ANNUAL REPORT OF THE DEPARTMENT OF AGRICULTURE FOR THE YEAR ENDING 30th JUNE, 1940.

DIRECTOR'S REPORT.

Owing to sick and recreation leave, the Director was absent from the Territory for four and a half months in the early part of the year under review, Mr. J. L. Froggatt acting as *locum tenens*.

The Director completed his "Outline of Policy for the Agricultural Development of the Territory of New Guinea", and has submitted it to His Honour the Administrator. This "Outline of Policy" is based not only on a life-long experience in Papua and New Guinea, but on many discussions during the past 35 years with trained planters and scientific agricultural officers in tropical countries of both hemispheres.

During the year, Mr. R. C. Hutchinson, B.Sc., was appointed Agricultural Chemist and took up his duties in Rabaul in November, 1939. Mr. Hutchinson has also been appointed Editor of the *New Guinea Agricultural Gazette*.

The Entomologist, Mr. J. L. Froggatt, B.Sc., was absent on leave from 15th August, 1939, to 10th February, 1940.

Coco-nuts.

Copra.—For a short period in the early part of this financial year there was a slight improvement in the copra industry, but unfortunately it was only short lived. Shortly after the outbreak of war, depression set in on account of lack of shipping and matters got steadily worse. The progress of the war deprived the Territory of its European market, with the result that ultimately there was a complete collapse of the industry. During the Director's leave in Australia, he explored every possible avenue for dealing with the crisis.

On his return to the Territory he carefully investigated the question and gave the fullest consideration to the best means of meeting the emergency. He drew up the frame work of a scheme which had the approval of persons whose interests, standing and qualifications to make sound decisions in relation to this particular industry, are unquestionable.

The gist of the Director's scheme was that the Government should take control of the industry, as has been done in similar cases of emergency in other countries, buy the copra at a stated price, store the product for future sale, and if necessary erect an oil crusher. In the meantime every possible avenue could be explored to discover new uses for coco-nut oil.

For several years past, the Department of Agriculture has been carrying out experiments with copra and it has found that when such an article has been thoroughly cured, with not more than 6 per cent. moisture content, it can be kept without deterioration for eighteen months and longer, provided it is stored in a weather-proof and well-ventilated building, such as has been erected by a Rabaul firm for storage purposes. In one instance, good copra has been kept in storage for 42 months and when opened up was "bone dry" and free from insect and fungus attack.

This does not, of course, imply that inferior copra of high moisture content can be stored for any length of time. Such copra will soon deteriorate, providing ideal conditions for breeding the insect pests of stored products and should therefore not be stored with copra of good quality. It would be a comparatively simple matter for the inspectors of the Department to pass only first-class copra for storage, rejecting all else. In twelve months time, or less, an oil crushing plant could be established, and the refined oil could be kept almost indefinitely in air-tight containers.

Palm oil has been, and perhaps still is, used as fuel for diesel engines on river vessels on the Congo. It seems not unreasonable therefore to think that coco-nut oil might be put to some practical use other than soap-making, margarine, and glycerine production. Coco-nut oil, of course, can be used like palm oil as liquid fuel, but the cost of production from copra would not permit its competition with crude oil. A serious obstacle to the use of coco-nut oil as liquid fuel is that it solidifies at a temperature of 68-79° F. which precludes it for that purpose outside the tropics. In discussing this question with the Roman Catholic Bishop at Vunapope, New Britain, the Director learned that the Mission had already experimented with coco-nut oil as liquid fuel and found it so satisfactory that they had ordered another and larger oil crushing plant.

Some critics of the Director's scheme have advocated the ceasing of copra making, and recommend the indefinite storage of coco-nuts in the husk, overlooking the fact that in the humid tropics coco-nuts germinate rapidly, and even frequently sprout before falling from the parent palms. The Director of Plant Industry in the Philippines writes: "In this connexion we are not aware of any experiments conducted on the storage of coco-nuts", i.e., in the husk.

Desiccated Coco-nuts.—There are three coco-nut desiccating mills in the Territory, producing a first-class article which has a good sale on the Australian market.

Coir Fibre.—The only mill for producing coir fibre is now in operation and produces an article superior to the samples seen from Ceylon.

Fresh Coco-nuts for the Fruit Trade.—This is but a very minor industry as the infrequent shipping facilities do not permit serious competition with coco-nut-growing countries having regular and frequent shipping services to Australia.

The copra exports for the year ended 30th June, 1940, are as follow:—

Location.	Copra Submitted.	Copra Inspected.	Approximate Weight.	Unfit for Shipment. Destroyed.	Unfit for Shipment. Reconditioned.	Regraded.	Passed for Shipment Overseas.	
	Bags.	Bags.	Tons.	Bags.	Bags.	Bags.	Bags.	Tons.
Rabaul	614,680	71,424	43,985	182	13,258	14,517	606,115	42,236
Madang	186,032	18,768	13,402	139	3,744	6,208	166,384	11,883
Kavieng	94,703	12,779	6,706	106	2,137	3,926	14,163	989
Kieta	99,872	10,208	7,077	..	33	197	70,788	4,963
Manus	38,138	3,892	2,632	1	..	1,079	17,224	1,153
Travelling Inspector..	13,203	1,376	987	..	..	..	13,203	987
	1,046,628	118,447	74,789	428	19,172	25,927	887,877	62,211

Cocoa.

The area under this crop is steadily increasing, but unfortunately many planters are still planting low quality seed instead of getting only selected seed of good quality from high yielding trees. Nevertheless, there are a few plantations planted up with the best seeds from the Demonstration Plantation. One of these plantations is now coming into bearing and proves the wisdom of planting selected high quality seed. There is a certain prejudice against the use of *Tephrosia candida* as temporary shade in young cocoa plantations, although it is recognized by leading authorities as the most valuable leguminous plant in the tropics for that purpose. On account of its heavy leaf growth and branching habit it is considered of the greatest importance as a green manure plant on plantations in Ceylon, apart from its use as temporary shade for cocoa. It has proved of special value in New Guinea, particularly in the volcanic sand soils of the Gazelle Peninsula, which are very deficient in humus. It also proved even more successful than *Leucaena glauca* (a permanent shade of cocoa) in controlling "kunai" grass (*Imperata arundinacea*), the greatest weed pest of the eastern tropics. Planted in rows 7 feet 6 inches apart, the branches met in five months and smothered out the kunai leaving the ground in ideal condition for the growth of the permanent crop. In the same area *Leucaena glauca* was very patchy, some plants showing normal growth while others were stunted with few branches. Where the ground is enriched by the decomposing leaf mulch of the temporary shade, *Leucaena glauca* eventually makes ideal permanent shade for fine cocoa plants.

Coffee.

As noted in a previous annual report, *Robusta* coffee suffered a serious blow from the collapse of a plantation company, but another plantation, under very able management, is now showing indications of being a profitable proposition.

Arabian (Blue Mountain Jamaica) coffee at Aiyura Agricultural Station at 6,000 feet elevation on the mainland of New Guinea, is showing excellent growth, and there can be little doubt that it will produce just as high quality beans as in the Blue Mountains, Jamaica, from where it was originally obtained.

The Blue Mountain coffee grown at Wau continues to give heavy yields of excellent quality, and the acreage is being extended.

Rubber.

There are small areas under Para rubber (*Hevea brasiliensis*) to which the owners are now paying some attention and getting satisfactory prices. In the early days of the rubber planting industry *Hevea* seed was in such demand that the planters in New Guinea, during the German régime, were unable to get supplies, and a few large areas were planted with Assam rubber (*Ficus indica*). This species provided a marketable rubber when it was obtained only from jungle trees, but was less suited than Para for cultivation as a plantation crop, and was soon abandoned. When the prices for rubber increased, the Director was of the opinion that these areas of *Ficus* lying idle could be put to profitable use. It was realized that such trees could not produce sheet rubber but as the caoutchouc content in the latex was practically the same as in Para rubber, there seemed to be no reason why it could not be sold as scrap rubber. Tapping demonstrations were conducted and the samples of rubber obtained were favorably received by manufacturers in Australia.

The advice of the Director to tap *Ficus* areas for the production of scrap rubber was taken by the owners of the largest areas of *Ficus* in New Guinea. The result was so successful that £1,350 worth of rubber was sold in little over three months, and they have had steady sales since. Similar areas of Assam rubber are being tapped and these plants, which were considered an encumbrance, are now valuable assets. The planters have been advised not to look upon this species of rubber as a permanent crop, but to replace gradually the trees with Para (*Hevea*) trees. They have been advised to cut lanes or rentices 4 feet wide through the *Ficus*, to be lined and planted with Para rubber, the former to be gradually eliminated as the latter increase in size. By following this method the planter will have permanent Para rubber plantations with little expense, in about five years.

Tea.

The growth of these plants at Aiyura is very satisfactory, indicating the suitability of the country for tea cultivation. Tea planting is proving a highly profitable industry in the highland districts of Ceylon and in Malaya reports show that even lowland tea is proving profitable.

Cinchona.

The four species and hybrids of cinchona introduced to the Aiyura Agricultural Station on the mainland of New Guinea are showing excellent growth. The seeds were obtained from Amani Agricultural Research Station, Territory of Tanganyika, through the kindly offices of Sir Frank Stockdale, K.C.M.G., Agricultural Adviser to the Secretary of State for the Colonies. Amani was established long before the war of 1914-18 by the Germans in German East Africa (to-day Territory of Tanganyika) by obtaining cinchona from Java. Some of the plants showed an alkaloid content of 12½ per cent., but by selection and breeding, the Dutch in Java have still further improved the strain. Cinchona seed is of extreme fineness, somewhat resembling bran, minus the flour, and there are about 70,000 seeds to the ounce. It is needless to say that the germination and growth of such seeds and seedlings require very careful treatment, and the cultivation of the plants in the early stages is only suitable for trained planters.

Once the plants have reached the stage ready for transplanting, they cause little trouble, and, provided all conditions are favorable as to soil, climate, and management, cinchona can prove a profitable industry. The value of the crop per acre has been stated to be six times that of mountain-grown tea.

Rice.

This crop is maintained at Keravat and on a more extensive scale at Maprik, the head-quarters of the Inspector and Instructor in the Wewak District. Unfortunately, however, it is difficult to keep up interest in the cultivation of this valuable food plant. This should not be so as in districts where there is ample rainfall, the cultivation of rice is not heavy work.

Cassava.

This, the most valuable of all root crops in the tropics, grows practically wild in New Guinea notwithstanding its many economic uses. In Java, it is esteemed a valuable food used with, or as a substitute for, rice while other products of the plant form important items of export. As a war emergency measure, on

the outbreak of war, the Director issued instructions to his staff to encourage the cultivation of cassava, as it provides starch, meal, and flour of high food value and is the most important of cultivated plants for the production of power alcohol. These instructions were issued as he anticipated that there might be a shortage of rice and petrol during the war, when the country would be in urgent need for substitutes. He also instructed the chemist to make inquiries in Australia regarding power alcohol production, but the samples of cassava did not reach him before his departure from Australia. The fears about the shortage of petrol in Australia have materialized and the Government are now discussing the possibilities of power alcohol as a liquid fuel substitute.

Minor Crops.

Such crops as peanuts, derris, maize, kaffir corn and beans of many kinds, are in cultivation to a limited extent. One planter is preparing to grow the first named on a commercial scale.

Assistance to Planters.

The Department has followed its clearly defined policy of rendering every assistance in its power to planters as follows:—

(1) By advocating the maintenance and improvement of the staple agricultural industry of the Territory.
(2) By encouraging the cultivation of new permanent crops for export, such as cocoa, rubber, *Robusta* coffee, derris at lower levels, and cinchona, pyrethrum and Arabian coffee at high elevation.
(3) By encouraging the cultivation of grain and other food crops for home and labour consumption.
(4) By encouraging planters to adopt modern methods in cultivation and production of all such crops.
(5) By the inspection of produce for marketing.
(6) By the supply of seeds and other planting material of high quality, economic crops.
(7) By controlling insect pests and diseases.

Inspectors and Instructors are allocated to specific districts and frequently inspect plantations to advise planters in agricultural practice and the control of pests. In cases where more intensive investigations are necessary, an agricultural officer is sent from the head-quarters of the Department and stays long enough in the district to see that his recommendations are carried out.

Cultural advice is given by correspondence and by visits of the Director or other technical officer. In certain cases arrangements are made with planters to carry out experiments on their plantations, under the advice of the Director.

Two planters have been carrying out such experiments with regard to shade on cocoa plantations using *Tephrosia* and *Leucaena glauca* in accordance with the advice of the Director.

Control of Pests and Disease.

