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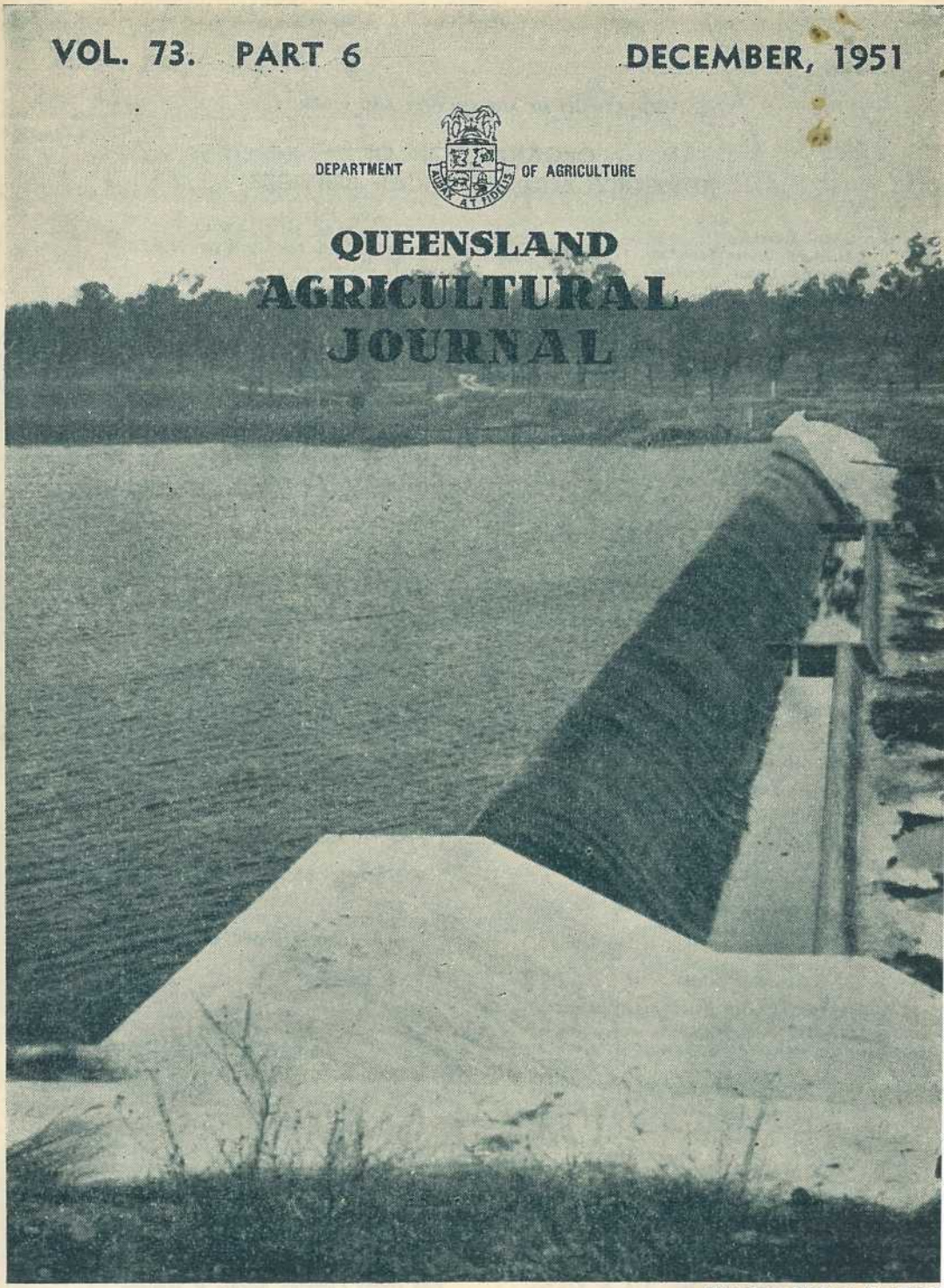
DEPARTMENT OF AGRICULTURE

QUEENSLAND AGRICULTURAL JOURNAL



The Bruce Weir on the Walsh River, North Queensland.

