

REPORT OF WORK  
OF THE  
**EXPERIMENT STATION**  
OF THE  
HAWAIIAN SUGAR PLANTERS' ASSOCIATION

**Leaf-Hoppers and their  
Natural Enemies**

(PT. II. *EPIPYROPIDÆ*)  
*Lepidoptera*

BY R. C. L. PERKINS

HONOLULU, H. T.  
JUNE 3, 1905

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## LETTER OF TRANSMITTAL

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Honolulu, T. H., May 22nd, 1905.

To the Experiment Station Committee, Hawaiian Sugar Planters' Association.

Gentlemen:—I herewith submit for publication the second part of a bulletin entitled "Leaf-hoppers and Their Natural Enemies."

Yours obediently,

R. C. L. PERKINS,  
Director, Division of Entomology.



## INTRODUCTORY REMARKS

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The first record of caterpillars parasitic upon Homoptera was that of Bowring in 1850, who discovered a Coccus-like insect on the back of one of the lantern flies, *Pyrops candalaria*, at Hong Kong. Subsequently the moth was bred, and Westwood described it as a new genus and species of the family Arctiidae, under the name of *Epipyrops anomala*. He likewise described the caterpillar and the pupa of the same insect. Since Westwood's time other species of *Epipyrops* have been noticed in Japan and North and Central America, but as the references to these are given below in the bibliographic list it is not necessary to specially refer to them here.

When Mr. Koebele and myself arrived at Cairns in Northern Queensland and started a systematic investigation of the enemies of leaf-hoppers, these parasitic caterpillars naturally came under our observation at the very beginning of our researches. Although so far as I know no record of their occurrence in Australia has yet been published, yet their presence was not unknown to some of the Australian entomologists. Mr. F. P. Dodd, a dealer in entomological specimens, had bred one or two species, though the most casual inspection was sufficient to show me that these were neither of the two species we had found in abundance at Cairns at that time. Mr. Henry Tryon, the Government Entomologist for Queensland, had long since found the curious cocoon of these moths in that State. In fact, they are very common insects. In the case of certain species of Delphacid leaf-hoppers at Cairns, a large percentage carried one or more of the parasitic caterpillars. Another species of the parasites affected a commonplace Jassid that lives on the leaves and shoots of a species of *Terminalia*, and the number of cocoons formed on the leaves was almost incredible. As Mr. Koebele's notes well express it, they were "in millions," and at a glance gave the leaves somewhat the appearance of being badly affected with a *Pulvinaria*, or some such scale-insect. Species also occurred at Bundaberg, and after I left Australia, Mr. Koebele found them

in profusion around Sydney, where nearly a score of hoppers were found to be affected. It is therefore probable that they will be found commonly throughout Australia, and that the species are fairly numerous.

## GENERAL ACCOUNT OF THE LIFE HISTORY OF EPIPYROPIDAE.

The following account is mainly taken from the study of the species I call *Agamopsyche threnodes*, it being parasitic on the sugar cane leaf-hopper and a few more or less closely allied Delphacids. This is the only species known to us, of which numbers were obtained, which is obviously parthenogenetic, no male at all having been bred. The female is sluggish, and generally commences to lay very soon after emergence. The eggs were invariably fertile, very numerous, disc-like, of small size, and laid in large numbers in a batch. In nature they were found deposited on dead grass leaves, on which the cocoons were also collected. The development of the embryo could be watched through the thin egg-shell. The imago was not studied in the field, but I bred a number of specimens of a Sydney species from cocoons sent to Honolulu by Koebele, after my own return. These were kept in a large cage over growing cane and in every way reminded me strongly of a species of *Fumca*, with which I was very well acquainted many years ago, when I confined my attention to the Lepidoptera. It was to the characters of *Fumca* that I turned, when working out the material here considered, feeling sure that the resemblance was more than superficial, and the investigation has satisfied me that such is really the case. The superficial appearance of the larva in most of its stages is admirably described by Bowring in the words "a Coccus-like insect," for the larva, and also to some extent the cocoon, of many species greatly resembles certain mealy bugs in superficial appearance. In the well-grown larva of *Agamopsyche* the head is extremely small, and retractile; the mandibles minute and usually wholly, or almost wholly, concealed beneath the labrum; and the labium is produced into a spine-like process or spinneret, directed downwards. The larva is able to let itself hang down by a silken thread, and when freed from its host was often seen to do this. The head bears a number of longish bristles, the body a few inconspicuous ones. The eyes are distinct and set on a darkly pigmented area, and so placed together on the head as



