INSECTS OF HAWAII

A Manual of the Insects of the Hawaiian Islands, including an Enumeration of the Species and Notes on their Origin, Distribution, Hosts, Parasites, etc.

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VOLUME 3

HETEROPTERA

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PREFACE TO VOLUME 3

In this third volume of the series *Insects of Hawaii,* 224 species of Hemiptera–Heteroptera, or true bugs, are listed. This group includes some of the finest and most interesting of Hawaiian insects, and they are, in general, better known than most of the other sections of the endemic Exopterygota. There are, however, many new kinds to be described, and little is known regarding the bionomics of most of the endemic species.

The "Preface to the First Five Volumes" (in volume 1) contains a detailed discussion of this series of volumes and should be consulted for general comment and acknowledgments.

The illustrations for this volume were made mostly by Frieda Abernathy, University of California; Arthur Smith, British Museum (Natural History); and W. Twigg-Smith and J. T. Yamamoto, Experiment Station, H.S.P.A.

Dr. Harry Arnold, Jr., editor of the *Hawaii Medical Journal,* kindly gave permission for the use of the material on *Triatoma.*

I owe many thanks to W. E. China, British Museum (Natural History), for reading the manuscript, for answering many questions, for sending many notes regarding types in the British Museum and for much constructive criticism. My close friend, R. L. Usinger, who has contributed so much to the knowledge of the Heteroptera of Hawaii, naturally has taken a keen interest in this volume, and I have leaned heavily on him for aid and guidance. He has read the manuscript, has answered innumerable questions and has helped me in many ways. My colleague, R. H. Van Zwaluwenburg, Experiment Station, H.S.P.A., read the manuscript and proof for the entire volume. I am deeply indebted to these gentlemen for all they have done to make this volume better.

E.C.Z.

Honolulu,
July, 1948

Genus **PORONOTELLUS** Kirkaldy, 1904:280

Poronotus Reuter, 1871.
Buchananiella Reuter, 1885.

This genus is also represented in Hawaii by a single immigrant species. Our species is somewhat similar in color pattern to that of our *Xylocoris,* but the two genera can be separated by a glance at the metapleura. On this genus the metapleural orifice curves backward to the middle of the hind margin of the metapleuron whereas it curves sinuously to the fore margin in *Xylocoris.*

Poronotellus sodalis (White) (fig. 75).
Cardiastethus sodalis White, 1878:372.
Buchananiella sodalis (White), of authors.

Kauai, Oahu, Maui. (Type locality not given by White, but probably Oahu.)

Immigrant. Known also from Guam; probably a widespread species.

Hostplants: *Acacia farnesiana, Acacia koa,* corn, sabal palmetto, sorghum, sugarcane, under dead *Eucalyptus* bark, among fungi on *Acacia koa.* I have found many dead specimens caught on the surface of tobacco leaves infested with "white fly."

Family **CRYPTOSTEMMATIDAE**

Dipsocoridae Dohrn, 1859.
Ceratocombidae (Reuter) Fieber, 1860.

Jumping Ground Bugs

This is a small family of peculiar bugs. A recently discovered, immigrant species is the only representative known to occur in Hawaii; it resembles somewhat certain anthocorids.

Small species less than 2 mm. long; ocelli situated close to eyes; antennae four-segmented, basal two segments stout, apical two slender, conspicuously hairy; rostrum long, three-segmented; hemelytra semimembranous, and of nearly similar texture throughout; tarsi three-segmented.

Genus **CERATOCOMBUS** Signoret, 1852

Genotype: *Anthocoris cleopatrata* Zetterstedt, the only species included by Signoret.

Subgenus **Xylonannus** Reuter, 1894

Ceratocombus hawaiiensis Usinger (fig. 76).

Ceratocombus (*Xylonannus*) *hawaiiensis* Usinger, 1946:633.

Kauai.

Immigrant. Source undetermined, but closely similar to the American *vagans* McAtee and Malloch. First found by Krauss beneath the bark of a dead tree at Waipahee, Kauai (type locality), in January, 1944.

This tiny, smoky-winged, peculiar bug is easily distinguishable from all other bugs in Hawaii. The hemelytra do not overlap behind, but are divergent caudad.

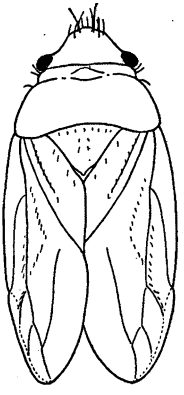

Figure 76—*Ceratocombus hawaiiensis* Usinger. (Outline sketch of holotype by J. T. Yamamoto.)

Family **MIRIDAE** (Hahn, 1831)

Mirides Hahn, 1831.

Capsinae Burmeister, 1835.

Capsidae Kirby, 1837.

Leaf Bugs

This is the largest family of Heteroptera. It is generically the most diversified of the Hawaiian bugs, and is only exceeded in numbers of known species by the Lygaeidae. However, the group has not been studied adequately, and there are many undescribed species as well as some new genera in our collections. It is the largest family of Hawaiian bugs, I believe, and it is probable that detailed study will reveal that only a modest fraction of the existing species has been described.

The family may be distinguished by the following diagnosis: ocelli absent; antennae four-segmented; rostrum four-segmented, the first segment as long as or longer than the head; hemelytra (when not brachypterous as in some species) with clavus, corium, fracture, cuneus (fracture and cuneus absent in *Sulamita*) and membrane usually well developed, membrane with one or two closed cells (areoles), one larger than the other; tarsi three-segmented, claws with arolia in most genera and sometimes with pseudarolia.

Most of the species are small, delicate, soft bodied and need special care when being collected and mounted. Many of our species are beautiful insects and have striking colors, including greens and reds, arranged in pleasing patterns and shades. Most species are fast-moving insects, and some are difficult to capture.

There is a large number of species over the world which are of minor or major importance as pests of economic plants. We have several of these noxious species here, but we also have some species which have predaceous habits and are definitely beneficial and aid materially in the control of certain important crop pests.

It is known that many species of Miridae drill holes with their beaks and then force their ovipositors into the prepared holes to lay their eggs. One or two eggs to a puncture is the usual number. They may be inserted in soft growing tissue, in old woody tissues, in scars or in dead wood.

Blackburn (1888:348) said of this family:

> The *Capsina* are, comparatively speaking, rather plentiful in the Hawaiian Islands. I possess upwards of forty species, of which I have not been able to send much more than a dozen to Dr. White. Unfortunately these are among the frailest of insects, and a great many of my species are represented by single types, some of them in inferior condition. From collecting expeditions I was usually obliged to bring home most of my captures unmounted, in sawdust, and the *Capsina* often suffered. The obscurity and difficulty of this group are so great that I think an entomologist who has not made them a special object of study would be more likely to hinder than assist future workers if he attempted to deal with them in print, and I act on this opinion by passing on without further remark....

Knight (1941:2) says,

> Many mirid species have been observed to possess during nymphal development the curious habit or ability of protruding a posterior portion of the rectum; when a nymph is dislodged and falls from a branch or leaf to the foliage below, the rectum is protruded, and, being provided with sticky material, acts as an adhesion disk upon striking the foliage of the limbs below. The nymph then scrambles for a foothold, pulls the adhesion disk free, retracts the rectum and runs for cover among the leaves. Thus the eversible rectal disk saves many falling nymphs from losing contact with the host plant.

It will be noted from the following text that considerable changes have been made in the arrangement of the Hawaiian members of the family. Study revealed that several of the genera had been assigned to subfamilies with which they had little in common. In spite of these changes, I realize that the group remains in great need of detailed study and thorough revision. We have accomplished little more than a preliminary survey of these interesting Hawaiian creatures.

KEY TO THE SUBFAMILIES OF MIRIDAE FOUND IN HAWAII

1. Head, viewed from above, porrect, cone-shaped, eyes appearing to be slightly overlapped by prothorax; tylus strongly and peculiarly produced, laterally compressed, about as long, measured from side, as length of eye; head as in figure 95 (*Oronomiris*).....part of **Mirinae.**
Head not so formed, even if porrect..... 2

2(1). Fracture and cuneus absent, but hind femora never greatly enlarged for leaping (*Sulamita*).....part of **Bryocorinae.**
Fracture and cuneus present, or hind femora greatly enlarged for leaping 3

3(2). Areoles of hemelytra each entire, not divided into a large and small cell by a vein (fig. 80)..... 4
Areoles of hemelytra each divided into two cells by a vein (fig. 91) (look carefully; sometimes the small cell is difficult to see) or hind femora enlarged for leaping..... 7

4(3). Pronotum strongly inflated and conspicuously gibbose posteriorly (fig. 80) (*Pycnoderes*).....part of **Bryocorinae.**
Pronotum not strongly gibbose posteriorly..... 5

5(4). Tibiae with fine hair only and without numerous long slender spines .....**Cylapinae.**
Tibiae with numerous, conspicuous, long, erect, slender spines in addition to shorter hairs..... 6

6(5). Pronotum with a conspicuous collar.....**Dicyphinae.**
Pronotum without a collar.....part of **Phylinae.**

7(3). Hemelytra without membrane, jumping species (*Halticus* and *Nesidiorchestes*).....part of **Heterotominae.**
Hemelytra with membrane developed..... 8

8(7). Pronotum with a distinct collar; tarsal arolia distinctly strongly divergent .....**Capsinae.**
Without such a combination of characters..... 9

9(8). Arolia of tarsal claws conspicuous, finger- or flap-like, not bristle-like, curved or sinuate, distinctly convergent; tarsal claws normally widely divaricate.....10
Arolia of tarsal claws absent or indistinct, if present, straight, erect and bristle-like but not fleshy or finger- or flap-like; tarsal claws normally divergent rather than divaricate in most of our species.....12

10(9). Tibiae hirsute or finely setose but not bearing spines (*Kalania*).....part of **Bryocorinae.**
Tibiae with numerous, long, conspicuous, well-developed spines 11

11(10). Pronotum with well-developed collar (*Nesiomiris*).....
.....part of **Mirinae.**
Pronotum without a collar.....**Heterotominae.**

12(9). Eyes distinctly separated from thorax, head constricted and shortly neck-like behind them (see fig. 88 of *Cyrtorhinus*).....part of **Heterotominae.**
Eyes contiguous or subcontiguous to prothorax, obviously unlike *Cyrtorhinus,* but as in figures 77, 78.....**Phylinae.**

Subfamily PHYLINAE Reuter, 1910

In this group the hemelytral membrane has the cell divided into two areoles, the pronotum lacks a conspicuous collar, the tarsal arolia are either absent or bristle-like, the eyes are placed near the pronotum and the tylus is not compressed or protuberant as in the Mirinae.

Key to the Genera of Phylinae Found in Hawaii

1. Second antennal segment little longer than third, never conspicuously longer, but it may be heavier....**Leucopoecila** Reuter.
   Second antennal segment much longer than third, longer than remainder of antenna in some forms..... 2
2. Hemelytra with fine prostrate or reclinate hair only, without erect bristles; pale yellowish species; tibial spines not arising from dark spots.....**Campylomma** Reuter.
   Hemelytra with two distinct types of setae, one fine, prostrate or reclinate, the other erect, or suberect, stouter, darker colored, conspicuous bristles; tibial spines arising from dark spots.....**Psallus** Fieber.

Genus **LEUCOPOECILA** Reuter, 1907:26

Leucopoecila albofasciata Reuter (fig. 77).
Leucopoecila albofasciata Reuter, 1907:26. Genotype.

The garden fleahopper.

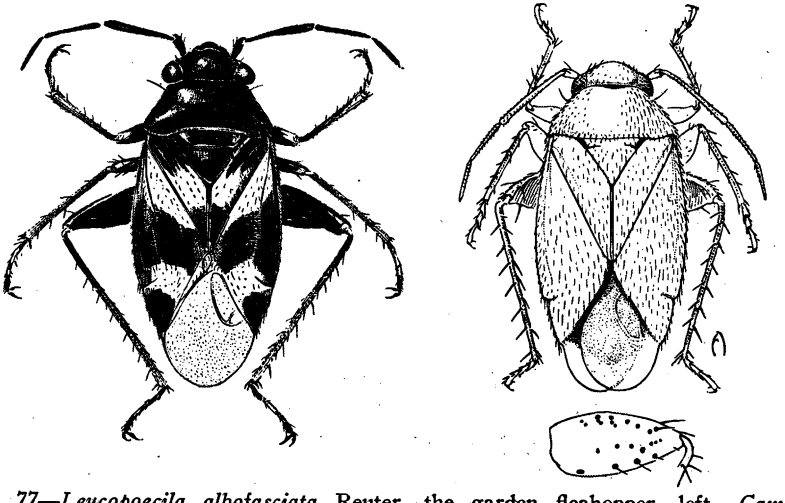

Figure 77—*Leucopoecila albofasciata* Reuter, the garden fleahopper, left. *Campylomma hawaiiensis* (Kirkaldy), right, with a sketch of a hind femur to show the characteristic dark spots. (Abernathy drawings.)

