PROSPECTS FOR TEA PRODUCTION IN PAPUA AND NEW GUINEA

(Extracts from report of Mr. G. K. Newton, a Tea Expert, who recently visited the Territory at the invitation of the Commonwealth Government to report on the prospects of establishing a Tea Industry.)

BOTANICALLY the tea plant is usually known as *Thea Sinensis*, belonging to the small natural order TERNSTROEMIACEAE. There are two distinctive types, one indigenous to N. India and the other to China, the former being the stock from which natural hybrids are chiefly grown in Ceylon and India, and the bushes seen growing in Papua and New Guinea (although the seed was imported from several sources) are of the same North Indian hybrid stock.

It has been suggested seed from selected gardens in North India should be imported; this raises many difficulties and is considered unessential. The seed garden at Garaina is well established and if suggestions made in the report on that property are followed, selection (done on similar lines to the cocoa experiments at Keravat) will eventually provide suitable and ample material.

The time lag for such selection can be criticized, but from the slow rate of road development, progress of selection and communications may keep pace. To open large areas of tea unconnected with seaports by road cannot be recommended for economic reasons; meanwhile the existing supply of seed should be sufficient for the requirements of the Agricultural Department and the few pioneers who are planting small areas here and there.

Left to itself the tea plant will grow up to 30 or 40 feet, but for commercial cropping is kept pruned down, plucked regularly and not allowed to grow to a height whereby leaf cannot be conveniently removed.

According to elevation above sea level at which the plant is grown, maturity for plucking is reached at 3-7 years. From observations of the soil, and tea already growing at different elevations in the Territory, together with the fact that climatic conditions at practically all localities seem suited for tea growing, it appears safe to say bushes may be brought to plucking in 3-4 years in the Lowlands and Midland areas and say 4-5 years in the Highlands.

Tea produced from Low and Midland areas will be inferior in quality to that produced in the Highlands. Briefly the areas mays be defined, if one follows the Ceylon practice, at :—

Sea level—1,999 feet—Lowland area.

2,000 feet—3,999 feet—Midland area.

4,000 feet—upwards—Highland area.

Inversely, yields from lower elevation growth will be higher than Highland yields; an empiric figure is not attempted but, provided suitable technique is followed, there seems to be no reason why yield results similar to those obtained in Ceylon and India should not be possible.

The Territory of Papua and New Guinea is situated between the 3rd and 10th parallel south latitude and 142nd to 150th meridian longitude, the whole area being within the tropics with recorded rainfall at centres where tea is growing experimentally or may be grown with success.

FOUR-YEAR AVERAGE 1947-1951.

		Goroka	Garaina	Warangoi (Keravat)	Aiyura	Wau	Mt. Hagen.
January		1220	985	1062	969	660	930
February	N.W.	1189	1683	1021	1052	797	1654
March		1354	1002	1499	680	863	1748
April		833	1607	898	908	756	1284
May		422	814	715	459	508	813
June		84	550	840	339	355	904
July	S.E.	285	746	739	144	391	600
August		110	538	1017	86	488	1104
September		486	1250	609	538	500	719
October		610	874	909	624	502	790
November	N.W.	523	1065	950	542	750	1310
December		1143	2484	1270	591	790	1175
	Totals	82.59	135.98	115.29	69.32	73.60	130.31

Wanigela probably 150-160 ins. taken from Tufi records.

At Aiyura where accurate records have been kept for several years the annual mean temperature is 62 degrees, the coldest night temperature recorded 46 degrees, the avreage minimum 52 degrees, and maximum 71 degrees. These recordings may be taken as representative of the Highland areas between Goroka and Mount Hagen.

Generally speaking the climate is moist and atmosphere humid except at high altitudes. There is no defined winter and summer, the two seasons which are experienced being described as South-East and North-West corresponding with the periods of the year when the South-East trade winds and the North-West monsoons direct the main airflow. The South-East season prevails approximately from May to October, while the North-West monsoon flows over a period between December and March.

Tea grows well from sea level to elevations up to 8,000 feet according to distance from the equator, provided soil conditions are suitable; rainfall comes within the 100 inches to 200 inches bracket, and long sustained droughts are not a regular feature. In some tea growing areas rainfall is considerably less than 100 inches where droughts take their toll from time to time.

The tea plant is tough and will thrive on soil practically any texture; successful plantations have been established on areas ranging between light sand to stiff clays. The root system is greatly controlled by the texture of sub-soil, extending down from two to five feet whilst lateral range is limited by competitors. By a suitable drainage system deep rooting may be encouraged, otherwise shallow rooted bushes may result to suffer during dry periods.

Although tough the tea plant naturally prefers rich friable well drained loam, with a not too stiff sub-soil liable to restrict penetration of tap roots.

Before planting on a large scale is attempted, chemical examination of the soil is necessary to find out its pH value in solution.

Briefly, tea requires an acid soil with optimun conditions at pH 5.5.

Without going into detail it is sufficient to say the strength of soil acids is measured in terms of pH, the pH = 7 representing neutrality. Strength in excess of 7 denotes increasing alkalinity and below 7 increasing acidity.

During the tour soil tests were taken, proving in most cases sufficient acidity required for tea.

Although a large area of the Territory is unsuited to agriculture on account of swamp, altitude, steepness of mountain slopes and poor eroded soil, the extent of undeveloped land suited for tea production is great, in fact the more one gives consideration to the potentialities the more one realizes what resources are at hand. The climate is suitable and many areas of soil up to requirements. There are, however, two major handicaps :—

(1) Labour.