LEADING FEATURES

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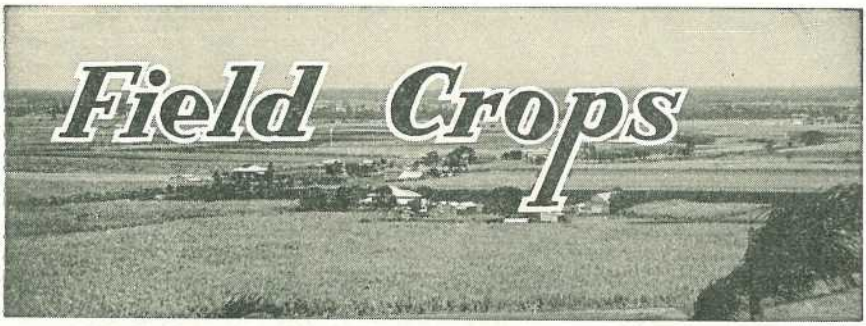


Tropical Pasture Investigations.

T. G. GRAHAM, Agrostologist, Agriculture Branch.

THE sugar growing industry is firmly established on the arable lands of the coastal belt north of Townsville, but the establishment of other primary industries in the area would be desirable from many points of view. Tobacco growing is making progress in the Ingham area and there is a small amount of other agricultural and horticultural production from centres scattered along the northern coastal belt.

For a number of years the Bureau of Tropical Agriculture at South Johnstone has been experimenting with various tropical crops which may have commercial prospects on the wet coastal lands. Among these crops are tea, rice and fibre plants, but much remains to be investigated before the stage of economic production of these crops is reached. The main activity at the Bureau, however, has been the investigation of suitable tropical pastures.

The possibilities of using pastures to fatten beef cattle on the northern coastal and sub-coastal districts have attracted attention for some time and there are indications that the development of suitable tropical pastures can offer practical prospects of using country in this area which is not suitable for cultivated crops. Much of the area has an abundant rainfall for upwards of nine months of the year and, if good tropical pastures could be grown, an excellent outlet would be provided for fattening cattle from the breeding areas of the adjoining north-western country.

It had already been shown that stores could be brought in from the larger holdings and fattened under intensive grazing conditions on the coast, as was done for example on properties in the Daintree River area, in the venture by the late Mr. Brice Henry and in the coastal fattening experiments carried out by the Department of Agriculture and Stock on Mr. Henry's property at "Riversdale" in the Tully area. These experiments showed clearly that cattle could be topped off within a year on introduced pastures. It still remained to be proved, however, whether the pastures would stand up to grazing and whether they could be improved in any way. There was also the question of management and the part that it played in maintaining the sward and increasing the output.

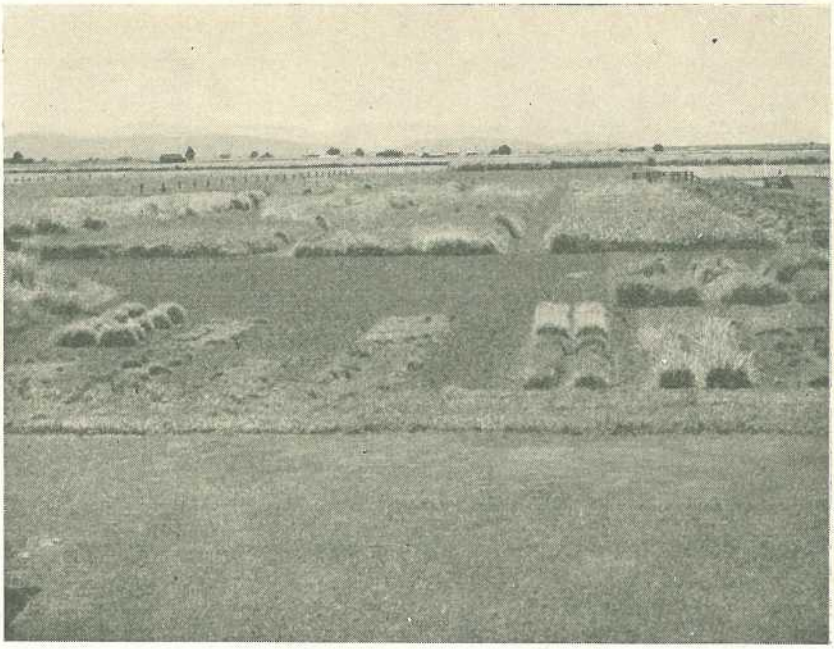


Plate 166.

