harvest

SECOND QUARTER

1972

VOLUME 2; NUMBER 2

PAPUA NEW GUINEA

Registered at the G.P.O., Port Moresby, for transmission by post as a qualified publication.

Harvest is published quarterly by the Department of Agriculture, Stock and Fisheries under the authority of the Minister of Agriculture, Stock and Fisheries. It is distributed free to primary producers and other qualified persons.

harvest

Cover Photo—

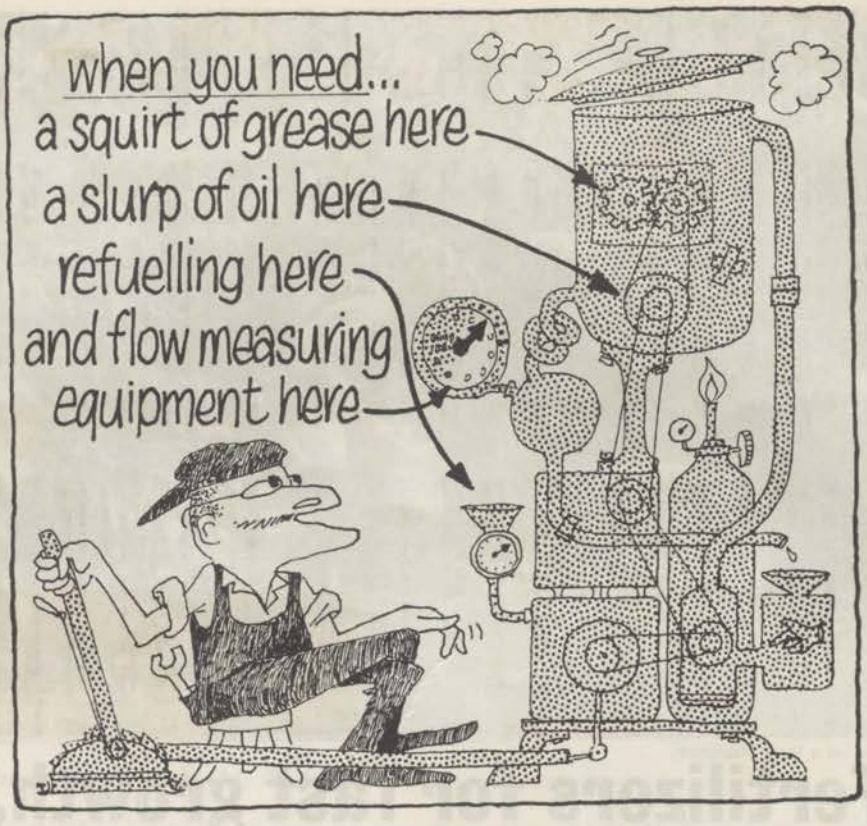
Sawing of the beef carcass at Tiaba Abattoir near Port Moresby. The slaughterman uses the power-operated saw causing the minimum of saw burns and bone dust. Sawing-down time is between one and two minutes, depending on the size and age of the beast.

(Photo—M. Ondrasek)

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



Macnaught's got it made!

Macnaught make grease guns, pumps, lubricators and liquid flow measuring equipment. The best available.

Whatever you do, Macnaught can help you do it better. Their maintenance systems ensure clean fuel, clean oil, clean grease for your machinery, your trucks and cars, your materials handling equipment.

Macnaught maintenance systems help keep your business running trouble-free.

Macnaught maintenance systems include a range of hand-operated lubricators for 5 and 45lb tins, grease guns, measuring equipment and grease, oil and fuel handling pumps.

MACNAUGHT
MAINTENANCE SYSTEMS

Distributed throughout Australia by CASTROL AUSTRALIA PTY. LIMITED

MAC 2420.24

"BURNS PHILP (NEW GUINEA) LTD."

Shell fertilizer in use on a local plantation.

Fertilizers for fast growth, fast profit. From Shell Chemical.

Shell Chemical's world wide experience in the field of tropical agriculture is your guarantee of fertilizers which work hardest to increase plantation vegetables and rubber.

Check with your local Shell Chemical supplier for his recommendations on the type of fertilizer best suited to your conditions and crop... for most profitable results.

For ready supplies of Shell Fertilizers, plus advice and directions on their use, contact:

N. J. Camps — Mt. Hagen
P. Harbeck — Banz
Collins & Leahy — Kundiawa
Shell Company (Pacific Islands) Ltd; or Burns Philp (N.G.) Ltd. — Goroka.
Booij Bros. — Kianantu
Wau Valley Motors — Wau
Shell Company (Pacific Islands) Ltd., P.O. Box 169, Port Moresby

Shell Chemicals SHELL

SC706/SP1107

harvest

Vol. 2, No. 2 Second Quarter, 1972

CONTENTS

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

Teaching of Agriculture in Primary Schools

K. C. ROGAN, Superintendent (Curriculum) Primary, Department of Education

As a result of representations from members of the Primary Curriculum Seminar, the Director of Education has agreed in principle to the teaching of Agiculture in primary schools. At a meeting of the Agriculture syllabus sub-committee held in Madang in March, members produced a programme of suggested activities, and copies of the programme were subsequently forwarded to 30 *developmental schools.*

The suggested programme is divided into two sections. The first section sets out some general activities and the second section deals with the project approach to the teaching of Agriculture. The programme is not a detailed one. However, it will be extended and modified during the year as a result of suggestions received from developmental schools. It may be possible to design a number of programmes, or alternatively, a single broad programme which will enable many more schools to teach Agriculture during the 1973 school year.

The Department of Agriculture, Stock and Fisheries is giving its full support to the programme and has already assigned Rural Development Officers to act as advisers to developmental schools. Teachers are responsible for putting the programme into operation and Rural Development Officers will be available to give advice and other assistance (but not classroom teaching!).

The objectives of the Primary Agriculture teaching programme are as follows:—

1. To show children that they can have a satisfying life in the rural areas through involvement in the life of the community.

2. To help children to appreciate and understand traditional agriculture so that they will come to value this as a part of their own culture.

3. To help children to appreciate and understand the important role that their parents and other traditional agriculuralists play in the development of the country and thus to foster greater respect for traditional farmers and their rural way of life.

4. To show children that a study of traditional agriculture can help them to grow other crops.

5. To teach children how animals and plants work and of the balance of nature. To show how plants are affected by weather, soil, insects, diseases and other plants.

6. To show children that they can improve their diet by introducing better and/or different plant varieties and farm animals.

7. To teach children how to look after and feed farm animals.

8. To teach children to appreciate the beauty of much of their fauna and flora and hence the value of conservation including soil conservation.

SUGGESTED ACTIVITIES

Class I and Standard I

A. Build up a vocabulary of words about farming and markets—words such as banana, taro, dig, plant, pick, carry, sell, market, cost, price.

Oral and written composition lessons about visits to gardens and markets.

B. Visits to gardens and markets. Activities based on these visits "What I saw", "What I did", map of garden or market, drawing of the people doing things.

Keep a class diary of the weather and what is happening in the gardens.

C. Each child will look after a very small garden and help to keep a class diary of the life cycle of a plant.

Standard II

In Standard II there should be a constant theme of helping parents. Teachers should encourage pupils to help their parents in the garden or markets during the weekends. Then on Monday the teacher will ask the children to tell how they helped their parents and devise language drills and oral and written composition exercises on this theme.

Children in Standard II should be encouraged to keep an individual agriculture diary. This will be a record in drawing and sentences about what each child observed and did with

parents and villagers in the gardens, e.g. weeding, harvesting, clearing, planting, fencing and marketing. Each child should be able to write two to four sentences.

The diary can be written in a long sentence book or in a book made of scribble pad pages. The teacher should help the children to use sentence patterns from language drills lessons.

Parents could be asked to visit the school and talk about current agriculture activities and the reasons for them.

Pupils could visit gardens and gradually build up a list of what the farmer does about these things—weather, soil, the different types of plants and weeds, plant diseases, insects, livestock and fish ponds.

Pupils could keep a rough record of whether it rained heavily, lightly or not at all, whether it was windy or not, whether it was hot or cold, where winds came from and whether there was a high tide.

Standards III and IV

Pupils should be encouraged to collect different plants and seeds in the garden and to collect all animals living on the plants and in the soil.

They should try to see the relationships between living things in the gardens, and find out what eats what. These observations could be recorded by drawings and using arrows.

(Photo: D.I.E.S)

Plate I.—An agricultural project at Balupwine Primary School, East Sepik District.

(Photo: D.I.E.S)

Plate II.—At Balupwine School all boys and girls are involved in the agricultural projects.

Each standard looks after its own garden and its own farm animals. The children would also take part in school projects.

Pupils should visit people working in the gardens and, back in the classroom, discuss the life of the farmer and how useful he is in the community.

Pupils should find out how a farmer earns his money and what he spends it on. They should also find out what happens to commercial crops in the area, e.g. coconuts, coffee, rubber, pyrethrum, fish and cocoa.

Standards V and VI

Pupils should study how animals work and the types of food they need, how a plant works and how it makes its food.

Get pupils to study different soils and see what kinds of plants grow in the different types of soil. Point out that there is a need for fertilizers for certain types of crops.

Pupils should visit a lot of farms and see management, good and bad. They should learn costs of various objects such as farm tools and fertilizers, together with the prices of produce such as sweet potato, coffee, etc. They should come to understand the use of credit facilities such as those offered by the Development Bank.

In Standard VI it is very important for children to draw the conclusion that crops can be grown for a profit.

Reference books for Standards V and VI is "Introduction to Tropical Agriculture"—Sutherland. "Basic Science Series".

Throughout the 6-year primary course there will be many opportunities for teachers to correlate the teaching of Agriculture with teaching in other subject areas. In the programme we have included a number of suggestions where this correlation could be attempted in

vocabulary, oral and written composition, mathematics and measurement, and Social Studies.

For the schools that wish to adopt a project approach to the teaching of Agriculture a number of suggestions have been given with regard to size, length, siting and correlation with other subject areas. This section stresses the need to involve the community in all stages of the planning of school projects.

Developing countries such as Papua New Guinea normally depend on the improvement of Agriculture for their future progress. Our programme of Agriculture teaching will therefore attempt to create an interest, a knowledge and an awareness to school children of rural activities and possibilities and give future growers of subsistence and cash crops some basic knowledge of Agriculture practice.

Members of the Primary Curriculum Seminar stressed that there was a need for our schools to become more involved with the communities around them. The suggested programme in Agriculture should give primary teachers many opportunities for worthwhile interaction between school and community.

Dwarf Coffee Seems Promising

A. E. CHARLES, Chief Agronomist.

Much interest has been shown in trial plantings of recently introduced dwarf varieties of coffee at the Highlands Agricultural Experiment Station, Aiyura (see *Harvest* Vol. 1 No. 1, pp. 10-11). As the trees are only four years old it is too early to make any definite statement about yields. However, in the first year of bearing the best dwarf variety gave yields per tree which were as high as the yields from many of the normal varieties. As all varieties were planted at the same spacing, the full potential of the dwarf trees was not being realized and it is possible that at a closer spacing the dwarf trees could give high yields per acre. It is of interest that the dwarf San Ramon variety (which was introduced to New Guinea pre-war) in a trial at Aiyura, when planted at 5 ft x 5 ft spacing has given yields almost as high as Arusha planted at 8 ft x 4½ ft.

While the variety is not recommended for large-scale planting, limited quantities of Caturra Dwarf (red fruit) will be made available to growers who would like to establish small plots for observation. Such plots would serve as a source of seed if later results show the variety to be worth planting on a larger scale.

The dwarf varieties have short internodes and form much more compact bushes than normal varieties. However, they do continue to grow and eventually become quite large bushes.

Requests for Caturra seed should be addressed to:

Agronomist-in-Charge,
Highlands Agricultural Experiment Station,
Aiyura, via Kainantu,
Eastern Highlands District.

Recent Advances in Yield Stimulation of Rubber

R. J. McDONALD, Iloilo Estates Pty Ltd, Port Moresby

Despite competition with synthetic rubber, the natural rubber industry is still an expanding industry. Each year it increases its production, and it is consistently selling its entire producton. The sharp fall in rubber prices over the past few years (Figure 1) *however, has made it essential for the industry to develop cheaper methods to remain viable. While the rubber industry has not yet fully evaluated the use of the new stimulant Ethrel, it is a major hope that this product will make natural rubber more economically competitive with synthetic rubber.*

Following this article there is a report of trials on Ethrel carried out by DASF staff at the Bisianumu Rubber Centre on the Sogeri Plateau, Central District.

Remarkable advances in rubber production have been achieved over the years, through selection of high-yielding clones, improved nursery and field selection methods, use of fertilizers and so on. High-yielding clones have been developed which have produced up to 6,000 lb/acre/year. Many established stands, however, consist of much lower-yielding trees and it is on these older stands that the newly developed stimulants are expected to be of greatest value.

THE CONCEPT OF PLUGGING

Little is known of how and why latex is produced in a rubber tree. It is manufactured when the tree is wounded—the tree is then exploited by tapping which is only a sophisticated form of wounding.

Immediately after tapping, latex flow is quite rapid; it then slows down progressively and finally stops. If a tree is re-cut ten minutes later the flow increases sharply and this procedure can be repeated several times with the same result. (*Figure* 2).

This means that very soon after tapping some sort of barrier develops in the latex vessels close to the cut, and this is removed by further tapping. Thin sections of bark have been studied using an electron microscope and photographs have been obtained showing the

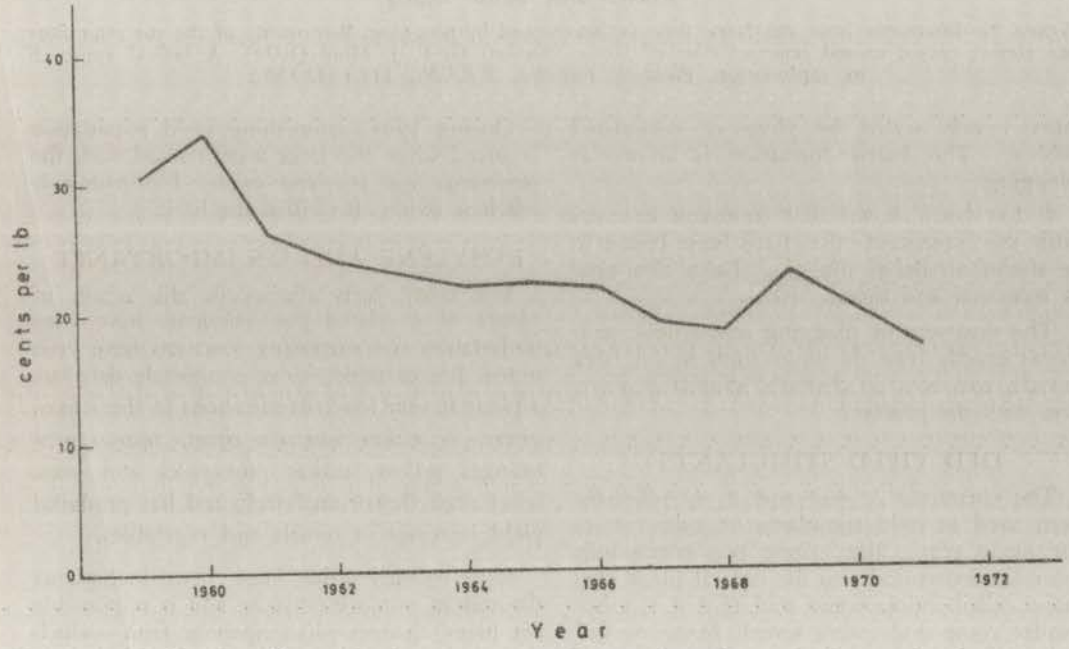


Figure 1.—Decline in rubber prices in recent years. Current Australian price is around 16 cents per lb (R.S.S.). (Graph by courtesty of Economics Section, DASF.)