(2) Communications.

The paragraph entitled "Native Labour" amplifies limitations already manifested by the fact that of 180,000 square miles (115 million acres) only 591,000 acres are under plantation and farm products by non-indigenous ownership being :—

204,000 acres—Coconut.

19,000 acres—Rubber.

6,000 acres—Cocoa.

500 acres—Coffee.

200 acres—Kapok.

Balance 361,300 acres minor products and pastoral.

Communications, except for the road systems around the main town centres, are almost non-existent. Jeep tracks have been cut round about centres of Government control, but such tracks are not suited to commercial transport required for carrying the requisites and produce for tea estates.

Labour limitations will restrict the extent of any progress undertaken in the establishment of tea, but given adequate communications some private enterprize may be expected. Transport by air between midland and highland areas growing tea will force up production costs to an uncompetitive level. It seems to the writer that roads must come first, then private enterprize for tea plantations will be encouraged to follow.

The problem for Government is an economic and political one, bearing in mind that whatever road system is developed, the amount and type of labour available must restrict agricultural development, however, much one is able to mechanize.

Native Labour—

In order that the size of Papua and New Guinea may be appreciated in relationship to population, the attached map gives an indication of the areas from

which Native labour is likely to be available for recruitment. The Eastern and Western Highlands are the most densely populated areas, even here at only 28 and 16 souls per square mile, and of the total recorded adult male population in Papua and New Guinea approximately 53,000 are estimated to be in employment now.

POPULATION AND AREA.

	Adult Males	Estimated Total Pop.	Square Miles	Population per Square Mile.
Sepik	55,834	194,603	27,826	7
Madang	36,013	123,564	10,489	12
Western Highlands	14,055	157,181	9,725	16
Eastern Highlands	72,732	262,551	9,260	28
Morobe	40,437	174,825	12,850	14
Northern District	14,100	44,828	9,280	5
Central District	24,677	80,532	11,560	7
Gulf District	13,155	50,000	18,000	3
Southern Highlands	1,633	79,946	25,700	3
Western District	7,923	32,023	38,000	8
New Britain	280,559	1200,053	172,690	7
	20,000	85,115	14,150	6
	300,559	1,285,168	186,840	7

The figures given are current ones obtained through the Department of Agriculture, but it must be appreciated there are still large numbers of Natives uncounted; a total population of 1,500,000 may be taken as a fairly accurate estimation. The area in square miles recorded in various official publications is given at 180,000 approximately, or 115 million acres.

On the assumption that 53,000 males are already absorbed in employment, a balance of 227,559 appear available as recruits for plantations; this number includes residents of the sparsely populated districts, from which areas, it is unlikely recruits will be forthcoming, or Government encourage recruiting; in fact the policy for building up the Native population may severely restrict or forbid employment of labour from these areas.

This seems to restrict the areas from which plantation labour may be drawn to Madang, Western Highlands, Eastern Highlands and Morobe having a total male adult population of 163,237.

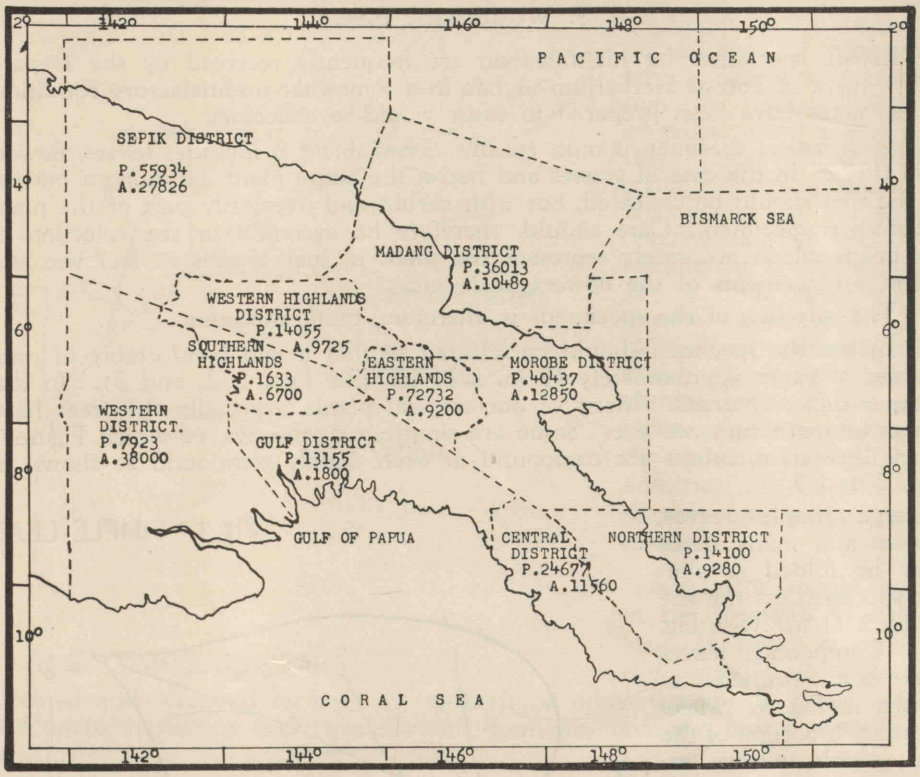
Provided the Natives are willing and other objections are not evident, possibly up to 20 per cent. of these adult males might be employed as tea plantation labour—say 33,000.

