REPORT ON MECHANIZATION OF AGRICULTURAL CROPS IN NEW GUINEA

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Plantation Crops.

FOLLOWING on my visit to New Guinea in February-March, 1952, an interim report was prepared dealing mainly with mechanization of kenaf production. This final report covers field mechanization problems associated with plantation crops, viz. coconuts, rubber, cocoa, coffee and miscellaneous crops such as kapok and tung nuts. It has been prepared in three separately bound sections; this one deals exclusively with coconut plantations.

Coconut Plantations.

The outstanding field operations in copra production reviewed in terms of possible assistance from mechanization are :—

1. Maintaining clean plantations.
2. Pest control.
3. Harvesting the nuts—
   (i) gathering;
   (ii) extraction of meat; and
   (iii) transport.
4. Tractor use.

1. *Maintaining Clean Plantations.*—

There are important conditions which have to be taken into consideration in maintaining clean plantations. The terrain in the volcanic areas is often hilly and broken and coconuts and other obstacles lie in the ground cover. The primary objectives are presumably to maintain a ground cover which will protect the coconut palm roots, keep the soil temperature below the point of denitrification, check leaching and soil erosion, provide free nitrogen from a legume if possible and at the same time have a low, controlled growth on which the nuts can be readily seen and collected. This latter condition would be easy to achieve by cultivation or by mowing were it not for the other conditions desired. Cultivation cannot go beyond the use of the tandem disc harrow used in effect as a pasture harrow but plantation management would often consider this too severe on the vegetative ground cover needed. Mechanical mowing could be used under certain conditions but generally the terrain, hidden obstacles and speed of plant regrowth, make it impracticable. Where mowing can be done light engine-functioned, hand-directed, walking-type auto-scythes have manœuvrability and control which the tractor mower has not got. Anything would be better than the labour wasting sarif which is so much in evidence.

Rugged equipment which will crush down and cut vegetation without destroying it offers attractive possibilities and experimentation with what are variously known as brush, stalk or bracken cutters would be fully justified. There are two main types. One is based on a mechanically driven rotary cutting blade and it is considered that in the New Guinea environment there would be limitations to the effectiveness of this type. While more rugged than a mower it would have some of the limitations of the mower. It is the other type which has more scope. The basic principle of this second type is a self-revolving roller, skeleton drum or a series of wheels or discs on which metal flanges or cutting blades are welded. Obstacles such as coconuts, stones and light logs would not affect the operation of these implements and rough terrain would create no difficulties. If desirable, a light angle-blade or side rake could be fitted in front of the implement to push coconuts to one side. However, problems associated with avoiding damage to the nuts arise in the first place from failure to control the ground cover and would disappear once the control of vegetation (including refuse such as husks and palm fronds) became effective.

As there is no mechanical drive and the construction is simple and rugged, the maintenance of these implements is low, their operation simple and the initial capital cost is reasonable. There is a wide range of sub-types which should receive consideration for trial because their relative effectiveness varies widely with the environment and the work to be done.

Coconut tree nursery at "Matupi", Madang District.

Coconut plantation at Madang showing vine pest and Kunai grass.

Plantation at "Raenau", New Britain. Young cacao is seen growing underneath the canopy of twenty-feet-spaced coconut palms.

Coconut trees at "Raenau", showing broken, hilly country which forms large part of many plantations.

Sub-types suggested for consideration are :—

(*a*) *Wheel-type Bracken Crusher.*—

Cuthbertson Ltd., of Biggar, Scotland, has a design consisting of eight pairs of wheels in a heavy frame with "V" shaped cutters welded across each pair of wheels. The width of cut is eight feet, and the speed of working is approximately sixteen acres in an eight-hour day. The price of this unit delivered in Australia would be to the order of £380. Each pair of wheels has its own flexible axle so that if one pair of wheels rises over a ground obstruction, the other seven pairs retain contact with the ground.

(*b*) *Disc-type Cutter* (unrelated to a disc harrow).—

Cuthbertson of Scotland have what they call a "disc cultivator" consisting of two rows of four large discs set in tandem with transverse cutters around the periphery of each disc. Cuthbertson Ltd. describes the use of the disc cutter in the following terms :—

"This machine is being used for inter-row work in sisal fields in Africa, and for similar work in coconut groves. The action is that the vegetations between the crop rows should be chopped up and left on the ground, forming an insulating mat which prevents the ground temperatures from rising and retarding the growth of the crop. The machine is not intended to work at a considerable depth, as there is no necessity to bring up the parent soil".

