverfish, *Ctenolepisma lineata pilifera*. (Drawings by C. Feller.)

3 Macrochaetae smooth, often bifid apically (3A); last abdominal tergite elongate, with posterior margin truncate or feebly rounded (3B)

-----common silverfish, *Lepisma saccharina*

Macrochaetae spinulose under high magnification (3C); last abdominal tergite short and broad, with posterior margin straight, emarginate (3D) or bluntly pointed (3E)

4

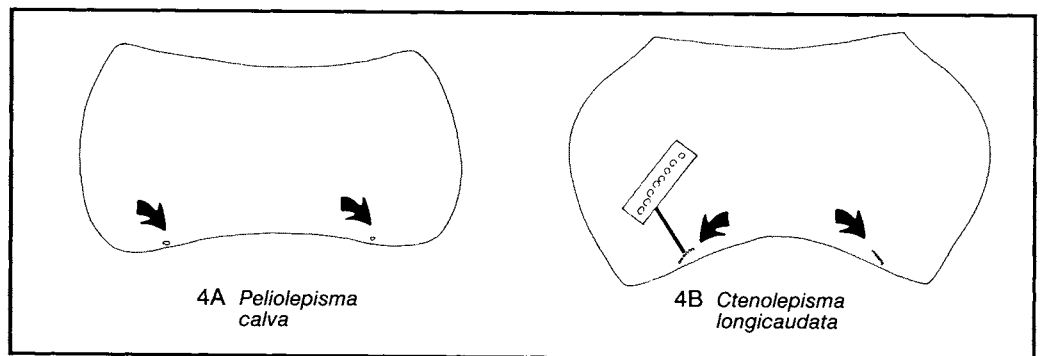


4 Hind margins of thoracic nota with 1 + 1 single macrochaetae (4A)-----

5

Hind margins of thoracic nota with 1 + 1 bristlecombs consisting each of at least 2 macrochaetae (4B)-----

6

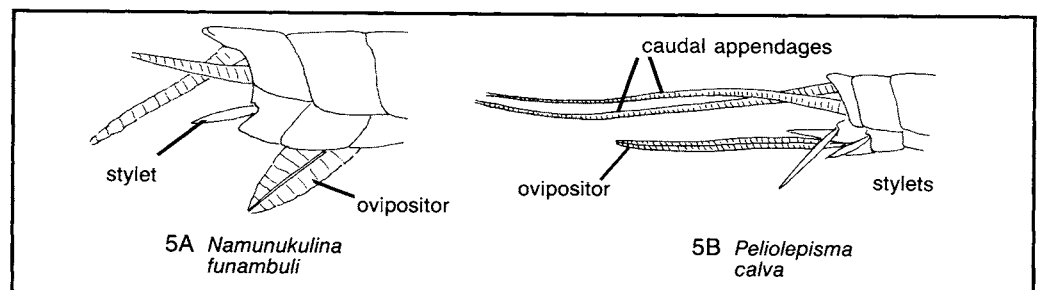


5 Abdominal stylets in 1 pair only; caudal appendages shorter than abdomen; ovipositor subconical, not extending beyond tip of abdomen (5A)-----

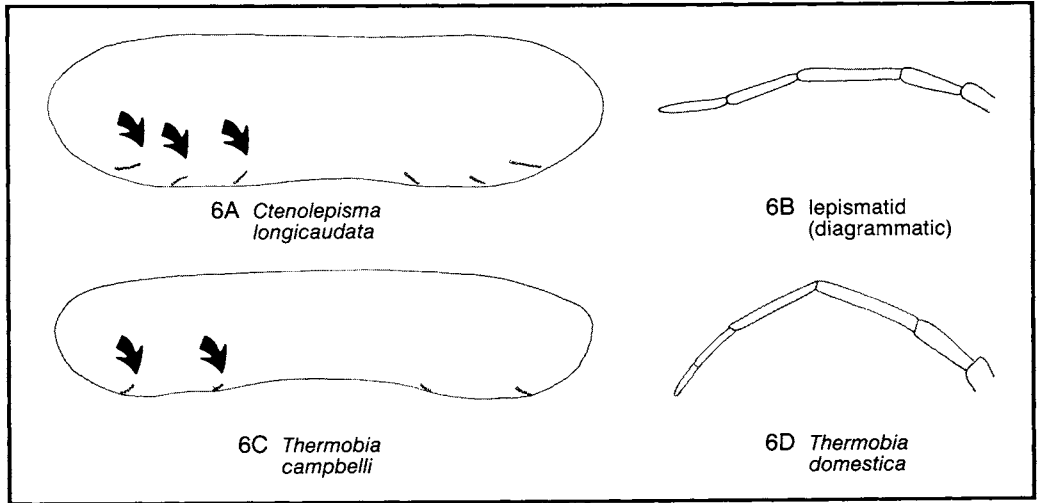
-----*Namunukulina funambuli*

Abdominal stylets in 2 pairs; caudal appendages as long as or longer than abdomen; ovipositor elongated, rod-shaped, projecting beyond apex of abdomen (5B)

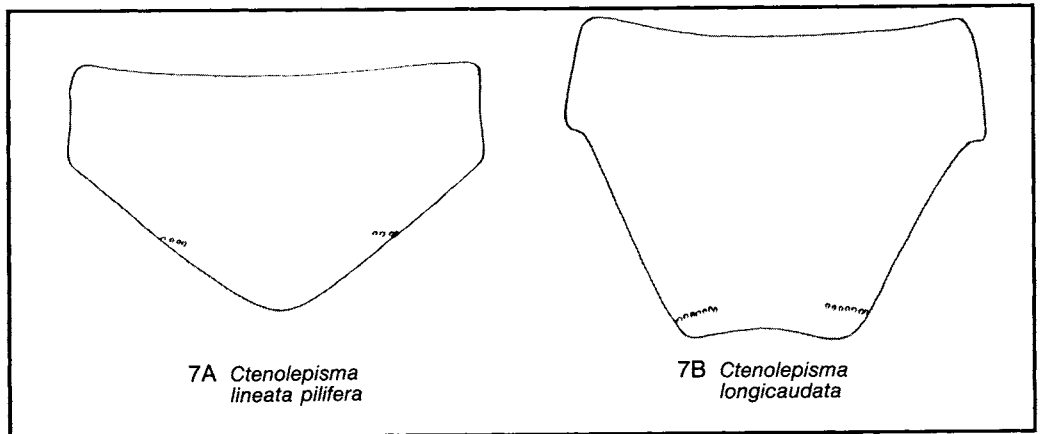
-----*Peliolepisma calva*



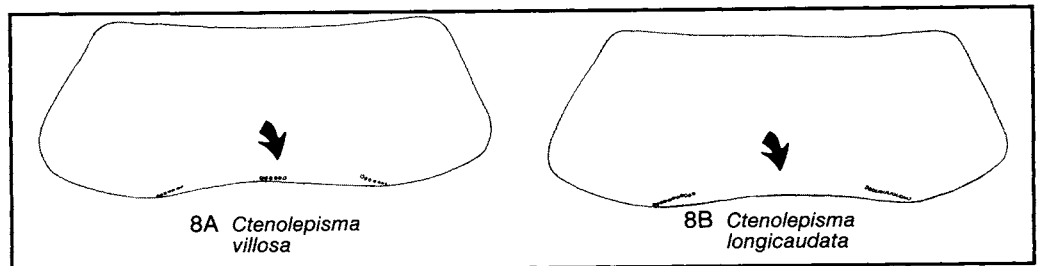
- 6 Several abdominal tergites with 3 + 3 bristlecombs (6A); maxillary palp invariably with 5 segments (6B)----- 7  
 Abdominal tergites with no more than 2 + 2 bristlecombs (6C); maxillary palps with 5 (6B) or 6 (6D) apparent segments----- 9



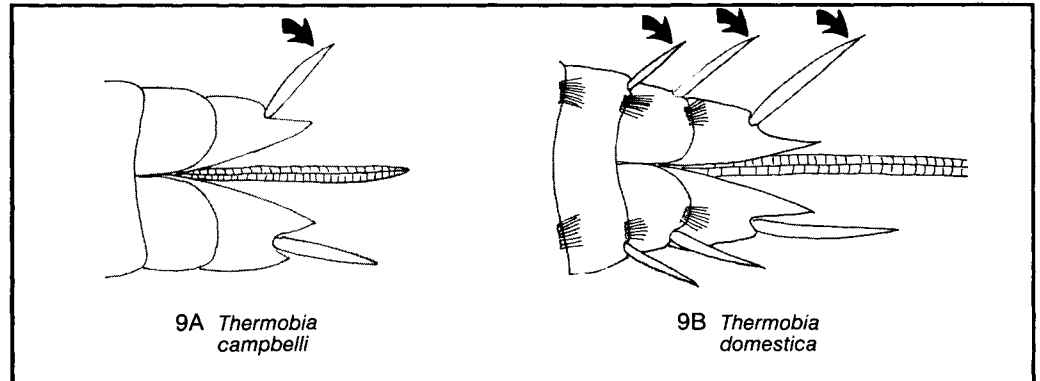
- 7 Abdominal tergite X subtriangular (7A); fig. 21.1B  
 -----fourlined silverfish, *Ctenolepisma lineata pilifera*  
 Abdominal tergite X with posterior margin straight or faintly emarginate (7B) ----- 8



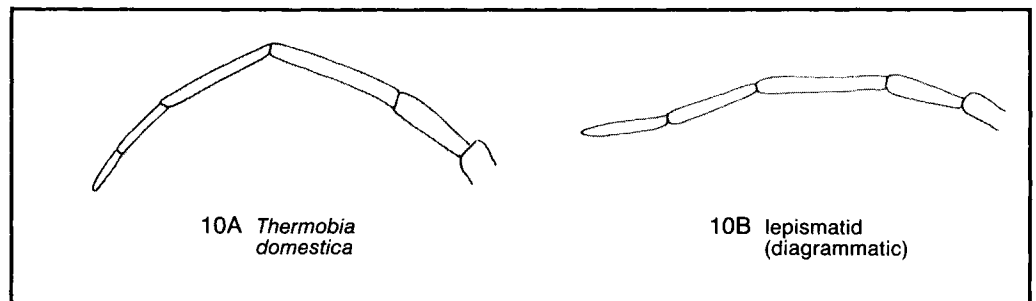
- 8 Median bristlecombs present on abdominal sternites II to VI (8A)-----*Ctenolepisma villosa*  
 Median bristlecombs absent from abdominal sternites (8B)  
 -----gray silverfish, *Ctenolepisma longicaudata*



- 9 Abdominal stylets present in 1 pair only (9A); intact specimens uniformly gray dorsally-----*Thermobia campbelli*  
 Abdominal stylets present in 2 or 3 pairs (9B)----- 10



- 10 Maxillary palp with 6 apparent segments (10A); scales of dorsum forming complex pattern in intact specimens; fig. 21.1A----- **firebrat**, *Thermobia domestica*  
 Maxillary palp with 5 segments (10B); pattern of dorsum unknown  
 -----*Thermobia aegyptiaca*



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**Notes and Sketches**

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The Order Psocoptera (16, 20, 25-28) contains many forms which seem adaptable to living in human habitations. The fifty species included in this key undoubtedly do not represent all of the species that are found in stored foods, but, to my knowledge, they represent all such species mentioned in the literature through 1982. Few surveys have been made of psocids in domestic situations; additional surveys will probably yield other species.

Certain generic and specific names which have appeared in the psocidological literature are either not used in this key or are used in a different sense, namely: *Atropos* Leach, a synonym of *Trogium* Illiger; *Ectopsocus pumilis* (Banks), a name erroneously applied by Chapman (8) to *Ectopsocopsis cryptomeriae* (Enderlein) and used in that sense by all North American authors until 1965 (4); *Hemipsocus roseus* (Hagen), unidentifiable; *Liposcelis divinatorius* (Müller), unidentifiable; *Liposcelis granicola* Broadhead, synonym of *L. bostrychophilus* Badonnel; *Liposcelis simulans* race A Broadhead, synonym of *L. kidderi* Hagen; *Liposcelis subfuscus* Broadhead, synonym of *L. corrodens* Heymons; *Psocatropos lachlani* Ribaga, unidentifiable; *Psocatropos slossonae* Banks, probably a synonym of *P. microps* (Enderlein); *Tapinella africana* Badonnel, synonym of *Nanopsocus oceanicus* Pearman; *Troctes* Burmeister, synonym of *Liposcelis* Motschulsky.

The following comments on structures mentioned in the key may be of value to the nonspecialist. The antennae of psocids are filiform, generally nearly as long as to longer than the body. The mouthparts are of the chewing type, with laciniae in the form of elongate rods. The lacinial tips often provide useful characters (see couplet 16 in the key). Venation of the forewing (see couplets 4, 5, 18, 47) is often used in determinations. In female psocids abdominal sternum VIII (subgenital plate), somewhat enlarged and variously modified (see couplets 49, 51, 53), underlies the genital chamber. To the sides of this plate, and sometimes partially covered by it, lie the gonapophyses, the ovipositor valvulae (see couplets 44, 49), typically three on each side, but sometimes reduced to one. Abdominal sternum IX (hypandrium) of the male is comparable to the subgenital plate. The hypandrium has characters useful for separating some species (see couplets 7, 13). The XI abdominal segment is reduced to the epiproct (a single lobe above the anus) and to the paraprocts (lobes on each side of the anus). These structures may provide characters of specific value (see couplets 7, 48).

Because of the small size of psocids, it is often necessary

for the taxonomist to prepare slides of cleared and stained parts before attempting an identification. Even counts of antennal segments can be difficult on whole specimens. Starting with material preserved in 80% ethanol, one can obtain suitable results with the following procedures.

1. Cut off head and posterior third of abdomen and place them in a tube containing 10% aqueous KOH solution.
2. Place the tube in a water bath and allow it to sit at room temperature until the parts sink to the bottom.
3. While waiting for the parts to sink, remove wings and legs from one side, pass them through absolute ethanol, then through euparal essence in a spot plate, and mount in euparal.
4. Bring the parts in KOH slowly to a boil on a hot plate and allow to cool to room temperature.
5. Pass the parts through one or two baths of distilled water in a spot plate, then through 80% ethanol.
6. If staining is desirable, place the parts in a saturated 95% ethanol solution of acid fuchsin for 0.5 to one hour in a spot plate, covering the well to prevent evaporation.
7. Pass the parts through one to two baths of absolute ethanol.
8. Pass each part separately through euparal essence, and place in a drop of euparal on a slide.
9. For the terminal abdominal segments, cut with a microknife by pressure against the slide to each side of the subgenital plate or hypandrium, and set this structure apart from the remainder of the parts; cut to each side of the valvulae and set this piece apart; separate the phallosome from the hypandrium and set these two pieces apart from the rest. The remaining parts are the clunium (fused terga VIII-X or IX-X), epiproct, and paraprocts.
10. With fine needles, tease paraprocts apart ventral to the anus.
11. Arrange the parts and add cover slip.
12. Dissect the head as follows. With fine needles remove the antennae and set them apart; loosen the maxillary cardines (= basal sclerites; singular, cardo) from head wall; break through mandibular attachments on one side; push off mouthparts as a group, or cut first through membrane at base of labrum; remove head capsule from the preparation and store separately; tease off labrum and mandibles.
13. Arrange the parts on the slide and add cover slip.

With very small specimens, such as *Liposcelis*, one can dispense with the dissections. It suffices to cut fine holes in the lateral abdominal cuticle to facilitate clearing, and to carry out the clearing, staining, and mounting procedures outlined above.



**KEY**

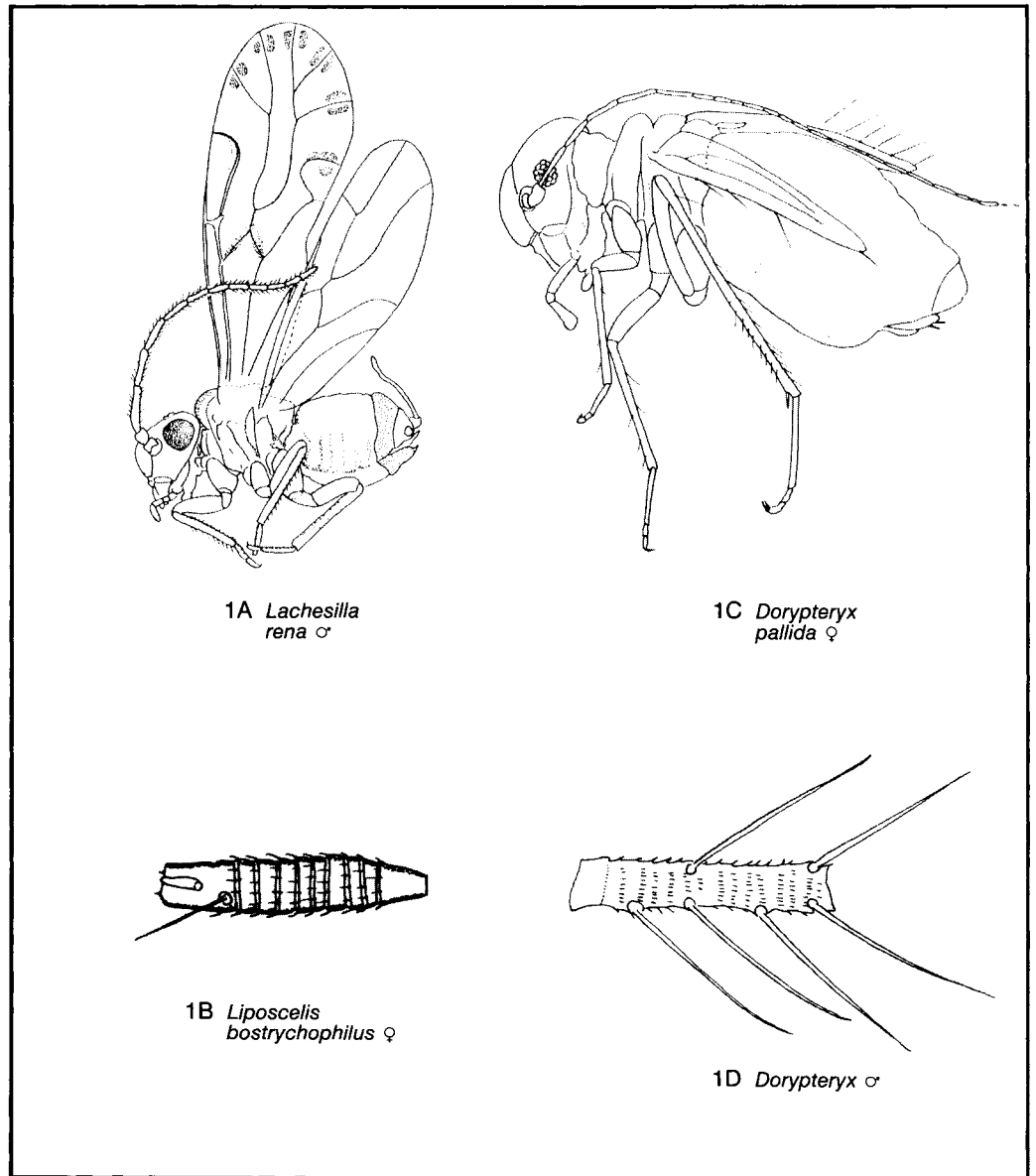
Drawings by E.L. Mockford  
unless otherwise noted.

1 Antenna with 13 to 15 segments (1A); if 15 segments present, some or all flagellar segments secondarily annulated (1B)----- 2

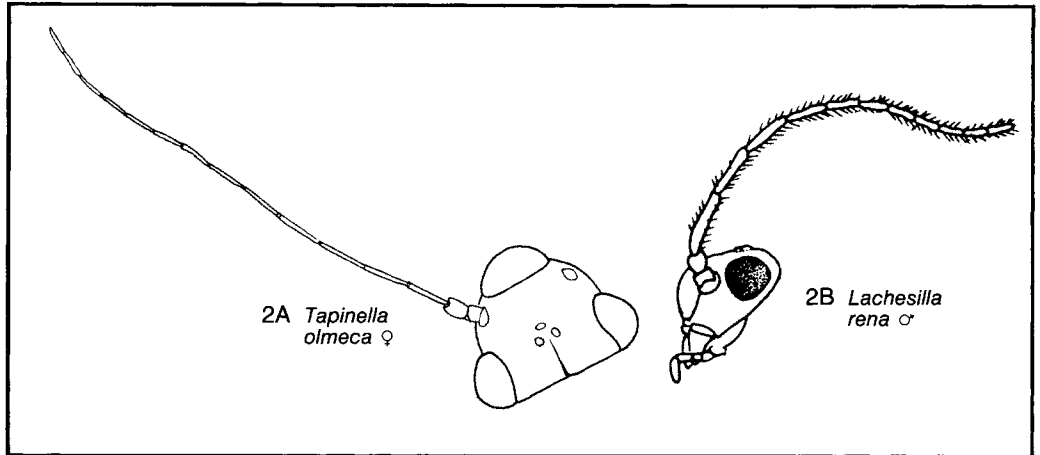
Tarsi 2- (1A) or 3-segmented.

Antenna with more than 20 segments (1C); segments never secondarily annulated, but often with whorls of microtrichia (1D). Suborder Trogiomorpha----- 3

Tarsi 3-segmented (1C).

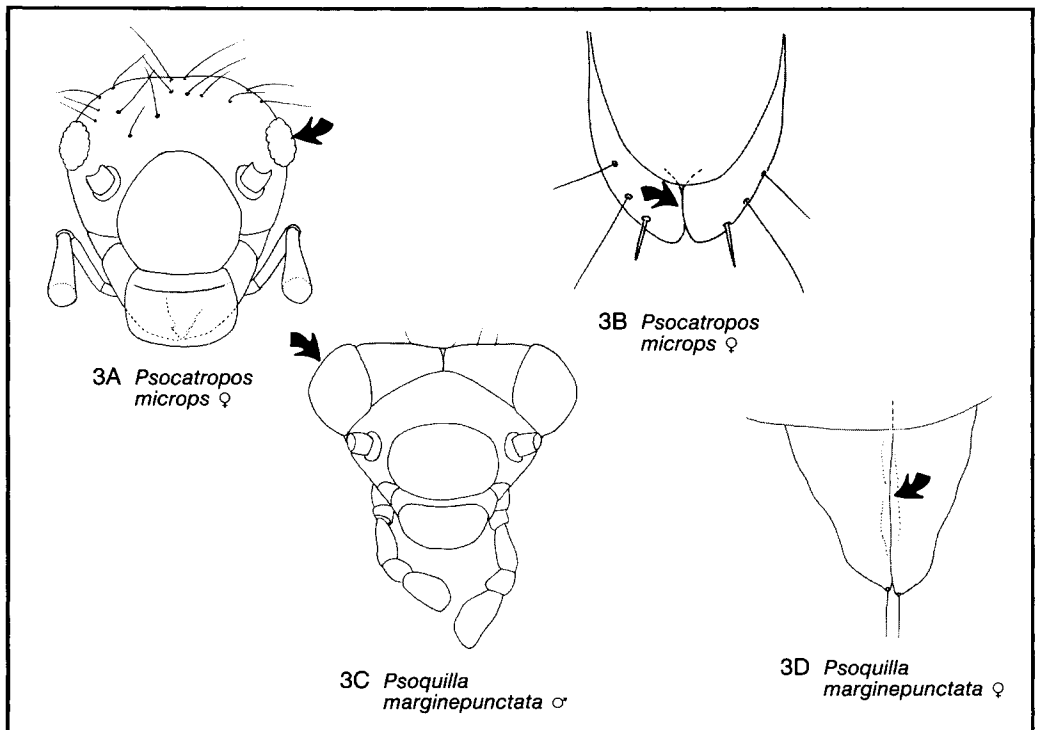


- 2 Antenna 15-segmented (2A), with secondary annulations (apparent only under high magnification). Suborder Troctomorpha----- 18  
 Antenna 13-segmented (2B), lacking secondary annulations. Suborder Psocomorpha 43



**Suborder Trogiomorpha**

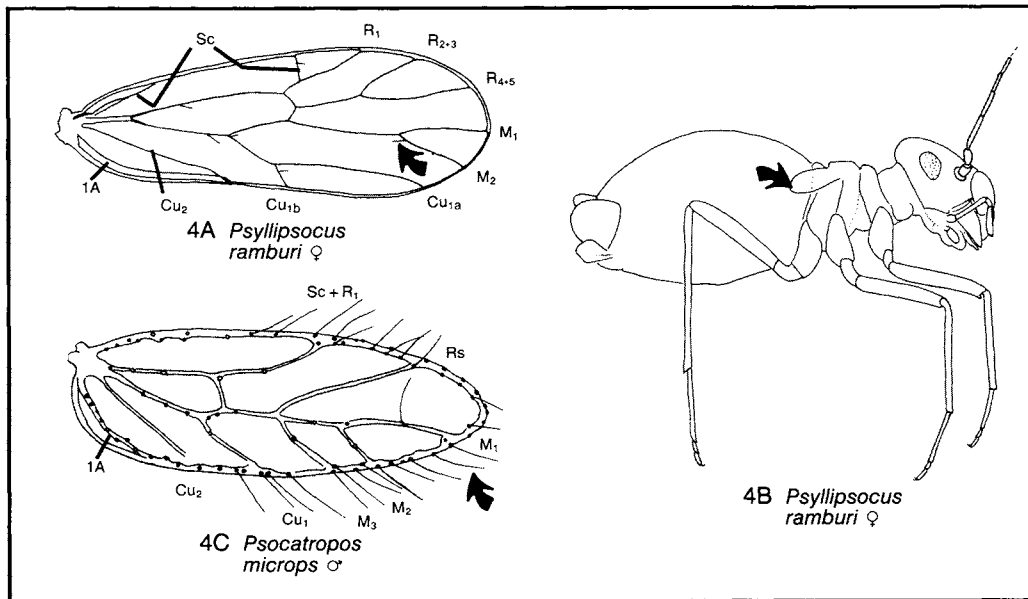
- 3 Head in anterior view relatively narrow, with compound eyes subdorsal (3A); ovipositor valvulae of opposite sides separated by a space or touching only at their apices (3B). Group Psocatropetae. Psyllipsocidae----- 4  
 Head in anterior view relatively broad, with compound eyes contiguous with dorsal surface (3C); ovipositor valvulae of opposite sides joined along midline (3D). Group Atropetae ----- 8



4 Forewing bearing only short setae (4A), or individuals micropterous (4B) ----- *Psyllipsocus ramburi*

Cosmopolitan; in caves and houses. References: 1, 9-12, 27.

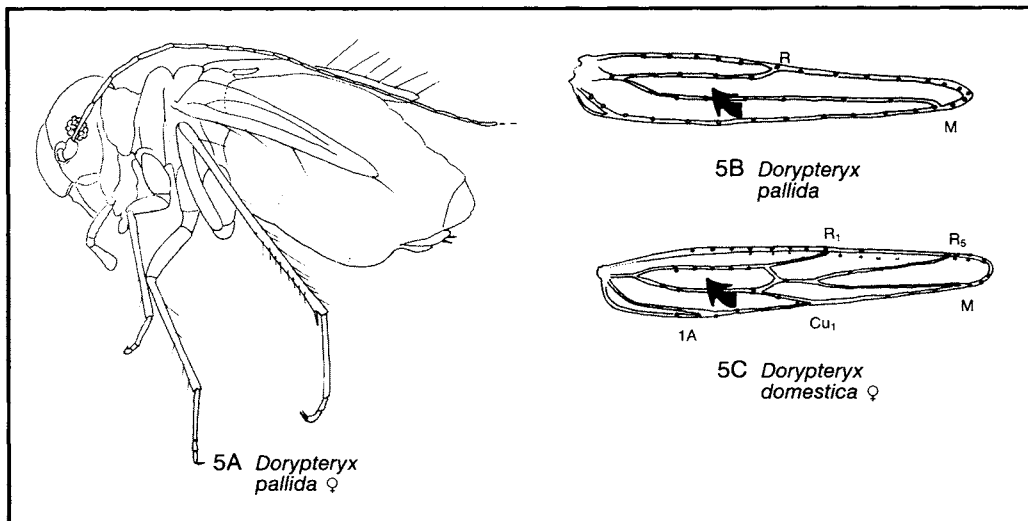
Forewing beset with long setae (4C) ----- 5



5 Forewing with only 2 longitudinal veins, both branching from a single basal vein; no closed cells (5A, 5B) ----- *Dorypteryx pallida*

Known from domestic situations in Philadelphia, and in central and southern Europe, and from a cave in Egypt. References: 9-11.

Forewing with more complex venation including at least 1 closed cell (5C) ----- 6

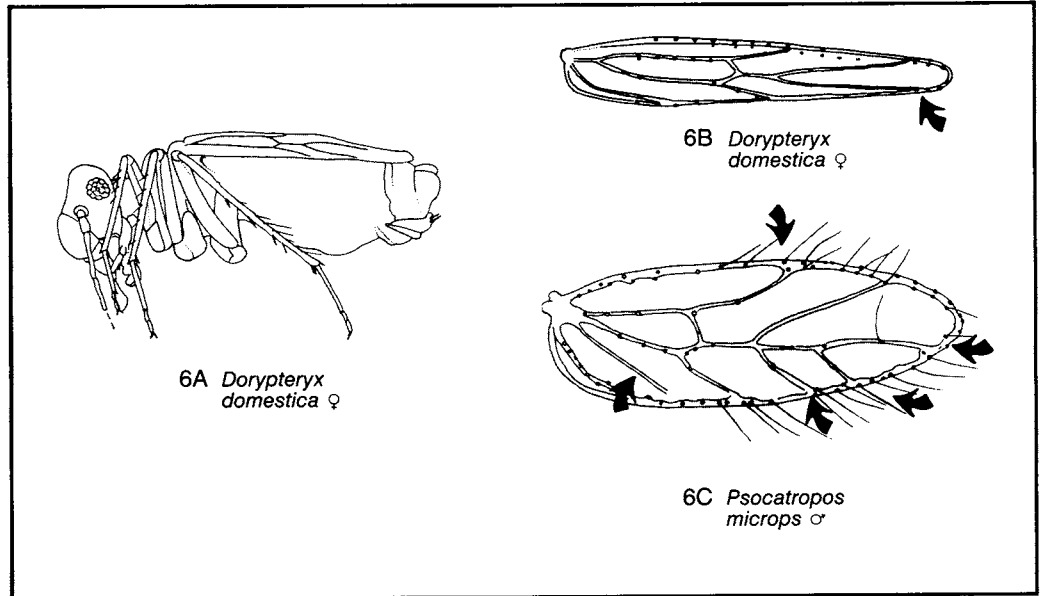


6 Forewing with M simple and Sc and Cu<sub>2</sub> absent (6A, 6B)-----*Dorypteryx domestica*

Known from buildings in Southern Rhodesia and central Europe. References: 11, 24.

Forewing with M at least once-branched, and Sc and Cu<sub>2</sub> present (6C). Genus *Psocatropos* -----

7

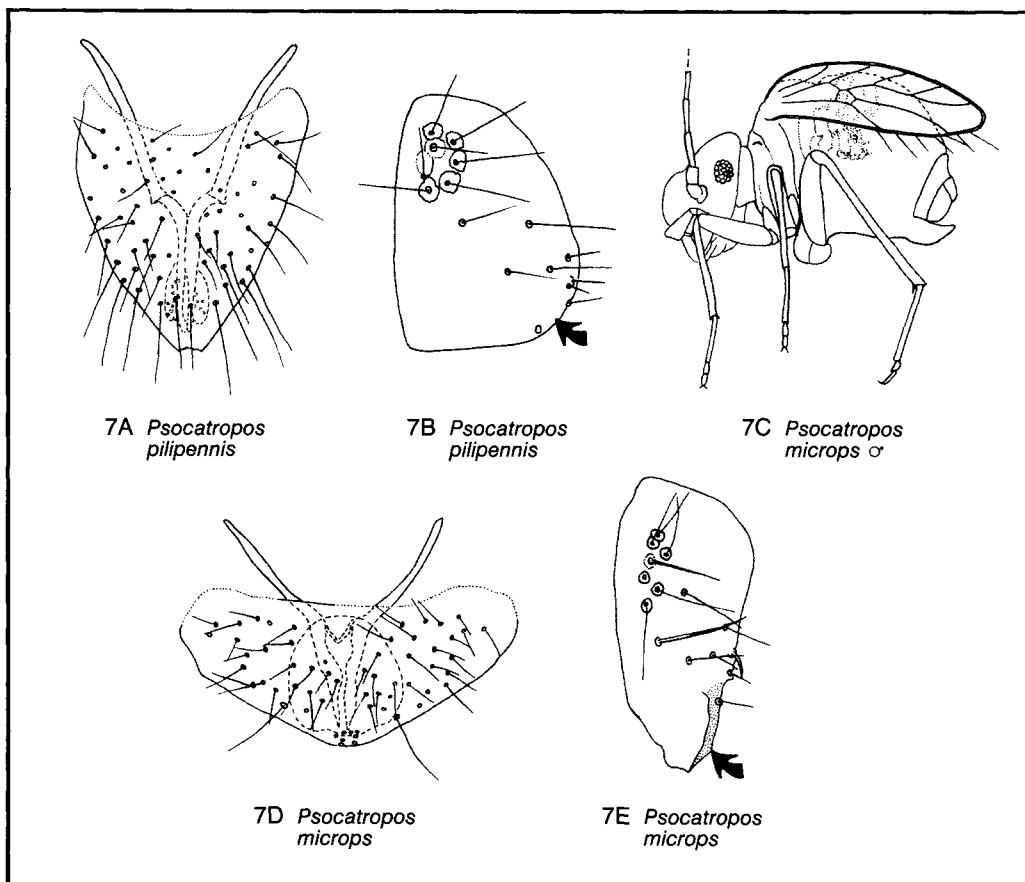


7 Forewing generally reaching or surpassing tip of abdomen; hypandrium longer than its basal width (7A); male paraproct lacking a sclerotized ridge on its distal margin (7B)-----*Psocatropos pilipennis*

Known from houses in India, Madagascar, and the Seychelles. Reference: 3.

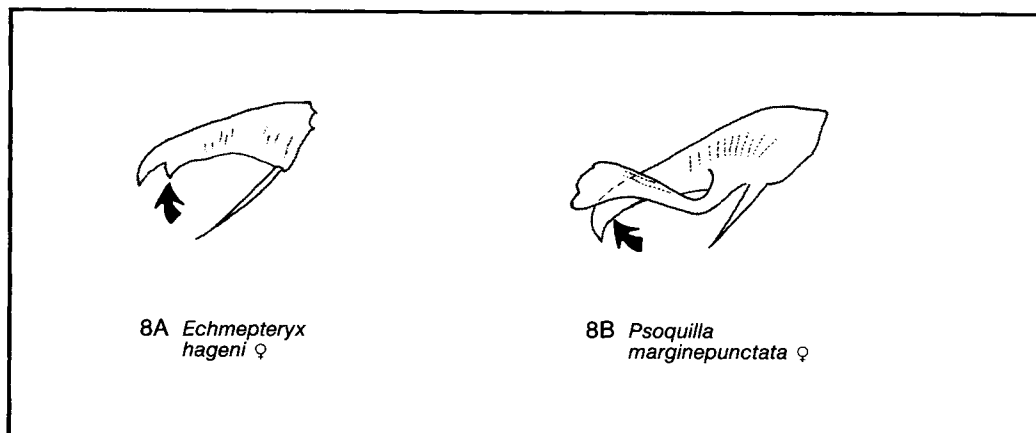
Forewing generally not reaching (or just barely reaching) tip of abdomen (7C); hypandrium shorter than its basal width (7D); male paraproct pointed ventrally, with a sclerotized ridge on its distal margin (7E)-----*Psocatropos microps*

Known from houses, stored food, and outdoor situations throughout the tropics. See also 3A, 3B, 4C. References: 3, 5, 13.



8 Pretarsal claws each with a preapical denticle (8A); body and wings covered with scales (see 9A, 9B). Lepidopsocidae----- 9

Pretarsal claws without preapical denticle (8B); body and wings lacking scales (see 10A, 10B)----- 10



9 Forewings reaching to about posterior margin of abdominal segment I (9A); head marked with 4 longitudinal brown stripes on a creamy yellow background (9A)

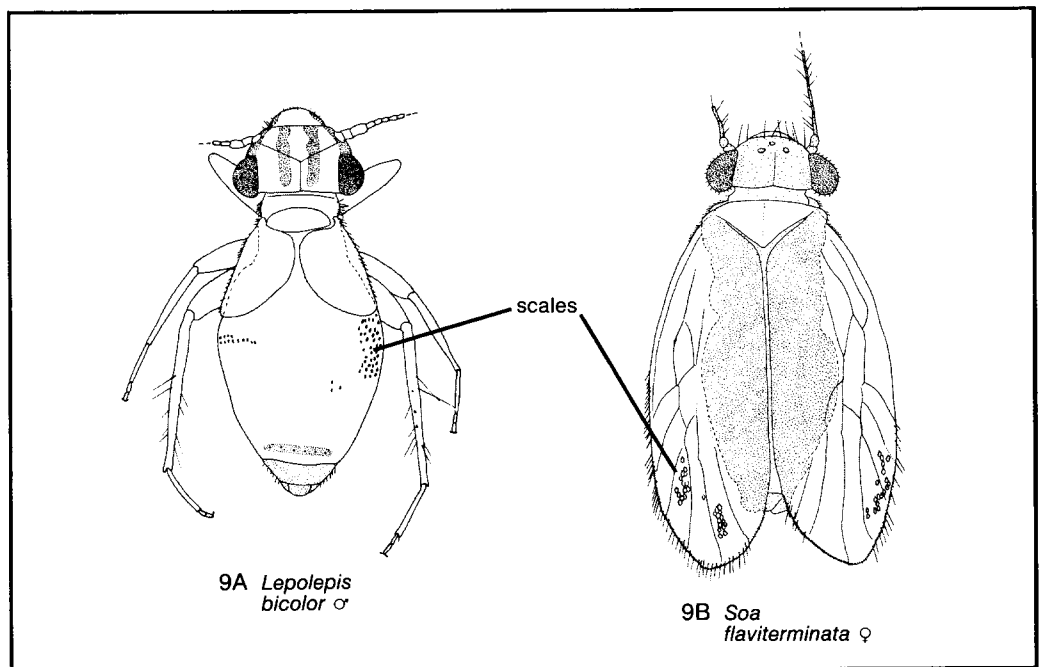
-----*Lepolepis bicolor*

Collected from West African peanuts in a British port, and also from India (circumstances not noted).  
Reference: 7.

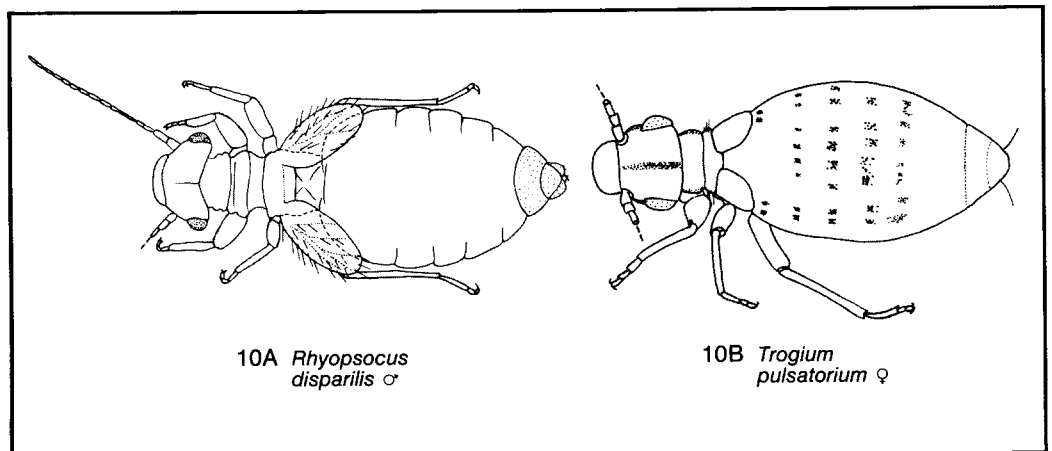
Forewing surpassing posterior margin of abdomen (9B); head a uniform medium brown

-----*Soa flaviterminata*

Circumtropical, but recorded from stored foods only in West Africa. References: 5, 9, 15.



10 Forewings well-developed or reduced, but always with veins (10A). Psoquillidae-- 11  
Forewings reduced to tiny scales or knobs, never with veins (10B). Trogiidae----- 14



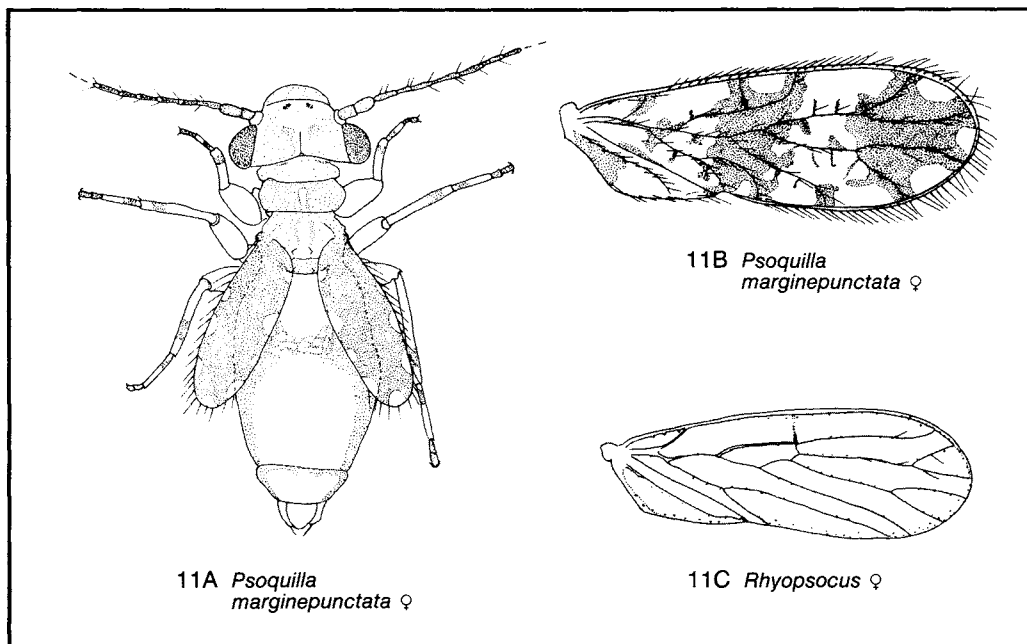
11 Forewings marked with a conspicuous pattern of dark and clear areas (11A, 11B)

----- *Psoquilla marginepunctata*

Circumtropical; introduced into central Europe and southern United States; known mostly from outdoor situations in the tropics, but from stored food in West Africa and from domestic situations outside the tropics. See also 3C, 3D, 8B. References: 1, 5, 9, 19.

Forewings uniform in color, pale brown to nearly colorless (11C). Genus *Rhyopsocus*

12

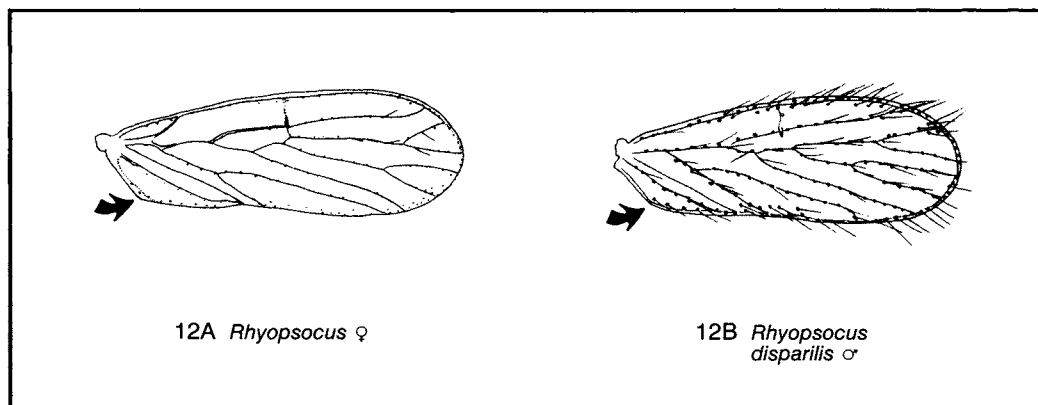


12 Anal lobe of forewing with angular posterior margin (12A)-----*Rhyopsocus peregrinus*

Found in a store at Manchester, England.  
Reference: 17.

Anal lobe of forewing with rounded posterior margin (12B)-----

13

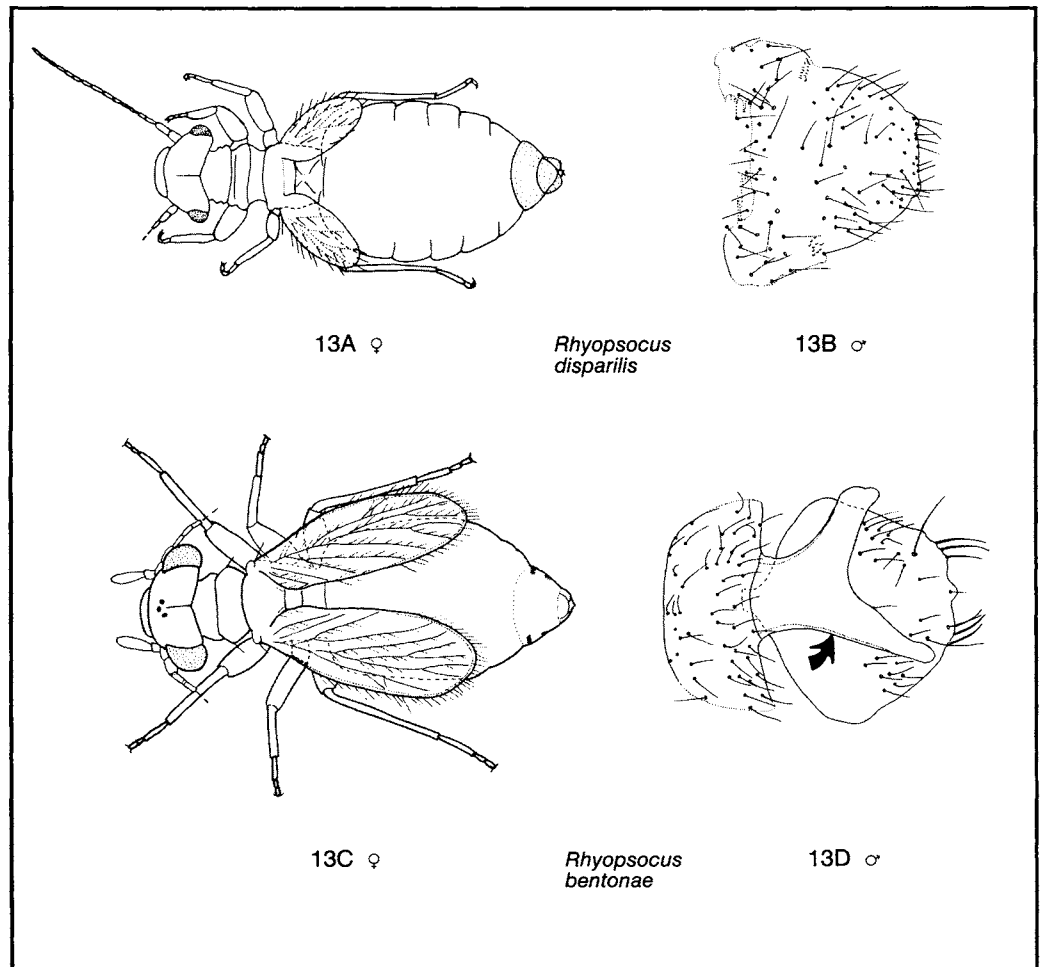


- 13 Body color a pale, creamy-yellow; wings variable in length, reaching as far as the basal fourth of the abdomen in the shortest-winged form (13A) to about tip of abdomen in longest-winged form; hypandrium not partially covered by preceding sternum (13B)-----*Rhyopsocus disparilis*

Taken in England and at New York on West African cacao, at United States ports on rice from the Philippines and Japan, on beans from the West Indies, and on pigeon peas from Guyana. References: 4, 5, 19.

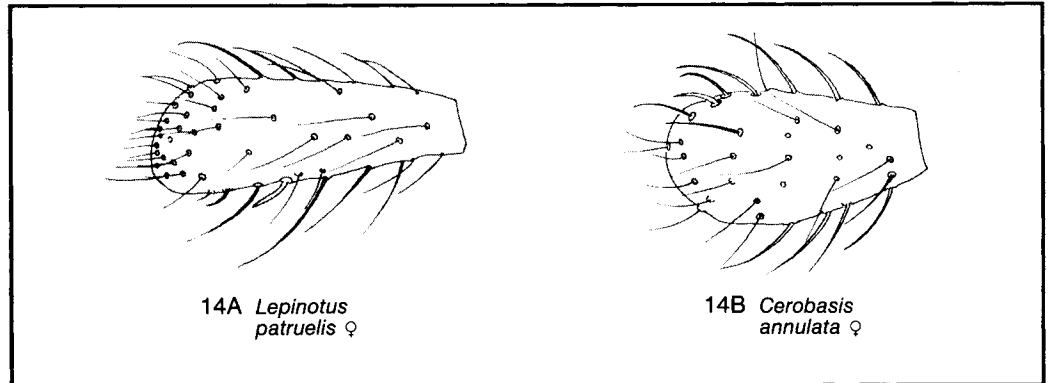
- Head and thorax a tawny brown; wings variable in length, extending from about midlength of abdomen (13C) to beyond tip of abdomen; hypandrium partially covered by fishtail-shaped lobe of preceding sternum (13D)-----*Rhyopsocus bentonae*

Found in houses in southeastern United States.  
Reference: 31.





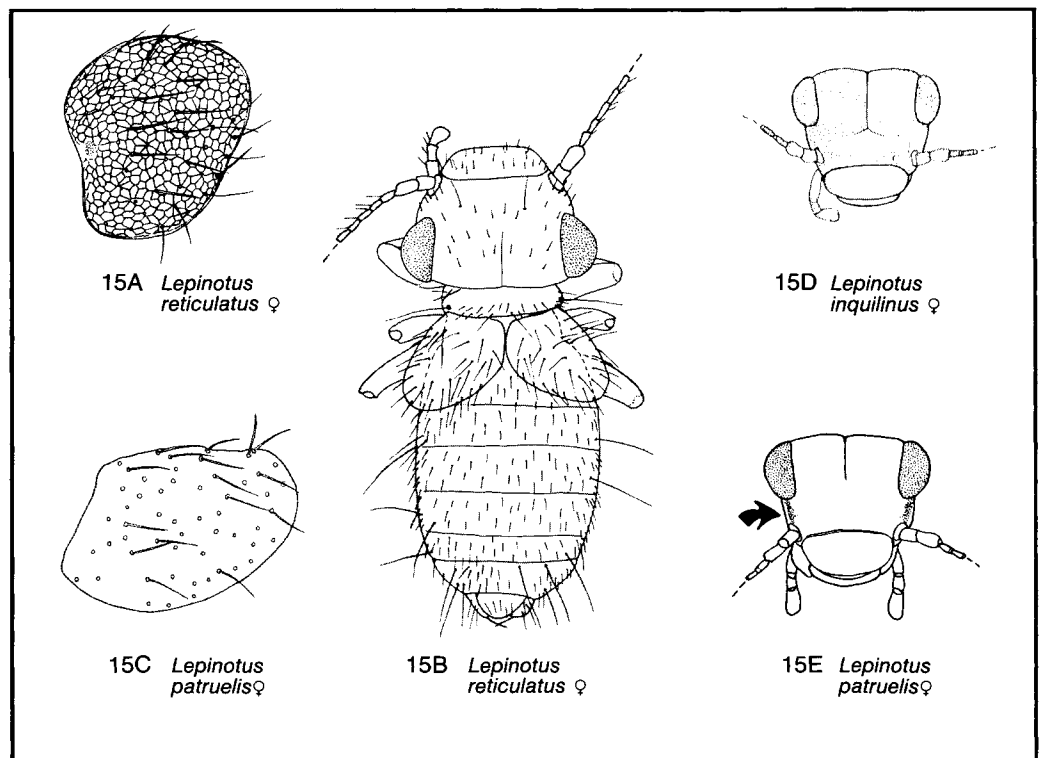
- 14 Segment IV of maxillary palp relatively elongate and slender (14A); abdomen uniform in color (see 15B)----- 15  
 Segment IV of maxillary palp relatively short and broad (14B); abdomen spotted or mottled (see 17A, 17B)----- 17



- 15 Slide-mounted wing with a reticulate pattern (15A); head a uniform yellowish brown (15B)-----reticulatewinged trogiid, *Lepinotus reticulatus*

Cosmopolitan; usually in outdoor situations but common in stored grain in the United States. References: 4, 5, 9-11, 21.

- Slide-mounted wing lacking reticulate pattern (15C); head dark brown (15D) or with a dark brown band from compound eye to antennal base (15E)----- 16

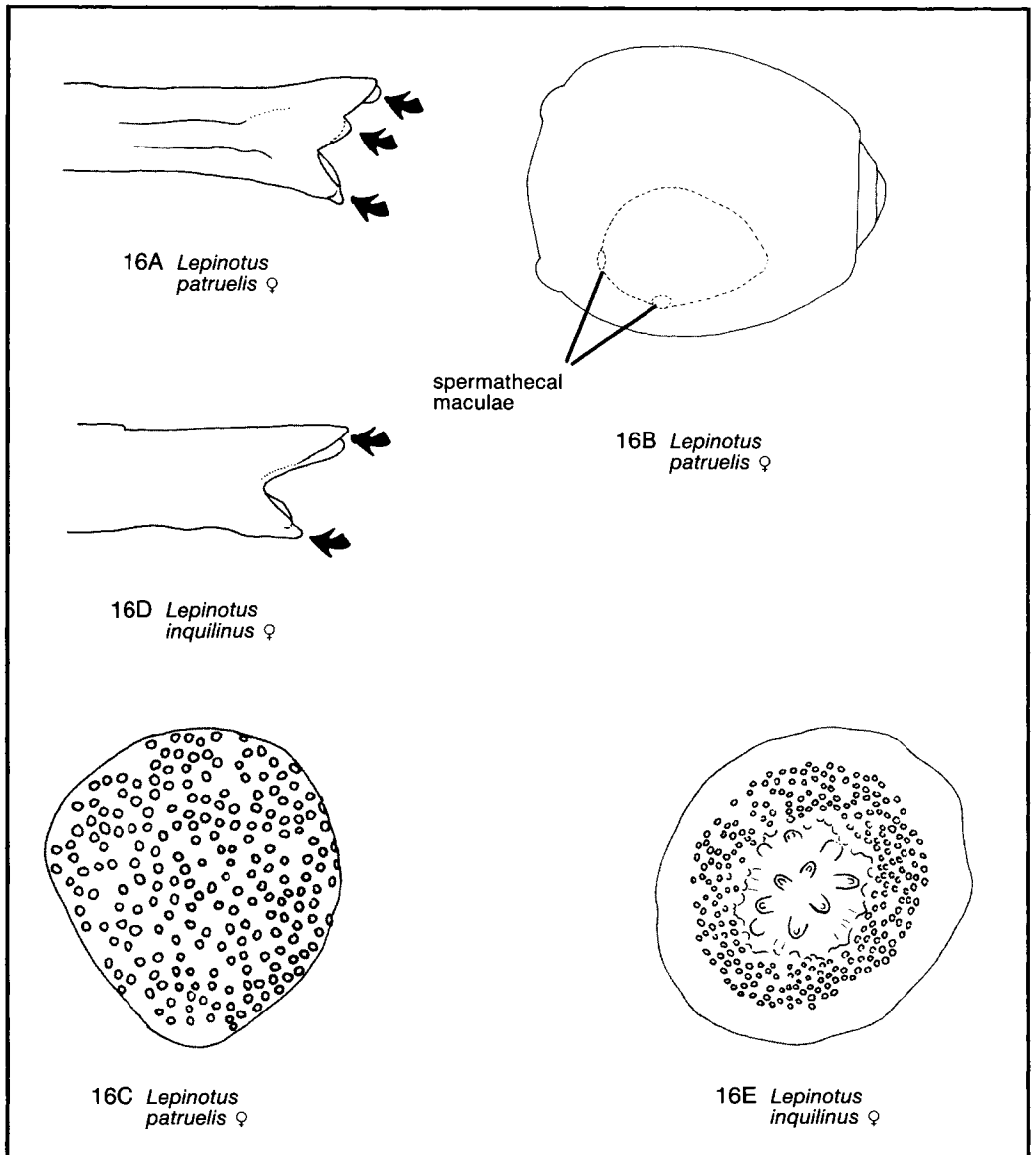


16 Lacinial tip distinctly tridentate (16A); spermathecal maculae (16B) each with uniform, minute papillae (16C)-----*Lepinotus patruelis*

Common in houses in central Europe; often seen at United States ports on dried plant materials from central Europe. See also 14A, 15C, 15E. References: 7, 9, 11, 18.

Lacinial tip bidentate, any medial protuberance being at most a low mound (16D); spermathecal maculae (16B) each with large central spinelike papillae and smaller peripheral granular papillae (16E) -----*Lepinotus inquilinus*

Relatively common in houses in Europe, North America, Africa, and Madagascar. See also 15D. References: 1, 9, 10, 27.



17 Frons with a brown, anchor-shaped mark; wings brown-spotted (17A)

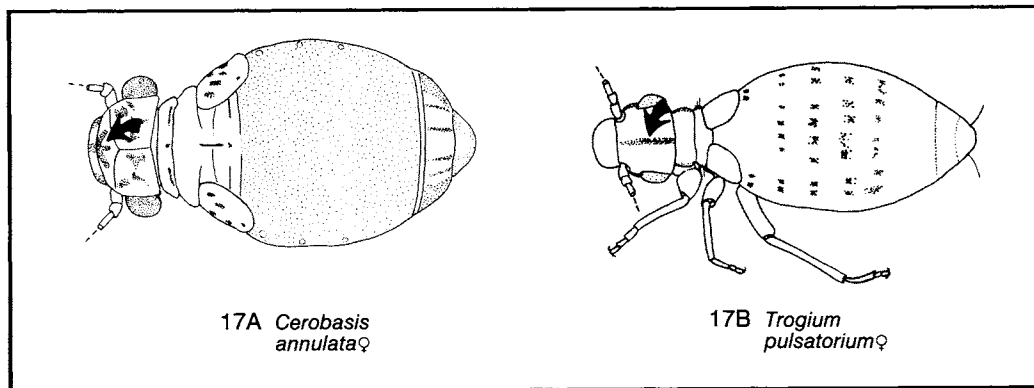
-----*Cerobasis annulata*

Occurs in houses in Europe and North America. See also 14B. References: 9, 10.

Frons marked with a dark longitudinal line; wings uniform in color (17B)

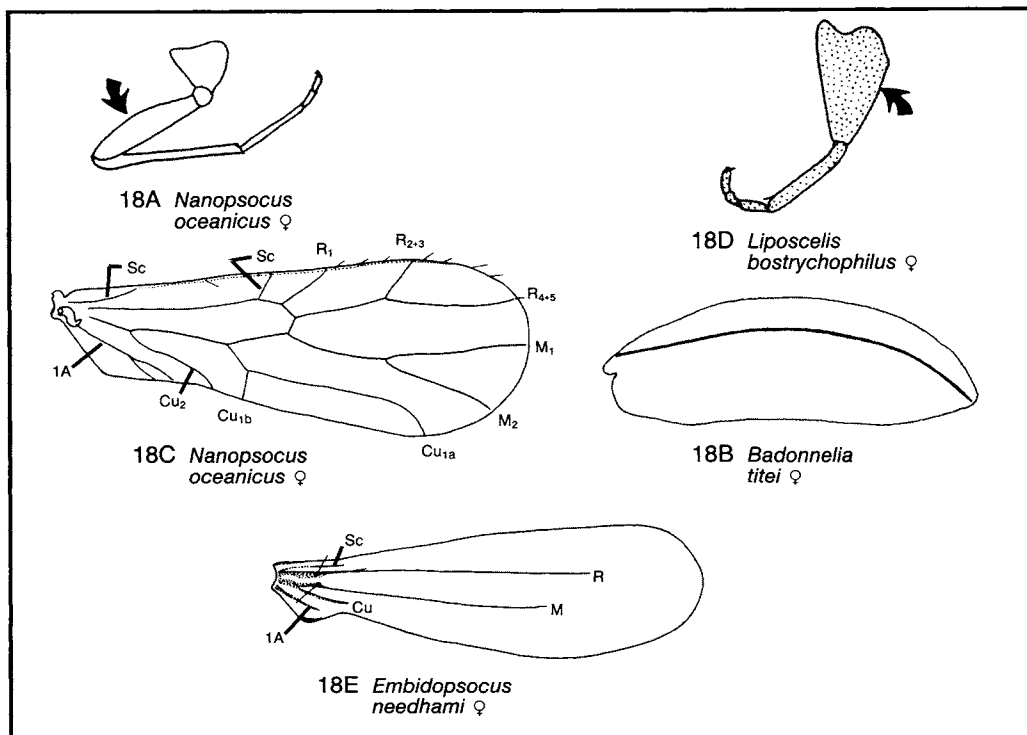
-----**larger pale trogiid**, *Trogium pulsatorium*

Common in houses in Europe and North America. References: 9, 10, 12, 27.



**Suborder Troctomorpha**

18 Body not depressed; femur III not dilated (18A); forewings, if present, either elytriform, with reduced venation (18B), or with venation essentially complete (18C)----- 19  
 Body depressed; femur III dilated (18D); wings, if present, with venation greatly reduced (18E). Liposcelidae----- 20



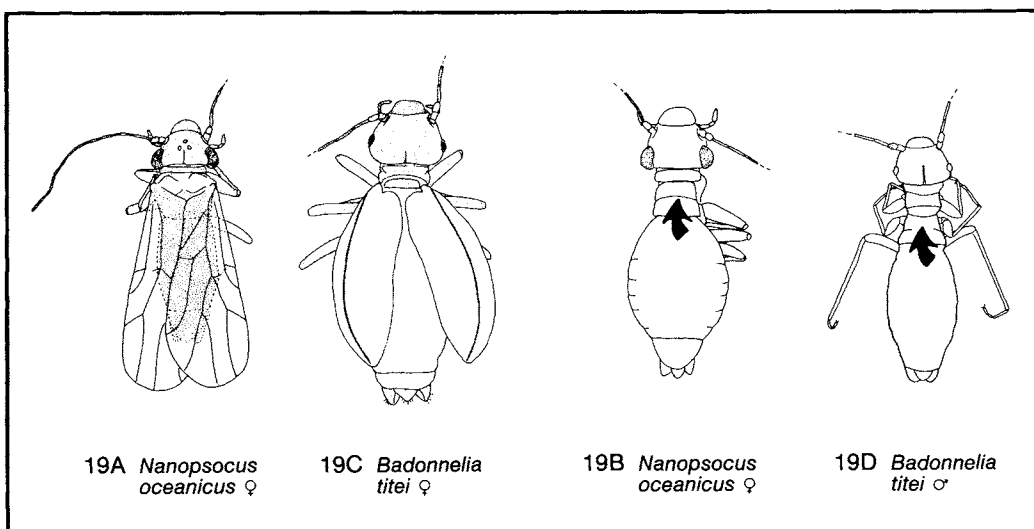
19 Wings, if present, flat, with many veins (19A); apterous forms with mesothorax and metathorax separated by an obvious suture (19B). Pachytroctidae

-----*Nanopsocus oceanicus*

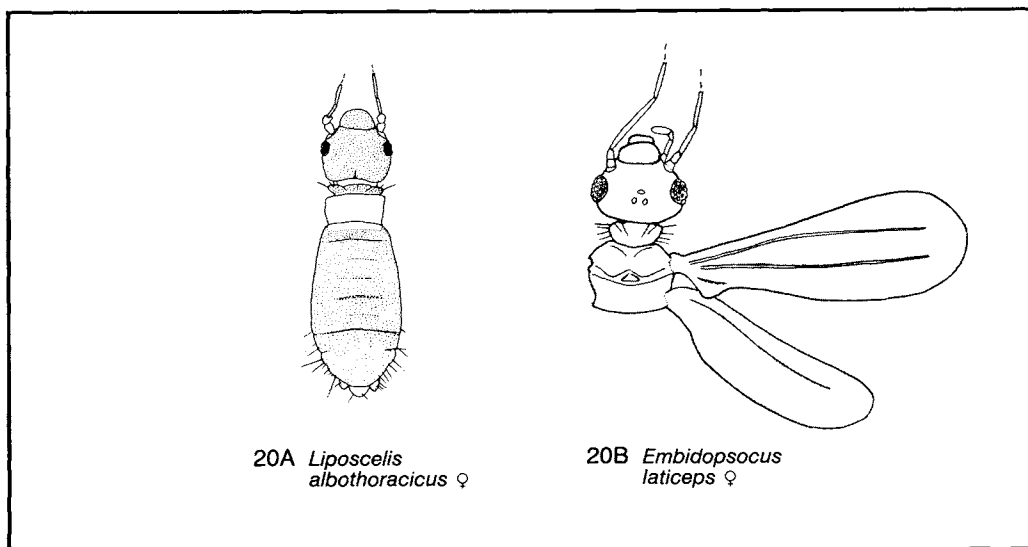
Occurs in houses in southeastern United States and Japan (also in dried mushrooms in Japan); also known from West Africa and New Hebrides. See also 18C. Reference: 4 (= *Tapinella africana* and *T. pallida*).

Wings, if present, convex, elytriiform, with few veins (19C); apterous forms with mesothorax and metathorax fused (19D). Sphaeropsocidae -----*Badonnella titei*

Known from domestic situations, including stored food, in central Europe and England. References: 9, 11, 22, 23.

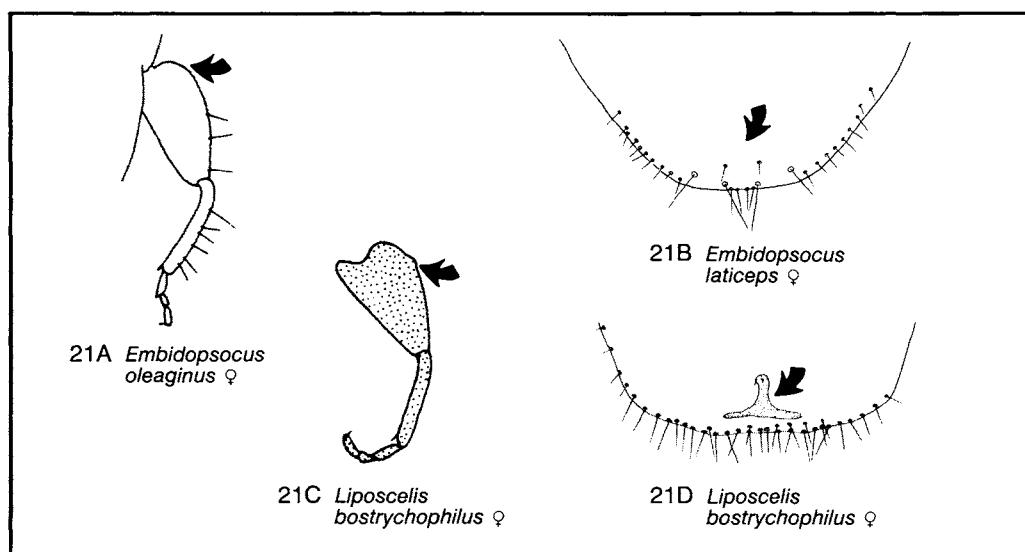


20 Wings and ocelli absent (20A)----- 21  
 Wings and ocelli present (20B)----- 22

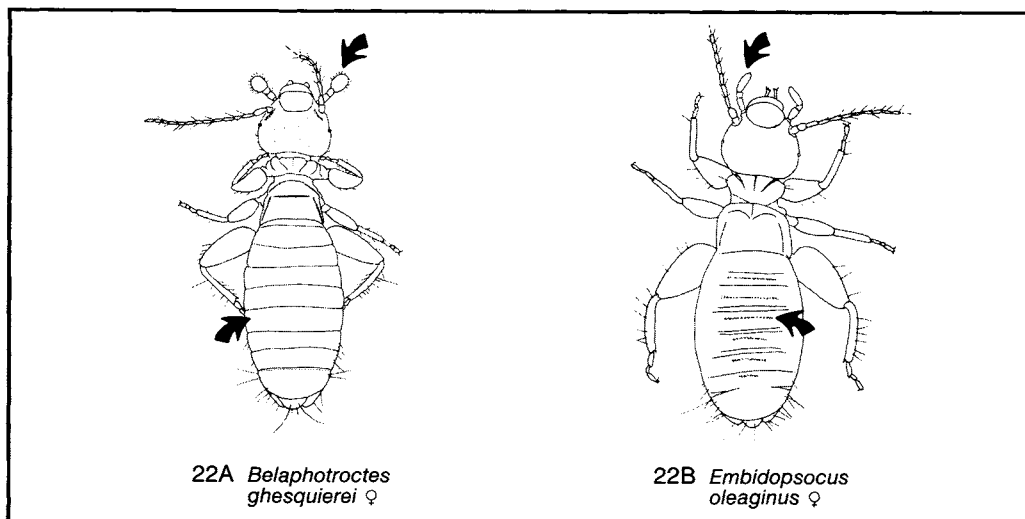


- 21 Femur III moderately broad, without a lateral process (21A); subgenital plate without a T-shaped sclerite (21B)----- 22  
 Femur III very broad, with a small lateral process (21C); subgenital plate with a T-shaped sclerite (21D). Genus *Liposcelis*----- 25

Males of *Liposcelis* are determined at present largely by association with females. For some species, males are unknown or nonexistent. The sexes may be distinguished as follows: females larger than males; subgenital plate with T-shaped sclerite (21D); the phallosome (an elongate, partially-enclosed frame above the hypandrium) occupying about half the length of abdomen. Reference: 6.



- 22 Terminal segment of maxillary palp at least slightly dilated (22A); abdominal terga III-VIII each lacking a slender, heavily sclerotized transverse strip (22A). Genus *Belaphotroctes* ----- 23  
 Terminal segment of maxillary palp not dilated (22B); abdominal terga III-VIII each with a slender, heavily sclerotized transverse strip (22B). Genus *Embidopsocus* ----- 24

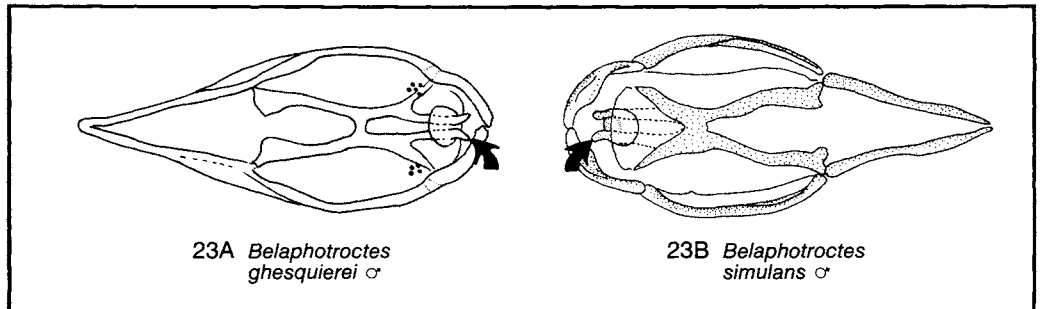


23 Endophallic central prongs with pointed tips (23A)-----*Belaphotroctes ghesquierei*

Known from Brazil, Florida, and West Africa, primarily from outdoor situations, but from stored food in West Africa. See also 22A. References: 3-5.

Endophallic central prongs with blunt tips (23B)-----*Belaphotroctes simulans*

Found in stored food in West Africa.  
Drawing adapted from 5 by C. Feller.

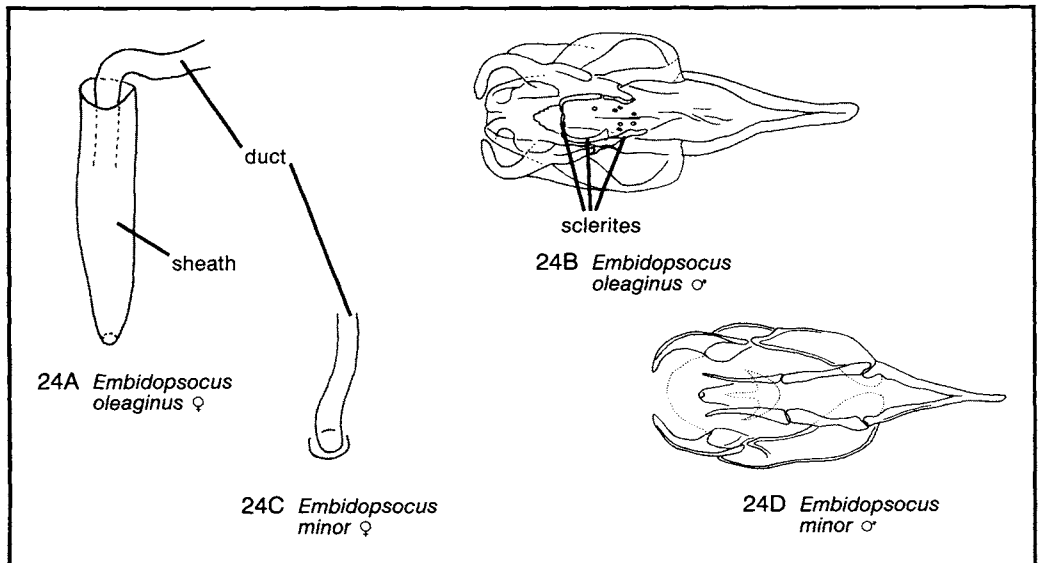


24 Spermathecal duct with sheath around spermapore end (24A); endophallus with arch of small sclerites (24B)-----*Embidopsocus oleaginus*

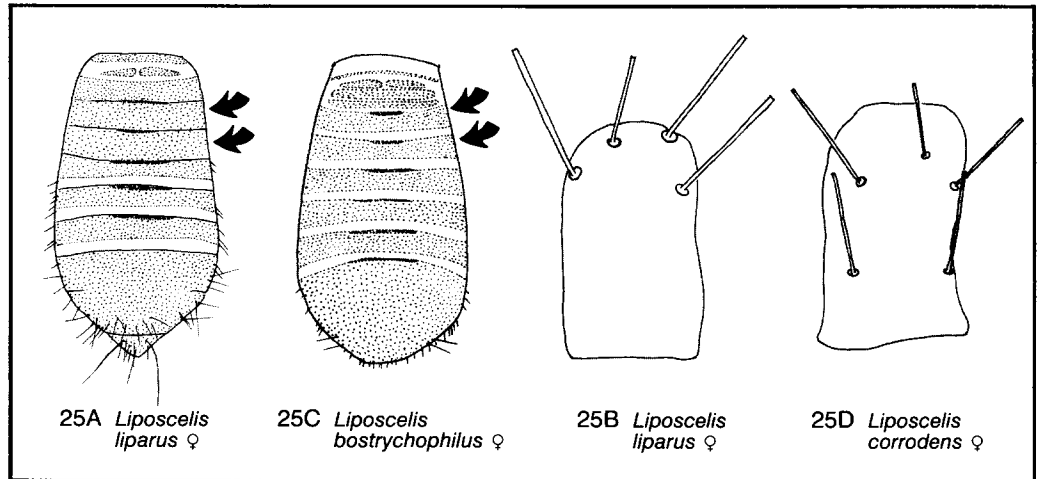
Associated with stored foods in West Africa, Sri Lanka, and several western Pacific localities (Philippines, Taiwan, Okinawa). See also 21A, 22B. References: 1, 5.

Spermathecal duct without sheath (24C); endophallus without arch of sclerites (24D)-----*Embidopsocus minor*

Taken from West African cacao in a British warehouse, and from stored foods in West Africa. References: 5, 19.  
Drawings adapted from 5 by C. Feller.



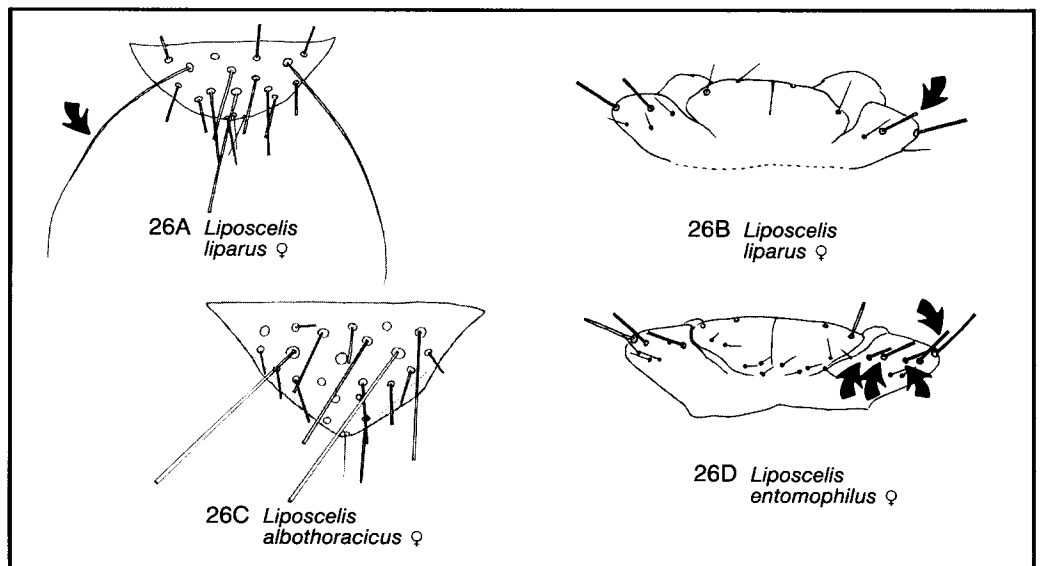
- 25 Abdominal terga III and IV uniform in color, not presenting, at least in their central portions, a posterior membranous band with sculpture different from their anterior parts (25A); all prosternal setae anterior (25B). Section I----- 26
- Abdominal terga annulate, with distinct intersegmental membranes in posterior parts of terga III to VII showing different sculpture and paler color than the more sclerotized anterior parts of these segments (25C); prosternal setae either restricted to anterior half (25B) or distributed in both halves (25D). Section II----- 34



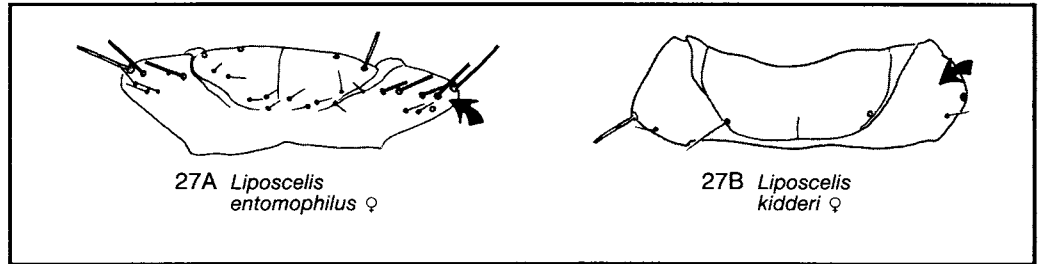
- 26 Epiproct with a pair of long, slender, acuminate setae (26A); lateral pronotal lobe with a long, strong humeral seta and a single long supplementary bristle (26B)  
----- *Liposcelis liparus*

In buildings in England; common in outdoor situations in western United States and South Africa. See also 25A, 25B. References: 6, 9, 11.

- Epiproct without acuminate setae (26C); pronotal lobe with 2 or more supplementary setae (26D), or supplementary setae absent----- 27



- 27 Lateral lobe of pronotum with a transverse row of 2 to 5 strong setae in addition to humeral seta (27A)----- 28  
 Lateral lobe of pronotum with humeral seta and scattered small setae, but without a transverse row of strong setae (27B)----- 30



- 28 Body without a striking pattern, uniform in color except apical half of abdomen somewhat darker than basal half-----*Liposcelis transvaalensis*

Recorded from stored foods in West Africa. Reference: 5.

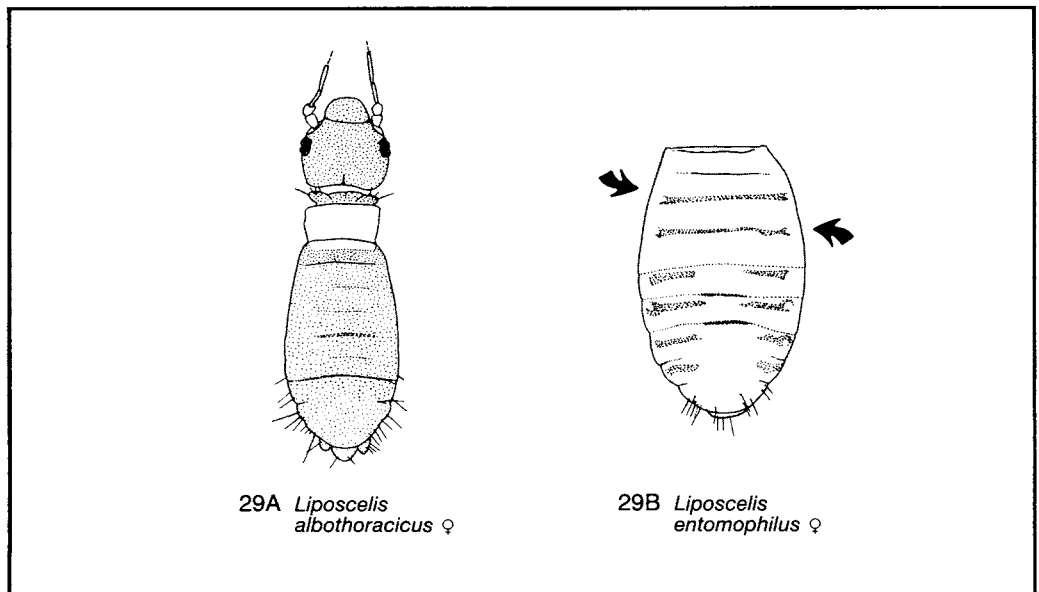
- Body marked with a striking pattern of contrasting colors----- 29

- 29 Mesothorax, metathorax, and abdominal segment I white; other portions of body brown (29A)-----*Liposcelis albothoracicus*

Collected from Turkish millet seed in a ship at Liverpool, England, and from an outdoor locality in southern India. See also 26C. Reference: 7.

- Body generally a creamy yellow, with lateral reddish-brown bands on abdominal terga III to VIII, continuous across terga III and IV (29B)-----*Liposcelis entomophilus*

Cosmopolitan; common in stored grain. See also 27A. References: 2, 9, 13.

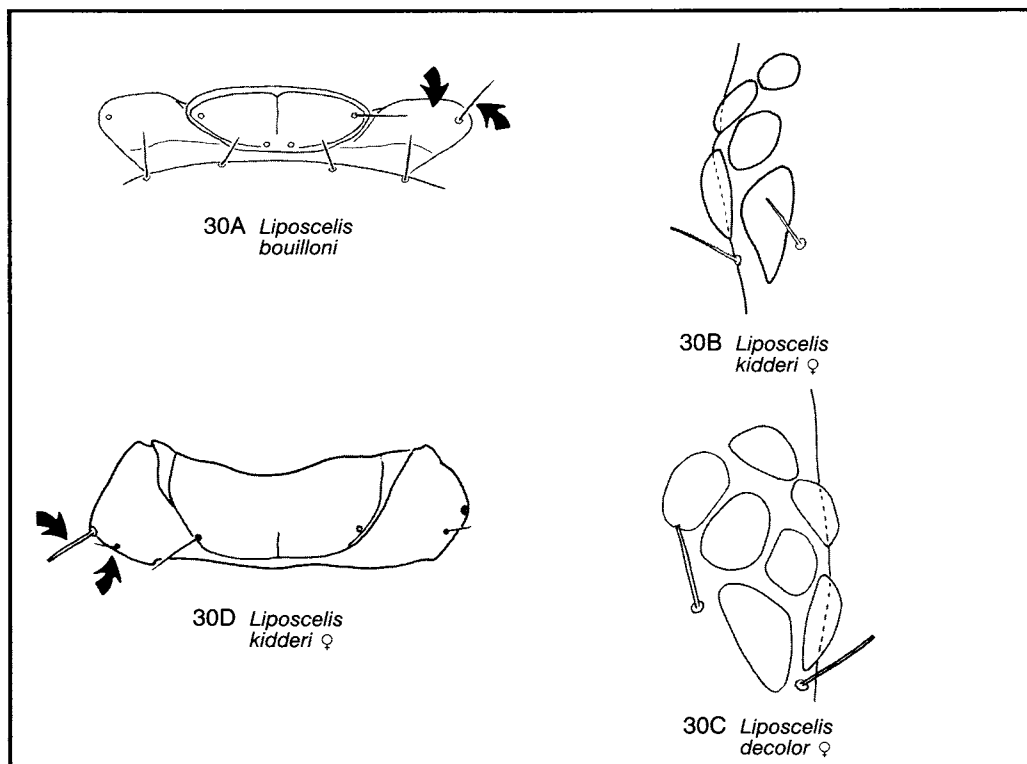




30 Compound eye of both sexes with 4 facets; lateral lobe of pronotum with only humeral seta, no smaller setae (30A)-----*Liposcelis bouilloni*

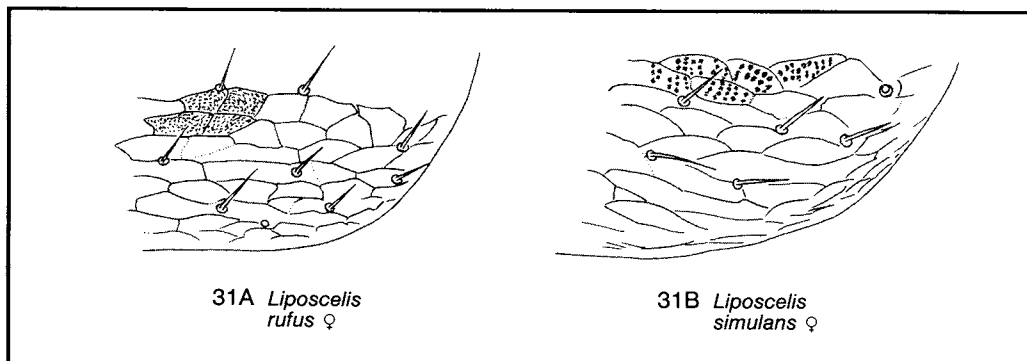
From stored coffee in West Africa, and from outdoor situations in Brazil.  
Drawing adapted from 5 by C. Feller.

Compound eye of female with 5 (30B) to 7 facets (30C), of male, 4 to 5 facets; lateral lobe of pronotum with humeral seta plus 1 or more smaller setae (30D)----- 31



31 Vertex sculptured with finely granulate areoles (31A; details shown only in selected areoles)----- 32

Vertex sculptured with areoles bearing small tubercles forming anteroposteriorly-oriented wavy lines (31B)----- 33



- 32 Compound eye of female with 5 (see 30B) to 6 facets, of male, 4 to 5 facets; body color medium brown-----*Liposcelis kidderi*

Occurs in houses in Europe and North America. See 30B, 30D. References: 6, 9, 11.

- Compound eye of female with 6 to 7 (usually 7) facets, of male, 5 facets; body color reddish-brown-----*Liposcelis rufus*

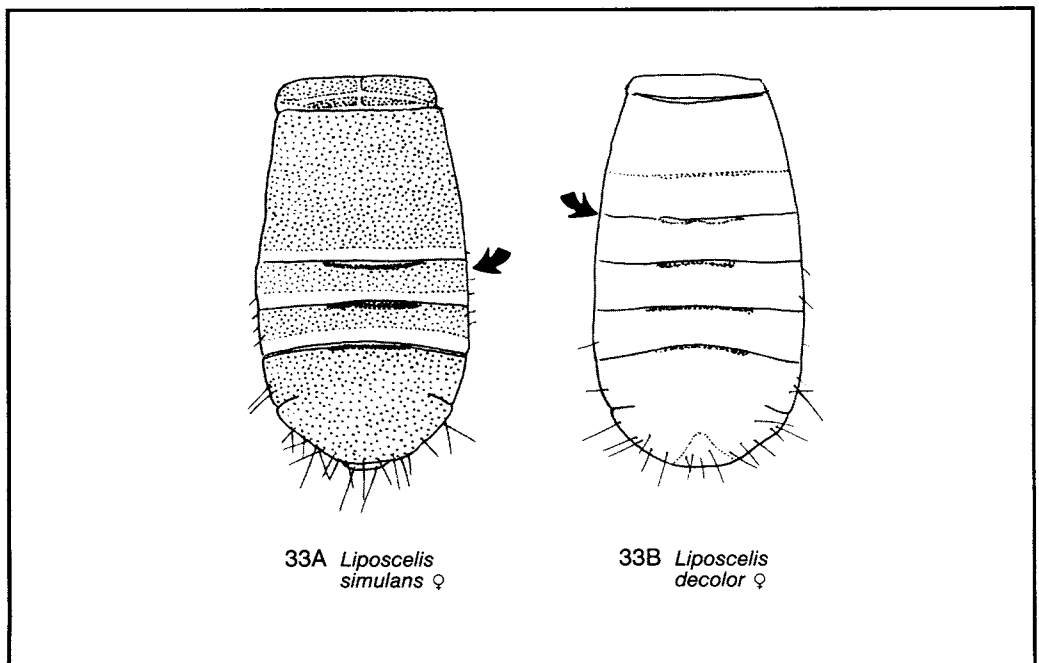
Recorded from a building in Ohio, from an outdoor locality in California, and from England (situation unknown). See 31A. References: 4, 6.

- 33 Anterior margins of abdominal terga VI-VIII with prominent dark, transverse, sclerotized strips (33A); body color medium brown-----*Liposcelis simulans*

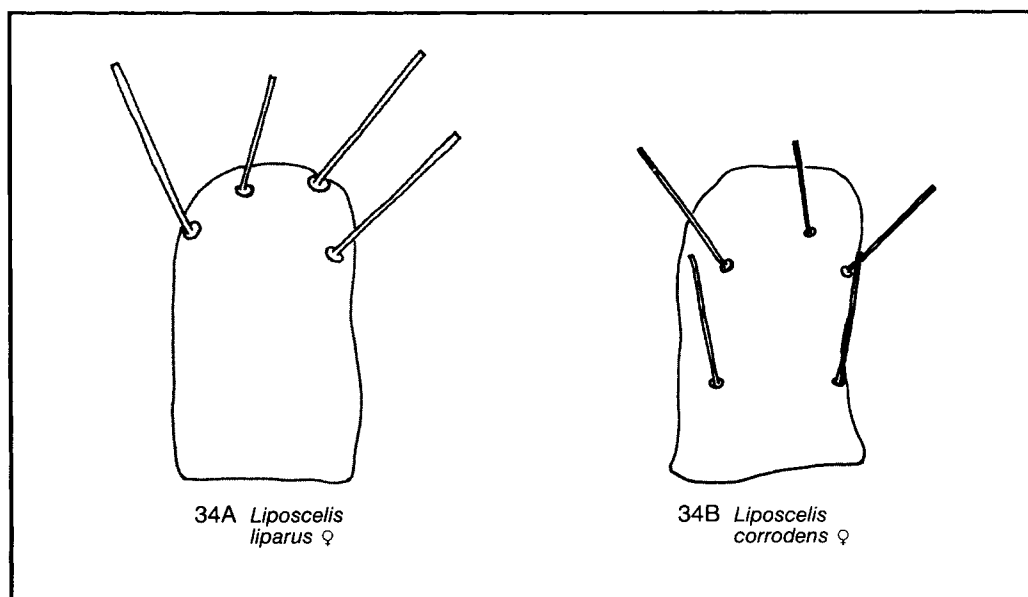
Known from houses and bird nests in central Europe, England, and the United States; frequently found in stored grain. See 31B. References: 6, 9, 11.

- Anterior margins of abdominal terga V-VIII with prominent dark, transverse, sclerotized strips (33B); body color ochre yellow-----*Liposcelis decolor*

Probably cosmopolitan; occurs in houses and in stored agricultural products in Europe and, less commonly, in the United States. See also 30C. References: 2, 4, 6, 11 (= *L. terricolis*).



- 34 Prosternal setae all in anterior half of prosternum (34A)----- 35  
 Prosternal setae distributed in both anterior and posterior half of prosternum (34B) 40



- 35 Compound eye of female with 7 facets ----- 36  
 Compound eye of female with fewer than 7 facets----- 38

- 36 Lateral lobe of pronotum with transverse row of 4 to 6 long bristles in addition to shorter setae (as in 27A) ----- *Liposcelis pubescens*

Collected from a granary and other buildings in England; also known from central Europe, Argentina, Tristan da Cunha, and New Zealand. References: 6, 9.

- Lateral lobe of pronotum with 1 long bristle (humeral seta) and several shorter setae (as in 27B)----- 37

- 37 Body length of female less than 1 mm; body color a pale reddish-brown ----- *Liposcelis exiguus varians*

Reported once from stored peanuts in Zaire. References: 4, 5.

- Body length of female 1.2 to 1.4 mm; body color a pale chamois-brown ----- *Liposcelis mendax*

Occurs in houses in Europe and in stored foods in Zaire. References: 5, 6, 9.

38 Compound eye of female with 5 facets -----*Liposcelis mendax*

See also couplet 37.

Compound eye of female with fewer than 5 facets----- 39

39 Compound eye of female with 4 facets -----*Liposcelis obscurus*

Collected from wheat caked in the hold of a ship in Bristol, England. References: 9, 15.

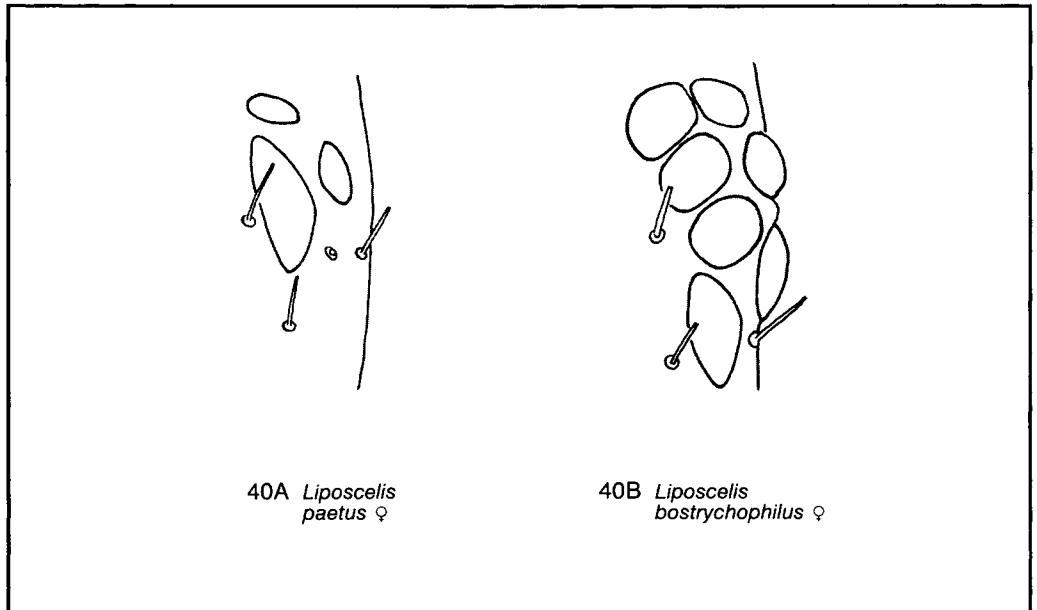
Compound eye of female with 2 facets-----*Liposcelis paetulus*

From a building in England. References: 5, 6, 9.

40 Compound eye of female with 3 facets (40A)-----*Liposcelis paetus*

Cosmopolitan; common in stored grain. References: 5, 6, 9, 21.

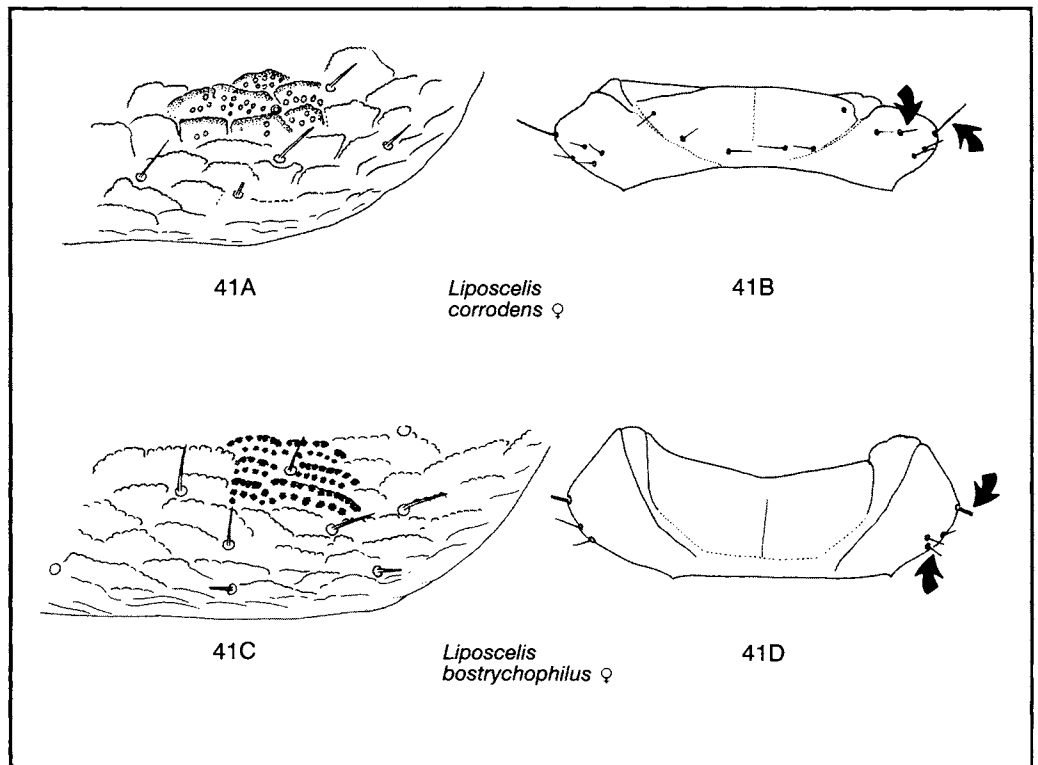
Compound eye of female with 5 to 7 facets (40B)----- 41



- 41 Sculpture of vertex and abdominal terga consisting of areoles that are separated by depressed lines and are tuberculate except near their borders (41A; details shown only in selected areoles); lateral lobe of pronotum with humeral seta about 3 times longer than other setae (41B) -----*Liposcelis corrodens*

Known from Europe, North America, Japan, and Chile;  
occurs frequently in stored foods. See also 25D.  
References: 9.

- Sculpture of vertex and abdominal terga consisting of densely tuberculate areoles that are separated by bare spaces and (or) by lines of relatively more pronounced tubercles (41C); humeral seta no more than twice as long as other setae on pronotal lobe (41D) ----- 42

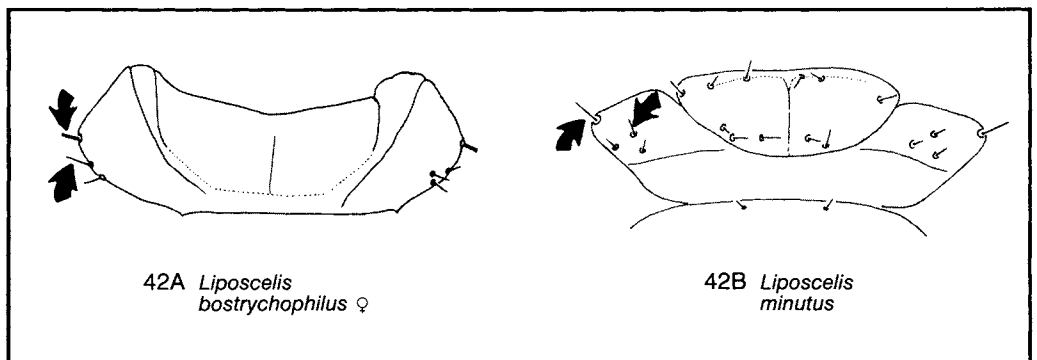


42 Humeral seta about same length as other setae on lateral lobe of pronotum (42A); compound eye of female usually with 7 facets-----*Liposcelis bostrychophilus*

Cosmopolitan; common in stored grain. See also 1B, 21C, 21D, 40B, 41C. References: 2, 4-6, 9, 13.

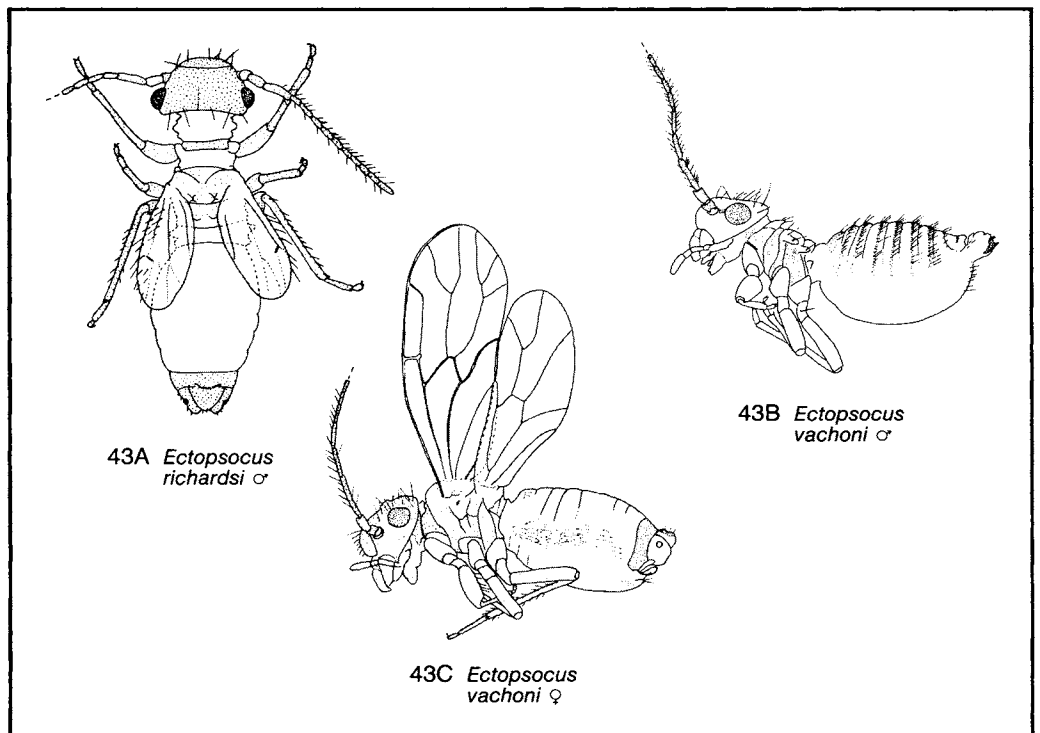
Humeral seta about twice length of other setae on lateral lobe of pronotum (42B); compound eye of female usually with 5 facets-----*Liposcelis minutus*

Found in stored food in Zaire.  
Drawing adapted from 5 by C. Feller.



**Suborder Psocomorpha**

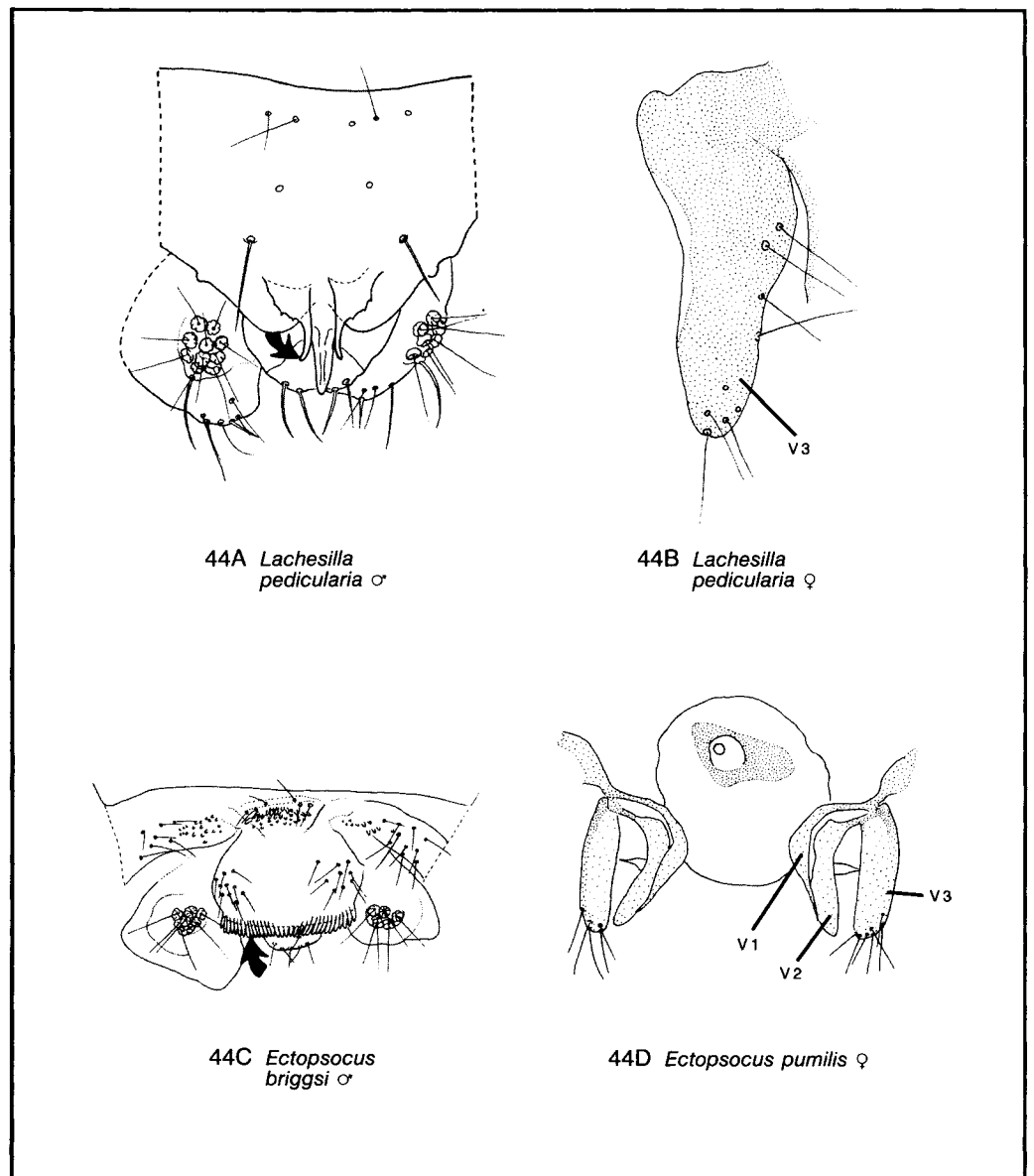
43 Individuals brachypterous (43A) (wings not extending beyond midpoint of abdomen) or micropterous (43B)----- 44  
Individuals macropterous (43C) (wings reaching or extending beyond apex of abdomen)----- 45



- 44 Clunium of male with posterodorsal margin bearing a pair of pointed processes (44A); gonapophysis of female a single valvula (44B). Lachesillidae (in part)  
 -----cosmopolitan grain psocid, *Lachesilla pedicularia*

Distributed throughout Europe and North America, primarily in outdoor situations but also common in houses and occasional in stored grain. See also 47A.  
 References: 7, 9, 10, 30.

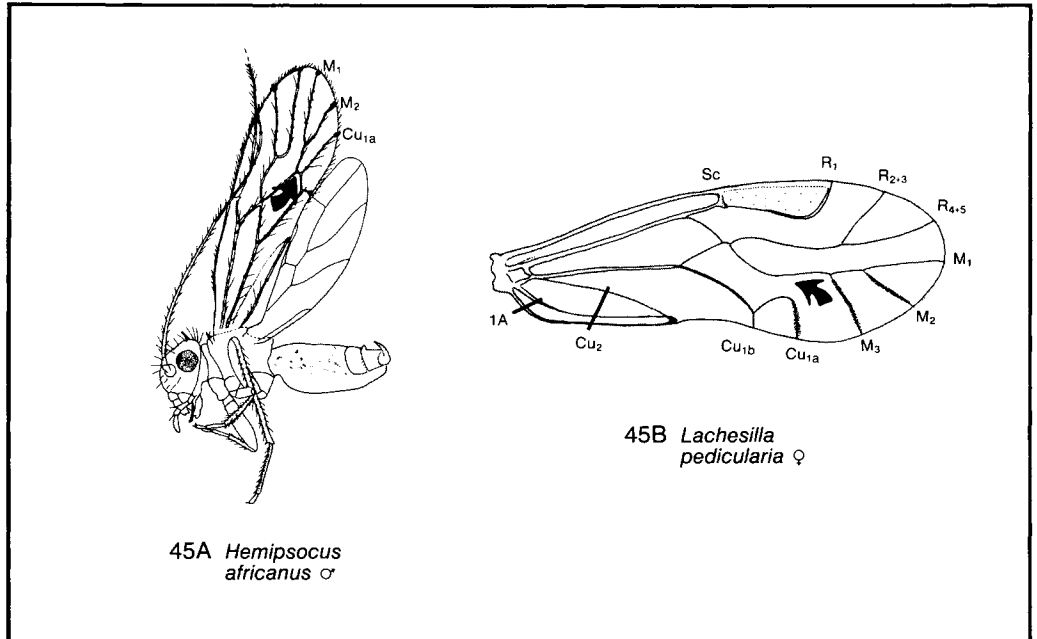
- Clunium of male with a transverse comb of small teeth on posterodorsal margin (44C); gonapophysis of female composed of 3 valvulae (44D). Ectopsocidae (in part) ----- 50



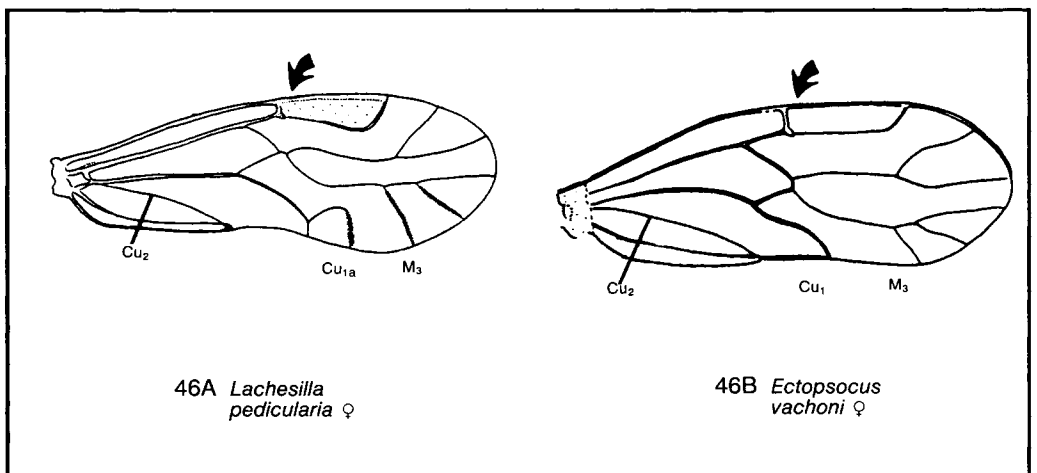
- 45  $Cu_{1a}$  and M of forewing joined by crossvein; M of forewing 2-branched (45A). Hemipsocidae ----- *Hemipsocus africanus*

Collected from Mexican pineapples and papayas at United States ports. Reference: 4.

- $Cu_{1a}$  of forewing either absent or not joined to M; M 3-branched (45B) ----- 46



- 46  $Cu_{1a}$  present in forewing; pterostigma with basal constriction (46A). Lachesillidae (in part) ----- 47
- $Cu_{1a}$  absent in forewing; pterostigma about as wide at its base as at its middle (46B). Ectopsocidae (in part) ----- 49

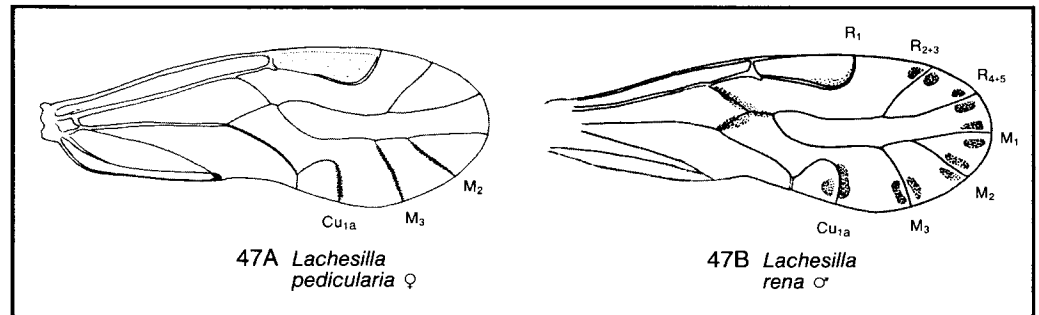




47 Forewing completely clear, without spots, but with  $Cu_{1a}$ ,  $M_2$ , and  $M_3$  narrowly brown-bordered (47A)-----**cosmopolitan grain psocid**, *Lachesilla pedicularia*

See couplet 44.

Forewing with a cloudy brown spot around distal end of each radial and medial vein and around  $Cu_{1a}$  (47B)----- 48

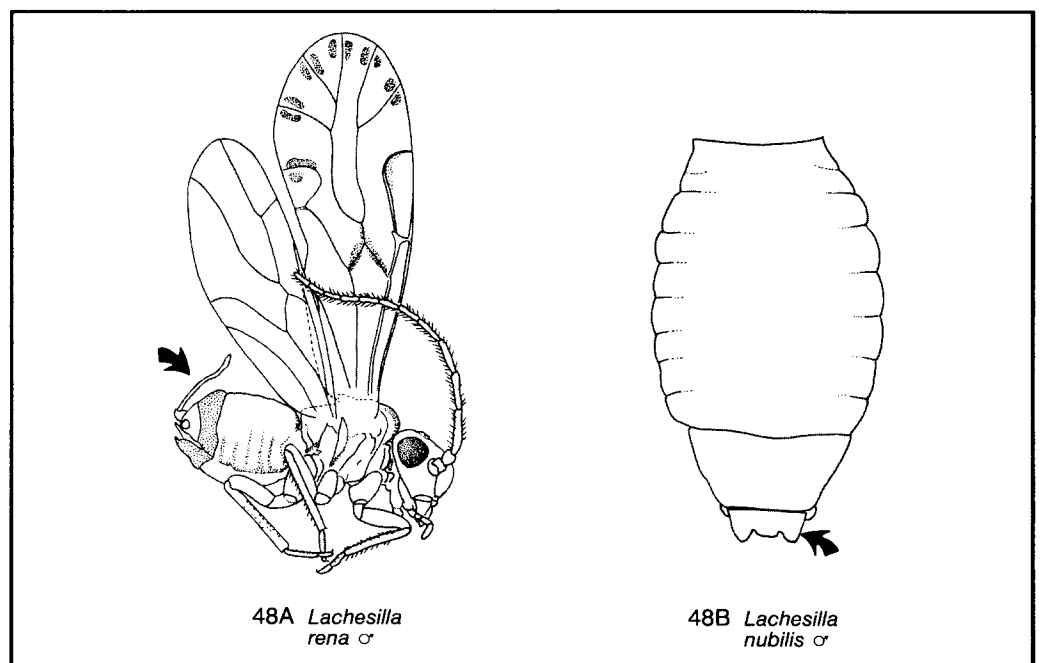


48 Forewing 1.5 to 1.7 mm in length; epiproct of male with an elongate, slender, medial process directed anteriorly on dorsal surface of abdomen (48A)----- *Lachesilla rena*

Found once on peas in pods in storage; common on dried soybean plants in fields of western Mexico. Reference: 30.

Forewing 2.1 to 2.5 mm in length; epiproct with 2 short lateral processes but no medial process (48B)-----*Lachesilla nubilis*

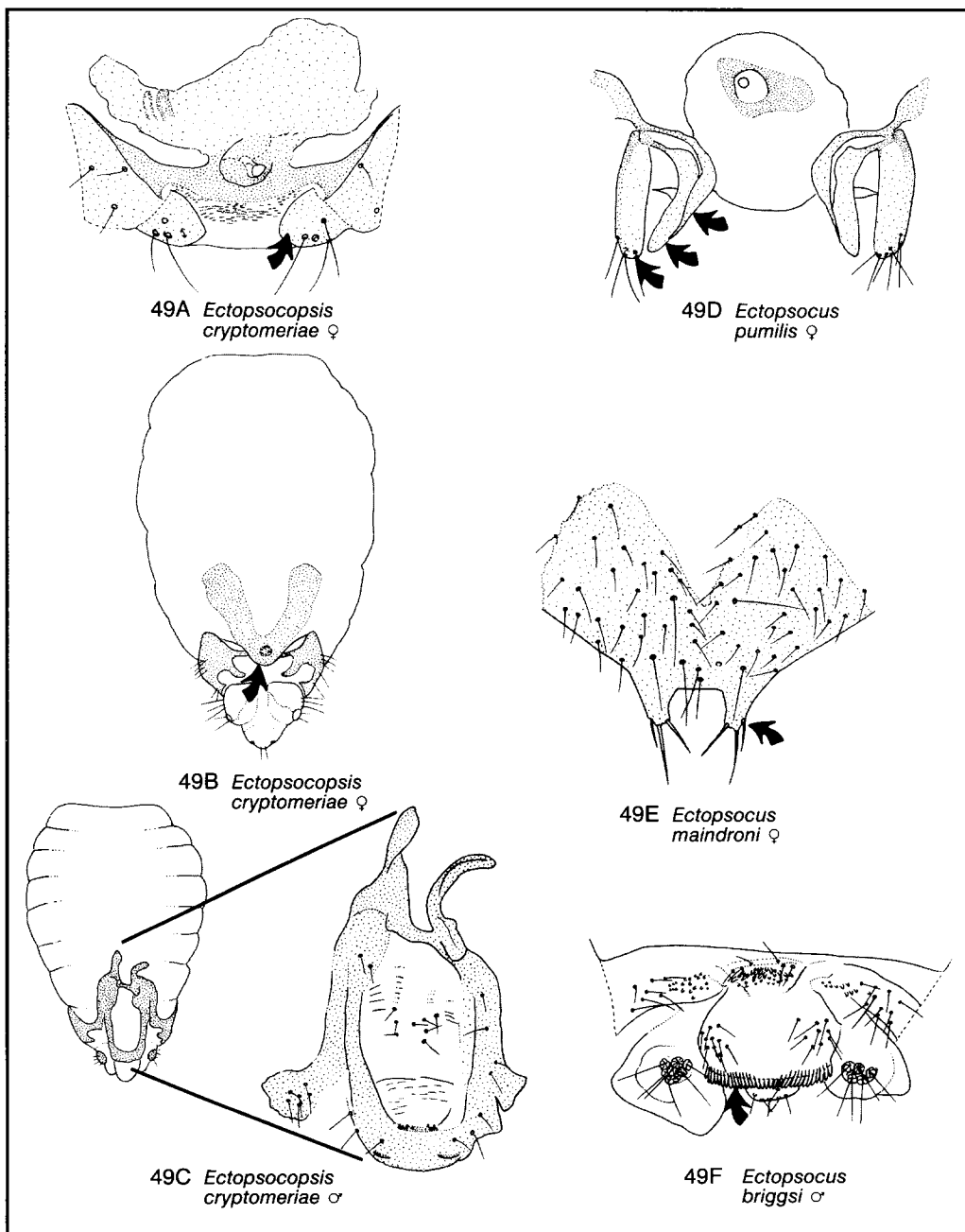
Widespread in North America, mostly in outdoor situations but also from stored grain. Reference: 30.



49 Gonapophyses of female reduced to a rudimentary third valvula (49A); subgenital plate prolonged posteriorly by a medial process (49B); clunium of male with dorsal apophyses forming a complex clasping organ (49C) -----*Ectopsocopsis cryptomeriae*

Nearly cosmopolitan; common in stored foods.  
Reference: 13.

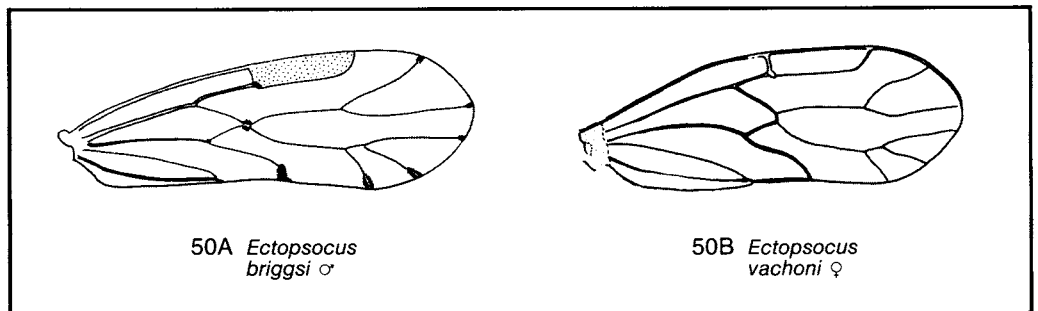
Gonapophyses complete with 3 valvulae (49D); subgenital plate usually bilobed medially (49E); clunium of male carrying dorsally only a transverse comb (49F).  
Genus *Ectopsocus* -----



50 Individuals macropterous; forewings with faint pattern of spots, 1 on end of each longitudinal vein and 1 at junction of Rs and M (50A)-----*Ectopsocus briggsi*

Present on most continents; occasionally found in houses along the Pacific coast of the United States; occasionally collected from imported herbs, citrus, and other fruits at United States ports. See also 44C. References: 9, 27.

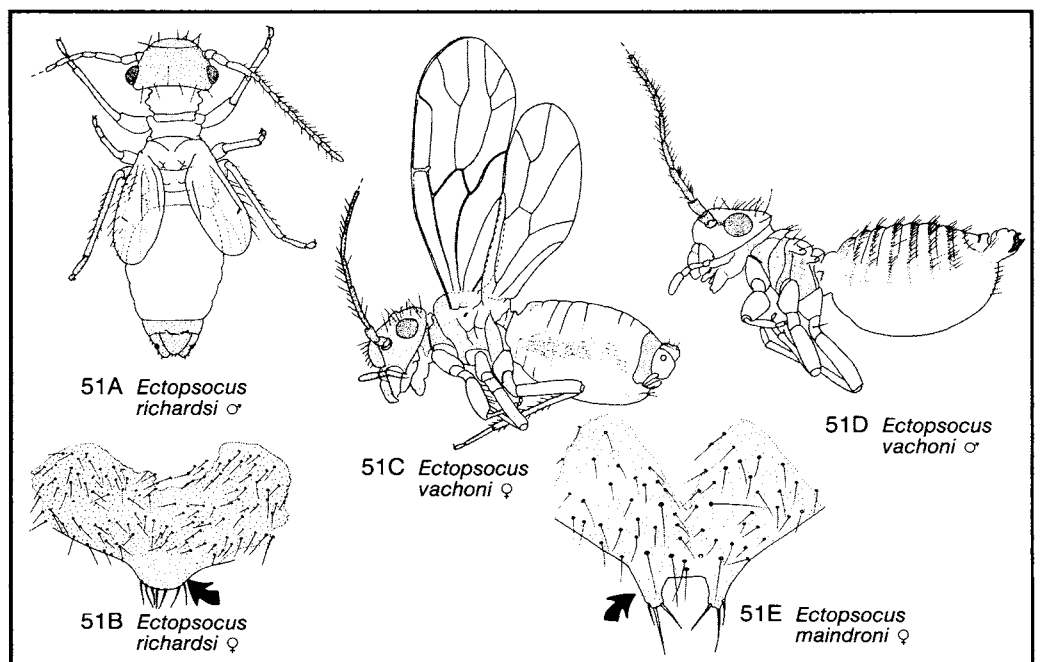
Individuals macropterous or short-winged; no spotted pattern on forewings of macropterous individuals (50B)----- 51



51 Head color a medium brown, contrasting with a paler body; adults brachypterous (51A); subgenital plate with a single, rounded, posteromedian lobe (51B)-----*Ectopsocus richardsi*

Widespread in world trade, usually in stored grain and other dry foods. References: 5, 14, 17, 21, 29.

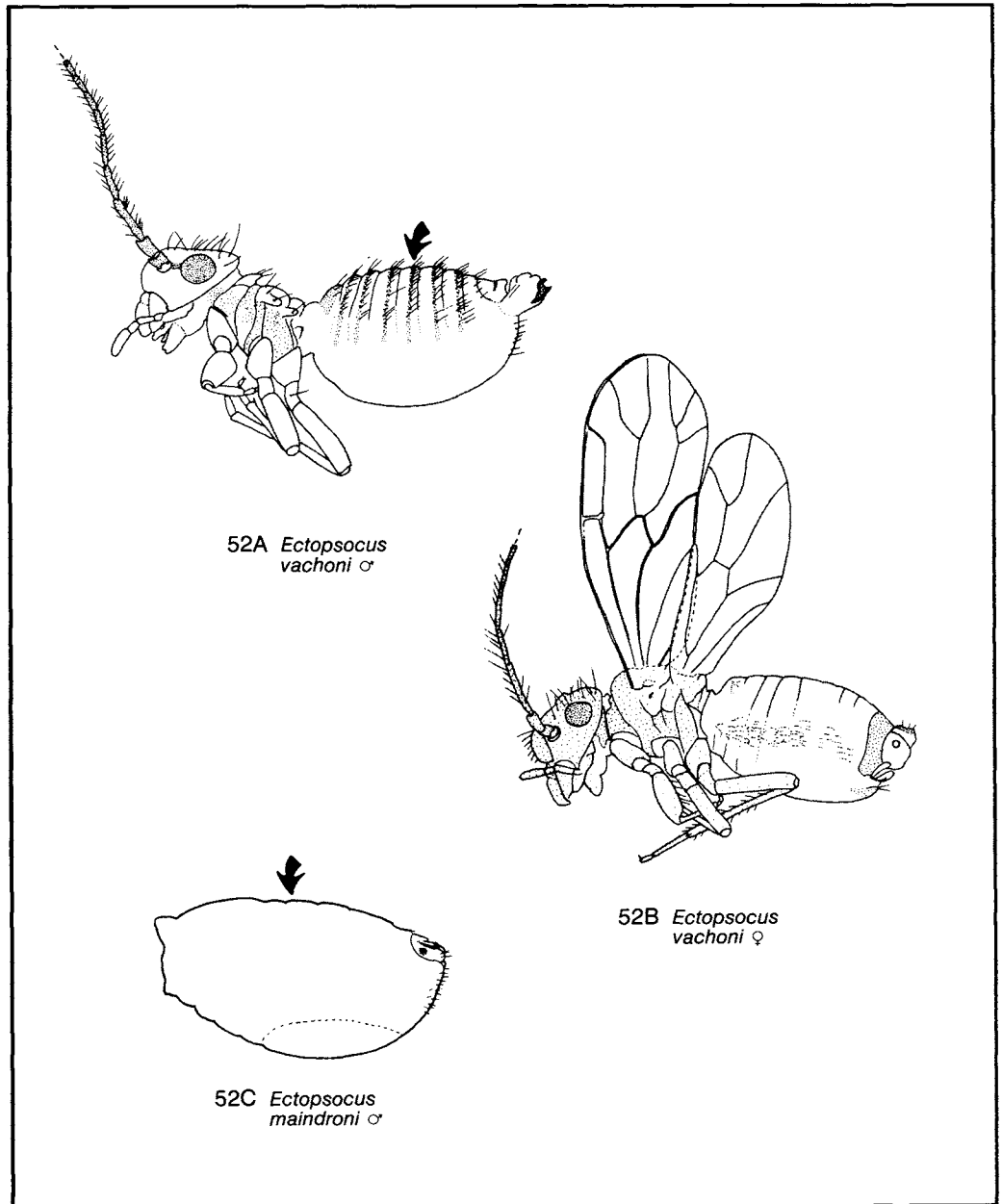
Body color approximately uniform throughout; adults macropterous (51C) or micropterous (51D); subgenital plate bilobed posteriorly (51E)----- 52



52 Males micropterous (52A); females micropterous or macropterous (52B); body color a medium reddish-brown; abdomen with reddish-brown annulations on a paler background (52A)-----*Ectopsocus vachoni*

Widely distributed in the subtropics; collected once from Mexican mixed vegetables on ice at Nogales AZ.  
References: 14. (= *E. dimorphus*).

Adults macropterous (similar to 52B); body color a creamy yellow to pale tawny; abdomen not annulated (52C)-----

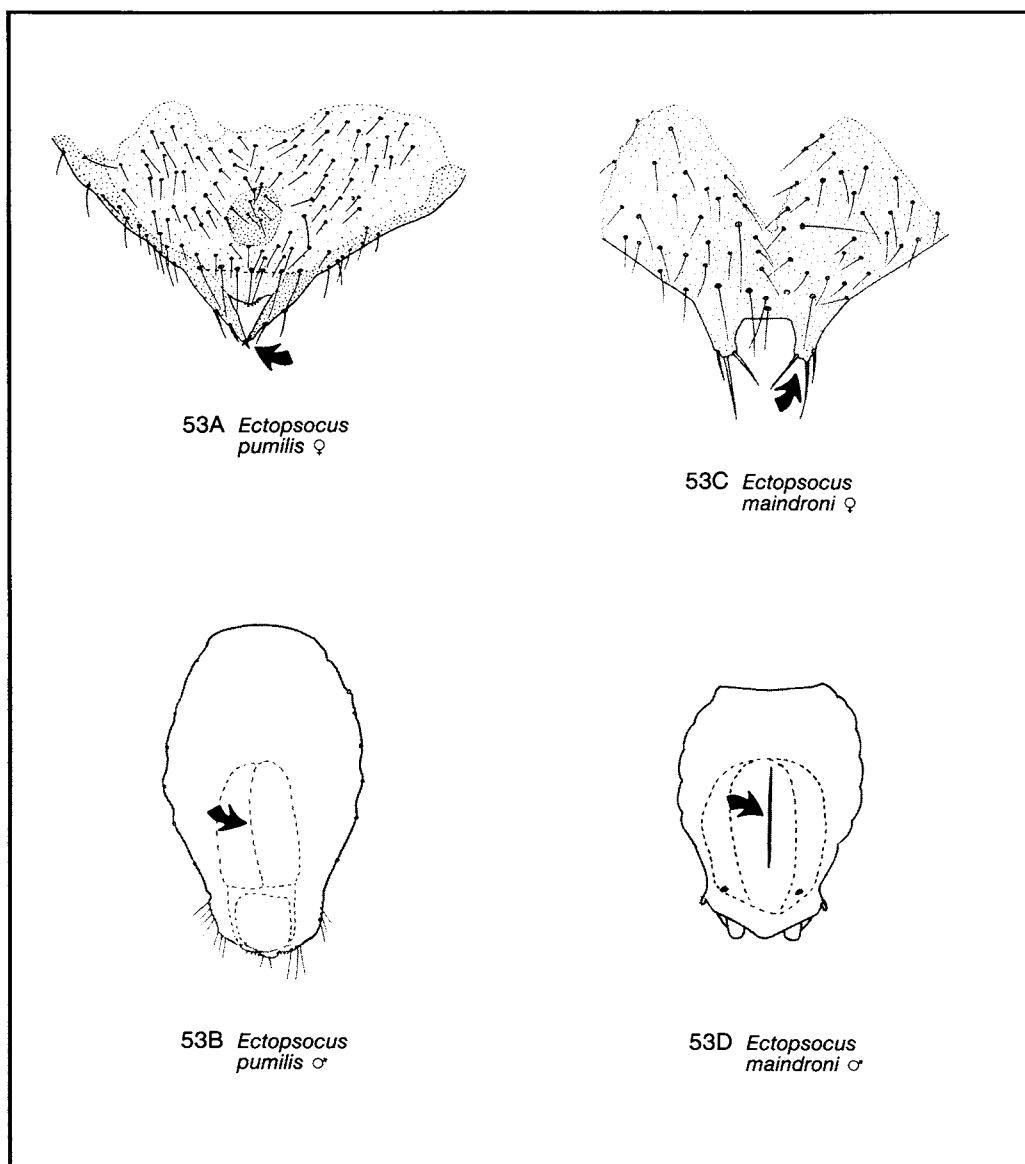


53 Lobes of subgenital plate apically pointed (53A); abdominal venter of male without a posteromedial suture (53B)-----*Ectopsocus pumilis*

Occurs in houses in Florida, the West Indies, and Hong Kong. See also 44D. Reference: 4.

Lobes of subgenital plate apically truncated (53C); abdominal venter of male with a posteromedial suture (53D)-----*Ectopsocus maindroni*

Probably circumtropical; often found around stored foods. See also 52C. Reference: 5.



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**KEY TO MACROPTEROUS  
FEMALES OF COMMON  
SPECIES**

Drawings by C.S. Papp  
unless otherwise noted.

1 With sawlike ovipositor (1A); forewing with longitudinal veins and sometimes cross veins (1B); wings covered with microsetae (1C). Suborder Terebrantia-----

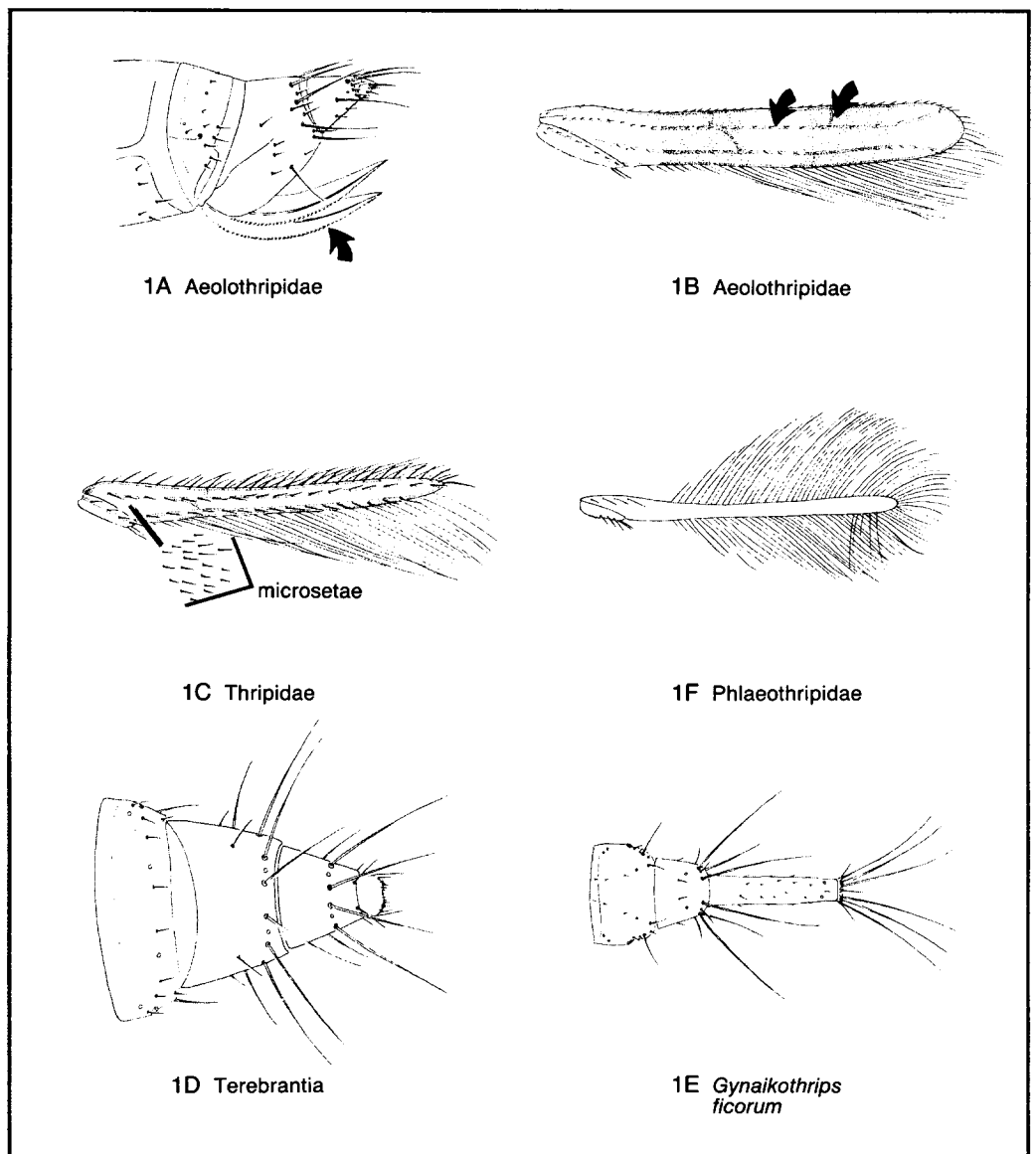
2

Last abdominal segment usually conical (1D), rarely tubular.

Without sawlike ovipositor (1E); forewing without longitudinal veins (1F); wings without microsetae. Suborder Tubulifera. Phlaeothripidae-----

18

Last abdominal segment usually tubular (1E).  
Drawing 1E by T. Kono.



The assistance of Tokuwo Kono and Steve Nakahara in the preparation of this chapter is gratefully acknowledged.



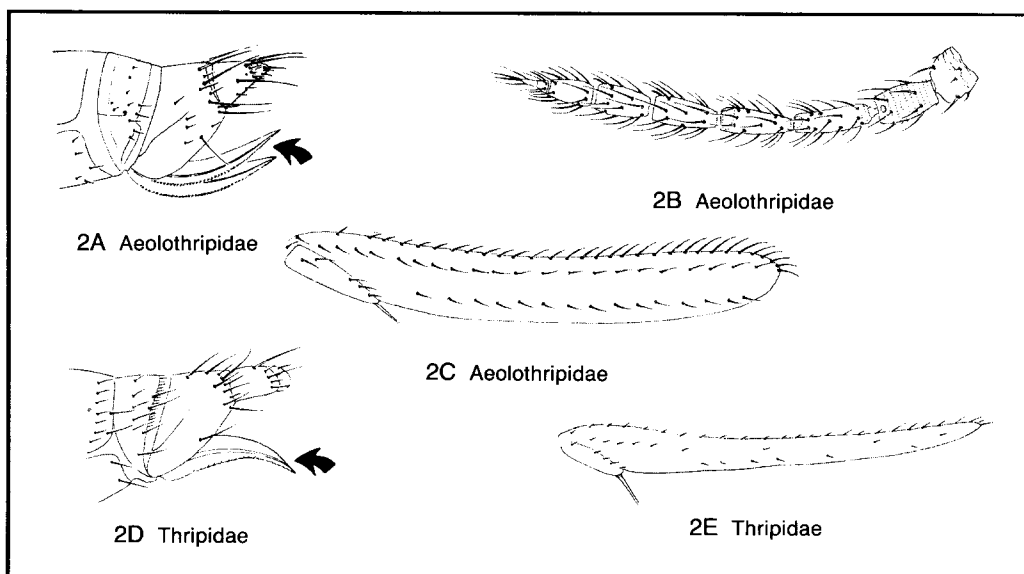
Terebrantia

2 Ovipositor upturned (2A). Aeolothripidae. Genus *Rhipidothrips*----- 3

Antenna 9-segmented (2B); wings broad, rounded at tip (2C). The lens-shaped sensoria (2B) on antennal segments III and IV separate this genus from most other members of the family.

Ovipositor downturned (2D). Thripidae ----- 4

Antenna 6- to 9-segmented; wings usually narrow, pointed at tip (2E). CAUTION: Heterothripidae also keys out at this point, but species of this family are unlikely associates of fruits and vegetables.

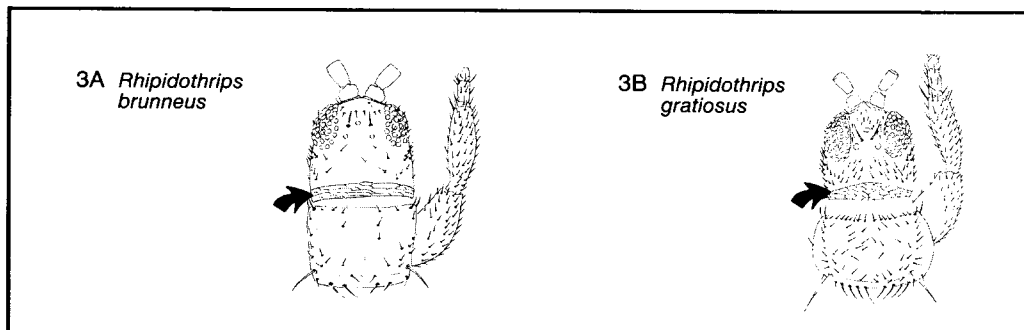


3 Antennal segment II brown; pronotum brown; head with a collar of transverse striations at the posterior margin (3A)-----*Rhipidothrips brunneus*

Distribution: England, Finland, Netherlands, USA (California, Oregon), USSR. Hosts: Grasses.

Antennal segment II yellow; pronotum white, with a small, brown, median blotch in the posterior half; dorsum of head with a collar of polygonal reticulations at the posterior margin (3B)-----*Rhipidothrips gratiosus*

Distribution: Europe, USA (California). Hosts: Oats, grasses.



4 Antenna appearing 9-segmented (due to cleavage of segment IV) (4A)

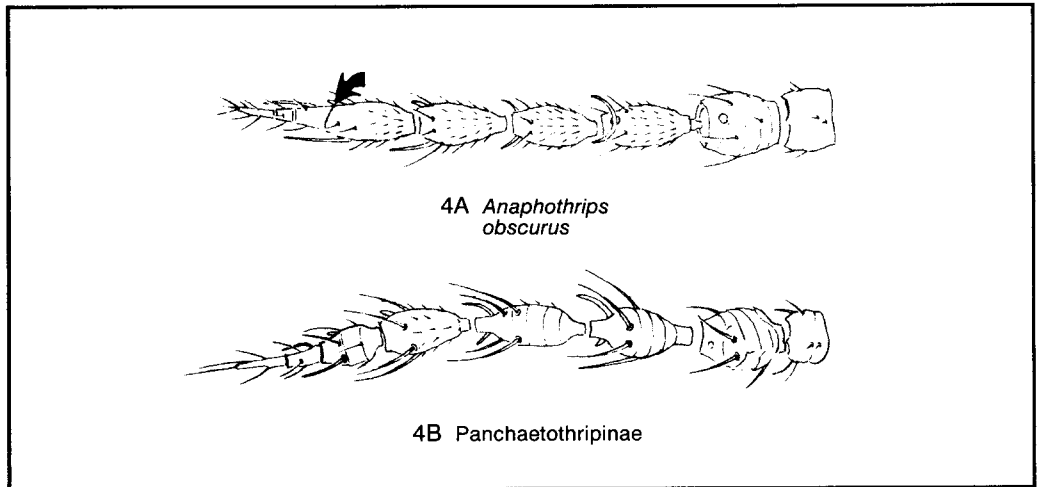
----- **grass thrips, *Anaphothrips obscurus***

Body color mainly yellow, with brown markings on base of head, thoracic dorsum, and abdominal tergites.

