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Pilot Survey of
Port Moresby

Further Records
New Guinea

Observations on
Salmonellosis in

Anita M. I.

The Use of Mis-
Social Organizati-
Book Reviews



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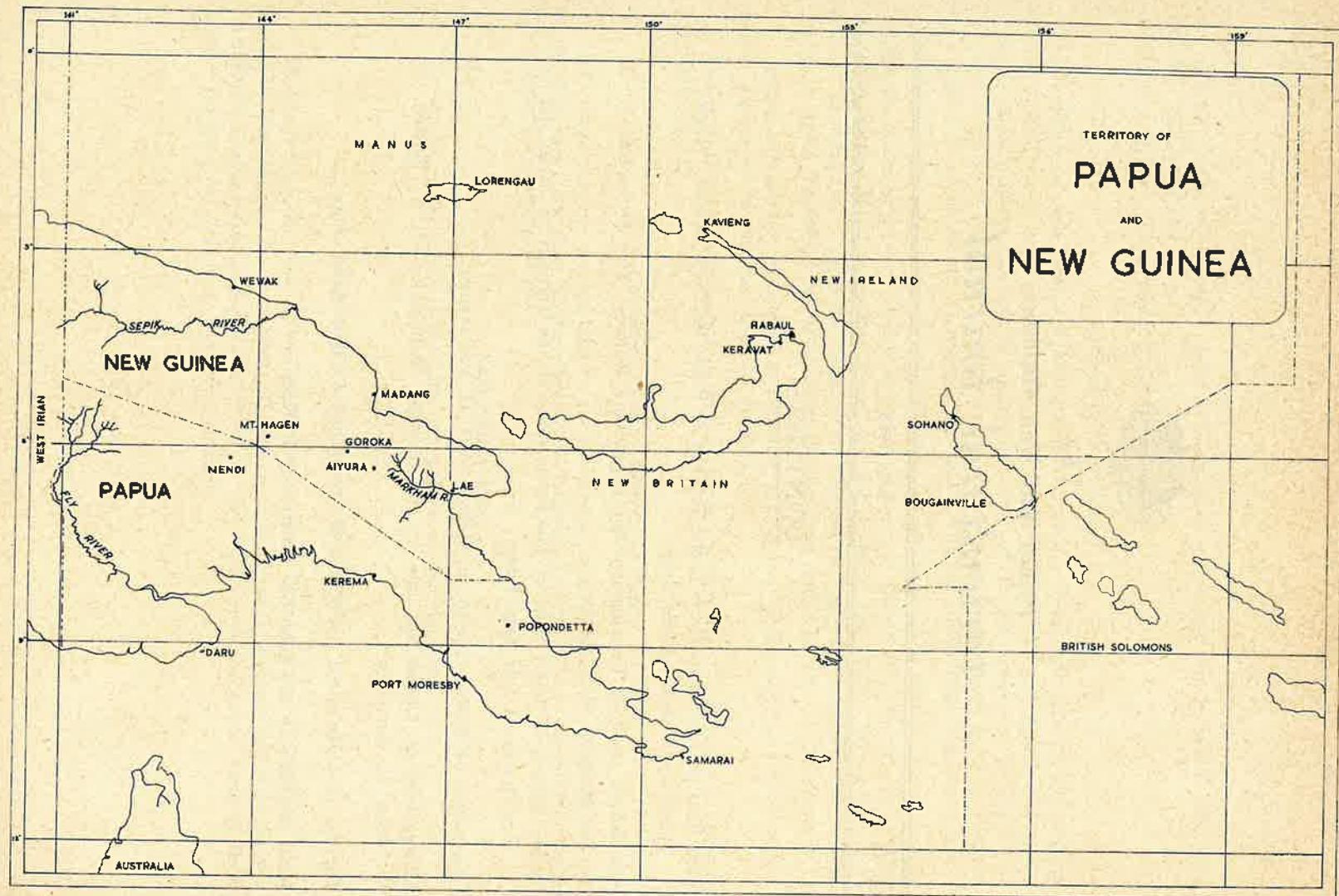
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Insect Pest Papua and

THE insects attacking cacao in Papua and New Guinea are described on the following pages. The description of their type of damage and the control methods

The insects include

Cacao weevils
Longicorn borers
Flush defolia

L. Tigris

sabulosa V.

Mealybugs

Coccidae

Aphids. Flam-

Capsids (In-

Helopeltis

Giant Cacao

Amblypelta.

A short discussion is employed in the article on the insects which can be found here also. The expressions which follow are the theories behind the methods.

TECHNIQUES OF INSECTICIDE

There are four main types of insecticides, each used under different conditions. Spraying, low volume dusting, high volume dusting, or concentrated spraying.

High volume dusting is used when the carrier, and plant, are thoroughly wet. High amounts of a very fine spray, amount of spray, and volume of air, the

Insect Pests of *Theobroma Cacao* in the Territory of Papua and New Guinea: Their Habits and Control.

LANCE SMEE.

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

THE insects which are most often found attacking cacao throughout the Territory of Papua and New Guinea are described on the following pages. Included also is a brief description of their life histories and habits, the type of damage they inflict, and a resume of the control methods which are applicable to each.

The insects included are:—

Cacao weevil borers. *Pantonhytes* spp.

Longicorn borers. Family Lamiidae.

Flush defoliating caterpillars. *Achaea janata* L.

Thraulodes phagata Walk. *Ecnopsis sabulata* Warr. *Hypocidra talaca* Wlk.

Mealybugs and scale insects. Family Coccoidae.

Aphids. Family Aphididae.

Capsids (mirids). *Pseudodoniella* spp.

Helopeltis claviger Walk.

Giant Cacao termite. *Neotermes* sp.

Amblypelta. *Amblypelta* spp.

A short discussion of the various techniques employed in the application of insecticides is to be found here also, in order to help clarify expressions which are commonly used, as well as the theories behind the use of the different methods.

TECHNIQUES FOR THE APPLICATION OF INSECTICIDES.

There are four basic methods of applying insecticides, each of which has use under different conditions. They are: high volume spraying, low volume spraying (also known as misting or concentrate spraying), fogging and dusting. High volume spraying uses large amounts of a very dilute mixture, with water as the carrier, and plants are sprayed until they are thoroughly wet. Misting uses a much smaller amount of spray, which is carried in a high volume of air, the air replacing the water which

is used in high volume spraying. In misting the droplets form a discrete pattern, they do not coalesce and there is no run-off—the residue often is not visible to the naked eye. Fogging uses an even smaller amount of spray material, and extremely small droplets are formed—these are carried by natural air movement, rather than the air blast produced by the machine. Foggs are used mostly for interior work, and are generally considered unsatisfactory for outside use as they do not provide adequate residual deposits and coverage because of the reliance on air drift to carry the insecticide. In dusting, the insecticide is carried by movement of the air, and like fogging can be used only when there is little wind.

Under Territory conditions, low volume spraying and dusting are the most popular methods of insecticide application, mainly because of inadequate water supplies and difficulties of terrain.

High Volume Spraying.

This form of spraying is commonly found in the use of hand-pumped knapsack sprayers (Plate I) for the treatment of young cacao or coconuts, e.g., the application of insecticides to young cacao for the control of caterpillars.

Spraying can often be selective and thus the amount of spray material used may be reduced. The limits to the use of knapsacks are in the volume of water required per acre and the height which has to be reached with the insecticide. Dilute mixtures of insecticide are used, for example, for caterpillar control on young cacao an 0.25 per cent. DDT mixture is recommended.

Misting.

Mist spraying is probably the commonest form of insecticide application found in the Territory. The main advantages lie in the low volumes of water required per acre, low cost for the amount

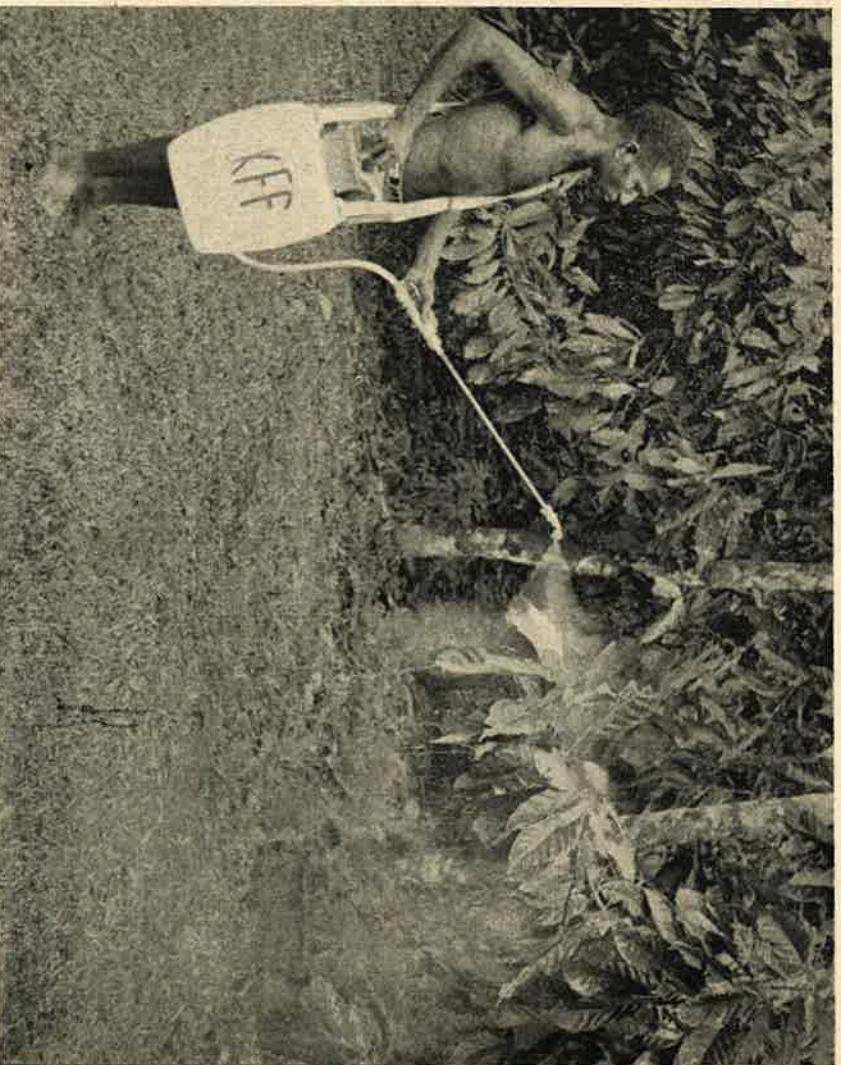


Plate 1.—A type of hand-operated knapsack sprayer used for high volume application of chemicals.—N.B.—Excess spray running off.

of insecticide used, and the versatility of modern power-driven shoulder-mounted misting machines. In contrast to the dilute mixtures used in high volume spraying, concentrated mixtures of insecticides are applied, again, for caterpillars on cacao, a 2.5 per cent. DDT solution is recommended.

The disadvantages of misting are that there is less effective deposition of insecticide, compared with high volume application, when equal amounts of active material are applied per acre. As the amount of spray per acre is reduced there is a corresponding decrease in the effective deposition of active material, as a higher percentage of the mist falls to the ground, particularly on young trees.

Dusting.

Dusting is generally used for capsid control in cacao; however it is probably the most expensive way to apply a given amount of insecticide. For example, in the control of capsid, it costs 8s. 10d. per acre for each application of BHC dust (at 8 lb. per acre) but only 1s. 8d. per acre to use an endrin mist for equivalent results (see section on capsids). The main advantage of dusting is in the speed and ease of an application, also, no water or preparation is required. Hand operated machines can be utilized in the treatment of small areas. Apart from expense, dusting is at a disadvantage because of the poor resistance of the deposits to washing by rain.

It is important methods are just used, equal amounts given area) must results. The second that an even coverage obtained.

CACAO.

There are five species of weevils attacking cacao V, VI and VII) (*P. plautus* Obsoletus (*P. proximus* Fissicornis) Papua (*P. szentivani*) of the weevils in



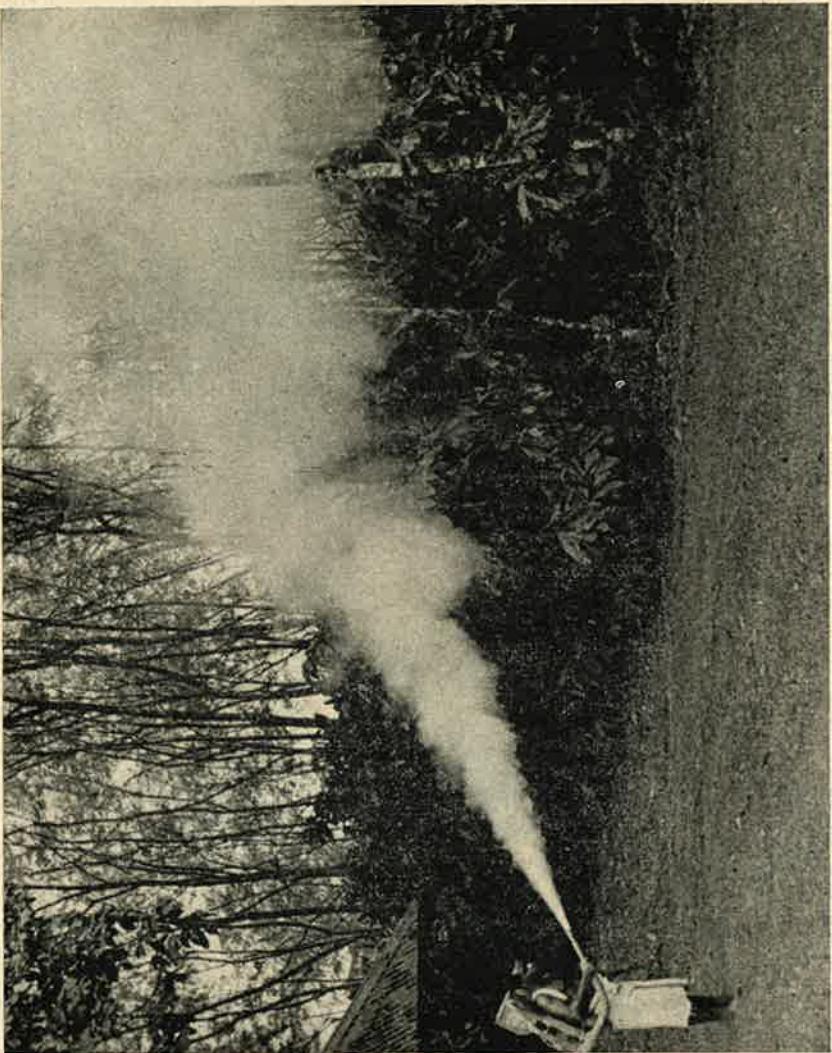


Plate III.—A shoulder-mounted motor-driven duster in action.

It is important to remember that all these methods are just different ways of applying the insecticide to the plant, and whatever method is used, equal amounts of *actual* insecticide (to a given area) must be used to obtain equivalent results. The second important point is to ensure that an even coverage of the crop is being obtained.

CACAO WEEVIL BORERS.

Pantorbytes spp.

There are five species of *Pantorbytes* recorded as attacking cacao in New Guinea (Plates IV, V, VI and VII) though it is only in New Britain (*P. planus* Oberth.), the Markham Valley (*P. proximus* Fst.) and the Northern District of Papua (*P. szenivaryi* Mshl.) that the incidence of the weevils is yet sufficiently high to cause



application of

for capsid control probably the most effective amount of insecticide control of capsid, each application of 1s. 8d. but only 1s. 8d. for equivalent capsids). The main speed and ease of preparation is utilitaine can be util- areas. Apart at a disadvantage of the deposits to

serious damage. The adults are wingless and entrance to cacao plantations must be by walking or by human agency.

Life History.

The length of the life cycle from egg to mature adult varies from nine to sixteen months (this has been found for *P. planus*). The egg is laid in roughened bark or cracks and takes 14 to 16 days to hatch. The larva has a robust curved body, but no legs and bores into the sapwood. After a larval period of six to fourteen months pupation takes place in a fibrous cocoon constructed just beneath the surface of the bark. This stage is short (13 to 22 days); however the young adult undergoes a maturation or hardening period of about 14 days before final emergence. Adults of *P. planus* have been kept

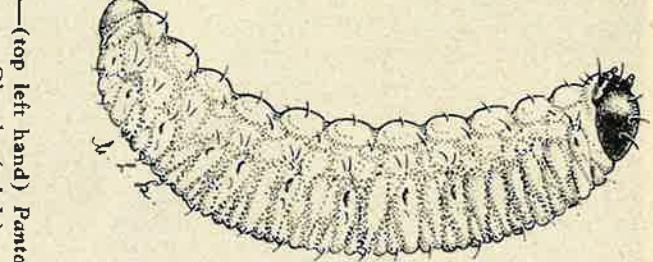
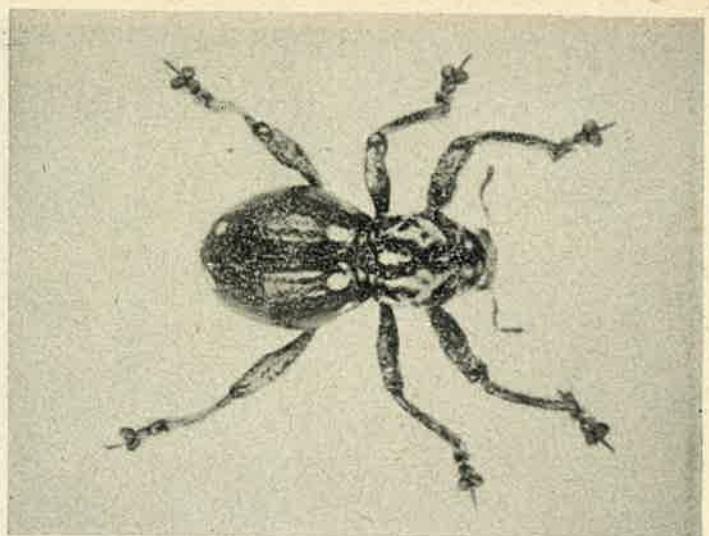
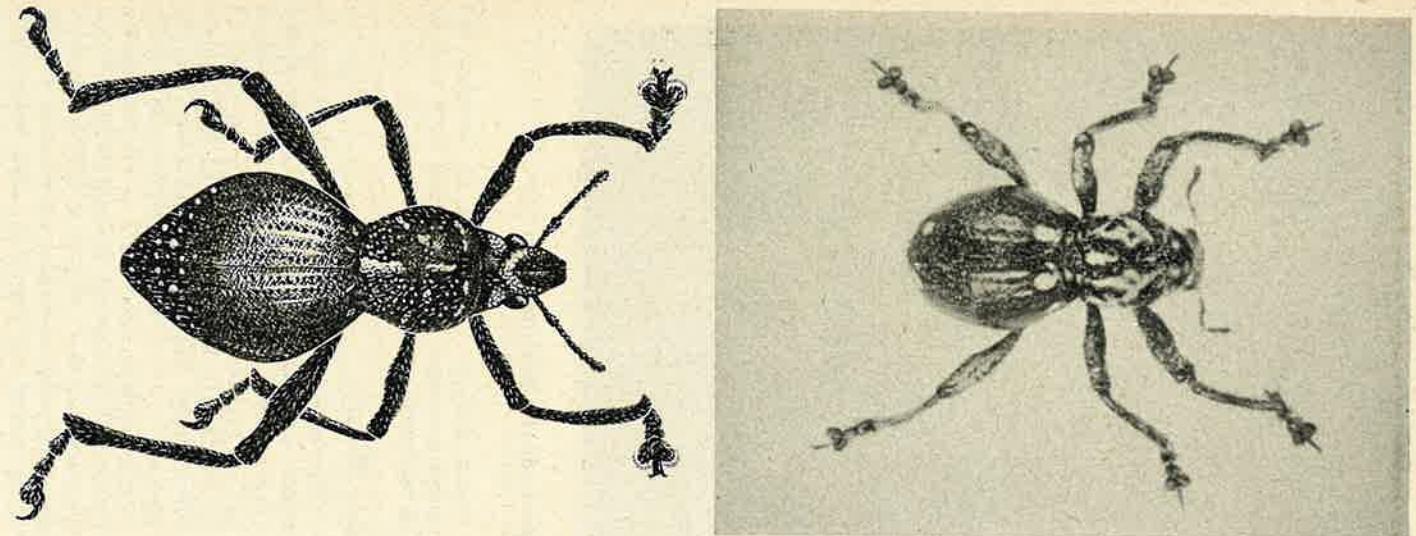


Plate IV.—(top left hand) *Pantorhytes planus* Oberth. (adult).

Plate V.—(below left hand) *Pantorhytes scutellarisvani* Mshl. (adult).

Plate VI.—(above) *Pantorhytes proximus* Fst. (larva).

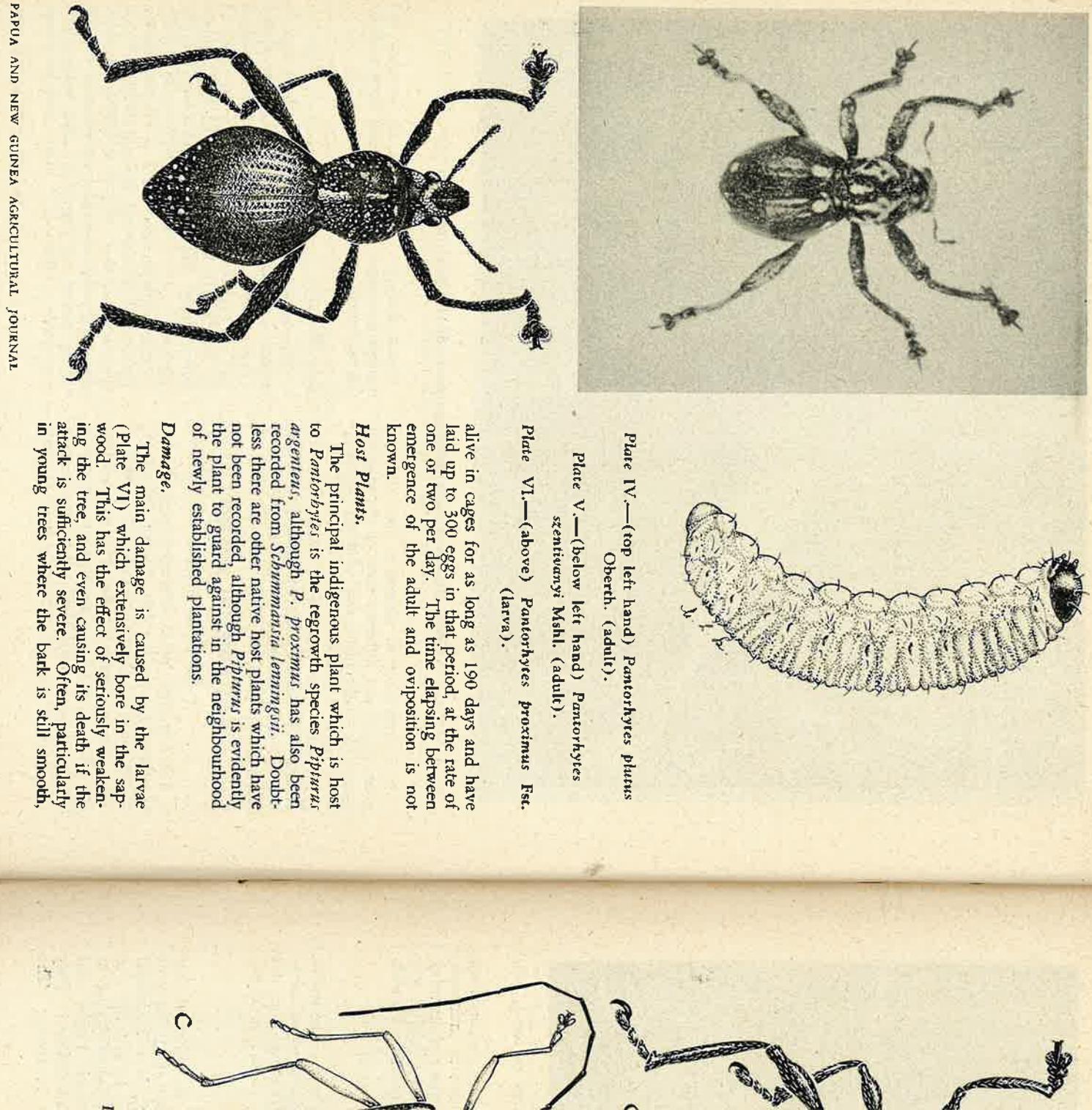
alive in cages for as long as 190 days and have laid up to 300 eggs in that period, at the rate of one or two per day. The time elapsing between emergence of the adult and oviposition is not known.

Host Plants.

The principal indigenous plant which is host to *Pantorhytes* is the regrowth species *Pipturus argenteus*, although *P. proximus* has also been recorded from *Schumannia lemingii*. Doubtless there are other native host plants which have not been recorded, although *Pipturus* is evidently the plant to guard against in the neighbourhood of newly established plantations.

Damage.

The main damage is caused by the larvae (Plate VI) which extensively bore in the sapwood. This has the effect of seriously weakening the tree, and even causing its death if the attack is sufficiently severe. Often, particularly in young trees where the bark is still smooth,



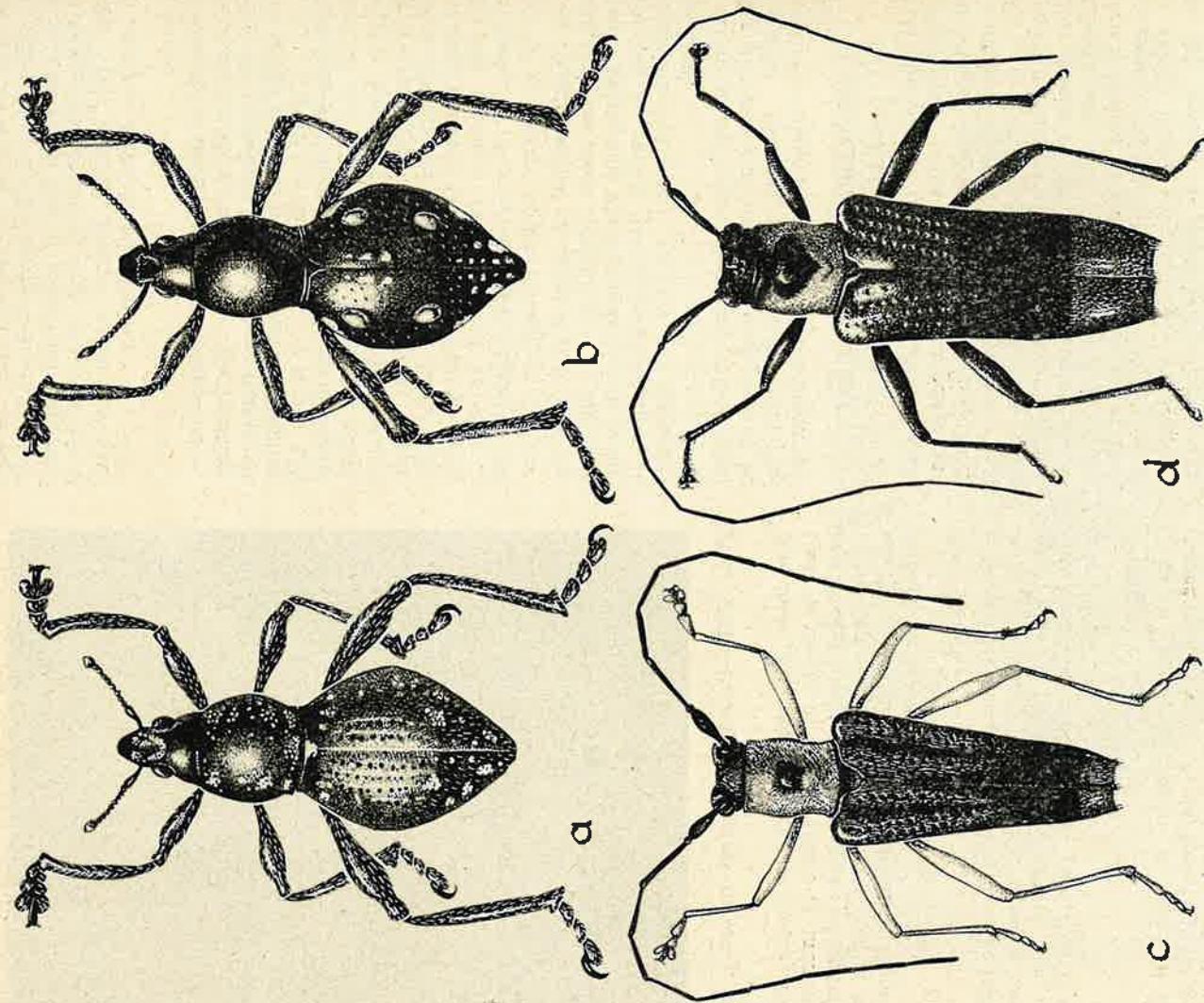


Plate VII.— a *Pantorhynchus pilatus* Chevr.
 b *Pantorhynchus proximus* Fst.
 c *Glenca ahensis* Gah.
 d *Glenca lefebvrei* Guer.

Pantorhynchus pilatus

) *Pantorhynchus*
 adult.

proximus Fst.

90 days and have
 food, at the rate of
 elapsing between
 oviposition is not

plant which is host
 species *Pipturus*
 has also been
Ulmus, *Prunus*, *Malus*,
Quercus, *Pinus*, *Acacia*,
Albizia, *Leucaena*,
Gliricidia, *Psychotria*,
Psychotria which have
Pipturus is evidently
 one neighbourhood
 is.

and by the larvae
 bore in the sap-
 seriously weaken-
 its death if the
 often, particularly
 is still smooth,

the eggs are laid in the jorquette, and the subsequent feeding by the larvae weakens the tree to such an extent that it splits when subjected to undue strains such as high winds or heavy rain. This type of damage is common with *P. proximus* in the Morobe District.

Control.

Removal of all nearby *Pipturus* is the first requirement in attempting control. The establishment of a mechanical barrier between host plants and uninfected cacao trees is a useful controlling factor. The effectiveness of such a barrier will depend on its "obstruction value" to the movement of the weevils. Suitable barriers which suggest themselves are *Imperata*, dense stands of *Leucaena glauca*, taro or sweet potato. Mechanical cutting, and removal of the larvae from the cacao trees can achieve good results provided that the operation is commenced as soon as infestation is observed and care is taken in the cutting to prevent undue damage to the tree.

