Superfamily **TORTRICOIDEA** (Latreille)


Family **TORTRICIDAE** (Latreille)

*Tortricida*: Leach, 1815: 133.


*Platyomidae*: Duponchel, 1834: 5.

*Sciaphilidi*: Guenee, 1845: 29.


*Exapatidae*: Stainton, 1845: 10, 11.

*Plicatidae*: Stainton, 1858: 188.

*Tortricodidae*: Stainton, 1859c: 277.

*Tortricoidae*: Spuler, 1898a: 30.


The taxonomy of the Hawaiian tortricids has been in a state of almost complete confusion, and a similar situation applies to many of the faunas of the world. The classification of the Tortricoidea has been one of mostly “inflated” categories which is out of step with the taxonomy of other orders. The task of revising even the small Hawaiian fauna has been most difficult, and the presentation advanced here is a tentative one. An extraordinary divergence of opinion exists among workers concerning even such fundamental questions as the number of families, subfamilies or tribes included in the Tortricoidea. I have found much of the literature to be confusing, contradictory, or useless for the purposes of this text. Fortunately, however, there has been an increase in interest in the tortricoids in recent years, some workers have made enlightened contributions, and there is now good reason to hope that much of the chaos existing in the classification of the group will be eliminated. Obraztsov, Diakonoff, Common, Dugdale, and Freeman have been the leaders in the new classification, and readers are referred to the writings of those authors for additional information. Powell has made an excellent beginning of the study of western North American species. Margaret MacKay has made worthy contributions to a general knowledge of the family in her well-illustrated studies of the larvae of many American species. Swatschek has published on the European larvae.
The separation of the Tortricidae into suprageneric categories is a difficult task when one must attempt to fit a particular fauna such as that of Hawaii into published schemes of classification based upon the faunas of other regions. Surely, the taxonomy in most texts is untenable. Some characters which may appear to be of value in separating possible subfamilies in one limited faunal region prove worthless elsewhere. Some authors use the family names Eucosmidae, Olethreutidae, Cnephasiidae, Sparganothidae, Schoenotenidae, and others, without being able adequately to define them as families in the sense that families are used in other orders of insects. Until more detailed and comprehensive studies of the Tortricidae of the world have been made, the subdivision of the family will remain unsatisfactory.

Heinrich was a strong advocate of maintaining the Olethreutinae as a family distinct from the Tortricidae, and he had the following to say (1923:8-9):

The family Olethreutidae is sharply distinguished from the Tortricidae on genitalia, which alone enable clear and exclusive definition of the two families, and on genitalia the Olethreutidae are distinctly in advance of the Tortricidae. The genitalia of the Olethreutidae with the peculiar fusing of the upper margin of sacculus [sic] to the costal edge of the harpe [valva] leaving a restricted opening toward the base of the harpe, the narrowed articulating base of the harpe, articulating against the juxta of the anellus and connecting with the tegumen only by the costal hook, or (as in Rhyacionia) by a thin membrane from the place usually occupied by the hook, rather than the primitive articulation along the lateral margin of vinculum, as well as the loss of transtilla and the progressive reduction and elimination of many fundamental structures all indicate a specialized and advanced type. From this no generalized type could have developed, and in every way the Tortricid genitalia are distinctly the more generalized type. The genitalia of the Olethreutidae are unique and like those of no other group in the Lepidoptera. Indeed it is hard to see just where the connection is made between the two families, so complete is the break. At any rate, it is far back, and one thing is certain, the Tortricidae could have developed from no group with the genitalic development of the present Olethreutidae. Exactly reversing Meyrick’s order I would derive the Olethreutidae from the Tortricid stem, interpreting the Laspeyresiinae as their most advanced development. The Olethreutidae as a whole are a newer more plastic group, with structural characters unsettled, generic limits poorly defined, and many species in process of change. From it no other family has yet developed.

Clarke, a fellow worker and disciple of Heinrich, and a firm believer in maintaining the olethreutids as a family distinct from the Tortricidae, said in his introductory volume to his series on Meyrick’s Microlepidoptera (1955:25–26) that

the family TORTRICIDAE characteristically possesses vein 1C of the forewing, no cubital pecten on the hindwing, symmetrical male genitalia with broadly attached harpe [valva] and moderate to slender aedeagus and a subtriangular, somewhat folded, anellus. The signum, when present, consists of a single stellate plate, a sclerotised band or a single thorn with a large bulbous base. . . .

Among the five Tortricoid families the OLETHREUTIDAE are the most closely related to the TORTRICIDAE. The genitalia of this family, however, serve to distinguish any member from any species of Tortricid. In fact, there are no genitalia in the Lepidoptera that can be easily confused with those of the OLETHREUTIDAE. The peculiar anellus with the aedeagus strongly fused to it is unique and is diagnostic of the family. The female of any Olethreutid may be distinguished from any Tortricid, or from species of other families of this complex, by the signum, which consists of a single or double thorn without large bulbous base, or a pair of small dentate cones. Exceptions to this [there] are . . . , but other characters leave no doubt as to their family position.

Although the features mentioned may serve to distinguish most species, they do not characterize families, and there is no reason to use them to inflate the tortricoid taxonomy.

Heinrich, in his revision of the North American Laspeyresiinae and Olethreutinae (1926:79), demonstrated some of the exceptions and noted the confusion when he said: “On several characters . . . Episimus would go as well
in the Eucosminae as in the Olethreutinae.” And he also said (1923:12) of
the American Pseudogalleria, a relative of Cryptophlebia, “On genitalic [genital]
structure this genus would go into the Laspeyresinae. Its hind wing venation,
however, is typically Eucosmid and it will have to go here as the highest
development of the Eucosminae, linking that subfamily and the Laspey-
resinae.” In writing about the separation of the olethreutids into “sub-
families”, Heinrich (1926:5) said that “in female genitalia there are no
definitive subfamily characters. . . . There is a certain habitus that tells one
experienced with the genitalia of the group whether a specimen belongs to
one subfamily or another; but it does not seem possible to express this in any
satisfactory description.” Does something which cannot adequately be
described exist as a family?

Margaret MacKay, in her detailed study of the larvae of the North American
“Olethreutidae” (1959:5), said: “One hundred species or more in the other
families of the Tortricoidea were cursorily examined, but no characters were
found that would define the Olethreutidae.” Edna Mosher, in her monograph
on lepidopterous pupae (1916:51) said: “It was impossible to group the pupae
of this superfamiy according to any of the schemes of classification now in use.
The four groups into which the Tortricoidea discussed in the following pages
have been divided are designated as Epiblemidae, Olethreutidae, Tortricidae,
and Sparganothidae. These names, however, are without any significance
whatever as far as previous classifications are concerned, and are merely used
as a matter of convenience.”

What is the unfortunate student to do when confronted by such conflicting
opinions and confusing problems? One can hardly escape the conclusion that
the groups in question cannot be considered to be separate families. Moreover,
to separate them as families results in de-emphasizing their close interrelation-
ship and evolutionary history. No useful purpose is gained by continuing to
maintain the olethreutids as a family distinct from the tortricids.

The cell of the forewing of some tortricids contains an accessory cell at the
costal-distal corner of the main cell which is formed by the development of
the vein called the chorda (Turner, 1918:155; 1947:310) which extends from
the radial sector to the apex of the cell (see figure 18). An examination of only
a select few species might lead to the incorrect conclusion that considerable
reliance may be placed on this character to separate genera. The character,
however, is variable. In the Hawaiian Tortricinae, the chorda is absent on
Croesia, Spheterista, Epiphyas, Bradleyella, and Amorbia; it varies from being very
faintly indicated in Paraphasis to feebly developed in Panaphelix and Mantua;
and it may be feebly or absent in Pararrhaptica. In none of the Hawaiian
Tortricinae which I have examined is it very strongly developed. In contrast,
most Hawaiian Olethreutinae have it strongly formed, although it is absent
from Eccoptocera, Epinotia, and Episimus. The remaining genera, Bactra, Crypto-
phlebia, Macraesthetica, Cydia, Strepsicrates, and Crocidencea, have it fully deve-
loped.

A number of years ago I discovered a character—one that apparently has
been overlooked heretofore—which has proven to be of value in the identifica-
tion of the Tortricidae. The squamae on the lower part of the face on the
Tortricidae are directed dorsad, whereas they are directed ventrad (toward the base of the proboscis) on most other Microlepidoptera. It is particularly significant that many of the Cossidae, as well as some genera of Tineidae, have a similar arrangement. This lends support to the placement of the Tortricidae near those families. I have used this character to advantage when sorting some rather confusing specimens, and other workers may find it of value.

The separation of the genera of the tortricids is difficult if genital characters are not used. The long-used features of palpi, wing venation, legs, and tufts of hair are often confusing and unreliable. Great variation in wing venation is often found between species of the same genus. “Odd” individuals may have atypical venation; for example, the venation of the left and right wings of the same individual often may differ. Specimens of some species vary in characters which one might reasonably expect to be constant for the genera to which they belong.

A new system of classification is needed for the tortricids, and characters of the body sclerites, in addition to wing venation, genitalia, and hair tufts, eventually may come into general use. Why should lepidopterists overlook the fact that beneath the obscuring scales of the head and thorax are many features of taxonomic importance?

Although Hawaii has a rich tortricid fauna, the species are not usually found in abundance in the forest. The scarcity of individuals is not a recent phenomenon, and Perkins remarked upon this (1896: 192) as follows: “Tortrices were very scarce [on Haleakala, Maui, in May, 1896], as they are throughout the whole group [of islands]; probably they are kept down by the large number of endemic Odyneri, which seem to prefer their larvae to those of other moths for provisioning their cells. A species of Proteopteryx [not this genus; probably Eccoptocera], well known to me on other Islands, was amongst the Ohia trees, one or two other species of probably undescribed genera turning up singly. A few specimens of Bactra sp.? flew gently around at sunset.”

VARIABILITY AMONG THE HAWAIIAN TORTRICIDAE

Many of our tortricids display a bewildering variability in color and pattern. It is possible that several of the names listed below represent color forms and are, therefore, synonyms. It is probable that the type series of some are mixtures of species; it is also probable that the sexes of various species are not correctly associated. Swezey (1908c: 16) called attention to “the great variability among the Tortricids of the Hawaiian Islands. . . .” He demonstrated the correctness of his conclusions regarding the variability of some species by rearing the moths. He noted that “this variability has led to some confusion by Lord Walsingham in his recently published ‘Microlepidoptera’ (Fauna Hawaiensis, I, Pt. V). He has apparently often made varieties of some of these variations. Each species and variety is figured; hence, it should be easy to identify any Hawaiian ‘Micro’; but on account of such great variation in so many species, one may often not have a specimen of any certain species, which agrees with the particular specimen figured by Lord Walsingham. This makes it very difficult to identify specimens with any certainty, altho from a first glance at the excellent colored plates, it would appear an easy matter.”
My text suffers greatly, because, with few exceptions, series of specimens have not been reared for study. It is, therefore, impossible to comment upon range of variation, or, in many species, to be sure that the sexes before us are correctly associated. Several years’ work in the Hawaiian forests will be necessary before even a moderately comprehensive text on the Tortricidae can be written. I have been denied the opportunity for such work.

HABITS OF THE LARVAE OF THE TORTRICIDAE IN HAWAII

Tortricids are commonly called “leaf-rollers”, but the larvae of many species do not roll leaves. Some are stem-, twig-, or shoot-borers, others are seed-eaters; some are flower-head eaters; others eat berries or fruits; and many tie leaves together or form extensive webbings on their hosts, especially during their later instars. I have used the broad term “leaf-tier” instead of “leaf-roller”, because it more accurately describes the habit of many species and includes those which do roll leaves.

In the total Hawaiian tortricid fauna (that is, both endemic and introduced species), there are species whose larvae bore in the stems of sedges, some which web the leaves of a native lily, some which web the leaves of orchids, some which bore in stems, twigs, or shoots of various dicotyledons, some which feed on the seeds of various dicotyledons, other which feed on buds or flower heads and many which are leaf-tiers on a wide range of many genera in many families of dicotyledons. None are known to attack any grass or fern. With the exception of the endemic Panaphelix which is a leaf-tier on an endemic lily, all of the endemic Hawaiian Tortricidae are confined exclusively to dicotyledons. Many genera of native plants are attacked by them.

The following are the genera of Tortricidae found in Hawaii together with their larval habit and hostplant genera:

TORTRICINAE

Amorbia: leaf-tiers on many genera of plants, including orchids.  
Bradleyella: leaf-tiers on Lysimachia, Perrottetia, Phyllanthus, Xylosma.  
Croesia: leaf-tier on Rubus.  
Epiphyas: leaf-tier on many genera of plants.  
Panaphelix: leaf-tier on Astelia.  
Paraphasis: unknown.  
Spheterista: leaf-tiers, twig tip-borers, bud-eaters on Cassia, Cheirodendron, Pipturus, Pterotropia, Reynoldsia, Santalum, Tetraplasandra, Urera.  
Mantua: leaf-tier on Xylosma.

OLETHREUTINAE

Bactra: sedge stem-borers.  
Crocidosema: flower buds, fruits, and seeds of various Malvaceae.  
Cryptophebia: seed-eaters on many hosts.  
Eccoptocera: leaf-tiers on Cheirodendron, Metrosideros, Osteomeles, Psidium (guava), Syzygium.
Epinotia: stem-borers and twig-borers, and are found in the pods and flower heads of Bignonia, Lantana, Litchi, Tecoma.
Episimus: leaf-tier on Schinus.
Cydia: twig-borers, and stem-borers, and seed-eaters on Acacia, Canavalia, Sophora, Strongylodon.
Macraesthetica: unknown.
Strepsicrates: leaf-tier on Myrica.

In the Hawaiian fauna, only the Carposinidae and Tortricidae of the old, untenable concept of the "Tortricoidea" are represented, and they can easily be separated as follows:

1. Hindwings with only four veins from cell, thus the hindwings have only six veins; forewing with vein 2 leaving cell close to apex, distad of three-fourths the length of the posterior margin of cell, as in figure 537; ocelli absent; chaetosemata absent; forewings characteristically with patches or strong clusters of raised or erected scales; squamae on the lower part of the face directed ventrad ........................................... Carposinidae.

2. Hindwings with five or six veins from cell, thus with a total of seven or eight veins; forewings with vein 2 leaving cell far before apex and much more basad than the apical three-fourths of the length of the posterior margin of the cell, as in figure 221; ocelli present in all genera in Hawaii except Amorbia; chaetosemata present; squamae on the lower part of the face directed dorsad ...... ........................................... Tortricidae.

The genitalia of the carposinids differ greatly from the genitalia of the tortricids, as the illustrations will demonstrate. As discussed elsewhere, the two groups belong to different superfamilies. They cannot be associated as they were for many years and as some workers continue to associate them.

KEY TO THE SUBFAMILIES OF TORTRICIDAE IN HAWAII

1. Ocelli absent (in Hawaiian species); abdomen with a conspicuous, single, median, dorsal pit near base . . . .
   .................................................................. Amorbia in the Tortricinae.
   Ocelli present; abdomen either without such a single pit or with a pair of pits on tergites 2 and 3 ................. 2

2. Dorsal surface of hindwing with a line of very long, specialized hairs, or a dense row, or a large, conspicuous, elongate mass of such hairs ("cubital pecten") definitely along the basal part (cubitus) of the posterior margin of cell (be very careful not to confuse hairs elsewhere than actually on the cell margin); or, if such a pecten is absent, then there are many long, conspicuous
hairs over most of the area between vein 1a and the inner (basal) margin of the wing, and there may be a line of such hairs along the basal parts of vein 1a, but there is not a consolidated, isolated tuft of hair only at the origin of vein 1 (do not confuse the often rather similar tuft of hair usually evident in the axil between the wing base and thorax), and/or metanotum (metascutum) on either side of metascutellum mostly clothed with scales or rather broad, scalelike, flattened hairs, but not fine hairs only. \textbf{Olethreutinae.}

Hindwing without such vestiture along posterior margin of cell basad and without long hairs over most of the area between vein 1a and inner (basal) wing margin, but usually with a well-developed, consolidated hair tuft at the origin of vein 1 (in addition to the rather similar tuft of hair which is usually conspicuous in the axil between wing base and thorax), and this hair tuft is definitely not on the posterior margin of the cell (cubitus) but is near the origin of vein 1; metanotum (metascutum) on each side of metascutellum with a patch of long, fine hairs or long and very narrow hair scales (but not squamose) in all Hawaiian genera except the anomalous \textit{Paraphasis}. \textbf{Tortricinae.}

\textbf{NOTES ON THE KEY}

For convenience, I have separated first the common, introduced pest \textit{Amorbia}, because it is the only member of the Tortricidae in Hawaii which lacks ocelli, and, being one of the commonest tortricids encountered in Hawaii, it must often be identified.

The character of the cubital pecten, or hair tuft, and the hairs on the hindwing of some species may be confusing to the student, especially if the specimen being examined is abraded or in poor condition. The character of the vestiture of the caudal parts of the metanotum adjacent to each side of the metascutellum is usually quite distinctive and easily recognized once the differences are appreciated. Unfortunately, one anomalous genus (\textit{Paraphasis}), which otherwise appears to belong in the Tortricinae, has this character developed more as in our Olethreutinae. The undersides of the hindwings provide another character which may usually easily be seen; they are either conspicuously and extensively dark-maculate, or they are immaculate or nearly immaculate. The undersides of the hindwings of most Hawaiian Olethreutinae are plain and not spotted, but, unfortunately, the wings of \textit{Cryptophlebia} are strongly spotted and the undersides of the hindwings of \textit{Crocidosema} have some spots along the anterior parts (these genera belong to the Olethreutinae). Moreover, \textit{Paraphasis}, a confusing genus of uncertain status, and \textit{Bradleyella}, obviously a member of the Tortricinae, lack the spotting which is so character-
istic of other Hawaiian Tortricinae. These unfortunate exceptions add to the confusion and compound the work of determination.

Briefly restated, using characters which are often more easy to distinguish than the pectens or hairy vestiture of the hindwing, we may note that all species which have the vestiture of the metanotum at each side of the metascutellum consisting mostly of scales or flat or rather broad hair scales and not fine hairs (except laterad on some species) belong to the Olethreutinae with the exception of the anomalous Paraphasis (whose wing venation is unusual and the antennae of the male are strongly bipectinate). Also, the undersides of the hindwings of all of the Hawaiian Olethreutinae are immaculate or nearly so, with the exception of Crocidosema (which has some spots along the anterior part of the wing), Cryptophilebia (which has strongly maculate wings—as conspicuously maculate as some of the more pronounced maculation found in our Tortricinae), and Cydia which has some feeble marginal maculation. In Hawaiian Tortricinae, the vestiture on the metanotum on each side of the metascutellum of all genera consists of long fine hairs, or very fine hair scales which contrast sharply with the squamae of the metascutellum; the only exception to this is the anomalous Paraphasis which has broad and elongate-scale-like hairs. Also, Hawaiian Tortricinae all have the undersides of the hindwings strongly maculate on the discs and overall, with the exception of Paraphasis and Amorbia, which have immaculate hindwings, and Bradleyella, which has immaculate or mostly immaculate hindwings. Once these characters are learned by experience, the entomologist will find that they assist materially in identifying many Hawaiian specimens.

The males of many, but not all of the species of Cydia (Olethreutinae) have a peculiar elongate “pocket” behind vein 2 or along vein 1c in the hindwing which extends beneath the wing as a flaplike structure. No other moths in Hawaii have such a feature. The males of Cryptophilebia have a strongly developed “sex patch” of modified squamae beneath veins 1a and 1b of the hindwing, but it is very different from the structure in Cydia. The males of Eccoptocera, Strepsicrates, and Epinotia of the Olethreutinae have strong costal folds or flaps on the forewings. Similar strong costal folds are found in the Tortricinae in the males of Epiphyas and some, but not all, species of Spheterista. The antennae of the males of Eccoptocera and Strepsicrates (both Olethreutinae) have a so-called “notch” on the dorsal surface near the base. The males of Panaphelix and Paraphasis (Tortricinae) have strongly bipectinate antennae, and the males of Mantua have long hairs beneath.

Subfamily T O R T R I C I N A E (Latreille) Fernald

Tortricidi: Guenée, 1845a: 136.
Tortricidae: Meyrick, 1881b: 413.
Diakonoff, 1953–6, key to New Guinea genera.

Most of the Hawaiian species of Tortricinae are variable or highly variable; some are sexually dimorphic, some are dichromatic, and some have many
color forms. This often leads to confusion and compounds the task of description and identification. It is possible that the sexes under several of the names are not correctly associated. This text reflects the confusion, and I regret that circumstances beyond my control prevent me from elucidating the problems.

KEY TO THE GENERA OF TORTRICINAE IN HAWAII

1. Ocelli absent ........................................ Amorbia.
   Ocelli present .........................................2

2(1). Forewing with vein 7 running to costa, not to termen,
   thus six veins end on costa, figure 221; forewings
   with small patches of raised scales (one introduced
   species whose larvae feed on blackberry) ....... Croesia.

2(2). Forewing with vein 7 running to termen and not to
   costa, thus with only five veins ending on costa;
   forewings without raised scale patches ..........3

3(2). Forewing with veins 7 and 8 fused for a distance
   beyond cell, then forked, as in figures 225–231....
   ...................................................... Spheterista.

3(1). Forewing with veins 7 and 8 free from origins or
   connate, not stalked ...............................4

4(3). Venation of forewings and hindwings unusual, as in
   figure 300; forewing with vein 2 ending on posterior
   margin ("dorsum") of wing instead of on termen
   as is normal; hindwing with vein 5 widely separated
   from 4 at origin and 6 widely separated from 7 at
   origin; antennae of male strongly bipectinate, as in
   figure 220 ......................................... Paraphasis.

4(4). Venation very different .............................5

5(4). Second (subterminal) segment of labial palpus
   moderately to strongly and rather evenly expanded
   distad above and below to produce a characteristic
   shape, as in figure 310; undersides of hindwings not
   spotted or, at most, weakly maculate. ....... Bradleyella.

5(5). Second segment of labial palpus not expanded
   beneath in such a design, most of the expansion
   is on the dorsal side; undersides of hindwings
   strongly maculate .....................................6

6(5). Labial palpus with terminal segment distinctly and
   fully separated from the subterminal segment, as
   in figures 302,307, or even more isolated, and
   ventral margin of penultimate segment with scales
   mostly closely appressed; large species, 28 to 37 mm
   in expanse ........................................... 7
Terminal segment of labial palpus more definitely enclosed or basally concealed by the rougher scaling of the subterminal segment, and scaling more expanded or suberect dorsad and ventrad, as in figures 268, 273.  

7(6). Males ................................................................. 8  
Females ............................................................... 9  

8(7). Antennae strongly bipectinate, figure 220  Panaphelix.  
Antennae long-hairy, but not bipectinate  Mantua.  

9(7). Scales on mesonotum and tegulae mostly multidentate at apices; inner terminal spur on hind tibia only slightly longer than outer spur  Panaphelix.  
Scales on mesonotum and tegulae mostly rounded at apices and not dentate; inner terminal spur on hind tibia about one-third longer than outer spur  Mantua.  

10(6). Forewing with vein 10 much nearer to 9 than to 11, as in figure 273  Pararrhaptica.  
Forewing with the origin of vein 10 about halfway between 9 and 11, as in figure 268  Epiphyas.  

Figure 220—Ventral aspects of bipectinate male antennal segments of two species of Tortricidae. Left, a segment just basad of the middle of the right antenna of the holotype of Panaphelix marmorata Walsingham. Right, the third segment beyond the scape of the left antenna of the type of Paraphasis perkinisi Walsingham. The fine hairs on the shafts of the segments are not shown.  

Genus CROESIA Hübner  


This is a rather poorly known assemblage of a few species recorded from Eurasia and America. A Mexican species has been introduced purposely to Hawaii for use as a biological control agent against pest blackberry. Because of misidentification, it was recorded erroneously as a species of *Apotoforma* (wrongly also as "*Aptoforma*") in Hawaiian literature. When I finally saw
specimens of the moth, I examined the wing venation and genitalia and realized immediately that an error in generic assignment had been made. I then called for assistance from J. D. Bradley who placed the moth in *Croesia*. Because the species appears to be undescribed, I have asked my friend J. F. Gates Clarke (who has had long experience with the American fauna) to supply a description, and this he has kindly done. I have taken the liberty of altering parts of his text to make it conform more closely to the style of this book, and the material contributed by him is enclosed in quotation marks.

**Croesia zimmermani** Clarke, *new species* (figs. 221, wing venation; 222, moth; 223, male, female genitalia; 224, pupa).

"Alar expanse 11–14 mm. Labial palpus cinnamon buff; second segment anteriorly and third segment slightly infuscated. Antenna fuscous; scape cinnamon buff with a sayal brown spot dorsally. Head cinnamon buff. Thorax sayal brown with sparse fuscous irroration. Forewing ground color sayal brown with variable leaden markings; from basal third of costa an outwardly curved transverse leaden fascia; on inner edge of fascia, at fold, a small group of raised blackish scales; from middle of costa a leaden, transverse fascia splits into two narrow fasciae which terminate at tornus; origins of fascia, on costa, sometimes strongly overlaid with buff scales; terminal area spotted with leaden scales; at middle of wing a transverse series of three small groups of

![Figure 221](image-url)
raised blackish scales edged with buff. Cilia cinnamon buff with leaden basal line from apex to about vein 3, then leaden colored around termen to tornus. Hindwing greyish fuscous; cilia grey, somewhat paler at extremities. Legs cinnamon buff to buff shaded with fuscous on outer sides. Abdomen fuscous dorsally, buff ventrally.

"Male genitalia (slides JFGC 11899, 11923, 11925, in the U.S. National Museum) with the valva broad basally; ventral edge deeply excavated, bluntly terminated in a setose area; cucullus small, broadly digitate. Gnathus basally a rectangular plate, giving rise to a long, sharply pointed median process. Uncus obsolete. Vinculum a narrow band. Tegumen broad, arched. Anellus a small sclerotized plate. Aedeagus curved, moderately slender, narrowed before apex, terminating in a curved point.


"Holotype male (U.S. National Museum 70108), one male and two female paratypes reared in Honolulu (September 1968), and three male and five female paratypes from Volcano House, island of Hawaii (August 1968; E. Yoshioka, collector).

"This species appears to resemble most closely bergmanniana, but it is easily distinguished by its darker color. It pleases me to name it for Elwood C. Zimmerman, my friend and colleague, who has contributed so much to the

Figure 222—Croesia zimmermani Clarke, from an Hawaiian reared specimen. The wing expanse of this species is about 11 to 14 mm. Do not confuse the several abraded areas on the wings for pale maculae. USNM photograph.)
Figure 223—Male and female genitalia of *Croesia zimmermani* Clarke. Middle right, lateral aspect of the dorsal part of the tegumen with the socii and gnathus. Aedeagus at bottom right.
knowledge of Hawaiian entomology.

"The drawings of the genitalia were made by André del Campo Pizzini, and the photograph [figure 222] is by Victor Krantz."

Kauai, Maui, Hawaii.

Introduced purposely from Jalapa, Veracruz, Mexico by the Hawaiian Department of Agriculture for the control of blackberry (collected by N. L. H. Krauss).

Hostplant: *Rubus* (introduced blackberry).

The moth was first released in Hawaii at Olinda, Maui, in August 1964; at Kokee, Kauai, in July 1965; and at Kauhuku Ranch on the island of Hawaii in August 1966. It became established quickly and dispersed rapidly.

Genus **SPHETERISTA** Meyrick


This supposedly endemic genus resembles such genera as *Dichelopa* Lower, 1901, *Clepsis* Gueneé, 1845a, and *Adoxophyes* Meyrick, 1881c, but it appears to me, at this writing, that it is very close to the Old World *Epagoge* Hübner,
1825 (1816–1826). Vein 4 is absent from the hindwing of true *Dichelopa* from Australia (monotype: *dichroa* Lower), and, further, vein 7 of the forewing runs to costa or apex instead of to termen as it does on *Spheterista*. In *Clepsis*, veins 7 and 8 in the forewing are separate instead of being stalked as in *Spheterista*. In the forewing of *Adoxophyes*, vein 3 leaves the cell at a point about midway between veins 2 and 4, obviously far removed from the end of the cell or from vein 4; but on *Spheterista*, vein 3 originates near or at the end of the cell at a point not far removed from vein 4. The wing venation of both the forewings and hindwings of *Spheterista* is identical with that of *Epagoge*. Furthermore, the genitalia of *Spheterista* and *Epagoge* are similar. (Note that the wing venations of *Clepsis*, *Adoxophyes*, and *Epagoge* have been illustrated by Obraztsov, 1954, in the first part of his monograph *Die Gattungen der palaearktischen Tortricidae*.) I am tempted to merge *Spheterista* and *Epagoge*, but, because of my lack of experience with this group outside of Hawaii, I feel it best to leave the decision regarding possible synonymy to those who have had more experience with the family.

The stalking of veins 7 and 8 in the forewing will separate *Spheterista* from all other tortricids in Hawaii with the exception of the female of *Amorbia*, which lacks ocelli, and of *Eccoptocera*, which belongs to the Olethreutinae and has only 11 veins in the forewing and only seven in the hindwing instead of 12 and eight.

The forewing of the male has a costal fold or flap on most of the species, but there is no costal fold on *infaustana*, *ohoheana*, or *urerana*. Males of *argentinotata*, *glaucoviridana*, *pernitida*, and *xanthogona* are unknown. The remaining males I
have examined, and they all have the costal fold. They are: *cassia*, *flavocincta*, *flavopicta*, *fulva*, *ochreocuprea*, *pleonectes*, *pterotropiana*, *reynoldsiana*, *tetraplasandra*, and *variabilis*.

As my illustrations demonstrate, there is much variation in the wing shape and some variation in the venation. In the hindwing the discocellulars may be distinct, faint, or evidently obsolescent; veins 6 and 7 may be separate, connate, short- or long-stalked; veins 3 and 4 may also be separate, connate, or stalked.

The uncus displays great specific differences; it may be solid and single, split and bipartite, broad or narrow. The socii vary from small to large.

The female genitalia display various differences that must reflect differences in habit. The ovipositor lobes differ considerably in shape and sculpture. It is regrettable that I have been unable to illustrate each form as it should be illustrated. The bursa copulatrix is thinly membranous, and there is no signum. Many abdomens of the females examined appeared to have decomposed before drying, and it has been impossible to make satisfactory dissections of some of them.

See color plates 1, figures 5–8; 2, figures 1–4.

**DISTRIBUTION OF THE SPECIES OF SPHETERISTA**

Listed by type locality only, the species have the following distributions: Kauai; seven; Oahu, five; Molokai, one; Maui, none; Lanai, none; Hawaii, four. There probably are many new species remaining to be collected, and only a few areas of the Islands have been searched for *Spheterista*. As now recorded, the distributions of the species are as follows (the type locality of each species is on the island whose name heads each list, unless the word "type" follows some other island name after the species name):

![Figure 226 — Male wing venation of Spheterista cassia (Swezey). Kaena Point, Oahu (slide Z-IX-3-61-6).](image-url)
Kauai (eight species)

*flavopicta* (Walsingham)

*fulva* (Walsingham)

*glaucoviridana* (Walsingham)

*infaustana* (Walsingham), Oahu, Molokai, Maui, Hawaii

*ochreocuprea* (Walsingham)

*oheoheana* (Swezey)

*pleonectes* (Walsingham), Oahu, Hawaii (type)

*pterotropiana* (Swezey)

Oahu (seven species)

*cassia* (Swezey)

*flavocincta* (Walsingham), Hawaii

*infaustana* (Walsingham), Kauai (type), Molokai, Maui, Hawaii

*pleonectes* (Walsingham), Kauai, Hawaii (type)

*reynoldsiana* (Swezey)

*tetraplasandra* (Swezey)

*uerana* (Swezey)

Molokai (two species)

*infaustana* (Walsingham), Kauai (type), Oahu, Maui, Hawaii

*variabilis* (Walsingham), Maui

Maui (two species)

*infaustana* (Walsingham), Kauai (type), Oahu, Molokai, Hawaii

*variabilis* (Walsingham), Molokai (type)

Figure 227—Female wing venation of *Spheterista cassia* (Swezey). Kaena Point, Oahu (slide Z-IX-3 61-7).
Figure 228—Wing venation of \textit{Spheterista flavocincta} (Walsingham) (\textit{=santalata} Swezey). Male from Waikakalana, Oahu (slide Z–XII–62–8). Female from Palolo, Oahu (slide Z–VII–62–9).
Lanai (no species recorded)

Hawaii (six species)

- *argentinotata* (Walsingham)
- *flavocincta* (Walsingham), Oahu
- *infaustana* (Walsingham), Kauai (type), Oahu, Molokai, Maui
- *pernitida* (Walsingham)
- *pleonectes* (Walsingham), Kauai, Oahu
- *xanthogona* (Walsingham)

Figure 229—Spheterista wing venations. Top left, *infaustana* (Walsingham), paratype (BM slide 8609); Molokai, over 3,000 feet. Top right, *flavopicta* (Walsingham) from a paratype of the synonym *picta* (BM slide 7571); Kauai, 3,000 to 4,000 feet. Bottom left, *fulva* (Walsingham), paratype (BM slide 7572); Kauai, 3,000 to 4,000 feet. Bottom right, *ochreocuprea* (Walsingham), paratype (BM slide 7573); Kauai, 3,000 to 4,000 feet. Note that *infaustana* lacks a male costal fold, and note the differences in origins of veins 6 and 7 in the hindwings.
HOSTPLANTS AND LARVAL HABITS OF SPHETERISTA

The hostplants of argentinotata, fulva, glaucoviridana, ochreocuprea, pernitida, variabilis, and xanthogona are unknown. The hostplants of the other species are as follows:

Urticaceae

*Pipturus: infaustana* (Walsingham), tip-borer and leaf-tier.

*Urera: urerana* (Swezey), twig-borer.

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Figure 230—Wing venations of some female *Spheterista*. Top left, okehuheana (Swezey), paratype (slide Z–XII–62–6); Halemanu, Kauai. Top right, pleonectes (Walsingham), paratype (BM slide 7550); Kilauea, Hawaii. Bottom left, pterotropiana (Swezey), paratype (slide Z–XII–62–7); Halemanu, Kauai. Bottom right, tetraplasandra (Swezey), Milolii, Kauai (slide Z–XII–62–10).
Santalaceae

*Santalum*: flavocincta (Walsingham), flavopicta (Walsingham), leaf-tiers.

Leguminosae

*Cassia*: cassia (Swezey), leaf-tier.

Araliaceae

*Cheirodendron*: pleonectes (Walsingham), leaf-tier

*Reynoldsia*: reynoldsiana (Swezey), leaf-tier

*Tetraplasandra* (= *Pterotropia*): oheoheana (Swezey), from twigs; pterotropiana (Swezey), from terminal buds; *tetraplasandra* (Swezey), from fruits and leaves.

I regret that I have not had an opportunity to prepare a key to the species of this little-known, difficult assemblage.

**Spheterista argentinotata** (Walsingham), new combination (figs. 234, moth; 255, female genitalia).

*Epagoge (?) argentinotata* (Walsingham), 1907b:711, pl. 12, fig. 10.

*Capua argentinotata* (Walsingham) Meyrick, 1913b:15.

Endemic. Hawaii (type locality: Olaa).
Hostplant: unknown.
Only two females of this species are known to me.

Figure 231—Wing venation of *Spheterista reynoldsiana* (Swezey). Left, male paratype (slide Z–XII–62 11). Right, female paratype (frenulum lost) (slide Z–XII–62–12). Both specimens are from Wailupe, Oahu.
**Spheterista cassia** (Swezey), **new combination** (figs. 226–227, wing venation; 232, pupa; 234, moth; 245, male genitalia; 257, female genitalia).

*Capua cassia* Swezey, 1912b: 183.

Edemic. Oahu (type locality: Kaena Point).

Hostplant: *Cassia gaudichaudii*.

Parasite: *Sierola* species.

Although the type locality is at the far northwestern end of the Waianae Mountains, part of the type series came from Niu near the southeastern end of the Koolau Mountains. Hence, the species can be expected to be found over almost all of Oahu where its hostplant grows.

The larvae feed singly, eating the lower epidermis and parenchyma, leaving the upper epidermis; with a web the leaflet is folded together for a hiding place, often along the midrib, sometimes a portion of the margin of the blade is folded over, or contiguous leaflets fastened together for this purpose.

The full-grown larva is about 9 mm. in length, uniform leaf-green; head concolorous, eyes black and a black spot at the postero-ventral angle; anal comb of green spines.

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Figure 232—Caudae of *Spheterista* pupae. *a, b, c*, lateral, dorsal, and caudal aspects of *pterotropiana* (Swezey) from a paratype from Halemanu, Kauai. *d, e, f*, *urerana* (Swezey), from the lectotype male from Mt. Tantalus, Oahu. *g, h, i, cassia* (Swezey) from a male from Kaena Point, Oahu.
The pupa is formed in the same place where the larva has fed, in a slight cocoon. It is 5 mm. in length, greenish, wing-cases bright green, extending to apex of fourth abdominal segment; abdominal segments, except first, with two transverse dorsal rows of minute spines, the basal row on segments 3 to 8 larger; cremaster with a few hooked bristles fastened into the silk of cocoon.

A parasite larva (Sierola sp.) was found feeding on one of the moth larvae. It was feeding externally, and was about 2.5 mm. long, plump, greenish with white spots all over—perhaps the fat-bodies showing through. This larva spun a silken cocoon, from which the adult parasite emerged in 12 days. (Swezey, 1912b: 183–184.)

The caudal process of the pupa has two strongly hooked dorsal setae that arise from simple sockets which are not surrounded by rugae or carinae. Laterad of each of these setae is a similar seta which is placed in a sulcus in the lateral margin of the caudal process. Beneath the middle of the caudal margin of the caudal process are four setae. Of these four setae, each lateral seta projects caudad and is visible from above, but the two middle setae are bent cephalad, are not visible from above, and their apices are not curled.

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Figure 233—Caudae of pupae of Spheterista and Pararrhaptica. a, b, c, lateral, dorsal, and caudal aspects of Spheterista tetraplasandra (Swezey) from a female from Milolii, Kauai. d, e, f, Spheterista reynoldsiana (Swezey) from a female from Wailupe, Oahu. g, h, i, Pararrhaptica dermatopa (Meyrick), Mt. Olympus, Oahu.
Figure 234—Spheterista. Top, argentinotata (Walsingham), holotype; Olaa, Hawaii (abdomen lost); forewing 7 mm., the pale areas are shiny squame and not holes. Middle, pleonectes (Walsingham) from the holotype of the synonymous asaphopis Meyrick; Mt. Kaala, Oahu; forewing 8 mm. Bottom, cassia (Swezey), holotype; Kaena Point, Oahu; forewing 5.25 mm.
Figure 235—Spheterista. Top, *pleonectes* (Walsingham), from the holotype male of the synonymous *castaneana* (Walsingham) (BM slide 1981); Kauai, 3,000 to 4,000 feet; forewing 8.5 mm. Middle, *flavopicta* (Walsingham), holotype female (BM slide 1971); Kauai, 3,000 to 4,000 feet; expanse 17 mm; the pale areas are bright canary yellow. Bottom, the same species from the male holotype of the synonymous *picta* Walsingham (BM slide 1961); Kauai, 3,000 to 4,000 feet; expanse 15 mm.
Figure 236—Spheterista flavocincta (Walsingham). Top, holotype female (BM slide 1960); Kona, 4,000 feet, Hawaii; forewing 7.5 mm.; the pale costal area on the forewings is orange bordered by metallic fuscous. Bottom, the same species from the male holotype of the synonymous trigonifer Walsingham (BM slide 1970); Kona, 4,000 feet, Hawaii; forewing 5 mm.; the pale triangular area beyond the middle of the forewing is white, the darker area bordering it costad is orange, and the pale costal areas are mostly cream. The apex of the hindwing appears to be dark because the end of the wing has been rolled downward and is thus not evenly illuminated.
Figure 237—*Spheterista*. Top, *fulva* Walsingham, holotype male (BM slide 1980); Kauai, 3,000 to 4,000 feet; forewing 9 mm. Compare the similar-appearing *ochreocuprea* in figure 238. Bottom, *glaucoviridana* (Walsingham), holotype female (BM slide 1972); Kaholuamano, 4,000 feet, Kauai; expanse 16.5 mm.
Figure 238—Spheterista. Top, *infaustana* (Walsingham), allotype male (BM slide 1914); Kauai, 3,000 to 4,000 feet. Forewing 5 mm. long; it lacks a costal fold. Bottom, *ochreocuprea* (Walsingham), holotype male (BM slide 3849); Kauai, 3,000 to 4,000 feet. Forewing 9 mm. long; note the strong costal fold. Compare the similar, but specifically distinct, *fulva* on figure 237.
**Spheterista flavocincta** (Walsingham), **new combination** (figs. 228, wing venation; 236, 242, moth; 247, male genitalia; 259, 265, female genitalia).

*Capua (?)* flavocincta Walsingham, 1907b: 704, pl. 11, fig. 27.

*Capua flavocincta* Walsingham, Meyrick, 1913b: 15.

*Capua trigonifer* Walsingham, 1907b: 704, pl. 11, fig. 28. Synonymy by Meyrick, 1913b: 15.

*Capua santalata* Swezey, 1913f: 276. **New synonym.**

Endemic. Oahu (type locality of santalata: Diamond Head, Honolulu), Hawaii (type locality of flavocincta: Kona; of trigonifer: Kona, 4,000 feet).

Hostplants: *Santalum freycinetianum*, *Santalum* species.

Parasite: *Trathala flavo-orbitalis* (Cameron).

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Figure 239—Spheterista. Top, *okeoheana* (Swezey), paratype female; Halemanu, Kauai; expanse 10 mm. as mounted. The specimen is considerably abraded, poorly mounted, and the figure is thus misleading in appearance. Bottom, *pleonectes* (Walsingham), "cotype" female (BM slide 14308); Kilauea, Hawaii; expanse 26 mm.; mostly brownish with a large yellow macula on the posterior margin of each forewing.
The names *flavocincta*, *santalata*, and *trigonifer* apply to extremes of the color forms of this highly variable species. *Spheterista flavopicta* is a closely allied species, but its uncus is distinctly different, as the illustrations demonstrate. The moth is probably more widely distributed than the recorded locality data indicate, and it should be sought on sandalwood on other islands.

Figure 240—*Spheterista*. Top, *pernitida* (Walsingham), holotype female (BM slide 1918); Olaa, Hawaii, 2,000 feet; forewing 7 mm. long. Bottom, the male specimen (BM slide 1919) from Hilo, 2,000 feet, Hawaii, mentioned by Walsingham at the bottom of p. 710 of *Fauna Hawaiiensi* as being "closely allied to *pernitida*" (this may not be true). Forewing 6.5 mm.; lacking a male costal fold. See figure 249 for genitalia.
Figure 241—Sphisterista. Top, pleanectes (Walsingham), holotype male (BM slide 5549); Kilauea, Hawaii; expanse 9 mm. Middle, pterotropiana (Swezey), paratype female; Halemanu, Kauai; forewing 10 mm. long. Bottom, reynoldsi (Swezey), holotype male; forewing 7 mm. long.
Figure 242—Spheterista. Top and middle, flavocincta (Walsingham) from the holotype male (top) and allotype female (middle) of the synonymous santalata Swezey; Diamond Head, Oahu; forewing 5 mm. long on holotype, 5.5 mm. on allotype. Bottom, tetraplasandra (Swezey), holotype male; Kaumuahona, Oahu; forewing 8 mm. long.
The form of this beautiful little moth which Dr. Swezey called *santalata* was not described in *Fauna Hawaiiensis*, but there are 33 specimens under the Walsingham manuscript name "Capua dictyodes" in the British Museum. Two of these were collected by Dr. Perkins on Oahu in 1900, and the other 31 were taken by him in the northwest Koolau Mountains in July 1901.

The caterpillars of this small moth occur on webbed leaves of nearly all species of *Santalum* on Oahu, practically everywhere the plant is found. (Swezey, 1954:185.)

Full-grown caterpillar about 8 mm.; pale green; head concolorous, eyes black and a black dot at postero-ventral angle; anal comb of 6 pale stiff bristles.

Figure 243—*Spheterista urerana* (Swezey). Top, paralectotype male (here designated); forewing 5.5 mm. long. Bottom, lectotype male (here designated) (slide Z-1-26-67); forewing 5.75 mm. long. Both specimens are from Mt. Tantalus, Oahu. There is no costal fold on the forewing of the male. These two specimens were originally mounted in these relative positions on a single piece of cork, and the mount was labeled "Type". They evidently were taken to be a male and a female, but they are both males. They demonstrate the great variability in the species. The top example bears a superficial appearance in color pattern to *Pararrhaptica notocosma* (Meyrick).
Figure 244—*Spheterista*. Top, *variabilis* (Walsingham), holotype male (BM slide 9536 Clarke); Kahanui Molokai; forewing 10 mm., with a strong male costal fold. Bottom, *xanthogona* (Walsingham), holotype female (BM slide 1916); Kona, 5,000 feet, Hawaii; forewing 6 mm. long.
Pupa 5 mm.; pale greenish or yellowish; wing-sheaths and posterior leg-sheaths extend about to apex of fourth abdominal segment, antenae-sheaths not quite so long; two transverse rows of short backwardly-directed spines on abdominal segments 3–7, one row on segments 2 and 8; cremaster with two strong downwardly-curved hooks wide apart, and a few hooked bristles. The pupa is formed within the folded-over edge of a leaf. The pupal period is about a week. (Swezey, 1913: 277.)

**Spheterista flavopicta** (Walsingham), new combination (figs. 229, wing venation; 235, moth; 246, male genitalia; 259, female genitalia; col. pl. 1:6, 7, 8).

*Capua (?) flavopicta* Walsingham, 1907b: 703, pl. 11, fig. 25; female.

*Capua picta* Walsingham, 1907b: 703, pl. 11, fig. 26; male. Synonymy by Meyrick, 1913b: 15.

Endemic. Kauai (type locality of both *flavopicta* and *picta*: 3,000 to 4,000 feet).

Hostplant: *Santalum.*

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Figure 245—Male genitalia of *Spheterista cassia* (Swezey). Top, from a specimen determined by Dr. Swezey (slide JDB 2); Lihue, Kauai; *ex Cassia.* Bottom, from a paratype from Kaena Point, Oahu (slide Z–IX–3–61–6).
Figure 246—Male genitalia of *Spheterista*. Top, *pleonectes* (Walsingham) from the holotype of the synonymous *castanea* (Walsingham) (BM slide 1981); Kauai, 3,000 to 4,000 feet. See other figures of *pleonectes* on figure 250. Bottom, *flavopicta* (Walsingham) from the holotype of the synonym *picta* Walsingham (BM slide 1961); Kauai, 3,000 to 4,000 feet.
Dr. Swezey (1943:282), who evidently was not aware of Meyrick’s having merged *picta* and *flavopicta* in 1913, said, upon collecting the male form *picta* and the female form *flavopicta*, “These might be the same species. They were both reared from caterpillars on *Santalum* leaves, Kumuwela, Aug. 13, 1925. There is a similar difference in wing pattern of the sexes of *Capua santalata* Sw. on Oahu.”

This moth is a close ally of the other sandalwood leaf-tier, *flavocincta*, which is known from Oahu and Hawaii.

Figure 247—Male genitalia of *Spheterista flavocincta* (Walsingham). Top, from the holotype of the synonymous *trigonifer* Walsingham (BM slide 1970); Kona, 4,000 feet, Hawaii. Bottom, the same species from a specimen of the synonymous *santalista* Swezey, determined by Dr. Swezey (slide JDB 5); Opaeula, Oahu; ex *Santalum*; the aedeagus is mounted in a different position.
Figure 248—Spheterista male genitalia. Top, infaustana (Walsingham), allotype (BM slide 1914); Kauai, 3,000 to 4,000 feet. The apex of the uncus is broken so I have added dorsal and lateral aspect sketches of a paratype (Busck slide 111; Walsingham specimen 27454); setae omitted and not to the same scale. Bottom, pterotropiana (Swezey), paratype (slide JDB 1); Halemanu, Kauai. I have added a sketch of the uncus as seen from the side with setae omitted and at a different scale. Note the strongly developed socii and the broad top of the tegumen. The slide was broken in transit after the photograph was taken, and I have remounted the specimen in a different position.
Figure 249—Male genitalia of _Spheterista_. Top, _ohoheana_ (Swezey), determined by Dr. Swezey (slide JDB 4); Halemanu, Kauai. The apex of the uncus and part of the right valva are missing. I have sketched the caudal and lateral aspects of the uncus of another paraotype (not to the same scale and with setae omitted) and have inserted the drawings. The socii are strongly developed. Bottom, _Spheterista_ species from the specimen mentioned by Walsingham at the bottom of p. 710 of _Fauna Hawaiiensis_ as being possibly allied to _pernitida_ (BM slide 1919); see the moth illustrated on figure 240.
Figure 250—Male genitalia of *Spheterista pleonectes* (Walsingham). Top, from the holotype (BM slide 5549); Kilauea, Hawaii. Bottom, from a paratype of the synonym *asaphopis* Meyrick (Busck slide 126); Mt. Kaala, Oahu. Compare figure 246, top.
Figure 251—*Sphisteria* male genitalia. Top, *fulva* (Walsingham), holotype (BM slide 1980); Kauai, 3,000 to 4,000 feet. Bottom, *tetraplasandra* (Swezey), paratype (Busck slide 143); Oahu. The genitalia of these two species resemble those of *ochrocuprea*, but there are differences in uncus, transtilla, and aedeagus.
Figure 252—*Spheterista ochrocuprea* (Walsingham) male genitalia. Top, from a paratype (Busck slide 110; Walsingham specimen 27262); Kauai, 3,000 to 4,000 feet. Middle, from the holotype (BM slide 3849) from the same locality. Bottom, hair tufts on the eighth abdominal segment from the holotype.
Figure 253—Male genitalia of *Spheterita*. Top, *reynoldsiana* (Swezey), paratype (slide Z-XII–62–11); Wailupe, Oahu. Bottom, *urerana* (Swezey), lectotype (slide Z-I–26–67); Mt. Tantalus, Oahu.
Figure 254—Male genitalia of Spheterista variabilis (Walsingham). Top, holotype (BM slide 9536 Clarke); Kahanui, Molokai. Bottom, from a paratype (BM slide 1973) called “var. D” by Walsingham; Molokai, over 4,500 feet. This figure shows the uncus, socius, and gnathus in lateral aspect.
Figure 255—Female genitalia of Sphisterista. Top, *argentinotata* (Walsingham), paratype (BM slide 1917); Hilo, 2,000 feet, Hawaii. Bottom, *pleonectes* (Walsingham), paratype (BM slide 7550); Kilauea, Hawaii.
Figure 256—Female genitalia of *Spheterista*. Top, *pleonectes* (Walsingham) from the lectotype of the synonymous *asaphothis* Meyrick (BM slide 3894); Waianae, Oahu. The dotted area below the ostium is part of the torn ventral integument and may be misleading. Compare figure 263. Bottom, same species from the synonymous *castanea* Walsingham, holotype (BM slide 1982); Lihue, 4,000 feet, Kauai.
Figure 257—Female genitalia of Spheterista. Left, top and bottom, cassia (Swezey) (slide Z-IX-3-61-7); Kaena Point, Oahu. Note the short posterior apophyses; compare other species and note general resemblance to xanthogona in figure 267. Right, top and bottom, infaustana (Walsingham), holotype (BM slide 1915); Kauai, 3,000 to 4,000 feet; see also figure 258.
**Spheterista fulva** (Walsingham), (figs. 229, wing venation; 237, moth; 251, male genitalia).

*Capua fulva* Walsingham, 1907b:708, pl. 12, fig. 6.

*Capua fulva* variety *B* Walsingham, 1907b:708.

*Spheterista fulva* (Walsingham) Meyrick, 1913b:16.

Endemic. Kauai (type locality: 3,000 to 4,000 feet).

Hostplant: unknown.

Walsingham (1907b:709) said: “It is not impossible that these may be varieties of *Capua ochreocuprea*, but the unicolorous dark hindwings appear to separate them.” *Spheterista fulva* is specifically distinct from *ochreocuprea*, and in addition to the differences noted in the coloration of the hindwings, the shapes of the forewings differ, and there are differences in the genitalia. The rather similar white spot on the forewing of each species may lead one to assume that they are the same species at first sight, but study will reveal obvious differences between the two species. I have not seen the female.

![Figure 258—Female genitalia of *Spheterista infaustana* (Walsingham), paratype (BM slide 1431); Kauai, 3,000 to 4,000 feet. See also figure 257.](image-url)
Figure 259—Female genitalia of Spheterista. Top, flavocincta (Walsingham), holotype (BM slide 1960); Kona, 4,000 feet, Hawaii. This species has a short ovipositor; the genitalia are rather similar to those of flavopicta. Bottom, left and right, flavopicta (Walsingham), holotype (BM slide 1971); Kauai, 3,000 to 4,000 feet.
Figure 260.—Female genitalia of *Spheterista*. Top, *glaucoviridana* (Walsingham), holotype (BM slide 1972); Kaholuamano, 4,000 feet, Kauai. Bottom, *variabilis* (Walsingham); paratype (BM slide 1974); Molokai, 4,000 feet.
Figure 261—Female genitalia of Spheterista. Top, ochrocuprea (Walsingham), allotype (BM slide 3755); Kauai, 3,000 to 4,000 feet. Note that the bursa copulatrix is torn away and lost; this figure may be misleading if wrongly interpreted. Bottom, tetraplasandra (Swezey); Milolii, Kauai (slide Z–XI–62–10).
Figure 262—Female genitalia of Spheterista. Top, left and right, pernitida (Walsingham), holotype (BM slide 1918); Olaa, 2,000 feet, Hawaii. Bottom left, region of the ostium of oheoheana (Swezey), paratype, moldy and decomposed (slide Z–XII–62–6); Halemanu, Kauai; the posterior apophyses are long. Bottom right, xanthogona (Walsingham), holotype (BM slide 1916); Kona, 4,000 feet, Hawaii; see the better illustration of the paratype in figure 267.
**Spheterista glaucoviridana** (Walsingham), (figs. 237, moth; 260, female genitalia).

*Capua (?) glaucoviridana* Walsingham, 1907b:706, pl. 12, fig. 3.
*Spheterista glaucoviridana* (Walsingham) Meyrick, 1913b:16.

Endemic. Kauai (type locality: Kaholuamano, 4,000 feet).
Hostplant: unknown.
This species is known only from the female holotype.

**Spheterista infaustana** (Walsingham), **new combination** (figs. 229, wing venation; 238, moth; 248, male genitalia; 257–258 female genitalia).
*Epagoge infaustana* Walsingham, 1907b:709, pi. 12, fig. 7.
*Capua infaustana* (Walsingham), Meyrick, 1913b:13.

Endemic. Kauai (type locality: 3,000 to 4,000 feet), Oahu, Molokai, Maui, Hawaii.
Hostplant: *Pipturus*.

Dr. Swezey was the first to find this species on Oahu (Dr. Perkins had collected it on the other islands), and in 1923 (*Proc. Hawaiian Ent. Soc. 5*:181) he reported that he “had previously reared a few specimens from larvae boring in the tips of twigs of *Pipturus* on Tantalus. One tree was found in Makaleha Valley on which were hundreds of larvae. They were feeding on the leaves, skeletonizing them, and hiding in webbed-together leaves at the tip, or a bit of the turned-over edge. They pupated in similar places.”

**Spheterista ochreocuprea** (Walsingham) (figs. 229, wing venation; 238, moth; 252, male genitalia; 261, female genitalia; col. pi. 2:3).
*Capua ochreocuprea* Walsingham, 1907b:708, pi. 12, fig. 5.
*Capua ochreocuprea* variety B Walsingham, 1907b:708.
*Spheterista ochreocuprea* (Walsingham) Meyrick, 1913b:16.

Endemic. Kauai (type locality: 3,000 to 4,000 feet).
Hostplant: unknown.
This species is closely allied to and superficially resembles fulva, but it is distinct. The uncus is more deeply cleft in ochreocuprea and the armature of the transtilla differs. See other comparative notes under fulva above.

**Spheterista oheoheana** (Swezey), **new combination** (figs. 230, wing venation; 239, moth; 249, male genitalia; 262, female genitalia).
*Capua oheoheana* Swezey, 1933b:301.

Endemic. Kauai (type locality: Halemanu).
Hostplant: *Tetraplasandra (= Pterotropia) kauaiensis* (“ohe ohe”).
Parasite: *Sierola* species.
The larvae and pupae of the type series were collected from dead twigs.
Spheterista pernitida (Walsingham), **new combination** (figs. 240, moth; 262, female genitalia).

*Epagoge (?) pernitida* Walsingham, 1907b:710, pi. 12, fig. 9.

*Capua pernitida* (Walsingham) Meyrick, 1913b:15.

Endemic. Hawaii (type locality: Olaa, 2,000 feet).

Hostplant: unknown.

Only the female holotype is known.

I have listed at the end of the discussion of this genus as "*Spheterista species?*" the species mentioned by Walsingham at the bottom of p. 710 of *Fauna Hawaiensi* as known from one worn male only.

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Figure 263—Female genitalia of *Spheterista pleonectes* (Walsingham), "cotype" (BM slide 14308); Kilauea, Hawaii.
Spheterista pleonectes (Walsingham) (figs. 230, wing venation; 234–235, 239, 241 [type], moth; 246, 250, male genitalia; 255–256, 263 female genitalia; col. pl. 1:5).

Capua pleonectes Walsingham, 1907b:705, pl. 12, fig. 1.
Spheterista pleonectes (Walsingham) Meyrick, 1913b:16.
Capua castaneana Walsingham, 1907b:705, pl. 12, fig. 2. Type locality: Kauai, male, 3,000 to 4,000 feet; female, Lihue, 4,000 feet.
Spheterista asaphopis Meyrick, 1928c:96. Type locality: Mt. Kaala, Oahu.
New synonym.

Endemic. Kauai, Oahu, Hawaii (type locality: Kilauea).
Hostplant: Cheirodendron gaudichaudii.
Parasites: Horogenes blackburni (Cameron), Pristomerus hawaiiensis Perkins, Trichogramma semifumatum (Perkins).

Swezey (1954:49), speaking of Spheterista pleonectes, castaneana, and asaphopis, said: “The green larvae of these moths feed between webbed leaves of Cheirodendron, and appear to be attached to this tree. The species are variable, and the three could be considered a single species. Caterpillars (perhaps one of the above-named species) were found on Cheirodendron on Maui, but none was reared. Instead, these parasites emerged: Horogenes blackburni (Cameron) . . . and Pristomerus hawaiiensis Perkins. . . .”

Further studies, including examinations of the genitalia, show that castaneana and asaphopis are synonyms, as suggested by Dr. Swezey. I was not prepared, however, to discover that the male and female genitalia of the specimens of these brown forms are similar to those of the very different appearing moths described as variabilis. One can hardly believe that they are color forms of a single species, but that is what they appear to be. We may have here one of those extraordinary assemblages of remarkably distinct color forms as are found in some of the European Acleris such as Acleris hastiana (Linnaeus), Acleris literana (Linnaeus), and Acleris cristana (Denis and Schiffermüller) which have been studied carefully by British entomologists. John Bradley and Arthur Smith (1962:117) have published colored plates showing 20 color forms of Acleris literana, and the extremes shown there are as great as the differences displayed by the series of Hawaiian tortricids resting under the names variabilis, pleonectes, castaneana, and asaphopis. Although the genitalia of pleonectes and variabilis appear to be identical, none of the pleonectes forms have been found with the variabilis forms. For the present, therefore, it may be best to list them temporarily as distinct entities until further studies have been made. The brown pleonectes forms have been found on Kauai, Oahu, and Hawaii, whereas all of the variabilis specimens have been collected on the adjacent islands of Molokai and Maui.
Figure 264—Female genitalia of *Sphaterista*. Left, top and bottom, *pterotropiana* (Swezey), paratype (BM slide Z–XII–62–7); Halemanu, Kauai. Right, top and bottom, *reynoldsiana* (Swezey), paratype (slide Z–XII–62–12); Wailupe, Oahu. The signalike spots in the bursa are debris.
**Spheterista pterotropiana** (Swezey), **new combination** (figs. 230 wing venation; 232, pupa; 241, moth; 248, male genitalia; 264, female genitalia).

*Capua pterotropiana* Swezey, 1933b:301.

Endemic. Kauai (type locality: Halemanu).

Hostplant: *Tetraplasandra* (= *Pterotropia*) *kauaiensis*. The larvae of this beautiful green-marked species feed in the terminal buds of the hostplant.

The caudal process of the pupa has two widely spaced, strongly hooked, dorsal setae, each of which arises from beneath the edge of a transverse carina. Another similar seta arises on each side from beneath the lateral edge of the caudal process. Beneath the caudal edge of the caudal process are four stout, bent-tipped setae (not hooked or recurved).

**Spheterista reynoldsiana** (Swezey), **new combination** (figs. 231, wing venation; 233, pupa; 241, moth; 253, male genitalia; 264, female genitalia).

*Capua reynoldsiana* Swezey, 1920b:384, figured; 1954:180, fig. 31.

Endemic. Oahu (type locality: Wailupe).

