PROCEEDINGS

OF THE

Hawaiian Entomological Society

Vol. III, No. 5. For the Year 1917. April, 1918.

JANUARY 4TH, 1917.

The one hundred thirty-sixth meeting of the Society was held in the usual place. Members present were: Messrs. Bridwell, Ehrhorn, Fullaway, Illingworth, Kuhns, Muir, Osborn, Swezey and Timberlake. In the absence of the president and vice-president, Mr. Muir was chosen to preside.

Minutes of previous meeting read and approved.

On motion of Mr. Swezey, it was voted that a bound copy of the "Proceedings," Vols. I to III and succeeding numbers, be sent to the Trustees of the Hawaiian Sugar Planters' Association.

Mr. Muir suggested closing Vol. III with the next issue, and offered to prepare the index for the same.

ENTOMOLOGICAL PROGRAM.

Sclerogibbinae.—Mr. Bridwell exhibited a specimen which he had captured indoors at Kaimuki, apparently representing a new genus in this subfamily of Bethylidae. He considered that his species had probably been introduced to Hawaii from the Orient.

Bembidula spp.—Mr. Bridwell exhibited specimens and discussed certain species of this genus of wasps.

FEBRUARY 1ST, 1917.

The one hundred thirty-seventh meeting of the Society was held in the usual place, Vice-President Pemberton in the chair. Other members present: Messrs. Bridwell, Ehrhorn, Fullaway, Illingworth, Kuhns, Muir, Osborn, Swezey and Timberlake.

Minutes of previous meeting read and approved.

It was suggested by Mr. Muir that all new captures be indexed in the "Proceedings". Mr. Bridwell added that it would be an advantage to have all introductions on record in the "Proceedings".

ENTOMOLOGICAL PROGRAM.

Scolia manilae.—Mr. Swezey reported the collecting of 1125 females of this recently introduced wasp during the past few weeks. They were all collected in one place where they were first liberated about ten months previously in a cane field badly infested by *Anomala orientalis* grubs in the plantation of Oahu Sugar Co. The male wasps appeared much more abundant flying about near the ground, the females being seen only when they came to feed on the blossoms of various weeds in the middle of sunny days. The wasps collected were used to distribute to other places helping in their dispersal.

Pheidole megacephala.—Mr. Pemberton reported having observed this ant pulling small fruitfly larvae out of infested coffee at Kona, Hawaii. Mr. Timberlake mentioned having observed the same ant destroying the eggs of the cabbage butterfly. Mr. Bridwell reported ants caring for *Aleurodes* in South Africa.

Lucillia serricata.—Mr. Illingworth reported finding the larvae of this fly in the vent of a hen. On killing and examining the hen these larvae were found feeding and were reared to maturity on meat.

Musca domestica.—Mr. Bridwell reported having noticed

large numbers of housefly maggots breeding in potatoes in the hold of a vessel from South America.

Murgantia histronica.—Mr. Ehrhorn reported capturing the harlequin cabbage bug in packing in furniture.

Sarcophagid flies.—Mr. Timberlake exhibited specimens of five different species caught here, four of which he had determined from Aldrich's recent book on this group of flies, and one species yet unnamed. He presented a table for distinguishing the species.

Key to Separate Hawaiian Sarcophaga.

BY P. H. TIMBERLAKE.

Males

Hind tibiae with a long pubescence (villous).

- Hypopygium black — *S. dux* Thomson
- Hypopygium reddish.
  - Prescutellar bristles present — *S. barbata* Thomson
  - Prescutellar bristles absent — *S. haemorrhoidalis* Fallen

Hind tibiae shortly pubescent (not villous).

- Epaulets pale, apical scutellar bristles absent.
  - Hypopygium reddish — *S. pallinervis* Thomson
- Epaulets black, apical scutellar bristles present and crossing.
  - Hypopygium black — *Sarcophaga* sp.
  - Hypopygium reddish — *S. robusta* Aldrich

Females

Prescutellar bristles absent — *S. haemorrhoidalis* Fallen

Prescutellar bristles present.

- Epaulets pale, cheeks black pubescent *S. pallinervis* Thomson
- Epaulets black.

Hypopygium reddish, at least in part.

Dorsum of abdomen with bristles along the posterior margin of the third segment *S. barbata* Thomson

Dorsum of abdomen without bristles the posterior margin of the third segment *S. robusta* Aldrich

Hypopygium concolorous with rest of abdomen.

Occiput with not more than two rows of black bristles behind the posterior corners of the eyes, the second row generally incomplete or irregular *S. dux* Thomson

Occiput with three rows of black bristles behind the posterior corners of the eyes *Sarcophaga* sp.

MARCH 1ST, 1917.

The one hundred thirty-eighth meeting of the Society was held in the usual place, Vice-President Pemberton in the chair. Other members present: Messrs. Bridwell, Giffard, Illingworth, Mant, Muir, Osborn and Timberlake.

Minutes of previous meeting read and approved.

ENTOMOLOGICAL PROGRAM.

Kelisia paludum.—Mr. Muir exhibited specimens of this Delphacid from Fiji, Queensland, Java and the Philippines, and pointed out their variation in color. This is the first of the Hawaiian Kelisias to be recognized outside of the Hawaiian Archipelago.

Kelisia swezeyi.—Mr. Bridwell reported finding this Delphacid on a coarse sedge on the slope leading up to Konahuanui. He stated that the usual habitat of the species was on bunch grass (*Eragrostis variabilis*) in wind-swept localities. Mr. Giffard said that this leafhopper was not unusual in the region of the Nuuanu Pali.

Aloha swezeyi.—Mr. Timberlake reported capturing this leafhopper on *Campylotheca* on Mt. Tantalus.

A new Jassid.—Mr. Giffard exhibited specimens of a pretty little Jassid new to the Islands, which he had captured on bunch grass (*Eragrostis variabilis*) near Diamond Head. He also exhibited a green Jassid from grass.

Spodoptera mauritia.—Mr. Bridwell exhibited two of this moth caught on a sand burr (*Cenchrus echinatus*).

Blapstinus sp.—Mr. Bridwell called attention to the fact that this beetle had not been correctly recorded heretofore, but in collections had been labelled *Alphitobius diaperinus.* The latter, however, is a much rarer beetle, only two or three specimens occurring in collections here. Discussing other Tenebrionids, Mr. Bridwell said that *Gonocephalum* (*Opatrum*) *seriatum* was first known from the Marshall Islands, and that Blackburn had credited it to these Islands without giving authority for his determination. The original description is entirely insufficient for identification of the species and might apply to any *Gonocephalum.* Whether our very common species is really *seriatum* seems doubtful. *Sciophagus pandanicola* reported by Blackburn from *Pandanus* has not since been collected.

Eucoila sp.—Mr. Timberlake exhibited a specimen of *Eucoila* reared from *Pipunculus.* Mr. Muir had reared the *Pipunculus* from a Delphacid. The *Eucoila* must have entered the *Pipunculus* while still in the Delphacid.

Gelechia gossypiella.—Mr. Bridwell reported having bred the pink boll-worm from milo (*Thespesia populnea*) pods brought by Mr. Stokes from one of the small islands on the windward side of Oahu. When Mr. Busck made a study of the pink boll-worm in Hawaii he failed to find it breeding in milo pods, and questioned it as a food-plant of this moth.

APRIL 4TH, 1917.

The one hundred thirty-ninth meeting of the Society was held in the usual place, Vice-President Pemberton in the chair. Other members present: Messrs. Bridwell, Ehrhorn, Fullaway, Illingworth, Kuhns, Osborn, Swezey and Timberlake.

Minutes of previous meeting read and approved.

ENTOMOLOGICAL PROGRAM.

New Curculionid.—Mr. Ehrhorn exhibited a new weevil captured at light at night. Later, specimens were found in decayed wood.

Cerambycid beetle.—Mr. Swezey exhibited a beetle reared from the *Cryptomeria* wood of an insect cage made in Japan, and used to bring living insects from there.

Carabids.—Mr. Bridwell exhibited specimens of rare native Carabids taken in moss on tree trunks, on Mt. Kaala.

Carabid larva.—Mr. Timberlake exhibited a larva of a native Carabid which he is rearing.

Notes on the Mating of Cockroaches.

BY J. F. ILLINGWORTH.

It was April 20, 1914, that I first observed the mating habits of our common cockroach (*Periplaneta americana*).

Hearing a rapid running about, after I had gone to bed, I turned on the light and saw several of these large roaches, which commonly live in a crevice on the veranda, chasing each other as if playing a game. They were too excited to stop, even in the light, and I soon discovered that several were chasing one individual, which in order to escape would fly across the room, dashing into the wall and running rapidly from place to place, closely followed by the pursuers.

Finally, the fleeing one was pounced upon, and I discov-

ered that they were in the act of mating: tho the male at first stood on the back of the female in the normal position, they remained thus for only a brief moment, when by their rapid movements the male was dislodged, and tho still in copula, end to end, they were able to make rapid progress along the wall, the female preceding and the male running backward. After about a minute I succeeded in getting them into a cyanide bottle, but they broke apart before dying.

Again in March, 1915, at the same place I made similar observations upon our other common species (*Periplaneta australasiae*).

The roaches have a favorite retreat in a crevice under the edge of the roof. When I turned on the light I saw several of them running along the board, at the edge of this crack, and I recognized that they were in the activity of mating. The female ran from place to place, very rapidly, and now and then a male dashed out of the crevice after her,—if not pursued far the female soon returned, apparently in an effort to entice other males. After a rapid scamper a male succeded in landing upon her back and mating took place, tho they remained in this position for only a few seconds, before the female ran off with the male still attached and running backwards. Apparently this is the normal method of mating with roaches, at least if disturbed while this act is taking place, for I made similar observations last year as noted above on *P. americana*. I succeeded in securing the pair in the cyanide bottle and they died *in copula*.

The Leather Beetle (*Dermestes vulpinus* Fab.), a Troublesome Pest of Dried Fish in Hawaii.

BY J. F. ILLINGWORTH.

This cosmopolitan Dermestid is an important pest of dried fish in Honolulu, as was recently brought to my attention by Mr. M. B. Bairos, Territorial Food Inspector, Nov. 15, 1916.

He gave me a sample from some bales of dried cod, which were found in the fishmarket so badly infested that the whole consignment had to be destroyed.

In looking up the food habits of this beetle I find that it has become notorious as a boot and leather pest, particularly in the United States, where it shows a fondness for sole-leather. At one time this species became so destructive in the large skin warehouses in London that a reward of £2,000 was offered for a remedy, without any being discovered. There is also a report that considerable damage was done to hams in Arizona, and that the larvae sometimes destroy entomological specimens. Furthermore, this beetle is said to injure both corks and hard-wood planks; the larvae bore these substances, however, only when searching for a safe retreat to pupate.

LIFE HISTORY.

Newly emerged beetles were confined in glass jars for a period of fourteen days before young, freshly-hatched larvae were discovered. Since it was found that the eggs require an incubation period of three days, the preovipositing period of the beetles is about ten or eleven days.

The several stages in the life history have been well described by Riley (1885), but it is interesting to compare observations taken under tropical conditions.

Egg:—The freshly laid, cylindrical eggs lack the transverse impressed lines that Riley describes, tho we found that just before hatching, the segmentation of the larva, within, gave this appearance.

It was found that the beetles place the eggs in any available crevice, hence they are rather difficult to locate at first. The incubation period we found to be approximately three days, in place of four to seven days as observed by Riley.

Larva:—The newly-hatched larva is at first very light colored, but soon darkens; there is a noticeable lighter area on the median dorsal line, which branches on the head in the form

of a Y. At this stage the larva is covered with very long hairs, those extending from the caudal segments equaling its entire length. The last segment terminates in a single proleg or sucker, which is used effectively whenever the grub is forced to travel over a smooth surface, such as glass or tin.

The larvae molt in five to eight days after hatching as compared to Riley's four to nine days for this instar*. The second stage larvae molt in four to ten days—Riley's time four to seven days. The third stage is passed in five to eight days—Riley's three to six. The fourth stage larvae molt in three to thirteen days, against Riley's three to six. The fifth instar required five to eight days—Riley's five to seven days. The sixth was six to nine days—Riley's six days.

Under normal conditions the larvae are fully developed after the sixth molt and at once seek a place to pupate; they leave the food and bore into any substance at hand. It is at this stage that they do damage to cork, etc., even boring into hard planks, if nothing else offers a hiding place in which to pupate. Both their habits and structure make it appear that the pupae are preyed upon in their natural development. The last larval skin bears a transverse row of spines above on each of the posterior segments, as Riley has noted, and these project outward, after the skin is shed and crowded into the opening of the pupation burrow. From our observations there are no indications that the pupae of this species are destroyed by the larvae, even when they are left exposed.

Pupa:—The pupal period here lasts for ten to eleven days, while Riley found that this stage required fourteen days.

There are similar pockets on the dorsum of the abdomen to those that are found in *Attagenus plebius*. In this case, however, there are only five in place of six, as found in that species, and tho they bear chitinized edges they lack the teeth.

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*It was noticeable that where food was abundant, development was rapid, while a scarcity of food not only lengthened the period for each of the several instars, but, in some cases, greatly increased the number of molts.

These mouths have the same habit of closing upon any object inserted into them.

The complete larval period for the seven instars was found to require fifty days, while the life cycle, from egg to adult, was passed in sixty-four days. This is slightly longer than Riley found from his experiments in the eastern United States, under summer conditions.

Adult:—The beetles that emerged Jan. 2, 1917, are still alive and actively reproducing (April 5th, 1917). They have been kept in glass jars with screw tops and abundantly supplied with the dried fish. There is no tendency to leave the food and apparently they are well adapted to subsist and reproduce generation after generation, shut away from the air and absolutely without water.

ANNOTATED BIBLIOGRAPHY.

1839. Westwood, J. O.—Introduction Modern Classification Insects. I, 157-158.
Common throout Europe and America, Java, Brazil and Chili.

1884. Walker, J. J.—Ent. Mo. Mag. IV, 161.
Said to destroy thick oak planks by their pupation burrows.

1885. Riley, C. V.—Rept. Comm. Agric. U. S. 258-264.
Common in old hides and later in shoes and leather goods, preferring the undressed parts, *i.e.* soles, heels, etc. Reports injury to hams in Arizona. Gives life history as completed in about 60 days. Describes and figures stages in life history.

1889. Jones, F. M.—Insect Life II, 63-64.
Notes injury to goat skins from Mexico, Russia, Cape Town, Arabia and South America.

1898. Howard, L. O.—Yearbook U. S. Dept. Agric. 148.
Describes pupation in packages of tobacco.

1896. Holland, W. J.—Ent. News, 68.
Records destruction of cork from Spain.

New Records of Insects on Kauai

BY O. H. SWEZEY.

On a recent trip to Kauai, visiting the sugar plantations, several species of insects were observed which had not hitherto been recorded from that Island, and occasion is now taken for recording them. In most cases these immigrants have not been purposely taken to Kauai, their arrival there having been accomplished accidentally thru commercial means, *Ceromasia* and *Pseudogonatopus* being the only ones purposely introduced there.

Cremastus hymeniae. This Ichneumonid was found very abundant at Waipouli, where it was parasitizing the coconut leaf-roller, *Omiodes blackburni.* Adults were numerous, as were also the empty cocoons on the coconut leaves where the leaf-rollers had spun up after feeding. One specimen was bred from *Cryptophloebia illepida* in a pod of *Acacia farnesiana* at Waimea.

Psammochares luctuosus. One or two specimens of this Pompilid wasp were seen in the canefields at Waimea. It is now very abundant on the other Islands, but had not been seen yet on Kauai.

Pseudogonatopus hospes. This Chinese Dryinid, parasitic on the sugarcane leaf-hopper, introduced in 1907, had not heretofore been recovered on Kauai. It was found in cane fields at Kealia and Waimea.

Helegonatopus pseudophanes. This hyperparasite on Dryinids was found at Waimea and Mana.

Sarcophaga haemorrhoidalis. This Sarcophagid fly was collected at Kealia, Grove Farm and Makaweli. At the latter place they were abundant on the cane in cane cars at the mill, being attracted by the juice on the cane.

Atractomorpha crenaticeps. This grasshopper was found at

Waipouli, Koloa and Makaweli. This is the first record for it on any of the Hawaiian Islands except Oahu.

Gryllotalpa africana. In low land at Waimea a few burrows of the mole cricket were observed in the irrigation ditches. By digging a few minutes a specimen of the cricket was secured. The first record for the Islands outside of Oahu.

Ceromasia sphenophori. In a coconut grove at Waipouli, quite a number of the coconut leaves had the borings of the sugar cane borer (*Rhabdocnemis obscura*) in the bases of the petioles. In some of these the borer grubs themselves were found; in others were borer cocoons with puparia of the imported New Guinea Tachinid; and some borer larvae were found having the maggots of the Tachinid. This is the first record in the Islands of this fly attacking the borer larvae in any other plant than sugar cane.

Note on Occurrence of an Endemic Itonidid on Oahu.

BY P. H. TIMBERLAKE.

On March 4 the writer captured a female Itonidid ovipositing in the terminal bud of *Pelea clusiaefolia* on Mt. Kaala, Oahu, at an elevation of about 2500 feet. Only three species of Itonidids have been recorded from the Hawaiian Islands and all these are introduced forms of the lowlands (Swezey, Proc. Haw. Ent. Soc. vol. 1, p. 79). One or two other species of this class have been observed more recently. No endemic species have been taken hithertofore, or none at least have been placed on record.

Note on Rearing of a Native Carabid Larva.

BY P. H. TIMBERLAKE.

A larva of *Metromenus palmae* (Blackburn) was captured hiding at the bases of terminal leaves of *Freycinetia* on the west side of Kalihi Valley, Oahu, on March 11, at about 1200

feet elevation. This larva was brought home alive and molted a few days later, finally pupating on March 27 and issuing as adult on April 3rd. It was fed on small partially crushed or stunned Diptera, mostly Drosophilids, but probably would have accepted other insect food if it had been offered. The beetle assumed a blackish brown coloration within 24 hours after emergence, but up to the present (April 5) it still presents an immature appearance. The larva was of the usual Carabid type.

At least two other species of *Metromenus* captured on March 4th hiding in moss on trees on Mt. Kaala were exhibited, these having been kept alive by feeding them with small Diptera.

Note on the Non-Identity of a Common Hawaiian Jassid with Nesosteles hebe Kirkaldy of Fiji.

BY P. H. TIMBERLAKE.

Kirkaldy in 1910 (Fauna Hawaiiensis, vol. 2, pt. 6, p. 574) identified one of the common grass-inhabiting Jassids of the Hawaiian Islands as *Nesosteles hebe* which he had described in 1906 (Ent. Bull. 1, H. S. P. A., p. 343) from Fiji. Recently the writer took occasion to examine the male genitalia of specimens from Fiji and found that there were good specific differences between them and the genitalia of Hawaiian specimens. The dorsal plate or valve of the genitalia in both species is produced into a strong hook on each side. In the Hawaiian species the hook is simple but in *hebe* it is armed at the base with three or four small but distinct spurs. The aedeagus also presents some differences. Kirkaldy called attention to a small difference in the coloration, and thought that the Hawaiian specimens might possibly be distinguished as a variety, for which he proposed the name *hospes*. This name must be elevated to specific rank for our local form. Kirkaldy also identified an Australian insect as *hebe*, but this has entirely different genitalia.

MAY 3RD, 1917.

The one hundred fortieth meeting of the Society was held in the usual place, Vice-President Pemberton in the chair. Other members present: Messrs. Bridwell, Ehrhorn, Fullaway, Illingworth, Kuhns, Osborn and Swezey.

Minutes of previous meeting read and approved.

Mr. Bridwell presented the name of Mr. H. F. Willard for active membership in the Society.

ENTOMOLOGICAL PROGRAM.

Carpophilus humeralis.—Mr. Illingworth reported finding this Nitidulid beetle attacking the ears of field corn in the field, while yet in the milk.

Plutella maculipennis.—Mr. Swezey exhibited specimens of this moth reared from leaves of *Capparis sandwichensis* near Diamond Head, April 16, 1917. The larvae were found feeding singly between the new folded-together leaves, the margins being nicely fastened with silk. Eight moths were reared, also two *Limnerium polynesiale,* an Ichneumonid parasite.

The moths were paler than the usual *P. maculipennis* reared from cabbage. It was expected, when the larvae were collected, that they would turn out to be the same as the *P. albovenosa* bred by Mr. Bridwell from larvae in the pods of *Capparis* collected by him Dec. 11, 1916, on the coral plain south of Ewa Mill. Further observations are desirable to determine whether these moths breeding on *Capparis* are distinct species or varieties of *P. maculipennis.*

Omiodes blackburni.—Mr. Illingworth reported finding the larvae of this moth recently abundant on the palm *Pritchardia pacifica* in Honolulu.

Cryptorhynchus sp.—Mr. Fullaway exhibited the larva and pupa of a weevil from rotten wood,—the same weevil exhibited by Mr. Ehrhorn at the previous meeting.

Strumigenys lowesii?—Mr. Bridwell exhibited three specimens of a peculiar new ant taken in rotten wood in Palolo Valley, where he had found a colony. He also exhibited a large number of specimens of the ant, *Tetramorium guinense,* from specimens of the peat found on Washington Island.

Scoparia dactyliopa and *S. bucolica.*—Mr. Bridwell reported having reared two moths of the former and one of the latter species from larvae found in moss on Mt. Kaala.

Mestolobes n. sp.—Mr. Bridwell exhibited this moth, reared by Mr. Timberlake from a larva in moss on Mt. Kaala.

Armadillo albospinosus.—Mr. Bridwell reported this sowbug abundant in moss on trees on Mt. Kaala.

Sarcophaga robusta.—Mr. Illingworth reported this fly breeding in meat. It is a very large species, not previously reported as occurring here. Specimens had recently been determined by Mr. Timberlake by the use of Aldrich's book on Sarcophaga flies.

Crocidosema lantana.—Mr. Swezey exhibited a moth reared by Mr. Illingworth from the young shoots of *Tecoma stans* at the College of Hawaii, which is apparently this species, but more material is needed to definitely confirm it.

JUNE 7TH, 1917.

The one hundred forty-first meeting of the Society was held in the usual place with President Potter in the chair. Other members present: Messrs. Bridwell, Ehrhorn, Osborn, Pemberton, Swezey and Willard.

Minutes of previous meeting read and approved.

Mr. H. F. Willard was elected to active membership.

ENTOMOLOGICAL PROGRAM.

*Ohia Psyllids.**—Mr. Swezey exhibited four different spe-

* Published in the Hawaiian Planters' Record, Vol. XVII, pp. 174-183, 1917.

cies of Psyllids, and material showing their work on leaves of the ohia tree, and reported briefly on a few days' investigation of these and other insects of the ohia forest in the Kohala Mountains, Hawaii.

Baeus sp.—A specimen exhibited by Mr. Bridwell, taken by him in Palolo Valley.

Glyptogastra ashmeadi.—Mr. Bridwell exhibited four specimens of this Ichneumonid, taken by him in Palolo Crater, Kalihi Ridge and Lanihuli Ridge.

Diachus auratus.—Mr. Bridwell exhibited specimens of this Chrysomelid from Palolo Valley.

Plagithmysus acuminatus.—Mr. Bridwell exhibited a specimen of this beetle collected May 3rd, by Mr. Forbes in Wailupe Valley, on *Sapindus oahuensis.*

Scolytid in palm seeds.—Mr. Bridwell exhibited specimens of a Scolytid beetle which he had found attacking palm seeds on the ground at the Queen's Hospital, in April.

Mites on potatoes.—Mr. Bridwell stated that Mr. Carpenter, the Pathologist at the Federal Experiment Station, had called his attention to a diseased condition of potato vines apparently caused by a peculiar species of mite.

Mango blight.—Mr. Ehrhorn reported that dusting mango trees with powdered sulphur was very successful in checking the blight which causes the blossoms to blight and fall off.

Aegosoma reflexum.—Mr. Swezey exhibited a specimen of this Prionid beetle reared from a pupa found by him in a dead ohia tree in the Kohala Mountains. Mr. Ehrhorn related the digging up of a Prionid larva from a root 25 feet under ground in the Santa Clara Valley, California.

Trimera lacerta.—Mr. Bridwell called attention to the scarcity of this dragonfly, which in Dr. Perkins' time was evidently as abundant as the other two species: *Pantala flavescens* and *Anax junius.* It is possibly retreating before the more successful related species.

Notes on the Entomology of Hawawiian *Euphorbia* with the Description of a New *Dictyophorodelphax* (*Homoptera, Delphacidae*).

BY JOHN COLBURN BRIDWELL.

The endemic Hawaiian species of *Euphorbia* form a natural group of closely related species, either shrubs or small trees, ranging from the arid regions of the coastal belt to some of the rainy ridges more than two thousand feet in elevation, most commonly growing on the dry ends of the lateral ridges at the outer limit of native vegetation. They support a diversified insect fauna which has as yet been very imperfectly studied. Some beginning has been made upon this work on Oahu but on the other islands the *Euphorbia*-fauna is practically unknown. These notes refer to Oahu only.

At least one and probably two or three species of *Proterhinus* feed in the larval condition in the wood of recently dead stems and on reaching maturity emerge and live for a time on the foliage on *E. hillebrandi* on the lateral ridge leading out to the eastward from Mt. Kaala in the Waianae range, on *E. clusiaefolia* on Kaumuohona ridge in the Koolau range, and on *E. multiformis* on the Ewa ridge bounding Kalihi valley in the same range.

Mr. Swezey has found the *Phycitid* moths *Genophantis iodora* and *G. leahi,* attacking the foliage of *Euphorbia,* the former in the mountains, the latter in the lowlands.

A number of Heteroptera of the families *Coreidae, Lygaeidae,* and *Miridae* have been taken on *Euphorbia* but have not yet been worked up systematically nor has their biology been studied sufficiently to be sure they are really attached to these plants. One species of the *Cicadellid* (Jassid) genus *Nesophrosyne* has been taken attached to *Euphorbia hillebrandi* on the Kaala ridge and another upon what is considered by Mr. C. N. Forbes as a form of *E. multiformis* growing on the Ewa coral plain near Sisal, a few feet above sea level. The *Del-*

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phacid, Aloha kirkaldyi, is attached to *E. hillebrandi* growing on the same ridge of Kaala before referred to. Another *Euphorbia* insect and one of the most interesting of our endemic insects is the bizarre *Delphacid, Dictyophorodelphax mirabilis* Swezey, which the writer had the pleasure of relating to its foodplant *Euphorbia clusiaefolia* in 1916 and later with Mr. Timberlake and Mr. Swezey of finding it attached on Mt. Kaala to *E. hillebrandi* some twenty-five miles in an airline from its original habitat in the other range of mountains. On May 6, 1917, while collecting in Wailupe in the southeastern Koolau Mountains in company with Mr. Swezey after climbing out of the valley at the end of the middle ridge dividing the two main branches of the valley at an elevation of about twelve or fifteen hundred feet we came upon some bushes of a *Euphorbia* determined for me by Mr. Forbes as *E. celastroides* Upon sweeping these bushes I secured four specimens of a *Dictyophorodelphax* and when I informed Mr. Swezey of my find, he secured two adults and a single nymph. Upon comparison of these specimens with *D. mirabilis* it became evident that we had discovered a second species of this peculiar endemic genus of *Delphacidae.* It will be interesting to learn if other species occur attached to other species of *Euphorbia* upon the other islands.

* *Dictyophorodelphax swezeyi* n. sp.

Total length, 6 mm.; length of the prolongation of the head in front of the eyes, 2.5 mm.

Closely resembling *D. mirabilis* Swezey but smaller and darker; the prolongation of the head relatively shorter, more slender and tapering, not bent downward apically but with a slight upward curve; tegmina proportionally a little longer but not reaching the apex of the abdomen.

♂ Genital styles blunt at the apex, only slightly curved, not prolonged into an acute curved tooth, apical slender portion of aedeagus nearly in a straight line with the thicker basal portion.

Nymph. The nymphs may be readily distinguished from those of *D. mirabilis* by the much darker coloration and the less prolonged head in corresponding instars.

*This description supplied just before the MS. for this number of the Proceedings went to press.—[Ed.]

Described from 3 ♂ ♂, 3 ♀ ♀, and 1 nymph, Wailupe, May 6, 1917 (J. C. Bridwell and O. H. Swezey); and 15 ♂ ♂, 14 ♀ ♀, and 12 nymphs, collected on *Euphorbia celastroides,* Niu, Feb. 10, 1918 (O. H. Swezey and P. H. Timberlake). These localities are adjacent in the southeastern Koolau Mountains, Oahu, Hawaiian Islands.

Type ♂ and ♀ and paratypes in the Bernice Pauahi Bishop Museum, paratypes in the collection of the Hawaiian Sugar Planters' Experiment Station, and in the private collections of J. C. Bridwell, O. H. Swezey, and P. H. Timberlake.

Named in appreciation of Mr. O. H. Swezey, who first discovered and described the genus, for his extensive and successful work in advancing our knowledge of the biology of Hawaiian insects.

NOTE.—The writer had hoped to have the species described by Mr. Frederick Muir, but his departure to take up war service in England prevented this and in default of some one more familiar with the group has described the species to place on record this interesting addition to our fauna.

JULY 6TH, 1917.

The one hundred forty-second meeting of the Society was held in the usual place, Vice-President Pemberton in the chair. Other members present: Messrs. Bridwell, Ehrhorn, Newell, Osborn and Swezey.

Minutes of previous meeting read and approved.

ENTOMOLOGICAL PROGRAM.

Mr. Ehrhorn discussed the confusion which is apt to occur regarding the injury to plants. For example: he had noticed African daisies attacked by some kind of blight, the cause of

which was not determined. The injury had been checked by dusting powdered sulphur on the plants. Subsequent observation had shown the infected areas to be covered with mites, but it was uncertain whether they were the original cause of the injury.

Proterhinus on *Hibiscadelphus.*—Mr. Swezey exhibited 15 specimens of *Proterhinus* beetles collected by him in dead twigs of the lone *Hibiscadelphus Giffardianus* tree in the "Kipuka" known as the Bird Park at Kilauea, Hawaii, June 27, 1917. It is probably a new species, as no *Proterhinus* has previously been collected from that species of tree.

Cis sp.—A large series of *Cis* were also taken from dead twigs of the above tree by Mr. Swezey.

Ephestia elutella.—Mr. Pemberton exhibited specimens of this moth bred from corn meal and peanut candy.

Calandra remota.—Mr. Bridwell exhibited specimens of this weevil found by him in banana plants in Pauoa Valley. The larvae were found feeding in the bases of banana stems where there was a great deal of juice, and might be considered as practically aquatic. This is the first record of the larval habitat.

Cerambycid in papaia.—Mr. Bridwell exhibited a specimen of a Cerambycid beetle of which he had reared three from dead leaf stems of papaia that were still attached to the tree. It had not previously been observed here.

