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THE PRINCIPAL INSECTS ATTACKING THE COCONUT PALM (PART II).

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In Part I of this paper, insects which attack the trunk and the undeveloped leaves and flower clusters of the coconut were discussed. All the forms which have been described belong to the Coleoptera, but there are also certain species of Lepidoptera and Coccidae which attack the coconut to a sufficient extent to warrant their being designated as injurious.¹

Two forms of Lepidoptera are found upon the leaves of the coconut, one belonging to the Rhopalocera and the other to the Heterocera; the first is the coconut skipper, *Padraona chrysozona* Plötz, of the family Hesperidae, and the second, *Thosca cinereamarginata* Banks, of the Limacodidae. While the nature of the damage done by the caterpillars of these two forms is very similar, the insects differ entirely from each other both in the larval and adult stage. Neither is likely to prove a very serious menace to the life of the tree. Each attacks the leaflets after they are practically full grown. A single caterpillar confines itself to a single leaflet until, with the exception of the midrib, it has entirely devoured it, whereupon it proceeds to another, and so on until the caterpillar has attained full growth. In the case of the coconut skipper, the caterpillar not infrequently eats a space from the blade of the leaflet at a point near its attachment to the main petiole, leaving the distal part untouched. (See Pl. I.)

¹ The bibliography of coconut insects, appended, includes all forms known to attack the tree, either here or in other countries, and is intended to be of further aid to those interested in the subject from an economic standpoint.

DESCRIPTION.

DESCRIPTION.

Phaenocarpa torquatus (Hilleb.).

During the months of September and October many of the surfaces of small current trees of from 5 to 25 feet in height are partially encased. Portions of these bodies have their outer edges worn together by means of a processive silk which is collected inside, so that the leaf may be pulled slightly apart without tearing the covering. Inside these bags the light, yellowish-green caterpillar, having a distinctive head somewhat broader than the body and leading marked with a very regular pattern, is contained.

Toward the lower part of October the sensitive pupa is found in these "cocoons," partially covered and surrounded by a more-white fibrous covering, which has a variable feel. The substance has very much the appearance of the wax secreted by certain species of *Chalcids* and is exuded from the skin pores of the caterpillar toward the end of its larval stage. It serves as a protection for the pupa.

The voracious caterpillar, like nearly all *Phaenocarpa*, flies during the very early morning or the late afternoon and early evening hours, and hence it is very difficult to observe its feeding habits.

The eggs are found upon the under side of the leaves of the current and last nearly more than one week upon a single leaflet. They hatch in from seven to eight days and the young caterpillar, after devouring all of the epidermal tissue that portion in contact with the leaf surface, at once proceeds to the edge of the leaf and begins to feed. This process consists in cutting out an oblong notch extending toward the middle of about the width of the insect's head. Frequently the caterpillar abandons a portion of the leaf, after having fed upon it for a short time, the result being that leaflets are encountered the margins of which are deeply notched, as shown by Plate II, fig. 2. Under normal conditions, and after the caterpillar has cut the leaflet to the middle, it sews the margins together to form its nest, feeding upon the cut edge, either toward the apex or the base of the leaflet.

The back of this caterpillar is much constricted, and therefore the head has considerable freedom of motion, but in a state of repose the normal dorsoventral axis of the head is so inclined that it lies nearly in a plane with the longitudinal axis of the body, thus causing the mouth to be elevated and projected forward to form the extreme anterior point of the insect (Pl. II, fig. 3 A), which, in such larvae as those of *Athous albis* Linn., and *Thanaos circumscriptus* Banks, is formed by the frons of the face or the clypeus. The caterpillar of the latter has the head deflected beneath the body.

DESCRIPTION AND LIFE HISTORY.

Egg (Pl. II, fig. 2 and 2 A).—Diameter 1.65 millimeters, height 0.85 millimeter; of a rather flat, oblate-spheroidal shape, yellow-glabrous when first laid, with crimson, subcentral ring and central spot covering the micropyle, and developing after two days. The under surface nearly flat, glabrous; upper surface minutely punctured. It adheres strongly to the leaf surface.

The eggs of *Padruona chrysozona* Plötz are always laid singly upon the leaf, thus differing from those of *Erionota throx* Fabr., which may be found in groups of from 8 to 15.

The period of incubation is from seven to eight days.

Larva (Pl. II, fig. 3).—Length 3.5 millimeters, width of head 1.2 millimeters; upon emerging from the egg. At this stage the larva is of a pale, greenish-yellow, with a black head, the size of which appears somewhat disproportionate to that of the body. A very fine, light-grey, sparse pile covers the body, especially the posterior segment.