to superficially resemble a simple form of compound eye on each side. The thoracic legs have a small and very sharp claw, which is abruptly bent backwards. Segmentation is deep and conspicuous, the cuticle corrugated and in life more or less thickly covered with a floury efflorescence. The third, fourth, fifth and sixth abdominal segments bear very short prolegs, which, however, are capable of further protrusion than is usually observed in preserved specimens. They are furnished with a regular circle of hooks to the number of about 20 in large and 12 or 14 in smaller larvae. An additional terminal pair of legs or claspers very closely approximated, are imperfect, being armed with hooks only along the front side. In some species of *Heteropsyche* the hooks are much more numerous, 40 or 50 to each proleg.

One or more larvae may be seen on a single hopper, but, in some cases at least, it appears that only one of these is able to become mature. The moults take place on the hoppers' back, and one or more cast skins were frequently noticed thereon. In the case of *Agamopsyche* the caterpillars were found only on mature Delphacids. They affect both short and long winged forms alike, and either sex of the hopper. In most cases at least the parasite (unless resting or moulting) has the head turned towards the tip of the abdomen of the host. Although in many of the hoppers, that were found affected, there is no waxy excretion, such as the parasitic caterpillars have been supposed to feed on, yet it is probable that these feed largely on the sweet liquid excretion or honey-dew, which is abundantly produced at all times. This opens up the question as to whether the parasite is or is not fatal to the host. Koebele from observations made at Sydney believed that the hoppers died soon after the parasite quitted them. In some cases at least with *Agamopsyche* at Cairns, death followed quickly on the withdrawal of the full-fed caterpillar. Even immediately after this event in some specimens of a Delphacid, a collapse or distortion of the dorsal sclerites of the abdomen was obvious, and healthy hoppers included in the same jar as parasitized ones outlived the latter. It would however be premature to say that a mature hopper bearing these parasites is incapable of laying fertile eggs. In the case of species other than *Agamopsyche*, the caterpillars were observed on nymphs as well as on mature hoppers. Should the nymphs moult, it would appear probable that the parasitic caterpillar would be also discarded, but it is quite possible that the drain on the strength of the host is sufficient to prevent moulting, as is

always the case with the dryinized leaf-hoppers considered in Pt. 1 of this Bulletin.

It is, however, the first stage or instar of the caterpillar that is most interesting, not only on account of its utter dissimilarity in appearance, when compared with the later stages, but because it considerably resembles in general appearance that first larval stage of some parasitic insects of other Orders, which more or less resembles the primitive form of insects included in the Aptera.

The newly hatched larva is very minute, in shape subcampodeiform, very long and slender, and tapering to the caudal extremity. The head and thoracic segments together form about half the whole length of the larva, and are much more bulky than the rest. The head is large and remarkable for the great, ovate, black-pigmented eye on either side, and for the character of the labium, which in lateral view is often seen forming a large downward continuation of the head, of more or less triangular shape, its pointed lower extremity being armed with a long sharp spinose spinneret. It is not, however, always thus extruded, but can be withdrawn beneath the head so as not to be seen in lateral aspect. On either side of this, on the under surface of the head, and projecting nearly straight downwards, is a longish palp-like organ with slightly dilated base, which probably carries a sense organ. Its position would suggest that it is palpal rather than antennal. The segmentation is very distinct, the thoracic legs are large and in reality very elongate for a caterpillar, if they are expanded; but in dead specimens the joints are usually folded up on one another. There are two longish joints followed by an indistinct small piece resembling an empodium, over which is a long curved spinose bristle. The second to the seventh abdominal segments inclusive bear very long ambulatory bristles, set on projections or pseudopodia; the penultimate and apical segments have shorter ones, and the apex of the abdomen two excessively long and fine downward curved hairs.