Tea requires large numbers of workers for successful cultivation under existing methods practised in Ceylon and India and, of the type of labour available, at least 1½ labourers per cultivated acre seem necessary.

On the estimation of such labour availability, probably the maximum area of tea which may be cultivated will be from 20,000 to 25,000 acres—in this case the limiting factor being labour.

Other industries are springing up, from which competition may be expected. With this factor clearly illustrated it is considered desirable to confine any

large scale tea plantation to areas where land is flat and routine work may be mechanized as far as possible. Mechanization on steep and broken land has been found impracticable.



TERRITORY OF PAPUA AND NEW GUINEA.

P.—POPULATION—Number of Adult Males. A.—AREA in square miles. SCALE.—2 7/26—200 miles.

Forestry Notes—

NOTES ON THE COLLECTION OF BOTANICAL SPECIMENS

J. S. WOMERSLEY, B.Sc. *

PLANT specimens for identification are frequently received by the Department of Forests Herbarium in Lae in a somewhat unsatisfactory condition. These notes have been prepared to assist would-be collectors.

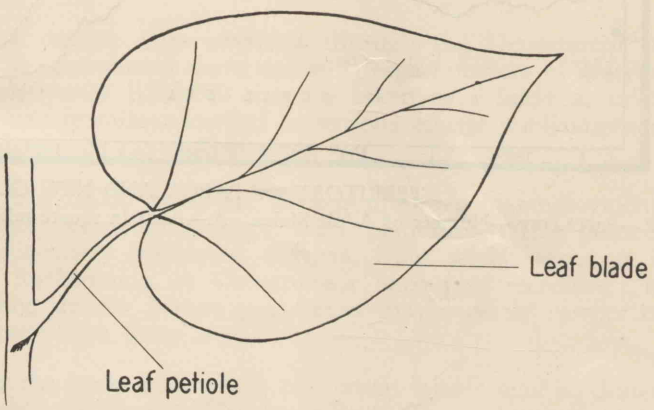
A botanical specimen is most readily identifiable if it includes leaves, flowers and fruits. In the case of grasses and herbs, the entire plant including a portion of the root should be collected, but with shrubs and trees only part of the plant becomes a specimen. Care should, therefore be exercised in the selection of specimens which accurately represent the plant in such details as leaf size and shape, arrangements of the flowers, fruit, etc.

The selection of the specimens is, therefore, quite important.

In size the specimen should be selected so that it will comfortably fit onto a sheet of paper approximately 17 in. x 11 in. (See Figs. 1, 2, and 3). In this another difficulty arises. Many of our tropical plants, especially the trees have leaves of truly immense size. Some are simple, e.g., the figs, of which Figure 1 is an illustration, others are compound or even doubly compound as shown in Figs. 2 and 3.

Large simple leaves, grasses and many herbs may be folded so that the specimen fits the size 17 in. x 11 in. (See Fig. 4.) Compound leaves are best pruned as shown in Fig. 4. Make sure that a portion of the leaf petiole always remains as an indicator of the portion removed.

Fig. 1 SIMPLE LEAF



For reference it is necessary to number the various specimens. Each portion of the same plant should have the same number. When lists of identifications are sent out numbering facilitates reference to the collections.

Now, if you have carefully selected your specimen so that it shows leaves, flowers and fruits, and prepared it to fit on the 17 in. x 11 in. paper, it will be ready for pressing. The most useful form of press for use in New Guinea takes the form of a pair of wooden frames 18 in. x 12 in. as shown in Fig. 5. The frames are constructed of wooden slats 1 in. wide and $\frac{1}{4}$ in. thick. Substitutes which can be used satisfactorily include strong cardboard, masonite or plywood cut to size or a frame made by interlacing strips of split bamboo.

With some sort of frame then as support the specimens are placed between sheets of absorbent newsprint. One specimen between two (2) thicknesses of paper is usually enough. When all specimens are in the bundle a second frame is placed on top and the bundle tied firmly with several turns of string. It is unnecessary to place excessive pressure on the specimens.

* Forest Botanist, Department of Forests, Lae, Territory of New Guinea.

If you live in a dry area the bundle could be hung in a sunny place for a day or so. In most parts of New Guinea though, it is best to preserve the material against attack by mould. This is done by immersing the bundle—paper, specimens and all in formalin solution of approximately 5 per cent. concentration of formaldehyde. A 44-gallon drum is useful for this if no other suitable container is available. The Department of Forests has constructed for field use rectangular boxes measuring 18½ in. x 12½ in. x 12½ in. internal dimensions. The material is galvanized iron which is heavily painted within with a bitumastic paint. A fitting lid covers the specimens when in use and two (2) handles fixed to the ends, makes portage easy.

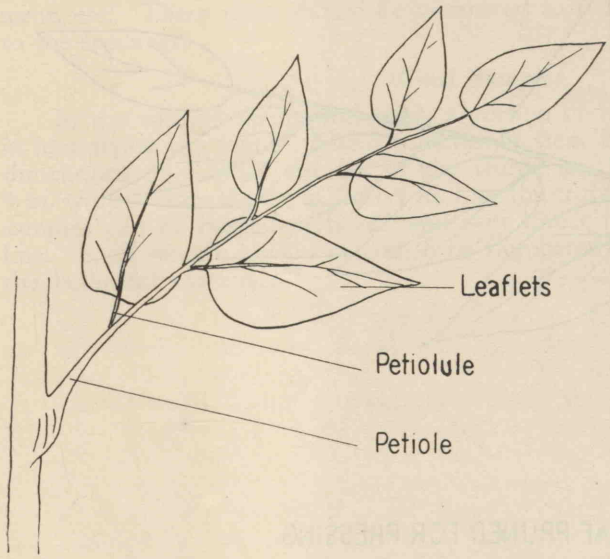


Fig. 2. COMPOUND LEAF

Specimens should be left in the formalin solution at least 24 hours after which the bundle is removed, drained and wrapped securely in sisalkraft or other waterproof paper. If the specimens have not been treated with formalin, ordinary brown wrapping is adequate.

