RÉSUMÉ OF THE ACTIVITIES OF THE DEPARTMENT OF AGRICULTURE.

FOR THE YEAR ENDED 30TH JUNE, 1936.

On 9th February, 1936, the Director returned from nearly twelve months' leave of absence, during which he attended the Imperial and International Botanical and Entomological Congresses in London, Amsterdam, and Madrid, respectively.

At these Congresses he had the opportunity of hearing many valuable papers and took part in some of the discussions, while personal contact with fellow workers from other fields was also of inestimable value in connexion with his work in New Guinea.

The rest of his leave was spent in study at agricultural research stations, departments of agriculture and estates in several tropical countries.

The violent fluctuations in the prices of copra and coco-nut oil have been succeeded by strong upward movements which have given a feeling of greater hopefulness and security to the coco-nut planters of the Territory, some of whom were beginning to fear the stability of our staple crop, and were interplanting their palms with cocoa.

Various abnormal causes have, no doubt, been partly responsible for the upward trend in prices, as e.g., droughts in America, resulting in a shortage of domestic fats and the vicissitudes of the European political situation and the prospects of war.

Whatever the cause, however, the natural consequence of increased copra prices was a larger output, and it is satisfactory to note that there was also a general improvement in the quality of the copra. Improved weather conditions after the drought, in some districts, have, no doubt, had some affect on the larger production, and the better quality of the copra is due to the system of copra inspection and inspection of driers by inspectors and instructors. The export of copra during the past year was 66,684 tons, as against 56,251 tons for the previous year.

The method of processing all town refuse from whatever source into innocuous compost was demonstrated to the Public Health Department, and is now put into general practice at the Sanitary Depot near Rabaul. The method was devised by Sir Albert Howard, C.I.E., Director of Indore Agricultural Research Station, and hence is known as the "Indore Process." When properly carried out, no flies are bred, while there is an absence of noxious odours, and the resulting compost has the appearance of any good garden soil.

Copra.

As already noted, the output of copra has greatly increased and the quality improved during the past year; the prospects for the industry are now much better than formerly.

Exports of copra during the year ended 30th June, 1936, amounted to 66,684 tons, valued at £761,309.

Desiccated Coco-nut.

Restriction of production of this product has been necessary owing to the fact that our market is confined to Australia and New Zealand. The quantity exported during the year amounted to 1,647 tons, valued at £65,880.

Coir Fibre.

A mill has been erected for the preparation of this product, but there were no exports during the year ended 30th June, 1936.

Coffee.

Although two plantations of this product are in a very satisfactory condition, and are commencing to yield, the exports for the year amounted to only 11 tons, valued at £880. The quality of the coffee is very good indeed, and is well received on the Australian market. There is a considerable local market for this article, and a few of the smaller planters dispose of their crops in this way. The Arabian coffee (the original stock imported from Blue Mountains, Jamaica) is doing very well, and is all sold locally at good prices.

Cocoa.

Greater interest than ever is being taken in the cultivation of this crop, for which the prospects seem very favorable. The quality of the bean is good, and apparently the prejudice in Australia against New Guinea cocoa is breaking down. The export for the year amounted to 127 tons, valued at £3,810, an increase of 32 tons over that of the preceding year.

Tobacco.

This crop is grown only for local consumption by natives who, so far, do not take very kindly to the locally-manufactured stick tobacco. Dry leaf is, however, acceptable to them, and is part of the ordinary issue in accordance with the Native Labour Ordinance.

Rice.

Results, at the demonstration plantation, and by native cultivation under officers of the Department of Agriculture, prove conclusively that good rice can be grown successfully here. Numerous experimental plantings have been made by mining companies on the mainland, and the yields per acre were quite satisfactory.

Some planters at Siassi Island have, to some extent, successfully encouraged the growing of rice by natives. It is produced under the condition that the natives grow the rice, while the rice is bought and milled in a small mill, by the planters concerned.

Kapok.

Only one planter has taken up the cultivation of this product seriously, and he is more than satisfied with his results, his crop all having been sold locally.

Derris.

Experimental plantings of this crop are being continued at the demonstration plantation, and a small lot was sent to London for valuation.

Peanuts.

A little more interest has been taken in the cultivation of this crop, as 35 tons, valued at £653, were exported to Australia—an increase of 10 tons over the preceding year. A considerable quantity is also consumed locally by the Chinese community.

Areas under Cultivation.

Owing to incomplete statistical returns, it is not possible to supply full details, but from inspectors' reports it is certain that there has been an increase in areas under coco-nuts, and there is a steady increase of areas under cocoa, some of which is being interplanted amongst mature coco-nut palms.

Assistance to Planters.

Considerable assistance has been rendered to planters, not only by correspondence, but, whenever necessary, inspectors and instructors have been specially detailed to visit planters to render advice and assistance in cases of emergency apart from ordinary inspection patrols.

Seeds and Plants.

Many seeds and plants of economic and ornamental value have been distributed to planters, missions, Government stations, and to various parts of the mainland, particularly the mining district, for the adornment of growing settlements there. Seeds of specially selected strains of the best cocoa have been distributed to those planters desiring such.

Native Agriculture.

With the exception of inspection of native coco-nut groves by inspectors and instructors in the course of their patrols, native agriculture in connexion with annual crops like rice and peanuts has not increased to any extent. In the Gazelle Peninsula, there are 168 villages, the natives of which were being instructed in the cultivation of these annual food crops, with a certain amount of success.

Reports on the progress of the Sexava campaign and work in the Botanic Gardens and demonstration plantation are submitted *in extenso*, as the Director was absent on leave during the greater part of the year, and he is not in a position to give a full report from personal knowledge.