The discs have independent flexible axles enabling each one to float over an obstacle. The discs are mounted under a box frame and weight is added, up to two tons, if necessary, as ballast in the box to give penetration in dense vegetation. The action is more severe than that of the bracken cutter and would not be so suitable where a green manure crop was used. Approximate price delivered in Australia would be to the order of £590.

(*c*) *Skeleton Drum Stalk Cutter.*—

This is an American type designed for cutting weeds. Long cutting blades (eight to twelve) are bolted on to an open drum structure in the Caldwell model, which is typical. This sub-type is for relatively light work. The width of cut is variable depending on the number of drums employed. The cost is not available but the simplicity of this sub-type would insure that the cost was relatively low, say to the order of £250.

(*d*) *Roller Cutters.*—

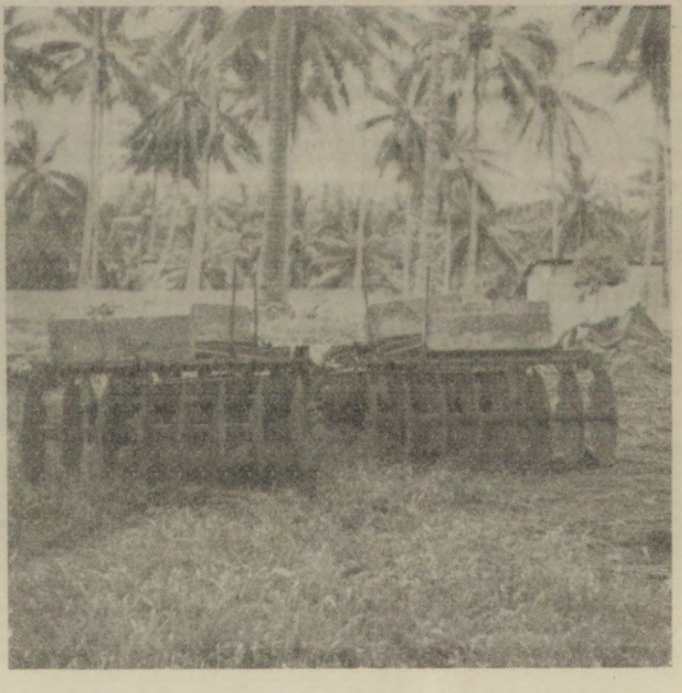
This sub-type is basically a weighted roller, single or in gangs of two, three or four, with cutting flanges welded or bolted transversely across the cylindrical roller. The most advanced design is the American Marden used effectively in Texas and the South-West generally for clearing mesquite scrub. The principle is similar to the improvisation at Epo in the Mekeo area of New Guinea where flanges were welded on to an oil drum filled with concrete. There is also an Australian-made sub-type called the Robinson Wollard Bracken Fern Crusher manufactured by Hadens, Taree, New South Wales. This sub-type of cutter has worked effectively in bracken control in New South Wales and is well reported upon by the Agricultural Department for that State.

It is an important feature with all these sub-types that they have flexibility so that each unit in a gang floats over obstacles independently. This imposes a serious limitation on the roller used at Epo. The design and construction of independent axles is a difficult job; so is the design of suitable bearings and provision for lubrication.

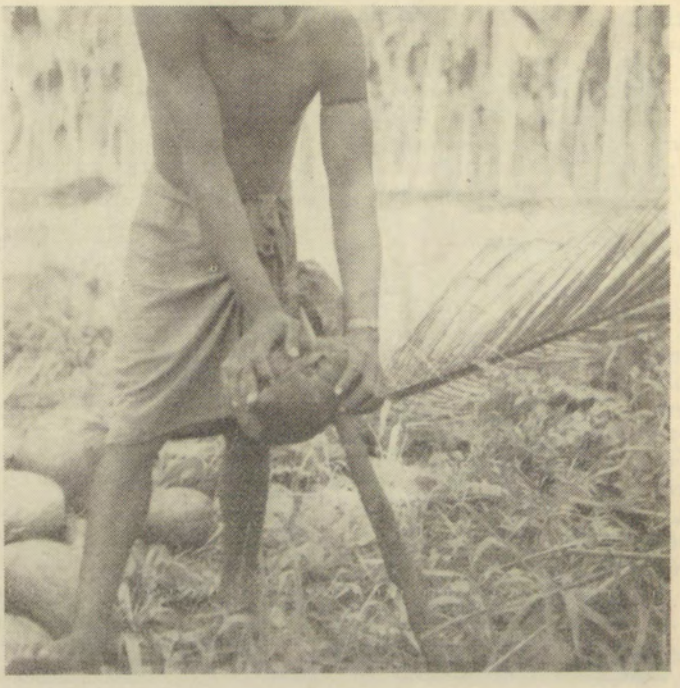
There have been improvisations in New Guinea (see Dylup and elsewhere) such as a heavy channel iron drag, a heavy anchor chain drag and log rollers. There are disadvantages in the channel iron and log improvisations. They lost contact with the ground when passing over depressions and obstacles, and there is little scope for adjustment of weight or ground pressure. The channel iron and the log cannot float a section over an obstacle and has to ride high over its whole length, thus leaving vegetation untouched. Keeping plantations clean is so important that even minor improvements in the implement used are justified and the professionally designed and constructed implements are favoured. Nevertheless, credit is due to plantation managers who have improvised equipment.