The cocoons of the Epipyropidae are white, and have a mealy appearance in most cases, as have the larvae. They exhibit much variety of form, being usually more or less ornamented with carinae or outstanding lamellae, and though there may be individual variation, yet in many cases those of different species are quite distinct. Those of the genus *Heteropsyche* are more ornamental than those of *Agamepsyche* and *Palaeopsyche*, as far as the species we collected are concerned. One extremely beautiful cocoon collected by Koebele is rosette-like, being

nearly round, and with three tall vertical lamellae concentrically arranged about the more solid round centre, which itself has a central depression. The moth from this was unfortunately not bred. When the moths hatch the pupa case always remains largely emergent from the cocoon, but its posterior segments are never freed, at least under natural conditions, whether the moth produced be male or female.

### CLASSIFICATION.

The parasitic moths of the genus *Epipyrops* have been placed in various families by different authors. Westwood as already mentioned assigned the typical genus to the Arctiidae, but neither the neuration nor the structure of the legs will admit of such a position. Sir George Hampson has suggested placing it in the *Heterogeneidae* (*Limacodidae*) but the neuration and other structural points, as well as the larval prolegs, exclude it. Dyar who made a critical examination of an indifferent specimen from N. America, concluded that it was a "Tineoid form not referable to the Tineidae proper." This is practically the conclusion I have myself arrived at after a careful examination of the three genera here characterized, though I much regret that I have not been able to examine *Epipyrops* itself. Briefly I consider these insects to form a distinct family most nearly related to *Fumea* and *Taleporia* of the *Tineidae* and to the *Psychidae* of the *Psychina*.

#### *Epipyropidae*, fam. nov.

Head and thorax mostly with appressed scales, sometimes more or less hairy; eyes small and widely separated in front, ocelli wanting, palpi wanting (said to be present but minute in *Epipyrops*). Antennae one-half or less, with very long ciliated bipectinations in the male, much shorter ones, not ciliated, in the female. Thorax with appressed scales or more or less hairy; legs smoothish, not hairy, middle spurs absent, apical spurs at most represented by extremely minute spines. Forewings with 1a (often absent), 1b and 1c separate; 1b sometimes furcate at base, vein 8 to tip of wing, always very closely approximated to 7 at the base, or with 7 out of it. In the Australian species here described, the cell is divided into three parts by two indistinct longitudinal veins and the apex of the cell is closed only by in-

distinct or obsolete discocellulars. Hindwings with vein 8 (and 7 if present) free to the base not connected with cell.

The mouth parts are so degraded that it is hard to homologize the existing structures with those of an ordinary Tineid. The slight projection densely covered with scales and visible just below the clypeus, is seen, if denuded, to be a single piece with emarginate apex, divided by a suture from a basal portion, which occupies the middle of the head beneath. This structure resembles a simple labium in many insects, but its position seems that of the base of the proboscis of ordinary moths. The labrum lies in the deep emargination of the clypeus, and no other mouth-parts are present.