Agricultural Statistics.

The following statistics of areas under cultivation in the various districts of the Territory, show the predominance of coco-nuts over other crops:—

	All Crops. Hectares.	Coco-nuts. Hectares.
New Britain	30,466	28,321
New Ireland	27,044	27,781
Madang	13,653	13,424
Manus	9,177	9,176
Kieta	10,590	10,116
Sepik	2,531	2,531
Morobe	1,585	1,418
Total	95,046	92,767

REPORT OF THE ENTOMOLOGIST.

YEAR ENDED 30TH JUNE, 1936.

Up to 10th February, in the absence of the Director on leave, the Entomologist was Acting Director, and on the 24th February, 1936, he proceeded abroad on extended leave.

SEXAVA RESEARCH STATION.

In July, 1935, Mr. B. A. O'Connor, Assistant Entomologist, proceeded to Australia on recreation leave, returning in October of the same year. The essential work of breeding and liberating of parasites of *Sexava spp.* was carried on by Mr. A. W. S. Corfield during this period.

Leefmansia bicolor.

This Hymenopteron bred well in captivity, and was liberated on all sections of Arawe plantation and in several village groves in the vicinity.

By October, 1935, there was definite evidence to show that *L. bicolor* was breeding in the field in areas where liberated previously.

Doirania leefmansi.

Only a very attenuated colony of this species survived the delays in transport from New Hanover to Arawe, and very great difficulty was again experienced in breeding this Trichogrammatid under the conditions existing in the field laboratory. This was therefore discontinued in November, 1935, and the colonies in hand were liberated in the field.

Encyrtid sp. (from New Hanover).

This species continued to breed fairly well in the laboratory, and was liberated in the field with *L. bicolor.*

Mymarid sp. (from New Hanover).

Although a large number of Sexava eggs collected in the field on New Hanover were transported to Arawe in gauze cages, the transport delays proved too long, and the attempt to transport this parasite to Arawe failed completely.

From the high degree of incidence of *D. leefmansia* and *Mymarid sp.* in the plantations and groves on New Hanover, and the comparatively rarer infestations of Sexava on that island than in some other parts of the Territory, it appears to be highly desirable to test these two egg parasites of Sexava in some other locality where they are not yet present. As Manus is the most seriously infested district in the Territory, an attempt has been made to take these parasites to Manus by direct transport of Sexava eggs collected in bulk in the field on New Hanover, where, by placing them in the field in gauze liberation cages, this will give every opportunity for the parasites on emerging to spread direct into the surrounding coco-nuts.

Mokareng plantation will again be the first centre of operations.

In view of the difficulties of laboratory breeding of these species, as referred to above, this method appears to offer the best possibilities of establishing them in the new centre. In order to minimize the possibility of any one colony meeting with unsuitable conditions on arrival, *at least* five such colonies should be transported at approximately weekly intervals.

Mr. O'Connor travelled to Manus with the first colony, to ensure it receiving proper handling on arrival.

While the station is situated in the Manus district, investigations will be carried out into the incidence of *L. bicolor* in the field where previously established, the binomics of the other parasites transported from New Hanover, &c. Tests will also be made on the possibilities of the application of sprays, also costs, &c., of same. It is proposed to ascertain whether this method of attack has any possible application in the control of Sexava, more especially in the early stages.

GENERAL.

In September, 1935, Mokareng plantation, Manus, was visited by the Entomologist, where it was observed that the Sexava infestation, which had commenced to develop before the research station moved to New Hanover, has spread over most of the Salami end of the plantation. Sexava eggs collected prior to my arrival showed parasite emergence holes in a small percentage of eggs, but this was not as high as might have been expected.

Promecotheca antiqua.

In the early part of 1936, one plantation in the Kokopo district showed marked infestation by this Hispid. Control measures were carried out under the advice of the Entomologist, and a satisfactory control of the pest was obtained in a comparatively short period. The advent of dry weather completed the elimination of the pest.

The pest was reported to be bad in the vicinity of the Ring Ring plantation and on that plantation, and slight on Lindenhafen.

During the Entomologist's visit to Manus, *Promecotheca* attack was in fairly strong evidence at Lorengau, Salami and Lombrum plantations, and was reported from several other areas in that district.

Scolytidae in Kapok.

Shot-hole borers were reported from living kapok in one plantation. Investigation showed that the trees were planted in an unsuitable situation, and were decidedly sickly; this was most probably the cause of the attack as other kapok trees growing in a more suitable situation looked healthy and showed no signs of infestation.

Ant Control in Seed Beds.

A number of inquiries were made in reference to control of ants in seed beds, and chemicals and instructions were given for testing out against these pests. Only one reply was received; in that case the instructions had not been carried out, and unsatisfactory results were only to be expected.

Other tests with a sample of a proprietary preparation were very promising.

Tirathaba rufivena.

This moth was reported from several localities, and on one plantation in the Kieta district it was stated to be attacking young nuts after setting. The latter is not usual.

Sparganobasis subcruciata.

This weevil (base borer of coco-nuts) was reported by Mr. Corfield (Inspector and Instructor) from one locality on the south coast of New Britain, in neglected native coco-nut groves; in this case the infestation was as high as 3 feet from the ground in the trunks.

Brontispa froggatti.

Investigations into the bionomics of this pest were started in the insectaries in Rabaul.

Collections.