It is considered that very considerable benefit could be obtained by field demonstrations to planters of sound examples of the agricultural engineering designs describ-

Sarif "sword" used for grass control by Native labour. It is made from hoop iron and is beaten out when the edge needs sharpening. The work with this universal New Guinea tool is slow and wasteful of labour.



Tandem disc harrows on "Raenau" used for keeping plantation clean.



Dehusking stick in use. The pointed stick is rammed tight into the ground.

Coconut halves shown with splitting knife alongside; jute sack filled with coconut halves ready for transport to the drying shed is in the background.

ed and that there would be justification in importing several machines for comparison. The following are suggested :—

(*a*) The Australian Robinson Wollard Bracken Crusher from Haden's, Taree, N.S.W., at an approximate price of £160;

(*b*) The Cuthbertson Bracken Crusher from Jas. C. Cuthbertson Ltd., Biggar, Scotland, at an approximate cost of £380, Australia.

(*c*) The English Hayter Bracken Fern Cutter (Rotary Cutting Blade principle) from Farm Fitters Aust. Ltd., Melbourne (Australian agent). Approximate cost £190.

The Cuthbertson disc cutter is also recommended if there is likely to be use for it in sisal plantations.

It is a recognized practice in some countries to associate cattle grazing with copra production and thus provide control over vegetation as a side line. This practice would not obviate the need for mechanical cutters as they would assist in bringing plantations under pasture and in renovating the heavy matted growth formed by many tropical pastures.

2. *Pest Control.*—

The control of such insect pests as sexava which involves spraying or dusting is difficult to accomplish by reason of the height of mature coconut palms; these may average some eighty feet.

Ground machines such as fog forming machines, high pressure volume sprayers, low volume sprayers and blast sprayers and dusters project or drift the specific for limited distances; 35 feet is usually considered a maximum distance in Australia for effective distribution of the pesticide. High pressure volume sprayers with, say, 600 pounds pressure and an exceptionally large nozzle opening could project a powerful stream of fluid to the under-side of the palm fronds. Such equipment would have to be specially made and would create difficult problems; the capital cost would be high; the unit would be exceedingly heavy; finally, an exceptionally wasteful amount of wash would be used and the costs on this account would be high. The top side of the fronds might not receive sufficient wash. The use of a high pressure volume sprayer with a tower mounted on a trailer could be given some consideration. However, in the U.S.A. where this type is sometimes used, the trees sprayed are not much over 30 feet high; there are practical limits to the height of the tower. Native labour could spray the palm tops by the laborious and slow process of climbing the trees; long hoses from high pressure volume sprayers or pressure knapsack sprayers could be used.

There is an American high-level blast-type machine which might be effective. It is called a Rotomist Duster and is made by the John Bean Division of the Food Machinery Corporation, San Jose, U.S.A. [Australian Agent—Food Machinery (Aust.) Ltd., Melbourne]. The manufacturers claim a maximum height for the direction of a pesticide of 100 feet. Liquid or dust can be used. The unit has a twenty-six horse power (rated) engine, weighs 2,200 pounds and is for mounting on a truck or utility. The approximate price is to the order of £1,500. The nozzle velocity is 165 miles per hour but the velocity loss is very rapid over a distance (roughly one-third for every six feet). The terrain would have to be sufficiently smooth to permit the passage of a motor truck. However, details and specifications (obtainable from the Melbourne agent) would be worth careful consideration.