Work of this nature is part of the regular routine of the Department's operations and is described in detail in annexed reports.

Distribution of Seeds and Planting Material.

These are supplied to planters at reasonable prices and gratis when supplied for experimental purposes.

Inspection of Copra.

This work has been steadily maintained and every effort has been made to see that the quality of the Territory's copra is kept at a high standard.

Avenues in Rabaul.

The avenues in Rabaul have received constant attention and are steadily recovering from the damage they sustained in the eruption of 1937. The avenue of Royal Palms (*Oreodona regia*) in Kombiu-street is now beginning to show to advantage, although there are several misses to be filled.

The Museum.

No additions of any consequence have been made to the Museum during the year, but everything has been kept in good order.

Botanic Gardens.

The Gardens have been maintained in good order during the year. Shortage of water, combined with the poor soil, which consists of volcanic sand with only a little humus, is a heavy handicap on the growth of plants. The only manure available is that formed by leaves and grass cuttings, which are placed in pits to decay.

Some years ago the Department demonstrated that an odorless hygienic manure could be prepared from all town waste by what is known as the Indore Process. This is a thoroughly scientific process established by Sir Albert Howard, Director of the Agricultural Research Institute, Indore, endorsed by the Indian Medical Service, and used in military cantonments and many towns throughout India. Eventually it was adopted by the Public Health Department on the recommendation of the Director of this Department. It proved very successful and the Botanic Gardens were greatly benefited by the application of this valuable manure. Unfortunately, the process was abandoned after the eruption of 1937, and the Botanic Gardens have ever since suffered in consequence.

Up to date all the propagation of decorative and economic plants of the Department has been done by the Botanic Gardens' nursery staff. One of the most important activities of the Botanic Gardens' staff is the vegetative propagation of plants by marcotting and grafting, some very satisfactory results having been obtained with a seedless pomelo. Many experiments have been made to propagate the very decorative plant *Monodora myristica,* but they have always failed. On the arrival of the chemist to the staff he was instructed to carry on experiments with the recently discovered method of using auxins to encourage root development. He used Hortomone A. Recently, the Chinese gardener, Ah Fat, made experiments on his own account without any root-promoting substance, and had 10 per cent. strikes, all of which are flourishing. Practically all imported seeds or plants are handled at the nursery and established before distribution to the Demonstration and other plantations. Planting material for shipment is also frequently sent to other countries, even as far as Russia, a quantity having been sent to the Institute of Applied Botany, Leningrad, for introduction to the Caucasus. A correspondence is maintained by the Department with the Royal Botanic Gardens, Kew, and other leading botanic gardens throughout the world.

Economic Section or State Plantation.

This part of the Department's activities is situated at the western end of the Botanic Gardens. The Economic Section consists of about 10 acres, three-fourths of which is sloping ground with a fall of 31 feet from the eastern boundary. In 1929 the area was laid out in blocks and planted with economic crops, particularly selected Robusta coffee and cocoa with suitable shade. The soil, being composed largely of volcanic sand and pumice, is very subject to erosion on account of its steep slope, but it was hoped this could be obviated by cover plants, and ridging each or every second row of trees if necessary. This proved to be unsatisfactory, and it was decided to terrace the area. The contours for three terraces were surveyed and the construction work was performed by the Botanic Gardens Assistant with garden labourers. The sides of the terraces were revetted with turf and, have stood up to the heaviest of tropical downpours before even the ground was able to settle properly. After manuring with leguminous plants and all the town waste available, the area was handed over to the Economic Botanist for his experimental work.

Animal Husbandry.

Sheep.—A new step in the development of the Territory was the introduction of six head of Romney Marsh ewes and one ram to the Aiyura Agricultural Station. Unfortunately, the young ram died at sea a few days after leaving Brisbane, but the ewes duly arrived at their destination. Much of the country on the Upper Ramu consists of rolling uplands covered with good grazing and the animals are thriving in their new home land. A new ram is being ordered from Australia, and there is good reason to believe that this experiment will prove the embryo of a profitable industry. Javanese or hairy sheep thrive in the lowlands of the Territory and provide good quality mutton. In fact, fresh lamb from these sheep is quite equal, if not superior, to the frozen meat imported from Australia.

Goats.—These animals are to be found on many coco-nut plantations and make a very good substitute for sheep mutton. Milking breeds of goats have been introduced to the Territory, and appear to thrive under tropical conditions.

In this Territory it is essential that they should be provided with dry shelter against rain, and have good sleeping quarters.

Cattle.—These animals thrive in the uplands of the Territory, but need care against swamp cancer in the lowlands. European breeds with a strain of Zebu blood are practically resistant to tropical stock diseases and pests. There is a pure bred herd of Friesian cattle in the neighbourhood of Rabaul kept for the local milk supply and, with due care, it is not troubled with pest or disease. One of the owner's main difficulties is to obtain suitable land close to Rabaul for grazing.

Native Agriculture.

Native coco-nut groves have been regularly inspected by the inspectors and instructors of the Department, and the owners duly instructed in the work of maintenance. The collapse of the copra industry has affected this branch of agriculture but, of course, the crisis is not such a serious matter to natives as to the European planter. The inability to sell copra means, to the native, a loss of luxuries, but to the European planter, the loss of his very livelihood.

During the last half of the year under review, there has been an increasing accumulation of fallen coco-nuts in the groves and, if this state of things continues,

indefinitely, they must eventually go back to jungle. This condition has been intensified by overplanting of coco-nuts in the past, contrary to the advice of this Department, and it will be a hardship on the natives if they are compelled to maintain such groves in good order. Small groves with good ground covers of *Centrosema pubescens* will require little trouble to maintain, but unfortunately many natives have not carried out this practice. The natives have ceased attempting to sell their coco-nuts or make copra, usually only smoked, but they have taken things philosophically as they have not suffered any serious loss. When copra prices were higher, many of the more experienced natives in the Rabaul District erected hot-air driers in localities recommended by the Department and under its supervision. To these natives the losses were considerable, as the structures cost about £70 each and, in many cases, were built with borrowed money.

For some time past Inspectors and Instructors have been allocated to certain districts with head-quarters centrally situated. Thus they can be in closer contact than formerly with natives. Village gardens are inspected frequently and new crops and improved methods introduced to native agriculture. In this way the natives come to know the agricultural officer personally, and, in some districts, his influence has spread so widely that they come long journeys to visit him, for advice and to obtain planting material. This is particularly the case at Aiyura and Maprik.

In the Kieta District, native coco-nut groves are well cared for, many having good ground covers of *Centrosema* (a leguminous creeper) which assists in suppressing noxious weeds. In fact, some of these native groves are better maintained than many European plantations. This is largely due to the practical knowledge of tropical agriculture and an understanding of natives on the part of the Inspector and Instructor who was, for a long time, stationed in the same district. His work has also been of valuable assistance to other branches of the Administration, and has received the praise of the District Officer.

The native groves in the Kavieng District, New Ireland, are only visited at irregular intervals, as the Inspector and Instructor stationed there has also to act as Customs Clerk. These added duties prevent him from giving the attention required for native agriculture which suffers in consequence.

An Inspector and Instructor is now stationed at Bo, Namatanai, a sub-district of New Ireland. From this centre he will be able to devote a large part of his time to native agriculture, giving advice and instruction and distributing fresh seeds of economic plants.

An Inspector and Instructor is now stationed at the Talasea sub-district of New Britain. Large areas of native coco-nut groves have been planted up in this district, but, so far, there is nothing special upon which to report. When the Inspector and Instructor has become fully established, every effort will be made to have native agriculture organized on the same lines as in the Kieta District.

An Inspector and Instructor is now stationed at Maprik, Wewak District, at about 700 feet elevation and two days walking distance from the Sepik River. Several economic plants have been established at this centre, and the Inspector and Instructor has been in contact with many thousands of natives.

In the Madang District, an Inspector and Instructor has been stationed on the upper Ramu highlands for the past four years. His centre is at Aiyura 6,000 feet above sea level, where he has shown amazing enterprise.

The land on the Ramu Plateau consists largely of rolling downs covered with a vegetation of grasses and heavy forest, usually occurring in clearly defined areas thus giving the country, in places, a somewhat park-like appearance. The principal grass is *Themeda quadrivalvia* with thickets of *Saccharum spontaneum* and sub-species on the banks of streams, while forests contain a large percentage of millable oak (*Quercus* sp.)

The climate is that of perennial spring and, on Aiyura station, it is now a common sight to see strawberries thriving side by side with paw-paws or Papaya (*Papaya carica*) though the latter take longer to reach maturity than at low levels.

Work was started at this station over four years ago for the cultivation of cinchona (quinine) and other mountain crops and the improvement of native agriculture.

The Officer-in-Charge, Mr. R. F. Brechin, has been very successful in all these enterprises, and his influence extends far beyond the tribes in his immediate neighbourhood.

On account of the absence of bamboo and palms at that elevation in the mountains of New Guinea, light native building material is scarce. He has nevertheless constructed a dwelling for himself and wife with walls and roof of grass thatch, and a floor of plaited reeds.

His outside work shows equal enterprise and thoroughness, as the station is well laid out with many economic plants. Sustenance crops of value to natives are receiving every attention and the number of natives from distant villages who come for instruction and planting material is a sure indication that the work done on their behalf is appreciated. The natives have been taught to grow several European food plants, all of which have entered into their own dietary. Potatoes, maize, cabbages, celery, cauliflowers, onions, soy beans, groundnuts, beans, and cucurbits of many kinds are all found thriving on the stations, and many have become established in native gardens. The natives, however, are very thriftless and will devour their whole crops of maize, groundnuts &c., and come to the station for fresh seed for planting instead of saving their own. Cinchona, Arabian coffee of the famous Blue Mountain (Jamaica) type, and many varieties of fruit and other economic trees are also thriving on the station, some of which should be of value in native agriculture.

Goats and sheep (Romney Marsh) have been introduced to the station and are thriving there. The station is now entirely self-supporting as far as rations are concerned. An important activity on the station is pit-sawing of jungle timber, raw bush natives having been trained for such work. Store and other out-houses have now been built from hardwoods (oaks), pit sawn on the station, even the roofs being made of experimental shingles split on the place. All the labour is performed by bush natives trained by the Inspector himself. For the past three years he has been pit-sawing and seasoning hardwoods for his bungalow, and he has now 10,000 superficial feet of various dimensions suitable for the purpose.

The natives are taught not only the cultivation of new sustenance and other economic crops, but how, given the necessary tools, they may go into the jungle, fall and pit-saw timber and work the material into stable wooden dwellings. On the authority of missionaries, miners, and other unprejudiced persons, it can be said that the influence of this Government Agricultural Station has extended well into uncontrolled areas.

The Inspector and Instructor in the Rabaul district was granted war leave, but the Assistant, Botanic Gardens, spends two or three days per week in inspecting and instructing native agriculture in the Taliligap-Kokopo area. This work has added considerably to the duties of the relieving officer, but on the whole, agriculture has been creditably maintained under his supervision. There are 168 native groves and hundreds of gardens for the cultivation of vegetables and sustenance crops in the Gazelle Peninsula, and it cannot be expected that he could regularly inspect them all.

Every possible effort is being made to encourage the production of more sustenance crops, and planting material has been supplied to many natives gratis. The cultivation of ground nuts and maize is extending to many districts and it is a common sight to see the first-named for sale in the native markets. In fact, it has become a regular article of diet in many villages. The cultivation of ground nuts, maize, and European vegetables such as tomatoes, spring onions, carrots, and cabbage is an established industry in the main European centres and is even extending to less developed districts.

Many natives have acquired the taste for European vegetables, which have now entered into their own dietary. Although natives are very conservative, some have even acquired the taste for vegetables common in the southern States of America, India, and other tropical or sub-tropical countries, but which are not appreciated by Australian residents in this Territory. As New Guinea natives are largely root eaters, such additions to their diet should have a salutary effect on their health.