### SYNOPSIS OF GENERA.

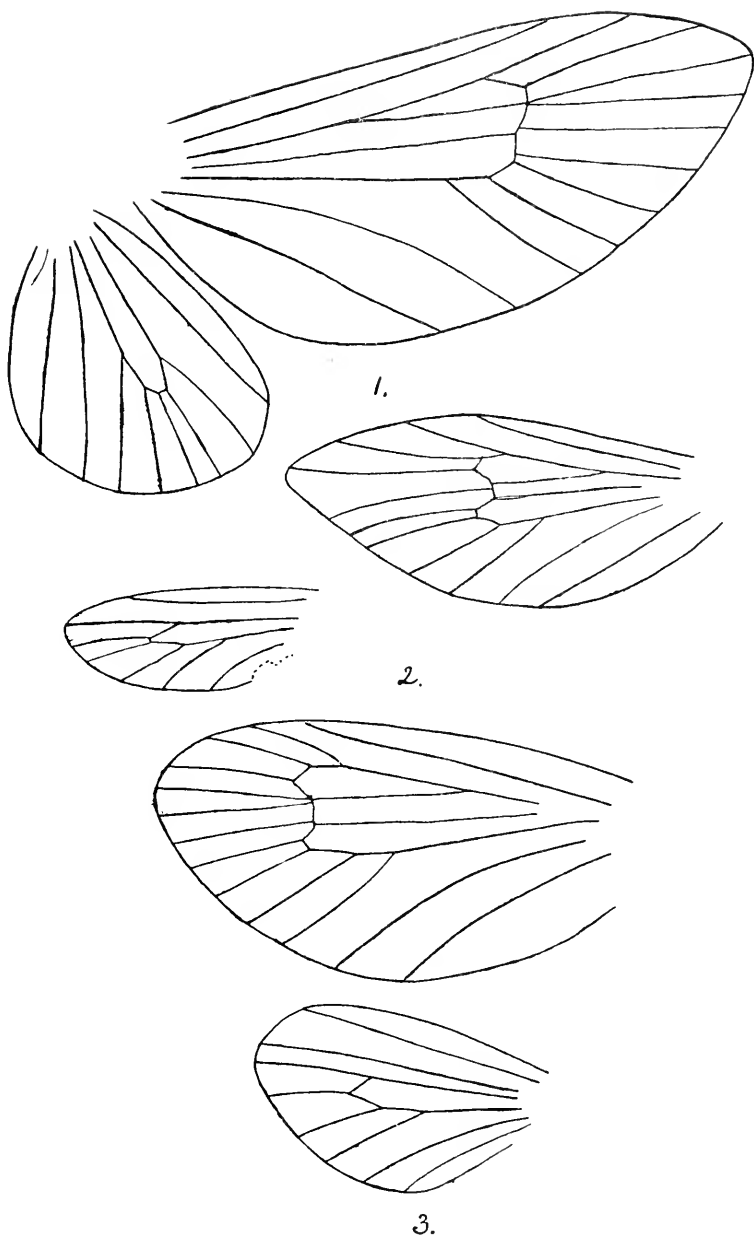
1. (2) Cell of hindwings emitting only 4 veins, (vein 4 absent) 7 free to base.....*Palaeopsyche*
2. (1) Cell of hindwings emitting 5 veins (vein 4 present) 7 absent.
3. (4) Forewings with vein 7 out of 8 near the apex.....  
.....*Agamopsyche*
4. (3) Forewings with veins 7 and 8 basally approximated but distinct.....*Heteropsyche*

#### *Palaeopsyche*, gen. nov.

Forewings with 2 very distinct internal veins, vein 2 rising from cell far beyond the middle, widely separated from 3, being about as distinct from it as 3 is from 4; 7 and 8 very closely approximated at base, the cell apparently open at the apex, being only closed by obsolescent veins; vein 12 free. Posterior wings with only 6 veins in addition to the internal, vein 4 being absent; apex of cell an acute angle giving rise to vein 5 only; 7 and 8 free to the base. (Pl. fig. 3.)

#### *Palaeopsyche melanias*, sp. nov.

Male and female, 7-8.5 mm. Head and thorax black, somewhat hairy, antennae more or less pale, black or dark at the points of origin of the pectinations. Antennae in the male with 9 very long bipectinations, and the apex bifid to form a tenth, the longest pectination about half as long as the whole antenna;



DESCRIPTION OF FIGURES.

1. Neuration of fore and hind wing of *Heteropsyche* (female).
2. The same of *Agamopsyche* (female). Hind wing partly wanting.
3. The same of *Palaeopsyche* (male).



a short basal pectination, apparently sometimes absent. Antennae of female with much shorter bipectinations than those of the male, the longest of these twice as long as the space between itself and the next following. Anterior wings dull black, purple-tinged in some lights, shorter and broader in the male, more pointed and with very oblique termen in the female; cilia black or blackish fuscous. Hind wings dark fuscous, greyish tinged, cilia long, dark fuscous. Abdomen black, no pale anal tufts in female.