The entomological collections have been enlarged and maintained. Two collections have been forwarded to the Imperial Institute of Entomology, London, embracing the orders *Coleoptera, Hymenoptera, Rhyncota, Thysanoptera, Diptera, Lepidoptera, Neuroptera* and *Orthoptera,* in addition to *Acarinae.*

Four collections of identified species have been received from this Institute, comprising in all 106 species, embracing the orders *Coleoptera, Hymenoptera, Diptera, Lepidoptera* and *Rhyncota.* Several species new to science were represented.

REPORT OF THE ECONOMIC BOTANIST.

YEAR ENDED 30TH JUNE, 1936.

A considerable portion of the available time has been spent in visiting outside plantations and agricultural areas, both in an advisory capacity and to gain further experience of the flora, soil and climatic conditions which obtain over the widely-scattered areas of New Guinea.

The investigations carried out during the period under review were necessarily of a preliminary nature, and also most of the work carried on was in conjunction with other spheres of the Department's activities.

The completion of a new botanical laboratory and office, which is fully equipped with necessary apparatus and chemicals, will allow of much extension of work on botanical, and particularly plant pathological studies, as it is now possible to culture the pathogens.

The following article was published: "Derris. Its Culture and Economic Possibilities for the Territory of New Guinea", while another article, "A Survey of the Coco-nut Industry in the Mandated Territory of New Guinea", has been prepared for publication. (See *New Guinea Agricultural Gazette*, Volume 2, No. 2.)

Plant Disease Investigations.

Specimens of diseased plants brought in from time to time have been examined and identified as far as possible.

Some very interesting discoveries regarding the incidence of coco-nut diseases have been confirmed. It appears that chlorotic diseases associated with soil deficiency are very important here, especially on old plantations. Under these conditions fungi such as *Thielaviopsis, Pestalozzia palmarum, Helminthosporium spp.* and other weakly parasitic fungi gain the ascendency and hasten the decline of particular areas. It is seen that the fronds die off from the base while the few remaining fronds present a feathery and very unhealthy chlorotic appearance. In late stages the top falls over, leading to a condition not unlike bud rot. This condition is serious in New Guinea, and is the subject of further investigation.

During the visit to Bougainville Island and other islands, numerous areas of what are constantly referred to as "lightning struck areas" were seen and investigated on most of the plantations visited. It did appear that this condition was relatively scarce on young planted areas and was more prevalent in certain districts than in others. Bleeding of the stems was noticed (association with *Thielaviopsis*) and the foliage of the affected palms was usually drooping and withered with often the petioles split transversely. *Fomes spp.* and *Polyporus spp.* were seen on the dead coco-nut stems, while *Marasmius palmivorus* (perfect stage) was also present.

At Inus, Numa Numa and Teopasino plantations, Bougainville, several palms were cut down and the fronds, and also the dead wood, thoroughly examined. Specimens from the worst affected palms were also microscopically examined.

This condition is found all over the Territory, but nowhere so serious as at Bougainville Island, where severe lightning storms were experienced in the wet season, e.g., Numa Numa reported that during eight months they lost 53 palms

spread over ten isolated areas, caused by new strikes and delayed effects of such strikes. This disease is apparently identical with Lightning Strike causing False Bud Rot, described by Sharples in Malaya.

A comparable disease, but apparently with a different primary cause, was seen at Malapau plantation, New Britain, where 300 palms were affected. This area had been badly burnt over several times, and the bases of the palms were badly affected. Stem bleeding was present on all of the palms, while the fronds showed the same drooping overhanging appearance as was seen in several lightning struck areas in Bougainville. Microscopic examination of the fronds which died back from the tip showed that a species of *Helminthosporium* had spread through the area and only became serious when the vitality of the palms was low. Cultivation, cutting off the diseased fronds and manuring with ashes from the copra drier, made a decided improvement in this area.

The most baffling coco-nut diseases in New Guinea are the conditions of Frond Choke and Head Droop (Corkscrew or Cabbaging). These have been previously referred to, but it is noticed that it has a particularly wide spread in New Ireland. Microscopical examination has given no results. In the condition of Head Droop it is seen that the top bends over as a complete semi-circle, while the leaves are all bunched and twisted into a distinct rosette, with the lower leaves sparse, short and dying back. In many cases the whole stem may form a distinct loop, or in some cases becoming S-shaped. In the final stages there is failure to bear coco-nuts, while the spathes completely die back. These are not hereditary abnormalities, because many palms recover and may develop the condition more than once. As far as it is known virus diseases have not been recorded in coco-nuts, but from analogy are strongly suspected as the causal agent of the conditions mentioned, although some growers suggest that it is caused by an injury to the young bud, e.g., by insect.

As an addition to the list of coco-nut diseases recorded in New Guinea, which was published in the last annual report, it is to be noticed that Karl Rechinger, 1907, recorded *Macrophoma palmarum* on *Areca Rechingeriana* and on *Cocos nucifera* at Bougainville, Kieta, while he also found *Anthostoma cocois* on the leaf and midribs of *Cocos nucifera*. A new Bacterial Leaf Blight, Leathery Copra, associated with soil deficiency, and "Silver Leaf Disease," believed to be caused by an unidentified fungus, are also recorded by the present author. Ring Disease of immature coco-nuts was recorded by H. W. Simmonds in 1924. Dr. Noble found evidence of *Botryodiplodia theobromae* being associated with the disease, but could not say whether it was causal.

Coffee Diseases.

Coffee Rust, *Hemelia vestatrix*, has not been found in New Guinea.

