THE JOURNAL OF AGRICULTURE
OF THE UNIVERSITY OF PUERTO RICO

Issued quarterly by the Agricultural Experiment Station of the University of Puerto Rico, for the publication of articles by members of its personnel, or others, dealing with any of the more technical aspects of scientific agriculture in Puerto Rico or the Caribbean Area.

Vol. XXIX October, 1945 No. 4

A SURVEY OF THE FOREST INSECTS OF PUERTO RICO

PART II

(A Discussion of the Most Important Insects Affecting Forest, Shade and Ornamental Trees in Puerto Rico.)

By LUIS F. MARTORELL

Associate Entomologist, Agricultural Experiment Station

CLASS INSECTA OR HEXAPODA
THYSANURA

FAMILY LEPSIMIDÆ

The insects belonging to this family are commonly known as bristle-tails. Two different species belonging to the genera **Lepisma** and **Nicoletia** have been previously recorded as causing pits in the roots of *Bambos vulgaris* Schrad. Seín in 1930, published about this subject. Making reference to these two insects, he says:

"Another cause for puzzling was the continuous finding of another type of feeding cavities or pits which are larger and not so evenly circular as those made by the Symphilid and not located in the cortex of the mature roots but at or near the tips in the tender tissues. These larger pits were not the entrance to tunnels and for a time we attempted to explain them as the work of the larger root caterpillars; but this was unusual because they never developed into tunnels. They were merely feeding pits out of which the tender tissues had been scooped. They could also be found in the roots of *B. vulgaris* (and *G. sagittatum*) on which the root caterpillar does not work.

"A large white bristle-tail (**Nicoletia** sp.) found in the soil near the cane, bamboo and *G. sagittatum* roots was isolated in vials and found to be the cause of the larger pits. Another bristle-tail, smaller and golden-brown in color (**Lepisma** sp.) was also found to produce pits but this latter one is not so abundant as the former. When several bristle-tails in a vial are allowed to work on a root, they may make several pits close

together or even enlarge some of them, but they never make tunnels. Both bristle-tails have been determined by Dr. J. W. Folsom and are probably undescribed species." (Seín, August 1930, p. 177.)

DERMAPTERA

Not knowing exactly the economic importance of the Puerto Rican species of earwigs and their relation to the trees, they are not listed as tree pests on the annotated list in the first part of this work. However, one is apt to find many different species on trees, in such situations as under the bark, in rotten trunks, in old burrows in twigs perhaps caused by twig-borers, etc., and even in abandoned cocoons of the "plumilla", *Megalopyge krugii* (Dewitz). The following are the most common species found on trees:

Euborellia annulipes (Lucas)
Labia curvicauda (Motschulsky)
Labia dorsalis (Burmeister)
Prolabia unidentata (Beauvois)
Doru albipes (Fabricius)
Psalis americana var. **gagathina** (Burmeister)

Of these the most common is *Doru albipes* (Fabricius). This species is usually found in old, abandoned burrows in twigs of trees, breeding inside. On opening one of these bores, it is possible to find eggs, and sometimes young in all stages of development, as well as adults.

Although some species of earwigs are injurious to vegetation and still others are beneficial for their predatory habits, it is difficult to place our species in a relative position in reference to the economic importance as far as trees are concerned, because not enough is known about the life history of the different species.

ORTHOPTERA

FAMILY BLATTIDÆ

The roaches are the insects included in this family and although they are of no economic importance as far as trees are concerned, they are so abundantly found in them under different situations, that it is worthwhile to mention some facts about these insects.

Many tropical species of roaches live on trees, in places such as under the bark, crevices of the trunk, in the roots and between the leaves of bromeliaceous plants on the tree trunk and branches, in old, abandoned leaf-webbers nests and even in abandoned cocoons of the "plumilla", *Megalopyge krugii* (Dewitz). Presumably all the species feed upon the

decayed vegetable matter and some perhaps act as scavengers. The following species are commonly seen on trees:

Aglaopteryx absimilis Gurney
Aglaopteryx diaphana (Fabricius) = **A. devia** Rehn
Cariblatta stenophrys Rehn & Hebard
Panchlora sagax Rehn & Hebard
Hemiblabera brunneri (Saussure)
Plectoptera dorsalis (Burmeister)
Plectoptera rhabdota Rehn & Hebard

Of these, the most common are *Aglaopteryx devia* Rehn and *Plectoptera rhabdota* Rehn & Hebard. According to Mr. Gurney of the U. S. National Museum, all records under *A. diaphana* should be placed now under *A. devia* Rehn, because *diaphana* is a Cuban species.

FAMILY TETTIGONIIDÆ

The only representative of this family which is known to do some damage to trees, is the common "esperanza" or katydid, **Microcentrum triangulatum** Brunner.

Habits: The eggs of this insect are glued along the edges of the leaves, sometimes on twigs or on the bark of trunks or branches. These are laid in a row, being flat, light gray in color and oval in shape. The writer has been able to observe many of these eggs, with small, round, conspicuous holes on the chorion, which are undoubtedly exit holes of parasitic insects which destroy the eggs.

The young nymphs are variegated and bright colored, later becoming entirely green, except at the distal end of the tibia and angles of short wings, which are brown. In the last instar these nymphs are entirely green, thus resembling to the adult insect. In the early stages of their development the young insects are very voracious, usually preferring the young and tender growth. The adults feed on the young or old foliage.

Host: *M. triangulatum* have been recorded from the following host trees:

Andira jamaicensis (W. Wright) Urban	"moca"
Coccolobis laurifolia Jacq.	"uvilla"
Guaiacum officinale L.	"guayacán"
Guarea trichilioides L.	"guaraguao"
Isandrina emarginata (L.) Britton & Rose	"vela muerto"
Lagerstroemia speciosa (L.) Pers.	"reina de las flores"
Malpighia fucata Ker-Gawl.	"olaga"
Petitia domingensis Jacq.	"capá blanco"

ISOPTERA

This order of insects comprises the so-called termites or white ants. Some of our insular species are very injurious to trees, others are not abundant enough to be of economic importance. With the exception of our common termite or "comején", *Nasutitermes* (*N.*) *costalis* (Holmgren) very little is known about the biology of the other forms affecting our trees.

The following species have been recorded on trees:

FAMILY KALOTERMITIDÆ

Kalotermes (Kalotermes) snyderi Light

This species is very common in the Island of Mona, not so in Puerto Rico.

Habits: The termite attacks living trees as well as dead wood. It does not build tunnels or nests on the trunk of trees like our common termite or "comején". The work is chiefly inside the wood, making a complicated system of galleries and tunnels. The soldier is characterized by its huge mandibles and head (fig. 1). (Martorell, Jan. 1941, p. 81.)

Host: The following trees have been recorded as affected by this termite. All records are from Mona Island:

Amyris elemifera L.	"tea"
Canella winterana (L.) Gaertn.	"barbasco"
Coccolobis uvifera (L.) Jacq.	"uva de playa"
Dipholis salicifolia (L.) A. DC.	"sanguinaria"
Bursera simarouba (L.) Sarg.	"almácigo"
Gymnanthes lucida Sw.	"tabaco"
Metopium brownei (Jacq.) Urban	"papayo"
Pithecellobium unguis-cati (L.) Mart.	"rolón"
Coccolobis laurifolia Jacq.	"uvilla"
Conocarpus erectus L.	"mangle botón"
Rauwolfia nitida Jacq.	"muñeco"

Kalotermes (Glyptotermes) pubescens Snyder

This is an interesting species of termite and yet nothing is known to us about its biology. Is a high altitude species dwelling at about 2000 ft. or more in elevation. In one instance the insect was found infesting a trunk of *Ochotea moschata* (Pavon) Mez, at 2,500 ft. in altitude, at the Guavate Unit.

The soldier was described as follows:

"Soldier: Head light yellow-brown, darker anteriorly, where deeply lobed, longer than broad but relatively short, subcylindrical, narrowed slightly at front, highest in center; front rimmed with black, almost vertical, with scattered long, light yellowish hairs on margins and 4 long hairs in a transverse row on dorsum at about middle of head, the 2 inner hairs being slightly shorter than the outer, another row of hairs is on the anterior of the head.

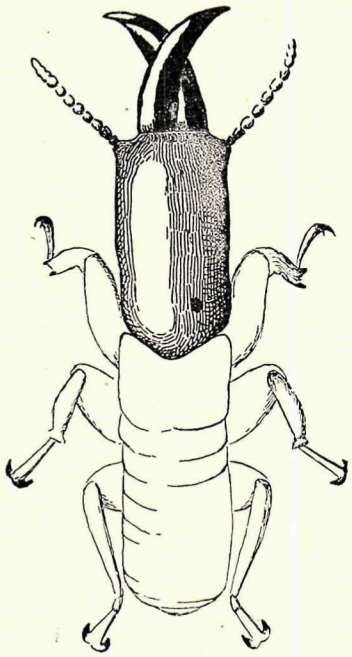


FIG. 1. *Kalotermes* (K.) *snyderi* Light, Soldier (10×). (Drawn by G. N. Wolcott.)

"Antennae light yellow-brown, 10 or 11 segments, a little longer than mandibles, with long hairs, segments become broader toward apex; first segment elongate, cylindrical; second shorter than first, not clavate; third longer than second, clavate, appears to be divided near narrow base, latter however, with no hairs; fourth broader, shorter than third; last segment elongate, subelliptical.

"Eyes pale, large, elongate, subelliptical, near antennal socket.

"Labrum yellow-brown, longer than broad, somewhat tongue-shaped, rounded at apex, with 2 long hairs (longer than labrum) set in center of apex, also with shorter hairs.

"Mandibles blackish, short, not as long as width of head, broad at base,

pointed and incurved at tips; 2 pointed, small marginal teeth near tip and a border tooth near base on left mandible; right mandible with 2 broader marginal teeth nearer base.

"Gula elongate, narrowed in center, not twice as broad at front as in center.

"Pronotum paler than head, twice as broad as long, anterior and posterior margins nearly parallel, anterior corners high, sides rounded, gradually slope to posterior, with long, light-yellow hairs on margins.

"Legs with tibae and tarsi yellowish, fairly elongate, femora thickened.

"Abdomen gray-white, with long, dense, light-yellow hairs.

"Measurement: Total length of soldier, 5.5 to 6.5 mm." (Described from Aibonito, P. R., see: Snyder, 1924, pp. 10–11.)

Host: The termite has been recorded from the following trees:

Cyrilla racemiflora L.	"colorado"
Ocotea moschata (Pavon) Mez	"nuez moscada"
Tamonea guianensis Aubl.	"camasey blanco"

FAMILY TERMITIDÆ

Nasutitermes (Tenuirostritermes) discolor (Banks)

A rare species in Puerto Rico. This termite does not build an exterior nest, but just galleries or tunnels on the infested trunk.

Host: Only recorded from "guaba", *Inga vera* Willd. at a coffee plantation at Ciales, P. R., 1922.

Nasutitermes (Tenuirostritermes) wolcotti Snyder

Another rare species of termite from the Island, which was found years ago, during 1923, at Boquerón, on the south-western corner of Puerto Rico. The insect was described by Dr. T. E. Snyder as follows:

Soldier: "Head yellow-brown (light castaneous), beak darker, head constricted at about middle, with exception of depression at constriction, head and beak are in nearly straight line in profile, head and beak with dense fairly long hairs and head with a few longer hairs, head widest posteriorly where broadly rounded. Small projections on front of head near beak. Beak slender and conical. Mandibler points vestigial (fairly short, slender and pointed.)

"Antennae yellow-brown, with 13 segments, pubescent; third segment subclavate, longer than second; fourth shorter than second segment; segments become longer to apex; last segment shorter, subelliptical.

"Pronotum same color as head, darkest anteriorly where margin is

slightly emarginate, saddle shaped, posterior margin slightly emarginate, margins with long hairs.

"Legs yellow-brown fairly elongate, slender, pubescent.

"Abdomen yellow-brown, tergites with dense fairly long hairs and a row of longer hairs at the base of each tergite". (Snyder, 1924, p. 131; illustration of soldier.)

Measurement of entire soldier: 2.60 mm.

Habits: The tunnels of this species are made out of soil, are broader than those made by the common "comején", being about an inch or more in width. These tunnels lead to no nest but just to the rotten wood of the tree.

Host: On dead wood of "úcar", *Bucida buceras* L.

Nasutitermes (Nasutitermes) acajutlae (Holmgren)

Another species of termite of which very little is known, perhaps due to its scarcity. Recorded only once during 1921, from "algarrobo", *Hymenaea courbaril* L.

Referring to this species, Wolcott in IB., said the following:

"The nest is light brown in color, the outside layers being of uniform brittle character, the interior layers very hard and tough and containing many hard balls about an inch in diameter with two or more narrow tunnels leading to the interior. The exterior tunnel to the ground was nearly an inch broad. Only workers, nasuti and immature stages found (July 8). The workers bit viciously." (IB., p. 49–50.)

Nasutitermes (Nasutitermes) costalis (Holmgren)

(El Comején)

The common termite or "comején" is not only an insular species but it is also scattered throughout the West Indies. It is our most abundant species of termite and is well known by everybody in Puerto Rico.

It constructs large oval nests, about 2 feet in diameter on trees, fence posts, houses, rocks and even on the ground. From this nest or "nigger head", a series of tunnels of carton radiate, connecting it with the ground, by which the termites get their water supply. Each nest represents a complicated social organization, headed by a queen-mother, which is capable of laying eggs at the rate of three per minute or several thousands a day.

Wolcott's latest paper on termites, contains a full discussion of this interesting insect. (Wolcott, March 1939).

The "comején" is perhaps our most destructive termite and the damages

done to trees every year have not been determined yet, but presumably are worth of consideration.

The insect thrives best at low altitudes, especially in the dry forests of Puerto Rico, like the Guánica Insular Forest, Susua Unit and also is common in the mangrove swamps or "manglares" along the coast. At 1,000 ft. in altitude is less abundant and at 2,000 ft. few trees are attacked. From 2,000 ft. up it is seldom observed. (See Plate I, for figures of soldier and worker).

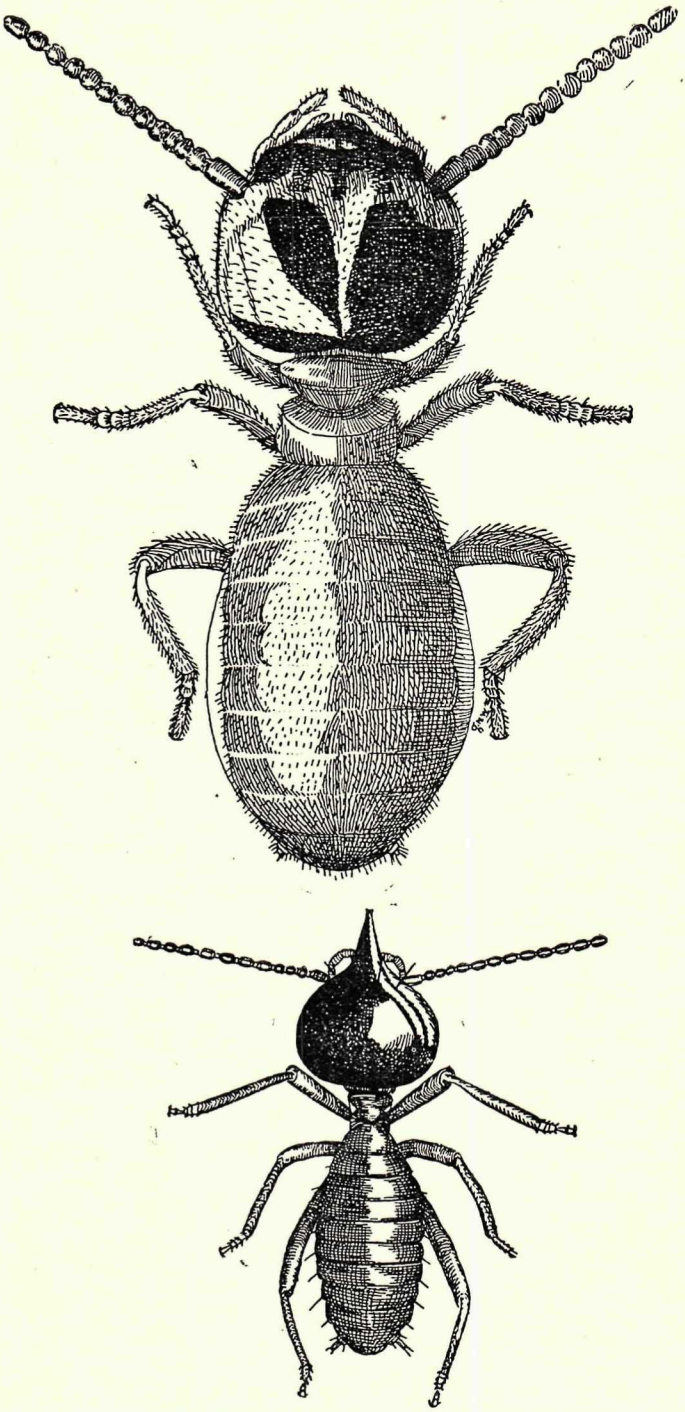
Applied Control: The nests may be destroyed with a cutlass, or their inhabitants killed by placing a tablespoonful of Paris green or white arsenic in the top of the nest, or in the main tunnels if the nest can not be easily localized.

Host: The following trees have been recorded as affected by this insect in Puerto Rico:

Agati grandiflora (L.) Desv.	"gallito"
Albizia lebbeck (L.) Benth.	"amor platónico"
Albizia procera (Willd.) Benth.	"albizia"
Alchornea latifolia Sw.	"achiotillo"
Anacardium occidentale L.	"pajuil"
Andira jamaicensis (W. Wright) Urban	"moca"
Artocarpus communis Forst.	"palo de pan"
Avicennia nitida Jacq.	"chifle de vaca"
Bixa orellana L.	"achiote"
Bucida buceras L.	"úcar"
Buchenavia capitata (Vahl) Eichl.	"granadillo"
Bursera simarouba (L.) Sarg.	"almácigo"
Calophyllum calaba Jacq.	"maría"
Canangium odoratum (Lam.) King	"ilanilán"
Capparis portoricensis Urban	"burro blanco"
Casearia decandra Jacq.	"gía mansa"
Casuarina equisetifolia Forst.	"casuarina"
Cecropia peltata L.	"yagrumo hembra"
Cedrela odorata L.	"cedro español"
Ceiba pentandra (L.) Gaertn.	"ceiba"
Clusia rosea Jacq.	"cupey"
Coccolobis laurifolia Jacq.	"uvilla"
Coccolobis uvifera (L.) Jacq.	"uva de playa"
Cocos nucifera L.	"coco"
Colubrina arborescens (Mill.) Sarg.	"abeyuelo"

PLATE I

Nasutitermes (*N.*) *costalis* (Holmgren), worker 20× (Drawing by G. N. Wolcott)
Nasutitermes (*N.*) *costalis* (Holmgren), soldier 20× (Drawing by G. N. Wolcott)



(Luis F. Martorell: A Survey of the Forest Insects of Puerto Rico)

Conocarpus erectus L.	"botoncillo"
Cordia nitida Vahl	"cereza"
Cordia sulcata DC.	"moral"
Crescentia cujete L.	"higüera"
Dacryodes excelsa Vahl	"tabonuco"
Dalbergia ecastophyllum (L.) Taub.	"palo de pollo"
Dalbergia sissoo Roxb.	"siso"
Delonix regia (Bojer) Raf.	"flamboyán"
Didymopanax morototoni (Aubl.) Dcne. & Pl.	"yagrumo macho"
Elaeodendrum xylocarpum (Vent.) DC.	"coscorrón"
Erythrina glauca Willd.	"bucare"
Eucalyptus robusta Smith	"eucalipto"
Eugenia jambos L.	"pomarrosa"
Eugenia monticola (Sw.) DC.	"birijí"
Euterpe globosa Gaertn.	"palma de sierra"
Ficus elastica Roxb.	"palo de goma"
Ficus laevigata Vahl	"jaguey"
Ficus lyrata Warb.	"palo de goma"
Ficus stahlii Warb.	"jagüey"
Genipa americana L.	"jagüa"
Gilibertia arborea (L.) E. March	"palo de cachimba"
Guarea trichilioides L.	"guaraguao"
Guazuma ulmifolia Lam.	"guácima"
Haematoxylon campechianum L.	"campeche"
Hernandia sonora L.	"mago"
Hura crepitans L.	"javillo"
Hyeronima clusioides (Tul.) Griseb.	"cedro macho"
Hymenaea courbaril L.	"algarrobo"
Inga vera Willd.	"guaba"
Inga laurina (Sw.) Willd.	"guamá"
Krugiodendron ferreum (Vahl) Urban	"palo de hierro"
Laguncularia racemosa (L.) Gaertn.	"mangle bobo"
Leucaena glauca Benth.	"acacia pálida"
Lonchocarpus glaucifolius Urban	"geno"
Lonchocarpus latifolius (Willd.) H.B.K.	"hediondo"
Lucuma multiflora A. DC.	"jácana"
Mammea americana L.	"mamey"
Mangifera indica L.	"mangó"
Manilkara pleeana (Pierre) Cronquist	"mameyuelo"
Melicocca bijuga L.	"quenepa"
Metopium brownei (L.) Krug & Urban	"papayo"
Moringa oleifera Lam.	"ben"

Nectandra sintenisii Mez	"laurel amarillo"
Ochroma lagopus Sw.	"guano"
Persea gratissima Gaertn	"aguacate"
Petitia domingensis Jacq.	"capá blanco"
Piper aduncum L.	"higuillo"
Pisonia albida (Heimmerl.) Britton	"corcho"
Pisonia subcordata Sw.	"corcho"
Pithecellobium arboreum (L.) Urban	"cojóbana"
Pithecellobium dulce (Roxb.) Benth.	"guamá americano"
Pithecellobium unguis-cati (L.) Mart.	"rolón"
Prosopis juliflora (Sw.) DC.	"bayahonda"
Pterocarpus indicus Willd.	
Quararibaea turbinata (Sw.) Poir.	"garrocho"
Randia aculeata L.	"escambrón"
Rapanea ferruginea (R. & P.) Mez.	"mantequero"
Rhizophora mangle L.	"mangle colorado"
Roystonea borinquena Cook	"palma real"
Sabinea florida (Vahl) DC.	"retama"
Sapium laurocerasus Desf.	"manzanillo"
Sciacassia siamea (Lam.) Britton	"cassia amarilla"
Sideroxylon foetidissimum Jacq.	"tortugo amarillo"
Spondias cirouella Tussac.	"ciruela"
Spondias dulcis Forst.	"cítara"
Spondias mombin L.	"jobo"
Sterculia apetala (Jacq.) Karst.	"anacagüitas"
Swietenia mahagoni Jacq.	"caoba"
Tabebuia heterophylla (DC.) Britton	"roble prieto"
Tabeuia pallida Miers	"roble"
Tamarindus indicus L.	"tamarindo"
Terminalia catappa L.	"almendra"
Tetragastris balsamifera (Sw.) Kuntze	"masa"
Thrinax microcarpa Sarg.	"palma de escoba"
Torrubia fragans (Dum.-Cours.) Standley	"corcho prieto"
Trema lamarckiana (R. & S.) Blume	"cabrilla"
Trichilia hirta L.	"cabo de hacha"
Trichilia pallida Sw.	"caracolillo"
Vachellia farnesiana (L.) Wight & Arn.	"aroma"
Vitex divaricata Sw.	"higüerillo"
Zanthoxylum caribaeum Lam.	"espino rubial"
Zanthoxylum martinicense (Lam.) DC.	"cenizo"
Zanthoxylum monophyllum (Lam.)	"mapurito"

CORRODENTIA

The insects belonging to this group should be mentioned due to the fact that the trunk and branches of trees sometimes are covered by a very fine silken web, produced by these insects. This might give the erroneous impression that the tree has been attacked by a terrible pest or invasion of caterpillars or any other injurious insect. On removing carefully the web or silken covering, small aphid-like insects, running very fast over the bark, winged and wingless forms present, will be observed. These are the so called, dust-lice, bark-lice, book-lice or psocids.

The exact role of these insects in nature is not exactly known. It has been said that some species are predaceous on scale insects, others feeding upon insect eggs and even small aphids. Possibly some act as scavengers.

The most common species in Puerto Rico, which is often found on trees is **Pseudocaecilius pretiosus** (Banks). This species is perhaps the most abundant and is simply recognized by the white, silken web which sometimes covers the entire trunk and even branches of trees.

It would be a most interesting investigation, to study the life history of these insects so as to define exactly their economic importance if any.

THYSANOPTERA

The minute, almost inconspicuous insects included in this group are the so called thrips. They are very abundant everywhere on trees, shrubs and plants. The thrips are phytophagous as well as predaceous in their habits. Some species are very injurious to vegetation, others feed exclusively upon insects, even to the point as to prey on members of its same group. *Aleurodothrips fasciapennis* (Franklin) one of our insular species, feeds on the citrus white fly, *Dialeurodes citri* Ashmead in Florida, and on the scale insect, *Aspidiotus destructor* Signoret, in other parts of the world. Only few species in our insular fauna are injurious to trees. The most important species are:

Heliothrips haemorrhoidalis (Bouché)

(Greenhouse Thrips)

This insect which is popularly known as the greenhouse thrips is fairly common in Puerto Rico.

Adult: The adult is dark brown in color with light-colored appendages, its size ranging from $\frac{1}{20}$ to $\frac{1}{24}$ of an inch. The antennae are 8-segmented.

Larva: The larva of this species on maturity is yellowish and the abdomen for the most part is covered with small, wartlike elevations. Most of the hairs of the body except at the tip of the abdomen, are knobbed.

The apical abdominal segments are somewhat tubular. These apical segments are usually slightly stained on the sides with brown. (Franklin, 1908, p. 719.)

Habits: The nymphs and adults suck the plant juices, feeding especially on the foliage of the host trees or plants. When these insects become abundant they are capable of producing an intense chlorosis in the leaves of the plants attacked.

Host: Recorded from *Barringtonia speciosa* Forst. Extent of damage unknown, presumably not a serious pest on this tree.

Selenothrips rubrocinctus (Giard)

(Cacao Thrips)

This is perhaps the most common and injurious species of thrips in the Island, attacking a large variety of plants, shrubs and trees. The common name of this insect is the cacao thrips, on account of its ravages on the cacao plantations in some of the West Indian islands. The species was originally described by Giard (1901, p. 263–5) as *Physopus rubrocincta* from specimens collected on cacao leaves at the island of Guadaloupe, French West Indies.

The insect was re-described by Franklin (1908, p. 719–723). The form which one usually sees attacking the foliage of host trees is the nymph and usually all stages are observed crawling on the undersides of the leaves.

"Larva: At least in their latter stages the larva is bright yellow with a wide bright red hipodermal pigment band running across the base of the abdomen on the upper-side and with the abdomen tipped with bright red on account of the hypodermal pigment. The posterior corner of some of the intervening segments are also often touched slightly with red. Head also usually irregularly mottled more or less, especially about the eyes with reddish or orange pigment. (See illustration in IB, p. 66.)

"Mature nymph: Length, about 0.92 mm.; width of thorax, about 0.27 mm.; greatest width of abdomen, about 0.37 mm. Colored in general like the adult insect but lighter as a rule, especially the abdomen; the band of red pigment at the base of the abdomen is quite noticeable. Shape more chunky than that of the adult, the segments of the body being drawn closely together. Wings rather darker than in adult. Red pigment at apex of abdomen conspicuous. The wing pads reach to about the seventh segment." (Franklin 1908).

Type of injury: When the insect becomes abundant it causes a very heavy chlorosis on the leaves, which makes these turn light brownish or whitish, sometimes giving a silvery appearance to the foliage. This is

especially noticeable on trees of "almendra", *Terminalia catappa* L. when they suffer from a heavy infestation. After such an attack usually a shedding of leaves takes place.

Natural Enemies: The eulophid wasp, *Dasyscapus parvipennis* Gahan which is parasitic on thrips, was imported into Puerto Rico from the Gold Coast (Africa) and after thousands of parasites were released, none have been recovered yet.

Applied control: If it is necessary to control the thrips, soap sprays, Black Leaf-40 or some of the new insecticides in the market having derris or pyrethrum as a basis can be effectively used.

Host: The following trees are attacked in Puerto Rico by this species of thrips:

Anacardium occidentale L.	"pajuil"
Bixa orellana L.	"achiote"
Chrysobalanus icaco L.	"icaco"
Coccolobis laurifolia Jacq.	"uvilla"
Mangifera indica L.	"mango"
Psidium guajava L.	"guayaba"
Spondias mombin L.	"jobo"
Terminalia catappa L.	"almendra"
Zanthoxylum monophyllum Lam.	"espino rubial"

Gynaikothrips ficorum (Marchal)

(The Ficus Thrips)

This species is very common in Puerto Rico and has also been recorded from Florida, Cuba, Canary Islands, Algeria (Africa) and Java. They were first described from specimens collected at Algiers, affecting the trees in the avenues of that city, especially the species *Ficus laevigata* and *Ficus nitida*. The thrips were originally described under the name of *Phloethrips ficorum* by Dr. Marchal (1908, p. 251–3). The previous Puerto Rican records under the name *G. uzeli* Zimmerman should be placed under the new adopted name *ficorum* (Marchal).

Adult: The adults are black, from 2.5 to 3 mm. in length and the entire body surface including the femora and tibiae conspicuously reticulated.

Habits: The insect becomes especially abundant when the host trees are beginning to develop new shoots and leaves. They reproduce in such tremendous numbers that many trees are attacked at the same time. The young and tender leaves are curled by the effect of the infestation and after several days they look brownish, as if burned. Most of the tender foliage is killed. On trying to open one of these curled leaves, one may find the insides full of minute immature stages and even smaller eggs of the thrips.

Not only these thrips do damage to the trees attacked, but they become so abundant as to be falling constantly in the eyes of by-passers. When one of these minute insects comes in touch with the eye, a burning, very disagreeable sensation is produced, causing the subsequent irritation of the mucuous membranes of the eyes. People going to "plazas" or squares of towns where these host trees are used as shade and ornamental trees, are bothered by these insects.

The thrips attack the host trees at lower elevations as well as middle altitudes. The writer has observed trees at about 1,400 ft. with intense infestations, produced by this insect.

Natural Enemies: The thrips are attacked by hemipterous insects belonging to the Family Anthocoridae. The following species have been recorded as predators of this thrips: *Cardiastethus rugicollis* Champion and *Macrotrachelielia nigra* Parshley; also *M. laevis* Champion. The tetrastichid wasp, *Tetrastichus tatei* Dozier has been listed as a parasite of the thrips.

Host: The chief host of this species of thrips in Puerto Rico is the common "laurel de la India", *Ficus nitida* Thunb., used as an ornamental and shade tree in gardens and "plazas".

HOMOPTERA

FAMILY MEMBRACIDÆ

The insects belonging to this family are the so called tree-hoppers or membracids. Although the Puerto Rican species are not known to be of economic importance from the standpoint of being injurious to trees, nevertheless they are so abundant and commonly observed on trees, that they are worthy of mention.

In general, the food of tree-hoppers consists of plant juices, but never become sufficiently abundant as to cause severe damages. The female usually lays the eggs under the bark of smaller branches and in buds or stems. Some species cause injury to the trees during the egg-laying process.

The most common species on our Island are the following:

Nessorhinus gibberulus Stål

Nessorhinus vulpes Amyot & Serville

Monobelus fasciatus (Fabricius)

Nessorhinus gibberulus Stål has been recorded from the following trees: "guaba", *Inga vera* Willd., "pomarrosa", *Eugenia jambos* L., and "jobo", *Spondias mombin* L. (see illustration in IB, p. 73.)

Nessorhinus vulpes Amyot & Serville, has been recorded from the following trees: "icaco" *Chrysobalanus icaco* L., "maga" *Montezuma*

speciosissima Sessé & Moc., and "guayaba", *Psidium guajava* L. (see illustration in IB, p. 74.)

Monobelus fasciatus (Fabricius) is a common West Indian species and undoubtedly our most common tree-hopper. It has been recorded from the following trees:

Cestrum diurnum L.	"dama de día"
Erythrina glauca Willd.	"bucare"
Ficus sintenisii Warb.	"jagüey"
Inga laurina (Sw.) Willd.	"guamá"
Spondias mombin L.	"jobo"
Terminalia catappa L.	"almendra"

FAMILY CERCOPIDÆ

The insects included in this family are commonly known as spittle-insects or frog-hoppers. The common name, spittle-insect, originated from one of the peculiar habits of these insects. The immature stages are passed in a midst of a white froth, very similar to a spittle. Years ago it was called frog-spittle, and the popular belief was that frogs were responsible for such spittles on trees.

Some species of frog-hoppers are very injurious to vegetation. Our tree forms so far known do not cause any appreciable injury.

The most common species on trees are: **Epicranion championi** Fowler and **Philaenus fusco-varius** Stål. Mr. P. W. Oman of the U. S. National Museum, believes that all the previous records under *E. championi* Fowler should be under a different name, because *championi* is a Central American form, presumably not present in our Island.

Epicranion championi Fowler which is a very common insect on coffee, has also been recorded from "jagüey", *Ficus stahlii* Warb. and "guamá", *Inga laurina* (Sw.) Willd.

Philaenus fusco-varius Stål is more abundant than the preceeding species. It has been recorded from "guaba", *Inga vera* Willd., "guamá", *Inga laurina* (Sw.) Willd., "pomarrosa", *Eugenia jambos* L., and "guayaba" *Psidium guajava* L.

FAMILY CICADELLIDÆ

The members of this family known as "leafhoppers", are insects of great economic importance as far as agricultural crops are concerned. Some species affect our trees, many of them being quite harmful. These insects are phytophagous in their habits and obtain their food by sucking the juices of plants, especially from their foliage. When they become abund-

ant they can cause intense chlorosis of the trees attacked, the leaves either turning yellowish or brownish followed by a partial defoliation in most cases. The life history of our forest species has not been studied yet, but the nature of the damage as well as the host trees of most species have been recorded. The following species are injurious to trees in Puerto Rico.

Agallia albidula Uhler, is a species recorded as causing considerable defoliation on "gallito" trees, *Agati grandiflora* (L.) Desv. (illustration in IB, p. 76.)

Protalebra cordiae Osborn, the "capá prieto" leaf-hopper is a species abundant on "capá prieto" trees, *Cordia alliodora* (R. & P.) Cham. Sometimes it becomes so abundant as to be the cause of intense chlorosis in the foliage by a subsequent defoliation. The leafhopper attacks the trees in the lowlands as well as those at middle elevations up to the 2,000 ft. mark. It is most abundant during the dry seasons of the year, when it causes its maximum injury. The species was described by Dr. H. Osborn from *Cordia* sp. collected at Aguirre. The specific name of the tree is not given in the description. The writer believes it was *Cordia nitida* Vahl, a common tree in the vicinity of Aguirre, found along roadsides and pastures. (Illustration of species in Osborn 1935, p. 179).

Protalebra tabebuiae Dozier, the common "roble" leafhopper is found in great numbers among the foliage of "roble" trees, *Tabeuia pallida* Miers. Like the preceeding species this insect is capable of producing intense chlorosis and defoliation in infested trees. The species is very abundant in the lowlands and has been also recorded at 900 ft. in altitude. It has also been listed on "almendra" *Terminalia catappa* L., presumably just resting there and not feeding on the foliage.

Empoasca fabalis DeLong, is a fairly common species in Puerto Rico. It has been recorded on "gallito", *Agati grandiflora* (L.) Desv., causing yellowing of leaves and defoliation. All stages were found abundantly on the foliage of the host tree.

Empoasca sexmaculata Delong has been recorded from "esmajagua", *Pariti tiliaceum* (L.) Hil., causing yellowing of the foliage on trees at Punta de Cangrejos, near Santurce. All stages were found abundantly on the undersides of the leaves.

Empoasca minuenda Ball is one of the most common species in the genus. It has been recorded from "anona blanca", *Annona diversifolia* Safford, "maga", *Montezuma speciosissima* Sessé & Moc., and "aguacate" *Persea gratissima* Gaertn.

Dikraneura cedrelae Oman, our common "cedar leafhopper" is possibly the most injurious forest species. The insect attacks the foliage of cedars,

Cedrela odorata L. and *Cedrela mexicana* Roem., in the lowlands as well as at middle elevations up to 2,000 ft. It is more abundant during dry spells of the year, causing intense chlorosis of the foliage and heavy defoliation. When abundant, hundreds of trees are attacked at the same time in certain section of the Island. The leafhopper is controlled in the field by the fungus, *Hirsutella verticilloides*.

Hybla maculata McAtee has been recorded from "mamey", *Mammea americana* L., and "esmajagua", *Pariti tiliaceum* (L.) Hil. On *Pariti* the insect is often very abundant causing yellowing of the leaves as the writer has been able to observe at Cayey (altitude 1,000 ft.) and in Mona Is., at sea-level. At Mona many trees were heavily infested by this species.

The insect species just mentioned are the most important as far as economic importance is concerned in relation to forest, shade and ornamental trees in our Island. As the different species of leafhoppers are so similar in their general appearance, no attempt has been made to give a description of each species. However, if the reader is interested in knowing more about this group of insects, reference should be made to Osborn's publication on the Homoptera of Puerto Rico. (Osborn, 1935).

FAMILY FULGORIDÆ

This family includes a group of insects which depend exclusively upon plant juices for their existence. We have some species in the Island but none of them are injurious to trees as far as we know. Since they are commonly seen on trees, even breeding on twigs and on the undersides of the leaves, it is worthwhile to mention the most common species as well as the host trees of which they have been recorded.

Bothriocera venosa Fowler is a common species in Puerto Rico. It has been recorded from the following trees: "uva de playa", *Coccolobis uwifera* (L.) Jacq., "guaba", *Inga vera* Willd. and "guamá", *Inga laurina* (Sw.) Willd. (See illustration on IB, p. 94.)

Ormenis pygmaea (Fabricius) is one of our most common species of fulgorids in Puerto Rico. They are usually present on the twigs or under the leaves of trees, breeding sometimes abundantly. (See illustration in IB, p. 103.) The species has been recorded from the following trees:

Coccolobis laurifolia Jacq.	"uvilla"
Coccolobis uwifera (L.) Jacq.	"uva de playa"
Eugenia jambos L.	"pomarrosa"
Piper amalago L.	"higuillo de limón"
Torrubia fragans (Dum.-Cours.) Standley	"corcho prieto"

Varronia angustifolia West	"basora"
Varronia corymbosa (L.) Desv.	"saragüazo"
Zanthoxylum monophyllum Lam.	"espino rubial"

Ormenis marginata (Brunnich) is perhaps our most abundant fulgorid in Puerto Rico. It occurs in almost the same situations as *O. pygmaea* (Fabr.) and often both species are seen together on the same twigs or leaves. All these species of fulgorids are very fond of the semi-darkness of the forest or shrubs, not liking those trees which are more or less exposed to the direct sunlight. The writer has been able to observe twigs and leaves of many different trees fully infested by this species, yet no appreciable injury was noticed. The species has been recorded from the following trees:

Coccolobis laurifolia Jacq.	"uvilla"
Coccolobis uvifera (L.) Jacq.	"uva de playa"
Inga vera Willd.	"guaba"
Nectandra sintenisii Mez	"laurel macho"
Ocotea portoricensis Mez	"laurel"
Petitia domingensis Jacq.	"capá blanco"
Terminalia catappa L.	"almendra"
Torrubia fragans (Dum.-Cours.) Standley	"corcho prieto"

Ormensis quadripunctata (Fabricius) is another common species very abundant on trees. It is quite different from the two preceeding species, being blue gray in color and with distinguishing dark dots on the elytra. (See illustration in Osborn, 1935 p. 221.) It has been recorded from the following trees:

Chrysobalanus icaco L.	"icaco"
Citharexylum fruticosum L.	"péndula"
Coccolobis laurifolia Jacq.	"uvilla"
Coccolobis uvifera (L.) Jacq.	"uva de playa"
Erythrina glauca Willd.	"bucare"
Montezuma speciosissima Sessé & Moc.	"maga"
Persea gratissima Gaertn.	"aguacate"
Varronia corymbosa (L.) Desv.	"saragüazo"

FAMILY CHERMIDÆ

The jumping plant lice or psyllids are the common names applied to the members of this family. These insects are very similar in appearance to the aphids, but can be distinguished from them by their stouter legs, the hind pair fitted for jumping, the firmer texture of the body and the ten-jointed antennae, very seldom nine or eleven-jointed. They live and breed on the foliage of trees and some species become so abundant as to

be the cause of partial defoliation. In general they are not injurious insects and more or less can be compared with our white flies in this respect. The species attacking trees in the Island are the following:

Heteropsylla mimosae Crawford, which also occurs in Texas is a light orange to reddish brown species not abundant in the Island. (Described by Crawford, 1914, p. 48).

Host: Recorded only from "aroma" *Vachellia farnesiana* (L.) Wight & Arn.

Heteropsylla puertoricoensis Caldwell is another species, although not common. The head and thorax is yellow and the abdomen greenish in the females. (Caldwell 1942, p. 28.)

Host: Only recorded from the foliage of "samán", *Samanea saman* (Jacq.) Merrill.

Ceropsylla sideroxyli Riley is perhaps our most abundant lowland species. The adult is greenish yellow on the upper side, abdomen and venter green: the praescutum brownish on the anterior half or two-thirds, the head with a black area between the antennae, extending up around front ocellus and including genal cones. The antennae are brown, greenish on the basal half. (Crawford 1914, p. 101.)

Habits: The immature form of this species causes a pit or cup-shaped excavation on the leaves of the host trees, which is very characterictic of the species. A wax-like secretion covers the dorsal surface of the larva and on looking to infested leaves, one can only see pits full of whitish powder. When these insects become abundant they cause partial defoliation of the host trees.

Host: Recorded from "tortugo amarillo", *Sideroxylon foetidissimum* Jacq. in Puerto Rico. Also from same host tree at Florida, from which the species was originally described.

Ceropsylla martorelli Caldwell, is abundant in our mountain forests at middle and higher elevations. The following are the main characteristics of the species:

"General color of the male, red to light orange, the female light to dark brown. The head as broad as thorax, scarcely deflexed. Eyes very prominent. Genal cones three-fourths as long as vertex, continuous throughout; apices acute. Antennae one and one-fourth times as long as width of head" (Caldwell 1942, p. 28–9.)

Habits: The eggs of this insect presumably are laid on shoots or very tender foliage of the host trees. The adults are commonly seen during the rainy seasons of the year, when new shoots are appearing on the trees. Otherwise, one can only see the immature forms during the rest of the year.

The immature forms or larvae of the psyllid, are the cause of certain

small pits or cup-shaped excavations about one-fourth or one-fifth the size of those caused by the related species *C. sideroxyli* Riley. These excavations open to the undersides of the leaves and are very close one to the other, sometimes as many as a hundred or more are observed on a leaf. Looking at the leaves from the upper surface it gives the false appearance of galls. The young larvae are covered by a whitish bloom, not so noticeable as that of *C. sideroxyli* Riley.

The writer has not been able yet to observe this insect in the lowlands, apparently it is a middle and higher altitude species where most of its host trees grow.

Host: The following trees are infested by this psyllid in Puerto Rico:

Ocotea leucoxylon (Sw.) Mez	"laurel geo"
Ocotea portoricensis Mez	"laurel"

Euphalerus nidifex Schwarz is present where its host tree is growing, usually along the coast. The species is not very abundant due to the scarcity of its host tree. The chief characteristics of the species are as follows:

The general color is greenish white, speckled with brown or black spots over the entire surface, including wings and legs; antennae tipped with black on each segment; wings maculated apically and covered over the entire surface with dots. The vertex and pronotum very finely punctate or smooth, eyes scarcely recessive; genal cones one-half to five-sixths as long as vertex. (Crawford, 1914, p. 119.)

Habits: This species is one of the nest making psyllids, of which only few are known to science.

"The species from Key West (Florida) forms a nest-like globular structure of whitish color, usually along the midribs of the fully developed leaves. Upon examination the walls of this structure is seen to be composed of fine, cotton-like threads. When inhabited by the larvae the nests are of a sticky nature, but old specimens become brittle in time. They are fastened to the leaves by a broad base so that the larva, in feeding, is forced to push its beak through this space into the parenchyma of the leaf." (Proc. Ent. Soc. of Wash. vol. 6, 1904, p. 153–154.)

Host: The insect breeds on the foliage of "ventura", *Piscidia piscipula* (L.) Sarg. It has been previously recorded from the same host in Florida and Cuba. There is a record of one female from British Honduras.

Arytaina cayeyensis Caldwell is a recently described species and nothing so far is known about its habits. The general characteristics of the species are as follows:

"General color straw yellow over all with indications of broad white stripes on the thorax; five terminal antennal segments black.

"Head rather declivious, finely pubescent, as broad as thorax. Vertex twice as broad as long, somewhat rounding downward in front. Posterior ocelli strongly elevated. Genal cones half as long as vertex, divergent, broadly rounded. Antennae almost two and one half times as long as width of head." (Caldwell 1942, p. 29–30.)

Host: Recorded from *Inga* sp., collected by Dr. H. Osborn at Cayey, P. R., Jan. 28, 1929.

Psylla minuticona Crawford is our most common species, particularly abundant at middle altitudes, where the host trees are seen in coffee groves. The general characteristics of this species are:

"General color greenish yellow to light orange; antennae flavous on basal half, rest black." (Crawford 1914, p. 159.)

This species resembles *P. torrida* Crawford described from Para, Brazil. In referring to some specimens which Dr. J. Caldwell identified for the writer some years ago, he says in a personal letter the following:

"The longer I look at the specimens of *minuticona* from Puerto Rico the more I think they are not *minuticona*. I have specimens from El Salvador and Mexico that fit the description much better. The Puerto Rico specimens do not have anything that can be called a crotch-shaped structure between the forceps, and the head is flat not rounded down as in *Calophya*. As you will note, everything is compared with *torrida* and it may be the true *minuticona*. I will try to send some specimens to Hawaii for comparison. Meanwhile I am sorry I ever put a label on our so called *minuticona*."

Host: The psyllid affects the leaves of "guaba", *Inga vera* Willd., especially abundant on the young tender foliage. Also recorded from Guatemala, El Salvador and Mexico, but no host plants or trees are mentioned.

Psyllia martorelli Caldwell has been found living under the same situation as *Psylla minuticona* Crawford. The species was collected while breeding in the young and tender shoots of "guaba" trees, at the mountains north of Villalba, about 1,200 feet in altitude.

The species is described as follows:

"Length 2.5–3.5 mm., forewing 2–2.5 mm. Specimens in preservative color unknown. Mesoscutum with broad light stripes.

"Head broader than thorax; eyes somewhat stalked; posterior ocelli greatly elevated. Vertex scarcely deflexed, rolled somewhat roundedly forward. Genae scarcely swollen; frons much sunken but not covered by genae. Antennae almost as long as entire insect. Thorax scarcely arched. Forewings little over twice as long as broad; apical margins almost flat; pterostigma not apparent; costal margins pubescent.

"Apices of male forceps slightly bifurcate. Female genital segment as long as rest of abdomen; both valves very slender, stylate in apical half." (Caldwell, J. S., Dec. 1944, p. 339.)

Nothing is known yet about the biology of this insect.

Host: Breeding on the tender growth of "guaba", *Inga vera* Willd.

FAMILY APHIIDÆ

This family includes a group of soft bodied insects having a complex system of reproduction and very interesting life histories, commonly known as aphids or "pulgones". Some species are very injurious to important crops, like sugar cane, cucumbers, melons, beans, cotton, etc. The Puerto Rican species are not really of economic importance as far as trees are concerned. Some species attack some of our trees but they rarely become sufficiently abundant to be considered as pests. Our insular forms which affect trees are the following:

Aphis gossypii Glover is a fairly common species in the Island; doing considerable damage to crops of economic value like cotton, cucumbers, melons, etc. The chief characteristics of the species as described by Gillete and Palmer, 1932, p. 400 are as follows:

"Color.—Viviparae. Pale yellow to pale sordid or yellowish green to mottled blackish-green without dusky markings, except on lateral areas; legs pale; cornicles black; nymphs of alatae green with dorsum of abdomen flesh color, powdered on head and thorax and usually tesellated on abdomen" (for more descriptive characters see Gillette & Palmer 1932, p. 400) (see fig. 2).

Natural Enemies: The aphids reproduce in alarming numbers in the field, but they are also likewise controlled by a group of parasites and predators which under normal conditions keep them on check. The following are some of the insect enemies of aphids:

The coccinellid beetles: *Cryptolaemus montrouzieri* Mulsant, *Cycloneda sanguinea* Linnaeus, *Diomus roseicollis* Mulsant, *Hippodamia convergens* (Guerin), *Hiperaspis festiva* Mulsant, *Hyperaspis connectens* (Thunb.), *Psyllobora nana* Mulsant, *Scymnus loewi* Mulsant and *Scymnus* sp. (see Fife, 1939.)

The syrphid fly larvae, *Baccha clavata* (Fabricius) and *Baccha latiusculus* (Loew) prey upon this species of aphid and are one of their most efficient means of control.

The larva of *Chrysopa* sp. (Chrysopidae: Neuroptera) also attacks the aphid.

On the parasitic group the most important species is the braconid

wasp, *Aphidius testaceipes* (Cresson). This parasite is very abundant in the field and very efficient in its control.

The insect is also attacked by the fungus *Acrostalagamus aphidum* Oud., becoming at times abundant in the field and destroying large numbers of aphids.

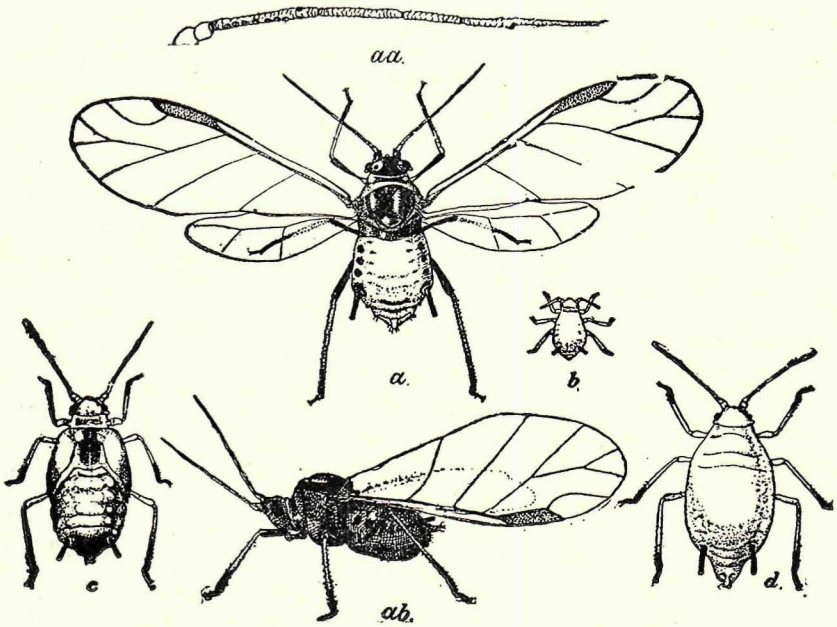


FIG. 2. *Aphis gossypii* Glover: a. winged female; aa. antenna of same greatly enlarged; ab. dark female from the side; b. small nymph; c. fully grown nymph; d. wingless female. (After Chittenden.)

Host: The following trees are attacked by the aphid:

Cecropia peltata L.	"yagrumo"
Mangifera indica L.	"mango"
Psidium guajava L.	"guayaba"
Tabebuia pallida Miers	"roble"
Terminalia catappa L.	"almendra"

Aphis nerii Fonscolombe is a very conspicuous and easily recognizable species due to its large size and bright yellow color. Undoubtedly is the largest species of aphid in the Island.

Color:—Viviparae. Large yellow aphis with black antennae and legs.

Habits: Usually on the undersides of leaves, but when abundant, found in all places even on the twigs. The insect is a typical low altitude form,

not seen at middle elevations. Fairly common in the drier as well as moist sections of the Island, usually on different host plants in each section.

Natural Enemies: In the field these aphids are naturally controlled by syrphid fly larvae. Three species of flies all in the same genus have been recorded as feeding on this aphid: *Baccha clavata* (Fabricius), *B. fasciatus* Roeder and *B. latiusculus* Loew.

Host: In the dry sections of the Island it attacks the foliage of the giant milkweed or "algodón de seda", *Calotropis procera* (Ait.) R. Br.

Aphis rumicis Linnaeus is another of our species, although not very common. The chief characteristics of the species are:

"Color.—Viviparae. Dark olive-green to black, cauda and cornicles black; legs and antennae mostly pale. Nymphs of alatae blackish except meso- and meta-thorax which are pale green; abdomen tesselated with 4 rows of powdery spots on dorsum." (Gillete & Palmer 1932, p. 439.)

Habits: Like nearly every aphid the insects are usually found on the undersurface of the leaves. They rarely become abundant enough to cause injury of economic importance.

Host: Recorded from the foliage of "uva de playa", *Coccolobis uvifera* (L.) Jacq.

Toxoptera aurantii (Fonscolombe), is perhaps our most common species attacking trees and shrubs. It has been recorded in the lowlands as well as middle altitudes up to 2,000 ft. The main characteristics of the species are:

Apterous females: The apterous females are dark brown, nearly black; margin of abdomen not bearing tuberculate hairs. The sixth antennal segment of winged female equal to one-sixth the terminal filament; wing veins and stigma fuscous; fork of cubital vein arising before the point where the stigmal vein originates. (Phillips & Davis 1912, p. 8.)

Habits: The aphids are usually found on the undersides of the leaves, but sometimes they attack the young shoots of the plants. When abundant they cause curling of the leaves.

Natural Enemies: The insect is controlled by the larvae of syrphid flies, *Baccha clavata* (Fabricius), *B. fasciatus* Roeder and *B. latiusculus* (Loew). The larva of the coccinellid *Psorolyma maxillosa* Sicard is also an enemy of this insect.

Perhaps the most efficient parasite contributing in the natural control of this aphid is the braconid wasp, *Aphidius testaceipes* (Cresson).

The fungus *Acrostalagmus aphidum* Oud. when abundant in the fields controls the aphids efficiently.

The most common among the predators is the larva of the blue-black syrphid fly *Bacca clavata* (Fabricius) (see fig. 3.) The larvae are legless,

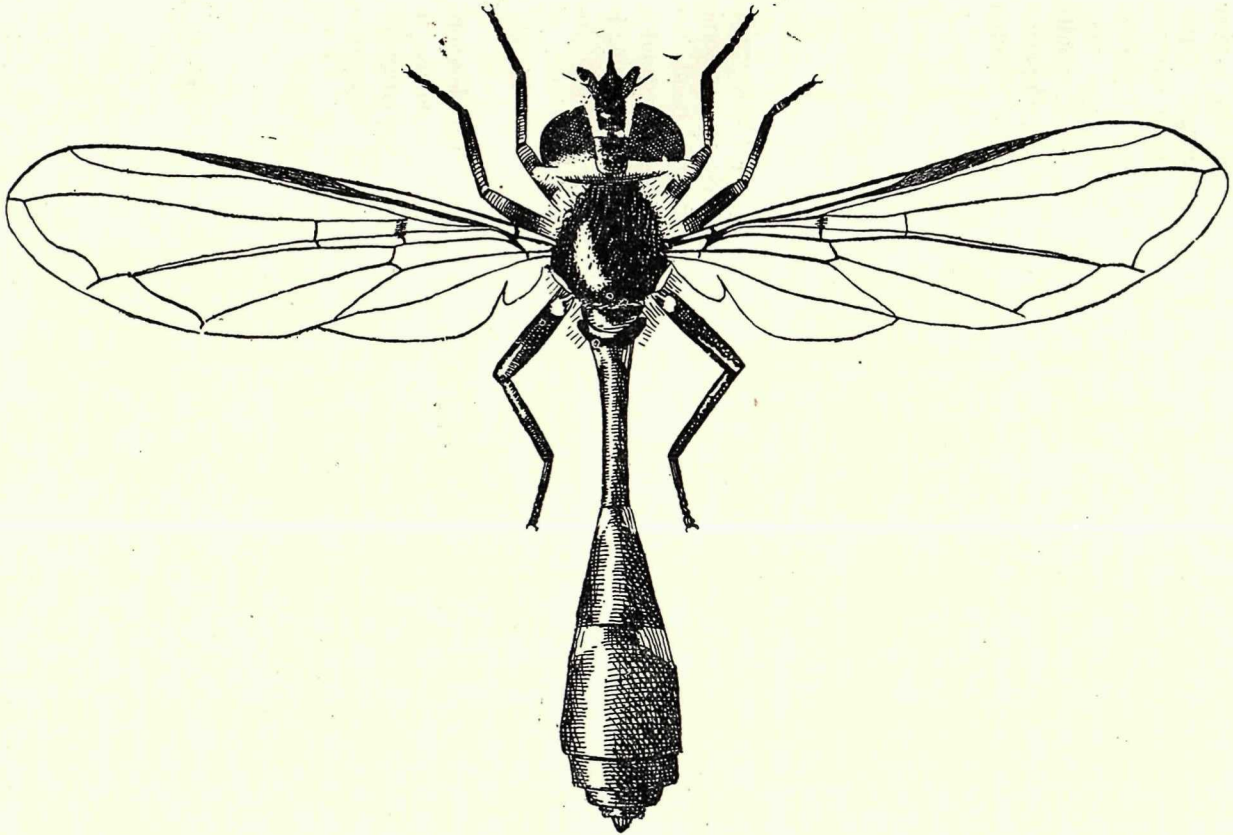


FIG. 3. *Baccha clavata* (Fabricius) Twelve times natural size. (Drawn by G. N. Wolcott.)

slug-like, semi-transparent, greenish yellow maggots, shaped like a very elongate triangle. Their bodies are adorned by numerous minute, transparent projections and are bluntly cut off behind, but their head ends are long and flexible, continually being waved about in search of its prey, when the maggots are not engaged in feeding. These maggots are very voracious and they feed all the time on the aphids, thus growing rapidly and attaining a much larger size than their prey in a short time. Pupation occurs on the leaves, a pear-shaped puparium being formed out of which a beautiful blue-black fly emerges in a few days.

No less interesting than this fly is the internal parasite of aphids, *Aphidius testaceipes* (Cresson). Wolcott, writing about this parasite says:

"Sometimes one finds a large mature grape-fruit leaf completely covered on one side with the dead bodies of extraordinarily large, plump and unnaturally rounded aphids, the back of each one having a small black hole. Through this hole has emerged a single, elongate black wasp, *Aphidius* sp. The female wasp in laying her egg, takes a position at some distance from the aphid to be parasitized, and facing it, then bends her elongate abdomen under her body and between her legs until its extended tip comes in contact with the abdomen of the aphid, into which the egg is quickly inserted. The maggot hatching from this egg feeds on the interior of the aphid. As the aphid is quite small in proportion to the size of the parasite, its growth is stimulated or its skin stretched, so that the body of the parasitized aphid becomes greatly distended, attaining an unnatural size far beyond that of normal, healthy aphids. The development of the parasite is so rapid that the adult wasp is ready to emerge in less than a week after the egg was deposited in the aphid. Ordinarily the wasp is so thoroughly efficient in her egg-laying activities, missing not a single aphid, as to completely wipe out the entire colony." (Wolcott, EEWI p. 432–3.)