The full-grown larva measures 45 millimeters in length and 4.5 millimeters in width, the head being 3.75 millimeters in diameter. It is of a pale, ochre-green, semi-transparent, permitting the viscera, especially the heart and the malpighian and urinary glands, to be seen readily through the skin. The head, which is about one-tenth the length of the entire body, is biscuit shaped or of a very flat, oblate-spheroidal. The surface is strongly and coarsely punctured. The eclysiac sutures are strongly marked by narrow sulci. It is of a glabrous, tawny, flesh-color. A dark-brown line extends from the base of each mandible around the side of the head to the occiput, where it is deflected forward, following the eclysiac suture and being again deflected toward the side of the head, ending in a sharp point, the lines of each side thus forming a Y on the median, dorsal aspect of the head. The ocelli, which lie in the beginning of the dark line posterior to the mandibles, are 6 in number on each side and of a dark-brown. The mouth parts are dark-brown and glabrous and are surrounded by a rather coarse, porrect pile. The anal segment is glabrous and its posterior margin is strongly rounded, with numerous, white, curved setae projecting from it posteriorly. The legs are light yellowish-buff with many white setae on their lower surfaces. The abdominal feet, of which there are 10, are strongly pubescent. The spiracles, which are functional on the 1st and 4th to the last body segments, are of a light-yellow.

Pupa (Pl. II, fig. 4 and 4 A).—Length 25 millimeters, width 4.5 millimeters. The pupa is of a glabrous, dark-brown, but is frequently so covered with a white, flocculent substance that its true color is not apparent. It is strongly seto-pilose, especially on the anterior dorsal part of the head and thorax and on the abdominal segments. The setae upon the thorax project anteriorly, those upon the abdomen posteriorly. Very dark-brown rings extend around the apical margins of the 4th, 5th, and 6th segments. The proboscis extends to the apex of the 6th, its apical fourth being force free and transversely rugose.

A very remarkable feature of this pupa is the form assumed by the prothoracic spiracles. They are completely protected by a reniform patch of dense setae and are located one on each side of the posterior dorsal margin of the pronotum. See Pl. II fig. 4 B.

Imago, male (Pl. III, fig. 1).—Length of body 15-16 millimeters, length of fore-wing, 15.5-17.5 millimeters. Ground color, bright, yellow-ocher, with the following dark-brown markings or suffusions: The veins and a more or less obli-ent longitudinal patch along the posterior part of vein VII₂ and VII₃ from the base for one-half its length, in some specimens suffused with yellow-ocher; a similar, somewhat wider patch from the end of the cell to a point its own length from the outer margin. In some specimens this patch is confluent with the basal

Upon this ground, I believe, Staudinger's opinion that *tambux* is a variety of *augiades* can never be right according to my way of thinking."

"The female of *chrysocoma* varies greatly in the width of the dark markings; I have some which are as dark upon the upper side of the forewings as Moore's *palmarum*, others again have, with exception of the border, only fine, black stripes along the veins and a faint, dark shadow on the end of the cell. The ground color is darker than in *palmarum*, and the same as in *augiades*. The female on the upper side is exactly the same as the drawing of *palmarum*, but differs on the underside in that the light bands are nearly as clearly marked as they are above. The ground color is greenish-gray-brown."

This species is also found upon the betel palm (*Areca catechu* L.); in fact, Semper indicates in his note concerning this insect that the larva is only encountered upon that tree. My observations disprove this statement; indeed, it rarely is seen on any palm other than the coconut.

Preventives and remedies.—This insect is never found in sufficient numbers to justify the fear that it may become a serious menace to coconut culture, but as its feeding upon the leaves of small trees may have a tendency to debilitate them, its larvae should be destroyed whenever they are encountered.

Parasites.—This insect is probably, to a great extent, held in check by two small Hymenopterous parasites, *Chalcis obscurata* Walk., and an unidentified Braconid, both of which attack the larva, laying their eggs within its body, their young feeding upon its fats and body fluids. The larvae of the former parasite, of which there may be as many as 10, pupate within the pupa of the coconut skipper, which they kill, emerging therefrom in from five to six days thereafter (Pl. IV, fig. 1); those of the Braconid leave their host when they are full grown and, like all true Braconidae, they spin pure-white cocoons in the vicinity of the now dead and shriveled caterpillar. After spinning their cocoons the insects emerge in about 4 days. (Pl. IV, fig. 2.)

DESCRIPTION OF PARASITE.

Walker's description of the Chalcid is as follows:

Chalcis obscurata Walk., *Proc. Ent. Soc. Lond.* (1874) 399.