Hostplant: *Reynoldsia sandwicensis*.

Parasites: *Brachymeria obscurata* (Walker), *Echthromorpha agrestoria fuscator* (Fabricius), *Ephialtes hawaiiensis* (Cameron), *Trathala flavo-orbitalis* (Cameron).

*"The caterpillar is green and spins together leaves to feed between. It pupates in spun-together leaves. The pupa is brown, 7–10 mm. long, with the usual two dorsal transverse rows of minute spines or serrations on the abdominal segments."* (Swezey, 1920b:385.)

The pupa has two strongly hooked setae situated dorsally on each side of the base of the caudal process, and each pair arises from beneath the edge of an oblique costate elevation. Beneath the caudal margin of the caudal process there are four stout setae, the median pair of which are each apically moderately hooked whereas the lateral setae have strongly curled apices.

**Spheterista tetraplasandra** (Swezey) (figs. 230, wing venation; 233, pupa; 242, moth; 251, male genitalia; 261, female genitalia).

*Capua tetraplasandra* Swezey, 1920b:385.

*Spheletista tetraplasandra* (Swezey) Swezey, 1933a:241.

Endemic. Oahu (type locality: Kaumuahona).

Hostplant: *Tetraplasandra*. The larvae have been found in the fruits and on the leaves of the hostplant.

The caudal process of the pupa has two long, hooked, dorsal setae which arise from elongate elevations. A similar seta is laterad to each of the dorsal setae, but it arises from beneath the lateral margin of the caudal process. From beneath the caudal margin of the caudal process arise four stout, hook-tipped setae.
**Spheterista urerana** (Swezey), new combination (figs. 232, pupa; 243, moth; 253, male genitalia).

_Epagoge urerana_ Swezey, 1915:p.93.

Endemic. Oahu (type locality: Mt. Tantalus).

Host plant: _Urera sandvicensis_.

Dr. Swezey found the “larvae boring in twigs . . . near growing tip of new shoots.” He described the larva and pupa as follows (1915:p.93–94):

LARVA. Full-grown larva about 12 mm.; pale greenish, head pale testaceous, eyes black, lateral margin of head with a black line beginning a little back of eyes; cervical shield fusco-testaceous, tubercles distinctly slightly infuscated, those of line ii [D2] wider apart than those of line i [D1]; spiracles circular, dark margined; skin minutely roughened; anal comb of five stiff bristles.

PUPA. About 7 mm.; pale yellowish brown; wing-sheaths and posterior leg-sheaths extend to apex of 4th abdominal segment; antenna-sheaths shorter; segments 3-7 with two transverse rows of very fine backwardly directed spines, one row on segments 2, 8 and 9 . . . spiracles slightly raised. Pupa enclosed in cocoon made by rolled-over edge of dead leaf.

The pupa has two comparatively short, curved, hooked setae on each side of the caudal process. There are four apical setae: two heavy, divergent, sharp, thornlike, apical setae between and beneath which there are two stout, strongly recurved setae.

Figure 265—Female genitalia of _Spheterista flavocincta_ (Walsingham) from a specimen of the synonym _santalata_ Swezey; Palolo, Oahu (slide Z–XII–62–9).
This species was described from four specimens reared from larvae. There were two male examples on the cork mount marked "Type", and evidently Dr. Swezey considered them to be male and female. As my illustrations demonstrate, however, they are both males. I have designated the specimen nearest the pin as the lectotype male and have removed the other specimen from the mount and designated it as a paralectotype. The specimens are in Bishop Museum. I have not studied a female.

*Spheterista variabilis* (Walsingham) (figs. 225, head, wing venation; 244, moth; 254, male genitalia; 260, 266, female genitalia; col. pl. 2:2).

*Capua variabilis* Walsingham, 1907b:706, pl. 12, fig. 4. Molokai.


*Capua variabilis* variety C Walsingham, 1907b:707. Maui.

*Capua variabilis* variety D Walsingham, 1907b:707. Molokai.


*Spheterista variabilis* (Walsingham) Meyrick, 1912a:2; 1913b:16, pl. 4, fig. 60. Clarke, 1958:228, pl. 114, figs. 1–1d.

Figure 266—Female genitalia of *Spheterista variabilis* (Walsingham), paratype (BM slide 14309); Molokai, 4,000 feet.
Endemic. Molokai (type locality: Kahanui), Maui.
Hostplant: unknown, but presumed to be Cheirodendron.
This may be a color form of pleonectes, as astonishing as that may seem. See the discussion under pleonectes, above.

Spheterista xanthogona (Walsingham), new combination (figs. 244, moth; 262, 267, female genitalia).
Epagoge (?) xanthogona Walsingham, 1907b: 710, pl. 12, fig. 8.
Capua xanthogona (Walsingham) Meyrick, 1913b: 14.

Endemic. Hawaii (type locality: Kona, 4,000 to 5,000 feet).
Hostplant: unknown.
Only two females of this moth are known. It is an unusual species whose status will remain uncertain until the male is discovered.
Spheterista species? (figs. 240, moth; 249, male genitalia). Walsingham, 1907b:710, bottom of page.

Endemic. Hawaii (Hilo, 2,000 feet).

The status of the species mentioned by Walsingham immediately following his discussion of pernitida remains uncertain. It may be an unnamed species. The male genitalia (BM slide 1919) are evidently unlike those of the other species I have studied, but, because the males of argentinotata, glaucoviridana, pernitida, and xanthogona are unknown to me, I cannot now form a conclusion regarding the single specimen.

Genus EPIPHYAS Turner


Because of weaknesses in the original description, the generic name *Epiphyas* was misunderstood and mostly forgotten until Ian Common published his paper in 1961 (p. 177). Under the circumstances, Bradley was fully justified in erecting the now synonymous name *Austrotortrix*. Common gave a new and corrected description of the genus, and he assigned 32 Australian species to it.
Figure 269—Epiphyas postvittana (Walker). Top, a specimen from Puu Kapele, Kauai, ex Dodonaea; forewing 9.5 mm. Middle, a paler specimen from Honolulu, ex Citrus; expanse 17.5 mm. Bottom left, male genitalia of a specimen from Melbourne, Australia (BM slide 1957); the aedeagus has lost the three long, rodlike, deciduous cornuti. A set of cornuti from a virgin male from Olinda, Maui are figured at the lower right at a larger scale; ex gorse.
Other species occur in New Zealand. Bradley said that “this genus has characteristics of the *Archips-Adoxophyes* group, and can be placed systematically near to *Isotenes* Meyrick and *Harmaloga* Meyrick.” The genus also bears some resemblance to such genera as *Clepsis*. In the Hawaiian fauna the male genitalia resemble those of *Spheterista*, but the apophyses of the female genitalia are much shorter than are those of *Spheterista*. One introduced species represents the group in Hawaii.

Figure 270—Female genitalia of *Epiphyas postvittana* (Walker), holotype (BM slide 1815); Sydney, Australia. (Courtesy of J. D. Bradley.)
Epiphyas postvittana (Walker) (figs. 268, head, wing venation; 269, moths, male genitalia; 270, female genitalia; 271–272, pupae).

Teras postvittana Walker, 1863:297.

Teras scitulana Walker, 1863:299.

Teras basialbana Walker, 1863:299.

Teras secretana Walker, 1863:300.


Dichelia retractana Walker, 1863:322.

Dichelia foedana Walker, 1863:326.

Dichelia vicariana Walker, 1869:82. Synonymy by Meyrick, 1911a:84.

Dichelia viceareana, misspelling by Bradley, 1956a:103.

Archips postvittana (Walker) Walsingham, 1907b:690, pl. 11, fig. 7.


Tortrix stipularis Meyrick, 1910c:226.

Figure 271—Epiphyas postvittana (Walker). Pupal skins on gorse; Olinda, Maui. (Photographs by D. J. Davis.)
Tortrix oenopa Meyrick, 1910c: 230.


Tortrix postvittana (Walker) Meyrick, 1913b: 32.

Tortrix phaeosticha Turner, 1939(1938): 76.


The light brown apple moth.

Kauai, Oahu, Molokai, Maui, Hawaii.

Immigrant. Described from Australia and known from Tasmania and New Zealand; it is now also established in England (Meyrick, 1937: 256). It was first found in Hawaii by Dr. Perkins who collected it at Lihue, Kauai, in 1896.

Hostplants: the larvae are leaf-rollers on many kinds of plants including, in Hawaii, Acacia species, Acacia koa, Citrus, Cucurbita pepo (pumpkin), Dodonaea viscosa, Euphorbia, Pipturus, Rubus hawaiiensis, Ulex europaeus (gorse), Santalum, Vaccinium, Wikstroemia foetida, and Wilkesia. In Australia, Tasmania, and New Zealand it is considered an important pest of apples. A complex of forms occurs in Australia.

Parasites: Bracon omiodivorum (Terry), Brachymeria obscurata (Walker), Echthromorpha agrestoria fuscator (Fabricius), Ephialtes hawaiiensis (Cameron), Trichogramma minutum Riley.

Predators: Odynerus nigripennis Holmgren, Odynerus species.

The internal sac of the aedeagus bears two to four long, narrow, flattened cornuti. These are deciduous and may be missing from mated specimens, and this may lead one to consider that the specimens with the cornuti represent a different species from those which have lost them. When the cornuti are shed, however, the points of articulation can still be seen.

The moths may be confused with Amorbia emigratella Busck, but postvittana has ocelli which are lacking in Amorbia, the undersides of the hindwings are conspicuously spotted overall instead of being mostly immaculate as in Amorbia, and the second abdominal tergite lacks the conspicuous median pit near the base which is present in Amorbia. See the key to separate the larvae and pupae under the discussion of Amorbia emigratella, below.

This is a very common, highly variable moth. Some specimens are nearly concolorous, but others are conspicuously maculate. The attack of the larva resembles that of Amorbia emigratella, with which it may be confused. The larvae are green, as in Amorbia, but the prothorax does not have a black line on each lateral margin as does the larva of Amorbia.

It is of interest that, although the species is established in southwestern England, it has not been recorded there either from the apple tree or the common and widespread gorse. C. J. Davis and others have found heavy infestations of Epiphyas postvittana on gorse in the Hawaiian Islands. The common name used in the Islands, the light brown apple moth, is the same as that used in the Antipodes, and it is not altogether satisfactory.
Figure 272.—Pupa of *Epiphys waswiciana* (Walker) with an inset sketch of the cauda in left lateral aspect. Length 10.5 mm. Olinda, Maui; ex gorse. cx2, mesocoxa; fl, profemora; lb, labrum; lp, labial palpus; 11, 12, 13, legs; mx, galea of maxilla (proboscis); W2, hindwing.
Genus **PARARRHAPTICA** Walsingham

*Pararrhaptica* Walsingham, 1907b:689. Type-species: *Pararrhaptica perkinsiana* Walsingham, by original designation and monotypy.

This apparently endemic genus was described to include only its type, although Walsingham at the same time described a number of other species of the same genus which he mistakenly placed in *Eulia*. Meyrick (1913b:27) placed the type-species incorrectly in *Tortrix*, and he was followed by T. B. Fletcher (1929:163, 228) and Diakonoff (1939:223). Meyrick later described several species of this genus, but he assigned them to *Eulia*, and he said (1928c:96): “The species placed by Lord Walsingham in *Archips*, I refer to *Eulia*; no species of *Cacoecia* ( = *Archips* Wals.) has been found in Hawaii.” Dr. Swezey followed Meyrick and assigned the species he described to *Eulia*. In his original description, Walsingham said “Allied to *Archips*, Hb., but distinguished by the fringe of long hairs along the fold in the forewings.”

In our present state of knowledge, it is difficult to place the genus in relation to other genera with any degree of accuracy. Superficially, it is not greatly unlike such genera as *Epiphyas* ( = *Austrotortrix*) and *Spheterista*, but the valvae of the male genitalia are unusual. They are mostly thinly sclerotized, flexible, their apical parts curl upward and inward, and the inner faces of the curled

![Figure 273—Head and wing venation of Pararrhaptica perkinsiana Walsingham. Head of the holotype; Haleakala, 5,000 feet, Maui; the dorsal vestiture on the labial palpus is expanded upward (probably artificially on the damaged type; the scales may normally be laid down and thus the palpus will appear narrower than is shown here). The wings are from a female paratype (BM slide 1948); Olinda, 4,000 feet, Maui; the frenulum has been broken off. There is much interspecific variation in the course of vein 3 in the forewings in this genus. The male has a weak costal fold. This is the type-species of Pararrhaptica.](image-url)
areas are densely clothed with long, fine hair. These features can be best appreciated by examining the illustrations. The genitalia are not like those of *Eulita* or *Archips*. The males may or may not have a moderate costal fold on each forewing. Some females have a poorly developed signum in the bursa copulatrix. I do not know whence the genus has come.

See color plate 2, figure 5.

**DISTRIBUTION OF THE SPECIES OF PARRHAPTICA**

Arranged by type locality only, the following numbers are recorded on the main islands: Kauai, two; Oahu, six; Molokai, four; Maui, three; Lanai, one; Hawaii, three. Surely, many species await discovery and description. As now recorded, the distribution of the species is as follows (unless otherwise stated, the type locality is on that island under which each species is listed):

Kauai (three species)

- *leopardella* (Walsingham)
- *longiplicata* (Walsingham), Oahu?, Maui (type), Lanai?, Hawaii?
- *lysmachiae* (Swezey)

Oahu (eight species)

- *capucina* (Walsingham), Molokai (type), Hawaii
- *chlorippa* (Meyrick)
- *dermatopa* (Meyrick)
- *leucostichas* (Meyrick)
- *longiplicata* (Walsingham), Kauai?, Maui (type), Lanai?, Hawaii?
- *lysmachiana* (Swezey)
- *notocosma* (Meyrick)
- *pycnomias* (Meyrick)

Molokai (six species)

- *capucina* (Walsingham), Oahu, Hawaii
- *falerniana* (Walsingham)
- *perkinsiana* (Walsingham), Maui (type)
- *punctiferana* (Walsingham), Maui (type), Hawaii?
- *subsenescens* (Walsingham), Hawaii
- *trochilidana* (Walsingham)

Maui (three species)

- *longiplicata* (Walsingham), Kauai?, Oahu?, Lanai?, Hawaii?
- *perkinsiana* (Walsingham), Molokai
- *punctiferana* (Walsingham), Molokai?, Hawaii?

Lanai (two species)

- *fuscoviridis* (Walsingham)
- *longiplicata* (Walsingham), Kauai?, Oahu?, Maui (type), Hawaii?
Hawaii (seven species)

*capucina* (Walsingham), Molokai (type)

*fuscocinerea* (Swezey)

*lichenoides* (Walsingham)

*longiplicata* (Walsingham)?, Kauai?, Oahu?, Maui (type), Lanai?

*punctiferana* (Walsingham)?, Molokai?, Maui (type)

*sublichenoides* (Swezey)

*subsenescens* (Walsingham)?, Molokai (type)

It is noteworthy that Dr. Perkins found only one species on Oahu, but after the *Fauna Hawaiian* was published, Dr. Swezey found six new species on Oahu. Dr. Perkins found more species on Molokai than on any of the other islands.

HOSTPLANTS OF PARARRHAPTICA

The hostplant is known for only eight of the 19 known species of *Pararrhaptica*, and six of these have *Myrsine* (Myrsinaceae) as hostplant. The other two species feed upon *Lysimachia* (Primulaceae).

**Pararrhaptica capucina** (Walsingham), new combination (figs. 274, head, wing venation; 277h, ovipositor lobes; 278, moth; 285, male genitalia; 292, female genitalia).

*Tortrix (?) capucina* Walsingham, 1907b:701, pl. 11, fig. 23.


*Eulia capucina* (Walsingham) Meyrick, 1913b:38; 1928c:96.

Endemic. Oahu, Molokai (type locality: 4,000 feet), Hawaii.

Hostplant: unknown.

Dr. Swezey told me that his records (1915g:101, 106) of parasitism of this species by *Sierola* and *Horogenes blackurni* (Cameron) were probably made in error and that his material reported from Oahu as this species was evidently misidentified.

**Pararrhaptica chlorippa** (Meyrick), new combination (figs. 278, moth; 286, male genitalia).

*Eulia chlorippa* Meyrick, 1928c:98.

Endemic. Oahu (type locality: Mt. Olympus).

Hostplant: *Myrsine* (= *Suttonia*) *lessertiana*. 

TORTRICIDAE
Figure 274—Head and wing venation of *Pararrhaptica capucina* (Walsingham) from a specimen from the northwest Koolau Mts., Oahu (BM slide 1897).

Figure 275—Head and wing venation of *Pararrhaptica fuscoviridis* (Walsingham), holotype male (BM slide 1910); Lanai, 2,000 feet. Note the separate origins of veins 4 and 5 in the hindwing. Compare the connate condition of *longiplicata* on figure 276 and the stalked arrangement of *perkinsiana* on figure 273 and *capucina* on figure 274.
Figure 276—Wing venation of *Pararrhaptica longiplicata* (Walsingham), paratype male (BM slide 8039); Waianae Mts., 2,000 to 3,000 feet, Oahu. The crossvein between veins 11 and 12 in the forewing is evidently an abnormality.

Figure 277—Outline sketches of the ovipositor lobes of some species of *Pararrhaptica*. a, a species formerly incorrectly considered a paratype of *fuscoviridis* by Walsingham (BM slide 1911), see the text for comment; b, *subsenescens* (Walsingham), holotype (BM slide 1906); c, *leucosticha* Meyrick, lectotype (BM slide 9542 Clarke); d, *lichenioides* (Walsingham), holotype (BM slide 1907); e, *trochilidana* (Walsingham), holotype (BM slide 1913); f, *perkinsiana* Walsingham, paratype (BM slide 1948); g, *punctiferana* (Walsingham), paratype (BM slide 1967); h, *capucina* (Walsingham), holotype (BM slide 1896); i, *longiplicata* (Walsingham), paratype (BM slide 1969). a–e, all to the same scale; f–i, drawn to a larger scale.
Figure 278—Pararrhaptica. Top, capucina (Walsingham), holotype female (BM slide 1896); Molokai, 4,000 feet; expanse 22 mm. Middle, chlorippa (Meyrick), holotype male (slide Z-1X-5-61-G); Mt. Olympus, Oahu; forewing 8 mm. Bottom, dermatopa (Meyrick), holotype male; Mt. Tantalus, Oahu; forewing 9 mm.
Figure 279—Pararrhaptica. Top, *falerniana* (Walsingham), holotype female (abdomen lost); Molokai, 4,000 feet; expanse 24 mm. This print is too pale. Middle, *fuscocinerea* (Swezey), holotype male (slide Z–IX–3–61–1); Kilauea, Hawaii; forewing 9 mm. Bottom, *fuscoviridis* Walsingham, holotype male (BM slide 1910); Lanai, 2,000 feet; forewing 12 mm.
Figure 280—Pararrhaptica. Top, leopardella (Walsingham), holotype male (BM slide 1965); Kaholua-manu, 4,000 feet, Kauai; expanse 20 mm. Middle, leucostichas (Meyrick), a male ex Myrtine shoots, Honolulu; expanse 27 mm. Bottom, lichenoides (Walsingham), holotype female (BM slide 1907); Kilauea, Hawaii; expanse 32 mm. Note the narrow costal folds on the males.
Pararrhaptica dermatopa (Meyrick), new combination (figs. 233, pupa; 278, moth; 285, male genitalia).

_Eulia dermatopa_ Meyrick, 1928c: 96.

Endemic. Oahu (type locality: Mt. Tantalus).

Hostplant: _Myrsine ( = Suttonia) lessertiana._

The pupa has two long, hooked, lateral setae beneath each carinate lateral edge of the caudal process (there are no middorsal setae), and there are four similar setae under the caudal edge of the caudal process.

Figure 281—*Pararrhaptica.* Top, the specimen Walsingham considered to be a paratype of _fuscoviridis_, but it is not that species. It is a greyish, black, and green species that resembles _lichenoides_, but its genitalia are different. Walsingham called it a male, but it is a female. Northwest Koolau Mts., Oahu (BM slide 1911); expanse 25 mm. Bottom, _lysimachiae_ (Swezey), holotype male (slide Z-IX-5-61-E); Kalalau Trail, Kauai; forewing 8 mm.
Figure 282—Pararrhaptica. Top, longiplicata (Walsingham), holotype male (BM slide 1968); Haleakala, 5,000 feet, Maui; forewing 11 mm. Middle, lysischiana (Swezey), holotype female (slide Z-IX-5-61-H); Hapapa, Waianae Mts., Oahu; forewing length 7 mm. Bottom, notocosma (Meyrick), paratype female; Mt. Olympus, Oahu; forewing 11 mm.
Figure 283—Pararrhaptia. Top, *perkinsiana* Walsingham, holotype male (abdomen lost); Haleakala, 5,000 feet, Maui; expanse 20 mm. Middle, *punctiferana* (Walsingham), holotype male (BM slide 1966); Haleakala, 5,000 feet, Maui; expanse 25 mm. Bottom, *pycnomias* (Meyrick), holotype male (Busck slide 209); forewing 9 mm.
Figure 284—Pararrhaptica. Top, sublichenoides (Swezey), holotype; Kilauea, Hawaii; forewing 14.5 mm. Middle, subsenescens (Walsingham), holotype female (BM slide 1906); Molokai; left forewing 14.5 mm. Bottom, trochiidana (Walsingham), holotype male (BM slide 1912); Molokai, about 4,000 feet; forewing 10 mm.
**Pararrhaptica falerniana** (Walsingham), *new combination* (fig. 279, moth).
*Tortrix (?) falerniana* Walsingham, 1907b:701, pl. 11, fig. 22.
*Eulia falerniana* (Walsingham) Meyrick, 1913b:38.

Endemic. Molokai (type locality: 4,000 feet).  
Hostplant: unknown.  
This moth is known only from the holotype which lacks its abdomen.

**Pararrhaptica fuscocinerea** (Swezey), *new combination* (figs. 279, moth; 288, male genitalia).
*Archips fuscocinereus* Swezey, 1913e:237, misspelling in list.  
*Archips fuscocinereus* Swezey, 1913f:275.

Endemic. Hawaii (type locality: Kilanea).  
Hostplant: unknown.  
This species is known only from the male type in Bishop Museum.

**Pararrhaptica fuscoviridis** (Walsingham), *new combination* (figs. 275, head, wing venation; 279, moth; 287, male genitalia).
*Archips fuscoviridis* Walsingham, 1907b:693, pl. 11, fig. 12.  
*Eulia fuscoviridis* (Walsingham) Meyrick, 1913b:38; 1928c:96.

Endemic. Lanai (type locality: 2,000 feet).  
Hostplant: unknown.  
This moth was described from two specimens: the male holotype from Lanai and a female paratype from Oahu. In Walsingham's text, the sexes of the specimens have been reversed, because the Lanai holotype is a male, not a female as stated by Walsingham, and the Oahu specimen is a female (BM slide 1911). I do not believe that the female paratype (figs. 277a, ovipositor lobe; 281, moth; 293, female genitalia) from Oahu is the same species as the holotype from Lanai, and I have deleted Oahu from the locality records. The Oahu paratype resembles *leucostichas* (Meyrick), which is also from Oahu, but there are differences which appear to indicate that the paratype is yet another species. The lack of adequate material renders impossible the solution of the problems involving this complex at this time. This species and *trochilidana* are closely allied, and their male genitalia are distinct from the other members of the genus (see the illustrations).

**Pararrhaptica leopardella** (Walsingham), *new combination* (figs. 280, moth; 287, male genitalia).
*Archips leopardella* Walsingham, 1907b:692, pl. 11, fig. 9.  

Endemic. Kauai (type locality: Kaholuamano, 4,000 feet).  
Hostplant: unknown.  
This moth is known only from the male holotype.
Figure 285—Male genitalia of *Pararhaptica*. Top, *capucina* (Walsingham) (BM slide 1897); northwest Koolau Mts., Oahu. Bottom, *dermatopa* (Meyrick) (BM slide 3982); Olympus, Oahu; note the long cornuti in the aedeagus.
Figure 286—Male genitalia of Pararrhaptica. Top, cholorippa (Meyrick), holotype (slide Z–IX–5–61–G); Mt. Olympus, Oahu. Bottom, lysimachiae (Swezey), holotype (slide Z–IX–5–61–E); Kalalau Trail, Kauai.
Figure 287—Male genitalia of Pararrhaptica. Top, fuscoviridis (Walsingham), holotype (BM slide 1910); Lanai, 2,000 feet. This is an unusual species which appears to differ from all other known species of Pararrhaptica except trochilidana, which see. Bottom, leopardella (Walsingham), holotype (BM slide 1965); Kaulualii, 4,000 feet Kauai.
Figure 288—Male genitalia and abdominal apex of *Pararrhaptica fuscinerea* (Swezey); Kilauea, Hawaii (slide Z–IX–3–61–1).
Figure 289—Male genitalia of Pararrhaptica. Top, *longiplicata* (Walsingham), holotype (BM slide 1968); Haleakala, 5,000 feet, Maui. The uncus terminates in two conical points; note the approximate arms of the gnathus. Bottom, *punctiferana* (Walsingham), holotype (BM slide 1966); Haleakala, 5,000 feet, Maui.
Figure 290—Male genitalia of Pararrhaptica. Top, *pyanomias* (Meyrick), paralectotype (BM slide 3851); Wailupe, Oahu. Bottom, *subserescens* (Walsingham), determined by Dr. Swezey (Slide Z–VI–18–61); Kilauea, Hawaii.
Figure 291—Male genitalia of Pararrhaptica. Top, trochilidana (Walsingham), holotype (BM slide 1912); Molokai, about 4,000 feet. Compare the similar, but not identical, genitalia of fuscontrids in figure 287. Bottom, sublichenoides (Swezey); Kilauea, Hawai`i (slide JDB 6).
Figure 292—Female genitalia of *Pararrhaptica*. Top, *capucina* (Walsingham), holotype (BM slide 1896); Molokai, 4,000 feet. The figure of the whole genitalia has been reversed in the print. Bottom, *lichenoides* (Walsingham), holotype (BM slide 1907); Kilauea, Hawaii.
Figure 293—Female genitalia of a *Pararrhoptica* species confused as a paratype of *fuscoviridis* by Walsingham; northwest Koolau Mts., Oahu (BM slide 1911). See figure 281 for an illustration of the moth, and see the discussion under *fuscoviridis* in the text. What appears to be a second signum to the right of the signum in the top left figure is a piece of debris—the true signum is enlarged at upper right.
Figure 294—Pararrhaptica genitalia. Top three figures, female genitalia of a specimen of *longicipicata* (Walsingham) from the northwest Koolau Mts., Oahu (BM slide 1969); note the strong, elongate signum as enlarged. Bottom, male genitalia of a specimen of *notocosma* (Meyrick) from Mt. Olympus, Oahu (BM slide 3850).
Figure 295—Female genitalia of Pararrhaptica lysimachiana (Swezey), holotype (slide Z–IX–5–61–H); Hapapa, Waianae Mts., Oahu. The signum is the crescent-shaped dark object near the middle of the bottom figure (the photographic negative was printed from the wrong side, and the print is thus reversed).
Figure 296—Female genitalia of *Pararrhaptica perkinsiana* Walsingham, paratype (BM slide 1948); Olinda, 4,000 feet, Maui. The print of the photograph of the whole genitalia has been reversed. At the bottom is an enlarged view of the cluster of deciduous cornuti transferred from the male during copulation.
Figure 297—Female genitalia of Pararrhaptica. Top, punctiferana (Walsingham), paratype (BM slide 1967); Molokai, about 4,000 feet. Bottom, leucostichas (Meyrick), lectotype (BM slide 9542 Clarke); Honolulu, Oahu; ex Myrsine shoots.
Figure 298—Female genitalia of *Pararrhaptica sublichenoides* (Swezey); Kilauea, Hawaii (slide Z-IX-5-61-1). The photographic negative was reversed when the print for the bottom figure was made.
Figure 299—Female genitalia of Pararrhaptica. Top, *subsenescens* (Walsingham), holotype (BM slide 1906); Molokai. Bottom, *trochilidana* (Walsingham), holotype (BM slide 1913). The delicate, weakly stained bursa was not photographed; there is no signum.
**Pararrhaptica leucostichas** (Meyrick), **new combination** (figs. 277c, ovipositor lobes; 280, moth; 297, female genitalia).

*Eulia leucostichas* Meyrick, 1932:258.

Endemic. Oahu (type locality: Honolulu).
Hostplant: *Myrsine* (= *Suttonia*).

This species was described from two specimens reared from the shoots of the hostplant by Perkins in June, 1906. Although the label states that the locality of these specimens is "Honolulu", it is probable that the true locality is the mountains behind Honolulu. The lectotype female (BM slide 9542, Clarke) and a paralectotype (abdomen lost) are in the British Museum.

**Pararrhaptica lichenoides** (Walsingham), **new combination** (figs. 277d, ovipositor lobes; 280, moth; 292, female genitalia).

*Archips (?) lichenoides* Walsingham, 1907b:694, pi. 11, fig. 13.
*Eulia lichenoides* (Walsingham) Meyrick, 1913b:38; 1928c:96.

Endemic. Hawaii (type locality: Kilauea).
Hostplant: unknown.

Only the female holotype is known. Swezey’s note of 1913b:237 applies to *sublichenoides*.

**Pararrhaptica longiplicata** (Walsingham), **new combination** (figs. 276, wing venation; 277i, ovipositor lobes; 282, moth; 289, male genitalia; 294, female genitalia).

*Archips longiplicatus* Walsingham, 1907b:691, 736, pi. 11, fig. 8.

Endemic. Kauai?, Oahu?, Maui (type locality: Haleakala, 5,000 feet), Lanai?, Hawaii?
Hostplant: *Myrsine* (= *Suttonia*).
Parasite: *Sierola capuana* Fullaway.

I question all of the localities except that of Maui, because there is a mixture of species under this name. Walsingham’s notes concerning the supposed variability of the species are based upon more than one species. Walsingham’s paratype 25065 (a male from Oahu), for example, is not the same species as the holotype, as can be ascertained by examining the genitalia.

The hostplant and parasite data require confirmation.

**Pararrhaptica lysimachiae** (Swezey), **new combination** (figs. 281, moth; 286, male genitalia).

*Eulia lysimachiae* Swezey, 1933b:302.

Endemic. Kauai (type locality: Kalalau Trail, about 3,800 feet).
Hostplants: *Lysimachia glutinosa*, *Lysimachia hillebrandii venosa*. The larvae have been found on the leaves.
**Pararrhaptica lysimachiana** (Swezey), new combination (figs. 282, moth; 295, female genitalia).

*Tortrix lysimachiana* Swezey, 1946:626.

Endemic. Oahu (type locality: Puu Hapapa, Waianae Mountains).
Hostplant: *Lysimachia rotundifolia*.

This moth is known only from the female holotype which was reared from a caterpillar found on the leaves of the hostplant.

It has been confusing that, although Dr. Swezey described this species in *Tortrix*, he placed the allied *lysimachiae* in *Eulia*.

**Pararrhaptica notocosma** (Meyrick), new combination (figs. 282, moth; 294, male genitalia).

*Eulia notocosma* Meyrick, 1928c:97.

Endemic. Oahu (type locality: Mt. Olympus).
Hostplant: *Myrsine lessertiana*.

I believe that there has been confusion regarding the hostplant of this species, because Meyrick had two males bred from *Myrsine* (= *Suttonia*) and one female supposedly bred from *Astelia varatroides* before him when he described the moth. Swezey (1954:138) states that one specimen had been reared from *Astelia*, and presumably he was referring to the one recorded by Meyrick. Meyrick said that the specimens he had were “unquestionably sexes of the same species”, but because *Astelia* is a lily and *Myrsine* is a myrsinaceous tree, I believe that either two species are involved or that there has been an error in recording the hostplant of the specimen supposedly reared from *Astelia*.

**Pararrhaptica perkinsiana** Walsingham (figs. 273, head, wing venation; 277f, ovipositor lobe; 283, moth; 296, female genitalia).

*Pararrhaptica perkinsiana* Walsingham, 1907b:689, pl. 11, fig. 6.


Endemic. Molokai, Maui (type locality: Haleakala, 5,000 feet).
Hostplant: unknown.

The male holotype has lost its abdomen, and no other male has been seen by me. This is particularly unfortunate, because *perkinsiana* is the type-species of *Pararrhaptica*.

**Pararrhaptica punctiferana** (Walsingham), new combination (figs. 277g, ovipositor lobe; 283, moth; 289, male genitalia; 297, female genitalia).

*Archips punctiferanus* Walsingham, 1907b:692, pl. 11. fig. 10.


Endemic. Molokai?, Maui (type locality: Haleakala, 5,000 feet), Hawaii?
Hostplant: unknown.
This moth was described from one male from Maui, and Walsingham had a single specimen from Molokai which he thought might be the female. It is possible that it represents a different species. I have questioned the Hawaii record also, because it is based upon material determined as this species (probably from literature only) by Dr. Swezey from specimens collected at light at Kilauea by Giffard. It is possible that three species are involved in these records.

**Pararrhaptica pycnomias** (Meyrick), **new combination** (figs. 283, moth; 290, male genitalia).

*Eulia pycnomias* Meyrick, 1928c:97.

Endemic. Oahu (type locality: Wailupe).

Hostplant: *Myrsine (= Suttonia) lessertiana*.

This species was described from two males, and I have not seen the female.

**Pararrhaptica sublichenoides** (Swezey), **new combination** (figs. 284, moth; 291, male genitalia; 298, female genitalia).

*Archips sublichenoides* Swezey, 1913f:276.

Endemic. Hawaii (type locality: Kilauea).

Hostplant: unknown.

Dr. Swezey’s notes of 1913f:237 apply to this species instead of to *lichenoides*.

**Pararrhaptica subsenescens** (Walsingham), **new combination** (figs. 277b; ovipositor lobe; 284, moth; 290, male genitalia; 299, female genitalia).

*Archips (?) subsenescens* Walsingham, 1907b:695, pl. 11, fig. 14.

*Eulia subsenescens* (Walsingham) Meyrick, 1913b:38; 1928c:96.

Endemic. Molokai (type locality: no specific locality is on the label, but the type was collected by Perkins “5-VIII-1893”), Hawaii?

Hostplant: unknown.

This species was described from one female. I have questioned the Hawaii record which is by Dr. Swezey from specimens collected at light at Kilauea by Giffard, because the specimens have not been compared with the holotype.

**Pararrhaptica trochilidana** (Walsingham), **new combination** (figs. 277e, ovipositor lobe; 284, moth; 291, male genitalia; 299, female genitalia).

*Archips trochilidanus* Walsingham, 1904b:693, pl. 11, fig. 11.

*Eulia trochilidana* (Walsingham) Meyrick, 1913b:38; 1928c:96.

Endemic. Molokai (type locality: 3,500 feet).

Hostplant: unknown.

This moth is close to *fuscoviridis* and shares the unusual kind of male genitalia of that species. It has very dark fuscous hindwings.
Genus **PARAPHASIS** Walsingham

*Paraphasis* Walsingham, 1907b: 730. Type-species: *Paraphasis perkinsi* Walsingham, monotypic.

This endemic genus was assigned to the wrong family by Walsingham. He placed it in the Tineidae, but an examination of the accompanying illustrations will demonstrate that it belongs in the Tortricidae. It was described from one male specimen, and nothing has been recorded concerning it since it was described.

Although the male genitalia indicate that the type-species belongs to the Tortricinae, as defined in this text, the vestiture of the sides of the metascutum differs from all other Hawaiian Tortricinae and agrees with the Hawaiian Olethreutinae. The vestiture distinctly consists of elongated squamae and not hairs on the metascutum. Also, the lack of maculation on the undersides of the hindwings renders it more confusing in the Island fauna. It is unfortunate that only one damaged specimen is known to have been collected.

The wing venation is "loose" and peculiar. Vein 2 in the forewing terminates on the posterior wing margin ("dorsum") instead of on the termen as it does in all other Hawaiian tortricids; this is a highly peculiar character. In the hindwing, vein 6 is basally well separated from 7, as illustrated, and this is another peculiarity. The male antennae (figure 220) are conspicuously bipectinate; in Hawaii *Paraphasis* shares this character only with *Panaphelix*, although it is not allied to that genus.

*Paraphasis* is a strange moth, and I have been unable to determine its affinities.

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Figure 300—Head and wing venation of *Paraphasis perkinsi* Walsingham, holotype male (BM slide 1860); Kauai, 3,000 to 4,000 feet. Note the strange "open" venation and the unusual course of vein 2 which runs to the hind margin in the forewing instead of to the termen. The head is abraded and shriveled and not in good condition. A fold in the collapsed, abraded occiput largely conceals the small left ocellus. The labial palpus is displaced downward from its normal attitude; it should be more ascending. Although this is a tortricid, it was wrongly placed in the Tineidae when it was originally described.
Figure 301—Paraphasis perkinsi Walsingham, holotype male and its genitalia (BM slide 1860); Kauai, 3,000 to 4,000 feet; forewing 6.5 mm. The dark macula near the middle of the posterior margin of the forewing is a mixture of mostly orange and brown scales, and there is a scattering of orange scales over most of the wing. The large pale subbasal area is an abrasion.
**Paraphasis perkinsi** Walsingham (figs. 220, male antenna; 300, head, wing venation; 301, moth, male genitalia).

*Paraphasis perkinsi* Walsingham, 1907b: 730.

Endemic. Kauai (type locality: 3,000 to 4,000 feet).

Hostplant: unknown.

The unique male holotype is partly abraded, especially on the head and thorax, and the head is partly crushed and has been glued to the thorax. It is, therefore, impossible to ascertain the true nature of certain characters. The ocelli are small and difficult to see because of the deformed integument. The holotype bears the Walsingham label "*Entlechia perkinsi* Wlsm.”

This is one of the very few species of Hawaiian Microlepidoptera which Walsingham did not illustrate in *Fauna Hawaiensis*.

Further details concerning this highly unusual moth must await the capture of additional specimens.

**Genus PANAPHELIX** Walsingham


This is a group of large tortricids (about 20 to nearly 40 mm. in expanse). The genus appears to be endemic. Meyrick (1922a: 495) described a *Panaphelix allomorpha* from Reunion Island (east of Madagascar), but the specimen does

Figure 302—*Panaphelix marmorata* Walsingham. Head of the allotype female; the labial palpi are generally similar to those of *Mantua* (see figure 307). Wings of the male holotype (BM slide 9596 Clarke).
not belong to *Panaphelix*. I have examined the type in the Paris Museum. Diakonoff (1957b:254) placed *allomorpha* in *Borboniella*. In the Hawaiian fauna, *Panaphelix* appears closest to *Mantua*. It somewhat resembles the complex of genera which includes *Pandemis* Hübnner, 1825; *Parapandemis* Obraztsov, 1954; and *Borboniella* Diakonoff, 1957b, and associates, as well as some *Archips*. I do not, however, know to what *Panaphelix* is most closely allied or whence it has come, but it may be a development from Holarctic *Archips*.

The males are easily recognized by their strongly bipectinate antennae (see figure 220) together with their large size. The only other genus in Hawaii which contains a male whose antennae are bipectinate is *Paraphasis*, but the only known male of that genus is only 14 mm. in expanse, and *Paraphasis* is otherwise very different. The broad valvae of the male *Panaphelix* genitalia are distinctive in the Hawaiian fauna. There are conspicuous pairs of pits on abdominal tergites 2 and 3 which are noteworthy (see the details under *asteliana*, below). Freeman (1958:85) figures similar pits on the Holarctic *Archippus*, and he reports that pits may be present or absent on species of *Archips*. Also in Hawaii, *Amorbia* has a single pit. The pupae of *Panaphelix* and *Amorbia* also bear dorsal foveae as shown in figures 302–A, e and 327.

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Figure 302–A—Details of tortricid pupae. a, b, lateral and dorsal aspects of the cauda of *Bradleyella thoracina* (Walsingham)?, as determined by Swezey; Mt. Tantalus, Oahu, ex *Perottetia*; length, 9.25 mm. c, d, lateral and dorsal aspects of the cauda of *Panaphelix asteliana* Swezey; Mt. Kaala, Oahu; length 13.5 mm. e, dorsal aspect of sixth abdominal segment of *asteliana* to show the two conspicuous foveae which occur on tergites two to seven inclusive.
Figure 303—Panaphelix asteliana Swezey. Top, male holotype; Mt. Kaala, Oahu; forewing 11 mm. Bottom, part of the female genitalia of a paratype (Busck slide 149); Oahu; ex Astelia.
Figure 304—Panaphelix marmorata Walsingham. Top, holotype male (BM slide 9596 Clarke); Haleakala, 6,000 feet, Maui; forewing 16 mm. Bottom, allotype female (BM slide 9597 Clarke); Haleakala, 5,000 feet, Maui; expanse 30 mm.
Figure 305—Male genitalia of *Panaphelix*. Top, *asteliana* Swezey, paratype (Busck slide 148); Oahu; ex *Astelia*. The sacculus sclerotization is almost obsolete, but its apex remains as a small sclerotized flange as noted by the arrow. Bottom, *marmorata* Walsingham, holotype (BM slide 9596 Clarke); Haleakala, 6,000 feet, Maui. Note the sclerotization of the sacculus; compare figure 306.
Figure 306—Panaphelix marmorata Walsingham. Top, genitalia of a female paratype (BM slide 9597); Haleakala, 6,000 feet, Maui. Bottom, genitalia of a male paratype (Busck slide 80 in the Bishop Museum; Walsingham specimen 28128); compare figure 305.
In addition to the two species listed here, Walsingham (1907b:697) stated that he had a single female of what appeared to be a new species of the genus from Kilauea, Hawaii; this specimen was in poor condition.

**KEY TO THE SPECIES OF PANAPHELIX**

1. Pattern of forewing mostly a series of pale lines on a brown background (veins pale-scaled); hindwings rather shiny brown; figure 303. .................**asteliana** Swezey.
2. Forewings boldly marked with large pale maculae on a brown and orange background; hindwings nearly white with pale brownish maculae; figure 304 .................**marmorata** Walsingham.

**Panaphelix asteliana** Swezey (figs. 302, pupa; 303, moth, female genitalia; 305, male genitalia).

Panaphelix asteliana Swezey, 1932:202, pl. 13, fig. 8.

Endemic. Oahu (type locality: Mt. Kaala, about 3,200 feet).

Hostplant: *Astelia veratroides*.

The larva is greenish with some fuscous marks on head and cervical shield. It feeds beneath web on apical part of the Astelia leaf. The leaf is partially eaten on a transverse line on lower side about 6 inches to a foot from the apex. The apical portion then bends down and is the part on which the larva feeds, eating off the under surface and leaving the extreme apical portion rolled and spun together for a retreat which eventually becomes filled with the frass.

The pupa is brown, about 15 mm. in length. The wing and leg sheaths reach the apex of the 3rd abdominal segment; the abdominal segments have two dorsal transverse rows of short spines; near the base of each abdominal segment 1 to 7 is a pair of circular dorsal pits wide apart; cremaster somewhat extended, bluntly conical with 8 hooked bristles, 4 on apical margin and 2 on each side. (Swezey, 1932:202.)

There is a pair of conspicuous pits on the second and third abdominal tergites of the moth (compare these with the pits found on the pupa as described by Swezey in the quotation above).

The color pattern of the forewings, which consists principally of a brown background on which the ochreous-scaled veins stand out as pale lines, is so different from the type-species that the two appear to be widely separated forms.

At first sight, the valvae of the male genitalia may appear to differ from *marmorata* more than they really do. This is because the sacculus is well-developed on *marmorata* but it is much reduced on *asteliana* on which species only its apical part is developed as a sclerotized flange.

**Panaphelix marmorata** Walsingham (figs. 220, male antenna; 302, head, wing venation; 304, moths; 305, 306, male, female genitalia).

Panaphelix marmorata Walsingham, 1907b:696, pl. 11, fig. 15 (male). Dia- konoff, 1957b:243, pl. 8, figs. 24–25, male genitalia.

Panaphelix chrysochroa Walsingham, 1907b:697, pl. 11, fig. 16 (female).

Endemic. Maui (type locality: Haleakala, 6,000 feet, male; 5,000 feet, female).
Hostplant: unknown.

It is not certain that the sexes are correctly associated under this name in collections, and, as the illustrations demonstrate, the holotype male and allotype female appear to be of different species. Walsingham (1907b:697) said that he had at first described the female "as distinct under the name *chrysochroa*, and should it be proved to represent a constant form or variation, or to belong to another closely allied species, this name may be applied to it."

This species may contain the largest individuals of any of the genera of Hawaiian Tortricidae; specimens have been seen which range from 32 to 37 mm. in expanse. Other large Hawaiian tortricids with wing expanses exceeding 30 mm. are *Mantua fulvosericea*, *Pararrhaptica lichenoides*, and *P. subsenescens*.

Genus **MANTUA** Zimmerman, *new genus*

Head, as illustrated; roughly scaled between and behind antennae, with closely appressed scales on front, those on lower half smoothest. Labial palpi, as illustrated, comparatively slender, ascending-porrect, second segment mostly smooth-scaled, especially along ventral edge, and dorsal expansion at most moderate; third segment conspicuous, longitudinal, subcylindrical, and exposed for most of its length. Ocellus strongly protuberant, as far from antennal fossa as the diameter of its dark base and closer to eye than the diameter of its lens. Chaetosema strong. Antenna extending to about middle of costa of forewing; ventral cilia on males conspicuous, numerous, and long (longer over most of the length of the antenna than the breadths of the antennal segments and, in the type-species, nearly twice as long as the basal segments are wide). Proboscis evidently shorter than the palpi.

Figure 307—Head and wing venation of *Mantua fulvosericea* (Walsingham), holotype male (BM slide 1894).
Figure 308 *Mantua fulvoxerica* (Walsingham). Top, allotype female (BM slide 1895); Kauai, 3,000 to 4,000 feet; expanse 34 mm. Bottom, holotype male (BM slide 1894); Molokai, 3,500 feet; forewing 12 mm.
Figure 309—*Mantua fulvosericea* (Walsingham). Top, genitalia of the holotype male (BM slide 1894); Molokai, 3,500 feet. Bottom, female genitalia of allotype (BM slide 1895); Kauai, 3,000 to 4,000 feet; the photographic print of the whole genitalia has been reversed.
Thorax smooth, without a crest; metanotum with broad, smooth scales at middle (metascutellum), but with long, fine, hairlike vestiture on each side of the metascutum. Legs without unusual characters; tibial spurs long, inner spurs longer, and those of middle legs much longer than outer spurs and a little longer than the distance from base of spur to base of inner side of tibia; inner, submedial spurs of hind tibiae reaching over base of apical spurs; hind tarsus a little shorter than hind tibia, ventral surfaces with numerous spines protruding from the vestiture.

Abdomen lacking subbasal dorsal pits.

Wings with shape and venation as in figure 307, hindwings with a strong hair-tuft arising from near base of vein 1b and another from the axil between wing and thorax (in both sexes); no specialized hairs along posterior margin of cell; undersides of hindwings strongly maculate.

Genitalia of male and female as in figure 309. Uncus very strong, broadly expanded distad, socii moderate setose plates, gnathus fused medially into a sharp hook, transversa without denticles, sacculus long, slender, bladelike, lying entirely along ventral margin of valva, extending well beyond middle of valva and with free apex. Ductus bursae lacking cestum (sclerotized longitudinal band). Bursa copulatrix lacking a signum.

Type-species: Dipterina fulvosericea Walsingham.

This group outwardly appears to resemble Panaphelix, and it has similar wing venation and palpi; but the genitalia are distinctive, as the illustrations demonstrate, and the abdomen lacks the subbasal dorsal pits of Panaphelix. The antennae of the male are long-hairy beneath, but the male antennae of Panaphelix are strongly, peculiarly bipectinate (see figure 220). Mantua is proposed for one endemic Hawaiian species which was originally assigned incorrectly to Dipterina by Meyrick, 1881 (type-species: imbriferana Meyrick of New Zealand; see also Dugdale, 1966: 749 and figures). I have been unable to determine the extra-Hawaiian relationships of Mantua.

Mantua is derived from the name of Virgil’s birthplace. Its gender is to be taken as feminine.

Mantua fulvosericea (Walsingham), new combination (figs. 307, head, wing venation; 308, moths; 309, male, female genitalia).

Dipterina fulvosericea Walsingham, 1907a:697, pl. 11, figs. 17, 18.

Cnephasia fulvosericea (Walsingham) Meyrick, 1913b:46.

Endemic. Kauai (type locality of female allotype: 3,000 to 4,000 feet), Oahu, Molokai (type locality of male holotype: 3,500 feet), Lanai.

Hostplant: Xylosma hawaiiense, the caterpillars spin the leaves together.

This moth is widely distributed in the islands, but few specimens have been captured. I can recall having collected only one female (at Kokee, Kauai in June, 1937). It is a large moth with a wing expanse of 28 to 36 mm. The male holotype is so different in appearance from the female allotype that one wonders if they represent the same species. Much remains to be learned about this extraordinary moth. I have examined only one male during this study, but I have seen several females.
Genus **BRADLEYELLA** Zimmerman, *new genus*

Head as illustrated; with appressed, smooth scales on front but roughly scaled between and behind the antennae. Labial palpi as illustrated, ascending, second segment with scaling expanded dorsad and ventrad, thus making the segment subtriangular in shape; third segment exposed, subcylindrical, and continuing the medial longitudinal axis of the second segment. Ocelli moderate, well separated from the antennal fossa and separated from eye margin by about the diameter of the ocellar lens. Chaetosemata moderate. Antennae not reaching middle of costa of forewing; male antennae short-furry beneath, the cilia not strong and not as long as the breadths of the segments; rather similar, but narrower, in female. Proboscis moderate.

Thorax smooth, without a crest; metanotum with hairlike scales on each side; metascutellum with smooth, broad scales. Legs without unusual characters; inner spurs on middle legs much longer than outer spurs; inner submedial spur on metatibia capable of overlapping bases of terminal spurs; metatarsi a little shorter than metatibia and the several spines on the ventral surfaces of the segments with only their tips exposed through the scaling.

Wings with shape and venation as illustrated; hindwings with a strong hair-tuft from the base of vein 1b and with another tuft in the axil between the base of the wing and the thorax in both sexes; undersides of hindwings maculate distad only, not conspicuously maculate on discs or basad.

Genitalia as illustrated; uncus and gnathus well-developed, the arms of the latter joined at apices to form a median hooklike process; socii reduced;

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Figure 310—**Bradleyella chlorocalla** (Walsingham). Head of the female holotype. Wings of a male paratype (BM slide 1904). Both specimens are from Olaa, 2,000 feet, Hawaii. This is the type-species of **Bradleyella**.
transtilla simple, unarmed; female lacking a signum in the bursa copulatrix and without a sclerotized band (cestum) in ductus bursae; male with an extraordinary development of very large, curved spines on each side of the apex of the eighth abdominal segment.

Type-species: *Tortrix chlorocalla* Walsingham.

*Bradleyella* is erected for a group of poorly known species heretofore “dumped” into *Tortrix* and *Eulia*. The males bear highly unusual spines at the apices of the abdomens (see the illustrations), and this character alone will separate them from all other genera in Hawaii. Spines similar to these have been seen by me in only one other species, *Tortrix endopyra* Meyrick from Africa (but it is not a *Tortrix*). The character is a parallel development only, and it does not indicate any relationship (see Clarke, 1958:239, fig. 1c for an illustration of the African species). I am unable at this time to say to what genus *Bradleyella* is allied or whence it might have come. It has certain features which recall *Pararrhaptica*, but the genitalia differ.

It is with a deep feeling of gratitude and obligation that I dedicate this unusual genus to my friend, Dr. J. D. Bradley, formerly British Museum (Natural History) and now Commonwealth Institute of Entomology, who has contributed so much toward this volume and who has given generously of his aid over the entire period of years during which I have been working on the Hawaiian Lepidoptera. Without his able assistance this volume could not have been done as it has been done.

Only five species of *Bradleyella* have been described, but numerous species may await discovery and description.

Figure 311—*Bradleyella metallurgica* (Walsingham). Wing venation of a female paratype (BM slide 19026); Lanai, 2,000 feet.
We know little about the distribution and habits of Bradleyella. Representatives of the genus have been found from Kauai to Hawaii, but, strangely, no specimens have yet been recorded from the large, high, central island of Maui where several species must occur. Recorded by type locality only, there is one species from Kauai, one from Oahu, one from Molokai and two from Hawaii. The Kauai species (*thoracina*) has been recorded from the adjacent island of Oahu, and *metallurgica* has been recorded from Oahu, Molokai (type locality), Lanai and Hawaii, but there appears to be confusion in the records.

The known hostplants of *Bradleyella* are *Perrottetia* (Celastraceae), *Phyllanthus* (Euphorbiaceae), and *Xylosma* (Flacourtiaceae).

**Bradleyella chlorocalla** (Walsingham), new combination (figs. 310, head, wing venation; 313, moth; 315, male genitalia; 319, female genitalia). *Tortrix chlorocalla* Walsingham, 1907b:699, pl. 11, fig. 19. *Eulia chlorocalla* (Walsingham) Meyrick, 1913b:38.


Figure 312—*Bradleyella thoracina* (Walsingham). Wing venation of a male paratype (BM slide 1900); Kaholuamano, 4,000 feet, Kauai.
Figure 313—Bradleyella. Top, *chlorocalla* (Walsingham), holotype female (BM slide 1903); Olaa, Hawaii; expanse 20 mm. Middle, *metallurgia* (Walsingham), holotype male (BM slide 1901); Molokai, 3,000 feet; expanse 14 mm. Bottom, *phyllanthana* (Swezey), holotype male; Malamalama, Oahu; forewing 6 mm.
Figure 314—Bradleyella. Top, semicinereana (Swezey), holotype male; Kilauea, Hawaii (abdomen lost); forewing 9 mm. Bottom, thoracina (Walsingham), holotype female (BM slide 1899); Kauai, 3,000 to 4,000 feet; forewing 11 mm.
Endemic. Oahu, Molokai (type locality: 3,000 feet), Lanai, Hawaii.
Hostplants: *Phyllanthus*, *Xylosma*.
Parasites: *Horogenes blackburni* (Cameron), *Trathala flavo-orbitalis* (Cameron).

This species was described from the male holotype from Molokai and a female from Lanai. I am not positive that the female from Lanai is the same species. In 1954:228, Dr. Swezey recorded the species from Oahu (“This moth was once reared from *Xylosma* leaves on Mt. Tantalus, Oahu. It occurs on other trees also.”), but I have not studied his material from *Xylosma*, and I am not sure that his determination is correct. In 1910:142, he recorded it from *Phyllanthus*, without mentioning a locality, but he did not list *Phyllanthus* in his 1954 book on Hawaiian forest entomology. Is it possible that he formerly confused with *metallurgica* that which he later described as *phyllanthana*? *Phyllanthus* (Euphorbiaceae) and *Xylosma* (Flacourtiaceae) are in widely different plant families, and these hostplant records and the parasite records require confirmation. Dr. Swezey also determined specimens from Honakaa, Hawaii, as *metallurgica*, and the identity of those specimens also requires verification.

**Bradleyella phyllanthana** (Swezey), new combination (figs. 313, moth; 317, male genitalia; 320, female genitalia).
*Tortrix phyllanthana* Swezey, 1940b:462.

Endemic. Oahu (type locality: Malamalama Ridge).
Hostplant: *Phyllanthus sandwicensis*.
The green larvae were found by Dr. Swezey between spun-together leaves. Is it possible that this is the species which Swezey had previously confused with *metallurgica* when he recorded *metallurgica* from Oahu?

**Bradleyella semicinereana** (Swezey), new combination (fig. 314, moth).
*Tortrix semicinereana* Swezey, 1913f:276.

Endemic. Hawaii (type locality: Kilauea).
Hostplant: unknown.
This moth was described from one specimen (abdomen lost) taken at a light in 1912 and not recorded since.

**Bradleyella thoracina** (Walsingham), new combination (figs. 302–A, pupa; 312, wing venation; 314, moth; 318, 321, male genitalia; 319, 321, female genitalia).
*Tortrix thoracina* Walsingham, 1907b:700, pl. 11, fig. 21.
*Eulia thoracina* (Walsingham) Meyrick, 1913b:38.

Endemic. Kauai (type locality: Kaholuamano, 4,000 feet), Oahu.
Hostplant: *Perrottetia*.
Parasite: *Horogenes blackburni* (Cameron).
This moth was described from one female and a questionably associated female from Kauai. Dr. Swezey is responsible for the Oahu record and for the hostplant and parasite records, and I have not verified his determinations.
Figure 315—Male genitalia and apex of abdomen of *Bradleyella chlorocalla* (Walsingham), paratype (BM slide 1904); Olaa, 2,000 feet, Hawaii. The figure of the aedeagus is upside down.
Figure 316—Male genitalia of *Bradleyella metallurgica* (Walsingham), holotype (BM slide 1901); Molokai, 3,000 feet. The dissection is mounted in a cavity slide. The aedeagus is viewed from the side. The uncus is U-shaped in dorsal view. Note the greatly reduced ectal caudal abdominal processes (marked "p").
Figure 317—Male genitalia of Bradleyella phyllanthana (Swezey), paratype (slide JDB 3); Malamalama, Oahu. The aedeagus is seen in lateral aspect. There appear to be only two abdominal hooks on each side.
Figure 318—Male genitalia of *Bradleyella thoracina* (Walsingham), paratype (BM slide 1900); Kaho- 
luamano, 4,000 feet, Kauai. The aedeagus is viewed from beneath (it later rotated in the mounting medium 
and may now present a different side when viewed on the slide). There are three abdominal hooks on each 
side, but one of those on the right side is concealed.
Figure 319—Female genitalia of Bradleyella. Top, chlorocalla (Walsingham), holotype (BM slide 1903); Olaa, 2,000 feet, Hawaii. Bottom, thoracina (Walsingham), holotype (BM slide 1899); Kauai, 3,000 to 4,000 feet. Compare figure 321.
Figure 320—Female genitalia of Bradleyella. Top, phyllanthana (Swezey), paratype (slide Z–IX–5–61–F); Malamalama, Oahu. Bottom, metallurgica (Walsingham), paratype (BM slide 1902); Lanai.
Figure 321—Bradleyella thoracina (Walsingham). Top, female genitalia (Busck slide 215). Bottom, male genitalia (Busck slide 214); one left and two right hooks have been broken away; note the expanded base of the aedeagus. Both specimens are from Kaholuamano, Kauai, and both were determined by Dr. Swezey.
Genus **AMORBIA** Clemens


This genus is easily recognized in the Hawaiian fauna, because it is the only genus of Tortricidae now known in Hawaii that lacks ocelli. The male genitalia are quite similar to those of *Sparganothis*. In the forewing, veins 7 and 8 are stalked in the female but coincident in the male. Thus, the female has 12 veins in the forewings, but the male has only 11 veins. The only other genera of Tortricidae in Hawaii that have vein 7 branching from 8 are *Eccoptocera* and *Spheterista*. There are 25 or more species of *Amorbia* in America, and one of these was introduced accidentally to Hawaii where it has become a pest species.

*Amorbia* belongs to the group called Sparganothinae or Sparganothidinae (Obraztsov, 1945a:22; 1954:149) or Sparganothinini (MacKay, 1962:7, 72; Powell, 1964:66). The group is confined mostly to America with the greatest proliferation in the Neotropical zone. It is poorly understood. MacKay (1962:29) said “There is difficulty in defining the tribes Archipsini and *Sparganothis* on larval characters.” I do not believe that there are subfamily differences between the Tortricinae and the *Sparganothis* group and would not give the latter more than tribal rank. The vestiture of the posterior margin of

![Figure 322—Head and wing venation of a male *Amorbia emigratella* Busck (BM slide 3846); Hawaiian specimens. Note carefully: in the male, veins 7 and 8 in the forewing are fused (hence there are only 11 veins in the forewing of the male), but in the female both veins 7 and 8 are present and stalked (hence there are 12 veins in the female). There are no ocelli in this genus.](image-url)
the cell in the hindwing is certainly not similar to that of the Olethreutinae, as one might conclude from some statements in the literature. The fact that the arms of the gnathus are free and not fused apically has been given undue weight; the genitalia are otherwise quite similar to typical Archipsini.

Amorbia emigratella Busck (figs. 322, head, wing venation; 323, moth, male genitalia; 324, moth; 325, female genitalia; 326, larva; 327, pupa). Amorbia emigratella Busck, 1910a(1909):201. Fullaway, 1911:23–27, fig. 8, moth, larva, pupa. Meyrick, 1913b:56.


The Mexican leaf-roller.
Kauai, Oahu, Molokai, Maui, Hawaii.

Immigrant. Although this species was described from Hawaii (Mt. Tantalus and Makiki in Honolulu), it is known to be a native of Mexico and Central America. It was first discovered in Hawaii at Honolulu in 1902 by Dr. Perkins who found it to be common on orange trees. In 1909, Dr. Sweezy wrote to August Busck (Busck, 1910a[1909]:202) that “This tortricid is quite a pest in the Hawaiian Islands. The larvae are leaf-rollers on many kinds of plants, shrubs, and fruit-trees, often so numerous as to defoliate the trees and sometimes attacking the fruit as well. It is an introduced species here which has been present for several years.”