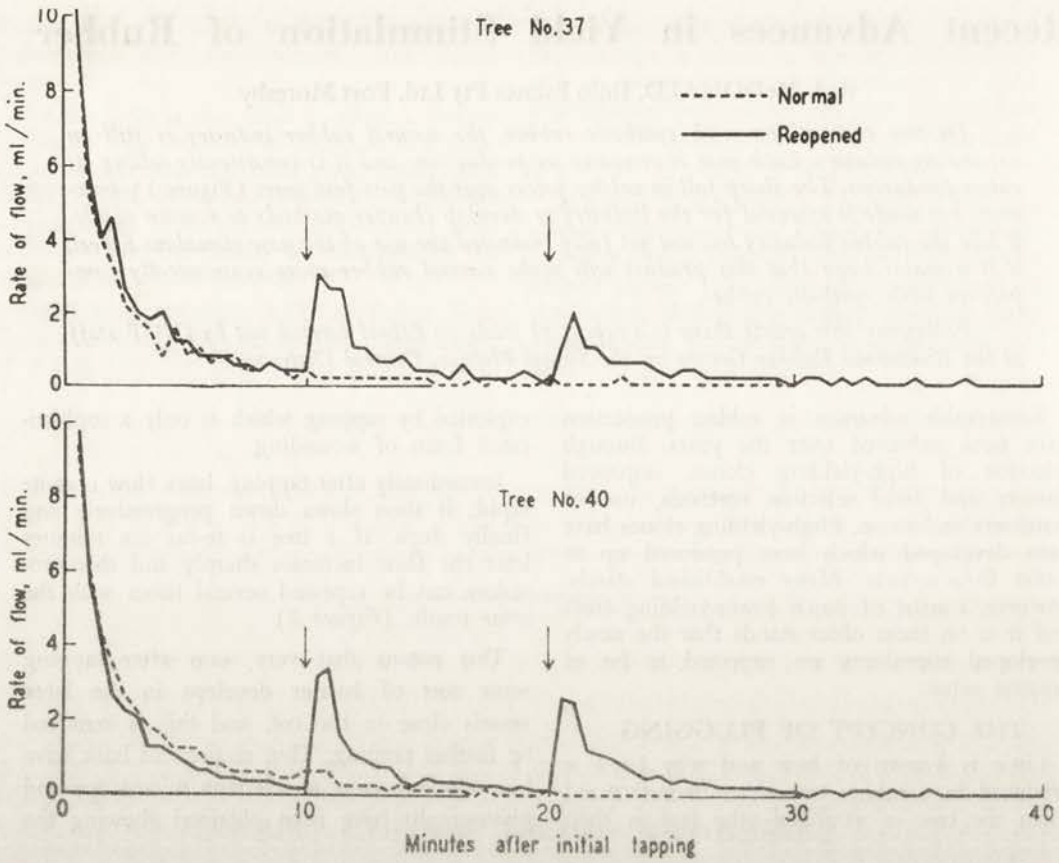


Figure 2.—Illustrates how the latex flow is interrupted by plugging. Re-opening of the cut after flow has almost ceased caused renewed flow of latex. (Source: G. F. J. Moir (1970). A radical approach to exploitation. *Planters' Bulletin, R.R.I.M.*, 111 : 342-350.)

latex vessels sealed by plugs of coagulated rubber. This barrier-formation is known as plugging.

It has been shown that treatment of trees with the compounds that have been found to be stimulants delays plugging. Latex flow-time is increased and thereby yields.

The discovery of plugging raised new questions: exactly how do plugs form in cut latex vessels, and how do chemical stimulants interfere with the process?

OLD YIELD STIMULANTS

The chemicals 2, 4-D and 2, 4, 5-T have been used as yield stimulants on rubber trees for many years. Since these two compounds are related chemically to the natural plant hormone called indole acetic acid (I.A.A.), other similar compounds were tested. Many proved to be stimulants, but none was really very much better than 2, 4, 5-T.

During 1961, astonishing yield stimulation occurred when the trees were treated with the poisonous gas ethylene oxide. Unfortunately ethylene oxide also killed the bark.

ETHYLENE AND ITS IMPORTANCE

For many years studies of the action of plants of a related gas, ethylene, have been undertaken and surprising reactions have been noted. For example, it can completely defoliate a plant at very low concentrations in the atmosphere, it makes bananas ripen, turns green oranges yellow, makes pineapples and some other fruit flower uniformly and has produced yield increases in cereals and vegetables.

More recently it has been found that plants themselves produce ethylene and is responsible for many changes—like ripening fruit—which occur during the life cycle of a plant. Ethylene is, in fact, a natural plant hormone.

Moreover, it has been found that plants are stimulated to *make* ethylene by the hormone I.A.A., by 2, 4-D, by 2, 4, 5-T, by copper sulphate, by some poisons and by physical injury such as cutting. Ethylene produced by the plant actually produces naturally the same kind of changes applied to the plant.

So perhaps yield stimulants of rubber might be working by making the tree produce ethylene. To test this, ethylene was tried out on rubber trees to see whether it would act as a stimulant.

It was announced in 1968 that large increases in latex production were obtained by treating trees with ethylene gas, and a similar result with the chemically similar gas acetylene. This discovery led to tests of a mixture of (2-chloroethyl)-phosphonate and palm oil, a mixture which had already been found to be a convenient means of applying ethylene to plants.

(2-choroethyl)-phosphonic acid is commonly called ethephon and is the active ingredient of 'Ethrel'. It has the property of decomposing gradually in the presence of water, releasing ethylene and it will do this within the tissues of plants. It proved to be a very effective stimulant and it is probably a more direct and specific 'unplugging agent' than 2, 4, 5-T and other stimulants, since these appear to work by making the plant produce ethylene.

ETHREL FIELD TRIALS

Comprehensive large and small scale field trials were commenced by the Rubber Research Institute of Malaya to evaluate response to Ethrel. Commonly planted clones of different ages were treated using a variety of tapping systems. Various concentrations of the active ingredient were tried and applied to the tree in a range of methods. 2, 4, 5-T was included in the trials for comparison.

Yield Increase

Applications of 2, 4, 5-T gave an average increase in yield of 35 per cent when tapped on S/2.d/2 system (½ spiral on alternate days). The response to Ethrel was nearly twice as good on average.

There are large differences between clones in their response to stimulants. This is related to stimulants (since the latex flow will be to the "plugging index" of the clone. Clones with a high plugging index, that is, clones whose latex flow rapidly ceases after tapping, like Tjir 1, should theoretically respond more allowed to continue longer) than clones with a low plugging index such as RRIM 501, whose flow is relatively slow initially but flows for a longer period.

Figure 3 shows the results for the nine clones tested in this trial. Note the striking response of clone PB 86 to Ethrel.

Results of trees tapped on the shorter cuts were interesting. The plugging reaction varies not only with clones but also with cut length. The shorter the cut the more intense and rapid plugging becomes. This suggests that short cuts would respond better to stimulants than long cuts. In these trials S/3.d/2 (1/3 spiral on alternate days) gave approximately the same yield as S/2.d/2 with Ethrel stimulation in both cases. This means that when Ethrel stimulation is used, shorter cuts may be used, with less damage to the tree as a result. Tests currently being carried out are examining the possibility of using tapping cuts as little as ⅜ inch long, in conjunction with Ethrel stimulation.

Third daily tapping frequency was not included in the earlier large scale field trials. However, results from current trials show that reponse to stimulation from trees tapped S/2.d/3 (½ spiral every third day) would equal or exceed that of trees tapped S/2.d/2, the benefit being the same yield with 1/3 less tapping force.

Age

The responses obtained have been greater on first renewed bark (panels C and D) than panel B, which is the second panel of virgin bark. The response from panel A—first panel of virgin bark—has been the lowest. Size and age of the trees are probably the important factors and not that the bark is renewed.

Concentrations

Mixtures of Ethrel in palm oil from 0.25 to 22 per cent active ingredient have been tried and 10 per cent was adopted for most of the commercial trials. The mixture is applied to the scraped bark below the tapping cut at 2-monthly intervals. The width of the treated band is equal to the bark consumption over 2 months. Treatment at 2-monthly intervals was found to be more effective than a single application during 6 months. Responses to frequent applications of more dilute mixtures were not as good as the 10 per cent Ethrel applied every 2 months.

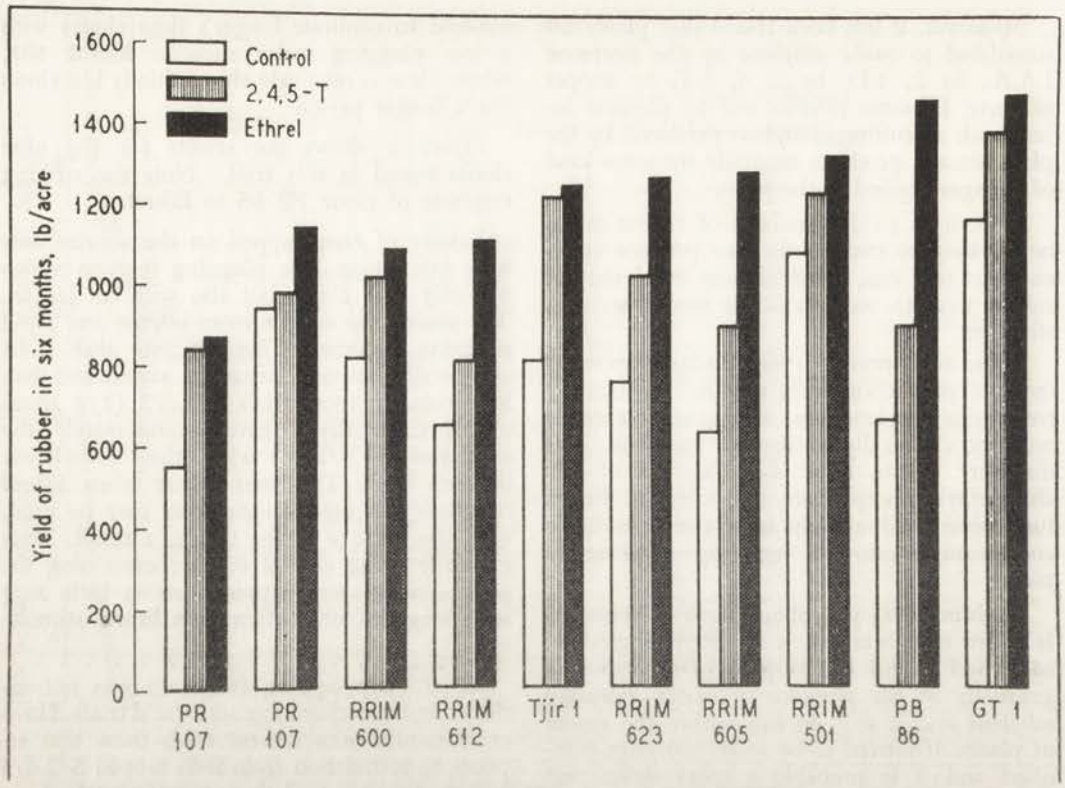


Figure 3.—Results of Ethrel and 2, 4, 5-T trials on a number of clones. (Source: J. W. Blencowe (1970). Recent advances in the yield stimulation of rubber. Paper presented to the Sabah Planters' Association at Tawau, on 20th November, 1970.)

In the range 6.7 to 13 per cent the difference in response is not large; planters may, for reasons of economy, prefer to treat larger numbers of trees with a 6.7 per cent mixture and accept a possibly lower response.

Dosage is inevitably imprecise; applying a greasy mixture to the scraped bark gives a somewhat arbitrary dosage per tree. Although the preparation may be thoroughly mixed and applied to a band of standard width, the girth (and therefore the treated area) of a tree is variable and the thickness of the layer applied cannot be standardized exactly.

Ethrel can be bought as a readymixed compound containing 10 per cent active ingredient. Papua New Guinea planters are currently using it at the rate of two thirds of a pint per acre (150 to 180 trees). The latest results of trials comparing response to different concentrations of active ingredient are shown in the *Table*. It can be seen that the highest response was at 10 per cent active ingredient.

The response to Ethrel is rapid, over 200 per cent increase within a few tappings, declining sharply within a month and then tapering down to prestimulation levels. Applications to areas should be staggered to allow for the initial surge of latex to be processed within each factory's capacity. Transport in some cases would be required to cope with this crop and either late or twice-daily collections arranged for the extended drip.

Late collections are successfully carried out at Ilolo by supplying the tapper with two churns. If afternoon rain is likely the second collection is brought forward. Latex still dripping after the second collection (considerable for 2 weeks after applying Ethrel) can be recovered as ground scrap and processed as Crepe (see *Plate* 1). In Ethrel-treated areas at Ilolo, at least 5lb dry rubber per tapper per day (450 trees) is recovered as ground scrap.

Plate I.—Ground scrap being processed. The rollers have a tearing action and foreign material is washed out of the rubber.

EFFECTS ON DRY RUBBER CONTENT

The large increases in yield obtained by the application of Ethrel are accompanied in some cases by a fall in the dry rubber content (d.r.c.) of the latex. Reduction in d.r.c. also follows successful stimulation with 2, 4, 5-T. For instance, in experiments in Malaysia involving a number of commonly planted clones tapped S/2.d/2, mean percentage d.r.c. was 35.4 in latex from unstimulated trees, 32.4 from 2, 4, 5-T stimulation and 28.8 from Ethrel-treated trees.

There are several practical steps which may be taken to compensate for this. The tapping frequency or the length of the cut may be reduced, the trees may be rested, or the Ethrel

applied less often. If any of these measures are taken the d.r.c. can be expected to improve quite rapidly. Results in Malaysia suggest that resting trees from stimulation will restore the d.r.c. to the level obtained before treatment.

Table 1.—Response to different concentrations of Ethephon[1]

% active ingredient	mg Ethephon per tree	Yield[2]	Response % of Control
Control	0	49.5	
6.7	134	72.3	146
10.0	200	95.8	194
12.0	240	90.4	183
13.3	260	86.1	174

1. Ethephon is the common name for the active ingredient in the commercial product Ethrel. Ethrel normally contains 10 per cent of ethephon but in this case various concentrations of ethephon were used.
2. Yield is measured as average number of grammes of latex per tree for the first year.

DRY TREES (BROWN BAST)

The incidence of brown bast (or of totally dry trees) has so far been very small and has occurred randomly in the various treatments. Totally dry trees have been treated with Ethrel and have sometimes started to yield once more, but this improvement was short-lived and the observation may have been confounded with the re-opening of trees when experimental treatment began.

One example of the onset of dryness following Ethrel treatment was attributed to the concurrent use of the fungicide Antimucin W.B.R. as a treatment for black stripe disease of the tapping panel. Antimucin has been found to react with Ethrel causing a fairly rapid evolution of ethylene. Whether the damage to the trees is due to the over-rapid release of ethylene or to the toxic effects of the reaction products is not known, but careful watch must be kept for interactions of this sort.

LONG-TERM EFFECTS

A rubber plantation is a very long-term investment and naturally the question has been asked, "What are the long-term effects of Ethrel when used as a latex stimulant?" There is no definite answer to this question; long-term effects can only be determined by long-term trials. Large scale field trials have been in progress now in Malaysia for 3 years without any indications whatsoever of deleterious effects. It is recommended however, that Ethrel should only be used on mature trees and areas destined for replanting.

With rising rural wages to contend with, planters in Papua New Guinea will find old low-yielding areas unprofitable. Stimulation is possibly the only answer to keep these blocks economically viable.

Acknowledgement

The experiments discussed in this article were carried out at the Rubber Research Institute of Malaya. Further details can be found in the Planters' Bulletin of the Rubber Research Institute of Malaya, November, 1970.

