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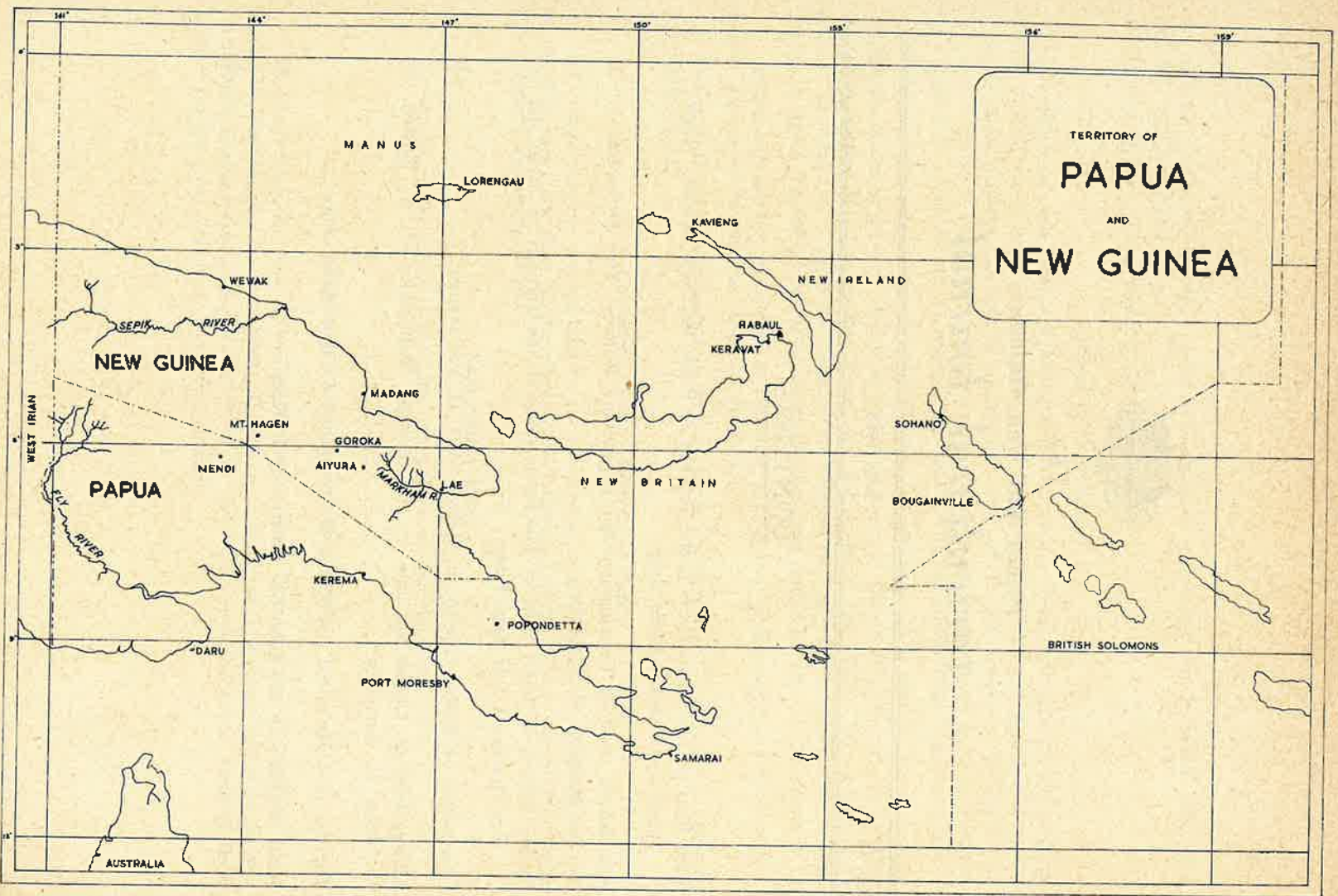
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Insect Pests of Theobroma Cacao in the Territory of Papua and New Guinea: Their Habits and Control.

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. *Pantorhytes* spp.

Longicorn borers. Family Lamiidae.

Flush defoliating caterpillars. *Achaea janata*

L. *Tinacola plagiata* Walk. *Ectropis sabulosa* Warr. *Hypocidra talata* Wlk.

Mealybugs and scale insects. Family Coccidae.

Aphids. Family Aphididae.

Capids (mirids). *Pseudodoniella* spp. *Helopeltis clavifer* 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. Fogs 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

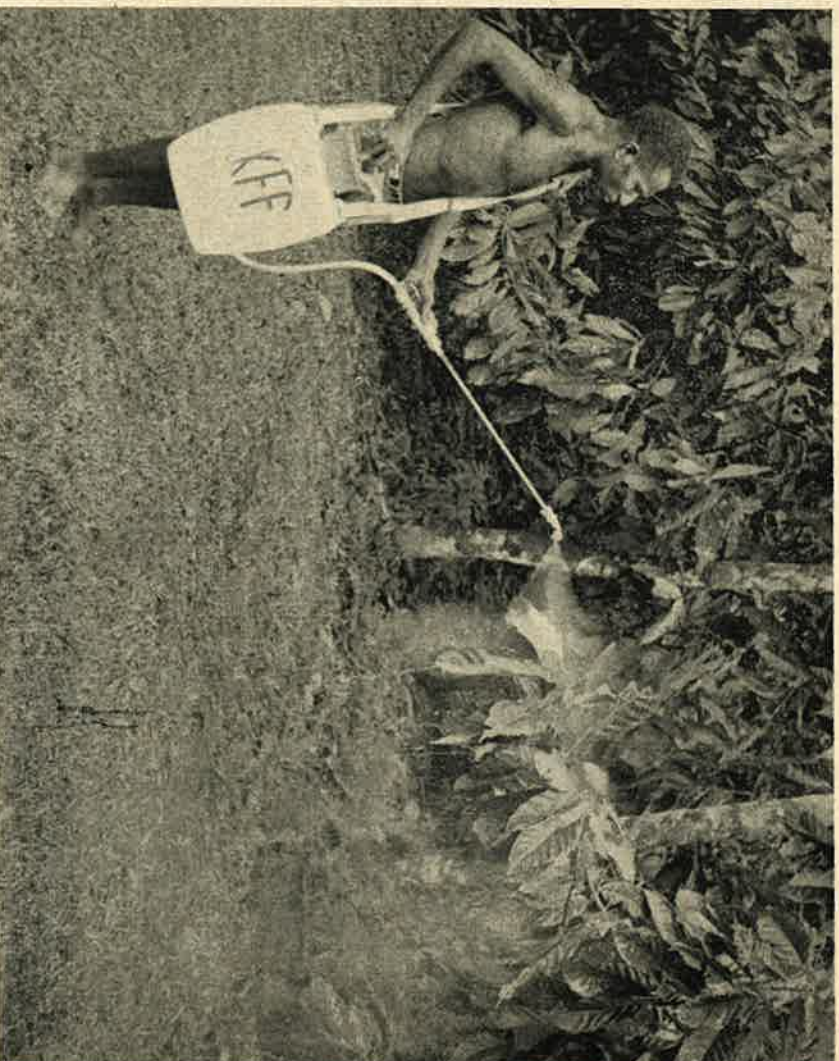


Plate 1.—A type of hand-operated knapsack sprayer used for high volume application of chemicals.—N.B.—Excess spray running off.

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.

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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.



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for capsid control. The amount of insecticide applied must be sufficient to control the capsid, but only 1.5 g/l. is required for equivalent speed and ease of preparation is not a disadvantage. The main disadvantage is that small areas. Apart from a disadvantage of the deposits to

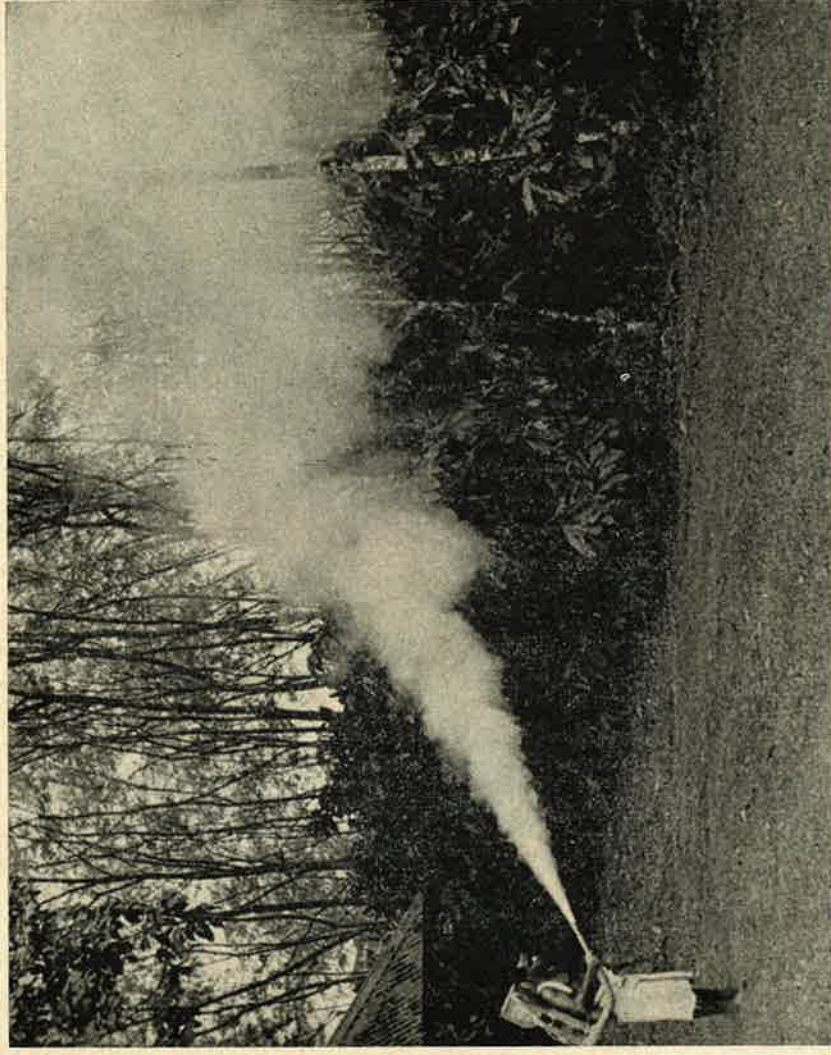


Plate III.—A shoulder-mounted motor-driven duster in action.

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. platus* Oberth.), the Markham Valley (*P. proximus* Fst.) and the Northern District of Papua (*P. szentivanyi* Mshl.) that the incidence of the weevils is yet sufficiently high to cause

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. platus*). 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. platus* have been kept



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

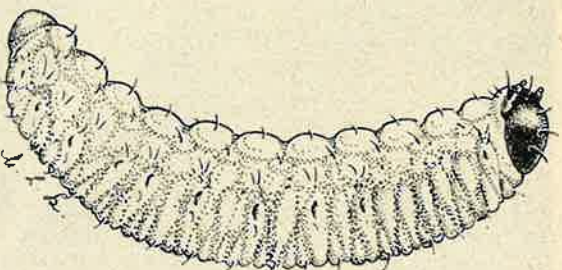


Plate V.—(below left hand) *Pantorhytes*
szentivanyi Mshl. (adult).