Hostplants: Acacia koaia, Arachis hypogaea (peanut), Brassia, Brassica oleracea (broccoli), Carica papaya (papaya), Cassia leschenaltiana, Citrus sinensis (orange), Dodonaea viscosa, Draecena, Gardenia, Gliricidia sepium, Gossypium species (cotton), Ipomoea batatas (sweetpotato), Lycopersicon esculentum (tomato), Macadamia, Orchidaceae, Passiflora, Persea americana (avocado), Phais, Phaseolus species (garden beans), Pipturus, Psidium guajava (guava), Rosa, Rubus species (blackberry), Rubus hawaiensis, Solanum melongena (eggplant), Solanum tuberosum (potato), Sophora, Theobroma cacao (cocoa), Ulex europaeus (gorse), Wikstroemia foetida, Zea mays (maize corn), and other plants.

Parasites: Bracon omiodivorum (Terry), Brachymeria obscurata (Walker), Echthromorpha agrestoria fuscator (Fabricius), Ephialtes hawaiensis (Cameron), Trichogramma minutum Riley.

Predators: Iridomyrmex humilis Mayr (Argentine ant), Odynerus rudolphi Perkins, Pachodynerus nasidens (Latreille), Pheidole megacephala (Fabricius) (all the foregoing are Hymenoptera), Xiphidiopsis lita Hebard (Orthoptera).

The often-abundant larvae of this moth attack many kinds of plants. They roll the edges of the leaves (especially young growth) or web together the leaves. Their activities frequently disfigure, injure, or defoliate many ornamental and crop plants as well as other plants including native species in the mountain forests. The eggs are deposited in coated-over masses on the leaves of the hostplant. The larvae, which are green with a conspicuous black line on each side of the pronotum “sometimes eat the young fruits of the orange and [avocado], if a leaf lies near or in contact” (Sweezy, 1912a:166). The damage done by the larvae is similar to that done by Epiphyas, which see, and they may occur side by side.
Figure 323—*Amorbia emigratella* Busck. Top, an Hawaiian male, forewing 10 mm. The antennae of the male have conspicuously long hairs beneath. The dark spot at the base of the second abdominal tergum is a conspicuous fovea (present in both sexes). This is of assistance in separating this species from rather similar species in Hawaii, such as *Epiphytus postvittana*. Bottom, male genitalia of another Hawaiian specimen (BM slide 3846); the dark mass in the apex of the aedeagus is a fascicle of setae.
Fullaway (1911:23–27) figured the adult, larva, and pupa, and the following details are mostly abstracted and augmented from his account. The moth increased very rapidly after first being discovered in Hawaii, as do many introduced insects which are not checked by parasites or other factors, and its great range of food plants makes it an unusually destructive form. The larvae are often so numerous as to defoliate trees, and they also attack the fruits of some trees. The young larvae feed beneath coarse web. When attacking fruits, they commence to bore inside, but they soon desist and work on the surface beneath a web or they fasten the fruit to the nearest object such as another fruit or a leaf. They destroy the blossoms of papaya and prevent the setting of fruit. The eggs are laid in clusters of from about 65 to 120, although sometimes only a few eggs are deposited in a cluster, these usually being deposited on the upper surface of a leaf or sometimes on other objects. The cluster of eggs has a greenish color and has a whitish protective covering which extends beyond

Figure 324—Amorbia emigratella Busck, two females from Kokee, Kauai. Top, expanse 23 mm. Bottom, expanse 25 mm. The color pattern of the forewing is subject to much variation. This is a very common and widespread moth in the gardens, fields, and forests of Hawaii. It may be confused on occasion with Epiphyas postvittana, which see.
Figure 325—Amorbia emigratella Busck. Female genitalia of an Hawaiian specimen (BM slide 3753).
Figure 326—Details of the larva of Amobia emigratella Busck. a, setal map of the pro- and mesothorax and abdominal segments 1, 2, 6, and 7; b, the same of abdominal segments 8 and 9; c, ocellar area of the left side of the head; d, the VI setae along the midline of abdominal sternites 7, 8, and 9; e, crochets of a mid-abdominal and an anal proleg; f, prothoracic shield; g, lateral aspect of a thoracic leg tarsus; h, metacoxae and the associated VI setae; i, dorsal setae and dermal spinules of an anterior abdominal tergum; j, frontal aspect of head; k, anal fork; l, dorsal aspect of abdominal segments 8, 9, and 10. (Plate loaned by Margaret MacKay.)
the edge of the egg mass. The eggs are flat, elliptical, about 1 mm. long, slightly iridescent, finely reticulated, and are deposited in a slightly imbricated manner. The egg stage occupies about 10 days.

Fullaway found the larval period to be 28 to 35 days in Honolulu, and he described the pupa as follows (pp. 24–26): "Pupation takes place within the folded leaf. Pupa 9 to 12 mm., dark brown on dorsum shading into golden-brown on venter; wing-cases luteous, extending beyond middle of fourth

Figure 327—Pupa of Amorbia emigratella Busck; Olinda, Maui; ex gorse; length 11.5 mm. A sketch of the cauda in left lateral aspect and an outline of the eighth abdominal tergite in left lateral aspect to show the subbasal fossae are inserted. A, antenna; Cx2, mesocoxa; f, profemora; lb, labrum; lp, labial palpus; 11, 12, 13, legs; mx, galea of maxilla (proboscis); W2, hindwing. Ventral setae mostly omitted.
abdominal segment; spiracular openings small, reddish-brown; on dorsum of abdominal segments 2 to 8 two transverse rows of minute blunt spines, near anterior and posterior margins, becoming smaller outwardly from median line and disappearing before the spiracles; posterior row a trifle more extensive than the anterior; in front of anterior row on median line of dorsum of segments 2 to 7 [8] a pit, partially covered by narrow blackish lip extending from posterior margin of preceding segment [This statement is in error; the sclerotizations arise from the same segment as each pit, and there is also a sclerotization caudad of each pit.]; on segment 9 a few scattered hairs; cremaster moderately pointed with eight short recurved spines. The pupal stage covers 10 days.”

Margaret MacKay (1962:88, fig. 83) has given a modern description of the larva, as follows: “Last-instar larva about 25 mm. . . . Head brownish yellow, with dark ocellar area and a narrow band of dark pigment extending posteriorly from ocellus 1 parallel to the dark bar of pigment beneath it, which extends anteriorly from the postgenal juncture; the latter not always distinct. Thoracic shield yellowish, bordered laterally with a narrow band of dark pigment as illustrated. Thoracic legs yellowish or brownish. Remainder of body pale. Pinacula of body colour, moderately large, the dorsal and subdorsal ones on the mesothorax, and to a lesser extent on the metathorax, elongated posteriorly as illustrated; setae long, unusually so on anal shield. Spinules slender, of body colour or slightly darker, easily observed.”

This common, widespread, variable moth may on occasion be confused with Epiphyas postvittana; it often is attracted to light in company with that species, and the larvae of the two species may sometimes be found in close association on the same hostplant. There are three easily seen external characters that will serve to distinguish the imagos of the Amorbia from the Epiphyas. Amorbia has at the base of the second abdominal tergite a conspicuous median fovea, but Epiphyas has no such structure. Amorbia lacks ocelli, but ocelli are present on Epiphyas. Amorbia has the discs of the undersides of the hindwings immaculate, but on Epiphyas the undersides of the hindwings are conspicuously multimaculate overall.

Because the larvae and pupae of Amorbia emigratella and Epiphyas postvittana may often be taken together on the same hostplant, and the observer may be confused by them, one should make certain of the identity of the specimens he observes. They are easily distinguished, as follows:

**KEY TO THE LARVAE AND PUPAE OF AMORBIA EMIGRATELLA AND EPIPHYAS POSTVITTANA**

**I. LARVAE**

1. Sternum of the 9th abdominal segment with the V1 setae (the two setae that occur one on either side of the middle), about twice as distant from each other as are the V1 setae of sternite 8; (the three L setae of the 9th abdominal segment form a more or less distinct triangle with L1 obviously cephalad of a line drawn from L2 to L3; side of head with seta A2 much closer to A1 than to
A3, and a line drawn between setae O3 and O2 and extended dorsad passes far caudad of A2 and nearer A3 than A2; these characters may vary); at each side of the pronotal shield there is a conspicuous dark vitta

\textit{Amorbia emigratella} Busck.

2. Ninth abdominal sternum with the V1 setae slightly less distant from each other than are the V1 setae of the 8th sternum, or subequally separated; (the three L setae of the 9th abdominal segment form a nearly straight (but oblique) line with L1 only slightly out of line; side of head with seta A2 more nearly equidistant from A1 and A3, and a line drawn between setae O3 and O2 and extended dorsad passes close to A2; these characters may vary); pronotal shield not bordered by a dark vitta ............ \textit{Epiphyas postvittana} (Walker).

\textbf{II. Pupae}

1. Abdominal tergites 2 to 8 each with a conspicuous, unusual, subbasal pit bordered cephalad and caudad by heavy sclerotizations which form lips overhanging the pits and the sclerotizations are, at least in part, darkened or black ......... \textit{Amorbia emigratella} Busck.

2. Dorsum of abdomen without any pits .................

................. \textit{Epiphyas postvittana} (Walker).
Subfamily OLETHREUTINAE (Hübner) Walsingham

Olethreutinae: Walsingham, 1895: 500, 518, 1897a: 56; 1897b: 121.
Penthinidi Guenée, 1845a: 151.
Spilonotidi Guenée, 1845a: 154.
Grapholithidae Meyrick, 1881a: 413.
Trichophoridae Walsingham, 1895: 517.
Epiblemidae Meyrick, 1895: 453.
Eucosmidae Meyrick, 1907a: 731.

My conclusions regarding the status of the Olethreutinae, and the characteristics which serve to distinguish the group in Hawaii are outlined in the key on p. 402 above and in the notes preceding and following the key. As stated there, Margaret MacKay could not find characters in the larvae to define the Olethreutinae as a subfamily separate from the Tortricinae. The male genitalia are representative, as noted in the quotations above from Heinrich and Clarke, and as an examination of my illustrations will demonstrate.

For an extensively illustrated report on the larvae of many of the North American species, see MacKay, 1959.

KEY TO THE GENERA OF OLETHREUTINAE IN HAWAII

1. Forewing with only 11 veins, vein 7 stalked with 8; hindwing with only 7 veins, vein 5 obsolete; venation as in figure 328. .......................... Eccoptocera.
   Forewing with 12 veins, veins 7 and 8 free from origins; hindwings with all eight veins developed .............. 2
2(1). Hindwing with veins 3 and 4 forking at apex of cell, as in figures 344, 354, 368 .......................... 3
   Hindwings with veins 3 and 4 fused for a distance beyond cell and then forking, as in figures 371, 403, 417 .......................... 6
3(2). Forewing with veins 3 to 7 tending to condense on termen, thus the distance between apices of veins 3 and 7 measured along termen is not greater (usually distinctly less) than the distance between these veins measured at the point of greatest arcuation of vein 7, as in figure 421 .......................... Episimus.
   Forewing with veins 3 and 7 all diverging to termen, thus the distance between the apices of veins 3 and 7 along termen is much greater than the distance between these veins measured at the point of greatest arcuation of vein 7, as in figures 344, 354, 368  ........... 4
4(3). Labial palpi widely expanded by vestiture and terminal segment normally hidden by the shaggy scaling, as in figure 344 .................. **Bactra.**
Labial palpi narrower, terminal segment exposed, as in figures 354, 368 .................. 5

5(4). Undersides of hindwings strongly maculate with many conspicuous dark spots ............ **Cryptophlebia.**
Undersides of hindwings not maculate . **Macraesthetica.**

6(2). Forewings with veins 3, 4, and 5 obviously more widely separated at termen than at origin on cell, venation and head as in figures 371, 399 .................. 7
Forewings with veins 3, 4, and sometimes 5 about as close together on termen as at origin, as in figures 403, 417 ................................. 8

7(6). Hindwings with vein 8 reaching costa at a point far beyond apex of cell and at a point about opposite middle of vein 7, or farther distad; males without a dorsal costal fold or flap on forewing, but most species with a pocket extending from the undersides of the hindwing of the male as illustrated in figures 371–375; antennae of male not “notched” above near base ............................. **Cydia.**
Hindwings with vein 8 reaching costa at a point moderately beyond apex of cell and at a point about opposite the basal one-fourth or less of vein 7; male with a conspicuous dorsal costal fold or flap and without a pocket on the underside of hindwing, as in figure 399; male antenna strongly “notched” on dorsal edge at a point about equal to the diameter of an eye beyond base .......................... **Strepsicrates.**

8(6). **Crocidosema** and **Epinotia.** I have been unable to find reliable external characters to separate both sexes of these two genera which are maintained by various authors on the basis of genital characters. However, the male of our **Epinotia** has a well-developed costal fold, and the chorda is absent; the pecten on the hindwing is weak; the hair-tuft in the posterior axil of the hindwing next to the metathorax (do not confuse hairs on wing membrane) is strongly developed and consists of long, conspicuous, specialized, basally thickened hairs obviously different from those adjacent on the wing membrane, and these hairs have long, somewhat expanded apical
sections (easily broken off). On the males of our *Crocidosema*, however, there is no costal fold, the chorda is present, the hindwing pecten is conspicuous to large and heavy, the hair-tuft in the hindwing axil is inconspicuous and the hairs it bears are not specialized as on *Epinotia*, but are similar to the hairs on the wing membrane between veins 1a and the inner wing margin. Heinrich, in his monograph of the North American olethreutids, separated the two groups on characters of the male genital valvae, but he did not (could not?) give characters for separating the females. To separate the species in Hawaii by the use of the male genitalia, we may use the following summary:

a. Valva with about the apical one-half (cucullus) directed subhorizontally, ectal side of valva with a distinct, submedian, subhorizontal “rib” which may or may not bear one to three long, usually strongly differentiated, conspicuous setae directed ventrad from near its apex (figure 407) ................. **Crocidosema**.

b. Valva with apical one-half or more curved upward and without a “rib” on ectal surface and without any such long spinelike setae (figure 407) ................. **Epinotia**.

**Genus ECCOPTOCERA** Walsingham

*Eccoptocera* Walsingham, 1907b:673. Type-species: *Steganopycha foetorivorans* Butler, by original designation and monotypy.

The loss of a vein in both fore- and hindwings (the wings thus have only 11 and seven veins instead of the normal 12 and eight) will distinguish this endemic genus from all other tortricids in Hawaii. The forking of veins 7 and 8 in the forewing is shared in the Hawaiian tortricids only with *Spheterista* and the female of *Amorbia*. The male has a strong costal fold on the forewing and a narrow vannal fold on the hindwing. Walsingham (1907b:673) stressed the fact that the dorsal side of the male antenna has an “excised notch above beyond the basal joint”. The only other tortricid genus in Hawaii whose male antennae are “notched” is *Strepsicrates*, but its “notch” is about the length of an eye beyond the basal segment.

Much of what Walsingham said about the possible relationships of *Eccoptocera* is meaningless. The genus appears quite similar to the Indo-Pacific *Hermenias* Meyrick, 1911c:225, but *Hermenias* has all wing veins present. *Hermenias* is close to the large and widespread genus *Spilonota* Stephens, 1829 (type-species: *Tortrix ocellana* Denis and Schiffermüller from Europe). Typical *Spilonota* lacks...
an uncus, but *Eccoptocera* has the uncus developed. *Spilonota* supposedly ranges across Eurasia to Japan, and from India to Africa and out through the Pacific to New Zealand and through Fiji and Samoa to southeastern Polynesia. Australia has the largest number of recorded species. Many of the species assigned to *Spilonota* may not belong to it, however. *Spilonota ocellana* (Denis and Schiffmüller), the well-known European pest of apples and some other fruits, has been introduced accidentally to North America.

*Eccoptocera* has remained monotypic in the literature since its description, and considerable confusion exists regarding it. It includes a swarm of closely similar species, and the group appears to be in the process of “flowering”. A second described species is added here by the transfer of a species from “*Epagoge*” where it was erroneously placed by its author. I have examined a number of new species, some of which are illustrated here. Much work remains to be done on *Eccoptocera* for we have hardly begun to study the group.

Species of *Eccoptocera* are, at times, commonly attracted to light, and I found them to be the most abundant tortricids caught in my light trap at Kokee, Kauai in July, 1937.

In addition to the more obvious differences in the color and pattern of the forewings, the legs are variously marked. The genitalia of both sexes reveal characters useful in species differentiation, as the illustrations demonstrate. The females display distinct differences in the ostium and the bursa copulatrix. Some of the differences in the male genitalia are obscured in microscope slide-mounted specimens, and it may be best in the future to preserve the prepared genitalia in tubes of glycerin instead of mounting them on microscope

Figure 328—*Eccoptocera foetidiorans* (Butler). Left, head of the male allotype; Waialua, Oahu. Right, wing venation of the female holotype, Oahu (BM slide 1871). See also figure 329.
slides. The shapes of the apices of the valvae and the dorsal, caudal, and lateral views of the uncus often not only cannot be clearly shown in slide mounts but may, in fact, be distorted or obscured. I discovered this fact after most of the dissections for these studies had been made. The aedeagus contains a large cluster of deciduous spines which may be lost in mated specimens, a characteristic which may be confusing to one unfamiliar with it.

For an illustration of some details of the pupa, see figure 417-A a–c.

See color plate 2, figure 6.

**Figure 329**—Wing venations of *Eccoptocera*. Left, *foetorivorans* (Butler), allotype (BM slide 5198); Waialua, Oahu (genitalia on same slide). Right, *osteomelesana* (Swezey), Wailupe Valley, Oahu (slide Z–VI–27–61–A); the crossvein at cell apex is obsolete. Note the different positions of veins 10 and 11 in the forewings in relation to the origin of vein 2.

**Eccoptocera foetorivorans** (Butler) (figs. 328, head, female wing venation; 329, male wing venation; 330, antennal base; 331a–c, 332a–c, male genitalia; 333, moths; 340, female genitalia).

*Steganoptycha foetorivorans* Butler, 1881:394.

*Eccoptocera foetorivorans* (Butler) Walsingham, 1907b:674, 735, pl. 10, figs. 12, 13, 14.

Endemic. Kauai?, Oahu (type locality: “Mountains of Oahu”; the holotype bears the Blackburn code data “Hawaiian Islands 81.7 66”), Molokai?, Maui?, Lanai?, Hawaii?

**Figure 330**—Basal parts of the male antenna of *Eccoptocera foetorivorans* (Butler); northwest Koolau Mts., Oahu.
Figure 331—Details of the male genitalia of *Eccoptocera* drawn in glycerin and all to the same scale. 
*a, b, c, foetorivorans* (Butler), allotype (BM slide 5198); Waialua, Oahu: 
*a*, lateral aspect of aedeagus with a different view of its apex at *b*; 
*c*, ectal aspect of the apical part of the right valva. 
*d, e*, new greyish species 2; mountains near Honolulu, 2,000 feet (BM slide 14278): 
*d*, lateral aspect of aedeagus of a mated male which has lost the deciduous cornuti; 
*e*, ectal aspect of the distal part of the right valva. See figure 332 for other drawings of these specimens.

Figure 332—Details of *Eccoptocera* male genitalia. 
*a, b, foetorivorans* (Butler), allotype (BM slide 5198); Waialua, Oahu: 
*a*, dorsal aspect of tegumen and uncus; 
*b*, caudal aspect of apex of uncus; 
*c*, lateral aspect of part of tegumen, socius ("S"), and uncus of another specimen of *foetorivorans* from the northwest Koolau Mts., Oahu (BM slide 14284). 
*d, e, new grey species 2*: 
*d*, dorsal aspect of tegumen and uncus; 
*e*, caudal aspect of apex of uncus; 
*f*, lateral aspect of part of the tegumen, socius, and uncus (*d* and *e*, from a specimen from mountains near Honolulu, 2,000 feet, BM slide 14278; 
*f*, from a specimen from the northwest Koolau Mts., Oahu, BM slide 14286). All specimens drawn to the same scale from specimens in glycerin as are other sketches in figure 331, which see. Allowance should be made for some variation in shape according to the position from which the objects are viewed as well as some individual variation.
Hostplants: *Cheirodendron*, *Metrosideros* (preferred host), *Psidium guajava* (guava), *Syzygium sandwicensis*. These hostplant records may apply to several species of *Eccoptocera*, and the true host range of *foetorivorans* remains to be determined.

**Parasite:** *Pristomerus hawaiiensis* Perkins.

**Predator:** *Odynerus* species.

The larvae feed amongst webbed-together leaves. Blackburn, who first collected the species, wrote in his field notes (as quoted by Butler, 1881:395) “Occasionally taken by beating; also bred from a larva spinning together leaves of a tree unknown to me by name. The tree in question superficially resembles box; but the leaves are somewhat larger, and have a strong, rather unpleasant scent.”

Walsingham, who had 70 specimens of *Eccoptocera* before him when he prepared the Fauna Hawaiiensis monograph, said that “this is a most variable species, but . . . I cannot regard any of the numerous forms included in Mr Perkins’ various consignments as entitled to special distinction.” After more detailed study, I have found that several species have been confused under the one name *foetorivorans*. I have not had an opportunity to make a detailed study of specimens from all of the islands from which the genus has been reported, but I have found that some of the specimens collected on islands other than Oahu are new species. Moreover, more species than *foetorivorans* occur on Oahu. I have, therefore, questioned all locality records other than Oahu pending confirmation that the species occurs on the other islands. It may be that *foetorivorans* does range over several of the islands, but its distribution remains to be determined. Several species occur on some islands. Perkins said (1913:clxvii) “The single species of *Eccoptocera* is one of the commonest of Hawaiian moths and is extremely variable. It is especially attached to *Metrosiderus* [sic], and its caterpillars are much sought after by the wasps of the genus *Odynerus*. There is no reason to doubt its endemicity.” Perkins, as other authors, confused several species under one name.

I have designated as allotype male a specimen in the British Museum bearing the label data “Waialua Oahu Hawaiian Is. V. 1901 Perkins 29192”, and the right wings and the genitalia are on slide BM 5198. I have illustrated its wing venation and the genitalia. Because the female holotype is not a good specimen and because it would not make a good photograph, I have not included an illustration of it as a whole moth. I have, instead, included a photograph of another specimen whose markings are closely similar to those of the holotype.

The pair mentioned by Walsingham (1907b:674) as having been taken “in cop.” are specimens of a pale form which has no bold markings, and they represent a new species. They are briefly described under “*Eccoptocera* new species 2.”
**Eccoptocera osteomelesana** (Swezey), **new combination** (figs. 329, wing venation; 337, male genitalia; 341, moth, female genitalia).

*Epagoge osteomelesana* Swezey, 1946:626.

This moth was described from an unique female, but J. W. Beardsley has caught a number of specimens in light traps in recent years. It is the smallest species of *Eccoptocera* I have seen.

**Eccoptocera new species 1** (fig. 334, moth).

*Eccoptocera* species formerly confused with *foetorivorans*.

Endemic. Kauai (Kaholuamano). Hostplant: unknown. This is a greyish species.

**Eccoptocera new species 2** (figs. 331d, e, 332d–f, male genitalia; 334, moth; 318 male abdomen; 342–343, female genitalia).

*Eccoptocera* species formerly confused with *foetorivorans*. Male genitalia slides BM 5197, 14279, 14286; female genitalia, BM 14280.

Endemic. Oahu (Koolau Mts., near Honolulu, 2,000 feet). Hostplant: unknown. This is another greyish species.

**Eccoptocera new species 3** (figs. 334, moth; 342–343, female genitalia).

*Eccoptocera* species formerly confused with *foetorivorans*. Female genitalia on slide BM 14285.

Endemic. Oahu (northwest Koolau Mts.). Hostplant: unknown. This is a boldly marked species.

**Eccoptocera new species 4** (figs. 335, moth; 337, male genitalia, abdomen).

*Eccoptocera* species formerly confused with *foetorivorans*. Male genitalia on slide BM 14283.

Endemic. Maui (Haleakala, 5,000 feet). Hostplant: unknown. This is a dark colored species.
**Eccoptocera new species 5** (fig. 339, male genitalia).
*Eccoptocera* species formerly confused with *foetorivorans*. Male genitalia on slide Z-I-16-65-C.

Endemic. Maui (Haleakala, 5,000 feet).
Hostplant: unknown.
This is a mostly dark maculate species with a partly pale posterior forewing margin.

**Eccoptocera new species 6** (figs. 335, moth; 342–343, female genitalia).
*Eccoptocera* species formerly confused with *foetorivorans*. Female genitalia on slide BM 14282.

Endemic. Hawaii (Kona).
Hostplant: unknown.
This is a mostly dark species.

**Eccoptocera new species 7** (fig. 338, male genitalia).
*Eccoptocera* species formerly confused with *foetorivorans*. Male genitalia on slide Z-I-16-65-A.

Endemic. Hawaii (Olaa).
Hostplant: unknown.
This is a mostly brownish species.

**Eccoptocera new species 8** (fig. 335, moth).
*Eccoptocera* species formerly confused with *foetorivorans*. Male genitalia on slide BM 14281.

Endemic. Hawaii (Kilauea).
Hostplant: unknown.
This is a grey species.

**Eccoptocera new species 9** (fig. 339, male genitalia).
*Eccoptocera* species formerly confused with *foetorivorans*. Male genitalia on slides BM 1870, Z-I-16-65-B.

Endemic. Kauai (Kaholuamano).
Hostplant: unknown.
This is a boldly marked species rather similar to new species 3 from Oahu.
Figure 333—Eccoptocera foetorivorans (Butler). Top, male, Kukuiala Valley, Oahu; ex "ohia ha"; forewing 7 mm. Middle, another male of the same species; northeast Koolau Mts., Oahu; expanse 15 mm. (BM slide 14284); see the drawing of the uncus of this specimen. Bottom, a female closely similar to the holotype; northwest Koolau Mts., Oahu (Walsingham specimen 28930); abdomen lost. Note the strong costal folds on the forewings of the males.
Figure 334—*Eccoptocera*. Top, new species 3 (female genitalia figured here, BM slide 14285); northwest Koolau Mts., Oahu; expanse 17 mm. Middle, new species 2, male (BM slide 5197); northwest Koolau Mts., Oahu; expanse 13.5 mm. Bottom, new species 1, female (abdomen lost; Walsingham specimen 27732); Kaholuamano, Kauai; expanse 17 mm.
Figure 335—Eccoptocera. Top, new species 4, male (BM genitalia figured here; BM slide 14283; Haleakala, 5,000 feet, Maui; expanse 15 mm. Middle, new species 8, male (BM slide 14281); Kilauea, Hawaii; expanse 14 mm., as set. This specimen is figured in Fauna Hawaiiensis. Bottom, new species 6, female (genitalia figured here, BM slide 14292); Kona, Hawaii; expanse 13 mm.
Figure 336—Eccoptocera. Top, male genitalia of foetorivorans (Butler), allotype (BM slide 5199); Waialua, Oahu; caudal part of the abdominal pelt of the same at lower left. Bottom, the same of new species 2 (BM slide 14279); mountains near Honolulu, 2,000 feet; see figure 338 for the genitalia of this specimen.
Figure 337—Male Eceoptocera. Top and middle, new species 4 (BM slide 14283); Haleakala, 5,000 feet, Maui; the dark-colored moth is illustrated on figure 335. Bottom, osteomelesana (Swezey); Wailupe Valley, Oahu (slide Z−VI−24−61). Comparison will show the aedeagus and uncus of this species to differ from the other species.
Figure 338—Male genitalia of *Ecoptocera*. Top, new grey species 2; mountains near Honolulu (BM slide 14279); see abdomen on figure 336. Middle, the same species from a specimen from the northwest Koolau Mts., Oahu (BM slide 14286). Bottom, brownish new species 7; Olaa, Hawaii (slide Z–I–16–63–A).
Figure 339—Male genitalia of *Eccoptocera*. Top, new species 9; Kaholuamano, Kauai (BM slide 1870). Middle, the same species from the same locality (slide Z-1-16-65-8). Forewing darkly maculate with a mostly pale posterior part. Bottom, new species 5; Haleakala, 5,000 feet, Maui (slide Z-1-16-65-C; Walsingham specimen 28177, in the Bishop Museum); possibly the same as new species 4 illustrated in figure 335, top. The aedeagi of these species are quite distinct from that of *foetorivorans*. 
Figure 340—Genitalia of the female holotype of *Eccoptocera foetirvorans* (Butler) (BM slide 1871); mountains of Oahu ("Hawaiian Islands 81.7 66", Blackburn).
Figure 341—Details of the female holotype of Eccoptocera osteomelesana (Swezey) (slide Z-V-5-61); Manoa, Oahu; forewing length 4 mm.
Figure 342—Female genitalia of *Eccoptocera*. Top left, new species 3 (BM slide 14285; Walsingham specimen 29066), a boldly maculate species; northwest Koolau Mts., Oahu; moth illustrated in figure 334. Top right, new grey species 2 (BM slide 14290; Walsingham specimen 28906); northwest Koolau Mts., Oahu; moth illustrated in figure 334; note the strong transverse plate at the base of the posterior signum. Bottom, new dark species 6 (BM slide 14282; Walsingham specimen 25261); Kona, Hawaii; moth illustrated in figure 335. Note the differences in the signa.
Figure 343—Ec Hippocera. Enlargements of the female genital ostia of the specimens shown in the preceding figure. Top left, new species 3 (BM slide 14285). Top right, new species 2 (BM slide 14280). Bottom, new species 6 (BM slide 14282). See figure 342 for other data.
Genus **BACTRA** Stephens


*Bactra* is a genus of many species, and it is nearly worldwide in tropical and subtropical regions. Diakonoff has written extensively on the genus in recent years, and he has brought considerable order out of chaos. His papers should be consulted for detailed discussions. He has divided the genus into a number of subgenera which are based upon characters of the male genitalia. The largest and most widespread subgenus is *Chiloides* (Butler).

**Subgenus CHILOIDES** (Butler)


Diakonoff, 1963: 287, defines this subgenus as *Bactra* whose male genitalia have “a well-developed, clavate and coronate valvula present between cucullus and sacculus” and “cucullus diversely shaped [but not short and broad], usually elongate, not sclerotized, always with normal spines and bristles.”

The two species in Hawaii are externally similar in appearance, and each is so extremely variable that I have been unable to prepare a satisfactory key to them based upon external characters. An examination of the illustrations, however, will demonstrate that the species may be distinguished easily by the many differences in genitalia. Most parts of the male genitalia are distinctive, and attention is directed to the very different signa of the female bursa copulatrix as well as to the region of the ostium.

*Bactra* (*Chiloides*) *straminea* (Butler) (figs. 344, head, wing venation; 347, moths; 348, 350, male genitalia; 349, 351, female genitalia; 353, larva of another species for comparison).


*Bactra* *iomolybda* Meyrick, 1932: 224. Synonymy by Diakonoff, 1959a: 183, pl. 1, fig. 2, who gave it the status of *Bactra* (*Chiloides*) *straminea* male forma *iomolybda*.

Kauai, Oahu (type locality: salt marshes near Honolulu [now destroyed by landfill and covered by the city of Honolulu]), Molokai, Maui, Lanai, Hawaii (type locality of *iomolybda* Meyrick: Kilauea). Immigrant? Source not determined, but Indo-Pacific or Palaeartic; possibly a natural immigrant in recent geologic time and possibly endemic.
Meyrick (1885:142) recorded it from New Zealand, but this was a misidentification of *Bactra noteraula* Walsingham, as noted by Meyrick (1892d [1891]:217) and Walsingham (1907b:689). Meyrick determined material from Fiji as *Bactra iomolybda*, but this record also is based upon a misidentification. [Since I wrote this, the Fijian form has been described as *Bactra (Chiloides) cerata insularis* Diakonoff, 1964:49.]

Hostplants: *Carex*, *Cladium angustifolium*, *Scirpus maritimus*. The larvae bore in the stems of these sedges.


This species, or complex, is extraordinarily variable in color, pattern, size, and even in genitalia. Diakonoff (1956a:26) said that it was the most variable of all the many species of *Bactra* known to him and he considers it to be most similar to the Palaearctic *Bactra robustana*. Could it be that this species is in the early stages of explosive evolution in Hawaii? I am not completely satisfied with the conclusion that we are concerned here with one form only. Perkins (1913:clxviii) said that "*Bactra straminea* is a very widely distributed species in the islands and extremely variable, examples differing greatly in size and pattern. Probably several species are really included under this name, for we have observed scores of specimens in some localities, without remarking any special variability. If there is only one species, then the variation is to a large extent local or racial. Melanochroic forms occur and these are sometimes of gigantic size. In some varieties there is constant and conspicuous sexual dimorphism."

Figure 344—Head and wing venation of *Bactra straminea* (Butler); Hawaiian specimens (BM slide 3848). These specimens were labeled "cotype" in the old sense of meaning "similar to the type", but they are not members of the type-series.
Some workers in the past have found difficulty separating this species from the European type of the genus, *lanceolana* Hübner. It superficially resembles *lanceolana*, but the genitalia are distinctive. Walsingham (1907b:688) believed that it might be considered a "geographical and local race", and he said: "After examining a very long series of this species I find I can separate it from *lanceolana*, Hb., by one character only, viz., the comparative length of the palpi which in the European species are distinctly shorter. In all other respects the numerous varieties found in both regions can be absolutely matched." He noted further that "Butler called attention to the 'separate emission of the second and third median branches' of the hindwings, this observation applies equally to very numerous specimens of our common *Bactra lanceolana* although not to all, and in the Hawaiian series exactly similar specimens from the same locality taken on the same day vary in this particular." Had Walsingham examined the genitalia, which were ignored in his work, he would have noted major differences between the species.

In 1958, when we were both at the British Museum, Diakonoff and I studied the type material of *straminea* and *iomolybda* and concluded that they were probably the same species. In 1959a:183, Diakonoff summarized the details as follows:

A comparison of the genitalia of the type specimen and close study of further material at the British Museum revealed that *Bactra iomolybda* Meyrick is only a synonym of *straminea* Butler. The only slight differences between the types which is traceable is a transverse series of additional moderate spines across the inner side of the disc of the saucculus [sacculus], running beside and parallel to the base of the median coronate appendage of the valva (valvula) . . . . This difference, however, is very slight and occurs in several male specimens from Hawaii studied by me.

Figure 345—Wing venation of *Bactra venosana* (Zeller); a male from Lihue, Kauai (BM slide 5429).
**Bactra (Chiloides) venosana** (Zeller) (figs. 345, wing venation; 346, pupa; 347 moth; 348, male genitalia; 349, female genitalia; 350, male genitalia; 352, female genitalia; 353, larva of another species for comparison).

*Phoxopteris venosana* Zeller, 1847:738.


*Bactra venosana* (Zeller) Rebel, in Staudinger and Rebel, 1901:113.

*Bactra (Chiloides) venosana* (Zeller) Diakonoff, 1956a:33, figs. 31–33.


*Bactra (Chiloides) truculenta* Meyrick, Diakonoff, 1956a:27, figs. 28–30; 1956b:147; 1959a:184, fig. 4; 1963:331 (synonymy); 1968 (1967):64, fig. 536.


The nutsedge (nutgrass) borer.

Kauai, Oahu, Molokai, Maui, Lanai, Hawaii.

Introduced from the Philippines in 1925 by Pemberton and first released in Hawaii on the grounds of the Experiment Station, Hawaiian Sugar Planters' Association, in Honolulu. The type locality of *venosana* is Sicily, and *truculenta* was described from Coorg, 3,500 feet, India. The moth is widely distributed from southern Europe, North Africa, and Asia Minor to India, Ceylon, South China, Malaya, Australia and into many Pacific islands including Java, Borneo, the Philippines, Formosa, Timor, Solomon, Caroline, Fiji, and others. “This is the most common species of *Bactra* in the eastern part of South Asia.” (Diakonoff, 1956a:31).

Hostplants: *Cyperus rotundus* (nutsedge, nutgrass), *Kyllingia brevifolia*, *Kyllingia monocephala*.

Parasites: *Chelonus blackburni* Cameron, *Eriborus* species, *Trathala flavo-orbitalis* (Cameron), *Trichogramma minutum* Riley (often over 90 percent parasitism of the eggs).

I have compared Hawaiian specimens, including the genitalia, with the lectotype of *truculenta* in the British Museum, and they agree perfectly. After detailed study, Diakonoff has concluded that *truculenta* is a synonym of *venosana*.

This is one of the insects purposely introduced by the entomologists of the Hawaiian Sugar Planters' Association Experiment Station to aid in the fight against the nutsedge (nutgrass) weed pest. Specimens were first brought to Honolulu in 1922 by F. X. Williams for experimentation, but the moth was not released at that time. In 1925, C. E. Pemberton brought in another culture which was released and quickly became established. Subsequently, cultures were sent to the outer islands. For a few years after its introduction, the moth became very common, and its work on nutsedge was conspicuous.
In some areas nearly 100 percent of the nutsedge was attacked by the larvae.

F. X. Williams (1931:311), in quoting from his report on the activities of the moth on Maui in 1929, said “Brown patches of nutgrass showed the good work of Bactra, which was extraordinarily numerous, for its pupal shells, sometimes averaging more than one per square inch of ground, could be seen protruding from the base of the plants or from the soil... The nutgrass, of course, is not being extirpated here; very often the plant is killed, sometimes new shoots appear from the basal bulb, while the ‘nut,’ deeper in the ground is unharmed. However, the growth subsequent to the attack is comparatively sparse and the work of the Bactra caterpillar may be said to substitute in some measure, the process of hoeing and has proved useful beyond expectation.”

Most unfortunately, parasitism by Trichogramma gradually became greater and greater, and finally such a high percentage of the moth eggs were destroyed.

Figure 346—Pupa of Bactra venosana (Zeller). Honolulu; ex nut grass; length 8.5 mm. A sketch of the cauda in left lateral aspect is inserted. The setae are very short, inconspicuous, and they are mostly omitted from the drawings. A, antenna; C2, mesocoxa; fl, profemora; lb, labrum; l1, l2, l3, legs; mx, galea of maxilla (proboscis); W2, hindwing.
Figure 347—Bactra (Chilodes). Top, straminea (Butler), from the lectotype male of the synonym iomolybda Meyrick (BM slide 9545 Clarke); Kilauea, Hawaii; expanse 14.5 mm. Middle, straminea (Butler), holotype male (abdomen lost); Honolulu; expanse 18 mm. Bottom, venosana (Zeller); Honolulu; ex nutgrass; expanse 16.5 mm.
Figure 348—Male genitalia of Bactra. Left, straminea (Butler). Right, venosana (Zeller) with the left valva of another specimen below to show variation. (Drawings loaned by A. Diakonoff.)

Figure 349—Female genitalia of Bactra. Left, venosana (Zeller). Right, straminea (Butler). (Drawings loaned by A. Diakonoff.)
Figure 350—Male genitalia of Bactra. Top, *straminea* (Butler), from the lectotype of the synonym *iomolybda* Meyrick (BM slide 9545 Clarke); Kilauea, Hawaii. Middle, *straminea* (Butler) (BM slide 3848); mountains near Honolulu, 2,000 feet; from the specimen illustrated in *Fauna Hawaiiensis* and photographed at a different focal level from the top figure. Bottom, *venosana* (Zeller) (BM slide 5429); Lihue, Kauai; aedeagus in situ.
by the parasite that the effectiveness of the moth in the control of nutgrass was greatly reduced. On occasion, 100 percent of the egg clusters of the moth are parasitised. Because of this parasitism, the moth today is unable to contribute much to the control of the weed pest. Poinar (1964:418) said that “parasitized eggs appear totally black to the naked eye, in contrast to the yellow color of unparasitized eggs. The color appears to be due to a darkening of the inside of the chorion and not to the body of the parasite itself.”

Dr. Williams stated further (1931:309, figs. 141–143) that:

It is a very active insect that, when disturbed from the herbage, dashes off in a short low flight, then alighting, wraps its wings about the body and remains quiet and usually unseen. The female lays a number of flat oval eggs measuring about 0.60 by 0.90 mm., in the midrib groove of the upper side of a nutgrass leaf, arranging them in a single line of from two or three to perhaps twenty slightly overlapping eggs; these are in part sculptured with a delicate network of raised lines; at first they are pale green but darken and become blackish when it is time for them to hatch. They hatch in 3 or 4 days. The young were observed not to eat the egg shells; they immediately enter the central leaf bundle and tunnel the stem and, in many cases, destroy the bulb, which may be borered [sic] from top to bottom. The affected plant first shows a withering of inner leaves, which become yellow and finally die, causing ‘deadheart’, the whole plant eventually succumbing. The freshly hatched young is pale, glassy yellowish, excepting that the head is
shining black, the prothoracic shield nearly black and the rest of the prothorax permeated with pinkish.
The full-fed caterpillar is a half-inch or more in length, when it may be green or pale yellowish. It spins
a tube of silk in the stem and in this cocoon sheds its skin to turn into a pupa about 5 to 7 mm. in length.
At the end of a few days the pupa, by means of some backward-pointing spines on the abdomen, which it
now moves actively, works its way out of the cocoon and, pushing itself part way through a specially made
hole in the Cyperus stem, splits at the fore end and liberates the moth. Mr. Swezey who reared an adult
to maturity found the caterpillar stage to be less than 25 days, and the time from the hatching of the eggs
to disclosing the moth occupied 31 days. In another case approximately 38 days were required for the
transformation. We have found that only one borer matures in a single stem.

Figure 352—Bactra venosana (Zeller), female genitalia (BM slide 7548); Kaiva, Dakar, Africa.

Figure 353—Details of the larva of Bactra verutana (Zeller), or a closely allied species. This American (?)
species does not occur in Hawaii. Because of the lack of a similar plate of details for the Hawaiian species,
however, this illustration is reproduced for comparative purposes and should assist in the separation of
larvae of the Hawaiian members of the genus from the larvae of other genera. Diakonoff places the species

a, setal map of the pro- and mesothorax and abdominal segments 1, 2, 6, and 7; b, the same of abdominal
segments 8 and 9; c, dorsal setae, pinacula, and dermal spinules of an anterior abdominal tergite; d, crochets
of a mid-abdominal and an anal proleg; e, dorsal aspect of abdominal segments 8, 9, and 10; f, spinneret
and labial palpi; g, ocellar area of the left side of the head; h, V1 setae on the midline of abdominal sternites
7, 8, and 9; i, lateral aspect of a thoracic leg; j, prothoracic shield; k, frontal aspect of the head. (Plate
loaned by Magaret MacKay.)
Figure 353—See page 558 for legend.
Poinar (1964:418) found that under laboratory conditions and at about an average of 75°F as many as 130 eggs were laid by one female and the incubation period was from 5.5 to 6.0 days. "The eggs are white when first laid, and the embryo can be distinguished after two to three days. The eyes are visible after three to four days and the internal organs in five to six days. At the time of hatch, the larva is pale yellow with a black prothoracic shield and head capsule." He found the larval period to range from 18 to 20 days, the pupal period about 7 days and the females were able to oviposit in about 2 days after emergence.

Genus **CRYPTOPHLEBIA** Walsingham  
*Pogonozada* Hampson, 1905a:586. Type-species: *Pogonozada distorta* Hampson (from China).  

![Image of Cryptoplebia illepida](image_url)

Figure 354—*Cryptoplebia illepida* (Butler). Head of a female ("cenotype") from the Waianae Mts., Oahu. Wing venation of a female ("homotype"; BM slide 1889); Waianae Mts., 2,000 to 3,000 feet, Oahu. The hindwing of the male has a conspicuous, irregularly formed "sex patch" on the underside of the hindwing beneath the distal parts of veins 1a and 1b which contains a large mass of peculiarly modified squamae.
Meyrick erroneously referred the Hawaiian species to the genus *Argyroplece*, a course also followed by T. B. Fletcher, and in Hawaiian literature the species are found under both generic names. Bradley (1952) and Diakonoff (1957a) have done much to clarify many problems in the genus, and they have laid a firm base for future work on *Cryptophlebia*.

Figure 355—*Cryptophlebia*. Ental aspects of the hindlegs of males to show the differences in structure. Top, *ombrodelta* (Lower); Java. Bottom, *illepida* (Butler); Honolulu; ex stem of *Acacia farnesiana*.
Figure 356—Cryptophlebia. Top, illepida (Butler), holotype male (abdomen lost); near Honolulu; forewing 7.5 mm. Bottom, the color form "fulva" Walsingham, holotype male (BM slide 1890); Kona, 4,000 feet, Hawaii; expanse 11 mm.
MacKay (1959:79) noted the close similarity between the larvae of Cryptophlebia, Pseudogalleria Ragonot, and Ecdytolopha Zeller (= Gymnandrosoma Dyar, synonymy by Diakonoff, 1957a:132), and her discoveries support the conclusions reached by Diakonoff (1957a) from his studies of the moths. *Cryptophlebia* is widespread from Africa and Madagascar through the Oriental Region and out through the islands of the Pacific as far as the Mar-

Figure 357—*Cryptophlebia illepsida* (Butler), color forms. Top, a male from Honolulu; expanse 17.5 mm. Bottom, a female from Honolulu; expanse 21 mm.
Figure 358—Cryptophlebia illepida (Butler), synonymous color forms. Top, "suffusa" Walsingham, holotype male (BM slide 1891); Kona, 4,000 feet, Hawaii; expanse 20 mm. Middle, "tetrao" Walsingham, holotype male; Kona, 3,500 feet, Hawaii; expanse 14 mm. Bottom, "vulpes" Walsingham, holotype male (BM slide 2565); Kilauea, Hawaii; forewing 5 mm.
Figure 359—*Cryptophlebia ombrodela* (Lower). Top, a male from Buitenzorg, Java; expanse 19 mm. This shows the large scale and hair tufts on the metatibia and tarsus, but this dorsal view does not show the huge mass to best advantage. See the separate enlargement in figure 355. Bottom, a female from Queensland, Australia; expanse 19.5 mm.
quesas. There are more than 25 species; the greatest concentration of species is in the Indo-Pacific area. Four or more species occur in Fiji. A single species (*carphophagoides* Clarke, 1951) has been described from Argentina, but there is reason to suspect that it is not a native of that country. *Cryptophlebia* includes several species of economic importance.

Externally, there are not many striking features to separate this group from most other Hawaiian olethreutids; the male genitalia are very distinctive, however, and they do serve easily to separate the genus from all others in Hawaii.

Diakonoff (1957a: 136–142) split *Cryptophlebia* into two subgenera: *Cryptophlebia*, sensu stricto, and *Phanerophlebia* Diakonoff (from Indonesia). Only *Cryptophlebia*, sensu stricto, is represented in Hawaii. The two subgenera, as defined by Diakonoff, may be distinguished as follows:

1. Valva of male genitalia with a stout, toothlike projection from the lower margin near the apex of sacculus; maculations of male forewing ill-defined, consisting of a pattern of small strigulae, distinctly maculate in female, and coloring pale tawny without any violet. ...........

   Phanerophlebia.

2. Valva lacking a tooth on ventral margin near apex of sacculus; maculations of forewings strongly marked in both sexes and of the ombrodelta type and the coloring more or less dark brownish violet. ........ Cryptophlebia.

Subgenus **CRYPTOPHLEBIA** Walsingham, Diakonoff

*Cryptophlebia* subgenus *Cryptophlebia* Walsingham, Diakonoff, 1957a:138. Type-species: *Cryptophlebia ombrodelta* (Lower).

**KEY TO THE SPECIES OF CRYPTOPHLEBIA IN HAWAII**

1. Male: metatibia and first metatarsal segment with the large tufts of hair mostly ochreous (but some scales usually apically dark and some specimens might be confused with ombrodelta); inner surface of metatibia with a differentiated mass of erect setae but no bare area (figure 355); distal part of genital valva with two long, heavy spurs and many shorter spines distad of these around the apical margin of the valva. Female: genitalia as illustrated (note especially the differences in the ostium) (figure 362). ........ igelepid (Butler).

2. Male: metatibia and first metatarsal segment with the large tufts of hair mostly distally fuscous or dark and iridescent; metatibia with a large, conspicuous, ovate, mostly bare, concave area on inner side (figure 355);
distal part of genital valva with three long, heavy spurs placed in a subapical triangle and with few or no shorter stout spines distad of these. Female: genitalia as in figure 363. .............. **ombrodelta** (Lower).

The dorsum of the abdomen of the male of *ombrodelta* is clothed with much more long wooly hair than is that of *illepida*.

**Cryptophlebia illepida** (Butler) (figs. 354, head, wing venation; 355, male metatibia; 356–358, moths; 360–361, male genitalia; 362, female genitalia; 364, pupa; 366, larva, pupa; 367, larval damage).

*Teras illepida* Butler, 1882: 42.

**Cryptophlebia illepida illepida** (Butler) Walsingham, 1907b:681, pl. 10, fig. 23.

**Cryptophlebia illepida illepida** variety *fulva* Walsingham, 1907b:681, pl. 10, fig. 24.


**Cryptophlebia illepida illepida** variety *suffusa* Walsingham, 1907b:682, pl. 10, fig. 25.


**Cryptophlebia vulpes** Walsingham, 1907b:683, pl. 10, fig. 27. Synonymy by Zimmerman, in Swezey and Zimmerman, 1946:631.


**Cryptophlebia illepida** (Butler), Bradley, 1952:684, fig. 1, male genitalia; pl. 24, fig. 3, adult female; pl. 25, figs. 3, 3a, female genitalia.

Namba, 1957:284, fig. 1, biology.

The koa seedworm (also called: klu tortricid, koa seed moth, litchi borer, litchi moth, macadamia nut borer, or macadamia nut moth).

Kauai, Oahu (type locality: “In the neighborhood of Honolulu”; the holotype bears the following Blackburn label: “Hawaiian Isln. 82.9 99”), Molokai, Maui, Lanai, Hawaii.

Immigrant? Although, to my knowledge, this species has not been found outside of Hawaii, it appears to be an immigrant. Perkins considered it to be an immigrant. Records for the species from outside of Hawaii, such as that by T. Bainbridge Fletcher (1921 [1920]:55, for example) are erroneous and are based upon misidentifications. The situation regarding the immigrant or endemic status of this moth is comparable with that of *Bactra straminea* discussed above, and it is possible that *Cryptophlebia illepida* is a native insect which reached Hawaii in recent geologic time and is in the preliminary stages of evolving new endemic Hawaiian forms. The species appears not far removed from such forms as the widespread *ombrodelta*.


In some earlier literature, *Cryptophlebia ombrodelta* (Lower) and *Cryptophlebia carpophaga* Walsingham have been listed as synonyms of this species. However, Dr. Swezey and I demonstrated (1946) that *illepida* and *ombrodelta* are distinct species, and Bradley (1952) has shown that *carpophaga* is the same as *ombrodelta*.

This is a common, widespread, extremely variable species. Its variability led Walsingham to describe two "varieties" and two "species" as new in *Fauna Hawaiiensis*. It is possible that, had more examples been available to Walsingham, he would have described additional forms. I have found a wing expanse range of from 12 to 25 mm., and the great variability in color, pattern, and size may easily lead to confusion. The genitalia, however, display good characters which make positive identification in Hawaii easy. A study of the variations of the moth is desirable.

The larvae are particularly fond of the developing seeds of *Acacia* and destroy large numbers of them. Each larva may eat several seeds and may leave one seed pod and enter another. In addition to feeding on the seeds, the larvae also feed upon the pulp of the pods. Seed production in Hawaiian endemic acacias is considerably reduced by the attacks of this species, and it is sometimes difficult to obtain good seeds for reforestation projects following the depredations of the larvae. Dr. Swezey (1919:102–105, figs. 1–6) examined 200 pods of *Acacia koa* from a hill above Honolulu, and he found all 473 seeds contained in these pods destroyed. He said that the "trees everywhere blossom profusely, but the growing pods are attacked by the larvae of four different species of Tortricid moths (*Adenoneura rufipennis*, *Enarmonia walsinghami*, *Cryptophlebia vulpes* and *C. illepida*). The larvae of these moths devour the young growing seeds, traveling from one to another in order to obtain a sufficiency for their nourishment and growth. Sometimes they reach the neighboring seeds of the same pod at the place where a seed has been eaten, proceed to the position of another seed, and then burrow to reach it. Several seeds may be eaten by one larva, the number depending on the size of the growing seeds at the time." The larvae also feed in mango pulp, litchi fruits, and on many other hosts, and the species is the most important pest of macadamia nuts in Hawaii (see Namba, 1957:284). When feeding upon macadamia fruits, the larvae usually damage only the husks, but their attacks may prevent normal development of the nuts or may permit other organisms to enter through the husk and destroy the kernels. Attacked fruits may produce malformed or undersized nuts. Namba found as many as seven larvae in a single macadamia fruit.

It is possible that some of the records for this species in Hawaii are in error and really refer to the more recently established *Cryptophlebia ombrodelta*. 
Dr. Swezey (1908:14), who reported upon the immature stages and habits, described the egg, larva, and pupa. His descriptions have been mostly replaced by the modern work of Namba (1957:284) who discussed the biology and gave a more accurate and extensive description and figures of the larva and pupa. Namba discussed the species in relation to macadamia nut culture. The following details are abstracted and modified from his report. The flat, circular or oval eggs are 0.8 mm. long and have a finely reticulated shell. They are white or ivory when first laid, but after the first day red maculations appear which grow more extensive and then disappear before the eggs hatch. They are laid on the surface of the host fruit, and several may be laid together, in which case they are slightly imbricated. The incubation period of the egg is three to five days. There are five larval instars which occupy 8 to 34 days, with an average of about 16 days. The larvae are whitish and often have a pink tinge. The pupal period ranges from 8 to 12 days. Thus, the egg-to-adult cycle may occupy between 19 and 51 days. Namba found that as many as 367 eggs are laid by a single female, and as many as 128 eggs are laid in one day by one individual. He also reported that mature females lay fertile eggs the same day that they are mated; that only males more than two days old are able to fertilize females; that some females lay fertile eggs up to four days after contact with males; that oviposition, once begun, usually occurs daily; and that the oldest female to oviposit was 11 days old.

I have included Namba's illustrations of the larva and pupa. The reader is referred to his 1957 paper for detailed description. Margaret MacKay (1959:81) gave a brief summary of characters of the larva of some specimens from macadamia nuts from Honolulu which she had examined, and there are certain details which do not agree with Namba's descriptive notes. These may reflect differences of interpretation and descriptive method. Miss MacKay's diagnosis (1959:81) is as follows: length 13 to 14 mm., "spiracle apparently oval; V1s on segment 9 slightly farther apart than or twice as far apart as those on segment 8; SV group on segments 1, 2, and 7 usually 3:3:3 and on 9 a single seta; D2s on segment 8 with no tendency to be either closer together or farther apart than D1s; anal fork absent; crotchets numerous, biordinal or even triordinal, noticeably short laterally on the ventral prolegs, even forming a mesal penellipse on some of the prolegs."

Miss MacKay said that the larva of Cryptophlebia ombrodelta had "characters as for C. illepida Btlr. but indications of an anal fork on some of the specimens."

Namba reported that the pupa has two transverse rows of stout spines on the dorsal tergites of abdominal segments 2 to 7 and that the spines of the anterior rows are larger than those of the posterior rows of each pair. This is an opposite arrangement to that found on some genera where the spines on the caudal row in each pair are the larger. The tenth abdominal segment has two to five spines dorsad and one on each side of the anal opening. The apices of the wing sheaths extend to the anterior part of abdominal segment 3.

Namba (1957:288) found that the larva on macadamia nuts “often after emerging from the egg...will insert its head back into the egg to eat the contents. Usually the larva crawls away from the egg shell and bores into the husk, but less frequently it bores directly into the husk from within the egg shell.
Figure 360—Male genitalia of *Cryptophlebia*. Top left, *illepida* (Butler); Oahu (Busck slide 220). Top right and bottom, *ombrodelta* (Lower), from the type of the synonymous *Argyroplecia asiandra* Meyrick (BM slide 7179 Clarke); the top right photograph is of the male structures at the apex of the abdomen; Ceylon.
When the hole is about one-half body length in depth, the first-instar larva forms a shield over the hole and itself with silk and excrement and appears to rest before continuing to bore. It bores directly to the shell [of the nut] and then along the husk next to the shell. If the shell is still soft, it may bore through the shell to the kernel; however, this does not occur until the second or later instars. Sometimes a larva will leave one fruit and enter another.” And he noted that “the larva, if it enters the husk in the third or later instars, will

Figure 361—Male genitalia of Cryptophlebia illepida (Butler) from an old photograph of the first slide of lepidopterous genitalia made by the author. Bottom, from the holotype of the synonymous color form “illepida fulva” Walsingham, Kona, 4,000 feet, Hawaii [BM slide 1890].
Figure 362—Female genitalia of Cryptophlebia illepida (Butler); Waianae Mts., 2,000 to 3,000 feet, Oahu (BM slide 1889).
Figure 363—Female genitalia of Cryptoplebia ombrodelta (Lower); Queensland, Australia (BM slide 1924).
manifest its presence within the fruit by extruding excrement through the entrance hole of its tunnel. If it enters the husk in the first instar, the hole calluses over with the disappearance of the excrement shield and only a black dot remains.” Namba stated further that “as many as seven larvae, a mixture of all instars, have been observed in one fruit. All stages, including the first instar to the pupa, can be found on matured but not-yet-dried-up fallen fruits. The larva does not feed on dried husk; therefore, it must pupate before this condition occurs in order to survive.” He continued, “Pupation occurs in the tunnel near an exit hole in the husk. Sometimes, when the husk splits before pupation, the cocoon may be built along one edge of the crack. When the pupa is first formed it is light brown, then gradually becomes darker, and when time for adult emergence it is almost black. The pupa wriggles two-thirds of the way out of the cocoon and extends through the exit hole when nearing eclosion.”
Cryptophlebia ombrodelta (Lower) (figs. 355, male metatibia; 359, moths; 360, male genitalia; 363, female genitalia; 365, pupa).

Arotrophora (?) ombrodelta Lower, 1898:48.
Cryptophlebia ombrodelta (Lower) Bradley, 1952:682, pl. 24, fig. 1, pl. 25, fig. 1, la. Diakonoff, 1957a:139, figs. 11–15, 20, 22, synonymy, bibliography, redescription, discussion.
Cryptophlebia carpophaga Walsingham, 1899:106, pl. 7, fig. 1a–d; described from Calcutta. Synonymy by Bradley, 1952:682.
Argyroploce lasiandra Meyrick, 1909c:592; described from Ceylon. Synonymy by Clarke, 1958:327.
Meyrick, 1910c:218, incorrectly synonymized this species under illepida, which he placed in Argyroploce. Some other authors have followed this error, and there are various records in literature under the name illepida that belong to ombrodelta.

The litchi fruit moth.
Kauai, Oahu, Hawaii.
Immigrant. Widespread from Ceylon and southern India through Malaya, Indonesia, Formosa, the Philippines, Australia (type locality: Sydney), Solomon Islands, and Guam. Probably accidentally introduced to Hawaii from Guam during or soon after the Second World War. First reported from Hawaii by C. J. Davis in 1961 (Proc. Hawaiian Ent. Soc. 18:2, 1962), but specimens were taken by J. W. Beardsley in light traps in 1958 (same reference).
Hostplants: Acacia farnesiana ("klu"), Bauhinia seedpods, Cassia javanica × Cassia fistula (rainbow shower), Cocos nucifera (seagrape), Euphorbia longan, Filicium decipiens (fern tree, Sapindaceae), Indigofera suffruticosa (damages terminal stems and seedpods), Litthi chinensis ( = Nephelium Litchi), Macadamia, Phaseolus limensis (lima bean), Phaseolus vulgaris (garden beans), Pithecolobium dulce, Poinciana pulcherrima, Poinciana regia, Prosopis pallida ("kiawe" or mesquite) seedpods.
Dr. Swezey (1940c:173) reported upon this species (under the name Argyroploce carpophaga) in Guam, as follows: "The larvae fed on the seeds in pods of both pole beans and lima beans. The larvae also destroy a large proportion of the seeds of such leguminous trees as Pithecolobium dulce, Adenanthera pavonina, Poinciana regia, and Acacia farnesiana. In two counts made of seeds in

Figure 365—Caudal aspect of a pupa of Cryptophlebia ombrodelta (Lower); Pusa, India.
Adenanthera pods, 67 per cent and 77 per cent respectively of the seeds were destroyed. In a similar count, 21 per cent of Poinciana seeds were destroyed. Acacia farnesiana seeds were nearly all eaten.

Diakonoff (1957a:139) considers that it is “apparently of Indian origin”, and he lists the following genera of plants which are not mentioned in my details under hostplants above: Aegle, Feronia, Parkinsonia, Sesbania, and Tamarindus. Bradley (1952:692) also records orange fruit as a host.

Beardsley (Proc. Hawaiian Ent. Soc. 19:15, 1965) reported severe damage to young ornamental shade trees of Cassia and Filicium on Oahu. The larvae bored in and killed numerous young twigs of the hostplants.

J. Nichols (Proc. Hawaiian Ent. Soc. 19:20, 1965) found a larva in the stem end of a coconut fruit being mailed from Honolulu to California, and this larval habit may have assisted in the wide dispersal of the moth.

Figure 366—Larva and pupa of Cryptophlebia illepida (Butler). a, head, pro- and mesothorax in lateral aspect; b, third abdominal segment from left side; c, frontal aspect of head; d, caudal view of head (removed from body); e, left lateral aspect of abdominal segments 9 and 10; f and g, dorsal and lateral aspects of pupa. (After Namba, 1957.)
Margaret MacKay (1959:81) reported that the larvae she had examined were much like those of Cryptophlebia illepida, but that on some larvae she found indications of an anal fork, which structure is missing from the larva of illepida.