A reliable method of chemical control of the adult has not been devised so far, but if a regular programme of plantation hygiene is carried out, this would have a beneficial effect in maintaining the weevil numbers at a reasonably low level.

There are indications that treatment of larval channels by various insecticides may prove to be beneficial. However, these trials have not proceeded far enough to warrant a firm recommendation.

LONGICORN STEM BORERS.

Lamidae—several species.

At the present time, *Glenea alienus* Gah. (Plate VII), in the Bismarck Archipelago and the Solomon Islands, and *Glenea lefebvrei* Guér., on the mainland of New Guinea including West Irian, are the commonest representatives of the species of longicorns found in cacao. Several other species of different genera occur also in different parts of the Territory, but their importance is limited by the localized nature of their occurrence. The longicorns are primarily pests of heavily shaded areas and so are commonest on the borders of plantations adjoining the rainforest, and in over-shaded cacao.

Life History.

Few details are known about the life history of these longicorns beyond the fact that the larval and adult stages are somewhat shorter



Plate VIII.—*Pantorhytes* damage to cacao, n.b. adult.

than those of *Pantorhytes*. *Glenea novemguttata* Cast., a species of *Glenea* found in Indonesia, lays its eggs singly on the lower part of the trunk of the cacao, and the young larvae feed at first on the bark, later making serpentine channels through the sapwood.

Host Plants.

Several regrowth trees are known to be native hosts of *Glenea*, although infestation is infrequent and the need for their removal does not arise as it does with *Pipturus* (and *Pantorhytes*) infestations.

Damage.

In all species the damage is similar to that caused by *Pantorhytes* except that the larvae tend to move under the bark e.g., in a horizontal direction and are more likely to kill the tree (Plate IX). The larvae are subcylindrical in shape with an enlarged thoracic region and prominent intersegmental constrictions. They are white to creamy yellow in colour. The



Plate IX.—Lo...

longicorn larval tunnels can be distinguished from those of *Pantorbytes* by the presence of masses of fibrous frass which are ejected from the tunnels. The frass from *Pantorbytes* tunnels is usually very wet and contains no fibrous matter.

Control.

The larvae may be killed either by mechanical removal from their channels with a knife or by the fumigation effect of a small quantity of 15 per cent. Dieldrin applied over the channels.

CACAO DEFOLIATING CATERPILLARS.

Achaea janata L.

Ectropis sabulosa Warr.

Hyposidra tabaca Wlk.

Tiracola plagata Walk.

1. *ACHAEA JANATA* L.

Achaea janata is a moth belonging to the family Noctuidae; it occurs from Malaya to Australia and has a particularly wide range of host plants. The adult (Plate X) is a greyish brown moth with a wingspan of 2½ inches, while the caterpillar, a semi-looper, (Plate XI) is a greyish-blue with black and white markings and two red protuberances on the eighth abdominal segment, although in their middle instars they may be predominantly black or brown.

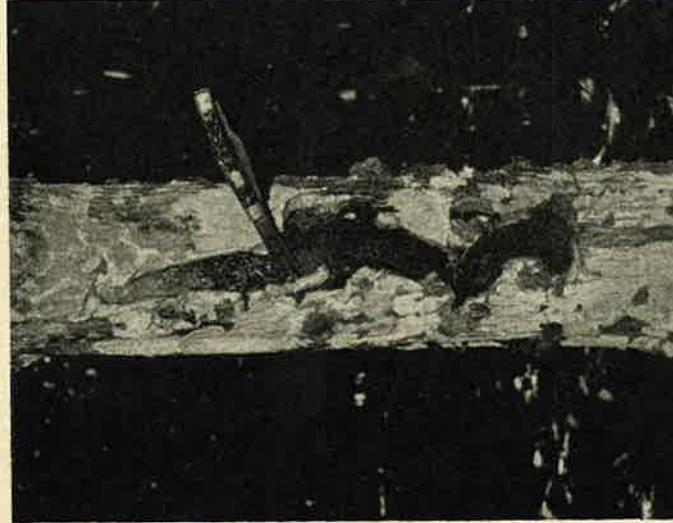


Plate IX.—Longicorn channel in cacao.



Achaea janata L. (adult).
A black and white photograph of an adult moth of the species Achaea janata. The moth has a wingspan of approximately 2 1/2 inches. Its forewings are greyish-brown with prominent dark, wavy bands. The hindwings are a lighter, mottled greyish-brown. The body is dark and hairy.



Plate X.—*Achaea janata* L. (adult).

is similar to that of *Pantorbytes* in that the larvae tend to bore in a horizontal line in a horizontal line to kill the tree. They are subcylindrical in the brachial region and constrictions. They are in colour. The

is similar to that of *Pantorbytes* in that the larvae tend to bore in a horizontal line in a horizontal line to kill the tree. They are subcylindrical in the brachial region and constrictions. They are in colour. The

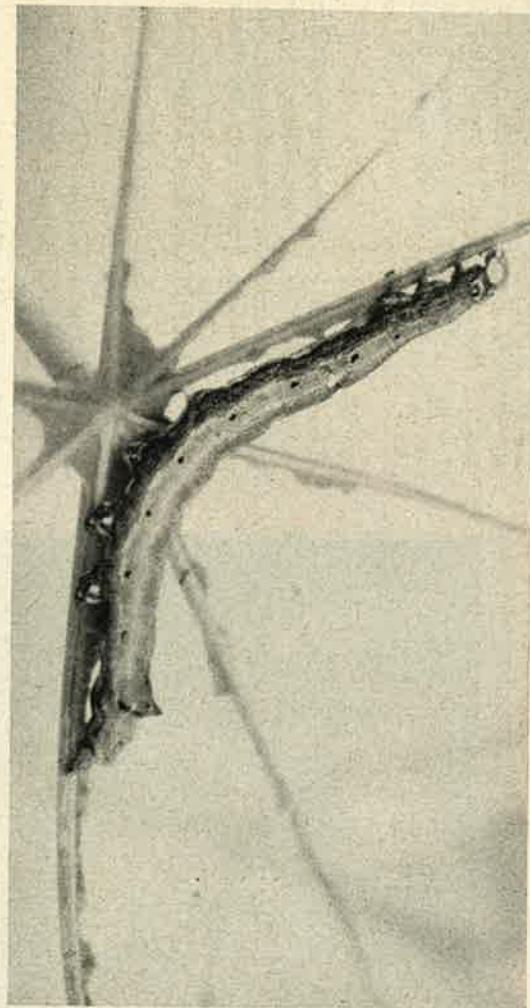


Plate XI.—*Achaea janata* L. (lara).



Plate XII.—*Achaea janata* L. (pupa).

Control.

Good control of DDT sprays. Nine feet, the man knapsack sprayer with 0.25 per cent high volume spray. Territory conditions of water require

fifth night, with a total of about 600. Eggs are laid at random over the surface of the leaves and stem, batches seldom containing more than a dozen eggs, but this figure may sometimes rise as high as 40 eggs. The eggs are a pale green at first, changing to blue with red markings as the caterpillar develops inside. Pupation takes place in a cocoon made from the leaves of the host plant (Plate XII) or, frequently from leaf litter underneath the host tree.

Life History.

The total life cycle covers a period of 32 to 38 days, including a pre-oviposition period of ten to fourteen days and a caterpillar stage of 11 to 17 days. The adults can live for up to three weeks, though females exhausted by egg-laying usually die within ten days. The rate of egg-laying is high—200 to 250 eggs the first night, gradually dropping to 60 or 70 on the

Host Plants.

A. janata has *Albizia*, *castor* and many other

Damage.

The caterpillar (Plate XIII), a mature leaves, attack the under commence eatings midrib is left, attack the growing the young shoot excessive branch

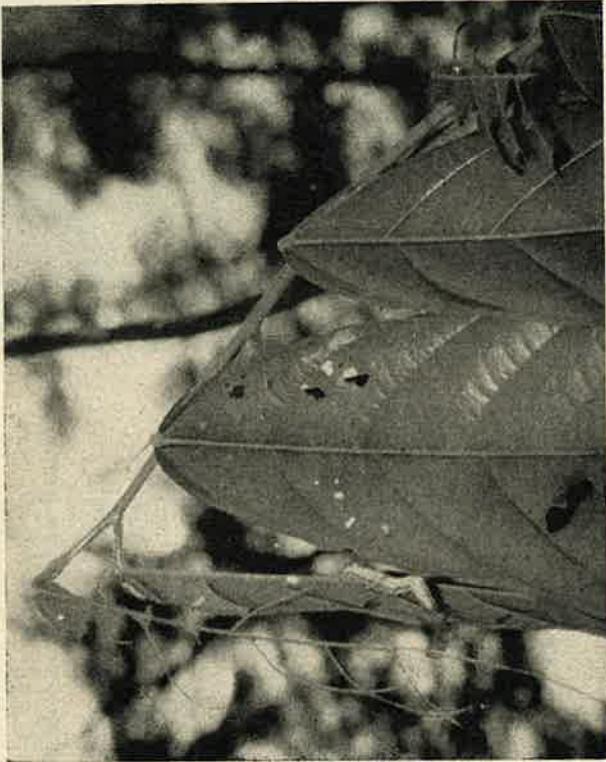


Plate XIII.—*Achaea janata* L. (damage).

Host Plants.

A. janata has been recorded on rubber, *Albizia*, castor bean, crotoms, peanuts, cacao and many other plants.

Damage.

The caterpillars feed only on the cacao flush (Plate XIII), and not on the hardened and mature leaves. First instar caterpillars initially attack the under surface of the leaf, but soon commence eating the remainder until only the midrib is left. Under conditions of severe attack the growing point and the epidermis of the young shoot is eaten, which kills it and causes excessive branching with subsequent malformation of the tree.

Control.

Good control has been obtained by the use of DDT sprays. On young cacao, up to about nine feet, the most economical method is to use knapsack sprayers and high volume spraying with 0.25 per cent. DDT. On larger trees, high volume spraying is not practicable under Territory conditions owing to the large amounts of water required, so a low volume or misting

technique is employed. Power-driven shoulder-mounted misting machines are used with a 2.5 per cent. DDT solution. Spraying with knapsacks requires four to eight gallons per acre (for young cacao), and the misting machines four to six gallons (mature trees), depending on the size of the trees being treated.

The treatments must be repeated as required, although a maximum interval of two weeks is required to maintain adequate control.

An 0.2 per cent. mixture of "Sevin" in water, used as a spot spray on young cacao, with a knapsack sprayer, gives good results with a very quick knockdown. All the larvae are affected within minutes, and fall to the ground where they rapidly die.

2. LOOPER CATERPILLARS.

Ectropis sabulosa Warr. and *Hyposidra talaca* Wilk.

E. sabulosa and *H. talaca* are members of the moth family Geometridae, and their larvae are known as "loopers" or "loopers" caterpillars because of the characteristic mode of locomotion (Plate XIV).

out 600. Eggs are
of the leaves and
ing more than a
sometimes rise as
Pale green at first,
lings as the cater-
takes place
eaves of the host
ately from leaf litter



Plate XIV.—"Looper" caterpillar of *H. talacea*.

The larvae of both species are similar in colour, though *Hyposidra* is generally a greenish colour, rather than the yellowish brown of *Ectropis*. *Ectropis* has a more pronounced thorax which gives it a slightly humped appearance, and a definite black spot on each side of the body one third of the body length from the head.

The adult of *Ectropis* is a fawn or grey coloured moth which is commonly found sitting with wings spread and tightly pressed against the surface, on cacao and *Leucaena*. It is quite hard to locate with a casual glance as it resembles a small irregular patch of lichen. The adult of *Hyposidra* is a smoky black moth which is freely attracted to lights in large numbers when there is an infestation present.

Life History.

Very little is known of the life history of these two insects. *Leucaena* is apparently the preferred host for oviposition, probably because it provides more hiding places in the bark for the female to conceal her eggs. The larvae hatch out on *Leucaena* and produce and use silken threads to descend and ascend the host plants. When they reach cacao with suitable flush they attack it in the same manner as *Achaea* and *Tiracola*.

Host Plants.

Hyposidra has been recorded on cinchona, coffee, kenaf, tea, tung oil, tamarind and derris as well as cacao and *Leucaena*. *Ectropis* probably has a similar range of hosts.

Damage.

The damage is similar to that caused by *Achaea* and *Tiracola*.

Control.

Control is also as for the other flush defoliating caterpillars. When misting older cacao it is desirable to include the *Leucaena* as well.

3. CACAO ARMYWORM.

Tiracola plagiata Walk.

Tiracola plagiata is capable of causing serious damage to many agricultural crops; however, it is relatively unimportant as a pest in tropical countries as it is usually controlled by parasites and predators. It has recently assumed the status of a major pest in the cacao growing areas around Popondetta in the Northern District of Papua.

The caterpillar of *Tiracola* is smoky black with a prominent cream to yellow band along both sides of the abdomen. The head is reddish-brown in colour. The larvae produce silken threads which they use for descent and ascent of the trees—however, after the larvae reach the fourth instar the thread is no longer used for this purpose, possibly because the insect is too heavy. The adult is light grey to fawn in colour, with a distinct black V-shaped mark on the anterior margin of the forewings. It is strictly nocturnal, like *Achaea janata*, and is rarely seen in the plantation during the day.

Life History.

The eggs are laid in batches of 200-1,200, generally on the underside of new flush leaves of cacao. They hatch in about four days, and the young larvae immediately commence feeding. The larvae undergo six instars then, when mature, pupate in small cells excavated in the ground. The adults emerge at dusk or during the night.

Stage of life	Total
Eggs ...	
Larva	
Pre-pupa ...	
Pupa ...	
Pre-ovipositionic	

Tiracola has an adult life span of 10-12 days. The young larvae leave the veins leaving the veins. As the larvae grow, the harder tissue point in a severe attack.

Damage.

The young larvae leave the veins killing of the grain, mis-shapen trees tenance. Also it is considerably, dependent on the older trees.

Control.

At present there is no effective control in the Popondetta area. To exert any say reliance has to be had on the older trees.

Under the conditions in the area so that spraying the most susceptible insects have just been together around the older trees.

DDT, as an on the young trees, the older trees,

MEALYBUGS

Scale insects a from all parts of cacao. The

Host Plants.

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alk to the ground
a cell which is
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artard and derris
Ectropis probably

other flush de-
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is smoky black
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of 200-1,200,
ew flush leaves
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mence feeding
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excavated in the
dusk or during

chii (Risso) (Plate XV) but there are many other species which are less common. Aphids also are relatively common, though they do not appear to cause significant damage.

Life History.

The life history of these insects has been studied in only a few cases. Many kinds of reproduction are known, including production of eggs and live nymphs from mated and unmated insects. The eggs are protected in various ways, sometimes in a cover of waxen threads (as by the mealybugs) or under the scale-like covering of the female. The first instar nymphs have functional legs and by their mobility ensure the dispersal of the species. The later nymphal stages and the adult females of scale insects and mealybugs are stationary, being attached to the host plant by their mouth-parts. The adult males are often winged, always have legs, and are mobile. Aphids have both winged and wingless forms.

Many scale insects and mealybugs secrete honeydew, which makes them attractive to ants. Many different species of ants are found in attendance, and when present in large numbers make conditions around the cacao very unpleasant. These ants protect the scale insects and mealybugs from predators and so lead to greatly increased multiplication of the pests (Plate XV). The ants also carry them about and find new host plants to colonize.

Control.

At present the natural parasites and predators in the Popondetta area are in insufficient numbers to exert any satisfactory degree of control, so reliance has to be placed on the use of insecticides.

Under the conditions at Popondetta, *Tinacola* appears in waves, at five to six weeks intervals, so that spraying can be timed to coincide with the most susceptible stage, which is when the insects have just hatched, and are still clustered together around the hatching site. DDT, as an 0.25 per cent. high volume spray on the young trees, or as a 2.5 per cent. mist on the older trees, gives good control.

MEALYBUGS, SCALE INSECTS AND

APHIDS.

Coccidae.

Aphididae.

Scale insects and mealybugs have been recorded from all parts of the Territory as minor pests of cacao. The common mealybug is *Planococcus*

Stage of life cycle	Days' duration
Eggs	... 3½-4
Larva	... 15-17
Pre-pupa	... 4
Pupa	... 10-15
Pre-oviposition	... 4
TOTAL—eggs to egg	35-40

Host Plants.

Tinacola has an extremely wide range of host plants, those in the Territory including rubber, sweet potato, cassava, *Crotalaria*, cacao, *Leucaena*, taro, milkweed, crotoms, coffee, bananas and many others.

Damage.

The young larvae at first skeletonize the leaves, leaving the veins which are too hard for them. As the larvae grow, they eat all the soft young tissues on the plant, even killing the growing point in a severe infestation. They do not eat the harder tissues and older leaves, thus mature trees are not greatly damaged unless the attacks recur continually. In young unramified trees, the killing of the growing point can result in grossly mis-shaped trees which require extensive maintenance. Also bearing can be set back considerably, depending on the severity of the attack.

Control.

At present the natural parasites and predators in the Popondetta area are in insufficient numbers to exert any satisfactory degree of control, so reliance has to be placed on the use of insecticides.



Plate XV.—Mealybugs attended by the Fire Ant on cacao, *Solenopsis geminata* var. *rufa*.

Host Plants.

Aphids, scale insects and mealybugs are found on almost all plants.

Damage.

The order *Hemiptera* (commonly known as bugs) probably cause more injury to plants than any other group of insects, and aphids, scale insects and mealybugs are amongst the most destructive. These insects are capable of transmitting many virus diseases (*Planococcus citri* and *Ferrisiella vingata* (Ckl.), widespread in the Territory, transmit swollen shoot disease in West Africa, and are vectors of a strain of this disease in Ceylon), but fortunately do not appear to be virus carriers in the Territory.

The most important factor bearing on the damage caused by these insects is their extremely rapid rate of reproduction. When the numbers become high they kill the growing points, and cause distortion of the leaves and tips by the mechanical damage to the cells of the plant and the withdrawal of plant juices. In the absence of any transmitted disease, small numbers do not cause serious damage. Although large numbers are often seen on cacao pods they do not seem to affect them, except when the pod is very small.

Control.

In most cases, natural enemies maintain low population levels, however, when the colonies of these pests are tended by very offensive ants such as the Fire Ant and the Tree Ant, then the enemies are prevented from reaching their prey. Thus it has been found that good control of the scale insects and mealybugs can be obtained by destroying these ants.

Ants can be controlled by spraying the base of the trees and the surrounding ground with a solution of either 0.2 per cent. Chlordane or 0.5 per cent. Dieldrin. It is desirable to treat the nests at the same time. If direct insecticidal treatment of the scale insects or mealybugs is required, then a standard white oil/malathion mixture (containing $1\frac{1}{2}$ pints of 50 per cent. malathion concentrate and $2\frac{1}{2}$ gallons white oil to 100 gallons of water), will give good control when applied as a high volume spray.

Host Plants.**CACAO CAPSIDS.*****Pseudodoniella* spp.*****Helopeltis clarifier* Walk.**

The capsids are the most economically important of the plant bugs attacking cacao, five species of *Pseudodoniella* (Plate XIX), as well as *Helopeltis clarifier* (Plate XIX), being recorded from cacao. *Pseudodoniella* are mostly reddish brown or black, fairly stoutly built and about $\frac{1}{2}$ inch long with a typical protuberance between the wings in the middle of the back. *Helopeltis* is more lightly built with longer, fragile legs and antennae. Their colour varies from red to black with intermediate forms.

There are also a number of other species which feed occasionally on cacao, mainly on young trees, but which are of minor significance.

Life History.

For *Pseudodoniella*, the period from the deposition of the egg to the emergence of the adult is 25 to 30 days—12 days as the egg and the remainder in the various nymphal stages. The eggs are laid beneath the surface of the pod and as soon as the nymphs hatch they commence feeding. Few details of the life of the adult and its habits are known as they are extremely difficult to handle in the laboratory.

Little is known about the biology of *Helopeltis*, though it is probably similar to *Pseudodoniella*.

Capsids are commonly found feeding on various native species of *Ficus* (wild figs). *Helopeltis* also attack a number of cultivated plants, including tea and sweet potato.

Damage.

Capsid attacks are confined primarily to the pods (Plate XVI), though they can cause extensive tip die-back, particularly on young trees before the pods are formed (Plates XVII and XIX). The lesions caused by the capsids are found mainly around the base of the fruit, where the insects seek shelter, and as each individual can feed in 40 to 80 places each 24 hours, actual mechanical damage can be high.

A considerable percentage of pod loss is caused by secondary infections by the fungi *Gloeosporium* and *Phytophthora*.

**Control.**

The established use of BHC "Gammexane" N 1.3 per cent. of BHC. Any other

use of BHC of about three pounds of dust

Another method of

use of lindane as active ingredient; the concentrate

Endrin mist has a

(half ounce of

gallons of water)

when using endrin

Host Plants.

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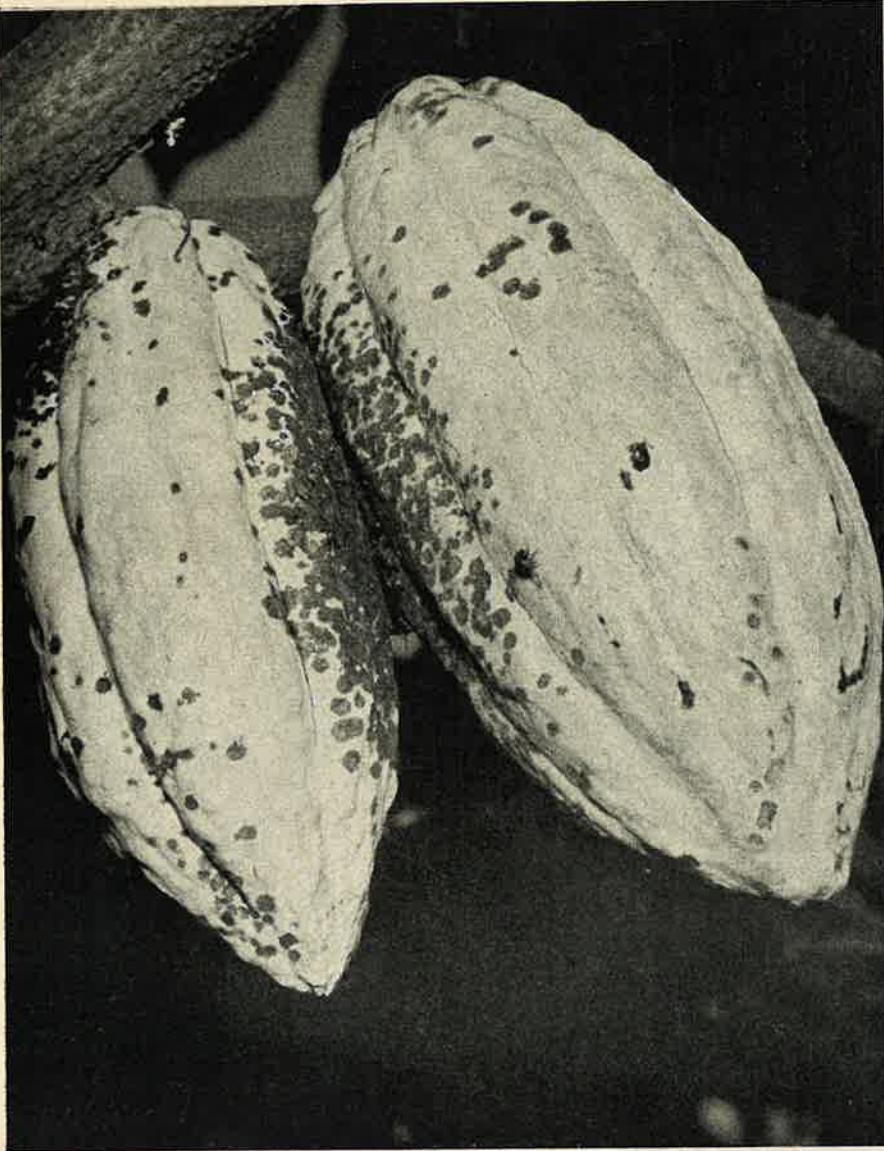


Plate XVI.—Injury to cacao pods by capsid.

Control.

The established method of control is by the use of BHC dust—a common type being "Gammexane No. 10 Dust," which contains 1.3 per cent. of the active gamma isomer of BHC. Any other dust with a similar formula is suitable. Usually two treatments, of ten pounds of dust per acre, applied at an interval of about three weeks, give good control. Another method which gives good control is the use of Lindane as a mist (Lindane is the purified active ingredient from BHC) with one ounce of the concentrate per two gallons of water. An Endrin mist has also been found to be successful (half ounce of endrin concentrate per two gallons of water), but great care must be taken when using endrin as it is very poisonous.

primarily to the young feeding on figs (wild figs). can cause extensive loss on young trees and on cultivated potato.

of pod loss is by the fungi

IDIIDS.

spp.

Walk.

most economically important species attacking cacao, (Plate XIX), as *Pseudonotoceratitidis* (Plate XIX), being mostly stoutly built and with a typical protuberance in the middle of the back. The body is built with longer, their colour varies intermediate forms.

other species which mainly on young significance.

period from the emergence of the days as the egg is nymphal stages. The surface of the tree hatch they complete of the life of the tree as they are known in the laboratory. Biology of *Helopeltis*, *Pseudonotoceratitidis*.

Misting is very much cheaper than dusting, but dusting is faster, and can utilize cheaper machinery (see section on spraying and dusting techniques).

AMBLYPELTA.

Amblypelta spp.

Five species of the coreid bug, *Amblypelta* have been recorded as feeding on cacao pods. The most important species is *Amblypelta theobromae* Brown (Plate XIX), which is found in parts of the Morobe District of New Guinea and the Northern District of Papua. *Amblypelta* is a light brown coloured bug about three-quarters on an inch long, all the species being quite similar in appearance.

Control.

It has been found that spraying the pods only with 0.15 per cent. Dieldrin in water gives good control. Control measures as applied for capsids are also effective.

**CACAO TERMITES.***Neotermes spp. and other species.*

There are a number of species of termites found on cacao, the most important being *Neoterme* spp., which can cause considerable damage to cacao and *Lecania*. One species, common in the Gazelle Peninsula, attacks through dead wood in the aerial parts of the tree. Another, found in New Ireland, attacks through the roots, tunnelling through the ground from one tree to another.

Neoterme is a larger species of termite, with the workers up to three eighths of an inch long, and the soldiers and alates up to half an inch.

Life History.

Plate XVII.—Injury to young cacao by capsid.

Life History.

Very little is known about their life history apart from the fact that one generation lasts from six to seven weeks.

Damage.

The damage caused by *Amblypelta* is similar to that caused by the capsids, but the brown scars on the surface of the pods are larger and more evenly distributed. When the damage is severe the scars may run together, forming large areas of dead tissue. As with the capsids, the lesions may be entered by secondary fungi. Young pods attacked by *Amblypelta* become severely distorted (Plates XX and XXI).

Damage.

Amblypelta attacks many different plants, but most species are common on tapioca. *A. cecropiagae* causes serious nutfall of coconuts in the British Solomon Islands Protectorate and the Bougainville District.

Host Plants.

Amblypelta attacks many different plants, but most species are common on tapioca. *A. cecropiagae* causes serious nutfall of coconuts in the British Solomon Islands Protectorate and the Bougainville District.