Kauai, Oahu, Molokai, Maui, Hawaii.

Immigrant. Widespread in North America. First found in the Territory by Terry in 1909 on Kauai.

Hostplants: beets, Bermuda grass, carrot, Chinese cabbage, corn, pigeon pea, *Portulaca,* nightshade, Swiss chard.

This is a nervous-acting, fast-moving bug that is difficult to capture—especially on a hot, bright day. It takes wing at slight disturbances. Sometimes it becomes abundant in gardens and is common in the field. The eggs are inserted in the leaves and stems of its hostplant. It occasionally comes to lights.

Both brachypterous and macropterous forms occur. The second antennal segment is enlarged in the male (conspicuously more swollen than in the female), and its lower surface is concave to form a large, conspicuous, sensory canal which extends almost the entire length of the segment.

It has been reported damaging seedlings of beets, carrots, chard, cabbage and pigeon pea in Hawaii by causing the cotyledons to shrivel with subsequent death of the young plants. The grass of golf course greens in some places in the United States has been damaged.

No satisfactory control measures have been worked out for it in Hawaii.

Genus **CAMPYLOMMA** Reuter, 1884

Genotype: *Campylomma nigronasuta* Reuter, fixed by Distant.
Opuna Kirkaldy, 1902:140, new synonym.

Campylomma reaches its greatest development in the Indo-Pacific regions. It is well developed in the islands from Fiji to the Marquesas (eleven species have been described from the Marquesas alone). The genus can be distinguished from our other Phylinae as follows: its second antennal segment is subequal in length to the third and fourth combined, thus separating it from *Leucopoecila;* from *Psallus* it differs by not having erect setae on the hemelytra (both genera have hair) and by lacking the dark spots at the bases of the spines on the tibiae. The dark spots at the bases of the femoral spines are not so well defined on our species as on some of those found elsewhere.

The single species established here has caused considerable confusion to local workers ever since it was so poorly and inaccurately described by Kirkaldy. He described *Opuna* as having a "wide collar" on the pronotum and stated that he had "placed this provisionally in *Halticaria,* notwithstanding its well-marked collar. It has the general appearance of an *Orthotylus.*" (1902:140.) His figure shows no such collar, and it has been suggested that the insect described and the one figured were different species. Mr. China has kindly examined Kirkaldy's unique type in the British Museum for me and has sent the following note: "*Opuna* Kirk. is undoubtedly synonymous with *Campylomma* Reuter. The collar mentioned by Kirkaldy is an optical illusion caused by the teneral state of the specimen whereby

the anterior third of the pronotum is transluscent so that the internal structure of the prothorax and occipital foramen of the head shows through, giving the appearance of a definite transverse suture. The upper surface of the pronotum is actually devoid of any transverse suture." Certainly one could not identify Kirkaldy's genotype from his description, but the confusion is at long last cleared up.

Campylomma hawaiiensis (Kirkaldy), new combination (fig. 77).
Opuna hawaiiensis Kirkaldy, 1902:140, pl. 5, fig. 29.
Campylomma hawaiiensis Usinger, 1943:287, fig. 1. New synonym.

Oahu (type locality: "S.E. Coast").
Immigrant. Known also from Wake Island and probably more widely spread.
Hostplant: *Sida.*
This species is easily recognized among our related Heteroptera, for it is unusually pale yellowish. It is a lowland species which has been found only in the Honolulu area.

Genus **PSALLUS** Fieber, 1858

Genotype: *Cimex roseus* Fabricius, fixed by Distant, 1904.

A widespread, nearly cosmopolitan genus with four described species in Hawaii, but there are undescribed species in our collections. A careful study of the Hawaiian members of the group will probably reveal a rather large complex of species here. As it now stands, the group is poorly known in these islands. The long second antennal segment (which is longer than the remainder of the antenna in some species) in combination with the spotted tibiae and two types of vestiture on the hemelytra will serve to separate our species from the members of *Leucopoecila* and *Campylomma* occurring here. The species closely resemble our *Orthotylus.*

In 1917 Van Duzee used *Apocremnus* Fieber, 1858, for this group because the name has page priority. However, he was not the first reviser, and *Psallus* stands.

On the mainland, especially in the southern states, a member of this genus is a serious pest. It is *Psallus seriatus* (Reuter), the cotton fleahopper, which attacks small cotton buds causing them to drop.

The Hawaiian forms are poorly known, and some confusion exists as to their proper names. A careful revision will be required to clarify the situation. An inquiry sent to Mr. China brought the following reply:

We have in our collection only one Hawaiian species of *Psallus,* that is *P. sharpianus* Kirk. We have a card on which two specimens had been mounted and one of which has been lost. The specimen (male) is labelled:—"Halemanu, Kauai 4,000 ft. Perkins V. 1895. *Psallus sharpianus* Kirk. Type. Specimen figured?" In running it down in your key I would scarcely call it mostly reddish. It would go better into the alternative since it is a pale testaceous. The hemelytra are scattered with distinct small fuscous spots. The hind femora of the lost

specimen, which remain on the card are pale with fuscous spots but those of the sole remaining specimen are pale with the spots very much less distinct. There is one more specimen (female) under this specific label and this is labelled "Kona, Hawaii 4,000 ft. 8. 1892 Perkins. Sharpi male, female, specimen figured." This specimen is minus antennae, legs and hemelytra and wings so that it is difficult to say what it really is. There is no variety *a* at all.

This poses several questions. Kirkaldy definitely states that typical *sharpianus* is a reddish species, and his colored figure leaves no doubt of this. Only one form was illustrated, but Mr. China points out that two examples are labeled as having been figured. Kirkaldy, in some supplementary notes (1908:197) published without access to his types, stated that the type of *sharpianus* was a "Kauaian specimen." As noted elsewhere, Kirkaldy made many confusing statements, and I believe this is another. It appears that the type of typical *sharpianus,* and the specimen figured, is the Kona, Hawaii, example which is now in fragments, and that the pale, testaceous form from Kauai (I have collected specimens on Kauai that agree with the description of this form) is what Kirkaldy called variety "*a.*" Perhaps he labeled the pale form "specimen figured," and planned to figure it but such a figure was not published. The type of *pelidnopterus* should be in the British Museum with *sharpianus;* perhaps it has been lost or destroyed.

There may be some material in the Bishop Museum's and Perkins' shares of the *Fauna Hawaiiensis* material which would reveal certain details of value in interpreting the species of this group, but, unfortunately, that material was not available for study because of the war. It is on loan to Dr. Usinger.

Key to the Hawaiian Psallus

1. Species mostly reddish in color 2
   Fuscous or testaceous species 3
2(1). Hemelytra unspotted ..... **kirkaldyi** (Perkins).
   Hemelytra with scattered but distinct small fuscous spots ..... **sharpianus** Kirkaldy.
3(1). Hind femora broadly infuscated ..... **swezeyi** Kirkaldy.
   Hind femora pale or pale with fuscous spots 4
4(3). "Blackish-brown, cuneus (more or less), femora (more or less), apical half of head, lateral margins (widely) of pronotum, and two spots at base of pronotum—yellowish" (original description) ..... **pelidnopterus** (Kirkaldy).
   Pale testaceous, hemelytra with scattered, small dark spots ..... **sharpianus luteus** Zimmerman.

Psallus kirkaldyi (Perkins), new combination.
Tichorhinus kirkaldyi Perkins, 1912:731.

Endemic. Hawaii (type locality: Kilauea).
Hostplant: *Styphelia* (*Cyathodes*).
This species has the characters of *Psallus,* not of *Orthotylus* (*Tichorhinus*), and must be transferred. The types are in the Bishop Museum.

Psallus pelidnopterus (Kirkaldy).

Psallus sharpianus variety *pelidnopterus* Kirkaldy, 1902:132.

Psallus pelidnopterus (Kirkaldy) Kirkaldy, 1909:197.

Endemic. Hawaii (type locality: Hualalai, 5,000 feet).

Hostplant: *Acacia koa.*

I do not know where the type is. I have been unable to find it in Hawaii, and the species is not represented at the British Museum.

Psallus sharpianus Kirkaldy (fig. 78).

Psallus sharpianus Kirkaldy, 1902:131, pl. 5, fig. 31; 1908:197.

Endemic. Kauai, Maui, Hawaii (type locality: Kona, 4,000 feet).

Hostplants: *Acacia koa, Euphorbia.*

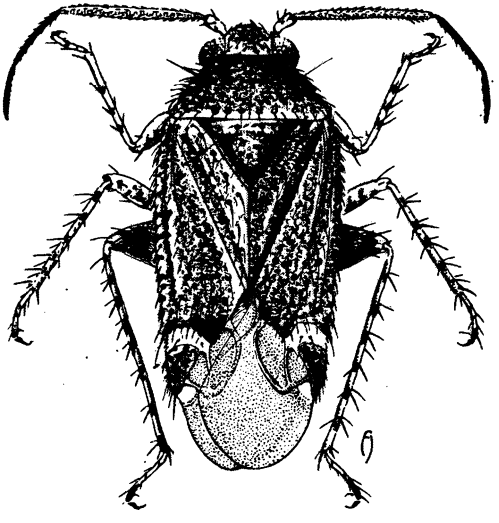

Figure 78—*Psallus sharpianus* Kirkaldy. (Abernathy drawing.)

Psallus sharpianus variety **luteus,** new name.

Psallus sharpianus variety *a* Kirkaldy, 1902:132.

Endemic. Kauai (type locality: Halemanu, 4,000 feet), Oahu, Maui, Hawaii.

Hostplant: *Acacia koa.*

Kirkaldy said that this form differs from typical *sharpianus* because it has the sanguineous coloring replaced by luteous. It may be a distinct species.

Psallus swezeyi Kirkaldy.
Psallus swezeyi Kirkaldy, 1910:120.

Endemic. Oahu (type locality: Waianae Mountains, 2,000 feet).
Hostplant: *Pipturus.*
The holotype is in the Hawaiian Sugar Planters' Association Experiment Station, Honolulu.

Subfamily DICYPHINAE Oshanin, 1912

Our members of the Dicyphinae may be distinguished from our other subfamilies of bugs by the following combination of characters: body elongate, slender; pronotum with a conspicuous collar; cell of hemelytral membrane not divided into two areoles, and tibiae with well-developed spines. A single genus represents the group in Hawaii.

Genus **ENGYTATUS** Reuter, 1875

Our species have been included in the genus *Cyrtopeltis,* but Dr. Usinger says that *Engytatus* should be used for them (see his detailed discussion, 1946:73–75). One immigrant plant pest and two native species have been recorded from Hawaii, but there are a number of new species awaiting description in local collections. The genus is a large one in our fauna, I believe. The asymmetrical male genitalia display fine specific characters which undoubtedly will be used extensively when future workers revise the group.

Key to the Hawaiian Species of Engytatus

1. Second antennal segment more than twice as long as breadth of head across eyes.....**confusus** (Perkins).
   Second antennal segment less than twice as long as breadth of head across eyes 2

2. Narrowest interocular distance about three-fourths as great as length of median line of pronotum from base to collar; second antennal segment but little longer than breadth of head across eyes; dorsum yellow, not infuscate or maculate; setae of corium spine-like, dark colored as compared with corium; antennae predominantly yellow.....**hawaiiensis** (Kirkaldy).
   Narrowest interocular distance about one-half as long as median line of pronotum from base to collar; second antennal segment one-third longer than breadth of head across eyes; dorsum infuscate and maculate; setae of corium fine, hair-like, pale; antennae predominantly dark.....**geniculatus** Reuter.

Engytatus confusus (Perkins) (fig. 79).

Cyrtopeltis confusa Perkins, 1912 (1911):729, fig. *a*.

Engytatus confusus (Perkins) Usinger, 1946:75.

Endemic. Oahu (type locality not further delimited by Perkins, but probably from the Mount Tantalus region).

Hostplants: *Cyrtandra, Gouldia* (common on this host), *Straussia, Touchardia.*

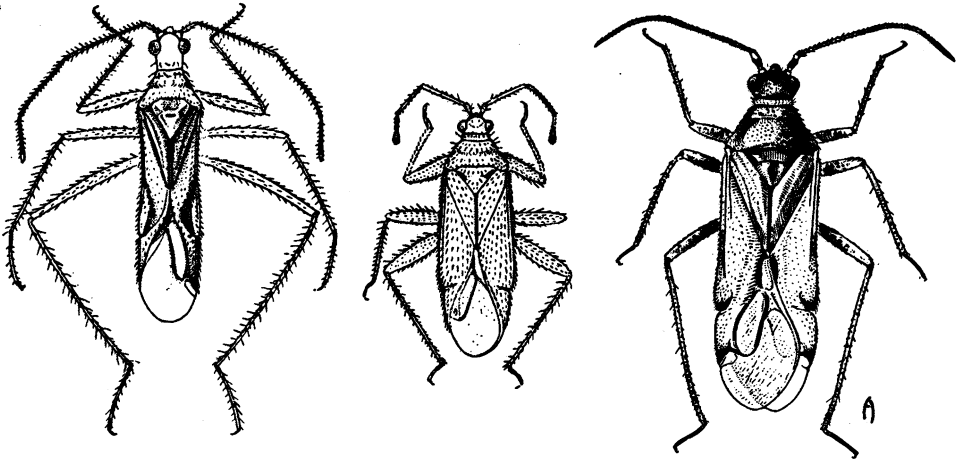

Figure 79—*Engytatus confusus* (Perkins), left. *E. hawaiiensis* (Kirkaldy), middle. *E. geniculatus* Reuter, right. (Drawings by Abernathy; not to same scale.)

