harvest

THIRD QUARTER

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Cover Photo—

The Superb Bird of Paradise

(Photo: W. S. Peckover)

Department of Agriculture, Stock and Fisheries,
Konedobu
Papua New Guinea

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Trade Names

To simplify the information given, it is sometimes necessary to use trade names of products or equipment. No preferential endorsement of named products is intended, nor is criticism implied of similar products not mentioned.

Department of Agriculture, Stock and Fisheries,
Konedobu,
Papua New Guinea.

Birds of Paradise—Are They in Danger?

M. C. DOWNES, Officer-in-Charge, Wildlife Section

Did you recognize the bird on the cover as a bird of paradise? There are 32 different species of birds of paradise and they don't all look like Papua New Guinea's national emblem. Most people think of the Raggiana bird of paradise, with the brilliant red plumes, as "The bird of paradise". Although killed in great numbers to provide head-dresses for singsings, this species is not in danger of extinction in the immediate future because of a widespread distribution in sparsely populated areas.

However in all areas where economic development is taking place, most species of birds of paradise are in danger of being so greatly reduced in numbers that eventually they will no longer be a feature of the lives and customs of the people.

It is no coincidence that Papua New Guinea's national emblem is a bird of paradise. The birds belong to the country as much as the people do. And from earliest times the people have used the birds' plumes—from rare species as well as common species—in traditional ceremonies.

But now population growth and economic development are threatening the birds. More bushland is being cleared for subsistence agriculture and cash cropping; large areas of land are being cleared by logging companies. This means economic development for the people, but for the birds it means eviction from their homes. When you look around, there still seems to be plenty of forest, and the birds only have to move. But quite apart from the fact that economic progress in some places is reaching the stage where there is no other suitable home for the birds to fly to, most forest is already holding as many birds as it can carry. It must be remembered that the forest provides food for the birds as well as shelter, and there is therefore a limit to the number of birds that an area of forest can support.

When a man buys a shotgun he feels he is making progress. Although it would be illegal if he used his gun to shoot birds of paradise, this cannot always be stopped. Birds of paradise live in lonely places, a long way from a Police Station, and it is difficult to enforce the law. In another way, the coming of government pacification has added to the slaughter of the birds. In the days when government patrols were unknown, a man could shoot birds of paradise (with his bow and arrows) in his own tribal area. But he did not dare go beyond it. Now he can, with confidence, go much further afield. The man is safer but the birds are not, because the hunters and plume traders are killing birds in *every* area.

No Papua New Guinean would want to see the birds killed in such quantities that they died out completely. Yet this has already happened in certain areas.

Unless we plan now to save the birds, more and more will disappear as the land is developed. In 20 years' time there could be very few live birds of paradise. The few traditional plumes we will have left in the museums will be a sorry reminder of the glorious birds that used to be.

Some of the species which require special attention are:—

Lophorina superba—the Superb bird of paradise. This is the bird illustrated on the cover. Although fairly widespread at altitudes of 3,200 to 7,300 ft for the full length of the central mountain range, this bird is heavily used for head decorations. The plumes which appear blue in the photo are actually iridescent and vary in appearance as the angle of the light falling on them changes.

Paradisaea rudolphi—the Blue bird of paradise—lives along the central mountain range but only within narrow altitude limits (4,500 to 6,300 ft). It has a black head and brilliant blue wings and tail.

Epimachus fastosus—the Black Sicklebill bird of paradise—lives in the Highlands region at altitudes of 4,200 to 7,700 ft. It has long black tail feathers, up to 24 in long which are greatly prized for head-dress decoration.

Pteridophora alberti—the King of Saxony bird of paradise. The species may be found right along the central mountain range in both

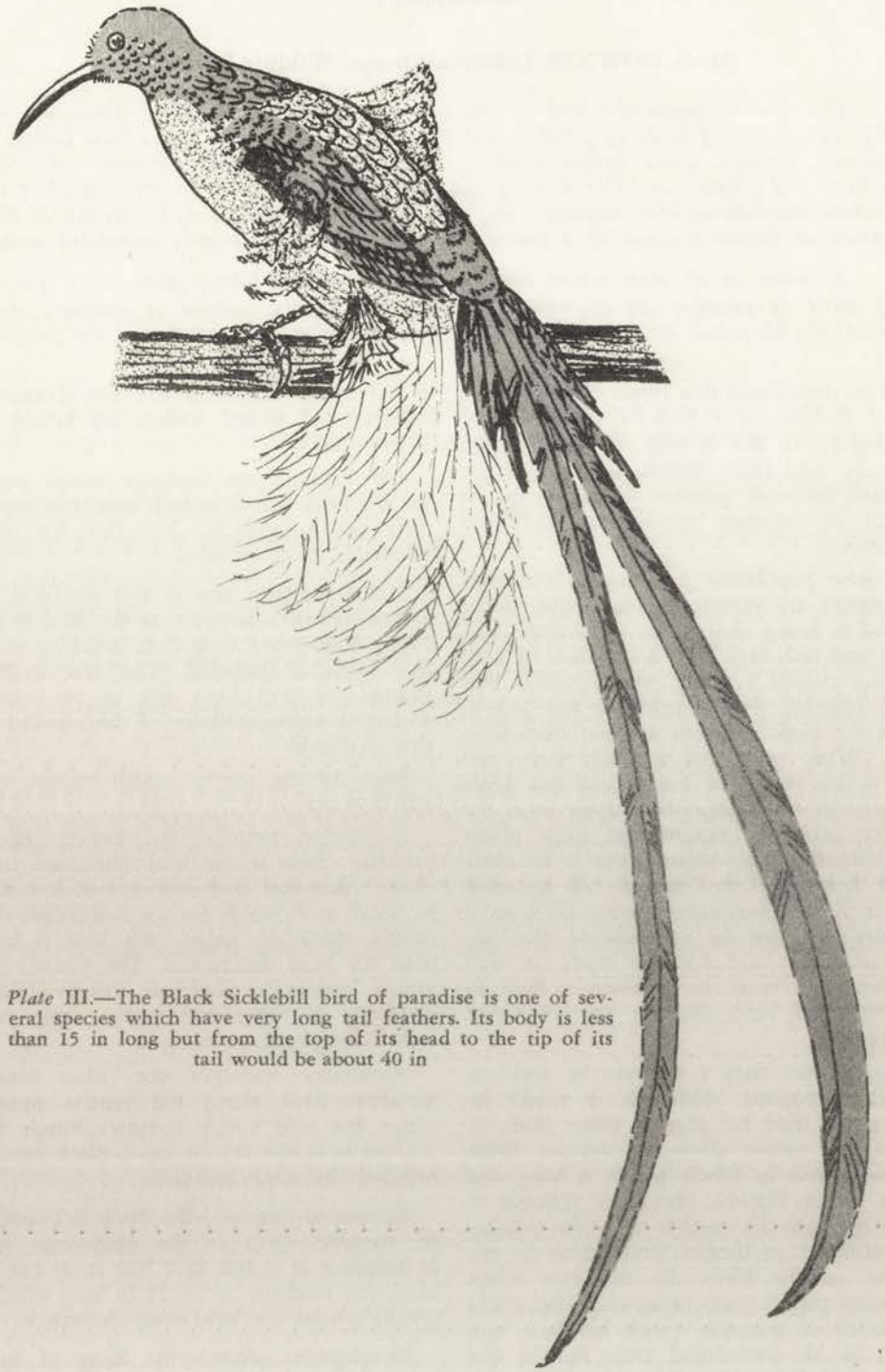


Plate III.—The Black Sicklebill bird of paradise is one of several species which have very long tail feathers. Its body is less than 15 in long but from the top of its head to the tip of its tail would be about 40 in

Plate I.—The King of Saxony bird of paradise. These line drawings indicate the great variety in appearance of birds of paradise. This bird is about 10 in from head to tail, but the head feathers are twice this length

Papua New Guinea and West Irian at altitudes of 4,800 to 8,900 ft. It is unique in the long enamelled feathers of the male. These are popular for nose decorations by the Wahgi people. This bird was featured on the 5 cent stamp issued in May, 1970.

Astrapia rothschildi and *Parotia wahnesi* are both limited to a very small area north of Lae, on the Huon Peninsula, and could easily be shot out.

Paradisaea decora—Goldie's bird of paradise—is found only on Fergusson and Normanby Islands, off the south-eastern tip of Papua. Because of the small numbers of birds confined to a very limited area, any increase in hunting activity will have a serious effect on the bird population.

PLANS TO SAVE THE BIRDS

In August, 1971, the Administrator's Executive Council approved plans for a National Project to save the birds of paradise against the threats of increasing shotguns, cutting of special forest habitat and uncontrolled slaughter for commercial sale of plumes.

Special effort will be made to enforce the law, thus preserving the traditional right of the people to use plumes in ceremonies and for cultural purposes, to hunt birds of paradise using traditional weapons, not shotguns, and to exchange plumes for native customary considerations, not money.

In September, 1971 a joint application was made to the World Wildlife Fund in Switzerland for a grant of $78,000 representing approximately 40 per cent of the total cost of a 3-year programme. The application has been approved by the World Wildlife Fund, which is now seeking the funds by public subscription.

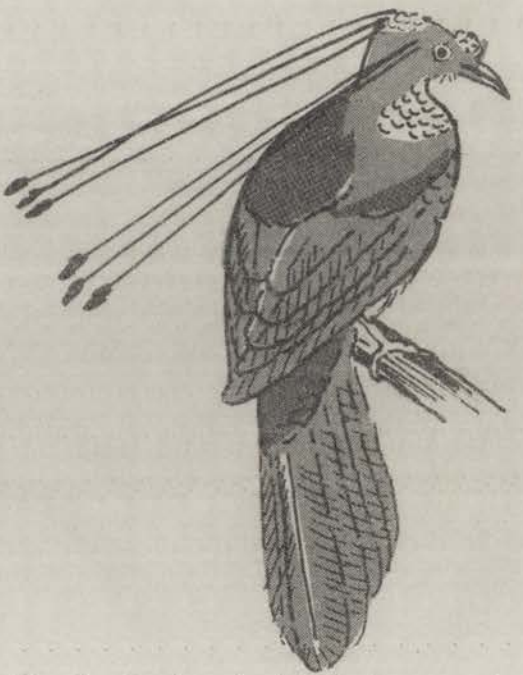


Plate II.—*Parotia wahnesi* is also known as the six-wired bird of paradise. It measures about 15 in from head to tail

Plate IV.—Traditional method of hunting birds of paradise. This print is taken from a book published in 1869—*The Malay Archipelago* by A. R. Wallace. The hunters have made mats of leaves under which they hide from the birds. Sharp-pointed arrows would draw blood which would spoil the feathers, so blunt-ended arrows were used

Officers from the Wildlife Section of DASF, and the National Parks Board commenced a survey of the most important bird of paradise forests. The objective is to establish a series of 15 to 20 bird of paradise conservation areas, throughout the country. All of this habitat is native-community-owned and most of it is likely to be cleared for subsistence gardens or for the sale of timber. Even where the forests remain untouched, there is still the danger of illegal shooting by native plume traders.

Each conservation area would be managed independently according to its particular requirements. The habitat would be protected from logging and other forms of commercial exploitation. It is envisaged that hunting, if permitted at all, would be carefully controlled and limited to traditional methods only. Wildlife officers would assist the indigenous landowners to manage the wildlife in their area. In specially productive bird of paradise forests, it would be possible to harvest plumes for traditional use.

BEHAVIOUR OF THE BIRDS

Even in places which have been very heavily hunted in the past, it is surprising how quickly the birds can come back, if the shotgun shooting is stopped. With traditional methods of hunting, there was never any problem of the birds dying out completely.