Host: The following trees are attacked by the aphid in the Island:

Calophyllum calaba Jacq.	"maría"
Coccolobis uvifera (L.) Jacq.	"uva de playa"
Genipa americana L.	"jagua"
Mammea americana L.	"mamey"
Mangifera indica L.	"mango"
Ocotea leucoxylon (Sw.) Mez	"laurel geo"
Rapanea ferruginea (R. & P.) Mez	"mantequero"

Cerataphis lataniae (Boisduval) is a species usually found on palms. As far as we know there is only one species in this genus on the Island. A species belonging to the allied genus *Aleurodaphis* also attacks palms in Puerto Rico. The two genera can be distinguished as follows: in *Cerata-*

phis the antennae of the aleyrodiforms are 4-jointed while in *Aleurodaphis* they are 5-jointed. The species is very characteristic and peculiar in shape and can be identified very easily. Wolcott, (EEWI p. 362–3) says the following about this aphid:

"A most peculiar aphid, *Cerataphis lataniae* (Boisduval) is reported from Jamaica as occurring on coconut, although it normally lives on orchids and ornamental plants. In Puerto Rico, a heavy infestation on an ornamental palm, observed for several years, did not spread to the overhanging leaves of a coconut palm, and the record in Jamaica doubtless represents exceptional instance. The aphids are far from typical, being black and lens shaped, and so little inclined to wander that a ring of whitish filaments surrounds each insect, like a halo, where it rests on the leaf." (For a description of the species see Gillete & Palmer, 1934, p. 241–42.)

Natural Enemies: The adults and larvae of the lady-bird beetle *Cycloneda sanguinea* Linnaeus prey upon these aphids, destroying large numbers of them.

Host: Recorded from "palma de Borbón", *Livistona chinensis* R. Br.

FAMILY COCCIDÆ

(Scale Insects and Mealybugs)

This family comprises a very large group of insects which in Puerto Rico are among the worst pests of trees. Some species are so injurious as to kill trees, others destroy branches and twigs. However in spite of the fact that some species are very abundant on trees no appreciable damage is observed. As a popular description of the insects will not be of much value in identifying the scale insects and technical descriptions are too complicated, the description of species will be omitted, except in a few instances. The host trees will be listed under each species.

Subfamily Monophlebinae

Crypticerya rosae (Riley & Howard)

This species which is usually found on the branches, twigs or trunk of trees growing at low altitudes in the Island, is not an abundant insect.

Natural Enemies: The phorid fly *Syneura cocciphila* Coquillet has been reared from this coccid and presumably is one of its main parasites.

Host: The following trees have been recorded as being infested by the coccid:

Casearia aculeata Jacq.	"cambrón"
Casuarina equisetifolia Forst.	"pino australiano"
Guaiacum officinale L.	"guayacán"
Haematoxylon campechianum L.	"campeche"

Icerya montserratensis Riley & Howard

This is a fairly common species in Puerto Rico, usually found at low altitudes and elevations up to 1,300 ft. It is similar in appearance at first glance to the cottony cushion scale, *Icerya purchasii* Maskell, but upon inspection, many differences are noted between the two species (see fig. 4).

Natural Enemies: The insect is parasitized by certain hymenopterous insects, among them, the braconid *Rhyssalus bruneiventris* Ashmead and the encyrtids *Brethesiella* sp. and *Cheiloneurus pulvinariae* Dozier.

Host: The following trees in Puerto Rico have been recorded as host trees:

Brysonima spicata (Cav.) Rich.	"maricao"
Calophyllum calaba Jacq.	"maría"
Casearia sylvestris Sw.	"laurel espada"
Casuarina equisetifolia Forst.	"pino australiano"
Chrysophyllum argenteum Jacq.	"caimito verde"
Cocos nucifera L.	"coco"
Ficus nitida Thunb.	"laurel de la India"
Inga vera Willd.	"guaba"
Inga laurina (Sw.) Willd.	"guamá"
Mammea americana L.	"mamey"
Psidium guajava L.	"guayaba"
Samanea saman (Jacq.) Merrill.	"samán"

Icerya purchasii Maskell

(The Cottony Cushion Scale)

This introduced species which for a short time appeared to be a serious threat to our agriculture is now under natural control. Although it has widely spread around the Island, fortunately it has become less destructive since it is readily controlled by its natural parasites and predators when it becomes abundant. Since its introduction this insect has been fully discussed in different publications issued by the Agricultural Experiment Station at Rio Piedras, P. R. (see IB, p. 120 and SIB, p. 56.)

The original home of this insect is said to be Australia from where it passed to New Zeland and subsequently into South Africa, Fiji, the Sandwich Islands, the West Indies and continental United States. The species also occurs in many parts of Europe (Portugal, France, Italy) (see Fig. 5).

Natural Enemies: The most important of the natural enemies of this pest is the coccinellid beetle, *Rodolia cardinalis* (Mulsant). Both the adult and larvae of this insect prey upon the coccid. The agromyzid fly *Cryptochaetum iceryae* (Williston) was introduced and several releases

were made at Mona Island to help in the control of the coccid which was infesting a plantation of young australian pines or casuarinas. Other predaceous and parasitic insects which also control the mealybug are the following: the coccinellid beetle *Decadiomus pictus* Chapin and the phorid fly *Syneura cocciphila* Coquillet. The fungus *Spicaria javanica* Bally has been also cited as an enemy of this insect. (Wolcott & Martorell, Feb. 1940, p. 202.)

Host: The following trees are recorded as being infested by this scale insect:

Casuarina equisetifolia Forst.	"pino australiano"
Erythrina glauca Willd.	"bucare"
Isandrina emarginata (L.) Britton & Rose	"vela muerto"
Prosopis juliflora (Sw.) DC.	"mesquite"
Pithecellobium dulce (Roxb.) Benth.	"algarrobo del Hawaii"

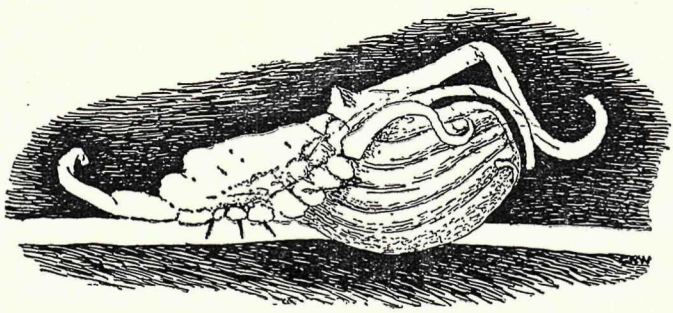


FIG. 4. *Icerya montserratensis* Riley & Howard. Five times natural size. (Drawn by G. N. Wolcott.)

Subfamily Ortheziinae

Orthezia insignis Douglas

This species although very abundant and injurious to small plants is seldom observed on trees. So far it has only been reported from "Martín Avila", *Chione venosa* (Sw.) Urban.

Subfamily Asterolecaniinae

Asterolecanium bambusae (Boisduval)

(The Bamboo Scale)

A very common species in Puerto Rico, ranging from low altitudes to middle elevations up to 2,000 ft., but more abundant in the lowlands. The species is cosmopolitan in its distribution and occurs in nearly every part of the tropical world. The scale is found on the leaves as well as the

stems of the host trees. The main host plant of this scale insect are the tree-like grasses belonging to the genus *Bambos*.

Natural Enemies: A native coccinellid beetle feeds on the coccid: *Scymnillodes cyanescens violaceous* Sicard. Recently several species of ladybird beetles have been introduced for the purpose of controlling this

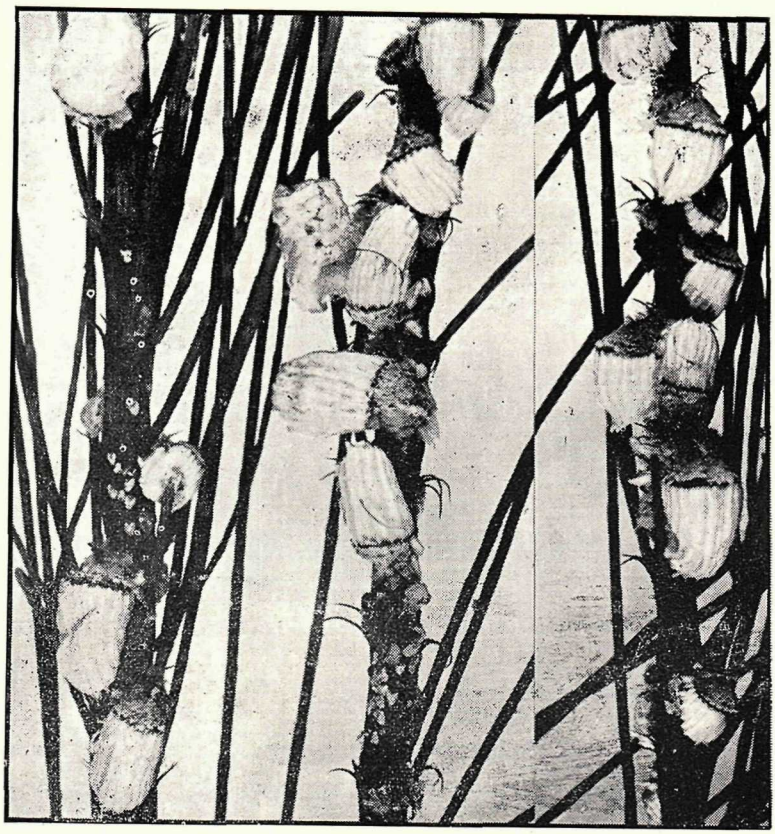


FIG. 5. The cottony cushion scale, *Icerya purchasii* Maskell on twigs of australian pine, *Casuarina equisetifolia* Forst.

pest. Originally they came from Trinidad, Br. W. I. and were collected there while feeding on the bamboo scale. They are: *Cryptognatha nodiceps* Marshall, *C. simillima* Sicard and *Azya trinitatis* Marshall. After they were released here, they preferred feeding on the coconut scales rather than on those of bamboo. Two more coccinellids, *Egius platycephalus* Mulsant from Cuba and *Chilocorus cacti* (Linn.) from Cuba and Texas, were also introduced. Like the others they seem to prefer other scales but the one on bamboo.

Host: Recorded from *Bambos vulgaris* Schrad, our common "bambúa". The insect has been observed infesting various different species of bamboo planted at the Agricultural Experiment Station at Mayagüez, but the exact names of the plants have not been given.

Asterolecanium longum (Green)

Not a common species in the Island, only recorded from "bambúa", *Bambos vulgaris* Schrad.

Asterolecanium miliaris miliaris (Boisduval)

Another species which is not abundant in the Island also recorded from "bambúa", *Bambos vulgaris* Schrad., and listed from other species of bamboo at Mayaguez.

Asterolecanium pustulans (Cockerell)

(The Pustule Scale)

This is our most injurious species to forest trees in Puerto Rico affecting a wide variety of trees. The insect is cosmopolitan in its distribution. Russell, 1941, discussing this species in her monograph of the genus lists the localities where the species has been previously collected and the host plants. (Russell, 1941, p. 167–8.)

Habits: The pustule scale, as the name implies, is a pustule or pit producing insect. These pits produced on the bark of the trunk, branches and twigs, make the species very distinguishable, since we do not have in the Island any other species capable of producing such injury. The depth of these pits depends chiefly on the host plant infested, certain tree species being very susceptible to the attack of the insect and thus having deep pits produced while in others they are very shallow.

This scale insect sometimes kills whole trees, especially in the susceptible species like *Sciacassia siamea* (Lam.) Britton and *Grevillea robusta* A. Cunn. Wolcott, Oct. 1940, p. 6, making reference to an infestation of this insect on "maga", *Montezuma speciosissima* Sessé & Moc. says:

"Observations made during the past few months by the writer and Mr. L. F. Martorell indicate a surprisingly extensive infestation by *Asterolecanium pustulans* (Cockerell) on roadside specimens of "maga" from Dorado to Isabela. Infestations are readily noted, for even a small number of scales on a twig causes all the leaves to die and turn brown. Injury resembles fire blight of pear and apple, for the dead leaves remain attached to the dead twig for some time in a manner very different from the natural maturity of the leaves which drop as soon as they become yellow. The scale does not produce as deep a pustule as on some other hosts, but its

effect is more rapidly toxic in causing prompt death of the infested twig or branch. For the most part, the trunk and the main shoot are rarely infested, but one sometime sees as many as half of the lateral branches infested and killed at one time. This widespread infestation on maga may be a very recent development, for no old records of infestation on this host are available, and it may disappear as rapidly as it has appeared, but just at present it looks serious."

Comparing the depth of the pits produced on this host trees with others like *Sciacassia siamea* (Lam.) Britton, *Grevillea robusta* A. Cunn. and *Conocaupus erectus* L., one comes to the conclusion as to the depth or character of the pits in relation to the susceptibility of the host.

The insect ranges from the lowlands to the middle altitudes, but as far as observations have demonstrated, the coccid is not so dangerous, neither so abundant at altitudes over 1,000 ft., as on the lowlands.

Natural Enemies: Fortunately the insect is eventually reduced to control by means of its natural parasites, all minute wasps: the mymarid, *Alaptus borinquensis* Dozier, the aphelinid, *Aspidiotiphagus citrinus* (Craw.) and the encyrtids, *Euaphycus portoricensis* Dozier and *Mercetiella reticulata* Dozier.

Host: The insect affects the following trees in our Island:

Annonna muricata L.	"guanábana"
Annonna reticulata L.	"corazón"
Bambos vulgaris Schrad.	"bambúa"
Cassia fistula L.	"caña fístula"
Conocarpus erectus L.	"botoncillo"
Cupania americana L.	"guara"
Delonix regia (Bojer) Raf.	"flamboyán"
Grevillea robusta A. Cunn.	"roble australiano"
Inga vera Willd.	"guaba"
Mangifera indica L.	"mango"
Montezuma speciosissima Sessé & Moc.	"maga"
Ochroma lagopus Sw.	"guano"
Rapanea guianensis Aubl.	"bádula"
Rauwolfia nitida Jacq.	"palo amargo"
Salix chilensis Molina	"sauce"
Sciacassia siamea (Lam.) Britton	"casia amarilla"
Ternstroemia stahlii Krug & Urban	"mamey del cura"
Zanthoxylum flavum Vahl	"aceitillo"

Subfamily Pseudococcinae

This subfamily includes a group of insects commonly known as mealybugs. Generally they are easily separated from the other members

of the family by their large size and flour-like covered bodies, because of which they are called in Spanish "chinches harinosas." Generally they are found on the undersides of the leaves, but also on the twigs and smaller branches. When abundant they cause injuries of economic importance. Some species are abundant in the lowlands as well as middle altitudes. Most of the insular species in this subfamily are included in one genus: *Pseudococcus*. The following are the species affecting our trees:

Pseudococcus brevipes (Cockerell)

This insect is one of the worst pests of pineapple, *Ananas sativus* Schult. f., in the Island. Fortunately it affects very few trees and is not abundant on them. The principal characteristics in identifying the insects are the following:

Adult female: The adult female is very pale, olivaceous or greyish, or obscurely yellowish, with a close but not very dense covering of white powdery secretion; margin with short, subconical waxy tassels, most of which may be missing in old specimens. Body rather broadly ovate, convex and tumescent above, flattish beneath; limbs and antennae relatively small. Antennae either seven or eight jointed; terminal joint always the longest and markedly stouter than the preceeding joints. Ceriferous tracts seventeen on each side, each with from two to four (rarely five) small but stout conical spines, three or four slender setae, and an irregular group of small ceriferous pores. Average length 2 to 3 mm., width 1.5 to 2 mm. (Green 1922, part 5, p. 381).

Host: Recorded from "jagüey", *Ficus laevigata* Vahl and "tamarindo", *Tamarindus indicus* L.

Pseudococcus adonidum (Linnaeus)

A fairly common species in Puerto Rico, regarded as a cosmopolitan insect, but limited to greenhouses in the temperate regions of the world. The chief characteristics of the species are as follows:

Adult female: The adult female is elongate ovate, at first dull pinkish orange, the older individuals greyish orange. Limbs yellowish. Dorsum thinly covered with white mealy secretion, almost completely hiding the color of the insect. Margin with a complete fringe of white tassels (seventeen on each side) which are shorter in front, and increase in length towards the posterior extremity, the terminal four being exceptionally long, sometimes exceeding the length of the body of the insect. Average length from 3.5 to 4 mm. (see fig. 6.) (Green 1922, part 5, p. 383.)

Natural Enemies: The coccid is parasitized by the encyrtid wasp, *Acerophagus nubilipennis* Dozier.

Host: The mealybug attacks the following trees in the Island: *Barring-*

tonia speciosa Forst., "maría", *Calophyllum calaba* Jacq., "bucare", *Erythrina glauca* Willd. and "esmajagua", *Pariti tiliaceum* (L.) Hil.

Pseudococcus citri (Risso)

(The Citrus Mealybug)

This cosmopolitan pest is abundant in Puerto Rico, attacking a wide variety of crops and other plants, but seldom observed on trees. As its

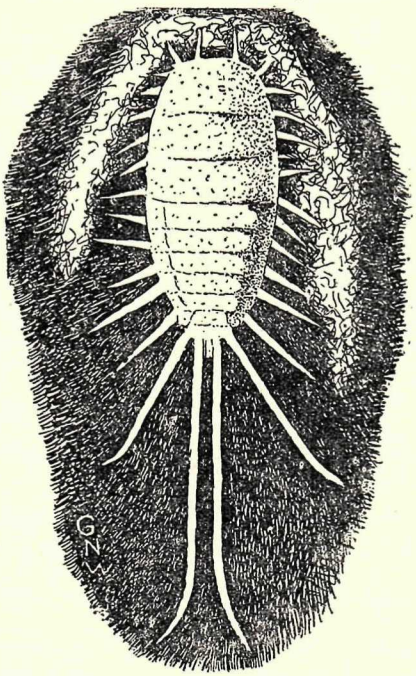


FIG. 6. *Pseudococcus adonidum* (Linn.) Twelve times natural size. (Drawn by G. N. Wolcott.)

name implies it is chiefly a pest of citrus trees. The following are the characteristics of the species:

Adult female: The adult female is yellowish, pinkish yellow, purplish or greyish yellow above; usually yellowish beneath. The color on the dorsum is almost completely concealed by a close covering of white mealy powder; there is usually, however, a median and sometimes a lateral stripe partially free from the secretion, revealing the true color of the insect. The venter is only thinly dusted with mealy powder. There is a complete marginal series of thirty-four short, stout, white, waxy tassels, subequal in length, tough rather stouter on the abdominal segments. Between

the last pair of tassels is a pair of small ligulate processes of a denser and smoother wax, proceeding from the anal orifice. Form broadly oval, convex above, flattish below, with the segments more or less tumescent. Average size 2.6 mm. long.

The specimens in nature are readily distinguished from the related form *P. adonidum* (Linnaeus) by the shorter and stouter fringe of waxy tassels. Dried specimens (which usually lost their appendages) are not so easily separated. The following microscopical points may be used in separating both species:

P. citri (Risso) has thirty-six marginal ceriferous tracts, the spines on each of equal diameter; caudal setae much longer than those of the anal ring; tarsus approximately half the length of the tibia.

P. adonidum (Linnaeus) has thirty-four marginal ceriferous tracts, the spines of the terminal and penultimate tracts conspicuously larger and stouter than those on the remaining tracts; caudal setae scarcely longer than those of the anal ring; tarsus approximately one-third length of tibia. (Notes from Green 1922, part 5, pp. 376–7.)

Host: Recorded from "maga", *Montezzma speciosissima* Sessé & Moc.

Pseudococcus maritimus (Ehrhorn)

This species although not common in the island has been recorded several times on different host plants. The species probably occurs throughout the tropical and subtropical regions of the world, but due to its similarity to *P. adonidum* (Linnaeus) its identity may have been overlooked.

Adult female: The adult female is grayish or dull pink, the dorsum closely covered with white mealy secretion. Form long ovate, length approximately twice the breadth. Margin with seventeen equidistant, slender, straight, waxy tassels on each side, short on the anterior parts, and progressively longer towards the posterior extremity of the body, the posterior (caudal) pair of tassels twice as long as the preceeding pair, and more than half the length of the actual body of the insect. Antenna eight-jointed, third and eight joints longest, subequal. (In *P. adonidum*, the antenna is eight-jointed but the eighth segment is considerably the longest, first, second and third, next longest and approximately equal; fourth to seven shortest but varying in their relative lengths.) One more characteristic which serves to differentiate these two species is that in *adonidum* the tibia of the hind leg possesses conspicuous translucent spores, which in this particular species are crowded. The next closest species to this one is *P. comstocki* and here the translucent spots are scattered. (Green 1922, part 5, p. 384.)

Host: Recorded from "tamarindo", *Tamarindus indicus* L.

Pseudococcus nipae (Maskell)

This mealybug is undoubtedly our most common member of the genus. It is quite different in appearance from the rest of the insular species and it does not need a complete description for its identification. The insect occurs usually on the undersides of the leaves, but also may be present on twigs and smaller branches. It ranges from the lowest elevations up to

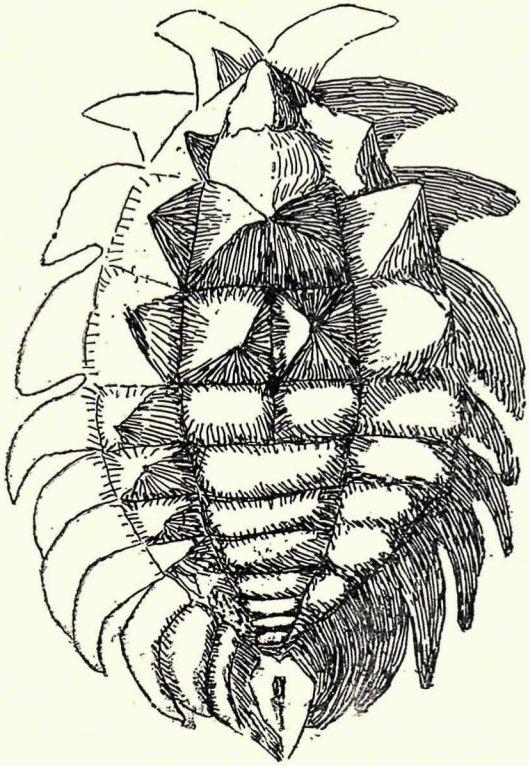


FIG. 7. *Pseudococcus nipae* (Maskell) Twenty times natural size. (Drawn by G. N. Wolcott.)

the middle and higher altitudes as high as 2,500 ft., rarely higher (see fig. 7).

Adult female: The adult female is short, oval, covered with yellowish white cereous matter, arranged almost in the same way as in the genus *Orthezia*, but much less compact; margin all around with a series of downward, curved, broad, laterally joined, lamellae, longest behind; dorsum rarely presenting regular plates; when such is the case, however, they are arranged in thick squarish masses, with the body of the insect showing

through the divisions; generally the dorsum is covered with one conglomerate mass, with little or no segmentation. Length about 2 mm. or more. (Notes from Newstead, 1893 p. 187.)

Natural Enemies: In Puerto Rico the insect is controlled by a group of predators and parasites, all of which seem to be very effective in controlling the pest. The chrysopid, *Chrysopa collaris* Schneider, presumably feeds on this insect. The coccinellid beetles *Hyperaspis connectens* Thunberg, *H. apicalis* Mulsant, *Cryptolaemus montrouzieri* Mulsant, *Scymnillus nunenmacheri* Sicard and *S. variipenis* Sicard prey upon the coccid. These ladybird beetles are the most effective means of control, both the larvae and adult feeding on them. The entomogenous fungi, *Cephalosporium lecanii* Zimm., *Empusa fresenii* Nowak and *Botrytis Rileyi* Farlow have been recorded as parasitizing this mealybug.

Host: The insect attacks a large variety of trees and shrubs in Puerto Rico. The following have been recorded:

Annona muricata L.	"guanábana"
Annona reticulata L.	"corazón"
Barringtonia speciosa Forst.	"coco marino"
Calophyllum calaba Jacq.	"maría"
Chrysophyllum argenteum Jacq.	"caimito verde"
Coccolobis laurifolia Jacq.	"uvilla"
Coccolobis uvifera (L.) Jacq.	"uva de playa"
Cocos nucifera L.	"coco"
Erythrina glauca Willd.	"bucare"
Ficus laevigata Vahl	"jagüey"
Ficus lyrata Warb.	"palo de goma"
Ficus sintenisii Warb.	"jagüey"
Ficus stahlii Warb.	"jagüey"
Guarea trichilioides L.	"guaraguao"
Ilex nitida (Vahl) Maxim	"brigueta naranjo"
Livistona chinensis R. Br.	"palma de Borbón"
Mammea americana L.	"mamey"
Miconia prasina (Sw.) DC.	"camasey"
Micropholis garcinifolia (Pierre) Urban	"caimitillo"
Nectandra coriacea (Sw.) Griseb.	"avispillo"
Nectandra membranacea (Sw.) Griseb.	"laurelillo"
Nectandra sintenisii Mez.	"laurel amarillo"
Ocotea floribunda (Sw.) Mez	"laurel"
Ocotea portoricensis Mez	"laurel"
Persea gratissima Gaertn.	"aguacate"
Phoebe elongata (Vahl) Nees	"laurel bobo"
Psidium guajava L.	"guayaba"

Sloanea berteriana Choisy	"cacao motillo"
Sterculia apetala (Jacq.) Karst.	"anacagüitas"
Tetrazygia elaeagnoides (Sw.) DC.	"cenizo"
Torrubia fragans (Dum.-Cours.) Standly	"corcho prieto"
Trema lamarckiana (R. & S.) Blume	"cabrilla"

Pseudococcus virgatus (Cockerell)

This species has been recorded several times from the Island, but is not very abundant. Elsewhere it occurs in Jamaica, (from which it was originally described) Sandwich Islands, Mauritius, Mexico and Texas. The species was described as folllows:

"Female: 4.5 mm. long. Very white mealy brown above, except dark purplish grey subdorsal stripes, which are broadly interrupted centrally. Caudal filaments about 2 mm. long, i.e., about half length of body. No obvious lateral appendages. Segmentation distinct. Beneath whitish, legs pale brown. The caudal filaments are rather slender but not filiform. The lateral appendages seem to be represented by long and very fine hairs, which are obvious in the young, but are lost in the adult. Very young individuals are pale yellow. Femur (of adult) about as long as tibia; tibia about three times as long as tarsus. Antennae with eight joints, 3 and 8 subequal, or 8 a little longer; 2 sensibly shorter than 3; 4 rather longer than 5; 5, 6 and 7 about equal." (Described as *Dactylopius virgatus* Cockerell, 1893 p. 178.)

Host: Infesting the following trees:

Cicca disticha L.	"grosella"
Inga vera Willd.	"guaba"
Melicocca bijuga L.	"quenepa"
Terminalia catappa L.	"almendra"

Antonina bambusae (Maskell)

This coccid is not common in the Island. It has been previously recorded from the Sandwich Islands, Mauritius, Ceylon and Brazil.

Host: Only recorded from the common "bambúa", *Bambos vulgaris* Schrad.

Subfamily Coccinae

Pulvinaria psidii Maskell

A common species in the Island, collected at low and middle elevations. Fortunately the insect is kept under control by its natural enemies and no heavy outbreaks are noticeable.

Natural Enemies: One of the most efficient enemies of this coccid is

the Australian ladybird beetle, *Cryptolaemus montrouzieri* Mulsant. The ochthiphilid fly *Leucopsis bella* Loew has been reared from the insect also.

Host: The coccid attacks the following trees in the Island:

Cedrela mexicana Roem.	"cedro"
Cedrela odorata L.	"cedro español"
Chrysophyllum cainito L.	"caimito"
Citharexylum fruticosum L.	"péndula"
Ficus sintenisii Warb.	"jagüey"
Mangifera indica L.	"mango"
Manilkara pleeana (Pierre) Cronquist	"mameyuelo"
Psidium guajava L.	"guayaba"
Rauwolfia nitida Jacq.	"palo amargo"
Spondias dulcis Forst.	"cítara"
Trema lamarckiana (R. & S.) Blume	"cabrilla"

Pulvinaria urbicola Cockerell

A species not common in the Island, also listed from Jamaica, Barbados and Trinidad.

Host: Recorded from "uva de playa", *Coccolobis uwifera* (L.) Jacq.

Cryptostigma inquilina (Newstead)

Fairly abundant in the Island, especially in coffee groves where it attacks coffee and its shade trees. This coccid is attended by the ant or "hormiguilla", *Myrmelachista ramulorum* Wheeler which occurs abundantly in coffee groves. Writing about this ant Wolcott says as follows:

"In some compartments of their tunnels they rear their young, in others they care for the fleshy, pink scale insects, or the mealybugs, that suck sap from the tree and secrete a honey-dew eaten by the ants. These fleshy, pink scale insects have been found only in connection with colonies of ants, for they live only in tunnels in the live wood made by the ants, never being found on the outside of the tree." (EEWI, p. 316.)

Host: The following trees are attacked in Puerto Rico by this coccid:

Ficus laevigata Vahl	"jagüey"
Inga vera Willd.	"guaba"
Inga laurina (Sw.) Willd.	"guamá"

Ceroplastes ceriferus (Anderson)

(Japanese Wax Scale)

This scale insect is not common in the Island. It has been recorded from India, Australia, Ceylon, Japan, Hawaiian Islands, Chile, Mexico, Antigua and Jamaica.

Host: Recorded from "almácigo", *Bursera simaruba* (L.) Sarg.

Ceroplastes cirripediformis Comstock

(The Barnacle Scale)

This insect is a pest of orchard fruits, but also attacks other trees in the Island which does not belong to this group. It has been listed from Florida, Mexico, Louisiana and the West Indies.

Natural Enemies: The following parasitic insects help in the natural control of this coccid: the aphelinid wasps, *Marietta busckii* (Howard), *Plagiomerus cyanea* (Ashmed), *Aneristus ceroplastae* Howard and the encyrtid *Aphycus* sp. near *eruptor* Howard.

Host: The following trees are attacked by this insect in Puerto Rico:

Cedrela mexicana Roem.	"cedro"
Guaiacum officinale L.	"guayacán"
Myrcia citrifolia (Aubl.) Urban	"hoja menuda"
Rauwolfia nitida Jacq.	"palo amargo"

Ceroplastes floridensis Comstock

(Florida Wax Scale)

Fairly abundant in Puerto Rico, recorded from a long list of trees and shrubs. Also distributed throughout the tropical and subtropical parts of the globe, Central America, Brazil, British Guiana, Cuba, Bermuda, Florida, Louisiana, Mississippi, Australia and the Orient.

Host: In the Island it has been recorded from the following trees:

Annona reticulata L.	"corazón"
Elaeodendrum xylocarpum (Vent.) DC.	"coscorrón"
Ficus laevigata Vahl	"jagüey"
Ficus nitida Thunb.	"laurel de la India"
Genipa americana L.	"jagua"
Laguncularia racemosa (L.) Gaertn.	"mangle bobo"
Mangifera indica L.	"mango"
Persea gratissima Gaertn.	"aguacate"
Psidium guajava L.	"guayaba"
Rapanea guianensis Aubl.	"bádula"

Ceroplastes denudatus Cockerell

This scale insect was introduced into Puerto Rico several years ago and was first reported on the introduced African cloth bark trees, at the Muñoz Rivera Park, Puerto de Tierra. Also found in Antigua and Demerara. Not a common species in the Island, being limited in its distribution.

Host: Recorded from the African cloth bark tree, *Ficus nekbuda* Warb, and from coconut palm, *Cocos nucifera* L., in the vicinity of the original hosts.

Vinsonia stellifera (Westwood)

A very common species in the Island, also recorded from Trinidad, Jamaica, Antigua, Barbados, Demerara, Grenada, Brazil, Central America, California and Ceylon. This coccid is found at low and middle altitudes.

Adult Female: The adult female is covered by a transparent waxy test, the margins of which are flattened and produced into seven rays that give the insect the appearance of a miniature star-fish. The color of living specimens is pink, darkening with age to purplish red. In dried specimens this tint fades to reddish brown. The anal operculum is dark brown. Margin colorless during life and yellowish in dry specimens. A pair of small white waxy processes project from the posterior margin immediately behind the anal aperture. Diameter across the median rays, 3.5 to 4.5 mm. (Green 1909, part 4, p. 280.)

Host: The following trees have been recorded as being affected by this scale insect:

Coccolobis laurifolia Jacq.	"uvilla"
Eugenia jambos L.	"pomarrosa"
Lawsonia inermis L.	"resedá"
Mangifera indica L.	"mangó"
Psidium guajava L.	"guayaba"

Inglisia vitrae Cockerell

This scale insect is rare in the Island. It is also found in Trinidad.

Host: Recorded from "achiote", *Bixa orellana* L. and "guaba", *Inga vera* Willd.

Eucalymnatus tessellatus (Signoret)

A fairly common species in Puerto Rico, also recorded from France, England, Australia, Mauritius, Hawaii, Ceylon and Jamaica.

Natural Enemies: The parasitic wasp, *Aneristus ceroplastae* Howard (Aphelinidae) has been reared from this coccid.

Host: The scale insect has been found affecting the following trees:

Calophyllum calaba Jacq.	"maría"
Eugenia malaccensis L.	"pomarrosa malaya"
Mangifera indica L.	"mangó"
Sideroxylon foetidissimum Jacq.	"tortugo amarillo"

Coccus acuminatus (Signoret)

(Mango Shield Scale)

This scale insect is not abundant in our Island. It has been recorded from the United States, Bahamas, Jamaica, Cuba, Grenada, Antigua, Barbados, Mexico and the Orient.

Adult female: The adult female is of a pale green or yellowish green color, thin, flat and shaped like an irregular triangle, having a length of about 3 mm.

Signoret, in the description of this species says, "Cette espèce est facile à distinguer par la forme de son corpe ovale court, acuminée vers le sommet, arrondi, très large vers l'extremité. Les antennes sont de sept articles avec le quatrième le plus long, le troisième égal aux cinquième et sixième reúnis, ceux-ci les plus courts, le septième aussi long que les deux précédents. Les pattes, larges, aplaties offrent un tarse court, à peine de moitié aussi long que le tibia; le reste comme dans les *Lecanium* en general. La longueur est de 2–3 millimètres." (Green 1904, part 3, page 195.)

Host: The following trees have been recorded as host species:

Bixa orellana L.	"achiote"
Eugenia jambos L.	"pomarrosa"
Eugenia malaccensis L.	"manzana malaya"

Coccus hesperidum Linnaeus

(The Brown Soft Scale)

Another coccid which is not abundant in the Island and however it is a cosmopolitan species recorded from tropical and subtropical regions of the world.

Adult female: The adult female is bright yellow or greenish yellow, minutely speckled with red-brown, the specks sometimes agglomerated into transverse bars, especially on the median abdominal region, in other parts tending to form dotted lines radiating from the center to the margin. In older individuals the ground color may be ochreous or pale fulvous; and the maculation may form a broad median fascia. Form oblong-oval often very irregular in outline, narrowest in front, more or less convex above, according to age. Length from 2.25 to 3.5 mm. Width 1.25 to 2.50 mm. The insect is ovoviviparous and the living larvae are usually found beneath the body of the parent. (Green 1904, part 3, p. 188).

Natural Enemies: The coccid is parasitized by the aphelinid wasp, *Coccophagus lunulatus* Howard.

Host: Only recorded from two trees in the Island:

Cicca disticha L.	"grosella"
Mangifera indica L.	"mangó"

Coccus mangiferae (Green)

Fairly abundant in the Island, also recorded from Jamaica, Trinidad, Barbados, Antigua, Grenada and Ceylon.

Adult female: The adult female is pale yellowish green, the malphigian

tubules showing through the skin of the dorsum as an indistinct chain of oblong fulvous spots. Deltoid, blunty pointed in front, broadly rounded behind, usually asymmetrical. Very thin; margin broadly flattened, with slight ridges above the stigmatic areas. Antennae with eight joints, second and eighth equal and longest, seventh always shortest. Length from 3 to 4 mm. Width 2.5 to 3.5 mm. (Green 1904, part 3, p. 216).

Natural Enemies: The entomogenous fungi *Cephalosporium lecanii* Zimm. and *Botrytis Rileyi* Farlow are very effective enemies of the coccid in the field.

Host: The following trees are recorded as host species:

Artocarpus communis Forst.	"pana"
Cinnamomum zeylanicum Nees	"canela"
Eugenia jambos L.	"pomarrosa"
Mangifera indica L.	"mangó"

Coccus viridis (Green)

(The Green Scale)

This is one of our most abundant and pestiferous scale insects ranging from the lowlands up to middle elevations. It is a pest of coffee and citrus not only in Puerto Rico but in Brazil, Ceylon and Mauritius. On account of its intensive infestations on coffee, it caused the abandonment of the cultivation of this crop on large sections of the coffee districts in Ceylon.

Adult female: The adult female is bright pale green, with an irregular, but very distinct loop of blackish spots on the middle of the dorsum (the contents of the malphigian tubules). Dried specimens become dull fulvous, and loose the chain of dark spots. Eyes conspicuous, black, close to margin. Oval in form, rounded behind, subacuminate in front, moderately convex above, especially in females with ripe ova. Antennae seven jointed; third and fourth longest subequal; seventh nearly equal to previous two together. Length 2.5 to 3.25 mm; width 1.5 to 2 mm.

Habits: The scale insects are more abundant on the undersides of the leaves, especially towards the midrib. Very often they attack the young shoots and when this occurs they cover the entire shoot and all one can see is a uniform mass of scale insects. Usually the presence of this species is related to sootie-mold. The foliage turns black or rather looks black, because every leaf is covered with a thin coat of the mold. The fire ants *Solenopsis geminata* are usually seen attending this coccid.

Natural Enemies: This species is very effectively controlled by the entomogenous fungi *Cephalosporioum lecanii* Zimm.

Host: The following host trees have been recorded:

Citharexylum fruticosum L.	"péndula"

Coccolobis laurifolia Jacq.	"uvilla"
Coccolobis uvifera (L.) Jacq.	"uva de playa"
Coccolobis venosa L.	"calambreña"
Guarea trichilioides L.	"guaraguao"
Lagerstroemia speciosa (L.) Pers.	"reina de las flores"
Miconia prasina (Sw.) DC.	"camasey"
Psidium guajava L.	"guayaba"
Rauwolfia nitida Jacq.	"palo amargo"
Sideroxylon foetidissimum Jacq.	"tortugo amarillo"
Tectona grandis L.	"teck"
Terminalia catappa L.	"almendra"

Saissetia hemispaherica (Targioni)

(The Hemispherical Scale)

This is one of our most common scale insects and well known by nearly every farmer. The species is cosmopolitan in its distribution and occurs in tropical as well as subtropical regions of the globe. It is chiefly a pest of coffee and citrus, but attacks a wide variety of plants and trees also.

Adult female: As the name implies the female of this species is oval in shape, hemispherical, the margin usually outturned and slightly flattened, but often concealed by the bulging sides. The color varies from pale brownish fulvous to deep chestnut brown; all intermediate shades being represented often on a single plant. The dorsal surface is highly chitinous, polished and shiny. The size of the insect is very variable, from 2 to 3 mm. long and 1.2 to 2 mm. in width. (Green 1904, part 3, p. 233).

Habits: The insect usually infests the twigs and smaller branches of host plants, sometimes going under the leaves. They are abundantly found in the lowlands as well as at middle elevations, up to 2,000 ft. When abundant they cause injury to twigs and tender shoots killing many of them.

Natural Enemies: Undoubtedly one of the most efficient means of natural control of this pest is by means of the common entomogenous fungus, *Cephalosporium lecanii* Zimm., which has been recorded many times as attacking this coccid. The fly *Cecidomyia coccidarum* Cockerell has been reared from the scale; also the aphelinid wasp, *Aneristus ceroplastae* Howard.

Host: The scale insect has been recorded from the following trees:

Annona muricata L.	"guanábana"
Annona reticulata L.	"corazón"
Ardisia obovata Desv.	"mameyuelo"
Eugenia jambos L.	"pomarrosa"
Lawsonia inermis L.	"resedá"
Mammea americana L.	"mamey"

Myrcia deflexa (Poir.) DC.	"cieneguillo"
Persea gratissima Gaertn.	"aguacate"
Psidium guajava L.	"guayaba"
Psychotria berteriana DC.	"palo moro"
Rauwolfia nitida Jacq.	"palo amargo"
Sideroxylon foetidissimum Jacq.	"tortugo amarillo"
Spathodea campanulata Beauv.	"tulipán africano"
Spondias cirouella Tussac	"ciruela"
Tamarindus indicus L.	"tamarindo"
Tectona grandis L.	"teck"

Saissetia nigra (Nietner)

Fairly abundant in Puerto Rico; but not so common as *S. hemisphaerica* and *S. oleae*. The species has more or less the same habits as *hemisphaerica* and is found in the lowlands as well as at middle elevations. Cosmopolitan in distribution and with a long list of host plants from all parts of the tropical and subtropical world.

Adult female: The adult females are very variable in size, form and color. The typical form is irregularly oval, usually asymmetrical, narrowed in front; strongly convex, the dorsum above the abdominal region sometimes forming a pronounced hump. The color of the mature insect varies from bright castaneous to deep purple black, the tint usually deepening with age. The surface is smooth, but not highly polished, faintly papillose. Length 3 to 5 mm.; width 2 to 3 mm. (Green 1904, part 3, p. 229.)

Natural Enemies: The encyrtid wasp, *Arrhenophagus chionaspidis* Aurivillius and the eupelmid, *Eupelmus coccidivorous* Gahan are parasites of this scale insect in Puerto Rico.

Host: The scale insect has been recorded from the following trees:

Barringtonia speciosa Forst.	"coco marino"
Ficus laevigata Vahl	"jagüey"
Ficus stahlii Warb.	"jagüey"
Hura crepitans L.	"javillo"
Melia azedarach L.	"alilaila"
Montezuma speciosissima Sessé & Moc.	"maga"
Moringa oleifera Lam.	"ben"
Terminalia catappa L.	"almendra"

Saissetia oleae (Bernard)

(The Black Scale)

This is the most abundant species of this genus in the Island. It has been also recorded from the tropical and subtropical regions of the world

and attacks a wide variety of plants. In Puerto Rico it occurs in the lowlands as well as at middle altitudes up to 2,500 ft., commoner near the coast.

Adult female: The adult female is densely chitinous, dull purplish brown, surface roughened and minutely specked with small grayish or colorless waxy granules. Form highly convex, usually distinctly angular, with prominent median longitudinal and two transverse ridges; a smaller longitudinal raised line connects the transverse ridges on each side. These ridges on the dorsum usually have the form of an H, this being one of the distinguishing characteristics of the species. (Green 1904, part 3, p. 227.)

Habits: This insect has more or less the same habits as its related forms *hemisphaerica* and *nigra*. It is usually found on the twigs and smaller branches and very seldom on the foliage of trees.

Natural Enemies: The caterpillar of the phycitid moth, *Laetilia portoricensis* Dyar has been recorded as feeding on this coccid. The eupelmid wasps, *Eupelmus saissetiae* Silvestri and *Lecanobius cockerelli* Ashmead are effective parasites of this scale.

Host: The following are the host trees, recorded in Puerto Rico:

Andira jamaicensis (W. Wright) Urban	"moca"
Annona muricata L.	"guanábana"
Cedrela mexicana Roem.	"cedro"
Cordia alliodora (R. & P.) Cham.	"capá prieto"
Cordia sulcata DC.	"moral"
Crescentia cujete L.	"higüera"
Erythrina berteroana Urban	"machete"
Erythrina glauca Willd.	"bucare"
Erythrina poeppigiana (Walp.) O. F. Cook	"bucare"
Ficus laevigata Vahl	"jagüey"
Ficus nitida Thunb.	"laurel de la India"
Gleditsia triacanthos L.	honey locust
Guarea trichilioides L.	"guaraguao"
Guazuma ulmifolia Lam.	"guácima"
Isandrina emarginata (L.) Britton & Rose	"vela muerto"
Eugenia jambos L.	"pomarrosa"
Lagerstroemia speciosa (L.) Pers.	"reina de las flores"
Manilkara bidentata (A. DC.) Chev.	"ausubo"
Montezuma speciosissima Sessé & Moc.	"maga"
Ocotea portoricensis Mez	"laurel"
Petitia domingensis Jacq.	"capá blanco"
Psidium guajava L.	"guayaba"
Sciacassia siamea (Lam.) Britton	"cassia amarilla"
Sideroxylon foetidissimum Jacq.	"tortugo amarillo"

Spathodea campanulata Beauv.	"tulipán africano"
Spondias dulcis Forst.	"cítara"
Sterculia apetala (Jacq.) Karst.	"anacagüitas"
Swietenia mahagoni Jacq.	"caoba"
Tamarindus indicus L.	"tamarindo"
Tectona grandis L.	"teck"
Terminalia catappa L.	"almendra"
Trema lamarckiana (R. & S.) Blume	"cabrilla"
Trema micrantha (L.) Blume	"palo de cabra"
Zanthoxylum flavum Vahl	"aceitillo"

Chionaspis citri Comstock

Host: Recorded only from "mango", *Mangifera indica* L. This scale insect is chiefly a pest of citrus, not affecting ornamental, shade or forest trees.

Howardia biclavis (Comstock)

(The Mining Scale)

This is a common species in the Island also recorded from the tropical and subtropical regions of the world. In Puerto Rico the scale insect is found at lower and middle elevations, but is more abundant in the lowlands.

Scale: The scale of the adult female is circular, about 2.5 to 3 mm. in diameter, white, but usually so concealed beneath the epidermis of the host that its color is obscured. (Ferris 1937, SI-65.)

Natural Enemies: The following parasitic enemies have been recorded from the coccid: the entomogenous fungus *Myrangium Duriaei* Mont. & Berk. and the aphelinid wasp, *Pseudopteroptrix imitratix* Fullaway.

Host: The coccid has been recorded from the following trees:

Bixa orellana L.	"achiote"
Casearia arborea (L. C. Rich) Urban	"rabo de ratón"
Cassia fistula L.	"cañafístula"
Castilla elastica Cerv.	"palo de goma"
Casuarina equisetifolia Forst.	"casuarina"
Cedrela mexicana Roem.	"cedro"
Cedrela odorata L.	"cedro español"
Cestrum laurifolium L'Her.	"galán del monte"
Chrysophyllum cainito L.	"caimito"
Cupania americana L.	"guara"
Genipa americana L.	"jagua"
Gliricidia sepium (Jacq.) Steud.	"madre de cacao"

Guettarda scabra Sw.	"prickle wood"
Hymenaea courbaril L.	"algarrobo"
Mammea americana L.	"mamey"
Myrcia citrifolia (Aubl.) Urban	"hoja menuda"
Plumeria rubra L.	"alelí"
Tabebuia pallida Miers	"roble"

Diaspis boisduvalii Signoret

A cosmopolitan species, rare in our Island. Chiefly a greenhouse pest in temperate regions of the world, attacking palms, orchids and cacti.

Scale: The scale of the adult female is almost white, transparent, thin, flat, circular, the exuvia subcentral; the scale of the male, white, elongate and tricarinate. (Ferris 1937, SI-32.)

Host: The only tree from which this scale has been recorded in the Island is from the imported "manzana malaya", *Eugenia malaccensis* (L).

Pseudaulacaspis pentagona (Targioni)

(The West Indian Peach Scale)

A very common scale insect in Puerto Rico and in the West Indies in general. Cosmopolitan in distribution and with a considerable long list of host plants from all parts of the world. In Puerto Rico it is common in the lowlands as well as at middle and higher altitudes, going up sometimes to the 3,000 ft. mark. When abundant it is very pestiferous and capable of killing young trees and destroying branches and twigs in mature ones. (Listed in IB, p. 135 as: *Aulacaspis pentagona* Targioni.)

Scale: The scale of the female is white, subcircular, the exuvia near the margin, the first exuvium sometimes projecting; the one of the male, elongate, white and non-carcinate. (Ferris 1937, SI-109.)

Natural Enemies: The aphelinid wasp. *Prospaltella diaspidicola* Silvestri has been reared from this coccid.

Host: The coccid has been recorded from the following trees in the Island:

Calotropis procera (Ait.) R. Br.	"algodón de seda"
Clibadium erosum (Sw.) DC.	"turma de toro"
Erythrina glauca Willd.	"bucare"
Erythrina poeppigiana (Walp.) O. F. Cook	"bucare"
Fraxinus sp.	ash
Gleditsia triacanthos L.	honey locust
Mammea americana L.	"mamey"
Mangifera indica L.	"mangó"
Montezuma speciosissima Sessé & Moc.	"maga"

Pariti tiliaceum (L.) Hil.	"esmajagua"
Salix chilensis Molina	"sauce"
Trema lamarckiana (R. & S.) Blume	"cabrilla"
Trema micrantha (L.) Blume	"palo de cabra"

Pinnaspis buxi (Bouché)

A species rarely seen on trees in Puerto Rico. The species is regarded as an Old World form, but it has been recorded from many parts of the New World, such as United States, Jamaica, Trinidad, Grenada, Panama, etc.

Scale: The scale of the female is about 1 mm. long, very thin, and quite translucent. The insect occurs on the leaves of the host plants. (Ferris 1937, SI-98.)

Host: Recorded from the "corozo" palm, *Acrocomia media* Cook.

Pinnaspis minor (Maskell)

(The Lesser Snow Scale)

A common scale insect in Puerto Rico, found in the lowlands as well as middle elevations. The species has been recorded from Florida, Jamaica, Antigua, Grenada, Panama, Brazil, Japan, Ceylon and New Zealand.

Characteristics: The species can be distinguished by the presence of the female and male puparia on the infested trees.

Female puparium: The female puparium is opaque snowy white, often specked with brown from the incorporation of fragments of the cuticle of the bark; rather broadly dilated behind. Pellicles fulvous, the second deeply tinged with reddish brown. In fully developed individuals the second pellicle occupies a little less than one third the length of the puparium. First pellicle half length of second. Central scale thin, remaining attached to plant. Length 1.50 to 2 mm.

Male puparium: The male puparium is snowy white, narrow, with the sides almost parallel, posterior extremity slightly wider, distinctly tricarinate, the ridges even and moderately smooth. Pellicle fulvous. Length 1 mm. (Green 1899, part 2, p. 115.)

Habits: The scale insect may occur on the foliage, but seems to prefer the trunk and larger branches. When it becomes abundant the trunk looks as if painted with a white wash. This behavior is very characteristic of the species and trees like these have been observed even at 2,000 ft. in elevation.

Natural Enemies: The entomogenous fungus *Myrangium Duriaei* Mont. & Berk., attacks the coccid in the field.

Host: The insect has been recorded from the following trees:

Annona muricata L.	"guanabána"

Annona reticulata L.	"corazón"
Colubrina arborescens (Mill.) Sarg.	"abeyuelo"
Guazuma ulmifolia Lam.	"guácima"
Melia azedarach L.	"alilaila"
Montezuma speciossissima Sessé & Moc.	"maga"
Pariti tiliaceum (L.) Hil.	"esmajagua"
Samanea saman (Jacq.) Merrill.	"samán"
Tectona grandis L.	teck
Thespesia populnea (L.) Soland	"emajaguilla"
Trema lamarckiana (R. & S.) Blume	"cabrilla"
Trema micrantha (L.) Blume	"palo de cabra"
Zanthoxylum flavum Vahl	"aceitillo"

Leucaspis indica Marlatt

Rare in the Island, presumably a scale insect of Indian origin. Recorded from "mango", *Mangifera indica* L., at Mayagüez, P. R.

Aonidiella orientalis (Newstead)

(The Oriental Yellow Scale)

A fairly common species in Puerto Rico, also recorded from India, (its native home) Ceylon, Arabia, Australia, Florida, Cuba and the West Indies. Listed in (IB:37) as: *Aspidiotus cocotiphagus* Marlatt.

Scale: The scale of the female is quite thick, circular, flat, white to light brown in color, with the exuviae central, and the second exuviae dark brown. The scale of the male is slightly elongate oval, the yellowish exuvia near one end. (Ferris 1938, SII-180.)

Habits: This scale insect usually occurs on the foliage of the host plants, usually at low elevations in the Island.

Host: The coccid has been recorded from the following trees in Puerto Rico:

Calophyllum calaba Jacq.	"maría"
Cocos nucifera L.	"coco"
Erythrina berteroana Urban	"machete"
Persea gratissima Gaertn.	"aguacate"
Tamarindus indicus L.	"tamarindo"
Zanthoxylum flavum Vahl	"aceitillo"

Aspidiotus cyanophylii Signoret

A common species in Puerto Rico, especially abundant in the lowlands. Also recorded from Florida, Texas, Brazil, Mexico, England, France, Ceylon and Mauritius.

Scale: The scale of the female is flat, elongate oval, whitish or gray,

exuviae central; the one of the male is similar in form, but the exuviae is near one end. (Ferris 1938, SII-237.)

Habits: The scale insect usually affects the foliage of host plants.

Host: The coccid has been recorded from the following trees:

Aleurites moluccana (L.) Willd.	"nuez de India"
Barringtonia speciosa Forst.	"coco marino"
Dillenia indica L.	
Eugenia malaccensis L.	"manzana malaya"
Mangifera indica L.	"mangó"
Neowashingtonia robusta (Wendl.) Britton	"palma del desierto"
Vitex divaricata Sw.	"higüerillo"

Aspidiotus destructor Signoret

(The Coconut Scale)

A very common scale insect in the Island, also recorded from Florida, Mexico, the West Indies, Demerara, China, Formosa, India, Mauritius and Laccadive Islands.

Scale: The scale of the female is straw-colored, circular, flat, very thin and delicate, exuviae central and quite pale, that of the male is slightly elongate, similar to that of the female in color and texture. (Ferris 1938, SII-191.)

Habits: The scale insect is usually found infesting the foliage of the host plants. It is very abundant in the lowlands, and is seldom observed at middle or higher elevations. This scale insect is very pestiferous and when abundant it can cause damages of considerable economic importance. Dr. Wolcott's description of the behavior of this scale insect on coconut palms is herewith cited:

"The lower surface of the infested leaves are often entirely covered by its round, semi-transparent shells, yellow and opaque only in the centre. The leaf tissue underneath each young scale begins to turn yellow soon after the beak of the insect has been inserted and its saliva spread among the plant cells. Beneath a mass infestation the entire leaf is soon killed. In such cases, scale infestation only hastens the natural process of maturing and dropping of the frond." (EEWI, p. 358.)

Natural Enemies: The scale insect is attacked in the field by the larvae and adults of the following ladybird beetles: *Scymnillus nunenmacheri* Sicard, *S. variipennis* Sicard and *Scymnillodes cyanescens violaceous* Sicard, all of which are native. Recently the Agricultural Experiment Station at Mayagüez, imported several species of ladybird beetles or coccinellids from Trinidad, Cuba and Texas for the purpose of controlling the bamboo scales. Now they are feeding preferably on the coconut scales. The imported

beetles are *Cryptognatha nodiceps* Marshall, *C. simillima* Sicard, *Azya trinitatis* Marshall and *Chilocorus cacti* (Linnaeus). All these species are now well established in the Island and undoubtedly they will play an important role in the natural control of this pest.

The ladybird beetles are not the only enemies of the coconut scale insect. The aphelinid wasps, *Aphelinus chrysomphali* Mercet and *Aspidiotiphagus lounsburyi* Berleze & Paoli are also effective in the control of the pest the former being responsible for the practical control of the pest in the field.

The entomogenous fungus *Botrytis Rileyi* Farlow has been recorded as attacking this scale insect. Its effectiveness as a natural means of control is uncertain.

Host: The coccid has been reported from the following trees in Puerto Rico:

Annona glabra L.	"cayur"
Barringtonia speciosa Forst.	"coco marino"
Cocos nucifera L.	"coco"
Grevillea robusta A. Cunn.	"roble australiano"
Mammea americana L.	"mamey"
Persea gratissima Gaertn.	"aguacate"
Phoenix dactylifera L.	"dátil"
Psidium guajava L.	"guayaba"
Terminalia catappa L.	"almendra"

Aspidiotus lataniae Signoret

This scale insect is not common in Puerto Rico. It has also been recorded from Brazil, Mauritius, Galapagos Islands and is frequently seen in greenhouses in Europe.

Host: Recorded from "roble", *Tabebuia pallida* Miers. and "uva de playa", *Coccolobis uvifera* (L.) Jacq.

Aspidiotus herculeanus Hadden

Rare in Puerto Rico, also recorded from Cuba, Florida and Society Islands (Pacific Ocean).

Host: Recorded from "roble", *Tabeuia* sp.

Selenaspidus articulatus (Morgan)

A common scale insect in the Island, also recorded from Mexico, Costa Rica, Panamá, West Indies, Brazil, West Africa and England. Originally described from Demerara, British Guiana. Abundant at lower elevations in Puerto Rico.

Scale: The scale of the female is flat, circular, white, the centrally

placed exuviae being darker; the scale of the male is almost white, oval, and with a subcentral exuvia. (Ferris 1938, SII-265.)

Natural Enemies: The scale insect is parasitized in the field by the entomogenous fungus, *Microcera Fujikuroi* Miyabe & Saw.

Host: The coccid has been recorded from the following trees:

Annona muricata L.	"guanábana"
Annona reticulata L.	"corazón"
Calophyllum calaba Jacq.	"maría"
Chrysophyllum cainito L.	"caimito"
Ficus nitida Thunb.	"laurel de la India"
Eugenia jambos L.	"pomarrosa"
Tamarindus indicus L.	"tamarindo"

Pseudaonidia tesserata (de Charmoy)

Rare in the Island, also recorded from Mexico, Cuba, Mauritius and Java.

Host: Recorded from "guamá", *Inga laurina* (Sw.) Willd.

Chrysomphalus aonidum (Linnaeus)

(The Florida Red Scale)

An important pest of citrus in the Island and also in other parts of the world. The insect has been recorded from United States, Cuba, Jamaica, Barbados, Central and South America, Europe and the Orient.

Scale: The scale of the female is flat, circular, variable in color, but usually dark, the centrally placed exuviae being somewhat paler than other parts. The scale of the male is somewhat elongate oval and the exuvia is near one end.

Habits: The scale insect usually is found on the foliage of the host trees. In citrus, it also infests the fruits. In Puerto Rico this species is found at low elevations, not yet recorded at middle or higher.

Natural Enemies: The insect is parasitized by the aphelinid wasp, *Aspidiotiphagus citrinus* (Craw.).

The entomogenous fungi *Sphaerostilbe coccophila* (Desm.) Tul. and *Microcera Fujikuroi* Miyabe & Saw. are parasitic on the scale insect too, helping to keep the insect in control.

Host: The coccid has been recorded from the following trees:

Annona muricata L.	"guanábana"
Cocos nucifera L.	'coco"
Ficus nitida Thunb.	"laurel de la India"
Ternstroemia stahlii Krug & Urban	"mamey del cura"
Terminalia catappa L.	"almendra"

Aonidiella aurantii (Maskell)

(The California Red Scale)

A world wide distributed species, considered as a pest of citrus fruits. The species is not abundant in the Island. (In Wolcott's, IB. as *Chrysomphalus aurantii* Maskell).

Scale: The scale of the female is circular, quite flat, with the exuviae central, the scale itself thin, and pale, permitting the red-brown color of the heavily sclerotized adult female to show through. The scale of the male is elongate oval, paler in color than the female, exuvia slightly toward one end. (Ferris 1938, SII-179.)

Host: Recorded from "guanábana", *Annona muricata* L.

Chrysomphalus distyospermi (Morgan)

(The Spanish Red Scale)

A scale insect not common in the Island, also found in United States, Mexico, Central America, Brazil, British Guiana, Europe, Africa and the Orient.