It would appear that this newly established moth may become a pest in Hawaii.

Figure 367—Macadamia nuts showing evidence of attack by the larvae of Cryptophlebia illepida (Butler); Honolulu. (University of Hawaii photograph.)
Genus **MACRAESTHETICA** Meyrick


This monotypic genus has escaped the notice of Hawaiian entomologists, for it does not appear in their named collections or literature. The wing venation is similar to that of *Cryptophlebia*, but the unusual male genitalia make this a distinctive group in Hawaii. Its relationships and status require further elucidation. Meyrick placed the genus in the “Tortricidae”, but it should be placed with the Olethreutinae. [Since this manuscript was written, Clarke, 1958:476, has transferred it to the “Olethreutidae”].

**Macraesthetica rubiginis** (Walsingham) (figs. 368, head, wing venation; 369, moths; 370, male genitalia).

*Tortrix rubiginis* Walsingham, 1907^b:702, pl. 11, fig. 24.

*Eulia rubiginis* (Walsingham) Meyrick, 1913^b:38.


Endemic? Oahu (type locality: Waianae Mountains).

Hostplant: unknown.

This moth was described from one female specimen (which has lost its abdomen), and it has seldom been collected. Fortunately, we now know the male with its singular genitalia, but I have not examined a female abdomen.

I regret that I cannot give additional information about this strange moth. I do not know whence it has come or to what it is most closely allied. Does it belong in association with *Olethreutes* and *Argyropleco*? Is it really an endemic insect or is it an immigrant?

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Figure 368—*Macraesthetica rubiginis* (Walsingham). Head of a specimen from the northwest Koolau Mts., Oahu. Wings of the male holotype (BM slide 9609 Clarke); Waianae Mts., Oahu.
Figure 369—Macraesthetica rubigenis (Walsingham). Top, left forewing of the holotype male (BM slide 9603 Clarke); Waianae Mts., Oahu; length 7.5 mm. Middle, a female from the northwest Koolau Mts., Oahu (abdomen lost); expanse 17.5 mm. Bottom, a male from the Koolau Mts., Oahu; expanse 14 mm. Note the difference in the thickness of the antennae in the two sexes.
Genus CYDIA Hübner


_Endopisa_ Gueneé, 1845a: 182. Type-species: _Pyralis nigricana_ Stephens.

_Cerata_ Stephens, 1852: 77. Type-species: _Penthina servillana_ Duponchel.

_Adenoneura_ Walsingham, 1907b: 677. Type-species: _Adenoneura falsifalcellum_ Walsingham, by original designation. **New synonym.** Obraztsov, 1959: 175, extensive synonymy and redescriptions.

There has been much confusion and extensive debate concerning the name to use for this genus. Most workers now use _Cydia_, although Obraztsov used _Laspeyresia_ in his major Palaearctic monograph (1959: 175), and I had been inclined to follow him. _Laspeyresia_ Hübner is held to be a homonym of _Laspeyresia “R.L.”_ (Jena. Allg. Lit. Zeitung 1: 288, 1817; reference not seen by me) which is either an unjustified emendation or an erroneous spelling for _Laspeyria_ Germar, 1811. Under the Code of Nomenclature, Article 33(a) ii, the _Laspeyresia_ of “R.L.” (whoever that may be) “has status in nomenclature” and thus...
has precedence over Hübner’s _Laspeyresia_. One might hold the view that the emended or erroneously spelled name of “R.L.” should be considered stillborn, and that it should not effect the use of Hübner’s _Laspeyresia_.

Walsingham’s _Adenoneura_ was based upon a secondary sexual character, and that name must fall as a synonym of _Cydia_. The Hawaiian species of _Cydia_ that have the sex pouch on the hindwing of the male were placed in _Adenoneura_ by Walsingham, and he placed the two species known to him which lack the sex pouch in _Enarmonia_. When he knew only the female, he could not decide under which name to place the species; therefore, he placed several species known only from the females into “_Enarmonia (?)_”.

In Hawaii, _Cydia_ forms a complex of many closely allied, mostly poorly understood species. Numerous species probably remain to be described. There is great variation in color and pattern in some of the species. Elsewhere the genus includes species of paramount economic importance and, of these, _Cydia pomonella_ (Linnaeus) (_Carpocapsa, Laspeyresia_) is the most notorious. It is the widely distributed, well-known pest, the codling moth (a codling is a kind of European apple used for cooking purposes). Many species of _Cydia_, including the widespread pea moth pest, _Cydia nigricana_ (Stephens), attack legumes such as peas and alfalfa (lucerne); some attack fruits and nuts; and others attack conifers and a wide variety of other plants. For an extensive review of some of the well-known pest species, see Bovey in Balachowsky et al., 1966:632:738.

The males of most of the described Hawaiian species have a peculiar, strongly developed “pocket” or sex pouch that extends conspicuously below the ventral surface of the hindwing; it opens through a long slit in the dorsal

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Figure 371—Head and wing venation of _Cydia falsifalella_ (Walsingham), holotype male (BM slide 2051); _Olaa, 2,000 feet, Hawaii_. The stippled area in the hindwing indicates the large male sex pouch which extends beneath the wing. Compare the paratype in figure 373.
surface of the wing near vein 2, as is shown in the drawings of the wings of several of the species herewith (figures 371–375). The pouch encloses a mass of long hairs and scales, and it is presumed to function as a scent-disseminating structure. It is strange that this is not a constant feature of all Hawaiian species, but some of them lack the pouch. I have examined the males of 10 of the 13 described species of Hawaiian Cydia, and, of these, the males of crassicornis and walsinghamii lack the pouch which is present on conspicua, falsifalcella, gypsograpta, latifemoris, montana, parapteryx, plicata, rufipennis, and new species 1. I have not seen the males of chlorostola, obliqua, and storeella. It is noteworthy that on the males of those species which do have the pouch, vein 2 leaves the cell farther basad than it does on the species which lack the pouch (see my illustrations). The North American Melissopus Riley has a similar but less-developed pouch, but is Melissopus really a different genus?

There are obvious differences in the genitalia, but they are not clearly shown in all of my illustrations. The details require drawings from various aspects when the dissections are in fluid, because various features become difficult or impossible to see on single microscope slide mounts.

There are probably many species remaining to be found in Hawaii, and we have only begun to study the group. It would appear that the genus came to Hawaii from the Holarctic, and I would guess that it came from the Palaearctic. The genitalia of some Hawaiian species are quite similar to those of the widespread European pea moth, Cydia nigricana (Stephens).

Specimens of Cydia have been collected on all of the main islands except Molokai and Lanai. The genus no doubt occurs on those islands also, and it is strange that we have no records from them. According to type locality, Kauai has one species; Oahu, four; Maui, four; and Hawaii, five, with one of these shared in type locality with Maui (because the male type is from Hawaii and the female is from Maui). One species is supposed to be distributed over

![Figure 372—Cydia conspicua (Walsingham), wing venation of the male (slide Z-XII–62–4), Kahanaiki, Oahu, and the female (slide Z-XII–62–5), Mt. Tantalus, Oahu.](image)
Kauai, Oahu, Maui, and Hawaii, but the records may be partly in error. Two species are found on both of the adjacent islands of Maui and Hawaii; one species shares the adjacent islands of Kauai and Oahu; and one, Oahu and Maui. The other eight species have each been found on one island only.

The hostplants of five species are unknown, but all the known hostplants, including Acacia koa, Acacia koaia, Sophora, Canavalia and Strongylodon, are Leguminosae. It will be interesting to learn whether all of the Hawaiian Cydia species are attached to Leguminosae. It would appear that the ancestor which gave rise to the Hawaiian complex was a legume-eater.

Meyrick, 1932:222, said “Some mental confusion is probably responsible for Lord Walsingham’s use of his generic name Adenoneura as neuter, which is grammatically impossible. Walsingham’s marcidella, placed doubtfully in [Enarmonia], is really referable to Crocisodea; on the other hand his conspicua, placed doubtfully in Enarmonia, is truly referable to Adenonenra [sic], and I think probably also storeella and obliqua.”

Figure 373—Wing venations of Cydia. Top left, crassicornis (Walsingham), paratype (BM slide 8038); Kona, 4,000 feet; this is a male, but it lacks a sex pouch on the hindwing. Top right, falsifalcella (Walsingham), paratype (BM slide 7530); Olaa, 2,000 feet, Hawaii; compare figure 371 of the holotype. Bottom left, montana (Walsingham), paratype (BM slide 7531); Kilauea, Hawaii. Bottom right, latifemoris (Walsingham), holotype female (BM slide 2054); Haleakala Crater, Maui.
Figure 374—Wing venations of Cydia. Left, parapteryx (Meyrick), paratype (BM slide 7592); Honolulu. Right, plicata (Walsingham), paratype (BM slide 7570); summit crater of Mt. Hualalai, Kona, 8,000 feet, Hawaii.

Figure 375—Wing venations of Cydia. Left, rufipennis (Walsingham), Lihue, 4,000 feet, Kauai (BM slide 2058). Right, walsinghamii (Butler), Kilauea, Hawaii (BM slide 1892). Note that this male lacks a sex pouch on the hindwing. These specimens were determined by Walsingham.
The inadequate material available for study and the unknown range of variability in this variable group make it unwise now to attempt to present a key (which might easily lead to confusion), and I refer my readers to the illustrations and the text for details which should assist in the identification of the described species. This is not an easy group to understand.

See color plate 2, figures 7, 8.

**Cydia chlorostola** (Meyrick), **new combination** (figs. 378, moth; 389, female genitalia).


Endemic. Oahu (type locality: Waialua).

Hostplant: unknown.

This moth was described from one female collected by Perkins in 1909. Meyrick said, "This species is almost certainly introduced with some leguminous plant, and is probably of Asiatic origin, but is not at present known to me elsewhere." I believe that Meyrick was wrong and, until more definite evidence to the contrary is obtained, I shall consider this to be an endemic species.

**Cydia conspicua** (Walsingham), **new combination** (figs. 372, wing venation; 376, pupa; moth; 385, male genitalia; 390–391, female genitalia).

*Enarmonia (?) conspicua* Walsingham, 1907a:684, pl. 10, fig. 28.

*Adenoneura conspicua* (Walsingham) Meyrick, 1928c:98; 1932:222.

Endemic. Oahu, Maui (type locality: Haleakala, 5,000 feet).

Hostplant: *Acacia koa*.

Parasite: *Pristomerus hawaiiensis* Perkins.

Dr. Swezey told me that he had bred this species from larvae which he had taken from dead bark and seeds of *Acacia koa* on Oahu and Maui. Only the female holotype was known to Walsingham.

The caudal segment of the pupa, in caudal view, has a corona of seven or eight conical spirelike processes.

Figure 376—Details of the cauda of the pupa of *Cydia conspicua* (Walsingham); Kahanaiki, Oahu. Determined by Meyrick.

**Cydia crassicornis** (Walsingham), **new combination** (figs. 373, wing venation; 378, moth; 384, male genitalia).

*Enarmonia crassicornis* Walsingham, 1907b:683, pl. 11, fig. 2.

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

Hostplant: unknown.

This is one of the two described Hawaiian species that lack the sex pouch beneath the hindwing of the male (other undescribed species also lack the pouch); compare *walsinghamii*. I have not seen the female.
Cydia falsifalcella (Walsingham), **new combination** (figs. 371, head, wing venation; 373, wing venation; 379, moth; 384, male genitalia).

*Adenoneura falsifalcellum* Walsingham, 1907b: 677, pl. 10, fig. 17.

Endemic. Hawaii (type locality: Olaa, 2,000 feet).

Host plant: unknown.

Nothing is known regarding the habits of this species, and the records on distribution and host plants previously published under this name by Perkins and Swezey apply to *parapteryx*.

This species is closely similar in external appearance to *parapteryx*, and it may be the Hawaii representative of that species. See the commentary under *parapteryx*.

I regret that I have not seen and cannot illustrate the female.

Figure 377—*Acacia koaia*, showing the results of a heavy infestation by a new species of *Cydia*. Almost all the defoliated twigs had emergence holes, and 50 to 75 percent of the crowns of some trees were infested at the *Acacia koaia* sanctuary on the Kohala Road, 3,500 feet, Hawaii, in February, 1965, according to C. J. Davis who took this photograph.
Figure 378—*Cydia*. Top, *chlorostola* (Meyrick), holotype female (BM slide 9546); Waialua, Oahu; expanse 15 mm. This is an unusual, very pale yellowish, nearly white species. Middle, *conspicua* (Walsingham), holotype female (BM slide 2052); Haleakala, 5,000 feet, Maui; expanse 18 mm. Bottom, *crassicornis* (Walsingham), holotype male (BM slide 1880); Kona, over 4,000 feet, Hawaii; forewing 5.5 mm.
Figure 379—*Cydia*. Top, *falsifascella* (Walsingham), holotype male (BM slide 2051); Olaa, Hawaii; forewing 9 mm. On some examples the entire area basad of the oblique dark fascia at mid-wing is dark scaled. Bottom, *gypsograpta* (Meyrick), holotype male (BM slide 9543); Honolulu, Oahu; expanse 13 mm.
Figure 380—*Cydia latijemoris* (Walsingham). Top, allotype male (BM slide 2053); summit of the crater of Hualalai, 8,000 feet, Hawaii; forewing 6 mm. Bottom, holotype female (BM slide 2054); Haleakala Crater, Maui; forewing 7 mm.
Figure 381—*Cydia*. Top, *montana* (Walsingham), allotype female (abdomen lost); Kona, 4,000 feet, Hawaii; expanse 10.5 mm. Middle, *obliqua* (Walsingham), holotype female (BM slide 1882); Hualalai, Kona, 5,000 feet, Hawaii; forewing 7 mm. Bottom, *parapteryx* (Meyrick), lectotype (BM slide 9544 Clarke); Honolulu, Oahu; expanse 19 mm.
Cydia gypsograpta (Meyrick), new combination (figs. 379, moth; 384, male genitalia).

Adenoneura gypsograpta Meyrick, 1932:222.

Endemic. Oahu (type locality: Honolulu).
Hostplant: unknown.
Only the male holotype is known.

Figure 382—Cydia. Top, plicata (Walsingham), holotype male (note the sex pouch showing on the hindwing) (BM slide 1885); Kona, 4,000 feet, Hawaii; expanse 15.5 mm. Bottom, rufipennis (Butler), holotype female (not dissected); Oahu (Blackburn numbers 81.7 109); expanse 9 mm. One may consider from these photographs that these two species are closely similar, but rufipennis appears to be a diminutive plicata in superficial appearance—note the great difference in size. Compare the illustrations of the genitalia on figures 387 and 388.
Cydia latifemoris (Walsingham), new combination (figs. 373, wing venation; 380, moths 385, male genitalia; 392, female genitalia). Adenoneura latifemoris Walsingham, 1907b:679, pl. 10, fig. 17.

Endemic. Maui (type locality of the female: Haleakala crater), Hawaii (type locality of the male: Hualalai, summit of crater, 8,000 feet).

Hostplant: Sophora chrysophylla.

Dr. Swezey found that the larvae may destroy nearly one-half of the seed crop of Sophora.

Further study of specimens from Maui and Hawaii is required to make certain that the male and female types represent the same species.

Figure 383—Cydia. Top, storeella (Walsingham), holotype female (BM slide 1881); Haleakala, 5,000 feet, Maui; expanse 13 mm. Bottom, walsinghamii (Butler), holotype female (BM slide 3756); near Honolulu; expanse 11.5 mm. The “X” marks indicate abraded areas which appear as a white macula on the left forewing and as two white fascia on the right forewing. This specimen was originally determined to be a male, but it is a female.
Figure 384—Male genitalia of *Cydia*. Top, *crassicornis* (Walsingham), holotype (BM slide 1880); Kona, above 4,000 feet, Hawaii. Middle, *falsifalcella* (Walsingham), holotype (BM slide 2051); Olaa, Hawaii (right valva turned over). Bottom, *gypsograpta* (Meyrick), holotype (BM slide 9543 Clarke); Honolulu.
Figure 385—Male genitalia of *Cydia*. Top, *montana* (Walsingham), holotype (BM slide 2055); Kilauea, Hawaii; left valva twisted and broken. Middle, *latifemoris* (Walsingham), allotype (BM slide 2053), summit of crater of Mt. Hualalai, Hawaii; aedeagus out of focus and left valva twisted. Bottom, *conspicua* (Walsingham), determined by Dr. Swezey; Kahauiki, Oahu (slide Z–XII–62–4). Note the emarginate uncus and compare the other species.
Cydia montana (Walsingham), **new combination** (figs. 373, wing venation; 381, moth; 385, male genitalia; 393, female genitalia).

*Adenoneura montanum* Walsingham, 1907b:679, pl. 10, fig. 21.

Endemic. Hawaii (type locality: Kilauea, male; Kona, 4,000 feet, female).

Hostplant: *Sophora chrysophylla*.

The larvae feed upon the seeds of the hostplant.

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Figure 386—Male genitalia of *Cydia*. Top, *parapteryx* (Meyrick), lectotype (BM slide 9544 Clarke); Honolulu. Bottom, new species 1 (slide Z-11-27-65); Kawaihae Uka, Hawaii; reared from *Acacia koaia* twigs by C. J. Davis.
Figure 387—Male genitalia of *Cydia*. Top, *plicata* (Walsingham), holotype (BM slide 1885); Kona, Hawaii. Middle, supposedly a paratype of *plicata* (Busck slide 222; Walsingham specimen 28662), but it may represent another form although the contour of the sacculus of the valva may be somewhat distorted on the slide; Hawaii. Bottom, another specimen of *plicata* from an example reared from *Sophora* seeds at Kilauea, Hawaii (slide Z–VI–21–61).
Figure 388—Genitalia of Cydia. Top three figures, female walsinghamii (Butler), determined by Walsingham (BM slide 1893); Kona, 4,000 feet, Hawaii; the left signum is seen in basal view; it is similar to the right signum. Upper male genitalia, rufipennis (Butler); Lihue, 4,000 feet, Kauai (BM slide 2058); the right valva is twisted (note the broad, shallow, midventral sinus on the right valva which is correctly displayed as mounted). Bottom male genitalia, walsinghamii (Butler) from a specimen determined by Walsingham (BM slide 1892); Kilauea, Hawaii. The sharpness of the points at the lower middles of the valvae is somewhat exaggerated here because of the position of the valvae on the mount.
Figure 389—Female genitalia of *Cydia chlorostola* (Meyrick), holotype (BM slide 9546 Clarke); Waialua, Oahu.
Figure 390—Female genitalia of *Cydia conspicua* (Walsingham), holotype (BM slide 2052); Haleakala, 5,000 feet, Maui. Note the approximation of the signa; compare *plivata* and *storeella*. Compare figure 391.
Figure 391—Female genitalia of a specimen of *Cydia conspicua* (Walsingham) from Mt. Tantalus, Oahu (slide Z-XII-62-5). Compare figure 390.
Figure 392—Female genitalia of *Cydia latifemoris* (Walsingham), holotype (BM slide 2054); Haleakala Crater, Maui.
Figure 393—Female genitalia of *Cydia montana* (Walsingham), paratype (BM slide 2056); Kilauea, Hawaii.
Figure 394—Female genitalia of *Cydia obliqua* (Walsingham), holotype (BM slide 1882); Hualalai, 5,000 feet, Hawaii.
Figure 395—Female genitalia of *Cydia parapteryx* (Meyrick), paralectotype (BM slide 7549); Honolulu.
Figure 396—Female genitalia of *Cydia plicata* (Walsingham), allotype (BM slide 1886); Kona, over 6,000 feet, Hawaii. Note the closeness of the signa; compare *conspicua* (figure 390) and *storeella* (figure 398).
Figure 397—Female genital parts of *Cydia rufipennis* (Butler) from a specimen determined by Walsingham (BM slide 2057); Waianae Mts., Oahu. The ductus bursae (not shown here) is longer and more slender than normal and is somewhat longer than the length of the bursa.
Figure 398—Female genitalia of *Cydia storeella* (Walsingham), holotype (BM slide 1881); Haleakala, 5,000 feet, Maui. Note the close approximation of the signa and compare *conspicua* (figure 390) and *plicata* (figure 396).
Cydia obliqua (Walsingham), **new combination** (figs. 381, moth; 394, female genitalia).

*Enarmonia (?) obliqua* Walsingham, 1907b: 686, pl. 11, fig. 4.
*Adenoneura obliqua* (Walsingham) Meyrick, 1932: 222.

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

Cydia parapteryx (Meyrick), **new combination** (figs. 374, wing venation; 381, moth; 386, male genitalia; 395, female genitalia).

*Adenoneura parapteryx* Meyrick, 1932: 222.

Endemic. Oahu (type locality: Honolulu).
Hostplants: *Canavalia galeata, Strongylodon lucidus*.
Parasite: *Trathala flavo-orbitalis* (Cameron).

This species was confused with the closely similar *falsifalcella* until it was described in 1932, and the life history data applied to *falsifalcella* prior to 1932 belong to this species. This moth has the outer edge of the dark fascia near the middle of the forewing less acutely angled than it is in *falsifalcella*, and the contour of the uncus and the aedeagus are different. The illustrations demonstrate these and other distinctive features.

Dr. Swezey (1908: 15-16) made the following observations on the larvae of this species which he then called an “*Enarmonia sp.*” found attacking *Canavalia* beans:

In July, 1907, I found a few larvae of this moth eating the growing seeds of *Canavalia galeata*, a native species of bean with a woody twining vine and very large pods containing 2 to 4 black beans about ½ inch long. The vine had been planted by a fence in Honolulu and had gotten considerable of a growth, and a few pods had already formed. As the vine continued to grow and produce pods these larvae increased in abundance so that finally nearly every pod was attacked by them. They did not confine their attacks to the pods, however; besides feeding in the fleshy walls of the green pod and eating the growing beans within, they also bored the peduncles of the flower clusters, the petioles of the leaves, and the branches of the vine itself; practically attacking all parts of the plant.

Quite a series of this moth was bred from the vine during January and February, 1908. There is some little variation in coloration as shown by the specimens exhibited. . . .

The eggs are laid on the surface of the bean pod, singly or one or two together in slight unevennesses of the surface. They are irregularly oval, about half a mm. long; flattened below, slightly convex above and finely reticulate; whitish in color, sometimes iridescent, becoming pinkish a little before hatching.

On hatching, the larva bores into the pod, feeding for awhile in its fleshy walls, but when it gets larger, attacks the seeds. One larva may eat several of the large seeds before reaching its full growth. When full-grown, the larva is 18 to 20 mm., plump, yellowish white; head medium brown, strongly bilobed; cervical shield slightly infuscated; tubercles faintly infuscated; hairs pale, short; spiracles pale brown.

Before pupating the larva constructs a silken gallery where it has been feeding, extending often through one or more beans, and it finally extends this to the outer wall of the pod, through which it eats a circular hole, except a thin layer on the outside, which can easily be broken through when the moth emerges; then the larva recedes back into the gallery, spins a silken partition across about a quarter of an inch from the outer end, and in this place of security pupates.

The pupa is 10 mm.; light brown; head, thorax and wing-cases darker; the latter and antenna-cases extend to apex of 3rd abdominal segment, a free tip extends a little farther. Abdominal segments 3 to 7 have on dorsal side two transverse rows of numerous tiny, very short, conical spines, those of the anterior row larger than those of posterior row; segment 2 has one row of very tiny spines near posterior margin; segment 8 has but one row of few large spines; segment 9 has but two large dorsal spines and a terminal row of 7, there are also several slender hooked bristles at apex of abdomen.

Dr. Perkins (1913: clxviii) also observed the larva which he said “feeds on the beans in the pods of leguminous plants and also bores in the stems, sometimes destroying the plant.”
Cydia plicata (Walsingham), **new combination** (figs. 374, wing venation; 382, moth; 387, male genitalia; 396, female genitalia).

*Adenoneura plicatum* Walsingham, 1907b:678, pl. 10, fig. 19.

Endemic. Maui, Hawaii (type locality: Kona, 4,000 feet, male; Kona, 6,000 feet, female).

Hostplant: *Sophora chrysophylla*.

Parasites: *Eupelmus pelodes* Perkins?, *Pristomerus hawaiiensis* Perkins.

One would imply from Perkins’ field note, as recorded under this species in Walsingham’s original description, “Larvae in seeds of native *Acacias* . . .”, that the species feeds upon *Acacia koa*, but discoveries of the species since it was collected by Perkins indicate that it is a *Sophora*-eater. Dr. Swezey told me that he found as many as 70 percent of the seeds in green *Sophora* pods eaten by this moth. I have compared material reared from *Sophora* with the holotype.

Cydia rufipennis (Butler), **new combination** (figs. 375, wing venation; 382, moth; 388, male genitalia; 397, female genitalia; col. pl. 2:8).

*Phoxopteris rufipennis* Butler, 1881:395.

*Adenoneura rufipennis* (Butler) Walsingham, 1907b:680, pl. 10, fig. 22.

Endemic. Kauai, Oahu (type locality: no specific locality given, and the female holotype bears only the Blackburn code “Hawaiian Islands, 81.7 109”; the same code number has been used for specimens coming from “the mountains of Oahu”, and I presume that the type came from the mountains behind Honolulu).

Hostplant: *Acacia koa*.

The larvae feed upon the developing seeds within the pods, but they are at times to be found feeding in the flowers and buds. The larvae were reported by Bridwell (1919:24) to emerge from the pods and to pupate elsewhere. *Cryptophlebia illepida* also feeds in the koa pods. See the quotation from Swezey under that species name for additional data.

Superficially, specimens of *rufipennis* may appear to be diminutive *plicata*, but an examination of their genitalia will reveal their distinctiveness.

Cydia storeella (Walsingham), **new combination** (figs. 383, moth; 398, female genitalia).

*Enarmonia (?) storeella* Walsingham, 1907b:686, pl. 11, fig. 3.

*Adenoneura storeella* (Walsingham), Meyrick, 1932:222.

Endemic. Maui (type locality: Haleakala, 5,000 feet).

Hostplant: unknown.

This species was described from one female, and I have no further information regarding it.
Cydia walsinghamii (Butler), new combination (figs. 375, wing venation; 383, moth; 388, male, female genitalia).

Proteopteryx walsinghamii Butler, 1882: 43.
Enarmonia walsinghamii (Butler) Walsingham, 1907b: 684, 736, pl. 11, fig. 1.

Endemic. Kauai, Oahu (type locality: "In the neighbourhood of Honolulu"; the type bears the Blackburn collecting code "Hawaiian Isld. 82.9 161"), Maui, Hawaii.
Hostplant: Acacia koa.
Parasite: Pristomerus hawaiiensis Perkins.

I am not positive that the species has such a wide distribution as the literature indicates, although this may be true. I have seen specimens reared from Acacia and determined as this species but which represent new species.

The female holotype bears a Walsingham label stating incorrectly that it is a male.

Dr. Swezey (1954:5, fig. 2) said that "the caterpillars live in dead twigs of koa and also bore into tips of living twigs. They have been found most abundantly in the enlarged phyllodes and twigs which have been infected and malformed by the rust, Uromyces koae Arthur. Sometimes such malformed twigs grow into branches of an inch or more in diameter, within which the caterpillars of this moth are found in the bark or in the living wood."

See the quotation from Swezey under Cryptophlebia illepida for additional information. Although this species has been reported to be a koa seed eater, Dr. Swezey did not mention koa seeds in his 1954 report on this species. It is possible that there has been some confusion in the records, and some of the details credited to walsinghamii may really belong either to a new species from Hawaii which I list below or to other new species.

The males of this species and of crassicornis lack the sex pouch beneath the hindwing.

Cydia new species 1 (figs. 377, larvae damage; 386, male genitalia).
Enarmonia species confused with walsinghamii by some workers in Hawaii.

Endemic. Hawaii (Kawaihae Uka and Kohala Road, 3,500 feet).
Hostplant: Acacia koaia.

This species has been confused with walsinghamii, and it is possible that some of the published information concerning walsinghamii belongs to this species. As is demonstrated by my illustrations of the male genitalia, two species are involved. The specimen whose male genitalia are illustrated on figure 386 has sex pouches on the hindwings which are absent from walsinghamii.

I am indebted to C. J. Davis for information and specimens of this species. Further details are included with figure 377.
Genus **STREPSICRATES** Meyrick


*Strepsicrates* Meyrick, 1888a:73, a replacement name for *Strepsiceros*.

*Phthinolophus* Dyar, 1903b:307. Type-species: *Phthinolophus indentanus* Dyar, monotypic.

The species assigned to this generic name are in need of study, and the status of the group in relation to its allies requires revision. At present, the group supposedly includes species from Ceylon, Australia, New Zealand, New Hebrides, Fiji, Samoa, Austral Islands, and two from America. A supposedly widespread American species has been introduced to Hawaii. Meyrick originally placed the genus in the “Grapholithidae”, and he later assigned some of the species to *Spilonota*. T. B. Fletcher (1929:208) wrongly listed *Strepsicrates* as a synonym of *Spilonota* Stephens, 1834 (see Stephens, 1829–1834), but he probably only followed Meyrick.

**Strepsicrates smithiana** Walsingham (figs. 399, head, wing venation, antennal base; 400, moths; 401, male, female genitalia; 402, larva; 417–A, d–f, pupa).

*Strepsicrates smithiana* Walsingham, 1892(1891):506 (type locality: St. Vincent, West Indies).


Figure 400—*Strepsicrates smithiana* Walsingham. Top, a male from Cape Henry, Virginia. Bottom, a female from Everglade, Florida. Expanse about 13 to 14 mm. (USNM photographs.)
Figure 401—*Strepsicrates smithiana* Walsingham. Top, female genitalia of the holotype (BM slide 11780); St. Vincent, West Indies. Bottom, male genitalia from the lectotype of the synonymous "*Spilota imminens*" Meyrick (BM slide 6260); Guyana.
Spinules dense, minute, dark dorsally and laterally on body.

Figure 402—Details of the larva of *Strepsicrates smithiana indentana* Dyar. a, setal map of the pro- and mesothorax and abdominal segments 1, 2, 6, and 7; b, same of abdominal segments 8 and 9; c, dorsal setae, pinacula and dermal spinules of an anterior abdominal segment; d, spinneret and labial palpi; e, VI setae of abdominal sternites 7, 8, and 9; f, ocellar area of the left side of the head; g, dorsal aspect of abdominal segments 8, 9, and 10; h, lateral aspect of a thoracic leg; i, prothoracic shield; j, frontal aspect of head; k, crochets of 6th ventral and anal prolegs of left side; l, anal fork. (Drawing loaned by Margaret MacKay.)
Oahu.

Introduced purposely from Florida and Georgia, U.S.A., in 1955, by the Hawaiian State Department of Agriculture to aid in the control of the pasture weed *Myrica faya*, or firebush. It was found to be established on Oahu in 1960. The species is reported to be widely distributed in North and South America.

Hostplants: *Myrica cerifera* (wax myrtle), *Myrica faya* (firebush). I have seen specimens reared from *Psidium guajava* (guava) in the West Indies. The larvae roll the larvae of the hostplants.

The forewing of both sexes has a conspicuous patch of raised scales posterior to the fold at about the basal one-fourth of the wing. The antenna of the male has a dorsal "notch" on the shaft at about the length of an eye beyond the basal antennal segment. In Hawaii, *Eccoptocera* also has "notched" antennae but, on that genus, the "notch" is more basad. The forewings of the males have strong costal folds enclosing hair tufts.

**Genus CROCIDOSEMA** Zeller

*Crocidosema* Zeller, 1847b:721. Type-species: *Crocidosema plebejana* Zeller, 1847b:721. (figs. 403, head, wing venation; 415, larva; 407, 409, 411, male genitalia.)

Heinrich, 1923:189, figures.

Confusion exists regarding the taxonomic positions of the species of *Crocidosema*. It is not known how many of the names that have been proposed represent species, nor is it known how much of the supposed synonymy is correct. A number of names have been proposed for supposed species in Eurasia, Africa, America, and various Pacific islands. The genus may include only a few species or it may include series of closely similar forms whose specifically diagnostic characters remain to be ascertained and described. There is no doubt that this group has greatly confused taxonomists, and little more can be said here than to call attention to our great ignorance of *Crocidosema*. *Crocidosema* and *Epinotia* are closely allied.

*Crocidosema* appears to be widely spread over the warmer parts of the world, but we do not know to what extent man has contributed to this distribution. There is no doubt, however, that he has aided in the wide dispersal of some forms, and the genus is extraordinarily widespread even to remote islands. It does seem evident, however, that, although these moths are confusingly variable in color and pattern, several species do exist in the genus. Perhaps *Crocidosema* is a group in a highly plastic state of early evolution with a marked tendency to variation.

I have not seen what I consider to be typical *Crocidosema plebejana* Zeller from Hawaii, although many Hawaiian specimens have been named *plebejana* and the bulk of Perkins' Hawaiian collection (26 of 29 specimens) were named *plebejana* by Walsingham in *Fauna Hawaiiensis*. 
The first record for the group in Hawaii is that of Butler who, in 1881, described "Proteropteryx" blackburnii from two specimens collected by the Reverend Blackburn on Maui. Walsingham (or Durrant for Walsingham) determined one of these as a male (holotype) and the other as a female (paratype), but they are both females (each has lost its abdomen). Walsingham placed the name blackburnii (Butler) as a synonym of plebejana in Fauna Hawaiiensis, but it is not plebejana. Walsingham described a large female specimen as Adenoneura? marcidellum, and he described a third Hawaiian form (lepraraum) from a small, pale specimen which he assigned to a third genus, Gypsonoma. It is obvious that Walsingham was confused by these moths, as were all other workers. The entire genus requires long and careful study, but, because I do not now have the time or the opportunity to engage in such work, I can only call attention to some of the problems. I have found what appear to be constant differences in the Hawaiian material I have studied, and I propose to recognize three species in Hawaii: blackburnii (Butler), leprara (Walsingham), and marcidella (Walsingham). It is possible that these forms are geologically recent additions to the Hawaiian fauna, and perhaps their immediate ancestors were introduced by the Polynesians. More sibling species may be involved than the three species presently recognized. I shall temporarily consider these Crocidosema to be endemics, although it may later be demonstrated that one or more of them occurs elsewhere.

The males of most of the forms of Crocidosema that I have seen have a much heavier mass of erect hairs (cubital pecten) along the basal section of the posterior margin of the cell on the hindwings than do the females. On leprara, however, the cubital pecten is only slightly more developed on the male than on the female. The recognition of this character enables easy sexing of specimens.

Figure 403—Head and wing venation of Crocidosema plebejana (Zeller), the type-species of Crocidosema, holotype male (BM slide 1838); Sicily.
Insofar as is known, the larvae of Hawaiian *Crocidosema* feed on Malvaceae and attack mostly the flowers, fruits, and seeds, but occasionally they may bore in leaf petioles. Bovey, in Balachowsky et al. (1966:848–850), quotes details of *Crocidosema plebejana* feeding on cotton; but Pearson and Darling, in their detailed study of cotton pests in tropical Africa (1958), did not find that *C. plebejana* attacked cotton, although it was found in cotton fields. I have no records of any *Crocidosema* from cotton in Hawaii, and perhaps elsewhere an error has been made in recording the genus from *Gossypium*.

As previously stated, I have not seen any typical *Crocidosema plebejana* from Hawaii. I have illustrated the male genitalia of the holotype of *plebejana*; note that the “rib” of the valva is comparatively close to the ventral margin of the valva. The “rib” of all of the specimens of *Crocidosema* examined from Europe and North America is similarly formed. In the Hawaiian specimens, however, the “rib” is placed distinctly farther from the ventral margin of the valva—it is more medial in position. This feature may be appreciated better by examining figure 410 of *plebejana* and *marcidella*, for example.

The larvae of *Crocidosema* may be distinguished from those of *Epinotia* because the outer seta of the dorsal, apical pair of setae on the claw-bearing segment of the thoracic legs is obviously longer than the inner one, whereas the setae are subequal on *Epinotia*. See figures 415 and 420.

**KEY TO THE HAWAIIAN SPECIES OF CROCIDOSEMA**

1. Palpi and head clothed with mostly pale, straw-colored vestiture, and the moth is a comparatively pale colored species, as in figure 405, with variations; hindwing of male with the cubital pecten (fringe of hair along posterior margin of cell near its base) only moderately more strongly developed than that of the female and without an extensive area of erect hair between the pecten and inner posterior corner of wing; male genitalia as in figures 408–410, ectal “rib” of valva without any stout, conspicuously differentiated subterminal, spurlike setae; female genitalia as in figure 413, the signa broad; a lowland and coastal species........

   ................................................. **leprara** (Walsingham).

Much darker species, palpi and head extensively clothed with dark vestiture; male hindwing with the cubital pecten very strongly developed as a comparatively huge mass of dense hair, conspicuously more strongly developed than that of female, and the area between vein 1b and posterior inner corner of wing densely clothed with erect hair; valvae of male genitalia with one to three distinctly differentiated, long, heavy, subterminal, spurlike setae, as at the bottoms of figures 410 and 411, of *marcidella* and *blackburnii*; female genitalia as in figures 412, 414, the signa sharply pointed........... 2
2. Forewings with outer margin of the broad subbasal dark fascia strongly angled distad, often externally subacute, as in figure 406; eighth abdominal tergum and sides of tergum of female (the penultimate segment of the ovipositor to which are attached the anterior apophyses) with a complete, transverse, submedial, mostly double but partly triple row of more than 35 long setae extending continuously across the disc (figure 404); expanse 15–20 mm. . . . . . . . . . . . . marcidella (Walsingham).

Forewings with outer margin of the broad subbasal dark fascia rather moderately convex, as in figure 405, or less convex; eighth abdominal tergum and sides of tergum of female with about 10 or fewer long setae on each side and none in middle of disc (figure 404); expanse about 10–12.5 mm. . . . . . . . . . . . . blackburnii (Butler).

Figure 404—Caudal parts of the dorsal surfaces of the penultimate sections of the ovipositors of Crocidosema marcidella (Walsingham), left, and blackburnii (Butler), right, to illustrate the differences in chaetotaxy.

Crocidosema blackburnii (Butler) (figs. 404, ovipositor; 405, moth; 411, male genitalia; 412, female genitalia).

Proteopteryx Blackburnii Butler, 1881:393.
Proteopteryx Blackburnii variety Butler, 1881:393.
Incorrectly synonymized with Crocidosema plebejana Zeller, by Walsingham, 1907b:675, 736.

Endemic? Nihoa, Kauai, Oahu, Molokai, Maui (type locality: “flying about low plants at Makawao, Maui”; the Blackburn code is “81.7” over “132”), Lanai, Hawaii.

Hostplants: Abutilon (= Abortopetalum) eremitopetalum, A. menziesii, A. molle, A. sandwicense, Sida fallax, Sida species. The larvae feed in flower buds, fruits, and seeds.

Parasites: Bracon mellitor (Say), Brachymeria obscurata (Walker), Trathala flavo-orbitalis (Cameron), Pristomerus hawaiensis Perkins.

Predators: Nesodynerus rudolphi (Dalla Torre), Odynerus montana Smith.

This moth was described from two females (although the holotype was incorrectly considered a male), both of which now lack abdomens. It has long been masquerading under the name Crocidosema plebejana Zeller. This moth is the most common and widely spread species of Crocidosema in Hawaii, and appears to be mostly a lowland species. About the size of leprara, but smaller
than marcidella, blackburnii averages about 10 to 12 mm in expanse. It is highly variable in color and pattern, and some forms are so distinctive in appearance that one wonders if it is possible that several sibling species may be involved.

Perkins (1913:clxvii), following Walsingham in considering it to be plebejana, said that it is "a natural immigrant, attached to the immigrant plant Sida, in the buds of which the caterpillar lives. It is an important food-supply of the larvae of many of the endemic wasps, that frequent the lowlands and lower mountain slopes, since it is excessively numerous and ubiquitous, wherever its food-plant flourishes. Near Honolulu, Nesodynerus rudolphi, Odynerus montanus, and other wasps are always to be seen searching the ‘Ilima’ buds in their season for these small caterpillars."

Figure 405—Crocidosema. Top, leprara (Walsingham), holotype female (BM slide 1878); Molokai, sea level; expanse 12.5 mm. Bottom, blackburnii (Butler), female; Kamehameha Schools, Honolulu; reared from seeds of Abutilon eremitopetalum; forewing 5.8 mm.
Figure 406—Crocidosema marcidella (Walsingham). Top, holotype female (BM slide 1875); Waianae Mts., Oahu; forewing 8.5 mm. Bottom, a specimen reared from Hibiscus on Mt. Tantalus, Oahu; forewing 7.5 mm.
Crocidosema leprara (Walsingham), new combination (figs. 405, moth; 408–410, male genitalia; 413, female genitalia).

Gypsonoma leprarum Walsingham, 1907b:676, 736, pl. 10, fig. 16.

Endemic? Oahu, Molokai (type locality: sea level), Nihoa, Necker, French Frigate Shoal?, Laysan?

Hostplants: undetermined, but probably Abutilon and Sida.

Parasites: undetermined, but probably the same as for blackburnii.

This moth has been confused with plebejana in Hawaii, and it has not been recognized since the publication of Fauna Hawaiensis. It is the palest of the Hawaiian Crocidosema, and it is undoubtedly more widely distributed in the islands than the records indicate. It was described from one pair collected by Perkins in May, 1893. In addition to the type pair, there are two other males (although one of these was labeled as a female) determined as this species by Durrant in the Fauna Hawaiensis collection in the British Museum. They were collected by Perkins in 1901—one from the northwest Koolau Mountains,
Figure 408—Male genitalia and caudal abdominal processes of *Crocidosema*. Top and bottom left, *leprara* (Walsingham); Nihoa Island (slide Z–I–14–65–B); see also the holotype on figure 409. Middle and bottom right, *marcidella* (Walsingham); Mt Tantalus, Oahu (slide Z–I–15–65–A). Compare figure 410.
Figure 409—Male genitalia of Crocidosema. Top, *plebejana* Zeller, holotype (BM slide 1838); Sicily. One or two long spines have been broken off the left valva, and the cornuti of the internal sac of the aedeagus have been shed. Middle, *leprana* (Walsingham), holotype (BM slide 1877); Molokai, sea level. Bottom, *marcidella* (Walsingham); Kauai (Busck slide 224). Compare the enlargements in figures 410 and 411.
Figure 410—Male genitalia of *Crocidosema*. Top, ectal aspect of the right valva of *leprara* (Walsingham), holotype (BM slide 1877). Bottom, ental aspect of the right valva of a specimen of *marcidella* (Walsingham) from Kauai (Busck slide 224). Compare figures 408 and 409.
Figure 411—Male genitalia of Crocidosema. Top, ectal aspect of the right valva of the holotype of plagiola Zeller (BM slide 1838); Sicily. Bottom, the same view of a specimen of blackburnii (Butler); Lanai (Busck slide 104).
Figure 412—Crocidosema blackburnii (Butler), female genitalia (BM slide 7551); Waianae Mts., Oahu.
Oahu, and the other from Honolulu. They were mentioned by Walsingham in his supplementary remarks on page 736 of his Fauna Hawaiensis monograph. Perkins said (1913:clxvii): "Gypsonoma leprarum is less abundant [than blackburnii] and may be an introduction. If not, it is probably a natural immigrant and will be found elsewhere."

I have examined several specimens, and they all agree in the characters of the male and female genitalia as illustrated and as described in the key.

**Crocidosema marcidella** (Walsingham) (figs. 404, ovipositor; 406, moths; 408–410, male genitalia; 414, female genitalia).

*Adenoneura? marcidellum* Walsingham, 1907b:678, pl. 10, fig. 18.


Endemic? Kauai, Oahu (type locality: Waianae Mountains).

Figure 413—Female genitalia of *Crocidosema leprara* (Walsingham), holotype (BM slide 1878); sea level, Molokai. A specimen from Nihoa Island is exactly like this specimen, including details of the ostium and signa.
Figure 414—Female genitalia of Crocidosema marcidella (Walsingham), holotype (BM slide 1873); Waianae Mts., Oahu. Another specimen reared from Hibiscus on Mt. Tantalus, Oahu, has closely similar genitalia.
Spinules short, dark. Enlarged bases give pebbly appearance to integument.

Figure 415—Details of the larva of Crocidosema plebejana Zeller, American specimen. a, setal map of the pro- and mesothorax and abdominal segments 1, 2, 6, and 7; b, the same of abdominal segments 8 and 9; c, dorsal setae, pinacula, and dermal spinules of an anterior abdominal segment; d, dorsal aspect of abdominal segments 8, 9, and 10; e, spinneret and labial palpi; f, anal fork; g, crochets of a mid-abdominal and an anal proleg; h, lateral aspect of a thoracic tarsus; i, the VI setae of abdominal sternites 7, 8, and 9 of two specimens to show variation; j, ocellar area of the left side of the head; k, prothoracic shield; l, frontal aspect of head. (Plate loaned by Margaret MacKay.)
Hostplants: *Abutilon* (= *Abortopetalum*) *sandwicense*, *Hibiscus arnottianus*.
Parasites: *Pristomerus hawaiiensis* Perkins, *Trathala flavo-orbitalis* (Cameron).

This species was described from one female collected by Perkins in April, 1892, but it has since been found also in the Koolau Mountains of Oahu and in the highlands of Kauai. In contrast to the lowland species *blackburnii* and *leprara*, *marcidella* is an upland form. It is distinctly larger than either *blackburnii* or *leprara*; some specimens may have a wing expanse of 20 mm.

Most of what is known regarding the distribution and habits of this moth is the result of the work of Dr. Swezey. In 1915b:61–62, he published a paper

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Figure 416—Details of the larva and pupa of *Crocidosema* (supposedly *plebiana* Zeller): American specimens (rearranged from Heinrich, 1921). a, dorsal aspect of the abdomen of a pupa; b, lateral aspect of an abdominal tergite to show the dorsal denticles; c, d, ventral aspects of male and female pupal abdomens; e, f, frontal and left lateral aspects of the larval head capsule; g, caudal aspect of the abdomen of a larva showing the anal fork at *AF*; h, ventral aspect of a ventral abdominal proleg of a larva showing the SV and V setae. The nomenclature of the chaetotaxy is that of Heinrich. ao, anal opening; go, genital opening.
“Notes on ‘Crocidosema marchellurri’ (Walsm.)”, in which he reported upon his having reared 34 specimens, including many which “exactly match the figure given by Walsingham. . . .” He stated that:

My series of specimens were all reared from larvae in fruits of the native Hibiscus (*H. arnottianus*) collected from a tree along the Manoa Cliffs Trail of Mt. Tantalus, March 15th, 1914. It was the first time that I ever found fruits on a tree of the native Hibiscus, and I noticed that they were much eaten, so took along about two dozen of them (about all that I could conveniently obtain) to rear the moth from the numerous larvae infesting them. My 34 specimens emerged April 3rd to the 16th.

Mr. J. F. Rock told me once that he had found the fruits of this Hibiscus and other related trees in the mountains of Hawaii badly eaten by insects. I have no doubt [that] they were the larvae of this moth.

The eggs of the moth are laid on the outside of the enclosing calyx. On hatching the young larva eats through this, and feeds for a time between it and the fruit, finally eating inside of the fruit and destroying all of the seeds. In the lot of fruits that I collected were but three seeds remaining uninjured when the larvae had finished with them.

The young larvae have the head and cervical shield black. The full-grown larva is about 12 mm. in length, dirty whitish or yellowish with a rosy tinge; head very pale testaceous, eyes black, a black streak behind eyes and above this the posterior margin of the head is black; cervical shield concolorous, two submedian blackish spots at posterior margin; spiracles circular, black margined; surface of body minutely roughened except circular areas at base of setae.

The pupa is about 7 mm. in length; yellowish brown; wing-sheaths and posterior leg-sheaths extend to apex of 4th abdominal segment, antenna-sheaths a little shorter; two transverse rows of small backwardly-directed spines on dorsum of abdominal segments 2–7, those of the anterior row the larger, one row on segments 8 and 9; cremaster blunt, with two lateral and two dorsal spines.

In 1933:^302, Dr. Swezey reported: “One specimen . . . was reared from a larva found boring in a petiole of leaf of *Abortopetalum sandwicense* in Makaha Valley, 1850 ft. elevation, March 30, 1933, by Mr. Glenn Russ. Five specimens were reared from the same plant in Kamokuiki Valley, about 2000 ft. elevation, Waianae Mts., April 13, 1933 (Swezey and Williams). The petioles in which larvae are boring become considerably swollen. The only previous rearing of this moth was from fruits of *Hibiscus arnottianus* on Mt. Tantalus, 1914 and 1924 (Swezey).”

Although this form appears to be very close to *blackburnii*, it does appear to be a distinct species with different habits. I have been able to separate the moths I have seen from those of *blackburnii* by external appearance and by the structure of the female genitalia as noted in the key. I have, however, been surprised to have been unable to find any reliable differences in the male genitalia.

**Genus EPINOTIA** Hübner


See Heinrich, 1923:194, for redescription, discussion and extensive synonymy.

*Epinotia* is a large, widespread genus whose only representative in Hawaii has been purposely introduced to assist in the biological control of *Lantana*. It is closely similar to *Crocidosema*, and one can only wonder whether the species in Hawaii is really generically distinct from *Crocidosema*. The females are closely similar, but the male genital valvae of *Crocidosema* each has a conspicuous longitudinal “rib” on the ectal surface which is distinctive.
Epinotia lantana (Busck) (figs. 417, head, wing venation; 417–A, g–i, pupa; 418, moth, male genitalia; 419, female genitalia; 420, larva).

Crocidoosema lantana Busck, 1910b:132. Swezey, 1924:76, fig. 3.

Epinotia lantana (Busck) Heinrich, 1923:190.


The lantana flower-cluster moth (lantana tortricid moth).

Kauai, Oahu (type locality: Mt. Tantalus, Honolulu; type 13149 in U.S. National Museum), Molokai, Maui, Hawaii.

Purposely introduced by Koebele from Mexico in 1902 to aid in the control of the Lantana weed pest.

Hostplants: Bignonia chrysantha (in pods), Lantana (in flower heads, feeds on berries and bores in tender twigs), litchi (in stem), Tecoma stans (in terminal twigs).

Parasites: Bracon mellitor Say, Perisierola emigrata Rohwer, Pristomerus hawaiiensis Perkins.

Predator: Pachodynerus nasidens (Latreille).

In 1924, Dr. Swezey reported that the...
count made of the flower clusters on some lantana bushes, showed that 73% of them were infested by
the larvae and a few of the larvae of the plume moth. On the same bushes the older flower heads showed
a 65% destruction by the Tortricid larvae. Of this 65%, 26% had been destroyed by the larvae boring in
the peduncle or flower stem and thus killing it before the flowers were developed; 39% of them had flowered,
but the flowers had been eaten off or sufficiently injured so that no fruits had been produced. Of the re-
mainining 35% of flower clusters that had produced fruits, there was an average of but 4.17 fruits per cluster
as compared with 37.2 the normal average of flowers per cluster. This enormous reduction was largely due
to the moth larvae, though the butterfly larvae and also the Tingid bug may have had a share in it.

In many places the general appearances indicated almost an entire destruction of flower clusters by
the Tortricid and plume moth larvae, though no actual count was made for comparison.

The eggs are laid in the flower heads, often before the blossoms open, and are attached to the surface of
a bract or other part of the flower. Length about 0.5 mm., flattish, nearly circular, upper surface evenly convex,
covered with a fine reticulation, pale yellowish and slightly iridescent.

The full grown larva is about 6 mm. long, fuscous colored, with a slight reddish tinge, the head black,
and a black spot on dorsum of first thoracic segment. Pupation takes place within the place where the larva
fed, either in the receptacle of the flower cluster or webbed-together remains of the flowers or fruits. The
pupa is brown, about 5 mm. long, and has transverse rows of short spines on the abdominal segments.

In some districts of the Islands and at certain times, this insect accomplishes more than any other in the
prevention of lantana seed formation. (Swezey in Perkins and Swezey, 1924).

About 1914, this moth was purposely introduced from Hawaii into Australia
where it has become widespread along the east coast where Lantana grows. Turner failed to recognize it as the introduced species, and he described three
of its color forms as supposedly new Queensland endemics. For details con-
cerning these facts, see Common, 1957:230. In 1948 and 1949, the moth was
sent by Pemberton from Honolulu to Ponape in the Caroline Islands where
it became established on the Lantana pest.

Figure 417-A—Details of the caudac of some tortricid pupae. a, b, c, lateral, dorsal, and caudal aspects
of Eccoptocera species; Olinda, Maui, ex Metrosideros; length 7 mm. d, e, f, the same of Strepsicrates smithiana
Walsingham; Panaewa Forest, Hilo, Hawaii; ex Myrica cerifera; length 7.5 mm. g, h, i, the same of Epinotia
lantana (Busck); Honolulu; ex Tecoma stans; length 5.5 mm.
Figure 418—*Epinotia lantana* (Busck). Top, a moth from Manoa, Oahu; expanse 13 mm. Middle, male genitalia from a paratype from Mt Tantalus, Oahu (BM slide 1876). Bottom, a specimen from Honolulu (BM slide 5431).
Figure 419—Female genitalia of *Epinotia lantana* (Busck). Top, from a specimen from Manoa, Oahu (Busck slide 226). Bottom, the area of the ostium from another Honolulu specimen (BM slide 5400).
Figure 420—See legend on page 637.
Genus **EPISIMUS** Walsingham

*Episimus* Walsingham, 1892 (1891):501; 1897:122. Type-species: *Carpocapsa transferrana* Walker.

Heinrich, 1926:78, redescription and illustrations.

*Episimus* is American, and, although some of the species range as far north as southern Canada, the genus is predominantly tropical. A purposely introduced species represents the genus in Hawaii.

**Episimus utilis** Zimmerman, new species (figs. 421, head and wing venation; 422, moths; 423, male, female genitalia; 425, larva and pupa; 426, pupa).

**Episimus argutanus**, as a misidentification, not of Clemens, 1860:358.

Closely similar in color pattern to *argutanus*, variable, but usually paler, especially in the male, that sex having a pale area containing many white areas.
Figure 422—Male, top, and female *Episimus utilis* Zimmerman; Mapulehu, Molokai; reared from *Schinus* by J. W. Beardsley; expanse about 14 mm.
squamae extending from near base to about the distal two-thirds of the posterior margin of the forewing and expanded moderately costad at midwing, but this pale area obscured by more contained dark maculation in the female (see figure 422). Sides of metanotum (metascutum) clothed with mostly long, slender squamae with a cluster of long hairs on ectal edges (in argutanus, clothed entirely with broad or very broad, apically broadly truncate or subtruncate squamae). Male genitalia with uncus slender and needlelike (dorsoventrally broader and more bladelike in argutanus), with the ectal angle between the ventral margin of the valva and the ventral process of the margin of the valva much broader in utilis and approximating 130° (instead of about 90°–100° in argutanus), and the aedeagus appears comparatively shorter and apically broader in utilis. Female genitalia evidently closely similar to argutanus. Larvae and pupae differing from argutanus as described below.

Holotype: male, from Wailupe Valley, Oahu, Hawaii; taken in a light trap by J. W. Beardsley in December, 1958. Allotype: female, from Ewa, Oahu, taken in a light trap by J. W. Beardsley, December 2, 1958. One male paratype with the same data as the holotype but collected on February 15, 1959 (wings on BM slide 6201); one male paratype with the same data as the allotype (male genitalia on slide BM 6211); one male paratype bred on Schinus in the laboratory in Honolulu, January, 1960 (genitalia on slide BM 6213); one female paratype with the same data (genitalia on slide BM 6114), and three male paratypes with the same data. All of these specimens are in the British Museum (Natural History).

Kauai, Oahu, Molokai, Maui, Hawaii.

Purposely introduced from Rio de Janeiro and Salvador, Bahia, Brazil in 1954, by the Hawaiian Department of Agriculture.

Hostplant: Schinus terebinthifolius (Christmas berry, Brazilian peppertree).

Parasite: Bracon omiodivorum (Terry).

The original stock for the importation of this species to Hawaii was collected in Brazil by Noel Krauss, and it was introduced to assist in the biological control of the Christmas berry, a pasture and range pest in Hawaii. The larvae web together and feed upon the leaves of the hostplant. The first Hawaiian liberation consisted of 200 adults which were released at Naalehu, Hawaii in December, 1954 (see Krauss, 1963:281). J. W. Beardsley first recorded it in the literature in 1959 as being established in the Hawaiian Islands (Proc. Hawaiian Ent. Soc. 17:28), after he had found the species on Molokai in 1958. He noted that the moth had been found to be established on Kauai, Oahu, Maui, and Hawaii by 1957 or earlier.

I am indebted to J. D. Bradley, J. F. G. Clarke, and Margaret MacKay for comments regarding this species. Miss MacKay most kindly illustrated the larva and pupa and provided some descriptive notes which I have rearranged as follows:

**Larva:** Length of largest larvae is about 15 mm. Length and width, respectively, of the heads of two specimens: 1.08 mm. and 1.22 mm.; 1.05 mm. and 1.13 mm. Head pale, sometimes tinged with reddish, with a distinct blackish
Figure 423—Episimus utilis Zimmerman. Male genitalia (BM slide 6211); Ewa, Oahu. Female genitalia (BM slide 6114); Honolulu.
ocellar area and bar extending anteriorly from postgenal juncture almost to the ocellar area. Thoracic shield pale, edged laterally with a narrow area of brown. Lateral pinaculum on prothorax with some brown pigment. Thoracic legs pale. Body color pale, sometimes tinged with reddish, or bright red. Pinacula of body color or slightly darker, easily observed. Spinules slender, dark, easily observed. Other characters as illustrated.

DISTINCTIVE SPECIFIC CHARACTERS: A distinct dark lateral bar is present on head; thoracic shield narrowly edged laterally with brown, and prothoracic lateral pinaculum with some brown pigment; each D1 seta on abdominal segment 9 on its own pinaculum which is equidistant from those of SD1 and D2 or occasionally fused with that of D2; D1 on anal shield as long as SD1 or almost so.

PUPA: with specific characters as compared with Episimus argutanus—proboscis extending posteriorly to caudal tip of prothoracic femur; caudal row of spines on abdominal tergite 8 present in both sexes and distinct; with a considerably greater number of spines on abdominal segments 9 and 10 than on argutanus; length of pupa: 6.5–7.0 mm. (On argutanus, the proboscis distinctly does not extend to the caudal tip of the prothoracic femur; the caudal row of spines on the 8th abdominal tergite of the female is absent and on the male there are only four or five widely spaced spines; spines on abdominal tergites 9 and 10 sparse; length of pupa about 5.0 mm.)
spinules sparse, slender, dark

Figure 425—See legend on page 643.
Figure 426—Pupa of *Episimus utilis* Zimmerman; female, length 12 mm.; Honolulu, laboratory reared. A sketch of the cauda in left lateral aspect is inset. A, antenna; Cx2, mesocoxa; f1, profemora; t1, t2, t3, legs; mx, galea of maxilla (proboscis); W2, hindwing.

Figure 425—Details of the larva and pupa of *Episimus utilis* Zimmerman, drawn especially for this text by Margaret MacKay. a, setal map of the pro- and mesothorax and abdominal segments 1, 2, 6, 7; b, setal map of abdominal segments 8 and 9, in left aspect; c, dorsal setae and pinacula of an anterior abdominal segment together with an enlargement of the spinules of the derm; d, frontal aspect of head; e, ocellar area of the left side and the "lateral bar"; f, anal fork; g, ventral aspect of a male pupa; h, dorsal aspect of segments 8 to 10 of the male pupa; i, crochets of a mid-abdominal and a caudal proleg; j, the V1 setae on the mid-ventral line of abdominal segments 7, 8, and 9; k, dorsal aspect of abdominal segments 8, 9, and 10.
Superfamily **GRACILLARIOIDEA** (Stainton)


**Family GRACILLARIIDAE** Stainton


*Gracilaridae*: Staudinger and Wocke, 1871:310.

*Gracilarianae*: Walsingham, 1890:150.

*Gracilariadae*: Meyrick, 1912b:25; 1912c.

*Gracillariidae*: McDunnough, 1939:95.

*Ornichidae* Stainton, 1854:10 (used by error? in key; nomen oblitum).


*Phyllorycteridae* Walsingham, 1914:336 (1909–1915) [recte Phyllonorycteridae].

*Eucostidae* Hampson, 19186:387.

*Caloptiliadae* Fletcher, 1929:v.

*Caloptiliidae*, auctorum.