The plumed species have a courtship behaviour in which only a relatively few fully adult males of each generation are needed for the species to survive, and the only birds having any commercial value are the fully adult males. No pair bond develops between the sexes and the males take no part in the duties of nesting or in the rearing of the young. Another reason for the resilence of these birds is that the males do not acquire their commercially valuable adult plumage until they are 4 or 5 years old.

But conditions are changing rapidly in Papua New Guinea and the very factors which up until the 1960s ensured that there was always a plentiful supply of plumes are being quickly altered.

In the first place the reservoirs of unhunted species beyond the last patrol post no longer exist in their untouched condition. New airstrips, forest access tracks, new highways, and most important of all, the possibility of hunters and plume traders travelling unmolested in new areas has greatly increased in the past few years.

Commercial plume traders, Papua New Guinean businessmen, can now fly into many undeveloped areas. By distributing ammunition and money to local hunters (quite illegally of course) they can fully exploit all the sources of birds of paradise. In addition they can buy cheaply and market the skins in the densely populated villages where plumes are scarce.

WHAT CAN YOU DO?

At this period of time the conservation of wildlife is attracting attention from all over the world. Particularly is this the case for countries such as Papua New Guinea with many unique types of wildlife not found elsewhere

Much more information and scientific study of the birds' habits and distribution is needed.

If you know of bird of paradise forests which might be preserved in your district, write to the Wildlife Section, DASF, Konedobu. Talk to your Lical Government Council about the need to save birds of paradise from the shotguns and the clearing of the forests.

It will depend on the people of Papua New Guinea whether the excessive hunting of the birds of paradise is controlled sufficiently. It is the people who will lose if the bird of paradise conservation areas are not established where the birds can remain while the country is being developed.

Why Do Prices Vary?

D. R. J. DENSLEY, Assistant Director
(Rural Economics and Commodity Research)

Over the past year prices paid to rural producers of coffee, cocoa and copra have varied considerably from month to month. These changes in prices puzzle many people and many growers have not understood why the price for their product changes so quickly.

This article attempts to explain how prices are fixed and why they go up and down. Coffee is used as an example but the same basic factors apply in determining the prices of tea, copra, rubber, cocoa and other commodities.

HOW THE MARKETING SYSTEM WORKS

To understand price variations it is first necessary to understand how produce like coffee is sold in the international market.

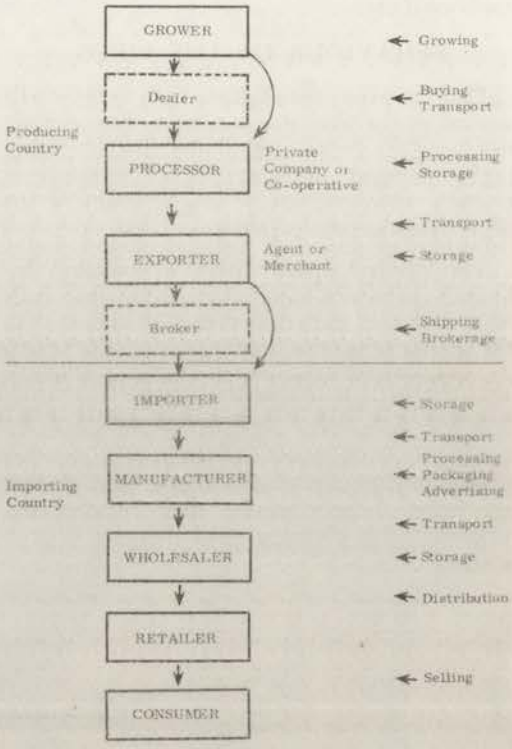
In a town market a grower of vegetables can sell his produce to the people who will eat it. However, parchment coffee produced by Papua New Guinea growers has to pass through many stages before it can be bought by a housewife as roasted and ground coffee beans or as instant coffee in a store in, say, Germany. There are many people involved in the work of processing, storage and transport of coffee to bring the coffee from the grower to the consumer. These different people, and the jobs they perform, are shown in *Figure* 1.

1. *The Processor*

The smaller coffee grower in Papua New Guinea usually sells his parchment or cherry coffee to a processor whose job it is to mill the coffee to a green bean form ready for export. This processor can be either an individual, a company, or a co-operative. Larger coffee growers usually process their own coffee. The coffee processor often employs buyers who buy the coffee from the smallholder growers. However, many processors buy parchment coffee from coffee dealers who in turn have bought the coffee from the growers.

Both the coffee dealer and the coffee processor incur costs in carrying out their functions A large cost for the coffee dealer or processor is that he needs money to buy from the growers. If he buys 1,000 tons of coffee in a year and pays 15 cents a lb for it, he will need over $300,000. If he borrows this money from a bank he has to pay interest to the bank for the money until he can sell the coffee and pay back the loan. He also has to buy trucks and pay drivers and office staff. The processor has to pay for machinery to mill the coffee and the men to operate the machines. He also has to pay for bags to put the coffee in and for a building to store the bags of coffee. As well he has to make a profit.

Figure 1.- Agencies in the International Marketing System



2. *The Exporter and the Broker*

The processor (or the grower/processor) usually then sells the green bean coffee to an exporter who in turn sells it to an importer or a manufacturer in an importing country.

Plate I.—Airfreighting is expensive, but in many cases it is the only way to get produce to the market

Photo: D.I.E.S.

overseas. Usually the importer of coffee in Papua New Guinea acts as a merchant which means that he actually buys the coffee from the processor and takes it into his own store for bulking, rebagging and storage. In few cases the exporter may act as an agent; in this case he doesn't own the coffee but takes it into storage and charges the processor a commission for arranging the sale to an importer overseas.

Sometimes the exporter does not know which importer or manufacturer in a particular overseas country wants the type of coffee that he has bought and wants to sell. In this case he will ask another agent (or broker) to arrange a sale for him. This broker may only arrange the sale "on paper" but he has costs and expects to make a profit and so charges the exporter for this service.

The exporter has to decide what price he can afford to pay processors or grower/processors for a particular quality of coffee. To work out what price to pay, he first estimates what price he is likely to receive from an overseas buyer. He then deducts from this price the costs of storage and the selling costs he incurs, together with the profit he expects to make. After he has considered all these factors he arrives at the price he should offer to the grower or processor.

3. *The Importer and Manufacturer*

The exporter in Papua New Guinea arranges shipment of coffee to an importer in an overseas country. The importer then arranges the sale and transport of the coffee to a manufacturer. He in turn processes the green bean coffee into roasted coffee or instant coffee in a packaged form. This packaged coffee is then sold and transported to a wholesaler, then to a retailer and is eventually sold to the consumer.

FACTORS WHICH DETERMINE PRICES

The people who go to a broker to buy coffee always want to buy at a low price to spend as little money as possible to buy a certain amount. The people who are selling always want a high price so they can receive the greatest amount of money possible for their work. What factors decide what the price will be?

1. *Supply and Demand*

Generally the price for a particular quality of product varies according to two factors:

(i) *the demand* which is the amount that consumers want to buy;

(ii) *the supply* which is the amount that is produced.

If the demand is greater than the supply then the price will rise. This happens because many people are competing with each other to buy the coffee and the people selling can ask for higher prices.

If the supply is greater than the demand then the price will fall because producers in many countries will be competing with each other to sell their coffee and will have to reduce the price they are asking to ensure they sell their products.

If the supply and demand were exactly equal all the time then the price would never vary. But this does not happen in practice even though the International Coffee Agreement was drawn up to make sure that people don't grow far more coffee than is needed.

Thus the changes in price which worry so many people occur because supply or demand changes. It is more usual for supply to change suddenly than demand and thus we can say that variations in supply are usually the cause of price changes.

2. *Quality*

There are many different types and grades of coffee produced both in Papua New Guinea and other producing countries. Consumers and manufacturers in importing countries have their own special types or qualities of coffee they are prepared to buy. In this way some types or qualities of coffee will receive a higher price than others.

3. *Currency Variations*

International commodities sales are usually made in Sterling or U.S. dollars—rarely in Australian dollars. In December, 1972 Australia revalued its dollar upwards, while the U.S. dollar remained the same. Prices in U.S. dollars have not altered, but now those prices are lower when they are converted to Australian dollars.

FACTORS AFFECTING SUPPLY AND DEMAND

1. *Production Performance*

Whatever the crop, the production in Papua New Guinea is very small compared with the production in the whole world, so it is production rises or falls in other countries which determine what the international price will be.

In the case of coffee, it is production in Brazil which determines what the world supply (and hence the world price) will be. When Brazil was having trouble with coffee rust, coffee buyers felt there would be less coffee available so the price rose. Then the price dropped again as people felt that more coffee would again be produced. This year the price has risen again because Brazil has had frosts and buyers thought the crop would be reduced considerably.

For copra and coconut oil it is the Philippines which is the world's largest producer. If they have cyclones or typhoons there, the supply of copra goes down and the international price goes up.

For tea, India and Ceylon are the world's major producers. Last year tea production in India dropped because of the war with Pakistan, and the price of tea on the international market rose.

If every country has a good year the price goes down. This happened with copra last year. Every country produced plenty of copra, and the price was the lowest for 40 years.

When supplies go down and the price rises, then growers produce more coffee. This happens because the growers are more willing to work at growing coffee when prices are high than when they are low. The result is that prices later fall again as the extra production comes on sale.

When supplies go up and the price falls, then producers become less willing to produce and supply is reduced so that prices rise again.

2. *Supply of Substitutes*

It sometimes happens that though there is no increase in the production of a crop, a substitute is found which has the same effect as increasing the supply.

For example, if someone discovers a way of making synthetic rubber that is better and cheaper than natural rubber, then the demand for natural rubber will fall. Similarly, for coconut oil, many of the uses of coconut oil are interchangeable, that is, if coconut oil is not available or costs too much, some other oil can be used instead. For soap manufacture the raw material can be coconut oil, palm oil or soya bean oil. So if the supply of coconut oil is suddenly reduced it may not mean that the price will increase. In this case soap manufacturers may buy some other oil instead.

If the price of coffee rises too high then people may stop drinking coffee and, instead, drink tea, cocoa, or some other drink.

3. *Temporary Disruption of Marketing Routines*

It often happens that something will prevent the normal marketing system from operating for a limited time. When this happens the effect is the same as for a change in the supply of, or demand of, the product.

One example will suffice. It has already been stated that the Philippines is the world's major producer of copra. Last year there was a serious dock strike in U.S.A. and Philippines copra growers could not deliver their copra to their usual markets in U.S.A. So instead they sold it on other world markets, thus reducing the prices there for the reasons given earlier about the effects of changes in supply on price.

4. *Release of Stockpiles*

Official agencies in some countries keep stockpiles of essential commodities for any of a number of reasons. They may want to safeguard against loss of supply as occurs, for example, during a war. They purchase at low prices and store for consuumption when prices rise. They may purchase surplus production from friendly producers to preserve political or strategic interests.

If a country with a stockpile decides it has too much of a commodity and it releases part of its stocks, the result is that supply is increased and the price declines. An example of this occurred last year when the U.S.A. released some of its stockpile of natural rubber and thus contributed to the factors which forced the price of rubber to a record low price.

5. *Stocks Held Already in the Consumer Country*

The international buyer has to assess what the sale of the commodity will be at the wholesale and retail level in his country. If he knows that too much coffee was bought last year and that wholesalers are still holding large quantities of coffee, he will certainly not buy more large stocks at high prices.

