

# ANNUAL REPORTS OF THE DEPARTMENT OF AGRICULTURE FOR THE YEAR ENDING 30TH JUNE, 1939.

## DIRECTOR'S REPORT.

The Director, apart from administrative duties, paid many visits to plantations in the Gazelle Peninsula and directed operations at the Demonstration Plantation, Keravat. He also made an extensive tour of inspection of plantations on New Ireland from Kavieng to Namatanai, with Mr. G. W. Stanley, Inspector and Instructor, during which land for the head-quarters of an inspector and instructor was selected at Bo, Namatanai district. The locality chosen is on a branch road of the East Coast-road, New Ireland, so that, with a vehicle, the inspector can be in frequent touch with most planters and natives on New Ireland, the largest coco-nut growing area in the Territory. The Director addressed a meeting of planters at Kavieng on copra production which was well attended.

A visit was paid to Aiyura, 6,000 feet elevation, for the purpose of inspecting cinchona, coffee and other crops introduced to that highland district. Too much cannot be said for the energy and enterprise shown by the Officer-in-charge of that station, and the commanding influence he and his wife have over natives from the so-called uncontrolled area.

Later, the Director visited Wau, 3,000 feet, where he inspected several farms which the owners were struggling to establish by the production of food crops for the European settlement. The coffee, *Arabica* (Blue Mountain Jamaica), introduced by the Department eight years ago is still thriving and producing heavy crops which shows the district to be well suited for this valuable crop.

At Lae the holdings of the settlers in that district were inspected and instructions given to the owners individually, in addition to a public address on cacao and rubber planting. The meeting was attended by practically all the residents of Lae and apparently was greatly appreciated.

Mr. J. L. Froggatt, Entomologist, was largely engaged during the year on the breeding and distribution of parasites, particularly *Pleurotropis parvulus*, of the coco-nut leaf mining pest *Promecotheca papuana*, full particulars of which are given in a separate report.

Mr. R. E. P. Dwyer, Economic Botanist, made an extensive patrol of the north-western islands to investigate the decreased production of coco-nuts in that portion of the Territory.

An Agricultural Chemist was appointed to the department and when he commences duty, reliable advice on chemical fertilizers can be supplied to the planters.

Mr. B. A. O'Connor, stationed at the Entomological Field Laboratory at Manus, was engaged on investigations for the control of the coco-nut tree-hopper, *Sexava*, and proved that dusting with arsenical powders could effectively control the pest. He was also employed in breeding and liberating *Pleurotropis parvulus*, on Lindenhafen and other areas infested with *Promecotheca papuana*.

Mr. C. C. Marr, Inspector and Instructor, has been stationed at Vunakanau in charge of native agriculture and to advise planters in the Kokopo district. The natives in this district being between two centres like Rabaul and Kokopo, are probably the most sophisticated in the Territory, but Mr. Marr's experience of native mentality has given him considerable influence over them.

Mr. Breechin, Officer-in-charge of the Agricultural Station at Aiyura, on the Upper Ramu, Mainland of New Guinea, is doing good work amongst totally uncivilized natives. Soy beans and other new foods have been introduced to them and the improved dietary should have a beneficial effect on their stamina. Natives come from long distances within the uncontrolled area and make friendly visits to the station, getting instruction in agriculture and taking seeds and plants back to their village gardens. Cinchona of four types, including high quality *C. ledgeriana*, are thriving at the station and there is good reason to believe that it may yet be the foundation of a new industry. Arabian coffee, tea, pyrethrum and many fruits are established on the station.

### Pests and Diseases.

The two most serious coco-nut pests in the Territory have received careful study by the entomological staff and very satisfactory progress has been made. The parasite, *Pleurotropis parvulus*, has, we have good reason to believe, become established in the Territory and has brought the coco-nut leaf-miner beetle, *Promecotheca papuana*, under control. The parasite, *Leefmansia bicolor*, has not proved as successful as hoped on Manus, but demonstrations prove that the pest can be kept under control by dusting with arsenical powder.

Attempts are being made to introduce *Tetrastichodes*, parasites on the leaf hispa, *Brontispa froggatti*.

The *Bufo marinus*, introduced from French Guiana, via Trinidad, Hawaii and Queensland, has become thoroughly established and reports indicate that it is successful in controlling various insect pests including *Hippotion celerio*, a serious pest of sweet potatoes. Many other insect pests and diseases have been investigated by the entomological staff and the Economic Botanist.