Much confusion exists regarding the spelling of the name *Gracillaria*. Haworth (1828:527) originally spelled it *Gracillaria*, but some of us believe that he misspelled the name which is derived from the Latin *gracilis*, “slender”, in reference to the slender appearance of the tiny moths. Haworth drew attention to this characteristic by calling them “the slenders”; he named them “the livid slender”, “the violaceous slender”, “the buff-blotched slender”, etc. In 1839, Zeller, who was evidently well-versed in the classics, corrected the spelling to *Gracilaria*. The classical scholars who assisted the Oxford and Cambridge entomological societies in the preparation of the useful work *An Accentuated List of the British Lepidoptera with Hints on the Derivation of the Names* (Anonymous, 1858) used the corrected spelling *Gracilaria*. Meyrick, a teacher of the classics, used *Gracilaria*, and many experienced and well-known authorities have accepted the emendation. The corrected spelling *Gracilaria* was used by Zeller, Herrich-Schäffer, Stainton, Heinemann, Meyrick, Walsingham, Butler, Hampson, Tutt, Chapman, Börner, Handlirsch, Mosher, Comstock, Clemens, Forbes, Fracker, Busck, Dyar, Ely, Braun, Costa Lima, Packard, Imms, Tillyard, Turner, Swezey, Brues, Melander and Carpenter, and many, many other authorities. To obtain stability in the use of the terms *Gracilaria* and *Gracilariidae*, N. D. Riley and I appealed to the International Commission on Zoological Nomenclature to have the names placed on the Official Lists of accepted names. See Zimmerman and Riley, 1966, 1967; Whalley et al., in Whalley, 1967; Common and Key, 1967.

Much to my astonishment and dismay, long after this text was completed and the form *Gracilaria* used scores of times throughout the work, the Commission voted to refuse our appeal and to revert to what I consider to be the erroneous spelling *Gracillaria*. I believe that they did so without independent...
research into the questions involved. Supplementary evidence supplied by me emphasizing the overwhelming usage of the corrected form *Gracilaria* was not circulated to the members of the Commission (and evidently not shown to the Secretary until several months after I submitted it, and then only after a complaint by me). Before submitting our application for the preservation of the corrected form *Gracilaria*, detailed and prolonged examinations of a large number of books and articles were made by us, and we ascertained conclusively that, without question, the corrected form *Gracilaria* has been used by more than 75 percent, and possibly 90 percent, of those authors who have had occasion to use the name since 1839. With few exceptions, it has been only within the last comparatively few years that a few workers, including several of those who have opposed our application on the grounds that they believe it best to follow absolute priority, have used the erroneously formed but original spelling *Gracillaria*. In effect, most of the members of the Commission evidently listened to the opposition to our proposal without making an independent investigation or consulting us, and I consider this to be unfortunate.

The ruling on the Gracillaria problem is included as Opinion 912, *Bull. Zool. Nomenclature* 27(1):27, 1970. I was astounded to see Opinion 905 on page 6 of the same part of the same publication in which the Commission has approved the emendation of *Pollyxenus* to *Polyxenus*! One can only ask: how is it possible for a supposedly impartial Commission to approve the logical application of Dr. Kraus to correct *Pollyxenus* to *Polyxenus* but refuse to accept our plea for exactly the same kind of correction from an erroneously formed *Gracillaria* to *Gracilaria*? If Dr. Kraus was thought correct, then our application, being entirely comparable and having been accepted by the overwhelming majority of authors since 1839, should also have been accepted. How can the Commission have it both ways? Professor Bonnet’s *A Plea Against the Re-Establishment of Incorrectly Spelt Names* [Bull. Zool. Nomenclature 23 (3/4): 160, 1969] is suggested reading in connection with this case.

Because of the Commission’s ruling, I have been obliged to alter the spelling as I had used it many, many times in this text. I can only hope that all of the alterations have been made in the right places and that no further confusion has been introduced.

Vari included a key to the genera of Gracillariidae in his important, well-illustrated volume on the South African species (1961), but he overlooked the Hawaiian *Philodoria*, evidently because some workers had placed it incorrectly in the Glyphipterigidae. His illustrations of various characters of the type-species of most of the genera of the family are of great assistance. It is unfortunate that Vari wrongly chose to use the family name Lithocolletidae instead of Gracillariidae.

Stainton, in his work on British Microlepidoptera (1854:193), said that “the species of this family sit on their tails, having the head considerably raised from the surface on which they repose, the anterior pair of legs being put forward, the middle pair rather stretched out sideways, and the posterior pair placed close beside the abdomen; by this peculiarity any species of this family may be immediately recognized if seen at rest.” Vari (1961:xii) observed that “the peculiar posture of most species of the imagines is characteristic for this family. The anterior part of the insect is elevated and the fore and middle legs
prominently displayed. In Cuphodes and Lithocolletis, however, the head is kept down, the abdomen lifted and supported by the hind legs, the fore and middle legs stretched forwards. I regret that I cannot record details regarding the postures of the Hawaiian endemics, but see the note under Caloptilia.

This is a group of mostly highly colored, beautiful little leaf miners that are now represented in Hawaii by three genera, one of which has been purposely introduced for biological control purposes, one accidentally imported, and one extensively speciated endemic group.

KEY TO THE GENERA OF GRACILLARIIDAE IN HAWAII

1. Head with scaling of front shaggily overlapping anterior parts of eyes, and crown with erect, bristling vestiture; labial palpi short and drooping; wing venation much reduced, as in figure 427........... Cremastobombycia. Head all smooth-scaled; labial palpi long and sickle-shaped; wings with more complex venation as in figures 432–433.................................................................2

2. Middle tibiae thickened by heavy scaling and obviously thicker than posterior tibiae (figure 443); posterior tarsi very long, more than twice as long as posterior tibiae; wings as in figure 432.............. Caloptilia. Middle tibiae slender and clothed as posterior tibiae; posterior tibiae about three-fourths as long as posterior tarsi; wings as in figures 432–435..........Philodoria.

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Figure 427—Head and wing venation of Cremastobombycia lantanella Busck; paratype, Honolulu (BM slide 5139).
Genus **CREMASTOBOMBYCIA** (Braun)


This is a small American genus, one species of which has been purposely introduced to Hawaii.

*Cremastobombycia lantanella* Busck (figs. 427, head, venation; 428, moth, larva, pupa, cocoon; 429, moth, male and female genitalia).


*Cremastobombycia lantanella* Busck, 1910b:133. Swezey, 1924:78, fig. 5.

The lantana leaf miner.

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

Introduced purposely from Mexico in 1902 to aid in the control of the *Lantana* weed pest.

![Figure 428](image-url)

**Figure 428**—*Cremastobombycia lantanella* Busck. *a*, larva; *b*, lateral aspect of pupa; *c*, cocoon suspended within a larval mine in a lantana leaf; *d*, the moth. (After Kotinsky, 1906:123.)
Figure 429—Cremastobombycia lantanella Busck. Top, a specimen from Palolo, Oahu; forewing = 2.75 mm. Middle, female genitalia, Puu Kapele, Kauai (slide Z-VII-1–61–A). Bottom, male genitalia, Waipio, Oahu (slide Z–VII–1–61); the aedeagus is at the left and the left valva is in the middle.
Hostplant: *Lantana*.


The larva makes a large bulged or inflated mine on the leaf of *Lantana*, equally visible on both sides of the leaf. It makes a white, spindle-shaped, slender cocoon, suspended within the mine by silken threads from each end like a hammock. (Busck, 1910b: 133.)

This tiny little moth is very abundant everywhere in the Islands wherever the lantana is growing. It is very light brown with whitish bars on the fore wings, and about 7 mm. with wings expanded. Its larvae feed inside the leaves, producing the appearance of dead spots on the leaves. Count of mines in a lot of leaves gave an average of 5.65. There may be as many of them as a dozen to twenty per leaf and the result is to destroy the leaf, or at the least to cripple it so that it is of very little use to the plant. Where all the leaves are thus attacked it interferes greatly with the welfare of the plant and tends to check its normal growth and lessens its ability to produce flowers and fruit.

The larva is very pale green and by the time it is full grown has produced an irregular blotch mine and the leaf has crinkled in such a way that a space is formed between the upper epidermis and lower epidermis. In this space the larva constructs a white, spindle-shaped ribbed cocoon about 5 mm. long, having a delicate silken thread attached at each end, so that the cocoon is suspended hammock-like within the space. The transformation to pupa and adult moth takes place within this cocoon. (Swezey, 1924: 78.)

The method of suspending the cocoon in the mine is interesting, and this led Miss Braun to form the name *Cremastobombycia*, meaning "suspended cocoon".

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Figure 430—Details of the pupa of *Cremastobombycia lantanella* Busck. *a*, ventral aspect; *b*, dorsal aspect of head and part of thorax; *c*, outline of lateral aspect of head; *d*, lateral aspect of the three caudal abdominal segments; *e*, dorsal aspect of the caudal segment. *b*—*e* are drawn to a larger scale.
Genus **CALOPTILIA** Hübner


*Gracilaria* (Haworth) Zeller, 1839:208, corrected spelling. Meyrick, 1907^:64, incorrectly designated *alchimella* Scopoli as type-species.


*Caloptilia* is a large and widespread genus. More than 50 species occur in America north of Mexico, and a larger number is known from Eurasia. The generic name *Caloptilia* has not appeared in Hawaiian literature heretofore, but I have found that one of the species previously assigned to *Parectopa* in Hawaii is really a *Caloptilia* and is not related to the endemic complex. The wing shape and venation (see figure 432) is like no other genus now known from Hawaii. The characters of the legs and wings, as noted in the generic key, make comparatively easy the identification of this genus among the other *Gracillariidae* known to be established in Hawaii.

For a recent, well-illustrated report on some of the Japanese species of *Caloptilia*, see Kumata, 1966.

Some authors consider *Gracillaria* to be a subgenus of *Caloptilia* instead of a synonym. See Vari, 1961:27, for example.

*Caloptilia mabaella* (Swezey), **new combination** (figs. 431, male and female genitalia; 432, venation; 439, cocoon; 443, moth; col. pl. 3:1).

*Gracillaria mabaella* Swezey, 1910a:89, pl. 3, fig. 6.

*Parectopa mabaella* (Swezey) Swezey, 1928d:190.

The Hawaiian ebony leaf miner.

Oahu (type locality: Niu Ridge).

Immigrant. Although this species is not now recognized from any locality outside of Hawaii, I believe that it is an introduced insect. It appears similar to some Japanese and American *Caloptilia*, and it is probable that it has been introduced from Japan or from North America.

Hostplants: *Diospyros (= Maba) Hillebrandii, Diospyros sandwicensis.*

Parasites: *Euderus metallicus* (Ashmead), *Sierola gracilariae* Fullaway.
Figure 431—Male and female genitalia of *Caloptilia mabaella* (Swezey). Top, a specimen from Kuliouou, Oahu (slide Z-VI-15-61). Middle, a specimen from Makua, Oahu (slide Z-1-24-61-3). Bottom, female genitalia of a specimen from the same locality (slide Z-V-16-61).
The usual form of mine begins near margin of leaf towards base, approaches the margin, then follows it to near apex, thence to midrib which it follows downward, soon widening quite regularly to a broad blotch extending nearly or quite to the base of the leaf. On the old leaves these blotches are conspicuous by their having become blackened after the emergence of the larva.

The larva emerges from the mine to construct its cocoon, which is rounded-oval, white and parchment-like, about 7 mm. long by 4 mm. wide, and is made on the surface of the leaf in a depression, or a slight fold at the margin.

The resting position of the moth is with the anterior end of the body raised at an angle of 45°, supported by the fore and middle legs which are placed together, the hind legs being extended backward beneath the body and concealed by the wings, whose tips touch the surface of the leaf. The antennae are folded on the back. (Swezey, 1910a: 89–90.)

The resting position, as described by Dr. Swezey, is characteristic of Caloptilia and has been noted by other authors elsewhere.

There is an error in the original description. In line 11 of the first paragraph, read "Fore and middle femora..." instead of "Fore and hind femora..."

Genus PHILODORIA Walsingham

Philodoria Walsingham, 1907b: 717. Type-species: Philodoria sucedanea Walsingham, by original designation.

Philodoria is an endemic genus of beautiful, mostly highly colored, tiny leaf miners. Some of the species have the general facies of some species of the

![Image of Philodoria and Caloptilia](image-url)

Figure 432—Philodoria and Caloptilia. Top, head and wing venation of Philodoria (Eophilodoria) marginestrigata (Walsingham), holotype male (slide BM 2866). Note the maxillary palpus at MP. Bottom, wing venation of a male Caloptilia mahaella (Swezey) (slide Z-V-20-61-3); Makua, Oahu, ex Maba.
widespread genus *Phyllonorycter* ( = *Lithocolletis*), and the genitalia appear to be rather close to the type found in that genus. There are also similarities to some *Caloptilia* ( = *Gracillaria*) (figures 435–436). These groups are distinct, however; the wing venation and other features are different. *Philodoria* was placed originally in the Tineidae by Walsingham, and Meyrick, (1912b: 3, 1914rf: 25) assigned it incorrectly to the Glyphipterygidae.

The long antennae may be as long or longer than the wings, and the first segment lacks a pecten. The labial palpi are slender, smooth scaled, rather drooping, and as figured. The maxillary palpi are developed, reduced, or obsolete. The proboscis is developed. Ocelli are absent. The head and thorax are smooth scaled. The forewings are narrow, as illustrated, and have 11 or 12 veins with parts of veins 4 to 7 often faint or obsolescent and somewhat

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**Figure 433**—Head and wing venation of *Philodoria (Philodoria) succedanea* Walsingham, holotype male; Haleakala, 4,000 feet, Maui (BM slide 2755). The point where veins 6+7 begins varies in this genus, and vein 5 may share the same stem. Note the absence of maxillary palpi. Compare figure 432.

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**Figure 434**—Head and wing venation of the female holotype of *Philodoria (Philodoria) spilota* (Walsingham) which was described erroneously as an “Elachista”. The head is badly abraded. BM slide 2039. Compare figure 433.
confused; vein 6 is evidently subject to partial or entire loss. The hindwings are very narrow, with only 7 veins; vein 8 short, bearing bristles at apex on costa; vein 5 stalked with 6 which is out of 7; cell apex open between veins 3 + 4 and 5, and veins 2 and 3 + 4 are stalked. The legs are slender and the genitalia are as illustrated. The ovipositor is very short and the eggs are deposited on the leaf surfaces. In the pupa, the hindleg cases reach to the end of the abdomen, and the antennal cases extend distinctly beyond the apex of the abdomen.

Much confusion has existed concerning this genus. Walsingham said in the original description that ocelli are present, but that was a serious error. The group lacks ocelli.

Figure 435—Wing venations of Gracillariidae. Top, Philodoria succedanea Walsingham; Hawaii. Middle, Caloptilia (Gracillaria) syringella (Fabricius), the type-species of Gracillaria; Europe. Bottom, Parectopa lespedezafofotella Clemens, the type-species of Parectopa; North America.
When Walsingham (and Durrant) reported upon this group in *Fauna Hawaiiensis*, he listed seven species in *Philodoria* and two species in "*Gracilaria*". Another species was erroneously placed in "*Elachista*". Walsingham separated *Philodoria* from "*Gracilaria*" because of the presence of maxillary palpi in what he called "*Gracilaria*" and the apparent lack of these organs in *Philodoria*. However, one of the species (*nigrella*) which he placed in *Philodoria* has developed maxillary palpi which he apparently overlooked, so *nigrella* should have been placed in "*Gracilaria*" according to the Walsingham-Durrant plan.

Many years after the publication of Walsingham's *Fauna Hawaiiensis* report, Meyrick (1928: 104) said that "the Hawaiian species placed by Walsingham in *Gracilaria* belong properly to *Parectopa*, well represented in America." He placed them in the Gracilariidae. Species supposedly belonging to *Parectopa* (type-species: the American *Parectopa lespedezaefoliella* Clemens, figures 435–436) have been described from many localities from America, through Europe, and out to Samoa. There are about 10 species listed for North America. When

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**Figure 436**—Male genitalia of the type-species of two non-Hawaiian genera of Gracillariidae. Various endemic Hawaiian species have been incorrectly assigned to these genera. Left, *Parectopa lespedezaefoliella* Clemens (USNM slide 3789 Clarke). Right, *Caloptilia (Gracillaria) syringella* (Fabricius) (USNM slide 3783 Clarke).
Figure 437—Top, larval mines of Philodoria hibisciella (Swezey) in a leaf of an endemic Hibiscus; Oahu. Bottom, mines of Philodoria hauicola (Swezey) in a leaf of Hibiscus tiliaceus; Oahu. (Photographs supplied by C. J. Davis.)
I began my study, I found generic differences between the Hawaiian species assigned to *Parectopa* and the type-species of the genus, including differences in the male and female genitalia. After considerable study and much thought, I have reached the surprising conclusion that the many species in Hawaii, heretofore assigned to *Parectopa* because they have maxillary palpi, and the many species placed in *Philodoria* because they are supposed to lack maxillary palpi, all belong to one genus; and, astonishing as it may appear, the presence or apparent absence of maxillary palpi in this group is subject to specific variation. The wing venation, genitalia, and other features of the two groups are identical. There are more differences in characters of the male genitalia between species assigned to *Philodoria* than there are between the genitalia of those here assigned to *Eophilodoria* and various species assigned to *Philodoria*. To include two groups of species in the same genus when one apparently lacks maxillary palpi and the other has them well-developed appears to be absurd and inadmissible “lumping”. I am as astonished by this as will be most of my readers. However, we have here another example of the unusual features of the magnificent and astounding Hawaiian biota. Moreover, although the fact is not well known, many genera of Lepidoptera display such great differences in the development of the maxillary palpi. Sattler (1967, pl. 11), for example, has illustrated the palpi of *Ethmia*, and he demonstrated that the maxillary palpi vary from one to four segments and the labial palpi may have two or three segments within that one genus.

Figure 438—*Philodoria hauicola* (Swezey) larva in its mine in a leaf of *Hibiscus tiliaceus*; enlarged five times. (Drawn by S. N. A. Jacobs.)
Figure 439—Top, cocoon of Philodoria (Eophilodoria) lipochaetaella (Swezey); length 5 mm. Bottom, cocoon of Caloptilia mabaela (Swezey); total length including the protruding pupal skin, 10.5 mm.
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For the present, at least, it will be appropriate for reasons of convenience to
use subgeneric or group names to separate the two sections. It appears that
various species at various times have given rise to species or groups of species
with greatly reduced or vestigial maxillary palpi and which now may be
assigned to Philodoria, sensu stricto. Philodoria, sensu stricto, is not a monophyletic
group. If one examines carefully some specimens of Philodoria, sensu stricto, it is
possible to see rudiments of the obsolescent maxillary palpi, and other species
have the maxillary palpi variously developed from very small to distinctly
formed, although greatly reduced as compared with those of Eophilodoria.
The development of these organs is probably controlled by a relatively simple
genetic mechanism. The two groups may be defined as follows:

KEY TO THE SUBGENERA OF PHILODORIA
1. Maxillary palpi developed (figure 432)
Eophilodoria.
2. Maxillary palpi greatly reduced, vestigial or obsolete
(figures 433-434)
Philodoria.
See color plate 3, figures 2-5.

The larvae mine the leaves of many kinds of broad-leaved plants. Some of
the species pupate within the larval mines, but others emerge from their mines
to pupate. No detailed, accurate, descriptive report has yet been prepared on
the early stages. [For comparative studies of a related group, see Jayewickreme,
1940:74, who has described and illustrated some features of the European

Parectopa syringella (Fabricius).]

We owe most of what we know about the biologies of these wonderful little
leaf miners to Dr. Swezey who took special interest in rearing many of the

Figure 440—Details of the pupa of Philodoria hibiscella (Swezey) from a specimen from Honolulu;
length 4.4 mm. Left, ventral aspect. Top right, dorsal aspect of head and pronotum, further enlarged.
Bottom right, left aspect of caudal parts of abdomen and appendages.


species. Our knowledge is, however, widely incomplete, and much confusion exists in the published record and in collections. A large amount of work remains to be done on the group, and there are many new species to be recorded.

The hostplant relationships of the species are most interesting, and the known hostplants are given in summary in the following list. It is obvious from a study of this list that there must be a large number of unrecorded species of Philodoria. It will be noted that *Eophilodoria nanaeiella* (on two genera of Compositae), *Philodoria neraudicola* (on two genera of Urticaceae), and *Eophilodoria marginestrigata* (on four genera in the Compositae, Malvaceae, and Ambrosiaceae) have each been recorded from more than one host genus, whereas all of the other species known appear to be restricted to single plant genera. *Eophilodoria marginestrigata* attacks several species of introduced weeds, a most unusual habit for an autochthonous insect. The host genus with the most species recorded from it thus far is *Pipturus* (in the Urticaceae), and it has seven species of *Philodoria, sensu stricto*, attached to it, but only one *Eophilodoria*. *Dubautia*, in the Compositae, has six species of *Eophilodoria* but no known *Philodoria, sensu stricto*, recorded from it. It is strange that the common, widely distributed, endemic Hawaiian species of *Acacia*, which are the hosts of multitudes of Hawaiian insects, are not represented in the hostplant lists. One wonders why it is that there is not more sharing of hosts between *Philodoria* and *Eophilodoria*. Much remains to be learned about the hosts of these beautiful little moths.

The larvae have the thoracic legs partly reduced, and there are ventral prolegs only on abdominal segments 3, 4, and 5. Thus, there are only three, instead of the normal four, pairs of ventral prolegs. The vertical triangle of the head is deep and narrow. The prosternum is armed with a large, pigmented, nodulose pad which evidently assists in the movement of the larva within its mine; there is a pair of less-developed pigmented areas on the pronotum which serve a similar purpose.

The pupae of several species examined by me have broad bands of multitudes of spinules on the abdominal tergites, excepting the first, and which are also reduced on the caudal tergites; the hindlegs extend to near the apex of the abdomen, and the antennae extend much beyond the end of the abdomen (see figure 440). The spiracles are small and the dorsal setae are inconspicuous. *Chedra* pupae may appear to be somewhat similar because of their long legs and antennae, but they are basically very different (see the discussion under *Chedra* in the Momphinae of the Gelechiidae).

The plant family names in the following list are in small capital letters, the plant genera are in boldface type, and the moth names are in italic type.

### HOSTPLANT LIST OF PHILODORIA

**UNKNOWN**

*Eophilodoria epibathra* (Walsingham), Molokai.

*Eophilodoria nigrella* (Walsingham), Hawaii; possibly on *Dubautia*.

*Philodoria spilota* (Walsingham), Maui; possibly on *Pipturus*. 
AMBROSIACEAE

**Xanthium**
Eophilodoria marginestrigata (Walsingham), Nihoa, Kauai, Oahu, Molokai, Hawaii.

CAMPANULACEAE

**Clermontia**
Philodoria species, Maui.

COMPOSITAE

**Argyroxyphium** (*Wilkesia*)
Philodoria wilkesiella Swezey, Maui.

**Dubautia** (*Railliardia*)
Eophilodoria dubauticola (Swezey), Maui.
Eophilodoria dubautiella (Swezey), Oahu.
Eophilodoria marginestrigata (Walsingham), Nihoa, Kauai, Oahu, Molokai, Hawaii.
Eophilodoria naenaeiella (Swezey), Oahu.
Eophilodoria nigrelloides (Swezey), Kauai.
Eophilodoria species, possibly confused with naenaeiella, Kauai.

**Hesperomannia**
Eophilodoria naenaeiella (Swezey)?, Oahu.

**Lipochaeta**
Eophilodoria lipochaetaella (Swezey), Maui.
Eophilodoria sciallactis (Meyrick), Oahu.

MALVACEAE

**Abutilon** (*Abortopetalum*)
Eophilodoria marginestrigata (Walsingham), Nihoa, Kauai, Oahu, Molokai, Hawaii.

**Hibiscus**
Eophilodoria hauicola (Swezey), Kauai, Oahu, Maui, Hawaii.
Eophilodoria hibiscella (Swezey), Oahu, Hawaii.

**Sida**
Eophilodoria marginestrigata (Walsingham), Nihoa, Kauai, Oahu, Molokai, Hawaii.

MYOPORACEAE

**Myoporum**

MYRSINACEAE

**Myrsine** (*Suttonia*)
Philodoria auromagnifica Walsingham, Maui, Hawaii.

MYRTACEAE

**Metrosideros**
Philodoria basalis Walsingham, Maui, Hawaii.
Philodoria splendidia Walsingham, Kauai, Oahu, Molokai, Lanai, Hawaii.
NYCTAGINACEAE

**Pisonia**

*Eophilodoria?* species, Oahu (see Swezey, 1954:167).

PITTOSPORACEAE

**Pittosporum**

*Eophilodoria pittosporella* (Swezey), Oahu.

PRIMULACEAE

**Lysimachia**

*Philodoria lysimachiella* Swezey, Oahu.

*Philodoria molokaiensis* Swezey, Molokai.

*Philodoria* species, Kauai (see Swezey, 1954:121).

URTICACEAE

**Neraudia**

*Eophilodoria neraudicola* (Swezey), Kauai, Oahu, Molokai, Hawaii.

**Pipturus**

*Eophilodoria neraudicola* (Swezey), Kauai, Oahu, Molokai, Hawaii.

*Philodoria costalis* Swezey, Oahu.

*Philodoria floscula* Walsingham, Molokai, Maui, Hawaii.

*Philodoria micropetala* Walsingham, Kauai.

*Philodoria pipturiana* Swezey, Hawaii.

*Philodoria pipturicola* Swezey, Oahu.

*Philodoria pipturiella* Swezey, Oahu.

**Touchardia**

*Eophilodoria touchardiella* (Swezey), Maui.

**Urera**

*Eophilodoria ureraella* (Swezey), Oahu.

*Eophilodoria urerana* (Swezey), Oahu, Hawaii.

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**DISTRIBUTION OF EOPHILODORIA AND PHILODORIA BY ISLAND**

A + sign following a species name indicates that it is found also on the other island or islands listed. If the type locality is an island other than that under which the species is listed, the word “type” is inserted following the type locality island.

**Nihoa, 1 species**

*Eophilodoria marginestrigata* (Walsingham), + Kauai, Oahu (type), Molokai, Hawaii
GRACILLARIIDAE

KAUAI, 8 species

**Eophilodoria haucicola** (Swezey), + Oahu (type), Maui, Hawaii

**Eophilodoria marginestrigata** (Walsingham), + Nihoa, Oahu (type), Molokai, Hawaii

**Eophilodoria neraudicola** (Swezey), + Oahu (type), Molokai, Hawaii

**Eophilodoria nigrelloides** (Swezey)

**Philodoria micropetala** Walsingham

**Philodoria splendidida** Walsingham, + Oahu, Molokai, Lanai (type), Hawaii

**Philodoria species**

OAHU, 17 species

**Eophilodoria dubautiella** (Swezey)

**Eophilodoria haucicola** (Swezey), + Kauai, Maui, Hawaii

**Eophilodoria hibiscella** (Swezey), + Hawaii

**Eophilodoria marginestrigata** (Walsingham), + Nihoa, Kauai, Molokai, Hawaii

**Eophilodoria naenaeiella** (Swezey)

**Eophilodoria neraudicola** (Swezey), + Kauai, Molokai, Hawaii

**Eophilodoria pittosporella** (Swezey)

**Eophilodoria sciallactis** (Meyrick)

**Eophilodoria ureraella** (Swezey)

**Eophilodoria urerana** (Swezey), + Hawaii

**Philodoria auromagnifica** Walsingham, + Molokai, Hawaii

**Philodoria costalis** Swezey

**Philodoria lysimachiella** Swezey

**Philodoria pipturiola** Swezey, + Maui

**Philodoria pipturiella** Swezey

**Philodoria splendidida** Walsingham, + Kauai, Molokai, Lanai (type), Hawaii

MOLOKAI, 7 species

**Eophilodoria epibathra** (Walsingham)

**Eophilodoria marginestrigata** (Walsingham), + Nihoa, Kauai, Oahu (type), Hawaii

**Eophilodoria neraudicola** (Swezey)

**Philodoria auromagnifica** Walsingham, + Oahu (type), Hawaii

**Philodoria floscula** Walsingham, + Maui, Hawaii (type)

**Philodoria molokaiensis** Swezey

**Philodoria splendidida** Walsingham, + Kauai, Oahu, Lanai (type), Hawaii

LANAI, 1 species

**Philodoria splendidida** Walsingham, + Kauai, Oahu, Molokai, Hawaii
**MAUI, 11 species**

- *Eophilodoria dubauticola* (Swezey)
- *Eophilodoria hauicola* (Swezey),
  + Kauai, Oahu (type), Hawaii
- *Eophilodoria lipochaetaella* (Swezey)
- *Eophilodoria touchardiella* (Swezey)

**HAWAII, 13 species**

- *Eophilodoria hauicola* (Swezey),
  + Kauai, Oahu (type), Maui
- *Eophilodoria hibiscella* (Swezey),
  + Oahu (type)
- *Eophilodoria marginestrigata* (Walsingham), Nihoa, Kauai, Oahu (type), Molokai
- *Eophilodoria neraudicola* (Swezey),
  + Kauai, Oahu (type), Molokai
- *Eophilodoria nigrella* (Walsingham)
- *Eophilodoria species*
- *Eophilodoria urerana* (Swezey),
  + Oahu (type)

*Philodoria basalis* Walsingham,
+ Hawaii

*Philodoria fioscula* Walsingham,
+ Molokai, Hawaii (type)

*Philodoria pipturicola* Swezey,
+ Oahu

*Philodoria species*

*Philodoria splita* (Walsingham)

*Philodoria succedanea* Walsingham,
+ Hawaii

*Philodoria wilksesiella* Swezey

Our knowledge of the geographical distribution of the species is fragmentary. It is surprising, however, that so many of these tiny moths are so widely spread over the islands. The greater number of species listed from Oahu probably reflects only the greater amount of collecting which has been done there. Lanai no doubt has several species, and all of the other islands surely have more species than those listed here. It is interesting that there are about twice as many *Eophilodoria* as *Philodoria* reported from Oahu, whereas, on Maui, the situation is reversed.
Subgenus **EOPHILODORIA** Zimmerman, new subgenus

Type-species: *Gracilaria marginestrigata* Walsingham, 1907b:721.

"Parectopa", in the sense of Meyrick and Swezey, not of Clemens. Similar to *Philodoria* but maxillary palpi fully developed.

**KEY TO THE SPECIES OF EOPHILODORIA**

1. Forewings with two or three oblique pale maculae from costa within basal three-fourths (the more basal one or two of these may or may not continue across the wing), or much of costal area pale......2
   Forewings with only one oblique pale macula from costa and this at about the distal one-fourth......8

2(1). Much of costal area pale, as in figure 446. .................*ureraella* (Swezey).
   Not so. ........................................3

3(2). Forewings with two oblique white or pale maculae from costa in basal three-fourths, as in figure 441. .................*dubauticola* (Swezey).
   Forewings with three oblique pale maculae from costa in basal three-fourths...........6

4(3). Forewing with a white submedial vitta in basal one-third (along plica), and posterior margin with only two white maculae, as in figure 441..........
   .................................*dubautiella* (Swezey).
   Forewings without such a white submedial vitta, and posterior margin with three white maculae....5

5(4). Forewings with the first oblique costal pale macula beginning basad of middle and very much longer than the second, as in figure 442.*hauicola* (Swezey).
   Forewings with the first oblique pale costal macula beginning at about middle and subequal in length to the second, as in figure 441..............
   .................................*sciallactis* (Meyrick).

6(3). Most of posterior edge of forewing white, as in figure 442.............*lipochaetaella* (Swezey).
   Posterior edge of forewing not mostly white.........7

7(6). Subbasal oblique white costal macula on forewing continued basad along costa to or about to wing base; second oblique white costal macula not continued distinctly across wing, as in figure 445
   .................................*sciallactis* (Meyrick).
Subbasal white costal macula on forewing distinctly separated from base of wing and continued more as a fascia directly across wing to posterior margin; second oblique white costal macula continued across the wing as a sub-\(\to\) shaped fascia; figure 443. \textbf{marginestrigata} (Walsingham).

\textbf{8(1).} Posterior margin of forewing almost continuously white, pattern as in figure 445; on \textit{Pittosporum}, Waianae Mountains, Oahu......................................................... \textbf{pittosporella} (Swezey).

Not so. ....................................................................................... \textbf{nigrelloides} (Swezey).

\textbf{9(8).} Posterior margin of forewing with the three white maculae shaped as in figure 441, the first and third distinctly broad and suborbicular or subquadrate; Molokai. \textbf{epibathra} (Walsingham).

White maculae on posterior margin of forewing differently formed. ......................... \textbf{nigrelloides} (Swezey).

\textbf{10(9).} First (subbasal) white maculae on posterior margin of forewing very small and confined to margin, as in figure 444; forewings with background color bronzy brown; on \textit{Dubautia} on Kauai. ......................................................... \textbf{nigrelloides} (Swezey).

Not so. ....................................................................................... \textbf{nigrelloides} (Swezey).

\textbf{11(10).} Middle white macula on posterior margin of forewing not strongly curved distad, as in figures 444-445 of \textit{nigrella} and \textit{touchardiella} ......................................................... \textbf{nigrelloides} (Swezey).

Middle white macula on posterior margin of forewing strongly curved distad, as in figures 442, \textit{hibiscella}; 443, \textit{naenaeiella}; 444, \textit{neraudicola}; and 446, \textit{urerana} ......................................................... \textbf{nigrelloides} (Swezey).

\textbf{12(11).} Forewing with the apex of the white macula at about distal one-third of posterior margin separated from the opposite white macula arising from costa by a distance subequal to its length; subbasal white macula on posterior margin of wing prominent and extending to plica; male genitalia as in figure 451; \textit{Hawaii} .............................. \textbf{nigrelloides} (Walsingham).

Forewing with the maculae mentioned above closer together, separated by only about one-half the length of the macula on the posterior margin of the wing; subbasal white macula on posterior
margin of the wing small and not extending on
to plica; male genitalia as in figure 452; on
*Touchardia* on Maui...........**touchardiella** (Swezey).

13(11). Distal one-fourth of forewing pale lemon yellow; on
*Urera* on Oahu and Hawaii; figure 446........... 

.........................**urerana** (Swezey).

Not so..............................................14

14(13). Background color of forewings yellowish; on *Hibiscus*
on Oahu and Hawaii; figure 442.............

..............................**hibiscella** (Swezey).

Background color of forewings brownish.............15

15(14). Background color of forewings “brownish fuscous”;
on *Neraudia* and *Pipturus* on several islands;
figure 444.................**neraudicola** (Swezey).

Background color of forewings “pale brownish”; on
*Dubautia* on Oahu; figure 443.....**naenaeiella** (Swezey).

**Philodoria (Eophilodoria) dubauticola** (Swezey), new combination
(figs. 441, moth; 447, male genitalia).

*Parectopa dubauticola* Swezey, 1940b:463.

Endemic. Maui (type locality: ridge above Haelau).
Hostplant: *Dubautia plantaginea*?

**Philodoria (Eophilodoria) dubautiella** (Swezey), new combination
(figs. 441, moth; 447, male genitalia; 454, female genitalia).

*Gracilaria dubautiella* Swezey, 1913f:278.
*Parectopa dubautiella* (Swezey) Swezey, 1928d:191.

Endemic. Oahu (type locality: Mt. Olympus).
Hostplant: *Dubautia plantaginea*.
Parasites: *Eucremnus* sp.? (misprinted *Necremnus* in Swezey, 1954:73),
*Euderus metallicus* (Ashmead), *Pnigalio externa* (Timberlake),
*Sierola planiceps* Fullaway.

The eggs are deposited singly on the surface of the leaves; circular, about .5 mm. in diameter, broadly
convex and with the surface reticulated and somewhat iridescent [sic]. The young larva on hatching,
immediately eats into the leaf, at first producing a very slender mine lengthwise in the leaf and back and
forth a few times, but eventually broadening to a blotch. A purplish discoloration is produced in the leaf
by the mining larva, forming streaks following the course of the mines. Often several mines are begun in
the same leaf. I have found as many as 11, but not all of the larvae reach maturity, however, often 3 or
4 cocoons are found in the same leaf.

The full-grown larva is 6–7 mm. long; pale greenish-yellow, head pale brownish, eyes black; head very
deply notched and retracted into segment 2 which is widened and has a fuscous longitudinal dorsal streak
each side of median line, darkest at posterior margin; ventrally there is a large squarish patch of fuscous
which is minutely roughened, cervical shield also slightly roughened....

Pupa 4mm., pale greenish, a little browned on thorax, and middle of dorsum of abdomen, leg—and
antenna—sheaths; wing-sheaths extend about to apex of fifth abdominal segment; antenna-sheaths extend
beyond apex, curved up over abdomen to near middle. The pupa is formed in a cocoon within the mine,
its position being indicated by a bit of white silk showing where the larva ate a slit through the epidermis
for the emergence of the moth. (Swezey, 1913:279.)

The leaf mines of the larvae may be abundant.
Figure 441—Philodoria (Eophilodoria). Top, dubauticola (Swezey), holotype female; ridge above Haelau, Maui, ex Dubautia; forewing = 4 mm. Middle, dubautiella (Swezey), holotype male; Mt. Olympus, Oahu; forewing = 3.5 mm. Bottom, epibathra (Walsingham), holotype female; Molokai; forewing = 3.5 mm. (BM slide 2884); this specimen is figured in Walsingham, 1907b, pl. 25, fig. 27, but the artist considerably altered its appearance in his drawing.
Figure 442—Philodoria (Eophilodoria). Top, hauicola (Swezey), holotype; Mt. Tantalus, Oahu; forewing = 3.25 mm. Middle, hibiscella (Swezey), lectotype, hereby selected from the two cotypes on the type mount; Mt. Tantalus, Oahu; forewing = 4 mm. Bottom, lipochaetaella (Swezey), lectotype, hereby selected from the four cotypes on the type mount; Lahainaluna, Maui; forewing = 3 mm.
Figure 443—Top, *Caloptilia mabaella* (Swezey), holotype male; Wahiawa, Oahu; forewing=5 mm.; this photograph shows the expansion of the mesotibia which is exposed on the right side. Middle, *Philodoria (Eophilodoria) maginetrigata* (Walsingham), female holotype; Waianae Mts., 1,400 feet, Oahu; expanse=6.5 mm. This is a rather poor photograph. This specimen is figured in Walsingham, 1907, pl. 25, fig. 26, but that figure is inaccurate and misleading. Bottom, *Philodoria (Eophilodoria) namarella* (Swezey), holotype male; Mt. Olympus, Oahu; forewing=4 mm.
Figure 444—Philodoria (Eophilodoria). Top, neraudicola (Swezey), holotype male; Punaluu, Oahu; forewing = 3.75 mm. Middle, nigrella (Walsingham), holotype male (BM slide 4173); Hilo, 2,000 feet, Hawaii; expanse 9 mm. Bottom, nigrelloides (Swezey), holotype female (slide Z–I–10–67); Alakai Swamp, Kauai; expanse 9 mm. See figure 466 for a photograph of this specimen before it was remounted.
Figure 445—Philodoria (Eophilodoria). Top, *pittasporella* (Swezey), holotype; Mt. Kaala, Oahu; forewing = 4 mm. Middle, *sciallactis* (Meyrick), paratype; Kaena Point, Oahu; expanse = 5.5 mm. Bottom, *touchardiella* (Swezey), holotype; Iao Valley, Maui; forewing = 3.25 mm. This specimen appears rubbed on the basal parts of the posterior margins of the forewings. However, it has been reported to me that the specimen is not abraded and that the area is clothed with pale scales. Another specimen that I saw is entirely dark in that area.
Figure 446—Philodoria (Eophilodoria). Top, ureraella (Swezey), lectotype, hereby selected from one of four cotypes on the type mount 213, Bishop Museum; Mt. Tantalus, Oahu; forewing = 4 mm. Bottom, ureraana (Swezey), holotype; Mt. Tantalus, Oahu; forewing = 4.3 mm.
Figure 447—Male genitalia of *Philodoria* (*Eophilodoria*), Top, *dubauticola* (Swezey), paratype (slide Z-1-24, 61-4); Ridge above Haelau, Maui; ex *Dubautia*. Bottom, *dubautiella* (Swezey) (slide Z-1-28-61-2); Pacific Heights, Oahu; ex *Dubautia*; caudal abdominal segment above, aedeagus at right above.
Figure 448—Male genitalia of Philodoria (Eophilodoria). Top, hauicola (Swezey); Mt. Tantalus, Oahu (slide Z–VI–13–61); aedeagus not photographed. Bottom, hibiscella (Swezey), Waiakule, Oahu; ex Hibiscus (slide Z–I–26–61–2); aedeagus in situ.
Figure 449.—Male genitalia of Philodoria (Enphilodoria). Top, *lipochaetaella* (Swezey), Lahainalua, Maui, ex *Lipochaeta lavarum* (slide Z-I-27-61-3); aedeagus not photographed. Middle, *naenaeiella* (Swezey), paratype; Pupukea, Oahu; ex *Hesperomannia*; aedeagus in situ (slide Z-I-26-61-1). Bottom, *neraudicola* (Swezey), paratype (slide Z-I-26-61-3); south of Hilo, Hawaii.
Figure 450—*Philodoria* (*Eophilodoria*) *marginestrigata* (Walsingham), male and female genitalia. Male, holotype, Waianae Mts., 1,400 feet, Oahu (BM slide 2866). Female paratype (BM slide 2019); Molokai, above 3,000 feet; this shows the ostial plate in an oblique view, also see figure 455.
Figure 451—Male genitalia of Philodoria (Epiphilodoria). Top, nigrella (Walsingham), holotype (BM slide 4173); Hilo, 2,000 feet, Hawaii. The left valva is mounted in a poor position, and the right valva is nearly in full view with the lobe of the sacculus visible. The valva is distinctly different in shape from that of sciallactis, for example. Bottom, sciallactis (Meyrick), Kaena Point, Oahu (BM slide 2754); from the Meyrick collection; aedeagus not photographed; note the stout setae on the valvae.
Philodoria (Eophilodoria) epibathra (Walsingham), new combination
(figs. 441, moth; 459, female genitalia).

Gracilaria epibathra Walsingham, 1907b: 722, pl. 25, fig. 27.

Parectopa epibathra (Walsingham) Meyrick, 1928c: 104.

Endemic. Molokai (type locality: not more specifically noted on the type labels).

Hostplant: unknown.
The unique type is a female, not a male as noted by Walsingham. Dr. Swezey never knew this species. His Kauai record and hostplants given for the species (Swezey, 1928d:190) are in error and apply to *naenaeiella* (Swezey). Timberlake [*Proc. Hawaiian Ent. Soc. 6(3):524, 1927*] recorded the parasite *Pnigalio* ("Notanisomorphomyia") *externa* Timberlake from this species from material collected on Oahu and determined by Swezey, but this record also evidently is based upon an incorrect determination of the moth. The record of the parasite *Euderus metallicus* (Ashmead) is also in error.

**Philodoria (Eophilodoria) hauicola** (Swezey), *new combination* (figs. 437, 438, mine; 442, moth; 448, male genitalia; 454, female genitalia).

*Gracilaria hauicola* Swezey, 1910d:106, pl. 3, fig. 5.

*Parectopa hauicola* (Swezey) Swezey, 1928d:190.

The hau leaf miner.

Endemic. Kauai, Oahu (type locality: Mt. Tantalus), Maui, Hawaii.

Hostplant: *Hibiscus tiliaceus* ("hau"). This is usually a common moth, and frequently all the leaves of its hostplant will be mined.


"Often very scarce, this moth at other times may be very abundant; sometimes as many as 60 mines can be found in a large leaf. Even so, the plant does not seem to be severely injured, for it is constantly producing new foliage. The larva issues from the mine to form its oval, white cocoon, usually on the upper leaf surface [but they may also be formed on nearby objects]. In cases where mines are numerous, most of the larvae are parasitized when small, and only about one-third of them attain full growth." (Swezey, 1954:107.)

*Hibiscus tiliaceus* is considered to be an immigrant plant. It was probably introduced by early Polynesians who made extensive use of it, particularly for cordage. It is of interest that this is the only known hostplant of this moth, and one might wonder if the moth originated as a species since the plant was introduced by the Polynesians, perhaps about a thousand years ago. (See Zimmerman, 1960, for other possible evidence of rapid speciation in Hawaiian moths.) The plant may be attacked wherever it grows from the seashore to the mountains. It is probable that the moth has been accidentally distributed about the islands by man.

**Philodoria (Eophilodoria) hibiscella** (Swezey), *new combination* (figs. 437, mine; 440, pupa; 442, moth; 448, male genitalia; 455, female genitalia).

*Gracilaria hibiscella* Swezey, 1913f:279.

*Parectopa hibiscella* (Swezey) Swezey, 1928d:191.

The hibiscus leaf miner.

Endemic. Oahu (type locality: Mt. Tantalus), Hawaii.

Hostplants: *Hibiscus arnottianus, Hibiscus rosa-sinensis*.

Parasites: *Derostenus fullawayi* Crawford, *Diaulinus species, Euderus metallicus*.
GRACILLARIIDAE

(Ashmead), *Pauahiana* ("Necremnus") *maculatipennis* (Ashmead), *Pauahiana swezeyi* Yoshimoto has been recorded from this species by Yoshimoto, 1965: 677; one wonders if an error has been made, however, because the other records for the parasite appear to indicate that it is a parasite of Psyllidae), *Pnigalio externa* (Timberlake), *Symphiesis* ("Pseudopheliminus") *vagans* (Timberlake).

The mine usually begins towards base of leaf, proceeding upward irregularly and following the margin for a part of its course, it eventually reaches the apex, then follows down the opposite margin of the leaf rapidly widening until the larva has finished its growth. It then breaks through the epidermis to form its white oval cocoon on the surface of the leaf.

The full-grown larva is about 9 mm.; pale bluish-green; head with blackish mouth-parts, eyes, and 2 lines bordering the paraclypeus, much retracted into segment 2 which is widened and has a large black spot ventrally and 2 black spots near anterior margin dorsally; thoracic legs minute; abdominal prolegs on segments 7–9 [= abdominal segments 3–5].

Pupa 5 mm.; pale testaceous-greenish, with a fewfuscous markings ventrally; wing-sheaths extend to apex of fifth abdominal segment, free beyond fourth segment, dark fuscous at tip; posterior leg-sheaths extend beyond apex of abdomen; antenna-sheaths extend beyond apex of abdomen, recurved over the back forward to base of fourth abdominal segment. Pupal stage about a week. (Swezey, 1913:280.)

The larvae occasionally cause severe local damage to ornamental hibiscus, and extensively mined leaves may drop from the plants. The white, oval cocoon is made on the surface of a leaf.

The specimen on figure 442 is hereby designated lectotype. It is one of two cotypes on the type mount.

**Philodoria (Eophilodoria) lipochaetaella** (Swezey), new combination
(figs. 439, cocoon; 442, moth; 449, male genitalia; 455, female genitalia).


Endemic. Maui (type locality: a gulch above Lahaina).

Hostplant: *Lipochaeta lavarum*.

Dr. Swezey had two series of specimens of this species in two boxes; one series was collected in 1928 and the other in 1929. Because of improper labeling and an oversight, Dr. Swezey described the species twice from these series. I have selected the specimen shown on figure 442 as the lectotype from the series of four specimens on the type mount.

**Philodoria (Eophilodoria) marginestrigata** (Walsingham), new combination
(figs. 432, head, wing venation; 443, moth; 450, male, female genitalia; 455, female genitalia).

*Gracilaria marginestrigata* Walsingham, 1907b:721, pl. 25, fig. 26.

The ilima leaf miner.

Endemic. Nihoa, Kauai, Oahu (type locality: Waianae Mountains, 1,400 feet), Molokai, Hawaii.


Figure 453—Male genitalia of Philodoria (Eophilodoria). Top and middle, *urerella* (Swezey); at the top is the caudal end of the abdomen; Mt. Tantalus, Oahu (slide Z-I-29-61-3). Bottom, *urerana* (Swezey); Mt. Tantalus, Oahu; ex *Urera* (slide Z-I-29-61-2); aedeagus not photographed.
Figure 454—Female genitalia of Philodoria (Eophilodoria). Top left, dubautiella (Swezey); Moanalua, Oahu; ex Dubautia (slide Z-31-61-2); this species lacks signa in the bursa. Top right and bottom, hauicola (Swezey); Punaluu, Oahu; ex Hibiscus tiliaceus (slide Z-1-27-61-1); note the strong signa.
Figure 455—Female genitalia of Philodoria (Eophilodoria). Top left, hibiscella (Swezey); Mt. Tantalus; ex Hibiscus (slide Z-V-16-61-A). Top right, lipochaetaella (Swezey); Lahainalua, Maui; ex Lipochaeta lavarum (slide Z-V-19-61). Bottom, marginestrigata (Walsingham); Kaimuki, Oahu; ex Xanthium (slide Z-II-1-61-1); this species also lacks signa; see also figure 450.
vagans (Timberlake), Zatropis tortricidis Crawford, Zagrommosoma flavolineatum Crawford.

The observations on host plants and localities by Perkins and Walsingham (Walsingham, 1907b:722) are confused, and there may be more than one species involved in the records in literature.

This is often a common leaf miner in the lowlands. There may be as many as 12 mines in a single leaf, and the cocoon is made within the mine. It is unusual for an endemic insect to attack introduced plants as does this species.

Walsingham's figure of the moth is inaccurate and misleading and does not show the white maculae on the costa of the forewing.

**Philodoria (Eophilodoria) naenaeiella** (Swezey), new combination
(figs. 443, moth; 449, male genitalia; 457–458, female genitalia).

*Parectopa naenaeiella* Swezey, 1940b–462.

Endemic. Oahu (type locality: Mt. Olympus).

Host plants: *Dubautia laxa* ("naenae"), *Hesperomannia swezeyi*?

Parasites: *Euderus metallicus* (Ashmead), *Sympiesis vagans* (Timberlake).

"The larva issues from its mine to form a white, flat cocoon on the leaf." (Swezey, 1954:73.)
In addition to the two hostplants recorded above, which are both Compositae, Dr. Swezey (1954:113) reported that he had once reared the moth from *Hedyotis* (= *Kaudua*) at Kumuwela, Kauai. I have deleted that record as a probable error. Because *Hedyotis* is a member of the Rubiaceae, it probably does not serve as a host of this species. Dr. Swezey included in his type series material reared from *Hesperomannia* on Oahu on two occasions (see figures 457 and 458, female genitalia), yet he did not mention this as a hostplant in his 1954 book on Hawaiian forest entomology. Dr. Swezey also included in his type series material he had reared from *Dubautia latifolia* on Kauai (although at that time he did not know the identity of the plant and called it an “unknown composite”). However, in 1954:75, he appears to have recorded the same material again, stating that “a single poor specimen of the moth was obtained . . .,” which he considered to represent another species. The latter opinion is correct as can be determined from an examination of my figures 456–458 of the female genitalia. All of these problems require further detailed study.

![Figure 457](image1)

*Figure 457—Philodoria (Eophilodoria). Female genitalia of a paratype of *naenaiella* (Swezey); Pupukea, Oahu; ex *Hesperomannia* (slide Z–I–10–66–B). This requires careful comparison with material reared from the type host at the type locality. Compare figures 456, 458.*
Figure 458—Female genitalia of Philodoria (Eophilodoria). Top two figures are of *sciallactis* (Meyrick); that on the left is from Barber’s Point, Oahu (slide Z–I–29–61–1); that on the right is from Kaena Point, Oahu (slide Z–I–30–61–1); both specimens ex *Lipochaeta*. Bottom left, *nanaiella* (Swezey); Pupukea, Oahu; ex *Hesperomannia* (slide Z–V–17–61). Bottom right, *neraudvola* (Swezey); south of Hilo, Hawaii; ex *Pipturus* (slide Z–V–18–61).
Figure 459—Female genitalia of *Philodoria (Eophilodoria) nigrelloides* (Swezey) holotype (slide Z—I—10—67); Alakai Swamp, Kauai; ex *Dubautia*. Bottom, *epibatha* Walsingham, holotype (BM slide 2884); Molokai.
Philodoria (Eophilodoria) neraudicola (Swezey), new combination
(figs. 444, moth; 449, male genitalia; 458, female genitalia).
Gracilaria neraudicola Swezey, 1920b: 385.
Parectopa neraudicola (Swezey) Swezey, 1928d: 191.

Endemic. Kauai, Oahu (type locality: Punalu'u), Molokai, Hawaii.
Hostplants: Neraudia melastomaefolia, Pipturus albidus (the preferred host).
Parasites: Euderus metallicus (Ashmead), Pnigalio externa (Timberlake).
The type host of this species is Neraudia, but Dr. Swezey stated that he later found that the larvae prefer Pipturus. I have not had an opportunity to examine material under this name from the two hosts and from different islands. It is possible that more than one species is involved in the records.

Figure 460—Female genitalia of Philodoria (Eophilodoria). Top, ouchardielia (Swezey); Iao Valley, Maui; ex Touchardia (slide Z-1-27-61-2). Bottom left, ureraella (Swezey); Puu Kana, Oahu (slide Z-1-31-61-1). Compare the similar sciallactis, figure 458; two specimens of ureraella were studied and also found to be similar. Bottom right, urera (Swezey); Mt. Tantalus, Oahu; ex Urena (slide Z-1-30-61-2).
Philodoria (Eophilodoria) nigrella (Walsingham), **new combination**
(figs. 444, moth; 451, male genitalia).
\*Philodoria nigrella\* Walsingham, 1907*: 721, pi. 25, fig. 25.

Endemic. Hawaii (type locality: Hilo, 2,000 feet).
Hostplant: unknown.
I have no record of this species having been collected since Perkins captured the original two specimens.
Although this moth has developed maxillary palpi and is typical of \*Parectopa\*", in the sense of Walsingham, it was, for reasons unknown, described in \*Philodoria\* by Walsingham. It is closely similar to \*touchardiella\* (Swezey) (see the notes under that species below).

Philodoria (Eophilodoria) nigrelloides (Swezey), **new combination**
(figs. 444, moth; 459, female genitalia).
\*Parectopa nigrelloides\* Swezey, 1946: 628.

Endemic. Kauai (type locality: Alakai Swamp, 4,000 feet).
Hostplant: \*Dubautia*.
This moth is known only from one female specimen reared from a leaf mine by Dr. Swezey in 1921.

Philodoria (Eophilodoria) pittosporella (Swezey), **new combination**
(figs. 445, moth; 452, male genitalia).
\*Parectopa pittosporella\* Swezey, 1928а: 189.

Endemic. Oahu (type locality: Mt. Kaala, above 3,000 feet).
Hostplant: \*Pittosporum*.
The larva emerges from its mine to spin a cocoon on the leaf surface.

Philodoria (Eophilodoria) sciallactis (Meyrick), **new combination** (figs. 445, moth; 451, male genitalia; 458, female genitalia).
\*Parectopa sciallactis\* Meyrick, 1928с: 104.

Endemic. Oahu (type locality: Kaena Point).
Hostplant: \*Lipochaeta integrifolia*.

Philodoria (Eophilodoria) touchardiella (Swezey), **new combination**
(figs. 445, moth; 452, male genitalia; 460, female genitalia).
\*Parectopa touchardiella\* Swezey, 1928д: 189.

Hostplant: \*Touchardia latifolia*.
Externally, this species so closely resembles \*nigrella\* that I am not sure that the wing maculation characters I have used in the key will prove to be adequate to separate all specimens of the species. I have not seen enough specimens to test the effectiveness of the key characters I have used. The male genitalia are different, and there is no doubt that two species are involved.
Philodoria (Eophilodoria) ureraella (Swezey), new combination (figs. 446, moth; 453, male genitalia; 460, female genitalia).

Gracilaria ureraella Swezey, 1915e: 94.
Parectopa ureraella (Swezey) Swezey, 1928d: 191.

Endemic. Oahu (type locality: Mt. Tantalus).

Hostplants: Urera sandwicensis, Urera kaalae.

Parasites: Euderus ("Omphale", "Secodella") metallicus (Ashmead), Pauahiana ("Necremnus") maculatipennis (Ashmead), Sierola pulchra Fullaway, "an undetermined chalcid". Dr. Swezey found that nearly as many parasites as moths emerged from the material he reared.

Dr. Swezey (1933a: 303) noted that the specimens he reared from Urera kaalae in the Waianae Mountains differ slightly from those he reared from Urera sandwicensis in the Koolau Mountains. I have not made a study of specimens from the two localities and cannot comment upon the situation. It is possible that more than one species is involved.

Larva. Full-grown larva about 6mm.; slender, segment 2 much enlarged, head mostly retracted into it; pale greenish[;] head strongly bilobed, testaceous with brown sutures, eyes black; cervical shield slightly testaceous and roughened on the disk; a similarly roughened area on ventral side between the legs, black lengthwise in middle; abdominal prolegs on segments 7-9.

Pupa. Pupa slender, 4mm., pale greenish; wing-sheaths extend to apex of 5th abdominal segment, free beyond 4th segment; posterior leg-sheaths extend to apex of abdomen; antenna-sheaths extend to apex of abdomen and curve up over the back to about middle of abdomen; cremaster rounded, unarmed.

Mine. The mine at first is a small roundish blotch becoming irregular as it becomes larger from the eating of the larva within. The larva emerges to spin its whitish cocoon on the surface of the leaf. The moths emerged from the cocoons in about ten days. (Swezey, 1915e: 95.)

Philodoria (Eophilodoria) urerana (Swezey), new combination (figs. 446, moth; 453, male genitalia; 460, female genitalia).

Gracilaria urerana Swezey, 1915e: 95.
Parectopa urerana (Swezey) Swezey, 1928d: 191.

Endemic. Oahu (type locality: Mt. Tantalus), Hawaii. The determination of specimens from Kilauea, Hawaii as this species is that of Dr. Swezey. I have not made a comparative study of specimens from the two widely separated localities and cannot confirm the distribution records.

Hostplant: Urera sandwicensis.

Parasites: Euderus ("Omphale", "Secodella") metallicus (Ashmead), Sierola species.

"The mine is very slender where it starts from an egg placed on the under side of the leaf, it gradually widens as the larva grows, becomes serpentine and towards the last enlarges to a blotch. The larva emerges to spin its whitish cocoon on the surface of the leaf. The moths emerged from the cocoons in about ten days." (Swezey, 1915d: 96.)

It is of interest to note that the type series of this species was reared by Dr. Swezey from the same lot of leaves from which the type series of ureraella was reared. Are mines of both of these species to be found in the same leaf at the same times?

The specimen illustrated on figure 446 is designated lectotype from the series of four cotypes on the type mount.
Subgenus **PHILODORIA** Walsingham, *sensu stricto*

Maxillary palpi greatly reduced, vestigial, or obsolescent.

**KEY TO THE SPECIES OF PHILODORIA, SENSU STRICTO**

1. Forewings basically brown with the maculae consisting of conspicuous white maculae only (figures 465, 466, *pipturiana*, 467, *wilkesiella*) ................................2
   Not so ............................................3

2(1). Posterior margin of forewing with three prominent white maculae; one near base, one just basad of middle and one beyond middle, and opposite the interspaces between these white maculae there are two similar white maculae on the costa and there are no maculae along the plica; on *Argyroxyphium* (= *Wilkesia*) *grayana* on Maui; figure 467 ..........

................................................. **wilkesiella** Swezey.

Posterior margin of forewing with only one prominent white macula and that situated at about the apical one-third; a prominent, elongate, white macula or vitta runs along plica from base toward an orbicular white macula on plica at basal one-third of the wing length, and on costa at a point beyond the macula on the plica is a short, oblique, white dash (directed toward the white macula on posterior wing margin) and beyond this on costa is a white crescent (this extends beyond apex of the white macula on posterior margin); on *Pipturus* in the Kohala Mountains, Hawaii; figure 465 .......... **pipturiana** Swezey.

3(1). Background scaling of forewings basically yellow with an iridescent white or metallic white submedial vitta extending from extreme base to about one-fourth or to near about one-half the length of the wing (in addition to other markings) ..........4
   Not so, forewings never with a submedial basal vitta ........................................5

4(3). Forewings with a basal, submedial (along the plica) vitta extending distad nearly to middle of wing, and beyond its apex only one similarly colored pale diagonal fascia completely crosses the wing from costa to posterior margin before the dark terminal area (also with other maculae); on *Lysimachia* on Oahu; figure 463 ..........

................................................. **lysimachiella** Swezey.
Forewings with the basal, submedial vitta extending out into area of cell for only about one-fourth the length of wing, and beyond its apex two similarly colored pale diagonal fasciae completely cross the wing from costa to posterior wing margin (also with other maculae); on Lysimachia on Molokai; figure 464... *molokaiensis* Swezey.

5(3). Forewings with one or more diagonal fasciae extending completely across the wing from costa to posterior margin within about the basal two-thirds (do not include those maculae that are in the apical one-third or less) ......................... 6
Forewings without any of the maculae within the basal two-thirds extending entirely across the wing as complete diagonal fasciae. ......................... 9

6(5). Background scaling of forewings chocolate brown with bright yellow or orange, metallic silvery white and black maculae; with four orange costal maculae and between these there are three metallic white maculae; the subbasal orange macula surrounded almost entirely by dark brown scaling; posterior margin of wing with an orange macula distad of the submedial metallic white fascia; on Myrsine on Oahu; figure 461... ......................... *auromagnifica* Walsingham.

Background scaling of forewings partly yellow or orange and with a different pattern ....................... 7

7(6). Almost entire basal half of forewing concolorous creamy-grey (or an approximation to such a color) or mauve and without any enclosed maculae or any yellow in this basal area which is continuous in color with that of pronotum; on Metrosideros on Maui and Hawaii; figure 461... ......................... *basalis* Walsingham.

Not so colored, basal area maculate ....................... 8

8(7). Forewing with basal one-fourth of costal area black or very dark brown; the metallic white costal macula between the submedial and subapical fasciae directed obliquely distad from costa; on Myrsine on Maui and Hawaii; figure 467... ......................... *succedanea* Walsingham.
Forewing with basal one-fourth of costal area pale; the metallic white costal macula between the submedial and subapical fasciae directed almost straight toward opposite side of wing; on Metrosideros on various islands; figure 466..............