Scale: The scale of the female is rather thin, flat, circular, light brown or yellowish, the exuviae central. The one of the male is elongate oval, similar in color to the female, exuvia towards one end. (Ferris 1938, SII-200.)

Natural Enemies: The scale insect is destroyed by the larvae and adults of the coccinellid beetle, *Scymnillus nunenmacheri* Sicard.

Host: The coccid has been recorded from the following trees:

Mangifera indica L.	"mangó"
Psidium guajava L.	"guayaba"
Swietenia mahagoni Jacq.	"caoba"

Chrysomphalus personatus (Comstock)

(The Masked Scale)

A common scale insect in Puerto Rico, also listed from Mexico, British Guinea, Brazil, the West Indies and England, (in greenhouses). Usually a lowland species not observed at middle or higher elevations.

Scale: The scale of the female is black, almost hemispherical or somewhat thimble-shaped, with the exuviae central; that of the male flat, oval, lighter in color. (Ferris 1941, SIII-372.)

Natural Enemies: The scale insect is parasitized by the signiphorid wasp, *Thysanus fax* (Girault).

Host: The coccid has been recorded from the following trees:

Annona muricata L.	"guanábana"

Calophyllum calaba Jacq.	"maría"
Cocos nucifera L.	"coco"
Ficus nitida Thunb.	"laurel de la India"
Inga laurina (Sw.) Willd.	"guamá"
Laguncularia racemosa (L.) Gaertn.	"mangle bobo"
Mammea americana L.	"mamey"
Symplocos martinicensis Jacq.	"aceituna blanca"

Chrysomphalus (Melanaspis) portoricensis Lindinger

(The Coccolobis Scale)

A typically native scale insect with a very limited distribution in the Island. Possibly present in Colombia and Mexico.

Scale: The scale of the female is black, circular, high convex, with the exuviae subcentral. The scale of the male is oval, with the exuvia at one end. (Ferris 1941, SIII-364.)

Habit: The scale insect usually attacks the twigs of the host plant.

Host: The coccid has been recorded from the following trees:

Coccolobis uvifera (L.) Jacq.	"uva de playa"
Coccolobis venosa L.	"calambreña"

Chrysomphalus nigropunctatus (Maskell)

Rare in Puerto Rico, also recorded from Mexico and Panama.

Habits: The scales of the type are common to the genus, the female with the exuviae tending to be submarginal. The scale insect occurs in exposed situations, on the bark of trees or concealed beneath the bark flakes. (Ferris 1941, SIII-360.)

Host: Collected beneath bark flakes on the trunk of "guayacán" trees, *Guaiacum officinale* L., at Salinas, near the coast.

Furcaspis biformis (Cockerell)

(The Orchid Scale)

A fairly common scale insect in the Island, particularly attacking bromeliaceous plants. Also recorded from Trinidad, the West Indies and Central America. Apparently a pest of orchids.

Scale: The scale of the female is dark, red-brown, circular, moderately convex and with a central exuviae. The male is similar in color, elongate, slender, with the exuvia close to one end. (Ferris 1938, SII-231.)

Natural Enemies: The aphelinid wasp, *Prospaltella diaspidicola* Silvestri has been reared, as a parasite of this species.

Host: The coccid has been recorded from the following trees:

Mangifera indica L.	"mangó"
Persea gratissima Gaertn.	"aguacate"

Pseudischnaspis bowreyi (Cockerell)

This scale insect is not common in Puerto Rico. It has been recorded from Brazil, Trinidad, Jamaica and Mexico.

Host: The coccid has been found attacking the following trees:

Persea gratissima Gaertn.	"aguacate"
Spondias purpurea L.	"jobillo"

Pseudoparlatoria ostreata Cockerell

(The Papaya Gray Scale)

This scale insect is very abundant in the Island and is considered as one of the worst pests of "papayas", *Carica papaya* L. It is also recorded from Jamaica.

Scale: The scale of the female is thin and papery, dark grey, exuviae subcentral. The one of the male of a similar color and texture, but elongate and with exuvia at one end. (Ferris, May 1942, SIV-416.)

Natural Enemies: This scale insect is very efficiently controlled by the twice-stabbed ladybird beetle, *Chilocorus cacti* (Linnaeus).

Host: Recorded from "higuillo de limón", *Piper amalago* L.

Pseudoparlatoria parlatorioides (Comstock)

This scale insect is not common in the Island. It has been recorded from southern United States, Mexico, Panama, the West Indies, South America, Italy and Ceylon.

Scale: The scale of the female is flat, thin and papery, of a yellowish or yellowish brown color, circular, or oval, with the exuviae submarginal. The one of the male similar in color and texture, but somewhat elongate and the exuvia at one end. (Ferris 1942, SIV-417.)

Host: The coccid has been recorded from the following trees:

Amyris elemifera L.	"tea"
Laguncularia racemosa (L.) Gaertn.	"mangle bobo"

Lepidosaphis crotonis (Cockerell)

Rare in Puerto Rico, also recorded from Jamaica, from which it was originally described.

Host: Recorded from "guaba", *Inga vera* Willd.

Lepidosaphes gloverii (Packard)

(Glover's Scale)

A species not common in Puerto Rico, but with a world wide distribution. Recorded from United States, Cuba, Mexico, Central America. South America, Africa, Hawaiian Islands and the Orient.

Scale: The scale is very similar to the related species *L. beckii* (Newman). The scale of the female is 3 mm. in length, but much more slender than in *beckii*. (Ferris 1937, SI-74.)

Host: Recorded from "guayaba", *Psidium guajava* L.

Ischnaspis longirostris (Signoret)

(The Black Thread Scale)

A very common scale insect in the Island, easily identified on account of its peculiar shape and size, and different from any other scale insect present in our insular fauna. It is distributed throughout the tropical and subtropical regions of the globe.

Scale: The scale of the female is slender, filiform, reaching a length of 3 mm., black and with a terminal exuviae The scale of the male similar. (Ferris 1937, SI-67.)

Habits: The scale insect usually occurs on the leaves of the host plants, but when abundant it also affects the twigs. Found from low elevations and up to 1,500 ft.

Host: The coccid has been recorded from the following trees in Puerto Rico:

Acrocomia media Cook	"corozo"
Citharexylum fruticosum L.	"péndula"
Cocos nucifera L.	"coco"
Ficus nitida Thunb.	"laurel de la India"
Guarea trichilioides L.	"guaraguao"
Neowashingtonia robusta (Wendl.) Britton	"Palma del desierto"
Pterocarpus officinalis Jacq.	"palo de pollo"
Roystonea borinquena Cook	"palma real"
Swietenia macrophylla King	"caoba de Honduras"

FAMILY ALEYRODIDÆ

This family includes the white flies or "moscas lanudas", the members of which are phytophagous in their habits. They are of little economic importance as far as forest trees are concerned. Some species infest trees and become so abundant as to give a whitish appearance to the foliage.

As the name implies the adult looks like a small fly, but with the wings and body covered with a mealy bloom giving to it a whitish appearance. The pupal stages of white flies are very similar in form and size to scale insects and are apt to be confused with them. The pupal stages of *Aleuroplatus*, for example, look very much like a soft bodied scale insect resting on the leaf of a tree. This is particularly true if no adults of the white flies are present in the vicinity.

The Puerto Rican species affecting our trees and shrubs are the following:

Aleurodicus griseus Dozier is a species fairly common in the Island. (Description of the species in IB, p. 143–4).

Host: Recorded from the following trees:

Eugenia myrtoides Poir.	"anguila"
Eugenia biflora lancea (Poir,) Krug & Urban	"pitangueira"
Myrica cerifera L.	"arrayán"

Aleurodicus cocois (Curtis) is not a common species in the Island. Only has been recorded from the following trees:

Cocos nucifera L.	"coco"
Neowashingtonia robusta (Wendl.) Britton	"palma del desierto"

Aleurodicus antillensis Dozier is another of our species, not common in the Island. (Description in IB, p. 145).

Natural Enemies: The insect is parasitized by the entedontid wasp, *Euderomphale vittata* Dozier.

Host: Recorded from the following trees:

Calophyllum calaba Jacq.	"maría"
Erythrina glauca Willd.	"bucare"

Aleurodicus minimus Quaintance a pest of guavas is an abundant species in the Island.

Natural Enemies: The insects are controlled in the field by means of entomogenous fungi: *Aegerita Webberi* Fawcett, *Aschersonia Aleyrodis* Webber and *Aschersonia flavo-citrina* P. Henn.

Host: Recorded from the following trees:

Cestrum diurnum L.	"dama de día"
Psidium guajava L.	"guayaba"

Aleurothrixus floccosus (Maskell) is undoubtedly our most common white fly, considered as a minor pest of citrus in Puerto Rico and attacking a few trees and other plants in the Island.

Natural Enemies: The insect is parasitized by some species of parasitic wasps: the entedontid, *Euderomphale aleurothrixi* Dozier, the aphelinid, *Encarsia basicincta* Gahan, the signiphorid, *Thysanus flavus* (Girault) and the last and possibly the most efficient of the group, the aphelinid, *Eretmocerus portoricensis* Dozier.

Host: The white fly has been recorded from the following trees:

Coccolobis uvifera (L.) Jacq.	"uva de playa"
Bursera simarouba (L.) Sarg.	"almácigo"
Guaiacum officinale L.	"guayacán"
Psidium guajava L.	"guayaba"
Spondias dulcis Forst.	"cítara"

Aleuroplatus vinsonioides (Cockerell) is not a common species. It has

been collected several times on forest trees at lower and middle elevations.

Host: The following are the host trees of this species:

Daphnopsis caribaea Griseb.	"majagua de sierra"
Nectandra sintenisii Mez	"laurel amarillo"
Ocotea leucoxylon (Sw.) Mez	"laurel geo"

HEMIPTERA

FAMILY TINGITIDÆ

The members of this family are the so called lace-wing bugs, characterized by the reticulated and gauze-like structure of the hemielytra, usually accompanied by expansions of the prothorax of a similar form. Generally they are small insects, but usually very abundant. They occur in large numbers on the foliage of a few trees, especially on the undersides of the leaves, which they puncture in order to suck the plant juices. Our most common insular species are:

Corythucha gossypii (Fabricius)

This is an abundant species in Puerto Rico attacking many different kinds of plants. It is widely distributed through the southern United States, Mexico, Central America, northern South America and the West Indies.

Adult: Lightly maculated with brown. Pronotal vesicula, viewed dorsally, rather small; viewed laterally, not much elevated above the strongly elevated median carina; dorsal outline almost semicircularly rounded. The following parts spinose: lateral margins and transverse median veins of the paranota, pronotal vesicula, lateral margin of the corium, discal elevation, and some of the veins of the costal region. (Barber 1939, p. 369). (See fig. 9).

Habits: The infestation usually occurs on the undersides of the leaves, but when the insects are abundant they can be seen all over the foliage, even on the twigs. The general symptoms of presence of lacewing bugs are: first a whitening and later a russeting of the infested leaves, especially along the midrib. As the infestation progresses, many leaves will turn completely white on account of the heavy drain of the plant juices. In most cases a partial defoliation follows such attacks.

When one observes closely the infested foliage, a tremendous number of adults and nymphs are noticed walking around and feeding on the leaves. Wolcott, referring to this species says, "The adults are an eighth of an inch in length and half as wide, quite large enough to be seen with the naked eye, even tho the use of a lens facilitates noting the characteristic rounded thickenings of the grey wings, on account of which the insects are

called lacewing bugs. The eggs can be seen less readily, for they are partially inserted in the leaf tissue along the midrib or larger veins on the underside of the leaf, and are surrounded with a mass of black, gummy substance which leaves only the cap projecting, or which may sometimes almost entirely cover the cap. The just hatched nymphs are minute, and even those which are fully grown and about to moult to adult appear much smaller than the adults because lacking wings. They are green and brownish in colour, and on the underside of freshly infested leaves will be found in various stages of growth in compact clusters, often in company with several adults. Both nymphs and adults can move about read ly,

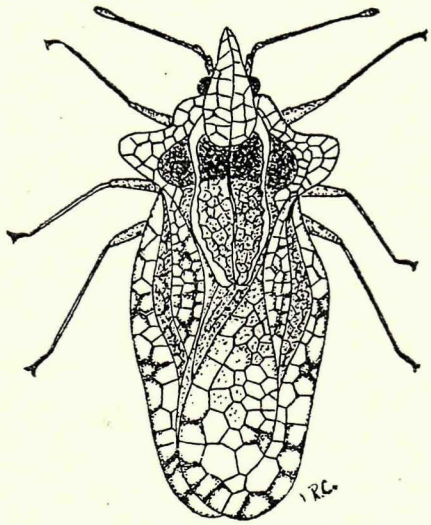


FIG. 8. *Corythaica cyathicollis* (Costa) 20× (Drawn by G. N. Wolcott).

but rarely do so unless disturbed, and while the adult can fly, and may be carried long distances by the wind, ordinarily their dispersion in a field is only to the next adjacent plants. When mass infestations develop on the plants in one corner of a field, however, dispersion is more rapid, and within a few days every plant will be found to have some adults in it. Development from egg to adult is rapid, under favourable conditions being somewhat under three weeks." (Wolcott, EEWI, p. 603–4.)

This species can be mistaken in the field with the closely related form *Corythaica cyathicollis* (Costa). At first glance they look almost alike, but on close examination many differences will be noted. (See figs. 8 and 9 for distinguishing characteristics.)

Applied Control: If a shrub or an ornamental tree is infested by this pest it can be controlled by using any commercial insecticide having as a

basis pyrethrum or rotenone, preferably the last. Usually infestation are heaviest during dry spells. Often sudden showers for days will check infestations. Sometimes a good spraying twice a day with water under high pressure will control the insects.

Host: The tingitid attacks the following trees in the Island:

Annona muricata L.	"guanábana"
Artocarpus communis Forst.	"palo de pan"
Capparis baducca L.	"sapo"
Capparis flexuosa L.	"palo de burro"
Capparis indica (L.) Fawc. & Rendle	"linguam"
Hernandia sonora L.	"mago"

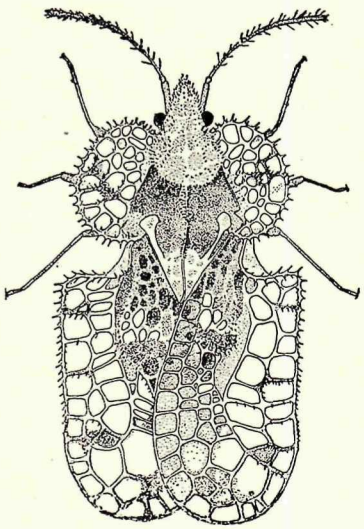


FIG. 9. *Corythucha gossypii* (Fabr.) (20×) (Drawn by F. Seín.)

Isandrina emarginata (L.) Britton & Rose	"vela muerto"
Lonchocarpus domingensis (Pers.) DC.	"genogeno"
Piscidia piscipula (L.) Sarg.	"ventura"
Zanthoxylum caribaeum Lam.	"espino rubial"
Zanthoxylum flavum Vahl	"aceitillo"
Zanthoxylum monophyllum Lam.	"mapurito"

Leptodictya bambusae Drake

(The Bamboo Lacewing Bug)

This is a species with a limited distribution and not so common as the preceeding. Also occurs in Haiti (island of Hispaniola). The main characteristics of this insect are:

"Body elongate, narrow. Head with five distinct spines. Paranota with two rows of areolae, the outer margin straight. Costal area widest just behind the middle, with 3 or 4 rows of areolae. Discal area extended a little beyond middle of corium." (Barber 1939, p. 370).

"Color: Areolae transparent, slightly irridescent, the nervures yellowish white. Thorax beneath reddish brown, the abdomen testaceous. Legs testaceous, the tarsi darker. Head, eyes, and a small portion of the pronotum just back of the hood black. Bucculae and rostral laminae whitish. Antennae whitish, the third segment slightly embrowned towards the apex." (Drake 1918, p. 174).

Host: The tingitid has been recorded only from "bambúa", *Bambos vulgaris* Schrad., affecting the foliage.

Monanthia monotropidia Stål

(The Capá Prieto Lacewing)

Another injurious member of the group, found in the lowlands as well as middle elevations. The main characteristics of the species are:

"Paranota narrowly turned back over the lateral margin of the pronotum, anteriorly a little wider, with a single series of areoles. The posterior C-shaped part of the discal area not so strongly outwardly as in *M. c-nigrum* Champion." (Barber 1939, p. 371–2.)

In general the insect is small, about one eighth of an inch long and of a dark brown color.

Habits: Like all the members of the family the adults and nymphs are found on the undersides of the leaves, in great numbers. When abundant they cause intense chlorosis of the leaves and usually heavy devoliation. The insect has been found in the lowlands and also at middle altitudes up to 1,500 ft. (Martorell, April 1940, p. 23).

Host: The insect is chiefly a pest of the Spanish elm or "capá prieto", *Cordia alliodora* (R. & P.) Cham., but also has been found on the foliage of "mago", *Hernandia sonora* L.

FAMILY PYRRHOCORIDÆ

Dysdercus andreae (Linnaeus)

(The Cotton Stainer)

This insect is fairly abundant in Puerto Rico and is considered as a cotton pest. The insect also attacks the seeds of various trees, thus destroying a large quantity of them which otherwise might be used for propagation purposes. This species is distributed throughout tropical America: Cuba, Jamaica, Haiti, Dominica, Antigua, Guadeloupe, St. Kitts, Montserrat and Florida.

The main characteristics of the insect are the following:

Pronotum with both anterior and posterior margins narrowly pale. At least outer margin of clavus and posterior margin of corium narrowly margined with white or pale yellow. Ventral segments of abdomen posteriorly conspicuously margined with white. Hemielytra with clavus infuscated, outer margin lineate with white; corium bright red, posterior margin narrowly white, disk commonly with a black spot. (Barber 1939, p. 366).

Habits: The common name of this insect in Spanish is "unión", very well adapted to the species indeed, referring to the fact that the adults are more often noted in coitu than singly. The eggs are laid singly or in small clusters in opening bolls (in the case of cotton), in trash on the ground or in the pods of trees which they attack.

The nymphs of most species are reddish in color, tending to be gregarious in their habits. Both nymphs and adults are present together in enormous quantities in the field, especially feeding on the ground on pods and seeds of trees which they prefer.

Host: The insect affects the following trees in the Island:

Ceiba pentandra (L.) Gaertn.	"ceiba"
Montezuma speciosissima Sessé & Moc.	"maga"
Thespesia populnea (L.) Soland	"esmajaguilla"

Dysdercus sanguinarius Stål

This species which is related to the preceeding, is fairly abundant in the Island and has also been recorded from Haití and Cuba. The main characteristics of the insect are:

Pronotum with only posterior margin narrowly pale. Hemielytra bright red, margin of clavus and corium concolorous, latter with transverse or ovate discal spot and extreme apex black; clavus with black mark of variable size. Ventral segments of abdomen unicolorous. (Barber 1939, p. 366).

Habits: More or less similar to those of *D. andreae*.

Host: The insect feeds on the pods of:

Montezuma speciosissima Sessé & Moc.	"maga"
Thespesia populnea (L.) Soland	"esmajaguilla"

COLEOPTERA

FAMILY BUPRESTIDÆ

(Metallic Wood-borers or Buprestids)

This family which in our fauna is represented by 14 species only, includes a group of insects which can be easily recognized by their metallic

coloring. Their bodies are hard and inflexible, and usually appear as if made of bronze.

Some of the adults are flower-loving, usually found in blossoms, others occur on the bark of trees, either basking in the hot sunlight or looking for a place to oviposit. They are strong fliers; some species flying very fast and with a loud buzzing noise.

The larvae of these insects are borers and feed under the bark of trees or to a lesser extent in the solid wood. They are called "flat-headed borers" because of the general shape of the cephalic and thoracic segments. The burrows of most species are flattened, thus following the general pattern of their flattened thorax. Some species of buprestids are leaf-miners, but in these the body is rather cylindrical in shape. The tree borer forms are legless, while the leaf-miners are furnished with three pairs of legs.

Some species are very injurious to forest, shade and ornamental trees. The biology of our insular forms has not been studied yet, not even that of our most common species. Only the following species have been recorded as enemies of forest trees:

Chrysobothris megacephala Castelnau & Gory

(The Aceitillo Borer)

This is a fairly common insect in Puerto Rico, also recorded from Hispaniola. All specimens recorded from the Island are from the western end, particularly from the dry southwestern areas. Presumably the insect thrives best in the xerophytic forests peculiar to that region.

Adults: The male is rather elongate, moderately convex and subopaque; color uniformly dark aeneous; each elytron with four round, deep impressions, which are slightly more aureous or cupreous at the bottom; tarsi aeneo-piceous.

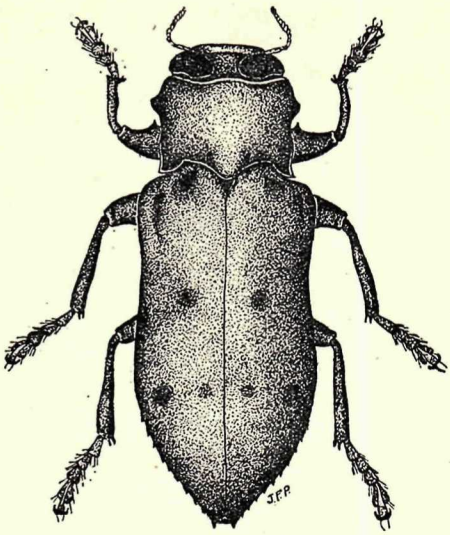
"The female differs from the male in having the front of head more convex and the sides feebly arcuately rounded, apex of abdomen with two semi-circular emarginations (the median tooth not as long as the lateral ones), anterior tibiae without dilatations, and the middle pair straight." Length, 9 mm.; width, 4 mm. (Fisher 1925, p. 112–13.) (See Plate II.)

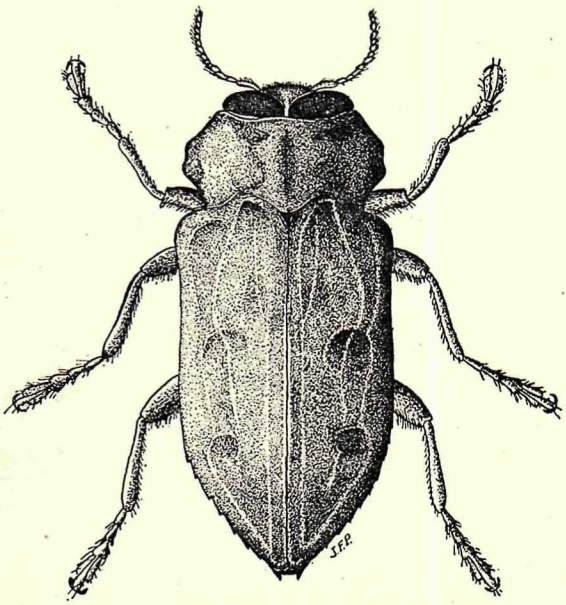
Host: Adults have been reared from larvae attacking the following trees:

Agati grandiflora (L.) Desv.	"gallito"
Zanthoxylum flavum Vahl	"aceitillo"

PLATE II

Chrysobothris megacephala Cast. & Gory
Chrysobothris tranquebarica (Gmelin)





(Luis F. Martorell: A Survey of the Forest Insects of Puerto Rico)

Chrysobothris tranquebarica (Gmelin)

(The Mangrove Borer)

Perhaps this is our most common metallic wood-borer and also the largest species in the entire family. It has been recorded from Santo Domingo, Haití, (Hispaniola) St. Thomas, Grenada, Guadeloupe, Bahamas and Florida. Fisher (1925 p. 96–99) gives a complete description of the species, the following being a part of it:

"Male: Form short, rather broad, and strongly depressed, subopaque; head cupreous or aeneous, with the epistoma auro-viridis; pronotum and elytra dark aeneous; each elytron with four foveae, a deep one at basal lobe, a more shallow one near humerus, a large bilobed one on disk near middle, interrupting the second costa, and an obcordate one at apical third, situated between the second and fourth costae, usually the foveae are concolorous, but sometimes the discal ones are of a lighter shade, and rarely of a reddish-cupreous color; beneath dark aeneous and more shining than above." (See Plate II.)

Female: Differs from the male in having the front of head less pubescent and the chevron on vertex more distinct, anterior and middle tibiae nearly straight, the last ventral segment of abdomen with a broad median carina at base, a depression on each side, and the apex with two shallow semicircular emarginations, the median tooth short and the lateral ones long and acute. Length, 12–16 mm.; width, 5–7."

The life history and habits of this insect are very well discussed by Snyder (1919). From his publication the following notes are taken on the biology of this interesting borer.

Egg: The egg has the shape of a scallop shell, flattened and irregularly ribbed. It is white, ranging from 1 to 1.5 mm. in length and an average width of .75 mm. The egg hatches in about 7 days.

Larva: "The larva is white and a typical "flatheaded" borer. It is of the common *Chrysobothris* type, moderately compressed, and sparsely covered with course, light-colored bristles. The first thoracic segment is large and oval; the second wider and shorter than the third; the third wider than the first abdominal segment, which is narrower than the second abdominal; the third to eighth abdominal are about equal in width, the ninth and tenth successively narrower; the lateral folds of the second to ninth abdominal segments are well developed; the dorsal plate of the first thoracic segment is marked with a well developed, inverted V of grooves and pointlike rugosities; the ventral plate has a well developed groove extending back three-fourths of the distance from the anterior margin, and rugosities which tend to form ridges. The length is 30 mm. and the width of the first thoracic segment 7 to 8 mm." (Snyder 1919, p. 158.)

Pupa: The pupa is whitish or creamy in color, with the head resting on the breast and the legs and wings folded on the ventral surface. The length of the pupa ranges from 15 to 20 mm. The average duration of the pupal period is about 2 weeks.

Habits: The female lays its eggs on the bark of trees singly, in twos or threes. It is rare to find more than four of them in a row. The young larva bores in the tree and feeds on the cambium layers, making horizontal or spiral tunnels and feeding all the time until fully grown. At this stage the larva bores inside the wood and pupates. The adult gnaws its way out of the wood to the outside and then flies away. The whole life cycle from egg to adult takes about a year.

Natural Enemies: The Porto Rican petchary, *Tolmarchus taylori* (Sclater) has been found to prey on this insect. Undoubtedly we must have more predators and parasites that help to keep this insect under control, but these have not been recorded yet.

Host: The following trees are attacked by the beetle in the Island:

Bucida buceras L.	"úcar"
Casuarina equisetifolia Forst.	"casuarina"
Inga vera Willd.	"guaba"
Rhizophora mangle L.	"mangle colorado"

FAMILY COLYDIIDÆ

Phloeonemus martorelli Fisher

Described from adults collected by the writer, on the gummy exudations on the trunks of "aceitillo" trees, at the Guánica Insular Forest, 200 ft. in altitude. These gummy exudations were the results of "machete" wounds produced by careless laborers while clearing the brush in the forest.

Fisher (July, 1943) on describing the insect says, "This species is closely related to *Phloeonemus haroldi* Reitter, described from Cuba, but it differs from that species in being larger, in having the longitudinal costae on the elytra not interrupted, the carinae above the eyes obtusely rounded on the tops, and the costae on the pronotum more distinct with the lateral one on each side vaguely sinuate." (Description of insect, in Fisher, 1943.)

Host: Collected and apparently not doing any damage of economic importance on the trunks of "aceitillo" trees, *Zanthoxyllum flavum* Vahl.

FAMILY ANOBIIDÆ

Catorama neltumae Fisher

Abundant on the dry or xerophytic forests of the southwestern region of the Island. The insect breeds in the pods of "mesquite", a very com-

mon tree in the Guánica Insular Forest and in all the southwestern area of Puerto Rico.

Described by Mr. W. S. Fisher, as follows:

"Oblong-oval, strongly convex, moderately shining, uniformly black above, slightly more brownish beneath, with the antennae and tarsi yellowish, rather densely clothed with short, recumbent, more or less silky, whitish pubescence, which does not conceal the surface. Head and pronotum confluently punctate with fine and coarse punctures intermixed. Elytra finely, densely punctate, with numerous, irregularly arranged, coarse punctures; each elytron with two rather deep lateral striae extending from middle of elytron to apex, but obliterated basally. Anterior tibia unisulcate externally. Middle tibia without a marginal groove. Metasternum not carinate anteriorly, rather sparsely, coarsely, uniformly punctate over entire surface. Length 3.5 mm., width 2 mm." (Fisher, 1941.)

Host: Doing considerable damage to the seed pods of "mesquite", *Prosopis juliflora* (Sw.) DC.

FAMILY BOSTRICHIDÆ

Dinoderus minutus (Fabricius)

(The Bamboo Powder-post Beetle)

This small beetle commonly known as "la polilla de la bambúa" or the bamboo powder-post beetle, is a pest of bamboo, destroying the wood while it is in storage or use. The beetle may attack trees in the field, when these are dead or in a very weak condition due to the attack of other insects or pathological organisms.

The Agricultural Experiment Station at Mayagüez has been doing research for the control of this pest for the past few years. (See SIB, p. 94, for references.)

Natural Enemies: The beetles are eaten in the field by lizards, among them *Anolis cristatellus* Duméril & Bibron.

While in the course of investigations with this insect Dr. H. K. Plank found that the beetle was attacked by a reduviid bug, *Peregrinator biannulipes* Montr., which attacked and killed the adults. The reduviid fed in the following manner:

"When placed in a tube containing a number of powder-post beetles and some pieces of bamboo wood, a nymph or an adult of *Peregrinator biannulipes* almost immediately seized one of the beetles and began feeding by inserting its beak between the prothorax and mesothorax at a point to one side of the middle of the ventral portion, usually below the point where a wing cover was attached. The beetle struggled very little

and soon died. After feeding for about 30 minutes, the predator searched for another beetle and repeated the process." (Plank 1939, p. 151.)

None of the natural enemies of the beetle are abundant enough to be of economic importance as efficient means in controlling the pest.

Host: The beetles attack the "bambúa", *Bambos vulgaris* Schrad.

Apate monachus Fabricius

(The Apate Borer)

A very common insect in the Island found in the lowlands and at middle elevations, boring the trunks and branches of shrubs and trees.

Adult: The adult is very easily distinguished from all other members of the family by its large size. It is dark brown to black in color and about 10 to 16 mm. long. (See illustration in IB, p. 243.)

Habits: The insect breeds in logs or in nearly dying trees, also in branches and small trunks of trees left in the fields to rot after a plantation or a forest is cleared from undesirable trees or shrubs. In the past, heavy outbreaks were recorded on coffee trees and then the insect was known as "the coffee tree borer". Really the insect does not have a preference, it breeds in dead wood and when abundant it attacks every standing tree in the vicinity whether alive or dead. The attacks on the coffee trees were undoubtedly the results of large scale breeding of this pest on slash left in the coffee groves after a clearing and trimming of the shade trees.

When an outbreak occurs the adults fly in large numbers and attack healthy trees, boring in their trunks and killing many of them. Then the females oviposit in these dying trees and the larvae emerging from these eggs live inside the wood, boring deep and long tunnels inside the hard wood. The life history of this species has not been so far studied in detail.

Applied Control: The following are means of controlling and preventing the attacks of the insect:

(1) On clearing plantations or forests, the trash of tree trunks and branches should not be left in the field. It should either be destroyed by fire or buried deep in a hole in the ground. This will prevent breeding of the insect in this dead wood.

(2) As soon as an outbreak is noticed, the insect should be controlled immediately without losing time.

(3) The only effective method of control ever used in the Island is by running a long flexible wire (No. 6 or 8) into the tunnels to kill the adults. (See Martorell. Oct. 1939, p. 25.) Although this method seems quite primitive, it works to perfection if started as soon as the outbreak is noted. Most of the females are killed and the infestation is stopped.

Host: The beetle attacks a large number of trees and the following have been recorded:

Bixa orellana L.	"achiote"
Bucida buceras L.	"úcar"
Casuarina equisetifolia Forst.	"casuarina"
Delonix regia (Bojer) Raf.	"flamboyán"
Inga vera Willd.	"guaba"
Eugenia jambos L.	"pomarrosa"
Linociera domingensis (Lam.) Knobl.	"hueso blanco"
Melia azedarach L.	"alilaila"
Persea gratissima Gaertn.	"aguacate"
Picramnia pentandra Sw.	"guarema"
Salix chilensis Molina	"sauce"
Swietenia mahagoni Jacq.	"caoba"
Tamarindus indicus L.	"tamarindo"

Heterarthron gonagrum (Fabricius)

A species which is similar in appearance to the Apate Borer, but smaller in size and not so abundant.

Adult: The adult beetle is dark reddish brown to black in color and from 7 to 10 mm. long.

Host: The insect has been reared from only two trees in the Island: "palinguán", *Capparis flexuosa* L., and "bayahonda", *Prosopis juliflora* (Sw.) DC.

FAMILY SCARABAEIDÆ

The members of this family are the so called May beetles, June bugs or hardbacks. Our local name for the adult is "caculo", the larva being known as "gusano". The larvae or white grubs are very injurious to vegetation feeding on the roots of plants and trees. The adults when abundant are responsible for defoliation of such crops of economic importance as sugar cane, citrus and bananas, also inflicting the same damage to many species of trees. The insular species affecting forest trees are the following:

Phyllophaga vandinei (Smyth)

This is one of the largest species of *Phyllophaga* in the Island, almost identical in general appearance to *P. portoricensis* (Smyth). They differ in the sexual characters of the males and in geographical distribution. *P. vandinei* (Smyth) is restricted to the western end of the Island and its farthest occurrence being Manatí on the north coast and Peñuelas in the

south, while *portoricensis* occurs in the eastern two-thirds of Puerto Rico and also on Vieques. This insect is usually abundant at lower elevations, seldom observed at middle altitudes.

Adults: The adult is oblong, convex, broader behind, pale chestnut in color on elytra to dark reddish brown on the head, smooth and faintly shining in both sexes but not polished. Length 17 to 22 mm. The main distinguishing characteristic of the species is the male genitalia, having a collar-shaped sheath, ("theca" of Smyth) protractile, chitinous and open ventrally. The adnate armatures are distinct, chitinous and bifurcate at tip; the spicula medial and sharply deflexed ventrally. (IP, p. 102.)

Larva: The larva of this species is very similar in appearance to all others of the same group. The white grub is of the common scarabecid type; that is U-like in shape, plump, whitish with a yellow brown head bearing a pair of powerful mandibles, the thorax having three pairs of strong thoracic legs. (See Plate III.)

Habits: The adult female lays its eggs in the soil, and in about 14 days the larvae emerge. The young larva feeds during the first days upon the humus in the soil then changing the diet to very fine roots, feeding on this sort of food until fully grown and ready to pupate. During this larval period the immature insect goes through three instars. The first instar lasts for 36 days, the second takes 47, the third 183, at the end of which it pupates. During this last instar is when the white grub does its most intense damage, feeding exclusively on the roots of plants and trees. When fully fed and about ready to pupate, the grub digs deeply in the ground and constructs an oval cell around itself where it pupates. The pupation period lasts for about 21 days. The total life history or cycle of this species takes about a year. In Guánica, the adults are at their maximum abundance during the later part of April and August, very few being present from September to March. Great abundance of adults are usually followed after the first showers of Spring in the Guánica district.

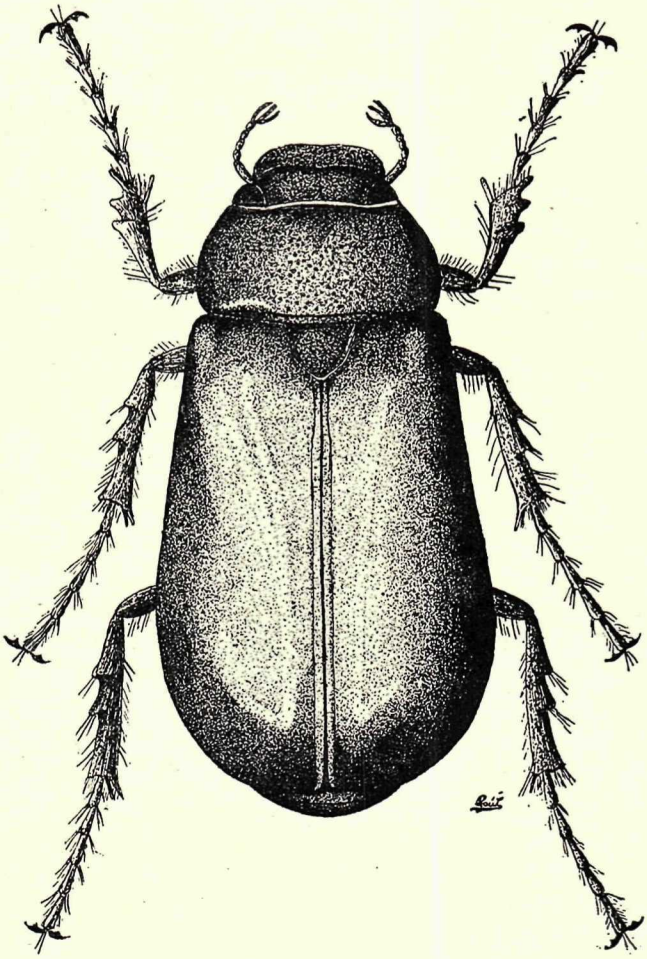
Natural Enemies: Many are the parasites and predators which are responsible for the control of this insect in the field. Some have been introduced into the Island and others are native.

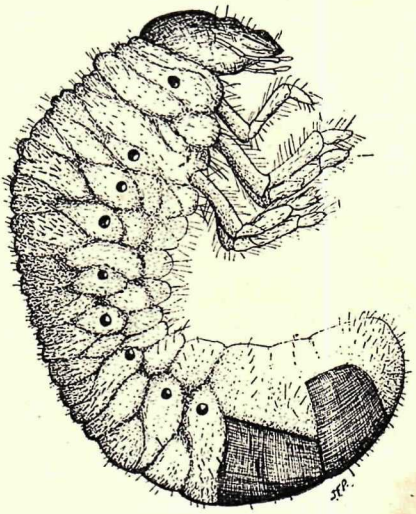
The most important factor in the control of this pest has been the imported Surinam toad, *Bufo marinus* (Linn.). Since its introduction the infestations of "caculos" have been greatly reduced, especially in the southern and southwestern districts of the Island, where the beetles caused intense depredations on the cane fields. The toads feed on the adult

---

PLATE III

Phyllophaga portoricensis (Smyth)
White-grub or larva of *Phyllophaga* sp.





(Luis F. Martorell: A Survey of the Forest Insects of Puerto Rico)

beetles, and when these are abundant they become the main food of the amphibian. Studies made by Dexter (1932) show that 41% of the food of toads constituted of *Phyllophaga* and *Diaprepes* adults.

Wolcott, commenting about the introduction and beneficial aspects of the toad says,

"The major factor in a changed environment for white grubs is the introduction and wide-spread dispersal of the giant toad, *Bufo marinus* (Linn.). Nearly a third of the food of this animal in cane fields consists of

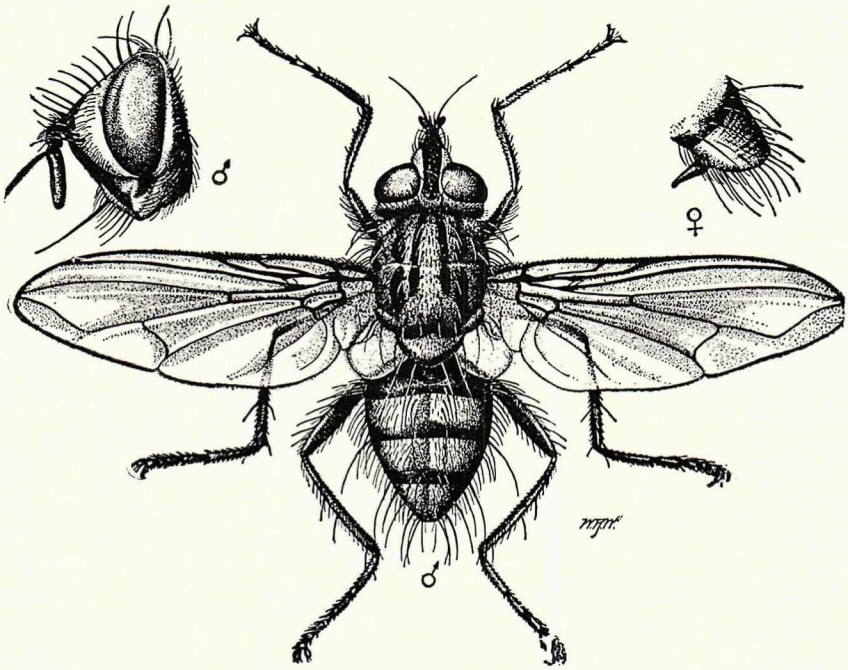


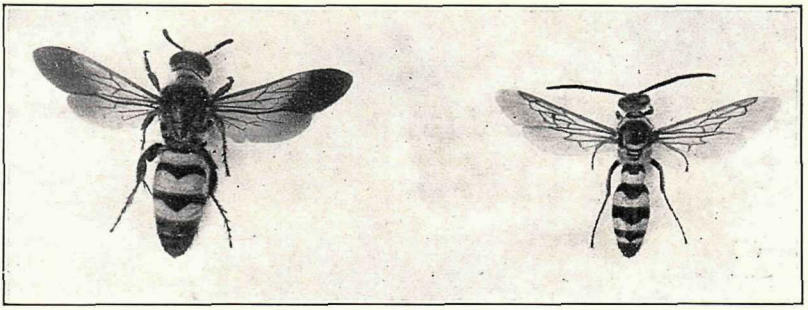
FIG. 10. *Emphanopteryx aurifacies* (Walton). Ten times natural size. (Drawn by W. R. Walton.)

May beetles, the adults of the white grubs. If the toads were comparatively scarce, as are the native toads for instance, their influence might be negligible, but as a matter of fact they are at the present time very numerous, not only along the coast, but also far up into the hillier districts of the interior. On account of their individual size, their abundance, and their preference for May beetles as food, they have rapidly changed the status of white grubs in the cane fields of the south coast, and in the agricultural regions of the Island generally, from that of a major pest to one of comparatively minor importance. (Wolcott, July 1933, p. 268.)

The larvaevorid fly *Emphanopteryx aurifacies* (Walton) (see fig. 10),

previously recorded as *Cryptomeigenia aurifacies* Walton, is a parasite of the adult beetle in the more humid parts of Puerto Rico. The fly is nocturnal in habits and deposits the eggs under the elytra of the May beetles in flight. The fly maggots pierce the integument of the beetles and feed on the internal organs, soon causing the death of those attacked. The less abundant larvaevorid fly *Eutrixoides jonesii* Walton, attacks the adults in the same fashion, also helping in the natural control of this pest.

Also playing an important role in the control of the insect in the field is a group of parasitic wasps. The tiphiid *Myzine ephippum* (Fabricius) parasitizes the 3rd. instar larva, the 2nd. instar is parasitized by *Myzine haemorrhoidalis* (Fabricius). The scoliid wasps, *Campsomeris dorsata* (Fabricius), *C. trifasciata* (Fabricius) (see fig. 11) and *C. tricincta* (Fabricius)



A. B.

FIG. 11. *Campsomeris trifasciata* (Fabricius). One and one-fourth natural size. (Photo, H. L. Dozier). A: Female B: Male.

are parasitic on the 3rd. instar larvae. A complete study of this parasitic insect was made by Box (1925).

The adults are also eaten by birds, such as the Least grebe or "tigua", *Colymbus dominicus dominicus* (Linnaeus), the West Indian killdeer or "putilla", *Oxyechus vociferus rubidus* (Riley), and the grubs by the Porto Rican thrush or "zorzal de patas coloradas", *Mimocichla ardosiacea portoricensis* (Bryant). (Danforth 1926, pp. 30, 79 and 126.)

The white grubs are also attacked in the field by the green muscardine fungus, *Metarrhizium Anisopliae* (Metschn.) Sor. However, this fungus is not efficient as a practical means of control of the grubs or adults.

Host: The adult beetles feed on the foliage of trees, often causing heavy defoliation. The following trees have been recorded:

Andira jamaicensis (W. Wright) Urban	"moca"
Roystonea borinquena Cook	"palma real"
Sterculia apetala (Jacq.) Karst.	"anacagüitas"
Swietenia macrophylla King	"almendra"
Terminalia catappa L.	"caoba de Honduras"

Phyllophaga portoricensis (Smyth)

This species is considered as the eastern analogue of *P. vandinei* (Smyth) having its distribution in approximately the eastern two-thirds of the Island.

Adults: The adults are nearly the same in appearance as those of *P. vandinei* (Smyth), but they are usually larger in size, averaging 1 to 2 mm. more in length, darker in color, and the surface of their bodies somewhat more polished. However, the main difference is found in the genital structures of the males. The male genitalia has the adnate armatures spatulate at the tip instead of bifurcate; spicula roundly deflexed ventrally instead of sharply. (For illustration of adult, see plate III.)

Habits: The habits and life history are similar to those of *P. vandinei* (Smyth).

Natural Enemies: The species is controlled by more or less the same predators and parasites that control the preceding species of May beetle, but with few exceptions. The giant toad, *Bufo marinus* (Linnaeus) is at the head of the list. The third instar larva is attacked by the parasitic wasps, *Campsomeris trifasciata* (Fabricius), *C. dorsata* (Fabricius) and *C. tricinta* (Fabricius). The 2nd instar larva is parasitized by the tiphiid wasp, *Myzine ephippum* (Fabricius).

Another important enemy of this species is the larva of the "cucubano" or wireworm *Pyrophorus luminosus* (Illiger). (See figs. 12 and 13.) "One larva of the "cucubano" which transformed to adult killed and ate eight first instar white grubs, fifteen second-instar grubs, forty-two third instar grubs and three pupae of *Phyllophaga* (*Lachnosterna*) *portoricensis* (Smyth)" (IB, p. 249).

The May beetles are also attacked in the field by the fungus *Metarrhizium Anisopliae* (Metschn.) Sor. The grubs are eaten by the lizard *Ameiva exsul* Cope.

The "múcaro", *Gymnasio nudipes* (Daudin) is the most important bird feeding on the adult beetles. The Little blue heron, *Florida caerulea caerulescens* (Latham) also feeds on the adults, but not to the extent of the "múcaro". The Porto Rican grackle, *Holoquiscalus niger brachypterus* (Cassin) feeds on the grubs. (Wetmore 1916.)

Host: The adult beetles have been found defoliating the following trees:

Coccolobis uvifera (L.) Jacq.	"uva de playa"
Didymopanax morototoni (Aubl.) Dcne. & Pl.	"yagrumo macho"
Lagerstroemia speciosa (L.) Pers.	"reina de las flores"

Phyllophaga citri (Smyth)

(The Citrus May Beetle)

Another species of *Phyllophaga* common in all parts of the Island with

the exception of the southwestern corner, also attacks the foliage of our trees. This species also has a one year life cycle. Its grubs are often abundant in the sandy soils of the north coast, feeding on the roots of citrus trees, while the adults feed on the leaves of citrus and other plants

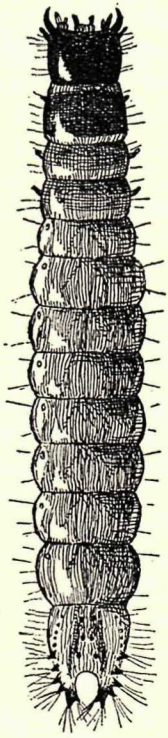


FIG. 12. *Pyrophorus luminosus* (Illiger) Larva, twice natural size. (Drawn by G. N. Wolcott.)

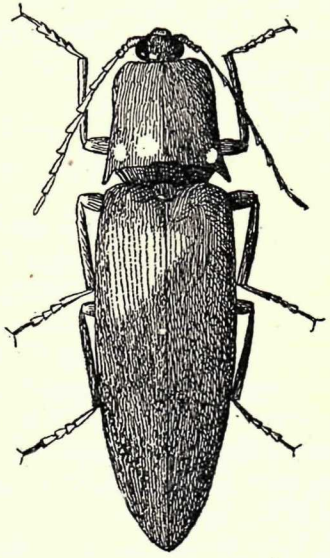


FIG. 13. *Pyrophorus luminosus* (Illiger) Adult, twice natural size. (Drawn by G. N. Wolcott.)

and trees. The main characteristics of the species as redescribed by J. D More, are as follows:

Adults: The adult is oblong, convex, broader behind. The male is dull brown, elytra with plumbeous bloom, the female less bloom, posterior half of elytra polished chestnut brown; thorax rich mahogany brown; head darker. Length 14 to 17 mm.

The genitalia of the male with sheath collar-shaped, protractile, chitinous and open ventrally; adnate armatures fused into single spatha, spatha depressed, chitinous and polished above, unsymmetrical, hooked upwards on the left side and terminating in a serrate edge; spicula dextral. (Complete description of both sexes in IP, 103–4.)

Natural Enemies: The giant toad, *Bufo marinus* (Linn.) is the enemy number one of this beetle, recorded as feeding on the adults as well as grubs whenever they get the opportunity to find this last in the field.

The third instar grubs are parasitized by *Myzine ephippum* (Fabricius) and rarely by *Campsomeris trifasciata* (Fabricius). The second instar larva is parasitized by *Myzine haemorrhoidalis* (Fabricius).

The beetles are eaten by the lizard, *Anolis cristatellus* Duméril & Bibron and the white grubs are attacked by the fungus, *Metarrhizium Anisopliae* (Metschn.) Sor. Wolcott also cites the owl and the larva of the "cucubano", *Pyrophorus luminosus* (Illiger) as enemies of this species. (EEWI, p. 463.)

Host: The adults attack the foliage of the following trees:

Grevillea robusta A. Cunn.	"roble australiano"
Miconia racemosa (Aubl.) DC.	"camasey racemoso"
Psidium guajava L.	"guayaba"

Phyllophaga guanicana (Smyth)

This species has a limited distribution in the Island, being confined to the southwestern corner. It is similar in appearance to *citri*. The species as redescribed by J. D. More is as follows:

"Elytra of the female polished chestnut brown with sometimes a trace of bloom. Length 13 to 17 mm. Elytra sparsely ciliate becoming more dense along the lateral margine. Pygidium densely but closely ciliate. Male with adnate armatures of genitalia fused into single spatha, spatha thicker vertically than horizontally, bilaterally symmetrical, fleshy with the exception of the two rows of minute, prostrate spinules on the dorsal and ventral surfaces". (IP, p. 104–5.)

This species is very rare and not enough studies have been made on its habits.

Natural Enemies: The only recorded enemy of this insect is the green muscardine fungus, *Metarrhizium Anisopliae* (Metsch.) Sor.

Host: The adult has been recorded as feeding on the foliage of the following trees:

Bucida buceras L.	"úcar"
Psidium guajava L.	"guayaba"
Varronia angustifolia West.	"basora"

Strataegus quadrifoveatus Palisot de Beauvois

(The Coconut Rhinoceros Beetle)

A common scarabaeid in Puerto Rico, distributed over the entire Island, presumably present in Vieques, Culebra and Mona. The insect has been also recorded from Hispaniola. It is the largest species of scarabaeid

in Puerto Rico and it could only possibly be confused with the related species *S. barbigerus* Chapin.

Adult: The adult of the coconut beetle is distinguished from that of the sugar cane rhinoceros beetle, *S. barbigerus* Chapin, by its much larger size and more highly polished surface, also by the longitudinal row of punctures present in the smaller species. In the male of this species, the anterior horn is never divided at the tip, whereas in the other species (*barbigerus*) it shows a strong tendency to divide into two short prongs.

Habits: The eggs which are laid in the soil, hatch within 20 days. The young larva grows fast and attains a size not comparable to that of any other scarabaeid larva in the Island. It goes through three instars, with an average length of 39 days for the first, 71 for the second and 275 for the third. It has been determined that the total life cycle for the species is around 454 days or 15 months.

The grub or larva only feeds upon decayed wood or partly rotted coconut fiber. It is the adult beetle which does the damage and kills coconut palms, by eating the succulent tissue of the trunk of palms. It is remarkable how these beetles can tear their way into the tough, woody stem of a living coconut palm, by boring inside using their powerful barbed legs and mandibles.

Natural Enemies: The most important enemy of these beetles is the mongoose, *Herpestes birmanicus* Thomas, which consumes a great amount of adults.

The Puerto Rican grackle or "mozambique", *Holoquiscalus niger brachypterus* (Cassin), is most efficient in destroying the larvae when they are turned by the plows in the fields under cultivation.

The green muscardine fungus, *Metarrhizium Anisopliae* (Metschn.) Sor., also attacks the insect, both the adult and immature stages. The stage most susceptible to attack by the fungus seems to be the pupa; that least susceptible the egg. (Complete discussion about this insect, in Smyth, E. G. 1920.)

Host: The adults attack the roots and trunks of the coconut palms. *Cocos nucifera* L.

FAMILY CERAMBYCIDÆ

(Long-horned Beetles or Cerambycids)

A fairly large family of the Coleoptera, represented in our Island by sixty-nine species. The beetles are of small, medium or large size, with an elongated body, often cylindrical. The antennae are long, usually longer than the whole body, thus giving origin to its common name.

The larvae are borers and attack all sorts of trees and woody plants,

some species living in the solid wood and others under the bark. The larval stages of most species are long, sometimes taking two or three years, while the pupal stages are comparatively short, lasting only few days or weeks.

The life history of many of our insular forms has not been studied yet. We really know very little about the habits of the different species. All that we know so far is the exact host trees of the species that we have been lucky enough to rear from infested material collected in the field.

The Puerto Rican forms affecting our trees are the following:

Stenodontes bituberculatus (Beauvois)

This is a large reddish brown to dark, shiny, cerambycid, measuring from 45 to 57 mm. in length. Undoubtedly it is one of our largest species in the family. It possesses long and powerful mandibles by which it can bore its way out of the trunk of trees.

Host: The insect has been found attacking the following trees:

Guazuma ulmifolia Lam.	"guácima"
Melicocca bijuga L.	"quenepa"

Derancistrus thomae (Linnaeus)

A fairly large dark reddish brown beetle, with yellowish margins on the elytra. (See Plate IV.)

The larva has been reared from "achiote", *Bixa orellana* L.

Chlorida festiva (Linnaeus)

(The Mango Borer)

A common species in Puerto Rico, collected in the lowlands as well as at middle elevations.

Adult: The adult beetle has green elytra, bordered by yellow, legs yellow to brown, thorax yellow or reddish brown with brown markings. (See Plate V.)

Natural Enemies: The adults are eaten by birds, such as ani or "judío", *Crotophaga ani* (Linnaeus).

This species is usually associated with the presence of uropodid mites, whose nymphs cling to the thorax of the beetles.

Host: The larvae of this species have been found attacking the following trees:

Albizia lebbeck (L.) Benth.	"amor platónico"
Casuarina equisetifolia Forst.	"casuarina"
Mangifera indica L.	"mangó"
Stahlia monosperma (Tul.) Urban	"cóbana"

Elaphidion irroratum (Linnaeus)

This is a fairly common species in Puerto Rico and Mona Island, the adults often collected at lights.

Adult: The adult is shiny dark brown, head, thorax and elytra mottled by gray, legs and antennae reddish brown. Length 15 to 20 mm.

Natural Enemies: The larvae of the elaterid *Chalcolepidius silbermanni* Chevrolat prey upon the larvae of this cerambycid.

Host: Adults and larvae breeding in the trunk of dead "amor platónico" trees, *Albizia lebbeck* (L.) Benth.

Elaphidion nanum (Fabricius)

Another common species in the Island, also recorded from Hispaniola. The adults are often collected at lights.

Adult: The adult is chestnut brown in color, body, antennae and legs covered with a grayish pubescence, the elytra appears as if it has a longitudinal stripe running on the middle of each elytron from the thorax to nearly the apex.

Host: The insects have been reared from the larvae attacking the trunk of "casuarinas", *Casuarina equisetifolia* Forst.

Elaphidion spinicorne (Drury)

A species collected in Puerto Rico and Mona Island, especially abundant at lights on Mona.

Adult: The adult is light reddish brown, with the elytra mottled with brown markings. Length 15 to 20 mm.

Natural Enemies: The larva of the elaterid *Chalcolepidius silbermanni* Chevrolat preys upon the larva of this cerambycid.

Host: Infestations on the trunk of "amor platónico" tree, *Albizia lebbeck* (L.) Benth, at Ponce.

Elaphidion tomentosum Chevrolat

Perhaps not so abundant as the other species in the genus.

Host: Larva reared to adult, in "cupey", *Clusia rosea* Jacq.