A Trial with Ethrel Stimulant on Rubber at Bisianumu

A. E. CHARLES, Chief Agronomist and A. J. H. VAN HAAREN, Experimentalist

A small trial on the effects of Ethrel stimulant on latex flow in rubber was begun at the Department of Agriculture, Stock and Fisheries' Rubber Centre, Bisianumu, in late 1970. *The following is an outline of the results up to the end of May,* 1972.

The only trees available for the trial were unfortunately not typical of commercial rubber plantings. They were 30-year-old seedling trees which had been tapped for only a very short part of their life, and the trial tapping was on virgin bark on the lower part of panel A. The tapping system was a half circumference V-cut every second day, Monday to Saturday (V/2 d/2 6d/7). Two plots A and B were used, each of 110 trees.

Recording of latex yields began in November, 1970 for the purpose of comparing the yields of the plots with and without stimulation. Stimulant was first applied in February, 1971. However, the treatment used was a locally prepared mixture of Ethrel concentrate with peanut oil and the components did not mix satisfactorily. There was no obvious treatment effect, and tapping was therefore discontinued until a commercial preparation of pre-mixed Ethrel in palm oil became available. This was first applied on 10th March, 1971 and application was repeated at 2-month intervals thereafter. One pint of commercial preparation was used at each treatment.

At the first application, a 3in. band of bark below the tapping panel was scraped and, after one or more days, the mixture was applied to the scraped bark with a paint brush. From the May, 1971 application the band of scraped bark was reduced to 2in. as this proved to be the amount of bark consumed. At the November, 1971 treatment, the stimulant was applied immediately after scraping the bark, but from January, 1972 the bark was scraped, left for 2 days, then lightly scraped again immediately before the stimulant application.

The stimulant was applied to trees of plot A over the period March to November, 1971, while plot B remained untreated as a control. From January, 1972, the treatments were reversed; stimulant was applied to plot B and plot A received no further stimulant.

Results

Latex yield over the full period of recording is summarized in *Figure* 1. In order to reduce the complexity of the graph, yields shown have been totalled over three consecutive tappings when morning collection was successful. Rainy days and holidays are omitted, so the three tappings sometimes covered a period longer than 1 week.

After the first Ethrel treatment, there was a big increase in the volume of latex flow and in the duration of flow, so that it became necessary to make a second latex collection at 3 p.m. on the treated plot. On 15 per cent of days when the morning collection was successful, the afternoon collection was lost because of rain.

As well as increasing the latex flow, Ethrel stimulation caused a decrease in dry rubber content (d.r.c.) of the latex. The d.r.c. was determined by coagulation and drying 1 kg samples of latex from each plot on numerous occasions. During the period April to October, 1971, average d.r.c. of latex from plot A was 27.3 per cent and from plot B, 34.4 per cent. After reversal of the treatments, there was not a consistent change in d.r.c. as had been anticipated. Over the full period January to April, 1972, the d.r.c. averaged 29.5 per cent for plot A and 30.3 per cent for plot B. However, by the end of April, plot A was showing higher d.r.c. levels than plot B.

In addition to the increase in latex, the quantity of scrap from stimulated trees was about 40 per cent higher than from untreated trees.

Discussion

As may be seen from *Figure* 1, plot A was yielding about 15 per cent less latex than plot B before stimulant application was started. Over the period from the first application of stimulant to plot A in March, 1971 to the time

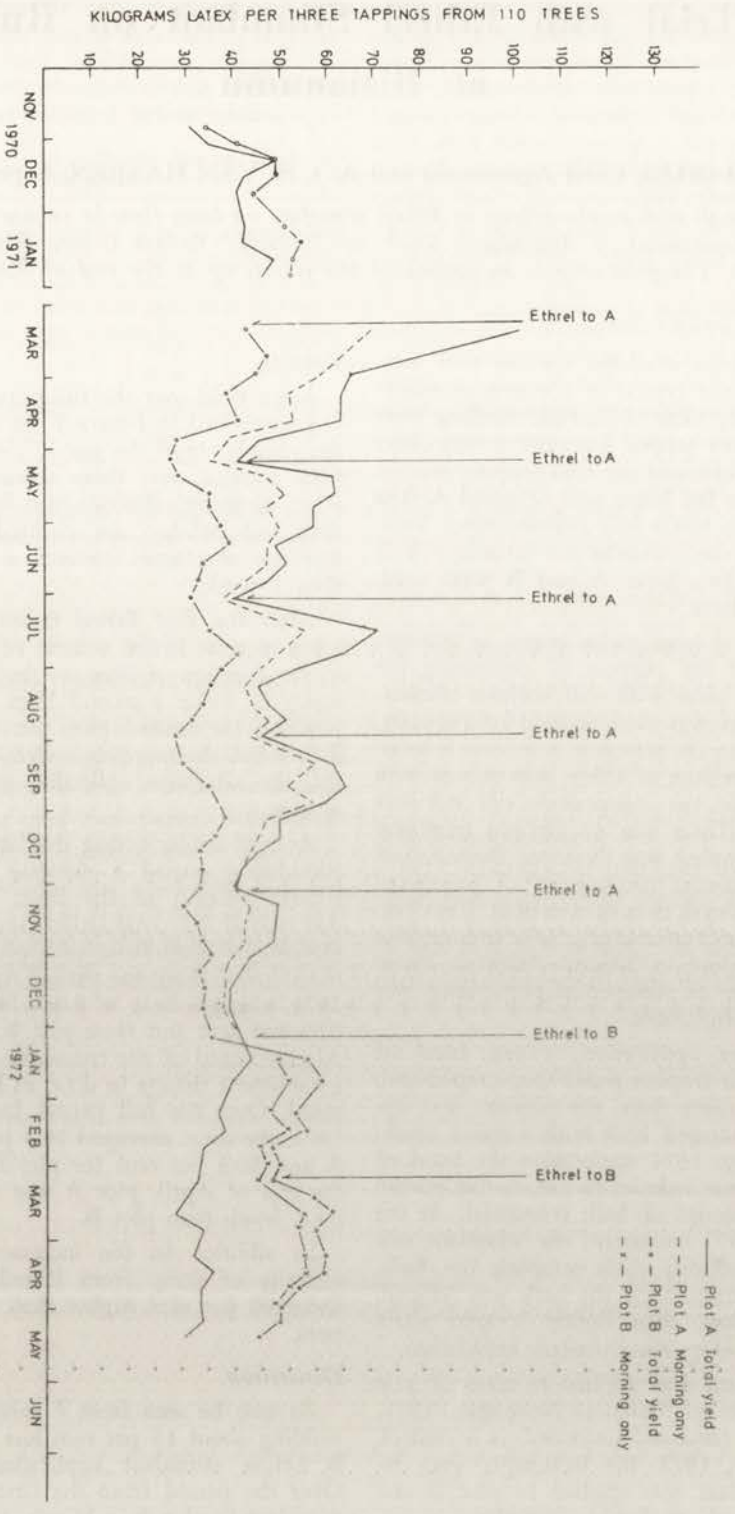


Figure 1.—Graph showing latex yield following stimulation with Ethrel.

when treatments were reversed in January, 1972, plot A yielded 53 per cent more latex than plot B. There were however, signs of a diminished effect of stimulation over the 10-month period. Firstly the increases in yield over the successive 2-month periods were 71, 55, 57, 49 and 32 per cent respectively. Secondly, as may be seen from *Figure* 1, immediately after the application of the stimulant, there was a big difference in the amount of latex collected with one or two collections per day. As time went on, however, there was less and less difference between the yield of "total collection" and the "morning only collection".

Following the reversal of treatments, over the period from application of stimulant to plot B up to the third stimulant application (i.e. over two 2-month periods), plot B yielded 59 per cent more latex than plot A. The increase was 44 per cent in the first 2-months and 73 per cent in the second 2-months. As the previous stimulation of plot A may have still had some effect during January and February, the later figure is probably the more accurate estimate of stimulant effect.

Taking into account the lower yield of plot A before treatments started, the overall result indicates an increase in latex production of the order of 60 per cent. However, this latex was of lower d.r.c. than that from unstimulated trees. Although there was not a clear reduction in d.r.c. after the reversal of treatments, overseas experience confirms that the type of reduction observed over the period March, 1971 to January, 1972 is to be expected. This lower d.r.c. of the extra latex reduces the estimate of increase in dry rubber yield to 27 per cent. This is a somewhat smaller response than has been reported in some overseas trials, the difference possibly being due to the non-typical type of trees being tapped at Bisianumu.

Cost Considerations: Considering the economics of Ethrel stimulation, on current prices the use of seven pints of Ethrel mixture (costing about $21) produced sufficient latex to yield an extra 170 kg of dry sheet rubber (worth about $60 on current prices). There was also an increased quantity of scrap. Allowance must be made for the cost of processing and marketing the additional latex. There could also be an increase in cost from the need for a second latex collection in the afternoon. It might be argued that, if Ethrel were used, collection could be deferred till later in the day, but under Bisianumu conditions, this would involve a significant risk of loss of latex due to rain falling before 3 p.m.

These figures indicate that the use of Ethrel would be profitable. Recent results from Malaysian trials indicate that the concentration of Ethrel used at Bisianumu may have been unnecessarily high. If the same result could be achieved with lower concentrations of Ethrel, profit would be increased.

Conclusions and Recommendations

The trial at Bisianumu supports overseas indications that Ethrel is a powerful stimulant of latex flow and showed that profits could be increased by its use. Growers who have trees suitable for stimulation would be well advised at least to experiment with Ethrel. In Malaysia, results have been greatest in older trees (for example, tapping renewed bark on panel C), and in view of lack of knowledge of long-term effects, the Rubber Research Institute of Malaya recommends that initial trials be restricted to old trees due for replacement within a few years.

If you plan to experiment with Ethrel, a simple and reliable trial could be conducted by treating every second tree in a row, leaving alternate trees untreated for comparison. All trees should be tapped consecutively, regardless of treatment, but latex would have to be collected separately from the treated and untreated trees for recording. Yields would have to be recorded for a minimum of 2 months to assess the likely average response to stimulation. It is to be expected that latex from stimulated trees would have lower d.r.c. and it should be noted that the Metrolac is not accurate enough to give a reliable measure of the effect.

The authors would be grateful if growers could send them reports of results of any experiments they carry out with Ethrel.

An Examination of Poultry Distribution and Survival under Village Conditions

W. J. TURNER, Animal Production Officer (Poultry), Three Mile Station, Lae, Morobe District

In 1964 *the Department of Agriculture, Stock and Fisheries commenced a poultry distribution scheme in an effort to improve the quality of village poultry and to stimulate interest in poultry as a cash crop. This scheme centred around the distribution of dual purpose Rhode Island Red chickens at* 8 *weeks of age. Day-old chickens were imported and reared to distribution age at one of the four rearing centres at Port Moresby, Lae, Goroka and Rabaul. The scheme was described by J. L. Anderson in the "South Pacific Bulletin", Second Quarter,* 1970.

In 1968 the rearing centre at Lae was expanded into a breeding centre and the day-old chickens for distribution to the New Guinea Mainland Region were hatched at the centre.

Some crossbreeding between the Rhode Island Reds and "native" chickens was commenced about this time. The native chickens are most likely descendants of poultry introduced to New Guinea many years ago—perhaps hundreds of years ago. It is doubtful if there is a type of chicken which is truly native to Papua New Guinea.

By the end of 1969 the Lae breeding centre was producing sufficient day-old chickens to supply the other rearing centres and the importation of day-olds ceased.

TRIAL 1. GROWTH OF POULTRY IN THE VILLAGE

When the poultry research section started in 1969 it was decided to study the value of the distribution scheme. A trial was arranged to cover eight distribution centres. The chickens used for the trial were crossbreds of both sexes, hatched and reared to 8 weeks of age at Lae. They were distributed to villages in the normal manner via the eight centres which were Kainantu, Wapenamanda, Boana, Kaiapit, Wau, Madang, Kandrian and Finschhafen. About 50 birds were sent to each station.

Each bird was identified by a leg band and was weighed before leaving Lae and then at 4-weekly intervals after distribution up to 32 weeks of age. Records were kept of weight gain, mortality, the age the birds started to lay and whether or not hens went broody on their eggs.

Results

The results of the monthly weighings of the chickens showed an average weight at distribution of 0.8 lb. The average weight of the survivors at 32 weeks of age was 3.0 lb. However, this average was calculated including the final average weight of the birds at Wau which was 4.1 lb. These birds were cared for better than those at the other centres in that they were regularly given some simple feeds (usually vegetables and fruits such as pawpaw, tomatoes, pumpkin and lettuce) which improved weight gains. If the figure from Wau is not included, the average weight of each bird at 32 weeks was 2.6 lb and this could be regarded as the base level of village production of these crossbred birds under a "no management" system (that is, the birds have to find their own food and shelter).

A large number of chickens died soon after distribution. Most deaths occurred within 2 weeks of leaving Lae, and only 49 per cent of the birds survived to 12 weeks of age (4 weeks after distribution). At 32 weeks of age only 28 per cent of the birds remained alive. The cause of death was not always easy to determine, but in most cases it could be put down to exposure or attack by predators, particularly village dogs. The level of mortality varied considerably between centres. At some centres no chickens reached 32 weeks of age, while at Wau, 60 per cent of the birds survived to this age. Generally the birds which had the best weight gain were more likely to survive.

The only hens laying eggs by 32 weeks of age were those distributed to Wau and Kaiapit, these being the largest birds at that age. Some of the hens at Wau had been laying for

about 1 month when the trial finished and had started to sit on their eggs. One hen had actually hatched out about 15 chickens by this time.

TRIAL 2. THE EFFECT OF AGE OF DISTRIBUTION

Because of the many deaths within 2 weeks of distribution at 8 weeks of age, it was recommended that birds be distributed at 10 weeks of age when they are larger and more able to withstand the initial shock of the harsh village environment.

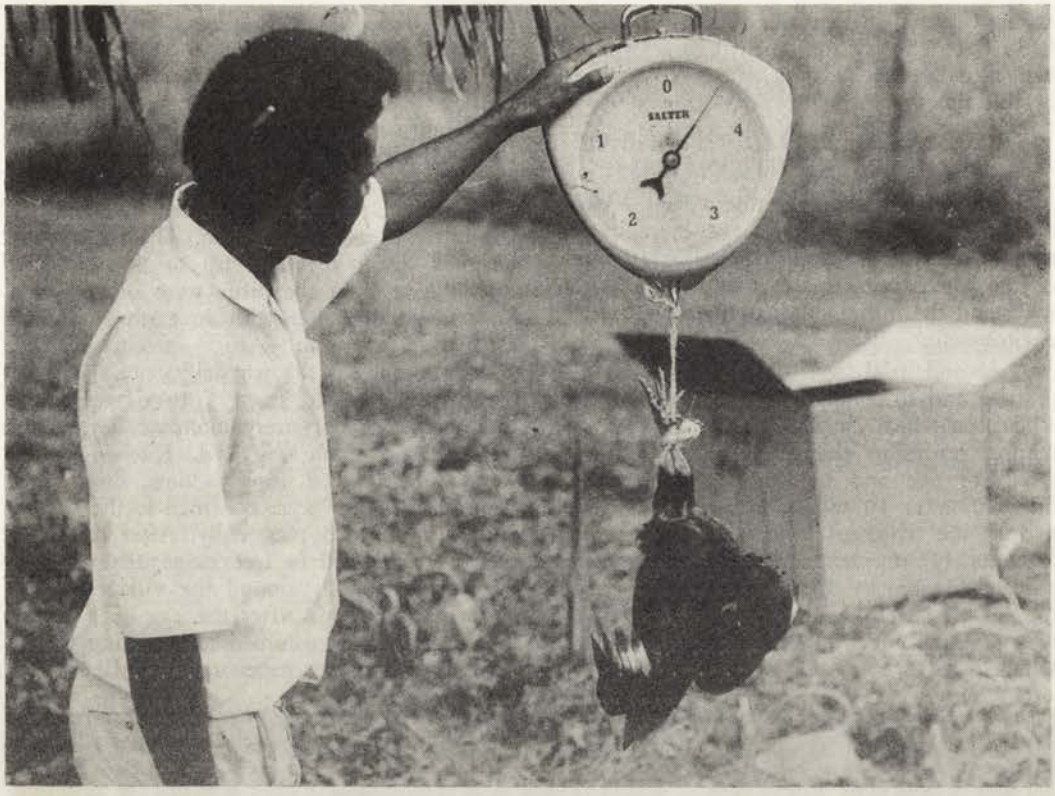
A second trial was designed to test this practice and to compare it with an alternative scheme in which chickens were sent from the rearing centre to the extension station at 4 weeks of age and held at the station until distribution at 10 weeks. During this 6-week period the chickens were fed only small amounts of supplementary feed, this being reduced to zero by 10 weeks. In other words the chickens were gradually introduced to the type of environment they could expect in the village.