................................................. splendida Walsingham.

9(5). Background scaling of forewing brownish, with a short, subbasal, white vitta on plica followed by a suborbicular white macula on plica before middle of wing, and beyond this is a diagonal, narrow, white macula from costa pointing toward a suborbicular white macula at about the apical one-third of the posterior margin of the wing and another small white macula on costa and some small subterminal white patches; Maui; figure 467........... spilota (Walsingham).

Not so.................................................................10

10(9). At about distal one-third of forewing there is a sub- shaped fascia which is black at the point and white at the apices of the arms (that is, forming a white spot on costa and on posterior margin of wing with black scaling on the mid line of the wing), and beyond this fascia is an area containing yellow or orange squamae; the aforementioned area of yellow or orange scaling containing numerous dark squamae which normally form a dark medial vitta; on Pipturus on Kauai; figure 463........... micropetala Walsingham.

The above-mentioned subapical area formed entirely of yellow to orange squamae and with no indication of a dark medial vitta through the yellow to orange area..................11

11(10). Forewing with costa entirely dark scaled basad of middle and wing without any yellow to orange scaling excepting a bright orange subapical macula which extends from costal margin to posterior margin and is preceded and followed by black scaling; Hawaii; figure 462..............

................................. floscula Walsingham.

Forewing with costa narrowly white or pale-scaled from near base to the oblique white costal macula beyond middle and wing with a yellow area or yellow maculae basad of the subterminal yellow macula..............................12
12(11). Forewing with an oblique, white, costal macula just distad of middle and the area basad of this oblique macula entirely dark or brown-scaled except for the costa which is narrowly white and a white suborbicular plical macula; with only one area of yellow scaling basad of the subterminal yellow fascia and that is a costal macula distad of the oblique white costal macula; on Pipturus on Oahu; figure 464. ................. \textit{pipturiella} Swezey.

Forewings with the color pattern rather similar but with more orange or yellow areas, and the subcostal area basad of the above-mentioned oblique costal macula is yellow to orange at least as far basad as the suborbicular plical macula. ....... 13

13(12). Mid line area of forewing between suborbicular plical macula and the sub-\textsuperscript{>} - shaped fascia at about the distal one-third dark to brown-scaled; suborbicular white plical macula distinctly removed from posterior margin of wing; on Pipturus on Oahu; figure 462. ................. \textit{costalis} Swezey.

The mid line area just described yellow scaled; the macula on plica extending to or near to posterior margin of wing; on Pipturus on Oahu and Maui; 464. ................. \textit{pipturicola} Swezey.

\textbf{Philodoria (Philodoria) auromagnifica} Walsingham (figs. 461, moth; 468, male genitalia; 474, female genitalia).

\textit{Philodoria auromagnifica} Walsingham, 1907b: 718, pi. 25, fig. 20.

Endemic. Oahu (type locality: mountains near Honolulu, 2,000 feet), Molokai, Hawaii.

- Hostplant: \textit{Myrsine} (= \textit{Suttonia}).
- Parasite: \textit{Euderus metallicus} (Ashmead).

“The larvae emerge from the mines to pupate in oval cocoons on the surface of the leaves.” (Swezey, 1913d: 223.)

\textbf{Philodoria (Philodoria) basalis} Walsingham (figs. 461, moth; 468, female genitalia, cocoon; 475, female genitalia).

\textit{Philodoria basalis} Walsingham, 1907b: 720, pl. 5, fig. 24.

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

- Hostplant: \textit{Metrosideros} (the record by Swezey, 1913d: 222, for \textit{Pipturus} was in error).
- Parasite: \textit{Euderus metallicus} (Ashmead).

Dr. Swezey told me that the oval cocoon is made on the outer surface of the dead epidermis of the leaf covering the larval mine. The epidermis is cut around at a slight distance from the cocoon so that it falls easily out of the leaf carrying the cocoon with it. \textit{Philodoria splendida} has a similar habit.
Figure 461—Philodoria auromagnifica Walsingham, at top, holotype male; mountains near Honolulu; forewing = 3.5 mm. (BM slide 4172). This photograph gives a poor impression because of the reflections of the metallic scales. This should be compared with colored figure 20 of plate 25 of Walsingham, 1907b, which differs so much from this specimen that it would be difficult to determine an example by the use of that figure. At bottom is the female holotype of basalis Walsingham; Olinda, 4,000 feet, Maui; forewing = 4.5 mm. (BM slide 3952).
Figure 462—Top, Philodoria costalis Swezey, holotype; forewing = 3.5 mm.; Makaha, 3,000 feet, Oahu; ex Pipturus. Bottom, Philodoria floscula Walsingham, holotype female (BM slide 3950); forewing = 3 mm.; Hilo, 2,000 feet, Hawaii. The area below the "X" marks on the forewings is a band of orange scales which extends entirely across the wings and is margined basad and distad by black scales. The other marks are white or whitish on a brown background. This orange macula shows as a pale area on the right wing, but it is obscured on the left wing in this photograph. Walsingham's pi. 25, fig. 21 is misleading because it shows the pale fascia basad of the orange band to be continuous, whereas it is broken by the black scaling. This can be seen on the left wing in this figure. Also, the positions of the pale maculae near mid-wing are not correctly shown in the Walsingham figure.
Figure 463—Philodoria. Top, *lysimachiella* Swezey, holotype male; Hapapa, Waianae Mts., Oahu; forewing 2.5 mm.; ex *Lysimachia*. Bottom, *micropetala* Walsingham, holotype female (BM slide 3951); Halemanu, Kauai, 4,000 feet.; forewing = 3.5 mm.
Figure 464—Philodoria. Top, holotype of molokaiensis Swezey; Kawela, 3,700 feet, Molokai; ex Lysimachia; forewing = 4 mm. Middle, pipturiola Swezey, lectotype hereby designated from the four cotypes on the original type mount in the Bishop Museum; Punaluu, Oahu; forewing = 3 mm. Bottom, holotype of pipturiella Swezey; Palolo, Oahu; ex Pipturus; forewing = 2.3 mm.
Figure 465—Philodoria pipturiana Swezey, holotype male and its genitalia (slide Z–I–10–67–A); Upper Hamakua Ditch Trail, Hawaii; forewing = 4 mm., mostly brownish fuscous with white maculae; see figure 466 for a dorsal view.
Figure 466—Philodoria and Eophilodoria. Top left, (Eophilodoria) nigrelloides (Swezey), the unique holotype; Alakai Swamp, Kauai; ex Dubautia; length = 5 mm. See figure 444 which shows this specimen after it was remounted. Top right, Philodoria pipitiana Swezey, holotype; Upper Hamakua Ditch Trail, Hawaii; ex Pipturus; length = 4.5 mm. See figure 465 for this specimen in lateral view. Bottom, Philodoria splendida Walsingham, holotype male (BM slide 1858); Lanai, 2,000 feet; forewing = 4 mm.
Figure 467—Philodoria. Top, spilota (Walsingham), holotype female (not male as originally stated); Haleakala, 5,000 feet, Maui; forewing=3 mm. (BM slide 2030). This hardly resembles the Walsingham 1907b, pl. 15, fig. 18; it is a faded, broken specimen. The photograph does not reveal the basal white streak on the fold, but that is shown on the Walsingham figure. Middle, succedanea Walsingham, holotype male (BM slide 2755); Haleakala, Maui, 4,000 feet; forewing=4 mm. Bottom, wilkesiella Swezey, holotype; forewing=3.25 mm.; Puu Kukui, Maui; ex Wilkesia grayana.
Figure 468—Philodoria. Top two figures, male genitalia of *auromagnifica* Walsingham, holotype (BM slide 4172); mountains near Honolulu. Middle and bottom figures, *basalis* Walsingham, female genitalia of the holotype (BM slide 3952); Olinda, 4,000 feet, Maui; with cocoon of another specimen inset at lower right (its open end at the right); compare figure 475.
Figure 469—Male genitalia of Philodoria. Top, costalis Swezey, paratype (slide Z-XII-20-62-2); Makaha, Oahu, 3,000 feet; ex Pipturus. Bottom, lysimachiella Swezey, paratype (slide Z-XII-20-62-1); Hapapa, Waianae Mts., Oahu; ex Lysimachia. Compare figure 470.
Figure 470—Male genitalia of Philodoria molokaiensis Swezey, holotype (slide Z-XII-19-62-25); Kawela Molokai, 3,700 feet; ex Lysimachia. In the upper figure the aedeagus has floated out of position in the mount. The lower figure is the caudal end of the abdomen. The genitalia represent an extreme type in the genus. The wing venation of this species is normal for the group. Compare lysimachiella, figure 469, an allied species, and also note figure 472.
Figure 471—Male genitalia of Philodoria. Top, pipturicola Swezey; Wailuku, Maui, 2,000 feet; ex Pipturus (slide Z-XII–19–62–23); the tegumen has been broken away, and the aedeagus was not photographed. Bottom, splendida Walsingham; Waialae Nui, Oahu (slide Z-XII–19–62–20).
Figure 472—Philodoria succedanea Walsingham. Top, male genitalia of a paratype (Busck slide 100); note the two small signa in the bursa, the comparatively narrow ostial plate, and the divergent male valvae.
Philodoria (Philodoria) costalis Swezey (figs. 462, moth; 469, male genitalia; 476, female genitalia).

*Philodoria costalis* Swezey, 1934: 524.

Endemic. Oahu (type locality: Makaha Ridge, about 3,000 feet, on the west side of Mt. Kaala).

Hostplant: *Pipturus*.

The larvae form “oval brown cocoons on the surface of the leaves...” (Swezey, 1934: 525.)

Philodoria (Philodoria) floscula Walsingham (figs. 462, moth; 477, female genitalia).

*Philodoria floscula* Walsingham, 1907b: 718, pi. 25, fig. 21.

Endemic. Molokai, Maui, Hawaii (type locality: Hilo, 2,000 feet).

Hostplant: *Pipturus*.

Philodoria (Philodoria) lysimachiella Swezey (figs. 463, moth; 469, male genitalia).

*Philodoria lysimachiella* Swezey, 1928d: 188.

Endemic. Oahu (type locality: Puu Hapapa, about 2,000 feet, Waianae Mountains).

Hostplant: *Lysimachia rotundifolia*.

This species is a close ally of *molokaiensis*, but the wing maculation is distinctive.

Figure 473—Male genitalia of *Philodoria wilkesiella* Swezey, paratype; Puukukui, Maui; ex *Wilkesia grayana* (slide Z-XII-19-62-18).
Dr. Swezey (1928d: 188–189) said that he had collected mined leaves of *Lysimachia* on the ridge back of Kalihi Valley, Oahu, and on two occasions from *Lysimachia Hillebrandi* on the high plateau of Kauai, but he was unable to rear any moths. These records may represent the work of additional species of *Philodoria*.

**Philodoria (Philodoria) micropetala** Walsingham (figs. 463, moth; 476, female genitalia).

_Philodoria micropetala_ Walsingham, 1907b: 719, pl. 25, fig. 22.

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

Hostplant: _Pipturus._

Parasites: _Derostenus fullawayi_ Crawford, _Euderus metallicus_ (Ashmead).

The various records of this species from localities outside Kauai are evidently in error; the species appears to be confined to Kauai. The records for Oahu apply to _pipturiella_ Swezey; see the note under that species name.

**Philodoria (Philodoria) molokaiensis** Swezey (figs. 464, moth; 470, male genitalia; 478, female genitalia).

_Philodoria molokaiensis_ Swezey, 1928d: 188.

Endemic. Molokai (type locality: Kawela, 3,700 feet).

Hostplant: _Lysimachia Hillebrandi_, variety.

This species is an ally of _lysimachiella_ from Oahu.

**Philodoria (Philodoria) pipturiana** Swezey (figs. 465, moth, male genitalia; 466, moth).

_Philodoria pipturiana_ Swezey, 1923a: 295.


Hostplant: _Pipturus._

This species is known from only two moths collected by Swezey from a _Pipturus_ tree, but it was not reared.

**Philodoria (Philodoria) pipturicola** Swezey (figs. 464, moth; 471, male genitalia; 476, 479, female genitalia).

_Philodoria pipturicola_ Swezey, 1915e: 96.

Endemic. Oahu (type locality: Punaluu), Maui. 

Hostplant: _Pipturus._

Parasites: _Euderus metallicus_ (Ashmead), _Pnigalio externa_ (Timberlake).

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**Larva.** 7mm.; pale yellowish; head with a dark brown or blackish spot in each lobe, deeply bilobed and mostly retracted into segment 2, which is wider than the rest, other segments gradually tapering backwards; distinct constrictions between segments; cervical shield somewhat roughened, two pale brownish longitudinal streaks; thoracic legs feeble; abdominal prolegs on segments 7–9.

**Pupa.** 3mm.; very pale brownish, abdomen yellowish; wing-sheaths pointed, extending to 5th abdominal segment; posterior leg-sheaths extend to apex of abdomen; antenna-sheaths extend beyond apex of abdomen and curve over dorsally and forward about two segments.

**Mine.** At first serpentine, later a blotch. The larva emerges to spin a light brownish cocoon on some convenient surface. (Swezey, 1915e: 96–97.)

The specimen illustrated in figure 464 is selected as lectotype from the series of four syntypes on the type mount in the Bishop Museum.
Figure 474—Female genitalia of Philodoria auromagnifica Walsingham; Wailupe, Oahu (slide Z-XII-20-62-6).
Figure 475—Female genitalia of Philodoria basalis Walsingham; Kohala Mts., Hawaii (slide Z-XII-20-62-4); compare figure 468 of the holotype.
Figure 476—Female genitalia of Philodoria. Top left, costalis Swezey, paratype (slide Z-XII-20-62-3); Makaha, Oahu, 3,000 feet; ex Pipturus. Top right, micropetala Walsingham; Kumuwela, Kauai; ex Pipturus (slide Z-XII-19-62-27). Bottom, left and right, pipturicola Swezey, determined by Swezey; Wailuku, Maui, 2,000 feet; ex Pipturus (slide Z-XII-19-62-24); see also figure 479.
Figure 477—Female genitalia of Philodoria. Top, left and right, floscula Walsingham, holotype (BM slide 3950); Hilo, Hawaii, 2,000 feet. Bottom, bursa copulatrix of a paratype of splendida Walsingham (Busck slide 101); Lanai, 2,000 feet; compare figure 481.
Figure 478—Female genitalia of *Philodoria molokaiensis* Swezey (slide Z-XII-19-62-26); Kawela, Molokai; ex *Lysimachia*.
Philodoria (Philodoria) pipturiella Swezey (figs. 464, moth; 480, female genitalia).

Philodoria pipturiella Swezey, 1923: 294.

Endemic. Oahu (type locality: Palolo).

Hostplant: Pipturus.

Parasites: Derostenus fullawayi Crawford, Euderus metallicus (Ashmead), Sympiesis sparsus Yoshimoto.

Dr. Swezey said (1923: 294-295) that he had found it on "practically the whole island [of Oahu] wherever Pipturus grows. I have reared it many times from mines in Pipturus leaves collected at various places in the S.E. Koolau Mountains: Palolo, Kaumuahona, Tantalus, and Pacific Heights, and also from Mount Kaala and Makaleha, in the Waianae Range. The large leaves of Pipturus often contain great numbers of the mines, even up to a hundred, but usually the larvae in most of them die or are parasitised so that but few of them reach their full growth and spin cocoons. The cocoons are made on the under side of the leaf alongside a prominent vein, white and not very conspicuous.

"Any mention that I have previously made to micropetala in the Proceedings of the Hawaiian Entomological Society pertains to this species."

Figure 479—Female genitalia of Philodoria pipturiola Swezey (Busck slide 99); a Maui specimen determined by Swezey; ex Pipturus; see also figure 476.
Figure 480—Female genitalia of Philodoria. Top left and right, *spilota* (Walsingham), holotype (BM slide 2030); Haleakala, 5,000 feet, Maui. Bottom left, *pipiurella* Swezey, ostial plate; Palikea, Waianae Mts., Oahu; ex *Pipturus* (slide Z-XII-19-62-22). Bottom right, *wilkesiella* Swezey, ostial plate of a paratype (slide Z-XII-19-62-19); Puu Kukui, Maui; ex *Wilkezia grayana*.
Figure 481—*Philodoria splendida* Walsingham, genitalia of a female specimen determined by Swezey (slide Z-XII-19-62-21); Mt. Tantalus, Oahu. This should be compared with toptotypic material from Lanai when additional specimens from Lanai are collected. Compare figure 477.
Philodoria (Philodoria) spilota (Walsingham), new combination (figs. 434, head, wing venation; 467, moth; 480, female genitalia).

*Elachista spilota* Walsingham, 1907b:513, pl. 15, fig. 18.

Endemic. Maui (type locality: Haleakala, 5,000 feet).

*Hostplant*: unknown.

It is strange that Walsingham separated this species from the other *Philodoria* he described and placed it in *Elachista*, which he placed in the Hyponomeutidae, a genus and family to which it does not belong. The unique holotype is a faded, damaged female and not a male as Walsingham stated in his original description. Walsingham said that the type was "injured when being figured". It is badly broken—the hindwings and abdomen are glued to the fore part of the body; the head is badly abraded and glued to the thorax; the left antenna is missing.

Philodoria (Philodoria) splendida Walsingham (figs. 466, moth; 471, male genitalia; 477, 481, female genitalia).

*Philodoria splendida* Walsingham, 1907b:719, 737, pi. 25, fig. 23. Meyrick, 1914:26. pi. 2, figs. 21, 35.

Endemic. Kauai, Oahu, Molokai, Lanai (type locality: 2,000 or 3,000 feet), Hawaii.

*Hostplant*: *Metrosideros*.

*Parasites*: *Pauahiana metallica* Yoshimoto, *Sierolaphilodoriae* Fullaway.

The larvae of this species mine the leaves of *Metrosideros polymorpha*. They are found common on all the Islands. The larva emerges to form its oval cocoon, which is made on the surface of the mine, the dead epidermis being cut around a little distance from the cocoon so that it readily falls away carrying the cocoon with it. The silk of the cocoon is light brownish resembling the dead epidermis of the mined leaf (Swezey, 1913:223.)

Philodoria (Philodoria) succedanea Walsingham (figs. 433, 435, head, wing venation; 467, moth; 472, male, female genitalia).

*Philodoria succedanea* Walsingham, 1907b:717, pl. 25, fig. 19.

Endemic. Maui (type locality: Olinda, Haleakala, 4,000 feet), Hawaii.

*Hostplant*: *Myrsine (= Suttonia)*.

Walsingham recorded the species doubtfully from Kauai on the basis of one specimen in poor condition. I have deleted the Kauai record because the Walsingham specimen is not *succedanea*.

Philodoria (Philodoria) wilkesiella Swezey (figs. 467, moth; 473, male genitalia; 480, female genitalia).

*Philodoria wilkesiella* Swezey, 1940b:464.

Endemic. Maui (type locality: Puu Kukui).

*Hostplant*: *Argyroxyphium (= Wilkesia) grayana*.

This species has a distinctive color pattern. Although Dr. Swezey stated that "it is not closely related to any other of the known species", its genitalia are of the most common type and are close to such species as *Eophilodoria naenaeiella* which breeds in the related plant genus *Dubautia*. It is one of the few moths known to attack the extraordinary endemic composite *Argyroxyphium*. 
Family **BUCCULATRIGIDAE** Fracker


This group is represented in Hawaii by one immigrant American species of *Buculatrix* which was discovered established on Oahu after this text was submitted for publication. I have added details concerning it during editing of the text, because there is reason to believe that the moth, its larvae, and the damage it does to cotton may be noticed frequently and because it is a family new to the Hawaiian fauna.

*Buculatrix* has been a “problem group” of moths which has caused taxonomists considerable difficulty. Fracker (1915:67) said:

Systematists have come to think of the genus *Buculatrix* as a chronic obstacle to the satisfactory classification of the lower Micros. It has been driven from “pillar to post” and the end is not in sight. The situation usually consists in the positive denial of admittance to the particular family which an investigator is studying. The author erects a new family for the genus, first because specialists on adult Microlepidoptera will not admit the validity of placing *Buculatrix* in any one of the recognized families, second, because the larvae can not be closely associated with those of any other genus of which specimens have been examined.

The moths, each of whose heads has a characteristic large, spreading tuft on the crown (which may resemble some tineids) and whose basal antennal segments have such enlarged pectens that they appear to be eye-caps, are externally so similar to *Lyonetia* and *Bedellia* that one would tend upon superficial examination to consider them to belong to the same family. However, the wing venation and genitalia are quite different (see the illustrations), and the larvae and pupae are conspicuously different. As demonstrated by my illustrations, the pupa of *Buculatrix*, which has exposed coxae and loose appendages and is enclosed in a cocoon, is a more primitive form than *Bedellia*, which has a naked, butterfly-like pupa with concealed coxae and tightly fused appendages.

In the Hawaiian fauna, *Buculatrix* moths can be separated from the outwardly closely similar *Bedellia* on external characters—their labial palpi are unusually short (hardly projecting beyond the apex of the pointed face), and the metatibiae have very long dorsal hairs which extend far beyond their apices. On *Bedellia*, the labial palpi are well developed, the face is apically broadly rounded, and the metatibiae have only short dorsal setae.

Genus **BUCCULATRIX** Zeller


Figure 481-A—See legend on page 721.
Bucculatrix is a large genus of more than 200 species and is known from all of the continents. More than 100 species occur in North America. It appears to me, however, that more than one genus is involved in the complex as it is now constituted. The genitalia, larvae, and pupae support such a conclusion.

The relationships of Bucculatrix remain obscure. Braun (1963:13), suggested (perhaps without having seen it) that Comodica might have a possible relationship. Comodica is, however, a member of the Tineidae that has been wrongly assigned to the Lyonetiidae by some authors.

Many female Bucculatrix have only the posterior pair of apophyses, but some species, including the one established in Hawaii, have a partly developed second (anterior) pair.

The known eggs of the North American species are flattened, excepting for those of thurberiella which are upright.

The larvae are miners in the first two instars and part of the third, but they feed exposed in instars four and five.

The pupal skin is partly extruded from the cocoon before emergence of the imago.

The only representative of Bucculatrix in Hawaii is the following newly immigrant species:

Bucculatrix thurberiella Busck (figs. 11–A, e, antenna; 481–A, moth, head; 481–B, forewing maculation, wing venation, cauda, male and female genitalia; 481–C, 481–D, 481–E, larva; 481–F, pupa; 481–G, larval damage).


The cotton leaf perforator.

Oahu.

Immigrant. Native to the southwestern United States and northern Mexico (type locality: Santa Catalina Mt.s., Arizona; discovered originally on wild cotton in Arizona by W.D. Pierce in 1913). First found in Hawaii at Nanakuli, Oahu, early in 1971 by J. W. Beardsley.

Hostplant: Gossypium tomentosum (endemic Hawaiian cotton). In America, the species is associated with the wild cotton, Thurberia thespesioides, but it not infrequently attacks cultivated cotton (Essig, 1929: 750, fig. 628).

McGregor, who discovered the species on cultivated cotton at El Centro, Imperial Valley, California, in 1916, has published a noteworthy, illustrated account of the species, and much of what he had to report applies equally...
Figure 481-B—Details of Bucculatrix thurberiella Busck. a, sketch of color pattern of a forewing; b, wing venation; c, eighth abdominal tergite of male; d, processes of eighth abdominal sternite of male; e, aedeagus; f, male genitalia, ventral aspect; g, ental aspect of right genital valva of male, artificially flattened; h, eversible "scale sac" of male (in membrane between abdominal tergites two and three); i, ventral aspect of female genitalia, bursa copulatrix not shown; j, setae on sclerotized area of eighth abdominal somite of female; k, a small area of the signum of the female to show the spicules. (Rearranged from Braun, 1963; slide preparations by August Busck.)
to the study of the species in Hawaii. I therefore quote extensively from McGregor. He found as much as 100 percent of the leaves of some cotton plants attacked by the larvae, and he considered the species a major pest of cotton in California in 1916. He said (1916:506–509):

When present, cotton clearly shows the effect of the caterpillar, the foliage being riddled and perforated, often, until little more than veins and epidermis remain (Pl. 37, fig. 4). Small, ill-nourished plants are usually killed, while larger plants are often severely injured. Occasionally larvae feed upon the calyx and involucral bracts which results usually in the shedding of the form. On account of the thickly honeycombed nature of the leaf lesions, which is so characteristic of Bucculatrix-infested cotton, we propose as a common name for this species the “cotton leaf-perforator.”

**Life-History**

The Egg.—The egg is very small, being barely discernible to the naked eye. It is projectile-shaped, pale straw-color, with about ten longitudinal ridges and intervening grooves, giving it a strongly fluted appearance. In addition to this, a reticulate system of smoky-colored mottingings decorate the surface. The egg is placed upright on the leaf, standing on its largest end. No preference seems to be shown in ovipositing as between the top and under sides of the leaf. Since we have been unable to induce egg-laying under control, it is impossible to present data as to the duration of the incubation period. Eggs in out-of-door locations on a few occasions have been observed 24 hours prior to hatching which indicates that the period is somewhat in excess of that interval.

The Larva.—First Instar.—Upon hatching the larva bores into the leaf directly at the point of attachment of the egg and begins to tunnel. The mine lies nearer the upper surface than the lower, and progresses tortuously, ever widening in calibre. The average total length of the tunnel, as determined from a measured series, is about one inch. When this instar is about completed an exit hole is cut through the upper epidermis, and the larva deserts for all time the inner tissue. Upon coming to the exterior the first instar individual occasionally feeds for a brief period on the upper leaf tissue. The time required for the completion of this instar is about three days.

When the feeding activities of this stage are finished the larva weaves a tiny circular web over some slight depression on the under side of the leaf into which it repairs for the first molt. The initial molting web consists of two fabrics, first a “fly” web of loose texture is woven and under this is spun the more compact fabric. A somewhat concealed aperture is left through which the individual makes its exit after molting. A large series of these primary molting webs averaged \( \frac{1}{32} \) inch in diameter. The molting period covers about twenty-four hours.

Second Instar.—Upon the appearance on the leaf of the second larval instar, feeding at once begins. This may take place on either the upper or the under surface. The leaf tissue is devoured only to the opposite epidermis, but the remaining tissue often collapses, thus forming irregular-shaped lesions (see Pl. 36, fig. 2). After about 1.5 days at El Centro, the larva selects a concavity, normally on the under surface between two large veins, and spins the second molting cocoon. These are similar to the primary cocoons but are larger, averaging about \( \frac{1}{16} \) inch in diameter. The larva lies in a looped position—head to tail. The quiescent period is determined from our data to be 1.1 days.

Third Instar.—At the conclusion of the second molt the larva of the third instar emerges and at once begins to feed in a manner similar to individuals of the second instar. This is the most aggressive stage and the one causing the greatest amount of injury to the cotton leaf. As a rule, not more than two or three larvae occur on a single leaf, but occasionally as many as a half dozen have been seen. The last act of the third larval instar individual, after the completion of the pupal cocoon, is the shedding of the larval skin which occupies a position within the cocoon just behind the posterior end of the chrysalis. Just prior to pupation the color of the mature larva undergoes a change from the olive-green of the active condition to a smokydrab which is apparently indicative of maturity. The third instar at El Centro required during midsummer about 1.9 days of completion.

The Pupa

The pupal cocoon may be placed in one of several locations. It is occasionally seen at some point on a leaf; it is often formed on the leaf petioles; but most frequently it is placed at some point along the main or lateral stems (see Pl. 36, figs. 1 and 3). Just before making the cocoon a series of stout, upright bristles is placed in a graceful ellipse so as finally to surround the cocoon. These closely set stalks form a stockade and are intended, probably, as a protection against predatory species.

In constructing the cocoon each end is woven to a point near the middle, whereupon the larva withdraws into one half of the cocoon and deftly spins a few tie-fibrils between the ends of the opposed flutings; the gap is then entirely closed with a mesh of cross-fibrils. From the pupal records of a large series of bred individuals we find that the average duration of the pupal period for June and July at El Centro is 5.7 days. The development of the cotton leaf-perforator may be summarized, then, as follows:
McGregor thought that the "stockade hairs" (see Jäckh, 1955, and Ross, 1953, for illustrations) that the larva places around the cocoon no doubt imitate the hairs of the cotton plant, but he was evidently not aware that the

<table>
<thead>
<tr>
<th>Stage</th>
<th>Days</th>
</tr>
</thead>
<tbody>
<tr>
<td>Egg stage</td>
<td>1 (plus)</td>
</tr>
<tr>
<td>Leaf-mining stage</td>
<td>3</td>
</tr>
<tr>
<td>First molt</td>
<td>1</td>
</tr>
<tr>
<td>Second larval instar</td>
<td>1.5</td>
</tr>
<tr>
<td>Second molt</td>
<td>1.1</td>
</tr>
<tr>
<td>Third larval instar</td>
<td>1.9</td>
</tr>
<tr>
<td>Pupal period</td>
<td>5.7</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>15.2</td>
</tr>
</tbody>
</table>

Figure 481—C—Details of the larva of *Bucculatrix thurberiella* Busck; length about 6.0 mm.; Nanakuli, Oahu. a, frontal aspect of head, color pattern omitted. b, left lateral aspect of head and pronotum; sp = spiracle. c, an enlarged sketch of the ocellar area. d, spinneret, ventral aspect. e, dorsal aspect of pronotum. f, ventral aspects of prolegs of left side (segments 3 to 6 and 10, as numbered) to show crochets; it should be noted that the number and arrangement of the crochets varies individually. g, ventral aspect of the fourth abdominal segment to show the arrangement of the V and SV setae.
hairs are characteristic of many species of *Bucculatrix*. Slingerland and Fletcher (1903:69), gave an early, detailed account of the construction of the characteristic, longitudinally ribbed cocoon of *Bucculatrix*, and Jäckh (1955:118) has published a modern paper, with photographs, showing the construction. The "stockade hairs" are easily abraded and may escape notice.

Annette Braun, in her admirable monograph on the North American *Bucculatrix* (1963:180), placed *thurberiella* in "Section VIII", the ultimate section of her work, together with three other species. Of these she said:

Included in Section VIII are four species of our fauna, feeding in the larval state on members of the plant family Malvaceae. These species are characterized by unusual and unique features of the genitalia in both sexes. Chief of these are, in the male, the lobed harpes [valvae] and the tendency for the development of sclerotized plates on the sternite or of both sternite and tergite of the eighth abdominal segment; these

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Figure 481-D—Further details of the larva of *Bucculatrix thurberiella* Busck. a, left lateral aspect of metasthorax and first abdominal segment. b, left lateral aspect of third abdominal segment with a sketch of an enlarged area including the spiracle to show the nature of the dermal asperities. The irregular patterns formed by the dark colored asperities, although conspicuous, have not been shown in my drawings. c, a left prothoracic leg. d, dorsal aspect of third abdominal segment. e, a proleg of the sixth abdominal segment; note the elongate form.
plates may extend as free arms. In the female, the characteristic features are the position of the ostium at the posterior margin of the sclerotized basal half of segment 8, the development of a second pair of apophyses, those on the eighth segment, and perhaps most unique and distinctive, the presence of a dorso-lateral group of setae on a sclerotized area at the base of the membranous posterior half of segment 8. These characters are also present in the Mediterranean Bucculatrix lavaterella Millier...

Some species of Bucculatrix have the third antennal segments of the males "notched" or distorted, but the third segments are simple in thurberiella, as noted in my illustration.

Figure 481-E—More details of the larva of Bucculatrix thurberiella Busck, a, left lateral aspect of abdominal segments 8, 9, and 10. b, caudal view of the abdominal apex with an enlargement of dermal spicules. c, dorsal aspect of abdominal segments 8, 9, and 10. d, ventral aspect of the three thoracic segments to show the arrangement of the bases of the legs. a to e drawn to same scale; d and e drawn to a larger scale.
Family **LYONETIIDAE** Stainton


*Lyonetidae*: Anonymous, 1858:106.


*Lyonetiidae*: Hampson, 1918a:337.

*Bedelliidae* Meyrick, 1880a:133, 169.

*Cemiostomidae* Spuler, 1898a:33.

*Cemiostomatina*: Wallengren, 1881:125.

*Leucopterygidae* Heinrich, 1918:27. This is an unnecessary replacement name for *Cemiostomidae* and is incorrectly formed. It is based upon *Leucoptera* Hübner, 1818, which antedates *Cemiostoma* Zeller, 1848, and should be *Leucopteridae*.

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Figure 481-F—Details of the pupa of *Bucculatrix thurberiella* Busck.  
*a*, ventral aspect; length 3.0 mm.; Nanakuli, Oahu: An, antenna; CX1, CX2, pro- and mesocoxae; E, eye; F1, profemora; FW, forewing; HW, hindwing; Lb, labrum; L1, L2, L3, fore, middle and hindlegs; Md, mandible; MX, maxilla (proboscis);  
*b*, right lateral aspect of head and adjacent parts;  
*c*, enlarged dorsal aspect of third abdominal tergum showing subbasal denticles and the dermal asperities;  
*d*, enlarged dorsal aspect of the cauda.
Figure 481-G—Leaf of *Gossypium tomentosum*, the native Hawaiian cotton, from Nanakuli, Oahu, showing typical damage caused by the larvae of *Bucculatrix thurberiella* Busck. The whole leaf is shown in natural size. The enlarged bottom figure shows the characteristic fecal pellets in the eaten areas. The larvae feed in a curled position and are longer than the lengths of their feeding areas. Specimen collected by J. W. Beardsley.
Our representatives (Bedellia) of this family have an unusually strongly developed squamose pecten on the basal segment of each antenna which resembles an eye-cap more than it does a typical pecten. On the Hawaiian species the maxillary palpi are vestigial. Perhaps the only groups in Hawaii with which the members of this family might easily be confused, principally because of the eye-cap-like antennal pectens, are the Opostegidae and the Bucculatrigidae. They might also be confused on occasion with the Momphi-nae, but our representatives of the momphids are easily distinguished because they lack antennal pectens. The Lyonetiidae has been the “dumping ground” of many genera which do not belong to it, and its literature is in a highly confused state. In 1893:477, Meyrick restricted the group “to the smooth-headed genera with eyecaps”. The larvae mine the leaves of both monocots and dicots.

Genus BEDELLIA Stainton


The species assigned to Bedellia in Hawaii are utterly confused in collections and in literature. I regret very much that circumstances beyond my control prevent me from presenting here an adequate revision and proper interpretation of these tiny leafminers. I have superficially examined many more undescribed than described species, and it is obvious that many species occur in Hawaii. Much careful field work must be done on this group to ascertain the number of Hawaiian species, their habits, hostplants, and distributions. Without the opportunity to pursue the problem to a successful conclusion, all I can do here is to point out what little I know and leave the task of revision to future workers. Much of what may be said of the Hawaiian group now may be little more than conjecture.

Perkins and Swezey were aware of the confusion in Walsingham’s treatment of the Hawaiian Bedellia, and Swezey (1913d:224–225) said:

Bedellia minor Busck, and B. somnulentella Z.—The larvae of these two species are said to mine the leaves of sweet potato and various other vines of the genus Ipomoea. I consider that the leaf miners in sweet potatoes and all other Ipomoea vines here are the same species, whatever it may be, whether it is the minor or somnu lentella . . . or something else. Dr. Perkins thinks that there must have been an error in the determination of the species of Bedellia that Lord Walsingham had from him, for Walsingham has identified as somnulentella specimens which came from an elevation of 4000 feet, whereas Dr. Perkins says that there are no Ipomoea vines growing at that elevation. Some of the specimens that he determined as minor, came from an elevation of 4000 also, while others of them Dr. Perkins had bred from Ipomoea at lower elevations. More recently, Mr. Busck has determined specimens reared from sweet potato as orchillella [sic] Walsm.

The species of Bedellia are so similar and so difficult to separate, especially if not in perfect condition, that I now think that the specimens from 4000 feet elevation determined as Walsingham as minor and somnulentella belong to my species oplismeniella.

Without careful study, it is best not to accept the opinions that all of the Ipomoea miners are the same species or that some of the specimens Walsingham determined as minor and somnulentella are oplismeniella.
At the British Museum, I compared the Hawaiian *orchilella* Walsingham, including its genitalia, with the Eurasian type-species, *somnulentella*, and they are congeneric. Whether or not all of the species of this group in Hawaii should be considered to belong to a single genus is a question that remains to be answered. Bradley (1961:160) gave notes on *Bedellia somnulentella* and designated the lectotype. Jayewickreme (1940:82) has described and figured some features of *Bedellia somnulentella* in England. I have examined specimens of *minor* at the U.S. National Museum. It is different from any species I have seen from Hawaii—the male genital valvae are entirely rounded at the apices, and the female signa are distinctive. The species which I have examined from mines in sweetpotato leaves in Hawaii is *orchilella* Walsingham. The species *somnulentella* (Zeller) and *minor* Busck do not occur in Hawaii.

As noted in the foregoing quotation from Dr. Swezey, the adults of at least some of these tiny moths do not appear to display gross interspecific external differences. The genitalia, however, are distinctive, and the valvae of the males and the signa of the female bursa copulatrix display good characters. The pupae appear to have numerous characters which are useful for species separation, and it may be true that the species can be more easily differentiated by the pupae than by external differences in the adults. The pupae have distinctive ear-like protuberances on the pronotum. It is unfortunate that a complete collection of pupae has not been assembled.

Figure 482.—*Bedellia*. Top, head and wing venation of a paratype of *struthionella* Walsingham; Kona, Hawaii (BM slide 2230) (drawings by Arthur Smith). Bottom, wing venation of *somnulentella* Zeller (= *orpeela* Stainton), the type-species of *Bedellia* (drawn by J. F. G. Clarke).
In Hawaii species of *Bedellia* have been reared from a sedge, grasses (*Panicum* and *Oplismenus*), *Dianella* (Liliaceae), *Boehmeria* (Urticaceae), and *Ipomoea* (Convolvulaceae). With such a wide range of hostplants already known, it would appear that many Hawaiian plants are attacked by these tiny leaf miners. Concentrated study in the field should be rewarded by many interesting discoveries.

See color plate 3, figure 6.

**PRELIMINARY KEY TO THE NAMED SPECIES OF HAWAIIAN BEDELLIA**

1. Forewing with conspicuous areas of yellow scales and areas of white scales in addition to brown speckling; from Kona, Hawaii 4,000 feet; figure 485.
   \[\text{struthionella} \text{ Walsingham.}\]

2(1). Forewing with purplish reflections; genitalia as in figures 486, 492; on *Boehmeria* on Oahu.
   \[\text{boehmeriella} \text{ Swezey.}\]

3(2). On sweetpotato and other Convolvulaceae; genitalia as in figures 487, 493.
   \[\text{orchilella} \text{ Walsingham.}\]

Bedellia boehmeriella Swezey (figs. 484, moth; 486, male genitalia; 492, female genitalia).

*Bedellia boehmeriella* Swezey, 1912b:185.

Endemic. Oahu (type locality: in the mountains at the head of Manoa Valley).
Hostplant: *Boehmeria grandis* (= *stipularis*); the larvae mine the leaves.

The signum of the female bursa copulatrix is unlike that of any other species I have studied. It is in the form of a continuous, longitudinal, serrated tape. The male genitalia are also distinctive.

Dr. Swezey (1912b:186) said that the adults are distinct from the other species known to him because the forewings are purplish. Perhaps it would have been more accurate to say that the wings are tinged with purple. The basic color pattern appears not unlike the common pepper-and-salt speckled wings of most of the group. Dr. Swezey said, "I first noticed the work of this
Figure 485—*Bedellia*. Top, *orchitella* Walsingham, holotype male; Waianae Mts., Oahu; forewing = 3.0 mm. (BM slide 4064). Bottom, *struthionella* Walsingham, holotype male; Kona, Hawaii, 4,000 feet; forewing = 4.0 mm. (BM slide 4063).
leaf-miner September 5, 1909, in the mountains at the head of Manoa Valley, and bred specimens from material collected that day. Since then I have observed it wherever I have seen its food-plant in the mountains of Oahu.” More than one species has been confused by Dr. Swezey under this name, however. I have examined specimens collected by Swezey in the Waianae Mountains that have quite different genitalia. Further collecting and study are required to clarify the confusion. Dr. Swezey made the following observations on the early stages:

Figure 486—Male genitalia of _Bedellia_. Top, _boehmeriella_ Swezey, holotype; head of Manoa Valley, Honolulu (slide Z-IX-3-61-5). Bottom, _oplismeniella_ Swezey; Palolo, Oahu (slide Z-V-12-61-1). Note the great differences in the genital valvae.
The full-grown larva is a little over 6 mm., strongly constricted between segments, segment behind head large, head much retracted in it, remaining segments gradually narrowing to posterior end of body; pink on dorsal surface except head and following segment which are yellowish, yellowish below; eyes black; spiracles minute, circular, very pale brown; prolegs on segments 7–10. When full-grown the larva emerges from the leaf and pupates on the under side of the leaf beside a rib, especially in an axil at base, after having spun a few fibers of silk in which to fasten itself.

The pupa is 4.5 mm. long. Head triangularly pointed; a lateral projection behind each eye, curved a little anteriorly; a small longitudinal lateral curved projection on mesothorax; a much larger one on metathorax; a low median dorsal ridge on thorax; a lateral thin narrow flange along abdomen, containing the spiracles on its margin; no median dorsal ridge on abdomen; wing-sheaths extend nearly to tip of abdomen; antenna-sheaths extend a little beyond tip of abdomen; cremaster bifid with two widely diverging projections, each having 2 or 3 hooked bristles; all the dorsal setae are hooked into the few fibers of silk in which the pupa is suspended, ventral surface turned outward. Color yellowish, with a pink tinge on the back; projections on thorax, lateral flange of abdomen and eyes pale brownish; tips of antenna-sheaths black, also two short oblique black lines ventrally between anterior leg-sheaths and antenna-sheaths. One larva under observation produced a pupa which was very pink above and brown below. The adult emerged in 9 days.

**Bedelia oplismeniella** Swezey (figs. 484, moth; 486, male genitalia; 494, female genitalia).

*Bedelia oplismeniella* Swezey, 1912b:184.

Endemic. Oahu (type locality: Castle Trail, Pauoa side of Mt. Tantalus), Molokai?, Hawaii?

Hostplants: commonly mines the leaves of the grasses *Oplismenus compositus* (the type host) and *Panicum torridum*.

Parasite: *Euderus (Secodella) metallicus* (Ashmead).

This species resembles *Bedelia struthionella* Walsingham, and it is possible that the records concerning these two species may in part be confused. I have questioned the Molokai and Hawaii records for this reason. The specimens under this name in collections require further study.

Dr. Swezey (1912b:184) said “I cannot with certainty separate specimens of my species from the Ipomoea one [orchilella]; but, as my specimens are all bred from a grass, I have considered it a different species, particularly as the pupae have several differences. The pupa of the *Ipomoea* species has an elevated median dorsal ridge on the thorax, a median dorsal ridge on the abdomen, and the wing-sheaths are roughed with minute points; while in *oplismeniella*, the thorax has a low median dorsal ridge, median dorsal ridge lacking on the abdomen, and the wing-sheaths are not roughed with minute points.”

Dr. Swezey often found the larvae abundant in its widespread hostplant, and he said (p. 185), “The mine is usually lengthwise in the leaf, widening as the larvae has grown in size.” He described the larva and pupa as follows (p. 185):

The full-grown larva is about 5 mm. in length, pale green with a mid-dorsal purplish-red stripe, also some more or less lateral motlings of the same color, especially anteriorly; head green, sutures, lateral edges and mouth-parts brown, eyes black; head retracted into second segment which is wider than following segments, green with some blackish dots on sides and posterior part; hairs pale. When full-grown, the larva emerges from the leaf, spins a few fibers beside the mid-rib of the leaf, at the base, or in some other partially secluded place; then pupates among these fibers without making a cocoon.

The pupa is about 4 mm. in length, pale yellowish, with several fuscous streaks ventrally, also two pairs of conspicuous blackish spots, eyes reddish brown; head with a compressed triangularly pointed projection in front, a large lateral projection behind each eye with sharp point directed anteriorly; thorax with low median dorsal ridge; abdomen with broad lateral flange on each side just on the line of spiracles so that the latter are just beneath its outer edge, no dorsal median ridge; setae “iii” [SD1] are situated on upper surface of this flange, they as well as setae “i” [D1] and “ii” [D2] are quite long and stout and hooked...
into silk which the larva has spun on the surface of leaf; setae “i” and “ii” in a straight line; cremaster bilobed, a number of hooked bristles fastened into the silk by which pupa is suspended, dorsal side towards leaf; antenna-sheaths extend to apex of abdomen, wing-sheaths almost as far, not roughened with minute points as in the *Ipomoea* species *orchilella*. Pupa stage occupies 8 days.

Figure 487—*Bedellia orchilella* Walsingham, male genitalia. Top, holotype; Waianae Mts., Oahu (BM slide 4064). Middle, paratype of same (BM slide 2231) from same locality. Bottom, from a specimen from sweetpotato leaf from Pupukea, Oahu (slide Z-X-30-60). Note the hooked apices of the valvae on this species. Is the variation exhibited by these specimens more than individual?
488—Male genitalia of Bedellia. Top left, a paratype of struthiomele Walsingham; Kona, 4,000 feet, Hawaii (BM slide 2230). Top right, the aedeagus of the holotype of the same species, also from Kona (BM slide 4063). Middle, "species 5"; Kona, 4,000 feet, Hawaii (BM slide 7024); partly decomposed. Bottom, "species 6", Waianae Mts., Oahu (BM slide 7029); this example was incorrectly determined as "minor" by Walsingham, 1907b:724.
Figure 489—Male genitalia and base of abdomen of *Bedellia struthionella* Walsingham, paratype (BM slide 13881); Kona, 4,000 feet, Hawaii (Walsingham specimen 25416). Compare figure 490.
Figure 490—Male genitalia of *Bedellia* species. Top, *struthiomella* Walsingham, paratype (BM slide 16294); Waianae Mts., Oahu. Bottom, new species 14 (BM slide 16295), formerly confused as paratype 4/4 of *architella* by Walsingham; Olaa, Hawaii (Walsingham specimen 28056). The caudal tergite of the abdomen adheres to the tegumen, thus giving the confusing appearance of an unusual uncus. Note the peculiar saccus—the cephalic end is artificially deformed.)
Figure 491—Male genitalia of Bedellia. Top, “species 7”; Molokai (BM slide 7072); from the series incorrectly determined as “minor” by Walsingham, 1907:724. Bottom, “species 12”; Mt. Kaala, Oahu; reared from Boehmeria (slide Z-V-13-61).
Figure 492—Female genitalia of *Bedellia*. Top, paratype of *boehmeriella* Swezey; the enlarged bursa copulatrix is from a second paratype; above Manoa Valley, Oahu (both specimens on Busck slide 279). Bottom, "species 12"; Mt. Kaala, Oahu; reared from *Boehmeria* (slide Z-V-14-61). Note the great differences in the sigma of these species.
**Bedellia orchilella** Walsingham (figs. 11-A, f; 483, head, venation; 485, moth; 487, male genitalia; 493, female genitalia; 497, leaf mines; 498, larva, pupa).

*Bedellia orchilella* Walsingham, 1907b: 725.

*Bedellia minor*, as an error of identification by some authors, including Walsingham, 1907b: 724.

*Bedellia somnulentella*, as an error of identification by some authors. Walsingham, 1907b: 723.

The sweetpotato leaf miner.

Kauai, Oahu (type locality: Waianae Mountains), Molokai, Maui, Hawaii.

Immigrant? This species has been considered an endemic Hawaiian insect, but I believe that it may be an immigrant. Its genitalia demonstrate that it does not belong to the same species group as the many certainly autochthonous Hawaiian *Bedellia* species. Its genitalia are closely similar to the

Figure 493—*Bedellia orchilella* Walsingham, parts of female genitalia of a specimen reared from a mine in a sweetpotato leaf; Pupukea, Oahu (slide Z-X-31-60).
widely dispersed species group to which belongs the well-known type-species, *Bedellia somnulentella* (Zeller). It is possible that *orchilella* will be found elsewhere in the Pacific or in Asia when the *Bedellia* of those areas are more adequately known.

**Hostplants:** *Ipomoea tuberculata,* sweetpotato and other species of *Ipomoea.*

**Parasites:** *Derostenus fullawayi* Crawford, *Apanteles bedelliae* Viereck (this braconid was purposely introduced to Hawaii to aid in the control of this moth, and it has been highly effective), *Euderus metallicus* (Ashmead) (this species often causes a high rate of parasitism), *Pnigalio* (“*Notanisomorphomyia*”) *externa* (Timberlake).

The larvae of this leaf miner are often pests of significant importance to sweetpotatoes in Hawaii. The larval mines may cause the yellowing of the leaves of entire fields of sweetpotatoes. “The leaf-miner, after the stem borer, is perhaps the most destructive insect enemy of the sweet-potato vine. Its injuries are confined to the foliage, which as a result [of attack] presents a notched and withered appearance and bears traces of excrement. The newly hatched larvae penetrate the leaves and feed upon the green coloring matter. The leaves gradually lose their color and wither, and the leafstalks drop.” (Chung, 1923:12.)

Dr. Swezey (1912b:184) said that the pupa “has an elevated median dorsal ridge on the thorax, a median dorsal ridge on the abdomen, and the wing-sheaths are roughened with minute points . . .” It thus differed distinctly from the endemic Hawaiian *Bedellia* pupae known to him.

Much confusion exists regarding the name of this species as it has been used in literature. At various times it has erroneously determined as the species known in America as *Bedellia minor* Busck (see my comments above under the discussion of the genus) and the widely dispersed (including southern Europe) *Bedellia somnulentella* (Zeller). *Bedellia orchilella* resembles *somnulentella,* but it is specifically distinct. Pierce and Metcalfe, 1935:90, pl. 55, made a serious error, which will undoubtedly cause much confusion, when they said, “No signum”. I have examined their slide mount, now in the British Museum, and it appears that the bursa copulatrix was accidentally removed and lost during dissection because the specimen is now without a bursa. I have examined the female genitalia of the lectotype of *somnulentella* (BM slide 5965), and it has two strong signa toward the caudal end of the bursa and a heavy U-shaped signum toward the cephalic end. It thus differs distinctly from *orchilella* which has two pairs of separate signa, as demonstrated in my figure.

Several species have been confused as *somnulentella.* Several names proposed in various parts of the world have proved to be synonyms, and others may also be synonyms. *Bedellia ipomoeae* Bradley, 1953:14, from Fiji, and *Bedellia mnesileuca* Meyrick, 1928b:397, from Australia, were shown by Bradley, 1961:160–161, to be synonyms of *somnulentella.* Szöcs, 1967:231, and Klimesch, 1968:9, give details on *somnulentella* and other species. Klimesch illustrates the male and female genitalia of *somnulentella.*
Figure 494—*Bedellia oplismeniella* Swezey, details from the female abdomen. Top left, ovipositor and associated areas. Top right, the base of the abdomen; one of the sclerotized basal processes has been broken away. Bottom, the signa and bursa copulatrix; Mt. Kaala, Oahu; reared from *Panicum kaalense* (slide Z-V-12-61-2).
Figure 495—*Bedellia*. Female genitalia of a specimen from Kona, Hawaii, 4,000 feet (BM slide 7028), incorrectly determined as "minor" by Walsingham, 1907:724.
Figure 496—Bedellia. Genitalia of a female of species 6 from Waianae Mts., Oahu (BM slide 7030) from the series of specimens incorrectly determined as minor by Walsingham, 1907b: 724; this specimen was labeled as a "caenotype" by Walsingham.
Figure 497—Sweet potato leaves showing damage done by the leaf-mining larvae of *Bedellia orchilella* Walsingham; Oahu. (University of Hawaii photographs.)
Figure 498—Details of the larva and pupa of Bedellia orchilella Walsingham. a, setal map of the pro- and mesothorax and abdominal segments 1, 3, 4, 5, and 7; b, setal map of abdominal segments 8 and 9; c, ventral and subventral setae on abdominal segments 7, 8, and 9; d, a thoracic leg; e, ocelli and associated setae; f, proleg crochets; g, prothoracic shield; h, dorsal aspect of abdominal segments 8 to 10; i, frontal aspect of head; j, ventral aspect of pupa. (Drawn especially for this text by Margaret MacKay.)
**Bedellia struthionella** Walsingham (figs. 482, head, venation; 485, moth; 488, 489, 490, male genitalia).

*Bedellia struthionella* Walsingham, 1907*: 725.

Endemic. Oahu, Hawaii (type locality: Kona, 4,000 to 5,000 feet).

Hostplant: I have examined material that may be this species that was reared by Dr. Swezey from *Panicum torridum* on Oahu. He said (1913d: 225) that *struthionella* “must be a miner in some native tree, but I have not yet discovered its food plant.” I do not know why Dr. Swezey presumed that this was not a grass miner. The male genitalia are closely similar to those of Swezey’s *oplismeniella*. It is possible that this is a widely dispersed species in Hawaii, but evidently a confused cluster of species associated with *struthionella* awaits study.

**Bedellia species 5** (fig. 488, male genitalia).

*Bedellia somnulentella*, in the sense of Walsingham, 1907*: 723, pl. 25, fig. 28, not of Zeller (BM slide 7024).

Endemic. Hawaii (Kona, 4,000 feet).

Hostplant: unknown.

Walsingham, in *Fauna Hawaiiensis*, reported that Perkins had taken at Kona, 4,000 feet, “Two large specimens which are certainly not *minor*, Busck, I name with some doubt *somnulentella* Z.” The upper lobes of the male genital valvae each terminate in a thornlike process. The genitalia are otherwise of the basic *struthionella* kind.

**Bedellia species 6** (figs. 488, male genitalia; 496, female genitalia).

*Bedellia minor*, in the sense of Walsingham, 1907*: 724, in part, not of Busck, (BM slides 7029, male; 7030, female).

Endemic. Oahu (Waianae Mountains).

Hostplant: unknown.

Walsingham placed 24 specimens from Oahu, Molokai, and Hawaii under the name *minor* Busck in *Fauna Hawaiiensis*. None of these is the American *minor*, and there appear to be three species mixed under this name in the Walsingham series. I confine “species 6” to the specimens collected by Dr. Perkins in the Waianae Mountains. I am not certain that Walsingham is speaking of this species when he says, “Larva mining *Ipomoea*. Bred in Oahu from larvae mining *Convolvulus* leaves. Larvae whitish. Pupa on leaves in web. Common (Perkins).” The male genitalia I have examined indicate a species near *struthionella* which is a grass miner. It might be that Walsingham’s *Fauna Hawaiiensis* series also contained some specimens of the *Ipomoea*-mining *orchilella*, and, if so, that would account for the host reference made in the quotation from Perkins’ field notes.

**Bedellia species 7** (fig. 491, male genitalia).

*Bedellia minor*, in the sense of Walsingham, 1907*: 724, in part, not of Busck (BM genitalia slide 7027).

Endemic. Molokai.
Hostplant: unknown.
The pair of specimens in the *Fauna Hawaïensis* collection from sea level on Molokai represent one, or possibly two species that differ from “species 6”. The male genitalia indicate a species in the *struthionella* complex.

**Bedellia species 8.**

*Bedellia minor*, in the sense of Walsingham, 1907: 724, in part, not of Busck.

Endemic. Hawaii (Kona, 4,000 feet).

Hostplant: unknown.

This is a third species from the series which Walsingham placed originally under the name *minor*. The genitalia indicate that this is another species of the *struthionella* complex.

**Bedellia species 9.**

Endemic. Molokai (Kamiloloa).

Hostplant: *Panicum torridum*.

Dr. Swezey (Proc. Hawaiian Ent. Soc. 6: 419, 1927) reared what he considered to be a new species from grass which he collected at Kamiloloa. I have not studied the genitalia of this form.

**Bedellia species 10.**

Endemic. Oahu (Mt. Kaala).

Hostplant: *Panicum kaalense*.

This species, reared by Dr. Swezey, has distinctive genitalia.

**Bedellia species 11.**

Endemic. Hawaii (Kohala Mountains).

Hostplant: sedge.

The only species known to me to have been reared from a sedge (by Dr. Swezey); it is new with clearly distinct male genitalia.

**Bedellia species 12** (fig. 491, male genitalia; 492, female genitalia).

Endemic. Oahu (Mt. Kaala).

Hostplant: *Boehmeria*.

Moths reared by Dr. Swezey from *Boehmeria* on Mt. Kaala and determined by him to be *boehmeriella* have very different male (slide Z-V-13-61) and female (slide Z-V-14-61) genitalia from true *boehmeriella* from the type locality in the Koolau Mountains and represent a new species.

**Bedellia species 13.**

Endemic. Kauai (Kokee).

Hostplant: *Dianella*.

Dr. Swezey reared this new species from mines in *Dianella* (Liliaceae) (see Swezey, 1954: 67). This is the only record of a *Bedellia* attacking a member of the lily family in Hawaii. I have not examined the genitalia of this species and cannot comment upon its relationships.
**Bedellia species 14** (fig. 490, male genitalia).

Endemic. Hawaii (Olaa).

Host plant: unknown.

This species, collected by Perkins and listed as Walsingham’s specimen 28056, was wrongly considered a paratype of *orchilella* by Walsingham. It has an unusual saccus, as the illustration demonstrates (B.M. slide 16295).

**Superfamily YPONOMEUTOIDEA** (Stephens)

*Yponomeutidae* Stephens, 1829:48.


*Yponomeutidae*: Guenée, 1845b:103.


*Hyponomeutinae*: Walsingham, 1890:144.

*Ypsolophidae*: Guenée, 1845b:97.


*Hypsilophidae*: Hampson, 1918b:387.


*Pluttelinae*: Walsingham, 1890:144.

*Pluttellidae*: auctorum.

*Acrolepidae*: auctorum. Spuler, 1898a:35.

*Acrolepiinae*: Walsingham, 1890:144.

The spellings *Yponomeuta* and *Yponomeutidae* are based evidently upon incorrect transliteration, and *Hyponomeuta* and *Hyponomeutidae* would be better forms. The International Code of Zoological Nomenclature does not permit changing of names because of incorrect transliteration, but it might have been better to have accepted the very early correction of the spelling by Sodovsky in 1837, as noted above.

The classification of the moths assigned here is confused. I have decided to accept the merging of the Pluttellidae into the Yponomeutidae instead of considering that there are two families represented as so many workers have believed. I have also accepted the inclusion of *Acrolepia* within the Yponomeutidae instead of treating that group as a member of a separate family.
called Acrolepidae as do some authors. Clarke (1955:24) stated that the
"Hyponomeutidae and Plutellidae... are inseparable, as indicated by
structures of both immature and adult stages." Some workers continue to
divide the group into several "families" without clearly defining such supposed
families. Prays is a more divergent group, and it and Acrolepia and Plutella (the
genera represented in Hawaii) might be placed in separate tribes or perhaps
subfamilies within the Yponomeutidae.

In the Yponomeutidae the proboscis is not squamose (it is minutely pilose
but is called naked). This character assists in the separation of the ypome-
meutids from the gelechioids with which they might be associated. All of the
Hawaiian species have "pectens" of long hair on the anal vein areas of the
hindwings.

**KEY TO THE GENERA OF YPONOMEUTIDAE IN HAWAII**

**A—ADULTS**

1. Ocelli absent; maxillary palpi rudimentary........... *Prays.*
   Ocelli present; maxillary palpi developed, squamose
   and conspicuous.............................2

2(1). Second segment of labial palpus with the squamae
   projecting strongly below and beyond the terminal
   segment, as in figure 504; hindwing with veins 3 and
   4 separate from the cell, as in figure 504........... *Plutella.*
   Second segment of labial palpus without a distal
   expansion of the squamae, but as in figure 512; hind-
   wing with veins 3 and 4 stalked, as in figure 512.....
   .............................................. *Acrolepia.*

**B—LARVAE**

1. Crochets of the abdominal prolegs arranged in double
   series; larvae of known Hawaiian species on *Pelea*
   or *Fagara* (= *Xanthoxylum*)....................... *Prays.*
   Crochets of abdominal prolegs arranged either in
   single rows (figure 509) or with only a short extra
   transverse internal row of a few crochets enclosed
   within the single external row (figure 53); the
   Hawaiian species on crucifers, onions and related
   plants or on *Nothocestrum*............................2

2(1). Spiracles of the abdomen each with the seta next
   above it (seta SDI) enclosed by a common pinac-
   lum (sclerotized area); ventral prolegs short and
   stout............................................ *Acrolepia.*
   Spiracles of the abdomen and the seta just above each
   spiracle not enclosed by a common pinaculum;
   ventral prolegs long and slender.................... *Plutella.*
Genus **PRAYS** Hübner


*Prays* is an Old World group with species recorded from Eurasia and Africa to Australia and parts of the Pacific. It would appear, however, that more than one genus may be included under the name *Prays*. The taxonomic position of *Prays* is uncertain. Some workers exclude it from the Yponomeutidae. Some have suggested that it be placed in the Scythrididae, but that suggestion is untenable. The genitalia are peculiar, and the genus is isolated.