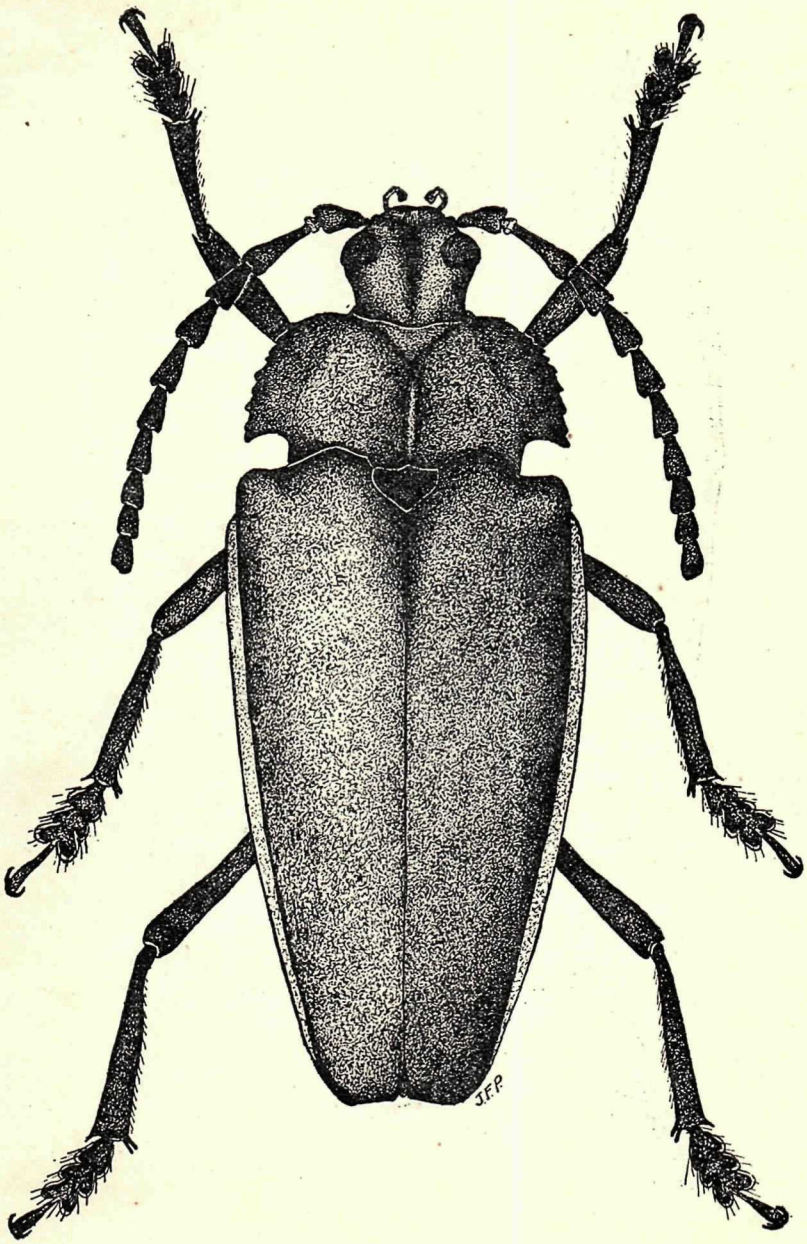
Stizocera vanzwaluwenburgi Fisher

(The Roble Borer)

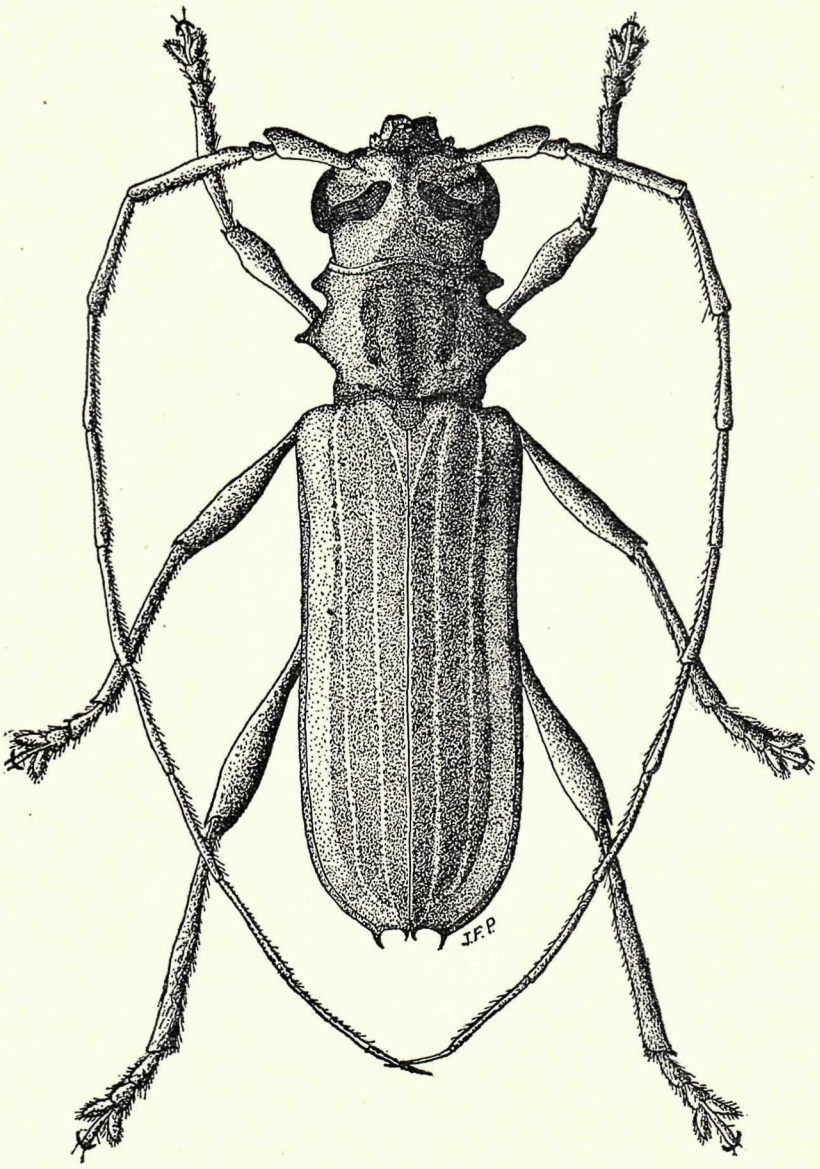
Not a very common species in the Island. The adults are shiny light reddish brown and from 11 to 15 mm. in length.

PLATE IV

Derancistrus thomae (Linnaeus)



(Luis F. Martorell: A Survey of the Forest Insects of Puerto Rico)



(Luis F. Martorell: A Survey of the Forest Insects of Puerto Rico)

Host: The writer observed heavy infestations in the trunks of "roble" trees, *Tabebuia pallida* Miers, which were used as beams for supporting the zinc roof in a cow barn at Trujillo Alto, Oct. 1935. On approaching these infested beams a funny squeaking noise was heard, apparently produced by the adults or the larvae while working in the wood. Presumably these trunks were infested in the field.

Cylindera flava (Fabricius)

A common species in Puerto Rico and Mona Island, often collected at lights.

Adult: The adult beetle is rather small in size, ranging from 4 to 9 mm. in length, shiny, pale brown in color.

Host: The adults have been reared from larva infesting trunks and logs of the following trees:

Bucida buceras L.	"úcar"
Casuarina equisetifolia Forst.	"casuarina"
Coccolobis uwifera (L.) Jacq.	"uva de playa"

Euryscelis suturalis (Olivier)

A species not common in the Island, the adults collected sometimes at lights and also reared from logs of *Prosopis juliflora* (Sw.) DC., our common "bayahonda".

Neoclytus araneiformis (Olivier)

A fairly common insect in the Island, collected at lower and middle elevations.

Adult: The adult beetle is black, with reddish brown markings and greyish pubescence forming a definite pattern on the elytra, very characteristic of the species.

Host: The females have been observed ovipositing on freshly-cut logs of *Inga vera* Willd. and the adults have been reared from larvae collected on logs of "úcar", *Bucida buceras* L.

Lagochirus araneiformis (Linnaeus)

(The Almácigo Borer)

One of our most common species of cerambycid, collected in the lowlands as well as in middle altitudes.

Adults: The adult beetle has the elytra and thorax with markings of different shades, grayish to brown and dark brown, these varying very

---

PLATE V

Chlorida festiva (Linnaeus)

much in the same species, among different individuals. (See Plate VI, fig. 4.)

Habit: Very little is known about the life history of this insect, except that it attacks a tree of the genus *Bursera*. The larva feeds in the woody trunk, boring a series of tunnels. When it is nearly full grown it comes to the cambium layers close to the bark, and while there by chewing towards the outside makes a sort of a circular incision, thin enough not to go through the bark on the outside, but yet fragile enough to permit the adult beetle escape without difficulty. The larva then constructs a cell under the bark where it pupates and when the adult is ready to emerge this circular incision is opened as if it were a trap door. Infested trunks show many of these trap doors, which at first were the cause of investigations by Mr. Willis R. Whitney of Schenectady, New York. (See Whitney 1942.) (See Plate VI, fig. 3.)

Natural Enemies: The larvae of this cerambycid beetle are attacked by the larvae of the introduced, non-luminous elaterid *Chalcolepidius silbermanni* Chevrolat. The larva of this elaterid is very similar in appearance to that of the "cucubano", *Pyrophorus luminosus* (Illiger) which preys on white grubs. (See Plate VI, figs. 1 and 2.)

This predaceous insect was discussed by Wolcott & Martorell, (Jan. 1942) and from that article the following is cited:

"The luminous spots on the prothorax of the "cucubano" are sharply defined even in the pupa. The larva, however, is luminous generally in the prothorax, and slightly so on the rear edge of following segments. The elaterid larvae from the "almácigo" log, so closely resembling "cucubano" larvae morphologically, are not luminous at all, even when repeatedly stimulated in a photographic darkroom. Dr. W. H. Anderson, of the U. S. National Museum, to whom material was submitted, notes that the "cucubano" larvae are separable from them also "on the shape and ornamentation of the ninth abdominal segment, on the structure of margin of nasale and on the sculpture of dorsal surface of head". Reared to adult they proved to be *Chalcolepidius silbermanni* Chevrolat, a large non-luminous elaterid, dark-chocolate brown in color, with deeply furrowed elytra, until recently not known to exist in Puerto Rico".

Host: The larva of the cerambycid attacks only one tree in Puerto Rico, as far as the writer has been able to observe: "almácigo", *Bursera simarouba* (L.) Sarg.

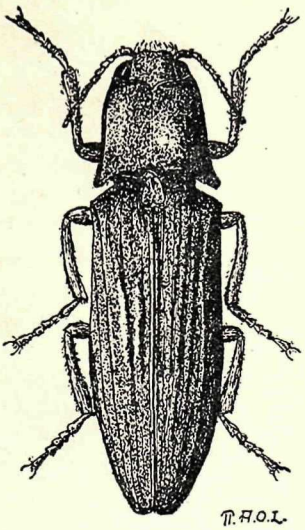
PLATE VI

FIG. 1. Adult *Chalcolepidius silbermanni* Chevrolat.

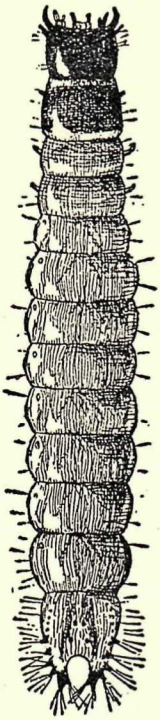
FIG. 2. Larva of "cucubano" *Pyrophorus luminosus* (Illiger) predaceous on white grubs.

FIG. 3. Log of "almácigo" *Bursera simaruba* showing exit holes of *Lagochirus*.

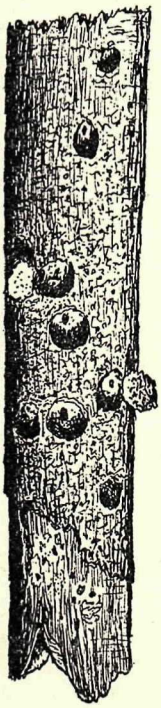
FIG. 4. Adult *Lagochirus araneiformis* (L.)



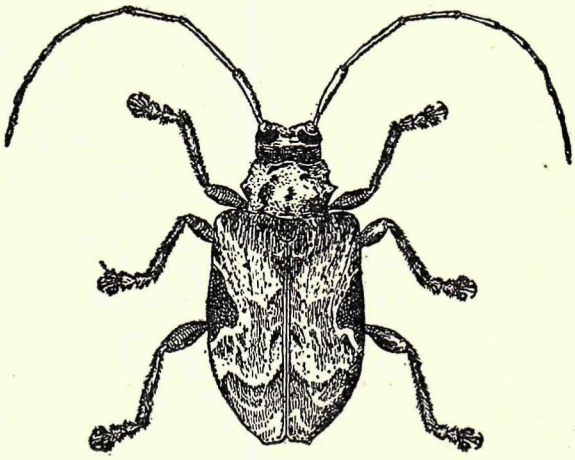
1



2



3



4

(Luis F. Martorell: A Survey of the Forest Insects of Puerto Rico

Leptostylus argentatus Jacq. Duval

A common cerambycid in Puerto Rico, rather small, the body covered with a grayish pubescence forming a definite pattern on elytra and thorax. Length, 7 to 10 mm.

Host: Reared from larvae attacking the trunk of "aceitillo" tree, *Zanthoxylum flavum* Vahl.

Lepturges guadeloupensis Fleutiaux & Sallé

This is one of our smallest species of cerambycids, rather common in the Island.

Adult: The adult beetle is dark reddish brown, with the body covered by a grayish brown pubescence, thus giving a mottled appearance to the elytra and thorax. Antennae filiform, delicate, and about three times as long as the body.

Natural Enemies: The adult beetles are eaten by the Porto Rican tody, *Todus mexicanus* (Lesson) and also by the common lizard, *Anolis cristatellus* Duméril & Bibron.

Host: The adults have been reared from pods of "aroma" *Vachellia farnesiana* (L.) Wight & Arn., and also from dry branches of "palinguán", *Capparis flexuosa* L. Adults have been collected on branches of "mangle colorado", *Rhizophora mangle* L.

FAMILY CHRYSOMELIDÆ

This family includes the so called flea-beetles, leaf-beetles or chrysomelids. It is represented in Puerto Rico by quite an extensive number of species, some of which attack the foliage of trees, although not causing injuries of economic importance. The biology of our insular species has not been studied yet. Only the most common forms will be listed here, with their respective host trees.

Cryptocephalus tristiculus Weise

A common species in the Island, recorded as feeding on the foliage of "guaba" *Inga vera* Willd. and "almendra", *Terminalia catappa* L.

Cryptocephalus nigrocinctus Suffrian

Our most common species in the genus, attacking a large group of plants and trees. Very polyphagous in its habits.

Host: The adult beetles have been recorded from the following host trees:

Chrysobalanus icaco L.	"icaco"
Coccolobis uvifera (L.) Jacq.	"uva de playa"
Cordia borinquensis Urban	"muñeca"

Dalbergia ecastophyllum (L.) Taub.	"palo de pollo"
Inga laurina (Sw.) Willd.	"guamá"
Ochroma lagopus Sw.	"guano"
Psidium guajava L.	"guayaba"
Rhizophora mangle L.	"mangle colorado"
Salix chilensis Molina	"sauce"

Cryptocephalus perspicax Weise

A common species in the Island, quite different from the preceding which is bluish black or nearly black in color, while this is bright yellow with prothorax and elytra light brown with large yellow spots.

Host: Feeds on the foliage of the following trees:

Coccolobis uvifera (L.) Jacq.	"uva de playa"
Dalbergia ecastophyllum (L.) Taub.	"palo de pollo"
Inga vera Willd.	"guaba"
Inga laurina (Sw.) Willd.	"guamá"

FAMILY BRUCHIDÆ

(Pea-weevils or Bruchids)

The members of this family are small beetles, weevil-like in appearance, the head of the adults prolonged into a broad beak and the wing-covers or elytra rather short, leaving the tip of the abdomen always exposed. The larvae are usually found attacking the seeds of leguminous plants as well as others like the seeds of certain tropical palms. The local name for the adult of this insect is "gorgojo". Some of our insular species are very injurious to the seeds of trees. The following are the species affecting our trees:

Acanthoscelides dominicanus (Jekel)

This common species of bruchid has been found in the pods of different trees, feeding in the seeds and causing the total destruction of the infested pods.

Host: Reared from the pods of the following trees:

Hymenaea courbaril L.	"algarrobo"
Prosopis juliflora (Sw.) DC.	"bayahonda"
Vachellia farnesiana (L.) Wight & Arn.	"aroma"

Amblycerus martorelli Bridwell

A common species in the southern and southwestern districts of Puerto Rico, where its host tree grows best. Also recorded from Haiti and the Dominican Republic.

Described by Mr. J. C. Bridwell of the U. S. National Museum (Bridwell, 1943) as follows:

"Nearly the size and habits of *Amblycerus robiniae* (Fabricius) (= *Spermophagus haffmanseggi* of the Leng Catalogue not of Gyllenhal) but lacks the black integumentary areas of that species, is smaller, and has differently shaped pronotum and scutellum, shorter calcaria and numerous differences in sculpture. Reddish brown with appressed pubescence, uniformly yellowish cinereous above and pale beneath, nearly evenly disposed and partly concealing the surface sculpture, without blackish hairs except for single black hairs in the larger punctures of pronotum and elytral intervals. Pectus often infuscate, sternites with ill-defined paler margins.

"Length, 5–6, width, 3–5. mm.

"Eyes emarginate for about one-fourth their length, coarsely faceted, strongly convex, projecting about one-half their width; front at clypeus separating the eyes by about one-half their width, strongly punctulate, without coarser punctures, with only a slight vestige of a glabrous unpunctured line near clypeus, mentum without punctures. Antennae with 3 narrow joints at base, joints 2 and 3 together about as long as 1 joint and longer than 4, joints 4–10 longer than broad, compressed and expanded with inner apical angles produced, these joints subserrate and closely applied to each other.

"Prothorax about as broad at base as the elytra, transverse, dorsum coarsely and rather densely punctured on the sides, a broad longitudinal median area without these punctures, impressed lines along lateral margins above and below ending far from the anterior margin, flanks without coarse punctures; prosternum very narrow between the coxae, extending slightly beyond them, slightly expanded and truncate at apex, not received in any special structure of mesosternum; this nearly vertical, flat, hairy, and truncate at apex, meeting metasternum at an obtuse angle; metasternum not gibbous, with apex set off by the impressed marginal line; scutellum parallel sided, oblong-subquadrate, pointed at apex, emarginate on either side of the point, the lateral angles rounded.

"Elytra about thrice as long as prothorax, widest near middle, broadly, obliquely, subtruncately separately rounded at apex, intervals 2, 4, 6 and 8 slightly costate giving a slight vittate effect, intervals dotted with fine darkish punctures each bearing a single black decumbent hair. Pygidium nearly plane, oblique, about as broad as long, margins converging in a convex curve to the broadly truncate or rounded apex, disc infuscate, margins pale, a pale pubescent longitudinal line, punctured except for a small subbasal area on either side. Last sternite longer than the preceding in female, shorter than preceding in male.

"Hind coxa with about 30 irregularly disposed, rather coarse shallow

punctures on the large pubescent area and with several fine strongly impressed punctures on the glabrous shining area near the insertion of the trochanter. Inner and outer carinae of ventral margin of hind femur obsolescent on basal half, inner carina unarmed as is usual in *Amblycerus*. Calcaria of hind tibia but little unequal, as 5 to 4, longer outer calcar not half as long as basal tarsal joint; outer dorsal surface of hind tibia with a line of closely placed punctures extending from base to apex, ventral surface with two lines of punctures where it meets the outer and inner faces in an even curve, apex obliquely truncate with about five rounded teeth at dorsal apex." (More information in Bridwell, 1943.)

Habits: Presumably the insect attacks the pods in the field, while they are still on the tree. The larva breeds inside the pods, feeding on the seeds and causing tremendous damages. A large percentage of the seed pods of the host tree are useless due to the intense attack of the beetle. The insects keeps on reproducing and breeding even when the seed is kept in storage. (See Plate VII, for illustration of adult.)

Host: Only recorded from the seeds of "bayahonda", *Prosopis juliflora* (Sw.) DC.

FAMILY CURCULIONIDÆ

(The Curculios, Snout-beetles or Weevils)

This family comprises a large group of insects chiefly characterized by the prolongation of its head into a well defined beak, which is usually long and curved downward. The same as the members of the preceding family these are locally called, "gorgojos".

Some species are injurious to our trees, either by attacking the seeds, roots, or causing extensive defoliation. The members of the family injurious to forest, shade and ornamental trees are the following:

Attelabus coccolobae Wolcott

(The Sea-grape Leaf-roller)

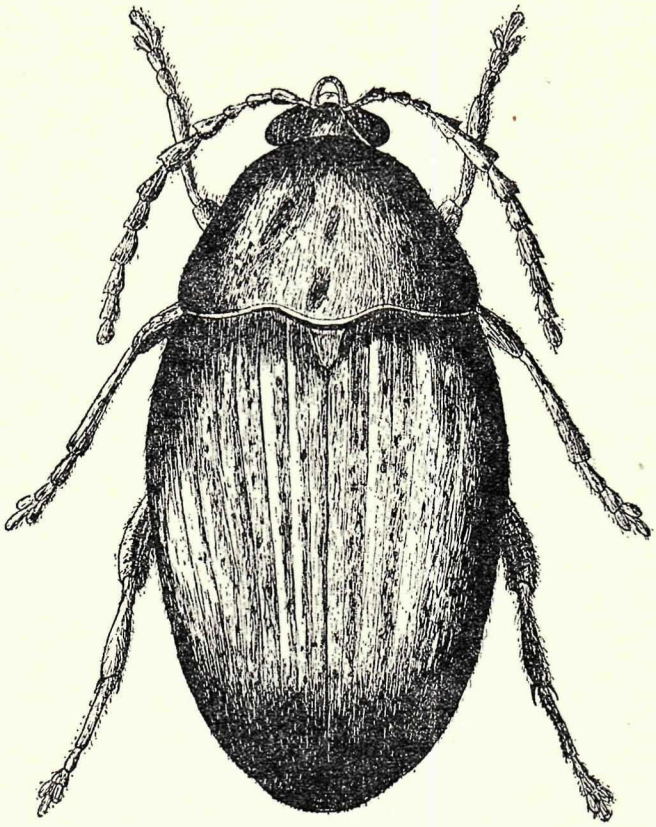
A common insect in the Island, also recorded from St. Thomas, abunnant in the lowlands where most of the host trees grow, but also present at middle elevations up to 2,000 ft.

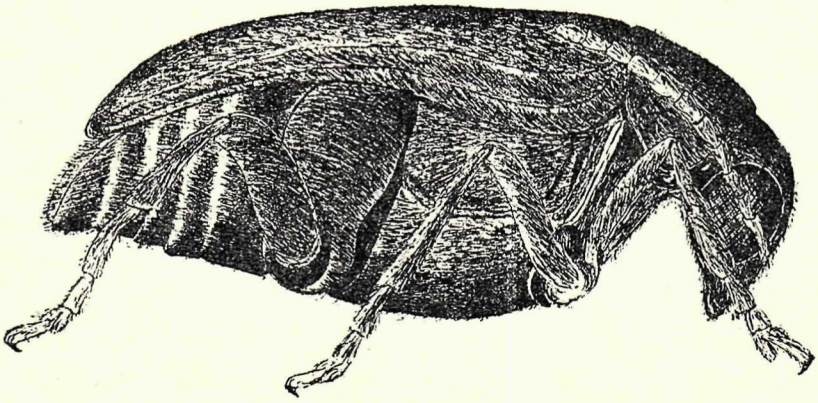
Adult: The adult is shining, robust, dark purplish red in color, tending to become dark bronze green especially in the more heavily chitinized

---

PLATE VII

Amblycerus martorelli Bridwell
(dorsal view)
Amblycerus martorelli Bridwell
(side view)





(Luis F. Martorell: A Survey of the Forest Insects of Puerto Rico)

portions of the male. The basal half of the median and posterior femora light yellowish brown, apical half in female and tarsi of both sexes light reddish brown. (Complete description of the species in (IP, 123–4)).

Habits: The first pair of legs of the insects in this genus (*Attelabus* Subfamily Attelabinae) are specialized for rolling the leaves. During plain daylight and in midst of the warmest hours of the day one can see the female of the species rolling the leaves of the sea-grape tree. First she cuts a strip of about 3 inches long and one-half inch in width along the edge of a leaf. With the help of the heat of the sun (which wilts the leaf) and its first pair of legs the strip is folded lengthwise just by the middle, then it is rolled and at the same time the outer edges are folded towards the inside of the roll. When the strip is about one-third rolled, the female lays an egg in the middle of the roll and keeps on rolling, at the end of which a compact, small and cylindric roll is obtained. During this operation the male acts as a spectator. Later on, the egg hatches and the young larva feeds on the leaf tissues of the inside of the roll, later changing to pupa and then completing its transformation to adult. Sometimes several of these rolls are observed in a single leaf. (Wolcott 1922, p. 6.)

Host: The beetle has been recorded from the foliage of the following trees:

Coccolobis grandifolia Jacq.	"moralón"
Coccolobis laurifolia Jacq.	"uvilla"
Coccolobis uvifera (L.) Jacq.	"uva de playa"

Attelabus sexmaculatus Chevrolat

(The Guava Leaf-roller)

Another interesting member of the subfamily Attelabinae, very abundant in Puerto Rico at lower and middle elevations. The insect was described originally by Mr. August Chevrolat as follows:

"Assez semblable a l' *A. carneus* Er., d'un brun de poix luisant, les quatre pattes posterieures, les tarses anterieurs, et sur chaque élytre, trois taches arrondies, jaunes; cuisses antérieures renflées; jambes antérieures dentelées sur la tranche interne. Prothorax rebordé en avant et en arriere, transversalment silloné au milieu. Long. 5 mill. larg. 3 mill." (Chevrolat 1876, p. 228.)

The main difference between this species and the preceding is the presence of six golden dots on the elytra, that is, three on each elytron. Also exists what can be called host specificity in the two species. *A. coccolobae* Wolcott will invariably be found on trees of the genus *Coccolobis*. If the species is in any other tree the best indication is that it is not *coccolobae* but *sexmaculatus*. In general appearance and color both species are nearly the same.

Habits: The insect has the same habits of rolling the leaves and laying the egg in the roll as the preceding.

Natural Enemies: The maternal cares and precautions of the female in laying her egg well inside the roll are not enough apparently, because a small parasitic wasp, the trichogrammid *Poropoea attelaborum* Girault always finds its way to parasitize the egg.

Host: The insect has been found rolling the leaves of several trees. The last record on "almendra" is not very clear, supposedly the adult was collected while resting on a leaf, not necessarily rolling the leaf.

This insect has been recorded from the following trees:

Eucalyptus citriodora Hook.	"eucalipto"
Eucalyptus robusta Smith	"eucalipto"
Psidium guajava L.	"guayaba"
Terminalia catappa L.	"almendra"

Apion martinezi Marshall

(The Aceitillo Seed Weevil)

This weevil is abundant on the southern and western sections of the Island, where its host tree is found. The economic importance of this species is tremendous, on account of the total destruction of the "aceitillo" seeds. This being one of our most valuable trees, it has been tried to be propagated by seeds, but the attacks of the weevils are so intense, that no sound seed can be collected for propagating purposes. The insect was described as *Apion xanthoxyli* by Sir Guy A. K. Marshall. (Not to be confused with *Apion xanthoxyli* Fall from Texas.) The original description of the species is as follows:

Adults: "Male, female. Derm red-brown, the head and rostrum with sparse yellowish scaling above; prothorax with fairly dense yellowish-brown scaling (sometimes varying to greyish) dorsally, which does not entirely conceal the integument, the lower surface with much denser whitish scaling; elytra with yellowish-brown scaling more or less interspersed with grey or whitish scales, and with a large common oval transverse patch of dark brown and fulvous scales in the middle of the disk, which is surrounded by an indefinite border of whitish scales; underside with rather dense yellowish or whitish scaling, but bare in the middle of ventrites 3 and 4.

Head shallowly impressed transversely behind the eyes; the forehead a little narrower than the base of the rostrum, finely rugulose; the eyes strongly convex and coarsely faceted. Rostrum as long as the pronotum, slightly curved, constricted at the base, moderately stout, angulated above the antennae, parallel-sided in the apical half, shallowly rugulose in male.

more finely punctate but otherwise similar in female. Antennae ferruginous; joint 1 of the funicle subglobular and its apical half with dense white scaling, the remaining joints with stiff white erect setae, 2 and 3 longer than broad, 4–7 transverse, 7 the widest; the club broadly ovate, with long fine erect setae. Prothorax as long as broad, subconical, widest at the base, which is deeply bisinuate, strongly narrowed to the apex, with the sides almost straight, but with a shallow subapical constriction; the dorsum highest at the base and sloping steeply forwards, forming a continuous line with the steep anterior declivity of the elytra, with shallow fine punctation, which is partly concealed by the setiform scales. Scutellum small, almost an equilateral triangle, bare. Elytra short and broad, with the shoulders very prominent; the dorsal outline extremely convex, highest at about one-third from the base and sloping almost steeply in front as behind; the striae deep but narrow, with rather shallow catenulate punctures which are mostly hidden by the scaling; the intervals flat, much broader than the striae, with fine shallow confluent punctation; the scales elongate, those on the disk narrower than the lateral ones. Legs stout, ferruginous, with fairly dense pale scaling; the claws stout, divaricate, black. Length 2 mm., breadth 1.1 mm. (Marshall 1934, p. 629–30.)

Habits: The habits of this species are unknown yet. The seeds collected in the field show an enormous percentage of infestation by the weevil larvae. Sometimes 40% of the seeds are infested, but the writer has been able to see nearly total infestation by this weevil, in seeds collected at the Guánica Insular Forest. The insect thrives as well in the lowlands or at middle altitudes and higher elevations up to 3,000 ft.

Natural Enemies: The parasitic wasp *Emersonopsis* sp. is the only insect so far recorded as enemy of this weevil. From a small amount of seeds a good series of these parasites were reared, but the percentage of parasitism has not been determined so far.

Host: The weevil larva is responsible for the destruction of "aceitillo" *Zanthoxylum flavum* Vahl seeds.

Exophthalmodes quindecimpunctatus (Olivier)

(The Corcho Prieto Weevil)

A very interesting weevil, recently found in Puerto Rico, but presumably present in the Island all the time. The insect was described by Mr. A. G. Olivier in 1807 and since then the species was not recorded again. The original description of the curculionid is in Latin and French; the following is a part of the French version:

"Les antennes sont d'un vert gris obscur. La trompe est courte, verte, avec une ligne élevée, noire. Le corcelet est d'un vert-doré, avec quatre

points noirs, placés sur une ligne transversale. L'ecusson est vert. Les élytres sont d'un vert doré, avec sept pointes noirs sur chaque, dont l'un a l'angle de la base, at un impair sur la suture, vers l'extremité: elles ont des stries de points, et sont terminées en pointe aigue. Le dessous du corps et les pattes sont vert-dorés. Les cuisses sont simples.

Il se trouve a Porto-Rico."

The weevil can be simply described as a 21-spotted iridescent green weevil. Presumably Olivier based his name on the approximate number of spots on the elytra, not taking in consideration the rest of the spots on the thoracic region.

This beetle can not be confused with any other in our insular fauna, because it is the only one of such color bearing spots on the elytra and thorax. Our common *Exophthalmodes roseipes* does not have the iridescence neither the spots on the body, this being the insect closest to it in general appearance. (See Plate VIII.)

Habits: The biology of the insect has not been studied yet. The adults feed on the foliage of its host tree and presumably the females lay their eggs on the foliage, following the same habit of our common "vaquita" *Diaprepes abbreviatus* (Linnaeus). This weevil has been only recorded from the southeastern corner of the Island.

Host: The weevils feed on the foliage of the "corcho prieto" tree, *Torrubia fragans* (Dum.-Cours.) Standley.

Exophthalmodes roseipes (Chevrolat)

(La Vaquita Verde)

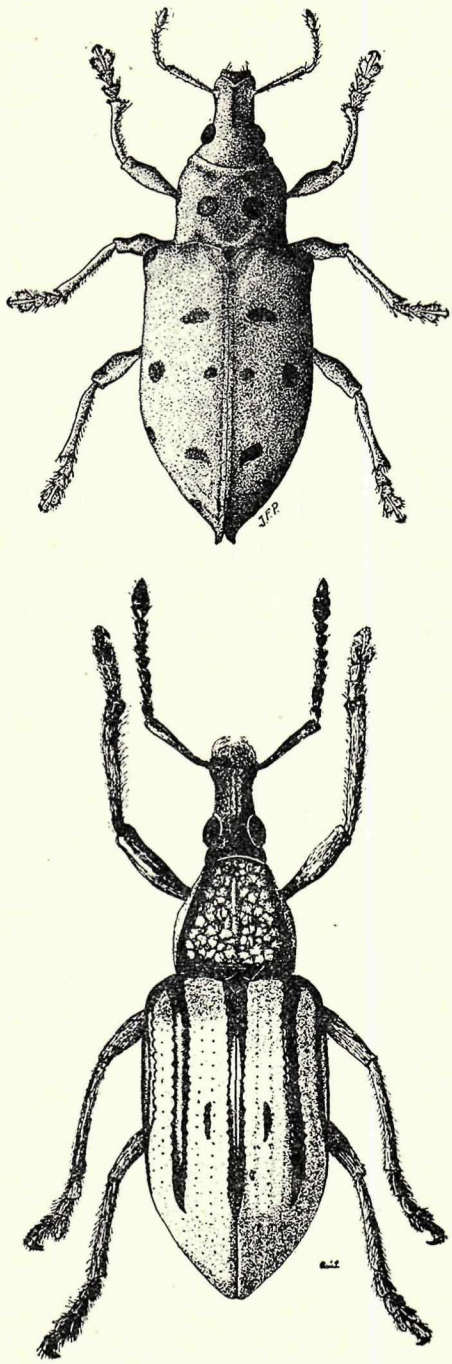
This abundant weevil commonly known as "la vaquita verde" or the green bug is considered as a pest of citrus in the northern coast of the Island, where it is most abundant. The insect also attacks many plants and trees, the adults feeding voraciously on the foliage. The weevil is only found on the north coast and there are no records of its presence in the interior or southern districts. The insect was originally described by Chevrolat, as follows:

"*Pachneus roseipes* sp. nov. D'un verte tendre, pattes et dessous du corps rosés. Trompe de la longeur de la tete et du prothorax, assez large, voutée en dessus, marquée d'une ligne noire. Yeux noirs, arrondis, saillants. Antennes longues, vertes, les trois derniers articles et la massue noirs. Prothorax couvert de petits points, poreux. Écusson arrondi, sillonné. Élytres offrant chacune quatorze stries punctuées, les quatre

---

PLATE VIII

Exophthalmodes quindecimpunctatus (Oliv.)
Diaprepes abbreviatus (Linnaeus)



(Luis F. Martorell: A Survey of the Forest Insects of Puerto Rico)

centrales réunies entre elles au de la du milieu. Long. 7.5 a 8.5 mill.; larg. 3 a 4 mill. (Chevrolat 1876 p. 227.)

The species was described originally under the generic name of *Pachneus*, later on, a generic transfer was made to the genus *Exophthalmodes*.

The adult has the same color of the tender leaves and is about one-fourth to three-eighths of an inch long. The legs and the ventral part of the body are of a rosy tinge.

Habits: The adult weevils are seen the whole year. The females lay their eggs between the leaves of host plants, usually in small groups of about six to twenty-four eggs. The larvae feed on the roots of plants, while the adults do the same on the foliage.

Natural Enemies: The giant toad, *Bufo marinus* (Linnaeus) is the principal enemy of the weevil.

Host: The adult weevil is polyphagous in its habits. It has been recorded from the following trees:

Andira jamaicensis (W. Wright) Urban	"moca"
Chrysobalanus icaco L.	"icaco"
Coccolobis uvifera (L.) Jacq.	"uva de playa"
Conocarpus erectus L.	"botoncillo"
Dalbergia ecastophyllum (L.) Taub.	"palo de pollo"
Elaeodendrum xylocarpum (Vent.) DC.	"coscorrón"
Hymenaea courbaril L.	"algarrobo"
Inga vera Willd.	"guaba"
Inga laurina (Sw.) Willd.	"guamá"
Terminalia catappa L.	"almendra"

Diaprepes abbreviatus (Linnaeus)

(The Sugar Cane Root-weevil)

This is undoubtedly the most common weevil in the Island, a species which has been thoroughly studied by different investigators. (See IB, pages 294–7 for ref.) This insect is also recorded from Hispaniola and the Lesser Antilles.

Adults: The adults are variable in their markings and even in the general coloration of the elytra. Wolcott describes the adult as follows:

"The beetles are really black, but they are so thickly covered with minute or bright-coloured scales that their general appearance is far from sombre. These round or oval scales on the ridges of the back are often rubbed off, greatly changing the appearance of the beetles in forming a pattern of denuded black bands on a white or light-coloured background. The colours of the scales are almost as varied as those of the rainbow, descriptions of the various varieties mentioning white, bright yellow, empire yellow, ochreous, tawny-ochreous, yellow-green, greenish, golden-

green, blue-green, dark Hessian brown, light buff, buff-yellow, grey, salmon and alizarine crimson. The weevils vary as much in size as in colour, some being twice as long as others, three-eighths and three-fourths of an inch being the maximum and minimum length." (Wolcott, EEWI, p. 136-7.) (See Plate VIII.)

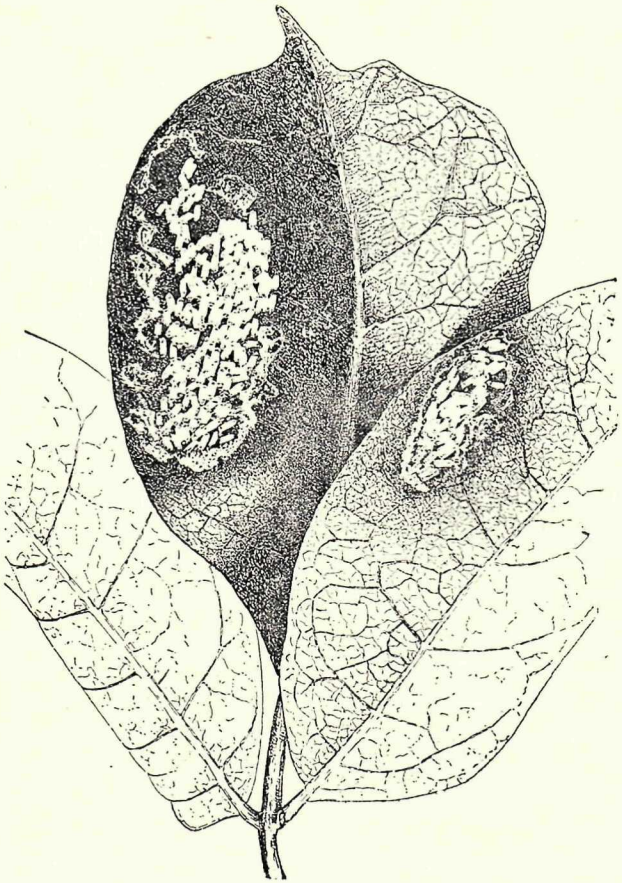


FIG. 14. Egg-clusters of *Diaprepes abbreviatus* (L.) between "jobo" leaves. Twice natural size. (Drawn by F. Sein.)

Egg: The eggs are very small, elongated in form and are laid in masses or clusters usually of more than 50 eggs. (See fig. 14.) The largest number of eggs counted in a mass have been 264. The eggs as described by Jones (1915), are as follows:

"The eggs are oblong-oval, smooth, glistening, with a rather tough

membranous covering, about 1.2 mm. in length and .4 mm. in diameter. Newly laid eggs are of a uniform milky white, but within a day or two after being laid, clear spaces appear at either end of the egg, this space being more pronounced at one end. Before hatching, the clear spaces disappear and the egg takes on a faint brownish tinge, the mouth-parts of the larva, contained within, being visible through the walls of the egg."

The egg hatches in about seven days, the young larva falls on the ground, digs in and feeds on the roots of plants. The life history of the larva has been very well studied by Wolcott (Oct. 1936) and from his work the following is cited:

"The females of *Diaprepes abbreviatus* (Linn.) lay 5,000 or more (or less) eggs in as few as two months, May and June, or in as many as seven months at other times of the year, often living over twice as long as do the males after emergence from the soil.

"The incubation period of all eggs is seven days. Larvae attain full size in two to four months. A diapause period is absolutely essential before pupation. The pupal period is about two weeks. Fully-formed adults remain within the pupal chamber for a variable period of weeks or months, the length of this period and that of the diapause period of the larva being subject to great variation.

"The great variation in the duration of the diapause period of the larva and before the emergence of the adult from the pupal cell in the ground permits some individuals to complete their life-cycle (hatching of eggs to first egg-cluster laid by the female, or emergence of male from soil) in less than eight months, but for other individuals it may extend for eighteen months (hatching of egg to last egg-cluster laid by female, or to death of male)." (Wolcott, Oct. 1936, p. 912.)

Natural Enemies: One of the favorite foods of birds is the adult beetle of this species. The following birds have been recorded as feeding on "vaquitas": Porto Rican petchary, *Tolmarchus taylori* (Sclater) 18.47 %, (the percentage indicates the amount of "vaquitas" eaten as compared with the total bulk of the stomach contents) Gray kingbird, *Tyrannus dominicensis dominicensis* (Gmelin) 17.19%, flycatcher, *Myiarchus antillarum* (Bryant) 11.22%, "mozambique" or Porto Rican grackle, *Holoquiscalus niger brachypterus* (Cassin) 9.69%, ani or "judío," *Crotophaga ani* (Linnaeus) 7.09%, owl or "múcaro", *Gymnasio nudipes* (Daudin) 1.8%, yellow shouldered blackbird or "mariquita", *Agelaius xanthomus* (Sclater) 1.72%, (Wetmore 1916.) Danforth also names the owl, mangrove cuckoo, Porto Rican oriole and ani as predators of these weevils.

The common lizard, *Anolis cristatellus* Duméril & Bibron feeds on the adults in the field. So the giant toad, *Bufo marinus* Linn., which can consume a large amount of insect food.

Among the insect enemies of the "vaquita" the following could be mentioned: The larva of the neuropteroid *Chrysopa collaris* Schneider feeds on the eggs. The most important parasite is the tetrastichid wasp, *Tetrastichus haitiensis* Gahan a parasite of the egg (See fig. 15.) Not all the eggs of the weevil are parasitized as expected, due to the deviation from a one year life-cycle in which it enables its eggs to escape the attacks of the parasitic wasp, which is most abundant during the late Spring, but is very scarce during the Autumn and Winter. Two other parasites have been obtained from the eggs, but these presumably are secondary

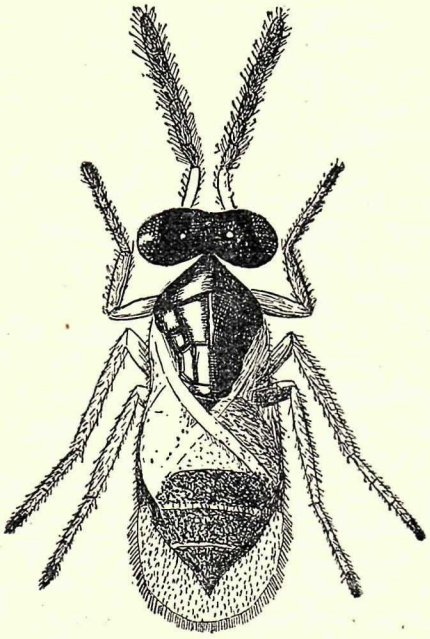


FIG. 15. *Testrastichus haitiensis* Gahan. Sixty times natural size. (Drawn by G. N. Wolcott.)

parasites, attacking the larva of *Tetrastichus* rather than the weevil eggs. The more common one is an exceptionally large trichogrammid of a bright yellow color, *Ufens osborni* Dozier. The second is an entedontid black wasp, *Horismenus graciliventris* (Girault) (EEWI, p. 141).

Host: The weevils are polyphagous in their habits feeding on a long list of trees. The following have been recorded:

Acnistus arborescens (L.) Schlecht	"galán arbóreo"
Agati grandiflora (L.) Desv.	"gallito"
Albizia lebbeck (L.) Benth.	"amor platónico"

Amomis caryophyllata (Jacq.) Krug & Urban	"malagueta"
Andira jamaicensis (W. Wright) Urban	"moca"
Byrsonima spicata (Cav.) DC.	"maricao"
Cedrela mexicana Roem.	"cedro"
Cedrela odorata L.	"cedro español"
Ceiba pentandra (L.) Gaertn.	"ceiba"
Chrysobalanus icaco L.	"icaco"
Chrysophyllum cainito L.	"caimito"
Coccolobis uvifera (L.) Jacq.	"uva de playa"
Conocarpus erectus L.	"botoncillo"
Cordia alliodora (R. & P.) Cham.	"capá prieto"
Delonix regia (Bojer) Raf.	"flamboyán"
Erythrina berteroana Urban	"machete"
Erythrina poeppigiana (Walp.) O. F. Cook	"bucare"
Faramea occidentalis (L.) A. Rich	"cafeillo"
Ficus laevigata Vahl	"jagüey"
Ficus stahlii Warb.	"jagüey"
Gliricidia sepium (Jacq.) Steud.	"madre de cacao"
Guaiacum officinale L.	"guayacán"
Guarea trichilioides L.	"guaraguao"
Haematoxylon campechianum L.	"campeche"
Ilex syderoxyloides (Sw.) Griseb.	"gongolí"
Inga vera Willd.	"guaba"
Inga laurina (Sw.) Willd.	"guamá"
Lagerstroemia speciosa (L.) Pers.	"reina de las flores"
Leptoglottis portoricensis (Urban) Britton & Rose	"zarzilla"
Lonchocarpus domingensis (Pers.) DC.	"genogeno"
Longhocarpus latifolius (Willd.) H. B. K.	"hediondo"
Melicocca bijuga L.	"quenepa"
Montezuma speciosissima Sessé & Moc.	"maga"
Ocotea portoricensis Mez.	"laurel"
Persea gratissima Gaertn.	"aguacate"
Psidium guajava L.	"guayaba"
Spondias mombin L.	"jobo"
Swietenia macrophylla King	"caoba de Honduras"
Swietenia mahagoni Jacq.	"caoba"
Tamarindus indicus L.	"tamarindo"
Terminalia catappa L.	"almendra"
Torrubia fragans (Dum.-Cours.) Standley	"corcho prieto"
Triplaris caracasana Cham.	"triplaria"
Zanthoxylum caribaeum Lam.	"espino rubial"

Lachnopus coffeae Marshall

(The Coffee Weevil)

This weevil is considered as a minor pest of coffee. It is abundant during the months of April and May, when the adults feed on the foliage, blossom buds and berries.

From the original description the main characteristics are herewith cited:

"Male and female: Integument piceous, with the legs, antennae and apex of the rostrum reddish brown; clothed above and below with small, convex, shiny, suborbicular or very shortly ovate, white scales, which are mostly not contiguous, but more closely set here and there, leaving much of the integument exposed; the median area of the prothorax with very

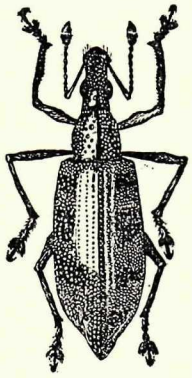


FIG. 16. *Lachnopus coffeae* Marshall. Six times natural size. (Drawn: G. N. Wolcott.)

few scales, and on each side of it a more condensed but indefinite stripe, and a similar one just above the coxae, which continues across the mesosternum and broadens out on the metasternum; the elytra usually with three very irregular transverse subdenuded patches, sub-basal, median and postmedian, and sometimes a small one on the declivity." (Marshall 1922 p. 60.) Length 5.5 to 6.25 mm. Breadth 1.8 to 2 mm. (See fig. 16.)

Habits: Like the other weevils, this species lays its eggs between the leaves, in masses or clusters of fifty or more. The eggs are somewhat elongated with rounded ends, white or creamy in color, about one-thirtieth of an inch in length. The young larva emerges in twelve to fourteen days, drops to the soil, burrows in and feeds on the roots of plants. The life cycle takes about one year in this species. The adult weevils feed on the foliage of plants and trees, having a particular preference for coffee.

Natural Enemies: The eggs of the weevil are parasitized by the tetra-

stichid wasp, *Tetrastichus vaquitarum* Wolcott. This minute parasitic insect has a shining blue-black thorax, reddish eyes and yellowish head, antennae, abdomen and legs. Unfortunately it is not abundant in the fields. (Wolcott 1922, p. 18.)

Host: The weevils recorded from the foliage of "higüerillo", *Vitex divaricata* Sw.

Lachnopus curvipes (Fabricius)

This weevil is similar in general appearance to the coffee weevil, but it has never been found feeding on coffee leaves and also is much larger in size, being about 9 mm. long. The species feeds on the foliage of different host trees, but never occurs in sufficient numbers to be considered a pest of economic importance.

Natural Enemies: There are many birds which feed on the adult beetles. Among them (Wetmore 1916) the following have been listed: Cuckoo, Ani, Owl, Kingbird, Porto Rican Petchary, Flycatcher, Mockingbird, Vireo, Parula Warbler, Honey Creeper, Yellow-shouldered blackbird, Oriole, Mozambique, Tanager, Spindalis, Grossbeak and Grasshopper Sparrow.

The common lizards *Anolis pulchellus* Duméril & Bibron and *Anolis cristatellus* Duméril & Bibron also feed on the adults.

The giant toad, *Bufo marinus* (Linnaeus) also helps in the control of the insect.

Host: The beetle feeds on the foliage of the following trees:

Coccolobis uwifera (L.) Jacq.	"uva de playa"
Conocarpus erectus L.	"botoncillo"
Dalbergia ecastophyllum (L.) Taub.	"palo de pollo"
Guaiacum officinale L.	"guayacán"
Guaiacum sanctum L.	"guayacán de vera"
Inga vera Willd.	"guaba"
Isandrina emarginata (L.) Britton & Rose	"vela muerto"
Pisonia albida (Heimmerl.) Britton	"corcho"
Varronia angustifolia West.	"basora"

Lachnopus seinei Wolcott

This insect is apparently not abundant in Puerto Rico. The only specimens collected came from the mountains north of Yauco and from Aibonito. The description of the species is as follows:

"Integument piceous to black, legs and antennae purplish-pink; entirely and evenly clothed with very small convex, shiny, subcircular scales with no constant areas of denudation. Length 6–8 mm." (IP, p. 302.)

Host: Collected on tender leaves of "mantequero", *Rapanea ferruginea* R. & P.) Mez.

Lachnopus yaucona Wolcott

Another species showing the same habits as the preceding, described as follows:

"Integument light brown to piceous, legs and antennae light yellow to reddish-brown; body and legs, except tarsi, evenly and densely clothed in light yellow, subcircular scales; punctures of elytra devoid of scales. Length 8 mm." (IB, p. 302.)

Host: On tender leaves of "mantequero", *Rapanea ferruginea* (R. & P.) Mez.

Apodrosus argentatus Wolcott

Another common weevil, particularly abundant in the lowlands and highly polyphagous in its habits. Also found in Mona Island. The chief characteristics of the species are the following:

"Integument piceous to black, legs dark reddish brown; except eyes, antennae, tarsi and puncture and striae of elytra, evenly and closely covered with small, subcircular, silvery scales, interspersed scantily on head, more thickly on prothorax with black scales.—Antennae yellowish brown, club darker.—Length 4 to 4.5 mm.; breadth 1.8 to 2 mm." (IP, p. 130.)

Host: The weevils feed on the foliage of the following trees:

Colubrina arborescens (Mill.) Sarg.	"abeyuelo"
Dalbergia ecastophyllum (L.) Taub.	"palo de pollo"
Guaiacum officinale L.	"guayacán"
Guaiacum sanctum L.	"guayacán de vera"
Peiranisia polyphylla (Jacq.) Britton & Rose	"retama"
Tamarindus indicus L.	"tamarindo"

Apodrosus wolcotti Marshall

A species related to the preceding but less abundant, found in the lowlands as well as at middle elevations. The main characteristics of this species are:

"Male and female: Integument black or dark piceous, fairly closely covered above with small, nearly circular, pinkish buff scales having a distinct coppery sheen; the elytra with sometimes and indefinite narrow band of dark brown scales behind the middle between striae 3 and 6; the lower surface with coppery grey scaling along the sides of the sternum and venter, the median area with sparse short curved pale squamiform setae.—Antennae testaceous brown, long and slender, the distal joints of the funicle much longer than broad.—Legs piceous, with rather sparse scales and spatulate setae; the femora unarmed.—Length 3.5 to 5 mm.; breadth 1.6 to 2.4 mm." (Marshall 1922, p. 59.)

Natural Enemies: The weevils have been eaten by the lizard, *Anolis krugii* Peters. (IB, p. 303.)

Host: Abundant, feeding on the foliage of "guaba", *Inga vera* Willd.

Peridinetus concentricus (Olivier)

(The Higuillo Weevil)

A very interesting and conspicuous weevil with white and black markings, found in the lowlands and mountains of the Island. The species is also reported from Sto. Domingo, from which it was originally described by Olivier, as follows:

"Il est ovale. Les antennes sont noires. La trompe est noire, courbée, cylindrique, marquée vers sa base d'une ligne peu élevée. Le corcelet est d'une couleur cendrée ferrugineuse, avec une grande tache trés-noire. Les élytres sont striées, noires, avec une tache ferrugineuse a la base extérieure, une autre irréguliere a l'extremité, quelques points irréguliers et une grande tache presque annulaire, commune, vers le milieu. Les pattes sont noires, avec un anneau ferrugineux sur les cuisses. Toutes les cuisses sont dentées. Il se trouve a Saint-Domingue." (Olivier 1807, p. 207.)

In Olivier's original description the insect is described as ferrugineous and black, presumably he based his description on old specimens, which undoubtedly were somewhat discolored. Fresh specimens observed in the field show distinctly black and white markings. The insect is very easy to recognize because it is our only fairly large weevil with black and white markings. (See illustration in IB, p. 306.)

Habits: The adults feed on the foliage of plants, doing small circular holes in the leaves while feeding. The larva has been recorded as boring in the stems of the host plants.

Host: The following trees are attacked by the weevil:

Piper aduncum L. "higuillo"
Piper amalago L. "higuillo de limón"

Lechriops psidii Marshall

A common weevil found at lower and middle elevations in Puerto Rico, considered as a pest of guava fruits. The following are notes about its original description.

"Male and female: Integument red-brown; the head with a dense edging of pale buff scales between and behind the eyes; the prothorax clothed with rather sparse narrow brownish-yellow scales, mostly transverse in position and leaving much of the integument exposed, . . . the elytra fairly densely covered with mingled pale buff and whitish scales, and with an ill-defined, curved dark transverse band about the middle between

striae 1 and 8, which is deepest on interval three and rapidly narrows outwards to a point on interval eight; . . . the mesosternum, metasternum and abdomen uniformly covered with large subcontiguous white scales.

Antennae with joint 2 of the funicle longer than 1, as long as 3–5 together.—Legs testaceous, the femora with dense white scaling, the tibiae with thinner hair-like scales.—Length 2 mm.; breadth 0.9 mm." (Marshall 1922, p. 69–70, with illustration on Plate I, fig. 4.)

Habits: The maggots or larvae of this weevil infest the fruits of guava trees, destroying a large percentage of them. Most of the attacked fruits turn black when about half grown, later becoming hard and mummified as the maggots of the beetle develop within them. (EEWI, p. 519.)

Host: The weevil which is apparently limited in distribution to the island of Puerto Rico, has been only recorded attacking "guayaba", *Psidium guajava* L. fruits.

Sitophilus linearis (Herbst)

(The Tamarind Weevil)

An interesting species of weevil described from the West Indies by Herbst in 1797, probably a native of India, introduced in tamarind seeds into the West Indies. The insect is also found in the Atlantic States. The species is similar to *S. oryza* ((Linnaeus) but is distinguished from it by its more convex thorax with fine even punctures, distinctly separated. *S. linearis* is also a larger insect; it can be described as follows:

"Elongate-oblong. Color variable, usually piceous or brown, the head black. Beak usually black, its tip red, twice as long as head, straight, cylindrical, finely striate-punctate. Thorax nearly twice as long as wide, convex, strongly narrowed in front and constricted behind the apex; . . . Elytra subdepressed, scarcely longer and not wider at base than thorax, striae closely punctate; alternate intervals slightly wider. Under surface finely and closely punctate. Length 3.3 to 3.8 mm." (Blatchley & Leng 1916, p. 574–5.)

Host: The larvae of the weevil feed in the tamarind seeds, *Tamarindus indicus* L.

Sitophilus oryza (Linnaeus)

(The Rice Weevil)

This cosmopolitan insect pest of stored grains is very abundant in the Island. The insect has more or less the same appearance of *S. linearis* (Herbst), but the punctures of the thorax are rather coarse, deep, very dense, especially toward the sides, rounded, not elongate and the surface

rather depressed on the disc. It is a small species of about 2.1 to 2.8 mm. in length. (Description in Blatchley & Leng 1916, p. 575.)

Natural Enemies: The weevil is eaten by birds. Wetmore 1916, lists the Latimer's vireo as feeding on the weevil. It is also parasitized by pteromalid wasps, *Aplastomorpha calandrae* (Howard).

Host: The weevil has been collected on the foliage of casuarinas, *Casuarina equisetifolia* Forst., and also reared from "mamey" seed, *Mammea americana* L.

FAMILY PLATYPODIDÆ

The Family Platypodidae and its related Family the Scolytidae is discussed by certain authors as different families under one single group known as the Superfamily Scolytoidea. Others include the Platypodidae as a subfamily under the Family Scolytidae and divide it as follows: (1) Platypodinae (2) Scolytinae and (3) Ipinae.

For the purpose of this discussion the two families will be treated separately.

The members of the Family Platypodidae are very few in number in our insular fauna, as compared with the large number of species in other parts of the American continent.

The biology of our forms has not yet been studied. Investigators in all parts of the world, especially those of the temperate regions of the globe have done extensive investigations in these two groups of insects. Chamberlin (1939) recently published a complete study on the North American species, containing valuable information on the biology and taxonomy of the Scolytoidea.

The two families can be separated by means of the following key:

Tarsi with the first segment as long as the others united; head prominent and as broad as the thorax.....PLATYPODIDÆ

Tarsi with first segment much shorter than the others united; head invisible from above or much narrower than the thorax..SCOLYTIDÆ.

The following species in the Family Platypodidæ are the ones affecting our trees:

Platypus excisus Chapuis

A species recorded from "guaba", *Inga vera* Willd., at middle elevations.

Platypus ratzenburgi Chapuis

A fairly common species in Puerto Rico, also found in Mexico, Central America and Texas. The insect has been collected at lights at the Guánica

Insular Forest, at lower elevations and also in flowers at Aibonito, at middle altitudes. The following is the description of the species:

"Male front entirely opaque, finely rugose; prothorax feebly punctulate. Elytra finely, not deeply striate, transversely impressed at tip, without subapical processes. Ventral segments shining, sparsely and finely punctured.

Female front areolate, prothorax unequally punctulate and punctured, less finely at the sides. Elytra deeply striate-punctulate, interspaces more convex behind; second elevation forming a small cusp at the posterior declivity. Posterior processes with three teeth of nearly equal length, the outer one broad and not very distinctly separated from the upper one, the inferior one a little shorter and acute. Prothorax but little longer than wide. There is no transverse impression at the anterior apex of the impressed dorsal line." (Chamberlin, p. 110.)

Host: Recorded from the following trees:

Andira jamaicensis (W. Wright) Urban	"moca"
Dacryodes excelsa Vahl	"tabonuco"

Platypus compositus (Say)

This is a very common species of beetle in continental United States with a wide variety of host trees. In Puerto Rico, it has only been recorded once at middle elevations, boring in the trunk of a tree. The species is described as follows:

"Antennae, terminal segment dilated, compressed, oval, nearly as large as the eye; elytral striae with subquadrate punctures, approximate, slightly indented; tip of each elytron with two small longitudinal teeth and an elongated process which is tridentate, intermediate teeth emarginate. Male apical part of front smooth, prothorax scarcely punctulate; elytra transversely impressed near the tip, without posterior process. Ventral segments shining, sparsely punctulate. Female prothorax distinctly punctulate; elytra with the second interspace compressed and forming an acute cusp near the tip. Fifth and ninth interspace prolonged into a large process, which is concave above and tridentate at the tip. The outer tooth much longer, narrow and truncate or emarginate at tip according to age of specimen. Fifth ventral segment flat, not carinate nor tuberculate." (Chamberlin, p. 110–11.)

Host: From "tabonuco", *Dacryodes excelsa* Vahl, logs.

Family Scolytidae

Stephanoderes brazilensis Hopkins

A species recorded from "almendra" fruits, *Terminalia catappa* L., from dry guava fruits, *Psidium guajava* L., and from branches of "flamboyán", *Delonix regia* (Bojer) Raf.

Stephanoderes brunneus Hopkins

This species was originally described from Texas as follows:

"Length female type, 1.35 mm., body stout, dark brown, shining; pronotum with rugose space red, anterior margin with two widely-separated teeth." (Chamberlin, p. 309.)

Host: Recorded from mangrove seed balls, *Rhizophora mangle* L.

Stephanoderes buscki Hopkins

This species has been recorded from the pods or fruits of the following trees:

Hymenaea courbaril L.	"algarrobo"
Psidium guajava L.	"guayaba"
Tamarindus indicus L.	"tamarindo"

Stephanoderes georgiae Hopkins

A species which is not abundant in the Island, also recorded from Georgia, U. S. A., from which the original specimens were described as follows:

"Length female type, 1.5 mm.; uniform dark reddish brown; pronotal margin with six marginal teeth; front convex, with median line and minute posterior elevations; elytral striae distinctly impressed, punctures coarse." (Chamberlin, p. 303.)

Host: From guava fruits, *Psidium guajava* L.

Stephanoderes trinitatis Hopkins

A species reared from branches of "guaraguao", *Guarea trichilioides* L.

Hypothenemus parvus Hopkins

Reared from the pods of "maga", *Montezuma speciosissima* Sessé & Moc.