Fig. 3. DOUBLY COMPOUND LEAF

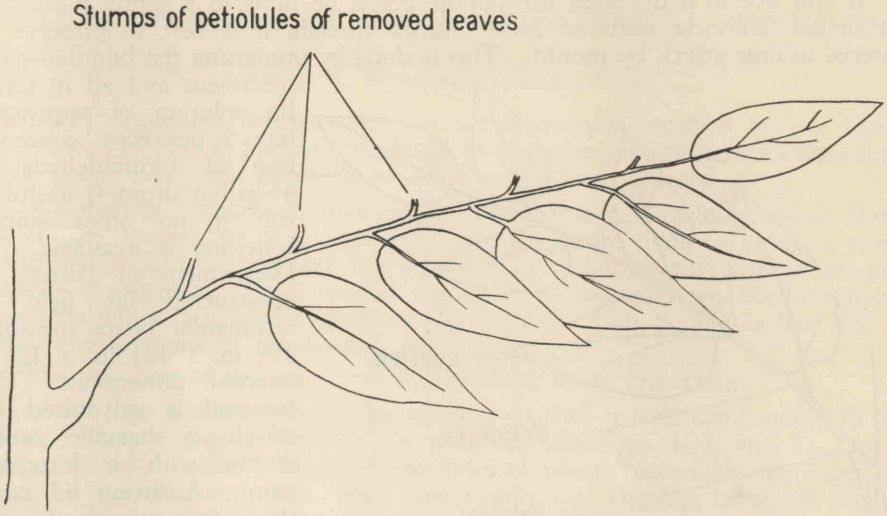


Fig. 4. COMPOUND LEAF PRUNED FOR PRESSING

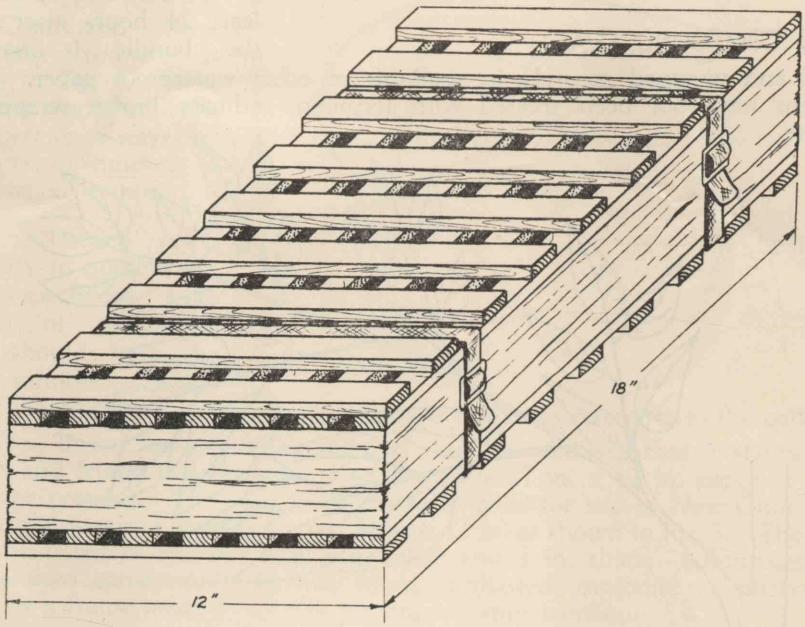


Fig 5

Press of two wooden frames and paper for drying or treating botanical specimens

The parcel should be addressed to the Forest Botanist, Department of Forests, Lae. In a covering letter, please supply details of the collectors name, place and date of collection, dimensions (approximate) of the plant, colour, scent, etc. These notes should be numbered so that they may readily be related to the specimen.

Wood Samples.

In the case of shrubs and trees, a portion of the wood is of great assistance in identifying the plant. About 6 inches of stem if the shrub or tree is of small dimensions or a block cut out of the trunk, say 6 inches to 8 inches long by 4 in. wide and extending at least 4 in. into the trunk in a radial direction. Wood samples can be bagged or boxed and sent direct to the Department of Forests, Lae. Each sample should of course be numbered with the same number as on the botanical material.

Rural Broadcasts—

(The following is the second of a series of talks prepared by the Department of Agriculture, Stock and Fisheries and currently being broadcast by Station 9PA, Port Moresby.)

COPRA MARKETING QUALITY AND PRICES

IN the previous talk the importance of the copra industry to Papua and New Guinea has been adequately stressed.