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 *Schinumantia lenningii*. 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,



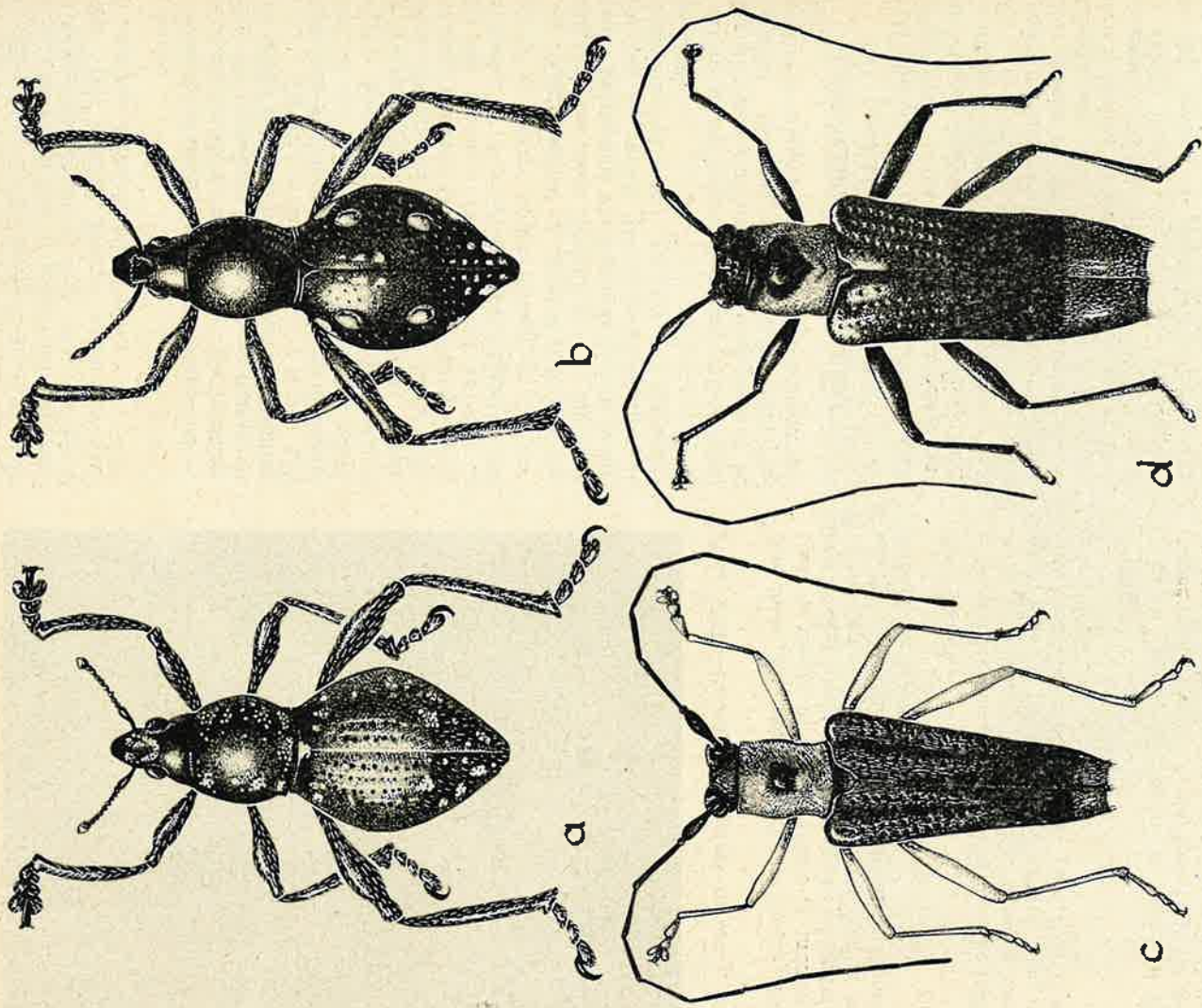


Plate VII.— a *Pantorhytes biplagiatus* Chev.
 b *Pantorhytes quadripustulatus* Gestro.
 c *Glenea aluensis* Gah.
 d *Glenea lefebueri* Guer.

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.

Lamiidae—several species.

At the present time, *Glenea alienis* Gah. (Plate VII), in the Bismark Archipelago and the Solomon Islands, and *Glenea lefebvieri* 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.—Longicorn damage to cacao, n.b. adult.

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 talaca Wlk.

Tiracola plagiata 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.

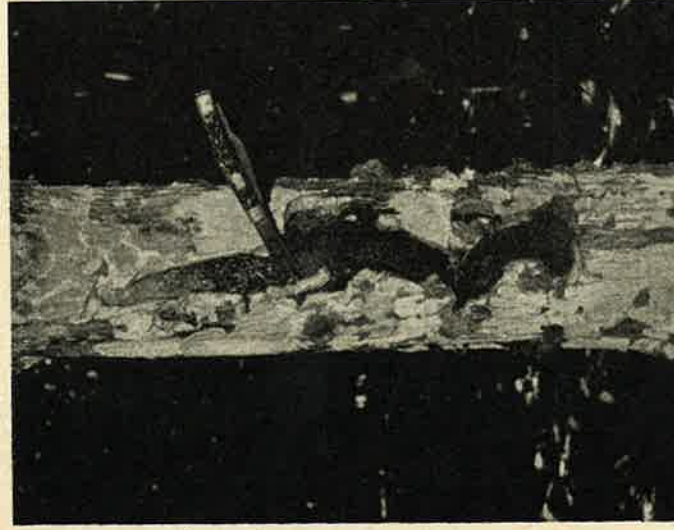


Plate IX.—Longicorn channel in cacao.



Plate X.—*Achaea janata* L. (adult).

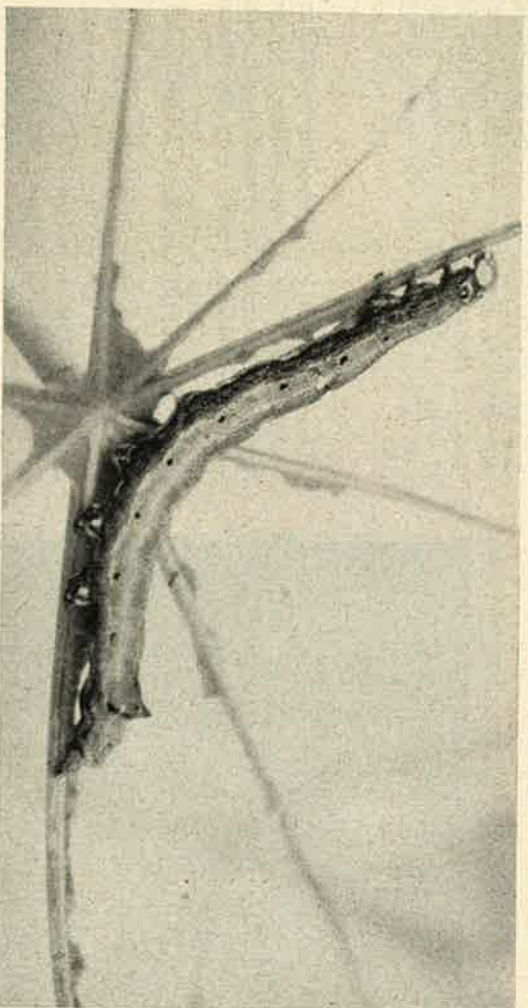


Plate XI.—*Achaea janata* L. (larva).



Plate XII.—*Achaea janata* L. (pupa).

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

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.

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Host Plants.

A. janata has been recorded on *Albizia*, castor and many other

Damage.

The caterpillars (Plate XIII), as mature leaves, attack the undercommence eating midrib is left. attack the growth the young shoot in excessive branch tion of the tree.

Control.

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



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

Host Plants.

A. janata has been recorded on rubber, *Albizia*, castor bean, crotons, 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* Wlk.

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

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Table A.

Stage of life cycle	Days' duration
Eggs	34-4
Larva	15-17
Pre-pupa	4
Pupa	10-15
Pre-oviposition	4
TOTAL—egg to egg	
35-40	

Host Plants.

Tiracola has an extremely wide range of host plants, those in the Territory including rubber, sweet potato, tapioca, *Crotalaria*, cacao, *Leucaena*, taro, milkweed, crotons, 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-shapen 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.

Under the conditions at Popondetta, *Tiracola* 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*

citrini (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.



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 *Ferrisia virgata* (Ckll.), 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 of 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.

CACAO CAPSIDS.

Pseudodoniella spp.

Helopeltis clavifer Walk.

The capsids are the most economically important of the plant bugs attacking cacao, five species of *Pseudodoniella* (Plate XIX), as well as *Helopeltis clavifer* (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*.

Host Plants.

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 (gamma-hexachlorocyclohexane) 1.3 per cent. of BHC. Any other pounds of dust F of about three Another method use of lindane as active ingredient the concentrate P Endrin mist has a (half ounce of gallons of water) when using endrin

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(Plate XIX), as
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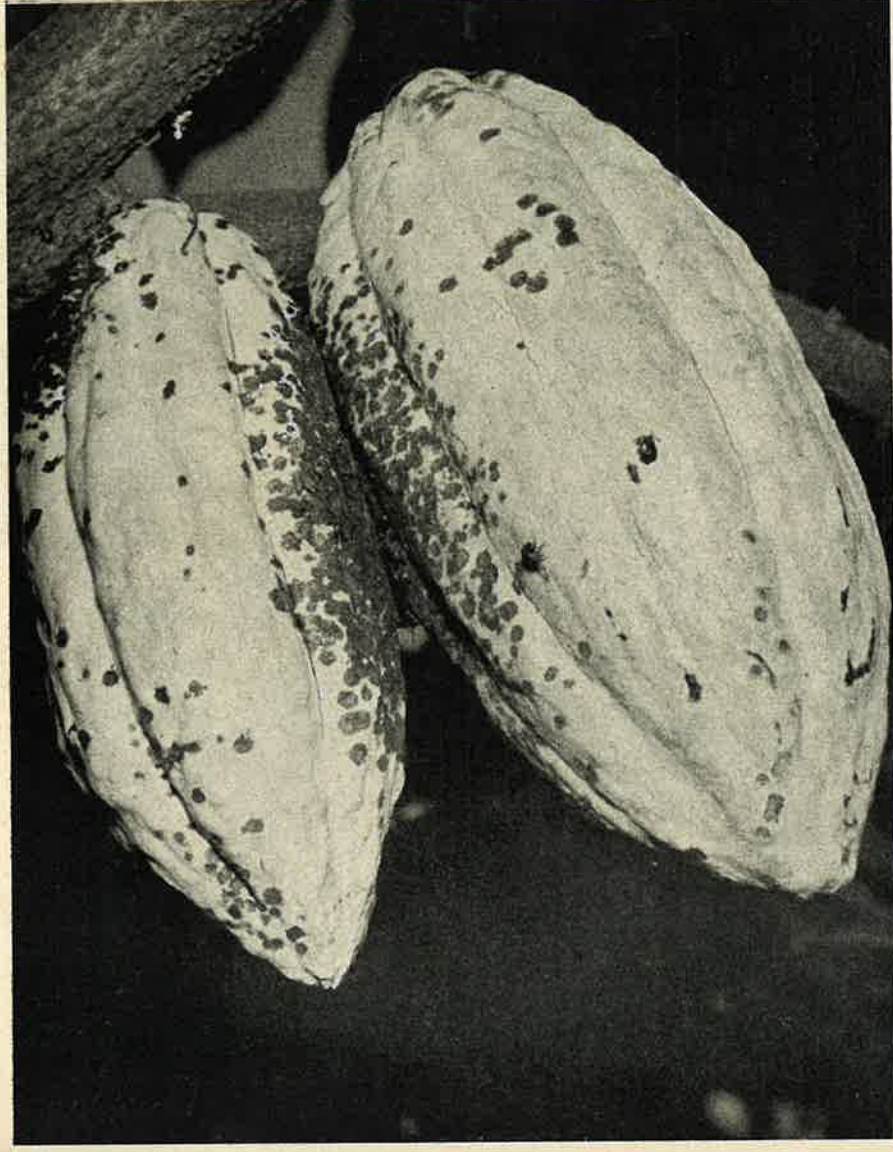


Plate XVI.—Injury to cacao pods by capsid.

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-tion 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.

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 of an inch long, all the species being quite similar in appearance.

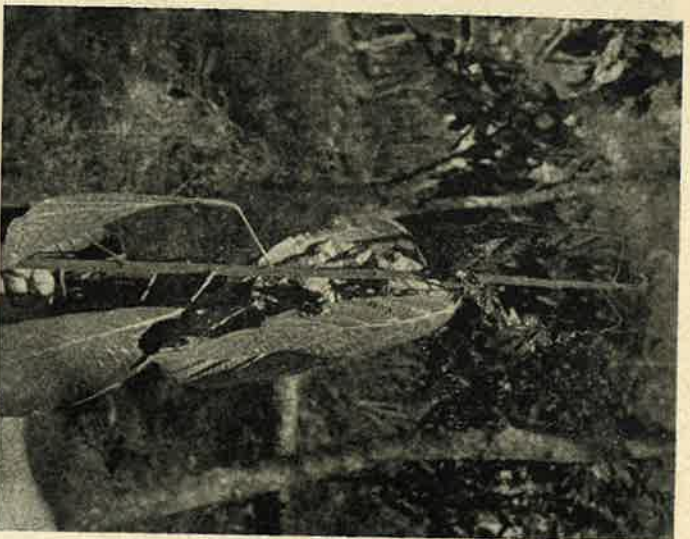


Plate XVII.—Injury to young cacao by capsid.