The natives in the Rabaul district are amongst the most sophisticated in the Territory, and in order to train them to be independent, it is no longer deemed advisable to make gratuitous issues of vegetable seeds, except under special circumstances. Natives who have reached such a stage of civilization that they can afford to purchase bicycles, have shares in motor lorries, and copra driers, should be taught to realize their responsibilities and purchase their own seeds, otherwise they or their descendants will never be fit to become native citizens of their own country. New varieties of crops are issued to them gratuitously, and one native has had an orchard of fifteen imported fruit trees lined out and planted for him by the Department of Agriculture. The plants are as follow:—

4 Bambutan 4 Kapeolasan 4 Langsat 10 Mangosteen	imported plants from Java.
12 Avocada Pear	—imported plants from Manila.
2 Grape Fruit 9 Pomelo 5 Mandarin	plants grown and seed imported from Manila.
12 Pomelo 12 Orange 6 Mandarin 8 *Garcinia oblongifolia* 4 Litchee	plants from seed imported from Hong Kong.
12 Orange	—grown from seed from New Ireland.
5 Brazilian Nut	—from Mr. G. H. Murray.
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These trees are of considerable value and were introduced by the Department from abroad for the purpose of planting on an area of waste land at Taliligap, several hundred feet above sea level. Being unable to obtain a small area of this land, and as they could not be kept longer in the nursery at Rabaul, an arrangement was made with a "Luluai" to plant the trees on his land. The conditions are that the fruit of the trees are his property, and the Department is free to take all the planting material, seed or vegetable, that it may require for distribution amongst natives or others. An Inspector and Instructor visits the orchard weekly in the course of other duties to see that the "Luluai" maintains the area in good order. Since transfer of the plants from the low elevation of Rabaul, they have made considerable growth.

It is again necessary to point out the evil of shifting cultivation which is going on year by year. To prepare a piece of land for a garden, the native partially falls the timber, which is then burned and, in most cases, the fires spread far beyond the area required for planting. In this way, standing timber and seedlings are destroyed. The process being repeated year by year, noxious grasses take the place of valuable forests. Later, these grass areas are periodically fired to hunt a few pigs and rats, and continue the sad story of land destruction. This shifting cultivation has of course been the custom of primitive races for ages, during which history tells us that much of the earth's surface has been rendered useless. It is within the memory of officers of this Department that a great part of what is now only poor second-growth bush, and even kunai, was once high forest timber. The rapid degradation in the vegetation of the country is a serious matter and must be resisted within a decade, or the future utility of much of the Territory will be imperilled.

Other Governments controlling primitive native races have taken necessary steps to check the evil by the introduction of a system of permanent farming. The Inspector and Instructor at Aiyura, in the mountain district of inland New Guinea, has given this matter careful consideration, and estimates that, even with the native system of so-called rotation under control, 1,000 acres would permit a 40-year rotation for 250 natives.

No time should be lost in defining native lands for cultivation of present and future sustenance crops and legislation enacted to prevent the destruction of the greatest of the Territory's assets, viz., its cultivable land.

Entomologist.

The Entomologist continued as Acting Director until the Director's return on 13th August, 1939, and then proceeded on leave, resuming duty on 10th February, 1940. During the Director's absence on recreation leave, the Entomologist was appointed Acting Director from 7th March, 1940, to 21st June, 1940.

The Assistant Entomologist, Mr. B. A. O'Connor, proceeded on recreation and long leave on 7th March, 1940.

The breeding and field-distribution of *Tetrastichodes brontispae* were continued without interruption throughout the year, the *Brontispa* larvae and pupae being collected from an area of young coco-nuts close to Rabaul. Larvae were fed on fresh leaf in jars at the laboratory and pupae sorted out each day for breeding work. The distribution of parasitized pupae covered the Districts of New Britain, New Ireland, Manus and Kieta; mass liberation for closer observation was made

in an area of young coco-nuts in the vicinity of Rabaul, and from this area, the parasites have been recovered on several occasions from *Brontispa* pupae collected in the field.

Laboratory breeding and distribution of *Pleurotropis parvulus* was discontinued towards the end of 1939, as the parasite was well established throughout the Rabaul-Kokopo area, and was reported to be so well established at Lindenhafen as to have the pest under control. Whenever a colony has been required for liberation in any other locality, it has not been difficult to collect a satisfactory supply in and around the Rabaul-Kokopo district, although the degree of *Promecotheca* infestation in this area is very slight.

Pest Occurrences.

Sexava infestations have been reported in portion of New Hanover and in Manus. Damage by large *Dynastid* beetles, *Xylotrupes gideon,* L. and *Scapanes grossepunctatus,* Sternb. has been severe in many parts of the Rabaul-Kokopo District, especially in and adjacent to areas where logs and stumps have been left to rot out after clearing.

Spodoptera mauritia, Boisd. (*Noctuidae*) occurred in large numbers on couch grass around Rabaul on two occasions for short periods. Dusting or spraying with derris or arsenate of lead gave a satisfactory control when undertaken at the beginning of the infestation. *Microdus* sp. (*Braconidae*) was bred from the larvae, and apparently exercised a large degree of control.

Plant Bugs, belonging to the family *Plataspidae,* were reported on a number of occasions from various leguminous crops, especially beans.

Four species of "Shot-hole Borers" were bred from sections of stems of cocoa trees from the Talasea District.

A large *Pentatomid* bug (as yet unidentified) was very prevalent on *Hibiscus tiliaceus* around Rabaul, the egg-masses encircling the leaf stems, and the young bugs feeding on the flower-buds. This insect was bred through a life-cycle series in cages at the office.

Dysdercus papuensis, Dist. was also found breeding on *Hibiscus tiliaceus* in the same localities as the previous insect.

Rhyparida spp. (*Eumolpidae*) have been collected feeding on the young flush leaves of cocoa, and, as stated in other reports, may cause damage to the growth of the young tips when the infestation is severe.

Exopthalmida spp. and *Platyachus ruralis,* Fst. (*Curculionidae*), caused considerable damage to garden plants and shrubs in various parts of the Territory.

Telicota bambusae, Moore, has been reported from areas of young coco-nuts in different parts of the Territory; a *Braconid* parasite (not previously noted) was bred by Mr. G. F. Gee from this *Hesperid,* larvae of the host having been collected in the Namatanai District.

Agrotis ypsilon., Hufn. caused damage to vegetable plants in one area.

The egg parasite of *Brontispa froggatti, Trichogrammatoidea nana,* Zehnter, was bred by the Assistant Entomologist from *Brontispa* eggs collected during the latter half of 1939. At the request of Levers' Pacific Plantations, Ltd., a number of eggs of *B. froggatti* were collected in an area in which this parasite was known to be prevalent, and the colony was forwarded to the Manager of the Company at Gavutu, British Solomon Islands.

Insect Collections.

The insect collections have been maintained in good order, and have been increased with specimens collected by the Entomologist, Assistant Entomologist and by members of the field staff of the Department of Agriculture.

In the reference collections of species identified by the Imperial Institute of Entomology and other specialists in various groups of insects, there are now represented 15 orders, 184 families, 771 genera, and 1,335 species; a large number of insects are still with the above institute and others for identification have not, as yet, been returned.

During the year, a number of insects was sent for identification to the Imperial Institute of Entomology, London, covering the Orders *Rhyncota, Orthoptera, Lepidoptera, Coleoptera, Diptera, Hymenoptera*, comprising 254 species.

One hundred and seventy-one identified species were received from the above Institute during the year, of which four species were new to science, eight new to the Institute, seven species were not in their collections, and twenty-three species were retained for further study.

Five species of *Coccidae* were sent to the Entomological Division of the British Museum (Natural History), London, and identified specimens were returned.

Termite ("White Ant") specimens were sent to the Entomological Division of the Council for Scientific and Industrial Research, Canberra, and other insect material to the Entomologist, Adelaide Museum. Identified material was received from the Entomological Divisions of both the above Institutions.

Economic Botanist.

During the year under review advisory and investigational visits to plantations in outside areas were continued. Investigations were carried out on the economic possibilities of various crops while plant-breeding, plant introduction and a certain amount of plant disease work was carried out, mainly at Rabaul and at the Keravat Demonstration Plantation.

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

(1) "Annual Report of the Economic Botanist for the year 1939-1940." Vol 5, No. 2.
(2) "Some Investigations on Coco-nut Diseases associated with Soil Conditions in New Guinea." (This article was published in two instalments in Vol. 5, No. 3, and Vol. 6, No. 1, issues of the *Gazette*.)

In the hands of the printer are notes on a "Somatic Colour Mutation in a Cavendish Banana Plant," and in the course of preparation is an article on the rubber industry.

Property Inspections.

Under an arrangement made by the Custodian of Expropriated Property with the Director of Agriculture, further inspections of old declining properties were conducted. Reports were furnished and, as far as possible, recommendations were made as to possible means of rehabilitation.

The Portland Islands coco-nut plantations were visited in company with Messrs. Richards and Herkert, plantation inspectors to the Expropriation Board. It was found that the position on the Portland Islands, which have shown serious

decline in production, closely parallels that of the older and more exhausted areas of the Western Islands and the problems involved are closely related only more exaggerated. The areas carrying coco-nut palms on the Portland Islands may be grouped under three categories as related to the soil and water-table conditions present—

(*a*) Good bearing areas which are economical producers;

(*b*) Areas which are still producing coco-nuts but the coco-nut palms are poorly bearing or uneconomical producers;

(*c*) Worthless areas of palms bearing no crops.

The proportion of uneconomic producing and worthless areas to good areas on these islands is very high and is increasing. Coincident with the spread of poorly producing areas the cost of production increases while the real value of the property decreases.

Those planted areas in the third category are abandoned (e.g., all of the Colenusa and Belligilla Islands). It was recommended that every attention should be paid to keeping up the profitable production of the present good bearing areas and to try and bring the palms on the marginal areas (category (*b*)) back into good production. Introduction of erect and creeping cover crops and conservation of all fronds, husks, and vegetable matter were among the recommendations made. Those badly tapered palms situated on shallow sandy soils and near the central lagoons do not warrant expenditure even on maintenance. The problems involved are discussed in a report on the Ninigo Group, Western Islands, where the soils' geology and derivation of typical coral formations are also detailed. The position on these islands may well be a guide to the ultimate fate of numerous other plantations in this Territory situated on soils of coral type.

Other properties inspected under the same arrangement last season were Djaul Island and properties on Lavongai Island (New Hanover), but *interim* reports only were furnished, as separate soil and maintenance problems were involved. Some reports submitted by the Custodian's inspectors on other properties were submitted for comments and recommendations.

It was of general interest to note that two of the plantations visited on Lavongai were situated on old terraced areas. These well preserved terraced areas were probably old rice sawahs and relics of a civilization long extinct on Lavongai Islands. Samples of the edible sub-soil (red clay), which is eaten by the natives in that vicinity, were brought in for future analysis.

In company with the Chemist an extended visit was paid to various plantations on Bougainville Island and Small Buka Island. Hakau Plantation, which is devoted to coffee and cacao, was visited, and a report furnished to the Directors. On this plantation there is at present 130 acres devoted to coffee and 100 acres devoted to cacao, and planting is being continued. Pruning the coffee seems to be one of the most difficult operations so far as New Guinea natives are concerned, as the "boys" rarely recognize that different bushes require different treatment, depending on their habit of growth. It is the time and labour involved in this class of work as well as in weeding and pest control, which is making coffee a difficult culture at low-levels in this Territory regardless of how much effort and supervision is expended. Pruning operations are not nearly so difficult with *Arabica* coffee at high altitude. Everywhere there was evidence

of careful cultivation and the bushes were of good appearance. It was only on exposed ridges or where the top soil was relatively shallow that any backward areas were seen. The cacao had flourished and it was recommended that the cultivation of this crop be energetically carried out, as the combination of coffee and cacao culture should make this a successful venture.

Near Kieta, Aropa Plantation, which was an extensive experimental area in German times, was visited. Coco-nuts, cacao, *Hevea* and *Ficus* rubber had been planted, also some areas of *Hevea* and cacao, and *Hevea* and coco-nuts were interplanted. This latter combination was a complete failure. Advice was given on how to exploit the *Hevea* and *Ficus* rubber present and the tapping of this considerable area has now been commenced. Further south of Kieta and in other areas on Bougainville, areas planted with young cacao were visited and advice given regarding cultivation. Several virgin areas of country were visited (some of which had already been felled) and reported on as to suitability for cacao, coco-nut and rubber culture. On one large area on Inus Plantation, which had been planted with kapok, it was recommended that cacao planted as a mixed crop would give a very profitable mixed culture if a certain amount of shade was used.

Several of the larger coco-nut plantations were also visited and special attention was paid to young coco-nut areas where a "maturation wilt" was apparent in the young plants. This condition has been fully described in a *Gazette* article previously mentioned.

The Chabai Mission Station, where Dr. Hennessy has established a school for training native boys in school subjects and the elements of native agriculture, was visited. Dr. Hennessy had planted up large areas with native foods, the selected seed and planting material having been obtained from Keravat but it was possible to recommend some new crops.

On nearly every plantation visited some attempt had been made to plant considerable areas of native food crops as recommended by this Department and the Planters' Association, in case of emergency.

Coco-nut Cross-breeding and Improvement.

The chief aims in the improvement programme being carried out at Keravat Demonstration Plantation are concerned mainly with increased yield of copra per palm and production of earlier maturing palms because any reduction in the period of coming into bearing will greatly reduce the cost of plantation establishment.