The marketing of copra in New Guinea, as is well known, is under United Kingdom contract for 10 years, which has been arranged by the Commonwealth Government with the United Kingdom Ministry of Food. The actual marketing authority is the Papua and New Guinea Copra Marketing Board, which is a continuation of the Australian and New Guinea Production Control Board, established during the war under National Security Regulations. The former operates under an Ordinance recently enforced which reduced the functions of the Board to copra marketing mainly, although Commonwealth shipping in the Territory comes under its control. Mr. Ian MacDonald, Chairman, has been associated with the copra industry for a number of years, and the actual selling, is, as far as this Territory is concerned, more a matter for his control than for the Department of Agriculture, Stock and Fisheries.

Copra prices greatly increased in post-war years, as the world shortage of fats and oils as essential foods became evident. The market price for copra became controlled under the United Kingdom contract, after 1st March, 1949. Under the contract, the British Ministry of Food undertook to purchase for nine years, all the copra produced in the Territory, surplus to Australia's requirements. Australia's requirements were not quantitatively assessed in the contract, nor was the price, but later the manufacturers there contracted to pay the same price as the United Kingdom contract price. Under the contract the United Kingdom can grant permission for specified quantities to be sold outside the contract, to countries other than the United Kingdom, and some small, but successful parcels, have been sold under this clause.

The importance of this guaranteed contract to the stability of the Territory industry cannot be under-estimated. The present price is about £65 sterling per ton, with differentials. The f.o.b. price is fixed by the Minister for Territories from time to time and varies with realization costs and costs of administration, freights, and so on, the latter having increased greatly since the war.

The copra pays duty here on a sliding scale and there is no doubt that it contributed hundred of thousands to the Territories' coffers last year. This provision for levying duty also existed pre-war.

The copra price at the beginning of the contract was fixed at £48 sterling per ton f.o.b, Territory ports, with provision for review each year in the light of the market and cost situation, and other factors, to give a maximum variation up or down of 10 per cent. of the previous year's price. There have been three upward movements of price since the beginning of the contract, and it is understood that the price for 1953 will not vary.

During and immediately after the war doubts were felt by those controlling the disposal of the copra from the Territory about the future of copra prices, and provision was made for a levy, on a sliding scale according to the price, to be made and paid into a reserve fund. The proposal was made that, when practicable, discussions would be held between the planters, the Production Control Board and representatives of the Administration and the Commonwealth Government regarding the use of the accumulated reserve fund to form the nucleus of a scheme to stabilize prices against any disastrous fall.

Between the years 1945 and 1951 the fund grew to approximately £1,000,000, the world price for copra continued high, and the contract with the United Kingdom removed, until 1958 at least, any fear of a collapse in price. Planters

pressed for a clarification of the Government's intentions with respect to the ultimate use of these funds. In July, 1951, the Minister for Territories announced that the levy (then £5 per ton) would be reduced by £3 per ton owing to the satisfactory state of the fund.

The questions of copra quality and copra price differentials are directly controlled by a separate Ordinance, which empowers the Administrator to appoint Produce Inspectors (Copra). The objective of copra inspection is to improve the overall quality of the Territories' copra. The important idea is to ensure that the copra from Papua and New Guinea will be of a standard to meet competition from that of other producing countries, in the event that this Territory no longer has the protection of a long term contract, after the present United Kingdom contract expires in December, 1957. The trade and other sources from overseas have continuously stressed the lessening in demand for smoke grade copra consequent on the increased use of soapless detergents, and the need for increased quantities of edible oils obtainable from high grade copra.

The necessity for copra inspection must be stressed. Of the copra export before the war the amount of smoke grade copra had decreased from 38 per cent. to 8 per cent. Since the war, there has been a marked and regrettable upward trend in the production of smoke grade copra. This has, in some cases, been due to causes outside the control of the planters. Even recently the percentage of smoke grade copra has increased from 34 per cent. to 41 per cent. from 1951 to the year ending 12th December, 1952, and this does not augur well for the future of the industry unless the position is remedied. It might be pointed out that the demand for copra is sustained at a high level for many reasons also there is more demand for low grades of copra in time of war, or threat of war, when the glycerine and fatty acids as by-products have more uses.

The resumption of inspection of copra in the near future, will be gratifying to those planters of both Territories, who have the good of the country at heart, and who have been requesting some such steps for some time past. The *Copra Ordinance* 1952, has been assented to and the *Copra Regulations* 1953, have been prepared to control proper inspection and grading of copra. The proposed provision of the Regulations under the Copra Ordinance were discussed with the Presidents of both Planters Associations and alterations were made on their advice and that of the Chairman of the Copra Marketing Board, to meet special requirements. Action is now being taken to appoint inspectional staff. It has been requested that such positions be filled as soon as possible as it is this Administration's wish to re-introduce copra inspection at all main ports as soon as competent men are available and appointed.

It is the Government's desire that the standard of copra produced shall be raised to the equivalent of that produced prior to the outbreak of the war and copra inspection is being resumed with that object. It is well-known that Rabaul Hot Air Copra, mainly because of the Copra Inspection Ordinance introduced in January, 1929, had an excellent name and received a premium on the world market. This premium was in operation until recently in post-war years, when unfortunately it has been lost and has meant a fall in revenue to the country as a whole.

With regard to price differentials, the question of maintenance of copra quality is linked with that of price differentials between hot air and other grades of copra and the matter is still under consideration.

The proposal to initiate an inferior fourth-grade copra, with the provision of an adequate differential to prevent undue production of such a grade, has been accepted by planters of both Territories. It has been pointed out that even a rise of 4 per cent. or 5 per cent. in the moisture content of the copra which is exported, is eliminating the advantage of any normal price premium. Both the exporters and the buyers know that the careless producer can get a

higher cash return for undried copra and thus there is no incentive to reduce the moisture content to proper proportions, while the producer gets well paid for moisture alone.

