

## PRESIDENTIAL ADDRESS.

**The Insect Fauna of Trees and Plants as an Index of  
Their Endemicity and Relative Antiquity in the  
Hawaiian Islands.**

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In the study of the insect faunas of the different species of trees and plants of the Hawaiian Islands, a good deal of information has already been accumulated. Enough so that some significant considerations can be made, and one of these, it seems to the writer, is that the relative antiquity of the endemic trees may be indicated by a comparison of their respective insect faunas. In other words, the species of trees having the greatest number of endemic insects attached to them should be considered to have had a longer existence\* in the Islands than have those trees with much fewer endemic insects attached to them. Furthermore, that trees with no native insects attached to them would be of most recent arrival, and possibly or probably not endemic.

When the writer began collecting and studying the native insects of Hawaii twenty years ago, it was found desirable to learn at once the names of the trees with which the various kinds of insects were associated. It soon became evident that certain kinds of trees support a much greater insect fauna than others. Thus it was learned which were the trees for good insect collecting, and which were the poor ones, or the ones on which it was useless to collect. The beginning of the faunistic studies of the respective trees was thus made, and, although considerable progress has been made, it is a field in which there is yet a vast amount to be done.

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\* By this period of existence, I mean the time from when the tree first became established down to the present, and including all of the ancestral forms the tree may have passed through by evolution before reaching the present form to which we attach its specific name.

Among the common or better known trees, examples of those having a large number of native insects attached to them, are:

*Acacia koa*, *Metrosideros collina polymorpha*, *Pipturus albidus*, *Pelea* spp., and *Euphorbia* spp. Such trees and plants as *Straussia*, *Suttonia*, *Gouldia*, *Bohea*, *Coprosma*, *Freycinetia*, *Eugenia Sandwicensis*, *Cheirodendron*, *Cibotium* spp. *Astelia* and banana have a fair number of insects attached to them. Examples of those having only a small native insect fauna are *Santalum*, *Xylosma*, *Maba*, *Antidesma*, *Byronia*, *Wikstroemia*, *Perrottetia*, *Scaevola*, *Urera*, *Sapindus*, *Charpentiera*, *Xanthoxylum*, *Pritchardia*, *Hibiscus*, and *Hau*. Such trees as *Aleurites Moluccana*, *Eugenia Malaccensis*, *Callophyllum Inophyllum*, *Thespesia populnea*, *Cordyline terminalis*, and *Artocarpus incisa*, have no native insects attached to them. These latter are among the trees considered by some to have been brought to the Hawaiian Islands by the Hawaiian race in prehistoric times. The fact that during the time since then no species of insect has developed on these trees is quite significant when comparison is made with trees that are very evidently of greater duration in the Islands and have numerous kinds of insects attached to them. Of course, I am speaking from what is at present known. It may be that when greater biological knowledge is obtained, many more insects will be found associated with some of the trees on which at present few are known; for there is yet a great deal to be learned along these lines. All of the entomologists here are interested in the host relations of the native insects, and we are continually increasing our knowledge along these lines, and adding to what has already been published in the *Fauna Hawaiiensis* and the *Proceedings of the Hawaiian Entomological Society*.

Taking it from what we know at present, it is apparent that those trees which are attacked by the greatest number of species of insects, or that have the greatest number that are specially attached to them, must be those which have been in existence on the Islands for the greatest length of time, and thus have given the insects greater opportunity to become specialized and to develop the particular species which we now find attached to them. The *Acacia koa* may be taken as an example of such a tree.