Nesidiorchestes hawaiiensis.—Specimens of this bug were exhibited by Mr. Bridwell, who had collected them from dry leaves and trash. Since the publication of the Fauna Hawaiiensis few specimens have been collected or noted.

Acanthia sp.—Mr. Bridwell exhibited a series of two species of this genus of bugs, collected by him in wet moss along the stream in Palolo Valley. Nymphs were also found there.

Kelisia swezeyi.—Mr. Bridwell reported the finding of both

long and short winged forms of this Delphacid. The long winged form is rare, this probably being the first record for it.

Rhyncogonus koebelei.—Mr. Bridwell reported collecting this weevil in Palolo Valley.

Proterhinus maurus.—Mr. Bridwell exhibited specimens of this very large Proterhinid beetle collected by him from a variety of *Suttonia lessertiana* having very large leaves clustered at the ends of rather thick twigs. The adult beetles feed in the axils of the leaves, and the larvae feed in the pith of the newly dead twigs. Other collectors of this beetle had collected it only from this form of *Suttonia.* The type specimen was 5 mm. long, the average being about 3 mm., but Mr. Bridwell collected one specimen 9 mm. long which is undoubtedly the largest *Proterhinus* ever collected.

Insects on ti.—Mr. Bridwell stated that heretofore he had found this plant very free from insects, but on June 28th he had found both *Cis* and *Proterhinus* on dead ti and ieie leaves on the ground in a ravine on the Pali road on windward Oahu.

Delphacid on Baumea.—Mr. Bridwell reported collecting one specimen of an unknown Delphacid on the large sedge *Baumea.*

AUGUST 2ND, 1917.

The one hundred forty-third meeting of the Society was held in the entomological laboratory of the new building of the Hawaiian Sugar Planters' Experiment Station, Vice-President Pemberton in the chair. Other members present: Messrs. Bridwell, Ehrhorn, Fullaway, Kuhns, Muir, Swezey, Timberlake, and Willard, and Mr. D. L. Crawford, visitor.

In the absence of the Secretary, Mr. Swezey was appointed Secretary pro tem.

Minutes of the previous meeting read and approved.

Mr. Swezey proposed the name of Mr. D. L. Crawford for active membership.

ENTOMOLOGICAL PROGRAM.

Gonioryctes koae and *Callithmysus* sp.—These two beetles exhibited by Mr. Bridwell. He had collected them recently on Mt. Kaala. The *Callithmysus* was a very large species and was taken on *Broussaisia.* It was recognized by Mr. Swezey as the same species of which he had taken a specimen on ohia last year on Mt. Kaala.

Carabid.—Mr. Bridwell reported having taken more specimens of a moss-inhabiting species previously collected by him on Mt. Kaala.

Nesosydne gunnerae.—Mr. Bridwell reported recently finding this leafhopper abundant at the same place where it had been formerly collected on Mt. Kaala. It was most abundant on the partly dead leaves of its host-plant, *Gunnera.*

Proterhinus sp.—A golden-colored species exhibited by Mr. Bridwell, taken recently by him on *Clermontia,* and probably a new species.

Lycaena boetica in pigeon peas.—Mr. Swezey reported that of 233 pods of pigeon peas gathered in his garden in Kaimuki, 44 pods, or 18.88%, contained one or more peas destroyed by the larvae of this butterfly. A count of the seeds in these pods gave 985 good peas, and 69 that had been destroyed, or 6.54%.

Coptotermes sp.—A stalk of sugar cane quite badly honeycombed by this termite was exhibited by Mr. Swezey. It was the first instance of termites damaging sugar cane in Hawaii. A few stools of cane had recently been found attacked in a field on the peninsula in Pearl Harbor below the R. R. station at Waipahu. This is the same termite which was found so abundant in the floor timbers of the Chapel at the Kamehameha School in 1913, and the following year in the band stand and flag pole at the Capitol grounds; also in the Alakea street wharf. The species has not yet been determined.

Kelisia swezeyi.—Reported by Mr. Bridwell from the lower slope of Mt. Kaala. The first record of this Delphacid from the Waianae Mountains.

Potato mite.—Mr. Bridwell reported that Mr. Carpenter of the Agricultural Experiment Station had found that sulphur dusted onto potato plants was quite successful in combating this pest.

PAPERS.

Notes on the Habits of Brosconymus optatus Sharp (Carabidae).

BY J. C. BRIDWELL.

The genera *Derobroscus* and *Brosconymus* were described* from eight specimens collected by Dr. Perkins in the mountains of Oahu and I have been unable to find any records of their having been taken since. Upon two occasions while in company with Mr. Timberlake it has been my good fortune to take what I take to be *Brosconymus optatus* in considerable numbers. The locality in which it was found is somewhat out of the range of Dr. Perkins' collecting grounds.

The trail which leads up from Leilehua to the summit of Mount Kaala in the Waianae Mountains ascends a lateral spur at right angles to the main ridge, the initial sharp ascent ending at about 2500 feet in elevation and for a mile or more the ascent is much more gradual, the ridge joining the main mass of the mountain at about 3500 feet. Along this ridge the ohia lehua (*Metrosideros polymorpha*) trees have their trunks covered with mosses and on their branches from six to eight feet from the ground are mats of moss of several species but principally of two species, one pale green, erect and densely matted together, the other dark green, branched and in loose mats. While *Brosconymus* was occasionally found among the

* Sharp, Fauna Hawaiiensis 3:197-9 and 290, 1903.

mosses on the trunks of the trees, their usual and apparently proper habitat seemed to be on the moss-mats on the branches, for here were to be found both larvae and pupae.

These moss-mats furnish food for a number of lepidopterous larvae, among them *Scoparia bucolica* and *Scoparia dactyliopa* and a new and as yet undescribed species of *Mestolobes*. Other lepidopterous larvae also shelter themselves in these mats either in intervals of feeding or for moulting and pupation. It is probable that these form the major part of the food of these beetles and their larvae.

Adults showed surprising hardiness upon being brought down into the summer temperatures of the coast region, remaining alive with but little attention from late July until the end of September in moss enclosed in a tightly covered tumbler, devouring ant larvae and pupae placed with them. The pupae brought down, however, were not very successful in completing their transformation.

Brosconymus optatus is described as lacking prothoracic setae and this is true of a few of the individuals taken, but the great majority of about a hundred taken have a seta on the posterior angles.

In this connection it is perhaps worth while to record taking several individuals at various times of the closely related *Derobroscus politus* from the type locality on Lanihuli Ridge in the Koolau Mountains and from the parallel ridges bounding the adjacent Kalihi and Nuuanu valleys. Part of these were taken in small moss-mats and others in small cavities in low dead trees.

Notes on Hawaiian Prosopidae.

BY D. T. FULLAWAY.

These notes are based upon an examination of the large collection of bees belonging to Mr. W. M. Giffard, who, as is well known, has been an indefatigable collector of insects for years, paying special attention in his collecting to the Aculeate Hymenoptera. Of the 60 described species and varieties of native bees, 49 are represented in the collection, most of them by fine series. Oahu forms are complete, only two are missing out of the large number found on the island of Hawaii, with Maui and Kauai not so well represented. The principal result of this examination has been the accumulation of data on distribution and variability which tends to weaken the value of certain species in groups of closely related forms. Owing to the contradictory nature of some of the evidence, however, it is considered inadvisable to go further than to point out certain well marked duplications. An attempt has also been made, with some success, to match up forms represented by but one sex. Novelties, at this date, were hardly expected, but a few have turned up, notably the much-sought male of *rugulosa*. Altogether, it is believed considerable is added to our knowledge of the bees. Acknowledgment is gratefully made of help received from Dr. R. C. L. Perkins.

SIMPLEX—*loc. rec.* Hilea, Kau, many specimens. Honuapo, 2. Kilauea-Honuapo auto road, 1.

LAETA—*loc. rec.* Hawaii, Kau lava flows, many. Kilauea, several.

KONA—*loc. rec.* Kilauea and Kau. Not common.

RUGULOSA—Two specimens, taken on different occasions, are referred to this. Both bear tags in Dr. Perkins' handwriting indicating their peculiarity but without attaching a name. The type of *rugulosa* is not available but these specimens ap-

proach the description closely. A peculiar unique is believed to be the ♂. It is described as follows:

Male black, only the anterior face of the front tibiae, as usual, and the front tarsi a dull orange yellow, and the flagellum of the antennae dull reddish beneath. Face a trifle broader than long, not convex longitudinally, moderately emarginate behind, dull, front roughly rugulose, fairly closely but not deeply punctate, clothed with pale hairs, smoother alongside the antennal fossae, where there is a well marked depression, the clypeus with rather large punctures towards the apex, cheeks very short, the base of the mandibles nearly touching the eye, the supraclypeal plate wide and short, the anterior margin nearly twice as long as the lateral, antennal scape strongly dilated though evidently longer than wide, posterior margin strongly curved, anterior margin straight, punctate above, arched beneath. Mesonotum and scutellum dull but not excessively so, and even with a faint sheen in certain lights, the former with a microscopically fine surface sculpture and shallowly though fairly closely punctate, the latter somewhat more deeply and closely pitted and both clothed with pale silvery hairs. Propodeum rugose, the anterior area with an irregular network of wrinkles extending to the brow. Abdomen more or less dull, the wings of the 7th ventral segment rather wide as in *assimulans* and the process of the 8th ventral segment expanded at the bend, the upper arm fairly long with a fringe of long hairs above and bifurcated outwardly somewhat as in *coniceps*. Wings clear.

VICINA—*vicina, koae* and *connectens* appear to be closely related forms. Is there not ground for considering only one species present? The complex has a representative on each island in the group. Kauai, Oahu, Molokai and Maui examples are brighter than the Hawaii ones, but the genitalia are uniform throughout, confirming the closeness of the relationship. It is impossible to separate *koae* and *vicina* for instance on the presence or absence of yellow markings on the supraclypeal plate and hind tibiae when Kauai examples resemble the Hawaii ones, with Oahu, Molokai and Maui examples different.

UNICA—*unica, laticeps* and *kauaiensis* form another complex similar to the preceding.

NEGLECTA—*neglecta=haleakalae.*

COMES—bears a strong resemblance to *coniceps*. I have not material to compare the genitalia.

CONICEPS—A common form at Kilauea. As the descrip-

tion in the Fauna is very meagre in details, I redescribe it below:

♂ black, the clypeus however with the exception of a narrow strip along the anterior margin and a wider area along the lateral and posterior margins, also somewhat produced triangular markings laterally outside the clypeus, the anterior tibiae in front and the posterior ones narrowly at the base yellow; tarsi reddish brown. Dull, the head emarginate behind, the face fairly wide, closely and rather deeply punctate above the antennae, with a very evident plaga immediately behind the antennae, supraclypeal plate a little wider than long, cheeks extremely short, scape of antennae dilated but nearly twice as long as wide, hind margin somewhat curved, anterior margin almost straight, arched beneath. Mesoscutum and scutellum rugulose, shallowly and not too closely punctate, propodeum finely rugose and wrinkled anteriorly. Wings somewhat infuscate. Abdomen brighter than the head and thorax but hardly shining, the wings of the 7th ventral segment narrow, short and slender, process of the 8th ventral segment short and slightly curved, greatly expanded above, the expansion fringed with long hairs; the bifurcations also expanded with the surfaces clothed and the edges fringed with fairly long hairs.

Described from a specimen authenticated by Dr. Perkins.

♀ referred to this ♂ black throughout and brighter than the ♂, shining. Head deeply emarginate, closely and deeply punctate above the antennae, the punctures rather coarse, becoming finer near the center, supraclypeal plate short and wide, clypeus rugulose, shallowly but not finely punctate, mesoscutum and scutellum finely rugulose, evenly and closely punctate, the punctures sparser on the latter. Propodeum finely rugose and wrinkled anteriorly. Abdomen fairly smooth and shining. Wings infuscate with pronounced bluish reflections.

DUMETORUM—common at Kilauea.

SPECULARIS—considered the ♀ of *homeochroma* on the strength of their similarity and having been taken together on several occasions.

DIMIDIATA—2 ♂♂ and 1 ♀ specimens taken at Kahuku, Kau, are referred to this. These forms are certainly rightly associated, but the ♀ does not conform to the description in Fauna Hawaiiensis, and it is believed the original association was wrong. The Kahuku specimen is described as follows:

Female black with two yellow lateral spots, an interrupted thin yellow line on prothorax posteriorly, yellow tubercles and the base of the front and middle tibiae narrowly and the hind tibiae rather widely yellow banded. Head wide and of moderate length, fairly thick, emarginate be-

hind and slightly convex longitudinally, the face dull, microscopically rugulose and shallowly and remotely punctate on the front. Mesonotum and scutellum dull but with a faint sheen, microscopically fine surface sculpture, the former very shallowly and remotely punctate, the latter shallowly but more closely punctate, the punctuation inconspicuous in both cases. Propodeum microscopically rugose with a few short longitudinal wrinkles at the anterior margin. Abdomen a little brighter than the thorax, especially the 1st segment. Wings clear.

BLACKBURNI—*loc. rec.* coast of Lanai, 2 ♀ ♀.

LONGICEPS—*loc. rec.* Makapuu, Oahu, 1 ♂ 3 ♀ ♀. Lanai specimens with yellow spot on labrum. Oahu ♂ with yellow spot near apex of scape.

OBSCURATA—*loc. rec.* Kawaihae, Kohala, 3 ♂ ♂, 1 ♀. Kilauea, 2 ♂ ♂.

FLAVIPES=*blackburni*. *Loc. rec.* Honuapo, Hilea, Kau, many specimens.

HILARIS—*loc. rec.* Molokai, one specimen.

SATELLES—*loc. rec.* Iao Valley, Maui, 1 ♀.

FILICUM—occasionally with an interrupted yellow line on prothorax.

The following descriptions are to amplify and complete those in Fauna Hawaiiensis.

Nesoprosopis vicina.

♂ black, the clypeus however with the exception of a narrow strip along the anterior and lateral margins, the anterior part of the supraclypeal plate, anterior tibiae in front and posterior tibiae narrowly at the base yellow. Face fairly long, dull, finely rugulose, closely and rather shallowly punctate above antennae, supraclypeal plate a trifle wider than long—to antennal fossae, cheeks rather short, antennal scape dilated but much longer than wide, posterior margin curved, anterior almost straight, strongly arched beneath. Thorax dull throughout, mesoscutum finely rugulose, closely and finely punctate, scutellum closely and shallowly punctate, the punctures larger, clothed with grayish hairs, propodeum rugulose, with longitudinal wrinkles anteriorly extending almost to the brow. Abdomen shining throughout, with dark hairs at the tip. Wings clear. Wings of 7th ventral segment not very wide nor long, the process of the 8th ventral segment much expanded in the upper arm, bearing long hairs outwardly, the bifurcations also expanded and very hairy.

♀ black throughout, head and thorax and the abdomen except at the posterior margin of the segments, dull. Head emarginate behind, clothed with pale hairs, closely and finely punctate above the antennae, clypeus also punctate and a trifle convex, supraclypeal plate short and wide, mesoscutum closely and finely punctate, scutellum finely punctate but not so closely, propodeum with rather short longitudinal wrinkles. Wings clear.

N. flavipes.

♂ with the whole face below the antennae yellow, the marking being continued up the side of the face along the eye margin as a broad vitta, often a yellow spot on the scape outwardly and the labrum and prothoracic tubercle yellow, all the tibiae and tarsi likewise yellow, the middle and anterior tibiae however with a black spot behind and the posterior tibiae incompletely banded with black. Face longer than wide, not at all convex, the cheeks between the eyes and mandibles short, scape of antennae hardly dilated, more than twice as long as wide, gently arched beneath, the supraclypeal plate not much longer than wide, head above the antennae hardly shining but not altogether dull, rather coarsely rugulose and fairly closely, irregularly, shallowly and not too finely punctate. Mesoscutum and scutellum dull, probably more so than the head, mesoscutum with the surface finely rugulose and rather regularly, closely shallowly and finely punctate, scutellum a little more shining, the punctures of larger diameter and not so regular. Propodeum rugose with a few rather long wrinkles at anterior end. Abdomen not so dull as the thorax, finely rugulose, the 1st segment especially smooth. Wings slightly infuscate. Wings of the 7th ventral segment narrow and short, the process of the 8th ventral segment expanded at the flexure, the bifurcations turned upward.

♀ entirely black, only the front of the anterior tibiae and the under side of the flagellum reddish yellow, shining but not highly polished, sculpture of the head distinct, the punctures large but shallow, the punctuation of the mesoscutum and scutellum regular, close and fine, the punctures a trifle larger on the scutellum and not so close together, propodeum rugose and much wrinkled anteriorly, abdomen fairly smooth. Wings clear.

N. anomola.

♂ black, the face marked with yellow on the clypeus anteriorly and (sometimes) on the supraclypeal plate, also two fairly wide yellow vittae along the orbital margin extending beyond the antennae, the mandibles also bear yellow markings, the antennal scape is orange red as is also the under side of the flagellum, there is a complete thin yellow line on the prothorax, the legs also are orange red with the exception of the coxae and sometimes with fuscous markings, and abdominal segments 1, 2 and 3 (sometimes) are orange red at the base. Head and thorax dull, the abdomen shining, head wider than long, closely and rather coarsely punctate above the antennae, supraclypeal plate with the anterior margin about as long as the lateral, the clypeus shallowly punctate bearing pale setae, the antennal scape is somewhat expanded, almost straight in front but well curved behind and arched beneath, mesoscutum and scutellum

closely, shallowly punctate, propodeum short, rugose, irregularly wrinkled in front, the entire thorax with a heavy clothing of pale brown to cinerous hairs, abdomen with a delicate surface sculpture and finely, shallowly punctured and hairy, the punctures on the 1st segment sparse, the hairs more thickly set towards apex. Wings clear. The genitalia are not much different from those of *setosifrons,* its ally.

SEPTEMBER 6TH, 1917.

The one hundred forty-fourth meeting of the Society was held in the usual place, President Potter in the chair. Other members present: Messrs. Bridwell, Ehrhorn, Fullaway, Muir and Timberlake.

Minutes of previous meeting read and approved.

Mr. D. L. Crawford was elected to active membership.

ENTOMOLOGICAL PROGRAM.

Heterospilus prosopidis.—This Braconid was reported by Mr. Bridwell, he having recovered it by sweeping in Kapiolani Park, Honolulu. It was introduced as a Bruchid parasite by Mr. Fullaway in 1910, and had not yet been known to have become established.

Bruchus pruininus.—Mr. Bridwell reported the capture of this Bruchid in Kapiolani Park, being the first record of its occurrence in the Islands.

Anthicid.—Mr. Bridwell reported collecting a strange beetle with enlarged femora in Kapiolani Park, which is probably an Anthicid.

Alphitobius diaperinus.—A large number of these beetles found in a fallen mynah bird's nest by Mr. Bridwell.

Nesosydne nephrolepidis.—The capture of this Delphacid in the Koolau Range back of Honolulu, reported by Mr. Bridwell.

Nesosydne timberlakei.—Mr. Muir reported the capture of a male specimen of this Delphacid on *Cyanea truncata* near Waiahole tunnel, August 26th.

Apterocyclus sp.—Mr. Bridwell reported that Mr. Forbes,

the botanist at the Bishop Museum, on a recent collecting tour on Kauai, had collected a number of dead specimens of this rare Lucanid beetle.

Pycnophion fuscipennis.—Mr. Bridwell also reported that Mr. Forbes collected this Ophionid on Kauai.

Megachile palmarum.—Mr. Timberlake reported that in examining collections of this bee he had separated out some which are of a different species, hitherto not recognized. This makes the fourth species of *Megachile* known here. Some specimens of it bore date of 1902; and were collected at the Government Nursery.

Alphitobius sp.—Mr. Fullaway exhibited specimens of a Tenebrionid beetle near to this genus, collected by Mr. Ehrhorn in destroying a nest of the fire ant on the waterfront.

Hormiopterus sp.—Mr. Fullaway exhibited specimens of this and another Braconid near *Eubadizon* which had been in the collections a long time without notice.

Notes on Some of the Immigrant Parasitic Hymenoptera of the Hawaiian Islands.

BY P. H. TIMBERLAKE.

During a recent visit in Washington, D. C., the writer compared certain of our introduced or immigrant parasitic Hymenoptera with types or other specimens in the U. S. National Museum. The comparisons in some cases confirmed previous determinations, but brought to light errors of identification in other cases. The writer's thanks are due to Mr. A. B. Gahan for aid in the determination of several species.

Ichneumonidae.

Exochus femoralis (Fourcroy). A female from Honolulu (Oct. 16, 1916) was found identical with a female from

Blankenburg, Thüringen, Germany, except for a slight difference in the degree of infuscation of the head.

Hemiteles tenellus (Say). Ashmead divided our *Hemiteles* among three so-called species, namely *tenellus* (Say), *variegatus* Ashmead and *melitaeae* Ashmead. Ever since the writer became acquainted with the character of the Hawaiian fauna he had been skeptical about these determinations. It seemed improbable, to say the least, that three closely allied species should become established here, and moreover all the material that was extant in the local collections was clearly referable to a single species. A study of the *Hemiteles* in the National Museum showed that the following described forms are extremely alike and might well belong to a single species, although showing some variations in size and coloration. The list includes *tenellus* (Say), *utilis* Norton, and the following all described by Ashmead: *melitaeae, variegatus, coleophorae, orgyiae* and *periliti,* the last two under *Otacustes.* Although there may be more than one species included here it would be hopeless to attempt to distinguish more than one by means of any descriptions so far published, and until the genus receives a thorough revision at the hands of a competent specialist, the writer recommends that the earliest American name, or *tenellus* (Say), be used for our Hawaiian parasite. In his work on the Hymenoptera of Connecticut, Viereck goes one step further and makes *tenellus* a variety or subspecies of the European *areator* (Panzer). This parasite has been reared frequently in the Islands from the cocoons of *Chrysopa microphya* McLachlan. It is probably distributed on all of the Islands, as the writer has seen it from Kauai, Oahu and Hawaii.

Angitia polynesialis (Cameron). Viereck's species *plutellae* and *hellulae* are synonymous with Cameron's *polynesialis.* Viereck separated his two species on the presence or absence of yellowish markings on the sides of the abdomen. Hawaiian specimens usually have the yellowish markings and are thus identical with the types of *hellulae.* Such specimens

have been reared in the United States from *Plutella maculipennis* Curtis and this is the usual host here. It is also not unlikely that this species occurs in Europe and an earlier name may possibly be found for it.

Braconidae.

Ephedrus incompletus (Provancher). Our *Ephedrus* was determined by Mr. Gahan as Provancher's species. It has been reared by the writer from a green species of *Macrosiphum* on rose bushes at Honolulu, and Mr. Swezey obtained it from the same host at Wailuku, Maui, on June 18, 1916. This species seems to have been first collected by Dr. Lyon on April 18, 1914, on the same host.

Diaeretus chenopodiaphidis (Ashmead). Our species of *Diaeretus* is not *rapae* (Curtis), but Ashmead's species which is chiefly distinguished by having 13 antennal joints in the female and 16 in the male, instead of 14 and 17 respectively, and by a slight difference in coloration and sculpture. This species has been reared from *Aphis brassicae* Linnaeus, and *Rhopalosiphum persicae* (Sulzer) from several localities near Honolulu.

Dinocampus terminatus (Nees). The writer has examined specimens of this species from Hungary; Barcelona, Spain; Palroa, New Zealand; Fiji; Okitsu, Japan; and from many localities in the United States from Massachusetts and Virginia to California and Washington. Perkins also records it from Queensland, Australia. *Perilitus americanus* Riley and *Euphorus sculptus* Cresson are synonyms, (the latter synonymy taken from a female in the National Museum which was compared with Cresson's type by Mr. R. A. Cushman). The species is extremely constant throughout its vast range, and although there is a slight variation in color this seems to be independent of its geographic distribution. In the Hawaiian Islands it was probably introduced with *Olla abdominalis* (Say) from North America, but it now usually attacks *Coel-*

ophora inaequalis (Fabricius). It does not seem to be nearly so common here now, as it was when Perkins first found it.

Apanteles sp. According to Mr. Gahan, our banded-winged *Apanteles* is entirely distinct from any known North American species. The species was first taken in 1911 at Honolulu, unless it is one of those mentioned by Perkins in 1910 without name or description. Mr. Swezey has reared it from *Opogona.*

Opius sp. The small *Opius* that has been reared recently by Messrs. Swezey, Bridwell, and the writer from the Lantana *Agromyza* on Oahu was determined by Mr. Gahan as most probably a new species close to *nanus* Provancher.

Hormiopterus sp. This is another recent immigrant which has been taken in Honolulu, Palolo, Niu, Kuliouou, and on Tantalus by several collectors. The first specimens examined by the writer were taken by Mr. Swezey in 1914.

Pteromalidae.

Pachyneuron siphonophorae (Ashmead). This species is readily recognized in the female sex by having three ring-joints and only five funicle joints. Mr. A. A. Girault has recently erected a new genus or subgenus, *Propachyneuronia,* for this species, but it is hardly worth recognition as the male sex does not show the supposed generic character. He has also synonymized *Pachyneuron micans* Howard and *P. aphidivorum* Ashmead with it, the latter incorrectly, as Mr. Gahan's notes on the types, taken when they were in a better state of preservation than at present, show that *aphidivorum* has only two ring-joints.

This species is hyperparasitic in Aphidids, and with us attacks both *Ephedrus incompletus* and *Diaeretus chenopodiaphidis.* It has been found at or near Honolulu, and at Wailuku, Maui, by Mr. Swezey.

Pachyneuron syrphi (Ashmead). This species was reared

from a puparium of *Xanthogramma grandicorne* Macquart, from the plantation of the Oahu Sugar Company in April, 1904, by F. W. Terry. Apparently it is not common here. In the United States it has a wide range of Syrphid hosts, apparently all aphidivorous or coccidivorous species however, and is widely distributed. It is a primary parasite of the Syrphids and in consequence beneficial to the Aphidids and inimical to man.

Mr. Girault has synonymized this species with *albutius* Walker, but the recognition of Walker's species is extremely doubtful from the descriptions alone. Mr. Girault's recent synopsis of the North American species of *Pachyneuron* is marred by too much reliance being placed on colorational characters, and does not prove to be very helpful in the identification of the species.

Encyrtidae.

Encyrtus infelix (Embleton). This is the species which was wrongly determined by Ashmead as *Encyrtus fuscus* (Howard). *Infelix* is a widely distributed species parasitic on *Saissetia hemisphaerica* (Targioni). The writer has seen it from Edinburg, Scotland; South Kensington, England; Torto, Portugal; and San Francisco and Sacramento, California. Masi has recently recorded it from the Sychelles Islands.

Blepyrus mexicanus Howard. The writer is unable to distinguish the three species of *Blepyrus* described by Howard, after a careful comparison of the types with a large series from Honolulu. *Mexicanus* was described from Monterey and was reared from a host said to be *Ceroputo yuccae* (Coquillett). The host remains mounted with the types, however, show the long, glassy filiaments so characteristic of *Pseudococcus virgatus* (Cockerell) and an error of identification is evident. *Texanus* was described from Brownsville, Texas, and the recorded host is *P. virgatus* which is definitely known to be the only host of *Blepyrus* here, described by Howard under the name of *marsdeni*. *Coccophoctonus dactylopii* Ashmead is

another synonym of *Blepyrus mexicanus*. Ashmead recorded his species from Australia and cited an undetermined *Pseudococcus* as the host. The eleven type specimens, however, are labeled Honolulu and bear the same Insectary No. (of the U. S. Department of Agriculture) and date as Howard's types of *marsdeni*, so that undoubtedly both series were reared from the same lot of material.

Aphelinidae.

Prococcophagus orientalis (Howard). Our abundant, small, banded-winged Coccophagus-like parasite of Lecaniine scales, seems to be altogether too close to Howard's species for separation. The usual size of our specimens is nearly twice that of the types and the coloration of the pleura and legs is blacker. The types, however, are evidently undersized specimens, and have been considerably bleached by the action of alcohol in which they were preserved at some former time. The species has been recorded in the local literature variously as *Coccophagus orientalis*, *Aneristus* sp. and *Aneristus ceroplastae*. It seems to agree very well with Silvestri's conception of *Prococcophagus*, and is kept out of *Aneristus* by the absence of well developed bristles on the hind tibiae.

This is one of our most efficient coccid parasites, and has a wide range of hosts. It is extremely active, and carries the abdomen tilted upward.

Figitidae.

Eucoilidea micromorpha Perkins. This is clearly congeneric with Ashmead's genotype species, and is distinct from any of the species in the National Museum. It is parasitic in the puparia of *Agromyza pusilla* Meigen and has a wide distribution on Oahu, chiefly in the lowlands.

OCTOBER 4TH, 1917.

The one hundred forty-fifth meeting of the Society was held in the usual place, Vice-President Pemberton in the chair. Other members present: Messrs. Bridwell, Crawford, Ehrhorn, Fullaway, Giffard, Muir, Timberlake and Willard; and Mr. Robert Veitch of Suva, Fiji, visitor.

Minutes of previous meeting read and approved.

ENTOMOLOGICAL PROGRAM.

Mr. Giffard exhibited two boxes of Delphacids and Fulgorids collected by him in California, during certain months of 1916. There were many new species. The collection was worked up by Mr. Van Duzee of the California Academy of Sciences and will be published elsewhere.

Lerp-forming Psyllid.—Mr. Ehrhorn exhibited specimens of a lerp-forming Psyllid from Australia.

Mr. Veitch spoke of the principal sugar cane insects in Fiji—cane borer, root grubs and wire-worms, and of their peculiar problems and methods of control.

PAPERS.

Certain Aspects of Medical and Sanitary Entomology in the Hawaiian Islands.

BY J. C. BRIDWELL.

[Withdrawn for publication in Report Hawaiian Medical Association, 1916-1917.]

Two New Species of Nesosydne (Delphacidae).

BY F. MUIR.

Nesosydne phyllostegiae sp. nov.

♂ Vertex slightly longer than broad, apex rounded; length of face twice the width, slightly widened in the middle; median carina furcate near base; antennae reaching well beyond base of clypeus, second joint

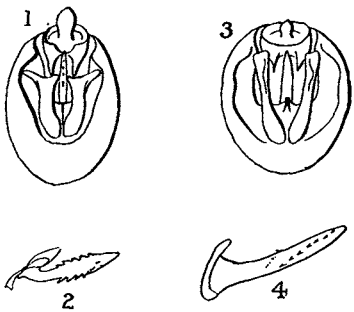
nearly one and one-half times the length of first (1.4); hind tibia longer than the tarsi, first tarsal joint slightly longer than the other two together. Tegmina reaching to the base of pygophor.