### Copra.

The year 1938-1939 has been an unfortunate one for the coco-nut planter on account of the depressed state of the copra market. The drop in prices started in February, 1938, and there was a slow and steady decline so that only those planters producing under the most favorable circumstances were able to have a margin of profit. Nevertheless, there is no reason for undue despondency, as copra produces the most valuable of all vegetable oils but, like the wheat farmer, the coco-nut planter must endeavour to increase his yields per acre at the lowest possible costs if he is to obtain reasonable profits. The correct use of leguminous cover crops, tall as well as creeper, and the right application of suitable fertilizers, have been repeatedly used to increase yields unless the plantation is too far gone.

### Desiccated Coco-nut.

The production of this commodity has been maintained and sells at remunerative prices in Australia. There is no possibility of expanding this branch of the industry as Australian demands can be met with the present production and, as an export trade, there is not much likelihood of being able to compete with Ceylon.



### Fresh Coco-nuts for the Fruit Trade.

This small industry apparently has collapsed as it suffered from infrequent shipping facilities and could hardly be expected to be able to compete with nearer coco-nut growing countries like Fiji.

### Coir Fibre.

There is one mill established in the Territory and the samples of fibre examined by the Department were quite equal, if not superior, to the Ceylon article.

### Coffee (Robusta type).

In one instance, this industry suffered from bad plantation management, but another large plantation has been put under a capable manager and reports show that there has been a great improvement in its maintenance and yield. Arabian coffee at Wau, 3,500 feet above sea level, still continues to yield heavily and the owner has extended his planted area. The small area of this variety (Blue Mountain Jamaica) at Aiyura is very healthy and has commenced bearing.

### Cocoa.

The area planted with this crop continues to increase but, despite recommendations of the Department of Agriculture, few planters take the trouble to plant selected seed, although seed of high quality trees at Keravat are available at reasonable rates.

### Tea.

The plants introduced to the Agricultural Station, Aiyura, suffered a serious set-back and a number were destroyed by fire, but those remaining are now coming on well.

### Derris.

Little advance has been made in the cultivation of this valuable crop. It is a relatively quick-growing crop compared with coco-nuts but many planters in this Territory, accustomed as they have been to the latter, find difficulty in entering upon a new crop that requires cultivation in its early stages.

### Rubber.

On account of the higher prices now obtained from this product and the depressed state of the copra market, several planters are talking of entering upon its cultivation. Numbers of planters have purchased seed of *Hevea*, but no new plantations have yet been started.

### Cinchona.

Four species and hybrids, including *C. ledgeriana*, of this plant have been established at the mountain agricultural station, Aiyura. The growth of these plants has been very satisfactory and, considering their age, seems to indicate that soil and climate are even suitable for the more delicate and valuable *C. ledgeriana*.

### Peanuts.

This plant has now entered into native agriculture, being always found in every village garden, and is much appreciated in native diet.

### Vegetables.

An increasing quantity of European vegetables is now being grown by natives in the neighbourhood of settlements for which there is a good demand from Europeans and Chinese. Seeds were introduced by the Agricultural Department in the first place, but the product is far inferior to cold storage vegetables imported from Australia. Inspectors and instructors of the Department are doing their best to raise the standard of these crops by instruction to natives.

### Assistance to Planters.

Every possible assistance continues to be rendered to planters. Parasites for the control of *Promecotheca*, a serious pest of coco-nuts, has been bred in the Department's entomological laboratory and distributed to planters in all those districts attacked by this pest.

Advice has been given on many subjects to planters by the Director and other members of the staff, and several planters have expressed their appreciation of the assistance thus rendered.

Selected seeds of high-yielding cacao, coco-nut and other plants have been distributed in large quantities at reasonable prices from the Demonstration Plantation. Small numbers of plants of economic and ornamental types have been distributed gratis for experimental purposes from the Botanic Gardens.

Samples of soil have been continued to be sent to the Waite Institute in Australia for analyses. This is very kindly done as a special favour to the Department, as we have no claim on the services of this institution.

### Native Agriculture.

This branch of the Department's activities has received every attention throughout the year, as it is an important part of the duties of inspectors and instructors.

Three inspectors have been stationed in centres of relatively large native population and have been able to be in frequent contact with the natives to advise and instruct them in improved methods of cultivation, and introduce new food plants to them. In certain cases, even tools have been issued to them on loan.

Practically all native coco-nut groves throughout the Territory have been inspected, and in many cases there has been a marked improvement in their maintenance by the introduction of cover plants and correct cultural practice.

Owing to the slump in market prices, natives have shown a distinct disinclination to turn their nuts into copra, which, after all, clearly shows that copra production is not essential for their maintenance. Their gardens are sufficient to provide them with all their food requirements and copra is only used to provide them with the luxuries of life. Until these luxuries become essentials, thus raising the standard of living, we can hardly hope for any permanency in advanced native agriculture.