Male.—Body, antennae and legs black, with the usual structure. Body convex. Head and thorax scabrous, dull. Antennae stout, nearly filiform. Prothorax about four times as broad as long. Sutures of the parapsides, distinct. Abdomen smooth, shining, sub sessile, with cinereous tomentum toward the tip. Femora yellow at the tips, hind femora minutely denticulated beneath. Tibiae yellow, striped beneath with black; hind tibiae black at the base. Tarsi yellow, tips black. Wings cinereous; squamulae yellow; veins black; ulna about half as long as the humerus.

Hab.: Iligo (George Lewis), Philippines (Banks).

This is the first record of this species of the Chalcididae as from the Philippines.

THE COCONUT SLUG-CATERPILLAR.

LEPIDOPTERA.

LIMACODIDÆ.

Thaon ciceremarginata Banks.*Thaon ciceremarginata* Banks, Phil. Jour. Sci. (1906), 1, No. 2, p. 229.

The slug-caterpillar is easily distinguished from other Lepidopterous larvæ by the form of its body and its mode of locomotion, which is more like that of slugs or snails than of insect larvæ. Several species are known in the Philippines, many of them feeding upon palms. In Manila, this caterpillar is quite common and is usually found feeding either upon the upper or the lower surface of the leaves of the coconut. It presents a rather forbidding aspect, due to its being well armed with a double series of spinous tubercles placed upon either side, but, as a matter of fact, unlike most Limacodidæ, it possesses no poisonous properties. I have handled the larvæ freely without experiencing any discomfort.

The damage which this insect does to the coconut leaves is about equal to that of *Padraona chrysozona* Plötz.

Egg.—Diameter 1.5 millimeters, height 0.95 millimeters; of a flat, oblate-spheroidal shape and with minute reticulations upon the surface, pale-ochraceous. The larva escapes through a slit which divides the shell across its face, and the latter is not eaten as in the case of *Padraona chrysozona* Plötz. The period of incubation is from 5-7 days.

Larva (Pl. V, fig. 1).—When full grown, length, 23.75 millimeters, width, 14.25 millimeters including the tubercles. It is pale-green above and pale greenish-yellow at the sides, being almost pure-white beneath, and with the following markings: a median, light-purple or heliotrope band with symmetrical scalloped margin, the scallops expanding upon the respective segments. The margin of this band is darker purple and shades into the green of the dorsum. The band is developed into more or less of a patch upon the fourth and seventh segments, where the colors are darker. External to this band, on either side, is a series of 9 horizontally-projecting, spiniferous tubercles, those upon the second, fourth, sixth, eighth, and eleventh being twice or slightly more than twice as long as the remaining ones. Below these, ventrally on either side, is a series of 8 light-purple spots, one on each segment from the third posteriorly, and below these another series of 8 spots beginning upon the 4th segment. At the latero-ventral angle, a series of 11 horizontally projecting spiniferous tubercles, one of which projects anteriorly and another posteriorly on either side. The spines of these tubercles interlace and are yellowish-green at their bases and purple or black at their tips. Many of the spines have a white hair at their tips, and the shorter ones at the bases of all tubercles have somewhat inflated tips. The head is yellow-green and when the caterpillar is not feeding, is retracted within the 1st thoracic segment. The length of the larval stage varies from 21-25 days.

Pupa (Pl. V, figs. 2 and 2A).—Length 8.5 millimeters, width 5.5 millimeters. The color is a light yellow, with ochraceous bands on the posterior margins of the dorsal, abdominal segments; the wing pads are livid flesh-color and the eyes are dark-gray.

Cocoon.—Length, 8.75 millimeters; dark-brown, ecciform or oblate ovoid, composed of finely comminuted hair fiber held together with silk. The interior is white and silk lined. The pupal stage lasts about 22 days. Time of flight, the month of January.

Adult.—A description of the adult male and female of this species occurs in the *Phil. Jour. Sci.* (1906) 1, No. 3 p. 229. It is quite closely related to *Thaon minima* Semper, from which, according to Semper's description, it differs chiefly in having the prominent antemedial oblique sinuate band extending from near the cell spot to the middle of the inner margin.

Preventives and remedies.—The same methods of treatment apply to this species as to the Coconut skipper, though, as in the case of the other, there is no possibility of its ever becoming a serious pest.

SCALE INSECTS.

With exception of a few species from which useful or commercial products are obtained, such as the cochineal insect, *Elaeagnus cacti* Linn., and the lac insect, *Tachardia lacca* Kerr, practically all known species of scale insects are detrimental to man's agricultural interests. In some parts of the world they do more damage to crops and trees than is due to the effects of all the other insects of the region. While, in the Philippines, this is not so strikingly true in the case of the coconut palm, still the damage done to this tree by species of the family Coccidae is very considerable. It is rare to find a coconut which does not, by its yellow or brown leaves, indicate the ravages of these pests. Scale insects differ so greatly from ordinary insects that they may easily escape detection. As a rule, the commoner forms appear merely as rusty-brown or yellowish patches upon the surfaces of the leaves, or on the bark of the stems or trunk of the plant.