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Plate XVIII.—Dieback

Swarming takes place two or three times each year, and species found in the Gazelle Peninsula then seek out dead wood which is still attached to the tree (Plates XXII and XXIII). It appears necessary that initial colonization be through dead wood which has not decayed and is still quite solid. Other species of *Neoterme* gain entry to the tree via the top or lateral roots, and here the damage is seldom observed until the tree has collapsed at ground level or the jorquette.

praying the pods only
in water gives good
as applied for capsids

MITES.

other species.

species of termites
most important being
cause considerable
Neotermites. One species,
attacks through
parts of the tree.
attacks through
ground from

species of termites, with
mouths of an inch long,
up to half an inch.

termites, *Neotermites*,
mite, has distinctly
male and female
soldiers and workers.
entirely inside the
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found on cacao and
species which attack

or three times each
Gazelle Peninsula
(which is still attached
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top or lateral roots,
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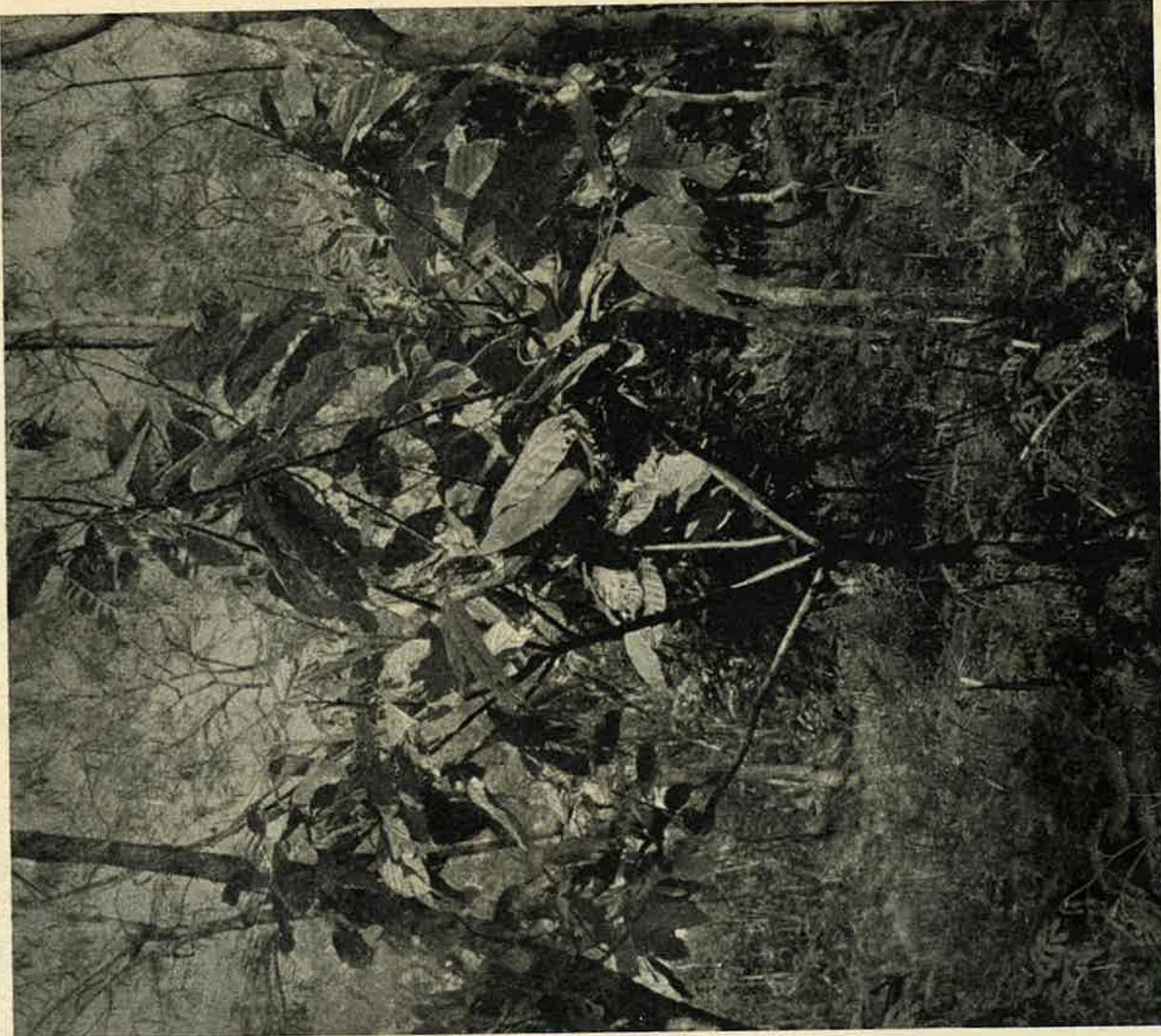


Plate XVIII.—Dieback of cacao caused by the capsid *Pseudodondella*. The chupon in Plate XVII was taken from this tree.

erated into the tree
i, then tunnel into
ly, the tree is
(Plate XXII) that
avy strain due to

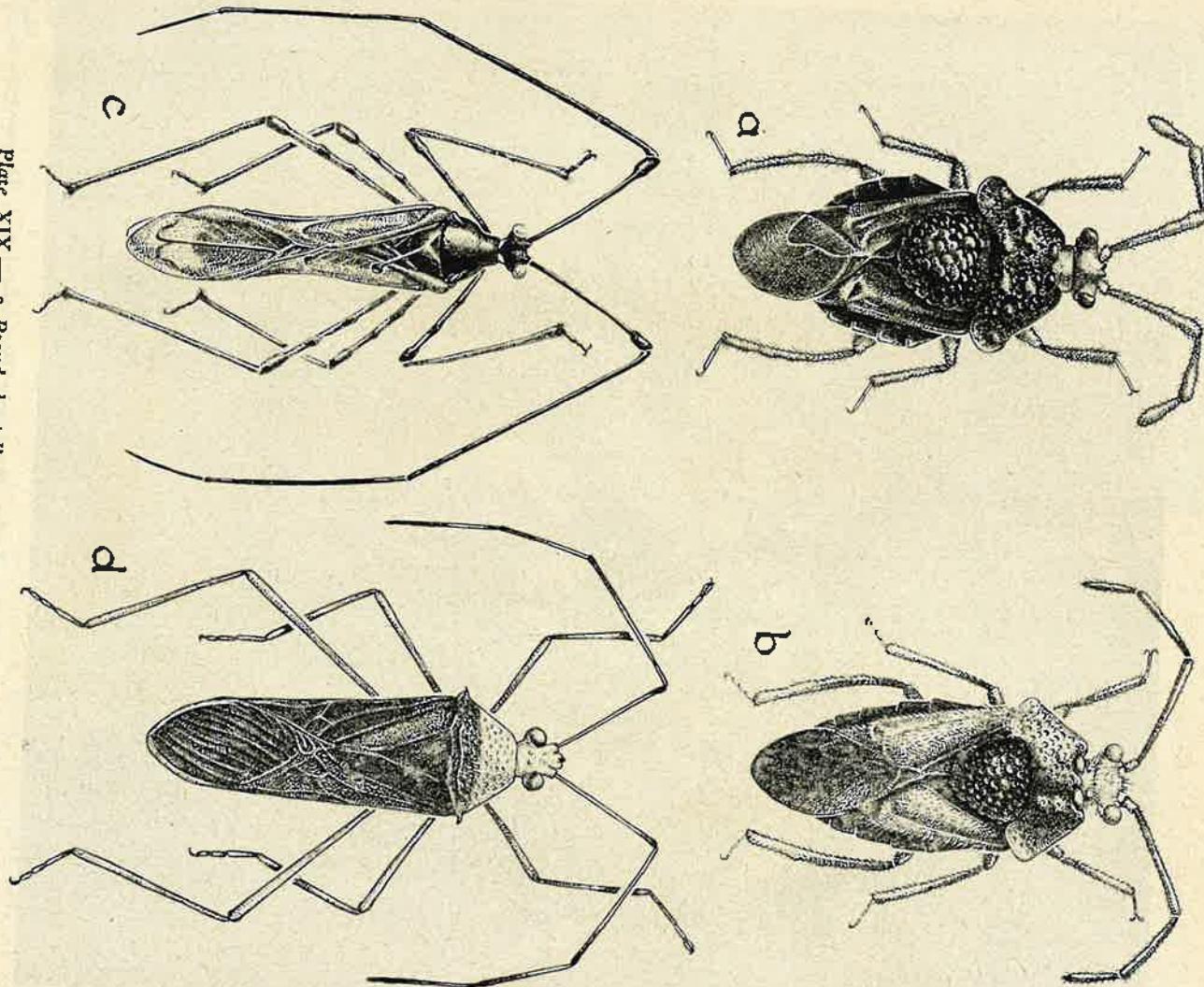


Plate XIX.— a *Pseudodonella typica* China & Gav.
b *Pseudodonella laevis* Mill.
c *Helopeltis claviger* Walk.
d *Amblypelta theobromae* Brown.

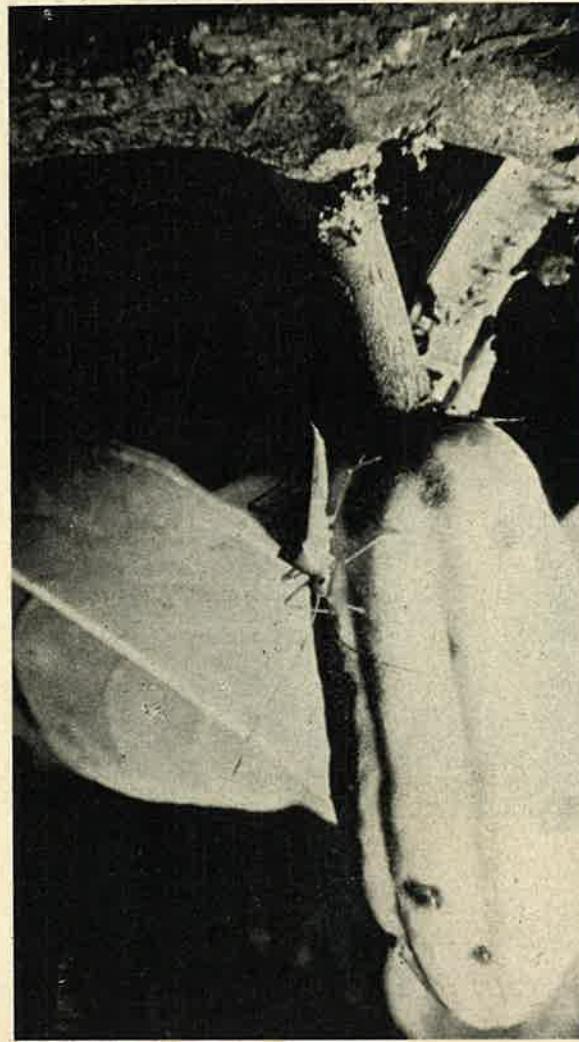


Plate XX.—Injury to cacao pod by *Amblyptela*.



Plate XXI.—Injury to cacao pod by *Amblyptela*.

Externally, the presence of the termites inside a tree is often hard to detect, but the bark over the nest usually has a water logged appearance and can be readily picked out with practice. The younger colonies which have not made extensive tunnels can only be found by cutting or breaking off the dead wood in which the attack was initiated.

Host Plants.

The native hosts of these termites are not known. On plantations they readily attack both cacao and *Leucaena*.

Control.

As *Neoterpes* probably attacks many different trees surrounding, as well as inside, the plantation, and the colonies are often hard to detect,

it can be expected that continual re-infestation will occur. Thus control of this termite has two aspects:

1. *Control of colonies already present.*

All trees in the plantation, including the cacao and *Leucaena*, should be checked and any nests present treated. As the infestation usually commences in dead wood, all such wood should be cut open and examined. When a nest is found, an opening is made in the upper part and a solution of 0.05 per cent. Dieldrin in water poured into it. Enough insecticide should be used to saturate the nest thoroughly. This has been found to average out at about one-third of a pint of solution per nest.

2. *Prevention of nests.*

As dead wood entrance for the insects when pruning that the cut is made, preferably to the point as possible to the main flush with the main wound should then be

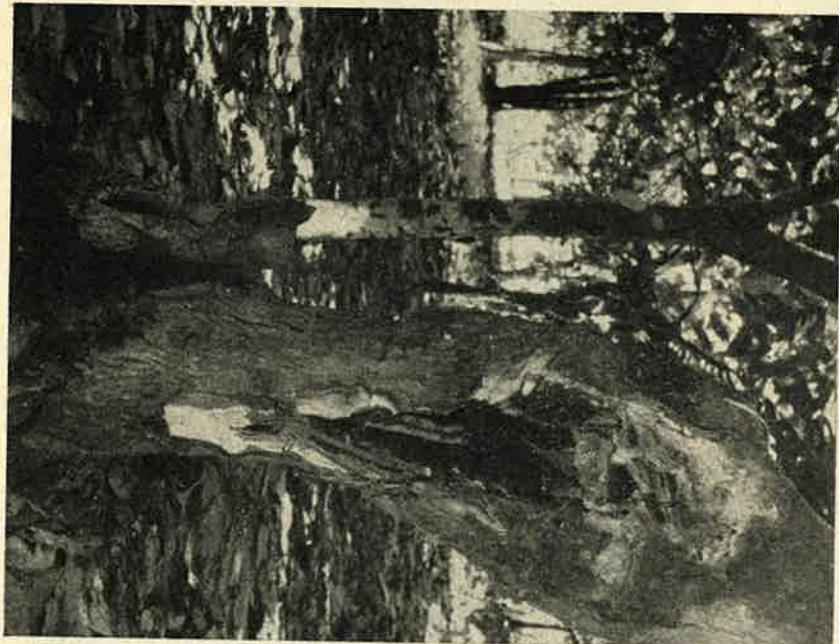


Plate XXII.—The shade tree *Leucaena glauca* almost hollowed out by *Neoterpes*.

continual re-infestation
of this termite has two

ways present.

1. Including the cacao
trees checked and any nests
seen. The re-infestation usually com-
mences when a branch wood should be
removed. When a nest is found,
the upper part and a solu-
tion of copper in water poured
over the nest should be used to
kill the termites. This has been
done about one-third of a



Plate XXIII.—A badly pruned branch of cacao which has been attacked by *Neotermes*.

2. *Prevention of future infection.*

As dead wood on the trees provides an entrance for the insects, care should be taken when pruning that when a branch is removed, the cut is made, preferably with a saw, as close as possible to the point of origin of the branch, flush with the main branch or trunk. The wound should then be covered with a protective

covering. If pruning is carried out correctly, callus tissue will grow over the wound and thus prevent entry of the termite.

Once initial control has been gained, it can be maintained by assuring that pruning operations are carried out correctly, as well as regularly, and that all nests are treated as they are found. The control procedures are best inserted as a regular feature of the normal cultural programme.

(Received July, 1963).

Pilot Survey Pattern

ONF of the development centres. This group of the economic and social administering authority permanent settlers which has defined relating to economic food consumption

It has been estimated that the population of the urban centre in the Guinea, was approximately 10,000. Although no comprehensive annual increase conducted, it is estimated that the population over the last

With these figures in mind, a group of four who are settled in the complex (the traditional and another squat people in the Kona area). Unfortunately these people are banded in the main

The data covers the migrants and the are not representative and expenditure Moresby area. The survey period of ever, the findings factual backing to problems in this un

- (a) The figure for is derived from the New Guinea National University
- (b) Fuller details of

Pilot Survey of Food Consumption and Expenditure Patterns — Two Settlements in Port Moresby.

G. R. SPINKS.

Agricultural Economist, D.A.S.F., Port Moresby.

ONE of the main features of economic development is the rapid growth of urban centres. This growth creates a number of economic and social problems which plague the administering authority and the migrant and permanent settlers. One of these problems which has definite implications on policies relating to economic development is changing food consumption and expenditure patterns.

It has been estimated that the total indigenous population of the Port Moresby area, the largest urban centre in the Territory of Papua and New Guinea, was approximately 22,500 in 1962.⁽¹⁾ Although no complete survey of the rate of annual increase in population has been conducted, it is estimated to be about 2,000 per annum over the last few years.

With these figures in mind, a pilot survey was started to gain some insight into the food consumption and expenditure patterns of three settlements in the Port Moresby area. Samples of households were selected randomly from these. They were drawn from the squatter canoe settlement at Koke; one village in the group of four which makes up the Hanuabada complex (the traditional home of these Papuans) and another squatter settlement of Gulf District people in the Konedobu area of Port Moresby.⁽²⁾ Unfortunately the last sample had to be disbanded in the midst of the survey period.

The data covering two settlements, one of migrants and the other of permanent settlers, are not representative of the food consumption and expenditure patterns of the whole Port Moresby area. The samples are small and the survey period of one week was limited. However, the findings of the survey do give some factual backing to certain assumptions about these problems in this urban centre.

(1) The figure for total population is tentative and is derived from a census conducted in 1962 by the New Guinea Research Unit of the Australian National University.

(2) Fuller details of these settlements in Appendix A.

PRINCIPAL FACTORS INFLUENCING FOOD CONSUMPTION PATTERNS.

A number of factors operate to influence food consumption patterns in any community and the following are the main ones responsible for shaping these patterns in the urban centres:

1. Traditional foods;
2. The supply or availability of traditional and other foods;
3. The income levels of the settlers;
4. The price relationship between traditional foodstuffs and others; and

5. A vague but powerful influence which for want of a better word is usually referred to as "demonstration effect" whereby another culture, usually stronger, is copied.

The newly arrived migrant and to a lesser extent the permanent settler is faced with limited supplies of traditional foodstuffs in the Port Moresby area. The many different groups of migrants have their own traditional foods which range from sweet potato, taro, yam, banana and sago or a combination of two or more of these. The agricultural potential in the immediate Port Moresby area is limited by soil and climatic factors. Furthermore, even for those foods which can be produced, the traditional agricultural system is not orientated to commercial production but to subsistence needs. Even with very strong price incentives, assuming that the farmers are part of the cash economy, supply is particularly inelastic. The bulky low value nature of the staple products also places an economic limit to the distance these foods can be transported into Port Moresby.

The general shortage of traditional foodstuffs can be assessed from the first part of a survey of the native market at Koke. During one week representing the seasonal distribution of produce for that time of the year, the total

quantity of all produce offered for sale was about 26 tons. Of this, banana, sweet potato, yam, taro, coconut and tapioca made up 57 per cent. Bananas were the most important single item of these foods and alone made up 39 per cent. of the total quantity. No sago was on sale in the market during that week.⁽³⁾ With the present population and the rapid annual rate of increase it is apparent that supplies of traditional foodstuffs are inadequate. Income levels, particularly for unskilled labour are generally low and food purchases must be confined to the cheapest source, which is usually imported foodstuffs in the Port Moresby area.

The "demonstration effect" is particularly powerful in influencing food consumption and expenditure patterns in any urban area. The copying of "foreign" consumption patterns rests on many factors such as prestige but is also greatly influenced by the advantages of the imported foodstuffs. Of these, the main ones are convenience and ease of availability, while advertising and health campaigns relating to nutrition play an important part.

All migrants and the permanent settlers are therefore forced to modify traditional food habits. The first stage may be of an exploratory nature even within a limited income range and it is in this period that serious declines in diet can occur. However, this seems to pass as knowledge of different foods is gained.

PERCENTAGE OF EXPENDITURE
DEVOTED TO FOODSTUFFS OF

THE SURVEY AREA.

Considerable difficulty was experienced in assessing the levels of income of the households, as pooling of wages was common where more than one wage earner resided in the same house or canoe. This practice was most noticeable in the Hanuabada sample. However, because of little or no savings, weekly expenditure presented an adequate measure of income.

The levels of weekly expenditure varied between the two samples and indicated that incomes in the Hanuabada sample were higher than those in the Koke canoe settlement.⁽⁴⁾ Only 20 per cent. of the households had weekly

(3) This market survey which is in progress is to cover three periods of a year to account for seasonal variation in supplies of produce. Only during the second stage of the survey was a small quantity of sago offered for sale in the market.

Percentage of Sample in Each Expenditure Class. Shillings per Week.		
Expenditure Class Shillings per week.	Hanuabada	Koke
Less than 50	...	—
50 to less than 100	...	6
100 to less than 150	...	31
150 to less than 200	10	31
200 to less than 250	30	25
More than 250	30	7
TOTAL	100	100

The most important single item of expenditure was food, a common feature of expenditure patterns in under-developed countries. The average weekly percentage of expenditure on foodstuffs over the samples was 79 per cent.⁽⁵⁾ for the Hanuabada sample and 67 per cent. for the Koke sample—Table 2.

Table 2.
Average Percentage of Expenditure on Food.⁽⁶⁾
Hanuabada and Koke Settlement Samples.

Expenditure Class Shillings per week.	Hanuabada	Koke
Less than 50	...	82
50 to less than 100	...	72
100 to less than 150	...	67
150 to less than 200	78	70
200 to less than 250	78	62
More than 250	74	—
Average^b	79	67

^a See footnote 6.

^b Significant at 5 per cent. level.

(4) Henceforth the sample of households in the Koke canoe settlement will be referred to as the Koke survey.

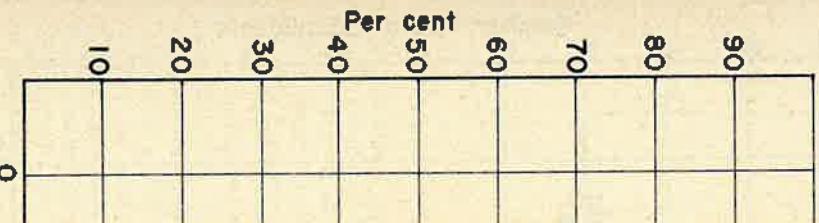
(5) This figure is somewhat higher than it should be as there was only one household in the 50-100 shillings per week expenditure group. The wage earner although working during the survey week had been unemployed up till that time and was not in receipt of his wages. The percentage of his weekly expenditure on food was 90 so that this has tended to raise the average figure for the Hanuabada sample.

(6) In the Hanuabada sample three of the households were issued with rations, but in most cases these were given to friends and relatives.

The evidence suggests that as income increases expenditure on foodstuffs occurs that at very low levels expenditure could be point where immediate ship may not hold a

expenditure of less than 150 shillings in the Hanuabada sample. The corresponding figure for the Koke settlement was 68 per cent.—Table I.

Table 1.



0 shillings in the corresponding figure is 68 per cent.—

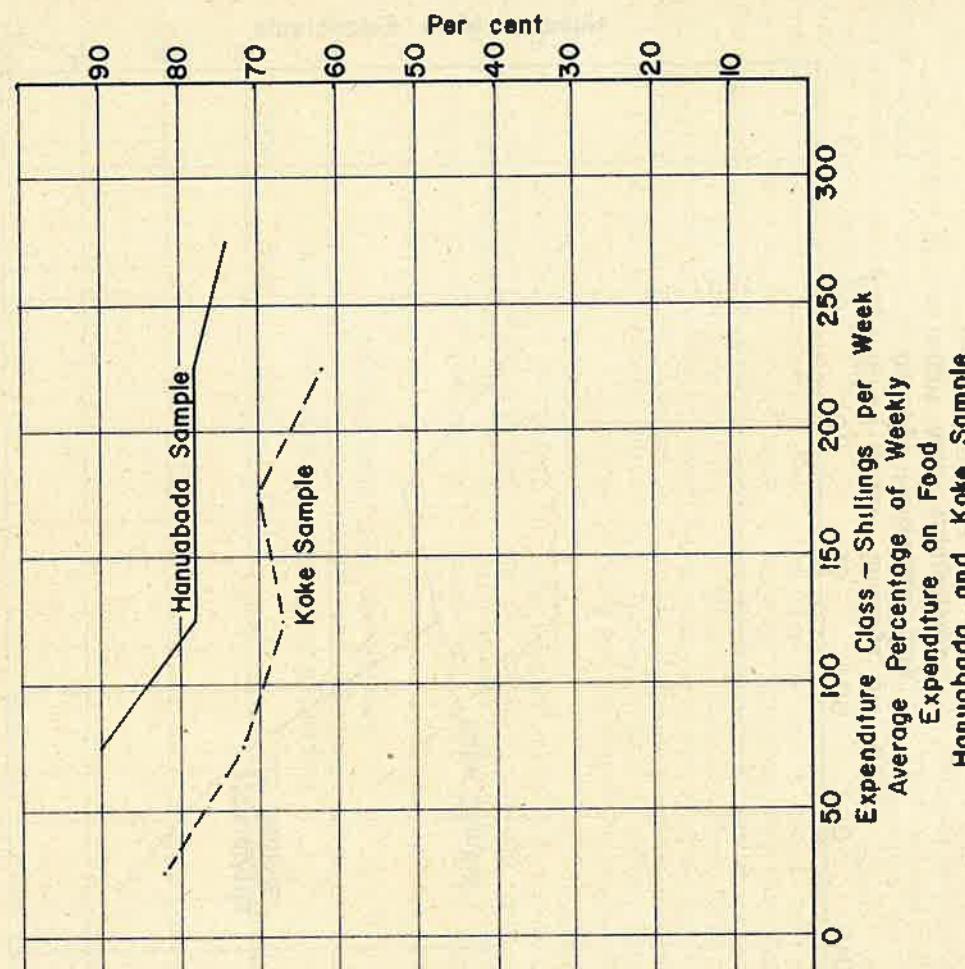
Expenditure Class.
Penitentiaries.

Hanuabada	Koke
—	6
10	51
10	31
30	25
30	7
20	—
100	100

The evidence suggested that the proportion of expenditure devoted to food purchases declined as expenditure (income) increased. This relationship is shown graphically in Fig. 1. Although the data are limited, it is evident that as income increases, a decrease in expenditure on foodstuffs occurs. However, it is likely that at very low levels of income, this relationship may not hold as any increase in income or expenditure could be all used for food up to the point where immediate food needs are met.

With increased weekly expenditure, the percentage of expenditure on food fell in both samples; the sharpest fall occurring in the Koke sample. In this sample, the percentage decreased from 82 in the lowest expenditure group to 62 in the highest. In the Hanuabada sample, this decline was not as marked and was somewhat misleading because of an unusually high percentage in the lowest income group (50 to 100 shilling) which was represented only by one household. The reason for this

Figure 1



iture on Food. (6)
ment Samples.

Hanuabada	Koke
—	82
90 ^a	72
78	67
78	70
78	62
74	—
79	67

sehholds in the Koke referred to as the Koke her than it should household in the 50-100 group. The wage during the survey week that time and was The percentage of food was 90 so that average figure for e of the households in most cases these inatives.

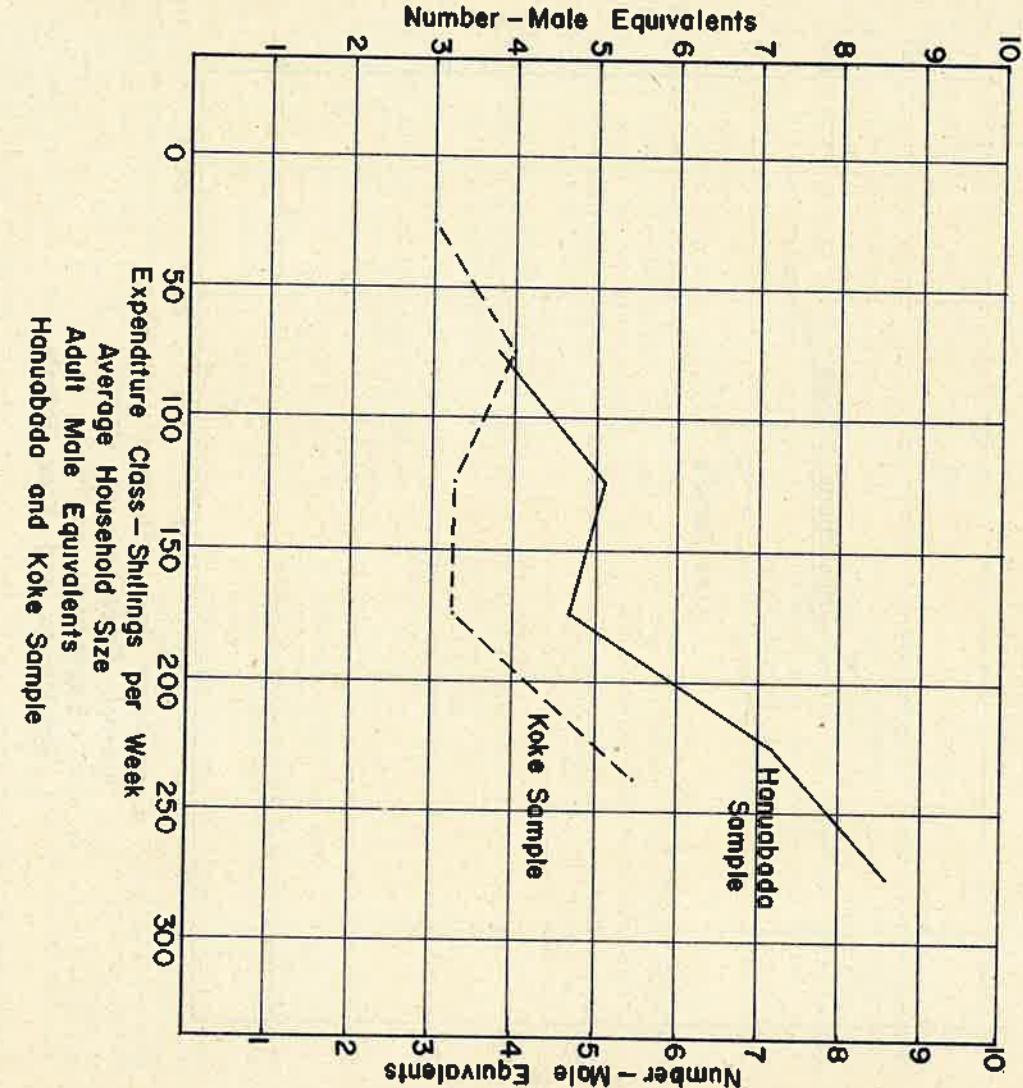
more gradual decline seemed to be linked to the rapid increase in average household size in the Hanuabada sample—Figure 2.

The graphs in Figure 3 showing the average weekly per capita outlay on foodstuffs suggest a high income elasticity of demand for food in both samples. This outlay rose as expenditure increased; with the steepest rise occurring in the Koke settlement. These figures have been

calculated in terms of adult male equivalents⁽⁷⁾ and rose from 16 shillings per week at the lowest expenditure group to 26 shillings in the highest. The corresponding figures for the Hanuabada sample ranged from 18 shillings to

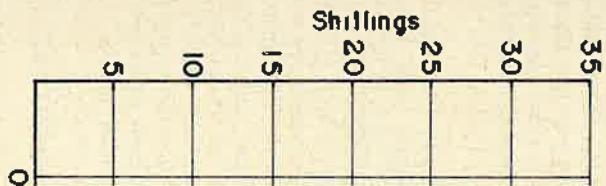
(7) Man value coefficients taken from Thomson Betty Preston. *Two Studies in African Nutrition, An Urban and a Rural Community in Northern Rhodesia*: The Rhodes-Livingston Papers, No. 24. Manchester University Press, 1954, p. 57.

Figure 2



Unfortunately any statistical analysis of demand for food and consumption in Hanuabada sample weekly expenditure is limited. However Figure 3. This and consumption implications on development is concerned.

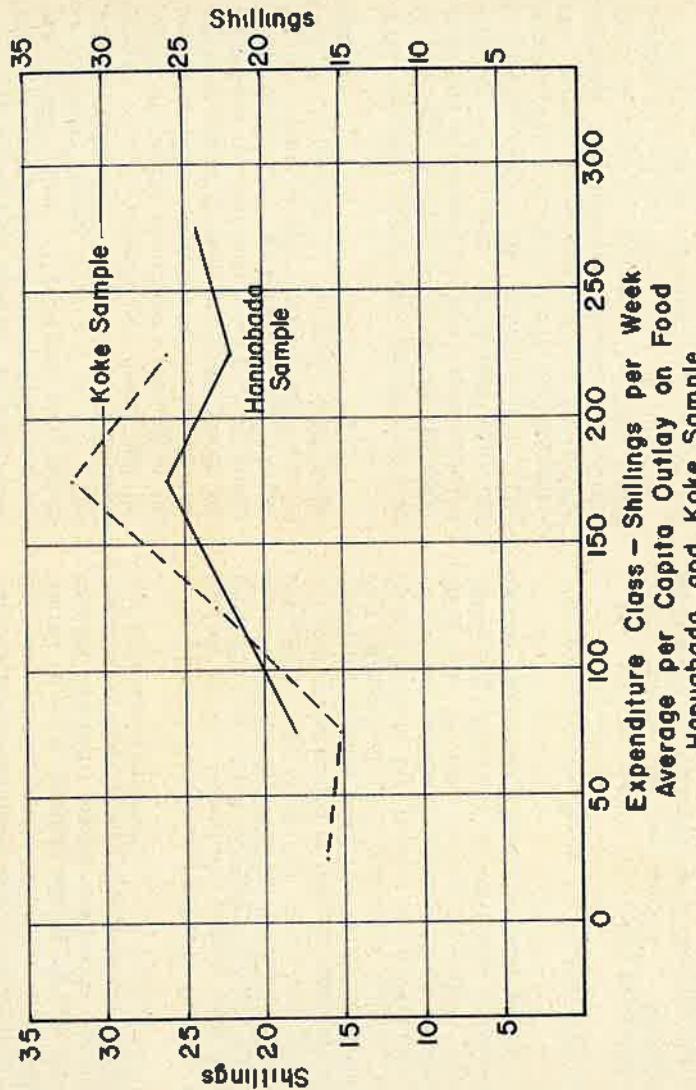
Statistical analysis coefficients in the income elasticities been calculated at an increase in income than eight per cent



: male equivalents.⁽⁷⁾
35s per week at the
26 shillings in the
ng figures for the
from 18 shillings to

n from Thomson Betty
*African Nutrition, An
Community in Northern
Livingston Papers, No.
Press, 1954, p. 57.*

Figure 3



26 shillings. Again these figures were somewhat influenced by the average household size (in adult male equivalents) which in the Hanuabada sample increased steeply with rising weekly expenditure.