Some very interesting observations were made on specimens of coffee derived from Keravat demonstration plantation and Vunalama, New Britain, also Rugen Harbour, and Dr. Kroening's coffee plantation, Bougainville. It was seen that in the coffee nurseries Thread Blight was serious—this was particularly the case at Vunalama, where old decayed leaf fronds were allowed to dry and shrivel up without being removed. These fell on to the young plants and constituted the focus for infection. Thread Blight (*Corticium Koleroga*) was rather bad in the

native areas at Keravat demonstration plantation. Leaf Spot caused by *Brachysporium* or *Helminthosporium spp.*, was seen to a greater or lesser extent on all areas visited.

Root rots are the most formidable diseases in the main coffee areas of New Guinea; this is because coffee was planted after new clearings, hence the wood roots, &c., had not completely decayed. Such vegetable matter served as a source of infection to the coffee. An excellent specimen of the well known root-rotting fungus *Rosellinia pepo* was collected, and also the perfect stage of *Fomes spp. Ganoderma subrugosum* (Pat et Boisd) was also collected in a couple of instances on coffee areas.

Chlorosis or die-back of the deficiency type of diseases is probably the main cause for the presence of numerous sickly and weakly bushes in the coffee plantations here, and naturally fungous pests are usually associated with the devitalized condition of the plants. It is most important that all plants with knotted roots be rejected in the nursery, as a large percentage of the chlorotic bushes in the mature areas had badly constricted and knotted roots, which led to restriction of the sap flow and thus affected the plants. Such plants are easily recognized in the nursery by the shrivelled and unhealthy appearance of the leaves, thus a good deal of costly replacement could be saved by selection in the nursery. Other causes of die-back and chlorosis here, and probably of more importance, are soil and manurial deficiencies, such as an inadequate supply of nitrogen or carbohydrates, which can only be resisted by promoting healthy condition of growth. An excellent example of such chlorosis was seen where approximately 10 acres of coffee was growing on an area with an underlying limestone hardpan, which had been deposited from solution.

HERBARIUM.

A drying house for specimens was erected in the Botanic Gardens. About 200 covers have been added to the collection, and where possible six specimens of each plant were collected for despatch to other countries.

Lane-Poole's valued collection was reviewed and classified according to his own notes. Proper facilities for storing specimens are being constructed, and some blocks of shelves are already on hand.

Investigations on Natural Products.

Parinari Laurini (the "Kusta" nut).

The fruits of this local tree have attracted considerable attention on account of the drying oil they contain, reputed to be not unlike Tung oil, and the oil has been the subject of chemical investigation. Specimens of the nuts were sent to Kew Botanic Gardens and to the Imperial Institute for further examination and report, as it is also worth investigation from a perfumery viewpoint. The mashed kernels are used by natives for stopping holes in canoes and for fixing spear heads.

New Guinea Rattans (*Calamus spp.*).

Numerous experimental shipments have been sent to various manufacturers in Australia for report as to their suitability for furniture-making. The reports so far are not promising, but much work remains to be done to prove what future

there is for the product. Comprehensive botanical collections, for proper identification of the species concerned, are being made. Also, more attention to preparation and selection of the best canes is necessary for future shipments.

Lalang or Kunai Grass (*Imperata arundinacea*).

Is known to compare favorably with Algerian esparto grass for paper-making. Some Australian firms are seeking concessions to exploit this product in New Guinea, where large areas of kunai grass exist. Cutting an experimental area in Rabaul indicated that a yield of about 3 tons per acre per annum could be expected with two cuttings per year.

Native Fibre Plants.

The fine strong fibre derived from a climber (*Cryptostegia spp.*) is widely used in Bougainville and New Britain for making very fine and strong fishing nets, which will last three years in salt water. Specimens of the fibre were sent to Kew.

Gnetum gnemon.

The bark of this native tree is also widely used, particularly in Lavongai, for the same purpose.

Cephalohibiscus Peekelii and other spp. used for making strong ropes and small bags. Some excellent specimens were collected.

A species of Pandanus is used on the Mortlock Islands for weaving fine samples of cloth, which is both strongly and neatly woven on crude looms.

The fibre derived from native *Musa spp.* is also used widely in native work on Bougainville Island, and this could be a valuable commercial product.

Elan. Homalium foetidum (Roxb.) Bent. *Flacourtiaceae.*

One of the finest hardwoods from Lovlungai was identified by Kew Botanical Museum. This is a very large forest tree which grows to a height of 100 feet, and at maturity has a diameter of about 10 feet. This is being sold for commercial purposes by the Leper Quarantine Station.

Two trees, native to Lavongai and suited for timber purposes, were identified as *Olachidon Novo-Guineense* (native name Kenem) and *Terminalia spp.* (native name Eiraula).

A species of *Elatostemma* (*Urticacaea*) was sent is as a weed suspected of being poisonous to cattle. It would appear that the hairy nature of the foliage would render it rather indigestible.

INVESTIGATIONS AND VISITS TO OUTSIDE AREAS.

The first visit during the current season was to the Leper Station at Anelaua Island, and to the leper quarantine area at Taskul, New Hanover, and a comprehensive report was submitted. The objective of this visit was to advise the authorities on methods of controlling soil erosion, which was very serious on Anelaua Island. It is the intention to make these stations as self-supporting as possible, and agriculture plays a big part in the community life of the stronger patients; hence advice was given on rotation of crops, utilization of forest resources, &c. Much suitable planting material was later supplied by the Department of Agriculture to these stations.