Perkins (1912:730) wrote concerning this species and *hawaiiensis*:

This is the species referred to by Kirkaldy in his supplement to the Hemiptera, "Fauna Haw.," II, p. 553, as *Cyrtopeltis hawaiiensis,* but it clearly has nothing to do with that species, described in the same work, p. 138. The original series of *C. hawaiiensis,* excepting the type set, was destroyed during one of Mr. Kirkaldy's illnesses in hospital for want of attention. There was therefore no reason to assume, without comparison of specimens, that his original description of *Cyrtopeltis* was erroneous. I have an example from near the Waianae coast of Oahu, which agrees exactly with Kirkaldy's description of *C. hawaiiensis,* but is rather smaller. I should think *C. confusa* is decidedly not even congeneric with *C. hawaiiensis,* the very different antennae and pronotum, the larger and more coarsely faceted eyes and many other distinctions separating the two. At present, however, it is only necessary to call attention to the existing confusion of species with entirely different habits and appearance, especially as *C. confusa* is one of the most familiar endemic Hemiptera of the Honolulu district. *C. hawaiiensis* will probably be found on *Dodonaea viscosa,* which grows freely both above and below the true forest belt.

Engytatus geniculatus Reuter (fig. 79).

Engytatus geniculatus Reuter, 1876:83. Genotype.

Cyrtopeltis geniculatus (Reuter), not of Fieber.

Cyrtopeltis varians (Distant), as a misidentification.

The tomato bug.

Kauai, Oahu, Molokai, Maui, Hawaii.

Immigrant from the United States. First found in the Territory by Swezey in Manoa Valley, Honolulu, in 1924.

Hostplants: *Gynandropsis pentaphylla, Lagenaria* (gourd), *Plumbago,* tobacco, tomato, squash.

This species has in recent years become a pest of importance in Hawaii where it causes severe losses to the tomato crop. The bugs feed on the stems of the flower buds, ringing them with punctures and causing the buds to drop off before opening, thus reducing set of fruit. The exact nature of the cause of the so-called "blossom drop" has not been satisfactorily explained. Some workers have thought that egg laying caused the blossoms to drop, others believe that there is a physiological upset resulting from the feeding punctures, and some workers have considered soil deficiencies and other factors to be involved and that the bug was not a serious factor in blossom drop. It appears, however, that this bug is really a culprit and does cause blossom drop. Illingworth thought that it might be involved in the transmission of a mosaic disease, but no conclusive data have been presented.

These insects have predaceous as well as herbivorous habits, for they are known to feed upon mealybugs, aphids, eggs and young lepidopterous larvae (including those of the cabbage butterfly), and other small insects. They occasionally are attracted to lights and are active at night.

The nymphs pass through five stages in about nine or ten days. The first stage nymphs are yellowish with very conspicuous red eyes. Second stage, lighter color, more greenish and active, eyes brown. Third stage, greener body, yellowish head, nodes and distal segment antennae blackish. Fourth stage, more green, wing pads beginning to show, eyes blackish. Fifth stage, very green, eyes darker, wing buds reaching one-third the length of the abdomen. (Illingworth, 1937:457–458.)

Control: Illingworth reported good control by using a fine fog spray of one quart Pyrethrum 20 to five gallons of deo-base oil.

Engytatus hawaiiensis (Kirkaldy) (fig. 79).

Cyrtopeltis hawaiiensis Kirkaldy, 1902:138.

Engytatus hawaiiensis (Kirkaldy) Usinger, 1946:75.

Endemic. Oahu, Maui (type locality: Haleakala Crater).

Hostplants: *Raillardia* sp., *Raillardia menziesii.*

Kirkaldy (1910:553) altered his original description, but was in error by doing so. He confused another species with *hawaiiensis.* See Perkins' explanation and discussion under *E. confusus* above.

Subfamily BRYOCORINAE Douglas and Scott, 1865

The three genera representing this subfamily in Hawaii are easily distinguished as follows: eyes contiguous to thorax, second antennal segment longer than the following two segments together, pronotum usually conspicuously convex and inflated or gibbose; *Pycnoderes* and *Sulamita* have each hemelytral areole entire, not divided by a vein into two cells, but it is divided in *Kalania;* fracture and cuneus absent in the peculiar endemic *Sulamita;* tibiae not spinose.

Key to the Tribes of Bryocorinae Found in Hawaii

1. Fracture and cuneus absent.....**Sulamitini.**
   Fracture and cuneus present..... 2
2. Hemelytral areoles entire.....**Pycnoderini.**
   Areoles each divided into two cells by a distinct vein.....**Kalaniini.**

Tribe PYCNODERINI (Reuter, 1910)

Genus **PYCNODERES** Guérin-Méneville, 1857

We have one Neotropical immigrant garden pest to represent this genus in Hawaii. It is a conspicuous, distinct and easily recognized species.

Pycnoderes quadrimaculatus Guérin-Méneville (fig. 80).

Pycnoderes quadrimaculatus Guérin-Méneville, 1856:169.

The bean mirid (bean capsid).

Kauai, Oahu, Molokai, Maui, Hawaii.

Immigrant from the United States mainland; originally a Neotropical species. First found in the Territory by Illingworth in 1929 on Oahu.

Hostplants: *Cucumis dipsaceus,* cucumber, dishcloth gourd, garden bean, lima bean, okra, pole bean, *Portulaca,* pumpkin, spiny cucumber, squash, sweet potato, white mustard cabbage.

Parasite: *Anagrus yawi* Fullaway (Hymenoptera: Mymaridae), introduced from Mexico in 1943.

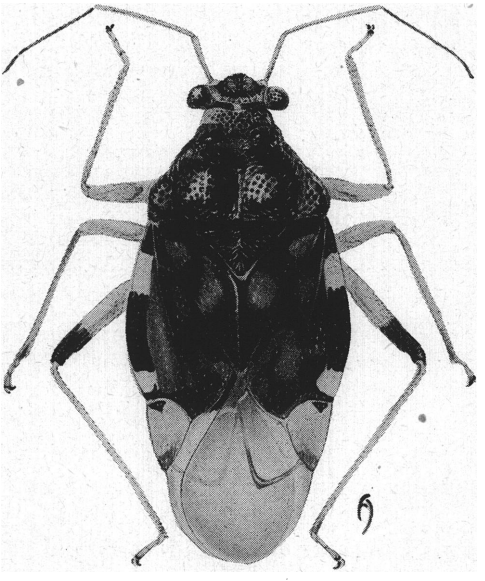

Figure 80—*Pycnoderes quadrimaculatus* Guérin-Méneville, the bean mirid. (Abernathy drawing.)

This species, whose salient and distinctive features are clearly demonstrated by our illustration, has become a pest of considerable importance to the growers of green beans in Hawaii, especially in the drier areas. At times, the bugs become excessively abundant on bean foliage, which becomes heavily spotted with black excrement beneath; the upper surface becomes pale speckled. The bug is attracted to lights.

On the mainland, this species is variously known as the squash capsid, the cucumber, melon or cassaba bug and is reported by Essig (1929:363) as "a pest to cucurbs and is particularly injurious to cucumbers, cassaba, cantaloupes, muskmelon, squash and watermelon, but also feeds on beans, lettuce, other garden vegetables, and weeds."

Control: various dusts and sprays give good control. The Hawaii Agricultural Experiment Station found that a 3 percent nicotine–lime dust and a "1:600 nicotine sulfate plus 1 pt. per 100 gal. fish-oil soap" gave satisfactory control.

A fungus (*Entomophthora sphaerosperma* Fresenius) attacks the bugs and they are preyed upon by *Zelus renardii*, a reduviid.

Tribe SULAMITINI, new tribe

Division *Sulamitaria* Kirkaldy, 1902:129.

This is an endemic group chiefly characterized by the peculiar absence of the usual mirid fracture and cuneus of the hemelytra. Kirkaldy's original diagnosis

(1902) reads "No trace of a cuneal suture in either form. Anterior part of scutellum covered, no pronotal collar. Pronotum and elytra impresso-punctate, membrane with two cells (one obsolete), clavus distinct, corium with a central nervure; wings with an areole, no hamus. Posterior coxae almost contiguous, remote from lateral margin of body; posterior femora subelongate, not incrassate."

In answer to my inquiries, W. E. China has kindly sent me the following information from the British Museum:

Sulamita is undoubtedly a member of the Bryocorinae and I think you are right in considering it as representing a distinct tribe, Sulamitini, based largely on the absence of a cuneus. This genus is obviously derived from the Prodromini (*Prodromus* Dist. and *Stenopterocoris* China) which are represented by four oriental species and two African species of the former and one African species of the latter. *Prodromus* agrees with *Sulamita* in having a strongly convex regularly punctate pronotum, small scutellum, cuneus feebly delimited from corium, embolium very narrow and parallel sided and membranal cell very long, extending nearly to apex of cuneus. No doubt when the Miridae are better known there will be found in the Austro-Oriental region (Melanesia), connecting links between *Prodromus* and *Sulamita* which will better show how *Sulamita* and *Prodromus* have been related in the past. The posteriorly carinate vertex of *Sulamita* is very distinctive although *Stenopterocoris* has a similar very broad vertex posteriorly between the eyes. The latter are more prominent, almost pediculate in the Prodromini.

Genus **SULAMITA** Kirkaldy, 1902:129

There have been four species described thus far, but there are new forms in the collection studied. The status of *oreias* and *dryas* has been in doubt because Kirkaldy gave no adequate summary of diagnostic characters which would enable them to be recognized now. Usinger has pointed out to me that Perkins designated types from Kirkaldy's material after the latter's death, but that the new type localities do not agree with the localities cited by Kirkaldy; therefore Perkins' type designations appear to be invalid; but the problem requires further study.

Both macropterous and brachypterous forms occur.

Key to the Species of Sulamita

This key was prepared by W. E. China and is based upon the types in the British Museum.

1. Anterior lobe of pronotum yellow; puncturation of head very sparse along posterior margin, no distinct median line of punctures present; puncturation of pronotum relatively sparse ..... **opuna** Kirkaldy.

   Anterior lobe of pronotum black; puncturation of head relatively dense along posterior margin of vertex, a distinct median line of punctures present; puncturation of pronotum dense 2

2(1). Posterior lobe of pronotum yellow; hemelytra without brown markings except for a narrow brown border to apical margin of corium.....**dryas** Kirkaldy.

Black coloration extending over greater part of posterior lobe of pronotum; hemelytra with a distinct semicircular marking across both coria..... 3

3(2). Clavus black except for a narrow pallid border along claval commissure; first antennal segment longer than breadth of vertex between eyes.....**lunalilo** Kirkaldy.

Clavus mainly pallid with slight infuscation at base along claval suture; first antennal segment shorter than width of vertex between eyes.....**oreias** Kirkaldy.

Sulamita dryas has the relative lengths of antennal segments 1 and 2 as 32:72, whereas they are as 40:95 on *lunalilo*.

Sulamita dryas Kirkaldy (fig. 81, a).

Sulamita lunalilo, variety, Kirkaldy, 1902:130, pl. 4, fig. 12.

Sulamita dryas Kirkaldy, 1908:197.

Endemic. Hawaii (type locality: Kilauea).

A specimen in Perkins' collection at the Bishop Museum, collected by him at 3,000 feet on Lanai, was identified by Perkins as this species.

Sulamita lunalilo Kirkaldy (fig. 81, b).

Sulamita lunalilo Kirkaldy, 1902:130, pl. 4, figs. 12a, 14. Genotype.

Kirkaldy's pl. 4, fig. 12, applies to *S. dryas*, and fig. 13 to *oreias*.

Endemic. Kauai, Oahu, Lanai, Hawaii (type labeled "Makulaiia"; paratypes from Kona).

Hostplants: *Freycinetia, Xanthoxylum.*

Sulamita opuna Kirkaldy (fig. 81, d).

Sulamita opuna Kirkaldy, 1902:131.

Endemic. Oahu (type locality: Mount Kaala, 2,000 feet).

