

Insect Pests of *Cocos Nucifera* In the Territory of Papua and New Guinea : Their Habits and Control.

LANCE SMEE.

Entomologist, D.A.S.F., Port Moresby.

MANY of the insects which attack coconuts are common to a large number of the coconut-growing areas throughout the world, whilst others are found only in one or two localities. However, even those which are confined to a relatively small area can cause serious damage. On the following pages the main pests of coconuts in the Territory of Papua and New Guinea are described; some, like the Asiatic rhinoceros beetle and the palm weevil are found in many of the coconut-growing areas of the world; others like *Brontispa* and '*Sexava*' are confined to the Western Pacific area. A description of these pests is given, together with their habits, the type of damage they inflict and a short resume of the control measures applicable to each.

The list includes :—

Rhinoceros Beetles.	<i>Oryctes rhinoceros</i> (L.). <i>Oryctes centaurus</i> Sternb. <i>Scapanes Grosseopunctatus</i> Sternb. <i>S. australis</i> Boisd. <i>Trichogomphus semilinki</i> Ritz. <i>Xylotrupes</i> spp.
Palm Weevil.	<i>Rhynchophorus</i> sp.
Coconut Leaf Miner.	<i>Promecotheca papuana</i> Csiki.
Brontispa.	<i>Brontispa Longissima</i> Gestro.
Sexava (Coconut Treehopper).	Various species.
Lesser Spathe moth.	<i>Tirathaba rufivena</i> Walk.
Coconut Spathe moths.	<i>Batrachedra arenosella</i> Walk.
Amblypelta.	<i>Amblypelta</i> spp.
Axiagastus.	<i>Axiagastus cambelli</i> Dist.

RHINOCEROS BEETLES.

Oryctes rhinoceros (L.).
Oryctes centaurus Sternb.
Scapanes Grosseopunctatus Sternb.
S. australis Boisd.
Trichogomphus semilinki Ritz.
Xylotrupes spp.

There are a number of beetles in the family *Dynastidae*, commonly known as "Rhinoceros Beetles", which attack coconuts. *Oryctes rhinoceros* (Plate I) is one of the most widespread pests of coconut palms in South-East Asia and the Pacific Region. It is indigenous to most of South-East Asia and has been introduced recently to Manus Island, New Ireland and New Britain as well as many other islands in the Pacific area. However, other species found in the Territory include *Scapanes australis* (on the New Guinea mainland), *S. grosseopunctatus* (in the New Guinea islands, Plate VI), *Oryctes centaurus*, *Trichogomphus* and *Xylotrupes* spp. (also known as the Elephant Beetle, Plate VII.). *Oryctes Scapanes* and *Trichogomphus* have very similar habits, and cause similar damage.

The adults are generally 1½ inches to 2 inches in length, though *Xylotrupes* can be found up to 3 inches, the colour varying from light brown to black depending on age. The female *Xylotrupes* is quite distinct from the male, in the complete absence of any protuberances; the females of the other species have horns though generally smaller than those found on the males. The larvae of all the species are very much alike (Plate II) being the common "white curl grubs" found in decaying vegetable matter.

Life History.

This description applies to *Oryctes rhinoceros*, though the other species are very similar. The eggs are laid in decaying vegetable matter, or

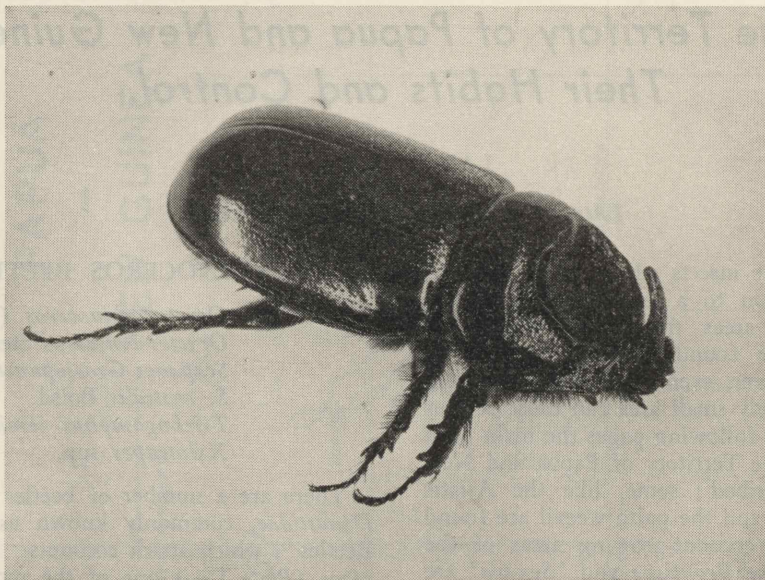


Plate I.—*Oryctes rhinoceros* L. (adult).

even soil rich in humus, and are often found in the decayed parts of living palms which have been attacked by the palm weevil (*Rhynchophorus*). The larvae emerge after an incubation period of 11 to 13 days, and are then about $\frac{1}{4}$ inch in length; they eventually reach a length of some 3 inches before pupating. The larval period ranges from 74 to 191 days and pupation takes place in a cell which has been formed in the soil or vegetable matter in which the larva has developed. The adult emerges from the pupal shell after an average of 20 days but remains within the cell for a further period of up to three weeks, till the cuticle hardens and the dark colour is developed.

