Mr O'Connor.

VOL. 29 NO. 1 MARCH, 1959

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Notes for Librarians and Research Institutes

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So many requests are received for parts of the "Agricultural Journal" which were never published or which are now out of print, that the following list of all issues published is given for reference. Those volumes and numbers which are not now available are marked with an asterisk. It will be noted that copies of all parts of ten volumes and parts of nine other volumes are unobtainable. Should any reader have unwanted copies of these publications, the Librarian would be grateful to receive them.

Vol.			
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AGRICULTURAL CIRCULAR, 1920-25

NUMBERS and year of issue of the "Agricultural Circular" :—

Vol. 1, 1920, 12 numbers.
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Vol. 4, 1923, 1 number.
5, 1924-5, 2 numbers.

As number 4 of Vol. 3 was printed as "Volume 4" and number 1 of Vol. 4 as "Volume 5" it would appear from an inspection of a complete set that Volume 4 comprised only a number 4 and that there were two issues of Volume numbered as 5, No. 1.

ANNUAL BULLETINS, 1931-38

COPIES of Annual Bulletins of Divisional Reports for the year 1933 and 1934 ONLY are available.

AGRICULTURAL BULLETINS

A FEW copies of the following bulletins are available at the prices shown. Other Bulletins previously listed are out of print.

No. 1. Sisal Hemp in Fiji, by C. H. Knowles, 1911. Price 2s.
7. A Mission to Java for a Coleopterous Pest of Bananas, by Jepson, 1914. Price 2s. 6d
23. Insect Pests of Fiji, by R. J. A. W. Lever, 1946. Price 1s.
24. The Botanical Gardens, Suva, by J. W. Parham, 1948. Price 1s. 6d.
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26. Mechanisation of Rice Padi Cultivation by R. R. Mason. Price 2s. 6d.
27. Index to Agric. Journal. Vols. 1–21 by B. E. V. Parham. Price 2s.
28. Soil Erosion and its Control in Fiji, by C. E. Whitehead. Price 2s.
29. Annual Reports of Divisional and Specialist Officers 1954. Price 4s.
30. The Grasses of Fiji, by J. W. Parham. Price 5s.
31. The Declared Noxious Weeds of Fiji and their Control, by T. L. Mune and J. W. Parham. Price 2s. 6d. (Revised Edition).
32. Copra Driers by G. B. Gregory, V. E. Sills and J. A. Palmer. Price 3s.
33. The Koronivia Farm Institute by R. L. Hartley. Price 5s.
34. The Weeds of Fiji by J. W. Parham (In the press). Price 5s.

AGRICULTURAL REPORTS

RECENT reports on Agricultural subjects are available as follows :—

Report by Sir Geoffrey Clay on his Visit to Fiji in 1954. C.P. No. 31, 1955. Price 1s. 6d.
The Fisheries Industries of Fiji. C.P. No. 1, 1956. Price 1s.
Department of Agriculture Annual Report for 1955. C.P. No. 8, 1956. Price 2s.
Department of Agriculture Annual Report for 1956. C.P. No. 8, 1957. Price 2s.
Department of Agriculture Annual Report for 1957. C.P. No. 18, 1958. Price 2s.

OTHER PUBLICATIONS

A FEW copies of the following important book are available :—

The Coconut Moth in Fiji, by J. D. Tothill, H. C. Taylor and R. W. Paine. Imperial Bureau of Entomology, 1930. Price £1.

FORTHCOMING PUBLICATION

THE following publication is in the press and will be available shortly :—

Book ... ... The Fishes of Fiji, by H. W. Fowler (approximately 600 pages and 200 illustrations).

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EDITOR	G. B. Gregory.

EDITORIAL . . .

The Editor regrets any inconvenience and disappointment caused by the non-publication of the Fiji Agricultural Journal during 1958.

The current Volume (1959) *has been numbered Volume* 29 *in order to preserve continuity. Subscriptions for the* 1958 *issues will be transferred to the* 1959 *issues unless subscribers instruct us to the contrary.*

STAFF NOTES

Mr. J. S. Rennie, Secretary, proceeded on pre-retirement leave in August, 1958, after more than 30 years service with the Fiji Government. Mr. Rennie, who has spent more than half his service in the Department of Agriculture, also served in the Fiji Military Forces, rising to the rank of Major; he was awarded the Efficiency Decoration in 1945.

Also on pre-retirement leave is Mr. A. D. Mercer, Agricultural Officer; Mr. Mercer joined the Department in 1947 and was appointed Agricultural Officer in 1951.

Mr. I. T. Twyford, Chemist, who has been with the Department since 1952, leaves Fiji in April to take up an appointment with the Imperial College of Tropical Agriculture in Trinidad.

Before he leaves Mr. Twyford will have completed the Soil Survey of Fiji, his report on which will shortly go to press.

Two officers have resigned: Mr. J. S. Pillai, Entomologist since 1956, is proceeding to the United Kingdom for further studies.

Mr. J. A. Palmer, appointed Agricultural Officer in 1956, has gone to take up private employment in Malaya.

New appointments have included:— Mr. K. G. York, Mr. N. M. Williams and Mr. W. H. Wildin, Agricultural Officers.

Mr. J. L. Baker and Mr. A. D. Donald (re-appointment), Veterinary Officers.

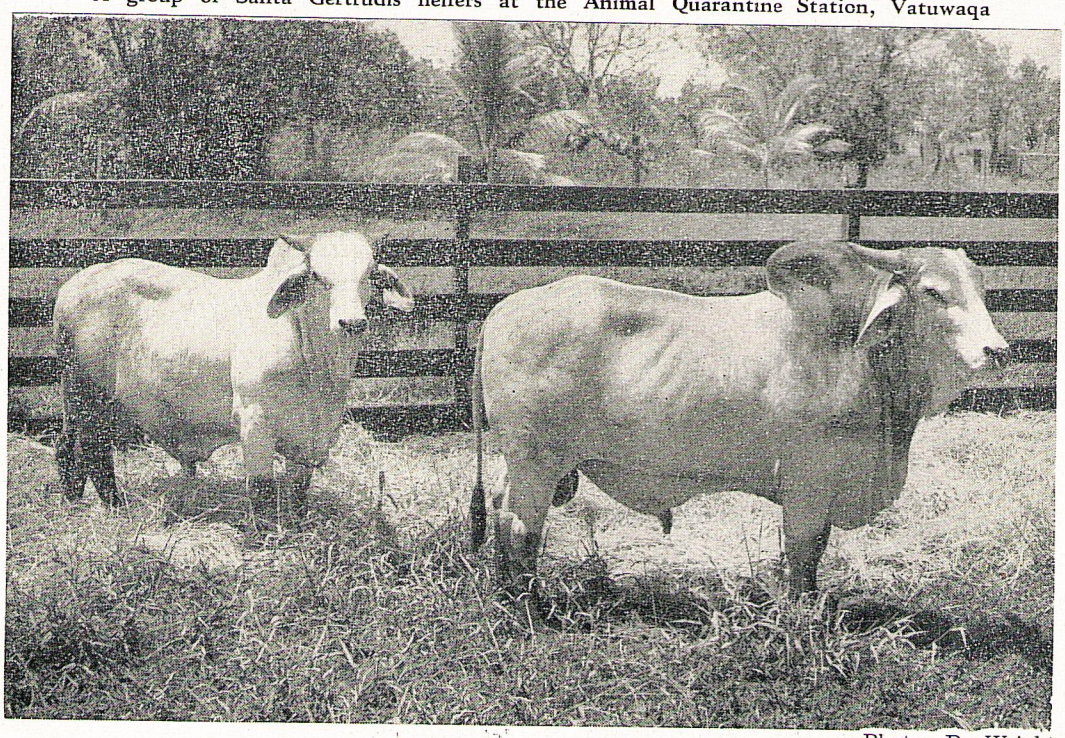
Dr. J. S. Simonyi and Mr. N. C. Jain, Chemists.

OBITUARY

Mr. R. S. Vera, M.B.E., died at Labasa in December, 1958. Mr. Vera, who joined the Department in 1927 as a Stock Inspector, was appointed to the post of Livestock Officer in 1958. He was awarded the M.B.E., in the 1951 Birthday Honours. The sympathy of all his colleagues is extended to his bereaved wife and family.

Photo—R. Wright

A group of Santa Gertrudis heifers at the Animal Quarantine Station, Vatuwaqa



Photo—R. Wright

Two imported Zebu bulls at the Animal Quarantine Station, Vatuwaqa

ANIMAL HUSBANDRY . . .

SANTA GERTRUDIS AND ZEBU CATTLE INTRODUCTIONS

BY A. F. S. OHMAN

Fiji is not self-supporting in its meat supplies. Large quantities of beef, mutton, pig meats and small goods are imported, mainly from New Zealand and Australia.

In 1954 it was decided to introduce the Santa Gertrudis breed of beef cattle to the Colony. There was a two-fold intention, namely, to determine if cattle weights could be increased and to see if an earlier maturing animal could be produced.

Some time previously a shipment of Santa Gertrudis cattle had been made to Australia from King Ranch, Texas, so it was natural to look to Australia for the supply of stock.

The King Ranch (Australia) operates in Southern Queensland and it also has a small stud in Victoria. Because of the presence of certain animal diseases in Queensland which do not exist in this Colony, cattle are banned from that State. Approach was made to the Victorian branch of the Company and in 1955 it was possible to select four yearling bulls for shipment to Fiji. They were among the first Santa Gertrudis cattle dropped in Australia and the first exports from the Commonwealth.

At the time of purchase of the bulls, heifers were not available, so it was agreed that the imported bulls should be mated with Hereford and Red Poll females in the Colony. The intention was to obtain seven-eighths Santa Gertrudis bulls, and, by selection and culling, suitable sires for distribution to breeders. It was also intended that progeny from these two crosses should be appraised. This work is now in progress but it is too early to assess the results.

The picture altered considerably when it was learned that Santa Gertrudis heifers were available in the United States of America. After prolonged negotiations with various shipping companies transport was obtained and in January, 1958, ten Santa Gertrudis heifers were landed in the Colony. These animals are being held at the Principal Agricultural Station, Koronivia, and it is intended that they should be mated with the pure-bred Santa Gertrudis bulls towards the end of 1958.

Because of the availability of these heifers the breeding programme appears to be considerably advanced and it is anticipated that pure-bred bulls can be distributed earlier than was expected.

The Department of Agriculture also possesses a Zebu herd. It is claimed that this is one of the healthiest Zebu herds in existence. The nucleus of this herd was acquired from the Colonial Sugar Refining Company some years ago, when the Company decided to dispose of the herd.

The progeny of the Zebu stock is in keen demand and to the extent that bulls are reserved up to 18 months in advance. Zebu bulls have been supplied outside the Colony to New Guinea, Samoa, British Solomon Islands Protectorate and the New Hebrides.

In order to preserve and improve the Zebu herd, opportunity was taken to introduce two sires from the United States of America at the same time as the Santa Gertrudis heifers were obtained. These two sires are now at the Agricultural Station, Sigatoka, and are being mated with the female stock.

PIGLET ANAEMIA

BY A. D. DONALD

Recent losses from piglet anaemia in a local piggery have drawn attention to this disease. The anaemia, simply due to a dietary deficiency of iron, is most likely to occur in the most hygienic piggeries which are exercising good control of the Kidney worm (*Stephanurus dentatus*) **by not allowing piglets access to soil.**

This condition usually appears between three and six weeks of age and the mortality rate can be quite high. When it is remembered that a rapidly growing piglet may reach five times its birth weight at three weeks of age and that the sow's milk is generally low in iron it is not difficult to see how an anaemia may develop if there is no other dietary source of the mineral.

Feeding iron to the sow will not appreciably increase the iron content of the milk and even when the sow is given an iron supplement during pregnancy the piglets will still have only sufficient iron reserves for a few days growth. A little iron is obtained by piglets from the sows' food and faeces but this is usually insufficient to prevent the development of anaemia during the first three weeks of life. At about three weeks piglets should be taking some solid food from a creep, but unless the creep feed is specially supplemented with iron and it is known that the piglets are taking it readily, the return towards normal may be very slow and lead to a reduction in appetite and growth rate. It is advisable, therefore, to ensure an adequate intake of iron from birth by treating the piglets.

SYMPTOMS

It is not easy to diagnose anaemia on simple examination of the piglets, unless it is well advanced. The skin may be pale and in severe cases a dead white pallor of the conjunctiva is a reliable sign.

In the early stages and before growth is retarded it is common to find anaemic pigs looking sleek, plump and apparently in extremely good condition, although they may have a stocky appearance and often look heavy in the fore-quarters due to fullness in the neck region. These signs are often present in piglets about three to four weeks old. If adequate iron is then provided the majority of piglets will continue to grow unchecked and the stocky appearance gradually disappears; otherwise the anaemia becomes more severe and ultimately growth is retarded. Eventually, growth ceases and the piglets often appear very pale and hairy.

DIAGNOSIS

A firm diagnosis can only be made from a haemoglobin estimation. If the disease is suspected, a Veterinary Officer should be consulted when arrangements can be made for this blood examination to be carried out. It would be better still to submit a typically affected live piglet for destruction and post-mortem examination so that the possibility of any other condition can be ruled out.

PREVENTION

Piglet anaemia is simply prevented by the administration of iron to the suckling piglets. It is important to begin dosing early—the first treatment should be given as soon as possible after birth and in any case not later than the seventh day.

Iron sulphate in solution has been used but it is rather astringent and large doses will irritate the stomach lining, leading to vomiting. Frequent small doses are therefore necessary. A simple prescription is as follows:—

Iron sulphate	..	3 drachms
Copper sulphate	..	1 drachm
Water.	.. ..	1 pint

Dose: One small teaspoonful daily.

Reduced Iron is generally to be preferred since comparatively large amounts can be given to small pigs without ill-effect. Two doses of 500 mg. (8 grains) in pills or as a paste at weekly intervals is usually sufficient.

Another method of prevention is to smear the udder and teats of the sow at daily intervals with a syrup containing iron salts. Such a mixture is:

Iron sulphate	..	3 oz.
Copper sulphate	..	¾ oz.
Water ..	..	1 pint
Molasses ..	..	1 pint

This, however, tends to produce soreness of the teats. Alternatively, a piece of old motor tyre can be placed in the pen on which the syrup is smeared daily.

Finally, a small quantity of soil thrown into the pen daily will generally provide the piglets with adequate quantities of supplementary iron. However, this is not to be encouraged in Fiji where the Kidney Worm of pigs (*Stephanurus dentatus*) is such a serious parasite. If this practice is resorted to, the soil must come from an area to which other pigs have had no access.

TREATMENT

If severe clinical cases of piglet anaemia are present, the quickest and simplest, although somewhat more expensive, treatment is provided by intramuscular injection of special iron-dextran preparations. This can be carried out by officers of the Veterinary Division. Otherwise, Reduced Iron in oral doses of 500 mg. (8 grains) every second day for ten days will produce a good response.

THE TOXICITY OF CREEPING INDIGO IN FIJI

BY J. D. YELF

Creeping Indigo (Indigofera endecaphylla) is a vigorous creeping legume which grows well in Fiji where it was introduced in 1950. *Payne et al.* (1955) *reported it as a promising legume but recognized that it might be toxic, as described by other workers ; however, an experiment on chickens at Sigatoka did not show conclusive proof that it is dangerously toxic in Fiji (Payne and Naidu,* 1955).

Because it is such a promising plant in Queensland the Plant and Soils Laboratory of the C.S.I.R.O. have been trying to detect variations in the amount of the toxin B-Nitro-propionic acid. They say that every strain of *Indigofera endecaphylla* they have tested is toxic and a ration containing 38 per cent of creeping indigo would kill a sheep in five days as a result of breaking down of the liver cells (Private communication). But a goat tethered on a pure stand of creeping indigo for three weeks was not affected in Fiji and therefore gave rise to doubts about its toxicity under Fiji conditions.