Unfortunately the survey data did not permit any statistical analysis of income elasticity of demand for food but the data indicate that the coefficient would be fairly high as in the urban centres or other under-developed countries—Figure 3. This feature of food expenditure and consumption in these countries has important implications on policy as far as economic development is concerned.

Statistical analysis of income elasticity coefficients in underdeveloped countries is limited. However, in urban centres in India, the income elasticity coefficient for all foods has been calculated at 0.79 which means that of an increase in income of ten per cent, slightly less than eight per cent. of this rise will be utilized

for increased purchases of foodstuffs. Such figures are considerably higher than the coefficients for all foods in the urban centres of advanced countries. In the U.S.A., the income elasticity coefficient has been estimated at 0.39.⁽⁸⁾

High elasticities of demand for food can lead to serious problems in policy decisions for economic development of underdeveloped countries. Any rise in income will usually be associated with increased demand for foodstuffs. Unless the supply can meet the increased demand, price rises in foodstuffs will occur and inflationary tendencies can develop. This increased demand can be accommodated by further imports of foodstuffs but these will then compete for limited foreign exchange reserves with imports of capital goods for developmental purposes.

(8) The figures for India and U.S.A. were published in *The State of Food and Agriculture 1959* FAO Rome—Annex, Table 16, p. 195.

The survey indicated a sharply rising average household size with increasing weekly expenditure—Figure 2. In the Hanuabada sample, the average household size increased from 3.7 adult male equivalents in the lowest expenditure group to 8.7 in the highest. The corresponding figures for the Koke survey were 3.1 to 5.6. This suggests that there is a direct relationship between income (expenditure) levels and the number of people permanently residing in the household. This situation of rising incomes and more people residing permanently with the wage earner has also been noted in some similar surveys in African countries. If this relationship is a feature of urban development, it could lead to a number of economic and social problems.

The difference in the range of the figures in the two samples seems to be mainly the result of the type of housing in each. Accommodation in canoes at Koke limits the number which can be housed under the same roof.⁽⁹⁾ The European style housing in the Hanuabada settlement permits greater numbers to live in the one house. Overcrowding in houses is a normal feature of urban development in underdeveloped countries.

Effect of Supplies of Staple Foodstuffs from Villages and Gardens.

Supplies of traditional foods from home villages have a marked influence on the expenditure pattern of those migrant families who have come from areas close to Port Moresby. Fairly regular supplies of traditional foods were shipped to the canoe settlement by means of the canoe traffic between the home villages, mainly in the Abau Subdistrict, and Koke. Of the 16 households surveyed, 11 reported fairly regular supplies of traditional food, and one occasional supplies. The regularity of the supplies seemed to vary somewhat but most interviewers indicated weekly shipments. In the majority of cases the food came from the householder's own garden in the village.

PATTERN OF FOOD EXPENDITURE.

The general pattern of food expenditure varied between the two samples. Although expenditure on imported foods was the major part of total expenditure, this source of foodstuffs was more important in the Hanuabada sample than at Koke. In the former, an average of four per cent. over the whole sample was used for the purchase of traditional foods. The corresponding figure for the Koke survey was 17 per cent.—Table 3.

Starchy Foods.

The most significant figure from the survey was the importance of purchases of imported starchy foods such as rice, flour and bread.⁽¹⁰⁾ Within the Hanuabada sample this group of foodstuffs accounted for an average of 29 per cent. of total expenditure. The figures for the expenditure classes showed no real variation between the classes—Table 3. The corresponding average percentage for the Koke survey was 18 per cent.—Table 3.

(9) The type of canoe used for accommodation can be seen from the photographs, particularly Plate I, in the article, Jefford, A. W., *Dugout Canoes of Papua and New Guinea*, in *The Papua and New Guinea Agric. J.* 14, 167-176.

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The supplies received into the Koke settlement during the survey week may have been atypical. The survey coincided with the preparation for an exhibition of traditional dancing by some of the people from the Abau Subdistrict. It is possible that some of these brought additional supplies of foods. In the lower expenditure groups, this source of supply was particularly important.

Supplies of traditional foodstuffs from local gardens in the Hanuabada sample were very limited; being mainly confined to tapioca tubers and a few bananas. The survey was conducted towards the end of the dry season and garden activities at that period of the year were severely limited by climatic conditions in the immediate Port Moresby area. The limited supplies of foodstuffs from the gardens of the Hanuabada sample had no influence on expenditure patterns. There may be some influence on the pattern during and at the end of wet season when production from the gardens is much greater.

Purchases of foodstuffs per week averaged 33 per the Hanuabada sample. Of expenditure on bananas, sweet potato cent. for the Hanuabada for that of Koke.

Expenditure Classes shillings per week	Percentage of Expenditure Hanuabada
Less than 50	a Classified as "at
50 to less than 100	b Significant at 5 per
100 to less than 150	cent.
150 to less than 200	
200 to less than 250	
More than 250	

Average	Expenditure Classes shillings per week
Less than 50	a Classified as "at
50 to less than 100	b Significant at 5 per
100 to less than 150	cent.
150 to less than 200	
200 to less than 250	
More than 250	

The reasons for reported starchy food factors. Firstly, the spread of foodstuffs is the spread adoption. people have had local culture and have, to effect, tended to come of this group. Thirteen have more knowledge group has not had the "foreign" see occupants of these Moresby for many

However, an increasing proportion of expensive foods seems to be calories which can money is much greater foods than the traditional available—Table 4.

(10) It was interesting to note that sliced wrapped bread was particularly popular although selling at a premium.

Table 4.
Edible Calories per Shilling^a
Traditional and Imported Starchy Foods.

Food	Calories per Shilling		
	Traditional	Imported	Traditional
Sago ^b	2,165
Taro	1,138
Tapioca—fresh tuber	1,412
Sweet potato	886
Yams	603
Banana	509

^a Prices for traditional starchy foods were those ruling in the native market at Koke. Prices for the imported foods were the averages of retail prices for the various stores about Koke and the main shopping centre of Port Moresby. The number of edible calories was calculated from Platt, B. S. *Tables of Representative Values of Foods Commonly Used in Tropical Countries*—Special Report, Series No. 253, HMSO London 1945. Reprinted 1960.
^b Supplies of sago are limited in the native market at Koke.

In addition to the prices per unit of calories, the people of Hanuabada are not prepared to pay the bus fare to the Koke market which is located about three miles from their village.

Marine and Animal Protein Foods.

Considerable differences in expenditure patterns emerged from the survey for this broad group of foodstuffs—Table 5. All households in the survey purchased tinned fish. Although both samples averaged about the same percentage of total expenditure on protein foods, the manner in which the figures were made up differed. In the Hanuabada sample, the source of protein was mainly from purchases of tinned goods, particularly fish, while the buying of fresh fish was limited—Table 5.

The reverse situation applied in the Koke settlement as purchases of fresh fish were the main source of protein. However, the purchases of the lowest expenditure group were confined to one household which utilized 44 per cent of total weekly expenditure on fresh fish. In fact, this particular household bought very little other traditional foodstuffs, as large quantities of starchy foods were shipped from home villages—Fig. 4.

Purchases of all types of starchy foods averaged 33 per cent. of total expenditure in the Hanuabada sample and 35 per cent. in the Koke sample. Of these figures, the percentage of expenditure on the traditional starchy foods, bananas, sweet potato, yams, taro was four per cent. for the Hanuabada sample and 17 per cent. for that of Koke.

Table 3.
Percentage of Expenditure on Starchy Foodstuffs.^a
Hanuabada and Koke Settlements.

Expenditure Class Shillings per week.	Hanuabada			Koke		
	1	2	3	1	2	3
Less than 50	4	18	22
50 to less than 100	22	19	16	35
100 to less than 150	12	23	35	17	16
150 to less than 200	4	33	37	19	25
200 to less than 250	2	27	39	6	10
More than 250	6	26	32	—	—
Average ^b	4	29	33	17	18

^a Classified as "traditional" and "imported".

^b Significant at 5 per cent. level.

The reasons for the importance of the imported starchy foods rest upon a number of factors. Firstly, the availability of this group of foodstuffs is the main reason for their widespread adoption. Secondly, the Hanuabada people have had long contact with the European culture and have, because of the demonstration effect, tended to copy the consumption habits of this group. Thirdly the people at Hanuabada have more knowledge of nutrition. The Koke group has not had such lengthy contact with the "foreign" sector although many of the occupants of these canoes have been in Port Moresby for many years—Appendix A.

However, an important reason for the high proportion of expenditure on imported starchy foods seems to be economic. The number of calories which can be purchased per unit of money is much greater for the imported starchy foods than the traditional foods most commonly available—Table 4.

The Koke settlement may have been linked with the pre-traditional dancing in the Abau Sub-district at some of these foods. In the former, an

the whole sample of traditional foods. The Koke survey

from the survey

cases of imported flour and bread. (10) While this group of average of 29 per cent. The figures for the no real variation

3. The cor-

or the Koke survey

that sliced wrapped

similar although settling

IMPORTED FOODS.

calories suggests that this is so. However, it should be remembered that in the Hanuabada sample the expenditure pattern of the lowest expenditure group only covers one household, the wage earner of which had been unemployed the week prior to the survey. This high figure may not be representative of this expenditure class, in fact if he had been in receipt of wages, no household would have fallen into this expenditure group. Similarly in the second lowest expenditure class, 100 to 150 shillings per week, the wage earner was not a Hanuabadan and the only one in the sample who did not have an occupation requiring some degree of skill.

As the urban centres or longer periods, tend to move more to imported food from traditional food.

AVERAGE ON ALL IMPORTED FOODS.

Hanuabada		Koke		Hanuabada		Koke	
Staple	Imp.	Staple	Imp.	Staple	Imp.	Staple	Imp.
70	37	—	—	—	—	—	—
72	37	—	—	—	—	—	—
66	—	—	—	—	—	—	—

AVERAGE ON ALL IMPORTED FOODS.

Hanuabada		Koke		Hanuabada		Koke	
Staple	Imp.	Staple	Imp.	Staple	Imp.	Staple	Imp.
70	37	—	—	—	—	—	—
72	37	—	—	—	—	—	—
66	—	—	—	—	—	—	—

AVERAGE ON ALL IMPORTED FOODS.

Hanuabada		Koke		Hanuabada		Koke	
Staple	Imp.	Staple	Imp.	Staple	Imp.	Staple	Imp.
70	37	—	—	—	—	—	—
72	37	—	—	—	—	—	—
66	—	—	—	—	—	—	—

AVERAGE ON ALL IMPORTED FOODS.

Hanuabada		Koke		Hanuabada		Koke	
Staple	Imp.	Staple	Imp.	Staple	Imp.	Staple	Imp.
70	37	—	—	—	—	—	—
72	37	—	—	—	—	—	—
66	—	—	—	—	—	—	—

AVERAGE ON ALL IMPORTED FOODS.

Hanuabada		Koke		Hanuabada		Koke	
Staple	Imp.	Staple	Imp.	Staple	Imp.	Staple	Imp.
70	37	—	—	—	—	—	—
72	37	—	—	—	—	—	—
66	—	—	—	—	—	—	—

AVERAGE ON ALL IMPORTED FOODS.

Hanuabada		Koke		Hanuabada		Koke	
Staple	Imp.	Staple	Imp.	Staple	Imp.	Staple	Imp.
70	37	—	—	—	—	—	—
72	37	—	—	—	—	—	—
66	—	—	—	—	—	—	—

AVERAGE ON ALL IMPORTED FOODS.

Hanuabada		Koke		Hanuabada		Koke	
Staple	Imp.	Staple	Imp.	Staple	Imp.	Staple	Imp.
70	37	—	—	—	—	—	—
72	37	—	—	—	—	—	—
66	—	—	—	—	—	—	—

AVERAGE ON ALL IMPORTED FOODS.

Hanuabada		Koke		Hanuabada		Koke	
Staple	Imp.	Staple	Imp.	Staple	Imp.	Staple	Imp.
70	37	—	—	—	—	—	—
72	37	—	—	—	—	—	—
66	—	—	—	—	—	—	—

AVERAGE ON ALL IMPORTED FOODS.

Hanuabada		Koke		Hanuabada		Koke	
Staple	Imp.	Staple	Imp.	Staple	Imp.	Staple	Imp.
70	37	—	—	—	—	—	—
72	37	—	—	—	—	—	—
66	—	—	—	—	—	—	—

AVERAGE ON ALL IMPORTED FOODS.

Hanuabada		Koke		Hanuabada		Koke	
Staple	Imp.	Staple	Imp.	Staple	Imp.	Staple	Imp.
70	37	—	—	—	—	—	—
72	37	—	—	—	—	—	—
66	—	—	—	—	—	—	—

AVERAGE ON ALL IMPORTED FOODS.

Hanuabada		Koke		Hanuabada		Koke	
Staple	Imp.	Staple	Imp.	Staple	Imp.	Staple	Imp.
70	37	—	—	—	—	—	—
72	37	—	—	—	—	—	—
66	—	—	—	—	—	—	—

AVERAGE ON ALL IMPORTED FOODS.

Hanuabada		Koke		Hanuabada		Koke	
Staple	Imp.	Staple	Imp.	Staple	Imp.	Staple	Imp.
70	37	—	—	—	—	—	—
72	37	—	—	—	—	—	—
66	—	—	—	—	—	—	—

AVERAGE ON ALL IMPORTED FOODS.

Hanuabada		Koke		Hanuabada		Koke	
Staple	Imp.	Staple	Imp.	Staple	Imp.	Staple	Imp.
70	37	—	—	—	—	—	—
72	37	—	—	—	—	—	—
66	—	—	—	—	—	—	—

AVERAGE ON ALL IMPORTED FOODS.

Hanuabada		Koke		Hanuabada		Koke	
Staple	Imp.	Staple	Imp.	Staple	Imp.	Staple	Imp.
70	37	—	—	—	—	—	—
72	37	—	—	—	—	—	—
66	—	—	—	—	—	—	—

AVERAGE ON ALL IMPORTED FOODS.

Hanuabada		Koke		Hanuabada		Koke	
Staple	Imp.	Staple	Imp.	Staple	Imp.	Staple	Imp.
70	37	—	—	—	—	—	—
72	37	—	—	—	—	—	—
66	—	—	—	—	—	—	—

AVERAGE ON ALL IMPORTED FOODS.

Hanuabada		Koke		Hanuabada		Koke	
Staple	Imp.	Staple	Imp.	Staple	Imp.	Staple	Imp.

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Figure 4. a.
Calories - Availability source
Adult Male Equivalents per day
Hanabada Sample

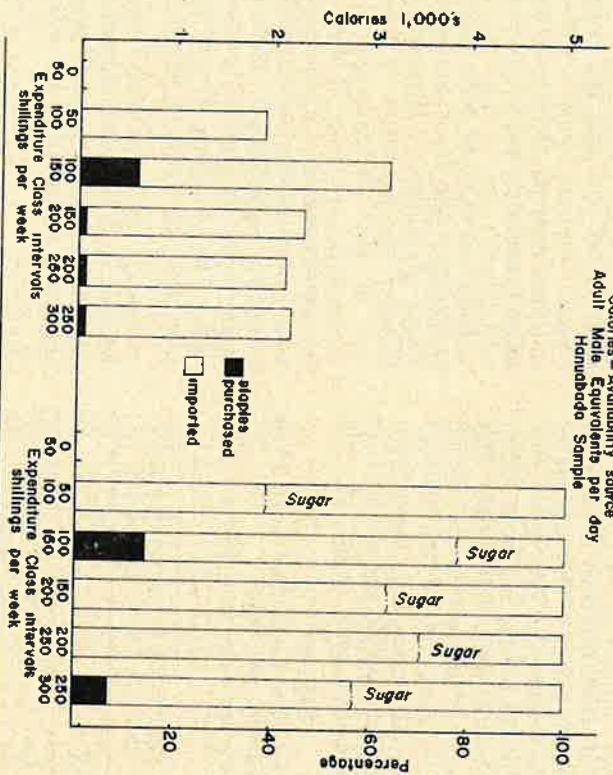
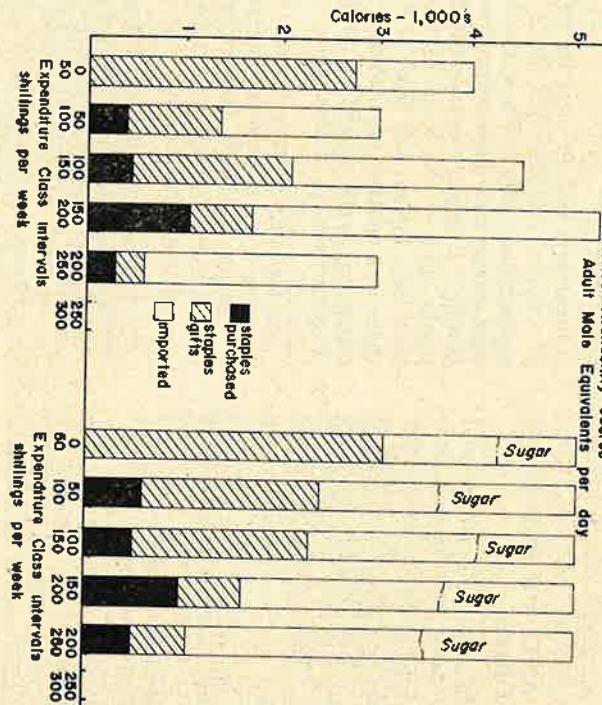


Figure 4. b.
Koke Sample
Calories - Availability source
Adult Male Equivalents per day
Hanabada Sample



Protein Intake.

As was shown of protein in the diet of imported food calculated. In all reported that shefally although the diet did not contain fish and occasionally but attempts to prove difficult.

In the Hanabada fish and occasionally but attempts to prove difficult. quantities were given to the child

3. When the sidered, the will be reduced the number or age, who day in the was consider.

In the form

least one m per household with one wife and four children instances visit food with the highest

4. These figures intake from employment, of bread, see

One of the main of survey is the of foodstuffs entering close to Port Moresby that considerable recently built an native market at Port Moresby and relatives living of air freight was result in serum intakes from this

fishermen in the calculated. In all reported that shefally although the diet did not contain fish and occasionally but attempts to prove difficult.

In the Hanabada fish and occasionally but attempts to prove difficult.

quantities were given to the child

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EXPENDITURE OTHER THAN FOOD.

Cigarettes and Tobacco.

These items were kept separate from purchases of foodstuffs but they accounted for a sizeable proportion of expenditure. In the Hanuabada survey, every household except one bought cigarettes or tobacco and preference was clearly for the former. Spending on "trade" tobacco was limited. Over the two samples the average weekly percentage of expenditure on cigarettes and tobacco was seven per cent. for the Hanuabada survey and eight per cent. for the canoe settlement at Koke. The figure for the latter sample was calculated on all the households included in the survey. This includes the religious sect which forbids smoking by its followers. Recorded purchases were undoubtedly understated as many isolated purchases would escape recording.

Betel Nut.

The relationship of betel nut to eating habits is somewhat obscure. However, apart from the religious sect in the Koke survey, all households purchased betel nut. In the Hanuabada survey, an average of nine per cent. of total weekly expenditure was utilized for betel nut and the corresponding figure for the Koke survey was ten per cent. In this sample, betel nut chewing is forbidden by the religious sect of which mention has previously been made.

Unfortunately, there appears to be little evidence on the relationship between the consumption of betel nut and dietary patterns, but the chewing of this nut is closely connected with social customs of this island.⁽¹⁴⁾ It is also possible that irregular purchases of betel nut were not recorded.

Fuel.

The principal sources of fuel are wood and kerosene. Not all households in the week of the survey bought fuel. Only five of the ten households in Hanuabada sample reported purchases of any type of fuel while 14 of the 16 households in the canoe settlement made some purchases. In some cases fuel was purchased

3. When the frequency of visitors is considered, the number of calories per adult will be reduced. Households were asked the number of visitors, irrespective of sex or age, who had at least one meal for each day in the survey. The number at Koke was considerably higher than at Hanuabada. In the former settlement, only one of the 16 householders reported no visitors for at least one meal. The number of visitors per household ranged from two households with one visitor to four with five visitors and four households with more than ten (the highest figure was 18). In some instances visitors brought small quantities of food with them.

4. These figures do not allow for calorie intake from meals taken at the place of employment. These meals usually consist of bread, scones or biscuits and soft drink.

One of the main problems facing this type of survey is the assessment of the total quantity of foodstuffs entering households from villages close to Port Moresby. It is of interest to note that considerable produce from a village which recently built an airstrip was not entering the native market at Koke but being given to friends and relatives living in Port Moresby. The cost of air freight was considerable. Those practices can result in serious errors in assessing calorie intakes from this type of survey.

Protein Intake.

As was shown previously, the major source of protein in the samples came from purchases of imported foods. An attempt to assess the protein availability proved unsatisfactory.

The proportion of the catch consumed by fishermen in the Koke settlement could not be calculated. In addition a number of households reported that shell fish were gathered occasionally although the religious group in that settlement did not consume this type of food.

In the Hanuabada sample, collection of shell fish and occasional fishing trips were common but attempts to assess the size of the catch proved difficult. In some cases, where small quantities were caught or gathered these were given to the children.

(14) Langley, Doreen "Food Consumption and Dietary Levels" — *Report of the New Guinea Nutrition Survey Expedition 1947*. Department of External Territories, Canberra. P. 104.

in small lots at a few days interval and considerable economy was practised in its use. In a number of households cooking only occurs once a day. The average weekly percentage of total expenditure devoted to purchase of fuel by the households was four per cent. in the Hanuabada sample and seven per cent. in the Koke sample. Purchases of kerosene are usually made in bottles of about 1.25 pints.

Clothing.

No conclusion can be drawn from the expenditure patterns on clothing although two of the ten households in Hanuabada and five of the 16 in Koke reported purchases of clothing or material.

Electricity.

Expenditure on electricity was confined to Hanuabada and seven of the ten households in the survey had electricity connected. The average percentage weekly expenditure over the sample was six per cent. Expenditure on this item was limited to the upper-middle and highest expenditure classes and the percentage declined; falling from seven per cent. in the 150-200 shilling per week group to 2 per cent. in the 250 shilling or more group.

CONCLUSION.

It is almost universally accepted among students of economic development that food production must keep ahead of population growth if economic development is to proceed.

The growing food requirements for the urban areas must be met to ensure that their development is orderly. The rate of growth in the total demand for foodstuffs will be determined principally by the rate of population growth in the urban areas and the extent to which any additional income is utilized for food purchases. Furthermore the pattern of food expenditure and food consumption can be expected to change considerably under the influence of rising incomes and the effect of "urbanization".

This pilot survey although of limited value has thrown some light onto the likely pattern of food consumption in the Port Moresby area. The importance of the imported foods in the diet of the permanent and migratory settler has been demonstrated and there seems little doubt that this trend will continue. Although the survey does not permit any statistical analysis of the income elasticity of demand for all foods,

the graphs in Figure 1 suggests that there is a high elasticity of demand for food. If this figure is in the order of those of other under-developed countries any increase in income can immediately be expected to result in increased demand for food.

Under the present traditional system of agriculture, supply is particularly inelastic so that any response to increased prices because of increased demand will be very slow. This will compete with imports of capital equipment for development plans for the scarce supplies of foreign exchange.

In addition, the low income workers will be squeezed by any increase in food prices as they cannot substitute cheaper sources of food. Any reduction in food intake could result in serious health problems.

At the present level, assuming no dependence on or access to subsistence, the migratory consumer, once he passes through the exploratory period, soon realises that imported foods are often the cheapest sources of energy and protein. The survey suggests that consumers in the Port Moresby area are purchasing rationally under existing price relationships.

There seems little doubt that in the immediate future food expenditures will continue to be the largest single item of expenditure and that there will be an increasing tendency for imported foods to take the major share of this expenditure. With existing population increase in the Port Moresby area and the inelastic supply of native staple foodstuffs, imported foods must supply the largest part of energy and protein needs.

Some knowledge of consumption patterns in the urban areas is essential for sound economic planning. In the Port Moresby area, increased attention must be given to the possibility of increasing the supply of native staple foodstuffs or those which can be grown in the area. This will mean that existing marketing and distribution channels will need re-organizing.

*Note.—This survey was conducted prior to the passing of the *Liquor (Licensing) Ordinance* 1963. The success of this survey rested on the field work of Mr. Sinaka Goava of the Department of Information and Extension Services and Miss Mary English of the Department of Native Affairs. In addition, both gave valuable assistance in the tabulation and preparation of the report.*

(Received June, 1963.)

Budgetary surveys were conducted in three native settlements were the area during September. random samples comprising housing units in the settlements were taken in one village of the Hanuabada complete Port Moresby, and Gulf District people.

The interviewing Papuans, both of the leaders of these households were visited recording and general purchases of foodstuffs. The original intention to cover two weeks interviewee resistance the end of the first then reduced to one accurate data would

BASIC CHARACTERISTICS

1. The Canoe Settlement

This settlement the commercial centre area of Port Moresby close to the principal Moresby area.

The settlement permanent section, from the total number permanently. Permanently on the basis that the household for at least six months for at least another

Fifteen of the settled people of the Division of the Abia District. The area Moresby. The other Subdistrict also of the less than half the population of the Marshall Islands of the 16 canoes in

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APPENDIX A.

Budgetary surveys of one week's duration were conducted in randomly selected households in three native settlements in the Port Moresby area during September-October, 1962. The random samples consisted of 20 per cent. of the housing units in the settlements. The three settlements were the canoe squatters at Koke, one village of the four which make up the Hanuabada complex sited on the foreshores of Port Moresby, and a squatter settlement of Gulf District people in the vicinity of Konedobu.

The interviewing was conducted by two Papuans, both of whom were well known to the leaders of these settlements. The selected households were visited prior to the week of recording and general data on each were collected. During the survey week the households were visited daily for one week and purchases of foodstuffs, etc., recorded.

The original intention was for the survey to cover two weeks but it was obvious that some interviewee resistance was developing towards the end of the first week, so the period was then reduced to one week. It seemed that more accurate data would be obtained in this way.

BASIC CHARACTERISTICS OF THE SETTLEMENTS.

1. The Canoe Settlement at Koke.

This settlement is located midway between the commercial centre and the main residential area of Port Moresby. The canoes are moored close to the principal native market in the Port Moresby area.

The settlement consists of a migratory and permanent section. The sample was drawn from the total number of canoes moored permanently. Permanence was determined on the basis that the canoes had been in the area for at least six months and intended to remain for at least another three months.

Fifteen of the sixteen canoes in the sample housed people of the Marshall Lagoon Census Division of the Abau Subdistrict of the Central District. The area is to the east of Port Moresby. The other canoe came from the Rigo Subdistrict also of the Central District. Slightly less than half the people came from one village of the Marshall Lagoon Census Division. Seven of the 16 canoes in the sample accommodated

people belonging to a religious sect which prohibits its followers from smoking, drinking stimulants such as tea and coffee, the chewing of betel nut and the consumption of shell fish.

Occupations of Principal Wage Earners.

The wage earners were mainly skilled and semi-skilled although it seems that there is a tendency to inflate the occupation in that some maintain they are "carpenters" when in fact they may be assistants to a skilled tradesman.

Occupation.

Occupation.	Number in Sample.
Painter
Foreman-painter
Fisherman
Carpenter
Drainer
Driver
Storeman-clerk
Total	16

Length of Residence in Port Moresby.

The length of the Principal wage earner's residence in Port Moresby was recorded and half those in the sample had been in the urban area for less than three years.

Length of Residence—Principal Wage Earner.

Period.	Number in Sample.
Less than 3 years	8
3 years to less than 6
6 years to less than 9
9 years to less than 12
12 years to less than 15
More than 15 years
Total	16

Of those who have been residing in the Port Moresby area for less than three years, two had been here for less than one year.

Household Size.

An adult male equivalent coefficient was used to measure household size as in most cases close relatives and friends reside permanently with the principal wage earner. Permanency was defined as applying to anyone who had been in

the household for the previous six months and intended to remain for at least another three months or the date of their departure was uncertain.

Household Size—Adult Male Equivalents.

Adult Male Equivalents.	Number in Sample.
2 to less than 3	6
3 to less than 4	5
4 to less than 5	2
5 to less than 6	2
6 to less than 7	1
Total	16

Income.

Considerable difficulty was experienced in attempting to estimate actual cash income. The practice of pooling incomes is fairly widespread and also there is some reluctance to disclose the actual amount. However, the following table gives some indication. Gambling also complicated this assessment.

Weekly Income—Shillings.

Shillings per week.	Number in Sample.
60 to less than 80	1
80 to less than 100	4
100 to less than 120	6
120 to less than 140	2
140 to less than 160	—
160 to less than 180	3
Total	16

Saving: Bank Accounts.

Only residents in two of the 16 canoes in the sample did not have savings bank accounts. The following table shows the ownership of the accounts.

Savings Bank Accounts—Classification of Ownership.

Classification.	Number in Sample.
Husband	7
Accounts for both husband and wife	2
One account for both	2
Child and one parent—husband	1
Child and one account for each parent	1
No accounts	2
Total	16

Utilization of Savings Bank Accounts.

Interviewees were asked the principal use of these accounts.

Principal Use of Savings Bank Accounts.