The adult has nocturnal habits, resting or feeding during the day and flying only at night. Their flight range is fairly closely restricted to the breeding site.

The total duration of the life cycle varies from five to nine months, with an average of seven months.

Host Plants.

Rhinoceros beetles attack many other plants besides the coconut palm. These include the African oil palm, sago palm, nipa palm, pandanus, sugar cane, bananas and pineapples.



Plate II.—*Oryctes rhinoceros* L. (larvae).

Damage.

The adults are the only stage to attack the coconut palm. *Oryctes* and *Scapanes* feed on the young unfolded leaves (Plate III) causing serious set-backs to the palms, as well as a loss of production caused by direct damage to the spathes. They do not ingest the solid plant material, but suck the juices that flow from the macerated cells. The older palms can generally survive the attacks by the beetles, though in some places, e.g., Palau Islands, up to 50 per cent. of the palms have been killed by the attacks of the rhinoceros beetle only. However young palms are much more susceptible and may often die from damage caused by the beetle. *Xylotrupes* adults feed on the underneath surface of the midribs of the fronds, and can cause the apical part to die or break.

The most serious aspect of rhinoceros beetle damage though, is the paving of the way for infection by other pests and diseases; the most important being the palm weevil (*Rhynchophorus*) (see the section dealing with the black palm weevil and Plate IV).

Control.

1. *Mechanical.* Mechanical treatment to destroy breeding places and remove beetles from the palms has been given considerable attention in the various coconut-growing areas of the world where the pest appears. It involves burning and burying of plant debris, as well as collecting and destroying eggs, larvae and pupae, and removal of the adults from the palms by means of a hooked instrument.



Plate III.—*Oryctes* damage to a coconut palm.



Plate IV.—Young palm killed by combined attack of *Oryctes* and *Rhynchophorus*.

2. *Chemical*. The use of chemicals is replacing to a large extent the use of mechanical means in the control of rhinoceros beetle; rather than actually collecting and killing the various stages, insecticides are being used with varying success. BHC has been found the most efficient of the different insecticides used; 0.01 per cent. BHC used as a spray gives good control in the breeding places and can be used on the palms mixed with sand or sawdust to give some protection from the adults (5 per cent. BHC dust is mixed in equal proportions with sand or sawdust and placed in the axils of the central leaves; this is most effective in dry weather).

Once the favourite breeding grounds have been eliminated, trapping should maintain control. The traps consist of attractive breeding materials such as split palm trunks treated with 0.1 per cent., BHC and covered with leaves.

3. *Biological*. Various insects (Plate V), notably the scoliid wasp (*Scolia ruficornis* F.), have been introduced into New Guinea in an attempt to find suitable predators or parasites for *Oryctes rhinoceros* and the other dynastid beetles which attack the coconut palm. This programme is being continued, with new possible predators or parasites being introduced as they are found.

However, biological control is a long term project, and it may be some time before these various predators can be evaluated.

PALM WEEVILS.

Rhynchophorus spp.

Palm weevils *Rhynchophorus* (Plate VIII) are probably the most destructive pests of coconut palms. They are unlike the rhinoceros beetle in

that the adult itself does not cause any damage, but the juvenile stages are passed in the palm and the damage they inflict is often fatal. The adult weevil is black, 1 inch to 1½ inches long and sometimes has reddish stripes running down the pronotum. It has a typical elongated snout or rostrum with small, weak mouth-parts at the apical end.

Life History.

The eggs are laid only in the softer portions of the palm, usually where the palm has been injured in some way. However, there is some evidence that oviposition takes place in the crown of the young palms where the tissues are soft or amongst the exposed rootlets of young palms which have been incorrectly planted. Incubation of the egg requires two to five days, and the larva period varies from 36 to 78 days. Pupation takes place in the palm, in a cocoon which the fully developed larva has constructed from the fibrous strands. After the cocoon is finished the larva assumes the inactive stage known as the pre-pupa, which changes into the pupa after about three days. Pupation takes 12 to 20 days, the young weevil then remaining in the cocoon for a further period of a week or so before finally emerging as a mature adult.

The weevils are most active during early morning and late afternoon, with flight and crawling generally restricted to daylight, though some activity is carried on at night. These insects are strong flyers and are capable of long flights in seeking their host plants.

Both sexes live for two to three months, and in this time the female lays an average of 200 eggs.

Host Plants.

The palm weevil is commonly found on a number of palms including the sago palm and has been reported attacking the oil palm and other ornamental palms.