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 *Amblypelia* 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 *Amblypelia* become severely distorted (Plates XX and XXI).

Host Plants.

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

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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.

Neoterмес spp. and other species.

There are a number of species of termites found on cacao, the most important being *Neoterмес* spp., which can cause considerable damage to cacao and *Leucaena*. 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.

Neoterмес 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.

In common with other termites, *Neoterмес*, known as the "Giant" termite, has distinctly differentiated castes—the male and female ("king" and "queen"), soldiers and workers. The colonies are found entirely inside the attacked tree, with no external runways. The external nests and runways found on cacao and other trees belong to other species which attack only the dead wood on the tree.

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 *Neoterмес* 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.

Damage.

The termites, having penetrated into the tree through dead branches or roots, then tunnel into the green timber. Eventually, the tree is weakened to such an extent (Plate XXII) that it falls when subjected to heavy strain due to wind or rain.



Plate XVIII.—Dieback of cacao.

praying the pods only
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as applied for capsids

MITES.

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

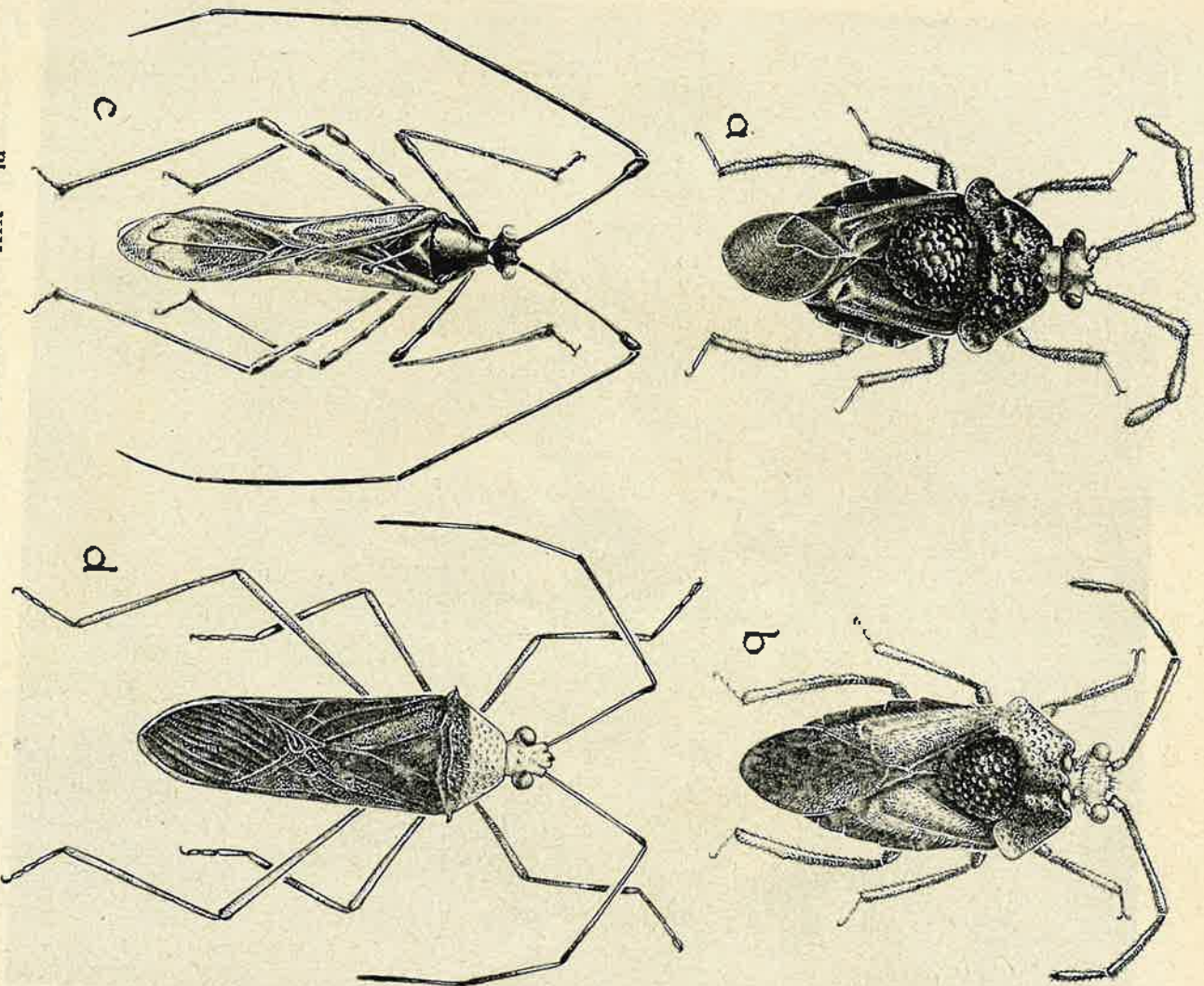


Plate XIX.— a *Pseudodoniella typica* China & Carv.
 b *Pseudodoniella laensis* Mill.
 c *Helopeltis clausifer* Walk.
 d *Amblypelta theobromae* Brown.



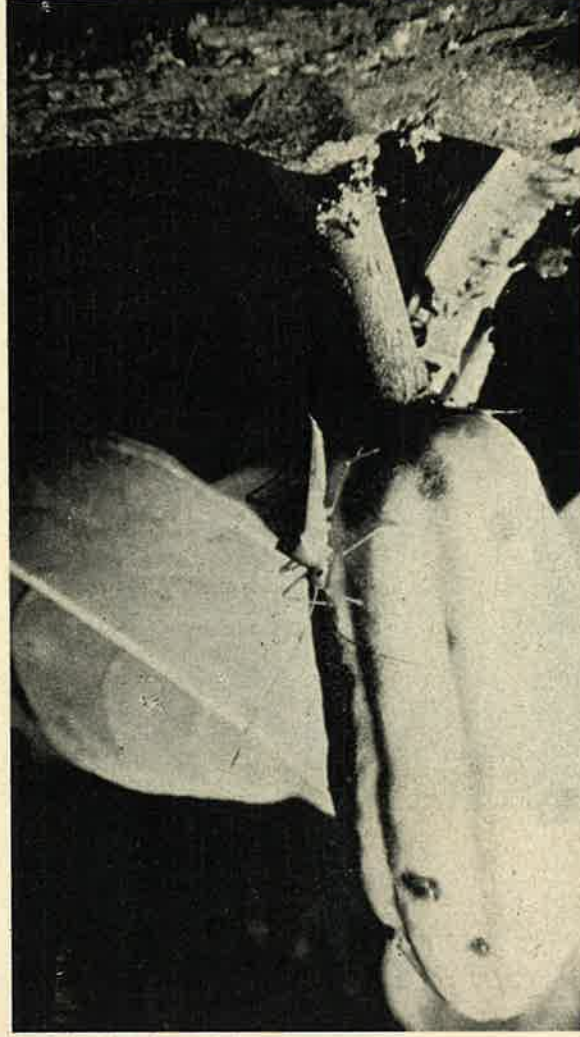


Plate XX.—Injury to cacao pod by *Amblyopelta*.



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

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 *Neotermes* 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.



Plate XXII.—The shade tree *Leucaena glauca* almost hollowed out by *Neotermes*.
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2. Prevention of future

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

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much wood should be
When a nest is found,
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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

ONE of the development centres. This grants economic and social administering and permanent settlement which has definite relating to economic food consumption.

It has been estimated that the population of the urban centre in the Guinea, was approximately 100,000 in 1960. Although no continuous annual increase has been recorded, it is estimated that the population over the last

With these figures was started to gauge consumption and settlements in the of households was these. They were canoe settlement group of four who complex (the traditional and another square people in the Kono. Unfortunately the handed in the m

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

(1) The figure for is derived from the New Guinea National Univer

(2) 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.

The pilot survey provides a lead to where future research into the food consumption and expenditure patterns of urban dwellers should be directed.

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.

expenditures of less than 150 shillings in the Hanuabada sample. The corresponding figure for the Koke settlement was 68 per cent.—Table 1.

Table 1.
Percentage of Sample in Each Expenditure Class.
Shillings per Week.
Hanuabada and Koke Settlements.

Expenditure Class Shillings per week.	Hanuabada	Koke
Less than 50	—	6
50 to less than 100	10	31
100 to less than 150	10	31
150 to less than 200	30	25
200 to less than 250	30	7
More than 250	20	—
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	90 ^a	72
100 to less than 150	78	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.

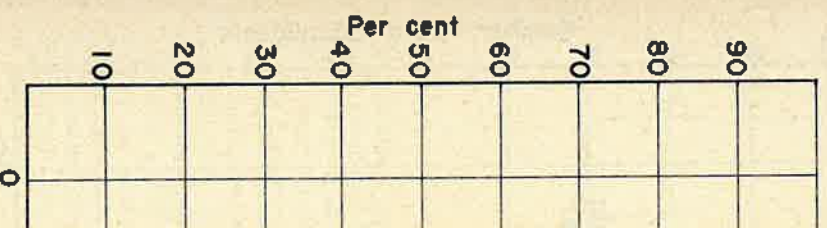
^b Significant at 5 per cent. level.

⁽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 expenditure declined as expenditure declined. This relationship is significant. Although the data that as income increase on foodstuffs occur at very low level ship may not hold a expenditure could be point where income



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

Expenditure Class.
Settlements.

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

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was 79 per cent.⁽⁶⁾
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Expenditure on Food.⁽⁶⁾
Settlement Samples.

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

Households in the Koke
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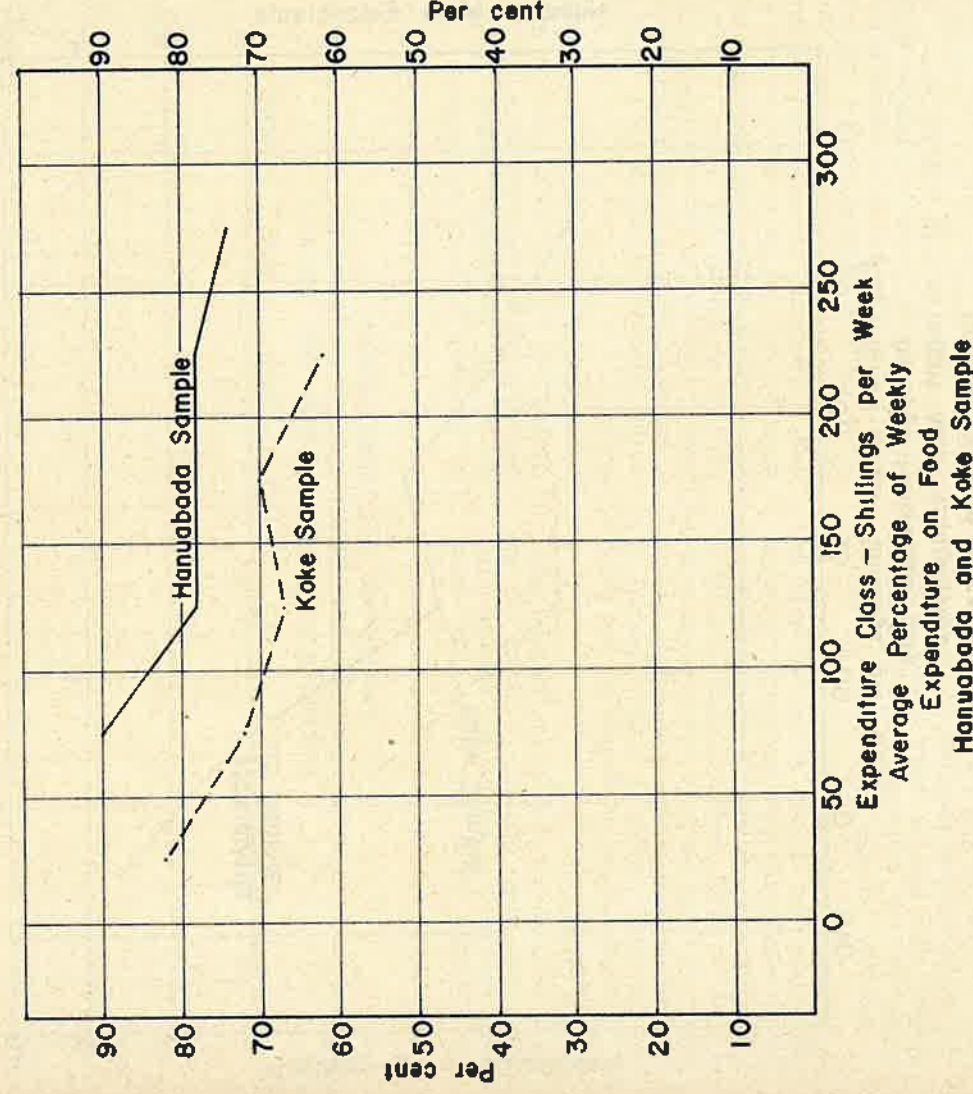
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The evidence suggested that the proportion of expenditure devoted to food purchases declined as expenditure (income) increased. This relationship is shown graphically in Fig. 1. Although the data are limited, it is evident that as income increases, 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