In order to confirm that this otherwise promising legume is dangerous to cattle under conditions in Fiji four cows were given diets containing between 25 per cent and 100 per cent creeping indigo. The cow which was on 100 per cent ration would only eat up to 60 lb. daily while the cow on a 25 per cent mixture would eat up to 120 lb. of the mixture a day. The fact that the body weights of the cows were not the same would account for some of the appetite difference but the palatability of the 100 per cent creeping indigo ration was probably not as good as that of the mixtures with grass.

The cows were housed in an airy loose box and had ready access to the feed. Weighed fodder was given to the cows thrice daily and the uneaten portion taken away later.

DETAILS OF TRIAL

Notes on Cow	Date Commenced	Percentage Creeping Indigo in forage fed	Weight of Cow (lb.)	Results
1. Friesian— Age four years ; two calves. A small, poorly developed cow	5/12/56 19/12/56 9/1/57	100 50 50	622 539 550	Proved not to be in calf ; sold 9/1/57 Lost 72 lb.
2. Jersey— Age six years; four calves; due to calve ag in 20/4/57. Average type	18/1/57 28/1/57 21/2/57	50 50 50	740 754 758	Aborted with retained afterbirth, 21/2/57 Gained 18 lb.
3. Jersey— Age seven years; five calves; due to calve 15th July, 1957. Average type	15/4/57 22/4/57 2/6/57 3/6/57	50 50 50 50	784 762 832 765 (After abortion)	Aborted with retained afterbirth, 3/6/57 Gained 48 lb. Calf weight 38 lb.
4. Jersey— Age six years; five calves; due to calve 7/11/57. Average type	19/7/57 22/7/57 10/10/57	25 25 25	890 878 919 822 (After abortion)	Aborted with retained afterbirth, 10/10/57 Calf weight 30 lb. Gained 29 lb.

All the cows appeared quite contented during the trial as they had been accustomed to being housed in the same building in previous Management trials. The prolonged retention of the afterbirth, which had to be helped away, was a feature of each case. Unfortunately, due to shortage of grazing, it was not possible to keep the cows to see if they would breed again.

From these feeding trials on cows, using varying amounts of *Indigofera endecaphylla*, it is evident that amounts of 25 per cent and upwards are likely to cause abortions in cattle. The plant is agressive in nature and it is more than possible that a cow would eat 25 per cent creeping indigo in a pasture which had been planted with it. At the Sigatoka Agricultural Station, where it was originally planted in plots, it has spread throughout the grass paths; it has also spread out of a field on to the grass verge alongside the road and it has persisted for eight years in a pasture. At the Principal Agricultural Station, Koronivia, it was planted as a leguminous cover in a banana experiment, but it has not persisted to the same extent in competition with *Axonopus compressus* in the higher rainfall area.

CONCLUSION

It is felt that a definite warning should be given to all who consider using creeping indigo, for even if it is grown as a cover crop there are chances of it spreading into pastures. On flat land it is quite easy to eradicate by ploughing but if it becomes established in hilly country it might prove difficult to get rid of. Because of its toxic effect in causing abortions in cattle it is advised that creeping indigo should not be used as a pasture or cover crop in Fiji.

ACKNOWLEDGEMENTS

The author wishes to thank Mr. J. W. Parham for access to correspondence with C.S.I.R.O. Officers; also the staff of the Sigatoka Agricultural Station for carrying out the trials.

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Payne, W. J. A., and Naidu, R. K., Agric. Journ. Fiji, 26, 1, 55.

Correspondence between Parham, J. W., and C.S.I.R.O., Plant and Soils Laboratory.

SELECTING A GOOD BULL TO GRADE UP A POOR DAIRY HERD

BY F. M. FATIAKI

A previous article in this Journal(1) dealt with the selection of a good milking cow. It is not necessary for a dairy farmer to commence his dairy herd with both sire and dam of a pure-bred type. Pure-bred animals are much more costly to develop and maintain.

In the forming of a grade herd, a farmer as a rule should have a pure-bred sire to mate with cross-bred or common females, because cross-bred animals are more vigorous and healthier and make better utility stock. Pure-bred herds are necessary for the production of stud stock. When purchasing a bull it is very important that he should be of the best and worth the purchase money. Future results really depend on the bull which the farmer has selected.

The bull is the deciding factor in influencing the quality of the herd and he must have all the points that should make the ideal type. The selection of the bull is one of the most important and responsible jobs of a dairy farmer; the selection must be sound from the beginning, for it is impossible to remedy faults once they have been made. If the bull is put to his first service at 15 months his first progeny should arrive when he is two years old; he will be five years old before his progeny are able to give any indication of their worth; even then it is not possible to be sure of a cow's milk production till she has completed her second lactation. The sire by this time is seven years old and at this age would be classed as an aged bull. Therefore a breeder cannot judge a bull on his own performances, but must judge him on the performances of his ancestors, more particularly his near ancestors. If the sire is of poor quality his heifers will never make good dairy cows.

It is possible to grade up a dairy herd to a high standard from cows of poor type, by using a high class pure-bred sire throughout the succeeding generations. In four generations an almost pure-bred herd may be developed from one of poor quality.

The mother of the bull must also be considered, bearing in mind the shape and quality of the udder and trueness to dairy type. It is not necessary to select a bull whose dam possesses an extremely high milking record. A very high milk producer can sometimes produce ill-nourished and under-sized calves because of the fact that, prior to birth, blood was used for milk production instead of nourishing the calf. Thus it will be wiser to select a bull whose mother had a high average milking record.

After being satisfied as to breeding and yield, the breeder or the farmer must make his final choice on type. A distinct dairy type is preferable, and a description is given here to guide the farmer when selecting.

Head—The bull's head is an excellent sign of his character, mental condition and health. A good head always gives the impression of strength and masculinity, without suggestion of coarseness. As one can judge character in a man by his face, so it is possible to judge a bull in the same way. A full, prominent eye with a broad forehead is a measure of the animal's intelligence. He should not be too short in the face from the eyes to the nostril. A broad, open nostril without too much flashiness indicates good breathing capacity and strength. A strong, broad muzzle and a broad, well set jaw enables him to feed well and consume large quantities of feed.

Neck—The head should be set on a strong neck, thick, but without coarseness. The throat must be clear and smooth.

Shoulder—Flat and sloping, not too heavy, but at the same time giving the impression of strength.

Barrel—A deep chest with good breadth between the front legs indicates efficient heart and lung action. The barrel should be well ribbed up, the ribs being broadly set and sloping well back. The back should be straight from withers to tail butt, with good breadth across the loins, and should not be too coarse at the withers.

Hind-Quarters—Hips should be wide apart and fairly light in the bone. Rump must be level, thighs should be flat, both inside and out, and fall off at rear. The hind quarters should be wide apart and straight when viewed from behind. Flanks should be thin.

Embryo Teats—Well developed, wide apart, set perpendicularly and away from the scrotum.

Milk veins should be well developed. The skin round this region should be yellow, fine, and possess an oily pigment.

Scrotum—Well developed with well-formed testicles evenly placed.

Skin and Hair—A good coat greatly adds to the appearance of a bull and shows to a large extent the quality of his breeding. The skin should be soft, loose, and elastic, and not too thickly fleshed. The colour in most milking breeds is yellow and may be observed inside the ear and under the flank. The hair should not be too coarse nor should it be long. Soft, fine hair is the ideal coat because smooth-coated animals thrive much better in Fiji, apparently due to their better heat tolerance.

REFERENCES

1. Fatiaki, F. M.—(1955) Notes on Points in Selecting a Good Milking Cow.—Fiji Agricultural Journal Vol. 26, No. 3.

NEXT ISSUE FEATURES COCOA

The next number of the Journal (No. 2, scheduled for June, 1959) will be devoted entirely to Cocoa. Articles will deal with the early history, progress and prospects of cocoa as an industry for Fiji. Of special interest will be articles covering the soil requirements and nutrition of the cocoa tree, its pests and diseases, and the harvesting and preparation of the crop for export. A final section will set out the Department's plans for the future by way of selection, breeding and introduction, development proposals, fertilizer investigations, marketing and suggested legislation for the furtherance and protection of the industry.

New Agricultural Publication . . .

THE WEEDS OF FIJI

BY J. W. PARHAM

A bulletin describing the weeds of Fiji is to be published shortly and will be on sale at the Department of Agriculture, Suva.

The bulletin contains botanical and general descriptions of most of the major and minor weeds of cultivation, pastures and wasteplaces in the Colony, together with notes on their distribution. About 90 of the most common weeds are illustrated by line drawings. The price of the bulletin will be five shillings (Fiji currency) per copy.

Advance orders may be addressed to the Director of Agriculture, Suva. It is expected that this bulletin will be available towards the end of May, 1959.

RURAL INDUSTRIES . . .

From time to time many minor industries which utilize agricultural produce as raw material have been tried out in Fiji. Regrettably, many of these attempts to establish new industries have been disappointing in outcome and successes have been few. However, economic conditions are constantly changing and new uses for agricultural products are constantly being sought; local markets increase in size as the Colony's trading activities expand and communications with overseas markets improve almost daily. It is therefore not unreasonable to take the view that the prospects of the "small" producer are getting better as each year goes by. Some of the more important of the minor industries which are worth considering for the future are discussed in the series of articles to follow.

1. GINGER PRODUCTS

BY V. E. SILLS

Both fresh ginger and green ginger preserved in brine used to feature regularly in our exports to New Zealand. Ginger grows well in Fiji yet farmers take little interest in it. The following article explains why ginger cultivation and processing have become a fairly highly specialized business in the major exporting countries.

Ginger is one of the earliest known spices, having been mentioned in ancient Chinese and Indian literature. It was introduced into the West Indies and Mexico by the Spaniards in the 16th century, since when Jamaica ginger has come to be regarded as the finest produced; other varieties from India and Africa are more pungent and less pleasantly aromatic in taste.

Commercial ginger is prepared from the underground tuberous stem or rhizome of *Zingiber officinale* Roscoe. It appears mainly in two forms:—as a hard, peeled, dried product, possessing much fibre and pungency; and as the popular preserved ginger in syrup prepared from young, tender, succulent rhizomes, free of fibre and of mild pungency. The young tender rhizomes are also marketed as "ginger in brine" but most of this eventually becomes the raw material for preserved ginger in syrup—after the salt has been removed by boiling in water; it is also used directly in the manufacture of sauces and pickles. Yet another version is the familiar sweetmeat "crystallized ginger", the result of taking the ginger-in-syrup process a stage further.

SOURCES AND TRADE

Practically all the dried ginger entering the world's markets is produced within the Commonwealth—Jamaica, India, Sierra Leone and Nigeria being the principal sources. On the other hand, virtually all the preserved ginger entering world trade comes from Hong Kong, having been grown largely in the moist, rich alluvial flats of the Canton delta.

Annual trade figures show that 5,000 tons of dried ginger were exported from Commonwealth countries in 1954 and that slightly under 3,000 tons of preserved ginger valued at £432,000 were exported from Hong Kong in the same year. The price of dried ginger has fluctuated widely in recent years: towards the end of 1953 Jamaica ginger sold at 105/- per cwt., but at the end of 1955 had rocketed to 450/- per cwt.; towards the end of 1958 Jamaica grades were offered at 280/- per cwt. By way of contrast, Nigerian peeled ginger was offered at 210/- (spot) and split ginger at 95/- per cwt. (late 1958).

TYPES OF DRIED GINGER

The following information on the various types of dried ginger met with in commerce has been provided by the Tropical Products Institute:

Ginger from Jamaica by virtue of its delicate odour and flavour is considered to be better than any other variety. It is "clean" peeled and is marketed in three grades, bold, medium or No. 2 and small or No. 3; the bold consists of large, firm unwrinkled hands, of pale uniform colour, free from mildew. This high grade ginger is in good demand for the grocery trade for sale unground; it is also used for distillation.

Sierra Leone ginger, which is coated (unpeeled), cannot be used for the grocery trade. Its flavour is somewhat camphoraceous but it is more pungent and contains more essential oil than other types, and is for this reason much in demand for the extraction of oleo-resin (gingerine) and for distillation.

Nigerian ginger resembles the Jamaican but is of lower quality. It is peeled but not quite as cleanly as the Jamaican; the producers often prefer to break the hands as this simplifies the process of peeling, but this grade, known as "splits", is of much lower market value.

Indian ginger is of two types—Cochin and Calicut, according to the district in which it is produced. It is sometimes coated but is usually "rough peeled" or scraped on the flattened sides of the rhizomes; clean peeling is not practised in India. Indian gingers are much used for blending; they have a distinct lemon-like odour and flavour, more pronounced in the Calicut spice, and are preferred by manufacturers of ginger beer.

METHOD OF CULTIVATION

As already mentioned, preserved ginger is derived from young, tender rhizomes; the age at harvesting is around 4 to 6 months, the optimum period depending on the month of planting. The succulence and slight pungency characteristic of Chinese ginger appear to be due to the special methods of cultivation and not to differences in variety as was once supposed. This type of ginger is best produced on a well drained, rich, vegetable loam, and in Canton is often grown in rotation with rice, being given heavy dressings of liquid manure.

Jamaica ginger, on the other hand, requires rather different growing conditions. According to the "Farmers Guide" (1954) it does best on a deep loamy soil overlying white or yellow limestone; stiff clays and sandy or gravelly soils are to be avoided; and in order to produce straight, undeformed rhizomes—which are the most valuable—the plant should be grown in a loose friable soil, one that offers little mechanical resistance to the development of the underground fleshy parts. Since this type of ginger is intended to be dried it is left in the ground until fully mature—9 to 12 months from the time of planting.

In Jamaica, yields are of the order of 1,000 to 1,500 pounds per acre. For further information on ginger in Jamaica see article by Prentice, "World Crops", January, 1959.

METHOD OF CURING

Dried ginger is comparatively simple to prepare but a certain amount of skill is called for on the part of the operator, especially during peeling.

On a peasant scale the first operation is to remove loosely adhering earth from the freshly dug rhizomes and to put them to soak in water overnight. The cleaned "hands" are then carefully scraped, or peeled, with the aid of a special knife—an operation both arduous and time-consuming. It is claimed that a good worker can "clean" peel no more than 10 to 14 pounds of rhizomes per day. At this rate it is clear that, to make the business profitable, cheap labour is essential. In an attempt to find an alternative to hand peeling certain commercial undertakings have tried using machines fitted with abrasive rollers, such as are used for peeling potatoes, but appear to have met with little success. Ginger hands are an awkward shape for a machine to deal with, particularly as only a thin outer layer of skin is required to be removed. Rough or clumsy peeling lowers the value of

ginger appreciably because most of the oil-bearing cells are located close to the surface just beneath the thin corky outer layer (0·4 mm. thick) and consequently unless care is taken much valuable oil is lost in the peelings.

After peeling, the hands are again washed in clean water and allowed to soak overnight. It is said that the more thorough this washing operation is done the whiter the finished product. The hands are then dried in the sun on a clean surface, e.g. cement, with frequent turning. Sun drying takes 6 to 8 days, so regular turning is necessary to ensure even drying and to prevent the growth of moulds on the moist underparts. If, at this juncture, the ginger is not considered sufficiently white in appearance, it may be bleached by further washing and drying in the sun.

Alternatively, ginger is sometimes parboiled in water, or in water containing lime juice, before peeling. This process gives rise to the " black " ginger of commerce.

In some parts of India ginger is " limed " by dusting with calcium sulphate or carbonate, giving the spice a whitish appearance. The purpose of liming is to make the ginger less susceptible to the attacks of insect pests, although, since this dust is objectionable in foodstuffs, it must be regarded as a form of adulteration and therefore the practice has little to commend it.