Purpose.	Number in Sample.
Saving for specific item	—
Used mainly for food purchases	6
No specific item but used for food purchases	2

Total 16

2. Village of the Hanuabada Group.

One village of this group was selected randomly and 20 per cent. of the houses was chosen. This group of villages is the traditional home of these people although one migrant family fell in the sample.

Occupations.

The bulk of the wage earners is occupied in skilled employment.

Occupation	Number in Sample.
Clerks—2 government	3
Carpenters	2
Drivers ^a	2
Foreman-sign writer	1
Mechanic-motor labourer ^b	1
Total	10

^a Of the drivers, one had been unemployed until the week of the survey.

^b Migrant.

Length of Residence in Port Moresby.

Apart from the migrant the people were still residing in their traditional village area.

Household Size.

As mentioned previously the method of assessing household size was based upon an adult male equivalent system. Household size was considerably larger than in the Koke canoe settlement.

Household Size—Adult Male Equivalents.

Classification.	Number in Sample.
Adult Males	—

Husband	2 to less than 3	—
Accounts for both husband and wife	2	—
One account for both	2	3 to less than 4
Child and one parent—husband	1	4 to less than 5
Child and one account for each parent	1	5 to less than 6
No accounts	2	6 to less than 7
		7 to less than 8
		8 to less than 9
		9 to less than 10
		10 to less than 11
		11 and over
Total	16	2

Income.

Difficulties were experienced in estimating individual incomes. These were more pronounced than in that at Koke. It was impossible to say whether the cash income of the earners shows the pooled or individual incomes.

Only three of the households provided meals for the week; the number of households providing quantities of food were operated by or a combination of

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Only three of the households provided meals for the week; the number of households providing quantities of food were operated by or a combination of

Bank Accounts.

	Number in Sample.
....
....	6
....	6
Food purchases	2
....	2
....	2
TOTAL	16

a Group.

Group was selected of the houses was as the traditional houses is the traditional enough one migrant

	Number in Sample.
....	3
....	2
....	1
....	1
....	1
TOTAL	10

	Number in Sample.
....	—
....	3
....	1
....	2
....	1
....	1
....	—
....	—
TOTAL	2
TOTAL	10

Income.

Difficulties were again experienced in assessing individual incomes as the practice of Pooling was more pronounced in the Hanuabada survey than in that at Koke. In some instances it was impossible to separate the individual wage earners' cash income but the following table shows the pooled income for the households.

Income—Shillings per week.

Range.	Number in Sample.
80 to less than 100	1
100 to less than 120	1
120 to less than 140	2
140 to less than 160	2
160 to less than 300	2
300 to less than 450	1
TOTAL	9

One wage earner had just commenced work as driver and his income was unknown at that stage. Of these in the sample four of the top five had pooled incomes.

Subsistence foods from Village Gardens.

Eight of the ten households in the sample possessed gardens. One family, although a member of the Hanuabada community, had no garden, while the migrant was also landless in this district. The principal crops were yam, banana, tapioca, taro and sugar cane. During the week of the survey these gardens produced a total of 130 lb. of staple foodstuffs of which tapioca made up 70 per cent. and yams 19 per cent.

Value Equivalents.

	Number in Sample.
....	—
....	3
....	1
....	2
....	1
....	1
....	—
....	—
TOTAL	2
TOTAL	10

Savings Accounts—Classification of Account Holders.

	Classification.	Number in Sample.
Husband	1
Children and one account for both parents	5
Children and one parent with account	3
Children and an account for each parent	1
TOTAL	10

Each survey household was asked if savings were being directed towards a specific item or for what the account was primarily used. The following table gives the break-up.

	Main Purpose.	Number in Sample.
Savings for specific purpose	5
Used when food is needed	4
No specific item but used for food purchases	1
TOTAL	10

3. Smaller Settlement of Gulf District People.

Unfortunately the survey of this settlement was not finalized because of insufficient interviewers. Some data were collected but were insufficient for any analysis. However some trends are evident and this area in particular deserves further study.

Six households were interviewed out of the sample of 15. The settlement is located in the Konedobu area of Port Moresby.

Occupations.

Most of the main household wage earners were employed in skilled and semi-skilled occupations.

Occupation.

	Type.	Number in Sample.
Foteman	1
Carpenter	1
Painter	1
Driver	1
Shop Assistant	1
Labourer	1
TOTAL	6

In all the survey households, savings accounts were operated by either the parents or children or a combination of these two.

Further Records of Insect Pests of Theobroma cacao in the Territory of Papua and New Guinea

J. J. H. SZENT-IVANY.

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

This is a supplement to the author's paper entitled: "Insect Pests of Theobroma cacao in the Territory of Papua and New Guinea" (Szent-Ivany, 1961). Seventy-six new cacao insects are listed, most of them representing new economic records. Besides this some corrections are made (including species omitted from the first paper because of the unavailability of relevant literature), and new distribution data of previously recorded cacao insects are given, together with some remarks on ecology and ethiology. Two moths, previously mentioned as minor pests (Szent-Ivany, 1961) are now considered major pests of Theobroma cacao. There are the noctuids *Tiracola plagiata* (Walk.) and *Achaea janata* L.

ONE hundred and forty-two insect species were recorded in the author's first comprehensive paper on the cacao pests of the Territory of Papua and New Guinea (Szent-Ivany, 1961). Since the publication of this paper another 76 insects were found associated with *Theobroma cacao* in Papua and New Guinea. Most of these represent new economic records. In the present paper all newly found cacao pests are listed, together with some new distribution records of previously recorded cacao pests, and some corrections are made partly based on literature references which were previously unknown or unavailable to the author (Aulmann, 1912, La Baume 1912.)

The insect orders follow the phylogenetic sequence of the ninth edition of Imms: "General Textbook of Entomology" (Imms, 1957, p. 252). The families within the orders, the genera within the families and the species within the genera are listed in alphabetical order. Much of the material has been collected by Mr. G. S. Dun, Principal Entomologist with the Department of Agriculture, Stock and Fisheries, by Mr. A. Catley, Entomologist with the Department, and by the author. The names of these three collectors are abbreviated as follows: D — G. S. Dun, Sz — J. J. H. Szent-Ivany, C — A. Catley.

Week.	Number in Sample.
...	4
...	1
...	—
...	—
...	1
...	6

Survey group had a ea. The remain- from the villages week of the survey from home villages tolds reported any week. One family e of the groups

es bank accounts found that one of es bank accounts.

of Port Moresby different groups living at the same nature will only particular point of people will arrive scatterers and must themselves to new the "problem of people" in a rapidly conducted into andture incurred ey indicated that these two.

PHASMIDA.
Auchiale maculata (Oliv.). Previously known as a widespread minor pest of cacao in New Britain (Szent-Ivany 1958, 1961). Recently it appeared in plague proportions in some plantations in the Madang District.

ISOPTERA.
Termitidae.
Nasutitermes princeps (Desneux). Matupi Plantation, Madang District, 6.9.62. Nests on healthy cacao trees (Primary attack.) (Coll. Sz.).

HEMIPTERA.
Aphididae.
Aphis grossipii Glover. Lowlands Agricultural Experiment Station, Keravat, New Britain District, February, 1960. In flowers. (Coll. L. Smeec and Sz.).

Cercopidae.
Clorinda sp. Jimboro Plantation, Northern District, 1.12.1961. (Coll. R. J. Cheetham and Sz.).

Clorinda sp. Girua Plantation, Northern District, 21.11.1961. (Coll. R. J. Cheetham and Sz.).

Asterolecanium sp. near *javae* Russell. Nara-
kepor Plantation, Morobe District, 31.1.1962.
Heavy infestation on branches; suspected to
be associated with die-back. (Coll. J. H.
Ardley).

Cyrtotocca theobroma Williams. Numa Numa
Plantation, Bougainville District, 1.8.1961.
Pods: tended by *Technomymex detorquens*
Walk. (Coll. C.).

Cricococcus tessellatus (Sign.) Plant Industry
Centre, Bubia, Morobe District, 21.10.1959.
Foliage. (Coll. J. H. Ardley).

Hemiberlesia palmae (Ckll.) Lowlands Agri-
cultural Experiment Station, Keravat, New
Britain District, 16.8.1962. Twigs. (Coll. D.).

Planoecus sp. near *citti* (Risso). Lowlands

Agricultural Experiment Station, Keravat,

New Britain District, January, 1960. (Coll.

D.).

Pseudococcus sp. Dylup Plantation, Madang

District, 8.3.1960. Pods. (Coll. Sz.).

Coreidae.

Amblypelta madangana Brown & Ghauri. This
species was found by the author on *Theobroma*
cacao at Amele village plantation in the
Madang District in June, 1959, and it was
described as a new species two years later
(Brown & Ghauri 1961). Specimens were
seen feeding on cacao pods and causing scars
very similar to those caused by *Amblypelta*
theobromae Brown. An unknown species of
the asilid genus *Heligmoneura* Bigot
(= *cimadus* van der Wulp) was observed
preying upon last instar neanides (nymphs).
The plantation was at the same time severely
infested with the cacao mirid *Pseudonoiella*
laevis Mill. (known also from the Markham
Valley and from the Northern District).
Amblypelta and *Amblypelta* damage was
found only on cacao trees along the south-
east boundary of the plantation near the
adjoining swampy rainforest. In this area
some pods were covered with both the small
regular scars caused by the mirid (capsid)
and the larger irregular scars caused by
Amblypelta madangana. The author revisited
Amele Plantation in March, 1960. No speci-

mens of *Amblypelta madangana* could be
found on this occasion and there was no sign
of *Amblypelta* damage on cacao pods. During
a third visit in September, 1962 some cacao
pods were seen with many typical *Amblypelta*
madangana were sighted. There was very
little evidence of mirid damage. In March,
1963 a few cacao pods which showed the
typical injury of both the mirid and the coreid
were submitted to the author. Thus, it is
believed that this species is still present in
the plantation area. However, it cannot be
considered a major pest. *Pseudonoiella*
laevis became thoroughly adapted to cacao
as a new host plant, and in 1959 it was found
in almost every part of the plantation causing
severe reduction of yield. *Amblypelta*
madangana and its typical damage was found
only on the edge of the plantation and despite
many visits to Amele by various officers of
the Department of Agriculture, Stock and
Fisheries, no live specimens of this species
could be collected apart from those which were
taken by the writer in June, 1959. It most
likely has more favoured indigenous host
plants in the surrounding rainforest than
Theobroma cacao.

Amblypelta theobromae Brown. This species,
previously known as a major pest of
Theobroma cacao in the Morobe and Northern
Districts (Szent-Ivany 1961) was found in
1962 also in the Milne Bay District of Papua.
Specimens were collected by Mr. E. Mobbs
of the Department of Agriculture at Naura
village (10 miles inland of the Western end
of the District) on the 1st November, 1962.
Mr. Mobbs observed extensive damage to
cacao pods and some damage to tips of
branches was also noticed. Damage to
growing points by *Amblypelta theobromae*
Brown has not been observed in the past.
However, it is quite possible that this species
also feeds on and around the growing points
of the branches, as another species of the
genus (*Amblypelta interspersa papuensis*
Brown) is known to cause extensive tipwilt
to various cultivated plants (Szent-Ivany and
Catley 1960).

Bathyphyes infexus Blote. This species was
observed feeding on cacao pods by Mr. L. A.
Bridgland at Popondetta in the Northern Dis-
trict (30.9.1959), by Mr. A. Catley at

Gabensis Plantata
(6.6.1960) and
Finschhafen (D)
Derbidae.

Diastrombus sp. C
District, 23.11.1
Derbidae.

Zoraida fuscipennis
Northern District
Sz. and E. Kanjiu
Zoraida punctipennis
District, Morobe
(Coll. C.).

Zoraida sp. near
hambo village, I
Foliage. (Coll.

Zoraida sp. Suamb
26.4.1960. Fol
Zoraida sp. Sangga
16.11.1962. (Co
Northern District
(Coll. C.).

Zoraida sp. Sumb
trict, 13.11.1962.

Zoraida sp. Pop
7.5.1962. Foli
Flatidae.

Enphanta sp. Jimb
trict, 1.12.1961.
Sz.).

Enphanta sp. Kaga
22.11.1961. (Co

Papuanella sp. Jil
District, 1.12.19
and Sz.).

Paradisca sp. J
District, 25.11.1

Paradisca sp. Su
District, 22.11.1

Sephena sp. Mag
Dagua, Sepik D
Sz.).

Sephena sp. Carbe
trict, 23.11.1961

Sephena sp. Jimbo
trict, 1.12.1962.
Sz.).

Amagana could be there was no sign of cacao pods. During 1962 some cacao typical *Amblyptella* forms of *Amblyptella*. There was very damage. In March, which showed the tritid and the coreid author. Thus, it is still present in any case, it cannot be st. *Prendorniella* adapted to cacao plantation causing field. *Amblyptella* damage was found plantation and despite various officers of Agriculture, Stock and of this species those which were 12, 1959. It most indigenous host than rainforest than

Gabensis Plantation, in the Morobe District (6.6.1960) and by Mr. K. G. Newton at Finschhafen (December, 1960). Derbidae.

Diostronbus sp. Carberry Plantation, Northern District, 23.11.1962. Foliage. (Coll. C.).

Proutista sp. Javuni Plantation, Northern District, 22.11.1961. Foliage. (Coll. R. J. Cheetham).

Zoraida fuscipennis Walk. Epa Plantation, Northern District, 24.11.1961. Foliage. (Coll. Sz. and E. Kanjir).

Zoraida puncipennis Walk. Suambu Plantation, Morobe District, 26.4.1960. Foliage. (Coll. C.).

Zoraida sp. near *puncipennis* Walk. Kapurahambo village, Northern District, 14.11.1962. Foliage. (Coll. C.).

Zoraida sp. Suambu Plantation, Morobe District, 26.4.1960. Foliage. (Coll. C.).

Zoraida sp. Sangara Estate, Northern District, 16.11.1962. (Coll. C.). Bakahari Plantation, Northern District, 13.11.1962. Foliage. (Coll. C.).

Zoraida sp. Sumbaripa Plantation, Northern District, 13.11.1962. Foliage. (Coll. C.).

Zoraida sp. Popondetta, Northern District, 7.5.1962. Foliage. (Coll. C.).

Flatidae.

Emphanta sp. Jimboro Plantation, Northern District, 1.12.1961. (Coll. R. J. Cheetham and Sz.).

Emphanta sp. Kagona Estate, Northern District, 22.11.1961. (Coll. Sz.).

Papuanella sp. Jimboro Plantation, Northern District, 1.12.1961. (Coll. R. J. Cheetham and Sz.).

Paratoksha sp. Javunie Plantation, Northern District, 25.11.1961. (Coll. Sz.).

Paratoksha sp. Sumbaripa Plantation, Northern District, 22.11.1961. (Coll. Sz.).

Sephena sp. Magafin Village Plantation, near Dagua, Sepik District, 7.3.1960. (Coll. Sz.).

Sephena sp. Carberry Plantation, Northern District, 23.11.1961. (Coll. Sz.).

Sephena sp. Jimboro Plantation, Northern District, 1.12.1962. (Coll. R. J. Cheetham and Sz.).

Lophopidae. *Kasyveta* sp. Finschhafen, Morobe District, 10.1.1956. (J. H. Ardley).

Lophops sp. Jimboro Plantation, Northern District, 1.12.1961. (Coll. R. J. Cheetham and Sz.).

Membracidae.

Terentius sp. Carberry Plantation, Northern District, 17.11.1961. (Coll. Sz.).

Terentius sp. Banap Plantation, Madang District, September, 1962. (Coll. Sz.). This species was breeding in vast numbers on pods, branches and on the bark of the main stems of cacao trees at Banap Plantation. On the pods it was tended by the ant *Anoplolepis longipes* Jerd and it caused very similar scars to those inflicted by cacao mirids.

Pentatomidae.

Annandazia franzemii Kim. Plant Industry Centre, Bubia, Morobe District. (Coll. J. H. Ardley.).

Coctotoris iridescens Walk. Plant Industry Centre, Bubia, Morobe District. (Coll. J. H. Ardley.).

Ricaniidae.

Euricania millica Stal. Hohota Plantation, Northern District, 14.4.1958. Foliage. (Coll. Sz.) Bakahari, Mamoo and Tentri Plantations, Northern District, 25.9.1961. Foliage. (Coll. Sz.).

Ricaniidae.

Ricania sp. Dylup Plantation, Madang District, 8.3.1960. (Coll. Sz.).

Ricania sp. Magafin Village Plantation, near Dagua, Sepik District, 7.3.1960. (Coll. Sz.).

Ricania sp. Magafin Village Plantation, near Dagua, Sepik District, 7.3.1960. (Coll. Sz.).

THYSANOPTERA.

Thripidae.

Heliothrips aethianni Kamy. New Guinea (La Baume, 1912).

Heliothrips haemorrhoidalis (Bouche) New Guinea (Frogatt, 1940; Dumbleron, 1954; Dun, 1951, 1954). This almost cosmopolitan species is probably widely distributed in the Territory of Papua and New Guinea representing a minor pest of cacao foliage.

Selenothrips decolor Kamy. New Guinea (La Baume, 1912).

Selenobrips rubrocinctus Giard. (New Britain) (Frogatt, 1940; Dun, 1951, 1954; Dumbleton, 1954). This species was found also by the author in a plantation in the Northern District in November, 1961. Leaves were severely attacked but only a few trees were infested.

Selenobrips rubrocinctus is a circum-tropical species and it is a serious pest of cacao in the West Indies (Kalschoven, 1947). It is only a minor pest of *Theobroma cacao* in the Territory of Papua and New Guinea.

LEPIDOPTERA.

Danaidae.

Epiphoea nemores subsp. ? near *ulugoma* Ribbe.

Lowlands Agricultural Experiment Station, Keravat, New Britain District, 1.9.1962. (Coll. D.).

Geometridae.

Hypocraea uluca Wlk. Lowlands Agricultural Experiment Station, Keravat, New Britain District, 13.8.1961. Foliage. (Coll. D.).

Extropis sabulosa Warr. Lowlands Agricultural Experiment Station, Keravat, New Britain District, 11.9.1959. Foliage. (Coll. D.). This and a near related species have caused severe damage to cacao foliage in various parts of the Gazelle Peninsula of New Britain in 1959-63.

Gracillariidae.

Acrocerops sp.? near *brochogramma* Meyr. Lowlands Agricultural Experiment Station, Keravat, New Britain District, October, 1961. (Coll. D.).

Limacidae.

Scopelodes venosus Walk. Anopa Plantation, Bougainville District, June, 1956. Foliage (Coll. W. Smith).

Pinzulenza kukiisch Hering. This species, previously recorded as a cacao pest from Kar Kar Island (Madang District) and from the Gulf District (Szent-Ivany 1959, 1961) appeared in 1960 in plague proportions at Dylup Plantation in the Madang District. (Coll. Sz.).

Lycenidae.

Lamprodes celeno Gram. Markham Valley, Motobe District, December, 1961. Foliage. (Coll. J. H. Ardley).

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Lymantidae.

Dasybira mendoa Hbn. Popondetta, Northern District, 16.11.1961. Foliage. (Coll. R. J. Cheetham).

Azerita Plantation, Northern District, 16.11.1961. Foliage. (Coll. Sz.).

Haugata Plantation, Northern District, 4.5.1962. Foliage. (Coll. C.). Jimboro Plantation, Northern District, 10.5.1962. Foliage. (Coll. C.).

Noctuidae.

Achaea janata L. This polyphagous noctuid mentioned earlier as a minor pest of cacao by the author (Szent-Ivany 1960) appeared to be more troublesome as a cacao defoliator during the last three years in New Britain (Smee, 1962a) and in the Northern District.

Elgydina sp. is suspected of feeding on cacao foliage. The species has been reared from pupae found in Bakahari Plantation, 7.11.1962 and Carberry Plantation, 8.1.1962 (both Northern District) in the ground under cacao trees. (Coll. C.).

Tinacola plagiata (Wlk.). Previously considered a minor pest (Szent-Ivany, 1960) since 1960 this species has become a very severe pest of *Theobroma cacao* in a new cacao growing area in the Northern District of Papua, causing complete defoliation of flush growth. (Cattley, 1962a, 1962b). In May, 1962, it also appeared in plague proportions in a plantation in the Motobe District. In September, 1962, the author found a small population of *Tinacola plagiata* in a cacao plantation near Madang.

Hypolymma dimena L. Lowlands Agricultural Experiment Station, Keravat, New Britain District, 7.11.1961. (Coll. D.).

Nymphalidae.

Teratia metiolasidii Guen. Lowlands Agricultural Experiment Station, Keravat, New Britain District. (Coll. J. H. Ardley).

Pyralidae.

Synchlora ariana Warr. Popondetta, Northern District, June, 1962. Foliage. (Coll. C.).

Thyrididae.

Endobates anomognamma Meyr. Lowlands Agricultural Experiment Station, Keravat, New Britain District, February, 1962. (Coll. R. J. Cheetham).

Macromonota regalis L. Smee and Sz.

Poecilophanus hirsutus Agricultural Experiment Station, Keravat, New Britain District, February, 1962. (Coll. R. J. Cheetham).

Lema staudingeri R. J. Cheetham.

Genus and spec.

Experiment ;

District, Matto

of *Neotermes*

D.).

Tortricidae.

Cryptophlebia ; Agricultural

New Britain

feed on the

ondetta, Northern
age. (Coll. R. J.
ation, Northern
age. (Coll. Sz.).
Northern District,
I. C.). Jimboro
District, 10.5.1962.

lyphagous noctuid
or pest of cacao by
1960) appeared to
a cacao defoliator
s in New Britain
Northern District.
feeding on cacao
been reared from
Plantation, 7.11.1962
8.1.1962 (both
round under cacao

previously considered
1960) since 1960
ery severe pest of
cacao growing area
apua, causing com-
growth. (Catley,
2, it also appeared
plantation in the
ember, 1962, the
ation of *Tinacola*
on near Madang.

lands Agricultural
at, New Britain
(Coll. H. Ardley).

Lowlands Agric-
Keravat, New
ndetta, Northern
ge. (Coll. C.).

Lowlands Agric-
Keravat, New
omes sp. (Smees,
a cacao.

Genus and species indet. Lowlands Agricultural Experiment Station, Keravat, New Britain District, March-April, 1959. Breeds in nests of *Neotermes* sp. damaging cacao trees. (Coll. D.).

Tortricidae.

Cryptophlebia sp.? *encarpa* Meyr. Lowlands Agricultural Experiment Station, Keravat, New Britain District, April, 1959. Larvae feed on the skin of ripe pods. (Coll. D.).

COLEOPTERA.

Anthribidae.

Phloeops platypterus Montr. Kerema, Gulf District, 21.3.1959. (Coll. J. Cox).

Bostrychidae.

Allorthrum kolbei Haged. Aulmann (1912, p. 37) reported this bark beetle as a pest of cacao in Peterhafen (New Guinea) in 1910.

Brentidae.

Ectocemus decemmaculatus Montr. Mamoo Plantation, Northern District, February, 1956. On the branches of young cacao tree (Coll. G. Pritchard). It is not known whether this species is able to cause primary damage to healthy cacao seedlings. However, it is not impossible because other brentids (*Miolispa papuana* Kleine, *Miolispa* sp. nr. *papuana* Kleine and *Miolispa* sp. nr. *ariensis* Kleine and *Miolispa novae-guineensis* Guer.) were observed causing primary injury to the growing points of rubber seedlings in Papua (Szent Ivany, 1956).

Cerambycidae.

Glycyphana nefotita Kr. Lowlands Agricultural Experiment Station, Keravat, New Britain District, February, 1960. Flowers. (Coll. L. Smees and Sz.).

Macronota regia (Fr.) Mamoo Plantation, Northern District, 3.11.1961. Foliage (Coll. R. J. Cheetham.).

Poecilophanus bimaculata Schurhoff. Lowlands Agricultural Experiment Station, Keravat, New Britain District, February, 1960. (Coll. L. Smees and Sz.).

Crioceridae.

Lema staudingeri Jac. Cassell Estate, Northern District, November, 1961. Foliage. (Coll. R. J. Cheetham and Sz.).

Cerambycidae.
Megaceresinum bomi Heller. Arawa Plantation, Bougainville, September, 1956. (Coll. F. R. McKittrick.).

Curculionidae.

Balaninus sp.? *missionis* Heller. Amele Village Plantation, Madang District, 7.12.1959. (Coll. J. H. Ardley.).

Eupholus sp. Arehe Plantation, Northern District, 30.11.1961. Foliage. (Coll. R. J. Cheetham, E. Kanjiti and Sz.).

Ioleptinus variiegatus (author?). This species has been mentioned by Aulmann (1912) as having caused damage to Criollo cacao at Peterhafen (New Guinea) in 1910. It is a small weevil, (5.5 mm. long, 3 mm. wide) which was found in large numbers under the bark of the cacao tree. It tunneled in the bark but it did not damage the wood (Aulmann, op. cit. pp. 40-41, Fig. 27).

Mecopis doryphorus Quoy & Gaim. Lowlands Agricultural Experiment Station, Keravat, New Britain District, October, 1959. Pods. (Coll. D.).

Orthorrhynchus sp. near *patruelis* Pasc. Warou-Gamenoku Village area, Talasea, New Britain District, 29.3.1962. (Coll. E. Tokebene).

Pantorhytes sp. nov.? Inauwauini Village, Mekeo, Central District, September, 1962. Larvae bore in stem and branches, causing severe damage. (Coll. B. P. Arrey).

Rhinoscapha sp. Arehe Plantation, Northern District, 30.11.1961. Foliage. (Coll. R. J. Cheetham, E. Kanjiti and Sz.).

Dermetidae.

Dermestes cadaverinus F. is reported to have been damaging the growing points of young cacao trees in Peterhafen (New Guinea). (Aulmann 1912, pp. 50, 51, Fig. 31).

Eumolpidae.
Dereirchia sp. Anir Island, New Ireland District, July, 1962 and Lowlands Agricultural Experiment Station, Keravat, New Britain District, 22.8.1962. On young cacao flush. (Coll. D.).

Rhyparida batalis Baly. Lowlands Agricultural Experiment Station, Keravat, New Britain District, 22.8.1962. On flush growth. (Coll. D.).

Rhyparida impressipennis Bry. This species was previously recorded from New Britain.

Recently it has been found as a common pest of cacao flush in the Northern District. (Coll. Sz. and C.).

Rhyparida sp. Cassell Plantation, Northern District, 21.11.1961, on flush growth. (Coll.

R. J. Cheetham and Sz.).

Lamidae.

Monohammus rusticator F. Mentioned as a pest of cacao in New Guinea by G. Aulmann (1912, pp. 19-20, Fig. 14).

Ropica sp. near *varipennis* Pasc. Kabeira Plantation, New Britain District, November, 1959.

Larvae found with those of the xyloxytid borer *Paneptia teletunga* in cacao branches. (Coll. D.).

Nitidulidae.

Caropophilus pallidens Murray. Mentioned to have been found on cacao in Peterhafen (New Guinea) where it probably fed on ripe pods. (Aulmann, 1912, pp. 52-53, Fig. 33).

Rutelidae.

Parastasia guttulata Fairm. "C.B." Plantation, near Kokopo, New Britain District, 3.4.1962. Boring into cacao pod. (Coll. C.).

Parastasia montrouzieri Fairm. Bba Plantation, Northern District, 17.11.1961. Folage. (Coll. Sz.).

Parastasia impictipes Ohs. "C.B." Plantation, near Kokopo, New Britain District, 3.4.1962, Boring into cacao pod. (Coll. C.).

Scolytidae.

Xyleborus confusus Eichhoff. This species is reported by Aulmann (1912, p. 34) to have caused very serious damage to cacao trees in 1910 in Peterhafen (New Guinea). It appeared as primary pests and killed 50 strong and healthy Criollo trees within four weeks.

Xyleborus morigerus Blandf. Panapau Plantation, Dyal Island, New Ireland, March, 1963. (Coll. R. E. McDonald). Borer in taproot of dead cacao seedlings.

Xyleborus morizatti Haged. * Walindi Plantation, Talasea Subdistrict, New Britain District, October, 1961. Borer in branches. (Coll. L. Searle.).

* Since the completion of the manuscript it was found that *Xyleborus morzatti* Haged. is a synonym of *X. compactus* Eichh. (Murayama, J. J. and L. G. E. Kalshoven (1962) Ent. Berichten, 22: 247-250.)

PAPUA AND NEW GUINEA AGRICULTURAL JOURNAL

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THE following received a study tour of the State of Selangor, Institute of Malaya, the period 23rd

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* Dollars and Cents

Observations on Rubber Growing in Malaya

A. J. H. VAN HAAREN.

Officer-in-Charge, Rubber Section, D.A.S.F., Bisianumu.

THE following report contains information received and observations made during a study tour of Malayan rubber estates in the State of Selangor, and of the Rubber Research Institute of Malaya at Kuala Lumpur, during the period 23rd April to 6th May, 1963.

Seed Treatment.

An interesting visit was made to Prang Besar Estate near Kajang (Selangor). This estate is well known in this Territory as a supplier of high yielding clonal seeds and has developed a number of widely used clones.

Prang Besar clonal seeds are transported daily from their isolated seed gardens over a distance of 180 miles to Prang Besar Estate, where the seed is inspected and sorted out. It was noticed at this inspection centre that PR 107 seeds were taken out and discarded. According to Prang Besar people PR 107 seed tends to become mouldy very quickly and does not give a good high yielding tree. PR 107 seed amounts to about 6 per cent. of total seeds collected from Gough Gardens, and this clone seems to serve mainly as a male parent in the Prang Besar seed gardens.

After inspection and sorting, the seeds are placed in germination beds for a few days and sold to Malayan plantations as germinated seed at 22 cents* per seed for Gough Garden I, II and Plot C seeds. Where a journey of three days and over is involved the seed is supplied ungerminated.

In cases where the roots of germinated seed are too advanced for safe packing and transport, seeds are planted in nurseries and sold six to twelve months later as clonal seedling stumps at 45 cents per stump.

Seed to be sent away as ungerminated seed is kept in cold storage at Prang Besar Estate. At a temperature of 40 degrees-50 degrees F. the seed was said to keep its viability for up to six months.

* Dollars and Cents are Malayan Currency.

Another method of keeping rubber seed viable was demonstrated at the R.R.I.M. Experiment Station where seeds are packed with sawdust in polythene bags in which are a few breathing holes. Here, ten pounds of seeds were mixed with moist sawdust (ten lb. dry sawdust to three lb. of water) and then placed in polythene bags. Seed may be kept viable for up to three months by this method. Normally rubber seeds can be kept viable for only ten days.