Seed coco-nuts have been introduced to Keravat from all parts of New Guinea and from Fiji, Java, Celebes, Malaya, the Philippines and the Solomon Islands for inclusion in this breeding programme. Selection and cross-breeding work between the dwarf and Markham selections has been completed. The resulting crossed nuts were planted out and already are showing very interesting variations which should yield superior planting material. Those selections included in the cross-breeding plots are just approaching the first flowering stage and will soon be ready for the second generation of selection. The Superintendent, Keravat, has kept detailed records on the yield of nuts, green copra, &c., of the best palms of the Markham regional strain and, as pointed out previously, all the inferior palms were cut out.

This season an intensive programme of artificial intercrossing within the best types of Markham coco-nuts was commenced. It might be pointed out that some of these palms yield 150 nuts per year, while the nuts are double the size and weight of the ordinary tall coco-nut. The selected palms have already been distributed to planters in all parts of the Territory of New Guinea as being well worthy of trial.

About twenty combinations between these best yielding palms have been made by artificial cross-breeding. Wooden stages were built near each palm and all of the flowering spathes used in this work were covered by "Window-lite" cages and fastened at the ends with a double thickness of muslin to prevent any out-crossing. This pollination required several weeks constant attention and was carried on over the week-ends, using a trained Malay and a couple of intelligent "boys" under supervision. The Superintendent is recording the setting and carrying on from the stage already reached with this work and finalized results will not be available until next season.

One Markham selection, No. 21B, which yielded 40 large nuts at three years from planting, is being widely used in an attempt to lessen the time of coming into bearing as indicated. It is only by reducing costs and increasing yields that such cultures will pay at reduced market prices. Further crossing has yet to be done between the selected ordinary tall coco-nuts derived from various sources as in New Guinea and the most promising selections of the dwarf and Markham varieties.

Rubber Improvements.

Rubber cross-breeding between some of the best yielding rubber trees in the Botanic Gardens was successfully commenced last season. So far only two crosses have been completed, namely, between tree No. 631 by tree No. 608, which were the two best yielders in the test tapping results, and between tree No. 645 and tree No. 631. Seedlings from the crossed seeds were raised, set out in baskets and despatched to Keravat, where they have already been planted out. Next flowering season (February, 1941) it is intended, if possible, to extend this cross-breeding programme.

About one acre of selected seedlings for a bud-wood garden have been planted out in the State Plantation (Economic Section). Here it is intended to increase bud-wood from the best trees available. What are lacking are intelligent Malays or Chinese trained in bud-grafting, both for cacao and rubber propagation.

Duplicate nurseries of some of the best available rubber selections are in Rabaul and have already been used to build up supplies of the best selections for planting of Keravat. Particulars of the more extensive rubber plantings at Keravat will be supplied by the Superintendent.

Coffee Cross-breeds.

The coffee crosses planted out last season are growing very well, but are not yet sufficiently advanced for further selection work. It is certain that the production of high quality *Arabica* coffee at the correct altitudes in New Guinea should be given every encouragement. It was seen at the abandoned coffee area at Rugen Harbour Plantation that *Arabica* coffee, growing at an elevation of 700 feet only, was still in good heart and producing well despite long neglect. This would not be possible in other countries where coffee rust is present.

Cinchona.

Mr. Brechin sent in some flowers of the *robusta* type from Aiyura for a close examination as to possible technique for cross-breeding. The vegetative growth and flowers are very similar to coffee, both belonging to the order *Rubiaceae*. The same technique is applicable to both plants both for vegetative propagation and cross-breeding, so the intended selection and cross-breeding will present no difficulty.

Cacao Improvement.

Most of the work at Keravat has so far been concerned with seed selection (about three generations) and vegetative propagation. Investigations on the pollination and possible cross-breeding with this crop are also intended, and the technique has been worked out. An isolation plot consisting of selections of pure breeding *Criollo cacao* has been established in the Economic Section of the Botanic Gardens. This move is also intended to insure that the pure *Criollo* mother-trees, which were badly damaged by the eruption, will not be lost to our work.

Plant Introduction.

This phase of the department's activities is continuous, but now that Government agricultural stations have been established in the various districts both the recording and distribution of the various introductions have become more complex.

Plants suited to highland culture at Aiyura are often introduced solely for that purpose; also many of the plants sent to Keravat and the other stations are not sent to Aiyura and vice versa. Where seed is of valuable type, but is suspected of carrying internal fungus, it is sown in the Economic Section; also where possible, small plots of the introduced seeds are established at Rabaul for checking purposes.

Dr. McTaggart, Chief Plant Introduction Officer of the Council for Scientific and Industrial Research has continued his kind co-operation in forwarding new and promising introductions from Australia to this department. Some of the most promising introductions brought in during the year are as follows:—

Ground nut strains from Department of Agriculture, Mysore State, India.

Velvet beans from the Department of Agriculture, New South Wales—these flourish in Rabaul and the white seeded variety is particularly liked by natives and is a heavy producer.

Rice varieties.—New upland varieties of rice have been introduced from the Rice Experiment Station at Valencia, Spain, and from the Philippine Islands, but their suitability for local conditions is not yet determined.

Other grain crops such as various kinds of millets, designed to raise the protein value of the native diet have been introduced from India and Australia.

State Plantation (Economic Section).

That portion of the Botanic Gardens known as the "Economic Section", which is devoted mainly to plant introduction and nursery work, is now being fully utilized, as is stressed in various sections of this report. Except for the Fruit Section and portion of the Nursery Area, the whole section was thrown out of

cultivation, following the recent eruption and later, when the old planted areas were completely terraced to prevent erosion, the ground had to be completely manured with compost (developed by the Indore process) and by green manuring.

New varieties of Avocado pears from the Philippines were planted out in the arboretum, also rambutans and mangosteens from Java and citrus varieties from Hong Kong, all of which are growing well.

Nurseries containing *Criollo cacao,* rubber selections and various other crops such as Changi No. 3, Derris, the best rotenone-containing variety available from Singapore, are being built up in this section for distribution. Several grain and fodder crops such as maize selections, pearl millet, Italian millet, broom millet from Fiji, Ragi (*Eleusine corarana*) selections, and peanuts from India, are doing well. Most of these crops are represented on other stations, although Ramie fibre, *Boehmeria nivea,* is not yet distributed.

Some fodder crops and grasses are also being tried out. There are 25 species of *Desmodium* in this country, and some of these are superior fodder types to most introduced kinds of fodder plants. Several local and introduced species of *Desmodium* are under trial and are being analysed by the Chemist for fodder value. There is an excellent plot of Townsville lucerne, *Stylosanthes sundiaca* established in Rabaul, but its protein value does not appear equal to some of the local *Desmodium* spp.

One local plant sent in by Mrs. Clemens, Botanical Collector, Morobe, as *Zornia* spp. appears to be a good leafy type of fodder plant. It appears that this may also be a *Desmodium* spp., and identifications are being made.

There are local species of sorghum in New Guinea which must be worthy of trial as fodder plants. These are *Sorghum laxifolium* collected by Mrs. Clemens, *Sorghum nitida* collected by Mr. Wood, Inspector and Instructor at Maprik Station on the Sepik, and *Sorghum plumosum.* There are wild varieties of rice on the mainland of New Guinea. Botanical specimens were collected last season but unfortunately the seed was non-viable.

Disease Investigations.

Owing to time spent in other projects this work was not greatly expanded except where actual identification was desired. It was found that a serious root rot of velvet beans in Rabaul was due to *Rhizoctonia* spp., probably *R. solani.*

A serious damping-off disease in cacao seedlings from Witu Island was found to be due to the same species of fungus, and recommendations were given as to its control. It appears also that this or a closely-related species was responsible for the disease in the tennis court lawns at Rabaul last season. The soil-inhabiting fungus *Rhizoctonia* spp. appears to be a very common cause of root-rotting in New Guinea.

A root disease of mammees was shown to be most likely due to *Sclerotium rolfsii,* but the exact identity of the soil-inhabiting fungus could not be determined. It spread from the *Crotalaria* cover crop to the mammees. *Sclerotium rolfsii* was unmistakably responsible for stem and root disease in cowpeas and peanuts at Keravat last year. Both of these root-rotting fungi are often found associated with nodular eel worm (i.e., *Heterodera radicicola*) attack on the roots.

So far it has not been possible to identify mildew on rubber leaves here caused by *Oidium heveae,* and it is believed this serious disease is not present in New Guinea. A suspected attack on rubber leaves this season was found to be due to *Gleosporium hevea,* which is not such a serious disease and is frequently associated with insect attack.

Diseased leaves of French beans and velvet beans sent in were shown to be affected by *Cercospora* spp., which is a very common leaf-spotting fungus here.

Specimens of luminous fungi from various plants were sent to the Imperial Mycological Institute at their request and they identified one specimen as being most probably *Armillaria mellea,* a common parasitic fungus. *Marasmius* spp., one of the common causes of thread blight, was also identified from old coffee leaves collected at Vunalama Plantation.

Herbarium.

During the year under review 500 specimens were added to the Herbarium, 300 of these being collected by the officers of the Forestry Department and the remaining 200 by officers of the Department of Agriculture. Of the latter, 100 specimens were sent in by agricultural officers stationed in the Markham and Sepik Districts.

Agricultural Chemist's Report.

The Agricultural Chemist joined the staff of the Department of Agriculture on 11th September, 1939. There was a small laboratory and a little apparatus awaiting him in Rabaul, but, as these were not quite adequate for the carrying out of the numerous analyses which he would be required to make, the Administration gave approval for the additional building of a fume cupboard, a store-room and a combined balance-room and office. Also, orders were placed overseas for additional apparatus and reagents.

A considerable portion of the Agricultural Chemist's time has been taken up in work of an advisory nature. Advice has been given on the feeding of poultry, goats and cattle, and on the fertilization of soils. Unfortunately, questions relating to soil deficiencies can only be answered in vague terms until such time as apparatus is available to make actual analyses.

The duties of Editor of the *New Guinea Agricultural Gazette* have also been undertaken by the Agricultural Chemist. This entails a lot of extra work, although, so far, only one *Gazette* has been prepared under his editorship. In future, it is proposed to issue four *Gazettes* regularly each year, and these *Gazettes* will include an editorial and advertisements. An article on the preparation of reptile skins for exportation was written for publication in the *Gazette.*

Since his appointment the Agricultural Chemist has visited numerous plantations on New Britain, New Ireland, and Bougainville Island, during which he discussed local problems with the planters and collected numerous soil samples. A special visit was made to Pondo, and a report which included suggestions for the improvement of the low-lying portions of the plantations was prepared.

To assist in the compilation of native food tables for the recent Native Labour Inquiry, nine brands of tinned meat, as sold in the open market, were analysed for water, protein, carbohydrate, ash and fat. The results of the analyses are published in the *New Guinea Agricultural Gazette,* Vol. 6, No. 2. Five varieties of local taro were also analysed.

One hundred and twelve samples of local milk have been analysed for fat, total solids and solids-not-fat. It was found that these samples were generally low in solids-not-fat, which appears to be common for milk produced under tropical conditions. This and the fact that New Guinea cows yield only about 1 quart of milk per day led to an investigation being carried out on the nutritive value of local pastures and fodder crops. Thirty-seven samples of pastures, grasses, sedges and legumes have been analysed for their moisture, carbohydrate, fibre, protein, ash and fat content.

During the course of these analyses *Desmodium tortuosum,* a legume indigenous to New Guinea, was found to have a remarkably high protein content. The plant is now growing in an experimental plot in the Botanic Gardens and analyses are being made at various stages of growth. The plant has possibilities as a fodder and green manure. Four other local legumes are also under observation. A detailed account of the above investigation will be published in a future issue of the *New Guinea Agricultural Gazette* when further data are available.*

During the year under review, several small analyses were undertaken for the Department of Public Health.

A summary of all the analytical work performed is given in the following table:—

Material.	Number of Samples.	Number of Individual Estimations.
Milk	112	336
Pasture	16	96
Other fodders	21	126
Tinned meat	9	45
Native foods	8	40
Copra	9	9
Rope	1	2
Shells	1	1
Total	177	655

Keravat Demonstration Plantation.

During the year under review no more bush was cut down, but an additional 25 acres were cleared and brought under cultivation; thus, at the end of the year, the total area under cultivation with permanent crops was approximately 340 acres.

Drains were made where necessary through the newly-cleared areas, existing bridges and culverts were maintained, and a new bridge 40 feet long was constructed over the Wanuwut Creek at a point about 20 chains above the main road.