Hostplants: *Claoxylon, Pisonia, Xanthoxylum.*

Sulamita oreias Kirkaldy (fig. 81, c).

Sulamita oreias Kirkaldy, 1908:197.

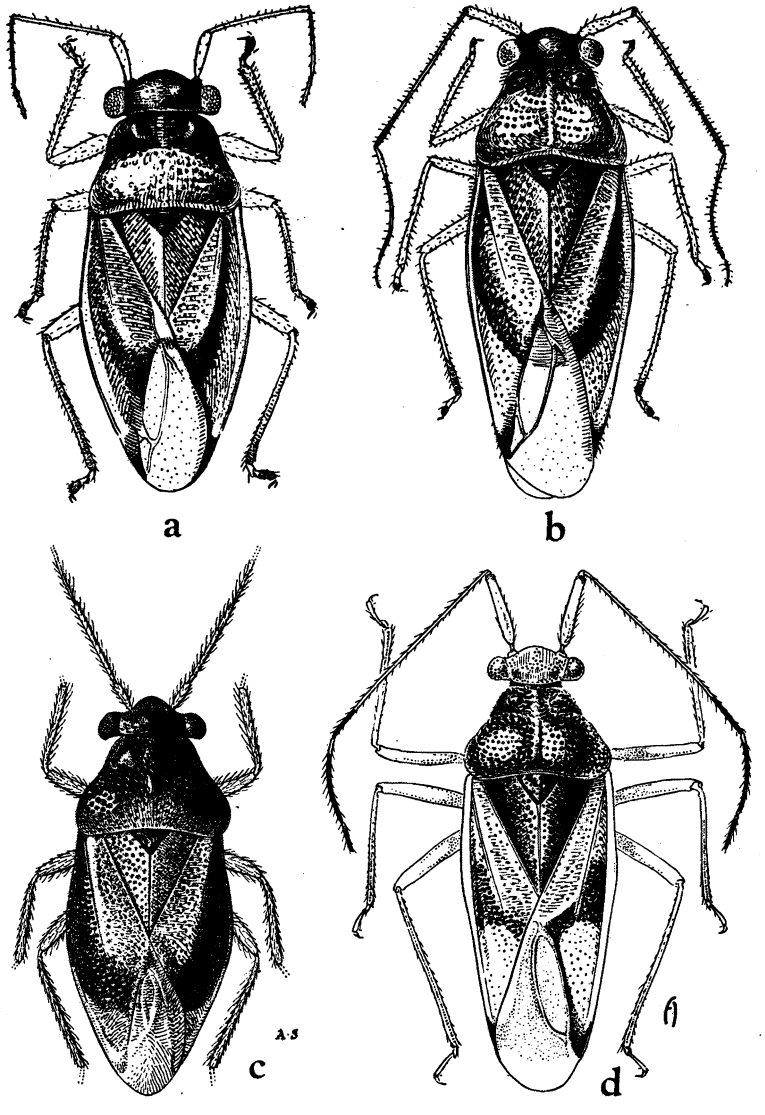

Figure 81—The species of *Sulamita*: **a**, *S. dryas* Kirkaldy (antennae reconstructed); **b**, *S. lunalilo* Kirkaldy; **c**, *S. oreias* Kirkaldy, holotype; **d**, *S. opuna* Kirkaldy. (Drawing **c** by Smith; others by Abernathy.)

Endemic. Kauai. No locality was given for this species by Kirkaldy, but the holotype bears Perkins' field number 631 which indicates that it was collected on Kauai on the "High Plateau, VIII '96."

Kirkaldy's 1902, pl. 4, fig. 13 belongs to this species, and the figured specimen will be the type. This example is illustrated herewith. A specimen bearing the following label is in Perkins' collection at the Bishop Museum: "Kauai 4000 ft. 1.02. *S. oreias* det RCLP."

Tribe KALANIINI, new tribe

This tribe is erected to receive our peculiar genus *Kalania* which has the pronotum margined at apex but without a collar; no hamus in cell of hind wing; fore wing with membrane areoles each divided into two areolets; tibiae not spinose; tarsi with first and second segments with longest chords subequal, third segment slightly swollen, slightly longer, the arolia fleshy and convergent. The antennae of the only known species has the first segment only one-fourth as long as the second which is longer than the following two together.

Genus KALANIA Kirkaldy, 1904:280

Baracus Kirkaldy, 1902:143, preoccupied.

Kalania is a peculiar genus. In our fauna it most closely resembles *Sarona,* next to which it was placed by Kirkaldy. It is easily distinguished from that genus, however, because it has a strongly protuberant scutellum and the tibiae are not spinose. As in *Sarona,* the head overlaps the apex of the pronotum, and the pronotum is margined at the apex where the base of the head fits against it. Only one species has been seen by me, and it is a rarity. Mr. China has kindly examined the type, and he agrees that a new tribe should be erected for it. He writes that it superficially might be placed in Reuter's division Perissobasaria (South America) because of the divided areoles of the fore wings which are unusual in the subfamily, but that the absence of a distinct pronotal collar on *Kalania* readily separates it from that group.

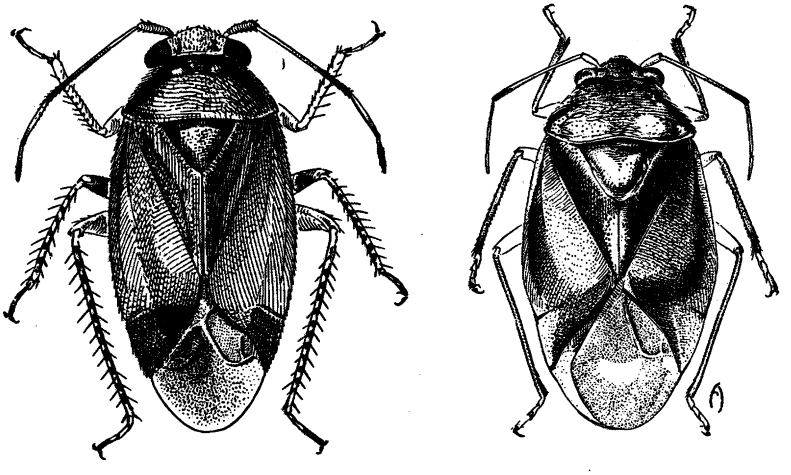

Figure 82—*Sarona adonias* Kirkaldy, left. *Kalania hawaiiensis* (Kirkaldy), right. (Drawn to same scale by Abernathy.)

Kalania hawaiiensis (Kirkaldy) (fig. 82).
Baracus hawaiiensis Kirkaldy, 1902:143, pl. 4, fig. 21.
Kalania hawaiiensis (Kirkaldy) Kirkaldy, 1904:280.

Endemic. Lanai (type locality: 2,000 feet).

Subfamily CYLAPINAE (Poppius, 1909)

A single immigrant species is the only representative of this group thus far recorded in Hawaii. The subfamily may be distinguished by the following combination of characters: head porrect, somewhat produced in front of eyes; areoles of hemelytral membrane entire; pronotum with a collar, not gibbose; tibiae setose but not spinose; tarsi without arolia. The group is mostly predaceous in habit.

Genus **FULVIUS** Stål, 1862

Fulvius is a cosmopolitan genus. Its members somewhat resemble lygaeids.

Fulvius peregrinator Kirkaldy (fig. 83).
Fulvius peregrinator Kirkaldy, 1910:120.

Kauai, Oahu, Hawaii. (Type locality not designated by Kirkaldy.)

Immigrant. I have collected it in Samoa, and it is probably more widely spread in the Pacific.

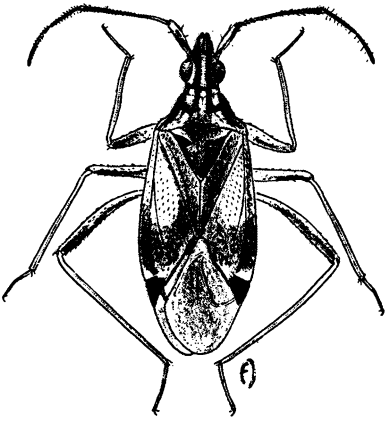

Figure 83—*Fulvius peregrinator* Kirkaldy. (Abernathy drawing.)

This species has been found in banana trash, sugarcane damaged by weevils and in similar places. It is evidently predaceous and probably has cryptic habits. A knowledge of the life history of this mirid is needed.

"Pemberton found a bug rather similar to this one that destroyed the eggs of a palm beetle-borer of the genus *Rhabdocnemis* in the Philippine Islands." (Williams, 1931:103.)

Subfamily HETEROTOMINAE Reuter, 1910

This is our most extensively developed mirid subfamily. It contains a number of complexes, is polymorphic, and is a difficult group. Because of the diverse groups of insects included, a brief, inclusive diagnosis of the subfamily is not easily written. The areoles of the hemelytral membrane are each divided into two cells (*Halticus* and *Nesidiorchestes* may lack the membrane, however); the pronotum lacks a collar; the tarsal arolia are present and usually finger- or flap-like (except in *Cyrtorhinus,* in which genus they are abnormally specifically variable); in *Pseudoclerada* the head is porrect, in the other genera it is deflexed.

Key to the Tribes of Heterotominae Found in Hawaii

1. Head porrect ..... **Pseudocleradini.**
   Head deflexed 2
2. Hind femora enlarged for leaping or head strongly embracing pronotum (anterior edge of pronotum covered by head) or both ..... **Halticarini.**
   Hind femora not enlarged for leaping; head usually obviously not overlapping fore edge of pronotum and fore edge of pronotum not extending anterior to hind edges of eyes (view from side) ..... **Heterotomini.**

Tribe HALTICARINI (Kirkaldy)

Division *Halticaria* Kirkaldy, 1902:139.

The genera *Halticus* and *Nesidiorchestes* include leaping insects with enlarged femora, especially prominent in *Nesidiorchestes.* The hind femora of the *Sarona* species are not so strongly expanded, and these bugs are not such characteristic jumping insects. The species of *Halticus* has long- and short-winged forms; the species of *Nesidiorchestes* is entirely brachypterous and cannot fly, and that of *Sarona* is always macropterous.

KEY TO THE GENERA OF HALTICARINI FOUND IN HAWAII

1. Membrane of hemelytra absent..... 2
Membrane of hemelytra present..... 3

2(1). First antennal segment not longer than greatest chord of an eye; dorsum with scattered, conspicuous ovate scales.... .....brachypterous **Halticus** Hahn.
First antennal segment distinctly longer than greatest chord of an eye; dorsum without scales..**Nesidiorchestes** Kirkaldy.

3(1). Head from top to apex of tylus much narrower than breadth across eyes; dorsum, excepting membrane, distinctly, densely punctate, without squamae; hemelytra with fracture slightly and indistinctly notched.....**Sarona** Kirkaldy.
Head as long as or slightly longer than broad; dorsum not distinctly punctate, with easily abraded, ovate, distinct squamae; hemelytra with fracture deeply, broadly, conspicuously emarginate.....macropterous **Halticus** Hahn.

Genus **NESIDIORCHESTES** Kirkaldy, 1902:139

This is a peculiar endemic genus of small, leaping bugs. The single species known is brachypterous, the hemelytra have no membrane, and the hind femora are greatly enlarged.

Nesidiorchestes hawaiiensis Kirkaldy (fig. 84).

Nesidiorchestes hawaiiensis Kirkaldy, 1902:139, pl. 4, figs. 15, 16. Genotype.

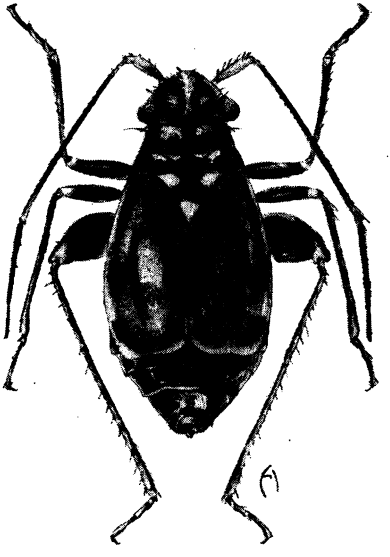

Figure 84—*Nesidiorchestes hawaiiensis* Kirkaldy. (Abernathy drawing.)

Endemic. Oahu (type locality: northwest Koolau Mountains, 2,000 feet).

I have collected this remarkable species by sifting dead leaves and ground litter in the mountains behind Honolulu. It is an agile and active jumper. I have seen it make leaps of about 1.5 inches high and 3 inches long in rapid succession.

Genus **HALTICUS** Hahn, 1832

Genotype: *Cicada aptera* Linnaeus, the only species included by Hahn.

A single immigrant species represents this genus in Hawaii. Both brachypterous and macropterous forms occur. The hind femora are greatly enlarged for leaping and the dorsum of the body has scattered, easily abraded squamae. This genus and *Nesidiorchestes* are our only genera in which the hind femora are so greatly swollen for leaping. However, they should not be easily confused, and the characters outlined in the key are ample for their separation.