Distribution: Australia, Europe, North America. Hosts: Cereals, grasses, and various other plants.

Antenna 7- or 8-segmented (4B)-----

5



5 Antenna 7-segmented (5A). Genus *Thrips* (in part)-----

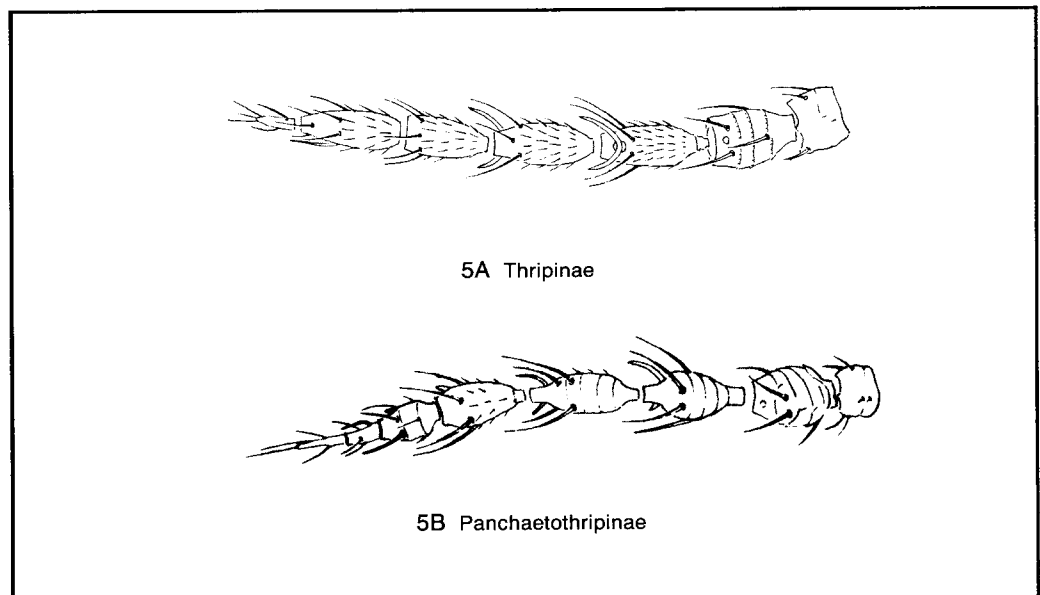
6

Pronotum with 2 pairs of long posteroangular setae.

Antenna 8-segmented (5B)-----

7

Pronotum with or without long posteroangular setae.

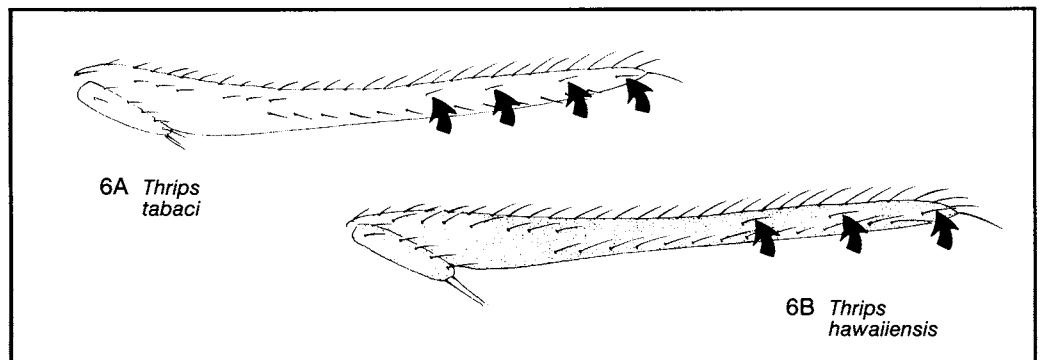


6 Forewing clear; anterior vein with 4 to 6 distal setae (6A); ocellar pigment gray; accessory setae absent from abdominal sternites-----onion thrips, *Thrips tabaci*

Distribution: Cosmopolitan. Hosts: Onions, flowers of many kinds of wild and cultivated plants.

Forewing grayish-brown, clear at base; anterior vein with 3 distal setae (6B); ocellar pigment red; accessory setae present on abdominal sternites II to VII -----Hawaiian flower thrips, *Thrips hawaiiensis*

Distribution: Australia, Oriental Region, many Pacific islands, USA (District of Columbia, Florida, Georgia, Hawaii, South Carolina, Texas). Hosts: Flowers of numerous cultivated and wild plants.

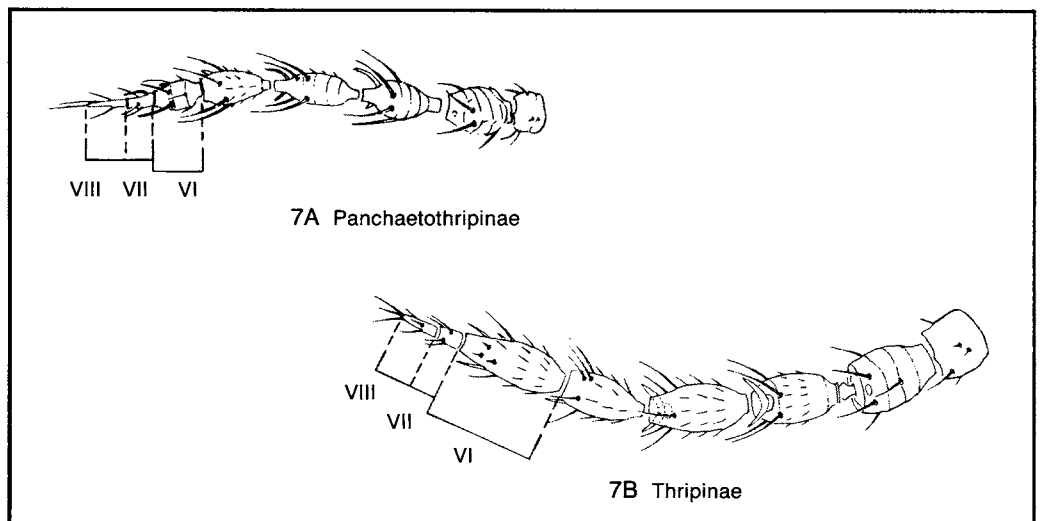


7 Antennal segment VI shorter than combined length of segments VII and VIII (7A); head conspicuously reticulated. Panchaetothripinae ----- 8

Antennal segments III and IV strongly vasiform (7A).

Antennal segment VI longer than combined lengths of segments VII and VIII (7B); head not conspicuously reticulated. Thripinae----- 11

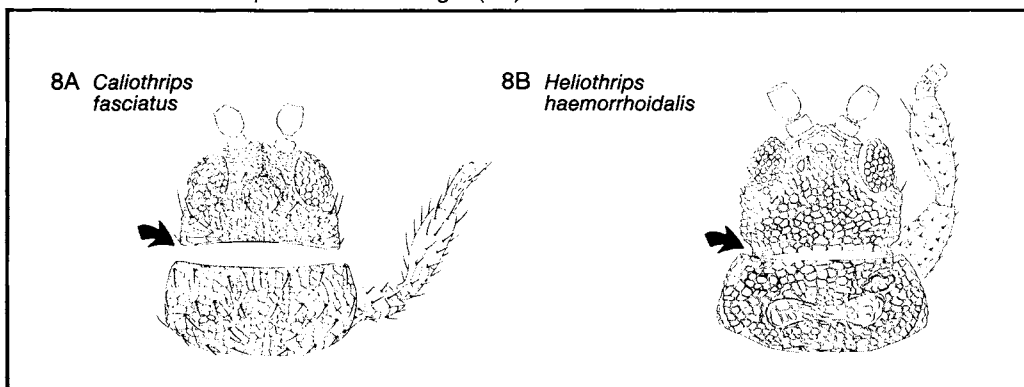
Antennal segments III and IV usually not strongly vasiform (7B).



8 Head not notched at posterolateral angle (8A)-----**bean thrips, *Caliothrips fasciatus***

Forewing banded; sides of abdominal tergites reticulated. Distribution: Mexico, USA (New York, Western States in general, including Hawaii). Hosts: Beans, lettuce, oranges; foliage of various garden vegetables; numerous nonfood plants. CAUTION: Some other species of *Caliothrips* may also key out at this point.

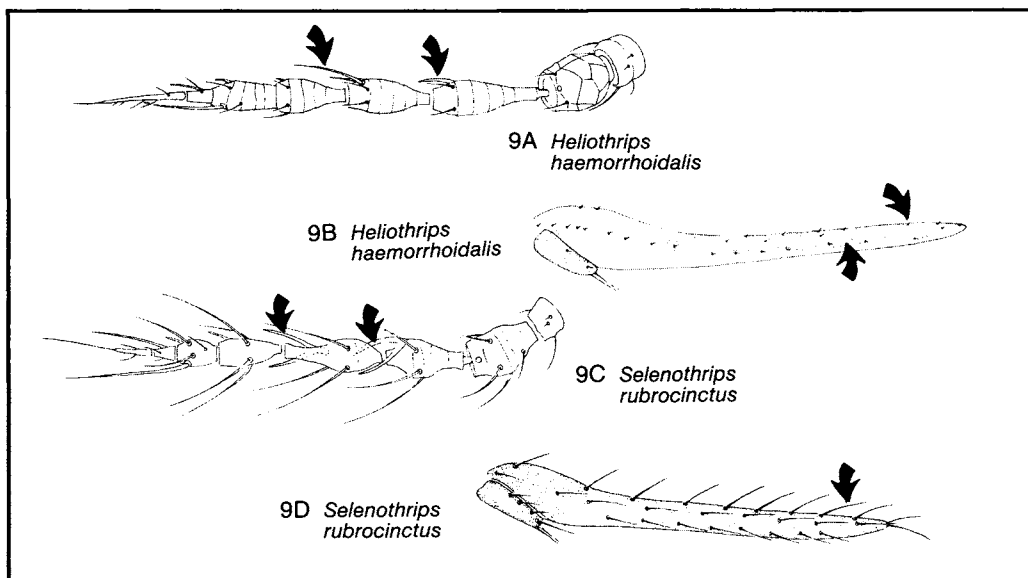
Head notched at posterolateral angle (8B)----- 9



9 Antennal segments III and IV with simple sensory trichomes (9A); wing veins with short, inconspicuous setae; forewing clear except for brown posterior vein (9B)-----**greenhouse thrips, *Heliethrips haemorrhoidalis***

Distribution: Africa, Australia, Neotropical Region, Pacific islands, USA; greenhouses in temperate regions. Hosts: Mangoes; numerous nonfood plants. See also 8B.

Antennal segments III and IV with forked sensory trichomes (9C); wing veins with long, conspicuous setae; forewing uniformly brown (9D) or brown with transverse white bands ----- 10

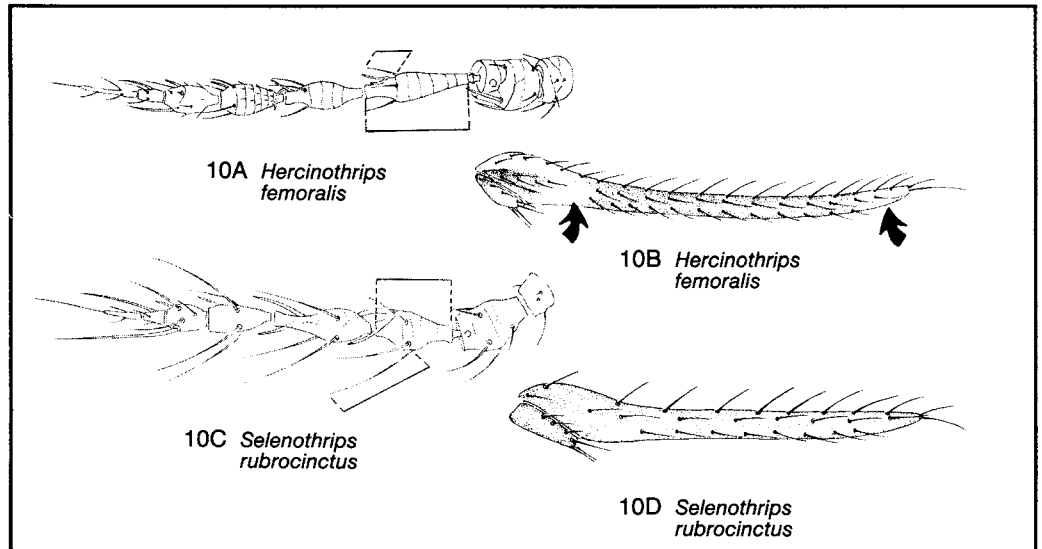


- 10 Setae on antennal segments III, IV, and V much shorter than their respective segments (10A); forewing with white and dark brown bands (10B)  
 -----banded greenhouse thrips, *Hercinothrips femoralis*

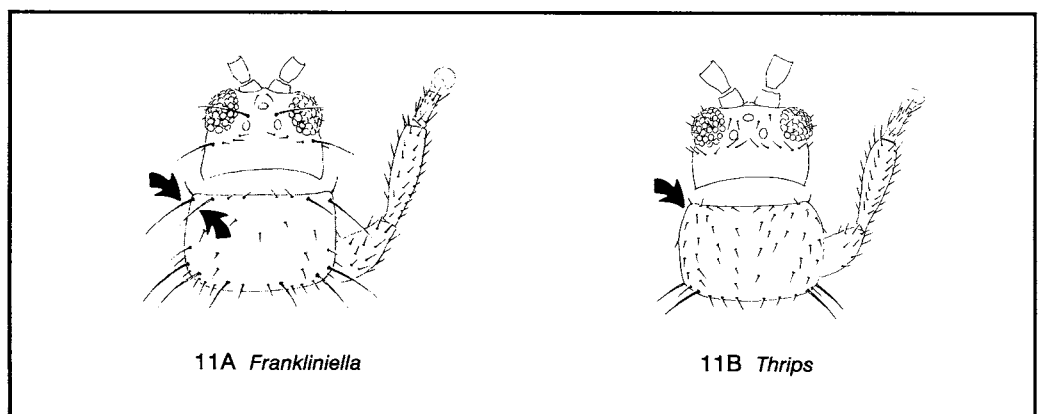
Distribution: Tropical and subtropical regions; USA (California, District of Columbia, Florida, Hawaii, Idaho, Illinois, Massachusetts, Missouri); greenhouses in temperate regions. Hosts: Sugarbeets; numerous wild and cultivated plants.

- Setae on antennal segments III, IV, and V much longer than their respective segments (10C); forewing uniformly dark brown (10D)  
 -----redbanded thrips, *Selenothrips rubrocinctus*

Distribution: Wide occurrence in tropical regions including parts of Africa, Central America, India, Philippines, South America, USA (Florida). Hosts: Mangoes; various fruit trees.



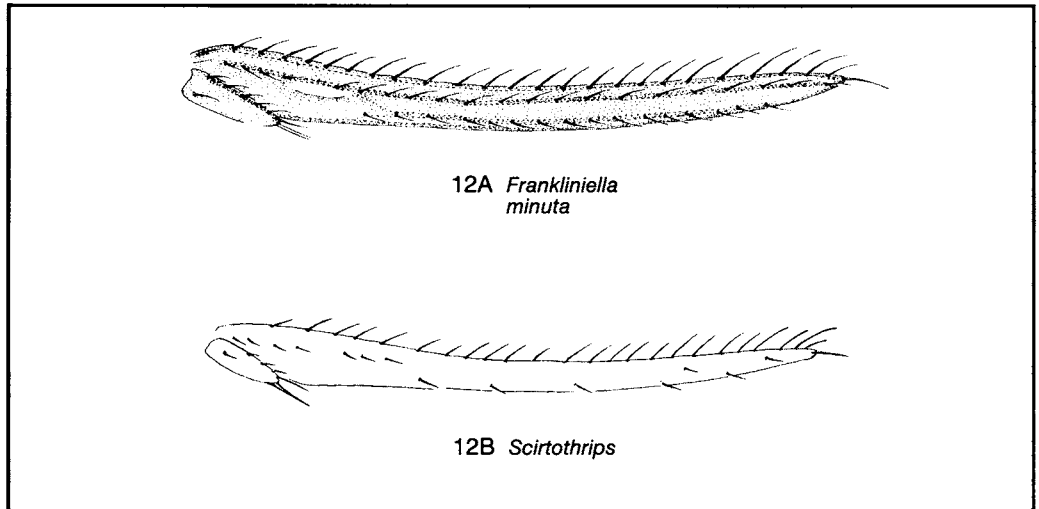
- 11 Pronotum with 1 pair of long anteroangular and 1 pair of anteromarginal setae (11A); forewing with complete row of setae on anterior vein (see 12A). Genus *Frankliniella* 12  
 Pronotum without long anteromarginal or anteroangular setae (11B); forewing with a few irregularly-spaced setae on distal half of anterior vein (see 12B)----- 13



12 Forewing uniformly dark brown (12A)-----*Frankliniella minuta*

Body dark brown; antenna completely brown, but occasionally with segment III a paler brown; pronotum with alternating short and long posteromarginal setae (see 13B). Distribution: Guatemala, Mexico, Panama, Peru, USA (Colorado, Hawaii, North Dakota, Texas, Wyoming, and several other Western States). Hosts: Flowers of numerous plants.

Forewing clear (as in 12B)-----other species of *Frankliniella*



13 Anterior margin of pronotum conspicuously narrower than posterior margin (13A).

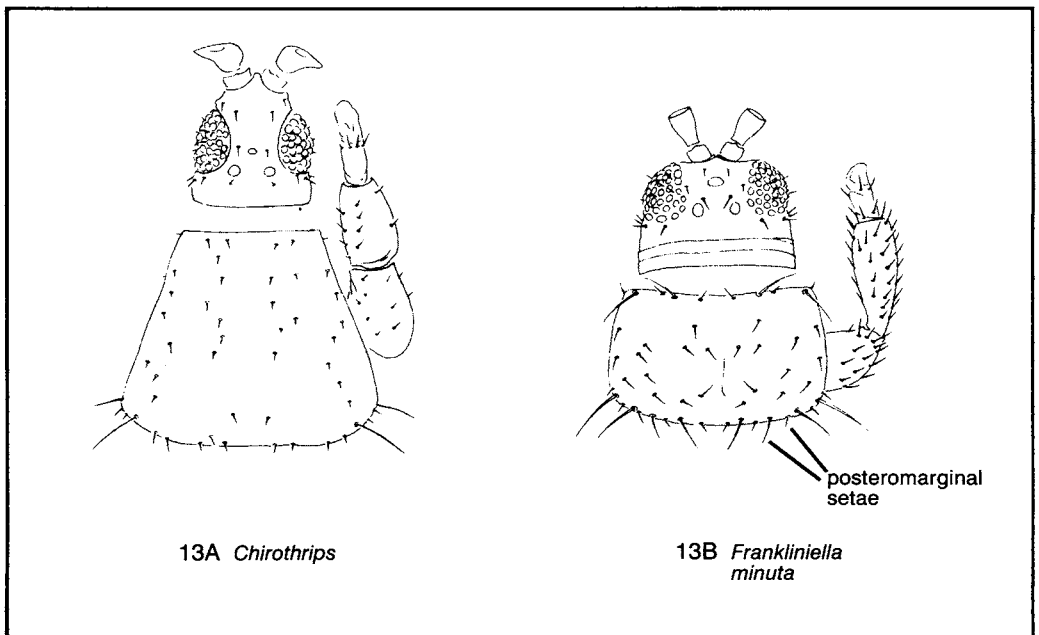
Genus *Chirothrips*-----

14

Anterior margin of pronotum equal to or slightly shorter than the posterior margin

(as in 13B)-----

15

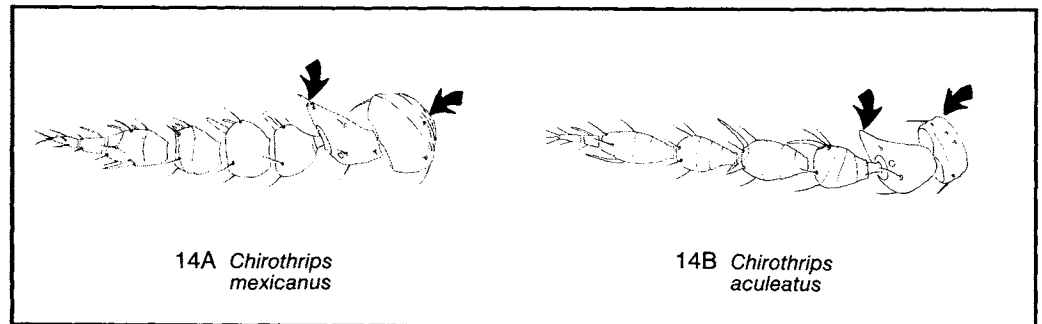


- 14 Antennal segment I large and conspicuously swollen; segment II with a short, stout seta at tip of apical projection; segment IV with a simple sensory trichome (14A); tibia I produced anteriorly on lateral apical margin-----*Chirothrips mexicanus*

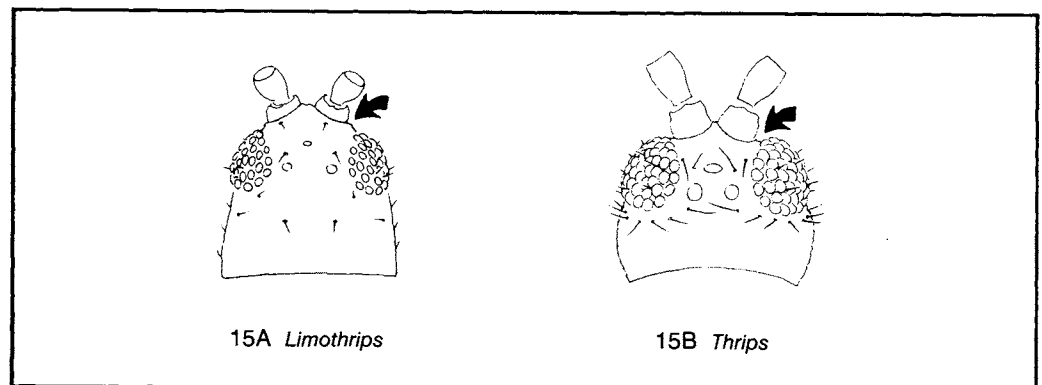
Distribution: Caribbean islands, Central and South America, Mexico, Philippines, South Africa, USA (Arizona, California, Florida, Georgia, Hawaii, Louisiana, Oklahoma, Tennessee, Texas). Hosts: Various grasses and other plants.

- Antennal segment I not large and conspicuously swollen; segment II without a seta at tip of apical projection; segment IV with a forked sensory trichome (14B); tibia I not produced on lateral apical margin-----*Chirothrips aculeatus*

Distribution: Central and southern Europe, England, USA (Pacific Coast). Hosts: Grasses.



- 15 Head produced in front of eyes (15A); abdominal tergite X bearing a pair of stout, spinelike setae. Genus *Limothrips*----- 16  
 Head not produced in front of eyes (15B); abdominal tergite X without spinelike setae 17

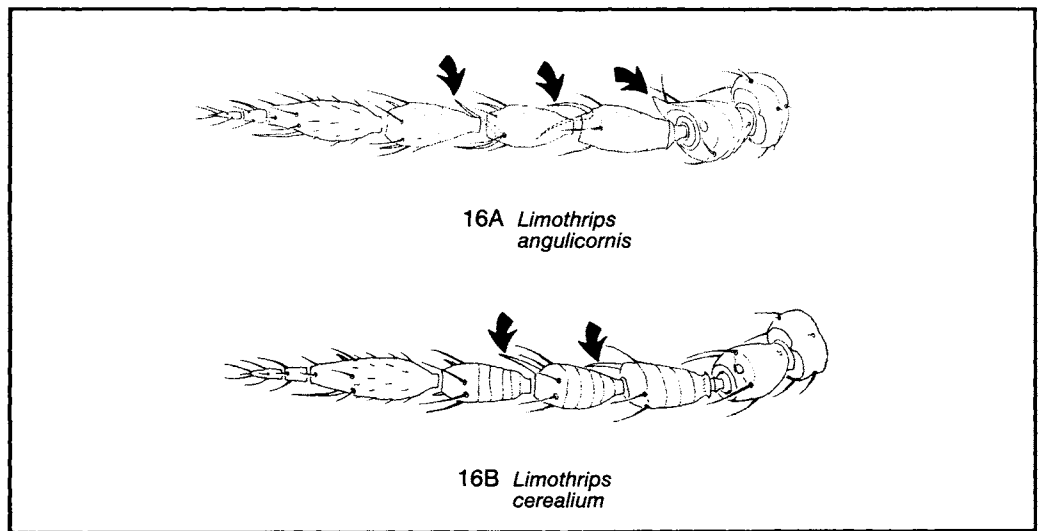


- 16 Antennal segment II with apical projection; antennal segments III and IV with forked sensory trichomes (16A)-----*Limothrips angulicornis*

Distribution: Australia, Chile, central and southern Europe, USA (California). Hosts: Grasses and various other plants.

- Antennal segment II barrel-shaped; antennal segments III and IV with simple sensory trichomes (16B)-----**grain thrips, *Limothrips cerealium***

Distribution: Europe, USA, and many other regions of the world. Hosts: Grasses, including oats and other cereals.



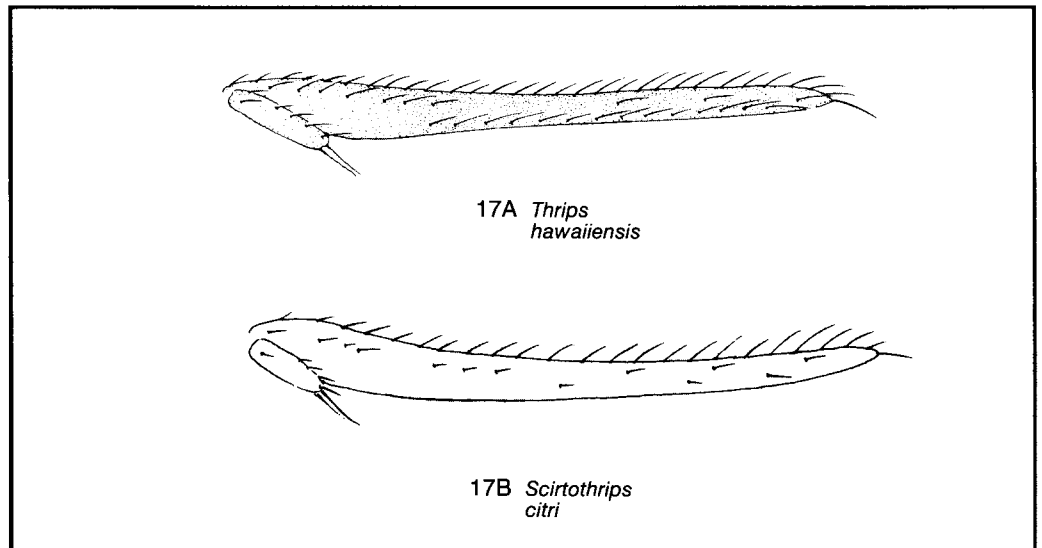
- 17 Forewing grayish-brown, clear at base, with setae in a complete row on posterior vein (17A); abdomen brown, without microsetae; abdominal sternites II to VII with accessory setae; head and thorax yellowish-orange to orange-brown. Genus *Thrips* (in part)-----**Hawaiian flower thrips, *Thrips hawaiiensis***

See couplet 6.

- Forewing clear, with orange veins and with 3 irregularly-spaced setae on posterior vein (17B); abdomen with numerous microsetae; abdominal sternites II to VII without accessory setae; body yellowish-brown-----**citrus thrips, *Scirtothrips citri***

Distribution: USA (Arizona, California). Hosts: Fruits and foliage of orange trees; various nonfood plants. CAUTION: *Sericothrips* also has numerous abdominal microsetae, but there is a complete row of setae on the anterior vein of the forewing. Members of the genus *Sericothrips* are widely distributed in most parts of the world; they feed on grasses, legumes, and many other plants including cucumbers.





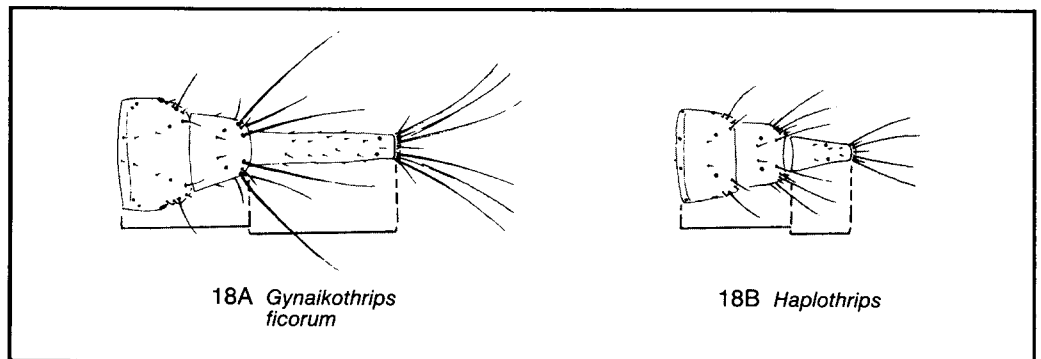
**Tubulifera**

- 18 Antennal segments III to VIII yellow, with VII and VIII shaded brown; forewing parallel-sided; terminal abdominal segment much longer than combined length of preceding 2 segments (18A)----- **Cuban laurel thrips, *Gynaikothrips ficorum***

Distribution: Many tropical countries; occasionally introduced to colder regions. Hosts: Feeds and causes leaf galls on *Ficus* spp.; also found occasionally on some other plants.

Antenna brown with segment III and basal parts of IV and V yellow, or III to VI yellow with apices of V and VI brown; forewing narrowed medially; terminal abdominal segment much shorter than combined length of preceding 2 segments (18B). Genus *Haplothrips*-----

19

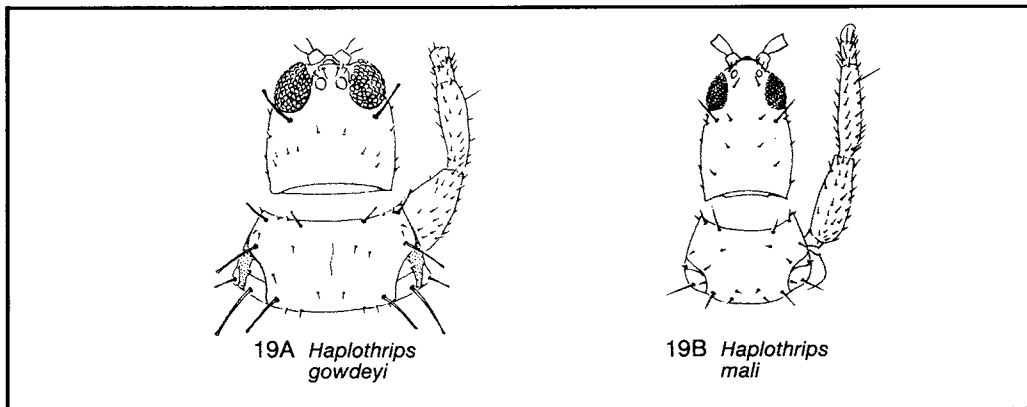


- 19 Head about as long as wide; pronotum with well-developed major lateral setae (19A); internal pigmentation red; antennal segments III and IV and basal parts of V and VI yellow----- **black flower thrips, *Haplothrips gowdeyi***

Distribution: Africa, Caribbean islands, Central and South America, India, Israel, Mexico, Pacific islands, USA (California, Florida, Georgia, Hawaii, Texas).  
Hosts: Flowers of numerous cultivated and wild plants.

- Head much longer than wide; pronotum with minute major lateral setae (19B); internal pigmentation purple; antennal segments III and basal parts of IV and V yellow----- **black hunter thrips, *Haplothrips mali***

Distribution: Canada, Mexico, USA. Feeding habits: Predaceous on eggs and immature stages of other insects.



**Manya B. Stoetzel**

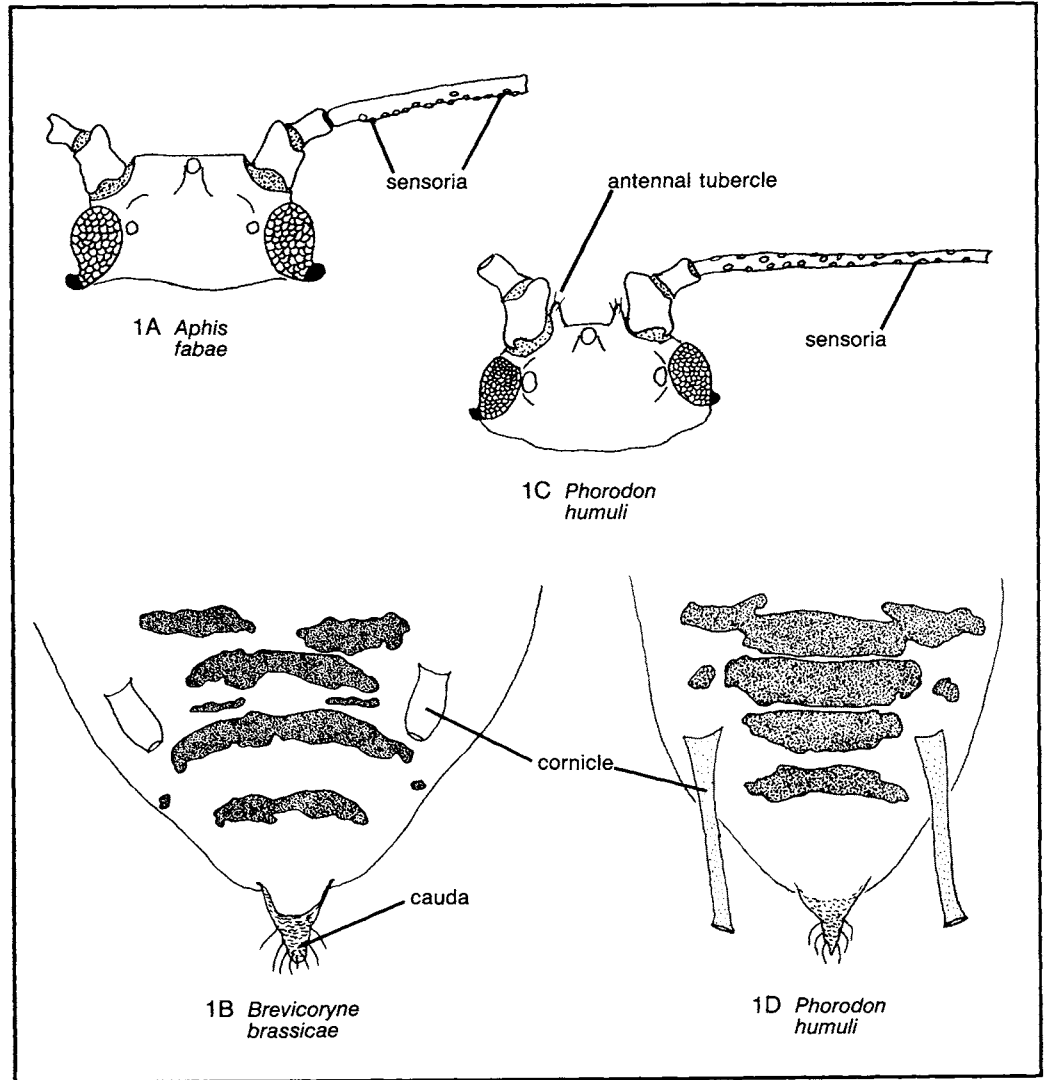
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Plant Sciences Institute  
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Beltsville MD 20705

**KEY**

Drawings by M.B. Stoetzel.

- 1 Head without prominent antennal tubercles (1A); cornicle never longer than 3 times length of hind tarsus (1B)----- 2  
 Head with prominent antennal tubercles (1C); cornicle 3 times or more longer than length of hind tarsus (1D)----- 3



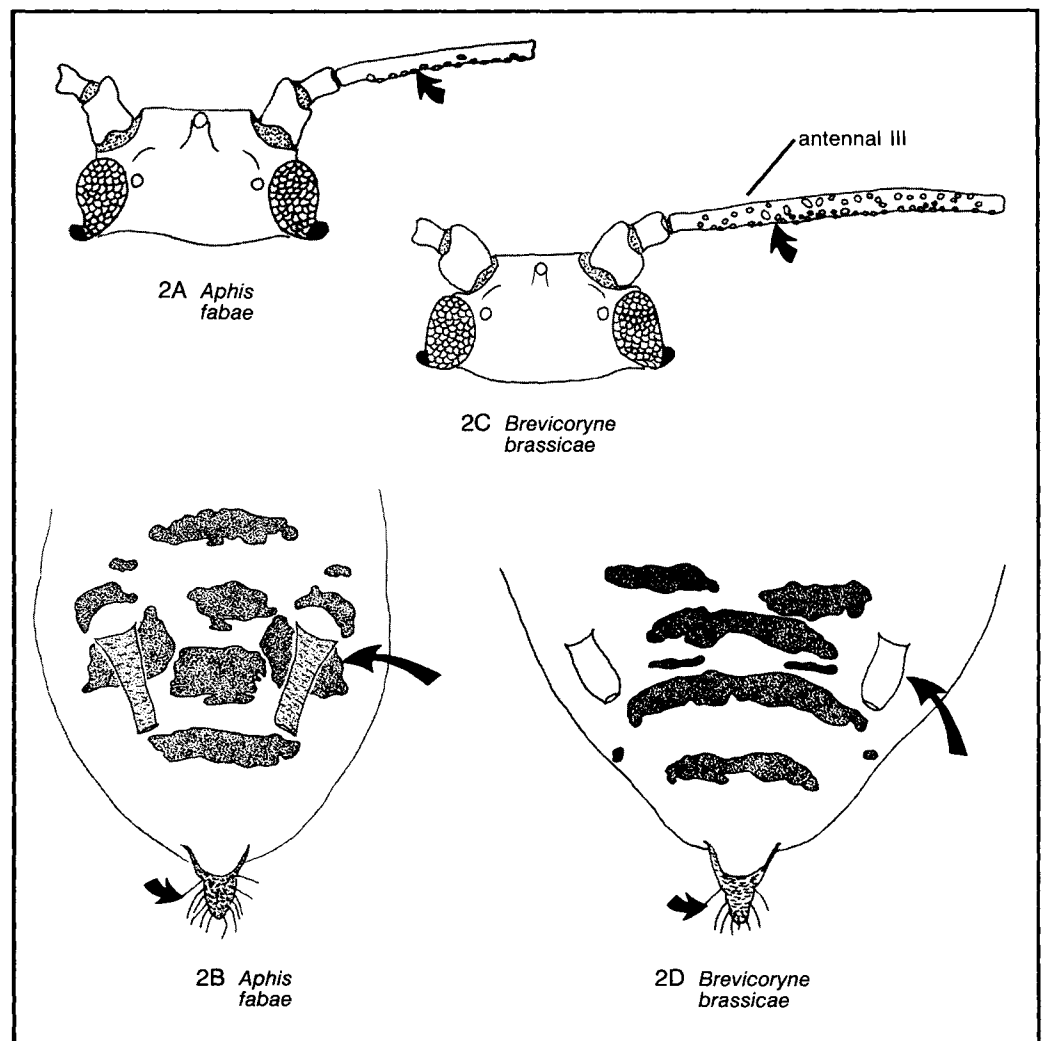
2 Alata with 12 to 18 sensoria on antennal III (2A); cornicle cylindrical, longer than cauda; cauda bushy with 12 to 14 hairs; abdomen of alata with 4 rows of dark spots and a dark area behind base of each cornicle (2B)-----**bean aphid, *Aphis fabae***

Distribution: Holarctic, Ethiopian. Hosts: Leaves and stems of *Euonymus* and *Viburnum* as winter hosts, and on various plants (beans, beets, carrots, corn, lettuce, rhubarb, squash) as summer hosts. References: 1, 2, 4-6.

Alata with 43 to 67 sensoria on antennal III (2C); cornicle swollen, not longer than cauda; cauda tapering, with 6 hairs; abdomen of alata with broken, dusky dashes but no dark area behind base of each cornicle (2D)

-----**cabbage aphid, *Brevicoryne brassicae***

Distribution: Worldwide. Hosts: Broccoli, brussels sprouts, cabbage, carrots, cauliflower, celery, kale, mustard, radishes. References: 1-7.



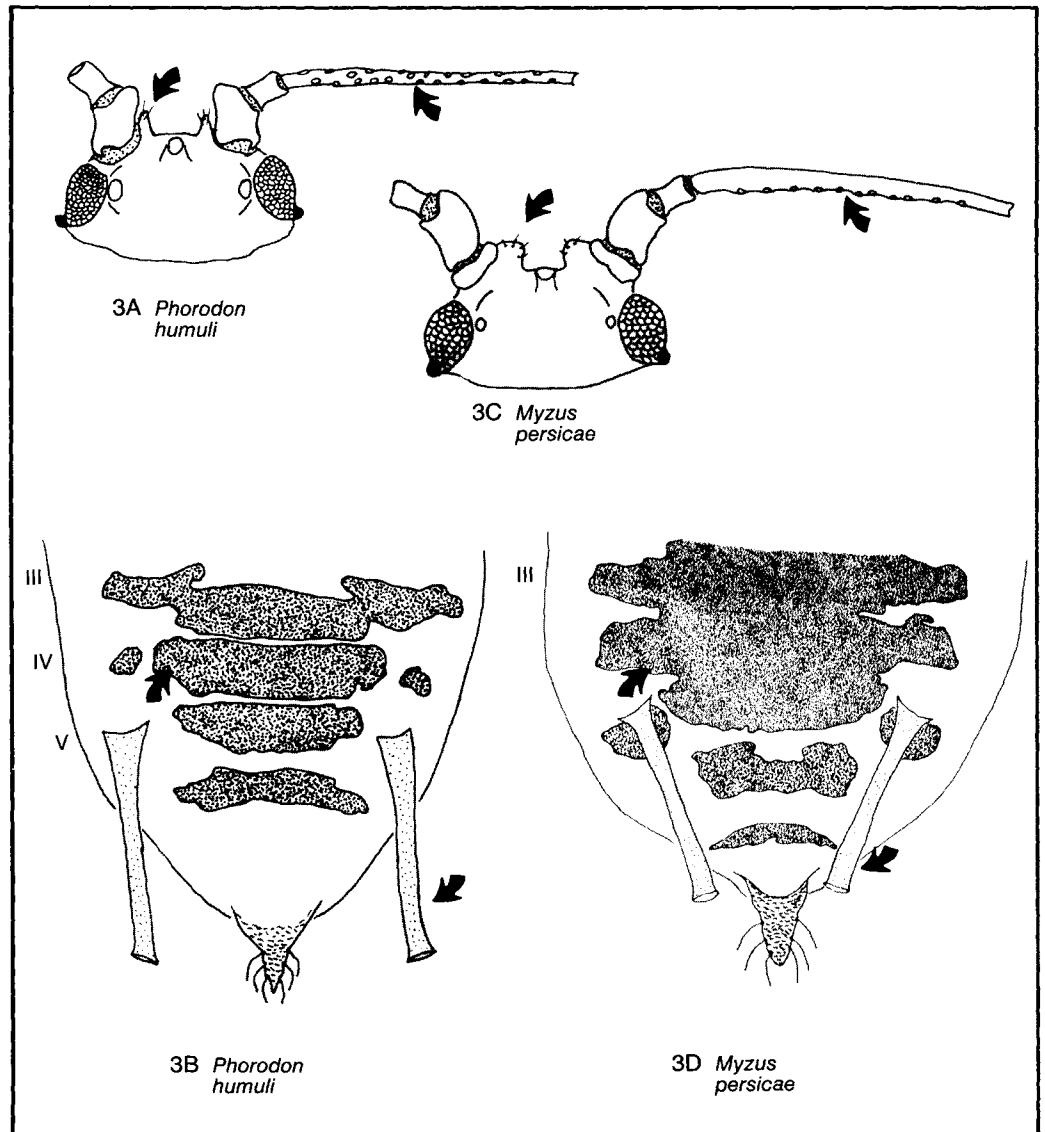
- 3 Alata with 23 to 27 sensoria widely distributed on antennal III; inner angle of antennal tubercle with elongate process (3A); cornicle cylindrical on distal half; abdomen of alata with dorsal bands, nearly coalescing, on III, IV and V; no dark area behind base of each cornicle (3B)-----hop aphid, *Phorodon humuli*

Distribution: Holarctic. Hosts: Plum leaves in winter and hop leaves in summer. References: 1, 6.

- Alata with 6 to 17 sensoria in a line on antennal III; inner angle of antennal tubercle rounded (3C); cornicle slightly dilated on distal half; abdomen of alata with dorsal patch extending from III to level of cornicle (3D)

-----green peach aphid, *Myzus persicae*

Distribution: Worldwide. Hosts: Polyphagous. References: 1-7.



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*Insect and Mite Pests in Food*

**Notes and Sketches**



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Scale insects are unique among the Insecta in that the adult females are wingless, neotenic (sexually mature nymphs), and often produce some sort of waxy covering. Adult males (fig. 25.1) superficially resemble small wasps or flies but are unique in having one pair of well-developed wings and a smaller second pair of wings (hamulohalterae). The males lack functional mouthparts and are often short-lived.

The first instar is usually called the crawler because it is generally the only active crawling stage. Immature instars may be recognized as such by their lack of a vulva or aedeagus. In most scale insects the remaining instars, excluding adult males, are sessile, even though some have legs and are capable of moving on the host. Male scales undergo an anomalous kind of complete metamorphosis that involves one or two "pupal" stages before the adult form is reached.

Several characters may be used to distinguish the Coccoidea from other homopterous insects: a single tarsal claw on each leg; a one-segmented tarsus (usually); wingless females; and adult males with one pair of wings and one pair of hamulohalterae.

In the United States there are 15 families of Coccoidea. Acleridae (aclerids), Cerococcidae (cerococcids), Conchaspidae (conchaspids), Dactylopiidae (cochineal insects), Kermesidae (gall-like scales), Tachardiidae (lac scales), Lecanodiaspididae (false pit scales), and Phoenicococcidae (phoenicococcids) are not included here because they are rarely collected and are unlikely food contaminants. Of the remaining seven relatively commonly collected families, three contain species that might be found in foods.

Foods that commonly have scale insects are citrus, tropical fruits, deciduous-tree fruits, and grapes. The three

families often associated with food may be recognized by the following field characters.

**Pseudococcidae (mealybugs):** The body is usually covered with a mealy, white secretion, and the margin of the body, particularly the posterior margin, normally has at least one pair of waxy filaments (fig. 25.2).

**Diaspididae (armored scales):** A solid waxy cover is produced that is separate from the body. The waxy cover may be round, oval, or elongate and incorporates the shed skins of the crawler and second instar (fig. 25.3).

**Coccidae (soft scales):** The body is usually without wax on the upper surface or the wax is transparent. Some species produce a thick, chewing-gumlike wax or a filamentous wax, but in soft scales the wax is attached to the body surface and there are no marginal filaments except those associated with the spiracles (fig. 25.4).

The classification system of scale insects is based primarily on adult females. The following key is restricted to species that occur in the United States and can be used only with adult females mounted on microscope slides and examined with a compound microscope. A handout on scale insect mounting techniques may be obtained by writing to me at the address given above.

Figures 25.5 and 25.7-25.29 are of bilaterally divided adult females (left = dorsal; right = ventral). Figure 25.4 shows the dorsal surface only; figure 25.6, the ventral surface only. Figures 25.7, 25.8, 25.13 and 25.14 do not show dermal morphology in detail. Figures 25.24 and 25.25 lack the multitude of dermal structures apparent on slide-mounted specimens; only diagnostic features are presented in these figures.

**KEY**

Drawings (figs. 25.4-25.29)  
by P.J. Hollyoak.

- 1 Abdominal spiracles present (fig. 25.5)----- 2
- Abdominal spiracles absent (fig. 25.9)----- 3
- 2 Anal orifice surrounded by a sclerotized ring on exterior surface of body; anal ring bearing setae and pores (fig. 25.5)-----**ensign scales**, Ortheziidae
- Anal orifice without sclerotization on exterior body surface; occasionally with internal tube leading to orifice sclerotized and having pores but not setae (fig. 25.6)-----**margarodid scales**, Margarodidae
- 3 Posterior abdominal segments forming a pygidium (fig. 25.9). Diaspididae (**armored scales**)----- 4
- Posterior abdominal segments not forming a pygidium (fig. 25.20)----- 16
- 4 Body elongate; body length at least twice greatest width (fig. 25.8)----- 5
- Body round or oval; body length less than twice greatest width (fig. 25.12)----- 9
- 5 Median lobes appearing as a single lobe (fig. 25.8). Genus *Pinnaspis*----- 6
- Median lobes separate, appearing as 2 lobes (fig. 25.9)----- 7
- 6 Scale cover white; preanal scars present (fig. 25.7)  
-----**lesser snow scale**, *Pinnaspis strachani*

Distribution: Worldwide. Hosts: Polyphagous.

- Scale cover brown; preanal scars absent (fig. 25.8)-----**fern scale**, *Pinnaspis aspidistrae*

Distribution: Worldwide. Hosts: Polyphagous; especially ferns, *Citrus*, *Aspidistra*.

- 7 With 3 pairs of lobes (fig. 25.9)-----**citrus snow scale**, *Unaspis citri*

Perivulvar pores present or absent. Distribution: Africa, Asia, Australia, Bermuda, Oceania, USA (Florida, Louisiana). Hosts: *Citrus*, *Severina*.

- With 2 pairs of lobes (fig. 25.11). Genus *Lepidosaphes*----- 8

Perivulvar pores present.

- 8 Thorax and anterior abdominal segments sclerotized; some abdominal segments with marginal spurs (fig. 25.10)-----**Glover scale**, *Lepidosaphes gloveri*

Distribution: Worldwide. Hosts: Especially *Citrus*.

- Thorax and anterior abdominal segments not sclerotized; abdominal marginal spurs absent (fig. 25.11)-----**purple scale**, *Lepidosaphes beckii*

Distribution: Worldwide. Hosts: Especially *Citrus*.

- 9 Perivulvar pores absent (fig. 25.12)----- 10
- Perivulvar pores present (fig. 25.15)----- 12

- 10 Body without prosomal lobes; pygidial lobes converging apically (fig. 25.12)  
-----**San Jose scale**, *Quadraspidiotus perniciosus*

Distribution: Africa, Asia, Australia, Cuba, Europe, Mexico, New Zealand, South America, USA (widely distributed). Hosts: Polyphagous, especially *Malus*, *Prunus*, and most Rosaceae.

- Body with large prosomal lobes; pygidial lobes parallel (fig. 25.13). Genus *Aonidiella* 11
- 11 Scale yellowish on host; without well-developed scleroses anterior to prevulvar apophysis (fig. 25.13)-----**yellow scale, *Aonidiella citrina***
- Distribution: Africa (Guinea, Zaire), Asia (including area around the Black Sea), Australia, Mexico, Oceania (Bonin Islands, New Guinea), South America (Argentina, Chile), USA (California, Florida, Texas). Hosts: Especially *Citrus*.
- Scale reddish on host; with well-developed scleroses anterior to prevulvar apophysis (fig. 25.14)-----**California red scale, *Aonidiella aurantii***
- Distribution: USA (Alabama, California, Florida, Georgia, Texas); widespread throughout warm parts of the world. Hosts: Especially *Citrus*.
- 12 Spiracular pores near anterior spiracles (fig. 25.15)----- 13  
Spiracular pores absent (fig. 25.17)----- 14
- 13 Second lobes each with 2 lobules; medial lobes fused at base; with more than 50 perivulvar pores (fig. 25.15)-----**white peach scale, *Pseudaulacaspis pentagona***  
-----**white prunicola, *Pseudaulacaspis prunicola***
- Distribution: Worldwide: Hosts: Polyphagous; white prunicola, especially *Prunus*.
- Second lobes simple, with 1 lobule; median lobes separate at base; with less than 50 perivulvar pores (fig. 25.16)-----**chaff scale, *Parlatoria pergandii***
- Distribution: Worldwide. Hosts: Especially *Citrus*.
- 14 Prepygidial abdomen with isolated cluster of submarginal, dorsal ducts on each side (fig. 25.17)-----**Florida red scale, *Chrysomphalus aonidum***
- Distribution: Throughout warm areas of the world. Hosts: Polyphagous, especially *Citrus*.
- Prepygidial abdomen with submarginal, dorsal ducts scattered along posterolateral margin (fig. 25.18)----- 15
- 15 Dorsal tubular ducts less than 5 times as long as wide; median lobes approximately parallel (fig. 25.18)-----**oleander scale, *Aspidiotus nerii***
- Distribution: Widespread; occurring out-of-doors in warm areas. Hosts: Polyphagous.
- Dorsal tubular ducts more than 5 times as long as wide; median lobes apically convergent (fig. 25.19)-----**latania scale, *Hemiberlesia lataniae***
- Distribution: Widespread; occurring out-of-doors in warm areas. Hosts: Polyphagous.
- 16 8-shaped pores somewhere on body (normally in a band near body margin) (fig. 25.20)  
-----**pit scales, Asterolecaniidae**
- 8-shaped pores absent (fig. 25.21)----- 17

- 17 Anal region with 2 anal plates forming an operculum (fig. 25.21). Coccidae (**soft scales**)----- 18  
 Anal region without plates (fig. 25.23)----- 19
- 18 Ventral tubular ducts in a band around body margin (absent from area between legs); inner filament of tubular ducts swollen (fig. 25.21)---**hemispherical scale, Saissetia coffeae**
- Distribution: Widespread; occurring out-of-doors in warm areas. Hosts: Polyphagous.
- Ventral tubular ducts in area between middle pair of legs (rare or absent near body margin); inner filament of tubular ducts not swollen (fig. 25.22)  
 -----**brown soft scale, Coccus hesperidum**
- Distribution: Widespread; occurring out-of-doors in warm areas. Hosts: Polyphagous. See also fig. 25.4.
- 19 Body without ostioles, cerarii, and circulus; tubular ducts invaginated; in life, without mealy secretion except on venter; without marginal filaments (fig. 25.23)  
 -----**eriococcid scales, Eriococcidae**
- Body with ostioles, cerarii, circulus, and noninvaginated tubular ducts (fig. 25.24); in life, covered with mealy, white secretion and bearing several marginal filaments (fig. 25.2). Pseudococcidae (**mealybugs**)----- 20
- 20 With 18 pairs of cerarii; ventral anal-lobe area with a narrow, sclerotized bar (fig. 25.24)  
 -----**citrus mealybug, Planococcus citri**
- Distribution: Widespread; occurring out-of-doors in warm areas. Hosts: Polyphagous, especially *Citrus*.
- With less than 18 pairs of cerarii; without narrow, sclerotized bar on anal lobe (fig. 25.25)----- 21
- 21 Oral-rim tubular ducts present (fig. 25.25). Genus *Pseudococcus* ----- 22  
 Oral-rim tubular ducts absent (fig. 25.27)----- 23
- 22 Many dorsal cerarii with 2 or more associated oral-rim tubular ducts; multilocular pores restricted to posterior 2 or 3 abdominal segments (fig. 25.25)  
 -----**longtailed mealybug, Pseudococcus longispinus**
- Distribution: Widespread; occurring out-of-doors in warm areas. Hosts: On many tropical plants. See also fig. 25.2.
- Dorsal cerarii with at most 1 associated oral-rim tubular duct; multilocular pores on at least posterior 5 or 6 abdominal segments (fig. 25.26)  
 -----**grape mealybug, Pseudococcus maritimus**
- Distribution: USA. Hosts: Especially grapes and deciduous fruit trees.
- 23 Dorsomedial areas with conical setae about same size as conical cerarian setae (fig. 25.27)-----**coconut mealybug, Nipaecoccus nipae**
- Distribution: Most warm areas of the world. Hosts: Many hosts, especially palms.
- Dorsomedial areas with slender setae unlike conical cerarian setae (fig. 25.28). Genus *Dysmicoccus*----- 24

24 Setae on dorsomedial area of abdominal segments VIII and IX noticeably longer than setae on rest of dorsum (fig. 25.28)-----**pineapple mealybug, *Dysmicoccus brevipes***

Distribution: Primarily the New World, but also reported from Africa, Asia, and Oceania. Hosts: Polyphagous, especially pineapple.

Setae on dorsomedial area of posterior abdominal segments about same length as those on rest of dorsum (fig. 25.29)

-----**gray pineapple mealybug, *Dysmicoccus neobrevipes***

Distribution: Mexico, Oceania. Hosts: Polyphagous.

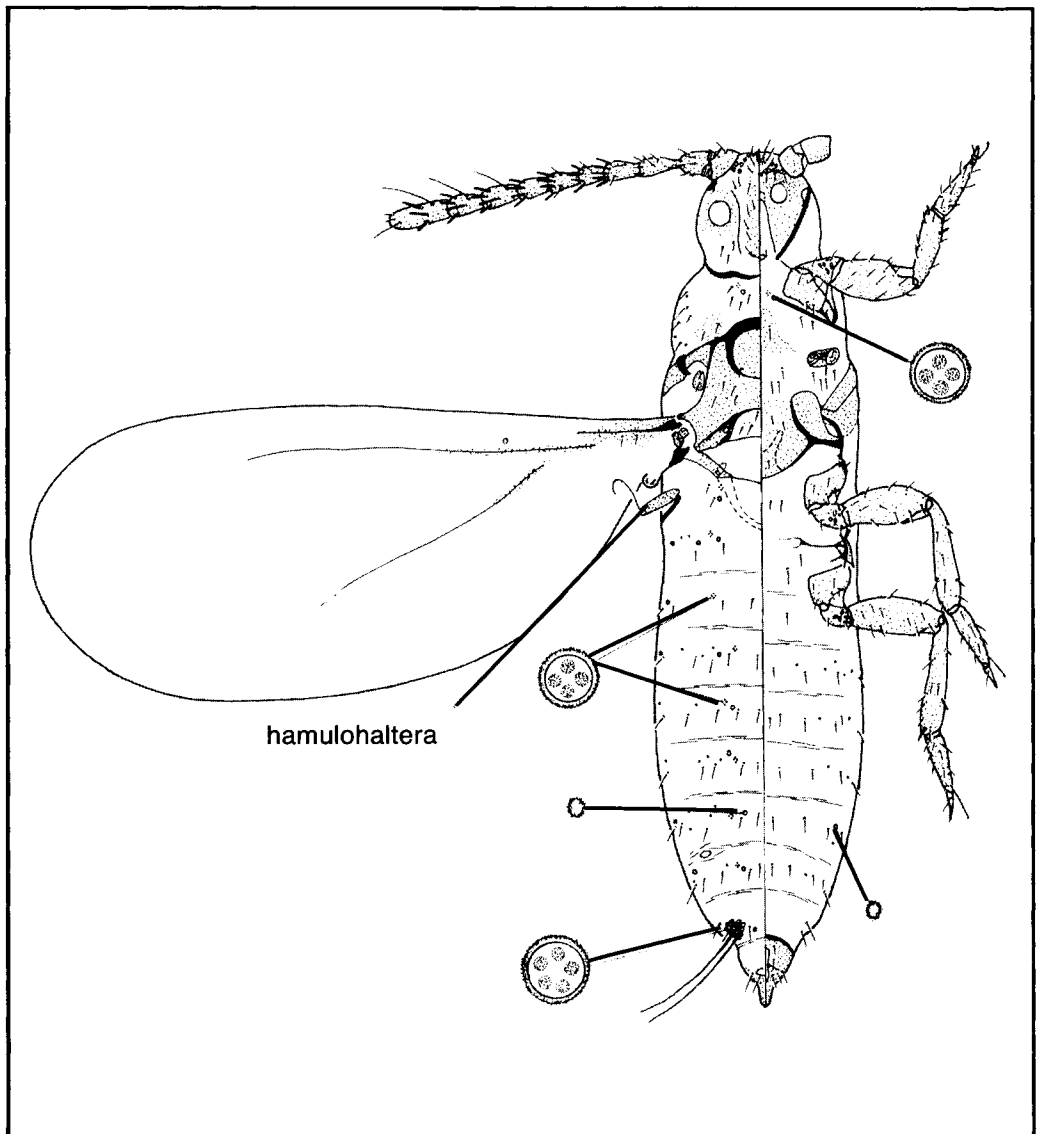


Figure 25.1 *Brevennia rehi* (Lindinger) (Pseudococcidae), male, dorsal (left) and ventral (right) views. (Drawing by D.R. Miller.)

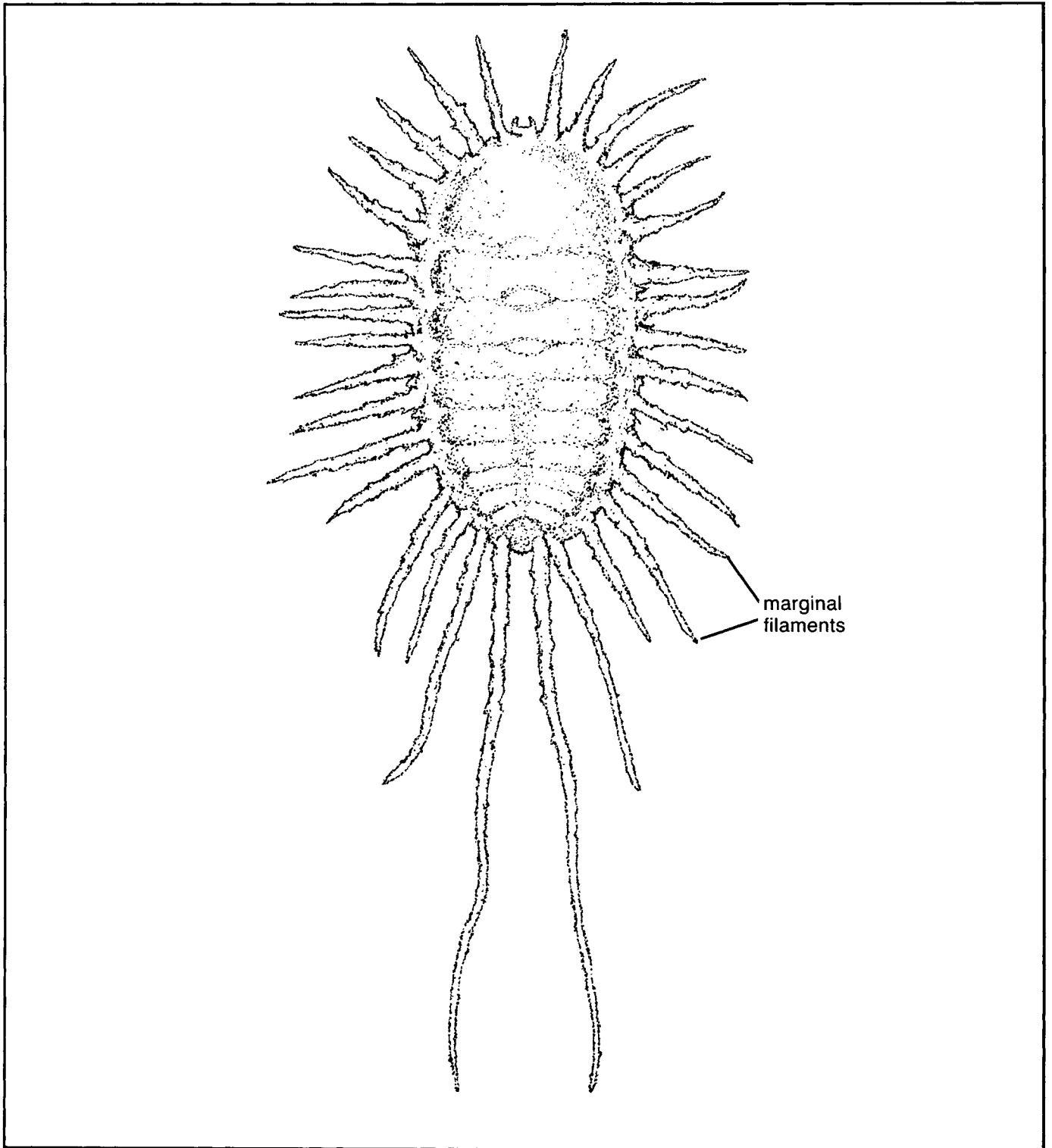


Figure 25.2. **Longtailed mealybug**,  
*Pseudococcus longispinus* (Pseudococcidae),  
female, dorsal view. (Drawing by P.J. Hollyoak.)

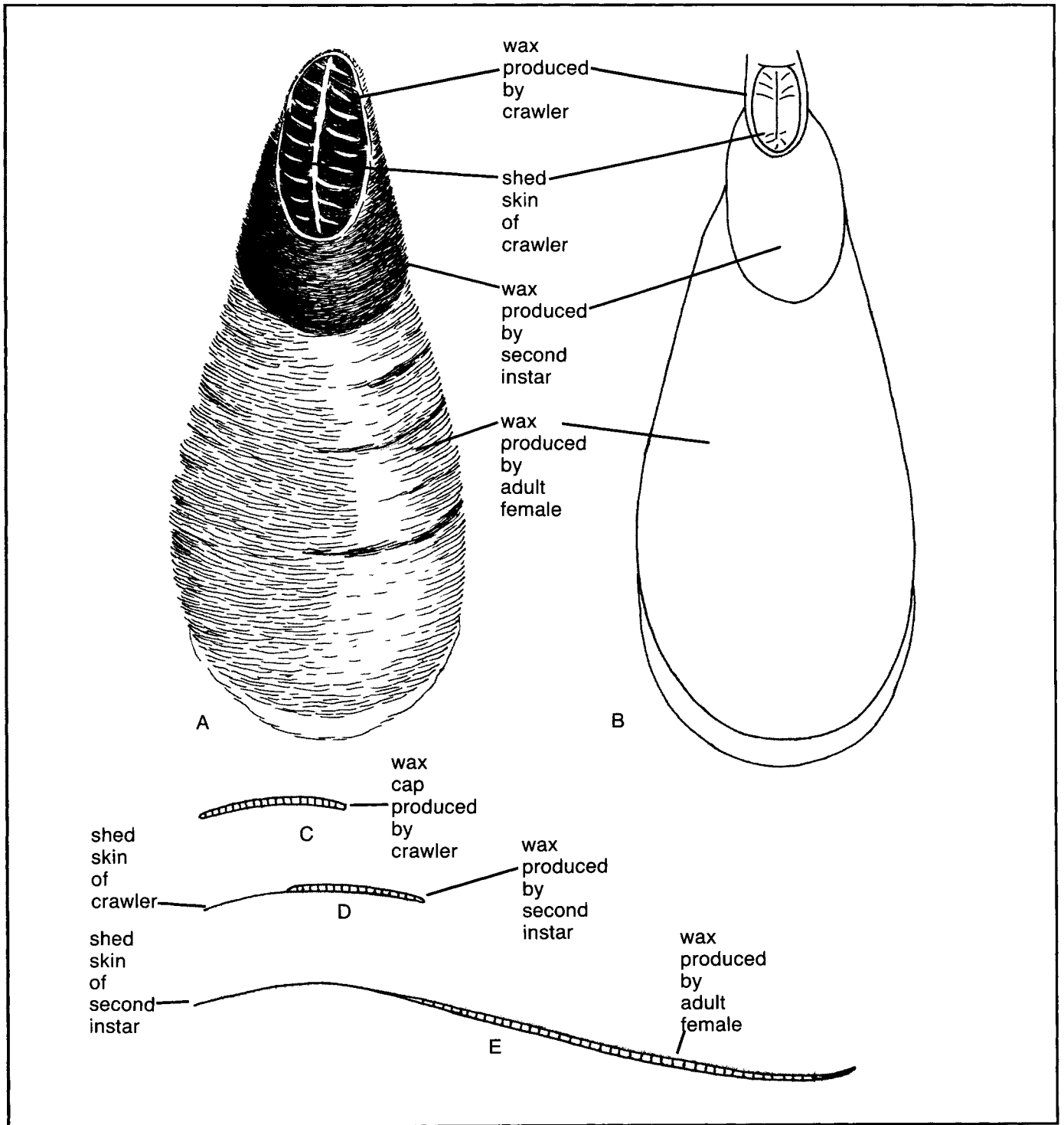


Figure 25.3. An armored scale (Diaspididae): A, scale cover, dorsal view, actual appearance; B, same, diagrammatic; C, D, E, lateral views, diagrammatic, of longitudinal sections through scale cover. (Drawings by J.A. Davidson.)



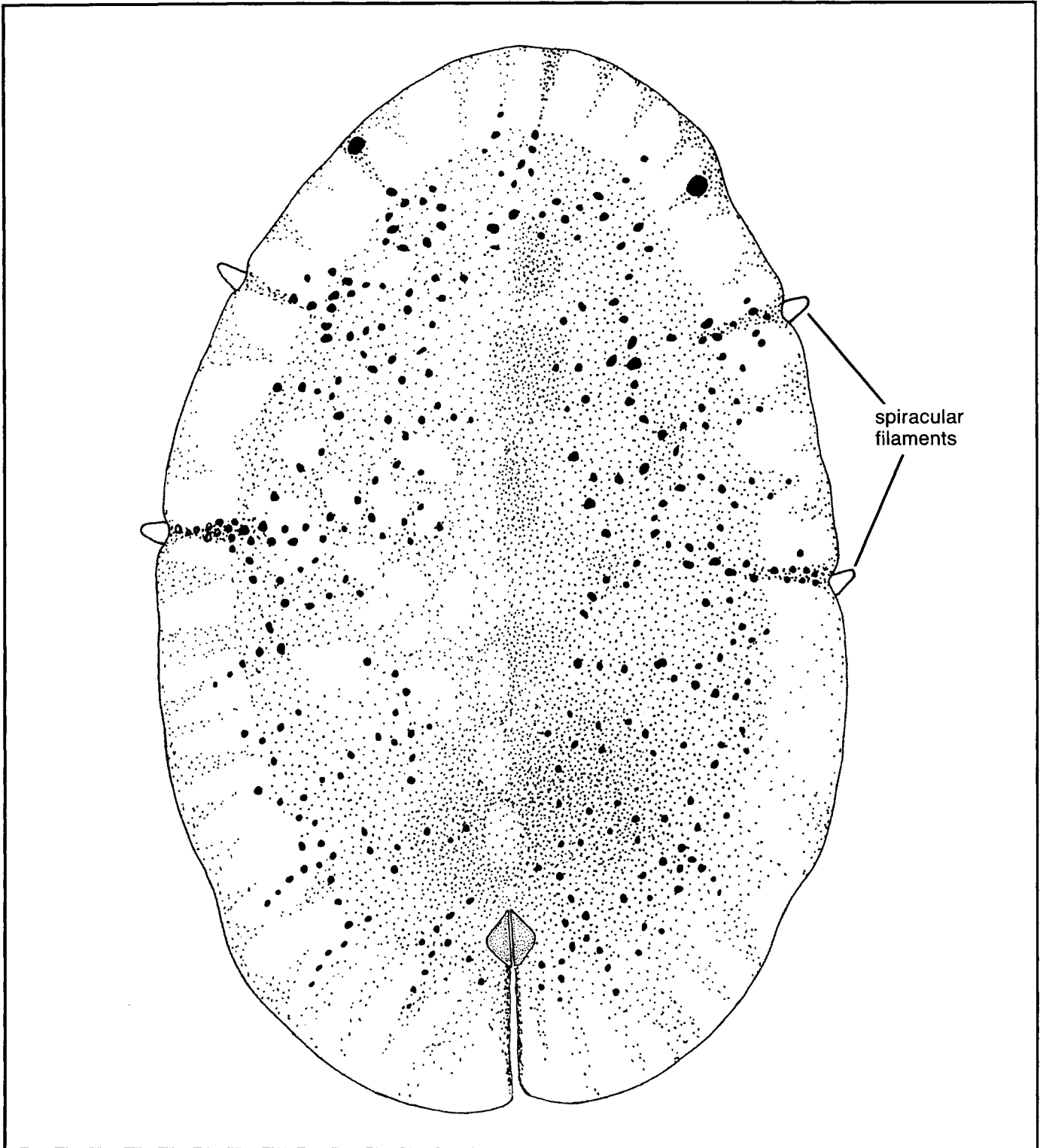


Figure 25.4. **Brown soft scale**, *Coccus hesperidum* (Coccidae), female, dorsal view.

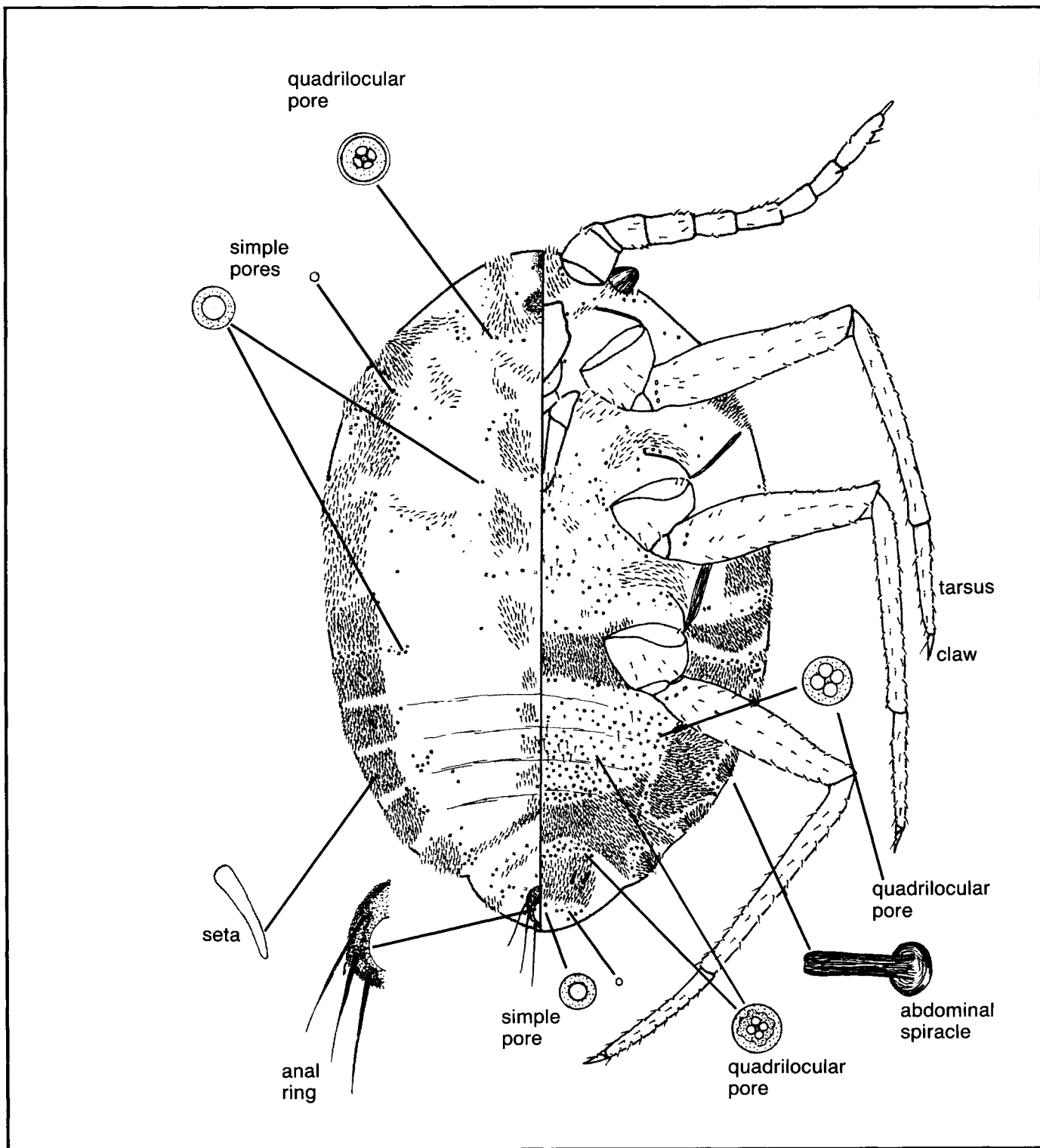


Figure 25.5. Greenhouse orthezia, *Orthezia insignis* Browne (Ortheziidae).

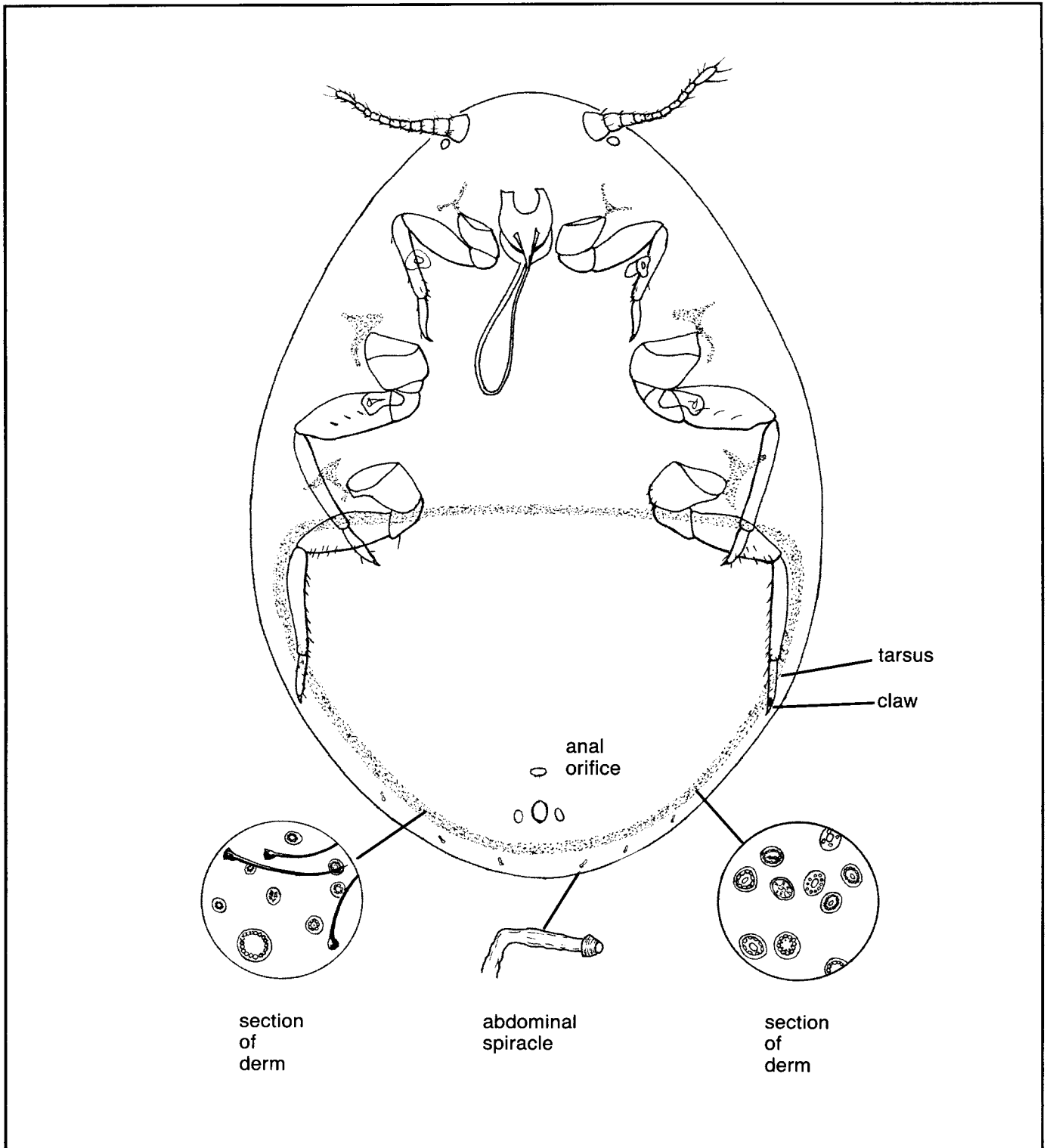


Fig 25.6. *Icerya seychellarum* (Westwood)  
(Margarodidae).

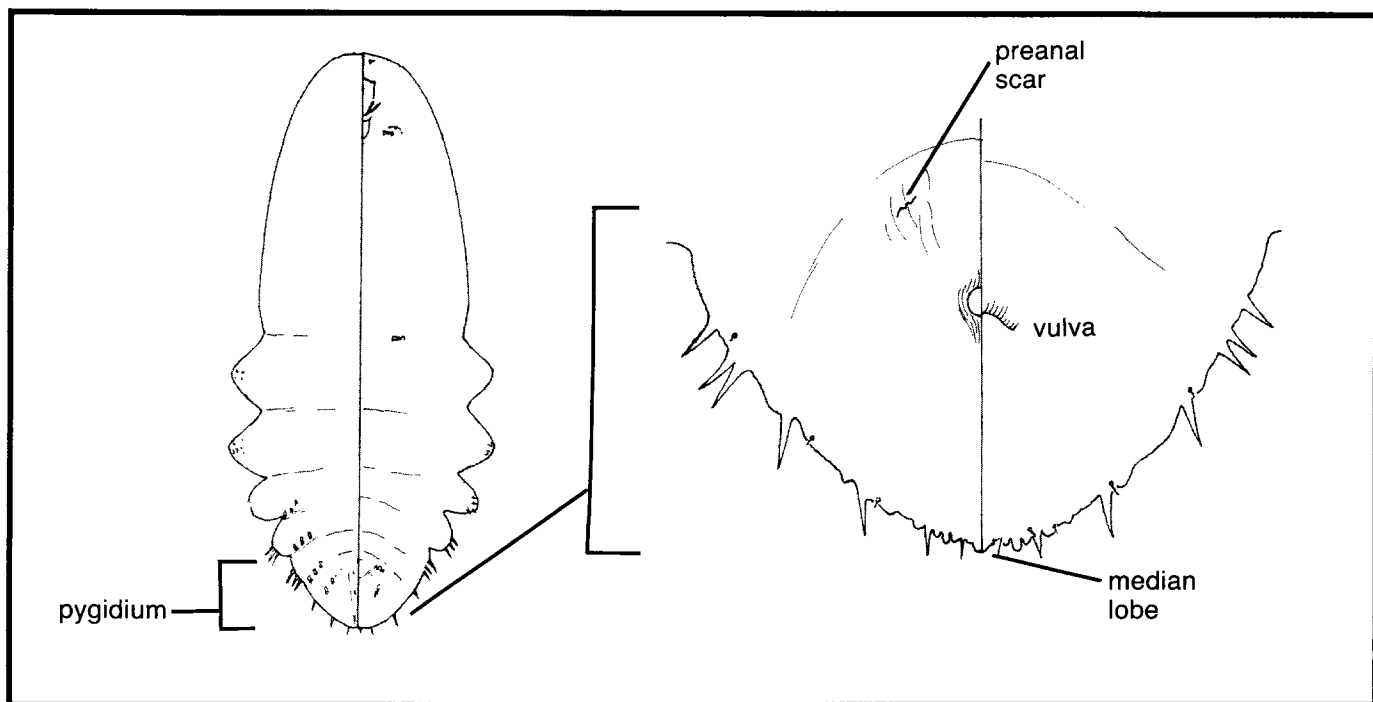


Figure 25.7. Lesser snow scale, *Pinnaspis strachani* (Diaspididae).

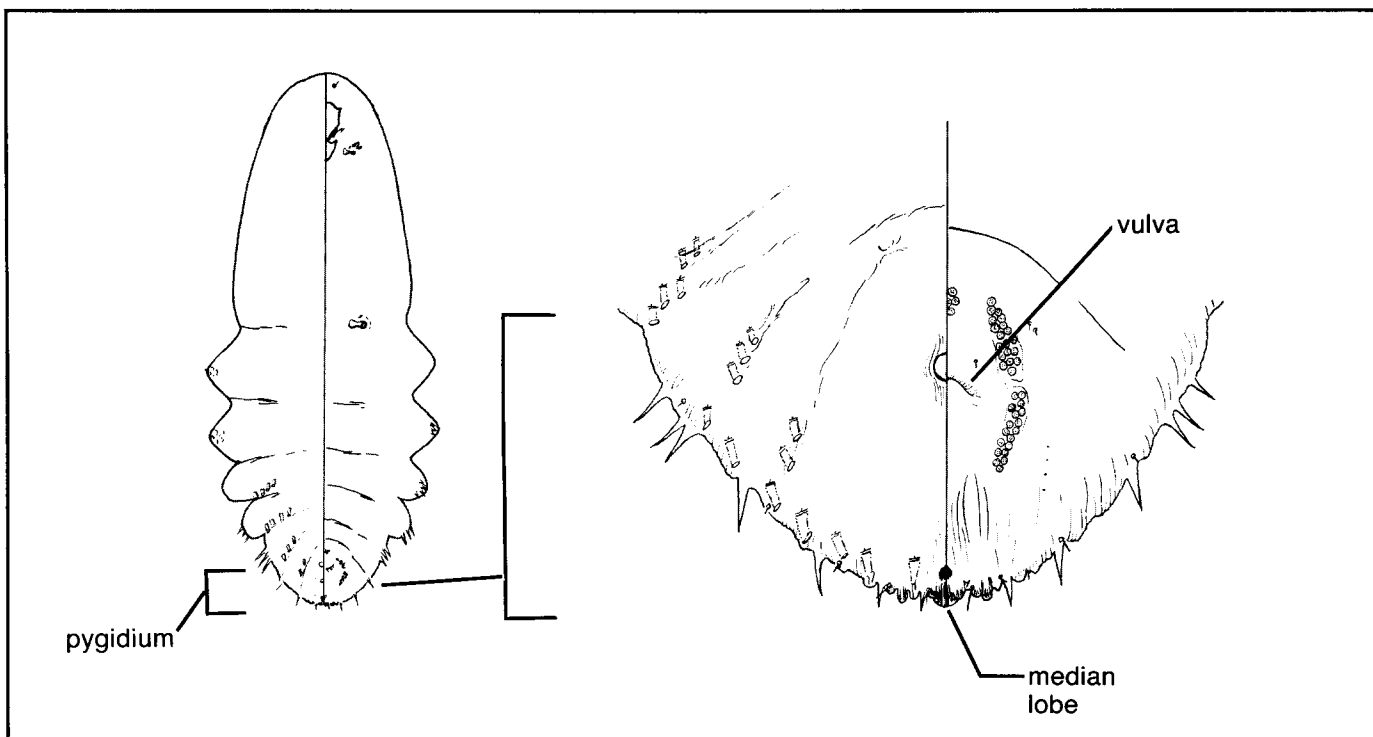


Figure 25.8. Fern scale, *Pinnaspis aspidistrae* (Diaspididae).



Figure 25.9. Citrus snow scale, *Unaspis citri* (Diaspididae).

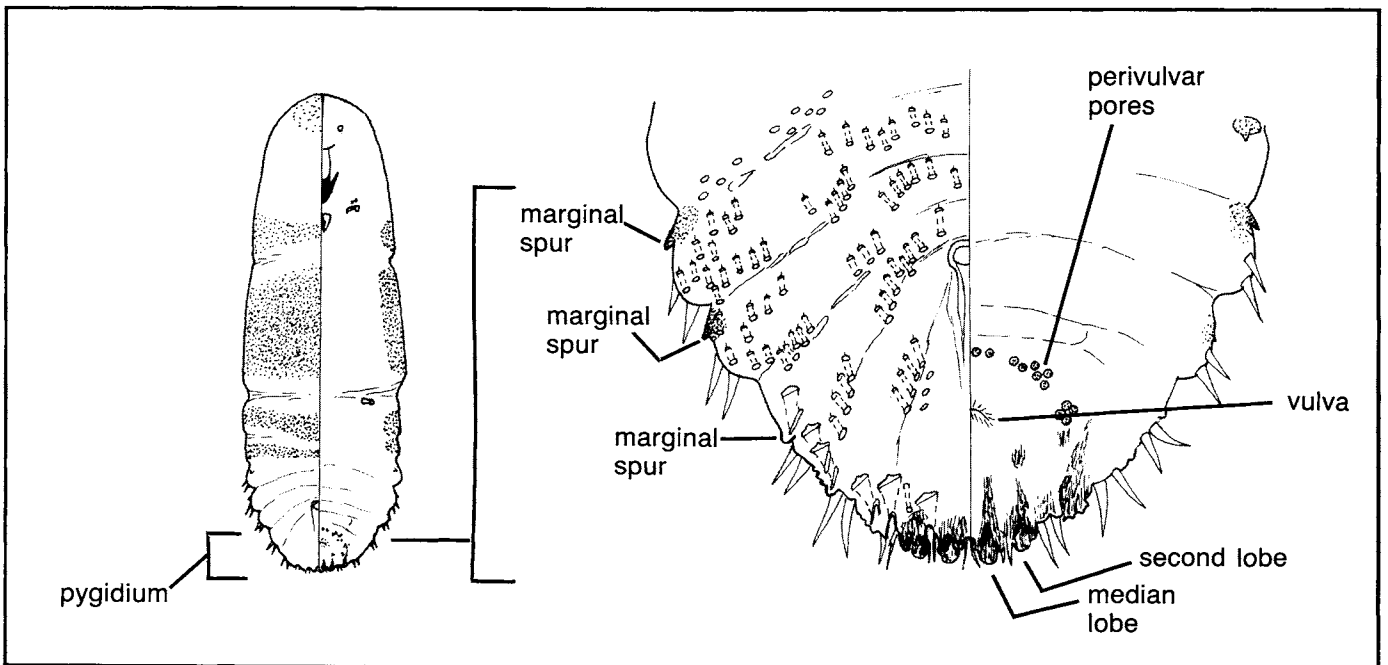


Figure 25.10. Glover scale, *Lepidosaphes gloveri* (Diaspididae).

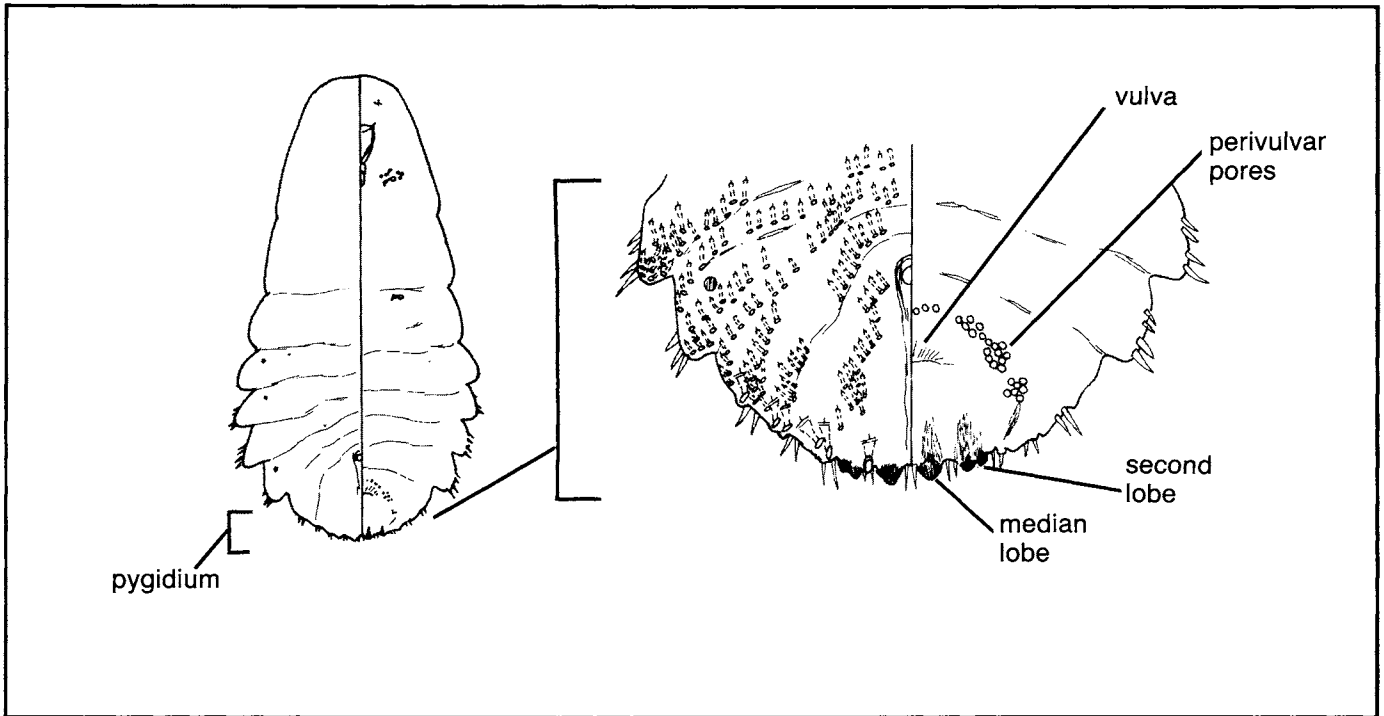


Fig 25.11. Purple scale, *Lepidosaphes beckii* (Diaspididae).

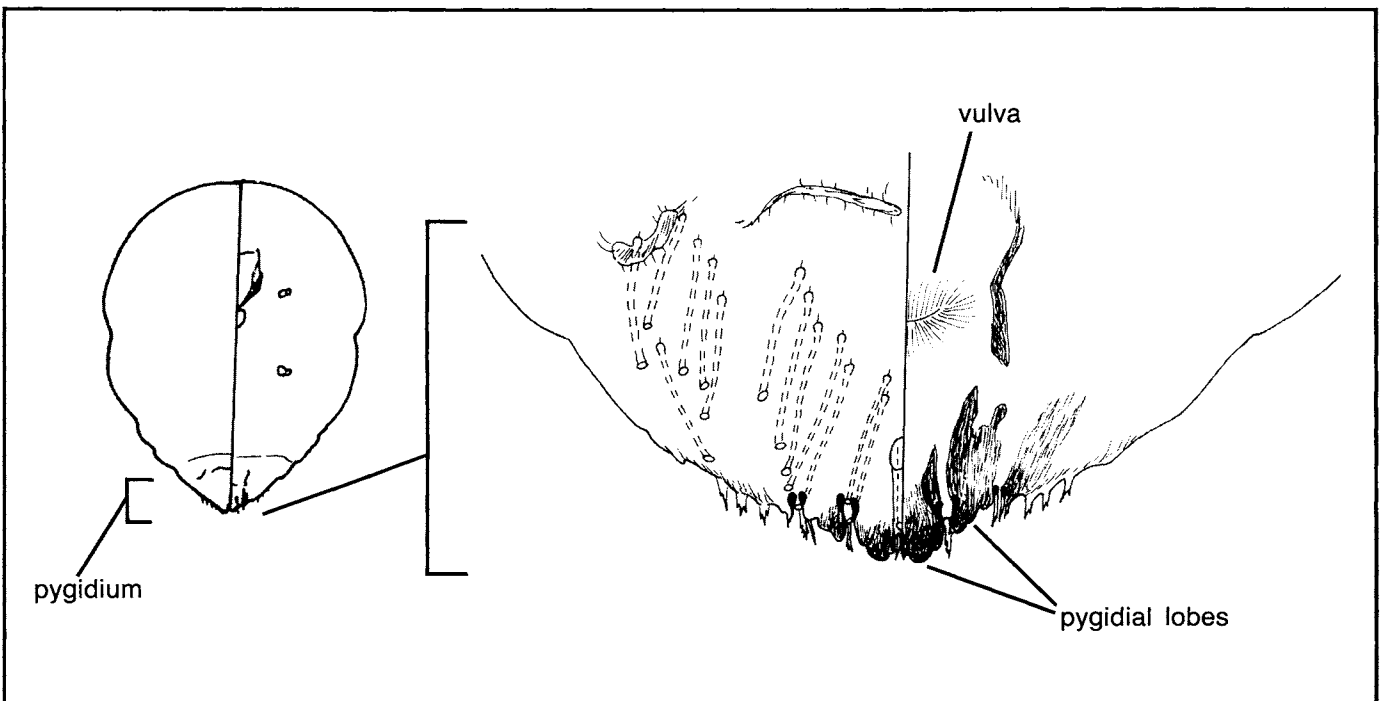


Figure 25.12. San Jose scale, *Quadraspidiotus perniciosus* (Diaspididae).

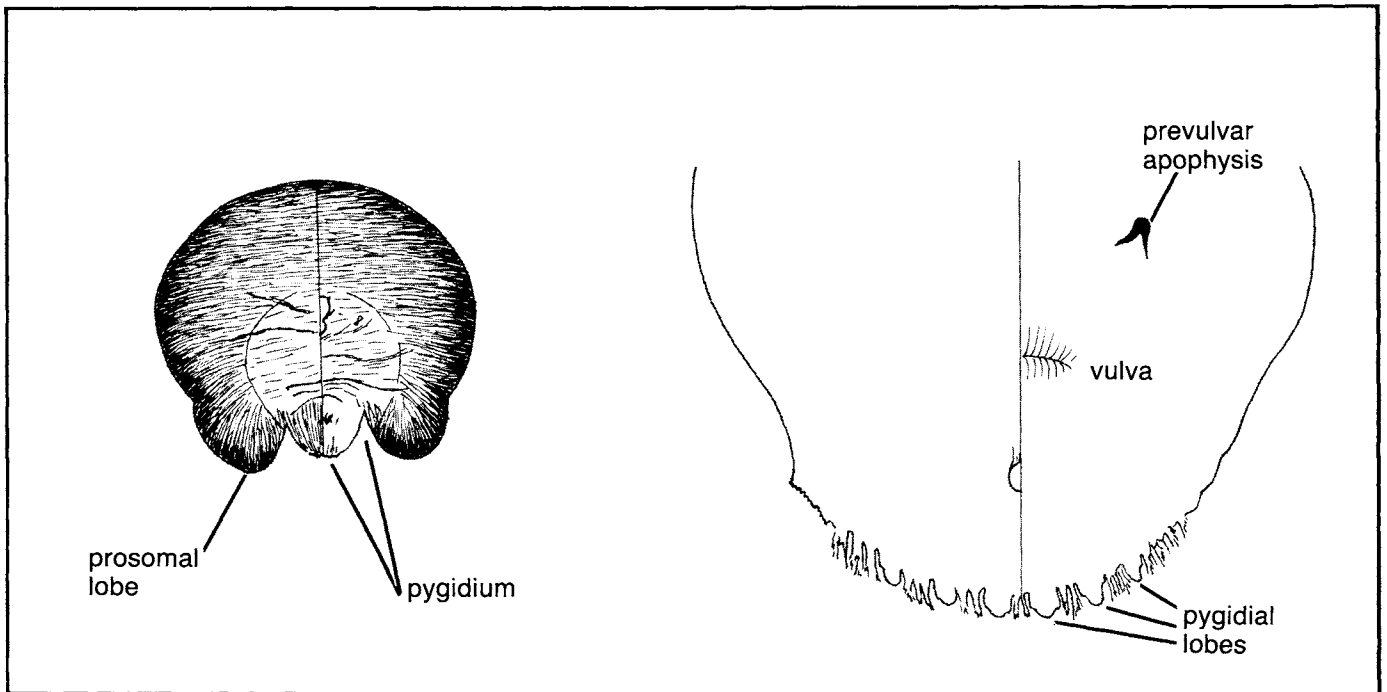


Figure 25.13. **Yellow scale**, *Aonidiella citrina* (Diaspididae): Left, dorsal/ventral habitus; right, dorsal/ventral detail of pygidium.

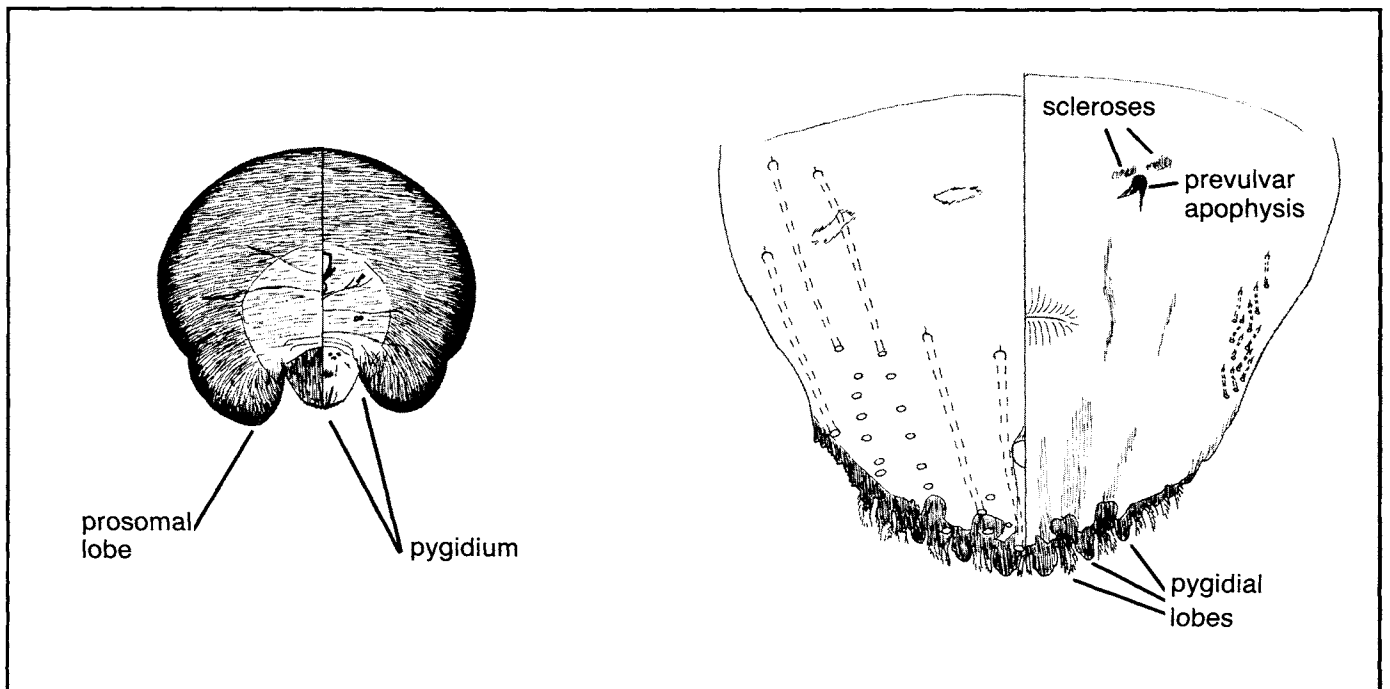


Figure 25.14. **California red scale**, *Aonidiella aurantii* (Diaspididae): Left, dorsal/ventral habitus; right, dorsal/ventral detail of pygidium.

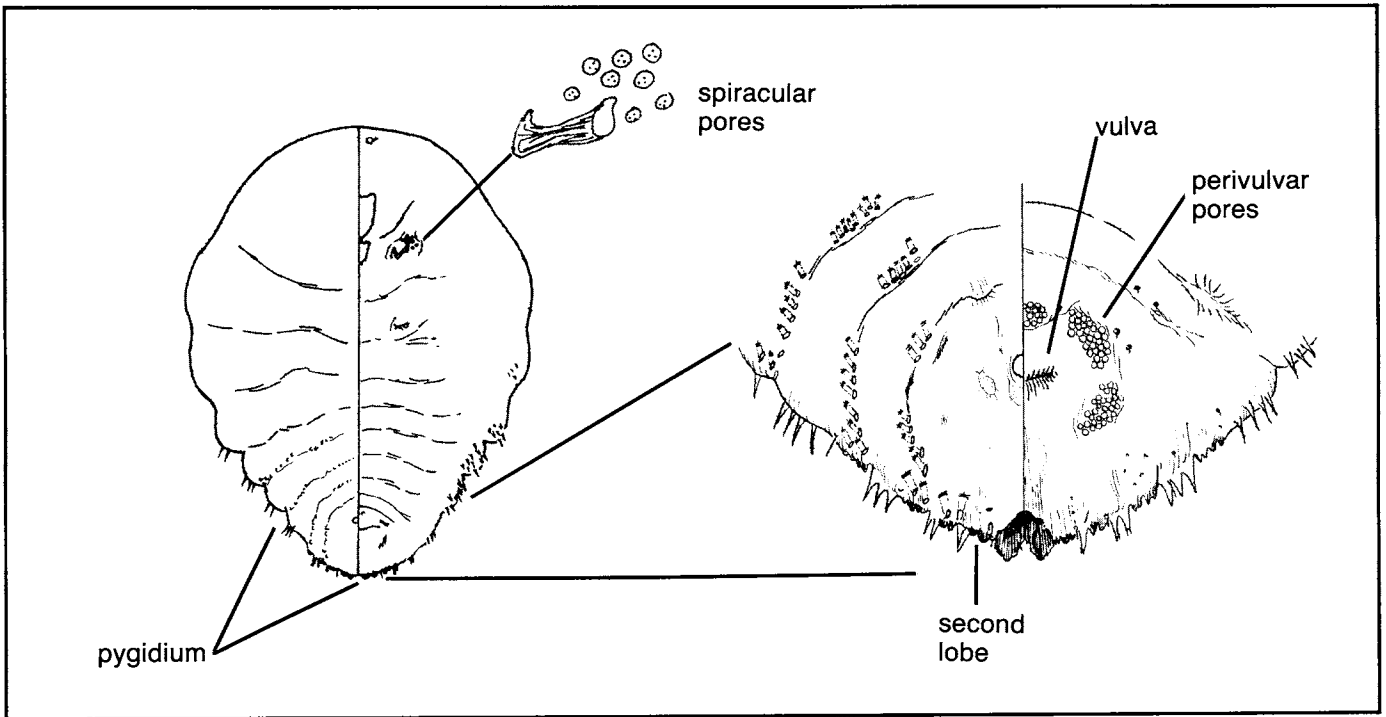


Figure 25.15. **White peach scale**, *Pseudaulacaspis pentagona* (Diaspididae).

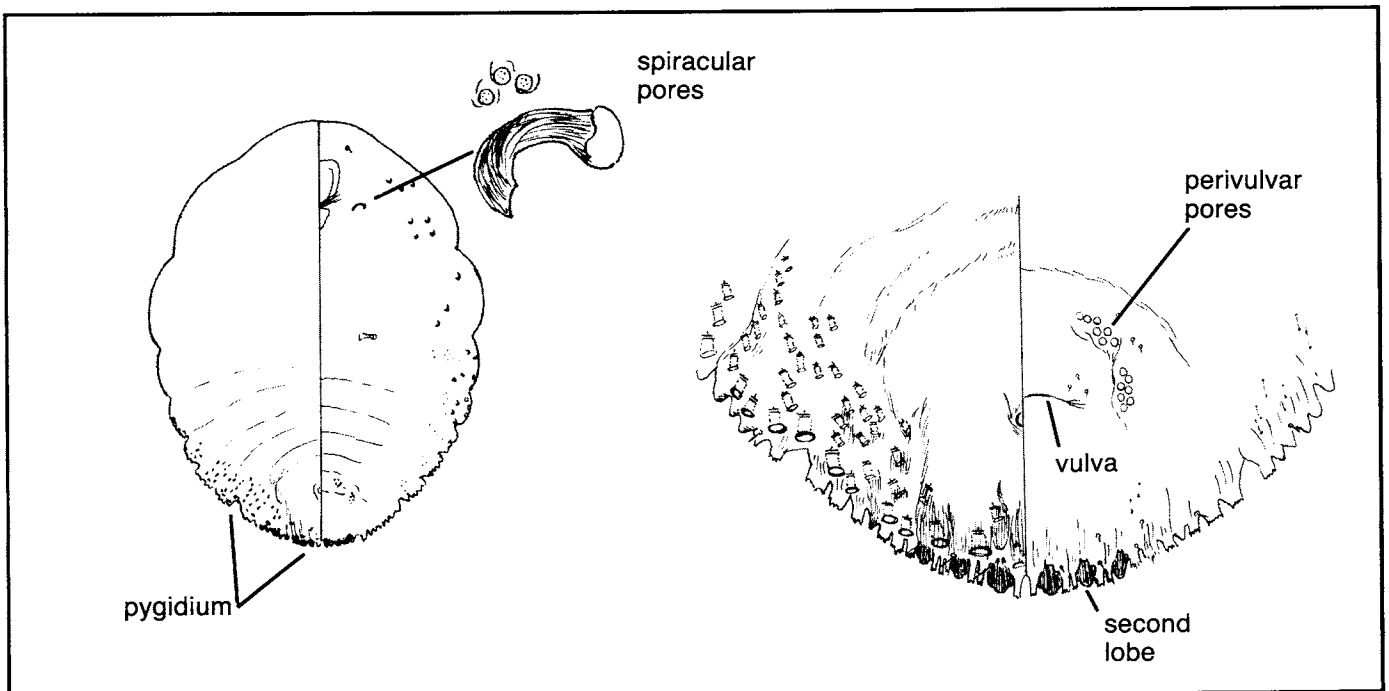


Figure 25.16. **Chaff scale**, *Parlatoria pergandii* (Diaspididae): Left, dorsal/ventral habitus; right, dorsal/ventral detail of pygidium.



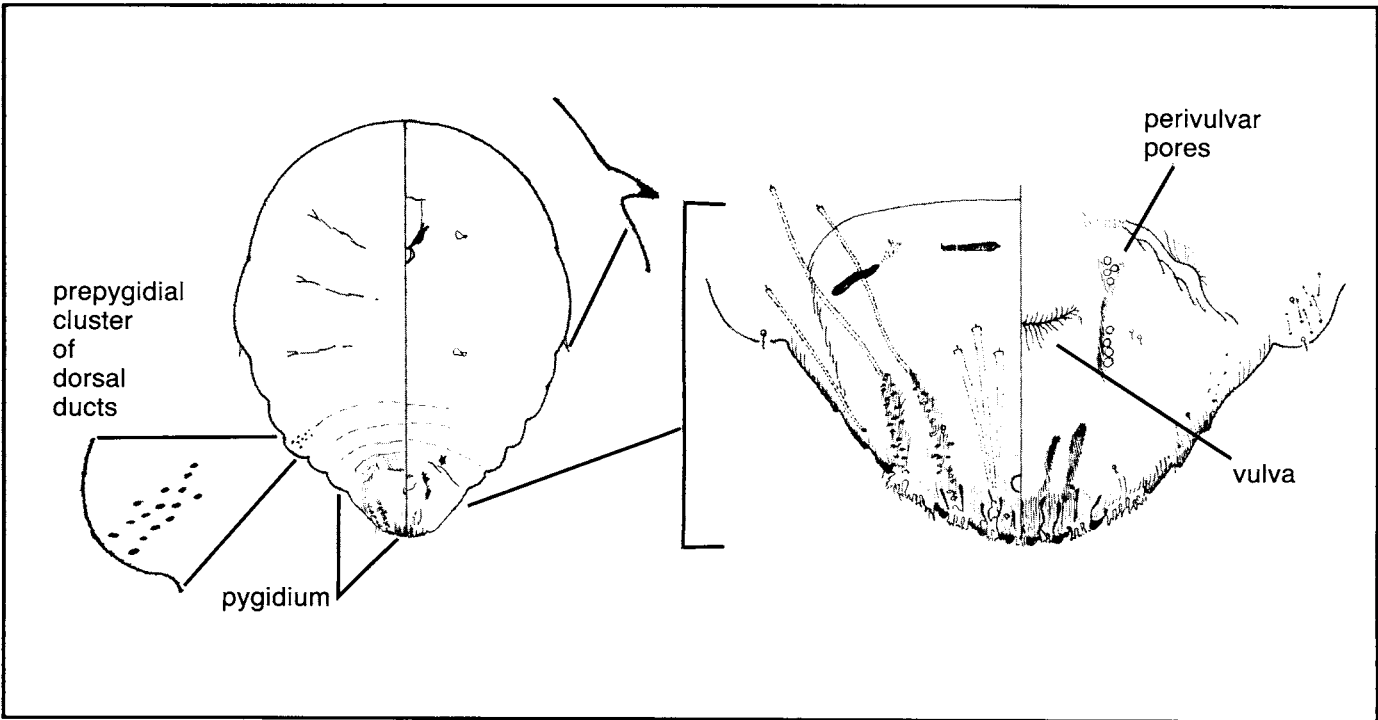


Figure 25.17. Florida red scale, *Chrysomphalus aonidum* (Diaspididae)

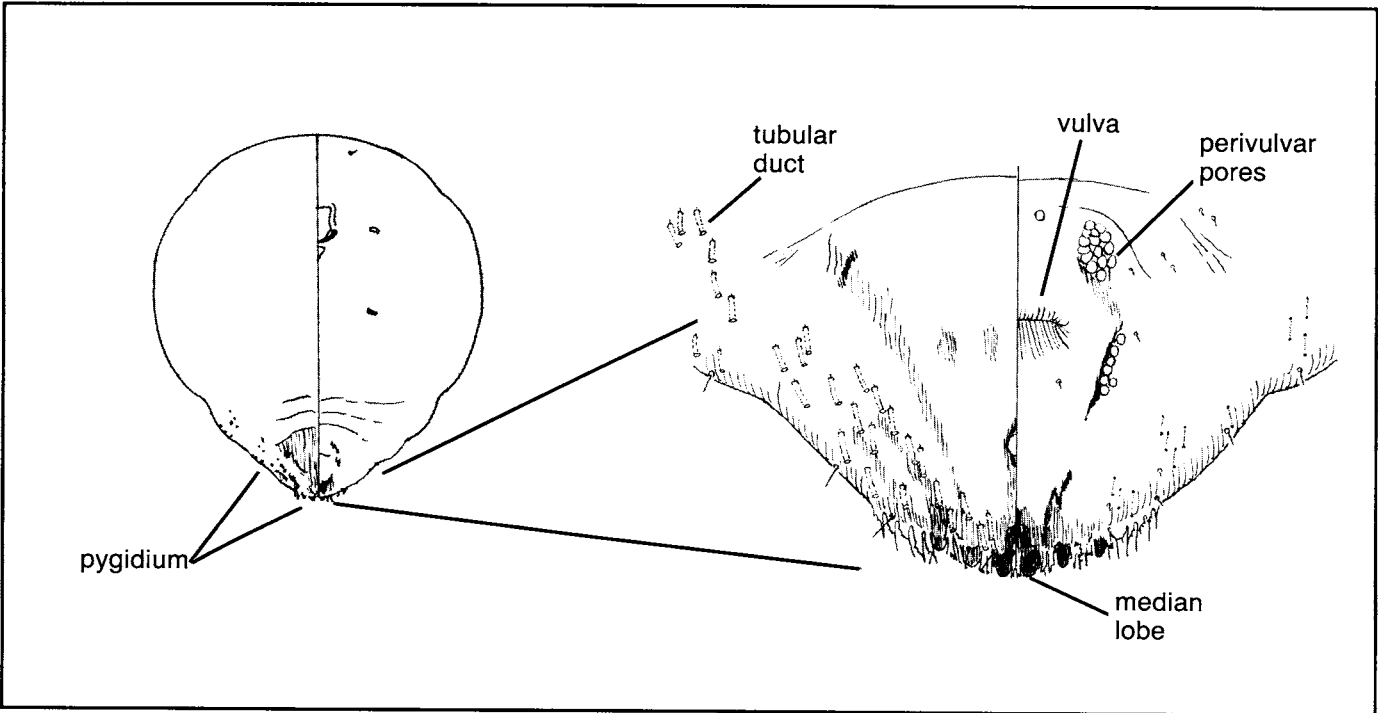


Figure 25.18. Oleander scale, *Aspidiotus nerii* (Diaspididae).

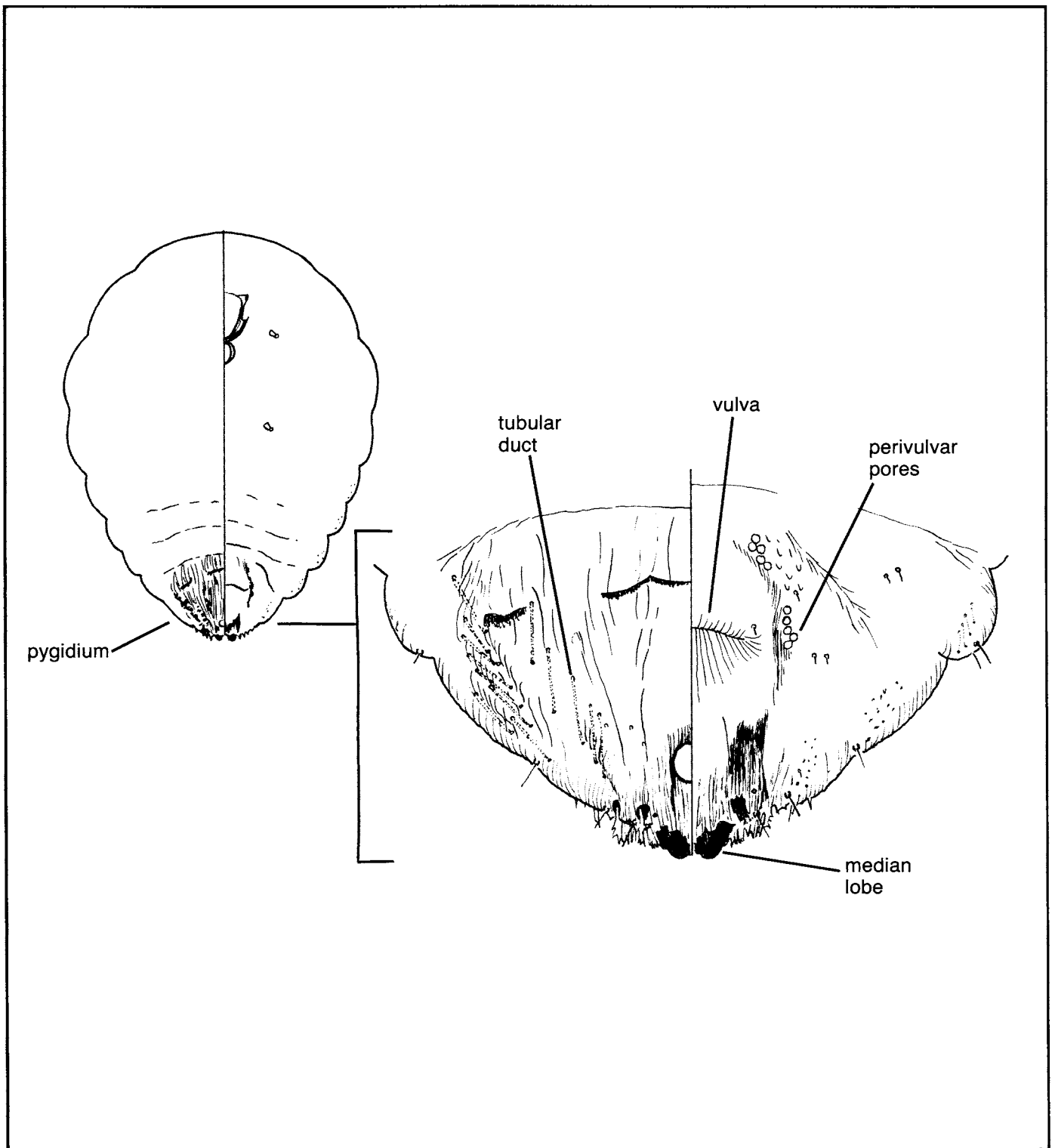


Figure 25.19. *Latania* scale, *Hemiberlesia lataniae* (Diaspididae).

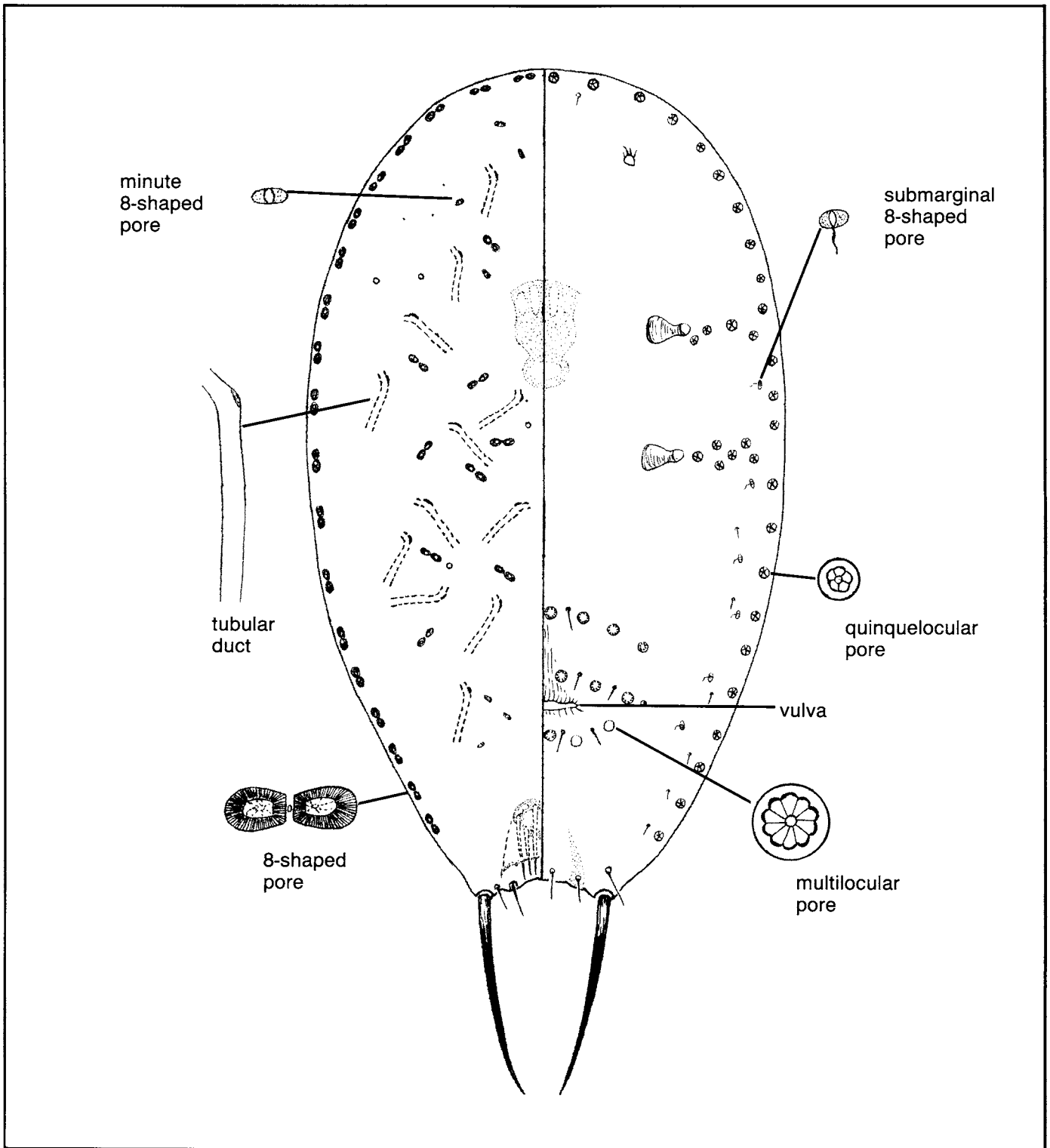


Figure 25.20. A pit scale, *Asterolecanium* sp. (Asterolecaniidae).

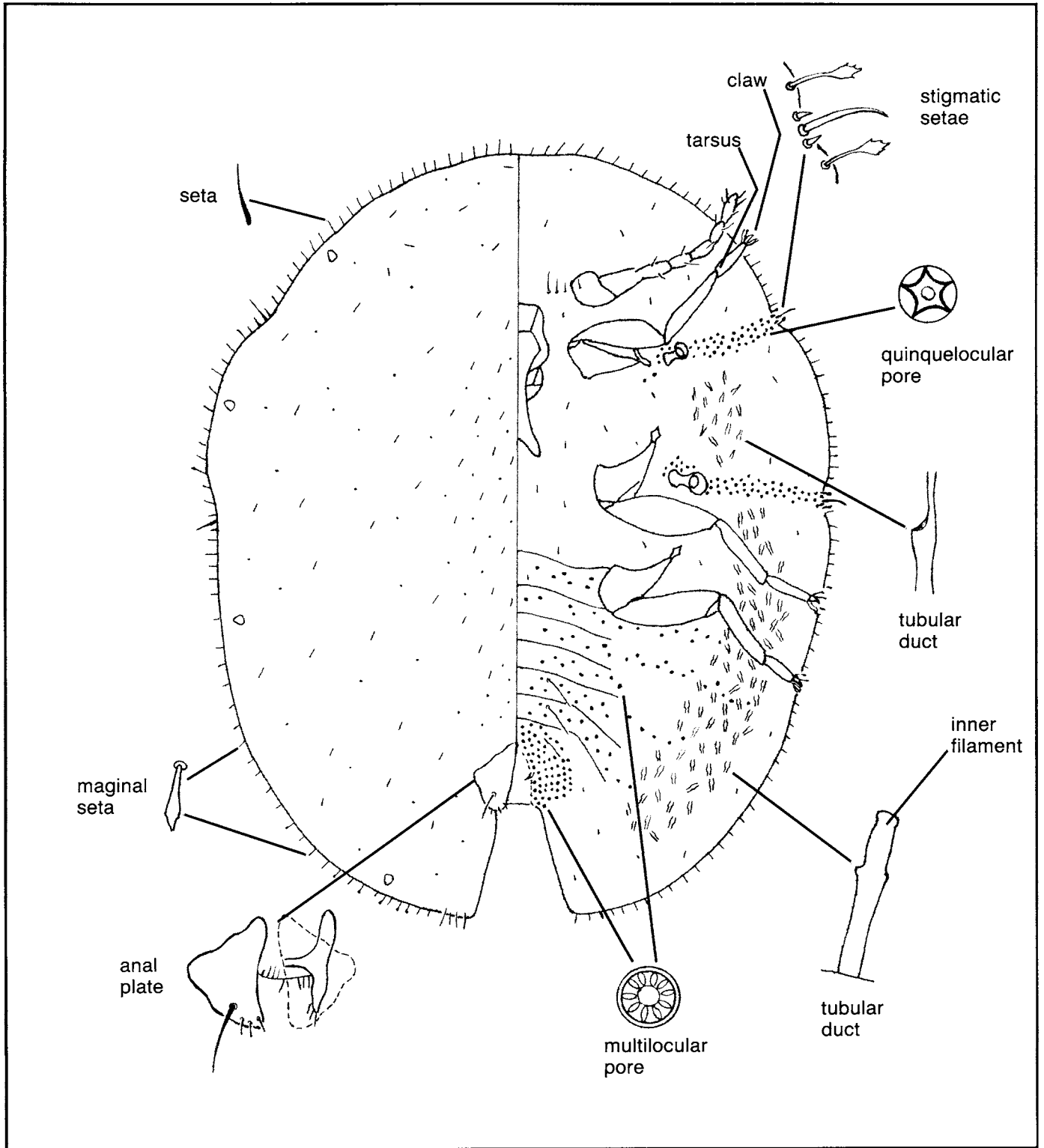


Figure 25.21. Hemispherical scale, *Saissetia coffeae* (Coccidae).

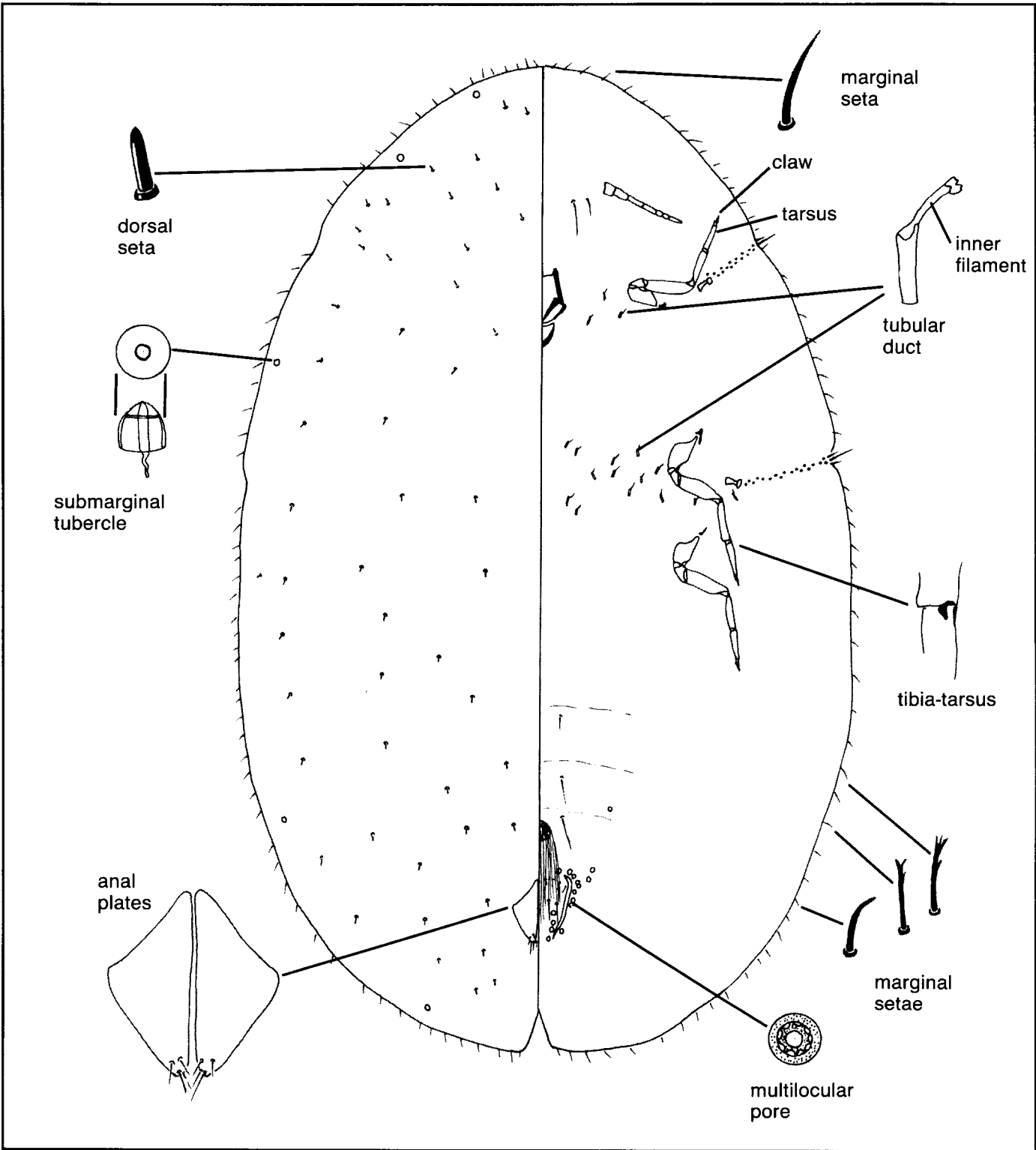


Figure 25.22. **Brown soft scale**, *Coccus hesperidum* (Coccidae).

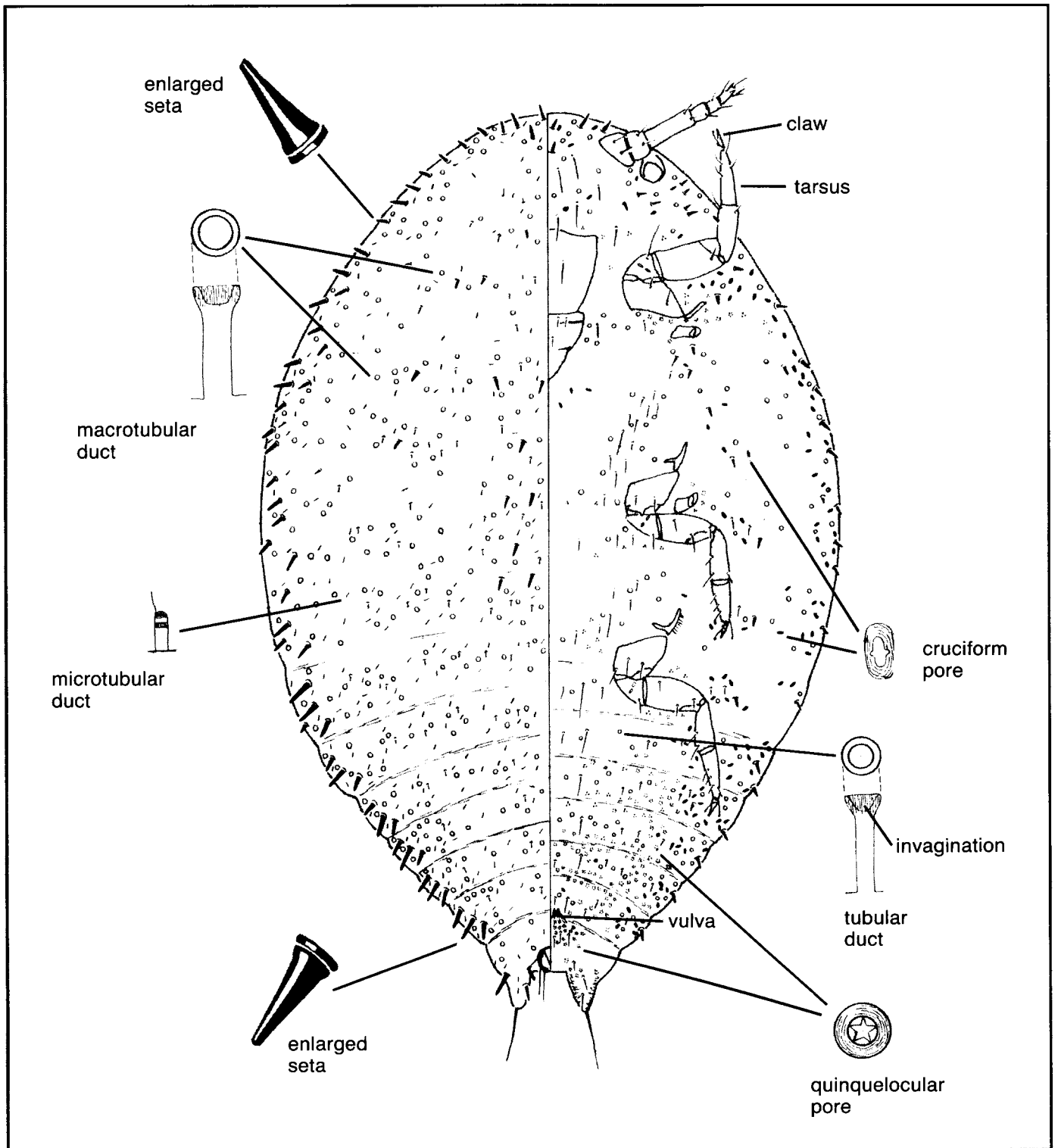


Figure 25.23. *Eriococcus coccineus* Cockerell (Eriococcidae).

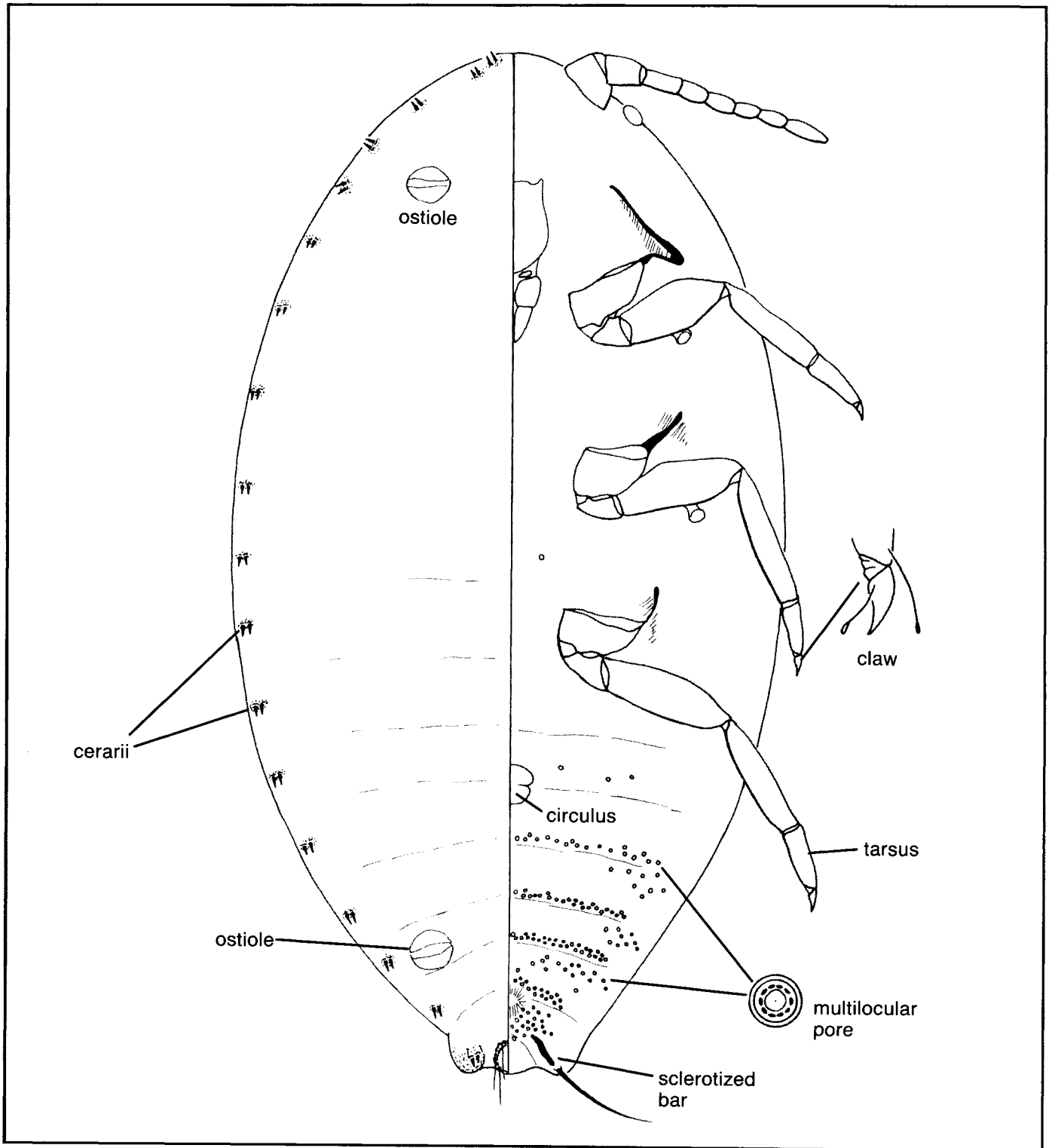


Figure 25.24. Citrus mealybug, *Planococcus citri* (Pseudococcidae).

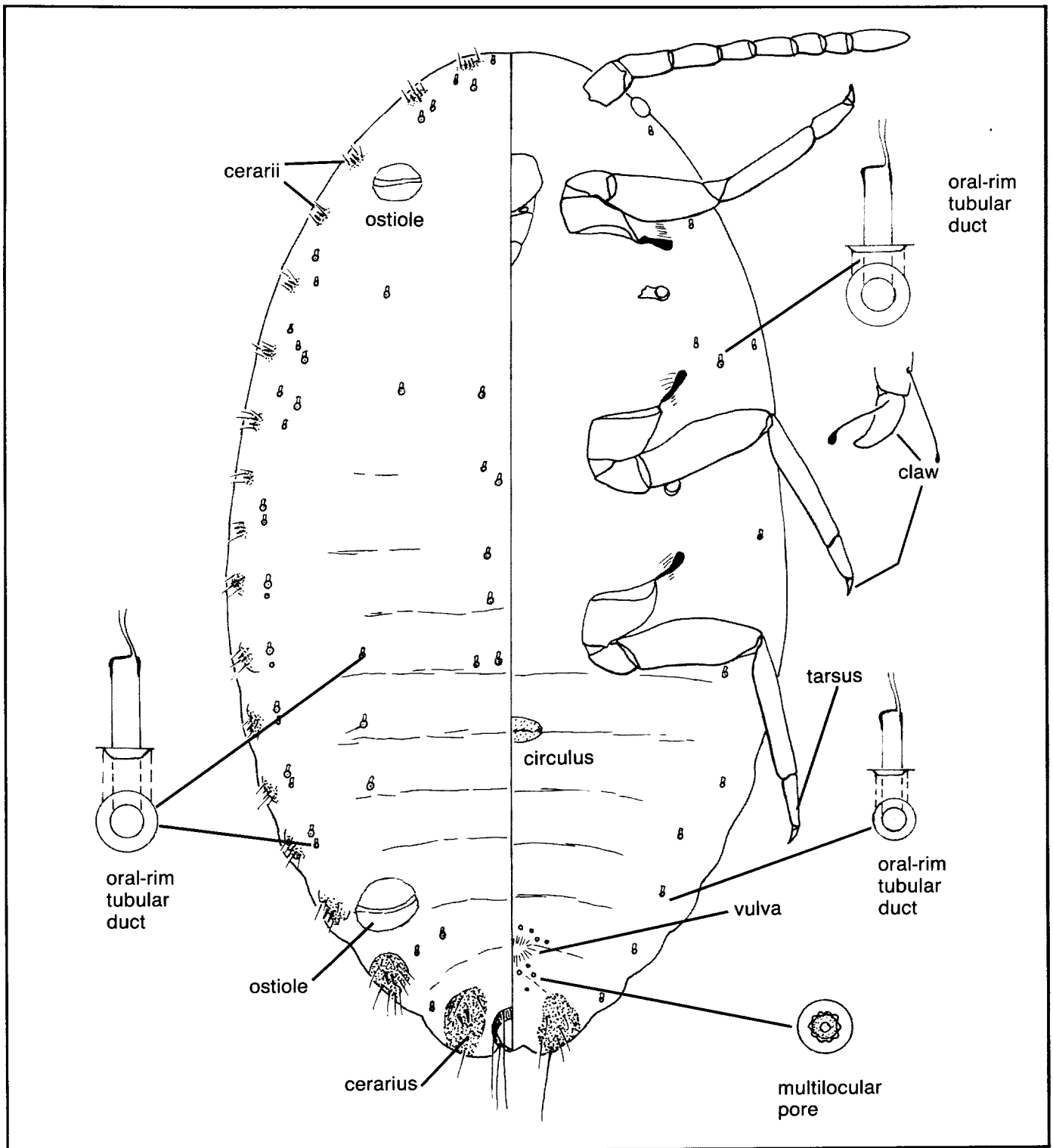


Figure 25.25. Longtailed mealybug, *Pseudococcus longispinus* (Pseudococcidae).