### ENTOMOLOGIST'S REPORT.

From January, 1939, to June, 1939, the Entomologist was appointed Acting Director during the absence of the Director on sick leave.

Owing to the very close attention required in the *Promecotheca* parasite breeding and the extra duties entailed as Acting Director, the Entomologist has not been able to visit other portions of the Territory for the greater part of the year.



The following areas, however, were visited:—

Manus and the Western Islands—from 19th July to 30th July, 1938.

Buka Passage sector—from 13th to 24th August, 1938.

South Coast, New Britain—from 5th to 13th September, 1938.

Pondo Plantation, New Britain—23rd to 29th September, 1938, and 12th to 16th May, 1939.

Rabaul-Kokopo area visited on single-day trips in connexion with observations on various pests.

Parasites of *Promecotheca papuana*. Csiki: On 6th October, 1938, a colony of *Pleurotropis parvulus* larval and pupal parasites of *P. papuana* was landed successfully by air liner from Fiji through the assistance and co-operation of W. R. Carpenter & Co. Ltd.

Two previous unsuccessful attempts had been made to introduce this parasite, one from New Hebrides and one from Fiji.

Breeding of *P. parvulus* to build up stocks of the parasite for liberation was immediately commenced; the life-history of this species, together with that of the two indigenous larval parasites *Eurytoma promecolthecae*, Ferr. and *Clostero-cerus splendens*, Kow. was studied in detail, and in each case the life was found to be approximately half that of the host. Instruction in breeding these parasites was given to several planters who desired to build up the parasite population on their own plantations.

Breeding material was drawn mainly from one plantation in the Kokopo district, where a mild infestation of *P. papuana* was present over a large area of young coco-nuts; a few other localized centres of mild infestation in the Rabaul-Kokopo area also contributed a quota. Early in December, 1938, the supply of material available showed a marked decrease and declined steadily until the end of January, 1939, when it had practically ceased. This was due to the combined effects of the three species of parasites referred to.

Liberation of *P. parvulus* was commenced early in November, 1938, in the Rabaul-Kokopo area wherever any evidence of infestation by *P. papuana* was observed. Colonies were also despatched from Rabaul to the Talasea sub-district, New Britain, and to Manus District.

Owing to the limited supply of breeding material from the inception of the work in Rabaul, and the continued prevalence of the pest in the Gasmata sub-district, New Britain, the Assistant Entomologist was, in November, transferred from Manus district to Gasmata sub-district, with head-quarters at Lindenhafen, to carry out breeding and distribution of *P. parvulus* and to make a general study of the pest and any indigenous parasites in the latter area.

From this area liberations of *P. parvulus* were commenced early in December, and were recovered from parasitized larvae collected in the field early in February. The single phase of *P. papuana* has persisted in Lindenhafen, and it has been found that this condition has, to date, militated against a mass carry-over of the parasite from one host generation to the next. This matter is receiving further study.

Colonies were also supplied from the Field Laboratory, Lindenhafen, to other centres in the Gasmata sub-district, for Linga-Linga, Talasea and for Manus.

A ready control of the adult beetles has been obtained by spraying with Arsenate of Lead and Nicotine.

*Rhyncophorus papuanus*, Kirsch (Black Palm Weevil), has given a considerable amount of trouble in the Gazelle Peninsula, New Britain. Tests are being started with a proprietary preparation from Ceylon.

Two consignments of copra from a plantation in the Manus group were so heavily infested with the larvae of *Ephestia cautella* that fumigation had to be resorted to in order to prevent increased population of the moths in the sheds. The bags were stacked in the Departmental fumigator in rows with dunnage between layers and treated with hydrocyanic acid gas for 48 hours, the fumigant being generated from "Cyanogas" calcium cyanide used at the rate of 3 lb. per 1,000 cubic feet.

The Braconid, *Bracon bebetor*, Say, was later found breeding in considerable numbers in the *Ephestia* larvae.

The Giant Toad, *Bufo marinus*, is being distributed to various parts of the Territory to endeavour to control the pest, *Hippotion celerio*, of sweet potatoes.

At the break of the dry season at Buka Passage, cutworms did considerable damage to various crops for a short period until parasites gained control. *Prodenia litura* on Taro, *Heliothis obsoleta* on Maize were particularly numerous and *Pseudococcus* sp. and *Coccus viridis* on coffee. Spraying with a miscible oil spray has given control of these coccid pests.