If the exact date of publication of *Eurycephala* Laporte is established, that genus may replace *Halticus*.

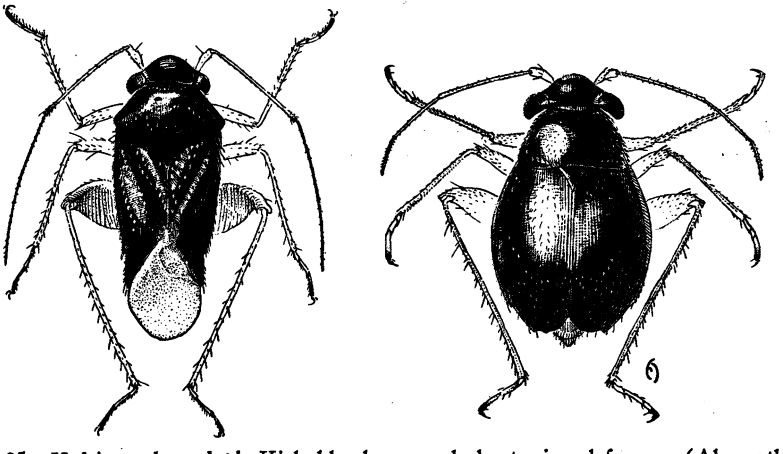

Figure 85—*Halticus chrysolepis* Kirkaldy, long- and short-winged forms. (Abernathy drawings; right figure eleven-tenths the size of the left.)

Halticus chrysolepis Kirkaldy (fig. 85).

Halticus chrysolepis Kirkaldy, 1904:179.

Oahu (type locality: Honolulu).

Immigrant. Source?

Hostplants: *Carex, Cynodon dactylon, Digitaria henryi,* "grasses."

This is a largely shiny black species, the hind femora are reddish-orange in life, and the dorsal squamae are iridescent green. It is often abundant in truck gardens.

The short-winged form may appear to one unfamiliar with the dimorphism to belong to a different genus from the long-winged form.

It is strange that this species has not yet been matched up with any of the species occurring elsewhere.

Genus **SARONA** Kirkaldy, 1902:142

This endemic genus is allied to no other in Hawaii, nor does it resemble any of our other mirids excepting *Kalania*. It appears to be an offshoot of Palearctic *Strongylocoris*. The body is stouter and more heavily sclerotized than in most of our other groups, the head is broad and short, the rostrum extends to or beyond the apex of the metacoxae, the hind femora are stout, and the entire insect has a distinctive facies that is apparent in the illustration.

Only one species has been described, but many new forms are in local collections. Perhaps more than a score of species will be described when the genus is studied carefully. The male genitalia display remarkable specific characters.

Sarona adonias Kirkaldy (fig. 82).

Sarona adonias Kirkaldy, 1902:142, pl. 5, fig. 23. Genotype.

Endemic. Molokai, Lanai, Maui, Hawaii (type locality: Kilauea; Kirkaldy, 1908:198).

Hostplants: *Metrosideros, Pelea.* Frequents flowers.

Tribe PSEUDOCLERADINI, new tribe

This tribe is erected for our peculiar endemic genus *Pseudoclerada* which Kirkaldy placed in his division Halticaria. Mr. China agrees that it cannot be retained in that tribe because of its unusual, porrect head. The cone-shaped head of the members of this tribe recalls that of certain predaceous bugs, and it is possible that this group has also developed a predaceous habit. The drawings show well the major characteristics of the tribe without the need of detailed explanation. The first two tarsal segments are subequal in length (measured along their greatest chords), the third segment a little longer than second; arolia convergent, membranous, finger-like. There is no hamus in the cell of the hind wing. Eyes very large, prominent; tylus protuberant. Pronotum without a collar.

Genus **PSEUDOCLERADA** Kirkaldy, 1902:140

This is one of our most peculiar bug genera, and its broad form combined with its porrect head will serve to distinguish it from the other mirids. Both macropterous and brachypterous forms occur.

Representatives of this genus have been collected on all of the main islands, and have been assigned to two species. I feel that confusion exists and that there are more than two species represented. There surely appear to be more than two species in the collections I have examined; perhaps almost every island has a distinct form. I have, therefore, questioned the locality records, other than the type localities, for the two described species. In answer to my request for information regarding the types in the British Museum, Mr. China sent the following comments:

I have examined the specimens of *Pseudoclerada morai* Kirk. in our collection and find that there are two species represented. The typical *P. morai* Kirk. has larger eyes in both sexes than *P. kilaueae* and the vertex between the eyes in the type male is very narrow. It is represented by the type male Molokai Mts. 3,000 ft. Perkins 1893, and three females—Honolulu, Oahu, 2,000 ft. Perkins 1896; 847 Hon. Mts. 12.1900; and Waialua, Koolau Range, Oahu, Perkins 1893. All the remaining specimens belong to a species with smaller eyes in both sexes (presumably *kilaueae* Kirk.). There is no specimen from Kilauea but there is a specimen labelled "figured" without precise locality, which could be regarded as the type (female). There are five other specimens including a male, which also has no precise locality. The remaining two specimens of *P. kilaueae* are from Kona, Hawaii, 4,000 ft., Perkins 1892, and Lanai, 2,000 ft. Perkins 1.1894. There is one broken specimen with head missing which cannot be identified. This makes thirteen specimens in all.

Kirkaldy did not have the specimen which China mentions as the female type of *kilaueae* before him when he described the species, for he was in Honolulu when he wrote the description which was based upon his figure in *Fauna Hawaiiensis*. It is the type, however, because it was the example used for the *Fauna Hawaiiensis* drawing.

Key to the Species of Pseudoclerada

Prepared from the types at the British Museum by Mr. W. E. China

1. Females. Vertex between eyes more than twice as wide as an eye (11:4.5).....**kilaueae** Kirkaldy.
   Vertex between eyes less than twice as wide as an eye (12:6.5) ..... **morai** Kirkaldy.
2. Males. Vertex between eyes at narrowest point, about two-thirds the width of an eye (7:9.5).....**kilaueae** Kirkaldy.
   Vertex between eyes at narrowest point one-half width of an eye (6:12).....**morai** Kirkaldy.

Pseudoclerada kilaueae Kirkaldy (fig. 86).

Pseudoclerada kilaueae Kirkaldy, 1908:198.

Kirkaldy's figure, 1902, pl. 4, fig. 19, applies to this species, not to *morai*.

Endemic. Lanai (?), Hawaii (type locality: Kilauea).

Kirkaldy's original description says only that "This has nothing to do specifically with *morai*, the eyes being much smaller, and the pattern and coloring quite dif-

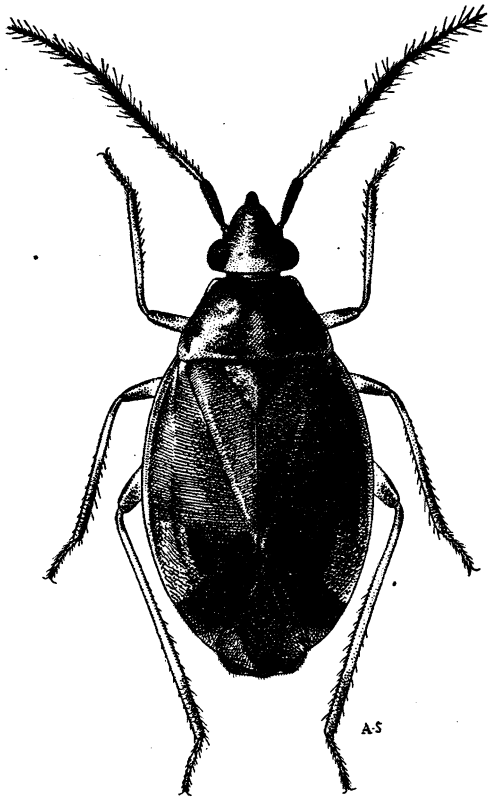

Figure 86—*Pseudoclerada kilaueae* Kirkaldy, holotype. (This is the same example as used by Kirkaldy, 1902, pl. 4, fig. 19, and misidentified there as *P. morai.*) (Drawn by Smith at the British Museum of Natural History.)

ferent." He may have come to the decision that this was a distinct species simply by examining his *Fauna Hawaiiensis* illustrations. This is a much smaller species than *morai.* The type in the British Museum is figured here.

Pseudoclerada morai Kirkaldy (fig. 87).

Pseudoclerada morai Kirkaldy, 1902:141, pl. 4, figs. 18, 18a.

Endemic. Kauai(?), Oahu(?), Molokai (type locality; Kirkaldy, 1908:198), Lanai(?), Maui(?), Hawaii(?).

Hostplants: *Elaeocarpus, Freycinetia, Pipturus, Tetraplasandra.*

Specimens have been found under dead bark and in hollow stems. The species may be predaceous, but nothing is known of its habits.

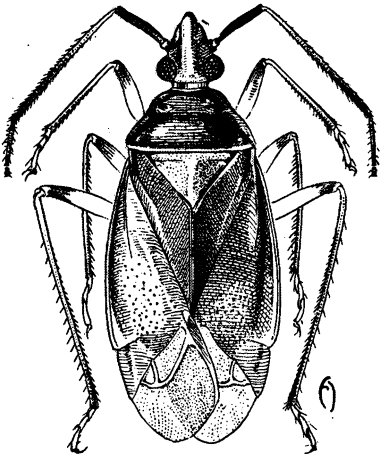

Figure 87—*Pseudoclerada morai* Kirkaldy. (Note: The "neck" is not always visible as is shown here.) (Abernathy drawing.)

Perkins (1913:ccii) noted that "There is great sexual difference in the development of the eyes, and brachypterous forms occur. The species inhabits damp shady places in the forest and has been found beneath bark of dead branches of trees, and also amongst the moss or creeping ferns growing on these. Like *Metrarga,* they hide at the bases of the leaves of *Freycinetia,* where rubbish accumulates."

Tribe HETEROTOMINI (Kirkaldy)

Division *Heterotomaria* Kirkaldy, 1902:132.

The members of this widespread group have a distinctive facies which is well displayed by the illustrations. I am not sure that *Koanoa* is correctly placed here.

Key to the Genera of Heterotomini Found in Hawaii

1. Rostrum extending behind metacoxae..... ..... **Kamehameha** Kirkaldy.
   Rostrum not reaching behind metacoxae..... 2
2(1). Hind margin of head not vertical, but horizontal, most posterior part shiny and somewhat narrowly "neck-like" ..... **Cyrtorhinus** Fieber.
   Hind margin of head vertical or nearly so, not neck-like, fitting closely to pronotum..... 3
3(2). Second antennal segment not reaching beyond posterior edge of pronotum; fracture of hemelytra deeply and conspicuously emarginate ..... **Koanoa** Kirkaldy.
   Second antennal segment reaching to far beyond posterior edge of pronotum; fracture of hemelytra usually shallowly emarginate..... **Orthotylus** Fieber.

Genus **CYRTORHINUS** Fieber, 1858

Cyrtorrhinus (Fieber) Reuter, 1884.
Genotype: *Capsus caricis* Fallen, the only species included by Fieber.

Two imported species represent this almost cosmopolitan genus in Hawaii. Usinger (1939:271–273) reviewed the distribution and host relationships and gave notes on the habits of the group. The genus is an economically important and valuable one, for its species feed upon the eggs of delphacid leafhoppers and are thus beneficial.

These bugs somewhat resemble *Nesiomiris,* but they lack the pronotal collar of that genus. "An apparent structural anomaly in *Cyrtorhinus* which has not been given sufficient attention is the absence, in certain species, of arolia between the claws. In such cases two very fine, small, parallel setae are the only structures to be seen between the claws. The presence or absence and form of the arolia is usually a very reliable guide to relationships in the Miridae . . ." (Usinger, 1939:272.) Our species *fulvus* has distinct arolia, whereas our *mundulus* has the paired setae. This is the only genus of the subfamily with such known variability.

In addition to the following two species, *C. lividipennis* Reuter was introduced by the Board of Agriculture and Forestry from Guam in 1939. It is a predator on the eggs of the corn leafhopper and is widespread in the Indo-Pacific. Unfortunately, that species has not become established here.