Green to yellowish brown in fresh specimens, the green turning yellowish and the yellow turning reddish in old specimens; infuscate between carinae of head, on pleura, coxae and over most of the abdomen. Tegmina hyaline, yellowish or greenish, veins concolorous with membrane with a few small granules bearing black hairs, a small dark mark at the apex of clavus and another at the apex of costal cell.

Genitalia figured (figs. Nos. 3, 4). The armature on the diaphragm below the aedeagus is produced into two curved spines; anal spines small, wide apart.

Length 2.5 mm.; tegmen 1.5 mm.

♀ Similar to male but the average color is lighter, some specimens being with little or no infuscation.



EXPLANATION OF FIGURES.

Figure 1. *Nesosydne cyrtandricola,* full view of pygophor.
2. *N. cyrtandricola,* lateral view of aedeagus.
3. *N. phyllostegiae,* full view of pygophor.
4. *N. phyllostegiae,* lateral view of aedeagus.

Hab. Puuwaawaa, North Kona, Hawaii, 3700 feet elevation; a long series of both sexes and young feeding on *Phyllostegia racemosa* Benth. (W. M. Giffard). There are two fairly distinct series including both sexes, one with the ground color light green, the other light brown or yellow. The aedeagus shows relationship to *N. cyrtandrae* but the genital styles are quite distinct. Type deposited in the collection of the H. S. P. A. Experiment Station.

Nesosydne cyrtandricola sp. nov.

♂ Vertex longer than wide, length of face 2.5 times the width, slightly narrowed between the eyes, the sides subparallel, median carina furcate about one-third from base; antennae reaching beyond the middle of the clypeus, second joint 1.7 times the length of first; first joint of hind tarsi distinctly longer than the other two together.

Light green, a fuscous or black line between the carinae of face, clypeus, genae and thorax; pleura and first and second legs (especially the tibiae) light fuscous, hind legs with a longitudinal line along femora and tibiae, the tarsi fuscous; pygophor and styles dark brown, a few fuscous marks or spots along the medio-lateral line of abdominal tergites. Tegmina hyaline, yellowish, a small dark mark at apex of costal cell and dark along the costa, a larger dark mark at apex of clavus which spreads out over the middle of the tegmen, becoming lighter as it reaches the radius where it reaches to near the apex and to near the base; veins thick, especially the radius, with minute granules bearing black hairs, apical veins and border light.

Genitalia figured (figs. Nos. 1, 2). Armature of diaphragm forming a thin, small, perpendicular plate below the aedeagus.

Length 2.6 mm.; tegmen 1.5 mm.

♀ Similar to male but somewhat lighter, the ovipositor brown.

Length 2.9 mm.; tegmen 1.7 mm.

Hab. Glenwood, Olaa, Hawaii, 2300 feet elevation; a long series of both sexes and young from *Cyrtandra* sp. Also some young reared to adults on *Charpentiera obovata* Gaud. (W. M. Giffard). The young nymphs are light green, later acquiring dark marks similar to the adults. This species comes near to *N. anceps* but is quite distinct. Type deposited in the collection H. S. P. A. Experiment Station.

Notes on Delphacids Collected on a Short Visit to Portions of the Intermediate Forests in Olaa and in North and South Kona, Island of Hawaii.

BY WALTER M. GIFFARD.

During the latter part of August, 1917, I had occasion to make a very hurried visit by automobile from Kilauea to Puuwaawaa, North Kona, Hawaii, via the belt road through the districts of Kau and South Kona. Accompanying me were

Prof. J. F. Rock of Honolulu and A. Holm of San Francisco, who were botanizing and collecting seeds from our indigenous forest trees for the Golden Gate Park in San Francisco. Our stay of one and one-half days at Puuwaawaa was quite too brief for systematic collecting of the insect fauna of that interesting region and I therefore utilized the few hours at my disposal searching for Delphacids and other Homoptera and such Heteroptera and Coleoptera as could be incidentally captured. The rough nature of this region, covered as it is with old lava flows of the a-a type, makes very slow walking or riding and by the time the interesting forest region is reached much of the day has been wasted getting there, and even then due to loose scoria it is most difficult walking and collecting amongst the sparse vegetation. Much of the latter, including the lower foliage of the trees, has been destroyed of late years by cattle and very many of the trees themselves destroyed by continuous drought and from other causes. A full week or ten days insect collecting in these forests would undoubtedly produce very satisfactory results but due to the limited time at my disposal (five hours in all of actual collecting) I endeavored to confine myself to the Delphacids none of which had as yet been recorded from this particular region in the district of North Kona. As a result only one new species (*Nesosydne phyllostegiae*) was collected, but several new food plants of certain known species of Delphacids were found which in itself was well worth the trip. These latter and the fact that a series of *Aloha swezeyi* was captured for the first time on any other island than Oahu, will be referred to in detail in the accompanying field notes. Incidentally, I believe this to be the third species of the Genus *Aloha* taken on the Island of Hawaii.

Before returning to Hilo from Kilauea a portion of the "inside" forests located at 29 Miles (so-called) about two miles north of the Volcano House, were visited for a few hours but nothing of any special importance not already published was captured. Due to a protracted drought in the neighborhood of Glenwood and "25 Miles" (so-called) Olaa, much interesting

data as to the insects of this almost continuously wet region might have been gathered had it been possible for me to remain at Kilauea for a sufficient length of time. As it was I was able to visit and collect at these latter places for a few hours on two separate days with satisfactory results. Besides the discovery of one new species of Delphacid (*Nesosydne cyrtandricola*) the hitherto unknown food plant of the single male *N. anceps* taken by Muir in 1915 was found to be *Freycinetia arnotti* (ieie vine). A good series of both sexes of the last named Delphacid was taken. Undoubtedly the absence of moisture overhead and on foot in the boggy forests of this region would have produced much better collecting had I been able to stay over another week, as insects in general were more plentiful there at the time than I had ever found them on previous visits, which were always attended by more or less precipitation and consequent inability to properly collect.

I am indebted to my friends Messrs. Muir and Rock for assistance, by the former in the determination of the Delphacids collected and by the latter of the food plants.

Following are the detailed field notes* covering certain of the species taken during the visits referred to, viz.:

Leialoha lehuae hawaiiensis Muir. Olaa 29 miles (Nos. 7 and 30. Long series males and females off *Metrosideros polymorpha* var. *incana* (Ohia lehua). Also reared a number of adults from nymphs on the leaves of this food plant. One male (No. 44) Olaa 25 miles, 3000 ft. elev., off *Platydesma* sp. Probably this was an accidental capture although no ohia was growing in this particular section of forest.

Nesodryas dryope Kirk. Glenwood 22 miles, 2300 ft. elev. (Nos. 26, 34 and 38) 12 males and 3 females off *Antidesma platyphyllum.*

Nesodryas maculata Muir. Kapua, South Kona, 2000 ft.

*Numbers refer to writer's field notes.

elev., near main road. Long series males and females (No. 9) off *Maba sandwicensis.*

Aloha myoporicola Kirk. Puuwaawaa (Waihou) N. Kona, 3700 ft. elev., 2 males and 2 females and nymphs (No. 14) off *Myoporum sandwicense* var. *seratum;* one male and one female (No. 11) ex *Phyllostegia racemosa* and 1 adult (No. 19) ex *Acacia koa* (no *Myoporum* near, both are possibly accidental captures); at Huehue, N. Kona, 1800 ft. elev., 12 males and 5 females (No. 10), all typical, off *Myoporum sandwicense.*

Aloha swezeyi Muir. Puuwaawaa (below Waihou) N. Kona, 3000 ft. elev., 10 males, 5 females and nymphs (No. 17) ex *Cheirodendron gaudichaudii.* Puuwaawaa hill, N. Kona, 3800 ft. elev., 8 adults and 3 young, including 2 macropterous females (No. 20), off the lower branches of *Anona cherimolia* under which and almost touching were a mixture of weeds including *Bidens pilosa, Verbena bonariensis* and *Erigeron canadense.* At same spot 2 males and 5 females with 2 nymphs (No. 20a) were taken off the mixed weeds above mentioned. In same locality on a large area where there were no trees or shrubs but only large patches of dwarf *Bidens pilosa* growing amongst immature and almost dry Bermuda grass, 3 males and 4 females and nymphs, including 1 macropterous female (No. 21) were taken. The macropterous form was not previously known and the species has hitherto been taken only on Oahu viz.: in Palolo Valley and on Tantalus. In North Kona it is evidently attached to the obnoxious weed *Bidens pilosa* and *Cheriodendron gaudichaudii,* but unfortunately I had no opportunity to rear any of the nymphs taken. On Oahu, Timberlake has taken series of both sexes off *Campylotheca macrocarpa* and Swezey one male off *Lythrum* sp., which latter may have been accidental.

Nesosydne koae Kirk. Puuwaawaa (Waihou forest) N. Kona, 3700 ft. elev., 2 males and 1 female (No. 16), sweeping young leaves sprouting from large roots of *Acacia koa.* Olaa 25 miles, 3000 ft. elev., 1 female (No. 44) sweeping. Olaa 29

miles, 4000 ft. elev., 5 females (No. 5) off *Acacia koa* (phyllodia only).

Nesosydne rubescens Kirk. Puuwaawaa hill, N. Kona, 3800 ft. elev., 2 adults (No. 20) off *Anona cherimolia* growing under tall koa trees and 2 adults and nymphs off phyllodia of *Acacia koa.*

Nesosydne rubescens var. *pulla* Muir. Puuwaawaa, N. Kona, 3700 ft. elev., 3 specimens (Nos. 15 and 19) off phyllodia of *Acacia koa.* Olaa 29 miles, 4000 ft. elev., 3 adults (No. 5) off phyllodia of *Acacia koa* and several specimens (No. 2) from *Broussaisia pellucida* and *Cyrtandra* sp. growing below koa trees. Olaa 25 miles, 3000 ft. elev., several nymphs (No. 48) off *Platydesma companulata,* one male of which was reared from this latter food plant.

Nesosydne pseudorubescens Muir. Olaa 29 miles, 4000 ft. elev., 2 adults (No. 6) off *Clermontia parviflora.*

Nesosydne anceps Muir. Olaa 25 miles, 3000 ft. elev., 4 males and 4 females off *Freycinetia arnotti* (ieie vine). This species was only known by one male before; the female is similar to the male and both show the usual range of coloration, the thorax being either dark or light. Hitherto the food plant for this species was unknown.

Nesosydne blackburni Muir. South Kona on main road at 1400 ft. elev., 7 males and 15 females and nymphs (No. 23), a dark form, off *Charpentiera obovata.* Two of the nymphs were later on reared to maturity on leaves of this tree. At Glenwood, Olaa, 2300 ft. elev., 1 male (No. 33) off *Strongylodon lucidum* (Nukuiwi vine) and 2 males and 6 females and nymphs, dark form (No. 36), off *Touchardia latifolia.* In the inside forest at Olaa 29 miles, 4000 ft. elev., 3 males, 1 female and nymphs (No. 31) off *Clermontia parviflora.* This makes up to the present 7 food plants recorded from which large or small series of this species have been taken on the island of Hawaii.

Nesosydne ipomoeicola Kirk. Puuwaawaa, N. Kona, 3700 ft. elev., 1 male and 10 females and nymphs (No. 13) off *Lythrum maritinum* sparsely distributed amongst cover of weeds, also 20 males, 16 females and nymphs (No. 22) in a large sparsely covered area of the Lythrum and Bermuda grass at somewhat higher elevation. These are all of the light form similar to that taken on *Sadleria* at Kilauea. In S. Kona along the main road at 1600 ft. elev., 2 males (No. 24) off *Gouldia elongata.* At Glenwood, Olaa, 3 females and 3 young (No. 27) off *Antidesma* sp. and *Cyrtandra* sp. mixed. Also a long series of both sexes (18 males and 19 females and nymphs), all dark forms (No. 33), off *Strongylodon lucidum* (Nukuiwi vine). Later 1 male was reared on leaves of the latter vine.

Nesosydne phyllostegiae Muir. Puuwaawaa (Waihou forest), N. Kona, at 3700 ft. elev., 8 males, 21 females (greenish in color) (No. 11) with a few nymphs off *Phyllostegia racemosa.* This proved to be a new species and has just been described by Mr. Muir.

Nesosydne cyrtandricola Muir. Olaa 25 miles, 3000 ft. elev., and Glenwood, Olaa, 22 miles, 2300 ft. elev., 18 males and 9 females together with nymphs (Nos. 27, 37, 39 and 43) off a tall and branching species of *Cyrtandra* as yet not described. Several nymphs were later on reared to maturity on leaves of this tree. This new species (a brachypterous form) when first captured is of a very bright green color but in the course of a few days changes to a dullish green.

Nesosydne (undetermined). Puuwaawaa, N. Kona, 3700 ft. elev., 2 females off *Coprosma cynosa* (Pilo).

NOVEMBER 1ST, 1917.

The one hundred forty-sixth meeting of the Society was held in the usual place, Vice-President Pemberton in the chair. Other members present: Messrs. Bridwell, Crawford, Ehrhorn, Fullaway, Kuhns and Swezey. Visitors: Mr. Robert Veitch and Mr. K. C. Brewster.

Minutes of previous meeting read and approved.

Mr. Swezey proposed the name of Francis X. Williams for active membership in the Society.

ENTOMOLOGICAL PROGRAM.

Bruchus pruininus.—Mr. Bridwell presented some observations on this weevil, which he has found infesting the seeds of *Leucaena glauca.*

Heterospilus prosopidis.—Mr. Bridwell gave some notes on this Braconid and gave it as his opinion that it was a parasite of the above Bruchid, from the fact of his collecting both of them in the same localities, tho he had not actually bred the parasite yet from the weevil.

Omiodes blackburni.—Mr. Bridwell remarked on the scarcity of the coconut leafroller at the present time.

Odynerus oahuensis.—A specimen of this wasp was exhibited by Mr. Bridwell, collected by him in Ainahau Park, Honolulu.

Euscelinus sp.—A specimen exhibited by Mr. Bridwell, collected in Honolulu.

Bostrychid.—A specimen of a hitherto undetermined Bostrychid beetle was exhibited by Mr. Bridwell. A small species with red marking on the elytra.

Gelechia gossypiella.—Mr. Swezey exhibited specimens of the pink boll worm bred by Mr. Giffard in September of this year, from fruits of *Hibiscadelphus hualalaiensis* collected by Mr. J. F. Rock at Puuwaawaa, Hawaii. Mr. Rock reported

the seeds to have been very badly infested. This is the first record of this insect in seeds of this native tree, altho Mr. Rock had previously reported its seeds badly eaten by some Lepidopterous larvae.

Colobicus parilis.—Mr. Fullaway reported the collecting of two specimens of this beetle.

Passer domesticus.—Mr. Fullaway reported having observed the English sparrow picking mealybugs from the leaves of poinsettia.

PAPERS.

A Note on Euxestus minor.

BY F. MUIR.

The insect described by Dr. Sharp as *Euxestus minor* (Fauna Hawaiiensis, III, p. 415) is stated by Arrow to be the same as *E. parki* Woll., which was first described from Madeira and now recognized by Arrow from China, Burma, Malay Peninsula, Philippine Islands, Java, Hawaii, Haiti and Central America (vide Ann. Mag. Nat. Hist., (8) 20, p. 138, 1917).

Homopterous Notes II.*

BY F. MUIR.

[Presented by O. H. Swezey.]

The material dealt with in these notes are two small collections, one kindly loaned to me by the American Museum of Natural History, New York, and the other by Prof. H. Osborn, and a few specimens belonging to the collection of the Hawaiian Sugar Planters' Association, Honolulu.

Measurements are from apex of head to anus and from

*Homopterous Notes I was published in Proc. Haw. Ent. Soc., III, 4, p. 311, 1917.

apex to base of one tegmen; colors are according to the Ridgeway standard.

The more one works upon the Fulgorids the more one is convinced of the necessity of using the genitalia for specific distinction. Unfortunately these characters are seldom mentioned by describers, except in one group of the Delphacidae, and in a great many instances the sex of the insect being described is not mentioned, or it is wrongly mentioned. There are good characters in both sexes for dividing the Homoptera into groups, and even among the Fulgorids there are good group distinctions which have not yet been fully worked out.

DERBIDAE.

Genus Herpis Stål.

Herpis obscura? (Ball).

Lamenia obscura Ball, 1902, Can. Entom. XXXIV., p. 262.

The specimens I have agree with the descriptions of this species as far as the descriptions go, but they are incomplete.

Anal segment much longer than broad, gradually constricted to the middle, apex truncate, anus near apex; length of genital styles twice the width, ventral or inner margin entire, slightly convexly curved, apex produced into a broad, sharp point turned inward, dorsal or outer margin turned at right angle to disk leaving an entire, nearly straight false margin when viewed from outside, the true margin strongly convexly curved on apical two-thirds with a slender projection near the base with its pointed apex at right angles to the stem.

One pair from Cabanas, P. de R., Cuba, one female from Pinar d. Rio, P. de R., Cuba, September, 1913; also one pair from Rockstone, British Guiana, July, 1911.

My specimens of *H. vulgaris* (Fitch) is a larger insect, the genital styles are longer in proportion to the width, the apical spine more slender, the dorsal margin more angularly produced and its basal process with two apical spines.

Genus Cyclokara Muir.

In my table of genera of Derbidae* I placed *Patara* West. in Group II. Westwood's figure was not clear to me at that time, but since then I have examined allied forms from the West Indies and now see that *Patara* should have been placed in Group I, as it comes near to *Cyclokara* Muir. *Dawnaria* Distant is close to *Cyclokara*. *Patara* West. differs from both of these in having a large, flattened antenna. I place *Patara vanduzei* Ball in *Cyclokara* but the neuration is not quite typical.

C. sordidulum sp. nov.

♂ In neuration, shape of head and antennae this species is typical of the genus. Head, thorax and abdominal sternites sordid pale orange yellow, carinae of face between eyes slightly infuscate, abdominal tergites cadmium orange. Tegmina sordid yellow, opaque with waxy secretion, slightly fuscous over apical cells, veins brownish in places; wings white opaque with waxy secretion, veins brown.

Edges of pygophor straight, entire, with a small, sharp point projecting on each side of the anal segment; anal segment small, about as long as wide; styles large, broad, apex roundly truncate, ventral edge slightly convexly curved, roundly produced in middle, dorsal edge very slightly and concavely curved, with a quadrate projection on basal half.

Length 2.1 mm.; tegmen 4.5 mm.

♀ Similar to male. Anal segment very small, as long as broad; pregenital ventral plate short, posterior edge widely angularly produced, the apex of the projection turned slightly dorsad.

Length 2.2 mm.; tegmen 5.5 mm.

Hab. Porto Rico, Aibonito, Mayaguez, July, 1914. Described from five males and five females. Type in the American Mus. of Nat. Hist., New York.

Genus Persis Stål.

The following species agrees with Stål's description of the genus. It has a similar neuration but the head is much more acutely angular in profile and the shoulder keels are only represented by a ridge. It differs from *Goneokara* Muir in having the head more produced, in profile the vertex and face form an acute angle, and the tegmen is longer and narrower.

*Haw. Sugar Planters' Assn. Exp. Sta. Ent. Bull. 12, p. 43, 1913.

P. stâli sp. nov.

♂ Mikado orange, fuscous along carinae of face and a little spot over the eyes, antennae lighter, genital styles much paler, nearly white. Tegmina with the veins and an adjoining portion of membrane white or creamy white with the median portion of the cells orange-buff.

Medio-ventral edge of pygophor subangularly produced, lateral edges broadly convex; anal segment very long and narrow, suddenly constricted slightly above base then gradually widened to the truncate apex, with each apical corner produced into a point and turned ventrad, anus near apex; genital styles long, the dorsal edge near base produced into a subquadrate, flat process with a rounded process in the middle of the apical margin, beyond this the dorsal margin is entire and slightly curved dorsad, ventral edge produced into a broad, blunt spine near base, beyond which it is sinuous, widest beyond middle, the apex forming a slender point.

Length 4 mm.; tegmen 6 mm.

♀ Similar to male. Preanal segment deeply emarginate to receive anal segment; anal segment much longer than broad, anus before middle where the segment is broadest, beyond anus it narrows to apex which is deeply emarginate leaving the corners projecting as spines; pregenital plate large, longer than wide, hind margin at first gradually and then steeply produced, the middle portion forming a subconical plate.

Length 4.2 mm.; tegmen 7 mm.

Hab. Paramaribo, Dutch Guiana, August, 1911. Described from four males and five females, also one damaged female from Bartica, British Guiana, March, 1901. Type in the American Mus. of Nat. Hist., New York.

P. fuscinervis sp. nov.

♀ Head not produced so greatly as in *P. stali.* Ochraceous-orange, slightly fuscous over abdominal tergites; tegmina hyaline, opaquely white with waxy secretion, veins yellowish with fuscous patches; wings hyaline, opaquely white with waxy secretion, veins concolorous with membrane.

Pregenital plate large, posterior edge produced from sides to middle into a large plate subconicle in outline, the produced portion as long as the rest of the segment; anal segment longer than broad, anus before middle, apex produced into two fine spines with a rounded emargination between; style well developed, projecting silghtly beyond pregenital plate.

Length 2.7 mm.; tegmen 5 mm.

Hab. Bartica, British Guiana, May, 1901 (*Coll. H. S. Parish*). Described from one female. Type in coll. Prof. H. Osborn.

Genus PHACIOCEPHALUS Kirk.

Until the types of *Phaciocephalus* Kirk. and *Cenchrea* Westw. are compared there must be some doubt as to the distinction of these two genera. *C. dorsalis* Westw. is described and figured as having the subcostal cell short whereas in *Phaciocephalus* it is long. I shall retain for the present the name *Phaciocephalus* Kirk. for those forms having the subcostal cell long.

P. uhleri (Ball).

Cenchrea uhleri Ball, 1902, Can. Entom., XXXIV, p. 261.

P. sp, ?

Two female specimens from Cuba which do not agree with any description, but I refrain from naming them without having males.

P. parishi sp. nov.

♂ First claval vein joining suture before it joins second claval, clavus closed.

Mikado-orange; tegmina hyaline, opaque with waxy secretion, light fuscous yellow over costal and apical portion of subcostal cells, veins yellowish; wings hyaline, opaquely white with waxy secretion, veins concolorous with membrane.

Medio-ventral edge of pygophor produced into a quadrate plate, slightly longer than wide, apex slightly narrower than base, turned slightly dorsad; anal segment very long and narrow, anus at apex, apex turned slightly ventrad and produced into two angular points; genital styles large, gradually widening to truncate apex, ventro apical corner produced into a long, thin spine turned inward, ventral edge slightly convex with a small quadrate process near base, dorsal edge concave with a small rounded process about middle.

Hab. Bartica, British Guiana, March, 1901 (*Coll. H. S. Parish*). Described from one male. Type in coll. of Prof. H. Osborn.

P. ? *bipunctata* sp. nov. (fig. 1).

This differs from the generic type in having a shorter subcostal cell, but not very short, the media has three sectors, the first two arising very near together, the media being bent at

that spot. Pronotum with two distinct and one indistinct carinae; shoulder keels large.

♂ Light orange yellow. Tegmina hyaline, very light yellow over costal and apical cells, opaquely white with waxy secretion, a small brown spot at fork of cubitus and another near cross vein of first median sector; wings hyaline, veins concolorous, opaquely white with waxy secretion.

Ventral edge of pygophor straight, ventral surface tumid in middle, lateral edges slightly convex; anal segment long, narrow, slightly widened at apex which is bilobed, anus near apex; genital styles long, ventral edge with an angular projection near base, beyond which edge is slightly sinuous, apex rounded with a subangular projection on the dorso-apical margin, dorsal margin entire, a carina runs down the outer surface near dorsal margin, on the inner surface in middle there is a spine with a curve and somewhat flattened crook at the apex.

Length 2.6 mm.; tegmen 3.7 mm.

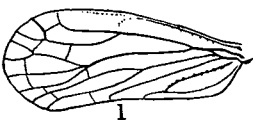


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Figure 1. *Phaciocephalus bipunctata,* tegmen.

Hab. Bartica, British Guiana, August, 1901 (*Coll. H. S. Parish*). Described from one male specimen. Type in coll. Prof. H. Osborn.

Genus Syntames Fowler.

Fowler describes *S. delicatus* from what he states to be males but they are females. The variety *chiriquensis* appears to me to be specifically distinct from *S. delicatus.*

When tabulating the genera of Derbidae* I had only a damaged specimen to examine and I placed the genus in Group I. In the two following species one has the clavus narrowly open and the other has it closed, otherwise they are congeneric with *S. delicatus.*

S. nigrolineatus sp. nov.

♀ Clavus closed, claval veins joining the suture a little before the apex. Shoulder keels large; no subantennal process; medio-frontal carina somewhat obscured towards the apex.

*H. S. P. A. Ent. Bull., XII, 1913.

Ochraceous-orange, fuscous over middle of base of face, fuscous over the lateral portions of mesothorax and continued as a broad, fuscous line down the inner half of tegmen; tegmina hyaline, light yellow, opaque with waxy secretion, veins concolorous; wings white with yellowish veins.

Pregenital sternite large, middle area tumid, medio-posterior edge produced into a semi-circular plate, the latero-posterior edge being slightly concave; styles and ovipositor well developed, reaching well beyond pregenital sternites.

Length 4.7 mm.; tegmen 6 mm.

Hab. Bartica, British Guiana, May, 1901 (*Coll. H. S. Parish*). Described from one female. Type in coll. Prof. H. Osborn.

S. sufflavus sp. nov.

♀ Clavus narrowly open, cubital veins not reaching hind margin.

Ochraceous-buff; tegmina lighter with darker veins, opaque with waxy secretion; a light fuscous mark in middle of clavus, in middle of cubital fork, near base of first median sector across to apex of subcostal cell.

Pregenital sternite large, base slightly tumid, posterior margin straight with a median portion produced into nearly a circular plate; styles and ovipositor well developed.

Length 4 mm.; tegmen 6 mm.

Hab. Bartica, British Guiana, June, 1901 (*Coll. H. S. Parish*). Described from one female. Type in coll. Prof. H. Osborn.

Genus Otiocerus Kirby.

O. schonherri ? Stål.

♂ I have not seen the original description of this species. The specimen before me is a little smaller but somewhat similar in color to *O. degeerii* Kirby. The head in profile is more slender and the apex turned slightly dorsad, the antenna has two long processes, one reaching to apex of head and the other a little shorter. Medio-ventral edge of pygophor roundly produced into a small plate, a depression runs across the base of this plate which gives the margin the impression of being entire, lateral edges roundly produced; anal segment long, narrow, apex curved slightly ventrad and rounded, anus near apex, lateral edges turned ventrad, the basal half subangularly produced; genital styles widely apart at bases, ventral edge sinuous, apex produced into a point and turned dorsad, dorsal edge entire, straight.

Hab. One male specimen from Aibonito, Porto Rico, July, 1914.

Genus DENDROKARA Melichar.

D. monstrosa Mel.

I have examined twenty males and eighteen females; in all the former the antennae are typical of *D. monstrosa* while in the latter they are typical of *D. torva*. It is possible that Melichar described *torva* from a female and not a male, and that they are the sexual forms of the same species.

Genus PLATOCERA Muir.

The distinction between *Platocera* and *Heronax* is likely to break down with the increase of specific forms, the antennae are not good generic characters.

P. rubicundum sp. nov.

♀ Face in profile not ascendingly produced as in the type of the genus; antennae as long as the face, second joint flattened, attached to first joint by the basal corner, arista at apex.

Brown tinged with red, or claret brown; rostrum, vertex and base of face and legs yellowish, abdominal sternites deeper red. Tegmina fuscous, a clear hyaline half circle on hind margin beyond clavus, another clear space on margin over median area, over costal cell and apical subcostal and radial cells, veins tinged with red.

Pregenital plate large, flattened, shield-shape, posterior margin angularly produced from sides to middle, the produced portion turned ventrad, apex with small angular emargination; anal segment fairly large, apex with rounded emargination in middle half; styles fairly well developed.

Length 4.33 mm.; tegmen 10 mm.

Hab. Bartica, British Guiana, July, 1901 (*Coll. H. S. Parish*). Type in coll. Prof. H. Osborn.

Genus NICERTA Walker.

N. cruenta Muir.

Philippine Islands; Luzon, Mt. Maquiling, Baguio; Mindanao, Davao.

This species was described from one female specimen from Amboina. I have five females and two male specimens from the Philippine Islands which I cannot separate from the

Amboina females. There is a large amount of variation in the size and intensity of the red splashes.

Genus Paraproutista Muir.

P. matsumurae sp. nov.

Pamendanga rubilinea Matsumura (not Distant), 1914, Ann. Mus. Nat. Hungary, XII, p. 297.

♂ Typical of the genus. The face is very narrow, formed of two contiguous carinae; antennae about as long as face.

Warm buff, slightly fuscous on apex of clypeus and over abdominal segments. Tegmina hyaline, opaquely white with waxy secretion, fuscous over basal third, along cubitus to hind margin and along media to third sector, from near the apex of radial cell to hind margin and along the fourth sector to its base, all the quadrate cross veins and some irregular marks at the end of veins; veins concolorous with adjoining membrane, or slightly yellowish, apical portion of sub-costal and radial veins reddish; wings hyaline, opaque with waxy secretion, veins fuscous spreading out into the membrane.

Ventral edge of pygophor very slightly convexly curved, lateral edges straight; anal segment longer than broad, slightly constricted near base, apex rounded, anus near apex, a small, transverse ridge just basad of anus; styles large, subquadrate, ventral edge strongly convexly curved near base, with a tooth about the middle, apex slightly convex, dorsal edge with a pointed process near base.

Length 3.3 mm.; tegmen 7.4 mm.

♀ In color similar to male. Pregenital plate large, longer than broad, posterior edge produced in middle into a small truncate process, with two sinuous emarginations reaching to the lateral angles.

Length 3.6 mm.; tegmen 8.6 mm.

Hab. Hokkaido, Japan, and Formosa. I have one specimen from Sapparo (det. Matsumura) and three from Horisha, Formosa (*coll. Muir*). These cannot be placed under *Pamendanga* as the face does not conform to that genus. Type in coll. H. S. P. A. Experiment Station, Honolulu.

Genus Mysidia Westw.

The facies of some of the species of this genus are very much alike and the best specific characters lie in the genitalia; unfortunately these characters have hardly been mentioned in descriptions of these insects.

M. nebulosa (Germ.).

I have specimens from Bartica, British Guiana, which agree with the descriptions of this species. The male pygophor short, mostly hidden within preceding segment, ventral edge straight, a thin projection from each lateral edge beside the anal segment; anal segment short, base hidden within pygophor, portion beyond anus roundly bilobed, a ridge running from each side of anus along each lobe to medio-apical edge; genital styles large, ventral edge curved, more strongly so on apical half, dorsal edge straight, a little beyond the middle there is a process pointing inward, flat, sub-quadrate, longer than broad with its truncate apex oblique, its plane at right angles to the plane of style.