This trial was carried out in the Buin Subdistrict of Bougainville where the problem of transporting the large 10-week old birds from Rabaul to Buin by air made the alternative scheme more practical if it were effective. All chickens were from the same batch and were reared together at Rabaul until 4 weeks when they were weighed and half of the birds were sent to Buin. The birds were weighed again regularly up to 30 weeks.

While at Buin the birds were housed in a bush material shelter with an earth floor and a small run. From 4 to 5 weeks of age, grower mash was thrown daily onto the floor of this shelter and from 5 to 6 weeks the mash was put out every alternate day. After 6 weeks no mash was fed. Kitchen scraps were available from time to time. From 4 to 5 weeks the birds were confined to the shelter and yard up to 3 p.m. daily. After this time they were allowed to free range, that is, they were free to walk around the village or the bush finding food. After the age of 5 weeks the birds were accustomed to returning to the yard and it was not necessary to confine them.

(Photo: D.I.E.S)

Plate I.—Newly hatched chicks at the Lae Breeding Centre



(Photo: W. Turner)

Plate III.—Weighing a chicken before distribution

Thus, after 6 weeks of age the birds were not receiving any proper ration or special attention and they were seeking their own food and shelter as they would be doing after distribution to the villages.

All the birds were weighed at 10 weeks of age before going to three purchasers in three different villages. Each of the purchasers received half of his birds from those held at Buin and half direct from Rabaul. All the birds were 10 weeks old. At this stage there were 42 birds from Rabaul which averaged 2.0 lb each and 38 from Buin which averaged 1.2 lb each. In both cases the weight of the birds at distribution was greater than that of the birds distributed in the first trial. This was partly due to the 2-week age difference and partly due to the fact that the quality of the birds being distributed had been improved during the time between the commencement of the two trials.

The survival rate of these larger birds (both from Buin and Rabaul) during the first 4 weeks after distribution was 96 per cent, a vast improvement on the results of the earlier trial in which only 49 per cent were still alive 4 weeks after distribution. At 30 weeks of age, 43 per cent of the birds were still alive—also an improvement on the previous results. The survival of the birds from Buin at 30 weeks of age was 50 per cent and of those from Rabaul 36 per cent, but it doubtful if this difference results from the different methods of distribution since most of the extra deaths in the Rabaul group occurred only in one village in the last 4 weeks of the trial.

By 30 weeks of age, virtually all the birds weighed more than 4 lb and could not be weighed with the scales available. Many birds were over 4 lb at 26 weeks. At 22 weeks old, the average weight was 2.6 lb with no difference between the Buin and Rabaul groups.

There were, however, quite large differences in growth and survival of the chickens between the three villages, and these differences do appear to be a result of the level of management of the different owners. The

results for the three villages are given in *Table* 1. The weights are given for 22 weeks since this is the last age at which all birds could be accurately weighed. The details of each farmer's management are:—

A. Chickens have free range in the morning only. Each afternoon they are returned to an enclosure where laying pellets are scattered at about the rate of 1½ oz. per bird per day. (Normal consumption without free range would be about 2½ to 3 oz. per bird per day.)

B. Chickens have free range from mid morning until evening. They are housed in a shed and wire enclosure overnight. Laying pellets are scattered in the enclosure each morning at the rate of about ½ oz. per bird per day.

C. Chickens have free range all day and return to a shed at night of their own free will. Birds receive small amounts of sweet potato and grated coconut.

Results

Farmer A's chickens received the most supplementary feed and had the best survival and growth rate. These birds commenced laying at 26 weeks.

Farmer B, who fed less supplementary feed, had birds with a reasonably good survival rate but not such fast growth as the birds of farmer A. Those chickens came into lay at 30 weeks.

(Photo: W. Turner)

Plate II.—Chickens being packed for dispatch

Table 1.—Survival and growth of chickens distributed in the Buin Subdistrict

Farmer	Survivors at 30 Weeks	Average Weight at 22 Weeks (lb)
A	12 out of 20 (60 per cent)	3.8
B	20 out of 40 (50 per cent)	2.0
C	2 out of 20 (10 per cent)	2.7

The only extra feed farmer C gave his chickens did not contain much protein and was of very little use. The survival rate of the chickens was very poor and although the average weight of the birds was fairly high, this is probably only a reflection of the fact that only the larger birds of the group managed to survive.

Conclusions

The second trial showed there were no differences in survival rate following the two methods of distribution. Both methods were superior to distribution at 8 weeks of age. It has therefore been recommended that distribution be carried out at 10 weeks direct from the distribution centre if transport is no problem or at 10 weeks after a 6-week period at extension stations with a low level of management if transport to the extension stations at 10 weeks does present a problem.

It would seem that for any real benefit to village poultry to be gained from the Department of Agriculture's distribution scheme, it is necessary for improvements to be made in the husbandry and nutrition of the birds once they reach the village. Without this improvement of the environment then the increased genetic potential of the distributed birds is of no benefit.

This fact is borne out in the trials described by the results at Wau where feedstuffs having a reasonable protein level were fed and by those at Buin with farmer A and to a lesser extent farmer B where a supplement of a prepared poultry ration was fed. The feeding of feedstuffs with a high carbohydrate and low protein content such as in the case of farmer C is of no apparent use unless some protein is also supplied.

It is interesting and encouraging to note that distributed chickens which do have the benefit of improved nutrition have the capacity to hatch and rear day-old chickens. This is happening at Wau. In other words it should be possible to improve village poultry by the introduction of improved strains of chickens provided that the level of management of the poultry is upgraded sufficiently to benefit from this improvement.

Acknowledgements

The co-operation and assistance of extension staff at Kainantu, Wapenamanda, Boana, Kaiapit, Wau, Omuru, Kandrian, Finschhafen, Buin and Konga and of the manager and staff of the Kurakakaul Animal Industry Centre Rabaul, is gratefully acknowledged. Without the assistance of these people the trials described here would not have been possible.

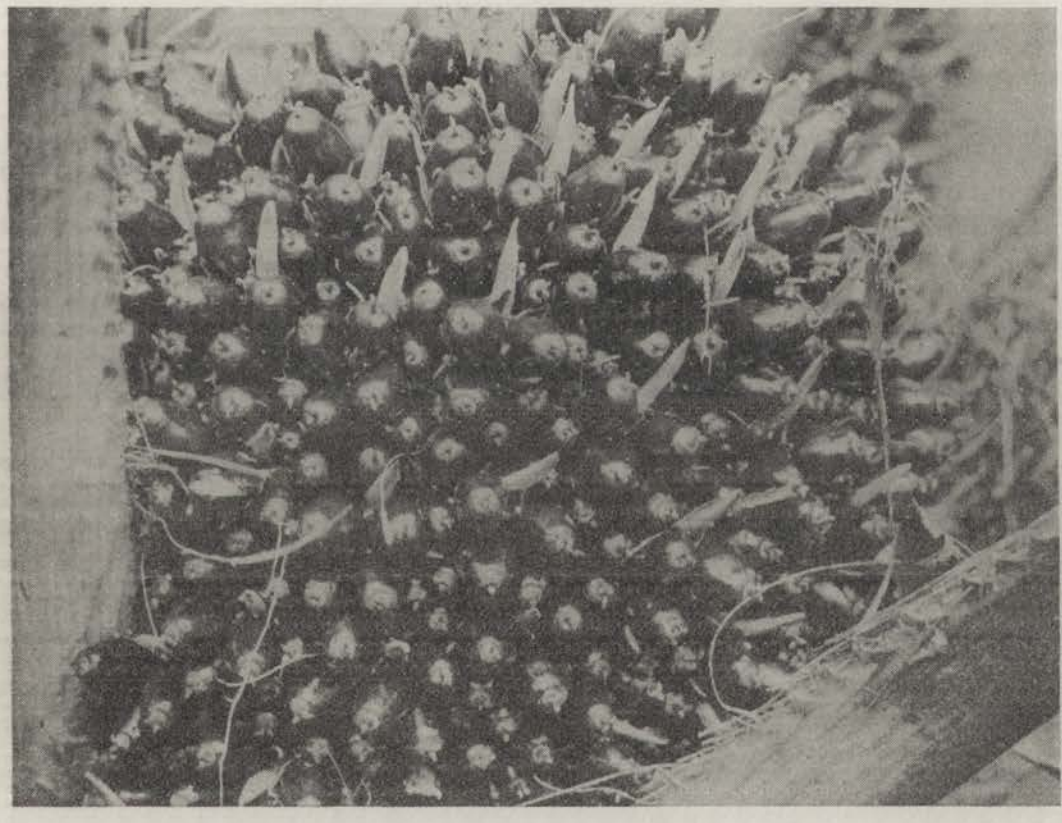
The Oil Palm Industry in West New Britain

Since 1966 work has gone ahead steadily on the oil palm project near Cape Hoskins in West New Britain. Last year the first results of five years' hard work were seen—fruit bunches were harvested and taken to the factory for processing, and the extracted oil was exported. The prospects for this new industry are most encouraging, but it must be noted at the outset that only a big oil palm project can operate efficiently and economically. You cannot make a profit out of a small oil palm plantation.

DASF is constantly looking for new crops which may prove better sources of income than our present sources and for crops that can be grown where no useful crop has grown before.

One crop that invited further investigation was the West African oil palm. Compared with coconuts, the oil palm nuts are very small —roughly the size of betelnuts—but they contain a very high proportion of oil. The fruits grow on the palm in big bunches; so big that a man can conveniently carry only one at a time. The fruit bunches growing on the palms at Kimbe now weigh 20 to 30 lb but as the trees get bigger, the fruit bunches will get bigger too, until they reach an average weight of 50 to 60 lb.

Because of their large size and weight, transport of fruit bunches presents problems where the use of trucks is not practicable. In Malaya workers tie the bunches onto a pole carried across the shoulder. In Africa a man may be seen balancing two or three bunches on his head; in Papua New Guinea they either carry them by hand or use a wheelbarrow.



(Photo: D.I.E.S)

Plate I.—A fruit bunch on a palm. Each individual nut is about the size of a betel nut.

(Photo: D.I.E.S.)

Plate II.—Seedling palms ready for planting out, are taken from the company's nursery to the smallholder blocks.

The best feature of these palms is that for one acre of land they produce three times as much oil as coconuts palms. Another advantage is the early maturity of the palms. After 3½ years from nursery planting, the first fruit bunches are ready for harvesting. This compares well with a time of 4 to 5 years for coconuts.

There are, of course, disadvantages too, the chief one being that the oil must be extracted from the fruit within 24 hours of the bunch being picked and preferably within 12 hours. After 24 hours the oil starts to go rancid. For the same reason it is essential that the palms are examined once a week and all ripe bunches are picked. If the fruit gets overripe the oil goes rancid before the bunch is picked. Naturally the factory will not accept overripe fruit bunches, as the rancid oil would spoil the rest of the oil.

Highly specialized equipment is needed for the extraction process and because this equipment is expensive, it must be used all the time to get an economic return from the expenditure. This means that there must be a big supply of fruit bunches to keep the extraction unit working full-time. This requires 2,000 hectares (5,000 acres) of oil palm with road access to the factory. It is therefore not an economic proposition to have a small isolated oil palm plantation.

After a careful study of the economics of the industry the Administration and the firm of Harrisons & Crosfield (which has had considerable experience with oil palm in other countries) agreed to set up a palm oil industry on a suitably large area of land that was available in West New Britain. A company was established called the New Britain Palm Oil Development Ltd. This is a joint venture which is owned equally by the Administration of Papua New Guinea and Harrisons & Crosfield (Australia & New Zealand) Ltd. The new company was initially granted a lease of 2,200 hectares (5,500 acres) and this area was later doubled in size. This is known as Mosa Planta-

tion. At the same time other land close by was made available to smallholders. Each smallholder is allocated a block of at least 6 hectares (15 acres) of first-class arable land of which he is expected to plant at least 8 acres to oil palm. The fruit from the smallholders' blocks and Mosa Plantation is processed in a large central processing factory. New plantings are still being made and eventually it is anticipated that some 4,000 hectares (10,000 acres) will be planted by the company and 5,000 hectares (12,500 acres) by 1,560 smallholders.

People living in nearby villages have also shown interest in oil palm and they have planted a total of about 200 hectares.

To finance these smallholder projects, the International Development Association has made two large loans—$1,337,000 in 1967 and $1,920,000 in 1970. The rest of the money needed was provided by the Administration.

Each smallholder gets a total loan of $1,800 (spread over three years) and his first repayments start when he starts harvesting. His repayments vary according to his total income and, on average, his loan is repaid four years after the first harvest. After this, with hard work and good management, he can anticipate an income of $1,500 to $1,800 per year.

The oil palms which were established first (nursery planting in August, 1967, field planting in August, 1968) matured even earlier than the agronomists anticipated. They based their estimates on Malayan experience, but the volcanic soil was so fertile and the climate so favourable for growth that the palms commenced flowering some 6 months earlier than anticipated. In July, 1971 the factory was opened and the supply of fruit bunches has been steadily increasing ever since. The yields of fruit from the palms have exceeded the estimates made five years ago.

In botanist's language, the oil palm fruit is a drupe. It consists of a thin epicarp, an oily mesocarp, a hard stony endocarp (shell) and a

(Photo: D.I.E.S.)

Plate III.—A smallholder starts planting his palms.

large endosperm (kernel) with one to three small embryos (*Figure* 1). The shell, kernel and embryo together form the nut or seed. Both the mesocarp and kernel contain oil.

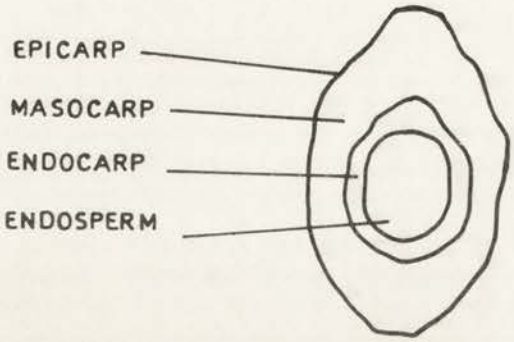


Figure 1.—An Oil Palm fruit cut lengthwise

The factory extracts palm oil from the mesocarp by pressing the fruit in large hydraulic presses that develop a pressure of about 3 tons per sq. in. After pressing, the shell and kernal are separated from the residue; the shell is cracked and the kernel recovered. Finally the kernels are sorted and bagged for export. All that remains—the stalks of the fruit bunch, the crushed mesocarp, the shells of the nuts—are all used for fuel. Nothing is wasted.