INTERNATIONAL TRADE AGREEMENTS AND ORGANIZED MARKETING

The supply of many commodities sold on world markets and consequently their prices, are governed by a wide range of international

Plate II.—Produce is loaded into the hold of a ship bound for Europe

Photo: D.I.E.S.

trade agreements. Papua New Guinea, together with Australia, is a member of the International Coffee Organization (I.C.O.). Coffee-producing and coffee-importing countries are members of this organization which controls the amount of coffee produced in the world and regulates its sale. I.C.O.'s aim is to see that too much coffee is not produced and that prices received by coffee growers do not fall below reasonable levels.

At the time of going to press (December, 1972) the I.C.O's quota have been suspended but they could be re-introduced again in the future. Since Papua New Guinea coffee is mostly of high quality it is hoped that we will now be able to sell all the coffee we produce. Although quotas have been suspended, the PNG Coffee Marketing Board will still control and regulate coffee exports for the country. It will still buy any coffee that cannot be sold and will pay for its storage until it is sold.

To pay for these costs the Coffee Marketing Board gets money from a levy (or tax) on all coffee exported from Papua New Guinea.

There are other trade agreements which affect Papua New Guinea's exports. For example, Australia gives Papua New Guinea a special advantage over other coffee-growing countries: Australian manufacturers have to use 30 per cent of Papua New Guinea coffee in their processing. If they don't do this they have to pay special import duties or taxes on the coffee they buy from other countries.

HOW THE PRICE TO THE GROWER IS DETERMINED

When coffee is grown in the Papua New Guinea Highlands the grower probably feels that he has done all the work and there is hardly anything else to be done. But a lot more people have to work before that coffee reaches, say, a shop in Germany where a housewife buys it. There are the people who process it, the people who work in the exporter's office, the crew of the ship that takes the coffee to the port in Germany, the broker who arranges the sale and the wholesaler and retailer in Germany. All these people have to work to help the coffee get to the family who will eventually make the coffee into a drink. All these people have to be paid. This is why there is a difference between the price the grower gets in Goroka and the price the housewife pays in Germany.

The importer or manufacturer in Germany knows what price his coffee must be if the housewife is to keep buying his coffee and not change to another brand of coffee or to another type of drink (such as tea). He has an idea of how much coffee is likely to be available from producing countries. The price he offers to the Papua New Guinea exporter is therefore based on what he feels he has to pay for the particular type of coffee and on his expected selling price less the cost of his operations, including profit.

The same process is repeated in the prices offered by the importers, then again by processors and coffee buyers until a final price to the grower is determined.

If there is a change in the likely amount of coffee available, then prices paid by importers to exporters will either fall or increase. As a result of this change the price to the grower will eventually fall or increase.

We're Going Metric—But Don't Worry

CLAIRE A. FOWLER

The world is "going metric"—and so are we. Nobody is forcing us to make the changes, but it will be to our advantage if we do. The changes will be spread over several years. This article is an introduction to the "new" units. They are not really new, but they may be new to you.

There are obvious advantages in having the whole world using the same units of measurement for length, weight, volume and so on. Most of the world realizes these advantages. About 140 countries have already changed to metric units or at least have started to change. In fact, there are only nine or ten that have not started to change. Papua New Guinea must keep up with the rest of the world.

So there will be changes—but don't let them worry you. Remember how difficult you thought it would be to change from £.s.d. to dollars and cents? Does it worry you now? Not at all. Would you like to go back to 12 pence = 1 shilling, 20 shillings = £1? Certainly not!

Although most people call them "metric" units the name being used increasingly overseas is "SI" units. This term covers a wide range of units, including those used in electrical and engineering fields. "SI" stands for "Systéme Internationale d'Unités". If you don't want to remember it in French, think of it as the System of International Units. That is not an exact translation; in the French version it is the system that is international, not the units. But when the system is really international, the units will be too.

There is a Metric Conversion Commission now established in Papua New Guinea, with its headquarters at Port Moresby. Several advisory committees have also been set up. One of these is the Rural Industries Advisory Committee and Mr E. D. Collins of Goroka is the Chairman. On this committee there are nominees of the various industries—coffee, rubber, cattle, forestry and so on.

The changeover to SI units will not be instantaneous, as the change to decimal currency was. It will be spread over a period of years. Advisory committees will tell the Commission when they are ready to change; the Commission will not dictate in this matter. Actually nobody will be forced to change to the new system, but eventually it will be easier to use the new units than the old ones.

For Papua New Guinea, the sooner the conversion comes the better. Each year there are more students leaving school and starting work than there were the year before. Life will be easier for everyone if, when they leave school, they are already acquainted with metres, kilograms and degrees Celsius, and so on. It will be better still if they don't have to "unlearn" yards, pounds and degrees Fahrenheit.

Actually we have already started using some metric units without realizing it. The familiar 44-gallon drum really contains 200 litres. For years Olympic swimming pools have been, not 50 yards long, but 55 yards. At least, that's the length we have thought they were. Actually are 50 metres long which is $11\frac{1}{4}$ inches short short of 55 yards.

And if you are in the habit of flying around Papua New Guinea and don't have your own private plane, you are allowed, you think, to take 44 lb of luggage with you for no extra charge. What you are really allowed, according to international rules, is 20 kilograms of luggage.

LENGTH MEASUREMENT

What is a metre, exactly?

In Paris in 1791, a committee was appointed to select new standard units for length and weight. They chose the metre as one ten-thousandth part of the length of a line from the North Pole, passing through Paris, to the Equator. A bar of platinum of this length was made to be the permanent standard metre, and it is still kept in Paris in the International Bureau of Weights and Measures. In the years since the bar was made, however, scientists have devised more accurate methods of measuring. These days the metre is defined in terms of the wavelength of light, and it is not exactly the same as was originally intended. Not many people are concerned about the difference, however.

Having one standard unit of length, the committee then proceeded to derive other units from it, all based on factors of 10. A tenth

of a metre is a decimetre but this is rarely used. A centimetre is a hundredth part of a metre and a millimetre is a thousandth part of a metre. Things usually measured in inches will in future be measured in centimetres. The easiest way to do the conversion without pencil and paper is to remember that 10 centimetres equal 4 inches.

For distances much longer than a metre, the standard is the kilometre. The Metric Conversion Commission has stated that it is to be pronounced with the emphasis on the first syllable, not the second (KILometre, not k'LOMetre).

A kilometre is almost $\frac{5}{8}$ mile. For a very rough approximation of distance, you can just halve the kilometre figure to get the number of miles. That is, a distance of 40 km is *about* 20 miles if you are going by car; but if you are going to walk it (and especially if you want to boast about walking it), it is 25 miles (40 x $\frac{5}{8}$). If you want to be very accurate, however, it is 40 x 0.621 = 24.84 miles.

What is a hectare?

The unit of area measurement will change from the acre to the hectare. A hectare is defined as an area equivalent to that of a square with sides of 100 metres. It is roughly $2\frac{1}{2}$ acres.

WEIGHT MEASUREMENT

What is a gram?

The metre was the only unit that the Paris committee chose. All the other units of both length and weight were derived from it.

The unit of weight is the gram, which is the weight of 1 cubic centimetre of water at 4°C. This makes it very easy to convert from weight to volume measurement for water, provided the temperature change is not very much. As in the case of the metre, more accurate weighing methods have shown that a gram is not *exactly* what it was supposed to be, but only specialist scientists are concerned about the difference.

It takes 28 grams to make 1 ounce so generally only scientists are concerned with fractions of a gram. The usual unit for shopping will be the kilogram (1,000 gm) which is 2.2 lb. So instead of buying 4 lb sugar you will buy 2 kilograms (4.4 lb) and you can expect the price of this amount of sugar to be 10 per cent higher than that for 4 lb.

Tons won't change much except in their spelling and pronunciation.

1000 kg = 1 tonne (rhymes with "John")
An old-fashioned long ton = 2240 lb
A new tonne = 2204 lb

VOLUME MEASUREMENT

Instead of pints, quarts and gallons there will be two units to learn for liquid measure —the litre and the millilitre. For all practical purposes, a millilitre and a cubic centimetre are the same thing, and 1,000 mililetres make a litre (pronounced "leeta"). A litre is just under a quart; 1 gallon = 4.5 litres. Eventually petrol pumps will deliver litres instead of gallons but this is not expected for several years yet.

A schooner of beer will still look the same and cost the same, only now it will be defined as 825 millilitres (usually abbreviated to "mls" and pronounced "mills").

WEATHER

The weather won't really be different under metrication, it will only sound different. The official changeover to Celsius temperatures has already been made, so no longer can we boast of a hot day as a century, since 100 deg. Fahrenheit becomes a mere 38 deg. Celsius. But we can boast about the rainfall like crazy! If you have a really wet night, don't tell anyone you had 8 inches; 200 millimetres sounds much wetter.

Most people don't care what the barometric pressure is anyway, but if you do care, 30 inches of mercury = 1016 millibars.

Celsius temperatures used to be called Centigrade—but in Europe, Centigrade means something else to some people, so the word will not be used for temperature. Anders Celsius was the Swedish scientist who worked out this temperature scale which has 0° for the freezing point of water and 100° for the boiling point.

CHANGES ALREADY MADE

Some changes have already been made without any serious difficulties. Tide heights are now reported in metres. Since September 1st, the Bureau of Meteorology has reported temperatures only in Celsius and barometric pressure only in millibars. The Department of Lands, Surveys and Mines measures land only in hectares.

The last Melbourne Cup over 2 miles has been run. This year's cup will be run over 3200 metres—60 feet shorter than in previous years.

3200 metres is the same as 3.2 kilometres. An 8-stone jockey will weigh in at about 50 kilograms.

There is one area where we might find some opposition to metrication. The glamorous blonde who shrugs her shoulders and says that she couldn't care less whether her measurements are in inches or centimetres, might change her mind when she finds out that her vital statistics have changed from 34-24-36 to 86-61-92!

FACTS TO REMEMBER

While undoubtedly it means more trouble for people to change than to keep on using the same units, cheer yourself up with the thought that from now on it will be easier when you have to help your children with their school homework. Didn't you have trouble remembering that there are 4,840 square yards in an acre and 640 acres in a square mile? And did you ever find out what a "rod, pole or perch" was? It doesn't matter now what it was; it's dead.

Your children will never have the problems that you had in arithmetic lessons. What they (and you) need to know now is that:

10 millimetres = 1 centimetre (two-fifths of an inch)

100 centimetres = 1 metre (just over a yard)

1000 metres = 1 kilometre (five-eighths of a mile)

A square 100 metres x 100 metres = 1 hectare ($2\frac{1}{2}$ acres)

1000 grams = 1 kilogram (2.2 lb)

1000 cubic centimetres = 1 litre (roughly a quart)

1 cc of water weighs 1 gram (1/28th of an ounce)

1 litre of water weighs 1 kilogram

The conversion figures given here are only approximate. When it gets near the time for the changeover, there will be plenty of information available on exact conversion rates for the people who really need them. The secret of easy adjustment, however, is not to use conversion figures at all if you can avoid it. Learn to think in SI units by remembering that a very tall man is about 2 metres, and he will weigh about 90 kilograms. On an average day in coastal Papua New Guinea, the maximum temperature is about 30°C and three stubbies of beer make a litre. You'll soon get used to it.

Revaluation of the Australian Dollar

On 23rd December, 1972, the Australian Government announced an upwards revaluation of the Australian dollar by 7.05 per cent. As Papua New Guinea uses Australian currency and comes largely within the Australian monetary system, this affects Papua New Guinea as if it were a state of Australia.

Before the change, $A1.00 was equal to $US1.191; after the change, $A1.00 could buy $US1.275. (United States currency is the leading World currency, and most other currencies are compared with it.) So Australian currency has now become more valuable compared with other currencies than it was before. Goods imported into Australia and Papua New Guinea now will cost 7.05 per cent less for us to buy. However, as most of our exports are rural products sold on world markets, we cannot alter the price of them, and we will have to accept an effectively lower price than we got before. So even though the world price for tea (in new British pence per lb.) and for rubber (in Singapore cents per lb.) stay the same, by the time that money which is owing to us for the sale of our produce is changed into our money (at the new exchange rate) we have got less than we would have got before.