The packing of clonal seed at Prang Besar estate is usually done in sawdust. The sawdust is boiled in water to take out the acidity which otherwise will effect the germ.

The following points on treatment of Prang Besar seed upon arrival in this Territory were stressed by Mr. J. B. McIntosh, Manager of Prang Besar Estate :—

Wash the seed free from sawdust, since ants, attracted to the sawdust, may disturb the soil around the seed;

The sooner the seed is planted the better will be germination results;

Keep seeds in a cool atmosphere during planting operations as direct sunlight will cause damage to tissues;

Use a light friable type of soil for a germination medium. At Prang Besar pure river sand is used. Aeration is more important than nutrition since seeds are mainly dependent on food reserves at this stage;

and Germination beds must be shaded and the germination medium should be kept moist but not wet.

Mr. McIntosh thought that wrong handling by planters was the main reason of the sometimes poor germination experienced in the Territory. Since there are two periods of seed fall in Malaya, namely the so-called autumn fall (August-September) and the spring fall (February-March) it will be noted from the above

that Prang Besar seed stored under refrigeration will be available at any time of the year. Purchase of seed could thus be planned to suit the planting conditions of the locality. There is no truth in the often heard opinion of Territory rubber planters that the Malayan autumn fall gives a better seed than the spring fall. There is a difference in quantity between these two falls, the autumn one being the heavier seed fall, but there is no difference in the quality of the seed.

Nurseries and Planting.

The well known practice of digging deep nursery beds, the raising of planting material on these beds, and subsequent transplanting to the field at an age of approximately one year seems on the way out in Malaya. On most of the estates the new technique is to raise planting material in polythene bags and transplant to the field at an early age (two to six months).

The advantage of polythene bag planting is that the roots of the young trees are not disturbed, there is practically no set-back after transplanting and very few losses occur. Time of planting to suit weather and other conditions can also be better controlled.

Seedlings, as well as budgrafts, are transplanted by the polythene bag method. The main aim of the new planting techniques is to reduce the period of immaturity. Several methods to shorten the time to maturity are under investigation at the Rubber Research Institute, but results will not be available for some time. An interesting article on polythene bag planting techniques by the Dunlop Research Centre was published in *Planters' Bulletin* No. 63, November, 1962.

Further details of polythene bag planting are reported under the heading *Vegetative Propagation*.

Stump Poisoning.

Poisoning of rubber stumps in replant areas is now done by 2, 4, 5-T treatment and has replaced the old method of sodium arsenite poisoning. A five per cent. solution is made by mixing one part of 2, 4, 5-T concentrate with 19 parts of Dieselene. Stumps are treated by painting this solution on the bark from ground level up to a height of 15 inches. The cut

surface of the stump is treated with Creosote to prevent fungi diseases entering the stump. Cost of poisoning is approximately 20 cents per tree.

Vegetative Propagation.

Experiments in propagation by means of cuttings are carried out by the Rubber Research Institute, but otherwise the only practical method of vegetative propagation is by budgrafting. The budgrafting technique is well known in the Territory and needs no further description.

Budgrafting on estates in Malaya is usually done by contract labour, which is paid approximately 6½ cents per successful budgraft. They bring their own tools and binding material and also do the opening-up and cutting back of the budgrafts. A skilled operator does about 40 budgrafts per hour by conventional method; in green budding they do more per hour but are at present paid at the same rate as for conventional budgrafting.

Green Budding.

The budgrafting on young seedlings of three sticks of approximately the same age (the so called green budding method) is becoming increasingly popular on estates in Malaya. The green budding technique has been fully described in the *Planters' Bulletin* of the R.R.I.M. (No. 62, September, 1962). A demonstration of green budding at the R.R.I. experiment station was witnessed by the writer and source bushes for greenwood budsticks and cuttings were inspected. It was stated that it takes about eight weeks from pruning to obtain suitable material for cuttings and green budwood sticks. A wide spacing is essential to build up a good framework in source bushes. Greenwood budsticks may be kept under refrigeration temperature in polythene bags for about two weeks. In a bucket with some water they can be successfully kept for three days.

The practical use of green budding was seen at Effingham Estate near Kuala Lumpur. On this estate large nurseries of seedling stock were established by planting seed in polythene bags during September, 1962. Green budding on these seedlings took place in December, 1962, and transplanting the buddings into the fields was done during April-May, 1963. Nurseries

and field planting looked most visited on 27th, i.e., without a fall rain had fallen s

the nursery to the pruned at all; the rain had fallen s around the roots removed. This ensures a very growth of the young buds, and withings, and withings are:

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Green budding on Effingham Estate

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The polythene month old green six month old to many planters this method are bags for raising cost 5-12 cents theme budding of 1,000 yards

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and field planting of these green buddings looked most vigorous when this estate was visited on 27th April, 1963, although very little rain had fallen since transplanting.

When transplanting green buddings from the nursery to the field the young plants are not pruned at all; they should be in a dormant stage, i.e., without a flush when a topwhirl of leaves is more or less matured. A cylinder of soil stays around the roots when the polythene bag is removed. This technique of transplanting ensures a very high survival and unchecked growth of the young trees.

Other methods of transplanting green buddings, and without the use of polythene bags, are:—

- (a) To transplant as a budded stump four weeks after the budding, i.e., one week after opening-up and cutting back; and
- (b) To transplant as a stumped budding at about nine months after budgrafting.

Green budding in the field was also observed on Effingham Estate. Germinated seeds were planted in the field, on 7th October, 1962, green budded 8th January, 1963, and cut back on 29th January, 1963. Opening-up and cutting back is done in one operation. Growth of the three month old budshoots, on the six month old stock, was excellent.

According to R.R.I.M. people, it was expected that green buddings generally would reduce the immature period of a planting by some four to six months. The writer is, however, doubtful on this particular aspect of the green budding after having observed at Prang Besar Estate no significant difference in growth between a field of PB213 green buddings at 15 months after budding (on six month old stock) and an adjoining field of nine month old PB213 buddings done by the conventional budding method (on 1½ month old stock). Seedling stock in both fields was planted at the same time.

The polythene bag planting method of three month old green buddings, budded on four to six month old stocks, will undoubtedly appeal to many planters. However, the economics of this method are not fully examined. Polythene bags for raising seedlings and green buddings cost 5-12 cents each, depending on size. Polythene budding tape is priced at \$3.30 for a roll of 1,000 yards length and $\frac{1}{8}$ inch wide.

Cuttings.

Another interesting method of vegetative propagation, cuttings, was seen at the R.R.I.M. experiment station at Sungai Buloh.

Greenwood cuttings of about one foot in length are placed in a rooting medium of rotted sawdust with river sand under a continuous overhead mist spray for six to eight weeks. Rooted cuttings are transferred to polythene bags and after hardening-off planted into the field. Most clones rooted only in very small percentages. Among the better known clones which did have good rooting success are: PB86, GT1, PB5/51, PR107, RRIM 600, 623 and 701.

The absence of a taproot system in rubber cuttings appears to be the more serious disadvantage in this method of vegetative propagation. This was quite obvious in a field of 2½ year old cuttings (clones PB86 and GT1), where a very heavy storm on 20th April, 1963, caused severe wind damage. Trees were blown over in most cases; an attempt was made to save the trees by pruning the crowns, erecting the trees, and anchoring them with ropes. Interesting to note was that 25 per cent of the trees obtained from cuttings and five per cent of the trees obtained from ordinary budgrafts had to be anchored.

PR86 trees from cuttings suffered comparatively greater wind damage than GT1 cuttings of the same age. A number of excavated root systems in four year old PR86 cuttings revealed a complete absence of any vertically growing roots, while excavated root systems of four year old RRIM 605 cuttings showed quite a number of roots growing downwards, which appeared to have taken over the function of the taproot. It was thought that this may be a clone characteristic in root development of clonal cuttings.

A point in favour of cuttings was the remarkably better girth of cuttings as compared with budgrafts of the same age in clones PB86 and GT1.

The propagation of rubber clones by cuttings is still experimental, and is more of an academic interest to our rubber planters than of practical value at the present stage. The most interesting point to watch will be the comparison in future yields between cuttings and budgrafts, the cuttings being on their own roots and the budgrafts on a seedling rootstock. The latter may adversely affect growth and yield of the scion. In this

regarded it may be mentioned that a 10 year old crown budding experiment was seen at the Sungai Buloh station, which clearly indicated that the influence of the scion on the stock is much greater than the influence of the stock on the scion.

It was stated that in post-war plantings on estates in Malaya the acreage of budgrafted trees is more than twice the acreage of clonal seedlings. Clonal seed of the more modern seed gardens is, however, gaining in popularity.

Cover Crops.

The extensive use of leguminous cover crops is one of the striking features of rubber cultivation in Malaya. There is practically no estate or smallholding which has not one or more of the well known cover crops established in their immature rubber areas. In some instances one even gains the impression that the cover crop is of more importance than the rubber trees. Cover crops in Malaya are meticulously weeded and fertilized as well. It is said that green manuring by leguminous cover crops and the suppressing of weeds increases growth of the rubber tree, thus reducing the immaturity period. This seems to be the main purpose of cover cropping in Malaya, soil protection apparently comes in second place. Weeding of cover crops is a major cost item. It is mostly done on a contract basis and works out at approximately seven dollars per acre per weeding round. If done by the regular labour force these costs could be double that amount. Total costs of legume cover crops for the first three years, including fertilizing, seed drilling and general upkeep, were quoted at 250 dollars per acre at the R.R.I.M. station but were said to be higher on some places.

Of the creeping legumes the combination of *Centrosema pubescens*, *Calopogonium mucunoides*, and *Pueraria phaseoloides*, is widely used. The most attractive among the creeping cover crops seen was *Calopogonium caeruleum* at Prang Besar estate. It forms a dense, quick growing cover, is easily established from cuttings (seed production is poor), shade tolerant, and does not die back during the dry season. *Calopogonium caeruleum* appeared to be one of the most promising new cover crops.

Of the bushy type of legumes, the most impressive was *Flemmingia congesta*. This is said to give about 10 tons of mulch per acre

per year at two years from planting. An excellent stand of *Flemmingia* was seen at Effingham Estate, where the plants were raised in small polythene bags and transplanted to the field as soon as a few leaves were formed. The dense growth of branches from ground level gives a wide coverage. *Flemmingia* is kept to a height of about three feet by regular slashing, which it stands well. It is most vigorous in the open but does not do well under shade; it has a deeper rooting habit than creepers, gathering soil nutrients from greater depths and aerating the soil more thoroughly. Spacing between lines is three feet by three feet kept about six feet from the rubber lines.

Another interesting cover crop seen at the R.R.I. experiment station was *Stylosanthes gracilis*. This is a quick and erect growing legume and is used to prevent soil erosion in rubber, oil palm, and coconut plantations. In Eastern Malaya it is also used as a cattle fodder, where it grows up to a height of seven feet. It can easily be established from seed as well as from cuttings. *Stylosanthes gracilis* appeared to be an effective cover crop in the R.R.I.M. trials; however, the R.R.I. has its reservations on Stylo. as a cover plant in rubber, because in some trials it showed a depressing effect on the growth of rubber trees.

Weed Control.

Hand weeding in immature rubber areas is the major cost factor in maintenance work and the R.R.I. has intensified its investigations into the use of weedicides. Most grasses can be controlled by spraying with a sodium arsenite solution, but the use of sodium arsenite is banned on plantations because of its toxicity. No cheap alternative to sodium arsenite has been found, but R.R.I. trials in this regard are at an advanced stage and results are likely to be published in the near future.

Among the weedkillers used are:—

Dowpon or *Dalapon*. This weedkiller is effective in the control of many grasses including *Imperata*, but is too expensive for use on a large scale.

Simazine, among the pre-emergence weed-killers, has proved effective in maintaining weed-free conditions for three to four months after initial clean weeding, but is also uneconomical in practical use.

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Pests and Diseases

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Paragnat, one of the newer contact herbicides, has shown promise and is likely to become more important in weed control if the price can be reduced. It will then be most useful in young rubber areas to keep planting lines free of weeds. *Paragnat* does not damage young rubber trees of one year and over and may be sprayed right up to the trees.

Pests and Diseases.

Insect pests in general are not a serious problem in Malaya. Insects, and their control, of interest to this Territory are:—

Goekschfers, damaging roots of young rubber trees. Control : 2E Heptachlore 20 per cent. emulsion, one part to 200 parts water. Holes are made around the base of the plant six to eight inches deep, one inch in diameter; two pints solution per point for trees up to two years of age, and for older trees four pints. One application is sufficient for approximately two years.

Termites, damaging taproots. Control : Dilute one part of Dieldrin emulsion to 600 parts of water—scrape soil around the tree to two to four inches deep and apply one to four pints of Dieldrin solution, depending on size of trees.

Caterpillars and leaf eating insects. Endrin is mostly used, sprayed with a solution of one to 300.

Of the rubber diseases in Malaya fungi are the most troublesome.

Root diseases, particularly in replantings, are a serious problem. After felling for replanting, all stumps are poisoned with 2, 4, 5-T concentrate (one part in 19 parts of Dieselene) and the cut surface of the stump is treated with Creosote. Root diseased trees are dug out and burned *in situ*. In the young replant regular collar inspection rounds are carried out, and sources of infection are removed and burned. The R.R.I. is investigating the use of chemicals as a protective dressing to the collar. The Oidium fungus disease of the leaves, which can cause serious leaf fall is not such a serious problem in Malaya as it is in Ceylon and Indonesia. Treatment consists of sulphur powder dusting by mechanical blower, but appears to be carried out in seed gardens only.

Powdery mildew caused by *Oidium niveum* was quite prominent in estates around Kuala Lumpur at the time of the visit, but little or no attention is paid to the disease and it is apparently regarded as of minor importance. *Pink disease* occurs mostly in young trees of two to seven years of age and can become a serious problem in clones susceptible to the disease, like RRIM 501. Control in immature rubber consists of spraying infected parts with Bordeaux mixture, and for trees in tapping the fungicide "Fylomac 90" is used.

Gloeosporium is widespread but causes serious damage in susceptible clones only. This was clearly demonstrated in a clonal trial visited at Harpenden estate (Selangor) where trees of clone RRIM 526 were partly or wholly defoliated and a number of these trees had died back severely while trees of other clones in the area were not affected. Incidentally, the I.R.C.I. clones 5, 6, 9 and 10 in the R.R.I. exchange clone trial prove all more or less susceptible to the disease and clone PB 86 in a clonal trial at Kuala Lumpur was also noticed to be very much affected by *Gloeosporium*. Control of the disease consists of spraying with "Trifungol" (active ingredient Ferbam), a wettable powder for high and low volume spraying. (\$33 per 10 lb.)

Brown Bast. Of the tapping panel diseases the most serious is Brown Bast. This is undoubtedly the greatest problem of rubber trees in Malaya, on estates as well as small holdings. On some estates the incidence of Brown Bast was as high as 10 per cent. of tappable trees. Investigations into the Brown Bast problem are given first priority by the R.R.I.M. The disease was hitherto thought to be a physiological response of the tree to excessive tapping, but recent investigations seem to point to a bacteriological cause, aggravated by heavy tapping. It appears also that Brown Bast is associated with soil types and minor elements in the soil. Interesting studies on the Brown Bast problem are at present going on at the Rubber Research Institute and it is expected that the nature of the disease, and prevention methods, will be known in about one to two years' time.

Wind Damage.

Serious damage by wind was evident in the Sungai Buloh and Effingham Estate areas when visited on the twenty-fifth of April, 1963. A big storm on the twentieth of May, 1963, lasting only ten minutes, caused thousands of pounds damage. At the RRI Station severe trunk snap occurred in clone AVROS 1907. Another clone which repeatedly suffered serious wind damage is RRIM 613. Practically all the young trees (2½ years) in the large scale clonal trial at Sungai Buloh suffered more or less from bending of the stem and crown, in particular clone RRIM 519. At an estate some seven miles outside Kuala Lumpur at least 40 acres of rubber were lost by wind damage in the big storm of twentieth of April—the damage claim by this estate amounted to £8,000 Stg. An insurance scheme exists against wind damage, and payment by insurance companies for totally lost trees was said to be £2 10s. Stg. for trees under seven years old and £3 16s. 2d. Stg. for trees of seven years and over.

Pollarding

Pollarding of trees is only done if the stand is in a wind-prone condition and is known to be liable to trunk snap (RRIM 501). Pollarding in the past was done at a height of 12 feet, but is no longer recommended because of:—

1. Serious loss in yield.
2. Slow renewal of branches and general recovering of the tree.
3. Big pruning wounds causing serious die-back and rotting of the pith.
4. Severe scorch by sudden exposure to the sun.

If pollarding is necessary it is done either by,

- (a) partly pollarding at 12 feet and after sufficient re-growth the other half is pollarded, or
- (b) pollarding all growth above 25 feet.

Before any pollarding is done the trees should be white-washed the day before to prevent scorch; white wash (lime) reflects the heat radiation.

Tapping.

The merits of the numerous tapping systems are a continuous source of discussion and each system has as many advocates as critics. It seems

quite impossible to recommend a uniform acceptable system of tapping. So much depends on the planting material used, its age, location, climatic conditions, and likes and dislikes of the manager, that the systems used vary almost from plantation to plantation.

Worth mentioning may be the tapping systems favoured by the manager of Prang Besar estate. Mr. McIntosh's contention is that with a 100 per cent. intensity tap the Sr/d3 system, i.e., full spiral cut reduced by six inches, third daily, is better than S2/d2 (½ spiral cut, second daily); and in a 67 per cent. intensity tap Sr/d4 is a better system than S2/d3. The methods favoured by Mr. McIntosh will, of course, give a higher production per tapper and thus be more economical in tapping costs, but will probably give less yield per acre and may have an adverse effect on girthring.

The RRI is conducting several tapping trials at present; recent observations were published in Planters' Bulletin No. 66, May, 1963. The writer was told that further results of tapping trials will be published in the July or September, 1963, issue of the Planters' Bulletin. Generally speaking, observations so far indicate that every second day tap over half the circumference (S2/d2) gives most economic results in seedling plantations. In budgraft plantations a third daily tap over a ½ spiral cut (S2/d3) with added stimulation every six months gives the highest production per tapper.

The aim of these tapping trials is to come to a more economic tapping system with higher yields per acre and per tapper and increasing the economic life of the tree.

Yield Stimulation.

In an experiment at the RRI station clone RRIM 600 has yielded 3,500 lb. per acre over a one year period by stimulation at six months interval, applying 2, 4, 5-T at 2½-3 inches below the tapping cut. Tapping system used was S2/d2 in virgin bark of the second tapping panel, sixth year of tapping in this case. Yield obtained represented an increase of some 40 per cent. over not stimulated trees of same age and same clone.

In another experiment it was shown that with half yearly stimulation in the second tapping panel on S2/d3 an increase in yield per acre was obtained of approximately 20 per cent. over S2/d2 without stimulation.

Discussions on

could be summarised as:

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Results of further

are to be published

Seed Gardens.

The clonal

Sungai Buloh sta-

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Arca : 41 acre

Budded : 1946

Spacing : 60 f

Production : /

Composition :

Percentage of

fall periods. Secon-

on five days dur-

is given in the fi-

Information	Collection date
Malayan seed	16.8.1960
3,000 seeds to 16	17.8.1960
The average for	29.8.1960
45,000 seeds per	5.9.1960
seed year, 80,000 seeds	12.9.1960
from a 12-year old	

plantation to plantation.

recommend a uniform So much depends on its age, location, and dislikes of the and vary almost from the tapping systems Prang Besar estate that with a 100 per cent system, i.e., full bushes, third daily, is better, tap Sr/d4 is a better method favoured in course, give a higher but probably give less an adverse effect

Several tapping trials as were published May, 1963. The results of tapping in July or September, Bulletin. Generally indicate that every the circumference results in seedling ratios a third daily (d3) with added gives the highest

trial is to come to system with higher and increasing the

Discussions on stimulants with the RRI staff could be summarized as follows—

- do not stimulate in virgin bark.
- 2, 4-D stimulant is safer to use than 2, 4, 5-T, as the latter is slightly stronger and will cause damage if applied too thickly. Increase in yield is about the same for both stimulants.

- six monthly application over three inches below the tapping cut gives best results.
- bark should be scraped very lightly before application, only the corky tissues are to be removed.

Results of further stimulant trials by the RRI are to be published shortly.

Seed Gardens.
The clonal seed gardens visited at the RRI Sungai Buloh station cover an area of approximately 200 acres, consisting of gardens A, B, C and D. Seed from these gardens is reserved exclusively for smallholders in Malaya.

Typical of the RRI seed gardens is garden B on which the following information was received:

Area : 41 acres.

Budded : 1949.

Spacing : 60 feet by 4 feet.

Production : Average 20,000 seeds per acre per year.

Composition : Clones AVROS 157, BR2, Tjir 1, RRIM 509 and PB 49.

Percentage of seed per clone varies during seed fall periods. Seed percentage per clone collected on five days during the main seed fall of 1960 is given in the following table :—

Collection date	Total No. of seeds collected	Percentage of seed per clone				
		Tjir 1	AV 157	BR2	RRIM 509	PB 49
16.8.1960	2233	45	4.3	49.7	0.5
17.8.1960	2077	44	8.4	41	0.4
29.8.1960	2258	29	2.3	65	6.2
5.9.1960	2004	40	0.8	52	1.3
12.9.1960	2068	33	2.2	53	5.5
						9.2

Information received on seed production of Malayan seed gardens varies from as low as 3,000 seeds to 100,000 seeds per acre per year. The average for Prang Besar Gough Garden is 45,000 seeds per acre and in 1962, being a good seed year, 80,000 seeds per acre were obtained from a 12-year old seed garden.

Climatic conditions influence seed production, for instance many overcast days during the flowering season reduces fruit setting.

Although cross pollination by insects is the rule, natural self-fertilization happens more than hitherto thought, particularly in clones Tjir 1, LCB 1320, RRIM 501 and 605.

Spacing of the trees in seed gardens is an important factor in seed production. A wide spacing to ensure good crown development and the maximum of sunlight to reach the crowns seems essential. Prang Besar Gough Gardens are spaced at 22 ft. x 22 ft., giving 90 trees per acre initially, and is later reduced to 60 trees to the acre. Even an initial spacing of 24 ft. x 24 ft. (76 trees per acre) is said to be not too extreme for seed gardens.

An interesting note on fertilization of seed gardens was received from the R.R.I.M. Experiments conducted showed that the application of a nitrogenous fertilizer increased seed production by 30 per cent, in one experiment, and by 100 per cent, in another. No effects due to phosphate or potassium fertilizers could be measured. There was also an indication that nitrogen increased the percentage of seed germinating.

At Prang Besar estate, fertilizing with sulphate of ammonia at the rate of two cwt.s. per acre annum gave approximately a 20 per cent. increase in seed production.

Sulphur dusting to control *Oidium* is essential in seed gardens in Malaya; *Oidium* fungus causes the dropping of flowers and immature fruit.

An examination into the clones in Malayan seed gardens revealed that AVROS 157, Tjir 1, RRIM 501 and PR 107 are most widely used. This is particularly interesting as our Bisianumu seed garden consists of these four clones with the addition of BR 2. In the light of present day experience and observations it was advised that

PR 107 and PB 49 should not be included in seed gardens anymore. PB 5/51 instead was strongly recommended. Other clones mentioned for possible use in seed gardens were: RRIM 600, 605, 614, LCB 1320 and PB 28/59.

Production Costs.

Production costs in Malaya vary from estate to estate. Cost price depends a great deal on the material planted and tapping system used. From the information gained the following table is an attempt to give cost factors in cents per lb. of dry rubber at various yield levels per acre.

Cost factor	Costs in Geuts at a yield per acre of—					
	400 lb.	600 lb.	800 lb.	1,000 lb.	1,200 lb.	
Planting and Maintenance	7	6	5	4	3	
Tapping	28	23½	18½	12½	7½	
Manufacturing	8½	8½	8½	8½	8½	
Packing and despatch	3½	3½	3½	3½	3½	
General costs	13	11½	9½	7½	5½	
TOTAL	60	53	45	36	28	

Note.—Planting and maintenance in this table

Tapping includes collection and transport to factory. includes clearing and fertilizing.

General costs include depreciation of plant, equipment and land, insurances, building, electricity, etc.

price for No. 1 smoked sheet rubber was 75 cents per lb. It was, however, expected that the price would go down and even a figure as low as 60 cents was mentioned as a possible future market price.

Smallholdings.

Although a study of the smallholders' set-up in Malaya was not included in the tour a few words have to be said about the excellent organization of the smallholders replanting schemes.

The Federal Government of Malaya as well as the State Governments have enterprising schemes to settle the small rubber planter. The main object of the various schemes is to assist the farmer in the planting and replanting of his

PAPUA AND NEW GUINEA AGRICULTURAL JOURNAL

land with high yielding material. It was expected that during 1963 some 125,000 acres will be replanted by smallholders, the 1962 figure was 79,665 acres replanted. The replanting grant to smallholders was increased from 600 dollars to 750 dollars per acre. This grant is paid in five instalments enabling the small producer to weather the first unproductive years. The Replanting Board requires certain standards in preparation of land, planting and maintenance to qualify for the grant. The RRI Smallholders Advisory Service and the Replanting Board Staff, advise the smallholder in his task.

One typical Government subsidised project of the State Development Scheme was seen near Ulu-Langkat village, about 12 miles south of Kuala Lumpur. In this settlement the State Government organized jungle clearing and rubber planting by contract labour, houses were built, and the settler only moved in when housing and planting were completed. Work on this particular settlement commenced early in 1961, and 42 families (28 Malay and 14 Chinese) were settled on their holdings at the time of the visit. Contouring, lining, planting, fertilizing, cover cropping, fencing, and maintenance for six months after planting was all done by contract labour at Government expense. Family settlers moved in and are expected to work the holding under the supervision and guidance of a manager appointed by the Land Development Authority. The new settler received a subsistence allowance to the amount of 400 dollars per acre spread over a number of years and has to pay back the interest free loans when his rubber comes into production. Budwood was supplied at one year after planting, the smallholder doing the actual budgrafting. Clones supplied were RRM 513, 605 and PR 107. Each family holding here consisted of six acres of rubber and two acres for house and gardens (fruit and vegetables). This is one example of the various schemes in existence to help the Malaian smallholders, who number 250,000. With such generous assistance it is not surprising that the smallholder is able to play such an important part in rubber production in Malaya.

Finance for the various schemes appears to come mainly from a cess of 4½ cents per lb. of rubber exported, while rubber research work is financed by another cess of ¾ cent on every pound of rubber exported.

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Notes on Clones.
A description use can be found in the recommendations published by the Institute of Malayan Research, PB 86. This describes the 1963-64 plantings in Malaya. The main growth of this example of extreme budgrafting on this plant can be taken into account when known clone extensiveness was—
PR 107, taken in 1961 at the age of 5½ years after 1,100 lb. per acre had been harvested. This old and proven plant is the best for extensive guinea. Of particular note is its thick bark and the high yield. The trees have a fairly wind-resistant exchange clone trial, considerable promise being shown by the vigorous growth of the two

ial. It was expected 1,000 acres will be replanted. The 1962 figure was grant from 600 dollars is grant is paid in three years. The Re-

turn standards in budgrafting and maintenance RRI Smallholders Planting Board Staff, task.

Subsidised project of one was seen near 2 miles south of Kepong. In the State clearing and neighbour, houses were done in when housing started early in 1961, (14 Chinese) were at time of the visit.

fertilizing, cover maintenance for six done by contract 2. Family settlers work the holding of a manager Pnment Authority. assistance allowance per acre spread to pay back the rubber comes into Pplied at one year doing the actual were RRM 513, holding here et and two acres and vegetables).

ememes appears to cents per lb. of research work is cent on every

Notes on Clones.

A description of the clones in commercial use can be found in the yearly Planting Recommendations published by the Rubber Research Institute of Malaya.

PB 86. This clone has been withdrawn from the 1963-64 Planting recommendations in Malaya. The main reason seems to be the slow growth of this clone on many estates. An example of extremely slow growth was heard of when Kepong estate was visited. PB 86 was budgrafted on this estate in 1951 and could not be taken into tap before 1961. Another well known clone extensively planted on this estate was—

PR 107, taken into tap at Kepong estate at an age of $5\frac{1}{2}$ years after budgrafting, and produced 1,100 lb. per acre in its third year of tapping. This old and proven clone may well be one of the best for extension work in Papua and New Guinea. Of particular importance in this regard is its thick bark in virgin as well as renewed bark and the high girth increment after tapping. The trees have a well balanced crown and are fairly wind-resistant.

PR 252 and 255. These two clones in the exchange clone trial at Harpenden Estate showed considerable promise. PR 252 was the more vigorous of the two.

PB 5/51. This clone is becoming increasingly popular in Malaya. Prang Besar recommends an initial stand of about 150 trees per acre with at least ten feet between trees in the planting line. This clone has a very nice horizontal branching habit. No wind damage has been reported so far. Yields at Prang Besar are around 1,600 lb. for the fifth year of tapping.

PB 217. According to the Manager of Prang Besar, this is one of the best of the newer P.B. clones. A robust tree with a fairly well balanced crown and seems resistant to wind damage. There is some evidence of above average susceptibility to *Gloeosporium*.

Conclusion.

Considerable knowledge was gained and important information received which will be of benefit to the rubber industry in this Territory. The work done by the Rubber Research Institute of Malaya is undoubtedly of great importance to our rubber producers.

As to the future of natural rubber in our Territory, I wish to state that it is of vital importance that we reduce cost of production by higher yields per acre and more efficient management. It was thought in Malaya that natural rubber will remain competitive for a long time, but further research is of the utmost importance. Production costs have to be reduced and technical qualities of rubber have to be increased.

To conclude I would like to quote the words of Dr. L. C. Bateman, Controller of Rubber Research in Malaya: "Competition in the future would not be between natural and synthetic rubber, but between efficient and inefficient producers of whatever kind of rubber."

ACKNOWLEDGEMENTS.

Thanks are due to the Administration of the Territory of Papua and New Guinea for the assistance given in making possible the tour of Malaya, and to the Director and staff of the Rubber Research Institute of Malaya, and to the estate managers for their co-operation in making the visit so successful.