Damage.

After hatching, the larvae begin feeding toward the centre of the palm, ingesting only the softer parts and passing the fibrous strands to the rear where they eventually block the tunnel. Following the feeding of a number of larvae, a large cavity may be formed in the centre of the palm. The larvae may be found anywhere in the trunk of a young palm but are confined to the top few feet below the crown in older palms.

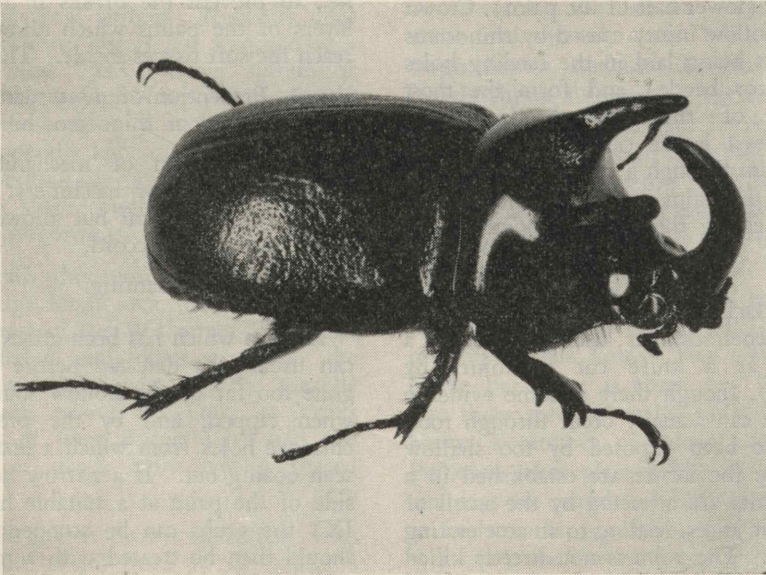


Plate V.—*Scapanes grossepunctatus*.

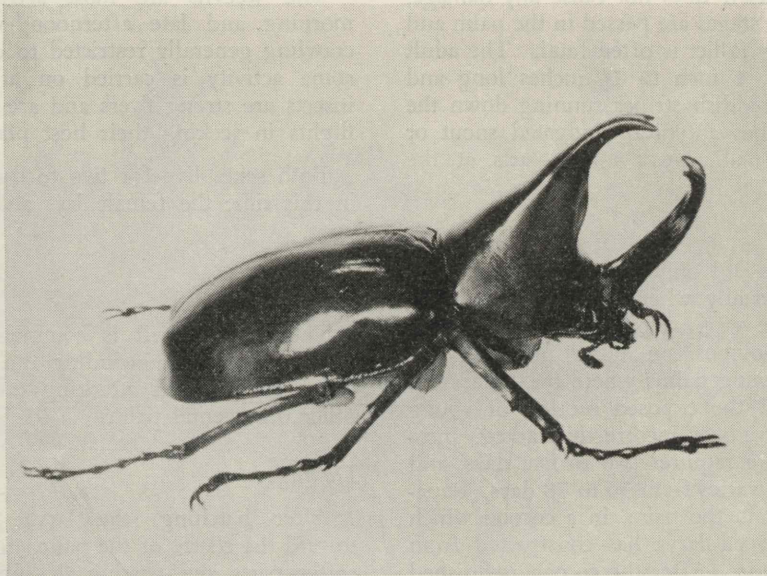


Plate VI.—*Xylotrupes* sp.

An attack may be initiated almost anywhere following injury to a young palm, though the type of damage may be generally classified as either "crown" (top half of the palm, see *Plate IV*) or "bole" (lower half of the palm). Crown attacks mostly follow injury caused by rhinoceros beetle (the eggs being laid in the feeding holes of the rhinoceros beetle) and form the most serious aspect of rhinoceros beetle attack, though the weevil larvae can penetrate to the trunk of the palm through a cut leaf petiole. In a crown attack the palm is usually killed by the larvae actually eating the growing point of the palm.

When the attack is in the lower half of the palm initial penetration is usually through a wound (such as a knife cut or injury by machinery, etc.), though there is some evidence that penetration can actually occur through rootlets which have been exposed by too shallow planting. Once the larvae are established in a palm, more adults are attracted by the smell of fermenting plant juices, leading to an accelerating rate of damage. The palm is not directly killed by this type of attack but is structurally weakened so that it eventually falls to the ground.

Control.

The first step to take in the control of this pest is to deny it oviposition places in the palms, i.e., to prevent the breaks in the outer fibrous layers of the palms which allow the weevils to reach the soft tissues inside. This is done by :—

1. Prevention of insect damage—mainly by control of rhinoceros beetle.
2. Prevention of mechanical damage—by knives or by machinery. Fronds should not be cut off but allowed to fall off of their own accord.
3. Correct planting.