Why did Australia do this? Over recent months, Australia has been having a boom period for exports which have consistently been worth more than imports. So much so, that Australia has accumulated a huge positive balance of payments of $A2,000 million dollars. It became obvious that the Australian currency was a very strong one, and was undervalued hence the change to bring the value of Australian currency closer to its real value.

Overall, in Papua New Guinea, this should have a good effect on the economy, as our imports are far greater than our exports. Our imports will now cost less. However our exports will also earn less income for us, which will mean less income for the primary producer.

Cattle Tick and its Application to the Cattle Industry

P. ROBEY, District Livestock Officer, Alotau

In the last issue an article by Dr Owen gave a detailed account of the life cycle and various characteristics of the cattle tick (Boophilus microplus).

This article deals with the practical problems related to tick fever, tick eradication, tick control and legal responsibilities of stock owners.

ECONOMIC IMPORTANCE OF CATTLE TICK

The presence of cattle tick in a herd can greatly reduce performance due both to the irritation caused by the tick and, most importantly, to the spread of tick fever, a disease which can kill cattle.

As well as this loss of production, the cost of the treatment of tick fever, tick control measures or tick eradication is a direct drain on the profits which can be obtained from cattle grazing.

Heavy infestations of tick will cause anaemia anl restrict growth, and therefore steers need to be held a year or more longer than normal before they are marketable.

A measure of the loss of production caused by cattle tick can be seen from these figures obtained in north Australia. A group of undipped, tick-infested cattle gained only 42 lb per head over a 6-month period. By contrast a group of similar cattle on identical pasture that were dipped regularly gained 132 lb per head over the same period. Another experiment demonstrated that average infestations of 40, 60 and 80 ticks on cattle caused a loss of growth rate of 56, 108 and 160 lb per year respectively under the conditions of the experiment. Although this research was done in Australia, it is an indication of the possible losses that can occur through the parasitic action of cattle tick. Because the skin is irritated where the tick have attached themselves, hides also can be damaged and the wound open to attack by the screw worm fly which can cause further losses in production.

Tick Fever

Tick fever is the name given to the various similar diseases caused by minute organisms called protozoa. When tick fever is present in the herd these protozoa live within the blood cells and destroy them, thus causing the disease.

It should be clearly understood that while the direct cause of the disease is a protozoan, the only method of spread of the disease is by the bite of the cattle tick. If there are no ticks on a herd, there can be no spread of tick fever. Cattle tick do not pass from one animal to another but spend their entire feeding period on a single animal. The germs of tick fever (protozoa) pass through the eggs of diseased ticks to their young and the young later get on new animals and so infect them.

The most common form of tick fever here is that caused by the protozoa *Babesia argentina.* In 1966 deaths due to *Babesia argentina* occurred in three herds in the Central District. One of these herds lost 75 head. A serological study at the time indicated a widespread infection of *Babesia argentina* in the Port Moresby and Sogeri areas.

Cattle are very susceptible to babesiosis (tick fever caused by *B. argentina* and a similar organism *Babesia bigemina*) when they have little or no resistance. This resistance is obtained by the continued presence of a small number of ticks carrying tick fever. The introduction of tick fever to a herd with little or no resistance can result in a very high number of deaths. Milking cows and pregnant animals are most susceptible, but calves have a resistance to infection and seldom suffer a severe attack.

The symptoms of the disease are high fever, loss of appetite, rapid breathing, loss of weight and dejected appearance, and in the advanced stages of the disease, the passing of red-coloured urine. This is due to the rapid destruction of blood cells.

In dead animals, fat and mucous membranes are often yellow, the spleen is swollen and pulpy, the liver is swollen and coloured yellow to orange, the bile thick and granular and the bladder may contain red urine.

There are drugs which can be used to treat cattle showing symptoms of babesiosis, and early veterinary advice should therefore be sought where tick fever is suspected.

Anaplasmosis is another type of tick fever but is not very common. It is like babesiosis except that there is no red urine.

TICK ERADICATION

The Highlands and the New Guinea mainland have had successful eradication schemes and these areas are now tick-free. The New Guinea Islands are tick-free except for a very small number of cattle on New Ireland where there are also some wild cattle.

In Papua, the Northern District and Southern Highlands are the only tick-free districts but tick has been eradicated from the Woitape and Tapini areas and from parts of the Milne Bay District. Eradication schemes are at present being conducted in the Bereina and Papuan south coast areas.

In the Port Moresby area the scheme was abandoned because of the presence of deer which also carry the cattle tick. Properties around Port Moresby and on the Sogeri Plateau now carry out control spraying. The presence of deer in the Western District will also restrict future attempts at eradication there.

The eradication scheme is a series of strictly controlled sprayings of all animals in the herd at very frequent and regular intervals. Tick eradication is carried out under the supervision of Livestock Officers and Veterinary Officers of DASF.

The most common method used is to spray the cattle weekly until 3 months after the last tick was sighted on the herd. The interval between spraying is then increased to every 2 weeks. Spraying is continued for a further 15 months provided there are no more tick sightings.

A second method of eradication involves the movement of livestock, after they have been intensively sprayed and all their ticks have been killed, to tick-free pastures for a long period to allow the ticks on the original pasture to die. Present DASF policy for this eradication is to leave the pastures without stock for 18 months.

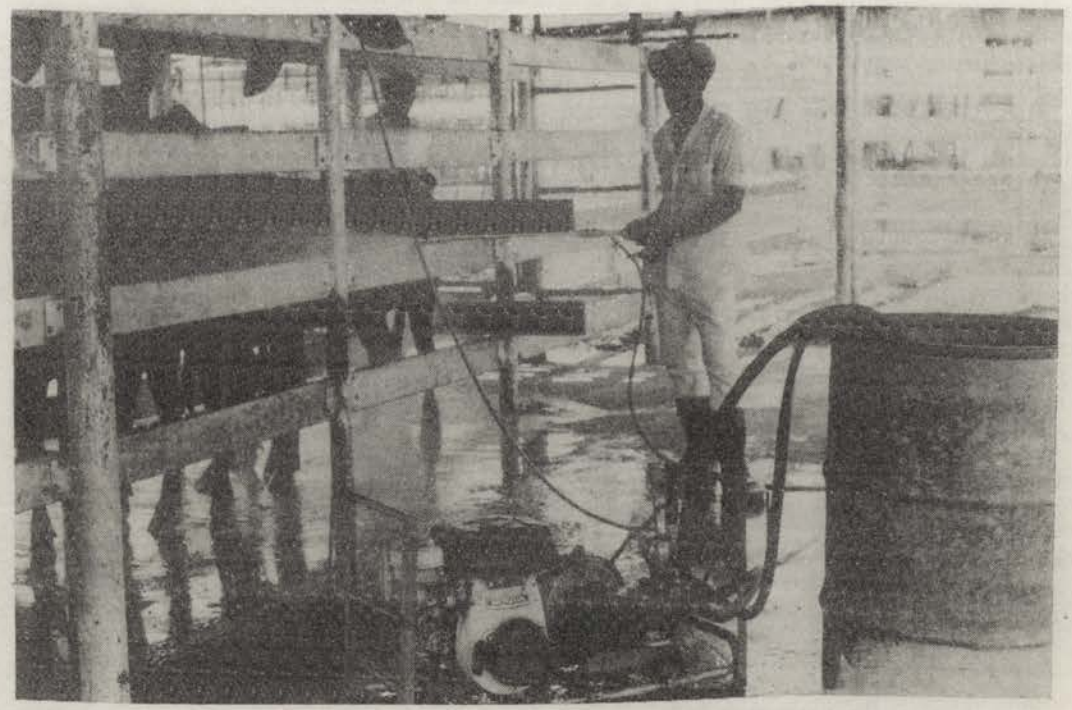


Plate I.—Machine spraying of cattle for tick. Because of the high pressure developed by the machine, this is the recommended method of spraying.

TICK CONTROL

In areas where there are ticks and no tick eradication is in progress, stock owners are required by law to carry out measures to control the infestation of tick in their herd.

These control measures are particularly applicable to stock owners in the Central District and other areas where deer have restricted the possibility of tick eradication.

The purpose of tick control is to keep the cattle tick to a minimum and this is usually done by the application of an insecticide by spraying approximately every 3 weeks. This interval can be adjusted by the farmer according to the number of ticks on the cattle. Some of the insecticides approved by DASF are Diazanon 20 per cent emulsion, Ausuntol 45 per cent wettable powder and Delnav 30 per cent emulsion.

If stock owners are using other insecticides a check with a Stock Inspector (Veterinary Officer or Livestock Officer) will determine if the insecticide is suitable.

The insecticide can be applied by dipping or spraying and the animals must be completely wetted by the solution. A machine must be used to apply spray and it must be capable of delivering the solution at a pressure of 150 lb per square inch.

The insecticide dilution must be no weaker than the dilution recommended by its manufacturer.

Control of Spelling

All ticks live by sucking the blood of a host animal. In the case of the cattle tick the host animal can be either cattle or deer. It is while the ticks are attached to the skin of the host that they develop from larvae to mature

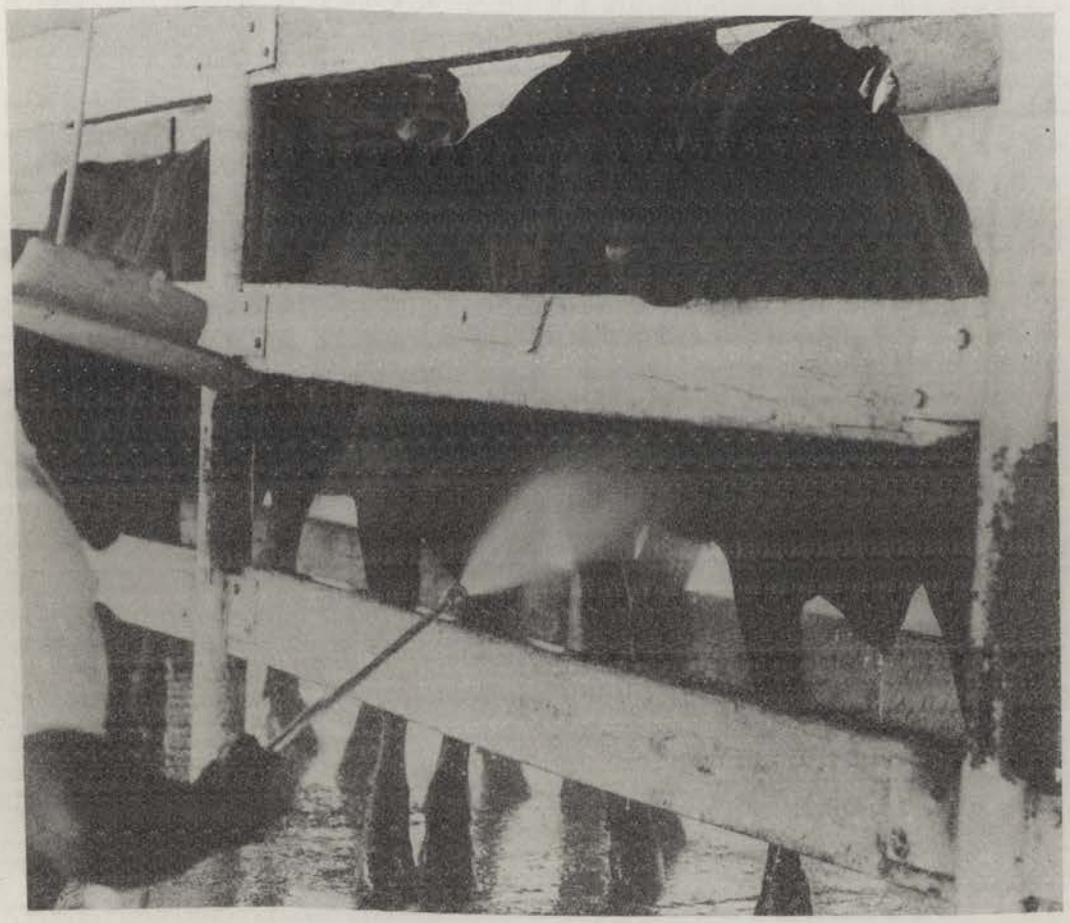


Plate II.—The cattle must get really wet all over.

adults, and fertilization of the females takes place. If this stage of the life cycle can be prevented, then obviously the ticks will die and there will be no eggs for the next generation.