## INSECT FAUNA OF ACACIA KOA.

There are caterpillars of several species of moths of the endemic genus *Scotorythra* of the family *Selidosemidae* that feed on the foliage of the koa tree. One of them, *rara* (Butl.), is perhaps the most common, but it is not attached to the koa, as it feeds also on a large number of other trees, and to some extent on tree-ferns. Another species, *idolias* Meyr., of the same genus feeds on the koa also, often denuding the trees, but we are not yet sure whether its caterpillars similarly feed on other trees as well. There is a group of species, however, of the same genus which are particularly attached to the koa, and these species have developed on different islands: *caryopis* Meyr. on Oahu, *isospora* Meyr. on Kauai, *corticea* (Butl.) on Maui, *aruraea* Meyr. on Hawaii. It is possible that still some of the other species that are quite similar to these species may also be attached to koa, but at present their habits are not sufficiently known.

Another endemic genus of moths, *Aphthonetus*, has one or more species whose larvae feed on the phyllodes of koa. As there are twenty-nine species in the genus, and their habits are mostly unknown, it may be found that different species of this genus occurring on the different islands may, more of them, be attached to koa.

Several species of Tortricidae feed on the seeds of koa; in fact, they so completely destroy the seeds, that it is very difficult to obtain seeds for planting in reforestation projects. Most prominent of these are *Cryptophlebia illepidia* (Butl.) and *C. vulpes* Walsm. A smaller species is *Adenoneura rufipennis* (Butl.), and in each of these genera one or more other species may have similar habits. Another tortricid, *Enarmonia walsinghami* (Butl.), feeds in dead twigs of koa, and also sometimes bores into the tips of living twigs. Larvae of an undescribed species of *Adenoneura* have been found abundant in and beneath the bark of recently felled koa. A good number of moths were reared, but await description. The larvae of one native butterfly, *Lycæna blackburni* (Tüely) feed on the blossoms and new foliage of koa.

There are four species and one variety of delphacid leaf-

hoppers attached to koa: *Ilburnia koae* (Kirk.), *I. rubescens* (Kirk.), *I. rubescens* var. *pulla* (Muir), *I. pseudorubescens* (Muir), *I. koae-phyllodii* (Muir). These species occur in different localities.

Of cerambycid beetles, there are quite a number belonging to three endemic genera. *Plagithmysus* has six species whose larvae feed in and beneath the bark and in the outer wood of dead branches or fallen koa trees. *Plagithmysus pulverulentus* (Motsch.) on Oahu; *arachnipes* Shp. and *aequalis* Shp. on Kauai; *finschi* Har. on Maui; *varians* Shp. and *blackburni* Shp. on Hawaii. *Callithmysus* has one species on koa: *cristatus* (Shp.) on Oahu. *Neoclytarlus* has ten species on koa; *fragilis* (Shp.) on Oahu; *obscurus* (Shp.), *longipes* (Shp.), and *annectens* (Shp.) on Kauai; *pennatus* (Shp.), *laticollis* (Shp.), and *modestus* (Shp.) on Maui; *debilis* (Shp.), *claviger* (Shp.) and *nodifer* (Shp.) on Hawaii. Besides these, two much larger cerambycids also feed in koa trees (*Parandra puncticeps* Shp. and *Aegosoma reflexum* Karsch), but they are not attached to koa, for they feed in other trees also.

The genus *Rhyncogonus* of the Curculionidae has two species (*blackburni* Shp. and *vittatus* Perk.) and possibly more which feed on the foliage of koa, though they may not be strictly attached to it.

Of the large genus *Proterhinus* of the family Proterhinidae, at least three species are attached to koa: *oscillans* Shp. and *vicinus* Perk. on Oahu; *validus* Shp. on Maui. Possibly a few others of the numerous species of this genus may also be found on koa.

A few species (undetermined) of Scolytidae attack koa; and a few species of Nitidulidae are attached to it.

A large bug (*Coleotichus blackburniae* White) feeds on the foliage oftentimes in large colonies, and a small bug (*Psallus sharpianus* var. *a* Kirk.) is more rare. One mealy bug (*Pseudococcus sweseyi* Ehrhorn) has been described from koa.