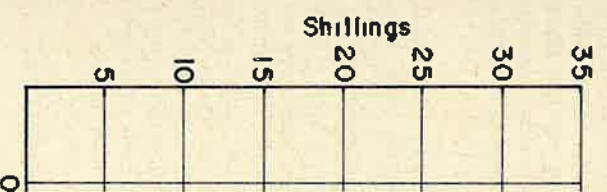
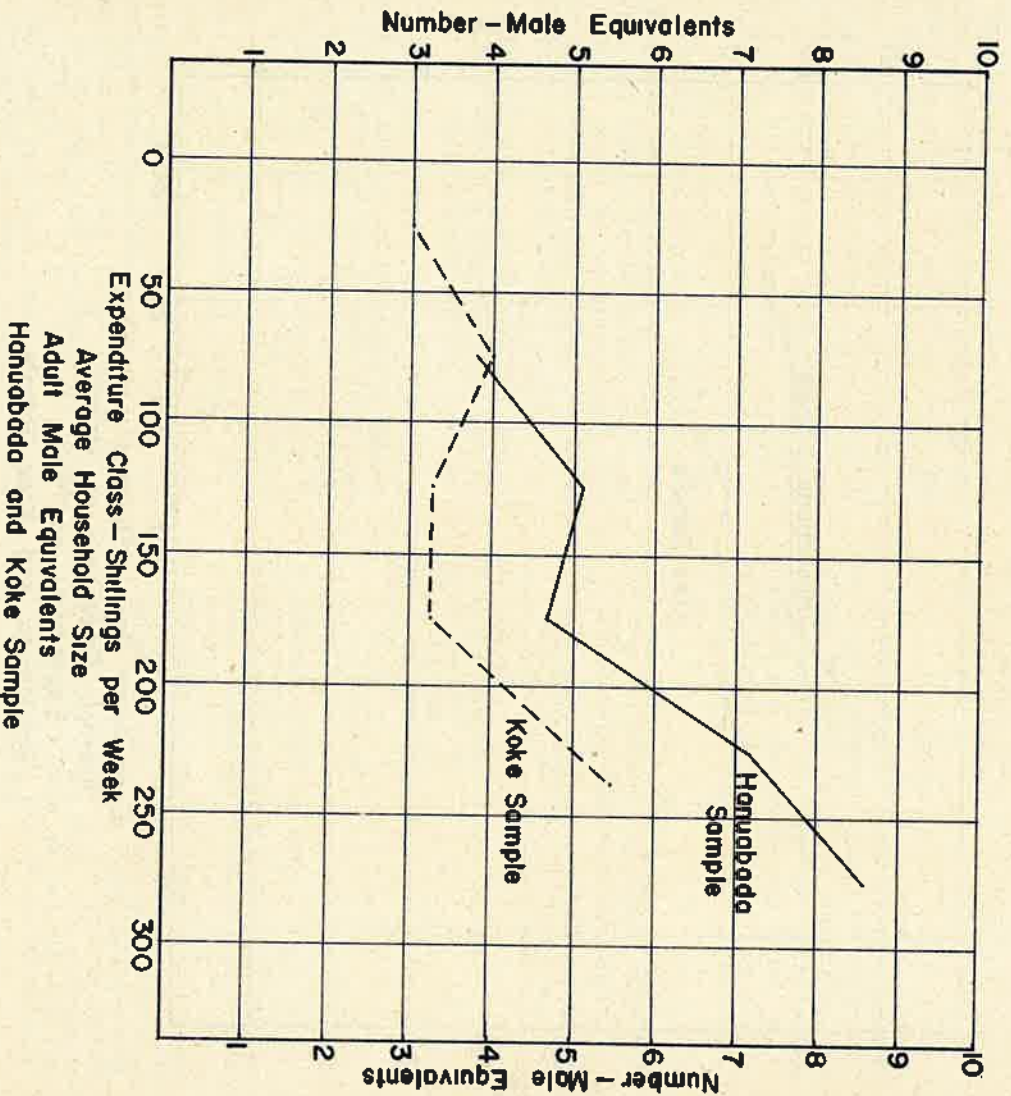
more gradual decline seemed to be linked to the rapid increase in average household size in the Hanuabada sample—Figure 2.

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 at the highest. The corresponding figures for the Hanuabada sample ranged from 18 shillings to

(7) Mean 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



26 shillings. As what influenced (in adult male Hanuabada sample) weekly expenditure. Unfortunately, any statistical analysis of demand for food coefficient would centres or other Figure 3. This and consumption implications on development is coefficients in limited. However, the income elastic been calculated at increase in income than eight per cent

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from Thomson Betty
African Nutrition, An
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Livingston Papers, No.
Press, 1954, p. 57.

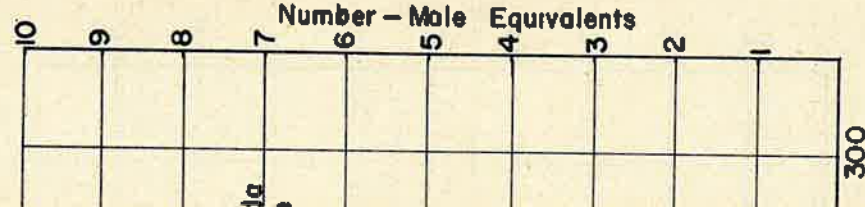
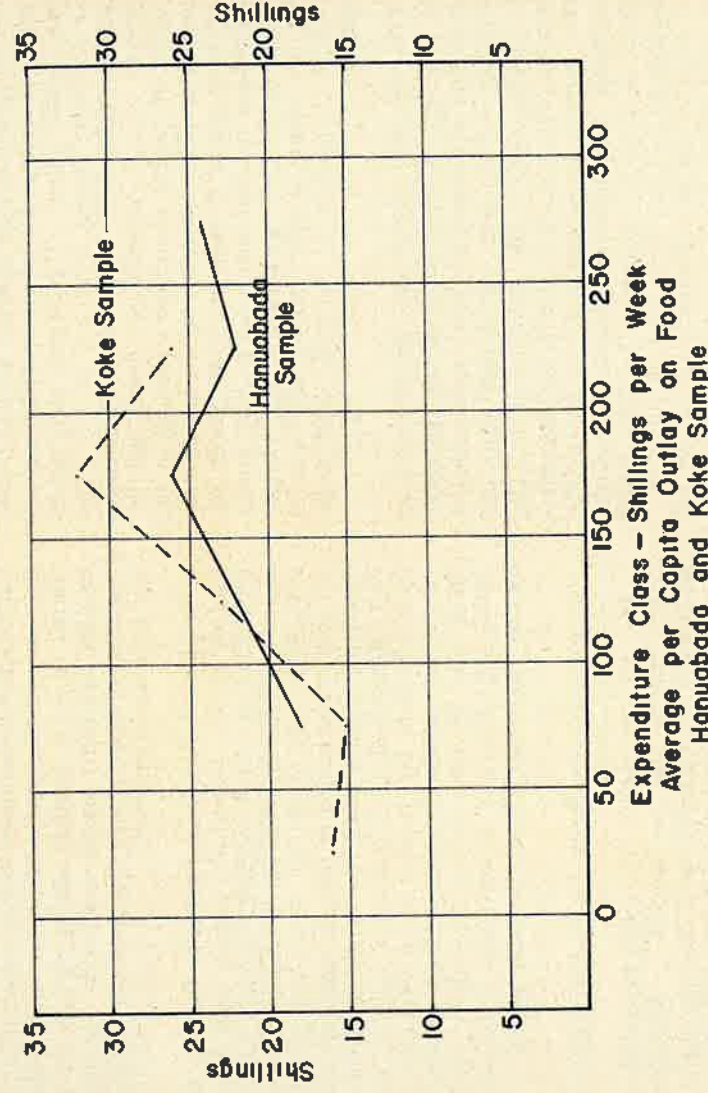


Figure 3



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.

⁽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.

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.

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.

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

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

Percentage of Expenditure on Starchy Foods

Expenditure Class	Percentage of Expenditure on Starchy Foods
Less than 50	...
50 to less than 100	...
100 to less than 150	...
150 to less than 200	...
200 to less than 250	...
More than 250	...

Average

^a Classified as "starchy" foods.

^b Significant at 5 per cent.

The reasons for the high expenditure on imported starchy foods are many factors. Firstly, the availability of foodstuffs is the main factor. Secondly, the spread adoption of starchy foods by people have had to do with culture and have, in effect, tended to create a demand for this group. Thirdly, the lack of knowledge of the "foreign" second occupants of these areas has led to a high expenditure for many Moresby for many

However, an important proportion of expenditure on starchy foods seems to be on calories which can be obtained from local money is much greater than the traditional foods than the traditional—Table 4.

the Koke settlement may have been predicted with the pre-traditional dancing from the Abau Sub- at some of these of foods. In the is source of supply

dstuffs from local sample were very d to tapioca tubers y was conducted season and garden year were severely ; in the immediate imited supplies of the Hanuabada penditure patterns. ce on the pattern season when pro- much greater.

EXPENDITURE.

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from the survey ases of imported ur and bread. (10) ble this group of average of 29 per he figures for the no real variation

3. The corres- or the Koke survey

that sliced wrapped lar although selling

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	
	Trad.	Imp.	Trad.	Imp.
Less than 50	—	—	—	4
50 to less than 100	—	22	22	19
100 to less than 150	—	12	23	35
150 to less than 200	—	4	33	37
200 to less than 250	—	2	27	39
More than 250	—	6	26	32
Average ^b	4	29	33	17
			18	35

^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 Hanuabadan 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.

Table 4.

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

Food	Calories per Shilling
Traditional	
Sago ^b	2,165
Taro	1,138
Tapioca—fresh tuber	1,412
Sweet potato	886
Yams	603
Banana	509
Imported	
Flour	2,465
Rice—polished—vitamin enriched	1,725
Bread	1,596

^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. 255, 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.

The range of protein foods varied considerably between the two samples. Protein intake from purchased sources was limited to tinned and fresh fish. Unfortunately total intake of protein could not be assessed.

In the Hanuabada sample, purchases of protein foods ranged from tinned fish, tinned meat, fresh meat, cheese, and bacon, although the wider range was only among the highest expenditure groups. In the lower expenditure groups, imported protein was the major source of supply.

Table 5.
Percentage of Expenditure on Protein Foods.
Hanuabada and Koke Settlements.

Expenditure Class Shillings per week.	Hanuabada			Koke		
	Trad.	Imp.	Total	Trad.	Imp.	Total
Less than 50	...	—	—	44	9	53
50 to less than 100	...	7	25	32	13	45
100 to less than 150	...	10	9	19	12	31
150 to less than 200	...	3	20	23	9	32
200 to less than 250	...	4	18	22	16	38
More than 250	...	3	18	21	—	21
Average ^a	...	4	18	22	14	26

^a Significant at 5 per cent. level.

As with the starchy foodstuffs the imported products are the cheapest source of protein and of these tinned fish is the cheapest—Table 6.

Table 6.
Grams of Protein per Shilling.^a
Traditional and Imported Preserved Foodstuffs.

Food	Grams of protein per shilling			
Fresh fish ^b	22
Tinned fish ^c	44
Tinned beef-corned	20

^a Calculated from the figures used in an unpublished paper J. Whiteman, *Hobolia Dietary Survey, July-August 1962*, Department of Public Health, Konedobu, Papua, December, 1962.

^b Prices based on the average price per lb. at the Koke market during July-August.

^c Average price per tinned fish in "trade" stores about Koke and the main stores in the shopping centre of Port Moresby.

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EXPENDITURE ON IMPORTED FOODS.

The proportion of total expenditure on all foodstuffs and beverages varied considerably between the two samples. In each expenditure group, more money was spent on imported foodstuffs in the Hanuabada sample than in the Koke sample—Table 7. The average percentage of weekly expenditure over the samples was 70 per cent. for the Hanuabada survey and 37 per cent. for that at Koke.