A palm which has been attacked near the base can usually be detected before the damage has gone too far by the hollow sound of the trunk when tapped, and by the presence of small entrance holes from which a brown fluid can be seen oozing out. If a narrow hole is cut in the side of the palm at a suitable height (see *Plate IX*) the grubs can be scooped out. The hole should then be treated with a mixture of 2 per cent. dieldrin in creosote, which will kill any grubs remaining, and act as a repellent to prevent

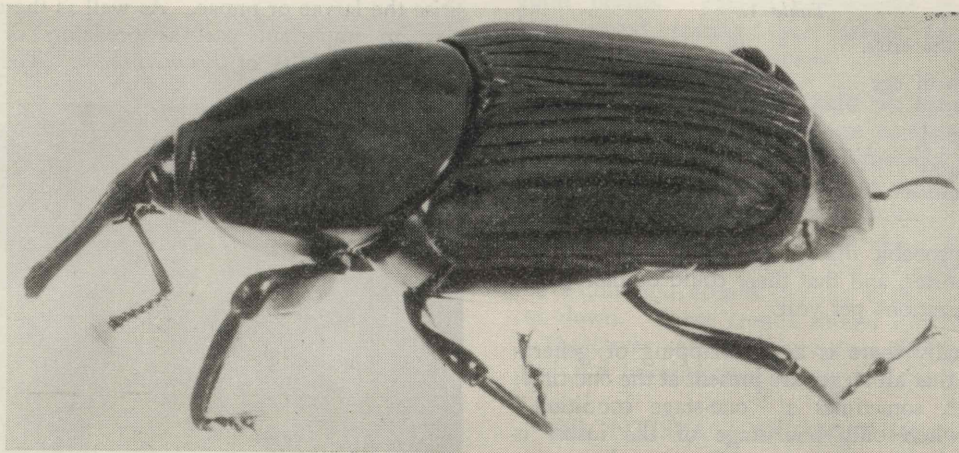


Plate VII.—*Rhynchophorus* sp.

re-infection. The use of a BHC/sand or sawdust mixture as for rhinoceros beetles has been found to have beneficial effect.

COCONUT LEAF MINER.

Promecotheca papuana Csiki.

The coconut leaf mining beetle, *Promecotheca papuana* Csiki, is a serious pest of coconuts only in some parts of New Britain. It occurs elsewhere in the Territory but is not recorded as a major pest in these areas. Other species of *Promecotheca* are found in New Guinea, mostly on pandanus, but do not attack coconuts. *P. papuana* is generally kept in check by natural enemies, but periodically appears in what is known as "one stage condition" when it can assume plague proportions.

In New Britain the most seriously affected areas are the Linga Linga area, the central north coast west and east of the Willaumez Peninsula, around Lindenhafen and other areas on the central south coast, and parts of the Gazelle Peninsula. Manus Island, the Duke of Yorks and other parts of New Britain have had less serious attacks at much more widely spaced intervals.

P. papuana is golden brown in colour, with the prothorax and distal third of the elytra a deep bluish-black and is about 1/3 inch in length.

Life History.

This beetle is closely associated with the coconut palm, all stages occurring in the palm crown, and with both adult and larvae feeding on the fronds.

The eggs are laid almost invariably on the underside of the leaflet and are covered with excrement by the female. They appear as a small oval mound, about 1/8 in. long, with a rough brown surface. Before ovipositing the female chews a furrow in the leaf surface, over which the eggs are laid. On hatching, the larvae penetrate directly into the inner leaf tissue by means of this furrow; the larvae, young or old, cannot penetrate an unbroken leaf surface as their mandibles work only in a horizontal plane. The larvae feed inside the leaf, leaving the epidermis above and underneath the mine, through which they can be readily seen if the leaflet is held up to the light. The average number of larvae per mine is three (in the Lindenhafen area there are five); though if the infestation is heavy, a number of mines may run together. Pupation takes place within the mine and takes ten days to complete. Adults can live as long as five months, possibly even longer, and during this time, the female can lay 80 to 100 eggs. Table 1 shows the average length of each stage of the life cycle.

Table 1.

Stage of life cycle.	Days.
Incubation of egg	15 days.
Larval period	28 days.
Pre-pupa {	
Pupa { to emergence of adult	15 days.
Post pupa {	
Pre-oviposition	25 days.
Adult	160 days upwards.

It is probable that in nature these periods are much shorter, and that there could be more than five generations per year.

Normally there is an overlapping of generations so that all stages are present at the one time. However, sometimes a "one-stage condition" arises, when only one stage of the insect is present, due to some external factor, such as parasites, weather, or even incorrect insecticide application. When this occurs a rapid build-up of the *Promecotheca* population takes place, as the parasites lack suitable host material for oviposition, and many beetle generations are required before the parasites can gain the upper hand and reduce the beetle population again. Once the "one-stage" condition is reached it is maintained for a long period; up to two years.

Damage.