GINGER IN FIJI

Judging from the results of drying experiments performed in the laboratory and of recent trials carried out in the field the type of ginger at present being grown in Fiji appears to be unsuitable for the production of commercial dried ginger. Local ginger is, however, excellent for marketing as " green ginger " and may be exported either fresh or preserved in brine. Until 1954, after which exports of ginger from Fiji ceased, regular quantities of green ginger were shipped to New Zealand, the amount in 1954 being 26 tons valued at about £1,000.

During 1958 two tons of rhizomes were harvested at the District Farm, Ra, and transported to the Principal Agricultural Station, Koronivia, for curing. The ginger was washed, peeled by hand and dried on a grain drier. During this operation the Department was left in no doubt as to the impracticability of peeling ginger by means of paid labour, and even drying costs proved high. The final yield of dried ginger was five hundredweights, indicating a drying ratio of eight parts fresh material to one part dry, which compares unfavourably with that obtained in Jamaica, where, it is claimed, four tons of freshly lifted rhizomes produce 1 ton of dried ginger. No doubt the reason for this poor yield can be attributed to differences in local soil conditions and methods of cultivation, with varietal differences playing a minor role.

On the other hand, dried ginger prepared from local material is not found lacking in pungency; comments on samples sent to overseas buyers have been encouraging.

Reference may be made here to " black " ginger, prepared by dipping fresh rhizomes in boiling water before peeling, washing, etc. A laboratory prepared sample showed that the boiling water treatment did not make the peeling operation any easier, while it gave the product a most unattractive colour, being both dark and uneven in intensity.

PRESERVED GINGER

According to Brown (1955) the process used in Hong Kong for preserving ginger is performed as follows :—First, clean, peeled ginger is boiled in water for a few minutes and when cool is removed and pricked with a fork. The purpose of pricking is to facilitate the entry of sugar during subsequent boiling in syrup. The ginger is then boiled for 45 minutes in syrup prepared by adding eight parts by weight of sugar to ten parts of ginger and sufficient water to cover. It is left in the syrup to soak for two days or more and is then reboiled, after which it is packed in fresh syrup.

To prepare dry or crystallized ginger the process of boiling in syrup is continued a stage further—in stronger syrup. After soaking in the heavy syrup the sugar-saturated product is removed, drained, dried, mixed with sugar and finally packed in heavily soldered tins.

Fiji-grown ginger can be preserved in syrup or crystallised with sugar quite successfully, provided care is taken to select suitable young, well-shaped hands. However, the finished product appears to be rather too "hot" to please the average domestic consumer, from which the conclusion may be drawn that it would be advisable to experiment first with different varieties of ginger and methods of cultivation before going in for a commercial venture of this sort.

CONSTITUENTS OF GINGER (DRIED)

Ginger contains from 0·25 to 3·0 per cent of a volatile oil possessing the characteristic aroma but not the pungency of the spice, the latter property being due to the presence of gingerol. Gingerol is an odourless, yellowish-coloured, fixed oil characterized by an intensely pungent taste; together with resin these constituents account for 3 to 4 per cent of the total weight.

In addition, ginger contains 50 per cent or more of starch and an average of 4 per cent of crude fibre, the limits being 1·7 to 9·0 per cent.

Oleo-resin or ginger oil is a commercial product, being an organic solvent extract of dried ginger. The present London spot price is 160/- per lb.

USES OF GINGER

Ginger is today extensively used in culinary preparations such as soups, puddings, pickles, gingerbread and so on, and is an ingredient of some curry powders. It is a popular flavouring in beverages such as ginger ale and ginger beer. In medicine it finds use as a carminative and digestive stimulant.

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2. CASSAVA STARCH

BY V. E. SILLS

Cassava starch is produced on a big scale in South America and Indonesia. What are the prospects here? The Fijian Co-operative Market Association Ltd. tried making it at Nausori but soon had to abandon the project. The problems encountered in local cassava starch production are discussed below.

CASSAVA STARCH

Cassava starch, or "tapioca flour" as it is known by the trade, is obtained from the roots of the cassava plant (*Manihot utilissima*). There are two common cultivated varieties, the "bitter" and the "sweet", although in Fiji it appears that only the sweet variety is grown (Mason 1956) The roots of both kinds contain hydrocyanic acid but fortunately this poisonous substance is eliminated in cooking and by the starch extraction process. The main cassava starch producing areas are found in Brazil and Indonesia.

The yield of roots per acre depends on variety, soil conditions, method of cultivation and so on, the details of which are given in a recent Food & Agricultural Organization Agricultural Development Paper (1956). According to Brautlecht (1953), yields vary between 5 and 12 tons of roots per acre on well managed plantations and may even reach 17 tons under favourable conditions. For starch production it is important not to lift the crop until it has reached maturity, which means 15 to 20 months from the date of planting.

PROCESSING

The principle of the method of cassava starch manufacture is much the same whether small or large amounts are made, but naturally a large factory with an efficient organization and modern plant can produce starch superior in quality to that produced by the small units run by peasant farmers. This does not mean to say, however, that with care, the small farmer cannot make a good product. Briefly, the general procedure for preparing cassava starch is as follows:—

The mature roots are first washed to remove loose soil. If the scale of operation is small the roots will be peeled by hand to remove skin and cortex; if large, the outer skin or corky layer only will be removed (in the washing process) since on a factory scale it becomes profitable to recover the starch from the cortex even though the proportion is only half that present in the core: the inner part of the peel represents about 8 to 15 per cent of the weight of the whole root.

To release the starch from the cellular matter the prepared roots are preferably sliced and then put through a rasping or grating machine which tears the flesh into a fine pulp. The rasper usually consists of a steel drum with saw blades fitted into its outer surface and is driven at high speed by means of a motor.

The cassava pulp is sieved to separate the fibrous matter from the starch milk, a liberal quantity of clean water being used at this stage to facilitate the separation. A popular form of sieve or screen is of the rotary type consisting of a 100 mesh phosphor bronze screen fastened to the outside of a hollow conical wooden frame which is made to revolve about its horizontal axis. Pulp from the rasper is fed directly into the narrow end of the rotating cone and is sprayed with jets of water; the strained, diluted starch milk falls into a collecting tank underneath.

The collecting and settling tanks may be made of cement but should be lined with wood of a kind known to be resistant to the action of starch milk. Care should be taken not to allow the starch milk to remain in contact with iron or steel for any length of time, owing to the reaction which occurs between iron and hydrogen cyanide to produce dark coloured compounds. Openings are made in the sides at different heights to let off the supernatant liquid after the starch has settled.

Settling takes at least six hours but should preferably not be allowed to take longer than this because of the presence of destructive enzymes and microorganisms. The supernatant liquid is drained away, leaving behind a mass of starch whose upper surface is somewhat yellowish-green in colour. This surface layer contains a good deal of impurities and is best scraped off and rejected. The remaining starch is then stirred up with fresh water and left to settle again. In most cases two settlings suffice to obtain a reasonably clean flour.

The moist starch cake from the sedimentation tanks can be dried cheaply by spreading it out on trays in the sun, but on a factory scale it proves more satisfactory in the long run to use hot-air driers. While sun drying has the advantage that the starch is bleached by the ultra-violet rays of the sun it also causes certain chemical degredation reactions to set in which ultimately have a harmful effect on quality. Furthermore, sundrying has the serious disadvantage that, on windy days, contamination from dust is likely to occur which spoils the appearance and reduces the value of the finished product. This experience was commonly met with by the Fijian Co-operative Market Association (F.C.M.A.) when starch was dried in the sun alongside the road at their Nausori factory.

Other drying methods involve the use of trays in drying cabinets or tunnels; and where the scale of production is large a revolving heated drum type of drier may be used successfully.

Finishing operations include "bolting" and screening which means crushing the hard lumps of dried starch into a powder and passing it through a gauze of 100 to 200 mesh/inch.

QUALITY

The quality of cassava starch is determined from a wide variety of tests: mesh size, colour, odour, cleanliness, pulp or fibre content, moisture, ash, acidity and viscosity (of cold flour slurry as well as cooked starch paste) are all used to assist in defining the grade and therefore the commercial value of the product.

Of particular importance is the moisture content which should fall within the range of 10 to 13·5 per cent. If the moisture is too high there is a likelihood of mould contamination taking place, especially when the starch is stored under tropical conditions.

YIELDS

F.A.O. Development Paper (1956) quotes the annual operational figures for a large cassava starch factory and gives the average starch content of mature washed roots as 26 per cent and the actual production of starch as 22·7 per cent of the total weight of fresh roots.

In Fiji the yields of starch obtained by the F.C.M.A. at Nausori before 1952 were less satisfactory than those quoted above, but this is probably accounted for by the absence of any attempts to get a supply of roots from heavy yielding varieties of cassava; also the efficiency of the factory extraction plant was not high. The F.C.M.A. reckoned that between 5 and 6 tons of roots were required to produce one ton of dry starch.

USES

Cassava starch is used in the food, textile, paper and glue industries. The food industry absorbs a small proportion in the gelatinized form known as " pearl ", " seed " or " flake " tapioca—a baked product consumed in the making of soups, puddings, pies and so on.

One of the most important end uses of cassava starch is found in the manufacture of glue. The starch is first gelatinized and then converted to dextrins by chemical or enzymatic means. These dextrins are practically free of odour and are agreeable in taste which means that they are eminently suitable for use as adhesives for postage stamps, gummed envelopes, tape and so on. Cassava starch is also used in making plywood and veneer adhesives.

PROSPECTS OF A CASSAVA STARCH INDUSTRY IN FIJI

Until the 1952 hurricane, cassava starch was produced in limited quantities by the F.C.M.A. at Nausori as previously mentioned. However, many difficulties were encountered during the short life of this factory, one of notable mention being the arranging of a regular daily supply of roots for processing. It is not possible to store roots once they have been lifted since deterioration sets in rapidly after the first 24 hours. Consequently, the F.C.M.A. sometimes either had no supplies at all or were unable to use the deliveries of roots fast enough and were left with inferior raw material on their hands.

The fixing of a purchase price for fresh roots also led to difficulties. For example, if roots are bought at, say, ½d. per lb. the cost of the raw material per lb. of starch produced is equal to five to six times this amount, i.e., 2½d. to 3d. Any slight alteration in the purchase price of roots is naturally reflected on a magnified scale in the production costs of the starch and can easily lead to losses instead of profits being made.

Mention has already been made of the F.C.M.A's experience with sundrying. Apart from the problem of avoiding dust contamination, during the early days of the factory starch production could only proceed smoothly when there was plenty of sunshine. During prolonged rainy periods production was completely disrupted, and consequently, kiln drying had to be resorted to in the end as a supplementary measure.

The market for starch in Fiji is at present less than 100 tons per annum. In 1957 the total weight of starch of all kinds imported into Fiji amounted to 157,937 lb. valued at £F9,632, most of which came from Australia.

There is a demand for cassava starch overseas but unless the price offered improves considerably there can be little prospect of a sizeable starch industry being set up successfully in Fiji.

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FORESTRY . . .

MAHOGANY—A VALUABLE TREE FOR FARMERS

BY G. W. COTTLE, ASSISTANT CONSERVATOR OF FORESTS

Large leaf Mahogany (*Swietenia macrophylla* King) was introduced into Fiji in 1911, and since that time it has proved to be a tree of remarkable promise. It is singularly free from pests and diseases; it grows rapidly in almost any soil or situation in the wet and intermediate zones and yields a valuable timber. To farmers especially, it could be of great value in avenues or to provide shade and shelter for stock, besides yielding wood for estate uses. The financial returns from planting Mahogany are excellent and a few examples are given.

The home of the large leaf Mahogany is in British Honduras where for the past two hundred years it has been the main source of the country's income. There are two types of Mahogany, namely, Large Leaf or Honduras Mahogany (*Swietenia macrophylla* King) and Small Leaf or Spanish Mahogany (*Swietenia mahogani* L.). Although the latter is a little superior in timber quality, it is the large leaf Mahogany which furnishes the bulk of the Mahogany which is exported from Central America to Europe and the United States.

In Fiji it has been found a simple matter to grow large leaf Mahogany, and although small leaf Mahogany can be grown it does not lend itself easily to raising and planting out and its growth rate is considerably slower than that of the former. The remainder of the comments and advice in this article therefore refer to the large leaf Mahogany.

The timber of Mahogany grown in Fiji was recently tested by the Commonwealth Scientific and Industrial Research Organization in Melbourne and it was found to give comparable results to the Mahogany used in commerce. The Fijian timber has a rich red colour and weighs 35 lb. to one cubic foot, which is normal. The general properties of Mahogany are that it seasons well, is durable and has good mechanical properties for its weight. Mahogany is used for furniture and cabinet making, interior fittings, plywood, boat and ship building, and high grade joinery. The timber nails and screws easily without splitting, does not dull cutting tools and glues well. Unfortunately, Mahogany is not a good firewood and the sapwood and poles of Mahogany are not durable.

It is recorded that the first introduction of large leaf Mahogany into Fiji was in 1911, when two trees were planted at the Nasinu Arboretum, now the site of the Approved School. These two trees are now 100 and 114 feet in height and 14 feet 1 inch and 12 feet 2 inches in girth respectively. There are other interesting specimens to be seen in the grounds of Government House in Suva and for those living in the dry zone of Viti Levu there are three large specimens to be seen in the C.S.R. Lines near Lautoka Sugar Mill; these were planted in 1925 and two of them already exceed nine feet in girth.

Of particular interest to the farmer are the specimens which were planted as avenue and shade trees at the Agricultural Station, Sigatoka, in 1932 and 1937. Most of these trees are fully grown and many are nearly 100 feet in height. They give the Station a dignity and charm which many other stations and farms in Fiji must find enviable. To anyone considering planting Mahogany, these trees are well worth a visit.

The major area of Mahogany plantations is to be found at Colo-i-Suva Forest Station where, up to the end of 1957, 700 acres have been planted. These plantations are mostly only a few years old but show excellent growth rates. There are a few plantations 19 years old which are impressive. Visitors are welcome and a Forest Ranger will be available to provide a guide if arrangements are made beforehand.

Mahogany has grown well in many other tropical countries where it has been introduced, but some of them have been less fortunate than Fiji as a species of shoot borer, *Hypsipyla grandella* Zell, has attacked younger trees and rendered the economic establishment of plantations difficult, if not impossible. This pest has not been noted in Fiji and, as there is almost complete freedom from pests and diseases, very little difficulty is experienced in establishing healthy plantations. It has been difficult in the past to obtain enough seed, either locally or from abroad, to satisfy the Forestry Department's plantation programme. However, there is now ample seed available annually from local sources thanks to the establishment of many small plantations by the Agricultural Department in the 1930's which are now bearing seed prolifically.

In the wet zone of Viti Levu, from Tailevu to Serua, Mahogany will grow on all but the poorest soils and may be planted either in the open or preferably under light shade. In the intermediate zone, which in Viti Levu includes parts of Ra and Nadroga, Mahogany will grow in the open if planted in particularly favourable sites but normally it is preferable to plant under light shade such as may be given by Vaivai (*Leucaena glauca* Benth.), Guava, or native scrub. Avenue trees, if planted in the open, would need a light reed shelter in the first and possibly second years' growth. In the dry zone Mahogany can be successfully grown under light shade on most forest soils. If it is desired to grow avenue or shelter trees in open positions it may be necessary to give artificial shelter for probably three years, and to water them occasionally in the driest parts of the year. It is not recommended to attempt to form plantations in the open in the dry zone as the expense of shelter and maintenance is too great. Similar considerations apply to the wet and dry areas of the other islands as in the wet and dry areas of Viti Levu.