In September an extended visit was paid to Bougainville Island, and in addition plantations at Namatanai, New Ireland, Nissan Islands and Buka Island were visited. Particular attention was paid to Rugen Harbour coffee plantation, Raua, and a report furnished, but on almost every plantation from Raua to Buin boundary some investigations were made. In the virgin areas at Hakau plantation, which are now being developed for coffee and cacao culture, the soil is rich and the forest covering heavy. Reports were furnished on diseases observed and various other aspects of coco-nut culture.

Later in the year a second visit was made to Amalgamated Coffee Plantations Ltd., at Vunalama, New Britain, and a report submitted. Attention to shade regulation has much improved the planted areas there.

The development of coffee culture here since 1930 has been promising and worthy of note, as about 1,200 acres are now planted to this crop and more areas are being planted (e.g., at Hakau). Rugen Harbour and Vunalama plantations are now coming into bearing, and are at a most interesting phase of development. In both instances the first coffee beans despatched was within two and a half to three years from the date of planting. When accurate costing and production figures are available, it will be possible to indicate the future possibilities for large-scale coffee-growing in this Territory.

An experimental area of about 10 hectares of Jackson's Hybrid coffee is yielding well at Rugen Harbour. In India this is known as Arabian Hybrid, but is not so well liked as Kent's Arabica Hybrid, some seed of which has been introduced and isolated in two situations by the Department of Agriculture; seed should be available for distribution in three years. It is believed that the development of high quality coffee production at high-level situations in this Territory should be worthy of much attention.

AREAS DEVOTED TO ECONOMIC CROPS, RABAUL.

The land in the economic section had been subject to rather serious denudation and erosion, so it was decided to level the area in addition to providing a large drain to carry off all surplus waters coming from the hills behind. This levelling work is about two-thirds completed; but, owing to the depth of soil removed, crops will not grow well, hence it has been necessary to bring the soil back into production by cover cropping and manuring.

Three large nurseries have been erected, one of which has been completely planted to coffee seedlings. These nurseries are also designed for budding and grafting work with cocoa, citrus, mangoes, and so on, to supplement the work carried on at Keravat and for teaching the more intelligent natives how to do this work. Provision is being made for improved seed storage facilities. It is also interesting to note that manure derived from the Rabaul town night soil, and treated by the Indore fermentation process, is being used on this section. There is provision made for using several tons per week when transport facilities are available.

An interesting experiment on propagation of citrus varieties and species from cuttings was carried out in nursery beds under calico covering, both stem and root cuttings being used. Tahiti lime, *Citrus medica* and *Citrus lemonia* all struck well, and although only a small percentage of sweet and sour oranges grew, these were from softwood cuttings, whereas the hardwood cuttings did not grow. Varieties of mandarins failed completely.

In addition to the fruit areas at Keravat, a more comprehensive but smaller collection is maintained in Rabaul. Last season superior varieties of *Achras zapota*, namely Sawo kollon and Sawa manila, were introduced from Java and transplanted to the economic orchard.

Two superior varieties of mangoes (Paw Paw and Kinara) were introduced from Queensland, and were transplanted to the fruit section. In addition to these, some valuable introductions, consisting of the Aravel, Urumahue, Puero, Rare, and Uruhuroro varieties of seedless breadfruits introduced from Tahiti, were planted out in two separate areas. As the natives are keen on some other improved varieties of seedless breadfruits just coming into bearing here, numerous root cuttings were made for distribution, and tried in various areas. Arrangements are also completed for grafting superior types of mangoes, of which seven varieties were introduced in German times, and to seedling stocks for the same purpose.

Budded superior varieties of Rambutans introduced from Java were sent to Keravat demonstration plantation, while others more recently introduced are being planted at Rabaul. Selections of *Bertholettia excelsa* (Brazil Nut) were introduced by the Director of Agriculture from Singapore, and also further stocks of selected Derris of known high rotenone content. Numerous marcots of superior Pomeloes and Rambutans already in bearing were propagated by the Nurseryman. Some introduced Mangosteens are well established.

Most important introductions last season were seeds of the following types of Cinchona (quinine):—

Cinchona ledgeriana.
Cinchona succirubra.
Cinchona robusta.
Cinchona hybrid.

These were introduced from Amani, East Africa, and from the Manager, Government Cinchona Plantation, Kalipong, Burma. Arrangements were made and nursery beds prepared at Ramu Post, Morobe district, to receive this seed, at an elevation of 5,200 feet.

General Plant Breeding.

Close co-operation with the work at Keravat demonstration plantation has been maintained, and good progress has been made with work carried on in conjunction with the Superintendent.

The programme of coco-nut improvement by close breeding and selection inaugurated last season has been much extended by using coco-nut selections derived from the most representative districts and plantations in New Guinea.

Vegetative propagation of cocoa selections first made by the Superintendent was commenced, and by approach grafting in the nursery 100 per cent. take was recorded at Keravat. It is necessary to increase these selections into vegetative or clonal families before their relative value is absolutely determined on a comparative basis. Approach grafting was also successful on a large scale with old trees at Rabaul, where seedlings of a strong Forastero hybrid stock was used. This work was again further increased on established trees at Keravat under the supervision of the Superintendent. The ease and quickness of this method indicates its value to planters, especially as it can be done by natives. Budding work is also to be commenced, as it is known that the Criollo cacao present in

New Guinea is equal to any in the world, and should flourish better on a strong hybrid stock—this experimentation is proceeding.

The numerous Java coffee selections introduced last season from the coffee-breeding stations have been planted out in separate plots for observation prior to further breeding work being carried on.

Re-selection has been carried out within the earlier-introduced and well-known Java coffee numbers Bangelan 105, 01 and Soembar Asim 78.11. This means that there is now much improved Robusta coffee seed available for distribution. Selections are also available from the Jackson's Hybrid and from several Keravat numbers.