Characters.—In all species the body of the adult female is either covered with a scale formed of a waxy secretion in which the exuvium of the earlier stages are compacted or else the body of the insect itself assumes a form which suggests a scale or tubercle upon the host plant. The males of all species are winged, but on account of their very minute size and pale colors escape notice unless they are bred upon the food plant under glass, in which case they may be captured upon emerging as adults. The newly hatched young of both sexes are, of course, much smaller than the adults of either sex and it is almost impossible to see them with the naked eye.

Upon hatching, the young, coming from beneath the parent scale, scatter upon the leaf surface in quest of a favorable place to settle. Shortly after their first meal, which is obtained by inserting their probosces into the succulent part of the leaf or twig, the insects shed their skins, but during the period of feeding there will have exuded from certain body pores a pale, wax-like secretion which, adhering to the first exuvium, after a brief period assumes the form of a scale-like covering.

In the first mode the females usually shed their legs and sometimes their antennae, so that a female nymph or adult appears as a mere scale attached to the plant by the prothorax. The female, in those species having a distinct scale, remains under this covering throughout life, while the male, after a succession of molts, comes forth with legs and wings well developed.

In view of the great difference in appearance between the male and the female, it is necessary to consider their respective characteristics separately for purposes of classification, it being impossible to identify two given specimens of different sex as belonging to the same species unless they are found in close association or are bred from a given lot. In view of the relative scarcity of males in most genera of *Locustia*, the characters found in the female form the chief basis upon which their determination is made.

In the Philippines, so far as is known, seven species of *Locustia* are found upon the coconut. Of these, *Aspidiotus instructus* Sign. is by far the most abundant and destructive; next in abundance is *Aspidiotulus graminis* Barber, a species which has usually been encountered in great numbers on all trees examined both in Manila and in the provinces. The order of abundance of the remaining species is that of the following notes:

THE TRANSPARENT SCALE.

Aspidiotus instructus Sign.

This extremely prolific scale is found on the coconut palm in all localities in the Archipelago where investigations have been conducted. It is extremely injurious to the tree, causing their leaves to assume a characteristic yellow color, which is easily noted from a distance. Where it is encountered, the under surfaces of the leaves are covered with thousands of small, rough, circular patches, which are almost transparent and so thin that the green and larvæ can be seen beneath. When the leaflets are rolled longitudinally or when it withers, the scales become striated over to the venation on the edges which are attached to the leaflet. These scales have a brown middle and young scales upon a leaflet. It will be noted that the latter have fixed themselves to the longitudinal veins and therefore are arranged in very regular rows. Fig. 1, A, shows young insects which have emerged from beneath the scale of the present female scales from which the progeny have been reared by a very predacious beetle of the family *Coccinellidae*, are also present. Fig. 2 shows a coconut leaflet attacked by a form of disease which causes spots very similar to those resulting from the attacks of *Aspidiotus instructus* Sign. to appear on the upper surface. In case of doubt as to the origin of the spots, certainty is reached by examining the underside of the leaflet, where, if it is attacked by some insect, the larvæ will be found just at the point of dissemination of the scales.

DESCRIPTION.

Egg (Pl. VII, fig. 4).—Length 0.2 millimeter, width 0.1 millimeter, regularly, bluntly oval, one side more convex, very pale lemon yellow, smooth, laid in two or three more or less regular concentric rows around the parent within the scale. This regular distribution necessitates a nearly complete rotation of the female around the point of insertion of the proboscis. This is accomplished by an undulating motion of the body and may be observed by placing the live insect upon a piece of glass, under the microscope.

Larva (Pl. VII, fig. 8).—Immediately after hatching the length is 0.25 millimeter, the width 0.15 millimeter. Pale yellow, slightly lighter in color than egg. Eyes dark red; antennae 5 jointed, slightly setose, last joint 3 times as long as the first 4; transversely, microscopically striate, biapical as shown by Plate VII, fig. 5, with a single seta from each apex; mouth two-fifths of distance from frontal to anal margin. Anal margin dentate, giving indication in both sexes of existence of pygidial lobes. These disappear in the male upon the second molt. Legs moderately long, femora somewhat stout. Tarsi single jointed with 2 knobbed spines on the dorsal margin. Proboscis about as long as the body. Four minute hairs project from the frontal and 2 from the anal margin of body, the anal being 4 times the length of the longest frontal.