To plant out, a hole approximately 18 inches square should be dug and the tree planted carefully with its roots well spread out. Planting should be carried out on a a wet or cloudy day, and care should be taken to see that the roots are not allowed to get dry. For private owners the best planting distance for a pure plantation in the open is 12′ x 12′ or, if planting under shade, 16′ x 8′ as the distance of 16′ between the lines reduces the expenditure on line cutting. Avenue trees should be spaced at 16′ to allow for thinning out to 32′ some 20 years after planting.

Growth is rapid and averages from three to four feet in height annually for the first 25 years, so that after the first two years the trees will require very little attention.

It is not realized how valuable even the smallest plantations can be so a few examples may be given.

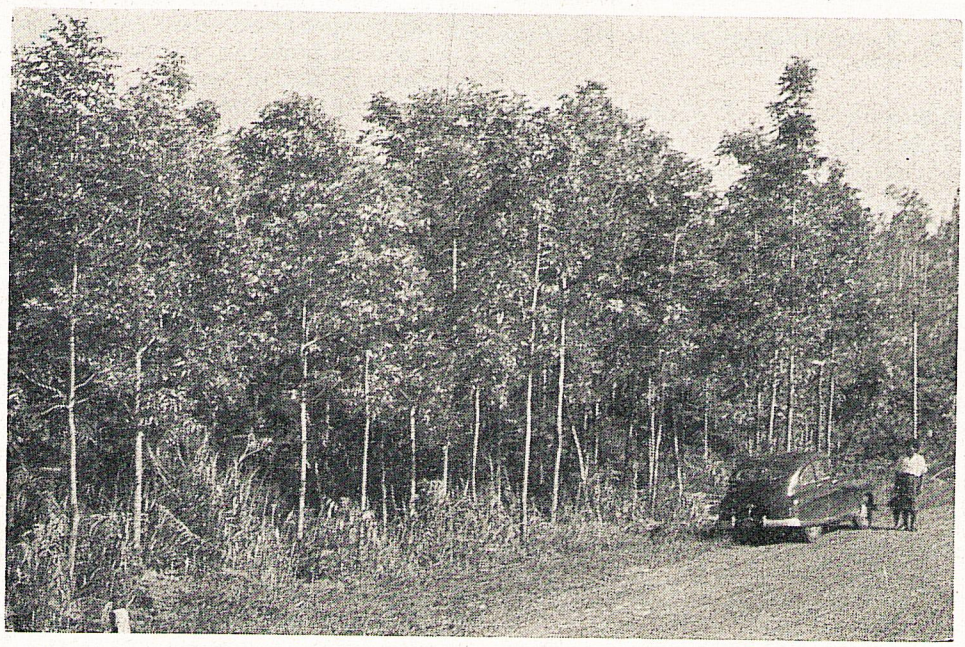
At Nasinu, in a paddock, 22 Mahogany trees were planted in 1937. They are situated within an area of about one acre and have not to any great extent interfered with the grazing of cattle for which the area is used. These trees now have a timber volume of over 8,000 super feet of timber, or a value, if sold standing, of approximately £80. Sawmillers are prepared to purchase

Photo—J. R. Angus

Figure 1. A fine 20 year old Mahogany tree, growing in the open at Tamavua

Photo—J. R. Angus

Figure 2. Plantation Mahogany, 21 years old, at the Nasinu Approved School



Photo—J. R. Angus

Figure 3. A ten year old Mahogany plantation, Colo-i-Suva

Photo—J. R. Angus

Figure 6. Young Mahogany 4 years old, direct sown, Colo-i-Suva

the Mahogany class of timber for 25/- per hundred super feet at road or ride side, and it is not thought that the tree felling costs would be in excess of 5/- per hundred super feet, thus giving an approximate nett return of £1 per 100 super feet if a lorry can reach the felling site.

At Sigatoka, in 1937, nine chains of Mahogany were planted in an avenue at a spacing of approximately 20 feet. The table below illustrates the value of this avenue.

Number of trees—			
Planted in 1937	..	54	
For thinning 1958	..	23	Volume 5,262 sup. ft.
Died		5	
Remaining		26	Volume 6,899 sup. ft.
Total Volume ..			12,161 sup. ft.

The value of the thinnings, if sold at stump, is about £52 and the remaining trees have a value of about £69.

A further avenue of 60 trees planted in 1932 at Sigatoka, in which the lines were spaced one chain apart and the spacing within the lines was ½ chain, now has a timber volume of 21,991 super feet, and has a value therefore of about £220 or £3 13s. 4d. per tree. The value of these trees and of the previous examples is increasing annually by not less than seven per cent compound interest. In plantations where Mahogany is grown as a crop the volume of timber produced will be considerably more, for when trees are grown in competition the trees have longer and straighter trunks and are of better form.

It is believed that the most profitable time to fell and replant will be about 25 years in the case of good soils, 30 years for intermediate soils, and 35 years for poor soils. It may be conservatively estimated that the yield per acre would not be less and may be considerably more than 30,000 super feet in each case.

From these figures it may be seen that the farmer who is prepared at negligible cost to plant and care for 50 amenity Mahogany trees per year will, besides adding to the beauty of his land and gaining valuable shade and shelter, also build up a considerable capital reserve for emergencies or, if he should prefer it, a regular income to supplement that of his farm. Those who are interested in planting an acre or two of this species each year, at a cost of about £15 per acre, will provide for themselves a considerable future income. It is an interesting thought that a better and cheaper insurance policy for one's old age could not be found anywhere.

The Forest Department is pleased to give advice on the planting of trees. It will also assist by supplying plants for 10/- per 100 or seed, both of which should be ordered in July.

It is hoped that this article will be of interest to farmers and planters and will encourage the planting of Mahogany as shade or avenue trees or on available areas of waste land or scrub. With this in mind the writer is preparing a pamphlet which contains very detailed data on the qualities of Mahogany, its timber, and recommended nursery and plantation practices. This pamphlet will be obtainable from the Conservator of Forests on application.

WEED CONTROL . . .

NAVUA SEDGE (CYPERUS MELANOSPERMUS (NEES) VALCK. SURING.) A COMMON PASTURE WEED

BY T. L. MUNE

Navua sedge, as its name implies, first became a major weed in the Navua district and is spreading throughout the Colony. Unlike most sedges, it appears to prefer the drier land to the wet swamps. It is not relished by livestock and they tend to avoid it as long as there is any alternate grazing. It is a plant without any redeeming feature and should be destroyed wherever it is found.

General description—The stem is triangular in shape and solid or pithy and not enclosed in a leaf sheath. The tapering pointed leaves are clustered round the base of the stem and are in three ranks with very short sheaths. The erect stem has six (three long and three short) subsiding leaf-like bracts given off by the apex and on the apex itself is a button-shaped cluster of flowers.

Distribution—A tropical plant of the Old World which has undoubtedly been accidentally introduced to Fiji. It was first seen on the island of Rabi and on Devo, Vanua Levu, as early as 1933. It first became a major weed in Navua from where it has spread to the rich Sigatoka valley, the Suva peninsula, the Waidina river valley, Vunidawa and Tailevu dairying districts and the islands of Vanua Levu, Taveuni and Ovalau.

Control—A knowledge of the manner of reproduction and the agencies responsible for the spread of Navua sedge is necessary in the prevention of the establishment of new infestations in both new and old farming districts. It is generally possible to trace it back to the purchase of livestock or farm produce and the transfer of farm implements or motor vehicles from infested areas. The movement of livestock, whether by droving, motor transport or ship is a common method of dispersing Navua sedge. Animals from infested areas cannot avoid grazing some sedge and will retain the seed in their digestive tracts for some time to void it finally in new pastures. The seed may also become attached to the body hairs of animals or in the mud attached to the wheels and undercarriage of farm implements and motor vehicles, and is transported long distances in this manner. It also grows vegetatively and small parts of the plant, which are capable of growth under favourable conditions, may be carried in the same way.

It is well to remember that if a determined effort is made to prevent the introduction of Navua sedge or if, once it is introduced, to prevent its spread by immediately destroying all plants when found, there is every possibility of keeping it under control. By taking the following precautions a good deal may be done to prevent the establishment of new infestations:—

(1) Do not permit livestock from infested districts to be moved directly on to your farm.

(2) Do not use rice seed from infested fields.

(3) Do not use animal manure from infested districts for flower or vegetable gardens.

(4) Ensure that motor vehicles and farm implements are thoroughly washed and cleaned before coming to your farm from an infested district.

(5) Do not use gravel, sand or soil from infested districts.

(6) Keep roadsides, rights-of-way and waste land adjacent to your boundaries under constant observation and destroy any plants as soon as they appear.

(7) Search your own lands at short and regular intervals.

(8) Prevent the sedge from seeding.

Navua sedge is a perennial and difficult to kill. It is resistant to the better known and most widely used hormone weedkillers 2,4-D, 2,4,5-T and MCPA. It is only temporarily controlled by ploughing and discing, while mowing and cutting with knives encourages its spread. To prevent it becoming established in new areas, the most drastic measures are warranted without regard to cost.

Isolated plants and new infestations can be eradicated by the use of non-selective weedkillers, but it must be remembered that eradication is seldom achieved with one application and that it will be necessary to keep the infested site under observation and to repeat the treatment at regular intervals to kill the germinating weed and regrowth.

Such weedkillers as common salt, diesel fuel oil and waste oils applied in large quantities have all been used with a varying degree of success, but as they persist in the soil for long periods their use is limited to small areas, waste land, roadways and fence lines.

Applied at the rate of twenty pounds per hundred square feet, the weedkiller sodium borate, available locally under the trade name of Borascu, has proved more satisfactory than the above chemicals. It is applied as a dry powder, is slightly soluble in water and persists in the soil from six to twelve months.

Sodium TCA, available locally as Stantox TCA 90, Weedone TCA 90 and Nocweed TCA, mixed at the rate of one pound dissolved in one gallon of water and applied as a fine spray at the rate of one quart of mixture per hundred square feet, will kill the sedge but will have to be repeated at short intervals to obtain complete eradiction. TCA is chiefly taken up by the root system of the plant and care should be taken to force the spray down to wet the base of the sedge and the surrounding soil. The best results are obtained when the spraying is carried out following rain when the ground is wet. When the sedge is growing on a hillside, the base of the plant and the soil just above it should be thoroughly wet with spray, allowing the weedkiller to be washed into the sedge by the rain. For the eradication of small infestations TCA is economical but for large scale operations would be too expensive and may persist in the soil preventing the use of the field for some time.

The control of large infestations is difficult and expensive, but a combination of cultivation, smother grasses and non-selective weedkillers offers a method of control which

Navua Sedge

allows the pasture grasses to compete economically with it. The infested pastures should be ploughed, disced and harrowed four or five times at three weekly intervals to weaken the sedge. This may be done at any time of the year but the best results are obtained between the months of May and August. Following the last cultivation, the field should be planted with a strong vigorous grass which will grow faster than the sedge and form a complete cover of the ground. Grasses which do not form a dense cover are rapidly displaced by the sedge and require frequent replanting. Of our pasture grasses, Batiki blue grass (*Ischaemum aristatum*) appears to form a better cover and to compete with the sedge more successfully than the others. Trials over the last three years have shown that, when used in conjunction with cultivation and chemical weed control, it will prevent the re-establishment of the sedge. Once the Batiki grass is established it should be kept fairly short by controlled grazing, which is an advantage as it allows the sedge to be seen and destroyed, as soon as it appears, by spot spraying with TCA or by applying Borascu in the manner recommended for the control of new infestations.

When cultivating sedge infested paddocks, the fence lines and land which could not be ploughed should be treated with weedkillers and planted with grass and not left as seed beds to re-infect the pastures.

It is realized that most of our hill paddocks cannot be cultivated but if Batiki grass is encouraged to grow and the infestations killed with weedkillers there is every chance of preventing the sedge becoming established. In many cases, a change to Batiki blue grass for hill pastures may prevent the sedge from ever appearing.

Every effort is being made to find a control for this weed, but your co-operation is required to prevent it becoming established on your land.

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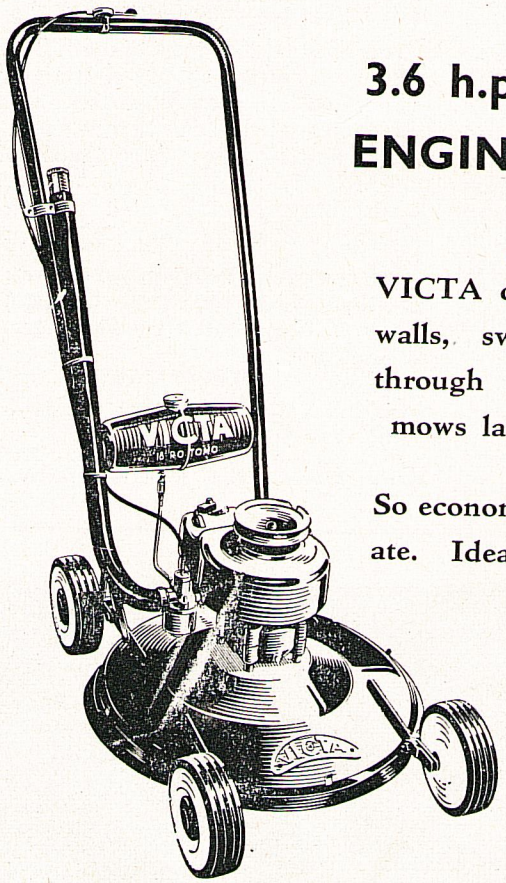

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BOTANY . . .

NOTES ON SOME KUMALA (SWEET POTATO) VARIETIES

BY C. WALKER

A short description of each of the varieties of Ipomoea batatas Linn. *held at the Plant Introduction Station is given below. The names given to the varieties are those by which they are known locally and may not be synonymous with the names by which they are called in other territories.*

The tuber growth of all varieties was poor at Naduruloulou and the varieties are at present kept going merely as a source of propagating material. The station would gladly receive material for propagation from other territories and from local sources. As with other native food crops the collection of varieties of *Ipomoea batatas* is far from complete.

F.D.A. 13407. *Variety :* NAVUSO LOCAL
Figure 1*a*—

Origin—This variety was received from a local source.

Description—The vine is green with a reddish tinge at the petiole attachments; the petioles are green with a light pinkish tinge at the leaf attachment. The veins, on the under surfaces of the leaves, are light pink in colour; on the upper surfaces they are green.

The tuber is round to lozenge shaped and its skin is light brown, similar to that of a potato. The flesh is white when uncooked. When cooked it is a steel gray and the flesh is firm and floury.

F.D.A. 13609. *Variety :* FUNAFUTI

Origin—Introduced from Funafuti on 10th May, 1952.

Description—This variety is identical with NAVUSO LOCAL.

F.D.A. 13564. *Variety :* NIUE ISLAND
Figure 1*b*—

Origin—Introduced from Niue Island on 1st March, 1952.

Description—The vine is green-red near the growing tips. The petioles are red-green (with more red than green), and hairy. The veins, on the under surfaces of the leaves, are reddish and, on the upper surfaces, green.

The tuber is round and long and the skin is pinkish. The flesh is cream coloured when uncooked and the smaller tubers may have a pinkish tinge in the centre. When cooked they are light yellow and the flesh is firm and has a good flavour.

F.D.A. 13053. *Variety :* HONG KONG
Figure 1*c*—

Origin—Introduced from Hong Kong on 10th September, 1950.

Description—The vine is entirely green in colour and the petioles are green, becoming reddish near the leaf attachment. The veins, on the upper and lower surfaces of the leaves, are green with the exception of the main veins which are pinkish on the under surfaces.

The tuber is long and has a light skin. The flesh is white when uncooked but light yellow when cooked. The flesh is firm.