The cost of producing smoke grade copra, is considerably less than that to produce high grade hot air copra, and the cost of driers and equipment necessary to produce smoke copra is also less.

There was no system of copra inspection in Papua pre-war, but it is considered that the fact that Papuan copra from recognized plantations received a premium over South Seas Grade in later years, was largely linked with the existence of a Rabaul Hot Air Grade because substantially the same drying methods were used on plantations in both Territories pre-war.

Under the old New Guinea Copra Marketing Ordinance the general average quality of New Guinea copra, improved greatly at its inception and the percentage of higher quality hot air copra produced nearly double in about two years while reclamation claims became almost non-existent. Then Rabaul Hot Air Copra gained a price comparable with Straits F.M.S. Copra. This then sold at a premium of over £1 per ton, compared with South Seas F.M. Copra which relative to present prices would be equivalent to a premium of about £7 per ton. As early as 1935 the following remarks were made re effects of Copra Inspection in the *Agricultural Gazette.*

"In some districts when the Ordinance came into force, it was estimated that 60 per cent. of the copra being submitted for export was badly and carelessly dried. There was distinct lack of grading in the produce and the methods of curing were carelessly applied; a position which in the great majority of cases, no longer exists."

It is desired to say something of the provisions of the Copra Inspection legislation. Both the previous Ordinance and the present Ordinance provide means for Inspectors to be appointed by the Administrator with powers to pass or condem copra, or have it reconditioned and regraded for export, and prescribe the grades. All copra shipped for export from plantations or brought from plantations to main ports, shall be inspected by an inspector before shipment or trans-shipment as the case may be, and if it complies with the provisions of the *Copra Ordinance* 1952 and Regulations, and is otherwise fit for export, the Inspector shall pass it for shipment and certify its grade.

If any such copra is shipped without inspection, or if copra which an Inspector has refused for export is shipped or trans-shipped to any vessel for export, all persons responsible shall be guilty of an offence, for which a heavy penalty is provided. Provisions are made under the Copra Ordinance for persons to obtain a special permit to be obtained from the District Commissioner, subject to such amendments and conditions as that officer specifies, to purchase undried copra (green copra or green coconut meat) for purposes of trade. There is not only the aim of hot air attracting a premium, to be considered, but the necessity for the largest proportion of the copra produced to be of Hot Air Grade and thus attract a premium, which is of greatest importance, and of course this means the necessity for a great increase in improved copra drying methods on the plantations.

Copra now passing through oil crushing mills, leaves much to be desired and the extraneous materials being removed from some batches, consisting sometimes of old iron, bolts, cog wheels, shells, all types of refuse and rubbish would never have passed the Inspectors pre-war, and also damage has been done in some of the Australian mills by similar materials being in the copra. It is the intention of the Department of Agriculture, Stock and Fisheries, to take all possible action to prevent the deterioration of the position of copra quality and this will be done with the very keen co-operation of the planters themselves. It

is considered to be the moral obligation of the Government to ensure that produce is up to standard, especially having regard to the long term future of the industry.

Under the B.M.O.F. Agreement, the price margin between F.M.S. and Smoke Grade Copra, provides little incentive for the production of the Hot Air Grade. The Territory at the present time is losing at least £80,000 per annum, owing to the fact alone that no premium has been payable at all from the United Kingdom.

There is some mention that Smoke Copra can be hydrogenated and deodorised, so that a relatively high quality oil can be produced from such copra. Present enquiries do not substantiate this claim as the smoke content generally occurs in the coconut oil, and the colour is affected for purposes of high quality margarine manufacture, and the big world need is for high quality foodstuffs; further enquiries are being made.

Regarding copra price movements and cost of production, this is far too big a subject to be dealt with in this talk, but it should be mentioned that copra has provided the main source of income for both Papua and New Guinea for the last half century and this applies to both Native and European alike.

In 1941 it was found necessary to form a Copra Board in New Guinea, as prices fell as low as £4 but the average price for the year was about £12, and the planters later received a dividend. Before the war marketing of copra was largely in the hands of several big shipping companies operating in the Territory, while individual planters in some cases sold direct or through agents either in Australia or overseas. In post-war years, as stated previously, all copra has been sold through the Marketing Board.

During the war years all New Guinea plantations were closed down and only some of the Papuan plantations remained open. However, the tonnage harvested during the war from Papua, was of very great value to the strategic needs of Australia and was generally sold under a guaranteed price of about £12 per ton. It was not until after the Territory was declared as a non-operational area that price movements could again be recorded.

COFFEE GROWING

This is a text of the Rural Talk from Station 9PA given on Thursday, 20th August, 1953. It has been included in this issue because of the great interest at present being shown in coffee growing by planters in the Central Highlands area.

COFFEE is rather tolerant and will grow under a wide range of soil conditions, but it does best on a deep well drained loamy soil, with slightly acid reaction. If the correct variety is selected, it can be grown from sea level to 7,000 feet. Overseas authorities normally maintain that Robusta coffee is most suitable from sea level to 3,000 feet and Arabica varieties thrive from 4,000 to 7,000 feet. However, New Guinea experience has shown that Arabica coffee can be grown successfully at 2,000 feet. As Coffee Rust (*Hemileia vastatrix*) does not occur in New Guinea, it may prove that the higher grade Arabica coffees, grow even below this altitude.