Hypothenemus eruditus Westwood

This species has been collected at Doña Juana Camp, altitude 1,900 ft. The insect is described as follows:

"Body elongate. Elytra black, pronotum dark to light but uniform reddish. Antennal club compressed throughout. Pronotum with apical margin broadly rounded and armed with several small marginal teeth. Elytral striae and strial punctures distinct, intervals with scales. Length of female scarcely 1 mm." (Blatchley & Leng 1916, p. 595.)

Host: From a dead pole that appeared to be "maricao", *Byrsonima spicata* (Cav.) Rich.

Ambrosiodmus lecontei Hopkins

A species recently recorded from the Island, also found in Florida.

Description: "Length, female type, 2.85 mm.; body elliptical, dark-reddish brown; pronotum lighter, broader than long, posterior dorsal area subopaque, lateral area shining, becoming smoother and punctured toward posterior angle; front subopaque, rugosely punctured and with median shining line; elytral striae with coarse and rather deep punctures, interspaces narrow and irregularly punctured, declivity convex, faintly impressed to middle, interspace 2 armed with two acute denticles, 3 to 6 granulate, apex obtusely rounded, posterior and lateral margins faintly elevated, smooth." (Chamberlin, p. 440.)

Host: The insect was reared from the wood of the following trees:

Cedrela mexicana Roem.	"cedro"
Dacryodes excelsa Vahl	"tabonuco"

Xyleborus affinis Eichhoff

A very common species in the Island, perhaps our most common member of the entire family. It is also found along the Atlantic States, Gulf States and Mexico.

Description: "The female is light reddish-brown, about 2.5 mm. long; the pronotum longer than wide, with the posterior area smooth, shining, sparsely and finely punctured; elytral striae weakly punctured in faintly regular rows, declivity oblique subopaque, first and third interspaces armed, second unarmed, flat or faintly impressed.

The male is smaller, 2.25 mm. long, lighter in color, with the anterior area of pronotum excavated and the apex produced; strial punctures somewhat confused." (Chamberlin, p. 452.)

Host: The beetle has been reared from the trunk of trees, which were nearly dying or in a very weak condition:

Albizia lebeck (L.) Benth.	"acacia amarilla"
Cocos nucifera L.	"coco"
Inga vera Willd.	"guaba"
Inga laurina (Sw.) Willd.	"guamá"

Xyleborus confusus Eichhoff

Another common species of *Xyleborus* found in the Island, also recorded from Chile, Venezuela and the United States (Mississippi).

Description: "The females are reddish-brown in color; about 2.5 mm. long, 2.7 times as long as wide. The front of the head is broad, subopaque, reticulate, moderately punctured, with a distinct elevated median line extending from the epistomal margin to above the level of the eyes. The pronotum is subquadrate, very broadly rounded in front, shining behind,

minutely and sparsely punctured. The elytra are narrower than the pronotum, brightly shining, with the striae very shallowly punctured on the disc, the declivity of the same type as *fuscatus*." (Chamberlin, p. 454.)

Host: Collected from the following trees:

Andira jamaicensis (W. Wright) Urban	"moca"
Cocos nucifera L.	"coco"
Erythrina glauca Willd.	"bucare"

Xyleborus inermis Eichhoff

A rare species in Puerto Rico, also recorded from New Jersey to West Virginia and Tennessee.

Description: "Elongate, cylindrical. Ferruginous-testaceous, shining sparsely pubescent. Thorax oblong, disc subimpressed on each side, punctate behind. Elytra faintly uniseriately punctulate with broad interspaces; apex declivous, depressed, flat, almost smooth, opaque, feebly armed, faintly impressed at suture. Length 2.4 to 2.6 mm. (Eichhoff.) Male 1.8 mm. long, oblong-elliptical, light yellowish brown. Pronotum with sides parallel, anterior area broadly impressed, with anterior margin scarcely produced with obtuse subapical tubercules, rugosities fine, extending to median broad elevation, posterior and lateral area shining, faintly punctured. Front convex, subopaque, with anterior median shining space. Elytra with sides parallel to vertex, basal and lateral areas shining, feebly punctured, declivity oblique, opaque, subconvex, striae with faintly shining discs, interspaces 1, 3 and 4 with a few granules, pubescence moderately long; head moderately large." (Hopkins.) (Chamberlin, p. 451.)

Host: From "mango", *Mangifera indica* L.

Xyleborus sacchari Hopkins

A very common species in the Island, particularly found in the sugar cane fields where all stages can be collected from rotten or dry canes. It also attacks trees, and so far it has been recorded from "guaba", *Inga vera* Willd. and "guayaba", *Psidium guajava* L.

Xyleborus fuscatus Eichhoff

Another species recently recorded from the Island described as follows:

"The female is reddish-brown in color, 2.6 to 3.2 mm. long; 2.9 times as long as wide. The front of the head is reticulate, subopaque, coarsely punctured with a short shining median longitudinal elevation; the pronotum is 1.18 times as long as wide with the sides sub-parallel, broadly rounded in front, the posterior area shining, rather finely punctured.

The elytra are shining, the striae weakly impressed, coarsely and closely punctured; the interspaces sparsely punctured; declivity sloping, first interspace with one small tooth at apex, otherwise unarmed, second flat, unarmed, third with several granules at summit, and with one large tooth midway of the descent." (Chamberlin, p. 453.)

Host: Collected in logs of "almácigo" *Bursera simarouba* (L.) Sarg.

Xyleborus grenadensis Hopkins

A recently recorded species collected in logs of "almácigo", *Bursera simarouba* (L.) Sarg.

DIPTERA

Very few species in this Order are injurious to trees, with the exception of several members of certain families like the Tephritidae and Itonididae, formerly known as Trypetidae and Cecidomyidae respectively. Some families in this group include parasitic and predaceous forms, like those belonging to the families Larvaevoridae and Syrphidae, the former previously known as Tachinidae. The members of these two families play a very important role in the natural control of tree pests. As already stated in the Introduction of this work, the parasitic forms will not be included in this discussion.

FAMILY ITONIDIDÆ

Itonida cocolobae (Cook)

This insect produces galls in the foliage of trees belonging to the genus *Coccolobis*. It was originally described by M. T. Cook, as *Cecidomyia cocolobae* from specimens collected in Cuba. The original description is as follows:

"*Cecidomyia cocolobae* Cook, is a small gall about 2 to 5 mm. in diameter and projecting on both surfaces of the leaf of *Cocoloba uvifera* Linn. Described from galls on a single dried leaf." (Cook, p. 145.)

No studies have been made on the biology of this species and the fly itself never has been described.

Host: The following host trees have been recorded for this species:

Coccolobis uvifera (L.) Jacq.	"uva de playa"
Coccolobis pirifolia Desf.	

Ctenodactylomyia watsoni Felt

This species is another gall forming insect also affecting trees of the genus *Coccolobis*. The insect has been thoroughly discussed by Felt in a previous publication. Presumably the type of gall caused by this species

is different from the one already discussed above. The following is a description of the fly:

Female: "Length, 3 mm. Eyes confluent. Antennae nearly as long as the body, sparsely haired, light brown; 14 segments, the third and fourth fused, the fifth with a stem about one-fifth the length of the subcylindric basal enlargement, which latter has a length three and one-half times its diameter and sparse sub-basal and subapical whorls of moderately stout setae; circumfili near the basal third and apically; terminal segment produced, apically with a finger-like process about one-third the length of the cylindric basal enlargement, which later has a length three times its diameter. Palpi; first segment with a length over twice its diameter, the second as long as the first, somewhat stouter, the third more than twice the length of the second, slender; mouth parts slightly produced, with a length about one-fourth the diameter of the head. Mesonotum dark-reddish brown, the submedian lines and median area a slaty gray. Scutellum pale orange apically, grayish basaly; postscutellum dark brown. Abdomen dark brown, sparsely short haired. Wings very narrow, with a length fully three times the width; subcosta uniting with the costa at the basal third, the cross vein indistinct, the third vein joining the posterior margin well beyond the apex of the wing, the fifth vein forked, the rudimentary anterior branch uniting with the margin near the distal third, the well-developed posterior branch at the basal third. Halteres yellowish white, the club slightly fuscous. Coxae dark brown, reddish brown apically, the anterior femora and tibiae mostly dark brown, the former yellowish white basally, the latter narrowly annulate with white basally; tarsi a dark grayish brown, the distal three segments mostly yellowish gray, the posterior femora with the basal half yellowish white, and the entire tarsi mostly yellowish gray, otherwise as in the anterior tarsi; claws moderately long, stout, distinctly angulate basally, with three relatively large and two minor pectin; pulvilli rudimentary. Ovipositor short, the lobes roundly rectangular and thickly setose, minor lobe tapering to a narrowly rounded apex.

Male: Length, 3 mm. Antennae probably extending to the second abdominal segment, the fifth with a stem about one-fourth the length of the cylindric basal enlargement, which latter has a length thrice its diameter and rather thick subbasal and subapical whorls of stout, nearly straight setae; terminal segment with a finger-like appendage nearly one-half the length of the cylindric basal enlargement, which latter has a length thrice its diameter; claws slender, slightly curved and with about five well-developed and two minor pectin. The claws are more slender and the pectin more numerous than in the female. Genitalia; basal clasp segment long, stout; terminal clasp segment as long as the basal, rather

stout, somewhat irregular and with a well-developed though inconspicuous tooth apically; dorsal plate short, deeply and roundly emarginate, the lobes well separated and tapering to a narrowly rounded, thickly and coarsely setose apex; ventral plate long, broad, broadly and slightly emarginate, the lateral angles rather thickly and coarsely setose; style rather long, stout, narrowly rounded. Other characters as in the female.

Gall: Diameter, 3 mm. circular, blisterlike, dark green, with a slight, darker, median nipple. The gall shows equally upon both sides of the leaf.

Larva: Length 3 mm., yellowish, the segmentation distinct and tapering toward the posterior extremity. Head and breastbone indistinct in the one specimen before us.

Exuviae: Length 3 mm., whitish transparent. Antennal cases extending nearly to the base of the abdomen, wing pads to the third abdominal segment, and the leg cases about to the sixth abdominal segment; cephalic horns large, chitinous approximate, the lateral margins strongly serrate and tapering irregularly to the median line, the abdominal segments each with a transverse row of about 8 chitinous spines near the anterior third, the number being reduced to about 4 on the penultimate segment; terminal segment bilobed.

Pupa: Length 3 mm., moderately stout and variably yellowish or dark brown, dependent upon the development, the external structures as in the exuviae." (Felt 1915, p. 200–1.)

Host: Producing the galls on the foliage of "uva de playa" or sea-grape, *Coccolobis uvifera* (L.) Jacq.

FAMILY TEPHRITIDÆ

Anastrepha mombinpraeoptans Seín

This species of fruit fly and its related form *A. unipuncta* Seín are fully discussed by Mr. F. Seín Jr., in a work published in the Journal of the De-

---

PLATE IX

FIG. 1. *Anastrepha mombinpraeoptans* Seín, right wing greatly magnified.

FIG. 2. *A. unipuncta* Seín, right wing greatly magnified.

FIG. 3. *A. fraterculus* Wied. right wing of this Argentina species, to show differences with *A. mombinpraeoptans* Seín.

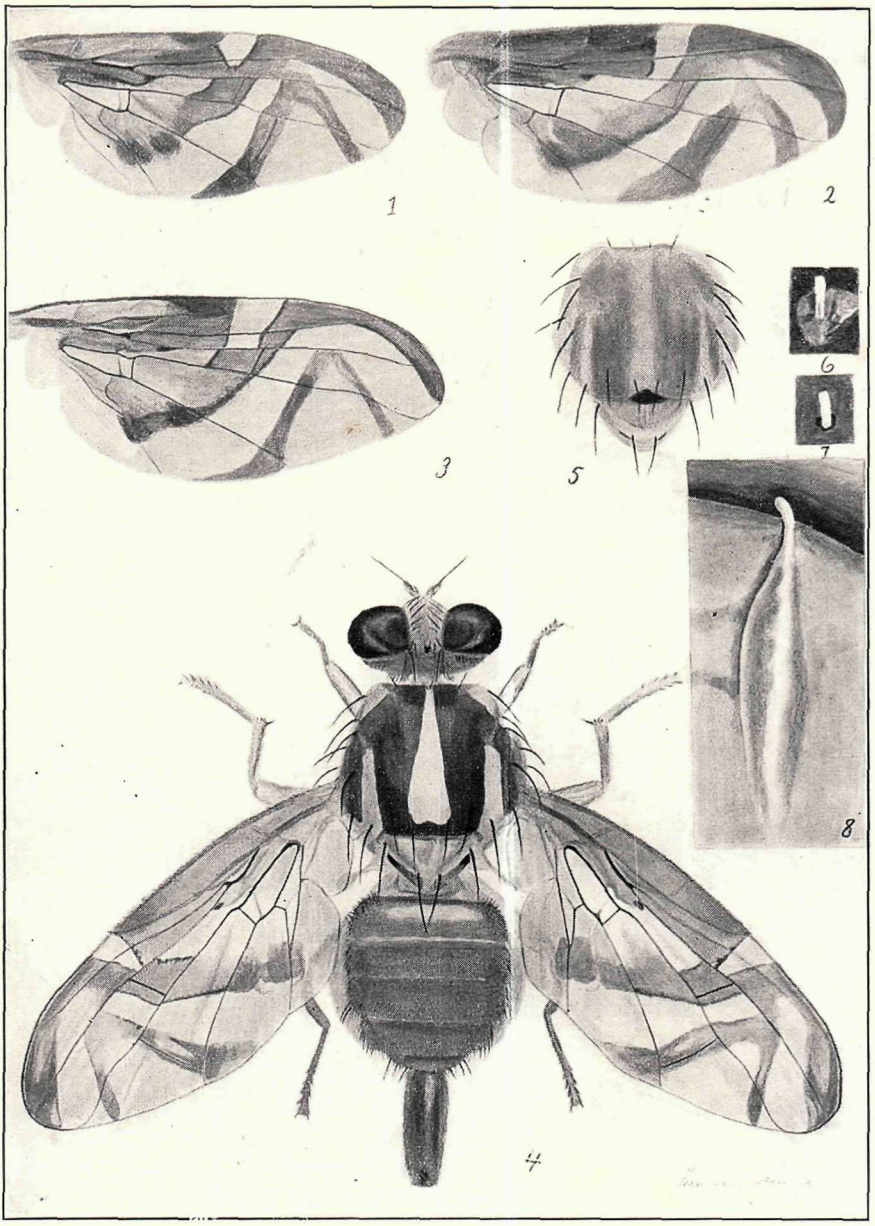
FIG. 4. *A. mombinpraeoptans* Seín, dorsal view of female adult, greatly magnified.

FIG. 5. *A. unipuncta* Seín, dorsal view of thorax.

FIG. 6. End of the egg of *A. mombinpraeoptans* Seín protruding out of the cuticle of a green fruit, greatly magnified.

FIG. 7. Same, the end of the egg protruding out of a ripe fruit.

FIG. 8. Shows insertion of the egg in a fruit of *Spondias mombin* L. greatly magnified. (Drawn by F. Seín Jr.)



(Luis F. Martorell: A Survey of the Forest Insects of Puerto Rico)

partment of Agriculture of Puerto Rico, volume 17, pages 183–196, 1933, in which the two species are described and illustrated by means of numerous plates.

While the two flies are almost impossible to be differentiated in their larval stages, yet the eggs and adults present enough differences to separate both species.

Habits: The fly lays the eggs in the fruit of the host tree. The egg is inserted in the fruit up to the shoulder, the head and neck protruding outside the cuticle. (See figs. 6 and 8 on Plate IX.) In this respect it differs from the egg of *A. unipuncta* Seín, in which the egg has no neck and is deposited entirely underneath the cuticle of the fruit. The larva on emerging bores inside the fruit and feeds on the tissue inside. After feeding for some time and when ready to pupate, the fully grown larva pierces the skin of the fruit, drops to the soil and pupates there. Few days later the adult fly emerges, and so the cycle is continued.

Natural Control: The fly is controlled in the field by a group of natural parasites, the most important of them being the braconid wasp, *Opius anastrephae* Viereck. Parasitism as high as 49.9% has been recorded with this species. The figitid wasps, *Canaspis hookeri* Crawford and *Eucoila atriceps* Kieffer have been also listed as parasites of this pest. Another braconid, *Microbracon* sp. has been reared from the larva.

Host: In Puerto Rico this species has been recorded from the fruits of the following trees:

Anacardium occidentale L.	"pajuil"
Eugenia jambos L.	"pomarrosa"
Eugenia malaccensis L.	"manzana malaya"
Mangifera indica L.	"mangó"
Psidium guajava L.	"guayaba"
Spondias cirouella Tussac	"ciruela"
Spondias dulcis Forst.	"cítara"
Spondias mombin L.	"jobo"
Spondias purpurea L.	"jobillo"

Anastrepha unipuncta Seín

The adult of this fly can be readily differentiated from *A. mombinpraeoptans* Seín by a dark spot on the suture between the metathorax and the scutellum. Also as stated before, the egg has no neck and is inserted entirely underneath the cuticle of the fruit. The larva has the hairs or rays in the posterior spiracles more numerous, closer together and somewhat less branched. No character has yet been found to distinguish the puparium. An occasional puparium may be formed inside the fruits in

which the larvae have developed, a habit which has not been observed in *A. mombinpraeoptans* Seín (Seín 1933, p. 190.)

Habits: More or less the same habits as the preceeding species.

Natural Enemies: The insect is parasitized by the figitid wasp, *Eucoila atriceps* Kieffer and also by the introduced parasitic spalangid, *Spalangia philippensis* Fullaway.

Host: The fruits of the following trees are attacked by this fly:

Annona reticulata L.	"corazón"
Chrysobalanus icaco L.	"icaco"
Chrysophyllum cainito L.	"caimito"
Eugenia jambos L.	"pomarrosa"
Psidium guajava L.	"guayaba"
Sapota achras Mill.	"zapodilla"
Spondias dulcis Forst.	"cítara"
Terminalia catappa L.	"almendra"

LEPIDOPTERA

Superfamily Papilionoidea

FAMILY PAPILIONIDÆ

Papilio pelaus (Fabricius)

(The Espino Rubial Swallowtail)

This large papilionid is fairly abundant in the island of Puerto Rico. It has been also recorded from Cuba, Jamaica and Hispaniola.

Butterfly: In general the upper surface of wings is of a black color, with a creamy white band running almost in a straight line from the inner angle of the fore wing to the middle of the costa, and with similarly colored marginal lunules on the hind wing, where there are also several brick-red submarginal spots, extending upward from the anal angle. The tail is well developed, black. The under surface is similar to the upper, except that the submarginal red spots of the hind wing form a complete row, each spot edged with white. Length of f.w., 48 mm. (Bates, p. 113.)

Caterpillar: The fully grown caterpillars are about 45 mm. long and 10 mm. broad at the thorax; head dull light yellow, very dark brown around the ocelli, numerous spots subtending hairs and the inverted Y creamy; general color of body purplish and greenish brown (olive-drab), intricately marked with darker brown anteriorly, especially partly surrounding two dull yellow areas just posterior to the orange-yellow osmateria, and posteriorly with numerous lighter markings like wisps of white smoke; large, very irregular creamy spots on the sides of 5th, 6th, and 7th,

(together) and 10th, and 11th, segments, with narrow whitish band, connecting them just above the legs; two latero-dorsal warts on each segment, usually lighter colored and with a small lavender spot, irregular but sharply outlined, mediad of each wart, similar lavender spots occurring along the sides and below the spiracles, additional smaller lateral warts on the thorax; true legs dull light yellow, tipped and laterally marked with brown. (IP, p. 147–8.)

Host: The caterpillar feeds on the foliage of "espino rubial", *Zanthoxylum martinicense* (Lam.) DC. Observed at altitudes ranging from sea-level to 1,000 ft.

FAMILY PIERIDÆ

Ascia monuste (Linnaeus)

This butterfly is very abundant in Puerto Rico. It is a typical lowland insect mostly seen around the coast and coastal hills, especially in the dry southern and south-western districts of the Island, but often observed at middle altitudes up to 2,000 ft. The insect has a wide geographical distribution over the American tropics and the West Indies. (Recorded by Möschler, p. 97 and in IB, p. 403 as: *Pieris monuste* Linnaeus.)

Butterfly: The butterfly is variable in color, thus it is very difficult to give an accurate color description of the insect. Usually it is whitish in both wing surfaces. On the upper surface the fore wings are bordered with black on the outer margin, projecting inward on the veins. The female is of a darker color and the borders of the wings still darker than in the male. (See illustration of butterfly on Plate X.)

Eggs: The eggs are spindle-shaped, with vertical, raised ridges, and of a bright yellow color.

Caterpillar: The fully grown caterpillar is 35 to 40 mm. long, body gray, covered with numerous black spots, dull; dorsally three bright yellow lines run parallel to the body from the head to the last anal segment; setae on the area between the yellow lines, black, all originating in small, but conspicuous tubercules. Laterally on both sides of the body a bright yellow line runs parallel to the dorsal lines. Ventral to this line all setae are white, abundant. Head gray, with numerous black and white setae, the black ones originating in small black tubercules; labrum and antennae white; epicranial region near the first body segment on the dorsal part, and part near mouth yellowish. Spiracles small, oval, shiny, black. Ventrally of a greenish gray, with green legs.

Habits: As soon as the caterpillar emerges from the egg starts feeding on the tender foliage. After two or three days of feeding in such a way,

it moves to older foliage, feeding upon it voraciously. In about 20 days they are fully grown and ready to pupate. Pupation period is about 7 days.

Host: The caterpillar feeds on the foliage of "burro", *Capparis coccolobifolia* Mart. and "burro blanco", *Capparis portoricensis* Urban.

Phoebis agarithe (Boisduval)

This butterfly has a wide range in distribution, from the southern United States, to Central South America and the West Indies. In Puerto Rico it is rather scarce, usually found at lower elevations.

Butterfly: The male is uniform bright orange above, somewhat lighter below, with various fine reddish brown markings. The female is sometimes quite similar to the male, often lighter colored with heavier markings. The sub-median spots of the fore wing on the under side form a straight line in both sexes. Length of f.w., 32–35 mm. (Bates, p. 135–6.)

Host: Mr. Cesáreo Pérez of Río Piedras, has reared the caterpillar from "guamá americano", *Pithecellobium dulce* (Roxb.) Benth.

Phoebis argante (Fabricius)

This butterfly occurs in Florida, Texas, Central and South America, (Surinam, Colombia, Brazil) Cuba and Hispaniola. Rather scarce in the Island, recorded only once, at Cayey (presumably around 1,000 ft. altitude).

Butterfly: The male is similar to the male of *P. agarithe* (Boisduval); it is most easily distinguished by the interrupted course of the postmedian spots, on the fore wing. In *agarithe*, the reddish bar on the under side of the fore wing, which extends from about vein Cu_2 to R_1 is entire, straight. In *argante*, this bar is interrupted in the middle, becoming a somewhat zig-zag series of spots. These characteristics apply only to the male of both species. The female is rather variable, often very heavily marked. Length of f.w., 32–35 mm. (Bates, p. 135.)

Host: The caterpillar feeds on the foliage of *Inga vera* Willd., our common "guaba".

Phoebis statira neleis (Boisduval)

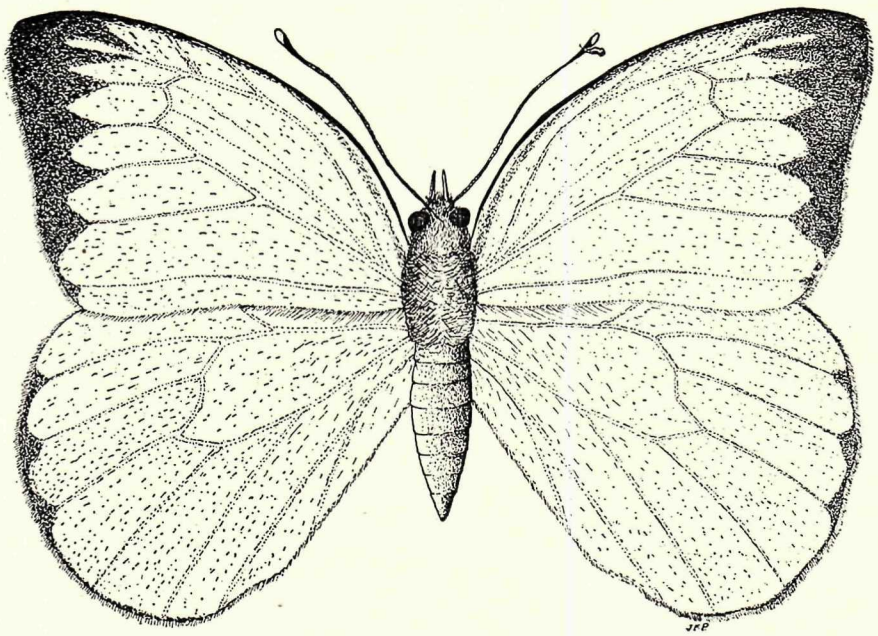
(The Quenepa Sulphur)

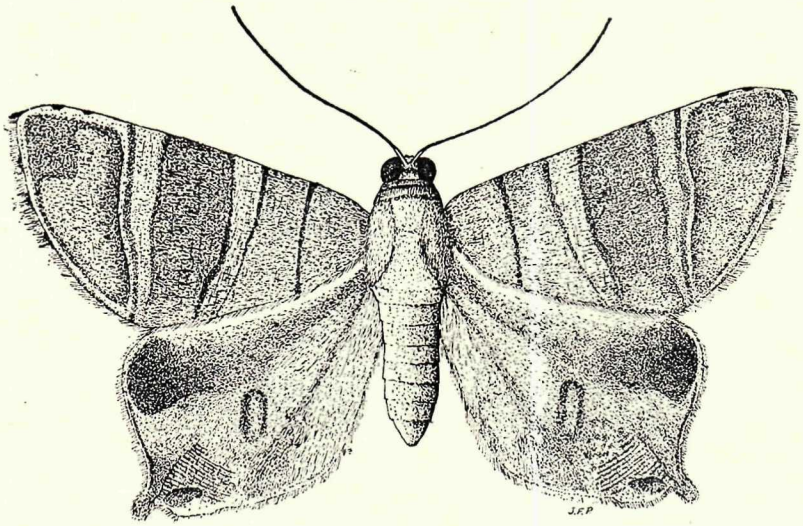
This butterfly although rather scarce in Puerto Rico, apparently is a rather common species in other parts of the American tropics. Also

---

PLATE X

Ascia monuste (Linnaeus)
Eulepidotis addens (Walker)





(Luis F. Martorell: A Survey of the Forest Insects of Puerto Rico)

recorded from Florida, the West Indies, Central and South America. (Listed in IB, p. 404 as: *Aphrissa statira* Cramer.)

Butterfly: From specimens observed at the U. S. National Museum the following general description of both sexes is given:

The male with half of the wings nearest to the base, of a yellowish green color, outer half light yellow to white. The female whitish or yellow with brown markings, very conspicuous on outer margin of fore wing and a brown spot at the end of the discal cell. Length of f.w. 25–30 mm.

Host: The caterpillar of this species feeds on the leaves of "quenepa", *Melicocca bijuga* L. The host tree is planted in the lowlands, and is especially abundant in the southern, dry districts of Puerto Rico. Apparently the butterfly is most abundant during the summer and fall months, from July to September.

Kricogonia castalia (Fabricius)

(The Guayacán Butterfly)

Due to the great scarcity of its host tree in Puerto Rico, this species is very scarce. Dr. Gundlach recorded this insect many years ago and he observed that it was common near the coasts. The butterfly is abundant in Haití, Cuba, Jamaica, Mexico, Florida, Texas, Venezuela and presumably in Central America. Mr. Cesáreo Pérez, collected three specimens at Salinas. Dr. G. N. Wolcott (1927) published an interesting article about the abundance of these butterflies in Haiti, in which he also gives a description of the caterpillars and chrysalis.

Butterfly: The ground color varies from white to greenish yellow; the base of the wings has only traces of yellow, and the undersurface, especially of the fore wing, is even less yellow. There is a great variation of color in the same species as well as in the size of different individuals. Wing expanse 37–53 mm.

Caterpillar: The fully grown last instar larva is about three-fourths of an inch long and one-eighth inch wide, cylindrical, of substantially uniform diameter, with a skin somewhat roughened and pubescent. The oval head is of nearly the same diameter as the body, dull green in color, with numerous irregularly-shaped lighter spots on the dorsal half, the ocelli and the bases of some of the hairs being black. On the body, the prominent but narrow silvery or grey mid-dorsal stripe is laterally broadly bordered with chocolate brown. At the sides this breaks up into numerous spots on a golden yellow background, which midway to the silvery lateral stripes become so numerous as to form a continuous stripe, sharply limited ventrally by the golden yellow background. The lateral silvery stripes are narrowly above and scarcely at all below, margined with brown.

Below, posteriorly, and at the sutures, the body is dull green like the head, but somewhat lighter around the prolegs. The claws of the prolegs are brown; those of the true legs are semi-transparent green.

Chrysalis: The chrysalis is bluish-gray in color, with whitish bloom, smooth but not shining, wing pads prominent and rather sharply depressed posteriorly to meet the small abdomen.

Pupal period: 6 days.

Host: According to Wolcott's observations, the caterpillar of this species feeds on the foliage of "guayacán", *Guaiacum officinale* L. Apparently the caterpillars, during the hours of the day are hidden under the bark and crevices of the trunk, feeding only during certain hours of the night. Presumably in Puerto Rico the larva feeds on the same host tree, but due to its scarcity the butterfly is not commonly observed.

Anteos maerula (Fabricius)

(The Isandrina Butterfly)

This butterfly is more or less in the same situation as the preceeding, that is, nearly on the verge of extinction due to the scarcity of its host tree. The species has been recorded from Cuba, Jamaica, Hispaniola, Florida, Mexico, Central America and the northern part of South America.

Butterfly: The upper surface of wings is a uniform lemon yellow, except for a black spot at the end of the cell of the fore wing, and a similar light brown spot on the hindwing. The underside is faintly reticulated with yellow on a lighter background. The sexes are very similar. Length of f.w. 40 to 48 mm. (Bates, p. 139.)

Eggs: The eggs are laid on the leaves of the host tree. They are about 1.5 mm. long, spindle-shaped, with striations starting at the base and ending at tip, yellowish or light yellow in color. They are laid singly, never in groups.

Caterpillar: In the early stages the larva is velvety green, with body and head covered by minute dark blue spicules and a yellowish green stripe running dorsolaterally on each side of the body from the first thoracic segment to the anal segment. The fully grown larva measures about 4 cm. in length.

Chrysalis: The chrysalis is about 30 mm. long, green, shiny, with two brownish, nearly oval spots, about 2 mm. long and 1 mm. wide, on the wing pads. On the first abdominal segment invariably one finds 2 small brownish spots, with a separation of 6 mm. between them. The anterior end bears a small hook of a green and brown color, the brownish pattern extending from the hook, laterally to the anterior part of body for a distance of about 7 to 8 mm. The chrysalis is attached to twigs by means of a

tuft of silken hairs at its anal end, and also supported by two fine silken hairs around the abdominal segments, more or less going around the middle of the body of the chrysalis.

Pupal period: Around 6 days.

Host: Dr. Gundlach observed the caterpillar feeding on species of *Cassia*. The writer has found the caterpillar abundantly during the summer and fall months defoliating "vela muerto" trees, *Isandrina emarginata* (L.) Britton & Rose, at Salinas. Undoubtedly Dr. Gundlach saw the caterpillars on this same host tree, which formerly was known as *Cassia emarginata* L.

FAMILY NYMPHALIDÆ

Danaus plexippus (Linnaeus)

(The Monarch Butterfly)

This milkweed butterfly known as the Monarch is very common in Puerto Rico, abundant during the spring and summer months, especially at lower elevations, in the lowlands and on the hillsides. (Recorded by Möschler, p. 94 as: *Danaus erippus* Cramer; in IB, p. 397 as: *Anosia plexippus* Linn.)

Butterfly: The upper surface of the wings is bright reddish, with the borders and veins broadly black, with two rows of white spots on the outer borders and two rows of pale spots of moderately large size across the apex of the fore wings. The males have the wings less broadly bordered with black than the females, and on the first median nervule of the hind wings there is a black scentpouch.

Egg: The egg is ovate conical, ribbed perpendicularly with many raised crosslines between the ridges, pale green in color.

Caterpillar: The caterpillar is bright yellow or greenish yellow, banded with shining black, and furnished with black fleshy thread-like appendages before and behind.

Chrysalis: The chrysalis is about one inch in length, pale green, spotted with gold.

Host: The caterpillar of this species feeds on the foliage of the giant milkweed or "algodón de seda", *Calotropis procera* (Ait.) R. Br.

Hypanartia paullus (Fabricius)

(The Trema Caterpillar)

This is a fairly large butterfly, not very common in the Island, usually flying around in thickets and hillsides, at lower elevations but also found in the middle altitudes up to 2,000 ft.

Butterfly: The ground color above is brown, with some dark bands on the apical half of the fore wing of the male, and a double dark marginal band in both sexes. The hind wing is brown, with dark submarginal lines, and a black anal spot with some central blue scaling; this wing is toothed at M_3 and Cu_2. The wings are more variegated on the under side, with various wavy lines of brown and silvery white. The male is darker than the female. Length of f.w., 27–32 mm. (Bates, p. 167). (See illustration of Plate XI.)

Caterpillar: Head either black or roughened with four kinds of cones; small black ones, medium-sized white or light-green ones, large light-green ones, darker at base and black at apex surrounding base of brown hair, and large black ones at top of head or darker green than body, with no black cones, altho some of the largest are black at apex. On the eighth abdominal segments on the anterior part of the body are seven yellow branched spines, often with apical half or two-thirds black or dark reddish-brown; four spines on the second and third thoracic and ninth abdominal; warts on the first thoracic. Body bright green below, with bluish grey bloom above. Spiracles white with faint black margin True legs opalescent reddish brown. Prolegs covered with quite long white hairs. (IP, p. 140.)

Chrysalis: The chrysalis is light green at first with whitish pubescence, later light bluish gray; 6 golden spots dorsally, two on each side of the anterior abdominal segments, with brownish prominences on those posterior along the median ridge. Two sharp horns on head; proboscis, legs, antennae and wing-veins outlined in darker green. Brown circle with yellow center anterior of the cremaster ventrally. (IP, p. 141.)

Host: The caterpillar feeds on the foliage of "palo de cabra", *Trema micrantha* (L.) Blume.

Gynaecia dirce (Linnaeus)

A rare butterfly in the Island, recorded few times; at El Consumo (on the Mayaguez-Las Marías road, probably around 2,000 ft. in altitude) once more at Mayaguez but at low elevation. Also found in Hispaniola.

Butterfly: The upper surface is a quite uniform gray, except for the broad transverse yellow band of the fore wing. The underside has a zebra-like pattern of black lines on a creamy background. Length of f.w., 35 mm. (Bates, p. 174.)

Caterpillar: The fully grown larvae are from 30 to 35 mm. long, dull black, covered with white and yellow spines.

Habits: The larvae are gregarious, feeding voraciously on the leaves as well as the larger veins. The caterpillars feed for about 10 days, after which they pupate. Pupation period at Río Piedras: 13 days.

Host: According to Dr. Gundlach, the caterpillar feeds on the tough veins of the underside of the leaves of *Cecropia peltata* L., our common "yagrumo". Möschler (p. 97) in referring to this species says, "Scarce, in the borders of forests and sometimes in coffee plantations from November to January. Caterpillar on *Cecropia* and *Cassia fistulosa*." The second tree recorded by Möschler, undoubtedly is: *Cassia fistula* L.

Adults have been reared from material collected at Río Piedras (150 ft. in altitude) and from El Yunque Mountains (3,000 ft. high). On "yagrumo," *Cecropia peltata* L. (LFM.)

Timetes chiron (Fabricius)

A very common species; occurs almost everywhere in the American tropics. Recorded from Cuba, Texas, Mexico, Central and South America. Not abundant in Puerto Rico.

Butterfly: The wings above are usually quite dark, with four longitudinal light lines, the basal line not as clear as the others. The apex of the fore wing has five or six small white spots, that may be partially or wholly obscured (*chironides* Stgr.) The underside is very variable, usually silvery white basally, grey or brown on the outer half. The tail at M_3 is well developed. The females are sometimes lighter in color than the males. Length of f.w., 28–30 mm. (Bates, p. 171.)

Host: According to Dr. Gundlach, the caterpillar feeds on the foliage of "palo de mora", *Chlorophora tinctoria* (L.) Gaud.

Historis odius (Fabricius)

(The Yagrumo Butterfly)

This species which has been recorded from Florida, Cuba, Jamaica, Hispaniola, Central and South America, is rare in Puerto Rico. (Listed in IB, p. 400 as: *Historis orion* Fabr.)

Butterfly: The upper side is brown, heavily bordered with black, with a single spot in the apex of the fore wing; the underside is more variegated, marked with various lines and shadings. The large size and simple pattern of this butterfly make it unmistakable. Length of f.w., 52–65 mm. (Bates, p. 173.) (See Plate XI, for illustration.)

Caterpillar: Flattish, medium-gray, with white saddle 5 by 10 mm. at middle of back and two prominent projections, with spiny protuberances projecting upward and outward from the head, about 3 mm. long. In the fully grown caterpillar the saddle was greyer and less conspicuous.

Chrysalis: The chrysalis is reddish brown in color, with two double-curved projections 4 to 5 mm. long extending forward from the head and almost touching at their apex, but 2 mm. apart at base. (E. G. Smyth: IP, p. 143.)

Host: According to Dr. Gundlach the caterpillar of this butterfly breeds on *Cecropia.*

SUPERFAMILY HESPEROIDEA

FAMILY HESPERIIDÆ

Astraptes talus (Cramer)

(The Guaraguao Skipper)

This species has been recorded from all the islands of the Greater Antilles and in the continent it ranges from Mexico to Brazil. Not very common in Puerto Rico and nothing known about its habits. (Listed by Möschler, p. 107 as: *Eudamus talus* Cramer; in IB, p. 407 as: *Goniurus talus* Cramer.)

Butterfly: This species is distinguished from the related species, by the distinctly green vestiture of the body and basal part of the wings. The fore wing is crossed obliquely by a row of five translucent yellow spots. Length of f.w. 25 mm. (Bates, p. 209.)

Host: Dr. Gundlach recorded the caterpillar of this skipper as feeding on the foliage of "guaraguao", *Guarea trichiloides.*

Acolastus amyntas (Fabricius)

(The Ventura Skipper)

The species has a wide range of distribution in the American tropics and has been reported from all the Greater Antilles, also St. Thomas and St. Croix. In the United States it is found in Florida and Arizona. In Puerto Rico the species is becoming scarce with the disappearance of its host tree, few of which are still remaining in the Island.

Butterfly: The butterfly may be recognized by the rather uniform purplish brown ground color of the wings above, the lobed hind wing, and the three prominent translucent white spots on the disc of the forewing. Length of f.w. 21–25 mm. (Bates, p. 208.)

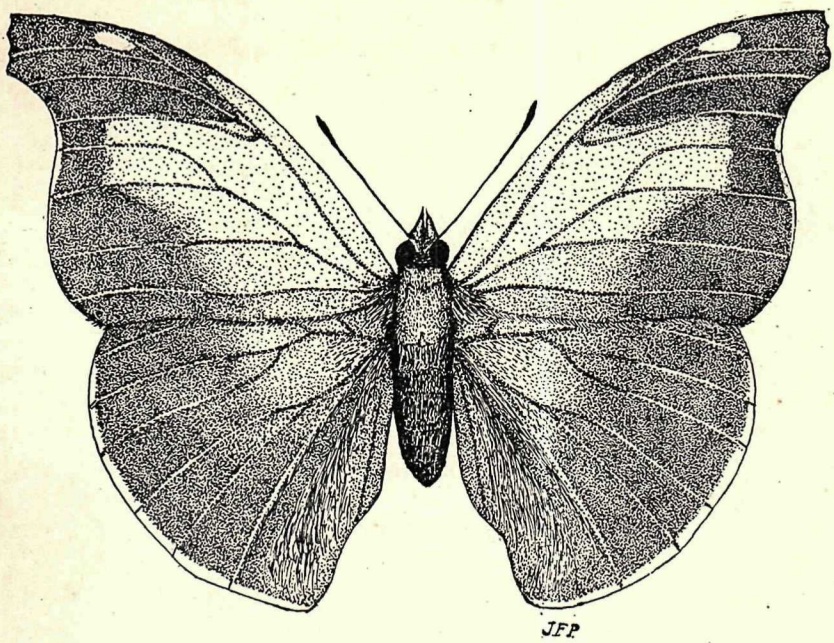
Caterpillar: The caterpillar has a flat, heart-shaped head, black in earlier stages or instars, lemon yellow in final instar with a large black spot on each of the dorsal cleft. (IP, p. 148.)

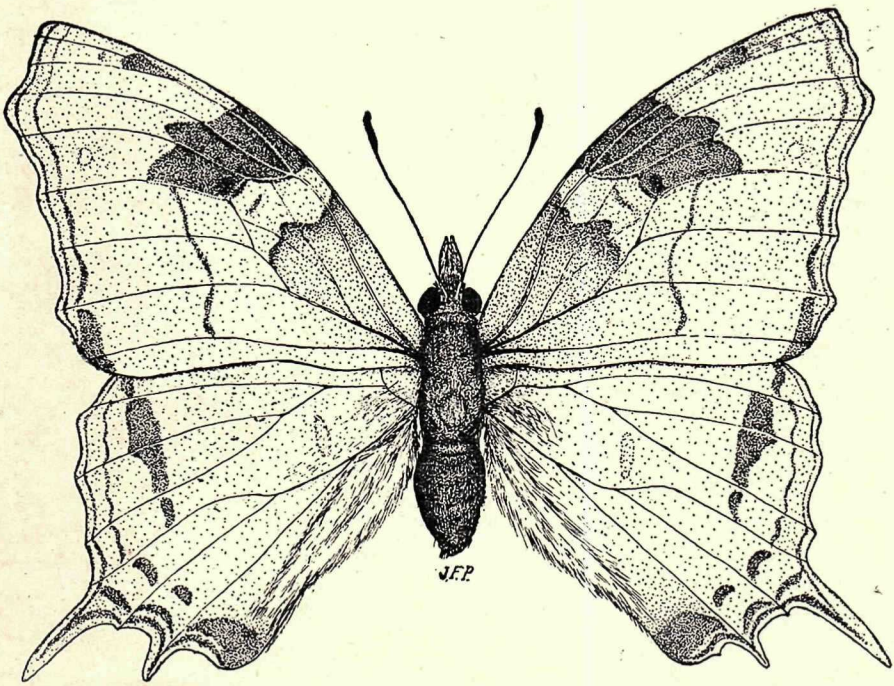
Host: In Cuba, Dr. Gundlach found the caterpillar on *Lonchocarpus domingensis* (Pers.) DC. In Florida the host tree is "ventura", *Piscidia piscipula* (L.) Sarg., the same host tree for Puerto Rico. Caterpillars

---

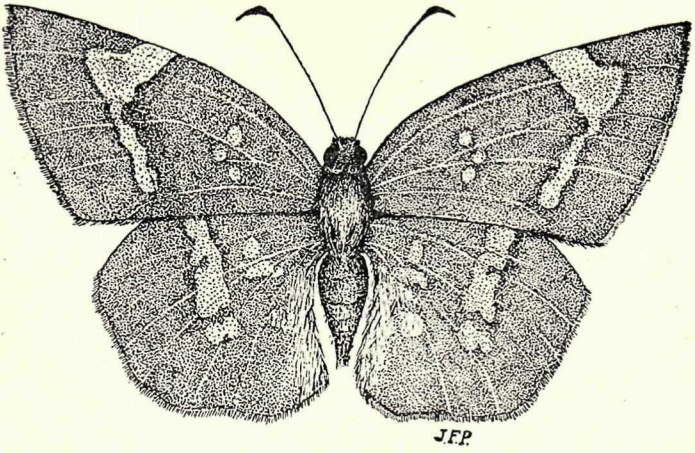
PLATE XI

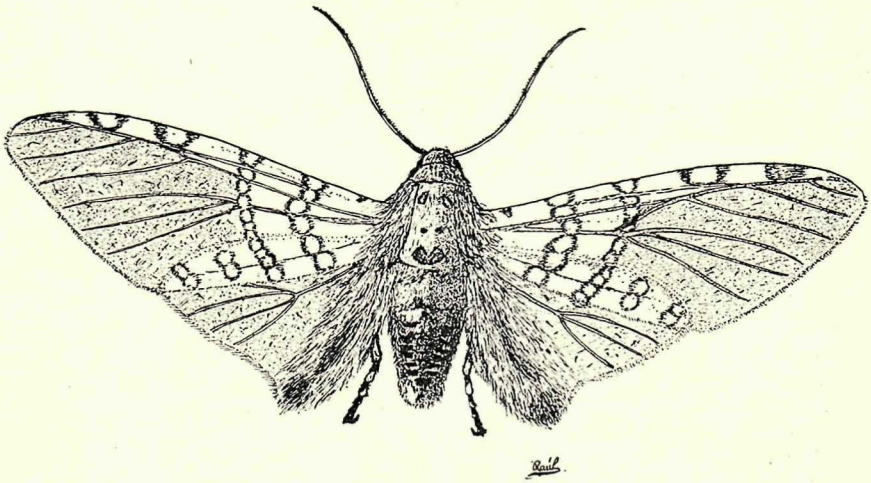
Historis odius (Fabricius)
Hypanartia paullus (Fabricius)





(Luis F. Martorell: A Survey of the Forest Insects of Puerto Rico)





(Luis F. Martorell: A Survey of the Forest Insects of Puerto Rico)

of this species have been collected at Punta de Cangrejos and Boquerón, where still some host trees grow.

Achylodes thraso (Hübner)

A fairly common species of skipper in Puerto Rico; also recorded from Texas to Paraguay and all the islands of the West Indies. (Listed in IB, p. 408 as: *Eantis thraso* Hübner).

Butterfly: A rather large, dark brown species, marked with spots and lines of lighter brown. Easily differentiated from other skippers by the very convex outer margin of the fore wing, the entire absence of white spots on the wings, and the prominent area of bluish scales on the outer margin of the underside of the hind wing. Length of f.w., 20–25 mm. (Bates, p. 213.) (See Plate XII, for illustration.)

Eggs: These are laid singly on the tips or on the undersides, near the edge of leaves.

Caterpillar: The head of the caterpillar is large, short, heart-shaped, in the earlier instars reddish brown, in the last instar greenish brown, with darker green narrow medio-dorsal stripe and broad lateral yellow bands made up to five irregularly rectangular spots on each segment. Neck and true legs yellow. Body in earlier instars is rounder and less tapering and with no indication of striping. (IP, p. 149.)

Chrysalis: The chrysalis is green, with a whitish bloom, easily rubbed off, protruding eyes, held in a silken girdle and by cremaster in a slight cocoon in a rolled leaf. It becomes dark bluish-purple a day previous to the emergence of the adult. (IP, p. 149.)

Host: Apparently the main host trees of this insect in the Island are those belonging to the genus *Citrus* (grapefruits, oranges, lemons, etc.) Sometimes they are so abundant that arsenate of lead sprays are used for their control. The caterpillar also feeds on the foliage of *Zanthoxylum monophyllum* Lam. Not very common in this tree. The insect is primarily a lowland type, very seldom observed at altitudes higher than 2,000 ft.

Brachycorene arcas (Drury)

This species is common in Puerto Rico, especially in the lowlands and on the hillsides. The insect has been previously recorded from Cuba, Jamaica, St. Thomas, St. Croix, Brazil, Cayenne, Panama and Central America.

PLATE XII

Achylodes thraso Hübner
Ecpantheria icasia (Cramer)

Butterfly: This skipper is distinguished from others by its immaculate, velvety, dark brown upper side, usually with a purple cast. Length of f.w., 18–22 mm. (Bates, p. 215.)

Caterpillar: The larva of this species, when fully grown is about 30 mm. long. Head, heart-shaped, short, broad ventrally, in earlier instars dark brown to piceous, roughly pitted subtending orange-colored hairs, with orange-colored markings; a large pair in front of the ocelli, a smaller pair behind, a dot above, a larger spot higher up and a broad band passing over the top of each side of the head; in last instar, light yellow in color with markings of chrome yellow as in earlier instars of orange; mandibles and ocelli shining dark brown. Body light green, approximating in color the underside of the leaves of the host plant, but darker in the middle and especially along the medio-dorsal line, nearly hemisphaerical in cross section, and held closely appressed to the leaf. The body color is made up of a ground work of gray-green, modified by numerous small bright yellow spots, which are confluent in two pairs of lateral lines, bounding the medio-dorsal line, and as latero-dorsal lines. Thoracic segments lighter in color, legs light yellowish green, spiracles bright yellow. (IP, p. 149–50.)

Chrysalis: The chrysalis is about 17 mm. long and 5.5 mm. broad. Shiny and glistening, with faint cocoon and well developed girdle, but well concealed in folded leaf. Light apple green in color, especially on the dorsum of the abdomen, where the yellow spots and four lines of the larva persist, elsewhere grayer, more cloudy and somewhat opalescent; head blunt with sharp corners and covered with transparent hairs, curved at ends; eyes opaque, white, subtriangular, margined posteriorly with black; venation of wings showing as faint white lines. (IP, p. 150.)

Host: The caterpillar feeds on the foliage of "olaga", *Malpighia fucata* Ker-Gawl. Adults were reared from caterpillars collected at Maunabo on this shrub.

Atrytone vitellius (Fabricius)

Quite a common species in Puerto Rico, also recorded from the Atlantic States, Gulf States and northward in the Mississippi valley as far as Nebraska and Iowa.

Butterfly: The male is small, with brilliant, shining, chrome yellow wings, margined with black, having a wing expanse of about 27 mm. The female on the upper side has the hind wings almost entirely fuscous, very slightly yellowish about the middle of the disk. The fore wings have the inner and outer margins more broadly bordered with fuscous than the male, and through the middle of the cell there runs a dark ray. On the

underside the wings are bright pale yellow, with the inner margin of the primaries clouded with brown. (Illustration of male in Holland 1914, Plate XLVI, fig. 6.)

Egg: The eggs are hemisphaerical, about 1.3 mm. in diameter, gray below, darker towards the apex, and marked with hexagonal reticulations.

Caterpillar: The larva when first hatched is light gray-green, so transparent that its internal organs are plainly visible, but becoming green, and more opaque as it grows. On the first segments there is a dorsal black band, terminating laterally just above a black dot, and the head is black, in the later instars. The fully grown caterpillar is 35 mm. long. The general color of the body is robin's egg blue, but looked at more closely is seen to consist of a lighter colored network surrounding numerous darker spots subtending small hairs. There is a darker medio-dorsal stripe, and the three anterior and posterior segments are somewhat more yellow-green than blue. The spiracles are yellow, and the true legs are also opalescent light yellow. On the dorsal half of the first segment is a black half-ring ending on each side just above a large black spot. The head is roughly granular, dull yellow, black where attached to the neck, around the outer edge, and in front in two broad straight vertical lines.

Chrysalis: The chrysalis is about 18.5 mm. long and 3.5 mm. wide, opalescent, creamy yellow on the wings, lighter on the abdomen, but a dull light red on the head, which also has many straight hairs, the rest of the chrysalis being faintly pubescent. (Notes on egg, caterpillar and chrysalis from Jones and Wolcott 1922, p. 42–3.)

Host: Mr. Francisco Seín, reared male and female of this species, from caterpillars collected while feeding on areca palm or "nuez de areca", *Areca catechu* L.

Panoquina nero (Fabricius)

A common skipper in the Island, also reported from Hispaniola, Jamaica, St. Thomas, Central America and Cuba (where the form *silvicola* is the predominant local subspecies). (Listed by Möschler, p. 103 as: *Hesperia nero* Fabr.; in IB, p. 411 as: *Prenes nero* Fabr.)

Butterfly: The adult is a dark brown, thick-bodied butterfly, with wings darker above than below and the ventral surface of the body nearly white. Of the seven, or less, white, semi-transparent spots on each of the fore wings, the largest is acutely triangular. The wing spread of the largest adult is 35 mm.

Egg: The eggs are hemispherical, about 1.8 mm. in diameter, and are laid singly on leaves. When first laid they are nearly white, becoming gray with age, often with a rosy tinge, and with the apex and a circle

about and just below it darkest. Under a lens the entire curved surface shows delicate reticulations, hexagonal in shape. The egg period is from 4 to 5 days.

Caterpillar: The mature larva is light green closely approximating the color of the underside of leaves. On closer inspection the surface is seen to be marked with pale, chrome yellow, transverse lines near the intersections of the segments, and four, light, longitudinal, dorsal lines. All markings more distinct at either end of the body. There are also numerous, very small, darker green dots and sparse short hairs. Below, the body is bluish green and laterally a white line extends along a slight fold just below the level of the stigmata.

Chrysalis: The chrysalis rests on a film of silvery silk, its ventral surface next to the leaf, and is held in place by a hand of silk over the thorax and by several strands at the anus. It is translucent, light green, with a number of slightly wavy light lines extending lengthwise dorsally. Four extend the full length of the thorax and abdomen, converging at either end, and one each side, laterally, follow the line of the stigmata. Ventrally, especially the wing pads and undeveloped legs, and at either attenuated end, the pupa is more opalescent and less green. On the head projects a curved, conical tubercule or horn. The pupa or chrysalis is about 30 mm. long and 5 mm. wide. A day or two before emergence of the adult, the eyes of the butterfly in the chrysalis become bright pink. Later the entire chrysalis becomes dark purplish.

Pupal period: The pupal period required is ten to twelve days in those individuals kept under observation, while rearing at the laboratory. (Illustrations of larvae, chrysalis and adult, in Jones & Wolcott, 1922, p. 39–40.)

Insect Enemies: The larva or caterpillar is parasitized by two species of hymenopterous insects: *Ardalus antillarum* Gahan and *Apanteles prenidis* Musebeck. The caterpillar is also attacked by the vespid *Polistes crinitus* (Felton), the adult of which devours the caterpillars in the field. However, the most important enemy of *Panoquina nero* (Fabr.) is the egg parasite *Trichogramma minutum* Riley.

Host: In Puerto Rico, the caterpillar has been recorded as feeding on the leaves of *Bambos vulgaris* Schrad., our common "bambúa". However, its most important host plant is the sugar-cane, *Saccharum officinarum* L.

Perichares coridon (Fabricius)

Another fairly common species in Puerto Rico, which has a wide range of distribution in tropical America, the form *coridon*, probably being the Antillean chloromorph.

Butterfly: This species may be distinguished by the yellow, translucent

spots of the fore wing; a large, curved cell spot, smaller spots between M_3 and C_2, and Cu_1, and Cu_2, a tiny spot, often absent on 2A. There are no subapical spots, and no markings on the upper side of the hind wing. The stigma of the male is narrow, curved and extends between veins 2A and Cu_1, hardly differentiated from the rest of the wing in color. The hind wing, on the underside, is beautifully variegated with brown and violaceous; the underside of the abdomen is conspicuously marked with orange. Length of f.w., male, 22–23 mm.; female 26 mm. (Bates, p. 233.)

Caterpillar: The caterpillar is largely light green in color, although the head is black in the earlier instars and has a dirty appearance even later, but the caterpillar is most readily differentiated by the long, fine, whitish hairs which cover both head and body. (EEWI, p. 206).

Host: The caterpillar has been collected at Mayaguez, feeding on *Bambos vulgaris* Schrad., our common "bambúa". Its chief host plant however is sugar cane, *Saccharum officinarum* L.

Superfamily Sphingoidea

FAMILY SPHINGIDÆ

Cocytius antaeus antaeus (Drury)

(The Giant Sphinx)

A rather common moth in Puerto Rico, also recorded from Florida, Cuba, Bahamas, Jamaica, Hispaniola, Central and South America, as far as southern Brazil. The insular form is *antaeus antaeus*, the continental is known as *antaeus medor*. The difference between the two is very slight. (Recorded as *Amphonyx antaeus* Drury, by Möschler, p. 111.)

Moth: The moth is large in size, robust, generally of a brown color, with some orange markings at the base of hind wing, the abdomen with a row of yellowish spots on each side. (Description of species in Rothschild & Jordan, p. 58; also color plate is shown in Holland 1913, Pl. VI, fig. 1.)

Egg: Elliptical, slightly flattened above and below, rounded, normal; shell white, thin, densely granular shagreened; probably green before hatching; size 2.4 by 2 by 1.8 mm.

Caterpillar: The last stage of the caterpillar is as follows: Head highly conical, but without the points observed in the earlier instars; vertex rounded, median suture impressed, clypeus very small, about one-fourth the height of head, vertical membranous triangle visible on the back, not reaching halfway to the conical apex; finely shagreened, also with minute, sparse, smooth granules and a very few secondary hairs toward vertex; green, slightly shining, a very obscure paler band up the anterior angles

from ocelli to vertex and a fainter one on occiput from base of vertical triangle; apices of lobes slightly yellowish; jaws black; labrum furcate, brownish; antennae mostly pale; ocelli brown, shaded, except the upper and lower ones; width 7 mm. Body large, robust, smaller before; anal plates large and thick; joint 12 enlarged dorsally with an enormous thick club-like horn, studded thickly with cones, the end rounded, not pointed. Segments 8- annulate, the ordinary granules minute, but the sparse ones distinct and pale with rather long and distinct brown secondary hairs, perfectly visible without a lens. Green, a dorsal vascular line shading into purple, bordered with yellowish posteriorly (joints 6 to 10), the lateral obliques very faint dark shades, lighter edged, except the one on joints 12–10, which is very distinct, broad, white line edged with dark green before. Horn olivaceous lilac above, the studding cones pale ochreous with brown tips. The three anal plates are rounded triangular, green, covered with large slightly elevated yellowish brown granules, faintly circled with yellow. Other abdominal feet green, the claspers black; thoracic ones yellowish white, streaked and spotted with black, with a few small whitish granules. Spiracles large, dark brown, shading paler above, and below, with a central vertical white line. Later the horn became dark violet above, the dorsal stripe violet, broad and distinct, narrowing anteriorly to obsolescence. The larva entered ground and formed a cell in the earth. (Dyar 1901, p. 257–8.)

Pupa: The pupa is long and rather slender, about 90 mm. in length, the eighth abdominal tergite with divided patch of tubercules.

Host: According to Dr. Gundlach, the caterpillar of this moth breeds on *Annona muricata* L. The insect is not abundant enough to be of economic importance.

Protoparce rustica (Fabricius)

(The Rustic Sphinx)

A common species in Puerto Rico, distributed throughout continental tropical America and the West Indies. Also recorded from St. Jan. (Listed by Möschler, p. 110 as: *Sphinx rustica* Fabr.; in IB, p. 445 as: *Phlegethontius rusticus rusticus* Fabr.)

Moth: The head and ends of palpi are blackish brown, with a short white dash on the vertex, and white spots at the base of the antennae; palpi beneath white. Thorax blackish with white spots on the disk, and tegulae at the base of anterior wings. Abdomen blackish brown, with a narrow blackish dorsal line, and three round orange-yellow spots margined with black on each side, and two rows of dorsal white spots. The under surface of the thorax and abdomen white. Fore wings blackish brown, or

ferrugineous brown; when faded, mottled with white; a few white spots at the base; the middle of disk crossed by two black lines and a brown one, which is margined on both sides with white, with serrated black lines traversing the nervules, margined broadly behind with brownish white; discal spot white, an irregular sub-terminal blackish line, with white marginal spots and a short, oblique apical streak, edged above with white; ciliae white spotted. Hind wings blackish, costa and disk yellowish, with a white spot near the base, and one above the inner angle crossed by black lines. (Morris 1860, p. 187.)