HAB. Cairns, Queensland; abundant on a Jassid on Terminalia.

*Heteropsyche*, gen. nov.

Differs from *Palaeopsyche* in that vein 9 of forewings is absent, vein 4 of hindwings is present, 7 being absent. (Pl. fig. 1). Type *H. melanochroma*.

The species of this genus are closely allied and difficult. The material at my disposal consists mostly of specimens that were allowed to die a natural death, since we wished to obtain eggs to send to the islands for economic purposes. They are therefore much abraded and practically useless for study of characters other than structural. However, either one or two examples of each species were killed while in fresh condition, and these served for the following descriptions. For the separation of the species, I have in the table used chiefly the number of pectinations of the male antennae, which appear constant in all the examples of the one species that was examined in numbers, in which I counted them. Apart from this, however, all differ in details of coloration. Koebele under number 2358 records that he found 2 species of *Epipyrops* on some 17 species of leaf-hoppers, Jassid and Fulgorid. I think it probable that had material of these been saved in good condition, there would have proved to have been several species of the moths under this number.

SYNOPSIS OF SPECIES.

MALES.

1. (4) Antennae with 12 pectinations on the inner side, not counting one formed by the bifid apex.
2. (3) Forewings more or less variegated; cilia of hind wings mostly white.....*H. poecilochroma*

3. (2) Forewings almost uniform blackish or blackish fuscous, cilia of hindwings dark . . . . . *H. melanochroma*
4. (1) Antennae with less than 12 pectinations on the inner side, excluding one formed by the bifid apex.
5. (6) Forewings maculately greyish and blackish; antennae with 10 bipectinations, not counting the bifid apex. . . . . *H. micromorpha*
6. (5) Forewings greyish fuscous indefinitely sprinkled or suffused with dark, antennae with 11 bipectinations (excluding that formed by the bifid apex) . . . *H. dyscrita*

1. *Heteropsyche pocilochroma*, sp. nov.

Male; expanse about 10 mm. Head and thorax greyish fuscous, antennae with 11 lateral bipectinations, an additional basal pectination apparently unpaired, or at least with the other of the pair scarcely visible, and the bifid apex of the antenna forming an additional pair of short pectinations; basal joint with a tuft beneath. Inner pectinations blackish with paler spots or lines, outer pale with dark tips. Forewings greyish fuscous strigulated with dark and brownish fuscous, and along the costa with black so as to have an ill-defined maculate appearance; termen slightly bowed, very oblique, dorsal margin strongly rounded; cilia dark fuscous. Hindwings dark fuscous somewhat brownish tinged, cilia except at their base white.

HAB. On the Mulgrave near Cairns, bred from a Fulgorid. (Koebele's number 2294).

2. *Heteropsyche melanochroma*, sp. nov.

Male and female; expanse about 10 mm. Head, thorax and abdomen black, or blackish fuscous. Antennae in the male with 12 bipectinations (in addition to those formed by the bifid apex) and a basal tuft beneath. Pectinations in the female very short. Forewings dull, nearly uniform, blackish fuscous or black, faintly purple tinged in some lights; hindwings blackish fuscous, hairy towards dorsum, cilia blackish fuscous.

HAB. Sydney, N. S. W. Very abundant according to Mr. Koebele. His Number 2358, which no doubt included more than one species. Said to have been bred from various Fulgorids and Jassids.



3. *Heteropsyche micromorpha*, sp. nov.

Male; expanse about 7 mm. Head and thorax dark fuscous, greyish tinged, abdomen blacker. Antennae with 10 bipectinations in addition to the bifid apex, and with a basal tuft beneath. Forewings greyish and dark blackish fuscous so arranged that the grey parts form many small roundish spots, along that costa partly blackish, cilia blackish fuscous. Hindwings blackish fuscous, cilia grey-tinged.

