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ALL HANDS AT THE THRESHING.

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Measurement of Animal Production On a Per Acre Basis

By W. WEBSTER, Director, Division of Animal Industry.

Australia's steadily increasing population is creating a growing demand for animal products for the local market. This must strengthen our primary industries and make the production of unmarketable surpluses less likely. In some of the animal industries—beef cattle, fat lambs and dairying—the greater proportion of production is now needed for the local market, whereas in the past the reverse was the case. Increase in the number of people engaged in the primary industries seems likely to accompany general population expansion. This will be possible through greater production per acre but that in turn can only come as the result of improved land usage.

Animal products in excess of local requirements will no doubt continue to be grown in Queensland for export for a long time, but they must be available at a price competitive with similar exports from other countries or else be superior in quality. As the export of primary products is a necessary part of the economic structure of Australia, it is the duty of the Division of Animal Industry of the Department of Agriculture and Stock to encourage greater efficiency and greater production while keeping these in their correct perspective. To do this, good husbandry must be practised and observed in its broadest sense. Good husbandry does not necessarily merely mean the spending of large amounts of money on property improvements, soil and crop treatments and disease control. It means doing these things to the extent that they will improve production while sustaining an adequate margin of profit. To be sure that this double objective is achieved we need some yard-stick of measurement.

It is becoming clear that in Queensland we should follow the lead of older countries and measure animal production by costs, returns and profits per acre rather than per animal.

It is understandable that in a country with land far in excess of the requirements of a small population stock have been run on a large area of native pasture and returns have been assessed on a per head basis. This has been so in other young developing countries but human population is increasing quickly and larger numbers of people are desirious of entering the agricultural and pastoral industries. To accommodate them some changes in methods must take place. In older countries this has been brought about by reducing the size of holdings, improving them and adopting more advanced husbandry methods. Higher costs must be accompanied by higher output, but profit margins must be

closely related to costs. It is therefore necessary to have some form of measurement which takes into consideration all costs and the assessment of production and profits on a per acre basis seems the obvious method.

It follows that when stock are run on large areas where native pasture forms the whole ration, production will be seasonal. Meat and milk production will be high in the late spring and summer and stock or production losses greater in the dry winter months. To avoid these and spread production throughout the year improved husbandry practices must be adopted. Subdivisional fencing, more watering points and the provision of winter feed by special grasses, crop or conserved fodder will allow increased stocking rates. All this must be controlled by profits and these can best be measured on a per acre basis.

It is generally accepted that contagious and infectious diseases are more easily spread in heavy stock populations. On the other hand, they cannot be prevented by inoculation or treated unless all stock can be handled. Thus smaller and better improved paddocks are needed. Although this increases the cost of production, the prevention of loss through disease control or eradication should increase the return per acre.

Such diseases as pleuropneumonia can be spread from one end of Australia to the other with travelling mobs and affect stock thousands of miles away from the area in which they were originally infected. Property improvement will enable the eradication of diseases such as this and the gain will almost certainly outweigh the costs.

The production of milk and milk products per cow in Queensland is nothing to boast about. This is largely due to the fact that dairying in many districts is seasonal and production is only high in the late spring and summer when native pastures are good. The returns per acre given over to dairying are correspondingly low, which indicates that we are not using land to its full capacity. The feeding of high quality roughages either directly—in the form of improved pastures and crop—or indirectly—as hay or ensilage—increases the return per cow and per acre.

It might be argued that a big increase in the total production of animal products could be an embarrassment for suitable markets may not be available. It is agreed that this would be true for some products but increase per acre need not necessarily mean a total increase of the product. It could mean that fewer acres would be used and the balance made available for the production of other primary products that are at present in short supply and for which there is an overseas and local market.

Thus by correct land usage it would be possible to increase production where desirable and make provision for a big increase in population so necessary for the strengthening of this country. In measuring this production, the productivity of the land must clearly be given the same consideration as the output of the animal.

Tea Growing Experiments in North Queensland

By T. G. GRAHAM (formerly Officer-in-Charge, Bureau of Tropical Agriculture, South Johnstone).*

Tea cultivation is restricted to the wet tropics in countries where labour is relatively cheap. India has become the biggest exporter of tea, producing half as much again as Ceylon and more than three times as much as the East Indies. Australia produces no tea commercially, but ranks high as a consumer, the annual value of tea imports now exceeding £15,000,000.

The tea plant in its natural state is a small tree growing to a height of from 20 to 30 ft. For ease of harvesting, it is maintained at a height of a few feet above ground level.

A small area of tea was first established at the Bureau of Tropical Agriculture, South Johnstone, North Queensland, in 1936 in order to examine the suitability of soil and climate. Seed for this plot came from the former Experiment Farm at Bartle Frere, N.Q., the seed for which had been imported some years previously. It is believed that these plants were of the Assam Hybrid type.

In 1942, an additional area of half an acre was established; this was allowed to grow unchecked for a number of years. In 1953, hedges of various widths up to 5 ft. and containing closely spaced plants were established. These now also occupy about half an acre. Seed for both later plantings came from the original plot at the Bureau, which had been converted into a seed garden by removing every second plant.

RAISING PLANTS.

Tea seed is harvested by collecting freshly fallen fruits from the ground. Good seed sinks in water and poor seed floats. However, seed which has remained on the ground for some time and has become a little dry may float, although perfectly good. April and May are usually the best months to harvest seed in North Queensland, although occasionally a small crop develops outside this period. Germination before planting is not necessary except when the seed is of questionable viability.

A site with good drainage is selected for raising seedlings. The area is ploughed to a depth of 6 in. early in summer and then kept under bare fallow for some months.

As planting time approaches, seedbeds 4 ft. 6 in. wide are formed and fertilized. A mixture containing 3 parts by weight of sulphate of ammonia, 7 parts of superphosphate and 1½ parts of sulphate of potash, applied at the rate of 1 lb. per 100 sq. ft., should suffice. The sides are then boarded up to 4 in. above ground level and the surface smoothed.

Since the seed must be planted fresh, it is taken direct from the garden in May and planted in this seedbed. The seed is placed with the small round scar downwards so that the tap root develops without bending. Before planting, the bed is marked off in lines and the fresh seed firmed into the soil 6 in. apart each way. Coarse sand is then spread over the seedbed until the seed is just covered.

Sand prevents caking of the surface and ensures that the soil close to the seed is kept moist. Furthermore, its quick-drying surface reduces the risk

(*Now Agrostologist at Rockhampton.)

Plate 1.

Tea Seedling Nursery, Bureau of Tropical Agriculture, South Johnstone. The tea seedlings visible here are in galvanised iron tubes of various sizes. The nursery is in the shade of 12-year-old tea plants, which are also used to provide the seed for planting.

from fungus diseases. During hot weather, care is needed to ensure that the beds do not become so dry as to cause scorching of the young plants.

When the plants attain a height of 3-4 in., they are pricked out into tubes which are watered frequently and kept under partial shade until the seedlings are properly established (Plate 1). By January, they are normally hardened off and ready for establishment in a tea garden.

VEGETATIVE PROPAGATION.

A garden of high-yielding, specially selected bushes can be established by using this method, and the procedure may have an important bearing on the development of tea hedges. At the Bureau of Tropical Agriculture, the selected mother bushes were allowed to grow unplucked until about 12-15 in. of green growth appeared above the red stems. This growth was cut and the top removed. The remainder was then divided into internodal sections, each consisting of a length of stem and a fully matured leaf.

In the first trial, the cuttings were set in a prepared seedbed, the stems being buried until only the leaf remained above ground. One portion was covered with bracken and the other with palm fronds and the whole area was kept constantly moist. The bracken went mouldy after heavy rain and thus many cuttings were lost. Palm fronds appeared to provide better shelter.

The cover was gradually removed as the cuttings became established. When the surviving plants had begun to develop a root system, determined by removing plants periodically and examining them, they were transplanted into tubes and treated in the same manner as seedlings (Plate 2). Unfortunately, the above method of vegetative propagation was only 15 per cent. successful in North Queensland.

CULTIVATION.

In new tea gardens, shallow cultivation to maintain a weed-free surface is essential. In the early stages when the plants were small a rotary hoe was used, but as the plants developed and the root system began to spread deep cultivation was abandoned. Less damage was caused to the spreading bushes by reverting to a horse-drawn scarifier; finally the hoe had to be used.

Some overseas plantations adopt a system of selective weeding by removing only some types of weeds, shallow-rooting leguminous weeds being allowed to remain. At South Johnstone, the spread of species of *Desmodium* has been encouraged. These are low, creeping legumes which protect the soil from erosion and help to suppress undesirable types of weeds. *Desmodium triflorum* was first tried, but the more vigorous *D. heterophyllum* is now providing a more effective ground cover.

FERTILIZERS.

Only healthy tea bushes can maintain a high output of leaf. The only true measure of the effect of fertilizer

Plate 2.

Vegetative Propagation of Tea. These tubes contain small plant cuttings, each group of cuttings being from a single selected plant.

Plate 3.

A Tea Garden in Condition for Picking. This picture shows the main tea garden at South Johnstone during its harvesting stages in March, 1950. The plants have been pruned to give a flat "table", and it is the "flush" leaf appearing above the "table" which is harvested.

on the vigour of the bushes, therefore, is their yielding capacity over many years.

In its early stages of development, the tea plant requires a complete fertilizer high in nitrogen. As the plant grows older, it is usually able to obtain sufficient potash and phosphoric acid from the soil, but will still require applications of nitrogen.

The soil at South Johnstone where the tea garden has been established consists of a brown clay loam of good structure. At a depth of about 18 in. this overlies a rather retentive yellow clay subsoil. The soil is distinctly acid, having a pH of 4.5.

At South Johnstone, a mixture of the composition 15:4.5:3 has been found very satisfactory for establishing the young plants. During later stages of growth, two applications of sulphate of ammonia were given each year, one in late spring and the other in late summer; the rate of each application was approximately 1 oz. per plant.

Tea thrives on acid soils. For this reason, sulphate of ammonia is generally recommended as the source of nitrogen because of its tendency to increase soil acidity. Where the soil is already acid, as at South Johnstone, other forms of nitrogen could be used in its place.

PESTS AND DISEASES.

In the tea garden, some plants have been lost through faulty drainage caused by continuous heavy rain, but very little disease has made its appearance. In the hedge garden, rust has had a retarding effect on growth, and periodic sprayings with wettable sulphur preparations have been carried out with good results.

Ordinarily, tea is not troubled greatly by insect pests, but at South Johnstone, a small black beetle (*Rhyparida discopunctulata*) has at times caused considerable damage to the young growth. Satisfactory control was obtained by spraying with 0·1 per cent. DDT. The spray is applied immediately after plucking, when attacks by this beetle have been severe. If the spray is applied at this stage, there is no danger of the insecticide contaminating the subsequent harvest.

PRUNING.

As tea in its natural state grows to a considerable height, it is necessary to control growth for ease of harvesting and in order to induce the bushes to send out fresh new growth called "flush". The tea bushes are therefore pruned and the tops maintained at a convenient and uniform distance above ground level.

It is important to induce leaf growth rather than stem growth. For this reason, the bush is formed or shaped in such a way as to spread these leaves over a wide plucking area.

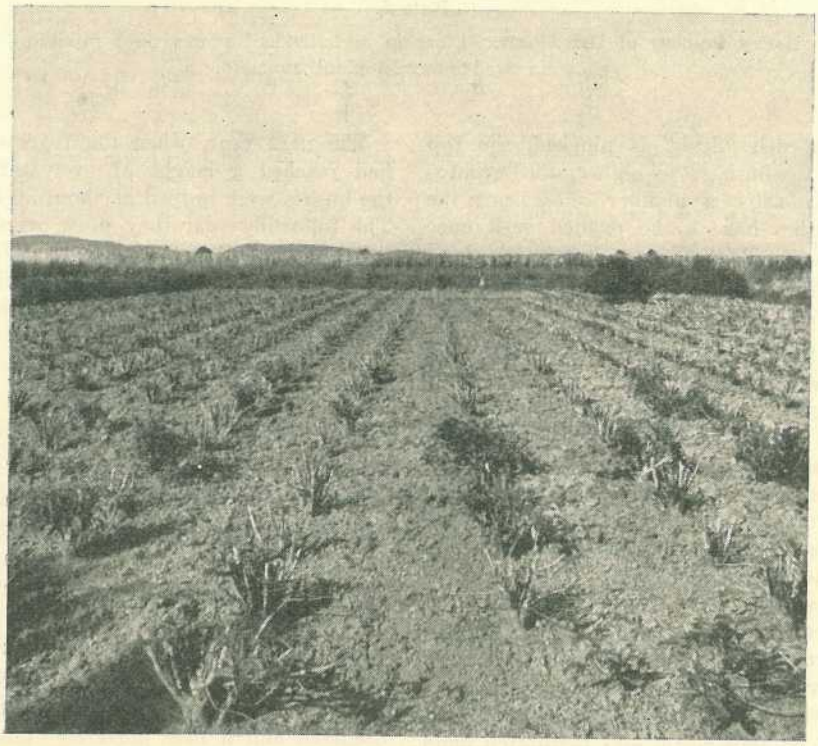

Plate 4.

Heavy Pruning of a Tea Garden. After a few years of picking, the tea garden shown in Plate 3 was pruned to about 1 ft. (May, 1952). During that winter, the area was thoroughly cultivated and fertilized to bring it into production again in the following summer.