Male puparium.—Oblong-oval, pale, translucent, larval exuviae at center slightly darker, yellowish. Plate VII, fig. 3, shows the male puparium.

Female puparium (Pl. VII, fig. 2).—Differs from male in being more nearly circular. Color as in male. Larval exuviae at or slightly removed from the center. Darker than the scale itself, yellowish.

Signoret's description* is very meager. It is as follows:

"The scale is round, of a transparent white, with the exuviae at the center, and of a yellowish transparent white.

The female is yellow, round; the extremity with six lobes, of which the two median are shortest; the pygidium with four groups of wax glands of eight to ten orifices in each [group] agglomeration."

He says further concerning the insect: "This species appears to cause great damage to coconut groves in the island of Réunion, where they are menaced with complete destruction. The scale is also found on palms and dates. We have found it likewise on *Gogonius psidium* [*Psidium guajava*] which we received in the same package."

It will be seen that Signoret's description is not sufficiently detailed to differentiate this scale from other very similar ones, as he makes no mention of the squames, their number, and arrangement, which, for example, is a very important point in distinguishing *Aspidiotus destructor* Sign., from *A. lataniae* Sign. The following description has been prepared from fresh material:

Adult female (Pl. VII, fig. 2).—Length 0.80–0.90 millimeter, width 0.65–0.75 millimeter, bright pale-yellow, broadly oval, nearly circular, narrowed posteriorly, with slight emargination at the base of the pygidium, which is only slightly paler; posterior margin, whitish creamy, due to waxy secretions; two submedian white spots on each side of the genital aperture show the position of the circumgenital glands, the posterior of which have 4 to 5 apertures, the anterior 7 to 9. Anterior margin of the body regularly rounded, abdominal segmentation laterally distinct. Antennae, small, oval knobs with inwardly curving bristles at the apex, situated one-third of the distance from the frontal margin to the rostrum. Between the

*Ann. Soc. Ent. de France (1869), (4) 9, 120; Plate XII, figs. 8 and 8a. Translation.

antennae on the ventral surface are from 5 to 10 minute spinous tubercles. Parastigmatic glands not present. Stigmata subcylindrical. Pygidium (Pl. VII, fig. 6) with 6 lobes, median pair shorter than the next, weakly tricuspid, light-brown, next pair bicuspid, slightly paler, exterior pair of the same color, bicuspid, of the same length as the median. Chitinous portions of all lobes run anteriorly for some distance into the pygidial area, the surface of which is closely, longitudinally striate. Squames as follows for each side: 2, apically fimbriated, between the median lobes, similar ones, but more slender, between 1st and 2d lobes, 3 stouter between 2d and 3d lobes, with fimbriation somewhat externally laterad of apex; a series of 9 broad, laterally fimbriated ones beyond the 3d lobe and extending one-third the distance from the latter to the base of pygidial margin. These squames decrease in length and increase in width from the third lobe and the number and length of their fimbriations decrease so that the last one bears but 1 prominent spine, the remainder being reduced to sharp serrations of its latero-apical margin. Setae placed as follows: One pair at the external base of each median lobe nearly twice the length of latter, 1 pair between the second lobe and its 1st external squame, 1 pair ventrad to external lobe, 1 very short, ventrad to the 4th of the exterior 9 squames, 1 ventrad to the last squame, a small setose tubercle near the ventral margin, two-thirds of the distance from the last squame to the base of the pygidium. Four groups of circumgenital glands, the posterior pair with 4 to 6 orifices, the anterior with 7 to 12. Tubular spinnerets filiform; their heads chitinous; tube obconical, chitinous; their tongues one-third the diameter of their heads and equal to them in length. Numerous trumpet-shaped or subcylindrical ducts toward the apex and having orifices on the margin, as do tubular spinnerets. Anal opening about halfway from genital orifice to posterior apex. For details of structure see Plate VII, fig. 6.

Adult male (Pl. VII, fig. 1).—Pale-yellow, with darker, pinkish-yellow, transverse apolema. Head about one-tenth the length of entire body, including genital sheath. Ocelli very dark red; upper pair slightly extra-marginal, lower pair posterior and contiguous on median line, their diameter one-fourth greater than upper ocelli. True eyes posterior to and their own diameter distant from the upper ocelli, submarginal. Antennae composed of 10 joints, of which the first 2 are subglobose, 3 to 5 subequal in length and about 3 times the length of second, all segments sparsely setose. Tenth segment attenuated, terminating in a clubbed hair, surrounded by 3 other curved hairs of equal length. This is shown by Plate VII, fig. 7. Legs moderately long, posterior femora slightly stouter than the others. The single jointed tarsi, two-thirds the length of tibiae, slender, subconical and moderately covered with spinous hairs. Tibiae subequal to femora, with a very few hairs each. Claws or ungues one-fourth the length of tarsi, their digitules two-thirds their length. Tarsal digitule as long as ungues. Genital sheath long and tapering to a sharp point; two-sevenths of the length of the rest of the body. Wings iridescent, hyaline, obovate; veins of about equal length and subparallel to the respective margins. Haltere has the first joint swollen to about one-third its length, just before the apex. Second joint of length equal to the first; spinous and hooked at extremity. Length of wing 0.63 millimeter. This insect so nearly resembles *Aspidiotus latanier* Sign. that it is very difficult to separate the two species. The chief points of difference in the female are the number of squames external to the outer lobe, the number of orifices in the circumgenital glands, and the relative length of the median and second lobes of the pygidium, the median in *A. destructor* Sign. being shorter than the 2d pair, while in *A. latanier* Sign., they are of equal length and more markedly tricuspid.