The following articles were published during the year in the *New Guinea Agricultural Gazette*:—

- (1) "Measures for Control of *Sexava* spp."
- (2) "Weevil Pests of Cocoa."
- (3) "Pests of Cocoa in the Territory of New Guinea."
- (4) "The Coco-nut Leaf-miner, *Promecotheca papuana*, Csiki, and its parasites in the Territory of New Guinea."
- (5) "Fumigation and Fumigants."
- (6) "Insect Pests of Rice."
- (7) "Copra Infestation by *Ephestia cautella* and fumigation for its Control." (With Mr. F. O. Moody as co-author.)

The following insect pests, parasites and predators are recorded for the year, and were either bred or collected in Rabaul and other parts of the Territory:—

COCO-NUTS—

*Coccidae*—*Dinaspis reitchii*, Green and Laing.

*Coccus mangiferae*, Green.

*Ischnaspis longirostris*, Sign.

*Pinnaspis pseudoaspidistrae*, Green.

Parasites of *Promecotheca papuana*—

*Eulophidae*, *Eurytoma promecotheca*, Ferr.

*Closterocerus splendens*, Kow.

*Deroslenus* sp.

(all larval parasites).

*Eupelmidae*, *Anastatus* sp. (egg parasites).

*C. splendens* and *Anastatus* sp. are recorded from Manus and New Britain.



Predator of *Promecotheca papuana* adults—  
*Pentatomidae*, *Anyolea reciprocus*, Wlk. var.  
*Sexara* egg parasites, Lilui Island—  
*Scelionidae*, *Prospagus attrellus*, Dodd.  
*Eulophidae*, *Tetrastichodes* sp.

#### COPRA—

*Pyralidae*, *Ephestia cautella*, Wlk.  
*Bracon hebetor*, Say, (*Braconidae*), larval parasite of *E. cautella*.

#### COCO-NUT SPATHES—

*Curculionidae*, *Meredolis cocotis*, Mshll. (collected Kokopo, New Britain).  
*Metrostylis sagu*—  
*Curculionidae*, *Rhyncophorus kaupi*, Schauf. (collected Huon Gulf, Morobe District).

#### COCOA—

*Noctuidae*, *Erias citrina*, Saalm. on foliage.  
*Eucosmidae*, *Laspeyresia* sp.—larvae boring in shell of pods.  
*Limacodidae*, *Scopelode* sp., on foliage.  
*Coccidae*, *Pseudococcus* sp. on pods.  
*Thysanoptera*—*Heliothrips haemorrhoidalis*, Bouche, *Selenothrips rubrocinctus*, Giard, both spp. on the foliage.

#### ERYTHRINA—

*Noctuidae*—*Othreis fullonica* L. on foliage; the adults of this moth caused marked damage to ripening citrus, pawpaws, bananas, &c.  
*Coccidae*—*Ferrisia virgata*, Ckll.

#### COFFEE—

*Coccidae*: *Coccus viridis* Green.  
 Mealybug predators—  
*Coccinellidae*, *Alesia lineata*, Thumb.  
*Cryptolaemus montrouzeri*, Muls.  
*Scymus* sp.

#### LYGAEIDAE—

*Scopistates* sp.—this specimen was always present in numbers on coffee bushes infested with mealybug.

#### MANGO—

*Trypetidae*, *Dacus frauenfeldi*, Schin. in fruit.  
*Boisteres* sp. nr. *compensans*, Silv. (*Braconidae*)—parasite of larvae of *D. frauenfeldi*.  
*Drosophyllidae*, *Drosophila punctipennis*—sub-sp. *parapunctipennis* Duda. in over-ripe fruit.  
*Eucosmidae*—*Argyroplote aprobola*, Meyr. on foliage.  
*Eugenia mallacensis*—  
*Trypetidae*, *Dacus frauenfeldi*, Schin. in fruit.  
*Drosophyllidae*, *Drosophila punctipennis*—sub-sp. *parapunctipennis* Duda in over-ripe fruit.  
*Tortricidae*, *Homona aestivana*, Wlk. on foliage.

#### TOBACCO AND TOMATOES—

*Capsidae*, *Euglytus tenuis*, Tent. on flowers—causing the blossoms to fall.