♀ The female I associate with the above has a very short anal segment sunk within the preceding segment, the styles are flat, subconical, somewhat longer than width of base, broadest at base and rounded on basal inner margin; ovipositor very small.

M. costata ? (Fabr.).

This agrees with the descriptions and figure of *costata*. There is a brown spot on each lateral portion of the pronotum, tegulae dark.

♂ Pygophor very short, ventral edge entire, lateral edges roundly produced in middle and turned inward, the produced portion can only be seen when the genital styles are widely parted; anal segment about as long as broad, subovate, the lateral edges slanting downward, apex with a small emargination, anus at base, a keel runs from each side of anus to near apical margin; genital styles large, narrow at base, widest in middle, apex rounded, ventral edge slightly convex and the rim slightly thickened, dorsal edge subangularly produced in middle, the margins being slightly concave, near base there arises a curved spine, rounded and slightly flattened at apex, a keel runs from base to near apex down the outer surface.

♀ Pregenital plate much wider than long, posterior edge medially produced into a subtriangular lip; styles and ovipositor abortive, the latter appearing as two small curved spines, genital area arcuate along the dorsal margin, the ventral margin formed by the pregenital plate; anal segment about middle, very short.

Hab. Three specimens from Bartica, British Guiana, April and July, 1901.

M. pseudonebulosa sp. nov.

♂ This differs from *M. nebulosa* as recognized above by the genitalia. Pygophor very short, ventral edge entire, lateral edges produced into a large, curved, flattened spine beside the anal segment; anal segment longer than wide, subconical in outline, apex with angular emargination, anus near base, a keel runs from each side of anus to apex at each side of emargination; genital styles large, ventral edge slightly con-

vex, apex rounded, dorsal edge subangularly produced on apical half, from near base a curved, flattened spine arises.

Length 3.7 mm.; tegmen 8.5 mm.

Hab. Bartica, British Guiana, May, 1901. Described from one male specimen. Type in coll. Prof. H. Osborn.

M. neonebulosa sp. nov.

♂ Similar to *M. nebulosa* as recognized above but the bands on tegmina fainter and narrower. Pygophor very short, edges entire; anal segment subquadrate, about as long as wide, sides very slightly convex, apex truncate or slightly concave, anus near middle, a carina runs from each side of anus to apical edge; genital styles broadest at apex, ventral edge slightly curved, apex slightly convex, dorso-apical corner angular, ventro-apical corner round, dorsal edge concave, from the middle arises a curved spine with a rounded apex.

Length 3 mm.; tegmen damaged.

Hab. Bartica, British Guiana, July, 1901. Described from one male with damaged tegmina. Type in coll. Prof. H. Osborn.

M. ? sp. nov.

♀ I have one female specimen with immaculate tegmina with the antennae longer than the face and the arista arising one-third from apex; the genital styles (ovipositor sheath) are abortive but the ovipositor is well developed and exposed. I refrain from naming from only a female.

Hab. Bartica, British Guiana, April, 1901.

M. sp. nov.

♀ Orange-buff, veins of tegmina and wings slightly darker than membrane, posterior margins of tegmina and wings bordered with fuscous. Posterior edge of pregenital plate produced in middle into a quadrate plate slightly longer than wide; styles small, covering ovipositor.

Length 3.4 mm.; tegmen 7.8 mm.

Hab. Bartica, British Guiana, May, 1901 (*Coll. H. S. Parish*). I refrain from naming only a female.

DELPHACIDAE.

Genus Ugyops Guerin.

U. occidentalis sp. nov.

This species is congeneric with *U. liturifrons* (Walk.), the tegmina are broadly tectiform, the median frontal carina double to near apex and the first joint of antennae slightly shorter than the second.

Ochraceous-buff with brown markings as follows: carinae of head and thorax, small spots alongside of median carinae of face, spreading across to sides at apex, two rings on apical antennal joint, bands on front and middle femora and tibiae, a longitudinal mark on hind femora, lateral areas of pro- and mesonotum, on the apical abdominal segment, base of pygophor and the anal segment. Tegmina hyaline, veins dark, broken with light patches, granules minute, bearing small hairs concolorous with vein.

Genitalia of the *Ugyops* type; anal segment dome-shape with anus at top, apical edge slightly emarginate, ventral edge of pygophor quadrately emarginate, a small angular emargination in the medio-ventral line; styles sub-cylindrical, the curve of apical two-thirds slight.

Length 4.5 mm.; tegmen 5.5 mm.

♀ Similar to male. Anal segment small, about as long as broad; ovipositor with more than one-third extending beyond pygophor; lateral plates reaching beyond middle of pygophor.

Length 5 mm.; tegmen 5.7 mm.

Hab. Aibonito, Porto Rico, July, 1914. Described from one pair in the American Mus. of Nat. Hist., New York.

Genus Punana Muir.

P. puertoricensis sp. nov.

♂ Width of vertex more than double the length along the middle line, projecting very slightly beyond eyes, base concave, apex convex, the Y-shape carina obscure, the fork forming a small areola at apex; face slightly broader than long, subcircular except at apex, face and clypeus medially and laterally carinate, carinae obscure; antennae not reaching to middle of clypeus, second joint 2.5 times the length of first, first subsagittate, second subovate, considerably flattened, with large sense organs on dorso-apical portion, both joints with stout hairs, arista apical. Pronotum slightly longer than vertex, hind margin shallowly and roundly emarginate, tricarinate, the lateral carinae curving parallel with hind margin of eyes and do not reach the hind margin. Tegmina broad, slightly decumbent beyond apex of abdomen, radius not touching media, cubitus and media touching at base of first median sector. Hind tibiae with one basal, one median, one subapical and five apical spines, hind tarsus two-thirds the length of tibia, first joint slightly longer than the other two

together, spur subulate with circular cross section, about half the length of first tarsal joint.

I have described the generic characters of this species as it differs in some points from the type of the genus and approaches *Onkelos* Distant in others; unfortunately the shape of the antennae and of the spur of the latter genus are not stated.

Ochraceous-buff, face between eyes and the clypeus slightly darker, antennae brown, carinae of pronotum, median portion of mesonotum and carinae lighter; a slight brown band on front coxae, and fainter ones on first and second tibiae. Tegmina pale, veins concolorous or lighter, thickly studded with brown granules bearing dark brown hairs.

Genitalia of the same type as *Asiraca*. Anal segment large, lateral edges turned ventrad so as to form a convexity on ventral surface, the apical edge not turned ventrad and, together with the square emargination of the ventral edge of the pygophor, forming a five-sided ventral opening; styles subulate, widest and slightly flattened at base, curved, bases and apices approximate.

Length 3.3 mm.; tegmen 3.9 mm.

♀ Similar to the male. Lateral plates small, reaching less than one-third from base, styles (ovipositor sheath) narrow, projecting well beyond pygophor, and slightly beyond anal segment, anal segment as long as wide in ventral view, styles dark brown.

Length 4.3 mm.; tegmen 4.4 mm.

Hab. Aibonito, Coamo Springs and Mayaguez, Porto Rico, July, 1914. Described from five males and five females in good condition, and one broken female in the American Museum of Nat. Hist., New York.

Genus NEOMALAXA nov.

Head considerably narrower than thorax; vertex prolonged well beyond eyes, broadest at base, apical two-thirds with sides parallel, length 1.6 times the width in middle; base of Y-shape carina obsolete leaving a semiobsolete, quadrate areola near apex, basal half excavate, base straight with carina; length of face four times the width, sides parallel, a simple median carina, sides carinate, an oblique carina from beneath antennae to apical corner of face; clypeus slightly wider than face, with three subobsolete carinae, antennae long, slender, both joints terete, reaching to beyond middle of clypeus, joints subequal in length, arista apical, long. Pronotum shorter than vertex, hind margin slightly concave, tricarinate, lateral carinae straight, diverging posteroirly, reaching hind margin; mesonotum normal, tricarinate. Hind tibiae with one basal, one median and seven or eight minute apical spines, hind tarsi subequal in length to tibia, first joint longer than other two together, spur two-thirds the length of the first tarsal joint, laminate, teciform, 14-16 small teeth on hind margin. Tegmina large, radius not touching media, first median sector joined to cubitus for a short distance near its base.

This genus comes near *Zuleika* Distant if that genus possesses the spur of the Delphacini; apart from the spur it approaches *Malaxa* Melichar.

N. flava sp. nov.

♀ Pale yellow-orange, eyes light brown, ocelli black, a longitudinal brown mark down antennae not quite reaching the base of each joint. Tegmina hyaline, milky white with waxy secretion, veins basad of cross-veins concolorous, cross-veins and veins apical of cross-veins brown.

Styles broad at base, gradually narrowing to apex, reaching to apex of pygophor and covering the greater portion thereof.

Length 2.4 mm.; tegmen 3.6 mm.

Hab. Mayaguez, Porto Rico, July, 1914. Described from two females, one in bad condition, in the American Mus. Nat. Hist., New York.

Genus DELPHACODES Fieb.

D. erectus nigripennis (Crawford)*.

Megamelus erectus nigripennis Crawford, 1914. Proc. U. S. Nat. Mus., Vol. 46, p. 625.

One male specimen from Point a Pitre, Guadalupe, W. I. This insect is very close to the brachypterous form of *D. mata-nitu* (Kirk.) from Fiji and Papua. They are hard to distinguish except for the aedeagi, which are quite distinct (figs. 2, 3). *D. erectus* is most likely the macropterous form of *nigripennis* and is paralleled by the light, macropterous form of *D. matanitu.*

D. mardininae sp. nov.

♂ Macropterous. Lateral pronotal carinae divergingly curved, not reaching hind margin; vertex square, carinae distinct; face slightly narrowed between eyes, sides subparallel, median carina simple; antennae reaching slightly beyond base of clypeus, second joint 1.5 times the length of first; hind tarsi shorter than hind tibiae, first joint longer than other two together, spur slightly shorter than first joint, laminate, subtectiform, with minute teeth on hind margin.

Head and thorax ochraceous-buff, abdomen ochraceous orange, carinae of head and thorax lighter, face and clypeus between carinae slightly fuscous, apical portion of each antennal segment, apex of rostrum and apices of tarsi brown. Tegmina and wings hyaline, veins fine, yellowish, fuscous at apices, granules very small.

Pygophor figured (figs. 4, 4a).

Length 2 mm.; tegmen 3 mm.

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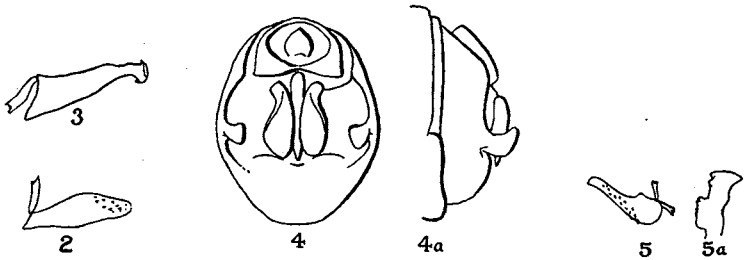
*I propose the new name *pseudonigripennis* for *D. nigripennis* Muir. 1917 Proc. Haw. Ent. Soc., III, No. 4, p. 338.



EXPLANATION OF FIGURES.

2. *D. matanitu,* aedeagus.
3. *D. matanitu,* aedeagus.
4. *D. mardininae,* full view of pygophor.
4a. *D. mardininae,* lateral view of pygophor.
5. *D. nigrifacies,* aedeagus.
5a. *D. nigrifacies,* right genital style of aedeagus.

Hab. Fort de France, Martinique (Mardinina), B. W. I., June, 1911. Described from one male in the American Mus. Nat. Hist., New York.

D. nigrifacies sp. nov. figs. 5, 5a.

♂ Brachypterous. Lateral pronotal carinae divergingly curved posteriorly, not reaching hind margin; vertex square, carinae not distinct; length of face less than twice the width (1.70 to 1) sides arcuate, carinae very fine, median carina simple, vertex and face in profile rounded; antennae reaching slightly beyond base of clypeus, second joint twice the length of first; hind tibia slightly longer than tarsi, first tarsal joint equal to the other two together, spur longer than first tarsal joint, broad, laminate, tectiform, with many minute teeth on hind margin.

Face, genae, vertex pro- and mesonotum shiny black, middle of vertex, posterior and lateral margins of pronotum and lateral and posterior angles of mesonotum yellowish, first segment of antennae dark, second lighter, clypeus, thorax (except parts of pro- and mesonotum), base of abdomen and legs capucine yellow or orange buff, abdomen brown, anal segment yellowish, tegmina reaching to middle of abdomen, hyaline, light orange buff, marginal border slightly fuscous.

Pygophor nearly as broad as long, edges entire, a wide emargination on dorsal edge, anal segment sunk within pygophor, with a pair of broad, short spines near basal corners which are not visible without dissection or without having the anal segment turned up dorsally; styles broad, apex truncate and very slightly convex, the inner edge near apex thickened and elevated, the inner edge on basal half squarely produced and meets the fellow style on the median line; aedeagus cylindrical,

largest at base, curved dorsad, many small spines pointing basad, starting from an apico-dorsal position and crossing over the sides to a ventro-basal point.

Length 1.5 mm.; tegmen .7 mm.

Hab. Fort de France, Martinique, B. W. I., June 27, 1911. Described from two male specimens, the type in the American Mus. of Nat. Hist., New York.

The Australian Sheep Fly in Hawaii.

BY J. F. ILLINGWORTH, QUEENSLAND, AUSTRALIA.

[Presented by O. H. Swezey.]

I was surprised to learn that the screw-worm fly that I bred in such abundance from dead cat and rat, before leaving Hawaii, is the common sheep-fly of Australia. Froggatt* calls it *Calliphora rufifacies,* but it should be placed in the genus *Chrysomyia.*

I collected this species in Fiji in 1913; and found it very abundant in Brisbane, during June of this year. At the present time (August, 1917) I am breeding these flies abundantly from dead animals at Gordonvale. This species was bred by Terry in Hawaii, in 1905, and four of his specimens are in the collection of the Experiment Station, H. S. P. A., but bear no name.

The species is of tremendous importance in Australia, where it has taken to living sheep, after breeding for many years in the dead carcasses—just as our *Chrysomyia dux* did in Hawaii.

The development of the species is very rapid as my Hawaiian notes would indicate. An animal exposed on the 16th of July; larvae hatching on the morning of the 17th and fully developed on the 20th ready to enter soil; pupal stage about 6 days.

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*N. S. W. Dept. Agric. Farmer's Bul. 95, illustrated, page 31. Agr. Gaz. N. S. W., XXV, p. 756, 1914.

The Jumping Plant Lice (Family Psyllidae) of the Hawaiian Islands.

A Study in Insect Evolution.

BY D. L. CRAWFORD.

The fauna and flora of the Hawaiian archipelago are of more than common interest because of the great isolation of these islands from other land bodies and also because they appear to have held such an isolated position for a very great lapse of time—perhaps since the Paleozoic era.

The native vertebrate fauna is exceedingly limited, an endemic bat being the only mammalian species surely native. A considerable number of birds occur, most of the species having developed here from a few early immigrants. No endemic reptiles nor amphibia are found here, with the possible exception of a species or two of skinks and these probably were brought in by human agency.

Among invertebrates, certain groups of land shells (Mollusca) and insects are the most abundant, and at the same time present some very remarkable features. First among these remarkable features is the large number of endemic species representing a comparatively small number of groups. That is to say a comparatively small number of insect and molluscan species have in the more or less remote past chanced to arrive here and establish themselves and, rejuvenated by the new and favorable environment in which they found themselves, have split up into a large number of derivative species and even genera, and in several cases even endemic families—one endemic family of beetles (Proterhinidae), one of land shells (Achatinellidae), and one of birds (Drepanididae). This of course indicates that plant immigrants had already established a flora of the Islands upon which these animal immigrants found sustenance.

A second remarkable and significant feature of the endemic

Proc. Haw. Ent. Soc., III, No. 5, April, 1918.

fauna is the fact that nearly all groups are inhabitants of dead wood and debris of the kind that sometimes drifts about the oceans, or if not of that type are usually strong in flight. There are no native leaf-eating beetles or grasshoppers or similar insects. The beetles are nearly all wood-borers or ground beetles which commonly hide away under bark. Nearly all the Hymenoptera are borers or forms which nest in logs, etc. Diptera are represented mostly by debris inhabiting forms, while of the Lepidoptera we have no native butterflies except one comparatively recent immigrant, but a considerable number of moths some of which are strong in flight and others pupate under bark or in similar situations.

The conclusion to be drawn from these facts is that these Islands have been in existence for a very great length of time —long enough for many species to have originated here from a few ancestors—a conclusion which is also supported by geological evidence which points to the existence of the land mass as far back as the Paleozoic. Another conclusion to be drawn from our data is that the islands have always been isolated and never a part of a continental land mass, hence receiving no migrations of animals overland but only by long and very precarious voyages over the ocean in logs and floating debris, and perhaps by flight and carriage by winds. From the very small number of ancestral types represented by the endemic species it would appear that only very rarely did insects and shells succeed in establishing themselves in these Islands.

The presence here of some very delicate insects is more difficult to explain. They do not inhabit logs nor debris although some are gall makers, and their span of life is very short, especially short in the absence of living foliage to furnish them food. Certain homopterous insects, the leaf hoppers and jumping plant lice, are good examples of this type. It is not possible to explain their entrance here by way of a land bridge now disappeared, for if there had been such a bridge beyond doubt more than the meagre few would have become established here. There remains, then, only the agency of

migrating birds, or high winds or ocean currents to account for the arrival here of such delicate insects.

Bird migrations hither are mostly, if not entirely, from America, and the Hawaiian jumping plant lice and leaf hoppers do not seem to have come from there. Windstorms seldom, if ever, blow from present land areas of the South Pacific to these Islands, nor do ocean currents come this way from that part of the world. However, we must consider that not more than one ancient immigrant of the Psyllidae and probably only three or four of leaf hoppers succeeded in establishing themselves here during several million years. It must be admitted that what now seems impossible might have succeeded by chance once in a million years. It is conceivable that once in several million years a windstorm might have carried a leaf with galls containing nymphal psyllids and dropped the leaf in an Hawaiian forest of the same kind of trees—an exceedingly rare chance!—whereupon the insect might establish itself. Another psyllid species has been a less ancient immigrant, but how it arrived or when it is not possible even to surmise. This one apparently has not given rise to other species than one which now lives on the native palms, but nevertheless seems to have arrived a long time ago.

The Jumping Plant Lice.

Psyllidae, or Chermidae (Homoptera).

The jumping plant lice (Psyllidae or Chermidae) constitute a family of the homopterous sucking bugs, being allied to the true plant lice and scale bugs and also to the leaf hoppers and lantern flies. They are small insects, from 1-32 to 1-4 inch in length, with four wings, the third pair of legs usually developed for leaping from which habit the first part of their popular name has been derived. Their superficial resemblance to true plant lice (Aphididae) has suggested the latter part of their name.

The psyllids live by sucking the juice from plants by means of their slender, pointed beak which arises from the

lower part of the head next to the thorax and passes back pressed against the ventral surface of the thorax between the front pair of legs and then bends downward. In this way a greater leverage by more of the body is brought to bear upon the beak in forcing it into plant tissues.

The immature, or nymphal, stages of these insects are passed upon the same plants with the adults, and in the same active, sap-sucking manner detrimental to the plant. In many species the reaction of the insects' activities on the leaves or stems of the plant and the poison wastes secreted by the insects cause the growth of tumors or excrescences of characteristic forms, known as galls. The galls are usually characteristic of certain species and may often be used as an index of the species even though the insects themselves may not be discovered.

The feeding habits of jumping plant lice render them harmful to plant life, but fortunately these tiny insects do not attack many of our cultivated or garden plants and therefore they are considered of relatively small economic importance in agriculture. Moreover, they are far less prolific than are the true plant lice and scale bugs, and for this reason also are viewed with much less concern by economic entomologists.

There are a few species of the family which cause considerable damage in the orchard, field or garden. The pear psylla (several species, one in each of several countries) causes extensive damage to pear and allied orchard trees and receives much attention and expensive treatment. The tomato psyllid (*Paratrioza cockerelli*) is responsible for severe injury to tomatoes and peppers and other plants in southwestern United States. The laurel psyllid (*Trioza alacris*) seriously disfigures bay trees in Northern Europe and now in the United States, causing the leaves to become much rolled, curled up and generally distorted. Other species attack alder trees in America and Europe, while another is a pest on citrus trees in the Malay Archipelago and India.

The family is a relatively small and homogeneous group,

with representatives present in nearly all land areas of the earth. In Europe, North America and Australia the largest number of species have been described but some are known from most all other countries. Much remains to be learned about the psyllid fauna of the south Pacific lands, Asia, South America and Africa, and until more is known especially of the first our knowledge of the Hawaiian fauna and its origin will be limited.

The several hundred species of Psyllidae of the world have been grouped into six subfamilies[1] characterized by wing venational features or peculiarities of the skeleton of the head or thorax. In North America five of the six subfamilies are represented, three very extensively and two less so. In Asia five of the six have representatives known and perhaps of the other also. In the Philippine Islands and Malay Archipelago at least four and perhaps all of the six groups have representatives. In other words, these insects have been well disseminated throughout the world, especially where land bridges have permitted a wider migration.

In the Hawaiian Archipelago, however, only one of the six subfamilies is represented, so far as known at present, and that by fifteen species falling into five genera, and thirteen of the fifteen are so suggestively similar in certain fundamental characteristics that one can scarcely avoid the conclusion that they have sprung from *one* common ancestral form. The extent of evolutional changes effected in this small fauna seems to indicate a considerable lapse of time since the first introduction.

The subfamily Triozinae, to which all the Hawaiian species belong, is a specialized group set apart from the others by certain wing venational characters. The largest genus in the subfamily is *Trioza,* to which about one hundred species have been assigned throughout the world. Most of these species live free on leaf surfaces, sucking out the juices without forming galls

[1] For details of classification the reader is referred to the author's monograph of this family, Bulletin 85 of the U. S. National Museum, 1914.

or at most merely distorting or curling the leaves. There are a few species, however, which have the habit of causing characteristic galls to grow on leaves and inhabiting the inside of these galls.

These species are found in a good many regions of the southern hemisphere and of the southern part of the northern hemisphere. The most northerly representative of this type of *Trioza* is the species *arbolensis* found in southern United States. One species occurs in Mexico, making galls on avocado leaves, two have been recorded from South America and several from southern Asia, a large number from Australia, a few from Malay Archipelago and still others from other southern countries. A few of these have been assigned to another genus, *Cecidotrioza,* and it is possible that when our knowledge is more complete all these gall makers will be referred to such a genus.

Nearly all of these gall-forming species of *Trioza* resemble each other in certain wing venational characteristics and in the male genitalia, thus indicating perhaps a generic relationship to each other and distinct from other species of *Trioza.* The first marginal cell of the forewing is of a peculiar shape, the cubitus forking at about the midpoint or basad of it. The male anal valve in lateral, or profile, view has a straight anterior margin but the posterior margins (the lateral wings) are characteristically convex.

Although the Hawaiian species have undergone changes in the shape and form of the head, armature of the legs and size and shape of the wings, yet a marked homogeneity in the characters above referred to shows not only a close inter-relationship among these species but also points to a close affinity of these with the gall forming species of *Trioza* in Malay Archipelago and elsewhere. The fact that many of the Hawaiian species are gall forming is further indication of this affinity.

Most of the Hawaiian species live upon the foliage of *Metrosideros polymorpha* Gaud., called by the Hawaiians "Ohia lehua", and other species of the same genus. One (and

perhaps others also), a much modified species, inhabits galls on leaves of several native species of *Pelea.* Three others have been found on foliage of other native plants but their feeding habits are not fully known. Ohia lehua appears to be, by far, the most commonly attacked tree in these Islands. Several make galls on ohia leaves while others live free on the leaf surfaces.

The genus *Metrosideros,* according to Rock[1] is represented in the Hawaiian archipelago by five species, four of which are endemic and one widely distributed over Polynesia, New Zealand, Tahiti and other Pacific islands. It is the cosmopolitan species which is the chief food plant of the Hawaiian psyllids. Thus far no psyllid galls have been reported from the south Pacific or elsewhere the insects making which seem to be in any close way related to the Hawaiian species.

It seems probable that the four native species of *Metrosideros* have not sprung from the cosmopolitan species, but that the latter has been introduced more recently. That its introduction was very ancient, however, is evidenced by its position in the forests and its relations in these forests with the more recent trees. It is quite probable that these trees were first introduced by the very small and light seeds which are blown to great distances by winds. At what time after the establishment of the Ohia lehua here the gall psyllids came in is impossible to say, because of the absence of fossils.

Because of the volcanic nature of the rocks of these Islands, fossil remains of plants or animals are almost never found. A few have been discovered in the stratum overlying the volcanic rock—obviously of comparatively recent date, for the lava flows followed a long, previous existence of the Islands. One such fossil, found by J. C. Bridwell on the Island of Oahu but very unfortunately lost, was evidently an imprint of a leaf of *Metrosideros.* Upon this leaf imprint, it is said, were galls which beyond doubt were of psyllid origin. This is

[1] "The Ohia Lehua Trees of Hawaii," by Joseph F. Rock. Hawaii Bd. of Agric. and Forestry, Bot. Bull. 4, 1917.

a most interesting and significant discovery, showing that these gall-making psyllids have been present here and living upon *Metrosideros* for a considerable period of time.

Probably the original immigrant species was one inhabiting leaf galls of *Metrosideros* and, as new species have evolved from this, some have retained the gall-making habit on the same plant, others have taken to living free on the leaf surface in the nymphal stages, while still others have gone off to other plants, making leaf galls or living free.

From this ancestral species, a *Trioza,* have been derived thirteen species in three genera. Five of these belong to the cosmopolitan genus *Trioza,* five to an endemic genus, *Hevaheva,* and the remaining three to a more or less cosmopolitan genus, *Kuwayama,* members of which have arisen independently it would seem in various countries. These three species here appear to be not related directly to other species of the genus in other lands but rather to species of *Trioza* here.

Hevaheva is the most specialized of the genera and indicates a long evolution. The five species are closely interrelated, but *H. giffardi* shows considerably more specialization than the others. The genus is more closely related to *Trioza iolani* than to the other species of the Islands, but this relationship shows a gap not now bridged over. The relationships of the species of each genus are discussed later.

The other two genera are both Polynesian and apparently have come in at a much later date than the ancestral forms of the other assemblage. *Megatrioza* is abundantly represented in the Malay and Philippine archipelagoes and probably elsewhere in the tropics of the Old World. The one species here probably has not arrived recently and probably is endemic, for it occurs only in the higher mountains on the native palm (*Pritchardia*). It does not occur on lowland introduced palms and hence it seems that its arrival here must have long antedated the modern epoch. Less is known of the other genus, *Cerotrioza,* both here and elsewhere. It is possible that our

species here dates back to a less remote period, but appears to be endemic.

On the basis of land shell distribution, Pilsbry and others have advanced a theory that all these islands once constituted a single large island and that by continued subsidence the higher points of the large island were left as individual islands separated by channels.

Our knowledge of the distribution of the native jumping plant lice is not yet sufficient to allow generalization, nor does it seem probable that this group has been resident here farther back than the Pliocene and possibly not as far back as that, while Pilsbry assumes the subsidence to have been earlier than that. So far as our present knowledge of this group goes it does not seem to indicate any union of the islands of this archipelago within the period of time in which this family has been resident here. Chance winds or currents or flights of birds might account for the present distribution of the species, for it is not wide. Most of them seem to be limited to one island, but *Trioza ohiacola* occurs on both Oahu and Hawaii, nearly at opposite ends of the archipelago, but apparently on none of the islands between.

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The type specimens of new species and a representative collection of all the Hawaiian species have been deposited with the custodian of types of the Hawaiian Entomological Society, Honolulu.

Synopsis of Genera.

A[1]. Forewings not opaque; vertex not produced into processes in front.

B[1]. Hind tibiae without basal spurs.

C.[1]. Forewing with three narrow black spots on hind margin, one in each marginal cell and a third between them; veins without prominent setae.

D[1]. Genal cones present.....*Trioza* Foerster

D[2]. Genal cones wanting.....*Kuwayama* Crawford

C[2]. Forewing without marginal spots; veins with prominent setae.....*Hevaheva* Kirkaldy

B[2]. Hind tibiae with basal spur and subapical spine.....*Megatrioza* Crawford

A[2]. Forewings opaque or nearly so; vertex produced in front into two protuberances above genae.....*Cerotrioza* Crawford

Genus Trioza Foerster.

This genus has representatives in practically all countries where Psyllidae occur. There are five closely related endemic species in this archipelago, so far as known all living on the foliage of ohia lehua (*Metrosideros* spp.). It seems quite certain that all are derivatives of a common ancestor which established itself here long ago, coming probably from some land area in the south Pacific. Living species resembling these in essential characters and certainly allied to them are known in Polynesia, Australia and South America, but it is not possible yet to make a more definite statement of the ancestry of these species.

The ancestral species has apparently divided by variation in the following manner: *Trioza iolani* and *ohiacola* are probably concurrent derivatives from the original species on the

Island of Oahu; *Trioza lanaiensis* split off from *T. iolani* by segregation on an island (Lanai) by itself and later gave rise to *T. pullata; T. hawaiiensis* was probably derived independently from the ancestral species but bears a closer resemblance to *T. iolani* than to *T. ohiacola.* The latter occurs now on both Oahu and Hawaii, but probably originated on the former.

Kuwayama and *Hevaheva* are derivatives here of the ancestral *Trioza* species.

Key to the Species.

A¹. Genal cones not as long as vertex; color of body typically dark brown; antennae not more than twice as long as width of head, usually less; cubital vein of forewing forked at or distad of midpoint; costa without visible setae. Oahu and Hawaii.
T. ohiacola n. sp.

A². Genal cones as long as vertex or longer.

B¹. Costa of forewing with setae; cubitus forked at or basad of midpoint; antennae twice as long as width of head or more; genal cones about as long as vertex; male forceps notched behind near apex; color usually orange or yellow. Oahu.
T. iolani Kirkaldy.

B². Costa of forewing without setae, or exceedingly short ones if present; male forceps not notched behind near apex.

C¹. Genal cones longer than vertex; antennae 2½ to 3 times as long as width of head; thoracic dorsum usually striped with brown; male forceps abruptly narrowed near apex. Lanai.
T. lanaiensis n. sp.

C². Genal cones about as long as vertex, rarely longer.

D¹. Color of body black, dorsum conspicuously reticulated; antennae about twice as long as width of head. Lanai.
T. pullata n. sp.