It had been assumed that there was only one variable, widespread foreign species of *Prays* in Hawaii. These studies have shown the true situation to be

![Figure 499—Prays. Top, *fulvocanella* Walsingham, holotype (BM slide 4171); Kaholuamano, Kauai. There are no ocelli and the proboscis is not squamose. The labial palpi are probably usually held more horizontally in life. Bottom, wing venation of *curtisella* Donovan, the type-species.](image)
quite the contrary—examinations of the genitalia have revealed the presence of a series of endemic Hawaiian species. Furthermore, I am not positive that the Hawaiian species are true *Prays*. The type of the genus and other non-Hawaiian species which I have been able to examine have the uncus divided (in the type-species it is apically concave with what appear to be the socii developed as armlike structures), but the uncus of all the Hawaiian species examined is long, slender, entire, and of a different character from that of the type-species. Except for this feature, however, the Hawaiian species appear to agree with *Prays*, although my studies may not have been adequate. The male genitalia are very distinctive in the Hawaiian fauna, and they do not approach the form found in any other group of moths in Hawaii.

Perkins (1913:clxvi) said that *Prays* are common insects “often disturbed from the branches of trees. It is a true forest insect and almost certainly endemic.” Perkins’ observations are correct, and many new endemic species remain to be described.

There are two well-known agricultural pest species of *Prays*. One is the destructive olive moth, *Prays oleella* (Fabricius), and it has been called the second most important pest of olives in some Mediterranean areas (see Silvestri, 1908:83; 1943:121–136, figs. 150–167). The second species, the widespread *Prays citri* Millière, is known in some places as the “citrus rind borer”, and it has been the subject of study in Europe and the Philippines. It is a well-known

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Figure 500—*Prays fulvocanella* Walsingham, holotype male (BM slide 4171); Kaholuamano, 4,000 feet, Kauai. A poor photograph.
pest of citrus in the entire Mediterranean region and ranges eastward to Australia and Japan and supposedly as far east as Samoa. A large body of literature has been published on these pests; see, for example, Silvestri, 1943: 136–139, figs. 168–172, and Balachowsky, 1966:926. See also Arambourg in Balachowsky, 1966:181–198, for illustrated discussions of the two species.

Prays pupate in cocoons of silk mesh similar to those of Plutella, and the larvae have long setae.

Prays fulvocanella Walsingham (figs. 499, head, wing venation; 500, moth; 501, male, female genitalia; 502, male genitalia; col. pl. 3:7).

Prays fulvocanellus Walsingham, 1907b:652, 735, pl. 25, fig. 8.

Endemic. Kauai (type locality: Kaholuamano, 4,000 feet).

Hostplant. Unknown, but it may be Pelea (= Platydesma) or Fagara (= Xanthoxylum) hawaiensis; see the note below.

Although this species has been recorded from Kauai, Oahu, Molokai, Maui, Lanai, and Hawaii, I have restricted it here to the type island of Kauai. I have examined the male genitalia of paratypes from the Waianae Mountains, Oahu; Lanai, 2,000 feet; and Kilauea, Hawaii, and they represent three distinct new species. I have not examined male specimens from Molokai or Maui, but specimens from those islands are also believed to represent new species.

Walsingham had 42 specimens before him when he described the species. He erroneously considered them all to represent one species which, he said, "varies considerably in size and in the amount of brown suffusion."

Dr. Swezey reared specimens of Prays from the flowers of Fagara (= Xanthoxylum) and buds and seeds of Pelea. These records probably apply to several new species.

Prays new species 1, from Kauai (fig. 503, pupa).

A single example of this species was reared from a seed of Pelea (Platydesma) collected by C. J. Davis and Donald Sugawa at Kumuwela. Mr. Davis told me that the fruits were "heavily infested".

Prays new species 2, from Oahu.

Prays new species 3, from Molokai.

Prays new species 4, from Maui.

Prays new species 5, from Lanai.

Prays new species 6, from Hawaii.

Larvae taken from Pelea on Hawaii and now in the U.S. National Museum may be of this species.
Figure 501—Prays. Top left, female genitalia of a paratype of _fulvocanella_ Walsingham (Busck slide 142; Walsingham specimen 27882); I am not absolutely certain that this is _fulvocanella_, but it may be. Top right, male genitalia of the holotype of _fulvocanella_ (BM slide 4171); see figure 502 of this specimen after remounting. Bottom, male genitalia of a new species, formerly considered as a paratype of _fulvocanella_; Kauai (Busck slide 141). Note that the appearances of the two mounts differ because the bottom specimen is spread open.
Figure 502—Male genitalia of Prays. Top, the not entirely satisfactory remount of the genitalia of the holotype of fulvocanella Walsingham (BM slide 4171); Kaholuamano, 4,000 feet, Kauai. Compare figure 501 which shows this specimen before it was remounted. Bottom, from a new species from Oahu, aedeagus in situ (Busck slide 139).
Genus **Plutella** Schrank


Our knowledge of *Plutella* in Hawaii is unsatisfactory, and we do not know how many species occur here. In addition to the imported, widely distributed, European pest species known as the diamond-back moth, *Plutella xylostella* (= *maculipennis*), one distinctive endemic species has been described. The existence of endemic *Plutella* in the Hawaiian fauna is surprising. Dr. Swezey reared a number of series of specimens which may represent additional allied endemic forms, but until the moths are studied critically it is impossible to say much more about them. I had hoped to be able to study the Swezey collections in careful detail when I was working on this group several years ago, but when I requested them from Honolulu it was reported that they could not be found. However, after my manuscript was completed and nearly ready to be submitted to the Press, the Hawaiian insect collections at the Sugar Planters’ Experiment Station were given to the Hawaiian State Department of Agriculture, and through the kind cooperation of C. J. Davis and George Funasaki I have recently been able to make a brief preliminary study of several specimens of *Plutella* from series reared from *Capparis* by Dr. Swezey. One series of specimens is from the Ewa Coral Plain, Oahu, the second series is from Diamond Head, Oahu, and the third is from Kailua and Napoopoo, Hawaii. From external appearances these series appear to represent three or, possibly, four species. Surprisingly, however, their male genitalia are con-
fusingly similar, and without further detailed study I cannot express an opinion regarding their status. It is possible that a series of sibling species is involved in the Hawaiian Plutella. It must be left for some future worker to elucidate the problems of the Hawaiian Plutella.

The adults of Plutella rest with their antennae extended horizontally in front of their heads.

The two described species in Hawaii are easily distinguished by the color patterns of the forewings and by their genitalia, as the illustrations demonstrate.

KEY TO THE DESCRIBED SPECIES OF PLUTELLA IN HAWAII

1. Forewings with a large, conspicuous, pale macula near middle of costa, and with a pale vitta along posterior margin extending diagonally across the wing to reach costa near apex; aedeagus strongly sinuous, male and female genitalia as in figure 505. . . . capparidis Swezey.

2. Forewings without any pale maculae on costal margin and the pale vitta along posterior margin is confined to the posterior margin; aedeagus straight and needle-like, male and female genitalia as in figure 508 . . . . .

......................... xylostella (Linnaeus).

Plutella capparidis Swezey (fig. 505, moth, male, female genitalia).


Endemic. Oahu (type locality: Ewa Coral Plain).

Hostplant: Capparis sandwichiana.

Parasite: Chelonus (Microchelonus) blackburni Cameron; parasitism may be heavy.

Figure 504—Head and wing venation of Plutella xylostella (Linnaeus) (BM slide 5193); Hawaiian specimens. The type-species of Plutella.
Figure 505—Plutella capparidis Swezey. Top, the holotype; forewing length 4 mm.; Ewa Plain. Middle, male genitalia, with aedeagus at right, of a paratype from the same locality (slide Z–XII–19–62–16). Note the conspicuously distinct aedeagus as compared with that of xylostella on figure 508. Bottom, part of the female genitalia of a paratype from the same place; ostium marked by “X” (slide Z–XII–19–62–17).
Figure 506—Platella xylostella (Linnaeus). Top, a specimen reared from cauliflower; Manoa, Honolulu; forewing 6 mm. Middle, a specimen of the color form called albovenosa by Walsingham; forewing length 5.5 mm.; Quarantine Island, Oahu. Bottom, a cocoon of the same form reared from Lepidium at Kailua, Oahu.
The light green larvae feed mostly on the surface of the leaves, eating one epidermis and the parenchyma and leaving the other epidermis, which shows as dead spots in the leaves. Occasionally the larvae have a tendency to mine within the leaf. Usually they are exposed, but sometimes covered by a slight web. The cocoon is made on the surface of the leaf. It is not so distinctly of an open network structure as is usual with *Plutella*, tho there is a tendency for it to be of fine network with a thin outer covering. It is denser than usual for *Plutella*, but thin enough so that the pupa can be made out inside. (Swezey, 1920:383–384.)

This species may represent a remnant of a lowland Hawaiian fauna which has been nearly exterminated. Further study of the male genitalia is suggested. Is the specimen I have illustrated normal?

**Plutella xylostella** (Linnaeus) (figs. 504, head, wing venation; 506, moth, cocoon; 507, male genitalia; 508, male, female genitalia; 509, larva; 510, larval damage; 511, pupa).

**Phalaena Tinea xylostella** Linnaeus, 1758:538.

**Cerostoma maculipennis** Curtis, 1832 (1824–1839): p. 2 of explanation of pl. 420.


**Plutella albovenosa** Walsingham, 1907b:653, pl. 25, fig. 11. New synonym. For detailed synonymy, see Walsingham, 1907b:652.


![Figure 507—Male genitalia of *Plutella xylostella* (Linnaeus).](image-url)
Figure 508—*Plutella xylostella* (Linnaeus). Top, male genitalia from the holotype of the syonymous *albovenosa* Wabingham (BM slide 2150); Kona, 4,000 feet, Hawaii. Note the dense tuft of setae (appearing as a black mass) at the base of each valva; this is not present on *capparidis*. Bottom, part of the female genitalia of an English specimen (BM slide 8141); Merton, Norfolk.
The diamond-back moth.
Kure (Ocean), Wake, Midway, Laysan, Pearl and Hermes Reef, Kauai, Oahu, Molokai, Maui, Hawaii.
Immigrant. A widespread economic pest. First recorded in Hawaii by Walsingham in 1907:652 from specimens collected as early as 1892 by Perkins. J. E. Hardy published a map showing the world distribution of the species in 1938:346. The moth was found on remote Pitcairn Island as early as June 1, 1883.
Hostplants (as recorded in Hawaii): Alyssum, broccoli, cabbage and other related cultivated cruciferous plants, Capparis sandwichiana, Lepidium, turnip.
Parasites: Horogenes polynesia (Cameron), Tetrastichus near sokolowskii Kurjmov (purposely introduced from Nairobi, Africa, to assist in the control of this moth). There are many other parasites of the moth known elsewhere, and J. E. Hardy gave a list of over 40 parasites together with an extended discussion of parasitism in England (1938:343).

Figure 509—Details of the larva of Plutella xylostella (Linnaeus) (rearranged from Peterson, 1962). Mature larva about 9.5 mm. long. a, left lateral aspect of head, pro- and mesothorax; b, left lateral aspect of fourth abdominal segment; c, dorsal aspect of head and prothorax; d, right mandible, mesal aspect; e, right proleg of the third abdominal segment. Note the unusually long proleg.
This is a serious pest of crucifers and has often caused trouble to cabbage crops in Hawaii where it is referred to as “the cabbage moth”.

Dr. Swezey reared a series of specimens from broccoli which included specimens of both the usual form and the form with the white wing veins that Walsingham considered a separate species and named *albovenosa*. The latter name represents only a color form and not a species, and I have placed it in synonymy.

Bridwell (1920:316) reported finding the *albovenosa* form feeding on *Capparis sandwichiana* and said, “the young larva [mines] under the cuticle of the green fruits, while the older larva burrows in its fleshy walls, emerging to spin a characteristic Plutella cocoon.”


The following notes are abstracted from Fullaway (1915:46–48): The eggs are deposited singly in large numbers on the leaves, usually in the hollow

![Figure 510—A leaf of broccoli showing extensive damage done by larvae of *Plutella xylostella* (Linnaeus); Honolulu. (University of Hawaii photograph.)](image-url)
alongside a vein. They are flat, oval, lemon-yellow, with an iridescent, roughened surface. The incubation period is about four days. The larval period is about ten days. The larvae damage the plants mostly by their attacks on the leaves, and when the caterpillars are numerous the plants quickly may become riddled with holes. They are most injurious to thin-leaved plants and seedlings, and they cause little damage to mature cabbage leaves. If the larva is disturbed, it will usually wriggle away with lively contortions and, suspended by a silken thread, drop from the leaf. The pupa is enclosed in an unusual, loosely woven, wide-meshed cocoon spun on a leaf. The pupal stage is about six to eight days.

Jayewickreme (1940:70) described some features of the larva, and Mortimer (1965:84) has described the alimentary canal of the adult. For a general discussion of the species outside of Hawaii, see Réal in Balachowski (1966:218–229).

![Figure 511](image-url)

Figure 511—Details of a broken, cast skin of the pupa of *Plutella xylostella* (Linnaeus). a, ventral aspect showing the arrangement of the appendages (mesothoracic spiracle at S); b, left lateral aspect of the five caudal abdominal segments; c, ventro-caudal aspect of the tenth abdominal segment. Note the strongly protuberant spiracles on this species. From an English specimen.
Genus **ACROLEPIA** Curtis


Numerous species from the Old and the New Worlds have been assigned to *Acrolepia*, but the assemblage requires revisional study. It would appear that the Hawaiian group is Holarctic in origin.

Considerable difference of opinion exists in literature regarding where to place *Acrolepia*. Some authors have believed it to belong to the Tineidae, others consider it to belong to a separate family, the Acrolepiidae, while others have assigned it to the Yponomeutidae, to the Plutellidae, or to the Argyresthiidae. Eyer (1924:315) said, "*Acrolepia* resembles the reduced Tineids, Ischnosia and Meesia, and unless further examination of the European species reveals a different type of genitalia it may be regarded as one of the saccus-bearing Tineidae. The family shows no close affinity with the Plutellidae,

![Figure 512](image-url)

Figure 512—Top, head and wing venation of *Acrolepia assectella* (Zeller) specimens from France (BM slide 5138). Bottom, wing venation of *Acrolepia beardsleyi* Zimmerman, paratype (slide Z–IX–29–65–1); Ulupalakua, Maui. Note the close agreement in most details of the European and Hawaiian species, and compare the type-species on figure 513.
where some authors have placed them.” Eyer’s opinion has not been generally accepted, and there is much resemblance to the Yponomeutidae where it is retained in this text.

Our knowledge of *Acrolepia* in Hawaii is fragmentary. It is probable that many species exist in Hawaii. Only three endemic species have previously been recorded in the Islands, and two of these are known only from the holotypes. Difficult though it is to comprehend, Dr. Perkins collected only one specimen during all the years of his extensive Hawaiian work. A fourth endemic species is described below, and a pest species has been accidentally introduced.

The endemic Hawaiian species, whose hostplants are known, have been reared from blotch mines in the leaves of *Notocestrum*, an endemic genus of trees belonging to the Solanaceae. The larvae of these native species emerge from their mines to spin cocoons of dense, pale silk on the leaf surfaces. The shape of the cocoons which I have seen resembles an overturned boat.

The valvae of the male genitalia bear long setae toward their bases, and when these setae are removed, as is easily done in the dissecting process, rows of conspicuous setal sockets remain.

Long after my work on *Acrolepia* was completed, I saw Gaedike’s paper “Revision der paläarktischen Acrolepiidae”, 1970. In that paper Gaedike

![Figure 513](image)

Figure 513—Male genitalia and wing venation of *Acrolepia pygmaeana* (Haworth), the type-species of *Acrolepia*. 
YPONOMEUTIDAE 769

divides the Palaearctic species into three genera: *Digitivalva*, *Acrolepiopsis* and *Acrolepia*, the two former being newly established genera. *Acrolepiopsis* was erected to include *assectella* (Zeller), the onion leafminer that occurs in Hawaii. I have not accepted Gaedike’s system, because it is untenable for non-Eurasian species.

See color plate 3, figure 8.

KEY TO THE SPECIES OF *ACROLEPIA* IN HAWAII

1. Forewings with two prominent pale or white maculae on posterior margin within basal half, neither of which extends much costad of plica ...............2
   Forewings without such isolated maculae, but with a broad, pale, whitish or greenish grey fascia (with darker included areas) which extends entirely across the wing just basad of middle and with or without a usually less pronounced pale fascia farther basad .......3

2(1). Forewing pattern as in figure 514, without a distinct white macula at end of cell; hindwings pale fuscous; genitalia as in figure 520; Oahu, Hawaii (and other islands?) ......................... *assectella* (Zeller).
   Forewing pattern as in figure 517, with much canary yellow background scaling and with a distinct white macula at end of cell; hindwing dark fuscous; Oahu .............. *nothocestri* Busck.

3(1). Maui species; forewing pattern as in figure 516; male genital valvae with the basal area which bears long setae prolonged mesad, thus making each valva sub-L-shaped, as in figure 518 . . . *beardsleyi* Zimmerman.
   Kauai and Molokai species with male genital valvae without such mesal projections but shaped as in figure 518 ..........................4

4(3). Forewing pattern as in figure 515; valvae of male genitalia attenuated distad and much narrower at apex than at base, as in figure 518; Molokai ......................... *aureonigrella* Walsingham.
   Forewing with pattern as in figure 514; valvae of male genitalia sub-semicircular in outline and shaped as in figure 518; Kauai ............... *aiea* Swezey.

*Acrolepia aiea* Swezey (figs. 514, moth; 518c, male genital valva; 519, male genitalia).

*Acrolepia aiea* Swezey, 1933b:303.

Endemic. Kauai (type locality: Kumuwela).
Hostplant: *Nothocestrum latifolium* (“aiea”).
This species is known only from the male holotype which was reared from a leaf mine.

The male genital valvae are more broadly rounded at their apices than are those of *nothocestri* or *aureonigrella*, and they lack the internal basal prolongation of *beardsleyi*. Dr. Swezey considered the holotype to be "undersized from lack of food", but this may not be true.

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Figure 514—*Acrolepia* species. Top, *siao* Swezey, holotype male; Kamuwela, Kauai; forewing 4 mm. Bottom, *assertella* (Zeller); France; forewing 6 mm.
Figure 515—Acrolepia aureonigrella Walsingham, holotype male (BM slide 4393); Molokai, over 3,000 feet; forewing 5.5 mm.; aedeagus at bottom right. Note the long saccus on this species as compared with that of nothocestri in figure 519.
Figure 516—Acrolepia beardsleyi Zimmerman, holotype male (slide Z—IX—29—65—A); expanse 10 mm.; Ulupalakua, Maui. The aedeagus is at the same magnification as the remainder of the genitalia.
Figure 517—Top, *Acrolepia nothocestri* Busck, holotype female (in U.S. National Museum); Mt. Olympus, Oahu. Bottom, a male of the same species demonstrating a different color pattern (slide Z-1-19-62-2); Mt. Olympus, Oahu.
Acrolepia assectella (Zeller) (figs. 10, 11, 12, 13, 23, 24, anatomy; 31, 35, male genitalia; 37, 39, female genitalia; 40, egg; 45, 46, 48, 49, 51, 53, 54, larva; 512, head, wing venation; 514, moth; 518e, male genital valva; 520, male, female genitalia; 521, pupa; 522, pupa, cocoon; 523, larval damage).

Roeslerstammia Assectella Zeller, 1839:203.

The onion leaf miner (called the leek moth in England).
Oahu, Hawaii (new record by Klaus Sattler), and probably some of the other islands.

Immigrant. A European species now widely distributed; described from Germany. First recorded in Hawaii in 1944, but it is known to have been established in Honolulu as early as 1939.

Hostplants: onion and related plants.
Parasite: Chelonus Microchelonus blackburni (Cameron).

I do not have a detailed account of the moth in Hawaii, but the following information abstracted from Jary and Rolfe, 1945, regarding the species in England may be of interest to workers in Hawaii.

On leeks, the larvae usually work their way toward the middle of the plant and feed between the folded leaves. On onions, they live almost entirely inside the hollow leaves, and there is little evidence of the formation of mines. About three weeks after hatching the caterpillars spin delicate openwork cocoons on

Figure 518—Outline sketches of the male genital valvae of Acrolepia species. The setae and setal sockets are omitted. The outlines will vary somewhat according to the way the specimens are oriented in the mounting medium. a, beardleyi Zimmerman, holotype; b, aureonigrella Walsingham, holotype; c, aiea Swezey, holotype; d, nothocestri Busck; e, assectella (Zeller), from a European specimen.
Figure 519—Male genitalia of Acrolepiia. Top, aiea Swezey, holotype (slide Z-1–19–61–1): Kamuwela, Kauai; aedeagus and apex of saccus broken. Middle and bottom, nothocestri Busck (slide Z-1–19–61–2); Mt. Olympus, Oahu. Note the scent fans and the differences in the shapes of the isolated valvae.
Figure 520—*Acrolepia assectella* (Zeller), male genitalia (BM slide 5191) and female genitalia (BM slide 5138) from French specimens. The dark spots on either side of the bursa copulatrix are signa. The scent fans are longer on this species than they are on the Hawaiian species; compare figure 519.
dead leaves of the host plant or on other material. The most serious damage occurs on leeks. The young caterpillars bore in from the upper surface of the leaves, forming elongated mines which appear white—the green material having been devoured, only the white upper and lower skins of the leaf remain. As the leaves grow, the mines split open, forming elongated holes, thus giving the plants a very ragged appearance. The larger caterpillars seem to feed chiefly among the folded leaves in the center of the plant and through these they bore in all directions, producing a shot-hole effect which is seen as the leaves unfold. Following the damage done by the caterpillars, extensive rotting often occurs, partly due to secondary attacks by other insects, and the plants may almost completely die away.

In onions, the small caterpillars, after slight mining, usually penetrate near the tips and feed inside the hollow leaves. Holes may be eaten through to the exterior again, but more commonly the areas attacked from inside show as pale spots, somewhat similar to the appearance caused by mildew. Sometimes, as foliage is dying off, the caterpillars bore into the onion bulb near the leaf bases, thus allowing entry of bulb-rotting organisms. Severe injury may be caused to seed heads of onion and leek. Caterpillars bore through the flowering

Figure 521—The pupa of *Acrolepia assectella* (Zeller) in dorsal, lateral, and ventral aspects. (After Frediani, 1954.)
shoot, usually near the head, and work upward into the fleshy tip from which the flower stalks arise. Their feeding in this region causes the flower stalks to become loose, so that the whole head, or a large part of it, may fall away. If the flower stalks are lifted and the tip of the stem examined, a quantity of green frass may be seen. This is often the first indication that the caterpillars are feeding within the seed head. The formation of seed may be almost entirely prevented by the attacks of the larvae.

Frediani, 1954, has published a detailed, well-illustrated account of the morphology of the egg, larva, pupa, and adult and an account of its biology and some of its parasites in Italy. See also Labeyrie in Balachowski, 1966:233–249, for a detailed, illustrated, general discussion.

Figure 522—Acrolepia assectella (Zeller). Top, dorsal, lateral, and ventral aspect of the apex of a pupa. Bottom, a pupa in its cocoon of silk net. (After Frediani, 1954.)

Figure 523—A section of a green-onion stem showing evidence of attack by the larvae of Acrolepia assectella (Zeller); Honolulu. (University of Hawaii photograph.)
Acrolepia aureonigrella Walsingham (figs. 515, moth, male genitalia; 518b, male genital valva).

Acrolepia aureonigrella Walsingham, 1907b:727.

Endemic. Molokai (type locality: above 3,000 feet).

Hostplant: undetermined, but presumed to be Nothocestrum.

This moth is known only from the male holotype in the British Museum. It is one of the very few species included in Walsingham’s Fauna Hawaiensis monograph that he did not illustrate.

Acrolepia beardsleyi Zimmerman, new species (figs. 512, wing venation; 516, moth, male genitalia; 518, a, male genital valva; 524, female genitalia; 525, 526, pupa, cocoon).

Male and female. Alar expanse about 9 to 10 mm. Head mostly creamy white with a small patch of black scales rising from the dorsal edge of each
eye caudad of the ocelli and usually with some dark squamae in front of the antennal insertions. Antennae with first segment white mixed with fuscous to black distad, remaining segments white basad and black distad and forming a strongly developed alternating black and white pattern. Maxillary palpi with a few dark squamae at base of terminal segment. Labial palpi with alternating bands of white and black; basal segment white basad and black distad; middle segment mostly broadly black basad and distad, white at middle and white tipped; terminal segment white at base, middle, and extreme apex with prominent black fasciae between. Thorax mostly creamy white but with variable medio-dorsal infuscation and sometimes with some medial ochraceous squamae; tegulae prominently fuscous basad. Forewings patterned as illustrated, variable and difficult to describe, with a mixture of white, ochraceous, and fuscous to black squamae; the basal almost one-half is mostly white with patches of ochraceous and mostly transverse lines of fuscous, but with the white squamae forming a broad submedial fascia which extends entirely across the wing and with a fuscous or black macula basad of this on costa and another opposite to the costal macula on the posterior margin and a less distinct dark macula near base of costa; distad of the prominent submedial white fascia the background scaling is extensively ochraceous with variable inclusions of white and black with a dominant black costal macula adjoining the white submedial fascia (and opposite this the extent of the black scaling may be variable along the posterior margin of the wing) and with extensive subapical black scaling tending to be arranged in narrow fasciae (or it may be broken into variable

Figure 525—Details of the pupa of Acrolepia beardsleyi Zimmerman; paratype; Ulupalakua, Hawaii; ex Notocertrum. Length 5 mm. a, ventral aspect of cast skin; b, spiracles of right sides of fifth and sixth abdominal segments as seen from left side; c, enlarged view of dorsal aspect of the cauda.
YPONOMEUTIDAE; terminal cilia ochraceous with a few included white maculae; undersides of forewings dark fuscous except caudad of vein 1 where it is noticeably paler where it overlaps the hindwings. Hindwings fuscous over all, including fringes. Abdomen fuscous dorsad with the segments laterad and ventrad fuscous basad and white distad. Legs white and black; externally the coxae and femora of the forelegs are mostly black and the tibiae are black and white; the middle legs have more white on the coxae, femora, and tibiae; the hind legs have the coxae white with fuscous apices, the femora are mostly white with a touch of fuscous at extreme base only and the tibiae are paler.

Figure 526—Acrolepia beardsleyi Zimmerman. Left, a cocoon; length 5 mm. Right, ventral aspect of a pupal case; length 4 mm. Both specimens from Ulupalakua, Maui, from larvae from mines in leaves of Notocestrum, collected by J. W. Beardsley.
fuscous; all of the tarsi are black strongly annulated with white. Genitalia as illustrated.

Holotype male, allotype female, and three paratypes in Bishop Museum and one paratype in the British Museum (Natural History).


Hostplant: *Nothocestrum* ("aiea").

The type series was reared from larvae found mining the leaves of the hostplant by J. W. Beardsley who collected them on May 17, 1965. I take pleasure in naming this beautiful little moth after Dr. Beardsley as an expression of thanks for the assistance he has given me during the writing of this text.

This species is much like *aureonigrella* and *aiea*, but the color patterns and the genitalia differ. The cocoon (figured) is made of white to pale brown silk. The pupa (figured) has mostly conical and strongly protuberant spiracles, those of the fifth abdominal segment are especially elongated. The abdomen ends in two heavy protuberances (as figured), each of which bears a single long apical seta and a short ventrolateral thornlike process. The wings extend onto the base of the fifth abdominal sternite, the antennae reach to beyond the middle, the proboscis reaches to the apex and the hind legs extend just over the caudal margin of the fifth abdominal sternite. The pupa lacks dorsal setae or protuberances.

**Acrolepia nothocestri** Busck (figs. 517, moths; 518d, male genital valva; 519, male genitalia; 527, female genitalia).

**Acrolepia nothocestri** Busck, 1914b: 106.

Endemic. Oahu (type locality: Mt. Olympus).

Hostplant: *Nothocestrum longifolium* ("aiea").

Several specimens of this species were reared from leaf mines by Dr. Swezey over half a century ago. I do not know that it has been collected since. The holotype is in the U.S. National Museum.

![Figure 527—Female genitalia of *Acrolepia nothocestri* Busck, holotype; on a USNM slide.](image-url)
Family SCHRECKENSTEINIIDAE (Fletcher)

Schreckensteiniidae T. B. Fletcher, 1929:iii.

Fletcher erected his “Schreckensteiniidae” as a replacement name for Heliodinidae Heinemann and Wocke, in Heinemann, 1876:518, evidently because he considered Heliodines a synonym of Chrysoesthia, and in his erroneous opinion Heliodines was thus not available for use in forming the family name. Thus, the name Schreckensteiniidae was proposed to include the heliodinids as well as Schreckensteinia.

Figure 528—Head and wing venation of Schreckensteinia festaliella Hübner (wings on BM slide 14292); European specimens. The frenulum has been broken off.

Figure 529—Schreckensteinia festaliella Hübner; Danby, New York. There is a pinhole in the left forewing near the curve of the antenna, and the costa of the right forewing is torn. (USNM photograph.)
This family group is represented in Hawaii by a purposely introduced *Schreckensteinia*. The genus has been placed by various authors in the Heliodinidae or Chauliodidae or the Schreckensteiniiidae without careful study. It has so many characters in common with the Epermeniidae that it would appear logical to keep it associated with that group where it was placed by Spuler, 1910 (1901–1910):433. However, the European *Epermenia illigerella* and *chaerophyllella* have only two setae in the prespiracular L group on the prothorax, whereas there are three setae on *Schreckensteinia*. Forbes, 1923, and Peterson, 1962 (possibly following Forbes), confusingly state that there are three prothoracic L setae on *Epermenia*. Are the Forbes and Peterson statements based upon an error of observation, or was their material incorrectly identified? Forbes, 1923, fig. 211, illustrates the details of the larva of what he called *Epermenia illigerella*, but his setal map does not agree with English specimens of *illigerella* which I have examined. The two setae of the prothoracic L group is an unusual character in the Microlepidoptera—it is found in the Pyralidae, Carposinidae, and in some Pterophoridae. I consider the family status of *Schreckensteinia* subject to question, and I leave it tentatively assigned to its own family while noting its apparent affinity to the Epermeniidae.

The following combination of characters will serve to separate the single representative of the family now in Hawaii from the other families at present in the fauna: head smooth scaled; ocelli absent; chaetosemata absent; proboscis developed, "naked" (minutely pilose); labial palpi moderate, smooth scaled, rather slender, curved upward, without erect bristles; maxillary palpi rudimentary; antennae shorter than forewings, first segment moderate, lacking a pecten. Wing shape and venation as illustrated. Hind tibiae with numerous, suberect, stiff, dorsal spines, an apical whorl of stiff spines and with protruding apical spines on basal tarsal segments; hind legs held obliquely elevated when at rest. Genitalia as illustrated. The “spiny” larvae feed externally on leaves, and the cocoon is an open network of silken mesh typical of the yponomeutoids.

![Figure 530—Schreckensteinia festaliella Hübner. Left, apex of a left metatibia, dorsal view to illustrate the stiff bristles. Right, a sketch of the male genitalia from the left side; setae and aedeagus omitted; southern Mendocino County, California (BM slide 14289).](image-url)
Figure 531—Schreckensteinia festaliella Hübn, male genitalia. Top, tegumen and uncus; bottom left, saccus and valvae; right, aedeagus; southern Mendocino County, California (BM slide 14289).
Figure 532—Schreckensteinia festaliella Hübner. Top, female genitalia (ends of apophyses broken off); right, ostium. Bottom, abdominal pelt; southern Mendocino County, California (BM slide 14290).
Figure 533—*Schreckensteinia festaliella* Hübner. Top, a moth on a blackberry flower (numerous adults are attracted to the flowers). Bottom, blackberry leaves damaged by the larvae. Kokee, Kauai. (Photographs by C. J. Davis.)
Genus **SCHRECKENSTEINIA** Hübner

*Schreckensteinia* Hübner, 1825 (1816–1826): 419.

*Chrysocorys* Curtis, 1833: 191.

Type-species (for both generic names): *Schreckensteinia festaliella* Hübner.

This is a genus of few species endemic to North and South America. The species introduced to Hawaii apparently was accidentally imported to Europe at an early date, and it is now widespread there. It is possible, however, that it may be a Holarctic species with a very wide natural distribution.

In his diagnosis in *Genera Insectorum*, Meyrick (1914: 25) erroneously stated that the ocelli are present in this genus.

Figure 534—*Schreckensteinia festaliella* Hübner. Left, net cocoon and pupal case; right, pupa within its net cocoon; on blackberry leaves; Kokee, Kauai. (Photographs by C. J. Davis.)
**Schreckensteinia festaliella** Hübner (figs. 528, head, wing venation; 529, moth; 530, leg, male genitalia; 531, male genitalia; 532, female genitalia, abdomen; 533, moth, larval damage; 534, pupa, cocoon; 535, larva; 536, pupa).

**Schreckensteinia festaliella** Hübner, 1818–1819, pl. 67, fig. 449.


*Elachista montandonella* Duponchel, 1838:553, pl. 309, fig. 11.

The blackberry skeletonizer.

Kauai, Maui, Hawaii.

Purposely introduced from Santa Barbara, California. Widely dispersed in the United States and in Europe. The Hawaiian Department of Agriculture introduced the moth in 1963 to assist in the control of foreign blackberries which have become weed pests. Davis and Krauss (1965:89) reported it established at Kokee, Kauai, in February, 1964, and at Olinda, Maui, in July, 1964. It was first released on Maui in October, 1963, on Kauai in November, 1963, and on Hawaii in August, 1966.

Hostplant: *Rubus* species (blackberries).

The eggs stand erect on the host. The very distinctive larvae are mostly green with brownish heads, and they feed on the undersides of the leaves and skeletonize them. Their most distinctive character is their peculiar dorsal setae which have expanded apices, and the D1 and D2 setae on each side of the abdominal tergites arise from a common pinaculum as in figure 535.

![Figure 535](image)

Figure 535—*Schreckensteinia festaliella* Hübner. Dorsal, subdorsal, and lateral setae and the spiracle of the sixth abdominal segment of the larva, left aspect; Waiakeomi, Maui, ex blackberry. No other moth larva now known in the Hawaiian fauna has such dorsal setae—they are immediately diagnostic of this species.
No other larvae now in the Hawaiian fauna has such setae. The pupa, enclosed in a beautiful silken network cocoon, is as in figures 534 and 536. Noteworthy are the protuberant spiracles, exposed labial palpi, exposed profemora, the apically widely separated antennae, the thorn-like processes on some of the abdominal tergites, and the strong dorsal setae (some of which are hooked as are those on the sternites).

Figure 536—Schreckensteinia festaliella Hübner. Dorsal and ventral aspects of a pupa; Waiakamoi, Maui; length 5 mm.
Superfamily **ALUCITOIDEA** (Linnaeus)


*Alucitides* Leach, 1815: 135, in part.


It appears unusual that lepidopterists have for so long failed to associate the families of this group, and I agree with Meyrick, 1928*: 25, 599, and Common, 1970: 826, who place them together. The Copromorphidae have many characters in common with the carposinids which they closely resemble. In the hindwing, vein 5 is absent in the carposinids but present in the copromorphids. The deeply cleft-winged species of Alucitidae, however, seem at first far removed, but when one studies them in detail, taking note of the fact that the larvae are closely similar to those of the other families, and ignoring for a while the distraction of the cleft wings, one must agree with the association. One also gathers a different impression when one examines the few known species of Alucitidae that do not have deeply cleft wings.

As noted in more detail below, the larvae of the Alucitoidea can be separated from the Tortricoidea, Tineoidea, Yponomeutoidea (except, so far as I now know, some of the unusual and confusing Epermeniidae which have only two prespiracular setae on the prothorax instead of the normal three setae), and the Gelechioidea because they have only two L setae in the prespiracular group on the prothorax and which character they share with the Pyraloidea and some of the Pterophoroidea.

The proboscis of true pyralids is squamose. The Pterophoridae, however, have a so-called “naked” proboscis (minutely pilose and not squamose) as do the Thyrididae, which do not occur in Hawaii. Although presently associated with the pyralids, these families are not correctly placed. In contrast to the typical pyralids, the Alucitoidea have naked proboscides and they lack the abdominal tympana of the pyralids. The maxillary palpi are greatly reduced or obsolete in most species, but some species of Alucitidae have moderately developed maxillary palpi. Such genera as the shallowly cleft-winged *Hexeretmis* Meyrick from South America and *Triscaedecia* Hampson from Ceylon have well-developed or large maxillary palpi. Chaetosemata are absent. None of the Hawaiian species have ocelli, but ocelli are present on many, but not all, species of Alucitidae. Ocelli are well developed on the shallowly cleft-winged genera *Hexeretmis* and *Triscaedecia* mentioned above. One or two veins are usually lost from the hindwings.

The carposinids and copromorphids have cubital or cubital and anal vein “pectens” of long hair on the hindwings, and many of the species have patches of raised scales on the forewings. Although most of the fully split-winged species of Alucitidae do not display easily distinguishable cubital hair “pectens” on the hindwings, or evidently lack them, some do have modified “pectens”. *Triscaedecia*, the shallowly cleft-winged genus from Ceylon, and an unidentified Brazilian genus, which also has nearly entire wings, have well-developed “pectens”. I have not seen any Alucitidae with the kind of raised scale patches of the forewings that are present on the Carposinidae and some Copromorphidae.
Three families are now included in the Alucitoidea: Carposinidae, Copromorphidae, and Alucitidae. Of these, only the Carposinidae are represented in the endemic Hawaiian fauna, and one evidently foreign species of Alucitidae appears to have been accidentally introduced.

Family **CARPOSINIDAE** Walsingham

*Tortricidae* subfamily *Carposinae* Walsingham, 1897a: 59.


This is a peculiar family. Its members were long associated with the Gelechiidae until they were referred to the tortricoids. The moths have certain features that recall the pyraloids, tineoids, gelechioids, and tortricoids. The status of the family has always been enigmatical. Meyrick differed considerably over the years in his opinion regarding the position and relationships of the family, and in 1922b: 1–2, he said: “The group is so clearly delimited by structural characters (especially the peculiar nervation of the hindwings) and usually by aspect, that no difficulty arises in recognizing it; the difficulty is rather to ascertain to what it is most allied, since there is no obvious affinity to any other existing form. *Carposina* was regarded by European entomologists for 30 years as an abnormal member of the Gelechiidae, but this is untenable. In 1881, having become acquainted with some of the Australian forms, I referred the group to the *Tortricina*, which is certainly so far correct. It

![Figure 537—Heads and wing venation of *Carposina olivaceonitens* (Walsingham). Top left, head of the male holotype. The other head and the wings are from the female allotype. Kauai, 3,000 to 4,000 feet, Kauai (BM slide 5028). There is considerable variation in the development of the labial palpi in the Hawaiian *Carposina*, and not all species are similar to this species. Note the great sexual difference demonstrated here.](image-url)
Figure 538—Wing venations of *Carposina*. Top, *divaricata* (Walsingham), paratype (BM slide 14311); Kauai, 3,000 to 4,000 feet. Middle, *gracillima* (Walsingham), paratype (BM slide 14310); Kaholuamano, 4,000 feet, Kauai. Bottom, *nigromaculata* (Walsingham) (BM slide 14312); northwest Koolau Mts., Oahu.
approaches the *Phaloniadae* somewhat in form and more particularly in neuration of forewings, and also in the internal feeding habits of the larvae, but differs widely in neuration of hindwings..." In 1927c, in his *Insects of Samoa* report, Meyrick separated the Carposinidae widely from the tortricids and placed them after the cosmopterigids which are gelechioid. In the revised edition of his British "Handbook", 1928d:25, 599, he demonstrated their

Figure 539—Male genitalia and wing venation of *Carposina berberidella* Herrich-Schäffer, the type-species of *Carposina*. See also figure 558.
affinity with the Copromorphidae and Alucitidae. But, as has been pointed out to me by Ian Common, his comments seem generally to have been overlooked.

In 1907:34, Busck said that Carposina “belongs to a very abnormal group of the subfamily Phaloniidae. . . .” In 1908a:135, he suggested that the group should be elevated to family rank, but Walsingham had already done this in Fauna Hawaiensis in 1907b:654.

In 1954a:115, Diakonoff said, “This family forms a natural and very distinct group, and stands isolated. In consequence of the last mentioned fact it has been subject to frequent rearrangements in the system, and was moved back and forth between the groups ‘Tortricina’ and ‘Tineina’. It seems advisable for the time being to let it keep an intermediate position between these two groups.” In 1961:124, Diakonoff said that the “Carposinidae. . . . for a long time has been tossed to and [fro] between the Tortricoidea and the Gelechioidea. It represents a very old group and its similarity with the two above mentioned superfamilies must be purely superficial. Such great differences as a decadent

Figure 540—Details of Carposina pupae. Left, ventral aspect of a cast, shriveled skin of a specimen determined by Dr. Swezey as graminicolor (Walsingham); Kilauea, Hawaii, ex Osmanthus fruits; length 6 mm. Right, dorsal and lateral aspects of the cauda of a specimen determined by Swezey as subumbrata (Walsingham) collected at “Hillebrand’s Glen”. The cauda is similar to that of the specimen used for the figure at the left.
and constant neuration of the hind wing, without vein 6, the most peculiar genitalia in the two sexes, with a unique aedeagus and often well developed tineoid saccus (which is an archaic character), and the presence of only two setae on the praestigmal prothoracic shield of the larva show that the group basically differs from both the leafrollers and the Gelechioidea. I now propose a new superfamily, Carposinoidea, for this family.


Perhaps we may fairly conclude that the carposinids have not yet been adequately studied and that more parts of their anatomy should be investigated. But, of course, this criticism may be directed at the classification of the Lepidoptera in general. The minutely pilose (naked) vestiture of the proboscis agrees with the tineoids, tortricoids, yponomeutoids, pterophoroids, and alucitoids and contrasts sharply with the squamose proboscis of the gelechioids and pyraloids. The vestiture of the lower part of the face differs significantly from the tortricids, because the squamae are directed ventrad as they are in the gelechioids (and most moths) whereas all of the tortricids which I have seen have the squamae of the face directed dorsal. Some tineoids also have dorsally directed vestiture on the face. I have studied the pupa of Carposina, and it is very different from that of the tortricoids. It lacks the typical dorsal abdominal spines of the tortricoids and tineoids. None of the Hawaiian larvae has been illustrated or described. Forbes, 1923:514, gives a setal map of the larva of an American species of Carposina. The known larvae of the Carposinidae may be separated easily from those of the Tortricidae and most other Microlepidoptera as follows:

1. Prespiracular L setal group on prothorax with only two setae. \textbf{Carposinidae}.
2. Prespiracular L group of setae on prothorax with three setae. \textbf{Tortricidae}.

The moths of the Hawaiian species resemble Scoparia and Eudonia (= Eudoria) in facies, and some Hawaiian species may be confused with Hawaiian Eudonia if examined superficially. (NOTE: In my Volume 8 on the Hawaiian Pyraloidea, I used Scoparia in the wide sense for what should best be segregated as Eudonia.) The adults of Carposina often rest on tree trunks much as do those of Eudonia, and they are often collected together. Some Hawaiian species parallel the color patterns of our Eudonia in an interesting way, and Hypomocoma in the Cosmopteriginae is also involved in the color pattern complex.

The moths have characteristic patches or conspicuous tufts of raised scales on the forewings which vary in development between the species. Ocelli and chaetosemata are absent. The proboscis is minutely pubescent and not squamose. The labial palpi are sexually dimorphic and are usually much longer in the females than in the males. Maxillary palpi are absent. The hindwings of the Hawaiian species have only six veins, because veins 5 and 6 are missing, and there is a variably developed fringe of long hairs along the basal part of the posterior margin of the cell and a more strongly developed brush of long
hairs along the basal part of vein 1b. The cilia on the undersides of the antennae of the males are very long and fine. The shaggy antennae thus contrast sharply with the plain antennae of the females. The hairy antennae and the usually much shorter palpi of the males are characters that render easy the separation of the sexes of Carposina.

The Carposinidae is a small family—when Meyrick treated them in Genera Insectorum in 1922, he listed only eight genera and 128 species then known in the world. It is obvious from a cursory examination that the classification of the family is in a poor state, and little reliance can be placed on the supposed geographical distribution of the genera as they are now constituted. Most of the species, however, occur in Indo-Pacific regions. Only a few species are known from North and South America (see D. R. Davis, 1969), and only one genus, Carposina, is recorded from Europe and Africa. The most diversified contemporary fauna appears to be in Australia, and the group is extensively developed from southeast Asia to Australia.

Some species of extra-Hawaiian Carposinidae are of economic importance. Some are pests of soft fruits such as apples, pears, plums, and peaches and also of berries and roses. Heterocrossa adreptella (Walker) is known in New Zealand as “the raspberry bud moth”, and its larvae mine the shoots and unopened buds of raspberry and blackberry.

Genus CARPOSINA Herrich-Schäffer

Carposina Herrich-Schäffer, 1855 (1843–1856): 38. Type-species: Carposina berberidella Herrich-Schäffer (southeast Europe to Asia Minor). Fernald, 1908: 34, type designation. Busck, 1907: 34, expanded description. Meyrick, 1922, in Genera Insectorum. (Figure 539, 558, wing venation, male genitalia.)

See color plate 4, figures 1–5.

Heterocrossa Meyrick, 1882: 178, has wrongly been used for the Hawaiian species of Carposina. It was described to include Epischnia neurophorella Meyrick, from Australia, Paramorpha adreptella (Walker) Meyrick, and Heterocrossa gonosemana Meyrick from New Zealand. Meyrick did not designate a type-species for his genus, but Walsingham, 1907: 654, designated Gelechia adreptella Walker as the type-species (see my figure 557). In Genera Insectorum (1922: 5), Meyrick listed Enopa Walker (1866: 1738, type-species Enopa medilla Walker, Australia), Oistophora Meyrick (1881: 699, with the same type-species) and Heterocrossa as synonyms of Carposina. I do not believe that Enopa and Heterocrossa are synonyms of Carposina because their genitalia are distinctive. Heterocrossa has a New Zealand species as its type, and it would appear that Heterocrossa may be used for the New Zealand species that agree with its type species, unless it can be demonstrated that Heterocrossa is a synonym of some other genus. Philpott (1928: 477) published a key and illustrations of 10 of the New Zealand species. Heterocrossa (see my figure 557) and Enopa have a long, slender, and well-developed uncus, and I consider the genitalia generically distinct from Carposina. The genitalia of Paramorpha represent another group allied to Heterocrossa and Enopa. Paramorpha also has a well-developed uncus, although it is shorter than in typical Heterocrossa and Enopa.
The Hawaiian and Australia–New Zealand species of Carposinidae have had different ancestral origins and are not closely allied. The source of the Hawaiian Carposina is unknown, but I believe that it is Boreal.

There are, as I recognize them here, 39 described, and many undescribed, Carposina species in Hawaii. Although the genus is also listed as occurring in Australia, New Zealand, Indonesia, Malaya, Japan, India, Asia Minor, southeast Europe, Africa, Madagascar, Madeira, North, Central, and South America, the Hawaiian assemblage is the largest known concentration of species in any one region. In Genera Insectorum, Meyrick listed 87 species known in the world in 1922 and of these 37 were Hawaiian. These data are meaningless, however, because Meyrick combined Enopa and Heterocrossa with Carposina. It should not be assumed that all of the extra-Hawaiian species now listed in Carposina are correctly placed in that genus. There are only four species of Carposina recorded from America north of Mexico. Diakonoff listed only one species in New Guinea in 1954a: 138. Some of the Hawaiian Carposina agree closely with the type-species of Carposina in genitalia and in wing venation. (Compare figures 539 and 558 of berberidella, the type species, with 538 and 558 of divaricata and the Hawaiian achrona, for example.)

Carposina is a wonderful group in Hawaii, and it deserves extended, concentrated, careful study. It has received comparatively little attention in Hawaii, and considerable confusion exists in literature and in the identification of specimens in collections. The material available for examination has been inadequate for the purposes of this introductory study. Many of the specimens seen are in poor condition, and some, including types, have lost their abdomens. Several species are known from only one sex. Many of the specimens were very fat when collected, and the body oil, which has come to the body surfaces, tends to spoil the appearance of some specimens in collections. Many species contain green scaling. Because green tends to fade, many of the descriptive notes of color made from old specimens may be misleading when compared with fresh material.

Walsingham listed 33 species and 2 “varieties” in Fauna Hawaiiensis in 1907b. I treat the supposed varieties as species here, thus making 35 listed in Fauna Hawaiiensis. I believe, however, that several of the names are synonyms, but I have not had an opportunity to prove the synonymy. Since 1907, when Fauna Hawaiiensis was issued, only five species have been added to the Hawaiian list, and they were all described by Meyrick in 1913e. I have seen several new species, and I believe that it is possible that there may be 100 or more species in Hawaii.

I regret most deeply that I have not been given the opportunity to study this genus with the care which it deserves. A completely new revisionary study, with adequate, fresh material at hand, is urgently needed. Many of my illustrations are inadequate, and it has often been impossible to obtain good photographs from the limited material available for study. Some of the old specimens were attacked by mold or were partly decomposed before drying, and it is impossible to make good microscope preparations from such material. Because of the complexity of the genitalia, various parts should have been drawn separately during the dissection processes. I leave this fascinating group in an unsatisfactory condition.
The genitalia of many of the species display excellent specific differences, as the accompanying illustrations demonstrate. The genitalia show that several species groups have evolved in Hawaii, and these may indicate potential origins of new genera.

It is difficult to make photogenic preparations of many of the male genitalia, and more than one microscope slide preparation should be made of each species where necessary and possible. It is often difficult to spread the genitalia for proper display of the parts, and sometimes it is necessary to cut the genitalia open or to tear them to display many of their characters. Figure 558 of achroana shows a satisfactory preparation with most of the structures displayed adequately. An examination of the other figures will show that many of the dissections and mounts are inadequate for our purposes, and they should have been remounted.

In the male genitalia the uncus is obsolete, but it appears to be represented by a small protuberance in some species. Socii appear to be absent. The gnathus arms (or what is called the gnathus) range in development from rudimentary to long and conspicuous. The anellus lobes differ between the species as do the shapes and armature of the valvae. The saccus ranges from very short to long and attenuated. The aedeagus is unusual and unlike that of any other Hawaiian genus.

The ostium of the female displays a variety of forms. The bursa copulatrix usually bears a pair of characteristic, two-pronged signa, as illustrated. No signa were found in some species such as gemmala. The signa are within the caudal third of the bursa in most species, but in some they are near the middle, and in others they are at the cephalic end of the bursa. The spermatophore is a very long, wire-like structure which may be as long as the entire bursa copulatrix and its ductus. Considerable difficulty was encountered in making microscope slide preparations of some of the females because their abdomens had been decomposed.

In his "Introduction" to Fauna Hawaïensiis Perkins said (1913:clxvii):

Thirty-three species of the genus Heterocrossa have been described, and doubtless many others remain to be discovered. The species appear to be often variable and very difficult to separate, a difficulty which will be much increased by the discovery of new forms. The moths are often very numerous, being attracted by light or disturbed from amongst foliage, especially that of the Ohia tree. They are also commonly found at rest on tree-trunks, and once, when sheltering from a heavy rain storm, I remember noticing half-a-dozen examples all close together on a single stem of a tree-fern, none of these individuals much resembling one another, and perhaps each formed a distinct species . . . The caterpillars attack many kinds of fruit of forest trees and shrubs, e.g. of Clermontia and other Lobeliaceae, of Vaccinium, Eugenia, Pittosporum, Mahoe [Alectryon], Sideroxylon [Planchnella] and, doubtless, many others. Others live in buds, e.g. those of Metrosideros. These caterpillars are sought after by the wasps of the genus Odynerus, and as many as three dozen have been found in a single cell. They are also obtained by the native birds, while the moths themselves are often caught and devoured by the 'Elepaio' (Chasiempis) and by some of the Drepanididae, especially by those belonging to the genus Oreomyza.

DISTRIBUTION OF THE HAWAIIAN CARPOSINA

If the species are listed by type locality only, the following is the result:

<table>
<thead>
<tr>
<th>Kauai</th>
<th>Maui</th>
<th>Oahu</th>
<th>Lanai</th>
<th>Molokai</th>
<th>Hawaii</th>
</tr>
</thead>
<tbody>
<tr>
<td>11</td>
<td>4</td>
<td>7</td>
<td>3</td>
<td>5</td>
<td>9</td>
</tr>
</tbody>
</table>
No species has yet been found on the Leeward Islands, and no specimens have been collected from great areas of the main islands. I have seen no record of the capture of any species on the vast, high bulk of West Maui where there must be many species. As recorded here, the known distribution of the described species among the main islands is as in the lists given below.

In the following lists, where no type locality indication follows the name, the type locality is the island under which the species is listed. Where the type locality is an island other than the island heading a list, the type locality island is indicated by the word “type” in parentheses after the appropriate island name. These lists demonstrate the supposed distribution as it has been recorded, but they also reveal our ignorance. There are probably several errors represented in the lists, and various uncertain distributions are noted by question marks.

Kauai (13 species)
- cervinella (Walsingham)
- corticella (Walsingham)
- distincta (Walsingham)
- divaricata (Walsingham)
- gracillima (Walsingham), Oahu, Molokai, Maui (type), Hawaii
- graminicolor (Walsingham), Oahu, Hawaii
- graminis (Walsingham)
- olivaceonitens (Walsingham), Oahu, Maui, Hawaii
- piperatella (Walsingham)
- plumbeonitida (Walsingham), Hawaii?
- semitogata (Walsingham)
- tincta (Walsingham)?, Lanai?, Hawaii (type)
- viridis (Walsingham), Oahu

Oahu (16 species)
- benigna Meyrick
- crinifera (Walsingham)?, Molokai (type)
- gemmata (Walsingham)?, Hawaii (type)
- glauca Meyrick
- gracillima (Walsingham), Kauai, Molokai, Maui (type), Hawaii
- graminicolor (Walsingham), Kauai (type), Hawaii
- herbarum (Walsingham)?, Lanai (type), Hawaii?
- lacerata Meyrick
- nigromaculata (Walsingham)
- nigronotata (Walsingham)?, Hawaii (type)
- olivaceonitens (Walsingham), Kauai (type), Maui, Hawaii
- pusilla (Walsingham)
- saurates Meyrick
- solutella (Walsingham)?, Hawaii (type)
- subumbrata (Walsingham)
- viridis (Walsingham)?, Kauai (type)
CARPOSINIDAE

Molokai (6 species)
  bicincta (Walsingham)
  crinifera (Walsingham), Oahu?
  ferruginea (Walsingham)
  gracillima (Walsingham), Kauai, Oahu, Maui (type), Hawaii
  punctulata (Walsingham)
  trigononotata (Walsingham), Maui

Maui (6 species)
  atronotata (Walsingham), Oahu, Hawaii
  gracillima (Walsingham), Kauai, Oahu, Molokai, Hawaii
  mauii (Walsingham)
  olivaceonitens (Walsingham), Kauai (type), Oahu, Hawaii
  togata (Walsingham)
  trigononotata (Walsingham), Molokai (type)

Lanai (4 species)
  herbarum (Walsingham), Oahu?, Hawaii?
  irrorata (Walsingham)
  subolivacea (Walsingham)
  tincta (Walsingham)?, Kauai?, Hawaii (type)

Hawaii (14 species)
  achoana (Meyrick)
  dispar (Walsingham)
  gemmata (Walsingham), Oahu?
  gracillima (Walsingham), Kauai, Oahu, Molokai, Maui (type)
  graminicolor (Walsingham), Kauai (type), Oahu
  herbarum (Walsingham)?, Oahu?, Lanai (type)
  inscripta (Walsingham)
  latifasciata (Walsingham)
  nigronotata (Walsingham), Oahu?
  olivaceonitens (Walsingham), Kauai (type), Oahu, Maui
  plumbeonitida (Walsingham), Kauai (type)
  pygmaeella (Walsingham)
  solutella (Walsingham), Oahu?
  tincta (Walsingham), Kauai?, Lanai?

HOSTPLANTS AND HABITS OF THE LARVAE OF CARPOSINA

The hostplants of less than half of the described species of Carposina are known. Most of the known larvae feed upon berries and fruits, but some feed upon leaves, some are leaf miners, some are stem borers or stem gall formers, and some feed upon terminal buds.

The following is a summary of the families and genera of the known hostplants in Hawaii together with the parts of the plants attacked by the larvae (when known):
Saxifragaceae: *Broussaisia* (fruit clusters)
Pittosporaceae: *Pittosporum*
Sapindaceae: *Alectryon*
Rhamnaceae: *Alphitonia* (seeds)
Tiliaceae: *Elaeocarpus* (fruits)
Myrtaceae: *Metrosideros, Eugenia, Syzygium* (terminal buds)
Ericaceae: *Vaccinium* (leaves and berries)
Epacridaceae: *Styphelia* (berries)
Myrsinaceae: *Myrsine* (berries)
Sapotaceae: *Pouteria* (flowers, buds, fruits)
Oleaceae: *Osmanthus* (fruit)
Gesneriaceae: *Cyrtandra* (stem borer)
Rubiaceae: *Bobea* (terminal buds), *Hedypotis* (fruit capsules), *Plectronia* (fruits)
Campanulaceae: *Clermontia* (buds, flowers, fruits), *Cyanea* (stem borer, leaf miner, buds, fruits)
Goodeniaceae: *Staevola* (stem galls)

[As this proof was being read, Dr. Sattler wrote to say that a large species has been reared from *Pritchardia* palm fruits on Hawaii. This is the first record of a species from a monocot.]

No key to the species of *Carposina* has been made, and it has been an almost impossible task to identify specimens of the genus. Many incorrect determinations have been made. I regret most deeply that I have not had an opportunity to construct a key. The illustrations presented here, especially those of the genitalia, will give major assistance to those who wish to identify species in this group. A detailed key is most urgently required, however.

In addition to the characters displayed by various parts of the male and female genitalia other characters which may be useful in constructing a key to the species include: the color patterns of the moths; their sizes, which range from 6 to 26 mm.; the size, shape, and proportions of the labial palpal segments; the nature of the vestiture on the undersides of the forewings (see *gemmata* for example); the scale tuft development; unusual scales on the forewings of such species as *herbarum*; the presence or absence and extent of curled scales on the forewings (these are revealed best when viewed with the light coming from the end of the wing). There appear to be good characters in the venation, and I regret that I have been unable to descale and to draw the wings of every species.