The aeroplane would overcome the problems facing ground machines but may create difficulties of its own arising from the rugged terrain and flying conditions generally. Furthermore, the deposit on the under-side of the fronds may not be adequate. If the aeroplane were used, certain Australian experiences may be helpful. In brief, these are given below :—

(*a*) Where manœuvrability is important, light aircraft have many advantages;

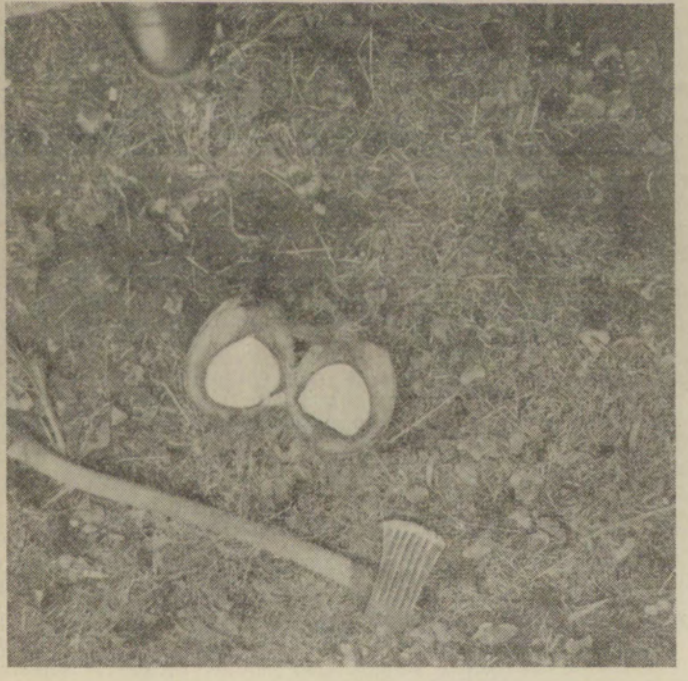
(*b*) The Tiger Moth (D.H. 82) was the principal machine used. This was due to the low capital cost and availability from war disposal stocks. The Tiger Moth lacks capacity and versatility; its operational pay load allows for only some 30 gallons of wash. Higher pay loads are desirable, particularly when operating from a landing ground an appreciable distance from the area to be sprayed.

(*c*) The aircraft design should give the pilot a clear view of the target. This is vital with fixed-wing aircraft.

Copra—coconut halves after drying in a Ceylon air drying plant at "Siar", Madang.

Transport trailer used with a 22 h.p. max. on drawbar tractor. At "Raenau", New Britain, the whole nuts were transported from the field into the drying shed by this trailer.

A pile of whole nuts outside "Raenau" drying shed awaiting splitting and extraction of the meat.



A whole nut split with a special type of light axe at "Raenau".

(*d*) Liquid sprays have proved more effective than dusts. In particular, they are less affected by wind and easier to control.

(*e*) Spray bars with nozzles and alternatively venturi systems have been used effectively. The efficiency of the pump is highly important. A constant speed air-screw pump is desirable.

(*f*) Rotary winged aircraft have not been used in Australia for pest control; the capital expense and the operation costs were extremely high (overseas trends are towards the construction of more economical helicopter types).

(*g*) Equipment including the tank, pump, spray line, spray bar and nozzles can be made in Melbourne or Sydney to meet requirements. There are aeronautical engineering consultants available to prepare detailed specifications for the manufacturer.

3. *Harvesting the Nuts.*—

The following basic data was observed from the plantations examined in detail (Matupi and Siar at Madang; Raenau in the Gazelle Peninsula, New Britain). The average size of the plantations was 800 acres. There were two distinct methods of harvesting the nuts and curing the copra.

Method 1:—

(*a*) The nuts were gathered from the ground into small piles and dehusked by ramming on to a pointed stake or chisel-pointed iron bar fixed in the ground;

(*b*) The dehusked nuts were split in two with a heavy knife, bagged and transported by truck to the central drying plant; alternatively the dehusked nuts were transported whole to the drying plant and subsequently split in two;

(*c*) The half-nuts (shell and meat) were dried sufficiently to shrink the meat out of the shell. The drying process was continued with the meat to form copra halves.

(*d*) A Ceylon air drier was used.

Method 2:—

(*a*) The nuts were gathered into piles and transported by tractor trailer to the central drying plant;

(*b*) The nuts were then split (through husk, shell and meat) into halves with an axe;

(*c*) The meat was cut out in slices with a small knife and the meat slices were then placed in the drying trays;

(*d*) A modern kiln drier, using fan-inducted hot air from a furnace, was used. The hot air was directed underneath perforated trays holding the copra slices.

The second method provided a by-product in the form of the coconut fibre from the husk as raw material for sale to a factory processing matting, etc.

The harvesting was essentially a manual process involving some 300 Native boys who have to be housed and fed.

The time factors in the above operations are variable but observations of Method 1 indicated the following:—

Gathering the nuts, 60 per cent.;

Dehusking, 25 per cent.;

Splitting and bagging, 15 per cent.