Aspidiotus destructor Sign., is by far the most pernicious of the scales which attack the coconut in the Philippines. It most frequently occurs on young trees having from one to five years' growth, in many cases completely covering the under surfaces of all the leaves, giving them a characteristic yellow tinge. It is certain that it is attacked by a Hymenopterous parasite, as female puparia have been found showing the exit holes of the adult parasite, but as yet the latter itself has not been discovered. A small Coccinellid beetle, *Scymnus* sp., is a voracious feeder upon the transparent scale, the adults as well as the larvae of this species frequently being encountered in considerable numbers upon coconut leaves which are covered with the scales. A description of this insect follows:

Scymnus sp.

Larva.—Length 1.75 millimeters, width 1.01 millimeters, exclusive of the pure white waxy tufts which project from the front, sides, and posterior margins of the body as shown by Plate VIII, fig. 2. The larva of this beetle when once known can easily be distinguished from all others which might be found among scale insects in this region. It is extremely active, running from place to place and greedily gnawing open the delicate scale in order to obtain the insect which lies beneath. The body is pale yellow with a grayish tinge.

Pupa.—Length 1.25 millimeters, of a light ochre-yellow. This insect pupates within the larval skin, as do many species of the family. In this case the skin splits along the median dorsal line, exposing the pupa.

Adult (Pl. VIII, fig. 1).—Length 1.35 millimeters, width 1 millimeter, of a dark brown, almost black, with a light-brown discal spot on each elytron. In some specimens this spot is sharply, in others ill, defined. The entire body covered with a fine, white, pubescence. Palpi, apices of femora, tibiae and tarsi, brownish ochre. (See Pl. VIII, figs. 3 and 4 for antenna and palpi.)

Habits. This beetle, the adult as well as the larva, feeds on many species of Coccidae but has been found in greatest abundance in colonies of *Aspidiotus destructor* Sign.

Chrysomphalus propinquus Banks.

Chrysomphalus propinquus Banks, Phil. Journ. Sci. (1895), 1, No. 3, p. 239. (Pls. I and II.)

This scale bears a general resemblance to *C. aspidium* Linn., but its color and size, together with its apparent predilection for the coconut palm, upon which it is always found, make its identification as a distinct species a matter of some doubt. The scales crowd themselves upon both surfaces of the leaves of neglected or deformed trees and frequently as many as 4 or 5 are found overlapping each other. In Manila they breed with great rapidity and soon cover the leaflets and even the petioles. The same species has been encountered in great numbers upon the betel palm (*Areca catechu* L.) at San Miguel de Mayumo, Province of Bulacan. It may be distinguished from other scale insects which might be found upon the coconut by the decided, shining red-orange color of the pellicles. The male scales are infrequently met with in comparison with those of the female. (See Pl. X.)

Parlatoria greeni Banks.*Parlatoria greeni* Banks, Phil. Journ. Sci. (1906), 1, No. 3, p. 231. (Pl. III, figs. 1 to 5.)

This delicate, though prolific, scale is frequently seen in Manila upon young, badly cared for coconut trees. It is found upon the upper surfaces of the leaves and because of its flat shape and gray color is difficult to detect. While not as serious a menace as either of the foregoing species, it merits attention because of the possibility of its great increase if it is left unchecked.

Chionaspis candida Banks.*Chionaspis candida* Banks, Phil. Journ. Sci. (1906), 1, No. 3, p. 232. (Pl. IV, figs. 1 to 5.)

Frequently coconut trees are found the partially opened leaflets of which are covered with small, pure-white spots, due to the scales of another species of insect differing totally as to color and form from the foregoing. This scale multiplies rapidly upon either surface of the leaf, usually in the protected parts. As a rule, the female puparium occurs near to a group of male puparia or else with a group of the young scales in their first or second molt (Pl. IX). This insect is not as nomadic as *Aspidiotus destructor* Sign., therefore its opportunity for debilitating the tree is not as great and the danger from it is not to be feared in the same degree as from *A. destructor* Sign.