D². Color orange or flavous, dorsum not conspicuously reticulated; antennae a little more than twice as long as width of head; male forceps converging uniformly to subacute apex; body usually large. Hawaii. *T. hawaiiensis* n. sp.

Trioza iolani Kirkaldy.

Length of body, male 1.3 to 1.5 mm.; female 1.8 to 2.1; length of forewing 2.5 to 3.1. General color flavous, often pale greenish yellow, or darker orange yellow, rarely brown; mesonotum usually with two darker spots cephalad and sometimes more or less distinct brownish streaks on mesoscutum; antennal segments 4–10 and often distal half or all of 3d brown; tarsi and tips of genal cones brown; femora often brown; abdomen usually irregularly browned ventrad; forewings hyaline, often fumate slightly or flavous, or more commonly clear.

Head nearly as broad as mesothorax, much narrower than metathorax, somewhat deflexed; vertex nearly twice as broad as long, elevated at posterior ocelli, with a prominent foveal depression on each side of median suture, posterior margin narrowly elevated, median suture deeply impressed in anterior half and on each side of it the vertex roundly bulging; a few short setae on vertex; anterior ocellus at bottom of impression of median suture and scarcely visible from above. Genae large; genal cones usually about as long as vertex, sometimes a little shorter, subacute, somewhat divergent, with a few setae on ventral surface and one longer seta at tip of each cone. Clypeus small. Eyes large, hemispherical. Antennae somewhat variable in length, about twice as long as width of head with eyes, or more or occasionally less, slender, third segment longest.

Thorax rather broad, not strongly arched; pronotum short; dorsulum narrow cephalad; legs moderately long and stout; tarsi thick; hind tibiae with two or rarely three small black spines at apex on inside and one outside. Forewings reaching half their length beyond abdomen, hyaline, rounded at apex, veins usually black and prominent, minutely setose, costal setae longer; first marginal cell larger than second; cubitus forked at or basad of midpoint.

Abdomen moderately long, male much shorter than female. Male genital segment not large; forceps three-quarters as long as anal valve or a little more, arched, slightly broadening to near apex then more or less deeply notched on hind margin and coming to a narrow point; anal valve straight on anterior margin, truncate at apex, lateral wings angulately convex, broadest below middle. Female genital segment nearly as long as abdomen, converging to acute apex, dorsal valve a little longer than ventral and both acuminate at tip.

Described from several males and females collected on Oahu and determined by Mr. Kirkaldy. The distribution of this species is as follows:—Island of Oahu—Mt. Tantalus

(elevation 1500 ft.), 65 specimens collected by W. M. Giffard and others by Swezey mostly in the months of December and January; Pacific Heights, May 30, 1905; Palolo Hills; Wailupe, January 23, 1915; Opaeula, March 30, 1913; Kuliouou; Mt. Kaala (at elevation of 1500 ft.); Kaumuohona.

This and the following are the two most common species on Oahu, and may be found at most any season of the year on leaves of Ohia lehua (*Metrosideros polymorpha*).

Trioza ohiacola n. sp.

This species appears to be very close to *T. iolani* and, in fact, more or less grades into it. The habitat and the food plant are the same and both are found on the Island of Oahu. Although the two species are found together and resemble each other, there are nevertheless differences sufficient to indicate that they are distinct species.

In average size of body and wings *T. ohiacola* is a little smaller than the other and differs in the following characteristics:—General color typically much darker, usually dark reddish or chocolate brown, but sometimes light reddish or light brown or even orange yellow (the latter seem to be newly emerged adults); legs and antennae usually all or nearly all brown or chocolate colored.

Head narrower than in *T. iolani;* vertex with shallower discal depressions; genal cones usually about two-thirds as long as vertex, but sometimes more than two-thirds or rarely as long as vertex; antennae seldom twice as long as width of head, usually about 1½ to 1¾ times as long. Thorax much more distinctly reticulated. Legs similar, less stout. Forewings usually clear, radius shorter than in *T. iolani;* cubitus forked at or distad of midpoint; costal setae much smaller, not easily visible.

Male forceps nearly or quite as long as anal valve, converging (in lateral view) gradually from near base to narrowly subacute apex, not as broad as in *T. iolani;* anal valve broadest at center, posterior margin angulately convex.

Distribution:—Island of Oahu—Alewa Heights, Pacific Heights, Mt. Tantalus, Kuliouou, Kaumuohona, Lanihuli, Palolo Hills, Palolo Crater, Mt. Kaala (at elevation of about 1600 ft.). Island of Hawaii—Niulii, May 19, 1917 (Swezey), on ohia lehua; Kilauea, June 27, 1917 (Swezey), on ohia lehua and also some collected at same locality by W. M. Giffard on August 21, 1917. The food plant in all cases seems to be ohia lehua (*Metrosideros* spp.).

Trioza lanaiensis n. sp.

Length of body, male 1.5 to 2.2 mm.; female 1.7 to 3.0; length of forewing 2.5 to 3.2. General color orange yellow to straw color, or commonly reddish brown, usually with darker streaks on mesonotum, and abdomen blotched with brown ventrad; antennae darker on distal half; tarsi dark; forewings usually clear but sometimes slightly milky or faintly yellowed. Body surface sparsely clothed with soft pubescence, stiffer and longer on vertex and mesoscutum.

Very similar in general to *T. iolani,* of which it appears to be a derivative, differing in some characteristics, however. Genal cones longer than vertex, sometimes one-quarter longer, acute, divergent, more hirsute. Antennae 2½ to 3 times as long as width of head. Legs stouter and longer; hind tibiae usually with three, rarely four black spines at apex. Forewings a little longer, clear or slightly milky; veins with smaller, scarcely visible setae, even the costal setae scarcely visible under considerable magnification. Male forceps nearly as long as anal valve, constricted near base and narrowed abruptly near apex into a narrower, somewhat finger-like ending. Anal valve large, convex on posterior margin, with broadest point at middle. Female genital segment as long as abdomen or nearly so.

Distribution:—Island of Lanai—200 males and females collected at various points, Kaikolani, Kapano, and others, at altitudes ranging from 1500 to 3400 ft., in December, 1916, and January and February, 1917 (W. M. Giffard). Most of these were taken on foliage of ohia lehua (*Metrosideros* spp.), which is probably the only regular food plant of the species.

This appears to be an incipient, not yet clearly marked, species developing from the Oahuan species, *T. iolani.* Thus far it has not been found on any other island of the group, but it appears to be a very common one on this Island.

In this species there is considerable variation in size, but none that in itself seems to mark off a distinct species. Out of 200 specimens, about six are very large and seven very small, but between these there is almost every degree of variation so that it would be impracticable to designate either of these extremes as distinct species, which one quite probably would do if the series which Mr. Giffard collected had not been so extensive. It is quite possible that in time these variations will break the species into several distinct ones, for along with size fluctuations are also fluctuations in size of anatomical parts. It would appear that the species is right

now in process of rapid evolution, probably having been a relatively recent immigrant to this Island.

Out of the 200 specimens, one individual has genal cones a little shorter than the vertex but otherwise conforming to the species. Some individuals were killed too soon after emergence and parts of the exo-skeleton have shrunk, thus shortening the genal cones, but the one female referred to above was not of this category.

Trioza pullata n. sp.

This appears to be an incipient species derived from *T. lanaiensis,* paralleling in its differentiation another species, *T. ohiacola,* but evidently not directly related to the latter.

In size of body similar to the average example of *T. lanaiensis.* Color wholly black, or in spots dark brown; thoracic dorsum conspicuously reticulately marked, sparsely hairy. Genal cones about as long as vertex, seldom shorter, divergent. Antennae twice as long as width of head or sometimes less. Forewings clear, venation as in *T. lanaiensis* except radius shorter. Female genitalia similar; male unknown.

Distribution:—Island of Lanai—three females from Waiopao, November 29, 1916 (W. M. Giffard, on leaves of *Cyathodes;* six females from another part of the Island not designated, December, 1916, and February, 1917 (Giffard).

The distinctive and constant characters of color, shorter genal cones and antennae probably mark this off as a separate species, though it is possible that a biologic study would show it to be but a local or perhaps even seasonal variation. The occurrence of some on *Cyathodes* does not indicate necessarily a difference in food habits, though that is possible.

Trioza hawaiiensis n. sp.

Length of body 2.0 to 3.0 mm.; length of forewing 2.8 to 3.9 mm. General color about as in *T. iolani;* front and middle tibiae on distal third or half and all tarsi black or brown; venter of abdomen blotched with brown; forewings clear.

Closely resembling *T. iolani* in many ways but larger and stouter; genal cones about as long as vertex, somewhat divergent, more pubescent. Antennae 2 to 2½ times as long as width of head. Legs longer and stouter; hind tibiae with a serrated callus at base. Forewings large,

veins and costa without visible setae or with very short setae. Female genitalia similar. Male forceps nearly or quite as long as anal valve, stout, uniformly converging on both margins to subacute apex, black pointed; anal valve short, posterior margin acuately rounded, broadest near mid-point.

Distribution:—Island of Hawaii—Kilauea, near Volcano, 4000 ft. elevation, August 21, 1917 (W. M. Giffard); Kau Road, January 16, 1917 (Giffard); Kahuku, January 15, 1917 (Giffard); Kilauea, June 27, 1917 (O. H. Swezey), on ohia lehua; Niulii, May 22, 1917 (Swezey).

This appears to be closely related to *T. iolani* but nevertheless not a derivative of it. It is more probably a corelated derivative form of the ancestor of both. It seems to be limited to the Island of Hawaii. Large individuals of *T. iolani,* equalling in size this present species, occur on Oahu but these differ sharply in male genitalia, costal setae and other minor characters.

Genus *Kuwayama* Crawford.

The chief distinguishing characteristic of this genus is the absence of genal cones, the genae beneath the antennal sockets being more or less roundly swollen but not produced into conical processes as in *Trioza.* The form of the genae in this subfamily appears to be not at all fixed but varies more readily than wing characters and some others. For this reason, it seems certain that the species placed in this genus from various countries of the world do not represent a common origin at all, but independent or parallel evolution toward the same end.

The three species of this genus, native to these Islands, seem almost certainly to have been derived from some *Trioza* species, probably *T. ohiacola* or an ancestral type preceding it.

KEY TO THE SPECIES.

A[1]. Color of body nearly all black or dark brown; dorsum conspicuously reticulately marked; cubital vein of forewing forked a little distad of midpoint; antennae scarcely longer than width of head; male forceps very short, not more than three times as long as broad. Oahu and Molokai. *K. gracilis* n. sp.

A[2]. Color not uniformly black, very rarely even brown over most of body; cubital vein of forewing forked at or very slightly distad of midpoint; male forceps at least 4 times as long as broad.

B[1]. Color typically yellow and black; head and some of notum black and remainder yellow, but sometimes color mostly yellowish or rarely mostly brown; reticulation of dorsum indistinct; antennae distinctly longer than width of head; insect about 2.5 mm. long to tip of folded wings. Hawaii and Lanai. *K. nigricapita* n. sp.

B[2]. Color uniformly orange or yellowish; reticulation sometimes distinct; antennae not longer than width of head; insect about 2.0 mm. long to tip of folded wings. Hawaii. *K. minuta* n. sp.

Kuwayama nigricapita n. sp.

Length of body, male 1.1 mm.; female 1.6 mm.; length of forewing, male 1.8; female 2.3. Color dark brown or black contrasted with yellow; head usually entirely black, sometimes brown on vertex but eyes black; male usually orange or pale yellow on thorax and abdomen; female usually with pronotum, anterior portion of dorsulum, mesoscutum, metascutum and narrow longitudinal band on abdominal notum black or brown, but sometimes some or all of these areas pale; remainder of female body orange or pale yellow; legs yellow in both sexes, with tarsi often black; antennae paler than head, the distal third or half sometimes darker than the basal portion; beak black.

Head nearly as broad as metathorax, somewhat declivous; vertex more than half as long as broad, with a prominent discal depression on each side of median line, reticulately marked, sometimes slightly hairy. Genae subspherically swollen beneath each antennal socket, lobes nearly contiguous beneath front ocellus, cones wanting and clypeus therefore not concealed from view. Beak short, conspicuous by its dark

color against the orange venter. Antennae slender, about 1¼ times as long as width of head.

Thorax narrow, scarcely arched, not hairy. Legs rather small, slender; forewings hyaline, clear, radius short, first marginal cell a little larger than second, veins not setose. Male genitalia small; forceps slender, acuminate, subacute, nearly or quite as long as anal valve. Anal valve straight on anterior margin but convex on posterior margin, broadest sub-basally. Female genital segment nearly as long as abdomen, dorsal valve longer than ventral, both acute.

Distribution:—Island of Hawaii—Niulii, May 19-24, 1917 (O. H. Swezey), 44 specimens of both sexes on foliage of ohia lehua (*Metrosideros* sp.). Some of these were bred from nymphs living free on the surface of the leaves. Other related species make galls on these same leaves. Kohala Mountains (Swezey), May 24, 1917, on ohia lehua; Mt. Kilauea, January 1, 1917 (W. M. Giffard). Island of Lanai—several localities at elevation of 2500 to 3000 ft., January, 1917 (Giffard).

Kuwayama minuta n. sp.

Length of body 0.8 to 1.1 mm.; length of forewing 1.6 mm. General color pale lemon yellow to orange; eyes brown or black; hind femora lemon yellow in dark forms as well as light; antennae brown except basal one-fourth pale.

Very similar to *K. nigricapita,* from which it appears to have been derived, but differing in the following respects: Body uniformly smaller in both sexes; color nearly uniform over entire body; antennae scarcely longer than width of head. Male genitalia smaller; forceps shorter and more slender.

Island of Hawaii—Mt. Kilauea, June 27, 1917 (O. H. Swezey), bred from free-living nymphs on surface of leaves of ohia lehua.

Kuwayama gracilis n. sp.

Length of body, male 1.0 mm.; female 1.7 mm.; length of forewing, male 1.3, female 1.9. General color black to dark brown; tibiae and sometimes basal half of antennae a lighter shade of brown. Body robust, small.

Head deflexed, not quite as broad as mesothorax; vertex reticulately marked, a little more than half as long as broad, with a shallow, broad foveal depression on each side of median suture. Genae swollen subspherically beneath antennal bases, with several long hairs. Eyes large. Antennae about as long as width of head, or a little longer, slender.

Thorax broad, arched, reticulately marked. Legs short and stout; hind tibiae with three short spines at apex. Forewings short, rounded at apex, hyaline, clear, veins black or reddish. Abdomen short. Male forceps short, relatively broad, about half or three-fourths as long as anal valve, narrowing to acute apex. Anal valve moderately broad, anterior margin straight, posterior margin arcuately convex, broadest below middle; female genital segment nearly as long as abdomen, dorsal valve longer than ventral, both acutely pointed.

Distribution:—Island of Oahu—Alewa Heights, March 26, 1916; Waialae Ridge, April 22, 1917; Mt. Kaala at elevation of 2000 to 2300 ft., March 4, 1917; Wailupe, January 23, 1916; Niu, Feb. 10, 1918 (Swezey), on ohia lehua; in all, there are 52 specimens, both sexes, collected by O. H. Swezey and P. H. Timberlake on leaves of ohia lehua. Island of Molokai—One female apparently of this species from Kamoku, July 15, 1910 (D. T. Fullaway).

Genus Hevaheva Kirkaldy.

Several good characters distinguish this from other genera of the Triozinae. The forewings lack the three narrow, granular spots on the hind margin which are present, so far as I know, in all other genera of the subfamily; the veins, as well as body surface, are covered with long stiff hairs. The hind tibiae have five to ten black spines at apex instead of the three or four present in most other genera of the subfamily. Genal cones are present, but variable in length and form.

This genus is probably endemic here and probably a derivative of *Trioza*. The wing venation is suggestively similar in these two genera here, and in the *Trioza* species the veins and body surface have minute setae which have apparently been highly developed in *Hevaheva*. The marginal granular spots are variable in size in our species of *Trioza* and slight indications of their presence in a few species of *Hevaheva* suggest the possibility of the transition.

KEY TO THE SPECIES.

A[1]. Forewings hyaline, not colored nor clouded.

B[1]. Body straw-yellow or pale orange colored; wing veins and body surface with long setae; living in galls on leaves of *Pelea*. Oahu. *H. perkinsi* Kirkaldy.

B[2]. Body brown or black; wing veins and body surface with short setae. Hawaii. *H. hyalina* n. sp.

A[2]. Forewings colored, not transparent.

B[1]. Forewings nearly all brown or black; body black, dorsum reticulately marked. Oahu. *H. silvestris* Kirkaldy.

B[2]. Forewings irregularly maculated or clouded with brown.

C[1]. Notum more or less variegated brown and reddish or orange; genal cones 2-3 as long as vertex; wing veins with moderately long setae; wing nearly all brown or black. Oahu. *H. monticola* Kirkaldy.

C[2]. Notum mostly brown or black; genal cones 1-3 as long as vertex or less; wing veins with very long setae (see wing pattern in figure). Hawaii. *H. giffardi* n. sp.

Hevaheva perkinsi Kirkaldy.

Length of body 0.8 to 1.4 mm.; length of forewing 1.7 to 2.3 mm. General color pale lemon yellow to orange red, vertex and dorsulum sometimes a little darker; antennae often brownish on distal half or two-thirds; tarsi dark. Body surface covered sparsely with stiff hairs.

Head nearly as broad as mesothorax, much narrower than metathorax, small, deflexed; vertex half as long as broad, deeply impressed discally on each side of median suture, with several very long stiff hairs near each posterior ocellus; genal cones not quite as long as vertex, conical, subacute, somewhat divergent and sparsely hirsute. Antennae about as long as or a little longer than width of head, slender, with several moderately long setae on apical third.

Thorax broad, not much arched, sparsely hirsute; pronotum short. Legs rather large, femora large; hind tibiae with 5 to 7 short black spines at apex; tarsi thick. Forewings hyaline, clear or slightly fumate or ochreous, veins setiferous; first marginal cell a little larger than second, latter variable in size.

Abdomen short. Male genitalia small; anal valve a little longer than forceps, truncate at apex, straight on anterior margin, very convex on posterior margin; forceps slender, subterete, arched, black-pointed at tips. Female genital segment about half as long as abdomen, thick at base and abruptly converging to acute apex, valves subequal in length.

Distribution:—Island of Oahu—Mt. Olympus (1800 to 2500 ft.), bred from conical galls on leaves of *Pelea clusiaefolia* and *P. lydgatei,* August 20, 1917 (Crawford); same locality on foliage of *Pelea* (Swezey); Wailupe, January 23, 1915, on *Pelea* (Swezey); Mt. Kaala, on *Pelea* (Swezey).

Hevaheva silvestris Kirkaldy.

Length of body about 1.3 mm.; length of forewing 1.9 mm. General color dark brown to blackish or reddish; legs and antennae pale, latter yellowish except last two segments dark; femora and tarsi darker than tibiae; forewings dark brown, with one or two irregular, more hyaline areas. Body surface covered sparsely with stiff hairs.

Head not quite as broad as mesothorax, much narrower than metathorax, deflexed; vertex not quite twice as broad as long, with a deep discal depression on each side of median suture, sharply elevated on posterior margin, with a few stiff hairs near posterior ocelli. Genal cones about half as long as vertex, conical, acute, sparsley hairy, scarcely divergent. Antennae not longer than width of head, slender.

Thorax moderately broad, stiffly pubescent. Legs short, femora thick; hind tibiae with about six short black spines at apex. Forewings not transparent, rounded at apex, narrow, veins setigerous, radial margin thick. Abdomen short. Male genital segment small; forceps a little more than half as long as anal valve, slender, terete on basal half but angulate above, apex sharply curved inward and subacutely pointed. Anal valve broad in caudal view, longer than forceps, anterior margin (lateral view) straight and posterior margin convex with greatest breadth sub-basally. Female genital segment short, thick at base, abruptly converging to subacute apex.

Distribution:—Island of Oahu—Mt. Tantalus (Perkins); Kaumuohona (Swezey), 1 female determined by Kirkaldy; Mt. Olympus, elevation 2000 ft. (Swezey); Wailupe, January 23, 1915 (Swezey); Palolo Hills, on foliage of *Pelea rotundifolia,* many males and females. The life habits of this species are not well known.

Hevaheva hyalina n. sp.

Size of body and wings about the same as in *H. silvestris*. Color of body about the same or a little lighter, but forewings hyaline or nearly so, very slightly browned or smoky, not opaquely colored; legs and antennae lighter colored or similar. Hairs on body surface and wing veins much shorter and somewhat less conspicuous.

Structural characters about the same, but antennae a little longer and genal cones a little larger; wing venation similar, but setae shorter; genitalia similar, differing only in minor characters.

Distribution:—Island of Hawaii—Olaa, Glenwood, elevation 2400 ft., September 9, 1917 (W. M. Giffard), 1 pair.

This species appears to be a derivative of *H. silvestris* by segregation on a separate island. Further collecting, however, is necessary to establish the relationships beyond doubt.

Hevaheva monticola Kirkaldy.

Length of body 1.4 mm.; length of forewing 2.1 mm. General color brown; vertex, posterior half of dorsulum, and notum between forewings very light brown or orange; antennae orange, except last two segments black; femora and tibiae brown, tarsi lighter; forewings hyaline but clouded and maculated with brown as indicated in figure. Body surface with stiff pubescence.

Head rather broad, as broad as mesothorax but narrower than metathorax, declivous; vertex about half as long as broad, with a deep discal depression on each side of median suture and much elevated narrowly on posterior margin, with a few long hairs near posterior ocelli. Genal cones about two-thirds as long as vertex, conical, subacute, only a little divergent, sparsely pubescent. Antennae only a little longer than width of head, slender, distal segments with setae.

Thorax rather narrow, not much arched, surface with scattered, stiff hairs; leg rather short, stout, femora thick; hind tibiae with about 7 short black spines at apex. Forewings elongate, rounded at apex, veins prominent, setose; marginal cells subequal or first a little larger than second; radial margin thick; membrane maculated with brown conspicuously.

Male genitalia small; forceps about half as long as anal valve, sharply curved inward and acute at apex, rather slender. Anal valve straight on anterior margin, roundly convex on posterior. Female genital segment short and thick, about half as long as abdomen, abruptly tapering to acute apex; valves subequal.

Distribution:—Island of Oahu—Mt. Tantalus, elevation 2000 ft., October (Perkins); Palolo Hills (Swezey); Kaumuohona (Swezey).

Hevaheva giffardi n. sp.

Length of body 1.7 mm.; length of forewing 3.0 mm.; general color dark brown to dull black; legs, metacoxae, pleurae and antennae light or pale brown or yellowish. Body surface covered sparsely with long stiff hairs.

Head as broad as mesothorax, not quite as broad as metathorax, somewhat declivous; vertex broad, about half as long as broad, narrowly elevated on posterior margin, with a deep, discal fossal depression on each side of median suture extending obliquely toward antennal bases, roundly convex between each depression and median suture; with a few long stiff hairs along median suture and near each posterior ocellus, genal cones short, one-third or one-fourth as long as vertex, divergent, subacute, with a tuft of short hairs at base of each near anterior ocellus. Antennae about as long as width of head, or sometimes a little longer, slender with a few setae distad.

Thorax moderately broad and arched, with conspicuously long and stiff hairs; legs rather long, slender, hary; hind tibiae with 4 or 5 short black spines at apex. Forewings broad, hyaline but maculated conspicuously with brown (as indicated in figure), veins and margins beset with long setae, the costal and apical margins with a double row and the others with single row; first marginal cell very large; radius long.

Abdomen short. Male forceps slender, acuminate, about ¾ as long as anal valve or more, subacute at apex. Anal valve with anterior margin straight, posterior margin convex, broadest near base, fringed caudad with long, fine hairs. Female genital segment not as long as abdomen, acutely pointed, dorsal valve a little longer than ventral, with a large tuft of long hairs at about the middle of the dorsal valve dorsad.

Distribution:—Island of Hawaii—Olaa, elevation 3000 ft., September 8, 1917 (W. M. Giffard), 26 specimens, both sexes. Taken on leaves of *Platydesma campanulata.*

This is the most ornate of the species thus far known in these Islands and appears to be limited to Hawaii in the mountains.

Megatrioza palmicola n. sp.

Length of body, male 2.7 mm.; female 4.0 mm.; length of forewing, male 3.8 mm.; female 4.7 mm. General color brown to light brown; head tawny or flavous, eyes dark, and often a short narrow dark streak on each side of median suture of vertex; pronotum usually brown; thoracic dorsum with several more or less prominent, longitudinal brown streaks; abdomen brown; venter, legs and antennae flavous. Body large, surface somewhat hairy.

Head about as broad as mesothorax but not as broad as metathorax, declivous; vertex about half as long as broad, with a discal depression

on each side of median suture, posterior ocelli slightly elevated, anterior half bulging and clothed with moderately long hairs. Genal cones short, seldom more than ¼ or 1-3 as long as vertex, subacute, divergent, somewhat separated. Eyes very large. Antennae slender, not quite twice as long as width of head.

Thorax large, broad, well arched, surface briefly and sparsely pubescent; legs rather long, stout, pubescent; hind tibiae with a spur at base and two prominent teeth at apex, one bifid and one simple and a third long tooth a little before the apex. Forewings large, long, hyaline or very slightly smoky, with four dark spots on hind margin, one at tip of clavus and the other three the regular marginal spots characteristic of this subfamily but darker and more prominent.

Abdomen long in both sexes; male forceps nearly as long as anal valve, slender, narrowing slightly toward subacute apex, hairy. Anal valve much broader than forceps, posterior margin convex, broadest near base and narrowing distad to truncate apex. Female genital segment large, not as long as abdomen but often nearly so, both valves acutely pointed, dorsal longer than ventral.

Distribution:—Island of Oahu—Punaluu (O. H. Swezey); Wailupe, January 23, 1915 (Swezey); Mt. Olympus, elevation 2500 ft., September, 1917 (Swezey and Crawford); Waiahole, August 23, 1916.

Food plant: Fan palm (*Pritchardia* spp.), native palms. This species appears to occur only on the endemic palms which are comparatively rare on Oahu. The insects live on the younger fronds, especially those just unfolding, from which they can readily suck the sap and in the folds of which they find good refuge and seclusion.

Megatrioza is a Polynesian genus, distinguished by the armature of the hind tibiae together with certain cephalic and wing characters. Thus far there are ten known species of this genus[1] in the Malay Archipelago and Peninsula and the Philippines, though there are doubtless many more to be discovered, as this appears to be a large genus. None of these known ten species shows any marked relationship to the Hawaiian species, so that it is probable that the latter is derived from some other still unknown species. It is possible that it may occur elsewhere, being merely an introduction here, but the indications

[1] These species are described in a forthcoming paper on paleotropical Psyllidae by the author of this paper.

are that it is truly endemic since it occurs only on the native palms in the mountains and not on cultivated palms in the coast lands.

The species bears some resemblance to the endemic *Trioza* species and at first was believed by the writer to have been derived from the same ancestry. In wing venation and male genitalia there is a similarity but the form of the genal cones and especially the tibial armature are distinct, while in all these characters there is considerable similarity to *Megatrioza.*

Genus *Cerotrioza* novum.

Head scarcely declivous, rather long; vertex produced in front into two horn-like epiphyses over antennal bases; genae produced more or less into cones or subspherically swollen. Antennae slender. Thorax not much arched, narrow; hind tibiae with small basal spur or callus and small subapical spine. Forewings narrow, opaque or semi-opaque, maculated; first marginal cell usually larger than second; hind wings nearly as long as forewings.

Type of genus:—*Cerotrioza bivittata.*

Two additional species, not yet described, are known from the South Pacific—one from Borneo and another from Singapore. The genus appears to be somewhat related to *Megatrioza* but has become very specialized in some features. The Hawaiian species is manifestly related to the other two but hardly derived from either. It is probably endemic here but its origin must still be a matter of conjecture. It appears to have no relationship to the other endemic species of psyllids here.

Cerotrioza bivittata n. sp.

Length of body 1.8 mm.; length of forewing 2.2 mm. General color pale greenish yellow on dorsum and venter; eyes dark and a broad, dark brown vitta alongside of head continued on pleurae of thorax to base of forewings and thence along central axis of each forewing to apex; legs pale yellow or straw colored; antennae whitish, except two basal segments brownish and apical two black. Body slender.

Head scarcely deflexed, very long. Vertex longer than broad, with a discal, sulcate depression on each side of median line and the two meeting at median line near anterior end; with two rounded, knoblike prolongations at anterior end of vertex reaching out beyond and over antennal sockets, with front ocellus at base of emargination between them. Frons visible as a very small sclerite bearing the front ocellus

at one end. Genae swollen somewhat beneath antennal bases. Clypeus small. Antennae slender, about 1½ times as long as width of head.

Thorax narrow, scarcely arched. Pronotum moderately long; legs long and slender, slightly hairy; tibial spines very small, black. Forewings long and slender, opaque and whitish, subacute at apex, venation similar to that of other species of this genus, with a broad, axial brown band from base to apex with numerous darker brown spots within it; veins beset with short setae.

Abdomen slender, long. Male genitalia small; forceps small, terete, acute, arcuate, about 2-3 as long as anal valve; latter broad in caudal view, posterior margin (lateral view) convex. Female genital segment half as long as abdomen, dorsal valve blunt, a little longer than ventral.

Distribution:—Island of Oahu—Opaeula, March 30, 1913 (O. H. Swezey), 3 males on *Xylosma Hawaiiense;* Niu, Feb. 10, 1918 (Swezey), 2 females and 1 male, on same plant.

Plate VIII.

Explanation of Figures.

Figure 1. *Trioza iolani,* forewing.

1a. Wing margin highly magnified and showing setae.

1b. Frontal view of head and genal cones.

1c. Profile view of male genitalia.

2. *Trioza lanaiensis,* forewing.

2a—2c. same views as in 1.

3. *Kuwayama nigricapita,* forewing.

3a—3c. Same as in 1, drawn to same scale.

4. *Hevaheva perkinsi,* forewing.

4a—4c. Same as above, drawn to same scale.

5. *Hevaheva giffardi,* forewing.