F.D.A. 13156. *Variety :* SAMOA
Figure 1*d*—

Origin—Introduced from Apia, Western Samoa, on 27th November, 1952.

Description—The vine is red and the petioles are green, becoming reddish at the leaf and vine attachments. The veins, on the under surfaces of the leaves, are reddish in colour while on the upper surfaces they are green. The edges of the leaves are reddish.

The tuber is round to lozenge shaped and the skin is a light pink. The flesh is cream coloured when uncooked and very pale yellow, firm and sweet, when cooked.

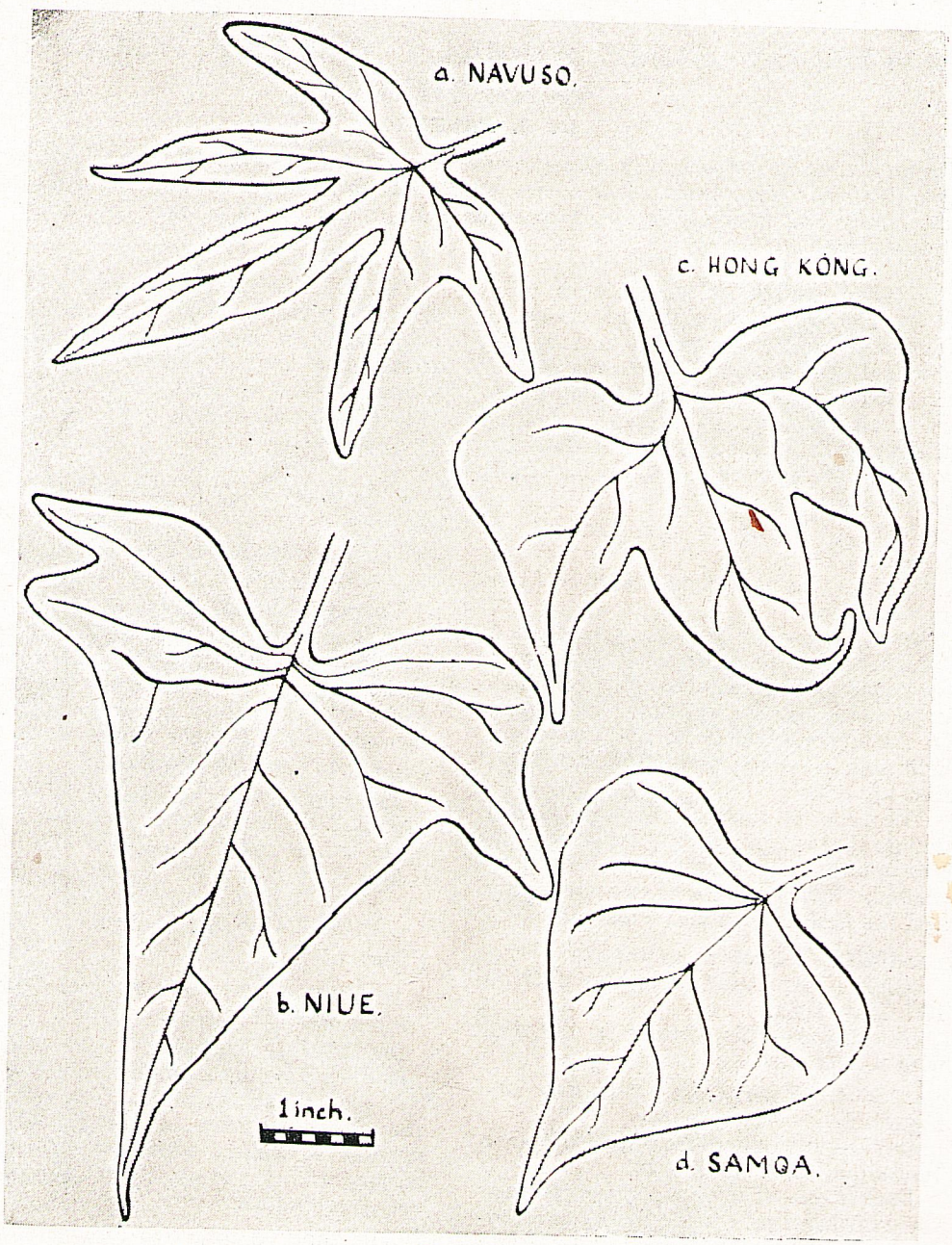

Figure 1

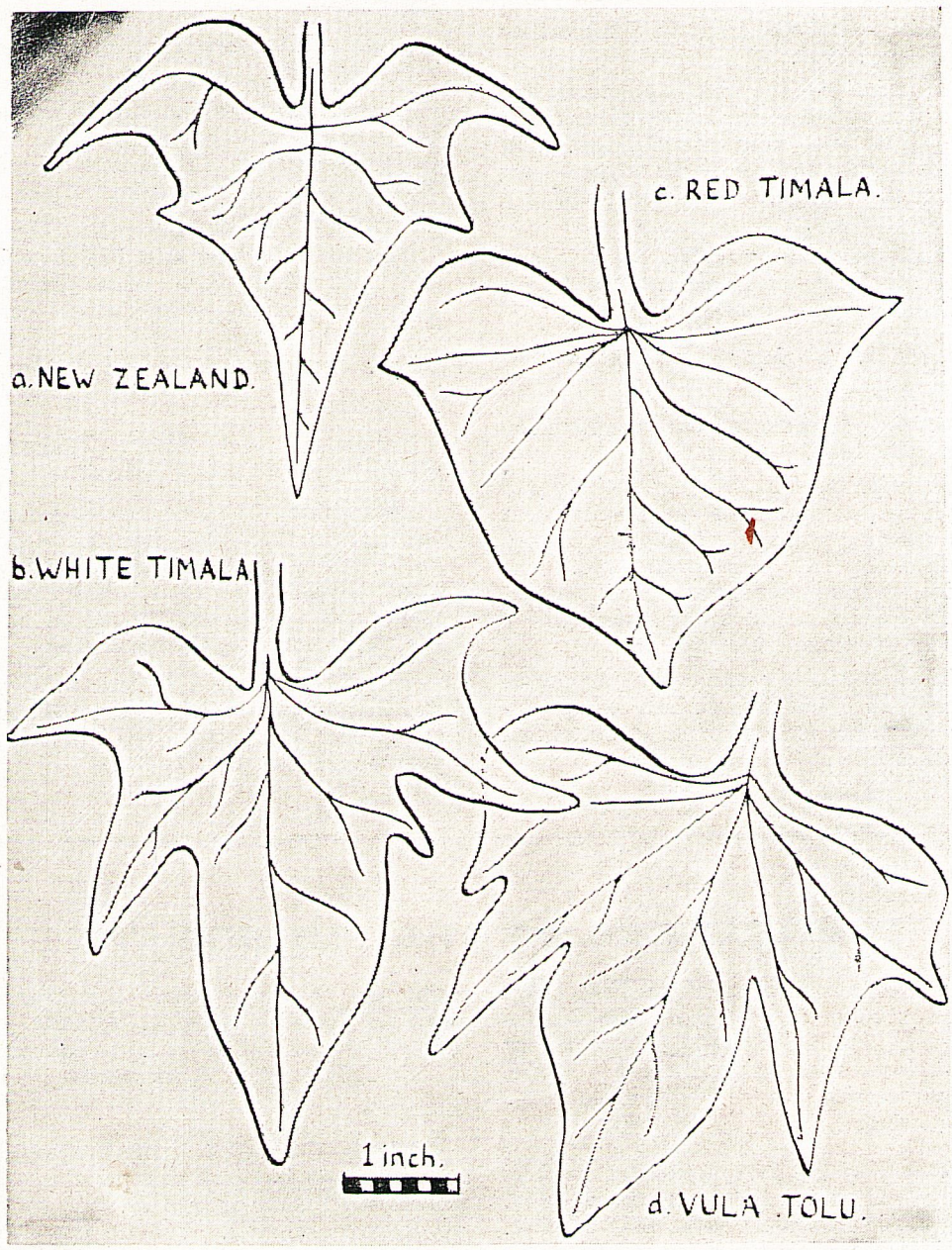

Figure 2

F.D.A. 13608. *Variety :* NEW ZEALAND

Figure 2a—

Origin—Introduced from Funafuti on 10th May, 1952.

Description—The vine is green-red and the petioles are green-red becoming red at the leaf and vine attachments. The veins, on the under surfaces of the leaves, are reddish while, on the upper surfaces, they are green.

The tuber is long with a red skin and white flesh when uncooked. The flesh is pale yellow when cooked.

F.D.A. 14512. *Variety :* RED TIMALA

Figure 2b—

Origin—Introduced from Niue Island on 7th July, 1955.

Description—The vine is entirely red with the exception of the portion near the growing point which is green flecked with red. The petioles are red. The veins, on the under surfaces of the leaves, are red while, on the upper surfaces, they are lightly tinged with red.

The tuber is long and its skin is reddish-pink. The flesh is pinkish when uncooked; the colour of a carrot when cooked.

F.D.A. 14513. *Variety :* WHITE TIMALA

Figure 2c—

Origin—Introduced from Niue Island on 7th July, 1955.

Description—The vine and the petioles are light green. The veins, on the upper and lower surfaces of the leaves, are green. The edges of the young leaves near the growing tips are reddish.

The tuber is long and has a pinkish skin and white flesh when uncooked. The flesh is light yellow when cooked.

Variety : VULA TOLU (Three Months)

Figure 2d—

Origin—A local variety extensively grown by the Fijians and Indians.

Description—The vine is green-red, with more green than red. The petioles are green, becoming reddish at leaf and vine attachments. The veins, on the under surfaces of the leaves, are red while, on the upper surfaces, they are green.

The tuber is round to lozenge shaped and has a light brown, potato coloured, skin. The flesh is cream when uncooked, yellow and firm when cooked.

PUBLICATIONS OF THE FIJI SOCIETY

The Transactions of the Fiji Society cover a wide range of subjects including anthropology, botany, ethnology, geology, history and zoology, with special reference to the research carried out in Fiji and in other Pacific areas.

Volume 5 of the Transactions of the Fiji Society will be available in May, 1959. This volume covers the years 1951 to 1954. Volume 6 of the Transactions will be available later in the year and will bring the publications of the Society up to the end of 1957. Orders are now being received for both volumes. The price per volume is twenty-five shillings (25s.) Fiji currency and this includes postage. (Please note that one pound Fijian (£1.F) is equivalent to two dollars eighty cents ($2.80) (U.S.A. currency).

Volumes 2, 3 and 4 of the Transactions are still available and the price is three pounds three shillings (£3 3s. 0d.) for the set of three volumes. Volume 1 is out of print.

Orders should be addressed to the Hon. Treasurer, Fiji Society, P.O. Box 358, Suva, Fiji.

THE SUVA BOTANICAL GARDENS

BY J. W. PARHAM

The Botanical Gardens were established in 1882 on the site of the old Fijian village of Suva. The history of the gardens up until 1947 has been dealt with in a previous article in this Journal(1) which also listed the species established up until that date, together with brief descriptive notes on each.

The management of the Gardens is the responsibility of the Suva City Council and considerable changes and improvements in the lay-out have been made since 1947. Mr. F. R. Allen, a very capable and energetic gardener, is largely responsible for the Gardens as they are at present while the present City Gardener, Miss M. Cronin, is actively engaged in the maintenance and continued improvement of the Botanical Gardens.

The labelling of the trees in the Gardens has always proved a problem, largely because of the activities of vandals who have, in the past, moved or damaged the labels. Most of the trees have lately been identified again and their positions mapped. The Suva City Council is now making a new set of labels which will be placed in position shortly. It is hoped that less trouble will be experienced with the labels than previously because, apart from the many citizens of Suva who use the Gardens, many tourists now visit them on their way to the Fiji Museum.

The following is a list of many of the plants growing in the gardens at present:

Acalypha hispida—Red Cat's Tail.
Flowers deep red, borne on spikes 9–12 inches long.

Adenanthera pavonina—Red Bead Tree.
A medium sized tree. The pods contain bright red seeds.

Agave americana—Sisal.
An ornamental sisal plant with leaves which have yellow edges and centres.

Albizzia procera—Silver Barked Rain Tree.
A large, handsome tree.

Alpinia nutans—Shell Ginger.
Attractive white, shell-like flowers.

A. purpuratum—Red Ginger.
Large red flowers.

Amomum magnificum—Torch Ginger.
Large banana-like leaves and big red, torch-like flowers.

Arundo donax var. versicolor—Ornamental Reed.
A large reed with white and green striped leaves (see Plate II).

Araucaria bidwillii—Bunya Bunya Pine.
A tall, symmetrical pine tree.

Arenga saccharifera—Sugar Palm.

Artocarpus altilis—Breadfruit; Uto (F.).
A handsome tree with large shiny, green leaves and round edible fruit.

A. integrifolia—Jak Fruit.
A tree with large, rough fruit borne on the stem.

Averrhoa bilimbi—Tree Cucumber.
A shrub with small, cucumber-like fruit borne on the stem.

Bambusa vulgaris—Bamboo.
A handsome bamboo which has golden internodes each with a thin streak of green.

Barringtonia speciosa—Vaturakaraka (F.).
A medium sized tree with shiny green leaves and large pinkish flowers.

Bauhinia purpurea—Pale Purple or Pink Butterfly Tree.
A small tree with large pale purple to pink flowers.

B. variegata var. *candida*—White Butterfly Tree.
A small tree with large white flowers.

Bixa orellana—Annatto.
A large shrub with pink flowers and reddish fruit which open to reveal seeds covered in a bright red pulp.

Brassaia actinophylla—Queensland Umbrella Tree.
A very handsome tree with shiny, compound leaves.

Caesalpinia pulcherrima—Pride of Barbados.
A small shrub with yellow or red flowers.

Calophyllum inophyllum—Dilo (F.).
A medium sized tree with attractive white flowers.

Canarium commune—Java Almond.
A large tree which bears masses of purple fruit.

Caryota mitis—Lesser Fish Tail Palm.
A small palm, many stems in a clump.

Cassia fistula—Golden Shower.
A small tree bearing many sprays of golden flowers. Particularly attractive after a prolonged dry season.

C. grandis—Pink Shower.
A medium sized tree bearing masses of pink flowers.

C. laevigata—
A small tree which bears numerous yellow flowers for most of the year.

Cerbera adollam—Vasa (F.).
A small, coastal tree with white flowers.

Ceiba pentandra—Kapok.
A large tree with branches given off at right angles to the trunk.

Chrysalidocarpus lutescens—Golden Cane Palm.
A very attractive ornamental growing in clumps. The stems are bright orange-yellow.

Cinnamomum camphora—Camphor Tree.

Citharexylum spinosum—Fiddlewood.
A rather brittle tree. The leaves become bright orange coloured before falling at the end of the dry season.

Cocos nucifera—Coconut; Niu (F.).
A tall handsome palm.

C. nucifera—Malayan Dwarf Coconut.
A small coconut palm often with orange nuts.

C. nucifera—Weeping Coconut.
An uncommon palm with drooping pinnae.

Codiaeum variegatum—Croton.
A well known and popular ornamental with brightly coloured leaves. There are many variations of this shrub.

Cordyline terminalis—Dracaena.
Large, often bronze coloured, leaves borne on the apex of a thin stem.

Couroupita guianensis—Cannonball Tree.
A large tree with big, fleshy, scented flowers borne on the trunk. Fruit large and round.

Crescentia cujete—Gourd Tree.
A small tree with large, round fruit.

Cycas rumphii var. *seemannii*—Cycad; Logologo (F.).

Delonix regia—Flamboyante.
A medium sized tree which bears many bright red flowers towards the end of the dry season.

Elaeis guineensis—Oil Palm.
A tall handsome palm when fully grown. The palm oil of commerce is produced from the fruit of this tree.