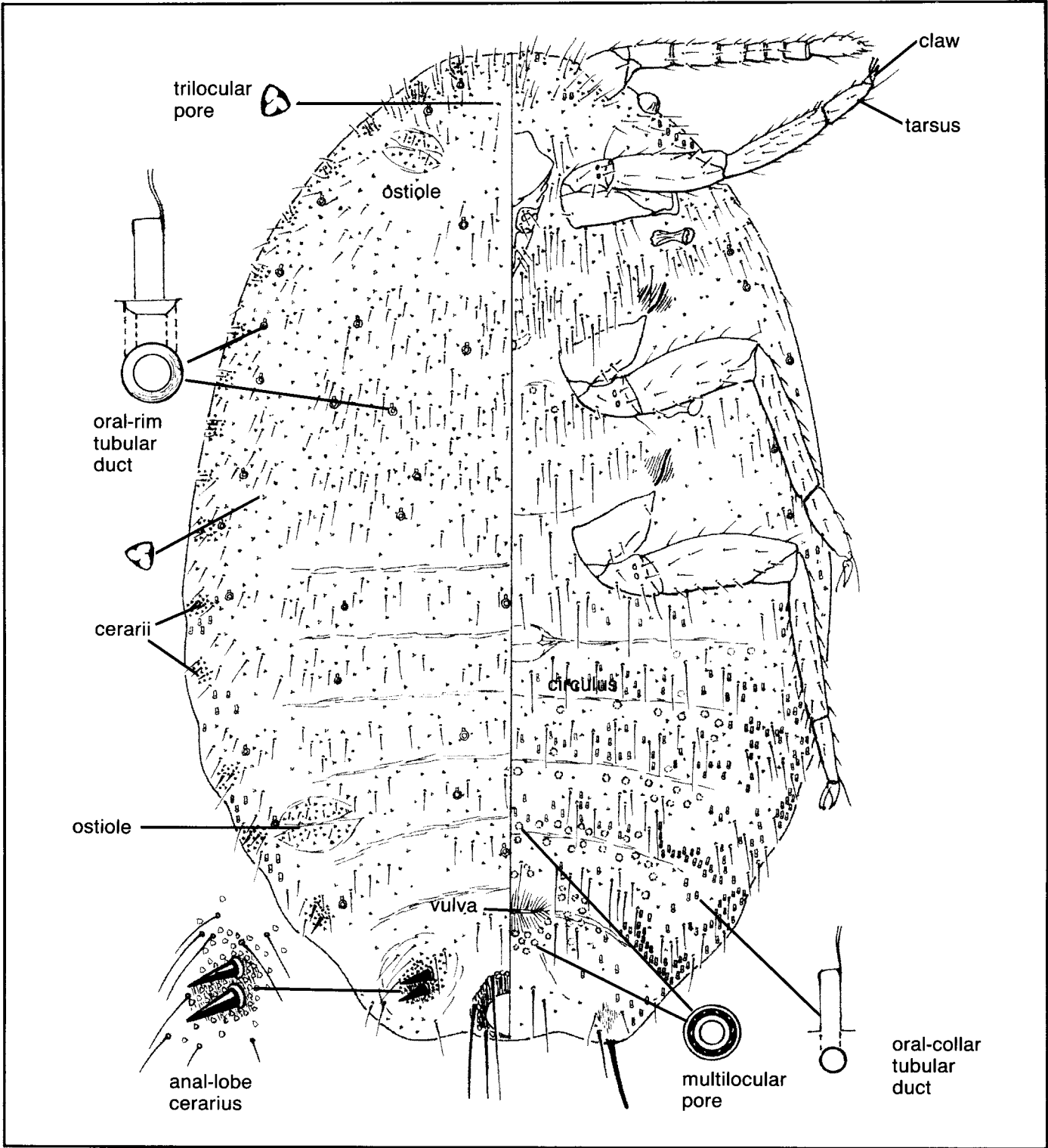


Figure 25.26. Grape mealybug, *Pseudococcus maritimus* (Pseudococcidae).

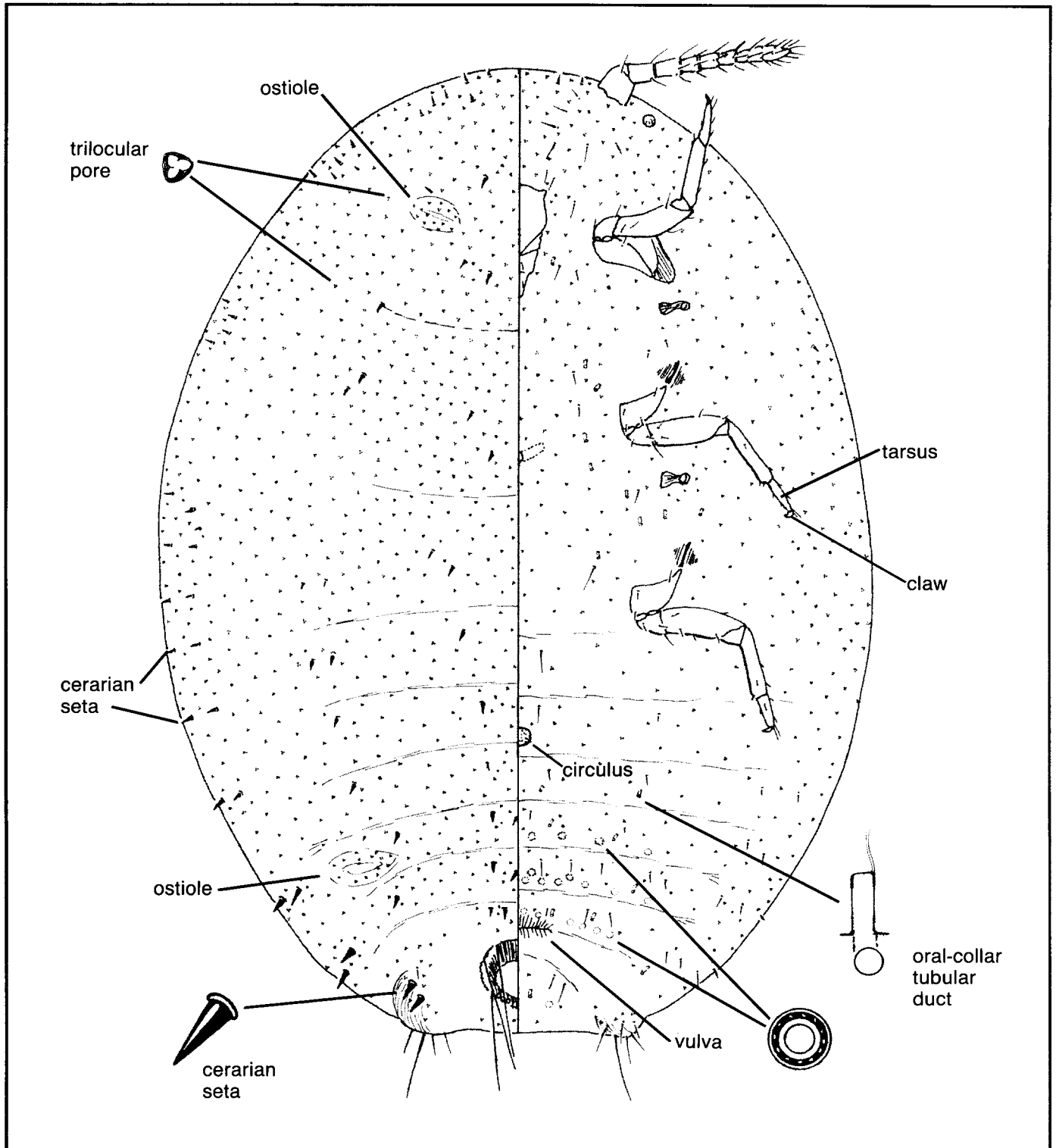


Figure 25.27. Coconut mealybug, *Nipaecoccus nipae* (Pseudococcidae).

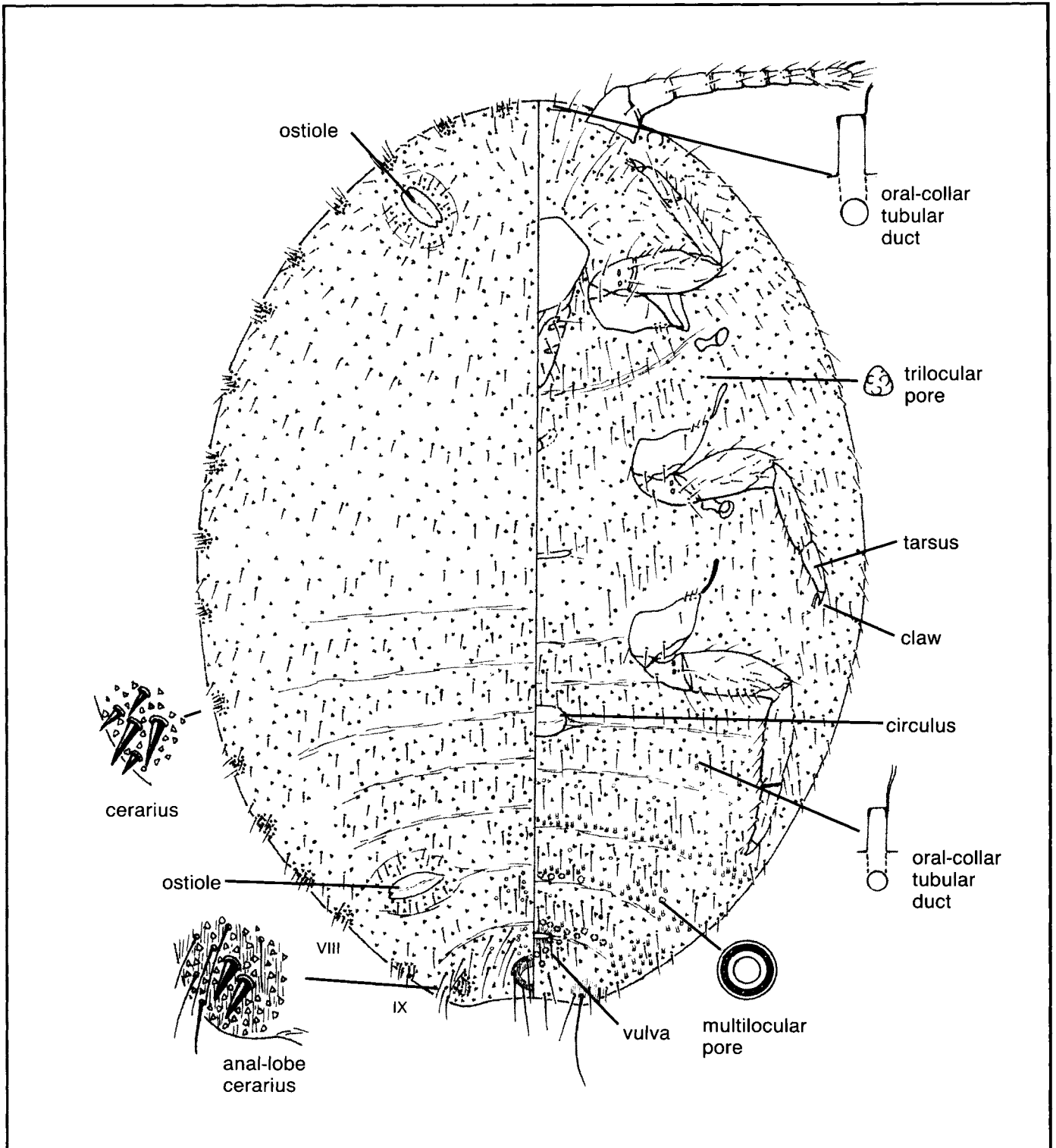


Figure 25.28. Pineapple mealybug, *Dysmicoccus brevipes* (Pseudococcidae).

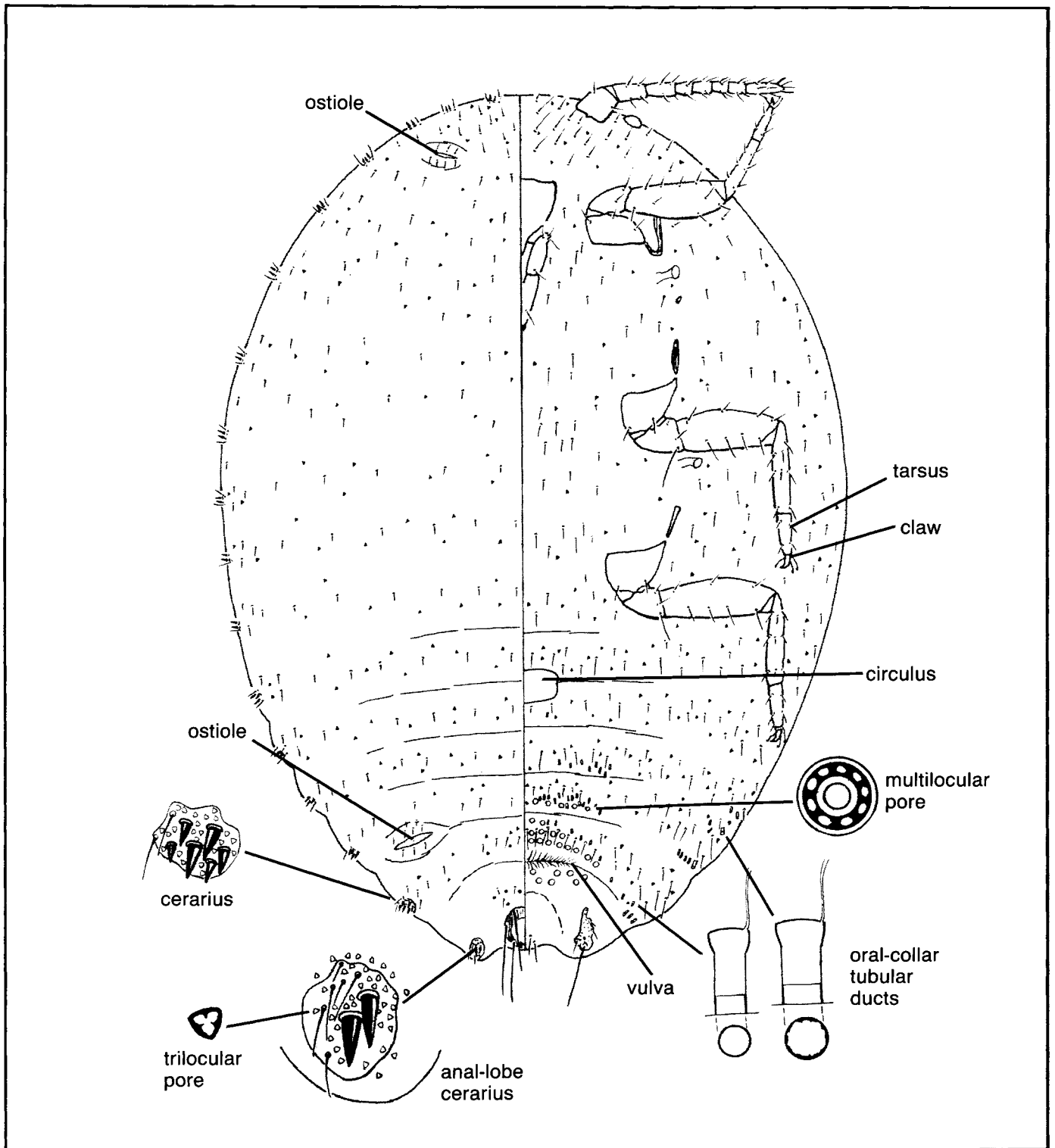


Figure 25.29. Gray pineapple mealybug, *Dysmicoccus neobrevipes* (Pseudococcidae).

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The Order Hymenoptera is among the largest and most highly evolved group within the Class Insecta. More than 100,000 species have been described and ultimately this number will be substantially larger when the taxonomic diversity of this order becomes more fully understood. This order is especially interesting because of its biological diversity. Some species are phytophagous, feeding on many agricultural and ornamental plants, but most of the species are beneficial in that they pollinate angiosperms or prey upon or parasitize destructive insects.

Most of the hymenopterous insects found in stored food are associated with stored-product pests. All the Hymenoptera known to be associated with stored products are members of the Suborder Apocrita (= Clistogastra or Petiolata). These insects may be recognized readily by the characteristic modifications of the thorax and abdomen: The first abdominal segment (propodeum) has become fused with the thorax and separated from the rest of the abdomen by a narrow constriction. The movable portion of the abdomen is called the gaster (the term used in this key) or metasoma (3). Wings, when present, are membranous; hind wings have no more than two closed cells (see fig. 26.2B).

The many species associated with stored products, all belonging to the Suborder Apocrita, do not comprise a homogenous group. Member species belong to several distantly related groups: Ichneumonoidea (Braconidae, Ichneumonidae), Evanioidea (Evanioidea), Chalcidoidea (Chalcididae, Encyrtidae, Eulophidae, Eupelmidae, Eurytomidae, Pteromalidae, Trichogrammatidae), and Chrysidoidea (Bethyloidea).

In some species males are rare or unknown, so I have excluded them from consideration here. The following key is based on female wasps. Selected morphological features are shown in figures 26.1 and 26.2, drawings that are based on those of Graham (2). Where specimens for some species were not available for study, I selected characters from the literature. In some instances in this key I have relied heavily on recently published keys, such as that of Evans (1) for the Bethyloidea. Sometimes it has not been possible to provide keys to species in certain genera because the taxonomy of the group is too uncertain. For example, this key gives generic names only for many pteromalids and trichogrammatids. Specific identifications can be done only by specialists in these groups.

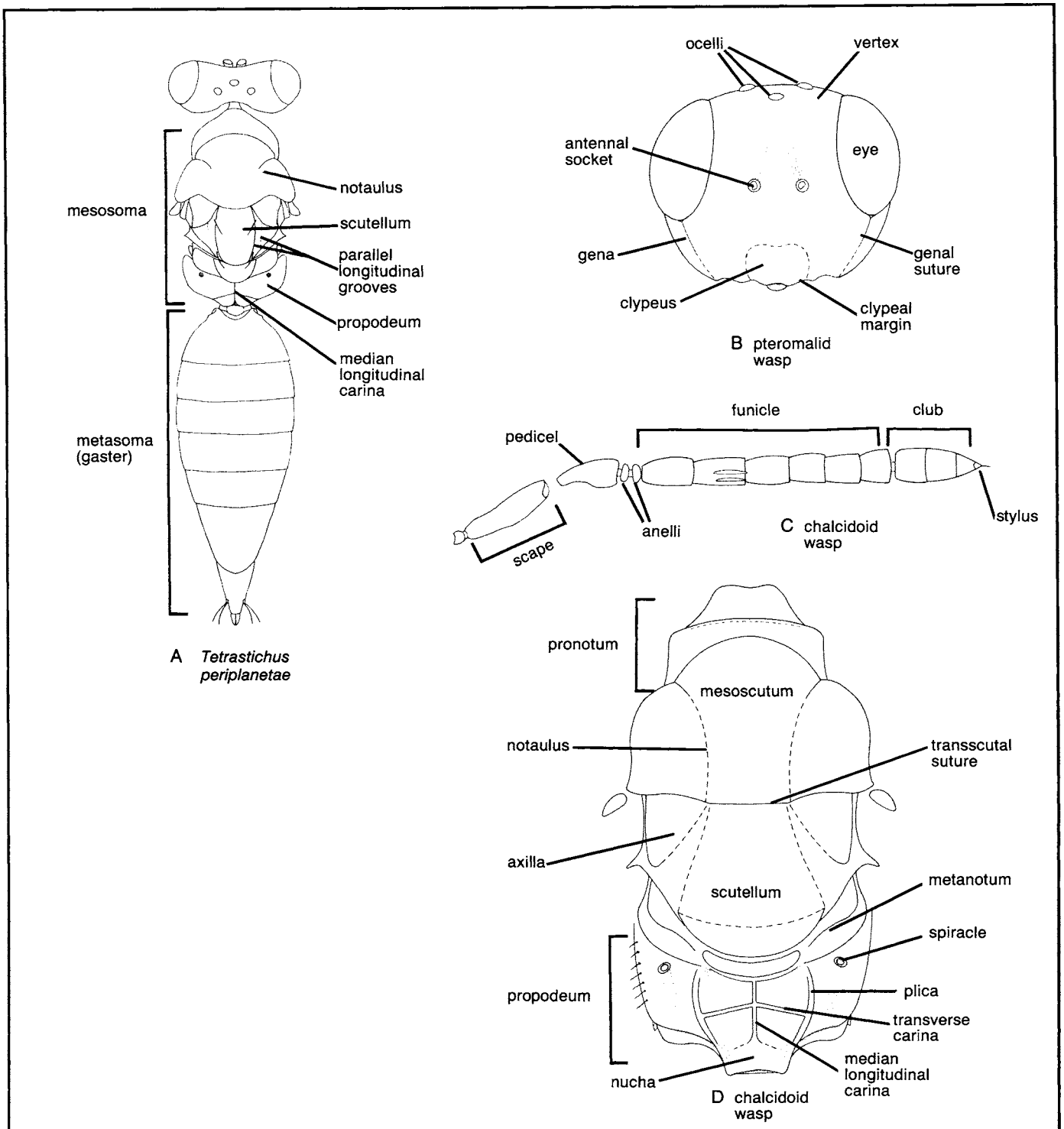


Figure 26.1. Selected morphological features of female Apocrita: A, body, dorsal view; B, head, anterior view; C, antenna; D, thorax, dorsal view. (Drawings by P. Mote.)

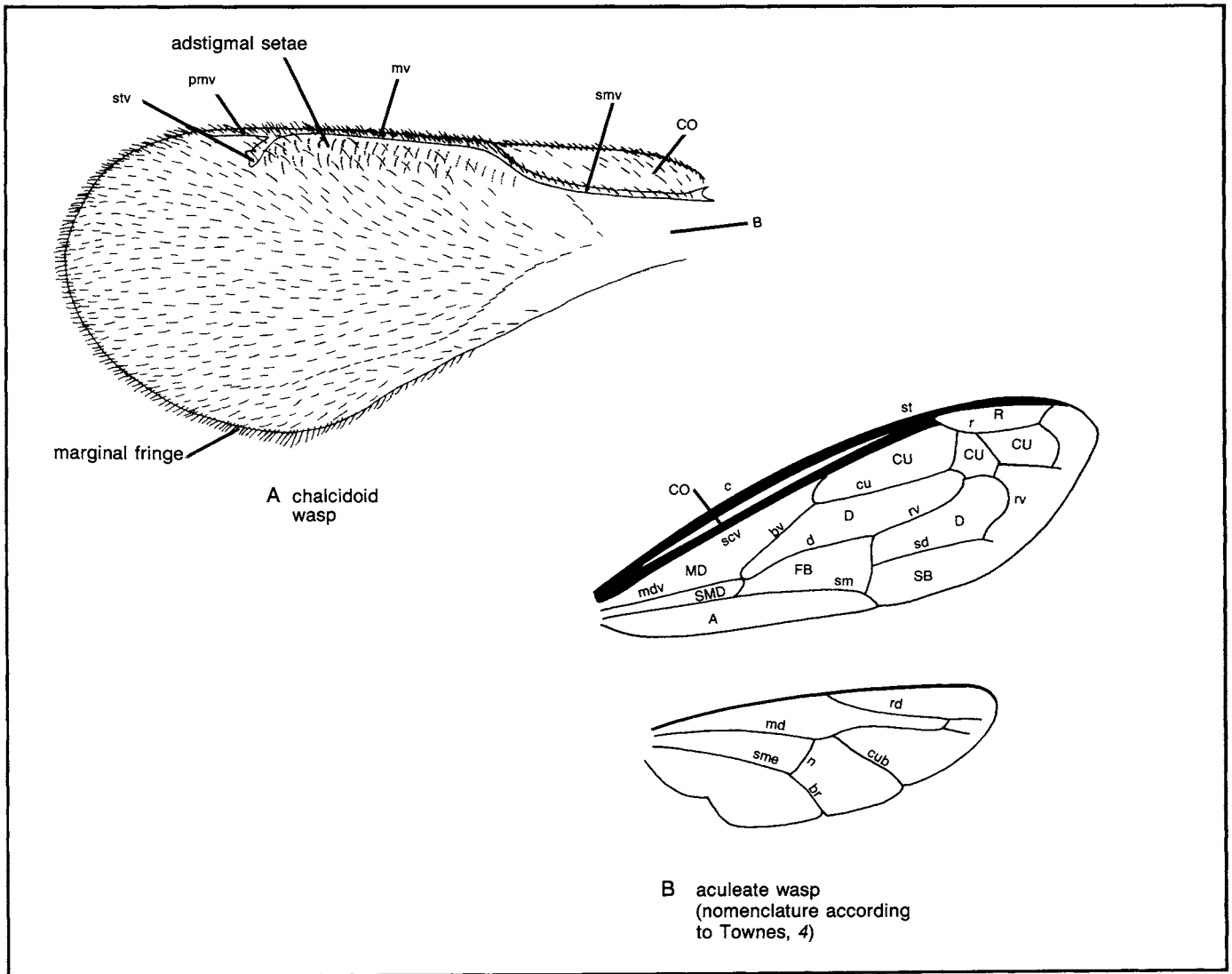


Figure 26.2. Wings of female Apocrita: A, forewing with reduced venation; B, wings with well-developed venation. The abbreviations given here apply to all wing drawings in this chapter. Veins: a, anal; br, brachiella; bv, basal; c, costal; cu, cubital; cub, cubitella; d, discoidal; ic, intercostal; md, mediella; mdv, median; mv, marginal; n, nervellus; pmv, postmarginal; r, radial; rd, radiella; rv, recurrent; scv, subcostal; sd, subdiscoidal; sm, submedius; sme, submediella; smv, submarginal; st, stigma; stv, stigmal; tm, transverse median. Cells: A, anal; AR, areolet; B, basal; CO, costal; CU, cubital; D, discoidal; DC, discocubital; FB, first brachial; FCU, first cubital; FD, first discoidal; M, marginal; MD, median; R, radial; SB, second brachial; SCU, second cubital; SD, second discoidal; SM, submarginal; SMD, submedian; TCU, third cubital; TD, third discoidal. (Drawings by P. Mote.)



**KEY TO PARASITICA  
IN STORED PRODUCTS**

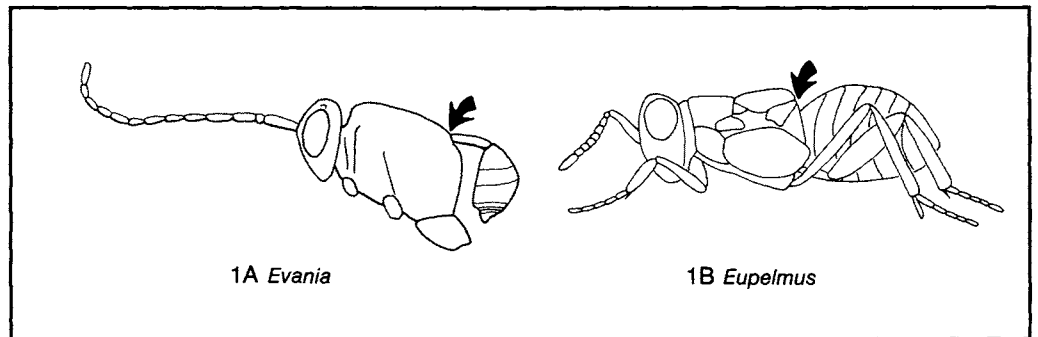
Drawings by G. Gordh, P. Mote,  
and S. McAlpine.

- 1 Petiole attached high on propodeum, well removed from coxa III (1A). *Evaniidae* (**ensign wasps**)----- 2

Petiole long, cylindrical; gaster strongly compressed.

- Petiole attached near or above base of coxa III (petiole frequently obscured) (1B)---- 4

Petiole length variable.



- 2 Tibia and tarsus III with conspicuous spines----**lesser ensign wasp, *Szepligetella sericea***

Distribution: Pacific islands from Hawaii to the Philip-  
pines and New Guinea. Hosts: Blattaria (oothecae).

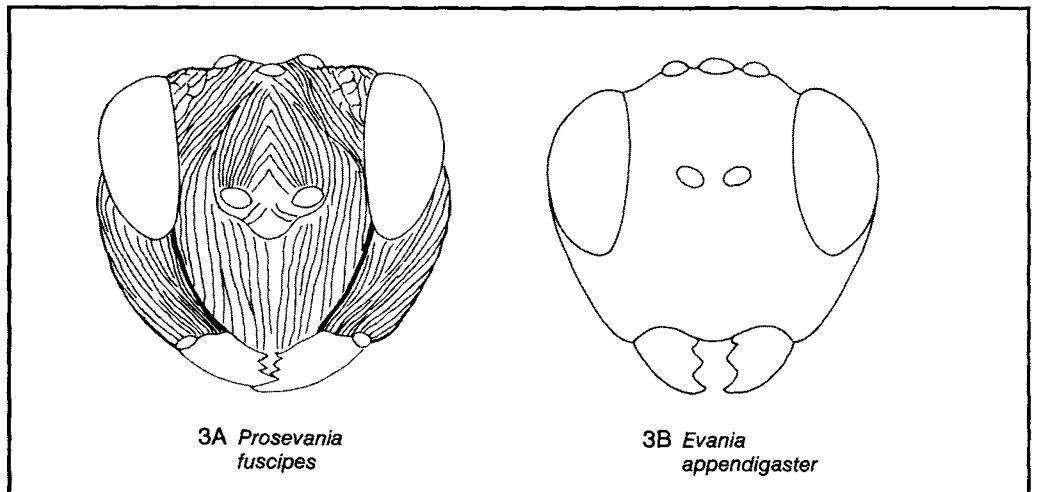
- Tibia and tarsus III without conspicuous spines ----- 3

- 3 Face and gena with longitudinal oblique striae (3A)-----*Prosevania fuscipes*

Distribution: Asia, Europe, Nearctic, North Africa. Hosts:  
Blattaria (oothecae).

- Face and gena smooth, bearing a few fine punctures (3B) -----*Evania appendigaster*

Distribution: Worldwide. Hosts: Blattaria (oothecae).



4 Forewing venation reduced but always with a costal cell, marginal vein, stigmal vein, and usually a postmarginal vein (4A, 12B; compare with 43A&B, 44A&B). Chalcidoidea (chalcids)-----

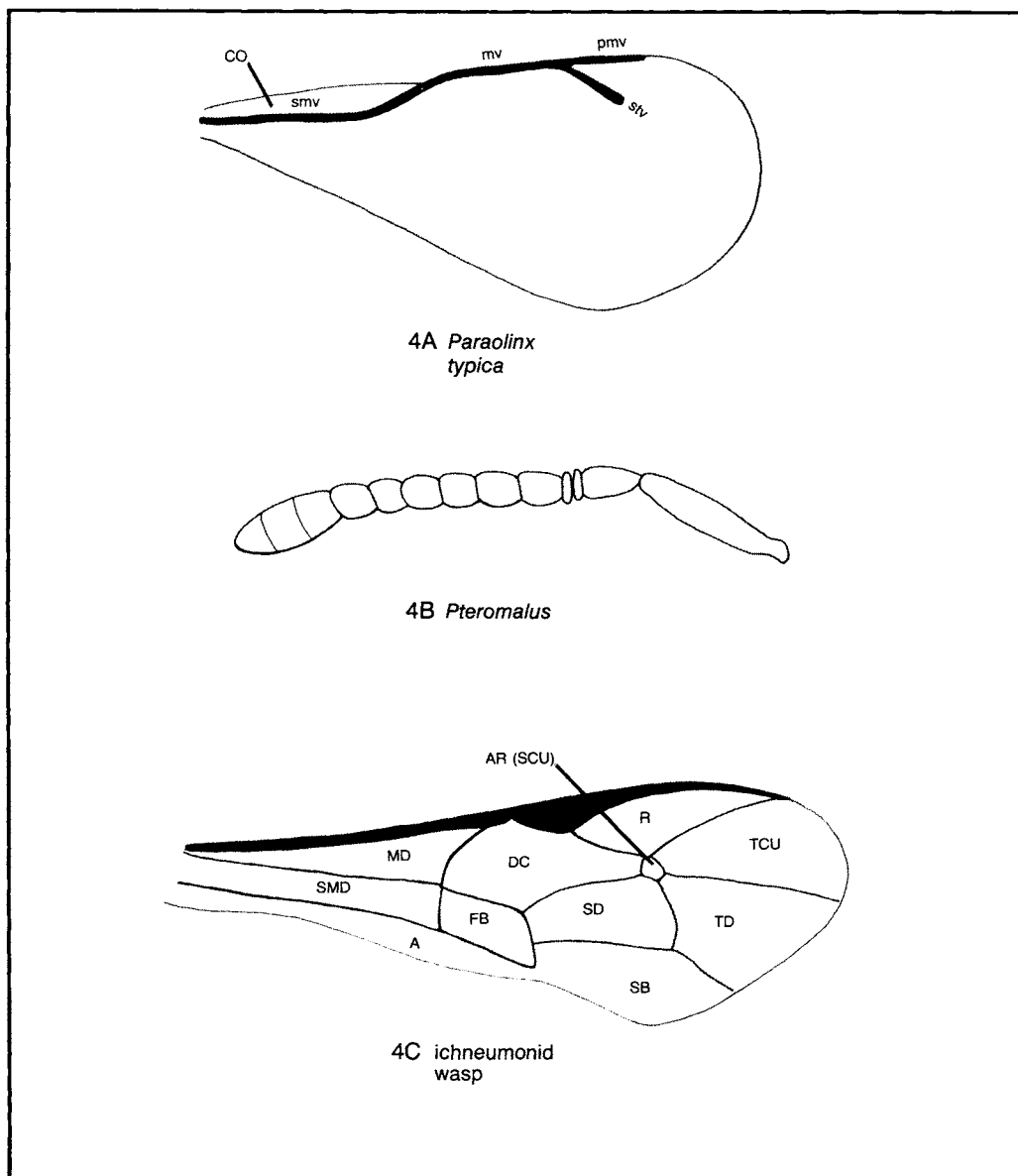
5

Antenna with 13 or fewer segments, including annular ring segments (4B); antennal club frequently formed from fused segments; postmarginal vein sometimes absent, as in *Tetrastichus* spp. (12D).

Forewing with many veins (4C); or if venation is reduced, then configuration not as above; or wings absent -----

35

Antenna with 12 or more segments; annular ring segments absent.

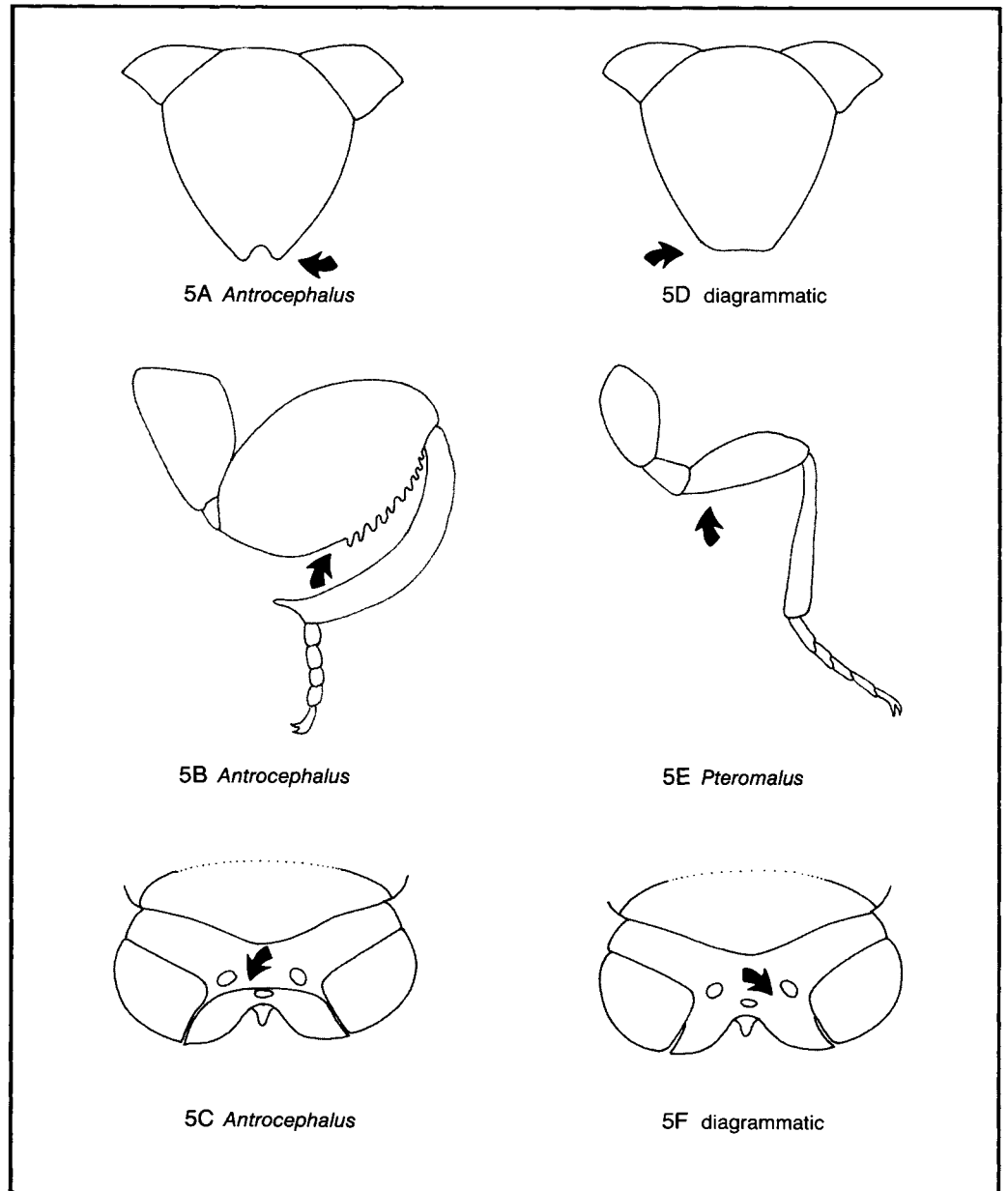


5 Scutellum with 2 toothlike projections (5A). Chalcididae (chalcidids). Genus *Antrocephalus* 6

Body rather robust; coxa and femur III enlarged and plump; femur III often with tubercles along ventral margin (5B); head with a sharp carina along medial margin of compound eye and extending behind median ocellus (5C).

Scutellum without apical projections (5D)----- 7

Body not as robust; femur III without tubercles (5E); head usually lacking a sharp carina, but if present, then not extending behind ocellus (5F).



6 Median carina of propodeum curved or arched -----*Antrocephalus mahensis*

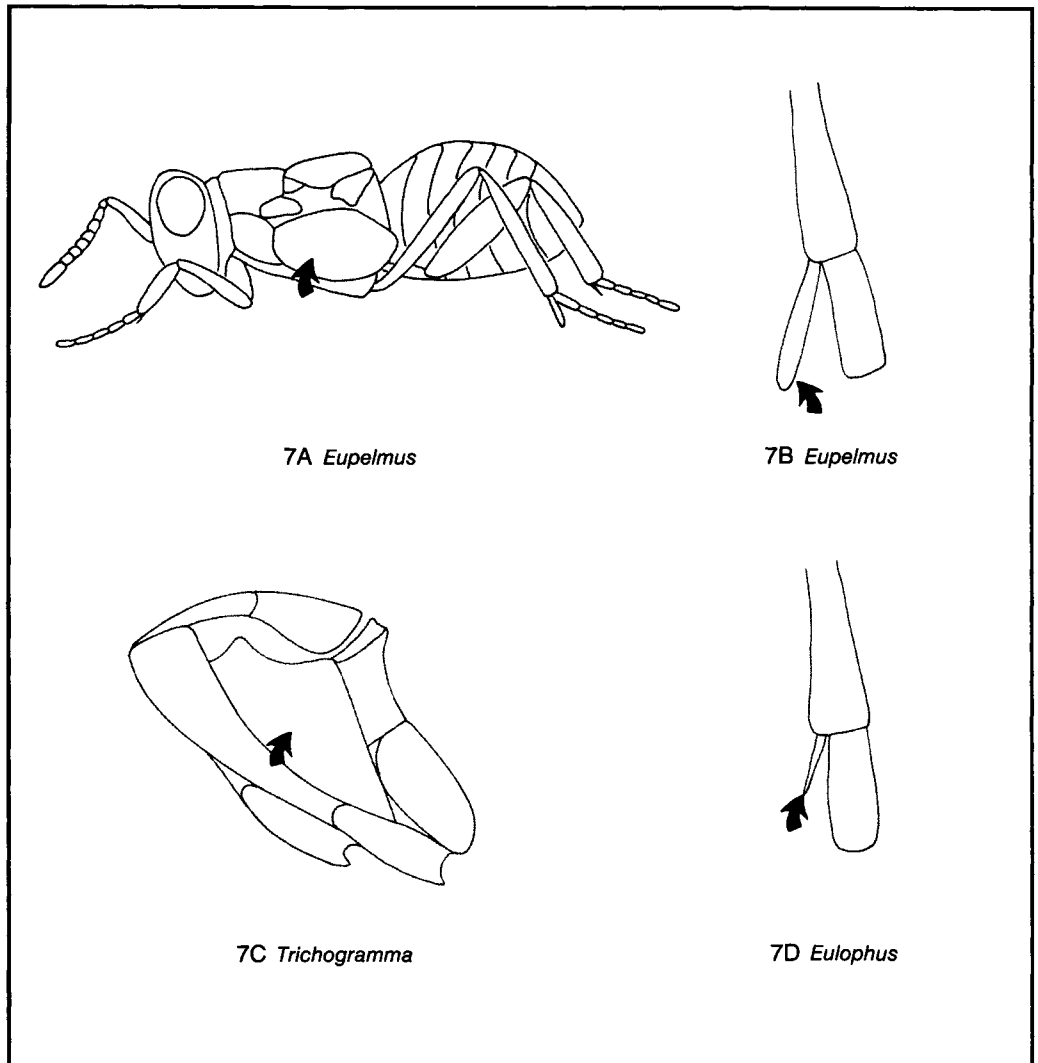
Distribution: Seychelles. Hosts: Pyralidae.

Median carina of propodeum straight -----*Antrocephalus aethiopicus*

Distribution: Ethiopian. Hosts: Pyralidae.

7 Mesopleuron convex, enlarged, not impressed (7A); pleural sutures not evident in lateral aspect; spur of tibia II enlarged and bluntly rounded apically (7B). Eupelmidae (eupelmids). Genus *Eupelmus* ----- 8

Mesopleuron not convexly enlarged, usually distinctly impressed (7C); pleural sutures evident; spur of tibia II not enlarged, usually pointed (7D)----- 9



8 Gonostyli (ovipositor sheaths) mostly whitish but with base and apex dark---*Eupelmus javae*

Distribution: Indo-Australian. Hosts: Larval Coleoptera.

Gonostyli mostly bluish with yellow coloration surrounding the medial portion

-----*Eupelmus cushmani*

Distribution: Nearctic. Hosts: *Araecerus fasciculatus*; also known from *Acanthoscelides ochraceicolor* (Pic), *Anthonomus grandis grandis* Boheman, *Cylindrocopturus adpersus* (LeConte), *C. longulus* (LeConte), *Lixus scrobicollis* Boheman, *Mimosestes nubigena* (Motschulsky), *Trichobaris texana* LeConte.

9 Tarsal formula 3-3-3; body minute, less than 0.75 mm long. Trichogrammatidae  
(trichogrammatid wasps)-----*Trichogramma*

Distribution: Worldwide. Hosts: Lepidopteran eggs. See 7C.

Tarsal formula 4-4-4 or 5-5-5; body length always greater than 1.0 mm----- 10

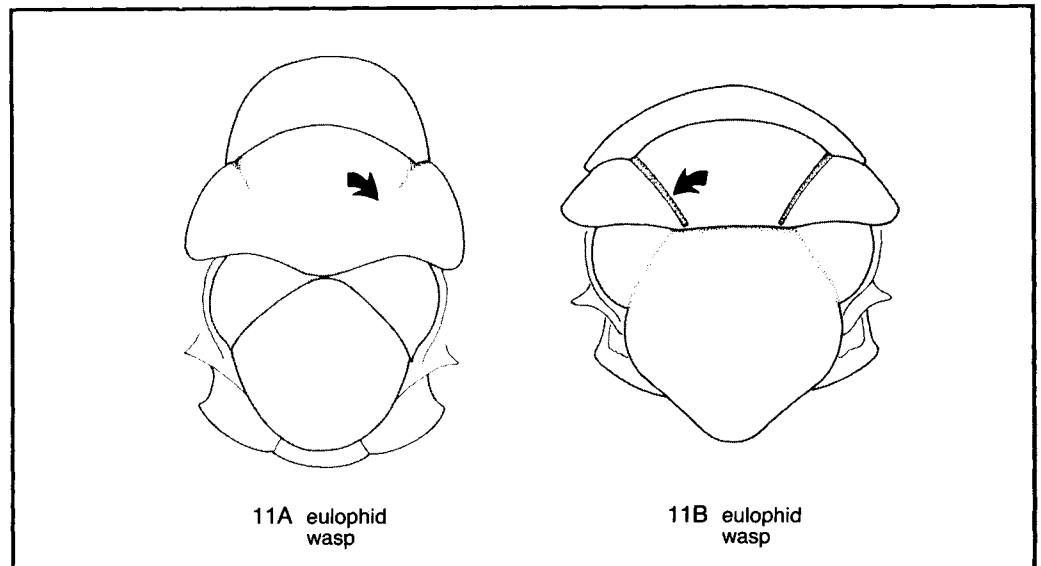
10 Tarsal formula 4-4-4. Eulophidae (eulophids)----- 11

Tarsal formula 5-5-5----- 16

11 Notauli incomplete, not extending posteriorly to transscutal suture (11A)  
-----*Entedon longiventris*

Distribution: Palearctic. Hosts: Coleopteran larvae.

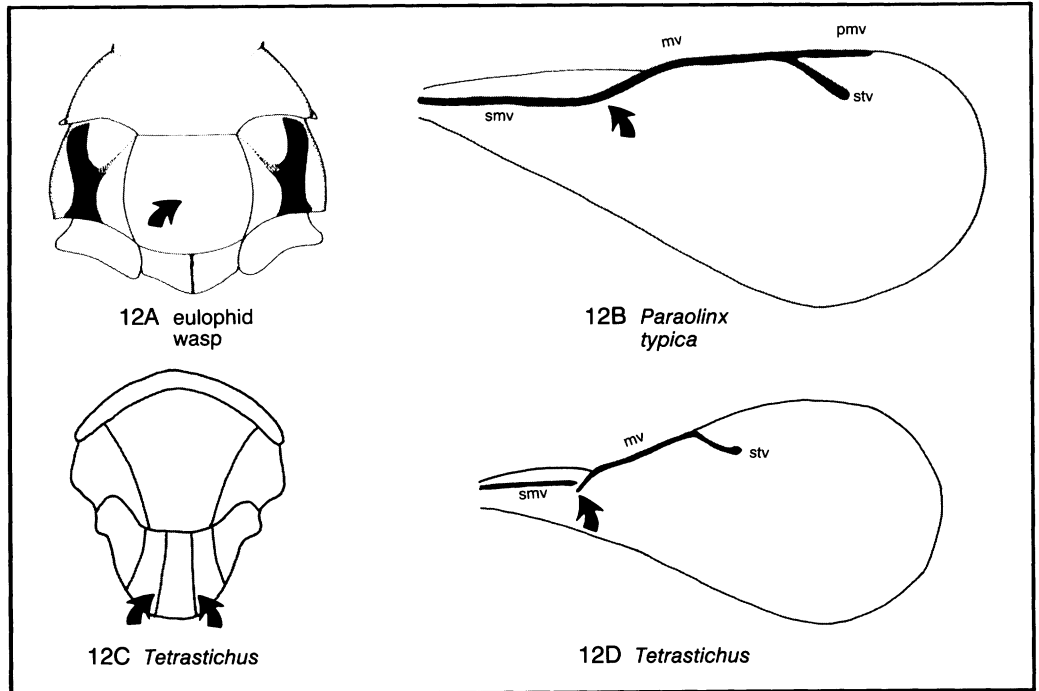
Notauli complete, extending from posterior margin of pronotum to transscutal suture (11B) 12



- 12 Scutellum without 2 grooved lines (similar to 12A); postmarginal vein as long as or longer than stigmal vein (12B); submarginal and marginal veins smoothly joined (12B)-----*Paraolinx typica*

Formerly called *P. nigriventis*.  
 Distribution: Eastern Nearctic. Hosts: *Grapholita molesta*,  
*Pyroderces rileyi*.

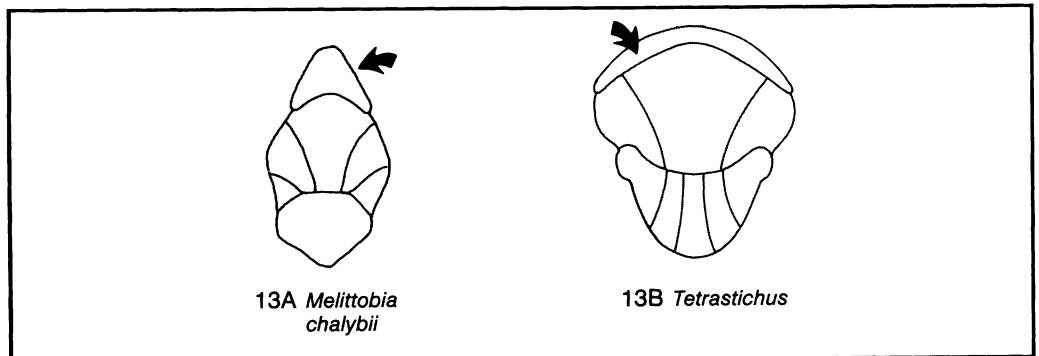
- Scutellum with 2 longitudinal, parallel, grooved lines (12C); postmarginal vein absent (12D); submarginal and marginal veins not smoothly joined (12D)----- 13



- 13 Pronotum unusually long, campanulate (13A); thorax depressed; genal suture absent -----*Melittobia chalybii*

Distribution: Nearctic. Hosts: Blattaria (oothecae), various  
 Hymenoptera.

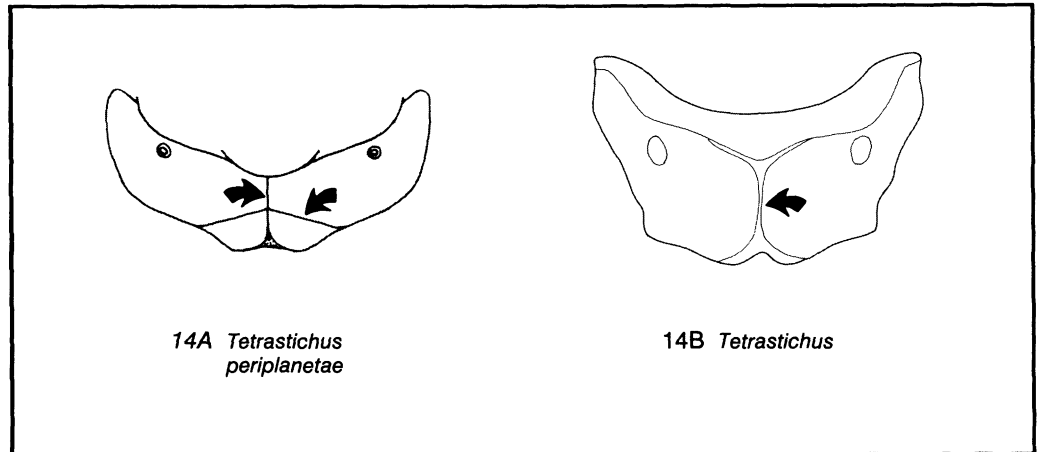
- Pronotum not unusually long (13B); thorax mostly convex; genal suture present ----- 14



14 Propodeum with a median longitudinal carina and 2 lateral (transverse) carinae (14A) ----- *Tetrastichus periplanetae*

Distribution: Ethiopian. Host: *Periplaneta americana*. See also text figure 26.1A.

Propodeum with only a median longitudinal carina (14B) ----- 15

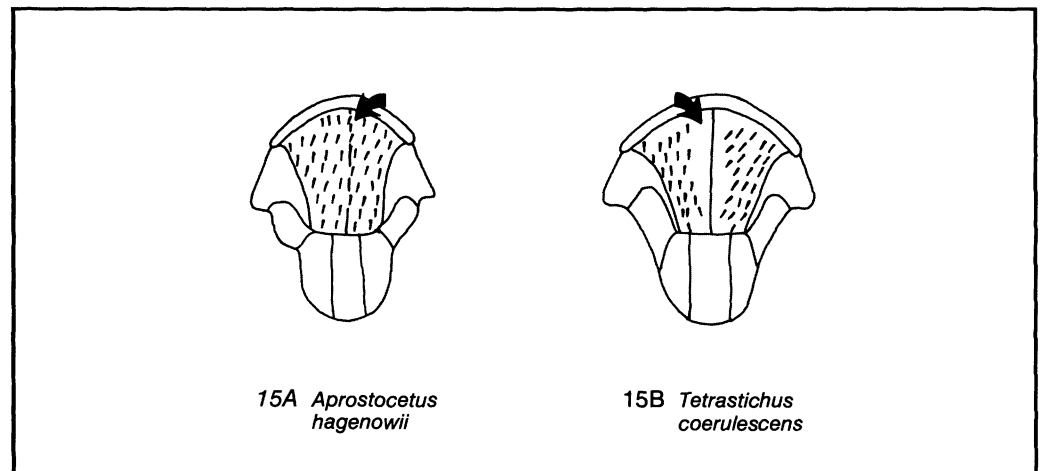


15 Setae on mesoscutum uniformly distributed over surface (contiguous with median longitudinal sulcus) (15A) ----- *Aprostocetus (Tetrastichodes) hagenowii*

Distribution: Nearctic. Hosts: Blattaria (oothecae).

Setae on mesoscutum arranged in 3 to 5 rows adjacent to notauli (absent from meson) (15B) ----- *Tetrastichus coeruleascens*

Distribution: Nearctic. Hosts: Larval Lepidoptera.

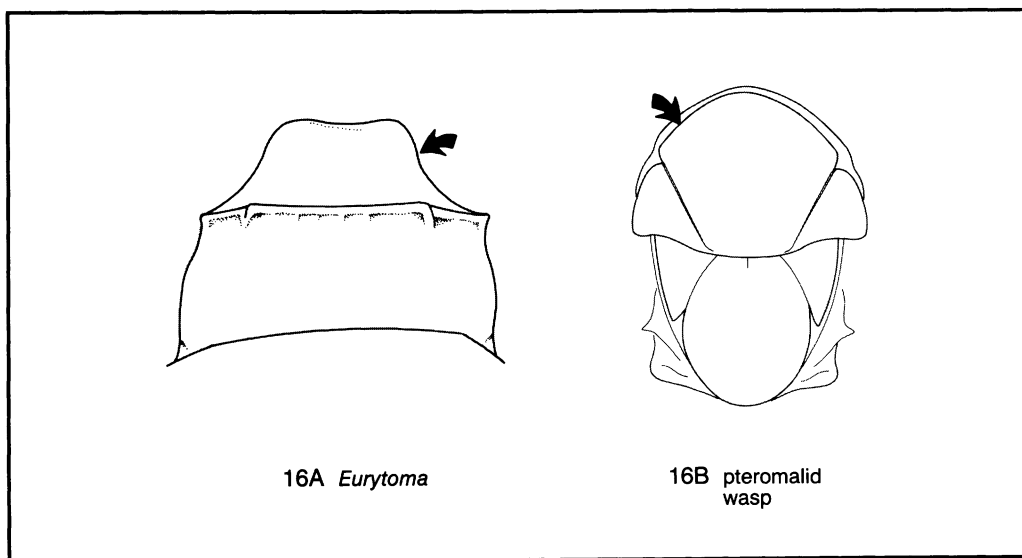


- 16 Pronotum quadrate in outline when viewed from above (16A); gaster compressed.  
 Eurytomidae (seed chalcids, eurytomids)----- 17

Head and thorax strongly punctate; body without metallic coloration.

- Pronotum not quadrate when viewed from above (16B), or if quadrate, then gaster not compressed. Pteromalidae (pteromalids)----- 19

Head and thorax usually not punctate, but if punctate, then body not robust and usually depressed, with head prognathous; body frequently with metallic or pale coloration.



- 17 Metanotum shorter than scutellum when viewed from above; coxa III and petiole each without a dorsal longitudinal channel-----*Eurytoma tylodermatis*

Distribution: Nearctic. Hosts: Larvae of Lepidoptera and Coleoptera.

- Metanotum longer than scutellum when viewed from above; coxa III and petiole with a dorsal longitudinal channel. Genus *Aximopsis*----- 18

- 18 Legs mostly reddish-----*Aximopsis tephrosiae*

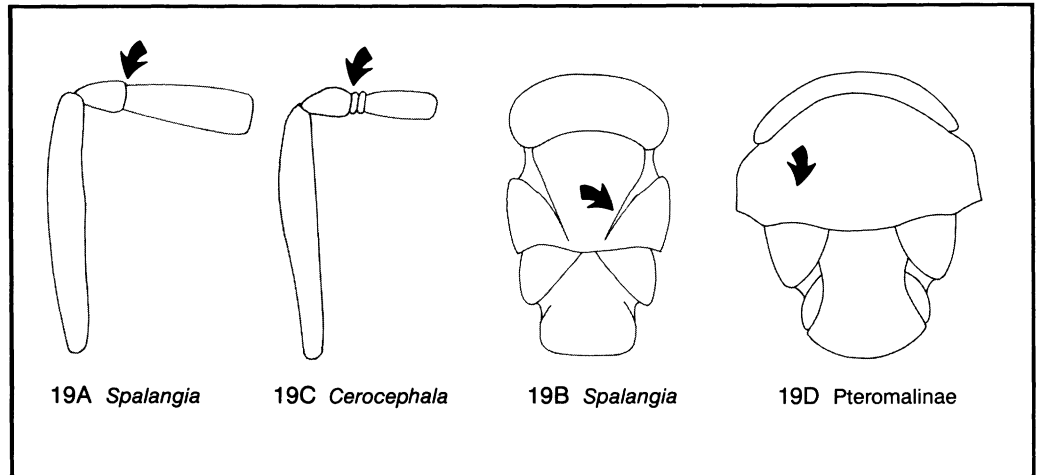
Distribution: Indo-Australia. Host: *Araecerus fasciculatus*.

- Legs mostly black-----*Aximopsis javensis*

Distribution: Indo-Australian. Host: *Araecerus fasciculatus*.



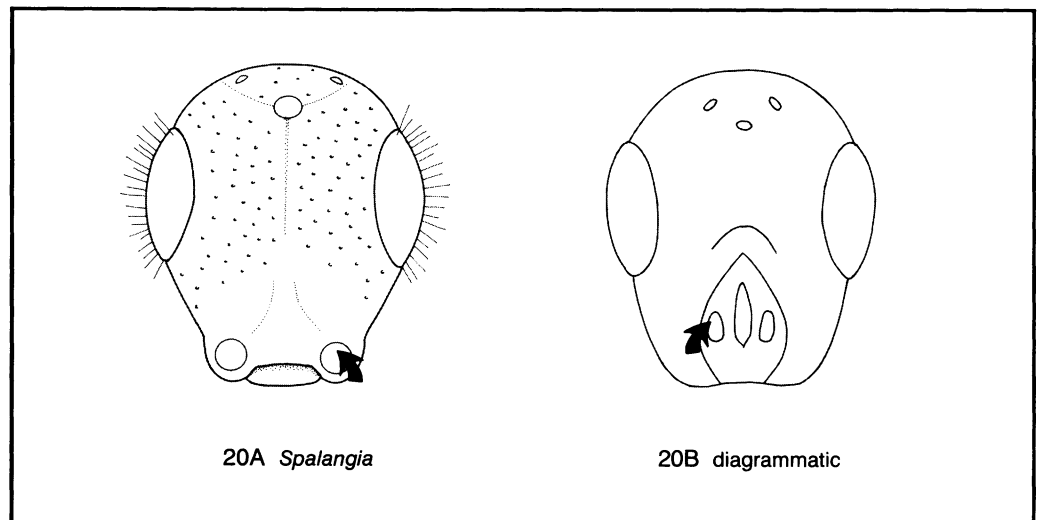
- 19 Antenna without annular ring segments (19A); notauli complete, extending from pronotum to transscutal suture (19B)----- 20  
 Antenna with at least 1 annular ring segment (19C); notauli incomplete, not extending from pronotum to transscutal suture (19D)----- 26



- 20 Antenna inserted at extreme anterior margin of head on facial lobes that extend ventrad of clypeus (20A); tibia III with 1 spur; body black or weakly metallic; head and thoracic dorsum with pits----- *Spalangia*

Distribution: Worldwide. Hosts: Puparia of Diptera. See also 19A&B.

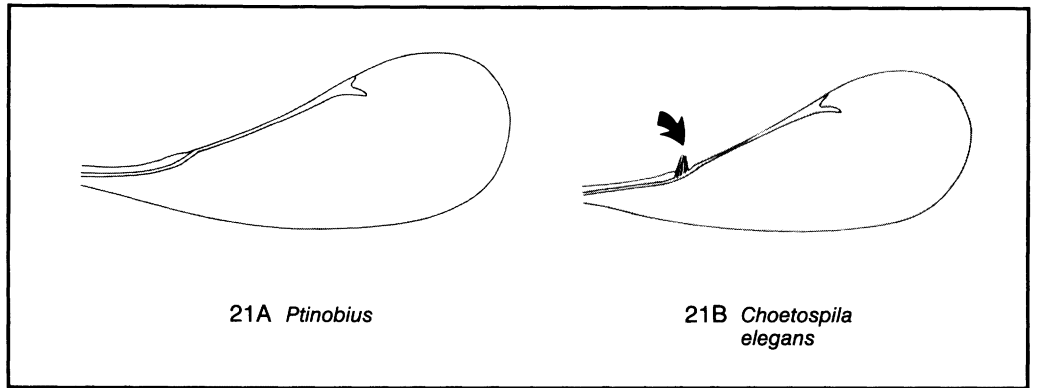
- Antenna inserted at a point at least slightly separated from extreme anterior margin of head (not inserted on facial lobes) (20B); tibia III with 2 spurs; body usually a pale color, but if dark, then lacking pits on head and thorax----- 21



21 Forewing without a conspicuous tuft of setae at junction of submarginal and marginal veins (21A); eye with conspicuous setae----- *Ptinobius*

Distribution: Nearctic. Hosts: Coleoptera.

Forewing with a conspicuous tuft of setae at junction of submarginal and marginal veins (21B); eye without conspicuous setae ----- 22



22 Antennal funicle 5-segmented----- *Choetospila elegans*

Distribution: Worldwide. Hosts: *Lasioderma serricorne*, *Stegobium paniceum*, *Sitophilus granarius*, *S. linearis*, *S. oryzae*, *Sitotroga cerealella*. See couplet illustration 28C in chapter 18.

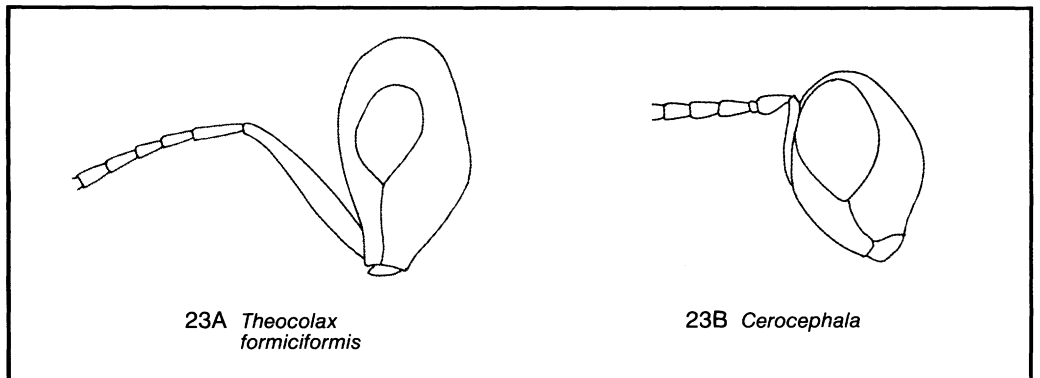
Antennal funicle 6-segmented ----- 23

23 Antenna inserted well below level of ventral margin of compound eye (23A) ----- *Theocolax formiciformis*

Usually micropterous. Distribution: Indo-Australian, Palearctic. Hosts: *Anobium* spp.

Antenna inserted at or above ventral margin of compound eye (23B). Genus *Cerocephala*----- 24

Usually macropterous.



24 Pronotum finely and completely longitudinally striate -----*Cerocephala aquila*

Distribution: Indo-Australian. Hosts: Coleoptera.

Pronotum smooth ----- 25

25 Antennal scape less than 3.6 times as long as wide; infuscation of forewing weak or absent -----*Cerocephala cornigera*

Distribution: Palearctic. Host: *Hylesinus orni* (Fuchs).

Antennal scape about 4 times as long as wide; infuscation of forewing beneath stigmal vein well developed-----*Cerocephala rufa*

Distribution: Palearctic. Host: *Anobium punctatum*.

26 Antenna with 3 annular ring segments and 5 funicular segments ----- 27

Antenna with 2 annular ring segments and 6 funicular segments ----- 29

27 Mandibles asymmetrical, one with 4 teeth, the other with 3 -----*Meraporus requisitus*

Distribution: Nearctic. Host: *Sitophilus oryzae*.

Both mandibles with 4 teeth----- 28

28 Underside of forewing without long curved setae -----*Anisopteromalus*

Distribution: Worldwide. Hosts: Coleoptera, Lepidoptera.

Underside of forewing posterior to marginal vein with a row of long curved setae -----*Zatropis*

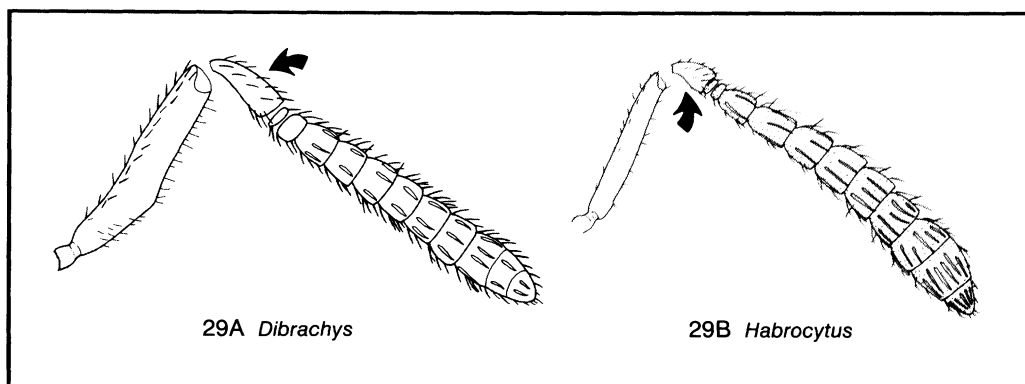
Distribution: Nearctic. Hosts: Coleoptera.

29 Pedicel unusually long (29A) -----*Dibrachys*

Forewing margin without cilia. Distribution: Worldwide. Hosts: Lepidoptera.

Pedicel not unusually long (similar to 29B)----- 30

Forewing margin usually with cilia (except *Tritneptis (Systellogaster) ovivora*).



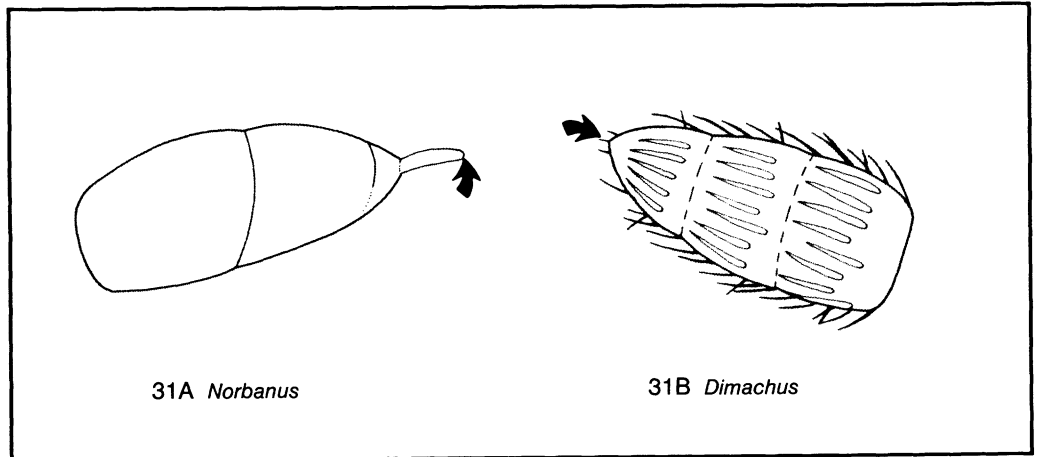
- 30 Tibia III with 2 apical spurs ----- 31  
 Tibia III with 1 apical spur ----- 32

- 31 Apex of antennal club with stylus (31A); pronotal collar sharp ----- *Norbanus*

Distribution: Worldwide. Hosts: Cephidae.

- Apex of antennal club without stylus (31B); pronotal collar rounded ----- *Dimachus*

Distribution: Palearctic. Hosts: probably Anobiidae.



- 32 Forewing with infuscated band ----- *Tritneptis (Systemlogaster) ovivora*

Distribution: Nearctic. Hosts: Blattaria (oothecae).

- Forewing hyaline ----- 33

- 33 Pronotum sharply margined; clypeus deeply incised ----- *Caenacis*

Distribution: Worldwide. Hosts: Hymenoptera.

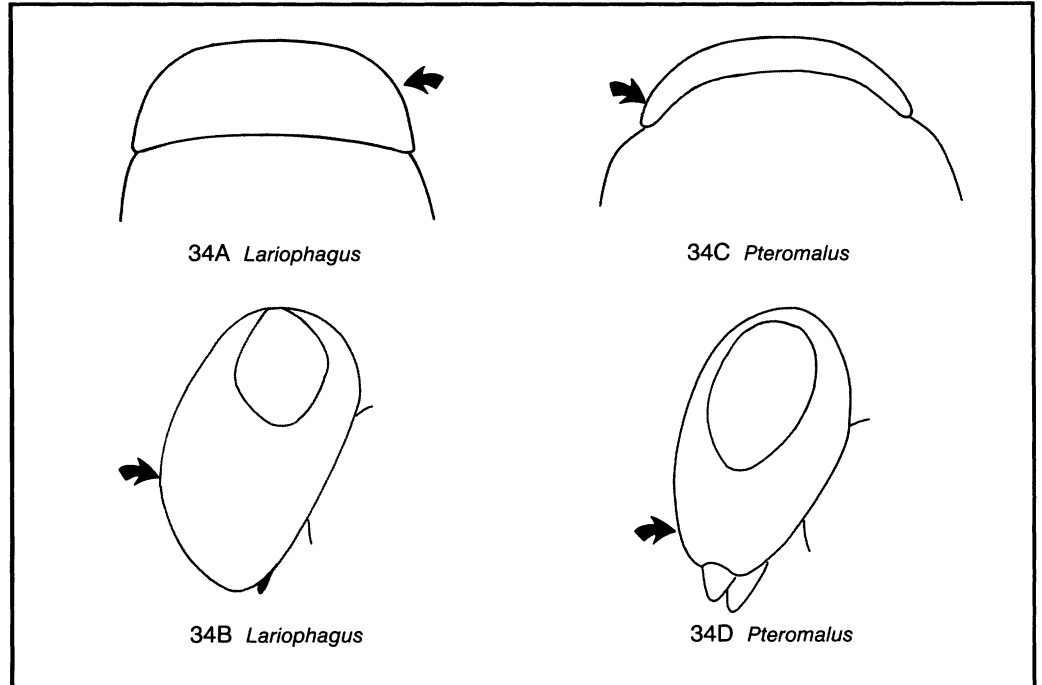
- Pronotum not sharply margined; clypeus not deeply incised ----- 34

34 Pronotum long, rounded (34A); face inflated (34B)-----*Lariophagus*

Distribution: Worldwide. Hosts: Coleoptera.

Pronotum short, transverse (34C); face not inflated (34D)-----*Pteromalus*

Distribution: Worldwide. Hosts: Coleoptera, Lepidoptera. See also 4B, 5E.

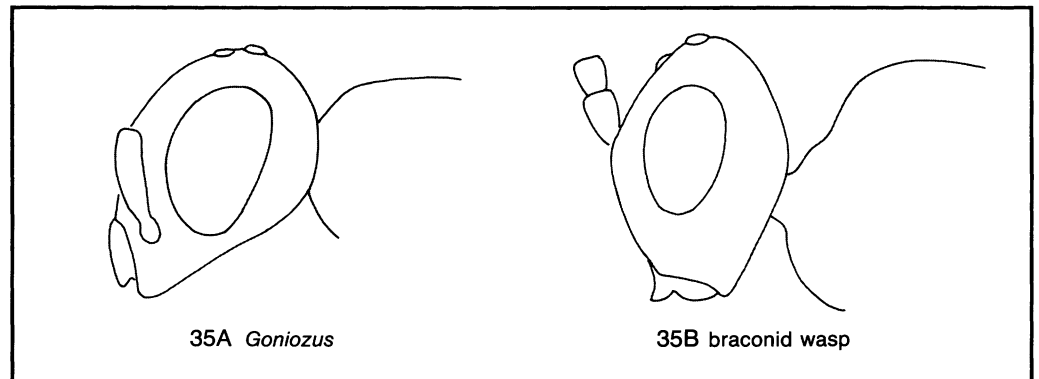


35 Head prognathous (35A); body depressed. Bethyidae (**bethylid wasps**)----- 36

Body shining black; ovipositor modified as a sting.

Head hypognathous (35B); body not depressed. Ichneumonoidea (ichneumonoid parasitic wasps)----- 47

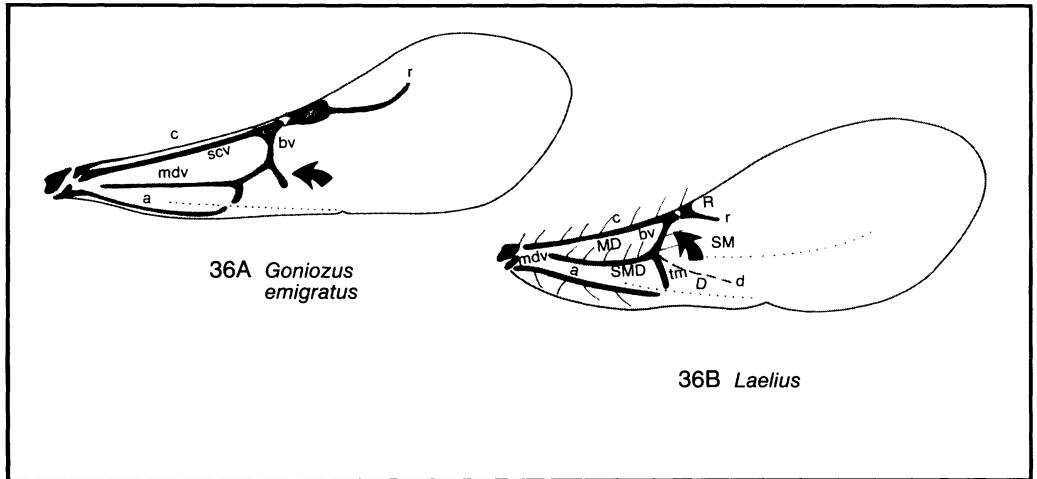
Body usually not shining black; ovipositor used as an egg-tube.



36 Wing with a vein or a stub of a vein arising from basal vein (36A) ----- *Goniozus emigratus*

Distribution: Nearctic. Hosts: Larval Lepidoptera.

Predominantly wingless, but if winged, then with basal vein simple or absent, not giving rise to a vein or a stub of a vein (36B) ----- 37

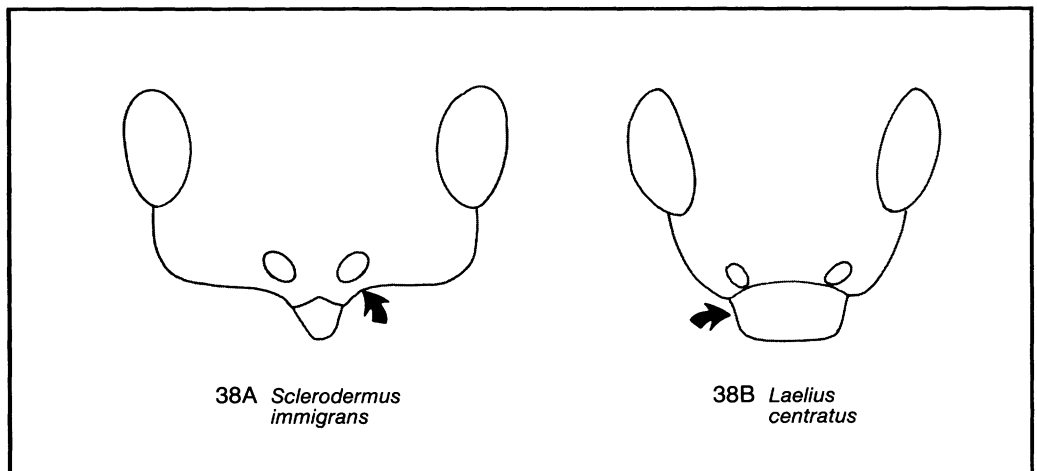


37 Antenna with 13 segments (funicle segment I small in some species) ----- 38  
 Antenna with 12 segments ----- 42

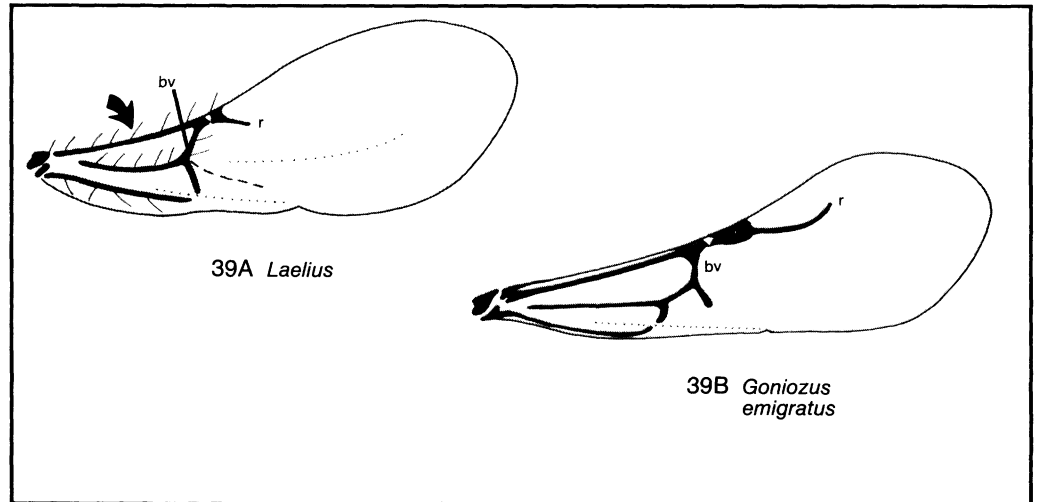
38 Clypeus with median lobe short, truncate (38A) ----- *Sclerodermus immigrans*

Distribution: Hawaii, Oriental. Host: *Caryedon serratus*.

Clypeus with median lobe angularly or narrowly rounded (38B) ----- 39



- 39 Veins with long, conspicuous setae; radial vein very short, at most slightly longer than basal vein (39A). Genus *Laelius*----- 40  
 Veins without long, conspicuous setae; radial vein much longer than basal vein (similar to 39B). Genus *Holepyris* ----- 41



- 40 Wing hyaline-----*Laelius centratus*

Distribution: Nearctic. Hosts: *Trogoderma ornatum*, *T. simplex*, *T. variabile*. See 38B.

- Wing slightly dusky (infuscated) -----*Laelius anthrenivorus*

Distribution: Oriental. Hosts: *Anthrenus* spp.

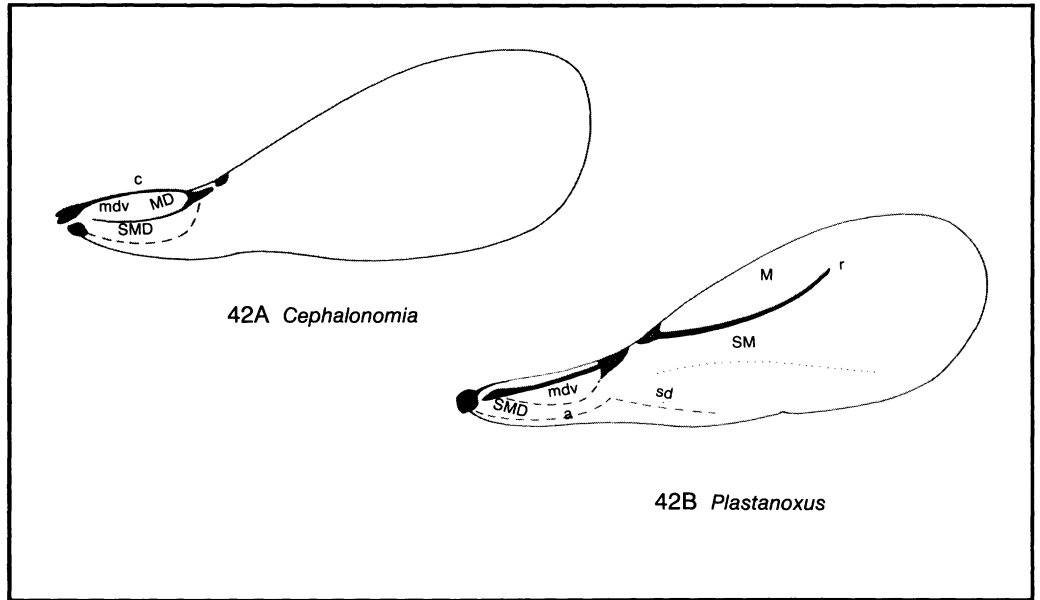
- 41 Eye setose-----*Holepyris sylvanidis*

Distribution: Worldwide. Hosts: *Oryzaephilus surinamensis*, *Sitophilus oryzae*, *Tribolium confusum*.

- Eye without conspicuous vestiture of setae -----*Holepyris hawaiiensis*

Distribution: Worldwide. Host: *Ephestia elutella*.

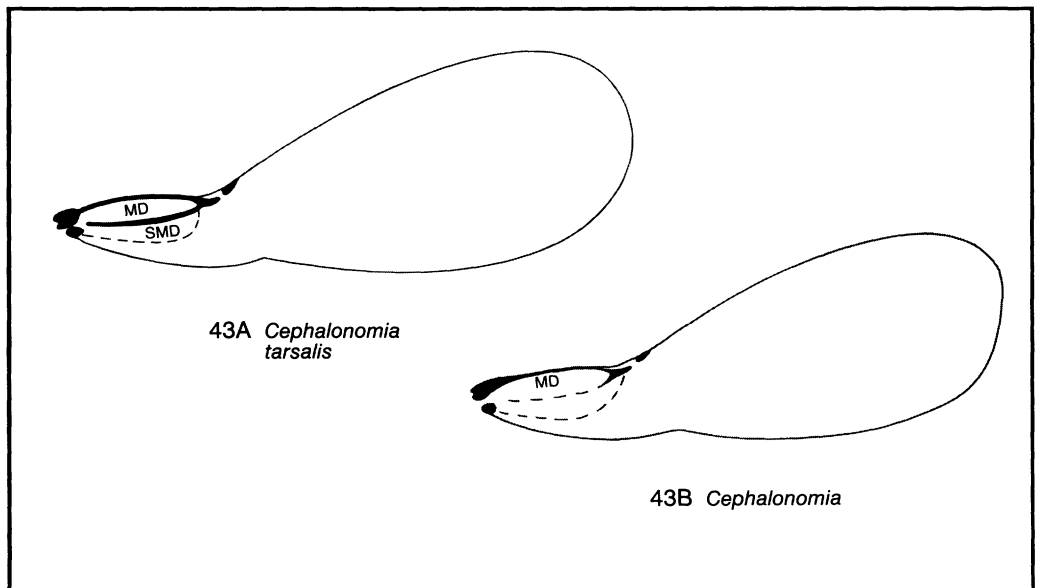
- 42 Radial vein absent (42A) or wings absent. Genus *Cephalonomia* ----- 43  
 Radial vein present (at least in part) (42B); wings fully developed. Genus *Plastanoxus* 46



- 43 Forewing with a closed median cell (43A)-----*Cephalonomia tarsalis*

Distribution: Worldwide. Hosts: *Oryzaephilus surinamensis*, *Sitophilus oryzae*.

- Forewing without a closed median cell (43B) ----- 44

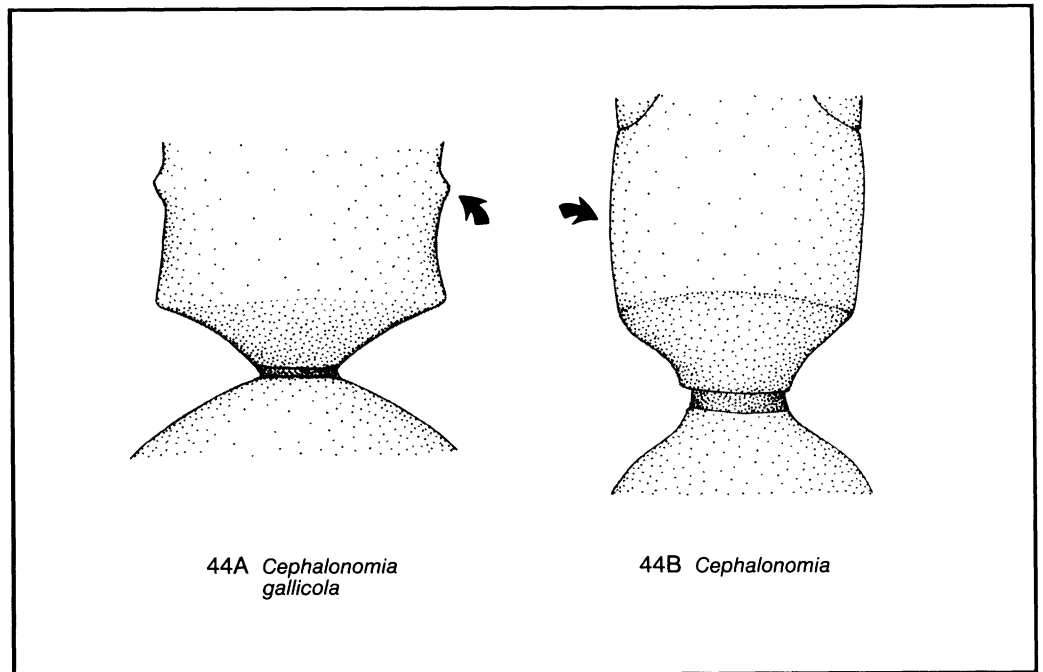




44 Propodeum with a small dentiform process on each side (44A) ----*Cephalonomia gallicola*

Distribution: Worldwide. Hosts: Anobiidae, Ptinidae.

Propodeum without dentiform processes (44B)----- 45

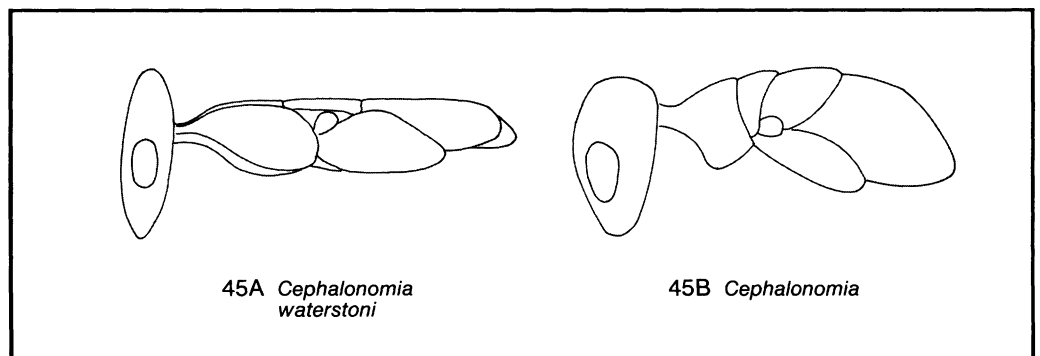


45 Thorax strongly depressed (45A) -----**parasitic grain wasp**, *Cephalonomia waterstoni*

Distribution: Worldwide. Host: *Cryptolestes ferrugineus*.

Thorax not strongly depressed-----other *Cephalonomia*

Distribution: Worldwide. Hosts: Coleoptera.

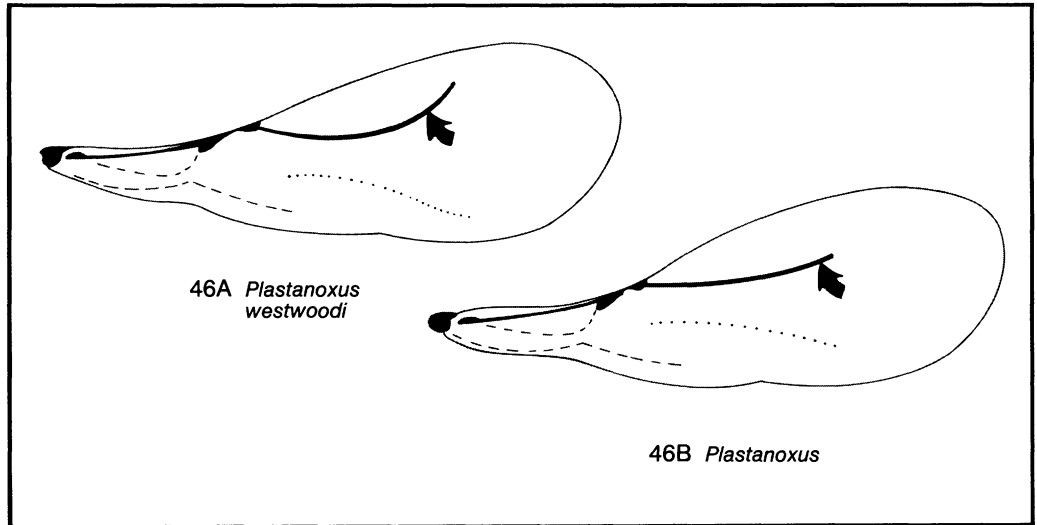


46 Radial vein gently curved (46A) -----*Plastanoxus westwoodi*

Distribution: Worldwide. Host: *Cryptolestes pusillus*.

Radial vein straight distally (similar to 46B) -----*Plastanoxus chittendenii*

Distribution: Holarctic. Hosts: *Cis* spp.

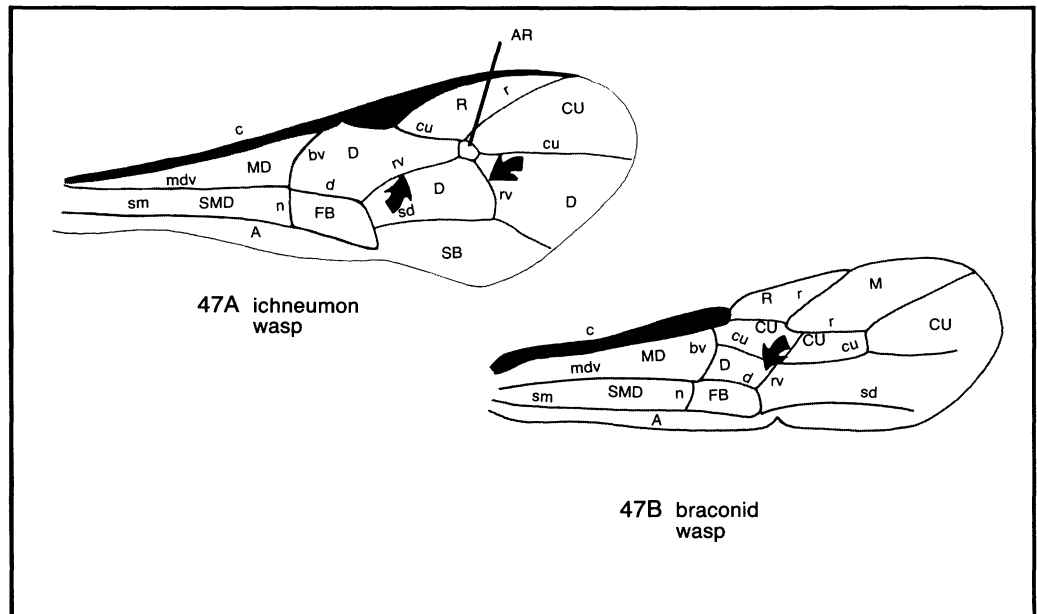


47 Forewing with 2 recurrent veins (47A). Ichneumonidae (**ichneumons**) ----- 48

Areolet (AR) often present.

Forewing with 1 recurrent vein (47B). Braconidae (**braconid wasps**) ----- 53

Aerolet absent



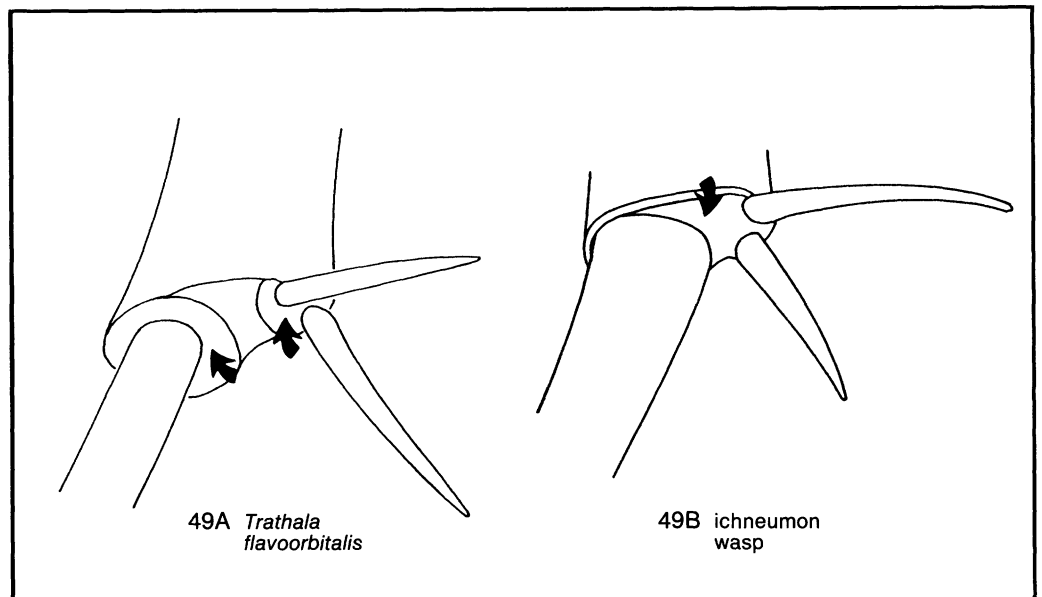
- 48 Gaster compressed; abdominal segments III and IV deeper than wide ----- 49  
 Gaster depressed or cylindrical; abdominal segments III and IV wider than deep- 52

- 49 Tibial spurs inserted in an area separate from area of tarsal insertion (49A)  
 ----- *Trathala flavoorbitalis*

Clypeus separated from face by a groove; face usually more or less pale. Distribution: Indo-Australian, Oriental. Host: *Ostrinia nubilalis*.

- Tibial spurs and tarsus inserted in a common area of tibia (49B)----- 50

Clypeus usually confluent with face; face usually black.



- 50 Gastral segment I near its basal third circular or depressed oval in cross section  
 ----- *Venturia canescens*

Gastral tergum I never with a pit in front of spiracle. Distribution: Worldwide. Hosts: *Anagasta kuehniella*, *Cadra figulilella*, *Ephesia elutella*, *Galleria mellonella*, *Plodia interpunctella*.

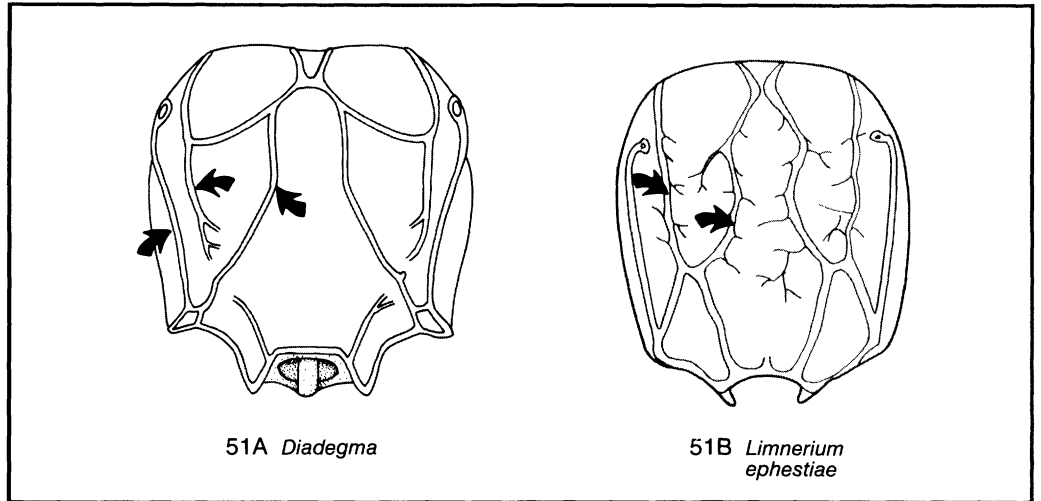
- Gastral segment I near its basal third somewhat quadrate, trapezoidal, or triangular in cross section----- 51

51 Propodeal carina usually strong (51A)-----*Diadegma*

Distribution: Worldwide. Hosts: Lepidoptera.

Propodeal carina usually weak (51B) -----*Limnerium ephestiae*

Distribution: Worldwide. Hosts: Pyraloidea.



52 Spiracle of gastral tergum I located somewhat behind midlength of tergum (52A)

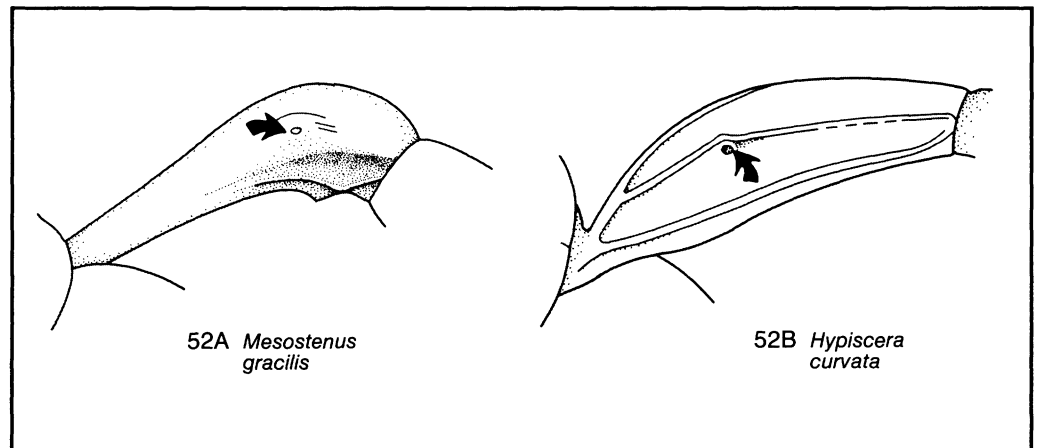
-----*Mesostenus gracilis*

Distribution: Worldwide. Hosts: *Anagasta kuehniella*,  
*Cadra figulilella*, *Ephestia elutella*, *Euzophora*  
*semifuneralis* (Walker), *Zophodia convolutella* (Hübner);  
also known from *Ozamia fuscomaculella clarefacta*  
Dyar.

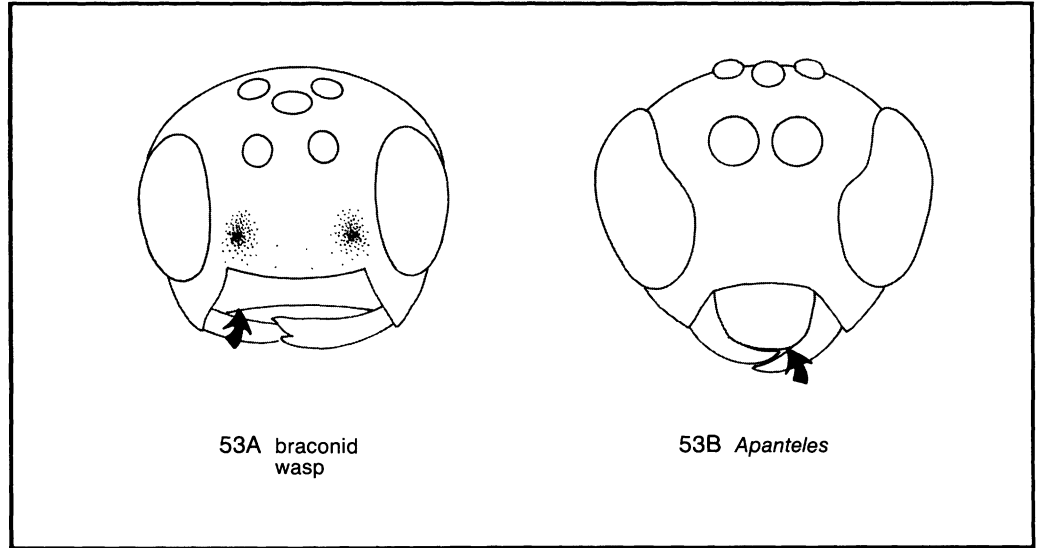
Spiracle of gastral tergum I located near or in front of midlength of tergum (52B)

-----*Hypiscera curvata*

Distribution: Neotropical. Hosts: Lepidoptera.



- 53 Clypeal margin concave (53A)----- 54  
 Clypeal margin arcuate (53B)----- 60



- 54 Occipital and prepectal carinae absent; maxillary palpus 5-segmented. *Habrobracon* 55  
 Occipital and prepectal carinae usually present; maxillary palpus 6-segmented---- 58  
 55 Gastral terga not shining-----*Habrobracon crassicornis*

Distribution: Palearctic. Hosts: *Anagasta kuehniella*;  
 also known from *Sparganothis pilleriana* (Denis &  
 Schiffermüller).

- Gastral terga shining----- 56  
 56 Antenna 17 to 21 segmented, much longer than head and thorax combined  
 -----*Habrobracon kitcheneri*

Distribution: Indo-Australian, Palearctic. Hosts:  
 Lepidoptera.

- Antenna 13 to 17 segmented, seldom longer than head and thorax combined ---- 57  
 -----*Habrobracon hebetor*

Distribution: Worldwide. Hosts: *Anagasta kuehniella*,  
*Cadra cautella*, *Ephesia elutella*, *Galleria mellonella*,  
*Plodia interpunctella*, *Sitotroga cerealella*, *Vitula ed-*  
*mandsii serratilineella*.

- Antenna 15 to 17 segmented, slightly longer than head and thorax combined  
 -----*Habrobracon brevicornis*

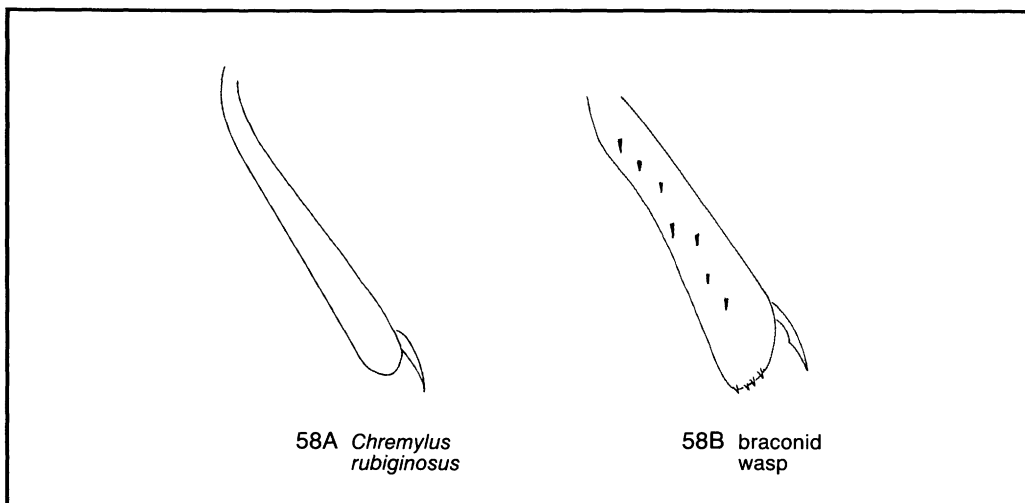
Distribution: Palearctic, probably Nearctic. Hosts:  
*Ostrinia nubilalis*; also known from *Dioryctria abietella*  
 (Denis & Schiffermüller).

58 Tibia I without a row or cluster of stout spines or pegs on anterior surface (58A) -----*Chremylus rubiginosus*

Prepectus sometimes margined. Distribution: Palearctic. Hosts: Lepidoptera.

Tibia I with a row or cluster of stout spines or pegs along anterior surface (58B)- 59

Prepectus always margined.

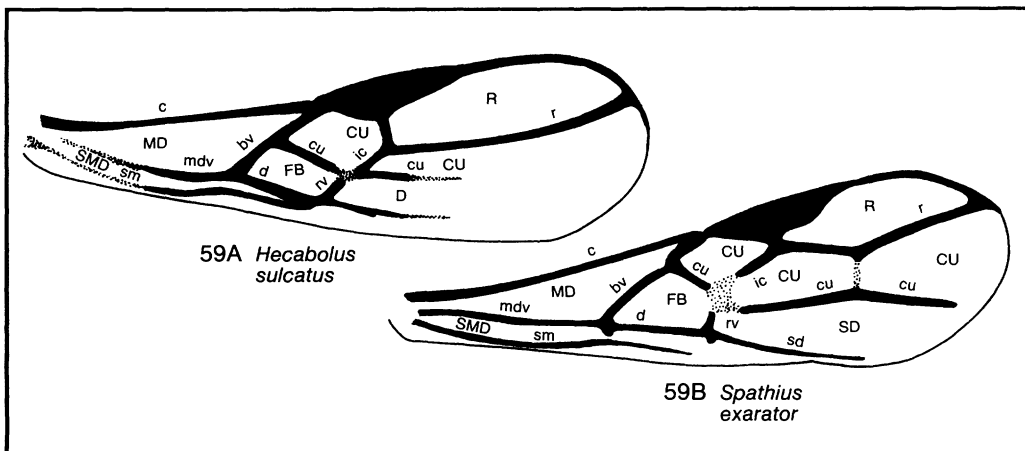


59 Forewing with 2 cubital cells (59A) -----*Hecabolus sulcatus*

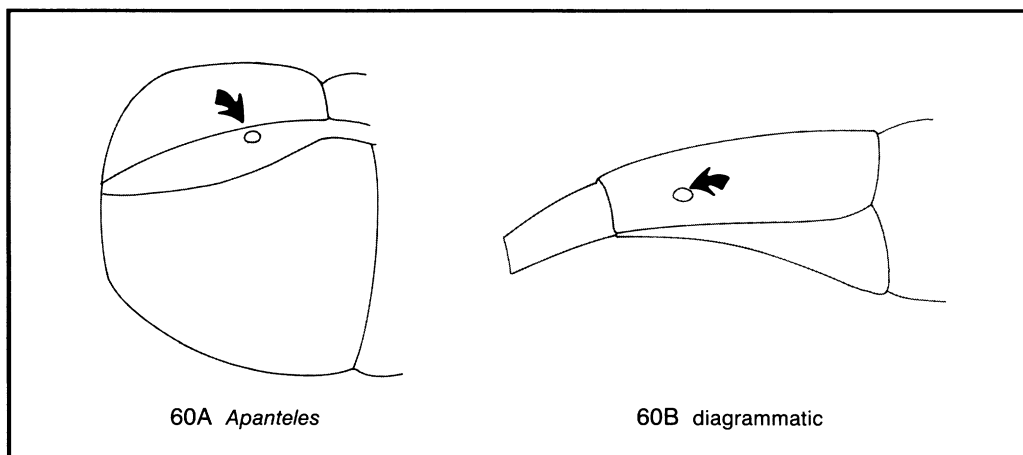
Distribution: Palearctic. Hosts: *Anobium punctatum*, *Ptinus fur*; also reported from *Anobium rufipes* Fabricius, *A. thomsoni* Kraatz, *Hylesinus varius* Fabricius, *Ochina ptinoides* (Marshall), *Phloeosinus bicolor* (Brullé), *P. thuyae* Perris, *Ptilinus* spp., *Phymatodes alni* (L.).

Forewing with 3 cubital cells (59B) -----*Spathius exarator*

Distribution: Palearctic. Hosts: Coleoptera.



- 60 Occipital carina absent; spiracle of gastral tergum I situated on lateral membrane of tergum, removed from sclerotized median plate (60A). Genus *Apanteles*----- 61  
 Occipital carina present; spiracle of gastral tergum I situated on lateral margin of sclerotized median plate (60B)----- 62



- 61 Mesoscutum dull, strongly and rather coarsely punctate-----*Apanteles araeceri*

Distribution: Indo-Australian. Hosts: *Araecerus fasciculatus*; also reported from *Phalacris immarginatus* Champion.

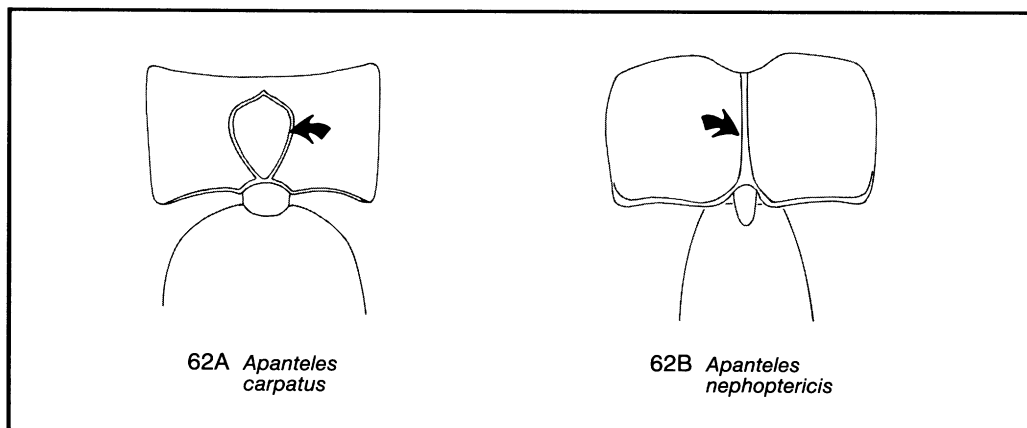
- Mesoscutum somewhat shining, not coarsely punctate ----- 62

- 62 Propodeum with a distinct areola, usually margined by a strong carina (62A)  
 -----*Apanteles carpatus*

Distribution: Nearctic. Hosts: *Tineola bisselliella*; also reported from *Phereoica uterella* (Walsingham), *Tinea pellionella* (L.), *Trichophaga tapetzella* (L.).

- Propodeum without a distinct areola, but with a median carina from base to apex (62B)  
 -----*Apanteles nephopteris*

Distribution: Nearctic. Hosts: *Anagasta kuehniella*, *Vitula edmundsii serratilineella*.

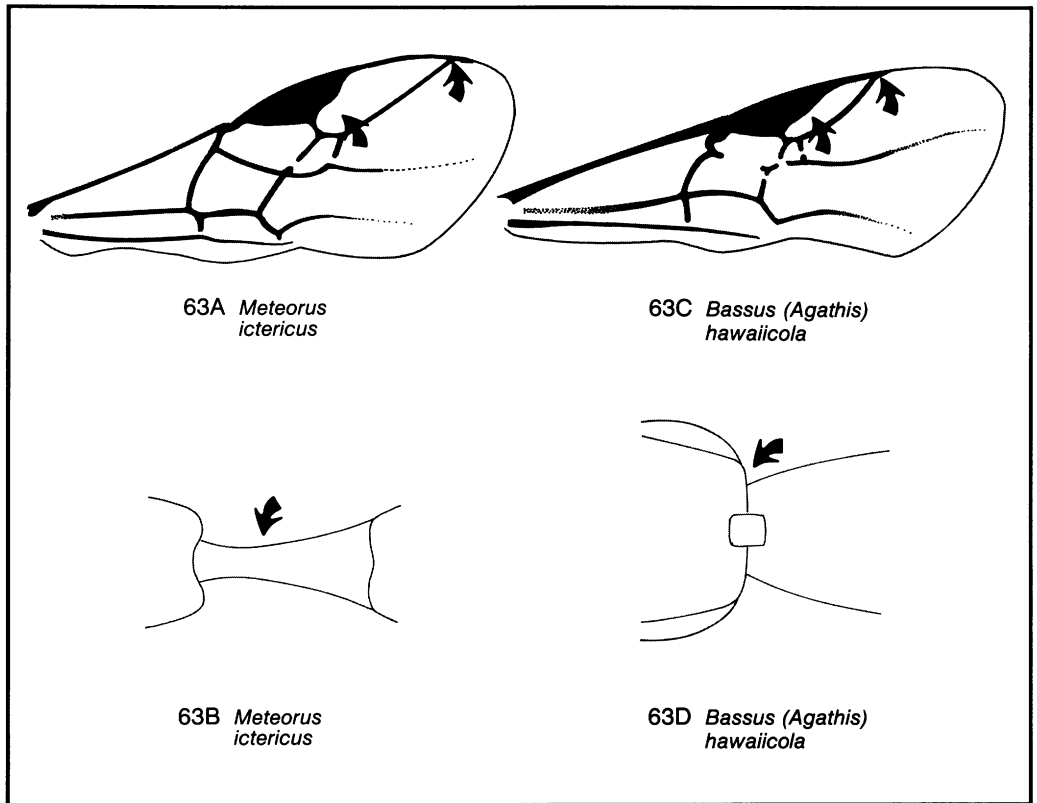


63 Radial cell long, radius nearly reaching wing apex (63A); gaster petiolate (63B)  
----- *Meteorus ictericus*

Distribution: Holarctic. Hosts: Lepidoptera.

Radial cell very narrow, radius meeting wing margin far from apex (63C); gaster sessile  
63D)----- *Bassus (Agathis) hawaiiicola*

Distribution: Indo-Australian. Hosts: Lepidoptera.





**References Cited**

- 1 Evans, H.E.  
1978. The Bethyridae of America north of Mexico. Mem. American Ent. Inst. 27, 332 p.
- 2 Graham, M.W.R. de V.  
1969. The Pteromalidae of north-western Europe (Hymenoptera: Chalcidoidea). Bul. British Mus. (Nat. Hist.) Ent., suppl. 16, 908 p.
- 3 Michener, C.D.  
1944. Comparative external morphology, phylogeny, and a classification of the bees (Hymenoptera). Bul. American Mus. Nat. Hist. 82(6)151-326.
- 4 Townes, H.  
1969. The genera of Ichneumonidae, part 1. Mem. American Ent. Inst. 11, 300 p.

*Insect and Mite Pests in Food*

**Notes and Sketches**

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## Part 3

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Approximate body length measurements of insects are shown in millimeters in parentheses in the legend of each plate. The scientific illustrators are credited in the appropriate places on the following pages.



## **MITES (ACARI)**

These illustrations, drawn by R.L. Smiley unless otherwise noted, are a continuation from part 1, chapter 1 (Mites), by R.L. Smiley. See figure 1.2 and couplet illustrations 8A, 8B, 11C, 47A, 48A, 48B, and 59A in chapter 1 for additional habitus illustrations of mites.

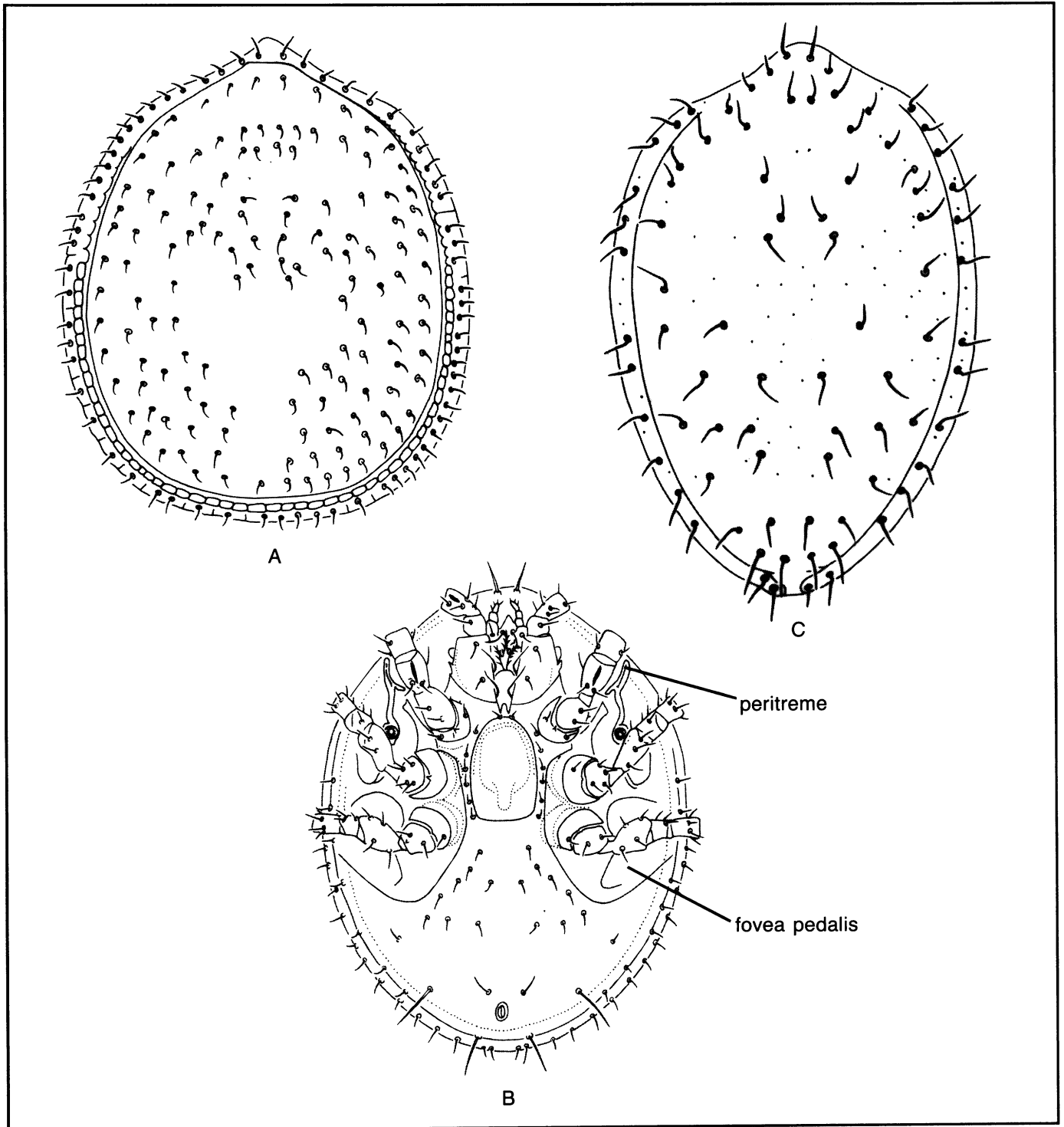


Plate 3. Uropodid mites (Uropodidae): A, *Leiodinychus krameri*, dorsal view of female; B, *Fuscuropoda* sp., ventral view of female; C, *Fuscuropoda marginata*, dorsal view of male.



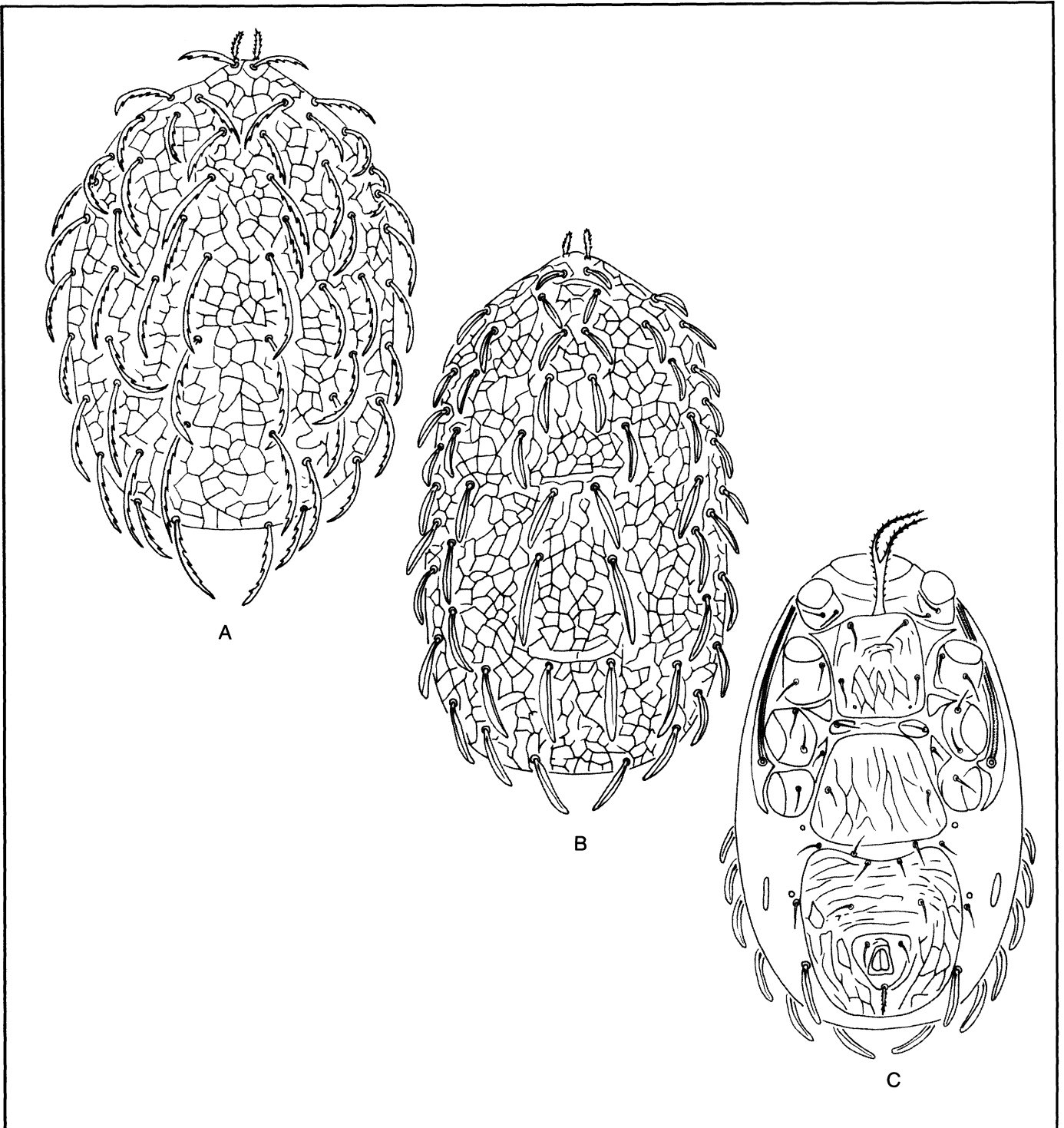


Plate 4. Ameroseiid mites (Ameroseiidae), females: A, *Kleemannia plumigera*, dorsal view; B, *Kleemannia plumosa*, dorsal view; C, same, ventral view.

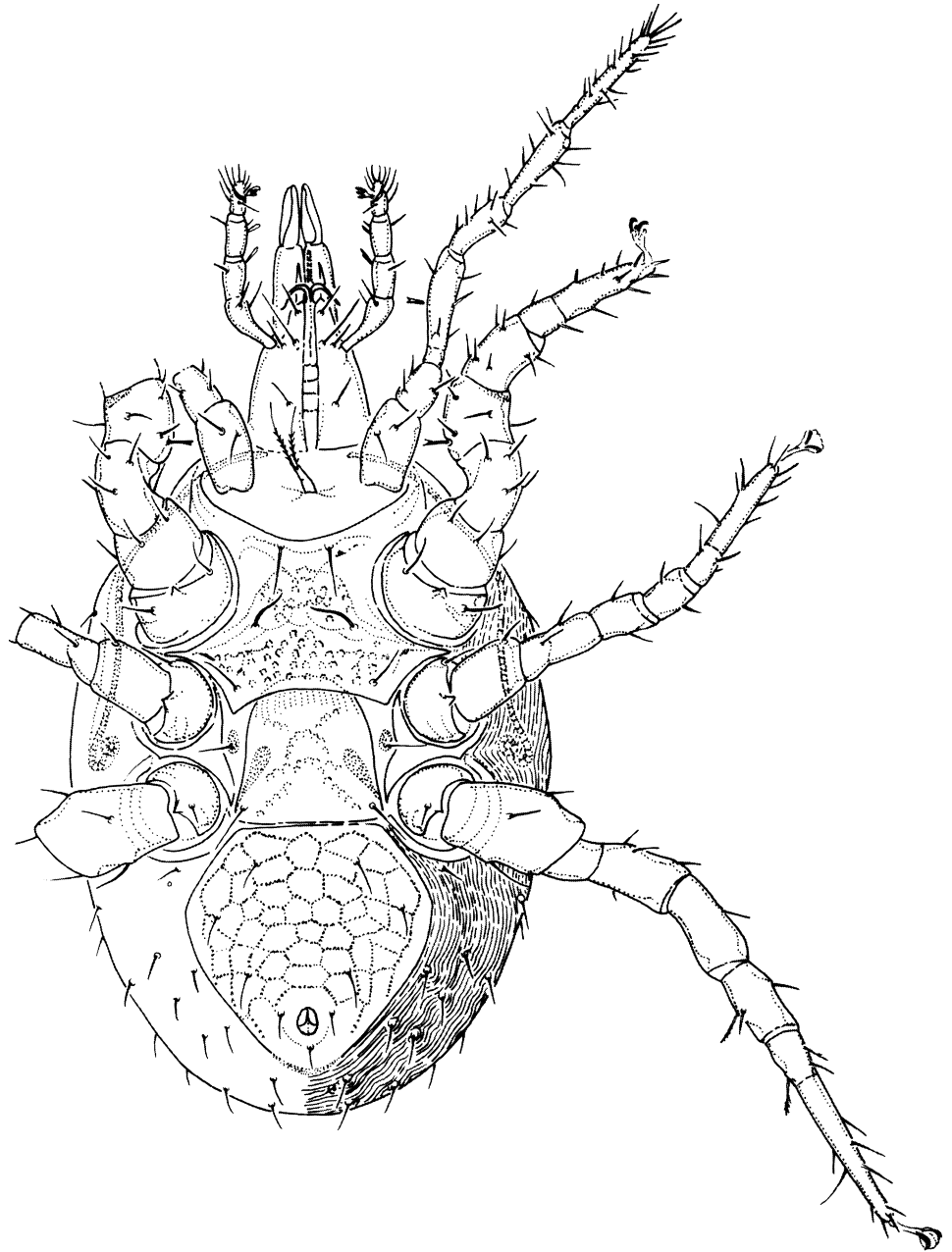


Plate 5. House fly mite, *Macrocheles muscaedomesticae* (Macrochelidae), ventral view of female. (Redrawn from 3 by C. Feller).

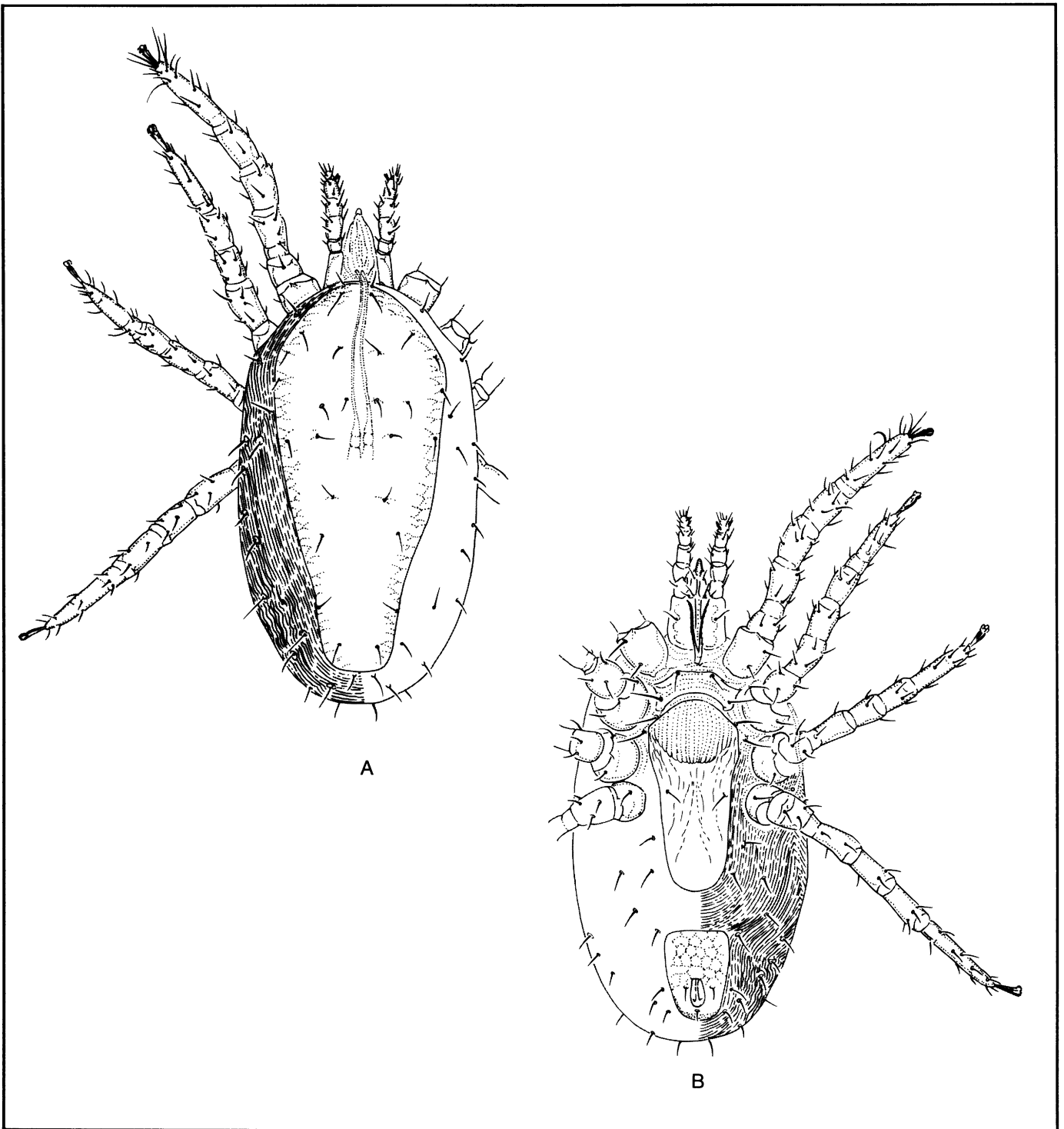


Plate 6. **Chicken mite**, *Dermanyssus gallinae* (Dermanyssidae), female: A, dorsal view; B, ventral view. (Redrawn from 3 by C. Feller.)

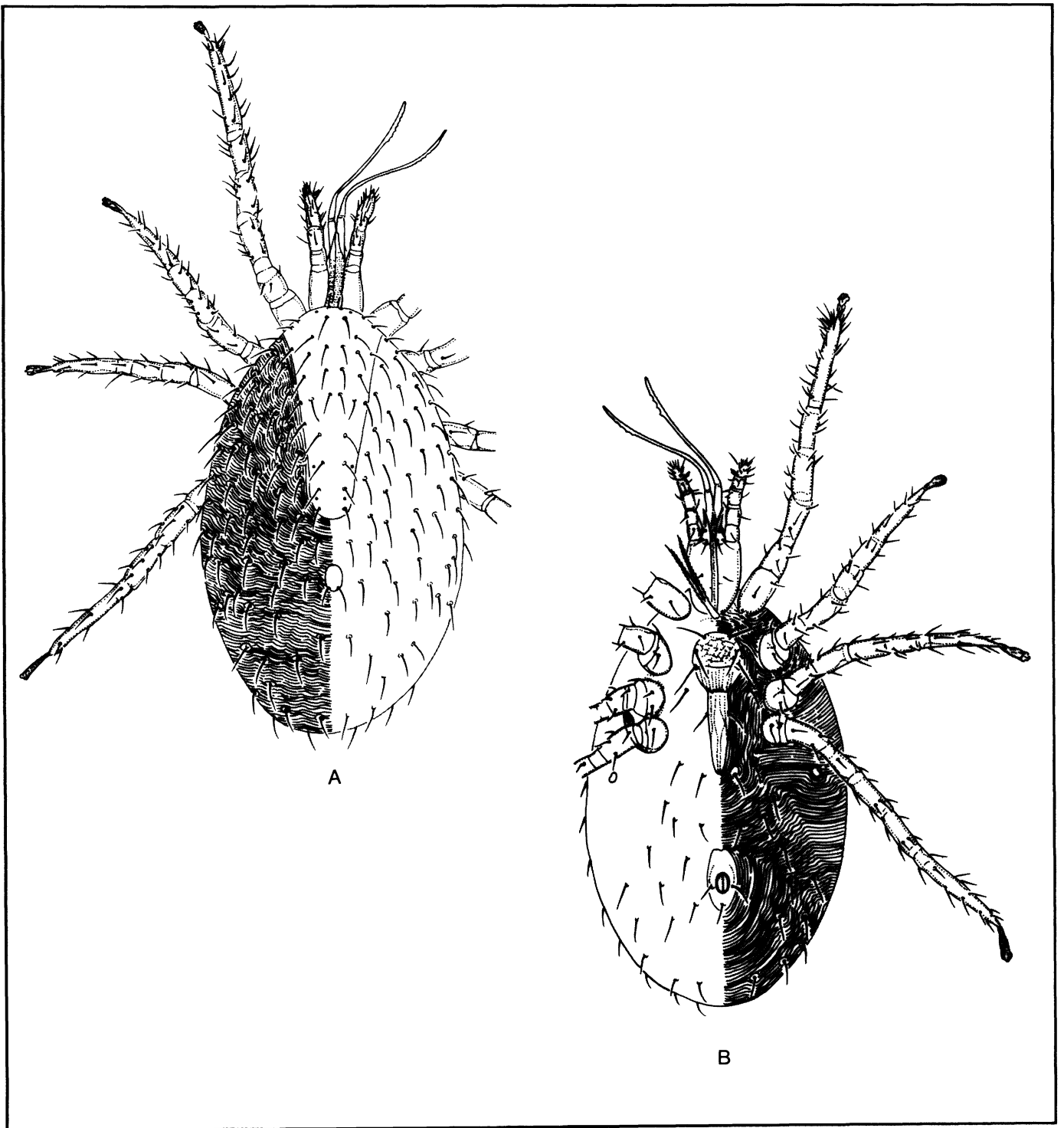


Plate 7. **House mouse mite**, *Liponyssoides sanguineus* (Macronyssidae), female: A, dorsal view; B, ventral view. (Redrawn from 3 by C. Feller.)

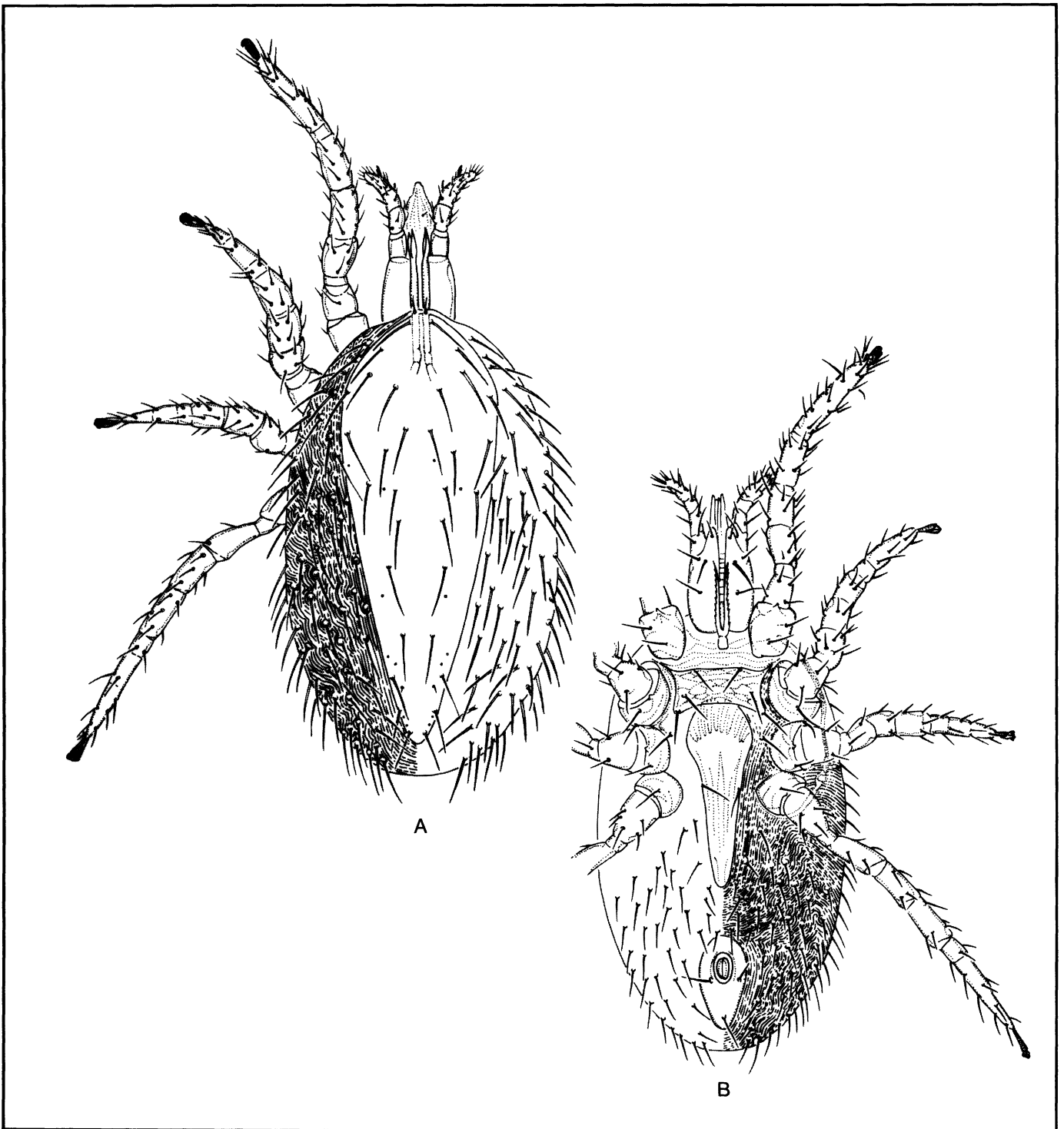


Plate 8. **Tropical rat mite**, *Ornithonyssus bacoti* (Macronyssidae), female: A, dorsal view; B, ventral view. (Redrawn from 3 by C. Feller.) (For the gravid female of *Ornithonyssus sylviarum*, see couplet illustration 11C.)

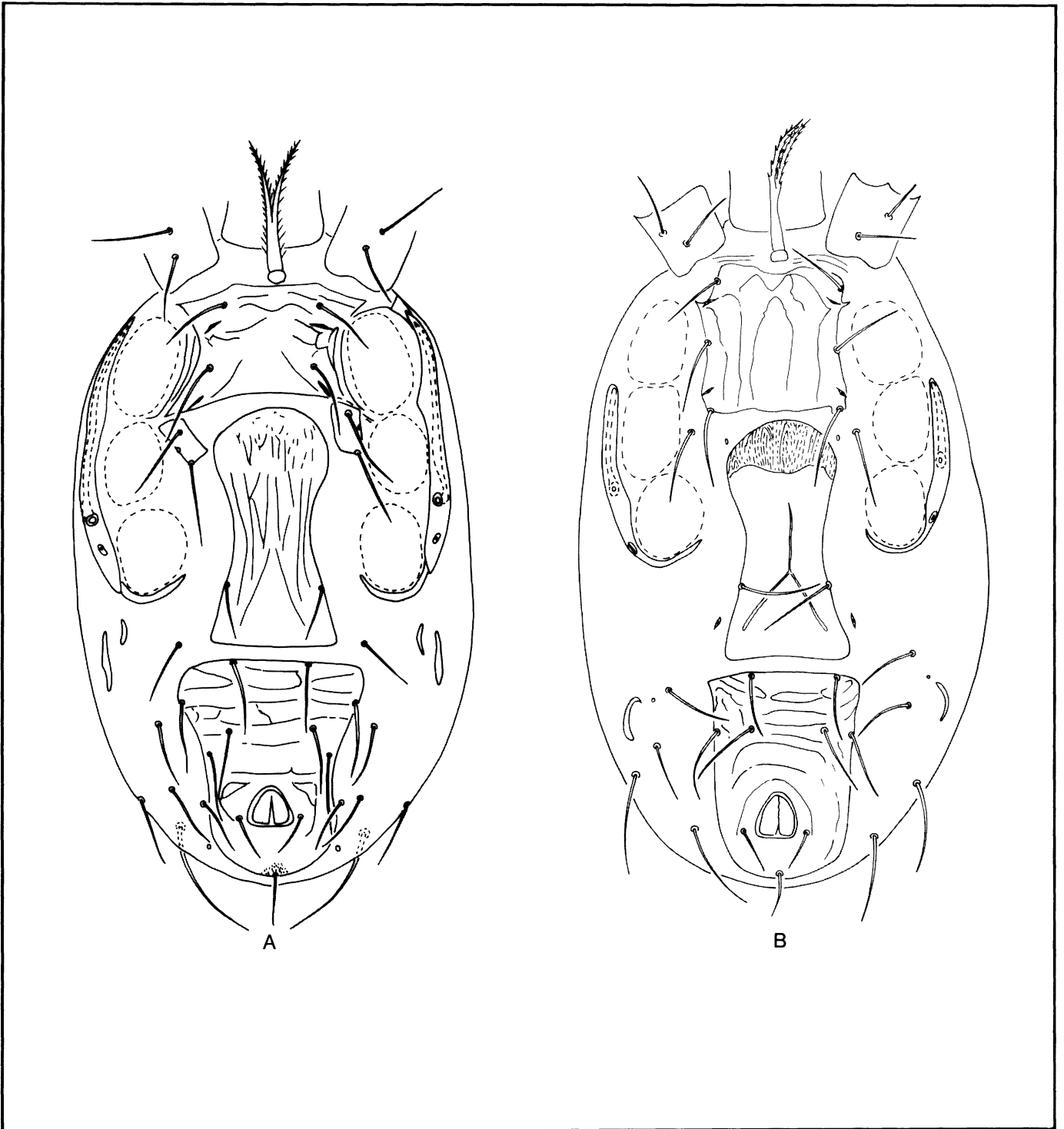


Plate 9. Ascid mites (Ascidae), females, ventral views: A, *Blattisocius dentriticus* (for dorsal view, see couplet illustration 8B); B, *Blattisocius tarsalis*.