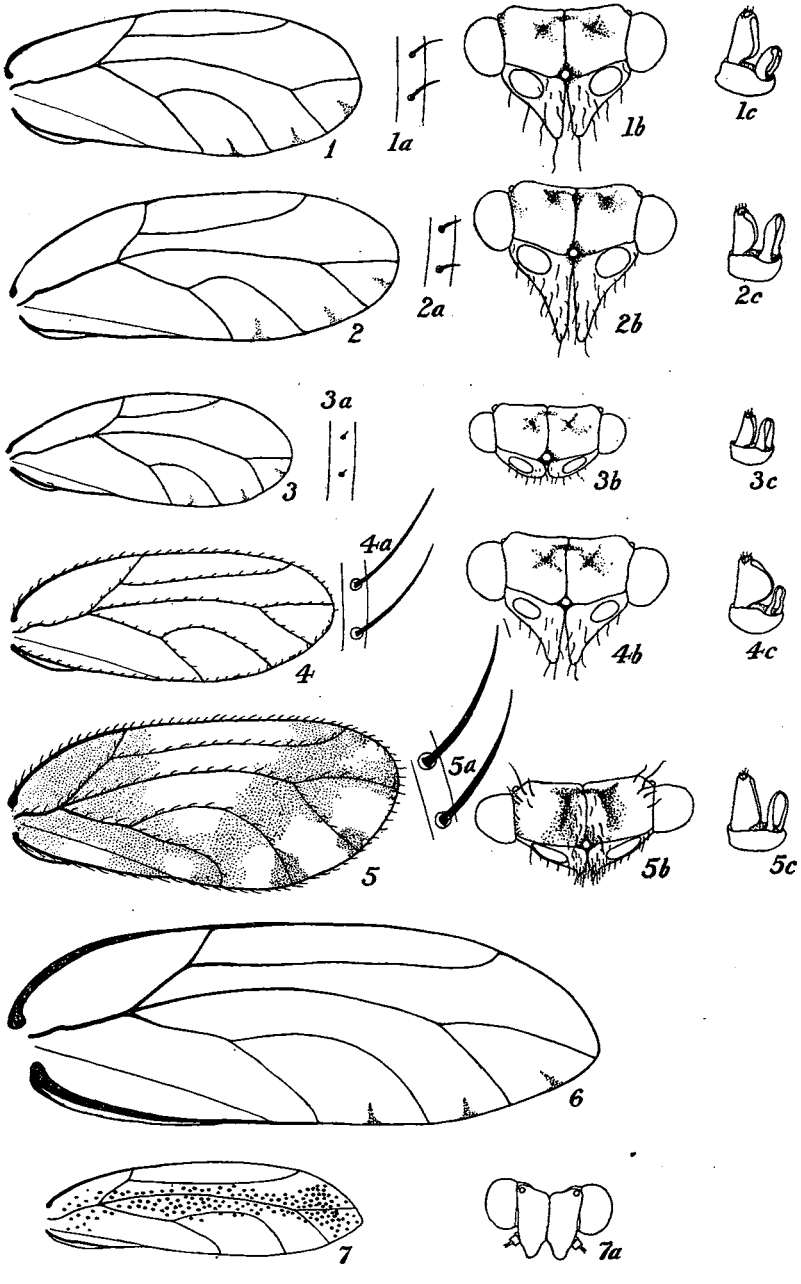
5a—5c. Same as above, drawn to same scale.

6. *Megatrioza palmicola,* forewing, drawn to same scale as others.

7. *Cerotrioza bivittata,* forewing.

7a. Dorsal view of head, showing processes of vertex; genae not visible.

Proc. Hawaiian Ent. Soc., III, Plate VIII.



DECEMBER 13TH, 1917.

The one hundred forty-seventh meeting of the Society was held in the usual place, President Potter in the chair. Other members present: Messrs. Bridwell, Crawford, Ehrhorn, Fullaway, Pemberton, Swezey, Timberlake and Wilder.

Minutes of previous meeting read and approved.

The Committee on dispositon of "types" of Hawaiian insects, submitted a recommendation that the Society establish a collection to be located at present in the Entomological Department of the Experiment Station of the Hawaiian Sugar Planters' Association, to be in the custody of the Executive Committee, and to be maintained especially for the deposition of types. The recommendation was unanimously approved.

Mr. F. X. Williams was elected to active membership in the Society.

The Treasurer's report for the year was submitted. It showed a balance of $19.51, and was accepted subject to being audited.

OFFICERS ELECTED FOR 1918:

President.....C. E. PEMBERTON
Vice-President.....P. H. TIMBERLAKE
Secretary-Treasurer.....D. T. FULLAWAY

NOTES AND EXHIBITIONS.

Scolia manilae.—Mr. Bridwell reported finding recently a female of this recently introduced wasp in Makiki Valley at least a mile from where any had been liberated.

Trypoxylon sp.—Mr. Timberlake exhibited a nest of this wasp made in a glass pipette, less than one-fourth inch in diameter and open at the top. The wasp had made the nest while the pipette was standing in a rack in the chemical laboratory.

Trioza sp.—Mr. Ehrhorn exhibited the peculiar larva of a Psyllid, taken by him on a canna leaf.

Gryllus pacificus.—Mr. Swezey exhibited sticks of sugar cane from a field in Oahu Sugar Company's plantation, showing large holes which had been eaten by this cricket. A large number were thus eaten in parts of the field. It was the first record of injury to cane by this cricket.

Phanerotoma sp.—A cocoon of this Braconid was found by Mr. Rosa near the remains of the larva of *Caryoborus gonagra* in a *Cassia* pod. In another case a cocoon of the same Braconid was found near the remains of a Lepidopterous larva in a *Cassia* pod.

Annual Address.

BY W. R. R. POTTER.

Before presenting these notes for the guidance of fellow members of the Hawaiian Entomological Society in the Art of Illustrating and the various means whereby they may most easily attain the end desired I wish to thank Mr. Fullaway for the public spirit he showed in assuming at a moment's notice the duties of the Secretary, Captain H. T. Osborn, when the latter was called to the Reserve Officers' Training Camp.

The methods used in reproducing photographs wash line and pencil drawings are very little understood by the average man and it is with the idea of simplifying matters for the engraver and the entomologist that these brief notes are written.

We will first take up the production of a line drawing. A line drawing is a drawing made with pen or brush, as distinguished from one made by washes of monochrome or sepia. We will assume that the specimen has been drawn in pencil and the author wishes it reproduced as a figure or plate to accompany his article for publication. The material required: Ross board, Winsor & Newton's Mandarin ink, a piece of blue transfer paper that will give easily discernible blue lines when traced, having been procured, we will proceed to produce a drawing that will satisfy both illustrator and engraver. Your

drawing we take for granted has been made two or three diameters larger than it is desired to appear as a finished plate. The advantages of drawing larger than the size of the illustration required, is that it allows of a coarser line which is conducive to blackness or density in the lines used. This is an all-important matter. Drawings made the same size generally have a lot of weak lines which are reproduced in the negative as grey as distinguished from the clear glass of a black line. The grey line in the engraver's parlance comes up "rotten" and not giving sufficient resistance to the acid used in etching, is etched away or lost and the engraving assumes a bald or ragged apearance. Having carefully fastened your pencil drawing by two or more corners to the Ross or Bristol board, place your transfer paper coated side down on the Ross board beneath the drawing, then take a tracing point and go over your drawing line for line, raising your copy and transfer paper at intervals to assure yourself that you have not missed any portion of the drawing. When a complete tracing has been made remove your pencil sketch and cover your copy with the exception of the portion you wish to work on with a clean piece of paper and proceed to put in your heaviest lines and portions of solid black. Your lines should curve with the curvature of the surface you are representing. Pits, protuberances and hollows should be shown by careful drawing, trying at all times to keep your lines open and free from any scratchiness and breaks. To one not used to line, stipple is far simpler and may be used to advantage. When your drawing is complete, your figures numbered or lettered, carefully rub out your tracing lines with stale bread or soft rubber, mark the reduction in blue pencil on the margin clear of the drawing and it is ready for the engraver.

We will now follow the drawing in its course of reproduction. The engraver having satisfied himself of the reduction required and focussed accurately takes a collodion plate and immerses it in a silver bath, then inserts it into a dark slide or plate-carrier and exposes it by the aid of the electric light for

a time known to be sufficient. The plate is then carried to the dark room and developed, fixed and washed, dried, coated with a rubber solution and stript from the glass, being then floated on to a thick sheet of plate glass with other negatives and put into a printing frame with a piece of sensitized zinc plate and printed, after which it is taken to the coating room and a light coating of etching ink is applied by means of a roller. This coats the whole of the plate. The parts affected by the light, the clear lines in the negative, are insoluble. The parts not affected are soluble and when the plate is washed under the faucet the soluble parts are washed away, leaving your drawing reduced to scale on a background of bright zinc. The plate is then dried and rosin is dusted on so as to strengthen the acid-resisting etching ink. It is then given a light etch sufficient to give a sharp line but of little depth. It is then further dusted to protect the sides of the lines, heated so that the resin becomes incorporated with the etching ink and etched until sufficient depth is attained. It then goes to the router, who routs out all the metal which is not wanted, and is ready for the blocker, who mounts it on a type-high block of pear or apple wood, and it is then ready for the press.

With your wash drawing the method you use is distinctly different. Your tones are secured by the depth of color applied and you assure texture by the fidelity of your drawing. The material used is Bristol board, India ink or sepia and your first wash will be of the same value and density as the lightest portion of your drawing, putting in successive washes and detail until the drawing is complete. We will now follow the wash drawing in its course thru the engraver's hands, who, to reproduce it, has to interpose a Levy screen at a known distance in front of his wet plate. These screens are ruled with lines varying from 50 to 400 lines to the inch and ruled in both directions. This when the negative is made you will find has broken up your drawing into thousands of small dots and the whole of the drawing is covered—not only the parts you have drawn but the white background as well. This is

then printed on copper in the manner outlined for zinc plates, using a sensitized enamel in place of etching ink and etched in perchloride of iron. The plate is then bevelled and mounted and made ready for the printer.

Just two methods have been briefly described and the others are more or less similar. A pencil drawing is reproduced by

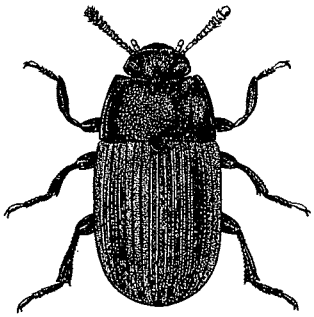


Fig. 1.

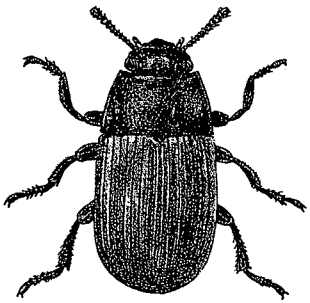


Fig. 3.

the halftone process, as is also photographs, drawings made with Conti crayon or lithographic crayon on prepared boards, having its surface specially prepared by rolling over an engraved cylinder, are reproduced without the aid of a Levy screen. The plate reproduced gives in fig. 1 a line engraving of a pen and ink sketch, in fig. 2 a halftone of a wash drawing, in fig. 3 a reproduction of a drawing on Ross's stipple board, and in fig. 4 of a pencil sketch made on

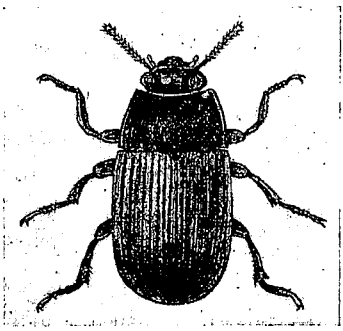


Fig. 2.

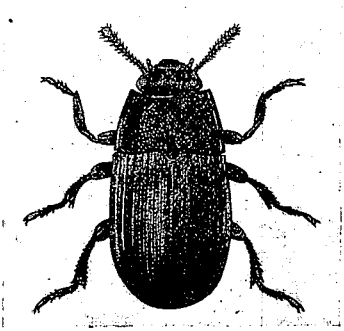


Fig. 4.

Whatman's paper and reproduced by halftone. This will give you some idea of the possibilities of each method and in conclusion it is advisable to state that black lines of good density, photographs with a fair amount of contrast and wash drawings of accurate and forceful drawing are desirable from the engraver's as well as the illustrator's point of view.

A New Genus of Pteroptricine Aphelininae (Hymenoptera).

BY D. T. FULLAWAY.

In 1913 I characterized the genus *Pteroptrichoides* to receive a truly remarkable insect bred by Mr. Jacob Kotinsky from a diaspine scale on a Bombay mango (*Leucaspis indica*?). Since then I have found other specimens of the same insect, bred from *Morganella longispina,* among which the male sex is represented, and as the original description was based on a slide mount and I now have abundant fresh as well as preserved material, I am able to add to its accuracy and completeness.

The head is transverse and the lower part, below the eyes, is strongly chitinized and protuberant. The lateral ocelli are separated from the margin of the eye by a space nearly as wide as their diameter. The antennae in both sexes are flattened outwardly. In the male the 1st and 3rd funicle joints and the three joints of the club are subequal, each a little longer than the pedicel and each fluted. The 2nd funicle joint is transverse, its length only one-third its width. The scutellum is short and wide and the posterior margin is rounded. The marginal vein is very much thickened and there is no postmarginal or stigmal.

In life *P. perkinsi* is black, the head (mostly) and a semicircular band on the thorax following the parapsidal grooves to and including the tegulae and the posterior margin of the mosonotum brown, scutellum lemon yellow, antennae and legs brown to fuscous.

The species referred at the same time to *Pteroptrichoides* and supposedly bred from *Asterolecanium pustulans* and *Howardia biclavis,* has since been recovered abundantly from the latter scale but not from the former, which I believe to be an erroneous record. It differs to such an extent from *P. perkinsi*

that the two cannot be included in the same genus, and I therefore propose a new genus for it, characterized as follows:

PSEUDOPTEROPTRIX gen. nov.

Belongs in the same category as *Pteroptrix* and *Pteroptrichoides* but wing and antennal characteristics essentially different. Short and stout, head transverse and widely impressed between the eyes, antennae attached just above the mouth, 8-jointed, scape slender, fusiform, nearly reaching vertex, flagellum stouter, pedicel obconic, less than one-half scape, 3-jointed funicle about twice the length of the pedicel, the two first joints short and narrow, almost moniliform, the 3rd wide and longer, of equal width with club, which is 3-jointed and about as long as funicle and pedicel together, flattened and fluted, the ultimate joint thin and pointed. Eyes fairly small and hairy, cheeks almost as long, ocelli forming an isosceles triangle, the anterior angle of which is obtuse, lateral members about twice their diameter from eye margin. Thorax rather flat, pronotum inconspicuous, mesonotum full and rounded, parapsidal grooves distinct, scutellum broad and rounded behind. Abdomen short and rounded behind, the ovipositor only slightly exserted, a fascia of long hairs coming from anterior lateral angle of ultimate segment. Wings with discal ciliation complete (except at very base and at apex of stigmal vein) and rather closely set, marginal ciliation short, longest on posterior margin outwardly, inwardly the margin is plainly chitinized, marginal vein shorter than submarginal and greatly thickened, the submarginal also at extremity and the short stigmal of equal width, the latter curved, no postmarginal.

P. imitatrix n. sp.

Black, legs and antennae pallid, scutellum lemon yellow often with a greenish or bluish tinge. Length .8 mm., antennae .35 mm., wing .5 mm. long, .2 mm. wide.

There is also a slide mount of this species marked "ex *Aspidiotus rapax*".

Notes on the Bruchidae and Their Parasites in the Hawaiian Islands.

BY JOHN COLBURN BRIDWELL.

Geographical.

The *Bruchidae* constitute one of the smaller families of Coleoptera, about 700 species being listed in the most recent catalogue, that of Pic (Coleopterorum Catalogus, pars. 55, 1913). In this work they are arranged in thirteen genera of which *Bruchus* alone is cosmopolitan in the sense that it extends into all the major zoogeographical regions. However, when this polymorphic genus is dismembered into its constituents it will doubtless be found that none of these are so widely distributed. Of the other genera *Spermophagus* and *Pachymerus* (=*Caryoborus* auct.) are widely distributed but do not extend into the Australian region if we include New Caledonia in the Indo-Malayan region where it belongs entomologically. *Pseudopachymerus* Pic (=*Pachymerus* auct.) has its metropolis in the Neotropical and extends into the Ethiopian and Palaearctic. *Carymenopon* occurs in the Indo-Malayan and Ethiopian regions. The remaining genera are known from a single region; *Rhaebus, Pygobruchus,* and *Kytorrhinus* from the Palaearctic; *Pygiopachymerus, Phelomerus, Impressobruchus, Megalorhipis,* from the Neotropical; *Diegobruchus* from the Ethiopian; no peculiar genera occur in the Indo-Malayan, the Australian, or the Nearctic regions. The Neotropical region has the greatest number of recorded species with about 300; next comes the Palaearctic with about 200; the Ethiopian and Nearctic have each about a hundred species known but when the African species are as well known as the North American they will doubtless approach the numbers of the Palaearctic; from the Indo-Malayan only about 50 species are recorded and from the Australian only about 10; none are known to occur in the Polynesian Islands or in New Zealand excepting those introduced through commerce.

Bruchidae Recent Immigrants Into Hawaii.

No species of *Bruchidae* are then members of endemic fauna of the Hawaiian Islands but at least eight species belonging to three genera have already become established here and several have been intercepted in quarantine inspection.

The following species have previously been reported as occurring in the Hawaiian Islands: *Bruchus obtectus* Say, the common bean weevil; *Bruchus chinensis* Linne, the cowpea weevil; *Bruchus quadrimaculatus* Fabricius, the four-spotted bean weevil; *Bruchus prosopis* Leconte, the mesquite or algaroba weevil; *Caryoborus gonagra* Fabricius, the tamarind weevil. To these may now be added (1) *Bruchus pruininus* Horn; (2) an undetermined *Bruchus* of the group of *B. chinensis* and *B. quadrimaculatus* closely related to *Bruchus ornatus* Boheman which may for convenience be termed the Dolichos weevil; and (3) a small *Spermophagus* or *Zabrotes,* as yet undetermined but perhaps identical with *Spermophagus* (*Zabrotes*) *pectoralis* Sharp. Aside from these *Bruchus pisorum* Linne and *B. rufimanus* Boheman occur commonly in imported peas (*Pisum sativum*) and broad or horse beans (*Vicia faba*) respectively.*

Table of Hawaiian *Bruchidae.*

The recognition of these species may perhaps be facilitated by the following table:

1. Hind femora slender, without teeth of any kind, hind tibiae with weak spinules within and two stout movable spines at the apex. A small, compact species, the female with two whitish transverse spots of pubescence on the sides of the elytra near the middle.....*Zabrotes.*

* In discussing these species I have preferred, in the absence of any general acceptance of any one set of proposed emendations of the nomenclature of the species and genera and lacking the necessary time or literature to arrive at independent conclusions, to use the terms in general use. At the same time I fully recognize the desirability of separating the natural genera confused under the old genus *Bruchus* and also the necessity of basing coleopterous nomenclature on the law of priority.

Hind femora thickened, with one tooth or more beneath near the apex ..... 2.

2. Hind femora strongly swollen, with several teeth beneath. A large, rather elongate species, reddish brown throughout ..... *Caryoborus gonagra.*
Hind femora less swollen, with one or two teeth and sometimes two denticles..... 3.

3. Hind femora with one tooth without and one within..... 4.
Hind femora with one tooth, with or without denticles.... 6.

4. Form compact, posterior middle lobe of pronotum clothed with snowy-white pubescence, antennae of male pectinate ..... *Bruchus chinensis*
Form more slender, pubescence of middle lobe dull, antennae of male serrate..... 5.

5. Smaller, pronotum and elytra more sparsely pubescent, integument of elytra dark along the lateral and hind margins usually expanded in the female into a dark semicircular spot, integument of pronotum largely dark, pygidium of female with large, distinctly separated, lateral, integumentary dark spots, outer subapical tooth of hind femora acute ..... *Bruchus quadrimaculatus*
Larger, pronotum and elytra more densely pubescent, pronotum and elytra reddish, narrowly crescentic dark integumentary spot on the sides of the elytra, pygidium of female reddish with a dark narrowly divided subapical cloudy spot, outer subapical tooth of hind femora blunt..... *Dolichos weevil*

6. Pronotum with a blunt obsolescent tooth on either side near the middle, hind femora with a single tooth..... 7.
Pronotum with the sides evenly rounded, hind femora with one tooth, with or without two denticles..... 8.

7. Hind femora acutely toothed, pronotum broader, pygidium with two definite dark spots..... *Bruchus pisorum*
Hind femora obtusely or obsoletely toothed, pronotum narrower, dark spots of pygidium absent or poorly defined.... *Bruchus rufimanus*

8. Hind femora with one tooth and no denticles. A small, compact species, entirely leaden gray above..... ..... *Bruchus pruininus*
9. Hind femora with one tooth and two denticles beyond the tooth. Larger, more elongate species, more or less mottled or marked above.....9.
9. Elytra reddish, hind femora entirely reddish, pygidium more nearly horizontal, sides of three ventral segments visible from above.....*Bruchus prosopis*
   Elytra dark, hind femora dark above, pygidium more nearly vertical, no ventral segments visible from above..... .....*Bruchus obtectus*

Bruchus pruininus.

Bruchus pruininus was taken in August, 1917, while sweeping beneath a clump of the bushes of *Leucaena glauca,* locally known as false koa or koa haole, from a fancied resemblance to the leaf-bearing shoots or young trees of *Acacia koa.* The plant was investigated as a host plant and *B. pruininus* has since been bred in large numbers from its seeds, both those naturally infested and those with eggs deposited on them by the beetles in captivity.

The pods of *Leucaena* are flat, about six inches long by a half inch broad, and contain about a dozen rich brown flat ovate seeds. They are produced in great abundance and hang in clusters upon the bushes for some time after they have ripened and turned brown. Then they split apart from the edges in the middle and thus the seeds are exposed for a little while before they drop to the ground and during this period a few of the eggs are deposited on them. Apparently most of them are, however, laid after the seeds have dropped. I have seen no signs of any eggs being laid upon the pods of this plant or on those of any other of its host plants. In one instance the eggs of this species were found deposited upon the seeds of indigo. (*Indigifera anil*) and subsequently some undersized adults emerged. The pods of the indigo are small and curved

and remain attached to the plant for long periods after they have split open and exposed the little blackish seeds but little larger than a full-sized adult *B. pruininus*. I have also found it attacking the seeds of *Sesbania sesban* in the open. In this plant the pods are long and slender and hang for a long time upon the tree, in time splitting open on one side so as to permit oviposition upon the seeds, though the opening is so narrow as to cause one to wonder how the beetle is able to reach them. The adults from these seeds are also somewhat under-sized. From less than a pint of these seeds I secured more than a thousand seeds upon which eggs had been laid, and a large part of these later produced beetles. It has been recorded from California as breeding in the seeds of the desert iron wood (*Olneya tesota*), from black locust (*Robinia pseudacacia*) and from some of the introduced species of *Acacia*.

In confinement I have induced *Bruchus pruininus* to oviposit upon 44 species of seeds, as may be seen in the table presented further on in this paper. Of these *Glycine hispida, Arachis hypogaea, Prosopis juliflora, Cassia fistula, C. nodosa, Desmodium uncinatum, Albizzia saponaria, Desmanthus virgatus, Acacia koa,* and *Caesalpinia pulcherrima* can serve as larval food and from them adults have been bred. It is hardly to be expected that any of these excepting perhaps *Desmanthus* and *Albizzia saponaria* will be found infested naturally.

Bruchus pruininus is easily reared in captivity, the adults mating immediately after emergence, the females ovipositing in about three days. The adults in nature visit the flowers of the host plants and feed upon the pollen. On the heads of *Leucaena* they soon work their way down among the stamens and remain for some time. In captivity they readily feed upon nectar, sugar and water, or honey, and if fed will live for a number of days. I should judge that they may live for a month or more. Feeding need not precede oviposition though apparently it does normally.

In mating the hind tibiae of the male are bent beneath the abdomen of the female, while the front and middle legs keep

up a tickling movement on the edges of the elytra and abdomen of the female, which responds with occasional slow kicking movements of her hind legs against the sternum of the male, which tends to dislodge him from his position.

The eggs of *Bruchus pruininus* are of a type common among Bruchid eggs broadly ovate and flattened by the glue-like substance which cements them to the seed, entirely covering the egg and affording after hardening a strong support from which the first-stage larva works in penetrating the tough seedcoat. As will be seen in a later discussion the female exercises but little discrimination in oviposition with regard to the fitness of the seed for larval food. Several eggs may be laid upon a single seed but the seed of *Leucaena* can supply nourishment for only about three larvae. A single larva can develop in an indigo or sesban seed, while in captivity several large individuals can be bred from a single kernel of a peanut.

None of the plants in which *Bruchus pruininus* breeds in the Islands is of any particular economic value at present and all are so free-seeding that it plays very little part in checking their spread. Whether it will continue to breed in stored seeds indefinitely remains to be seen. It is easy enough by securing unopened pods to keep seed free from infestation.

It is impossible to say with any certainty when *Bruchus pruininus* made its way into the Islands but the method of its coming is indicated by some notes accompanying some specimens of the species contained in the entomological collections of the Hawaii Agricultural Experiment Station. They were taken by Mr. Van Dine from a package of seeds of *Acacia mollissima* purchased from the Cox Seed Company, San Francisco, Cal., in 1904. This note by Van Dine under the head of Insect Enemies of the black wattle (*Acacia decurrens*) appears to refer to this insect, "An undescribed species of weevil (*Bruchus*) was taken from seeds purchased in San Francisco. It was presumably introduced into California from Australia or South Africa." There can be little doubt, however, of its

identity with *B. pruininus,* with the description of which it agrees. The insect is apparently extending its range in California since I have seen specimens taken by Mr. Swezey at Chico, while all the earlier records were from Southern California. Its establishment in the Hawaiian Islands was not, however, probably due to this particular shipment of seed, since this was probably fumigated at once, as is the custom there. It must, however, have been established from similar shipments about that time or earlier, since I am informed by Mr. David Haughs, plantings of *Acacia mollissima* and *A. decurrens* have practically ceased since that time because these trees have not proved adaptable to Hawaiian conditions.

Bruchus pruininus has been found generally distributed wherever looked for in the warmer coastal belt of Oahu and has been taken by Mr. Swezey in similar localities on Maui.

The Dolichos Weevil.

Mr. Swezey bred the Dolichos weevil in 1908 from the beans of a white variety of *Dolichos lablab* escaped from cultivation, and called my attention to it and to its peculiar method of oviposition upon the pods of its host-plant. The eggs are laid upon the pods often while still quite green in masses of from three to six and are attached to each other and to the pod by means of a glue-like substance extruded by the female, as are the single eggs of *B. pruininus* and many other species. The larvae from an egg mass enter a single bean and develop there, practically destroying it during their development. Upon emerging from the bean the adults pair immediately and eggs are laid within 24 hours. These eggs instead of being laid in egg masses are scattered singly over the surface of the other beans of the pod, several upon each bean. From 133 beans of a dark variety of *Dolichos lablab* naturally infested in the pods in the field, 563 weevils emerged or an average of 4.23 weevils. From 296 beans of a white-seeded variety also apparently naturally infested, 1286 adults were produced or 4.34 per bean. The greatest number of adults for any one bean

was 14 and the greatest number of adults were produced from beans developing 4 and 5 adults in the first lot and from those developing 5 adults in the second. The adults emerge from the pod by cutting circular openings similar to those made in emerging from the bean.

The Dolichos weevil apparently breeds commonly here only in *Dolichos lablab,* though I have found the eggs on the pods of the lima bean (*Phaseolus lunatus*) and have bred one diminutive individual from a lima bean apparently naturally infested. In captivity I have succeeded in breeding it from the pigeon pea, cowpea, soy bean, chick pea, adsuki bean, broad bean, mung bean and common pea. Repeated experiments failed to induce it to breed in common beans.

The Dolichos weevil is rather short-lived in confinement and I doubt if it will succeed in maintaining itself in storage though I have bred it from old cowpeas and Dolichos beans in which the cotyledons were very tough and hard. My breedings gave from 40 to 55 days as the period required for its development from egg to adult during the cooler part of the year in Honolulu.

Dolichos lablab, locally known as the papapa bean, is used to some extent as food, but the weevil would seriously interfere with its further use since the weevil is generally distributed and abundant. Dr. H. L. Lyon, who has been studying the varieties of *Dolichos,* tells me that it has often prevented his securing satisfactory seed. In examining some of his samples of seeds grown by him it is interesting to note that all varieties grown except one known as *Dolichos sudanensis* were attacked by this weevil. What were said to be samples of the original stocks of seed secured from a seed company in Philadelphia and from a German firm were infested, apparently having been infested at the time they were brought into the Islands. These shipments were long subsequent to the establishment of the weevil as shown by Mr. Swezey's breeding it in 1908.

The species appears closely related to *Bruchus quadrimacu-*

latus and is probably, like that species, Oriental, or possibly, African, like its host-plant.

Bruchus obtectus in Hawaii.

Bruchus obtectus was reported by Van Dine in 1904 as bred from stored beans from Kauai and has been frequently bred since then from beans purchased in stores in Honolulu but there has always been some uncertainty as to the source of the material from which they had been bred and in consequence some uncertainty as to its status here. I have seen abundant material bred from beans grown in Honolulu and from the island of Maui. No doubt remains as to its establishment and its presence in such abundance as to form a serious problem in the local production of beans. Its presence necessitates the fumigation of all of the large crop produced on Maui. While the data at hand do not indicate the time required for development there can be no doubt that from eight to ten generations may be produced in a year and that breeding is continuous here in stored beans infested while in the field.

Lima beans and tepary beans may be readily infested experimentally and the former have been found appreciably injured in the field. It is curious that the individuals developing at the expense of lima beans are much smaller than those from either common or tepary beans. This is also true of the individuals of *Bruchus quadrimaculatus* and the Dolichos weevil bred from the same host. I have so far been unable to rear the bean weevil from other beans and peas, though my experiments are as yet inconclusive.

From 187 beans of three different varieties including red kidney and bayou, the third of a similar size, all naturally infested in the field, 370 weevils emerged or a little less than 2 per bean. Of these 115 emerged from beans which produced only a single beetle.

Bruchus chinensis in Hawaii.

This species has been recorded elsewhere as breeding in seeds of *Phaseolus radiatus* (=*articulatus*), *Phaseolus mungo, P. vulgaris, Cajanus indicus, Pisum sativum, Ervum lens, Cicer arietinum, Dolichos lablab, Glycine hispida, Vigna chinensis,* and indefinitely from beans. It is common here, attacking pigeon peas in the field, the eggs being laid either upon the unbroken pod or if the pod has cracked open, as is common when the ripe pods have remained for some time on the bushes, upon the peas. When the eggs have been laid upon the pod and adults have bred out from the peas, they mate and oviposit before cutting their way out of the pod. Oviposition takes place within a few hours after emergence and mating, often within a few minutes.

Experimentally I have been able to secure oviposition upon 40 species of leguminous seeds and adults have been bred from *Phaseolus articulatus, P. aureus, Vigna chinensis, Cajanus indicus, Glycine hispida, Cicer arietinum, Vicia faba,* and *Pisum sativum.* Repeated experiments have failed to secure breeding in common beans, lima beans, tepary beans.

Bruchus chinensis has the shortest life cycle of any of the species studied, adults often emerging during the winter season here in 29 days from oviposition.