Cattle tick can therefore be controlled by the spelling of tick-infested paddocks. If the cattle are moved to new paddocks after they have been sprayed (and the old paddocks are left vacant) the ticks in the old paddock will eventually all die. The length of time the paddock has to be spelled (or left empty) depends on the climate—in hot, dry conditions, the eggs on the ground hatch quite quickly and so the paddock does not have to be spelled for so long. To eradicate all the ticks in a paddock, it would have to be spelled for at least 12 months, but regular spelling for a few months each time will help to keep tick numbers down.

Responsibilities of Stock Owners

The *Animal Disease and Control Ordinance* (1952) provides for the control of cattle tick anl restricts its spread to tick-free areas. Stock owners should know what is in the ordinance.* If they do not they may help the spread of tick, tick fever or other diseases. They may also be fined for not obeying the ordinance.

All movements of stock are controlled by DASF Stock Inspectors. Permission to move stock must be obtained from a Stock Inspector before the stock are moved. Permission is usually granted after stock have been inspected and sprayed for tick and have also been cleared for various other diseases such as brucellosis, tuberculosis and anthrax.

* Copies of ordinances may be obtained from the Government Printer, Box 3280, Port Moresby. It is intended to publish in *Harvest* a series of articles on agricultural ordinances and their practical application for the primary producers.

Cattle tick is a notifiable pest under the *Animal Disease and Control Ordinance* (1952) and although cattle tick has been confined to the few areas mentioned earlier, anyone who suspects that cattle tick may be in the herd should notify DASF. As there are many different species of tick in Papua New Guinea, expert attention is needed for positive identification.

QUARANTINE RESTRICTIONS

In order to prevent the introduction of cattle tick from overseas various restrictions are placed on the importation of livestock and fodder originating from the tick areas of Australia or stock passing through these tick areas. Tick areas in Australia are northern New South Wales, Queensland, Northern Territory and Western Australia north of the Kimberleys. These stock must be sprayed four times at 5-day intervals with an approved insecticide on arrival in Papua New Guinea.

The ship should not have carried cattle from a tick-infested area during the 12 months prior to the loading of the stock. If this is unavoidable, the ship has to be treated with an approved insecticide to free it of any tick infestation.

Thanks to the co-operation of cattle owners, this pest has been confined to a few areas of Papua New Guinea, but there is no room for complacency, and owners must be continually aware of the possibility of tick infestation in their cattle.

Opening of Rubber Processing Factory at Kubuna

MAUREEN A. WRIGHT

Shareholders of the Ibulo Society celebrated the opening of their rubber processing factory at Kubuna, in the Central District, last May. The factory has been built by the members of the Society with the help of Development Bank funds, and represents an important achievement for the area. It is the first rubber processing factory to be opened in the Kubuna area. Rubber currently is the only cash crop available to the area, so the opening of the factory signals the first opportunity many families have had of earning a cash income.

Seventeen settlers from the Kubuna area took up blocks and planted rubber about 5 years ago. Loans were granted to each settler by the Development Bank, ranging from $90 to $135, according to the number of trees planted. The Ibulo Society was established, with each settler contributing $65, of which $45 was drawn from his Development Bank loan. The remainder of the loan was used by the settler to buy equipment needed for tapping—knives, cups, buckets, etc.

The factory was built with the funds of the Society. Originally budgeted for at $1,100, the factory was completed, including all equipment, for only $800. This considerable saving in cost was achieved by the use of local materials wherever possible, and much of the equipment was made locally at the Bereina Vocational School.

The Regional Rural Development Officer, Mr Fred Kleckham, officially opened the factory. He praised the members of the society for

Plate I.—Opening ceremony at the factory Photo: D.I.E.S.

the hard work and effort which had been needed to build the factory. He told the shareholders that their achievements would provide an example for many other people in Papua who were thinking about starting a rubber project.

Rubber Production

Rubber production at the factory has already begun. In April, there were 2 days of tapping, and seven bales of rubber were produced. In May about 20 bales were produced. Production is expected to settle down to a rate of about one bale of rubber each day.

The rubber tappers are divided into two groups, each group working every second day. Trees are being tapped three times a week at present, using ½ spiral cuts. A trial is being carried out to determine whether this method is superior to the more common full spiral cuts, tapped twice a week.

Trees are tapped early in the morning, and by mid-morning all the latex has been collected and brought into the factory. Cup lump and ground scrap which has collected between tappings is also brought in and processed.

The latex is brought in by the tappers, measured with the metrolac and the volume and density recorded, and then poured into the latex coagulating tank. The latex is mixed with water in the tank, then a quantity of acid is added, according to the depth of latex in the tank. The acid causes the rubber to coagulate, and this rubber is processed the next day.

The strips of coagulated rubber are passed through a series of rollers to form the thin ribbed sheets ready for smoking. Water needed to irrigate the rubber as it is rolled is supplied from a small dam on a nearby creek.

The Kubuna smokehouse is built of local materials, using bark slabs for walls and roof. A tunnel under one of the walls conducts smoke into the smokehouse from a fire built outside the building. The strips of new rubber are hung in the smokehouse to cure before being baled and sold.

At the end of each month, processed rubber is bought by DASF, and payments are made to each settler according to the proportion of the monthly total of latex which he has produced.

Plate II.—Smallholders bring in their latex for processing Photo: D.I.E.S.

Women in the Workforce

The tappers do the work in the factory themselves each day when they bring in the latex. Women take their turn with the work of the factory as well as with the tapping.

Much of the work of tapping on this project is done by women. Figures collected by the Rural Development Officer assisting the project, Mr Matt Teffer, show that female tappers may well prove superior to male tappers. In one family there are two women tapping 300 to 400 trees, and producing about 75 lb of latex between them, while two men tapping 300 trees on another block, are only producing about 40 lb. One block of about 700 trees was formerly being tapped by an old man at the rate of 15 to 20 lb of latex per day; now his daughter has taken over the tappings and brings in 40 lb of latex. A similar production rate is being achieved on another block of 700 trees where four women and one boy are bringing in 160 lb of latex.

This is the first rubber project in Papua New Guinea where female tappers form an important part of the workforce. The women's success at tapping may be due to a superior tapping technique, or a greater number of trees tapped per day. In other countries, notably Malaysia, female tappers make up a major part of the workforce, and their work is generally considered to be better than that of the men. The experience at Kubuna indicates that women may well play an important part in the future of the rubber industry in Papua New Guinea.

Smallholders' Prospects

Projects like that at Kubuna have been established at Lake Murray, and Kiunga in the Western District, and Murua in the Gulf District.

The village rubber project, although generally on a small scale compared with the larger expatriate-owned plantations, has some advantages that larger plantations do not have. The

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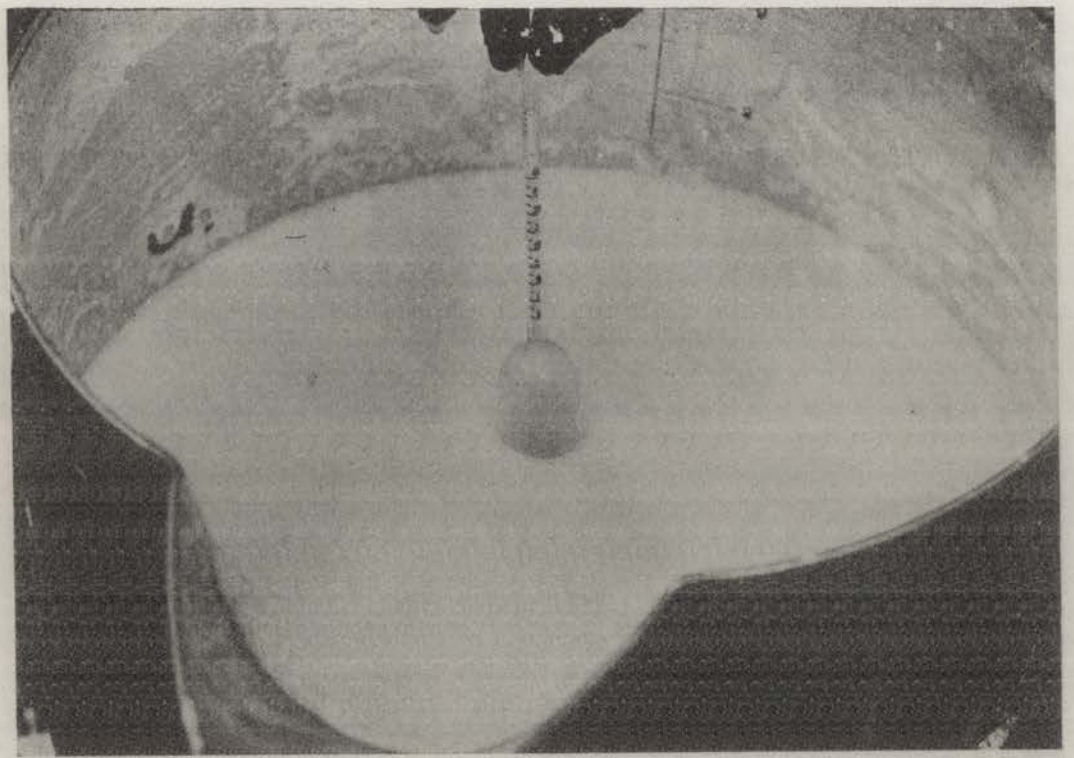


Plate III.—The metrolac is a hydrometer which measures the density of the latex, and hence the proportion of rubber which will be produced (dry rubber content). The metrolac has a weighted base so that when it is released from the hand it floats upright in the latex. If the latex is watery it will go down a long way; only the tip of the stem will be showing. The numbers on the vertical stem give a fairly accurate reading of the dry rubber content.

Sepik Fisheries—the Big Potential?

M. MITCHELL, Fisheries Superintendent

The Place

Whether the Sepik River is mighty or not, is a matter of opinion, but the Sepik River drainage basin is, without doubt, quite impressive. A rough calculation with a map and a rule will show that something like 10,000 square miles is involved in this. There is, of course, a seasonal dry period when the water area shrinks but we shall see later that this is probably a good thing. The whole area is a shambling complexity of river, lake and swamp. For a broad, general impression, it is necessary to fly over the region and gain a bird's-eye-view. *Plate* 1 shows what is revealed on such a trip, and even that which appears grassland is shown to be actually flooded when you catch the sun's rays reflected when looking directly beneath you. Here and there are good-sized lakes such as the Chambri (*Plate* 2). These lakes and other roundwaters are relatively shallow and fertile and probably benefit from drying out annually.