Caterpillar: The fully grown larva, in the height of its development after last moult, is five and a half inches long when fully extended, depth, dorso-ventrally, five-eighths of an inch. Head rounded; dark clear green two clear blue stripes from summit of centre of head in front diagonally down to basal outer corners of head. First three segments yellowish green, lighter above, with two dorsolateral lines composed of whitish yellow tubercules tipped with brown; these extend to beginning of fourth segment. A dorsal greenish blue-white line along centre of first four segments. Remaining segment shades from light pea-green (after quite yellow) down to dark clear blue-green below. From the line marking the beginning of the fourth segment and from a point opposite the stigma of that segment, an oblique yellow-white band, sharply cut, runs to near the top and rear of fourth segment, continued on over fifth segment, and ending in center of top of sixth, where it becomes nearly parallel with its fellow from the other side; after entering fifth segment this band changes to pinkish white, fainter on top of sixth: on its whole length it is sharply faced above with dark blue-purple (varying in some specimens to blue-brown) which fades into the light white-green of dorsum. The remaining six lateral oblique lines are mutatis mutandis, similarly arranged, only that the yellow band is brighter and wider and the dark facing above is more distinctly red-purple, than in the first line. The last of these lateral oblique bands, the seventh, ends at the base of the caudal horn, into the under portion of which the yellow band fades. Between and under each of these seven lateral bands, starting at beginning and near top of the last segment which each band covers, is a greenish parallel line converging with its fellow from the other side on the dorsum. Caudal horn clear yellow-green covered with yellow dark-tipped granulations. Anal lap edged with clear yellow-green. The oval stigmata whitish buff, thinly edged with black, with black central line. Rim of prolegs yellow, hooks black. True legs buff, black jointed. A central greenish blue interrupted dorsal line for whole length of body.

Pupa: The pupa varies in size from 2.7 to 3 inches in length and from .7 to .75 in diameter (at far end of wing). The "tongue case" is very stout, with a pear shaped swelling at the free end, which presses against

the median ventral line about five-eighths of an inch from anterior extremity of pupa. The color is shining black-brown. (Notes on pupa and description of fully grown caterpillar from Smyth Jr. 1900, p. 487–8; also color plate of stages of caterpillar are shown in same work.)

Host: According to Dr. Gundlach, the caterpillar of this species lives in "roble amarillo", *Tecoma stans* (L.) H. B. K.

Pseudosphinx tetrio (Linnaeus)

(The Plumeria Caterpillar)

A very common moth in Puerto Rico, distributed throughout tropical and subtropical America, from Florida to the West Indies and southward to Paraguay and southern Brazil. Listed by Möschler from St. Jan. The female of this species is probably the largest of American hawk-moths or sphingids.

Moth: The moth is large, with gray and brownish wings, the hind wings darker in color than the fore wings. The male usually has a triangular dark patch resting on the middle of the costa; the female is paler, much larger and without the patch. Wing expanse, 95–133 mm. (Description of the species in Rothschild & Jordan, p. 353–4; color illustration in Holland 1913, Plate VI, fig. 2.)

Caterpillar: When fully grown the caterpillar is about five inches in length, black, transversely striped with yellow to cream, with red head and tail. Very distinguishing and impossible to confuse with other Sphingid caterpillars.

Host: Dr. Gundlach, reported the larva on *Plumeria*. Mr. A. Busck, found the caterpillar in *Plumeria rubra* L. There are several records of the caterpillar in *Plumeria alba* L., at Guánica. The writer observed the caterpillars very abundant on *Plumeria obtusa* L. at Mona Island, causing total defoliation of some trees.

Pachylia ficus (Linnaeus)

(The Ficus Sphinx)

A common sphinx in the Island, also recorded from Florida, Texas, California, West Indies and South America as far south as Argentine.

Moth: A fairly large moth, wings olive-green in color with a conspicuous white spot on anal angle of hind wing. Very typical and easily distinguishable from other hawk-moths. (Description of species in Rothschild & Jordan, p. 373–4.)

Egg: The egg is laid singly, on the undersides of leaves.

Caterpillar: The middle and final instars show no essential differences, the ground color varying slightly in different specimens between light blue-

green and yellow-green. One very distinct mottled variety is herewith described: The dorsal area which is either the lightest or brightest portion, is enclosed by a couple of broad but tapering yellow bands from mouth to tail. The caudal horn is merely a short and hooked stump, light green in color, and the medio-dorsal stripe is represented by one or two spots of darker color on each segment. Unlike the oblique lateral stripes of the Acherontiinae, eight more or less ill-defined and rather narrow yellow lines mark the sides, directed headwards. Immediately beneath these are situated the spiracles which are dark ringed, but not very conspicuous. The legs are creamy pink and black ringed, and all the claspers possess a distinct fringe of hair. Head large and formidable, and together with plate and anal extremities of a light blue color inclining to violet. (Moss, 1912, p. 99.)

Pupa: The pupa is bright mahogany-brown, glossy, gracefully curved on ventral area. In general form robust and rounded, the cremaster being represented by only a very short blunt point.

Host: The caterpillar feeds on trees of the genus *Ficus*. Wolcott recorded the caterpillar feeding on "laurel de la India" *Ficus nitida* Thumb. and also on a related species, *Castilla elastica* Cerv.

Superfamily Phalaenoidea

FAMILY AMATIDÆ

Nyridela chalciope (Hübner)

This species which is not common in Puerto Rico, has been recorded from Cuba, Hispaniola and Jamaica. (Listed as *Isanthrene chalciope* Hübner, by Möschler, p. 113.)

Moth: The moth is blue with luteous antennae. Abdomen with lateral white dots. Wings limpid, margined with black. Fore wings with a black band. Morris, p. 264.)

Host: Nothing is known about the life history of this moth. According to Möschler, the caterpillar feeds on the foliage of "guara", *Cupania americana* L.

Horama pretus (Cramer)

This is a rather common species in Puerto Rico, and also has been recorded from St. Thomas, Santo Domingo, Jamaica, Cuba, St. John and Tortola.

Moth: The moth is fawn-colored, antennae banded with black. The first abdominal segment almost wholly pure white, the hind wings chocolate brown, fore wings testaceous.

Caterpillar: The fully grown larva is about 15 mm. long 7 mm. wide,

bright reddest orange, reddest on thorax and head, shining. Body clothed with numerous spreading tufts of gray and white hairs, curved towards their tips. On the seven anterior abdominal segments dorsally are four compressed tufts of black hair in pairs, bending towards each other, the anterior pair of each segment closer together and touching at apex.

Cocoon: The cocoon is made out of a thin gray silk with the longer hairs of the caterpillar entangled in it.

Pupa: The pupa is bright reddish brown in color. (Notes on caterpillar, cocoon and pupa, from IP, p. 414.)

Habits: The caterpillar of this species is a leaf-webber. They are gregarious and sometimes 8 or 10 larvae are found in one web. They seem to prefer the tender foliage at the terminal of branches, for this is the place where most of the webs are found on trees. The species is an insect of the lowlands, where its host tree grows best.

Host: The caterpillars web the leaves of "coscorrón", *Elæodendrum xylocarpum* (Vent.) DC.

Correbidia terminalis (Walker)

This species is rare in the Island. It has also been recorded from the West Indies, from Mexico to Venezuela and presumably is present in the Guianas. In Puerto Rico the insect has been collected at middle elevations around 2,000 ft. (Listed in Möschler, p. 114 as: *Charidea cimicoides* Herr.-Schaff.)

Moth: The writer has not been able to find a description for this moth except for the notes on Forbes 1930 p. 27, where it says, "forewing with blackish band and apex. . . . terminalis."

Host: According to Dr. Gundlach the caterpillar feeds on the foliage of "yagrumo", *Cecropia peltata* L.

FAMILY ARCTIIDÆ

Eupseudosoma involuta (Sepp)

(The Snowy Eupseudosoma)

A fairly common species in Puerto Rico, also recorded from Cuba and from Florida to Brazil. (Listed by Möschler, p. 114 as: *Eupsodosoma niveum* Grt.; in IB, p. 415 as: *Eupseudosoma involutum* Sepp.)

Moth: The moth is white, with a brilliant red abdomen. (Color illustration in Holland 1913, Plate XIV, fig. 1.)

Egg: Slightly more than hemispherical, base flat, apex very slightly produced, suggesting the conoidal shape; clear yellowish green with amber lights about the edges, later opaque whitish green; reticulations small,

regular, rounded hexagonal, slightly raised, smaller just around the micropyle, forming a ring of small cells with one central one; micropyle eccentric, a little to one side of the vertex of the egg; diameter, 1.1 mm.; height, 0.5 mm. Laid several together or in a mass on back of a leaf, not touching, often rather remote and scattering.

Caterpillar: The last instar larva, has head pale yellow, a diffuse reddish shade over the face of each lobe, the paraclypeal pieces grayish and some gray dots on clypeus; labrum, epistoma, and antennae white; ocelli brown, jaws black at tip; the black U-shaped band entirely absent; width 3.5 mm. Body, thickly covered with a brush of yellow hair, even, spinulose, the ends pointed, not tufted; four slight and slender pencils of white hairs arise from the subdorsal warts of thorax. Body and warts pale yellow like the hairs, without marks. Later the head becomes dark orange red. Other larvae, alike till this stage, came out with variously colored hair; bright yellow, mouse gray, chocolate brown, and orange red, the color always residing in the distal third of the hair in the spinulose part, the head and bodies not affected being all alike in color. All the thoracic pencils were white. Later the color dulls so that there are only two forms, yellow and chocolate brown, which continue till maturity. (Dyar 1901, p. 261.)

Cocoon: The cocoon is composed of the hair felted in a delicate web of silk.

Pupa: The pupa is dark brown, concealed by the cocoon. (Notes on the caterpillar, egg, cocoon and pupa, from Dyar 1901, pp. 259–61.)

Host: In Puerto Rico, the caterpillar has been recorded on trees of the genus *Eugenia* and also in "guayaba", *Psidium guajava* L. However in Florida (United States) the host trees are: *Eugenia myrtoides* Poir., and *Eugenia procera* (Sw.) Poir. The species is not of economic importance in the Island.

Calidota strigosa (Walker)

(The Streaked Calidota)

A common moth in Puerto Rico and Mona Island, in this last locality very abundant at lights. The species is also found in Texas, Florida, Greater Antilles and St. Croix. (Listed by Möschler, p. 115 as: *Halisidota strigosa* Wlk.)

Moth: The fore wings are streaked with grayish markings, hind wings whitish to light gray. Abdomen dorsally red, laterally with dark brown markings. (Color illustration in Holland 1913, Plate XVI, fig. 24.)

Caterpillar: On its last instar, the caterpillar has a black shiny head, basal joint of antennae reddish, epistoma slightly paler at the sides, mostly black; width 4 mm. Body fleshy brown with vascular dorsal blackish

stripe; warts and hair light pinkish brown. Hair regular, dense, with numerous longer concolorous ones at the ends. White subventral band (above wart v) present in the incisures only, obscure. Feet reddish. The hair is densely spinulose; seen at right angles it is pale pinkish brown; seen obliquely it is much darker and more reddish brown.

Cocoon: The cocoon is elliptical, rather thin, composed of hair and silk, spun among leaves, not entirely concealing the pupa.

Pupa: The pupa is dark mahogany brown in color. (Notes on caterpillar, cocoon and pupa from Dyar 1901, p. 270.)

Host: In Puerto Rico, the caterpillar feeds on the foliage of prickle-wood, *Guettarda elliptica* Sw. Same host tree in Florida (United States.)

Ecpantheria icasia (Cramer)

(The Tiger Moth)

A very common moth in Puerto Rico, collected at lower and higher elevations. The species is divided into many different races, scattered through Central and northern South America and the West Indies. (Listed by Möschler, p. 116 as: *Ecpantheria icasia* Cr. and *eridane* Cr.; according to Mr. Van Zwaluwenburg 1916, p. 12 as: *Ecpantheria eridanus* Cr.)

Moth: The species is very variable, the female has sometimes white wings and orange abdomen, the male white wings with circular spots in transverse rows on the upper surface of fore wings, the hind wings with a nearly black streak near the inner margin. Abdomen orange with black spots. (See Plate XII).

Egg: The eggs are subspherical, slightly flattened on side of attachment. The shell is covered with fine, irregular reticulations and the color, when the egg is first laid, is greenish yellow with a pearly irridescence. Color changes to steel gray shortly before hatching. Size, about .50 to .75 mm. in diameter, slightly less in height.

Caterpillar: Mr. Van Zwaluwenburg describes 7 instars of the caterpillar, instars 7 and 8 being just like 6 except for the larger size of the head. Instar 6 is described as follows: The head is broader than high, indian red in color, width about 2.25 mm. A distinct inverted "Y" in pink on the face, clypeus small. Cephalic hairs coarse and light brown. Body black, tubercules indian red, all hairs except a few dark-brown ones on the thoracic segments, black. A rather conspicuous lemon-yellow spiracle surrounded by a black ring on all segments but the last two thoracic and the last abdominal. Thoracic legs reddish brown, prolegs dark.

Cocoon: The cocoon is a loose tough web of brown silk in which the larva molts for the last time.

Pupa: The pupa is rounded, elliptical, obtected; dark mahogany brown. Cremaster consisting of a group of short hairs each bearing a knob of spines at its tip. Female pupa 22 mm. long, 9 mm. broad, 14 mm. from tip of head to and of wing cases; male pupa somewhat smaller.

Habits: The eggs are laid in clusters, either on the upper or lower surfaces of leaves or on the trunk of trees. Usually it takes a long time for a female to lay all its eggs. They lay an average of 500 eggs. The egg stage varies from 6 to 8 days, the larval stage taking 30 to 35 and the pupal 15 to 20.

Natural Enemies: The dipterous insect, *Carcelia amplexa* (Coquillet) (in IB, listed as *Exorista amplexa* Coquillet) has been reared from the caterpillar. The ichneumonid *Eremotylus angulatus* Hooker, also attacks the caterpillar.

Host: Egg masses have been found on the trunk of a young tree of *Cedrela odorata* L. at Villalba (Doña Juana Camp, 1900 ft. altitude) and the adults have been collected abundantly at lights in the same locality. Egg clusters have been also found on the foliage of "guayaba", *Psidium guajava* L. According to Mr. Van Zwaluwenburg the larva feeds on "bucare", *Erythrina micropteryx* Poepp. = *Erythrina poeppigiana* (Walp.) O. F. Cook.

FAMILY PHALAENIDÆ

Subfamily Acronyctinae

Laphygma frugiperda (Abbot & Smith)

(The Fall Army Worm)

This is a common moth in Puerto Rico and well known in the United States, where it occurs from the Atlantic States to the Mississippi valley, south to Mexico, Central and South America and then to the West Indies and the Lesser Antilles.

Moth: This insect shows a considerable variation in coloration and markings. In one type the upper surface of the fore wing is gray-brown, with markings indistinct or lacking; in the other the fore wings are rather attractively marked with white, black, yellow-brown, red-brown, and pale blue. The hind wigs are glistening white, bordered with gray-brown, both above and below. The body and the undersides of the fore wings are light gray-brown, darker on the upper side of the thorax.

Caterpillar: The caterpillar moults 6 or 7 times before becoming fully grown, and the total period to reach that stage is about 21 days or more. The general color of the caterpillar is olive-green, with darker stripes laterally and more transparent and greener, from the food seen within,

beneath. On the dorsum of each of the abdominal segments are four large dark spots which outline an isoceles trapezium. These spots and an inverted Y of white, light gray, or light yellow, on the yellow brown head are constant characters by which the larva may be identified.

Pupa: Pupation takes place in the soil. The pupa is about 15 mm. long, glistening, dark reddish brown, rounded at the head end and pointed at the other. Pupal period from 10 to 12 days.

Habits: The moth is inactive and thus hidden during the day: the activities of flying, mating and egg laying being carried on during the night. The caterpillar feeds mostly at night, but when the food supply in one place becomes exhausted then it moves with its other companions in large masses, just like an invasion, and thus the common name of army worm. It is more abundant during the Fall and Winter seasons, especially during the rains after a period of drought.

Natural Enemies: *Laphygma* is attacked in Puerto Rico by a group of predators and parasites, among which the three larvaevorid flies, *Achaetoneura archippivora* (Williston), *Phosocephalops grassicornis* (Fabricius) and *Pseudoarchytas incerta* Macquart are the most important in controlling the caterpillar. The eggs are laid on the head or thorax of the caterpillar and the young fly maggots, bore inside and eventually cause the death of the caterpillar. The parasitic wasp *Chelonus insularis* Cresson lays its eggs in the eggs of *Laphygma*, however, not destroying the egg, which resumes its normal activities and the caterpillar emerges but with a parasite inside its body which later as it grows kills him. Two other parasitic wasps also attack the caterpillar, *Apanteles marginiventris* (Cresson) and *Euplectrus* sp. The carabid, *Calosoma alternans* (Fabricius) and the assassin bug, *Zelus longipes* (Linnaeus) have been observed to prey upon the caterpillar in the field. Two entomogenous fungi, *Botrytis Rileyi* Farlow and *Empusa sphaerosperma* Thaxter are also parasitic on the caterpillars.

The blackbirds or Porto Rican grackle, *Holoquiscalus niger brachypterus* (Cassin), the ani or "judío", *Crotophaga ani* (Linnaeus) and some species of lizards destroy many caterpillars and moths.

Applied Control: Wolcott, in EEWI, p. 211 says the following about control: "Because the caterpillars are so largely parasitized, their destruction artificially by the application of arsenical poisons when they are fully grown and have already done most of the damage of which they are capable, not only does not justify the trouble and expense, but is a positive evil. The parasites within their bodies perish when the caterpillar is poisoned, and by thus reducing the number of parasites, another destructive outbreak of caterpillars is hastened. If the poison is applied early, when the caterpillars are still small, or if they are collected by hand at this time,

before they have done any considerable damage, such control is desirable regardless of its effects on the parasites, because the plant is protected."

Arsenate of lead or calcium arsenate in combination with an adhesive mixture can be used in their control. The common baits having as a basis wheat bran, and water and using for poison white arsenic, paris green or arsenite of soda, can be used effectively in the field. (For these formulas, see Metcalf & Flint 1939, p. 254.)

Host: The caterpillar has been recorded attacking seedlings of *Eucalyptus robusta* Smith, ("eucalipto") at the U. S. Forest Service Nurseries, at Río Piedras.

Subfamily Acontiinae

Atethmia repanda (Fabricius)

A fairly common species in the Island, having a wide geographical range in distribution, from the Gulf States south to Mexico, Central and South America as far as Argentine, the West Indies and Lesser Antilles. (Listed by Möschler, p. 114 as: *Atethmia inusta* Guenée; in IB, p. 427 as: *Bagisara subusta* Hübner.)

Moth: The adult is generally of a brownish color, but there is a great variation in coloration among individuals. The wings are marked, but these markings are also very indistinct in some specimens while in others are plainly visible.

Host: Mr. E. G. Smyth collected the caterpillar on "zarcilla" *Leptoglottis portoricensis* (Urban) Britton & Rose. Possibly this is the host tree of this species.

Subfamily Sarrothripinae

Characoma nilotica (Rogenhofer)

(The Willow Leaf-webber)

A widely distributed species in America, Asia and Africa, collected several times in Puerto Rico and considered as somewhat abundant. (Listed by Möschler, p. 121 as: *Paraxia chamaeleon* Möschler; in Biol. Centrali-Americana, Het. **2**:497 as: *Talpochares* (?) *laurea* Druce.

Moth: "Primaries dark grey, irrorated with darker scales, the base of the wing black in some specimens; secondaries semihyaline dusky brown; head, thorax, antennae and legs grey, the abdomen pale brown. Expanse three quarters of an inch." (Biol. Centr.-Am. Het. **2**: 497.)

Caterpillar: The caterpillar is small, semi-transparent greenish white.

Host: The caterpillar feeds on the buds and webs together, the leaves of *Salix chilensis* Molina, our common willow, or "sauce".

Subfamily Catocalinae

Erebus odora (Linnaeus)

(La Bruja)

This is a common species in the Island, also recorded from the southern part of the United States, Mexico, Central and tropical South America. Very abundant in the West Indies.

Moth: Undoubtedly this species is our largest Phalaenid, with a wing expanse of about 4 to 5 inches. The adult moths vary in color, but generally they are of a dark brown color in both wings as well as body with some markings on the wings. The female has a very characteristic white wavy band across the middle of both fore and hind wings, on the upper surface.

Host: The caterpillar of this species feeds on the foliage of the following trees: "caña fístula", *Cassia fistula* L., "samán", *Samanea saman* (Jacq.) Merrill., and trees of the genus *Ficus*. The first two species are listed as host trees by Möschler, the third is according to Mr. Van Zwaluwenburg's observations.

Eulepidotis addens (Walker)

A fairly common species in our mountain forests, the caterpillar living on the host tree, which is abundant at middle and higher elevations in Puerto Rico. This species is limited to the West Indies in its distribution. (Listed by Möschler, p. 194 and 195 as: *Palindia variabilis* Möschler and *P. variabilis* var. *obscura* Möschler.)

Moth: A small moth, olive brown in color, with rather peculiar markings on the wings. (See Plate X.)

Caterpillar: A small dark green, nearly dark brown caterpillar, fast in its movements and quite unrestful when taken outside of the web of leaves in which it lives.

Host: The caterpillar feeds on the tender shoots and leaves of "guaba", *Inga vera* Willd. It folds the leaves and sometimes makes a sort of a web in which it spends most of its time when not feeding. Sometimes 8 or 10 caterpillars are found in one of these webs. The only caterpillars observed by the writer, were collected at 2,000 ft. high at El Peñón del Collao, near Cayey, during an outbreak of this species. Presumably this insect if more abundant when the "guaba" trees begin to develop new shoots and leaves by the end of the Fall and beginning of the Winter.

Noropsis hieroglyphica (Cramer)

(The Hieroglyphic Moth)

A common species in the Island, also recorded from the southern parts of the United States and tropical America. (Listed by Möschler, p. 149 as: *Noropsis fastuosa* Guenée.)

Moth: A small moth, with yellow fore wings crossed by blue bands and other markings near the outer margins. Hind wings of a grayish color. (See illustration in Holland, Plate XXVIII, fig. 1.)

Caterpillar: The full grown caterpillar is about 25 mm. long and about 4 mm. across the head. The ground color of the body is bluish or greenish white with a black stripe running around the body on each segment. The segments are divided from one another by a narrow black line. The anal plate and head are reddish brown, the collar shiny black.

Cocoon: The oval pupal case is about 22 × 10 mm. and is formed of parchment-like material on the stem of the food plant and is covered with grass and bits of leaves. (Notes on the caterpillar and cocoon, from IB, p. 435).

Host: Dr. Möschler records the caterpillar on *Corchorus siliquosus* L., which is just a shrubby herb. The fully grown caterpillars have been observed boring in the trunks of casuarina trees, *Casuarina equisetifolia* Forst., causing severe injury to young trees. Mr. Van Zwaluwenburg recorded the caterpillar as feeding on the foliage of the leguminous tree, *Leptoglottis portoricensis* (Urban) Britton.

Pseudohemiceras krugii Möschler

Not a very abundant species in Puerto Rico, presumably endemic.

Moth: A small moth, with a wing expanse ranging from 31 to 38 mm., dark brown fore wings, white hind wings, some specimens with a broad, brown area around the outer margins of wings; thorax brown, abdomen white.

Host: Only recorded once, the caterpillar boring in the twigs of *Tabebuia heterophylla* (DC.) Britton (roble prieto.)

Melipotis acontioides Guenée

(The Flamboyán Caterpillar)

A very common moth in Puerto Rico, also recorded from Texas, Arizona, Mexico, Guatemala and Colombia. (Listed by Möschler, p. 183 as: *Stictoptera penicillum* Herrich-Schaffer.) The moth is attracted to lights, many of the Puerto Rican records obtained in such a way.

Moth: The moth is small, with a wing expanse ranging from 33 to 42 mm., the fore wings grayish with darker markings, the hind wings white, with a broad dark gray, nearly black band on the outer margin. The coloration of the species is extremely variable.

Caterpillar: The fully grown caterpillar measures about 4.5 cm. long, dorsally and laterally grayish, ventrally yellowish or creamy. The head is about the same color of the rest of the body, two light gray or whitish lines with a separation of about 2 mm. run all the way dorsally from the

first thoracic to the last anal segment. The caterpillar moves very slowly and usually is very hard to see, because its color matches exactly with the color of the bark of the trunk where it usually rests.

Pupa: The pupa is about 4 mm. long by 1.5 mm. in width and of a reddish brown color. Pupation period: 10 days.

Host: The caterpillar feeds on the foliage of the "flamboyán", *Delonix regia* (Bojer) Raf. and on "palo verde", *Parkinsonia aculeata* L. When the larvae are abundant they cause tremendous ravages, defioliating hundreds of trees at the same time. This is usually a lowland insect and never has been observed at middle altitudes.

Melipotis fasciolaris (Hübner)

A species recorded from southern United States, Mexico, Honduras, Panama, Venezuela, Brazil, Cuba, Jamaica, Santo Domingo, Dominica, Puerto Rico and the Virgin Islands. Common in the Island, especially on the dry southern districts, where the adult have been collected abundantly at lights.

Moth: The moths of the genus *Melipotis* are very difficult to describe, due to its great variability in their coloration, the variegated pattern of their wings and the similarity between the different species in the same genus. (For illustration of this moth, see Holland 1913, Plate XXX, fig. 22.)

Host: The caterpillar feeds on the foliage of the lignum vitae or "guayacán" trees, *Guaiacum officinale* L. Apparently the feeding takes place at night, during the day the caterpillars are resting under the bark of the trunk or in crevices. Adults were reared by the writer from caterpillars collected by Dr. Wolcott, June 1942 at the Guánica Insular Forest.

Melipotis januaris (Guenée)

(The Guamá Melipotis)

This species is widely distributed through tropical America. Not so common in the Island as the two preceeding species.

Host: Mr. Van Zwaluwenburg recorded the caterpillars feeding on the foliage of "guamá", *Inga laurina* (Sw.) Willd. Thousands of larvae on trees at Mayagüez, June 1917. Pupation takes place in the ground.

Melipotis ochrodes (Guenée)

(The Prosopis Caterpillar)

This is a very common species in Puerto Rico, perhaps the most common of all the species in the genus *Melipotis*. It is widely distributed in tropical America.

Moth: The species is very well illustrated in Holland 1913, Plate XXX, fig. 25, under the name, *Melipotis pallescens* Grote & Robinson.

Caterpillar: The caterpillar is apparently nocturnal in habits, during the day is hidden under the bark of trees and in crevices in the trunk or branches, or under the trash at the base of the trunk.

Host: The caterpillar feeds on the foliage of three tree species in Puerto Rico, all of which are abundant on the dry southern and southwestern districts: "zarcilla", *Leptoglottis portoricensis* (Urban) Britton & Rose, bayahonda, *Prosopis juliflora* (Sw.) DC. and "mesquite", *Prosopis glandulosa* Torrey. In addition Wolcott lists also, *Prosopis pubescens* (IB, p. 436), but this tree is not listed by Britton in his list of the local flora.

Anticarsia gemmatilis Hübner

(The Velvet Bean Caterpillar)

A very common moth in Puerto Rico, very widely distributed in the tropics, ranging from the southern United States to Mexico, Central America and as far south as Paraguay, also in the West Indies. (Listed by Möschler, p. 212 as: *Thermesia gemmatalis* Hübner; in IB, p. 437 as: *Thermesia gemmatilis* Hübner.)

Moth: The moth is grayish brown, although through a hand lens the wings have a peppered appearance, black specks showing on a lighter surface. A line, which may be either lighter or darker than the rest of the wing, extends from wing tip to wing tip, running half way up the wings so as to form a segment of a circle when the moth is at rest, with the wings arranged fan-shaped. This line, which is about a fourth of a millimeter in width, may be edged on each side with a parallel line which is lighter in color. The part of the wing on the caudal side of this line is of a darker brown than is the side nearest the head. Just below the line and near the abdomen there are two black dots on each wing. These are edged caudad, or toward the rear, with yellow, another sprinkling of black sometimes appearing caudad of the dash of yellow. The wings are bordered with a brown or yellow line, and are heavily fringed with gray or brown. On the underside of the wings is a row of white dots, consisting of seven dots on each wing. The row of dots appear about 2 mm. or a twelfth of an inch from the caudal end of the wings. Wing expanse 37 mm. (see illustration in IB, p. 437.)

Egg: The egg is slightly oval, 1 to 1.5 mm. in diameter and has a rather shiny appearance. These are deposited singly on the leaves of the host plants.

Caterpillar: The fully grown caterpillar is about 37 mm. long. The markings and coloration are variable. The ground color of the larva is

black or nearly black, although some specimens have a grass-green color instead of black. Dark stripes alternate with lighter and even with white ones, and run the full length of the body. A stripe in the middle of the dorsal part is always light, usually of a light green. This is bordered on each side with a broad dark stripe. From this to the ventral surface there may be one light stripe, or three light stripes alternating with dark ones. In the latter case the narrow dark stripe nearest the ventral surface is light brown. Spots around the setae or hairs, are not prominent, but they are still darker than the dark stripes. The ventral or under surface is never striped and is always dark. The legs are lighter in shade than the rest of the ventral surface.

Pupa: The pupa is of a dark brown color about 18 mm. long.

Habits: The egg hatches in three to five days and the young caterpillar starts feeding immediately. It is very voracious and when abundant can cause nearly total defoliation of plants attacked. Pupation takes place in the ground. When the caterpillar is fully grown, it drops to the soil, burrows its way in and pupates. (Notes on moth, caterpillar, pupa and habits, from Douglass 1930, pp. 684–690.)

Natural Enemies: Infestations of this caterpillar have been naturally controlled in the field by means of the fungus *Spicaria rileyi*. (Wolcott & Martorell, Feb. 1940.)

Host: The caterpillar feeds on the foliage of "gallito", *Agati grandiflora* (L.) Desv.

Gonitis praerupta (Möschler)

A species recorded from Puerto Rico and Cuba, very scarce in the Island. (Listed as *Anomis praerupta* Möschler in IB, p. 441.)

Moth: The adult moth has a wing expanse of about 45 mm. and is of a chocolate brown color.

Caterpillar: The fully grown caterpillar is green, about 2 inches long. Just before pupation it turns reddish. Pupation period is about 11 days.

Host: The caterpillar feeds on the foliage of "maga", *Montezuma speciosissima* Sessé & Moc. The insect is of no economic importance, due to its scarcity.

Gonodonta maria Guenée

This species is rare in Puerto Rico. It is distributed throughout tropical America (Mexico, Dutch Guiana and Brazil).

Host: The caterpillar feeds on the foliage of "cayur" (*Annona palustris* L.) = *Annona glabra* L. and *Oxandra lanceolata* (Sw.) Baill.

Gonodonta nitidimacula Guenée

(The Soot-soot Caterpillar)

A fairly common species in Puerto Rico, also recorded from St. Thomas, Cuba, Colombia and Jamaica.

Moth: The general color of the body of the moth is dark brown, the fore wings variegated with purple, the hind wings with a large yellow spot on the middle of each wing; head white with black eyes. (See Plate XIII.)

Caterpillar: The caterpillar is entirely velvety black except for yellow clypeus, two bright yellow semicircular spots on the sides of the first segment, two narrow reddish orange spots on the fourth segment and two small yellow spots dorsally, two small reddish orange spots on the sides of the seventh segment, four larger on the eighth, two large ones on the ninth and tenth and two small ones on the eleventh, all lateral, and two large crescents on the hump of the twelfth, dorsally. (IP, p. 176.)

Pupa: Fairly large, shiny, dark reddish brown. Pupation period 14 days.

Habits: The moth is never seen during the day, but is attracted to lights at night. The caterpillar is very plainly seen due to its velvety black color and its conspicuous orange markings. It feeds voraciously on the foliage of the host plant, one often finding three or four of them on a single leaf.

Host: The caterpillar feeds on the foliage of soot-soot or "higuillo de limón", *Piper amalago* L. (Also listed as *Piper medium*). Very abundant during certain seasons of the year in the mountains south of Cayey (1,200 ft. altitude) and at the Guajataca Gorge, near Quebradillas.

FAMILY NOTODONTIDÆ

Hippia insularis (Grote)

Very rare in Puerto Rico, also recorded from Cuba, Jamaica and Mexico.

Moth: Primaries dark brown, thickly speckled with minute black dots, and with a small spot at the end of the cell, a light brown colored patch beyond the cell, and a whitish streak at the apex (but considerably smaller than in any other described species of *Edema*); secondaries dark brown, palest at the base, the fringe whitish; the underside of both wings dark brown, shading to very pale fawn-colored in front, dark grayish brown behind, beneath and the sides pale greyish brown; tegulae dark greyish brown; abdomen above dark greyish brown, beneath and the sides pale greyish brown; legs dark brown, antennae and palpi dark reddish brown. Expanse 1.25 inches. (Biol. Centr.-Amer. Lep. Het. **1**:235, described as:

Edema mandela Druce; also illustration of adult in Möschler, 1886, fig. 30.)

Host: According to Dr. Möschler, the caterpillar of this species feeds on the foliage of "guara", *Cupania americana* L.

SUPERFAMILY GEOMETROIDEA

FAMILY GEOMETRIDÆ

Melanchroia cephise (Cramer)

(The Grosella Moth)

A very common moth in Puerto Rico; widely distributed throughout tropical America, recorded from Arizona, Florida, Mexico, Guatemala, Honduras, Costa Rica, Panamá and from Colombia to Argentine.

Moth: Dark grey with white band on apex of fore wings. (Illustration in Holland 1913, Plate XLII, fig. 19.)

Host: When the caterpillars are abundant they cause tremendous defoliation on "grosella" trees, *Cicca disticha* L.

Asellodes fenestraria Guenée

Although this species is widely distributed through tropical America from Mexico to Brazil, is not common in the Island. Also recorded from Cuba. (Listed in IB, p. 453, as: *Hydratoscia fenestraria* Guenée.)

Caterpillar: The caterpillar has a dark purplish brown head and five large irregularly rectangular spots of this color on the anterior abdominal segments, alternating with areas of dull green (the ground color) of approximately the same size, with small purplish spots on the second and third thoracic segments, and smaller purplish spots on the other segments. (IB, p. 453.)

Host: According to Mr. Van Zwaluwenburg, the caterpillar of this species lives on "jagua", *Genipa americana* L.

SUPERFAMILY PYRALIDOIDEA

FAMILY PYRAUSTIDÆ

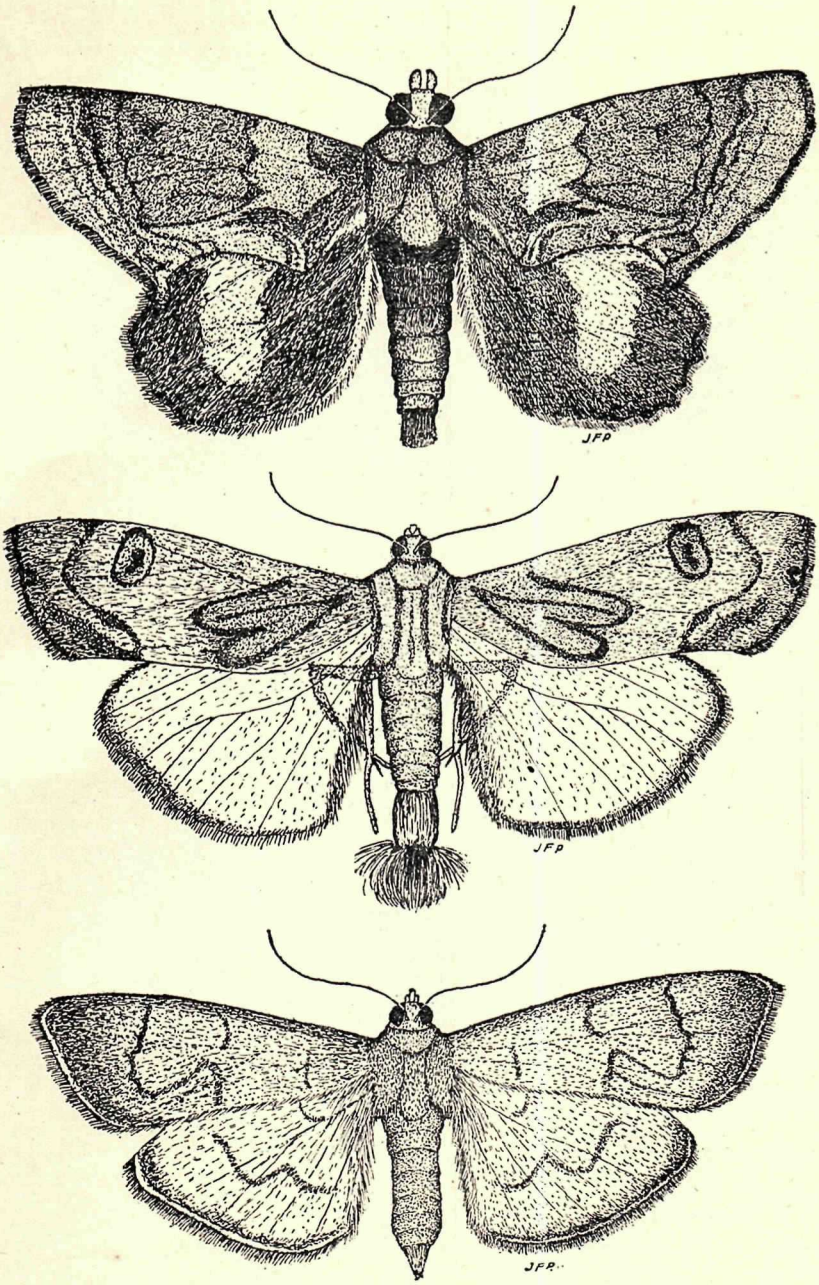
Eulepte concordalis Hübner

(The Roble Leaf-webber)

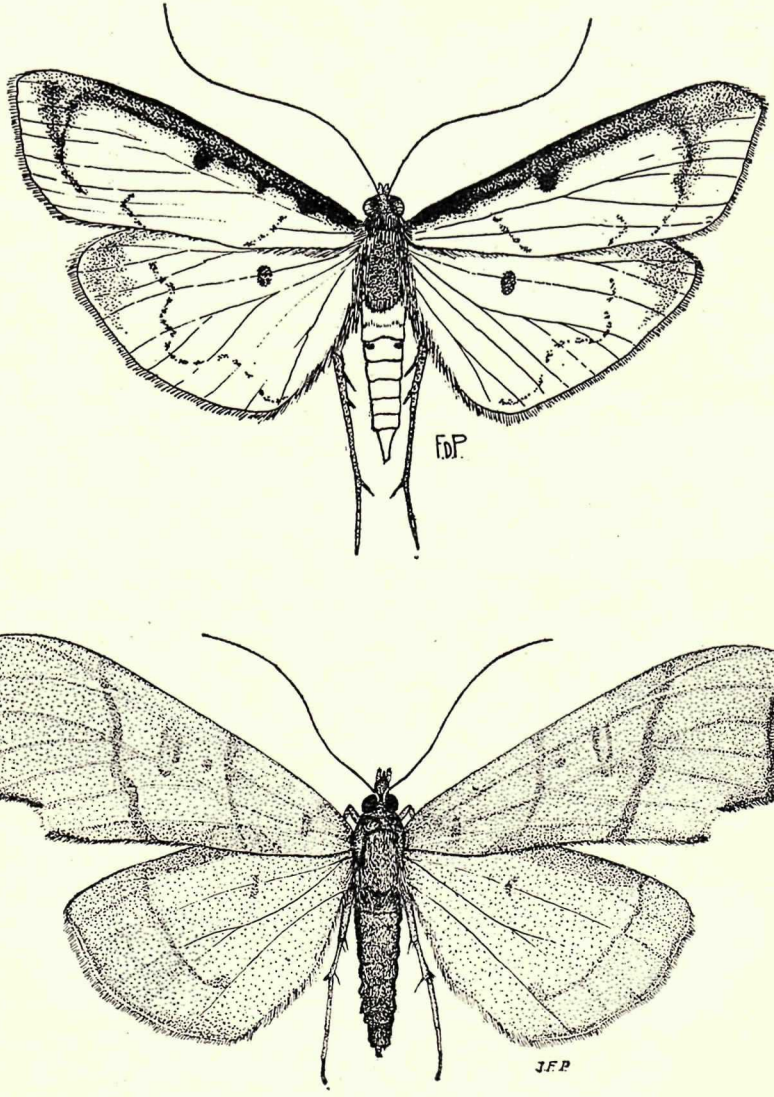
A very common moth in the Island, also widely distributed throughout tropical America, recorded from Cuba, Haití, Virgin Islands, Dominica.

PLATE XIII

Gonodonta nitidimacula Guenée
Dichogamma redtenbacheri Lederer
Sylepta silicalis (Guenée)



(Luis F. Martorell: A Survey of the Forest Insects of Puerto Rico)



(Luis F. Martorell: A Survey of the Forest Insects of Puerto Rico)

Guadeloupe, Mexico, Guatemala, Panamá, Venezuela, Dutch Guiana and Brazil. (Listed by Möschler, p. 294 as: *Acrospila concordalis* Hübner and *A. gastralis* Guenée; in IB, p. 459 as: *Mesocondyla concordalis* Hübner.)

Moth: The species is very variable in size and color, some individuals are pale hyaline yellow, others bright yellow with the dark markings on the wings and body very distinct. In general the moth can be described as follows:

The moth has a wing expanse of 25 to 30 mm., is light yellow with some irridescence on its wings. The costal area of the fore wing and the anterior part of the thorax are purplish brown. The costal area of the hind wing is nearly white; a very prominent brown spot is located on the outer portion of the discal cell, just crossing the discal vein; apex marked with a brown spot. Abdomen yellow, with two small brown spots on the dorsal part of the second segment. Eyes black, antennae filiform, yellowish, with basal part light brown. (See Plate XIV.)

Caterpillar: When fully grown the caterpillar is of a shiny dirty-green color, its translucent body giving it a somewhat slimy appearance.

Pupa: The pupa is very variable in color, ranging from light to dark brown, about 15 mm. long and 3 mm. wide. Pupation period 8 days.

Habits: The caterpillar is a leaf-webber and causes tremendous defoliations when it becomes abundant. Its system of feeding is very peculiar, destroying only the epidermis of the leaf instead of feeding on the entire leaves as most caterpillars do. Trees attacked show many skeletonized leaves, most of them in bunches, webbed together. The caterpillar usually remains, among the webs and when the food supply is exhausted, it moves and makes another web of fresh leaves, so repeating, until it becomes fully mature and ready to pupate. Pupation takes place among the leaves, and only a very fine and delicate silken web or cocoon is spun around the pupa. This web is easily broken at the slightest touch.

Eulepte is found at low altitudes as well as at middle and higher elevations. Personal observations made by the writer demonstrate that the insect is more abundant during the Fall and Winter in the lowlands and during the Winter at middle and higher elevations.

Natural Enemies: The caterpillar is attacked by the larvaevorid flies, *Argyrophylax albicinsa* (Wiedemann) and *Carcelia flavirostris* van der Wulp. This last record was obtained from a specimen in the collection at the U. S. National Museum, labeled, "from caterpillar on calabash tree, at Mayaguez, Jan. 5, 1912; coll., Hooker." The chalcid, *Brachymeria*

PLATE XIV

Eulepte concordalis Hübner
Sparagmia gigantalis Guenée

incerta (Cresson) and the braconid *Microbracon cushmani* Muesebeck, are also important parasites of this pest.

The following observations were made on the biology of the braconid, *M. cushmani* Muesebeck. The larva of the braconid is small, creamy, about 3 mm. in length, when fully grown. Before pupation it changes in color from creamy to grey and dark grey, nearly black. A fine silken cocoon is spun by each larva and this is attached to the leaf of the host tree by means of silken hairs. Usually all the cocoons are close together in a bunch of 15 to 20 according to the number of larvae feeding on each caterpillar. The pupation period is about 8 days at the end of which the adult parasites emerge. The parasitic wasps are from 2.5 to 3 mm. long, thorax and legs reddish brown, abdomen yellowish with light brown markings on the dorsal part of the first three abdominal segments. Wings smoky, eyes and antennae black, making a nice contrast with the light brown head. From 15 to 20 adults have emerged from a single caterpillar. (Notes on moth, caterpillar, pupa and natural enemies, from Martorell, Oct. 1940, pp. 18–19.)

Host: The caterpillar feeds on the foliage of the following trees:

Crescentia cujete L.	"higüera"
Spathodea campanulata Beauv.	"tulipán africano"
Tabebuia argentea (Bur. & Schum.) Britton	"roble de plata"
Tabebuia heterophylla (DC) Britton	"roble prieto"
Tabebuia lucida Britton	"roble de mona"
Tabebuia pallida Miers	"roble"
Tabebuia rigida Urban	"roble de sierra"
Tabebuia schumanniana Urban	"roble colorado"

Conchylodes diphteralis (Geyer)

(The Capá Prieto Leaf-webber)

Not a common species in Puerto Rico, also recorded from Cuba, Jamaica, Hispaniola and the Virgin Islands. (Listed by Möschler, p. 315 as: *Ledereria diphteralis* Hübner.)

Moth: The moth is white, with many black markings on the wings and body. Wing expanse 27 to 29 mm. (See Plate XV.)

Caterpillar: The fully grown caterpillar is 25 to 30 mm. long and 3.5 to 4 mm. in width, shiny dark green dorsally and laterally, light green ventrally. Body in general is transparent, the inside organs visible through the fine outer integuments. Two very conspicuous whitish lines run all the way longitudinally from the head to last body segment, these becoming very faint on reaching the last segment. These two lines are about 2 mm. apart and run dorsally. Thoracic legs dark brown nearly

black, prolegs and anal legs fleshy, light green in color. Head 2 mm. in width, shiny, epicranium dark brown with a mottled whitish pattern, front dark brown, clypeus grayish, mouth parts brown, antennae brown and gray. Cervical shield on first segment dark brown, with two whitish lines, really the beginning of those running all the way dorsally and longitudinally to the anal segments. Spiracles brown, plainly visible, especially those on the first thoracic segment. Dorsal markings on thoracic segments 2 and 3 are similar, each segment having two small spots of a dark brown color, somewhat circular in shape, surrounded by a whitish ring, each spot bearing two silvery setae. These spots are placed between the two longitudinal-dorsal lines, the outer end of each just touching the line. From segment 4 to 11 the pattern is changed and here four circular spots occur on each segment, arranged in a sort of a square, the pair in front larger than the posterior. These spots are also dark brown, nearly round, surrounded by a whitish line, each spot bearing a silvery setae and their outer edge just touching the longitudinal line on the dorsal part of body.

Pupa: The pupa is about 15 mm. long, shiny, reddish brown in color. Pupation period 12 to 13 days.

Habits: The caterpillars are leaf-webbers, gregarious in habits, sometimes 15 to 20 are found in a bunch of leaves webbed together in a large mass. Just before pupation the caterpillar cuts a section of a leaf, folds it back and makes a sort of an elongated, nearly oval-shaped cocoon about 20 to 25 mm. long and 8 to 10 mm. wide. A fine silken cocoon is spun then inside this bag, where pupation takes place. Usually the operation of forming the cocoon takes place 3 or 4 days before pupation begins.

The only caterpillars that have been reared to adults by the writer, were collected at El Peñón del Collao, about 1,900 ft. altitude, Oct. 1940.

Host: Dr. Gundlach recorded the caterpillar of this species from trees of the genus *Cordia*. The only record for Puerto Rico so far, is on *Cordia alliodora* (R. & P.) Cham., our common "capá prieto".

Dichogama fernaldi Möschler

(The Burro Caterpillar)

A fairly common species in Puerto Rico, also recorded from Vieques Island.

Moth: The front wings are brownish with a reddish tinge, hind wings whitish with a pinkish tinge, abdomen and anal tuft golden brown. Wing expanse about 20 mm.

Habits: The caterpillar is a leaf-webber and at the same time a pod-borer, causing tremendous damage when it becomes abundant. Pupation takes place either inside the pods or between the leaves.

Host: The caterpillar feeds on the pods and foliage of "burro", *Capparis flexuosa* L.

Dichogama redtenbacheri Lederer

(The Capparis Leaf-webber)

A fairly common species in our lowlands, especially in the southern and southwestern districts of Puerto Rico. Also recorded from Florida, West Indies, Virgin Islands, Mexico and Perú.

Moth: The species shows a great deal of color variation on the wings, but in general it is a very light yellow, the front wings with a peculiar pattern which in some individuals is very clear and in others almost obsolete. Wing expanse 25 to 33 mm. (See Plate XIII.)

Habits: The caterpillar of the species is a leaf-webber. Pupation takes place among the leaves inside the webs. The caterpillar is more abundant during the Fall and the beginning of the Winter. Although typically a lowland type, sometimes it is found at middle elevations.

Host: The caterpillar feeds on the foliage of "palinguán", *Capparis flexuosa* L. and "burro blanco", *Capparis portoricensis* Urban.

Dichogama gudmanni von Hedemann

(The Capparis Pod-borer)

A common species in the Island, also recorded from the Virgin Islands. Observed in the lowlands, particularly along the coast.

Moth: The moth is white, the front wing with an orange band on the outer margins and brownish transverse markings across the wing. Hind wings are white. Anal tuft yellow or orange. Wing expanse ranging from 25 to 28 mm. (See Plate XVI.)

Habits: The caterpillar is a leaf-webber and a pod-borer, destroying an enormous amount of pods. When abundant it causes heavy defoliation, particularly in small trees.

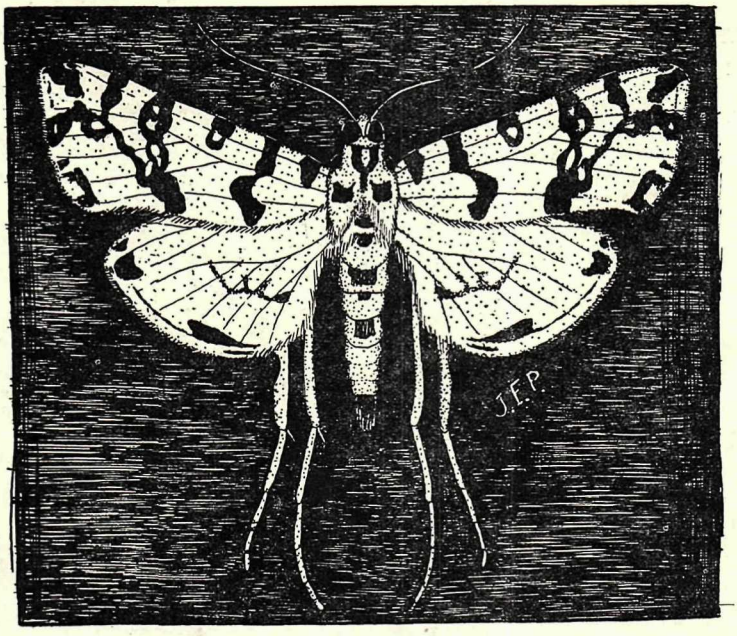
Host: The caterpillar feeds on the pods and leaves of "burro prieto", *Capparis cynophallophora* L.

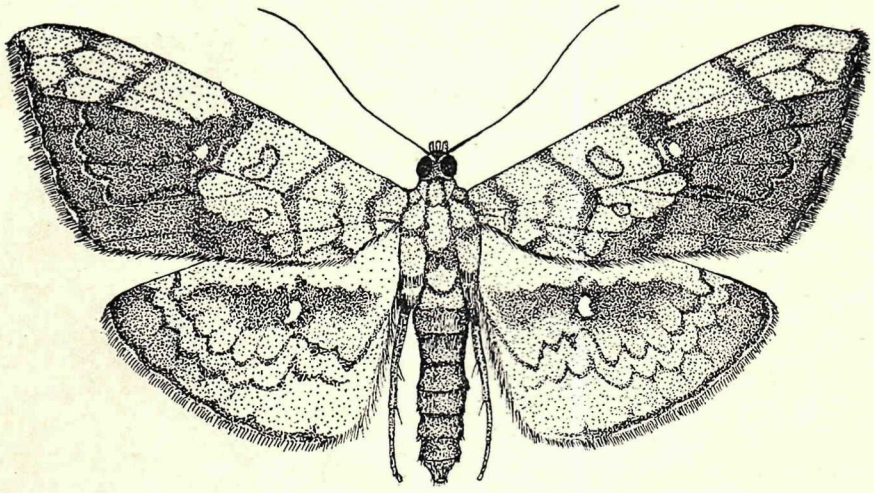
Phostria humeralis (Guenée)

A rare insect in Puerto Rico, found also in other parts of tropical America, Haiti and Colombia. (According to Möschler). (Listed by Möschler, p. 301, as *Omiodes humeralis* Guenée).

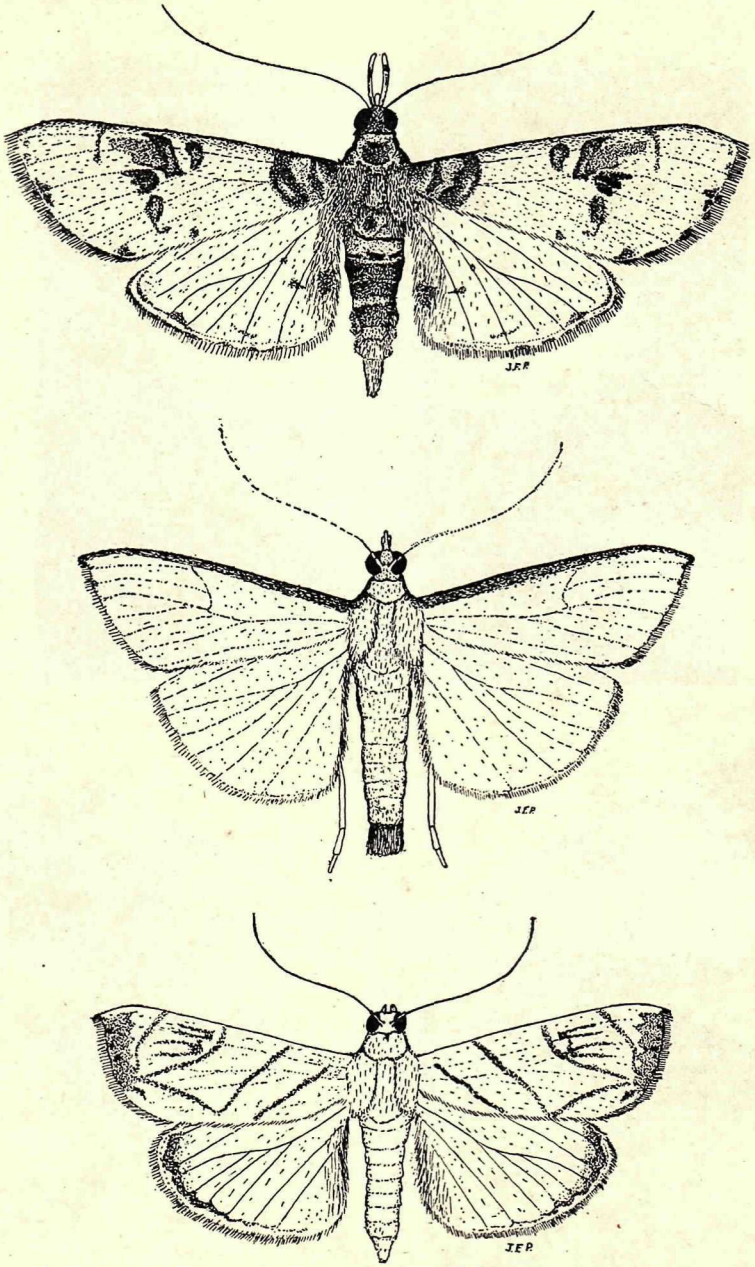
PLATE XV

Conchylodes diptheralis (Geyer)
Pantographa limata G. & R.





(Luis F. Martorell: A Survey of the Forest Insects of Puerto Rico)



(Luis F. Martorell: A Survey of the Forest Insects of Puerto Rico)

Moth: The moth is dark brown with darker transverse markings on both wings, anal tuft brown, wing expanse ranging from 24 to 34 mm.

Host: The caterpillars web three or four leaves together and then feed on them; when these are eaten the process is repeated. Collected while feeding on "guaba", *Inga vera* Willd., at 2,000 ft. in altitude, near El Peñón del Collao. Apparently the caterpillars are more abundant during the beginning of the Winter.

Phostria martyralis (Lederer)

(The Lonchocarpus Leaf-webber)

A fairly abundant species in Puerto Rico; also recorded from Cuba and Brazil. (Listed by Möschler, p. 300 as: *Coenostola martyralis* Lederer.)

Moth: The adult moth is of a reddish brown or rust color, fore wings sharply pointed, three fine irregular transverse bars cross both fore and hind wings, the bar towards the outer margin not crossing the hind wing, but only the fore wing. These bars or stripes are of a dark brown color and are very conspicuous. A noticeable yellowish fringe surrounds the outer and anal margins of the hind wings and the outer margin of the fore wings, making a nice contrast with the reddish brown color of the wings. Eyes brown, legs light brown and white, wing expanse from 21 to 23 mm. (See Plate XVIII.)

Caterpillar: The caterpillar when fully grown is about 20 mm. long, green, shiny, transparent, the body sparsely covered by small silvery setae; legs green; head yellowish brown, with one black dot on the middle of each epicranium close to the adfrontals; ocelli black, antennae and mouth parts yellowish brown. On the first thoracic segment just above spiracle there is a small longitudinal black spot.

Pupa: The pupa is brown on its dorsal aspect and greenish brown on the ventral side of the thoracic region, light brown on the ventral abdominal area, about 12 mm. long. The pupa is attached by its anal end to the leaf by means of a very fine silken hair.

Habits: The caterpillar is a leaf-webber and lives among the webs, using this also as a place for pupation. In the field numerous pupae can be collected just by looking in these webs. The larva is more abundant during the first part of December, when serious outbreaks occur. The caterpillar spins a very fine silken cocoon around its body just before pupation, taking a reddish color and then pupating within one or two days.

PLATE XVI

Azochis rufidiscalis Hampson
Diaphania costata (Fabricius)
Dichogamma gudmanni Hedemann

Natural Enemies: The caterpillar is attacked by a parasitic wasp of the genus *Apanteles*. Sometimes, in looking in the webs, one may find three or four of the white silken cocoons of the parasite and no pupa at all. These cocoons are very typical of *Apanteles*; white elongated-oval, about 4 mm. long, attached to the leaf by means of very delicate silken hairs. The parasite itself is about 2 mm. long, all black except for black and brown legs, wings hyaline, antennae filiform, black, and in the females the ovipositor is about 1 mm. in length. Quite a number of caterpillar are destroyed by the parasite, but unfortunately the parasite itself is parasitized by another parasitic wasp. The hyperparasite in this case belongs to the genus *Syntomosphyrum* of the Family Tetrastichidae. More than two or three of those minute hyperparasites emerged from each *Apanteles* cocoon. These are about 1 mm. long, all black except for brown and black legs, antennae short, wings transparent and irridescent.

Host: The caterpillar feeds on the foliage of *Lonchocarpus domingensis* (Pers.) DC. and *Lonchocarpus latifolius* (Willd.) H.B.K., commonly known as "genogeno" and "hediondo" respectively.

Phostria originalis (Lederer)

(The Moca Leaf-webber)

This species is not common in the Island, found only at higher altitudes during the coldest season of the year, very sporadic and not seen sometimes for years.

Moth: The moth is brown with transverse dark brown markings on both fore and hind wings. The anal tuft is brown and whitish. Wing expanse from 22 to 26 mm.