In storage *B. chinensis* does not seem to be able to hold its own in competition with *B. quadrimaculatus* though why this should be true is not apparent since in the only experiment made when adsuki beans were placed with large numbers of adults of both species *B. chinensis* emerged in large numbers from the infested beans in due time.

Bruchus quadrimaculatus.

This species has been met with here only as a stored bean and pea weevil, in no case so far has it been found depositing its eggs upon the pods of its host-plants in the field. In one instance the pods of pigeon peas were picked from the imme-

diate vicinity of a building in which the adults were emerging in large numbers from the stored pigeon peas and cowpeas but only *B. chinensis* emerged from the peas. In North America it readily attacks its hosts in the field but in India this tendency to limit its attacks to stored seeds has been noted.

The species is recorded as breeding in cowpeas and peas. I have bred it experimentally from *Phaseolus lunatus, P. articulatus, P. aureus, P. acutifolius, Vigna chinensis, Vigna lutea, Cajanus indicus, Dolichos lablab, D. sudanensis, Glycine hispida, Cicer arietinum, Vicia faba,* and *Pisum sativum.*

It requires from 40 to 50 days to complete its transformations during the winter season in Honolulu. Mating and oviposition take place shortly after emergence from the seed.

Bruchus prosopis.

This species was originally described from the Colorado Desert of California but is now known also from South America and may well have reached us from there. In California, Arizona and Texas it is known to breed in the seeds of *Prosopis glandulosa* and *velutina,* mesquite, and *P. pubescens,* the screw bean. It has been known for many years in Hawaii as a serious enemy of the algaroba or kiawe, *Prosopis juliflora.* Mr. Fullaway records breeding it from pigeon peas, but this has not come under my observation.

Adults of *Bruchus prosopis* confined in tubes feed readily on sugar and water and upon the syrupy fluid in the pods of its host-plant, but I was for a long time unable to secure normal oviposition. Several scattered eggs were seen which later disappeared, laid at random without cement to attach them. One was placed in a crevice in the hilum of a velvet bean and another under a flap of the cuticle on a *Prosopis* pod. The habits of the closely related bean bruchus suggested that it might perhaps oviposit in crevices, but the account given by Mr. Fullaway in the Hawaii Ag. Exp. Sta. Rept. for 1912 had led me to expect an egg cemented to the surface of the pod. However, failing to secure such oviposition and failing to find

any differences among the bruchid eggs deposited on the surface of the *Prosopis* pods, some of the pods were examined for openings and in the syrupy pulp of the pods were found some eggs resemblnig those of *B. obtectus,* eight or ten in a place which had been deposited through accidental openings through the cuticle and fibrous layer of the pod. Upon placing pods of *Prosopis,* in which similar holes had been made, with several individuals of *B. prosopis* among which were known to be females ready for oviposition, within fifteen minutes three females were observed with their ovipositors inserted through the artificial openings and eggs similar to those previously observed were found there. Accidental openings for oviposition can hardly ever fail to occur in sufficient numbers on account of the suspension of the pods on the spinose tree and their consequent swinging about in the wind against the branches and spines. Much breakage and penetration of the skin must also take place in falling. The cuticle also tends to flake away when the pod is ripe, giving the female a chance to oviposit under flaps of cuticle, and eggs are sometimes placed there.

Spermophagus sp.

Among some beans assembled by Director Westgate of the Hawaii Agricultural Experiment Station for some experimental work on the prevention of *Bruchus* injury were some lots purchased in the open market. A bruchid bred from these was found to be a species of *Spermophagus* not hitherto observed here. It is a smaller species than the American bean-weevil and shorter and more compact. In the female there is visible to the naked eye a transverse whitish spot on each elytron near the middle, while the male appears uniformly gray above. The body is black and the antennae slender in both sexes, about three-fourths as long as the head and body together and black except for the two basal joints, which are rufous. Examination of beans grown on the Station grounds showed that they too were infested by the same weevil.

Several varieties showed infestation, among them Maui calico, the Maui red, and small white navy beans. All those examined which showed infestation had been oviposited upon while in storage, as was to be seen from the presence of the eggs upon them. In most cases several eggs, from five to ten, and in one case as many as twenty-four, may be laid on a single bean. The eggs are cemented to the bean, much flattened, and nearly circular in outline. As many as 13 adults have been bred from a single mottled bean 10|16 by 5|16 in. in length and breadth, and six from a small white bean only 5|16 by 3|16 in. Examination of 102 mottled beans naturally infested gave an average of 4.77 beetles emerging from each bean. The species is speedily destructive to the beans, more so than *Bruchus obtectus*. Mr. Cowan, who had noticed this species as different from the common bean-weevil, observed it first during 1917.

If, as I have supposed it may be, this species is the species called the Mexican bean weevil by Chittenden, *Spermophagus* (*Zabrotes*) *pectoralis* Sharp, it has previously been bred from beans and cowpeas. I have been able to breed it experimentally from *Phaseolus vulgaris, P. lunatus, P. articulatus, P. acutifolius, Vigna chinensis, Cajanus indicus, Glycine hispida, Cicer arietinum,* and *Pisum sativum.*

Caryoborus gonagra.

This weevil breeds in the seeds of several trees and shrubs, among them *Tamarindus indicus, Cassia nodosa, Cassia fistula, Cassia grandis, Acacia farnesiana, Prosopis juliflora, Bauhinia tomentosa, Bauhinia monandra,* and *Caesalpinia pulcherrima.*

The eggs are laid indiscriminately on the pods of its host-plants, sometimes also on the seeds and frequently in other places where the larva has no chance whatever of finding food. It is remarkable that the newly hatched larva can find its way through the dense tissues of the pods and the hard seed coats unless it finds some food in the material penetrated. The larval stage passed within the seed resembles a *Bruchus*

larva with functional legs. The final stage is dull reddish, the integument is finely pubescent, and there are six short functional legs. If a single seed is insufficient to nourish the larva it can enter and feed upon others. When the larva is full fed the seed is usually too small to form a comfortable pupal cell and it emerges part way or entirely from it and prepares for the emergence of the adult by scraping away a circular patch on the pod until only a thin membrane remains, and spins an oval cocoon of a coarse, silk-like substance usually attaching the scrapings produced in making preparations for emergence to the edges of the opening in the seed and spinning the cocoon partly within the seed.

Bruchid Parasites in Hawaii

*Uscana semifumipennis.**

At the time of my arrival in the Islands in 1913 *Caryoborus gonagra* was one of the most abundant insects coming to light but its numbers have become much less, probably on account of the accidental introduction of the Trichogrammatid egg parasite *Uscana semifumipennis.* This has been supposed to have been introduced from Texas in 1909-10 in some work done by Mr. Fullaway in co-operation with the Federal Bureau of Entomology, but this need not be the case, since it can hardly reach the concealed eggs of *B. prosopis.* It is quite likely that it entered with some other Bruchid such as *Bruchus chinensis* or some species which has not become established and from our experience with larger and more conspicuous species it could have been present for a long time without attracting attention. It was first discovered by Mr. Fullaway in the latter part of 1910 and by 1912 he found it parasitizing about 25% of the eggs of *Caryoborus gonagra* on the pods of *Prosopis juliflora.* At the present time it seems to be even more effective since the examination of about six hundred eggs in two lots from different parts of Honolulu of similar material

* Girault, Trans. Am. Ent. Soc., 37, p. 23, 1911.

has shown a parasitization of about 90%. I have found it attacking also the eggs of *Bruchus pruininus, B. chinensis,* and the Dolichos weevil and it will probably attack any of the species depositing their eggs on the surface of pods and seeds in the field. This species must be considered a most valuable addition to the parasitic fauna of the Island, particularly since it seems to be the only known egg parasite of *Bruchidae.*

Heterospilus prosopidis.

In the same sweepings which contained the *Bruchus pruininus* were found individuals of an unfamiliar Braconid which was later bred from *B. pruininus.* It was then recognized by Mr. Fullaway as a species of *Heterospilus* introduced by him in the work before referred to. In the Annual Report of the Hawaii Agr. Expt. Sta. for 1910 he says, under the head of algaroba weevil parasites, "At the beginning of the year shipments of bean weevil parasites were received through the cooperation of the Bureau of Entomology. * * * Later a search was made to find if they had become established but this could not be demonstrated except in the case of the minute egg parasite. * * * All attempts to breed the parasites in confinement failed. * * * On advice only *Heterospilus* was released and in all 2303 were liberated. * * * The parasites were mostly liberated on the grounds of the experiment station. One lot of 250 specimens was released on the Alexander & Baldwin plantation at Puunene, Maui, another lot of 200 on the Isenberg ranch at Waialae, Oahu, and another of 100 on the Molokai ranch near Kaunakakai."

This species was described in 1911 by Viereck (Proc. U. S. Nat. Mus. 38:381) as *Heterospilus prosopidis* from Texas and Louisiana and Cushman (Journ. Econ. Ent. 11:489-509) records it as a parasite there of *Bruchus prosopis* bred from *Prosopis pubescens, Bruchus exiguus* breeding in seeds of *Amorpha fruticosa, Bruchus ochraceus* breeding in the two-seeded pods of a species of *Vicia, Bruchus sallei* breeding in pods of *Gleditsia triacanthos* and *Bruchus bisignatus* bred from *Acuan*

illinoensis. I have bred it in Honolulu during 1917 from *Bruchus prosopis* in the pods of *Prosopis juliflora,* from the dolichos weevil in the beans of *Dolichos lablab* within the pods, from *Bruchus pruininus* in the seeds of *Leucaena glauca* on the ground, and from *Bruchus chinensis* in pigeon peas.

It has not been observed in the Islands before since its introduction, but it may now be found quite commonly beneath the *Leucaena* bushes or bred in numbers from its various hosts.

The adults mate readily in captivity with but little preliminary courtship and the females oviposit readily in captivity in the seeds of *Leucaena,* in the pods of *Dolichos* and in various bruchus-infested seeds of legumes. The female is perhaps attracted by the movements of the bruchus larva as it prepares for pupation, oviposition taking place when the larva is full-grown the egg frequently failing to hatch before the bruchus larva has transformed *Heterospilus* then developing at the expense of the bruchus pupa. The egg is spindle-shaped; the poles are slightly different in form; and attachment is by one end and is slightly oblique to the perpendicular; the egg may be fixed on almost any part of the bruchus larva.

The species having been introduced as parasite of *Bruchus prosopis* and not proving in Mr. Fullaway's hands easy to breed in that host in captivity, it has been interesting to learn the conditions under which it oviposits in the pods of *Prosopis.* The structure of the *Prosopis* pod as it drops from the tree would seem to prevent oviposition on account of the moderately short ovipositor of *Heterospilus.* The ripe pods of *Prosopis juliflora* in the Islands may be from five to seven or eight inches in length, a half inch in width, and about five-eights of an inch in thickness, about an eighth of an inch of material intervening between the seed and the surface of the pod. The outer layer of the pod is made up of a thin, firm cuticle supported by a very thin fibrous layer; this layer is separated from the inner layer of the pod by a soft pithy substance filled with a syrupy fluid; around each seed a firm woody layer forms a separate envelope within which the seed rests

loosely. *Bruchus prosopis* oviposits in the pod while on the tree or after it has fallen to the ground and the larva on hatching bores its way through the woody envelope and into the seed. Upon reaching full growth it has consumed the contents of the seed and has grown so large, ordinarily, as to make the seed too small for a comfortable pupal chamber. It then eats its way through a hole in the seedcoat, gnaws away a part of the woody envelope, marks out a circle there almost cut away so as to permit the emerging adult to force its way out of the pod easily, and attaches the seed coat and the debris to the envelop to form a pupal chamber. It is at this time that the *Heterospilus* oviposits in the pod and by this time in the moister parts of Honolulu the pod lying on the ground has been wet by the rain, the syrupy fluid and pithy substance have fermented and disappeared, and the thickness intervening between the larva and the outer world has been reduced to no more than a sixteenth of an inch, which permits oviposition. Where there is less rainfall the fermentation may not take place and this does not interfere in the least with the emergence of the bruchus but I have not as yet found the *Heterospilus* breeding in such places. The thin membranous pods and thin seed coat of *Dolichos* and the seed coat of *Lucaena* thinned for the emergence of the adult present no particular mechanical obstacles to oviposition.

The position assumed by the female in oviposition is with the legs widely separated and the abdomen slightly bent down. The sheaths of the ovipositor are used to stiffen and guide the ovipositor during the act of penetrating the pod or seed, and during the act of oviposition and while removing the ovipositor are moved slowly up and down. The sheath bases and ovipositor base are rather widely separated and while the ovipositor is inserted the thicker terminal parts of the sheaths grasp the ovipositor longitudinally and the slender basal portion of the sheaths are sharply bent to form a sort of support for it. I have been unable to distinguish the actual passage of the egg along the ovipositor or to observe an actual stinging of the

bruchus larva though it probably takes place. In captivity I have succeeded in getting the *Heterospilus* to oviposit in the cocoon of *Caryoborus gonagra* though as yet I cannot say if it will develop at its expense. I have not found it attacking it in nature. Doubtless it will be found parasitizing the other species of *Bruchus* whenever favorable conditions offer in the field.

I have been able to distinguish three larval stages in *Heterospilus* and there are doubtless one or two intermediate ones not observed. The first resembles in a general way the first larval stage of the Opiine Braconids, as observed by Mr. Pemberton, though the head is, perhaps, somewhat less chitinized. The second stage is fusiform and somewhat flattened and the head is without mandibles. It is migratory and so far as I have been able to learn usually locates itself in a dorsal position on its host, in the cases observed upon the thorax. The final larva is of the usual eruciform type with mandibles and feebly chitinized head. The full-grown larva spins an elliptical brownish white silken cocoon within the pupal chamber of the bruchus host and the adult emerges from the seed or pod of the host plant through a circular emergence hole somewhat smaller than that of the bruchus

Heterospilus prosopidis is quite variable in size according to the size of its host. Those from *Bruchus prosopis,* the largest of its local hosts, being much larger than those from the little *Bruchus pruininus.*

On account of the brief period in the life of its hosts in which it can attack them, only a small proportion are parasitized, certainly not more than 10–15%. It would seem therefore to be of but minor importance in the control of Bruchids. I should not expect it to attack Bruchids in stored peas and beans.

A New *Scleroderma* Attacking *Bruchidae.*

Early in November, 1917, while examining old pods of *Prosopis juliflora* on John Ena road, Waikiki, I found a female *Scleroderma* which, however, escaped before I could exam-

ine it carefully. On November 23, while examining pods of *Acacia farnesiana* infested by *Caryoborus gonagra* along the Diamond Head road on the southeastern side of Diamond Head, I found several females of the same species without being able to note any indication of host relations. Since all of our species hitherto found in the mountains under conditions indicating their endemicity so far as their host relations are known have been parasitic upon various lepidopterous larvae, it seemed possible this species might be connected with the klu tortricid (*Cryptophlebia illepida*). However when a larva of this species had been found and placed with the *Scleroderma* no interest whatever was shown. On further search, a cocoon of *Caryoborus gonagra* was found containing the *Caryoborus* larva, a female *Scleroderma,* and three hymenopterous larvae. After this, two *Caryoborus* cocoons were found each containing remains of the *Caryoborus* larva, a female *Scleroderma,* and a compactly massed cluster of brownish, elliptical, hymenopterous cocoons, perhaps a dozen in a cluster. From one of these, sixteen days later, the first female *Scleroderma* emerged. Several of the *Scleroderma* were placed with the cocoons of *Caryoborus* and the pupal chambers of *Bruchus prosopis* and they immediately became interested in affecting their entrance into them by tearing away the wall with their mandibles. One cocoon of *Caryoborus* opened sixteen days later contained the *Caryoborus* larva, the female *Scleroderma,* and eight thick elliptical eggs, very large in proportion to the *Scleroderma* and scattered about indiscriminately in the cocoon.

This finding of the female *Scleroderma* remaining within the cocoons, not only until the eggs are laid but afterward until the larvae have hatched and become full fed and pupated, is of considerable interest and has also been observed in connection with the endemic species. There would seem to be some approach to maternal care of the larva. It may, however, be due merely to the slow maturing of the eggs.

In 1909, Mr. Swezey took the same *Scleroderma* upon a Cycad stem at Lihue, Kauai, and there are specimens of ap-

parently the same species in the collection of the Board of Agriculture and Forestry taken by Mr. Ehrhorn in Honolulu and labeled "from *Prosoplus*", which is one of our immigrant *Cerambycidae*.

The hitherto known Hawaiian species of *Scleroderma* are supposed to be endemic and are, as has been said, parasitic upon lepidopterous larvae. So far as I have been able to examine them characters have been seen which suggest their separation into a group of perhaps subgeneric rank owing to the presence of rudimentary ocelli in the female. The present species is known only in the female sex and has not the slightest trace of ocelli. It is believed to be an immigrant perhaps from the Orient and is here described as new.

Scleroderma immigrans sp. nov.

Female apterous, ocelli and scutellum entirely lacking. Head oblong, anterior, lateral, and posterior margins almost straight; eyes oval, facetted, more than twice their length from the occipital margin of the head and about twice their width from each other; with broad distinct malar and genal spaces; mandibles stout and tridentate; antennae approximate, inserted near the anterior margin of the head, 13-jointed; scape slightly incrassate, curved, about one-third the length of the flagellum; pedicel one-half the width of the scape, about as long as the first three joints of the flagellum; flagellum stout, broadest at the base of the apical segment which is a little longer than broad, the other segments broader than long.

Thorax a little narrower than the head, nearly twice as long as broad, broadest in the middle where the pleurae project beyond the mesonotum; pronotum narrowed abruptly in front to a marrow neck, behind this evenly but slightly wider to the mesonotum, a little longer than wide, the posterior margin nearly straight; mesonotum subtriangular, evenly rounded behind; propodeum a little longer than broad slightly broader behind, rounded down to the declivity.

Legs rather stout; anterior femora somewhat incrassate; anterior and middle tibiae a little shorter than their femora; hind tibiae a little more slender and a little longer than their femora; tarsi longer than their tibiae or femora, the basal joint about as long as the three following joints together, apical joint about as long as the two preceding joints together.

Abdomen broader than the head, elongate, a little longer than the head and thorax together; first tergite rounded, occupying but little of the dorsal aspect of the abdomen, tergites two, three, four subequal in length, a little broader than long; tergites 2-5 with the posterior margins triarcuately depressed; ultimate segment acute.

Testaceous sometimes drying to piceous, tergites 1-5 castaneous ex-

cept at the sutures, eyes black, mesonotum, mesopleurae, middle femora, and head somewhat darker than the other light portions of the body.

Head, thorax and abdomen minutely tessellate, shining, the propodeum somewhat duller. Head with a few scattered minute punctures. Antennae minutely pubescent; head, thorax and abdomen, particularly at apex, with a few scattered hairs; front and hind tibiae sparsely ciliate within, middle tibiae densely so on the outer side.

2.75 mm. long.

Described from 13 individuals taken from the pods of *Acacia farnesiana* on Diamond Head road, Oahu, Hawaiian Islands, on November 23, 1917, where they were parasitizing the larvae of the bruchid *Caryoborus gonagra.* Of these one has been designated as the type and deposited in the collection of the Hawaiian Entomological Society. The remaining are in the collection of the author and are designated as paratypes.

Scleroderma immigrans does not seem to be able to parasitize any great proportion of the larvae of *Caryoborus gonagra.* I should estimate that not more than 10% of the cocoons examined in the place where it was found were affected and I have not found it elsewhere in Honolulu upon this host. If Mr. Ehrhorn's material are, as I have supposed, of the same species, we may expect it to attack various other species of coleopterous larvae.

A Eupelmine Occasionally Attacking *Bruchidae,* Forming the Type of *Charitopodinus* gen. nov.

While sweeping for material on an embankment in the rice fields at Waikiki where seeds of *Leucaena glauca* were scattered on the ground and being attacked by the *Bruchus pruininus,* I took a single wingless female of a dark blue *Eupelmine* which I later placed with seeds of *Prosopis juliflora* infested with *Bruchus prosopis.* After a time she was observed in the act of oviposition and on a later examination of the seed in which oviposition had taken place there was found a pupa of the Prosopis bruchus which appeared to be too far advanced for the development of the parasite. There had been deposited two of its elliptical eggs, one on the dorsal side of the thorax and the other on the ventral side of the abdomen. Another pupa of *B. prosopis* in about the same stage was later found with a full-fed larva on the dorsal aspect of its abdomen and

this latter pupated; so the parasite can develop on very advanced pupae, or perhaps we may say upon tenerous adults. In all five adults have been bred from *Bruchus prosopis,* mostly larvae. Since this paragraph was written I have bred this parasite from *Bruchus pruininus* under natural conditions in the seeds of *Sesbania sesban.* Mr. Timberlake has succeeded in breeding five adult females from the cocoons of *Caryoborus gonagra.* These were the progeny of a virgin female which I had furnished him. Whether this species is more than an occasional parasite of *Bruchidae* is doubtful since it proves to be the insect bred by Mr. Swezey from *Isosoma* and described by Mr. Crawford as *Eupelminus swezeyi* (Insec. Ins. Menst. 2:181, 1914). By a *lapsus calami* Mr. Crawford assigns the *Isosoma* from which it was bred to Johnson grass instead of Bermuda grass. Mr. Swezey has also bred it from the cocoons of *Chelonus blackburni* and from a *Cryptid* cocoon. It was taken as early as June, 1905, on Oahu by Mr. Swezey and in May, 1906, on Kauai by Mr. Terry and it was doubtless an immigrant from the Orient since there are five specimens in the collection of the Hawaiian Sugar Planters' Association taken by Mr. Muir at Macao.

This species differs so much from the type of the genus *Eupleminus, E. excavatus,* that it must be placed in a separate genus, particularly since specimens in the collection of the Hawaiian Sugar Planters' Association represent another species taken by Mr. Terry in China, agreeing with it in all the generic characters.

Charitopodinus gen. nov.

Type *Eupelminus swezeyi* Crawford.

Related to *Charitopus* Foerster but with but one pair of rudimentary wings in the female, the male unknown. Head broader than the thorax or abdomen, convex before and behind, slightly concave at the insertion of the neck, malar furrow very distinct, eyes oval, ocelli arranged in an obtuse triangle upon the vertex; antennae with scape cylindrical, slightly curved, not quite half as long as the flagellum, flagellum slender, gradually widening to the club, pedicel one-third longer than the first funicular joint, 1st funicular joint about half the length of the second, 2-4

subequal, others successively shorter, last two quadrate, club with three closely fused joints, ovate, funicular joints 5 and beyond and the club joints with rows of elongate sensoria, a few also on 3 and 4; mandibles short and stout, tridentate, the two upper teeth blunt, the lower one more produced and somewhat acute; labial palpi 3-jointed, third joint about as long as the other two, second short and oblique; maxillary palpi 4-jointed, the last joint about as long as the other three expanded suboval with one side straight.

Thorax more than one and a half as long as wide; pronotum quadrate, with a transverse median ridge upon which are two pencils of long erect blackish bristles, impressed behind the ridge; mesonotum oblong, slightly narrowed behind, rounded in front, excavated behind, a short furrow in the bottom of the excavation, lateral margins abruptly deflexed at an acute angle and the extreme edge then reflexed, a row of erect silvery cilia in the furrow thus formed, there is thus a profound furrow between the disc of the mesonotum and the prepectoral plate and the large elongate tegula; axillary furrows confluent in front, the scutellum therefore not reaching the mesonotum; a brush of about three close-set rows of erect silvery cilia on the mesosternum along the sternopleural suture.

With one pair of rudimentary wings about as long as the scutellum, consisting of a basal chitinous portion bearing a stout erect blackish bristle and an apical hyaline portion of about the same length with a longitudinal submedian vein, ciliate with erect silvery cilia.

Legs slender, anterior femora slightly thicker; plantar surface of middle tarsi with a shallow groove, basitarsus swollen with the margin of the groove ciliate with very fine hairs but very little different from those of the general surface of the joint, without the spines characteristic of the *Eupelminae,* a minute black dot on either side of the plantar surface of the basitarsus and the second tarsal joint a little before the apex, a single fine bristle on either side of the plantar surface of the second and following tarsal joints near the apex, apex of middle tibiae within bearing a row of short stout black spines, the calcar a little longer than the basitarsi; tarsi of hind legs bearing two feeble calcaria.

Abdomen with the first tergite deeply excised, 2d-4th decreasingly sinuate.

The genus runs to *Charitopus* in Ashmead's tables of *Eupelminae* but would seem to differ by the excavated mesonotum as well as the rudimentary wings in the female. From *Eupelminus* the absence of plantar spines on the middle tarsi, the more elongate and less excavated mesonotum, the less elongate axillae, and the excised tergites and other characters abundantly separate it.

The two species referable to this genus are distinguishable thus:

Tegulae, prepectoral plates, and sides of mesonotum metallic, pronotal bristles about as long as the pronotum------*C. swezeyi*
Tegulae, prepectoral plates, and sides of mesonotum yellowish, pronotal bristles shorter----------*C. terryi* n. sp.

Charitopodinus swezeyi (Crawford). Mr. Crawford's description of this species may be supplemented further by these additions: Middle tarsi except apical joint, calcar except extreme apex, and tibia at base and apex pale, a pale elongate spot on the ovipositor sheaths above.

I have seen 23 examples of this species which vary greatly in size according to the host from which they have been bred. No males have been seen.

Charitopodinus terryi n. sp. Resembles *C. swezeyi* in minute details of pubescence and sculpture. The coloration differs in no significant way except as indicated above and in the pale markings of the hind legs. Hind tarsi except apical joint, apex of tibiae, trochanters, and coxae at summit pale while the hind legs in *C. swezeyi* are dark throughout. The two specimens before me are 3.6 mm. in length larger than the original specimens of *C. swezeyi* but not any larger than specimens of that species bred from *Bruchus prosopis.*

Described from two females collected by the late F. W. Terry at Kow Loon, China, in 1908, one of which has been designated as the type and the other as a paratype. Type and paratype in the collection of the Hawaiian Sugar Planters' Association.

Pteromalids Attacking *Bruchidae.*

At various times I have bred from *Bruchus quadrimaculatus* infesting pigeon peas in storage a *Pteromalid* doubtfully referred to *Pteromalus calandrae* and this species has been readily bred experimentally from the Dolichos weevil and *Bruchus chinensis.* The early part of the larval stages is passed as an internal parasite of the *Bruchus* larva. When nearing full growth the *Pteromalid* larva emerges from its host and completes its development externally. A second undetermined Pteromalid has been bred from *Bruchus pruininus* breeding in the seeds of *Sesbania sesban* in the partially opened pods upon the tree.

Pediculoides ventricosus.

In all the work undertaken upon the *Bruchidae* and their parasites the mite *Pediculoides ventricosus* has been troublesome, causing the loss of much of the material worked with, parasites and *Bruchidae* alike in larval, pupal and adult stages.

I have had whole lots of eggs of *Bruchus obtectus* destroyed by it. It is not possible to judge as yet how much influence it has upon the different species under natural conditions but there can be no doubt that it is a considerable factor in all the species. Persons handling the pods of *Prosopis juliflora* and of common beans are frequently affected by a rash produced by the young mites attaching themselves to the human skin. The mites affect the weevils more generally in some seeds than in others, according to whether the texture of the seed or its covering permits ready entrance or not. Thus all my experiments with the chick pea were seriously affected and in many cases not an adult was able to emerge on account of its attacks. The mesquite weevil is particularly subject to its attacks on account of its method of forming the pupal cell. Any introductions of the larval parasites of *Bruchidae* would need to be carried on with particular care to reduce the attacks of this mite upon them.

Observations and Reflections on the Oviposition of *Bruchidae* and Some Other Insects.

Early in November of 1917 while on the lookout for material which would throw light on the habits of *Bruchus pruininus,* a tree of opiuma (*Pithecolobium dulce*) was encountered at Waikiki, beneath which were lying on the ground considerable numbers of its seeds which were found on examination to have eggs of *Caryoborus gonagra* deposited on them, mostly on the side lying next to the ground. In all about a hundred seeds bearing eggs were found beneath this tree and thirty-five or forty of them were carefully examined and in no case were larvae found in a living condition within the seed nor were there any traces of successful breeding in them. In most cases the larvae had been able to penetrate through the seed coat into the cotyledon and had perished there as the result of their first meal upon its substance. Beneath the same tree were found scattered a number of the seeds of a *Livistonia* palm and on several of these round seeds, also utterly unfit for

its food, the *Bruchid* had deposited eggs. Mr. Swezey reported, in 1912, the eggs of *Caryoborus* deposited on green bananas where they hatched and the young larvae died after eating some way into the skin of the fruit. In one case I saw its eggs densely peppered over the surface of the wooden slats of the shutters of a house. We have, then, in this species a striking failure of an insect to discriminate in regard to oviposition upon suitable material for the larval food.

In the case of the *Bruchus pruininus* I have found the eggs deposited under natural conditions on *Ipomoea* seeds, on castor beans, and on seeds of *Cassia glauca,* in none of which the larvae can breed, and on indigo seeds which give an adult so small as to suggest sexual impotence. In experimental work almost any of the legumes used would be oviposited on without regard to its suitability as larval food. It would not be difficult to assemble many similar cases among other groups of insects. Thus the Mediterranean fruitfly (*Ceratitis capitata*) seems particularly fond of ovipositing in the rough-skinned lemon locally common in Honolulu though ordinarily none of the larvae produced can mature. Mr. Pemberton has found that in captivity the Opiine parasites, *Opius humilis, Diachasma tryoni,* and *D. fullawayi,* readily oviposit in the melon fly (*Bactrocera cucurbitae*) though entirely unable to develop there. Mr. Timberlake has observed *Dinocampus terminatus* ovipositing in Coccinelids in which they fail of development. Such "failures of instinct" to employ an old-fashioned term might be dismissed as "imperfect adaptations," but they seem worthy of some consideration since they seem to me to be of some importance in the economy of the species.

I take it that oviposition is an act resulting from several sensory impulses acting together upon the female in a state of nervous tension owing to the presence in her body of eggs ready for laying. These external stimuli may be tactile, visual, or olfactory or they may be compounded of these and other factors. Oviposition then is a complex reflex and will take place whether the material encountered is suitable for

food or not. In some species the factors of the sensory stimulus are so numerous or so particular that the species will react only under very narrow limits while in others the range of reaction is much broader and in such species we find these "lapses of instinct" occurring. These are the species in which we find considerable adaptability of habits and the wide range of reaction is of value to the species since the eggs laid almost at random serve to find for the species additional sources of food which would be missed by a species reacting within narrower limits.