Establishing a Coffee Area.—

In establishing a coffee area, either from virgin bush or in grasslands, it is preferable to concentrate the labour on a small area, and to clear, line, hole and establish shade over a small area as quickly as possible. This enables the shade to get away quickly without competition from the grass. Coffee may be lined either on the diagonal or on the square. The normal spacing for the crop is 9 feet x 9 feet or 10 feet x 10 feet. It is recommended that all lining be done on the diagonal, as more efficient use is made of the land under this system, and 13 per cent. more trees to the acre, are obtained. Immediately after lining, the holes should be dug, and left open to weather, until just prior to establishing the seedlings in the field. The larger the hole, the better start the seedling

gets. Holes should not be smaller than 2 feet x 2 feet x 2 feet. Immediately the holes are dug, both temporary and permanent shades should be established. Temporary shade is used for two purposes :—

1. To shelter the young plant in the early stages of its growth.
2. To smother grass and reduce maintenance cost.

Grass is most detrimental to the growth of coffee at all stages. Every effort should be made to keep the coffee area free of grass from the time of planting, until the end of the economic life of the coffee field. Coffee is a surface feeder and suffers severely from competition with grass, and if it is necessary to cultivate at maturity to control grass, considerable damage is done to the feeding system of the trees. Wise use of shade from planting to maturity, can prevent the formation of a surface mat of grass, and can reduce the need for detrimental surface cultivation to control weeds to a minimum.

In planting shade for Coffee, it is recommended that both temporary and permanent shade be planted in the lines of coffee on the diagonal. The most useful shade plant to use for temporary shade is Crotalaria, and this should be planted right up to the hole, and the permanent shade trees should be established in the centre, between the holes. By planting on the diagonal, and not straight up and down the lines, sufficient room is left between the lines of shade to permit free movement of labourers through the field. This facilitates maintenance and the planting of the Coffee seedlings later.

When the shade is sufficiently advanced (with Crotalaria, this should be about three months after planting of shade), the seedlings may be put out in the field. As the shade develops, it should form a complete cover between the holes and obviate maintenance. The only maintenance required is in weeding immediately in the vicinity of the coffee plant. As the young coffee plant grows, the shade immediately around the hole, should be cut out. Further cutting out should be carried out at any time the young plant begins to produce spindly, elongated growth.

Under lowland conditions, that is from sea level to 2,000 feet, *Leucaena glauca,* has proved a most satisfactory shade crop for New Guinea conditions, Unfortunately from 2,000 to 7,000 feet no truly successful shade tree, suitable for New Guinea conditions, has yet been proved. However, a number of species are well worth trying. Those we suggest are : *Albizzia stipulata, Grevillea robusta,* native species of Albizzias found in the Highlands, species of Acacia. It is fully recognized throughout the world, that permanent shade is required for lowland coffee. However, the position is not so clear for Highland coffee. In many parts of the world, coffee is grown between 4,000 and 7,000 feet without permanent shade, but all the evidence in New Guinea points to the necessity of establishing permanent shade for coffee, at whatever altitude it is grown. The advantages of using permanent shade for Highland coffee are :—

1. It prevents overbearing, and so prevents die back.
2. It lengthens the life of the plant.
3. It produces a more even crop.
4. It helps to control soil erosion.
5. It helps to control weeds.
6. It improves the quality of the coffee produced.

Under New Guinea conditions, coffee grown without shade will crop itself out. If a grower wishes to establish a permanent plantation, it is essential that he control the cropping of his coffee, and the only economical way to do this, is by shade manipulation. Experience will show on any property, the degree of cropping that can be permitted, without damaging the trees. Hence, in choosing permanent shade trees, care should be taken to choose trees that will stand lopping. The Department of Agriculture, Stock and Fisheries strongly advises the use of permanent shade for coffee wherever it is grown in New Guinea. A

grower should bear in mind that it is much easier to remove shade from an area, than it is to establish shade in an old Coffee area. Hence at low levels, using *Leucaena glauca,* the initial density of the stand, should be 10 feet x 10 feet; on the Highlands, when using larger species, such as Albizzias and Grevilleas, a minimum initial stand of 20 feet x 20 feet, is recommended.

Wherever coffee is grown, strong winds are harmful. Hence, in exposed areas, provision should be made for the establishment of wind breaks.

Preparation and Planting of Nurseries.—

Although shade is not necessary before Coffee seeds germinate, it is preferable to establish a canopy over the proposed nursery beds, before planting the seed. It is more convenient to have a canopy, high enough for men to work under with convenience, than a low one. Bush timber posts and bearers, on which may be placed slats, bamboo or palm fronds, are satisfactory. For ease of working, nursery beds should not exceed 5 feet in width. The ground should be dug to a depth of 18 inches to 2 feet, the soil returned in the order it was removed, and the surface worked to a fine tilth. Normally the beds are raised above the surface of the ground for drainage purposes, and paths are constructed around the beds, for ease of working. The seeds are planted 4 inches apart in rows spaced at 6 inch intervals. Depth of planting is normally about $\frac{3}{4}$ inch.

On completion of planting, it is advisable to cover the surface of the beds with straw or grass litter. This prevents damage to the seedlings during watering and protects surface from excessive evaporation. When the seedlings germinate, this litter should be removed.

During the growth of the young seedlings, shade is progressively reduced. At no time should the shade be so dense that leggy seedlings are produced.