The practical method of selective re-grafting was also commenced in the old coffee areas, and newly-appointed inspectors and instructors, together with some intelligent natives, were employed on this work. It was at the beginning of the dry season that the grafting commenced, and most success was attained in the more heavily shaded areas, due to the shade and moisture present. Bangelan 105,01 was used for grafting over the inferior bushes, which had been cut back earlier and one or more shoots allowed to develop.

Patch budding with kapok, using two intelligent natives for the work, was very successfully attempted, using spreading Bondowoso 5 on Java seedling.

Some selection work was carried out by the single tuber method in the various varieties of sweet potatoes (*Ipomoea batatas*) both at Keravat and Rabaul.

BOTANIC GARDENS—RABAUL.

The gardens have been well maintained and many new additions and improvements made. The nurseries have been re-arranged with all new beds properly lined out and well constructed. The existing plant houses have been repaired and roofed over with new bamboo lattice work; the cement foundations were also strengthened.

Although the watering facilities have been increased by the provision of new pipe lines, the water storage capacity is totally inadequate to sustain the gardens over the dry season. Plans have been drawn up with the intention of remedying this position.

A considerable number of large epiphyte orchids was received from Bougainville and Manus and was displayed in various positions in the main gardens.

One area at the approach to the Director's house was terraced and much improved by the establishment of ferns, Diffenbachias, Caladiums and other shade-loving plants. The introduced plants in the rockery, laid down during the previous season, have made a very fine display and filled up a large area where lawn grasses did not flourish. One large rockery was also laid down last season in the valley nearest No. 2 Garden House facing the main pathway, while two raised beds were also established in adjacent areas. This has again filled in an area where much silt collected and few plants were growing.

Carlodovicia palmata, *Pandanus variegata*, *Strelitzea* and various other plants were also used very successfully in densely shaded areas.

In close proximity to the avenue of *Glyricidia maculata* stretching through the centre of the gardens the ground was very bare, hence a representative collection of shrubs was planted to improve this area, with good effect. Near the centre path, where much washing was formerly evident, two well designed and terraced rockeries have been constructed.

The large and new expanse of lawns and shrubs laid down in the garden facing Malaguna-road has considerably improved the appearance and orderliness of the central areas. It is rather unfortunate that a great proportion of the tourists travel through the pathway at the head of Mango-avenue, and proceed to the nurseries and aviary without seeing the true scope of the Botanic Gardens. Considerable attention has been paid to this section, however, and beds of annual dowers, newly gravelled pathways, low hedges, extra potted plants and so on, have been provided.

In other areas of the gardens the provision of climbing plants on bare trunked trees, e.g. *Parkia spp.*, and on the *Spathodea alata* avenue, has effectively reduced the bare appearance. *Epipremum pinnatum, Calamus rotang, Bougainvillea spectablis*, &c., have been largely used for this purpose.

These gardens have maintained an extensive exchange with other botanic gardens and departments. Suitable collections of low land orchids were sent to Buitenzorg, Peradeniya and Singapore Botanic Gardens, and also a collection of tropical fruits to Queensland. Numerous other plants and orchids were obtained in exchange.

On his return from abroad the Director of Agriculture introduced a number of plants and orchids of economic and botanical interest.

The numerous new introductions brought in the previous season from Buitenzorg, Singapore and Hong Kong have in most cases been well established and have added a considerable variety of ornamental plants.

Although pest inspection has been regularly maintained, a number of the older palms were effected by palm weevils. A number of the very old palms appear to be declining, apparently owing to soil exhaustion, and much manuring and cultivation is rendered necessary.

Manuring with compost, adco and blood and bone is regularly carried out as is spraying where necessary. The gardens can use practically all the Rabaul night soil, treated by the Indore process. The new stand of the terrestrial orchids *Arachis maingayi*, and particularly *Vanda Miss Joaquin*, have been one of the features of the lawns in the central beds. The red flowering frangipanni from Mexico produced one of the most lovely blooms in this area as did the newly introduced *Arabidæa magnifica*.

A large collection of seeds and plants was forwarded for avenue planting in the township of Lae.

Avenues.

A line of natives was employed regularly on avenue work. On two occasions this line was increased and all the avenues systematically gone over and the dead and overhanging branches removed. This was particularly the case with Casuarina and Malaguna avenues.

The following new avenues were planted during the year:—

Kuanua-avenue—*Peltophorum inerme.*
Ulawun-avenue—*Cassia siemea.*
Park-street—*Lagerstroemia flos regina.*

The five new avenues planted the previous season were kept in order and replacements made where necessary. They were kept watered in the early stages. A plaited bamboo shade covering was placed over the avenue trees where required and particularly over the Royal palms in the Namanula-road.

REPORT ON THE DEMONSTRATION PLANTATION, KERAVAT.

YEAR ENDED 30TH JUNE, 1936.

During the year under review further economic development took place. An additional area of 24 hectares was cleared and brought under cultivation, and at the close of the year there were 92 hectares in cultivation and 17 hectares under secondary bush and ready for final clearing.

Approximately 1 mile and 10 chains of road was constructed, where necessary suitable avenue trees were planted, and bridges made from local hardwood timber were built across drains and creeks as the various sections of road were formed. The total road mileage at the close of the year was 3.6.

Long-term experiments were commenced in respect of coco-nuts, coffee and cacao, and short-term rotational and varietal experiments with annual food crops.

A native food area, comprising 12 hectares was maintained throughout the year, the crops being issued for food purposes to the labour and to supply outside demands.