Lepidosaphes mcgregori Banks.*Lepidosaphes mcgregori* Banks, Phil. Journ. Sci. (1906), 1, No. 3, p. 233. (Pls. V and VI.)

This scale is comparatively rare. It occurs upon both sides of the leaves of the coconut, especially on old ones, but seems to prefer that part of the upper surface that is near to the midrib. It is always encountered singly and the puparia are seldom distorted as in the case with *Chionaspis candida* Banks. Although rare, it may at any time and under favorable conditions propagate to the extent of being injurious. The most noteworthy features which distinguish it are the pair of white, waxy, horn-like projections on the front of the first pellicle, the light color of the female puparium and the regularity of its transverse striae.

Lepidosaphes unicolor Banks.*Lepidosaphes unicolor* Banks, Phil. Journ. Sci. (1906), 1, No. 3, p. 234. (Pl. VII, figs. 1 to 7.)

This species is of nearly the same shape and size as the preceding, being only distinguished externally by the narrower, interior margin, the color of the puparium and the absence of the waxy horns in old specimens. It is less frequently met with than *L. mcgregori* Banks and therefore less likely to prove a menace.

Paratetraneura cocophylla Banks.

Paratetraneura cocophylla Banks, *Phil. Journ. Sci.* (1866), 1, No. 3, p. 23. (Pls. VIII to XI.)

This insect differs from any of the foregoing in that, if a female, it does not lie beneath a puparium but is itself its own scale. It has easily been found upon nearly every coconut examined in Manila, and is readily distinguished from other species by its unusual size (being 5 to 6 millimeters long and nearly as broad), and by the 2 small patches of orange-yellow on the posterior region. It always occurs upon the inferior surface of the leaf. The male puparia are much scarcer than those of the female.

A peculiar characteristic of the male insect is that it comes from beneath its scale to shed the pupal exuvie, returning after it has completed its transformation. The length of time after the final molt and before it seeks the female, during which the adult male remains beneath the puparium is not known.

PREVENTIVES AND REMEDIES.

In all the work upon scale insects affecting the coconut, it has uniformly been observed that those trees which are ill cared for or which have become deformed by the attacks of beetles are the ones most infested by scales. The malformed or pathologically imbricated leaves, in their interstices, offer ideal places for the breeding of scale insects. This fact would point to the necessity of the removal and destruction of such portions at once.

Because scale insects can only migrate as wingless larvae, it would seem that their arrest would not be difficult, and yet, when we consider that every wind blows these larvae from leaf to leaf and from tree to tree, we can easily see that this fact, as well as the extreme fecundity of the insect, renders no tree entirely safe from their attacks. However, those trees which are the healthiest and best cared for are the ones which will best withstand these pests.

Spraying with lime-sulphur or kerosene emulsion washes might serve, if properly applied, for the preservation of young coconut trees, but these remedies would entirely be out of the question for full-grown ones. The necessity is apparent for clean, systematic and regular cultural methods for the protection of this valuable tree from scale, as well as from all other insect pests.

INSECTS AFFECTING COPRA.

In connection with work which has been carried on in this Bureau on coconuts, copra, and coconut oil, it has been noted that certain lots of commercial copra, when received from the bodegas, were badly infested by larvæ, pupæ, and adults of *Silvanus surinamensis* Linn., and *Necrobis rufipes* De Geer. Both of these insects are cosmopolitan and as they

feed upon stored products of a character similar to copra it is only necessary to mention them in this connection.

In the case of these, and of most other injurious insect forms, preventive measures are always most advisable and if care is taken in packing and shipping the copra, receptacles into which the insects can not find entrance being employed, their ravages will be prevented. It is difficult to exterminate them if once they secure a lodgment in a mass of copra. Carbon bisulphide, which might be used successfully against similar insects in grain, would probably prove detrimental to copra owing to its power of dissolving oil.

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ERRATA.

In Part I of this paper:

Page 142, line 1, and 143, line 14, for *Evandrya* read *Hedya*.

Page 156, Table of Illustrations, for Plate I, fig. 1, substitute *H. ferruginea* Fab., and Plate I, fig. 2, egg of *Corydalus rhomboides* L., magnified *per longiora* at 15.

Page VIII, fig. 2 should be reversed.

ILLUSTRATIONS.

[All figures are more or less magnified; exact size is indicated in descriptions.]

PLATE I.

Coconut leaf showing work of *Padraona chrysosoma* Plötz. Note that on some of the leaflets the apical portion of the blade has been eaten, while in others the basal portion is represented by the midrib alone.