The extracted oil is pumped into tanks and taken by tractor or truck to the "tank farm" at Kimbe. The tank farm looks like a petrol company's bulk storage installation. At present there are only two tanks, but the number of tanks will grow as the supply of oil grows. Each tank is about 30 ft. high and holds over 100,000 gal. of oil. The oil is stored in these tanks until a ship arrives to take it overseas. While it is in the tank the oil solidifies so that it has to be heated to melt it. Once melted it is pumped from the tank on land directly into the tanks on the ship through a pipeline of about 9 in. diameter.

Social Development

The whole oil palm project consists of a nucleus estate surrounded by many smallholders in a big land resettlement scheme. This is by far the largest land resettlement scheme in the country and is being watched with interest by those concerned with social development. In the design of the settlement there has been an attempt to encourage integration of people from many different parts of the country. Six to ten (but no more) families from a particular district or language group are settled on adjoining properties. In the overall choice of settlers, allocations have been made with a view to a balanced selection from the different geographical areas of Papua New Guinea. There have been minor social frictions but on the whole a sound community spirit appears to be developing in the settlements.

Since for these people the old village organization has been lost, a new setup has been devised. There is a Hoskins Local Government Council and a Settlers' Representative Committee has been formed. The agricultural extension work is carried out through this Committee.

Each subdivision of the project has its own co-operative store, and these are providing the people's day-to-day needs quite adequately, and making a profit too which is returned to the people.

Schools are well equipped and adequate. Every child of school age attends school. There are aid posts and Infant Welfare clinics in the subdivisions and a big hospital at Kimbe. Churches are active and so are sports clubs, with soccer being the main interest.

Research Work

The oil palm has only recently been introduced as a commercial crop in Papua New Guinea and there is still a lot to be learnt about it. Accordingly a research programme has been established at Dami Research Station close to Mosa Plantation. Here work is carried out to study the effect of tree spacing on yield, the use of chemicals for weed control, methods of assisted pollination and the effects of castration of palms for a period before they are allowed to start bearing. Particular attention has been paid to the economics of fertilizer applications, supported by chemical analysis of oil palm leaves which provide a guide to fertilizer needs.

Future Prospects

The rise of the oil palm industry has been watched with great interest by those concerned with agriculture, social development and economic expansion in Papua New Guinea. The project has proved successful in all these aspects and the prospects for both the company and the smallholders are very hopeful. The results now being obtained show that the optimism of the early planners was fully justified.

The Cattle Tick

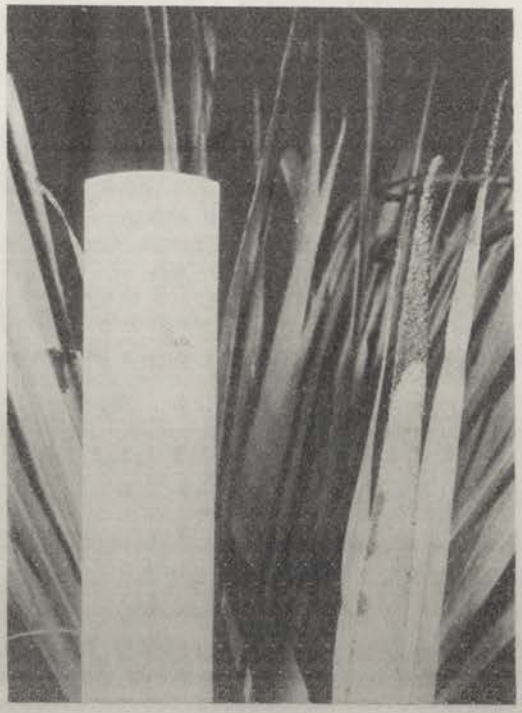
I. L. OWEN, Parasitologist, Veterinary Laboratory, Kila Kila

The cattle tick, Boophilus microplus, *is one of several species of ticks found on animals in Papua New Guinea. It is primarily a parasite of cattle, although it is also frequently found on rusa deer* (Cervus timorensis) *and has been found on goats, horses, pigs and dogs. It is widespread in the tropics, extending from South Africa, through East Africa to India and eastwards into Indonesia, the island of New Guinea, Australia and on the other side of the Pacific Ocean in Mexico, Central and South America and the West Indies.*

The genus *Boophilus* is considered to have four species, of which only one, *B. microplus*, is present in Papua New Guinea and Australia. It is an introduced pest in both countries, having been brought into Australia from Java in 1872 and into Papua New Guinea from the same area some time before the First World War. After the initial entry, the population in this country was replenished by the importation of ticky cattle from Queensland between the two World Wars. By the close of the Second World War the cattle population in Papua New Guinea had been drastically reduced but the tick remained wherever there were cattle. During the post-war period an eradication programme was begun and a stricter quarantine enforced. Under the provision of the Animal Disease and Control Ordinance (1952) it was made compulsory for cattle owners with ticky cattle to follow a set programme of spraying. Enforcement of this plan during the 1950's and 1960's resulted in all districts excepting Western, Gulf, Central, Milne Bay and New Ireland becoming free of cattle tick. At present most of the areas still tick-infested involve small isolated herds.

The presence of deer in two out of the five districts adds greatly to the problem of tick eradication. These deer, which carry tick and which roam uncontrolled in the vicinity of Port Moresby and the south-western part of the Western District, form a reservoir of the parasites.

The cattle tick is a one-host tick, i.e. it requires only one animal to live on (host) to complete its life cycle. This is in contrast with the dog tick, *Rhipicephalus sanguineus,* which requires three hosts before the adult stage of the tick is attained.



(Photo: D.I.E.S.)

Plate I.—The tick larvae climb to the top of a blade of grass and wait for a host animal to come past.

Boophilus microplus, like all ticks, feeds on the blood and tissue fluids, its mouthparts being highly adapted for piercing the skin of a host and for maintaining its position while feeding. Small blades at the tip of one pair of mouthparts (chelicerae) are used to penetrate through the host skin and this is followed by the insertion into the puncture of a toothed mouthpart (hypostome) which acts as an anchor. A secretion of the salivary glands of the tick affords an additional means of anchoring. This secretion is a cement-like substance

which hardens to bind the mouthparts to the surrounding host tissue. Once firmly attached, a small cavity filled with blood, white cells and tissue fluids develops in the host tissue at the tip of the mouthparts and the contents are sucked up into the body of the tick. This meal of blood gives the mature female tick its characteristic slate blue/brown colour.

When fully fed, the adult female tick withdraws its mouthparts from the host skin and drops to the ground. It crawls away from light and seeks out a crevice or dense undergrowth in which to hide. Within two or three days eggs begin to be laid and this process may continue for several weeks. During this egg-laying period the female gradually changes from slate blue to a bright orange/yellow colour, becomes shrivelled in appearance and eventually dies. The surface of the eggs is sticky so that they remain together as a dark brown mass.

The time which elapses between the dropping of the female from the host and the establishment of an emergent larva on another host is a non-parasitic phase in the life cycle and is affected by the temperature and the humidity of the environment. (The parasitic phase, which extends from the arrival of a larva on a host to the dropping of the engorged female tick from that host, is affected very little by climatic changes of the environment since it is in close contact with the warm, moist body of the host.) The optimum temperature for egg-laying is between 75°F and 80°F and similar warm conditions coupled with high humidity are needed for incubation of the eggs. At 97°F incubation is completed in 14 days but at 62°F the process takes 114 days. At these temperatures the constant relative humidity must not fall below 70 per cent. In Port Moresby eggs take 3 to 4 weeks to hatch but take about a week longer on the Sogeri plateau at a height of 1,800 ft. above sea level.

Once out of their egg shells the larvae or seed tick remain quiescent for a couple of days and then become extremely active, swarming over surrounding vegetation and climbing up vertical objects—be they grass blades, shrubs or gate posts. Although attracted by light, the larvae normally seek that side of a grass blade or leaf which faces away from direct sunlight and will congregate in such positions in considerable numbers. They are most active during early morning when they show questing activity by waving their front legs. This becomes particularly vigorous if a warm-blooded animal approaches. The larvae are extremely sensitive to local changes in temperature which occur when the body of a mammal stands near. They are also stirred to activity by warm carbon dioxide-laden air being breathed on them. Both these reactions condition the larva to be at the peak of responsiveness when an animal such as a cow is grazing in the vicinity. If contact is made with a host the larva immediately clings to the hair or skin and often within a few minutes the mouthparts are inserted into the skin.

The length of time larvae can survive on pasture without finding a host is, to a large extent, controlled by the climate. During this period the larvae do not feed but they can absorb moisture from dew and possibly from plant juices. Atmospheric humidity, more than any other factor, seems to control the survival time of larvae.

In Queensland larvae are able to survive for 3 or 4 months in summer and for 5 or 6 months in winter. Work is in progress to find out the survival time of larvae in locations around Port Moresby which have differing rainfall and temperature ranges. It is expected that the results will approximate more to those of the Queensland summer rather than to the winter data. Because of the equitable climate of a tropical country like Papua New Guinea and the absence of a winter season, there is no seasonable break in the cycling of the tick.

Most movement shown by larvae during their non-parasitic existence is in the vertical plane but their ability to move horizontally either actively or passively is of greater significance when considering control or eradication.

Larvae probably migrate only for short distances under their own steam. For a long time a buffer zone of 12ft. was considered adequate to separate infested and clean areas. More recently, it has been shown that larvae can travel much further with wind assistance—up to 80 ft. This distance can be achieved either almost entirely by wind action or possibly more commonly as a result of groups of larvae being blown from the tips of vegetation on to neighbouring vegetation or the ground, the larvae climbing up and the process being repeated.

Attachment to an unsuitable host followed by a release of the attachment at a later time can mean that larvae are transported a considerable distance from their source. Various mammals and birds, as well as the clothing of humans, fit into this category of transportation.

(Photo: D.I.E.S.)

Plate II.—A close-up photo of a blade of grass. When a warm-blooded animal comes close, the larvae wave their legs in excitement. At first opportunity they will cling to the skin of the animal, and immediately start feeding on it.

Once attached to a suitable host the tick larva begins its parasitic existence. The six-legged larva feeds mainly on tissue fluids and will become fully fed or engorged in 5 to 13 days. The engorged larva measures about 1.5 mm in length and will shed its skin before becoming an eight-legged nymph. This stage usually attaches itself near to the earlier point of attachment of the larva and proceeds to feed on tissue fluids and some whole blood for 10 to 20 days, by which time it measures up to 3 mm in length. The small size of the larva and also of the nymph means that these stages are usually overlooked when an animal is being examined for ticks. The presence of a nymph, at least, is often indicated by a slight raising of the host skin at the point of attachment and this can be felt when running a hand over the body of an animal.

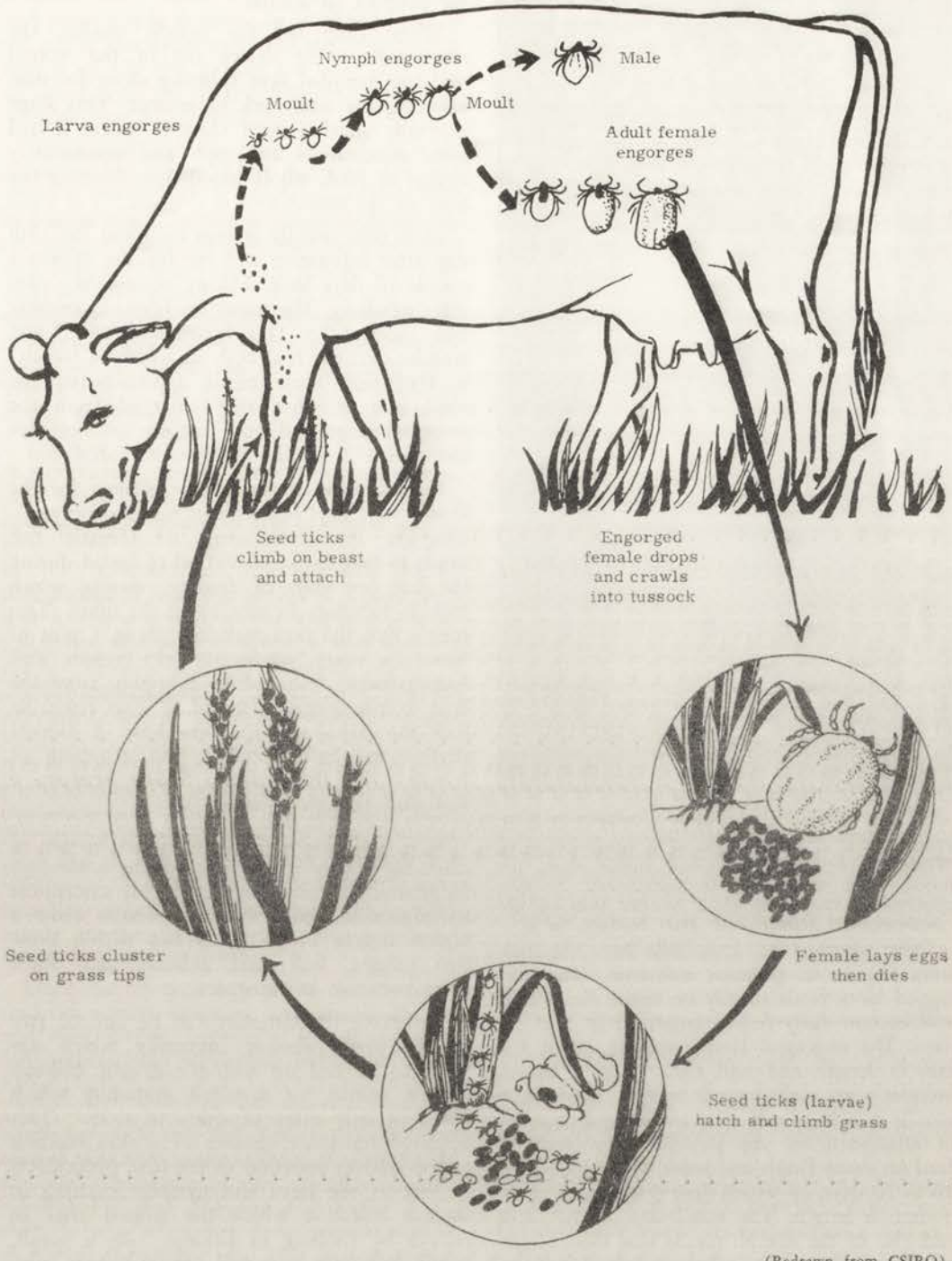
When fully fed the nymph moults, the mouthparts being drawn out of the wound and the nymphal skin splitting along its side, allowing the adult tick to emerge. This stage normally attaches itself close to where it had been attached as a nymph and immediately begins to feed, whole blood now forming the bulk of the meal.

Male ticks usually emerge on about the 13th day after infestation and the females appear a couple of days later. Mating occurs very soon after moulting. The males are fewer in number than the females. They feed intermittently and wander over the host body in search of females to fertilize. They remain approximately the same size as when they emerged from the nymphal stage and may live on the host for more than 2 months after initial infestation.

Engorgement of the female is slow for the first 3 or 4 days but then increases rapidly. To complete its development the female tick needs to take in 0.5 to 1.0 ml of blood during the last few days of feeding, during which time it increases in size about 40 times. This means that the host may lose about 1 pint of blood for every 500 female ticks present. Full engorgement, followed by dropping from the host, occurs between 19 and 37 days from the time the larvae arrive on the host. A diurnal rhythm has been noted in the dropping of female ticks, the majority falling between 6 a.m. and 10 a.m.

It is well known that different breeds of cattle show varying resistance to the cattle tick. In general, British breeds are highly susceptible to infestation, while Brahman breeds show a higher degree of resistance but within these two groups, individual animals may show great variation in resistance.

Resistance or immunity can be one of two kinds—either inherent immunity which appears to be tied up with the genetic makeup of the animal, or acquired immunity which develops only after exposure to ticks. This acquired resistance consists of a skin reaction to the salivary secretion of the tick, particularly to that of the larva and nymph, resulting in intense irritation which the animal tries to relieve by rubbing or licking. As a result, many ticks are removed, many others may wither and die or be drowned by a 'weeping' of the puncture.