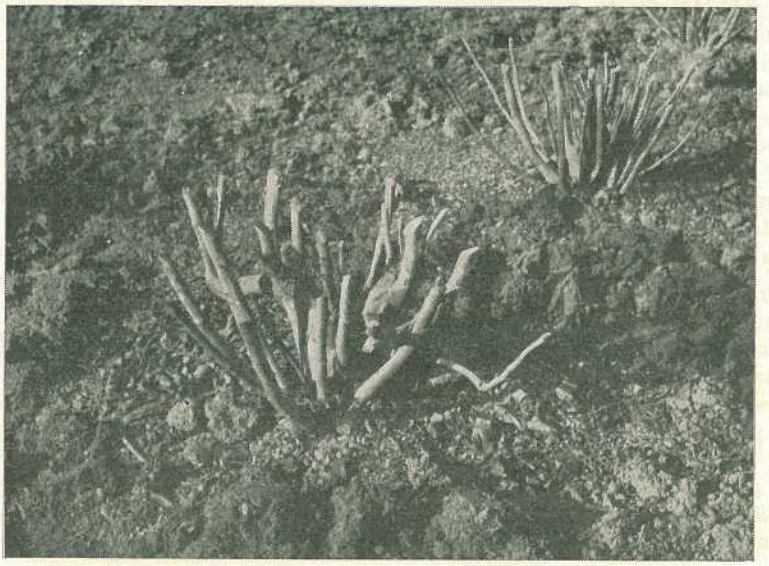

Plate 5.

Heavy Pruning of Tea Plants. Close-up of individual plants after pruning, showing well-branched plant structure.

As each "flush" is plucked, the top of the bush grows higher, until eventually after a number of seasons the bushes have to be pruned back once more. This is done when the level tends to become too high for ease of harvesting.

Single-stem pruning has been followed at the Bureau. The first half-acre tea garden was established there in 1942. Plants were placed 4 ft. apart in the field and allowed to grow for over three years before being brought into production. When the bushes were a little over one year old and the stems had attained the thickness of a lead pencil, they were first pruned by removing the centre growing stem to within 6 in. of ground level. This kept the lowest branches well off the ground, allowed the trunks to be kept clean, and facilitated hand cultivation.

The next year, when the regrowth had reached a height of over 3 ft., the bushes were topped at about 30 in. The following year they were pruned to a level height of 20 in., providing a flat plucking surface or "table" (Plate 3). Harvesting commenced when the flush appeared. After two years, they were pruned again to 15 in., and the process continued.

By the completion of the summer season of 1951-52, the bushes had again become excessively high and they were severely pruned to a height of approximately 12 in. (Plates 4 and 5). This pruning enabled careful attention to be given to the health of the plants and to thorough cultural and fertilizer treatments. During the following summer, a vigorous regrowth occurred and a new plucking "table" was established.

[TO BE CONTINUED]

Tobacco Diseases in Queensland

By W. PONT, Pathologist.

(*Continued from page 640 of the November issue.*)

II. MOSAIC.

Tobacco mosaic is a virus disease and is the most widely distributed disease of the crop. It is of historical interest because it was the first plant virus disease to be recognised as such. It also has the dubious distinction of being the most infectious plant virus disease in existence.

The characteristic symptom of mosaic is a light-green and dark-green pattern on the foliage of affected plants (Plate 4). It is this feature of the disease which gives rise to the name mosaic. This mottle is very obvious on plants in the field but may be overlooked in the seedbed, where plants are crowded and a diseased seedling may be hidden by adjacent healthy ones. The dark-green areas, which stand out in contrast to the normal green of the leaf, may be scattered over the leaf or may be present as bands along the veins and are often blistered or ballooned.

Plants affected early in their life are generally stunted and leaves are often malformed as well as mottled (Plate 5). Some small, brown, irregularly circular spots or brown flecks may develop on the middle and lower leaves. These spots or flecks sometimes follow the veins to give a vein-banding effect.

Plants affected in the later stages of growth show the symptoms only in the small leaves at the top of the stalk or of the suckers.

Mosaic disease may be responsible for considerable loss due to reduction in yield and to depreciation in leaf quality.

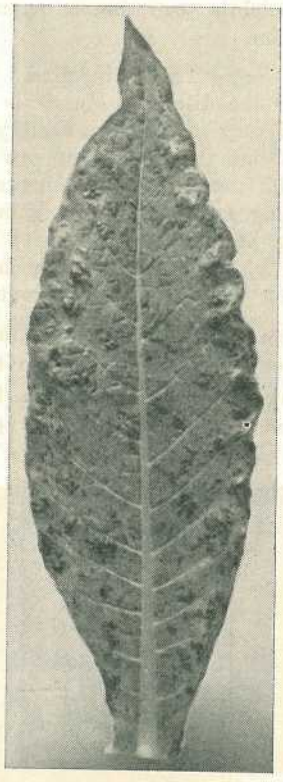

Plate 4.

Mosaic. Tobacco leaf showing the light and dark-green mosaic symptoms.

Source and Spread of the Virus.

The main features of the available information on the spread of tobacco mosaic virus may be summarised as follows:—

(1) The disease is not transmitted by insects.

(2) Seed from affected plants does not carry the virus but it has been proved that it can be present in the tissue of the capsule in which the seed is borne.

(3) It is not destroyed during the manufacturing processes and manufactured tobacco often contains living virus.

(4) The virus carries over in diseased plant remnants in the soil or elsewhere and soil contaminated with such debris can be a source of infection.

(5) Sap from infected plants carries the disease. Mosaic is transmitted very readily to a healthy plant in the minute amount of sap which may be present on the fingers after handling a diseased plant or on cultivating implements and spray appliances which may have been in brief contact with a diseased plant.

(6) Tobacco mosaic virus infects a number of plants related to tobacco which are often present in tobacco producing areas. Tomato, chilli or pepper, cape gooseberry and the weeds known as black nightshade and wild gooseberry can provide a source of infection.

The disease may originate either in the seedbed or in the field. From a consideration of the above information it will be seen that the sources of seedbed infection may be:—

(1) Seed contaminated with infected capsule remnants.

(2) Diseased plant remains in the soil.

(3) Infected juice from manufactured tobacco or sap from infected crops and weeds transferred to healthy seedlings on the hands of workers or on implements.

Field infection can be divided into two classes, depending on whether the plants were infected early or late in their life.

Plate 5.

Mosaic. Young tobacco plant (variety Hicks) infected by hand.

Early field infection may result from:—

(1) Direct transfer of diseased seedlings from seedbed.

(2) Infection of healthy seedlings during the transplanting operation with contaminated sap picked up on the hands from diseased seedlings, infected crops or weeds, or manufactured tobacco.

(3) Infected plant remains in the soil from a previous crop.

Late field infection results from transfer of infected sap from diseased plants to healthy plants during such operations as cultivating, priming, topping, suckering and harvesting.

Infection originating during topping, suckering and harvesting does not have a serious effect on the crop but provides in the form of diseased plant debris a possible source of infection for following crops.

Control.

Since serious infection can originate in the seedbeds, precautions to guard against introduction of the disease at this stage should become routine. The seedbed site should be fenced, seedbed soil should be sterilized by heat, and the seed used should be free from chaff and dust. The grower should ensure that there are no tobacco, tomato, capsicum or cape gooseberry plants near the beds, and all weed growth in the immediate vicinity should be eliminated.

Hands should be washed with soap and water before seedlings are handled either during routine seedbed work or during transplanting. The washing should be particularly thorough if the handler is a smoker and it would be wise not to smoke during these operations. Any abnormal seedlings should be rejected and the hands should be washed after such material has been touched.

When the plants are established in the field they should be inspected closely. If only a low percentage of plants is infected with mosaic these plants should be removed and destroyed and the sites replanted, preferably with the replant offset a little from the original planting site.

Care should be taken during the priming, topping and subsequent operations, especially in cases where the percentage of plants affected with mosaic has been too high for replanting to be attempted. It would pay to have two workers handling these operations, one dealing with healthy plants and the other working on infected plants. Alternatively, all the healthy plants should be worked first before the diseased plants are touched.

At the end of the season the plants should be uprooted and destroyed. It is desirable, also, at this time to plough the field to hasten the decomposition of any diseased root material which may have been left behind.

Certain varieties of tobacco and its relatives possess some resistance to mosaic. Plant breeders are attempting to eliminate the undesirable characters of these varieties and produce a resistant tobacco suitable for commercial cultivation.

III. FROG-EYE LEAF SPOT.

This is another disease caused by a fungus (*Cercospora nicotianae* Ell. and Ev.). However, unlike the blue mould fungus its development is favoured by high temperatures and it is therefore a disease mainly of tropical countries. In Queensland it is of importance only in the north, and there only on late crops which reach maturity during the hot weather.

Symptoms.

The spots show first on the lower leaves and when plentiful are small, roughly circular, brown areas, the centres of which bleach as they age to

give the typical frog-eye appearance of a band of dark-brown surrounding a light-brown or grey centre (Plate 6). If only a few spots are present on a leaf the spot is usually larger and more definitely rounded. The minute spores which spread the disease are produced on the centre of each spot.

The barn spot stage of the disease develops during curing operations on leaves or portions of leaves which were apparently healthy when they were put into the barn. These spots are darker brown in colour, more irregular in shape and very prominent on bright leaf.

Frog-eye spotting gradually works its way upwards on the plant and when a severe outbreak is experienced every leaf may be affected.

The incidence of the disease appears to be related to the vigour of the plants and any factor which produces a temporary or permanent check to the growth of the plants will increase the severity of frog-eye leaf spot. It has been suggested that summer growing conditions of high temperature and high humidity produce a type of plant which is more susceptible to this disease.

The spot is worse when it originates in the seedbeds. Efforts should be made to keep the seedlings growing vigorously and to ensure that frog-eye spot does not gain a foothold at this stage. The precautions to be observed are discussed below.

Control.

The disease can be carried on the seed, and when it is not known whether seed is free from disease it should be surface-sterilized before sowing by immersion in a 1 in 1,000 solution of silver nitrate in water for 15 minutes. After this period of immersion it is

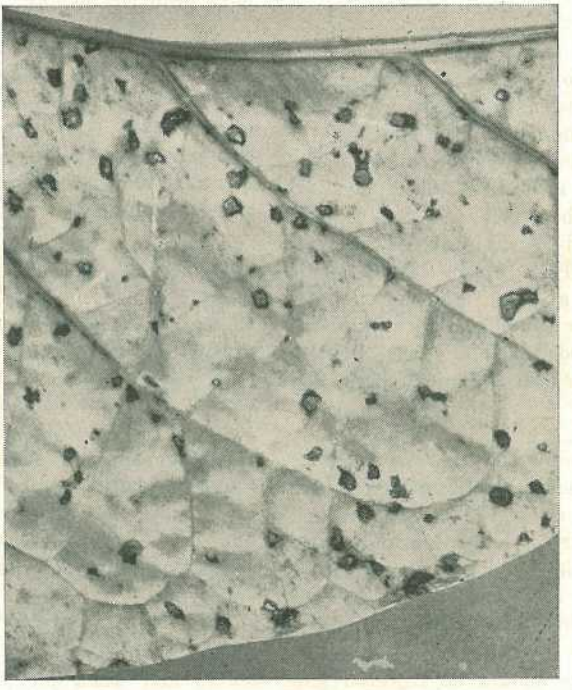

Plate 6.

Frog-eye Leaf Spot. Early and late-stage spotting on a mature leaf.

rinsed in clean water. The normal practice of sterilizing the seedbed soil should eliminate any infection which may originate from diseased tobacco plant debris in the soil. Care should also be taken to avoid contamination of seedbeds by diseased leaves from barns, bulk sheds or fields. All plant refuse should be burned.

The seedbeds should be sprayed thoroughly and often (at 5-day intervals) with home-made cuprous oxide or Bordeaux mixture.

Priming may help to combat frog-eye spot in the field by retarding the rate of spread, but as the fungus continues to produce spores on dead leaves this operation would be worthwhile only if it were possible to remove the primed leaves from the field.

IV. DAMPING-OFF.

This is a disease of seedlings which is caused by fungi living in the soil. The disease shows up quickly and spreads just as rapidly. The first indication of its presence in a seedbed is the collapse of a patch of plants. An examination of the affected seedlings will disclose either that the stems at about ground level are softened, discoloured and constricted or that the roots are rotted. The area of diseased seedlings rapidly increases unless steps are taken to check the spread of the trouble. Tender seedlings are naturally more prone to damping-off.

Control.

Crowding in the beds predisposes plants to attack, so care should be taken that the seed is sown at the recommended rate. If crowding does occur due to an accident in the sowing the stand should be thinned early.

The seedbed site should be changed regularly, for repeated use of a seedbed leads to a build-up in the number of damping-off fungi present. Overwatering should be avoided.

Since the fungi causing the trouble are carried in the soil, sterilization of seedbed soil is the obvious method of attack. The beds may be sterilized by heat or by fumigation with either formalin or methyl bromide. The procedure is described at the end of this article.

It is possible to contaminate sterilized seedbed soil with unsterilized soil from outside the treated area, and if damping-off starts in a sterilized bed, losses may be more severe than in the original unsterilized soil. Special care should therefore be taken with all implements to be used on the beds. They should be cleaned of soil and should be swabbed with 2 per cent. formalin before being used on the sterile area.

If damping-off appears in a seedbed, prompt action must be taken to prevent the spread of the disease. Drenching with thiram or captan, depending on the type of damping-off present, is recommended.

Thiram drench at the rate of 1 oz. of 80 per cent. thiram in 4 gallons of water will control damping-off of the type in which the root is shrivelled and rotted. If the seedlings are rotted at ground level with the root remaining healthy, then captan drench at 1¼ oz. of 50 per cent. captan in 4 gallons of water will give better control. The drenches should be applied at the rate of one-half to one gallon per square yard of seedbed.

V. STEM ROTS.

Two stem rots often cause losses in tobacco fields in North Queensland.