The average boy on "Matupi" gathered, dehusked, split and bagged 300 nuts (four bags). Loading and transport of the bagged half-nuts did not take up a major amount of time. Under Method 2, there was a saving in dehusking but loading and transport took more time and meat extraction was an added labour.

Mechanization possibilities are reviewed in terms of three processes; gathering the nuts, dehusking and splitting, and finally transport.

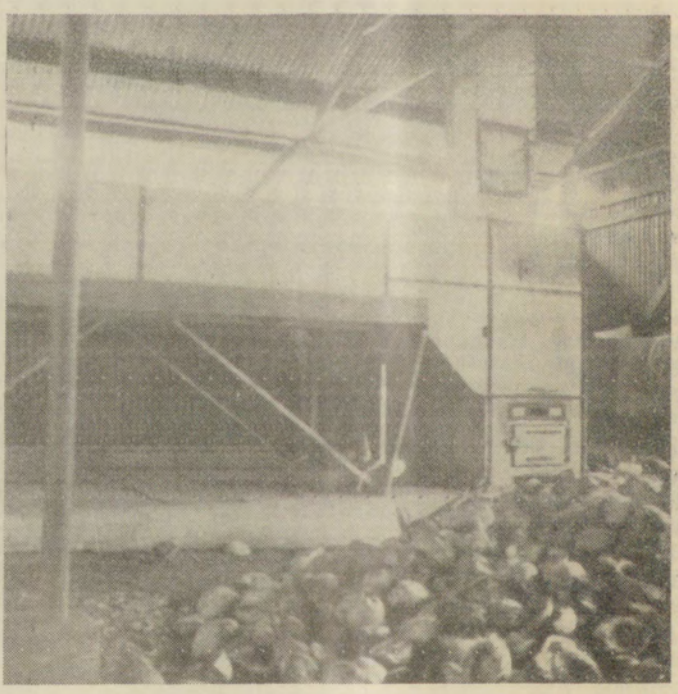
(*a*) *Gathering Nuts.*—

There is evidence that this takes up the greatest amount of time. The chief difficulty is to find the nuts hidden in the vegetation and debris. If the mechanization methods suggested for keeping the plantations clean were carried out efficiently, the nuts would be easy to see and pick up manually. It would not be difficult to devise an attachment for mounting in front or behind a tractor to sweep up the nuts. It is doubted, however, whether the cost would be justified; more than one tractor would be required. A first essential is clean ground with no more vegetation than is provided by a well-controlled legume of prostrate growth habit. Palm frond debris should not be allowed to accumulate and it is likely that a suitable scrub- or fern-crushing machine as described above will assist in disintegrating such debris. Machines with weight and blades properly adjusted

Slicing out the coconut meat with a knife. A series of cuts are made and the meat then loosens and lifts out. The halves with the fibre intact can be sold as raw material for coconut matting.

The dry shed (copra curing plant) at "Raenau".

Coconut slices in the drying tray of the kiln drier at "Raenau".



The "Raenau" Plantation's modern drying kiln processed 56 tons of copra a month. Hot air from a furnace is inducted by a fan down an air chamber underneath perforated drying trays.

should not disturb the legume growth beyond the necessary control required.

(*b*) *Dehusking and Splitting.*—

There have been experiments in dehusking and splitting mechanically but there is no available evidence so far of a successful machine. In any case, as indicated above, the time taken up in dehusking and splitting is less than half that of gathering the nuts.

(*c*) *Transport.*—

It is considered that this can be done most efficiently by the use of a light, mobile tractor and trailer. The tractor can negotiate wet, boggy conditions better than a truck and the floor of the trailer is lower for loading. It is appreciated that there are general uses for a truck for which it has advantages, particularly for transport of copra and supplies for relatively long distances. There are many uses for a tractor on a plantation as will be discussed below. The tractor trailer's work will be particularly effective in moving between the palms in rough or wet terrain. A likely type is a two-wheeled, three-ton capacity trailer with a trap about ten by six feet, and high sides. A tipping tray may have worthwhile advantages over a fixed one. The two-wheeled types give added traction by bearing their weight on the driving wheels of the tractor. They are highly manœuvrable and easy to couple.

(4) *Tractor Power.*—

The small extent which coconut plantation management drew on mechanical equipment and tractor power was surprising. No doubt this has an historical background involving cheap and plentiful labour supply. (It is no longer cheap, nor plentiful.) There are also present difficulties arising from the near-absence of local commercial servicing facilities and the cost of transporting a mechanic by air from a main centre (or the delay by water transport). In a changing scene, some plantation management has not yet sufficient mechanical knowledge to be independent of outside help. This is certainly a prerequisite to the use of tractors and field machines on plantations.