(Redrawn from CSIRO)

Figure 1.—Life cycle of the cattle tick.

It is said that it is in inherent resistance that the British and Brahman breeds of cattle show the greatest difference, the two types showing little difference in acquired resistance. Experiments have shown that on Brahman cattle not only are smaller numbers of female ticks produced but these ticks are actually smaller in size and lay fewer eggs than do those from British type cattle. Crossbred Brahman cattle are also resistant to a degree, but this resistance is relative and depends on the proportion of Brahman blood in the offspring.

Rusa deer, the other common host for ticks in Papua New Guinea, also seem to show more resistance than do British breeds of cattle. Experimental work with tick on this species of deer shows that a return of 3-4 per cent engorged female ticks can be expected from 20,000 larvae. This compares with a return of 7-8 per cent from British breed calves used as control animals. The average size of tick recovered from deer is slightly smaller than those from control calves and these ticks lay fewer eggs than do the control ticks. It has been calculated that under experimental conditions a typical engorged female tick from a deer will produce approximately 1,500 eggs while a similar tick from a calf lays 2,200 eggs. The progeny of tick collected from deer readily infest cattle and vice versa.

These facts mean that the rusa deer is an efficient host for cattle tick but is not as good as are mixed British breed calves. It means that once deer have become infested with tick it will be virtually impossible to eradicate tick from any cattle in that area, as long as the two animals have access to the same grazing grounds.

The importance of the cattle tick to cattle owners is two-fold. First, the tick is a parasite and therefore dependent on its host for food. This means a considerable and constant loss of blood in a heavy infestation leading to anaemia, loss of condition, reduction in growth rate and interference with weight gain. If the cattle are in poor condition for other reasons, the added burden of a heavy tick infestation may cause death. Futhermore, because of the swelling and reaction around the point where they attach themselves to the skin of the animal, the hides of ticky cattle are very uneven and of poor quality.

Second, cattle tick can transmit certain organisms that cause disease in cattle. The most important of these organisms in Papua New Guinea is a minute blood parasite, *Babesia argentina*, which has a similar effect in cattle to that of the malaria parasite in man. The disease it produces, babesiosis (red water fever or tick fever), when not fatal, has a long-term effect on the well-being and productiveness of cattle. Another organism which causes disease and which has been found in Papua New Guinea is *Anaplasma marginale*. This, like *Babesia*, is a parasite of the red blood cells and can be transmitted by the cattle tick from one host to another. The cost of combating these diseases by vaccination or with the use of drugs can be high.

The cattle tick is therefore of considerable economic importance, since it can (i) lower returns through reduced growth rates, mortality and decreased hide values; and (ii) increase costs of production through expenditure on drugs and vaccines for babesiosis and on spraying programmes for the control of the tick itself.

This is why the Department believes that the eradication of the cattle tick, wherever possible is important for the continued success of the cattle industry. All farmers can contribute to the success of this programme by ensuring that they get the approval of a Stock Inspector before moving their cattle and by mustering their cattle regularly for spraying in the last few remaining areas where eradication is being carried out.

The Tenderness of Beef

M. ONDRASEK, Senior Veterinary Officer (Inspection Services)

Tenderness is the most sought-after quality of table meat, particularly beef. It is also, unfortunately, one of the most variable qualities. This article discusses a new method of hanging which may assist in ensuring the tenderness of meat.

The Variability of Tenderness

Many factors are known to affect the tenderness of meat including the species, breed and age of the animal at slaughter, the particular muscle concerned, fatigue prior to slaughter and other pre-slaughter and post-slaughter variables, including the method of cooking. Be cause of the large number of factors which affect tenderness, it is unlikely that any simple theory will explain all the facts. Until recently, tenderness was thought to be affected mainly by the amount and type of connective tissue in the meat, and the extent to which it is softened during cooking. However, it is now realized that tenderness also depends to a considerable extent on the state of contraction of the muscle.

Much valuable information about tenderness can be obtained through the judgement of trained observers who score the amount of effort required to chew the meat. This quality can be also measured objectively by various instruments or mechanical devices.

Ageing

In the process of ageing, the natural breaking down of tissue (autolysis) is allowed to occur in meat, generally stored at temperatures just above freezing point for two to three weeks. More rapid ageing is possible at higher temperatures but the risk of rapid growth of microbes at higher temperatures is a serious disadvantage. Unless the temperature is kept below 7°C (45°F), food poisoning bacteria could make the meat dangerous to eat. One way to obtain greater tenderness whilst avoiding spoilage by bacteria is by ageing in an atmosphere that will slow down microbial growth. It has been demonstrated that such an atmosphere develops when meat is packed in gas-impermeable films, due to the liberation of carbon dioxide from the meat itself. This procedure has been widely accepted overseas. Both time and chiller space are required, which add to the costs. Other disadvantages of the process are that its success depends on the gas-tightness of the pack to maintain the inhibitory atmosphere. Variations in the composition of the atmosphere occur from pack to pack, and scrupulous care must be taken to ensure adequate sealing, sanitation and temperature control. Furthermore, any bacterial growth which does take place can cause greening on dark-cutting or low acid beef (pH 6 and above).

Plate 1.—A side of beef hanging conventionally.

Hanging of Carcasses

Meat is most tender at the time of slaughter and as the carcass passes into rigor mortis the muscle fibres shorten and the meat becomes progressively tougher, reaching maximum toughness when it has just gone into rigor. Within certain limits of contraction and elongation, the shorter the muscle fibre length, the tougher the meat. Any means, therefore, of reducing the contraction of muscles improves tenderness.

A recently developed method of hanging beef sides minimizes contraction and consequent toughening of certain meat cuts. Improvements in tenderness have occurred as a result of hanging sides from the pelvis or aitchbone, rather than from the hock or Achilles tendon, which is the conventional way.

Method of hanging: The hot side is suspended with a hook by the aitchbone as shown in Figure 1. This must be done within 1½ hours of slaughter. Some mechanical means is necessary to raise the side up and free the hock from the rail. One end of a sterilized hook is inserted into the eye ("pope's eye") of the aitchbone; then the side is lowered and the other end is hooked to a conventional roller on the rail. The full weight of the side is taken on the aitchbone. The hook should be of approved material and of sufficient length to ensure clearance between the top of the carcass and the rail above it.

The sides must be left in the chiller for at least 24 hours suspended by the aitchbone. After this period the side or quarter can be hung by the Achilles tendon.

Tenderization: The improvement in tenderness in the rump (sirloin butt) thick flank (knuckle), topside (inside), striploin and scotch fillet (cube roll) resulting from the aitchbone hanging is equivalent to 3 weeks' ageing at about 2°C (35.5°F). The improvement in tenderness of these cuts corresponds to changes from "slightly tough" to "tender".

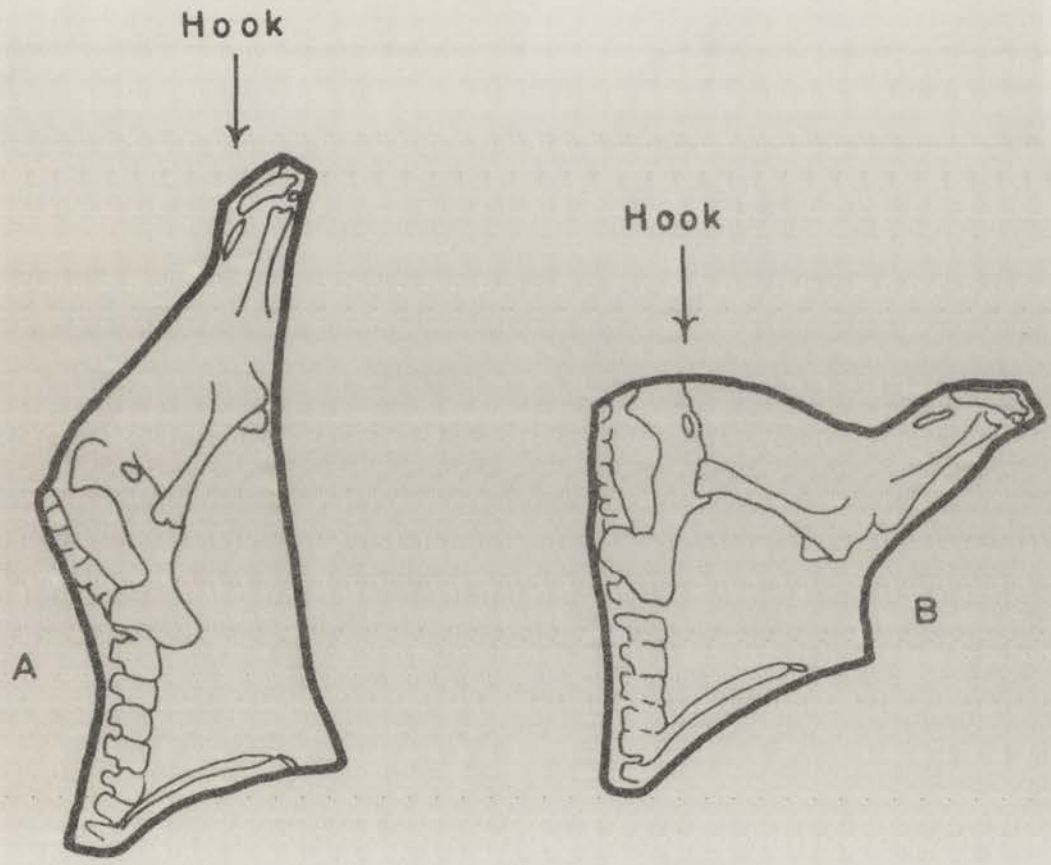


Figure 1.—A. Normal suspension from the Achilles tendon. B. Aitch-bone suspension.

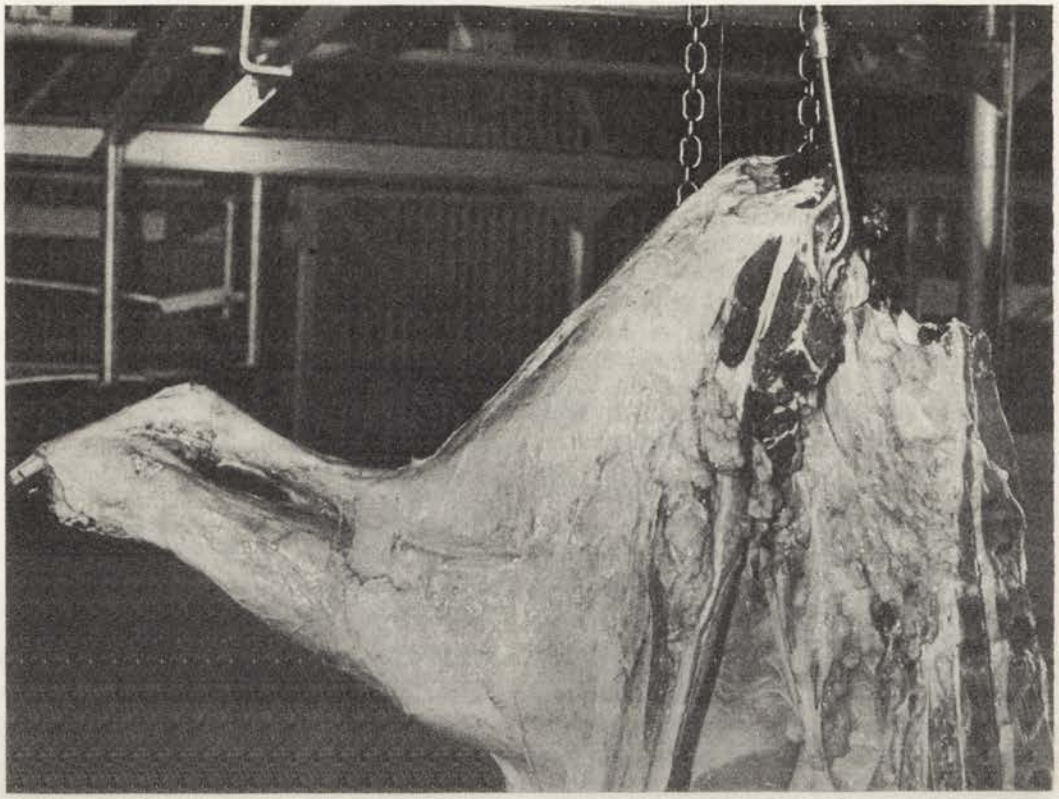


Plate II.—A side is suspended from a hook under the aitchbone, the leg protruding at right angles.

The silverside (outside) is not improved to the same extent as the above cuts, while the blade roll (chuck tender) is not affected at all. The fillet (tenderloin) becomes a little less tender but this is not sufficient to affect the acceptability. The percentage yield of cuts is not affected. A possible disadvantage is that butchers and boners may have to adapt to the new shape of some of the stretched muscles.

Other Methods of Producing Tenderness

There are other methods of making meat tender, although they are not used in Papua New Guinea. Both beef and mutton can be tenderized by subjecting muscle from freshly slaughtered animals to very high pressure for short periods. Pressures of the order of 1,000 atmosphere (15,000 psi) applied for about 2 to 4 minutes have given marked improvements in tenderness.

It has been known for some time that meat may be tenderized by injecting solutions of enzymes, such as papain, into the blood stream a few minutes before slaughter. Proteolytic enzymes such as papain can also be injected into selected parts of the carcass after slaughter.

Conclusion

In butcher's language, a beef carcass is described in terms of conformation, finish and quality. To the butcher the beast with the best conformation is one which will yield a large proportion of valuable joints and a small proportion of bone. 'Finish' refers to the external covering of fat. The quality of the meat depends on the condition of the muscle and is associated with the texture. This depends on the size of the muscle bundles and the quantity of connective tissue.

A large number of factors influence this quality in beef and among the more important are: breed, condition, age, sex, activity, pre-slaughter and slaughter conditions, and finally the methods of storage. A number of these are, of course, interdependent, but they all exert an important influence on the final product.

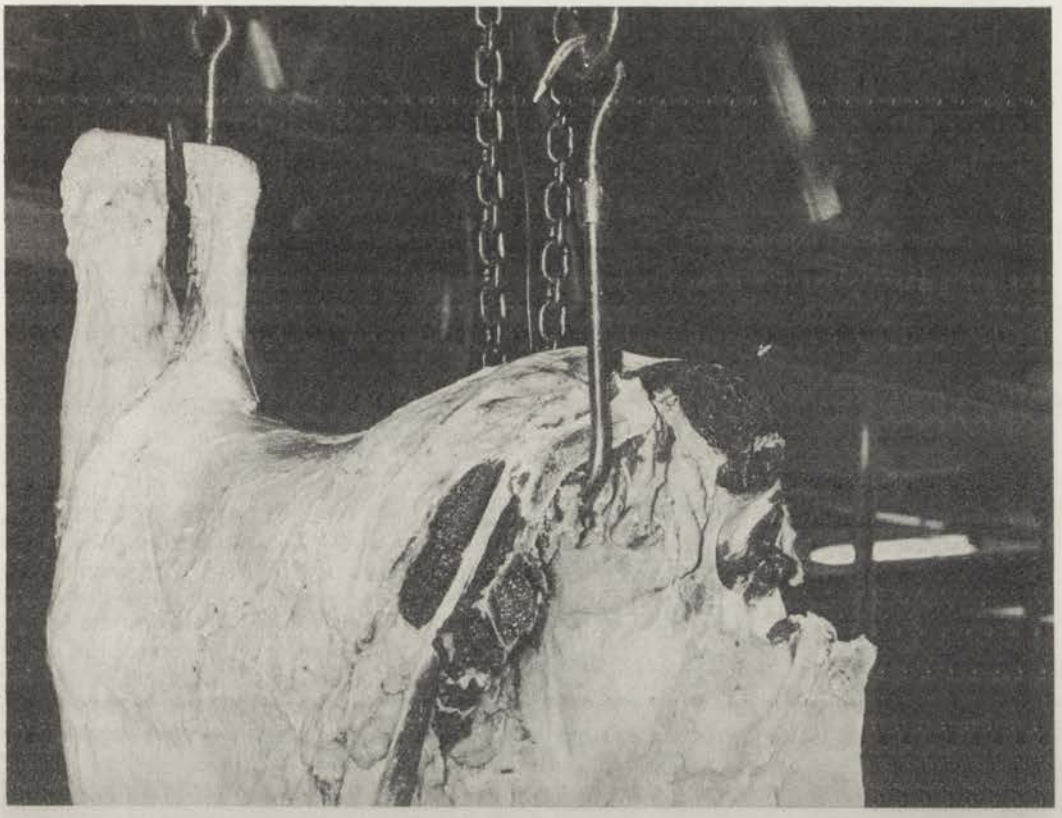


Plate III.—If preferred, the side may be suspended from both the aitch-bone and the Achilles tendon.