The first and the one most commonly observed attacks the plant at or below ground level and gives rise to a dark-brown or black sunken area at the base of the stalk. As the disease progresses this cankerous area extends up the stem and may reach a point several inches above ground level (Plate 7).

Plate 7.

Stem Rot. Tobacco plant artificially infected with **Rhizoctonia solani.**

If a plant showing this type of stem rot is examined in detail it will be seen that a breakdown of the pith accompanies the visible external rot. When the disease is in an advanced stage the pith of the lower part of the stem will have rotted completely and brown fungus threads will be found in the hollow pith cavity.

The stem is eventually completely girdled. By this time the supply of water and nutrients has been restricted and the plant wilts. The root system remains healthy and only breaks down in the very last stages of the disease.

The fungus which causes this disease (*Rhizoctonia solani* Kuehn.) is a very widely distributed soil inhabitant and is one of the organisms which can cause damping-off in the seedbed.

It is thought that stem rot infection may sometimes originate in the seedbed. There is a possibility that if the rot is in an early stage, infected seedlings may be planted out without the symptoms being noticed. The disease would then complete its development in the field.

It has been noted that stem rot infection on well advanced plants often originates through a leaf stalk scar on the base of the stem, and it has been shown that the fungus will enter the stem through a fresh scar of this type or through a wound in the stem. It apparently is not able, on half-grown plants at least, to penetrate uninjured stem tissue. It has also been shown that stem rot may be induced by inoculating an injured leaf stalk with the fungus.

These facts imply that in the field the fungus may invade the plant through leaf stalks injured and covered with soil during hilling operations or through the wounds left on the stem when basal leaves are snapped off during these operations.

The second stem rot is caused by a fungus (*Sclerotium rolfsii* Sacc.) which is one of the most widely distributed plant pathogens in Queensland. It affects a large number of cultivated plants in addition to some weeds.

This rot affects the same region of the stem as the first-mentioned. The infection originates at or below ground level but the damaged stem area in this case is lighter brown in colour, is restricted more to the basal portion of the stem, and very quickly becomes covered with the cottony wefts of the fungus. These strands in turn give rise to the light-brown resting bodies or sclerotia, which are the shape and size of radish seed. Affected plants are girdled and eventually wilt and die.

A feature of both stem rots is that the stalk tissues may become weakened by the fungus invasion and if strong winds are experienced infected plants may be blown over rather easily before they show signs of wilt.

Control.

The measures recommended for the control of damping-off should be applied in the seedbed. If damping-off has occurred in a bed, any seedlings that are taken from that bed in the vicinity of the patch where damping-off showed should be carefully inspected and all suspicious plants should be rejected.

In the case of the stem rot first described, the fact that the fungus can invade wounds on leaf stalks and stems suggests that early priming of the sand lugs to allow the scars to harden before hilling commences may be of some benefit on land which has a history of stem rot infection.

Stem rots occur most on land which is planted to tobacco for two consecutive seasons; therefore, rotational planting should be practised.

Seedbed Sterilization.

Heat Treatment.—Seedbeds can be cheaply and effectively sterilized by either of two methods of applying heat.

The first involves the firing of the soil with brushwood or light branches. These are piled over the seedbed and surrounding margins to a depth of about three feet. If the timber is cut up and closely packed, a depth of one foot is sufficient.

The second method takes advantage of the combustible properties of the organic material contained within a certain type of termite mould. A 4 in. layer of this material spread over the entire seedbed area provides sufficient heat for effective sterilization. Sawdust has been used as a substitute for antbed material, but in this case the depth should be increased to about nine inches.

It is important to have the soil moist and neither dry nor saturated with water when combustion begins.

Soil Fumigation.—Before fumigation, the seedbeds are prepared for sowing. They should be moist, but not wet, when fumigation is carried out. Either formalin or methyl bromide may be used.

Formalin should be applied to the beds as a 2 per cent. solution (that is, 1 gallon of commercial formalin in 50 gallons of water) at the rate of 2 gallons per square yard. Immediately after treatment the beds should be covered with sacking for two or three days to retain the formalin fumes in the soil. The beds are then aired for 10 days or until the odour of formalin can no longer be detected.

Methyl bromide is a poisonous, highly volatile fumigant. It is supplied as a liquid under pressure in cans or cylinders. When the pressure is reduced by opening the valve on the cylinder or by piercing the can with a special dispenser the liquid flows through a rubber tube into an evaporating pan previously placed under airtight plastic sheets covering the seedbed. The methyl bromide quickly evaporates from the pan and penetrates the soil. The covers are left on for one day to ensure maximum penetration. One pound of methyl bromide is sufficient to treat 40–50 square feet of seedbed.

Seed may be planted an hour after removing the covers.

It is important to pay careful attention to the manufacturers' instructions for applying methyl bromide and *to take extreme precautions against inhalation of the colourless, odourless, but very poisonous vapour.* Before commencing to use methyl bromide, the operator should be quite certain he is familiar with the full procedure involved and the precautions necessary.

Market Pumpkins Correctly.

Under the Fruit and Vegetables Act, all pumpkins offered for sale in Queensland must be sound, clean, mature, well-formed and free from sunburn. All pumpkins must be of even size and of similar varietal characteristics.

The outside of the bag must be stamped with the word "Pumpkins" and must also be marked with the name and address of the grower.

Pumpkins which do not comply with these conditions are withheld from sale until reconditioned at the grower's expense.

Lettuce Germination

By W. V. MUNGOMERY, Assistant Horticulturist.

Field germination of lettuce, like that of most other plants, depends upon three main factors—temperature, soil moisture and soil aeration.

For any species or variety, the best level for each of these is fairly well defined. Deviations from these levels adversely affect not only the germination percentage but also the rate of germination and the quality of the seedlings produced.

All three factors are influenced by climate, soil type, depth of planting and frequency of watering.

Climate.

Temperature has a considerable effect on germination in irrigated lettuce crops. In south-eastern Queensland, the crop is grown the whole year round, but it is in the hotter months that the demand for

Plate 1.

Four-row Lettuce Bed. Note uniformity of the plants which follows quick and even germination.

salad vegetables is greatest. At this time of the year, some difficulty may be experienced in establishing good stands of lettuce in the field.

The best temperature for lettuce germination is about 75 deg. F. When soil temperatures are lower than this, the percentage germination is not affected a great deal, but the time required for germination is increased —for example, from 2 days at 77 deg. to 49 days at 32 deg.

When soil temperatures are above 85 deg., germination is a little slower than at 75 deg., but the number of seeds which do germinate falls off rapidly.

At 95 deg., no germination occurs when the seed is sown in moist soil; dormancy is brought on and the seeds may remain in the soil for some months and germinate later when the temperature falls.

The risk of faulty germination at high temperatures can be reduced by moistening the seed and storing it in a refrigerator (not in the freezing chamber) or on ice for a period of 3-5 days. The seed is then dried before sowing.

Prolonged heavy rains, such as those frequently experienced in Queensland in late summer and early autumn, may reduce the oxygen in the soil to a level at which the germinating seed cannot get sufficient for its requirements. Seedling development is then prevented.

Prospects for an even strike are also reduced when heavy rain washes away seed sown at or near the surface of the soil, or produces a hard crust on the surface of the soil which the germinating seedlings cannot penetrate.

Soil Type.

A sandy soil has a lower water-holding capacity than a loam or a clay-loam and therefore dries out more quickly. Loams and clay-loams, on the other hand, are generally darker in colour and consequently absorb and retain heat from the sun more effectively.

Increasing the amount of humus in a sandy soil (for example, by green manuring) tends to give it some of the properties of a loam; soil moisture is held better and the colour is darkened. However, the effects of soil texture and colour on soil temperatures tend to cancel one another out, and variations due to green manuring practices have little significance in commercial lettuce production.

Depth of Sowing.

Depth of sowing in the lettuce crop is governed mainly by the irrigation facilities at the grower's disposal and his methods of land preparation for planting.

Cover crops are extensively used to increase the organic matter content of the soil, especially on sandy soils in areas where farmyard manure and poultry manure are not readily available.

Maize is commonly grown for this purpose because of its rapid growth and the large bulk of material produced. If this crop is incorporated in the soil when it is succulent, decomposition proceeds rapidly and the resulting humus is soon lost. If, on the other hand, the crop is allowed to become hard and fibrous, the presence of tough residues in the soil makes the preparation of a fine seedbed very difficult. Under these conditions, depth of sowing and, consequently, rate of germination are likely to be very uneven.

Some growers, therefore, sow lettuce on the surface of the soil and depend on the rear roller of the planter to press the seed into the ground. This practice has much to commend it. The grower can see if the planter is dropping the seed continuously and at the desired rate. Germination is rapid and, in summer

particularly, the seedlings have a better chance of competing with weeds.

The evenness in germination obtained from surface planting gives uniformity in crop maturity, and the harvesting period for any particular sowing is therefore reduced to a minimum.

Other conditions being favourable, the percentage germination in seed sown on the surface during hot weather is frequently better than that of seed sown beneath the surface, for the dormancy which is brought on at high temperatures is broken by light as well as by the pre-treatment with cold referred to earlier.

There are, however, some objections to surface planting. Frequent irrigation, especially in summer, is necessary to keep the seed moist and cool. If the water supply is limited and constant attention to the crop is impracticable, sowing at a depth of about one-quarter of an inch would be better. Other disadvantages of surface planting are the risk of seed being washed away during heavy storms and the possibility of bird damage.

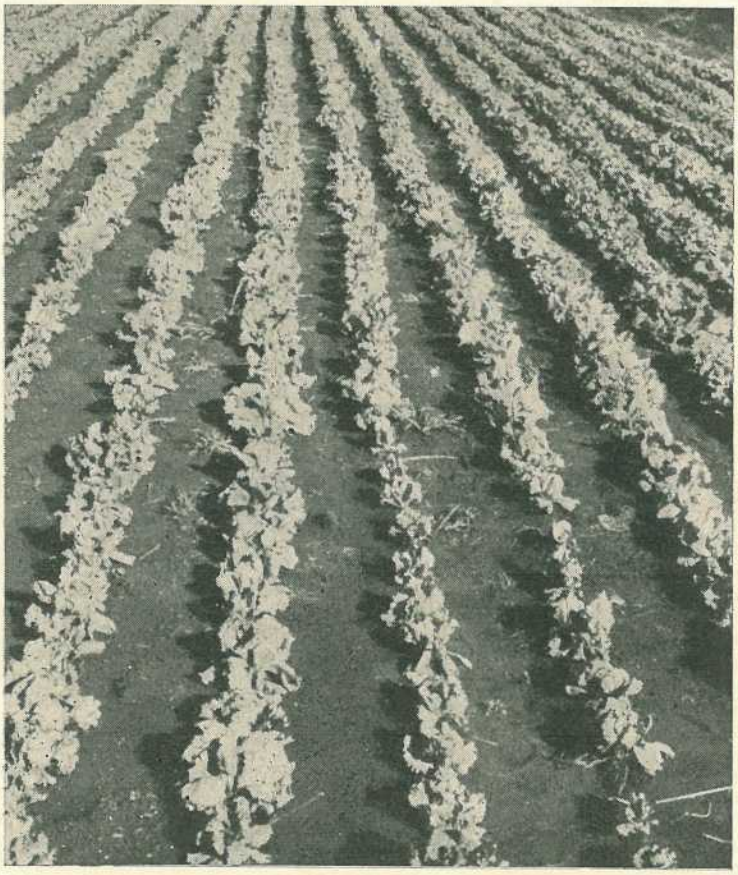

Plate 2.

Uneven Lettuce Stand of the Type Produced by Poor Germination of the Seed.
Harvesting extends over a long period in such crops.

Frequency of Watering.

The main functions of irrigation in newly-sown lettuce crops are to keep the seed moist and, in summer, to lower the temperature of the soil. The frequency with which water must be applied, therefore, is determined largely by factors which affect soil temperature and moisture. In practice, the soil should be kept moist but not saturated, at least until germination is completed and the young plants are established.

NEW TRELLIS BOOSTS TOMATO CROP RETURNS.

Parallel wire trellises for tomato crops are increasing yields of marketable fruit, the Minister for Agriculture and Stock (Hon. H. H. Collins, M.L.A.) said recently. This type of trellis helps to check the spread of some diseases and saves the fruit from blemishes.

It has now been proved to be the most suitable trellis for tomatoes and it is widely used by growers in the Redlands district.

The change to the parallel wire trellis system of management is a striking development in the tomato industry. It was prompted initially by excessive fruit wastage in ground-grown crops and the high cost of V-string trellising.

Trellising considerably increases the number of plants per acre. This is particularly important where land values are high and a premium is placed on efficient land usage.

The merits of the V-string and parallel wire types of trellises were compared at a recent trial at the Redlands Experiment Station. Some definite advantages in favour of the parallel wire trellis emerged.

The first was that the percentage of fruit harvested in the first three picks is greater in crops grown on the parallel wire trellis. Where the V-string trellis is used, the plants must be pruned to two stems and this delays flowering. Crops on parallel wires do not have this setback and they therefore fruit early.

More marketable fruit is obtained from crops grown on parallel wire trellises than from V-string trellised crops. There are fewer blemished fruit than in crops grown on V-string trellises because there is less plant movement during periods of high wind.

A third advantage is most pronounced in areas like Redlands where leaf-shrivelling virus and other diseases are widespread. Crops grown on parallel wire trellises are not pruned. The risk of transmitting the disease from plant to plant with the pruning knife is, therefore, ruled out.

CUTTING THE COST OF IRRIGATED PASTURE.