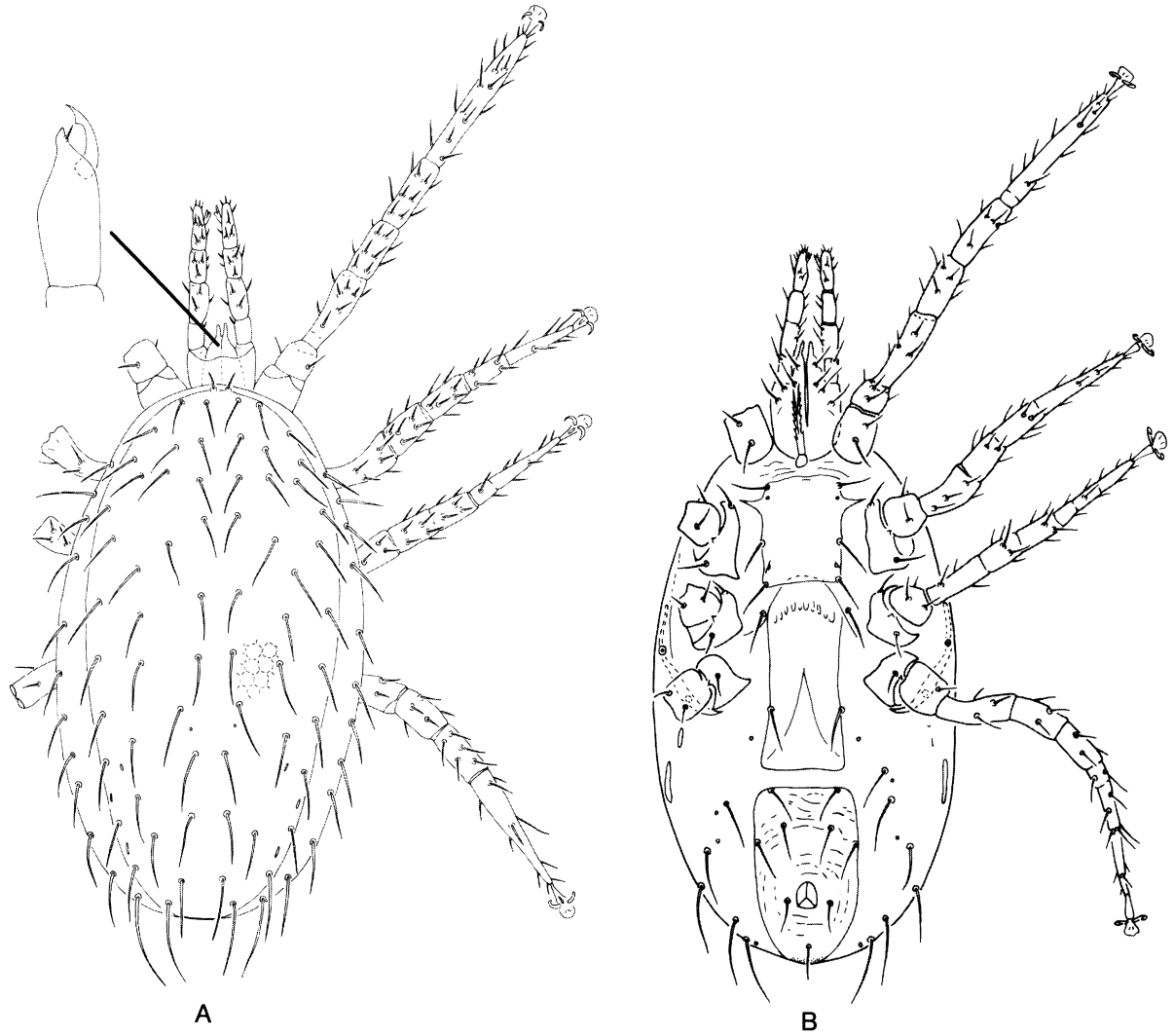


Plate 10. *Blattisocius keegani* (Ascidae), female:  
A, dorsal view; B, ventral view.

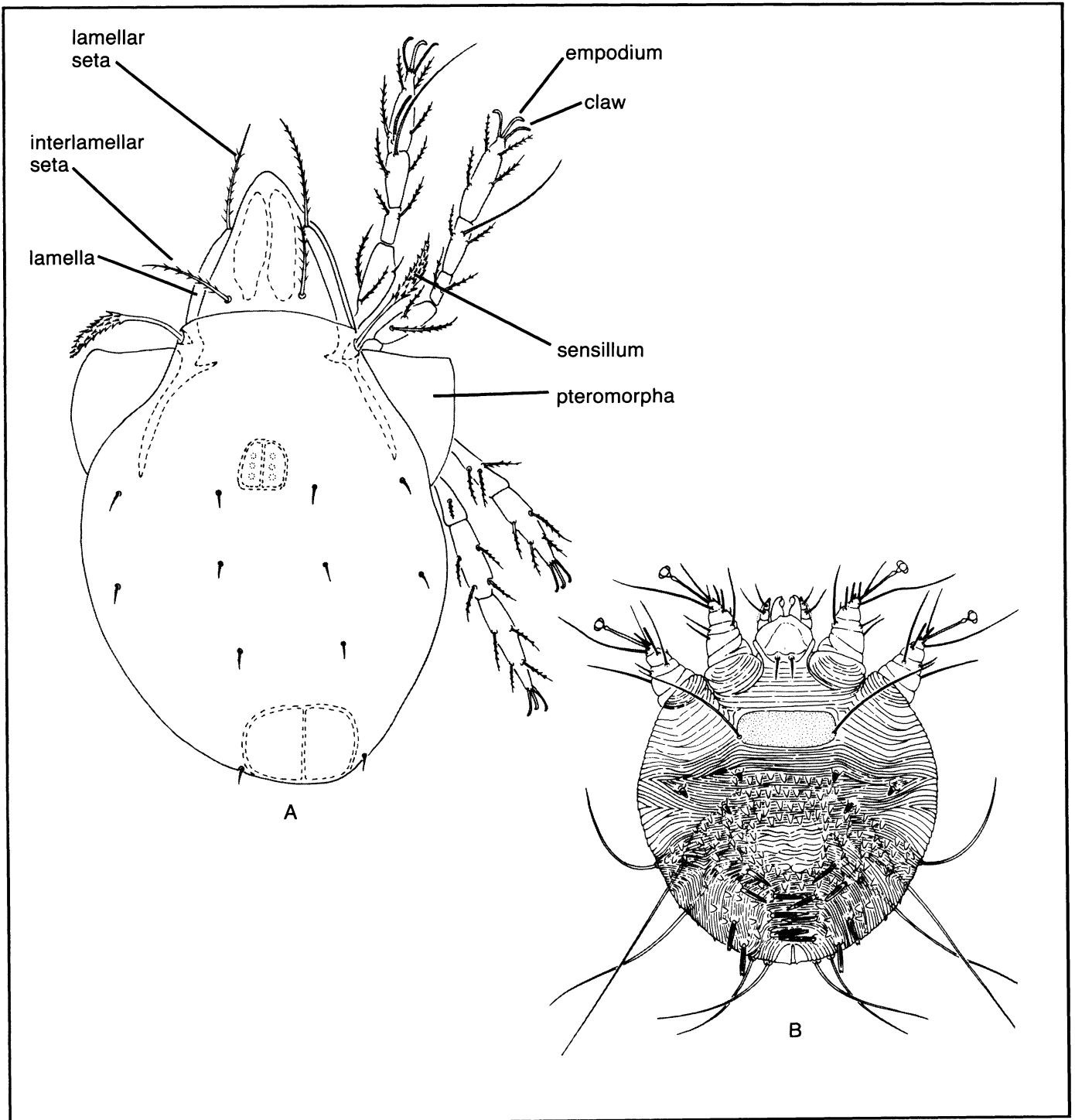


Plate 11. Acariform mites (Acariformes), females, dorsal views: A, a beetle mite, *Schelorbates* sp. (Oribatulidae); B, itch mite, *Sarcoptes scabiei* (Sarcoptidae) (redrawn from 3 by C. Feller).



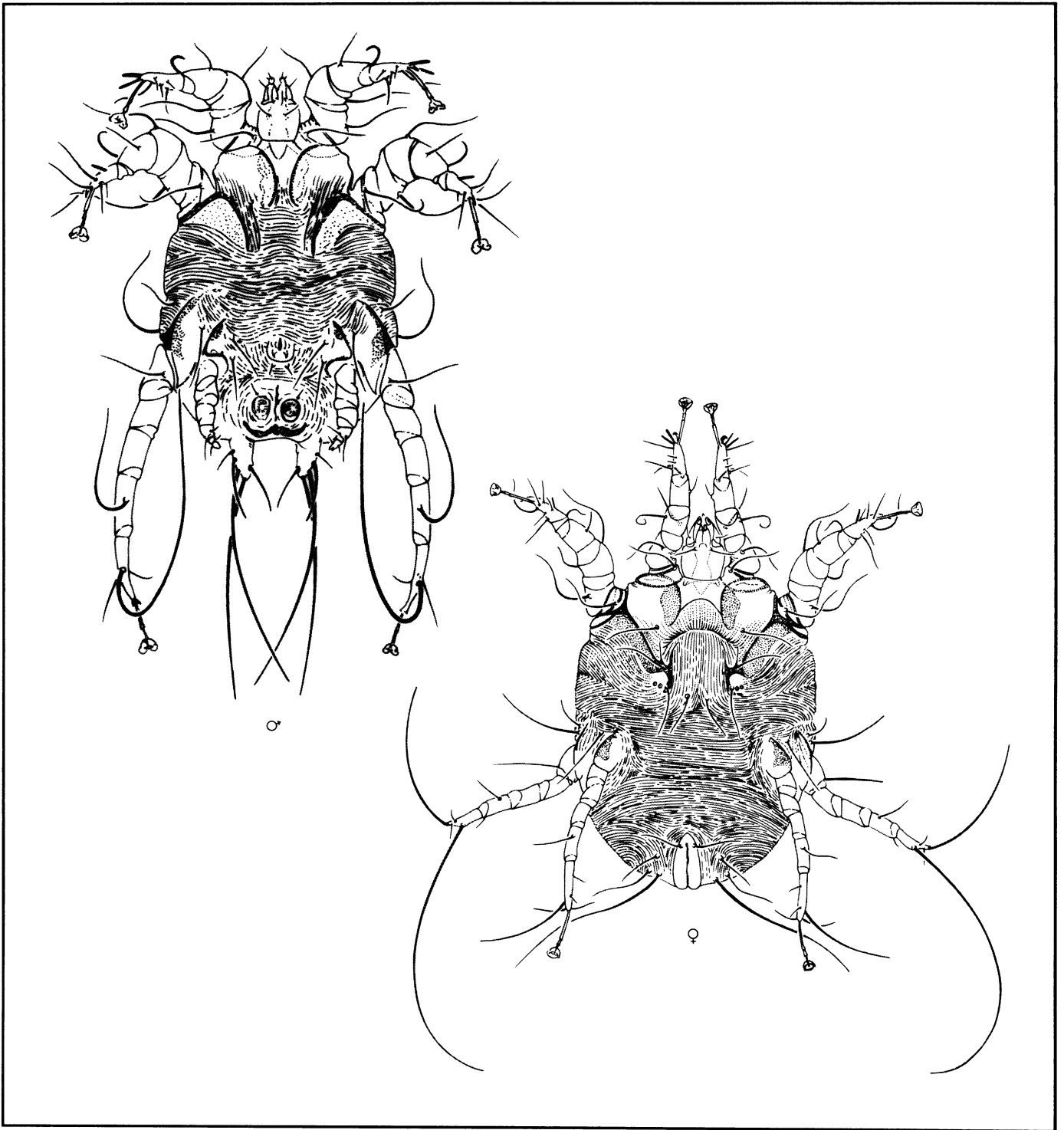


Plate 12. **Scab mite, *Psoroptes equi***  
(Psoroptidae), ventral views. (Redrawn from 3 by  
C. Feller.)

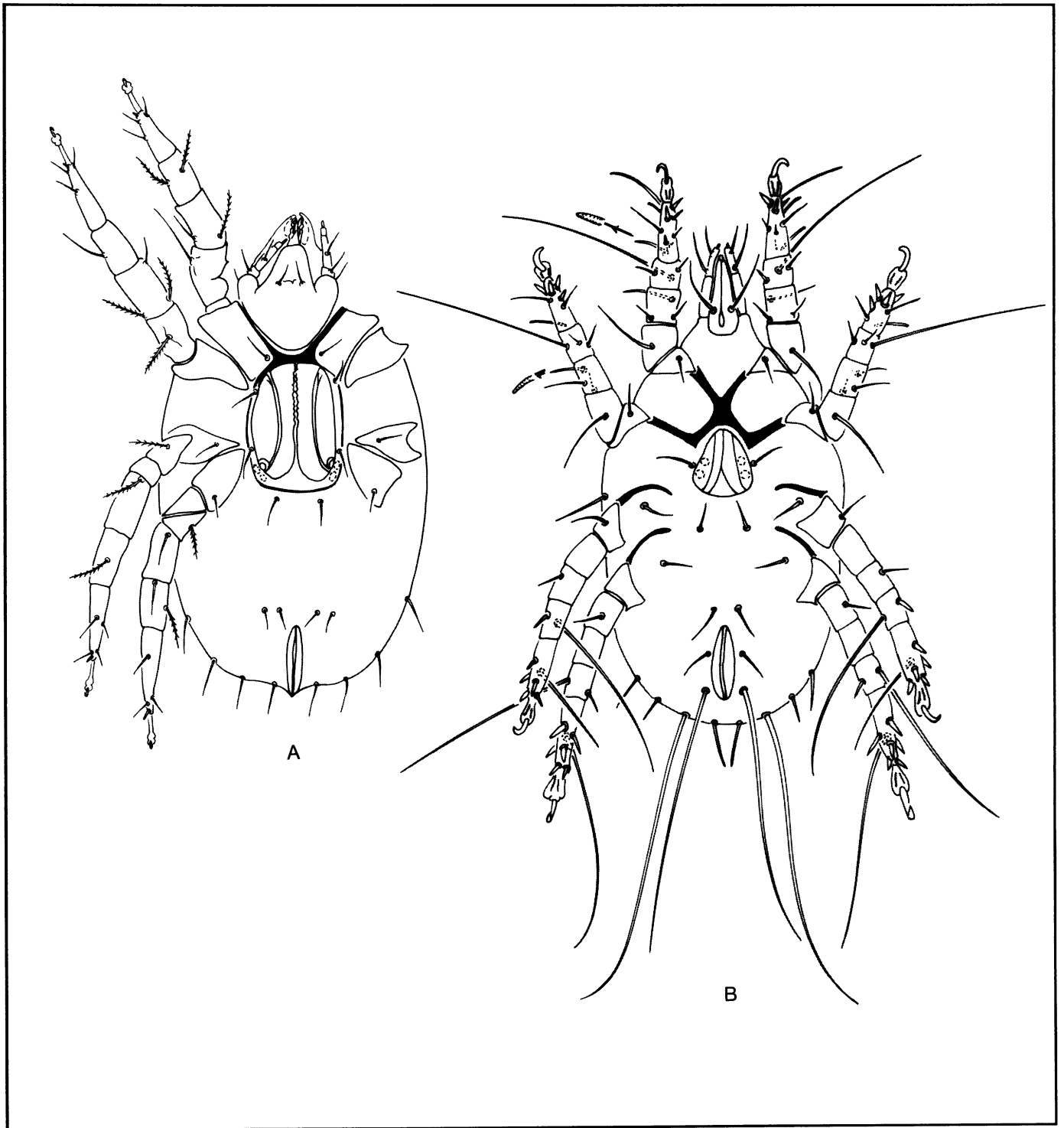


Plate 13. Astigmatid mites (Astigmata), females, ventral views: A, **brown flour mite**, *Gohieria fusca* (Glycyphagidae); B, **driedfruit mite**, *Carpoglyphus lactis* (Carpoglyphidae).

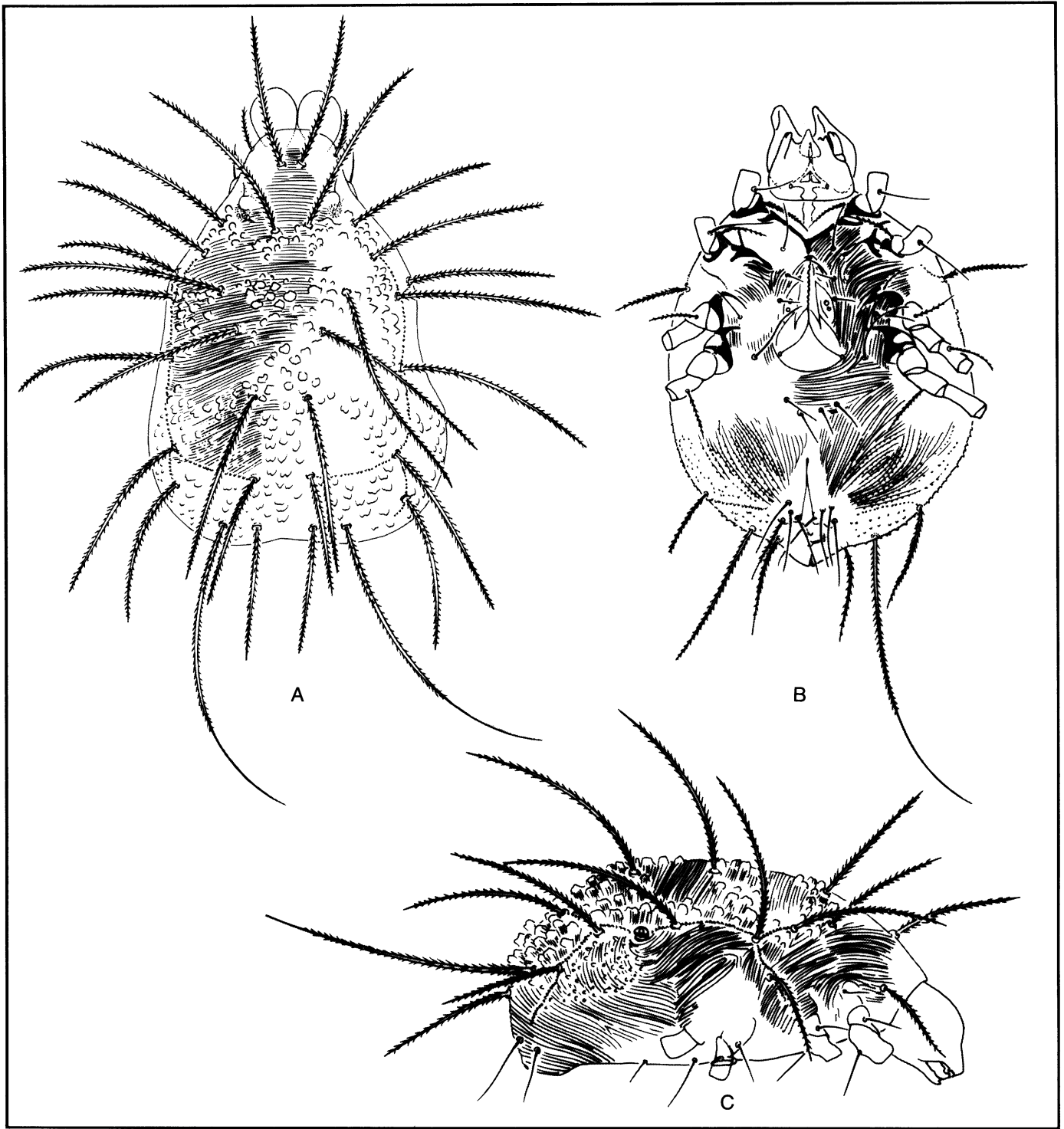


Plate 14. **Warty grain mite**, *Aeroglyphus robustus* (Glycyphagidae), female: A, dorsal view; B, ventral view; C, lateral view. (Redrawn from 2 by C. Feller.)

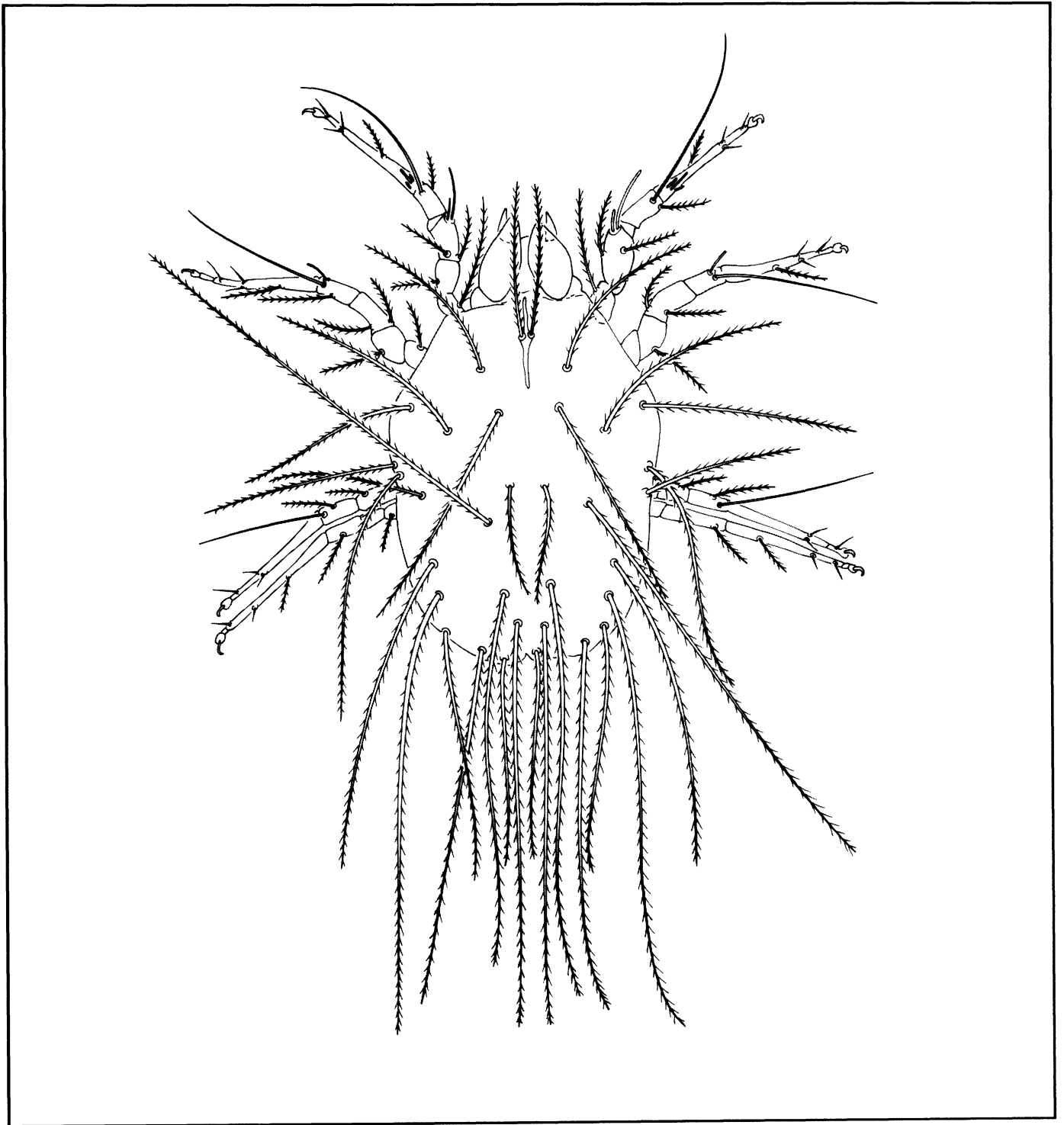


Plate 15. **House mite**, *Glycyphagus domesticus*  
(Glycyphagidae), male, dorsal view.

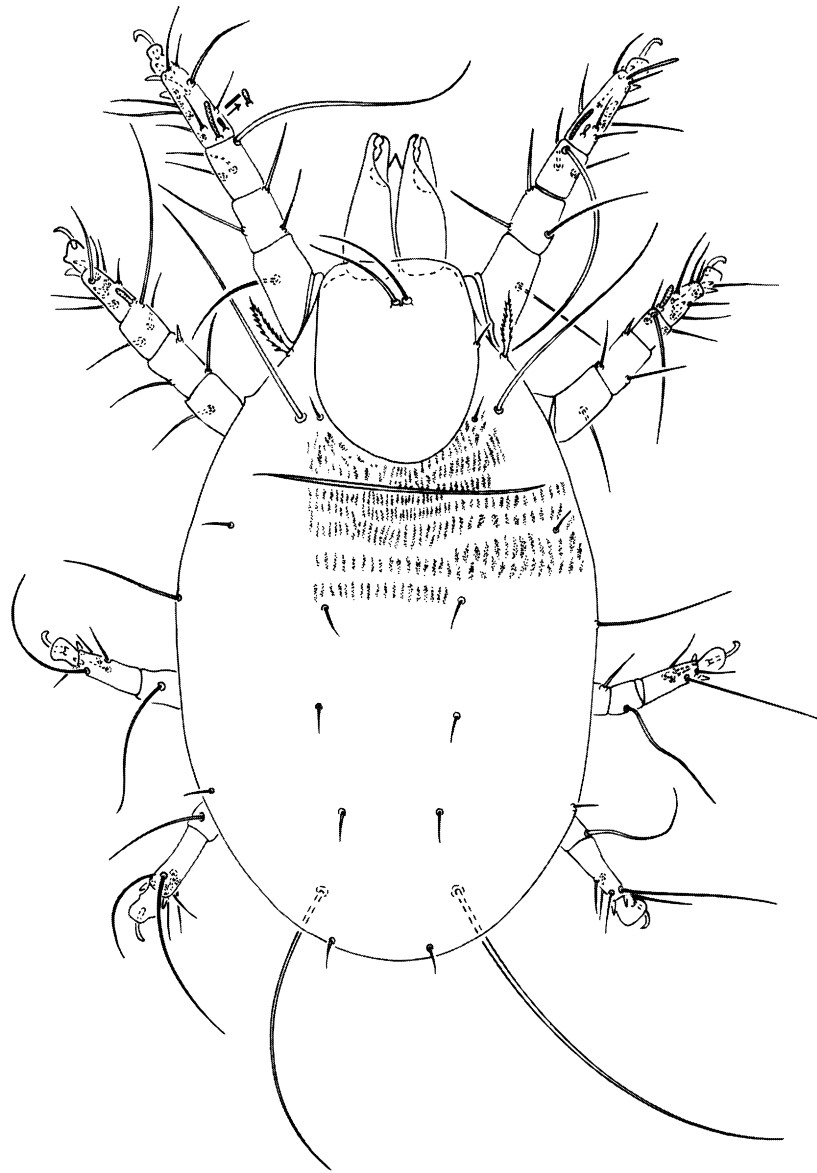


Plate 16. **Scaly grain mite**, *Suidasia nesbitti*  
(Acaridae), female, dorsal view.

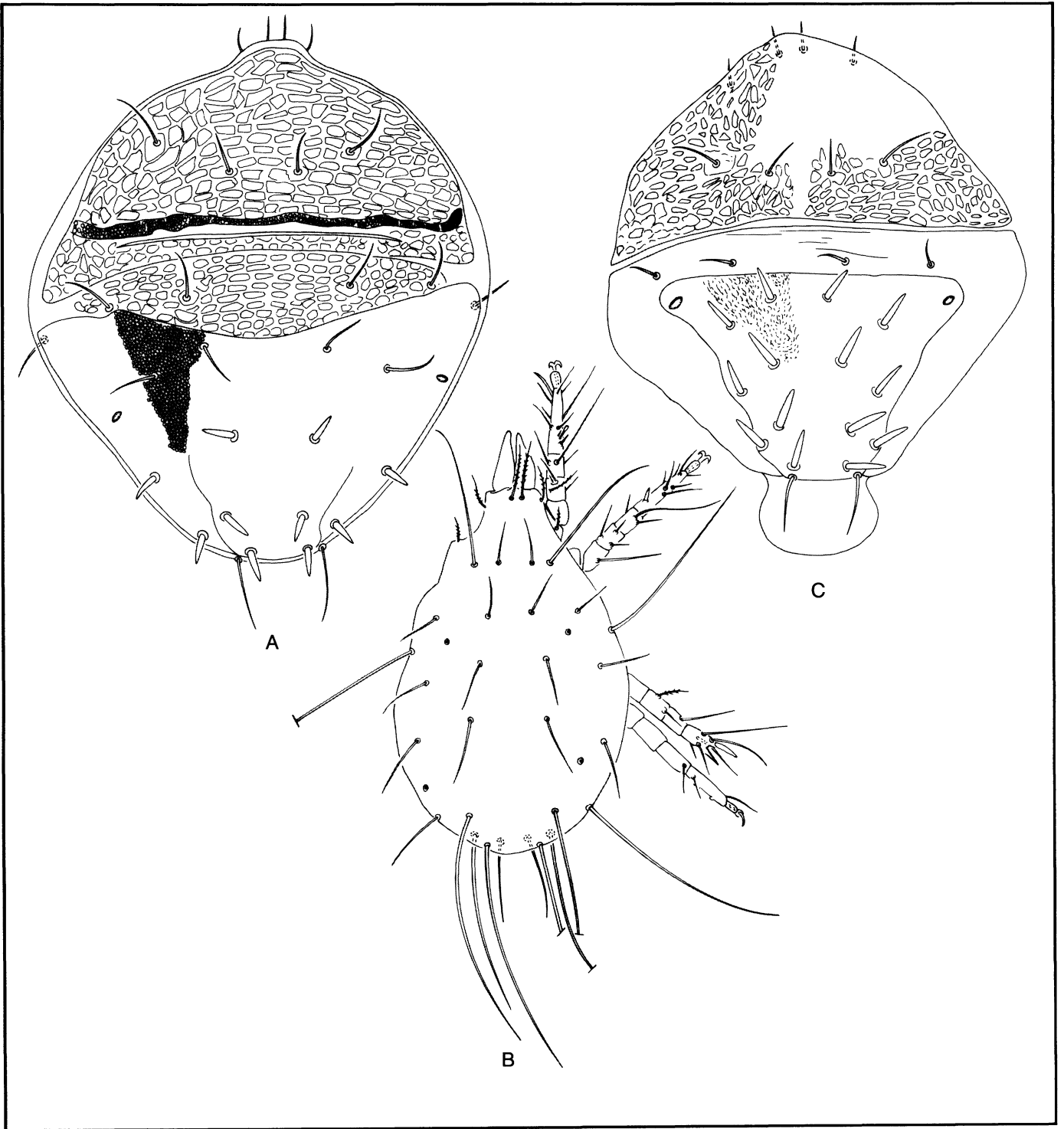


Plate 17. Lardoglyphid mites (Lardoglyphidae), dorsal views: A, *Lardoglyphus zacheri*, hypopus; B, same, male; C, *Lardoglyphus konoii*, hypopus.

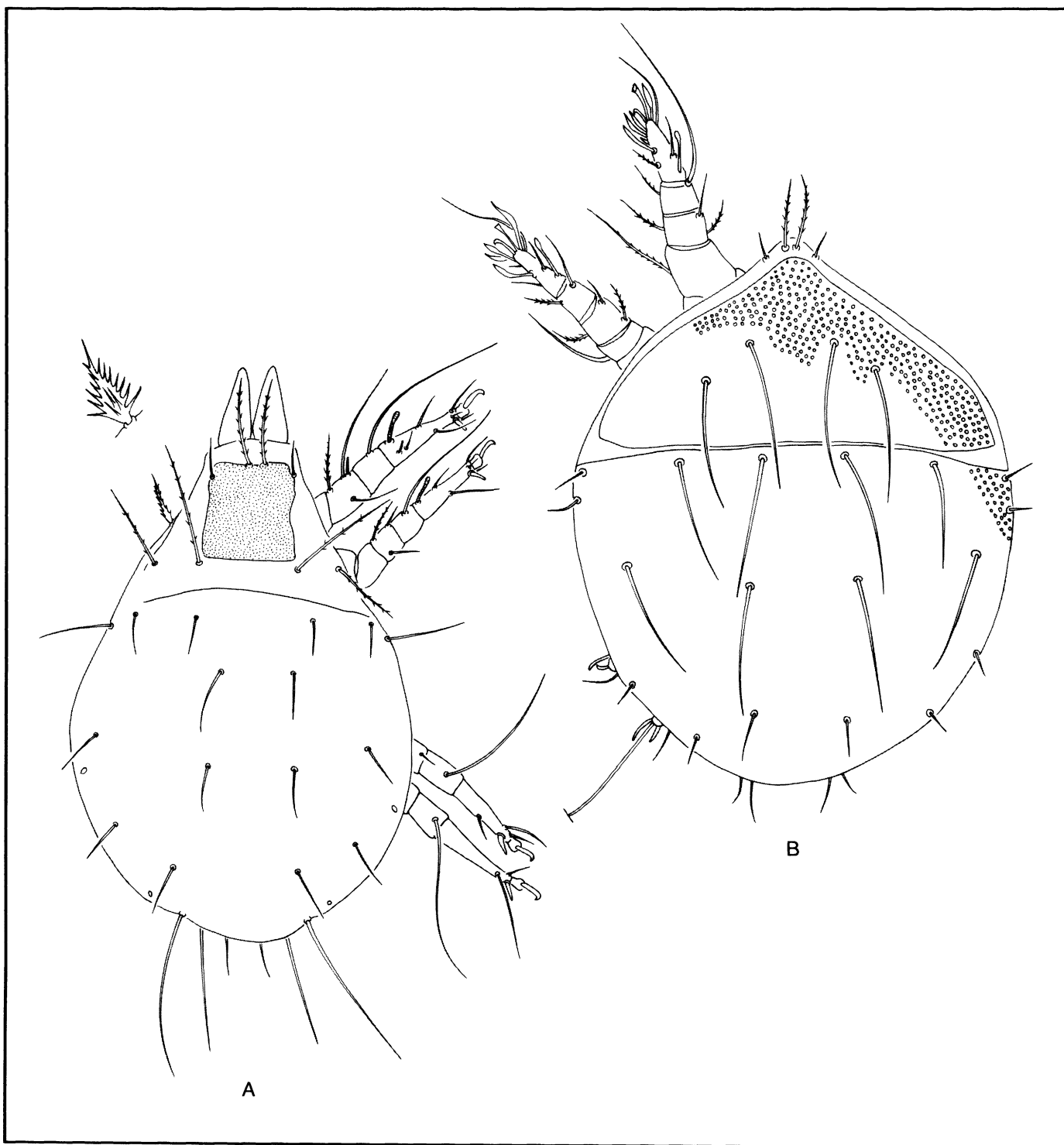


Plate 18. Grain mite, *Acarus siro* (Acaridae),  
dorsal views: A, female; B, hypopus.

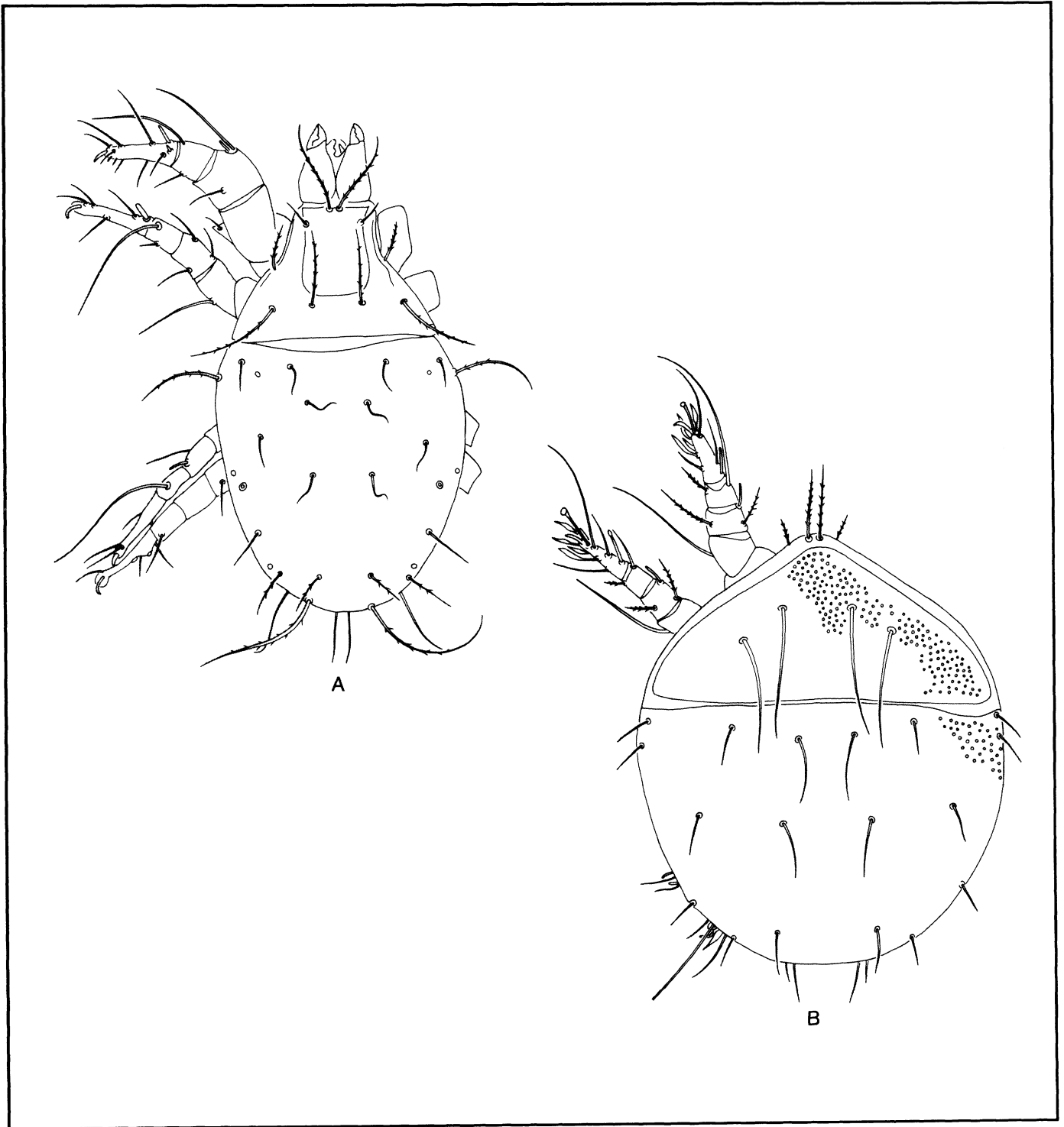


Plate 19. *Acarus farris* (Acaridae), dorsal views:  
A, male; B, hypopus.



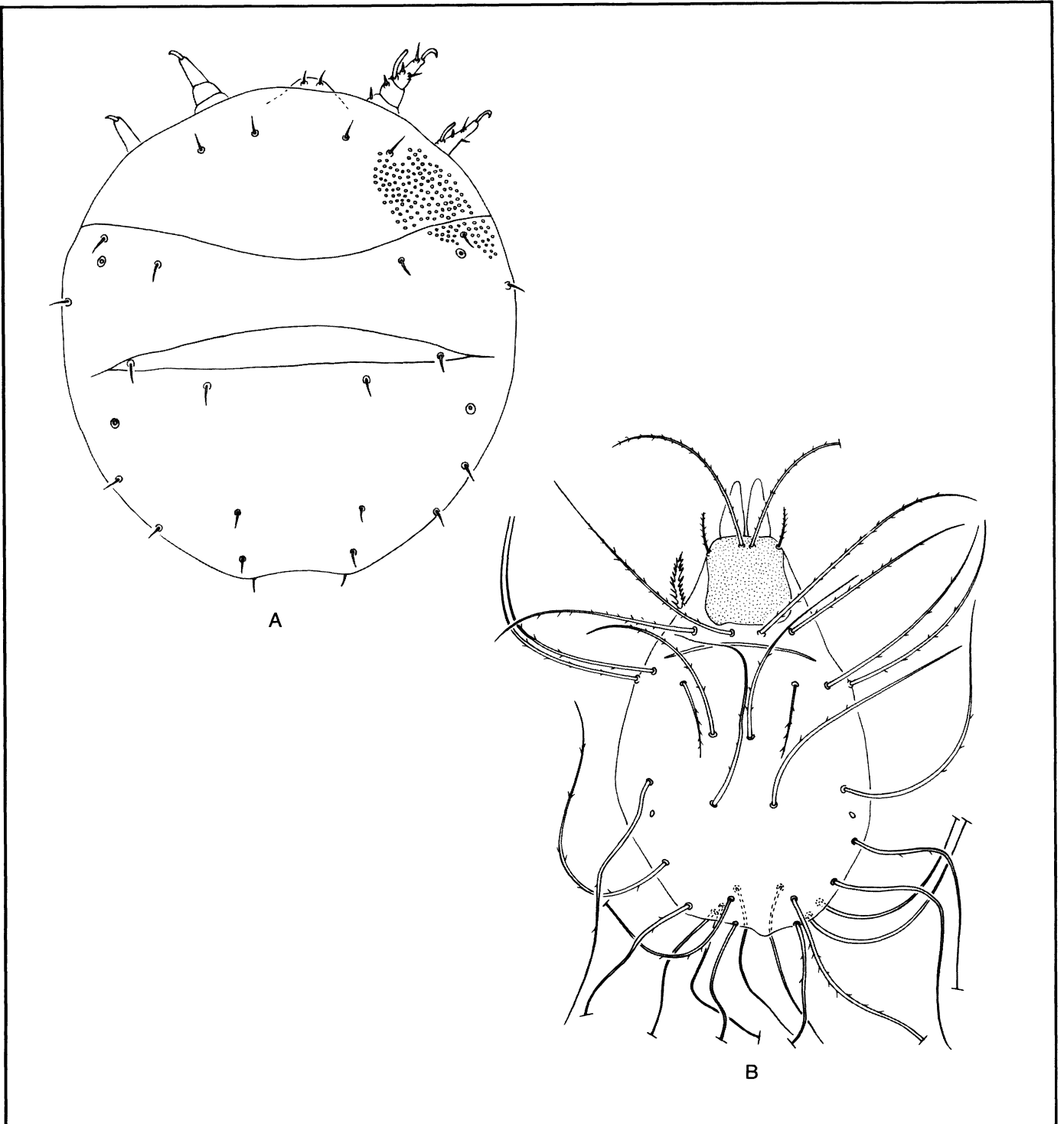


Plate 20. **Acarid mites** (Acaridae), dorsal views: A, *Acarus immobilis*, hypopus; B, **cheese mite**, *Tyrollichus casei*, female.

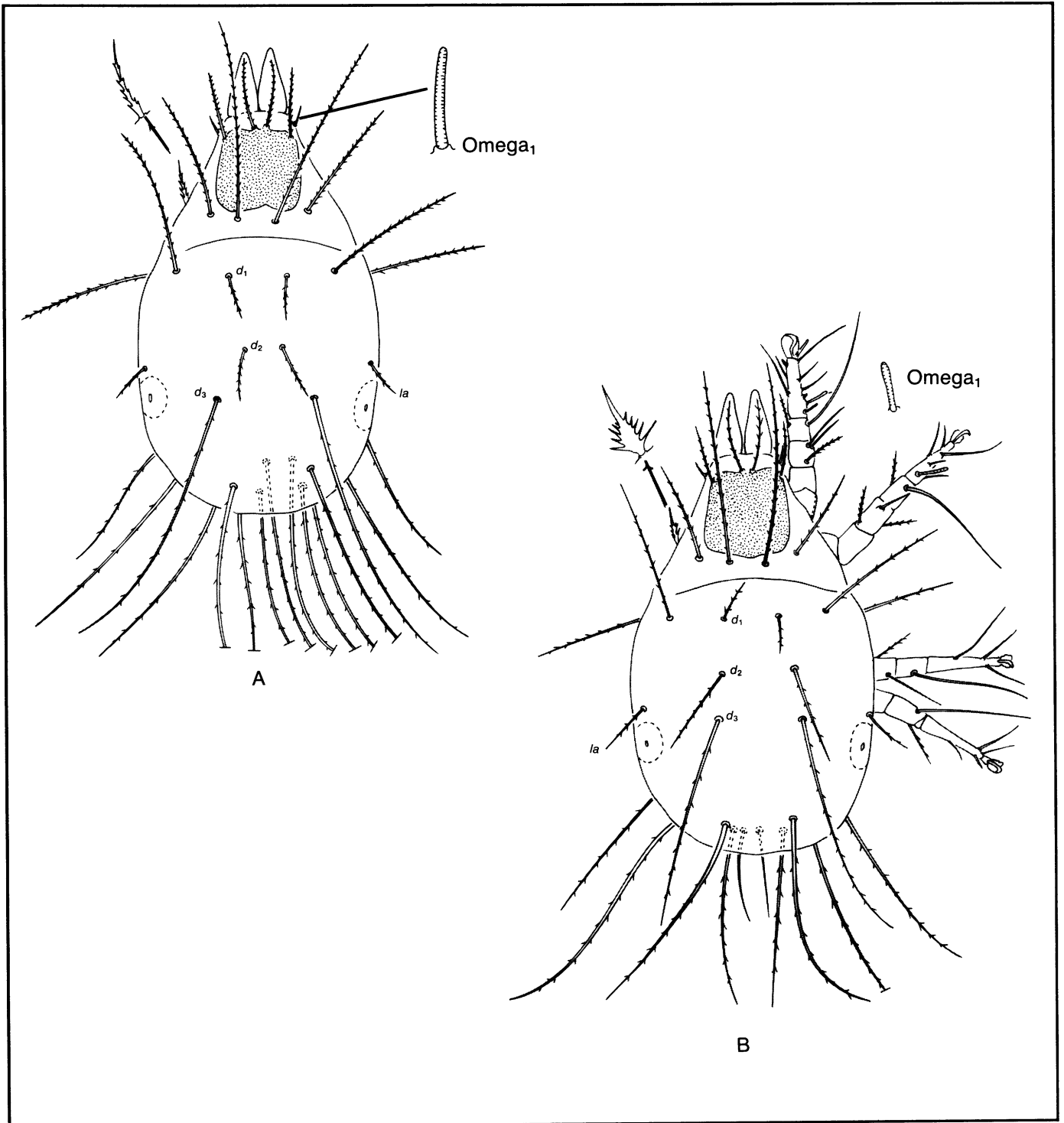


Plate 21. **Acarid mites** (Acaridae), dorsal views of females: A, *Tyrophagus longior*; B, **mold mite**, *Tyrophagus putrescentiae*.

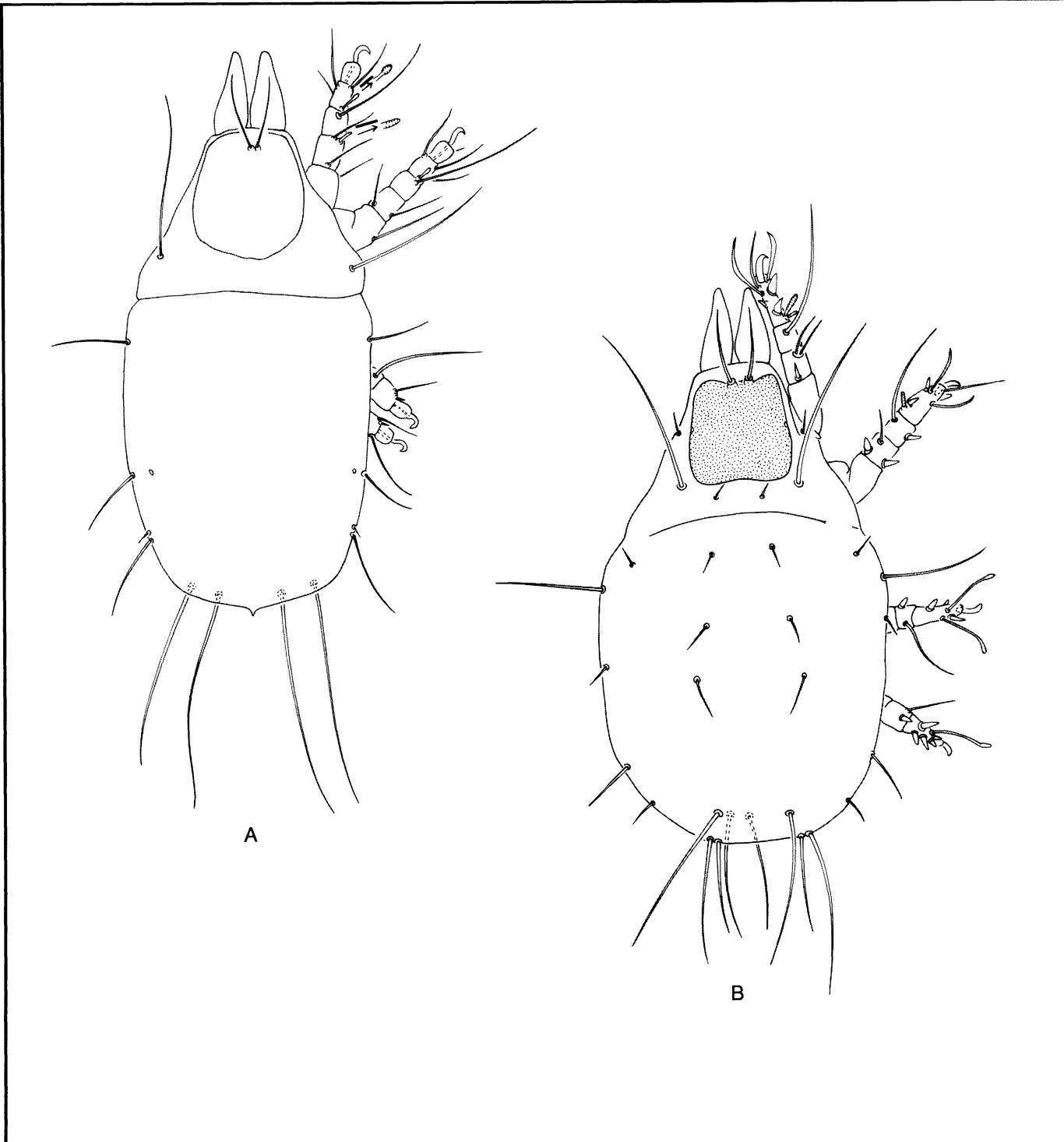


Plate 22. **Acarid mites** (Acaridae), dorsal views of females: A, *Thyreophagus entomophagus*; B, *Rhizoglyphus robini* (see also pl. 23).

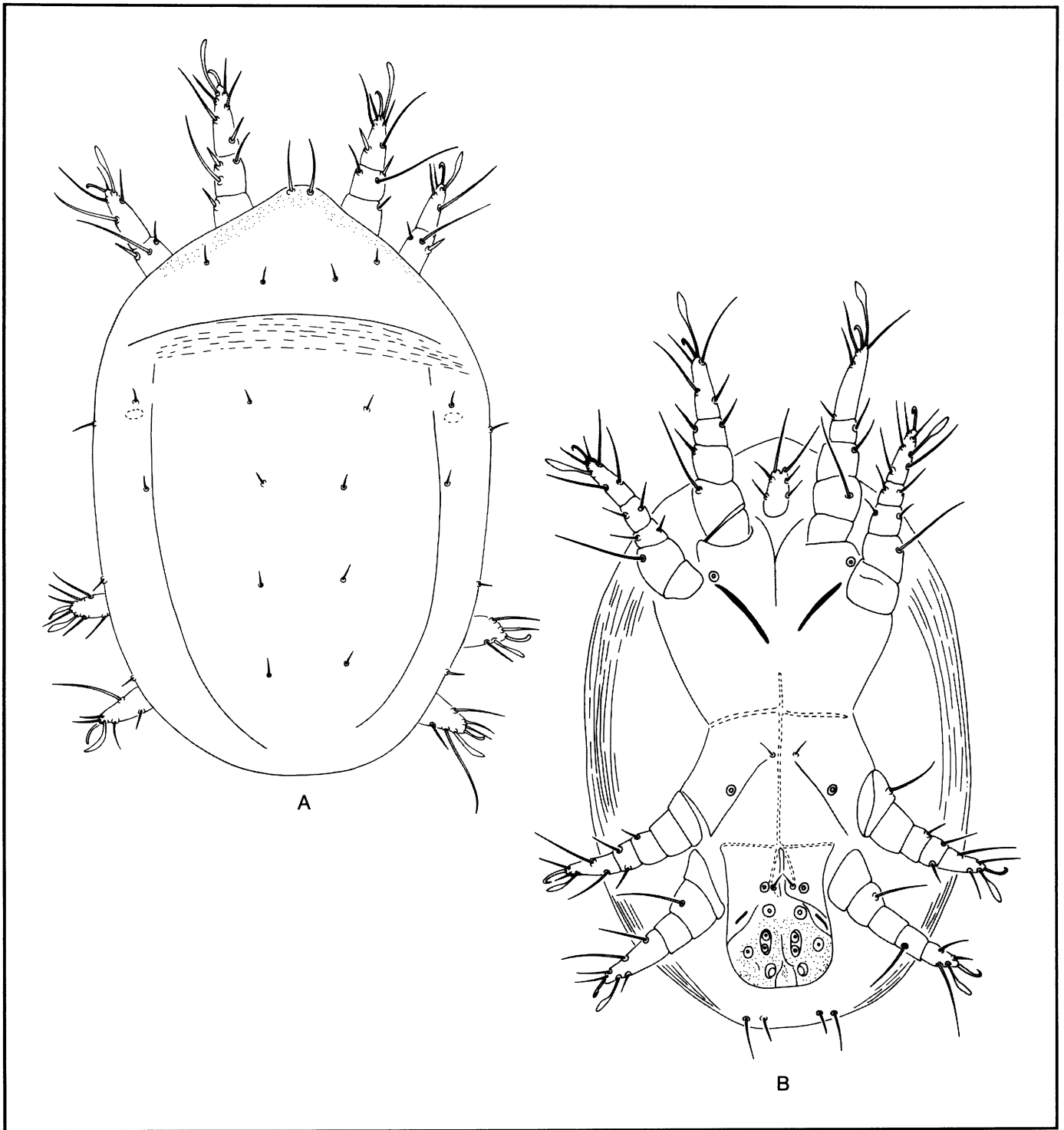


Plate 23. *Rhizoglyphus robini* (Acaridae),  
hypopus: A, dorsal view; B, ventral view. (See  
also pl. 22B.)

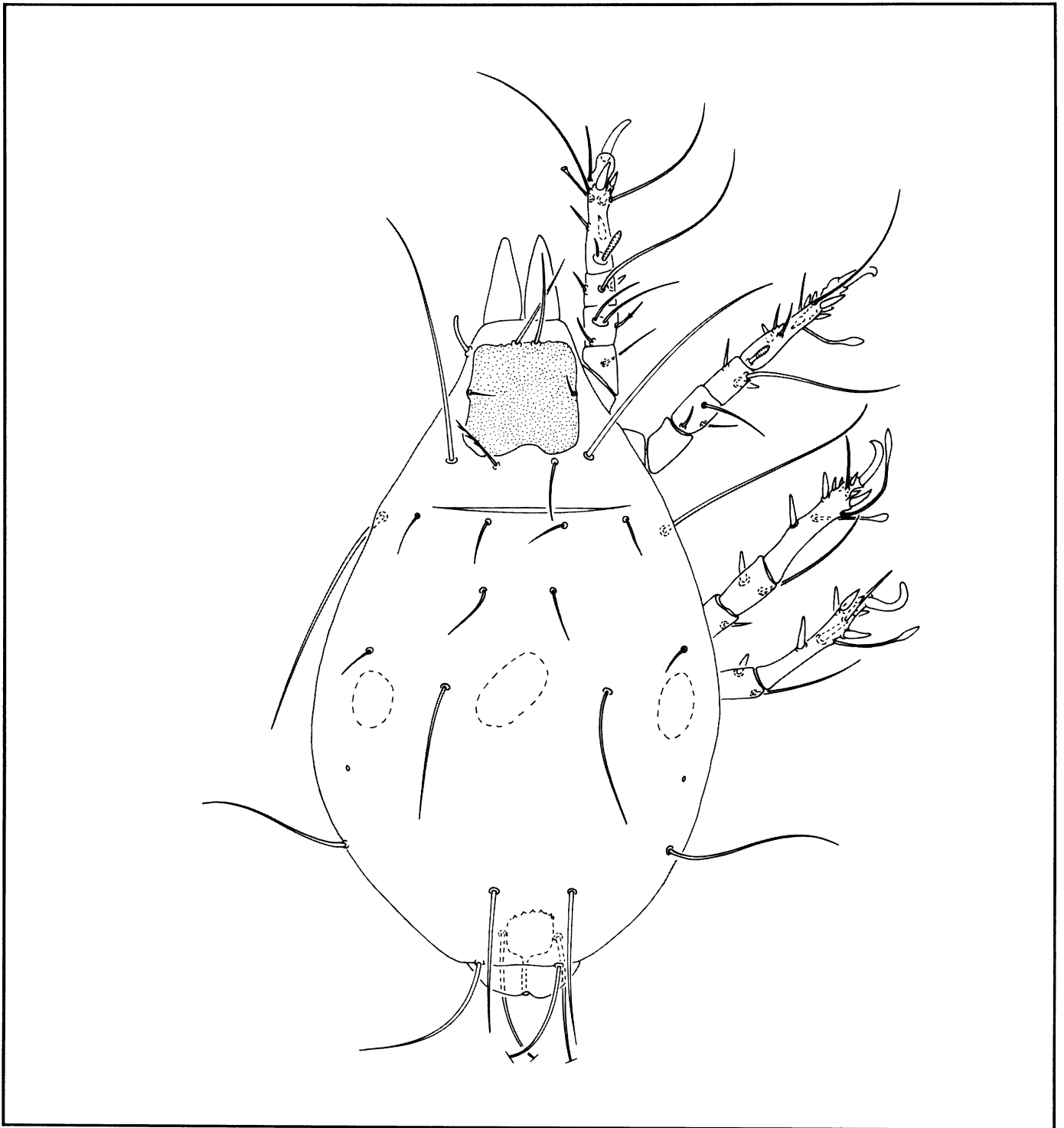


Plate 24. *Caloglyphus berlesei* (Acaridae), dorsal view of gravid female.

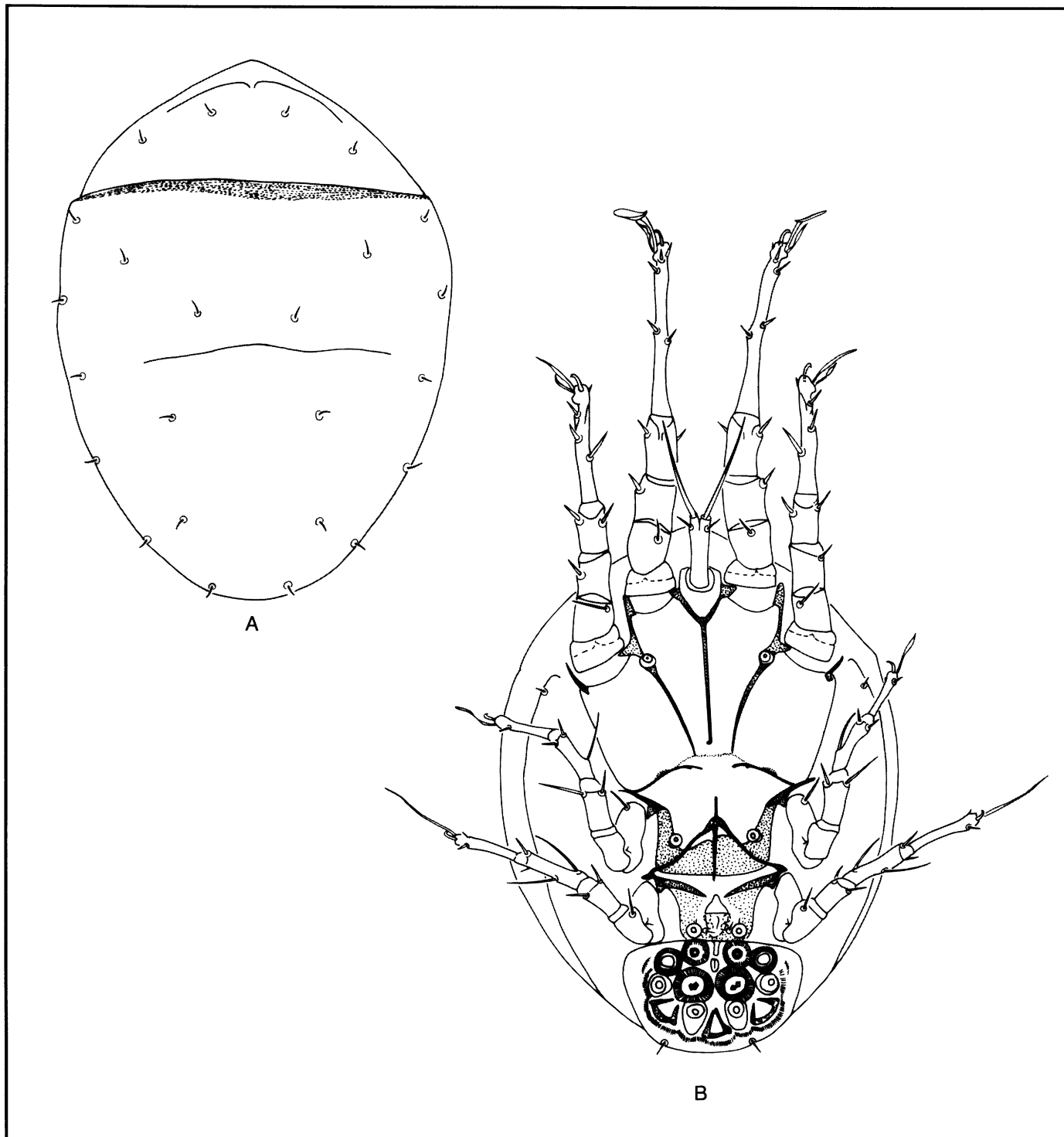


Plate 25. *Histiostoma heinemanni*  
(Histiostomatidae), hypopus: A, dorsal view; B,  
ventral view. (See also pl. 26 and 27.) (Redrawn  
from 15 by C. Feller.)

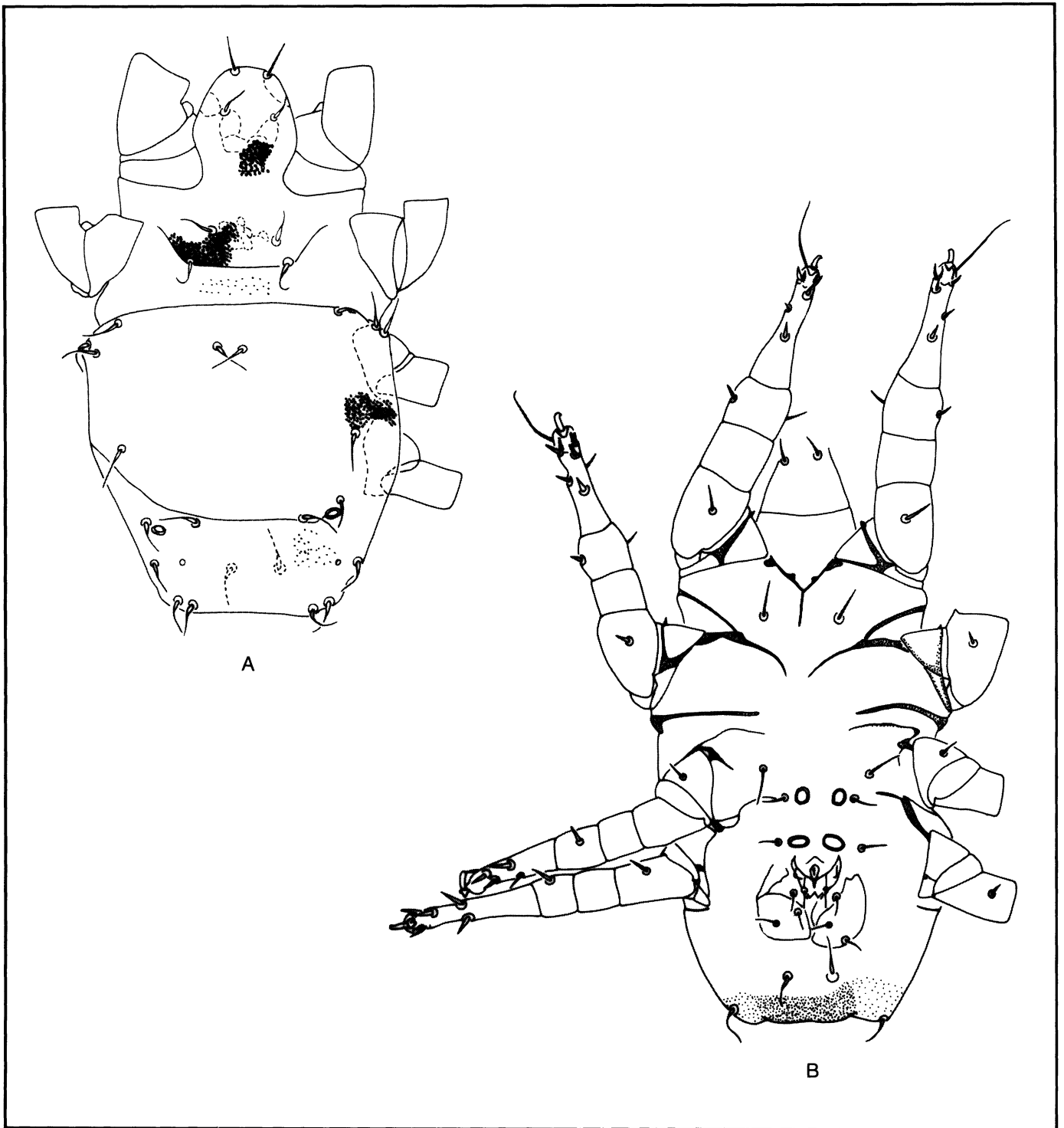


Plate 26. *Histiostroma heinemanni*  
 (Histiostromatidae), male: A, dorsal view; B,  
 ventral view. (See also pl. 25 and 27.) (Redrawn  
 from 15 by C. Feller.)

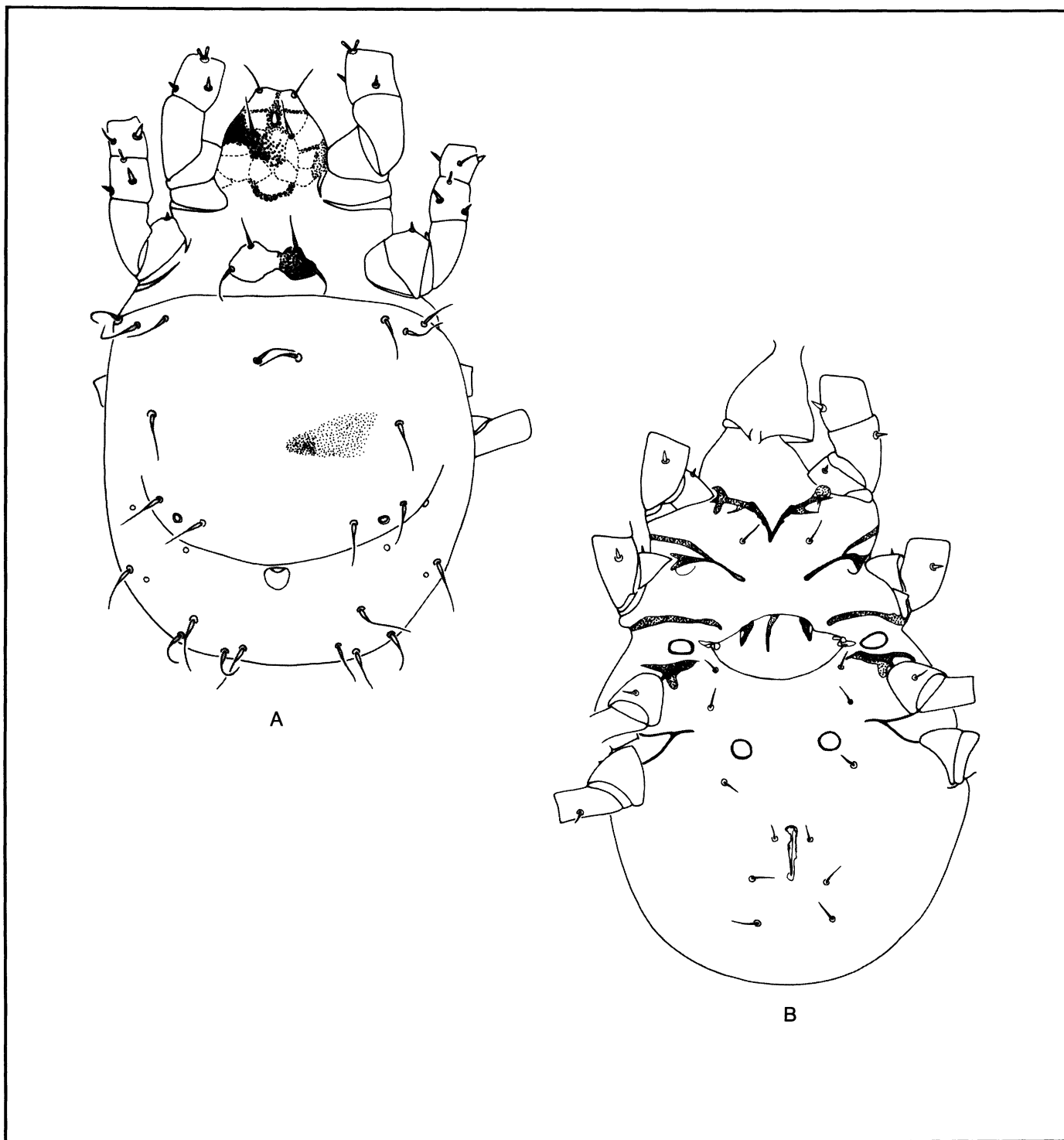


Plate 27. *Histiotoma heinemanni*  
(Histiotomatidae), female: A, dorsal view; B,  
ventral view. (See also pl. 25 and 26.) (Redrawn  
from 15 by C. Feller.)



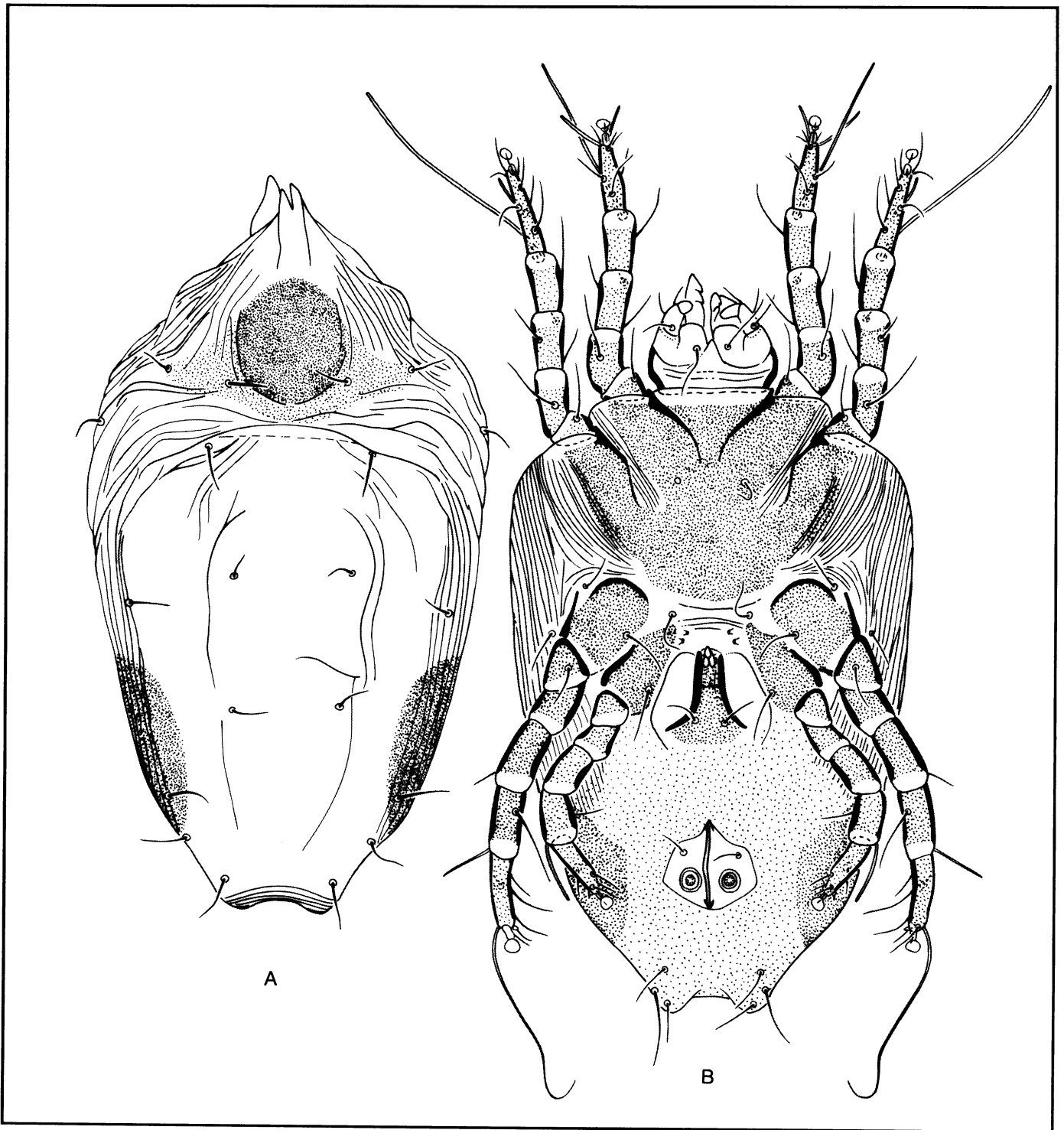


Plate 28. *Euroglyphus longior* (Pyroglyphidae), male: A, dorsal view; B, ventral view. (See also pl. 29.) (Redrawn from 10 by C. Feller.)

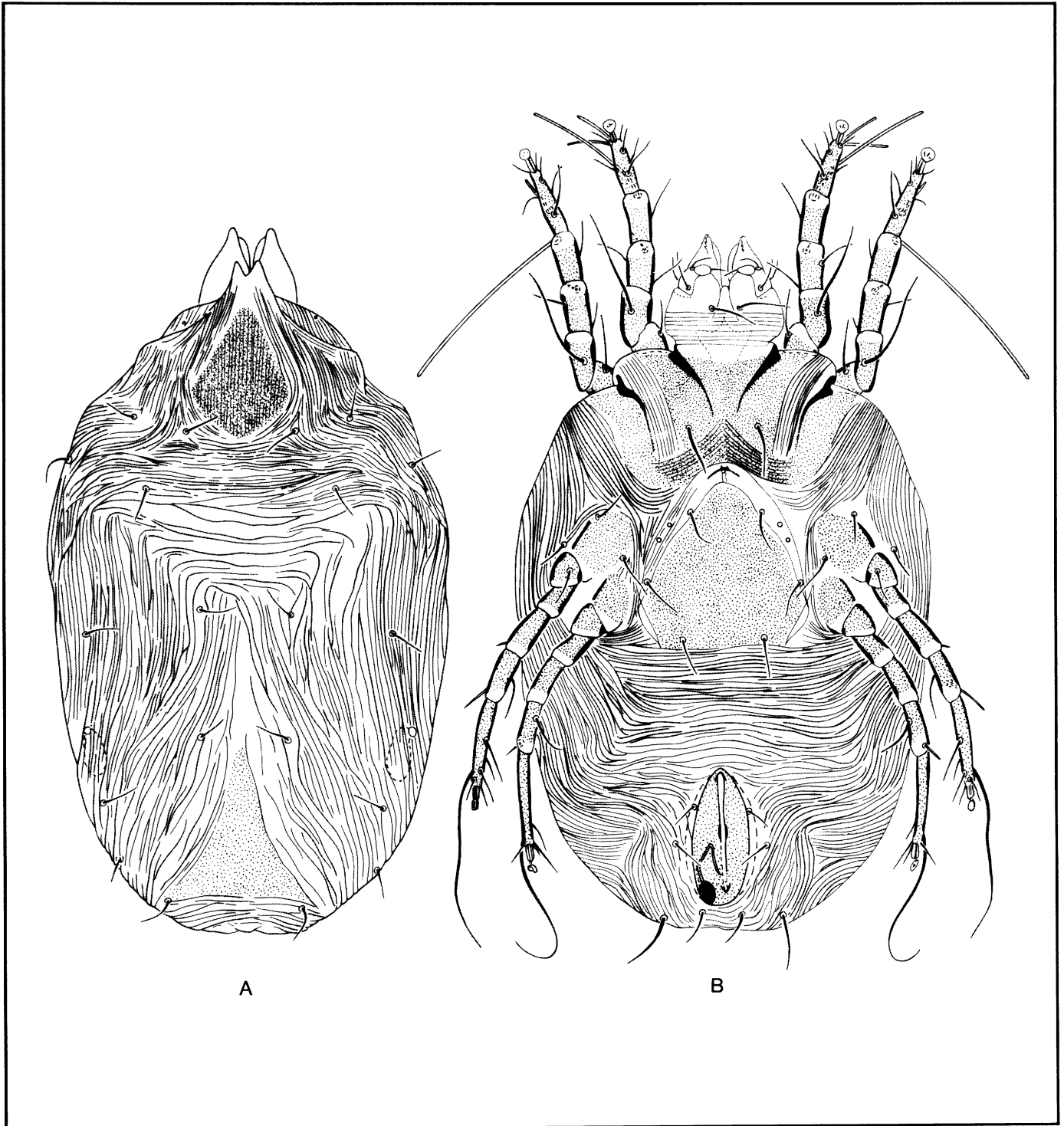


Plate 29. *Euroglyphus longior* (Pyroglyphidae), female: A, dorsal view; B, ventral view. (See also pl. 28.) (Redrawn from 10 by C. Feller.)

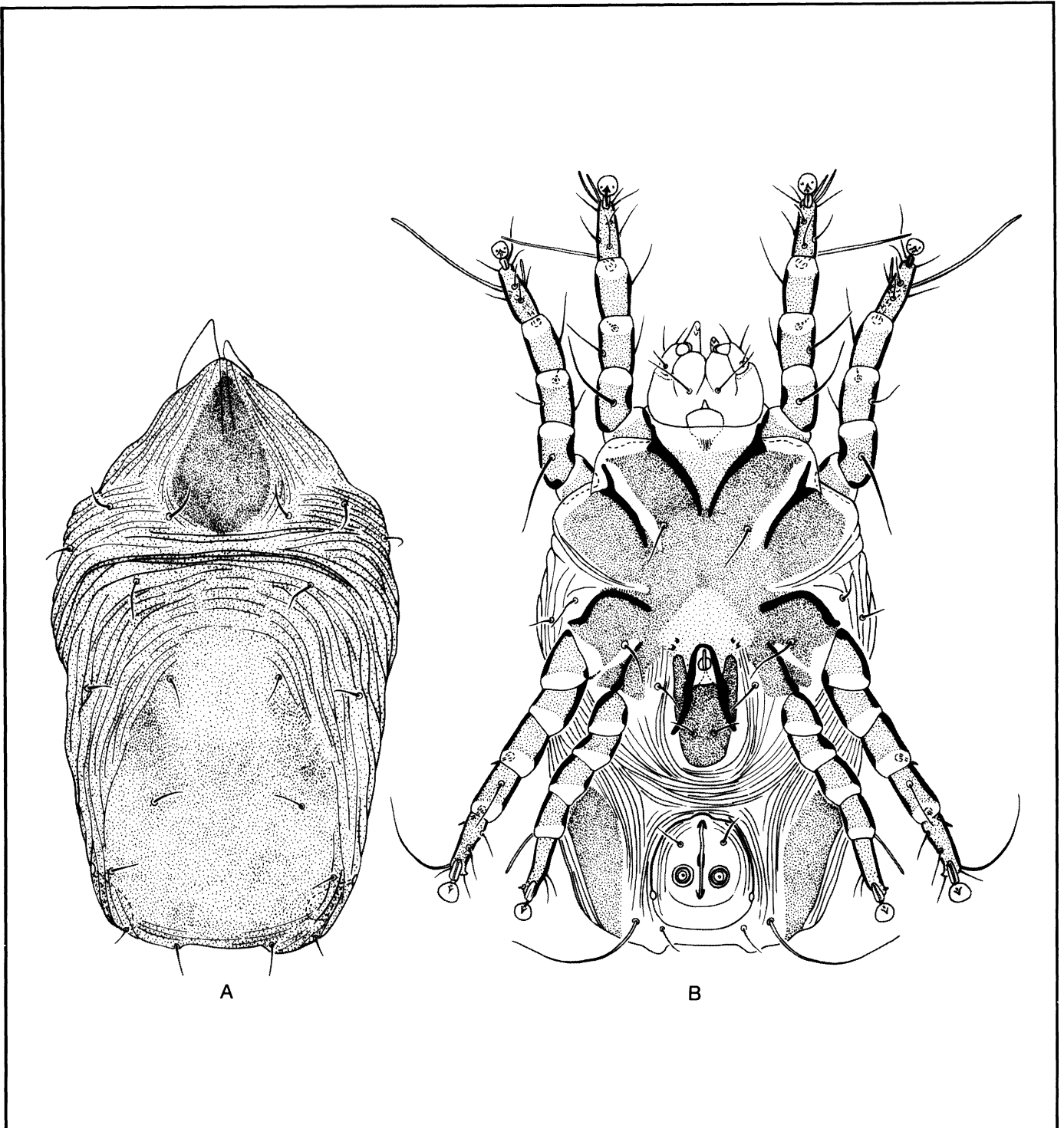


Plate 30. *Euroglyphus maynei* (Pyroglyphidae), male: A, dorsal view; B, ventral view. (See also pl. 31.) (Redrawn from 10 by C. Feller.)

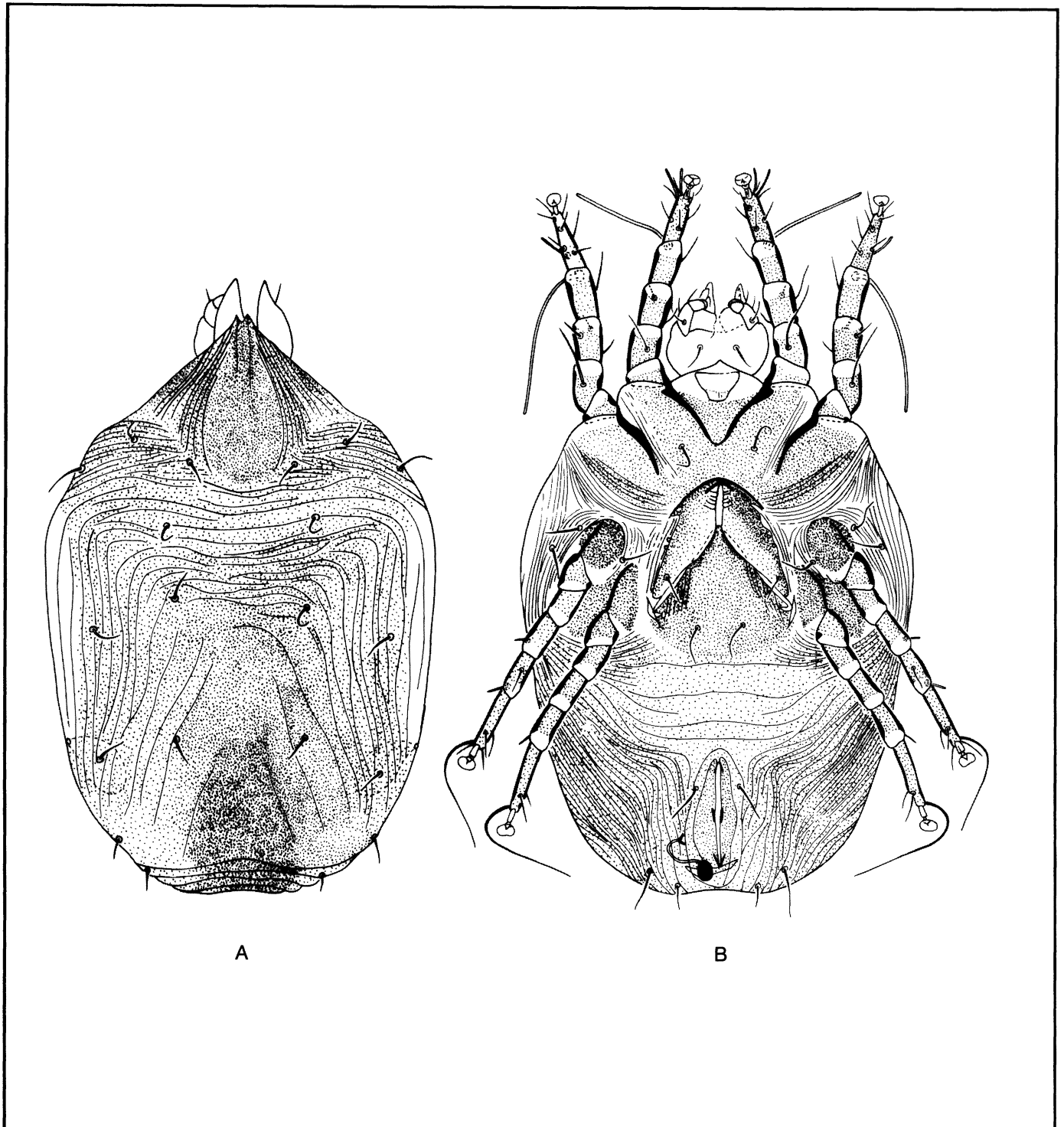


Plate 31. *Euroglyphus maynei* (Pyroglyphidae), female: A, dorsal view; B, ventral view. (See also pl. 30.) (Redrawn from 10 by C. Feller.)



Plate 32. **American house dust mite,**  
*Dermatophagoides farinae* (Pyroglyphidae),  
ventral view of female.

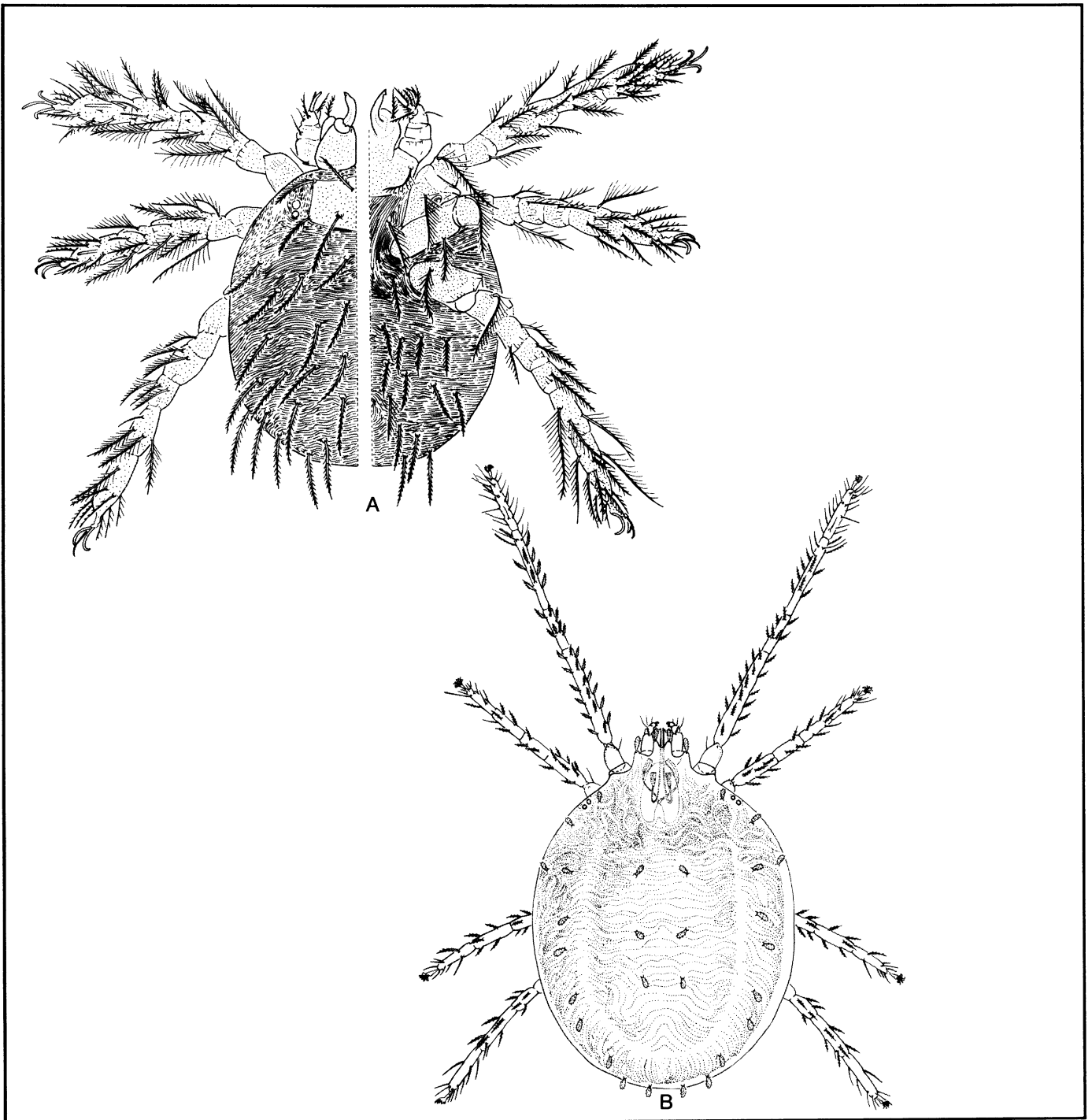


Plate 33. Prostigmatid mites (Prostigmata): A, *Leptotrombidium akamushi* (Trombiculidae), dorsal (left) and ventral (right) views of larva (chigger); B, clover mite, *Bryobia praetiosa* (Tetranychidae), dorsal view of female. (Figs. redrawn from 3 by C. Feller.)

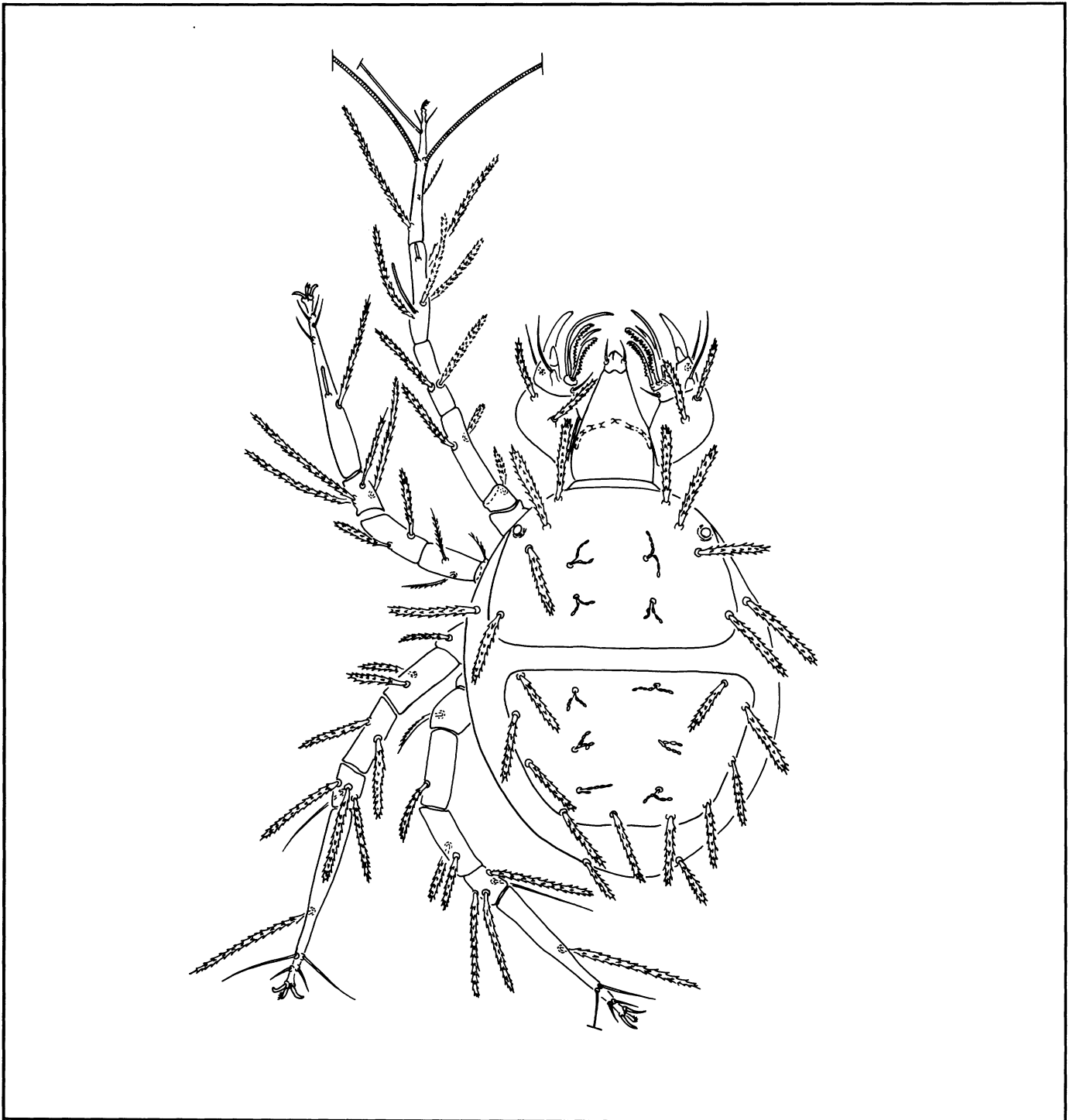


Plate 34. *Cheletomorpha lepidopterorum*  
(Cheyletidae), dorsal view of female  
(integumental striations not shown). (See  
couplets 51–53 for illustrations of other  
cheyletids.)

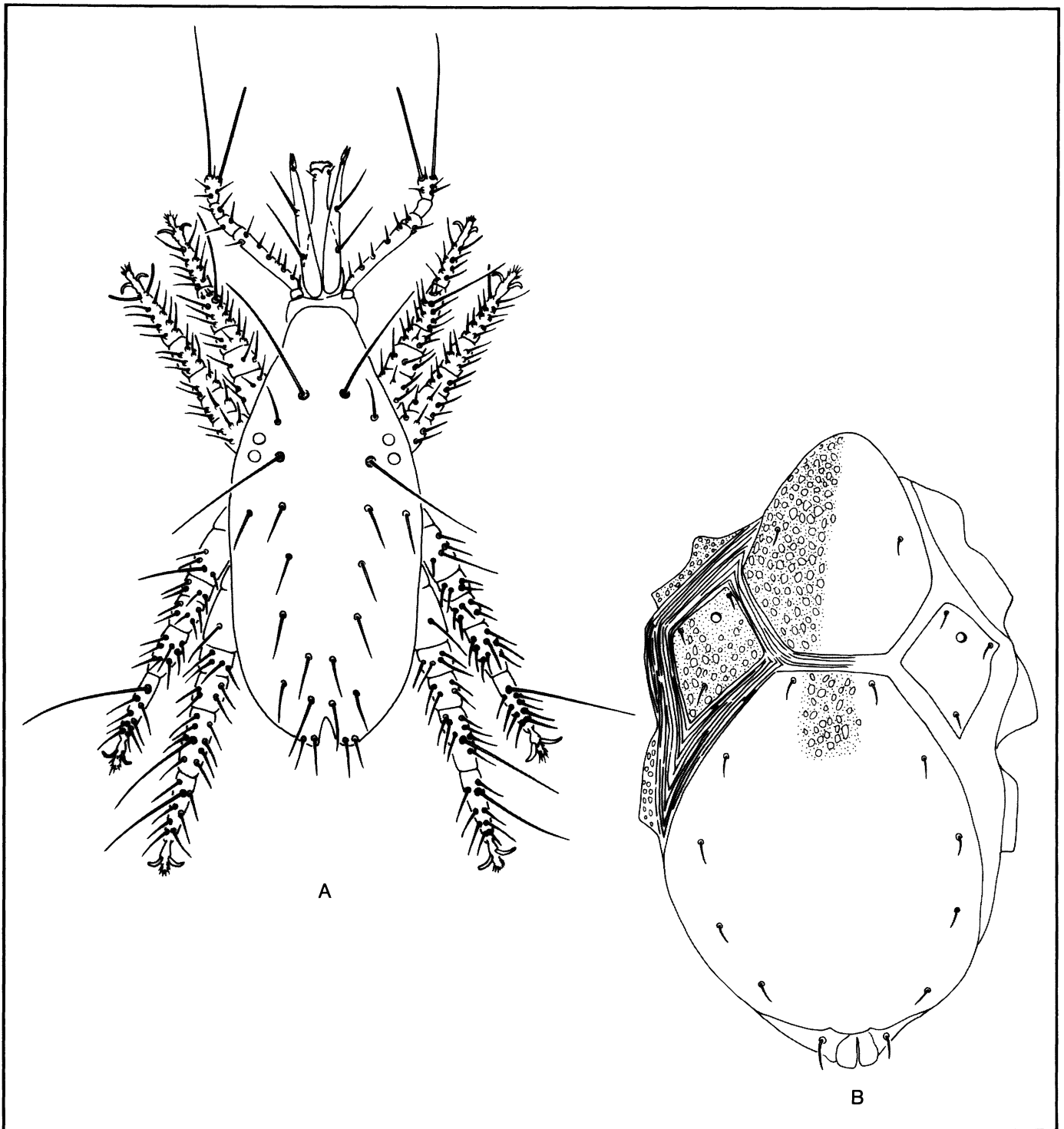


Plate 35. Prostigmatid mites (Prostigmata), dorsal views of females: A, *Spinibdella bifurcata* (Bdellidae); B, *Rhombognathides seahami* (Halacaridae).



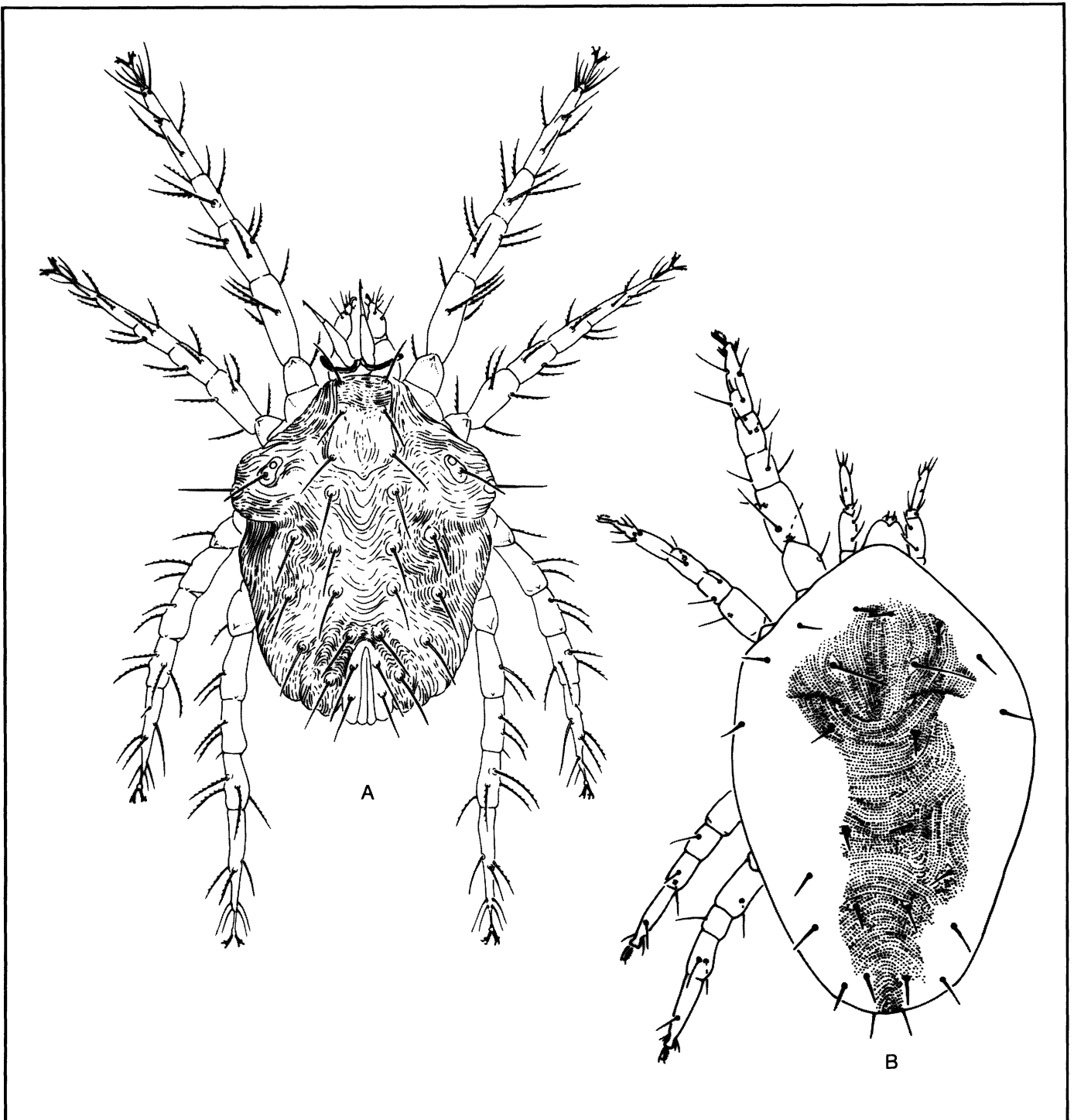


Plate 36. Prostigmatid mites (Prostigmata), females, dorsal views: A, cockroach mite, *Pimeliaphilus cunliffei* (Pterygosomatidae) (redrawn from 1 by C. Feller); B, *Tydeus* sp. (Tydeidae) (redrawn by C. Feller from original by E.W. Baker).

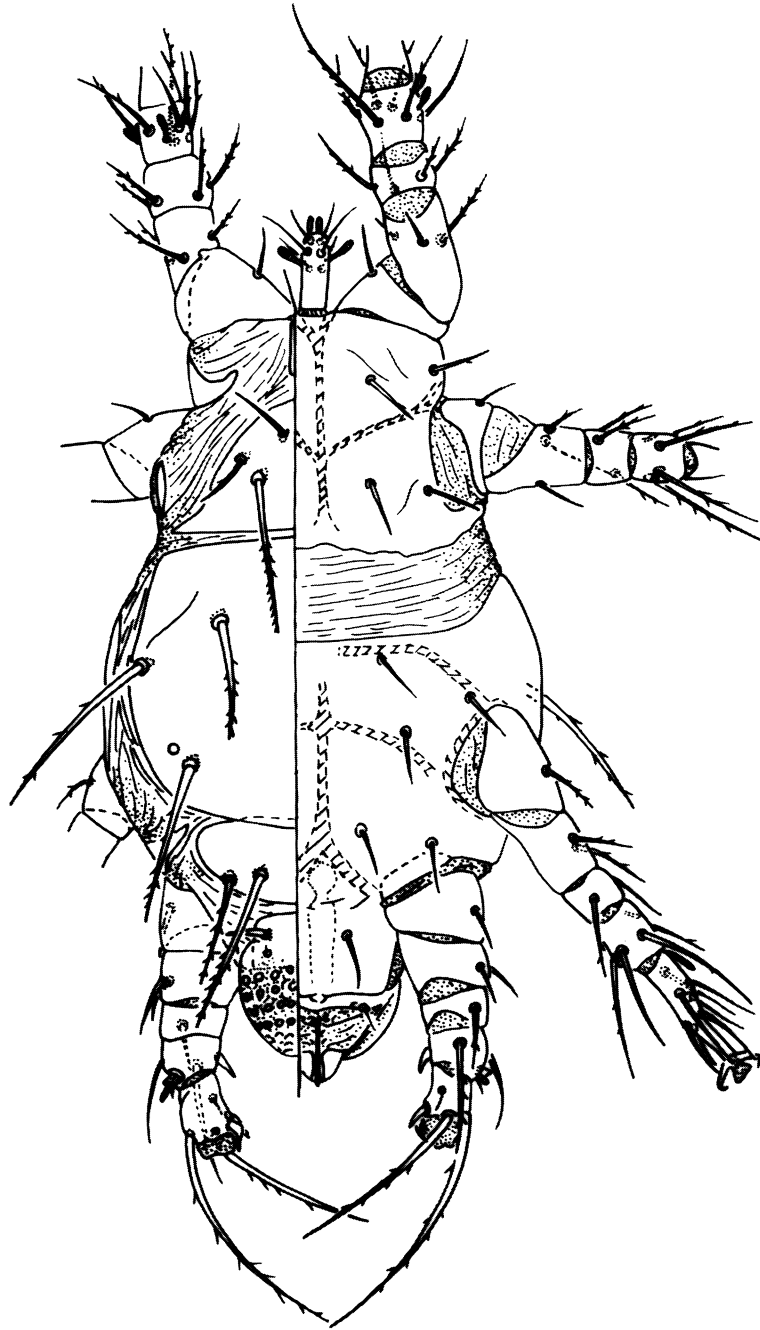


Plate 37. *Scutacarus baculitarsus agaricus*  
(Scutacaridae), male, dorsal (left) and ventral  
(right) views. (See also pl. 38.) (Redrawn from  
22 by C. Feller.)

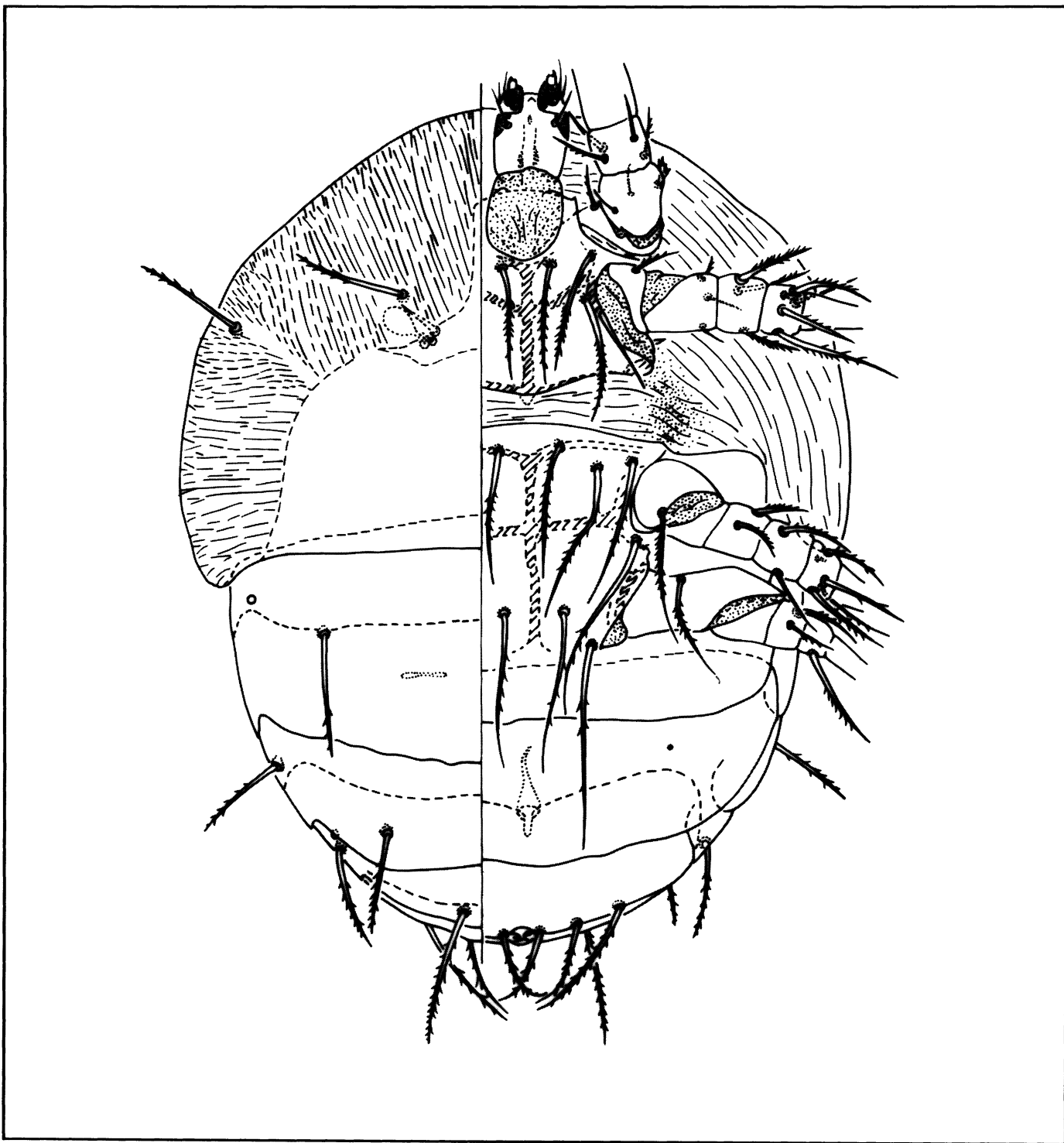


Plate 38. *Scutacarus baculitarsus agaricus*  
(Scutacaridae), female, dorsal (left) and ventral  
(right) views. (See also pl. 37.) (Redrawn from  
22 by C. Feller).

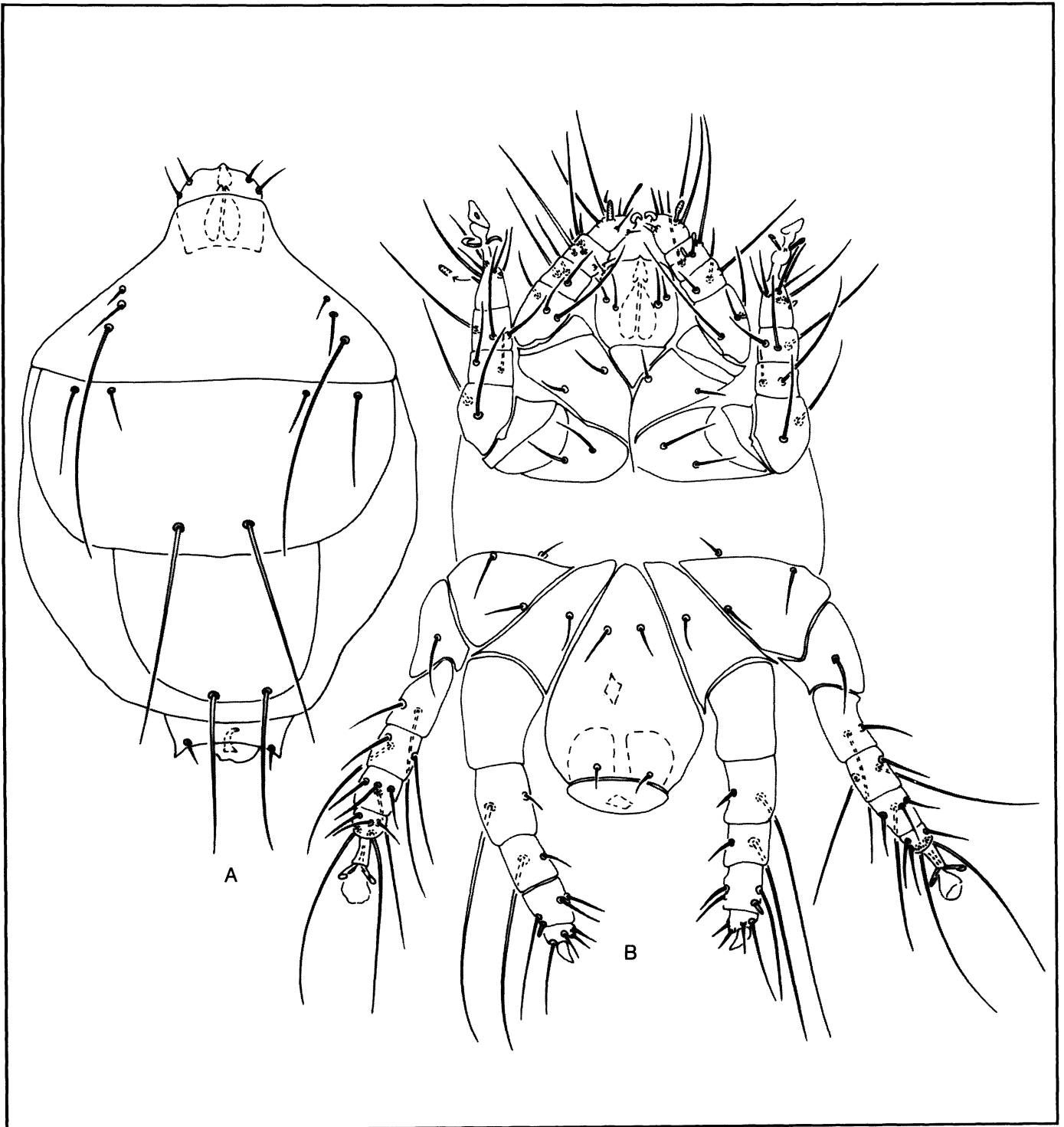


Plate 39. **Straw itch mite, *Pyemotes tritici*** (Pyemotidae), male: A, dorsal view; B, ventral view. (See also pl. 40.)

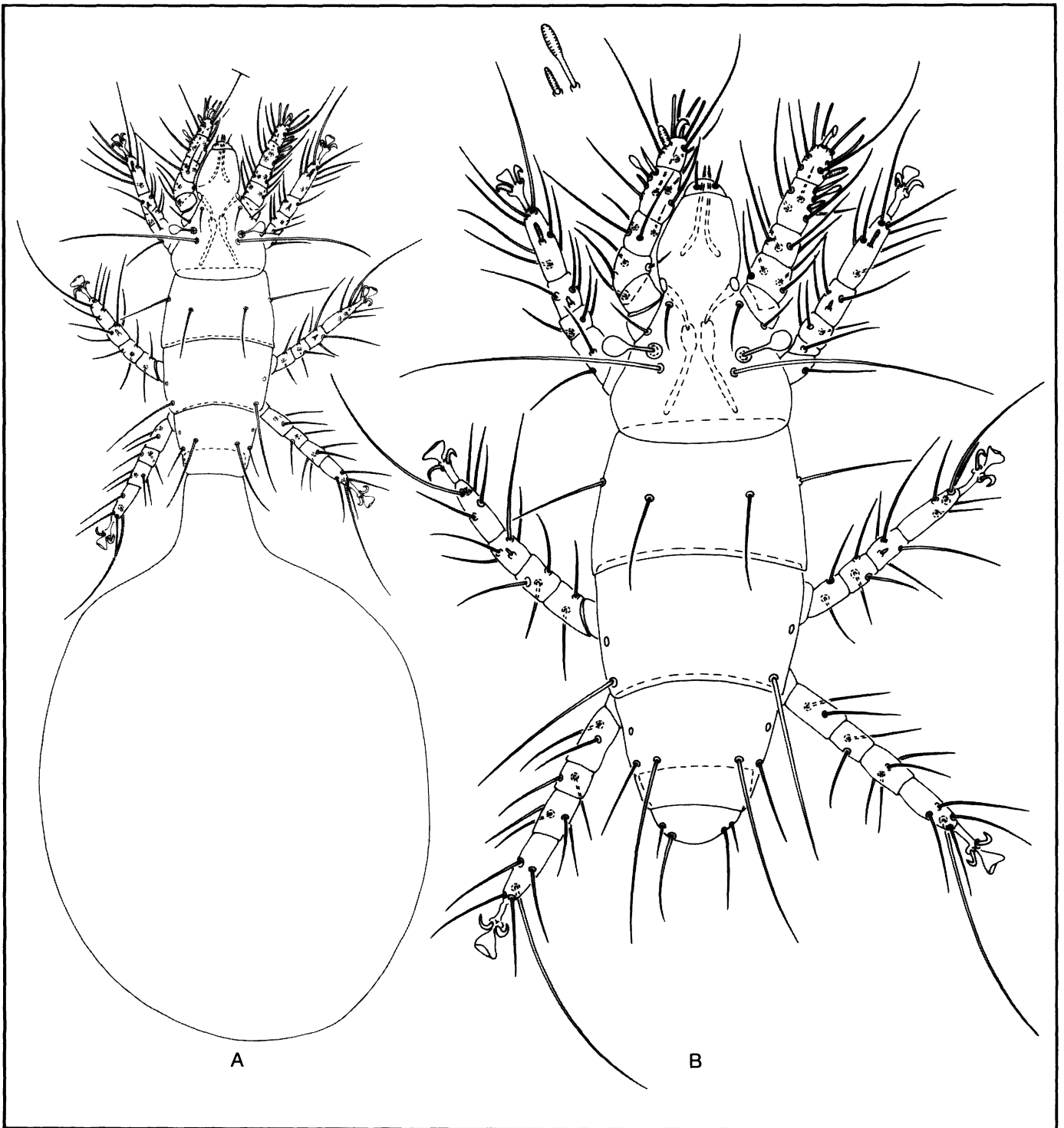


Plate 40. **Straw itch mite**, *Pyemotes tritici* (Pyemotidae), dorsal views of females: A, gravid; B, nongravid. (See also pl. 39.)

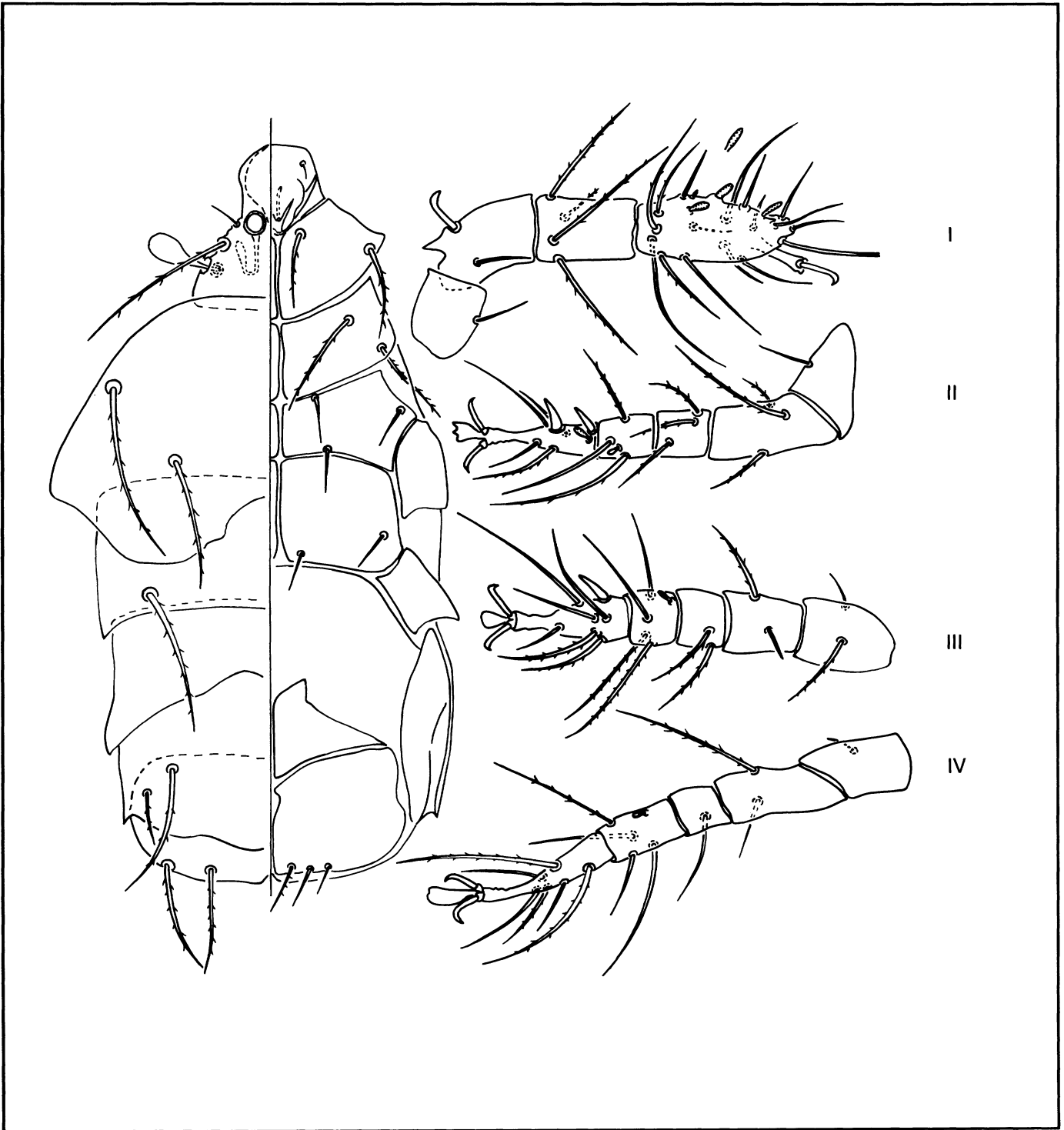


Plate 41. *Pygmephorus sellnicki*  
(Pygmephoridae), female, dorsal (left) and  
ventral (right) views; legs I-IV (redrawn from 25  
by C. Feller).

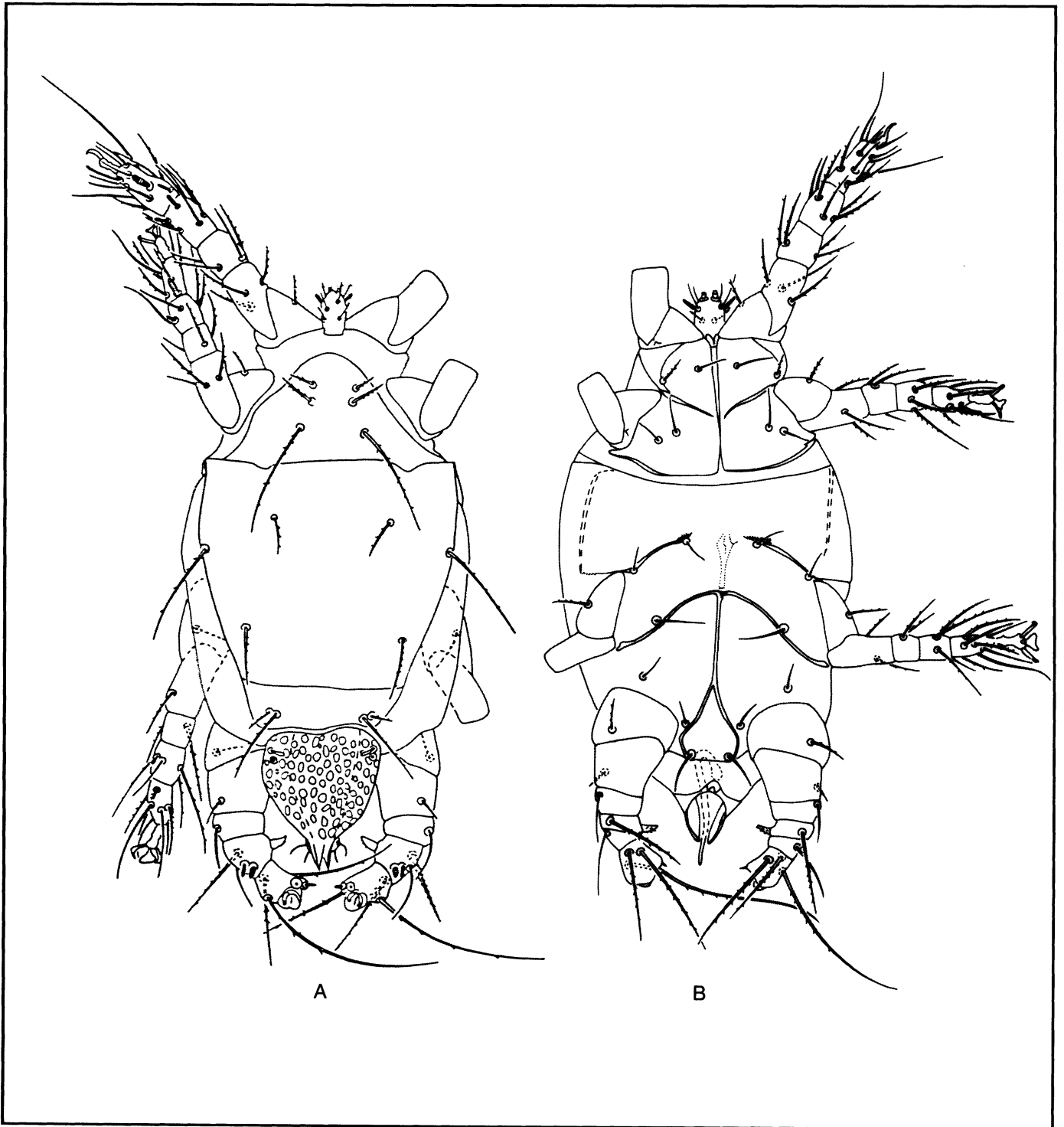


Plate 42. *Pseudopygmephorus smileyi*  
(Pygmephoridae), male: A, dorsal view; B,  
ventral view. (See also pl. 43.) (Redrawn from  
17 by C. Feller.)

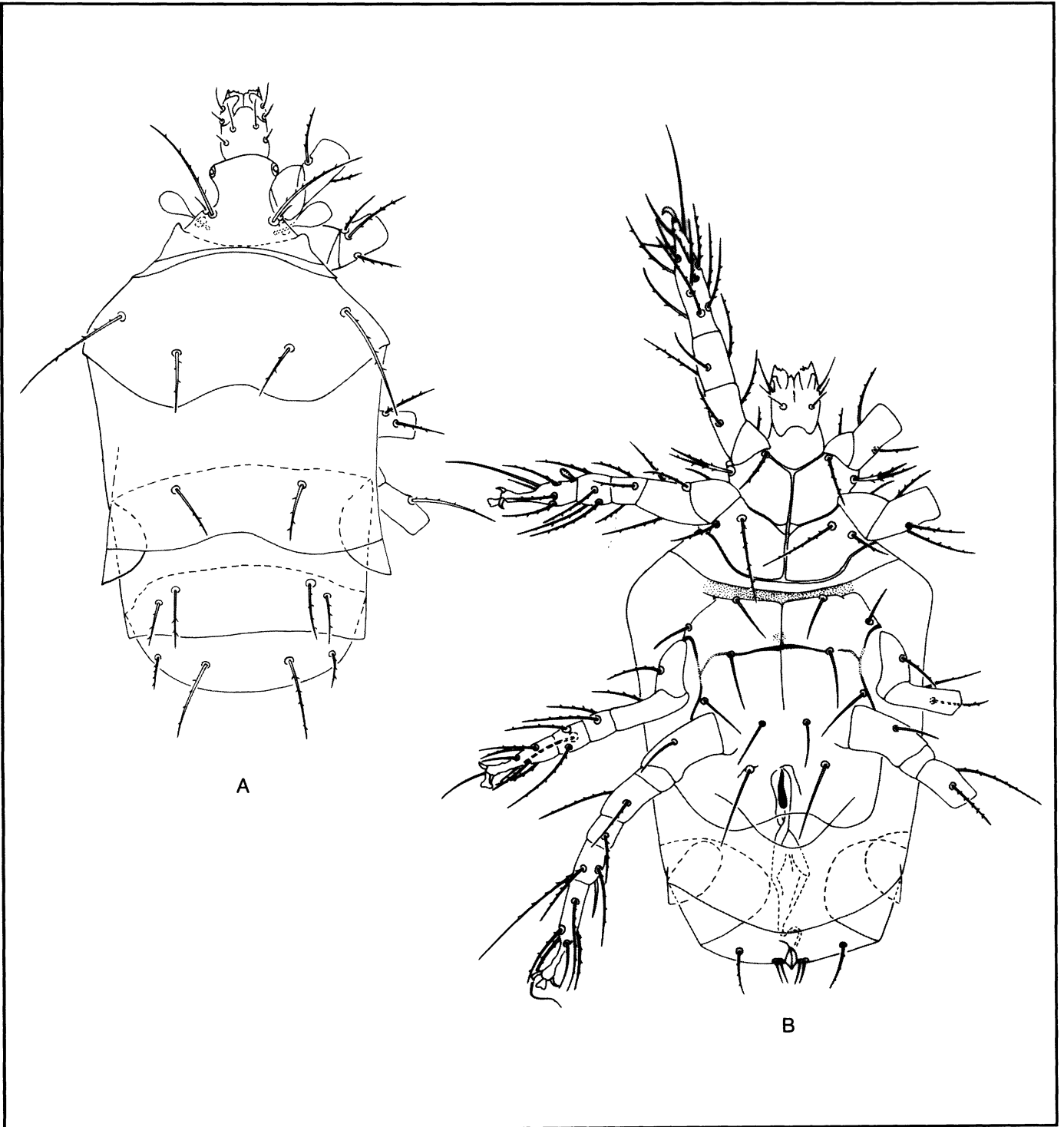


Plate 43. *Pseudopygmephorus smileyi*  
(Pygmephoridae), female: A, dorsal view; B,  
ventral view. (See also pl. 42.) (Redrawn from  
17 by C. Feller.)



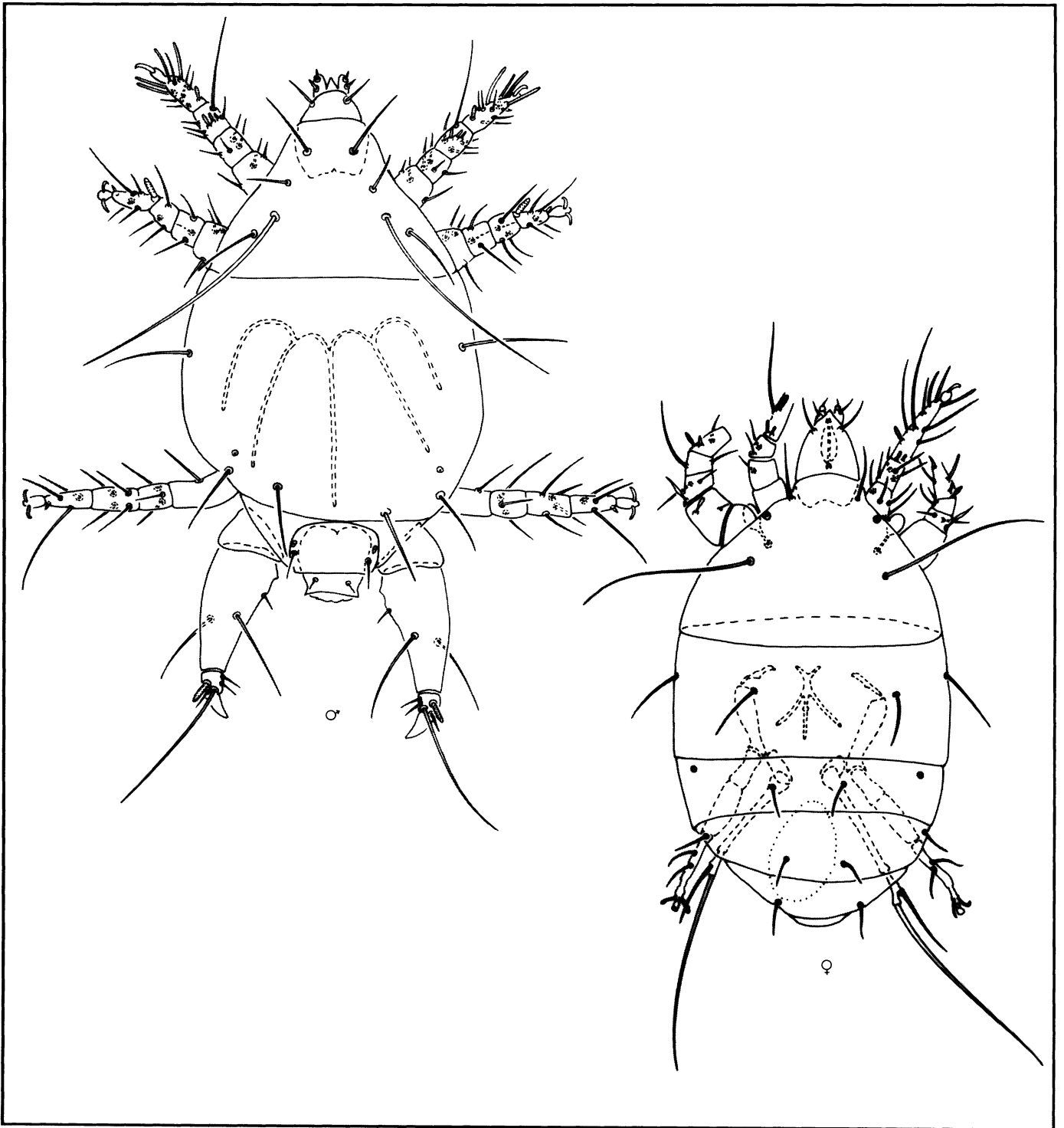


Plate 44. *Tarsonemus scaurus* (Tarsonemidae), dorsal views.

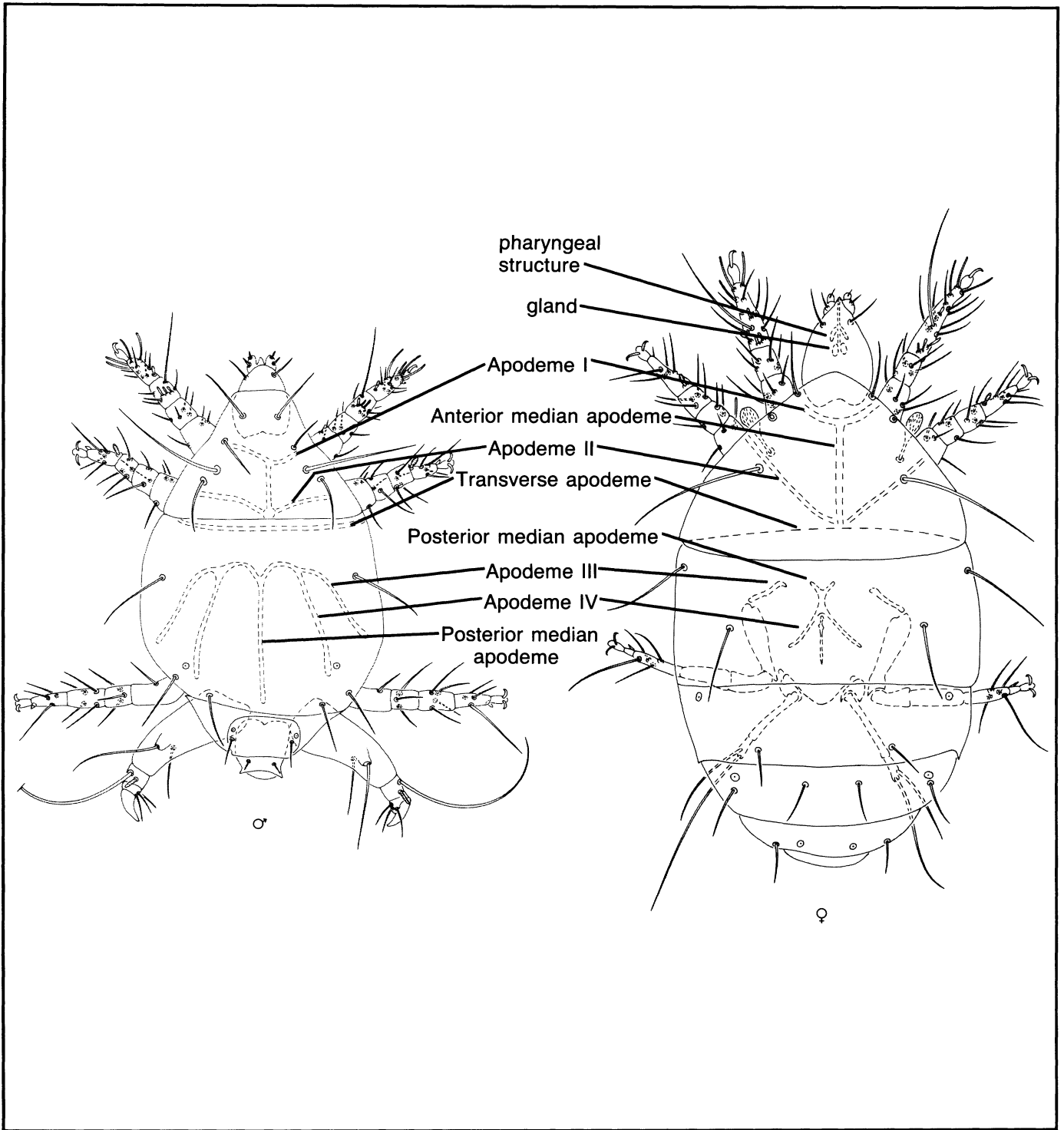


Plate 45. *Tarsonemus granarius* (Tarsonemidae), dorsal views.

## **COCKROACHES (BLATTARIA)**

These illustrations, drawn by A.D. Cushman unless otherwise indicated, are a continuation from part 1, chapter 2 (Cockroaches), by A.B. Gurney and F.W. Fisk.

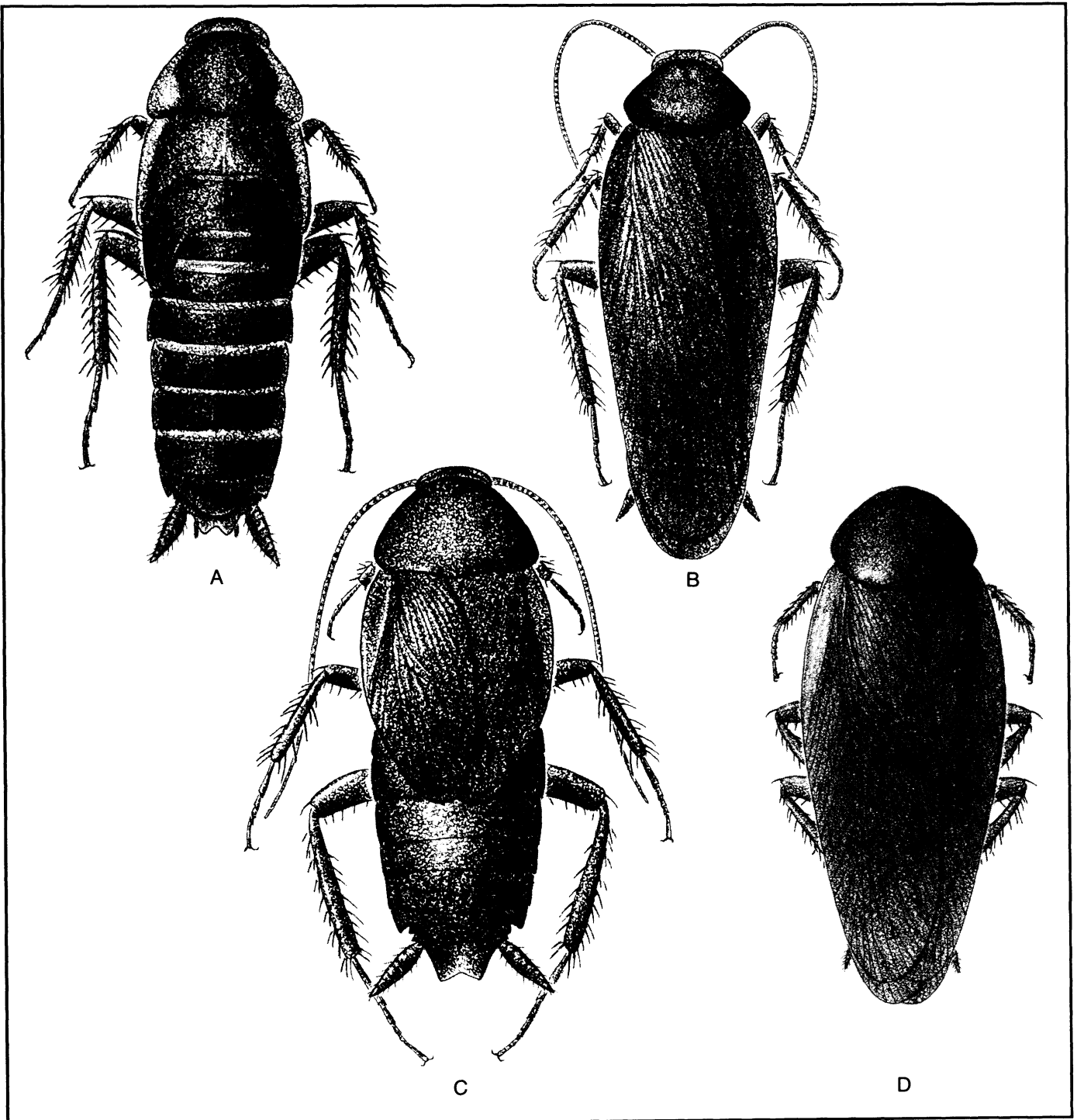


Plate 46. Blattid cockroaches (Blattidae), dorsal views (drawings by C. Feller): A, *Periplaneta japonica*, nymph; B, same, male (31-35); C, same, female (31-35); D, **smokybrown cockroach**, *Periplaneta fuliginosa* (31-35).

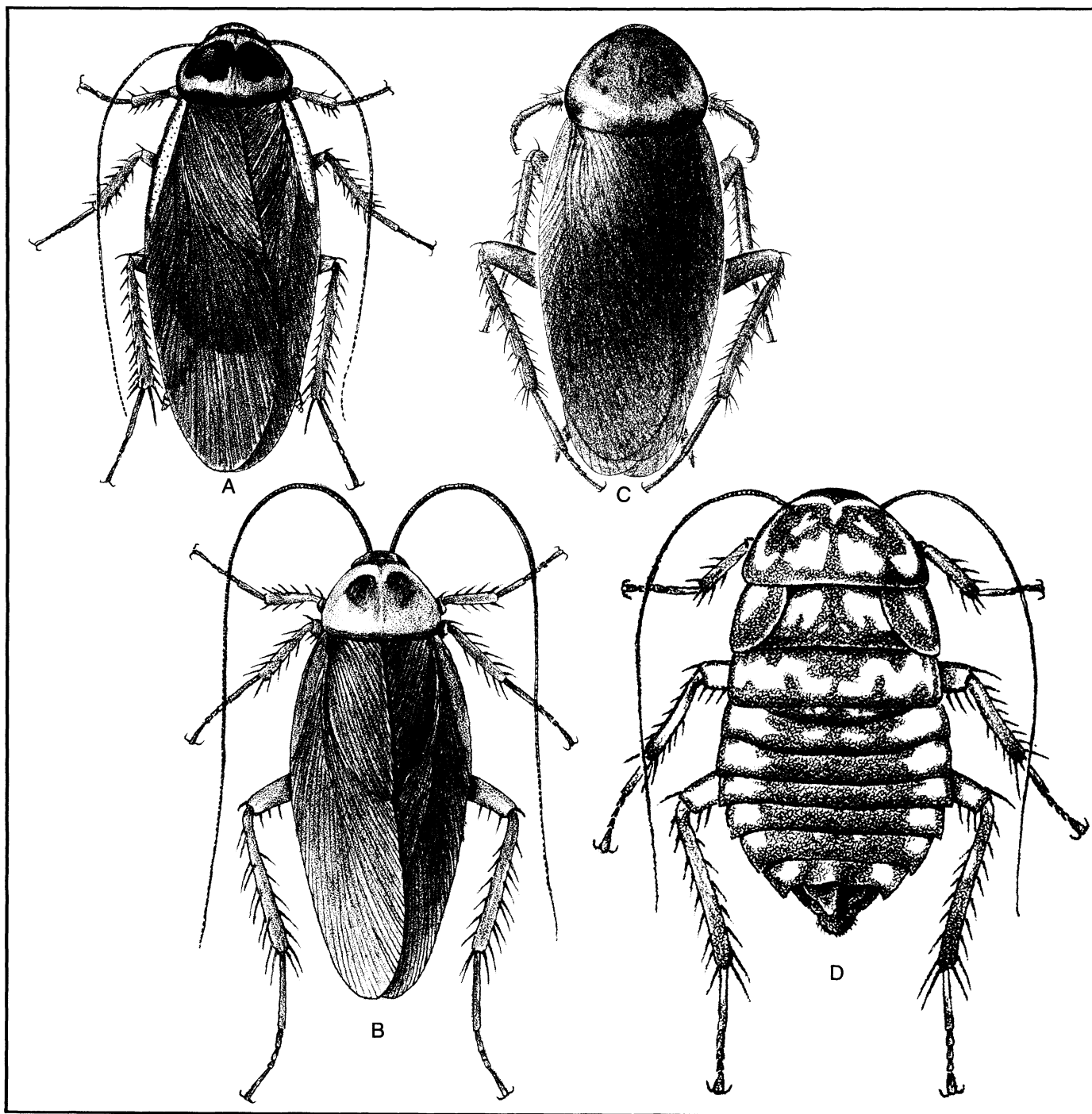


Plate 47. Blattid cockroaches (Blattidae), dorsal views: A, **Australian cockroach**, *Periplaneta australasiae* (27-33); B, **American cockroach**, *Periplaneta americana* (35-40); C, **brown cockroach**, *Periplaneta brunnea* (31-37) (drawing by C. Feller); D, **harlequin cockroach**, *Neostylopyga rhombifolia*, female (20-25).