Caterpillar: The fully grown caterpillar is about 19 mm. long and 3 mm. in diameter, dark green color, with several markings and spots over the body and two yellowish lines running longitudinally from head to anal segments on each side of the body.

Pupa: The pupa is dark reddish brown, about 14 mm. long and 3 mm. in diameter. Pupation period, about 10 days.

Habits: The caterpillar is a leaf-webber and when abundant causes nearly total defoliation of the trees attacked. It makes large webs and among them one can find 30 to 40 caterpillars. When the food is exhausted in one of these webs a new one is made, and so on. Often on looking at a tree the only thing one can see is the bare branches and twigs and several of these webs scattered around among the bare twigs. Pupation takes place inside these webs. By the time the caterpillar is ready to pupate it spins a very delicate silken cocoon around itself, becomes very slow in its movements, changes to a yellowish color and pupates. The

pupa at first is of a greenish color, in a day or so changing to brown, light brown, or dark reddish brown. There is a great variation in the coloration of the pupae.

The caterpillars are not common and apparently they are only abundant during the coldest season of the year. Sometimes they are seen every two or three years. They seem to prefer the middle or higher altitudes and never have been observed at lower altitudes where their host trees are abundant.

Host: The caterpillar feeds on the foliage of "moca", *Andira jamaicensis* (Wright) Urban.

Blepharomastix ebulealis (Guenée)

(The Heterotrichum Leaf-folder)

Not a common species in Puerto Rico; also recorded from the United States, South America and the West Indies. (Listed in IB, p. 460 as: *Lamprosema ebulealis* Guenée.)

Moth: The moth is yellow with brown markings across the wings, eyes black, antennae yellow, 2 characteristic black spots present on the dorsal part of the third abdominal segment, just at the end of second, legs silvery or white.

Caterpillar: The full grown caterpillar is about 13 mm. long, light green color, shiny and translucent.

Pupa: Pupation takes place on the leaves of the host plant. The pupa is small, about 8 mm. long and of a chestnut color.

Habits: The caterpillar although small is a very voracious feeder. It folds the leaf or sometimes webs two or three leaves together, feeding at the same time on the foliage. Sometimes one may find three or four folds in a leaf and in each a small caterpillar of this species. The species seems to thrive best at middle altitudes. The only specimens reared were from caterpillars collected at El Yunque Mountains, 1,900 ft. altitude. At the time many trees were infested by the larvae, but unfortunately nearly all were parasitized by larvaevorid flies.

Natural Enemies: On examining the folds on the leaves, several puparia of flies were collected and when reared and identified were: *Leskiopalpus flavipennis* (Wiedemann). The puparium was reddish brown and about 6 mm. long. The adult fly is about 6 mm. long, black eyes and antennae, yellow-brown abdomen, the legs yellow brown and black, wings hyaline, body densely covered by hairs or setae especially on the abdomen. This fly seems to be an efficient natural control for this insect.

Host: The caterpillar feeds on the foliage of "terciopelo", *Heterotrichum cymosum* (Wendl.) Urban.

Sylepta silicalis (Guenée)

A rare moth in the Island, widely distributed through tropical America from Mexico to Brazil and the West Indies.

Moth: A yellow moth with very faint markings across the wings, about 22 mm. in wing expanse. (See Plate XIII.)

Caterpillar: Fully grown caterpillar about 30 mm. long, green color with dark brown head.

Habits: The caterpillar was recorded once as a leaf-roller, however the writer found it boring in the buds or feeding on the tender leaves at the terminals on branches of "yagrumo" trees. The moth seems to prefer the middle altitudes, all the records from Puerto Rico indicating such.

Host: Recorded once as a leaf-roller on "yagrumo macho", *Didymopanax morototoni* (Aubl.) Dcne & Pl., at Lares, 1922. Later on, during Sept. 1940, the writer collected the caterpillars feeding in the buds of "yagrumo or yagrumo hembra", *Cecropia peltata* L., at El Yunque Mts. (altitude 1,900 ft.).

Paradosis flegia (Cramer)

Although this insect is not common in the Island, it is one of the most common moths of Central America, also recorded from Mexico, United States (Florida) and the West Indies. (Listed in IB, p. 462 as: *Margaronia flegia* Cramer.)

Moth: The moth is white, with a characteristic subcostal blue line or streak; anal tuft white; wing expanse 33 to 53 mm. The moth can be easily identified by means of the blue line on the fore wings.

Host: The caterpillar feeds on the foliage of "cabalonga", *Thevetia nereifolia* Juss.

Diaphania costata (Fabricius)

(The Rauwolfia Leaf-folder)

Fairly abundant in Puerto Rico, present also in other West Indian islands. (Listed by Möschler, p. 298 as: *Pachyarches aurocostalis* Guenée; IB, p. 462 as: *Margaronia aurocostalis* Guenée.)

Moth: The moth is white, with a light brown abdomen, brown anal tuft and a characteristic golden subcostal line or streak on the fore wings. Wing expanse 20 to 25 mm. (See Plate XVI.)

Caterpillar: The caterpillar is about 25 mm. when fully developed; green, transparent; head flattened, light brown except for dark brown labrum and black ommatidia. Thoracic shield light brown, legs green.

Pupa: The pupa is brownish in color, about 13 to 15 mm. long.

Habits: The caterpillar, which is a leaf-folder, feeds on the epidermis

of the leaves inside the fold, rarely piercing through. When the food supply is exhausted in one of the folds, it moves to another leaf, folds it and starts feeding again. Only a part of the leaf is folded, usually along the edge. Some leaves show two or three folds at the same time. The larva pupates in one of these folds. Before so doing it turns yellowish and then pink or reddish and the pupation takes place within a day or two. *Diaphania costata* is a typical lowland insect, very abundant especially in the dry districts of Puerto Rico where its host tree is commonly found.

Host: The caterpillar feeds on the foliage of "palo amargo", *Rauwolfia nitida* Jacq.

Agathodes designalis Guenée

(The Bucare Caterpillar)

A very common moth in Puerto Rico, also recorded from Florida and tropical America (Mexico, Guatemala, Costa Rica, Colombia, Ecuador, Brazil and Hispaniola.) (Listed by Möschler, p. 303 as: *Stenurges designalis* Guenée and also recorded by him as far south as Argentine in the South American continent.)

Moth: In a few words, the moth can be described as follows: hind wings pale semi-transparent, tinted with golden, fore wings having a peculiar colored pattern, in which tints of reddish are predominant. Wing expanse 27 to 32 mm.

This species which was described by Hulst (1886) p. 156, as *Stenurges floridalis* Hulst, is now in synonymy with *A. designalis* Guenée. Hulst's description is as follows:

"Expands 31 mm. Palpi dirty whitish; head same color in front; white between the antennae and along eyes in front; thorax white; patagiae dirty yellow. Abdomen, first segment white, the next reddish brown above, edged behind with white, then olive-brown, slightly annulated with dark brown at segments; blackish anteriorly on side; fore wings with costa narrowly white; a broad mixed pink and brown-red band starts from inner margin at middle and runs straight to costa, striking it two-thirds distance out from base, and there meets and merges with a smaller band from centre of outer margin; these lines are edged with a fine metallic silver line; field within the line basally, and apical space dirty olive; space at outer angle ferrugineous; at base in olive space is a dark fuscous dash; gringe wine red towards apex, whitish posteriorly; marginal white line, fine; outer border not angulated; hind wings pale fuscous, with an ochreus reddish tinge; beneath, pale dirty fuscuous; legs pure white." (See Plate XVII, also color illustration in Holland 1913, Plate XLVIII, fig. 3.)

Caterpillar: The larva is about 22 mm. long when fully grown, about 3 mm. in diameter in the widest part of the body about its middle, then

tapering towards the anterior and posterior ends. Head capsule light brownish orange, about 2 mm. in width when caterpillar is fully grown; mouth parts dark brown. General ground color of the larva is light green, dorsally two whitish or very light green lines or bands, separated about 2 mm. run all the way from the first thoracic segment to last anal segment of body. Segments 4 to 11, each of them bear dorsally, 4 black or black and green tubercules, arranged in a square, between the two whitish dorsal lines, the anterior pair larger than the posterior ones on the same segment; each tubercule bearing a silvery setae. Each tubercule is also surrounded by a whitish or light green line. The space between the tubercules in the area within the two whitish lines is darker green than the rest of the body. Thoracic legs dark brown, prolegs light green.

Pupa: The pupa is about 18 to 20 mm. long and light brown in color. Pupation period 10 days.

Habits: Newly hatched caterpillars are about 2 mm. long, and of a transparent green color. There is no color differentiation at first between the body and head capsule. For the first four or five days the young caterpillar feeds only on the upper epidermis of the leaves. It grows very fast and by the end of 8 or 10 days a single caterpillar can eat two whole leaves of *Erythrina* in a single day. On its eighth day the larva is nearly full grown. Many larvae reared, pupated on their tenth day.

The habits of the larva are very peculiar. At first, when they are very young, they start by doing a sort of little silken shelters, where they stay when not feeding. As they grow they begin to fold an edge of the leaf and then they are concealed beneath this fold; often two or three leaves are glued together and live among them, feeding constantly at the same time. Pupation takes place in the leaves, either in the fold previously made or between two or three leaves. The caterpillar spins a very fine silken cocoon around its body just before pupation.

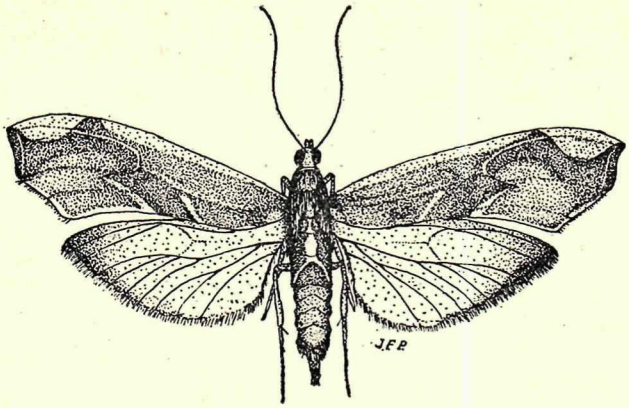
The caterpillar is a leaf-roller or leaf-folder and at the same time a twig-borer. When acting as twig-borer the ground color of the body instead of being green is creamy or cream reddish. In this case pupation takes place in the bore in the twig.

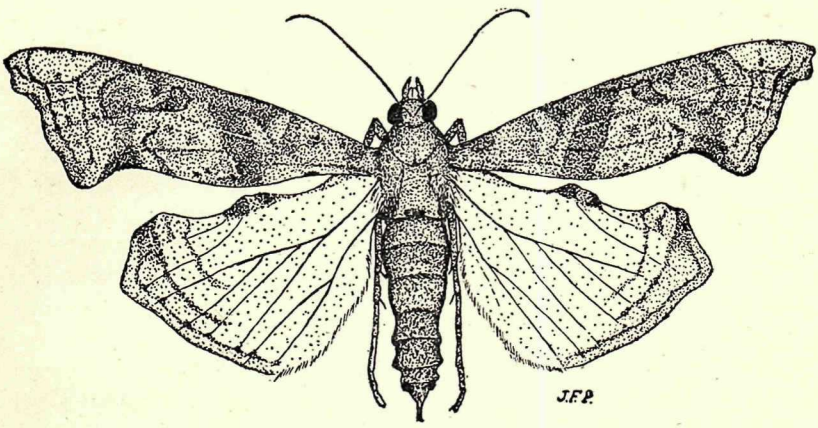
This species is very voracious and pestiferous, doing damage of considerable importance, not only by causing heavy defoliations but by destroying the new shoots as these develop year after year. The insect ranges from the low altitudes to the middle and higher in Puerto Rico. In Costa

---

PLATE XVII

Agathodes designalis Guenée
Terastia meticulosalis Guenée





(Luis F. Martorell: A Survey of the Forest Insects of Puerto Rico)

Rica (Central America) specimens have been collected at Volcán de Irazu at 6,000 to 7,000 ft. in altitude.

Natural Enemies: The only parasite recorded in the Island attacking this insect is *Lissonota* sp., a parasitic ichneumonid which attacks the caterpillar.

Host: Möschler recorded the insect from *Erythrina crista-galli* L., from Argentine. This tree species is occasionally planted in the Island but the insect has not been recorded so far from it. In general *Agathodes* should be called a pest of *Erythrina*. Locally it has been recorded from the following species:

Erythrina berteroana Urban	"machete"
Erythrina glauca Willd.	"bucare"
Erythrina poeppigiana (Walp.) O. F. Cook	"bucare"

The caterpillar has been also recorded as boring in the trunks of *E. glauca* Willd. and *Inga vera* Willd., our common "guaba".

Terastia meticulosalis Guenée

(The Bucare Twig-borer)

A fairly common species in Puerto Rico, although not so abundant as *Agathodes designalis* Guenée. Also recorded from Florida, tropical America (Mexico, Guatemala, Honduras, Costa Rica, and in the Antilles: Hispaniola and Puerto Rico) and the East Indies.

Moth: In general, the moth can be described as light brown in color, with very prominent dark brown markings in the fore wings; hind wings shining semi-hyaline. The peculiar shape of the fore wings is very characteristic of the species. Wing expanse 35 to 42 mm. (See Plate XVII.)

However, Hulst (1886, p. 156) described this species from Florida as *Megastes coeligenalis* Hulst, as follows:

"Expands 40 mm. Palpi and front dull ochreous; vertex yellow, white between the antennae and eyes; thorax and abdomen fuscous, lighter dorsally; fore wings fuscous hyaline; costa and base fuscous, the costa, within edge, black, especially near middle of wing; a fuscous olive broad inter-medial band oblique; orbicular and reniform prominent, annulate; space beyond band thinly fuscous, almost hyaline; a narrow shading running from orbicular to anal angle and a costal apical line soon returning beyond itself to costa near apex; outer margin somewhat falcate, sinous, angulate at middle of anterior margin; this angle and the outer angle dark brown; two faint submarginal cloudings near apex; margin blackish; beneath, semihyaline; orbicular and reniform distinct; two outer dark lines on fore wings, and apically on hind wings; markings brown; legs cinerous fuscous." (Color illustration in Biol. Centr.-Amer. Lep. Het. vol. 3, Plate 61, fig. 2.)

Caterpillar: The caterpillar is creamy or whitish in color, about the same appearance as that of *Agathodes designalis* Guenée.

Habits: The caterpillar is a twig and pod borer. All the adults reared have been collected from caterpillars boring in twigs and pods of trees. The insect is found at low, middle and higher altitudes.

Host: Recorded from the following: "machete" *Erythrina berteroana* Urban, *Erythrina glauca* Willd. and in "capá blanco", *Petitia domingensis* Jacq.

Sparagmia gigantalis Guenée

A rare species in Puerto Rico (see Plate XIV); also distributed throughout tropical America.

Host: Mr. F. Seín collected the larva on "yagrumo" or "yagrumo macho", *Didymopanax morototoni* (Aubl.) Dcne. & Pl.

Pyrausta cerata (Fabricius)

(The Péndula Leaf-webber)

This insect is very common in Puerto Rico, also recorded from the United States, Mexico, Guatemala, Panamá, Brazil, Venezuela, Honduras, Colombia, Jamaica, Hispaniola and the Virgin Islands. (Listed by Möschler, p. 283 as: *Botys cedipodalis* Guenée.)

Moth: The moth is yellow, with transverse yellow-brown markings on its wings, long whitish legs and yellow antennae. Wing expanse 30 to 40 mm.

Egg: The eggs which are laid on the leaves are more or less oval in shape, flat, light green, about 60 or more eggs to a mass, and arranged like the eggs of our common sugar cane moth-borer, *Diatraea:* that is, overlapping one over the edge of the other, just like fish scales.

Caterpillar: The fully grown caterpillar is semi-transparent green, 28–30 mm. long, with cadmium yellow head, on which are several small black spots subtending hairs. The first and last segments of the body with numerous small black dots, the other segments marked dorsally with four quite large black spots, irregularly oval, arranged in a square, each spot with a clear space near the center about the base of a hair; laterally a thick irregular black ring about the base of a hair above the spiracles, and below a narrower black ring around two black dots, each the base of hairs; ventrally a very narrow black ring around the black base of a hair and a group of three black-based hairs on each side of most segments. Legs transparent light yellow. (IP, p. 193.)

Cocoon: The cocoon is made out of a brown silk, in three distinct layers, formed in a folded-over leaf. The cocoon itself is very tough and

hard to break. In this way the pupa inside is partially protected from parasites and other enemies.

Pupa: The pupa is brownish in color. Pupal period 10 to 12 days.

Habits: The caterpillar is a leaf-webber and causes tremendous defoliation on trees. When abundant hundreds of trees are defoliated in the areas affected. The insect ranges from the lower to the higher altitudes in Puerto Rico.

The caterpillar feeds on the foliage of the trees, at the same time making large webs. Sometimes four or five caterpillars are found in a single web. Pupation takes place in the webs, the larvae spinning cocoons and pupating in them.

Natural Enemies: The caterpillar is parasitized by the ichneumonid wasp, *Epihosoma insularis* Viereck.

Host: The caterpillar feeds on the foliage of the following trees:

Citharexylum caudatum L.	"péndula"
Citharexylum fruticosum L.	"péndula"
Vitex divaricata Sw.	"higüerillo"

Spilomela fimbriauralis (Guenée)

(The Colubrina Leaf-roller)

This species is not abundant in Puerto Rico. It has been recorded from Mexico, Central America and South America as far South as Brazil, also the West Indies.

Moth: A beautiful dark or bright yellow moth with body and wings marked with brown and golden spots; the golden spots very plainly visible along the outer margin of the wings. Anal tuft dark brown, wing expanse from 16 to 23 mm. (See Plate XVIII.)

Caterpillar: The fully grown caterpillar is about 15 to 18 mm. long, green, shiny, transparent, head light brown, the sides of the epicranium mottled by dark brown markings, these markings following back and including the thoracic shield. Front, adfrontals, and clypeus very light brown, labrum and mandibles brown, antennae dark brown, ocelli black. Legs green.

Pupa: The pupa at first is brownish green, then turning brown, shiny. Pupation period 9 days.

Habits: The caterpillar is a leaf-roller usually found in shady places, never attacking trees exposed to the open sunlight. All the trees infested in the field were those just below a canopy formed by the branches of higher trees, thus producing ideal shady conditions. In some trees about 50 per cent of the leaves were rolled. Often one finds three or four rolls in a leaf. The caterpillar feeds on the foliage inside the roll. When the

food is exhausted it moves along and builds a new roll. The edges of the nearly perfect roll are kept together by means of fine but strong silken hairs; otherwise it would be impossible to keep the leaf so well rolled. The roll usually follows a pattern; that is, the leaf is rolled from the lower epidermis up, the shiny part of the leaf going towards the inside. Pupation takes place inside the roll, but sometimes the caterpillars when ready to pupate leave the rolls, web two or three leaves together and pupate between them. Before pupation the caterpillar takes a very light green color. A fine silken web or cocoon is spun around the pupa before pupation. Field observations demonstrate that the insect is a lowland type, it never has been collected at middle altitudes.

Host: The caterpillar is a leaf-roller on "abeyuelo", *Colubrina arborescens* (Mill.) Sarg.

Azochis rufidiscalis Hampson

(The Jagüey Twig-Borer)

A fairly common species in Puerto Rico, also recorded from the United States.

Moth: The moth is very light yellow, nearly white, with reddish brown markings on the fore wings and abdomen. Wing expanse about 26 mm. (See Plate XVI.)

Host: The caterpillar of this species is a twig-borer on "jagüey", *Ficus stahlii* Warb.

Pilocrocis secernalis (Möschler)

(The Capá Blanco Leaf-webber)

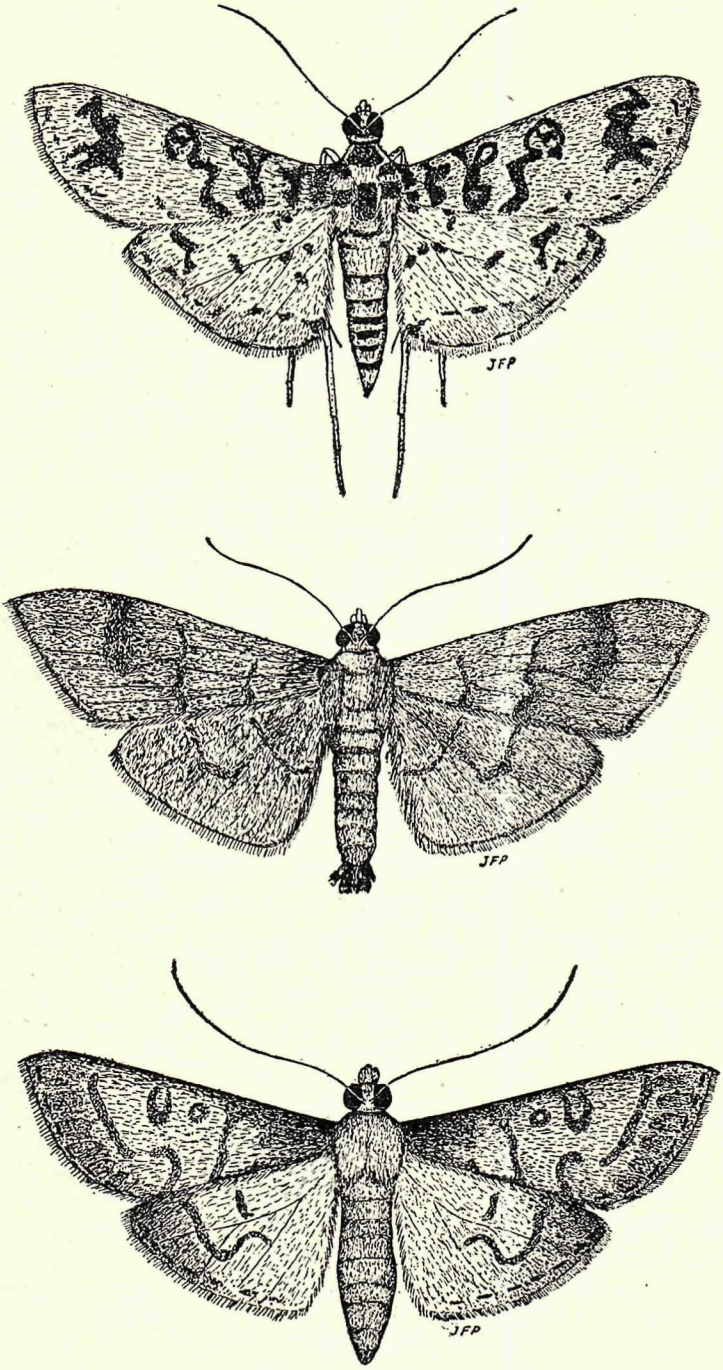
A species with a limited distribution in Puerto Rico, Jamaica and Hispaniola. (Described by Möschler, p. 288–9 as: *Botys secernalis;* in IB, p. 468, listed as: *Botys secernalis* Möschler.)

Moth: The moth is medium brown in color with transverse dark brown markings on both fore and hind wings. Wing expanse from 18 to 20 mm. (See Plate XVIII.)

Habits: The caterpillar is a leaf-webber and usually webs three or four leaves together, feeding upon them and pupating in the web also. A very fine silken cocoon is spun by the caterpillar just before pupation. The insect has been collected in altitudes ranging from sea-level to 1000 ft. in elevation.

PLATE XVIII

Spilomela fimbrauralis (Guenée)
Phostria martyralis (Lederer)
Pilocrocis secernalis (Möschler)



(Luis F. Martorell: A Survey of the Forest Insects of Puerto Rico)

Natural Enemies: A parasitic wasp of the genus *Microgaster* attacks the caterpillar.

Host: The caterpillar feeds on the foliage of "capá blanco", *Petitia domingensis* Jacq.

Pilocrocis inguinalis (Guenée)

(The Higüerillo Leaf-Roller)

A species which is not common in the Island, apparently adapted to middle and higher elevations.

Moth: The moth is yellow, with brown markings in fore and hind wings, yellowish antennae and white legs. Wing expanse 18 to 22 mm.

Natural Enemies: The caterpillar is parasitized by the larvaevorid fly, *Argyrophylax albicinsa* (Wiedemann) and by a braconid wasp, *Microgaster* sp. Both were reared from caterpillars collected at El Peñón del Collao, near Cayey, at 2,000 ft. in altitude.

Host: The caterpillar feeds on the foliage of *Vitex divaricata* Sw., commonly known as "higüerillo".

Pantographa limata Grote & Robinson

(The Guano Leaf-Roller)

This species is not abundant in Puerto Rico. The insect is widely distributed and ranges from Maine throughout the eastern States, to Mexico, Central and South America as far as Patagonia.

Moth: The moth is yellow with brown markings on both wings; legs and antennae white; wing expanse 36 to 38 mm. (See Plate XV.) (Color illustration in Holland 1913, Plate XLVII, fig. 38.)

Caterpillar: The fully grown caterpillar is 30 mm. long, dark green with dark brown head. The spiracles are very prominent, light brown. Larva shows very few setae on body.

Pupa: The pupa is dark brown, smooth, shiny, 18 to 20 mm. long. Pupation period 10 to 12 days.

Habits: The caterpillar is a leaf-roller. The young larva does very small rolls but as it grows the size of the roll is increased and sometimes these are about four or five inches in length. About 6 or 7 rolls have been noticed on a single leaf. The larva feeds on the foliage inside the roll and when the food is exhausted it moves and makes a new roll and so on, until ready to pupate. Pupation occurs in the rolls. The insect ranges from lower altitudes to middle altitudes from 600 to 1,800 ft.

Natural Enemies: On opening several rolls sometimes one finds only the head capsule, the body of the caterpillar being completely destroyed by a parasite. Instead, white silken cocoons, about 8 mm. long are found

near the head capsule. Parasites reared proved to be the braconid wasp, *Chelonus insularis* Cresson. These were very abundant and presumably played a good role in the control of this insect.

Host: The caterpillar is a leaf-roller in "guano", *Ochroma lagopus* Sw.

Syllepis marialis Poey

(The Thouinia Leaf-Roller)

A species which is not common in Puerto Rico, is also recorded from Cuba, Jamiaca, Costa Rica, Panamá, Colombia and Brazil. (Listed by Möschler, p. 276 as: *Syllepsis marialis* Poey; same name in IB, p. 463.)

Moth: The moth has light yellow fore wings with an elongated brown spot, starting at base and extending out by the costal area towards the middle of the wing, a large brown spot on apex, and a small brown spot on inner angle; hind wings light yellow, semi-transparent, with a brown spot on outer angle, this smaller than the one on the apex of fore wings. The spots on wings as well as the yellow area are irridescent, giving to the spots a somewhat bluish brown appearance. Head, thorax and abdomen dorsally brown, ventrally whitish except for the last segments of abdomen which are light brown. Legs white. Wing expanse 20–22 mm.

Caterpillar: Quite small caterpillar of a shiny green color.

Habits: The larva is a leaf-roller, doing small rolls on the foliage of host trees and later pupating in them. The only shrubs infested were those under the shade of trees. Trees examined in the open were free from infestation. Presumably this species exhibits the same habits of the Colubrina leaf-roller, that is, showing a marked preference for shady places where to live.

Host: The caterpillar feeds on the leaves of "serrezuela", *Thouinia portoricensis* Radlk.

FAMILY EPIPASCHIDÆ

Jocara majuscula (Herrich-Schaffer)

(The Laurel Leaf-Webber)

A moth which is rare in Puerto Rico; also recorded from Cuba. (Described by Möschler, p. 279 as: *Deuterollyta infectalis* Möschler: in synonymy.)

Host: The caterpillar gregarious in habits, is a leaf-webber and feeds on the foliage of the following trees:

Nectandra membranacea (Sw.) Griseb.	"laurelillo"
Nectandra sintenisii Mez	"laurel amarillo"
Ocotea leucoxylon (Sw.) Mez	"laurel geo"
Phoebe elongata (Vahl) Nees	"laurel bobo"

FAMILY CHRYSAUGIDÆ

Pachymorphus subductellus Möschler

(The Roble Twig-Borer)

This twig-borer is very common in Puerto Rico and affects the trees of the genus *Tabebuia*. It occurs from the lower to the higher altitudes, up to 3,000 ft. The following trees have been recorded as being attacked by this borer:

Tabebuia argentea (Bur. & Schum.) Britton	"roble de plata"
Tabebuia haemantha (Bert.) DC.	"roble colorado"
Tabebuia heterophylla (DC.) Britton	"roble prieto"
Tabebuia lucida Britton	"roble de mona"
Tabebuia pallida Miers	"roble"
Tabebuia rigida Urban	"roble de sierra"

FAMILY PHYCITIDÆ

Hypsipyla grandella (Zeller)

(The Cedar Shoot-Borer)

A very common insect in Puerto Rico, also recorded from Guatemala, Costa Rica, Panamá, Perú, Brazil, Venezuela and Trinidad.

Moth: The fore wings of the moth are brown or grayish brown with a darker pattern, the hind wings white with a dark narrow margin. The size is variable and the wing expanse ranges from 23 to 42 mm.

Egg: The egg is .90 mm. long and .75 mm. wide, more or less oval in shape in a horizontal section. When freshly laid it is white, translucent, changing to pink when ready to hatch. Just before hatching the color changes to nearly red. The young caterpillar can be easily observed through the transparent chorion, just before hatching. The chorion is very finely reticulated.

Caterpillar: The fully grown caterpillar is about 20 mm. long, whitish or creamy, with many brown tubercules or spots on the body segments, giving a somewhat spotted appearance; head brown.

Pupa: The brown pupa is about 10–12 mm. long.

Habits: The moth lays the eggs in the twigs, especially the tender ones, where the caterpillar on emerging can immediately bore in. Usually these are laid near the buds or in the intersection where the twigs divide, in this way the caterpillar works its way in, just at the intersection of the two twigs. Eggs are laid singly. The caterpillar is a twig-borer and causes tremendous damage. The heaviest infestations are during the Spring when new shoots are developed. Every year these new shoots are de-

stroyed and so on year after year. Finally the trees are killed, very few surviving. The damage is done principally to young trees. The writer has never observed injury in old trees, at least sufficiently noticeable to be alarming, as happens in two or three-year old seedlings. Complete plantations of cedars have been destroyed in Puerto Rico by this borer.

Natural Enemies: Only one parasitic wasp has been so far recorded as attacking the caterpillar. It is an ichneumonid, belonging to the genus *Calliephialtes*. The parasite attacks the caterpillar while it is in the bore inside the twig and feeds on it, destroying it completely in 10 or 12 days. After the caterpillar is eaten the parasitic larva pupates. Pupation period 10 to 11 days. A beautiful wasp emerges from the pupa which can be described as follows: slender, about 10 mm. in length, the female with an ovipositor nearly as long as the body, head black, thorax light reddish, abdomen dark brown and the legs whitish, spotted with dark brown. Wings hyaline with an irridescent violet and green very noticeable. *Calliephialtes* sp. seems to be a strong and active flier, always moving its wings in an up and down motion, keeping them close to its body during this operation. The abundance and efficiency of this parasite has not been determined yet.

Host: The caterpillar is a shoot borer on the following trees:

Cedrela odorata L.	"cedro español"
Cedrela mexicana Roem.	"cedro"
Swietenia mahagoni Jacq.	"caoba"

FAMILY HYBLAEIDÆ

Hyblaea puera Cramer

(The Hyblaea Moth)

A fairly common insect in the Island; also present in the warmer parts of the globe; Florida, West Indies, Mexico, Honduras, Guianas, Brazil, Mauritius, India, Ceylon, Burma, China, Java and South Africa.

Moth: The fore wings of the moth are brown, the hind wings dark reddish brown with orange spots, and orange band or border on the outer margins, the under surface of the wings reddish brown to orange with brown markings. Antennae filiform, brown; eyes brown; body on the ventral side hairy, yellowish; abdomen dorsally dark brown and at the posterior end of each segment a fine yellowish band.

Egg: The egg is yellowish or greenish in color, striated, oblong, with long diameter 0.05 of an inch. It is transparent, and just before hatching the dark head of the young larva is seen inside the egg. After hatching the empty egg-shell is colorless.

Caterpillar: The caterpillar is variable in coloration, just the same way

as the adult. Generally it is described as follows: Dark purple-gray above, olive-green below, with dorsal and lateral white lines, a subdorsal series of minute white dots and rings, a series of black dots on lateral line; head and first somite black. The body is covered with a few short hairs or setae. The full grown larva measures about 30 mm. long.

Pupa: The pupa is stout, dark brown to very dark purplish brown, with a few scattered bristles, shiny, about 17 mm. long and 6 mm. in diameter. The young pupa is light brown, its color turning darker with age. Pupation period 10 days.

Habits: The eggs are laid singly on the undersides of tender leaves, generally in an angle between two veins, or where the lateral veins join the midrib. In this way the young larvae will have enough tender tissue to feed upon as soon as they emerge from the eggs.

The caterpillar usually feeds at night, during the day it is hidden in a sort of shelter, made by folding an edge of a leaf and sticking its borders to the rest of the leaf surface. Sometimes they web leaves together, this is especially noticeable when infestations occur in nurseries. The caterpillar is very voracious and can consume large quantities of leaves in a single day. When it is ready to pupate, it will do so in many different ways: (1) by pupating among the leaves of the host tree, already webbed, (2) on the leaves of nearby shrubs or plants, (3) among dead leaves on the ground, (4) and in the soil. The total life cycle for this species is about a month.

Applied Control: Infestations of this caterpillar have been checked by means of arsenate of lead sprayed at the rate of 2.5 pounds per 50 gallons of water. (Martorell, Oct. 1939, p. 25.)

Host: This insect is a pest of teak, *Tectona grandis* L., in India and Burma. R. S. Hole (1904) published an interesting work on the life history of this insect, from which most of the notes on habits, description of caterpillar and egg were taken.

In Puerto Rico, the insect has been recorded as attacking the foliage of the following trees:

Petitia domingensis Jacq.	"capá blanco"
Spathodea campanulata Beauv.	"tulipán africano"
Tabebuia pallida Miers	"roble"

FAMILY COSSIDÆ

Psychonoctua personalis Grote

(The Mangle Stem-Borer)

A common species in Puerto Rico, ranging from the lowlands to the middle altitudes; also recorded from Cuba.

Moth: Fore wings gray, with a black spot at end of cell, hind wings light gray with a tint of brown or orange, body grayish. The size of individuals vary considerably and the wing expanse ranges from 22 to 48 mm. (Illustration in Forbes, 1930, Plate I, fig. 7.)

The insect was described by Grote (1865, p. 251.) as follows:

"Whitish cinereous. Ornamentation sub-obsolete. In the male some obscure marblings of brownish scales along internal margin and terminally. Secondaries whitish, without markings. In the female specimen there is a terminal line and a series of sub-terminal, dark, interspaceal, short dashes. Secondaries with a broad, diffuse, pale blackish band along external margin. Head, thorax and abdomen, whitish cinereous, clothed with long whitish hair which is shorter, however, than in the male."

Caterpillar: The caterpillar, which varies very much in size, is fairly large, white or creamy with a dark yellow or light brown head. (Illustrated in EEWI, p. 315 and IB, p. 484.)

Habits: The caterpillar, which bores in the main trunk and branches of coffee trees in Puerto Rico, also attacks forest trees. The presence of this borer is easily detectable in old wood by a characteristic knotty formation, but on younger branches there is no external indication of infestation until the branches are broken by storms, or when the crop is being picked. The caterpillar, which ranges from the lowlands to the middle elevations, seems to be more abundant in the "mangle" swamps of Puerto Rico. Undoubtedly, originally the host trees of this borer are the species growing in the mangrove swamps of the Island, later on going to "pomarrosa" and "coffee", after this two species were introduced into the Island. (See EEWI, p. 315, for economic notes on this pest.)

Host: The caterpillar bores in the following trees:

Eugenia jambos L.	"pomarrosa"
Laguncularia racemosa (L.) Gaertn.	"mangle bobo"
Rhizophora mangle L.	"mangle colorado"

FAMILY HYPONOMEUTIDÆ

Hyponomeuta triangularis Möschler

A fairly common moth in Puerto Rico, also recorded from St. Thomas and Bermuda. (Listed in IB, p. 484 as: *Yponmeuta triangularis* Möschler.)

Moth: The moth is light gray with numerous black dots, forming four longitudinal series on the fore wings. Hind wing brown-gray, with fringe at anal angle white. Wing expanse 18 mm. (Forbes 1930, p. 100.)

Caterpillar: The fully grown caterpillar is 14 mm. long, with an orange

head. Body canary-yellow, an irregular mediodorsal black spot on each abdominal segment, laterally bordered with white, lateral or which is a much larger irregular black, gray-bordered spot. On the second and third thoracic segments, these large lateral spots are broken in two by median white bands; on the first segment are two black crescents only. True legs black, spiracles black, lateral hairs with black areas at base, prolegs black and white banded.

Habits: The caterpillars are leaf-webbers and build considerable large nests or webs out of the leaves of the host trees. They are gregarious in habits.

Host: The caterpillar feeds on the foliage of "coscorrón", *Elaeodendrum xylocarpum* (Vent.) DC.

Pectinophora gossypiella (Saunders)

(The Pink Bollworm)

This is an insect of great economic importance, for it is the worst pest of cotton in our Island, and also in other parts of the Americas. It is widely distributed throughout the cotton growing regions of the world, Africa, Asia, Japan, Ceylon, Strait Settlements, Philippines and Hawaiian Islands, then in the western hemisphere in Mexico, Brazil, Venezuela, and the West Indies. In Puerto Rico it is widely distributed throughout the cotton areas of the Island, also present in Vieques and Mona.

Moth: "Labial palpi reddish brown; second joint with two diffused black bars exteriorly; terminal joint with two well-defined, broad, black annulations, one at base, the other at apical fourth. Antennae brown with narrow black annulations; basal joint with long black pecten. Face and head light reddish brown with some pale iridescent scales. Thorax reddish brown with a sprinkling of black around the collar; patagia somewhat lighter brown, unmottled. Fore wings darker brown with a series of small, ill-defined, black spots along the costal edge from base to apical fourth, where there is a larger dash of light ocherous brown; dorsal edge and apical part of wing suffused with darker, blackish brown; the middle of the wing is irregularly sprinkled with blackish scales and contains on the cell an ill-defined, round, blackish spot, sometimes divided into an upper and lower spot; there is also a smaller spot on the base of the cell; the pattern of the wing is rather vague and there is considerable variation in different specimens; in many there is an ill-defined blackish fascia at apical fourth just before the light costal dash, but in other specimens this fascia is not present and the round dorsal spot is dissolved into several smaller spots. Cilia light ocherous brown, streaked with blackish. Hind wings dark fuscous, somewhat iridescent, lightest towards base; cilia ocherous, ter-

minal and apical parts suffused with dark fuscous; vein 1c with long, ocherous fuscous hairs on the upper side. Abdomen flattened and ocherous above, dark brown laterally with underside suffused with black and with ocherous scaling at the joints. Legs blackish fuscous with narrow ocherous annulations at the joints. The abdomen is very similarly shaped in the male and in the female and it is exceedingly difficult to distinguish the sexes, even in living moths, without dissection or by examination of the frenulum. The male genitalia are remarkably small in proportion to the size of the species; harpes narrow at base, broadening towards tip; tip strongly haired; a cluster of long, heavy, straight spines from inner side, well within the tip; sacculus armed on its edge with a row of stout spines; uncus moderately long, broad at base, tapering to a point, laterally heavily haired; aedoeagus short, stout, with a terminal hook. In the female the the ovipositor is weakly chitinized, covered with stiff hairs; genital plate heart-shaped; bursa copulatrix with two opposite, strongly chitinized, hornlike, serrated invaginations. Alar expanse 15 to 20 mm. (illustration in IB, p. 493).

"Egg: Elongate oval, flattened; about 1 mm. long and 0.5 mm. broad; the shell is pearly white, with a finely wrinkled surface. When newly laid, the egg has a slightly greenish tint. At maturity it turns reddish.

"Caterpillar: The full grown larva is 11 to 13 mm. long, cylindrical, white, with dorsal side strongly suffused with pink. Head reddish brown with blackish brown mandibles and the other trophi yellowish. Thoracic shield rather small, dark brown. Tubercules small, but distinct, yellowish brown, surrounded by deeper pink than the prevalent suffusion and bearing rather short, dark-brown setae. Crotches of abdominal feet 15 to 17.

"Pupa: The pupa is 8 to 10 mm. long, rather plump, reddish brown; posterior end pointed and terminating in a short, stout, upwardly turned hooklike cremaster; entire surface finely pubescent; no long setae, spines or hooks, except on last joint; fronto-clypeal suture distinct and curved sharply upward; clypeus, labrum, pupal eyes and mandibles distinctly indicated; antennae diverging at their extreme tip and not reaching to the tips of the wings; metathoracic legs reaching slightly beyond the wings to fifth abdominal segment. Spiracles small, normal. Anal opening large, slitlike, surrounded by strong hooked setae, 5 or 6 on each side; cremaster surrounded with 6 to 8 similar, strong, hooked setae. Genital opening slitlike, single in both sexes. When mature, the pupa becomes much darker; the imago's eyes can be seen prominently under the gena of the pupal skin, and the segmentation of the adult and legs becomes discernible." (Description of moth, egg, caterpillar and pupa, from Busck 1917, p. 350–1.)

Habits: The small eggs are laid by the females usually singly or in small groups on any part of the fruit or seed pod, calyx and even in the flowers.

The egg hatches in from 4 to 12 days after it is laid. The caterpillar bores inside the pods and starts its life cycle in this way. The larva feeds in the interior of the pods destroying the seeds and fibers, in case of cotton. There are four larval instars, and is during the last one when the caterpillar attains the pink color which has caused its popular name of pink bollworm or "la oruga rosada de la cápsula del algodón." The larval stage lasts for about 20 to 30 days at the end of which pupation occurs. Pupation occurs within the seed pods and usually lasts for 10 to 20 days, depending on such factors as temperature, humidity, rain, etc. (For more interesting information about the habits and life history of this moth, see: Busck, 1917.)

Natural Enemies: The following insects are recorded as parasites of the pink bollworm, some of which were recently introduced, others are native: *Chelonus blackburni* Cam., *Exeristes robartor* (Fabricius) and *Microbracon kirkpatricki* Wilk. (all introduced); *Perisierola* n. sp. near *nigrifemur* (Ashmead) and *Calliephialtes ferrugineus* Cushman (natives). The common fire ant, *Solenopsis geminata* (Fabricius) has been recorded as a predator. (See Fife, 1939.)

Applied control: The best control for this pest is by the use of agricultural practices such as planting during certain seasons of the year, burning the trash left in the fields after the crop is collected (in the case of cotton) and the elimination of alternate hosts.

Host: The caterpillar attacks the pods or seeds of two trees in the Island: "maga", *Montezuma speciosissima* Sessé & Moc. and "Santa María" or "esmajaguilla", *Thespesia populnea* (L.) Soland. The maga is one of our most beautiful wood producing species and the seed pods are easily destroyed by this insect.

FAMILY COSMOPTERYGIDÆ

Homaledra sabalella (Chambers)

(The Palmetto Leaf-Miner)

A very common moth in Puerto Rico and Vieques, also recorded from Hispaniola and Florida. The insect was originally described from Florida, from specimens collected on saw-palmetto (*Sabal serrulata*) during the Spring of 1879.

Moth: The moth can be described as silvery gray in color, with a tinge of lavender in some individuals. The species shows two black dots in fold and at end of cell. Wing expanse about 15 mm.

The following is Mr. Chamber's description of the species:

"Very pale ochreous yellow, or perhaps rather stramineous. Outer surface of the second joint of the palpi brown. There is a small brown

spot on the fold near the hind margin of the fore wings, and a larger one at the end of the disk nearer to the costal than the dorsal margin. Alar expansion $\frac{5}{8}$ of an inch".

Caterpillar: The caterpillar is more or less about 14 to 16 mm. when fully grown, slender and subcylindrical in form. The ground color is white tinged with yellow, the head and prothoracic shield being a darker yellow and the mandibles brown. Extending longitudinally from prothorax to anus are eight somewhat irregular, reddish brown stripes, at equal distances apart around the whole body. These stripes are more pronounced as the caterpillar grows. The larva is very active and when disturbed or removed from its mine it drops hanging on a silken thread. These brown color stripes on the body change in color to brilliant pink or rose, when the caterpillar is preserved in alcohol or is mounted on a glass slide with Canada balsam. (Illustration in Comstock, J. H., "Introduction to Entomology", (revised edition) p. 630, Ithaca, N. Y. 1933.)

Pupa: The pupa is about 8 mm. long and rather slender. Abdomen reddish, wing pads yellowish brown. In general the pupa is smooth, shining; the wing pads extend to the eighth abdominal segment. (Notes on moth, caterpillar and pupa from Comstock 1880, p. 209–10.)

Habits: The caterpillar is gregarious and feeds on the undersurface of the leaves of several palms in Puerto Rico. It builds a sort of a silken nest covered by its excrement. This nest extends and covers the part of the leaf upon which it is feeding. The caterpillar is always under this protective cover. As soon as the food is exhausted in one place it keeps on moving and building more nests, feeding at the same time. The injury is sometimes insignificant but the appearance of ornamental plants is ruined by the ugly brown patches left after the insect had attacked a leaf. When abundant they completely ruin the fronds of palms. The fully grown caterpillar spins a silken cocoon under this nest and pupates there.

Natural Enemies: Parasitic wasps are responsible for the control of this caterpillar in the field. The following have been recorded: *Brachymeria incerta* (Cresson), *Spilochalcis homaledrae* Wolcott and *Spilochalcis cocois* Wolcott, all belonging to the Family Chalcididae.

Host: The caterpillar feeds on the leaves of the coconut palm, *Cocos nucifera* L., on "palma de sierra" *Euterpe globosa* Gaertn., and on "palma de Borbón", *Livistona chinensis* R. Br.

FAMILY PSYCHIDÆ

Oiketicus kirbyi Guilding

(The Bagworm)

A very common species in Puerto Rico, also recorded from Jamaica (?) and Cuba. (Listed by Möschler, p. 122 as: *Oeceticus kirbyi* Guilding.)

Moth: The female is a maggot-like creature, destituted of wings and legs, and never leaves the case or bag in which she lives. The male has a wing expanse of 30 to 36 mm., the wings are brown with nearly black areas on the cubital cell and around it, on the fore wings. Body covered by a woolly or brownish pubescence.

Caterpillar: The caterpillar is dark brown mottled with creamy or whitish spots all over the body and can be easily recognized because it is our only species of bagworm in the Island.

Habits: Very little is known about the biology of our species, but in general we might say that the bagworms are polyphagous in their habits, feeding voraciously on nearly all species of trees and causing often heavy defoliation. (F. Morton Jones, 1928, gives a very interesting account on his studies about the Bagworms of Texas.)

Host: The bagworm has been recorded as feeding on the following trees:

Casearia sylvestris Sw.	"cafeillo cimarrón"
Casuarina equisetifolia Forst.	"casuarina"
Ceiba pentandra (L.) Gaertn.	"ceiba"
Chrysophyllum pauciflorum Lam.	"caimito de perro"
Cordia sulcata DC.	"moral"
Cupania americana L.	"guara"
Guazuma ulmifolia Lam.	"guácima"
Montezuma speciosissima Sessé & Moc.	"maga"
Ochroma lagopus Sw.	"guano"
Persea gratissima Gaertn.	"aguacate"
Petitia domingensis Jacq.	"capá blanco"
Pisonia albida (Heimerl.) Britton	"corcho"
Randia aculeata L.	"tintillo"
Tabebuia pallida Miers	"roble"
Tabebuia rigida Urban	"roble de sierra"
Terminalia catappa L.	"almendra"
Thuja orientalis L.	"tuya"

FAMILY MEGALOPYGIDÆ

Megalopyge krugii (Dewitz)

(La Plumilla)

A very common insect in the Island, apparently endemic.

Moth: The moth is gray or light buff, with numerous white lines on and between the veins of the wings, and some white transverse shading on disc. Wing expanse from 25 to 30 mm. (See Plate XIX.)

Caterpillar: The caterpillar or "plumilla" as it is commonly called in the Island, is very easily identified and can not be possibly confused with any other caterpillar in our fauna. The size of the larva ranges between

25 to 30 mm. when fully grown, and it is all covered by means of white hairs and with brittle spines, which cause a burning sensation if allowed to come in contact with the skin. It really looks like a little powder feathered puff.

Cocoon: The cocoon or pupal case is sort of oval, about 16 by 10 mm. and 7 to 8 mm. in height, with a trap door or operculum by which the moth escapes on emerging. It is rather hard and parchment like and is made out of a special substance secreted by the mature caterpillar mixed with hairs and setae. (See Plate XIX.)

Habits: The caterpillar is a leaf-feeder and when abundant it causes defoliations, sometimes of considerable importance. The caterpillar makes its cocoons usually on the branches, but more often on the trunk of host trees, sometimes 200 or 300 of them are commonly found attached to a small trunk.

Natural Enemies: The two most important parasites of this insect are the chalcidid wasps, *Brachymeria incerta* (Cresson) and *Brachymeria robustella* (Wolcott).

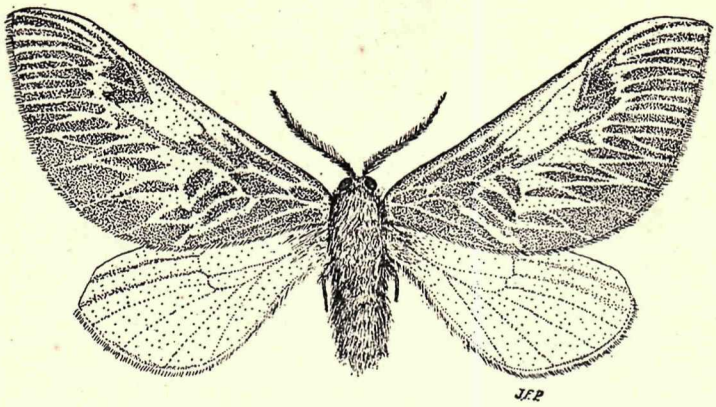
Host: The caterpillar feeds on the foliage of the following trees:

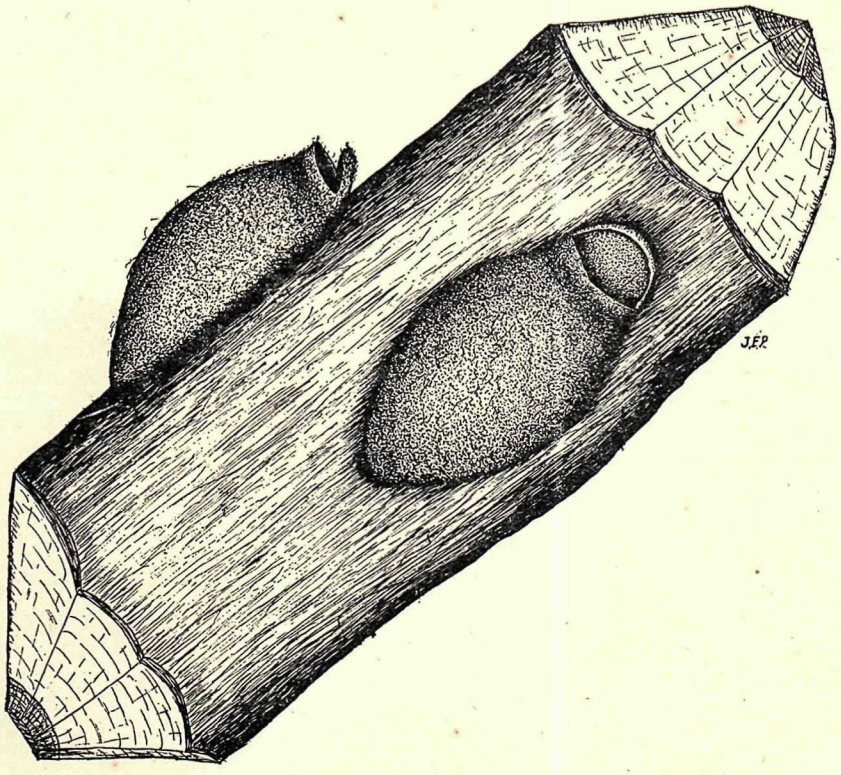
Andira jamaicensis (W. Wright) Urban	"moca"
Brysonima spicata (Cav.) Rich.	"maricao"
Cocos nucifera L.	"coco"
Cordia sulcata DC.	"moral"
Delonix regia (Bojer) Raf.	"flamboyán"
Erythrina glauca Willd.	"bucare"
Ficus laevigata Vahl	"jagüey"
Guaiacum officinale L.	"guayacán"
Guarea trichilioides L.	"guaraguao"
Guazuma ulmifolia Lam.	"guácima"
Inga vera Willd.	"guaba"
Inga laurina (Sw.) Willd.	"guamá"
Nectandra sintenisii Mez	"laurel blanco"
Ormosia krugii Urban	"palo de matos"
Psidium guajava L.	"guayaba"
Rhizophora mangle L.	"mangle"
Sciacassia siamea (Lam.) Britton	"casia amarilla"
Spondias purpurea L.	"ciruela del país"
Terminalia catappa L.	"almendra"
Triplaris caracasana Cham.	"triplaria"

PLATE XIX

Megalopyge krugii (Dewitz)

Cocoons of *M. krugii* attached to small twig





(Luis F. Martorell: A Survey of the Forest Insects of Puerto Rico)

FAMILY LIMACODIDÆ

Monoleuca albicollis Forbes

This moth was described originally from Puerto Rico and has not been reported from any other part of the West Indies yet. It is a fairly common species, especially at middle and higher elevations, where most of the specimens have been collected.

Moth: The moth was described by Forbes (1930, p. 167) as follows:

"Buff. Head with front white, contrasting, vertex olivaceous; palpi crimson, the terminal segment buff on upper side, not contrasting in color below; antennae (broken) with shaft crimson, at least toward base and pectinations buff. Prothorax white, contrasting, buff on sides. Mesothorax brown shading into crimson; metathorax pale, shading into white at sides. Abdomen without any red tint, but slightly olivaceous. Fore wing buff, the margins and veins crimson; antemedial line diffuse, broad, from middle of costa to fold; post-medial similar, strongly excurved opposite cell, the two lines fusing in fold and below into a large brown patch, which contains a rounded white spot, extended narrowly half way to base on inner margin. Hind wing buff, faintly lined with crimson on veins, with a stronger crimson shade in the fold. Fore wing beneath almost evenly suffused with dull salmon (about the color that would be produced by blending of the buff and crimson of the upper side); inner margin, below Cu, and hind wing pale buff. Fore leg crimson, with fuscous bars on tips of tibia and metatarsus; middle leg pale buff, slightly shaded with crimson, with tibia mostly fuscous, and a bar on metatarsus, the upper side heavily fringed with dense hair. Hind leg pale (damaged). Expanse 13 mm. ($\frac{1}{2}$ inch)".

Cocoon: The beautiful cocoon of this moth is whitish, mottled with brown or vice versa; it is nearly round, sort of oval, about 5 mm. long, 4 mm. wide and 4 mm. in height, with an operculum or lid usually on one end. The moth on emerging escapes through this door or operculum. The cocoons are attached to leaves, sometimes on the undersides and sometimes on the upper surface of the leaves, by means of a glue-like substance secreted by the caterpillar. The cocoon itself is made out of a parchment-like substance, smooth and hard in consistency, at first sight looking like a lizard's or very small bird's egg.

Host: The caterpillar presumably feeds on the foliage of "maricao", *Byrsonima spicata* (Cav.) Rich. and "cedro", *Cedrela mexicana* Roem. All the cocoons have been collected at altitudes ranging from 1,700 to 2,500 ft. Very abundant on the foliage of *B. spicata*. The writer has never been able to observe the caterpillar.

Also attacking the foliage of mahogany, *Swietenia mahagoni* Jacq., at lower elevations.

HYMENOPTERA

Very few, indeed, are the insects belonging to this large group which really cause injuries of economic importance to the trees in Puerto Rico. The Order includes mostly parasitic forms, which otherwise are beneficial and helpful in controlling our most noxious forest, shade and ornamental tree pests.

The most important forms are therefore discussed as fully as possible.

SUPERFAMILY TENTHREDINOIDEA

FAMILY TENTHREDINIDÆ

Sterictiphora Krugii (Cresson)

(The Sea-grape Sawfly)

This interesting sawfly is the only representative of this family present in the Island. It is very common around the coastal plains where most of its host trees grow, but also attacks the foliage of trees at middle and higher altitudes.

Historical: The sawfly was originally described by E. T. Cresson in 1880 as *Schizocera Krugii*, presumably in honor of Herr. F. Krug, who sent the specimens to Mr. Cresson for identification. A year later, Dr. H. Dewitz a German naturalist described the same species as *Schizoceras Zaddachi*, in honor of Prof. Zaddach, Director of the Zoological Museum at Könisberg, Germany. (Dewitz 1881, p. 207–8.) Cresson's description is based on the male of the species, and although no illustrations are given in the description, undoubtedly it is very accurate. Dewitz' description includes both males and females and also illustrations of both sexes, on Plate V, figs. 12 and 12A. The specimens described by Dewitz apparently suffered an intense discoloration by some reason, because he refers to the female, as a yellow insect. In nature the female is bright red. Nevertheless, his description as well as drawings are very accurate and undoubtedly he described the same insect Cresson had already described a year earlier. Later on the species had a generic transfer and was placed in the genus *Sterictiphora*, the specific name *Krugii* having priority over *Zaddachi*.

The species as described by Cresson, is as follows:

Male: "Short, robust, black; head short, very transverse, eyes prominent; antennae slender, flagellum bifurcate, ciliated beneath with blackish pubescence; prothorax, pleura, anterior margin of lobes of mesothorax, coxae and venter reddish-yellow; wings subhyaline, nervures and stigma black, three submarginal cells, the second quadrangular, longer than broad, receiving the second recurrent nervure near the base, under wing with two middle cells; four anterior legs more or less pale in front. Length .23 inch." (Cresson 1880, p. 2.)

The writer had already discussed this insect and its behavior. (Martorell, April 1941, p. 141–4.) The description of the adults, both male and female forms, with their colors as they are seen in the field, follows:

Adults: The female is 8 mm. long, with bright crimson thorax and abdomen; head and mouth parts shiny black; antennae dull, black; legs reddish with dark brown markings; wings transparent with black veins. The male is smaller than the female, about 6 mm. long, the dorsal part of the prothorax, part of the metathorax and dorsal part of the abdomen shiny black. Ventrally thorax and abdomen bright crimson. Head and mouth parts shiny, black; legs rufous. The antennae of the male is plumose, forked, giving the false impression of possessing four antennae. The wings are similar to the ones of the female but much more smaller. (Martorell, April 1941, p. 141.) (See Plate XX.)

Larva: The young larva is dirty green in color when it emerges from the egg. It immediately starts feeding on the foliage, especially on the young, tender leaves, adopting the characteristic posture of the members of this family while feeding. It attaches itself to the edge of the leaf by means of three pairs of thoracic legs, while the abdomen is then curled upwards and a little towards the side.

In the last instars the fully grown larva measures about 25 mm. long, the general color of the body is pink, with a light green line not well defined running dorsally from the first segment to nearly the last one. Dorsally the last abdominal segment is black. The whole body is covered by round, small, black spots regularly arranged. The head is reddish, shiny, with one shiny black line running longitudinally on its center. The region around the ocelli are also black. The legs are strong, fleshy, pinkish and covered with numerous black spots. The uropods and postpedes are pink and small. The larva as described above is the normal stage seen in the field. However, the last larval stage, which is very seldom observed in the field is quite different. Pupation takes place very shortly after this last instar. In it, the head and dorsum are shiny black; the first thoracic segment, the precoxae and the last abdominal segment carmine; the sides of the body wine-colored.