Experimental Fish Ponds in the Highlands

KAPA LA'A Assistant Experimentalist, H.A.E.S., Aiyura and J. GLUCKSMAN, Freshwater Fisheries Biologist

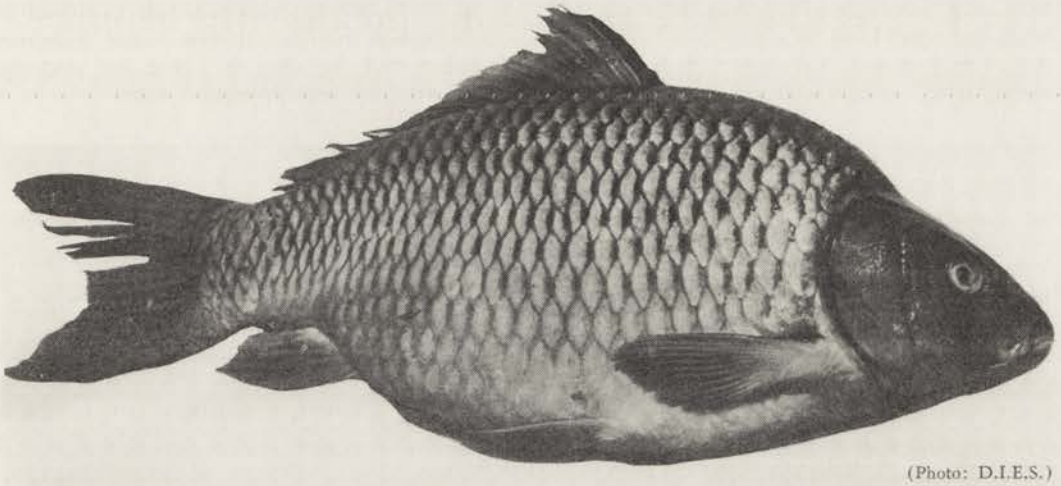
Because there is a clear need for more protein in the diet of the highlands people of Papua New Guinea, the Department of Agriculture, Stock and Fisheries is introducing aquaculture (fish farming) to these areas. There are experimental breeding ponds on the Highlands Agricultural Experiment Station, Aiyura, near Kainantu and at Dobel, near Mount Hagen. From both these places, fingerlings (young fish approximately the size of a finger) are distributed to highlands people for aquaculture in the same manner as seeds or seedlings are distributed by other divisions of DASF for agriculture. This article describes the work at Aiyura.

There are two varieties of Common or European Carp, *Cyprinus carpio,* now being bred. One is called "Golden Carp". This fish is bright orange or golden in colour. When mature it is about 24 in. long and normally weighs 8 to 12 lb, but specimens up to 80 lb have been reported. The other is the "Cantonese Carp" which is coloured with a typical fish pattern, i.e., green-black on the back fading to silver or white on the belly. It is generally smaller than the Golden Carp.

The layout and size of the various ponds at Aiyura may be seen in the *Figure.* Ponds 2, 3 and 4 are used to produce Cantonese and Golden Carp fingerlings. Each of these ponds is approximately 300 x 100 ft. In each pond approximately 150 sexually mature fish of one or the other variety are held. The water-supply is a mountain stream, which flows through a cow pasture before being diverted to the ponds. The sluice boxes are used to control the depth of the ponds, which is maintained usually at 3 ft. Excess water leaves the ponds through the sluice boxes and drains back into the stream.

(Photo: D.I.E.S.)

Plate I.—Golden Carp.



(Photo: D.I.E.S.)

Plate II.—Cantonese carp.

The fish receive a daily ration of as much rice-bran and cooked sweet potato as they can consume in 20 minutes. Since there are comparatively few fish for ponds of this size, they are also able to derive a significant part of their nourishment from algae and waterweed growing in the ponds.

Every four months these ponds are drained and approximately 2,000 fingerlings are transferred to the nursery ponds, where they are held pending distribution. The "breeders" (sexually mature fish) are placed in the holding ponds until the main ponds are refilled.

Supplying Fish to the Farmer

When fingerlings are requested, they are easily netted from the small nursery ponds. They are dispatched in water-filled polyethylene bags inside cardboard boxes.

Before fingerlings are distributed, Fisheries Extension Officers teach people how to build and manage fish ponds. It is important that people who receive fish understand the dangers of overcrowding and underfeeding. A pond a tenth of an acre or larger is preferred. This is an area of 484 sq yds. Examples of ponds with this area are 22 yds x 22 yds or 48 yds x 10 yds.

The Fisheries Officer will advise on the stocking rate which may vary from one fish per sq. yd of pond surface area to one fish per nine sq. yds of pond surface area, depending on the nature of the pond and the ability of the aquaculturist (fish farmer) to feed them adequately. It is best that the pond be designed so that it can be drained and filled when this is needed. Every precaution must be taken to prevent flooding, which can cause the loss of many fish.

For rapid growth, the fish must be fed a balanced diet (protein and carbohydrate) at a rate of between one tenth to two tenths of the fish's body weight daily. The average weight of the fish in the pond is determined weekly by removing, weighing and returning a representative sample (about 5 per cent) of the pond's population. Obviously the amount of food must increase as the fish grow. With intensive feeding of a proper diet, fingerlings may reach 4 lb in only 8 months.

New Investigations

Since the exact relationship of food ration and ration composition to growth rate is not yet fully understood, a joint experiment with the Department of Animal Husbandry, University of Queensland, is soon to begin. Various pelletized rations, with a controlled ratio of protein and carbohydrates will be manufactured in their laboratories and fed at measured rates to a measured weight of fish in pond 3. It is hoped that the ideal ration may be deduced from results of this experiment.

Trials are now underway with a new type of fish in pond 1, the Javanese Carp, *Puntius gonionotus*. This fish is strictly herbivorous (plant-eating). It prefers the very small green plants called algae. A dense growth of algae must be produced in ponds by fertilizing with a superphosphate fertilizer at the rate of approximately 360 lb per acre per year.

The advantage of the Javanese Carp is therefore that it does not need food supplied (rice

bran and sweet potato) as the other carp do. With the right kind of algae in the pond and the correct amount of superphosphate at the correct time, enough food will be grown in the pond to supply the fish with all the food it needs. When the trials are completed, Fisheries Officers will be able to advise on stocking rates and fertilizer application rates.

(Photo: D.I.E.S.)

Plate III.—For distribution from Aiyura, the fish fingerlings are put in water in a plastic bag. The bag is then placed inside a cardboard box.

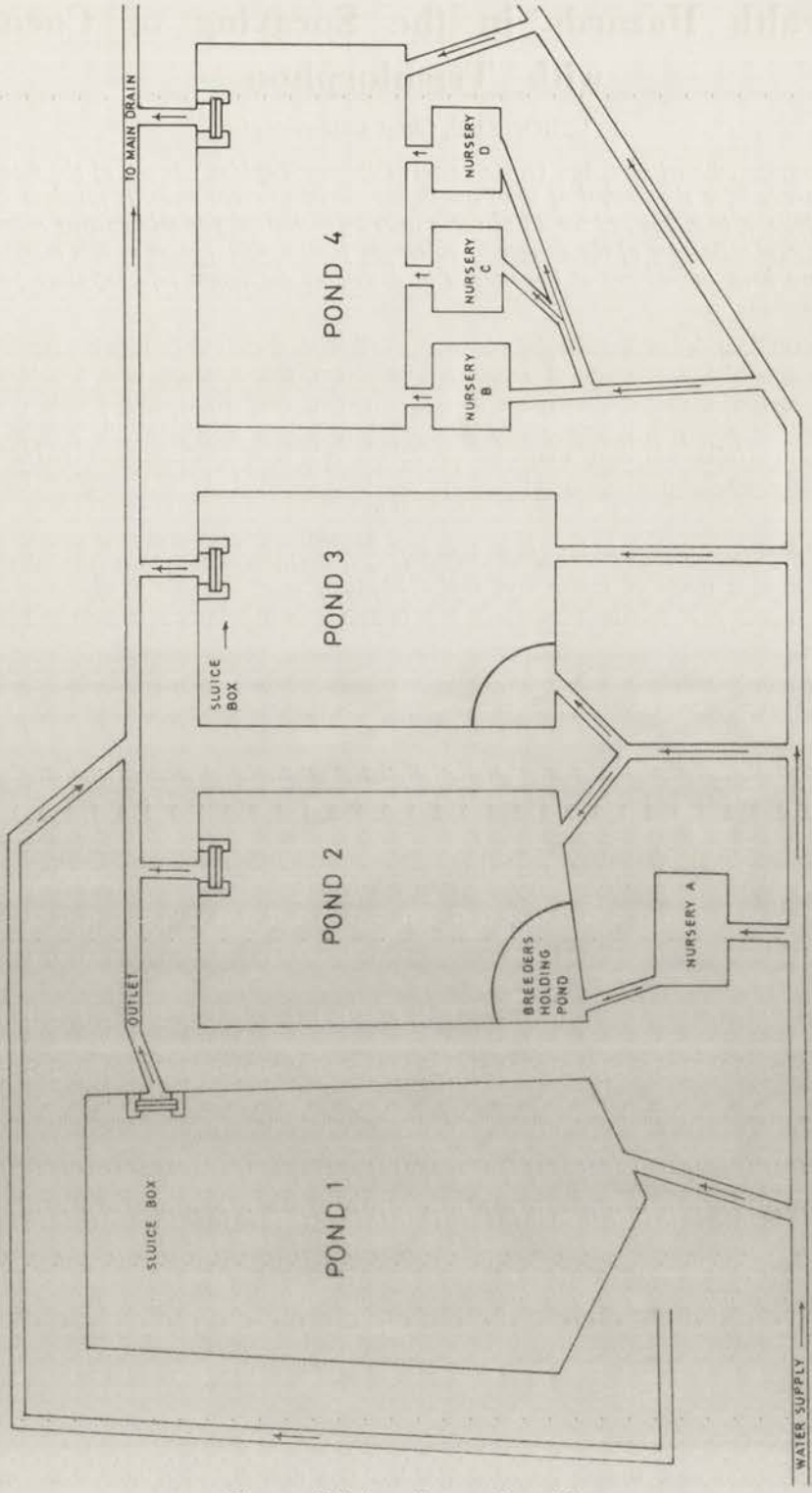


Figure.—Fish breeding ponds at Aiyura.

Health Hazards in the Spraying of Cocoa with Trichlorphon

T. V. BOURKE, Chief Entomologist

Spraying with trichlorphon (trade names: Dipterex, Lepidux) is one of the measures recommended for the control of the Pantorhytes *weevil in cocoa trees. It involves spraying of foliage, branches and trunks of cocoa trees by motorized portable misting machines every 6 weeks. Because of the danger of poisoning from over exposure to this insecticide, tests have been carried out at Popondetta to determine maximum safe exposure periods for spraymen.*

TRICHLORPHON is an organo-phosphorus insecticide which is considered relatively safe to use provided certain commonsense safety precautions are observed. If these safety precautions are not followed, then symptoms of poisoning and even death of spraymen can be expected.

Organo-phosphorus compounds came into being in 1940 as a result of research to find an efficient "nerve gas" for use in warfare. If swallowed, these compounds are rapidly absorbed from the stomach into the bloodstream. Poisoning may also occur through the lungs and spraymen should avoid walking through their own spray mist. In practice, however, the greatest danger is from absorption through the skin.

As well as from spraying operations, there is a risk in handling the concentrate, for a relatively small amount of the more toxic concentrates on the skin can cause rapid poisoning.

Plate I.—A sprayer at work without protective clothing. One difficulty with low volume spraying is that the spray coming from the nozzle is almost invisible.

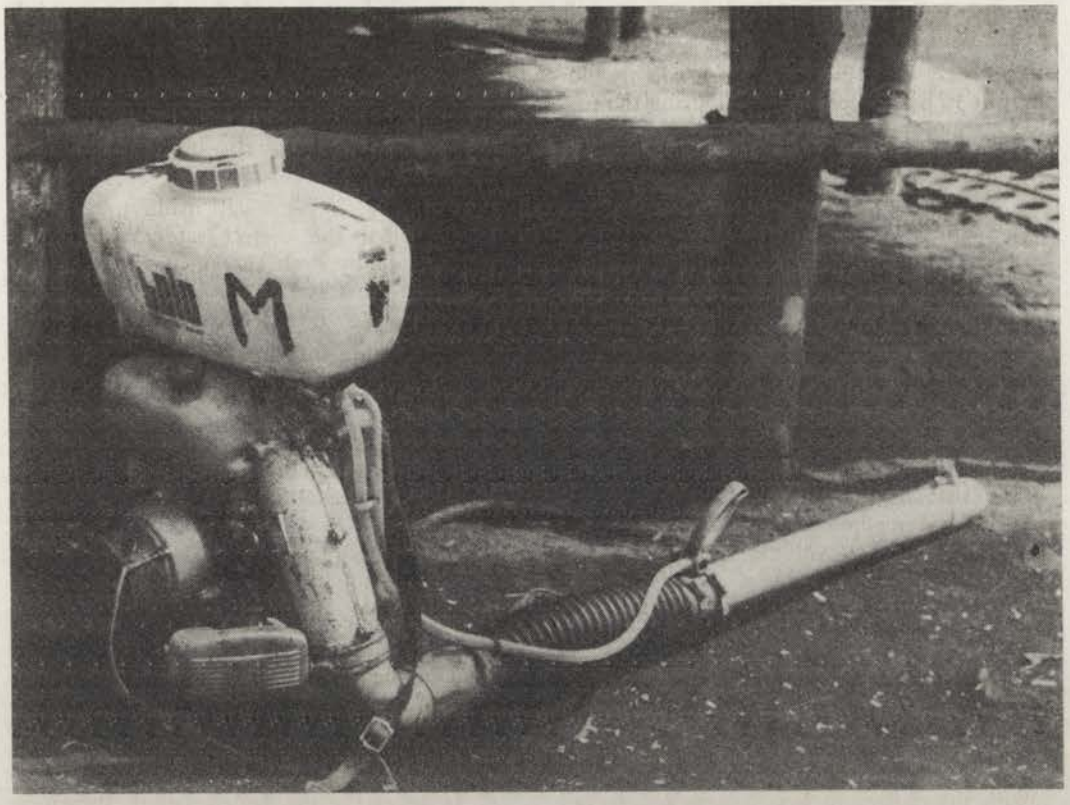


Plate II.—Spraying equipment.

Organo-phosphorus insecticides used in agriculture affect insects, animals and man by destroying the substance known as cholinesterase. Without this substance, a muscle can contract, but it cannot relax. The first muscles affected in poisoning are those which work automatically and are not under the control of the will, such as the muscles of the stomach, intestine and lungs. For these organs a regular pattern of contracting and relaxing is vital and any interruption to this pattern of action would be fatal.