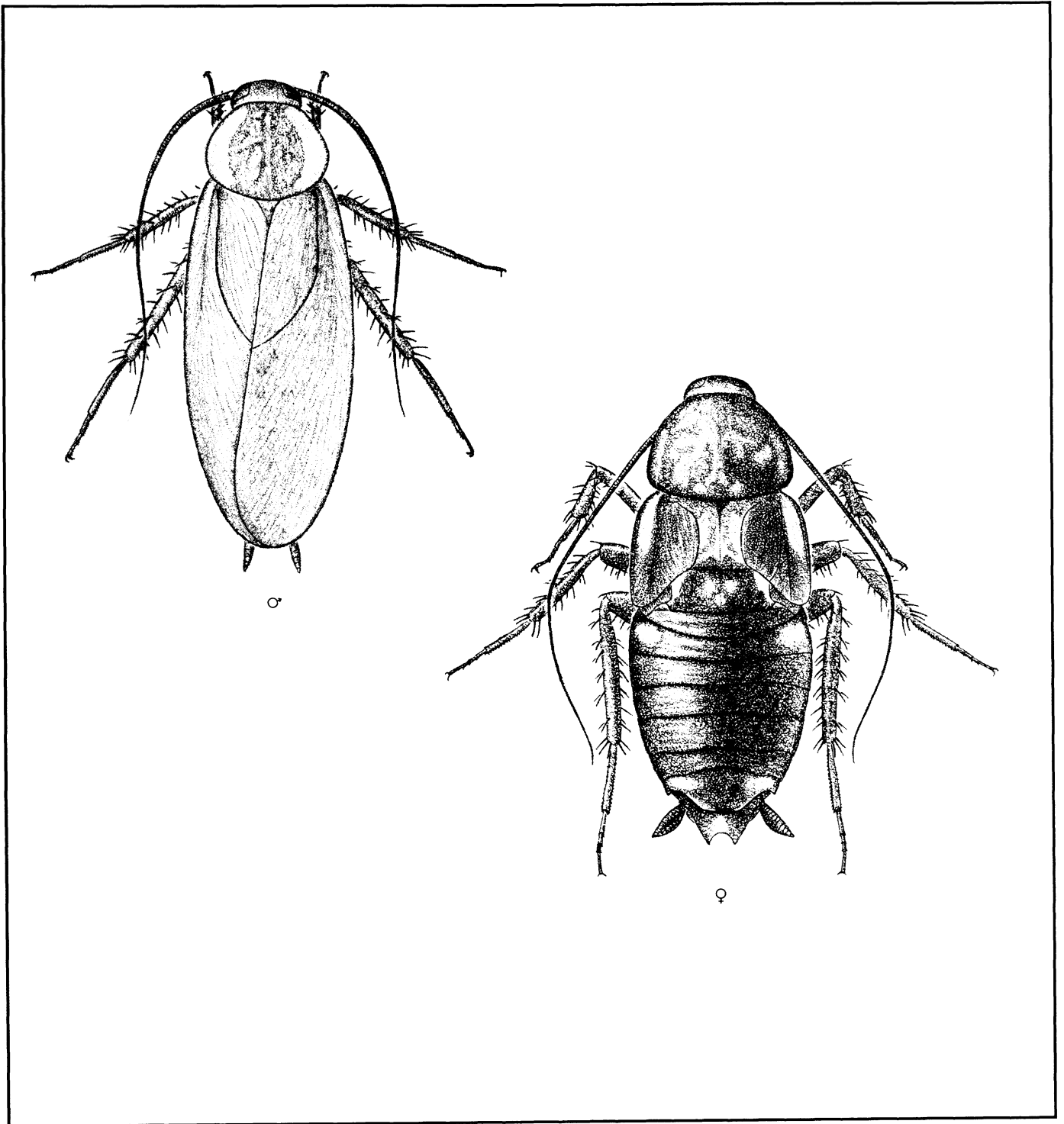


Plate 48. **Turkestan cockroach**, *Blatta lateralis* (Blattidae), dorsal views (male, 19-23; female, 22-25) (drawings by C. Feller).

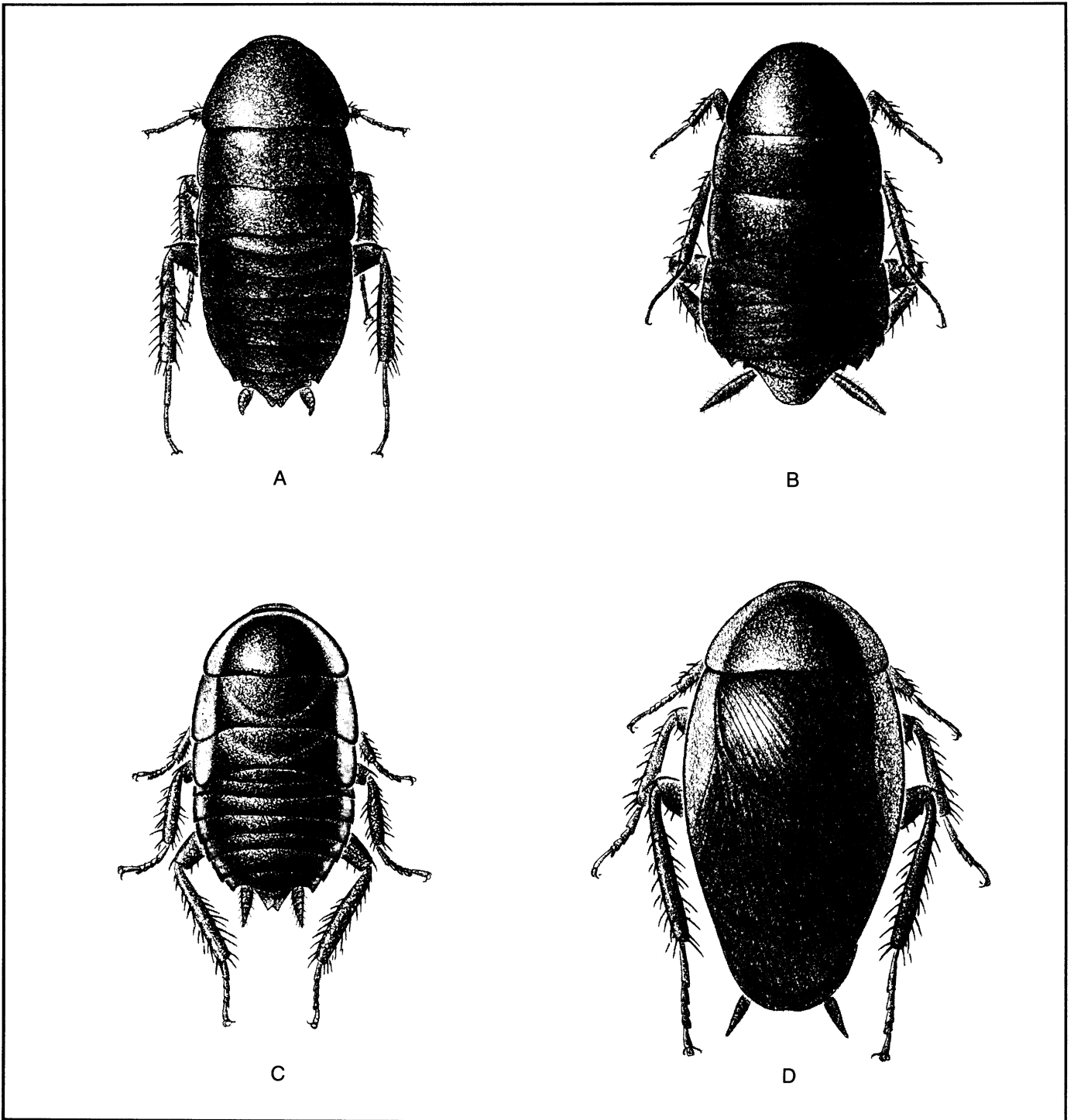


Plate 49. Blattid cockroaches (Blattidae), dorsal views (drawings by C. Feller): A, *Lamproblatta* sp., nymph; B, same, female (16-19); C, *Methana marginalis*, nymph; D, same, adult (28.2).

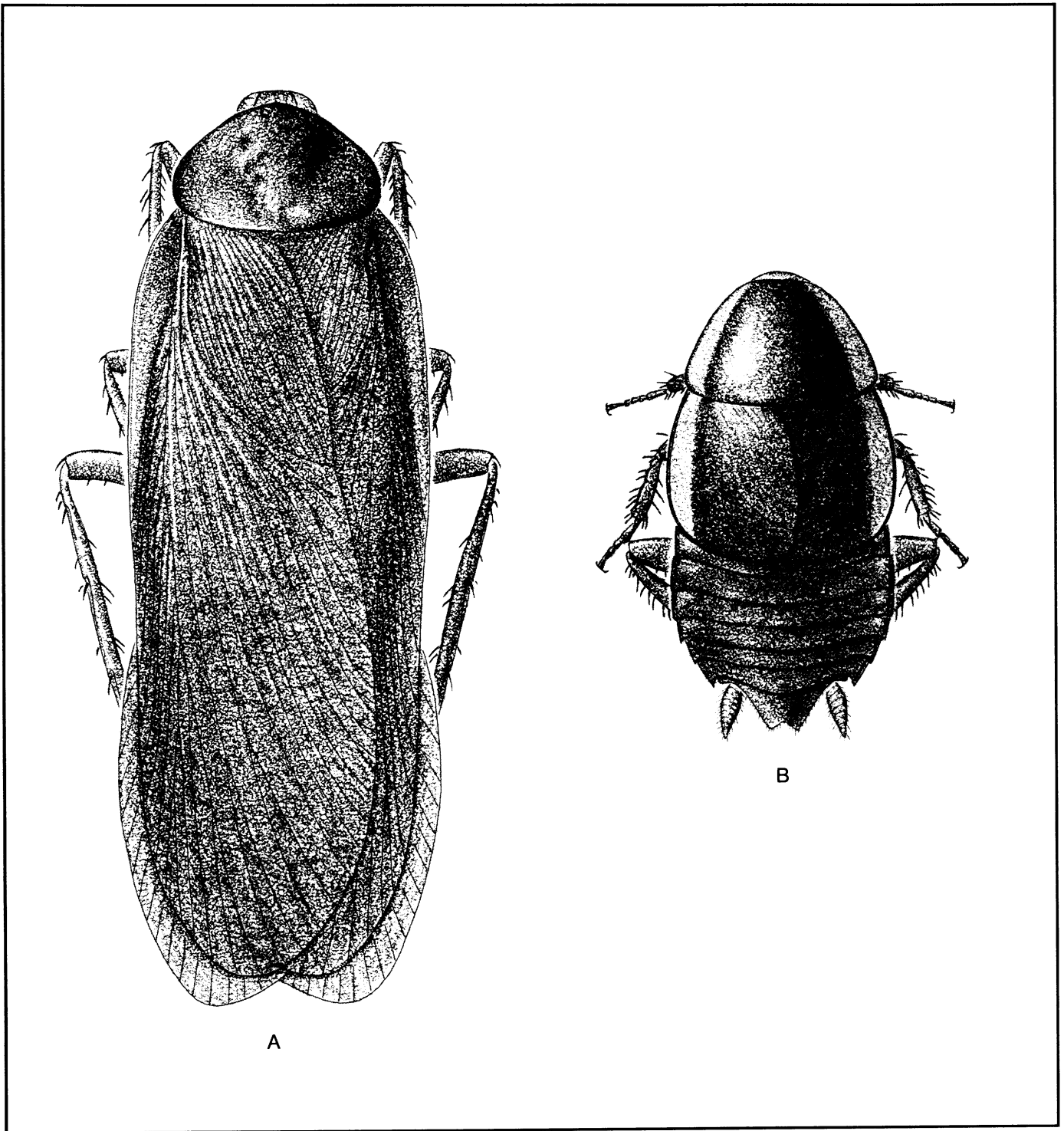


Plate 50. Blattid cockroaches (Blattidae), dorsal views (drawings by C. Feller): A, *Deropeltis erythrocephala*, male (36-40); B, *Pelmatosilpha* sp., female (17-21).



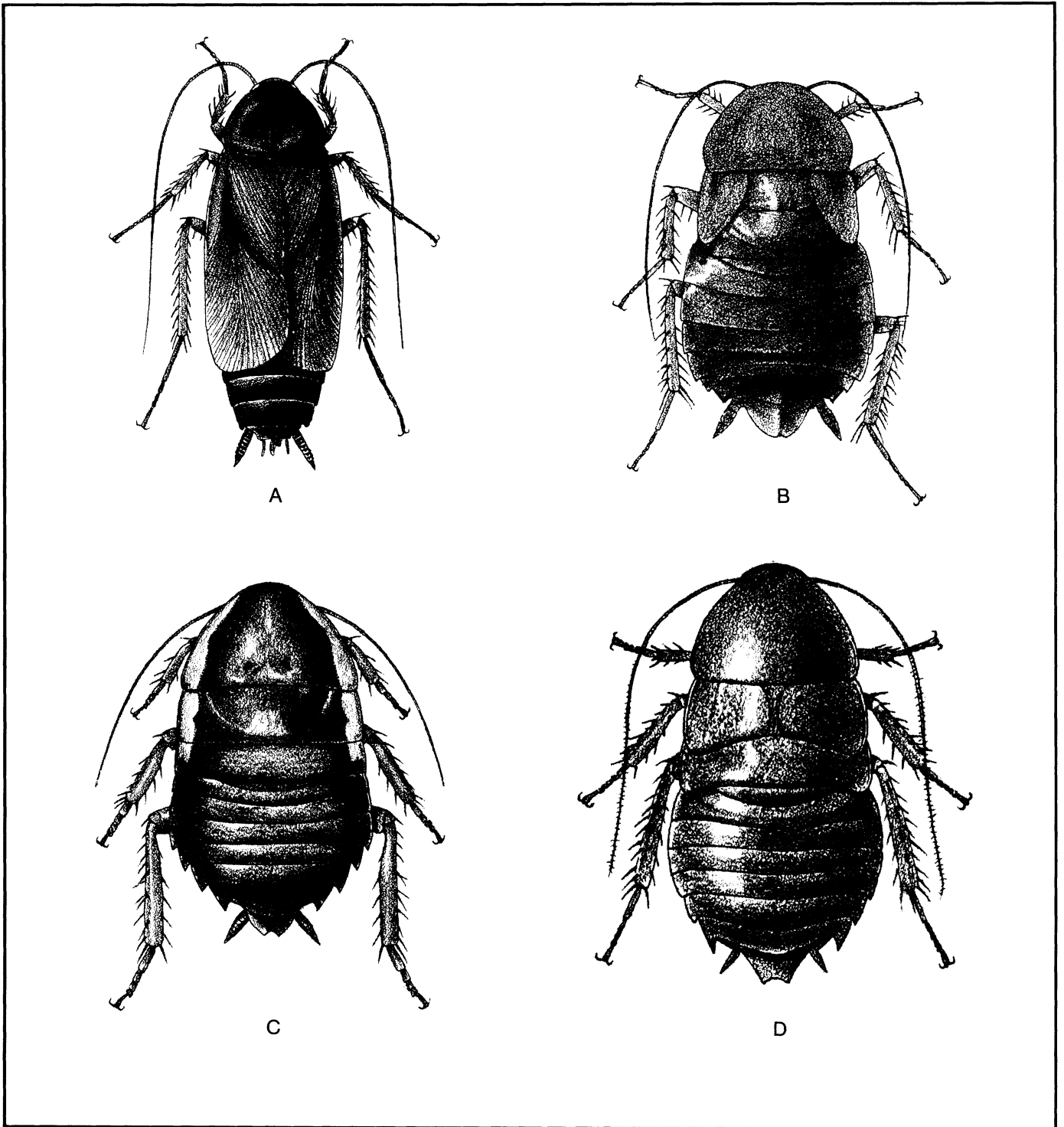


Plate 51. Blattid cockroaches (Blattidae), dorsal views: A, **oriental cockroach**, *Blatta orientalis*, male (20-27); B, same, female (20-27); C, Florida stinkroach, *Eurycotis floridana*, nymph; D, same, adult (30-40).

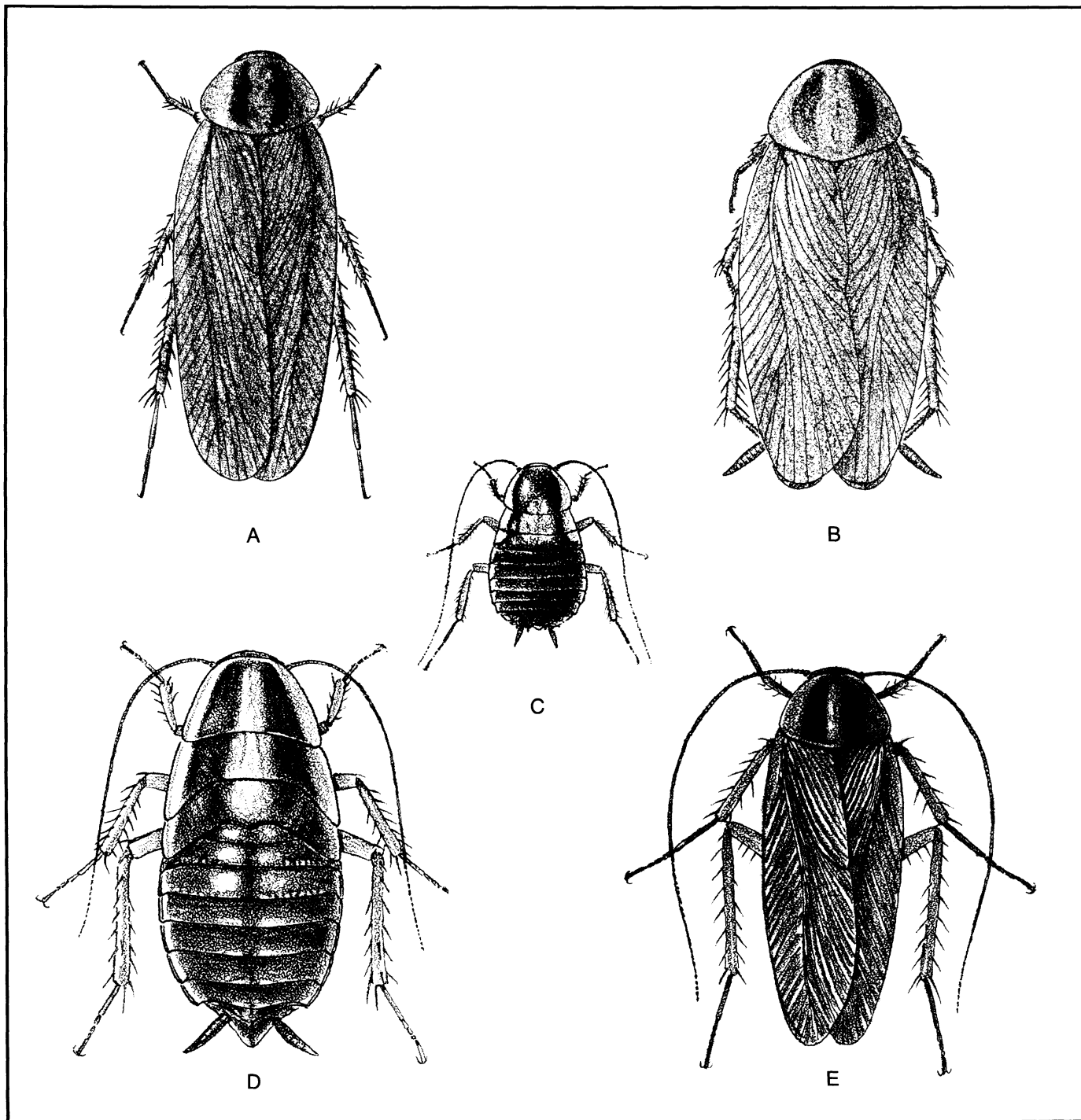


Plate 52. Blattellid cockroaches (Blattellidae), dorsal views: A, false German cockroach, *Blattella lituricollis* (11-12); B, field cockroach, *Blattella vaga* (10-15) (drawings A&B by C. Feller); C, German cockroach, *Blattella germanica*, nymph; D, same, nymph; E, same, adult (10-15).

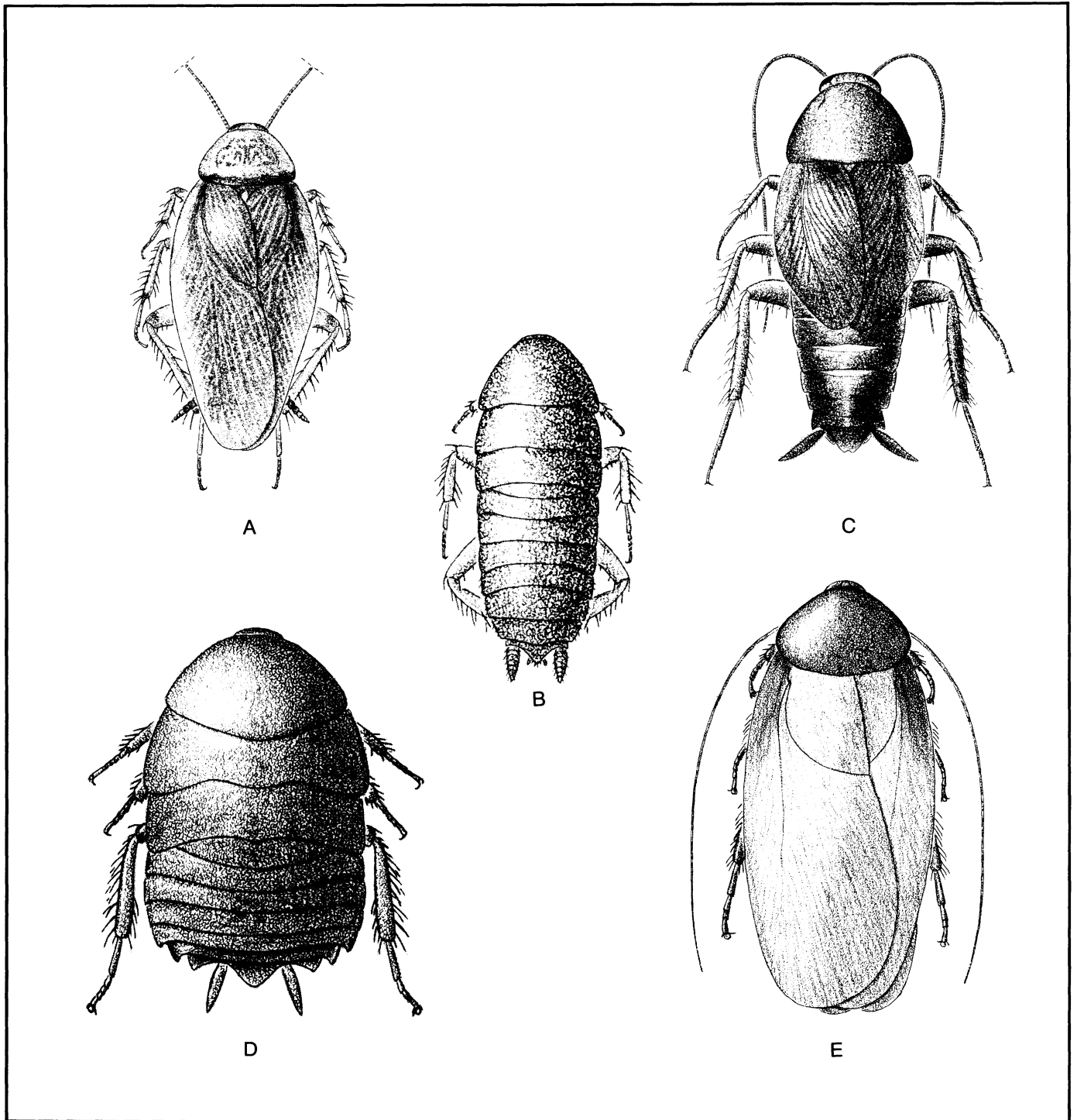


Plate 53. Blattellid cockroaches (Blattellidae), dorsal views (drawings by C. Feller): A, *Lupparia* sp. (10-12); B, *Shawella couloniana*, nymph; C, same, adult (15-22); D, banana cockroach, *Nyctibora noctivaga*, nymph; E, same, adult (33-35).

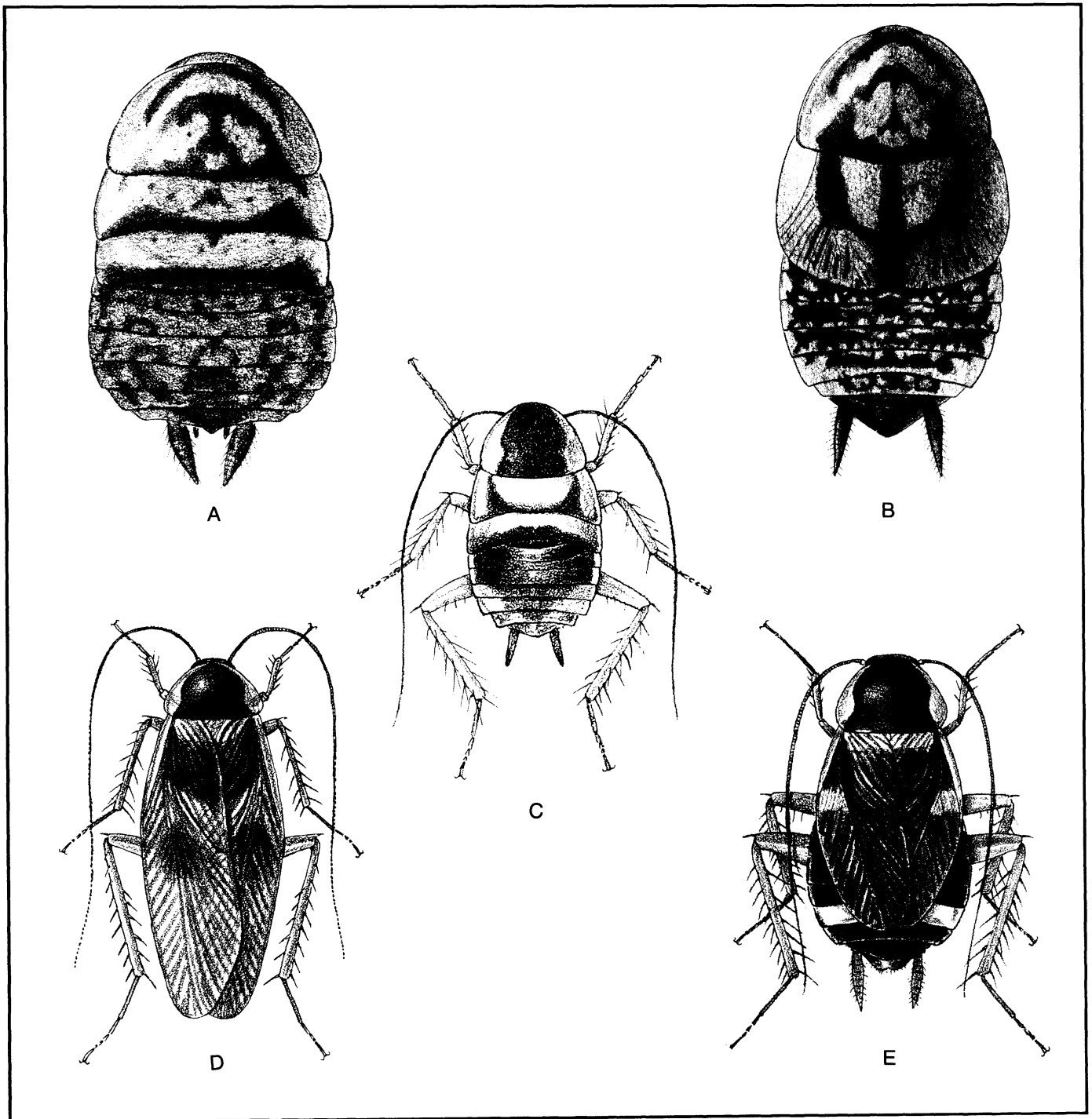


Plate 54. Blattellid cockroaches (Blattellidae), dorsal views: A, little gem cockroach, *Aglaopteryx gemma*, nymph; B, same, adult (7.5-9.3) (drawings A&B by C. Feller); C, **brownbanded cockroach**, *Supella longipalpa*, nymph; D, same, male (10-14); E, same, female (10-14).

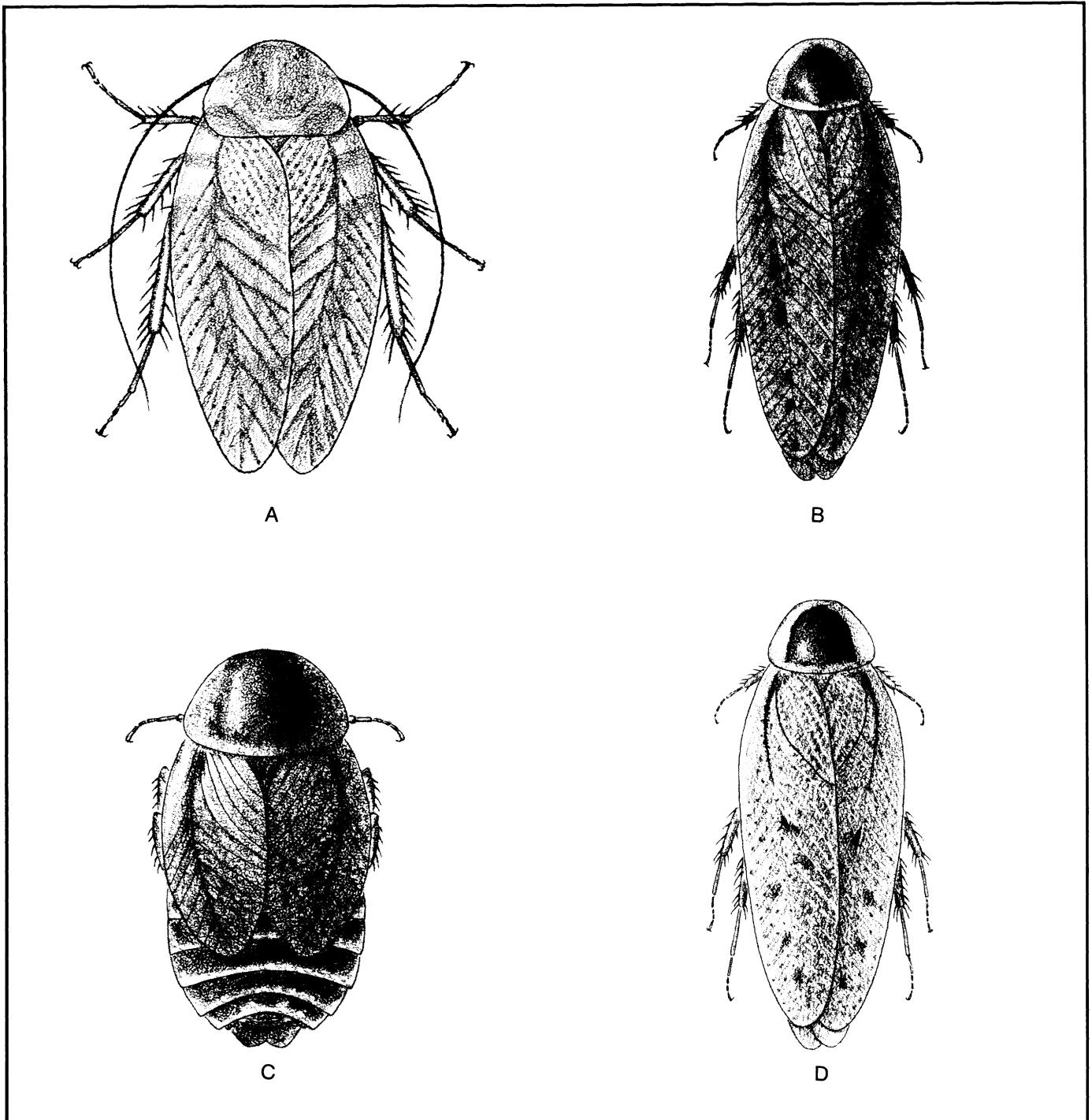


Plate 55. Blattellid cockroaches (Blattellidae), dorsal views: A, **spotted Mediterranean cockroach**, *Ectobius pallidus* (8-9.3); B, **dusky cockroach**, *Ectobius lapponicus*, male (9.5-11.3); C, same, female (6.8-7.9); D, **forest cockroach**, *Ectobius sylvestris*, male (7.8-8.5). (Drawings B-D by C. Feller.)

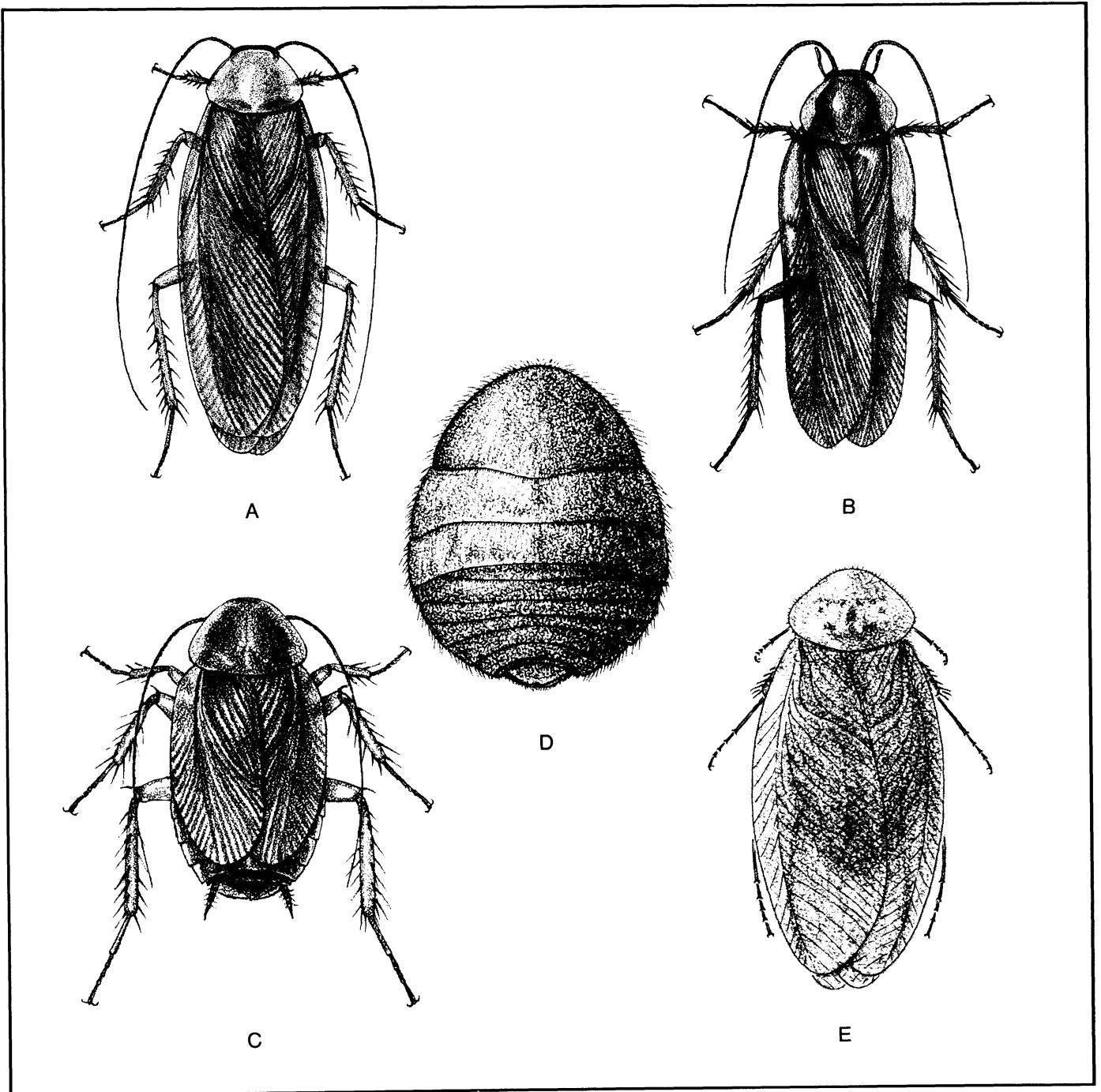


Plate 56. Blattellid and polyphagid cockroaches, dorsal views, A-C, wood cockroaches (Blattellidae): A, Virginia woodroach, *Parcoblatta virginica*, male (11.5-14.2); B, Pennsylvania woodroach, *Parcoblatta pennsylvanica*, male (22-30); C, same, female (13-20); D, sand cockroach, *Arenivaga* sp. (Polyphagidae), nymph; E, same, male (10.5-23.8) (drawings D&E by C. Feller).

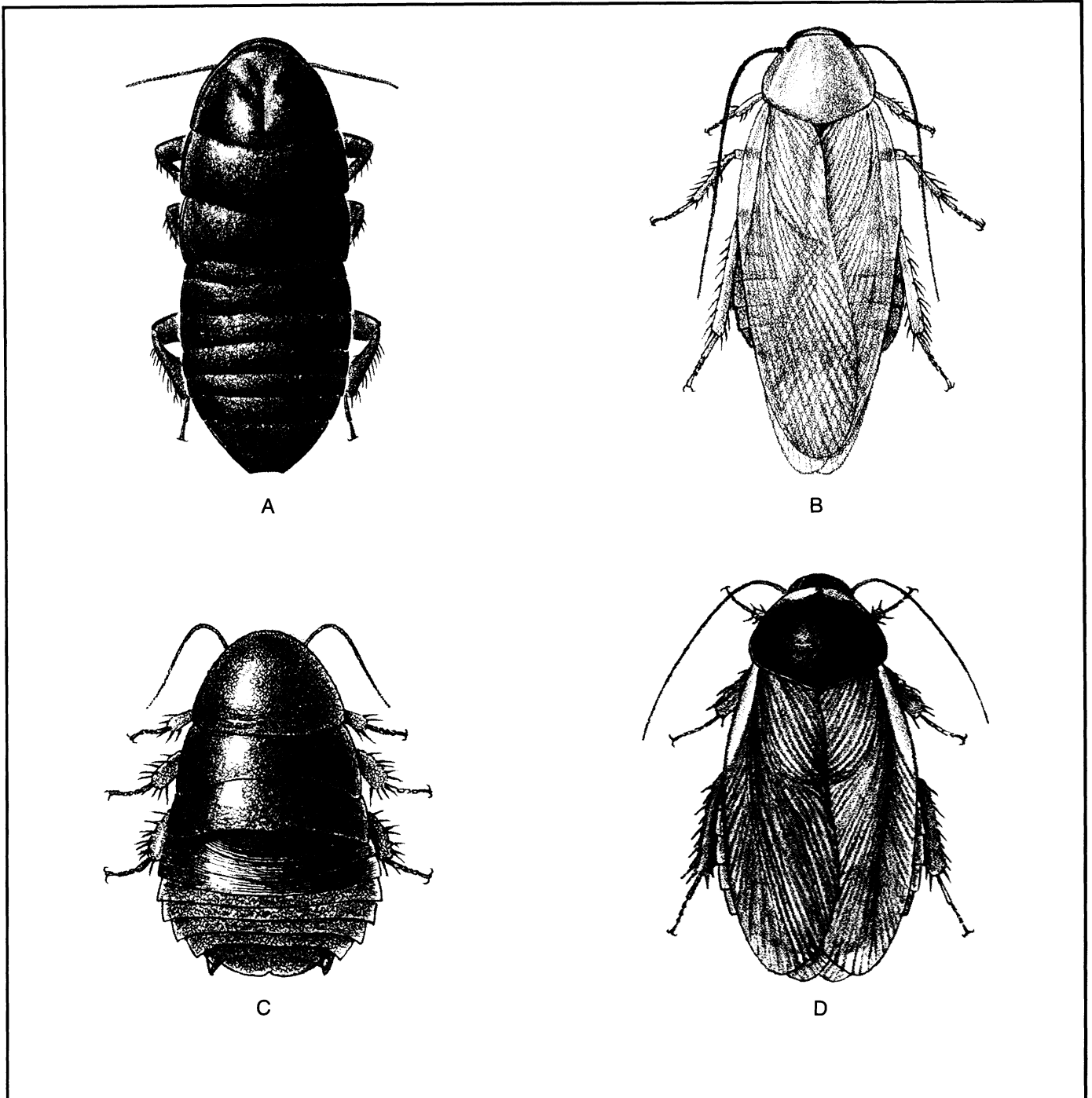


Plate 57. Cryptocercid and blaberid cockroaches, dorsal views: A, brownhooded cockroach, *Cryptocercus punctulatus* (23-29) (Cryptocercidae) (drawing by C. Feller); B-D, Blaberidae; B, Cuban cockroach, *Panchlora nivea* (15-20); C, Surinam cockroach, *Pycnoscelus surinamensis*, nymph; D, same, female (18-24).

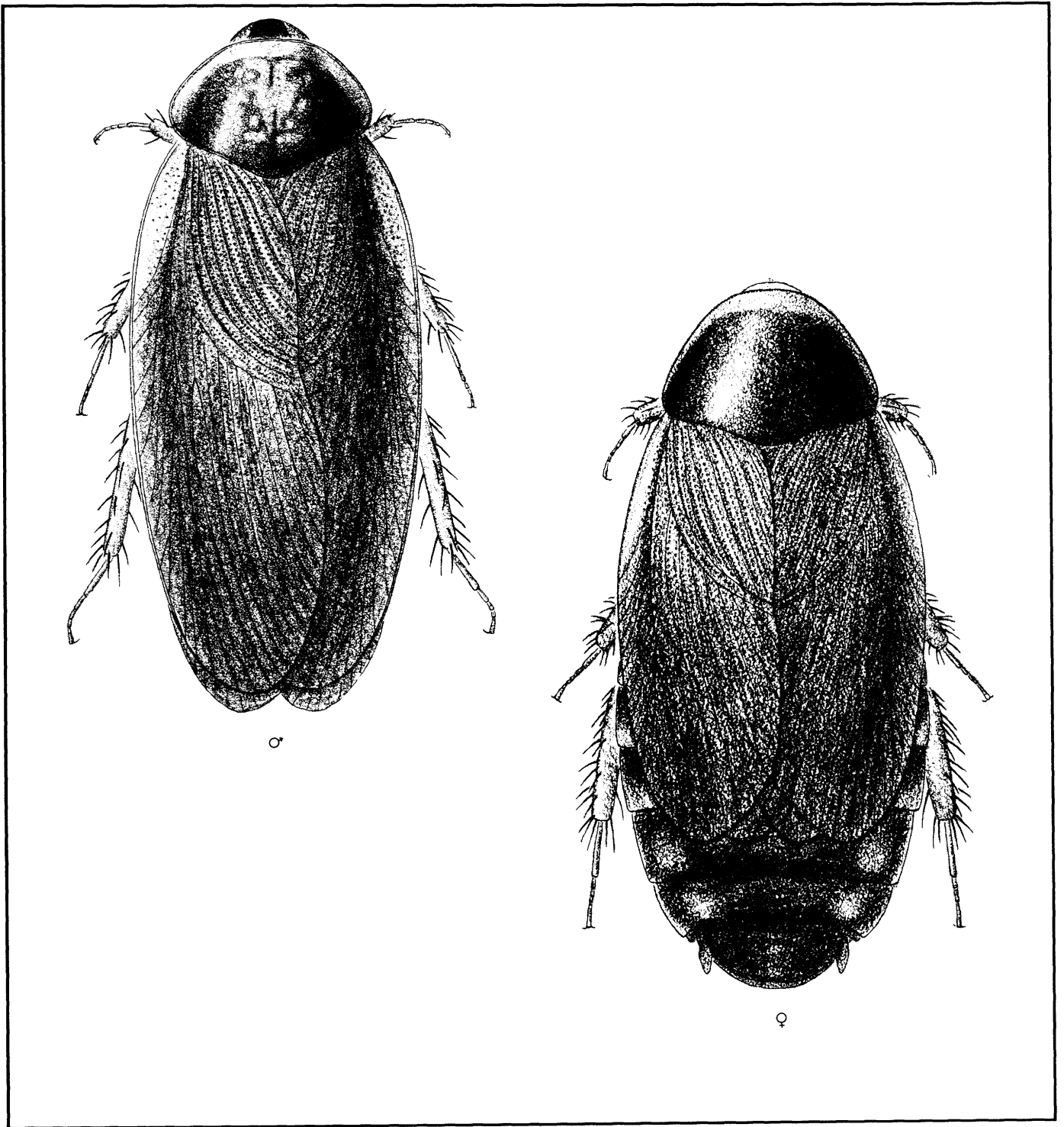


Plate 58. Indian cockroach, *Pycnoscelus indicus* (17-18) (Blaberidae), dorsal views (drawings by C. Feller).



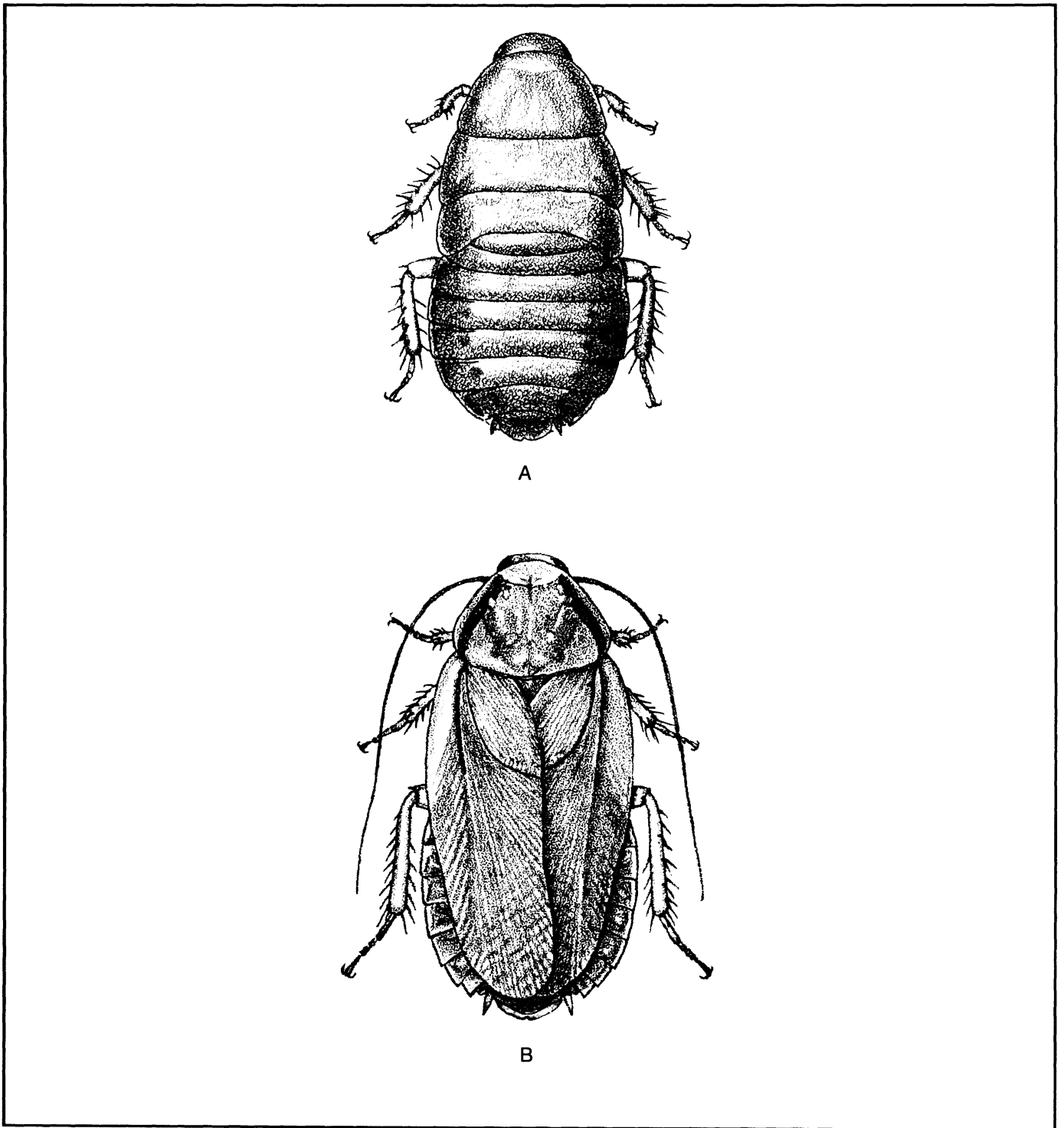


Plate 59. **Cinereous cockroach**, *Nauphoeta cinerea* (Blaberidae): A, nymph; B, adult (25-29).

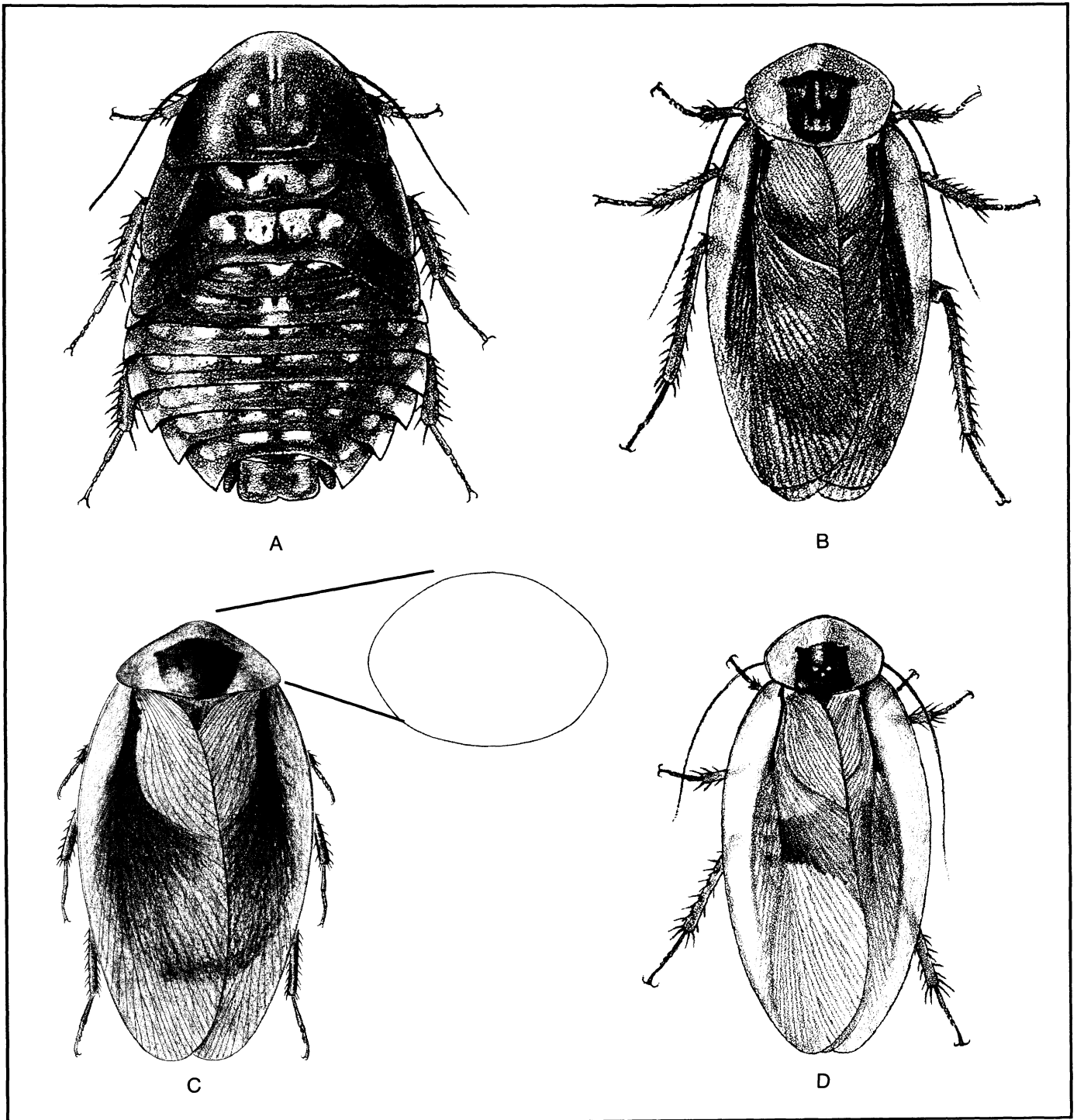
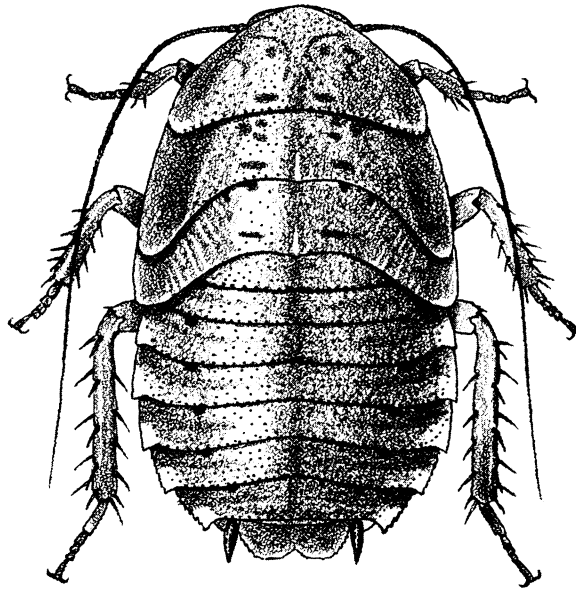
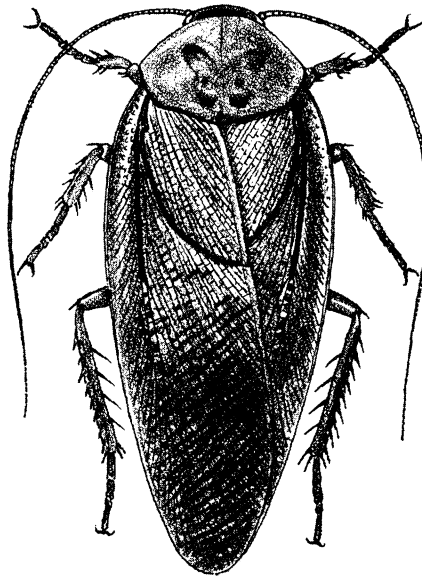


Plate 60. Giant cockroaches, *Blaberus* spp. (Blaberidae), dorsal views: A, *Blaberus craniifer*, nymph; B, same, adult (60-70); C, *Blaberus discoidalis* (49) (inset shows shape of pronotum in full dorsal view) (drawings by C. Feller); D, *Blaberus giganteus* (70-80).



A



B

Plate 61. **Madeira cockroach**, *Leucophaea maderae* (Blaberidae): A, nymph; B, adult (40-50).

**Notes and Sketches**

## **ADULT AND LARVAL BEETLES**

This series of illustrations, drawn by A.D. Cushman unless otherwise indicated, is a continuation from part 1, chapters entitled "Adult Beetles (Coleoptera)," by J.M. Kingsolver and "Larval Beetles (Coleoptera)," by D.M. Anderson.

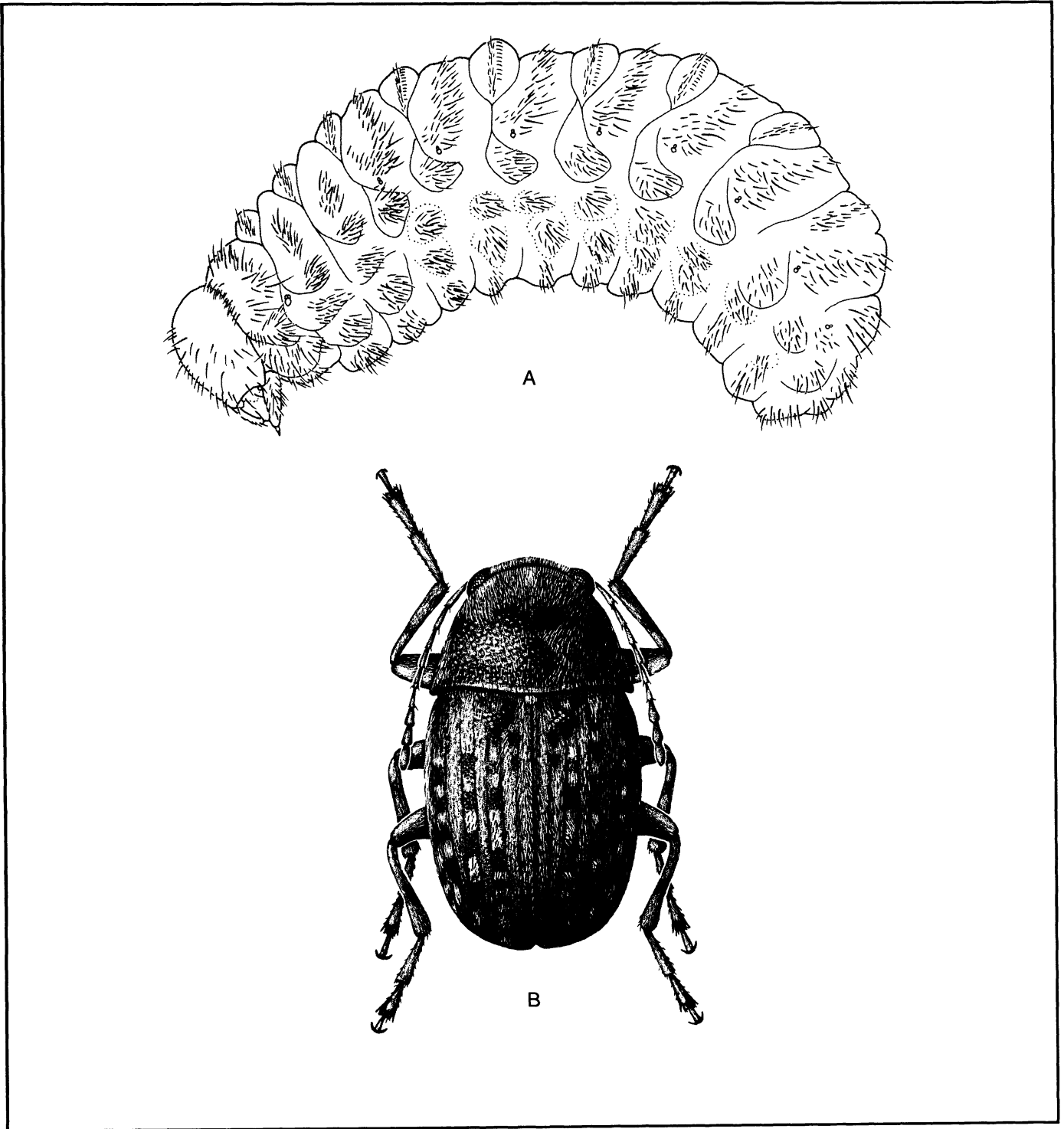


Plate 62. **Coffee bean weevil**, *Araecerus fasciculatus* (Anthribidae): A, larva (4.5-6) (drawing by M. Ryan); B, adult (2-4.5) (drawing by R. White).

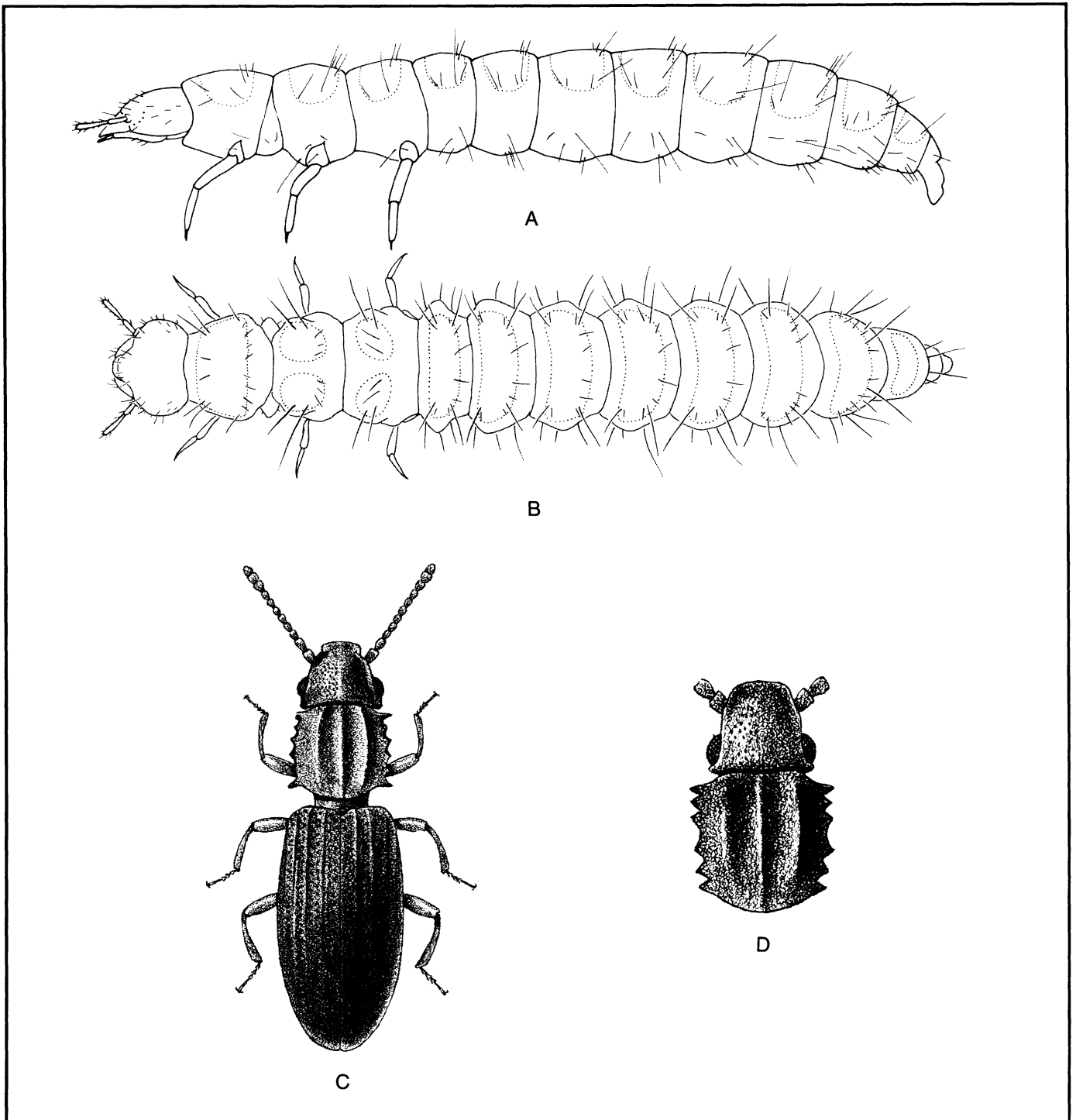


Plate 63. Grain beetles, *Oryzaephilus* (Cucujidae): A-C, **sawtoothed grain beetle**, *O. surinamensis*; A&B, larva (3) (drawings by C. Feller); C, same, adult (1.8-3.5); D, **merchant grain beetle**, *O. mercator* (2.2-3.5).

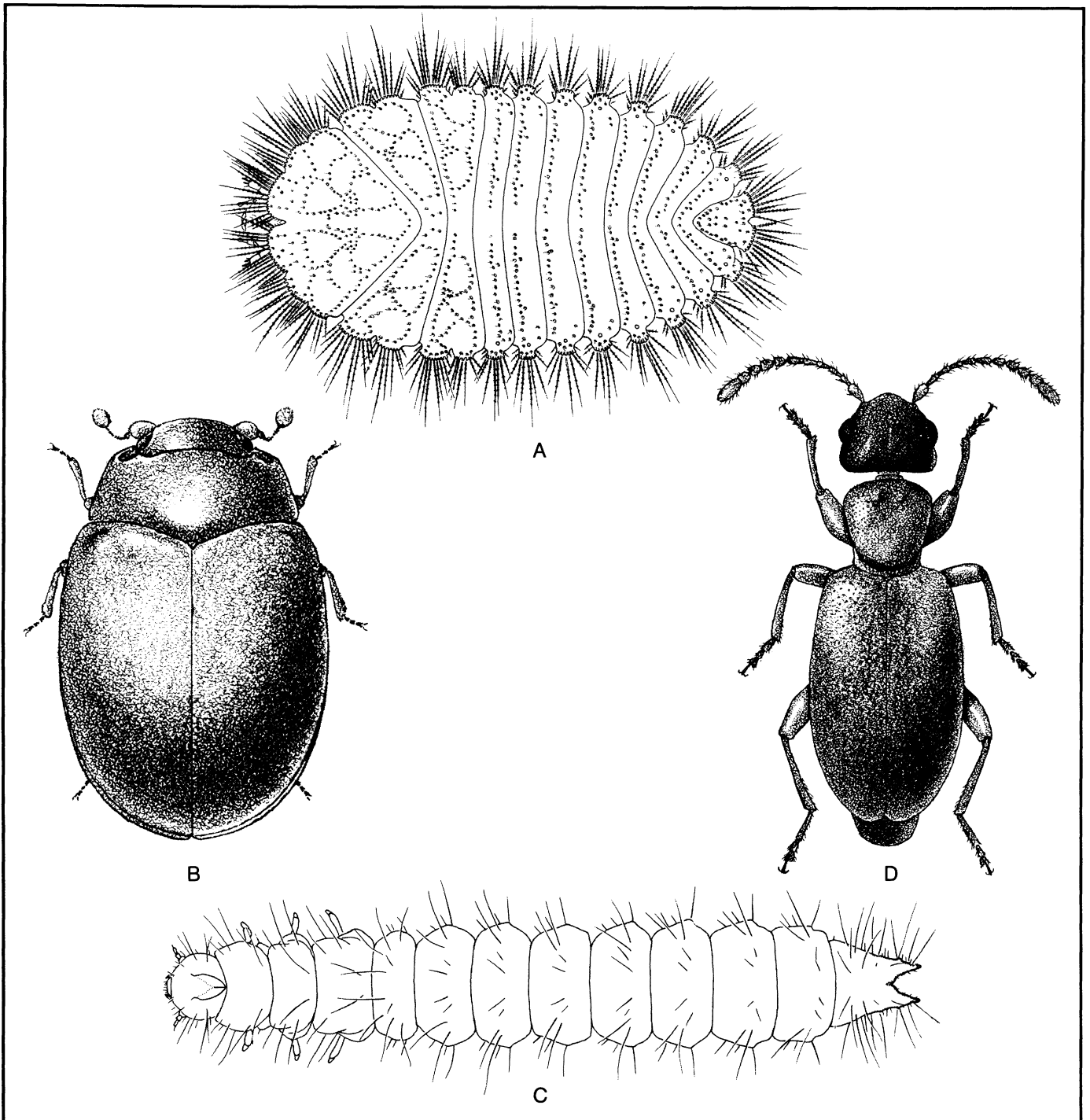


Plate 64. Cerylonid and anthicid beetles: A, oval grain beetle, *Murmidius ovalis* (Cerylonidae), larva (1.9) (drawing by C. Feller); B, same, adult (1.2-1.4); C, *Anthicus* sp. (Anthicidae), larva (5) (drawing by C. Feller); D, narrownecked grain beetle, *A. floralis*, adult (2.7-3.5).



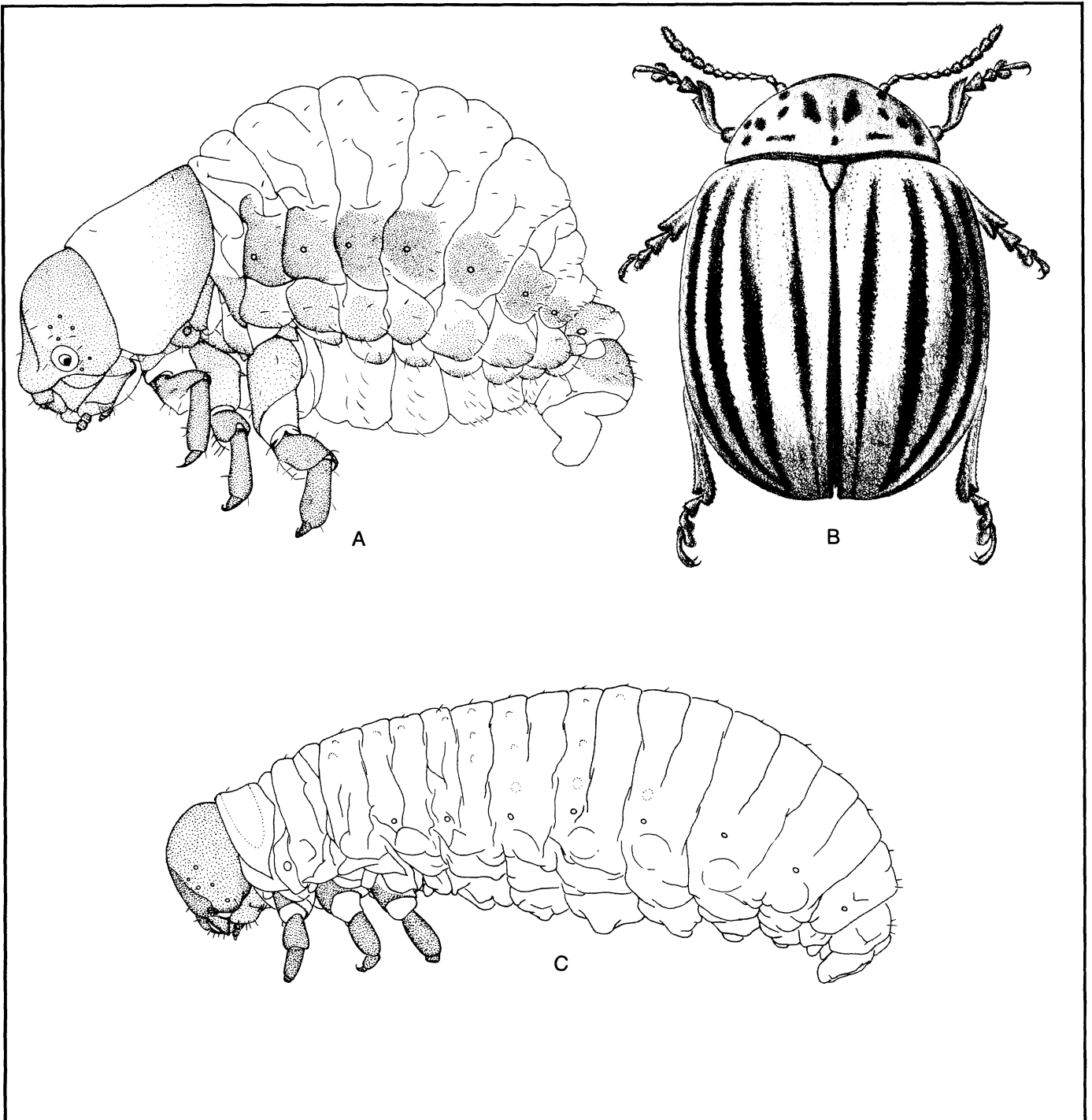


Plate 65. **Leaf beetles** (Chrysomelidae)  
 (drawings by C. Feller): A, **Colorado potato beetle**, *Leptinotarsa decemlineata*, larva (15); B, same, adult (7-10.5); C, **asparagus beetle**, *Crioceris asparagi*, larva (9) (for adults of *C. duodecimpunctata* and *C. asparagi*, see pl. 1N&O).

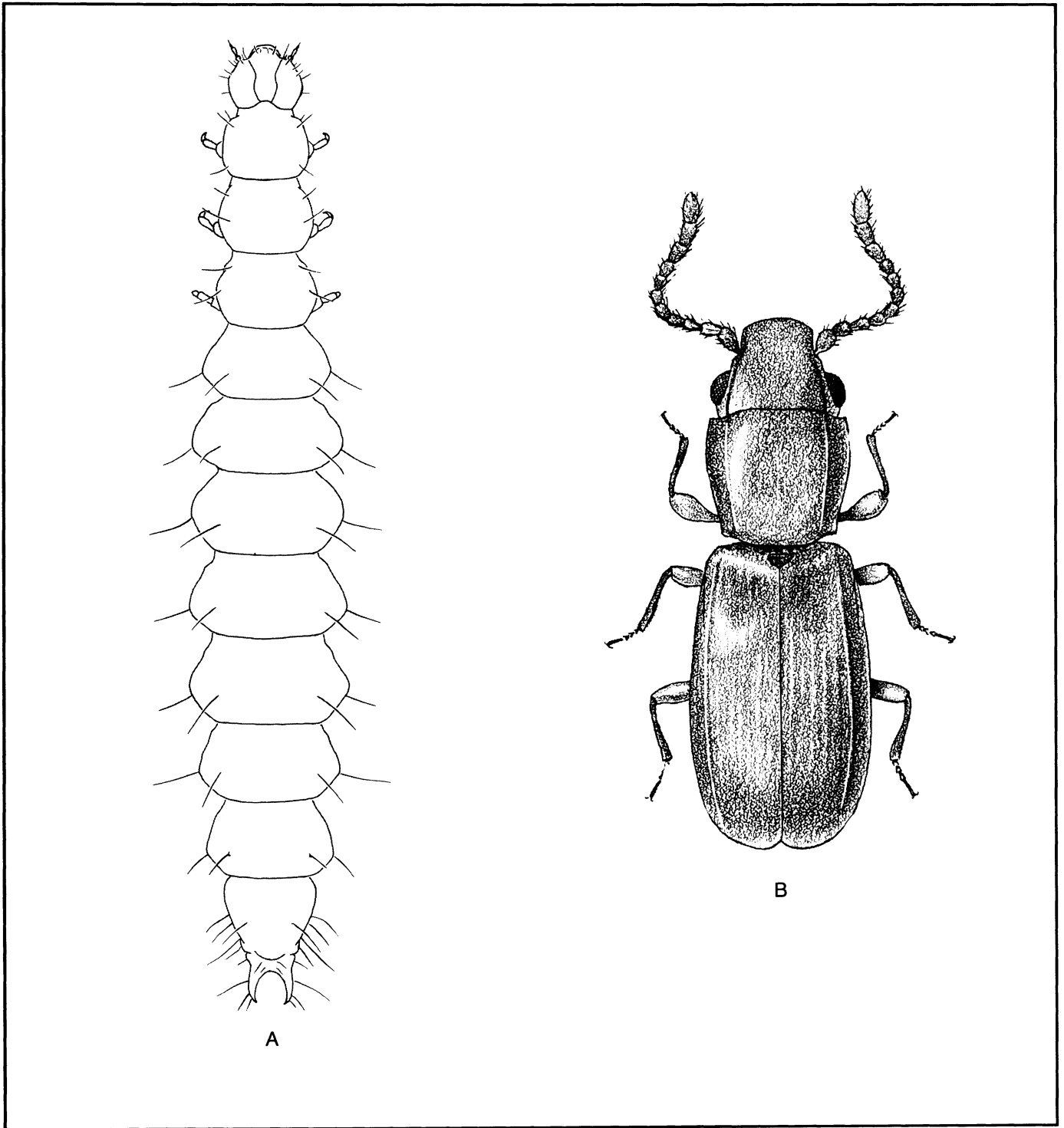


Plate 66. Grain beetles, *Cryptolestes* spp. (Cucujidae) (drawings by C. Feller): A, *Cryptolestes* sp., larva (3.5); B, flat grain beetle, *C. pusillus*, adult (1.4-1.9).

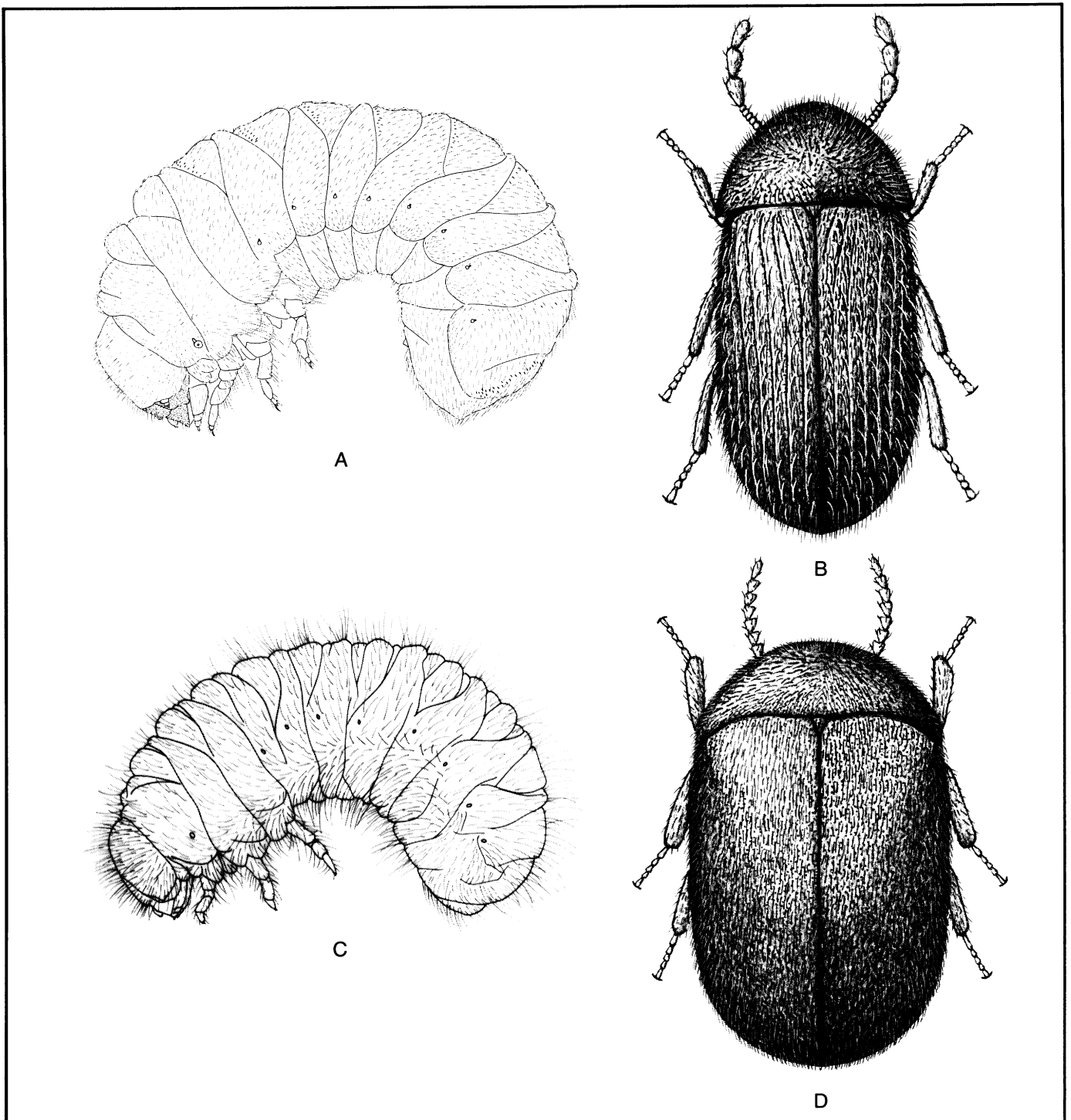


Plate 67. Anobiid beetles (Anobiidae): A, **drugstore beetle**, *Stegobium paniceum*, larva (3-4); B, same, adult (2.2-3.7); C, **cigarette beetle**, *Lasioderma serricorne*, larva (3-4) (drawings A&C by C. Feller); D, same, adult (1.8-3) (drawings B&D by R. White).

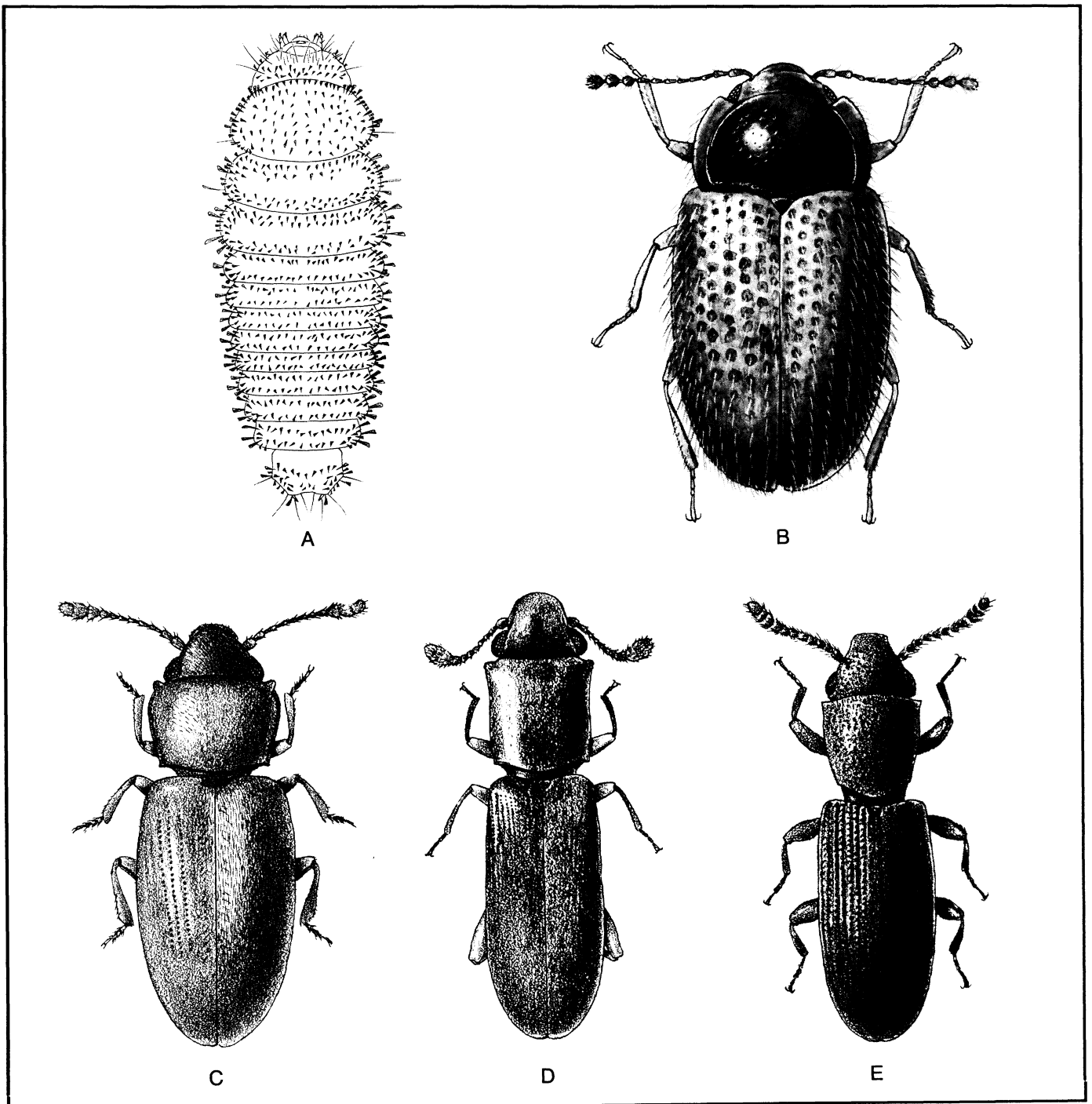
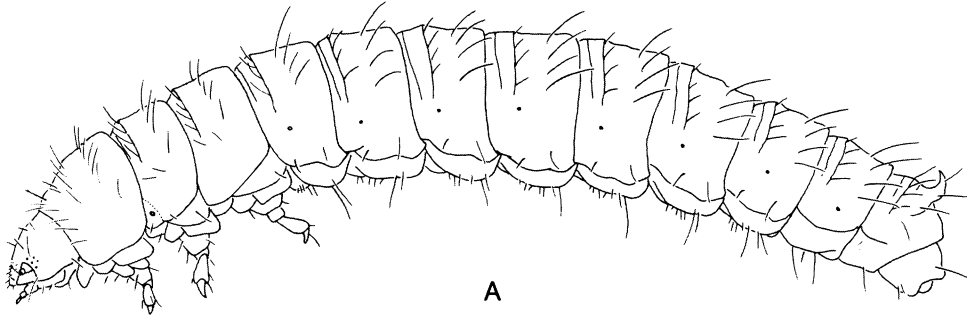
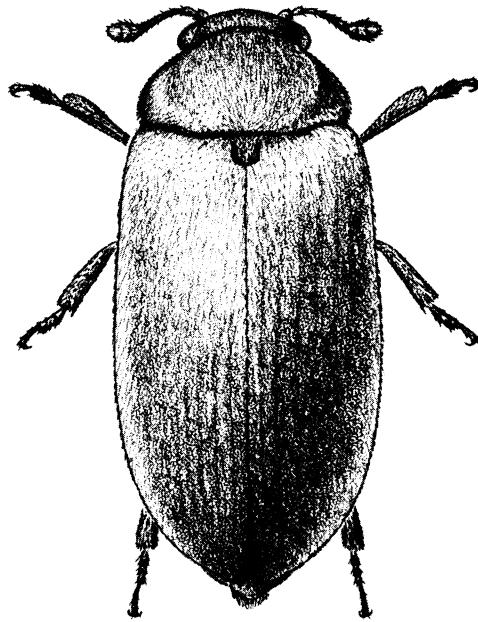


Plate 68. Endomychid and cucujid beetles: A, hairy cellar beetle, *Mycetaea subterranea* (Endomychidae), larva (2.2-2.5) (drawing by C. Feller); B, same, adult (1.5-1.8); C, **foreign grain beetle**, *Ahasverus advena* (Cucujidae), adult (2-3); D, **square-necked grain beetle**, *Cathartus quadricollis* (Cucujidae), adult (2-2.7); E, *Silvanus planatus* (Cucujidae), adult (2.7-2.9).



A



B

Plate 69. **Raspberry fruitworm**, *Byturus unicolor*  
(Byturidae): A, larva (6) (drawing by C. Feller);  
B, adult, (3.8-4).

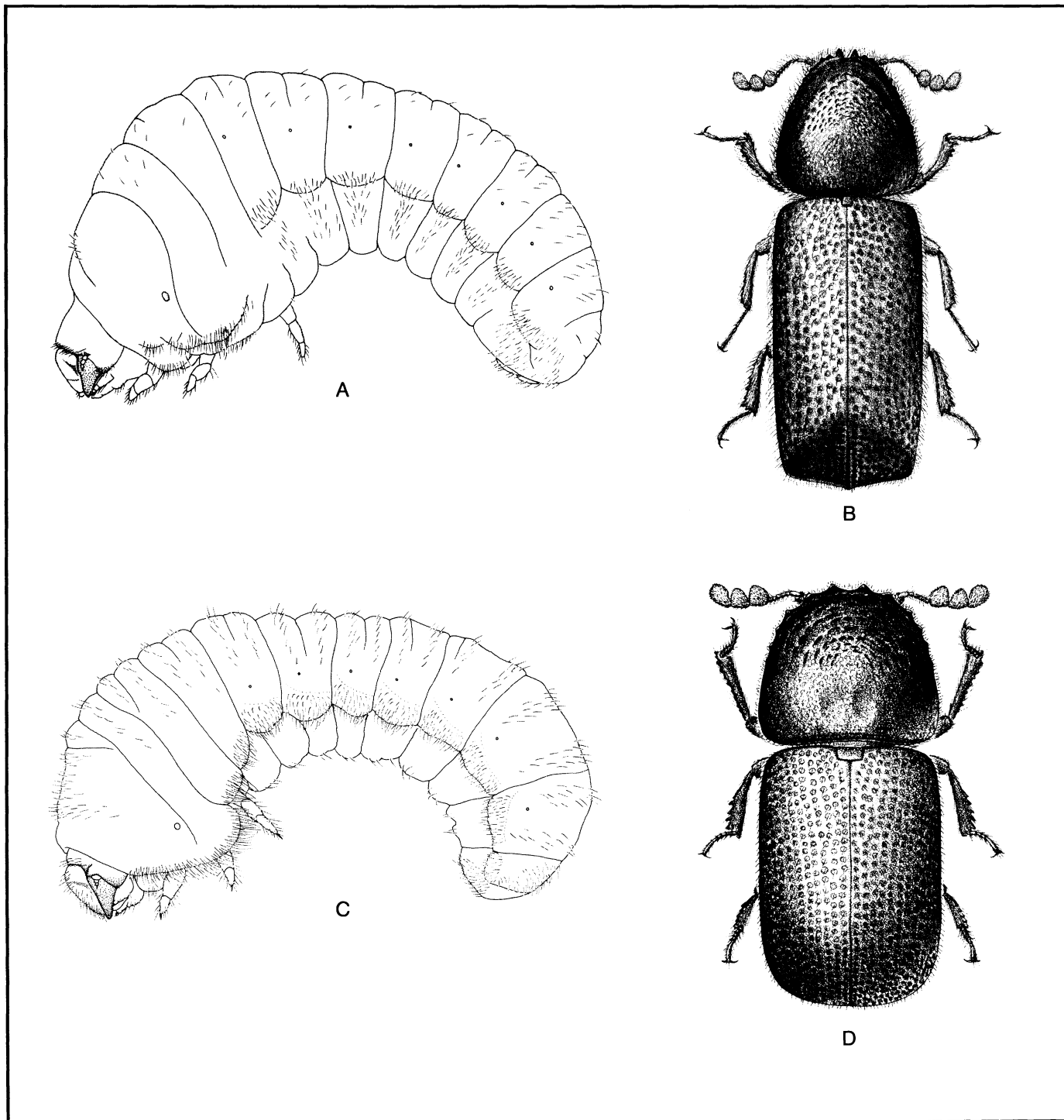


Plate 70. **False powderpost beetles** (Bostrichidae) (drawings by C. Feller): A, **larger grain borer**, *Prostephanus truncatus*, larva (3.6); B, same, adult (3.3-4.5); C, **bamboo powderpost beetle**, *Dinoderus minutus*, larva (3); D, same, adult (2.6-3.5).

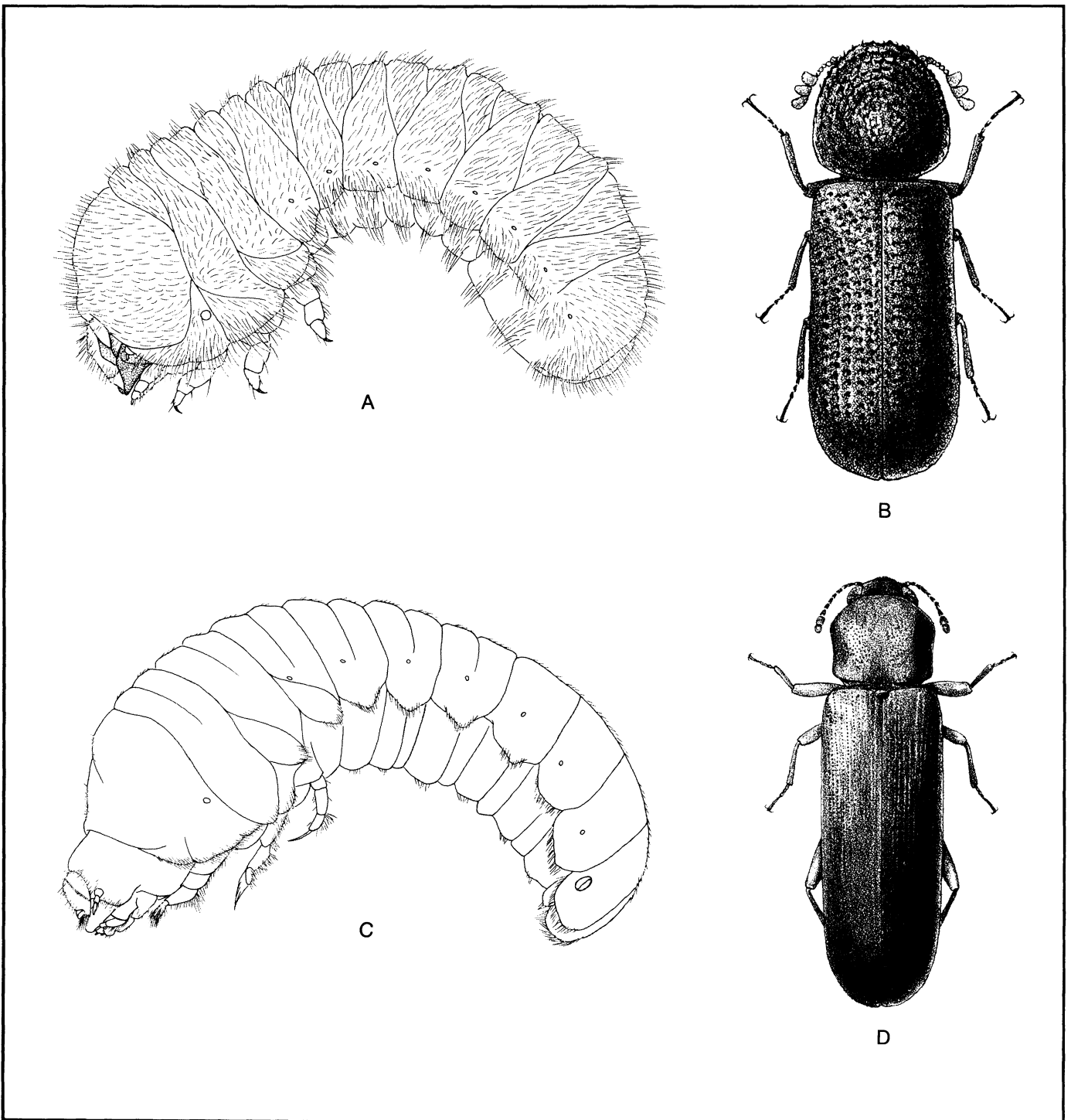


Plate 71. Wood-boring beetles: A, **lesser grain borer**, *Rhyzopertha dominica* (Bostrichidae), larva (3-3.1); B, same, adult (2-3); C, brown powderpost beetle, *Lyctus brunneus* (Lyctidae), larva (6) (drawings A & C by C. Feller); D, same, adult (2-2.7).

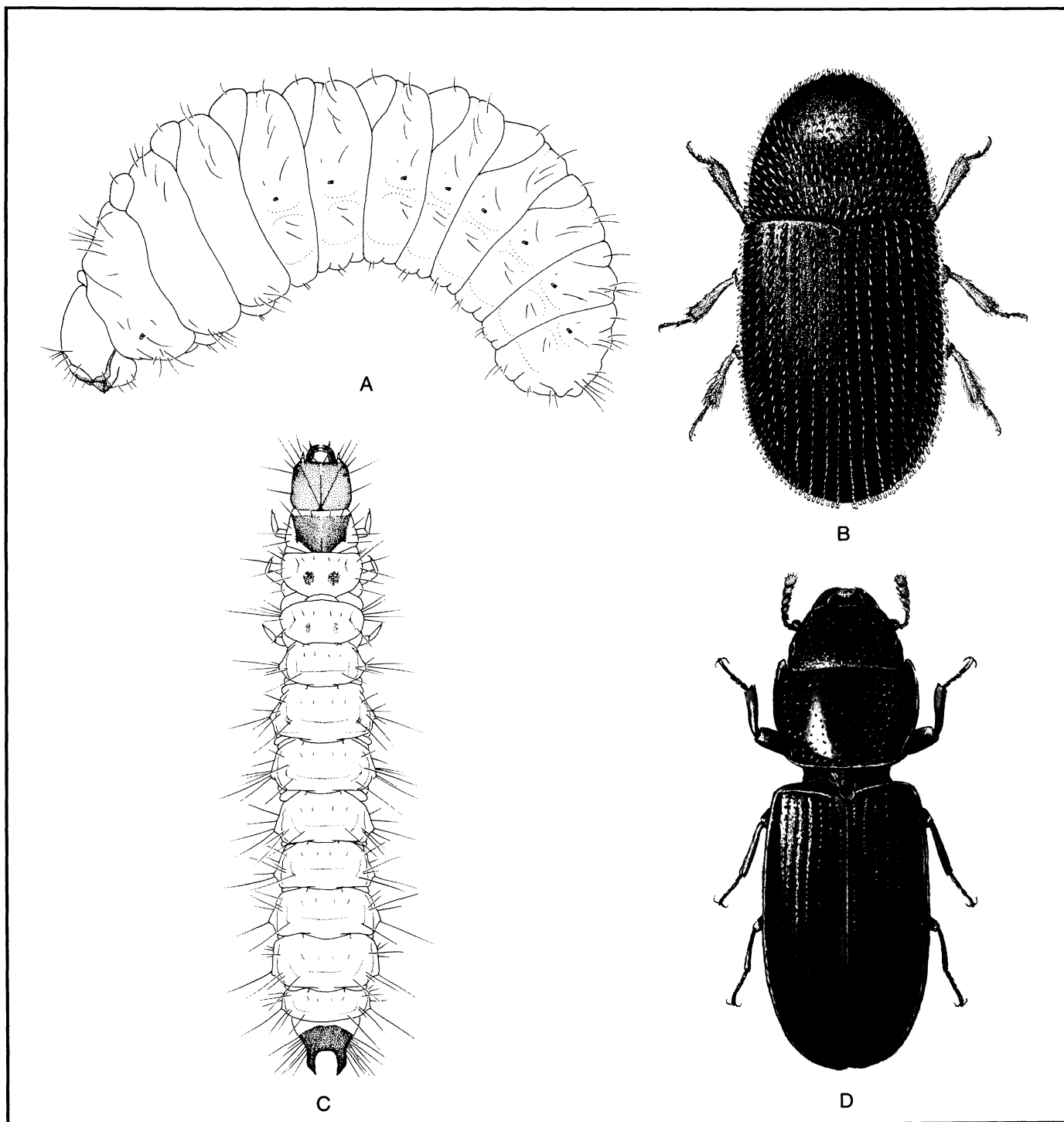


Plate 72. Scolytid and trogositid beetles: A, coffee berry borer, *Hypothenemus hampei* (Scolytidae), larva (2); B, same, adult (1.5-1.7); C, cadelle, *Tenebroides mauritanicus* (Trogositidae), larva (18-19) (drawings A-C by C. Feller); D, same, adult (5-11).



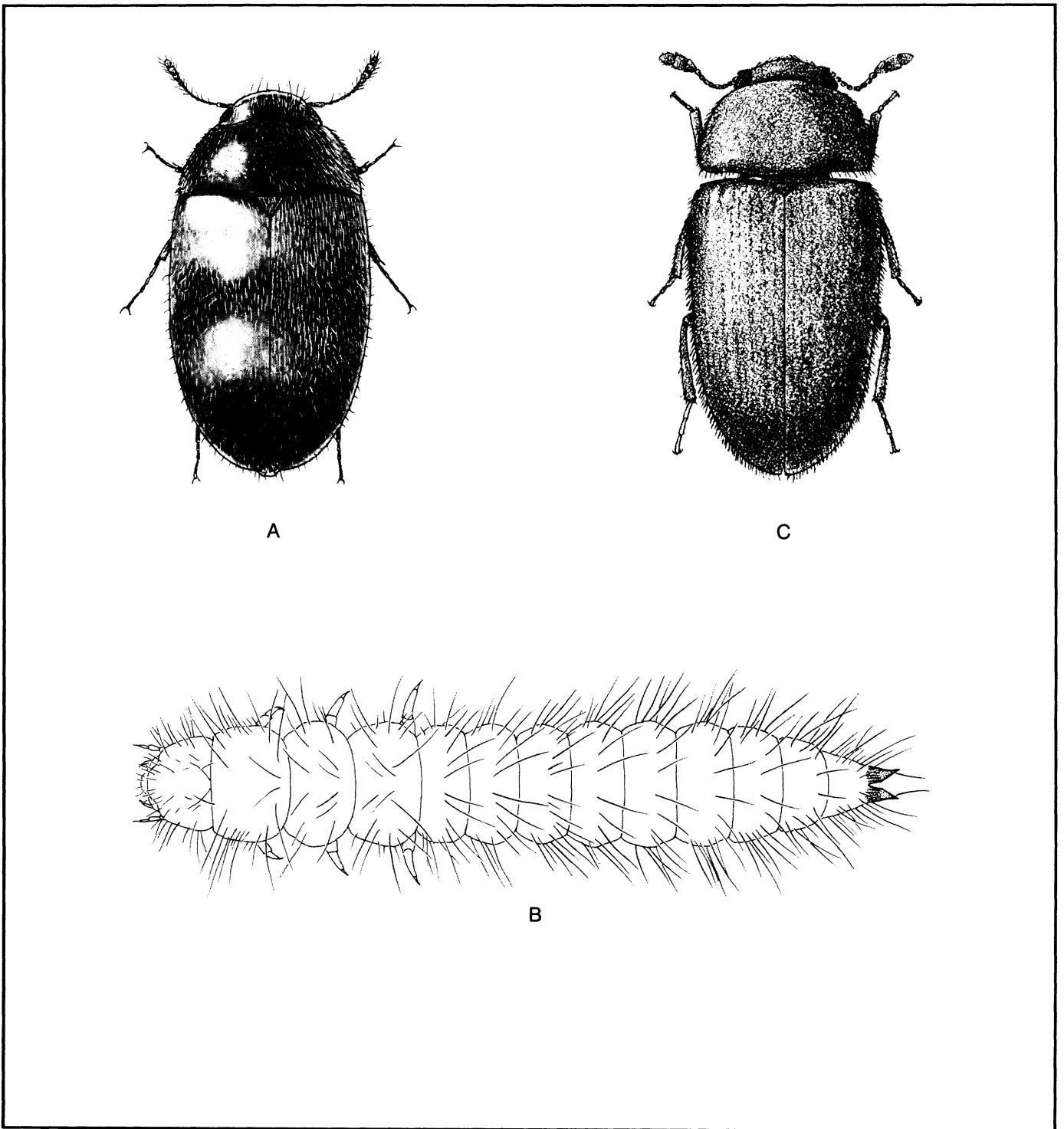


Plate 73. **Hairy fungus beetles**  
(Mycetophagidae): A, *Litargus balteatus*, adult  
(1.7-1.9); B, **hairy fungus beetle**, *Typhaea*  
*stercorea*, larva (4-4.5) (drawing by C. Feller); C,  
same, adult (2-2.3).

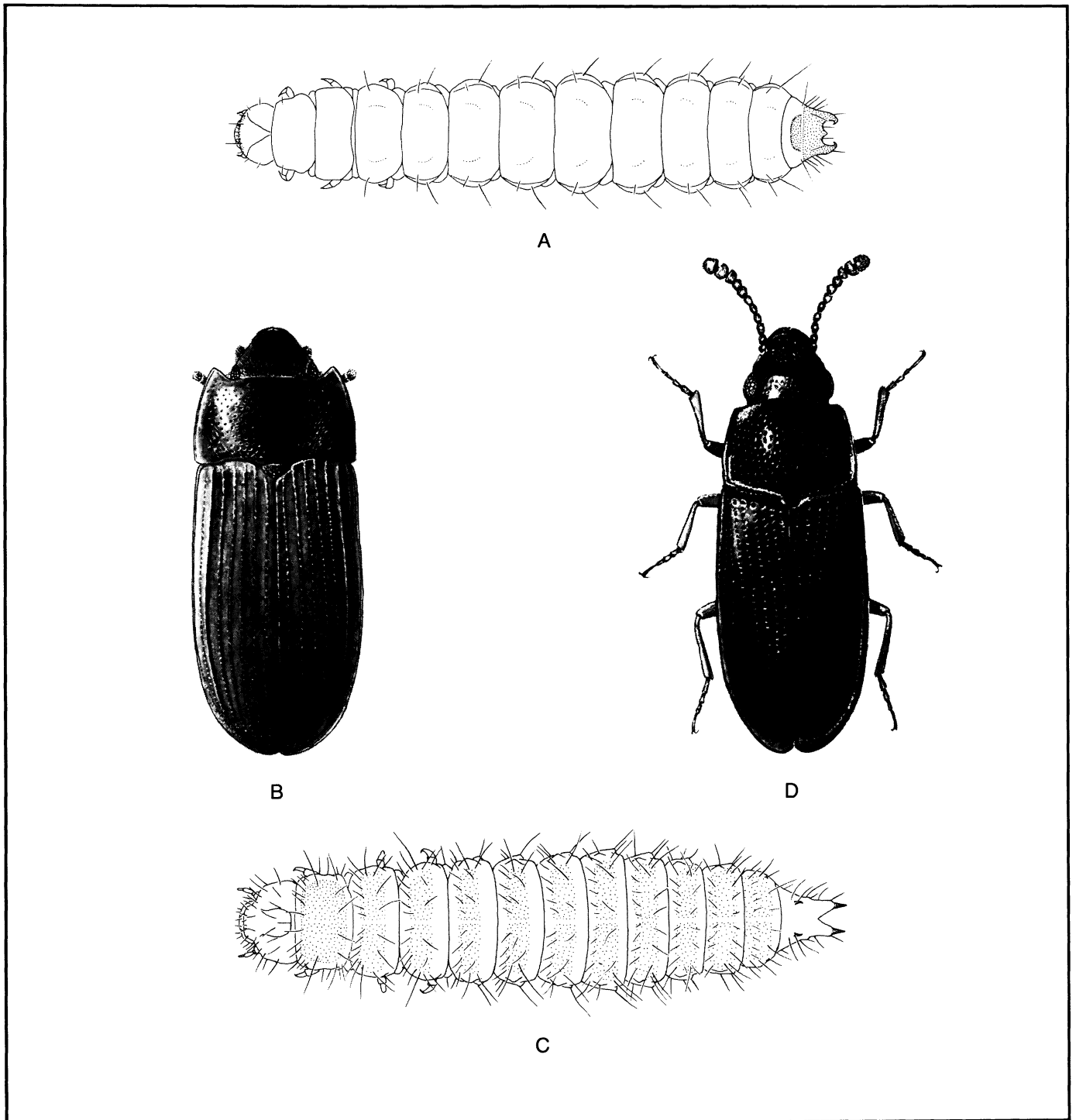


Plate 74. Grain beetles: A, Siamese grain beetle, *Lophocateres pusillus* (Trogositidae), larva (5.4); B, same, adult (2.6-3.2); C, Mexican grain beetle, *Pharaxonotha kirschi* (Languriidae), larva (8.5) (drawings A&C by C. Feller); D, same, adult (4-4.5).

## **DERMESTID BEETLES (DERMESTIDAE)**

This series of illustrations, drawn by A.D. Cushman (unless otherwise noted), is a continuation from part 1, chapter 5 (Dermestid Beetles), by J.M. Kingsolver.

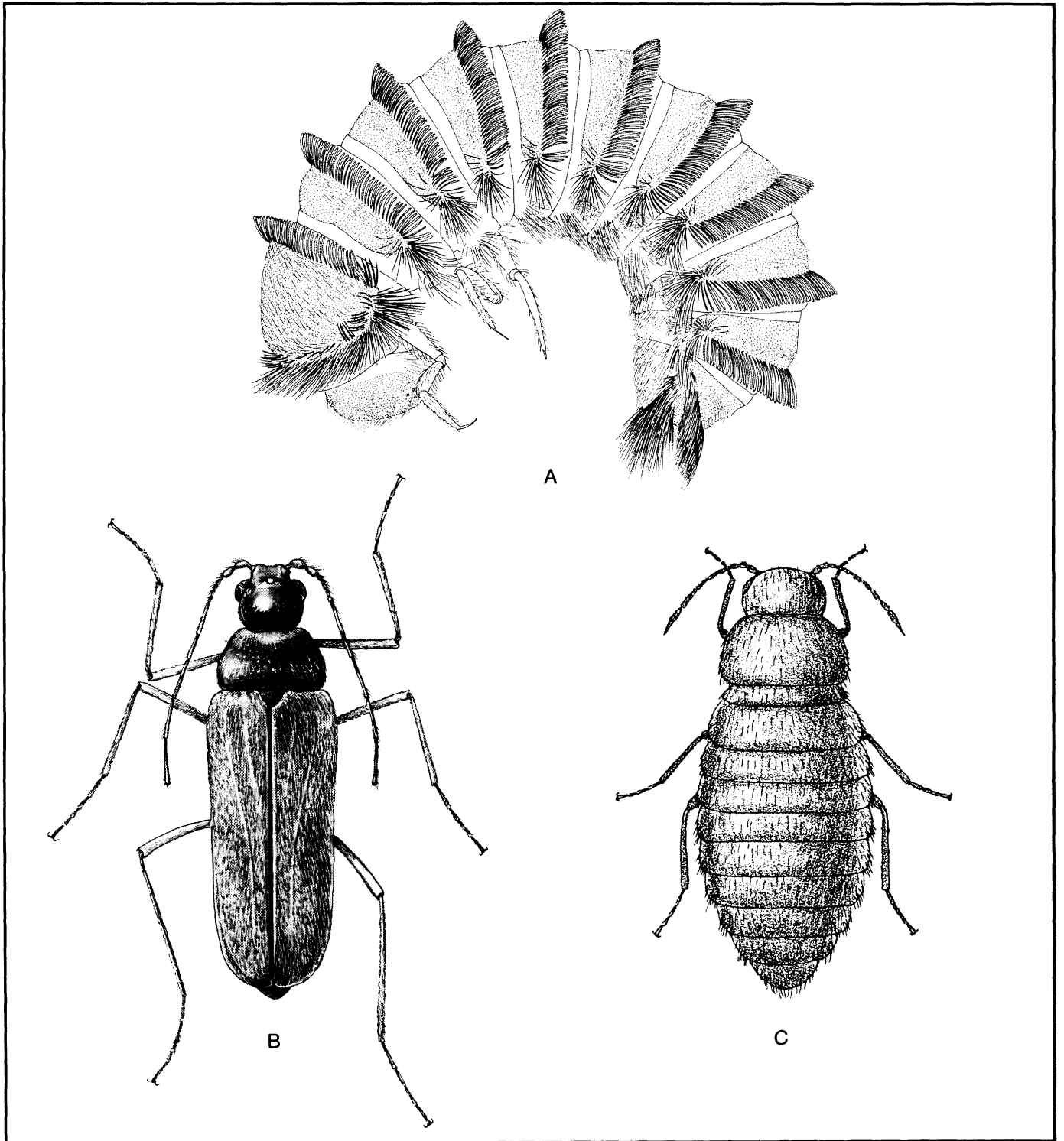


Plate 75. Odd beetle, *Thylodrias contractus* (Dermestidae): A, larva (4-4.8) (drawing by C. Feller); B, male (2.3-3); C, female (3.7-4.4).

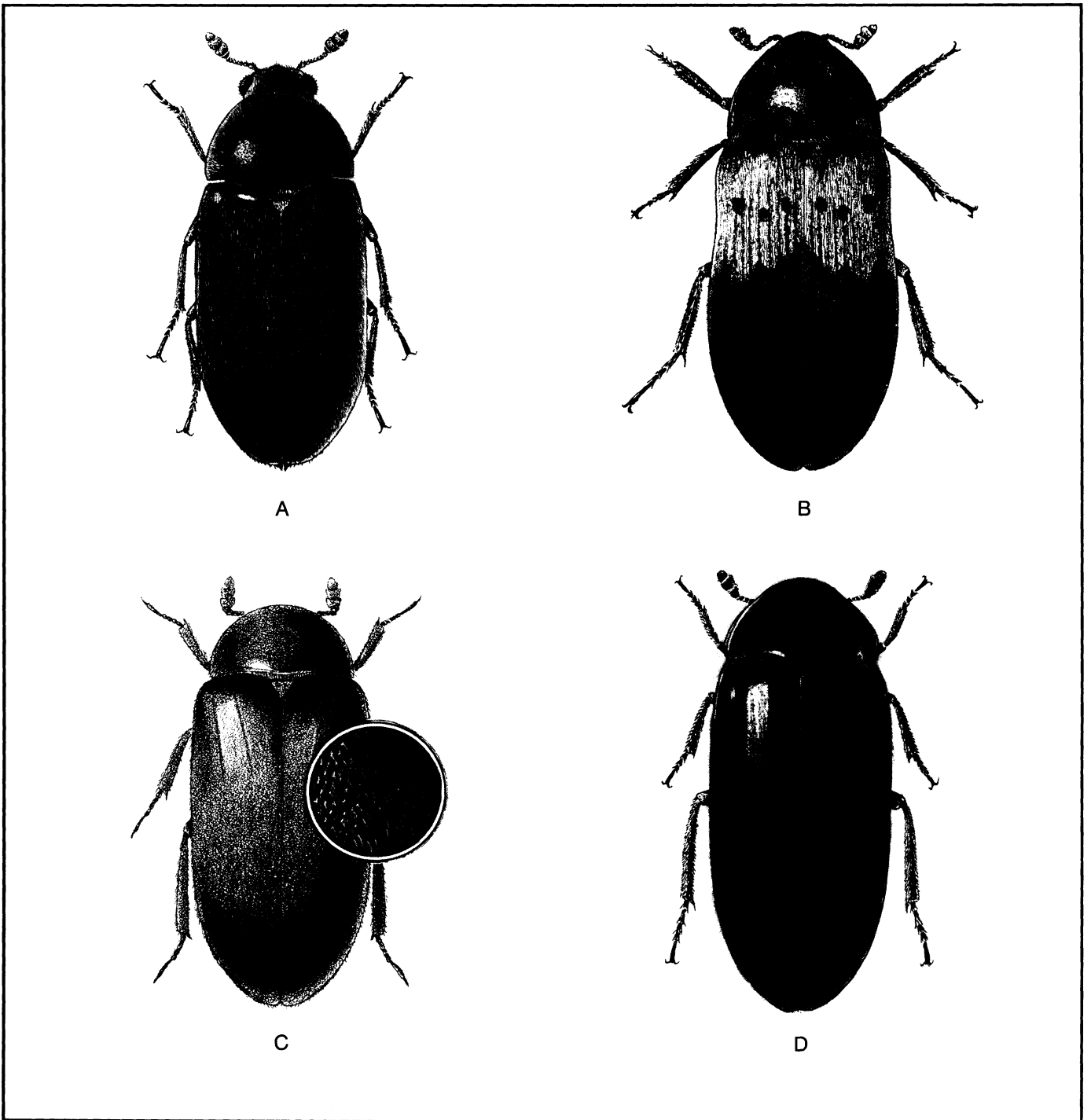


Plate 76. **Dermestid beetles** (Dermestidae): A, **hide beetle**, *Dermestes maculatus* (5.5-10); B, **larder beetle**, *Dermestes lardarius* (7-9); C, *Dermestes haemorrhoidalis* (male, 6.9; female, 7.7); D, Peruvian larder beetle, *Dermestes peruvianus* (male, 8.5; female, 9.6).

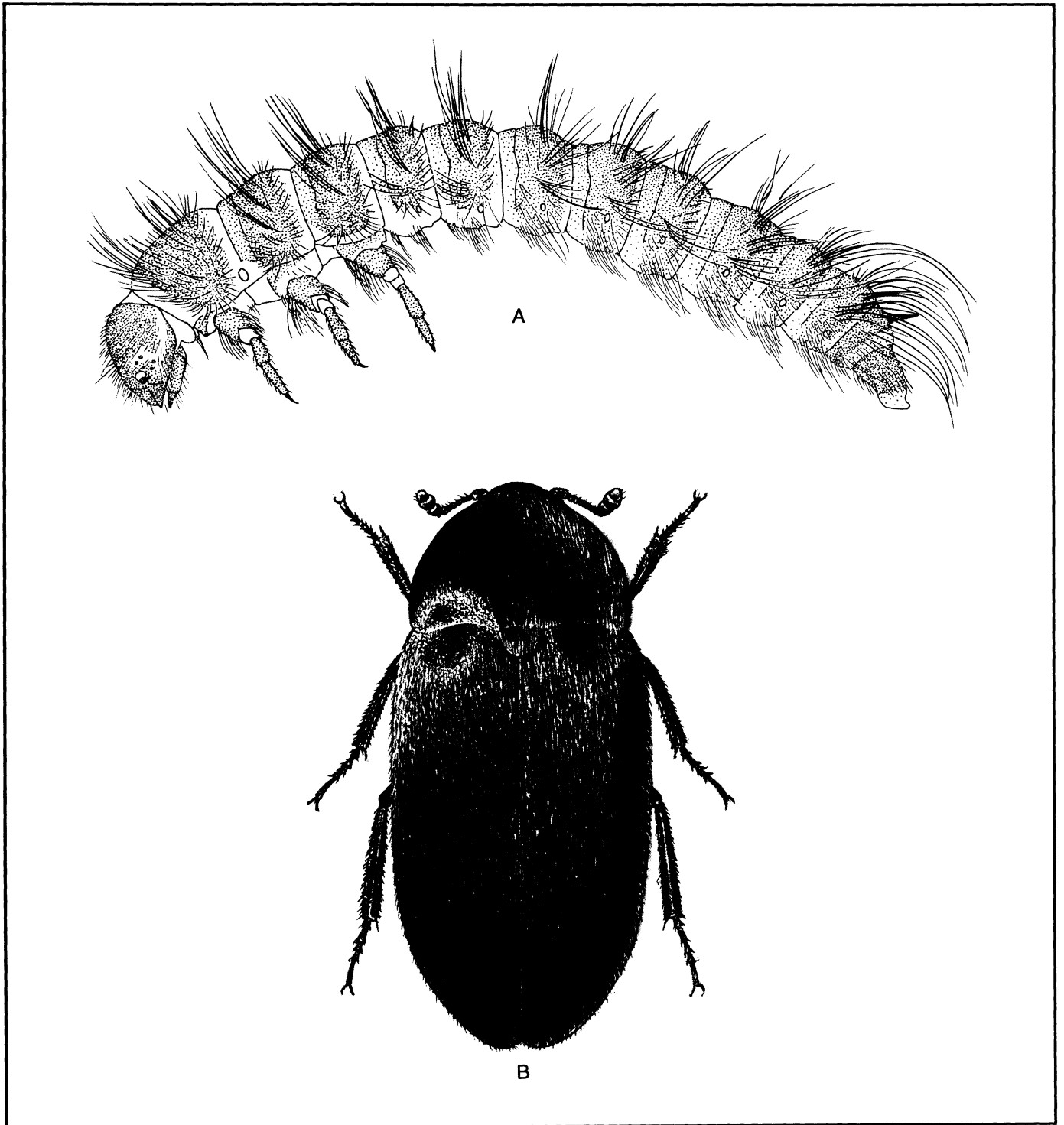


Plate 77. **Black larder beetle**, *Dermestes ater* (Dermestidae): A, larva (15-17) (drawing by C. Feller); B, adult (7-9.5).

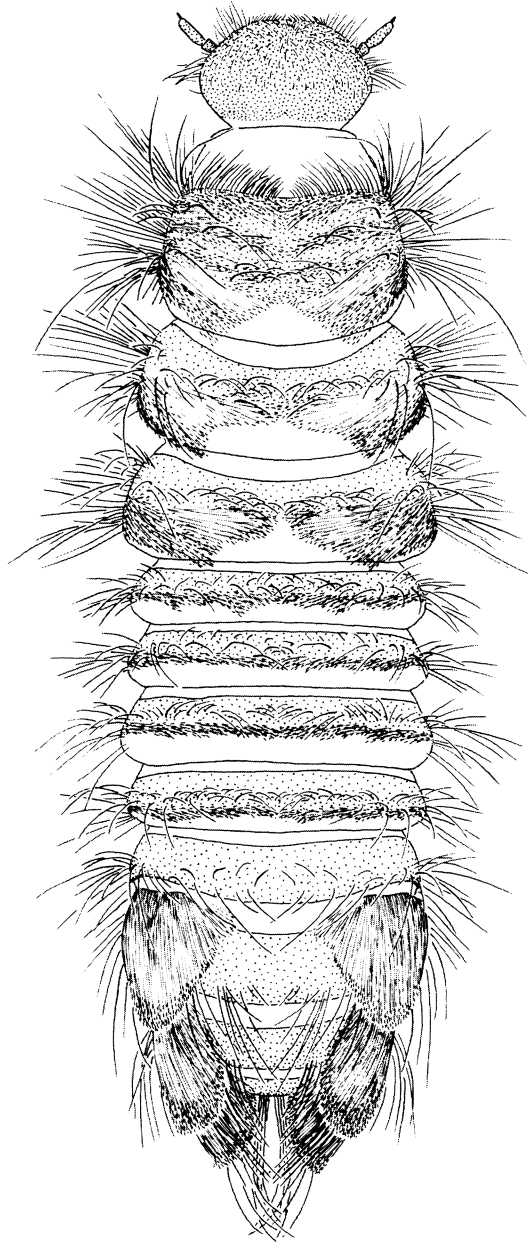


Plate 78. **Varied carpet beetle**, *Anthrenus verbasci* (Dermestidae), larva (4-4.5) (drawing by C. Feller); adult (1.7-3.2) is figured in plate 1A.

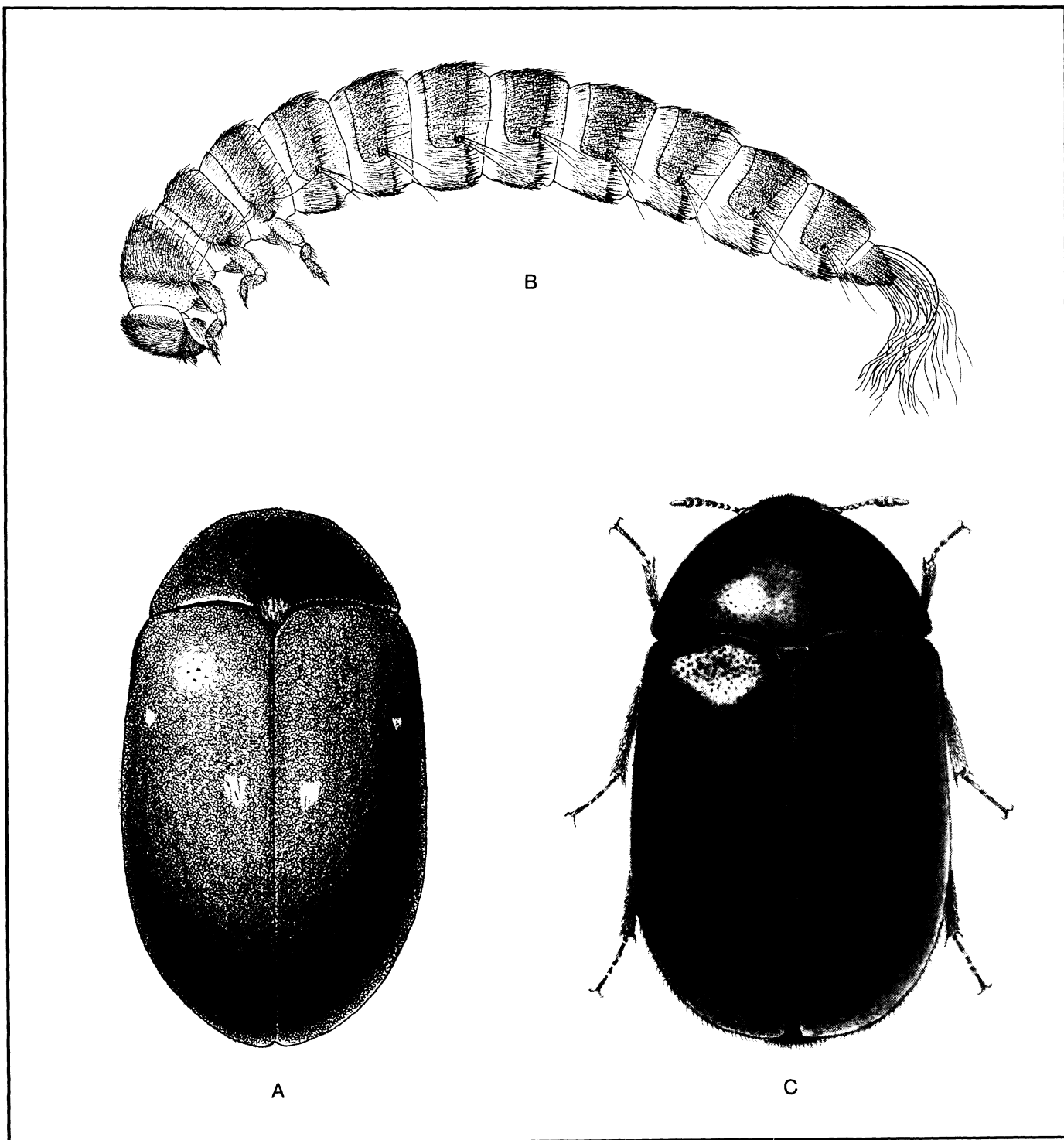


Plate 79. **Dermestid beetles** (Dermestidae): A, *Attagenus pellio* (3.6-5.7); B, **black carpet beetle**, *Attagenus unicolor*, larva (6-8.2) (drawing by C. Feller); C, same, adult (2.8-5).



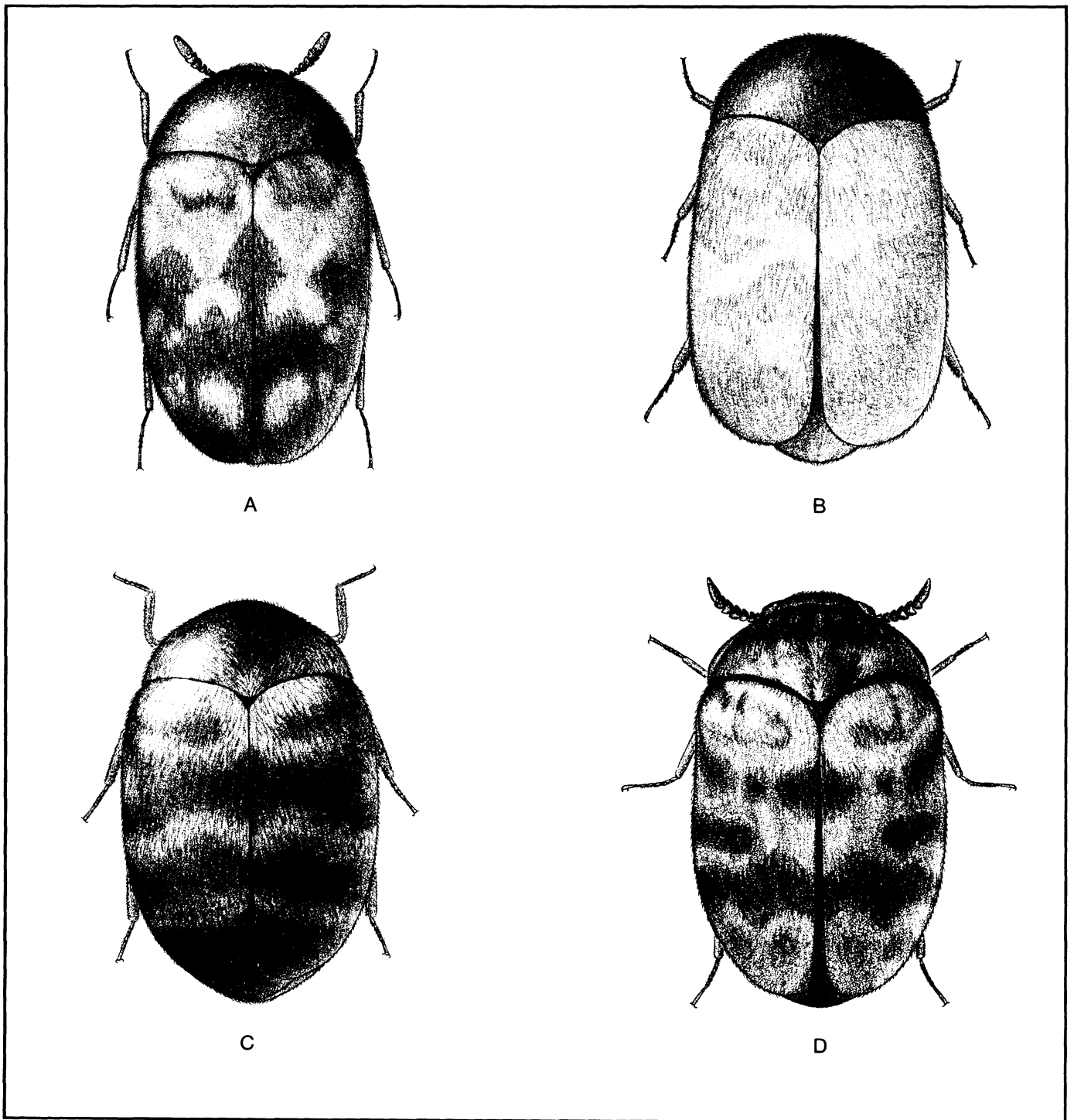


Plate 80. **Dermestid beetles** (Dermestidae)  
 (drawings by C. Feller): A, *Trogoderma simplex*  
 (2.2-4.4); B, **khapra beetle**, *Trogoderma*  
*granarium* (1.5-3); C, glabrous cabinet beetle,  
*Trogoderma glabrum* (2-3.9); D, European larger  
 cabinet beetle, *Trogoderma versicolor* (1.8-4.2).

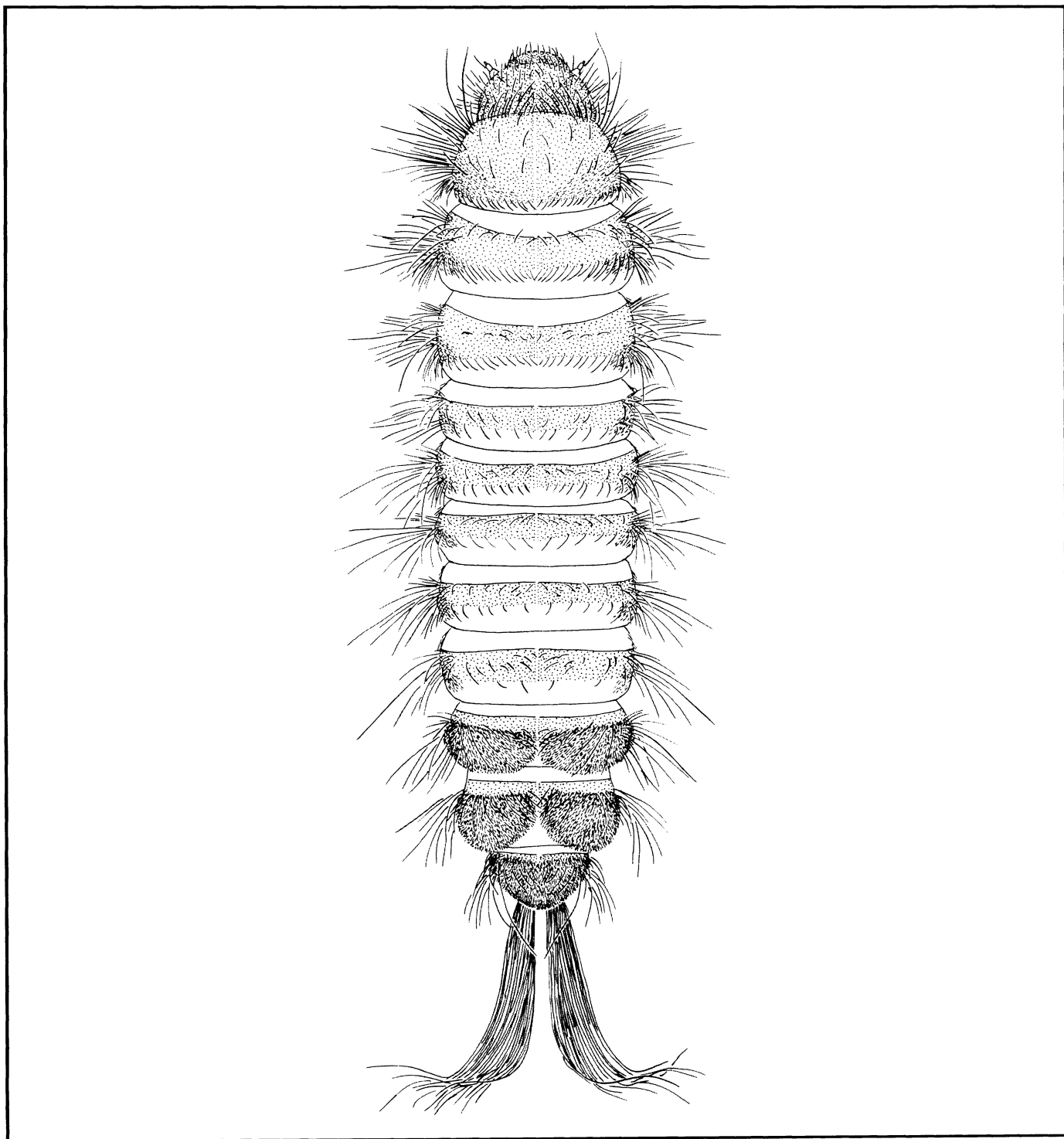


Plate 81. **Warehouse beetle**, *Trogoderma variabile* (Dermestidae), larva (5-6.5) (drawing by C. Feller); adult (2.7-3.5) is figured in plate 1C.

## **SPIDER BEETLES (PTINIDAE)**

This series of illustrations, drawn by A.D. Cushman unless otherwise indicated, is a continuation from part I, chapter 6, by T.J. Spilman.

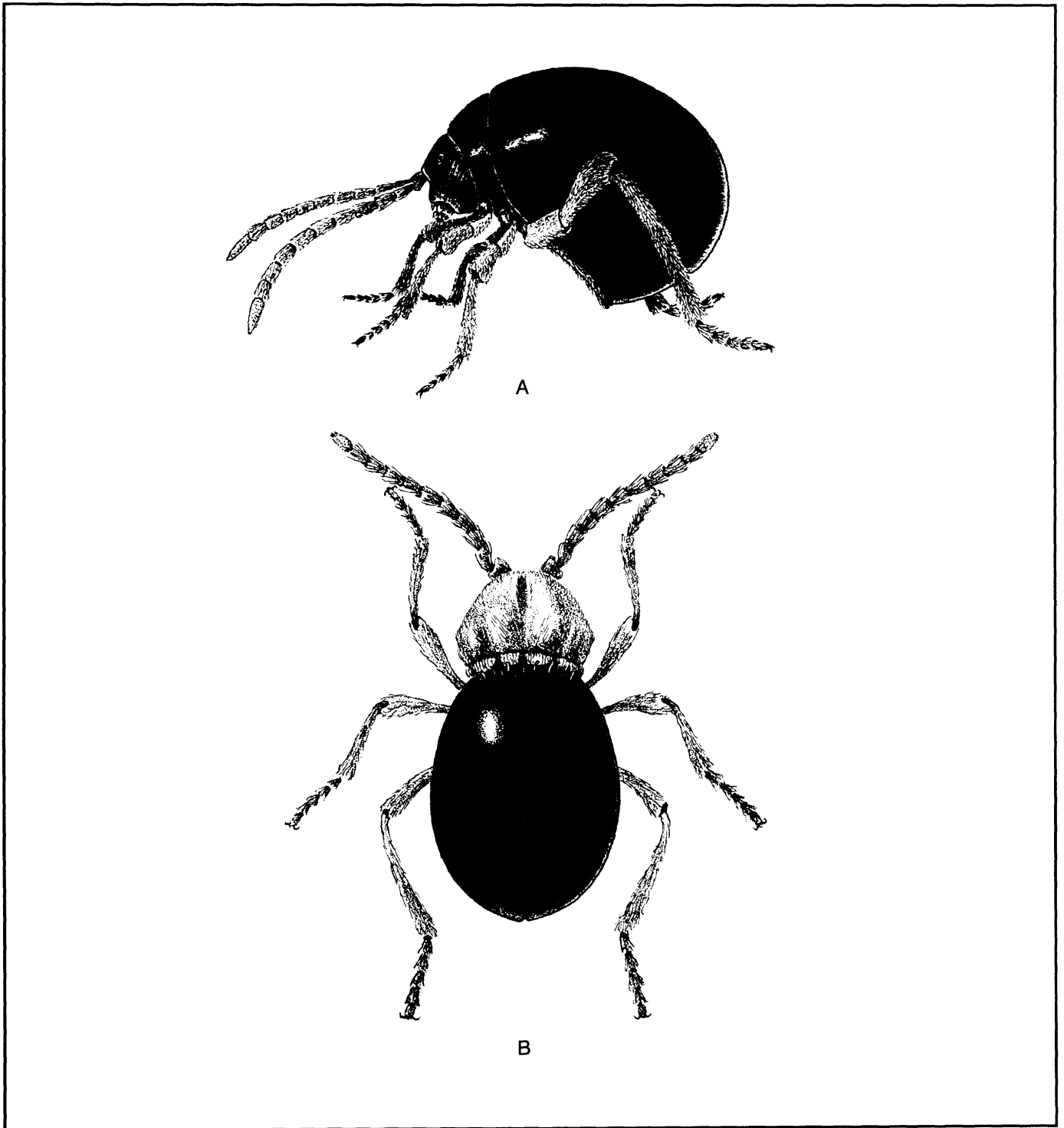


Plate 82. Spider beetles (Ptinidae): A, hump beetle, *Gibbium psylloides* (1.7-3.2); B, American spider beetle, *Mezium americanum* (1.5-3.5).

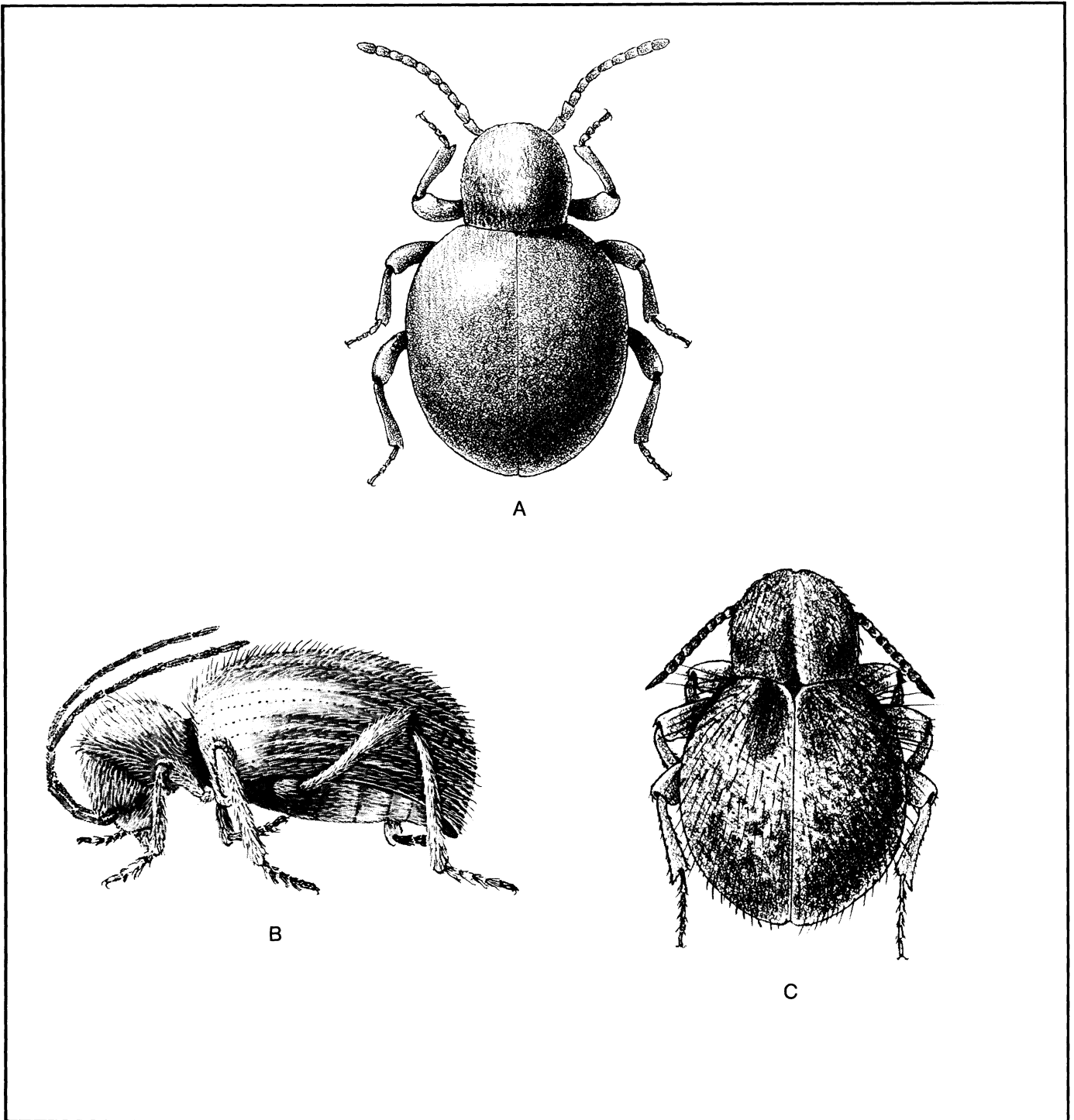


Plate 83. Spider beetles (Ptinidae): A, humpbacked spider beetle, *Sphaericus gibboides* (1.6-2.8); B, golden spider beetle, *Niptus holoeucus* (3-4.5); C, globular spider beetle, *Trigonogenius globulum* (2-4).

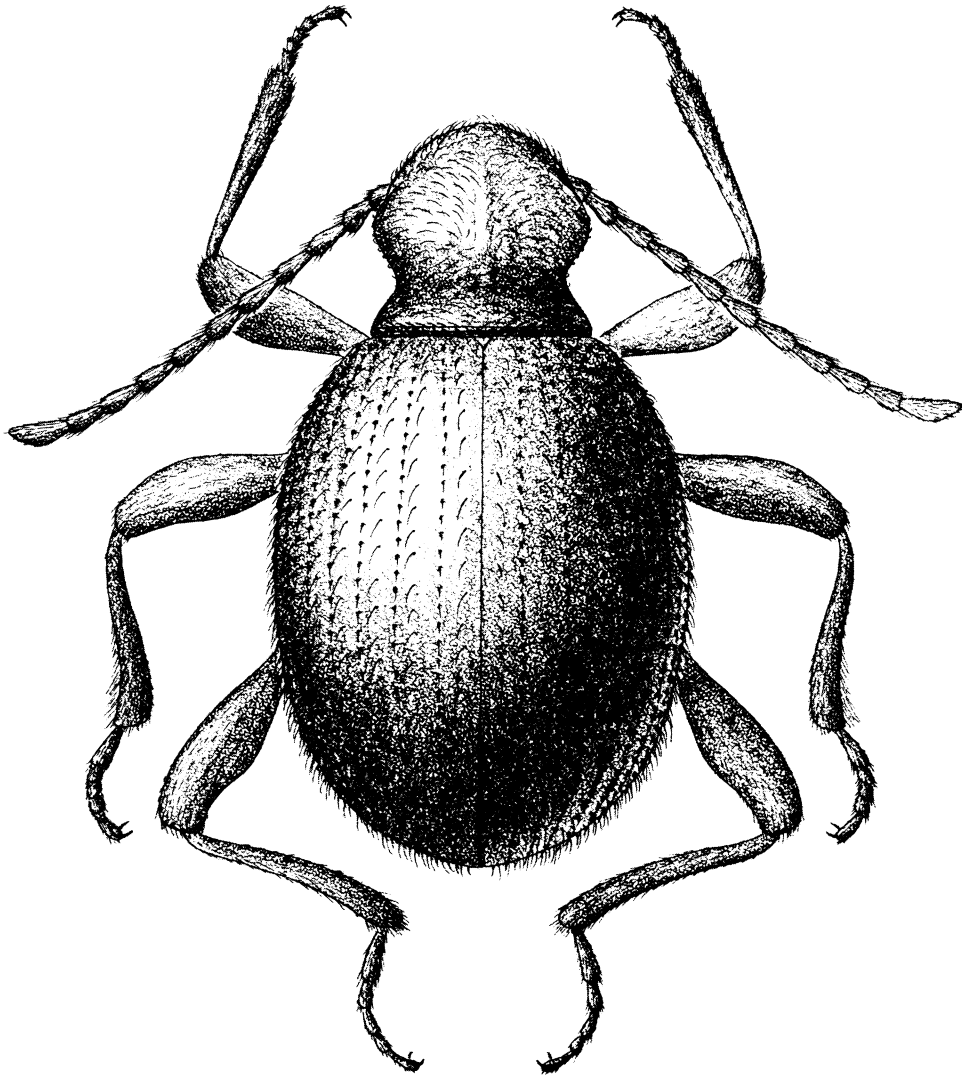


Plate 84. A spider beetle, *Pseudeurostus hilleri*  
(Ptinidae) (1.9-2.8). (Drawing by C. Feller.)