The large bridge on the main road and over the Wanuwut Creek was pulled down, and towards the end of the year work was commenced on a new one. The new bridge when completed will have a single, 70-foot span, 20 feet of which will be above the water; round bush timber stringers 75 feet long, supported by round timber piles set on concrete, will form the under structure, and sawn local hardwood will be used for decking.

* This work has now been completed and the results appeared in the last issue of the *New Guinea Agricultural Gazette.*

Experimentation in respect to coco-nuts, cacao, and native food crops was continued and extended, and experimentation with rubber (*Hevea braziliensis*) commenced by the planting of experimental areas in Block No. 32.

The outbreak of war early in the year curtailed to some extent experimental expansion, especially in new crops, as Mr. Hurrell, who was permanently appointed to the position of Assistant in October, 1939, was granted war service leave from 23rd January, 1940, and his position is being filled by a temporary officer.

Visitors.

Excluding departmental officers and many local Asiatics, there were 415 official visitors to the plantation during the year.

Meteorology.

The rainfall recorded during the year was 129.80 inches, an increase of 40.50 inches over last year, and the heaviest ever recorded on Keravat. The heaviest monthly records were July (19.73 inches), October (11.44 inches), November (15.77 inches), February (12.85 inches), June (11.62 inches), and the heaviest falls during a 24-hour period occurred on 7th July (4.04 inches), 23rd July (3.02 inches), 8th October (3.01 inches), 18th February (3.50 inches), 26th March (3.35 inches). There were 237 wet days during the year.

Native Labour.

The general health of the labour on the estate was excellent during the year, an average of only 2.40 per cent. being sick per day. One death occurred, and another labourer was accidentally drowned during a flood in the Keravat River.

The policy of employing married labourers, who are allowed to be accompanied by their wives, was continued during the year, and at its close there were 33 women on the estate. There were eighteen children born during the year, and one woman died due to complications during child-birth. The number of children on the plantation at the end of June totalled 32, of which 24 had been born on the estate. No marital troubles were experienced, and the women and children enjoyed good health.

The average number of working labourers on the plantation during the year was 153 per month. A total of 48 completed their contracts of service; of this number, twelve were ineligible for re-signing, and from the balance, 22, or 61 per cent., renewed their contracts for another period.

The diet of the labourers was constantly varied, the rice ration being supplemented by taro, yams, mammees, cassava, sweet potatoes, green maize, and cowpeas. Pineapples, paw-paws, bananas and mature coco-nuts were issued from time to time in addition to the normal ration. The preserved meat ration was supplemented with issues of fresh fish.

On the 21st June, 1940, four specially selected Solomon Island natives arrived on the estate to undergo a course of training in agriculture.

Plantation Activities.

Cacao.—In March, 1939, yield records from the spacing experiment in Block No. 11 were commenced, and continued throughout the year. The lay-out of this experiment is very simple and consists of two parallel areas, one planted at 15 feet

by 15 feet on the square system, the other at 15 feet by 7 feet 6 inches on the same system. The first section contains 670 trees, the other section 1,120 trees.

During the year under review, i.e., 30th June, 1939, to 30th June, 1940, the number of pods harvested was as follows:—

Section A (15 feet by 15 feet) 670 trees .. .. .. = 23,833
Section B (15 feet by 7 ft. 6 in.) 1,120 trees .. .. .. = 26,998

The above yields, based on the number of trees in each section, are equivalent to 35.57 pods per tree in section A, and 24.09 pods per tree in section B. The trees in both areas were planted during September, 1935; thus, at the conclusion of the first full year of recording, they were four years nine months old. It will be seen from the records so far obtained that although the number of pods harvested from section B exceeded by 3,165 those harvested from section A, the average number of pods per tree was 11.48 lower. Frequent tests throughout the year showed that an average of ten pods were required to make 1 lb. of dry cacao. In order to elucidate the foregoing information, the following Table, No. 1, has been compiled:—

TABLE NO. 1.

Section.	Distance apart.	Number of Trees.	Age at 30th June, 1940.	Twelve months' yield.	Pods per tree average.	Average pods.
						Per lb.
A	15 feet x 15 feet ..	670	4 years 9 months ..	23,833	35.57	10
B	15 feet x 7 ft. 6 in. ..	1,120	4 years 9 months ..	26,998	24.09	10

During the month of August, 1939, the flat section of Block No. 23, spaced at 12 feet on the equilateral triangle system and containing 1100 seedlings, was planted with first filial generation selections, namely T1, 2, K3A.25, SC.2, EC.34, K3A, 11, RC.3, K4.2. At the close of the year these young trees were making exceptionally good progress and the greater majority of them had ramified. In this block *Leucaena glauca* used both as temporary and permanent shade, is giving excellent results.

In September, 1939, twelve months' yield records were completed from selections in Block No. 11:—

Total number of pods produced = 4997
Average number of pods per tree = 60.20
Total weight cacao produced = 515.73 lb.
Average wt. cacao per tree = 6.21 lb.

Spraying and banding tests against the cacao weevil, *Pantorhytes plutus,* were instituted, but owing to unfavorable weather conditions had to be discontinued.

Towards the latter part of the year the young selected areas in Block Nos. 12 and 22, commenced to ripen pods and many of the trees will be sufficiently advanced to have yield records started in the coming year. Block No. 12 was planted in the months of October and November, 1937, and Block No. 22 in December, 1937.

In April, 1939, the contoured area of Block No. 23 was divided into five sections, four of these sections were planted the same month with first filial generation seedlings from the selections RC.1, RC.2, RC.3, SC.2, and in June the

fifth section was planted with first filial generation seedlings from the selection T1.1. During the current year all the seedlings have made excellent growth and the greater majority have ramified.

During the year 10.423 lb. of commercial cacao beans were sold in Australia, and 7,218 selected hybrid and *Criollo cacao* pods were supplied for planting. At the close of the year there were approximately 2,300 bearing trees aged 4 years 6 months to 4 years 9 months and 700 trees over 4 years 9 months old. Estimating at the rate of 10 pods per pound of dry cacao the 7,218 pods sold = 721 lb. cacao, this when added to the 10,423 lb. sold = 11,144 lb. (approx. 5 tons), an average of 3.71 lb. per tree, or at a spacing of 15 feet by 15 feet the equivalent of 742 lb. of commercial cacao beans per acre.

Coco-nuts.

In October 1939 yield records over a period of one year were completed with the 44 selected Markham coco-nuts, mentioned in the last annual report. In March, 1939, an investigation of nuts from each individual selection was commenced and the first series concluded in August, 1939, after six months investigation, in which a minimum of 16 per cent. of the nuts dropped each month from each palm was taken.

Seedlings of the Markham Valley King coco-nut, which were planted in the field during 1938-1939, have made great progress. During the year it was necessary to spray the seedlings three times as a control against *Brontispa* spp. and Skipper butterfly.

Macapuno Nuts.

The small area under Macapuno nuts was sprayed three times during the year, and an application of fertilizer at the rate of 8 ounces per palm applied. The manurial mixture was 2 parts superphosphate, 1 part sulphate of potash, 1 part sulphate of ammonia. The fertilizer has had a most beneficial effect on the nuts, and at the close of the year they were doing very well.

Beetle Pests.

During the year beetle pests were prevalent and large numbers of *Rhyncophorus* spp. larvae and adults, also *Dynastid* spp. adults, were collected. Traps consisting of short lengths of split coco-nut stem, cut surfaces facing one another have given a fairly large measure of control for palm weevils, *Rhyncophorus* spp.

Coffee.

The quantity of hulled coffee sold during the year amounted to 2,042 lb.; there were still stocks on hand at the end of June. The young selections in Block 19 which were planted in 1938-39 have made exceptionally good progress. This area was primarily planted in the form of a cultural and spacing trial, but lack of staff and pressure of other duties prevented the inauguration of the cultural experiments in the present year. However, during the coming year, it is hoped that this work will be commenced, before the trees become too old.

Excellent results were obtained from the re-juvenation experiments in the old *Robusta* coffee block, and during the year many of the stumped trees had flowered and set fruit. The yield of coffee on the estate was relatively lower this year, the main flowering and setting which occurs during May, June, July, and August being greatly affected on account of unfavorable weather conditions.

All coffee on the estate was continually pruned and de-suckered throughout the year, and the shade balance maintained. Re-juvenation by stumping of the balance of the old *Robusta* area is to be carried out during the coming year.

Rubber (Hevea braziliensis).

During the year Block No. 32 was experimentally planted with *Hevea* rubber, the layout being as follows:—The block was divided into four sections A, B, C, D. Section A was again divided into three sub-sections a, b, c. In sub-sections a and b, double rows of each of eight selections were planted at random, in sub-section c, single rows of each of the eight selections planted in the other two sub-sections, plus three other selections, were planted.

Section B contains double rows, replicated twice, of each of nine selections planted at random, and spaced 10 feet by 10 feet on the square system, and double rows replicated twice of the same nine selections planted also at random but spaced at 12 ft. 6 ins. by 12 ft. 6 ins. on the square system.

Section C is divided into two sub-sections, one sub-section contains seedlings from Koitaki Estate in Papua, the other, which at the close of the year was unplanted, will contain seedlings from Magaria Estate on the mainland of New Guinea.

Section D contains two Rabaul selections which were planted at stake.

At the close of the year the seedlings in Block No. 32 were growing very well, growth being particularly good after the application of a complete fertilizer in April. A section of the block was planted with *Tephrosia candida*, and throughout the whole block a cover of *Desmodium scorpiuris* is being established.

At the end of the year, Block No. 31 was being lined at 20 feet on the equilateral triangle system. When lining is complete the area will be planted with Kaotaki and Magaria selections.

During the year the Economic Botanist succeeded in crossing a number of selections in the Rabaul Botanic Gardens, and in June the following seedling crossings were planted out at Keravat in Block No. 37:—No. 645 x 651, 665 x 631, 631, x 608, 45 x 631, 148, 225, 231, 243, 155, 156, 18, 71. The area planted in this block is lined at 20 feet on the square system.

Oil Palm.

The oil palm areas were maintained throughout the year and a minor pruning carried out. The young areas in Blocks Nos. 4, 5, continued to make good progress. A small number of palms introduced from Malaya in 1934, and planted in the field in 1935, set fruit during the year.

Fruit and Nuts.

General maintenance of the fruit and nut sections of the estate was carried out during the year. Rambutans and avocado pears again bore crops. The quality of the fruit produced from the slip-stone variety of rambutan has improved considerably, due probably to the trees becoming older. The crops obtained from both the rambutan and avocado pear were far below those of last year.

Fruit was also produced on the variety of *Achras zapota* introduced from Java; again the crop was very small, but a few seedlings were raised from seed.

The Hawaiian and Queensland varieties of paw-paw continued to yield good crops during the year, and a further area of both varieties was established. Pineapples and bananas bore very well, but as usually happens with the bananas, the fruit is of very little use due to the effects of insect pests. Damage to banana fruit is caused by the banana fruit moth, *Notarcha octasems*; control measures against this moth are the dusting in of pyrethrum powder under the bracts as soon as they lift.

The Queensland nut (*Macedamia ternifolia*) section did not flower again this year. This area contains trees that were planted in April, 1934. They have grown very well but have shown no sign of flowering.

As was reported last year, the citrus area of the plantation is suffering badly on account of unsuitable ecological conditions. The heavy rainfall during the year under review made conditions worse with a result that many of the trees died and had to be cut out. Manuring and pollarding was again carried out but with no success.

Annual Root Crops.

Root crops received a great deal of attention during the year, the principle crops in cultivation being taro, yam, mammee, cassava and sweet potato.

Throughout the whole year a continuous supply of native food was despatched to the Government stores in Rabaul. The total amount of native food sent to Rabaul and used to supplement the rice ration on the plantations was 262 tons made up in the proportion of 169 tons to Rabaul, and 93 tons used on the estate. During the latter half of the year, that is from January to June, the average monthly supply to Government stores increased from 11½ tons to 16.66 tons.

Taro.

Single-plant selection work in connexion with native taro (*Colocasia* spp.) was continued during the year. The 22 new varieties obtained from labour gardens in February, 1939, proved to be inferior to the five named Keravat varieties. Investigations carried out during the year showed that the two Keravat varieties, "Utility" and "King", are much better than the other three varieties "Standard", "Pride", and "Mammoth". These three varieties are heavy yielders and produce exceptionally large tubers. The quality of the tubers, however, is not nearly so good as that of "Utility" and "King", as they are soft and inclined to be "mushy" when cooked. This softness makes the tuber more susceptible to beetle attack whilst the plant is growing. Both "Utility" and "King" are heavy yielders, the tubers are hard and do not become "mushy" when cooked, and there is a definite resistance to beetle attack.