(Received November, 1963.)

THE most common group association are *Salmonella enteriditis*. Word names those two in rodents and 1 have been recorded, *S. cholerae* port, *S. oxford*, *S. pauli* and *S. wortii*. paper is to describably due to the serotype colony of guinea-pig Central Veterinary Moresby.

The guinea-pig 1954 with stock. Sporadic losses, particularly, have been. The diet has been supplemented by *maximum*) and water. A high F from the colony has been checked for the. In July, 1962, a rate occurred and these animals yielded belonging to Grob scheme.

Over a period rate from Salmonella (17 bacteriologically population of 20

Salmonellosis in Guinea-Pigs due to the Serotype Weltevreden.

J. R. EGERTON.

Principal Veterinary Officer, D.A.S.F., Port Moresby.

ANITA M. RAMPLING.

Pathologist/Bacteriologist, D.A.S.F., Port Moresby.

THE most common species of the *Salmonella* group associated with disease in guinea-pigs are *Salmonella typhimurium* and *Salmonella enteritidis*, Worden (1947). Buxton (1957) names those two serotypes as the most common in rodents and lists nine other species which have been recovered from guinea-pigs.—*S. cholerae suis*, *S. muenchen*, *S. newport*, *S. oxford*, *S. poona*, *S. reading*, *S. saintpaul* and *S. washington*. The purpose of this paper is to describe an outbreak of Salmonellosis due to the serotype *weltevreden* in a laboratory colony of guinea-pigs (*Cavia aperea*) at the Central Veterinary Laboratory, Kila Kila, Port Moresby.

HISTORY.

The guinea-pig colony was established in 1954 with stock imported from Australia. Sporadic losses, probably due to dietary deficiencies, have been experienced since that time. The diet has been a proprietary guinea-pig pellet supplemented by green guinea grass (*Panicum maximum*) and ascorbic acid in the drinking water. A high proportion of dead guinea-pigs from the colony have always been autopsied and checked for the presence of infectious agents. In July, 1962, a marked increase in the death rate occurred and culture from the majority of these animals yielded a *Salmonella* serotype belonging to Group F of the Kauffman-White scheme.

Over a period of five months the mortality rate from Salmonellosis approached 10 per cent. (17 bacteriologically confirmed deaths from a population of 200 guinea-pigs).

An attempt was made to treat the outbreak by adding antibiotics at a therapeutic level to the drinking water. In vitro sensitivity tests had shown that the organism was sensitive to streptomycin and slightly sensitive to chloramycetin. Both these drugs were used with little apparent effect on the continuation of the disease.

CLINICAL SIGNS AND POST-MORTEM LESIONS.

Affected guinea-pigs were almost invariably found dead or moribund. There was never any evidence of diarrhoea. The most frequent lesion at necropsy was a greyish purulent peritonitis involving both the visceral and parietal layers of the peritoneum. Abscess formation occurred in the spleen, liver, lungs and mesenteric lymph nodes. Abscesses varied in size from $\frac{1}{4}$ inch to $1\frac{1}{2}$ inches in diameter, and were filled with a granular, rather inspissated and yellowish-brown pus. In one case a splenic abscess had ruptured into the peritoneal cavity. There was rarely any evidence of inflammation of the gastro-intestinal tract.

BACTERIOLOGY.

A *Salmonella* serotype later identified as *S. weltevreden* was isolated from all animals showing any of the lesions described above. *S. weltevreden* has the following characteristics:—

Cultural characteristics.

Growth occurs readily on nutrient agar. Colonies at 24 hours are 2-3 mm. in diameter, circular with a regular outline, slightly convex and translucent. The organism is motile.

Biochemical Properties.

The biochemical characteristics are typical of the *Salmonella* genus.

Indole—not produced.

Methyl red reaction—positive.

Voges Proskauer—negative.

Citrate utilization—positive.

Hydrogen sulphide production—positive.

Urea hydrolysis—negative.

The following "sugars" are fermented within 24 hours with the production of acid and gas:—glucose, maltose, dulcitol, mannitol, arabinose, xylose, rhamnose and mannose. Inositol is fermented at 14 days incubation. Neither acid nor gas are produced from the following reagents:—sucrose, lactose, sucrose and adenitol.

Serology.

S. weltevreden belongs to Group E of the Kauffman-White classification and has the serological formula O,3:10:H₂T₂6. Serological typing was carried out at the Bacteriological Research Department of the Commonwealth Serum Laboratories, Melbourne.

DISCUSSION.

The recovery of *S. weltevreden* from the guinea-pig colony at Kila Kila is the only record of the isolation of this serotype since its identification by Erber (1941). In that instance *S. weltevreden* was isolated from the faeces of four cases of gastro-enteritis in man in which the author considered the organism to have etiological significance. The cases occurred in Batavia in the then Dutch East Indies. A further strain of *S. weltevreden* was isolated by Erber from a guinea-pig following inoculation of material from a dead house rat.

Salmonellosis is a relatively common disease in guinea-pigs but had not occurred in this colony previously. The signs most commonly reported in affected animals are diarrhoea and wasting. At necropsy the predominant sign is gastro-enteritis. The type of disease caused by

S. weltevreden is quite different in that it is characterized by abscess formation in the viscera. It is probable that, following ingestion, the organism causes an asymptomatic gastro-enteritis then a bacteraemia occurs which results in localization of bacteria in organs such as spleen, liver and lungs.

The source of infection at Kila Kila was not established. Possible carriers included rats and lizards. Twenty each of rats and lizards about the station were caught and examined for *S. weltevreden* with negative results.

Treatment of the outbreak with antibiotics having failed, it was decided to depopulate the colony as extensively as possible. It had been noted that sera of animals dying with Salmonellosis agglutinated the causative organism using a slide test. Six females and two males selected at random from the colony and which gave negative slide tests were retained and the rest of the colony destroyed. The retained animals were placed in rodent proof enclosures and breeding commenced. No further cases of Salmonellosis have occurred in the three months since that time.

SUMMARY.

The isolation of *Salmonella weltevreden* from a new host, the guinea-pig, is reported. The unusual disease resulting from the infection in guinea-pigs is discussed.

ACKNOWLEDGEMENT.

The authors are grateful for the assistance of Dr. J. Gulasekharan, Commonwealth Serum Laboratories, Melbourne, in the serological typing of *S. weltevreden*.

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Introduction.

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FACTORS AFFECTING MISTING

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The Use of Mists in the Application of Insecticides to Cacao.

LANCE SMEE.

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

SUMMARY.

Kila Kila was not present in that it is included rats and and lizards about in the viscera. ingestion, the ingesting, the gastro-enteritis examined for results.

with antibiotics to depopulate the *Salmonella*. It had been reported. Two males selected and which gave

retained animals enclosures and further cases of in the three months reported. From the infec-

ment. In the assistance of Dr. Serum Laboratories, of *S. weltevreden*. (19563.)

Salmonella in Animals. Commonwealth Bureau of Health Ag. Bureaux, Tijdschr. Ned.-Ind. and Management of Handbook. Edited Tindall and Cox,

MIST spraying is the most economic method of applying insecticides to cacao. The optimum size of the droplets is within the range of 50-100 microns, with the mean 50 microns, and must be combined with a high velocity to give good impact percentages on the target. Spraying machinery should be selected on the basis of correct droplet size and high airstream velocity. Volumes per acre in the order of four to eight gallons of spray material give adequate coverage of mature cacao.

Introduction. The basis of successful pest control is the correct use of machinery, together with the choice of the right chemical for the particular application. With few exceptions, low volume techniques in the application of chemicals are generally followed throughout the cacao growing areas in the world. One of the main reasons for the emphasis on this type of spraying is the small amount of water required per acre, as most of these areas are lacking in storage and transport facilities for the quantities of water required for high volume spraying. In the African cacao growing areas low volume (Mist) spraying is used for the control of capsids. In this case five to ten gallons per acre are applied, the actual amount used depending on the number and size of the trees being treated.

Cacao growing areas are generally unsuitable for the use of large spraying machines, so that the types commonly found are the small shoulder mounted engine driven mist sprayers such as the "Motoblo Mistsprayer" or the "Limbo". Misting has other advantages in addition to the low water requirements. The deposits produced by misting are more resistant to washing by the rain than those produced by high volume spraying (Goossen, 1958) and there is less tendency for chemical damage to the trees (Whittaker & Henry, 1959). Work done in Malaya indicates that misting is more efficient than fogging (Henderson, 1957) as a better distribution of material is obtained together with an improvement in the residual deposit.

FACTORS AFFECTING DEPOSITION FROM A MIST.

There are a number of factors which must be taken into consideration when applying a mist, if efficient deposition of the material is to be obtained. These factors are related, and upsetting one factor can affect the whole spraying procedure.

1. *Droplet size and Velocity of the Airstream.*

The droplet size, together with the speed of movement of the droplet through the air, are factors affecting actual impingement of the droplet on the target. A droplet with a diameter of approximately 50 microns (one 500th of an inch) is generally accepted as being ideal (Whittaker & Henry 1959). As no machine has yet been made which can produce and apply droplets of an even and ideal size, for practical purposes, the accepted range is between 30 and 100 microns. If the droplet size is below this range it must be moving with a high velocity to penetrate the air layer around the leaves and branches; very fine droplets fail to impinge on surfaces and remain suspended in the air. This is the case with fogs where the droplet size is very small and their velocity very low, so that fogs are generally used only for flying insects (e.g., mosquito control) or inside enclosed spaces.

Generally it may be accepted that the smaller the droplet, the higher its velocity must be to ensure satisfactory impingement on the target. With large droplets such as those obtained in high volume spraying low velocities give satisfactory impact percentages.

If the droplets are too coarse, however, surfaces will be over wet and chemical burning could occur; also distribution of the material is affected unless substantially higher volumes per acre are used. Goossen (1958) shows that a droplet size of 150 microns is ideal when volumes in

1 amount to each tree. Table I shows to apply the rates of application/dilution constant at one.

trees	Time/trees
1	10 seconds
	20 seconds
1	40 seconds
	80 seconds

and allowing to dry thoroughly, from each of three (set) in each block under a dark room under 1 in one of three number and distribution on either surface.

Table II.

droplets on either

of the leaves.

east one surface of

droplets/square inch

less than ten

16 gals.

min/it

1 2 3

4 2 9 9

7† 0 0 20

0 0 20

1 2 9 49

ders.

Discussion of Results.

Overall, only a very low percentage of leaves showed no evidence of spray deposits, and it is thought that those from the five feet level were below the nozzle on the windward side of the tree, so that no drift landed on them. Normally they would receive spray from the drift when the next row was treated. Apart from this, distribution at all levels was quite even.

The table of results shows that four gallons per acre of the Sevin/water/Fluxit mixture gave adequate results, only one leaf having no visible deposit. The result for the three highest rates, four, eight and 16 gallons per 200 trees were very much the same, so that there would seem to be no advantage in using the higher rates. In actual practice however, while distribution is much the same, the deposits produced by the higher rates would be heavier, mainly due to the larger droplets produced at these rates.

ACKNOWLEDGEMENTS.

The material used in Appendix II was taken from an article published Gibson (1962) in the *Agricultural Gazette* of New South Wales.

(Received September, 1963.)

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APPENDIX I.

SUMMARY OF THE REQUIREMENTS FOR THE MISTING OF CACAO.

1. Control of Droplet Size.

Droplet size is controlled by the design of the spraying machine itself, so that all the user can do is to ensure the machine will produce droplets of the size required (i.e., 30 to 100 microns) and is suitable in other respects, such as horsepower and weight.

2. Control of Volume of Spray Material per Acre.

Under the conditions of the experiment described above, four gallons of spray material per 200 trees gave adequate distribution. However, allowing for varying conditions in the plantation, the range four to eight gallons per 200 trees is recommended.

3. Control of the Amounts of Active Ingredient per Acre.

It is generally accepted practice that the amount of insecticide (the actual active ingredient) used per acre remains constant, independent of the volume of spray applied. Thus, it is important to remember that when using low

volume techniques, substantially higher concentrations of insecticide or fungicide are required. For example, the recommendation for leaf eating caterpillars such as *Tritacra plagiata* and *Achaea janata* is 0.25 per cent. DDT as a high volume spray or 2.5 per cent. DDT as a low volume spray or mist. In this case six gallons of a 2.5 per cent. DDT mixture for misting would contain 4.8 pints of DDT concentrate (or approximately one and a half pounds of pure DDT) and would be equal to 60 gallons of an 0.25 per cent. DDT mixture.

Spray recommendations are often quoted in amounts of "active ingredient" or actual insecticide per acre, and in the above example would be quoted as one and a half pounds DDT per 200 trees. However, it must be remembered that the volume of spray required to give a good cover of insecticide will vary with the size of the trees, and that mature trees, closely planted, will require more spray and thus more insecticide than either small immature trees or those planted further apart.

4. Control of Distribution over the Tree.

The deposition of the small droplets used in misting depend to a large extent on their velocity; the higher this is the greater is the chance of the droplet impinging on a branch or leaf. The machines generally used for misting in the Territory of Papua and New Guinea have the high airstream velocities at the nozzle (in the vicinity of 200 miles per hour) but this falls off sharply with distance. The more powerful the machine, the higher the velocity at any distance from the nozzle. For this reason the higher powered machines give better impact percentages than those with less power, so that power should not be sacrificed for lightness when purchasing a machine for use in cacao. Thus adequate power is the first requirement in control of distribution over the tree.

When spraying the tree, it is better to hold the nozzle steadily in one direction for a definite period, to allow the airstream to build up velocity near its extremity at the tops of the cacao 20 to 30 feet away. This effect can be readily seen if the machine is operated in the open.

The correct sequence of spraying is to treat the lower branches of the tree first, then the upper branches. When spraying the lower, nearer part of the tree, the nozzle should be moving to prevent overspraying of the branches close at hand. However, when treating the top part of the tree, the nozzle should be held steadily for five to ten seconds to give maximum velocity to the airstream.

5. Control of Distribution per Acre.

The method of calculating the time required to apply a given volume of spray material per acre is as follows:—

1. The rate of application by the machine must first be found, by measuring the time taken for the machine to spray a

measured amount of material, for example one gallon. It has been found in practice that a figure close to 12 minutes for one gallon gives best results, though this would vary slightly with the different rates of application per acre (faster for the higher rates and slower for the lower rates).

2. The amount required for each tree should then be calculated, and also the time required to apply that amount to the tree.

3. From this figure, knowing the number of trees per acre, the time required to treat one acre can easily be calculated.

Example— 1. The machine has been found to take 12 minutes to apply one gallon.

2. If applying six gallons to 200 trees, then each tree would receive :

$$\frac{6}{200} \times 8 = \frac{1}{40} \text{ pint approximately.}$$

This would take $\frac{12 \times 60}{8 \times 4} = 20$ seconds approximately. Allowance must be made for the time taken to move from one tree to the next, and this has been found in practice to average out at about ten seconds. Thus, we would allow a total of 30 seconds for each tree.

3. From the above, we can calculate that the time taken to treat 200 trees is $200 \times 30 = 6,000$ seconds = 100 minutes.

This is, of course, a theoretical figure only and could vary under plantation conditions, with different planting distances, topography, etc.

APPENDIX II.

TWO NOMOGRAPHS TO ASSIST IN SOLVING PROBLEMS IN PESTICIDE CALCULATIONS.

The primary producer of today has at his disposal a large and increasing number of chemicals available as pesticides. These chemicals are often marketed at high or unusual percentages, for application at very low concentrations, confronting the user with time-consuming arithmetical problems in mixing.

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Introduction of concentrate and semi-concentrate applicators has added to these difficulties.

Many of the problems may be solved by the use of "nomographs" and the following series has been prepared for this purpose.

These nomographs consist of three parallel

Procedure.
It is first necessary to draw a straight edge such as a ruler across the three scales so that points on two of the third scale, at the 1 and 3 crosses it, is the answer.

Typical examples of nomographs presented.

Nomograph 1.

This chart is used for the preparation of wettable powder required to prepare diluted spray.

Example— A (illustrating nomograph)—

Assume that it is

per cent. spray

per cent. powder concentrate

per cent. and

Place the straight

it is on the P scale

scale and 50 P scale.

The straight edge

the point two P

Therefore two P

wettable powder

gallons of spray.

Example B—

To prepare 50 ga Spray from a 20

rate—

Procedure.

of material, for It has been found that a figure close to 12 gives best results, vary slightly with the application per acre rates and slower rates for each tree calculated, and also the amount to the

allowing the number

time required to

be calculated.

found to take 12

seconds.

to 200 trees, then

point approximately.

$$\frac{60}{12} = 50 \text{ seconds}$$

ence must be made

from one tree has been found in about ten seconds, total of 30 seconds

can calculate that the 200 trees is 100 seconds = 100

practical figure only on conditions, with topography, etc.

It is first necessary to select the correct nomograph for the particular problem. A straight edge such as a ruler is then placed across the three scales so that it passes through known points on two of the scales. The reading on the third scale, at the point where the straight edge crosses it, is the answer to the problem.

Typical examples are given for each of the nomographs presented here.

Nomograph 1.

This chart is used for finding the quantity of a wettable powder or emulsion concentrate required to prepare for use 100 gallons of a diluted spray.

Example A (illustrated by broken line on nomograph) —

Assume that it is required to prepare a 0.1 per cent. spray from a 50 per cent. wettable powder concentrate —

The two known points for the scales are 0.1 per cent. and 50 per cent. respectively.

Place the straight edge on the chart so that it is on the point 0.1 on the left-hand scale and 50 per cent. on the right-hand scale.

The straight edge crosses the centre scale at the point two pound. Therefore two pound of a 50 per cent. wettable powder is required for each 100 gallons of spray.

Example B —

To prepare 50 gallons of a 0.04 per cent. spray from a 20 per cent. emulsion concentrate —

The two known points for the scales are 0.04 per cent. and 20 per cent.

Place the straight edge on the chart so that it passes through the point 0.04 on the left-hand scale and 20 per cent. on the right-hand scale.

The straight edge crosses the centre scale at the point 32 fluid ounces, indicating that 32 fluid ounces are required to make 100 gallons of spray; but only 50 gallons are required, therefore half this amount (16 fluid ounces) is the quantity of concentrate to be used.

Nomograph 2.

Frequently the recommendation for application of a pesticide is given as a quantity of the active ingredient per acre and the material to be used may be available only as a water miscible solution.

Nomograph 2 is used to convert the weight of active ingredient recommended, to the equivalent volume of a solution of the pesticide.

Example —

The weight of active ingredient of an 80 per cent. weight/volume concentrate to be applied per acre is 8 oz. How much of the concentrate is required per acre?

The straight edge is placed across the chart so that it passes through the 80 per cent. on the left-hand column and 8 oz. on the centre column.

It will pass through the point $\frac{1}{2}$ pint (10 fluid ounce) on the right-hand column; this is the volume of concentrate to be applied per acre.

and semi-concentrates. These difficulties can be solved by the following series of three parallel type of problem.

PESTICIDE

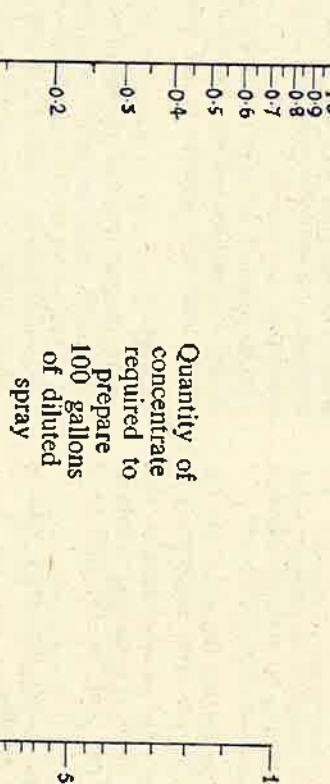
NOMOGRAPH 1

Active ingredient
required in
diluted spray

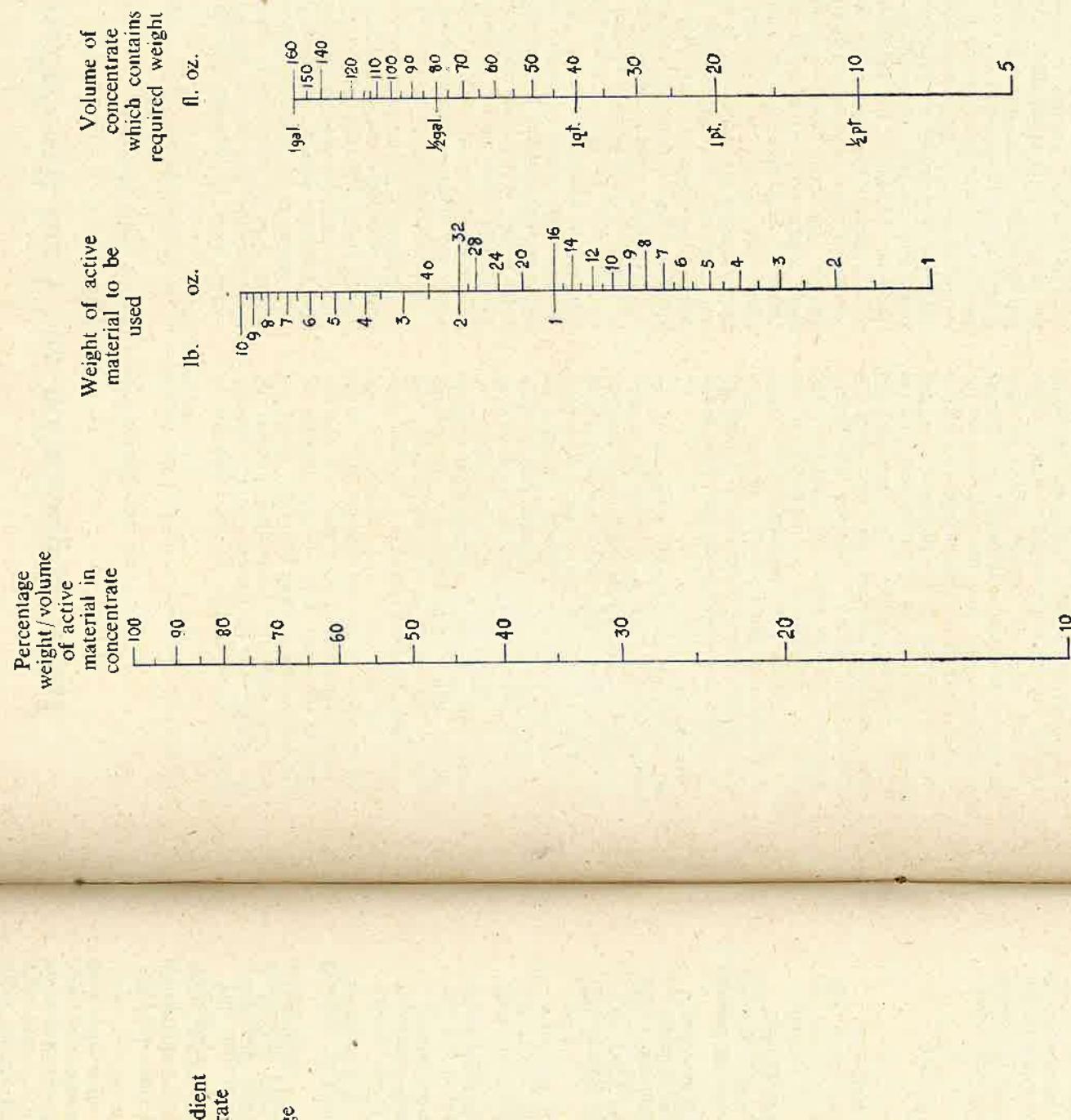
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Active ingredient
in concentrate

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NOMOGRAPH 2



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Social Organization and Land Use Pattern.

G. P. KELNY.

Plant Introduction Officer, D.A.S.F., Port Moresby.

This paper was presented at the UNESCO Symposium on the Humid Vegetation of the Tropics, Goroka, September, 1960.

THE various theories on the interaction of heredity and environment in the development of the individual are fairly well known and have received considerable publicity. Much less attention has been paid to the question of possible influences of hereditary and environmental factors in the development of a society as an organic unit, and further, on the action and reaction of society in a given environment in developing or evolving a social and land-use pattern appropriate for the circumstances. Another way of describing this situation would be in terms of social challenge. A society is faced with a challenge in the form of a certain physical environmental pattern—how does it respond to this challenge? Does it try to adjust its way of life to the environment or is it trying to adhere to its customary way of life within the possibilities presented by environmental factors? Or is it trying to develop and utilize its environment according to its social pattern?

Botanists and ecologists see the development of the flora as a result of geological, pedological, topographical, climatic and other factors. That is: the type of flora developing in a certain region is considered to be influenced, if not determined, by the interaction of physical and environmental factors. Similarly the agriculturist generally considers that man with his genius for adaptability and invention has developed a system of agriculture and land use within the context of his environment. That, generally speaking, the development of a pattern of agriculture and land use depended on the physical environment, topography, soil fertility interacting with the climatic factors of temperature, rainfall and humidity. Given certain environment and climatic conditions, the ecologist and agriculturist will expect to find certain agricultural patterns. The human factor in the development or utilization of land resources is

usually taken for granted, although naturally, allowance must be made of the fact that what appears to be the logical use of natural resources is delimited by the norms of human society in that particular region. In other words, little attention has been paid to the social organization of man, his food habits, his traditional form of agriculture, and consequently his pattern of settlement and land utilization.

The existence of large areas of grasslands within the humid tropics is usually considered to be the result of fire, i.e., the activity of man. The original vegetation was probably rain forest in the higher rainfall areas tapering to savannah with decreasing precipitation. This original forest vegetation was destroyed by man and regeneration of trees prevented by fires. In most parts of the tropics the large areas of grasslands are the result of the association of man, use of fire and livestock. Under tropical conditions the growth of grass is rapid and coarse and quickly becomes unsuitable for stock food. Therefore, it is customary, and probably has been so for many centuries, for the owners of stock, people whose way of life is associated with cattle raising, to burn the tall grass during the dry spells which occur even under tropical conditions. The fresh growth of grass following the fires is more suitable for feeding stock, but in this process the young tree seedlings are destroyed, preventing the regeneration of the forest and the trees bordering the grasslands are killed, thus further extending the grass areas and encroaching on the forest vegetation. These theories and procedures do not apply to New Guinea where cattle do not form part of the agricultural system, in fact were not introduced until the commencement of European settlement, less than 70 years ago. Yet there are extensive grasslands at all altitudes and under varying rainfall conditions (i.e., with or without a pronounced dry season). They too are man-made grasslands

and are the result of the extensive use of fire in clearing land for the shifting agriculture practised by the people or for facilitating hunting expeditions for killing small marsupials, rodents, etc. Whatever the purpose of the fires, the result is the same, the pushing back of the timber line, preventing the regeneration of the forest and the extension of permanent grassland areas.

The activity of man in using fire may be taken as his natural function in trying to exert his influence over his environment in creating an ecological pattern more suited to his purposes whether it be to provide fresh feed for his cattle or to facilitate hunting. The latter, as occurring in New Guinea, is exceptional, fire and grasslands being usually associated with stock (principally cattle) raising in most parts of the world. On seeing the extensive grasslands to-day, one may be inclined to think that stock raising developed in areas where grasslands occurred. That the presence of grazing lands, particularly in areas with a pronounced dry season where permanent agriculture would be difficult, have provided the natural "medium" for the multiplication of cattle and therefore a society evolved based on pastoral pursuits. However, it would be difficult to apply this theory to grasslands occurring in high rainfall areas where grass is not the natural vegetative cover, and, as we have seen before, in the tropics, grasslands follow the activities of man; he is responsible for creating the new environment through the introduction of stock. In other words, man in the course of his migration has brought with him his traditional agricultural techniques, whether stock raising, shifting agriculture, or intensive culture of the soil, which in turn established the pattern of agriculture and created a secondary ecological association (grass-lands).

Many examples of this could be found in Indonesia with its multiplicity of peoples each with its own social organization and method of land use. An outstanding example can be noted on travelling from Central Sumatra, the Minangkabau area, to North Sumatra the home of the Bataks. The Minangkabau are agricultural people, they have their intensively cultivated irrigated rice fields reputedly returning the highest yield of rice in Indonesia. This is probably due to their technique of applying

compost from the forest to the roots of rice seedlings as they are being transplanted to the field. But the whole Minangkabau area represents a forested appearance—much of it is under rain forest and there are also extensive groves of economic crops, rubber, cloves, cinnamon, nutmeg, etc., which are the source of considerable wealth to the people. But as soon as one approaches the Batak areas, the appearance of the whole landscape changes drastically and dramatically. The tree cover disappears, except in some steep gullies, and is replaced by open grassland, both on the mountain sides and on the upland plateaux. This is an area with high evenly distributed rainfall which one would expect to support a dense rainforest and intensive rice culture, as Central Sumatra does. But the difference in land use and the whole consequent appearance of the landscape is due to the influence of the inhabitants; the Bataks are pastoral people who own large numbers of cattle and water buffaloes and are responsible for the extension of grasslands at the expense of forests. The fires are obviously a permanent feature of husbandry—one can even see large areas of steep mountain sides planted with *Pinus Merkusii* by the Forest Service in an attempt at reforestation, but most of the seedlings having been destroyed before reaching an age at which the species becomes tolerant of fire. In certain parts of the Batak region, particularly overlooking Lake Toba, there are now irrigated rice fields worked intensively with hoe or plough, but they are a comparatively recent development. Elsewhere in the region one can still see the ancient techniques of turning the grass sod with digging sticks and the puddling of the flooded land by driving round and round a team of water buffaloes until sufficient mud has been stirred up to form a seed bed.