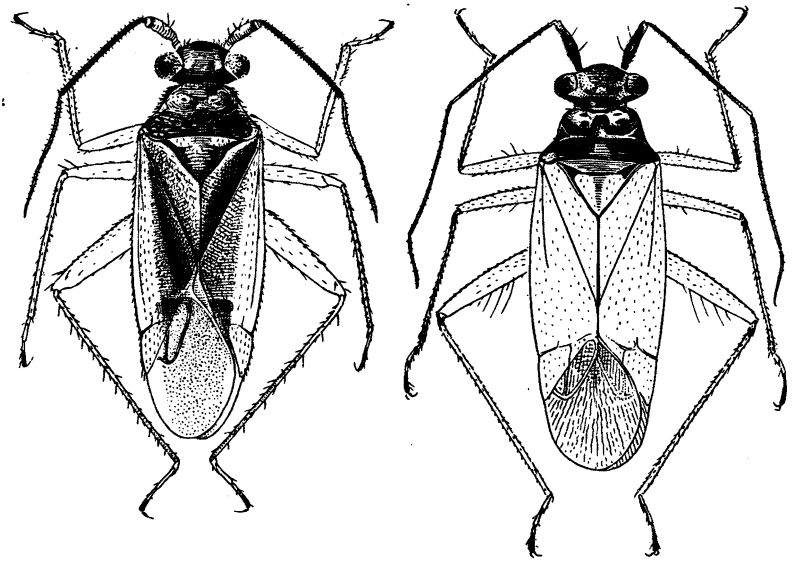

Figure 88—*Cyrtorhinus mundulus* (Breddin), the sugarcane leafhopper egg-sucking bug, left. *Cyrtorhinus fulvus* Knight, the taro leafhopper egg-sucking bug, right. (Drawn to same scale by Abernathy.)

KEY TO THE SPECIES OF CYRTORHINUS FOUND IN HAWAII

1. Head, thorax and abdomen mostly or entirely black; first antennal segment mostly yellow; fore wings in part fuscous, clavus almost black, outer wing edges pale, hyaline or subhyaline, closed wings appearing to be blackish down middle with whitish borders.....**mundulus** (Breddin).

2. Head and prothorax mostly black, remainder of thorax and abdomen orange; scutellum orange with a black median line; first antennal segment mostly black; fore wings orange, conspicuously contrasting with black pronotum.....**fulvus** Knight.

Cyrtorhinus fulvus Knight (fig. 88).
Cyrtorhinus fulvus Knight, 1935:205.

Oahu.

The taro leafhopper egg-sucking bug.

Purposely introduced to Hawaii in 1938 for the purpose of aiding in the control of the taro leafhopper, *Tarophagus proserpina.* Recorded from Java, the Philippines, Fiji and Samoa. Fullaway sent the first specimens to Hawaii from the Philippines, and they were liberated in taro patches near Kaneohe, Oahu.

Cyrtorhinus mundulus (Breddin) (figs. 88; 89, a–d).
Periscopus mundulus Breddin, 1896:106; genotype of *Periscopus.*

Kauai, Oahu, Molokai, Maui, Hawaii.

The sugarcane leafhopper egg-sucking bug.

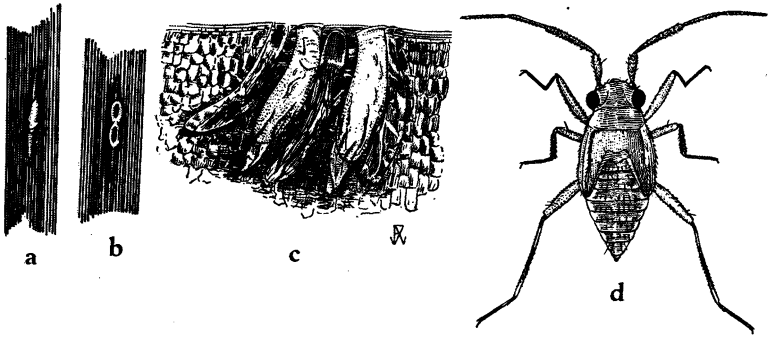

Figure 89—*Cyrtorhinus mundulus* (Breddin): **a**, an egg puncture of the sugarcane leafhopper in a sugarcane leaf; **b**, ends of two eggs of *Cyrtorhinus* protruding from an old leafhopper egg puncture; **c**, a section through the midrib of a sugarcane leaf to expose two unhatched *Cyrtorhinus* eggs inserted in a leafhopper egg slit among remnants of the leafhopper eggs; **d**, nymph. (**a–c**, after Williams, 1931.)

Purposely introduced from Queensland and Fiji in 1920 to aid in the control of the sugarcane leafhopper, *Perkinsiella saccharicida.* Known from Java (type locality), the Philippines, Australia and Fiji.

The introduction of this species, its subsequent successful establishment and the great good it has done is one of the most outstanding records in the history of biological control. This one bug has saved the Hawaiian sugar industry and the Territory millions of dollars—its true worth can hardly be estimated. Many people, I fear, have forgotten all too soon the ravages of the sugarcane leafhopper and how the failure of the sugar industry of the islands was averted by the successful control of the leafhopper by the concerted efforts of the faithful workers of the Experiment Station, H.S.P.A., at Honolulu.

An entire chapter could be devoted to the story surrounding this bug in Hawaii. There are those who were active during the establishment of control of the sugarcane leafhopper and who have already written excellent accounts. I can do no better here than to quote from Dr. Swezey's excellent report "Biological Control of the Sugar Cane Leafhopper in Hawaii" (1936:79–81) as follows:

When in Queensland in 1920 in search of additional natural enemies for the sugar cane leafhopper, Dr. Muir discovered that the little mirid bug, *Cyrtorhinus mundulus,* had the habit of piercing and sucking leafhopper eggs, and was the most efficient control agent of that pest. Although belonging to a family of bugs which are chiefly plant feeders, it seemed never to suck plant tissues. A small colony of the bugs was brought to Honolulu, and later in the year larger consignments were obtained and sent from Fiji by C. E. Pemberton. The bug had previously been known by Dr. Muir in Fiji cane fields without his having learned its habits. Three consignments were received from Fiji in September, October, and November 1920, and consisted of adults and young in cages with growing cane and leafhoppers. Several hundreds of the bugs were received in this manner. Some were released in plantation fields infested with leafhoppers, others were used for breeding in cages; breeding was kept up for a year. From the breeding cages many hundreds of bugs were obtained for distribution to the regions where the leafhoppers were most abundant. The bug readily became established in these places and spread from them throughout the entire sugar cane area and even reached Maui and Molokai without assistance. The first recovery was at Olaa only a month after liberation (their eggs were found in leafhopper-infested cane leaves sent in for examination). During the following year (1921) a few scattering recoveries were made and it seemed doubtful if the bug were becoming established sufficiently to be of any importance. In March 1922, the bugs were found very abundant at Ewa Plantation, at Waialua and at Olaa. During the year it was found sparsely in many regions, and during 1923 was found to be generally distributed throughout all the cane regions. The leafhopper was now almost entirely reduced, this bug proving to be more efficient in destroying the leafhopper eggs than were the egg parasites. In fact, without doubt, *Cyrtorhinus* caused a reduction in the efficiency of the egg parasites for it sucked leafhopper eggs regardless of whether they were already parasitized or not. In a few more years, with the scarcity of the leafhoppers, it became difficult to find the egg parasites in the fields or parasitized leafhopper eggs. At this time (from 1923 on) the control of the leafhopper was considered to be complete, having finally reached this condition through the introduction and establishment of the *Cyrtorhinus,* which had increased to great abundance wherever there were leafhopper eggs. As outbreaks of leafhoppers were reduced by the *Cyrtorhinus,* the latter disappeared also, to appear again and increase to abundance wherever any new outbreaks of leafhopper occurred. It was considered by the entomologists that if this had been the first to be introduced, it would by itself have been sufficient for the control of the leafhopper....

Their favorite habitat is within the spindle of the cane plant and when very numerous they were also found among the bristles of the leafsheath. Under favorable conditions *Cyrtorhinus* may produce ten generations per year.

Dr. Williams (1931:103–104) includes the following descriptive information in his discussion of the species:

The adult Cyrtorhinus is about 3 millimeters long; the general color is black, with the body in part (beneath the wings) reddish in males and in all young adults, the legs and the base of the antennae are pale and the light smoky wings have a broad whitish front border. It seeks the eggs of the leafhopper and sucks them through a minute puncture which it makes with its slender beak. Wary and exceedingly active, it is usually approachable only with caution, otherwise it will dodge behind a leaf or stem or make a hasty flight to the next plant. The eggs are inserted into small crevices in the cane leaf, a leafhopper egg-slit being frequently chosen; they are of shorter and stouter form than those of the leafhopper and occur singly or in very small groups. Rather close scrutiny is required for their discovery, when they may be recognized, where they are exposed, flush with the surface of the leaf, as rather evenly oval white discs or caps, the center of which is sunken and dark giving them a ring-like appearance in contrast to the irregularly protruding, waxy covering that protects the tips of the leafhopper eggs. The young Cyrtorhinus are rather short, and bright red and suggest somewhat red spiders or mites of the genus Trombidium; they may often be seen in and about the spindles of the sugar cane plant, under favorable conditions, to the number of 50 or more; they are brisk runners and undoubtedly suck dry many a leafhopper egg apiece. In the last moult the vivid coloration disappears and the duller, fully winged adult now appears.

Genus **ORTHOTYLUS** Fieber, 1858

Tichorhinus Fieber, 1858.
Genotype: *Cimex nassatus* Fabricius, fixed by Kirkaldy, 1906.

This nearly cosmopolitan genus contains a larger number of described species in Hawaii than any other genus of local mirids. There are, however, many new species awaiting description in our collections. It would not be surprising to me to see 50 or more species described in this genus. Careful collecting and revisional study may show that this group rivals the *Nysius* complex in its diversification and development. The species are small, soft and delicate. Many of them are brightly colored and have striking color patterns. Some are brilliant green, others are bright red, some are conspicuously maculate, while others are somber in color with obscure markings. They closely resemble members of the genus *Psallus,* and one *Psallus* has been described in this genus. However, the genera belong to different subfamilies, as outlined in the key. *Orthotylus* has the tarsal arolia convergent, finger-like or flap-like, whereas these structures are wanting or indistinct in *Psallus.*

I have taken several species at light in the native forests. Perkins (1913:ccii) noted that "The nymphs are often abundant on the under side of the leaves of the trees, in company with the adults. Unless disturbed by shaking, very rarely are any of the latter seen on the wing." Native plants occasionally swarm with them.

The following preliminary key has been expanded from Kirkaldy's key (1920: 132–133), and with the aid of Dr. Usinger, who worked on it during a visit to my office in 1943, and of Mr. China, who checked it with the types at the British Museum and made some valuable changes and additions. It is based upon color for want of knowledge of the other characters of the group. The male genitalia display excellent differential characters, but insufficient authentically determined material has been at hand to enable us to use those structures here. It need hardly be mentioned further that this large, complex group is too poorly known at present for us to more than indicate what has been done and to suggest what remains to be done.

Key to the Hawaiian Orthotylus

1. Color largely reddish 2
   Color largely greenish, yellowish testaceous or fuscous (sometimes with a slight reddish tinge, but never distinctly red) 3

2(1). Cuneus entirely red, pale only along fracture..... .....**kekele** Kirkaldy.
   Cuneus broadly white at base and narrowly so at apex.... .....**daphne** Kirkaldy.

3(1). Uniformly greenish or testaceous, immaculate..... 4
   Always more or less infuscated..... 5

4(3). Pale green; pubescence entirely pale.....**iolani** Kirkaldy.
   Bluish green; pubescence brownish.....**perkinsi** Kirkaldy.

5(3). Pronotum pallid testaceous (sometimes speckled with red anteriorly), with a distinct, dark brown, triangular mark in middle, its base along posterior margin and its apex just extending onto base of vertex of head..... .....**azalais** Kirkaldy.
   Pronotum without such a fuscous mark..... 6

6(5). Head, pronotum and inner apices of coria immaculate..... .....**tantali** (Perkins).
   Head, pronotum and inner apices of corium with fuscous markings 7

7(6). Cuneus with a dark red band across apical half leaving extreme apex and basal half pale pink; apical margin of corium surrounding cuneus pale pink; veins of membrane red; pronotum in female largely blackish..... .....**kassandra** (Kirkaldy).
   Cuneus uniformly pale (female) or with only an apical marginal infuscation (male) which is sometimes reddish; veins of membrane brown; pronotum of female with a large, pallid, median, anterior area.....**kanakanus** Kirkaldy.

The hostplant lists are obviously incomplete, and I feel that some of them may be inaccurate because of misidentification of the bugs.