Elaeocarpus grandis—White Quondong.
A fairly large tree with bright blue fruit.

Erythrina indica—Drala (F.).
A moderate sized tree with red flowers.

Eugenia jambos—Rose Apple.
A moderate sized tree with shiny green leaves and pale yellow fruit.

Galphimia glauca—Shower of Gold.
A small shrub bearing many small, yellow flowers.

Gmelina arborea—Yemane.
A tall tree.

Harpephyllum caffrum—Kaffir Plum.
A medium sized tree.

Hedychium coronarium—White Ginger.
White, strongly scented flowers.

Heliconia bihai—Crab's Claw.
Medium sized, banana-like leaves and large coloured flowers which resemble a crab's claw.

H. metallica—
Large, bronze coloured, banana-like leaves.

Hernandia peltata—Yevuyevu (F.).
A large coastal tree.

Inocarpus edulis—Tahitian Chestnut; Ivi (F.).
A large tree which produces small, strongly scented flowers and a seed which, when cooked, has a flavour resembling the chestnut.

Intsia bijuga—Vesi (F.).
A large tree. Hardwood.

Jacaranda mimosaefolia—Jacaranda.
A handsome tree which, under dry conditions, bears masses of purple flowers.

Lagerstroemia flos-reginae—Pride of India.
A medium sized tree bearing large mauve flowers.

Livistona australis—Australian Fan Palm.
A tall, handsome palm growing to 80 feet or more.

Mangifera indica—Mango.
A big, symmetrical tree bearing a large fruit—popular raw and in chutneys.

Melia azederach—Persian Lilac.
A small tree which bears many sweet scented, lilac coloured flowers.

Metroxylon vitiensis—Fiji Sago Palm; Sogo (F.).

Ochroma lagopus—Balsa.

Oreodoxa oleracea—Cabbage Palm.
A very tall, handsome palm.

O. regia—Royal Palm.
Handsome palms growing round the boundary of the gardens.

Pandanus tectorius—Pandanus; Screw Pine; Vadra (F.).
A common plant, particularly in coastal areas.

Pelagodoxa henryana—Marquesas Palm.
Only one specimen of this very rare palm survives in the Gardens.

Peltophorum inerme—Golden Flamboyante.
A medium sized tree which bears bright yellow flowers.

Persea americana—Avocado Pear.
A small tree which bears edible fruit.

Phoenix dactylifera—Date Palm.
The date palm of commerce.

P. sylvestris—Indian Date Palm.

Pimenta officinalis—Allspice.

Pithecellobium saman—Rain Tree.
A large tree with big, pink tinged flowers.

Plumeria acutifolia—Frangipani.
A small fleshy tree which bears many cream flowers.

Pritchardia pacifica—Fiji Fan Palm.
A tall, very handsome palm with large fan-shaped leaves.

Ravenala madagascariensis—Traveller's Tree.
A fan-shaped tree with leaves resembling the banana (to which family it belongs).

Salix babylonica—Weeping Willow.

Saraca indica—
A small tree with oblong leaves which are white when young. The red flowers are borne in clusters on the branches.

Spathodea campanulata—African Tulip Tree.
A tall, brittle tree which produces many large, bright orange-red, tulip-shaped flowers.

Tabebuia pentaphylla—
A medium sized tree which, after a long dry season, produces masses of large pale pink flowers.

Tamarindus indicus—Tamarind.

Tecoma stans—
A small shrub which produces many small, trumpet-shaped, yellow flowers.

Tectona grandis—Teak.
Large timber tree.

Terminalia arjuna—
Medium to large tree. Not particularly handsome.

Thevetia peruviana—Yellow Oleander.
A shrub with yellow flowers and round, spine covered fruit.

Zizyphus jujuba—Jujube.
A medium sized tree.

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(1) Fiji Agric. Journal Vol. 19, Nos. 3 and 4, 1948, reprinted as Bulletin No. 24, 1949.

A NEW WEED RECORDED

A weed specimen collected from Yalobi on Waya Island in the Yasawa Group during a tour of inspection by officers of the Department of Agriculture has been identified as *Elephantopus spicatus*. This plant is a declared noxious weed in Western Samoa and is common on other islands of the South West Pacific. It is closely related to Tobacco Weed (*Elephantopus mollis*), one of Fiji's serious declared noxious weeds. *E. spicatus* is reputed to be an even more serious weed than Tobacco Weed.

This weed has not been recorded from any other locality in the Colony and it is rather difficult to know how it came to be on Waya Island. It is possible that it may have been established on the island for some time. The plants collected were very stunted and not nearly as robust as those seen in Western Samoa.

A survey is to be made to discover the extent of the infested area and it is hoped that it will prove possible to eradicate existing infestations.

Specimens of plants which any reader suspects are weeds or potential weeds should be sent to the Botany Laboratory for identification.

J.W.P.

LIST OF PLANT INTRODUCTIONS 1956-1958

A list of the plants introduced by the Fiji Department of Agriculture between 1st January, 1956 and 31st December, 1958 is to be issued shortly. In future a list will be prepared at the end of each year.

The policy of the Department of Agriculture regarding initial observations on plant introductions has been modified during the three years under review. New introductions, in cases where quarantine is not considered necessary, are now sent to the Agricultural Station which appears to be most suitably placed for the particular plant. This has been brought about principally as a result of a new agreement between the Fiji Government and the South Pacific Commission. The Plant Introduction and Quarantine Station at Naduruloulou is now largely concerned with the propagation of cocoa for distribution within the Colony and with certain introductions in which the South Pacific Commission have a particular interest and towards the maintenance of which they make an annual contribution. Naduruloulou is also regarded as the quarantine station and all doubtful material is sent there for the required period before being released for trial.

The South Pacific Commission's contribution is specifically for the observation and maintenance of introductions of coffee, pepper, taro, bamboos and certain forage and pasture plants at Naduruloulou. The Department works in close co-operation with the Commission's Plant Introduction Officer, who pays regular visits to the Colony. A " Memorandum of Understanding " between the Commission and the Fiji Government is drawn up at the beginning of each year.

The Botanist of the Fiji Department of Agriculture is responsible for the introduction of plant material from overseas and for the maintenance of all the records of observations and trials once they have been completed.

J.W.P.

PEST CONTROL . . .

CONTROL OF LAND CRABS ("LAIRO TUI") IN FIJI

BY G. F. BURNETT, OFFICER-IN-CHARGE, FILARIASIS CONTROL, MEDICAL DEPARTMENT

The large land crab or "Lairo tui" (*Cardisoma carnifex*) is not only a garden pest but its holes provide breeding places for the mosquito *Aedes polynesiensis*, a nuisance and a carrier of the disease filariasis. The control of the crab is therefore of importance. Fumigation with carbon disulphide is often recommended but is very expensive. Of baits, one made of 2½ per cent DDT or Dieldrin in bran was found in Bermuda to give almost hundred percent control.(1) This bait has been taken as a model and a number of variations on it have been tried; a bait made from 5 per cent BHC in rice bran has been found most satisfactory. A number of other compounds have been matched against this, being used at such concentrations that the bait is of equal cost to 5 per cent. BHC.

PRELIMINARY TESTS

Preliminary tests showed that rice bran is as effective as coconut meal as a bait and it is much cheaper, keeps better and mixes more readily with the insecticide. It was also found that unbaited crabs might spend a week without coming to the surface, while poisoned ones might be nearly three weeks recovering. During dry spells activity is much less than when rain falls frequently. All early tests which were followed for less than three weeks had to be discarded and the results given below (Table 1) show how misleading a short period of observation can be.

PROCEDURE

The standard type of bait was made by mixing the correct amount of insecticide powder with the dry bran—e.g. for the 5 per cent BHC bait, one pound of BHC 50 per cent wettable powder was added to 10 lb. dry rice bran. Just before use, this was wetted with sea water until it bound. A piled teaspoonful of the bait was placed at the mouth of each crab hole and after two or more days the latter was closed. As far as possible the holes were visited on the succeeding days and open ones marked with coloured pegs. For up to seven days after baiting the holes were reclosed but after that newly opened holes were left. At the end of the experiment, which was followed for at least three weeks unless it was an obvious failure, the total number of holes opened since the seventh day was taken as the total number of crabs surviving. Care was taken to bait only holes known to contain live and active crabs.

RESULTS

The results of all the main experiments are given in Table 1. Neither DDT nor Dieldrin at 2½ per cent approaches complete control. The relative cost of BHC, DDT and Dieldrin wettable powders are about 1:2½:12 and so BHC at 5 per cent is not only more effective than the other two insecticides at similar concentrations, but cheaper. It will be noted that two trials each were done with DDT at 5 per cent and BHC at 5 per cent. These were done in pairs, one each during a period with long dry spells when the ground became hard (10 and 11) and one each during a period of continuous rain (13 and 14). It will be seen that in wet weather DDT appears less effective than when dryness reduces the activity of the crabs, while BHC appears equally effective in wet and dry conditions.

Of the other treatments, BHC at 10 per cent, while costing nearly 50 per cent more than the 5 per cent mixture, is not much more effective. Lindane is the highly refined active part of the crude BHC, which is a coarse and irritating product (to mammals at least) and it was thought that crabs might eat lindane more readily than crude BHC for this reason. One half

per cent is about equivalent in strength to 5 per cent BHC and why it would be less effective is puzzling. The most likely explanation is the difficulty in mixing so little insecticide evenly in 200 times its weight of bran. The same difficulty was expected with aldrin at half per cent but either mixing was more thorough or this chemical is more toxic to these crabs. Malathion was tried as a safe representative of the organophorus insecticides and pentachlorophenol has shown promise as a contact insecticide for crabs. Both failed as baits.

CONCLUSIONS

It is unlikely that one can hope for a complete kill if only because the crabs have to co-operate in their own destruction—if a crab is inactive when the bait is put down this may be dry and unattractive when the crab finds it. (On the other hand it is fairly certain that when dry baits are wetted by rain, crabs will feed on them afresh). Some baits may be buried by actively digging crabs. For these reasons it is not thought worth while to increase the concentration of BHC in the bait over 5 per cent, the extra cost not being matched by increased effectiveness. Aldrin, at ½ per cent, shows promise of being somewhat better and, if available, is to be recommended. DDT and dieldrin are not recommended for baiting Lairo tui.

RECOMMENDED BAIT

Rice bran 10 lb.
50 per cent BHC wettable powder 1 lb.
or 50 per cent aldrin wettable powder 1½ oz.
Sea water enough to bind.
This will treat about 700 crab holes, and costs about ·03d. per crab.

ACKNOWLEDGEMENTS

I am grateful to Mr. G. B. Gregory for drawing my attention to the Bermuda recipe and to Mr. H. H. Whiteside and Miss M. Cronin for permitting me to use the Gaol vegetable garden and the Botanical Gardens respectively for the experiments.

REFERENCE

1. Annual Report of Committee for Colonial Agriculture, Animal Health and Forestry Research for 1956/57. Control of Land Crabs, (*Geocarcinus lateralis*).

TABLE I

PERCENTAGE KILL OF LAND CRABS OBTAINED BY VARIOUS CHEMICALS USED AT DIFFERENT CONCENTRATIONS IN RICE BRAN BAITS

Insecticide	DDT			Dieldrin	BHC				Lindane	Aldrin	Malathion	Pentachloro-phenol
Experiment No.	20	10	13	15	21	11	14	12	22	18	16	17
Concentration per cent ..	2½	5	5	2½	2½	5	5	10	0·5	0·5	0·5	0·6
Number crabs baited	103	123	87	88	73	86	80	99	68	103	86	84
Apparent kill in first week ..	84	98	100	86	93	99	100	100	100	97	52	42
True final kill	50	84	68	43	82	93	93	96	86	96	....	....

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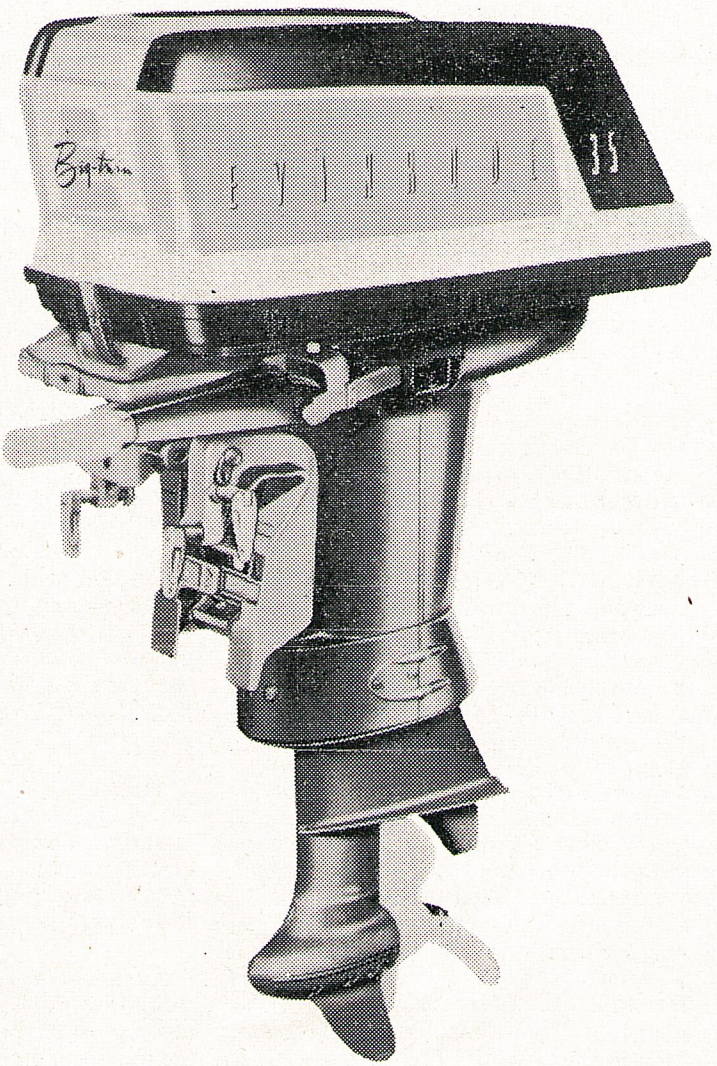

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MEETING OF THE RHINOCEROS BEETLE TECHNICAL ADVISORY COMMITTEE OF THE SOUTH PACIFIC COMMISSION

This Committee, which has been in existence for several years, normally conducts its business by correspondence. Its first meeting was held in Suva from 16th to 20th February, 1959.

The function of the Committee is to advise the South Pacific Commission on the conduct of research into methods of control of the Coconut Rhinoceros Beetle, *Oryctes rhinoceros* L. within the Commission's area. The Commission considered that a stage had been reached in its research programme where past work should be evaluated and a framework for future research should be laid down. Hence it convened the meeting of the Committee at Suva.

The meeting was attended by representatives of the South Pacific Commission, and by Committee members and invited specialists from the following countries:— Papua-New Guinea, New Zealand, Fiji, Hawaii, U.S.A., Tonga and the U.S. Trust Territory of the Pacific Islands. Netherlands New Guinea was unable to send a delegate, and Committee members from French Oceania and Eastern and Western Samoa unfortunately were prevented from attending because of the dislocation of aircraft schedules due to inclement weather.

Discussions at the meeting proved to be interesting and fruitful. Dr. Paul Surany, a research officer of the Commission who is studying the diseases of *Oryctes* spp., gave a most informative illustrated talk on his work in South-East Asia and the African region. He considers that diseases play a very important part in the control of *Oryctes* spp. in these areas. The more important are the so-called "blue" and "histolytic" diseases. The pathogens are unknown, but appear to be of a virus nature. The next step in Dr. Surany's research will be to identify the pathogens and their methods of transmission.