The nursery bed should be kept weeded, but this work must be done carefully; a hand fork or pointed stick should be used.

Seedlings are normally planted in the field when 12 to 18 inches high. The period required to reach this stage of growth, depends upon the conditions under which they are grown. Normally it takes 6 to 9 months. Where bamboo pots can be obtained cheaply, coffee seeds may be germinated in the beds, and then picked out into the pots. The bamboo pots are then lined under shade, and the seedlings allowed to grow in these, until ready to go into the field. Seedlings raised in this way receive less check on planting into the field, than do seedlings raised in a nursery.

Planting into Field.—

Transferring seedlings to the field is not complicated, but certain points should receive care :—

1. The open holes in the field should be filled with surface soil some time before the seedlings go out into the field. This allows the earth to settle down prior to planting.
2. All weak yellow seedlings in the nursery, should be discarded.
3. Seedlings should be removed from the nursery with as much soil as possible adhering to the roots. Exposed taproots should be pruned with a sharp knife.
4. Seedlings must be planted firmly in the soil, and covered to the same depth as they were in the nursery.
5. If seedlings have been established in bamboo pots, the pots must be removed before the seedlings go into the field.

Coffee seedlings take about six weeks to germinate. Normally with Arabica coffee, there are 2,000 seeds to the pound. Coffee seeds should be pulped carefully and never dried directly in the sun.

NEW AND INTERESTING IDENTIFICATIONS.

PLANT PATHOGENS

Phyllosticta spp. attacking kenaf (*Hibiscus cannabinus*). The seed crop at Laloki in 1952-1953 was noted as being attacked in the late stages following flowering in March and early April. Infused patches appeared on stems and leaves during periods of high humidity and these were subsequently stippled with dark pin-head dots with the infused areas becoming necrotic. Darkened patches with a black powdery surface appearance were also noted on capsules. Specimens of leaves and capsules were referred to the Pathology Department of the Faculty of Agriculture at Sydney University and Miss D. E. Shaw of that Department reported on them as follows :—

" The leaves and capsules are infected with *Phyllosticta spp.* this being the primary pathogen. On the leaves, spore cases (pycnidia) of the fungus occur in spots which are pale green fading to brown with indistinct margins. The pycnidia are visible with a hand lens, and can be seen on the portion of the leaf which is returned. Moisture causes the release of the pycnidial contents, which are masses of 1-celled hyaline spores, 10-12 x 2.5-3.

The pycnidia occur on the calyx, but are obscured by the growth of secondary fungi. They also occur on the involucre and protected pericarp, portion of which is also returned.

Phyllosticta idaecola has been recorded on cultivated species of *Hibiscus* and *Sida,* but no further details are available as to which species of *Hibiscus* are affected. A species of *Phyllosticta* affecting Roselle (*H. sabdariffa*) has been recorded, causing spotting of leaves and petioles at Delhi, but again there is no information as to whether this species attacks kenaf.

The fungus has been isolated and is established in pure culture.

Also occurring on the calyx among other saprophytes is a fungus with black chlamydospores and black stromatic tissue. It belongs to the Perisporiaceae group , sometimes called sooty moulds, which are, in most cases, saprophytic."

The spread of the necrotic areas was arrested following on the onset of normal dry season conditions during April and no marked deleterious affects on the crop were noted. However, it is considered that this pathogen may have been an important contributor to the total loss of the seed crop in the abnormal 1951-1952 season when wet and humid conditions prevailed right through to July.

RICE PATHOGENS.

Miss Shaw also examined specimens of diseased rice plants from the Madang District. A pathogen which caused serious damage to rice crops in the coastal area at Dylup, between Madang and Bogia, was identified as *Entyloma oryzae.*

Three varieties of rice grown on the District Agricultural Station at Madang showed a leaf spotting and causal organism was identified as *Ramularia sp.*, the identification being checked, at Miss Shaw's request, by the Commonwealth Mycological Institute in the United Kingdom, and the diagnosis confirmed by Dr. Ellis of that Instituute

In a later communication Miss Shaw states that a previous record by Deighton of Sierra Leone (1937) only applied to the hosts *Oryza barthii* and *Oryza glaberimma.* The fungus apparently has never previously been recorded affecting *Oryza sativa.*

Diseased heads of rice from Dagua, near Wewak, were also submitted to the Pathology Department of the Faculty of Agriculture at the Sydney University and the pathogen in this case was identified by Dr. N. H. White as *Ustilaginoidea virens* (Cke.) Tak. The symptoms are striking brown coloured sclerotia-like

structures similar in shape to rye ergots appearing between the glumes. The disease was not causing extensive damage at Dagua and Dr. White states that it is widely distributed throughout the World and usually considered to be of little importance though fairly severe epiphythotics have occurred in Burma and the Philippines.

PHYTOPHTHORA COLOCASIRE.

Phytophthora disease of taro reached epidemic proportions in the Australia Solomons, i.e., Buka Island and Bougainville Island, in the years 1947-1948 and caused such serious damage that in some cases the Native people changed to sweet potato as a staple crop. The disease has continued to cause damage throughout the District but even at the height of the epidemic certain resistant strains were notable in Native plantings and Native growers were multiplying these.

The Annual Report of the District Agricultural Officer for 1952-1953 notes a considerable lessening of the incidence of the disease in various areas and a return to this crop as a staple by Native subsistence farmers. This is particularly the case in Northern Buka Island where there is now little evidence of the disease and big areas of taro are being planted.

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