The larva of *Carposina* has the frons extending dorsad only about half the distance to the vertical triangle or to the level of the PI setae. Each mandible has three acute and one obtuse tooth. The prothorax has the L1 and L2 setae in a subvertical line (the L3 setae are obsolete). The pronotal shield has no secondary setae. On abdominal segments one to seven the D1 setae are shorter than the D2 setae and only slightly closer together than the D2 and are very small on segment eight. SD1 is directly above the spiracle on abdominal segments 1 to 7 and is above and in front of the spiracle on segment 8. L1 and L2 are on the same pinaculum, directly below the spiracle, and L2 is much shorter than L1; L3 is farther from L1 than L1 is from the spiracle. Spiracles are small and are not protuberant. The prolegs have uniordinal crochets.
Figure 541—*Carposina*. Top, *achroana* (Meyrick), holotype female (BM slide 1840); Hawaii, Blackburn, 1899; forewing 8 mm., pale straw-colored and white with a few yellow and fuscous flecks. Middle, *atrototata* (Walsingham), holotype female (BM slide 1863); Haleakala, 10,000 feet, Maui; expanse 18 mm.; forewings white and fuscous. This specimen is figured in *Fauna Hawaiensis*. Bottom, *benigna* (Meyrick), lectotype male (BM slide 9335 Clarke); Koolau Mts., Oahu; expanse 13 mm.; forewings white and yellow with fuscous maculae.
Figure 542—Carposina. Top, bicincta (Walsingham), holotype female (BM slide 7544); Molokai, about 4,000 feet; forewing 7 mm., brownish fuscous interspersed with white. Middle, cervinella (Walsingham), holotype male (BM slide 3876); Kahooluamano, Kauai; expanse 11.5 mm.; forewings flavous with a white or cream discal area and fuscous maculae. Bottom, crinifera (Walsingham), holotype male (BM slide 3880); Molokai, above 3,000 feet; expanse 14 mm.; forewings with white and greenish background with some yellow and with fuscous maculae. Each of these specimens was used for the illustrations in Fauna Hawaiensis.
Figure 543—Carposina. Top, *corticella* (Walsingham), holotype male (BM slide 3877); forewing 9 mm., mostly yellowish fuscous with yellow and white areas and fuscous maculae. Middle, *piperatella* (Walsingham), allotype male (BM slide 3878); Kaholuamano, 4,000 feet, Kauai; expanse 14 mm.; forewings white and brownish with fuscous maculae. Bottom, *semilogata* (Walsingham), holotype female (BM slide 7543); expanse 13 mm.; forewings white with mostly fuscous maculae but with some yellow as well. The top and bottom specimens were used for the *Fauna Hawaiienst* illustrations.
Figure 544—Carposina. Top, dispar (Walsingham), allotype male (BM slide 3881); forewing 4.75 mm., partly abraded, brownish fuscous with mostly scattered yellow squamae and a prominent oblique white macula from the costa. Bottom, distincta (Walsingham), holotype female (BM slide 3884); forewing 7.5 mm., cream- or straw-colored with some butter-yellow and with fuscous maculae. This specimen is figured in Fauna Hawaiensis.
Figure 545—Carposina. Top, *divaricata* (Walsingham), holotype male (BM slide 3882); expanse 12 mm.; forewings yellow and brownish fulvous with some olive and with fuscous maculae. Middle, *ferruginea* (Walsingham), holotype male (BM slide 3883); Molokai, about 5,000 feet; expanse 17 mm.; forewings yellow with brownish fuscous and white maculae. Bottom, *gemmata* (Walsingham), female paratype; abdomen lost; Olaa, Hawaii; expanse 22 mm.; forewing has fulvous, yellowish, and greenish background scaling with fuscous maculae and with mostly yellowish scale tufts with some white squamae. The top and middle specimens are illustrated in *Fauna Hawaiiensis*. 
Figure 546—Carposina. Top, glauca Meyrick, paralectotype; abdomen lost; Koolau Mts., Oahu; expanse 14 mm.; forewings white and pale fuscous, possibly with greenish tinges when alive. Middle, gracillima (Walsingham), holotype female (BM slide 1848); Haleakala, 5,000 feet, Maui; expanse 13 mm.; forewings mostly cream to white with a few fuscous spots (the darker maculae on the forewings are mostly abraded areas). This specimen is figured in Fauna Hawaïensis. Bottom, graminicolor (Walsingham), holotype female (BM slide 3888); Kaholuamano, 4,000 feet, Kauai; forewing 9 mm., white and, probably, greenish background sprinkled with fuscous and with fuscous maculae, some of which are edged with yellow.
Figure 547—Carposina. Top, graminis (Walsingham), allotype male (BM slide 3908); Kauai, 3,000 to 4,000 feet; forewing 8 mm., white and yellowish or greenish background scaling with brownish maculae. Middle, herbarum (Walsingham), holotype female (BM slide 3889), Lanai, 2,000 feet; expanse 17.5 mm.; forewings with pale yellow or greenish background scaling over white and with brownish fuscous maculae. Bottom, inscripta (Walsingham), holotype male (BM slide 1849); Kilauea Hawaii; expanse 13 mm.; forewings white and dark fuscous. These three specimens are figured in Fauna Hawaiiensis.
Figure 548—Carposina. Top, irrorata (Walsingham), holotype male (BM slide 1864); Lanai, 3,000 feet; expanse 12 mm.; forewings white and flavous with fuscous maculae. This specimen is illustrated in Fauna Hawaiensis. Bottom, lacerata Meyrick, holotype female, abdomen lost; Koolau Mts., Oahu; forewing 9.25 mm., white and yellow, evidently tinged with green when alive, with fuscous maculae.
Figure 549—Carposina. Top, latifasciata (Walsingham), holotype female (BM slide 3890); Kona, 3,500 feet, Hawaii; expanse as mounted 16 mm.; forewings white with the dark areas being pale and dark fuscous. Bottom, mauii (Walsingham), allotype male (BM slide 1869); Haleakala, 5,000 feet, Maui; expanse as mounted 12 mm.; forewings white, flavous, and fuscous. These specimens are illustrated in Fauna Hawaiensis.
Figure 550—Carposina. Top, saurates Meyrick, from the synonymous nereitis Meyrick, lectotype male (BM slide 9534, Clarke); Koolau Mts., Oahu; expanse 14 mm.; forewings white, brownish, and pale fuscous with darker fuscous markings and evidently tinged with green when alive. Middle, nigromaculata (Walsingham), allotype male (BM slide 3910); Waianae Mts., 2,000 feet, Oahu; expanse as mounted 10 mm.; forewings yellow and flavous with fuscous maculae. Bottom, nigronotata (Walsingham), holotype female (BM slide 7546); Olaa, 2,000 feet, Hawaii; expanse 17 mm.; forewings with dirty white background with some yellow (possibly greenish in life) and with fuscous maculae. This specimen in figured in Fauna Hawaiensis.
Figure 551—Carposina. Top, elisaeonitens (Walsingham), holotype female (BM slide 5028); Kauai, 3,000 to 4,000 feet; forewing 11 mm., background mostly olive with some white patches and with prominent, dark fuscous maculae. Bottom, plumbeonitida (Walsingham), allotype male (BM slide 3915); Kaholuamano, 4,000 feet, Kauai; expanse 16 mm.; forewings with white and yellowish (probably greenish in life) background with some greyish and with fuscous maculae. This specimen was figured in Fauna Hawaiensis.
Figure 552—Carposina. Top, punctulata (Walsingham), allotype male (BM slide 1843); Molokai, 4,000 feet; forewing 7.5 mm., white and flavous with fuscous maculae. Bottom, pusilla (Walsingham), holotype male (BM slide 1851); Waianae Mts., 2,000 feet, Oahu; expanse 7.5 mm., white and flavous with fuscous maculae. These specimens are figured in Fauna Hawaiensis.
Figure 553—Carposina. Top, pygmaeella (Walsingham), holotype male (BM slide 3909); Kona, 3,000 feet, Hawaii; expanse 6 mm.; forewings brownish fuscous with dirty white flecks. Middle, saurates Meyrick, lectotype male (BM slide 9533 Clarke); Koolau Mts., Oahu; expanse 15.5 mm., white and fuscous tinged with green. Bottom, solutella (Walsingham), allotype male (BM slide 1841); Kilauea, Hawaii; expanse 12 mm.; forewings white with yellow and fuscous scaling.
Figure 554—Carposina. Top, subumbra (Walsingham), holotype male (BM slide 3919); Waianae Mts., Oahu; expanse 13.5 mm.; forewings brownish fuscous with some white and yellow scaling. Bottom, trigonotata (Walsingham), holotype male (BM slide 1846); Molokai, 4,000 feet; expanse 17 mm.; forewings white, flavous, and brownish with fuscous maculae. These specimens are figured in Fauna Hawaiianit.
Figure 555—Carposina. Top, *tincta* (Walsingham), holotype female (BM slide 3892); Olaa, Hawaii; expanse 20.5 mm.; forewings pale yellow or greenish with some white and with flavous and fuscous maculae. Middle, *subolvacea* (Walsingham), holotype female (BM slide 7545); Lanai, 2,000 feet; expanse 17 mm.; forewings with white and pale yellowish (possibly green in life) background with dark fuscous maculae. Bottom, *viridis* (Walsingham), holotype female (BM slide 3893); Kauai, 3,000 to 4,000 feet; expanse 20 mm.; forewings white with dark fuscous maculae edged in part with yellow. These specimens are figured in *Fauna Hawaiiana*.
Carposina achroana (Meyrick) (figs. 541, moth; 558, male genitalia; 592, female genitalia).


_Carposina achroana_ (Meyrick) Meyrick, 1922b:5.

Endemic. Hawaii (type locality: Mauna Loa, 4,000 feet).

Hostplant: unknown.

The type series in the British Museum consists of two examples (collected by Blackburn) which Meyrick listed as male and female, but they are both females. Meyrick originally placed this species in the family Cochylidae (now Phaloniidae).

Figure 556—_Carposina togata_ (Walsingham), allotype male (BM slide 3956); Haleakala, 5,000 feet, Maui; forewing 7.5 mm., white, yellow, and brownish with fuscous maculae.
Carposina atronotata (Walsingham) (figs. 541, moth; 592, 593, female genitalia).

_Heterocrossa atronotata_ Walsingham, 1907b:669, pl. 13, fig. 9.


Endemic. Maui (type locality: Haleakala, 10,000 feet).

Hostplant: unknown.

This species was described from a unique female. It was recorded from _Vaccinium_ on Oahu by Swezey (Proc. Hawaiian Ent. Soc. 8:12, 1932) who also considered specimens from Hawaii to be members of this species. There are differences in the genitalia of specimens from Oahu, Maui, and Hawaii, and I have concluded that they constitute more than one species. I have, therefore, deleted the Oahu and Hawaii records and have listed the Swezey material under new species 1 below.

Carposina benigna Meyrick (figs. 541, moth; 560, male genitalia).

_Carposina benigna_ Meyrick, 1913c:76; 1922b:6, fig. 7.

Endemic. Oahu (type locality: Koolau Mountains).

Hostplant: unknown.

Carposina bicincta (Walsingham) (figs. 542, moth; 557, 593, female genitalia).

_Heterocrossa bicincta_ Walsingham, 1907b:661, pl. 12, fig. 23.


Endemic. Molokai (type locality: above 4,500 feet).

Hostplant: unknown.

This species was described from three females, and no other information has been assembled.

Carposina cervinella (Walsingham) (figs. 11-A, b-c, antenna; 542, moth; 561, 562, male genitalia; 589, 594, female genitalia).

_Heterocrossa cervinella_ Walsingham, 1907b:667, pl. 13, fig. 6.


Endemic. Kauai (type locality: Kaholuamano, 4,000 feet).

Hostplant: unknown.

Carposina corticella (Walsingham) (figs. 543, moth; 561, 562, male genitalia).

_Heterocrossa corticella corticella_ Walsingham, 1907b:664, pl. 12, fig. 28.


Endemic. Kauai (type locality: Kaholuamano, 4,000 feet).

Hostplant: unknown.

Although the species was originally described from Kauai, Oahu, and Molokai, I believe it best to restrict the name to the Kauai material until further study demonstrates beyond doubt that the species does occur outside of Kauai. Walsingham included only one specimen from Oahu and one from Molokai under this name. He considered _piperaeella_ and _semitogata_ as varieties, but the genitalia reveal that _corticella_ is a different species. All of Walsingham’s 13 specimens from Kauai are males as are the other two examples. Meyrick, 1922b:6, incorrectly listed _latifasciata_ as a synonym.
Carposina crinifera (Walsingham) (figs. 542, moth; 563, 564, male genitalia; 589, 593, female genitalia).

*Heterocrossa crinifera* Walsingham, 1907*6*:657, pi. 12, fig. 17.


Endemic. Oahu?, Molokai (type locality: above 3,000 feet).

Host plant: unknown.

This species was described from a pair from Molokai, but Walsingham included two specimens from Oahu as paratypes which he said “are not in good condition but they appear to belong to the same species”. I have, therefore, questioned the Oahu record; it may be in error.

Dr. Swezey (1954:42, 113) recorded what he supposed was *crinifera* from *Broussaisia* and *Hedyotis* (= *Kadua*) *grandis* on Oahu, but he made incorrect identifications. I have figured male genitalia from his material (figure 565) and have listed the species at the end of this chapter as new species 2.

In 1913*6*:222, Dr. Swezey misidentified another species which he had reared from *Cyanea* (= *Rollandia*) as *crinifera*, but he withdrew his determination in 1954:121. I have listed this species below as new species 3.

Carposina dispar (Walsingham) (figs. 544, moth; 566, male genitalia; 593, female genitalia).

*Heterocrossa dispar* Walsingham, 1907*6*:661, pi. 12, fig. 24.


Endemic. Hawaii (type locality: Kona, 2,000 feet).

Host plant: unknown.

This species is allied to *piperatella* and *semitogata*; its gnathus is obsolete but it is developed on the other two forms.

Carposina distincta (Walsingham) (figs. 544, moth; 595, female genitalia).

*Heterocrossa distincta* Walsingham, 1907*6*:666, pl. 13, fig. 5.


Endemic. Kauai (3,000 to 4,000 feet).

Host plant: unknown.

Dr. Swezey reported (1925:199, 203) that he had reared this species from the terminal buds of *Metrosideros* and *Syzygium* (*Eugenia*) *sandwicensis* on Oahu and had captured an adult on Mt. Olympus, Oahu, from which a *Gordius* worm emerged (note in *Proc. Hawaiian Ent. Soc.* 2:195, 1913). In 1949, however, he told me that these records are in error and that the species in question is undescribed (see also Swezey, 1954:214). I have listed the Swezey material under new species 4 below.

Carposina divaricata (Walsingham) (figs. 538, wing venation; 545, moth; 566, male genitalia; 590, 596, female genitalia).

*Heterocrossa divaricata* Walsingham, 1907*6*:665, pl. 13, fig. 3


Endemic. Kauai (type locality: Kaholuamano, 4,000 feet).

Host plant: unknown.
The extensive type series of *divaricata* contains more than one species, and I regret that I have not had time to study all of the material and to correct the confusion.

The male genital saccus is the longest and narrowest of any of the species I have examined. Other species which have an elongate saccus are *pusilla* and *solutella*.

Dr. Swezey reported this species from *Elaeocarpus bifidus* and *Syzygium sandwicensis* from Oahu. He said that *Pristomerus hawaiiensis* Perkins was a parasite, but his data were based upon misidentifications and do not apply to *Carposina divaricata*. I have figured male genitalia from specimens of Swezey’s wrongly named Oahu series. By comparing them with the figure of the holotype of *divaricata*, it will be seen that Swezey’s specimens are different from *divaricata*. I have listed the Swezey material as new species 5 at the end of this chapter.

**Carposina ferruginea** (Walsingham) (figs. 545, moth; 564, 568, male genitalia).

_Heterocrossa ferruginea_ Walsingham, 1907b:664, pi. 13, fig. 1.


Endemic. Molokai (type locality: about 5,000 feet).

Hostplant: unknown.

**Carposina gemmata** (Walsingham) (figs. 545, moth; 569, male genitalia; 594, 597, female genitalia).

_Heterocrossa gemmata_ Walsingham, 1907b:660, pi. 12, fig. 21.


Endemic. Oahu?, Hawaii (type locality: Olaa).

Hostplants: _Clermontia_?, _Cyanea_ (= _Rollandia_)?

The species was described from six females. The bursa copulatrix is unusual because there are no signa in either the holotype or a paratype that were dissected. Both dissected specimens contained a wirelike spermatophore. Another species which has obsolete signa is *atironotata*.

The hostplant and Oahu data are from Swezey. They may be incorrect and are subject to verification. Swezey (Proc. Hawaiian Ent. Soc. 4:10, 1919) reported that he had reared this species from the buds and fruits of the host-plants on Oahu.

**Carposina glauca** Meyrick (fig. 546, moth).

_Carposina glauca_ Meyrick, 1913e:74.

Endemic. Oahu (type locality: Koolau Mountains).

Hostplant: unknown.

There are three examples in the Meyrick collection in the British Museum. None of these has an abdomen, and I am unable to illustrate the genitalia.

(Text continued on page 869.)
Figure 557—Top and middle (acdeagus), male genitalia of *Heterocrossa adrapella* (Walker), the type-species of *Heterocrossa*, for comparison with the figures of *Carposina*; holotype (BM slide 1852); New Zealand. Bottom, female genitalia of *Carposina bicincta* (Walsingham), holotype (BM slide 7544); Molokai, about 4,000 feet; to show the long, wirelike spermatophore; the genitalia are partly decomposed, and part of the bursa copulatrix is missing.
Figure 558—Male genitalia of Carposina. Top, the type-species, *berberidella* Herrich-Schäffer from Europe (BM slide 1853); see also figure 539. Bottom, *achroana* (Meyrick), determined by Walsingham (BM slide 1845); Kilauea, Hawaii; A, anellar lobe; Ae, aedeagus; C, costa of valva; G, right gnathus; J, juxta; P, processus of sacculus; S, saccus; Sa, sacculus; T, tegumen; U, rudiment of uncus; V, valva.
Figure 559—Male genitalia of *Carposina* new species 1. Top, a specimen from Puu Kalena, Oahu; ex *Vaccinium* leaves (slide Z-V-6-61-1). Bottom, supposedly the same species; Kilauea section of Hawaii National Park, (slide Z-V-6-61-2). The gnathus is obsolete in this species. These specimens were wrongly determined as *atrotata* by Dr. Swezey.
Figure 560—Male genitalia of Carposina. Top, benigna Meyrick, lectotype (BM slide 9535 Clarke); Koolau Mts., Oahu. Bottom, herbarum (Walsingham)?, determined by Swezey (slide JDB-7). This may not be herbarum, which was described from an unique female; see the discussion in the text.
Figure 561—Male genitalia of Carposina. Top, cervinella (Walsingham), holotype (BM slide 3876); Kaholuamano, 4,000 feet, Kauai. Bottom, corticella (Walsingham), holotype (BM slide 3877); Kauai, 3,000 to 4,000 feet. Compare figure 562.
Figure 562—Male genitalia of *Carposina*. Top, *cervinella* (Walsingham), paratype (BM slide 15850); Kauai, 3,000 to 4,000 feet. Bottom, *corticella* (Walsingham), paratype (BM slide 15824); Kauai, 3,000 to 4,000 feet; compare figure 561.
Figure 563.—Male genitalia of *Carposina crinifera* (Walsingham). Top and middle, holotype (BM slide 3880); Molokai, over 3,000 feet (the out-of-focus dark mass near the middle of the genitalia was caused by dust on the slide). Bottom, a paratype (BM slide 3918); Waianae Mts., Oahu. Compare figure 564.
Figure 564—Male genitalia of Carposina. Top, crinifera (Walsingham), holotype (BM slide 3880, remounted; compare figure 563); Molokai, above 3,000 feet. Bottom, ferruginea (Walsingham), paratype (BM slide 3917, remounted; compare figure 568); Molokai, about 5,000 feet.
Figure 565—Male genitalia of Carposina. Top, new species 2 (slide Z-V-8-61-4) wrongly determined as crinifera by Dr. Swezey; Mt. Tantalus, Oahu; ex Kadua fruits; the saccus is more pointed than on the type of crinifera (compare figure 563). Middle and bottom, possibly the same species although perhaps distinct; Mt. Kaala, Oahu; ex Broussaisia berries (slide Z-V-8-61-3).
CARPOSINIDAE

Figure 566—Male genitalia of Carposina. Top, dispar (Walsingham), allotype (BM slide 3881); Kona, over 2,000 feet, Hawaii; note that the gnathus and anellar lobes are obsolete, and note the long, slender processus of sacculus; compare piperatella and semitogata which are rather similar but which have a developed gnathus. Bottom, divaricata (Walsingham), holotype (BM slide 3882); Kauai, 3,000 to 4,000 feet.
Figure 567—Carposina new species 5, formerly confused with divaricata by Dr. Swezey. Top, from Waialae Iki, Oahu; ex Elancarpus (slide Z–V–8–61–1). Middle, and the aedeagus illustrated at bottom, Palolo, Oahu; ex “ohia ha” fruits (slide Z–V–8–61–2). Some small individual differences and differences in staining and preparation are displayed. This is an unusually divergent species; see text for discussion. Note how distinct it is from divaricata in figure 566. A, anellar lobe; G, gnathus; J, juxta; P, processus of sacculus; S, saccus; T, tegumen; V, valva.
Figure 568—Male genitalia of Carposina ferruginea (Walsingham). Top, holotype (BM slide 3883); Molokai, about 5,000 feet; this is a poor preparation, and the left valva is removed. Bottom, a paratype from the same locality (BM slide 3917). Compare figure 564.
Figure 569—Male genitalia of *Carposina*. Top, *gemmata* (Walsingham)?, as determined by Dr. Swezey; Palolo, Oahu; ex *Clermontia* fruit; part of internal sac of aedeagus is at middle (slide Z-V-7-61-1); see text for comment. Bottom, *saurates* Meyrick, from the lectotype of the synonymous *nercitii* Meyrick (BM slide 9534 Clarke); Koolau Mts., Oahu. Compare figure 573.
Figure 570—Male genitalia of *Carposina gracillima* (Walsingham) from specimens determined by Dr. Swezey. Top, a specimen from Kokee, Kauai (slide Z—V—8—61—5). Bottom, a specimen from Lanihuli, Oahu (slide Z—V—8—61—6).
Figure 571—Male genitalia of *Carposina graminicolor* (Walsingham) from specimens determined by Dr. Swezey. Top, Kilauea, Hawaii (slide Z–V–10–61–1); ex *Osmanthus* fruits. Bottom, Wailupe, Oahu (slide Z–V–1–61–2); ex *Plectonia*.
Figure 572—Male genitalia of *Carposina*. Top, *graminis* (Walsingham), allotype (BM slide 3908); Kauai, 3,000 to 4,000 feet; compare figure 573. Bottom, supposedly one of the paratypes (Busck slide 77; Walsingham specimen 27330), of *graminis*, but this is evidently another species and demonstrates that the type series is mixed. Note the differences in the anellar lobes.
Figure 573—Male genitalia of *Carposina*. Top, *graminis* (Walsingham), paratype (BM slide 15826); Kauai, 3,000 to 4,000 feet; compare figure 572. Bottom, *saurites* Meyrick from the lectotype of the synonyms *nerellis* Meyrick (BM slide Clarke 9534, remounted; compare figure 569); Koolau Mts., Oahu.
Figure 574—Male genitalia of *Carposina*. Top, *inscripta* (Walsingham), holotype (BM slide 1849); Kilauea, Hawaii. Bottom, *irrorata* (Walsingham), holotype (BM slide 1864); Lanai, 3,000 feet.
Figure 575—Male genitalia of *Carposina*. Top, *mauii* (Walsingham), allotype (BM slide 1869); Haleakala, 5,000 feet, Maui. Note the dentiform processes on the costae of the valvae. Bottom, *nigromaculata* (Walsingham), allotype (BM slide 3910); Waianae Mts., above 2,000 feet, Oahu. Note the unusually broad apices of the valvae.
Figure 576—Male genitalia of *Carposina*. Top, *nigronotata* (Walsingham), allotype (BM slide 3911); Kilauea, Hawaii; see also figure 577. Bottom two figures are from a specimen incorrectly determined by Dr. Swezey as *nigronotata*, but it is evidently *subumbrata*; Halawa, Oahu; ex *Myrsine* (slide Z–V–7–61–2).
Figure 577—Male genitalia of Carposina. Top, nigronotata (Walsingham), allotype (BM slide 3911); Kilauea, Hawaii. Compare figure 576. Bottom, olivaceonitens (Walsingham), allotype (BM slide 3914); Kauai, 3,000 to 4,000 feet. See figure 578 of this specimen after remounting.
Figure 578—Male genitalia of *Carposina olivaceonitens* (Walsingham). Top, allotype (BM slide 3914), damaged during remounting (see figure 577 of this before remounting); Kauai, 3,000 to 4,000 feet. Bottom, a specimen from Makaleha, Oahu; ex *Pouteria (=Sideroxylon*) (slide V–7–61–3). Note that on the processus of the right sacculus the apical teeth are visible, but on the left sacculus and on the upper figure they cannot be seen because of their positions.
Figure 579—Male genitalia of Carposina. Top, plumbeonisida (Walsingham), allotype (BM slide 3915); Kaholuamano, 4,000 feet, Kauai; note the dentate apices of the crossed arms of the anellus; compare figure 580. Bottom, punctulata (Walsingham), allotype (BM slide 1843); Molokai, 4,000 feet.
Figure 580—Male genitalia of Carposina. Top, plumbeonitida (Walsingham), allotype (BM slide 3915, remounted; compare figure 579); Kahuluamano, 4,000 feet, Kauai. Bottom, subolivacea (Walsingham), allotype (BM slide 3916, remounted; compare figure 584); Lanai, 2,000 feet.
Figure 581—Male genitalia of Carposina. Top and middle, *pusilla* (Walsingham), holotype (BM slide 1851); Waianae Mts., Oahu. Bottom, *pygmaeella* (Walsingham), holotype (BM slide 3909); Kona, 3,000 feet, Hawaii. The rounded apices of the valvae are not spined; anellar lobes reduced or obsolete; gnathus obsolete; processus of sacculus long and daggerlike, its apex not dentate and reaching as far as distal fourth of the valva. (This is a poor and misleading preparation; compare figure 582.)
Figure 582—*Carposina pygmaella* (Walsingham), male genitalia and base of abdomen of a paratype (BM slide 15851); Kona, 2,000 feet, Hawaii. The anellar lobes are obsolete; compare figure 581.
Figure 583—Male genitalia of Carposina. Top, *semitogata* (Walsingham), allotype (BM slide 3879); Kauai, 3,000 to 4,000 feet. Bottom, *piperatella* (Walsingham), allotype (BM slide 3878); Kaholuamano, 4,000 feet, Kauai. These may prove to be the same species, but there appear to be differences in the processus of the sacculus. They were described as “varieties” of *corticella*, but that is a distinct species.
Figure 584—Male genitalia of *Carposina*. Top, *solutella* (Walsingham), allotype (BM slide 1841); Kilauea, Hawaii. Bottom, *subolivacea* (Walsingham), allotype (BM slide 3916); Lanai, 2,000 feet; compare figure 580.
Figure 585—Male genitalia of *Carpocina*. Top, *subumbrata* (Walsingham), holotype (BM slide 39). Waianae Mts., Oahu; compare figure 586. Bottom, *togata* (Walsingham), allotype (BM slide 39). Haleakala, 5,000 feet, Maui; compare figure 586.
Figure 586—Male genitalia of Carposina. Top, subumbrata (BM slide 15820, compare figure 585); northwest Koolau Mts., Oahu. Bottom, a specimen of a species erroneously designated as a paratype of tagata (Walsingham); Maui, 5,000 feet (BM slide 15848); compare figure 585.
Figure 587—Male genitalia of *Caprosina*. Top, *saurates* Meyrick, lectotype (BM slide 9533 Clarke); Koolau Mts., Oahu. Compare figure 569, 573. Bottom, *viridis* (Walsingham)?, determined by Dr. Swezey (slide JDB–8).
Figure 588.—Male genitalia of *Carposina trigonotata* (Walsingham). Top, holotype (BM slide 1846); Molokai, 4,000 feet. Bottom, a paratype (Busck slide 197; Walsingham specimen 26365); Molokai; aedeagus in situ. These genitalia differ from those of a paratype from Maui (Busck slide 189; Walsingham specimen 28135); study of the variation is required.
Figure 589—Female genitalia of Carposina. Top left, cervinella (Walsingham), allotype (BM slide 7533); Kaholuamano, 4,000 feet, Kauai; see enlarged ostium in figure 594. Top right, crinifera (Walsingham), allotype (BM slide 7540); Molokai, above 3,000 feet; see enlarged ostium in figure 593. Bottom left, gracillima (Walsingham), paratype (BM slide 8481); Kaholuamano, 4,000 feet, Kauai; enlargement of ostium in figure 596. Bottom right, graminis (Walsingham), holotype (BM slide 7539); Kauai, 3,000 to 4,000 feet; see figure 596 for enlargement of ostium. Note the different positions of the signa. The two specimens at bottom are partly decomposed.
Figure 590—Female genitalia of Carposina. Top left, divaricata (Walsingham), allotype (BM slide 7536); Kauai, 3,000 to 4,000 feet; see figure 596 for enlargement of ostium. Top right, mauii (Walsingham), holotype (BM slide 7535); Haleakala, 5,000 feet, Maui; ostium enlargement in figure 596. Bottom left, nigromaculata (Walsingham), allotype (BM slide 7534); Waianae Mts., 2,000 feet, Oahu; see figure 599 of enlarged ostium. Bottom right, nigronotata (Walsingham), holotype (BM slide 7546); Olaa, 2,000 feet, Hawaii; ostium enlargement on figure 599.
Figure 591—Female genitalia of Carposina. Top left, plumbeonitida (Walsingham), holotype (BM slide 7541); Kauai, 3,000 to 4,000 feet; ostium enlargement in figure 602. Top right, subolivacea (Walsingham), holotype (BM slide 7545); Lanai, 2,000 feet; ostium enlarged in figure 602. Bottom left, piperaeella (Walsingham), holotype (BM slide 7542); Kauai, 3,000 to 4,000 feet; ostium enlarged in figure 599. Bottom right semitogata (Walsingham), holotype (BM slide 7543) (the thread at the right of the bursa is debris); Kauai, 3,000 to 4,000 feet; ostium enlarged on figure 599. The two figures at the bottom may represent the same species; see text for discussion. Note the differences in the positions of the signa in the top and bottom figures.
Figure 592—Female genitalia of *Carposina*. Top left, *achroana* (Meyrick), holotype (BM slide 1840); Mauna Loa, Hawaii. Bottom, *atrototata* (Walsingham), holotype (BM slide 1863); Haleakala, 10,000 feet, Maui. The signa are obsolete in this species; a small sclerotized macula in the wall of the bursa of the holotype may or may not represent the remnant of a signum. See also figure 593.
Figure 593—Female genitalia of Carposina. Top left, a specimen determined as atronotata (Walsingham) by Dr. Swezey; Kilauea section of Hawaii National Park (slide Z-V-4-61); sigma obsolete. This is very close to the genitalia of the type, but there are minor differences; compare figure 592. Top right, bicincta (Walsingham), holotype (BM slide 7544); Molokai, about 4,000 feet; abdomen partly decomposed. Bottom left, crinifera (Walsingham), allotype (BM slide 7540); Molokai, above 3,000 feet. Bottom right, dispar (Walsingham), holotype (BM slide 7538); Kaawaloa, 1,500 feet, Hawaii.
Figure 594—Female genitalia of *Carposina*. Top, *gemmata* (Walsingham), paratype (BM slide 14307); Olaa, 2,000 feet, Hawaii; there are no signa. Bottom, *cervinella* (Walsingham), allotype (BM slide 7333); Kaholuaamano, 4,000 feet, Kauai; left is caudad; see figure 589 for entire genitalia.
Figure 595—Female genitalia of Carposina. Top and bottom left, graminicolor (Walsingham), holotype (BM slide 3888); Kaholuamano, 4,000 feet, Kauai. Bottom right distincta (Walsingham), holotype (BM slide 3884); Kauai, 3,000 to 4,000 feet.
Figure 596—Female genitalia of Carposina. Top left, *divaricata* (Walsingham), allotype (BM slide 7536); Kauai, 3,000 to 4,000 feet. Top right, *gracillima* (Walsingham), paratype (BM slide 8481); Kaholuuanano, 4,000 feet, Kauai. Bottom left, *graminus* (Walsingham), allotype (BM slide 7539); Kauai 3,000 to 4,000 feet; partly decomposed. Bottom right, *maui* (Walsingham), holotype (BM slide 7535); Haleakala, 5,000 feet, Maui.
Figure 597—Female genitalia of Carposina. The top two figures and the signa at bottom left are herbarum (Walsingham), holotype (BM slide 3889); Lanai, 2,000 feet. Bottom right, gemmata (Walsingham), holotype (BM slide 3885); Olaa Hawaii.
Figure 598—Female genitalia of *Carposina*. Top three figures, *inscripta* (Walsingham), allotype (BM slide 1805); Kilauea, Hawaii. Bottom three figures, *punctulata* (Walsingham), holotype; (BM slide 1844); Molokai, about 4,000 feet.
Figure 599—Female genitalia of Carposina. Top left, nigromaculata (Walsingham), holotype (BM slide 7534); Waianae Mts., 2,000 feet, Oahu. Top right, nigronotata (Walsingham), holotype (BM slide 7546); Olaa, 2,000 feet, Hawaii. Bottom left, piperatella (Walsingham), holotype (BM slide 7542); Kauai, 3,000 to 4,000 feet. Bottom right, semitogata (Walsingham), holotype (BM slide 7543); Kauai, 3,000 to 4,000 feet.
Figure 600—Female genitalia of Carposina. Top two figures and signa at bottom left, *latifasciata* (Walsingham), holotype (BM slide 3890); Kona, 3,500 feet, Hawaii. Bottom right, *olivaceonitens* (Walsingham), determined by Dr. Swezey (Busck slide 211); ex *Pouteria* (=Sideroxylon).
Figure 601—Female genitalia of *Carposina*. Top three figures, *solutella* (Walsingham), holotype (BM slide 1842); Kilauea, Hawaii. Bottom three figures, *tincta* (Walsingham), holotype (BM slide 3892); Olaa, Hawaii. Note the different positions of the signa on the bursa of these two species.
Figure 602—Female genitalia of *Carposina*. Top left, *plumbeonitida* (Walsingham), holotype (BM slide 7541); Kauai, 3,000 to 4,000 feet. Top right, *subolivacea* (Walsingham), holotype (BM slide 7545); Lanai, 2,000 feet. Bottom, left and right, *togata* (Walsingham), holotype (BM slide 7537); Olinda, 4,000 feet, Maui.
Figure 603—Female genitalia of Carposina. Top, trigonotata (Walsingham), allotype (BM slide 1847); Molokai, 4,000 feet; the signa are placed slightly caudad of the middle of the membranous part of the bursa. Bottom, niridis (Walsingham), holotype (BM slide 3893); Kauai, 3,000 to 4,000 feet; the signa are placed caudad of the middle of the membranous part of the bursa.
Carposina gracillima (Walsingham) (figs. 538, wing venation; 546, moth; 570, male genitalia; 589, 596, female genitalia; col. pl. 4: 1).

*Heterocrossa gracillima* Walsingham, 1907b: 672, pl. 13, fig. 16.

*Carposina gracillima* (Walsingham) Meyrick, 1922b: 5.

Endemic. Kauai, Oahu, Molokai, Maui (type locality: Haleakala, 5,000 feet), Hawaii.

Hostplant: *Styphelia* (= *Cyathodes*).

The larvae feed abundantly in the berries of *Styphelia*. The species is supposed to be widely distributed over all of the main islands. I have not, however, made a comparative study of specimens from all of the islands.

Carposina graminicolor (Walsingham) (figs. 540, pupa; 546, moth; 571, male genitalia; 595, female genitalia).

*Heterocrossa graminicolor* Walsingham, 1907b: 654, pi. 12, fig. 12.


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

Hostplants: *Osmanthus sandwicensis, Plectronia odorata*.

Parasites: *Pristomerus hawaiiensis* Perkins, *Trathala flavo-orbitalis* (Cameron).

This species was described from seven females from Kauai. The Oahu and Hawaii records and the hostplant and parasite records are Swezey's. I have not compared female specimens from Oahu and Hawaii with the Kauai holotype, and it is possible that more than one species is involved in the records.

Carposina graminis (Walsingham) (figs. 547, moth; 572, 573, male genitalia; 589, 596, female genitalia).

*Heterocrossa graminis* Walsingham, 1907b: 658, pl. 12, fig. 19.


Endemic. Kauai (type locality: 3,000 to 4,000 feet, holotype and allotype).

Hostplant: *Metrosideros*.

The type series contains more than one species. See figure 572.

Carposina herbarum (Walsingham) (figs. 547, moth; 560, male genitalia?; 597, female genitalia).

*Heterocrossa herbarum* Walsingham, 1907b: 658, 735, pl. 12, fig. 18.


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

Hostplant: unknown.

This species was described from one female. I have questioned the determinations of specimens from Oahu (made later by Walsingham) and Hawaii (determined by Swezey), and material from those localities requires careful comparison with the type.
**Carposina inscripta** (Walsingham) (figs. 547, moth; 574, male genitalia; 598, female genitalia; col. pl. 4:4).

*Heterocrossa inscripta* Walsingham, 1907b:669, pl. 13, fig. 10.


Endemic. Hawaii (type locality: Kilauea).
Hostplant: *Vaccinium reticulatum* ("ohelo").
Parasite: *Euderus metallicus* (Ashmead).
The larvae feed in the *Vaccinium* berries.

**Carposina irrorata** (Walsingham) (figs. 548, moth; 574, male genitalia).

*Heterocrossa irrorata* Walsingham, 1907b:668, pl. 13, fig. 8.


Endemic. Lanai (type locality: 3,000 feet).
Hostplant: unknown.

**Carposina lacerata** Meyrick (fig. 548, moth).

*Carposina lacerata* Meyrick, 1913c:74.

Endemic. Oahu (type locality: Koolau Mountains).
Hostplant: unknown.
The unique female holotype has lost its abdomen.

**Carposina latifasciata** (Walsingham) (figs. 549, moth; 600, female genitalia).

*Heterocrossa latifasciata* Walsingham, 1907b:662, pl. 12, fig. 25.

*Carposina latifasciata* (Walsingham) Meyrick, 1922b:6, incorrectly listed as a synonym of *corticella*.

Endemic. Hawaii (type locality: Kona, 3,500 feet).
Hostplant: unknown.
This species was described from one female.

**Carposina mauii** (Walsingham) (figs. 549, moth; 575, male genitalia; 590, 596, female genitalia).

*Heterocrossa mauii* Walsingham, 1907b:668, pl. 13, fig. 7.

*Carposina mauii* (Walsingham) Meyrick, 1922b:6, misspelling.

Endemic. Maui (type locality: Haleakala, 5,000 feet).
Hostplant: unknown.

**Carposina nigromaculata** (Walsingham) (figs. 538, wing venation; 550, moth; 575, male genitalia; 590, 599, female genitalia).

*Heterocrossa nigromaculata* Walsingham, 1907b:666, 735, pl. 13, fig. 4.


Endemic. Oahu (type locality: Waianae Mountains, over 2,000 feet).
Hostplant: unknown.
The type series of nine specimens was taken by Perkins "on tree trunks". Walsingham later added a series of 12 specimens taken by Perkins in July, 1901, "N.W. Koolau Range, Oahu" to the collection.
Carposina nigronotata (Walsingham) (figs. 550, moth; 577, male genitalia; 590, 599, female genitalia).
*Heterocrossa nigronotata* Walsingham, 1907b:656, pl. 12, fig. 16.


Endemic. Oahu?, Hawaii (type locality: male, Kilauea; female, Olaa, 2,000 feet).

Hostplant: *Myrsine (= Suttonia) lessertiana*; larvae in the berries and seeds?
Parasites: *Euderus metallicus* (Ashmead) ?, *Pristomerus hawaiiensis* Perkins?

The hostplant, parasite, and Oahu records are from determinations made by Dr. Swezey. They require confirmation—more than one species may be involved. Some material determined by him to be this species belongs to *subumbrata*.

Carposina olivaceonitens (Walsingham) (figs. 537, heads, wing venation; 551, moth; 577, 578, male genitalia; 600, female genitalia; col. pl. 4:3).

*Heterocrossa olivaceonitens* Walsingham, 1907b:655, pl. 12, fig. 13.


Endemic. Kauai (type locality: 3,000 to 4,000 feet), Oahu, Maui, Hawaii.

Hostplants: *Clermontia* (several species, including *kakeana* and *arborescens*), *Planchonella* (= *Sideroxylon*).

This moth was described from three examples from Kauai. The records for the other islands and the hostplant data are from Dr. Swezey who found the larvae of what he determined to be this species feeding in flowers, flower buds, and fruits. Some confusion may be involved in the records.

Carposina piperatella (Walsingham), **new combination, new status** (figs. 543, moth; 583, male genitalia; 591, 599, female genitalia).

*Heterocrossa corticella* variety *piperatella* Walsingham, 1907b:663, pl. 12, fig. 27.

Endemic. Kauai (type locality: Kaholuamano, 4,000 feet).

Hostplant: unknown.

This is not a form of *corticella* as it was originally described by Walsingham, but it is closely similar to, and may be the same as, *semitogata*.

Carposina plumbeonitida (Walsingham) (figs. 551, moth; 579, 578, male genitalia; 561, 602, female genitalia).

*Heterocrossa plumbeonitida* Walsingham, 1907b:654, pl. 12, fig. 11.


Endemic. Kauai (type locality: Kaholuamano, 4,000 feet), Hawaii?

Hostplant: unknown.

Dr. Swezey determined material collected at light at Kilauea, Hawaii, as being this species, but the determination requires verification.

Carposina punctulata (Walsingham) (figs. 552, moth; 579, male genitalia; 598, female genitalia).

*Heterocrossa punctulata* Walsingham, 1907b:671, pl. 13, fig. 13.

*Carposina punctulata* (Walsingham) Meyrick, 1922b:5.

Endemic. Molokai (type locality: 4,000 feet).

Hostplant: unknown.
Carposina pusilla (Walsingham) (figs. 552, moth; 581, male genitalia).

*Heterocrossa pusilla* Walsingham, 1907b: 670, 735, pl. 13, fig. 11.

*Carposina pusilla* (Walsingham) Meyrick, 1922b: 5.

Endemic. Oahu (type locality: Waianae Mountains, above 2,000 feet).

Host plant: unknown.

Only two specimens of this species are listed in *Fauna Hawaiiensis*, but seven additional specimens collected in the “N.W. Koolau Range, Oahu”, in July, 1901, by Dr. Perkins, are placed with the paratype in the British Museum. These specimens were probably taken on the trip made by Perkins and Koebele which was mentioned by Dr. Swezey in *Proc. Hawaiian Ent. Soc.* 2: 197–198, 1913, when he said:

> The northwest portion of the Koolau Mountain Range is very difficult of access and has not been visited by entomologists except when Dr. Perkins and Mr. Koebele made a trip into them about 15 [sic] years ago. They reached the main ridge from Wailua, following a large valley and taking three days to reach the higher part of the mountains, where they remained in camp for a few weeks collecting in the surrounding regions. It was found to be a rich collecting field. This part of the Range has now been made easily accessible by a trail which has been cut up the Punaluu Ridge on the windward side of the mountains.

Walsingham gave the expanse as 9 mm., but the expanse of his two original specimens is 6.5 to 7.5 mm. This species and *pygmaeella* are the smallest of the known Hawaiian carposinids.

Carposina pygmaeella (Walsingham) (figs. 553, moth; 581, 582, male genitalia).

*Heterocrossa pygmaeella* Walsingham, 1907b: 662.


Endemic. Hawaii (type locality: Kona, 3,000 feet).

Host plant: unknown.

This is one of the two or three species of Hawaiian Microlepidoptera which were not illustrated in Walsingham’s *Fauna Hawaiiensis* monograph.

With a wing expanse of only 6.0 mm., this is an extraordinarily small member of the Hawaiian carposinid fauna; its small size is approached only by *pusilla*.

Carposina saurates Meyrick (figs. 553, moth; 569, 573, 587, male genitalia).

*Carposina saurates* Meyrick, 1913c: 75; 1922b: 6, fig. 8.

*Carposina nereitis* Meyrick, 1913c: 75; type locality: Koolau Mountains.

New synonym.

Endemic. Oahu (type locality: Koolau Mountains).

Host plant: unknown.

Somewhat confused, Meyrick described this species under two different names on the same page.

Carposina semitogata (Walsingham), new combination, new status (figs. 543, moth; 583, male genitalia; 511, 599, female genitalia).

*Heterocrossa corticella* variety *semitogata* Walsingham, 1907b: 662, pl. 12, fig. 26.

Endemic. Kauai (type locality: Kaholuamano, 4,000 feet).
Hostplant: unknown.
This is not a form of *corticella* as originally described. The genitalia suggest that it may be the same as *piperatella*.

**Carposina solutella** (Walsingham) (figs. 553, moth; 584, male genitalia; 601, female genitalia).
*Heterocrossa solutella* Walsingham, 1907b:672, pl. 13, fig. 15.
*Carposina solutella* (Walsingham) Meyrick, 1922b:5.
Endemic. Oahu?, Hawaii (type locality: Kilauea).
Hostplant: *Hedyotis* (= *Gouldia*)?
Parasites: *Eupelmus peles* Perkins?, *Pristomerus hawaiensis* Perkins?, *Sierola* species?
Dr. Swezey is responsible for the host, parasite, and Oahu records. I have not verified the determinations.

**Carposina subolivacea** (Walsingham) (figs. 555, moth; 580, 584, male genitalia; 591, 602, female genitalia).
*Heterocrossa subolivacea* Walsingham, 1907b:655, pi. 12, fig. 14.
Endemic. Lanai (type locality: 2,000 feet).
Hostplant: unknown.
This may prove to be the same as *viridis*; *nigronotata* is an allied form.

**Carposina subumbrata** (Walsingham) (figs. 540, pupa; 554, moth; 576(?), 585, 586, male genitalia).
*Heterocrossa subumbrata* Walsingham, 1907b:660, 735, pl. 12, fig. 22.
Endemic. Oahu (type locality: Waianae Mountains).
Hostplant: *Scaevola chamissoniana*. The larvae form galls on the stems.
Walsingham described this species from only one male. However, he also placed 30 additional specimens taken by Dr. Perkins in the northwest Koolau Mountains in July, 1901, under this name in the *Fauna Hawaiiensis* collection. See the note above under *pusilla* for details concerning the locality where this material was collected as well as the note under *nigromaculata*.

**Carposina tincta** (Walsingham) (figs. 555, moth; 601, female genitalia).
*Heterocrossa tincta* Walsingham, 1907b:659, pl. 12, fig. 20.
Hostplant: unknown.
This moth was described from four females from the three islands mentioned. It is possible that the type series is a mixture of species.

**Carposina togata** (Walsingham) (figs. 556, moth; 585, 586, male genitalia; 602, female genitalia).
*Heterocrossa togata* Walsingham, 1907b:665, pl. 13, fig. 2.
Endemic. Maui (type locality: Olinda, 4,000 feet).
Hostplant: unknown.
There is more than one species included in the material under this name.
Carposina trigononotata (Walsingham) (figs. 554, moth; 588, male genitalia; 603, female genitalia).

_Heterocrossa trigononotata_ Walsingham, 1907b:670, pl. 13, fig. 12.

_Carposina trigononotata_ (Walsingham) 1922b:5.

Endemic. Molokai (type locality: 4,000 feet), Maui.
Hostplant: *Metrosideros*; Dr. Swezey reared moths from the terminal buds.
Parasite: _Pristomerus hawaiiensis_ Perkins.
The type series is composed of specimens of more than one species.

Carposina viridis (Walsingham) (figs. 555, moth; 587, male genitalia; 603, female genitalia).

_Heterocrossa viridis_ Walsingham, 1907b:656, pi. 12, fig. 15.


Endemic. Kauai (type locality: 3,000 to 4,000 feet), Oahu?
Hostplant: *Cyrtandra cordifolia*?

Only the female holotype was known to Walsingham, and it is possible that this may be the same as _subolivacea_. Dr. Swezey told me that he found larvae boring in the stem of *Cyrtandra* on Oahu, but I have not confirmed his report; this may be a different species.

Carposina new species 1 (figs. 559, male genitalia).

_Heterocrossa_ misidentified as _atronotata_ by Swezey, (note in Proc. Hawaiian Ent. Soc. 8:12, 1932), 1954:221.

Endemic. Oahu, Hawaii?
Hostplant: *Vaccinium*.
Parasite: _Pristomerus hawaiiensis_ Perkins.

Dr. Swezey reared this species from the leaves of *Vaccinium* which he collected on Mt. Kaala on Oahu.

Carposina new species 2 (fig. 565, male genitalia).


Endemic. Oahu (Mt. Kaala, Mt. Tantalus).
Hostplants: _Broussaisia_ fruit clusters, _Hedyotis_ (= _Kadua_ ) _grandis_ fruit capsules.
Parasite: _Pristomerus hawaiiensis_ Perkins.
The genitalia of this species are distinct from those of the holotype of _crinifera_ from Molokai.

Carposina new species 3.

_Heterocrossa_ misidentified as _crinifera_ by Swezey, 1913d:222.

Endemic. Oahu (Mt. Olympus).
Hostplant: _Rollandia humboldtiana_ (= _racemosa_).

In 1913d:222, Dr. Swezey reported that he had reared _crinifera_ from _Rollandia racemosa_ from Mt. Olympus, but in 1954:121 he stated “I believe this record is based on an error in determination.” It is unfortunate that there is a question regarding this record, because Dr. Swezey’s notes are of interest.
I quote them here, but at this writing I do not know to what species they pertain, because Dr. Swezey told me in 1949 that he could not find the specimens. In 1913d:222, he wrote:

The larvae mine the leaves of Rollandia racemosa. They feed largely in the midrib, following it outwardly, but cut lateral tunnels out into the mesophyll on both sides as they proceed. Usually there is but one larva in a leaf. I have found this in but one locality so far, on Mt. Olympus, Oahu. The leaves of the shrub were very commonly attacked by it. The leaves are quite large and are not entirely killed by the injury, but many may be seen with the injured portion decayed away leaving an irregular hole or space in mid-portion of leaf. The full-grown larva emerges and passes below to pupate in a slight cocoon amongst dead leaves or trash.

**Carposina new species 4.**

*Heterocrossa* misidentified as *distincta* by Swezey, 1925:199, 203.

Endemic. Oahu (Koolau Mountains).

Hostplants: *Metrosideros* (terminal buds), *Syzygium* (*Eugenia*) *sandwicensis*.

Dr. Swezey reported that he had reared the moths from the hostplants mentioned and that he had captured an adult on Mt. Olympus, Oahu, from which a *Gordius* worm emerged (note in *Proc. Hawaiian Ent. Soc.* 2:195, 1913). In 1949, however, he told me that these records are in error and that the species in question is not *distincta*, as recorded, but is undescribed. Also see Swezey, 1954:214.

**Carposina new species 5** (fig. 567, male genitalia).


Endemic. Oahu (Koolau Mountains).

Hostplants: *Elaeocarpus bifidus*, *Syzygium* (*Eugenia*) *sandwicensis*.

Parasite: *Pristomerus hawaiiensis* Perkins.

The male genitalia of this species are highly unusual. They do not appear to be closely related to those of any other Hawaiian species I have seen.

**Carposina new species 6.**


Endemic. Maui (Ha'elau).

Hostplant: *Clermontia kakeana* and *arborescens*. The larvae mine the leaves.

**Carposina new species 7.**


Endemic. Kauai (Halemanu).

Hostplant: *Alphitonia ponderosa* (= *excelsa*) (seeds).

**Carposina new species 8.**

"*Heterocrossa* sp.", Swezey, 1954:37.

Endemic. Kauai (Kumuwela).

Hostplant: *Bobea* (terminal buds).
Carposina new species 9.


Endemic. Molokai (Kainalu).
Hostplant: Clermontia grandiflora (fruits).
Parasite: Pristomerus hawaiiensis Perkins.

Carposina new species 10.


Endemic. Oahu (Keawaula, Palolo, Wailupe).
Hostplant: Plectronia (fruits).

Family ALUCITIDAE (Linnaeus)

Pterophorii Latreille, 1802:418; 1803:325; 1805:255, all in part.
Pterophorites Latreille, 1809:192, 233; 1810:442, all in part.
Alucitae Billberg, 1820:92.
Orneoides Herrich-Schäffer, 1843:14.
Orneoididae Meyrick, 1895:441; 1910b; 1913a. T. Fletcher, 1910a, 1910c, 1926.
Hampson, 1918b:386. Hofmann, 18986, Palaearctic fauna.
For a discussion of the family name, see Franclemont, 1952:310, and Hemming, 1957.

The Many-plumed Moths

There is one representative of this distinctive group in Hawaii. Both its fore- and hindwings are divided into six long plumes, and the clefts between the plumes extend nearly to the bases of the wings. This character alone easily serves to distinguish this family from all others in Hawaii. Members of the Pterophoridae, the other family in Hawaii whose species have lobed or plumed wings, have the forewings divided into two lobes and the hindwings into three lobes. The proboscis of the Alucitidae is pilose (“naked”, not squamose). The maxillary palpi, chaetosemata, and ocelli are absent in the Hawaiian representative although some other species of Alucitidae have maxillary palpi and ocelli.

This is a small but widely distributed family. It has most frequently been associated with the Pterophoridae, which usually has been considered a division of the pyraloids. Because of this I have already reported on the family in Volume 8 of Insects of Hawaii on the Pyraloidea. However, the alucitids are not closely allied to the pterophorids. Their true relationship has long been masked because many authors have been misled by the fact that the wings of the well-known species are cleft nearly to the base to form highly unusual plumes. There are, however, various South American and Oriental
species whose wings are only shallowly cleft and which appear nearly entire. These species have such different facies that at first one may easily conclude that they do not belong to the Alucitidae.

Some workers (Diakonoff, 1960: 16, for example) believe the family should be placed near the gelechiids, but the Alucitidae have “naked” proboscides whereas the Gelechioidae have squamose proboscides. Moreover, all of the Gelechioidae have three setae in the prothoracic prespiracular L group whereas the group contains only two setae on the Alucitidae.

Turner (1947:318–320) placed the Alucitidae with the Pterophoridae in his superfamily Pterophoroidea. T. B. Fletcher long ago (1910^a:150) called attention to how very different are the larvae of the Alucitidae and Pterophoridae: “The Orneodid larva and pupa are extraordinarily different from those of the Pterophoridae, and very closely resemble the forms found in the Tineidae [in the old broad sense]. The larvae of some, but not all, of the species are peculiar in their habit of burrowing within the flower-stalks, stems and shoots of the food plants, in which their presence gives rise to gall-like excrescences.”

T. B. Fletcher, translating from Hofmann (1898b:342–343), quoted as follows:

For the purpose of pupating, the larvae forsake the portions of the plant enclosing them and prepare for themselves on the upper surface of the ground an oval cocoon, which is usually covered with grains of earth or sand, or is composed solely of a wide-meshed web.

On emergence the empty pupa case remains behind in the cocoon. . . .

The moths fly voluntarily only towards evening, shortly before and after sunset, around their food plants. In repose the hindwings are spread out as in flight, but segments of the forewings which cover the first two segments of the hindwings, are so approximated to one another that they occupy only about half the breadth usual in flight, whereby their patterns appears very distinct. The fore part of the body is raised up a little, the palpi are stretched out horizontally and project widely; the recurved terminal joint is erected at an acute angle. The antennal flagellum forms with the basal joint, which lies on the fore part of the eye, an obtuse angle and rests under the wing.

The abdomen of the Hawaiian representative has transverse basal bands of minute cuticular spinules on the tergites. These spinules are not articulated spines as are found in some other groups in Hawaii (oecophorids, blastobasids, xyloryctids, and momphids) and are quite different from anything found on any other group in Hawaii.

I have studied the larvae of Alucita and compared them with Carposina, and I can report that they are extraordinarily similar. These larvae share the distinctive character of having only two setae in the prespiracular L group on the prothorax as do the Pyraloidea. In all other groups of Ditrysia in Hawaii this setal group is trisete. The chaetotaxy of the abdomen of Alucita (European species) and Carposina is essentially similar, seta for seta. Only on the heads have I been able to find characters to separate the Alucitidae from the Carposinidae. The habits of the larvae of both families are similar—they both include species which feed among flower stalks and terminal buds or bore in stems and shoots of the hostplants, and some cause gall formation.

I have not seen the larva of any member of the Copromorphidae and am not aware that any have been described. However, Ian Common has studied the copromorphid Phycomorpha larvae, and he has told me personally that they have the following characters: “Crochets uniorndinal in a complete
circle; prothorax with 2 prespiracular setae; spiracles prominent, tubular, that on abdominal segment 8 enlarged and arranged more dorsally than on other segments; skin surface finely spinulose; mandibles relatively deeply dentate; 6 ocelli.”

Genus **ALUCITA** (Linnaeus)


See Franclemont, 1952:310, and Hemming, 1957, regarding synonymy.

This genus is supposed to be a large, widely distributed group. It is in great need of revision and is evidently composite. The Hawaiian species has no ocelli and no externally distinguishable maxillary palpi, but in some species assigned to *Alucita* these organs are developed.

**Alucita objurgatella** (Walsingham) (figs. 604, moth; 605, head, wing venation; 606, male genitalia; 607, female genitalia).


*Orneodes angustestriata* Walsingham, 1907b:477, pl. 10, fig. 10. Synonymy by Zimmerman, 1958:413.

Kauai, Oahu, Maui, Hawaii.

Immigrant? Although I have considered this species not to belong to the endemic Hawaiian fauna, I have been unable to determine whence it has come. The faunas of the world are so poorly known that it is very difficult now to identify such an isolated species as this when one cannot determine its country of origin.

Figure 604—*Alucita objurgatella* (Walsingham); Palolo, Oahu; reared from *Plectronia* fruit; expanse about 10 mm.
Hostplant: Canthium ( = Plectronia) odoratum.
Parasites: Euderus metallicus (Ashmead), Eupelmus near aporostichus Perkins, Pristomerus hawaiiensis Perkins, Reikosiella melina Yoshimoto, Fidiobia species.

This distinctive little moth appears to be found in most places where its hostplant grows in Hawaii. Heavy infestations have been reported from flower buds, fruits, and seeds of Canthium (a genus that is widely distributed in the Pacific). It is probable that it also occurs on Molokai and Lanai where it may be found by interested collectors.

On 26 January 1967, about 20 terminal twigs of Canthium odoratum in various stages of fruiting were collected near Kolekole Pass, Waianae Mts., Oahu. The panicles of this plant contain clusters of about 7 to 10 fruits. Single fruits measure 5–8 mm in diameter, and the ripe fruit is dark green. The larva of Orneodes objurgatella attacks the developing fruit when it is small and pale green. About 30 Canthium fruits in various stages of maturity were examined. Many of these fruits were near maturity and contained 1 or 2 entrance holes which were probably made by Orneodes larvae eating their way into the fruits after hatching from eggs laid on the surface of the fruit or on nearby spikelets. A full-grown moth larva was found within one of the hard-shelled seeds.

A single female Eupelmus was found in an empty seed chamber of one of the 30 fruits examined. In other fruits, 10 or 15 cocoons (most of them empty) of Euderus lay deep within the mesocarp. Empty cocoons of Orneodes were found inside the endocarp. The entrance to the moth larval cell was closed with a thick substance made of the same materials as that of the moth cocoons. Approximately 80–90% of the examined fruits had been infested at one time or another with Orneodes larvae. In the abandoned fruits were found scattered frass, empty cocoons, living mites and in some silk webbing was on the inner wall of the seed. (Yoshimoto, 1969:631.)

I have not seen the pupa of this species, but I suppose that it has transverse, mesothoracic spiracles which are not strongly protuberant; slightly produced abdominal spiracles; antennae well separated throughout on the abdomen; exposed front femora; concealed labial palpi except at extreme base; and hidden maxillary palpi.

Figure 605—Head and wing venation of Alucita objurgatella (Walsingham).
Figure 606—Details of male Alucita objurgatella (Walsingham). Top left, coremata at apex of abdomen. Top right, genitalia, ventro-lateral aspect. Bottom left, base of abdomen. Bottom right, aedeagus. CCC Trail, Kealia, Oahu (slide Z-70-7).
Figure 607—Female genitalia of *Alucita objurgatella* (Walsingham); Keawaula, Oahu; ex *Plectonia* fruits (slide Z-70-8).
NOTES ON THE COLOR ILLUSTRATIONS

The photographs for the 64 color illustrations on the following pages were made by Edith Sattler from specimens collected by Klaus and Edith Sattler in 1973 and prepared and identified by Dr. Sattler at the British Museum (Natural History). These figures illustrate only a small selection of representative species from the Sattlers' unexcelled collection, but they will convey a modest impression of the moths as they appear in nature.

All of the figures are enlarged, and the wing expanse of each specimen is given in the legends. Further details, such as exact places of capture, are preserved in the British Museum (Natural History). The numbers in parentheses refer to the photograph numbers. Many of the species illustrated are new to science and thus are without trivial names.
1. *Opostega* species (63). Kauai. 10 mm.


5. *Spheterista pleonectes* (Walsingham) (59). Kauai. Male. 20 mm. This is similar to the type of the synonymous *castaneana*.

7. *Spheterista flavopicta* (Walsingham) (239). Kauai. Female color form. 16 mm.

2. *Opostega maculata* Walsingham (137). Maui. 7.5 mm.


1. *Spheterista* species (168).
   Kauai. Male. 17.5 mm.
2. *Spheterista variabilis* Walsingham (75).
   Molokai. Female. 27 mm.
   Kauai. Male color form. 18.5 mm.
4. *Spheterista* species (77).
   Kauai. Female. 27 mm.
5. *Pararrhaptica* species (99).
   Hawaii. Male. 30 mm.
   Kauai. Female. 18 mm.
7. *Cydia* species (70).
   Hawaii. Male. 18 mm.
8. *Cydia rufipennis* (Butler) (72).
   Kauai. Female. 10 mm.
1. Caloptilia mabaella (Swezey) (64).
   Kauai. Male. 11 mm.

3. Philodoria species (136).
   East Maui. Male. 9 mm.

5. Philodoria species (139).
   Kauai. Male. 7.5 mm.

7. Prays fulvocanella Walsingham (94).
   Kauai. Female. 13 mm.

2. Philodoria species (149).
   Hawaii. Female. 11.5 mm.

4. Philodoria species (138).
   Kauai. Female. 7 mm.

   Kauai. Male. 9 mm.

8. Acrolepia species (116).
   Kauai. Female. 12 mm.
5. *Carposina* species (170). Hawaii. Female. 19.5 mm.
   East Maui. Male. 27 mm.

   Kauai. Female. 24 mm.

   Kauai. Female. 15 mm.

   Kauai. Male. 12.5 mm.

   Hawaii. Male. 21 mm.

   Hawaii. Male. 9.5 mm.

   Hawaii. Female. 19 mm.

   Hawaii. Male. 21 mm.
8. *Hyposmocoma (H.) lucifer* Walsingham (1). East Maui. Male. 15 mm.

2. *Hyposmocoma (H.) species* (100). East Maui. Male. 17.5 mm.


4. *Hyposmocoma (H.) corvina* (Butler) (7). Kauai. Female. 16 mm.


1. *Hyposmocoma (H.)* species (159).
   East Maui. Female. 14.5 mm.
2. *Hyposmocoma (H.)* species (161).
   Hawaii. Male. 12.5 mm.
   East Maui. Male. 11 mm.
4. *Hyposmocoma (H.)* species (26).
   Kauai. Male. 26 mm.
5. *Merimnetria* species (60).
   Hawaii. Male. 20 mm.
   Kauai. Female. 11.5 mm.
   Hawaii. Male. 21 mm.
   Hawaii. Female. 22.5 mm.