These figures suggest that as the urban centres grow and migrants settle for longer periods, the consumption pattern will tend to move more towards the imported foods. The percentage figure for the Koke sample was influenced by the regular supplies of traditional food from village gardens.

Table 7.
Average Percentage of Expenditure on all Imported Foods—Hanuabada and Koke Settlements.

Expenditure Class Shillings per week.	Hanuabada	Koke
Less than 50	...	34
50 to less than 100	...	34
100 to less than 150	...	37
150 to less than 200	...	42
200 to less than 250	...	37
More than 250	...	—
Average ^a	70	37

^a Significant at 5 per cent. level.

Every household in the survey purchased bread and butter during the survey week. (11) The range of products varied between the samples. A religious sect in the Koke settlement forbids its followers to consume stimulants and therefore tea and coffee are not listed in purchases. In addition, practically all wage earners consumed bread or scones, soft drink, etc., for lunches or snacks at their midday meal whilst at work. Therefore these percentages of expenditure on imported foods are understated.

A comparison between the average percentage of expenditure on traditional and imported foodstuffs can be examined in Table 8. There is no clear indication that the percentage of expenditure on imported foodstuffs increases with higher expenditure but an examination of the source of

(11) Only one household bought margarine.

calories suggests should be remembered sample the expenditure group the wage earner class, in fact if he no household lowest expenditure per week, the wage and the only one an occupation re

Average (12) Percent
Hanuabada
Imp

Expenditure Class Shillings per week.	Hanuabada	Koke
Less than 50	...	34
50 to less than 100	...	34
100 to less than 150	...	37
150 to less than 200	...	42
200 to less than 250	...	37
250 and over	...	—
Average	70	37

^a Significant 5 per cent.
AVAILABLE

An assessment principal source equivalent in attempted from expected from source of calorie foodstuffs of important.

(12) The reliability and the follow the average will Reliability Probab

Staple	3.2-14.0
Staple	24.8-37.0

IMPORTED FOODS.

Expenditure on all imported foodstuffs was considerably less than in the Koke sample. The average percentage of expenditure on imported foodstuffs was 70 per cent. in the Koke sample and 37 per cent. in the Hanuabada sample.

The situation in the Koke survey was different from that in the Hanuabada sample. The average number of calories available to each adult male equivalent from staple foodstuffs was limited. Calories from purchases of imported foodstuffs averaged about 94 per cent. over the sample. The main sources were rice, sugar⁽¹³⁾, flour and bread, and there appeared to be some degree of substitution between the last two products.

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.

Table 8.

Average⁽¹²⁾ Percentage of Expenditure on all Foods Imported and Staple.

Expenditure Class Shillings per week.	Hanuabada			Koke		
	Staple	Imp.	Total	Staple	Imp.	Total
Less than 50	48	34	82
50 to less than 100	38	34	72
100 to less than 150	33	34	67
150 to less than 200	28	42	70
200 to less than 250	25	37	62
250 and over	—	—	—
Average ^a	9	70	79	31	36	67

^a Significant 5 per cent. level.

AVAILABILITY AND SOURCE OF CALORIES.

An assessment of the total and number and principal source of calories for each adult male equivalent in the expenditure classes was attempted from the survey data. As would be expected from the previous findings, the main source of calories was derived from imported foodstuffs of which sugar was particularly important.

⁽¹²⁾ The reliability of the averages was calculated and the following table shows the range in which the average will fall—

Reliability of Averages—Per cent.
Probability of 95 per cent.

Hanuabada		
Staple.	Imp.	Total.
3.2-14.0	61.4-72.2	74.2-83.4
Koke		
Staple.	Imp.	Total.
24.8-37.0	31.4-32.4	62.4-72.0

any purchased bread week.⁽¹¹⁾ The between the samples. settlement forbids ants and therefore in purchases. In earners consumed c., for lunches or whilst at work. f expenditure on

average percentage and imported food- e 8. There is no ntage of expendi- eases with higher n of the source of at margarine.

In the Hanuabada sample, the average number of calories available to each adult male equivalent from staple foodstuffs was limited. Calories from purchases of imported foodstuffs averaged about 94 per cent. over the sample. The main sources were rice, sugar⁽¹³⁾, flour and bread, and there appeared to be some degree of substitution between the last two products.

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Among the purchased staple foodstuffs, bananas were the most important single source of calories. Sweet potatoes provided the most important source from the village supplies.

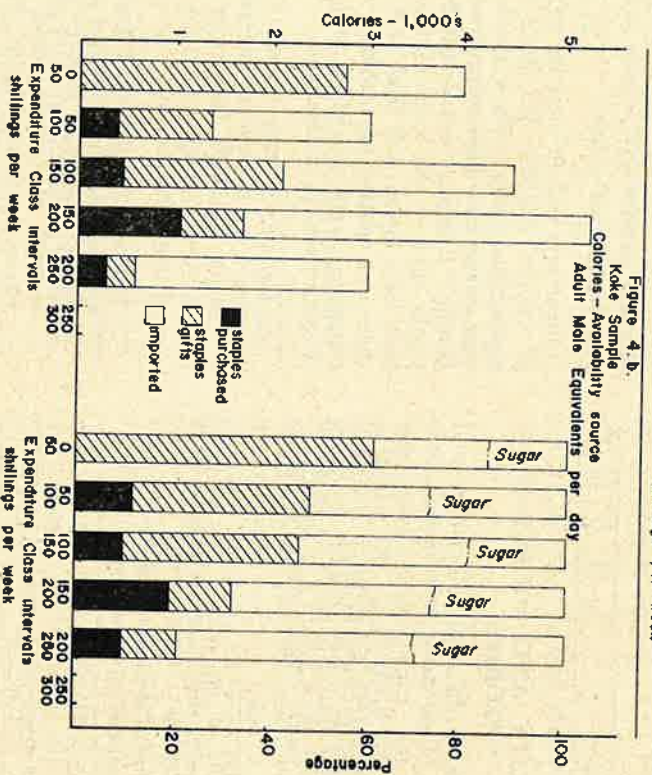
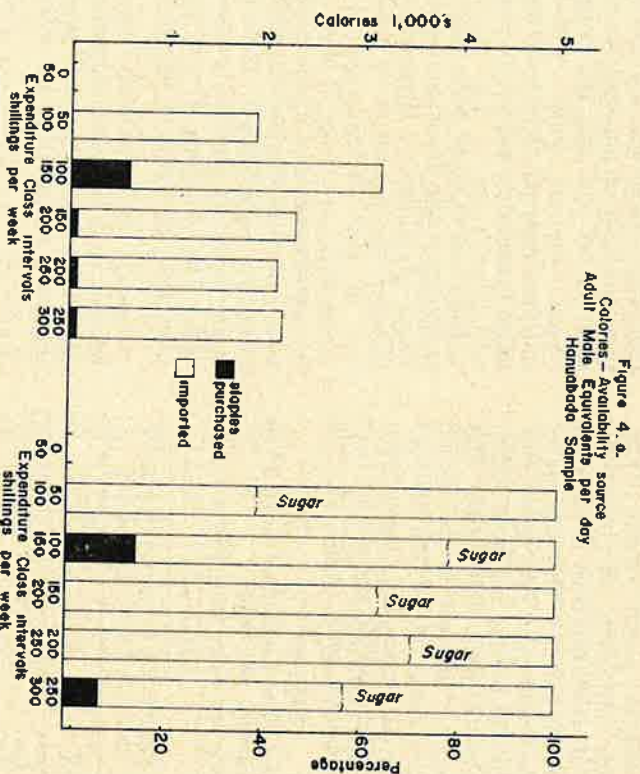
Average number of Calories available per day to each adult.

Figures 4a and 4b show the estimated number of calories available per adult male in each expenditure group. Those for the Koke survey were considerably higher than for the Hanuabada sample. It would be expected that the reverse would apply as the levels of income at Hanuabada were higher than those at Koke. However, there is a number of problems which must be considered some of which will be important in future surveys of this type.

1. The survey week for the Koke settlement could be atypical as increased supplies of staple foodstuffs came from village sources to feed visiting dancers for an exhibition of traditional dancing.

2. In these calculations it has been assumed that supplies from villages were consumed during the survey period; as a result the number of calories could be overstated. However, these supplies have been described as "regular".

⁽¹³⁾ Sugar was the cheapest source of calories at 3.121 per shilling.



3. When the considered, the will be read the number or age, who day in the was consider In the form 16 household least one n per household with one vi and four h (the highest instances visi food with th

4. These figure intake from employment of bread, sc

One of the n of survey is the of foodstuffs ent close to Port Mo that considerable recently built an native market at i and relatives livi of air freight wa can result in ser intake from this

Protein Intake.

As was shown of protein in the of imported foo protein availabili

The proportion fishermen in the calculated. In a reported that she ally although the ment did not con

In the Hanuab fish and occasion but attempts to proved difficult. quantities were given to the child

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.

Electricity.

CONCLUSION.

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".

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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 increased demand can therefore be met by increased imports of foodstuffs, however these will compete with imports of capital equipment for development plans for the scarce supplies of foreign exchange.

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.

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.

The success of this survey rested on the field work of Mr. Shaka 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.

area during September. Random samples of housing units in the settlements were then one village of the Hanuabada complex Port Moresby, and Gulf District people

The original intent was to cover two weeks of interviewee resistance at the end of the first interview, but this was then reduced to one week. Accurate data would

1. The Canoe Sell

This settlement the commercial cen-
 area of Port Mores-
 close to the princip-
 Moresby area.

Moresby area.

The settlement of the permanent section. From the total 700 permanently. Permanent the basis that the for at least six months for at least another

Fifteen of the housed people of the Division of the Abbe District. The are Morebby. The other Subdistrict also of t less than half the p of the Marshall Lag of the 16 canoes in

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.		Number in Sample.
Painter	....	3
Foreman-painter	....	1
Fisherman	....	4
Carpenter	....	2
Drainer	....	2
Driver	....	1
Storeman-clerk	....	1
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.		Number in Sample.
Period.		
Less than 3 years	....	8
3 years to less than 6	....	—
6 years to less than 9	....	1
9 years to less than 12	....	2
12 years to less than 15	....	2
More than 15 years	....	3
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	3
160 to less than 180	...
Total	16

Savings 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	6
Used mainly for food purchases	6
No specific item but used for food purchases	2
No accounts	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	1
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.

Adult Males	Number in Sample.
2 to less than 3	—
3 to less than 4	3
4 to less than 5	1
5 to less than 6	2
6 to less than 7	1
7 to less than 8	1
8 to less than 9	—
9 to less than 10	—
10 to less than 11	2
11 and over	—
Total	10

Income.

Difficulties were experienced in estimating individual income as more pronounced than in that at Koke. It was impossible to secure accurate figures of the earners' cash income. The following table shows the pooled

Income.

Range.
80 to less than 100
100 to less than 120
120 to less than 140
140 to less than 160
160 to less than 180
180 to less than 200
200 to less than 220
220 to less than 240
240 to less than 260
260 to less than 280
280 to less than 300
300 to less than 320
320 to less than 340
340 to less than 360
360 to less than 380
380 to less than 400
400 to less than 420
420 to less than 440
440 to less than 460
460 to less than 480
480 to less than 500
500 to less than 520
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560 to less than 580
580 to less than 600
600 to less than 620
620 to less than 640
640 to less than 660
660 to less than 680
680 to less than 700
700 to less than 720
720 to less than 740
740 to less than 760
760 to less than 780
780 to less than 800
800 to less than 820
820 to less than 840
840 to less than 860
860 to less than 880
880 to less than 900
900 to less than 920
920 to less than 940
940 to less than 960
960 to less than 980
980 to less than 1000

One wage earner as driver and his stage. Of these five had pooled in

Subsistence foods

Eight of the possessed garden member of the Koke garden, while the others in this district. The banana, tapioca, the week of the survey total of 130 lb. tapioca made up cent.

Number of visitors

Only three of provided meals week; the number of visitors a number of in quantities of food.

Savings Accounts

In all the savings were operated by or a combination of

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
250 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.

Number of visitors partaking of meals.

Only three of the households in the sample provided meals for visitors during the survey week; the number ranging from 2 to 5. In a number of instances visitors brought small quantities of food, mostly rice and tinned fish.

Savings Accounts.

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

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.

Principal Utilization of Savings Accounts.