Taken altogether, there are forty or more species of native insects already known to be attached to *Acacia koa* (including its related species or varieties on the different Islands), and there are many others associated with it in one way or another. For so many species of insects to become developed and to have

acquired such particular habits as to feed only on one kind of tree must have taken a very long period of time, and can be taken to indicate that the existence of the koa in Hawaii is of great antiquity. It probably has more species of insects attached to it than has any other native Hawaiian tree, and therefore may be considered one of, if not the most, ancient of the trees comprising the present Hawaiian flora.

#### [ INSECT FAUNA OF THE OHIA LEHUA. ]

The ohia lehua (*Metrosideros collina polymorpha*, and other species of the genus) is another tree much attacked by endemic insects. There are several caterpillars feeding on the foliage: *Eucymatoge monticolans* (Butl.) of the family Hydrimenidae; one or more species of *Scotorythra* of the family Selidosemidae; a tortricid, *Eccoptycera foetorivora* (Butl.), feeds on the leaves; a carposinid, *Heterocrossa distincta* Walsm., feeds in the terminal buds; two tineids, *Philodoria splendida* Walsm. on Kauai and Oahu, *P. basalis* Walsm. on Maui and Hawaii, are leaf-miners.

Ten delphacid leaf-hoppers are known on lehua: *Leialoha naniicola* (Kirk.) on Oahu and Hawaii, *L. ohiae* (Kirk.) on Oahu, *L. lehuae* (Kirk.) on Oahu and Kauai, *L. lehuae kauaiensis* Muir on Kauai, *L. lehuae oahuensis* Muir on Oahu and Lanai, *L. lehuae lanaiensis* Muir on Lanai, *L. lehuae mauensis* Muir on Maui, *L. lehuae hawaiiensis* Muir on Hawaii, *Nesodryas perkinsi* (Kirk.) on Oahu, and *N. gulicki* Muir on Hawaii.

One or more jassids are known, but the species are not determined.

Ten psyllids are attached to lehua: *Trioza iolani* Kirk. on Oahu and Kauai, *T. ohicola* Crawford on Oahu and Hawaii, *T. lanaiensis* Crawford and *T. pullata* Crawford on Lanai, *T. hawaiiensis* Crawford on Hawaii, *T. kauaiensis* Crawford and *T. lehua* Crawford on Kauai, *Kuwayama gracilis* Crawford on Oahu and Molokai, *K. nigricapita* Crawford on Lanai and Hawaii, *K. minuta* Crawford on Hawaii. Some of these form galls on the leaves, while others live freely on the surface of the leaves without galls.

A few species of Heteroptera are known, but undetermined.

Of the cerambycid beetles, three species of *Plagithmysus* are attached to lehua: *bilineatus* Shp. on Hawaii, *pulvillatus* (Karsch) on Maui, *aestivus* Shp. on Molokai. Of some of the other species of *Plagithmysus*, probably one on each of the other islands is attached to lehua, but it has not yet been ascertained. The large *Aegosoma reflexum* Karsch also is found in lehua, and it is likely that some others of the smaller beetles, such as Scolytidae, Proterhinidae, Nitidulidae, etc., will yet be found to be attached to this tree.

We have thus some thirty or more species of native insects which are attached to lehua, with probabilities of several more. Therefore, we consider that the lehua is another one of the trees which has for a very long period of time formed part of the Hawaiian flora.

#### INSECT FAUNA OF *PIPTURUS ALBIDUS*.

The mamake tree (*Pipturus albidus*) supports quite a large native insect fauna. The large spiny caterpillar of the Kamehameha butterfly (*Vanessa tameamea* Esch.) feeds on the foliage of this tree. It also feeds on *Neraudia*, *Urera*, *Touchardia* and *Boehmeria* to a slight extent (all closely related trees), but *Pipturus* is the chief host on all the Islands. Of other Lepidoptera, a leaf-roller, *Phlyctaenia stellata* (Butl.), feeds on the leaves; a twig-borer, *Epagoge infaustana* Walsm., bores the tips of growing shoots, and also feeds on the young leaves to some extent. Six tineid leaf-miners are already known, and other species may yet be discovered. Those known at present are: *Philodoria micropetala* Walsm. on Kauai, *P. pipturicola* Sw. on Oahu and Maui, *P. pipturiella* Sw. on Oahu, *P. floscula* Walsm. and *P. pipturiana* Sw. on Hawaii, *Gracilaria neraudicola* Sw. on Oahu and Hawaii. The latter was described from *Neraudia*, but was later reared more abundantly from *Pipturus*, which probably is its chief host plant.