The Fish

The Sepik has its own indigenous fishes such as eels, catfish and sharks. However, the focus of our attention is now upon a fish called tilapia. For once people have done the right thing and called a fish by its logical name, in this case from its scientific title of *Tilapia mossambica.* It is a native of Africa where it has many close relatives. Tilapia may also be found throughout south-east Asia and were brought to Papua New Guinea by DASF some years ago. It was released at several points in Papua New Guinea and was also put in some DASF ponds at Amanab. It is not clear whether some of these fish were transferred to

Plate I.—Aerial view of the Sepik River Basin

Plate II.—Aerial view of the Chambri Lakes taken from an altitude of 3000 ft.

the Screw River, near Ambunti, or whether there was a simultaneous stocking. Anyway, the Screw River tilapia escaped into the stream from a nearby pond, as you would guess, and found their way down into the main Sepik River and apparently from there to most points in the Sepik Basin.

Tilapia have found the new home much to their liking and from about 1958 onwards grew and thrived with the result that the Sepik system has a very impressive total stock.

In other smaller waters, the rapid breeding of tilapia has resulted in a large number of small fish which never grow any larger. In the Sepik system the fish can average 1 lb each, with some over 5 lb, so it seems that Sepik conditions do not encourage stunting.

This may be because of the annual drought. Each dry season the waters recede and many shallow swamps become dry. In the larger waters there is also a strong plankton 'bloom' (a vast increase in growth of small floating matter, both animal and plant). The physical choking of fish with perhaps a drastic reduction of oxygen also, may be one reason for the large amount of dead tilapia seen in the drainage channels leading from the larger waters. Whatever the cause, it is a fact that each dry season many of the fish die. This would of course, leave more food for the surviving fish and may be one contributory factor to the good growth of the fish.

Tilapia, so the scientists tell us, is a mouth brooder. The male makes a circular nest on the mud flats and the female lays her eggs in it. The fertilized eggs are then taken up and brooded in the mouth of the female. It is said that the very tiny young will also take refuge there when danger threatens. It is interesting to dwell upon how the female fares with a mouth full of children. Possibly she does not eat during the crucial period; but anyway a sneeze would be less drastic than a hiccup! With all that parental care it is likely that there is a good survival rate of the young. The circular nests made by the male would be about 12 to 18 in across and in the dry season one may see acres of nests in shallow water, all so close that the nests are almost touching each other.

The Sepik Basin is an enormous area. It is a reasonable guess to say that at least 2,000 square miles of water and swamp are available for tilapia and that there would be 100 lb of tilapia to the acre. With these figures we can calculate that there would be 64,000 lb to the square mile, or 128,000,000 lb in 2,000 square miles, and this is an excellent fishing potential. It is probably as good as tuna yields in Papua New Guinea waters.

Fishing Methods

The main river is not suitable for fishing owing to the depth, strong currents, drifting trees and debris; but the swamps, lakes and ox-bows are ideal. In fact when the smaller waters are drying out, Sepik women can catch the fish by hand merely by groping carefully in the grass. Sometimes this situation can be improved by placing a barrier of sticks and brushwood across a channel.

Gill netting is, of course, the established way of fishing, and choosing the right mesh size can regulate the size of fish caught. There are other more sophisticated methods which come to mind but at present things go quite well, with an occasional catastrophe when a crocodile or saw-shark blunders into the net.

Plate III.—Mr Kambaramba and Mr Mongendo holding fish ready for sale. It is pre-packed in plastic bags if it has to travel far to the market

This is one reason why comparatively heavy twine is used in the nets. Despite its inferior catching power, there are still enough fish being caught. For those who are not familiar with the term, gill nets are merely walls of light twine netting strung across suitable places and kept vertical in the water by means of floating headropes and weighted footropes. The fish blunder into the nets and are entangled by the gills after pushing their heads through a mesh. In practice many fish are tangled by various parts of their bodies rather than by the gills, for the tilapia have spiny fins and rough scales.

Processing

Originally it was intended that two processing points would be established, one at Angoram and one at Pagwi. Unfortunately owing to the transfer of the Father-in-Charge at the mission, the Pagwi venture has not materialized, but the project of Mr Jim McKinnon who has a sawmill at Angoram, has fared better. Two local government councillors, Mr Siau Kambaramba and Mr Banagu Mongendo who live close by are interested in a business partnership with Mr McKinnon.

The fish may be preserved by smoking or freezing, so the Angoram smokehouse also has a freezer. A Yanmar 14 h.p. diesel engine drives a compressor which chills the brine tank for freezing the fish. The frozen fish may be sold 'as is' or packed in plastic bags for distance travelling, as shown in *Plate* 3.

For smoking, either fresh or frozen tilapia can be used, but fresh fish seem to give the best results. Prior to smoking the fish are split from the back and cleaned (*Plate* 4) and then soaked in brine solution (normal temperature) to absorb some salt for keeping qualities. The fish are then drip-dried and later hung up in the smoke chambers. Mr McKinnon has four chambers fed from external smoke generators which can process about 2 tons per 24 hours. There is no shortage of fuel; there is always plenty of sawdust from the sawmill next door. The fish are given a short dose of fairly hot

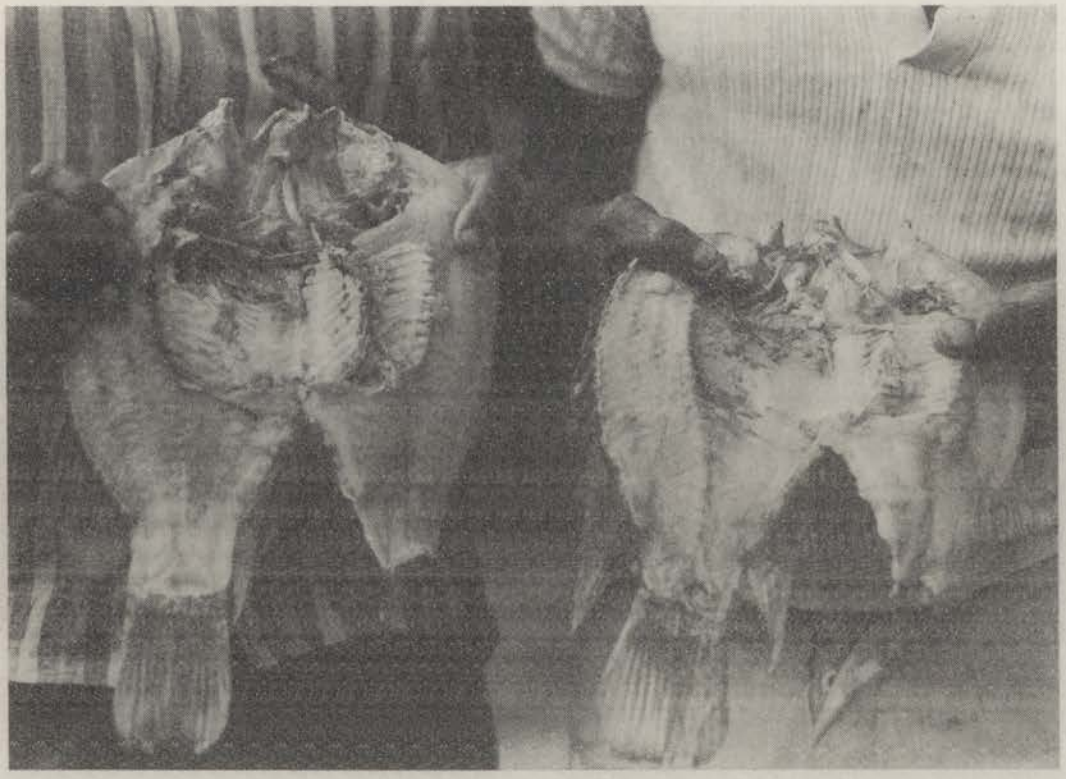


Plate IV.—Tilapia ready for smoking. The fish has been split from the back and cleaned. It will be soaked in brine before smoking

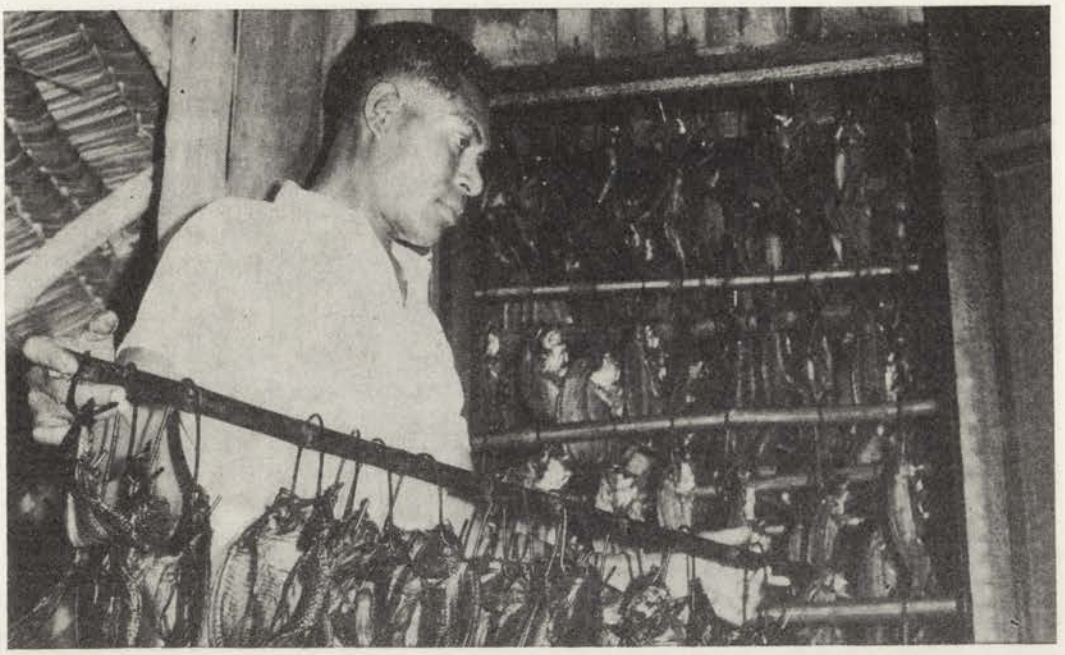


Plate V.—The fish in the smokehouse

smoke and then the fires are damped down to merely smoulder. This process is called "hot-smoking" and is the only really feasible one in the tropics owing to the humidity encounted (*Plate* 5).

Local fisherladies also smoke their fish so that it will keep long enough to reach market. In this case, however, the fish is partly cooked and slightly smoked over an ordinary fire. It serves quite well, for the fish can, say, be canoed to a point such as Pagwi and then sent by passenger truck into Wewak and still be fresh enough for market.

Distribution

As always in Papua New Guinea, a big problem is that of suitable transport. This hindrance is not unique to the fishing industry. Mr McKinnon has a DCA commercial licence to fly fish to the Highlands in his own Cessna. The distance between Angoram and the Highland main centres is not very far, thus two flights a day are quite feasible.

The problem now seems to be that of the organization of sales in the Highlands and other places where fish should be in good demand. Consumer preferences will have to be studied, of course, but it is expected that smoked tilapia will be very popular.

Prices, of course, require careful consideration, for such things as canned mackerel from Japan and Korea are established favourites at very low prices and therefore constitute a real source of competition. It is expected that the hotel and other more lucrative trades will accept tilapia fillets carefully prepared and of good quality. For the European tastes it may be necessary to skin the fillets, for the skin is somewhat dark. The flesh, however, is very acceptable and of good colour, provided that it is carefully handled from start to finish.

The Future

Fisheries research is being carried out on tilapia right now. It will also be necessary for our economists and marketing experts to find out the full extent of demand and preference in Papua New Guinea centres and possibly overseas. Lake Victoria (East Africa) tilapia fillets are exported to many places overseas and there seems to be no reason why our fish cannot also be exported. There may even be some possibility of canning tilapia or otherwise producing an acceptable product. Right now, of course, Papua New Guinea requires lots of low-priced protein and this is the line we should pursue as an immediate aim.