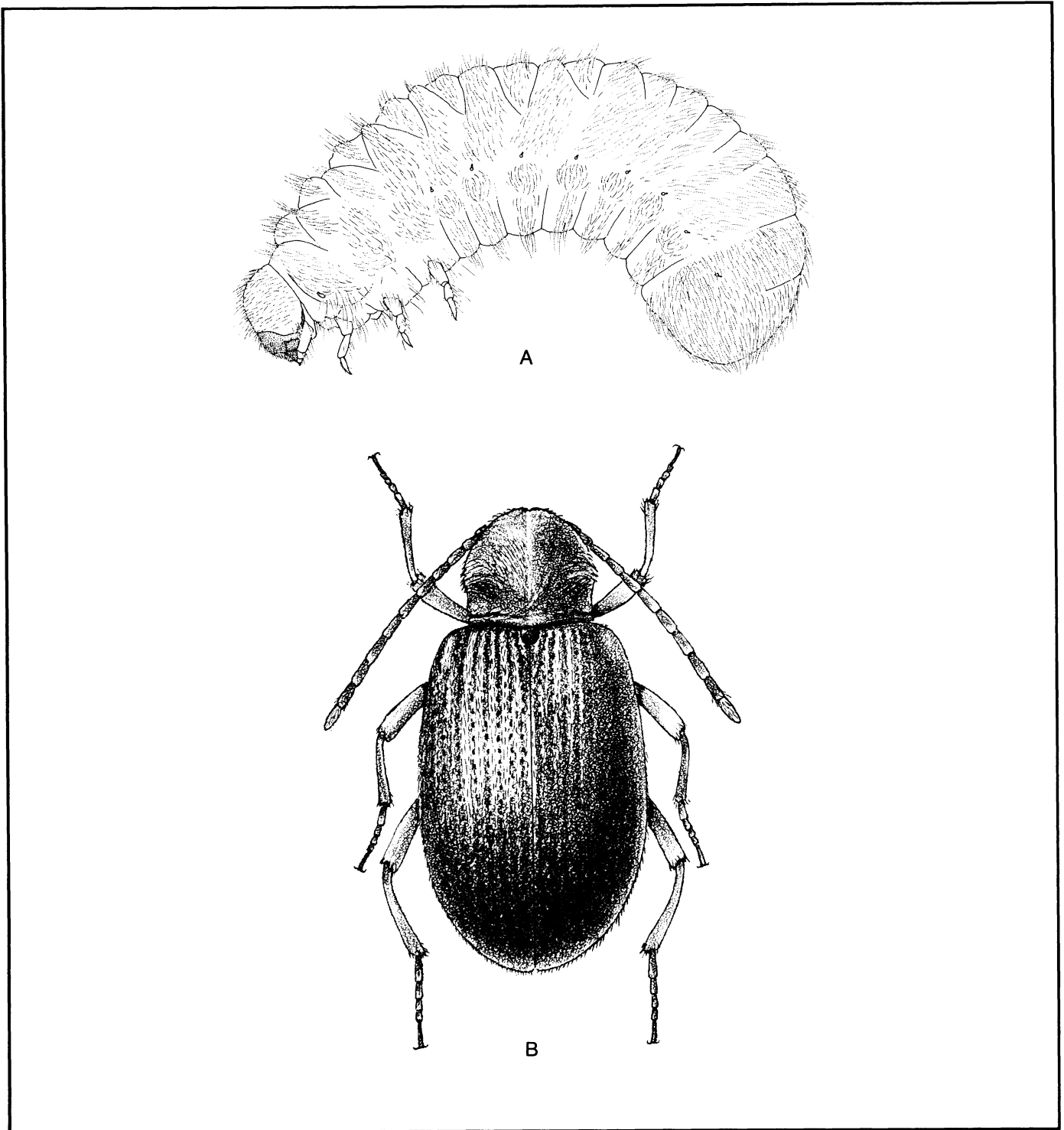


Plate 85. Spider beetles (Ptinidae): A, *Ptinus* sp., larva (3-5) (drawing by C. Feller); B, Australian spider beetle, *Ptinus ocellus*, adult (2.5-4.5).

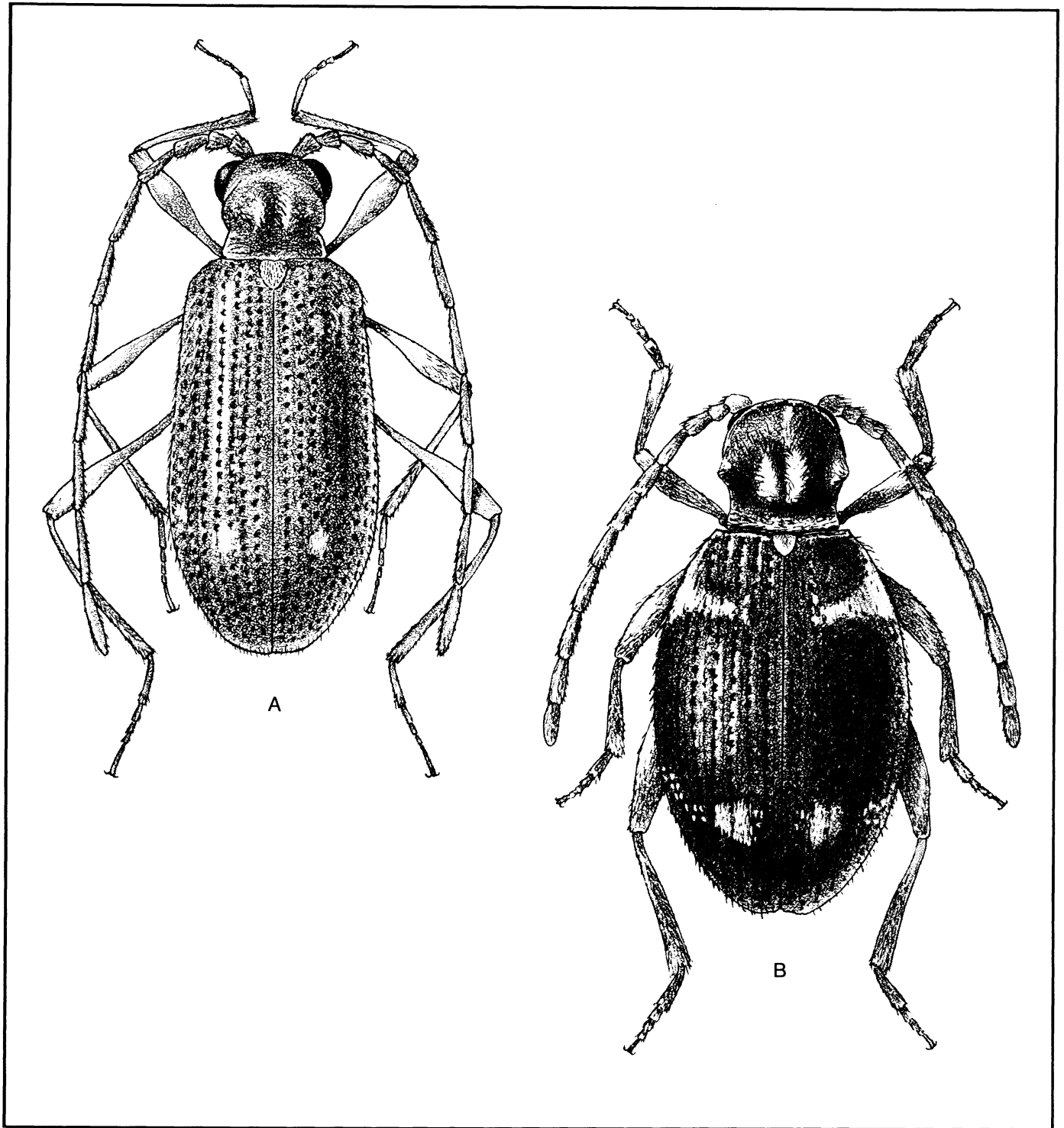
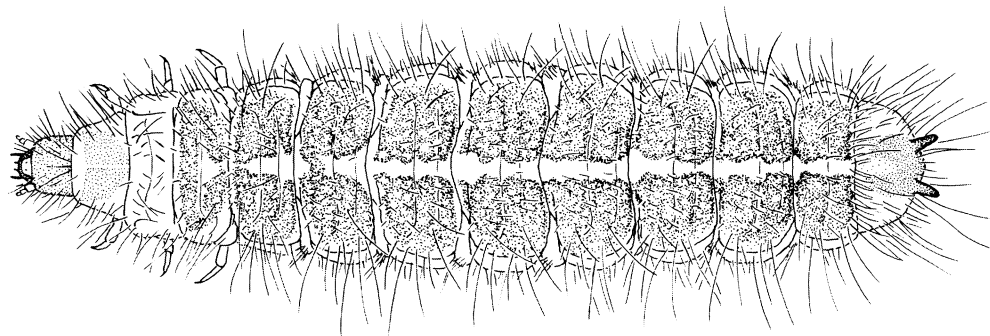


Plate 86. **Whitemarked spider beetle**, *Ptinus fur* (Ptinidae) (2-4.3): A, male; B, female.

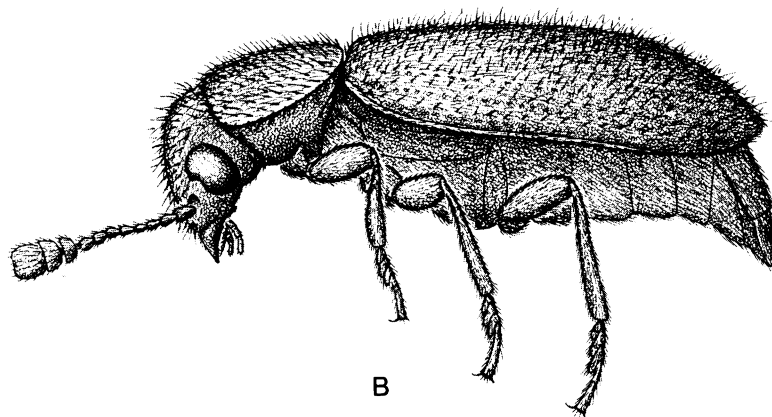


## **CHECKERED BEETLES (CLERIDAE)**

This plate, drawn by C. Feller, is a continuation from part 1, chapter 4, by D.M. Anderson and chapter 7, by J.M. Kingsolver.



A



B

Plate 87. **Redlegged ham beetle**, *Necrobia rufipes* (Cleridae): A, larva (9-10); B, adult (4-5).

## **SAP BEETLES (NITIDULIDAE)**

This series of illustrations, drawn by C. Feller, is a continuation from part 1, chapter 4 (Larval Beetles), by D.M. Anderson and chapter 8 (Sap Beetles), by W.A. Connell.

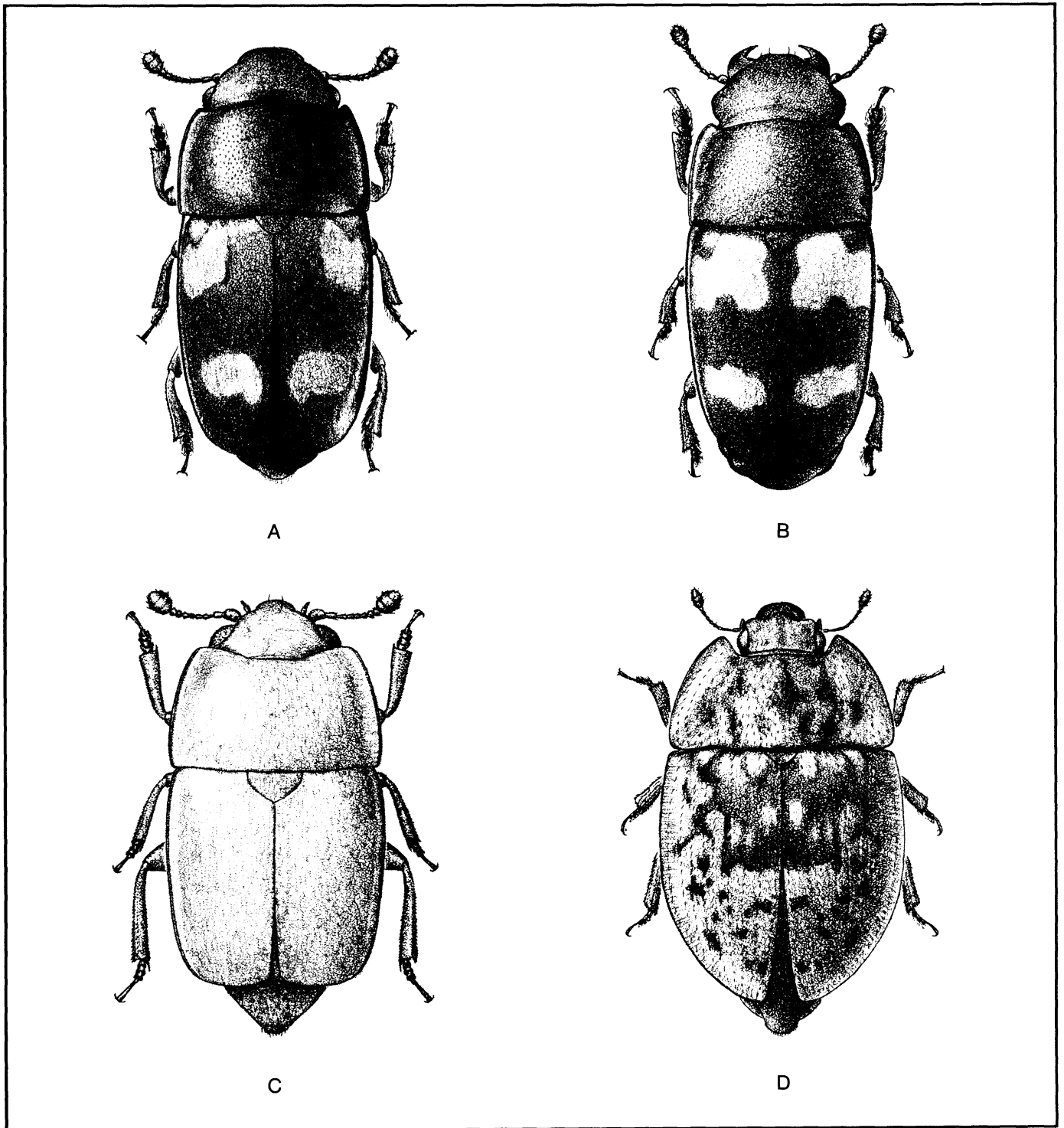


Plate 88. **Sap beetles** (Nitidulidae): A, *Glischrochilus quadrisignatus* (4-7); B, *Glischrochilus fasciatus* (4-7); C, yellowbrown sap beetle, *Haptoncus luteolus* (1.7-2.8); D, *Lobiopa insularis* (4.5-8).

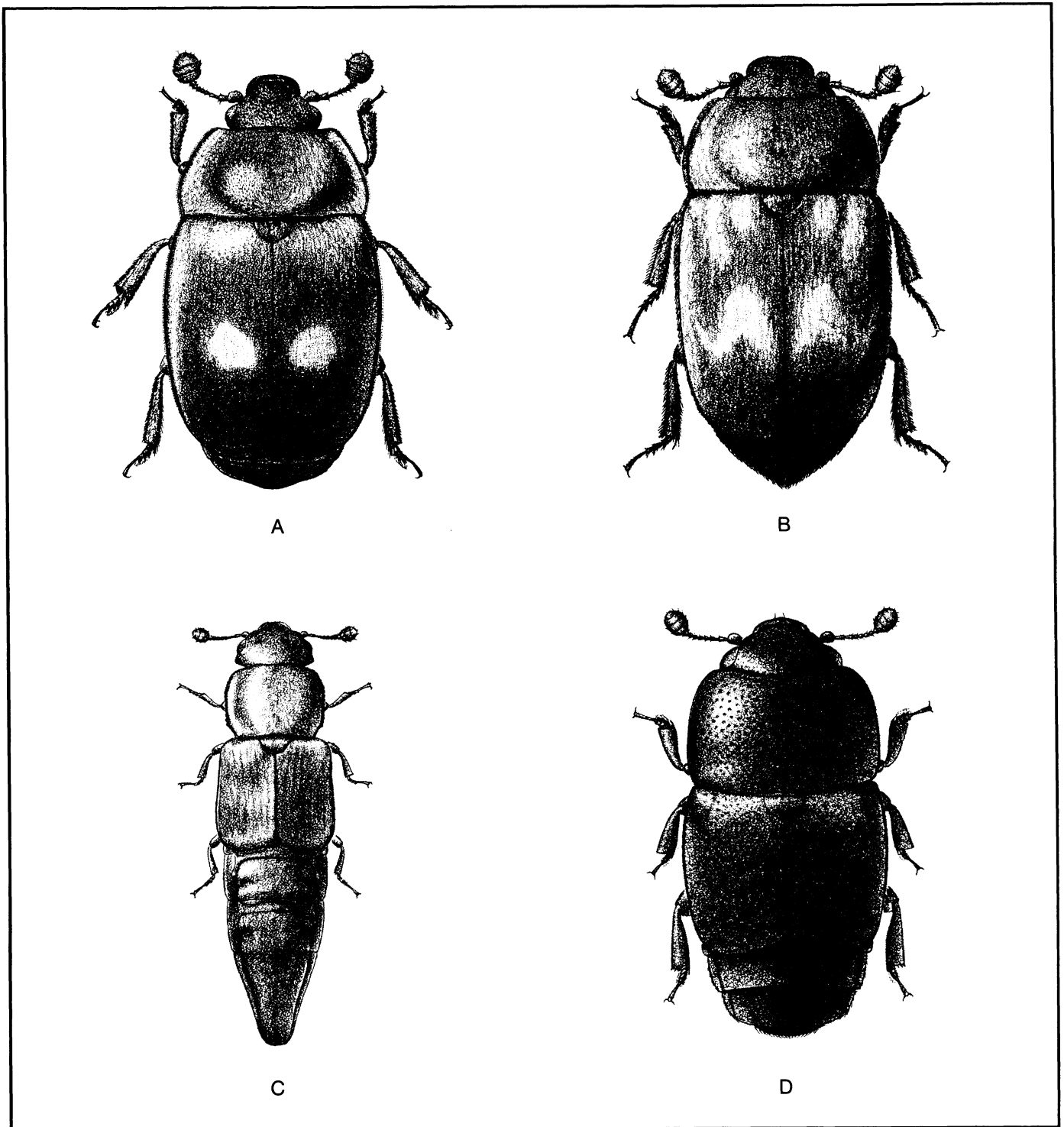


Plate 89. **Sap beetles** (Nitidulidae): A, *Nitidula bipunctata* (3-5); B, *Nitidula ziczac* (3-5); C, *Conotelus stenooides* (3.5-4); D, pineapple sap beetle, *Carpophilus humeralis* (3-4.2).

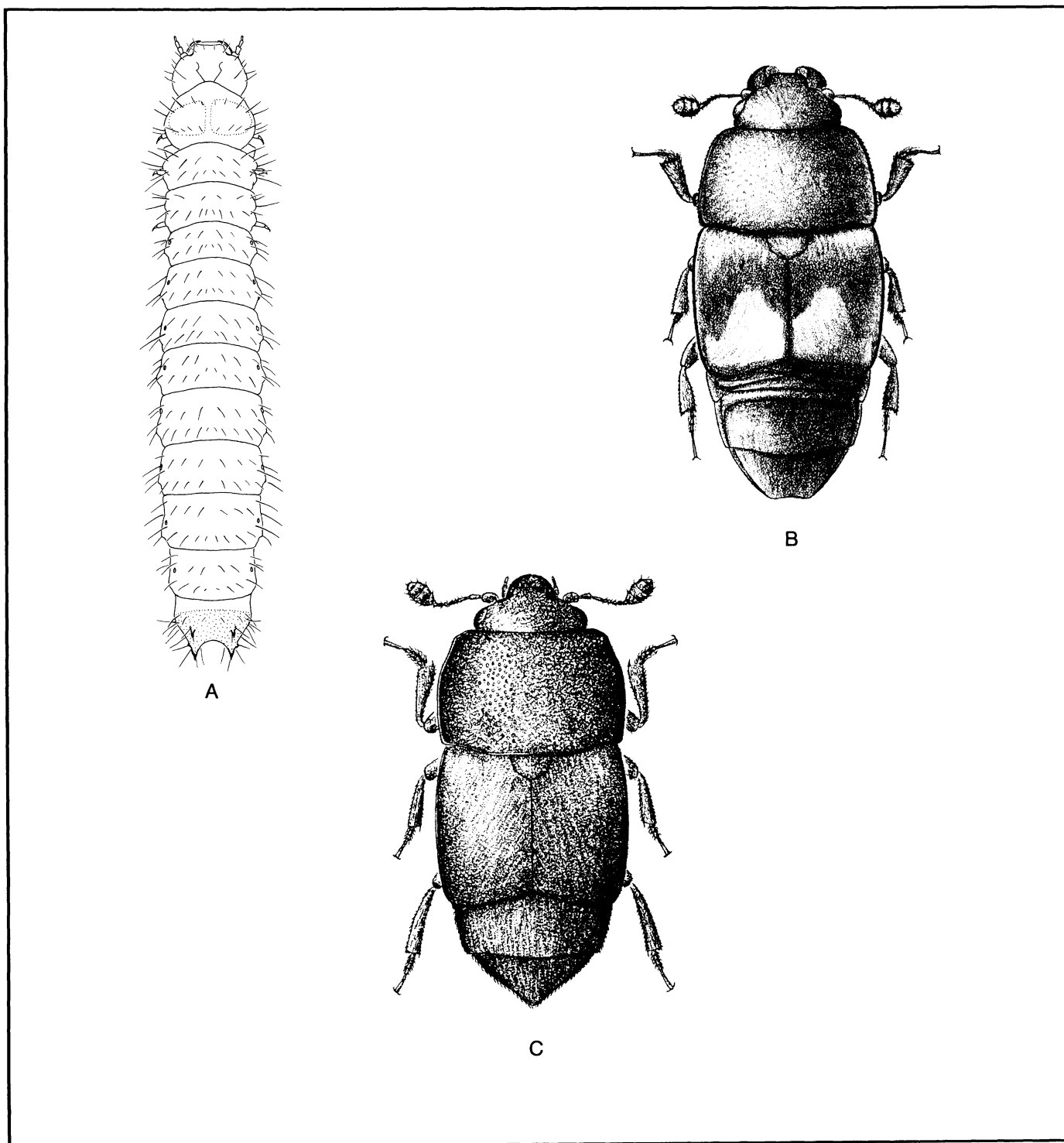


Plate 90. Sap beetles (Nitidulidae): A, driedfruit beetle, *Carpophilus hemipterus*, larva (6-9); B, same, adult (2-4); C, *Carpophilus obsoletus* (2.5-4).

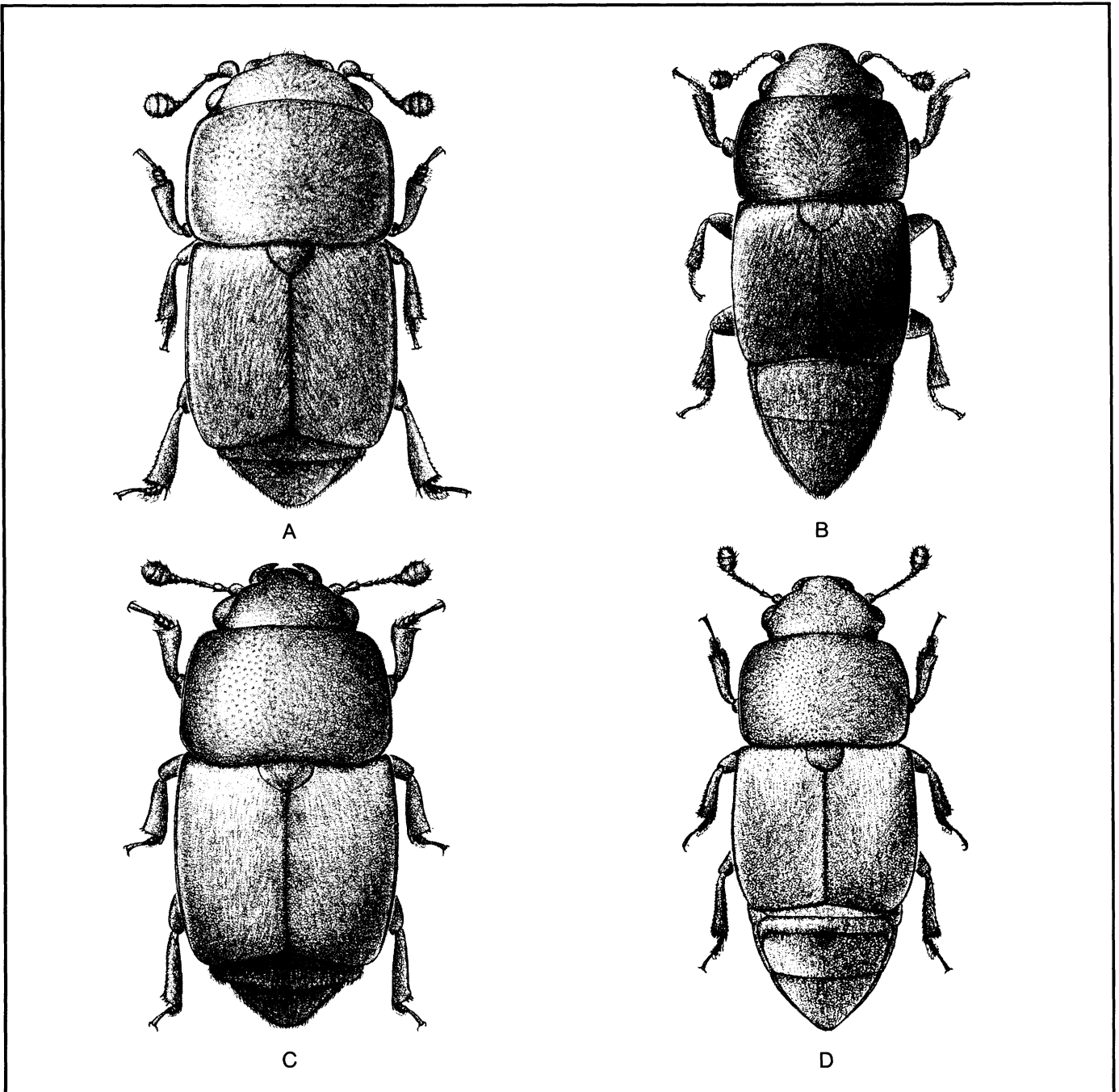


Plate 91. Habitus types (A-D) in the *Carpophilus dimidiatus* group (**sap beetles**, Nitidulidae). All the types and intermediates occur in each species. B and D are illustrated with distended abdomens. The complex consists of *Carpophilus dimidiatus* (2.2-3.2), *Carpophilus freemani* (1.9-2.9), *Carpophilus fumatus* (2.3-3.6), *Carpophilus maculatus* (2.5-3.4), *Carpophilus mutilatus* (2-3.4), and *Carpophilus pilosellus* (1.5-2.5).

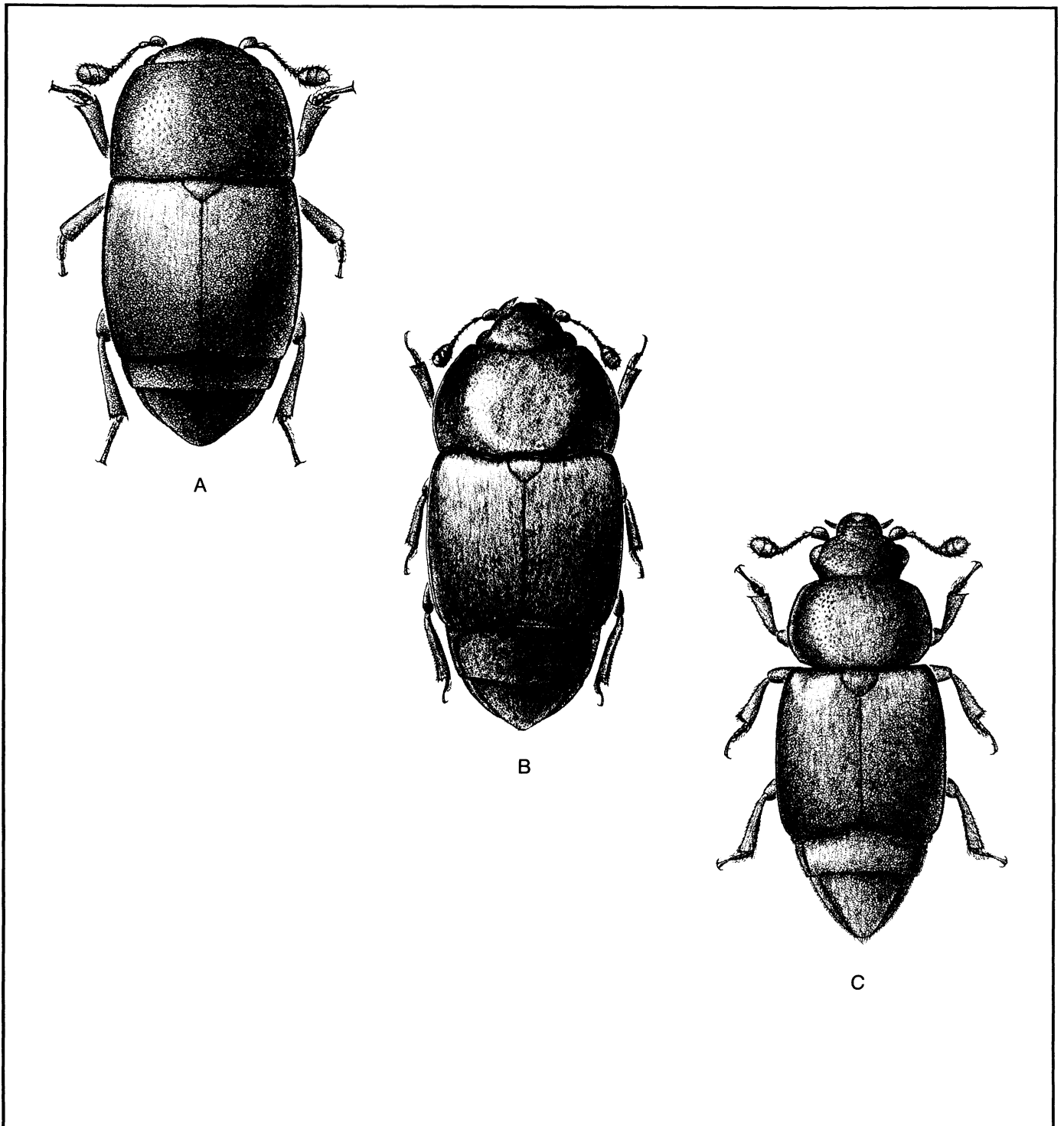
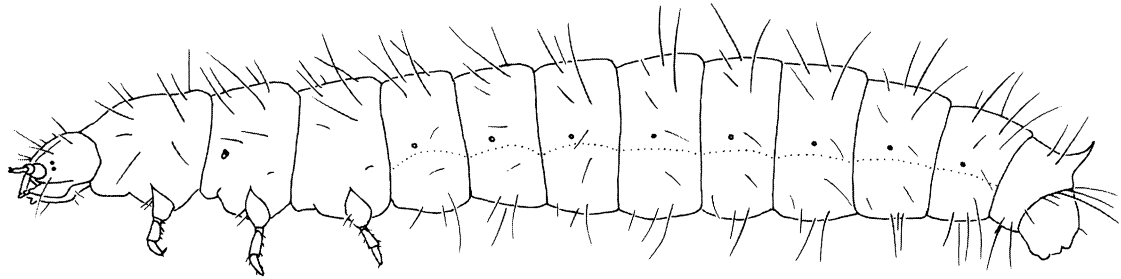


Plate 92. **Sap beetles** (Nitidulidae): A, *Carpophilus marginellus* (2.7-3.5); B, **dusky sap beetle**, *Carpophilus lugubris* (3-4.5); C, *Carpophilus ligneus* (2.5-3.2).

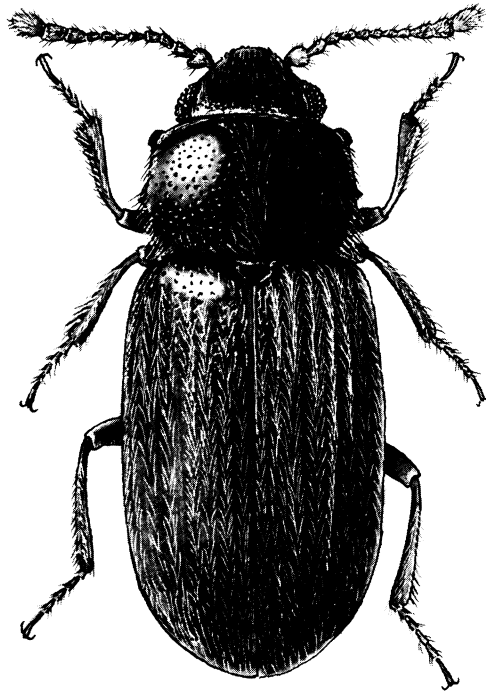


## **CRYPTOPHAGID BEETLES (CRYPTOPHAGIDAE)**

These illustrations are a continuation from Part 1, chapter 4 (Larval Beetles), by D.M. Anderson and chapter 9 (Cryptophagid Beetles), by J.M. Kingsolver.



A



B

Plate 93. **Silken fungus beetles**  
(Cryptophagidae): A, *Cryptophagus laticollis*,  
larva (2.5-3.3) (drawing by C. Feller); B, cellar  
beetle, *Cryptophagus cellaris*, adult (2.2-2.7)  
(drawing by A.D. Cushman).

## **MINUTE BROWN SCAVENGER BEETLES (LATHRIDIIDAE)**

These illustrations, drawn by C. Feller, are a continuation from part 1, chapter 3 (Larval Beetles), by D.M. Anderson and chapter 10 (Lathridiid Beetles), by J.M. Kingsolver and F.G. Andrews.

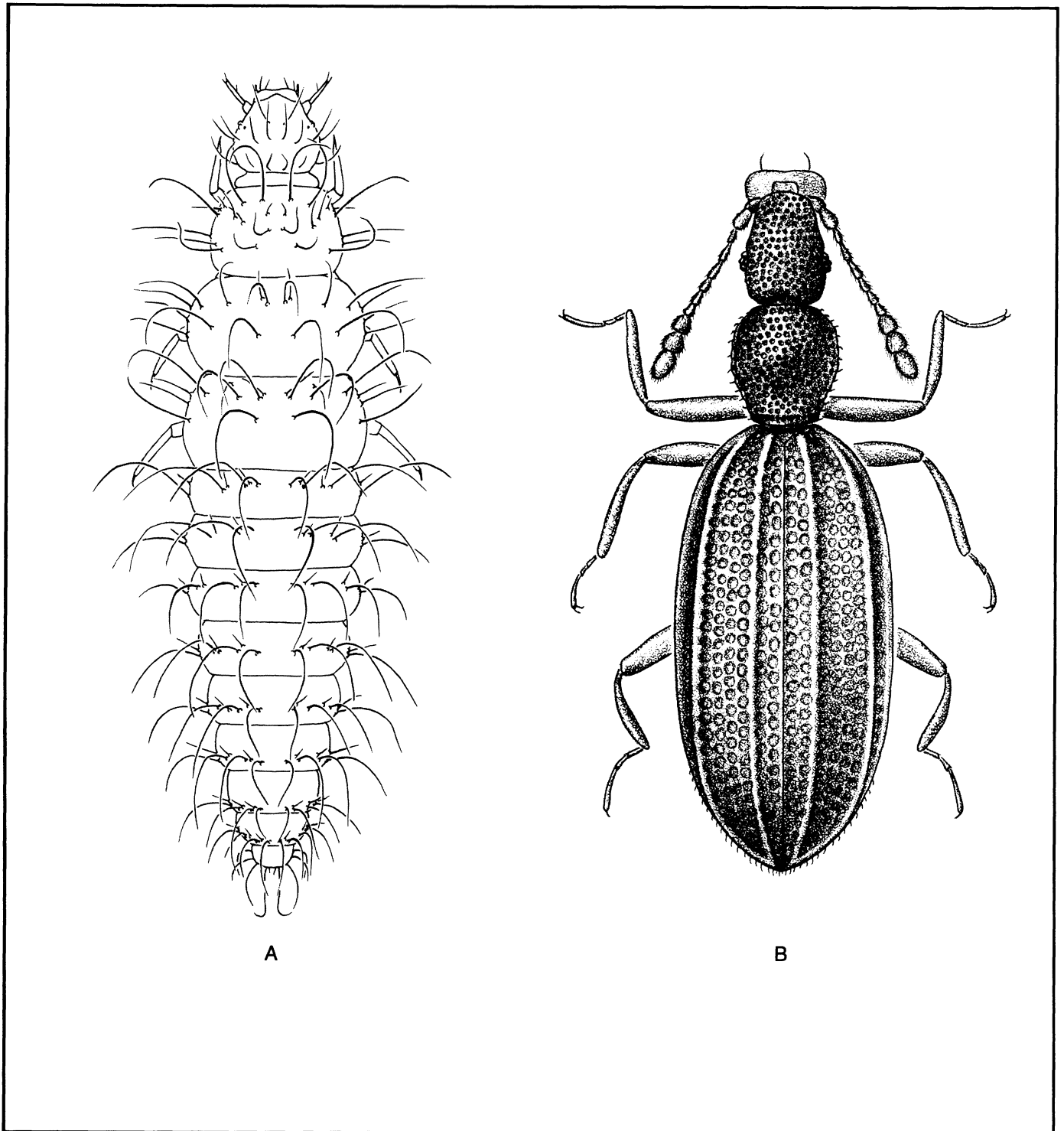


Plate 94. Minute brown scavenger beetles (Lathridiidae): A, *Aridius nodifer*, larva (2.4); B, *Adistemia watsoni*, adult (1.2-1.7).

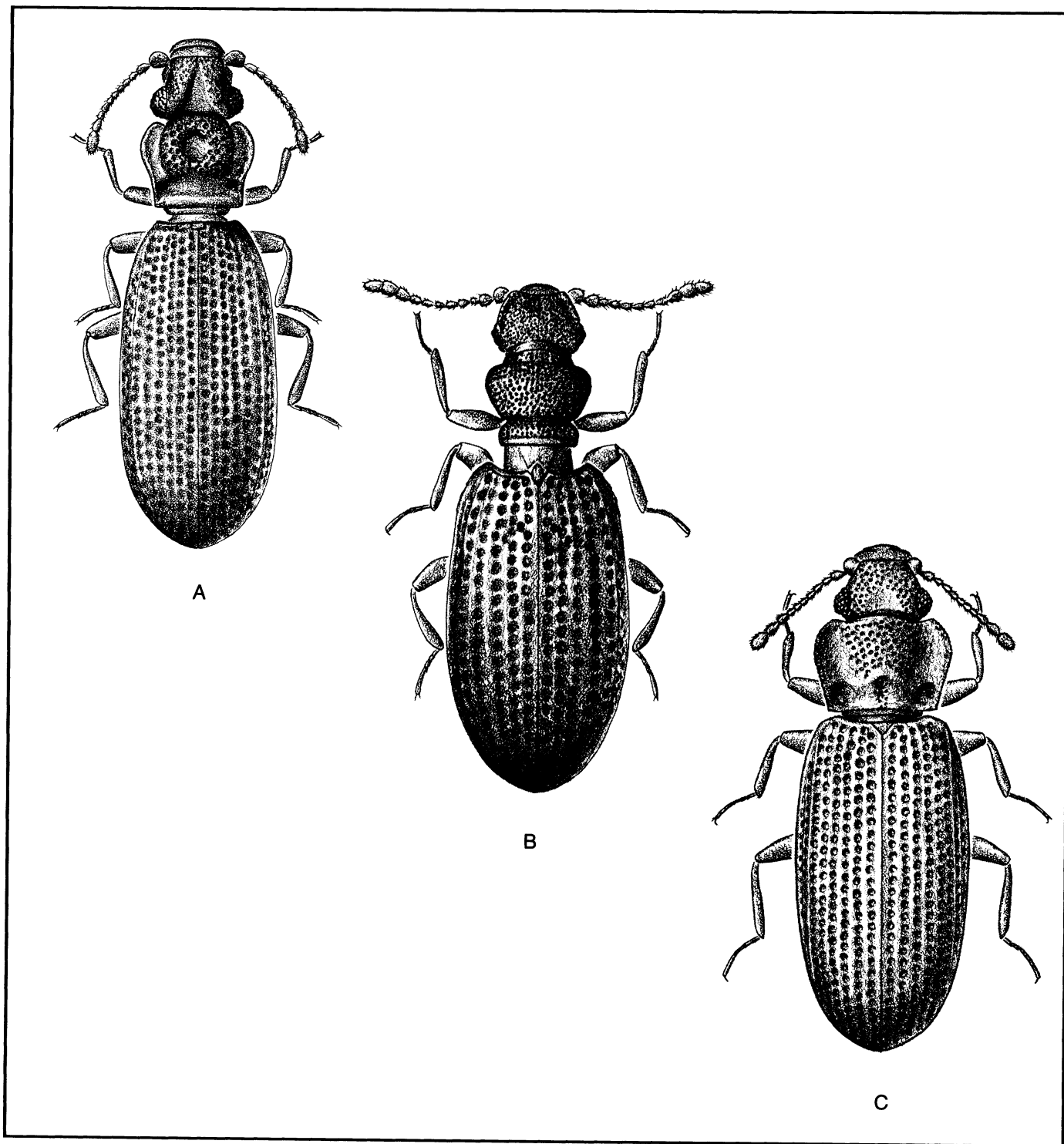


Plate 95. Minute brown scavenger beetles (Lathridiidae): A, *Dienerella filum* (1.2-1.6); B, *Dienerella ruficollis* (1-1.2); C, *Dienerella arga* (1.3-1.4).

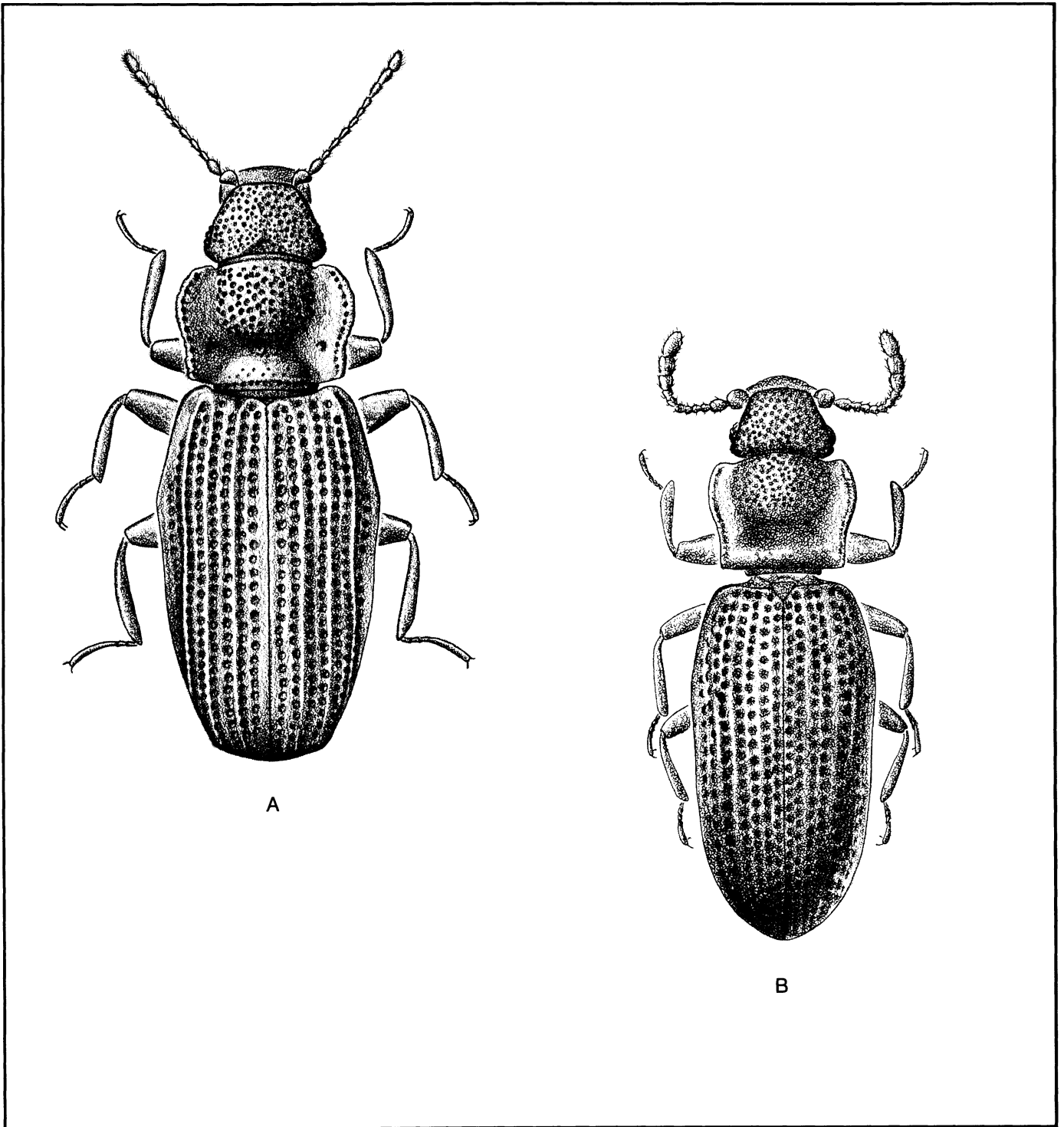


Plate 96. Minute brown scavenger beetles (Lathridiidae): A, *Dienerella costulata* (1-1.5); B, *Dienerella filiformis* (1.2-1.4).

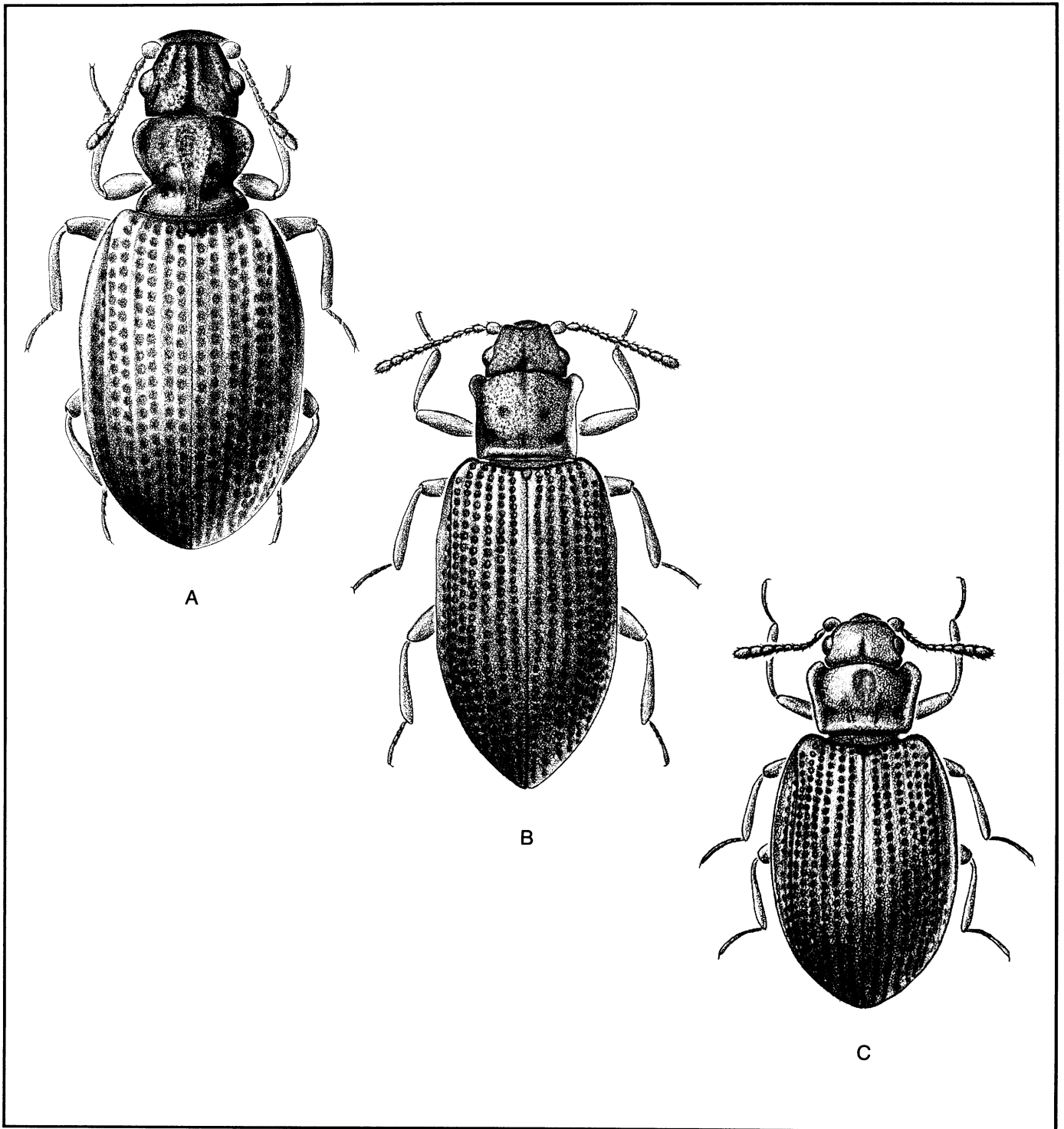


Plate 97. Minute brown scavenger beetles (Lathridiidae): A, plaster beetle, *Cartodere constricta* (1.2-1.7); B, *Lathridius protensicollis* (2.4-2.6); C, square-nosed fungus beetle, *Lathridius minutus* (1.2-2.4).

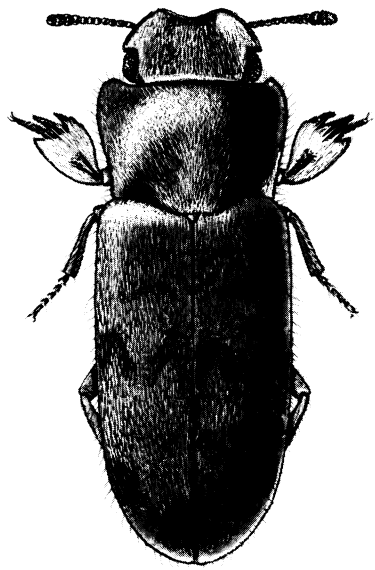
*Insect and Mite Pests in Food*

**Notes and Sketches**

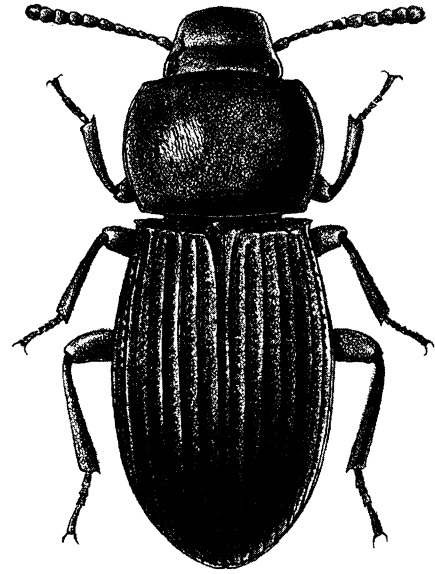


## **DARKLING BEETLES (TENEBRIONIDAE)**

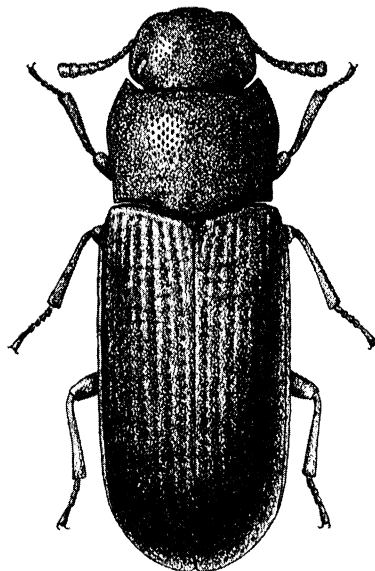
These illustrations, drawn by A.D. Cushman unless otherwise noted, are a continuation from part 1, chapter 3 (Larval Beetles), by D.M. Anderson and chapter 11 (Darkling Beetles), by T.J. Spilman.



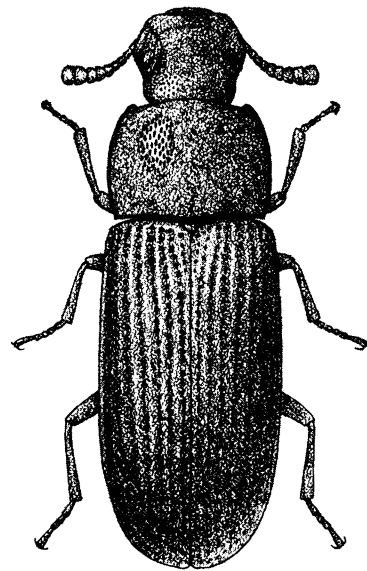
A



B



C



D

Plate 98. Tenebrionid beetles (Tenebrionidae):  
A, *Lepidocnemeplatia sericea* (2.6-4.4); B, fig  
engraver beetle, *Apsena rufipes* (4.2-7); C, giant  
flour beetle, *Tribolium brevicorne* (5-7); D, false  
black flour beetle, *Tribolium destructor* (4.5-5.7).

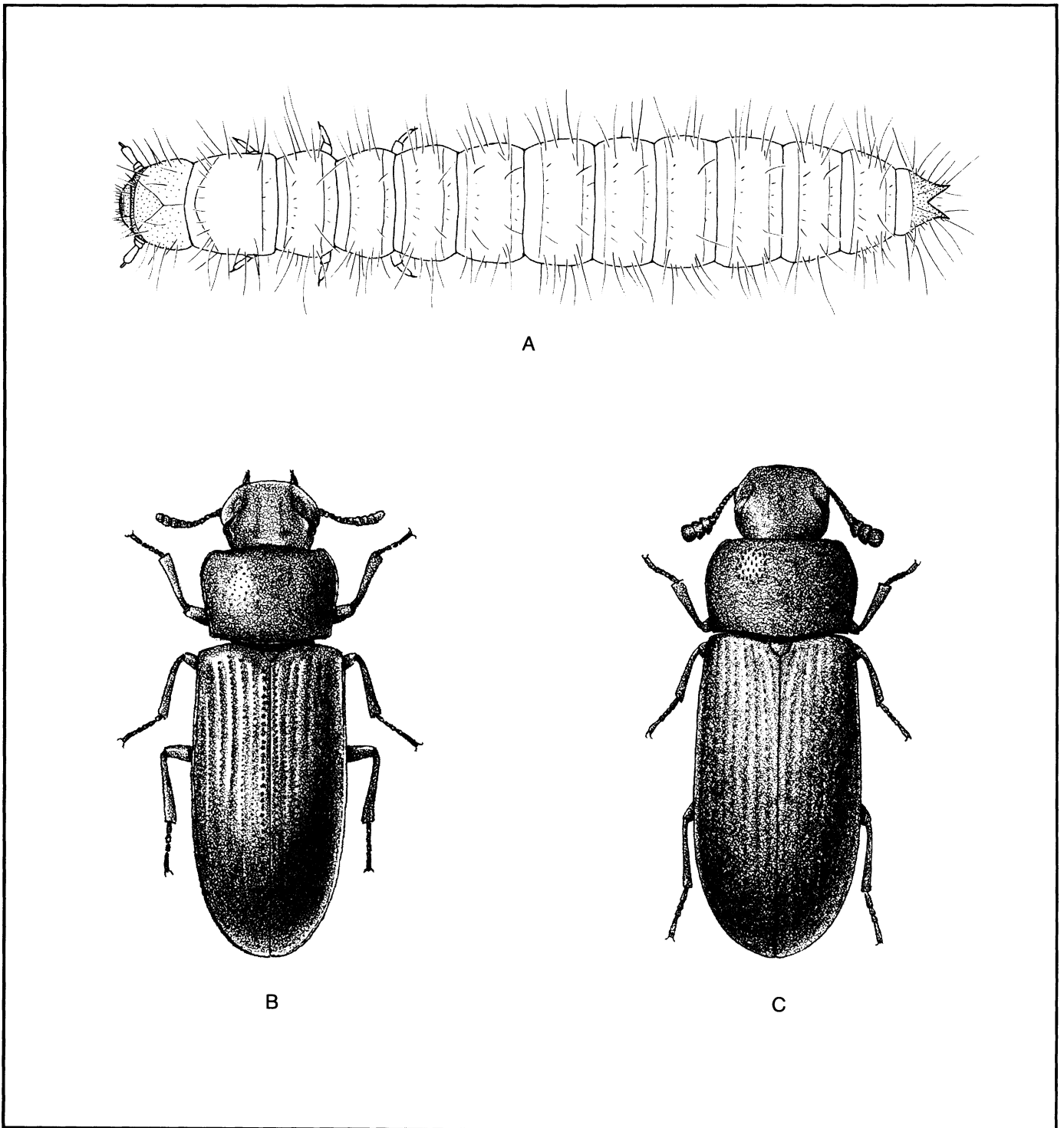


Plate 99. Flour beetles (Tenebrionidae): A, **confused flour beetle**, *Tribolium confusum*, larva (6-7) (drawing by C. Feller); B, same, adult (2.6-4.4); C, **red flour beetle**, *Tribolium castaneum* (2.3-4.4).

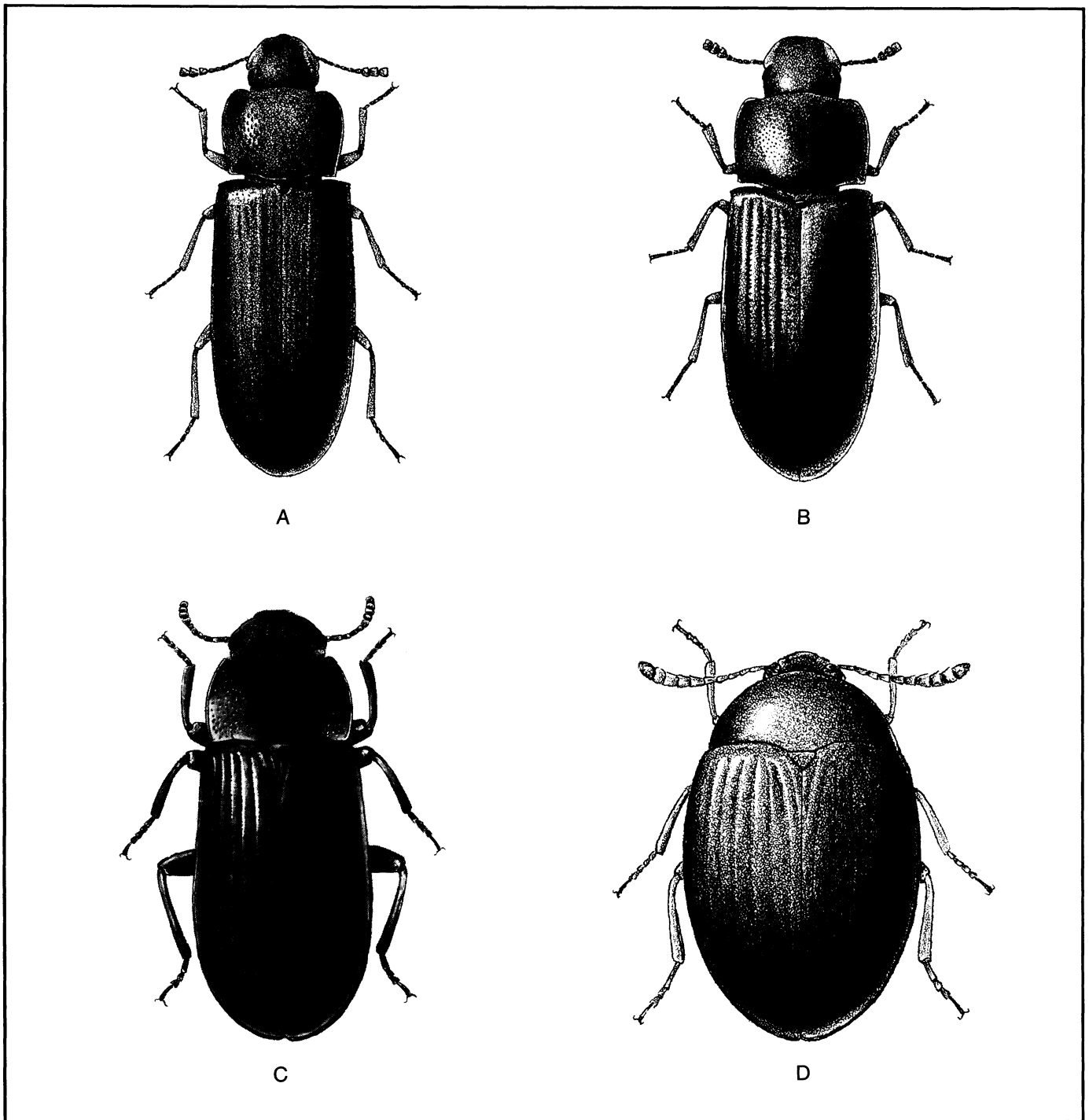


Plate 100. Tenebrionid beetles (Tenebrionidae): A, American black flour beetle, *Tribolium audax* (2.8-4.5); B, black flour beetle, *Tribolium madens* (3.9-5.1); C, *Neatus tenebrioides* (10.5-14.5); D, redhorned grain beetle, *Platydemus ruficornis* (3.5-5.8).

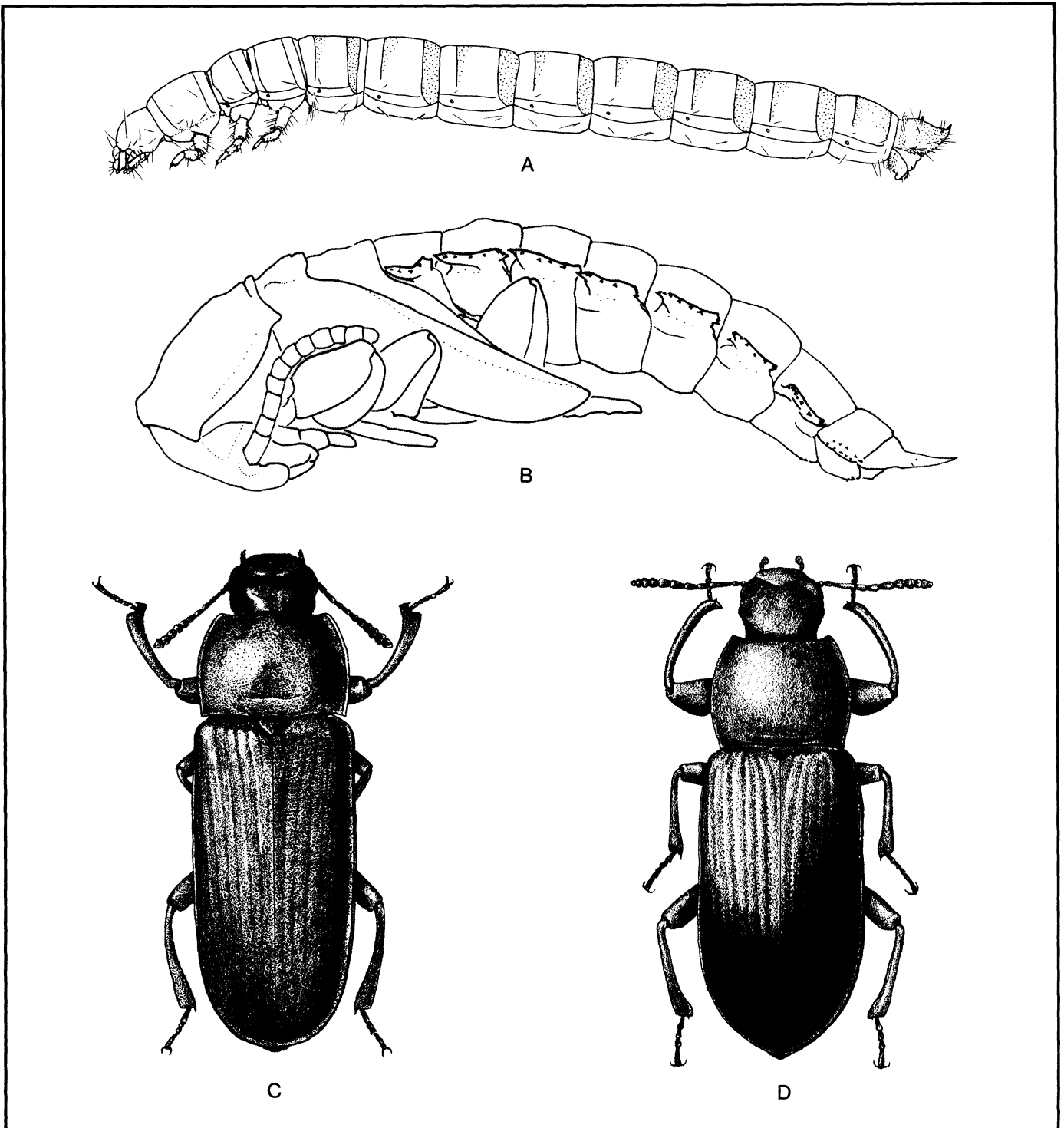


Plate 101. Mealworms (Tenebrionidae): A, **yellow mealworm**, *Tenebrio molitor*, larva (12-32); B, same, pupa (drawings A&B by C. Feller); C, same, adult (15); D, **dark mealworm**, *Tenebrio obscurus* (13.5-18).

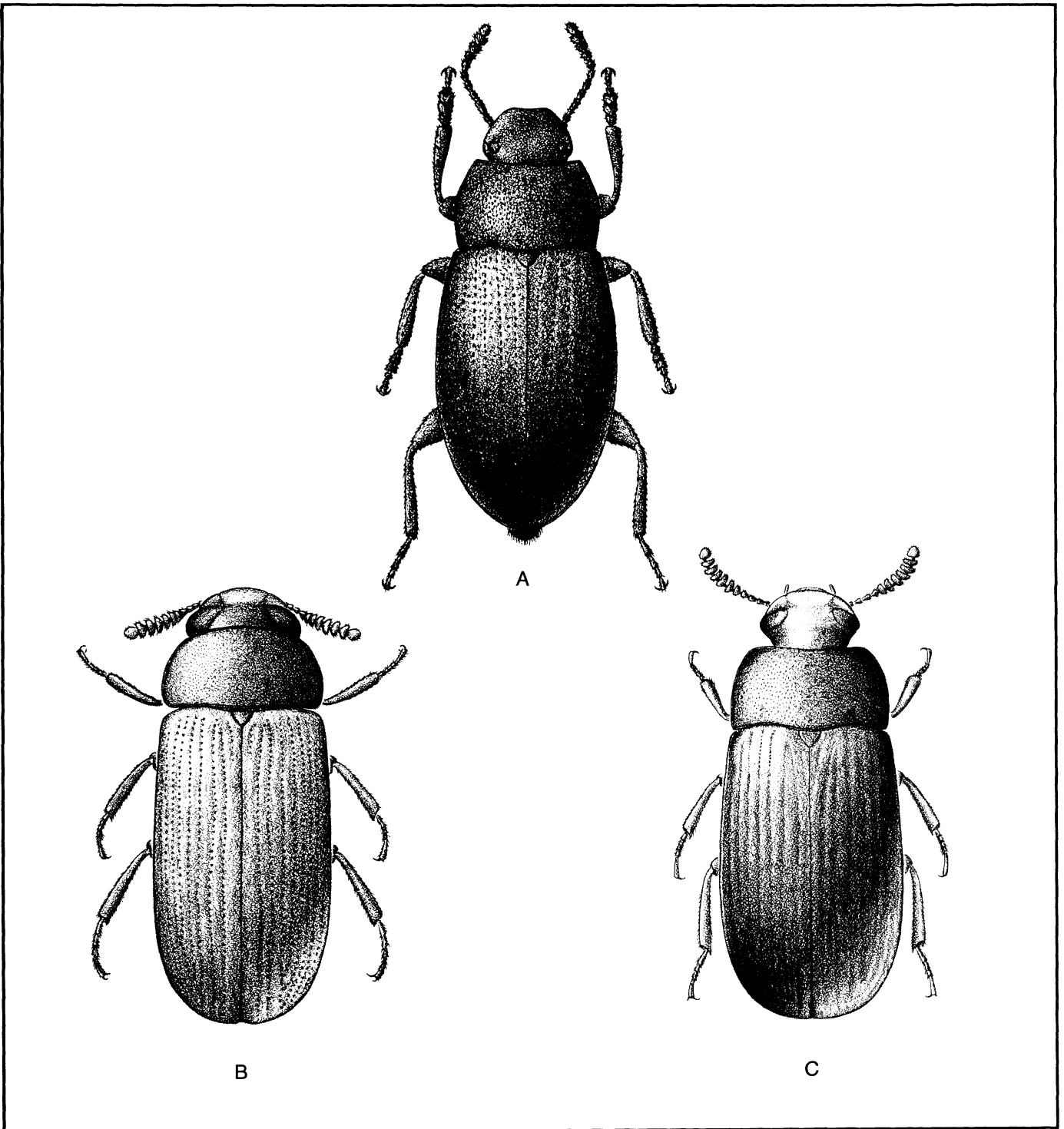


Plate 102. **Darkling beetles** (Tenebrionidae)  
(drawings by C. Feller): A, fig darkling beetle,  
*Blapstinus discolor* (4.1-7); B, *Palembus ocularis*  
(3.5-4.3); C, *Palembus dermestoides* (5.7-6.2).

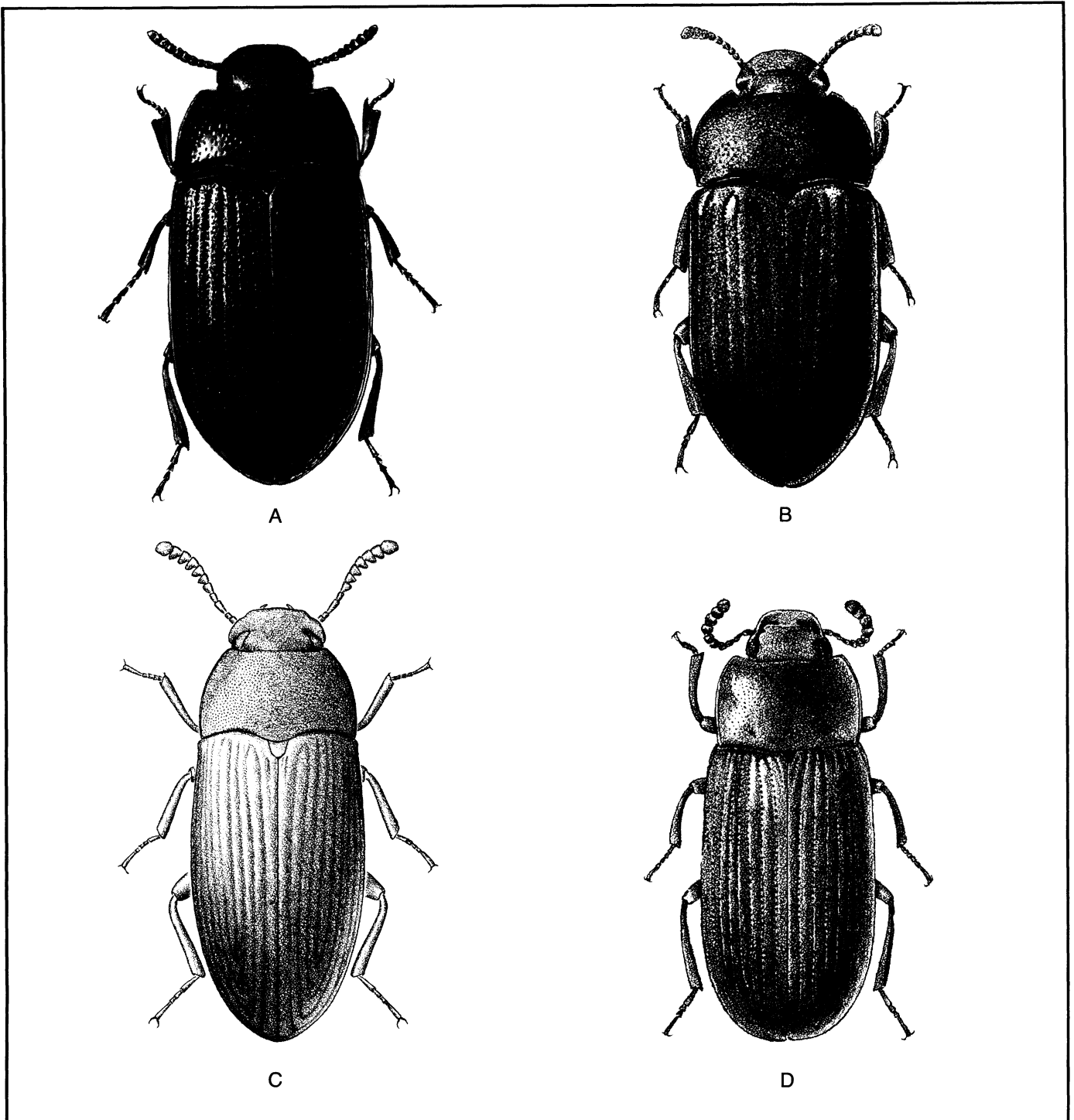


Plate 103. Tenebrionid beetles (Tenebrionidae):  
 A, **lesser mealworm**, *Alphitobius diaperinus*  
 (5.5-7); B, **black fungus beetle**, *Alphitobius*  
*laevigatus* (4.5-6.7); C, *Alphitobius viator*  
 (5.5-6.6) (drawing by C. Feller); D, **larger black**  
**flour beetle**, *Cynaëus angustus* (4.5-6.1).

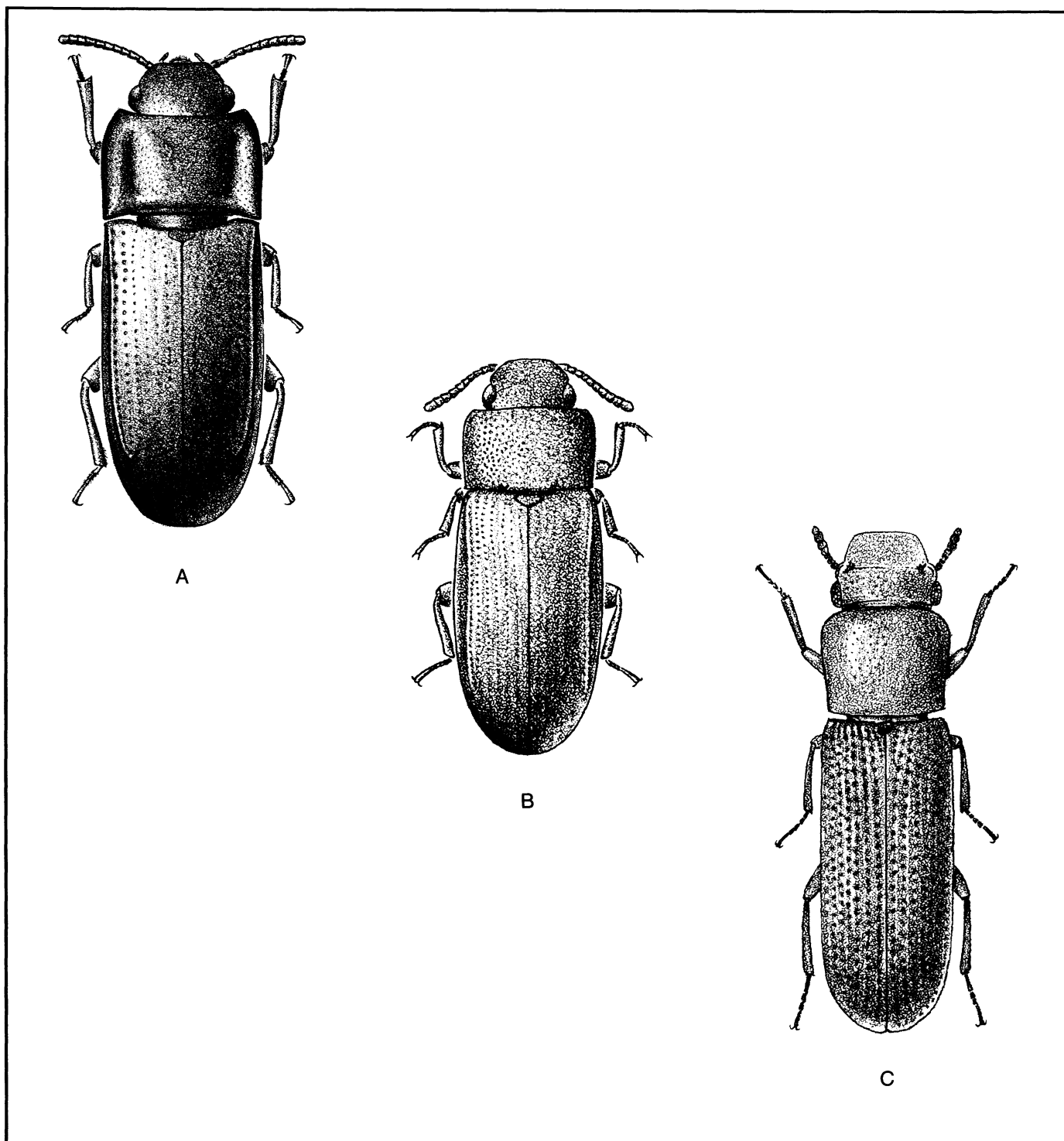


Plate 104. **Darkling beetles** (Tenebrionidae): A, *Coelopalorus foveicollis* (3.6-4.3); B, *Coelopalorus carinatus* (1.9-2.6) (drawings A&B by C. Feller); C, **longheaded flour beetle**, *Latheticus oryzae* (2.3-5.7).



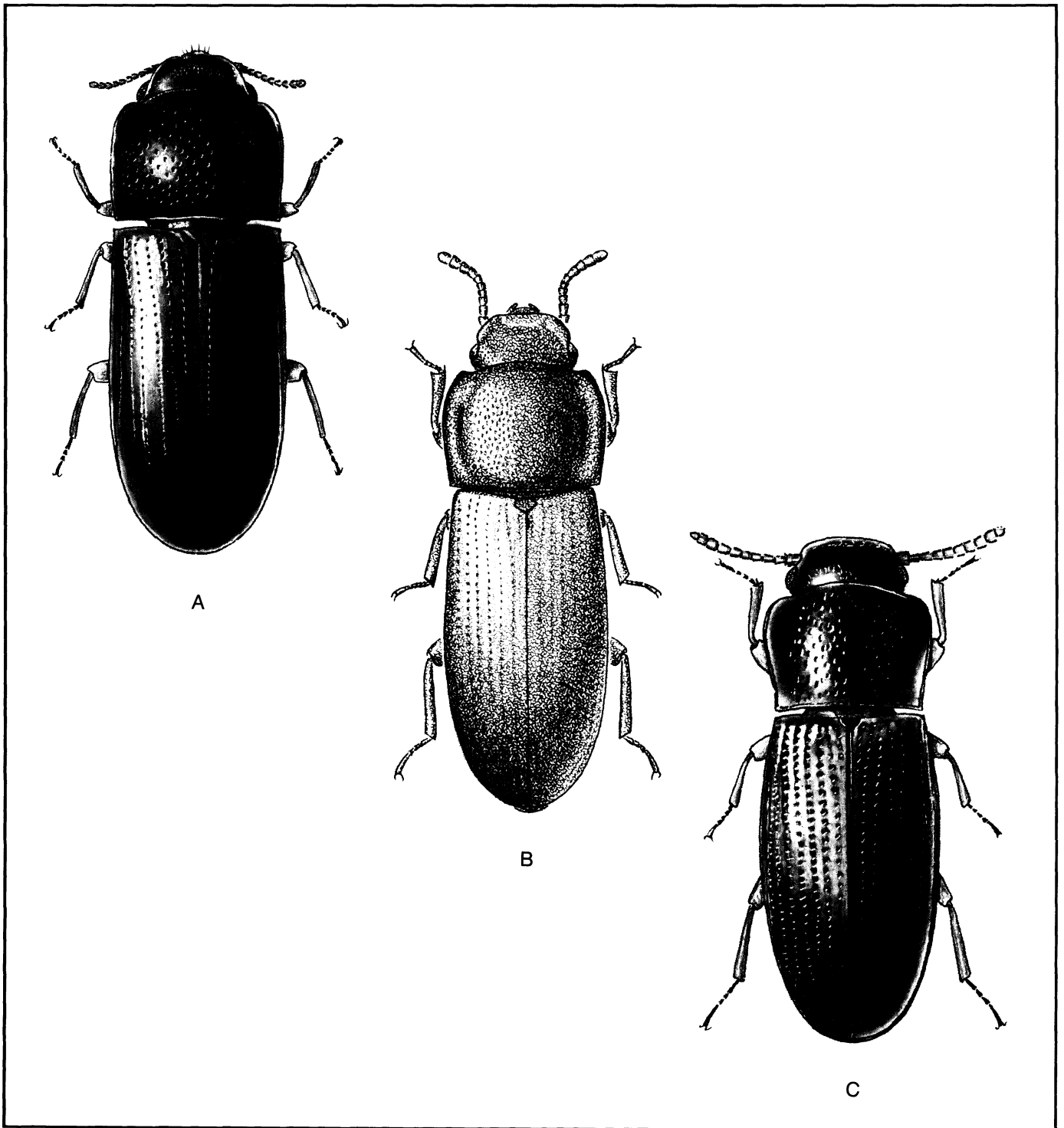


Plate 105. Tenebrionid beetles (Tenebrionidae):  
A, **depressed flour beetle**, *Palorus subdepressus* (2.7-3); B, *Palorus laescollis* (2.2-2.9) (drawing by C. Feller); C, **smalleyed flour beetle**, *Palorus ratzeburgii* (2.4-3).

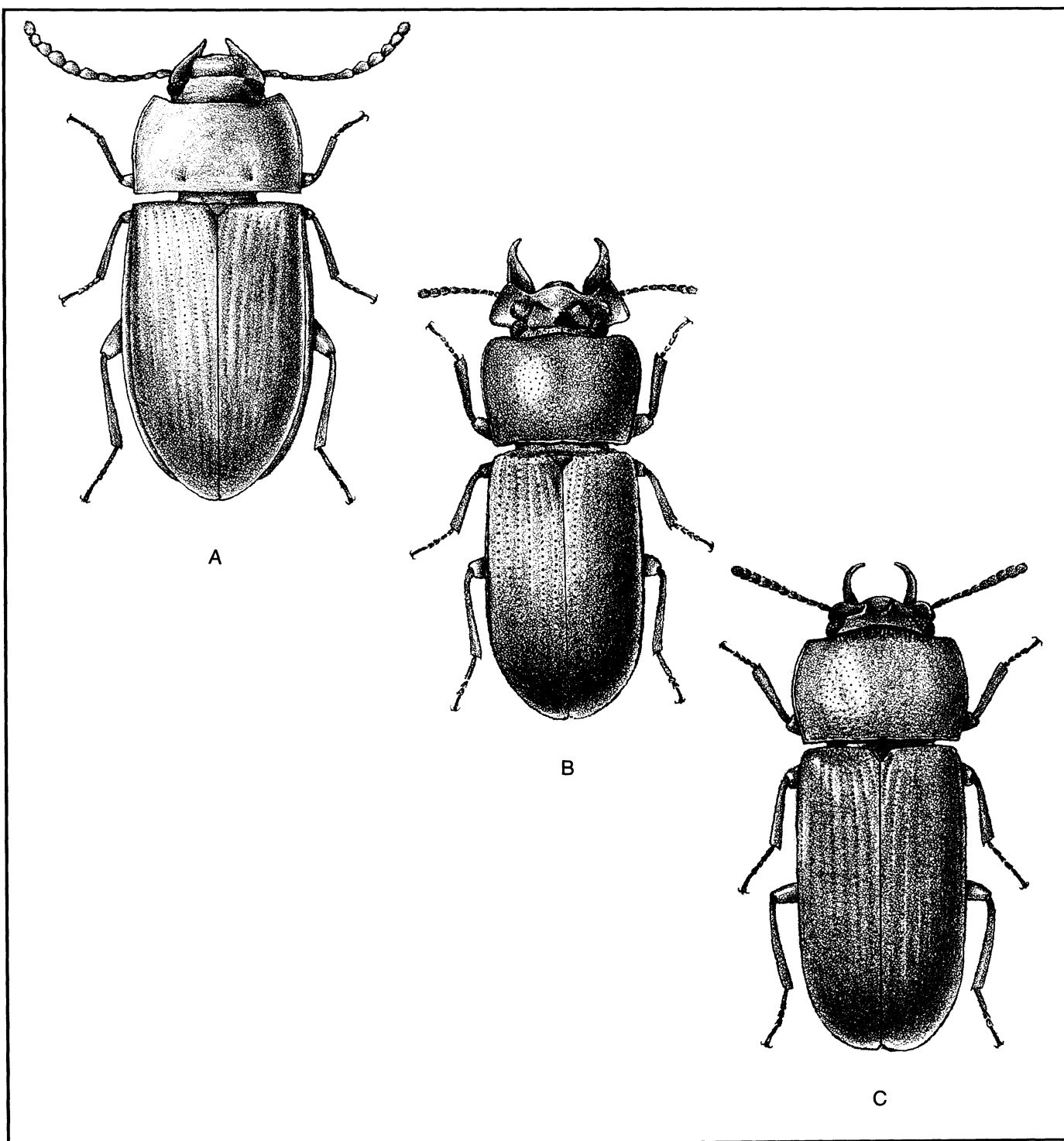


Plate 106. **Darkling beetles** (Tenebrionidae), males: A, *Sitophagus hololeptoides* (5-7.2); B, **broadhorned flour beetle**, *Gnatocerus cornutus* (3.5-4.9); C, **slenderhorned flour beetle**, *Gnatocerus maxillosus* (3-4).

## **SEED BEETLES (BRUCHIDAE)**

These illustrations, drawn by C. Feller unless otherwise noted, are a continuation from part 1, chapter 4 (Larval Beetles), by D.M. Anderson and chapter 12 (Seed Beetles), by J.M. Kingsolver.

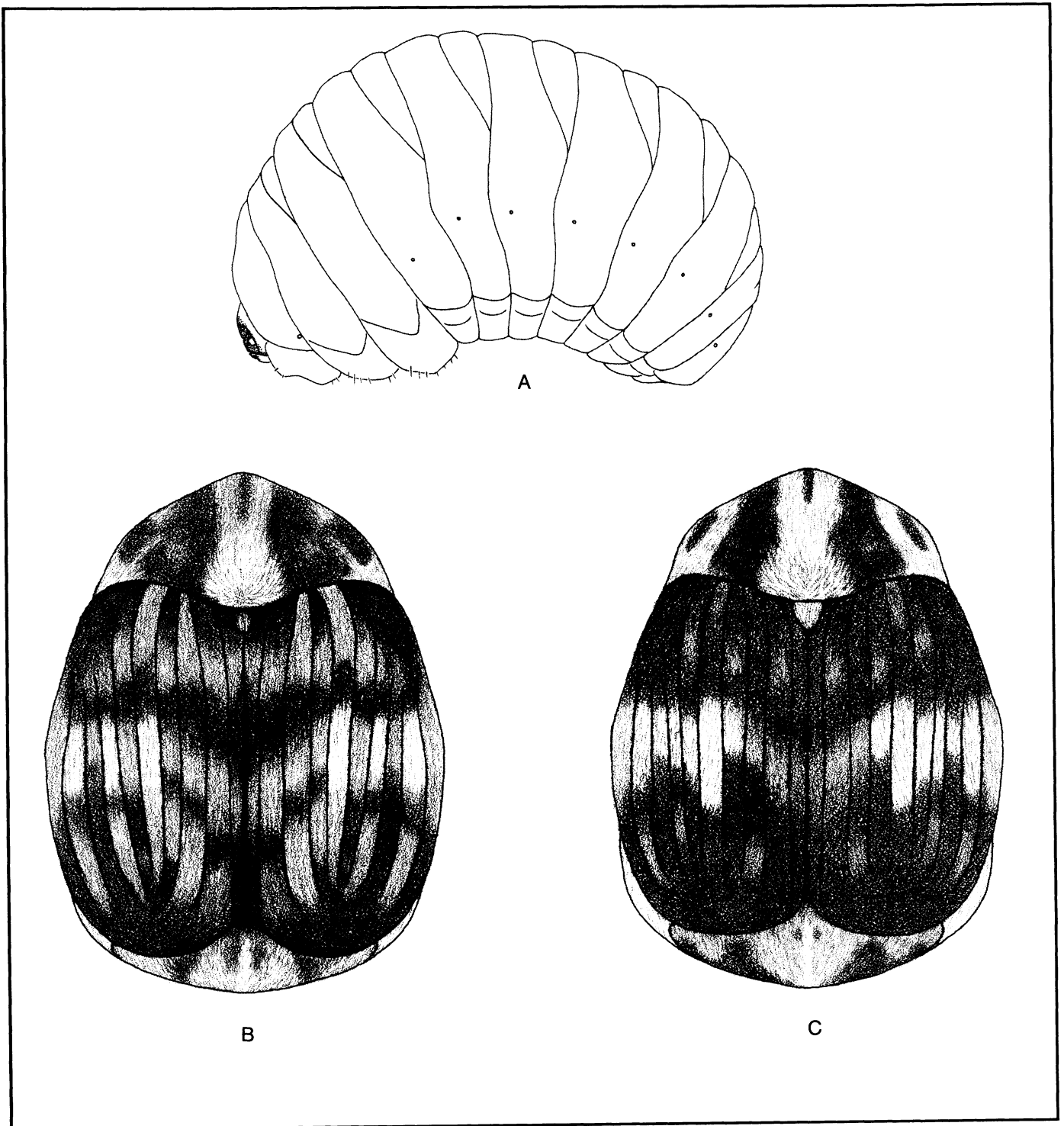


Plate 107. **Mexican bean weevil**, *Zabrotes subfasciatus* (Bruchidae): A, larva (3-3.5); B, male (1.9-2.2); C, female (2.3-2.5).

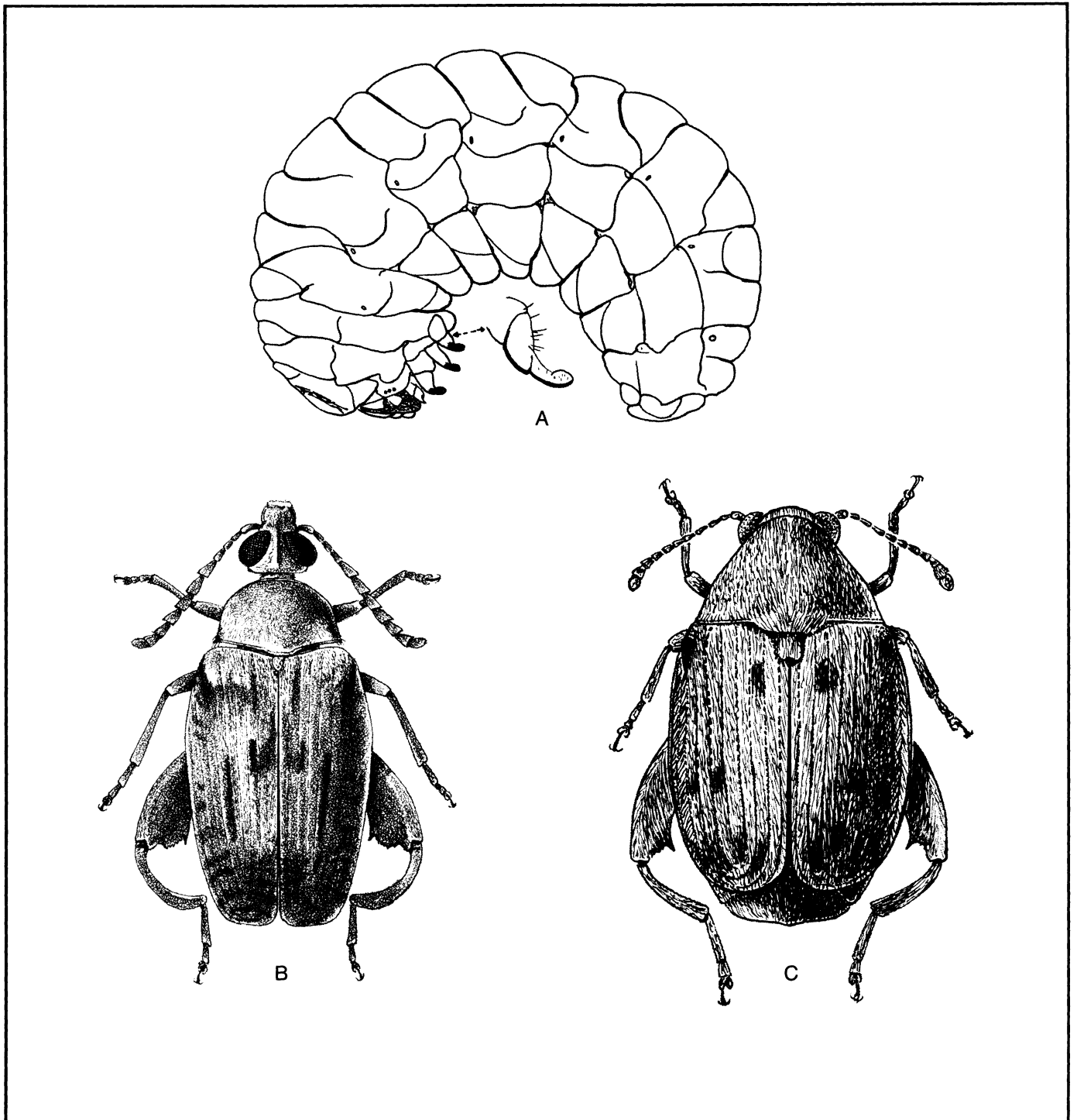


Plate 108. **Seed beetles** (Bruchidae): A, groundnut bruchid, *Caryedon serratus*, larva (6) (drawing by J.M. Kingsolver); B, same, adult (3.5-6.8); C, **bean weevil**, *Acanthoscelides obtectus* (3-4.5) (drawings B&C by A.D. Cushman).

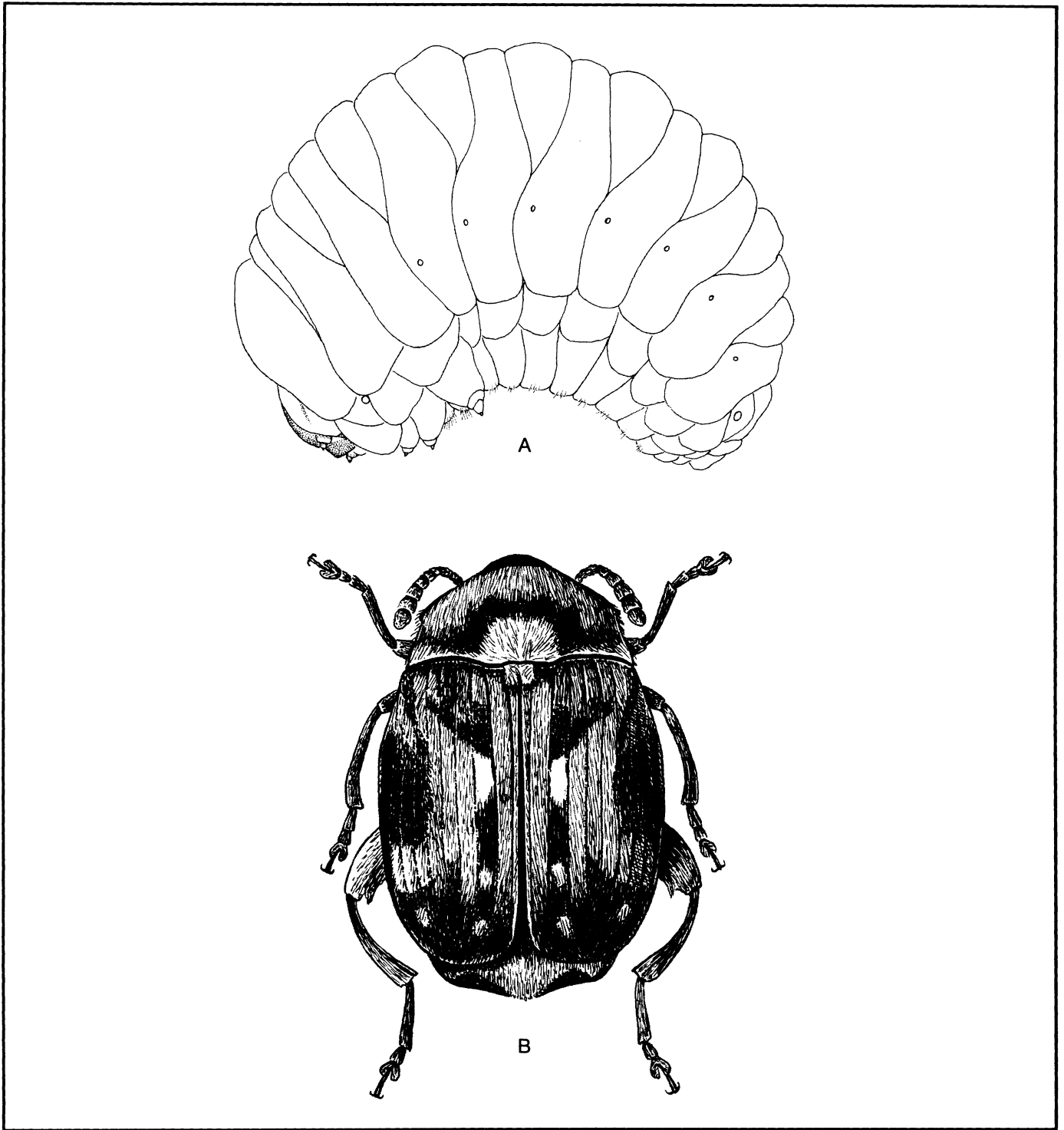


Plate 109. Pea weevil, *Bruchus pisorum*  
(Bruchidae): A, larva (4.5-5); B, adult (4.5-5)  
(drawing by A.D. Cushman).

## **WEEVILS (CURCULIONIDAE)**

These illustrations, drawn by C. Feller unless otherwise noted, are a continuation from part 1, chapter 4 (Larval Beetles), by D.M. Anderson and chapter 13 (Weevils), by D.R. Whitehead.

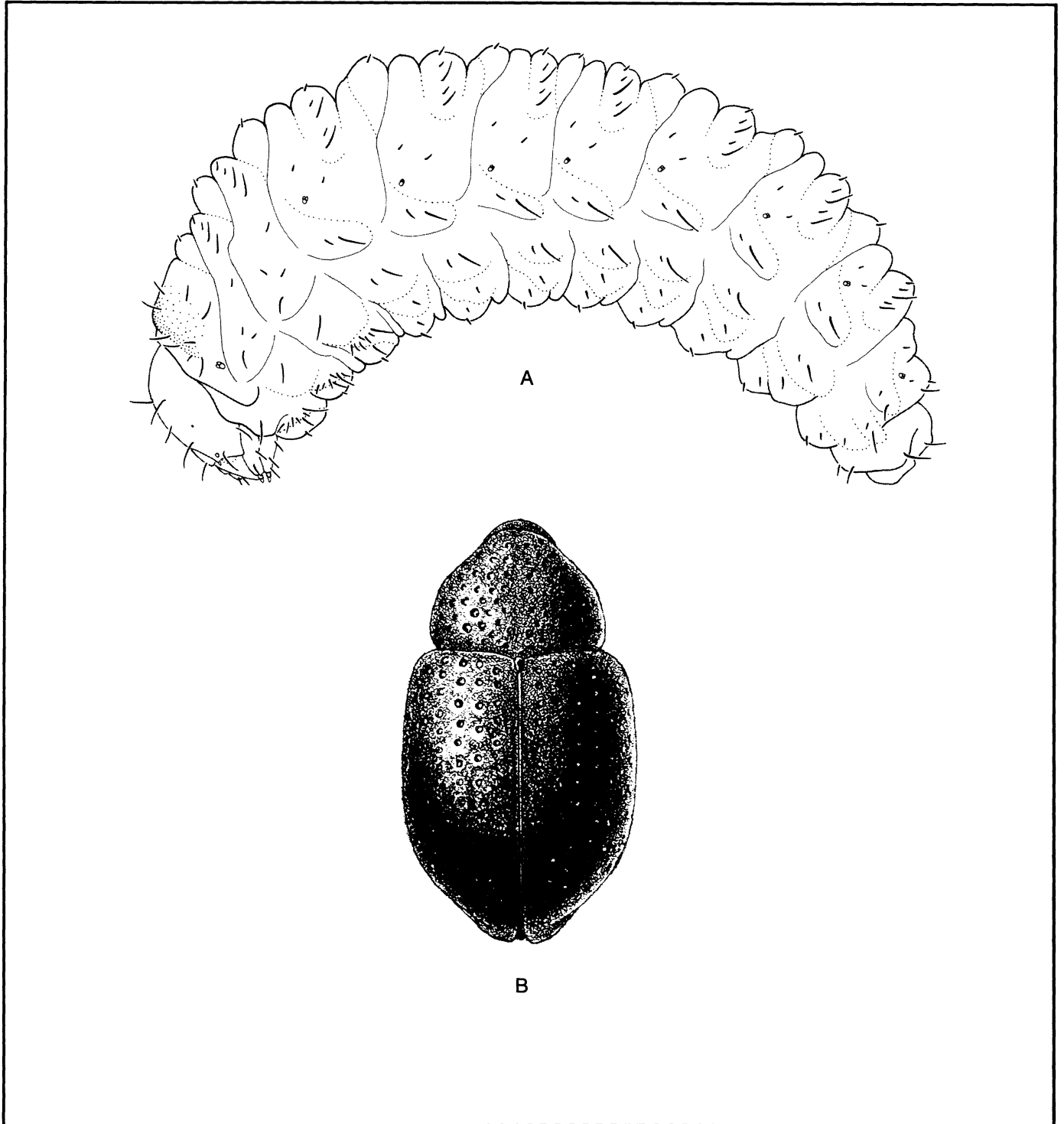


Plate 110. **Cowpea curculio**, *Chalcodermus aeneus* (Curculionidae): A, larva (7) (drawing by M. Ryan); B, adult (4-4.5) (drawing by A.D. Cushman).



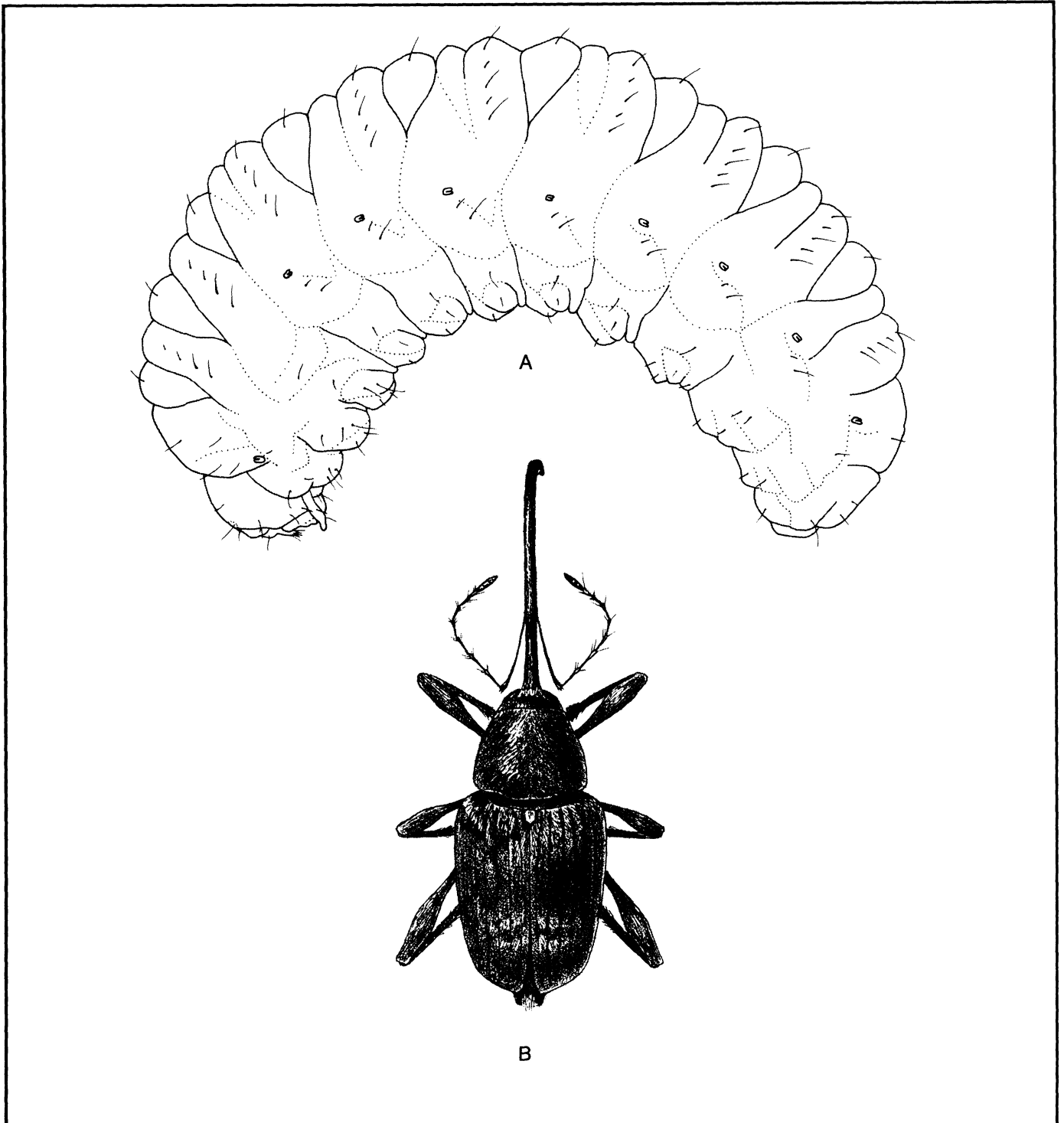


Plate 111. **Pecan weevil**, *Curculio caryae* (Curculionidae): A, larva (15) (drawing by M. Ryan); B, adult (7.5-12) (drawing by A.D. Cushman).

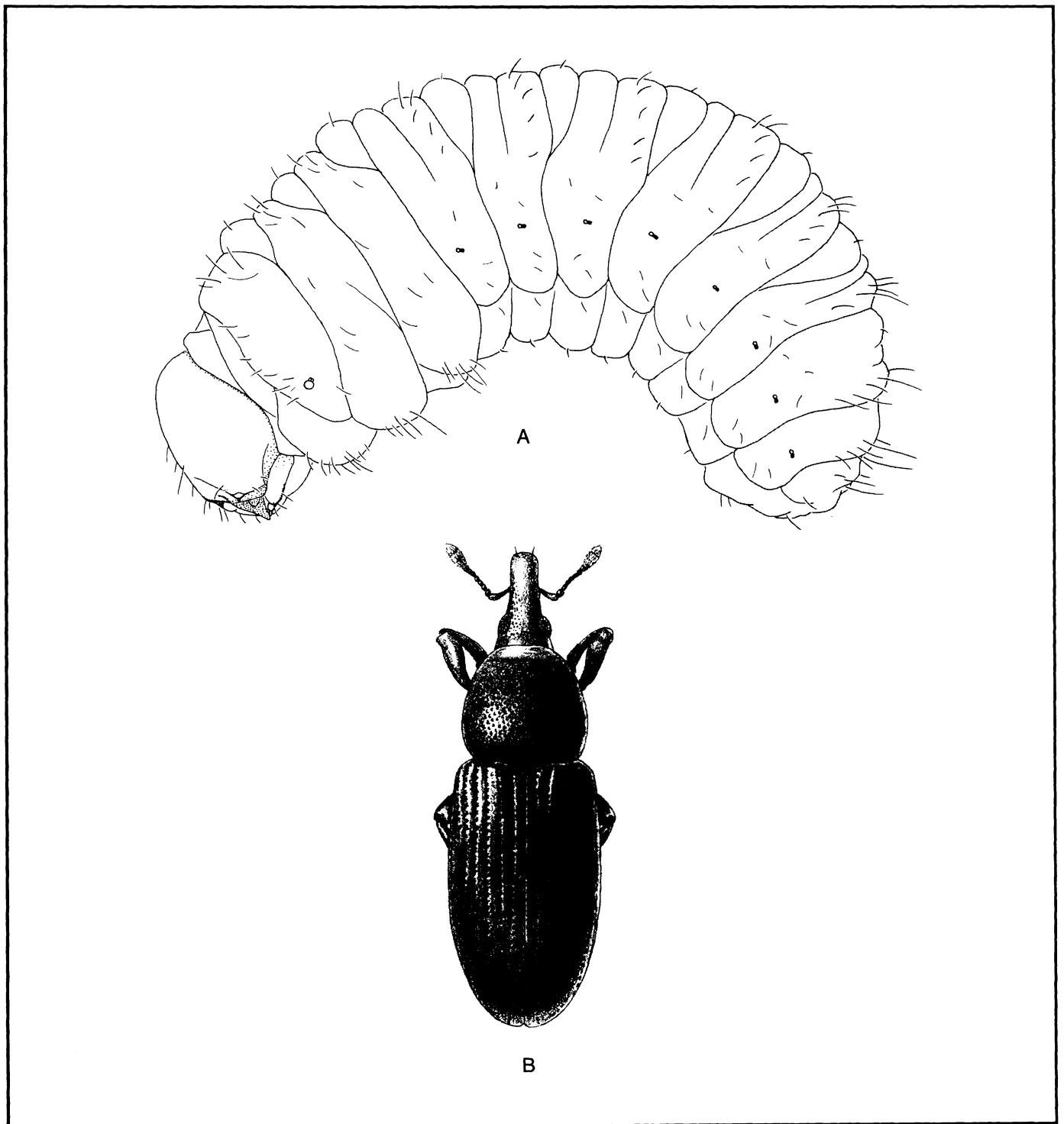


Plate 112. **Broadnosed grain weevil,**  
*Caulophilus oryzae* (Curculionidae): A, larva  
(2-2.5); B, adult (2.5-3.5) (drawing by A.D.  
Cushman).

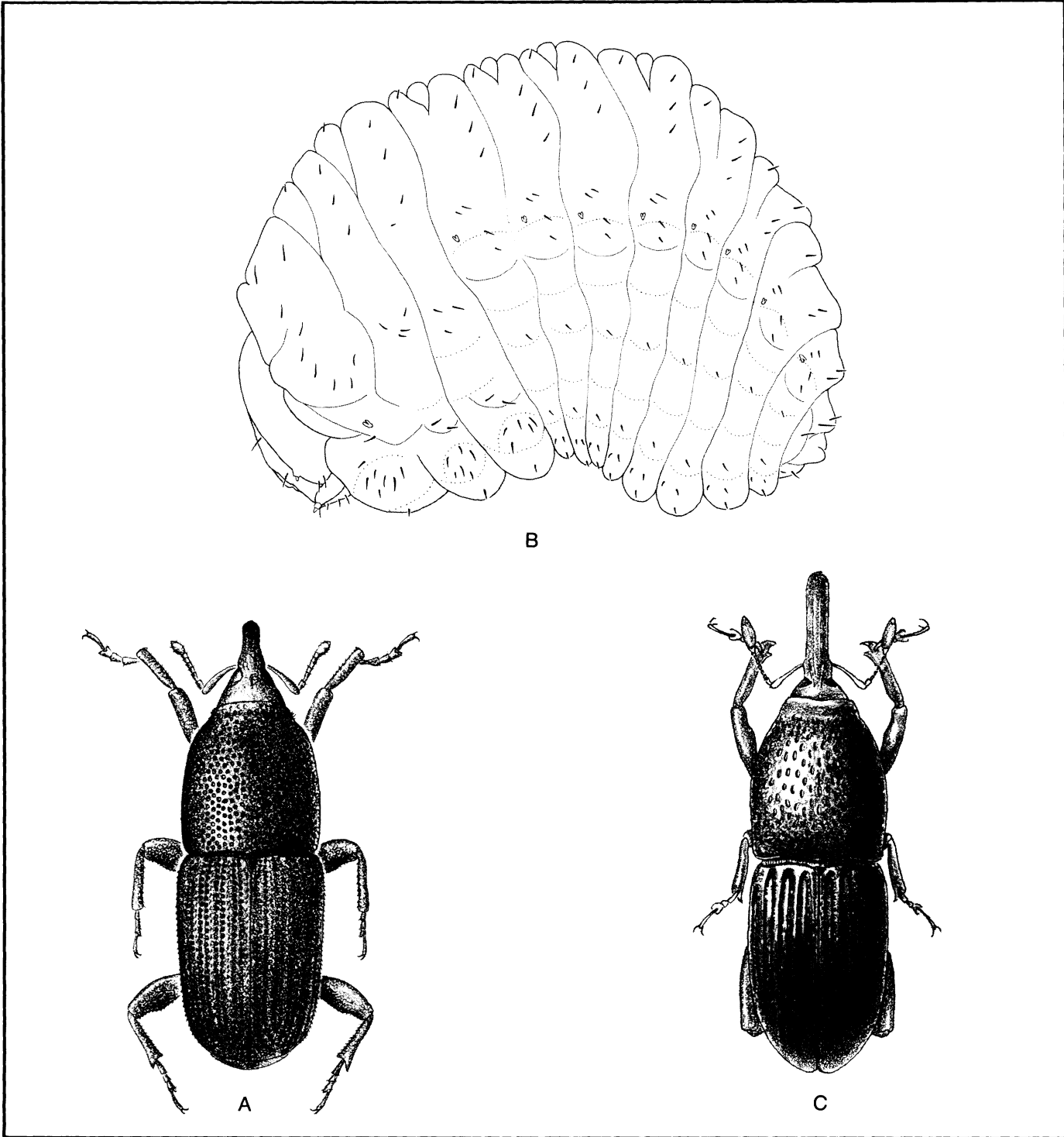


Plate 113. Weevils (Curculionidae): A, tamarind weevil, *Sitophilus linearis*, adult (3.5-5); B, granary weevil, *Sitophilus granarius*, larva (2.5-2.7) (drawing by M. Ryan); C, same, adult (3-4.5) (drawing by A.D. Cushman).

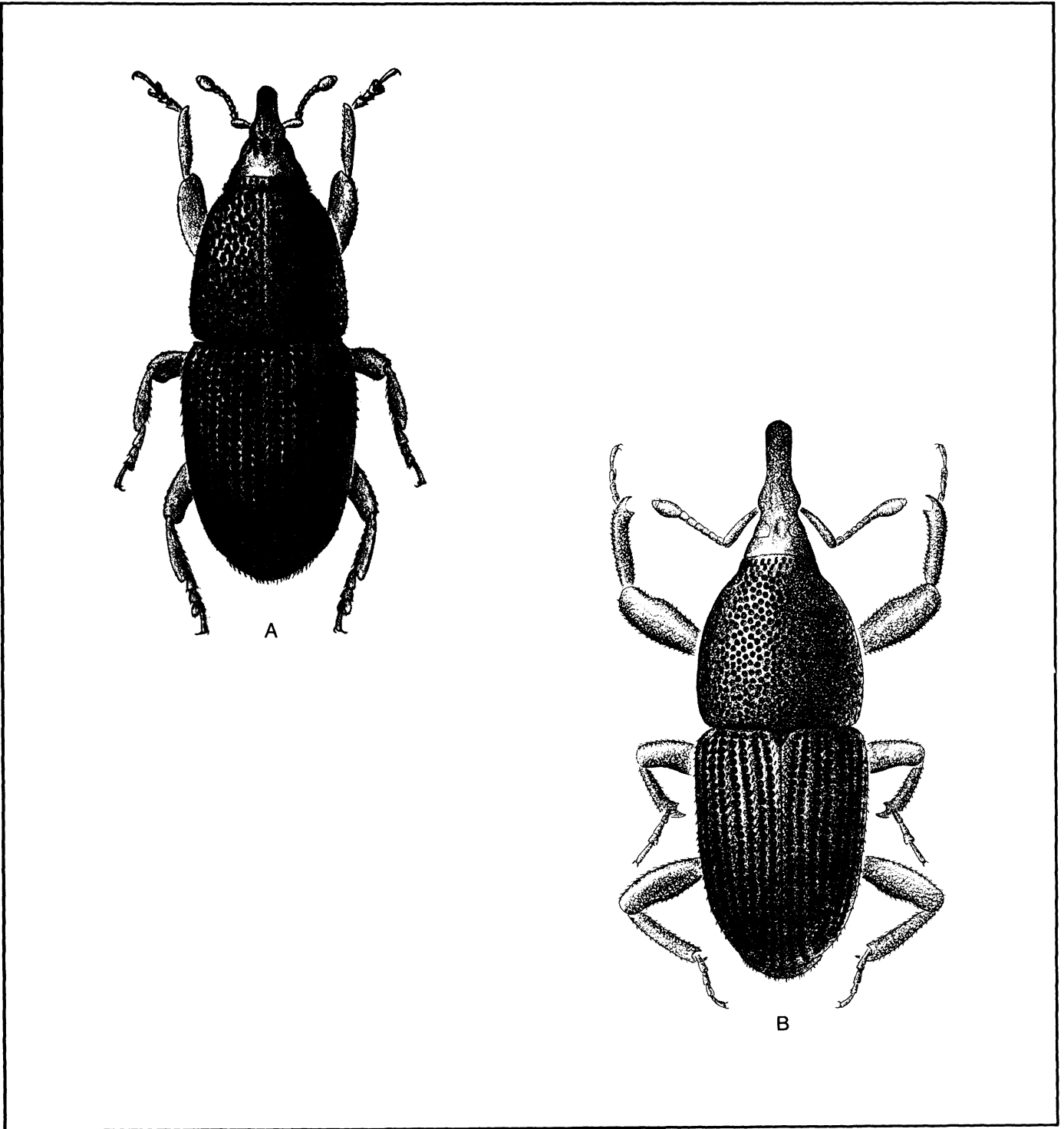


Plate 114. **Weevils** (Curculionidae): A, **rice weevil**, *Sitophilus oryzae* (2.5-4); B, **maize weevil**, *Sitophilus zeamais* (2.5-4.5).

## **MOTH AND BUTTERFLY LARVAE (LEPIDOPTERA)**

This series of illustrations, drawn by C. Feller, is a continuation from part 1, chapter 15 (Larval Moths), by D.M. Weisman.

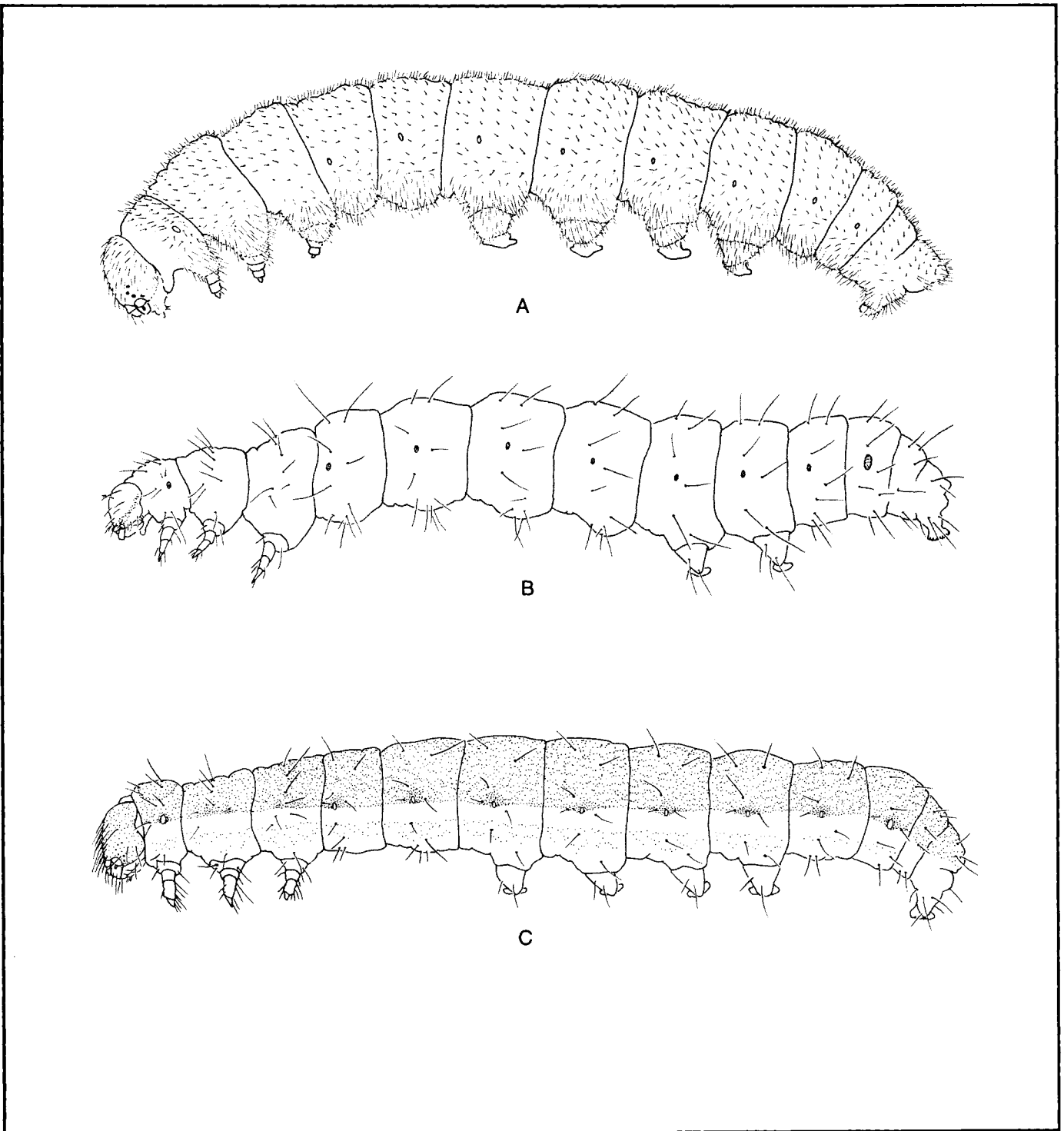


Plate 115. Pierid and noctuid larvae: A, **imported cabbageworm**, *Pieris rapae* (25-30) (Pieridae); B, silver Y moth, *Autographa gamma* (35-45) (Noctuidae); C, cabbage moth, *Mamestra brassicae* (40-45) (Noctuidae).

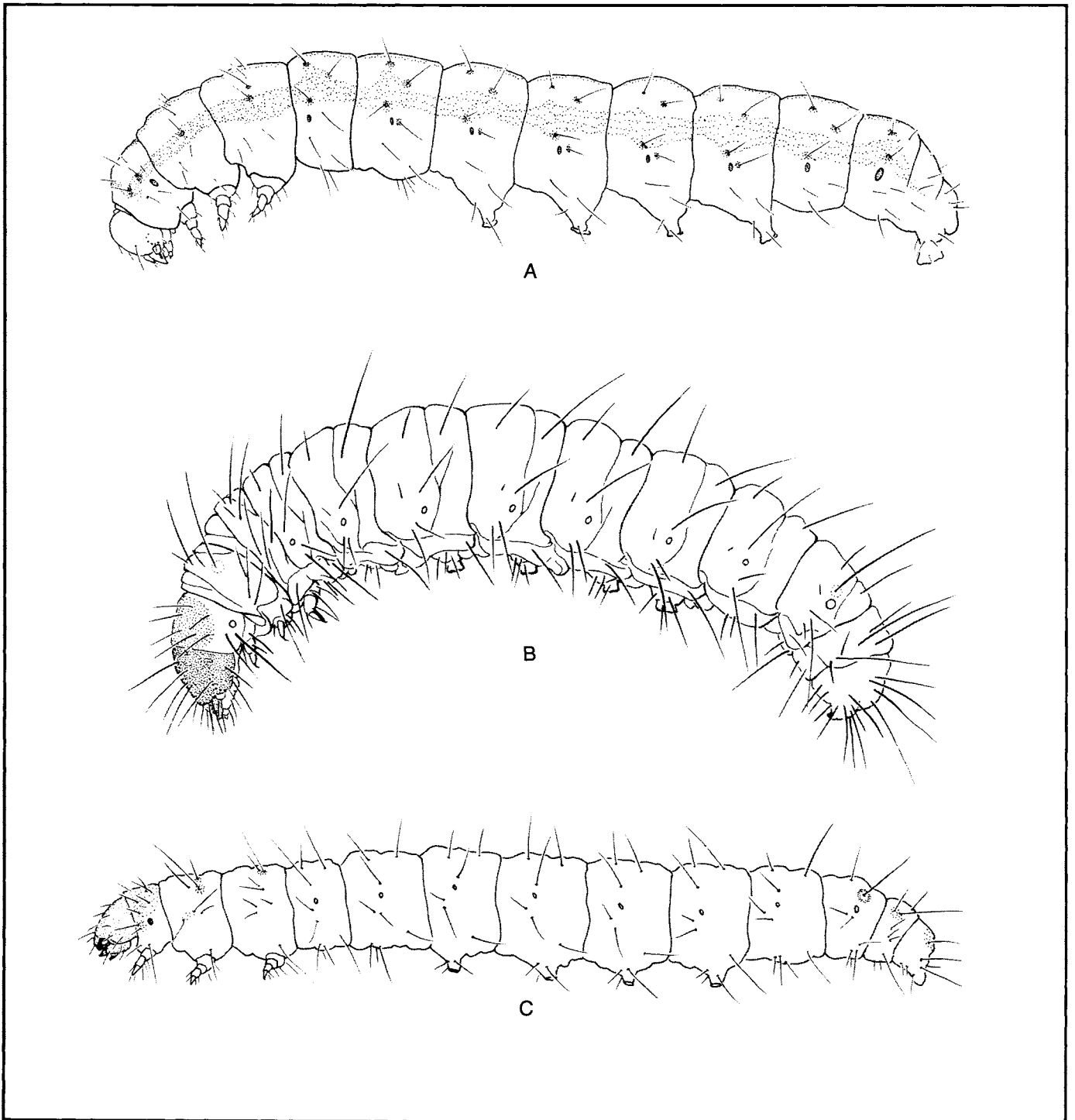


Plate 116. Noctuid and pyralid moth larvae: A, corn earworm, tomato fruitworm, *Helicoverpa zea* (25-38) (Noctuidae); B, Indianmeal moth, *Plodia interpunctella* (10-15) (Pyralidae); C, almond moth, *Cadra cautella* (12-14) (Pyralidae).

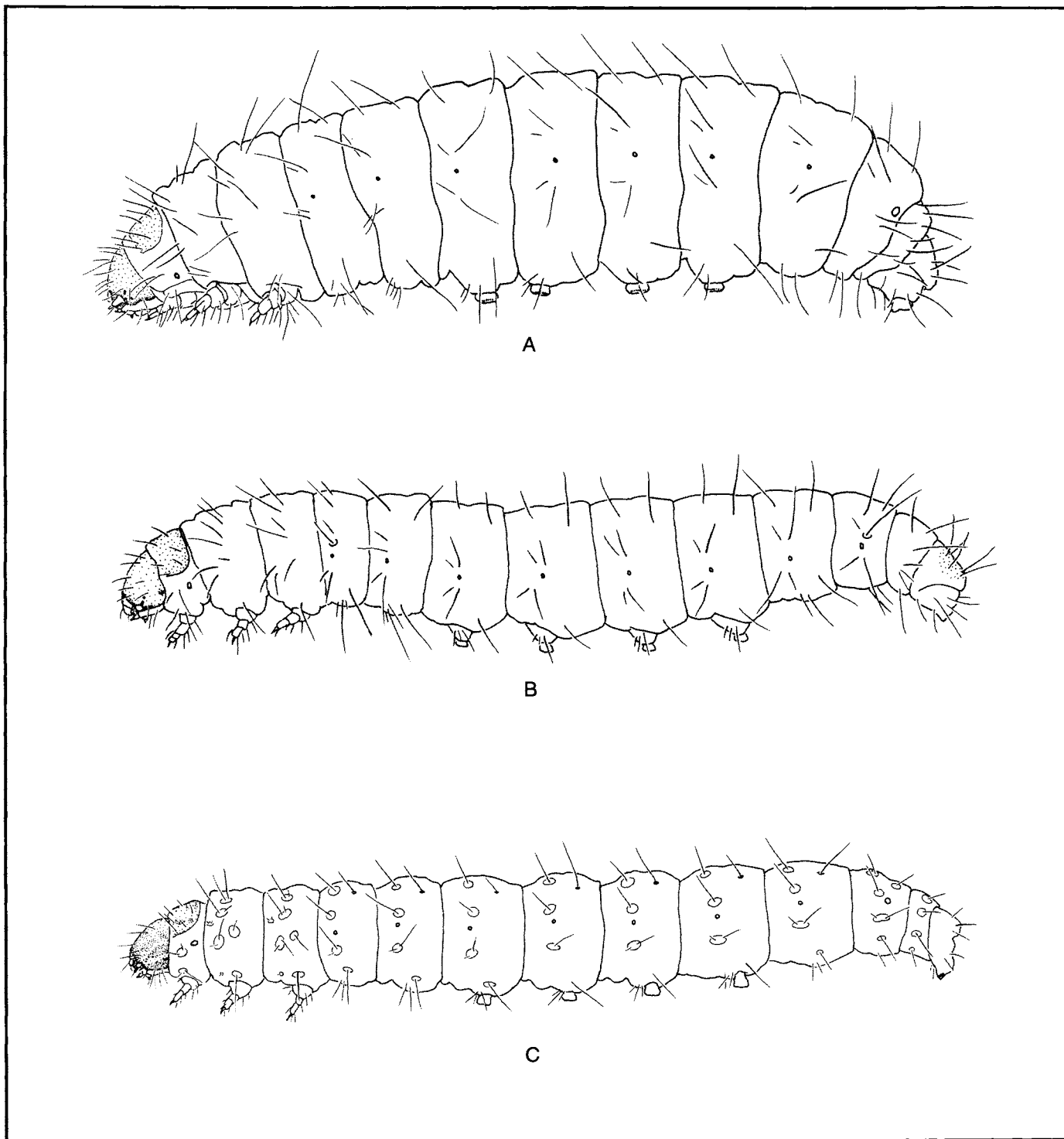


Plate 117. Pyralid moth larvae (Pyralidae): A, greater wax moth, *Galleria mellonella* (22-28); B, rice moth, *Corcyra cephalonica* (13-15); C, European corn borer, *Ostrinia nubilalis* (23-25).



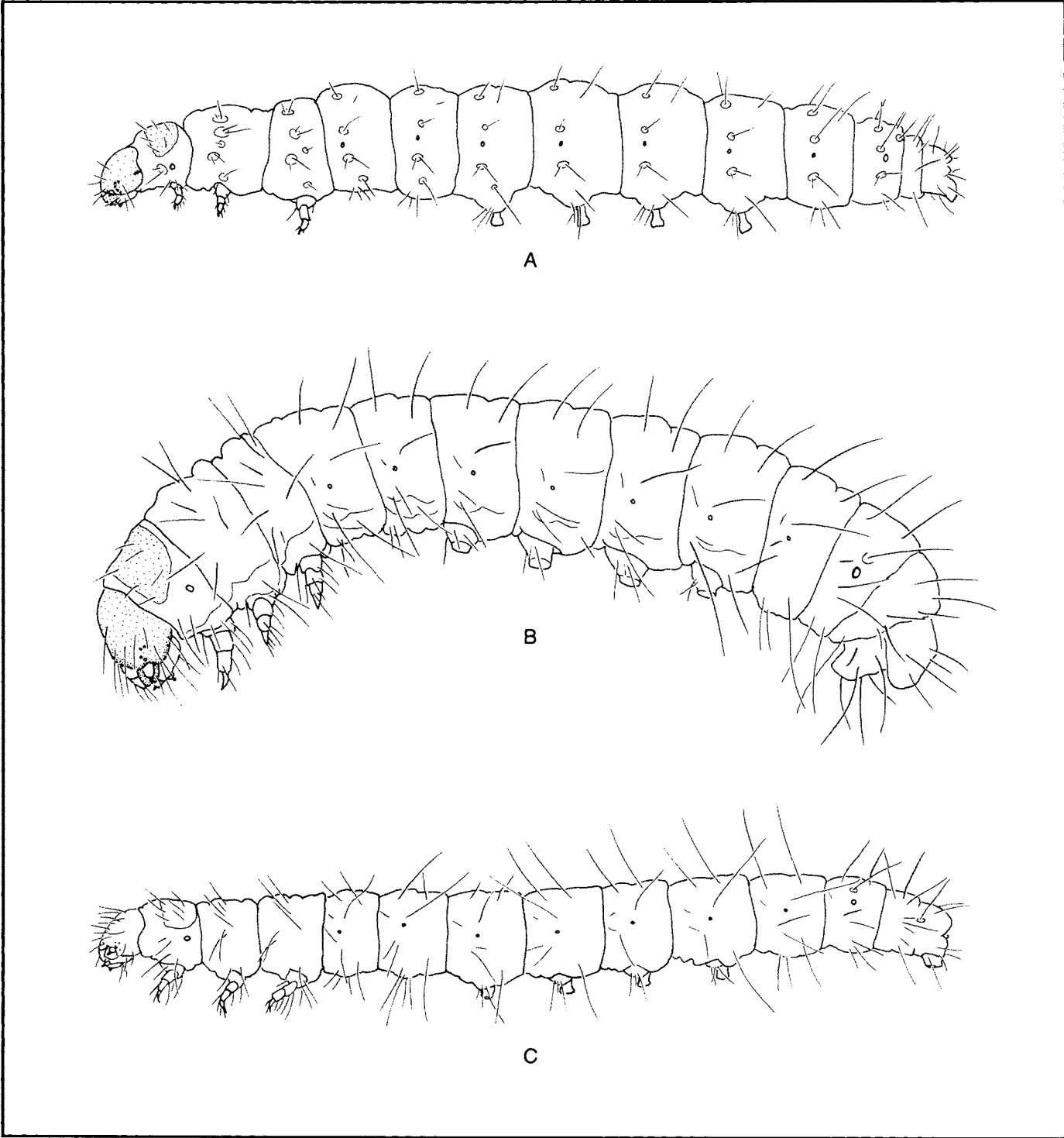


Plate 118. Pyralid moth larvae (Pyralidae): A, pickleworm, *Diaphania nitidalis* (25-30); B, meal moth, *Pyralis farinalis* (20-25); C, murky meal moth, *Aglossa caprealis* (25-28).

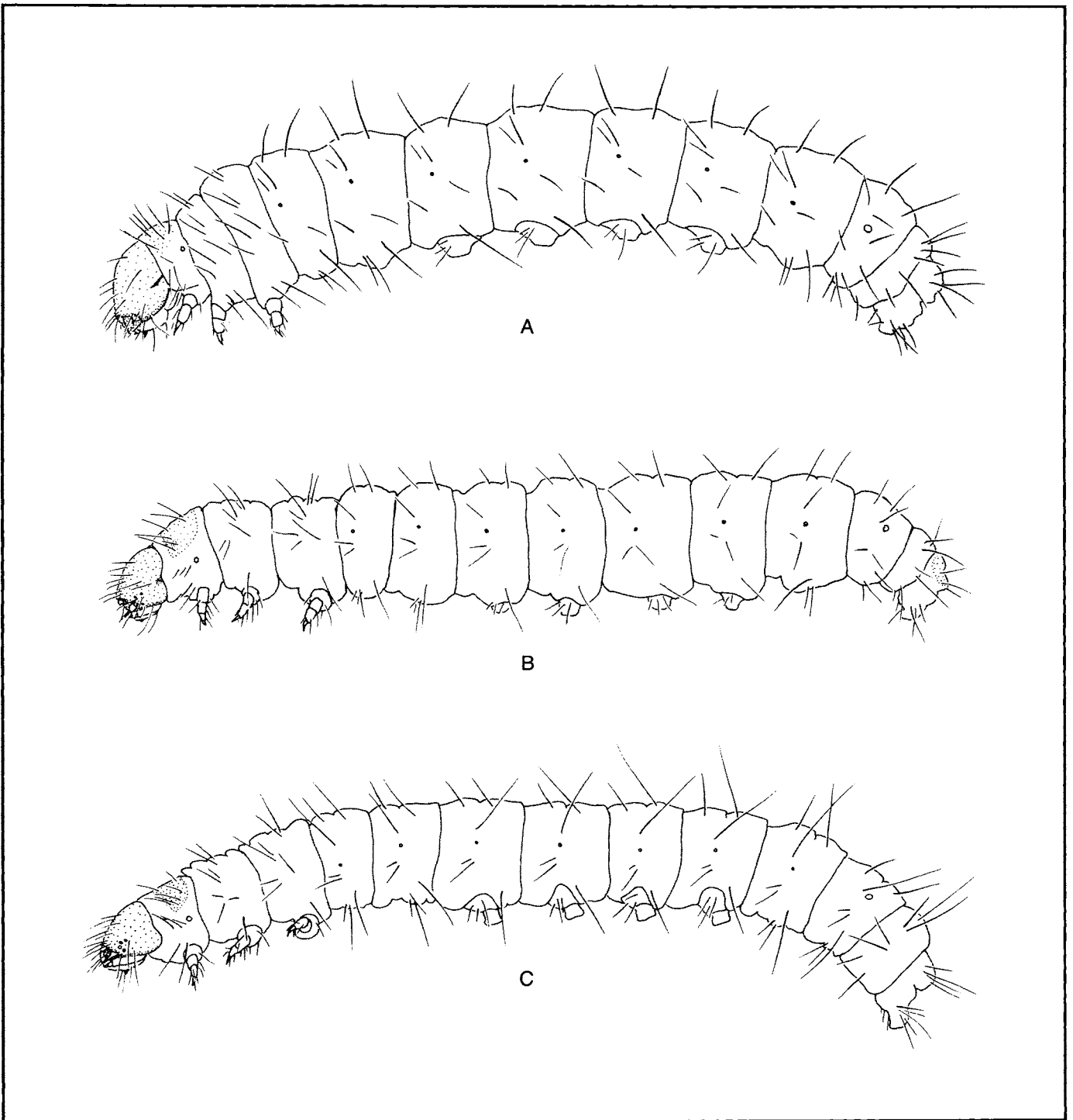


Plate 119. Lepidopterous larvae: A, **webbing clothes moth**, *Tineola bisselliella* (9-10) (Tineidae); B, **codling moth**, *Cydia pomonella* (14-16) (Tortricidae); C, **pink scavenger caterpillar**, *Pyroderces rileyi* (7-8) (Cosmopterigidae).

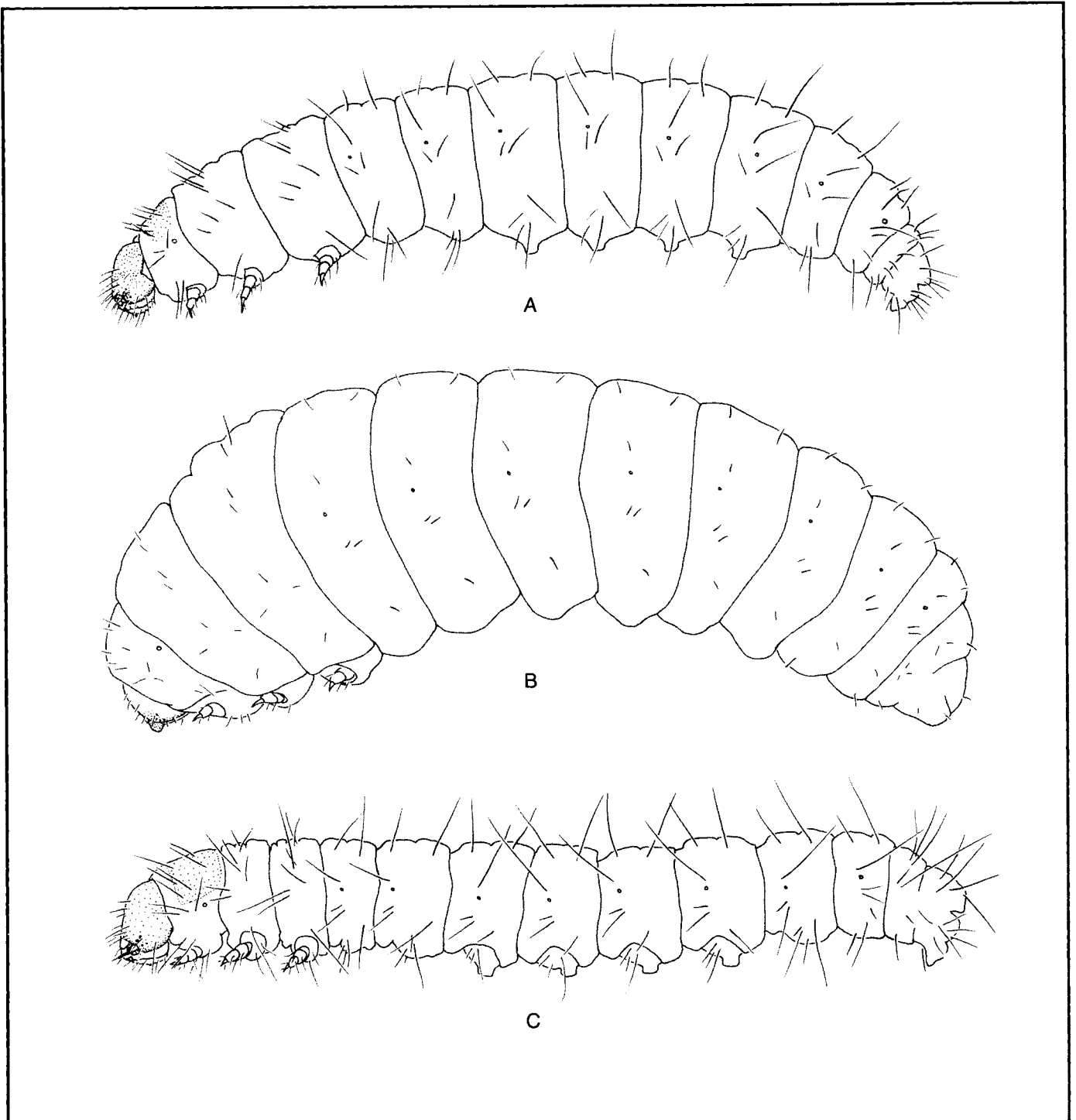


Plate 120. Lepidopterous larvae: A, **apple fruit moth**, *Argyresthia conjugella* (8-10) (Argyresthiidae); B, **Angoumois grain moth**, *Sitotroga cerealella* (4-7) (Gelechiidae); C, **brown house moth**, *Hofmannophila pseudospretella* (14-16) (Oecophoridae).