There is much scope for tractor use and the capital cost is small in proportion to the total capital employed in a plantation. Apart from obvious uses in maintaining clean plantations and providing transport, tractors can be used for many auxiliary purposes by using the belt drive or power take-off or by using pneumatic power from a compressor driven by the tractor. Wheel tractors of 20 to 25 horse-power maximum on the drawbar, with provision for direct coupling of equipment, would be suitable for transport and general work. Small crawlers are effective for clearing light scrub and debris and where the terrain is particularly difficult.

It would be feasible for a plantation to employ two tractors; a light or light-medium crawler of 25 to 35 horse-power maximum on drawbar and a light-wheel tractor as described above. With adequate tractor power available, it would be practicable to grow rice, sweet potatoes, peanuts and other crops to provide a balanced diet of plantation-grown rations for the Natives employed.

BRUCELLOSIS OF CATTLE

This is a scourge of the first importance, rendering thousands of cows sterile, lowering milk yields, upsetting breeding programmes, and disrupting genetic lines. It is also known as Contagious Abortion and Bang's Disease. The actual cause is a microscopic germ known technically as *Brucella abortus*. Contact with infection is the main factor which leads to the spread of the disease.

Cattle are susceptible after they have once reached sexual maturity. Young animals up to about six months of age frequently have a resistance to the disease, particularly when they are the progeny of infected cows. Horses and various other animals (including man to a small degree) are sometimes affected.

The infection is contracted mainly by eating the germ with the pasture. Infective discharges pass from the genital tract, and the dung and urine may carry the germ, so that the infection is readily picked up by grazing animals. Occasionally a bull may be affected in the testicles, in which case he may possibly infect cows at the time of service. It is possible that at times he may transmit the disease mechanically from an affected cow to the next uninfected cow which he serves. Infection may be introduced on to the farm by untested cattle which are carriers of the disease. Flies may transmit the disease. They may alight on the after-birth from an infected cow, and then on the eye of another beast. Infectious material placed in the eye will readily cause infection.

The germ may live for many months in shady, protected positions.

Cows which have been infected may abort once, but seldom abort again, as they develop tolerance to the disease. Though they do not abort, they remain carriers of the disease. Such carriers will avoid infectious dung, urine and discharges, and so act as disseminators of the condition.

Generally speaking, the animal shows no symptoms such as temperature, or obvious illness, but after infection the calf may be aborted at varying stages of pregnancy, often about the fourth or fifth month. The calf is frequently dead, even if old enough to be born alive. The aborted foetal membranes (after-birth) show patches of dead tissue on them. There may be a continuous discharge for some time, due to inflammation of the uterus, the neck of the uterus, or the vagina. At subsequent pregnancy, the cow usually retains the calf until full time, but the infection still remains, and in such cases the incidence of dead calves in the herd is markedly increased. Further, after calving has occurred, it is common for trouble to occur with " the cleanings ".

The cow retains the after-birth and, as a result of secondary infection, inflammation of the uterus and other parts of the genital tract is very common, resulting in sterility. Infection may travel up the fallopian tubes, leading to changes in the ovaries, such as cystic conditions, which effectively prevent further breeding.

It has been demonstrated that in the non-pregnant period, the germ may become located in the udder of an infected animal, and the presence of this udder infection appears to decrease the milk production somewhat. The economic loss due to this decreased production is hard to assess, but may be of significance.

The most reliable method of diagnosis is to collect blood samples, and forward the serum to a veterinary laboratory for submission to the agglutination test. This test, like other biological tests, is not one hundred per cent. accurate, and this is particularly so in the case of pregnant cows. Cases have been reported where carrier cows gave a negative reaction after calving or aborting. Further, one test must not be relied upon, but at least two negative tests must be obtained before a cow is presumed to be free from infection. Once a herd is free, no cow should be introduced unless it has passed two clean tests, and further, if pregnant, it is desirable to retain such an animal in isolation until a fortnight after calving, when a further test should be

carried out to ensure that she is free from the disease.

From cows that have aborted specimens may be forwarded to the veterinary laboratory for examination as follows :—

Where the foetus can be delivered in a fresh condition to the laboratory, this is the best specimen. If the foetus would be too decomposed on arrival, it should be autopsied and the following specimens forwarded—

Pipettes of foetal liver;

pipettes of foetal stomach content;

3 air-dried smears of foetal stomach;

2 air-dried smears of foetal cotyledons;

pieces of liver and cotyledons in formalin.