Of Coleoptera attached to *Pipturus*, there are two cerambycids: *Plagithmysus lamarckianus* Shp. on Hawaii, and *Callithmysus koebelei* Perk. on Oahu. There are three bark-beetles: *Proterhinus pipturi* Perk. on Oahu, *P. vestitus* Shp. on Oahu, *P. blackburni* Shp. on all the Islands. The two latter species

occur on other trees also. A dead wood weevil, *Dryophthorus oahuensis* Perk., is attached to *Pipturus* on Oahu.

Of leaf bugs there are three or more, the known species being *Tichorhinus iolani* (Kirk.) on Oahu and Hawaii, *T. tantali* Perk. on Oahu, *T. kanakanus* (Kirk.) on Oahu, Lanai, Maui, and Hawaii. Two jassid leaf-hoppers are known: *Nesophyrosyne pipturi* Kirk. on Oahu and Maui, *N. ponapona* Kirk. on Oahu and Hawaii. Three delphacid leaf-hoppers occur on *Pipturus*: *Ilburnia pipturi* (Kirk.) on Oahu and Molokai, *I. mamahe* Muir on Maui, *I. blackburni* (Muir) on Oahu, Maui, and Hawaii. The latter occurs on a number of other host plants as well.

One mealy bug, *Nesococcus pipturi* Ehrh., has been described from *Pipturus* on Oahu.

Altogether, there are twenty species of endemic insects attached to *Pipturus*, and the probabilities are that more will be added with further study.

#### INSECT FAUNA OF PELEA SPP.

The various species of *Pelea* in the Hawaiian Islands support quite a number of species of endemic insects. An interesting group of lepidopterous leaf-miners are: *Opostega maculata* Walsm., *O. serpentina* Sw., *O. callosa* Sw., *O. pelcana* Sw., *O. filiforma* Sw., all on Oahu. Perhaps there are a few more, as mines differing from the mines of the above species have been discovered in various parts of the forests, some on the other Islands, but so far the adults have not been reared from these mines to determine the species.

Three species of psyllids have been described from *Pelea*: *Hevaheva perkinsi* Kirk. on Oahu, *H. silvestris* Kirk. on Oahu and Kauai, *H. minuta* Crawford. on Kauai.

Several species of jassids are known, but still undescribed.

The larva of a moth, *Prays fulvocanellus* Walsm., feeds in buds and seeds.

Four species of wood-borers of the genus *Plagithmysus* are known: *diana* Shp. on Kauai, *collaris* Shp. on Maui, *bishopi* Shp. and *vicinus* Shp. on Hawaii. Three bark-beetles are at-

tached to *Pelea*: *Proterhinus archaeus* Perk., *P. pusillus* Shp. and *P. pusillus* var. *subpusillus* Perk., all on Oahu.

Thus there are sixteen or more endemic insects known to be attached to the *Pelea* trees.

#### INSECT FAUNA OF EUPHORBIA SPP.

*Euphorbia*, with several species, has fifteen species already known preying on it and apparently attached to it. One cerambycid beetle, *Neoclytarlus euphorbiae* Brid. on Oahu. Five delphacid leaf-hoppers: *Dictyophorodelphax mirabilis* Sw. on Oahu, *D. swezeyi* Brid. on Oahu, *D. praedicta* Brid. on Maui, *Aloha kirkaldyi* Muir on Oahu, *Nesodryas gulicki* Muir on Oahu and Hawaii. One jassid, undetermined. Two plant bugs: *Psallus sharpianus* Kirk. on all Islands, *Ithamar* undescribed species on Oahu and Maui. Two phycitid moths, whose larvae feed on and web the leaves: *Genophantis iodora* Meyr. on all Islands, *G. leahi* Sw. on Oahu. Four bark beetles: *Proterhinus euphorbiae* Perk. on Oahu, *P. impressiscutis* Perk. on Oahu, *P. euops* Perk. on Oahu, *P. bridwelli* Perk. on Maui.