There could be a bright future for our Sepik fisheries. One thing is certain, there are no hungry children along the Sepik now.

Fresh Fruit and Vegetable Marketing

F. D. EGGELTON, Economist

Rural Economics and Commodity Research Branch

In 1970/71 imports of fruit and vegetables into Papua New Guinea amounted to $3,580,000. Over a million dollars worth of these were fresh foods, the rest being mainly canned or frozen. This seems a considerable amount but it is really quite small when compared with the total amount of fresh food grown and consumed in the country. However imports are still increasing for these reasons:—

1. Some fruit and vegetables are not grown in Papua New Guinea at all because the climate is unsuitable. Examples are grapes, apples, pears, peaches and apricots and mushrooms.

2. Some areas of Papua New Guinea can produce more fruit and vegetables than are needed while other areas need more than can be grown. In the past the problems of organization of marketing and transport have prevented development of the fresh food industry on a nationwide scale.

3. It is found that as indigenes' incomes rise, they tend to buy more temperate climate vegetables and less kaukau, sago and other traditional foods.

DASF economists have been studying the fresh fruit and vegetable situation for some time. They have looked very carefully at the present markets and the quantities of goods being traded there and they have considered ways by which locally produced vegetables can replace imported vegetables sold in shops.

Plate 1.—The easy way for a grower to market his produce, a truck comes to his village and he is paid cash on the spot

Photo: D.I.E.S.

SURVEYS OF PRODUCTION AND MARKETING

There have actually been three surveys carried out in the last year. The first involved a study of the situation in Port Moresby and the area along the Rigo Road. It was found that local producers were eager to alter present marketing arrangements, and that they had begun to accept changes in their traditional production to fit in with market demands. They had greatly increased the amount of fruit and vegetables grown and sold in the market since the road was first upgraded to all-weather status. There was still land available and villagers were willing to increase production still more, if they could be sure of selling their produce.

The second survey was an initial look at the supply and demand for fresh fruit and vegetables on a national basis. Using Port Moresby, Lae, Madang and Wewak as representative areas, investigations were made into the present volume and source of supplies to urban centres. Attention was focused on the amount, type and value of produce going through the market, being consumed by institutions and being supplied by retailers. It was found that in Lae 71 per cent of the total locally produced vegetable trade went through the market, in Madang 65 per cent, in Wewak 50 per cent and in Port Moresby 43 per cent. It was also found that the demand for particular types of fruit and vegetables varied according to the district. For example, kaukau (sweet potato) was the most popular item traded in Lae and Madang but only fifth most popular in Wewak and fourth in Port Moresby. This highlights the need for regional planning rather than local area planning. For economic reasons it may be necessary to link areas of high demand to suitable production areas by low cost freight systems. The area where the produce is grown, should be connected by road to the town where it is to be sold. If the only method of transport to market is by airfreighting, the extra cost involved may make the produce more expensive than imported food. Airfreighting is

Plate II.—Selling at Koki Market may take all day—but many people like spending the day that way
Photo: D.I.E.S.

not only expensive, it is also unreliable, because air cargo may be offloaded from an aircraft. Transport by canoes or workboats is usually cheap but time schedules may be unreliable. This survey also looked at the overall increase in demand for both locally grown and imported fresh foodstuffs over the next 10 years.

The third survey involved an investigation of the potential development of the area to be served by the proposed Hiritano Highway and its effect on the Port Moresby market. This road will run west from Port Moresby to Bereina. It was found that, as soon as the road is completed, up to 13,000 tons of fresh produce could be grown each year. Plans are now being made so that work can start on this as soon as possible.

WHOLESALE MARKET PROPOSAL

From these surveys it was clear that it was easily possible to increase the production of fruit and vegetables in Papua New Guinea but there would be considerable problems in transport and marketing to be overcome. It was felt that a wholesale market was needed and that initially this should be conducted by the Administration on a trial basis. Once it was proved that it was economically successful, it would be handed over to some other organization to operate.

In August, 1972, the Minister for Agriculture, Stock and Fisheries obtained approval for a joint study by DASF and Department of Business Development into the practical and financial problems involved in setting up a wholesale market in Port Moresby. This study will include the setting up of such a market in temporary facilities and will look at what growers need in the way of marketing facilities, transport and packaging in order to sell fruit and vegetables in bulk.

The day-to-day running of this trial facility will be under the control of a DASF officer. He will keep in close contact with growers in areas around Port Moresby as well as growers in other parts of Papua New Guinea who may want to sell produce in Port Moresby. The study committee will also keep in close touch with the Port Moresby City Council, Koki Market Trust, the Development Bank and with people interested in selling fruit and vegetables in Port Moresby.

This trial operation will enable the Government to work out what form of wholesale market is best suited to the needs of growers and buyers in Papua New Guinea. It will also help to resolve the form of management required to operate such a facility in this country.

Since this will only be a wholesale market it will not compete with any present retail business, nor will it affect Koki Market or any proposed market developments which may occur around the urban area.

If this proposed wholesale facility proves to be satisfactory for both buyers and sellers, it is anticipated that similar markets will be set up in other urban areas.

KUBUNA RUBBER FACTORY—*continued from p.* 101

rising cost of labour is not such a problem in this situation. Blocks are usually worked by the owner and his family, so the cost of hiring labour is saved. The young trees planted on these blocks are modern, high-yielding varieties, which will give a better production rate than the old trees of the low-yielding varieties which make up much of the plantation rubber in Papua.

Increased production from smallholder projects may be able to offset declining production from older uneconomic plantations, enabling Papua New Guinea to maintain its place in the world rubber market. Although Papua New Guinea production is not large by world standards, and rubber is only a minor export crop compared with such crops as coffee and coconuts, even the small amount of export income earned is needed. As all of Papua New Guinea's rubber is bought by Australia, the Australian currency earned through this export will help offset the costs of products imported to Papua New Guinea from Australia, and will assist in maintaining future trade relationships between Australia and an independent Papua New Guinea.

Integrated Farming—Would it Work in Papua New Guinea?

IAN R. WATT, Pig Husbandry Adviser

Tropical Pig Breeding and Research Centre, Goroka

The use of animal faeces for the production of methane gas, algae, fish, fertilizer and irrigation water is practised in several countries of the world. The system works on the principle that waste matter is collected in a tank (the digester) and is broken down by bacteria to simpler substances. At the same time a gas, methane, is given off, which can be used for heating or lighting. The "simpler substances" are used as food for algae (green water weed). The algae then provide food for fish, ducks or pigs. These in turn become food for man.

Considerable attention is being given to the possibility of such a system of management being introduced into villages all over Papua New Guinea. A model unit has been established at Port Moresby and a much larger unit is under construction at Bomana Corrective Institution. The main purpose of these models is for the production of methane gas from animal waste matter, but the system has considerable agricultural implications.

The theory of the integrated system of farming works along the lines that waste matter is washed into a tank in which anaerobic breakdown or digestion takes place. A result of this digestion is the production of methane gas which is stored by means of a floating top on the tank. The waste matter and water are held for 24 hours in the tank and then overflow into an algae pond when the next day's waste material is washed into the tank. The overflow encourages algal growth which is harvested daily and fed wet to animals as high protein food. Water flows from the algae pond to the fish pond which produces fish for the animals and farmer. Ducks are also kept on the fish pond and these support themselves on larvae and algae. The overflow from the fish pond is used to irrigate an area of garden in which food is grown for the farmer and animals. The animals recommended for the system are pigs and poultry.

The idea of a complete farm enterprise in this sense is practised extensively in Taiwan and China. There is no doubt that it works effectively in these countries where there are high populations as well as severe land pressures.

Mr G. Chan, Lecturer in Environmental Health at the University of Papua New Guinea, presented a paper at the Sixth Waigani Seminar entitled "Waste Utilization in Rural Industrialization (with particular reference to the South Pacific)." He has also been instrumental in having two model units built—at Port Moresby and the Bomana Corrective Institution—as well as having a demonstration model working at the 1972 Papuan Agricultural Show. This has naturally created much interest in the system which is causing some concern to the Department of Agriculture, Stock and Fisheries as the system has considerable agricultural implications which the Department is not yet prepared to support.

Methane gas is produced at the experimental unit built at the Council Health Services Centre, Boroko. Algae have also been grown, and fish, ducks and vegetables. This does not necessarily mean that the system is a viable one for Papua New Guinea merely because it has worked on a small scale in Port Moresby. Besides certain technical aspects which could cause a breakdown in the system, there are social implications to be considered.

Presumably the village people of Papua New Guinea would be the people most likely to benefit from such a system as this. It is generally recognized that these people have a traditional dislike of food which has been fertilized with animal or human waste. At the moment DASF is more concerned with the technical aspects. These include:

1. Does the air temperature affect digestion and gas production?
2. Is a good water supply needed for high gas production?

3. What loading of faecal waste-matter gives the optimum level of production?
4. What are the labour requirements to maintain a family unit?
5. What sort of training would a farmer require to operate one of these units?
6. What sort of financial return can the farmer expect from the total enterprise?
7. What stocking rate will give optimum results?
8. What level of production can be expected from the algae and fish ponds? Is this enough to maintain the animals?

Experience of DASF officers in the past has suggested that pigs and fish ponds have not worked well when put together. One problem has been that frequently the supply of faeces was too great for the size of the pond. This was the cause of most of the failures in the Western Highlands District, where quite a few "fish/pig" projects have been tried. It may be that putting the faecal matter through the digester will overcome this problem.

Experience has also shown that pig project owners are reluctant to supply water in sufficient amounts to water their stock, let alone to wash faecal matter in the digester. They are also reluctant to feed their animals properly and in some cases do not maintain adequate gardens.

These and many more important points need to be clarified before DASF can support the adoption of this system.

The Tropical Pig Breeding and Research Centre at Goroka has set up a research programme to investigate these and other aspects of a technical nature in conjunction with Mr Chan. When this work has been completed we will be in a position to see whether the system is suited to coastal and highland conditions, whether it is technically sound and whether it could have a place in the villages of Papua New Guinea.

New Opportunities for Training in Agriculture

1973 will see two big steps forward in agricultural education in Papua New Guinea. The Faculty of Agriculture at the University of Papua New Guinea will commence a 4-year course leading to the degree of Bachelor of Agricultural Science, while DASF will open the Highlands Agricultural Training Institute which will concentrate at first on providing further training for staff already in the department.

The University course in Agriculture will, in general, follow the Science course for the first 2 years, though the study of Economics will be included right from the start. In the third year it will concentrate on specific aspects of agriculture, and in the fourth year the students will move to Lae where there are greater opportunities to see a diversity of agricultural developments. The course in Lae will be conducted at the Institute of Technology which has excellent facilities for instruction in agricultural engineering.

At the Highlands Agricultural Training Institute the students will, for the most part, be Rural Development Assistants and Project Managers. Some of these officers have had considerable experience in the field but they have missed the opportunity for advanced agricultural training. To make up for this lack, the course will broaden their general education and give them specific training in farm management, extension methods and rural credit facilities. Probably the most frequent help asked of DASF field staff is by farmers wishing to apply for a loan from the Development Bank. All extension staff should be able to assist in this matter. The course is primarily designed for DASF staff but applications will be considered from those who have had similar experience in private enterprise.

Vudal Agricultural College and Popondetta Agricultural Training Institute will continue to operate their current programmes. Entry to these institutions is not limited to those already connected with DASF, nor does it involve any kind of bond to the Department.