Also send from the dam—

blood serum;

milk sample (for ring test);

vaginal mucus in sterile bottle;

3 air-dried smears of vaginal mucus.

From milking herds send also—

bulk milk sample.

Advice should also be forwarded as follows :—

age of foetus if date of service known;

size of foetus;

whether foetus carries hair;

temperature of dam, taken as soon after abortion as possible;

whether dam has been driven, transported or otherwise physically exerted prior to abortion;

whether foetus shows any signs of goitre (if so, also send appropriate specimens).

The only effective means of control is to institute testing. When this is done, reacting animals should be removed forthwith. They may be sold for beef, or placed in a separate herd, which is kept under isolation. From such a herd of infected cows, healthy calves may be reared, if they are removed soon after birth and kept in uncontaminated premises. It will be necessary, in the transfer of such calves to clean premises, to shift them first into an intermediate resting property. If this is not done, they may act as mechanical carriers of the germ to older (and susceptible) animals on the clean property. Once a herd is clean, every care must be taken to prevent the introduction of animals not free from the disease.

The disease may be present in horses, and to a less extent in other animals, though rarely in sheep, and where eradication is difficult, blood testing of horses on the farm is usually carried out. The commonest symptom in the horse is fistulous withers.

Unless some care is taken, many cases of sterility may follow abortion infection.

Thus when the disease is in a herd, every care should be taken to limit its harmful effects, so far as possible. Aborting cows should be isolated, the foetus and membranes burned, and the cow syringed out with dilute antiseptic, such as one per cent. dettol, or 0.2 per cent. zinc sulphate, until all discharges cease. No cow that is showing a vaginal discharge should be put to the bull.

When there is any disease of the genital organs in various cows of the herd, it is of particular importance to keep the bull in a separate paddock, otherwise he will serve a "discharging" cow and then a "clean" one, and may in this way spread the disease from cow to cow.

Vaccination of calves is practised in some countries. This procedure is not completely safe, however, and will not be recommended in this Territory until we have further information on the incidence of Brucellosis here.

Calves should be inoculated between the age of four and eight months, preferably five months. After inoculation the calf becomes a positive reactor to the agglutination test for brucellosis but they become negative again by the time they reach breeding age. Most of them remain immune to further infection.

Before vaccination is carried out it is essential that a veterinary surgeon take a blood test of the herd to determine whether the condition is actually present.

Treatment of affected animals is likewise not recommended.

COVER CROPS AND GREEN MANURES

The subject of this talk is a most important one for all phases of agricultural production in the Territory. Ordinarily speaking, cover cropping and green manuring fall into the category of techniques for the conservation, restoration and improvement of soils by the use of selected plants and can be classed with major measures of this type such as reafforestation. These measures cannot be ignored in areas such as this Territory, where soils are subjected to the action of radical climatic factors in the form of high rainfalls and high temperatures. Also the cost structure of many Territory industries is such that the possibility of profitably using fertilizers is extremely doubtful and, therefore, all available natural methods of improving the soil must be used.

The two techniques have essentially different aims, the purpose of cover cropping being to provide a protective living cover on the soil while the aim of green manuring is to grow a crop which will provide a suitable bulk of green matter to turn into the soil for rotting down and thus increasing its humus content. Both, however, achieve the same sort of result in the long run; a well established cover crop is continually dropping organic matter on to the soil surface, which rots down and adds to the humus content of the soil, while the physical effect of increasing the humus content of top-soil with green manure is also protective against rain and other weather elements. The principal point of difference is that green manuring actually involves intensive cultivation to force the plant material into the top-soil, and for this reason it is less desirable than cover cropping under high rainfall conditions.

The group of plants which have achieved prime importance for use in this special field of agriculture are those known as "legumes". Originally, attention was concentrated on them because it was known that certain species of legumes, particularly the clovers, pulses and similar plants have bacterial nodules on their roots which could fix nitrogen in the atmosphere and convert it into a form suitable for plant food.

It was argued that this was the main reason why these crops were so valuable for soil restoration. However, it has now been found that this process does not take place with many legumes, including some of the more important ones used in the tropics and other reasons have been sought to explain their value. It is certain that the cultivated plants of the legume group very readily produce a bulk of soft green leafy material suitable for incorporation in the soil and that in many cases they will do this on soil which is exhausted or eroded to a point where general cropping is uneconomic. It is thought to be important that even though most of the legumes in use are relatively soft, creeping plants or small shrubs they, nevertheless, have deep strong tap-roots capable of bringing up mineral plant foods from the lower level of soils.

Discussing some of the more important types of legumes which are useful for this purpose in the Territory.