Two new automatic land levellers are reducing the cost of establishing irrigated pasture in Queensland. These implements, recently bought by the Agriculture Department with funds provided by the Commonwealth Extension Services Grant, are lent to farmers to demonstrate to them how their land may be prepared much more easily and cheaply than by using manually operated land levellers.

Commenting on this purchase, the Minister for Agriculture and Stock (Hon. H. H. Collins, M.L.A.) said one unit is stationed at Esk for the use of Brisbane Valley farmers, the other at Biloela to serve the Callide and Moura districts.

Because they are automatic, each of these implements can be operated by one man—the tractor driver. In southern irrigation areas, they are replacing the manually operated land levellers which need two men to operate them.

The machine at Esk can be drawn by a low-powered tractor and is suitable for preparing small areas of land. The one at Biloela is much bigger and can handle the large individual areas of land irrigated in that district.

The Department plans to use C.E.S.G. funds to buy one each of the two new types of leveller for demonstration in the Beaudesert and Lockyer districts.

Mr. Collins said that, for the last four years, the Department has made grading equipment available free to farmers preparing land for irrigated pasture. While these implements have proved very useful, the expanding acreage of irrigated pasture calls for knowledge by the farmers of the more efficient and cost-reducing automatic machinery.

Control of Common Pests of Citrus in Coastal Areas of Southern Queensland

By T. MANEFIELD, Entomologist.

Effective control of citrus pests depends primarily on four factors: a sound appreciation of the economic value of control measures; ready recognition of the different pests; the correct timing of the appropriate spray; and thoroughness of spray application.

In coastal areas of southern Queensland, the status of individual pests may vary considerably from year to year according to seasonal conditions and other biological factors.

Those most consistently important are the wax scales* and soft scales with the resultant sooty mould; and the Maori mite, which causes skin blemish. Hard scales, such as red scale, mussel scale and circular black scale, and white louse scale also become encrusted on the fruit, as well as on the leaves and branches, when reduced yields and tree damage may result.

Fruit fly attacks can reduce crop yields severely and spectacularly during the late autumn and spring. Until recently, citrus gall wasp was for several years a major pest in some districts.

Other pests which may cause occasional trouble are the bronze orange bug, green vegetable bug, aphids, thrips, and citrus bud mite.

In these districts at the present time, citrus is grown to supply metropolitan markets, and fruit is marketed in the appearance gradings of special, standard and plain. Most fruit produced falls into standard and plain gradings, and the recommended spraying programme has been designed accordingly.

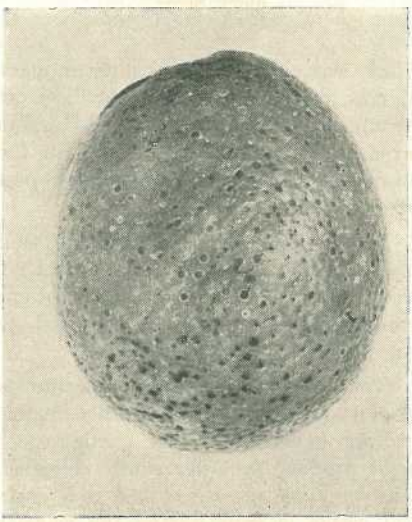

Plate 1.
Red Scale on An Orange.

In the normally humid coastal conditions, wax scales accompanied by sooty mould are the most common, but with successive dry spring and summer conditions hard scales can become prominent, particularly where irrigation is used. White wax scale is prominent throughout all areas, particularly in the Maroochy district.

* A list of scientific names of pests referred to appears at the end of this article.

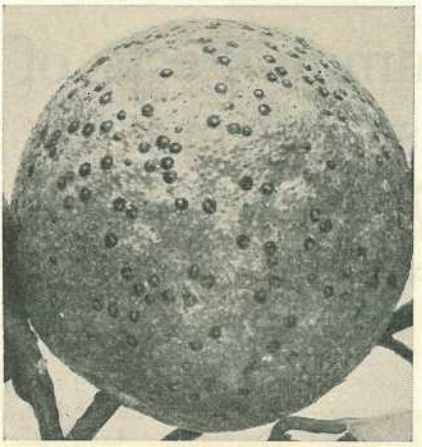

Plate 2.
Fruit Infested With Circular Black Scale.

Pink wax, heaviest on Emperor mandarins, is also widespread, but is most troublesome in the Howard-Burrum area. Due allowance is made in the spraying programme for these pest distributions.

Maori mite and its damage and sooty mould are the only causes of fruit blemish for which descriptions and comments may be required to supplement the illustrations.

The mite is yellowish, tapering to the posterior end, and hardly visible to the naked eye. Its feeding does not produce an immediate blemish, and may be unnoticed unless a careful watch is kept during the warmer months. The dusty appearance of fruit, sometimes called "gold-dust," is an early warning of mite attack and indicates that immediate spraying is necessary. Eventually, if mite feeding is allowed to continue, a dark-brown discolouration of the rind of oranges and mandarins is produced, whilst on lemons it causes a silver-grey appearance, sometimes with surface cracking.

Sooty mould is composed of the massed threads of a number of fungi which are not parasitic on the plant but grow in the sugary secretion or honey-dew produced by some of the scale insects. When these are eliminated the mould dies, and is removed eventually by rain and wind.

SPRAYING PROGRAMME.

Midwinter.

A *lime sulphur* spray is essential in all districts for the control of white louse scale, citrus bud mite, and Maori mite. A complete tree cover at a strength of 1:15 should be applied, preferably in July after the crop has been harvested. Particular attention should be paid to the wetting of the trunk and main limbs. If at this time fruit is still hanging, as for example with Late Valencias, the lime sulphur strength should be reduced to within the range of 1:20 to 1:25.

Early November.

If Maori mite populations are evident, apply a *wettable sulphur* spray according to label directions. To avoid complications with oil spraying in December and January, the early detection of Maori mite is most desirable. (See Warning 1.)

Plate 3.
Pink Wax Scale Infestation on Leaves.

Summer.

Scalicides.

(1) At the beginning of December if wax scales predominate trees should be sprayed with the following mixture:—

Washing soda—20 lb.
(or soda ash—7½ lb.)

Detergent* (34–40 per cent. active ingredient)—1½ pints.

Water—100 gallons.

or

If at this time heavy populations of hard scales are also present the following mixture should be substituted:—

Washing soda—12–14 lb.
(or soda ash—5 lb.)

Soap—8 lb.

White oil—2 gallons.

Water—100 gallons.

(2) With any further build-up of hard scales, apply *white oil* at 1:40 in late January.

(3) With heavy pink wax infestations, the following spray can be applied in March after the late summer hatch—

Washing soda—12–14 lb.
(or soda ash—5 lb.)

Soap—8 lb.

White oil—1¼ gallons.

Water—100 gallons.

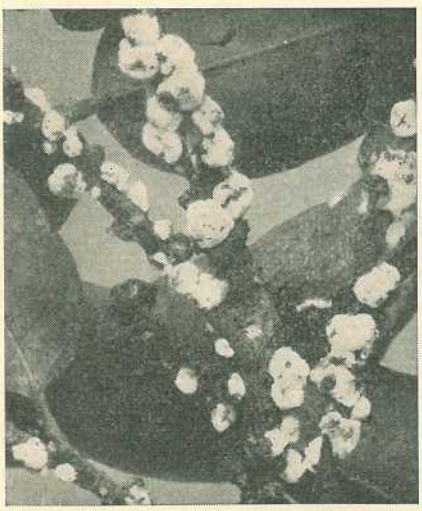

Plate 4.
White Wax Scale on a Citrus Branch.

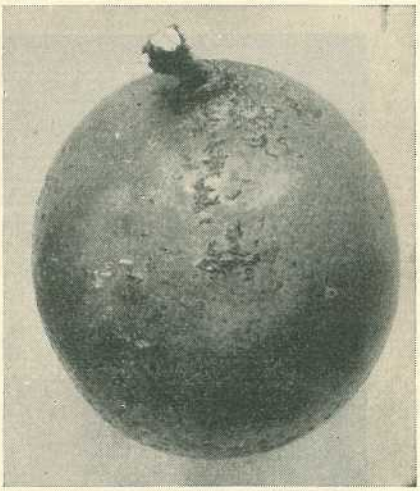

Plate 5.
Meyer Lemon Infested With Mussel Scale.

Miticides.

A further *wettable sulphur* spray should be applied only if Maori mite is active. (See Warning 1.)

INCIDENTAL CONTROLS.

Fruit Fly.

An 0.2 per cent. DDT spray applied at fortnightly intervals during periods of fruit fly activity will give control of this pest in citrus. The spray should be aimed at the inner side of the tree canopy, using 1 gallon per tree on large trees. With the continued use of DDT, abnormal activities of mite and scale populations have been experienced by most growers. Strict attention therefore must be given to the routine spraying for the control of these pests.

* The detergent used in successful Departmental experiments against white wax scale contained 34 per cent. sodium secondary alkyl sulphate.

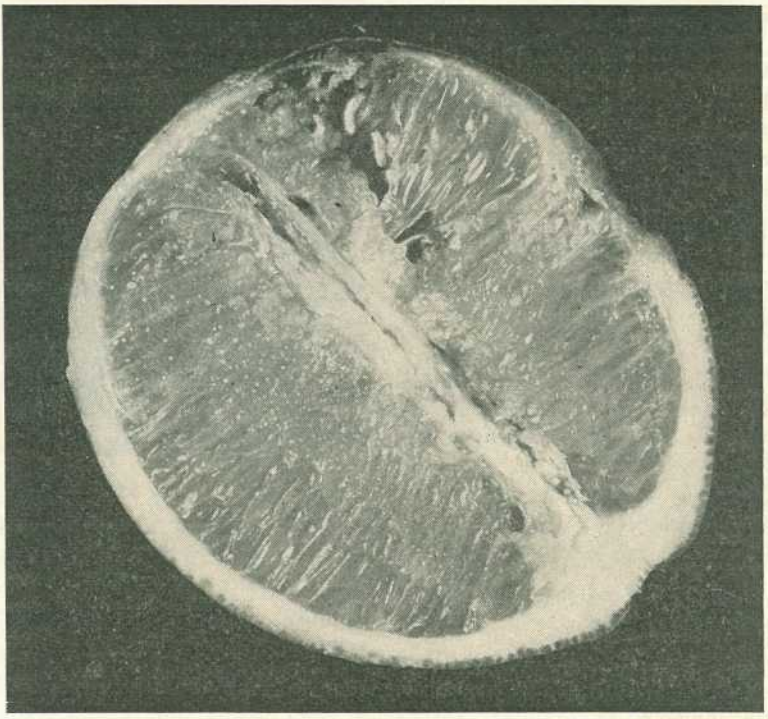

Plate 6.

Lemon Infested by Fruit Fly.

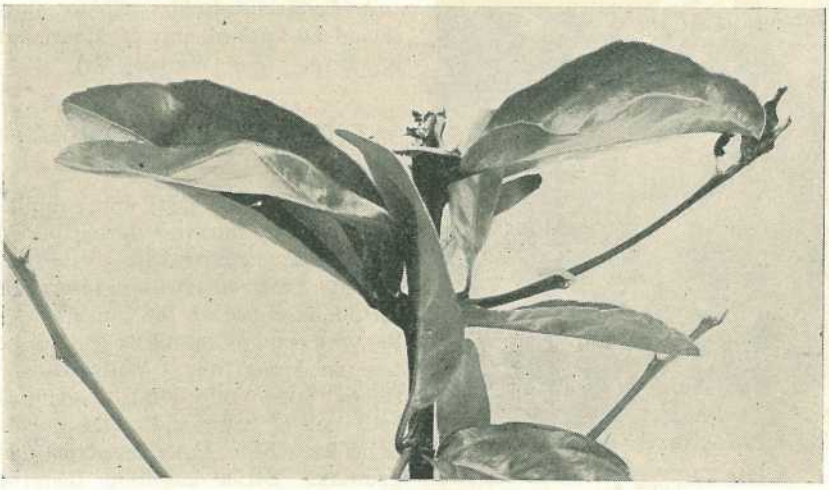

Plate 7.

Severe Citrus Bud Mite Damage.

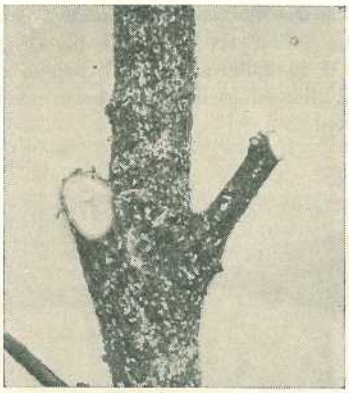

Plate 8.

White Louse on a Small Branch of a Citrus Tree.

Citrus Gall Wasp.

At the present time, pruning to remove as much gall-infested material as possible without injuring the tree will reduce considerably the damage caused by this pest.

Shield Bugs.

Usually applications of DDT to control fruit fly are sufficient to prevent appreciable damage by the bronze orange bug. A close watch, however, should be kept during spring and if many nymphs are present an 0.2 per cent. DDT spray should be applied. It is important that any spraying required should be done before the winged stage is reached towards the end of November. The green vegetable bug is also controlled by spraying with DDT.

Aphids and Thrips.

Aphid populations may increase rapidly and cause severe damage to flushes of new growth, particularly on young trees during spring. Predaceous ladybirds and their larvae often take toll of these pests but at times control measures may be necessary. Spot spraying with parathion (E605) at a strength of 0.01 per cent. active ingredient gives control.

Thrips control is rarely warranted but heavy populations in the blossoms may result in blemish to the mature fruit. Parathion spray (0.01 per cent. active ingredient) at ¾ petal fall satisfactorily kills these pests.

WARNINGS.