In a severe infestation the palms can be damaged very badly; the leaflets are completely destroyed, turning brown and giving the palms the appearance of being scorched. Sometimes the central shoot can be damaged so badly that the palm eventually dies. Recovery from severe infestation is slow, with the palm taking up to two years before nut production is resumed. With a less severe infestation, drying and curling of the tips of the leaflets is noticeable, together with the elongated patches due to the mining of the larvae within the leaflets.

Control.

No truly satisfactory artificial control measures against *Promecotheca* have been devised. In general it can be assumed that chemical treatment would do more harm to any parasites than to the beetle.

There are a number of parasites which are generally efficient in controlling *Promecotheca*, including a number of small wasps which para-

sitise the larvae or pupae. As well as these, ants play an important part as predators of both larvae and adults of *Promecotheca*. The most



Plate VIII.—Cutting a hole in a coconut palm to facilitate removal of *Rhynchophorus* larvae.

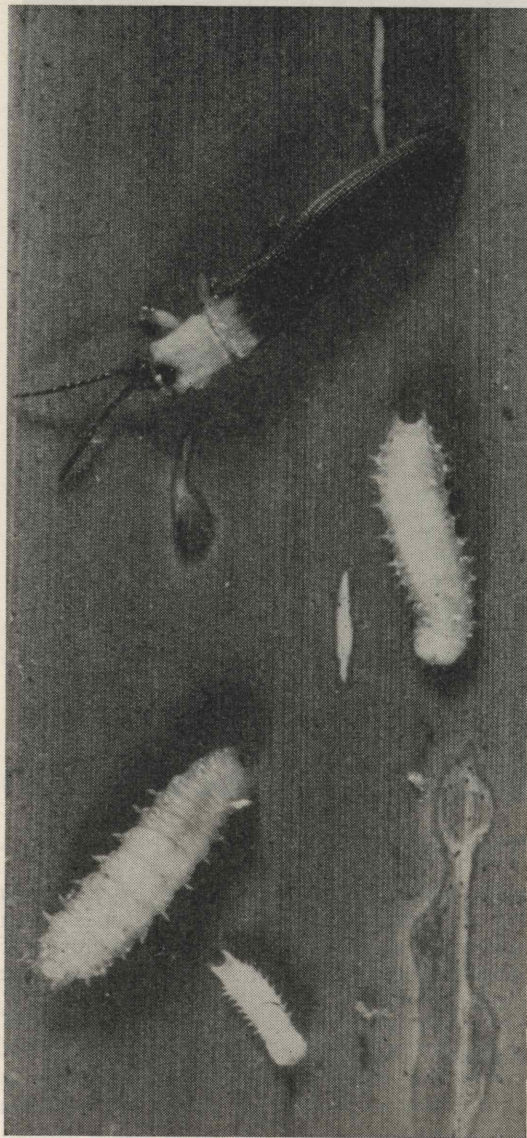


Plate IX.—Larvae and adults of *Brontispa*.

important of these predacious ants is the green tree ant, with others playing a less important part.

Vertebrates are often overlooked as predators of *Promecothea*. Various lizards are abundant in plantations and presumably would feed on the

adult beetles. Parrots (*Domicella* sp.) have been noted tearing open larval mines and apparently eating the larvae.

At the present moment, until the main factors contributing to an outbreak are understood, the only steps that can be recommended are the encouragement and protection of lizards, birds, ants, etc., and the periodic examination of random palms for detection of outbreaks. When an outbreak occurs insecticides can be used to kill the adults and fronds bearing eggs and larvae cut down. These fronds should not be burnt, as the larvae cannot mature once the frond has died and burning would only kill the parasites.

BRONTISPA (COCONUT HISPID).

Brontispa longissima Gestro.

The coconut hispid, *Brontispa longissima* (Plate X) is a small orange and black beetle which is an important pest of coconuts in the Solomon Islands and New Guinea. It attacks palms of all ages, but it is most severe in nurseries and young palms in the field. The adult is about $\frac{1}{2}$ in. long by $\frac{1}{8}$ in. broad, with the head and antennae black, and the thorax and a small portion of the elytra (wing cover) adjoining, yellow-brown. The remainder of the elytra is black.

Life History.

The eggs are laid between, and inside, the tightly-folded young leaflets, in groups of one to four. They are laid end to end in a furrow chewed by the female parallel to the axis of the leaf, and then covered with excreta. The larvae hatch after incubating for five days, and commence feeding between and inside the unopened leaflets. Pupation takes place between the unopened leaflets, where the adults also feed. Table 2 shows the average length of the different stages in the life history of *Brontispa*.

Table 2.

Stage of life cycle.	Days.
Incubation	5
Larva	36
Pupa	6
Pre-oviposition	74
Total, egg to egg	121



Plate X.—A young palm damaged by *Brontispa*.

This would give three generations per year. The shortest time for a generation is about 64 days.

Host Plants.