#### NATIVE TREES WITH SMALLER INSECT FAUNAS.

Of the trees having a smaller number of insects attached to them, so far as known at present, *Cheirodendron* has six species, *Eugenia sandwicensis* has five species, *Straussia* spp. have seven species, *Suttonia* spp. have six species, *Freycinetia Arnotti* has five species, *Cibotium* spp. have six species, *Sadleria cyatheoides* has four species, *Santalum Freycinetianum* has three species, *Xylosma Hawaiiense* has two species, *Hibiscus Arnottianus* has three species.

#### INSECT FAUNA OF CHEIRODENDRON SPP.

One bark beetle, *Proterhinus gigas* Perk. on Kauai. Four weevils of the genus *Nesotocus* on the different Islands: *kauaiensis* Perk. on Kauai, *giffardi* Perk. on Oahu, *newelli* Perk. on Maui, *munroi* Perk. on Hawaii. One moth whose larvae feed in dead stems: *Semnoprepia ferruginea* Sw. on Oahu.



## INSECT FAUNA OF EUGENIA SANDWICENSIS—OHIA HA.

A bud-moth, *Heterocrossa distincta* Walsm., whose larvae feed in the terminal buds; a seed-moth, *Heterocrossa divaricata* Walsm., whose larvae feed in the fruit (they also feed in the fruits of *Elaeocarpus*); a bark-beetle, *Proterhinus blackburni* Shp.; two wood-borers, *Plagithmysus concolor* Shp. on Kauai and *P. solitarius* on Oahu; a leaf-hopper, *Nesodryas eugeniae* Kirk.; a jassid leaf-hopper, *Nesophrosyne* sp. A total of seven species.

## INSECT FAUNA OF STRAUSSIA SPP.—KOPIKO.

A leaf-miner, *Aristotelia* sp.; seven bark-beetles, *Proterhinus subangularis* Perk. on all Islands, except Kauai, *P. anthracias* Perk. and *P. maculifer* Perk. on Kauai, *P. archaeus* Perk., *P. obscuricolor* Perk., *P. subplanatus* Perk. and *P. angularis* Shp. on Oahu; one delphacid leaf-hopper, *Ilburnia pele* (Kirk.); one or more jassid leaf-hoppers, *Nesophrosyne* spp.; a mealy bug, *Pseudococcus straussiae* Ehrh. A total of eleven species or more.

## INSECT FAUNA OF SUTTONIA SPP.—KOLEA.

A seed-moth, *Heterocrossa nigronotata* Walsm.; two leaf-miners, *Philodoria succedanea* Walsm. and *P. auromagnifica* Walsm., a leaf-roller, *Archips* sp.; a delphacid leaf-hopper, *Leialoha suttoniae* Muir on Kauai; one or more jassid leaf-hoppers, *Nesophrosyne* spp.; two bark beetles, *Proterhinus myrsineus* Perk. and *P. maurus* Perk., both on Oahu. A total of eight species or more.

## INSECT FAUNA OF FREYCINETIA ARNOTTI—IIEI.

Crown-borer, *Catantopis decipiens* Walsm., larvae numerous in crown of vine, on Oahu and Hawaii; stem-borer, *Euperissus cristatus* Butl., larva in dead stems, on Oahu, Molokai and Hawaii; two delphacid leaf-hoppers, *Nesodryas freycinetiae* Kirk. and *Ilburnia halia* Kirk., both on Oahu; a leaf bug, *Sulamita lunarililo* Kirk. on Hawaii. A total of five species.