Hab. Sydney, N. S. W. (Koebele's number 2352) bred from a peculiar Fulgorid on fern.

4. *Heteropsyche dyscrita*, sp. nov.

Male; expanse about 9 mm. Head greyish fuscous, thorax darker, antennae with 11 bipectinations (excluding those formed by the bifid apex) and with a basal tuft beneath. Forewings greyish fuscous, indefinitely sprinkled and suffused with dark fuscous, but not so as to be definitely marked or maculate; cilia dark fuscous more or less grey-tinged at the tips. Hindwings uniform dark fuscous, cilia paler, grey-tinged.

Hab. Sydney, N. S. W. (Koebele's number 2366). Another specimen under this number looked like quite another species, but was too worn for identification. On minute Fulgorid on *Cuscuta*.

5. *Heteropsyche stenomorpha*, sp. nov.

Female; small and with narrow front wings, expanse about 8 mm. the termen very oblique, the dorsum strongly rounded. Antennal pectinations very short, the longest hardly longer than the joint that bears them. Forewings black or blackish fuscous rather roughly scaled, the cilia dark; hindwings like the front, but rather more finely scaled.

Hab. Sydney, N. S. W. (Koebele's number 2358). Might be a depauperated form of *H. melanochroma*, which bears the same number, but more probably is distinct.

*Agamopsyche*, gen. nov.

Differs from *Heteropsyche* in that vein 7 of forewings is out of 8 near the tip of the wing, and in the female the antennae are

much more longly bipectinated. From *Palaeopsyche* it differs in the absence of vein 9 of forewings and vein 7 of hindwings. (Pl. fig. 2).

*Agamopsyche threnodes*, sp. nov.

Female, length 6-8 mm. Head and thorax blackish fuscous. Antennae with rather long pectinations, the longest much longer than the space between itself and the next following. Forewings, long and narrow, deep black or blackish fuscous, generally with a purplish reflection, and with some obscure and variable small whitish spots; cilia greyish or greyish fuscous, conspicuously paler than the wing. Hind wings black or blackish fuscous, cilia greyish fuscous.

Hab. Cairns on Delphacids, abundant.

BIBLIOGRAPHY.

- 1850 BOWRING, J. C. "Letter concerning a curious Coccus-like insect parasitic upon *Fulgora candelaria*." (Proc. E. S. London (2) I, p. XXXVI.)
- 1876 WESTWOOD, I. O. (Trans. E. S. London, 519-24, Pl. VII.) *Epipyrops anomala* g. and sp. n. parasitic on *Pyrops candelaria* from China.
- 1877 id. (Trans. E. S. London, 433-7, Pl. X, c. fig. 1-3). Notes on the parasitism of certain Lepidopterous insects. *Epipyrops* (?) on *Aphacna* (?) & *Eurybrachys spinosa* from India.
- 1883 CHAMPION, G. C. (Proc. E. S. London, pp. XX-XXI). Larvae parasitic on certain small Fulgoridae in Central America.
- 1877 id. in Distant W. L. *Biologia Centr. Am. Rhynch. Hom.* I, 27. Larvae on *Euchophora stillifer*.
- 1889 SHARP, D. *Cambridge Nat. Hist. Insects*, Pl. II, p. 404.
- 1902 DYAR, H. G. "A lepidopterous larva on a leaf-hopper, *Epipyrops barberiana* n. sp." (Proc. E. S. Washington, V, 43-5).

- 1903 NAWA, U. "Notes on a parasitic moth" (Insect World, VII, no. 1, Engl. suppl. 1-2; plate). *Epipyrops nawai* Dyar on *Pomponia japonensis*, and *maculaticollis* and *Graptosaltria colorata*. Similar larvae on *Ricania japonica*. See Dyar (P. E. S. Washington V, 43-5) and Kirkaldy (Entomologist XXXVI, 129-30.)
- 1904 HOLLAND, W. J. "Epipyrops barberiana Dyar." (Ent. News, XV, 344-5.) On *Ormenis pruinososa* in Texas; chalcid also bred.