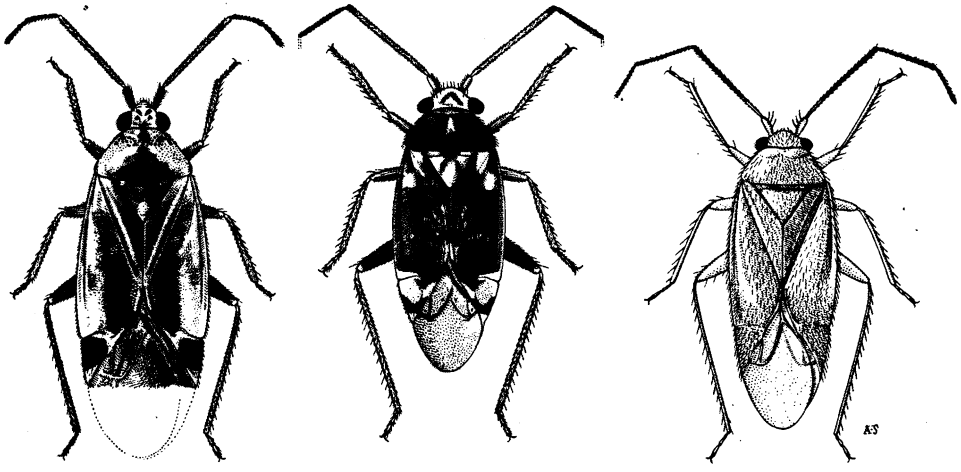

Figure 90—Holotypes of *Orthotylus azalais* Kirkaldy, left; *O. daphne* Kirkaldy, middle; *O. iolani* Kirkaldy, right. (Drawn at the British Museum of Natural History by Smith.)

Orthotylus azalais Kirkaldy (fig. 90).

Orthotylus azalais Kirkaldy, 1902:136, pl. 5, fig. 26.

Endemic. Kauai (type locality: Makaweli, 2,000 feet; Kirkaldy, 1908:198).

Hostplants: *Coprosma, Gouldia.*

The males and females differ in color pattern. The damaged type, figured here, is in the British Museum.

Orthotylus daphne Kirkaldy (fig. 90).

Orthotylus daphne Kirkaldy, 1902:135, pl. 5, fig. 24.

Tichorhinus daphne (Kirkaldy) Kirkaldy, 1908:198.

Endemic. Oahu (type locality: Waianae; Kirkaldy, 1908:198).

Hostplant: *Xylosma.*

The type is in the British Museum and is figured here.

Orthotylus iolani Kirkaldy (fig. 90).

Orthotylus iolani Kirkaldy, 1902:133.

Tichorhinus iolani (Kirkaldy) Kirkaldy, 1908:197.

Endemic. Oahu, Maui, Hawaii (type locality: Kilauea; Kirkaldy, 1908:197).

Hostplants: *Clermontia, Hibiscus, Pipturus albidus* (sometimes and in some places abundant on the leaves), *Sophora.*

Our figure was made from the type at the British Museum.

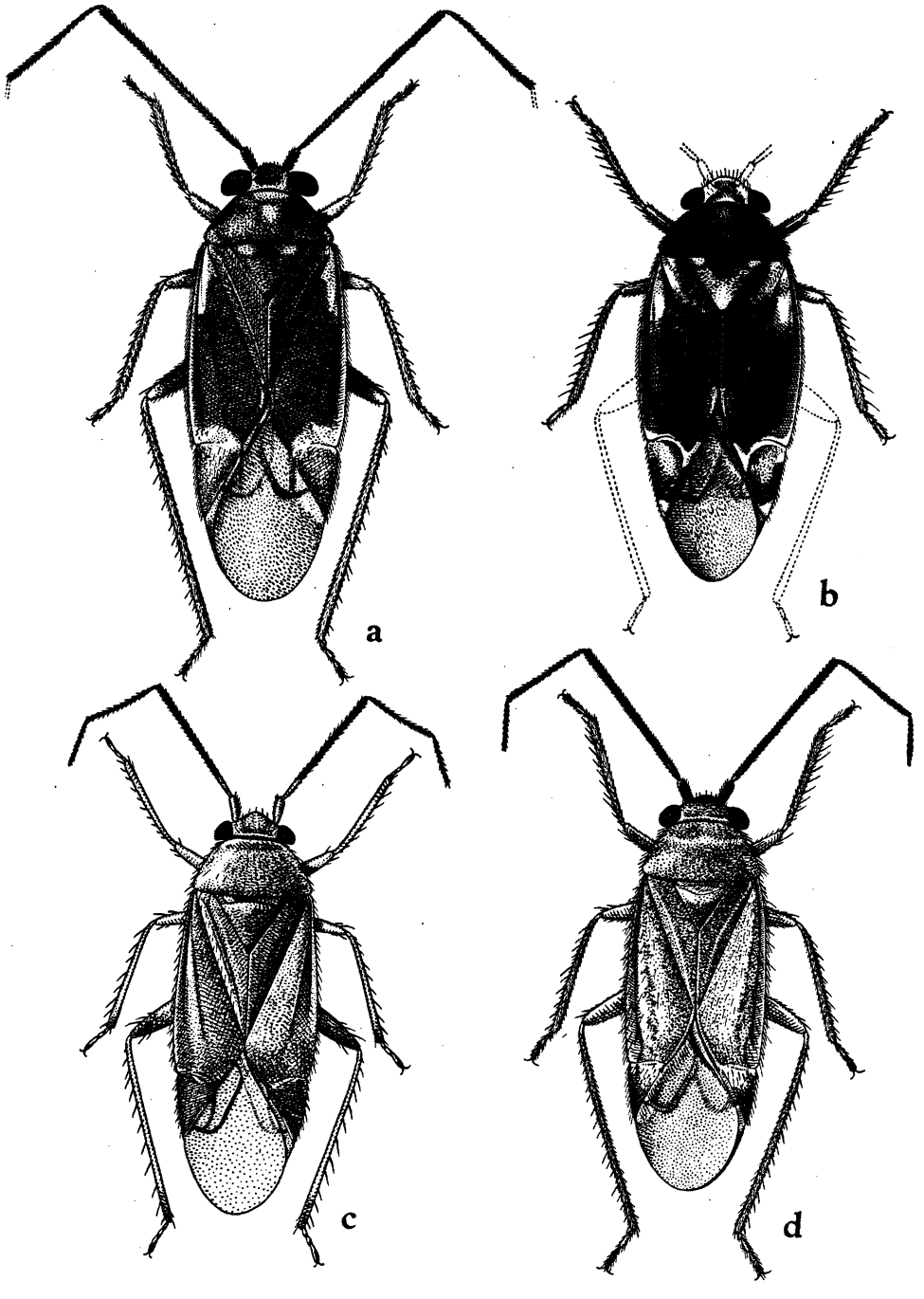

Figure 91—Holotypes of *Orthotylus*: **a**, *O. kanakanus* Kirkaldy; **b**, *O. kassandra* (Kirkaldy); **c**, *O. kekele* Kirkaldy; **d**, *O. perkinsi* Kirkaldy. (Drawn by Smith at the British Museum of Natural History.)

Orthotylus kanakanus Kirkaldy (fig. 91, a).
Orthotylus kanakanus Kirkaldy, 1902:134, pl. 5, fig. 27.
Tichorhinus kanakanus (Kirkaldy) Kirkaldy, 1908:198.

Endemic. Oahu, Lanai, Maui, Hawaii (type locality: Kilauea; Kirkaldy, 1908:198).
Hostplants: *Pipturus albidus, Straussia.*
Mr. China reports that the type male (figured here) and cotype female under this name at the British Museum are teneral specimens, but that Kirkaldy had labeled the mature examples *"persephone,"* a name he did not publish. There is sexual dimorphism in color in this species.

Orthotylus kassandra (Kirkaldy) (fig. 91, b).
Orthotylus daphne variety *kassandra* Kirkaldy, 1902:135, pl. 5, fig. 25.
Tichorhinus kassandra (Kirkaldy) Kirkaldy, 1908:198.

Endemic. Kauai, Oahu, Molokai, Lanai, Hawaii (type locality: Kilauea; Kirkaldy, 1908:198).
Hostplants: *Acacia koa, Alyxia, Ipomoea, Sadleria, Straussia, Pipturus.*
The British Museum type is illustrated here.

Orthotylus kekele Kirkaldy (fig. 91, c).
Orthotylus kekele Kirkaldy, 1902:134, pl. 5, fig. 28.
Tichorhinus kassandra (Kirkaldy) Kirkaldy, 1908:198.

Endemic. Kauai (type locality: "High Plateau").
Hostplants: *Broussaisia, Pipturus.*
The type is in the British Museum and is figured here.

Orthotylus perkinsi Kirkaldy (fig. 91, d).
Orthotylus perkinsi Kirkaldy, 1902:133.
Tichorhinus perkinsi (Kirkaldy) Kirkaldy, 1908:197.

Endemic. Kauai, Oahu, Lanai, Maui, Hawaii (type locality: Kilauea; Kirkaldy, 1908:197).
Hostplant: *Sophora.*
Our illustration was made from the type in the British Museum.

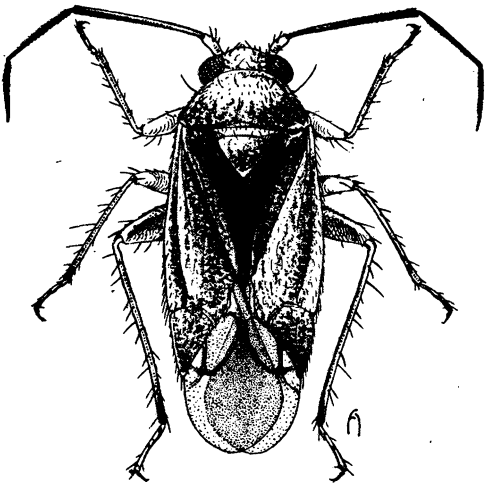

Figure 92—*Orthotylus tantali* (Perkins). (Drawing by Abernathy.)

Orthotylus tantali (Perkins), new combination (fig. 92).
Tichorhinus tantali Perkins, 1912:730, fig. *B*.

Endemic. Oahu (type locality: Mount Tantalus).
Hostplant: *Pipturus* (abundant at times).
The type is in the Bishop Museum.

Genus **KAMEHAMEHA** Kirkaldy, 1902:137

In our fauna, this native genus appears to include a large *Orthotylus* but the rostrum extends beyond the metacoxae, and the median line of the head is impressed. It closely resembles the large, widespread genus *Phytocoris*. It is, of course, named after the great Hawaiian, King Kamehameha I. Additional species will perhaps be discovered and described in this genus.

Kamehameha lunalilo Kirkaldy (fig. 93).
Kamehameha lunalilo Kirkaldy, 1902:137, pl. 5, fig. 22. Genotype.

Endemic. Oahu (type locality: Waianae; Kirkaldy, 1908:198).
Hostplants: *Cyrtandra, Pipturus.*
This species, named in honor of King Lunalilo, is a rather striking member of our Miridae. It is mottled and spotted, principally with browns, yellows and reds when dried, and the legs and antennae are long. The hemelytral membrane extends beyond the apex of the abdomen for a distance greater than the length of the venter behind the metacoxae.

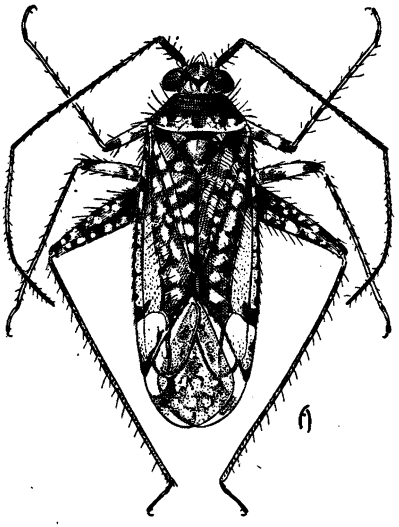

Figure 93—*Kamehameha lunalilo* Kirkaldy. (Abernathy drawing.)

It is "chiefly to be found in damp forests, living on the mosses or creeping ferns, which clothe the trunks and branches in such situations. Consequently it may be obtained from many kinds of trees by indiscriminate beating of the branches." (Perkins, 1913:ccii.)

Genus **KOANOA** Kirkaldy, 1902:136

The two species thus far described in this native genus somewhat resemble convex, black, submetallic *Orthotylus*. However, they differ from *Orthotylus* by having the second antennal segment much shorter and not passing the hind pronotal margin (it far surpasses the hind margin in *Orthotylus*), by having a short rostrum which does not extend onto the apices of the mesocoxae, and by having the outer edge of the hemelytral fracture comparatively deeply and conspicuously emarginate. They also vaguely suggest small species of *Sarona*. The longitudinal dorsal contour is unusual, as the illustration shows. There are several new species before me. Mr. China tells me that he feels that the genus is "far from being a typical Heterotomid."

Key to the Species of Koanoa

1. Second antennal segment concolorous, entirely yellowish; setae on disc of pronotum and hemelytra comparatively appressed and shorter and of different type than those of second antennal segment..... **hawaiiensis** Kirkaldy.
2. Second antennal segment partially (female) or entirely (male) black; setae on disc of pronotum and hemelytra long and about as long as those on second antennal segment, those on pronotum and scutellum comparatively erect, bristling..... ..... **williamsi** Usinger.

Koanoa hawaiiensis Kirkaldy (fig. 94).
Koanoa hawaiiensis Kirkaldy, 1902:136.