## INSECT FAUNA OF NATIVE BANANAS.

A weevil, *Polytus mellerborgi* (Boh.), whose larvae feed in the base of the stem and corm; six or more leaf-rollers, *Omiodes blackburni* (Butl.) on all the Islands, *O. euryprora* Meyr., *O. meyricki* Sw. and *O. fullawayi* Sw. on Hawaii, *O. musicola* Sw. on Maui, *O. maia* Sw. on Oahu and Kauai; an undescribed species of *Omiodes* has been reared from banana on each of the Islands Maui and Kauai. A total of nine species.

## INSECT FAUNA OF HIBISCUS ARNOTTIANUS.

A looper moth, *Cosmophila sabulifera* (Guen.), whose caterpillar feeds on the leaves; a leaf-miner, *Gracilaria hibiscella* Sw., on Oahu and Hawaii; a seed-moth, *Crociosema marcidellum* (Walsm.), whose larvae infest the seed capsules, on Oahu; *Aleyrodes hibisci* Kot. A total of four species.

## INSECT FAUNA OF PARITUM TILIACEUM—HAU.

Looper moth, *Cosmophila sabulifera* (Guen.); leaf-miner, *Gracilaria hauicola* Sw., *Aleyrodes hibisci* Kot. A total of three species.

## INSECT FAUNA OF CIBOTIUM SPP.—HAPU.

A delphacid leaf-hopper, *Nesorestias filicicola* Kirk., on Oahu; a jassid leaf-hopper, *Nesosteles* sp., on Kauai; six weevils in dead stems: *Heteramphus filicum* Perk. on Oahu, *Pentarthrum prolixum* Shp. on all Islands, *Proterhinus longulus* Shp. on Oahu, *Proterhinus blackburni* var. *hystrix* Shp. on Hawaii, *Oodemus aenescens* Boh. and *Pseudolus longulus* (Boh.) on all Islands. The two latter in dead wood of other trees also. A total of eight species.

## INSECT FAUNA OF SADLERIA CYATHEOIDES—AMAMAU.

Three leaf-hoppers: *Ilburnia ipomoeicola* (Kirk.) on Kauai, Oahu and Hawaii, *I. amamau* Muir on Maui, *Nesorestias filicicola* Kirk. on Oahu; a drosophilid fly, whose larva bores in the stems of the fronds, on Oahu and Hawaii. A total of four species.

## INSECT FAUNA OF SANTALUM FREYCINETIANUM.

Two looper caterpillars: *Scotorythra arboricolans* (Butl.) on Hawaii, *S. syngonopa* Meyr. on Kauai and Oahu; a leaf-roller, *Capua santalata* Sw. on Oahu; a mealy bug, *Pseudococcus gallicola* Ehrh. in galls on leaves on Oahu. A total of four species.

## INSECT FAUNA OF XYLOSMA HAWAIIENSE.

A tortricid moth, *Dipterina fulvosericæ* Walsm., larvae feeding on the leaves, on Kauai, Oahu, Molokai and Lanai; a psyllid, *Cerotriosa bivittata* Crawf., on leaves without galls, on Oahu and Maui. A total of two species.

## INSECT FAUNA OF COCONUT IN HAWAII.

Leaf-roller, *Omiodes blackburni* (Butl.), abundant on all the Islands; two weevils: *Rhabdocnemis obscura* (Boisd.), the sugarcane borer is occasionally in the base of the leaf stalks and the trunk, *Diocalandra taitensis* (Guen.), the Tahiti coconut weevil, a recent immigrant found on Hawaii and Oahu. A total of three species.