(1) To avoid fruit drop and other damage, applications of oil sprays and sulphur sprays must be separated by at least three weeks.

(2) Oil, soda, and lime sulphur sprays can cause severe damage to drought-affected trees. When the dry conditions ease, the grower may use his discretion as to the application of the most suitable spray. In irrigated orchards, the spraying practice need not be varied, as trees can be watered before spraying.

(3) When daily temperatures are persistently over 90 deg., sprays should be applied early in the morning, and operations should cease when the temperature rises above this reading.

Health Risk.

With any use of E. 605, full precautions must be taken. Spray operators should wear freshly laundered protective clothing daily and at all times avoid drift. Particular care must be taken when handling the concentrates.

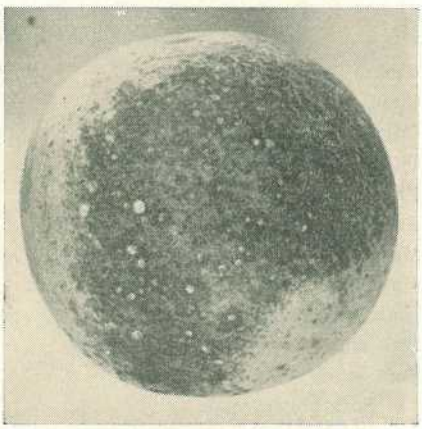

Plate 9.

An Orange Discoloured by Maori Mite.
Red scale is also present.

CLEANING THE FRUIT.

Should it be necessary to remove sooty mould from fruit, this may be done efficiently in the packing shed by the use of one of the modern detergents. The fruit should be dipped in a 1 in 2,000 solution, brushed, and then allowed to dry well before being packed.

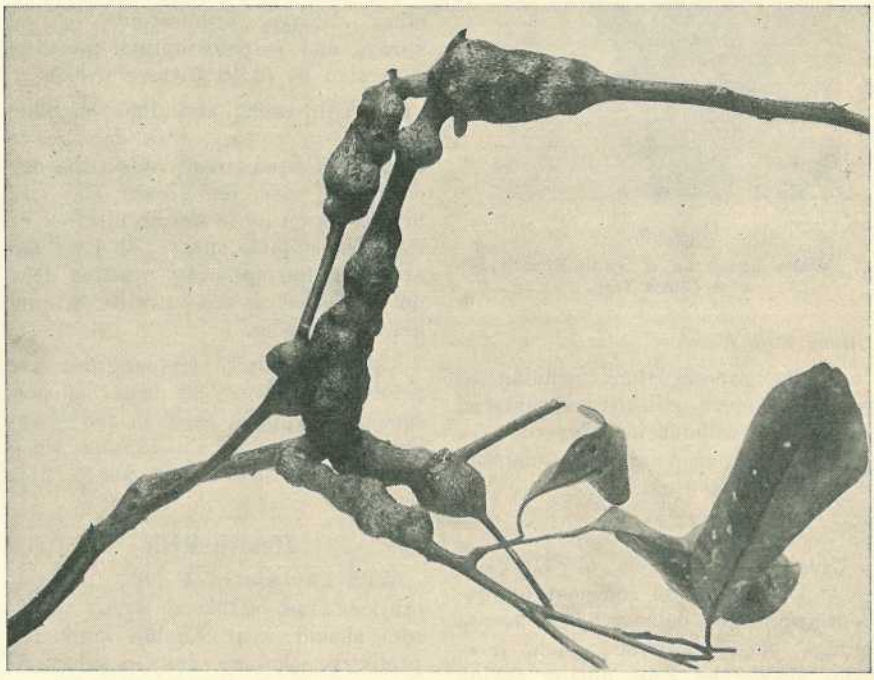

Plate 10.

Galls on a Citrus Twig.

SCIENTIFIC NAMES OF PESTS.

Bronze orange bug	*Rhoecocoris sulciventris* (Stal.)
Circular black scale	*Chrysomphalus ficus* Ashm.
Citrus bud mite	*Aceria sheldoni* (Ewing)
Citrus gall wasp	*Eurytoma fellis* Gir.
Fruit fly	*Strumeta tryoni* (Frogg.)
Green vegetable bug	*Nezara viridula* F.
Maori mite	*Phyllocoptruta oleivora* (Ashm.)
Mussel scale	*Lepidosaphes beckii* (Newm.)
Pink wax scale	*Ceroplastes rubens* Mask.
Red scale	*Aonidiella aurantii* (Mask.)
Soft scales—	
Soft brown scale	*Coccus hesperidum* L.
Pulvinaria scale	*Pulvinaria cellulosa* Green.
White louse	*Unaspis citri* (Comst.)
White wax scale	*Ceroplastes destructor* Newst.

The Occurrence and Control of Worm Parasites of Sheep in Queensland

Prepared by Dr. G. R. MOULE, Director of Sheep Husbandry, in collaboration with officers of the C.S.I.R.O. McMaster Laboratory, and the Department of Agriculture and Stock and woolgrowers in Queensland.

Although sheep can be infested with over 30 different species of worm parasites, the three main ones in Queensland to cause loss in production are:—

(1) Barber's pole worm, also called the large stomach worm (*Haemonchus contortus*).

(2) Small hair worm, also called the black scour worm or small intestinal worm (*Trichostrongylus* species).

(3) Nodule worm (*Oesophagostomum columbianum*).

It is practically impossible to eradicate all worms from sheep. Control means keeping the numbers low enough to avoid economic losses. This cannot be done by drenching alone, but depends on a knowledge of the following factors:—

(1) Type of worms infesting the sheep.

(2) The life cycle of worms.

(3) Seasonal conditions which favour a rapid increase in worm populations.

(4) The action of drugs used to treat infested sheep.

(5) The correct times to use these drugs.

Most sheep carry a few worms all the year round but loss in production occurs when worm numbers increase. Warm, moist weather, overstocking or sheep overcrowding on to small areas, insufficient pasture or grazing too long in one paddock may cause this to occur.

WHY WORMS CAUSE SERIOUS LOSSES.

Losses caused by worms should not be measured by deaths alone. Good management usually prevents losses from death. But even moderate infestations that cause no obvious symptoms can decrease wool cuts and growth rates.

Weaners and Breeders Suffer Most.

Young sheep, particularly weaners, usually suffer the most severely from worms. Breeding ewes also suffer, and control programmes should give particular attention to these sheep. Older sheep develop some resistance and although they may not show ill-effects they may require treatment. Otherwise they will pass worm eggs on to the pasture.

The nodules that form in the wall of the bowel of sheep infested with nodule worm are one sign of the sheep's resistance to worm infestation. Very young or very old sheep have little resistance to barber's pole worms.

Good Feeding Necessary.

Good feeding is essential to worm control. However, it is not of very great use in controlling barber's pole worm. Outbreaks often occur when

the pastures are very good. Outbreaks of hair worm and nodule worm tend to occur when feed is short.

Even light infestations of worms depress the sheep's appetite, lower wool production and decrease the digestibility of nutrients. Considerable economic loss may occur before worms are even suspected of causing trouble. Unless great care is taken in examining the sheep you may not know your flock is suffering from worms because the sheep may not show obvious symptoms.

Worms cause lower liveweight gains and affected sheep do not use the available feed very well. Reduced appetite is important, particularly if the sheep are suffering from hair worm and nodule worm infestations. Sheep suffering from diarrhoea as the result of hair worm infestation are almost starved to death. The small amount of food ingested passes through the digestive tract too quickly for it to be used.

Nodule worms have a marked effect on the sheep's appetite. The daily food intake of sheep dosed experimentally with nodule worm larvae decreased within three weeks from 2.5–2.8 lb. to 1.0–1.3 lb. Body weights fell from 82–100 lb. to 44–76 lb. Seven to 10 months elapsed before body weights returned to their original levels.

Effects on Wool Growth.

Recent experiments showed that a moderate infestation with small hair worm decreased the rate of wool production by as much as 40 per cent. below that of worm-free control sheep. The sheep given hair worm larvae in this experiment did not show any symptoms of worm infestation.

Worms and Fly Strike.

The mucus-covered faeces due to nodule worm infestation and the diarrhoea due to small hair worm infestation are frequently caught up in the wool of the breech region. Fly strike may result, thus causing more wool to be lost.

Weakness Due to Loss of Blood.

The barber's pole worm is a blood sucker. It is estimated that 1½ to 2 gallons of blood is taken from a sheep during the course of the infestation. This is indeed remarkable, as the body of a big sheep contains only about one gallon of blood! Two thousand female barber's pole worms take about ½ lb. of blood a week from a sheep. A vivid imagination is not required to visualise the ill effects produced. The symptoms produced are lack of stamina and paleness of the skin and eye membranes. This may result in serious losses in wet ewes and sheep whose pastures are inadequate.

Effect on Milk Production.

Ewes suffering from worm infestation produce little milk and their lambs lose weight. An example of this effect is shown in Table 1.

TABLE 1.

EFFECT OF BARBER'S POLE WORMS ON MILK PRODUCTION AND LAMB WEIGHT.

Days After Lambing.	Daily Milk Yield.	Weight of Lamb.
	Fluid Oz.	Lb.
1	43·0	8·5
9	53·5	17·0
18	52·0	23·0
29	49·5	30·0
33	53·0	33·0
Worm larvae given here		
44	29·5	41·0
50	11·5	42·5
59	23·0	47·5
66	22·0	48·0
71	29·0	51·0

The table shows the daily milk yield of a crossbred ewe and the liveweight of her lamb. The ewe was producing over 50 oz. of milk per day and was infected with barber's pole worms on the 33rd day. Seventeen days later (50th day) her milk production had

fallen to 11 oz. The growth rate of the lamb also decreased.

A ewe with a poor milk yield is liable to neglect the lamb, which may die in consequence. If it survives it will not grow normally.

INFESTATION BY WORM PARASITES.

Life Cycle.

Worms spend only half their life history in the sheep. The other half is spent on the ground. The stages passed in the droppings and on the grass are particularly important when planning control measures.

Eggs are passed in the droppings and under suitable conditions of temperature and moisture hatch into very small worms in 16–20 hours. These small worms are called the larvae. In 4–7 days they are capable of infesting the sheep. They ascend blades of grass when they are wet. Here they are picked up by grazing sheep and develop further after reaching the appropriate place in the animal's digestive tract. They grow rapidly and are capable of laying eggs about 18 days after they have been swallowed by the sheep.

There are therefore two stages in the life cycle:—

(1) A parasitic stage when the worms live in the sheep.

(2) A free-living stage when the worms live on the grass.

There are also two phases in the life cycle:—

(1) A contamination phase when the sheep is passing eggs.

(2) An infection phase when the sheep is eating larval worms.

A knowledge of these facts is essential before considering the control measures to be adopted. An understanding of the life cycle is basic to any plan to control worm parasites.

How Infestation Builds Up.

Plate 1, on page 696, shows that the worm burden follows definite seasonal patterns.

The degree of infestation is indicated by the height of the shaded area. Management should aim at keeping worm populations as low as possible. Several factors tend to favour their development.

Most worms produce large numbers of eggs. The female barber's pole worm may lay from 5,000 to 10,000 eggs per day, so in a sheep lightly infested with 200 worms, half of which are females, the daily egg output will be between 500,000 and 1,000,000.

Outbreaks of worm infestation occur in three different ways:—

(1) If there is insufficient feed the sheep fall easy victims to worms.

(2) Introducing worm-free sheep into an infested flock. Outbreaks among lambs born into infested flocks provide an outstanding example. This directs attention to the importance of treating breeding ewes before they lamb. Another example is the introduction of sheep from comparatively worm-free areas to pastures carrying worm larvae. This sometimes occurs when wethers are moved from the far west to the Darling Downs.

(3) The occurrence of weather that favours the survival of young worms on the grass. This means the pastures soon become contaminated. Faulty pasture or flock management may increase the rate at which the sheep become infested. Some of the factors that influence the survival of young worms in the pasture are discussed below.

Barber's Pole Worm.

Cold dry weather prevents the development of eggs and larvae on pastures. Therefore during the winter sheep acquire only light infestations. During the summer, dry hot weather

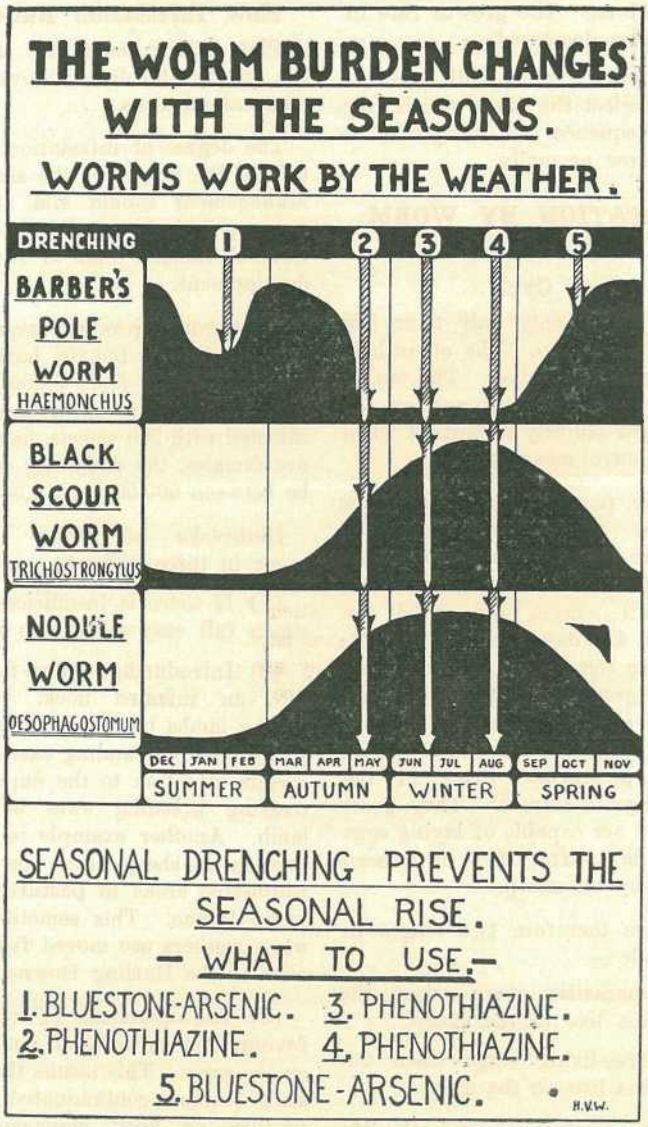

Plate 1.