## VARIOUS HOSTS—

*Lepidoptera.*

- Noctuidae*, { *Serrodex campana*, Mab. and  
*Oxyodes ochreatea*, Roth. on rembutan foliage.  
*Parallelia stuposa* F. on *Acalypha* foliage.  
*Parallelia palumba*, Guen. on citrus, on foliage.  
*Hyblaea fura*, Cram. on Teak foliage.  
*Erias fabia*, Cram. and *Anonis flava* F., on "Aibika."
- Sphingidae*, *Deilephila placida*, Wlk. on *Taberna montana*.
- Tortricidae*, { *Homona mermerodes*, Meyr. on *Clerodendron* foliage.  
*Adoxophyes* sp. nr. *melichron*, Low on peanut foliage.
- Lyonetidae*, *Opogona taochroa*, Mehr. in sugar-cane.
- Cosmopterygidae*, *Pyroderces tripola*, Meyr. in seed of pods of *Octomeles sumatrana*.
- Heliodinidae*, *Strathmopoda* sp. in ripe fruit of Madagascar plum.
- Eucosmidae*, *Laspeyresia* sp. in Carembola fruit.
- Gracillariidae*, *Acrocercops cramerella*, Snell, in fruit of *Synometra cauliflora*.
- Rhyncota*, *Halticus* sp. on beans.
- Platyaspidae*, *brachyplatys* sp. on beans.
- Coccidae*, *Pinnaspis aspidistrae*, Sign. on Maidenhair fern.

## ECONOMIC BOTANIST'S REPORT.

Advisory work has of necessity taken up a considerable proportion of the available time and the usual biennial furlough lasted until 24th August of the year under review.

Since arriving in this Territory, facilities have been made available so that most of the planted areas in New Guinea have been visited, many properties three or four times. The properties on the western islands and the plantations bordering Astrolabe Bay close to Madang were visited for the first time this year. The plantations not yet covered are on the mainland coast of New Guinea from Madang to Aitape, Dampier or Kar Kar Island, the Portland Islands and part of Gasmata sub-district.

During the year, the following articles were published in the *New Guinea Agricultural Gazette*:—

- (1) "Coco-nut Improvement by Seed Selection and Plant Breeding."
- (2) "Fall of Mature Palms in New Guinea Plantations."

In the hands of the printer is an article on "Coco-nut Diseases Associated with Soil Conditions in New Guinea."

Apparently, the low to moderate ruling prices and the uncertainty of the future prospects of the copra market are producing one desired effect in further turning the attention of local producers to other plantation crops. The position for the Territory as a whole is, nevertheless, unfortunate, as there is not so much money available for development.

Cacao cultivation has continued to receive increased attention, which has necessitated much preliminary advice and inspection of areas intended for this crop. Undoubtedly, the provisions of the Bounties Act has also had a good deal to do with this development.



Many inquiries have been received as to the possibility of rubber planting in New Guinea. Investigations of the economic prospects of this crop are being made, as these are not clear. No local publication on the subject has yet been prepared, but detailed notes on methods of planting, clearing, &c., have been furnished to interested planters. A similar circular containing particulars of tapping and factory equipment has been supplied to those plantations where ordinary rubber, *Hevea brasiliensis*, and *Ficus elastica* (Assam rubber), was established during the German régime.

The ruling high prices and the success of the industry in Papua, where 1,243 tons, valued at £129,448, was produced last season, have been to some extent responsible for this increased interest. A more important reason, however, is that on three properties *Hevea* rubber has been established and has flourished for many years without attention, and is now being successfully and profitably tapped. The fact that heavy restrictions have made the high prices possible, is the threatening circumstance.

In practically every instance, it is the economic prospects of the various crops which require elucidating before definite recommendations can be made. The experience of the intending planter and the type of labour available has to be taken into account. Nowhere is this more apparent than on the few lowland coffee plantations here, where the only hope of bringing them to the dividend-paying stage depends on experienced management and supervision. It is for reasons of this nature, that cacao rather than coffee planting seems to be preferable for New Guinea conditions.

It is now known that high-quality *Arabica* coffee, free from coffee rust and berry borers, can be grown at high levels here, but transport facilities and the factors already mentioned will determine future developments. The Kent's Hybrid *Arabica* coffee introduced from India was established on a small scale in an isolated area on the Bainings, through the courtesy of the Catholic Mission. Seed of this high-grade coffee was harvested and sent to the high level station at Aiyura.

It is interesting to note that, as there is no coffee rust (*Hemileia vastatrix*) present here, there are four widely separated places where small areas of *Arabica* coffee are flourishing almost at sea level. The best example of this is at Mandres Plantation, where a few acres of such coffee have been grown and utilized for many years. High-grade coffee is worthy of much greater trial at high levels.

Some planters are now growing their own cover crops and in three cases seed was sold on a commercial basis, which is a desirable development.

#### Property Inspections.

Under an arrangement made by the Custodian of Expropriated Property with the Director of Agriculture, inspections and investigations of a number of old declining properties were made.