During the year two distinct tuber types were isolated in the "Utility" variety, and although leaf and stem markings are identical, one type produces a round tuber, the other an oval tuber. At the last planting of the single-plant selections of this variety in March, both types were weighed and planted separately. The yield per acre throughout the year of "Utility" and "King" bulk selections, averaged 7 tons per acre, whilst individual yields of up to 6 lb. per tuber were recorded from single-plant selections.

In September, 1939, harvesting of the third generation single-plant selections took place. Yields were so satisfactory that it was possible to establish a new minimum weight of 2½ lb. per plant, and in March, 1940, when the fourth generation was harvested this minimum weight of 2½ lb. was retained.

During the year large quantities of taro planting material were distributed through the Department of Agriculture, working in co-operation with the Department of District Services.

Yams (Dioscorea Spp.)

Taitu variety.—During the month of April, the single-plant and bulk selections of the variety known as "Taitu" were harvested. These selections were planted on the 7th June, 1939, and harvested on the 17th April, 1940, thus the period from planting to maturity was 45 weeks.

The minimum weight for the parent single-plant selection was 21 lb., and the maximum 31 lb.; at the present harvest the average yield per plant was 16.203 lb. from 415 parents, which is equivalent to 29.47 tons per acre. The minimum and maximum weights for the bulk selections were 13 and 21 lb. respectively, these selections at this harvest averaged 10.78 lb. per plant from 815 plants, which is equivalent to 19.60 tons per acre.

When the single-plant and bulk selection planting was made, three sizes of "sets" were used, namely, small, medium, large. At harvest, separate records were kept of the weights from each "set" and it was shown that the highest yields were obtained from the large sets, followed by the medium-sized sets, with the small sets easily producing the smallest crop.

During the coming year when the next generation of single plant and bulk selections are planted the "size of sets investigation" will be continued.

It is worthy of note that the first recorded yield from Taitu yams was made in July, 1939, when unstaked, unselected yams yielded 6.45 tons per acre, and staked, unselected yams yielded 8.80 tons per acre.

In February, 1940, a large native-material yam store was erected, and the crop harvested in April was accommodated without difficulty.

Wewak Yam.

It will be recalled that in the annual report for 1938-1939 mention was made of the introduction from the mainland of New Guinea of two varieties of *Dioscorea* spp., one white and the other red. Since their introduction these two varieties, now referred to as "Wewak White" and "Wewak Red", have been multiplied to the extent that during the harvest in 1940, individual plant weighings were made and standards set, for single-plant and bulk selection work to commence at the next planting early in the coming year.

In the "Red" variety, single-plant selections were made of 25, 26, 27, 28, 29, 31, 34, 40, 44, 46, 48 lb., bulk selection No. 1 of 20, 21, 22 lb., and bulk selection No. 2 of 13-19 lb.; all below 13 lb. were discarded. In the "White" variety, single-plant selections were made of 20, 22, 23, 24, 25 lb. and bulk selection No. 1 of 12-20 lb., all under 12 lb. were discarded. These yams are exceptionally palatable, contain very little fibre, show every indication of being heavy yielders, and should prove an excellent type for use in the improvement of native food crops.

Mammees (*Dioscorea esculenta*).

During the current year single-plant experimental work was continued with the local type of *D. esculenta* known as mammee. The mammee closely resembles the Taitu and Wewak yam insofar as the leaves and stems are similar, and the quality of the tuber is good. However, the mammee, unlike the others, must be harvested once mature, and when stored, quickly loses palatability becoming either hard or mushy when cooked.

On 21st April, 1939, the first single-plant mammee selections were planted, and these were harvested on the 29th March, 1940, after a growing period of 49 weeks. At the time of this planting weight groups were made as follows:—15, 16, 17, 18, 24, 26, 31 lb. In the following table, No. 2, the results at harvest are shown:—

Table No. 2.

Parent Weight.	Number of Plants.	Total Yield.	Variation in Weight of Progeny.	Average Weight of Progeny.	Average Weight above or below Parent Weight.
lb.		lb.	lb.	lb.	lb.
15	12	371	25–40	30.91	15.91
16	16	465	25–40	29.06	13.06
17	65	1,621	18–37	24.92	7.92
18	60	1,414	19–43	23.56	5.56
24	7	166	20–29	23.71	0.29
26	8	276	20–38	34.50	8.50
31	12	343	21–37	28.58	2.42

It will be seen from the above table that there were seven single parent plant weight groups, and that in five instances the average yield from the progeny was greater than that from the original parent, further that the greatest increase occurred in the two lowest parent groups, namely, 15 and 16 lb., and the greatest decrease in the highest parent group (31 lb.).

On the 24th June, 1940, the first generation single plant selections obtained from the March harvest were planted out. Analysis of the weights obtained at the March harvest showed that 63.3 per cent. of the plants yielded 25 lb. more per plant, therefore a minimum of 25 lb. was set as a standard and weight groups as follows were established:—25, 26, 27, 28, 29, 30, 31, 32, 34, 38, 40, 43 lb.

Sweet Potatoes.

Cultivation of sweet potatoes on the plantation was greatly increased during the year, and exceptionally heavy crops were obtained. The introduced Giant Toad (*Bufo marinus*) continued to give 100 per cent. control of the sweet potato moth (*Hippotion celerio*).

During the year cultural experiments were commenced with the object of increasing the yield, and results obtained to date are very satisfactory.

The general methods of planting sweet potatoes in the Territory consists of making small, low, hills or ridges, and planting one end of a bunch of cuttings of indeterminate number and length in the top of the hill or along the top of the ridge, little or no attempt being made to make the hills or ridges regular or in lines. In the first series of experiments this local method of cultivation was

used as a check, and for comparison large hills and ridges at distance of 4 feet from centre to centre were made. Cuttings for planting were taken from a bearing crop, and three cuttings about 18 inches to 24 inches long, bent in the centre like an elbow, were planted six inches deep, with the bent section in the ground. In each hill the cuttings were planted in five places (top and sides) and in the ridges, the cuttings were planted at intervals of two feet on the top of the ridge, and along the sides midway between ground level and the top. The experimental areas were harvested when fully mature at the age of seven months and yields were as follows:—Check plots, the mean yield was 4.5 tons per acre, large hill and ridge plots, the mean was 15 tons. It is interesting to note that two areas outside the experimental plots which had large hills yielded 17.75 and 20 tons per acre. Only one variety of sweet potato was used, namely, "Keravat Purple" because this variety has for a long time past, proved to be the most reliable yielding type on the plantation.

Test yields were also made with three varieties, "Keravat Purple", "Red Skin", and "White", and the results proved that the "White" variety yielded much less than the "Red Skin", which in turn yielded a great deal less than the "Purple". In two parallel plots the yield from the "Keravat Purple" was exactly twice that of the "White".

Cassava.

Cassava is a crop which, prior to the outbreak of war, was not extensively cultivated on the estate, however, as a means for providing sufficient material for research work, in the manufacture of power alcohol, cassava flour, and starch, quite a large area was planted during the months of September and October, 1939.

Minor Root Crops.

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

Annual Grain Crops.

The main annual grain crops in cultivation are maize, cowpea, and rice.

Maize.—Selection of the Keravat strain was continued and large quantities of seed distributed for native and European cultivation throughout the Territory. This Keravat selection is by far the best type of maize growing on the estate, and yields good crops even when planted during unsuitable periods of the year.

The Sweet Corn variety, U.S.D.A. 34, remained in cultivation throughout the year. This variety, despite constant selection does not improve to any great extent, and on two occasions during the year the crop was almost a total failure.

Two new maize varieties were introduced, one a Dent maize known as "Early Morn" which came from Australia, and the other a Flint maize, variety unknown, which was received from one of the local mission stations. The first crop of "Early Morn" was very poor, the stalks grew to an average height of 4 feet 6 inches and the cobs were small and badly filled, the second crop is now ripening and does not show much promise.

The first crop of Flint maize grew fairly well but "lodged" badly just prior to tasselling, the second crop was much better and no "lodging" took place. Present indications regarding these two new varieties are that a great deal of improvement is necessary before they reach the standard of "Keravat" Selection.

Cowpea.—Extensive areas of cowpea were planted during the year; in the dryer months good crops were harvested, but on two occasions although the crop made excellent growth no seed was set on account of wet weather. Rats were again troublesome, especially just after planting and just before harvest when the grain was hardening. Cowpea is a valuable native food, and whenever possible the native labour rice ration was supplemented during the year with cowpeas. A total of 396 lb. was distributed for planting in other parts of the Territory in an endeavour to popularize the crop as a native food.

Rice.—Rice was kept in cultivation throughout the year, and field selection to maintain uniformity of maturity was continued. Two crops were grown, and rat damage was severe in both cases; the rats wait until the seed commences to germinate, and then dig it up and eat it. During the year a total of 459 lb. was distributed for outside planting.

Miscellaneous Grains and Legumes.

Millet.—A number of millet varieties were introduced during the year but all failed to set seed due to the abnormally wet year.

Velvet Bean.—Five varieties of velvet bean were introduced from Australia. A small crop was harvested from each variety after the first planting, and the seed obtained was planted in multiplication rows towards the close of the year.

Eleusine Coracana.—This grain crop was introduced but proved a complete failure, only a very small percentage of the seed germinated, and the plants died off when about one foot high.

Haricot Bean.—Two varieties of haricot bean were introduced, namely, "Little Navy" and "Haricot". The former grew poorly and produced a few seeds, whilst the latter proved a rampant grower but up to the close of the year, had not produced any seed.

Lima Bean.—A new variety of lima bean was introduced through the Director of Agriculture. It is a rampant grower (climbing type) but has not yet set any seed.

Fibres.—Demonstration areas of the principal fibres, Manila hemp, Amani sisal hemp, Sisal hemp, Sanseviera hemp, Pineapple fibre, Banana hemp, Kapok, Cotton, Red and White Rozella Fibre, were maintained in cultivation throughout the year.

Spices.—Demonstration areas of vanilla, turemic, ginger, pepper, and cinnamon, were maintained. The cultivation of pepper was extended during the year.

Annual Oils.—Groundnuts were cultivated in small areas during the year as any large scale planting is impossible on account of rats. A small area of *Sesamum indicum* was also maintained.

Insecticides, Drugs and Medicinal Plants.

Small demonstration areas of tobacco, *Tephrosia vogelii, Hydnocarpus anthelmintica,* and castor oil were maintained. During the latter half of the year the cultivation of *Derris elliptica* was extended considerably.

Cover Crops.

The following species of creeping cover crop are in cultivation:—*Pueraria javanica, Pueraria hirsuta, Centrosema pubescens, Centrosema plumerii, Calopogonium mucunoides, Calopogonium* spp. *Mimosa invisa, Dolichos hosea, Desmodium scorpiurus, Desmodium triflorum.* Small blocks of all species of cover crop were maintained for demonstration and comparison purposes.

Green Manure Crops.

Green manure crops of *Crotalaria anagyroides, Tephrosia candida, Leucaena glauca,* and Cowpea, were kept in cultivation throughout the year and sufficient areas to supply outside seed demands.

Shade Trees and Windbreaks.

The chief temporary and permanent shade trees and shrub varieties in cultivation are—*Crotalaria anagyroides, Tephrosia candida, Indigofera arrecta, Leucaena glauca, Erythrina lithosperma, Erythrina glauca, Erythrina micropteryx* and *Albizzia sumatrans.*

Other permanent shade and windbreak trees in cultivation are as follows:—*Albizzia falcata, Adenanthera avaonica, Gliricidia siamea, Cassia fistula, Cassia multijuga, Swietenia mahogani, Hydnocarpus wightiana,* and *anthelmintica, Bixa orellana, Sesbania grandiflora.*

Aiyura Agricultural Station.

For this year, the third since the establishment of this Station, steady progress and development can be claimed. With most of the purely constructional work completed, more time was devoted to crop production and, as the year closes, some financial return after three years of outlay, is in sight.

Cultivation on grassland and in the timber area was extended only slightly to 20 hectares, as it was found that with limited labour, and a very mixed variety of crops under tests, that no reclamation of extended new areas was possible.

Station roads and aerodromes have been maintained in good condition. Although aerial transport has been used exclusively to date, this Department pioneered the first road transport by road from Lae, when in November, Mr. Cantor lead a patrol in from the coast. The practicability of this road route was well demonstrated when it is taken in account that the walking time for the trip was 38 hours.

A feature for the year under review was the introduction of Romney Marsh sheep from Queensland to these highlands in April this year. These did not appear to pass through a period of acclimatization, as they immediately settled down on local pastures and have continued to thrive, although due to loss of the ram *en route* from Australia, there are no immediate prospects of lambing.