PLATE II. Drawn by W. Schultze.

- FIG. 1. Coconut leaflet showing abandoned notches made by young larva of *Padraona chrysosoma* Plötz.
 2. Egg on margin of leaf.
 2 A. Profile of egg.
 3. Full-grown larva.
 3 A. Profile of head.
 4. Pupa.
 4 A. Lateral view of pupa.
 4 B. First thoracic spiracle or stigma.

PLATE III. Drawn by W. Schultze.

- FIG. 1. *Padraona chrysosoma* Plötz, male.
 2. Female.

PLATE IV.

- FIG. 1. *Chalcis obscurata* Walk., adult.
 2. Coconut leaflet with cocoons of Braconid parasite on *P. chrysosoma* Plötz together with shriveled caterpillar skin of latter.

PLATE V.

- FIG. 1. *Thosca cineromarginata* Banks, full-grown larva.
 2. Pupa.
 2 A. Lateral view of pupa.

PLATE VI.

- FIGS. 1, 1 A. Coconut leaflet with adult females and young of *Aspidiotus destructor* Sign. Note arrangement of young along veins.
 2. Coconut leaflet attacked by disease causing spots similar to those produced by *A. destructor* Sign.

PLATE VII.

- FIG. 1. *Aspidiotus destructor* Sign., adult male.
 2. Female puparium, showing adult and eggs.
 3. Male puparium.
 4. Egg.
 5. Antenna of larva, distal segment.
 6. Pygidium of female.
 7. Antenna of adult male, distal segment.
 8. Young larva.

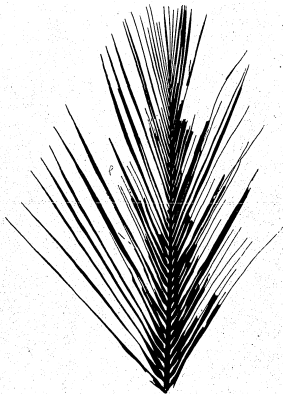


PLATE I.



2



2A



3A



3



4



4A



4B



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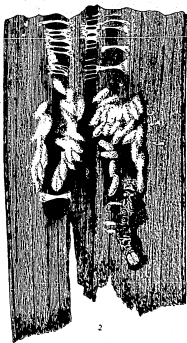
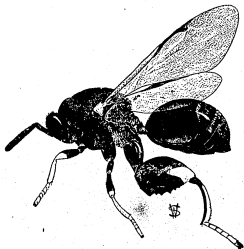
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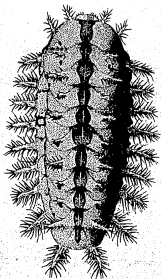


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PLATE III.





1



2



2 A



PLATE VI.

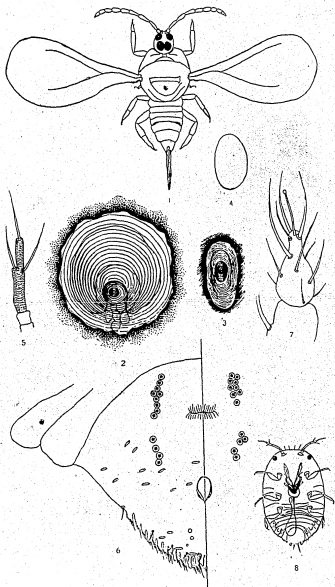
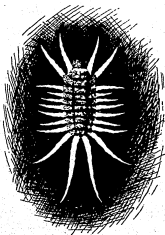


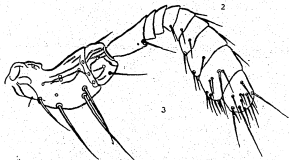
PLATE VII.



1



2



3



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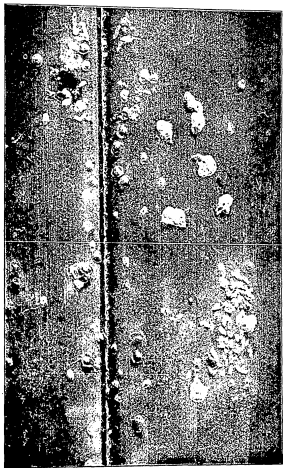


PLATE IX.

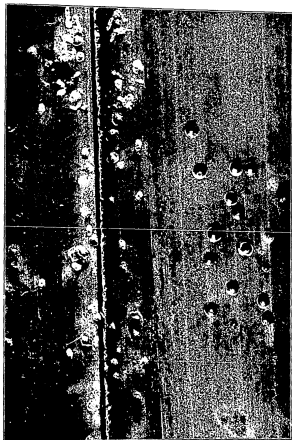


PLATE X.