Showing How the Worm Burden Changes During the Year and Indicating Appropriate Times for Drenching.

checks the development of the eggs and larvae. However, light infestations during the winter may cause early contamination of pastures in the spring.

A fall of rain of half an inch or more followed by cloudy, warm weather helps eggs hatch and young worms develop on pastures. As a result sheep may become infested with worms. Should the wet weather continue, a heavy infestation may be built up in a short time. If control measures are not adopted heavy losses may occur. The small numbers of worms in sheep in the semi-arid pastoral country are controlled to a large extent by the dry weather and the low stocking rates.

A series of unusual seasons—for example, two or three "wet" seasons in succession, such as 1949-1950—may lead to heavy worm infestations.

Because the barber's pole worm lays so many eggs (5,000 per female per day) it is able to multiply more rapidly than other types of worms. In lightly stocked areas a single wet season is not sufficient to allow heavy infestations of worms to develop if they have to increase from very small numbers. This is usually the case in the west, where it may take some time to build up heavy infestations.

In areas where stocking rates are low, overcrowding is generally of a local nature—for example, sheep crowding on areas of fresh feed. After spring storms, when conditions are favourable for larval development, river frontages, gilgais and watercourses are fruitful sources of reinfestation. Any part of the pasture that is overcrowded and heavily soiled with droppings may constitute a "danger area" because of the presence of worm eggs and larvae. Shade and moisture in lowlying places provide suitable conditions for development and survival of worm larvae. High stocking rates on such areas lead to rapid increases in the worm burden of sheep.

Recognition of these two important features—namely (1) "wet" seasons, and (2) local overcrowding and/or general overstocking—will enable you to apply control measures in anticipation of the trouble worms may cause.

Hair Worm.

The hair worm is found most often in areas receiving winter rainfall. Outbreaks have occurred, however, in most of the sheep-raising areas having an average annual rainfall of 18 inches or over. On the Darling Downs the heaviest rains fall in summer, but sufficient winter rain falls to ensure the annual occurrence of hair worm infestations. It is necessary to have good rainfall in successive years before outbreaks occur in the semi-arid areas of the far west. This is mainly because the rate of egg production is low (200 per female per day). However, the immature worms are extremely resistant.

It takes some time to contaminate pastures heavily and sheep usually pick up worms in small numbers over a long period. This accounts for the slow onset of the infestation.

In low-rainfall regions there may be local areas where the pastures become contaminated as a result of overcrowding and/or overstocking.

Outbreaks depend on:—

(1) Susceptible, young sheep.

(2) Climatic conditions favourable for the development of worm eggs and larvae.

(3) The presence of some worms in some sheep that contaminate the pasture.

(4) Moist or shaded places in the pasture where sheep congregate.

(5) Mismanagement.

Adult sheep carrying a few worms can be responsible for the infestation of weaners. Spring lambs weaned in the autumn usually show signs of infestation in the winter. Insufficient feed in winter usually increases the trouble. Autumn lambs run with ewes during the winter often do not show symptoms until they are weaned or until the late summer or autumn.

A wet autumn followed by a dry winter, or a wet winter followed by a dry or late spring, is likely to bring about severe outbreaks.

Lambs running with ewes seldom show symptoms though they may carry quite large numbers of worms. The ewe's milk helps to provide an adequate diet, so the balance is frequently tilted in favour of the lambs.

Nodule Worm.

This parasite is most common and causes lowered production in areas of high summer rainfall. In Queensland the Darling Downs, the area between the Downs and the New South Wales border, and the higher rainfall areas of central Queensland are regions where outbreaks usually occur. Outbreaks have been reported in other areas where sheep have been introduced from districts where nodule worm usually occurs and when climatic conditions are suitable. In a sequence of wet years this parasite is likely to become important in farther western and northern areas.

Irrigated pastures in any part of the State can carry free-living nodule worms. However, as they are not resistant to cold or dryness such unfavourable conditions can be used to advantage in a plan of control.

[TO BE CONTINUED.]

IRRIGATION IN QUEENSLAND.

A bulletin issued by the Government Statistician shows that the most important crop grown under irrigation in Queensland is sugar cane. The 58,762 acres of cane irrigated in 1955-56 made up over half of the total of 112,457 acres of crops irrigated. Relatively, however, tobacco is the crop most dependent on irrigation, the 5,545 acres of tobacco irrigated constituting 88 per cent. of the State's total tobacco area, compared with only 12.2 per cent. of the sugar area under irrigation. Vegetables on 19,828 irrigated acres made up 34.7 per cent. of the State's recorded vegetable area, while 3,671 acres of fruit and 685 acres of cotton grown with irrigation were only a small part of the total acreages of these crops. Other irrigated crops were mostly lucerne and green fodders.

Irrigation was applied during the season to 3,778 acres of improved permanent pasture, an increase of 1,243 acres over the previous year's figure. Nearly 20,000 acres of native pasture were under irrigation, practically all in the south-west.

Do You Dip Your Cattle with DDT?

By D. F. MAHONEY, Divisional Veterinary Officer.

How often do you hear that a DDT dip must be topped up at more than the recommended rate to maintain its strength?

In many cases this appears to be true. After a DDT dip has been charged for a while, you often find that it is hard to maintain its strength and efficiency without adding that extra quantity every so often. This increases the cost of an already expensive item, but in many cases the difficulty can be avoided by a little extra care in managing the dip.

It has been shown that you can keep a DDT cattle dip up to the required strength without the use of excessive concentrate by attention to some

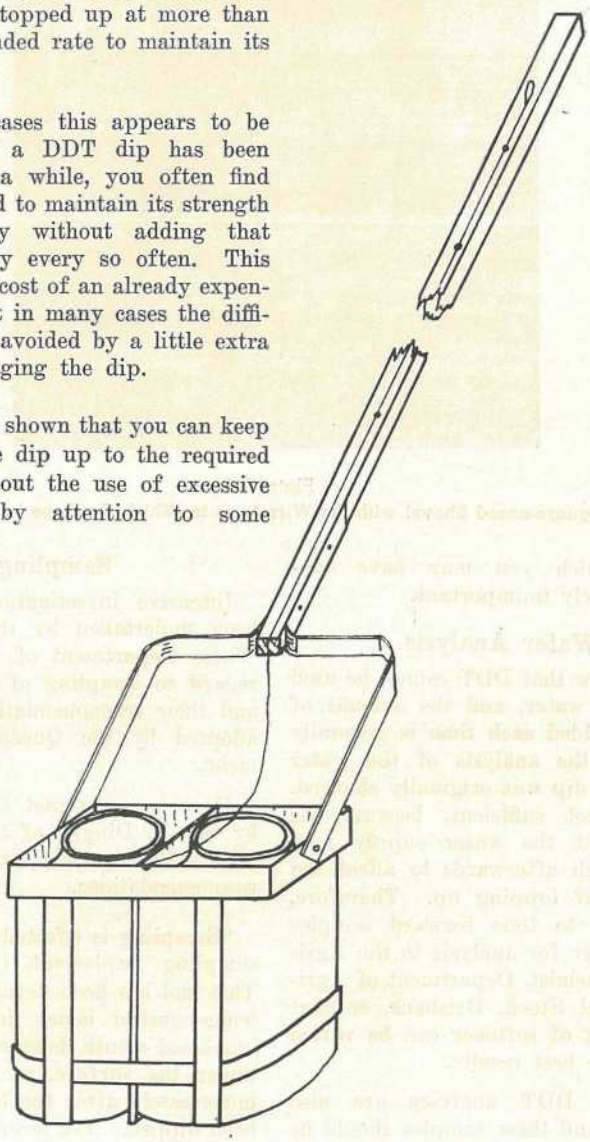

Plate 1.
Dip Sampling Implement.

Plate 2.
The Square-nosed Shovel with the Wire Loop to Which the Rope is Attached.

details which you may have considered fairly unimportant.

Water Analysis.

You know that DDT cannot be used with hard water, and the amount of softener added each time is generally based on the analysis of the water before the dip was originally charged. This is not sufficient, because the hardness of the water supply may vary enough afterwards to affect the efficiency of topping up. Therefore, from time to time forward samples of the water for analysis to the Agricultural Chemist, Department of Agriculture and Stock, Brisbane, so that the amount of softener can be varied to give the best results.

Regular DDT analyses are also advisable and these samples should be sent to the Biochemist, Animal Research Institute, Yeerongpilly.

Sampling.

Intensive investigational work has been undertaken by the New South Wales Department of Agriculture in regard to sampling of dipping fluids and their recommendations have been adopted by the Queensland Department.

Here is an extract from an article by Mr. J. Dingle, of the New South Wales Department, setting out these recommendations.

"Sampling is effected with a special sampling implement (see Plate 1). This tool has been devised to hold two wide-mouthed honey jars, which are immersed mouth downwards three feet under the surface, at the 'take off,' immediately after the last animal has been dipped. The lever is then pulled to upright the jars, which fill immediately. The plastic screw caps are

then placed on the jars, which are removed from the machine, labelled and sent to the laboratory as a duplicate sample. The advantage of this sampling machine is that it takes the sample in the jars which are sent to the laboratory, without transference to other vessels. The method of sampling is also standardized. The double wide mouth enables the jars to be filled without any filtering of the hydrocarbons which could happen with the use of narrow-mouthed bottles, such as beer bottles. The wide-mouthed bottle is also an advantage, as when the jars come into the laboratory they can be subsampled during stirring, without transfer to another vessel. Samples are taken at least at 28 days intervals."

Topping Up.

If you are using a DDT preparation which requires heating, be careful to melt it correctly. Both overheating and under-heating spoil the product. It must be stirred continuously while heating, and when the concentrate is a liquid of even dark-brown consistency, it is ready to add to the dip.

Do not leave it stand once it has melted, because DDT which has been allowed to cool is of no more use.

For those of you who have a thermometer, a temperature of over 95 deg. C. (approximately 204 deg. F.) indicates that it has been heated sufficiently.

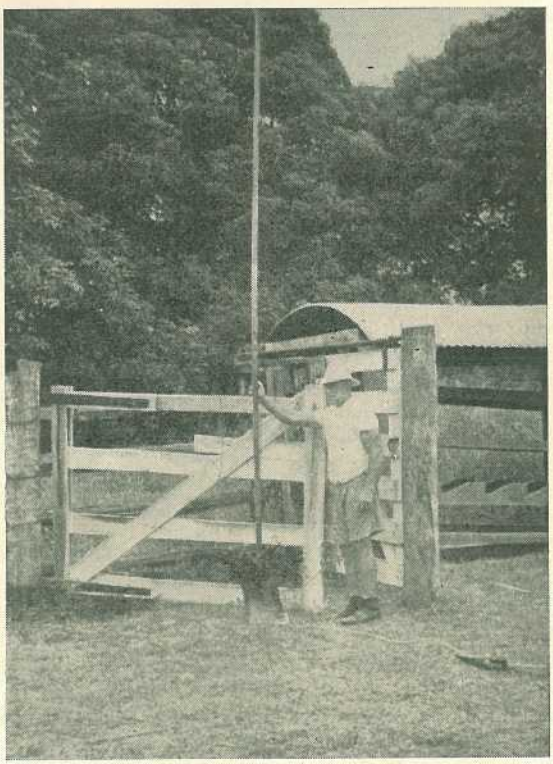

Plate 3.

A Long Handle is Necessary on the Shovel. This handle is 15 ft. long.

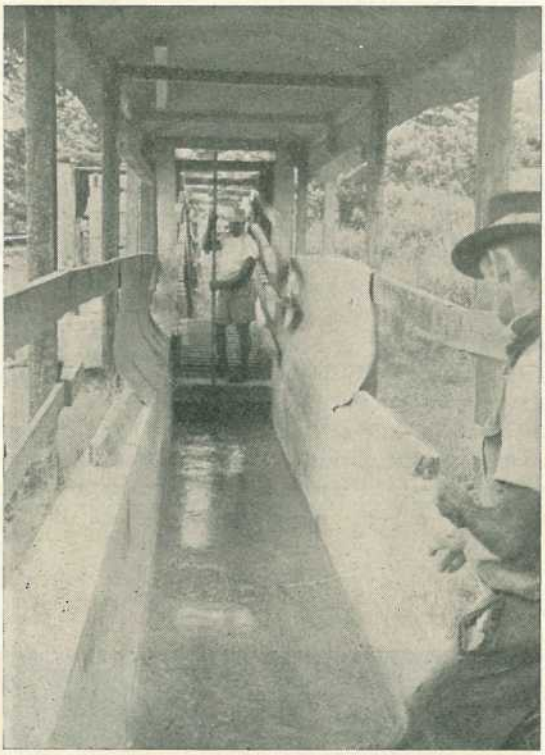

Plate 4.

Driving the Shovel Down Close to the Wall.