Firstly, the Creepers.—

Generally speaking these are most important in the field of cover cropping, particularly in coconut plantations. They tend to develop strong fibrous creeping stems and although they are wonderfully leafy and form a fine mat in plantations of permanent crops, they are less desirable for use in annual crop cultivation as they tend to tangle up implements. Also if any loose seed is left in the cropping area they grow strongly towards the light and will pull down annual crops such as rice, kenaf and sorghum. Some of the best known cover crops for coconut plantations are found in this group. They include the *Pueraria* or *Kudzus*, with their strong-growing, hairy vines, pretty pinkish-purple flowers and prominent hairy pods; the *Centrosemas* which are smoother leafed, with delicate blue flowers and minute hairy pods and the thicker-leaf *Calapogoniums* which do well in sandy soils near the sea. *Vigna marina*, a yellow-flowering legume occurs naturally

in this Territory in salty beach sand near the sea and often gives cover on the beach area of plantations where other legumes will not grow. It is cultivated for this purpose in some countries.

One of the most effective of the leguminous covers is small creeping Mimosa, there being few plants which give a better cover or are more easily worked into the soil. However, it is disliked because of its spininess, giving detrimental effects on livestock and tending to cause skin complaints with Native workers. Advice has recently been received of a spineless variety of this plant and this is being investigated. If such a variety exists it would really be a boon to the planting industry. It is important to note that two of the well-known covers, *Peuraria* and *Centrosema* are also valuable grazing plants in the tropics and it is thought that cattle raising and coconut production can be very profitably combined using these covers.

Secondly, the erect group of Legumes.—

Here we have a very wide variety of types from which to choose and the most important of the green manures are found in this category. Some of the most effective green manures belong to the annual pulses, such as the Cowpea or Poona pea and the Mungo bean or Green gram. These fast-growing annuals rapidly provide a dense mat of soft green matter which is very easily digested when worked into the soil. There are also a wide variety of shrubby legumes suitable for such purposes, which include such well-known members as the *Crotalarias*, Pigeon pea, and *Tephrosia*. This group often serves a dual purpose in providing early shade for crops such as cocoa and coffee, at the same time protecting the soil and when slashed giving a good mulch.

It should be fully appreciated that green manure crops, while they are growing, also serve as a cover for the soil, and indeed the cover cropping principal needs to be introduced into annual crop production in this Territory. Fallow land should never be cultivated here to the extent that it is kept bare as is often done in temperate climates. Under our conditions such exposed soils will not stand up to the effect of rainfall and sunlight and will lose their humus content and have valuable minerals leached out of the soil. A well-managed cover crop is a far better form of fallow than any other for this Territory. One misconception needs correcting here, and that is the prevalent idea that peanuts are valuable from this point of view. It is pointed out that peanuts when they are cropped remove large quantities of mineral nutrients from soils and although the vines should be returned to the soil the gain from this is far less than the general loss of plant foods. Peanuts should always be brought in at the end of a rotation, if possible.

MISCELLANEOUS BOTANICAL NOTES

A Foetid Weed from Rabaul

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FOR some years, probably at least from some time during the 1939-1945 War, a foetid-smelling weed has been found within the town of Rabaul on New Britain. In 1953, through the courtesy of the local District Agricultural Officer, flowering material of this plant was obtained. This has now been identified as *Paederia foetida* Linn, family Rubiaceae.

This plant has also been referred to under the name *Paederia tomentosa* Bl. which was reduced to a synonym of *P. feotida* Linn by Merrill in his *Enumeration of Philippines Plants*.

Paederia foetida is widespread from India to Japan, China, Malay Peninsula and the Philippines. It is probably an introduction to New Guinea, although a specimen was collected in the Kani Mountains by Schlechter in 1901 at an altitude of 2,200 feet. This record may refer to a plant other than the present species.

Herbarium material of the species is illustrated. The following description is based largely on dried herbarium material :—

Paederia foetida Linn.—

P. tomentosa Bl.

Twining shrub or scandent herb; leaves opposite, stipulate, petiolate, lamina thin, papery; stem, twining. Inflorescence axillary and terminal; flowers in scorpioid corymbs; calyx small, green, finely five-lobed; corolla tubular, lobes scarcely expanded; finely ferrugineously pubescent externally; internally glabrous, pale violet with dark violet spots. Ripe fruits not seen. All parts of the plant possess an unpleasant, foetid odour, especially towards evening. The plants apparently spread from the fine seed.

It is likely that this plant could be controlled or eradicated by use of a hormone spray or simple cultivation. It is a weed of waste land only.

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