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. Squatter 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.
Foreman	1
Carpenter	1
Painter	1
Driver	1
Shop Assistant	1
Labourer	1
TOTAL	6

Bank Accounts.

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

a Group.

roup was selected of the houses was the traditional through one migrant

ners is occupied in

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

een unemployed until

Moreby.

the people were still illage area.

y the method of as based upon an n. Household size in the Koke canoe

Male Equivalents.

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

Length of Residence in Port Moresby.

The wage earners had all resided in the Port Moresby district for many years, none being less than six years.

Length of Residence in Port Moresby.
Major Wage Earner—Male

Period.	Number in Sample.
Less than 6 years	—
6 to less than 9 ...	2
9 to less than 12 ...	1
12 to less than 15 ...	2
Over 15 years ...	1
Total ...	6

Household Size.

Some difficulty was experienced in gauging the degree to which individuals residing under the one roof co-operated in food expenditure. Sharing of accommodation was more widespread than in the other survey areas. These have been reduced to adult male equivalents. In the six houses in the survey the numbers living under the one roof ranged from 5.35 to 17.10, including the family unit of the owner.

Income.

The incomes in this survey are for the owner of the house as it seems that pooling of income is pronounced and sharing of food is a common practice.

Income—Shillings per week.

Wage.	Number in Sample.
60 to less than 80	4
80 to less than 100	1
100 to less than 120	—
120 to less than 140	—
140 to less than 160	1
TOTAL ...	6

Subsistence Foods from Villages.

Only one family in the survey group had a garden in the Port Moresby area. The remainder purchase sago which is sent from the villages of their district. During the week of the survey no family received any food from home villages in the Gulf District.

Visitors.

None of the survey households reported any visitors for meals during the week. One family was assisted with food by one of the groups sharing the house.

Savings Bank Accounts.

No parents reported savings bank accounts and four of the group maintained that one of their children had school savings bank accounts.

APPENDIX B.

SHORTCOMINGS OF THE SURVEY AND SUGGESTED AVENUES OF RESEARCH.

The pilot survey clearly showed that considerable additional research will be needed to analyse adequately the consumption pattern of urban dwellers in the Territory of Papua and New Guinea.

This survey has only looked briefly at the consumption patterns of the middle income group and does not profess to show that pattern for the large proportion of unskilled labourers. A glimpse has been obtained from the part survey of the Gulf people and it suggests that the range of foodstuffs was particularly limited. These people come from a sago staple area and supplies of this are limited in the Port Moresby area. The consumption patterns of the unskilled migrant labourer should be examined.

This type of study raises a number of problems which are often overlooked. Home pro-

duced foodstuffs do not offer much of a difficulty but the percentage of food coming from home villages and brought in by visitors is a major problem.

The urban areas such as that of Port Moresby are constantly changing in that different groups of people are entering and leaving at the same time. Thus any survey of this nature will only represent the position at a particular point of time. Each new group of people will arrive with traditional consumption patterns and must face the problem of adapting themselves to new dietary levels. This raises the problem of finding a "representative sample" in a rapidly changing situation.

Additional research should be conducted into the relationship between expenditure incurred and household size. The survey indicated that there is a relationship between these two.

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

J. J. H. SZENT-IVANY.

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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 etiology. Two moths, previously mentioned as minor pests (Szent-Ivany, 1961) are now considered major pests of Theobroma cacao. These are the noctuids *Tiracola plagiata* (W.alk.) 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.

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PHASMIDA.

Phasmidae.

Anchiale 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 gossypii Glover. Lowlands Agricultural Experiment Station, Keravat, New Britain District, February, 1960. In flowers. (Coll. L. Smee and Sz.).

Cercopidae.

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

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

Coccidae.

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

Cinnitococcus theobromae Williams. Numa Numa Plantation, Bougainville District, 1.8.1961. Pods; tended by *Technomyrmex detritus* Walk. (Coll. C.).

Cristococcus sp. Wanigela Plantation, Northern District, 22.9.1960. Branches and pods covered with scales. (Coll. Dr. D. E. Shaw).

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

Hemiberlesia palmarum (Ckll.) Lowlands Agricultural Experiment Station, Keravat, New Britain District, 16.8.1962. Twigs. (Coll. D.).

Planococcus sp. near *civii* (Russo), 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 *Heligmonema* Bigot (= *cinadus* van der Wulp) was observed preying upon last instar nearides (nymphs). The plantation was at the same time severely infested with the cacao midid *Pseudodoniella 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* scars, however no specimens of *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. *Pseudodoniella 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 lateris papuensis* Brown) is known to cause extensive tipwilt to various cultivated plants (Szent-Ivany and Catley 1960).

Brachylybas inflexus Blot. This species was observed feeding on cacao pods by Mr. L. A. Bridgland at Popondetta in the Northern District (30.9.1959), by Mr. A. Catley at

Gabensis Plantations (6.6.1960) and at Finschhafen (D.).

Derbidae.

Diosrombus sp. (Coll. C.).

Protista sp. Jarun District, 23.11.1961.

Zoraida fuscipennis Sz. and E. Kanji Northern District.

Zoraida punctipennis (Coll. C.).

Zoraida sp. near hambo village, 1 Foliage. (Coll. C.).

Zoraida sp. Suambu 26.4.1960. Foliage.

Zoraida sp. Sangay 16.11.1962. (Coll. C.).

Zoraida sp. Sumba trict, 13.11.1962.

Zoraida sp. Popondetta, 7.5.1962. Foliage.

Flatidae.

Euphanta sp. Jimb trict, 1.12.1961.

Euphanta sp. Kagay District, 22.11.1961.

Papuanelia sp. Jimb District, 1.12.1961.

Paradeksha sp. Jimb District, 25.11.1961.

Paradeksha sp. Su District, 22.11.1961.

Sephenia sp. Mag District, 22.11.1961.

Sephenia sp. Carbet trict, 23.11.1961.

Sephenia sp. Jimb trict, 1.12.1962.

- Gabensis Plantation, in the Morobe District (6.6.1960) and by Mr. K. G. Newton at Finschhafen (December, 1960).
- Derbidae.**
- Diosrombus* 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. Kanjiri).
- Zoraida punctipennis* Walk. Suambu Plantation, Morobe District, 26.4.1960. Foliage. (Coll. C.).
- Zoraida* sp. near *punctipennis* 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.**
- Euphanta* sp. Jimbora Plantation, Northern District, 1.12.1961. (Coll. R. J. Cheetham and Sz.).
- Euphanta* sp. Kagona Estate, Northern District, 22.11.1961. (Coll. Sz.).
- Papuanella* sp. Jimbora Plantation, Northern District, 1.12.1961. (Coll. R. J. Cheetham and Sz.).
- Pavakaksha* sp. Javunie Plantation, Northern District, 25.11.1961. (Coll. Sz.).
- Pavakaksha* sp. Sumbaripa Plantation, Northern District, 22.11.1961. (Coll. Sz.).
- Sepbena* sp. Magafin Village Plantation, near Dagua, Sepik District, 7.3.1960. (Coll. Sz.).
- Sepbena* sp. Carberry Plantation, Northern District, 23.11.1961. (Coll. Sz.).
- Sepbena* sp. Jimbora Plantation. Northern District, 1.12.1962. (Coll. R. J. Cheetham and Sz.).
- Lophopidae.**
- Kasserota* sp. Finschhafen, Morobe District, 10.1.1956. (J. H. Ardley).
- Lophops* sp. Jimbora Plantation, Northern District, 1.12.1961. (Coll. R. J. Cheetham and Sz.).
- Membracidae.**
- Terenitus* sp. Carberry Plantation, Northern District, 17.11.1961. (Coll. Sz.).
- Terenitus* 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 franzenii* Kim. Plant Industry Centre, Buba, Morobe District. (Coll. J. H. Ardley.).
- Coctoteris viridescens* Walk. Plant Industry Centre, Buba Morobe District. (Coll. J. H. Ardley.).
- Ricanidae.**
- Euricania villica* Stal. Hohota Plantation, Northern District, 14.4.1958. Foliage. (Coll. Sz.). Bakahari, Mamoo and Tentrí Plantations, Northern District, 25.9.1961. Foliage. (Coll. Sz.).
- 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 aulmanni* Karny. New Guinea (La Baume, 1912).
- Heliothrips baemorrhoidalis* (Bouche) New Guinea (Froggatt, 1940; Dumbleton, 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* Karny. New Guinea (La Baume, 1912).

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

LEPIDOPTERA.

Danaidae.

Euploea nemeus subsp. ? near *ulagona* Ribbe. Lowlands Agricultural Experiment Station, Keravat, New Britain District, 1.9.1962. Foliage. (Coll. D.).

Geometridae.

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

Ectopis 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.

Gracilariidae.

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

Limacodidae.

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

Pinzulanza kuteisch 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.

Lamphides celeus Cram. Markham Valley, Morobe District, December, 1961. Foliage. (Coll. J. H. Ardley).

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Lymantriidae.

Dasychnia mendosa 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.

Archaea 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 (Sme, 1962a) and in the Northern District.

Elyda 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.).

Tiracola 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. (Catley, 1962a, 1962b). In May, 1962, it also appeared in plague proportions in a plantation in the Morobe District. In September, 1962, the author found a small population of *Tiracola plagiata* in a cacao plantation near Madang. Nymphalidae.

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

Pyralidae.

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

Thyrididae.

Strigina aximina Warr. Popondetta, Northern District, June, 1962. Foliage. (Coll. C.).

Tineidae.

Endobethis anomogramma Meyr. Lowlands Agricultural Experiment Station, Keravat, New Britain District, January, 1959. (Coll. D.). Breeds in nests of *Neotermes* sp. (Sme, 1962b) damaging *Theobroma cacao*.

Genus and species
Experiment Station,
District, March
of *Neotermes*
D.).

Tortricidae.

Cryptophlebia
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COLEOPTERA.

Anthribidae.

Phloeops platypet
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Bostrychidae.

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Crioceridae.

Lema standinger
District, Nov
R. J. Cheetham

- 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.
- Phleops platypennis* Montr. Kerena, Gulf District, 1939. (Coll. J. Cox).
- Bostrychidae.
- Allorhrium 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 benthids (*Miolispa papuanus* Kleine, *Miolispa* sp. nr. *papuanus* Kleine and *Miolispa* sp. nr. *aruentis* Kleine and *Miolispa novae-guineensis* Guer.) were observed causing primary injury to the growing points of rubber seedlings in Papua (Szent-Ivany, 1956).
- Cetoniidae.
- Glycyphana rufopicta* Kr. Lowlands Agricultural Experiment Station, Keravat, New Britain District, February, 1960. Flowers. (Coll. L. Smeed and Sz.).
- Macronota regia* (Fr.) Mamoo Plantation, Northern District, 3.11.1961. Foliage (Coll. R. J. Cheetham.).
- Poeilophorus bimaculata* Schurhoff. Lowlands Agricultural Experiment Station, Keravat, New Britain District, February, 1960. (Coll. L. Smeed and Sz.).
- Crioceridae.
- Lema staudingeri* Jac. Cassell Estate, Northern District, November, 1961. Foliage. (Coll. R. J. Cheetham and Sz.).
- Cerambycidae.
- Megacerium horni* Heller. Arawa Plantation, Bougainville, September, 1956. (Coll. F. R. McKillop.).
- Curculionidae.
- Balaninus* sp.? *missiois* 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. Kanjiri and Sz.).
- Isoleptus variegatus* (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).
- Mecopus doryphorus* Quoy & Gaim. Lowlands Agricultural Experiment Station, Keravat, New Britain District, October, 1959. Pods. (Coll. D.).
- Orthorhinus* sp. near *patnelis* Pasc. Warou-Gamenoku Village area, Talasea, New Britain District, 29.3.1962. (Coll. E. Tokebene).
- Pantorhytes* sp. nov.? Inauwauni Village, Mekeo, Central District, September, 1962. Larvae borer in stem and branches, causing severe damage. (Coll. B. P. Arney).
- Rhinoscapa* sp. Arehe Plantation, Northern District, 30.11.1961. Foliage. (Coll. R. J. Cheetham, E. Kanjiri and Sz.).
- Dermestidae.
- 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.
- Deretricha* 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 batidis* Baly. Lowlands Agricultural Experiment Station, Keravat, New Britain District, 22.8.1962. On flush growth. (Coll. D.).

Rhypanida 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.).

Rhypanida sp. Cassell Plantation, Northern District, 21.11.1961, on flush growth. (Coll. R. J. Cheetham and Sz.).