As well as the coconut, a number of palms serve as host plants to *Brontispa*. They include the sago palm, betel-nut, oil palm, as well as various other ornamental palms.

Damage.

Both larvae and adults feed amongst unopened leaflets. The larvae chew off the surface of the leaf, causing browning and eventual death of the tissue attacked. The adults chew the tissues in narrow lines parallel to the midrib of the leaflet, and probably cause more damage than the larvae, as they live much longer. A

palm which has been damaged by *Brontispa* has a scorched appearance, with the fronds brown and curled at the tip. They retard the growth of the palms, and in cases of severe attack can cause death.

Control.

Brontispa is generally controlled by parasites and predators, but may get out of hand, particularly in large areas of young palms. A treatment which will give good control is to drench the central spike of the palm with 0.1 per cent. dieldrin in water. Equipment capable of delivering a fine low-volume spray controlled by an efficient trigger tap will use less than an ounce of mixture per palm up to three years old. Unnecessarily high volumes and concentrations should be avoided.

The life cycle of a typical tree-hopper is summarized in Table 3.

Table 3.

Stage of life cycle.				Days.
Egg	....	....	....	45-100 mean 78
Nymph (female)	....	....	....	90-124 mean 101
Nymph (male)	....	....	....	78-107 mean 101
Adult, pre-oviposition	....	....	....	33
Total, egg to egg				212

Host Plants.

Coconut treehoppers freely attack bananas, manila hemp, and oil palms as well as coconuts and are doubtless found on other plants also.

Damage.

The nymphs and adults of the coconut tree-hopper can completely strip the green leaves off the coconuts, causing a severe setback in growth, and loss of production.

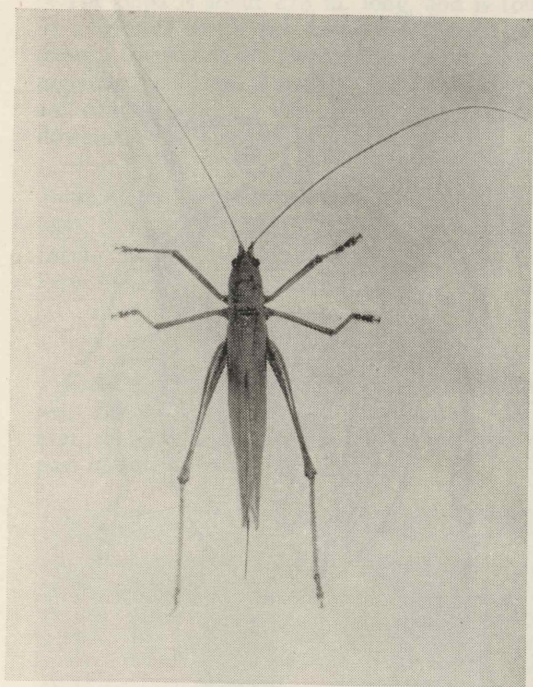


Plate XI.—*Sexava*.

Treatment should be repeated as required when damage to the palms can be seen.

'SEXAVA' (COCONUT TREEHOPPERS).

Family *Tettigoniidae*, sub-fams. *Mecopodinae* and *Conocephalinae*.

There are a number of species of treehoppers which are known under the name "*Sexava*". These are all rather similar in appearance (Plate XII) and habits. The colour of these treehoppers is generally green, though there are brown species. In appearance they are typical long-horned grasshoppers, with well-developed wings and jumping legs, and very long antennae.

Life History.

The eggs are laid either in the ground or in the accumulated debris around various epiphytes, etc. When the eggs hatch the young nymphs climb the palm and commence feeding on the leaves. All the nymphal stages, and the adult stage are passed in the top of the palm.

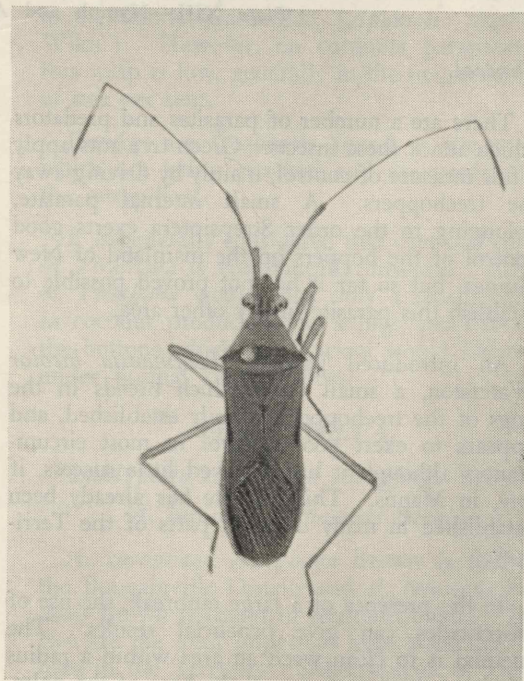


Plate XII.—*Amblypelta* (adult).