*Insect and Mite Pests in Food*

**Notes and Sketches**

## **FLIES (DIPTERA)**

This series of illustrations, drawn by C. Feller unless otherwise noted, is a continuation from part 1, chapter 16 (Flies), by R.J. Gagné.

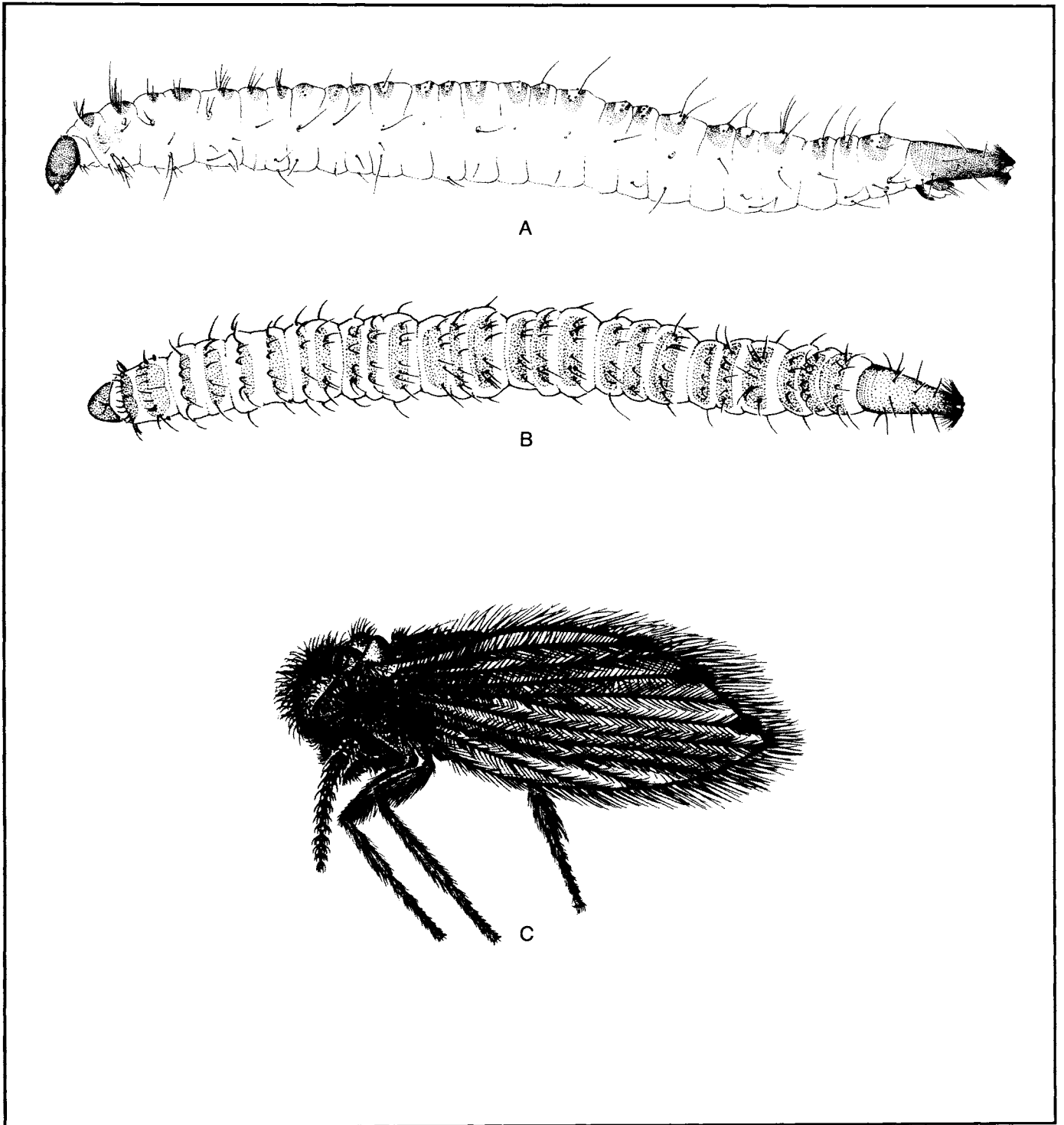


Plate 121. **Moth flies**, *Psychoda* spp.  
(Psychodinae, Psychodidae): A, larva (4.5-10),  
lateral view; B, same, dorsal view; C, adult  
(1.25-1.5).

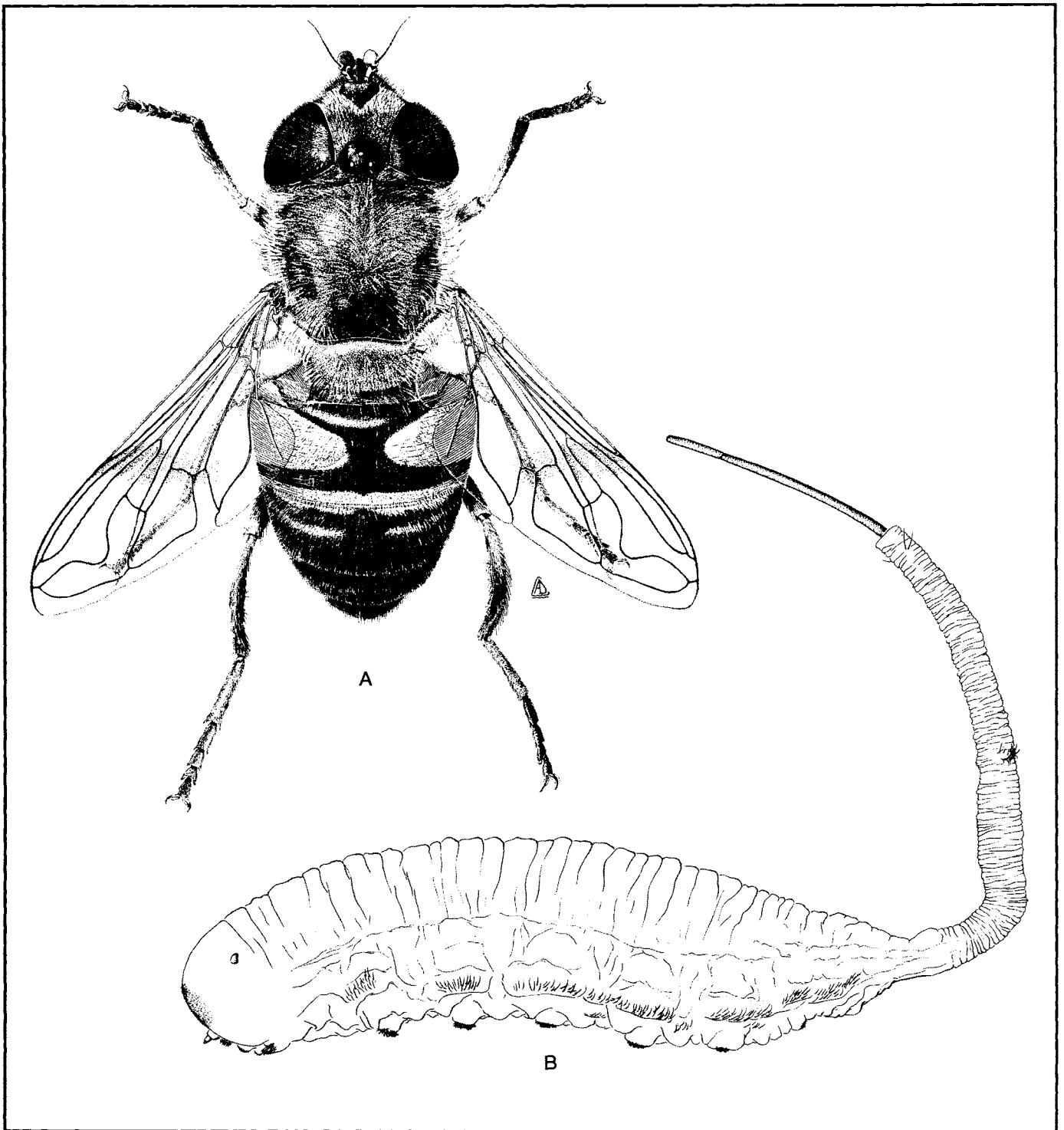


Plate 122. **Drone fly**, *Eristalis tenax*  
(Syrphidae): A, female (15) (drawing by A.D.  
Cushman); B, larva (10-15, excluding tail).

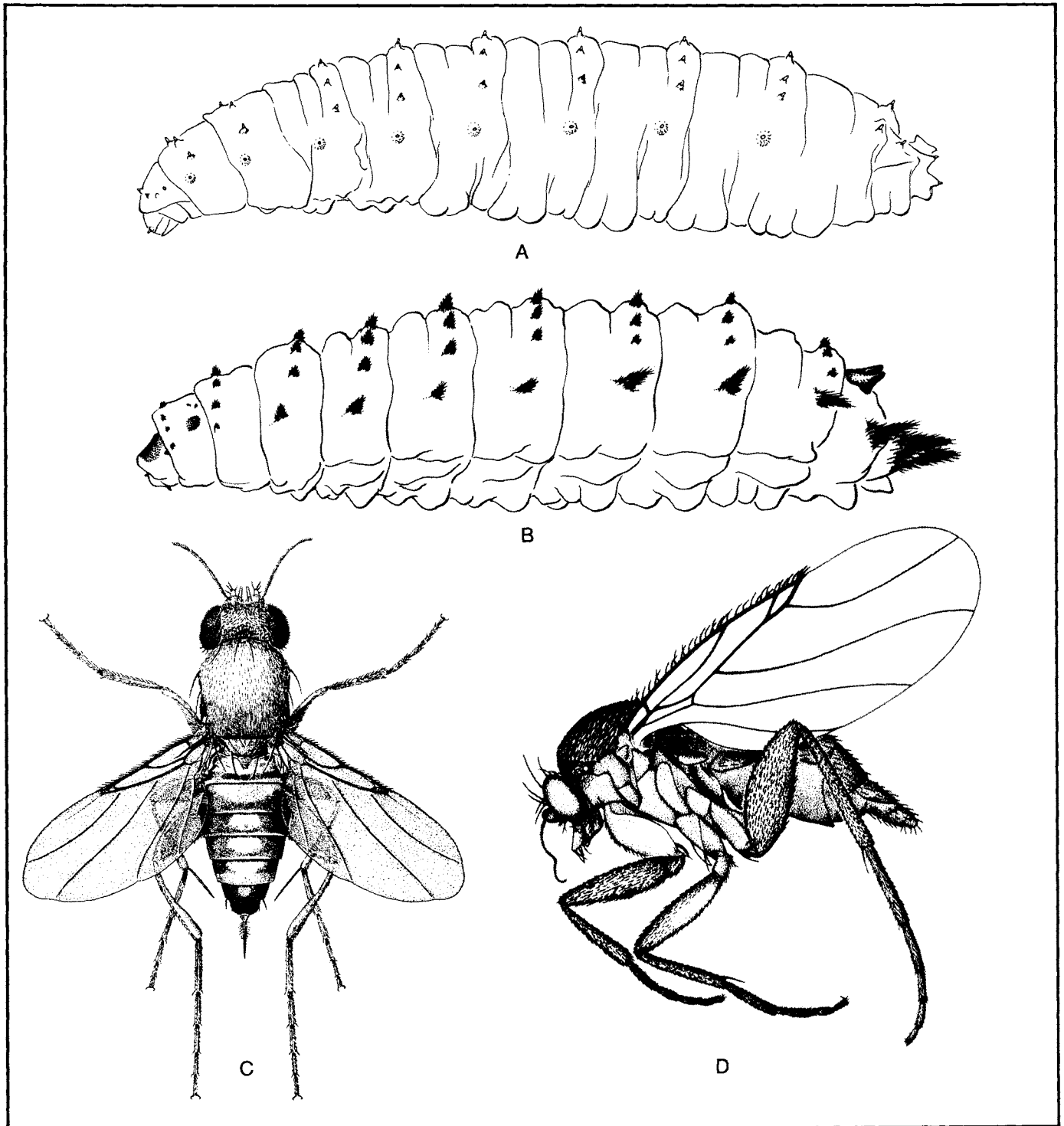


Plate 123. **Humpbacked flies** (Phoridae): A, *Megaselia* sp., larva (3.5-5); B, *Megaselia* sp., larva (3.5-5); C, *Megaselia scalaris*, adult (2-3), dorsal view (drawing by A.D. Cushman); D, *Megaselia* sp., adult, lateral view.



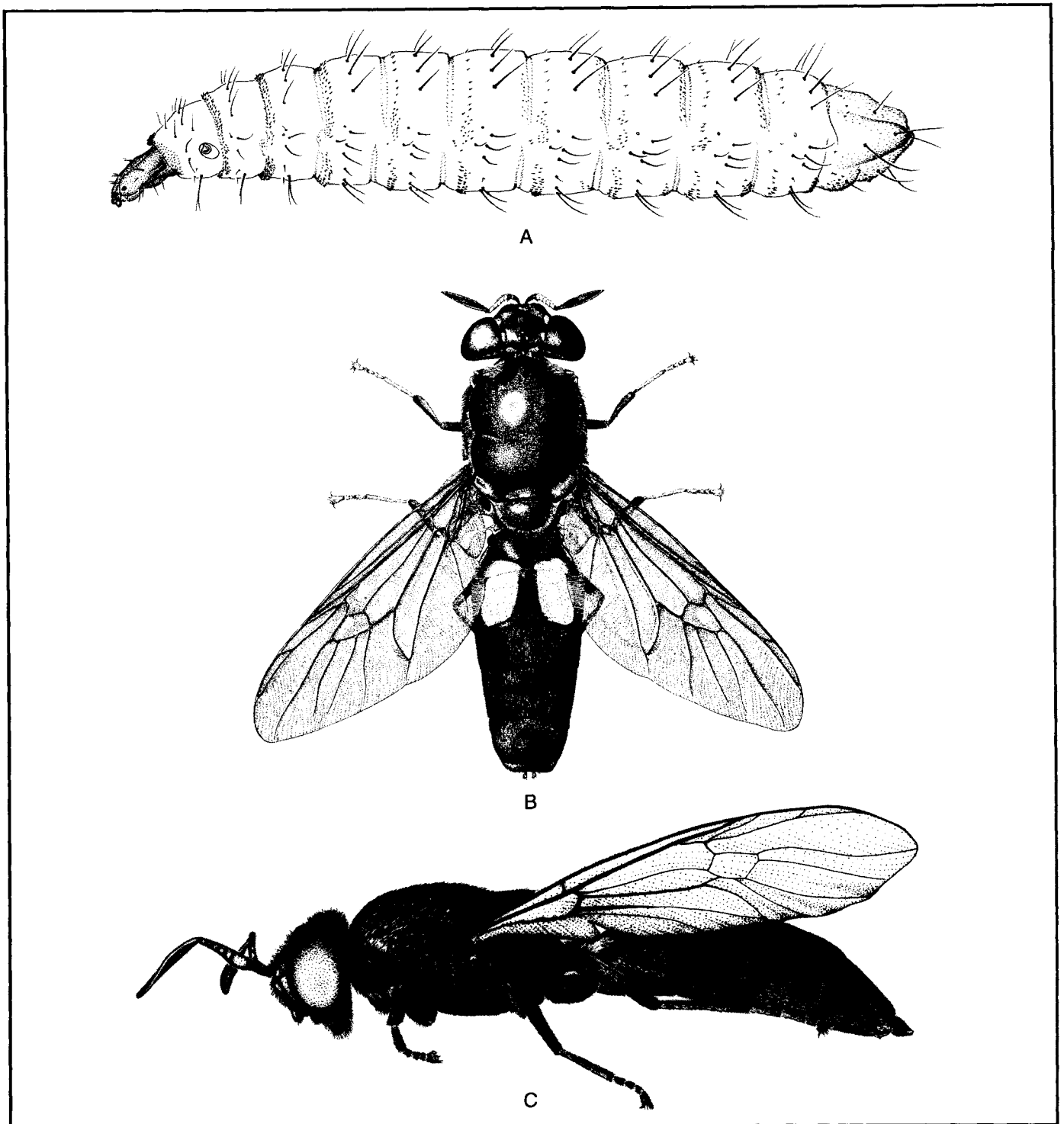


Plate 124. **Black soldier fly**, *Hermetia illucens*  
(Stratiomyidae): A, larva (15-20); B, female  
(15-20), dorsal view (drawing by A.D. Cushman);  
C, same, lateral view.

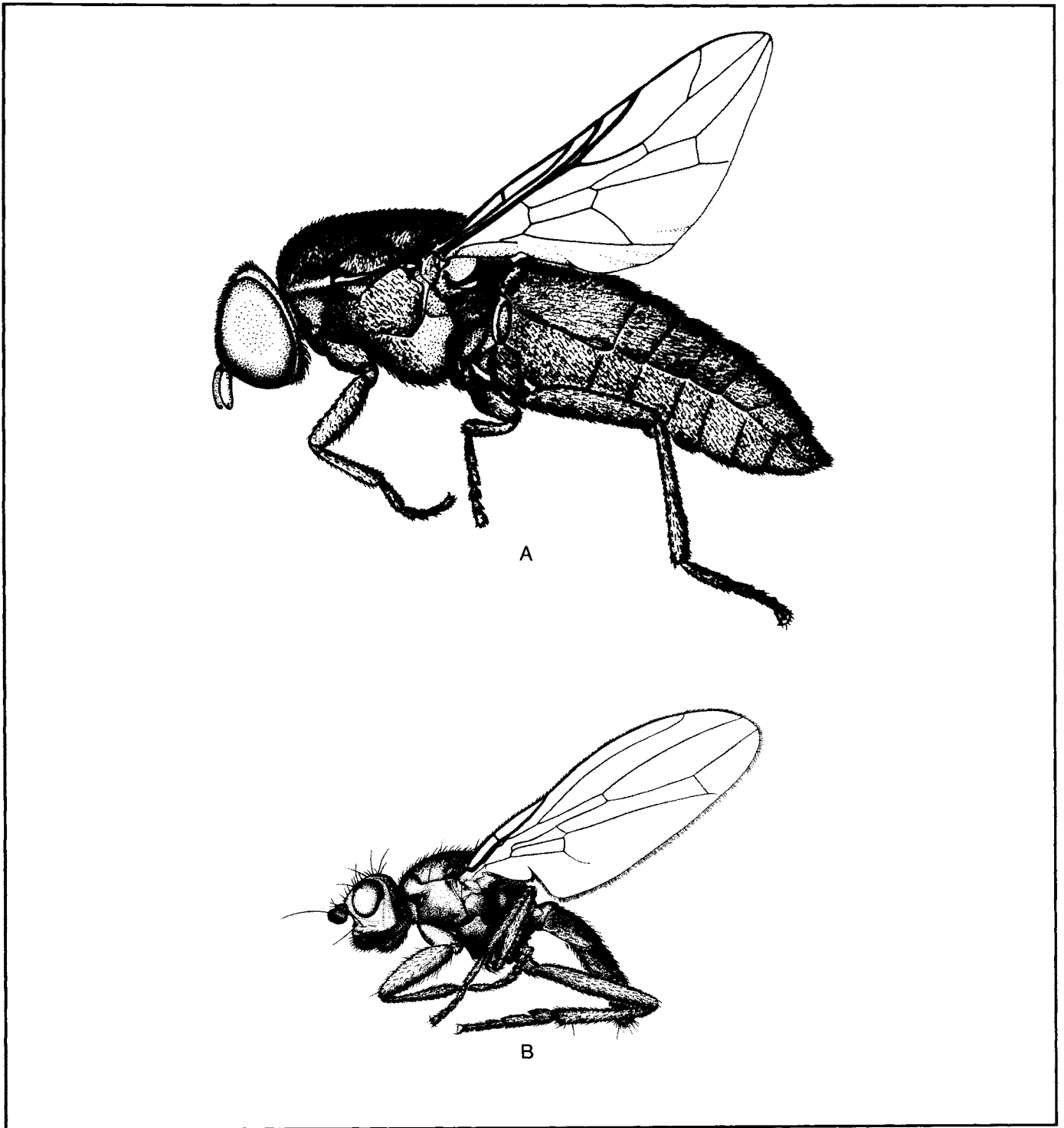


Plate 125. Scenopinid and sphaerocerid flies:  
A, *Scenopinus* sp. (Scenopinidae), adult (6); B,  
*Leptocera* sp. (Sphaeroceridae), adult (3).

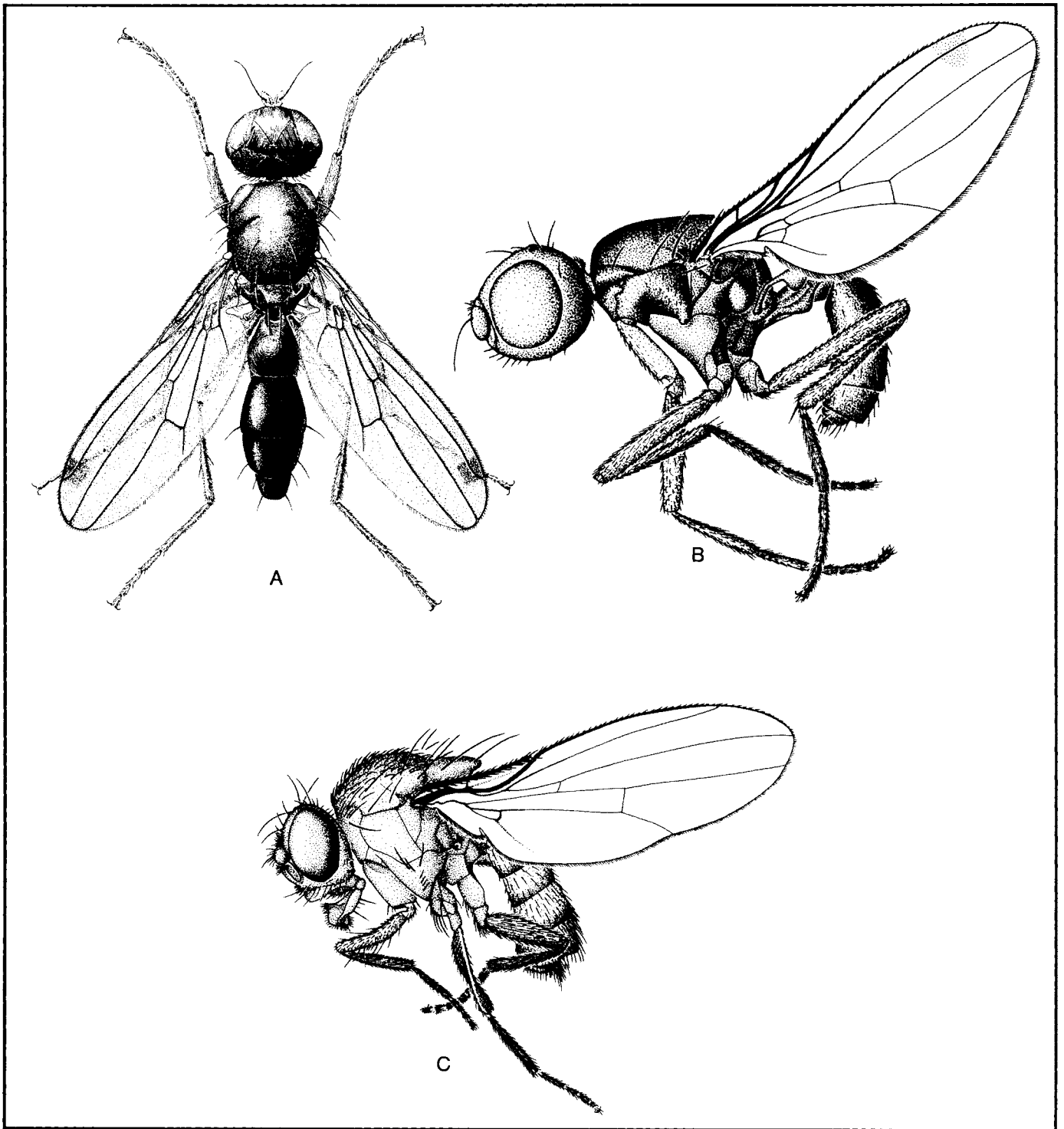


Plate 126. Sepsid and drosophilid flies: A, *Sepsis* sp. (Sepsidae), female (4), dorsal view (drawing by A.D. Cushman); B, same, lateral view; C, *Drosophila* sp. (Drosophilidae), adult (2.5).

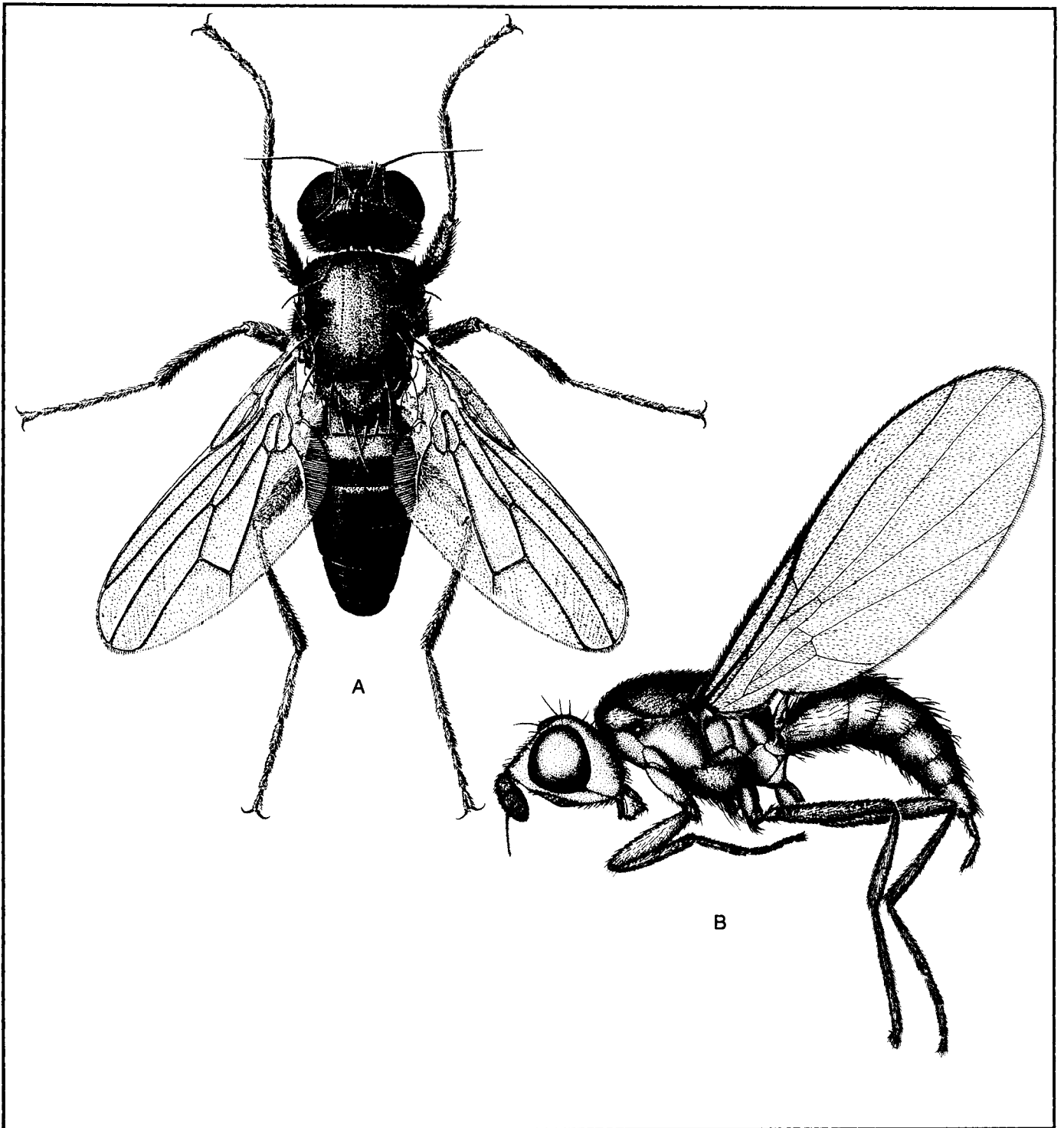


Plate 127. Piophilid and psilid flies: A, **cheese skipper**, *Piophila casei* (Piophilidae), female (2.5-4) (drawing by A.D. Cushman); B, **carrot rust fly**, *Psila rosae* (Psilidae), adult (3).



Plate 128. **Little house fly**, *Fannia canicularis* (Muscidae): A, larva (5-8); B, adult (5-7).

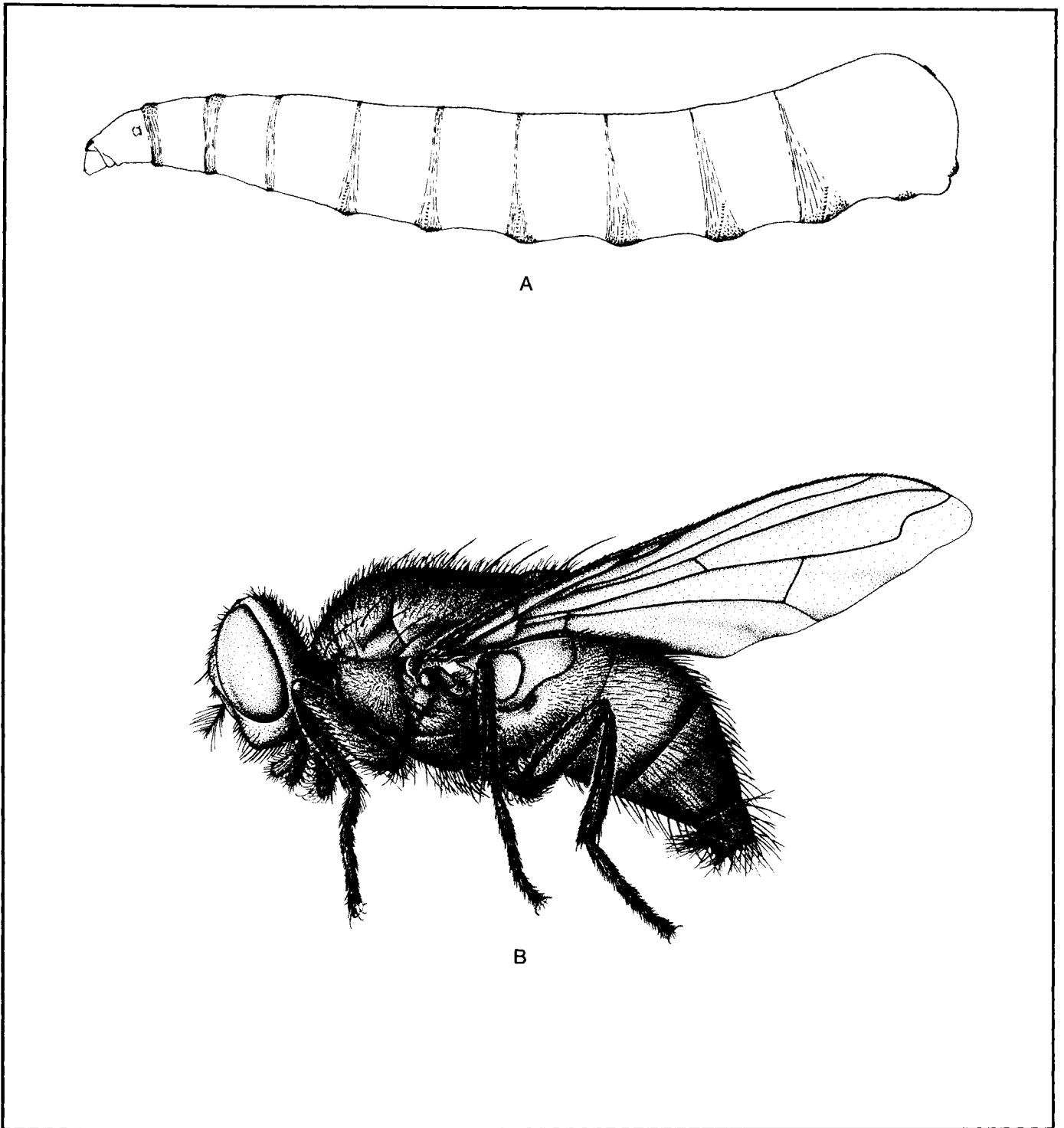


Plate 129. **House fly**, *Musca domestica*  
(Muscidae): A, larva (10-13); B, adult (6-9).

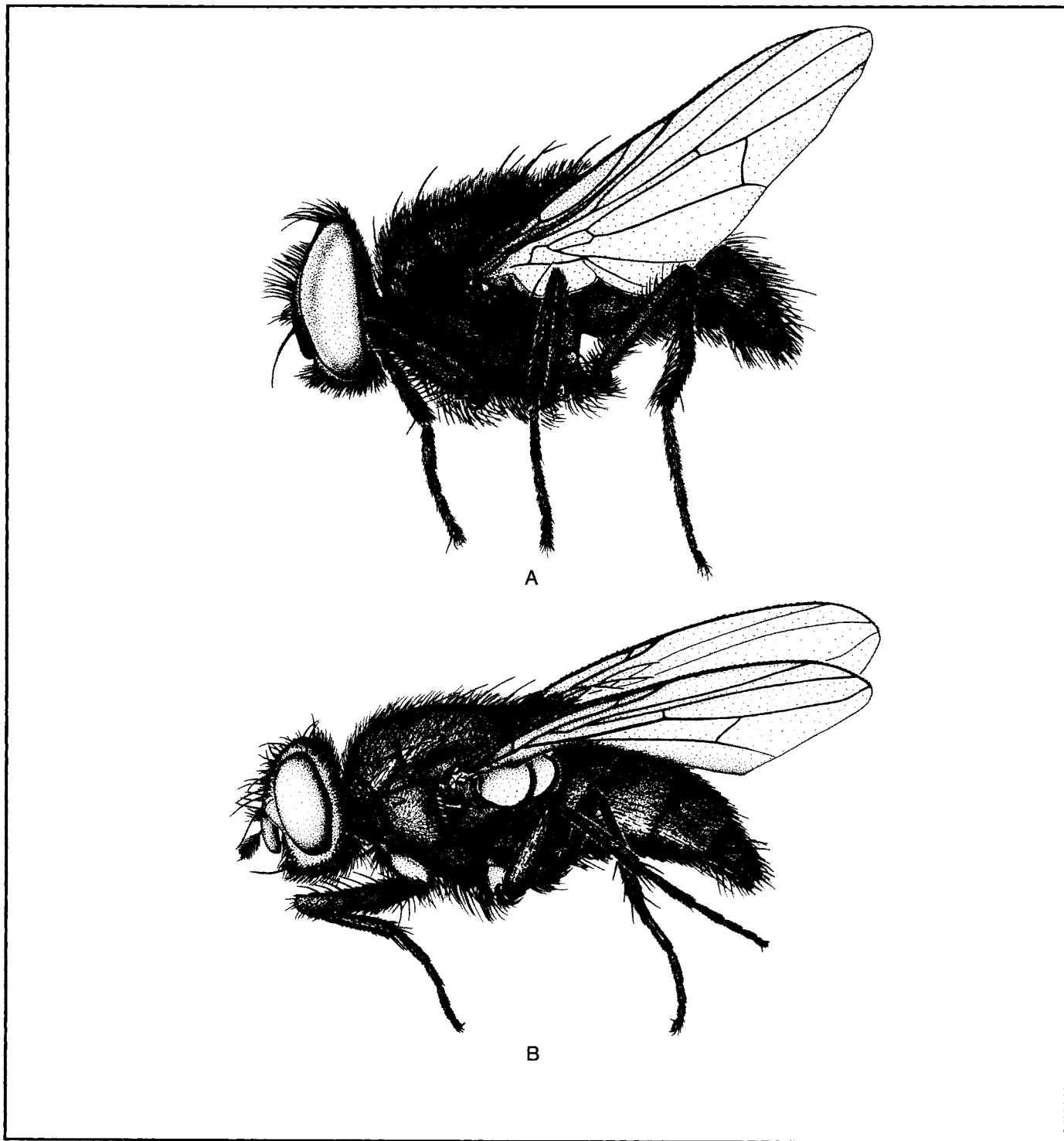


Plate 130. Muscid flies (Muscidae). A, bronze dump fly, *Ophyra aenescens*, adult (7); B, false stable fly, *Muscina stabulans*, adult (8).

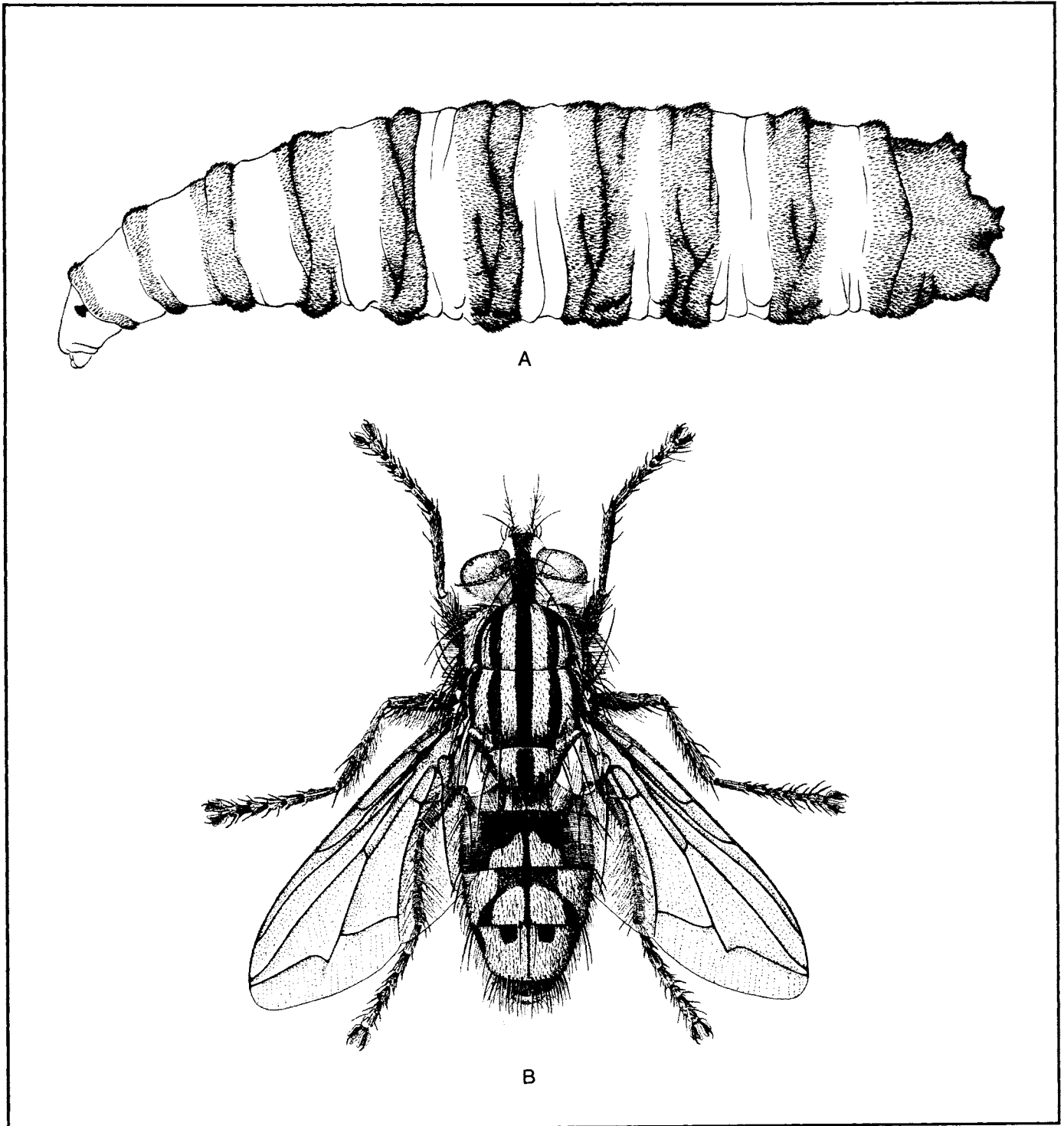


Plate 131. **Flesh flies, *Sarcophaga* spp.**  
(Sarcophagidae): A, *Sarcophaga* sp., larva  
(15-20); B, redtailed flesh fly, *Sarcophaga*  
*haemorrhoidalis*, adult (10-14) (drawing by A.D.  
Cushman).



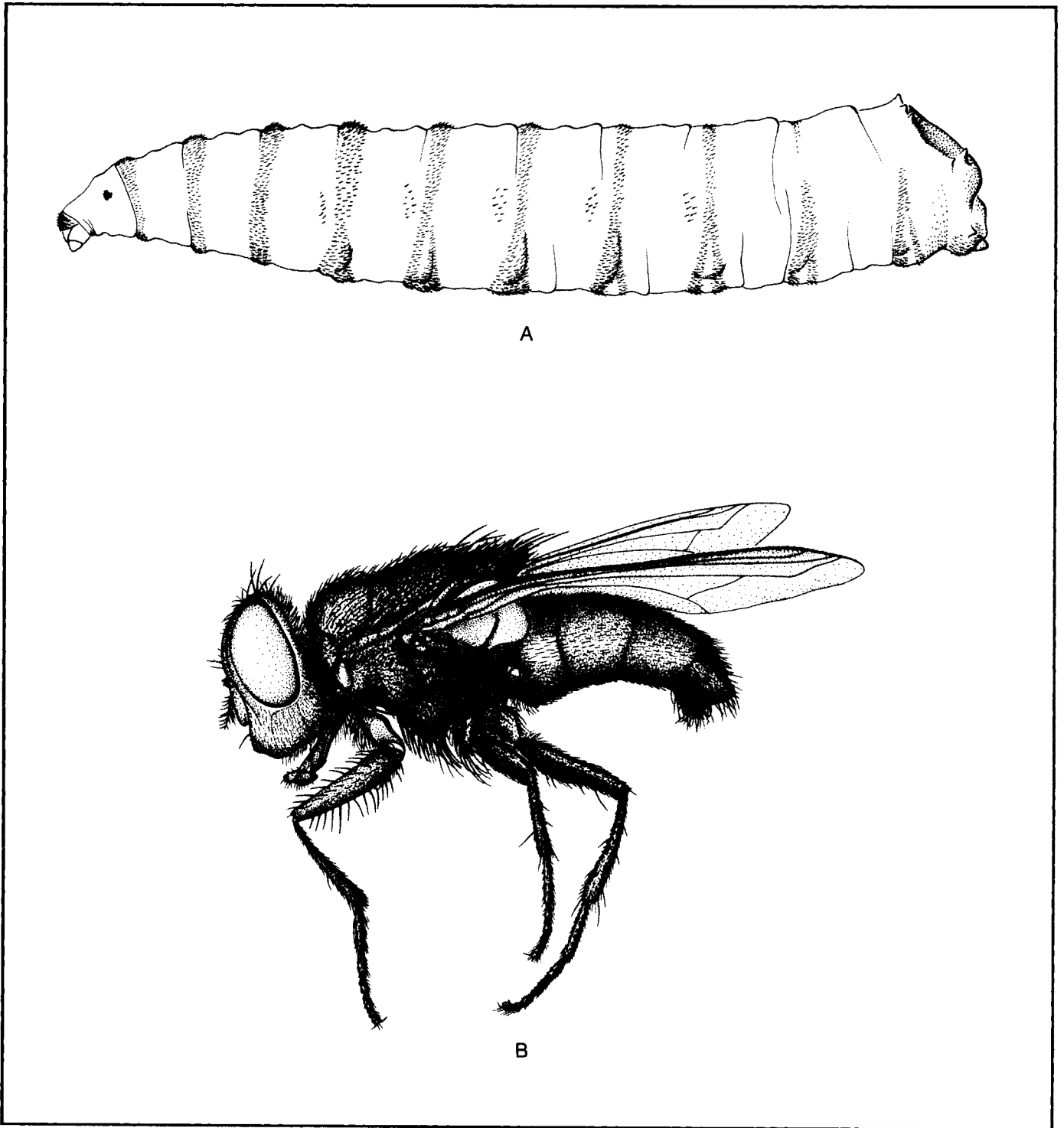


Plate 132. **Secondary screwworm, *Cochliomyia macellaria*** (Calliphoridae): A, larva (12-15); B, adult (8-10).

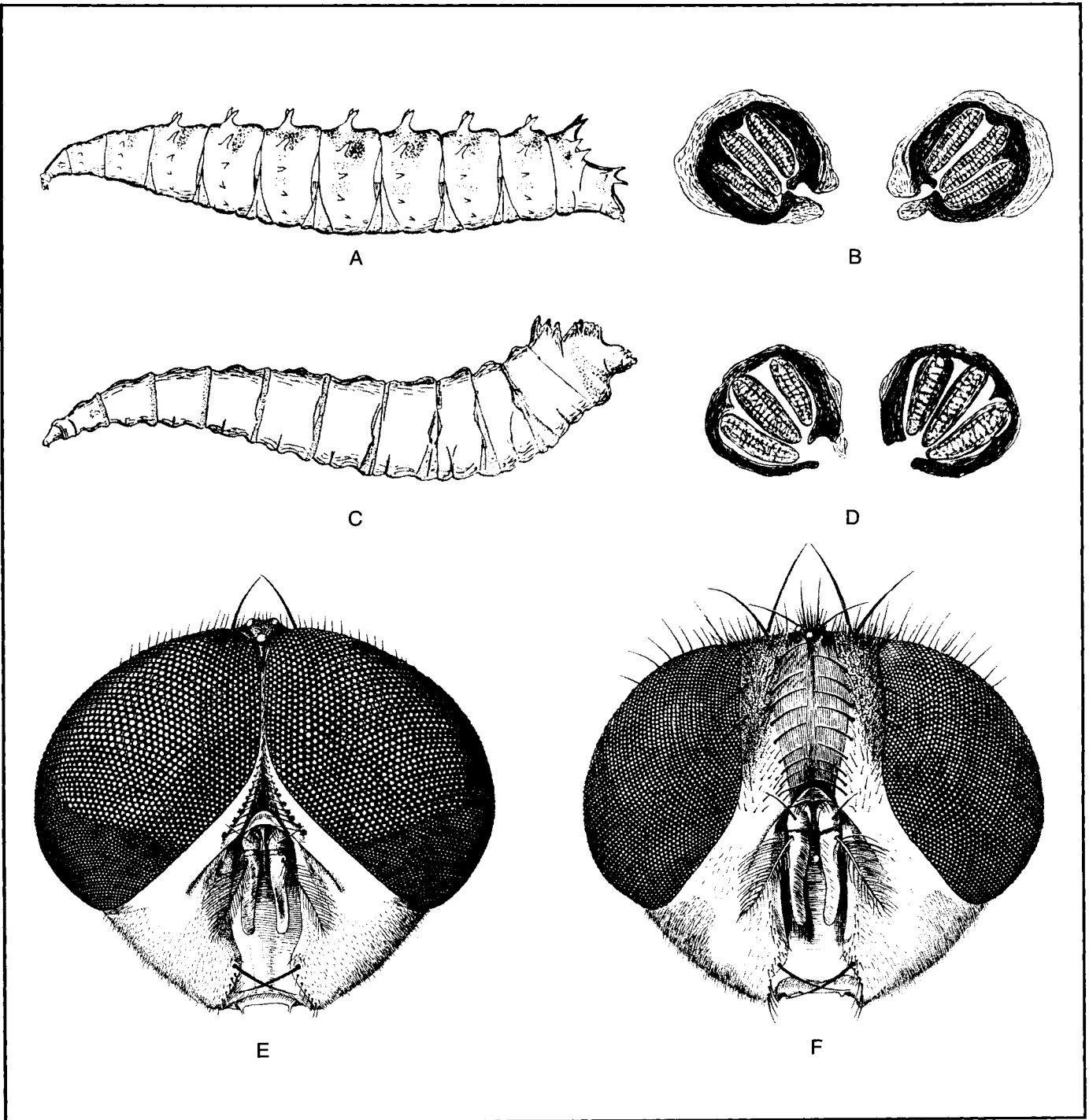


Plate 133. Old World screwworm flies, *Chrysomya* spp. (Calliphoridae) (drawings from 2): A, *Chrysomya albiceps*, larva (14-18); B, same, posterior spiracles; C, *Chrysomya chloropyga*, larva (12); D, same, posterior spiracles; E, *Chrysomya megacephala*, face of male; F, same, face of female.

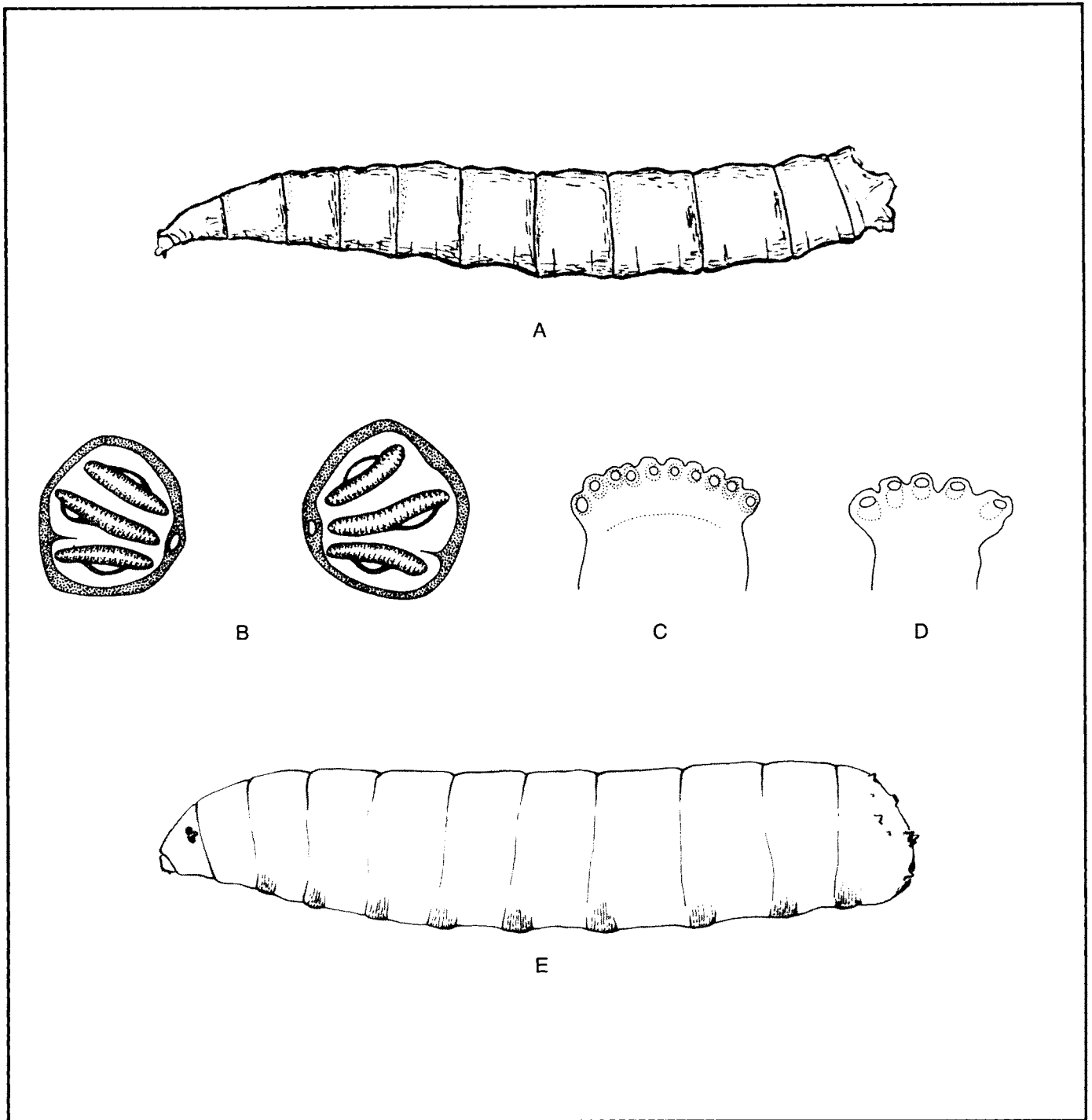


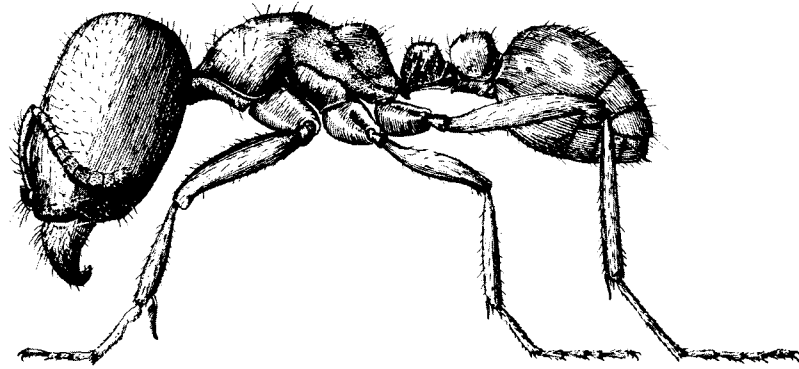
Plate 134. Calliphorid and anthomyiid flies: A, green bottle fly, *Phaenicia sericata* (Calliphoridae), larva (10-15) (drawing from 2); B, same, posterior spiracles; C, same, anterior spiracle; D, bronze bottle fly, *Phaenicia cuprina*, anterior spiracle of larva; E, *Hylemya* sp. (Anthomyiidae), larva (10).

*Insect and Mite Pests in Food*

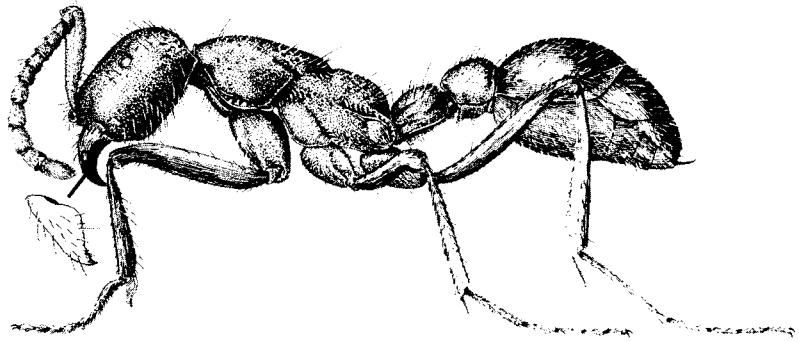
**Notes and Sketches**

## **WORKER ANTS (FORMICIDAE)**

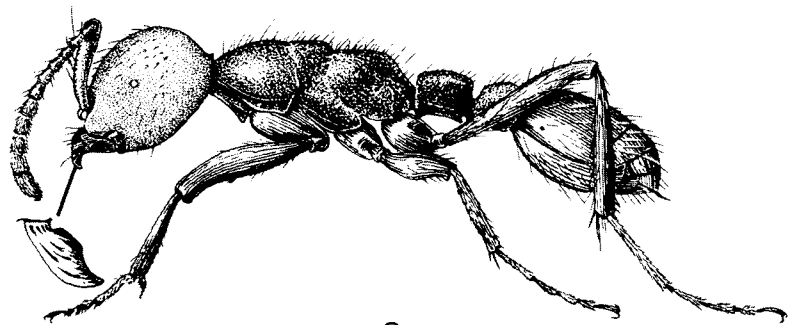
This series of illustrations, drawn by A.D. Cushman unless otherwise noted, is a continuation of chapter 17 (Ants), by D.R. Smith.



A



B



C

Plate 135. Army ants (Dorylinae, Formicidae):  
A, *Labidus coecus* (2.9-9.7); B, *Neivamyrmex  
nigrescens* (2.8-5.8); C, *Neivamyrmex  
opacithorax* (2.2-4.6).

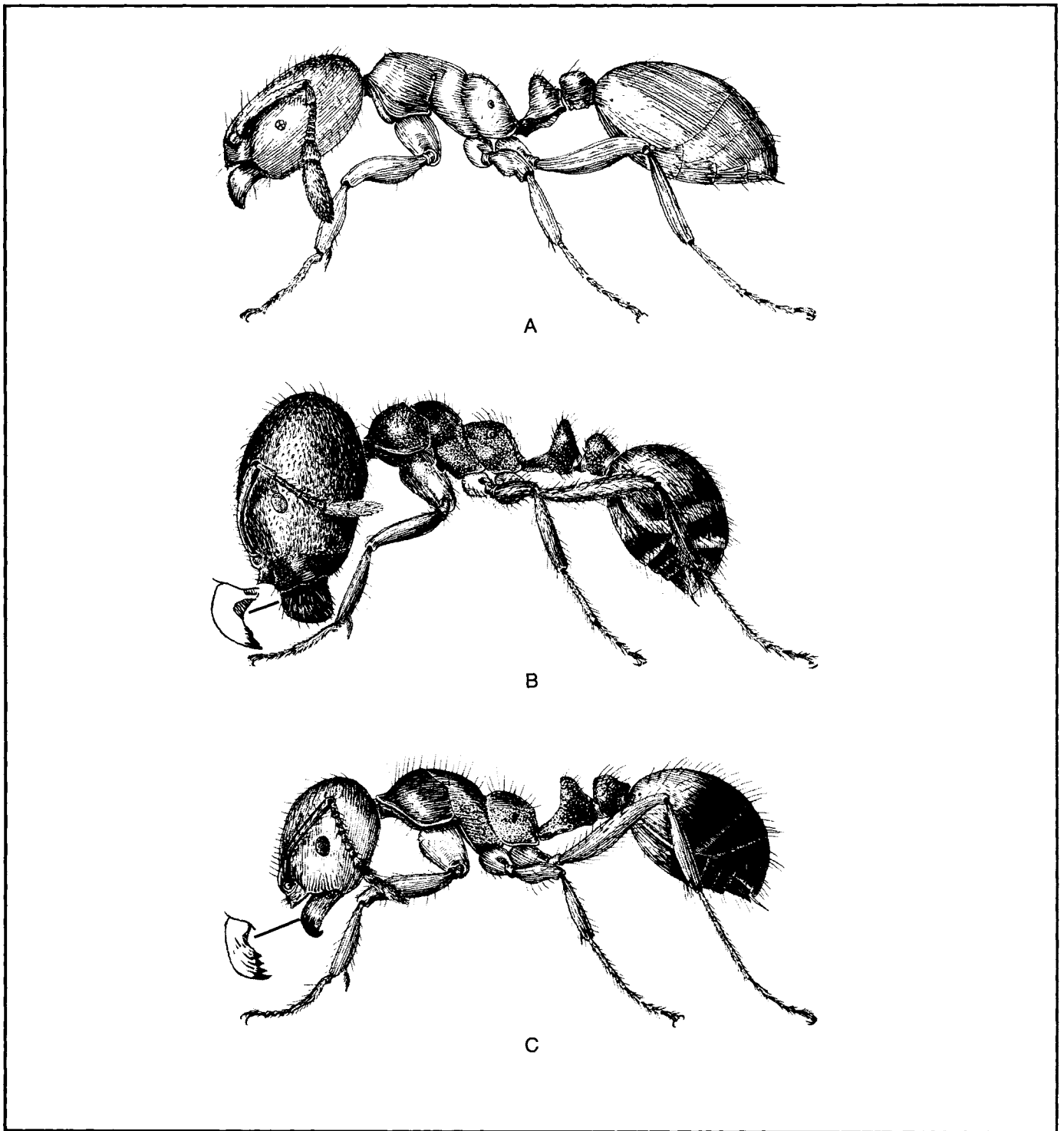


Plate 136. Myrmicine ants (Myrmicinae, Formicidae): A, thief ant, *Solenopsis molesta* (1.3-1.8); B, fire ant, *Solenopsis geminata* (2.4-6); C, red imported fire ant, *Solenopsis invicta* (2.8-6).

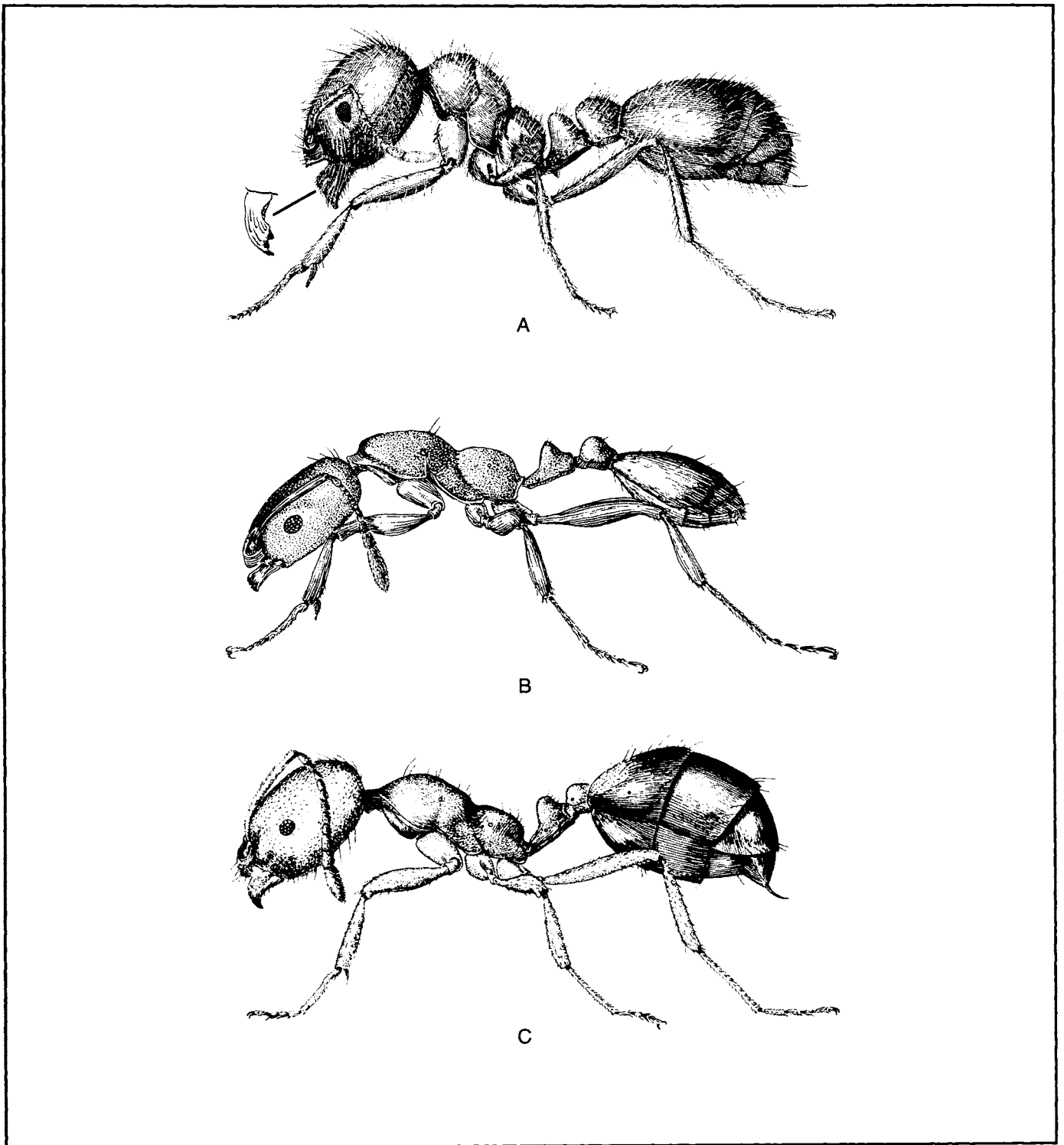
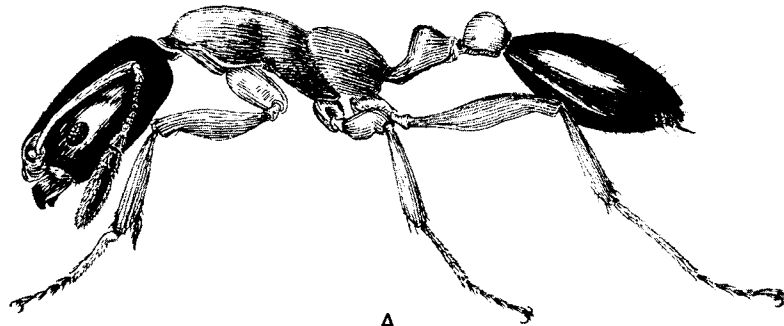
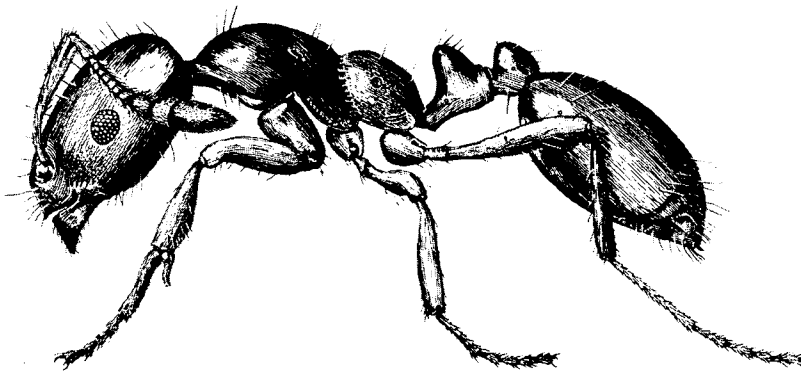


Plate 137. Myrmicine ants (Myrmicinae, Formicidae): A, **southern fire ant**, *Solenopsis xyloni* (1.6-5.8); B, **pharaoh ant**, *Monomorium pharaonis* (2); C, *Monomorium destructor* (1.8-3).

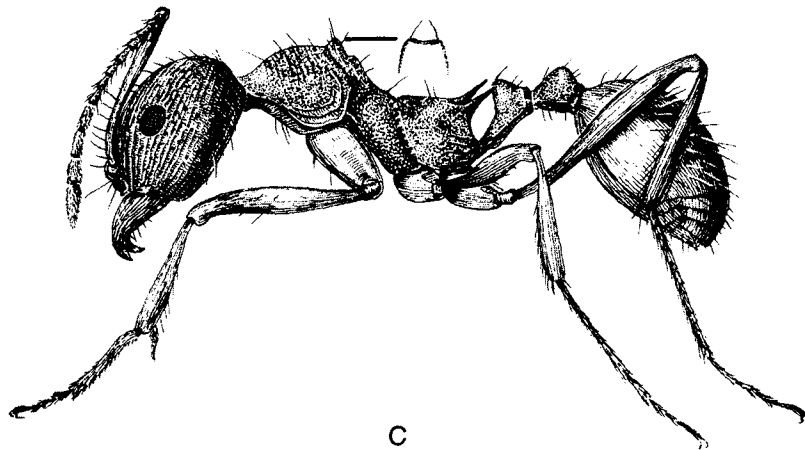




A



B



C

Plate 138. Myrmicine ants (Myrmicinae, Formicidae): A, *Monomorium floricola* (1.4-1.8); B, **little black ant**, *Monomorium minimum* (1.5-2); C, *Aphaenogaster fulva* (3.5-5.8).

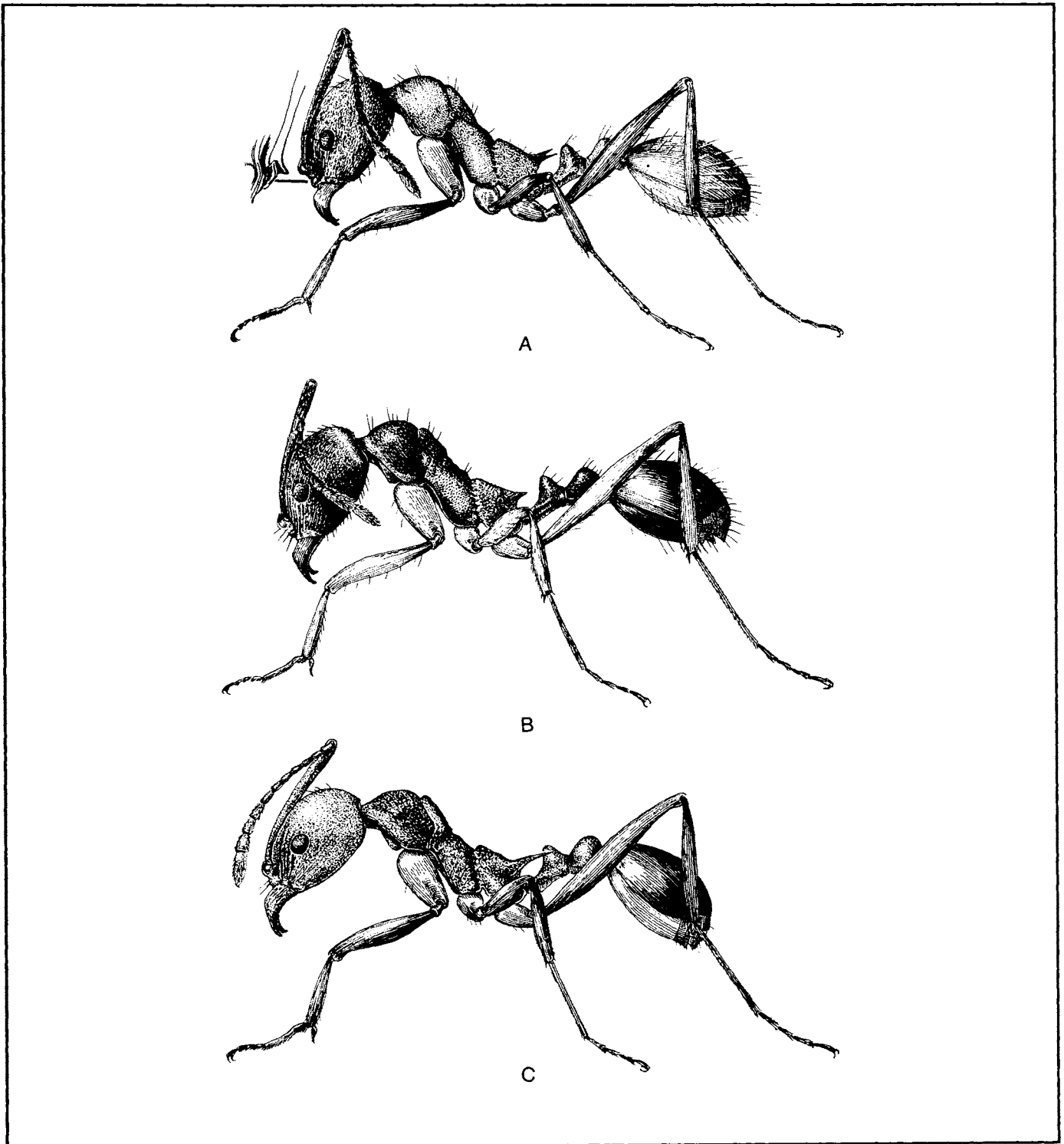
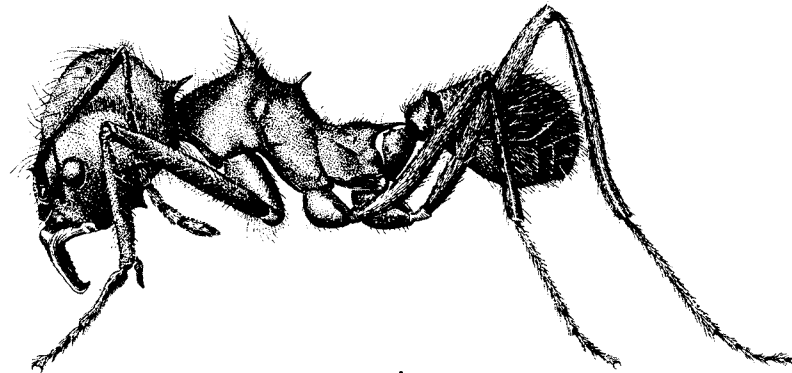
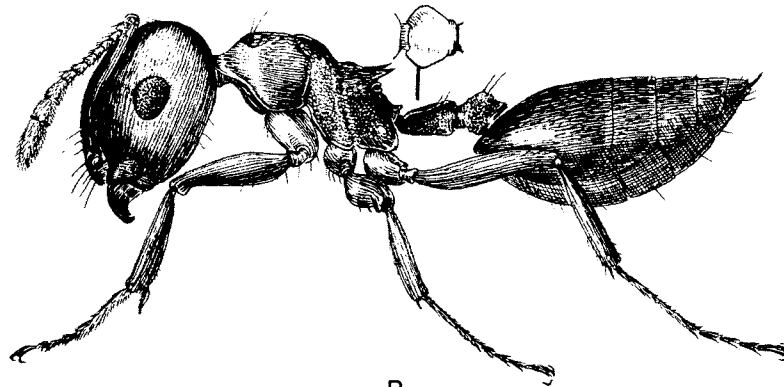


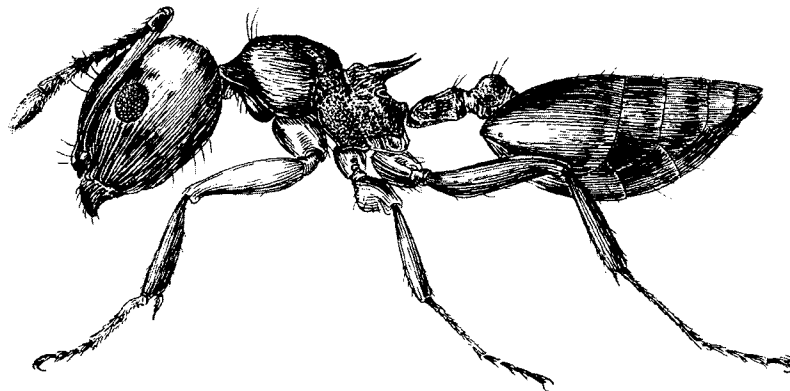
Plate 139. Myrmicine ants (Myrmicinae, Formicidae): A, *Aphaenogaster lamellidens* (4.1-6.5); B, *Aphaenogaster rudis* (4.5-5); C, *Aphaenogaster tennesseensis* (4.1-5.3).



A

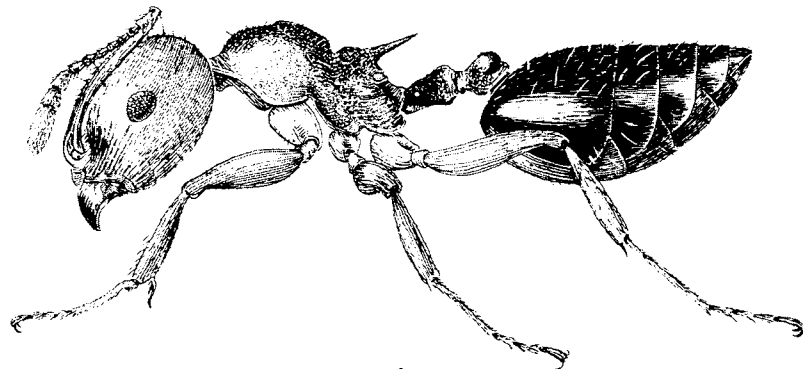


B

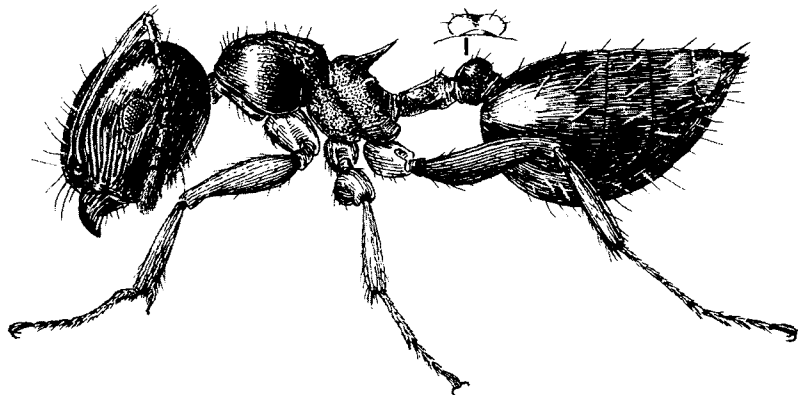


C

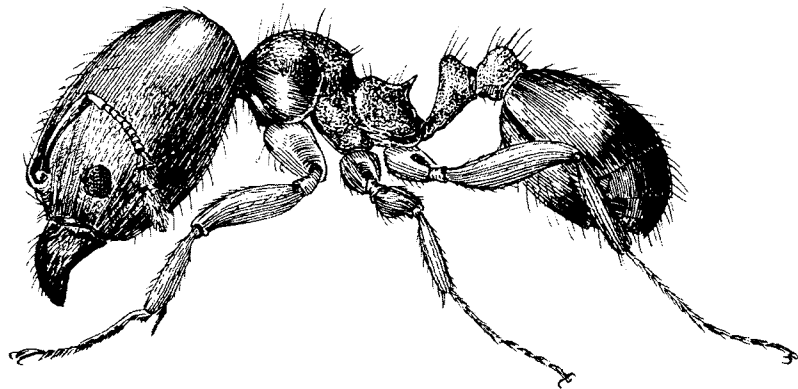
Plate 140. Myrmicine ants (Myrmicinae, Formicidae): A, **Texas leafcutting ant**, *Atta texana* (1.5-12); B, *Crematogaster ashmeadi* (2.6-3.2); C, *Crematogaster cerasi* (2.6-4).



A

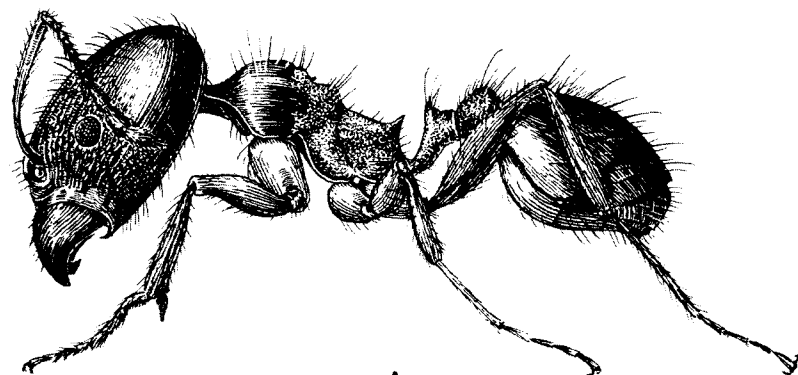


B

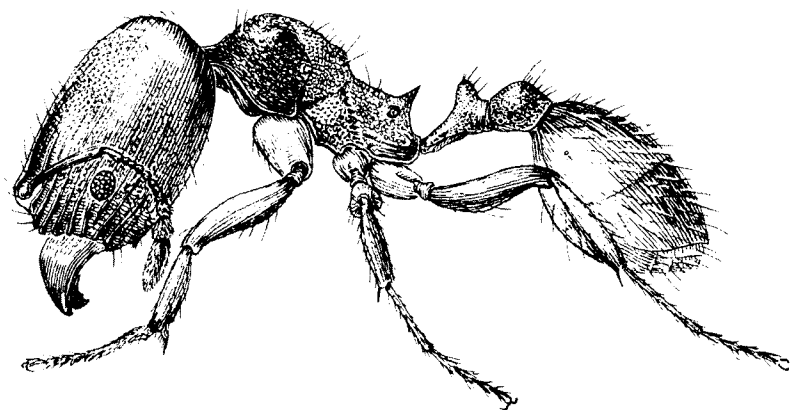


C

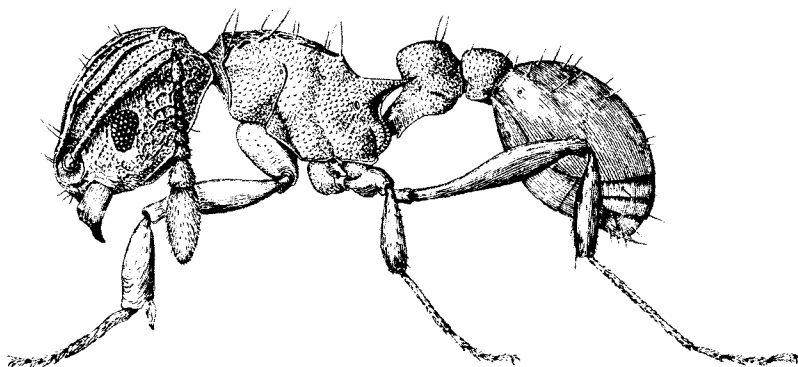
Plate 141. Myrmicine ants (Myrmicinae, Formicidae): A, *Crematogaster clara* (3.3-4); B, *Crematogaster lineolata* (2.5-3.5); C, *Pheidole bicarinata vinelandica* (1.6-3).



A



B



C

Plate 142. Myrmicine ants (Myrmicinae, Formicidae): A, *Pheidole dentata* (2.4-3.8); B, *Pheidole floridana* (1.5-2.6); C, little fire ant, *Ochetomyrmex auropunctatus* (1.5).

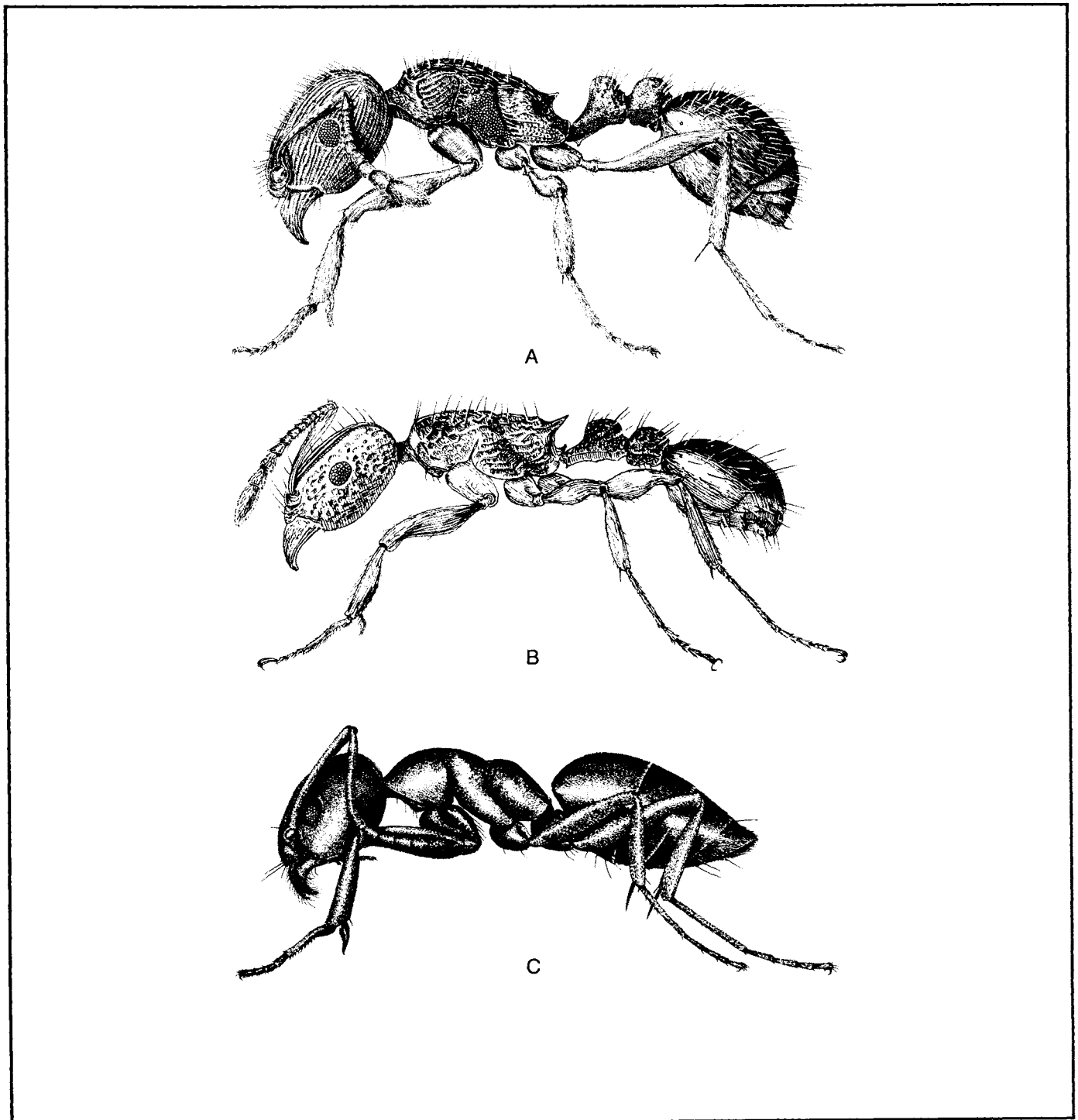


Plate 143. Myrmicine and dolichoderine ants (Formicidae): A, **pavement ant**, *Tetramorium caespitum* (2.5-3) (Myrmicinae); B, **Guinea ant**, *Tetramorium bicarinatum* (3-3.5) (Myrmicinae); C, **odorous house ant**, *Tapinoma sessile* (2.4-3.2) (Dolichoderinae) (drawing by S.H. DeBord).

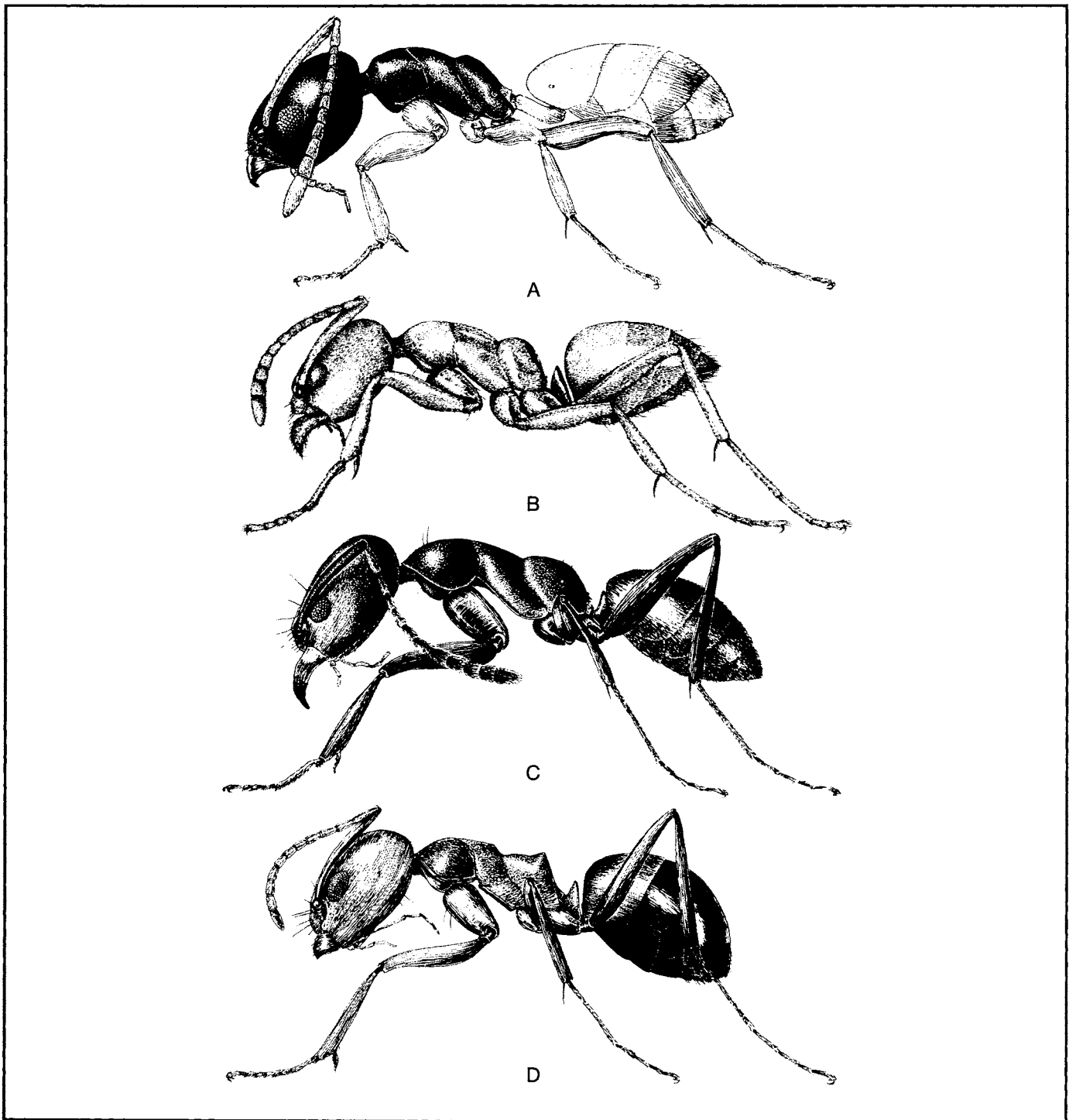
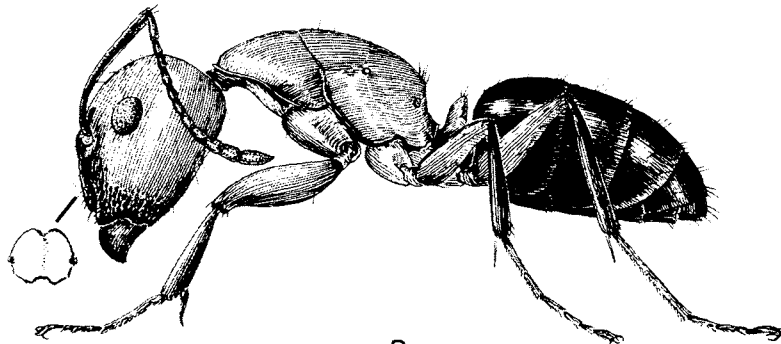


Plate 144. Dolichoderine ants (Dolichoderinae, Formicidae): A, *Tapinoma melanocephalum* (1.3-1.5); B, **Argentine ant**, *Iridomyrmex humilis* (2.2-2.6) (drawing by S.H. DeBord); C, *Iridomyrmex pruinosus* (1.8-2.5); D, **pyramid ant**, *Conomyrma insana* (3).



A



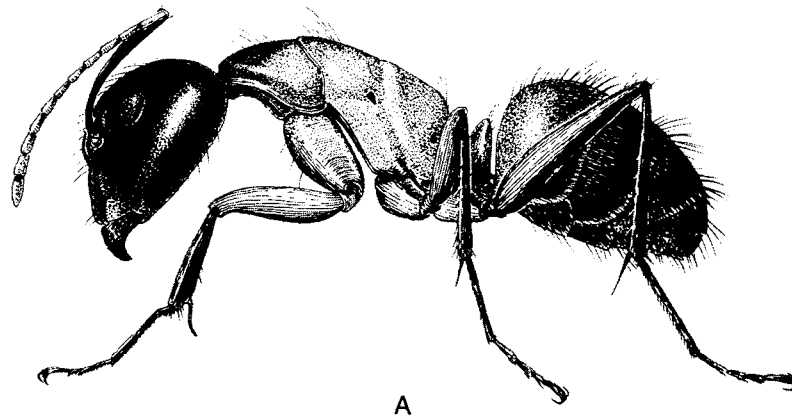
B



C

Plate 145. Carpenter ants (Formicinae, Formicidae): A, **Florida carpenter ant**, *Camponotus abdominalis* (5.5-10); B, *Camponotus caryae discolor* (3.5-7.5); C, *Camponotus castaneus* (7-10).

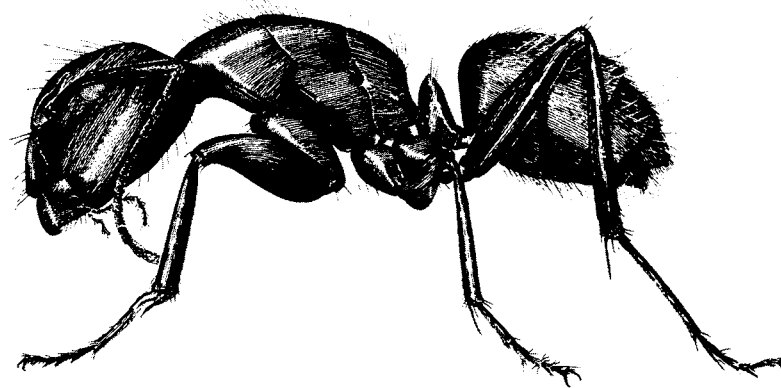




A

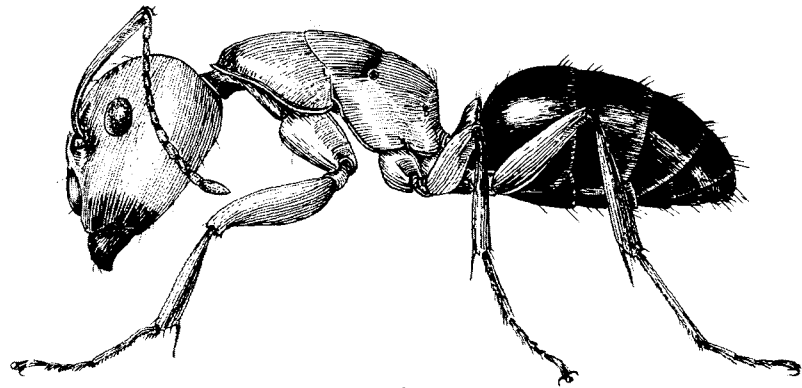


B

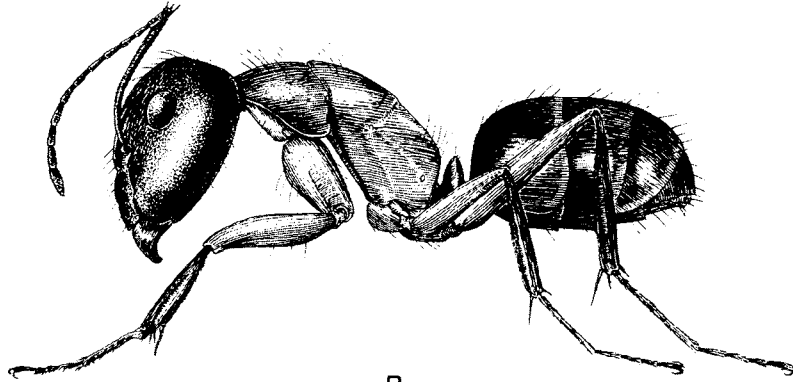


C

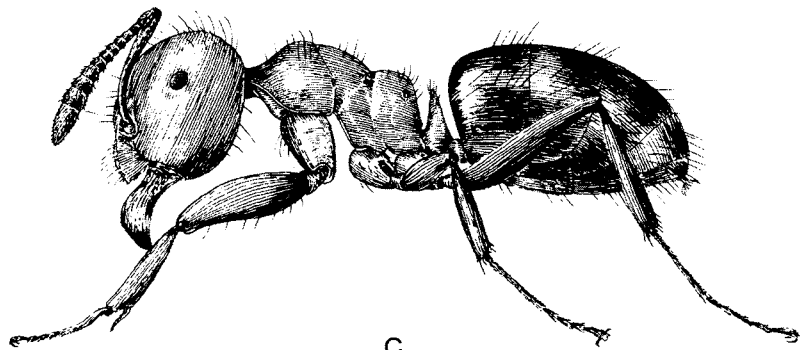
Plate 146. Carpenter ants (Formicinae, Formicidae): A, **red carpenter ant**, *Camponotus ferrugineus* (6-13); B, *Camponotus nearcticus* (4.5-7.5); C, **black carpenter ant**, *Camponotus pennsylvanicus* (6-13).



A



B



C

Plate 147. Formicine ants (Formicinae, Formicidae): A, carpenter ant, *Camponotus sayi* (4-9); B, carpenter ant, *Camponotus tortuganus* (6-11); C, **smaller yellow ant**, *Acanthomyops claviger* (3-4).

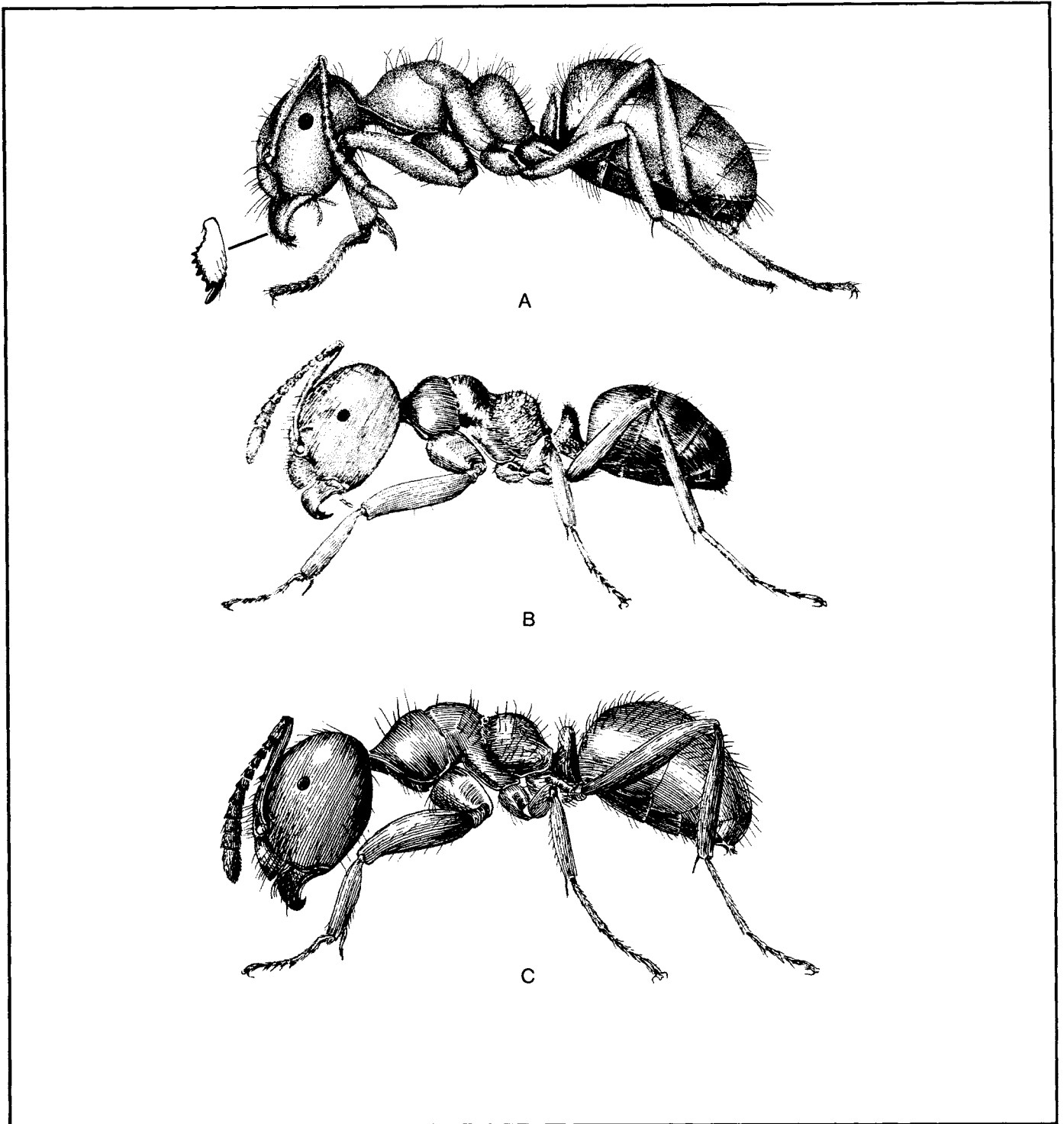


Plate 148. Formicine ants (Formicinae, Formicidae): A, **larger yellow ant**, *Acanthomyops interjectus* (4-4.5) (drawing by S.H. DeBord); B, *Acanthomyops murphyi* (3-3.7); C, *Acanthomyops latipes* (3.5-3.8).

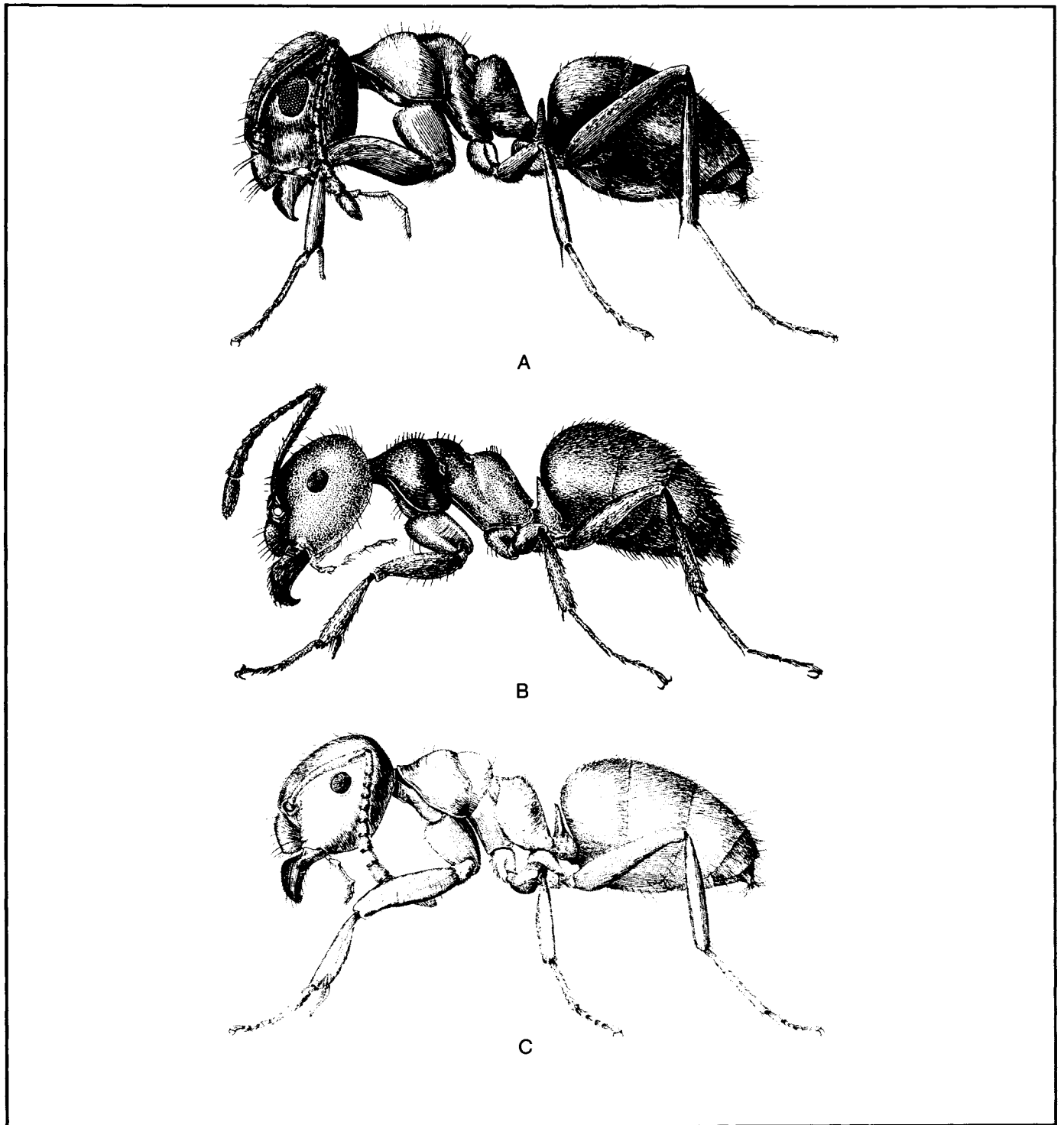


Plate 149. Formicine ants (Formicinae, Formicidae): A, **cornfield ant**, *Lasius alienus* (2-2.5); B, *Lasius neoniger* (2-2.5); C, *Lasius umbratus* (3.3-3.7).

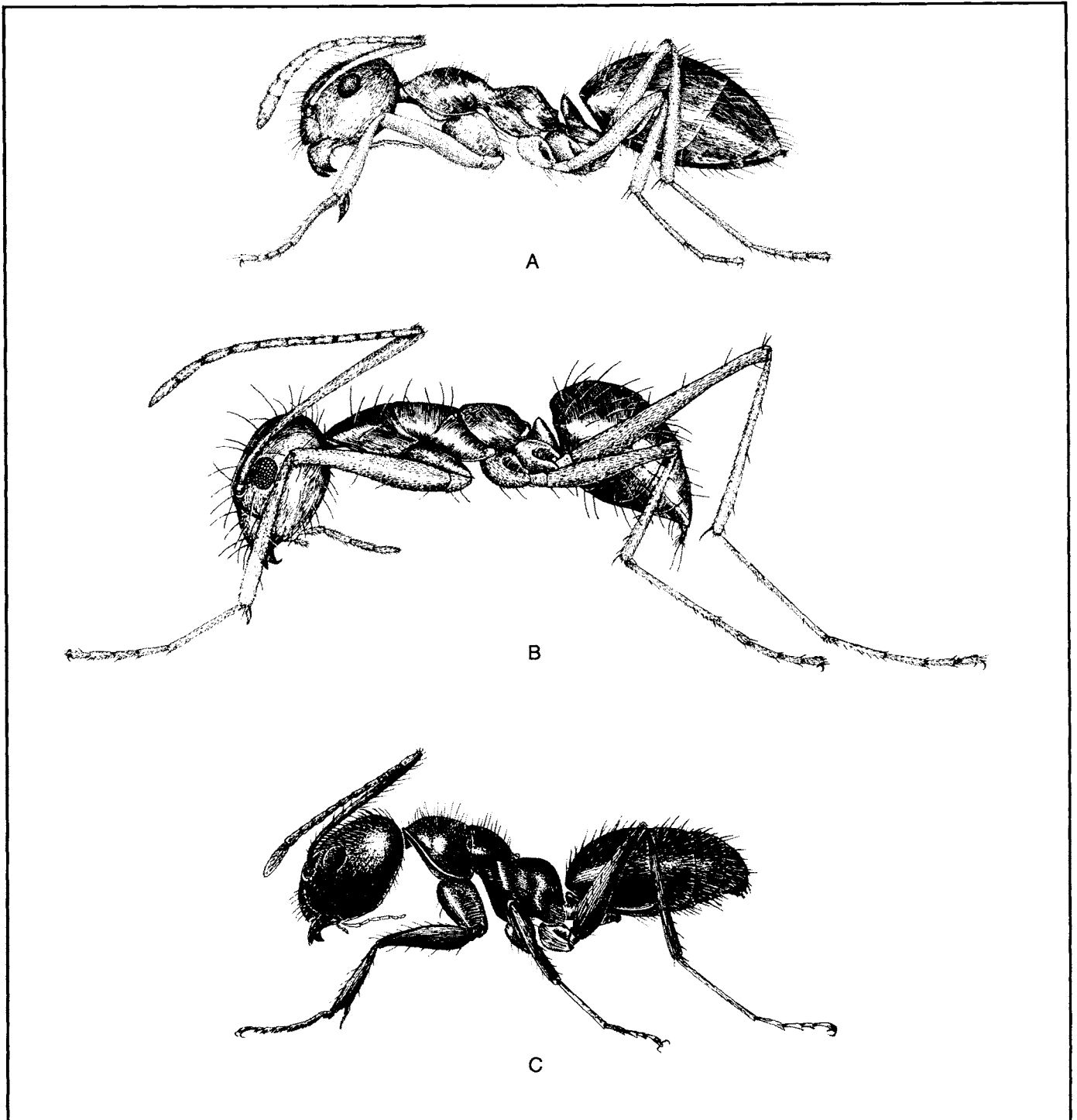


Plate 150. Formicine ants (Formicinae, Formicidae): A, false honey ant, *Prenolepis imparis* (2-4); B, crazy ant, *Paratrechina longicornis* (2.2-3) (drawings A&B by S.H. DeBord); C, *Paratrechina* (various species) (2.2-4).

**Notes and Sketches**

**J. Richard Gorham**

Food and Drug Administration  
Washington DC 20204

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Hundreds of insect and mite species have been associated at one time or another with various aspects of the food industry (**A001-A007**, **A009-A027**). Since user convenience is an important objective of this list (and of this entire handbook, for that matter), no attempt is made here to record all these species. This list is, however, more inclusive than were the earlier versions (**A012**, **A013**). Although some rare or unusual species are included, emphasis is given here to the common cosmopolitan pests, to pests likely to be encountered in FDA and USDA operations, and to pests of food stored in the home. Field crop pests have been largely excluded, but many pests associated with other aspects of the food industry, such as storage, transport, processing, vending, and serving, are listed.

A basic tenet of research on the prevention, detection, and control of infestations by food pests is that the investigator must be certain that the offending arthropod is correctly identified. Fortunately, many of our food pests (or even fragments thereof in some cases) can be readily identified. This handbook will be especially helpful in dealing with

arthropods in that category. In other instances, the services of a taxonomic specialist may be required to produce a trustworthy identification. Therefore, the simple consultation of the keys in this handbook or of the taxonomic literature listed below cannot guarantee correct identification of every specimen. Rather, the keys and references given here and elsewhere in this handbook are intended to assist the operational entomologist in deciding whether to do the identification at the local level or to submit the specimen to a competent taxonomic authority.

In the list below under the heading "Arthropod Pests of the Food Industry," the references are cited by number and are limited to those that provide keys, illustrations, or other useful details about the identification of a given pest. A few long-standing and widely used synonyms are placed in brackets. Common names in **boldface** have been approved by the Committee on Common Names of Insects (**A008**). Names followed by an asterisk (\*) represent taxa that have been keyed out or illustrated here. This list also serves as the taxonomic index for the handbook.

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#### Arthropod Pests of the Food Industry

Taxon	Common Name	Reference	Page
Acari* [Acarina] (subclass)	mites	A017 B001 B002 B004 B006-B009 B012-B015 AQ02 AQ06	3, 321, 483

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Taxon	Common Name	Reference	Page
Acariformes* (order)	acariform mites	A017 B002 B007	4, 7, 14, 492
Astigmata* (suborder)	astigmatid mites	A017 B002 B006 B007	4, 14, 16, 494
Acaridae*	acarid mites	A017 B007 C011	4, 22, 23, 497
<i>Acarus farris</i> * (Oudemans)		A017 C005	25, 500
<i>Acarus gracilis</i> Hughes		A017 C005	
<i>Acarus immobilis</i> * Griffiths		A017 C004 C005	25, 501
<i>Acarus siro</i> L*	grain mite	A017 B004 C005 C011	24, 499
<i>Aleuroglyphus ovatus</i> * (Troupeau)	brownlegged grain mite	A017 C001 C011	27
<i>Caloglyphus</i> * [ <i>Sancassania</i> ]		C010 C012	28
<i>Caloglyphus anomalus</i> Nesbitt		C010	
<i>Caloglyphus berlesei</i> * (Michael)		A017 C006	28, 505
<i>Caloglyphus hughesi</i> (Samsiňák)		A017	
<i>Caloglyphus mycophagus</i> (Mégnin)		A017 C006	
<i>Caloglyphus oudemansi</i> (Zakhvatkin)		A017	
<i>Caloglyphus rhizoglyphoides</i> (Zakhvatkin)		A017	
<i>Histiogaster</i> *		C012 C018	29
<i>Histiogaster carpio</i> Kramer		C018	
<i>Mycetoglyphus fungivorus</i> Oudemans		A017 C012	
<i>Rhizoglyphus</i> *		A017 C012	28
<i>Rhizoglyphus callae</i> Oudemans		A017 C008	28
<i>Rhizoglyphus echinopus</i> (Fumouze & Robin)	bulb mite	A017 C008 C011	28
<i>Rhizoglyphus phylloxerae</i> Riley		C002 C006	
<i>Rhizoglyphus robini</i> * Claparède		C008	28, 503, 504
<i>Schwiebia</i> *		C009	29
<i>Suidasia nesbitti</i> * Hughes	scaly grain mite	A017	22, 497
<i>Suidasia pontifica</i> * Oudemans [ <i>S. medanensis</i> Oudemans]		A017 C003	22
<i>Thyreophagus entomophagus</i> (Laboulbène)		A017 C014	28, 503
<i>Thyreophagus gallegoi</i> Portus & Gomez		C013	
<i>Tyroborus lini</i> Oudemans		A017 C012	
<i>Tyrolichus casei</i> * Oudemans	cheese mite	A017 C012 C014	26, 501
<i>Tyrophagus brevicrinatus</i> Robertson		A017 B007 C015	
<i>Tyrophagus longior</i> * (Gervais)		A017 B004 C006 C007 C014 C015	26, 502

Taxon	Common Name	Reference	Page
<i>Tyrophagus palmarum</i> Oudemans		A017 C007 C015	
<i>Tyrophagus perniciosus</i> Zakhvatkin		A017 C007 C015	
<i>Tyrophagus putrescentiae</i> * (Schrank)	mold mite	A017 C006 C014 C015 C016 C017	26, 502
<i>Tyrophagus similis</i> Volgin		A017 C006 C007 C015 C017	
<i>Tyrophagus tropicus</i> Robertson		A017 C007 C015	26

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Taxon	Common Name	Reference	Page
Carpoglyphidae*	driedfruit mites	A017	19, 494
<i>Carpoglyphus lactis</i> * (L.)	driedfruit mite	A017 B004 D001 D002	19, 494

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Taxon	Common Name	Reference	Page
Chortoglyphidae	chortoglyphid mites	A017 B007	
<i>Chortoglyphus arcuatus</i> (Troupeau)		A017	
Glycyphagidae*	glycyphagid mites	A017	19, 20, 494-496
<i>Aeroglyphus robustus</i> * (Banks)	warty grain mite	A017 C001	20, 495
<i>Austroglycyphagus geniculatus</i> (Vitzthum)		A017	
<i>Blomia freemani</i> Hughes		A017 F001	

Taxon	Common Name	Reference	Page
<i>Ctenoglyphus plumiger</i> (Koch)		A017	
<i>Glycyphagus domesticus</i> * (De Geer)	house mite	A017 B004 F002	20, 496
<i>Glycyphagus ornatus</i> Kramer		A017 F002	
<i>Glycyphagus privatus</i> Oudemans		A017	
<i>Gohieria fusca</i> * (Oudemans)	brown flour mite	A017	19, 494
<i>Lepidoglyphus destructor</i> * (Schrank)		A017 B004	20
<i>Lepidoglyphus fustifer</i> (Oudemans)		A017 B004	
<i>Lepidoglyphus michaeli</i> (Oudemans)		A017	

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Taxon	Common Name	Reference	Page
Histiostomatidae* [Anoetidae]	histiostomatid mites	G002	29, 506-508
<i>Histiostoma feroniarum</i> (Dufour)		A017 C006 G001 G002	
<i>Histiostoma heinemanni</i> * Hill & Deahl		G001	29, 506-508

- G001 Hill, A., and K.L. Deahl.  
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*Histiostoma* (Acari: Histiostomidae) associated  
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Taxon	Common Name	Reference	Page
Lardoglyphidae*	lardoglyphid mites	A017 B007	23, 498
<i>Lardoglyphus angelinae</i> Olsen		H001	23
<i>Lardoglyphus konoii</i> * (Sasa & Asanuma)		A017 H001	23, 498
<i>Lardoglyphus zacheri</i> * Oudemans		A017 H001	23, 498

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*Lardoglyphus angelinae* n. sp. (Acarina: Acaridae).  
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Taxon	Common Name	Reference	Page
Psoroptidae*	scab mites	B001	18, 493
<i>Psoroptes equi</i> * (Raspail)	scab mite	B001	18, 493
Pyroglyphidae* [Epidermoptidae]	pyroglyphid mites	A017 J001 J005	29, 509-513
<i>Dermatophagoides farinae</i> * Hughes	American house dust mite	J003 J005	32, 513
<i>Dermatophagoides microceras</i> * Griffiths & Cunnington		J004 J005	32
<i>Dermatophagoides pteronyssinus</i> * (Trouessart)	European house dust mite	J003 J005	31
<i>Euroglyphus longior</i> * (Trouessart)		J002 J005	31, 509, 510
<i>Euroglyphus maynei</i> * (Cooreman)		J002 J005	31, 511, 512
<i>Pyroglyphus africanus</i> (Hughes)		A017 J005	

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Taxon	Common Name	Reference	Page
Sarcoptidae*	sarcoptid mites	K001	18, 492
<i>Sarcoptes scabiei</i> * (De Geer)	itch mite	B001 B004 K001 K002	18, 492

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Taxon	Common Name	Reference	Page
Cryptostigmata* [Oribatida] (suborder)	beetle mites	<i>B003 B006 B007</i>	4, 14, 16
Aphelacaridae	aphelacarid mites		
<i>Aphelacarus acarinus</i> (Berlese)		<i>B003</i>	16
Ceratozetidae	ceratozetid mites		
<i>Trichoribates novus</i> (Sellnick)		<i>A017 M001</i>	16

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Taxon	Common Name	Reference	Page
Oribatulidae	oribatulid mites		
<i>Phauloppia lucorum</i> (Koch)		<i>A017</i>	16
<i>Scheloribates</i> *		<i>A017</i>	492
<i>Scheloribates laevigatus</i> (Koch)		<i>A017 N001</i>	16

**N001** Schweizer, J.

1949. Die Landmilben des schweizerischen Nationalparkes. Parasitiformes Reuter 1909. Rés. Rech. Scient. Parc Nat. Suisse 2(n.s.)(21)1-99, 1 map.

Taxon	Common Name	Reference	Page
Prostigmata (suborder)	prostigmatid mites	<i>A017 B006 B007 B009 B011</i>	4, 14, 32, 514
Acarophenacidae	acarophenacid mites	<i>O001</i>	
<i>Acarophenax tribolii</i> Newstead & Duvall		<i>A017 O001</i>	

**O001** Cross, E.A.

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Taxon	Common Name	Reference	Page
Bdellidae*	bdellid mites	<i>A017</i>	36, 516
<i>Spinibdella bifurcata</i> * Atyeo		<i>P001</i>	36, 516

**P001** Atyeo, W.T.

1960. A revision of the mite family Bdellidae in North America and Central America (Acarina, Prostigmata). Univ. Kansas Sci. Bull. 40(8)345-499.

Taxon	Common Name	Reference	Page
Cheyletidae*	cheyletid mites	Q001 Q005	35, 515
<i>Acaropsella volgini</i> (Gerson)		Q005	
<i>Acaropsellina docta</i> (Berlese)		Q004 Q005	
<i>Acaropsellina sollers</i> (Rohdendorf)		Q004	
<i>Cheletomorpha lepidopterorum</i> * (Shaw)		Q001 Q005	35, 515
<i>Cheyletus aversor</i> Rohdendorf		Q005	
<i>Cheyletus eruditus</i> * (Schrank)		B004 Q001 Q002 Q005	36
<i>Cheyletus malaccensis</i> * Oudemans		Q001 Q005	36

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1975. Males of three species of *Cheyletus*. Proc. Ent. Soc. Washington 77(4)446-455.

**Q004** Summers, F.M.

1976. A new genus for several cheyletid mites formerly in *Acaropsis*. Proc. Ent. Soc. Washington 78(2)190-194.

**Q005** Summers, F.M., and D.W. Price.

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Taxon	Common Name	Reference	Page
Cunaxidae	cunaxid mites	R001 R002	
<i>Cunaxa setirostris</i> (Hermann)		A017 R002	

**R001** Baker, E.W., and A. Hoffmann.

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**R002** Smiley, R.L.

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Taxon	Common Name	Reference	Page
Demodicidae*	follicle mites		33
<i>Demodex canis</i> * Leydig	dog follicle mite	B001	33
Eriophyoidea*	eriphyoid mites	T002	32, 35
Eriophyidae	eriphyid mites		
<i>Eriophyes ficus</i> * Cotte	fig mite	T001 T003	32

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T001 Baker, E.W.

1939. The fig mite, *Eriophyes ficus* Cotte, and other mites of the fig tree, *Ficus carica* Linn. California Dept. Agr. Bull. 28(4)266-275.

T002 Jeppson, L.R., H.H. Keifer, and E.W. Baker.

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T003 Keifer, H.H.

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Taxon	Common Name	Reference	Page
Erythraeoidea*	erythraeid mites	U002	34
Erythraeidae	erythraeid mites		
<i>Balaustium murorum</i> (Hermann)	wall mite	B011 U001	34

U001 Rack, G.

1984. Systematik, Morphologie und Biologie von Milben (Acari) in Häusern und Vorräten sowie Milben von medizinischer Bedeutung. 1. Allgemeines. *Balaustium murorum*, (Hermann, 1804). Der praktische Schädlingsbekämpfer 35(9)457-460.

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Taxon	Common Name	Reference	Page
Eupodidae	eupodid mites		
<i>Linopodes antennaepes</i> Banks	longlegged mite	C006 V001	

V001 Banks, N.

1894. American Acarina. Trans. American Ent. Soc. 21(June)209-222.

Taxon	Common Name	Reference	Page
Halacaridae*	halacarid mites	W001	37, 516
<i>Rhombognathides seahami</i> (Hodge)		W001	37, 516

W001 Newell, I.M.

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Taxon	Common Name	Reference	Page
Myobiidae*	myobiid mites		36
<i>Myobia musculi</i> (Schrank)		B001 X001	33, 36
<i>Radfordia affinis</i> (Poppe)		X001	36
<i>Radfordia ensifera</i> (Poppe)		X001	36

X001 Vitzthum, H.G.

1929. 5. Ordnung: Milben, Acari. Die Tierwelt Mitteleuropas 3(7)1-112.

Taxon	Common Name	Reference	Page
Pterygosomatidae*	pterygosomatid mites		37, 517
<i>Pimeliaphilus cunliffei</i> Jack	cockroach mite	Y001	37, 517

Y001 Jack, K.M.

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Taxon	Common Name	Reference	Page
Pyemotidae*	pyemotid mites	O001	40, 520, 521
<i>Pyemotes tritici</i> * Lagrèze-Fossat & Montané [ <i>P. ventricosus</i> (Newport)]	straw itch mite	Z001	40, 520, 521

Z001 Cross, E.A., and J.C. Moser.

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Taxon	Common Name	Reference	Page
Pygmephoridae*	mushroom mites	O001 AA01	40, 522-524
<i>Pseudopygmephorus smileyi</i> * Hill & Deahl		AA02	40, 523, 524
<i>Pygmephorus mesembrinae</i> Canestrini		AA01	
<i>Pygmephorus sellnicki</i> * Krczal		C006 AA01 AA03	40, 522

AA01 Gurney, B., and N.W. Hussey.

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AA04 Wicht, M.C., Jr.

1970. Practical key to pyemotid mites found in mushroom houses. Melsheimer Ent. Ser. 7:1-9.

Taxon	Common Name	Reference	Page
Scutacaridae*	scutacarid mites		38, 518, 519
<i>Scutacarus baculitarsus agaricus</i> * Norton & Ide		AB01	38, 518, 519

**AB01** Norton, R.A., and G.S. Ide.

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Taxon	Common Name	Reference	Page
Tarsonemidae*	tarsonemid mites	AC01 AC02	39, 525, 526
<i>Tarsonemus floricolus</i> Canestrini & Fanzago		AC02	
<i>Tarsonemus granarius</i> * Lindquist		AC01 AC04	40, 41, 526
<i>Tarsonemus lukoschusi</i> Hill & Deahl		AC03	39
<i>Tarsonemus mercedesae</i> Hill & Deahl		AC03	39
<i>Tarsonemus scaurus</i> * Ewing		AC01 AC02	40, 41, 525

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Taxon	Common Name	Reference	Page
Tetranychidae*	spider mites	AD01 AD02	35, 514
<i>Bryobia praetiosa</i> * Koch	clover mite	B004 AD02	35, 514
<i>Oligonychus pratensis</i> (Banks)	Banks grass mite	T002 AD01	
<i>Petrobia latens</i> (Müller)	brown wheat mite	T002 AD01 AD02	

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Taxon	Common Name	Reference	Page
Trombidioidea*	trombidoid mites		34
Trombiculidae	chigger mites		34, 514
<i>Leptotrombidium</i> *	chigger mites	B001 K002 AE01	33, 34

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Taxon	Common Name	Reference	Page
Tydeidae*	tydeid mites	T002 AF01	38, 517
<i>Tydeus</i> *		AF02	38, 517
<i>Tydeus interruptus</i> Thor		A017	

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Parasitiformes* (order)	parasitiform mites	B006 B010 M001	4, 7, 40
Mesostigmata* (suborder)	mesostigmatid mites	B006 B010	4, 7, 8
Ameroseiidae*	ameroseiid mites	B006 AG01	9, 485
<i>Kleemannia plumigera</i> * Oudemans		A017	9, 485
<i>Kleemannia plumosa</i> * (Oudemans)		A017	9, 485

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Taxon	Common Name	Reference	Page
Ascidae*	ascid mites	B006 AH02 AH05	12, 490, 491
<i>Arctoseius butleri</i> (Hughes)		A017 AH02	
<i>Arctoseius cetratus</i> (Sellnick)		B010 C001 M001 AH01	
<i>Arctoseius idiodactylus</i> Lindquist		AH01 AH04	
<i>Blattisocius dentriticus</i> * (Berlese)		B006 AH01-AH03 AH06	13, 490
<i>Blattisocius keegani</i> * Fox		B001 AH01 AH03 AH06 AH08	14, 491
<i>Blattisocius mali</i> (Oudemans)		A017 AH03	
<i>Blattisocius quadridentatus</i> Haines		AH03	
<i>Blattisocius tarsalis</i> * (Berlese)		A017 B001 AH01-AH03 AH06 AH08	14, 490
<i>Lasioseius</i> *		A017	13
<i>Lasioseius penicilliger</i> Berlese		A017 AH02	
<i>Melichares agilis</i> Hering		A017 B006	
<i>Proctolaelaps pomorum</i> (Oudemans)		A017 B006	
<i>Proctolaelaps pygmaeus</i> (Müller)		A017 AH01 AH06 AH07	

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Taxon	Common Name	Reference	Page
Dermanyssidae*	dermanyssid mites	B006 A102	11, 487
<i>Dermanyssus gallinae</i> * (De Geer)	chicken mite	B004 B006 B010 A101 A103 A104	11, 487

- A101** Evans, G.O., and W.M. Till.  
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- A104** Moss, W.W.  
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Taxon	Common Name	Reference	Page
Digamasellidae*	digamasellid mites	B006 B010	10
<i>Digamasellus</i> *		A017 AJ01	10

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Taxon	Common Name	Reference	Page
Laelapidae*	laelapid mites	B006 B010 X001	12
<i>Androlaelaps casalis</i> * (Berlese)		B010 AI02 AK01	6, 12
<i>Eulaelaps stabularis</i> (Koch)		A017 B001 X001	
<i>Haemogamasus pontiger</i> Berlese		A017 B001 AI02 AI03	
<i>Hypoaspis aculeifer</i> (Canestrini)		A017 B006 AI02	
<i>Hypoaspis lubrica</i> Voigts & Oudemans		A017 AI02	

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Taxon	Common Name	Reference	Page
Macrochelidae*	macrochelid mites	B006 B010 AL01	10, 486
<i>Macrocheles matrius</i> (Hull)		A017	
<i>Macrocheles muscaedomesticae</i> * (Scopoli)	house fly mite	B001 B010	10, 486

AL01 Krantz, G.W.

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Taxon	Common Name	Reference	Page
Macronyssidae*	macronyssid mites	B006	11, 488, 489
<i>Liponyssoides sanguineus</i> * (Hirst)	house mouse mite	B001	12, 488
<i>Ornithonyssus bacoti</i> * (Hirst)	tropical rat mite	B001 B004 B006 AI02	12, 489
<i>Ornithonyssus sylviarum</i> * Canestrini & Fanzago	northern fowl mite	B001 B004 AI02 AI03	12, 489
Parasitidae	parasitid mites	B006 B010	
<i>Eugamasus butleri</i> Hughes		A017	
Phytoseiidae	phytoseiid mites	B006 AO02	
<i>Amblyseius</i>		A017 AO01	
<i>Neoseiulus barkeri</i> Hughes		A017	

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<b>Taxon</b>	<b>Common Name</b>	<b>Reference</b>	<b>Page</b>
Uropodidae*	uropodid mites	<b>B006</b>	<b>8, 484</b>
<i>Fuscuropoda marginata*</i> (Koch)		<b>B006 B010 X001</b>	<b>8, 484</b>
<i>Leiodinychus krameri</i> (G. & R. Canestrini)		<b>B010 X001</b>	<b>8, 484</b>
<i>Trematura jacksonia</i> Hughes		<b>A017 B006</b>	
<i>Uroseius acuminatus</i> (Koch)		<b>A017 B010 X001</b>	
<hr/>			
Insecta* [Hexapoda] (class)	<b>insects</b>	<b>AQ01-AQ26</b>	<b>319-322, 334</b>

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- AQ02** Borror, D.J., D.M. DeLong, and C.A. Triplehorn.  
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Taxon	Common Name	Reference	Page
Dictyoptera* [Orthoptera, in part] (order)	dictyopterans		45, 46
Blattaria [Blattodea] (suborder)	<b>cockroaches</b>	<b>AQ02 AQ04 AS01-AS08</b>	46, 47, 527

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Thysanoptera. University of Hawaii, Honolulu.

Taxon	Common Name	Reference	Page
Blaberidae*	blaberid cockroaches	AQ02 AQ04	45, 46, 62, 65, 539-543
<i>Archimandrita tessellata</i> Rehn			
<i>Blaberus</i> *	giant cockroaches	AQ18 AS01 AT02	46, 47, 64, 65, 542
<i>Blaberus craniifer</i> * Burmeister		AQ22 AS03 AS07 AT02	46, 64, 542
<i>Blaberus discoidalis</i> * Serville		AS07 AT02	46, 64, 542
<i>Blaberus giganteus</i> * L.	giant cockroach	AS04 AS07	46, 64, 542
<i>Epilampra abdomennigrum</i> (De Geer)		AT04	
<i>Epilampra maya</i> Rehn		AT01 AT04	46
<i>Leucophaea maderae</i> * (Fabricius)	<b>Madeira cockroach</b>	AQ18 AQ20 AQ22 AS01 AS04 AS07 AS08	46, 64, 542
<i>Nauclydas nigra</i> (Brunner von Wattenwyl)			
<i>Nauphoeta cinerea</i> * (Olivier)	<b>cinereous cockroach</b>	AQ18 AQ22 AS01 AS04 AS07	46, 63, 541
<i>Panchlora nivea</i> * (L.)	<b>Cuban cockroach</b>	AQ18 AQ22 AS01 AS04	46, 62, 539
<i>Pycnoscelus indicus</i> * (Fabricius)	Indian cockroach	AT03	46, 63, 540
<i>Pycnoscelus surinamensis</i> * (L.)	<b>Surinam cockroach</b>	AQ18 AS01 AS03 AS04 AS06 AS08 AT03	46, 62, 63, 539

- AT01 Nickle, D.A., and B.W. Sibson.  
1984. *Epilampra maya* Rehn, a Central American cockroach newly established in the United States (Blattodea; Blaberidae; Epilamprinae). Florida Ent. 67(3)487-489.
- AT02 Rehn, J.A.G., and M. Hebard.  
1927. The Orthoptera of the West Indies. Blattidae. American Mus. Nat. Hist. Bull. 54:1-320, 25 pl.
- AT03 Roth, L.M.  
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- AT04 Roth, L.M., and A.B. Gurney.  
1969. Neotropical cockroaches of the *Epilampra abdomennigrum* complex; a clarification of their systematics (Dictyoptera, Blattaria). Ann. Ent. Soc. America 62(3)617-627.

Taxon	Common Name	Reference	Page
Blattellidae* [includes Ectobiidae]	blattellid cockroaches	AQ02 AQ04 AS02	45, 46, 48, 65, 534-538
<i>Aglaopteryx</i> * [ <i>Euthlastoblatta gemma</i> Hebard]	little gem cockroach	AS03 AS04	46, 48, 536
<i>Blattella asahinai</i> Mizukubo [ <i>B. beybienkoi</i> Roth]	<b>Asian cockroach</b>		46, 58
<i>Blattella germanica</i> * (L.)	<b>German cockroach</b>	AQ18 AQ22 AS01-AS04 AS06-AS08 AU05 AU09 AU11	46, 57, 58, 68, 534
<i>Blattella lituricollis</i> * (Walker)	<b>false German cockroach</b>	AS08 AU01 AU10 AU11	46, 57, 534
<i>Blattella vaga</i> * Hebard	field cockroach	AQ18 AQ22 AS01 AS07 AU05 AU11	46, 57, 58, 68, 534
<i>Ectobius</i>		AS01	
<i>Ectobius lapponicus</i> * (L.)	dusky cockroach	AS02 AS05-AS07 AU04	46, 60, 537
<i>Ectobius pallidus</i> * (Olivier)	<b>spotted Mediterranean cockroach</b>	AQ18 AQ22 AS02 AS04 AS05-AS07 AU04 AU06	46, 60, 66, 67, 537
<i>Ectobius panzeri</i> Stephens	lesser cockroach	AS02 AS05 AS06 AU04	
<i>Ectobius sylvestris</i> * (Poda)	forest cockroach	AS02 AS05 AS07 AU07	46, 60, 66, 537
<i>Eudromiella</i>			
<i>Ischnoptera deropeltiformis</i> (Brunner)	dark wood cockroach	AS04	
<i>Ischnoptera vulpina</i> Hebard			
<i>Lupparia</i> [ <i>Onychostylus</i> ] <i>vilis</i> (Brunner)	arboreal cockroach	AS01 AU02	46, 48
<i>Nyctibora noctivaga</i> * Rehn	banana cockroach	AQ22 AS07 AT02	46, 48, 535
<i>Parcoblatta</i> *	wood cockroaches	AQ18 AQ22 AS01 AS03 AS04	46, 47, 49, 60, 67
<i>Parcoblatta kyotensis</i> Asahina	Kyoto woodroach	AU03	60

Taxon	Common Name	Reference	Page
<i>Parcoblatta pennsylvanica</i> * (De Geer)	Pennsylvania woodroach	AS01 AS03 AS07	61, 538
<i>Parcoblatta virginica</i> * (Brunner)	Virginia woodroach	AS03 AS04 AS07	538
<i>Shawella coulouiana</i> * (Saussure)		AQ04 AS01 AS07 AU08	46, 48, 535
<i>Supella longipalpa</i> * (Fabricius) [ <i>S. supellectilium</i> (Serville)]	<b>brownbanded cockroach</b>	AQ18 AQ20 AQ22 AS02 AS03 AS04 AS07 AU09 AU10	46, 59, 66 67, 536

- AU01 Asahina, S.  
1964. Taxonomic notes on Japanese Blattaria, II. On the occurrence of *Blattella lituricollis* in Japan. Japanese Jour. Sanit. Zool. 15(2)61-67 (English summary).
- AU02 Asahina, S.  
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- AU03 Asahina, S.  
1976. Taxonomic notes on Japanese Blattaria, VII. A new *Parcoblatta* species found in Kyoto. Japanese Jour. Sanit. Zool. 27(2)115-120 (English summary).
- AU04 Brown, V.K.  
1980. Notes and key to the oothecae of the British *Ectobius* (Dictyoptera: Blattidae). Ent. Monthly Mag. 16(1392-1395)151-154.
- AU05 Buxton, G.M., and T.J. Freeman.  
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- AU06 Gurney, A.B.  
1978. The spotted Mediterranean cockroach, *Ectobius pallidus* (Olivier) (Dictyoptera, Blattaria, Blattellidae), in the United States. Coop. Econ. Insect Rpt. 18(29)684-686.
- AU07 Hoebeke, D.R., and D.A. Nickle.  
1981. The forest cockroach, *Ectobius sylvestris* (Poda), a European species newly discovered in North America (Dictyoptera, Blattodea, Ectobiidae). Proc. Ent. Soc. Washington 83(4)592-595.
- AU08 Johns, P.M.  
1966. The cockroaches of New Zealand. Rec. Canterbury Mus. 8(2)93-136.
- AU09 Narasimhan, A.U., and T. Sankaran.  
1980. On some diagnostic characters of the oothecae of six common cockroaches (Blattidae). System. Ent. 5(1)105-107.
- AU10 Roth, L.M.  
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- AU11 Roth, L.M.  
1985. A taxonomic revision of the genus *Blattella* Caudell (Dictyoptera, Blattaria: Blattellidae). Ent. Scandinavica suppl. 22:1-221.

Taxon	Common Name	Reference	Page
Blattidae*	blattid cockroaches	AQ02 AQ04 AS02	45, 46, 48, 65, 528-533
<i>Blatta lateralis</i> * (Walker)	<b>Turkestan cockroach</b>	AS01 AS05 AV01	46, 51, 56, 69, 532
<i>Blatta orientalis</i> * L.	<b>oriental cockroach</b>	AQ18 AQ20 AQ22 AS01 AS03-AS07	46, 49, 51, 56, 69, 322, 533
<i>Deropeltis erythrocephala</i> * Fabricius		AS07 AV04	46, 49, 532
<i>Eurycotis biolleyi</i> Rehn			
<i>Eurycotis floridana</i> * (Walker)	Florida stinkroach	AQ18 AQ22 AS01 AS03 AS04 AS07	46, 55, 70, 533
<i>Lamproblatta</i> *		AS04 AS07	46, 47, 49, 531
<i>Methana marginalis</i> * (Saussure)		AQ04 AV02	46, 41, 531
<i>Neostylopyga rhombifolia</i> * (Stoll)	<b>harlequin cockroach</b>	AS01 AS03 AS04 AS07 AS08 AU09	46, 54, 70, 529
<i>Pelmatosilpha</i> *		AT01 AV05	46, 49
<i>Periplaneta americana</i> * (L.)	<b>American cockroach</b>	AQ18 AQ20 AQ22 AS01 AS02 AS03 AS06-AS08 AU08 AU09 AV03	46, 50, 53, 69, 70, 529
<i>Periplaneta australasiae</i> * (Fabricius)	<b>Australian cockroach</b>	AQ18 AQ20 AQ22 AS01 AS03 AS04 AS06-AS08 AU08 AU09 AV03	46, 52, 70, 529
<i>Periplaneta brunnea</i> * Burmeister	<b>brown cockroach</b>	AQ04 AQ18 AQ22 AS01 AS03 AS04 AS07 AS08 AU09 AV03	46, 53, 70, 529
<i>Periplaneta fuliginosa</i> * (Serville)	<b>smokybrown cockroach</b>	AQ18 AQ22 AS01 AS03 AS04 AS07 AV03	46, 50, 70, 528
<i>Periplaneta japonica</i> * Karny	Japanese cockroach	AS01 AS07 AV03	46, 49, 528

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## AV02 Pope, P.

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1980. Description and keys to the first-instar nymphs of five *Periplaneta* species (Dictyoptera: Blattidae). Proc. Ent. Soc. Wash. 82(2)212-228.

## AV04 Princis, K.

1963. Blattariae. South African Animal Life (Results of the Lund University Expedition in 1950-1951) 9:9-318.

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AV05 Rehn, J.A.G.

1930. New or little known Neotropical Blattidae (Orthoptera). Trans. American Ent. Soc. 56(1)19-72, 5 pl.

Taxon	Common Name	Reference	Page
Cryptocercidae*	cryptocercid cockroaches	AQ02	45, 46, 62, 65, 539
<i>Cryptocercus punctulatus*</i> Scudder	brownhooded cockroach	AS03 AS04 AS07	46, 47, 62, 539
Polyphagidae*	polyphagid cockroaches	AQ02 AQ04 AS02	45-47, 61, 65, 538
<i>Arenivaga*</i>	sand cockroaches	AS02-AS05 AU08	46, 47, 61, 538
<i>Polyphaga aegyptiaca</i> (L.)		AS01 AS02 AS05 AS07 AX01	47, 61
<i>Polyphaga saussurei</i> (Dohrn)		AS01 AV01	61

AX01 Chopard, L.

1943. Orthoptéroïdes de l'Afrique du Nord. Larose, Paris.

Taxon	Common Name	Reference	Page
Coleoptera* (order)	beetles	A016 AQ02 AQ04 AQ10 AQ14 AQ17 AY01-AY11	75-77, 95, 96, 331-334, 347, 349, 545

AY01 Arnett, R.H., Jr.

1968. The beetles of the United States (a manual for identification). American Entomological Institute, Ann Arbor.

AY02 Arnett, R.H., Jr., N.M. Downie, and H.E. Jaques.

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AY03 Böving, A.G., and F.C. Craighead.

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1956. Coleoptera: Introduction and key to families. Handb. Ident. British Insects 4(1)1-59.

AY05 Dillon, E.S., and L.S. Dillon.

1961. A manual of common beetles of eastern North America. Row, Peterson, Evanston.

AY06 Hatch, M.H.

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AY07 Joy, N.H.

1976. A practical handbook of British beetles. 2 [1932]. vol. Classey, Faringdon.

AY08 Lepesme, P.

1944. Les coleoptères des denrées alimentaires et des produits industriels entreposés. Lechevalier, Paris.

AY09 Pratt, H.D., and H.G. Scott.

1962. A key to some beetles commonly found in stored foods (Coleoptera). Proc. Ent. Soc. Washington 64(1)43-50.



## AY10 Van Emden, F.I.

1942. Larvae of British beetles. III. Keys to families. Ent. Monthly Mag. 78(33-36)202-226, 253-272.

## AY11 White, R.E.

1983. A field guide to the beetles of North America. Houghton Mifflin, Boston.

Taxon	Common Name	Reference	Page
Anobiidae*	deathwatch and drugstore beetles	AQ01 AQ03 AQ13 AZ01 AZ05	82, 84, 98, 551
<i>Anobium punctatum</i> (De Geer)	furniture beetle	AQ07 AZ01	
<i>Lasioderma serricorne</i> * (Fabricius)	cigarette beetle	AQ07 AQ22 AY09 AZ01 AZ02 AZ03	84, 97, 335, 551
<i>Stegobium paniceum</i> * (L.)	drugstore beetle	AQ07 AQ22 AY09 AZ01 AZ02 AZ03	84, 98, 551
<i>Tricorynus</i> [ <i>Catorama</i> ] <i>confusus</i> (Fall)		AZ01 AZ04 AZ06 AZ07	84
<i>Tricorynus herbarius</i> (Gorham)	Mexican book beetle	AZ02 AZ04 AZ06 AZ07	84
<i>Tricorynus tabaci</i> (Guérin-Méneville)		AZ02 AZ06 AZ07	84

## AZ01 White, R.E.

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## AZ02 White, R.E.

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## AZ03 White, R.E.

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## AZ04 White, R.E.

1965. A revision of the genus *Tricorynus* of North America (Coleoptera: Anobiidae). Misc. Pub. Ent. Soc. America 4(7)283-368.

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## AZ06 White, R.E.

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## AZ07 White, R.E.