Lamiidae

Monobannus 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 xylocyrtid borer *Pausepia teletyga* in cacao branches. (Coll. D.).

Nitidulidae

Carpophilus pallens 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 montenzeri Fairm. Eba Plantation, Northern District, 17.11.1961. Foliage. (Coll. Sz.).

Parastasia simplicipes Obs. "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, Djaul Island, New Ireland, March, 1963. (Coll. R. E. McDonald.). Borer in taproot of dead cacao seedlings.

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

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

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Obser

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

Seed Treatment.

An interesting Estate near Kajang well known in the high yielding clover number of widely

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After inspection placed in germination sold to Malayan at 22 cents * per II and Plot C three days and supplied ungermi

In cases where are too advanced seeds are planted twelve months later at 45 cents per st

Seed to be sown is kept in cold storage At a temperature the seed was sown to six months.

* 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 to eight months with buds from green budwood 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 plantings looked most vividly on 27th April, when rain had fallen since

When transplanting the nursery to the field, the stock is pruned at all; that is, without a fall, i.e., without a fall, is more or less removed. This ensures a very rapid growth of the young trees.

Other methods of propagation, and with are:—

- (a) To transplant weeks after opening-up
- (b) To transplant about nine months after

Green budding on Effingham 1 planted in the green budded 8 on 29th January back is done in three month old stock, was excellent.

According to that green budding immature period six months. This on this particular after having no significant a field of PB21 after budding an adjoining field buddings done method (on 1 stock in both fields)

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and field plantings 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 12 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 $\frac{3}{8}$ inch wide.

Cuttings.

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

PB86 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 PB86 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

regard it may be mentioned that a 10 year old crown budding experiment was seen at the Sungei 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 mucronoides* and *Pueraria phaeoloides* 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 *Flemingia 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 :—

Dowdon 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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Paraquat, 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. *Paraquat* 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 :—

Cockchafers, 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 800.

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. *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 nevea* 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 Selangor was also noticed to be very much affected by *Gloeosporium*. Control of the disease consists of spraying with "Tri-fungol" (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 Sungei Buloh and Ethingham 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 Sungei 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 Sg. An insurance scheme exists against wind damage, and payment by insurance companies for totally lost trees was said to be £2 10s. Sg. for trees under seven years old and £3 16s. 2d. Sg. 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 (¾ 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 girdling.

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 ¾ 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 summar-

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Results of further are to be published

Seed Gardens.

The clonal seed Sungei Buloh station 200 acres, and D. Seed fruit exclusively for seed

Typical of the on which the foliage

Area : 41 acres

Budded : 1944

Spacing : 60 ft

Production : 1/4

Composition : F

Percentage of seed fall periods. See on five days during is given in the following

Collection date

16.8.1960
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12.9.1960

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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 Sungei 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	...	45	4.3	49.7	0.5	0.4
17.8.1960	2233	44	8.4	41	0.4	6.2
19.8.1960	2077	29	2.3	65	1.3	1.5
5.9.1960	2258	40	0.8	52	1.8	5.5
12.9.1960	2004	33	2.2	53	2.6	9.2
	2068					

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 cwts. per acre per 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 Bisanumu 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 Cents at a yield per acre of—				
	11 004	11 009	11 008	11 000	11 003
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 includes clearing and fertilizing.

Tapping includes collection and transport to factory.

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

At the time of the visit the Singapore market 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

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-Langkai 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 RRIM 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 Malayan 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.

Notes on Clones.

A description use can be found mentions public Institute of Malaya

PB 86. This clone the 1963-64 ph Malaya. The main growth of this example of extreme when Kepong established on this be taken into tapping known clone extreme was—

PR 107, taken i age of 5½ years at 1,100 lb. per acre This old and proven the best for exten Guinea. Of partic is its thick bark bark and the high The trees have a fairly wind-resistan

PR 252 and 27 exchange clone tr considerable promt vigorous of the tw

PB 5/51. This popular in Malaya initial stand of ab least ten feet betw This clone has a v habit. No wind da Yields at Prang B the fifth year of t

trial. It was expected that 10,000 acres will be planted by the 1962 figure was 10,000. The replanting grant was 10,000 from 600 dollars. The grant is paid in small instalments over a period of five years. The Re-planting standards in 1961 and maintenance standards in 1962. RRI Smallholders are working on the replanting Board Staff, task.

Smallholder project of 10,000 acres was seen near 10,000 miles south of 10,000. The State 10,000 clearing and 10,000 houses were 10,000 in when housing 10,000. Work on this 10,000 early in 1961, 10,000 Chinese) were 10,000 of the visit. 10,000 fertilizing, cover 10,000 for six 10,000 done by contract 10,000. Family settlers 10,000 work the holding 10,000 of a manager 10,000 Authority.

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10,000 appears to 10,000 cents per lb. of 10,000 research work is 10,000 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 5½ 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.)

Sa

THE most common group associated with salmonellosis are *Salmonella enteritidis*. Word names those two in rodents and I have been recognized as *blegdam*, *S. choleraesuis*, *S. oxford*, *S. portland* and *S. worthington*. This paper is to describe the serology of guinea pig colony of guinea pig Central Veterinary Moresby.

The guinea-pig colony was established in 1954 with stock from the colony. Sporadic losses, particularly in the first few months, have been observed. The diet has been supplemented by *maximum* and water. A high percentage of the colony has been checked for the disease. In July, 1962, a rate occurred and these animals were belonging to Gro scheme.

Over a period of 17 months the rate from Salmonellosis in the 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. blegdam*, *S. cholerae suis*, *S. muenchen*, *S. newport*, *S. oxford*, *S. poona*, *S. reading*, *S. saint-paul* and *S. worthington*. 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 chloromycetin. 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:—salicin, lactose, sucrose and adonitol.

Serology.

S. weltevreden belongs to Group E of the Kauffman-White classification and has the serological formula O₃,10:H₁,r₂₆. 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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The Use of Mists in the Application of Insecticides to Cocoa.

LANCE SMEE.

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

SUMMARY.

MIST spraying is the most economic method of applying insecticides to cacao. The optimum size of the droplets is within the range of 30-100 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 "Limblo".

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

taken to apply the measured amount to each tree checked with a stopwatch. Table I shows the different times required to apply the measured amount to each tree.

n/12½ minutes.

The table of per acre of the adequate results visible deposit. highest rates, for

visible deposit,

visible deposit,

Following the treatments, and allowing enough time for the deposits to dry thoroughly, twenty leaves were taken from each of three heights (five, nine and 15 feet) in each block. The leaves were examined in a dark room under a fluorescent light, and placed in one of three classes, depending on the number and distribution of the droplets visible on either surface. The classes are shown in Table II.

Table II.

Classes giving distribution of droplets on either upper or lower surfaces of the leaves.

Distribution of deposits as determined by examination under fluorescent light.

2. Control of V per Acre.

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amount to each
Table I shows
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ing constant at one
tes.

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

and allowing
to dry thoroughly,
m each of three
et) in each block.
dark room under
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mber and distribu-
on either surface.
e II.

droplets on either
f the leaves.

lass
east one surface of
droplets/square inch.
II less than ten

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ght.

16 gals. Fluxit	Class
	1 2 3
4	2 9 9
74	0 0 20
100	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 by Gibson (1962) in the *Agricultural Gazette* of New South Wales.

(Received September, 1963.)

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

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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 very 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:—

$$\frac{6}{200} \times 8 = \frac{1}{4} \text{ pint approximately.}$$

$$\text{This would take } \frac{12 \times 60}{8 \times \frac{1}{4}} = 20 \text{ seconds}$$

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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Procedure.

It is first necessary to prepare a nomograph for the particular problem, such as a rule of three scales so that the points on two of the scales, at the third scale, is the answer.

Typical examples of nomographs presented

Nomograph 1.

This chart is used to find the amount of wettable powder required to prepare a diluted spray.

Example A (illustrative nomograph)—

Assume that it is required to spray 100 trees per cent. spray powder concentrate.

The two known values are 100 trees per cent. and 100.

Place the straight edge on the 100 trees per cent. scale and 50 on the 100 scale.

The straight edge will then pass through the point two on the 100 trees per cent. scale. Therefore two parts of wettable powder to one part of concentrate.

Example B—

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

of material, for

It has been found figure close to 12 gives best results, slightly with the application per acre rates and slower

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ESTICIDE

and semi-concen-) these difficulties. be solved by the e following series urpose. of three parallel ype of problem.

Procedure.

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.

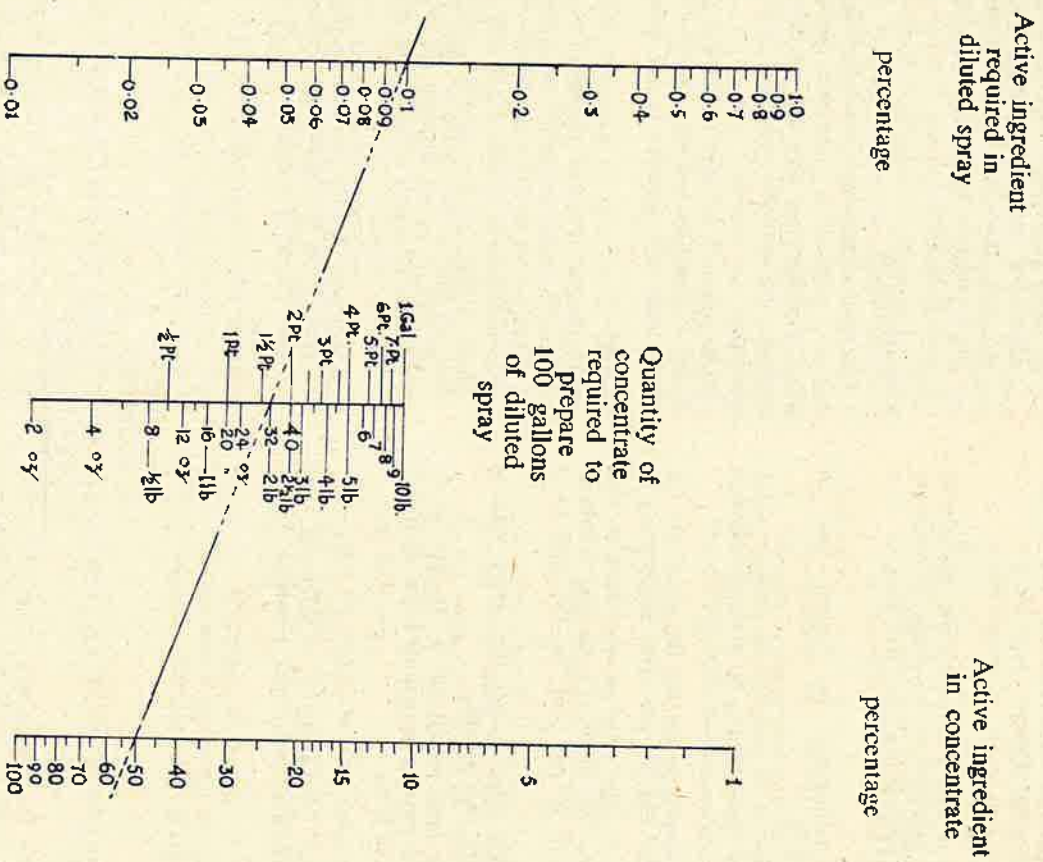
Example—

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?