The scheme for afforestation inaugurated last year in company with the Forestry Officer (Mr. J. B. McAdam), Wau, to gradually reforest non-arable areas, entered its first practical phase, when nurseries were established and approximately 50,000 seedlings raised.

The most promising crop under test undoubtedly is *Coffee Arabica* (Blue Mountain). Local residents and visitors have been greatly impressed with the excellent growth and the economics of this crop; and as soon as land can be alienated for European development, it is certain that good quality coffee will receive much attention.

A small hydro-electric plant was installed on a local stream, from which power is derived to supply lighting to Station Buildings. Electric fence units have been used with success in the control of livestock.

Native Labour.

The average number of labour units employed for the year has been 46 per month, comprised of 18 indentured labourers and 28 casuals (local). This average strength is 9 units less than in the preceding year, and in addition, about 6 units of the present year's strength were small "monkeys" used as interpreters and for light duties. Casual labourers were drawn principally from the Bena Bena area, as these natives are unquestionably superior to local Ramus for plantation work, but a few natives from Kambaidam in the Gadsup Area have had long contact with this Station and remain at work.

The station ration has been as varied and generous as in previous years. Apart from the usual native foods, French beans have been grown in large quantities for use by the labourers. Practically every "boy" has his own garden in which he produces particular delicacies.

Visitors.

Despite war conditions, there has been a steady flow of visitors to this Station, two worthy of especial mention being Mr. Hore-Lacy, of Rabaul, and Mr. F. Shaw-Meyer, Ornithologist, from the British Natural History Museum. All local Administration Officials have paid periodic calls, as have other Ramu residents. Mr. J. B. McAdam, Forestry Officer, Wau, paid visits in connexion with his work.

Meteorology.

Rainfall for the year amounted to 108.79 inches, distributed over 279 wet days. This exceeds last year's total by 18.81 inches, and again established a new record in rainfall. The wettest months again were March (15.74 inches) and January (13.87 inches), with the lowest fall in June (5.94 inches) and August (4.60 inches). The highest daily gauging (2.95 inches) ever recorded at Aiyura fell on October 25th.

The highest maximum shade temperature recorded for the year was 73.0 degrees on the 23rd December (a record) whilst the minimum air temperature was 51.2 degrees, observed on 30th September (also a record low temperature).

Permanent Crops.

Cinchona three-year-old blocks. These trees which include varieties *Robusta*, *Succirubra*, *Ledgeriana* and the hybrid *Ledgeriana* x *Succirubra* displayed remarkable vigour throughout the year; *Robusta* and *Succirubra* rees now average 15 feet in height throughout the blocks, whilst *Ledgeriana*, which is definitely less vigorous than the grafting varieties, is in a healthy condition and averages

about 10 feet in height. The hybrid is the only disappointment, for, as can be expected in a cross-bred, there is a very wide variation in type and vigour, in fact; in view of inconsistencies, these trees will be of little value apart from grafting purposes.

Late in the year, some trees of variety *Robusta* began to carry flowers, the perfume from which is unique and beautiful. However, it is now considered that such flowering was premature, as no seed has "set".

In other countries, apart from Java, *Cinchona* culture has been dogged by misfortune, the tree requiring peculiar physical and chemical soil properties of a fastidious nature. Although it is, as yet, too early to state that *Cinchona* appreciates local soil conditions entirely, the results so far encourage further experiment on a larger scale.

The variety *Succirubra,* during its early growth in the field, while the laterals are still close to the ground, can be propagated vegetatively. As the laterals droop over and touch the ground, a ready strike is obtained by covering the laterals for several inches with moist soil. Rudimentary roots soon appear, followed by the root system; when well developed, the lateral can be cut and the seedling planted out.

Successful propagation has also been made by using cuttings from more than one-year-old wood. Further experiment is proposed in this direction.

One-year-old seedlings.—There are over 5,000 seedlings of this age in the nurseries, which will be ready for transplanting to the field next wet season (September). These are of the variety *Ledgeriana* and the seventh cross *Ledgeriana* x *Succirubra.* In this case, the seedlings show uniformity in type, due no doubt to the seventh crossing back to *Ledgeriana.* The block to receive these seedlings has already been prepared.

Ledgeriana seedlings.—In addition to the above, 2 ozs. of *Ledgeriana* seed was planted into a nursery early in May. Good germination resulted in 35 days (which was delayed). It is impossible to accurately give the number of seedlings as these are still very small, but the bed is of 300 square feet and is well-stocked.

No serious pests have been observed and seedlings and trees have been remarkably free from disease. There have been two isolated cases of "Borer" attack into the base of trees.

Coffee Arabica, Blue Mountain, Three-year-old Block.

Early in the year this block flowered profusely, and as the year closes is carrying a heavy crop of cherries. For the last two months, harvesting of beans has been regular every ten days. The beans are of good size and quality, some have already been forwarded to Rabaul for inspection. It is not yet possible to give any accurate yields, as the trees are only settling down to regular bearing. All trees were topped at 6 feet, using the single-stem system.

Shade has been gradually reduced until it is no longer effective; the ground cover of *Calopogonium mucunoides* has, of course, been maintained. The block has been free from pest and disease attack.

In May, 75 mother trees were selected for seed purposes on trueness of type, lateral development, node spacing, fruiting ability and size of cherries. Since

then these trees have given an average of 1 lb. of beans each week, which has been immediately planted into the nursery, in order that a much larger area of coffee can be tested as soon as possible. After heavy culling, it is anticipated that there will be sufficient seedlings available for a further 30 acre block.

Coffee Arabica *ex* Kenya.

Four varieties—Harari, Columnasia, Maragogipe and San Ramon, each of approximately 100 seedlings, were planted without shade in an half-acre block during October. At first, the seedlings were severely attacked by leaf-eating insects, but as soon as shade was introduced these attacks were controlled. Hence, it has again been demonstrated that shading, at least in the early stages of establishment, is a necessity. All varieties are of the multiple-stem type developed in Kenya; later results and growth will be interesting.

Tea, *ex* British North Borneo.

A small block of 80 seedlings planted 8 feet x 8 feet has made fair growth through the year, although its vigour does not compare with the other permanent crops. Lateral development has been fairly good; the bushes appear to be perfectly healthy, so that it is concluded that the strain is not the best. It is regretted that it has not been possible up to date to procure seed from more reputable stock. The present height of the bushes is 5 feet.

Pyrethrum.

This crop continues to be full of promise. The area under crop was doubled during the year and next year it will be possible to plant several acres. Several pounds of seed and dried flowers have been collected, samples of the dried flowers having been forwarded to Rabaul for analysis. Picking of flowers is necessary every ten to fourteen days. It has been observed that as the flowers are picked, so the plant is stimuated to produce. Propagation by cuttings is more effective and labour-saving than from seed. The prospects for expansion of this crop, which is reported to have a market value of £140 per ton at present, appear bright.

Fruits.

The following fruits are now in full bearing:—

Passion Fruit (*Passiflora edulis*).—Very heavy yields of good quality fruit.

Banana Passion Fruit.—Heavy yields.

Strawberries.—Good quality fruit. A small block of 50 square yards produces 4 lb. a week.

Cyphomandra batacea (Tree Tomato).—These have fruited heavily and continuously.

Pineapple and Cape Gooseberries.

Figs.—A few figs of the Blue Province variety were produced, but were quite tasteless.

The only new plantings into the extensive orchard established last year were more tree tomatoes and Hawaiian papaws. The latter are thriving in a warm, protected corner of the plantation. These are 12 feet high and give early promise of bearing fruit.

Castor Oil.

Extensive planting has been abandoned, as the ground can be more wisely used for remunerative crops. A few trees of the four varieties previously tested —Ramu variety, Java, Bombay and Caledonia—are kept in bearing for seed purposes. If cheap transport becomes a reality, this will be a remunerative crop.

Tung Oil (*Aleurites fordii*).

In November, 23 lb. of seed *Aleurites fordii* were received from Queensland. These germinated satisfactorily and there are now 2,000 well-grown seedlings ready for transplanting to the field upon the arrival of the "wet" season. Local seedlings are very much superior to the 16 seedlings introduced from Rabaul in 1938.

Root Crops.

Sweet potatoes have again dominated this section. About 80 per cent. of the cultivated Station has been under this crop at some time during the year, the average yield for all areas being a little over 4 tons per acre. A line of Bena-Bena natives was observed for one week, when it was found that each labourer comfortably accommodated 15 lb. of uncooked sweet potatoes each day. Admittedly, their working ability is in proportion to their appetites for this staple food. Potatoes, yams, and taro have been maintained in cultivation in small quantities. Although potatoes are now in the fourth generation from original Australian stock, there is no sign of deterioration in size and quality, but it has been found that seed potatoes require a resting period of six months from digging to the next planting.

Annual Food Crops.

Maize.—The variety "Golden Nugget" has been kept in cultivation continuously and has given good all round results. One crop which matured in January did so in very wet weather, yet the cobs did not develop fungus or mould. Yields have not been spectacular, but have averaged 500 lb. of corn per acre. It is not possible to use any fertilizer.

Late in the year, another variety, "Early Morn", was introduced from New South Wales. This variety is a quick grower, and may possibly mature in 90 days. It also seems to have the ability to withstand prolonged wet spells without sunshine, as occurred in June.

Rats have again been the most serious pest of this crop. Largely due to the efforts of Mr. F. Shaw-Meyer, more is known of these rodents. The species most active against maize is the Giant Rodent which, when mature, weighs about 10 lb. and is the size of an opossum. Naturally, it has an appetite in keeping with its size, and if not captured or poisoned in time, will completely wreck a corn crop.

Rice.—Results have again been disappointing, due to "non-setting" of grain. However, three more varieties are under test now—Bomba, Benllech and "Kinastita 10"—these are reputed to be upland types, and the results are awaited with interest.

Indian Corn.—This crop has been kept in cultivation, primarily as a poultry food, for which purpose it has much to commend it. Local natives or indentured labourers, however, do not appreciate it as a food. Yields are heavy, and it has been found that a good second crop is obtained by cutting down the stalks after the first harvest, when fresh suckering is encouraged.

Groundnuts, Rhodesian.—Have been kept in cultivation, two crops of 1 acre each being harvested at the rate of 5 cwt. The nuts are of good quality and flavour.

Soybeans, Yellow Mammoth.—No improvement in earlier results has been obtained. This variety produces an excellent flour for bread purposes, but the plant itself is a dwarf type and does not appear entirely suited to local conditions. A request for the supply of seed of other edible varieties from the United States Department of Agriculture has been forwarded to Rabaul.

French Beans.—Excellent results have been obtained with this crop when interplanted with maize. The growing period is only 10 weeks, so that the beans are havested before the maize is advanced. Interplanted with maize in lines three feet apart, yields of 1,150 lb. of green beans per acre have been obtained. The beans when practically mature are greatly appreciated by native labour.

As the year closes, quantities of up to 1 cwt. each week have been forwarded to Lae for European use.

Sugar-cane.—The Station area was increased tc 1 acre, sufficient to meet labour requirements. The crop appears to thrive on exhausted soil at the end of the rotation. Planted in rows three feet apart, it quickly crowds out weeds and requires little cultivation.

Tobacco.

An experiment with tobacco has been commenced, the idea being to eventually supply Station needs. Seed of a pipe strain was obtained from Mr. Hore-Lacy. This was raised in a nursery, and the crop gives promise of giving an excellent return. One acre is under cultivation.

Cover Crops.

Calopogonium mucunoides remains the only effective ground cover. This has been propagated on all areas which require resting and as a means of arresting soil erosion. *Pueraria javanica* has been introduced, but it is devoid of vigour and of no value in weed control. *Desmodium acorniurus* and *triflorium* were eventually established here after much difficulty, but they are of little value as cover crops.

Tangier pea has become even more widely established around the station, and as a cover and sheep feed has good possibilities. Haricot beans also have been found effective when it is only necessary to have a good cover for six-eight months.

Vegetables.

The high quality of the more common European vegetables has been maintained, and as the year closes, it is likely that a market exists in coastal towns that will make vegetables of some value. A request from Guinea Airways Ltd., Lae, has been received to supply 3 cwt. each week at a rate of 2d. per lb. for all lines. Production can be expended to meet any further coastal requirements, but in order to do so seeds from Yates Ltd., Sydney, will be necessary as it is impossible to collect local seed for most of the year when conditions are too wet.

Pests.

A comprehensive collection of insects was made during the year and forwarded to the Entomologist, Mr. Froggatt, for classfication. None, however, are of great economic importance. Rodents remain the only serious pest of annual crops and of mature coffee beans, the sweet pulp of which they appear to appreciate.

Shade and Decorative Trees.