Biological control of *Oryctes* by insect parasites and predators was discussed at some length. Mr. R. P. Owen, of the U.S. Trust Territory of the Pacific Islands, showed a film dealing, among other things, with the breeding of the parasitic wasp, *Scolia ruficornis*. This is well established in the Palau Islands, where about half of the existing coconut palms in the infested islands had been killed by Rhinoceros Beetle, and is considered to be exercising a significant measure of control of the pest.

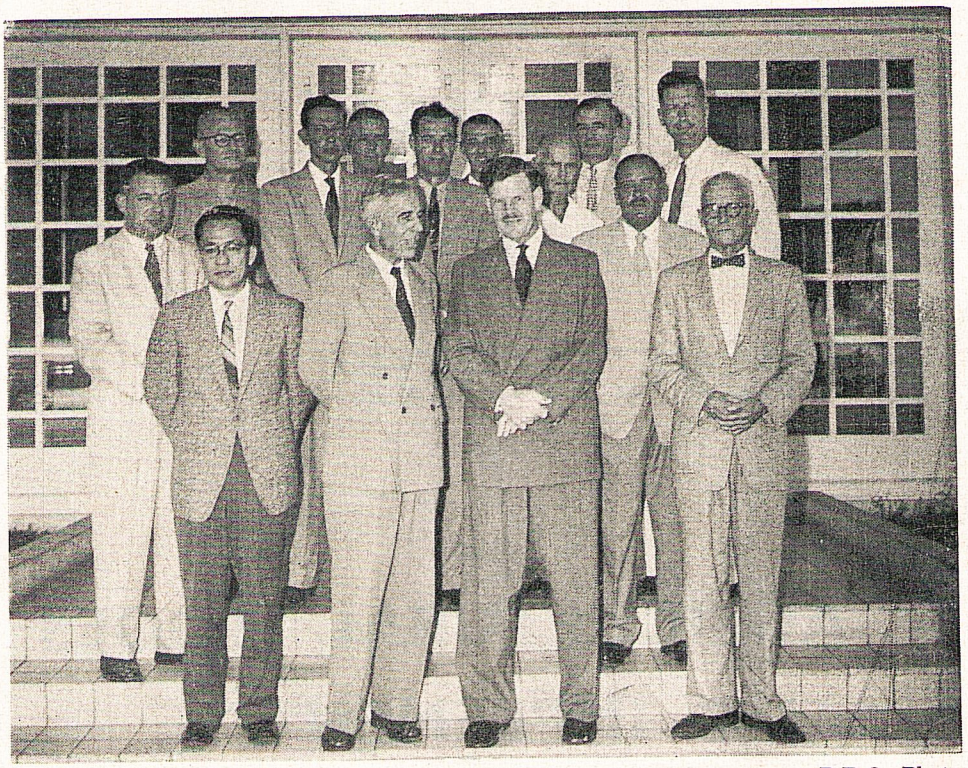
Consideration was given to other species of parasites and predators, and to the work which is being done on behalf of the Commission in Madagascar. It was considered that the search for and importation of parasites and predators should be greatly accelerated.

Among other subjects of discussion were crown-treatment of coconut palms with an insecticidal mixture, control of *Oryctes* in the vicinity of ports, and the influence of vegetation on breeding and damage done by the Rhinoceros Beetle.

A series of recommendations has been submitted for consideration by the Commissioners at the next session of the South Pacific Commission.

B. A. O'C.

OPENING OF THE RHINOCEROS BEETLE TECHNICAL ADVISORY COMMITTEE



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Front Row (L. to R.) Dr. Y. Tanada, Univ. of California; Dr. A. H. J. Kroon, Executive Officer for Economic Development, S.P.C.; Hon. P. D. Macdonald, C.M.G., Colonial Secretary, Fiji ; Dr. C. E. Pemberton, Hawaii.

Back Row (L. to R.) Dr. Paul Surany, S.P.C.; Mr. B. A. O'Connor, Sen. Entomologist, Fiji ; Dr. C. P. Hoyt, S.P.C.; Mr. L. J. Dumbleton, D.S.I.R., New Zealand ; Mr. R. P. Owen, Caroline Islands ; Mr. R. Cowell, 2nd U.K. Commissioner, S.P.C. ; Mr. H. W. Simmonds, O.B.E., Fiji ; Mr. J. M. Watson, O.B.E., Director of Agriculture, Fiji ; Mr. G. S. Dun, Terr. of Papua and New Guinea ; Mr. N. L. H. Kraus, Hawaii.

LAND UTILIZATION . . .

WATERSHED AND RANGELAND MANAGEMENT TRIALS ON THE BA CLOSED AREA

BY J. W. PARHAM, C. E. WHITEHEAD AND I. T. TWYFORD

In February, 1956, *the Land Conservation Board issued an Order under section* 8 *of the Land Conservation and Improvement Ordinance prohibiting the occupation and cultivation of land, the depasturing of cattle, and the cutting and destruction of vegetation within a defined area in the Ba Province. This, the Ba Closed Area, containing some* 44,000 *acres of land, stretches from the Ba river in the East to the Teidamu river in the West, and from the Southern boundaries of Teidamu, Tauarau, and Ravi Ravi freeholds in the North, to Varaciva Creek in the South.*

The area was originally used for cane growing to a limited extent and was illegally grazed by very large numbers of cattle, but bad farm management and poor soils, coupled with uncontrolled stocking, and in particular, repeated burning, have caused the land to erode severely. It was eventually decided to close the area to agriculture in 1956, and to try to rehabilitate it for a form of land use more suited to the properties of the types of soil on the area.

The soils are in general very poor latosols, i.e., soils of low, very low, and extremely low base status so that rehabilitation is not an easy matter. The optimum use for this type of land would appear to be forestry on the moderately steep slopes and stock on the strongly rolling and rolling slopes. There are only limited areas of flat.

EXPERIMENTAL PROGRAMME

It is necessary in the first instance to devise a rapid means of halting the continuing erosion and degeneration of the closed area. It has been suggested that aerial top-dressing to build up the natural vegetation should be employed to effect this and the experiments have been designed with this suggestion in mind.

The primary objects of the trials are:—

(1) To determine the most economic means of clothing the Ba Closed Area with vegetation to prevent further erosion and thus to halt the silting of the Ba river from this source.

(2) To determine whether an economic stock raising proposition could be developed in the Ba Closed Area.

(3) To determine the effect of burning on the present vegetation of Mission grass on easily degradable soils.

The experiments briefly described below are designed to show (*a*) how quickly natural regeneration of badly eroded areas can halt erosion; (*b*) whether this can be aided economically by the use of fertilizers; (*c*) whether it can be aided economically by improving the vegetation; (*d*) whether as a result of (*a*), (*b*) and (*c*) live-stock could be profitably raised under proper management without causing pasture or land degeneration; (*e*) whether burning need be incorporated into pasture management.

It is considered that information collected on the project will have a far wider application than merely to the Ba Closed Area. It can serve as a guide for pasture treatment of many dry zone hill lands, particularly the "talasiga" lands, in the Colony, and should be complementary to the work of the District Agricultural Station at Seaqaqa in Vanua Levu in trying to devise a grass-arable small holders' rotation for the gently sloping lands.

RESULTS TO DATE

So far burning and stocking have been brought under control. An initial experiment on the four main soil types, designed to ascertain (*a*) the natural regeneration rate; (*b*) the effect of three levels (none, low, high) of a mixed NPK fertilizer on the natural regeneration, was started in September, 1957. The fertilizer mixture was chosen as a result of soil analysis.

The first vegetation survey of these plots by which regeneration was to be measured was made in July, 1957, before the application of the fertilizer. The fertilizer was applied in October and a second reading was made in December, 1957, at the end of a long, dry season and before any rain had fallen. This almost certainly explained the drop that was recorded in percentage incidence of most species in nearly all the plots. A third reading (May, 1958) was carried out after a period of heavy rain and increased cover was recorded on all plots. This was undoubtedly due to the rain and, of course, on the fertilized plots, to the fertilizer. Generally speaking only small increases were noted in the percentage cover of the unfertilized plots but there was a marked difference between unfertilized plots and those fertilized at a low rate of application on which a tall and thick vegetation of grasses, shrubs and ferns appeared. The difference between low and high rates of application was noticeable but not so marked. It thus appears that even a moderate increase in the plant nutrient content of the soil greatly increases the amount of vegetation it can grow.

A fourth survey of the plots was carried out in October, 1958, and on this occasion samples were taken from each plot for drying and weighing, as it is hoped that this will enable an estimate of the " vertical " cover to be made. The vegetation on all the plots showed little change from that of the end of the previous wet season even though drought conditions had prevailed between May and October. A notable increase in the amount of Mission grass on nearly all the fertilized plots leads to the tentative conclusion that this grass might be a feature of the vegetation of the area after rehabilitation by fertilizers, and so its possible value as a pasture grass should not be neglected.

FUTURE WORK

It is proposed, during 1959 and 1960, to increase the number of experiments being carried out. The current trials will be continued for a number of years and in addition it is intended to initiate trials on the establishment of improved pasture grasses, trials to determine the effect of the conservation of organic matter on pasture establishment and a trial to determine the effect of burning on vegetation and soil. All these trials will be carried out in the Ba Closed Area near the new Ba Waterworks, on Bua clay.

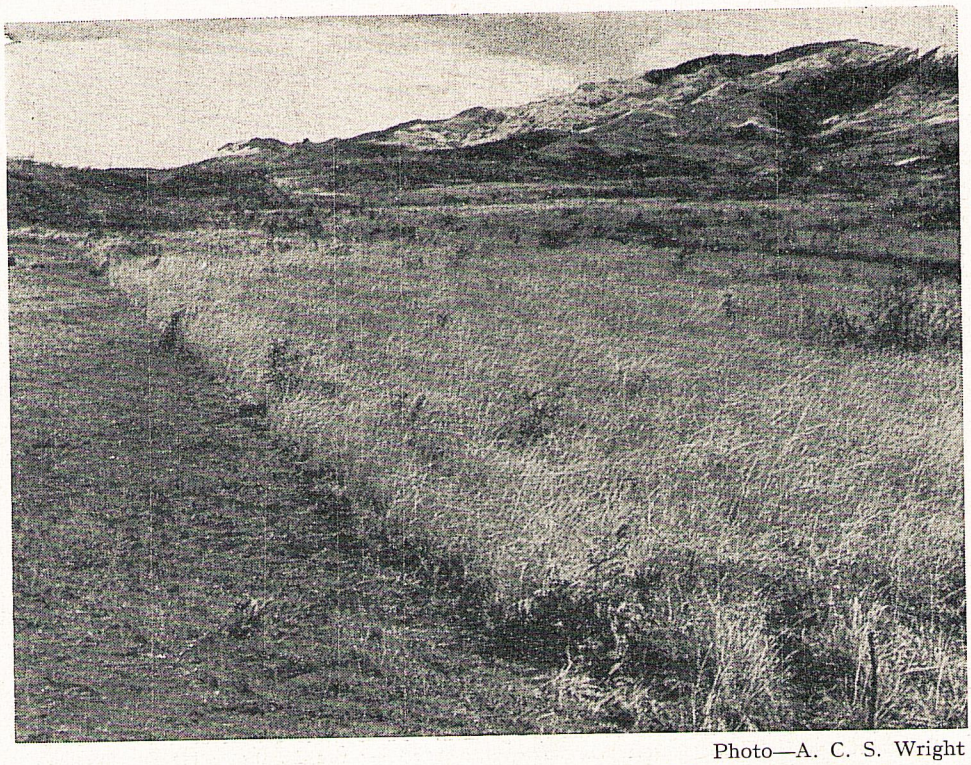
In 1959 the establishment of pasture grass trials will be commenced using two methods of establishment and two levels of fertilizer (none and the low level of the previously used NPK mixture). Attempts will be made, in the first instance, to establish pastures of Nadi Blue grass (*Dichanthium caricosum*) and Centro (*Centrosema pubescens*), Batiki Blue grass (*Ischaemum aristatum*) and Centro, and Mission grass (*Pennisetum polystachyon*) and Centro. The second experiment to be started in 1959 will be one to determine the effect of burning on vegetation and soil. The layout of this experiment has been submitted to the East African Agricultural and Forestry Research Organization, who have wide experience in this type of trial, and it will not begin until the Organization's comments have been received.

The trials to determine the effect of the conservation of organic matter on pasture establishment will be commenced in 1960, after the establishment of pasture trial results have become available, if these offer no clue as to how to produce an improved pasture on these soils.

CONCLUSION

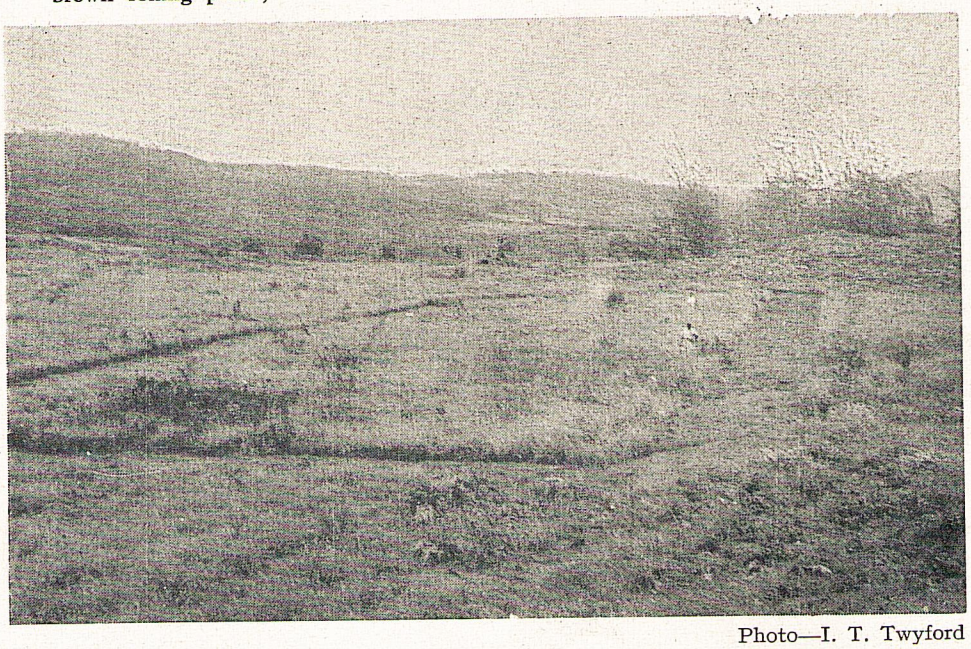
The Ba Closed Area is a large acreage of problem soils typical of a much larger area of range land in Fiji. Rehabilitation is not likely to be easy and it will probably take a long time to discover an economic way of doing it. The experiments described above are all only preliminary, and even if all give good results, rehabilitation will still be a long way off. The optimum rates of seeding and fertilizing, for example, will not be known, nor how much, if any, stocking may be allowed. Nevertheless, it is hoped to gain at least a good idea of the approach in converting " talasiga " land to stock country from the present and proposed experiments, and results are already being recorded.

With the areas available for new agricultural production gradually becoming smaller and poorer, it is felt that more and more attention will have to be paid to developing a form of land use and developing soils to fit it, even though it means that the Department of Agriculture will have to engage in research work over much longer periods than of late.