The main aspects of maintenance of plantation properties may be said to comprise—

- (a) Control of pests and diseases.
- (b) Conservation of the planted areas by cultural methods so that diminution in production is controlled.

Reference to an article entitled "A Survey of the Coco-nut Industry in the Mandated Territory of New Guinea" (see *New Guinea Agricultural Gazette*, Vol. 2, No. 2, October, 1936) and, also, various Departmental reports, outline the problems offered by the obvious decline in output of a considerable number of the older properties in this Territory. These properties very largely comprise the plantations taken over by the Commonwealth Government upon the expropriation of German colonists in 1920-21. Many of these properties are now approximately 50 years planted whilst the youngest of them is nineteen years under coco-nuts. It is obvious that properties giving a low yield of copra per acre show a high cost of production, which is particularly felt when the prices of copra are low.

Reports on the inspections made were submitted to the Department from time to time, and these reports, containing the conclusions arrived at, were passed on to the Custodian. It was found that usually a combination of circumstances, such as age of the palms, linked with soil exhaustion, lack of seed selection and care in the original plantings, and poor cultural methods, was largely responsible for the present condition of the declining properties. Some of them were originally planted all or in part on unsuitable soils, and little could be done about them.

It was also established that the solution of the difficulties is no easy matter. This is largely because soil conditions and the remedial measures which would apply to the soils of the coral atolls of the Western Islands, for instance, have little relationship to those found where plantations are situated on estuarine deposits on the mainland. The soil conditions of both these places are quite different from those of the volcanic pumiceous soils of the Gazelle Peninsula.

In practically every instance, it was possible to make recommendations for improving the planted areas though where the soil profiles are very unfavorable, very little improvement can be expected.

Increased use of cover crops, such as *Centrosema pubescens*, *Calopogonium mucunoides* and *Pueraria javanica*, such as has been long advocated by this Department, was indicated in most places.

#### Plant Improvement.

In view of the high variability of the population of palms in plantations, the need for a more scientific system of selection has long been apparent, and is being urged and practised by this Department. Similar variations in yield, quality and other characteristics and the certainty of isolating and breeding superior types, is the aim underlying the plant breeding and selection work on this and various other crops, carried out at Keravat Demonstration Plantation.

Regional strains of coco-nuts, the most noteworthy being the Markham Valley strain, have been isolated and are being grown at Keravat, where they are being used in the selection and breeding programme mentioned in the last annual report. There, it was also pointed out that 33 dwarf or King coco-nut palms were crossed with five selected Markham types of palms as pollen parents. The resultant crossed nuts have now been planted out in an isolated area, the crossed nuts from each mother palm being kept separate.

The Niu Luka, Malayan Dwarf cross palms, introduced from Fiji last season, are planted in the near vicinity and will provide an interesting comparison.



It was also pointed out that, assisted by the Superintendent, the best palms only were selected in both the Markham and Dwarf varieties. The Superintendent is now engaged in taking detailed records of the individual palm selections and, until this is complete, it is not possible to do any more crossing. As soon as possible, however, it is intended to artificially cross the best yielding palms within the Markham strain, so as to fix the most desirable types.

Further crossing will then be done between the selected ordinary tall coco-nuts derived from various sources in New Guinea, and the most promising selections of the varieties mentioned.

The coffee cross-breeds mentioned as being successfully raised last year have been planted out for observation and selection purposes.

As mentioned in previous reports, a number of selected rubber trees growing in the Botanic Gardens were test-tapped during the season 1937-38, and all of the inferior yielding trees were cut out to allow of cross-pollination between superior yielding types only. Seed of the higher yielding remaining trees was distributed to some interested planters here, and also to the Director of Agriculture, Fiji.

Extensive seed nurseries were also laid down at Keravat with rubber seed derived from the same selected trees. The various selections were kept separate, and are now ready for planting out in plots for comparative testing.

Duplicate nurseries were made with most of the best rubber selections at Rabaul, where an area has been lined and holed in the Economic Section of the Gardens to establish a bud-wood nursery for vegetative propagation purposes.

### **Plant Introduction and Exchange.**

During a visit to Canberra, Australian Capital Territory, arrangements were made with Dr. McTaggart, Chief Plant Introduction Officer of the Council for Scientific and Industrial Research, to take advantage of the extensive and Commonwealth-wide campaign of plant introduction. The Department is greatly interested in possible green manure and cover crops, as well as low-growing, temporary shade and over 60 introductions of these types of plants have already been made through the kind courtesy and co-operation of Dr. McTaggart.