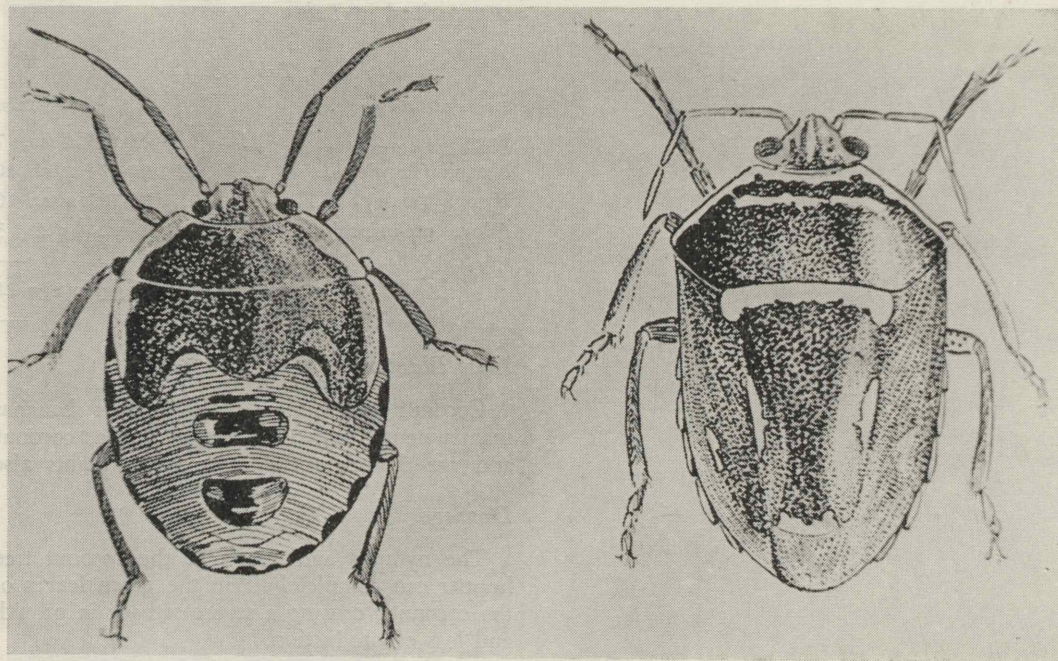


Plate XIII.—Nymph and Adult of *Axiagastus cambelli*.

Control.

There are a number of parasites and predators which attack these insects. Green tree ants apply a fair measure of control, mainly by driving away the treehoppers. A small internal parasite, belonging to the order Strepsiptera exerts good control of the hoppers on the mainland of New Guinea, but so far it has not proved possible to establish this parasite in any other area.

An introduced parasite, *Leefmansia bicolor* Waterston, a small wasp which breeds in the eggs of the treehopper, is easily established, and appears to exert good control in most circumstances although it has achieved little success, if any, in Manus. This parasite has already been established in many different parts of the Territory.

In the presence of a large outbreak, the use of insecticides can give beneficial results. The method is to clean weed an area within a radius of about three feet around the base of the palm, and then spray this area, plus the base of the

palm to a height of about three feet with an 0.25 per cent. dieldrin in water mixture. This method is best in areas of low rainfall.

COCONUT SPATHE MOTH.

Tirathaba rufivena Walk.

Tirathaba rufivena Walk. is a small fawn coloured moth, with the veins in the wings clearly marked in a reddish colour, and is about $1\frac{1}{4}$ in. long. It is found from Ceylon to New Caledonia.

Betrachedra arenosella Walk. commonly known as the Lesser Spathe moth, is also quite common on coconuts. Its larvae bore in the male flowers only, and the damage caused is not of economic importance.

Life History.

The female oviposits on the coconut flowers as the bud is just opening, and the caterpillars feed on the newly opened buds. The mature larvae are about $\frac{3}{4}$ in. long, and are a dark grey with the head and prothorax brown.

The pupa is about $2/3$ in. long, and is found in a cocoon which the larva has formed from debris, fragments of flowers and excreta, bound together by silken threads. The dried cocoons are often found in the accumulation of dead flowers in the bases of the fronds.

Table 4.						Days.
Stage of life cycle.						
Egg	....	....	....	....	....	4-5
Larva	....	....	....	....	....	12-30
Pupa	....	....	....	....	....	7-14
Total						30

Each generation appears in time to coincide with the production of the new spathes. However, under the right circumstances the cycle can pass in only 15 days.