Provision was made and sufficient areas maintained for the supply of economic seeds and plants.

Further coco-nut, coffee and cacao selections were made, and seed from selected mother trees was planted in the nursery.

Nursery and field trials were made in respect to the budding of kapok and the grafting of coffee and cacao.

A series of experiments was conducted in cacao fermentation and curing and the results have been published in the *Gazette*. A costing experiment with groundnuts was also made, and the data obtained is being compiled for publication.

During the year frequent visits were made to the plantation by the Economic Botanist who is collaborating in experimental work.

Native Labour.

The diet of the labourers was continually varied, the rice ration being supplemented by taro, yam, cassava, sweet potatoes and green maize. Bananas, paw-paw, pineapples, groundnuts and mature coco-nuts when available were issued in addition to the normal ration. The preserved meat or fish ration was supplemented with fresh fish, a total of 6,384 lb. being issued during the year.

Visitors.

Exclusive of departmental officers, 340 visitors to the plantation during the year were accorded advice and instruction.

Meteorology.

The rainfall during the year was the heaviest yet recorded, and totalled 124.74 inches, the heaviest falls occurring in November (14.97 inches), January (14.34 inches) and March (17.41 inches).

Precipitation was registered on 225 days, an average of 18.9 days per month.

PERMANENT CROPS.

Cacao (Theobromae cacao).

Maintenance work in connexion with this crop was carried out during the year.

A further number of trees came into bearing, and it was possible to make further selections and commence a new series of curing experiments.

Yield records were kept of the mother trees; the yields of trees Nos. 2, 4, 12, 13, 14, 15 were exceptional between the periods 29th October, 1935, and 1st June, 1936, and were as follows:—

Tree No. 2	..	..	..	13.0 lb.	dry	commercial cacao.
„ No. 4	..	..	..	15.7 „	„	„ „
„ No. 12	..	..	..	15.0 „	„	„ „
„ No. 13	..	..	..	12.1 „	„	„ „
„ No. 14	..	..	..	20.4 „	„	„ „
„ No. 15	..	..	..	16.3 „	„	„ „

Two acres that were prepared during the latter half of last year were planted experimentally with selected seedlings for yield comparisons.

Two acres were interplanted with coco-nuts and the area was laid out on an experimental basis.

The 7 acres that at the end of last year were in the course of clearing and preparation for a yield, and spacing trial of selected seedlings, were planted during the year.

The preliminary clearing of five hectares commenced last year for planting Criollo cacao was completed and 889 seedlings have been planted to date.

One series of curing experiments was completed and the results published in the *Gazette*.

"Approach" grafting trials were conducted in the nursery and field, and proved successful. A number of Criollo seedlings was grafted on hybrid stocks in preparation for planting in the Criollo cacao section.

Coco-nuts (Cocos nucifera).

Maintenance of the coco-nut area was carried out during the year and an additional 8 hectares were planted.

A long-term breeding and selection programme was instituted in collaboration with the Economic Botanist. One 5-hectare block is being cleared and planted as required. At the close of the year seed nuts from 25 mother trees selected on five estates throughout the Territory had been planted. Seed nuts from a further 25 mother trees selected on three other estates are in the nursery awaiting germination before transplanting.

Catch crops and cover crops were planted in the new areas as clearing and planting progressed.

Collection of insect pests and treatment of infested palms was maintained.

Nine King coco-nut selections were made, and seedlings planted as a windbreak on the northern end of the Criollo cacao block. The selections consist of six "Green" variety, two "Yellow" variety, and one "Red" variety.

Coffee (Coffea spp.).

Cultural methods were maintained throughout the year, and further selections were made by the Economic Botanist. There are now—

16 selections of	Koravat Berry	.. ..	(K.B.)
10 „	„ Koravat Berry-Stock	.. ..	(K.B.S.)
3 „	„ Koravat Stock	.. ..	(K.S.)
8 „	„ Koravat Robusta 78.11	.. ..	(K.R.78.11)
8 „	„ Koravat Bangalan 105.01	.. ..	(K.Bgn.)
6 „	„ Koravat Jacksons Hybrid Berry	..	(K.J.H.)
3 „	„ Koravat Jacksons Hybrid Stock	..	(K.J.H.S.)

A new nursery was constructed and 9,572 seeds of the various selections planted. An area of land sufficient to accommodate 2,975 seedlings was cleared, holed, and planted with temporary and permanent shade, preparatory to planting out the above selections on an experimental basis.

A certain amount of grafting in the field was conducted towards the latter half of the year in order to observe the best periods and methods of grafting to adopt. Observations showed that a certain degree of shade is required, in the field, and that nursery grafting would probably be more economic as the shade conditions can be controlled. Arrangements were therefore made when planting the new nursery for ample material to be available to carry out complete experiments under nursery conditions.

Harvesting of the main block continued throughout the year, and the yield up to the 1st June, 1936, was 2,443 lb. of hulled coffee which was sold locally at an average price of 9d. per pound.

An area of 2 acres, prepared last year for a variety trial of imported strains and Keravat selections, was planted.

Oil Palm (Elaeis guineensis).

The whole area under oil palm is yielding well, and cover crops have been established in the four blocks. Regular pruning was carried out every three months during the year. Neither pests nor diseases were troublesome during the year, although two palms affected with a form of "Bud rot" were destroyed.

Fruits.

General maintenance of the fruit section was carried out.