Pupa: The larva spins a tough, parchment-like, brown pupal case, made up of a secretion produced by the larva mixed with leaf particles. The pupal case is nearly oval, with one end truncate, measuring about 10 mm. long by 6 mm. broad. This is attached to the trunk, twigs or branches of a tree. Sometimes hundreds and thousands of these pupal cases are seen in large masses, one very close to the other, often overlapping, on the trunk of large trees. They are usually attached to the side of the trunk or branches where they are less exposed to the direct wind currents or rain. Pupal period about 20 days.

Habits: It has been observed that nearly always the number of females

double that of the males. During oviposition the females stay motionless, not moving even if disturbed while they are laying their eggs. The eggs which are laid on the undersides of the leaves are clustered, the number in each cluster varying from 15 to 40 eggs. Often 6 or 7 clusters are found on a single leaf. After all the eggs are laid, the females remain close to the egg mass, like trying to protect and watch them. The males are gregarious in their habits and often one can see 15 to 20 of them close together on the underside of a leaf, usually in places where the direct wind currents can not hit them. Both males and females are slow moving insects and hand collecting is very easy. At the seashore, the trees nearer to the coast are less infested than those inland or the ones which are back of other trees. The wind disturbs or blows away these small insects.

The larvae are also gregarious, and one often sees a whole row of 10 or 15 larvae close together while feeding on the edge of a leaf.

Applied Control: No natural enemies of the larva or eggs have been recorded so far. However, the larva can be controlled by applications of poison sprays, using powdered arsenate of lead at the rate of 3 pounds to 50 gallons of water, using soap as an adhesive.

Host: The following host trees are attacked by this sawfly:

Chrysobalanus icaco L.	"icaco"
Coccolobis grandifolia Jacq.	"moralón"
Coccolobis laurifolia Jacq.	"uvilla"
Coccolobis pirifolia Desf.	
Coccolobis uwifera (L.) Jacq.	"uva de playa"
Coccolobis venosa L.	"calambreña"

The writer has never seen the caterpillars nor the adults on *Chrysobalanus icaco* L. The only record on this tree is by Mr. Van Zwaluwenburg.

Superfamily Chalcidoidea

FAMILY EURYTOMIDÆ

Tanaostigma haematoxyli Dozier

(Campeche Seed Chalcid)

A common insect in Puerto Rico, Haiti and presumably in all of the West Indies and perhaps in continental tropical America, wherever its host tree is found.

PLATE XX

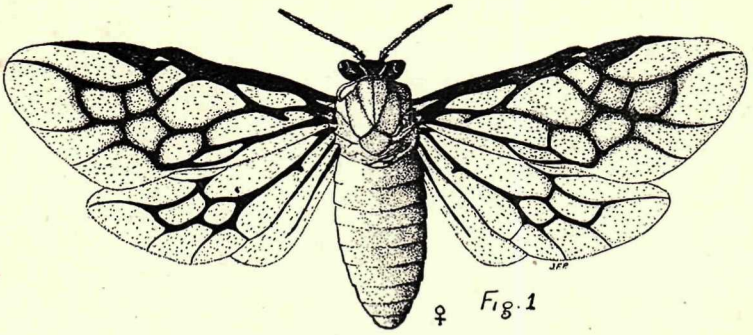
Sterictiphora Krugii (Cresson) (Tenthredinidae)

Fig. 1. Adult female (actual size 8 mm. long)

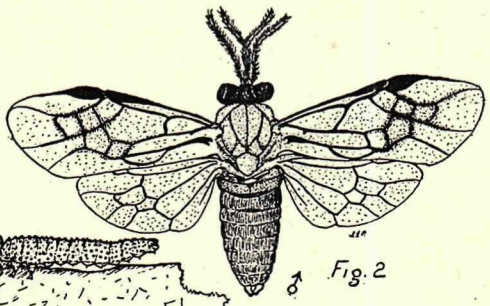
Fig. 2. Adult male (actual size 6 mm. long)

Fig. 3. Larvae 25 mm. long and eggs 2 mm. high

Fig. 4. Pupal cases on branch (actual size 10 mm. x 6 mm.)



♀ Fig. 1



♂ Fig. 2

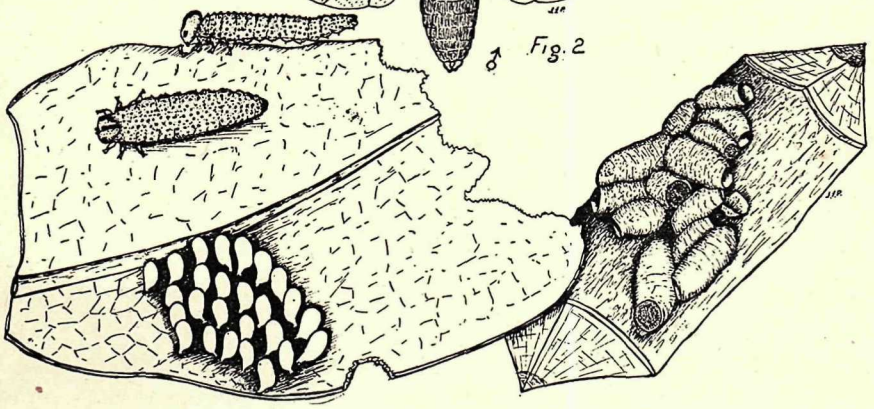


Fig. 3

Fig. 4

(Luis F. Martorell: A Survey of the Forest Insects of Puerto Rico)

Female: "Length 1.21 to 1.46 mm.; expansion 2.84 mm.; greatest width of forewing 0.573 mm. The general appearance of the female is stout and compact, the thorax decidedly humped or convexly elevated; slightly pubescent with light colored hairs. General color a dark honey-yellow, the vertex and more dorsal portions of the thorax and abdomen more or less infuscated giving a fuscous appearance except along the sides; the sides of the abdomen are pale in color. Antennae dark brown except the pale ring-joint and the white club; 11-jointed; club apparently solid; pedicel nearly twice as long as wide, followed by a small ring-joint and a second larger and darker joint that borders on being a true ring-joint, decidedly smaller and narrower than the funicle joints which are sub-equal in length and only slightly widening to the club. Head transverse. Pronotum narrower than the head and slightly longer, the scutellum convexly elevated, with reticulate markings or areas on surface. Forewings hyaline, venation pale brown, the stigmal vein very thick, covered with numerous curved setae. Under high magnification, specimens mounted in balsam, show the thorax and abdomen to be distinctly reticulated. Legs brown, the hind tibiae armed with pale rigid bristles along the inner margin". (See fig. 17, a.)

Male: "Length 0.86–1.37 mm.; expansion 2.65 mm.; greatest width of forewing 0.502 mm. Easily distinguished from the female by its smaller size, narrower and more slender build, lighter coloration, and immediately by its branched antennae. General color similar somewhat to that of the female but lighter yellowish. Antennae 13-jointed, composed of a rather broad scape, short stout pedicel, a pair of minute ring-joints, the next five funicle joints increasing in length, each one with a lateral prolongation, successively shorter, giving a branched appearance; the last funicle joint is slightly shorter than the two preceeding and has only a suggestion of a short lateral prolongation." (Description of female and male, from Dozier 1932, p. 105.)

Larva: The larva is pale creamy white in color and about 1.75 mm. long. (See fig. 17, b.)

Pupa: The pupa is creamy in color at first, but as it develops the eyes become distinctly reddish, and the mandibles take a reddish, chitinized appearance. Before emergence the pupa becomes much darkened. (See fig. 17, c.)

Habits: The habits of this insect were studied by Dozier and from his publication the following is cited:

"The adult wasps soon after issuing were observed to start mating, actively running over the seed pods. The eggs are extremely small and are deposited within the young tender pods by means of the ovipositor. The oviposition scars are readily visible from the outside and each seed

is occupied by a larva. The consequent reaction produces a gall-like deformation of the seeds and with it the pod is definitely thickened along the middle.

"The result is that in many cases every seed in the entire cluster of pods is completely destroyed. In this way the logwood is prevented from re-

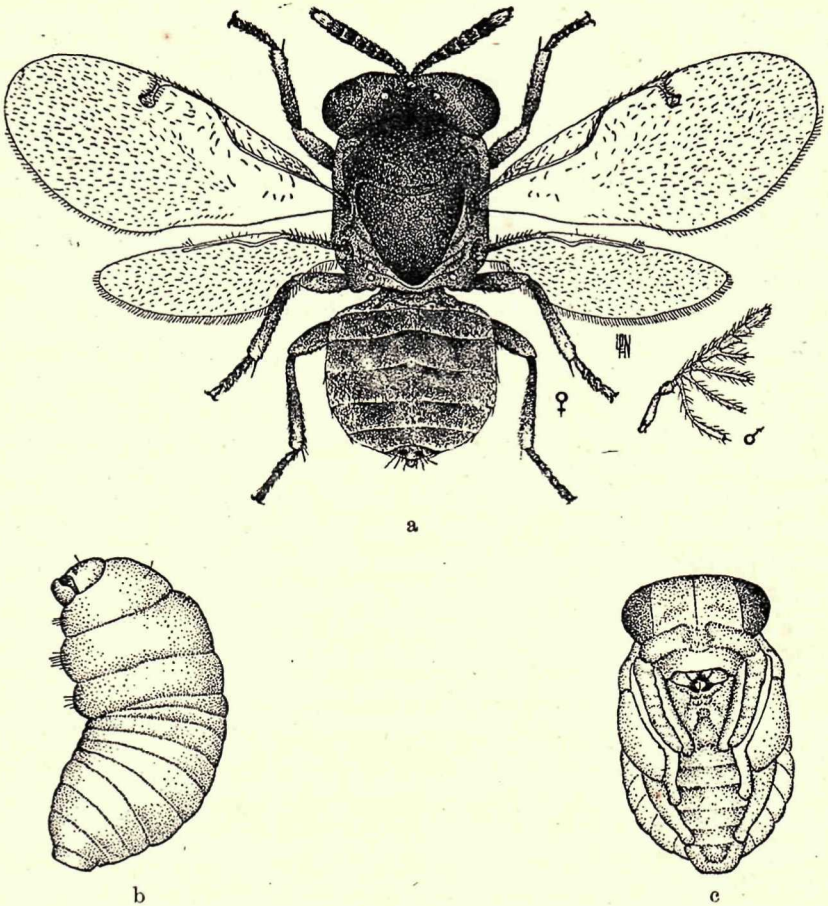


FIG. 17. *Tanaostigma haematoxyli* Dozier: (a) female, about 50×. (b) fully grown larva (c) pupa (d) antenna of male (Drawn by L. Pierre-Noel.)

seeding itself. Observations made over the two-year period show that this is serious. Fortunately, however, the logwood is so prolific that it is probably capable of producing enough seedlings to replace itself if freed, even if at long intervals, from the attack of this wasp by unusual activity and restraint on the part of its parasite."

Natural Enemies: None reported so far from Puerto Rico. Dr. Dozier

found two parasitic wasps, *Eupelmus* sp. and *Horismenus* sp., parasitizing the chalcid, in Haiti.

Host: The insect attacks the seeds of "campeche" *Haematoxylon campechianum* L.

Bephrata cubensis Ashmead

(The Annona Seed Chalcid)

A common species in Puerto Rico, also recorded from Cuba (from which it was originally described), Jamaica, Hispaniola and Florida. The writer found in Venezuela, a species closely related to this one, *B. maculicollis* Cam. infesting the seeds of *Annona muricata* L., at Caracas and La Providencia, near Maracay. (Martorell, Oct. 1939, p. 228.)

The insect was described from 3 specimens collected in Cuba. Original description:

"Female: Length 8 mm. Rufous, coarsely, umbilicately punctate; scape, except apex above, legs and tegulae, pale ferrugineous; flagellum brown; wings hyaline, with a dusky blotch on the disc below the marginal nervure, the latter being a little longer than the stigmal; the stigmal ending in a small knob, not longer than the post-marginal. First flagellar joint about as long as the scape, but stouter, the following joints longer than thick; frons with a deep antennal furrow. Abdomen longer than the head and thorax united, compressed, roundly elevated dorsally towards base, then depressed and curving upwards at tip, the ovipositor slightly projecting; petiole very short, wider than long; sides of abdomen with white hairs." (Ashmead 1894, p. 321–2.) (See fig. 18.) (See also Dozier 1932, pp. 109–12.)

Habits: The female wasps lay their eggs in the young developing fruit and when the larvae develop, they are already inside the seeds, upon which they feed and completely destroy. The insect leaves the fruits as an adult, by gnawing exit holes, which are plainly visible by the naked eye on the attacked fruits.

Host: In the Island the insect has been recorded from the seeds of:

Annona muricata L.	"guanábana"
Annona reticulata L.	"corazón"

SUPERFAMILY FORMICOIDEA

FAMILY FORMICIDÆ

Myrmelachista ramulorum Wheeler

(La Hormiguilla)

One of the most serious pests of coffee in Puerto Rico is this species of ant, popularly known as the "hormiguilla". It also affects the shade trees

in coffee plantations as well as many other trees on the Island. The insect is found in the lowlands as well as middle and higher altitudes.

Ant: The ant is small, with a reddish yellow thorax, blue-black head and abdomen, yellowish appendages and 8-segmented antennae (worker).

Habits: These insects do their damage by tunneling in the branches and trunks of trees, by girdling or causing large and unsightly galls. Inside these tunnels the ants harbor and take care of a species of coccid, *Cryptostigma inquilina* (Newstead), from which they obtain honeydew. They also obtain more of this substance by taking care of other insects,

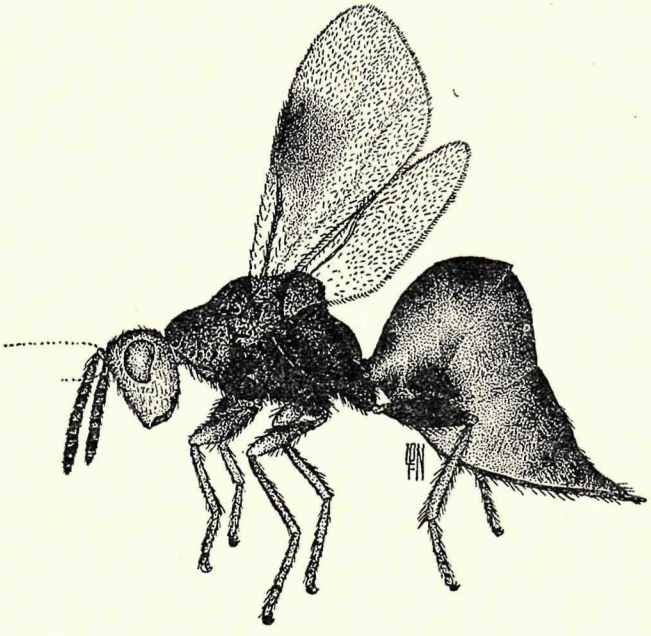


FIG. 18. *Bephrata cubensis* Ashmead, female. About one hundred times natural size. (Drawn by L. Pierre-Noel.)

such as the scale insects, *Coccus viridis* (Green), *Saissetia hemisphaerica* (Targioni), the mealybugs, *Pseudococcus nipae* (Maskell) and *P. citri* (Risso) and the aphid or plant louse, *Toxoptera aurantii* (Fonscolombe). The "hormiguilla" forms numerous colonies in the trees, and scarcely a tree is found in coffee plantations which the ants do not nest in. Smith, in studying this species, estimated that on a moderate sized "guaba" tree there were 37,100 workers, 89 fertile or mother queens, and 60 winged males, or an average of 415 workers per queen. (Smith 1936, p. 873.)

Applied Control: The artificial control of this insect in coffee planta-

tions is a problem by itself. Up to date all the methods tried have not been successful at all. Meat or fish baits mixed with thallium nitrate and acetate have been used, fish oil has also been employed as a repellent. "Continued experiments show no improvement in poison bait itself is needed, but in method of application, as water-soluble thallium compounds are very toxic to coffee shade trees." (Wolcott, IP, p. 150.)

For more information on the control of this species the reader may refer to the works of G. N. Wolcott. (See also EEWI, pp. 317–321.)

Host: The insect has been recorded from the following trees in the Island:

Bucida buceras L.	"úcar"
Coccolobis uvifera (L.) Jacq.	"uva de playa"
Erythrina berteroana Urban	"machete"
Erythrina poeppigiana (Walp.) O. F. Cook	"bucare"
Ficus laevigata Vahl	"jagüey"
Inga vera Willd.	"guaba"
Inga laurina (Sw.) Willd.	"guamá"
Eugenia jambos L.	"pomarrosa"
Mangifera indica L.	"mangó"
Spathodea campanulata Beauv.	"tulipán africano"
Spondias purpurea L.	"jobillo"
Triplaris caracasana Cham.	"triplaria"

Camponotus ustus Forel

A very common species in Puerto Rico, also present in Haiti and the Virgin Islands. This is probably one of our largest ants, very conspicuous and easily recognizable. However, it could be confused with its closely related form *C. sexguttatus* (Fabricius). The following characters will serve to differentiate the two species from others as well as to distinguish between *ustus* and *sexguttatus*. Both species have more than 9 segments in the antennae, the workers are polymorphic instead of monomorphic. Then the two species are differentiated one from the other by the following characteristics:

Head of major worker light red anteriorly; with pale spots often on first and third as well the second gastric segment; minor workers usually with spots only on the second segment. Head, thorax, and gaster of both major and minor workers dark brown, smooth and shining . . . *sexguttatus* (Fabricius)

Color light yellowish brown, with the head and segments of the gaster often infuscated . . . *ustus* Forel (Key from Smith 1936, p. 866.)

Habits: The insect is found abundantly in burrow in the branches and

twigs of trees. Whether they actually do their own boring or just nest in old abandoned bores has not been yet determined. (See Plate XXI.)

Host: The species has been recorded from the following trees:

Coccolobis uvifera (L.) Jacq.	"uva de playa"
Colubrina arborescens (Mill.) Sarg.	"abeyuelo"
Inga vera Willd.	"guaba"
Sideroxylon foetidissimum Jacq.	"tortugo amarillo"
Tetrazygia elaeagnoides (Sw.) DC.	"cenizo"
Zanthoxylum caribaeum Lam.	"espino rubial"

SUPERFAMILY APOIDEA

FAMILY XYLOCOPIDÆ

Xylocopa brasilianorum (Linnaeus)

(El Cigarrón)

This insect is the largest member of the Apoidea in the Island. The "cigarrón" is very abundant and well known in Puerto Rico, particularly the female of the species, which is seen frequently hovering around flower blossoms in fields and gardens.

Mr. A. J. Ackerman, redescribed the species in his revision of the carpenter—bees of the United States of the genus *Xylocopa* (See Ackerman, 1916) under the name of *Xylocopa Brasilianorum Brasilianorum* Linné. The following is his description of the male and female:

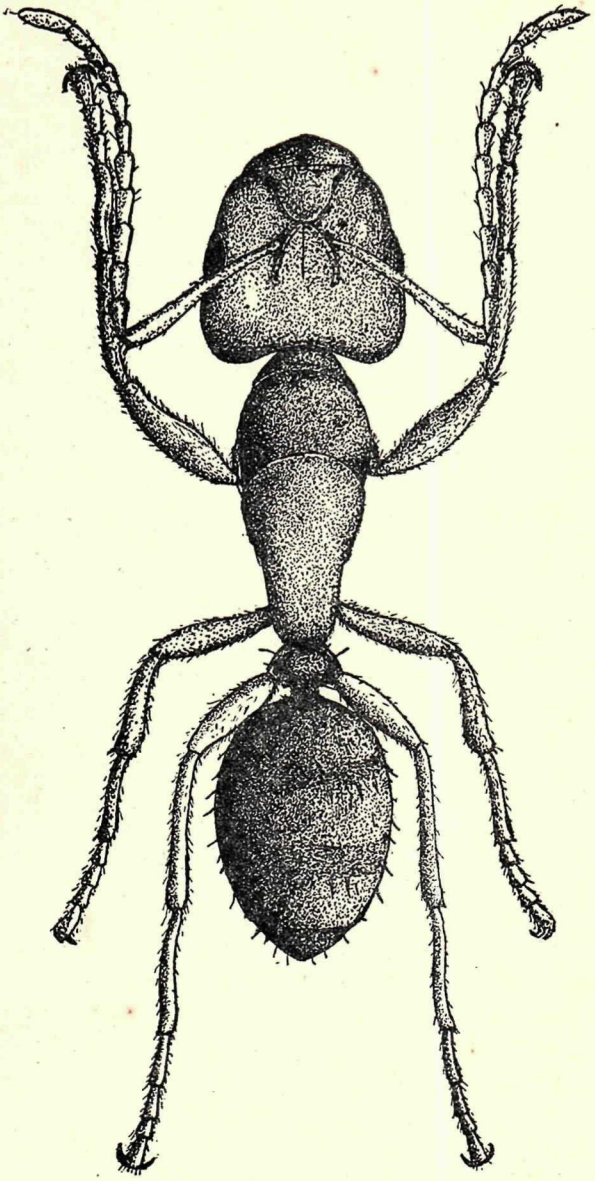
Length of male, 22–24 mm.; of female, 24–26 mm.

"Female: Head black, almost as wide as thorax, well punctured, hairs black; mandibles with two large teeth at apex and a small, rounded one on the middle of the upper margin, no depressed area at the base and with but few punctures, the upper longitudinal groove very deep with a depressed spot in the middle; labrum with three lobes, the lateral ones blunter and a little hidden beneath the hairs; clypeus flat, punctures large but few, longitudinal carina not present, the upper and lateral margins shining, impunctate, the upper margin a little elevated, the lateral ones more raised and more sharply ridged toward their lower extremities; frontal shield on a slightly higher plane than the clypeus; the frontal grooves marked by a shallow suture, the lateral foveolae very small; frontal carina rather prominent, not sharply pointed, the upper side verging into a furrow concurrent with the heart-shaped groove of the median ocellus; ocelli small, the posterior ones not carinated in front but with large circular pits behind, a

---

PLATE XXI

Camponotus ustus Forel



(Luis F. Martorell: A Survey of the Forest Insects of Puerto Rico)

short, fine furrow midway between; eyes rather small and widely separated; vertex well punctured, the cheeks finely and sparsely so.

"Thorax black, hairs black, short and not very dense on back; disk very large, including the anterior half of the scutellum, without hair or punctures and shining; scutellum behind the flat, unpunctured area rounded and sloping downward, and pilose; post-scutellum with few punctures, small and hairy.

"Abdomen entirely black, hairs black, rather elongate, punctures close and fine on the anterior half, coarser on the posterior half; a longitudinal carina along the middle of the tergum, and a corresponding carina along the venter but much sharper and more prominent; epipygium not wide at the base.

"Wings fuliginous, violet color predominating with tints of blue and purple; tegulae black; length of wings 20 mm.

"Legs black, hairs black; tibial scale with the anterior tooth longer, narrower and more pointed than the posterior one.

"Male: The male, besides being entirely fulvous, differs as follows: Head narrower, punctation fine; mandibles brownish black, with a yellow spot at base, constricted along the middle, smaller and no tooth present on the inner margin; labrum with only one lobe; clypeus more convex, the upper margin and sides not elevated, longitudinal carina rounded; frontal carina very small and pointed, the upper margin faintly grooved with a pit in its middle; ocelli not sunken, close together, ocellar pits minute or obsolete, a shallow groove midway between the posterior ocelli; eyes not large and wide apart; lower part of antenna yellowish on first segment, otherwise yellowish brown, its upper side brownish black throughout and with no pubescence; vertex and cheeks with long, dense yellow hair and very fine punctures.

"Thorax yellow with more or less brown, especially on the post-scutellum, propodeum and sides; hairs yellow; scutellum flat, shining, with but little hair and few punctures; post-scutellum also rather flat.

"Abdomen yellow, with a brown band along the hinder margin of each segment, but this is as variable as the color may become tawny in old specimens; pilosity yellow, rufous and long at the apex; finely and densely punctured throughout. Wings semihyaline; tegulae fulvous.

"The fore legs from their bases to and including the basal part of the femora, and the intermediate and hind legs as far as the tibiae brownish black, otherwise yellow or fulvous; hairs everywhere yellow with a slight red tinge on the tibiae and tarsi; tibial scale very small and black.

"Type: Locality unknown."

Habits: The adults bore into the trunk of trees, particularly in rotten wood. Breeding is carried on, inside galleries or tunnels in the interior of

the trunk of trees, fence posts, electric posts, etc. Often the insect bores in the healthy or live wood, thus causing some damage to the tree infested.

It is very rare to see the male of the species, which is of a golden or bright yellowish-brown color flying around. The female is the form one is able to observe in the fields and gardens. On digging inside bores of infested tree trunks, males are found inside the tunnels. The habits of this insect have not yet been studied in Puerto Rico.

Host: The "cigarrón" has been recorded as boring in the trunk of the following trees:

Albizia procera (Willd.) Benth.	White siris
Ficus stahlii Warb.	"jagüey"
Swietenia mahagony Jacq.	"caoba"

SUMMARY

This Survey is the result of eight years of studies and observations on the insect pests affecting the forest, shade and ornamental trees on the island of Puerto Rico. The work was started during the Fall of 1934, but the greatest part of it was done during the last two years from 1940 to 1942, when the project was being carried on as off-campus research work.

ORIGIN OF OUR INSECT FAUNA

Part of the introduction is devoted to a discussion of the origin of the insect fauna of the island of Puerto Rico. A short geologic review of the history of the island is presented together with the opinions of biogeographers and students of faunal dispersion in the world concerning the distribution of animal life in the Antilles. It is the general conclusion, based on such facts as the homogeneity of the Antillean fauna, its resemblance to that of Central and South America, etc., that the Puerto Rican fauna is purely of a South and Central American origin.

The discussion in the introduction leads to the following conclusions:

(1) That our insect fauna is purely of Central and South America affinities.

(2) That this fauna came to Puerto Rico by land migrations from Central America to Jamaica, Hispaniola and Puerto Rico, or

(3) In a smaller degree by the migratory habits of certain groups of insects; by the activities of man and in a lesser degree by means of air currents.

(4) The endemic species originated by means of evolution in the island, or else originated elsewhere by evolution, reaching Puerto Rico by immigration and becoming extinct in their original habitats.

PART I

(AN ANNOTATED LIST OF THE INSECTS AFFECTING FOREST, SHADE AND ORNAMENTAL TREES IN PUERTO RICO)

The first part of the work consists of an annotated list of the insects affecting the trees. The host trees are mentioned by their scientific names in alpahabetical order, and the insects are listed under each species of tree. Directly under the name of each tree, the family to which it belongs is cited, followed by notes on distribution, uses or economic importance and common names of the tree species. Then the insects are listed or recorded, following more or less this sequence: insects affecting the flowers, fruits or seeds, twigs, branches, trunk and roots. Often, species attacking the decayed wood or resting on the tree will be mentioned at the end of each

tree discussed. Only the insects affecting the trees are recorded, that is, such records as "on the leaves", or "collected on the fruit", "on the trunk", etc., are not taken in consideration in this work. The parasitic forms are only mentioned when the specific host is known, otherwise parasites and predators just resting on leaves or other parts of the trees are not listed.

This Survey is based on the insect population studies on 245 tree species, belonging to 169 genera.

In the annotated list some trees only show two or three insects records while others might show thirty, forty or more records.

Part II

(A discussion of the most important insect enemies of forest, shade and ornamental trees in Puerto Rico)

The second part of the work is an entomological discussion of the most important forms of the Insecta affecting our trees. Often, the following information is given about each insect species: general distribution of the insect; description of the adults (male and female), eggs, larval, nymphal, pupal and chrysalis stages; habits, natural enemies, applied control and host trees.

It would be really very hard to tell which are the most noxious insect pests of the forests, due to the fact that almost all of them are on the same level of importance. Only a few are outstanding as really dangerous pests of economic importance. Among the outstanding insect enemies the following can be mentioned:

Nasutitermes (*N.*) *costalis* (Holmgren)	"comején"
Selenothrips rubrocinctus (Giard)	cacao thrips
Asterolecanium pustulans (Cockerell)	pustule scale
Pseudococcus nipae (Maskell)	mealybug
Saissetia oleae (Bernard)	black scale
Apate monachus Fabricius	apate borer
Apion martinezi Marshall	"aceitillo weevil"
Diaprepes abbreviatus (Linnaeus)	"vaquita de la caña"
Eulepte concordalis	"roble leaf webber"
Agathodes designalis Guenée	"bucare caterpillar"
Hypsiphyla grandella (Zeller)	cedar shoot borer
Myrmelachista ramulorum Wheeler	"la hormiguilla"

This work is illustrated by 18 figures and 21 plates.

RESUMEN

El presente trabajo es el resultado de ocho años de estudios y observaciones en relación con insectos que afectan los árboles de bosques, sombra y ornamentales de la isla de Puerto Rico. La labor fué iniciada durante el otoño de 1934, pero la mayor parte de la misma fué realizada durante los dos últimos años—1940 a 1942—cuando se llevó a cabo el proyecto como trabajo de investigación extramuros.

ORIGEN DE NUESTRA FAUNA INSECTIL

Parte de la introducción está dedicada a discutir el origen de la fauna insectil de la isla de Puerto Rico. Contiene la misma unas breves notas geológicas de la historia de la Isla, junto con las opiniones de biogeógrafos y estudiantes, sobre la dispersión de la fauna en el mundo, en lo que se relaciona con la distribución del reino animal en las Antillas. Es la conclusión general, basada en hechos tales como la homogeneidad de la fauna antillana, su semejanza con la de la América Central y la América del Sur, etc., que la fauna de Puerto Rico tiene un origen puramente sur y centroamericano.

De acuerdo con los hechos discutidos en la introducción, se aducen las siguientes conclusiones:

(1) Que nuestra fauna insectil es completamente afín a la de la América Central y América del Sur.

(2) Que dicha fauna llegó a Puerto Rico mediante migraciones terrestres de la América Central a Jamaica, la Española y Puerto Rico, o

(3) En menor grado, gracias a los hábitos migratorios de ciertos grupos de insectos; mediante las actividades humanas y, en escala mucho menor, por medio de corrientes de aire.

(4) Las especies autóctonas se originaron en la Isla por evolución, o se originaron en otros sitios por evolución, emigrando a Puerto Rico y extinguiéndose en su habitat original.

PARTE I

(LISTA ANOTADA DE LOS INSECTOS QUE AFECTAN LOS ÁRBOLES DE BOSQUES, SOMBRA Y ORNAMENTALES DE PUERTO RICO)

La primera parte del trabajo la constituye una lista anotada de los insectos que afectan los árboles. Se mencionan los árboles huéspedes por sus nombres científicos en orden alfabético y se enumeran los insectos bajo cada especie de árbol. Inmediatamente bajo el nombre de cada árbol, se cita la familia a la cual pertenece, seguida de las correspondientes notas, su distribución, usos, importancia económica y nombres comunes de las especies de árboles. Luego se enumeran los insectos, siguiendo, más o menos, este orden de sucesión: insectos que afectan las flores, frutas o

semillas, retoños, ramas, tronco y raíces. A menudo se mencionan, al final de la discusión que se refiere a cada árbol, las especies de insectos que atacan la madera podrida o que descansan en el mismo. Sólo se enumeran los insectos que afectan los árboles, directamente. Tales expresiones descriptivas como "en las hojas", o "recogidos en la fruta", o "en el tronco", etc. no se toman en consideración en el presente trabajo.

Las formas parasitarias se mencionan solamente cuando se conoce el huésped específico; de otro modo, los parásitos y los predatores, que sólo se detienen a descansar en las hojas o en otros sitios de los árboles, no figuran en la lista.

Esta encuesta se basa en los estudios sobre población insectil de 245 especies de árboles pertenecientes a 169 géneros.

Parte II

(discusión sobre los insectos más importantes que atacan los árboles de bosques, sombra y ornamentales de Puerto Rico)

La segunda parte del trabajo constituye una discusión entomológica de las formas más importantes de los insectos que atacan nuestros árboles. Se suministra frecuentemente la siguiente información sobre cada especie: distribución general del insecto; de los imagos (macho y hembra), huevos, estados de larvas, ninfas, pupas y crisálidas; hábitos, enemigos naturales, control aplicado y árboles huéspedes.

Seria realmente muy difícil informar cuales son las plagas de insectos más nocivas a los bosques, debido a que casi todas tienen el mismo grado de importancia. Sólo unas cuantas se destacan como plagas realmente peligrosas de importancia económica. Entre los insectos enemigos más conspicuos podemos mencionar los siguientes:

Nasutitermes (*N.*) *costalis* (Holmgren)	comején
Selenothrips rubrocinctus (Giard)	candelilla del cacao
Asterolecanium pustulans (Cockerell)	queresa pustulosa
Pseudococcus nipae (Maskell)	chinche harinosa
Saissetia oleae (Bernard)	queresa negra
Apate monachus Fabricus	taladrador del cafeto
Apion martinezi Marshall	gorgojo del aceitillo
Diaprepes abbreviatus (Linnaeus)	vaquita de la caña
Eulepte concordalis	tejedor de las hojas del roble
Agathodes designalis Guenée	oruga del bucare
Hypsipyla grandella (Zeller)	taladrador del retoño del cedro
Myrmelachista ramulorum Wheeler	la hormiguilla

El presente trabajo ha sido ilustrado con 18 figuras y 21 planchas.

BIBLIOGRAPHY

Ackerman, A. J. 1916 "The carpenter-bees of the United States of the genus *Xylocopa*." Jour. N. Y. Ent. Soc. **24:** 223–225.

Anthony, H. E. 1925–26 "Mammals of Porto Rico, living and extinct." Sci. Surv. Porto Rico & Virgin Is., N. Y. Acad. of Sci. **9** (1 & 2): 1–238.

Ashmead, William H. 1894 "Descriptions of new parasitic Hymenoptera". Trans. Amer. Ent. Soc. **21:** 318–344.

Barber, H. G. 1939 "Insects of Puerto Rico and the Virgin Islands—Hemiptera-Heteroptera (excepting the Miridae and Corixidae)." Sci. Surv. Porto Rico & Virgin Is., N. Y. Acad. of Sci. **14** (3): 263–441, fig. 36.

Barbour, T. H. 1914 "A contribution to the zoögeography of the West Indies, with special reference to amphibians and reptiles. Museum Comp. Zool. Mem. **44**(2): 209–346.

Barbour, T. H. 1916 "Some remarks upon 'Mathew's Climate and Evolution', with a supplemental note by W. D. Mathew." N. Y. Acad. of Sci. Ann., **27:** 1–15.

Barbour, T. H. and Ramsden, C. T. 1919 "The herpetology of Cuba." Mus. Comp. Zool. Mem., **47:** 69–213.

Bartlett, Kenneth A. 1938 "The introduction and colonization in Puerto Rico of *Dasycapus parvipennis* Gahan, a parasite of thrips." Agricultural Notes. No. 87, P. R. Exp. Sta. of the U. S. D. A., Mayagüez, P. R.

Bates, Marston 1935 "The butterflies of Cuba." Bull. Museum Comp. Zool. **78** (2): 64–258.

Berry, Edward W. 1918 "Paleographic significance of the Cenozoic floras of equatorial America and the Adjacent regions." Geol. Soc. of Amer. Bull. **29:** 631–636.

Biologia Centrali-Americana (see Druce, Godman & Walsingham.)

Blatchley, W. S. and Leng, C. W. 1916 "Rhynchophora or weevils of North Eastern America." The Nature Publishing Co., Indianapolis, Ind., pp. 1–682.

Bond, James 1934 "The distribution and origin of the West Indian avifauna." Amer. Philos. Soc. Proc. **73:** 341–350.

Box, Harold E. 1925 "Porto Rican cane-grubs and their natural enemies." Jour. Dept. Agr. P. R. **9** (4): 291–356, fig. 21, ref. 15.

Bridwell, J. C. 1943 "A new *Amblycerus* affecting seeds of *Prosopis chilensis* in Puerto Rico and Hispaniola." Jour. Agr. Univ. P. R. **27** (3): 133–135.

Britton, N. L. and Wilson, Percy 1923–1930 "Botany of Porto Rico and the Virgin Islands. Descriptive Flora—Spermatophyta. Sci. Surv. Porto Rico & Virgin Is., N. Y. Acad. of Sci. Vols. V & VI.

Busck, A. 1900 "Notes on a brief trip to Puerto Rico in January and February, 1899." Bull. No. 22, New Series, U. S. D. A., Division of Entomology.

Busck, A. 1917 "The pink bollworm, *Pectinophora gossypiella*." Jour. Agr. Res. **10** (10): 343–370, 12 pl.

Caldwell, John S. 1942 "New Psyllidae from Puerto Rico with notes on others (Homoptera). Jour. Agr. Univ. P. R. **26** (2): 28–33.

Caldwell, J. S. 1944 Psylliidae from tropical and semitropical America (Homoptera). Jour. N. Y. Ent. Soc., Vol. LII, Dec. 1944, pages 335–341.

Chamberlin, W. J. 1939 "The bark and timber beetles of North America." Publ. O. S. C. Cooperative Ass., Corvallis, Oregon, pp. 1–513.

Chapman, R. N. 1931 "Animal Ecology, with special reference to insects." McGraw Hill Book Co., New York.

Chevrolat, Auguste 1876 "Séance du 27 Décembre 1876." Annales de la Societe Entomologique de France, Series V, vol. 6, pp. 227–229.

Cockerell, T. D. A. 1893 "The West Indian species of *Dactylopius*." The Entomologist, **26:** 177–9.

Comstock, J. H. 1880 "Report of the Entomologist in Report of the Commissioner of Agriculture for the year 1879." Washington, D. C. pp. 185–347.

Cook, Melville T. 1905 "Some insect galls of Cuba." Estación Cent. Agronómica, Second Rept. (English Edition) pp. 143–146, 5 pl. Havana, Cuba.

Cook, O. F. and Collins, G. N. 1903 "Economic Plants of Porto Rico." Contr. U. S. National Herbarium **8** (2): 57–269.

Crawford, David L. 1914 "A monograph of the jumping plant-lice or Psyllidae of the new world." Bull. 85, U. S. National Mus., Smiths. Inst. pp. 1–182, 30 pl.

Cresson, E. T. 1880 "Descriptions of new North American Hymenoptera in the collection of the American Entomological Society." Trans. Amer. Ent. Soc. **8:** 1–68.

Danforth, Stuart T. 1926 "Birds of Cartagena lagoon, Porto Rico." Jour. Dept. Agr. P. R. **10** (1): 1–136.

DeLeon, Donald 1941 "Some observations on Forest Entomology in Puerto Rico." Caribbean Forester, Trop. For. Exp. Sta. **2**(4): 160–3.

Dewitz, H. 1881 "Hymenopteren von Portorico." Berliner Entomologische Zeitschrift **25:** 196–208, 1 pl.

Dewitz, H. 1877 "Tagschmetterlinge von Portorico." Stetiner Entomologische Zeitschrift **38:** 233–245.

Dexter, Raquel R. 1932 "The food habits of the introduced toad *Bufo marinus*, in the sugar-cane sections of Porto Rico." Bull. No. 74, Fourth Congress, International Soc. Sugar Cane Tech. pp. 6, tab. 11, ref. 6, San Juan, P. R.

Douglass, W. A. 1930 "The velvet bean caterpillar as a pest of soy beans in southern Louisiana and Texas." Jour. Ec. Ent. **23** (4): 684–690.

Dozier, Herbert L. 1932 "Two important West Indian seed-infesting Chalcid wasps." Jour. Dept. Agr. P. R. **16** (2): 103–112.

Drake, Carl J. 1918 "Two new tingids from the West Indies (Hem.-Heter.)." Ohio Jour. of Sci. **18** (5): 174–176, Columbus, Ohio.

Druce, Herbert 1881–1900 "Biologia Centrali-Americana." Insecta. Lepidoptera-Heterocera, Vol. I, pp. 1–490.

Druce, Herbert 1891–1900 "Biologia Centrali-Americana." Insecta. Lepidoptera-Heterocera, Vol. II, pp. 1–621.

Druce, Herbert 1881–1900 "Biologia Centrali-Americana." Vol. III, (101 color plates).

Dyar, Harrison G. 1901 "Life histories of some North American Moths." Proc U. S. National Mus. **23:** 255–284, No. 1209.

Felt, E. P. 1915 "New genera and species of Gall midges." Proc. U. S. National Mus. **48:** 195–211, No. 2072.

Fernald, Maria E. 1903 "A catalogue of the Coccidae of the world." Special Bull. Hatch Exp. Sta., Mass. Agr. College, Bull. No. 88, pp. 1–360.

Fernald, M. L. 1931 "Specific segregations and identities in some floras of eastern North America and the old world." Rhodora, **33:** 25–63.

Ferris, G. F. 1937–1942 "Atlas of the Scale Insects of North America." Stanford Univ. Press, Stanford Univ., Calif. (First Series, Jan. 1937; Second Series, Nov. 1938; Third Series, March 1941; Fourth Series, May 1942.)

Fife, L. Courtney 1939 "Insects and a mite found on cotton in Puerto Rico, with notes on their economic importance and natural enemies." Bull. 39, P. R. Agr. Exp. Sta., Mayaguez, P. R. pp. 14, ref. 45.

Fisher, W. S. 1925 "A revision of the West Indian Coleoptera of the family Buprestidae." Proc. U. S. Natl. Museum, No. 2522, **65:** Art. 9, pp. 1–207.

Fisher, W. S. 1941 "New Coleoptera from Puerto Rico." Jour. Agr. Univ. P. R. **25** (4): 37–39.

Fisher, W. S. 1943 "A new species of *Phloeonemus* from Puerto Rico (Coleoptera: Colydiidae) Jour. Agr. Univ. P. R. **27** (3): 131–132.

Forbes, W. T. M. 1930 "Insects of Porto Rico and the Virgin Islands. Heterocera or Moths (excepting the Noctuidae, Geometridae and Pyralidae)." Sci. Surv. Porto Rico & Virgin Is., N. Y. Acad. of Sci. **12** (1): 1–171, 1 plate.

Franklin, Henry James 1908 "On a collection of thysanopterous insects from Barbados and St. Vincent Islands." Proc. U. S. National Mus. **23:** 715–730, plates LXIII–LXV. Publ. No. 1590.

Giard, Alfred 1901 "Sur un thrips (*Physopus rubrocincta* nov.sp.) nuisible au cacaoyer." Bull. de la Societé Entomologique de France, 1901, pp. 263–265.

Gillette, C. P. and Palmer, M. A. 1932 "The Aphidae of Colorado" Part II. Ann. Ent. Soc. Amer. **25** (2): 369–496.

Gillette, C. P. and Palmer, M. A. 1934 "The Aphidae of Colorado" Part III. Ann. Ent. Soc. Amer. **27** (2): 133–255.

Gleason, H. A. and Cook. M. T. 1927 "Plant ecology of Porto Rico." Sci. Surv. Porto Rico & Virgin Is., N. Y. Acad. of Sci. **7** (1–2): 1–172, illus.

Godman, Frederick D. 1879–1901 "Biologia Centrali-Americana." Insecta. Lepidoptera-Rhopalocera. Vol. I, pp. 1–485.

Godman, Frederick D. 1887–1901 "Biologia Centrali-Americana." Insecta. Lepidoptera-Rhopalocera. Vol. II, pp. 1–782. (Index included.)

Godman, Frederick D. 1879–1901 "Biologia Centrali-Americana." Vol. III. (112 colored plates.)

Green, E. Ernest 1896–1922 "The Coccidae of Ceylon." Dulau & Co., Ltd., London, England. (Part I, 1896; Part II, 1899; Part III, 1904; Part IV, 1909; Part V, 1922.)

Grote, Augustus R. 1865 "Notes on the Bombycidae of Cuba." Proc. Ent. Soc. of Philadelphia, **5:** 227–255.

Guppy, H. B. 1917 "Plants, seeds, and currents in the West Indies and Azores." London (Williams and Norgate), 531 pp.

Holdridge, L. R. 1942 "Trees of Puerto Rico." Occasional Paper No. 1. Trop. For. Exp. Sta. U. S. D. A. Forest Service, pp. 1–105, Río Piedras, P. R. (March).

Holdridge, L. R. 1942 "Trees of Puerto Rico." Occasional Paper No. 2. Trop. For. Exp. Sta. U. S. D. A. Forest Service, pp. 1–105, Río Piedras, P. R. (Sept.).

Hole, R. S. 1904 "Two notorious insect pests." Jour. Bombay Natural Hist. Soc. **15** (4): 679–697, 5 pl. Bombay, India.

Holland, W. J. 1913 "The moth book." Doubleday, Page & Co., New York City, N. Y.

Holland, W. J. 1914 "The butterfly book." Doubleday, Page & Co., New York City, N. Y.

Hollick, Arthur 1928 "Paleobotany of Porto Rico." Sci. Surv. Porto Rico & Virgin Is., N. Y. Acad. of Sci. **7** (3): 177–238. (Issued Oct. 31, 1928.)

Hulst, George D. 1886 "Descriptions of new Pyralidae." Trans. Amer. Ent. Soc. **13:** 145–168.

Ihering, H. von 1931 "Land bridges across the Atlantic and Pacific oceans during the Kainozoic era." Jour. Geol. Soc. London Quart. **87:** 376–391.

Jones, T. H. 1915 "The sugar cane weevil root borer (*Diaprepes splengeri* Linn.)" Bull. 14, Insular Expt. Sta., Río Piedras, P. R., pp. 19, fig. 11.

Jones, T. H. and Wolcott, G. N. 1922 "The caterpillars which eat the leaves of sugar cane in Porto Rico." Jour. Dept. Agr. P. R., **6** (1): 38–50.

Kennedy, C. H. 1928 "Evolutionary level in relation to geographic, seasonal and diurnal distribution of insects." Ecology **9** (4): 367–379.

Marchal, P. 1908 "Sur une nouvelle espece de thrips (Thysanopt.) nuisible aux *Ficus* en Algérie." Bull. de la Societé Entomologique de France, 1908, pp. 251–253.

Marshall, Sir Guy A. K. 1922 "Some injurious neotropical weevils (Curculionidae)." Bull. Ent. Res. **13** (1): 59–78, pl. 2, fig. 4.

Marshall, Sir Guy A. K. 1934 "New West Indian Curculionidae (Col.)." Ann. & Mag. Nat. Hist. Ser. 10, **14:** 621–631, London, Eng.

Martorell, Luis F. 1939 "Insects observed in the State of Aragua, Venezuela, South America." Jour. Agr. Univ. P. R. **23** (4): 177–232.

Martorell, Luis F. 1939 "Some notes on Forest Entomology." The Caribbean Forester, Trop. For. Exp. Station, Río Piedras, P. R., **1** (1): 25–26.

Martorell, Luis F. 1940 "Some notes on Forest Entomology." The Caribbean Forester, Trop. For. Exp. Station, Río Piedras, P. R., **1** (2): 31–2. (January, 1940.)

Martorell, Luis F. 1940 "Some notes on Forest Entomology." The Caribbean Forester, Trop. For. Exp. Station, Río Piedras, P. R., **1** (3): 23–4. (April 1940.)

Martorell, Luis F. 1940 "Notes on the biology of *Mesocondyla concordalis* Hübner and its parasites." The Caribbean Forester, Trop. For. Exp. Station, Río Piedras, P. R., **2** (1): 18–19. (Oct. 1940).

Martorell, Luis F. 1941 "Some notes on Forest Entomology IV." The Caribbean Forester, Trop. For. Exp. Station, Río Piedras, P. R., **2** (2): 80–82. (January 1941.)

Martorell, Luis F. 1941 "Biological notes on the sea-grape sawfly *Schizocera krugii* Cresson, in Puerto Rico." The Caribbean Forester, Trop. For. Exp. Station, Río Piedras, P. R., **2** (3): 141–143, 1 pl. (April 1941.)

Martorell, L. F. and Wolcott, G. N. 1939 "Forest tree insects." Ann. Rept. Agr. Expt. Station, Fiscal Year 1937–38, pp. 44, San Juan, P. R.

Mathew, W. D. 1906 "Hypothetical outlines of the continents in Tertiary times." Amer. Mus. Nat. Hist. Bull. 22, pp. 353–383.

Mathew, W. D. 1915 "Climate and Evolution." N. Y. Acad. of Sci. Ann., **24:** 171–318.

Mathew, W. D. 1919 "Recent discoveries of fossil vertebrates in the West Indies and their bearing on the origin of the Antillean fauna." Amer. Philos. Soc. Proc. **58:** 161–181.

Mathew, W. D. 1930 "Dispersal of land mammals." Scientia, pp. 33–42. (July, 1930.)

Maury, C. J. 1920 "Tertiary Mollusca of Porto Rico." Sci. Surv. Porto Rico & Virgin Islands, N. Y. Acad. of Sci., **3** (1): 77, illustr.

Metcalf, C. F. and Flint, W. P. 1939 "Destructive and useful insects, their habits and control." Second Edition. McGraw-Hill Book Co., New York City, N. Y. pp. 1–981.

Meyerhoff, H. A. 1927 "Tertiary physiographic development of Porto Rico and the Virgin Islands." Bull. Geo. Soc. of America, **38:** 557–576.

Meyerhoff, H. A. 1933 "Geology of Puerto Rico." Monographs of the Univ. of P. R., Series B. No. 1, Río Piedras, P. R. pp. 1–306.

Morris, John G. 1860 "Catalogue of the described Lepidoptera of North America." Smiths. Misc. Colls. Smithsonian Institution, Washington, D. C. pp. 1–358.

Morton, J. Frank and Parks, B. H. 1928 "The Bagworms of Texas." Bull. 382, Texas Agr. Expt. Station.

Möschler, H. B. 1886 "Beitrage zur schmetterlings-fauna von Jamaica." (Separatabdruck aus den Abhandlungen der Senckenbergischen naturfoschenden Gesellschaft,) Frankfurt, pp. 26–84, 1 pl.

Möschler, H. B. 1890 "Die Lepidopterenfauna der Insel Porto-Rico." (Separatabdruck aus den Abhandlungen der Senckenbergischen naturfoschenden Gesellschaft.) Frankfurt, pp. 10–346.

Moss, A. Miles 1912 "On the Sphingidae of Perú." Trans. Zool. Soc. of London, **20:** 73–118, 9 color plates.

Newstead, R. 1893 "Observations on Coccidae (No. 5)." The Entomologists Monthly Magazine, **29:** 185–188.

Nicholls, Henry Alford 1929 "A Text Book of Tropical Agriculture." MacMillan & Co., London.

Olivier, A. G. 1807 "Entomologie, ou histoire naturelle des insectes, etc. Coleoptera. Vol. 5, Paris, Boudoin, 1789–1808. (Vol. V publ. 1807.)

Osborn, H. 1932 "Geographic & ecologic factors in distribution of neotropic Homoptera." 5th International Congress of Entomology, Paris, France, pp. 461–8. (Paris, July 18–24, 1932.)

Osborn, H. 1935 "Insects of Porto Rico and the Virgin Islands. Homoptera (excepting the Sternorhynchi)." Sci. Surv. Porto Rico & Virgin Islands, N. Y. Acad. of Sci. **14** (2): 111–260, fig. 71, ref. 48.

Otero, J. I. and Toro R. A. 1931 "Catálogo de los nombres científicos y vulgares de algunas plantas puertorriqueñas." Est. Exp. Insular, Río Piedras, P. R. Bol. 37, 248 p.

Petrunkevitch, Alexander 1928 "The Antillean spider fauna—a study in geographic isolation." Science, **68:** 650.

Petrunkevitch, Alexander 1929 "The spider fauna of Panama and its Central American affiliation." Amer. Nat., **63:** 455–469.

Phillips, W. J. and Davis, J. J. 1912 "Studies on a new species of *Toxoptera*." U. S. D. A. Bur. Ent. Tech. Series No. 25, Part I, pp. 1–16.

Pilsbry, H. A. 1930 "Land molluscs of the Caribbean islands, etc." Proc. Acad. of Nat. Sci. Philadelphia, **82:** 221–261.

Plank, H. K. 1939 "*Peregrinator biannulipes* Montr., a predator on the bamboo powder-post beetle in Puerto Rico." Jour. Ec. Ent., **32** (1): 151.

Quayle, Henry J. 1938 "Insects of citrus and other subtropical fruits." Comstock Publs. Co., pp. 1–538, Ithaca, N. Y.

Rothschild W. and Jordan, K. 1903 "A Revision of the lepidopterous family Sphingidae." Novitates Zool. 9, Suppl., pp. 972, pl. 67.

Russell, H. M. 1912 "The red-banded thrips." U. S. Dept. Agr. Bur. Ent., Bull. 99, Part II.

Russell, M. Louise 1941 "A classification of the scale insect genus *Asterolecanium*." U. S. D. A. Mis. Publ. No. 424.

Scharff, R. F. 1912 "Distribution and origin of life in America." McMillan & Co., New York.

Schauss, William 1940 "Insects of Porto Rico and the Virgin Islands. Moths of the Family Noctuidae." Sci. Surv. Porto Rico & Virgin Is., N. Y. Acad. of Sci. **12** (2): 177–290.

Schmidt, K. P. 1928 "Amphibians and land reptiles of Porto Rico, with a list of those reported from the Virgin Islands." Sci. Surv. Porto Rico & Virgin Is., N. Y. Acad. of Sci. **10** (1): 1–160.

Schuchert, Charles 1935 "Historical geology of the Antillean-Caribbean region." John Wiley & Sons, Inc. pp. 1–811.

Seín, Francisco 1930 "The sugar cane root caterpillar and other new root pests in Puerto Rico." Jour. Dept. Agr. P. R., **14** (3): 167–191, pl. 10, ref. 18.

Seín, Francisco 1933 "*Anastrepha* (Trypetidae, Diptera) fruit flies in Puerto Rico." Jour. Dept. Agr. P. R., **17** (3): 183–196, 5 pl. 60 figs.

Simpson, C. T. 1894 "Distribution of the land and fresh water mollusks of the West Indian region and their evidence with regard to past changes of land and sea." Proc. U. S. National Mus., **17:** 423–450.

Smith, M. R. 1936 "The ants of Puerto Rico." Jour. Agr. Univ. P. R., **20** (4): 819–875, fig. 19, ref. 16.

Smyth Jr., Ellison A. 1900 "The larval stage of *Protoparce rustica* Fabr." Ent. News, **11** (6): 486–488.

Smyth, E. G. 1920 "The white grubs injuring sugar cane in Porto Rico." II The Rhinoceros Beetles. Jour. Dept. Agr. P. R., **4** (2): 1–31, pl. 4.

Snyder, Thomas E. 1919 "Injury to Casuarina trees in southern Florida by the Mangrove borer." Jour. Agr. Res. **16** (6): 155–164, 3 pl. 2 fig.

Snyder, Thomas E. 1924 "Descriptions of new species and hitherto unknown castes of termites from America and Hawaii." Proc. U. S. National Mus. No. 2496, **64:** 10–12, pl. 5.

Snyder, Thomas E. 1924 "Description of a new termite from Porto Rico." Proc. Ent. Soc. Washington, **26** (5): 131–132, fig. 1. (May, 1924.)

Standley, C. Paul 1920–1926 "Trees and Shrubs of Mexico." Contr. U. S. National Herbarium, Vol. 23, Parts 1–5, Washington, D. C., pages 1–1721.

Standley, C. Paul and Samuel J. Record 1936 "The Forests and Flora of British Honduras." Publ. 350, Botanical Series, Vol. XII, Field Museum of Nat. Hist., Chicago, Ill.

Trelease, W. 1902 "Bearing of the distribution of the existing flora of Central America and the Antilles on former land connections." Geol. Soc. of America, Bull. **29:** 649-656.

Van Zwaluwenburg, R. H. 1916 "Notes on the life history of *Ecpantheria eridanus* Cramer." Insecutor Inscitiae Menstruus, **4** (1–3): 12–17.

Walsinghan, Thomas de Gray 1909–1915 "Biologia Centrali-Americana." Insecta. Lepidoptera-Heterocera. Vol. IV, pp. 1–482, 10 color plates.

Watson, J. R. 1923 "Synopsis and catalog of the Thysanoptera of North America." Agr. Expt. Sta. Univ. of Florida, Tech. Bull. No. 168, pp. 1–100.

Wetmore, Alexander 1916 "Birds of Porto Rico." U. S. D. A. (Prof. Paper), pp. 1–140, pl. 10, Washington, D. C., Bull. 326.

Whitney, Willis R. 1942 "Isn't research fun." The Caribbean Forester, Trop. For. Exp. Station, Río Piedras, P. R. **3** (2): 47–56.

Wolcott, G. N. 1922 "Vaquitas de importancia económica en Puerto Rico." Circular No. 60, Est. Exp. Insular, Río Piedras, P. R., pp. 1–20, fig. 20.

Wolcott, G. N. 1924 "Insectae Portoricensis." A preliminary annotated checklist of the insects of Porto Rico with descriptions of some new species. Jour. Dept. Agr. P. R. **7** (1): 1–313, fig. 2.

Wolcott, G. N. 1927 "Notes on the Pierid butterfly *Kricogonia castalia* Fab. (Lepid.)." Ent. News, **38** (4): 97–100.

Wolcott, G. N. 1933 "The changed status of some insect pests in Puerto Rico." Jour. Dept. Agr. P. R., **17** (3): 265–270. (July, 1933.)

Wolcott, G. N. 1933 "An economic entomology of the West Indies." Publ. by The Ent. Soc. of P. R., San Juan, P. R.

Wolcott, G. N. 1936 "Insectae Borinquenses." Jour. Agr. Univ. P. R., **20** (1): 1–627 (January, 1936.)

Wolcott, G. N. 1936 "The life history of *Diaprepes abbreviatus* L. at Río Piedras, Puerto Rico." Jour. Agr. Univ. P. R., **20** (4): 883–914. (October, 1936.)

Wolcott, G. N. 1939 "Comején y polilla." Estación Exp. Agr. Bol. **48**, pp. 1–26, 13 figs.

Wolcott, G. N. 1940 "An outbreak of the scale insect, *Asterolecanium pustulans* Cockerell on maga, *Montezuma speciosissima*." The Caribbean Forester, Trop. For. Exp. Sta., **2** (1): 6–7.

Wolcott, G. N. 1941 "Supplement to "Insectae Borinquenses." Jour. Agr. Univ. P. R., **25** (2): 33–158. (April, 1941.)

Wolcott, G. N. 1941 "The dispersion of the cottony cushion scale in Puerto Rico in eight years." The Caribbean Forester, Trop. For. Exp. Station, Río Piedras, P. R., **2** (3): 132–134. (April, 1941.)

Wolcott, G. N. and Martorell, L. F. 1940 "Epidemics of fungus disease control insect pests in Puerto Rico." Jour. Ec. Ent., **33** (1): 201–2.

Wolcott, G. N. and Martorell, L. F. 1942 "The accidental introduction of a beneficial insect into Puerto Rico." The Caribbean Forester, Trop. For. Exp. Station, Río Piedras, P. R. **3** (2): 58–60, 1 pl.

HOST PLANT INDEX

Generic names are printed in **boldface** type, specific and common names in roman type, synonyms in *italics* and family names in SMALL CAPITALS. Page numbers in boldface type indicate important references.

T

GENERIC INSECT INDEX

Unless otherwise indicated the genera included in this Index belong to the Hexapoda or Insecta. The page numbers in **bold face** type indicate important references. The genera will appear in **bold face** type, the species in roman and synonyms in *italics*.