Numerous new plant introductions were made during the year, most economic species being distributed to the experimental stations although representative specimens of various types of fruit trees were retained for the Botanic Gardens.

A fine collection of plants containing several economic species of fruiting plants was obtained from Hong Kong by the Chinese nurseryman when returning from leave.

### **Herbarium.**

Several hundred mounted and carded herbarium specimens were added to the collection during the year. Particular mention should be made of the several specimens of grasses and legumes, collected by Mr. Wood, Inspector and Instructor, stationed in the Sepik District.

As is common in the tropics, it is most difficult to keep the dried specimens free of insect pests. It will probably be necessary to use tin containers inside the tight-fitting, storage cupboards which were obtained last year,

In collaboration with Mr. d'Espeissis, a good deal of plant identification work was carried out in the field as opportunity permitted. This work was also greatly aided by the kind assistance of Mr. J. H. L. Waterhouse, who lent some intelligent boys from Nodup School. He also supplied several lists of plants in which the native names from Nodup (Blanche Bay dialect) and other districts had been linked with botanic names of the plant identified for him by Dr. Merrill of the Harvard Arboretum. As far as possible, this work has been checked by cross-references. Other identifications were obtained direct from the Director of the Botanic Gardens, Kew, and from the Queensland National Herbarium.

Mrs. M. S. Clemens, Botanical Collector, sent in a species of grass belonging to the genus *Glyceria*, which is the first record of this genus occurring in New Guinea. She also sent in a species of *Euphorbia complanata*, Warb., which is really a Xerophytic or dryland plant spreading from India to the New Hebrides which is said to represent some botanical evidence of the original land connexions between these countries.

### Diseases.

Further investigations and observations on occurrences of physiological disorders (wilts, die-backs, &c.) of coco-nut palms in New Guinea have been continued. The results of these investigations are presented in a *Gazette* ready for publication.

Special attention has been paid to "Maturation Wilts" of young coco-nut palms at the first-bearing stage, which occur from time to time in various parts of this Territory. Reports on soil analyses by the Waite Institute and the comments of their chemist, Mr. J. S. Hosking, and plant pathologist, Mr. D. B. Adam, on the nutrient status and water-relationships of the soils associated with the occurrence of such wilts on plantations at Kokopo and Namatanai have been most helpful. They have indicated the close resemblance between these occurrences, and the "Bronze Wilts" described from Trinidad, although the effects are less severe and other inter-locking, limiting factors seem to be present.

Some pathological derangements of mature palms ("Mature palm wilt"), particularly from those plantations situated on the deltaic and estuarine deposits of the Huon Gulf and Astrolabe Bay areas of the New Guinea Mainland, have been investigated in the field and described together with contributory causes.

Soil profiles and root distributions of coconut palms in such soils and, also, their natural adaptations to changing conditions, have been studied. Although many fungi such as *Thielaviopsis paradoxa*, *Botryodiplodia* spp., *Fusarium* spp., &c., have been found associated with these derangements of coco-nut palms, in every case, the soil conditions were at fault. It was found that in those areas where heavy soils liable to waterlogging exist, there is decided necessity for root adjustment in the change-over period from the wet to the dry season, which under normal conditions often has a marked physiological effect on the palms. Seasonal breeding, nut-fall, leaf-droop, frond-fall and often loss of palms, may occur, where the surface-layers are liable to waterlogging with the formation of a super-imposed water-table in the wet season, and to drying out and cracking in the dry season. This effect is greatly exaggerated either where hard pans exist or conversely, where rubble and sand layers exist.



Some occurrences of the falling of healthy, mature coco-nut palms associated with particular physical conditions of soil and sub-soil have also been investigated in the field and the findings published (see *New Guinea Agricultural Gazette*, Vol. 5, No. 1).

In parts of the Witu Island Group coco-nut palms were found to flourish and produce good crops despite the fact that their roots could not penetrate more than 18 inches at the most, owing to the presence of hardened rock-layers as the newly-derived soil was of volcanic origin and very rich and friable. In the deep pumice soils of Rabaul, a few roots of young palms were seen to have reached a depth of at least 30 feet.

It has been clearly determined that from a practical standpoint, the study of soil profiles, as to depth, presence of hard-pans, &c., has yielded much information concerning the suitability of particular areas for coco-nut cultivation. It has also proved of great value in assessing the actual potential value of plantations even where chemical data cannot be obtained.

The importance of proper cultural conditions in relation to the control of most coco-nut diseases, but particularly those of physiological origin, is most apparent. The necessity for detailed chemical and botanical research on the nutrition of coco-nut palms in relation to the soil conditions found here has also been clearly indicated.