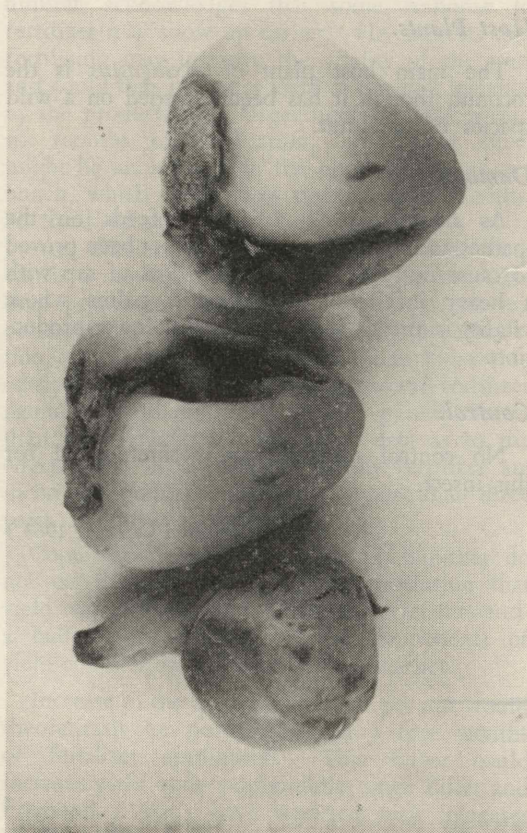


Plate XIV.—Nuts which have fallen prematurely due to *Amblypelta* attack.

The adult is nocturnal, and only the female is attracted to lights.

Host Plants.

Tirathaba attacks the following plants though it is best known from coconuts:—nipa palm, coconuts, oil palms, betel-nut, bananas and *Phaseolus*. It is thought that *Nipa fruticans*, the nipa palm, is the original host.

Damage.

The eggs are laid on the buds which have just begun to open. The caterpillars generally attack the male flowers, though occasionally the female flowers are attacked as well, and they often eat the peduncles (stalks) of the young buttons. In general *Tirathaba* causes a consistent but not serious fall of young nuts.

The damage caused by *T. rufivena* is most important on spathes which are defective in opening.

Control.

In the Solomon Islands, the caterpillars on the nipa palms are parasitized by a wasp belonging to the family Braconidae, (*Apanteles tirathabae* Wlkn.). However, on coconuts parasitism by this wasp is low, generally in the neighbourhood of one per cent.

Earwigs are frequently found in the spathes which are being attacked and are predators of the caterpillars.

It is generally considered that chemical control of *Tirathaba* is economically unsound. Control of *Tirathaba* would give only a small increase in coconut production, as a high proportion of the buttons which are attacked would fail to set under normal circumstances.

AMBLYPELTA.

Amblypelta cocophaga cocophaga Brown.

A. lutescens papuensis Brown.

A. cocophaga cocophaga Brown is found in the Bougainville District and *A. lutescens papuensis* Brown is found in Southern Papua. These two are the most important bugs attacking coconuts in the Territory. Other species of *Amblypelta* have been recorded on coconuts.

Amblypelta is a slender light brown to red insect slightly less than $\frac{1}{2}$ in. long. It was first recorded as attacking coconuts in the Solomon Islands, where it causes extensive nutfall. In the Territory it occurs in isolated pockets only in Bougainville. *A. lutescens papuensis* causes extensive nutfall on the south coast of Papua and on the islands extending to the east.

Life History.

The life cycle of *Amblypelta* is short, only about six weeks, and all stages can be found on the coconut palm. The eggs are laid on the central spike, and hatch in seven to eight days; the nymphal stages last 30 to 35 days.

Host Plants.

Amblypelta feeds on wild figs (*Ficus* species), poinciana, cacao, tapioca and various bush trees.

Damage.

Amblypelta feeds on the inflorescences and young nuts. When it feeds it injects salivary juices into the tissues, causing the death and distortion of quite a large area (of both cacao and coconuts), which can cause the nut to fall prematurely. Nuts which have fallen because of *Amblypelta* attack can be distinguished by the feeding scars (Plate XV).

Amblypelta has been known to cause 100 per cent. premature nutfall, so that production ceases altogether.

Control.

No satisfactory method of controlling this pest has been evolved, except by encouraging the tree ants which prey on it, and discouraging other ants which do not and which are antagonistic to the tree ants.

AXIAGASTUS.

Axiagastus cambelli Dist.

Axiagastus cambelli is a small brown and orange bug closely related to the "green vegetable bug" *Nezara viridula* L. (Plate XIV). It is often found in large numbers on the freshly opened spathes, however, it appears to feed mainly on the male flowers and has not been proved to cause nutfall.

Life History.

The various stages of the life cycle of *Axiagastus* cover about eight weeks (eggs 7 days, nymphs 46 days). The eggs are laid mainly on the dried spathes and fibrous stipules rather than on the leaves.

Host Plants.

The main host plant of *Axiagastus* is the coconut, though it has been recorded on a wild species of betel-nut.

Damage.

As noted above, *Axiagastus* feeds on the spathes and male flowers, and has not been proved to cause nutfall. However, the loss of sap with a heavy infestation can weaken palms whose vitality is already low, and possibly lower production.

Control.

No control measures are recommended for this insect.

(Received October, 1963.)