The first symptoms of organo-phosphorus poisoning include muscular trembling, weakness, cold sweats, nausea, vomiting, abdominal discomfort, irritability and restlessness. Pinpoint pupils of the eye and some tightness of the chest occur in some cases.

Fortunately it is possible to measure the amount of cholinesterase in the blood (and other organs) and the normal content of persons not exposed to organo-phosphorus insecticides usually falls within the range of 90 to 150 units. Symptoms of poisoning do not usually appear until the blood cholinesterase level drops to 25 to 30 units.

Cocoa trees form a dense interlocking canopy 6 to 7 ft above the ground level, 5 to 6 years after planting. The spraymen would thus be working in an insecticide-saturated atmosphere for 6 to 8 hours per day, 5 or 6 days per week.

As broadly outlined above, trichlorphon can be taken into the body through the lungs, the stomach or the skin. When used as a spray in cocoa, the greatest danger from the insecticide would be through skin absorption.

Because no information on the effects of continued spraying with trichlorphon under Papua New Guinea conditions was available, it was decided to conduct some trials at Popondetta. Six spraymen were chosen for the trial. Initial blood tests showed that their blood cholinesterase levels ranged from 125 to 150 units, slightly higher than average. It was agreed that a man would be taken off spraying when his blood cholinesterase level reached 50 units. This allowed a safety margin of 20 units,

since symptoms of poisoning do not usually appear until the level drops to 30 units.

The spray used initially was 1.5 lb trichlorphon in 30 gal. water per acre. During the trial, blood samples were taken three times weekly (Monday, Wednesday, Friday) from the spraymen and sent to Port Moresby for analysis.

As spraying continued, the cholinesterase level dropped by approximately 12 per cent between readings for the first 2 weeks, then the readings levelled off, and fluctuated between 70 and 90 units for a period of 6 weeks. Levels then dropped sharply to the predetermined "minimum safety" level of 40 to 50 units, at which point all spraymen were taken off the job. This level was reached some 9½ weeks after spraying commenced.

This first trial was carried out using the high volume method of spraying. With the introduction of low volume spraying, a new trial was run in conjunction with a trial to test the effectiveness of protective clothing. This clothing consisted of long-sleeved overalls buttoned at the neck and wrist, elbow-length heavy duty polythene gloves, plastic-brimmed hats and agricultural type respirators with replaceable canisters. The unprotected spraymen wore short-sleeved shirts and shorts.

With the change to low volume concentrate spraying, 2 lb trichlorphon in 2 gal water were sprayed on an acre of trees. The spray itself was therefore 20 times more concentrated although the total amount of trichlorphon per acre only increased from 1.5 lb to 2 lb.

Again, blood samples were taken three times per week and forwarded to Port Moresby. Results showed that there was a steady reduction in blood cholinesterase level of approximately 16 per cent per week over the first 2 weeks. There was no difference between the protected spraymen and the unprotected spraymen during the first 3 weeks, but for the remaining 7 weeks there was a difference of from 12 to 23 per cent in blood cholinesterase levels, the protected spraymen remaining at an average of 20 to 33 per cent below normal, while the unprotected spraymen had levels of 32 to 48 per cent below normal. The lowest reading obtained was a reduction of 53.1 per cent for an unprotected sprayman, still well above the safety level.

Blood samples taken from workers on other plantations showed a more rapid drop of blood cholinesterase than this. It was obvious that gross contamination of spraymen was occurring and investigation showed that this was mainly from leaking spray machines. However, with the introduction of the more concentrated spray (10 per cent as against 0.5 per cent for the wettable powder formulation) contamination of skin and clothing could also have been important.

Accordingly, a plea was made to planters to ensure that the correct safety precautions were adopted by both spraymen and planters. This led to a marked improvement in the field position.

The foregoing information may be summarized in the following precautions:

1. The 70 per cent w/v concentrate is poisonous. Avoid contact with the skin and avoid breathing in the vapour. If concentrate is spilled on the skin, wash thoroughly with soap and water.

2. Spillage of the concentrate or mixed spray should be avoided.

3. At no time should hands be used to mix spray, nor should they, for any reason, be immersed in the spray solution.

4. Sprayers must not eat or smoke while spraying or before they have washed after spraying.

5. At the end of the day's spraying, spraymen should wash thoroughly, using plenty of soap and water. All clothes worn during spraying should be washed the same day. A sprayman should never sleep in the unwashed clothes he has worn while spraying.

6. Spraymen should spray for no more than a 2-week period, and then be put on other work for 4 weeks.

7. Care should be taken to apply the insecticide at the correct concentration rate per acre. If either the rate or concentration is increased, the spraymen will be exposed to higher rates of insecticide and will therefore run a higher risk of being poisoned.

8. Spray machines should be checked regularly to ensure that there is no leakage from the tap, the nozzle or the tank. Serious contamination can result from a leaking machine.

Further Reading

Bourke, T. V., Morrison, W. B. and Macartney, Betty K. (1971). Effect of prolonged spraying with trichlorphon on blood cholinesterase levels of sprayers. *Papua New Guin. agric. J.*, 22(3): 151-164.

Hely, P. C. and Gellatley, J. G. (1966). Insecticides. How to use them safely and effectively. *N.S.W. Department of Agriculture Bulletin* S62.

Trainor, D. C. (1967). Agricultural chemicals. A synopsis of toxicity and a guide to treatment. *N.S.W. Department of Public Health Publication* G91065-1 K5322.

Book Review

THE VANISHING PEASANT

Innovation and Change in French Agriculture by Henri Mendras. Translated by Jean Lemer. M.I.T. Press, Cambridge, 1970.

Most countries in the world find that their agricultural sector lags behind other areas in developing into a modern economy. In Papua New Guinea the recent rapid development of our economy has largely been the result of new business enterprises owned by expatriates. Many village people have entered the cash economy by growing small areas of new crops or rearing livestock, but most of these people have continued to regard themselves as subsistence gardeners. They have remained on the edge of the cash economy and have not adopted new practices which would increase their productivity. This is causing concern to planners who want to see Papua New Guinea develop her economy rapidly.

Planners who are concerned with the failure of Papua New Guinea villagers to adopt more productive innovations should read "The Vanishing Peasant". Although it deals with the French peasant, many of the findings of Henri Mendras in his extensive study of rural communities in France are applicable to other countries including Papua New Guinea. The study is one of the most extensive ever carried out on the various aspects of change in rural communities. In particular his study of basic attitudes to work, the land, the family, the farm and to time contribute to our understanding of traditional societies. To the peasant, says Mendras, the fundamental professional qualities are a "feeling for the land" and "courage". The universal values of science, the economic rationality and the imposed direction of work and time, familiar to the town-based extension worker, are foreign values which are not relevant to their life. To the peasant the extension worker recommending changes is often seen as a threat. He is usually made more so by the methods he uses if he seeks to deal with individual farmers and have them adopt new innovations. The following passage would seem to have particular relevance to Papua New Guinea.

"The mechanism of change is essentially collective and social in nature: innovation must be integrated into the common routine of the entire village in order to be accepted. Hence the peasant is never inclined to be the only one to do something unaccustomed; on the contrary, he is carried along by his group. Extension work that is based on the assumption that it can be more effective when directed toward individuals is misguided. A single individual has great difficulty in making decisions, as psychologists have shown and recent experience has confirmed. Agricultural progress has been much more rapid when it was the act of groups and institutions" (p. 40).

Mendras concludes with a view of possible future developments in French agriculture. To revitalize rural life, he proposes a national system of agricultural "workshops" organized around towns of 4,000 to 6,000 people. His proposals verge on an ideal model for society that would in all probability prove impracticable, but they are based on a belief in the ability of peasant communities to adapt rapidly to change if they are given the right conditions; a vital condition is that a new, visible and easily understood system is rapidly established. A study of "The Vanishing Peasant" by planners in Papua New Guinea should assist them to ensure that the "right conditions" are developed here. This should enable a rapid change by village communities which will keep them in balance with the developments in urban centres.

R. McKILLOP.

Wanted: One Eel

PATRICIA KAILOLA, Fisheries Biologist, Fisheries Research Station, Kanudi

The staff of the Fisheries Research Station at Kanudi, Port Moresby, has for more than 10 years, been collecting specimens of Papua New Guinea fish. These fish specimens will eventually form the nucleus of a National Collection for the country.

MUCH of the Kanudi fish collection, comprising thousands of fish, was unidentified 3 years ago and it has been a full-time occupation identifying these fish along with new speciments received. Ian S. R. Munro's book "*The Fishes of New Guinea*" is the standard text used in identification: of the 1,067 species of fish he lists as being present in Papua New Guinea, the Kanudi collection holds 650. In addition, it contains approximately 220 species not before recorded from Papua New Guinea waters.

The fish held at Kanudi have been collected in the field by research staff, fishermen and schoolchildren. These are initially preserved in 10 per cent formalin, or frozen if no formalin is available. At the laboratory, they are transferred to isopropyl alcohol, identified, registered and entered on a card index. According to their size, they are either stored in glass bottles, 5 gal polythene bins, or large wooden tanks filled with formalin.

Whilst sorting through the fish in one of these tanks, I found a moray eel which turned out to be unusual. The identity of most moray eels can be quickly found by looking at photographs, as their colours are distinctive. In none of the usual texts, however, was there an eel anything like this one.

The reference books and papers on areas further afield were studied. These included works on the fishes of Hawaii, Fiji, the Marshall and Marianas Islands, Australia, south-east Asia, the Philippines, India and South Africa. Eventually, a picture of a similar eel, labelled *Gymnothorax pikei* Bliss, was found in a book entitled "The Fishes of the Seychelles". A brief description of this eel also appeared in a paper on "The Moray Eels of the Western Indian Ocean and the Red Sea." The description included the comment: ". . . said to come from very deep water of Mauritius, *known only* from Pike's single 1871 specimen from Mauritius." Our specimen was speared in 1968 at Fisherman's Island near Port Moresby—more than 5,000 miles from Mauritius, and 97 years later!

It was obvious my first identification of our specimen as *G. pikei* needed to be thoroughly checked. The original description of the Mauritius specimen, along with several other papers on morays, were obtained, and by writing to the Australian Museum and to the Bernice P. Bishop Museum in Hawaii, I was able to locate the original specimen (the holotype) at the Agassiz Museum of Comparative Zoology at Harvard University. Photographs and descriptions were exchanged with the Curator of the Museum, but it is proving extremely difficult to positively decide whether the two specimens are synonymous, simply because there *are* only two specimens.

It is the usual practice in species identification to examine as large a number of specimens of the one species as possible, so that a complete range of characters *within* the species can be observed. With only two specimens, this is impossible.

Unlike other fish, eels have no scales or fin rays to count, so the characters used in comparing them are the teeth arrangement and number, the coloration and relative body proportions.

Taking into account that the Mauritius *pikei* specimen has been preserved for nearly 100 years, and is thus warped and shrunken, most body proportions compare favourably with our specimen, except the eye, which is proportionally much larger than in our specimen. The number and arrangement of teeth is almost the same in both specimens, except for those on the vomer, a bone in the roof of the mouth. Ours has only six teeth, but the Mauritius specimen has nine on this bone.

The last major difference is in the colouring. The gill opening of the type specimen is encircled by a black ring, whereas our specimen has the gill opening situated in the middle of the second dark crossband.

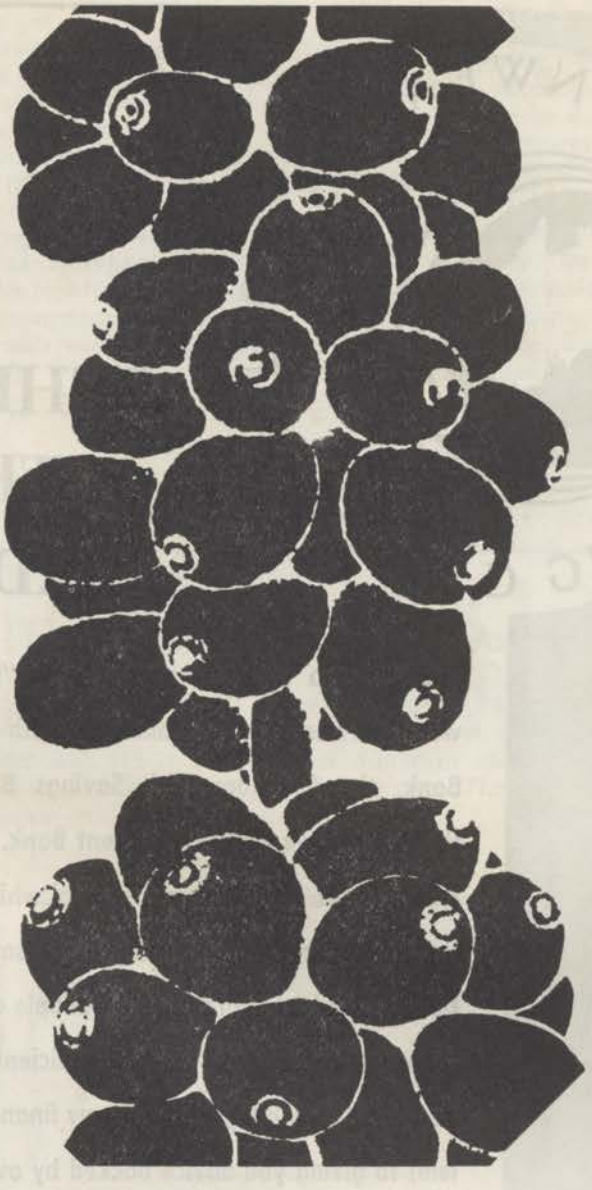
Plate I.—Have you seen a moray eel with markings exactly like this one? If you have, Mrs Kailola at the Fisheries Research Station would like to hear about it.

These differences may not be important. The point is, we don't know *how* important they are unless we can obtain more specimens with which to compare the two eels. It is likely that some variation will occur between the widely separated populations at Mauritius and Papua New Guinea. If more specimens from this area were all found to be consistent with the Fisherman's Island specimen, it may indicate a new subspecies of *Gymnothorax pikei*. On the other hand, if specimens varied between the type specimen and ours, the New Guinea specimens would probably be synonymous with *G. pikei*. In either case the results would be extremely interesting scientifically.

This article then is written as a plea for more specimens of moray eels similar to that in the accompanying photograph. The overall colour is pale, probably creamy, over which are about 27 irregular diagonal dark bars, narrower than the interspaces which may break into blotches on the ventral (lower) surface. The head is brown. The total length of the eel is 2 ft 8 in. If you catch an eel like this, please freeze it and contact me at Kanudi Fisheries Station, D.A.S.F., Konedobu. I shall then send you mailing instructions. In view of their possible scientific value, any specimens received will be greatly appreciated.

The Fishes of New Guinea

"The Fishes of New Guinea" referred to on p. 78 is available from the Government Printer, Box 3280, Port Moresby, at a cost of $15.00 posted within Papua New Guinea and $15.25 posted to an Australian address. The author is Ian S. R. Munro of the CSIRO Division of Oceanography. The book contains the most up-to-date information on local fishes yet published.



Up with ®Basfapon, down with unwanted grass

Is your coffee plantation overrun with weeds? It doesn't have to be. Basfapon, the systemic weedkiller, guards your plantation against annual and perennial grasses. It is absorbed by either leaves or roots and distributed throughout the plant in the sap. This is the secret of Basfapon's success: not only is the grass blade killed off; the entire root system is destroyed and never grows again.

For further information please contact:
Plantation Supply
& Service Co. Ltd.
P.O. Box 92
Goroka

Badische Anilin- & Soda-Fabrik AG
6700 Ludwigshafen
Federal Republic of Germany

BASF

UF/P 1499e