The extensive grasslands of many islands in the Lesser Sunda group are also associated with stock raising, e.g., on Sumba and Flores and the savannah vegetation of Timor. This part of Eastern Indonesia has generally a fairly pronounced dry season which favours and assists the annual fires which have largely exterminated the original forest cover (still seen on Flores capping some mountains). So in this area, too, and many other examples could be cited, the evidence is clear of the effect on the land of man and his choice of land use following his traditional pursuits of agriculture. In other

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On the other hand, maternal, matrilineal, associated with a massive form of agriculture basic tool. These are possible for the introduction of irrigated rice fields and gardens. The typical is the Javanese, being found in various parts of Minangkabau of which there are exceptions.

to the roots of rice being transplanted to the Langkabau area —much of it is under also extensive groves of pepper, cloves, cinnamon, source of considerable But as soon as one is, the appearance of changes drastically and disappears, except is replaced by open mountain sides and on is an area with high which one would in a rainforest and intensive which he whole consequent to the he aape is due to the Bataks; the Bataks are large numbers of and are responsible for at the expense of aperiously a permanent can even see large sides planted with Service in an most of the seedlings before reaching an comes tolerant of fire. region, particularly are now irrigated with hoe or plough, recent development. one can still see the the grass sod with digging of the flooded round a team of patient mud has been speed.

of many islands in also associated with and Flores and the Amor. This part of generally a fairly propitious favours and assists largely exterminated still seen on Flores So in this area, too, could be cited, the effect on the land of use following his agriculture. In other

words there is a correlation between the type of people on the one hand and the induced ecology of the land they inhabit. In considering these problems, attention should be drawn to the work of Terra (1952-1953) who has studied in detail the agricultural pattern and social organization of the many peoples and societies throughout Indonesia. These studies were extended to include the sociological aspects of agriculture in South-East Asia and he reached conclusions of extreme interest and of far reaching implications in elucidating the interaction between man and his environment. His studies confirm the thesis stated above that man is responsible for the creation of grasslands in the tropics, moreover that these grasslands are associated with people who keep stock as their primary occupation. However, Terra was able to pursue his enquiries one step further and establish a link between the social organization of the people and their method of agriculture. He claims that throughout Indonesia and even in other parts of South-East Asia having related people, evidence can be found that the keeping of stock, cattle and buffaloes, as a predominant form of agriculture is associated with a patriarchal (perhaps he means patrilineal) society. Following this line of thought, he traces the development of these forms of society in various parts of Indonesia and shows that the social organization of the people seems to be the determining factor in their way of life, including their agricultural practices. A patriarchal (or patrilineal) society can be expected to be based on stock keeping and as a result, the land it occupies is characterized by grasslands. This occurs irrespective of whether the land is in a high rainfall area, suited to other forms of agriculture, or in a dry region where the establishment of a permanent system of agriculture may be difficult.

On the other hand Terra shows that a maternal, matriarchal or matrilineal society is associated with or perhaps results in an intensive form of agriculture with the hoe as the basic tool. These forms of society were responsible for the introduction and extension of irrigated rice fields and the culture of mixed gardens. The typical example of such a society is the Javanese, but other representatives can be found in various parts of Indonesia, e.g., the Minangkabau of Central Sumatra. Naturally there are exceptions, due to acculturation and

the influence of neighbours or social pressures and population growth. The outstanding example of acculturation are the Sundanese in West Java, originally a patrilineal society, which has adopted the sawah rice culture of the Javanese, although many examples of their former system of agriculture can be seen, especially in Bantam, in West Java, i.e., furthest away from the Javanese influence, but is even noticeable close to Bogor where, despite the heavy evenly distributed rainfall, rice culture is not as extensive as one may expect. Terra considers that the Javanese "Malaisiens" must have reached Central Java at about the time of Christ, some three hundred years after the Sundanese ("Indonesiens"). They were cultivators of irrigated rice fields and gradually extended their influence east and west. The pattern of the extension of rice culture can be clearly seen on flying over Central Java. It is clear that what might have once been small valleys or watercourses were first dammed and check banks erected in terracing the land. As land use extended, further areas on either side of the central band of rice field were brought into cultivation, eventually leaving the village sites with their characteristic gardens of fruit trees as islands in the surrounding rice fields. Until one sees the pattern from the air, one does not realize that the villages are virtual islands, occupying the higher sites in the landscape. But curiously enough this is a relatively recent development. In about 1800 Java still had a population of about five million people (against 52 million in 1959) and the intensification of irrigation farming including the Javanisation of Sundanese areas occurred only in the past 150-200 years. South-west of Jogjakarta in Central Java one can still see the progress of this process where rough log barriers are erected across small rivers to divert water for new irrigation blocks. A further step, following population pressure in Java, has been the cultivation of dry, unirrigable hillsides, with dry rice and a very recent introduction, tapioca *Manihot utilissima* as the principal crops. The contention of Poggendorff (1953) that irrigation followed and displaced the culture of dry rice cannot be substantiated by examples from Indonesia.

Perhaps the conclusion of Terra (1953) could be best illustrated by quoting him.

"It appeared that all regions with a sedentary population and ecologically suited for mixed gardening, where mixed gardening was never-

Book Reviews.

From Stone to Steel.

R. E. SALISBURY.

Melbourne University Press, for Australian National University, Melbourne, 1962. 237 pp. 63s.

man those found at cultures in which, of stock raising, the has not developed. based on grainless however, be found in e.g., Nias and *Macaricia* sp. staple, *Halimaheras* with a *Ceram* where a *casta* sp. and Sago Rice is not usually it is, it is only a some of the new *lays*, sweet potato *Manihot utilissima*. *terra* in tracing a organization and land clearing, but are also of the "inevitable" and ecological of agriculture and cover of inhabited by man and is dent of a form of must be hope for effecting improvement man to adopt and improvement natural resources. 1962.)

some land use problems in *Australia*. 1955-56.

A. (1948), Native New Guinea. *Agriculture in New Guinea*. Department of *Production in Papua*. Printer, Sydney. Some Sociological East Asia. *Indonesia*, 439-455.

System in South-East Agricultural Science are in Economically in equatorial *Archipelago*. *Journal of* 3, 1-16.

easy to give rather too much weight to the conclusions drawn by Salisbury as a result of the logical and concise manner of his exposition. "From Stone to Steel" is a case study, and the applicability of its findings to other situations in other areas remains to be tested.

Within Siane society, Salisbury distinguishes three distinct types of activity—subsistence, ceremonial exchange, and the production of luxury items—the exterior signs of opulence and power. These three overlapped in many instances and to classify adequately a man's actions at any particular time posed a number of problems, but they do provide a useful classification for studying the changes made by the introduction of disturbing influences.

The other major indicator of change comprises the personal relationship of the Siane with other members of the tribe and with outsiders. Within each clan, relationships are built upon the need to equitably share the factors of production and the produce of the subsistence gardens, and to provide social security for the aged and infirm. Within and between clans one can distinguish the activities of promoters and politicians, the big men using luxury items and personal relationships, to establish positions of power and ensure a share in expected hand-outs of favours. And between clans, largely through marriage transfers, can be seen the ceremonial transfer of community wealth, usually the most "valuable" items, quickly giving way in an alternating progression to open hostility. To quote the Foreword "the segmentary social structure expresses itself in a more or less continuous tension between the components whose members have to do with each other, in the imprisonment of interdependence, by marriage, gift, prestation, trade, insult, violence, feud and war".

In tracing the effects on these activities and relationships, Dr. Salisbury uses mainly the tools of the anthropologist. Economists will doubtless find the book of interest, but may also be a little disappointed at some of the loose ends left unplied. One wonders, for instance, what the net effect of the introduction of steel axes on the productive process would have appeared as, if "opportunity cost" had been used in measure-

"From Stone to Steel" is the chronicle of an accident of history, but an accident which must have occurred among many other ethnic groups in many other areas of the Territory of Papua and New Guinea. It is a study of the introduction of modern technology, in the form of steel axes, to a group of stone age People. The Siane are a group of tribes, comprising about 15,000 people in the Goroka Subdistrict of the Eastern Highlands of New Guinea. Although some of them had seen Europeans during the period of intensive Highland exploration in 1933, they had no further contact with them until 1945. Yet in this period, the traditional stone axes of the Siane men were largely replaced by steel. These steel axes had found their way into Siane Territory along the channels of indigenous trade and exchange; and "their use in the native system of production became universal, and directly or indirectly, all other aspects of native life were affected by them".

In most areas of Papua and New Guinea, the introduction of steel was accompanied by the advent of Europeans—settlers, prospectors, traders, patrol officers, missionaries—and much of the change wrought in social and economic behaviour can be attributed to emulation and the new pattern of exchange (monetary or barter) between the Europeans and the native inhabitants. With the Siane, this was not the case, at least until 1945. Even the upheavals of the Second World War seem to have skirted around them, so they had twelve years in which they received steel axes to replace gradually their stone axes, and in which to make their own social adjustments to these new tools, slowly and independently.

Dr. Salisbury has traced the pattern of this adjustment on the evidence of the Siane themselves. And for the student of Territory affairs, or the administrator concerned with the evolution of the native peoples from the traditional to the modern world of commerce, it makes both interesting and valuable reading. In fact, it is

ment of factor costs. Or, to quote Dr. Stanner's Foreword again, "if increased leisure but no measurable increase of goods resulted, was the whole process truly one of development?" Anthropologically and socially, it undoubtedly was, but what was the real effect in terms of economic development?

The administrator concerned with the active promotion of economic development is likely to be more directly interested in the changes wrought in a society following the introduction of money and the incursions of Europeans. To this extent, he will be more concerned with the story of the Siame after 1952, which Dr. Salisbury has promised as the subject of a subsequent study.

One could not complete a review of this book without honourable mention of the excellent Foreword by Dr. W. E. H. Stanner. His reference to the Herskovits-Knight controversy and the differing anatomies of anthropology and economics as scientific disciplines is particularly apposite. Anthropological findings need to be used with caution in economic research. This does not mean that economists will not use Salisbury's work. They undoubtedly will. Fisk has already drawn on the Siame for at least two interesting forays into economic model building. With such a paucity of material available, economists specializing in the Pacific Area have developed very much into pragmatists, using whatever they can lay their hands on. "From Stone to Steel" adds considerably to the information previously available on the motivations underlying the behaviour of primitive peoples as they meet and adjust to the technology of a modern monetary society.

M. J. Phillips.
Reserve Bank of Australia,
Port Moresby.

Readings in Malayan Economics.

Edited by T. H. Silcock. Eastern University Press Ltd.,
Singapore. 1961. 501pp. M\$ 15.00.

The success of the Readings series issued by the American Economic Association has been largely responsible for the growing popularity of this type of publication. Although this book on the Malayan economy does not reach the high standard of the American series, it is an interesting and important contribution to the library shelves of those interested in the economics of Malaya.

The range of topics from which the Editor—Professor Silcock, Emeritus Professor of Economics, University of Malaya—had to choose must have been extremely limited. A number of the papers make only passing reference to Malaya, while the last section—"Currency and Credit"—could have been omitted without impairing the value of the book.

The publication consists of five sections; each introduced by a short summary covering the main aspects of the topic and suggesting further source material. The sections deal with Economic Growth; Macroeconomic Analysis; Rubber; Tin; and Currency and Credit. The papers were published between the years 1936 and 1959 and this makes review difficult.

Economic Growth.

This section has seven papers of which the most interesting is that by R. W. Firth—"Money, Work and Social Change in Indo-Pacific Economic Systems". Published in 1954 it is a pioneer in the field of Socio-economics. The thesis is that indigenous economic systems and social institutions can make partial and sometimes successful adaptation to the impact of the stronger money economy.

This is the case where the individual indigenous economy has its own internal medium of exchange. Its counterpart in the cash economy, although possessing both internal and external exchange values, is brought into the indigenous economic system. Thus, both the traditional and the new medium of exchange can operate successfully side by side. This is well illustrated in the Gazelle Peninsula of New Britain.

The effect of wage labour on the indigenous economic system is also examined in a similar context but Firth relies heavily on the notion of the backward sloping supply curve for labour. The author can be criticized for not showing that this concept is only valid in the initial stages of contact between the two economic systems, and that it rests on a fixed supply of labour. Once this becomes more elastic, the concept does not apply in its rigid form.

This paper can still be read by all those working on aspects of indigenous economic systems, as many of the suggestions and thoughts point to future research projects.

The second paper by M. G. Swift—"The Accumulation of Capital in a Peasant Economy"—follows the normal anthropological technique

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which the Editor—Professor of Economics—had to choose must be a reference to "Malaya, Currency and Credit" without impairing

of studying a particular problem on a narrow front but at considerable depth. It answers few of the questions which concern economists although it does suggest a number of fields where economic studies would be undertaken.

A short paper by Mr. Freedman on the economic sophistication of the overseas Chinese suggests that the success of these energetic immigrants rests, not so much upon their industry, but on their high degree of skill in handling money and their ability to organize men in relation to money.

The last four papers are by the Editor and cover a wide range of problems associated with economic growth in low income countries, particularly with reference to Malaya. Two studies on population and migration in the Far East are included.

Professor Silcock stresses the importance of developing those aspects of the economy which have high external economies and comes to the conclusion that education, research and transport are key factors in economic growth for low income countries. His emphasis on education—and its companion, research—is interesting in view of the current swing to the study of education in explaining the economic development of the high income countries. He touches on the distinction between consumption and investment education but does not follow up this important point. For the high income countries, investment education is a necessary condition for continuing growth. On the other hand, the low income nations are only just entering the stage of consumption education.

Macroeconomic Analysis.
The individual indigenous internal medium of the cash economy, internal and external into the indigenous both the traditional change can operate is well illustrated New Britain.

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into question many of the concepts on which national and international commodity policies are based. In this field, Bauer has no peer.

He is concerned that the upsurge in rubber production by the smallholder in Malaya, and the then Netherlands East Indies, at a time of low prices had a number of sound economic reasons. It was almost completely accepted in Malaya that their need for money was turning many away from rice production to rubber, a move which was frowned upon by the government.

Bauer examines the economics of this "unusual phenomenon." It simply was more profitable for the smallholder to produce rubber than rice. Rubber, according to Bauer, has a number of natural advantages for the smallholder over rice; firstly it is non-seasonal; weather risks are less; and most important, it is less labour intensive. There is evidence to suggest that the difficulties encountered in this Territory in encouraging the production of labour intensive crops reflect rational behaviour by the indigenous agriculturalist.

The final article of the section looks at the Malayan government's reaction to the Korean war boom. Unfortunately, the date of publication is not shown but the main features discussed are dealt with in the first two papers.

Rubber.

Bauer's work dominates this section and the value of these papers is heightened by comments of Professors Silcock and Benham. As mentioned previously, Bauer questions the foundations on which government policy in relation to the Malayan rubber industry was built. He shows that the role of the smallholder was not understood by the rubber industry in Malaya nor in the Netherlands East Indies. As a result, policy often worked against the interests of those low-cost producers.

His first paper examines the economics of planting densities from the viewpoint of the smallholder. These producers had much higher densities than those normally found on estates and also were obtaining higher yields per acre than the large scale producers. The results of experiments in the Netherlands East Indies and Sarawak show that higher yields per acre do occur from the heavier planting densities than those normally adopted on estates.

The third paper is by P. T. Bauer and deals with the Malayan rubber slump of 1929-1933. In common with much of Bauer's work, it calls

The second paper
study of tin mining
in Malaya.

Labour relations on
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Of particular interest to those engaged in work amongst primitive people is the chapter dealing with simple types of hives. Smith describes how simple hollowed-out logs, cylinders made from the bark of a tree, and containers made from woven cane, from clay, or sawn timber can all be used successfully to house bees. The production of this slim volume, little more than pocket-sized, is of a high standard. It is printed on high quality glazed paper and the text is very well illustrated with numerous line drawings and many excellently reproduced photographs.

This is a very informative and well-written book containing a good deal of practical information on beekeeping. However it is with a sense of disappointment that one finds very little material in it relates specifically to beekeeping in the tropics, although it is published in the "Oxford Tropical Handbooks" series. Most of the information it contains is applicable of course as much to tropical as to temperate climates. However no mention is made of two all-important factors limiting the keeping of bees in the tropics—namely high temperatures and humidity in coastal and low lying areas, and the presence of tropical flora suitable for honey production. Some mention of these points with a list of typical honey flora, both herbaceous and forest, would have greatly enhanced the value of this book.

The author, one understands, has had wide experience of beekeeping in Tanganyika, a country which exports considerable quantities of honey and beeswax. Of great interest would have been a brief account of beekeeping there. Some statistics from Tanganyika or elsewhere in the tropics on yields per hive and numbers of hives per apiary would have been very useful. Too little information is readily available on beekeeping in the tropics and unfortunately this volume does little to remedy this situation. It is not unlikely that many areas of the tropics could support a high bee population and that honey production could become a profitable tropical enterprise.

D. J. Edwards.

Manual of Fumigation for Insect Control.

H. A. U. MONRO.

F.A.O., Rome, 1961. 289 pp.

"In modern terminology, a fumigant is a chemical which, at a required temperature and

pressure, can exist in the gaseous state in sufficient concentration to be lethal to a given pest organism. This definition implies that a fumigant acts as a gas in the strictest sense of the word."

Fumigants are very adaptable, and are used in the control of many pests. This manual deals with the use of fumigants *above ground*, primarily for the control of insects. While it is not possible to describe a large number of treatments in any detail in a book of this size, the more general applications are discussed in enough detail to allow the reader to adapt the methods for specific problems. As this book is written more for the practical operator, it is inevitable that some of the more complex biological and physico-chemical aspects are over simplified, but the principles underlying the use of fumigants are presented in a form which can act as a guide to the operator. These principles are dealt with in the first section of the book—how to choose a suitable fumigant, and the dosages and concentrations required; the laws of diffusion, sorption, possible chemical reactions, effects of temperatures and residues are all discussed in detail.

As fumigants generally are as toxic to man as to insects, precautions must be taken to prevent any accidental poisoning. These are discussed generally in a chapter entitled "Precautions and Protective Devices". Special precautions applicable to individual chemicals or procedures are given in a chapter which describes the more important fumigants. In this chapter these more commonly used fumigants are considered in relation to their general properties, toxicity and effects, as well as the precautions to be taken, symptoms of poisoning and first-aid procedure.

A section on methods of fumigation, as distinct from the materials used, has pictures and diagrams of the various chambers in varying degrees of complexity, which can be used with the different methods and materials. Some of the simpler chambers could be easily set up and used in the Territory.

The final section of the book lists schedules representing a wide range of treatments from different parts of the world. These are given for reference only, and may have to be modified to suit local conditions.

L. Smeek.

The Economics of the Handloom Industry of the East Coast of Malaya.

E. K. FISK.
Journal of the Malayan Branch of the Royal Asiatic Society, Vol. XXXII, Part 4, December, 1959. 72 PP.

E. K. FSK.

Over the years, quite a deal has been said for and against the introduction and encouragement of cottage industries among the village peoples of Papua and New Guinea. Protagonists point to the labour intensiveness of cottage industries and their effect in distributing cash income to groups not otherwise likely to receive it; while opponents criticize them on the grounds of their difficulty in organization, the lack of usable inherited skills among the peoples of the Territory and the degree of government protection needed for the finished product.

Both sides will find food for thought in Mr. Fisk's study of the Handloom Industry of Malaya's East Coast.

Mr. Fisk, who has written several articles on the Territory's economic problems, is currently with the Department of Economics of the Australian National University. But previously he was for ten years with the Malayan Rural and Industrial Development Authority.

The handloom industry of the East Coast is the largest and most important of Malaya's surviving cottage industries. From the product's point of view, it is a narrowly based industry, practically the only item of output being the traditional "kain sarong", a strip of cloth about 42-43 inches in width and about two yards long. The basic material used is Chinese spun silk yarn, often with varying quantities of metallic thread added, though small quantities of cotton-rayon or silk-rayon mixtures are also produced.

Weaving is done on simple, locally-made frame hand-looms with hand-thrown shuttles, and the whole process shows little evidence of change over the past century. The weaving is done entirely by women, the skill being transmitted from mother to daughter in a continuing and gradual process commencing when the weaver is a young girl.

As with many such industries, middlemen

play a very big role. The supply of raw matepe is in the hands of a small number of 1

wholesalers who import the materials from abroad. These supply mainly to middlemen who in turn have groups of weavers working for them, for whom they provide certain technical advice and assistance. The weavers work for the middlemen for payment in piece rates and the finished cloth is the middleman's property.

If the economic handloom industry protection would culty. However, He concludes the handloom industry weaving of qualit

Fisk suggests that the handloom industry could benefit from better organization, particularly as regards entrepreneurial activity, and the exploitation of the export market. The market for an expanded output is said to be available if the industry was geared to meet the increased demand.

However, it is risk's comments on the possibilities of establishing a large-scale cottage cotton-weaving industry which are more apposite to Papua and New Guinea. The general considerations he raises are capable of application to almost any other cottage industry.

Cotton weaving revived to some extent in Malaya immediately after the war in the period of general textile shortage, but by 1952-1953 it had again died out. The local operators could not compete effectively with imported fabrics, even though the imports were subject to a substantial import duty. To re-establish the Malayan industry on a significant scale would need a substantial rise in tariffs on imported cotton fabrics, sufficient to raise the income from cotton weaving to a level which would be attractive in Malaya's generally high income situation. A rise of the magnitude needed would almost certainly produce a general rise in the cost of living which would be noticeable and which would fall most heavily on the lower income groups.

This would raise a second problem. Such a degree of protection for locally woven cotton fabric would probably produce urban industries ready to take advantage of the situation, and legislative protection against this would also need to be provided if the cottage industry was to survive.

Economic Develop.
Studies.

Adamantios Pepelai
Harper and Row, N.Y.

The continent development has seen the last world wide appearance of emerge. However widen, and the last years of the early years of the 1950's provide the "take-off" for the growing explanations of the world.

The authors of this undergraduate, complexity of a book entitled "Determinants of Economic Growth" discusses the primary traditional the "old" factors of production: Land, Labor, Capital, and Technology. The book also includes a chapter on Cultural Factors. The authors acknowledge that the ideas that students should have some knowledge of economics but also of anthropology to understand economic growth.

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the materials from only to middlemen weavers working for certain technical weavers work for in piece rates and middleman's property.

If the economic advantages of establishing a handloom industry were sufficiently great, such protection would prevent little technical difficulty. However, Fisk maintains they are not. He concludes that the future of the Malayan handloom industry will continue to lie in the weaving of quality yarns, rather than in cotton fabrics for the mass markets.

490 weavers active, estimated to have produced cloth valued at £A220,000, industry was assessed in 1950, of which eighty per cent of materials, capital.

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Fisk has put together an interesting study with his facts simply and logically presented. Although the industry considered may not be of direct interest to the Territory at this stage, some of its problems and the economic considerations for its expansion most certainly are.

M. J. Phillips.

Economic Development. Analysis and case Studies.

Adamantios Pepelasis, Leon Mears and Irma Adelman. Harper and Row, New York, 1961. 620 pp. U.S. \$8.50.

The continuing stream of books on economic development has not abated since the end of the last world war, and it would seem that the appearance of a general theory must soon emerge. However, the subject has continued to widen, and the purely economic explanations of the early years of a "solid dose of capital" to provide the "take-off", has been replaced by the growing emphasis on the sociocultural explanations of growth.

The authors of this publication, aimed at the undergraduate, have attempted to show the complexity of economic development. Part I, entitled "Determinants of Economic Growth", discusses the principal streams of thought under the traditional chapter headings of Natural Resources; Human Resources; Capital Techn-
nology and Entrepreneurial Function; Socio-
cultural Factors. The complexity of these makes one acknowledge Professor Everett E. Hagen's (1) ideas that students of economic development should have specialist training not only in economics but also in psychology, sociology, and anthropology to understand the process of economic growth.

Before embarking on this journey through the multitude of "theories", readers are guided by a brief but clear discussion of the problems

associated with the definition and measurement of underdevelopment. For a criterion of measurement, the authors state, "Throughout this book, national income is implied as the basic indicator of economic development. The inadequacy of this single criterion is indicated by the continued reference to other non-monetary indices . . .

" In the last analysis, the rate of output of an economy is a function of the level of employment of capital, of natural resources, of the quality of labour force and human resources, of technology and skills in production. But long-term economic trends are not determined alone by purely economic factors, and the rate of output is not a purely economic phenomenon. The sociocultural environment is as important in influencing economic life". From this, the general theme of the book unfolds.

Part II—Country Case Studies—departs from the usual texts on economic development. Although the authors do not explicitly expound the thesis that agriculture can provide the vehicle for economic development, the choice of country case studies implies this. The inclusion of New Zealand points to this fact. The countries, each written by an authority, cover the Belgian Congo, Uganda, Brazil, Chile, Mexico, China, India, Indonesia, Turkey, Greece, Yugoslavia and New Zealand.

The studies are a mixed bag and range from very good to inadequate. Some make no attempt to analyse the problems of economic growth.

Of the twelve, that by Walter Elkan on Uganda is the best. He questions a number of generally accepted notions of the determinants of growth. In discussing the role of the cotton industry in the development of Uganda, Elkan takes pains to show that "recurrent expenditure played as important a part in promoting this industry as the more orthodox investment of capital".

From this, Elkan makes three points "that have not by any means found universal acceptance among those concerned with economic development". Summarized, these are:—

1. "It is by no means certain that investment in social overhead capital must invariably precede directly productive activities."

2. "A growth of income cannot always be sensibly related to recorded investments of capital."

(1)Everett E. Hagen. "On the Theory of Social Change". The Dorsey Press Inc., Homewood, Illinois. 1962. 557pp.

3. "It is a mistake to place too much emphasis on capital investment as the means of economic growth"—p. 230.

This is followed by a warning that government intervention in promoting economic growth can proceed too far, and that after a time, market forces would be more appropriate. This point was brought out by the International Bank for Reconstruction and Development's mission to Uganda.

Of the other studies, that by Professor Mears on Indonesia, maintains that the lack of entrepreneurship and managerial skills in both the public and private sectors of the economy is hindering development.

Professor Datta of Calcutta University, writing on India, has a different approach, as he states that "since independence, the desire for industrialization, especially among the urban education sections, has been growing keener with every existing day. But it remains as yet a thing apart from, and to a certain extent opposed to, the religious urge of the people". P. 416.

The value of the text could have been greatly improved if the authors had related the individual case studies to the "theories" discussed in Part I. Furthermore, the date of publication of the case studies would have been of assistance as one is forced to use the statistical tables to assess this.

This book can be recommended to students, general readers, and more advanced scholars of economic development. It is very well written. One should not let the blurb of the dustcover adversely influence the bookshelf browser. It is a more valuable publication than the dustcover indicates.

G. R. Spinks.

Economic Bulletin for Europe.

Vol. 14, No. 2, United Nations Economic Commission for Europe, New York, 1962. 88pp. 7s. Stg.

This is one of the regular series of Bulletins issued by the U.N. Economic Commission for Europe dealing with the trends in trade and economic development in both Eastern and Western Europe. In its first eight chapters it provides a resume of recent developments in Europe with emphasis, perhaps, on events in Eastern Europe.

PAPUA AND NEW GUINEA AGRICULTURAL JOURNAL

As the issue is now one year old, it is interesting to read the appraisals of then existing policies and, with the confidence engendered by hindsight, compare the forecasts made with actuality. The first thing which impresses is the small amount of change which has taken place in twelve months, despite the varying pressures and crises which have occurred, particularly in the political arena. Inflationary pressures which were then evident in some Western European countries have been partially assuaged, and there are indications that the United States' problems are nearer solution, but in most other respects the same types of economic problems still confront both Eastern and Western Europe.

The Common Market has still to establish its final importance, and there is still "uncertainty whether—and on what terms—(it) will be enlarged to include the United Kingdom and other countries". And it certainly remains true that "the problem of built-in cost inflation in a number of countries remains one of the most intractable of those awaiting solution".

One wonders whether economic problems have entered a similar category to Arthritis and some forms of heart disease, where the role of the practitioner is mainly to teach the patient how to live with the disorder rather than to effect a cure.

Part 2 of the Bulletin contains an interesting and valuable discussion of long-terms plans in Western Europe, including a short discourse on "The Concept of Planning in Market Economies". "The notion, economic planning", it suggests, "has achieved so wide a currency that it is in danger of meaning all things to all men". Certainly the term "planning" has been used to mean many different things by different people. In the Bulletin, plans are considered only when they cover the economy as a whole and extend over a number of years, and only when prepared by or for the government. Even so, confusion exists between plans or programmes on the one hand and projections or forecasts on the other. In principle, the distinction can be made with ease, but in practice it is not clear-cut. The so-called "Five-year Plan" for Papua and New Guinea, for example, was more a series of projections or forecasts rather than a plan in the strict sense of the word. However, the terminology has stuck, and in general parlance it is a plan. To overcome this problem, the authors

of the Bulletin *stricto sensu* are to mislead to between planned and rigid classifications

A table is provided a main economic in countries which had in the 1950's. Such a number of hazards, four countries—France and Sweden—had All underestimated in investment (and foreign trade. The that "increasing the Europe" could not have

old, it is interesting of then existing economic engendered by forecasts made with which impresses is the which has taken place varying pressures ed, particularly in trying pressures which in Western European issued, and there United States' problems most other respects problems still concern Europe. still to establish its still "uncertainty s— (it) will be United Kingdom and certainly remains true cost inflation in a one of the most solution "

of the Bulletin have included "those which *stricto sensu* are forecasts," and have justified their position by suggesting that "it would be misleading to over-emphasize the contrast between planned and unplanned economies in Western Europe. Between clear extremes there is a gamut of intermediate positions defying rigid classifications".

A table is provided which attempts to compare the planned and actual movement in the main economic indicators in the four major countries which had long-term plans operative in the 1950's. Such a comparison involves a number of hazards, but it is noteworthy that all four countries—France, the Netherlands, Norway and Sweden—had one experience in common. All underestimated significantly the movement in investment (and labour productivity) and foreign trade. The Bulletin concludes from this that "increasing the capital stock in Western Europe" could not have been the problem it was

generally believed to be in the postwar years, and that "intra-Western European Trade" received a marked impetus from closer economic integration. Be that as it may, the plans prepared for the 1960's do not suggest that the previous decade was regarded as exceptionally favourable for economic growth. Rather they suggest confidence in a permanent rise in the trends of expansion of gross domestic product in countries of both long established and more recent industrialization. Whether these estimates are capable of achievement is a matter for conjecture. Certainly, there are signs that the rate of economic growth in Western Europe is starting to fall, and the problems posed by the need to maintain both investment and consumption demand, while enforcing policies which are basically anti-inflationary will require skilled handling if growth rates are not to fall even further.

M. J. Phillips.

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ains an interesting long-terms plans in short discourse on in Market Economic Planning", it provide a currency that things to all men" " has been used by different people. is considered only when whole and extend when prepared even so, confusion names on the one casts on the other. can be made with clear-cut. The so Papua and New a series of pro- an a plan in the ever, the termino- I. Parlane it is a problem, the authors