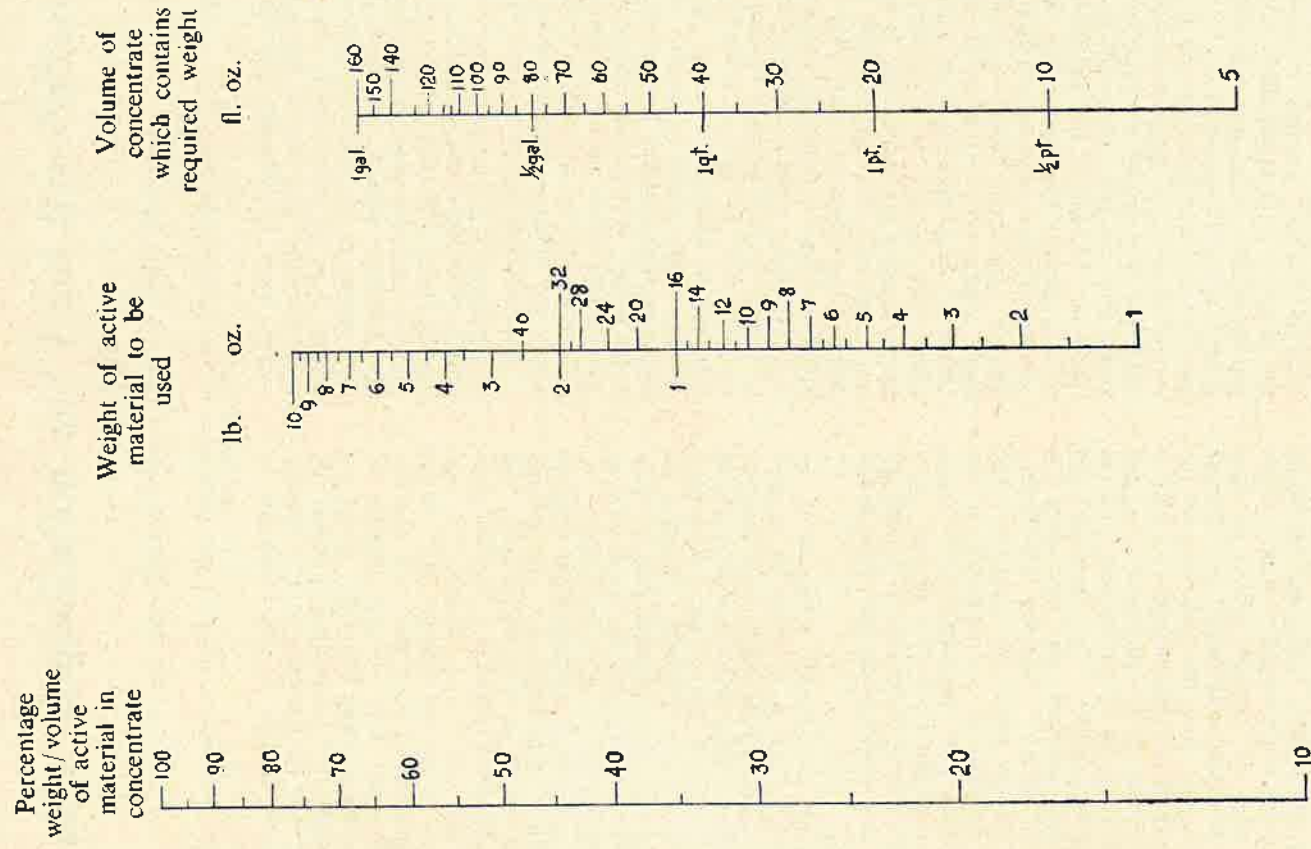
The straight edge is placed across the chart so that it passes through the 80 per cent. on the left-hand column and 8 oz. on the centre column.

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.

NOMOGRAPH 1



NOMOGRAPH 2



Social

This paper was presented

THE various the hereditary and environment of the individual have received considerable attention has been possible influences mental factors in the action and reaction as an organic unit in developing land-use pattern and stances. Another way would be in terms society is faced with a certain physical does it respond to it to adjust its way or is it trying to adapt life within the possible mental factors? and utilize its environment social pattern?

Botanists and ecologists of the flora as a result of topographical, climatic, is: the type of the region is considered determined, by the environmental factors. The tourist generally considers the genius for adaptation developed a system within the context generally speaking, of agriculture and physical environment interacting with temperature, rainfall and environment and climate and agricultural agricultural patterns development or utilization

Social Organization and Land Use Pattern.

G. P. KELENY.

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 agriculturalist 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 mammals, 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 (grasslands).

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 Batak. 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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In considering be drawn to the v has studied in and social organi societies through were extended to of agriculture in conclusions of reaching implica action between n studies confirm t is responsible fo the tropics, more associated with f primary occupati to pursue his ex establish a link l of the people an He claims that t in other parts of people, evidence of stock, cattle a form of agricu patriarchal (pet society. Follow traces the develop in various parts o social organization the determining including their a archal (or patrill to be based on the land it occu lands. This occu the land is in a h forms of agricult the establishment agriculture may be

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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 hill-sides, with dry rice and a very recent introduction, tapioca *Manihot utilissima* as the principal crops. The contention of Poggenдорff (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-

theless lacking, had father-right (Gajo, Alas, Batak, Nias, Mentawai, Pasumah, Moluccas) or a parental system probably based on a past with father-right (Toradja).... On the other hand, all regions suitable for and used for mixed gardening had mother-right or parental customs based on a past with mother-right. As already stated, some people in regions not suited to mixed gardening (the South Belu and the peoples of Wetar, etc.), nevertheless have mixed gardens and at the same time, mother-right. Thus in Indonesia there is a strong correlation between mixed gardening and mother-right.

"Thus, we see that in Indonesia, all regions with extensive grasslands are, or have been, inhabited by patriarchal cattle holding peoples or peoples with almost the same type of culture (Toradja).

"With the Indonesian peoples their cultural inheritance appears to have determined their type of agriculture, almost independently of their hereditary character and of ecological circumstances; cattle holding and grasslands in regions where the natural cover should be tropical rainforest; hoeing culture and mixed gardens in regions so dry that they are much more suited to cattle holding."

The above pattern of development draws its examples mainly from Indonesia and applies to conditions existing there. It cannot be applied to Papua and New Guinea where cattle or buffaloes have not been part of the traditional form of agriculture. A food gathering and hoeing agriculture is found over the whole area irrespective of the type of social organization, e.g., the people of the Highlands of New Guinea representing probably the most intensive form of agriculture and land use based on the sweet potato *Ipomoea batatas* are generally patrilineal. The Trobriand Islanders, who also have a fairly intensive system of land use, involving the utilization of compost, for Yam, *Dioscorea* spp. culture, are matrilineal. The Tolai people on the Gazelle Peninsula of New Britain having a staple diet of taro and *Musa* sp. are matrilineal, so are most of the Melanesians along the Papuan coast, one of the exceptions being the Motu at Port Moresby who are patrilineal. The people of the Western District of Papua (Sago staple) and most of those in the Sepik (Sago and Yam staple diet) are generally patrilineal. Thus, it would appear that the "Papuan" and the Melanesians inhabiting Papua and New Guinea

represent earlier cultures than those found at present in Indonesia, and cultures in which, perhaps due to the absence of stock raising, the same degree of specialization has not developed. The relics of older cultures based on grainless hoeing agriculture can, however, be found in many parts of Indonesia, e.g., Nias and Mentawai with a taro *Colocasia* sp. staple, Mandar on Celebes and the Halmaheras with a basic diet of *Musa* sp., and Ceram where a mixture of *Musa* sp., *Colocasia* sp. and Sago *Metroxylon* sp. is found. Rice is not usually found in these areas, and if it is, it is only a very recent introduction as are some of the new world plants, maize *Zea Mays*, sweet potato *Ipomoea batatas* and tapioca *Manihot utilisima*.

The investigations of Terra in tracing a correlation between social organization and land use are not only most interesting, but are also valuable in removing much of the "inevitableness" from land utilization and ecological environment. If the system of agriculture and indeed the present vegetative cover of inhabited regions is so greatly influenced by man and is merely the result of the accident of a form of social organization, then there must be hope for the possibility and success of effecting improvements to agriculture and inducing man to adopt practices leading to the preservation and improvement of the land and other natural resources.

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From Stone to Steel

R. E.

Melbourne University
University, Melb

"From Stone to Steel" is a book of history, have occurred among in many other areas and New Guinea. duction of modern steel axes, to a grove

The Siamese are a about 15,000 people of the Eastern Hemisphere. Although some of during the period of transition in 1953, they remained until 1945. traditional stone axes largely replaced by found their way into channels of indigenous and "their use in the became universal, and other aspects of native life."

In most areas of the introduction of steel advent of European traders, patrol officers of the change wrought behaviour can be attributed to a new pattern of exchange between the Europeans and the Siamese. With the Siamese least until 1945. Even World War seem to so they had twelve steel axes to replace them and in which to men to these new identity.

Dr. Salisbury has adjustment on the themselves. And for the or the administrator of the native people the modern world interesting and valuable

Book Reviews.

From Stone to Steel.

R. E. SALISBURY.

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

"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

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 distinguished 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 untied. 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-

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. Philipps,
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.

PAPUA AND NEW GUINEA AGRICULTURAL JOURNAL

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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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.

This section consists of four papers, the first two of which are extracts from the Annual Economic Surveys of Asia and the Far East for 1953 and 1957 issued by the United Nations Commission for Asia and the Far East. Although both deal with different aspects of the problems of economic stability and fluctuating world trade for the exports of these areas, they are now somewhat out of date. Declining terms of trade for raw materials are now demanding the most attention.

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

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 economics of the situation is based on the differences in the cost structure between the two production units. Bauer concludes that "in the virtual absence of cash costs and the lack of capital equipment for the smallholder, the maximization of gross yields per surface area is the overriding factor."

It is hard to understand why further work on this important aspect of small scale rubber production has not been undertaken. The reviewer has been unable to discover any arguments which shake Bauer's investigations. The implications of this work must be considered in any policy through small scale units. Comments by Professors Silcock and Benham, although raising some points for further investigation, do not upset the logic of Bauer's argument. It could be maintained and no doubt will be maintained, that the newer high-yielding varieties require high management skills and that Bauer's argument no longer applies. However, this should be tested.¹

The remaining papers by Bauer, Silcock and Benham look at the position of the smallholder in respect to the International Rubber Regulations Scheme (1934-1942) and the rubber policy of the Malayan government. Bauer argues that these worked against the interests of the smallholder but not those of the estates. He estimates the monetary losses suffered by the smallholders as a result of the quotas set by the International Scheme. The policy of the Malayan government towards replanting and new plantings would have in the long run eliminated the smallholder as a successful competitor to the estates.

This section is by far the most interesting in the book and like that on Tin is solely concerned with the position in Malaya. The Editor has carefully selected the papers and for this alone the publication should be read by all those interested in the future of rubber.

Tin.

Tin, the other prop of the Malayan economy, is not as well documented as rubber. The first paper, published in 1936, is only of historical interest but the workings of the International Tin Committee have considerable relevance to the present tendency towards international com-

modity stabilization schemes. The second paper is a fairly comprehensive study of tin mining in the Kinta Valley area of Malaya.

The paper dealing with labour relations on Chinese owned tin mines is worthy of study as it examines the complicated social and economic relations between management and workers.

Currency and Credit.

This section could have been omitted as it tells little about this important aspect of the economy of Malaya.

Professor Silcock has rounded off the publication with a list of graduation exercises on the economy, and these can be purchased from the Department of Economics, University of Malaya. They could provide some valuable source material.

Despite the comments, this publication is of considerable interest and now that the gaps in published data on the Malayan economy are known, work should be carried out to close these. It is to be hoped that a sister edition will appear in the near future.

G. R. Spinks.

Beekeeping.

A Beginner's Guide to Profitable Honey and Beeswax Production.

FRANCIS G. SMITH.

Oxford University Press, London, 1963. 124pp. Illustrated. Price in Australia 29s. 9d.

"The object of this book is to provide a guide to the profitable production of honey and beeswax for all who are interested in starting to keep bees" states Smith in his preface to this work.

After detailed descriptions of the internal organization of a colony of bees, the various functions of the comb, and the mechanics of hive ventilation and warmth, the author describes the construction of hives designed to facilitate man's exploitation of the honey bee to obtain both honey and wax. Chapters follow giving useful information on the management of hives, on routine apiary work, on control of swarming, and on production of new queens. A chapter on pests and diseases is followed by two chapters devoted to honey and beeswax. Smith devotes the final chapter to the all-important topic of marketing, and gives a summary of the normal outlets for honey and beeswax and of the importance of care, so as to obtain a clean and attractive product.

Of particular interest is the work amongst pri- dealing with simple- cribes how simple- made from the be- made from woven- timber can all be v-

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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. Smee.

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. M. \$5.

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. Proponents 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 information on which this study is based was gathered during surveys on that Authority's behalf.

The handloom industry of the East Coast is the largest and most important of Malaya's surviving cottage industries. From the producer'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-loom 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 materials is in the hands of a small number of large

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. He looks after the marketing.

In 1957-1958 there were 3,490 weavers active, all women, and they were estimated to have produced 225,000 yards of cloth valued at \$1,500,000 Malayan currency, about £A220,000. The capital invested in the industry was assessed to be no less than \$1.3 million, of which eighty per cent. or more was in stocks of materials, unsold goods, and working capital.

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 Fisk'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.

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Economic Development Studies.

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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.

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 Technology 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

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

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."

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. 5tg.

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-term 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

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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 in 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.