Eucalypts and *Acacias* are well established at Aiyura and display good size and growth after two years. About 2,000 seedlings of *Eucalyptus rostrata, globulus, alba, citriodora* and *terotornia* were planted on station hill-slopes during the year. This planting has at least proved one fact; that seedlings planted on cultivated land do much better than those planted in holes in grassland in competition with grass roots. The same remark applies to *Acacias baileyana* and *decurrens,* both of which respond quickly on cultivated areas but poorly in grass country, even when the grass is kept cut.

Afforestation.

Approximately 50,000 seedlings of *Arsucaria hoop* and *klinkii* are in the nurseries, the main nursery being established during October and November, 1939. Seed is being collected again towards the close of this year, although the results of this year's seedfall do not appear as good as for the last year.

Timber-sawing.

Timber-sawing of local hardwoods was maintained throughout the year with an average output of about 1,000 super. feet per month. Most of this timber is being used after a short drying period for station buildings, but the better quality timbers are being seasoned properly for later use. The "carpenter-boy" has done some good work, and the pit-sawn timber structure is of his making. Weather-board roofing is an experimental idea, but it is effective and time will be required to prove its durability. It is proposed to convert all native labour quarters to similar structures.

Stock.

Goats.—These increased to 46 in number during the period under review, and are in good condition.

Sheep.—The six Romney Marsh ewes introduced from Queensland quickly acclimatized and are doing well on local pastures. A ram is required, however, to make this experiment worth while.

Horses.—One foal was born last November and is now well grown. The two mares are used for hacking around the station and for making longer trips.

Bo Agricultural Station, Namatanai.

During the year, clearing of the site for the Agricultural Station was continued until approximately 40 acres of bush were dropped. As clearing continued, the area was divided into blocks, each containing 10 acres, and two such blocks are now completely planted up. One has been subdivided into nine equal sections and is used for the production of native foods in a four-cycle rotation; the other block has 4 acres laid out in orchard and the remainder of the block is planted to various crops.

The soil on the station is of good texture and improves considerably with cultivation and green manuring. It should continue to maintain good plant growth for many years, despite leaching due to the irregular topography of the block. The maintenance of soil fertility by green manuring, &c., should be easily carried out, as the appearance of the soil improves with the growing of each crop. The upper layers of the soil tend to dry out fairly rapidly, but the lower layers of the soil maintain a good supply of soil moisture.

Apart from the orchard, no permanent crops have yet been planted on the station, but some good annual crops have been harvested, especially maize of the Keravat "Long Cob" type and groundnuts, both "Pearl" and "Spanish Red" varieties. Seeds of both these crops have been distributed to the local natives for planting in their gardens. Papaws (variety Hawaiian) have come into bearing and show promise. The orchard trees are well established and for the most part are making good growth. Cowpeas (*Vigna catjang*) have been used in this section as a cover crop with good success.

For the greater part of the year, casual labour was employed on the station while attempts were made to recruit indentured labourers. The casual line has now been replaced by twelve indentured labourers and attempts are still being made to bring the establishment up to the allotted strength of fifteen labourers.

Native foods grown on the station throughout the year include sweet potatoes (*Ipomea batatas*), Mamis (*Dioscorea esculenta*), Native Taro (*Colocasia antiquorum*), Kong Kong Taro (*Xanthosoma saggitafolium*), Tapioca (*Manihot utilissima*), and Maize (*Zea mays*). Besides being used for the labour employed on this station, supply was made to other departments as shown:—

	lb.
Assistant District Officer, Namatanai	5,089
Namatanai-Uluputur road	4,844
Bopire Bridge construction	556
Department of Public Health, Namatanai	460

During the year the following introductions were made:—

Cowpea, var. Poona ex Lae.
Cowpea, var. Russia ex Keravat.
Kong Kong Taro suckers from Keravat.
Rice, upland, from Keravat.
Italian millet, from Department of Agriculture, Brisbane.
Pearl millet, from Department of Agriculture, Brisbane.
Broom corn millet, var. Scarborough Dwarf, from Department of Agriculture, Fiji.
Maize, long and short cob types, from Keravat.
Townsville lucerne, from Department of Agriculture, Brisbane.
Velvet beans, five varieties, from Department of Agriculture, Brisbane.
Haricot beans, from Yates, Sydney.
Maize, var. Early Morn, from Glen Innes, New South Wales.
Bananas, three varieties, from Keravat.
Pineapples, from Keravat.
Broom corn millet, *Panicum miliaceum,* from Hai Pa Gzu, Durbit.
Broom corn millet, three varieties, from Council for Scientific and Industrial Research, Canberra.
Garden orache, *Atriplex hortensis,* from Council for Scientific and Industrial Research, Canberra.
Subterranean clover, from Council for Scientific and Industrial Research, Canberra.
Ragi, *Eleusine coracana,* from Bangalore, India, two varieties.
Rice, two varieties, from Rice Experiment Station, Valencia, Spain.
Rice, var. Kinastila 10, from Department of Agricultura, Philippines.

All these introductions have been planted on the station, and, with few exceptions, have become well established.

Throughout the year, collections of insects in the district have been made and duplicates forwarded to Rabaul for identification. Many species not recorded in the Rabaul collections were forwarded, and it is possible that some of these specimens represent new species.

Meteorological observations were made daily at the station and forwarded monthly to Rabaul. 128.64 inches of rain were recorded for the year, precipitation occurring on 237 days. The highest fall recorded over a 24-hour period was 5.37 inches on 24th February, whilst the highest monthly aggregate was for February, 29.53 inches being recorded for 23 wet days.

Visits were made to various parts of the district during the year to investigate outbreaks of pests, for the routine inspections of native groves and plantations, and to advise on agricultural matters generally. An outbreak of *Sexava* reported from one plantation in the south of the island was investigated and measures instituted for the control of the pest. On the return trip to Namatanai, all native groves were inspected and, where necessary, instructions issued for their cleaning. All plantations in this section were visited and any necessary advice given. A patrol was conducted on the west coast, as far as Kalili Estate, for the routine inspection of plantations and native groves, and to investigate the incidence of *Sexava* in this section. New plantings are being made on this coast at Lamasbei, Konogogo and Komale Bay and have opened up the district considerably. In addition to coco-nuts, cacao is being planted at Lamasbei and Konogogo with satisfactory results and the young areas are coming on well. Slight traces of *Sexava* feeding are noticeable almost throughout this section, but, except in a portion of Kokola Plantation, the numbers of the pest are negligible.

An outbreak of *Sexava* in an area of young palms at Kolonoboi village necessitated a patrol in that section as far as Karu Plantation, and all native groves were cleaned up during the patrol. A strict watch was maintained on this area and several visits were made to ensure that the measures advised for the control of the pest were being undertaken. The outbreak now appears to have been successfully brought under control. A reported outbreak of *Sexava* at Karu village necessitated visits to that section to investigate the report and to advise the natives on control measures to be undertaken. A further visit was made to see that these instructions were being carried out.

During a routine patrol on the west coast, the presence of *Promecotheca antiqua* was recorded on one plantation and Rapuntaman village. In both cases the infestation was very light, being only in a few localized palms. This is the first time that this pest has been recorded on New Ireland. Accompanied by the Entomologist, a visit was made to all suspected areas and *Pleutotropis parvulus* was liberated in an attempt to control the pest. A further visit to the plantation showed the parasite to be apparently well established and holding the pest in check.

Two visits were paid to the native groves on the east coast, one as far as Sohun and the other to Matankuk, and instructions were issued for the cleaning of all native groves in this section. On the whole the native groves here are fairly well maintained. Much improvement could be effected in the groves, however, by the greater use of cover crops. In some parts there are good stands of *Centrosema pubescens* and *Calopogonium mucunoides* and these growths should be

encouraged and the seed used for sowing areas with no cover crops. Cowpea seed has also been distributed to the natives for planting in their groves as a cover crop, and also for planting as a green manure in their gardens.

With the present low price of copra the native is very reluctant to cut or sell the produce of his groves, although in most parts there are ample facilities for trading. There are exceptions in some parts where the natives have erected smoke driers and dispose of the copra to local traders, and in some parts the whole nuts are sold. The natives have been instructed that the nuts must not be allowed to remain in the groves till they germinate, but must be collected regularly and if not used for copra must be fed to pigs, used for food for themselves, or burnt.

Seeds of maize, groundnuts, rice, cowpeas and tubers of Jerusalem artichokes have been distributed over a wide area to the natives for planting, but results on the whole have not been completely satisfactory, especially in the case of groundnuts, where in some instances the natives preferred to eat them. Attempts are being made to establish demonstration plots in each village and to keep them under observation and also to endeavour to impress upon the natives the benefits of crop rotation over the native method of shifting agriculture, which is a very wasteful practice. New crops may be introduced into these plots and the natives' reluctance to plant something new may be gradually overcome.

Some form of transport, such as a utility truck, is badly needed to enable a comprehensive system of native agriculture to be carried out. To enable a scheme for improvement in the native methods of agriculture to be carried out it is necessary to make regular visits at short intervals to the demonstration plots, where instruction can be given during the growing periods of the crops under cultivation and any necessary advice given.

Plantations throughout the district are bearing well and in most cases the average yield has been more than maintained. As an example one plantation increased in yield from 17 tons per month in October, 1939, to 35 tons per month in March, 1940. Those plantations previously affected by the serious *Sexava* outbreak in 1937, and which had been yielding below the average since the infestation, now appear to have completely recovered and are bearing very well.

Young plantations in the district are doing very well. Three such places, Samo, Magah, and Belik plantations are now coming into full bearing and show great promise and the effects of the seed selection in the planting of these properties can now be clearly seen.

Cover-cropping is becoming more popular in the district and almost every plantation is now partly covered, at least, with a good leguminous cover crop. *Centrosema pubescens* is the most popular and appears well suited to the district. *Calopogonium mucunoides* and *Pueraria javanica* are also used, the latter appears well suited to the district and makes extremely vigorous growth wherever grown. For this reason it is not so popular as it is very difficult to locate fallen nuts in the very dense cover. This crop also seeds well in the dry season in Namatanai.

Mealy bug was reported as attacking young Cacao seedlings on two new plantations on the west coast, but oil sprays, applied promptly, had the desired result and quickly brought the infestation under control.

On Bo Station parasites of several pests were recorded. From *Telicota bambusae* larvae two parasites were recorded and each appears to be of economic importance. One was a Braconid wasp, possibly *Disophrys* sp. and the other was a Chalcid wasp not in the Rabaul collections. This latter parasite was also bred as a parasite of the Corn Stalk Borer in maize on this station.

Weed pests in the district include *Sida rhombifolia,* which is being successfully controlled on most plantations by a good cover of *Centrosema pubescens.* In native areas the owners have been advised to hand pull and burn this weed, in preference to cutting it, which seems to cause it to grow thicker and stronger.

Stachytarpheta indica (Blue Rat's Tail) was plentiful in parts but a campaign of eradication of this pest by hand pulling and burning seems to have been successful.

Throughout the district small patches of Milky Cotton Weed (*Asclepsia currasavica*) are to be found and in each case the owners have been advised to eradicate the weed, since there is the possibility of stock being poisoned if it is allowed to remain.

TUNG OIL.

The tung oil tree, *Aleurites fordii*, which is found growing in many parts of New Guinea, is indigenous to China, where it grows wild in the hills near the Yangtze River. The seed contains an excellent oil which has become well known as an essential component in the manufacture of quick-drying paints and varnishes, water-proofing and fire-proofing materials, oil cloth, linoleum, insulating compounds and many other products.

The Chinese way of treating the crop is as follows:—

The fruit is collected in a green state, made up into heaps and covered with straw or grass. Fermentation takes place and the fleshy parts of the fruit rot away until the nuts are easily removed. They are then placed in a large circular stone trough and crushed under a heavy stone roller, which, drawn by an ox or other animal, revolves in the trough.

After being roasted for a short time in shallow iron pans, the crushed mass is thrown into wooden vats with open-work bottoms, over cauldrons of boiling water and thoroughly steamed. Meanwhile, iron rings, about 18 inches in diameter, are placed on the floor and covered with layers of straw whereon the steaming meal is arranged to a depth of several inches, the ends of the straw being drawn over to cover the tops of the cakes which, thereby formed, are withdrawn from the rings and placed on end in sloping wooden presses.

When a press is nearly full of cakes, wooden wedges are inserted in the upper end of the slope and, as these are driven home, one after another, with a hammer, a brown fluid exudes from the cakes and drops into a tank underneath.

This fluid is commercial tung oil and amounts to approximately 40 per cent. of the weight of the seed.

Owing to war conditions, the demand for tung oil has increased and at present prices are exceptionally high. R.C.H.