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Taxon	Common Name	Reference	Page
Anthicidae*	antlike flower beetles	A016 AQ02 BA01	80, 105, 548
<i>Anthicus</i> [ <i>Omonadus</i> ] <i>australis</i> (King)			
<i>Anthicus floralis</i> * (L.)	narrownecked grain beetle	A016 AQ07 BA04 BA05 BA06	80, 105, 548

Taxon	Common Name	Reference	Page
<i>Anthicus troilus</i> Hinton		A016	
<i>Notoxus calcaratus</i> Horn		BA02 BA03	
<i>Notoxus desertus</i> Casey [ <i>N. constrictus</i> Casey]		BA02 BA03	
<i>Notoxus monodon</i> (Fabricius)		A016 BA03	

- BA01** Buck, F.D.  
1954. Anthicidae. Handb. Ident. British Insects 5(9)22-24.
- BA02** Chandler, D.S.  
1977. A revision of the Central and South [1978]. American *Notoxus* and description of a new genus, *Plesionotoxus* (Coleoptera: Anthicidae). Contrib. American Ent. Inst. 15(3)1-83.
- BA03** Chandler, D.S.  
1982. A revision of the North American *Notoxus* with a cladistic analysis of the New World species. Entomography 1:333-438.
- BA04** Kitayama, C.Y.  
1982. Biosystematics of anthicid larvae (Coleoptera: Anthicidae). Coleop. Bul. 36(1)76-95.
- BA05** Werner, F.G.  
1964. A revision of the North American species of *Anthicus*, s. str. (Coleoptera: Anthicidae). Misc. Publ. Ent. Soc. America 4(5)193-242.
- BA06** Werner, F.G.  
1983. Anthicidae of the Greater Antilles, and a new species from Venezuela (Coleoptera). Psyche 90(3)211-235.

Taxon	Common Name	Reference	Page
Anthribidae*	fungus weevils	A016 AQ02 BB03 BB04	78, 100, 546
<i>Araecerus fasciculatus</i> * (De Geer)	coffee bean weevil	AQ07 BB01-BB03 BB05 BB06	78, 100, 546
<i>Araecerus viellardi</i> (Montrouzier)		BB06	

- BB01** Anderson, W.H.  
1947. Larvae of some genera of Anthribidae (Coleoptera). Ann. Ent. Soc. America 40(3)489-517.
- BB02** Cotton, R.T.  
1921. Four Rhynchophora attacking corn in storage. Jour. Agr. Res. 20(8)605-614, 4 pl.
- BB03** Holloway, B.A.  
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- BB04** Valentine, B.D.  
1960. The genera of the weevil family Anthribidae north of Mexico (Coleoptera). Trans. American Ent. Soc. 86(1)41-85.
- BB05** White, R.E.  
1967. Identification of the coffee bean weevil, *Araecerus fasciculatus* (De Geer). Coop. Econ. Insect Rpt. 17(23)496.

**BB06** Zimmerman, E.C.

1942. Anthribidae of Guam. Bernice P. Bishop Museum  
172:65-72 + 1 pl.

Taxon	Common Name	Reference	Page
Bostrichidae*	false powderpost beetles	A016 AQ02 BC02	89, 99, 554, 555
<i>Bostrychoplites cornutus</i> (Olivier)		BC02	
<i>Dinoderus bifoveolatus</i> (Wollaston)		BC02	
<i>Dinoderus minutus</i> * (Fabricius)	bamboo powderpost beetle	BC02 BC05	90, 100, 554
<i>Prostephanus truncatus</i> * (Horn)	larger grain borer	AQ22 BC02 BC03	89, 100, 554
<i>Rhyzopertha dominica</i> * (Horn)	lesser grain borer	AQ07 AQ22 BC02-BC04 BC06	90, 99, 555
<i>Scobicia declivis</i> (LeConte)	leadcable borer	BC01 BC02	

**BC01** Burke, H.E., R.D. Hartman, and T.E. Snyder.

1922. The lead-cable borer or "short-circuit beetle" in California. U.S. Dept. Agr. Bull. 1107:1-56, 9 pl.

**BC02** Fisher, W.S.

1950. A revision of the North American species of beetles belonging to the family Bostrichidae. U.S. Dept. Agr. Misc. Pub. 698:1-157.

**BC03** Hodges, R.J.

1982. A review of the biology and control of the greater grain borer *Prostephanus truncatus* (Horn). Trop. Stored Prod. Inform. 43:3-9.

**BC04** Potter, C.

1935. The biology and distribution of *Rhyzopertha dominica* (Fab.). Trans. Roy. Ent. Soc. London 83(4)449-482.

**BC05** Spilman, T.J.

1982. False powderpost beetles of the genus *Dinoderus* in North America. Coleop. Bull. 36(2)193-196.

**BC06** Spilman, T.J.

1984. Identification of larvae and pupae of the larger grain borer, *Prostephanus truncatus*, and the larger black flour beetle, *Cybaeus angustus*. Proc. Third Internatl. Conf. on Stored-product Ent. (October 1983), Kansas State University, Manhattan, pp. 44-52.

Taxon	Common Name	Reference	Page
Bruchidae*	seed beetles	A016 AQ02 BD11	75-77, 82, 87, 101, 109, 215, 216, 599-602
<i>Acanthoscelides argillaceus</i> (Sharp) [ <i>A. obreptus</i> Bridwell]		BD02 BD04	
<i>Acanthoscelides obtectus</i> * (Say)	bean weevil	AQ22 AY08 BD01 BD02 BD04 BD09	218, 601
<i>Acanthoscelides obvelatus</i> Bridwell		BD02 BD04	
<i>Acanthoscelides zeteki</i> Kingsolver		BD02 BD06	

Taxon	Common Name	Reference	Page
<i>Bruchidius antrolineatus</i> (Pic)		BD11	
<i>Bruchidius incarnatus</i> Boheman		BD01	
<i>Bruchus affinis</i> Froelich		BD03	
<i>Bruchus brachialis</i> Fähræus		BD01 BD03	
<i>Bruchus dentipes</i> (Baudi)		BD01 BD03	
<i>Bruchus emarginatus</i> Allard		BD01 BD03	
<i>Bruchus ervi</i> Froelich		BD01 BD03	
<i>Bruchus lentis</i> Froelich		BD01 BD03	
<i>Bruchus pisorum</i> * (L.)	pea weevil	AQ07 AQ22 AY09 BD01 BD03	101, 219, 602
<i>Bruchus rufimanus</i> Boheman	broadbean weevil	AY09 BD01	
<i>Bruchus rufipes</i> Herbst		BD03	
<i>Bruchus signaticornis</i> Gyllenhal		BD01 BD03	
<i>Bruchus tristiculus</i> Fähræus		BD01 BD03	
<i>Bruchus tristis</i> Boheman		BD03	
<i>Bruchus viciae</i> Olivier		BD03	
<i>Callosobruchus ademptus</i> (Sharp)		BD05	
<i>Callosobruchus analis</i> (Fabricius)		BD03 BD05	
<i>Callosobruchus chinensis</i> * (L.)	southern cowpea weevil	BD01 BD05 BD12	ii, iii, 220
<i>Callosobruchus maculatus</i> * (Fabricius)	cowpea weevil	AQ22 AY09 BD01 BD05 BD11 BD13	ii, iii, 40, 220
<i>Callosobruchus phaseoli</i> (Gyllenhal)		BD01 BD05	
<i>Callosobruchus rhodesianus</i> (Pic)		BD05 BD11 BD12	
<i>Callosobruchus subinnotatus</i> (Pic)		BD05 BD11	
<i>Caryedon serratus</i> * (Olivier) [ <i>C. gonagra</i> (Fabricius)]	groundnut bruchid, tamarind seed beetle	BD01 BD07 BD10 BD11	87, 101, 218, 601
<i>Zabrotes subfasciatus</i> * (Boheman)	Mexican bean weevil	BD01 BD08 BD09	217, 600

**BD01** Herford, G.M.

1935. A key to the members of the family Bruchidae (Col.) of economic importance in Europe. Trans. Soc. British Ent. 2(1)1-32.

**BD02** Johnson, C.D.

1983. Ecosystematics of *Acanthoscelides* (Coleoptera: Bruchidae) of southern Mexico and Central America. Misc. Publ. Ent. Soc. America 56:1-370.

**BD03** Kingsolver, J.M.

1965. A preliminary key to species of the genus *Bruchus* (Bruchidae) commonly intercepted in USDA quarantine inspections. U.S. National Museum, Washington, DC.

**BD04** Kingsolver, J.M.

1968. A review of the *obtectus* group in *Acanthoscelides* Schilsky, with designations of lectotypes. Proc. Ent. Soc. Washington 70(1)4-9.

- BD05** Kingsolver, J.M.  
1969. A key to the species of *Callosobruchus* (Bruchidae) intercepted in USDA plant quarantine inspections. U.S. Dept. Agr. Plant Quarantine Memo. 690, Hyattsville.
- BD06** Kingsolver, J.M.  
1969. A new species of Neotropical seed weevil affecting pigeon peas, with notes on two closely related species (Coleoptera: Bruchidae: Bruchinae). Proc. Ent. Soc. Washington 71(1):50-55.
- BD07** Kingsolver, J.M.  
1970. Groundnut bruchid (*Caryedon serratus* (Olivier)). Coop. Econ. Insect Rpt. 20(18):303-304.
- BD08** Kingsolver, J.M.  
1970. A synopsis of the subfamily Amblycerinae Bridwell in the West Indies, with descriptions of new species (Coleoptera: Bruchidae). Trans. American Ent. Soc. 96(4):469-497.
- BD09** McFarlane, J.A., and A.J.S. Wearing.  
1967. A means of differentiating between *Acanthoscelides obtectus* (Say) and *Zabrotes subfasciatus* (Boh.) (Coleoptera, Bruchidae) in white haricot beans at the pupal stage. Jour. Stored Prod. Res. 3(3):261-262.
- BD10** Prevett, P.F.  
1967. The larva of *Caryedon serratus* (Ol.): The groundnut seed beetle (Coleoptera: Bruchidae). Jour. Stored Prod. Res. 3(2):117-123.
- BD11** Prevett, P.F.  
1971. The larvae of some Nigerian Bruchidae (Coleoptera). Trans. Roy. Ent. Soc. London 123(3):247-312.
- BD12** Southgate, B.J.  
1958. Systematic notes on species of *Callosobruchus* of economic importance. Bull. Ent. Res. 49(3):591-599.
- BD13** Southgate, B.J., R.W. Howe, and G.A. Brett.  
1957. The specific status of *Callosobruchus maculatus* (F.) and *Callosobruchus analis* (F.). Bull. Ent. Res. 48(1):79-89, 2 pl.

Taxon	Common Name	Reference	Page
Byturidae*	fruitworm beetles	AQ02	87, 104
<i>Byturus fumatus</i> Fabricius		BE02	
<i>Byturus tomentosus</i> (De Geer)		BE02	
<i>Byturus unicolor</i> * Say [ <i>B. bakeri</i> Barber, <i>B. rubi</i> Barber]	raspberry fruitworm	BE01	87, 553

- BE01** Springer, C.A., and M.A. Goodrich.  
1983. A revision of the family Byturidae (Coleoptera) for North America. Coleop. Bull. 37(2):183-192.
- BE02** U.S. Department of Agriculture.  
1980. Pests not known to occur in the United States or of limited distribution. Raspberry beetles. *Byturus tomentosus* Fabricius. *Byturus fumatus* Fabricius. Coleoptera: Byturidae. Coop. Econ. Plant Pest Rpt. 5(1):41-44 (addendum).

Taxon	Common Name	Reference	Page
Carabidae	<b>ground beetles</b>	<b>A016 AQ02</b>	
<i>Harpalus rufipes</i> (De Geer)		<b>A016</b>	
<i>Laemostenus</i> [ <i>Pristonychus</i> ] <i>complanatus</i> (Dejean)		<b>A016</b>	
<i>Laemostenus terricola</i> (Herbst)		<b>A016</b>	
<i>Plochionus pallens</i> (Fabricius)		<b>A016</b>	
<i>Somotrichus unifasciatus</i> (Dejean)		<b>A016</b>	
<i>Sphodrus leucophthalmus</i> (L.)		<b>A016</b>	
Cerylonidae* [ <i>Murmididae</i> ]	<b>cerylonid beetles</b>	<b>A016 AQ02 BG01</b>	80, 96, 548
<i>Murmidius ovalis</i> * (Beck)	<b>oval grain beetle</b>	<b>A016 BG02</b>	80, 96, 548
<i>Murmidius segregatus</i> Waterhouse		<b>A016</b>	

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Taxon	Common Name	Reference	Page
Chrysomelidae*	<b>leaf beetles</b>	<b>A016 AQ02</b>	81, 82, 107, 549
<i>Crioceris asparagi</i> * (L.)	<b>asparagus beetle</b>		ii, iii, 82, 107, 549
<i>Crioceris duodecimpunctata</i> * (L.)	<b>spotted asparagus beetle</b>		81, 107, 549
<i>Leptinotarsa decemlineata</i> * (Say)	<b>Colorado potato beetle</b>		
Cleridae*	<b>checkered beetles</b>	<b>A016 AQ02 B101 AQ07</b>	87, 103, 149, 150, 573, 574
<i>Exkorynetes analis</i> (Klug)		<b>AQ07</b>	
<i>Necrobia ruficollis</i> * (Fabricius)	<b>redshouldered ham beetle</b>	<b>AQ07 AQ22 B102 B103</b>	ii, iii, 150
<i>Necrobia rufipes</i> * (De Geer)	<b>redlegged ham beetle</b>	<b>AQ07 AQ12 AQ22 B102 B103</b>	ii, iii, 150, 577
<i>Necrobia violacea</i> * (L.)	<b>blacklegged ham beetle</b>	<b>AQ07 AQ22 B102 B103</b>	ii, iii, 150
<i>Tarsostenus univitattus</i> (Rossi)		<b>AQ07</b>	
<i>Thaneroclerus buqueti</i> (Lefebvre)		<b>AQ07</b>	

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Taxon	Common Name	Reference	Page
Colydiidae	colydiid beetles	A016 AQ02	
<i>Aglenus brunneus</i> (Gyllenhal)		A016	
<i>Anchomma costatum</i> LeConte			
<i>Colobicus parilis</i> Pascoe		A016	
<i>Myrmechixenus</i>			
<i>Sassaka</i>			
Cryptophagidae*	silken fungus beetles	A016 AQ02	78, 107, 175-177, 581, 582
<i>Cryptophagus</i> *			78, 107, 176
<i>Cryptophagus acutangulus</i> * (Gyllenhal)	acute-angled fungus beetle	A016 BK01 BK02	177
<i>Cryptophagus cellaris</i> * (Scopoli)	cellar beetle	A016 BK01 BK02	178, 582
<i>Cryptophagus croceus</i> Zimmermann		A016 BK02	
<i>Cryptophagus dentatus</i> (Herbst) [C. fumatus (Marsham)]		A016 BK01 BK02	
<i>Cryptophagus distinguendus</i> Sturm		A016 BK01 BK02	
<i>Cryptophagus hexagonalis</i> Tournier		BK01 BK02	
<i>Cryptophagus laticollis</i> Lucas [C. affinis Sturm; C. inscitus Casey]		A016 BK01 BK02	582
<i>Cryptophagus lecontei</i> Harold		BK02	
<i>Cryptophagus obsoletus</i> Reitter		BK01 BK02	
<i>Cryptophagus pilosus</i> Gyllenhal		A016 BK01 BK02	
<i>Cryptophagus saginatus</i> Sturm		A016 BK01 BK02	
<i>Cryptophagus scanicus</i> (L.)		A016 BK01 BK02	
<i>Cryptophagus schmidti</i> Sturm		A016 BK01	
<i>Cryptophagus scutellatus</i> Newman		A016 BK01 BK02	
<i>Cryptophagus setulosus</i> Sturm		BK01 BK02	
<i>Cryptophagus subfumatus</i> Kraatz		A016 BK01 BK02	
<i>Cryptophagus tuberculosus</i> Mäklin		BK02	
<i>Cryptophagus valens</i> * Casey		BK02	178
<i>Cryptophagus varus</i> * (Woodroffe & Coombs)	sigmoid fungus beetle	BK02	177

Taxon	Common Name	Reference	Page
<i>Ephistemus</i>			
<i>Henoticus californicus</i> (Mannerheim)		A016 AQ07	

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Taxon	Common Name	Reference	Page
Cucujidae* [Silvanidae]	cucujid beetles	A016 AQ02	79, 83, 85, 105, 108, 547, 550, 552
<i>Ahasverus advena</i> * (Waltl)	foreign grain beetle	AQ07 AQ22 AY09 BL04	86, 552
<i>Cathartus quadricollis</i> * (Guérin-Ménéville)	squarenecked grain beetle	AQ22 AY09	86, 552
<i>Cryptolestes</i> *		AQ22 AY09	83, 105, 550
<i>Cryptolestes capensis</i> (Waltl)	Cape grain beetle	BL01 BL08	83
<i>Cryptolestes duplicatus</i> (Waltl)		BL04 BL08	
<i>Cryptolestes ferrugineus</i> (Stephens)	rusty grain beetle	AQ22 BL01-BL03 BL05 BL08 BL10	83
<i>Cryptolestes klapperichi</i> Lefkovitch		BL05	83
<i>Cryptolestes pusilloides</i> (Steel & Howe)		BL01 BL08	83
<i>Cryptolestes pusillus</i> (Schönherr)[ <i>C. minutus</i> (Olivier)]	flat grain beetle	AQ22 BL01-BL03 BL05 BL08 BL10	83, 550
<i>Cryptolestes turcicus</i> (Grouvelle)	Turkish grain beetle	AQ22 BL01 BL02 BL08 BL10	83
<i>Cryptolestes ugandae</i> (Steel & Howe)		BL01	83
<i>Leptophloeus janeti</i> (Grouvelle)		BL08	
<i>Monanus concinnulus</i> (Walker)		BL09	
<i>Oryzaephilus acuminatus</i> Halstead		BL07 BL12	
<i>Oryzaephilus gibbosus</i> Aitken		BL07	
<i>Oryzaephilus mercator</i> * (Fauvel)	merchant grain beetle	AQ07 BL04 BL07 BL08 BL11 BL12	79, 547
<i>Oryzaephilus surinamensis</i> * (L.)	sawtoothed grain beetle	AQ07 AQ22 BL04 BL07 BL11 BL12	40, 79
<i>Silvanus planatus</i> * Germar		BL06	



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- BL12** Thomas, M.C., and R.E. Woodruff.  
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Taxon	Common Name	Reference	Page
Curculionidae*	snout beetles, weevils	A016 AQ02 BM07	78, 109, 11, 223, 224, 603-608

Taxon	Common Name	Reference	Page
<i>Balanogastriis kolae</i> (Desbrochers)	kola nut weevil		224
<i>Caulophilus oryzae</i> * (Gyllenhal)[ <i>C. latinasus</i> (Say)]	avocado seed weevil	AQ07 AQ22 AY09 BB02 BM06	112, 226, 606
<i>Caulophilus rufotestaceus</i> (Champion)		BM06	
<i>Chalcodermus aeneus</i> * Boheman	cowpea curculio		111, 225, 604
<i>Conotrachelus</i>		BM10	
<i>Craponius inaequalis</i> (Say)	grape curculio		224
<i>Curculio</i> *		BM10	224
<i>Curculio caryae</i> (Horn)	pecan weevil	BM02 BM10	225, 605
<i>Curculio caryatrypes</i> (Boheman)		BM02 BM10	
<i>Curculio obtusus</i> (Blanchard)	hazelnut weevil	BM02	
<i>Curculio occidentis</i> (Casey)	filbert weevil	BM02	
<i>Curculio sayi</i> (Gyllenhal)	small chestnut weevil	BM02 BM10	
<i>Dinocleus</i> [ <i>Cleonus</i> ] <i>pilosus</i> (LeConte)			
<i>Heilipus</i>	avocado weevils		224
<i>Sitophilus granarius</i> * (L.)	granary weevil	AQ07 AQ22 AY09 BB02 BM04 BM05	110, 228, 607
<i>Sitophilus linearis</i> (Herbst)	tamarind weevil		227, 607
<i>Sitophilus oryzae</i> * (L.)	rice weevil	AQ07 AQ22 AY09 BB02 BM01 BM04 BM05 BM08 BM09	40, 110, 229, 608
<i>Sitophilus zeamais</i> * Motschulsky	maize weevil	AQ07 AQ22 AY09 BM01 BM04 BM08 BM09	110, 229, 608

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Taxon	Common Name	Reference	Page
Dermeestidae* [including Thoricidae]	dermestid beetles	A016 AQ02 AY08 BN14 BN19	82, 83, 91, 101, 115, 559-566
<i>Anthrenocerus australis</i> (Hope)		A016	
<i>Anthrenus caucasicus</i> Reitter		A016	
<i>Anthrenus coloratus</i> Reitter		A016 BN11 BN22 BN25	
<i>Anthrenus fuscus</i> Olivier		A016 BN22 BN25	
<i>Anthrenus museorum</i> (L.)		A016 AY07 BN14 BN25	
<i>Anthrenus pimpinellae</i> Fabricius		A016 BN22 BN25	
<i>Anthrenus sarnicus</i> Mroczkowski		BN22	
<i>Anthrenus scrophulariae</i> * (L.)	carpet beetle	A016 AQ22 AY08 BN02 BN14 BN22 BN23 BN25	ii, iii, 4, 82, 120, 131
<i>Anthrenus verbasci</i> * (L.)	varied carpet beetle	A016 AQ22 AY08 BN02 BN11 BN14 BN22 BN25	ii, iii, 4, 120, 131, 563
<i>Anthrenus vorax</i> Waterhouse		A016 AY08 BN14	
<i>Attagenus brunneus</i> * Faldermann [ <i>A. elongatulus</i> Casey]		BN06 BN09	121, 131
<i>Attagenus cyphonoides</i> Reitter		BN09 BN18	
<i>Attagenus fasciatus</i> (Thunberg) [ <i>A. gloriosae</i> (Fabricius)]		A016 BN06 BN18	
<i>Attagenus insidiosus</i> Halstead		BN09	
<i>Attagenus lobatus</i> Rosenhauer		A016 BN06	
<i>Attagenus pellio</i> * (L.)	felt beetle, fur beetle	A016 AQ07 AQ22 AY08 AY09 BN02 BN06 BN14 BN18	121, 130

Taxon	Common Name	Reference	Page
<i>Attagenus schaefferi</i> (Herbst)		BN06 BN09 BN14 BN24	
<i>Attagenus smirnovi</i> Zhantiev		BN09 BN18	
<i>Attagenus unicolor unicolor</i> * (Brahm) [A. <i>megatoma</i> (Fabricius); A. <i>piceus</i> (Olivier) of authors]	black carpet beetle	A016 AQ07 AQ22 AY08 BN02 BN06 BN09 BN14 BN18 BN24	121, 131, 564
<i>Attagenus unicolor japonicus</i> Reitter		BN09	
<i>Attagenus unicolor simulans</i> Solskij		BN09	
<i>Dermestes ater</i> * De Geer	black larder beetle	A016 AQ07 AQ22 AY08 BN01 BN10 BN13 BN14 BN20	119, 130, 554
<i>Dermestes bicolor</i> Fabricius		A016	
<i>Dermestes caninus</i> Germar		BN09BN14	
<i>Dermestes carnivorus</i> Fabricius		AQ07 AY08 BN10 BN13 BN14	
<i>Dermestes dimidiatus</i> Steven		A016	
<i>Dermestes frischii</i> Kügelann		AQ07 BN10 BN13 BN14	119, 128
<i>Dermestes haemorrhoidalis</i> * Küster	sheepskin dermestid	AQ07 BN01 BN17	119, 129, 561
<i>Dermestes lardarius</i> * L.	larder beetle	A016 AQ07 AQ22 AY08 AY09 BN02 BN10 BN13 BN14 BN17 BN20	118, 130, 561
<i>Dermestes leechi</i> Kalik		BN01	
<i>Dermestes maculatus</i> * De Geer	hide beetle	A016 AQ07 AQ22 AY08 BN02 BN10 BN13 BN19	117, 128, 561
<i>Dermestes marmoratus</i> Say		A016 BN10	
<i>Dermestes murinus</i> L.		A016 AY08	
<i>Dermestes mustelinus</i> Erichson		A016	
<i>Dermestes nidum</i> Arrow		A016 BN14	
<i>Dermestes peruvianus</i> * (Castelnau)	Peruvian larder beetle	AQ07 AQ22 BY07 BN01 BN02 BN17 BN20	119, 129, 561
<i>Dermestes undulatus</i> Brahm		A016 AY08	
<i>Megatoma variegata</i> (Horn)		A016	
<i>Novelsis aequalis</i> (Sharp)		BN06 BN12	
<i>Phradonoma tricolor</i> (Arrow)		A016	
<i>Phradonoma villosulum</i> (Duftschmid)		A016	
<i>Reesa vespulae</i> (Milliron)			
<i>Thoricodes heydeni</i> Reitter		BN08	
<i>Thylodrias contractus</i> * Motschulsky	odd beetle	A016 AQ22 BN02 BN14	91, 116, 127, 560
<i>Trogoderma cavum</i> Beal		BN07	
<i>Trogoderma glabrum</i> * (Herbst)	glabrous cabinet beetle	BN02-BN05 BN15	124, 134, 565

Taxon	Common Name	Reference	Page
<i>Trogoderma granarium</i> * Everts	khapra beetle	A016 AQ07 AQ22 AY08 AY09 BN04 BN05 BN14 BN15 BN21	123, 124, 133, 565
<i>Trogoderma inclusum</i> * LeConte	larger cabinet beetle	AQ07 AQ22 AY09 BN02 BN04 BN15 BN16	ii, iii, 4, 124, 134
<i>Trogoderma ornatum</i> * (Say)	ornate cabinet beetle	AQ22 BN02-BN05 BN14 BN16	ii, iii, 4, 126, 134
<i>Trogoderma simplex</i> * Jayne	plain cabinet beetle	AQ22 BN03-BN05 BN15 BN16	122, 132, 565
<i>Trogoderma sternale</i> Jayne		A016 BN03 BN15 BN16	
<i>Trogoderma variabile</i> * Ballion [ <i>T. parabile</i> Beal]	warehouse beetle	A016 AQ22 BN02-BN05 BN15 BN16	ii, iii, 4, 125 134, 566
<i>Trogoderma versicolor</i> * (Creutzer)	European larger cabinet beetle	AY08 BN14	126, 134, 565

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- BN10** Kingsolver, J.M.  
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- BN11** Kingsolver, J.M.  
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- BN13** Lapesme, P.  
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- BN14** Mutchler, A.J., and H.B. Weiss.  
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- BN24** Geisthardt, M.  
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- BN25** Hoebeke, E.R., A.G. Wheeler, Jr., and R.S. Beal, Jr.  
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Taxon	Common Name	Reference	Page
Discolomidae [Notiophygidae]			
<i>Parafallia simoni</i> John			
Endomychidae* [Mycetaeidae]	handsome fungus beetles	A016 AQ02	85, 99, 552
<i>Mycetaea subterranea*</i> (Fabricius) [ <i>M. hirta</i> (Marsham)]	hairy cellar beetle	A016 AQ07 AQ22	85, 99, 552
Histeridae			
<i>Acritus analis</i> LeConte			
<i>Carcinops mayeti</i> Marseul		BQ02 BQ03	
<i>Carcinops pumilio</i> (Erichson) [ <i>C. quattuordecimstriatus</i> (Stephens)]		AQ07 BQ01 BQ02	
<i>Carcinops troglodytes</i> (Paykull)		BQ02	
<i>Dendrophilus punctatus</i> (Herbst)		BQ01 BQ02	
<i>Dendrophilus xavieri</i> Marseul		BQ01 BQ03	
<i>Gnathoncus nannetensis</i> (Marseul)		BQ01 BQ03	
<i>Gnathoncus nanus</i> (Scriba)		BQ01 BQ03	
<i>Hypocacculus metallescens</i> (Erichson)		A023 BQ03	
<i>Peranus bimaculatus</i> (L.)		BQ01	
<i>Saprinus semipunctatus</i> (Fabricius)		BQ03	
<i>Saprinus semistriatus</i> (Scriba)		A023 BQ01 BQ03	

- BQ01** Halstead, D.G.H.  
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**BQ03** Hinton, H.E.

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Taxon	Common Name	Reference	Page
Languriidae* [Erotylidae]	<b>lizard beetles</b>	<i>A016 AQ02 BR01</i>	93, 107, 558
<i>Cryptophilus integer</i> (Heer)		<i>A016</i>	
<i>Pharaxonotha kirschi</i> * Reitter	Mexican grain beetle	<i>A016 AQ22 AY09</i>	93, 107, 558

**BR01** Roberts, A.W.R.

1958. On the taxonomy of Erotylidae (Coleoptera), with special reference to the morphological characters of the larvae. II. *Trans. Roy. Ent. Soc. London* 110(8)245-285.

Taxon	Common Name	Reference	Page
Lathridiidae* [including Merophysiidae]	<b>minute brown scavenger beetles</b>	<i>A016 AQ02 BS04</i>	84, 108, 179-181, 583-587
<i>Adistemia rileyi</i> Hinton		<i>A016</i>	
<i>Adistemia watsoni</i> * (Wollaston)		<i>A016 BS01</i>	181, 584
<i>Aridius</i> [Coninomus] <i>nodifer</i> (Westwood)		<i>A016 BS01 BS03 BS04</i>	584
<i>Aridius subfasciatus</i> Reitter		<i>A016</i>	
<i>Cartodere</i> [Coninomus] <i>constricta</i> * (Gyllenhal)	<b>plaster beetle</b>	<i>A016 AQ07 BS03</i>	184, 587
<i>Corticaria elongata</i> (Gyllenhal)		<i>A016 BS01 BS04</i>	
<i>Corticaria fenestralis</i> (L.)		<i>A016 BS04</i>	
<i>Corticaria fulva</i> (Comolli)		<i>A016 BS01</i>	
<i>Corticaria punctulata</i> Marsham [ <i>C. pubescens</i> (Gyllenhal)]		<i>A016 AQ07 BS01 BS04</i>	
<i>Corticaria subtilissima</i> Reitter		<i>A016</i>	
<i>Corticaria</i> [ <i>Corticarina</i> ] <i>gibbosa</i> (Herbst)		<i>BS01 BS02</i>	
<i>Dienerella</i> [ <i>Cartodere</i> ; <i>Microgramme</i> ] <i>arga</i> * (Reitter)		<i>A016 BS01</i>	183, 585
<i>Dienerella costulata</i> * (Reitter)		<i>A016 BS01</i>	183, 586
<i>Dienerella filiformis</i> * (Gyllenhal)		<i>A016 BS01 BS03</i>	183, 586
<i>Dienerella filum</i> * (Aubé)		<i>A016 BS01</i>	182, 585
<i>Dienerella ruficollis</i> (Marsham)		<i>A016 BS01</i>	182, 585
<i>Enicmus histrio</i> Joy & Tomlin		<i>A016</i>	
<i>Eufalloides holmesi</i> Hinton		<i>A016</i>	
<i>Holoparamecus caularum</i> (Aubé)		<i>A016 BS01</i>	
<i>Holoparamecus depressus</i> Curtis		<i>A016</i>	
<i>Holoparamecus ragusae</i> Reitter		<i>A016 BS01</i>	
<i>Holoparamecus singularis</i> (Beck)		<i>A016 BS01</i>	
<i>Lathridius</i> [ <i>Enicmus</i> ] <i>anthracinus</i> Mannerheim			
<i>Lathridius minutus</i> * (L.)	<b>square-nosed fungus beetle</b>	<i>A016 BS01 BS03</i>	184, 587



Taxon	Common Name	Reference	Page
<i>Lathridius protensicollis</i> Mannerheim		A016 BS01	184, 587
<i>Lathridius pseudominutus</i> (Strand)			
<i>Lathridius suspectus</i> (Fall)		A016 BS01	
<i>Melanophthalma americana</i> (Mannerheim)		A016 BS01	
<i>Melanophthalma distinguenda</i> (Comolli)		A016 BS01	
<i>Melanophthalma longipennis</i> (LeConte)		A016 BS01	
<i>Melanophthalma picta</i> (LeConte)		A016 BS01	
<i>Metophthalmus serripennis</i> (Broun)		A016	
<i>Migneauxia orientalis</i> Reitter		A016	
<i>Thes</i> [ <i>Lathridius</i> ] <i>bergrothi</i> (Reitter)	ridgewinged fungus beetle	A016 AQ07 BS03	

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54(5)217-235.

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Taxon	Common Name	Reference	Page
Lyctidae*	powderpost beetles	A016 AQ02	90, 98
<i>Lyctus brunneus</i> * (Stephens)	brown powderpost beetle	AQ07 AQ22 BT01	90, 555

## BT01 Gerberg, E.J.

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Taxon	Common Name	Reference	Page
Mycetophagidae*	hairy fungus beetles	A016 AQ02	92, 106, 557
<i>Litargus balteatus</i> * LeConte		A016 BU03	93, 106, 557
<i>Mycetophagus quadriguttatus</i> Müller		A016 AQ07 BU03	
<i>Typhaea stercorea</i> * (L.)	hairy fungus beetle	A016 AQ07 AY09 BU01 BU02 BU03	92, 106, 557

- BU01** Hayashi, N.  
 1971. On the larvae of Mycetophagidae occurring in Japan (Coleoptera: Cucujoidea). *Kontyû* 39(4)361-367.
- BU02** Klausnitzer, B.  
 1974. Zur Unterscheidung der Larven von *Typhaea* Curtis und *Mycetophagus* Hellwig (Col., Mycetophagidae). *Ent. Nachr.* 18(11-12)188.
- BU03** Parsons, C.T.  
 1975. Revision of the Nearctic Mycetophagidae (Coleoptera). *Coleop. Bull.* 29(2)93-108.

Taxon	Common Name	Reference	Page
Nitidulidae*	sap beetles	A016 AQ02	87, 102, 575-580
<i>Brachypeplus pilosellus</i> Murray			
<i>Carpophilus dimidiatus</i> * (Fabricius)	corn sap beetle	A016 AQ07 BV03 BV04	160, 173, 579
<i>Carpophilus flavipes</i> Murray		A016	152
<i>Carpophilus freemani</i> * Dobson		BV02	162, 173, 579
<i>Carpophilus fumatus</i> * Boheman		BV03	152, 163, 172, 579
<i>Carpophilus hemipterus</i> * (L.)	driedfruit beetle	A016 AQ07 BV02-BV04	159, 171, 322, 578
<i>Carpophilus humeralis</i> * (Fabricius) [ <i>Urophorus humeralis</i> (Fabricius)]	pineapple sap beetle	A016 BV02-BV04	157, 167, 577
<i>Carpophilus immaculatus</i> Lucas		A016	152
<i>Carpophilus ligneus</i> * Murray		A016 AQ07 BV03	164, 168, 580
<i>Carpophilus lugubris</i> * Murray	dusky sap beetle	BV02 BV04	164, 171, 580
<i>Carpophilus maculatus</i> * Murray		A016 BV03	110, 161, 579
<i>Carpophilus marginellus</i> * Motschulsky		A016 BV02 BV03	161, 165, 170, 580
<i>Carpophilus mutilatus</i> * Erichson		BV02 BV03	163, 172
<i>Carpophilus obsoletus</i> * Erichson		A016 AQ07 BV03 BV04	159, 169, 578
<i>Carpophilus pilosellus</i> * Motschulsky		BV04	152, 160, 173, 579
<i>Carpophilus sexpustulatus</i> (Fabricius)		A016	152
<i>Conotelus stenoides</i> * Murray		BV01 BV04	156, 167, 577
<i>Glischrochilus fasciatus</i> * (Olivier)		A016 BV01 BV02 BV04	152, 154, 576
<i>Glischrochilus quadrisignatus</i> * (Say)		A016 BV01 BV02 BV04	154, 576
<i>Haptoncus flavidus</i> (Fairmaire)		A016	152
<i>Haptoncus luteolus</i> * (Erichson)	yellowbrown sap beetle	A016 BV01 BV04	152, 155, 576

Taxon	Common Name	Reference	Page
<i>Lobiopa insularis</i> * (Castelnau)		BV01 BV04	155, 166, 576
<i>Nitidula bipunctata</i> * (L.)		A016 BV04	152, 157, 577
<i>Nitidula ziczac</i> * Say		BV04	152, 157, 577

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**BV02** Connell, W.A.

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**BV03** Dobson, R.M.

1954. The species of *Carpophilus* Stephens (Col., Nitidulidae) associated with stored products. Bull. Ent. Res. 45(2):389-402.

**BV04** Parsons, C.T.

1943. A revision of the Nearctic Nitidulidae (Coleoptera). Bul. Mus. Comp. Zool. 92(3):119-278, 13 pl.

Taxon	Common Name	Reference	Page
Ptinidae*	<b>spider beetles</b>	A016 AQ02 BW05	89, 97, 137
<i>Gibbium aequinoctiale</i> Boieldieu		BW08	140
<i>Gibbium psylloides</i> * (Czenpinski)	hump beetle	AY07 AT09 BW03-BW06 BW08	140, 568
<i>Mezium affine</i> * Boieldieu	northern spider beetle	AQ07 AY09 BW03-BW06	140
<i>Mezium americanum</i> * (Laporte)	<b>American spider beetle</b>	AY09 BW01 BW04-BW06	ii, iii, 140, 331, 568
<i>Niptus hololeucus</i> * (Faldermann)	<b>golden spider beetle</b>	AQ07 AY09 BW01-BW04 BW07	ii, iii, 142, 569
<i>Pseudeurostus alienus</i> Brown		AY09 BW01	
<i>Pseudeurostus hilleri</i> * (Reitter)		AQ07 BW03-BW05	143, 570
<i>Ptinus bicinctus</i> Sturm		BW01 BW04 BW05	
<i>Ptinus clavipes</i> * Panzer [ <i>P. latro</i> of authors; <i>P. mobilis</i> Moore; <i>P. brunneus</i> Duftschmid; <i>P. hirtellus</i> Sturm]	<b>brown spider beetle</b>	AQ07 AY09 BW03-BW06	145, 146
<i>Ptinus fur</i> * (L.) [ <i>P. latro</i> Fabricius]	<b>whitemarked spider beetle</b>	AQ07 AY09 BW03-BW05	143-146, 572
<i>Ptinus gandolphei</i> * Pic		BW05 BW06	144
<i>Ptinus japonicus</i> Reitter		BW04	
<i>Ptinus ocellus</i> * Brown [ <i>P. tectus</i> Boieldieu]	<b>Australian spider beetle</b>	AQ07 AY09 BW01 BW03 BW04 BW05	143, 571
<i>Ptinus pusillus</i> Sturm		AQ07 BW03 BW04	
<i>Ptinus raptor</i> * Sturm	Canadian spider beetle	AY08 BW01 BW03-BW05	144
<i>Ptinus sexpunctatus</i> Panzer		BW03 BW04	
<i>Ptinus villiger</i> * (Reitter)	<b>hairy spider beetle</b>	AY09 BW01 BW02 BW04 BW06	

Taxon	Common Name	Reference	Page
<i>Sphaericus gibboides</i> * (Boieldieu)	humpbacked spider beetle	BW04-BW06	141, 569
<i>Stethomezium squamosum</i> Hinton		BW03	
<i>Tipnus unicolor</i> (Piller & Mitterpacher)		AQ07 AY09 BW01 BW03 BW04-BW06	
<i>Trigonogenius globulum</i> * (Solier)	globular spider beetle	AQ07 AY09 BW01 BW03-BW06	143, 569

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**BW02** Brown, W.J.

1959. *Niptus* Boield. and allied genera in North America (Coleoptera: Ptinidae). Canadian Ent. 91(10)627-633.

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**BW04** Hinton, H.E.

1941. The Ptinidae of economic importance. Bull. Ent. Res. 31(4)331-381.

**BW05** Papp, C.S.

1962. An illustrated and descriptive catalog of the Ptinidae of North America. Deut. Ent. Ztschr. (n.f.) 9(5)367-423.

**BW06** Papp, C.S., and G.T. Okumura.

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**BW07** Spilman, T.J.

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**BW08** Bellés, X., and D.G.H. Halstead.

1985. Identification and geographical distribution of *Gibbium aequinoctiale* Boieldieu and *Gibbium psylloides* (Czenpinski) (Coleoptera: Ptinidae). Jour. Stored Products Res. 21(3)151-155.

Taxon	Common Name	Reference	Page
Scarabaeidae	scarabs	A016 AQ02	334
<i>Cotinus mutabilis</i> (Gory & Percheron) [ <i>C. texana</i> Casey]	fig beetle	BX01	

**BX01** Goodrich, M.A.

1966. A revision of the genus *Cotinus* (Coleoptera: Scarabaeidae). Ann. Ent. Soc. America 59(3)550-568.

Taxon	Common Name	Reference	Page
Scolytidae*	bark beetles	A016 AQ02	90, 112, 556

Taxon	Common Name	Reference	Page
<i>Hypothenemus hampei</i> * (Ferrari) [ <i>Stephanoderes coffeae</i> Hagedorn]	coffee berry borer	AQ12 BY01 BY03	90, 112, 555
<i>Pagiocerus</i>		BY02	
<i>Pagiocerus frontalis</i> (Fabricius) [ <i>P. fiorii</i> (Egger)]		BY03	

**BY01** Duffy, E.A.J.

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**BY03** Wood, S.L.

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Taxon	Common Name	Reference	Page
Staphylinidae	rove beetles	A016 AQ02	331
<i>Aleochara sparsa</i> Heer		A016 BZ05	
<i>Anotylus</i> [ <i>Oxytelus</i> ] <i>tetracarinatus</i> (Block)		A016 AQ07 BZ04 BZ08	
<i>Atheta celata</i> (Erichson) [A. <i>arenicola</i> Thomson]		A016 BZ05	
<i>Atheta coriaria</i> (Kraatz)		A016 BZ05	
<i>Atheta nigricornis</i> (Thomson)		A016 BZ05	
<i>Atheta trinotata</i> (Kraatz)		A016 BZ05	
<i>Carpelimus pusillus</i> (Gravenhorst)		A016 BZ04 BZ08	
<i>Cilea</i> [ <i>Leucoparyphus</i> ] <i>silphoides</i> (L.)		A016 BZ01 BZ04	
<i>Crataraea suturalis</i> (Mannerheim)		A016 BZ05	
<i>Creophilus maxillosus</i> (L.)	hairy rove beetle	A016 BZ04	
<i>Falagria concinna</i> Erichson		BZ05	
<i>Gabrius nigrutilus</i> (Gravenhorst)		BZ04	
<i>Leptacinus pusillus</i> (Stephens) [ <i>L. linearis</i> (Gravenhorst)]		A016	
<i>Lithocharis ochracea</i> (Gravenhorst)		BZ04	
<i>Oligota apicata</i> Erichson		A016 BZ05 BZ09 BZ11	
<i>Oligota chrysopyga</i> Kraatz		BZ09 BZ11	
<i>Oligota granaria</i> Erichson		A016 BZ05 BZ09	
<i>Oligota parva</i> Kraatz		A016 BZ05 BZ09 BZ10	
<i>Oligota pseudoparva</i> Williams		BZ10	
<i>Oligota punctulata</i> Heer [O. <i>ruficornis</i> Sharp]		A016 BZ05 BZ09	
<i>Oligota pusillima</i> Gravenhorst [O. <i>atomaria</i> Erichson]		A016 BZ05 BZ09	

Taxon	Common Name	Reference	Page
<i>Omalius rivulare</i> (Paykull)		A016 BZ04 BZ08	
<i>Oxytelus sculptus</i> Gravenhorst		A016 BZ04 BZ08	
<i>Paederus duplex</i> Eppelsheim		BZ03	
<i>Philonthus discoideus</i> (Gravenhorst)		BZ04	
<i>Philonthus nigriventris</i> Thomson		BZ04	
<i>Philonthus sordidus</i> (Gravenhorst)		A016 BZ04	
<i>Philonthus varians</i> (Paykull)		BZ04	
<i>Phloeostiba plana</i> (Paykull) [ <i>Phloeonomus planus</i> (Paykull)]		A016 BZ04 BZ08	
<i>Proteinus ovalis</i> Stephens		A016 BZ04 BZ08	
<i>Quedius fulgidus</i> (Fabricius) [Q. <i>assimilis</i> (Nordmann)]		A016 BZ04 BZ06	
<i>Quedius fuliginosus</i> (Gravenhorst)		A016 BZ04	
<i>Quedius mesomelinus</i> (Marsham)		A016 BZ04 BZ06	
<i>Tachyporus</i>		BZ02 BZ04	
<i>Xylodromus concinnus</i> (Marsham)		A016 BZ04 BZ08	
<i>Xylodromus depressus</i> (Gravenhorst)		A016 BZ04 BZ08	

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**BZ07** Smetana, A.

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**BZ08** Tottenham, C.E.

1954. Coleoptera: Staphylinidae, section (a), Piestinae to Euaesthetinae. Handb. Ident. British Insects 4(8a)1-79.

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- BZ10** Williams, S.A.  
1972. A Brazilian species of *Oligota* (Col., Staphylinidae) new to science and imported into Britain. Ent. Monthly Mag. 108(1292-1294)38-39.
- BZ11** Williams, S.A.  
1974. *Oligota (Holobus) chrysopyga* Kraatz (Col., Staphylinidae) imported into Britain from Brazil. Ent. Monthly Mag. 109(1310-1312)164-165.

Taxon	Common Name	Reference	Page
Tenebrionidae*	darkling beetles	A016 AQ02 CA14	82, 83, 102, 185, 589-598
<i>Alphitobius diaperinus</i> * (Panzer)	lesser mealworm	AQ07 AQ22 CA05 CA08 CA16	194, 208, 595
<i>Alphitobius laevigatus</i> * (Fabricius) [ <i>A. piceus</i> (Olivier)]	black fungus beetle	AQ07 AQ22 CA02 CA05 CA08 CA16	195, 208
<i>Alphitobius viator</i> * Mulsant & Godart		CA05	186, 195, 595
<i>Alphitophagus bifasciatus</i> * (Say)	twobanded fungus beetle	AQ07 AQ22 CA02 CA08 CA16	ii, iii, 187, 211
<i>Apsena rufipes</i> * Eschscholtz	fig engraver beetle		186, 188, 590
<i>Blaps mucronata</i> Latreille	churtyard beetle	AQ07 CA16	
<i>Blapstinus discolor</i> * Horn [ <i>B. fuliginosus</i> Casey; <i>B. rufipes</i> Casey]	fig darkling beetle	CA03	193, 207, 594
<i>Coelopalorus</i> * [ <i>Palorus</i> ] <i>carinatus</i> (Blair)		CA06	596
<i>Coelopalorus foveicollis</i> * (Blair)		CA06 CA13	186, 196, 596
<i>Cyanaeus angustus</i> * (LeConte)	larger black flour beetle	AY09 BC06	199, 595
<i>Gnatocerus cornutus</i> * (Fabricius)	broadhorned flour beetle	AQ07 AQ22 CA02 CA08	200, 212, 598
<i>Gnatocerus maxillosus</i> * (Fabricius)	slenderhorned flour beetle	AQ07 AQ22 CA02	200, 210, 598
<i>Latheticus oryzae</i> * Waterhouse	longheaded flour beetle	AQ07 AQ22 CA02 CA08 CA16	199, 204, 596
<i>Lepidocnemeplatia</i> [ <i>Cnemeplatia</i> ] <i>sericea</i> * (Horn)			186, 187, 590
<i>Neatus tenebrioides</i> * Palisot			191, 208, 592
<i>Palembus dermestoides</i> * (Fairmaire)			194, 212, 594
<i>Palembus ocularis</i> * Casey		CA15	194, 211, 594
<i>Palorinus</i> [ <i>Palorus</i> ] <i>humeralis</i> * (Gebien)		CA06	186, 196
<i>Palorus cerylonoides</i> * (Pascoe)		CA06	186, 198
<i>Palorus ficicola</i> * (Wollaston)		CA06	186, 198
<i>Palorus genalis</i> * Blair		CA06	186, 197

Taxon	Common Name	Reference	Page
<i>Palorus laesicollis</i> * (Fairmaire)		CA06	186, 196, 597
<i>Palorus ratzeburgii</i> * (Wissmann)	<b>smalleyed flour beetle</b>	AQ07 AQ22 CA02 CA06 CA08 CA13	198, 203, 597
<i>Palorus subdepressus</i> * (Wollaston)	<b>depressed flour beetle</b>	AQ07 AQ22 CA02 CA06 CA08 CA13	197, 203, 597
<i>Platydema ruficorne</i> * (Sturm)	redhorned grain beetle	AQ22 CA15	193, 210, 592
<i>Sitophagus hololeptoides</i> * (Laporte)		CA04	199, 210, 598
<i>Tenebrio molitor</i> * L.	<b>yellow mealworm</b>	CA07 AQ22 CA02 CA08 CA15	186, 192, 203, 335, 593
<i>Tenebrio obscurus</i> * Fabricius	<b>dark mealworm</b>	AQ07 AQ22 CA02 CA08 CA15	192, 203, 593
<i>Tribolium audax</i> * Halstead	<b>American black flour beetle</b>	CA01 CA07 CA12	190, 206, 592
<i>Tribolium brevicorne</i> * (LeConte)	giant flour beetle	CA09	188, 206, 590
<i>Tribolium castaneum</i> * (Herbst)	<b>red flour beetle</b>	AQ07 AQ22 CA02 CA09 CA10 CA12 CA16	186, 190, 205, 591
<i>Tribolium confusum</i> * Jacquelin du Val	<b>confused flour beetle</b>	AQ07 AQ22 CA02 CA08 CA09 CA10 CA12 CA16	186, 189, 206, 591
<i>Tribolium destructor</i> * Uyttenboogaart	dark flour beetle	AQ07 AQ22 CA02 CA08 CA10 CA12 CA16	189, 206, 590
<i>Tribolium freemani</i> Hinton		CA11	
<i>Tribolium madens</i> * (Charpentier)	black flour beetle	AQ22 CA01 CA07 CA09 CA10 CA12 CA16	190, 205, 592

CA01 Becker, E.C.

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CA02 Brendell, M.J.D.

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- CA12 Sokoloff, A.  
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- CA16 Van Emden, F.I.  
1947. Larvae of British beetles. VI. Tenebrionidae. Ent. Monthly Mag. 83(997)154-160, (998)161-171.

Taxon	Common Name	Reference	Page
Trogositidae* [Ostomidae, Ostomatidae, Lophocateridae]	trogositid beetles	A016 AQ02	91, 103, 556, 558
<i>Lophocateres pusillus</i> * (Klug)	Siamese grain beetle	AQ19 AQ23 AY09 CB01 CB02	93, 104, 558
<i>Tenebroides mauritanicus</i> * (L.)	cadelle	AQ07 AQ19 AQ23 AY09 CB01 CB02	91, 104, 556

- CB01 Barron, J.R.  
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**CB02** Chittenden, F.H.

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Taxon	Common Name	Reference	Page
Lepidoptera* (order)	moths, butterflies	AQ02 AQ05 AQ10 AQ13 AQ17 AQ20 AQ25 CC01 CC02-CC10	231, 245, 248, 314, 343, 609-615

**CC01** Capps, H.W

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**CC03** Fracker, S.B.

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**CC04** Hinton, H.E.

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**CC10** Zimmerman, E.C.

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Taxon	Common Name	Reference	Page
Argyresthiidae* [Yponomeutidae]	argyresthiid moths	AQ02 CC09	264, 615
<i>Argyresthia conjugella</i> * (Zeller)	apple fruit moth	CC01 CC09 CD01	264, 615

**CD01** Werner, K.

1958. Die Larvalsystematik einiger Kleinschmetterlingsfamilien (Hyponomeutidae, Orthoteliidae, Acrolepiidae, Tineidae, Incurvariidae und Adelidae). Akademie-Verlag, Berlin.

Taxon	Common Name	Reference	Page
Cosmopterigidae*	cosmopterigid moths	CC01 CC09	264, 614
<i>Pyroderces</i> * [ <i>Sathrobrotia</i> ] <i>rileyi</i> Walsingham	pink scavenger caterpillar	AQ07 AQ22 AQ23 CC02 CC04 CC06 CC07	264, 335, 614
Gelechiidae*	gelechiid moths	CC01 CC04 CC09	242, 265, 615
<i>Keiferia lycopersicella</i> (Walsingham)	tomato pinworm	CC01 CC09 CE01	
<i>Phthorimaea</i> [ <i>Gnorimoschema</i> ] <i>operculella</i> (Zeller)	potato tuberworm	CC01 CE02	
<i>Sitotroga cerealella</i> * (Olivier)	Angoumois grain moth	AQ07 AQ19 AQ23 AQ25 CC01 CC02 CC04 CC09 CC10	40, 242, 265, 314, 615

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1946. Description of the larva of *Keiferia peniculo* Heinrich, with a key to the larvae of related species attacking eggplant, pepper, potato and tomato in the United States (Lepidoptera: Gelechiidae). Ann. Ent. Soc. America 39(4):561-563.

## CE02 Zagulyayev, A.K.

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Taxon	Common Name	Reference	Page
Libytheidae	snout butterflies	AQ02	
<i>Libytheana bachmanii</i> (Kirtland)		AQ02	
Noctuidae* [Phalaenidae]	owlet moths, underwings	AQ02 CC01 CC09 CC10 CG03	247, 610, 611
<i>Autographa gamma</i> * (L.)	silver Y moth	CC05 CC09 CG01	248
<i>Helicoverpa</i> [ <i>Heliothis</i> ] <i>zea</i> * (Boddie)	corn earworm, tomato fruitworm, bollworm	AQ13 CC01 CC07-CC09 CG02 CG04	249, 611
<i>Mamestra brassicae</i> * (L.)	cabbage moth	CC05 CC09 CG01	249, 610
<i>Trichoplusia ni</i> * (Hübner)	caggage looper	CC08 CC09 CG03-CG05	248

## CG01 Beck, H.

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## CG02 Crumb, S.E.

1926. The Nearctic budworms of the lepidopterous genus *Heliothis*. Proc. U.S. Nat. Mus. 68(2617):1-8, 1 pl.

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## CG04 Dekle, G.W.

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CG05 Eichlin, T.D.

1975. A guide to the adult and larval Plusiinae of California (Lepidoptera: Noctuidae). California Dept. Food Agr. Occ. Papers Ent. 21:1-73.

Taxon	Common Name	Reference	Page
Oecophoridae*	oecophorid moths	AQ02 CC01 CC04 CC09	242, 265, 615
<i>Endrosis sarcitrella</i> * (L.) [ <i>E. lactella</i> (Schiffermüller)]	whiteshouldered house moth	AQ07 AQ23 CC01 CC02 CC04 CC09 CC10 CH01 CH02 CH03	243, 265, 314
<i>Hofmannophila</i> [ <i>Borkhausenia</i> ] <i>pseudospretella</i> * (Stainton)	brown house moth	AQ25 CC01 CC02 CC04 CH02 CH03	243, 314, 615

CH01 Arbogast, R.T., G. Chauvin, R.G. Strong, and R.V. Byrd.

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Taxon	Common Name	Reference	Page
Pieridae*	whites, sulphur butterflies	CC01 CC09 CC10	246, 610
<i>Pieris brassicae</i> (L.)	cabbageworm	CC01 CC09	
<i>Pieris</i> [ <i>Artogeia</i> ] <i>rapae</i> * (L.)	imported cabbageworm	CC01 CC09	246, 610
Pyralidae*	pyralid moths	AQ02 CC04 CC09 CC10 CJ04	232, 247, 611-613
<i>Achroia grisella</i> * (Fabricius)	lesser wax moth	AQ23 CC02 CC04 CC10 CJ04 CJ07	236, 256, 314
<i>Acrobasis nuxvorella</i> * Neunzig	pecan nut casebearer	CC02 CC04 CC06	250
<i>Acrobasis vaccinii</i> * Riley	cranberry fruitworm	CJ06	250
<i>Aglossa caprealis</i> * Hübner	murky meal moth	AQ25 CC02 CC04 CC06 CC09 CJ04	235, 259, 613
<i>Amyelois transitella</i> (Walker)	navel orangeworm	AQ20 CC01 CC02 CC07 CC09 CJ01 CJ10	237, 251
<i>Anagasta kuehniella</i> * (Zeller)	Mediterranean flour moth	AQ03 AQ07 AQ19 AQ22 AQ23 AQ25 CC02 CC04 CC06 CC07 CC09 CC10 CJ01 CJ04 CJ05 CJ07 CJ09	238, 254, 314
<i>Cadra calidella</i> * (Guenée)	carob moth	CC02 CC09 CJ01 CJ04 CJ09	241, 255

Taxon	Common Name	Reference	Page
<i>Cadra cautella</i> * (Walker)	almond moth	AQ07 CC02 CC04 CC06 CC09 CC10 CJ01 CJ04 CJ07 CJ09	241, 254
<i>Cadra figulilella</i> * (Gregson)	raisin moth	AQ20 CC02 CC07 CC09 CC10 CJ03 CJ04 CJ09	240, 255
<i>Corcyra cephalonica</i> * (Stainton)	rice moth	AQ07 AQ23 AQ25 CC02 CC04 CC09 CC10 CJ04	232, 235, 236, 257, 314, 612
<i>Diaphania hyalinata</i> * (L.)	mellonworm	AQ13 CC09	258
<i>Diaphania nitidalis</i> * (Stoll)	pickleworm	AQ13 CC09	258, 613
<i>Ephestia elutella</i> * (Hübner)	tobacco moth	AQ23 AQ25 CC02 CC04 CC07 CC09 CC10 CJ04 CJ05	239, 254, 314
<i>Ephesiodes gilvescentella</i> * Ragonot [ <i>E. nigrella</i> Hulst]	dusky raisin moth	AQ20 CC07	237, 252
<i>Galleria mellonella</i> * (L.)	greater wax moth	AQ23 CC02 CC04 CC10 CJ04 CJ07	234, 235, 256, 314, 612
<i>Ostrinia nubilalis</i> * Hübner	European corn borer	AQ13 CC01 CC09 CG04 CJ05	258, 327, 612
<i>Paralipsa</i> [ <i>Aphomia</i> ] <i>gularis</i> * (Zeller)	stored nut moth	AQ07 AQ23 AQ25 CC02 CC04 CC06 CC09 CC10 CJ04	234, 236, 257, 314
<i>Plodia interpunctella</i> * (Hübner)	Indianmeal moth	AQ07 AQ19 AQ20 AQ23 AQ25 CC01 CC02 CC04 CC06 CC07 CC09 CC10 CJ01 CJ04 CJ07 CJ08	237, 253, 314, 592
<i>Pyralis farinalis</i> * L.	meal moth	AQ03 AQ07 AQ19 AQ23 AQ25 CC02 CC04 CC06 CC09	233, 259, 314, 322, 613
<i>Vitula edmandsii</i> <i>serratilineella</i> Ragonot	driedfruit moth	CC02 CC06 CJ06 CJ08	239, 252

## CJ01 Aitken, A.D.

1963. A key to the larvae of some species of Phycitinae (Lepidoptera, Pyralidae) associated with stored products, and some related species. Bull. Ent. Res. 54(2):175-188.

## CJ02 Allyson, S.

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- CJ07** Okumura, G.T.  
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- CJ09** Richards, O.W., and W.S. Thompson.  
 1932. A contribution to the study of the genera *Ephestia*, Gn. (including *Strymax* Dyar), and *Plodia*, Gn. (Lepidoptera, Phycitidae), with notes on parasites of the larvae. Trans. Ent. Soc. London 80(2)169-250, 8 pl.
- CJ10** Wade, W.H.  
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Taxon	Common Name	Reference	Page
Tineidae*	tineid moths	AQ02 CC04 CC09 CK01	242, 259, 614
<i>Dasyses rugosella</i> (Stainton)			
<i>Decadarchis miniscula</i> (Walsingham)			
<i>Haplotinea insectella</i> (Fabricius)		CK01 CK02	
<i>Monopsis crocicapitella</i> * (Clemens)		AQ25 CC02	243, 260
<i>Nemapogon granella</i> * (L.)	European grain moth	AQ03 AQ07 AQ22 CC02 CC04 CC07 CD01 CK01	244, 260, 314
<i>Tineola bisselliella</i> * (Hummel)	webbing clothes moth	AQ07 AQ23 AQ25 CC02 CC04 CC09 CC10 CD01 CK01	244, 260, 314, 614

- CK01** Hinton, H.E.  
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- CK02** Madrid, F.J., and R.N. Sinha.  
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Taxon	Common Name	Reference	Page
Tortricidae* [Olethreutidae]	leafroller moths	AQ02 CC01 CL04	261, 614
<i>Argyrotaenia velutinana</i> (Walker)		redbanded leafroller	
<i>Cydia</i> [ <i>Carpocapsa</i> , <i>Enarmonia</i> , <i>Laspeyresia</i> ] <i>caryana</i> * (Fitch)		hickory shuckworm	CL03 CL04 263
<i>Cydia nigricana</i> * (Fabricius)		pea moth	CC04 CL02 CL03 263
<i>Cydia pomonella</i> * (L.)		codling moth	CC01 CC02 CC04 CC06 CC09 CL01 CL03 CL04 263

Taxon	Common Name	Reference	Page
<i>Cydia</i> [ <i>Melissopus</i> ] <i>latiferreana</i> (Walsingham)	filbertworm	CC06 CL03	262
<i>Endopiza</i> [ <i>Paralobesia</i> ] <i>viteana</i> Clemens	grape berry moth		
<i>Grapholita</i> [ <i>Grapholitha</i> , <i>Laspeyresia</i> ] <i>molesta</i> * (Busck)	oriental fruit moth	CL01 CL03	261
<i>Grapholita packardi</i> * (Zeller)	cherry fruitworm	CL03	262
<i>Grapholita prunivora</i> * (Walsh)	lesser appleworm	CL03	262

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1963. Notes on the larvae and pupae of two fruit moths, *Grapholita funebrana* Treitschke and *G. molesta* Busck (Lepidoptera: Olethreutidae). Proc. Roy. Ent. Soc. London A38(10-12)212-222.

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## CL03 MacKay, M.R.

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## CL04 Swatschek, B.

1958. Die Larvalsystematik der Wickler (Tortricidae und Carposinidae). Akademie-Verlag, Berlin.

Taxon	Common Name	Reference	Page
Diptera*	flies	AQ02 AQ10 AQ18 AQ19 AQ21 CM01-CM07	269, 327, 334, 341, 345, 346, 617

## CM01 Cole, F.R.

1969. The flies of western North America. University of California, Berkeley.

## CM02 Greenberg, B.

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## CM07 Oldroyd, H.

1949. Diptera: Introduction and key to families. Handb. Ident. British Insects 9(1)1-49, 1 pl.

Taxon	Common Name	Reference	Page
Agromyzidae*	leafminer flies	AQ02 AQ18 CM01 CM05 CM07 CN01	289, 631
<i>Liriomyza brassicae</i> (Riley)	serpentine leafminer	CN01	
<i>Liriomyza sativae</i> Blanchard	vegetable leafminer	CN01	
<i>Ophiomyia simplex</i> (Loew)	asparagus miner	CN01	

CN01 Spencer, K.A.

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Taxon	Common Name	Reference	Page
Anthomyiidae*	anthomyiid flies	AQ02 CM01 CM02 CM07 CO03 CO04 CO07	292, 631
<i>Hylemya</i> * [ <i>Delia</i> ]			292, 631
<i>Hylemya antiqua</i> (Meigen)	onion maggot	CM03 CO04	
<i>Hylemya brassicae</i> (Bouché)	cabbage maggot	CM03 CO01 CO04	
<i>Hylemya cinerella</i> (Fallén)		CM02	
<i>Hylemya radicum</i> (L.)		CM02	
<i>Pegomya hyoscyami</i> (Panzer)	spinach leafminer	CO01 CO04-CO07	

CO01 Brooks, A.R.

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CO02 Chillcott, J.G.

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Taxon	Common Name	Reference	Page
Calliphoridae*	<b>blow flies</b>	AQ02 AQ18 AQ19 AQ21 CM01-CM07 CP01	270, 279, 293, 629-631
<i>Anastellorhina</i> [ <i>Calliphora</i> ] <i>augur</i> (Fabricius)	lesser brown blow fly	CM02 CP06	
<i>Calliphora terraenovae</i> * Macquart	Nearctic blow fly	CP01 CP03	284
<i>Calliphora uralensis</i> Villeneuve	Ural blow fly	CM02	
<i>Calliphora vicina</i> * Robineau- Desvoidy [ <i>C. erythrocephala</i> Meigen]	cosmopolitan blue bottle fly	CM02 CM04 CP01 CP02	284
<i>Calliphora vomitoria</i> * (L.)	Holarctic blue bottle fly	AQ23 CM02 CM04 CP01 CP02	284
<i>Chrysomya</i> *			281, 294
<i>Chrysomya albiceps</i> * (Wiedemann)	banded blow fly	CM02 CM04	
<i>Chrysomya chloropyga</i> (Wiedemann)	greentail blue bottle fly	CM04	
<i>Chrysomya marginalis</i> (Wiedemann)		CM04	
<i>Chrysomya megacephala</i> * (Fabricius)		CM02 CM04	630
<i>Chrysomya putoria</i> (Wiedemann)		CM04	
<i>Chrysomya ruffacies</i> (Macquart)	<b>hairy maggot blow fly</b>	CM04	
<i>Cochliomyia macellaria</i> * (Fabricius)	<b>secondary screwworm</b>	AQ23 CM02 CM04 CP01 CP02	281, 294, 629
<i>Cynomya mortuorum</i> (L.)		CM02 CP01 CP02 CP06	
<i>Cynomyopsis cadaverina</i> * Robineau-Desvoidy	blue bottle fly	AQ23 CM04 CP01 CP02	283, 293
<i>Phaenicia</i> * [ <i>Lucilia</i> ]		CP06	282, 293
<i>Phaenicia cuprina</i> * Wiedemann [ <i>P. pallescens</i> (Shannon)]	bronze bottle fly	AQ23 CM02 CM04 CP01 CP02	283, 631
<i>Phaenicia sericata</i> * (Meigen)	green bottle fly	CM02 CM04 CP01 CP02 CP06	283, 631
<i>Phormia regina</i> * (Meigen)	<b>black blow fly</b>	AQ19 AQ23 CM02 CM04 CP01 CP02 CP05 CP06	281, 294, 631
<i>Pollenia rudis</i> * (Fabricius)	<b>cluster fly</b>	AQ23 CM02 CM04 CP01 CP02 CP03 CP06	282
<i>Protophormia terraenovae</i> * (Robineau-Desvoidy)	Holarctic blow fly	AQ23 CM02 CP01 CP02 CP06	281
<i>Lucilia caesar</i> (L.)		CM02 CM04 CP01 CP04 CP06	
<i>Lucilia illustris</i> (Meigen)		CM02 CM04 CP01 CP02 CP04 CP06	

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Lanham MD].

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- CP02** Hall, R.D., and L.H. Townsend, Jr.  
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- CP03** Mihályi, F.  
1975. Contribution to the knowledge of the genus *Pollenia* R.-D. (Diptera: Calliphoridae). Acta Zool. Acad. Scient. Hungaricae 22(3-4)327-333.
- CP04** Mihályi, F.  
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- CP05** Perlstein, J.M.  
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- CP06** Van Emden, F.I.  
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Taxon	Common Name	Reference	Page
Cecidomyiidae	<b>gall midges</b>	AQ02 AQ18 CM01 CM05 CM07 CQ02-CQ04	272, 285
<i>Henria psalliotae</i> Wyatt		CQ05	
<i>Heteropeza pygmaea</i> Winnertz		CQ05	
<i>Lestremia cinerea</i> Macquart		CQ05	
<i>Mycophila barnesi</i> Edwards		CQ05	
<i>Mycophila fungicola</i> Felt		CQ01 CQ05	
<i>Mycophila speyeri</i> (Barnes)		CQ03 CQ05	

- CQ01** Foote, R.H., and C.A. Thomas.  
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- CQ02** Gagné, R.J.  
1981. Cecidomyiidae. In Manual of Nearctic Diptera, vol. 1, ed. by J.F. McAlpine *et al.* Agriculture Canada, Ottawa.
- CQ03** Hardy, D.E.  
1960. Diptera: Nematocera-Brachycera (except Dolichopodidae). In Insects of Hawaii, vol. 10, E.C. Zimmerman, ed. University of Hawaii, Honolulu.
- CQ04** Harris, K.M.  
1966. Gall midge genera of economic importance (Diptera: Cecidomyiidae). Part 1. Introduction and subfamily Cecidomyiinae; supertribe Cecidomyiidi. Trans. Roy. Ent. Soc. London 118(10)313-358.
- CQ05** Wyatt, I.J.  
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Taxon	Common Name	Reference	Page
Chironomidae	midges	CM05	286
Drosophilidae*	small fruit flies	AQ02 AQ18 AQ19 AQ21 AQ23 CM02 CM05 CM07	276, 289, 290, 346
<i>Drosophila</i> *		CM02	276
<i>Drosophila funebris</i> (Fabricius)	rotten potato drosophila	CM02 CM04 CR01	
<i>Drosophila melanogaster</i> Meigen	drosophilid fruit fly	CM02 CM04 CR01	
<i>Drosophila repleta</i> Wollaston	latrine drosophila	CM02 CR01	

CR01 Sturtevant, A.H.

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Taxon	Common Name	Reference	Page
Lonchaeidae	lonchaeid flies	AQ02 CM07 CS01	
<i>Lonchaea aristella</i> Becker		CS01	

CS01 Czerny, L.

- 1934 43. Lonchaeidae. In Die Fliegen der palaearktischen Region, vol. 5, E. Lindner, ed. Schweizerbart'sche, Stuttgart.

Taxon	Common Name	Reference	Page
Muscidae*	muscid flies	AQ02 AQ18 AQ19 AQ21 CM01-CM07 CO06 CQ01 CT04 CT07 CT10	277, 288, 291, 292, 625-627
<i>Atherigona orientalis</i> Schiner		CT05	
<i>Dasyphora</i>		CM02 CT03	
<i>Fannia</i> *		CT03	287, 288, 336, 345
<i>Fannia canicularis</i> * (L.)	little house fly	AQ21 AQ23 CM02 CM04 CT02 CT03 CT09	278, 625
<i>Fannia leucosticta</i> (Meigen)		CM02 CT02 CT09	
<i>Fannia scalaris</i> * (Fabricius)	latrine fly	CM02 CM04 CT02 CT03 CT09	625
<i>Musca autumnalis</i> De Geer	face fly	AQ23 CM02 CT03	
<i>Musca domestica</i> * L.	house fly	AQ19 AQ21 AQ23 CM02 CM04 CO06 CT03	10, 278, 291, 335, 626
<i>Musca sorbens</i> Wiedemann	market fly	CM02 CM04	279, 291
<i>Muscina</i> *		CT03	
<i>Muscina assimilis</i> (Fallén)		CM02 CM04 CT03	279
<i>Muscina stabulans</i> (Fallén)	false stable fly	AQ21 AQ23 CM02 CM04 CO06 CT03 CT08	279, 627
<i>Ophyra</i> *	dump flies	CT03	279, 292
<i>Ophyra aenescens</i> * (Wiedemann)	bronze dump fly	CT01 CT06	279, 626

Taxon	Common Name	Reference	Page
<i>Ophyra chalcogaster</i> (Wiedemann)		CT06	
<i>Ophyra leucostoma</i> * (Wiedemann)	dump fly	CM02 CT01 CT03	279
<i>Ophyra nigra</i> (Wiedemann)		CT06	

- CT01 Adams, R.G.  
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- CT02 Chillcott, J.G.  
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- CT04 Hennig, W.  
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- CT05 Pont, A.C.  
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- CT06 Sabrosky, C.W.  
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- CT07 Shinonaga, S., and R. Kano.  
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- CT08 Snyder, F.M.  
1955. Notes and descriptions of *Muscina* and *Dendrophaonia* (Diptera: Muscidae). Ann. Ent. Soc. America 48(6)445-452.
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1941. Keys to the Muscidae of the Ethiopian Region: Scatophaginae, Anthomyiinae, Lispinae, Fanniinae. Bull. Ent. Res. 32(3)251-275.
- CT10 Van Emden, F.I.  
1965. Diptera. Muscidae, part 1. In The fauna of India and the adjacent countries, vol. 7, R.B.S. Sewell and M.L. Roonwal, eds. Zoological Survey of India, Calcutta.

Taxon	Common Name	Reference	Page
Phoridae*	humpbacked flies, scuttle flies	AQ02 AQ18 AQ19 AQ21 AQ23 CM01-CM05 CM07	273, 288, 290, 345, 620
<i>Megaselia</i> * [ <i>Aphiochaeta</i> ]			620
<i>Megaselia agarici</i> (Lintner)		CU04	
<i>Megaselia bovista</i> (Gimmerthal)		CU02 CU04	
<i>Megaselia halterata</i> * (Wood)	mushroom phorid	CU04	327, 620
<i>Megaselia nigra</i> (Meigen)		CU02 CU04	

Taxon	Common Name	Reference	Page
<i>Megaselia rufipes</i> * (Meigen)		CM02 CU02	620
<i>Megaselia sandhui</i> Disney		CU03	
<i>Megaselia scalaris</i> * (Loew)		CU02	620
<i>Spiniphora bergenstammi</i> (Mik)	snail phorid	CU01	

## CU01 Borgmeier, T.

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## CU04 Robinson, W.H.

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Taxon	Common Name	Reference	Page
Piophilidae*	skipper flies	AQ02 AQ18 AQ21 AQ23 CM01-CM05 CM07	276, 290, 624
<i>Piophila casei</i> * (L.)	cheese skipper	CM02 CM04 CV01 CV02	276, 290, 624

## CV01 Hennig, W.

- 1943 40. Piophilidae. *In Die Fliegen der palaearktischen Region*, vol. 5, ed. by E. Lindner. Schweizerbart'sche, Stuttgart.

## CV02 Melander, A.L.

1924. Review of the dipterous family Piophilidae. *Psyche* 31(2)78-86.

Taxon	Common Name	Reference	Page
Psilidae*	rust flies	AQ02 AQ18 CM01 CM05 CM07	276, 290
<i>Psila rosae</i> * (Fabricius)	carrot rust fly	CW01	276, 290

## CW01 Hennig, W.

- 1941 41. Psilidae. *In Die Fliegen der palaearktischen Region*, vol. 5, E. Lindner, ed. Schweizerbart'sche, Stuttgart.

Taxon	Common Name	Reference	Page
Psychodidae*	moth flies	AQ02 AQ18 AQ21 CM01 CM02-CM05 CM07 CQ01	271, 286, 344, 346, 618
<i>Psychoda</i> *	drain flies	CX01-CX04	618

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- CX01** Duckhouse, D.A.  
 1966. Psychodidae (Diptera, Nematocera) of southern Australia: Subfamily Psychodinae. *Trans. Roy. Ent. Soc. London* 118(6)153-220.
- CX02** Freeman, P.  
 1950. Family Psychodidae. *Handb. Ident. British Insects* 9(2)77-96.
- CX03** Satchell, G.H.  
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- CX04** Usinger, R.L. (ed.).  
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Taxon	Common Name	Reference	Page
Sarcophagidae*	flesh flies	AQ02 AQ18 AQ21 CM01-CM06 CY02	279, 293, 628
<i>Sarcophaga</i> *		AQ21 CM01 CM02 CP06 CY01	279, 628
<i>Sarcophaga haemorrhoidalis</i> * (Fallén)	redtailed flesh fly	CM02 CP06 CY01	628
<i>Sarcophaga hirtipes</i> (Wiedemann)		CY02	
<i>Sarcophaga melanura</i> Meigen		CM02 CP06	

- CY01** Aldrich, J.M.  
 1916. *Sarcophaga* and allies in North America. Thomas Say Foundation, [Entomological Society of America, College Park].
- CY02** Rohdendorf, B.B.  
 1937. Fam. Sarcophagidae. *Fauna USSR*, vol. 19, No. 1. Academy of Sciences USSR, Moscow.

Taxon	Common Name	Reference	Page
Scatopsidae*	minute black scavenger flies	AQ02 AQ18 CM01 CM03 CM05 CM07 CQ01 CZ01	272, 286, 344

- CZ01** Duda, O.  
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Taxon	Common Name	Reference	Page
Scenopinidae* [Omphralidae]	window flies	AQ02 AQ18 CM01 CM02 CM03 CM05 CM07 CQ01	274, 287, 344, 622
<i>Scenopinus</i> *		CM01 CM05 DA01 DA02	274, 287
<i>Scenopinus fenestralis</i> (L.)	cosmopolitan window fly	A023 DA01 DA02	
<i>Scenopinus glabrifrons</i> Meigen	European window fly	A023 DA01 DA02	

**DA01** Hardy, D.E.

1944. A revision of North American Omphralidae (Scenopinidae). Jour. Kansas Ent. Soc. 17(1)31-51.

**DA02** Kelsey, L.P.

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Taxon	Common Name	Reference	Page
Sciaridae* [Lycoriidae]	darkwinged fungus gnats	AQ02 AQ18 CM01 CM03 CM05 CQ01 DB02	272, 344
<i>Bradysia coprophila</i> (Lintner)			
<i>Lycoriella</i> [ <i>Sciara</i> ] <i>agraria</i> (Felt)		DB01	
<i>Lycoriella auripila</i> (Winnertz)		DB01	
<i>Lycoriella mali</i> (Fitch) [ <i>Neosciara pauciseta</i> Felt]			
<i>Lycoriella multisetata</i> (Felt)			

**DB01** Lengersdorf, F.

1930. 7. Lycoriidae. In Die Fliegen der palaearktischen Region, vol. 2(1), E. Lindner, ed. Schweizerbart'sche, Stuttgart.

**DB02** Steffan, W.A.

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Taxon	Common Name	Reference	Page
Sepsidae*	black scavenger flies	AQ02 AQ18 CM01-CM05 CM07 CQ01 DC02	276, 289, 290, 346
<i>Sepsis</i> *		CM01 DC01	

**DC01** Hennig, W.

- 1943 39a. Sepsidae. In Die Fliegen der palaearktischen Region, vol. 5, E. Lindner, ed. Schweizerbart'sche, Stuttgart.

**DC02** Zuska, J., and D.H. Colless.

1984. Australian Sepsidae (Diptera). J. Australian Ent. Soc. 23(1)59-67.

Taxon	Common Name	Reference	Page
Sphaeroceridae* [Borboridae]	small dung flies	AQ02 CM01 CM02 CM05 CQ01 DD01 DD03	275, 622
<i>Leptocera</i> *		CM01	275, 622
<i>Leptocera caenosa</i> (Rondani)		DD02	

**DD01** Duda, O.

1938. 57. Sphaeroceridae (Cypselidae). In Die Fliegen der palaearktischen Region, vol. 6(1), ed. by E. Lindner. Schweizerbart'sche, Stuttgart.

**DD02** Roháček, J.

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DD03 Spuler, A.

1923. North American genera and subgenera of dipterous family Borboridae. Proc. Acad. Nat. Sci. Philadelphia 75:369-378.

Taxon	Common Name	Reference	Page
Stratiomyidae*	solider flies	AQ02 AQ18 AQ21 CM01 CM03-CM05 CM07 CQ01 DE02	274, 285
<i>Hermetia illucens</i> * (L.)	black soldier fly	CM04 CQ01 DE01 DE02	274, 285, 336 621

DE01 James, M.T.

1935. The genus *Hermetia* in the United States (Diptera, Stratiomyidae). Bull. Brooklyn Ent. Soc. 30(4):165-170.

DE02 McFadden, M.W.

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Taxon	Common Name	Reference	Page
Syrphidae*	flower flies	AQ02 AQ18 CM01-CM05 CM07 CQ01	273, 289, 346, 619
<i>Eristalis [Tubifera] tenax</i> * (L.)	drone fly	CM04 CM05 CX01 DF02 DF03	273, 289, 619
<i>Ornidia [Volucella] obesa</i> (Fabricius)		DF01	

DF01 Curran, C.H.

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DF02 Dixon, T.J.

1960. Key to and descriptions of the third instar larvae of some species of Syrphidae (Diptera) occurring in Britain. Trans. Roy. Ent. Soc. London 112(13):345-379.

DF03 Telford, H.S.

1939. The Syrphidae of Minnesota. Minnesota Agricultural Experiment Station Tech. Bull 140. St. Paul.

Taxon	Common Name	Reference	Page
Tephritidae* [Trypetidae, Trupaneidae]	fruit flies	AQ02 AQ18 CM01 CM04 CM07	274, 291, 622
<i>Anastrepha fraterculus</i> (Wiedemann)	South American fruit fly	AQ18 DG02 DG09 DG10	
<i>Anastrepha ludens</i> (Loew)	Mexican fruit fly	AQ18 DG02 DG09 DG10	
<i>Anastrepha obliqua</i> (Macquart) [ <i>A. mombinpraeoptans</i> Sein]	West Indian fruit fly	DG09 DG10	
<i>Ceratitis capitata</i> (Wiedemann)	Mediterranean fruit fly	AQ18 DG04 DG07 DG08 DG14	
<i>Dacus dorsalis</i> Hendel	oriental fruit fly	AQ18 DG03	
<i>Dacus oleae</i> (Gmelin)	olive fruit fly	AQ18 DG12	
<i>Rhagoletis cingulata</i> (Loew)	cherry maggot	AQ18 DG05	



Taxon	Common Name	Reference	Page
<i>Rhagoletis indifferens</i> Curran	<b>western cherry fruit fly</b>	DG05	
<i>Rhagoletis mendax</i> Curran	<b>blueberry maggot</b>	AQ18 DG06	
<i>Rhagoletis pomonella</i> (Walsh)	<b>apple maggot</b>	AQ18 DG07 DG13 DG15	

- DG01 Biological Assessment Support Staff.  
1982. Pests not known to occur in the United States or of limited distribution, No. 18: South American fruit fly. U.S. Dept. of Agr. APHIS 81-40. Washington, DC.
- DG02 Biological Assessment Support Staff.  
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- DG03 Biological Assessment Support Staff.  
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- DG04 Biological Assessment Support Staff.  
1982. Pests not known to occur in the United States or of limited distribution, No. 26: Mediterranean fruit fly. U.S. Dept. of Agr. APHIS 81-41. Washington, DC.
- DG05 Bush, G.L.  
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- DG06 Lathrop, F.H., and C.B. Nickels.  
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- DG07 Phillips, V.T.  
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- DG08 Quayle, H.J.  
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- DG09 Steyskal, G.C.  
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- DG10 Stone, A.  
1942. The fruitflies of the genus *Anastrepha*. U.S. Dept. Agr. Misc. Pub. 439. Washington, DC.
- DG11 Weems, H.V., Jr.  
1963. Mexican fruit fly (*Anastrepha ludens* (Loew)) (Diptera: Tephritidae). Fla. Dept. Agr. and Cons. Serv., Div. Plant Indus. Ent. Cir. 16. Gainesville.
- DG12 Weems, H.V., Jr.  
1966. Olive fruit fly (*Dacus oleae* (Gmelin)) (Diptera: Tephritidae). Fla. Dept. Agr. and Cons. Serv., Div. Plant Indus., Ent. Cir. 44. Gainesville.

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- DG13** Weems, H.V., Jr.  
1972. Apple maggot, *Rhagoletis pomonella* (Walsh) (Diptera: Tephritidae). Fla. Dept. Agr. and Cons. Serv., Div. Plant Indus., Ent. Cir. 126. Gainesville.

- DG14** Weems, H.V., Jr.  
1981. Mediterranean fruit fly, *Ceratitidis capitata* (Wiedemann) (Diptera: Tephritidae). Fla. Dept. Agr. and Cons. Serv., Div. Plant Indus., Ent. Cir. 230. Gainesville.

- DG15** Westcott, R.L.  
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Taxon	Common Name	Reference	Page
Hymenoptera*	ants, bees, wasps	AQ01 AQ02 AQ04-AQ06 AQ15 AQ17 AQ19 DH01 DH02 DH03	297, 298, 323, 330, 334, 349

- DH01** Ferrière, C., and G.J. Kerrich.  
1958. Hymenoptera: Chalcidoidea. Agaontidae, Leucospidae, Calcididae, Eucharitidae, Perilampidae, Cleonymidae and Thysanidae. Handb. Ident. British Insects 8(2a)1-40.

- DH02** Richards, O.W.  
1977. Hymenoptera: Introduction and key to families. Handb. Ident. British Insects 6(1)1-94.

- DH03** Short, J.R.T.  
1952. The morphology of the head of larval Hymenoptera with special reference to the head of the Ichneumonoidea, including a classification of the final instar larvae of the Braconidae. Trans. Roy. Ent. Soc. London 103(2)27-84.

Taxon	Common Name	Reference	Page
Agaonidae	fig wasps	AQ02	349
<i>Blastophaga psenes</i> (L.)	fig wasp	AQ20	
Apidae	honeybees	AQ02	
<i>Apis mellifera</i> * L.	honeybee	AQ23 DJ01 DJ02	330, 334, 349

- DJ01** Batra, S.W.T.  
1976. Honey bees (*Apis* spp.) likely to be intercepted at quarantine stations. Coop. Plant Pest Rpt. 1(48-52)900-902.

- DJ02** Economic Insect Survey and Detection.  
1972. An African honey bee (*Apis mellifera adansonii*). Coop. Econ. Insect Rpt. 22(12)158-160.

Taxon	Common Name	Reference	Page
Bethylidae*	bethylid wasps	A023 AQ02 DK01-DK04	450, 465
<i>Cephalonomia</i> *		DK01-DK04	469
<i>Cephalonomia gallicola</i> * (Ashmead)		DK02 DK03	469
<i>Cephalonomia tarsalis</i> * (Ashmead)		DK02-DK04	468

Taxon	Common Name	Reference	Page
<i>Cephalonomia waterstoni</i> * Gahan	parasitic grain wasp	DK02-DK04	469
<i>Epyris</i>		A023	
<i>Goniozus emigratus</i> * (Rohwer)		DK02	466
<i>Holepyris hawaiiensis</i> * (Ashmead)		A023 DK02-DK04	467
<i>Holepyris sylvanidis</i> * (Brèthes)		DK02 DK03	467
<i>Laelius anthrenivorus</i> * Trani			467
<i>Laelius centratus</i> * (Say)		DK01 DK02	467
<i>Plastanoxus chittendenii</i> * (Ashmead)		DK01-DK03	470
<i>Plastanoxus westwoodi</i> * (Kieffer)		DK01-DK04	470
<i>Rhabdepyris zeeae</i> Turner & Waterson		A023	
<i>Sclerodermus immigrans</i> * Bridwell			466

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Taxon	Common Name	Reference	Page
Braconidae*	braconid wasps	A023 AQ02 DH02 DL01 DL02	450, 470
<i>Apanteles araeceri</i> * Wilkins			475
<i>Apanteles carpatus</i> * (Say)			475
<i>Apanteles nephopteris</i> * (Packard)			475
<i>Bassus</i> [ <i>Agathis</i> ] <i>hawaiiicola</i> * (Ashmead)			476
<i>Chelonus sulcatus</i> Jurine		A023	
<i>Chremylus rubiginosus</i> * (Nees)			474
<i>Habrobracon</i> [ <i>Bracon</i> ] <i>brevicornis</i> * (Wesmael)			473
<i>Habrobracon</i> <i>crassicornis</i> * (Thomson)			473
<i>Habrobracon hebetor</i> * (Say)		A023	473
<i>Habrobracon kitcheneri</i> * (Dudgeon & Gough)			473
<i>Hecabolus sulcatus</i> * Curtis			474
<i>Meteorus ictericus</i> * (Nees)			476
<i>Spathius exarator</i> * (L.)			474

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Taxon	Common Name	Reference	Page
Chalcididae*	chalcidids	AQ02 DH01	450, 455
<i>Antrocephalus aethiopicus</i> * Masi			456
<i>Antrocephalus mahensis</i> * Masi			456
Encyrtidae	encyrtids	AQ02	450
<i>Comperia merceti</i> (Compere)			
<i>Copidosoma koehleri</i> Blanchard		DN01	
<i>Copidosoma phthorimaea</i> Logvinovskaya		DN01	

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Taxon	Common Name	Reference	Page
Eulophidae*	eulophids	AQ02 DH01	450, 457
<i>Aprostocetus</i> [Tetrastichodes, Tetrastichus] <i>hagenowii</i> * (Ratzeburg)			457, 459
<i>Entedon longiventris</i> * Ratzeburg			457
<i>Melittobia chalybii</i> * Ashmead			458
<i>Paraolinx typica</i> * (Howard) [ <i>P. nigriventris</i> (Girault)]			458
<i>Tetrastichus asthenogmus</i> (Waterston)			
<i>Tetrastichus coeruleus</i> * Ashmead			457, 459
<i>Tetrastichus hagenowii</i> * (Ratzeburg)			457, 459
<i>Tetrastichus periplanetae</i> * Crawford			451, 457, 459
Eupelmidae*	eupelmids	AQ02 DH01	450, 456
<i>Anastatus tennipes</i> Bolivar			
<i>Eupelmus cushmani</i> * (Crawford)			457
<i>Eupelmus javae</i> * Girault			457
Eurytomidae*	seed chalcids, eurytomids	A023 DQ01 DQ02	450, 458, 460
<i>Aximopsis javensis</i> * Girault			460
<i>Aximopsis tephrosiae</i> * Girault			460
<i>Eurytoma tylodermatis</i> * Ashmead		DP01	460
<i>Systole geniculata</i> Foerster	fennel seed wasp		

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Taxon	Common Name	Reference	Page
Evaniidae*	ensign wasps	A023 AQ02 DQ02	324, 450, 453
<i>Evania appendigaster</i> * (L.)		AQ02 DH01 DP02	453
<i>Evania dimidiata</i> Spinola		A023	
<i>Prosevania fuscipes</i> * (Illiger) [ <i>P. punctata</i> (Brullé)]			453
<i>Szepligetella sericea</i> * (Cameron)	lesser ensign wasp		453

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Taxon	Common Name	Reference	Page
Formicidae*	ants	AQ02 DR01-DR18	297, 298, 633-649

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- DR18** Young, J.H., and D.E. Howell.  
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Taxon	Common Name	Reference	Page
Dolichoderinae*	dolichoderine ants	AQ02 DR01-DR11 DR14	307, 642, 643
<i>Conomyrma insana</i> * (Buckley) [ <i>Dorymyrmex pyramicus</i> (Roger)]	pyramid ant	DR04 DR05 DR07 DR09 DR11-DR13 DR15	643
<i>Iridomyrmex humilis</i> * (Mayr)	Argentine ant	DR03 DR04 DR06 DR08 DR11 DR12 DR17	307, 324, 643
<i>Iridomyrmex pruinosus</i> * (Roger)		DR04-DR08 DR11 DR12 DR15 DR18	643
<i>Tapinoma melanocephalum</i> * (Fabricius)		DR03 DR09 DR11 DR17	307, 324, 643
<i>Tapinoma sessile</i> * (Say)	odorous house ant	DR04 DR05 DR07 DR08 DR11 DR12 DR15 DR17 DR18	307, 324, 643
<i>Technomyrmex albipes</i> (Smith)	whitefooted ant		
Dorylinae*	doryline ants	DR04 DR08 DR14 DR18	303, 634
<i>Labidus coecus</i> * (Latreille)		DR04 DR11 DR12 DR18 DT01	634
<i>Neivamyrmex nigrescens</i> * (Cresson)		DR04 DR11 DR12 DR15 DR18 DT01	634
<i>Neivamyrmex opacithorax</i> * (Emery)		DR04 DR11 DR12 DR18 DT01	634

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Taxon	Common Name	Reference	Page
Formicinae*	formicine ants	DR01-DR11 DR14	
<i>Acanthomyops claviger</i> * (Roger)	smaller yellow ant	DR04 DR05 DR11-DR13 DR18 DU03	646
<i>Acanthomyops interjectus</i> * (Mayr)	larger yellow ant	DR04 DR05 DR11 DR12 DR16 DR18 DU03	302, 646
<i>Acanthomyops latipes</i> * (Walsh)		DR04 DR05 DR11 DR16 DR18 DU03	646
<i>Acanthomyops murphyi</i> * (Forel)		DR04 DR05 DR11 DR16 DU03	646
<i>Anoplolepis longipes</i> (Jerdon)	longlegged ant	DR17	
<i>Camponotus abdominalis</i> * (Fabricius)	Florida carpenter ant	DR04 DR11	644
<i>Camponotus caryae discolor</i> * (Buckley)		DR04-DR06 DR11-DR13 DR18	644
<i>Camponotus castaneus</i> * (Latreille)		DR04-DR06 DR11 DR12 DR18	644
<i>Camponotus ferrugineus</i> * (Fabricius)	red carpenter ant	DR04-DR06 DR11 DR12	645
<i>Camponotus herculeanus</i> (L.)		DR07	
<i>Camponotus modoc</i> Wheeler		DR07 DU04	
<i>Camponotus nearcticus</i> * Emery		DR04 DR05 DR07 DR11 DR12 DR13 DR18	645
<i>Camponotus pennsylvanicus</i> * (De Geer)	black carpenter ant	DR04-DR07 DR11-DR13 DR18	645
<i>Camponotus sayi</i> * Emery [C. <i>rasilis</i> Wheeler]		DR04 DR07 DR11 DR12 DR18	646
<i>Camponotus tortuganus</i> * Emery		DR04 DR11	646
<i>Camponotus vicinus</i> (Mayr)		DR07	
<i>Lasius alienus</i> * (Foerster)	cornfield ant	DR03 DR04 DR06 DR07 DR11-DR13 DR15 DR18 DU02	648
<i>Lasius brunneus</i> (Latreille)		DU02	
<i>Lasius neoniger</i> * Emery		DR04 DR06 DR07 DR11 DR12 DR13 DR18 DU02	648
<i>Lasius pallitarsis</i> (Provancher) [ <i>L. sitkaensis</i> Pergande]		DU02	
<i>Lasius umbratus</i> * (Nylander)		DR04-DR06 DR11 DU02	648
<i>Paratrechina</i> *		DR02 DR04-DR06 DR08 DR11 DR18 DU01	308, 309, 649
<i>Paratrechina longicornis</i> * (Latreille)	crazy ant	DR03-DR05 DR09 DR11 DR17 DR18 DU01	309, 649

Taxon	Common Name	Reference	Page
<i>Paratrechina vividula</i> (Nylander)		DU01	
<i>Prenolepis imparis</i> * (Say)		DR04-DR06 DR08 DR11 DR12 DR18	649

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Taxon	Common Name	Reference	Page
Myrmicinae*	myrmicine ants	AQ02 DR01-DR11 DR14	303, 305, 635-642
<i>Aphaenogaster fulva</i> * Roger		DR04-DR06 DR11 DR12 DR18	637
<i>Aphaenogaster lamellidens</i> * Mayr		DR04 DR05 DR11 DR12	638
<i>Aphaenogaster rudis</i> * (Emery)		DR04 DR05 DR11 DR12	638
<i>Aphaenogaster tennesseensis</i> * (Mayr)		DR04-DR06 DR11 DR12 DR18	638
<i>Atta texana</i> * (Buckley)	Texas leafcutting ant	DR11	
<i>Crematogaster ashmeadi</i> * Mayr		DR04 DR11 DV01	
<i>Crematogaster cerasi</i> * (Fitch)		DR04 DR06 DR11 DV01	
<i>Crematogaster clara</i> * Mayr		DR04 DR11 DV01	640
<i>Crematogaster lineolata</i> * (Say)		DR04-DR06 DR11 DV01	640
<i>Monomorium destructor</i> * (Jerdon)		DR04 DR08 DR09 DR11 DR17	636
<i>Monomorium floricola</i> * (Jerdon)		DR04 DR09 DR11	637
<i>Monomorium minimum</i> * (Buckley)	little black ant	DR04-DR08 DR11-DR13 DR15 DR18	323, 637
<i>Monomorium pharaonis</i> * (L.)	pharaoh ant	DR03-DR06 DR08 DR09 DR11-DR13 DR17 DR18	305, 636



Taxon	Common Name	Reference	Page
<i>Ochetomyrmex</i> [ <i>Wasmania</i> ] <i>auropunctatus</i> * (Roger)	little fire ant	DR08 DR09 DR11	641
<i>Pheidole bicarinata</i> <i>vinelandica</i> * Forel		DR04-DR07 DR11 DR12 DR18 DV04	640
<i>Pheidole dentata</i> * Mayr		DR04 DR11 DR12 DR18 DV04	641
<i>Pheidole floridana</i> * Emery		DR04 DR11 DV04	641
<i>Pheidole megacephala</i> * (Fabricius)		DV04	
<i>Pogonomyrmex occidentalis</i> (Cresson)		DR07 DV03	
<i>Solenopsis geminata</i> * (Fabricius)	fire ant	DR04 DR09 DR11 DR12 DR17 DV02 DV05 DV06	635
<i>Solenopsis invicta</i> * Buren	red imported fire ant	DV02 DV05 DV06	635
<i>Solenopsis molesta</i> * (Say)	thief ant	DR04 DR05 DR07 DR08 DR11-DR13 DR15 DR18	304, 635
<i>Solenopsis richteri</i> Forel	black imported fire ant	DV02	
<i>Solenopsis xyloni</i> * McCook	southern fire ant	DR04 DR07 DR11-DR13 DR18 DV02 DV05 DV06	636
<i>Tetramorium bicarinatum</i> (Nylander) [ <i>T. guineense</i> (Fabricius)]	Guinea ant	DR03 DR04 DR09 DR11 DR12 DR17	642
<i>Tetramorium caespitum</i> * (L.)	pavement ant	DR03-DR05 DR08 DR11	300, 301, 306, 330, 642

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Taxon	Common Name	Reference	Page
Ponerinae*	ponerine ants	DR01-DR11 DR14	306
<i>Hypoponera punctatissima</i> (Roger)			
Ichneumonidae*	ichneumons	A023 AQ02 DX01 DX02	450, 470
<i>Diadegma</i> *		A023	472
<i>Diadegma armillata</i> (Gravenhorst)		A023	
<i>Diadegma chrysostictus</i> (Gmelin)		A023	
<i>Hypiscera curvata</i> * (Fabricius)			472
<i>Limnerium ephestiae</i> * (Ashmead)			472
<i>Mesostenus gracilis</i> * Cresson			472
<i>Trathala flavoorbitalis</i> * Cameron			471
<i>Venturia canescens</i> (Gravenhorst)		A023	471

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Taxon	Common Name	Reference	Page
Pteromalidae*	pteromalids	A023 AQ02 DH01 DY01	450, 460
<i>Anisopteromalus</i> *			463
<i>Anisopteromalus calandrae</i> (Howard)		A023	
<i>Caenacis</i> *		DY01	464
<i>Cerocephala aquila</i> * (Girault)			463
<i>Cerocephala cornigera</i> * Westwood		DY01	463
<i>Cerocephala rufa</i> * (Walker)		DY01	463
<i>Choetospila elegans</i> * Westwood		A023 DY01	330, 462
<i>Dibrachys</i> *		DY01	463
<i>Dibrachys cavus</i> (Walker)		A023	464
<i>Dimachus</i> *		DY01	
<i>Dinarmus laticeps</i> (Ashmead)		A023	
<i>Lariophagus</i> *		DY01	465
<i>Meraporus requisitus</i> * Tucker			463
<i>Norbanus</i> *		DY01	464
<i>Pteromalus</i> * [ <i>Habrocytus</i> ]		DY01	465
<i>Pteromalus cerealellae</i> (Ashmead)		A023	
<i>Ptinobius</i> *			462
<i>Spalangia</i> *		DY01	461

Taxon	Common Name	Reference	Page
<i>Theocolax formiciformis</i> * Westwood		DY01	462
<i>Tritneptis</i> [ <i>Systemlogaster</i> ] <i>ovivora</i> * (Gahan)			463, 464
<i>Zatropis</i> *			463

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Taxon	Common Name	Reference	Page
Trichogrammatidae*	trichogrammatid wasps	AQ23 AQ02 DH01	415, 457
<i>Trichogramma</i> *		DZ01	457
<i>Trichogramma evanescens</i> Westwood			

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Taxon	Common Name	Reference	Page
Vespidae	vespid wasps	AQ02 AQ19	
<i>Dolichovespula</i> [ <i>Vespula</i> ] <i>arenaria</i> (Fabricius)	aerial yellowjacket	AQ05 AQ19 EA01 EA02	
<i>Polistes annularis</i> (L.)	large paper wasp	AQ19 EA02	
<i>Polistes apachus</i> Saussure		EA02	
<i>Polistes exclamans</i> Viereck	zebra paper wasp	AQ19 EA02	
<i>Vespula</i> [ <i>Paravespula</i> ] <i>germanica</i> (Fabricius)	German yellowjacket	AQ05 EA01 EA02	
<i>Vespula maculifrons</i> (Buysson)	eastern yellowjacket	AQ05 AQ19 EA01 EA02	
<i>Vespula pensylvanica</i> (Saussure)	western yellowjacket	AQ05 AQ19 EA01 EA02	
<i>Vespula vulgaris</i> (L.)	common yellowjacket	AQ05 AQ19 EA01 EA02	

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Taxon	Common Name	Reference	Page
Collembola*	springtails	AQ02 AQ19 EB01-EB12	323, 351

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Taxon	Common Name	Reference	Page
Entomobryidae*	entomobryid springtails	EB01 EB02 EB04 EC01	
<i>Entomobrya atrocincta</i> * Schött		EB01 EB05 EB11	358
<i>Entomobrya griseoolivata</i> * (Packard)		EB01 EB06 EB11 EB12	358
<i>Entomobrya nivalis</i> * (L.)		EB01 EB02 EB05 EB07 EB11 EB12 EC01	358
<i>Entomobrya</i> [ <i>Entomobryoides</i> ] <i>purpurascens</i> * (Packard)		EB01 EB05 EB06	358
<i>Heteromurus</i> [ <i>Alloscopus</i> , <i>Ptenura</i> , <i>Verhoeffiella</i> ]*		EB01 EB02 EB05 EB10	357
<i>Lepidocyrtinus domesticus</i> * (Nicolet)			359
<i>Lepidocyrtus curvicollis</i> * Bourlet		EB01-EB03 EB05 EB11	360
<i>Lepidocyrtus cyaneus</i> Tullberg	silvery springtail	EB01 EB07 EB12	359
<i>Orchesella albosa</i> * Guthrie		EB01 EB06 EB11 EB12	357

Taxon	Common Name	Reference	Page
<i>Pseudosinella</i> *		EB01 EB02 EB04 EB05 EB12	360
<i>Seira</i> [ <i>Sira</i> , <i>Willowsia</i> ] <i>buski</i> * (Lubbock)	damp grain springtail	EB01-EB03 EB05 EB11 EB12	359
<i>Seira platani</i> * (Nicolet) [ <i>Willowsia nigromaculata</i> (Lubbock)]		EB02 EB05 EB06 EB11 EB12	359

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Taxon	Common Name	Reference	Page
Isotomidae*	isotomid springtails	EB01 EB02 EB04 EB08 EB10	356
<i>Cryptopygus</i> [ <i>Isotoma</i> ] <i>thermophilus</i> (Axelson)		EB01 ED02	
<i>Folsomia quadriculata</i> * (Tullberg)		EB01 EB02 EB05-EB07 EB12 ED01	361
<i>Isotomodes</i> [ <i>Dagamaea</i> ] <i>tenuis</i> * (Folsom)		EB01 EB06	361
<i>Proisotoma frisoni</i> * (Folsom)		EB01 EB11 ED02	360
<i>Proisotoma tenella</i> (Reuter) [ <i>Isotoma simplex</i> Folsom]		EB01 ED02	

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Taxon	Common Name	Reference	Page
Hypogastruridae*	hypogastrurid springtails	EB01 EB08	354
<i>Hypogastrura</i> [ <i>Achorutes</i> ] <i>armata</i> * (Nicolet)	gray springtail	EB02 EB05-EB07 EB11 EB12	355
<i>Hypogastrura manubrialis</i> * (Tullberg)		EB01 EB02 EB05 EB07 EB11	355
<i>Hypogastrura pseudarmata</i> (Folsom)		EB05 EB11	355
Onychiuridae*	onychiurid springtails	EB01 EB02 EB04 EB08 EB10 EF01	354
<i>Onychiurus armatus</i> * (Tullberg)		EB01 EB02 EB05-EB07 EB11	355
<i>Onychiurus fimetarius</i> * (L.)		EB05 EB07 EB11	355

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Taxon	Common Name	Reference	Page
Poduridae*	podurid springtails	EB01 EB02 EB06 EB07	353
<i>Podura aquatica</i> * L.		EB01 EB02 EB05 EB06 EB08 EB10 EB12	353
Tomoceridae*	tomocerid springtails	EB08 EB10	356
<i>Tomocerus</i> *		EB01 EB02 EB05 EB06 EB10 EB12 EH01	356

EH01 Scott, H.G.

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Taxon	Common Name	Reference	Page
Thysanura*	silverfish	AQ02 AQ05 AQ07 AQ14 AQ19 EI01	322, 334, 363, 364

EI01 Delany, M.J.

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Taxon	Common Name	Reference	Page
Lepismatidae*	silverfish	EI01 EJ03	364-366,
<i>Acrotelsa collaris</i> * (Fabricius)		EJ03	364, 365
<i>Ctenolepisma lineata pilifera</i> * (Lucas) [ <i>C. quadriseriata</i> (Packard)]	fourlined silverfish	AQ14 EJ01 EJ03	365-368
<i>Ctenolepisma longicaudata</i> Escherich [ <i>C. urbana</i> Slabaugh]	gray silverfish	AQ14 EJ01 EJ03	364-368
<i>Ctenolepisma villosa</i> * (Fabricius)			368
<i>Lepisma saccharina</i> * L.	common silverfish	AQ14 EI01 EJ01 EJ03	364, 365, 367
<i>Namunukulina funambuli</i> * Wygodzinsky		EJ02	367
<i>Peliolepisma calva</i> * Ritter		EJ03	367
<i>Thermobia aegyptiaca</i> * (Lucas)		EJ03	369
<i>Thermobia campbelli</i> * (Barnhart)		EJ03	369
<i>Thermobia domestica</i> * (Packard)	firebrat	AQ14 EI01 EJ01 EJ03	364, 366, 368, 369

EJ01 Slabaugh, R.E.

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Taxon	Common Name	Reference	Page
Nicoletiidae*	nicoletioid silverfish	EK01	364, 365
<i>Nicoletia phytophila</i> * Gervais [ <i>N. meinerti</i> Silvestri]		EK01	364, 365

EK01 Wygodzinsky, P.

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Taxon	Common Name	Reference	Page
Psocoptera*	psocids	AQ02 EL01-EL05	324, 371, 372

EL01 New, T.R.

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EL02 New, T.R.

1977. Psocoptera of the Oriental Region: A review of published taxonomic information with keys to families and genera. Oriental Insects, suppl. 6:1-83.

EL03 Smithers, C.N.

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EL04 Thornton, I.W.B., S.S. Lee, and W.D. Chui.

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EL05 Turner, B.D.

1975. The Psocoptera of Jamaica. Trans. Roy. Ent. Soc. London 126(4)533-609.

Taxon	Common Name	Reference	Page
Psocomorpha* (suborder)	psocomorph psocids	EL01-EL03	374
Ectopsocidae*	ectopsocids	EL01 EL02 EL04	395, 396
<i>Ectopsocopsis cryptomeriae</i> * (Enderlein)			372, 398
<i>Ectopsocus briggsi</i> * McLachlan		EL01 EL03 EL04 EM01	399
<i>Ectopsocus maindroni</i> * Badonnel		EL01 EL04	401
<i>Ectopsocus pumilis</i> * Banks		EM01	372, 401
<i>Ectopsocus richardsi</i> * (Pearman)		EL01 EM01	399
<i>Ectopsocus vachoni</i> * Badonnel		EL01	400

EM01 Broadhead, E., and A.M. Richards.

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Taxon	Common Name	Reference	Page
Hemipsocidae*	hemipsocids	EL02 EL04	396
<i>Hemipsocus africanus</i> * Enderlein			396
Lachesillidae*	lachesillids	EL01 EL02 EL04 EL05	395, 396

Taxon	Common Name	Reference	Page
<i>Lachesilla nubilis</i> * (Aaron)		EN01	397
<i>Lachesilla pedicularia</i> * (L.)	<b>cosmopolitan grain psocid</b>	EL01 EL04 EN01	395, 397
<i>Lachesilla rena</i> * Sommerman		EN01	397

EN01 Sommerman, K.M.

1946. A revision of the genus *Lachesilla* north of Mexico (Corrodentia: Caeciliidae). Ann. Ent. Soc. America 39(4)627-661.

Taxon	Common Name	Reference	Page
Troctomorpha* (suborder)	troctomorph psocids	EL01-EL03	374, 383
Liposcelidae*	liposcelids	EL01-EL03	374
<i>Belaphotroctes ghesquierei</i> * Badonnel			386
<i>Belaphotroctes simulans</i> * Badonnel			386
<i>Embidopsocus minor</i> * Pearman			386
<i>Embidopsocus oleaginus</i> * (Hagen)			386
<i>Liposcelis albothoracicus</i> * Broadhead		EL01	388
<i>Liposcelis bostrychophilus</i> * Badonnel		EL01 EP01	372, 394
<i>Liposcelis bouilloni</i> * Badonnel			389
<i>Liposcelis corrodens</i> * Heymons	<b>booklouse</b>		372, 393
<i>Liposcelis entomophilus</i> * (Enderlein)		EL01 EP01	388
<i>Liposcelis exiguus varians</i> * Badonnel		EP01	391
<i>Liposcelis kidderi</i> * (Hagen)			372, 390
<i>Liposcelis liparus</i> * Broadhead		EL01 EP01	387
<i>Liposcelis mendax</i> * Pearman		EL01 EP01	391, 392
<i>Liposcelis minutus</i> * Badonnel			394
<i>Liposcelis obscurus</i> * Broadhead		EL01	392
<i>Liposcelis paetulus</i> * Broadhead		EL01 EP01	392
<i>Liposcelis paetus</i> * Pearman		EL01 EP01	392
<i>Liposcelis pubescens</i> * Broadhead		EL01 EP01	391
<i>Liposcelis rufus</i> * Broadhead		EL01 EP01	390
<i>Liposcelis simulans</i> * Broadhead		EL01 EP01	372, 390
<i>Liposcelis decolor</i> * Pearman		EL01 EP01	390
<i>Liposcelis transvaalensis</i> * (Enderlein)		EP01	388



EP01 Broadhead, E.

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Taxon	Common Name	Reference	Page
Pachytroctidae*	pachytroctids	EL01 EL02 EL04	384
<i>Nanopsocus oceanicus</i> * Pearman			372, 384
Sphaeropsocidae*	sphaeropsocids	EL01	384
<i>Badonnelia titei</i> * Pearman		EL01	384
Trogiomorpha* (suborder)	trogiomorph psocids	EL01-EL03	373, 374
Lepidopsocidae*	lepidopsocids	EL01-EL04	377
<i>Lepolepis bicolor</i> * Broadhead		EL01	378
<i>Soa flaviterminata</i> * Enderlein		EL01	378
Psoquillidae*	psoquillids	EL01-EL04	378
<i>Psoquilla marginepunctata</i> * (Hagen)		EL01	379
<i>Rhyopsocus bentonae</i> * Sommerman			380
<i>Rhyopsocus disparilis</i> * Pearman		EL01	380
<i>Rhyopsocus peregrinus</i> * (Pearman)		EL01	379
Psyllipsocidae*	psyllipsocids	EL01-EL04	374
<i>Dorypteryx domestica</i> * (Smithers)			376
<i>Dorypteryx pallida</i> * Aaron			375
<i>Psocatropos microps</i> * (Enderlein)		EL05	372, 376
<i>Psocatropos pilipennis</i> * Enderlein			376
<i>Psyllipsocus ramburi</i> * Sélys-Longchamps		EL01 EL03 EL04	375
Trogiidae*	trogiids	EL01-EL03	378
<i>Cerobasis</i> [ <i>Myopsocnema</i> ] <i>annulata</i> * (Enderlein)			383
<i>Lepinotus inquilinus</i> * Heyden		EL01 EL03	382
<i>Lepinotus patruelis</i> * Pearman		EL01 EL03	382
<i>Lepinotus reticulatus</i> * Enderlein	reticulatewinged trogiid	EL01 EL03	381
<i>Trogium pulsatorium</i> * (L.)	larger pale trogiid	EL01 EL03	383
Thysanoptera*	thrips	AQ02 EQ01-EQ03	325, 329, 403

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- EQ01 Bailey, S.F.  
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- EQ02 Mound, L.A., G.D. Morison, B.R. Pitkin, and J.M. Palmer.  
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- EQ03 Stannard, L.J.  
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Taxon	Common Name	Reference	Page
Terebrantia* (suborder)		AQ02 EQ01-EQ03	404
Aeolothripidae*		AQ02 EQ01-EQ03	405
<i>Aeolothrips</i>		EQ01 EQ03	
<i>Rhipidothrips brunneus*</i> Williams		EQ01 EQ02	405
<i>Rhipidothrips gratiosus*</i> Uzel		EQ01 EQ02	657
Thripidae*		EQ01-EQ03 ER02 ER03	405
Panchaetothripinae [Heliiothripinae]			408
<i>Caliothrips</i> [ <i>Heliiothrips</i> ] <i>fasciatus*</i> (Pergande)	<b>bean thrips</b>	EQ01 EQ03 ER01 ER02 ER05	408
<i>Heliiothrips haemorrhoidalis*</i> (Bouché)	<b>greenhouse thrips</b>	EQ01-EQ03 ER01 ER02 ER03 ER05	408
<i>Hercinothrips</i> [ <i>Heliiothrips</i> ] <i>femoralis*</i> (O.M. Reuter)	<b>banded greenhouse thrips</b>	EQ01-EQ03 ER01-ER03 ER05	409
<i>Selenothrips rubrocinctus*</i> (Giard)	<b>redbanded thrips</b>	ER01 ER02 ER05	409
Thripinae*			408
<i>Anaphothrips obscurus*</i> (Müller)	<b>grass thrips</b>	EQ01-EQ03 ER01 ER03	406
<i>Chirothrips aculeatus*</i> Bagnall		EQ01 EQ02 ER06	411
<i>Chirothrips manicatus</i> Haliday	timothy thrips	EQ01-EQ03 ER03 ER06	
<i>Chirothrips mexicanus*</i> Crawford		EQ01 EQ03 ER01 ER02 ER06	411
<i>Frankliniella*</i>		EQ01 EQ03 ER01 ER02 ER04	409
<i>Frankliniella fusca</i> (Hinds)	<b>tobacco thrips</b>	EQ03 ER02	
<i>Frankliniella minuta*</i> (Moulton)		EQ01 ER01 ER04	409
<i>Frankliniella occidentalis</i> (Pergande)	<b>western flower thrips</b>	EQ01 ER01 ER03	
<i>Frankliniella tritici</i> (Fitch)	<b>flower thrips</b>	EQ03 ER02	
<i>Frankliniella williamsi</i> Hood		ER01 ER02	
<i>Limothrips angulicornis*</i> Jablonowski		EQ01 EQ03 ER01	412
<i>Limothrips cerealium*</i> (Haliday)	<b>grain thrips</b>	EQ01-EQ03 ER01-ER03	412
<i>Scirtothrips</i> [ <i>Euthrips</i> ] <i>citri*</i> (Moulton)	citrus thrips	EQ01 ER01	413

Taxon	Common Name	Reference	Page
<i>Thrips hawaiiensis</i> * (Morgan)	Hawaiian flower thrips	ER01 ER03	407, 413
<i>Thrips tabaci</i> * Lindeman	onion thrips	EQ01-EQ03 ER01-ER03	407

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- ER06 Zur Strassen, R.  
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Taxon	Common Name	Reference	Page
Tubulifera* (suborder)		AQ02 EQ02 EQ03 ER02	404
Phlaeothripidae*		EQ02 EQ03 ER02	404
<i>Gynaikothrips ficorum</i> * (Marchal)	Cuban laurel thrips	EQ02 ER01 ER02	413
<i>Haplothrips gowdeyi</i> * (Franklin)	black flower thrips	ER01 ER02	414
<i>Haplothrips mali</i> * (Fitch)	black hunter thrips	EQ03 ER01	414
Homoptera*	aphids, scales, and others	AQ02	326, 329, 415, 421, 422
Aphididae*	aphids	AQ02	326, 329, 415
<i>Acyrtosiphon scariolae</i> (Nevski) [ <i>Macrosiphum barri</i> Essig]		ET02	
<i>Aphis fabae</i> * Scopoli	bean aphid	ET02	417
<i>Brevicoryne brassicae</i> * (L.)	cabbage aphid	ET02 ET03	417
<i>Lipaphis</i> [Hyadaphis] <i>erysimi</i> (Kaltenbach) [ <i>Rhopalosiphum pseudobrassicae</i> (Davis)]	turnip aphid	ET02 ET03	
<i>Macrosiphum dactynotus</i> (Thomas) [ <i>M. ambrosiae</i> (Thomas)]	ambrosia aphid	ET02 ET03	
<i>Macrosiphum euphorbiae</i> (Thomas) [ <i>M. solanifolii</i> (Ashmead)]	potato aphid	ET02	

Taxon	Common Name	Reference	Page
<i>Myzus persicae</i> * (Sulzer)	green peach aphid	ET01-ET03	329, 418
<i>Phorodon humuli</i> * (Schrank)	hop aphid	ET02	418

ET01 Mason, P.W.

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Taxon	Common Name	Reference	Page
Coccoidea*	scale insects	AQ02 EU01	326, 327, 421, 422

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Taxon	Common Name	Reference	Page
Asterolecaniidae*	pit scales	AQ02 EU01 EV01	424, 439

EV01 Russell, L.M.

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Taxon	Common Name	Reference	Page
Coccidae*	soft scales	AQ02 EU01	422, 425, 429, 440, 441
<i>Coccus hesperidum</i> L.	brown soft scale	EW01	425, 429, 441
<i>Saissetia coffeae</i> * (Walker)	hemispherical scale	EW01	425, 440

EW01 Williams, M.L., and M. Kosztarab.

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Taxon	Common Name	Reference	Page
Dactylopiidae	dactylopid scales	AQ02 EU01	422
<i>Dactylopius coccus</i> Costa	cochineal insect		
Diaspididae*	armored scales	AQ02 EU01	422
<i>Aonidiella aurantii</i> * (Maskell)	California red scale		424, 435
<i>Aonidiella citrina</i> * (Coquillett)	yellow scale		424, 435

Taxon	Common Name	Reference	Page
<i>Aspidiotus nerii</i> * Bouché	oleander scale		424, 437
<i>Chrysomphalus aonidum</i> * (L.)	Florida red scale		424, 437
<i>Hemiberlesia lataniae</i> * (Signoret)	latania scale		424, 437
<i>Lepidosaphes beckii</i> * (Newman)	purple scale		423, 434
<i>Lepidosaphes gloveri</i> * (Packard)	Glover scale		423, 433
<i>Parlatoria pergandii</i> * Comstock	chaff scale		424, 436
<i>Pinnaspis aspidistrae</i> * (Signoret)	fern scale		423, 432
<i>Pinnaspis strachani</i> * (Cooley)	lesser snow scale		423, 432
<i>Pseudaulacaspis pentagona</i> * (Targioni-Tozzetti)	white peach scale		424, 436
<i>Quadraspidiotus perniciosus</i> * (Comstock)	San Jose scale		423, 434
<i>Unaspis citri</i> * (Comstock)	citrus snow scale		423, 433
Eriococcidae*	eriococcid scales	AQ02 EU01	425, 442
Margarodidae*	margarodid scales	AQ02 EU01	423, 431
Ortheziidae*	ensign scales	AQ02 EU01 EY01	422, 430

EY01 Morrison, H.

1952. Classification of the Ortheziidae. U.S. Dept. Agr.  
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Taxon	Common Name	Reference	Page
*Pseudococcidae	mealybugs	AQ02 EU01	422, 425-427, 443-448
<i>Dysmicoccus brevipes</i> * (Cockerell)	pineapple mealybug		426, 447
<i>Dysmicoccus neobrevipes</i> * Beardsley	gray pineapple mealybug		426, 448
<i>Nipaecoccus nipae</i> * (Maskell)	coconut mealybug		425, 446
<i>Planococcus citri</i> * (Risso)	citrus mealybug		425, 443
<i>Pseudococcus longispinus</i> * (Targioni-Tozzetti)	longtailed mealybug		425, 427, 444
<i>Pseudococcus maritimus</i> * (Ehrhorn)	grape mealybug		425, 445
Hemiptera*	true bugs	AQ02 FC01-FC03	326, 329

FC01 China, W.E., and N.C.E. Miller.

1959. Check-list and keys to the families and  
subfamilies of the Hemiptera-Heteroptera. Bull.  
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FC03 Southwood, T.R.E., and D. Leston.

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London.

Taxon	Common Name	Reference	Page
Anthocoridae [Cimicidae]	<b>flower bugs, minute pirate bugs</b>	AQ02 FC01-FC03	
<i>Lyctocoris campestris</i> (Fabricius)		FC02 FC03 FD02	
<i>Xylocoris flavipes</i> (Reuter)	<b>warehouse pirate bug</b>	FC03 FD01	
<i>Xylocoris galactinus</i> (Fieber)		FC03 FD02	

- FD01 Arbogast, R.T., M. Carthon, and J.R. Roberts, Jr.  
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Taxon	Common Name	Reference	Page
Joppeicidae	joppeicids	A023 FC01	
<i>Joppeicus paradoxus</i> Puton		A023 FE01	

- FE01 Davis, N.T., and R.L. Usinger.  
 1970. The biology and relationships of the Joppeicidae. Ann. Ent. Soc. America 63(2)577-587.

Taxon	Common Name	Reference	Page
Lygaeidae	<b>seed bugs, lygaeid bugs</b>	AQ02 FC01 FC03	
<i>Elasmolomus</i> [Aphanus] <i>sordidus</i> (Fabricius)			
Miridae	<b>plant bugs</b>	AQ02 FC01-FC03	
<i>Lygus lineolaris</i> * (Palisot de Beauvois)	<b>tarnished plant bug</b>	FC02 FG01	328

- FG01 Kelton, L.A.  
 1980. The plant bugs of the Prairie Provinces of Canada. Heteroptera: Miridae. Insects Arachnids Canada 8:1-408.

Taxon	Common Name	Reference	Page
Reduviidae	<b>assassin bugs</b>	A023 AQ02 FC01-FC03	
<i>Amphibolus venator</i> (Klug)		A023 FH01	
<i>Coranus aegyptius</i> (Fabricius)		A023 FH02	
<i>Peregrinator</i> [Allaeocranum] <i>biannulipes</i> (Montrouzier)		FH03	
<i>Reduvius personatus</i> (L.)	<b>masked hunter</b>	FC02 FC03 FH04	

- FH01 Dispons, P.  
 1951. Révision du genre *Amphibolus* Klug (Hem. Reduviidae) en Afrique du Nord. Bull. Soc. Ent. France 56(5)71-73.

- FH02** Dispons, P., and W. Stichel.  
1959. Familia Reduviidae Latreille (Hemiptera-Heteroptera). *Illustrierte Bestimmungstabellen der Wanzen II. Europa* 3:81-96.
- FH03** Distant, W.L.  
1904. Rhynchota. II (Heteroptera). *In* The Fauna of British India, including Ceylon and Burma. Taylor and Francis, London.
- FH04** Wygodzinsky, P., and R.L. Usinger.  
1964. The genus *Reduvius* Fabricius in western North America (Reduviidae, Hemiptera, Insecta). *American Mus. Novitates* 2175:1-15.

Taxon	Common Name	Reference	Page
Orthoptera*	orthopterans	AQ02 AS04	325, 331, 671
Gryllacrididae	<b>cave crickets, camel crickets</b>	AS04	
<i>Pristoceuthophilus</i> [ <i>Ceuthophilus</i> ] <i>pacificus</i> (Thomas)	mushroom camel cricket	AS04	
Dermaptera*	<b>earwigs</b>	AQ02 AS04 FK01 FK02	323, 331

- FK01** Hincks, W.D.  
1956. Dermaptera and Orthoptera. *Handb. Ident. British Insects* 1(5):1-21.
- FK02** Langston, R.L., and J.A. Powell.  
1975. The earwigs of California (order Dermaptera). *Bull. California Insect Surv.* 20:1-25.

Taxon	Common Name	Reference	Page
Carcinophoridae (including Labiduridae in part)	ringlegged earwigs	AQ02	
<i>Euborellia</i> [ <i>Anisolabis</i> ] <i>annulipes</i> (Lucas)	<b>ringlegged earwig</b>	AS04 FK01 FK02	
Chelisochidae	<b>black earwigs</b>	AQ02 FK01	
<i>Chelisoches flavipennis</i> (Fabricius)			
Forficulidae	European earwigs	AQ02 FK01	
<i>Forficula auricularia</i> L.	<b>European earwig</b>	FK01 FK02	
Labiduridae	<b>striped earwigs</b>	AQ02 FK01	
<i>Labidura riparia</i> (Pallas)	<b>shore earwig</b>	FK01	
Labiidae	<b>little earwigs</b>	AQ02 FK01	
<i>Marava</i> [ <i>Prolabia</i> ] <i>arachidis</i> (Yersin)	chief earwig	AS04 FK01 FK02	
Isoptera*	<b>termites</b>	AQ02 AS04	325, 330
Araneae* [Araneida]	<b>spiders</b>	AQ02	4, 321
Opiliones* [Phalangida]	<b>daddylonglegs, harvestmen</b>	AQ02 FQ01 FQ02	320

*Insect and Mite Pests in Food*

**FQ01** Sankey, J.H.P., and T.H. Savory.  
1974. British harvestmen. Arachnida: Opiliones. Keys and notes for the identification of the species. Synopses British Fauna (n.s.) 4:1-76.

**FQ02** Todd, V.  
1948. Key to the determination of the British harvestmen (Arachnida, Opiliones). Ent. Monthly Mag. 84(1008)109-113.

Taxon	Common Name	Reference	Page
Leiobunidae	leiobunids		
<i>Leiobunum blackwallii</i> (Meade)		FQ01 FQ02	
<i>Leiobunum rotundum</i> (Latreille)		FQ01 FQ02	
Phalangidae	phalangiids		
<i>Platybunus triangularis</i> (Herbst)		FQ01 FQ02	
Pseudoscorpiones* [Chelonithida]	pseudoscorpions	AQ02 FT01-FT04	321

**FT01** Beier, M.  
1932. Cheliferinea. Pseudoscorpionidea II. Das Tierreich 58:i-xxi, 1-294.

**FT02** Hoff, C.C.  
1949. The pseudoscorpions of Illinois. Bull. Illinois Nat. Hist. Surv. 24(4)407-498.

**FT03** Manley, G.V.  
1969. A pictorial key and annotated list of Michigan pseudoscorpions (Arachnida: Pseudoscorpionida). Michigan Ent. 2(1-2)2-13.

**FT04** Nelson, S., Jr.  
1975. A systematic study of Michigan Pseudoscorpionida (Arachnida). American Midl. Nat. 93(2)257-301.

Taxon	Common Name	Reference	Page
Cheiridiidae	cheiridiids	FT01	
<i>Cheiridium museorum</i> (Leach)			
Cheliferidae	cheliferids	FT03	
<i>Chelifer cancrivorus</i> * (L.)	house pseudoscorpion, book pseudoscorpion	FT01-FT04	321
<i>Paisochelifer callus</i> Beier		FT02-FT04	
Chernetidae	chernetids	FT03	
<i>Lamprochernes minor</i> Hoff		FT02-FT04	
Withiidae [Withiinae of Cheliferidae]	withiids		
<i>Allowithius congicus</i> Beier		FT01	
<i>Allowithius kaestneri</i> Vachon			
<i>Withius piger</i> (Simon) [ <i>W. subruber</i> (Simon)]		FT01	
Isopoda	pillbugs, sowbugs	AQ02 FW01 FW02	



**FW01** Edney, E.B.

1953. The woodlice of Great Britain and Ireland. A concise systematic monograph. Proc. Linn. Soc. London 164(1)49-98.

**FW02** Sutton, S.

1972. Woodlice. Ginn, London.

<b>Taxon</b>	<b>Common Name</b>	<b>Reference</b>	<b>Page</b>
Armadillidiidae	armadillidiids		
<i>Armadillidium vulgare</i> (Latreille)	greenhouse pillbug	<i>FW01 FW02</i>	
Porcellionidae	porcellionids		
<i>Porcellio laevis</i> Latreille	dooryard sowbug	<i>FW01 FW02</i>	

**Notes and Sketches**

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## APPENDIX

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U.S. DEPARTMENT OF AGRICULTURE  
 AGRICULTURAL RESEARCH SERVICE — PLANT SCIENCES INSTITUTE  
 SYSTEMATIC ENTOMOLOGY LABORATORY-TAXONOMIC SERVICES UNIT

IDENTIFICATION REQUEST

- NOTE:
- Please *type* or *print* all information.
  - Do not write in shaded areas.
  - Give explanations where requested in "Remarks" section at bottom of form.
  - Attach additional pages if (and only if) more space is needed.

TSU LOT NO.	TSU PRIORITY
DATE	Sender's Reference No.
DATE IDENTIFICATION REQUIRED (month, day, year) If less than two months, explain below.	
TOTAL NUMBER SENT	
Pinned: Vials: Slides:	
Other:	

NAME & COMPLETE MAILING ADDRESS OF SENDER (Include Zip Code)

RETURN TO (If other than sender) (Include Zip Code)

SOURCE

- |   |   |
|---|---|
| AR <input type="checkbox"/> ARS                       | SU <input type="checkbox"/> State University        |
| AP <input type="checkbox"/> APHIS-PPQ                 | OS <input type="checkbox"/> Other State             |
| FS <input type="checkbox"/> FS                        | PU <input type="checkbox"/> Private University      |
| DD <input type="checkbox"/> U.S. Military             | IN <input type="checkbox"/> Individual              |
| OF <input type="checkbox"/> Other Federal             | CO <input type="checkbox"/> Commercial Organization |
| SA <input type="checkbox"/> State Agricultural Agency | FN <input type="checkbox"/> Non-U.S.                |
|   | CI <input type="checkbox"/> CICP                    |

LEVEL/TYPE OF IDENTIFICATION NEEDED

- Family     Genus     Species
- Positive or negative verification of ecological group:
- phytophagous     parasitic     predaceous
- saprophagous     aphidophagous     other:

OTHER INFORMATION REQUESTED—Will be supplied as conditions allow, as determined by taxonomist. Note reasons information is needed.

SOURCE OF PROJECT SUPPORT

- |                                |  |                              |                               |   |
|--------------------------------|--|------------------------------|-------------------------------|---|
| <input type="checkbox"/> ARS   | <input type="checkbox"/> APHIS           | <input type="checkbox"/> FS  | <input type="checkbox"/> CSRS | Regional project no:                                      |
| <input type="checkbox"/> Hatch | <input type="checkbox"/> EPA             | <input type="checkbox"/> DOI | <input type="checkbox"/> NIH  | <input type="checkbox"/> NSF <input type="checkbox"/> FAO |
| <input type="checkbox"/> USAID | <input type="checkbox"/> Other (Specify) |                              |                               |   |

REASON FOR IDENTIFICATION (Check and complete as appropriate)

- a Biological control
- 1  Scientific name of target pest:
- 2  General quarantine or biocontrol research
- 3  Identity of host of natural enemy
- 4  Recovery of released natural enemy
- 5  Suspected contaminant in culture
- 6  Quarantine reference collection
- 7  Voucher specimen of field release
- 8  Holding living material pending identification
- b  Damaging crop, plants—*identify host plants*:
- c  Suspected pest of regulatory concern—*give details below*
- d  Stored product pest—*commodity affected*:
- e  Livestock, wildlife, or domestic animal pest—*host*:
- f  Danger to human health
- g  Household pest—*damage*:
- h  Possible immigrant—*new to*:
- i  Reference collection—*for*:
- j  Survey—*explain in detail below*
- k  Thesis problem—*describe project below*     M.S.     Ph.D.
- l  Other—*explain below*

SPECIMEN DISPOSITION—See Instruction Sheet. If you wish specimens returned, please provide justification below. Duplicate specimens encouraged — see instruction sheet.

Return     Keep or discard

TELEMAIL/ASRR or BITNET USER ID:

TELEPHONE REPORT REQUESTED  
 If yes, give number—include area code and extension.  
 Requests are handled at the discretion of SEL, TSU

DESCRIPTION OF PROJECT—Include Project Title and name of Project Leader. (Reference previous communications pertaining to this submittal)

REMARKS (Explanations, tentative identification, etc.)

FOR TSU USE  
 DATE RECEIVED

NO.  
 LABEL  
 SORTED  
 PREPARED

DATE ACCEPTED

CC's OR TEXT



United States  
Department of  
Agriculture

Agricultural  
Research  
Service

Beltsville Area  
Plant Sciences  
Institute

Systematic  
Entomology  
Laboratory  
Beltsville, Maryland  
20705

#### IDENTIFICATION REQUEST — INFORMATION/INSTRUCTIONS

The *Systematic Entomology Laboratory* (SEL) of the *Plant Sciences Institute* (PSI), is the primary U.S. Federal agency responsible for providing identifications and other taxonomic services for insects and related organisms. The *Taxonomic Services Unit* (TSU) is the unit within SEL that receives, sorts, and distributes the specimens and reports the identifications. We are pleased to be of assistance; however, it is appropriate that you determine if sources of identifications are available in your area or country *before submitting material*.

- Use this form for submission of each *lot—not* for individual specimens. Retain Part III for your records. Send Part I *in advance* and Part II enclosed with your submittal (or send Parts I and II with your submittal) to:
 

**Taxonomic Services Unit, Systematic Entomology Laboratory**  
**Plant Sciences Institute**  
**Building 046, Room 101A, Beltsville Agricultural Research Center-West**  
**Agricultural Research Service, USDA**  
**Beltsville, Maryland 20705**  
**U.S.A.**
- Each specimen or collection of specimens, whether on a pin, in a vial, or on a slide, *must* be labeled with complete collection data — specific locality (country, state, or other political subdivision, and city or pertinent local landmark), date of collection, name of collector, family, genus, and species names of host (*if known*), and voucher number (*if appropriate*). Include duplicate data labels when submitting specimens in alcohol, in the event the taxonomist wishes to keep part of the material. Each specimen should have a brief, unique number to facilitate reporting of identifications. Specimen label data should be recorded in the event the specimens are kept for the U.S. National Museum. See reverse side for preparation of specimens. Please see our statement on parasitic Hymenoptera for information on our requirements on host data for parasitic wasps.
- A brief description of your project will enable us to place the proper priority on your request. Early submittals, and submittals of small lots as studies progress, will ensure faster service. *Please*, do not wait until your project is complete to submit specimens for identification.
- Lots relating to agricultural interests are given highest priority. Requests for information on hosts, distribution, identification characteristics, literature references, etc., are generally answered at the option of the taxonomists based on their evaluation of the request and time available. To provide the requested information the taxonomist often must spend considerable time and effort. Please request only the information that is critically needed.
- Inquiries on the status of an identification request may be made by —
 

Correspondence to Taxonomic Services Unit at the above address  
Telephone — Mary Lacey (301) 344-3041  
Telemail — MLACEY or PPQ.ARS.MLACEY; ASRR - MLACEY; BITNET · MLACEY@UMDARS

Please refer to the TSU "lot" number when known.
- In recent years the cost of returning specimens has become a major budgetary concern. With the current budget restraints, we ask that you help us keep costs to a minimum. Therefore, we would be grateful if you would retain duplicate specimens in your collection so that material we identify can be retained in the U.S. National Collection or discarded. If it is important that material be returned, please indicate your need and we will attempt to accommodate your request. Specimens that represent new species, new host records, or new distribution records may be retained at the discretion of the taxonomist for placement in the U.S. National Collection of Insects in the Smithsonian Institution. Approximately 25,000 specimens are added to the National Collection every year as a result of the SEL identification service. The opportunity to retain specimens of interest is one way in which our collaborators can be recompensed for their assistance.
- Users of this service should appropriately cite the taxonomist who provided the identifications in their publications and reports. If the identifier cannot be given after the name of the taxon (e.g., in tables or lists), a footnote or other means of acknowledgment should be used. Proper formatting, as appropriate, is as follows:
 

Name of taxonomist, Systematic Entomology Laboratory, Agricultural Research Service,  
U.S. Department of Agriculture  
Name of taxonomist, Department of Entomology, Smithsonian Institution  
Cooperating entomologists at other institutions should be listed in similar format.
- We would greatly appreciate your sending reprints of publications and other documents in which our identifications are used to the *TSU, SEL* at the above address and to the taxonomist(s) who provided the determination(s).

The insect and mite taxonomic service program of the Systematic Entomology Laboratory, with the aid of entomologists in the Smithsonian Institution and other cooperators, provides identifications of about one-third million specimens per year (about 30,000 scientific names, or 17,000 consignments or lots) for an extremely wide variety of users. Unfortunately, some specimens must be returned unidentified because the poor condition of a specimen may prevent its identification, the classification of a group may need or be undergoing revision, the quantity of material may be too large for us to accept, or the request may not be in line with our priorities. We also lack specialists or cooperators for some groups (see list below).

Immature stages are accepted for identification, but the classification of immature forms is so poorly known in many groups that even identification to family is not possible. For this reason we urge all collectors to rear some of the specimens and submit adults with the associated immature stages.

**Preparation of Specimens Submitted for Identification.** . . . Because of a lack of sufficient technical assistance to prepare specimens for identification, we are including the following instructions to help you prepare specimens in a condition suitable for study.

**PINNED**—Most specimens should be pinned; those too small or fragile for direct pinning should be double mounted on minuten nadeln or carefully glued to paper points. Glue the point to the **right side** of the specimen, using care that the glue does not conceal critical characters. Do not glue tiny *moths* or *flies* to points; use minuten nadeln. Specimens should be pinned while fresh. *Moths* should be submitted with wings spread. Examination of properly prepared genitalia is necessary to identify many insects to genus or species level. Specific instructions for preparing genitalia will be supplied upon request. Puparia, pupal skins, cocoons, etc., should be placed in a gelatin capsule or glued to a card either separately or pinned below the adult.

**SLIDE MOUNTS**—Submit *mites*, *fleas*, *thrips*, *aphids*, *whiteflies*, *psychodid flies*, most *scales*, and *mosquito larvae* on microscope slides, if you can prepare good slides. This will enable us to identify the material more quickly. Some *trichogrammatid* and *mymarid wasps* and other minute insects must also be mounted on slides. Larval *ticks* are acceptable as slide mounts if they are not engorged. Specific instructions for slide-mounting the above groups will be supplied upon request.

**ALCOHOL**—Submit the following specimens in alcohol: *ichneumonid wasps*, *mayflies*, *bat flies*, all *soft-bodied insects* (including all *larvae* and *pupae*), and most *insects under 2 mm* in length, except as indicated below. Also, specimens in the groups listed under *Slide Mounts* should be preserved in 70% alcohol if not slide-mounted. Adult *whiteflies* may be submitted in alcohol, but identification of this stage usually is not possible. **Never** submit adults of the following in alcohol: *moths*, *bees*, *true bugs*, *psychodids* and *all other flies except minute Nematocera flies*. **Place Only One Kind of Insect in Each Vial.** Use neoprene-, rubber-, or silicone-stoppered vials rather than screw-capped or shell vials. Use clear glass vials of sufficient size to allow the use of forceps or an eye dropper to remove the specimens; however, if the vial is too large, very small specimens will be difficult to find. Do not use methanol or formalin solutions: use 70, 80, or 95% ethanol if possible. Isopropanol, the drugstore variety, is adequate only for temporary storage. To prevent dilution of the alcohol and subsequent decomposition of specimens, fresh alcohol must be placed in the vials within 24 hours after *initial immersion* of specimens. All vials containing soft-bodied insects should be shipped exclusive of all air bubbles. Insert a paperclip or pin with the stopper to eliminate all air bubbles; then remove the paperclip or pin.

**PREPARATION OF SPECIFIC FORMS**—Kill *larvae* by placing them in boiling water or in an alcohol-glacial acetic acid mixture, then transfer them to 70% alcohol. *Ichneumonid wasps* and *mayflies* should be killed and preserved in 95% ethanol; *thrips* should be killed and preserved in AGA (9 parts 70% alcohol:1 part glycerine:1 part glacial acetic acid). Nymphal, adult, and engorged larval *ticks* should be preserved in 70-80% ethanol.

**DRY, UNMOUNTED**—If *whiteflies* and *diaspidid scales* are not mounted on slides, they should be submitted on host plants placed between pieces of dry paper towel, blotters, or other absorbent paper. Do not place specimens belonging to these families in plastic bags.

**PILLBOXES**—Pillboxes and matchboxes are **NOT** acceptable containers for submitting insects, but they may be used to submit associated plant samples, galls, or similar material. Soft tissue paper or cellucotton, *not cotton*, should be used in such boxes.

**Identification Capability.** . . . Adults and immatures of all groups of insects and related arthropods are accepted for identification by SEL taxonomists, except those listed below. Groups marked by an asterisk are accepted but referred to cooperators outside the Institute. Identification of these is at the *discretion of the cooperator*. Groups *not marked* by an asterisk are usually returned unidentified. With appropriate justification, we may attempt to identify some of these groups or may provide names and addresses of other experts.

**INSECT GROUPS**

*Anoplura	*Ephemeroptera	*Neuroptera	Protura	Thysanura
*Collembola	*Mallophaga	*Odonata	*Psocoptera	*Trichoptera
Diplura	*Mecoptera	*Plecoptera	*Siphonaptera	
COLEOPTERA <sup>1</sup>	Pedilidae	*Dryomyzidae	HEMIPTERA	Hesperioidea
Amphizoidea	Psephenidae	Empididae	*Tingidoidea	*Incurvarioidea
Anthridae	Rhysodidae	*Ephyridae		*Micropterygoidea
*Buprestidae	Silphidae	*Heleomyzidae	HOMOPTERA	*Nepticuloidea
Carabidae	Sphaeriidae	*Lauxaniidae	Coccoidea	*Papilionoidea <sup>4</sup>
Cicindelidae	Staphylinidae <sup>3</sup>	Mydidae	Psyllidae	*Sesidae
*Cleridae		Nemestrinidae		Sphingidae
Dryopidae	DIPTERA	*Ptychopteridae	LEPIDOPTERA (adults)	*Tineoidea
Dytiscidae	Acroceridae	Scenopinidae	Bombycoidea	Tortricoidea
Elmidae	Apioceridae	*Tanyderidae	Copromorphoidea	Yponomeutoidea
Georyssidae	Asilidae	*Tipulidae	*Cossoidea	Zygaenoidea
Gyrinidae	*Blephariceridae	*Trichoceridae	*Eriocranioidea	
Halpiidae	Bombyliidae	*Trixoscelididae	*Hepialoidea	
Hydraenidae	*Camillidae			
Hydrophilidae	*Celyphidae			
Hydroscaphidae	*Ceratopogonidae			
Lagriidae	Chironomidae			
Limnichidae	*Coelopidae			
Melandryidae	*Culicidae			
Mordellidae	*Curtonotidae			
Nitidulidae <sup>2</sup>	*Diastatidae			
Noteridae	*Drosophilidae			
*Oedemeridae				

1 There are also several minor families for which no specialist is available.  
 2 USDA material will be accepted.  
 3 ARS Biological Control material will be accepted.  
 4 True butterflies (Papilionoidea)—from outside North America only will be identified if (1) voucher specimens may be retained, (2) the specimens have been reared or parasitized, and (3) all specimens are fully labeled, including food plant data.

**NON-INSECT GROUPS**

*Araneida (spiders)	Diplopoda (millipedes)	Pedipalpida ("whip scorpions")
*Argasidae ("softbacked ticks")	Gastropoda (snails & slugs)	*Phalangida ("daddy longlegs")
Chelonethida (pseudoscorpions)	Hydrachnellae (water mites)	Scorpionida (scorpions)
Chilopoda (centipedes)	*Ixodidae ("hardbacked ticks")	Solpugida (solpugids)
Crustacea (includes sowbugs & pillbugs)	*Oligochaeta (earthworms)	Symphyla ("symphylans")

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