Endemic. Kauai, Oahu, Molokai, Lanai (type locality: Kirkaldy, 1908:198), Maui, Hawaii.

Hostplants: *Acacia koa, Bidens cosmoides, Cheirodendron, Metrosideros, Sideroxylon, Styphelia* (*Cyathodes*).

The above distribution follows Kirkaldy, but there is reason to believe that more than one species was included in his type series.

Koanoa williamsi Usinger (fig. 94).
Koanoa williamsi Usinger, 1937:437.

Endemic. Oahu (type locality: Mount Lanihuli).

Hostplant: *Freycinetia* (not uncommon "... between and at the bases of the clasping leaves particularly toward the top of the leaf cluster where the youngest and tenderest foliage is to be found." Usinger, 1937:437).

Usinger described the first, second, fourth and fifth nymphal instars.

Subfamily MIRINAE (Reuter, 1910)

Two genera represent this subfamily in Hawaii. They are our most elongate native Miridae and are easily recognized. The two Hawaiian groups are easily distinguished as follows:

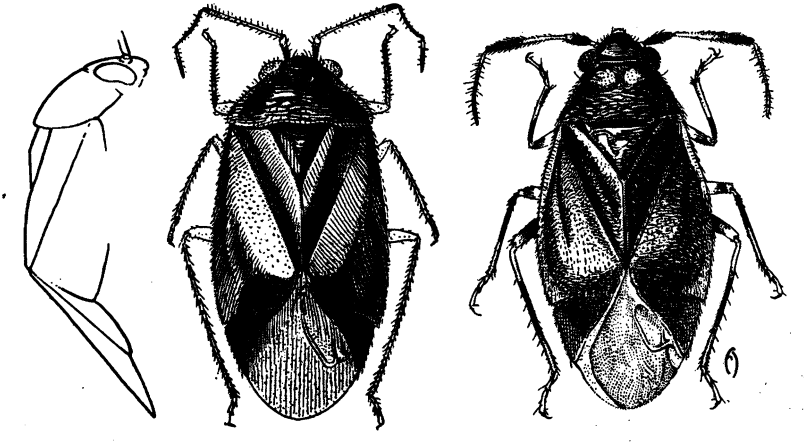

Figure 94—*Koanoa hawaiiensis* Kirkaldy, left (with side view of dorsal outline). *Koanoa williamsi* Usinger, left. (Abernathy drawings.)

1. Head porrect, more or less cone-shaped, elongate..... ..... **Oronomiris** Kirkaldy.
2. Head deflexed, broad.....**Nesiomiris** Kirkaldy.

Genus **ORONOMIRIS** Kirkaldy, 1902:144

In addition to the single described species, there are new species before us, some of which are peculiar brachypterous forms. They resemble closely the widespread genus *Trigonotylus* Fieber. The only Hawaiian group with which they might possibly be associated after a cursory glance is *Nesiomiris,* because of similar size and their elongate, slender bodies. Their heads, however, are peculiar, porrect, rather cone-shaped, the eyes are not strongly protuberant and hardly extend beyond the sides of the front of the pronotum, the tylus is peculiarly and strongly produced and compressed.

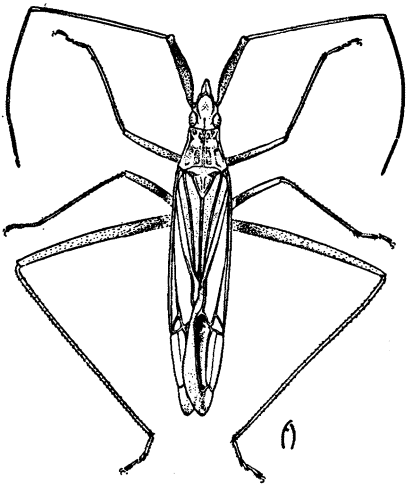

Figure 95—*Oronomiris hawaiiensis* Kirkaldy. (Abernathy drawing.)

Oronomiris hawaiiensis Kirkaldy (fig. 95).

Oronomiris hawaiiensis Kirkaldy, 1902:144, pl. 5, fig. 30. Genotype.

Endemic. Kauai, Oahu (type locality: Waimea; Kirkaldy, 1908:198), Lanai, Maui, Hawaii, Laysan.

Hostplants: native grasses (abundant at times), Bermuda grass, *Sporobolus virginicus.*

Perkins (1913:cc–cci) stated that he found it to be "a very abundant species on foreign grasses, [and it] occurs everywhere in suitable places, from the coast to 5000 ft. or more in the higher islands. This will, I think, almost certainly be found

outside the islands though possibly a natural immigrant." The discovery of new species of the genus now places this species on the endemic list, however, and I feel that there is a mixture of species in the series from which the above data have been derived.

Genus **NESIOMIRIS** Kirkaldy, 1902:144

This endemic genus is allied to the widespread *Teratocoris* Fieber. Although only the genotype has been described, there has been assembled in local collections a whole series of splendid new species which now await description. Perhaps several dozen species will eventually be discovered. The male genitalia display remarkable structural differences. The group contains some of our largest Miridae, and they are readily recognized by their comparatively large size and their slender, elongate forms. The species are mostly green, drying to yellows and pale browns. I have examined specimens from all of the main islands.

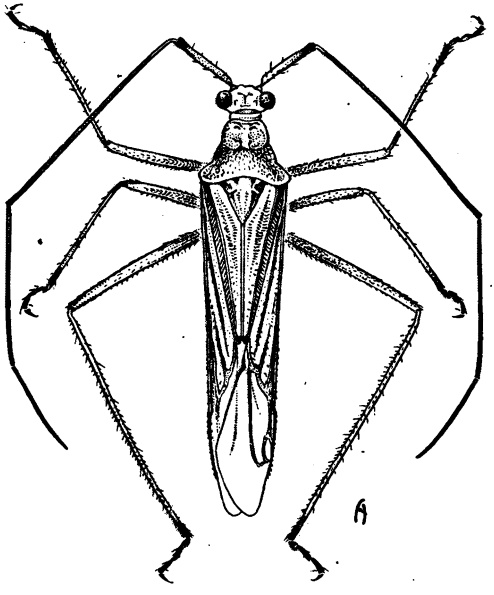

Figure 96—*Nesiomiris hawaiiensis* Kirkaldy. (Abernathy drawing.)

Nesiomiris hawaiiensis Kirkaldy (fig. 96).

Nesiomiris hawaiiensis Kirkaldy, 1902:145, pl. 5, fig. 50. Genotype.

Endemic. Hawaii (type locality: Olaa; type labeled *N. kekele* in error, Kirkaldy, 1908:198).

Hostplants: *Byronia, Cheirodendron gaudichaudi, Reynoldsia, Tetraplasandra hawaiiensis.* There may be errors in this list because of misidentifications of the bugs.

It is probable that the type series contained more than one species, and although the species has been recorded from Oahu, Molokai, Lanai and Maui, I believe that it may be confined to Hawaii.

Subfamily CAPSINAE (Reuter, 1883)

The combination of conspicuously collared prothorax, strongly divergent tarsal arolia and hemelytral cell divided into two areoles suffices to separate this group from all others in Hawaii.

Key to the Genera of Capsinae Found in Hawaii

1. Fore wings for most part transparent, hind wings and abdomen distinctly visible through them; clavus and corium mostly without coarse punctures and with fine setae confined mostly to margins; antennae nearly as long as body..... .....**Hyalopeplus** Stål.
2. Fore wings opaque; clavus and corium entirely covered with dense, rather coarse setiferous punctures; antennae only about one-half as long as body.....**Lygus** Hahn.

Genus **HYALOPEPLUS** Stål, 1870

This genus is largely confined to the Indo-Pacific area but it extends to the Ethiopian region. It is abundantly represented in the southern and western Pacific islands.

Hyalopeplus pellucidus (Stål) (fig. 97).
Capsus pellucidus Stål, 1859:255.

Kauai, Oahu (type locality: Honolulu), Molokai, Lanai, Maui, Hawaii.

Immigrant. Also known from the Society Islands.

Hostplants: *Acacia koa,* coffee, *Coprosma, Dodonaea,* avocado (breeds in the inflorescence), guava, *Hibiscus* (the common host in the lowlands), *Metrosideros, Pipturus, Sida, Straussia.*

This is a common insect which ranges from the seashore to several thousands of feet into the mountains. It is occasionally collected about lights. It is our most bulky mirid, and reaches a length of 8 to 10 mm. Kirkaldy (1907:159) described the fourth and fifth stage nymphs. It is variable in color; some individuals are

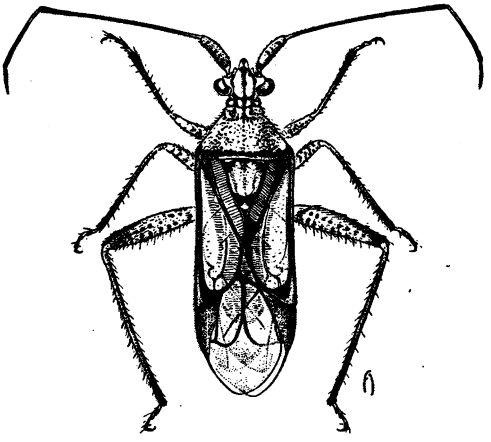

Figure 97—*Hyalopeplus pelucidus* (Stål). (Abernathy drawing.)

much darker than others. Kirkaldy (1904:185) noted that "It is predaceous and should not be destroyed." Its feeding habits are unknown, however, and some observers believe that it is phytophagous.

Genus **LYGUS** Hahn, 1831

This is a large, nearly world-wide, difficult-to-work-with genus. Although a number of species occur in the southwest Pacific and as near to Hawaii as Samoa, the genus has not reached Hawaii by natural means. A single American species, however, has recently been accidentally imported to our islands.

The genus is easily separated from all our other mirids by the characters summarized in the key to the genera and by the distinctive features of the subfamily. The convex, coarsely punctured dorsum might lead one to associate it with some of our Bryocorinae, but the presence of a collar on the pronotum is a conspicuous character for use in the easy separation of the two groups.

Lygus elisus (Van Duzee) (fig. 98).

Lygus pratensis variety *elisus* Van Duzee, 1914:20.

Lygus elisus (Van Duzee) Van Duzee, 1917:347. Knight, 1917:574, fig. 165 (genitalia). Shull, 1933:1–42, figs. 1–3.

The pale legume bug.

Immigrant. Described from California and widespread in western United States. First discovered in Hawaii in material taken in a light trap set up at Iroquois Point, Pearl Harbor, by Hawaiian Sugar Planters' Association entomologists in July, 1947.

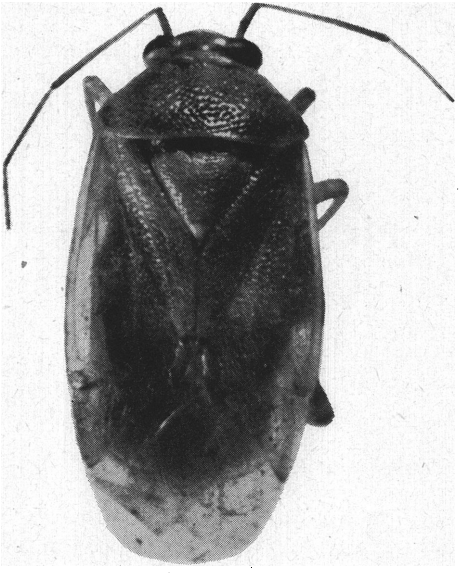

Figure 98—*Lygus elisus* (Van Duzee), the pale legume bug.

Hostplant: *Chenopodium album.*

Although we have found it only on one hostplant in Hawaii, we expect it to attack a number of other plants here, and it may become a pest of considerable economic importance. Shull (1933) lists the following as hostplants in Idaho: *Amaranthus retroflexus, Beta vulgaris, Chenopodium album, Daucus carota, Medicago sativa, Melilotus albus, Phaseolus vulgaris, Plantago major, Polygonum aviculare, Pyrus malus, Rumex crispus, Salsola pestifer, Seratina pitcheri, Solanum nigrum, Trifolium pratense, Trifolium repens.*

Shull (1933) states that the injury to beans "appears as a small hole in the seed coat, which is surrounded by a yellow area. Beneath the seed coat in the yellowed area are granules of starchy material. This injury may be caused from the time the bean pods are about half grown until the seed coat toughens just before maturity. The feeding of the insects on the blossoms causes them to drop."

The species causes loss of seed in alfalfa. It is a pest of cotton in California. When feeding on sugarbeets, it has been reported to prey also upon the sugarbeet leafhopper. Baker and Snyder (1946:500) have reported that "the toxic feeding of Lygus bugs is responsible in the California Lima bean crop for a seed spotting and pitting, and for some of the dropping of blossoms and pods." They also note that the insects have been reported to be "highly toxicogenic," to cause "severe blossom drop in alfalfa and cotton" and to "reduce germination of beet seed." They include a bibliography of ten titles.