Enough of these tree faunas have been given to show what a variation there is in the number of insects that are attached to the various Hawaiian trees, the numbers in these given ranging from forty down to two. Probably every Hawaiian tree has one or more native insects attached to it. Now we find that the kukui tree (*Aleurites Moluccana*), which is quite recent, considered to have been brought by the Hawaiian race, has no endemic insect attached to it. Some insects are found on it more or less, but there are none of them specially attached to it. Apparently, it has not been here long enough for any such to develop on it yet. The kukui belongs to the group previously mentioned, including *Eugenia Malaccensis* or ohia ai, *Callophyllum Inophyllum* or kamani, *Thespesia populnea* or milu, *Cordyline terminalis* or ti and *Artocarpus incisa* the breadfruit. These have no native insects specialized on them.

The hau tree (*Paritium tiliaceum*) apparently has been here somewhat longer than these latter, for it has a Tineid leaf-miner (*Gracilaria hauicola* Sw.) attached to it, and occurring on all

the Islands. It has not been here long enough, however, for this leaf-miner to develop into different species on different Islands as have its allies, which are leaf-miners in *Pipturus*, *Metrosideros*, and some others. The native *Hibiscus*, too, has a related leaf-miner (*Gracilaria hibiscella* Sw.) which is the same species on all the Islands, so far as I have yet determined. The hau tree and hibiscus should be considered as of comparatively recent arrivals, the latter would be considered the older, however, for it has developed one more species than has the hau.

The coconut is another tree whose arrival has been somewhat recent. It may not be certain whether it was brought by the Hawaiians, or existed here already at the time of their arrival. Using its insect fauna to assist in solving this question, there is one native insect which seems to be attached to the coconut, the leaf-roller (*Omiodes blackburni*) which causes it to always have very ragged leaves. This leaf-roller also feeds to a slight extent on a few of the exotic palms that are planted. It also feeds considerably on the native palms (*Pritchardia* spp.) when they are planted on the lowlands, but I have only once found a few on any of these *Pritchardias* where I have visited them in their native habitat in the mountain forests. At one time I considered that this species of moth was attached to the native *Pritchardias*, and that it had adapted itself to the coconut after the latter arrived, but that was before I had seen the *Pritchardias* growing in their native habitat. Since the leaf-roller is not found generally feeding on the *Pritchardias* in the latter situations (and I have seen many such), I have abandoned the idea that *Pritchardia* is its native host. Apparently, this leaf-roller has not always been the pest on coconut that it is now, for Dr. Hillebrand makes this comment in his "Flora of the Hawaiian Islands," published in 1888, speaking of the coconut: "It thrives very well, as can be seen in the vigorous groves of Lahaina and Southern Hawaii. For a number of years, however, its leaves have been subject to the attacks of a moth which deposits its eggs in the folds of the leaf-segments." The coconut insects have received much attention in the various parts of the world where it is an important commercial plant, but in none of the publications on the subject is there any mention of the Hawaiian

coconut leaf-roller, which seems to me sufficient proof that the leaf-roller is not an introduced pest that appeared at the time Dr. Hillebrand mentions it. It is rather a native insect which fed naturally originally on some other plant and has taken to feeding on the coconut, on which it now feeds almost exclusively.

Here enters the wild banana and appears to have some connection; for this coconut leaf-roller has been found feeding on the leaves of the wild banana plant. The wild bananas in the Hawaiian Islands have six species of leaf-rollers of this same genus (*Omiodes*) feeding on them. The species are distributed as follows: *Blackburni* (the coconut leaf-roller) on all the Islands; *maia* on Kauai and Oahu; *musicola* on Maui; *meyricki*, *fullawayi*, and *euryprora* on Hawaii. None of these, except *blackburni* (the coconut leaf-roller), have yet been found feeding on any other plant than the banana. In the mountain gulches wherever clumps of wild banana plants are found, they are found to have one or more species of these leaf-rollers feeding on them, the species depending on the locality. I expect that more species will be discovered when banana clumps are examined in unexplored valleys.

We have thus six related endemic species of moths feeding on the wild banana, one species of which has taken to feeding on the coconut, while the other five species still remain with the banana. We have a parallel case in five other species of leaf-rollers of the same genus of moths, which are naturally grass-feeders, but one species of the five has taken to feeding on sugar-cane, and sometimes has been a very injurious pest where the canefields adjoin grassy regions. The other four species, however, of this group continue feeding only on grasses.