The DDT can be poured directly into the dip provided the bath is agitated vigorously while this is being done. A good way is to have a bucket attached to the end of two long ropes. One man has one rope at the entrance and another man has the other rope at the exit. The bucket is on the bottom of the dip. By pulling on the ropes the men can raise and lower the bucket quickly through the fluid and keep it stirred.

Stirring.

Remember that DDT does not form a solution with water. It forms an emulsion, which means that the DDT is suspended in the water as fine particles. These particles are heavy and are only dispersed evenly throughout when the dip is *thoroughly* agitated. When the dip is allowed to stand the particles fall to the bottom along with the other heavy material, such as dirt.

The usual method of stirring by running about 20 head through is inadequate. Stirring by hand first and *then* running the live "stirrers" through is the only way to ensure that enough sediment is incorporated in the bath.

The New South Wales Department of Agriculture has introduced the shovel illustrated in Plate 2 and hand stirring is best done by this means. The shovel is square-ended and about a foot wide. A 20 ft. length of rope is tied to the wire loop in front of it. The length of the handle depends on the height of the roof and depth of the dip. About 15 ft. is the usual length.

The use of the shovel is illustrated in Plates 4-8. The man at the entrance to the dip pushes the shovel down close to the end wall as far as he can. Aided by a man at the exit pulling on the rope, he pushes the shovel along the floor as far as the length of the handle will allow. The shovel is then raised to the surface by two men, bringing the sludge with it. The shovel is then moved to and fro just beneath the surface to suspend the dirt and DDT which have been brought up.

This operation is repeated until no more sludge is left on the bottom. It takes about 15 minutes if the dip is not badly fouled. Where there is an extensive deposit just below the slide, shovelling can be continued for half an hour. This probably will not move all of the material, but it will bring a sufficient quantity of DDT back into the fluid. The "stirrers" are put through immediately after shovelling and the dip is ready for use.

The illustrations, taken by officers of our Research Branch, set out the necessary steps in shovel stirring.

Settling-out Rate of DDT.

DDT falls to the bottom very rapidly when the dip is let stand. After 10 minutes, the concentration of DDT in the bath falls below the level which is required to kill ticks.

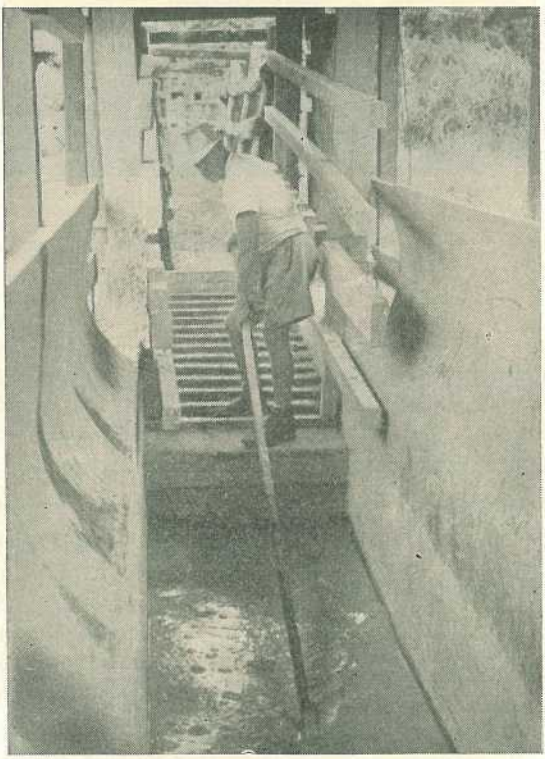

Plate 5.

Pushing the Shovel Along the Floor of the Dip.

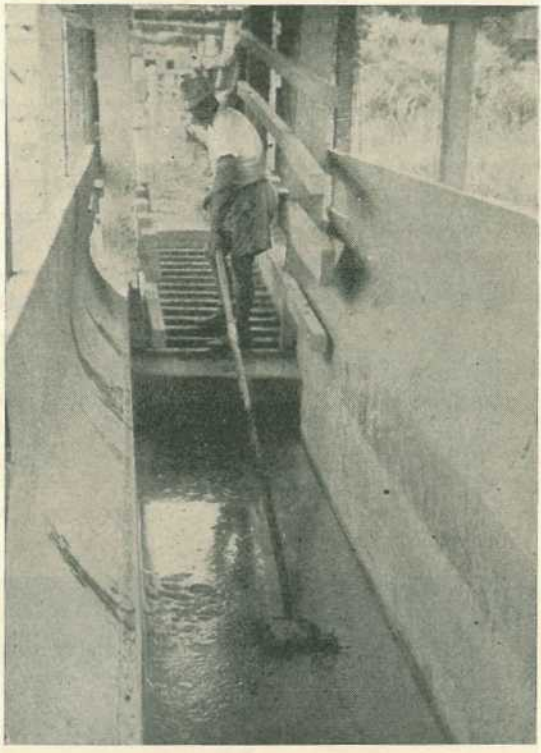

Plate 6.
Raising the Shovel to the Surface.

This has an important practical application. If hold-ups greater than five minutes occur during dipping, it is necessary to run "stirrers" through again before commencing. If this is not done, you need only two or three interruptions to occur and 50-100 head have received ineffective treatment.

The next time you are dipping, see how your management scores on these points:

(1) Has the hardness of the water supply been checked recently?

(2) If the concentrate requires heating, is it properly melted when added?

(3) Do you stir the bath while the DDT is being added?

(4) Do you stir by hand to re-suspend all or most of the sludge before the "stirrers" go through? Remember that both methods must be used. Either one is inadequate on its own.

(5) Do not forget to run the "stirrers" through again if an interruption of more than five minutes occurs.

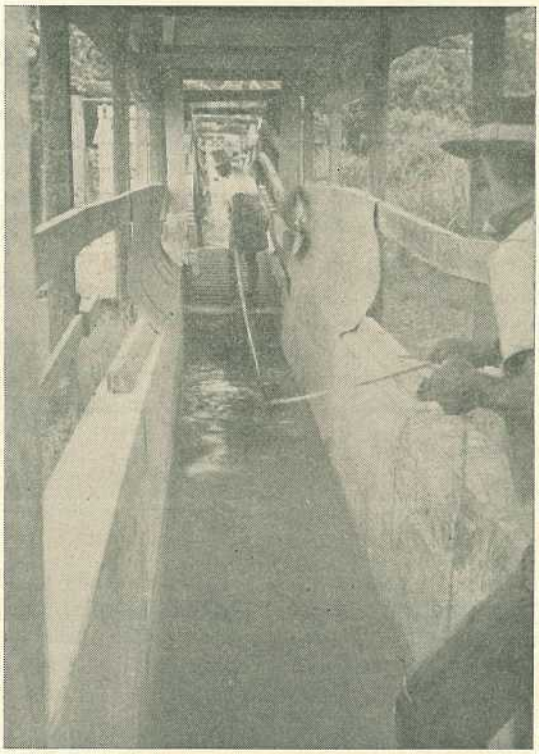

Plate 7.

By Moving the Shovel To and Fro Just Below the Surface the DDT is Brought Back into Suspension.

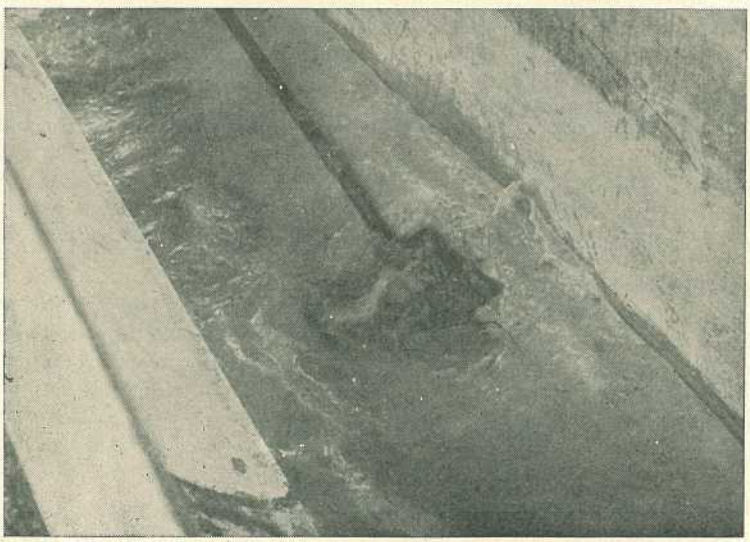

Plate 8.

This View Shows the Agitator Action Which Washes the DDT off the Shovel into Suspension. The whole operation is continued until no further DDT is raised from the dip floor with the shovel.

PRACTISING WHAT IS PREACHED.

Two types of experiment station have been established—the specialised, and sometimes one-crop, stations (e.g. horticulture, pasture, tobacco) and the general purpose or regional stations.

A consideration of the yields being obtained on these stations is very instructive as indicating how far the general State and district averages fall below those reasonably attainable under practical farming conditions.

Four regional stations have been established—on the Darling Downs (Hermitage), the Callide Valley (Biloela), the Lower Burdekin (Ayr), and Atherton Tableland (Kairi).

Nowhere in the world has agriculture as yet persisted indefinitely unless a system of mixed farming has been developed. It is therefore highly important that we demonstrate the role of this type of farming in the conservation of soil and the maintenance of soil fertility.

These stations are necessarily a combination of a laboratory and a show window where research results are displayed for inspection. Here we show what we do and the means by which the results are obtained with practically all field crops and pastures having potential value here. This is not without its problems, since we are alternatively criticised for having too much or too little equipment according to the viewpoint of the farmer.

These two attitudes are particularly evident in respect of machinery. However, we have accepted as policy that we should have on hand machines of a wide range of types to cope with a wide range of both crops and cultural treatments; at the same time the value of different implement designs can be appraised, and demonstrated to interested farmers. To this extent it is true that some stations are over-capitalised in machinery in comparison with a commercial farm, but, on the other hand, all machinery demonstrated is of the type which can be financed by the general run of good farms.

At Hermitage, on land which was run-down when repossessed in 1945, wheat trials conducted during the year yielded as much as 53 bushels per acre, while the average of all fields was in excess of 40 bushels. At Biloela, in a less favourable wheat area, yields averaged around 30 bushels. The State average was 21.5 bushels per acre.

Grain sorghum at Hermitage averaged 69 bushels; at Biloela the best yield was 58 bushels and the average about 40; the State average was 25 bushels.

Maize was grown at the Ayr and Kairi stations. On the former the highest yield was 78 bushels and the average over 60; on the latter (in a cyclone year) the highest yield was 72 bushels and the average yield on maize-grass rotational fields was around 50 bushels, compared with a State average of 25.

Cotton at Biloela has, over 30 years, averaged 1,400 lb. for irrigated fields and for dry fields 800 lb. in the first year after pasture, and 600 lb. for all fields. The State average, on mainly dry-land cultivation, is only about 300 lb.

Unquestionably these high average crop yields are due in a large measure to the systems of crop and pasture rotations followed and the cultural methods employed. Moreover, the fertility of the soils is being built up, not depleted.

Arthur F. Bell (Under Secretary) in his Annual Report presented to Parliament.

The 1956 Baconer Carcase Competitions

By F. BOSTOCK, Officer in Charge, Pig Branch.

The ninth annual Baconer Carcase Competitions sponsored by the Australian Meat Board in association with the Department of Agriculture and Stock were conducted in the four major districts.

The championship was again awarded to Mr. C. Schulz, who competed in the South Queensland Division and entered a crossbred carcase of 128 lb. which scored 87 points. The carcase was nicely proportioned and scored well in all points except leg length, which was too great. The breeding of this entry was by a Berkshire boar from a Large White-Berkshire sow.

Mr. Schulz has a very good record in these competitions. In 1953 he won the district competition and tied for reserve champion with a score of 89. In 1954 he again won the district competition and was reserve champion with 89½ points. Last year he received the championship with the excellent score of 91½ points, only ½ point below the Queensland record, and this year was again champion with a score of 87 points.