Photo—A. C. S. Wright

Figure 1. Three of the plots (control, low and high rates of fertilizer) on Ba clay, pale brown rolling phase, over the Teidamu River before the application of fertilizer



Photo—I. T. Twyford

Figure 2. The same plots as in Fig. 1 a year after the application of fertilizer. The plot with the high rate of application is closest to the camera and the control plot is at the far end. There has been approximately a 10 per cent increase in ground cover on the fertilized plots

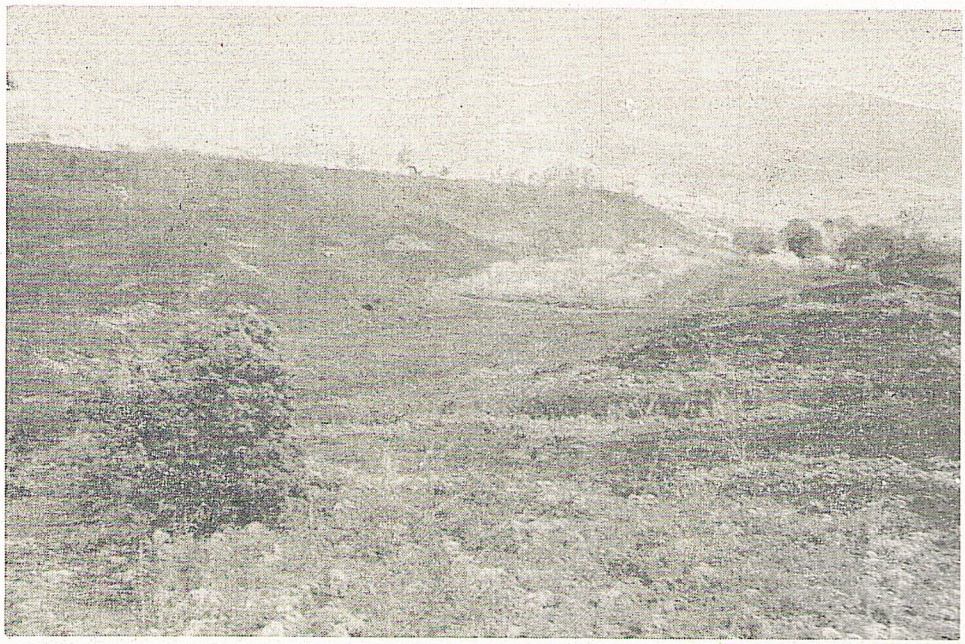


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Figure 3. A photograph taken from the control plot looking towards the fertilized plots on Namosau Colluvium. Note the considerable increase in Mission grass on the fertilized plots as compared with the plot in the foreground. These plots are in an area which was burnt in the 1958 dry season and were only saved by the 12 foot wide fire breaks

Photo—J. W. Parham

Figure 4. Three of the plots on Varaciva steepland gritty loam, unfertilized plot on the left, fertilized plots (low and high rates) on the right. Note the presence of Mission grass and the improved cover on the fertilized plots

Photo : J. W. Parham

Figure 5. A close-up of the boundary between the unfertilized and fertilized plots shown in Figure 4, showing a thick Mission grass cover on the fertilized plots as against a poor cover of stunted bracken and bare ground

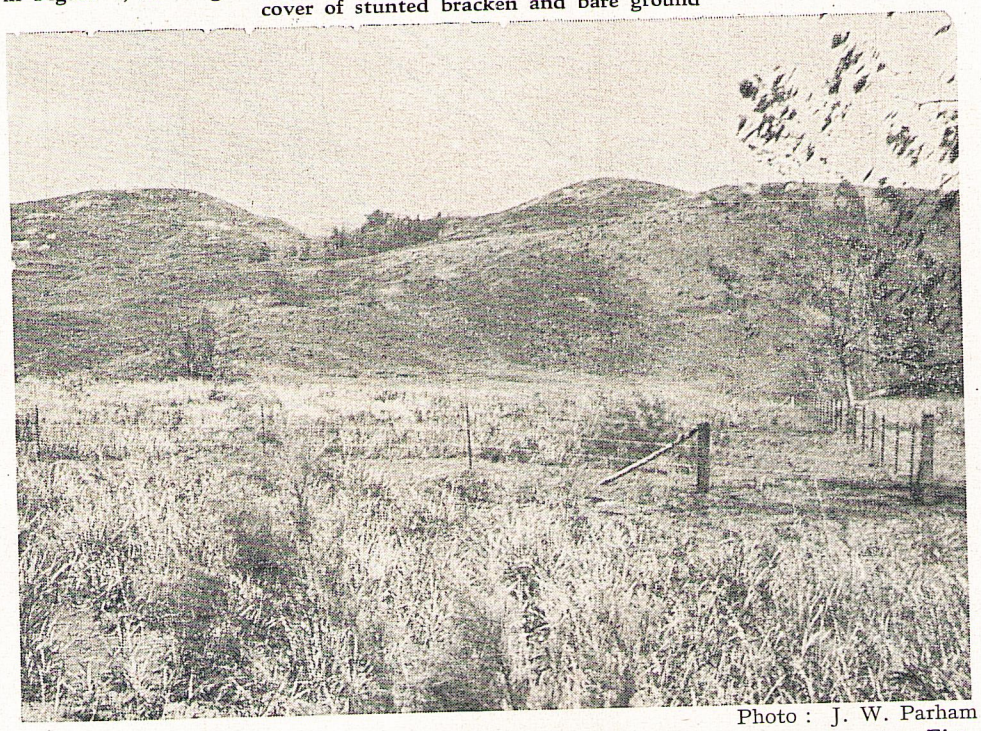

Photo : J. W. Parham

Figure 6. A general view of the plots on Bua clay laid out for future experiments. Fire-breaks have been built round the plots and a fence constructed to keep stray cattle off them

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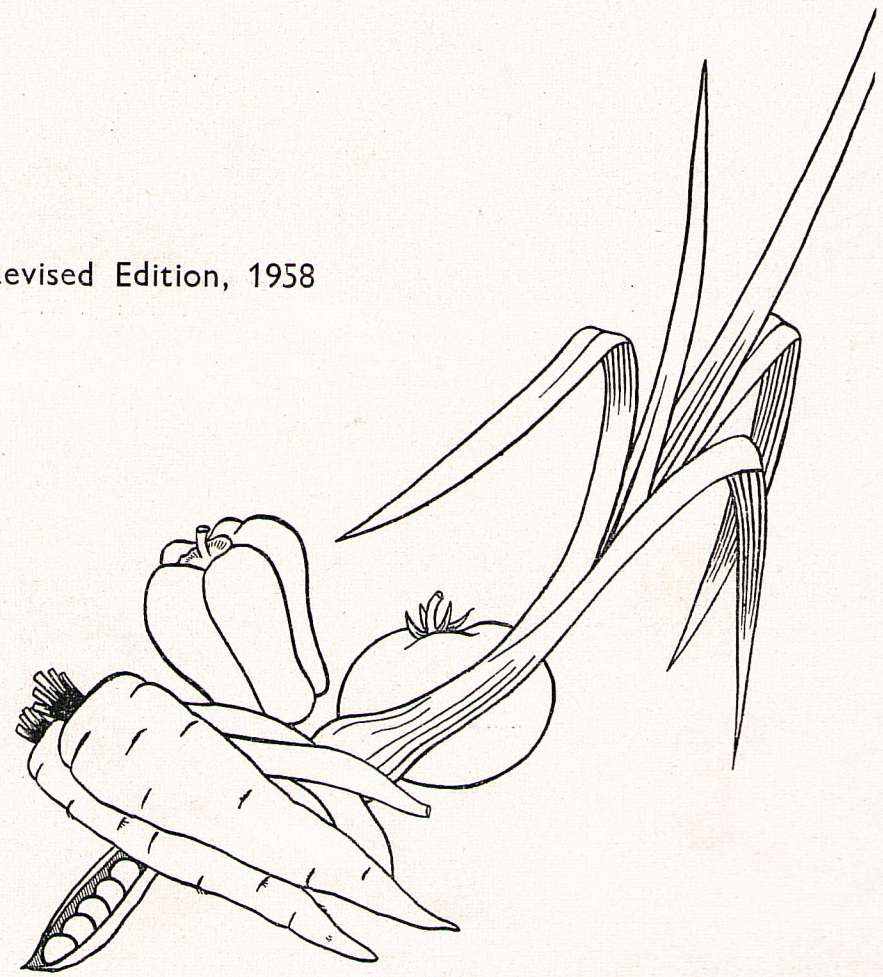

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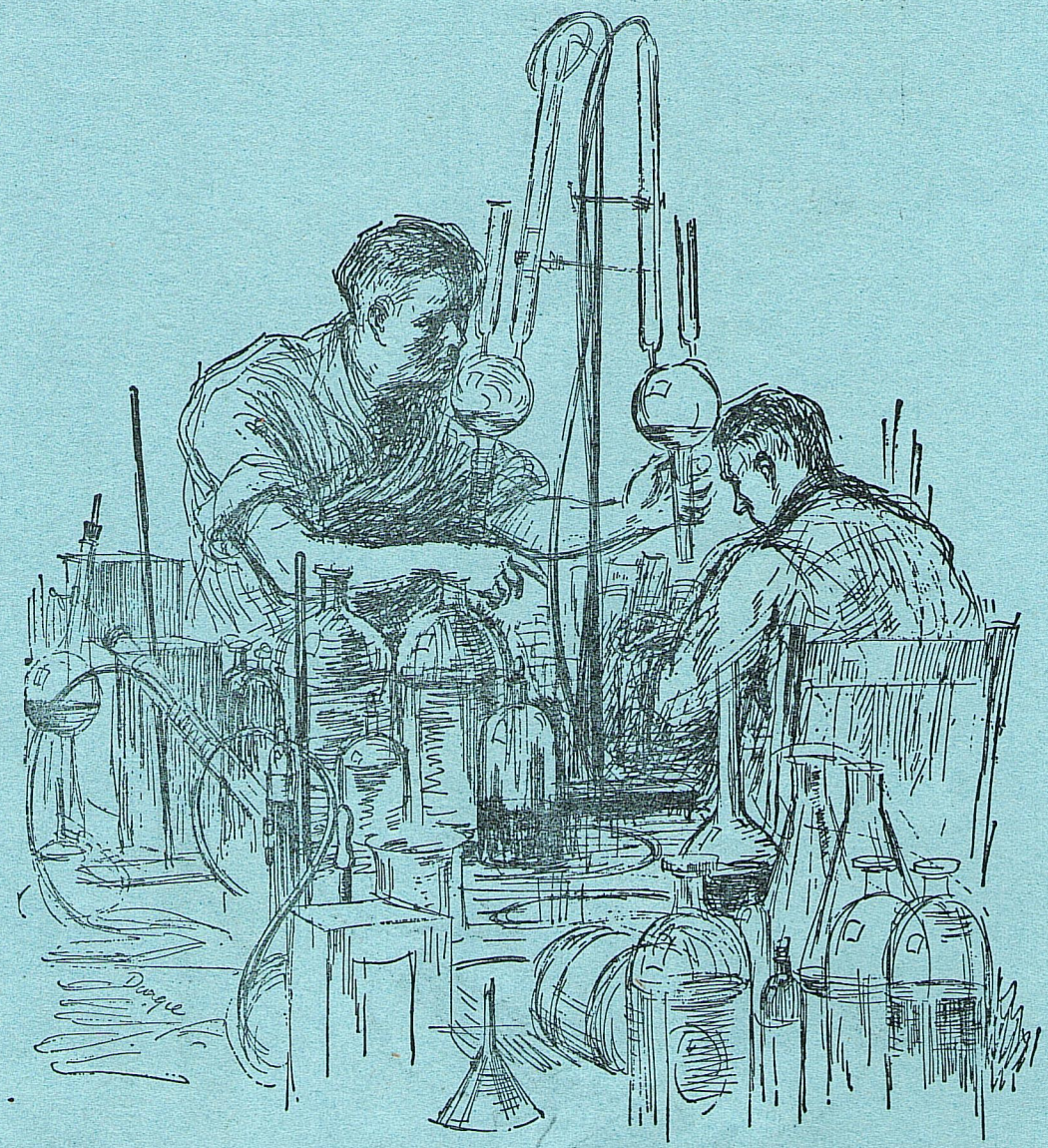

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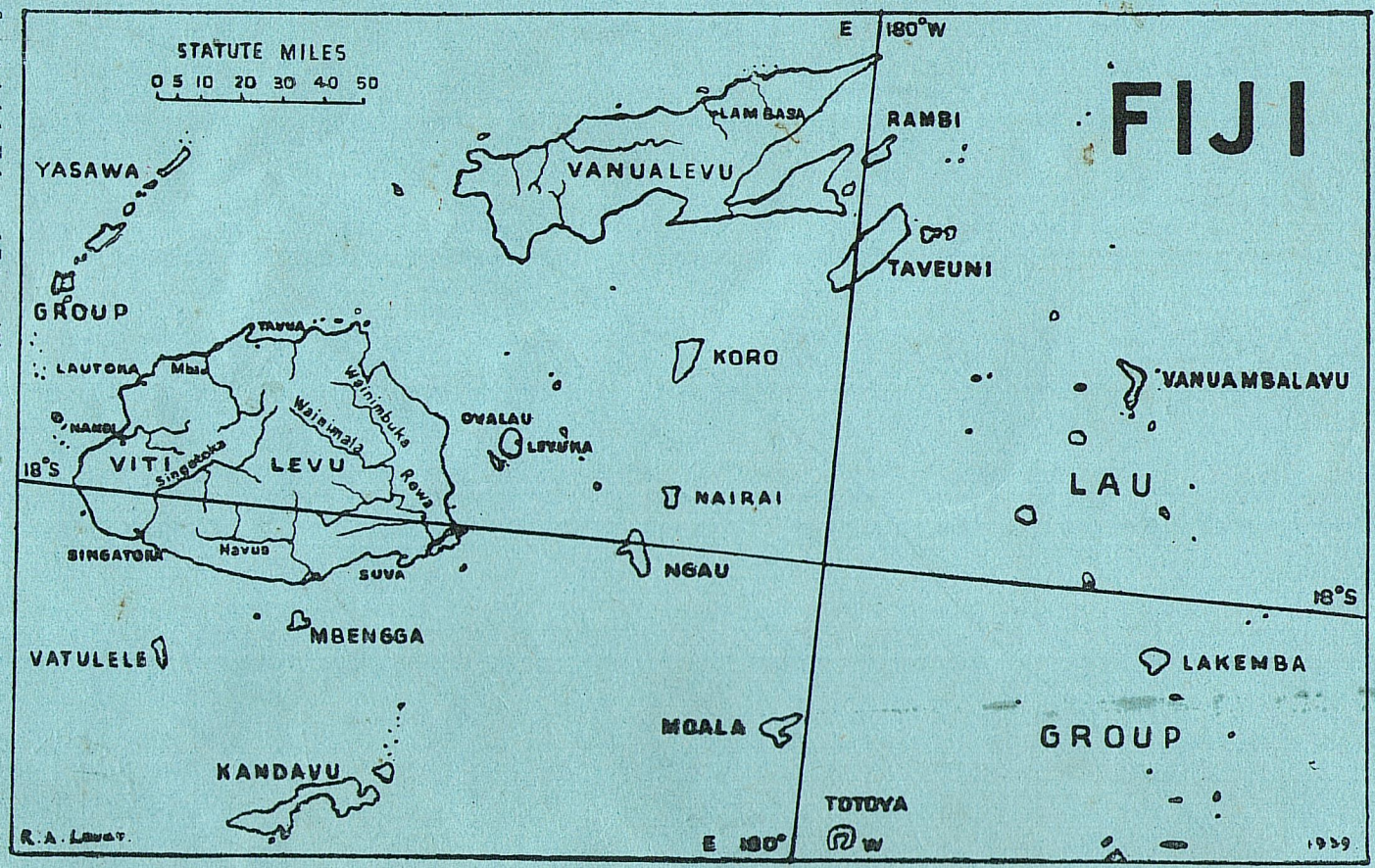

So as to include Kadavu and Totoya within the framework available the map has been rotated some 6° to the east.