The Director of Agriculture and other departmental officers investigated and macroscopically diagnosed true "bud-rot" on one plantation here. Microscopic examination of specimens of diseased tissue made by the Imperial Mycological Institute revealed the presence of fungus mycelium which they considered to be *Phytophthora* from measurements taken. Detailed microscopic examination of fresh specimens was later made in the laboratory at Rabaul. It was found definitely that the bud-rotting fungus *Phytophthora palmivora* was associated with the diseases. The best microscopic slides were obtained from a naturally-isolated, almost pure culture of the organism in the central tissue of the lower trunk (a most unusual site for this fungus to occur). The mature spores (oo-spores) and resting spores were unmistakable under the microscope as they showed the varying forms and the pronounced beaks characterising the spores of this fungus.

The same fungus was found associated with a case of "spear die-back" of oil palms at Keravat some time ago, but only a few palms were lost and the condition cleared up.

The bud-rot developed under flat and foothill conditions in a region of heavy rainfall in an abnormal climatic season, and even then only in areas where the palms were growing on heavy soil, liable to water-logging. A visit was made to investigate the possibility of this disease spreading to other properties. The indications are very strong that the disease would only prove serious under comparable conditions to those indicated, as the fungus can only develop in a very moist atmosphere.

It is certain that the fungus *Phytophthora palmivora* is widely spread in the Territory of New Guinea and, apart from the coco-nut palm, there are plenty of other host plants available (e.g., cacao, betel nut, *Areca catchu*, oil palm, pawpaws, *Hevea* rubber, &c.), which this fungus does attack. It would appear, therefore, that it is only under certain special circumstances that this fungus causes serious loss of coco-nut palms and probably only when a virulent strain

of the fungus is present. Strong measures are being taken to control the disease and, although there has been a loss of palms spreading over twelve months, the disease has been confined to one property.

On one coffee plantation here, improved plant sanitation, as recommended, has reduced the incidence of thread-blight (*Corticium kolera*), die-back (*Diplodia* spp.) and root rot to a minimum, although they were formerly causing much damage.

On old properties here, where rubber was interplanted with cacao and then neglected, it was seen that root rotting fungi, *Fomes* spp., *Ustilinia* spp., *Rigidoporus microporus*, &c., have spread from the cacao to the rubber which would indicate one danger from interplanting these crops.

Eelworms or parasitic nematodes (round worms) of microscopic size are common causes of plant diseases in New Guinea.

*Heterodera radiculicola*.—These nodular eelworms were found causing serious damage to the roots of crop and garden plants last season. They have a very wide range of hosts and are difficult to control. They were found here on tobacco, tomatoes, rice, pawpaws, *Patchouli pogostemon*, bush-shrubs, and caused very serious damage on the garden balsams, *Impatiens balsamina*, and on gerberas.

From specimens of diseased yams and slides sent, Dr. Goodey, of the Institute of Agricultural Parasitology, England, has identified *Anguillulina pratensis*, as associated with the sapronphytic eelworms, *Cephalobus striatus*, *Aphelenchoides parietinus* and *Rhabditis* spp. He recommended washing the yams for a certain period and painting their lesions with a solution of iodine in potassium iodide at a dilution of 1 in 5,000 as treatment.

The saprophytic eelworm *Cephalobus rigidus* has been isolated and identified from coco-nut fronds but, so far, no parasitic species such as occurs in the West Indies have been observed damaging the palms.

The fungus *Rhizoctonia* spp. was found causing serious damage on the tennis court lawns of the Botanic Gardens, Rabaul. The severe damage was probably assisted by pumice compaction and alteration of the soil reaction. Prompt action has been taken to remedy this by removing several inches of the surface soil and renewing with fresh soil which meant complete replacement of the lawns.

Several diseased plants were sent to the Department of Agriculture for identification. It was seen that leaf-spots due to *Cercospora* spp. were common cause of trouble with vegetable plants such as beans and frog-eye spots, *Xercospora nicotianae*, were so severe as to lessen the value of leaf tobacco for native use.

Specimens of *Diplodia* and *Botryodiplodia* fungi from rubber, cacao and coffee, were sent by request to the Agricultural Experiment Station, Florida, for comparative studies.

Numerous types of grass rusts were supplied to the University of Sydney to assist in scientific studies connected with cereal rusts.

Specimens of probable new kinds of loose smuts and flag-smut on various grasses and sedges were located and sent to Professor Zundel of the State College, Pennsylvania, for his studies on the "Smuts of the World".