Pasture Work in the Grasslands of the Northern District—Part 1

J. F. CLANCY, Livestock Lecturer

Popondetta Agricultural Training Institute

A considerable amount of research on pastures has been carried out at the Popondetta Agricultural Training Institute. To appreciate the problems, it is necessary to know something of the soil and climate of the area, so these facts are given first. The article gives details of a wide variety of legumes and grasses tested under normal grazing conditions.

Soil Type

The soil is known as Popondetta sand. It is a sandy pumice, severely leached and very porous. Average topsoil depth is 5 in, merging into a coarse sandy subsoil to a depth of 8 ft. Underlying this is a gravel aggregate. Generally this area is known for its nitrogen and sulphur deficiency and its poor moisture-holding capacity.

Vegetation

Owing to subsistence gardening and cash cropping, there is little climax forest left. Most of the area consists of secondary regrowth, interspersed with large areas of cane grass, blady grass, spear grass and kangaroo grass. This kind of grass mixture is frequently called "kunai" or "kunai complex', although botanists will insist that only *Imperata cylindrica* should be called "kunai".

Rainfall

Monthly rainfall average 1966-1969 inclusive:—

Month	*Points*	*Wet days*
January	1265	17
February	1290	15
March	841	13
April	1006	11
May	808	12
June	382	8
July	186	7
August	476	8
September	251	8
October	391	13
November	834	16
December	1080	17

PASTURE PERFORMANCE

The type of pasture initially planted on P.A.T.I. was determined largely by the amount of planting material available of promising species already growing well in ungrazed trials in the district. The same grasses were planted for local native cattle projects. The species available were:—

Grasses

1. Elephant grass (*Pennisetum purpureum*)
2. Guinea grass (*Panicum maximum*)
3. Para grass (*Brachiaria mutica*)
4. Molasses grass (*Merlinis minutiflora*)
5. Ruzi grass (*Brachiaria ruziziensis*)

Legumes

1. Centro (*Centrosema pubescens*)
2. Siratro (*Phaseolus atropurpureus*)
3. Puero (*Pueraria phaseoloides*)
4. Calopo (*Calopogonium mucunoides*)

The performance of these species under grazing is outlined below. The pastures were grazed at one beast per acre per year using a grazing cycle of 1 week in 5.

Elephant Grass and Siratro

After 6 months rotational grazing, Elephant grass showed signs of a severe nitrogen deficiency. There were very few leaves compared with the amount of stalk present, and the clumpy nature of the grass allowed a serious infestation of "broomstick" (*Sida rhombifolia*). The grass was slashed to stimulate new growth of leaves, and this renovation was repeated each year.

The Siratro established well with the Elephant grass but was severely attacked by insects. Skeletonizing of the leaves was so severe that Siratro barely existed after 2 years.

Guinea Grass and Siratro

Guinea grass tended to clump more than the Elephant grass, allowing a higher weed infestation. Nitrogen deficiency was even more evident. The performance of Siratro was the same as when planted with Elephant grass.

Molasses Grass

This species is easily established by seed, and produces a good ground cover. It is not very palatable and suffers heavily from trampling. Molasses grass burns easily, and in this district annual large-scale burning is practised. So there is always the danger of fire spreading to this pasture, which makes it unsuitable for most projects. Furthermore, often it will not re-establish after burning.

Para Grass and Siratro

Para proved an excellent grass on low-lying ground, especially on ground near streams where the water-table is not severely affected in the dry. On ground where the water-table drops considerably during the dry, Para suffered severely. Siratro was again unsuccessful due to insect attack.

Ruzi Grass and Centrosema

Ruzi grass cuttings established quite well on thoroughly prepared ground. Recovery after grazing was very slow. This species has now disappeared from the paddock. Centro established well but was severely affected by mosaic virus. It has spasmodic flushes through the year, but is very unreliable.

Pueraria

A pure stand of Pueraria was subjected to rotational grazing. It was obvious at the beginning of each grazing period that the natural grasses *Paspalum conjugatum* and *Paspalum paniculatum* were getting the upper hand Pueraria is severely affected if grazed during the dry season. Four years of grazing has virtually wiped out the species.

Calopogonium

This legume is naturalized in this area. It is not palatable to stock and is a problem because it competes with establishing pastures, especially on cultivated ground.

LOCAL CATTLE PROJECTS

Elephant grass, Ruzi grass and Para grass were used on local cattle projects. In the majority of cases the species proved unsuitable, the reasons being:—

1. Only small areas were planted. The labour involved in hand-planting discouraged project owners to continue their planting programme.
2. Ruzi grass is not suitable for this soil.
3. Elephant grass cannot be managed successfully under average project management without machinery.
4. The abovementioned species do not produce viable seed in this area, so natural reproduction is limited to vegetative regrowth, which is impossible under project management systems.
5. Overgrazing of these small areas resulted in an extremely severe weed problem.

PASTURE WEEDS

The six main weeds are:—

Broomstick (*Sida rhombifolia*)

Potato tree (*Solanum verbascifolium*) (see *Plate* I)

Digitaria longiflora

Sensitive plant (*Mimosa pudica*) (see *Plates* II and III)

Ferns

Roman Candle tree (*Cassia alata*)

Of these species, all except Broomstick and Sensitive plant are potentially poisonous. Occasional deaths—which might have been caused by plant poisoning—have occurred on projects where cattle were forced to graze these weeds on overstocked pastures.

It would be thought that Leucaena would suit our coastal high rainfall conditions. Many cattle projects already had areas of this species which had been planted for coffee or cocoa shade. Stands cut back for grazing were very slow to recover after grazing and it has generally been accepted that Leucaena on this soil area and under project management is not a successful grazing legume.

NEW SPECIES TESTED

To rectify the problems outlined above, a pasture mixture with the following qualities was required:—

1. Can be established by seed, preferably into a kunai burn;

Plate I.—This is a 3-year-old stand of Elephant grass, Para grass and Pueraria, completely overrun by Potato Tree and ferns

Plate II.—The foreground shows an Elephant grass pasture recently burnt. Twelve months ago this pasture was similar to the paddock in the background. Note the Sensitive Plant creeping in the foreground (arrow)

Plate III.—A 2-year-old stand of Elephant grass completely overrun with Sensitive Plant, Potato Tree and ferns

2. A hardy grass and legume mixture suitable to our soil conditions;
3. A pasture which can be managed satisfactorily without machinery;
4. A pasture which establishes quickly and supplies a good ground cover to compete with weeds.

With these factors in mind the following trial was carried out at P.A.T.I.:—

An area of one acre was selected and harrowed twice. The following species were planted:

Grasses

American Buffel (*Cenchrus ciliaris* cv American)
Biloela Buffel (*Cenchrus ciliaris* cv Biloela)
Green Panic (*Panicum maximum trichoglume*)
Hamil grass (*Panicum maximum*)
Rhodes grass (*Chloris gayana*)
Kazungula Setaria (*Setaria anceps* cv Kazungula)
Paspalum plicatulum
Brachiaria decumbens

Legumes

Lotononis bainesii
Silverleaf (*Desmodium uncinatum*)
Dolichos axillaris
Tinaroo (*Glycine javanica* cv Tinaroo)
Stylo (*Stylosanthes guyanensis*)
Perennial Cowpea (*Vigna luteola*)
Greenleaf (*Desmodium intortum*)

The trial was rotationally grazed at the rate of one beast per acre per year. The stocking intensity during grazing periods was eight cows to the acre.

Lotononis and Rhodes grass did not germinate so they were not included in the result. *Table* 1 sets out the results of the trial. "Exc'nt" means "excellent"; "Recovery" means not only the speed of recovery but also the amount of leaf produced after grazing.

Results

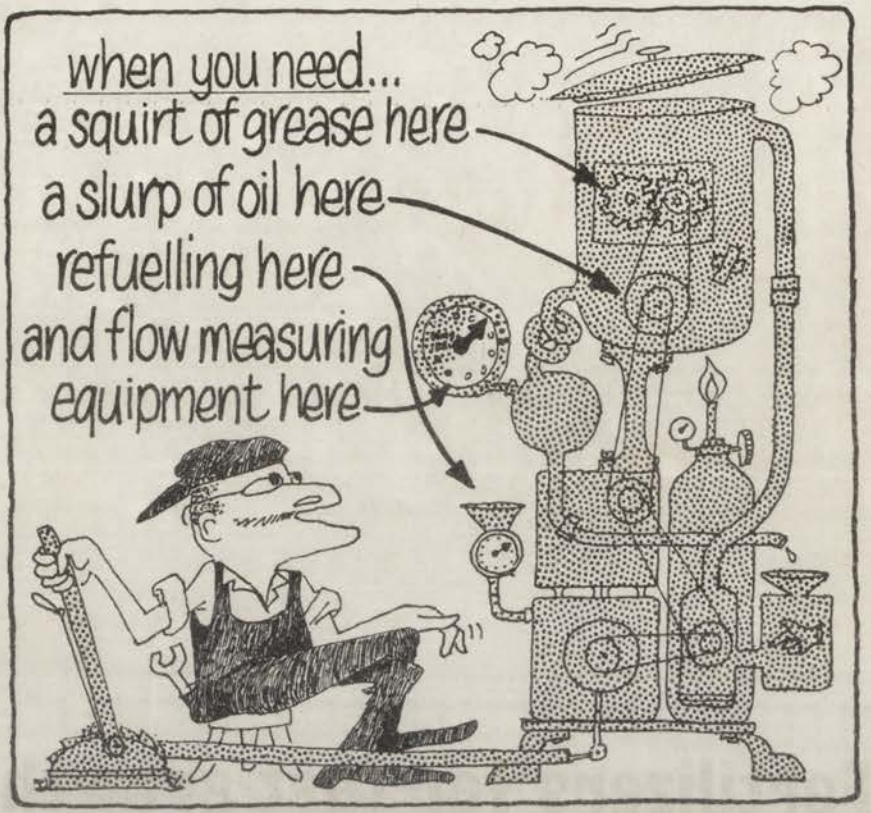
From *Table* 1 it is clear that the most promising grass species were *Paspalum plicatulum* and Kazungula Setaria. Most promising legumes were Stylo and Greenleaf Desmodium.

Following on from this trial a series of pastures were established, to test various combinations of grasses and legumes. Results of these trials are reported in Part II of this article which will appear in the next issue of *Harvest*.

Plate IV.—Kazungula Setaria in the trial after 12 months grazing. The photographer put his boot in the photo to give an indication of size

Table 1

Species	Palatability: Establishment	Palatability: Recovery	Remarks
Grasses			
American Buffel	Good	Fair	Tended to become woody—did not spread in trial
Biloela Buffel	Good	Fair	As above
Green Panic	Good	Exc'nt	Very soft and suffered from trampling. Did not spread
Hamil	Exc'nt	Good	Became very woody and showed nitrogen deficiency. Definitely requires mechanical control.
Kazungula Setaria	Exc'nt	Exc'nt	Spread well, vegetatively and by seed
Paspalum plicatulum	Good	Exc'nt	Spread by seed
Brachiaria decumbens	Fair	Exc'nt	Spread vegetatively
Legumes			
Silverleaf Desmodium	Fair	Good	Nil	Disappeared completely
Dolichos axillaris	Poor	Fair	Good	Thickened up gradually; a promising climbing legume not prone to virus or insect attack
Tinaroo Glycine	Good	Exc'nt	Poor	Disappeared eventually
Stylo	Exc'nt	Fair	Exc'nt	Spread vegetatively and by seed. Age improves palatability
Perennial Cowpea	Exc'nt	Exc'nt	Nil	Insect attack. Disappeared completely
Greenleaf Desmodium	Exc'nt	Fair	Exc'nt	Spread vegetatively



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