New plantings, consisting of sixteen mangosteens, *Garcinia mangostana*; twelve rambutans, *Nephelium lappaceum*; four sawo-kooloo, *Achras zapota*; four sawo manila, *achras zapota*; four duku, *Lansium domesticum*; four mundu, *Garcinia dulcis*; four durian, *Durio zibethinus*; two mlindjo, *Gnetum gnemon*; one nangka-nangka, *Artocarpus integrifolia*; two sukon, *Artocarpus incisa* (seedless); two duku, *L. domesticum*; and eight bilimbing spp. *Averrhoa carambola* and *A. balimbi*. All these varieties were brought from the Dutch East Indies by the Economic Botanist. N.B.—*Gnetum gnemon* is also native to New Guinea.

The citrus fruits were kept clean, weeded during the dry season and the cover crop allowed to re-establish during the wet season.

In April, 1936, sulphate of ammonia at the rate of 2 pounds per tree was applied to the oranges and lemons, and the same quantity of sulphate of potash was applied to the grapefruit and mandarins.

Tropical fruits, such as rambutan and avocoda pear, bore crops during the year; contrary to expectations the mango varieties did not bear. The Queensland paw-paw section was increased, also the Hawaiian paw-paw area. Pineapples continued to bear prolifically, the quality of the fruit, however, being only mediocre due possibly to the abnormally heavy rainfall. The banana area produced fruit throughout the year; the bunches were well formed but a big percentage of the fruit was damaged by insect pests.

ROOT CROPS.

The principal root crops under cultivation during the year were: taro, cassava, yam, mammee, sweet potato, and Jerusalem artichoke. All, with the exception of the latter, were utilized for native food purposes and to supply demands for seed.

The yield and palatability trial laid down in April, 1935, was continued, and certain varieties were rejected after the first harvest.

Seed of three new varieties of "Taitu" yam was introduced from the Trobriand Islands.

Sweet potato selections were made, and three strains definitely fixed. Single tubers of each of these strains were planted for multiplication purposes. Attack by the larvæ of the moth *Hippotion celerio*, occurred frequently throughout the year, and some measure of control was obtained by dusting with arsenate of lead. The sweet potato weevil (*Cylas formicarius*) was responsible for reduction in yield and damage to a big percentage of tubers.

Small demonstration areas of the minor crops such as *Canna edulis* and *Maranta arundinacea* were kept under cultivation.

ANNUAL FOOD CROPS.

Rice was kept in constant cultivation during the year; one large area was practically destroyed by heavy wind and rain in January, 1936. A fungus possibly *Helminthosporium spp.* was very prevalent, also a species of *Hemiptera*. The variety trial laid down in March, 1935, was a failure on account of disease.

Maize cultivation was maintained throughout the year, to provide native food and seed requirements.

Ground-nuts were in continual cultivation. "Red Spanish" and "Pearl" varieties being mostly used. A costing experiment with "Red Spanish" ground-nuts was carried out, and the crop which was forwarded to Australia for sale realized 3.5 pence (3½d.) per lb. Two new varieties of ground-nuts were introduced from Rhodesia and are growing well. Issues of ground-nuts were made from time to time for native food purposes; seed was also supplied for native agriculture and plantation requirements, and shelled nuts sold to local Chinese in Rabaul.

FIBRES AND SPICES.

Demonstration areas of the principal fibres and spices were maintained. Fibres under cultivation are—Manila hemp, sisal hemp, sansevieria hemp, pine-apple hemp, banana hemp, sunn hemp, jute, kapok and cotton.

The spices comprise—Cinnamon, clove, pepper, ginger, tumeric, and capsicums. The pepper and ginger sections were increased during the year.

DRUGS AND INSECTICIDES.

Small demonstration areas of tobacco, cocaine, *Tephrosia vogelii*, and *Hydnocarpus anthelmintica*, were kept in cultivation.

A section containing Derris spp. and selectedt Derris from Singapore, was cultivated for observation purposes, and portion of the area was harvested at the close of the year preparatory to forwarding samples overseas.

COVER CROPS.

Cover crops were extensively planted during the year, particularly *Pueraria javanica, Mimosa invisa, Centrosema pubescens, Calopogonium mucinoides,* and *Aeschynomene americana.*

The species of cover crops now under cultivation comprise: in addition to those listed above; *Psophocarpus palustris, Pachyrrhizus erosus, Dolichos hosei, Desmodium scorpiurus, Phaseolus spp.*

GREEN MANURE CROPS.

The chief green manure crops are cowpea, *Crotalaria anagyroides, Tephrosia candida, Clitoria cajanaefolia,* and ground-nuts. In addition *Cajanus indicus, Tephrosia vogelii,* and *Canavalia spp.* are kept in cultivation.

Sufficient areas of the above crops were maintained to supply seed for the plantation and outside requirements.

SHADE TREES, WINDBREAK TREES.

For the cultivation of coffee and cacao, both temporary and permanent shade trees are used. The former are chiefly *C. anagyroides* and *T. candida,* and the latter *Leucaena glauca, Albizzia sumatrana, Erythrina micropteryx,* and *Erythrina glauca.* The three latter permanent shade varieties were introduced during the year and are being used for comparative purposes with *L. glauca.*

In the spice section, species of *Leucaena, Albizzia, Adenanthera, Gliricidia,* and *Peltopherum* are used for demonstration purposes.

Trees such as *Pithecolobium saman, Pelthoporum inerme, Cassia siamea,* and *Hydnocarpus anthelmintica* were planted during the year to form windbreaks and to function to some extent as shade.

BUILDINGS.

A new barn constructed from native material and measuring 30 feet by 22 feet, an office, laboratory, hospital, and store with sliding roof were erected during the year.