From the above consideration, I am convinced that the banana plant is of greater antiquity in the Hawaiian Islands than the coconut. Whether the banana was originally brought by the Hawaiian people or occurred here already before their arrival, perhaps needs further consideration. We do not know how long a time it takes for species to differentiate, but from the fact that we have these six species of leaf-rollers feeding on the wild banana and that some of the species occur on only one island, and that only one of the species is known to feed on anything else, five of them being strictly attached to the banana, is suffi-

cient indication that a great length of time is involved, possibly much longer than has elapsed since the coming of the Hawaiian people. On the other hand, if it were positively known that the banana did not exist here before the arrival of the Hawaiians, that they brought it, and if it was known how long ago that was, we would have some knowledge of the length of time involved in the formation of these six species of leaf-roller moths. Several of them are closely similar, indicating that they are not very old as species.

As compared with the *Acacia koa* and *Metrosideros*, the banana would be considered very much more recent when its insect fauna is taken into consideration. Enough examples have been given to illustrate the value of their insect faunas in considering the relative antiquity or the endemism of trees or plants now occurring in the Hawaiian forests.

From this brief consideration of the subject, other questions are suggested. What was the food-plant of the ancestor of these banana leaf-rollers before the arrival of the banana, and have they all developed from one ancestor which first took to feeding on this plant? How does an insect change its habit so that it now feeds on an entirely different plant than did its ancestors? How do the species from a common ancestral form become so differentiated that each species feeds on a different plant, as is the case with many genera having numerous species in the Hawaiian fauna? What about the difficulty a new immigrant insect would have in becoming established in a place where its particular food-plant does not occur? The ancestors of our insect fauna must have succeeded in doing this, or else the flora of the Islands was entirely different at that time from the species of which it is at present composed.

Shall we consider the several species of any genus which have developed on separate plants, or at any rate are at the present time attached to different plants, as older than those species of a genus which have developed on the same plant, as where we have several closely similar species of a genus on the same plant? For example: The genus *Gracilaria*, the larvae of which are leaf-miners, of which *marginestrigata* is on *Sida* and *Xanthium*, *dubautiella* and *epibathra* on *Dubautia*, *mabaella* on *Maba*, *urerana* and *ureraella* on *Urera*, *hibiscella* on hibiscus,

*haucicola* on the hau tree, *neraudicola* on *Neraudia* and *Pipturus*. Should all of these species of the same genus, but on different food-plants, be considered older than the six species of *Omiodes* above mentioned as all occurring on banana? or the ten species of *Neoclytarus* all occurring on koa? or the four species of *Ilburnia* on koa? or the eight Psyllids on lehua? Proper treatment of these and similar questions would require a lengthy consideration.

Aside from these considerations, it is of great importance that a study be made of the particular insect faunas of the important forest trees of the various groups of islands in the Pacific, that comparisons may be made, and use made of this information in assisting in the solving of the problems of plant migrations in Pacific regions. It is possible that thus, indirectly, there may be found somewhat of interest also in the problems of migrations of the Polynesian peoples in Pacific regions. As before intimated, the kukui tree (*Aleurites Moluccana*) for example, which is considered to have been brought to the Hawaiian Islands by the Hawaiian people when they came, has no endemic insect attached to it. Now, if the insect fauna of this tree was studied in all regions where it occurs, that region where the greatest number of insects preyed on it might be considered its natural home; then other regions where there was a less and less insect fauna on the tree could be taken more or less as successive stages in the spread of the tree, whether naturally or by the assistance of man, on account of the interest he may have had in this particular tree.

The entomologists here have already taken considerable interest in this matter of the peculiar insect faunas of the different trees of the native forests, and would be greatly interested in the outcome of similar work being done in other groups of Pacific Islands.