The adaptability so secured may, as has been shown by Cushman, serve to carry over a species on unusual food when its preferred food-plant for any reason fails to seed. This adaptability may also serve to permit wider dispersal of the species. Thus the adaptability of the *Bruchus pruininus* permitted it to shift to *Leucaena glauca* from *Acacia* after having shifted from *Olneya tesota* to the *Acacia,* and it has been able to establish itself in the Islands while the more narrowly reacting *Bruchus pisorum* appears as yet to have failed.

One of the curious things in experimental work with *Bruchidae* is that very often, as shown by breedings made under natural conditions, a species will not naturally breed in certain host plants but when confined with the seeds will oviposit and develop in them. From this it seems to me we must distinguish between the sensory stimuli which cause the *Bruchus* to approach and alight upon the larval food and the oviposition stimuli proper. The visual faculties of the insects appear to be most prominent in the former, at any rate I have seen what were apparently attempts of a *Bruchus* to settle on seeds within a glass tube and resting on the glass over them when actual contact was impossible. In the oviposition reflexes tactile stimuli through the antennae and perhaps the tarsi must play an important part.

In some cases it is possible to analyse the complex reflex of oviposition with interesting results. Mr. Timberlake has been able to show that there is an olfactory element in the

case of *Dinocampus terminatus*. By irritating a *Coccinellid*, the natural host of *Dinocampus* so that it exuded fluid from its joints and applying this juice to *Collops* he was able to secure oviposition in *Collops* but without securing development within that host. I have been able to secure a similar result in another case in which the new host was suitable for the development of the parasite.

In April, 1915, while in Capetown, I found an undetermined species of the Ichneumonid genus *Allotypa* breeding in a *Sarcophaga* the larva of which feeds in human excrement. In extensive breedings of Diptera there I did not secure it under natural conditions from any other host. The adult female lies in wait for the larva when it emerges full-grown to enter the soil for pupation and attacks it with great fury and oviposits in its body, the adult parasite emerging from the puparium which is normally developed. On studying the species in captivity, I found that, while *Sarcophaga* larvae introduced into a tube containing the parasites stirred them up into a state of the greatest excitement in which they would attack them with great fury, charging them with the abdomen projected forward between their legs, climbing upon the body of the larvae and stinging them indiscriminately on the first part encountered and even attempted to sting the glass of the tube, any other muscid larvae such as that of *Musca lusoria* living in cow dung would be received with complete indifference, hardly moving away to avoid them as they wandered about in the tube. But if to such a tube containing the *Allotypa* parasites and the *Musca lusoria* larva even a single larva of *Sarcophaga* (of any of the species) was introduced the parasites would be almost as excited as if all the larvae were those of *Sarcophaga* and in this way the parasite was induced to oviposit in the *Musca lusoria* larva and from these larvae adults of the parasite were obtained, from a host which could never be utilized in nature since the olfactory stimulus from the *Sarcophaga* could hardly in nature ever be associated with the *Musca lusoria* larva. This limitation by an olfactory factor causes a

waste by the species of large possible sources of food available if the species reacted more broadly. The advantage gained by the narrower limitation is not obvious though perhaps the species wastes no eggs and in nature must rarely fail in readily finding its host.

The complex reflex of oviposition and the physiological reactions must be, like the external physical characters of a species, subject to variation whether Mendelian or Darwinian, and it seems to me that these variations must have played a considerable part in the evolutionary process. The elimination of the olfactory limitation of *Allotypa* to the smell of the *Sarcophaga* would obviously result in a wider range of food selection for the larva, perhaps to a wider extension of the range of the species, and probably in an absolute increase in the numbers of individuals of the species produced so that it would have greater opportunity for variation whether this might be produced by internal factors, by diverse climatic conditions, by change of food, by different nautral enemies, or whatever the forces may be which result in changes in the characters of species. A new olfactory limitation might then arise and serve as a factor in species limitation and segregation.

It is interesting to revert to the *Bruchidae,* to speculate on the few species which depart from the usual habits of the family. Several species of *Caryoborus* are known to attack the seeds of palms; *C. curvipes* attacks several species of palm nuts including the cocoanut, *C. bactris* and *C. luteomarginatus* have been bred from the seeds of the carnauba palm (*Copernicia cerifera*) and an undetermined species, like the others, from South America, destroys the vegetable ivory nuts (*Phytelephas macrocarpa*), the North American *C. arthriticus* feeds in the larval stage in the seeds of palmetto. To account for the development of such food habits and the breeding of *Pseudopachymerus pandani* from Madagascar in the seeds of *Pandanus,* we need not assume that the parent species had any greater variation in its oviposition reflexes than *Caryoborus gonagra* has when it will lay its eggs on palm seeds and on

bananas. What we should need to suppose is a variation in its powers of utilizing food and we do not know how little or how great a departure from the normal this would require, nor if it would have to be variation in the structure of the larval mouth parts or of its alimentary canal, or in the composition of its digestive fluids, or in its nervous control, or all these combined. We have found the *Bruchus pruininus* ovipositing on the seeds of *Ipomoea* and here again to secure the development of the habits of such species as the North American *B. discoideus* or the South African *B. convolvuli* breeding in convolvulaceous seeds it is only variation in the powers of food utilization which would be needed. Perhaps the same is true of the North American species *B. flavicornis* and *B. hibisci* breeding in the seeds of malvaceous plants and *B. alboscutellatus* in the capsules of *Ludwigia*. In the European *B. marginellus* such variation has, perhaps, been observed or at least it has an unusual variability in the utilization of food; for while it seems ordinarily to breed in the pods of the legume, *Oxytropis glycophyllos* it has been observed breeding in the capsules of *Verbascum officinale* widely separated in botanical relationship and in other ways.

In considering evolutionary matters too often attention has been centered upon obvious structures, especially those used for the distinction of species in systemic botany and zoology. Food habits, reflexes, tropisms, and transformations are no less characters of species and have played a large part in the development of the species and require consideration when we are making out our explanations.

Leguminous Pods and Seeds with Reference to Their Infestation by *Bruchidae*.

The *Bruchidae* were without doubt descended from a Chrysomelid group in which the larvae attacked the green pods of legumes and the oviposition of such species as *Bruchus obtectus* in which the eggs are laid in crevices in the pods of the host plant may perhaps represent the primitive method of egglaying

from which later forms developed in which the eggs were cemented to the larval food. There can be but little doubt that the evolution of the *Bruchidae* has proceeded in directions limited by the peculiarities of the *Leguminosae* and there is an interesting field for work in the investigation of the factors which limit the attacks of the different species of *Bruchidae.* In some experiments summarized further on I have attempted to make a beginning on such investigation. Some of these factors are readily discerned while others remain elusive. The following notes and inferences in regard to the limitation of Bruchid attacks have seemed worth recording.

When a species of *Bruchidae* oviposits in crevices in the pods or in openings made by the female into the pod or if the eggs are cemented to the seed but not to the pod the structure of the pod and its behavior upon ripening are important factors in reference to Bruchid injury. Thus *Prosopis juliflora* is not naturally attacked by *Bruchus pruininus* because of its indehiscent pods yet it readily breeds in the seeds when the coverings are artificially removed and this is also true of the peanut and the beggar's tick (*Desmodium uncinatum*).

In the species of *Bruchidae* cementing their eggs to the larval food they may be attached either to the pods or to the seeds, or in many species either to the pods or to the seeds.

Bruchus pisorum apparently always oviposits upon the pods; *Bruchus pruininus* apparently always upon the seed; while the dolichos bruchus, *Bruchus chinensis,* and *Caryoborus gonagra* may place their eggs either upon the seeds or the pods of their host plants. In any case the larva of the Bruchid finds confronting it on hatching the work of penetrating into the cotyledons of the seed which forms its principal or perhaps its exclusive food. If the egg should have been placed upon a dry, hard, woody pod such as that of *Delonix regia* we may suppose such a barrier might serve to exhaust the reserve energy of the larva so that it would perish before it could have opportunity for feeding. I have no record of finding the seeds of this species attacked by *Caryoborus gonagra* but

there are other mechanical difficulties in the way of a Bruchid larva penetrating this seed. We may conceive of a Bruchid larva overcoming such a difficulty as this, however, and that presented by similar difficulties in the hardness of seed coats and tough albumen by timing its attempt at entering so that it would have to encounter them in an immature condition before they have hardened. Whether to serve such a purpose or not, though probably for some other reason, the pea bruchus oviposits only upon the green pods of its host plants. Now in the Islands the host plants of this *Bruchus* are but rarely cultivated and if the species should be brought in through the importation of peas, as we know has been frequently, it would rarely be able to find conditions under which it could breed. This seems to me the probable reason that this species has not as yet been able to establish itself in the Islands.

In the case of *Cassia grandis* there is within the pod in the little compartment about each seed a considerable amount of a pitchy material surrounding the seed which would serve to retard a Bruchid larva and, perhaps, to cause its death. A similar substance but much less copious in quantity is found in the pods of *Cassia fistula* but it does not in either case wholly serve to prevent the entrance of the *Caryoborus* larva.

On the outer surface of the seeds of *Bauhinia tomentosa* and *Bauhinia monandra* is a layer of material which swells up with moisture and shreds away and would serve to detach any bruchus egg attached to it. This does not serve to prevent the entrance of the *Caryoborus* larva since the eggs of that species are usually attached to the pod and the entrance of the larva is affected before the pod is opened and the seed exposed to moisture. Eggs of *Bruchus pruininus* deposited on these seeds in captivity were detached when added moisture caused the swelling and shredding away of this layer.

The surface of some seeds such as those of different species of *Crotalaria* seem to be of such a nature as to prevent the attachment of bruchus eggs. It may be, however, that there is some other reason such as odor or size which prevented ovi-

position upon them by *Bruchus pruininus* which has otherwise been quite ready to oviposit upon very diverse seeds.

The seeds of *Delonix regia, Acacia grandis,* and of *Peltophorum inerme* among others are covered with a very dense and hard covering and it is doubtful if any *Bruchid* larva could pierce them. Eggs of *Bruchus pruininus* laid on the seeds of the latter species hatched properly but could not penetrate into the cotyledon, perishing before they had pierced the seed coat. They could not, likewise, penetrate the tough seed coat of *Acacia farnesiana.*

Within the seed coat of many leguminous seeds is an albumen which is very hard and tough when dry and this may serve as a sufficient barrier to prevent the further entrance of the larva. The seeds of *Cassia glauca* resemble the seeds of *Leucaena glauca* and *Bruchus pruininus* deposits its eggs upon them freely both in the field and in captivity. The seed coat is, however, harder and there is a layer of albumen within that. The bruchus larva is able to pierce the seed coat but perishes on its way through the albumen.

Seeds, not otherwise defended from bruchus attack, may be unfit for the food of the bruchus attacking it and the larva may perish as the result of feeding on the substance of the cotyledons.

Leguminous seeds vary greatly in their composition but appear to agree in having similar proteids which, as a group, differ from the proteids of other seeds, being said to resemble animal proteids more than those of grains or oil seeds. Their proteids are mostly globulins and the globulins of different species of edible legumes are by no means identical. Thus the phaseolin of the common bean is distinctly different from the legumin and vicilin of vetches, broad beans, lentils, and peas and it is not improbable that the inability of bruchids to breed in legumes otherwise similar in composition to their host seeds may be due to the diversity of ther proteids. The seeds of many legumes, particularly the greater part of the edible legumes, contain more than half their dry weight of starch,

while others contain none at all.

In general Bruchids which breed in starchy seeds cannot breed in those without starch and *vice versa.* The soy bean in which the carbohydrate is reduced and not in the form of starch, however, serves for the development of *Bruchus chinensis, B. quadrimaculatus,* the dolichos weevil, and *Zabrotes,* species ordinarily breeding in the other starchy food legumes. Its carbohydrate is, however, of a form similar to starch and is present to about .12 of the dry weight of the seed.

In general the food legumes contain but little oil while in the peanut it may be present to .28–.45 of the weight of oil, largely replacing the starch. While the eggs of *B. chinensis, B. quadrimaculatus,* the dolichos weevil, and *Zabrotes* are readily laid upon peanuts from which the shells have been removed and their larvae enter the cotyledons and the larvae of *B. obtectus* will, likewise, enter them, none of these species can develop and I have supposed their death to be due to the oil. I was, therefore, greatly surprised to find *B. pruininus,* under similar conditions, was able to breed in peanuts, although its other host seeds contain no starch and but little oil.

Many legumes contain poisonous principles, particularly alkaloids and glucosides, and we should expect Bruchids to be affected by some of these. Probably the inability of *Caryoborus gonagra* to breed in the seeds of *Abrus precatorius,* and *Pithecolobium dulce;* upon which it oviposits, and into which the larva can penetrate, is due to poisonous principles in them.

Some seeds are so small as to prevent the oviposition of *Bruchidae* on their surface, since the insect would not be able to reach conveniently any part of the surface of the seed with its ovipositor while resting on its surface and the weight of the insect also tends to dislodge the seed and its precarious position on a small seed seem to disturb the Bruchid so as to prevent egg-laying. Thus *Bruchus pruininus,* which is very catholic in its taste in regard to oviposition, is usually unable to deposit its eggs on such small seeds as those of *Indigifera anil, Desmodium uncinatum,* the smaller-seeded *Crotalarias, Phaseolus*

semierectus, and *Medicago lupulina,* while it will readily lay them on the larger-seeded *Crotalaria,* and on indigo seeds in the pod.

The seeds of *Cassia siamea* are almost paper-thin and their form alone would seem to forbid them being utilized by any Bruchid.

Entrance of the *Bruchidae* into the Seed.

Those species which cement the egg solidly to the seed itself have the advantage of the support of the egg in penetrating into the seed and need not wander about to find a favorable point for entrance. The species which attach the seeds to the pod at times and those which place them in crevices of the pod or loose among seeds in storage have to meet the problem of placing themselves as larvae in some position where they may secure some other support for the boring operation. If the egg is cemented on the pod directly over the seed the larva will frequently find the surface of the seed lying close against the pod where it has entered and the hole made in entering the pod will serve its purpose. In any case if it misses this point in entering the pod it can easily wedge itself between the seed and pod and get its purchase in that way and the larvae from eggs laid within the pod can do the same. Larvae from eggs of *Bruchus obtectus* laid among beans in storage have been seen to enter where two seeds touch or where seed touched the glass of the tube in which they were under observation.

Emergence of *Bruchidae* from Seeds.

Considerable difference of interpretation has existed as to the emergence of *Bruchidae,* some considering that the larva makes complete preparation for the emergence of the adult while others have supposed that the adult gnaws its way out of the seed. In the case of all *Bruchidae* which I have studied the adult pushes loose from the seed a circular bit of the seed coat which has been gnawed around and loosened from the rest

of the seed coat. Upon a careful study of the emergence of *Bruchus pruininus* it was found that in this species the procedure is as follows, the observations being made on it breeding in the seeds of *Leucaena glauca*. In this plant the seeds have a thin, albuminous endosperm which the larva gnaws away more or less on either side of the seed in the latter part of its feeding period, and this is particularly the case just opposite the place where it finally places its head and which will be in contact with the future mandibles of the adult. Here appears a definite circular patch where the albumen is entirely eaten away but if this be examined during the pupal period it will be seen that the circular cut has not yet been made which permits the separation of the bit covering the emergence hole. This is undoubtedly made by the adult just before emergence by revolving in its pupal cell.

TABLE OF EXPERIMENTS WITH VARIOUS SEEDS RELATING TO THE OVIPOSITION AND BREEDING OF HAWAIIAN BRUCHIDAE.

EXPLANATION OF CHARACTERS USED.

a—oviposits but cannot develop.
b—adults have been bred.
n—no oviposition observed.
o—no experiments made, but no oviposition or infestation observed.
1—Recorded by Fullaway but not observed by me.
2—My experiments not yet conclusive, but results so far negative.
3—Apparently can breed but my results not yet conclusive.
4—Reported by Van Dine as breeding but probably erroneously.
5—Very extensive oviposition but apparently but little breeding.

Name and Origin of Seed, Etc.	Bruchus chinensis	Bruchus quadrimaculatus	Dolichos weevil	Bruchus pruininus	Bruchus obtectus	Bruchus prosopis	Spermophagus (Zabrotes) sp.	Caryoborus gonagra
Phaseolus vulgaris, common bean, cultivated locally in many varieties, supposedly of American origin; starchy	a	a	a	a	b	o	b	o
Phaseolus lunatus, lima bean, cultivated locally in several varieties, supposedly of American origin; starchy	a	b	b	a	b	o	b	o
Phaseolus articulatus, adsuki bean, red variety, imported from Japan, of Oriental origin; starchy	b	b	b	a	o	o	b	o
Phaseolus aureus, mung or mundo bean, probably imported from Japan, a greenish yellow variety, also cultivated locally to some extent, of Oriental origin; starchy	b	b	b	a	o	o	a?	o
Phaseolus acutifolius, tepary bean, recently introduced into cultivation locally, of North American origin; starchy	a	b	?	a	b	o	b	o
Phaseolus semierectus, an introduced weed, generally distributed, of American origin; starchy	n	a	n	n	o	o	a	o
Vigna chinensis and *catjang,* cowpeas, locally cultivated mainly for green manure, elsewhere an important food crop, Oriental in origin; starchy	b	b	b	a	o	o	b	o
Vigna lutea, a native beach plant, probably of native introduction; starchy	a	b	a	o	o	o	o	o
Cajanus indicus, the pigeon pea, locally cultivated in several varieties, of African origin; starchy	b	b	b	a	2	1	b	o

TABLE OF EXPERIMENTS—Continued.

Name and Origin of Seed, Etc.	Bruchus chinensis	Bruchus quadrimaculatus	Dolichos weevil	Bruchus pruininus	Bruchus obtectus	Bruchus prosopis	Spermophagus (Zabrotes) sp.	Caryoborus gonagra
Dolichos lablab, the bonavist locally called the papapa bean, of limited use for food, also escaped from cultivation, of African origin; starchy	a	b	b	a	2	o	a	o
Glycine hispida, the soy bean, imported from Japan, a yellowish and a black variety in the Oriental stores, of Oriental origin	b	b	b	b	3	o	b	o
Cicer arietinum, the chick pea, of Mediterranean or West Asiatic origin, imported for food; starchy	b	b	b	n	2	o	b	o
Vicia faba, the broad, Windsor, or horsebean, imported in two or three varieties from California and Japan, also cultivated to a limited extent on Maui and Hawaii at the higher elevations, of Mediterranean origin; starchy	b	b	b	a	2	o	n?	o
Pisum sativum, the common pea, introduced for food, grown to a limited extent on Maui and Hawaii at the higher elevations; starchy	b	b	b	a	2	o	b	o
Arachis hypogaea, the peanut, grown locally only to a limited extent, imported for food, of American origin; starchy and oily	a	a	a	b	2	o	a	o
Lupinus hirsutus, blue lupine, grown to a slight extent at higher elevations for green manure, of European origin; starchy	a	a	o	o	o	o	o	o
Lupinus angustifolius, Italian lupine, grown to a limited extent at the higher elevations on Hawaii for food and green manure, of South European origin; starchy	a	o	a	o	o	o	o	o
Canavalia ensiformis, jack bean, locally grown for green manure, tropical	a	a	a	o	o	o	a	o
Stizolobium pachylobium, velvet bean, grown locally for green manure	a	a	a	a	o	o	a	o
Erythrina monosperma, wiliwili, a native lowland tree, with large bean-like dull scarlet seeds, unknown elsewhere; starchy	o	o	a	o	o	o	o	a
Erythrina indica, Indian coral tree, planted as an oddity, with large dull dark carmine seeds, of Indian origin; starchy	a	a	a	a	o	o	a	a

TABLE OF EXPERIMENTS—Continued.

Name and Origin of Seed, Etc.	Bruchus chinensis	Bruchus quadrimaculatus	Dolichos weevil	Bruchus pruininus	Bruchus obtectus	Bruchus prosopis	Spermophagus (Zabrotes) sp.	Caryoborus gonagra
Abrus precatorius, the praying bean, an herbaceous vine planted for its small bead-like scarlet and black seeds, Indian origin	a	o	o	a	o	o	a	a
Crotalaria spp., rattle pods, weeds, small-seeded species, Indian origin	o	o	o	n	o	o	o	o
Crotalaria juncea, sunn hemp, a fiber plant, but grown locally for green manure, with seeds much larger than the other species, Indian origin	o	o	o	a	o	o	o	o
Indigifera anil, indigo, locally escaped from cultivation and now a weed, American origin	o	o	o	b	o	o	o	o
Sesbania coccinea, a small tree with large ornamental flowers, said to be sparingly escaped from cultivation, Indian and Malayan	a	a	a	o	o	o	o	o
Sesbania sesban, sesban, a shrub or small tree, with small sub-cylindrical seeds, a fiber plant now growing naturally, of American origin	o	o	o	b	o	o	o	o
Leucaena glauca, locally called false koa or koa haole, a small tree or shrub, extensively naturalized, of American origin	a	a	o	b	o	o	o	o
Prosopis juliflora, algaroba or kiawe, a widely distributed tree in the lowlands, the pods forming an important cattle feed, of American origin	a	o	o	b	4	b	o	b
Piscidia erythrina, fish poison tree planted in Thomas Square, of American origin	o	o	o	a	o	o	o	o
Cassia grandis, pink shower, a flowering tree extensively planted, of American origin	a	o	o	a	o	o	o	b
Cassia fistula, golden shower, a flowering tree extensively planted, of Indian origin	a	o	o	b	o	o	o	b
Cassia nodosa, pink and white shower, an extensively planted flowering tree, of Indian origin	a	n	n	b	o	o	o	b
Cassia glauca, a small flowering tree, not very much planted, seeds almost exactly like those of *Leucaena glauca* but the seed coats harder, of Asiatic origin	a	o	o	a	o	o	o	o

TABLE OF EXPERIMENTS—Continued.

Name and Origin of Seed, Etc.	Bruchus chinensis	Bruchus quadrimaculatus	Dolichos weevil	Bruchus pruininus	Bruchus obtectus	Bruchus prosopis	Spermophagus (Zabrotes) sp.	Caryoborus gonagra
Cassia mimosoides, a low slender herbaceous weed, origin tropics in Old World	o	o	o	a	o	o	o	o
Cassia bicapsularis, a spreading semiscandent weedy shrub, of American origin	o	o	o	a	o	o	o	o
Cassia siamea, a flowering tree, extensively planted, of Indian origin	o	o	o	a	o	o	o	o
Cassia occidentalis, a coarse erect weed, of American origin	o	o	o	a	o	o	o	o
Cassia alata, a shrub or small tree, planted for its flowers, of American origin	a	o	o	a	o	o	o	o
Clitoria, sp., an herbaceous flowering vine, planted for ornamental purposes	a	a	n	o	o	o	o	o
Pterocarpus indicus, a large tree with the aspect of an elm and its fruit resembling that of the elm, of Oriental origin	o	o	o	a	o	o	o	o
Desmodium uncinatum, beggar's tick, an herbaceous weed, of American origin	o	o	o	b	o	o	o	o
Delonix regia, "Poinciana regia", a rather small tree extensively planted for its brilliant red flowers, native of Madagascar	a	o	o	a	o	o	o	o
Pithecolobium dulce, a large tree called opiuma by the Hawaiians, often escaped from cultivation, of American origin	a	o	o	o	o	o	o	a
Samanea saman, monkeypod, extensively planted as a shade tree, of American origin	o	o	o	o	o	o	o	o
Albizzia lebbek, a shade tree not very widely planted, of Indian origin	a	o	o	a	o	o	o	o
Albizzia saponaria, a shade tree, only a few trees in Honolulu, of Malay(?) origin	a	o	o	b	o	o	o	o
Adenanthera pavonina, a tree planted for its scarlet seeds, of Indian origin	a	o	o	a	o	o	o	5
Tamarindus indicus, tamarind, a tree planted for its acid pods, of Indian origin	a	o	o	a	o	o	o	b
Bauhinia tomentosa, a flowering shrub, not very generally planted, of Indian origin	a	o	o	a	o	o	o	b

TABLE OF EXPERIMENTS—Continued.

Name and Origin of Seed, Etc.	Bruchus chinensis	Bruchus quadrimaculatus	Dolichos weevil	Bruchus pruininus	Bruchus obtectus	Bruchus prosopis	Spermophagus (Zabrotes) sp.	Caryoborus gonagra
Bauhinia monandra, a small flowering tree rather generally planted, of American origin	a	o	o	a	o	o	o	b
Desmanthus virgatus, a weedy shrub, of West Indian origin	o	o	o	b	o	o	o	o
Acacia koa, koa, a native Hawaiian timber tree, planted to some extent in the cooler parts of Honolulu	a	o	o	b	o	o	o	o
Acacia farnesiana, klu, a spinose shrub or small tree of American origin occupying large areas of the drier lowlands	a	o	o	a	o	o	o	b
Caesalpinia pulcherrima, pride of Barbadoes, an ornamental prickly shrub formerly grown in hedges and sparingly escaped, of American origin	a	o	o	b	o	o	o	b
Peltophorum inerme, a beautiful tree extensively planted, of Malayan origin	o	o	o	a	o	o	o	o

Insects in Relation to Problems of Storage of Food in Hawaii.

BY JOHN COLBURN BRIDWELL.

[Read at November meeting.]

The problem of food storage and food conservation in Hawaii is affected by the destructive action of insects. A considerable number of species of stored-food insects are present but the different ones need not be considered separately since several species may be present in the same food and in general all these attacks are to be combatted in much the same way. There are differences in the resistance among these insects to the action of the instruments of sterilization and the measures resorted to must be adjusted to the most resistant.

Certain general facts in regard to stored-food insects are to be borne in mind. All stored-food insects are developed from eggs and in all of any great importance there is a larval, or grub, or caterpillar stage, followed by an inactive pupal stage before the insect emerges as an adult. In these different stages there is considerable difference in the insect's resistance to fumigation or other means of killing them and the character of the foot product and the way in which it is attacked causes variation in our methods of attack. Compact substances are but slowly penetrated by fumigants and aromatic and fatty substances cannot be subjected to heat.

Generally speaking, food is more likely to become infested in the mill or factory than in the store and in the store than in the home. If the mills and factories can be kept free of infestation there will be but little loss in stored foods consumed in the Islands within a short time after their importation. There is an encouraging increase in the number of mills and factories which sterilize their products before they are placed on the market. No doubt the number could be materially increased if there were concerted demands for such sterilization made by the importers. In many cases the food may become infested either by the adult insect entering loose masses of the food and laying their eggs or by the small larvae entering through the crevices in the containers.

The prevention of injury to food by insects requires that two things must be done, (1) all insects in their different stages must be destroyed, and (2) insects from without must be prevented from gaining access and reinfesting the food or if this is impossible any insects present must be prevented from further development.

The destruction of insects in foods may be secured more or less completely in a variety of ways of which three are of sufficient importance for discussion here. These are: (1) sterilization by dry heat, (2) fumigation by carbon disulfid, or bisulphide, and (3) fumigation by hydrocyanic acid gas.

If any insect is subjected to a temperature of 110° F. long enough for the heat to penetrate its tissues they will be cooked and the insect in any of its stages will consequently be destroyed. In practise it has been found desirable to use somewhat higher temperatures so as to secure quicker penetration of the food material by the heat. It has been found, for instance, that a satisfactory sterilization of peanuts in loose piles may be obtained without injury to their powers of germination if they are subjected to a temperature of 125° F. sustained for six hours. The heat desired may be obtained by piping a room for steam heat with radiators calculated for securing the temperature needed and sustained for the time found necessary by experiment to secure sterilization. The application of dry heat is one of the most generally applicable methods of food sterilization and is rapidly coming into wider use. In the home, cereals and flour may be sterilized in the oven if care is taken to secure a low heat so as not to cause scorching. There can be no doubt that if the dried foods imported into the islands could be treated in a properly constructed steam sterilizing plant before being distributed to the stores that much of the present loss in these products now being suffered would be obviated. Occasionally foods can be sterilized in the sunshine, the direct rays of the sun, especially when shining upon a dark background, serving to produce sufficient heat for the purpose. This method of application of dry heat

has been used with some success with weevilly beans. Moist heat on account of its tendency to promote the development of molds is rarely available for foods which are to be stored.

All fumigation methods have the disadvantage of uncertainty and while of very great use where the food is soon consumed are not advisable where long continued storage is planned.

It has been found that carbon bisulphide in the proportion of 2 pounds to 1000 cubic feet, kept in tight receptacles for not less than 48 hours will ordinarily sterilize bags of grain, destroying even the most resistant. More satisfactory results can be obtained where the receptacle is so tight as to permit the air to be exhausted.

One serious objection to the use of carbon bisulphide is the vile odor of many of the commercial grades which would utterly prevent its use in the home except in some outbuilding used for the purpose. Its fumes are also extremely inflammable and explosive when mixed with air. This is, however, a method widely used and with a high degree of success where absolute sterilization is not required.

Another exceedingly important method of fumigation employs hydrocyanic acid gas liberated by the action of sulphuric acid on potassium or sodium cyanide in an excess of water. This gas has higher penetrating power and is enormously more poisonous than the carbon bisulphide gas. Even in relatively loosely constructed mills fumigation with the gas produced by 1 oz. potassium cyanide and 1 oz. of sulphuric acid in 3 ozs. of water for each thousand cubic feet has given satisfactory results. In closer quarters the dose could be considerably reduced. This method of fumigation requires to be handled with great care and is not generally available in the home on account of the deadly poisonous nature of the potassium cyanide and the resulting gas and the caustic and corrosive nature of the sulphuric acid.

Both methods of fumigation may be employed without affecting the germinating properties of seeds. In neither case

is there any injury to the food value of ordinary cereals or dry foods. However a food product is sterilized it will become reinfested in these Islands within a few months unless protected in some manner. Even paper and cloth bags give a certain degree of protection and many efforts have been set forth to secure a vermin-proof paper or pasteboard cartons, and some of them have proved quite successful. However, any dry food product intended to be stored for long periods under present conditions should be sterilized in hermetically sealed tin containers. This is the method generally used in tropical countries. In case it is desirable to concentrate on this Island, flour, beans, and other such products for a year, two, or three years' rations there is no reason why it cannot be done in this way. The better mills are now practicing sterilization of their products and without doubt such products could be contracted for on this scale ready for indefinite storage in tins.

Even under present conditions considerable losses in the home may be avoided by sifting all flour and meal as soon as it is brought into the house and enclosing it in tight tins. Cereals in these tins or in packages placed in the oven and heated dry to any temperature not above the boiling point will be sterilized and not injured in any way for storage.

There are certain products which are not readily sterilized and protected in tin containers but are subject to insect attack. Many of these can be kept in ordinary cold storage while in other cases precautions must be taken to reduce the humidity of the air in order that the materials may not become waterlogged.

It is extremely desirable that the problems here discussed with reference to the food supply should be taken up by an entomologist who could devote his entire time to the subject. Our present knowledge of this subject is confined to the incidental observations of men whose other work has commanded the greater part of their attention.