Prize-winners in their respective districts were as follows:—

Prize.	Owner.	Breed.	Weight.	Points.
			Lb.	
		North Queensland.		
1st ..	Lowrey Bros. ..	Berkshire X Large White ..	128	83½
2nd ..	W. Drury & Son ..	Berkshire	136	82½
3rd ..	J. R. Soley	Berkshire X Wessex Saddleback —Berkshire	146	82
		Central Queensland.		
1st ..	C. J. Coombs ..	Berkshire X Tamworth—Large White	131	86½
2nd ..	C. J. Coombs ..	Berkshire X Tamworth—Large White	124	85
3rd ..	K. W. Forde ..	Large White	121	82½
		South-Eastern Queensland.		
1st ..	C. Schulz	Berkshire X Berkshire—Large White	128	87
2nd ..	A. E. H. Gibbons ..	Large White	159	86
3rd ..	A. E. Kleinhaus ..	Berkshire X Gloucester Old Spot—Tamworth	153	85½
		Darling Downs.		
1st ..	J. Hickey	Berkshire	151	82½
2nd ..	I. Jensen	Berkshire X Wessex Saddleback —Berkshire	129	82
3rd ..	E. C. Jurgs	Berkshire	135	81½

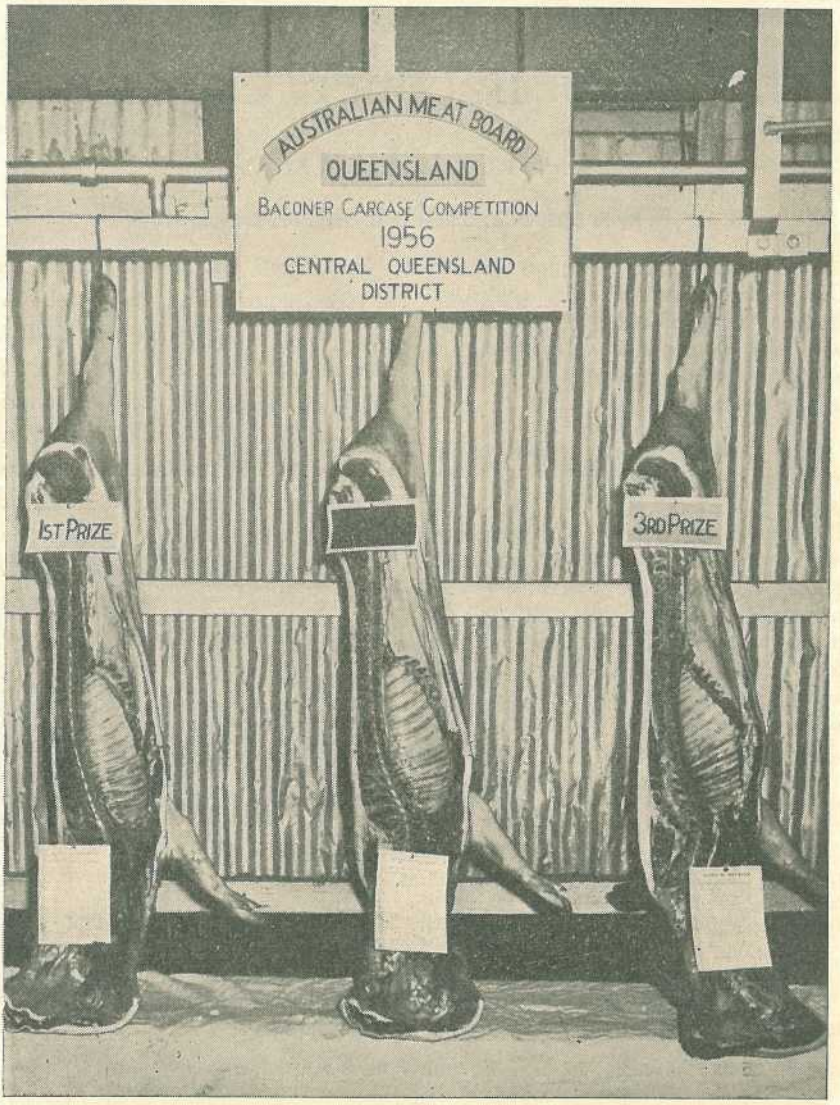

Plate 1.

Prize-winners in the Central Queensland District Competition.

The customary field days were arranged to coincide with the judging in each district, except Brisbane. However, the winning carcases in this section were exhibited at the Toowoomba field day. A good attendance of farmers was secured at these functions. Officers of the Department of Agriculture and Stock in co-operation with the Works Management in each district staged demonstrations and arranged for addresses on subjects dealing directly with the production of pigs.

Accepted entries numbered 135, this being 22 fewer than in 1955. It is thought the introduction of the voluntary grading system, as also the increased number of Country Show

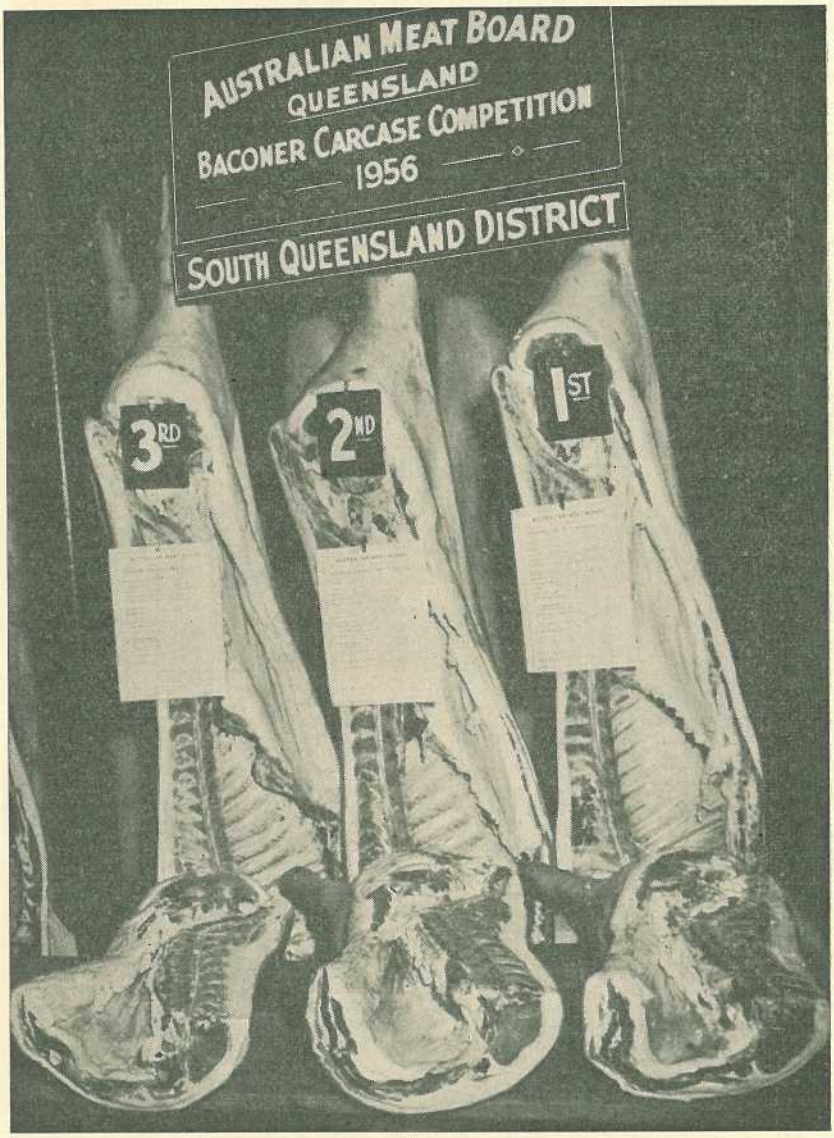

Plate 2.

Prize-winners in the South Queensland District Competition. The State champion is on the right.

Societies including the Cured Baconer Carcase Competitions in their schedules, has had an influence on the number of entries and practical interest shown in these competitions. However, now that grading is not being carried out in many districts and has been greatly relaxed in others, it is expected that these and cured carcase competitions will again become more popular as a means of determining the quality of pigs produced.

AVERAGE FOR EACH SECTION OF JUDGING SINCE 1949.*

Section.	1949.		1950.		1951.		1952.		1953.		1954.		1955.		1956.	
	Average Points Obtained.	Percentage of Possible Points.	Average Points Obtained.	Percentage of Possible Points.	Average Points Obtained.	Percentage of Possible Points.	Average Points Obtained.	Percentage of Possible Points.	Average Points Obtained.	Percentage of Possible Points.	Average Points Obtained.	Percentage of Possible Points.	Average Points Obtained.	Percentage of Possible Points.	Average Points Obtained.	Percentage of Possible Points.
By Inspection—																
Hams	6·27	78·40	6·097	76·213	6·44	80·52	6·286	78·571	6·67	83·37	6·12	76·5	6·19	77·40	5·81	72·6
Shoulders	5·92	84·57	5·849	83·564	5·92	84·60	5·947	84·959	6·02	86·00	6·06	86·6	6·05	86·67	5·66	80·9
Streak	5·57	46·40	7·766	64·724	7·41	61·79	6·982	58·185	8·29	69·08	7·52	62·7	7·59	63·24	7·86	65·5
By Measurement—																
Eye Muscle ..	18·04	64·42	14·262	50·936	20·15	71·96	19·114	68·265	19·15	68·39	20·82	74·4	20·88	74·56	18·28	65·3
Backfat Thickness..	15·26	76·30	14·572	72·864	15·45	77·23	14·729	73·643	15·97	79·85	16·00	80·0	15·87	79·36	16·08	80·4
Body Length ..	13·06	65·30	13·388	66·941	12·98	64·92	14·814	74·072	14·99	74·95	15·47	77·4	16·21	81·02	16·65	83·3
Leg Length ..	3·02	60·40	3·281	65·631	3·21	64·22	2·757	55·142	3·27	65·40	2·95	59·0	2·97	59·48	2·48	49·6
Total	67·97		65·218		71·57		70·629		74·87		74·94		75·78		72·82	

* The overall percentage of possible points in the first year (1948) was 60·805.

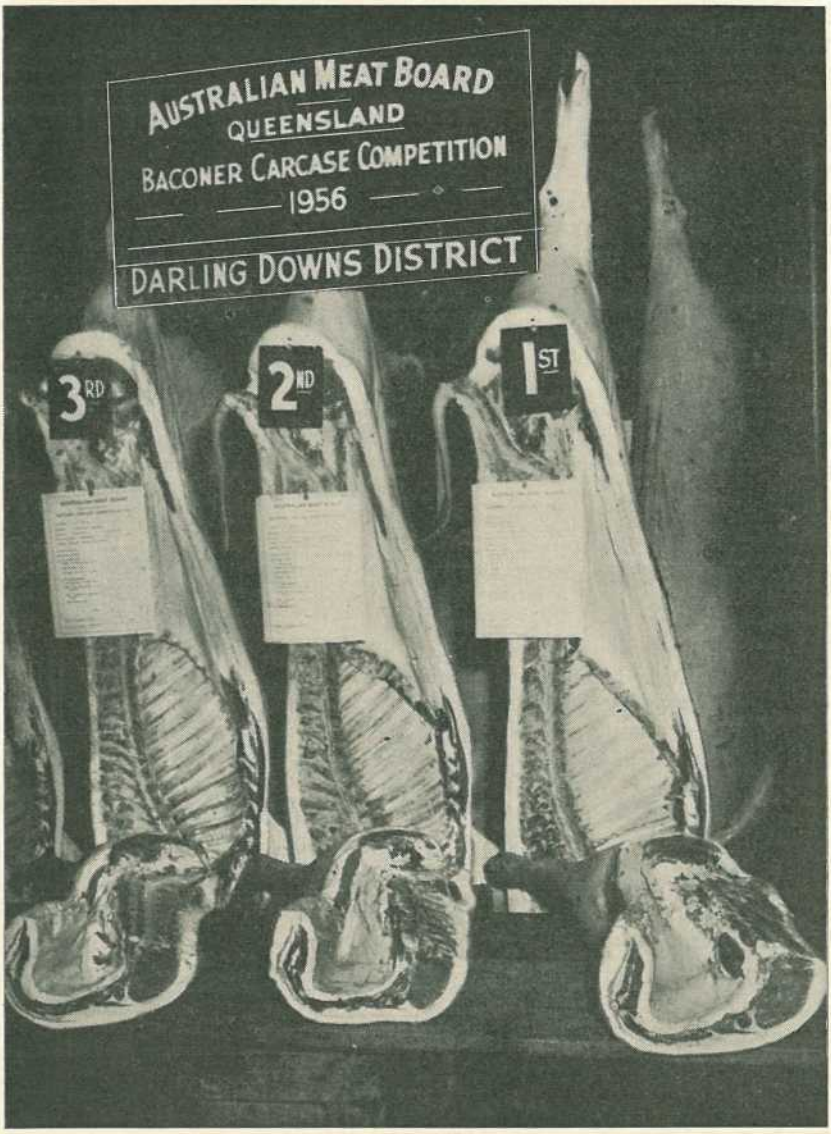

Plate 3.

Prize-winners in the Darling Downs District Competition.

At Mareeba 27 entries secured first class certificates, 2 second class certificates and 1 no recognition; at Rockhampton 14 secured first class, 4 second class and 1 no recognition; at Brisbane 21 obtained first class, 2 second class and 3 no recognition; and at Toowoomba 30 got first class, 10 second class and 11 no recognition.

First class certificates are issued to farmers exhibiting carcases scoring 70 points or more and second class certificates for scores of 60–70 points.

The hams did not maintain the standard of previous years and producers are advised to give more careful consideration to hams when selecting breeding stock.

The shoulders were also inferior. There was a tendency in all areas towards excessive shoulder development. Again careful selection of breeding stock is advised.

Streak or belly scored reasonably well, but as previously pointed out there is still room for much improvement. The amount of meat and fat development in the belly cannot be judged on the live animal, but good feeding in early life and no excessive feeding of liquid foods will help proper development.

Eye muscle scored well, but it would be pleasing to see a larger proportion of really good eye muscles. The development of eye muscle is controlled by both hereditary factors and proper feeding, especially during the early life of the pig, and attention to selection and the feeding of rations containing ample protein would greatly assist in increased size of eye muscles.

Backfat development was not as good as expected. It was thought that the operation of grading would have assured that overfat pigs would not be entered in these competitions. There were, however, a number overfat and it can only be emphasised again that farmers should forward their pigs for slaughter when in prime condition irrespective of age or weight.

Body length was very fair. Breeders are apparently paying attention to this point when selecting brood stock; the practice should be continued if the present standard is to be maintained or improved.

Leg length was again disappointing and it is hoped to see an improvement in this section at future competitions. However, breeders must not sacrifice body length for leg length.

The overall percentage score was 72.52. While this was lower than last year, it is nevertheless a good effort on the part of all competitors.

I would like to offer my congratulations to the championship winner for his very creditable effort and record over the past four years, to those scoring 1st, 2nd, and 3rd places in their respective districts, and to all competitors on the spirit in which the competitions were contested in all districts.

JOURNAL SUBSCRIPTION.

Readers are reminded that the annual subscription to the *Queensland Agricultural Journal* from January, 1957, will be five shillings for primary producers in Queensland whose main source of income is the land, for schools, for Schools of Arts, and for students. The cost to all others will be £1 a year.