Grass and Legume Observation and Seed Increase Plots, Bureau of Tropical Agriculture.

In addition to examining tropical pastures for beef cattle fattening, there is also the problem of deteriorated pastures and declining production in the dairying areas on the East Palmerston. This decline has been due in large measure to the failure of the pastures under the form of management practised on them.

VALUE OF LEGUMES.

The limiting factor in dairying pastures in the tropical coastal areas, as in most other dairying areas of Queensland, is the absence of a legume, either native or introduced, which will grow in association with the grasses and provide a source of protein when the grasses decline during the late spring and early summer months. Moreover, a suitable grass-legume mixture would assist very materially to maintain soil fertility and so promote the maintenance of a good permanent pasture.

Preliminary investigations into tropical pasture species had been carried out at the Bureau of Tropical Agriculture for some years prior to 1946, but in that year it was decided to take an important step forward in the investigations by introducing beef cattle on to a series of plots in which stands of what were then considered the most promising pasture species and combinations of species had been established. The primary purpose of this move was to examine the behaviour of the various species under stocking. It was also hoped, by measuring the body weight gains of the animals, to get a sound indication of stocking capacities and nutritive qualities of the species and combinations of species under test. To date, however, the main emphasis has been placed on the examination of the reaction of the pastures to grazing.

Research has been in progress since the establishment of the Bureau of Tropical Agriculture to find suitable legumes which will grow under tropical conditions. By the end of 1942, it was fairly well established that a number of legumes would grow and survive against competition in this locality. Little was known, however, of their palatability or of their place in a pasture mixture with one or other of the permanent pasture grasses available for trial. These grasses—Guinea grass (*Panicum maximum* var. *typica*), molasses grass (*Melinis minutiflora*) and para grass (*Brachiaria purpurascens*)—existed in pure stands without association with any legume.

PALATABILITY TRIAL.

After considerable initial work, six of the most promising legumes were selected and placed in a palatability trial. This trial consisted of 18 plots each about one-tenth of an acre in area, providing for three replications of each variety and making a total area of approximately two acres. From the results of grazing for three days continuously at 25-day intervals over a period of three years, it has been shown that puero (*Pueraria phaseoloides*), Dolichos (*Dolichos hosei*), stylo (*Stylosanthes gracilis*), centro (*Centrosema pubescens*), and Desmodium (*Desmodium heterophyllum*) are palatable to stock in approximately that order, while calopo (*Calopogonium mucunoides*) is only slightly palatable. Of these, puero and Dolichos are eaten at any stage of maturity. At certain times of the year stylo and centro are eaten more readily than at other times. This coincides with the mature stage of the plant and also with the decline in the protein level of the grasses.

With stylo and centro, and indeed with most of the tropical perennial legumes, it seems more likely that animals accustomed to grazing the soft flush growth of grasses are not anxious to graze harsher plants while their requirements can be met from the grasses alone. But as soon as the grasses show signs of becoming harsh and dry during the drier months of September, October, and November, they turn to the legumes to balance their diet. It seems also that animals have first to become accustomed to the legumes before they will take to them readily.

PASTURE MIXTURE TRIALS.

In 1946 four pasture mixtures in two-acre blocks were laid down at the Bureau.

There were at this time four grasses and four legumes with ample seed supplies from which to choose. The grasses were para grass, Guinea grass, purple top Guinea grass (*Panicum maximum* var. *coloratum*) and molasses grass, and the legumes were stylo, centro, puero and calopo. Para grass was known to be unsurpassed in the wetter localities but no legume was known which would grow in a similar environment. Moreover, as the area for which early information regarding pasture mixtures was required included the hilly Palmerston dairying lands on which molasses grass was known to do well, and for which the Guinea grasses seemed promising, it was decided to concentrate on molasses grass, Guinea grass and purple top Guinea grass in the initial pasture mixtures. The grass-legume mixtures were selected according to their habits of growth, and the treatments chosen were Guinea grass and stylo, purple top Guinea grass and centro, molasses grass and puero, and molasses grass and calopo.

By the middle of 1946 these pastures were well established and the fencing completed. In August of the same year eight Hereford steers were purchased as two-year-olds and the grazing experiments began. Including the palatability trial there were thus 10 acres of established pastures under rotational grazing.

The period of grazing for each paddock was set down at five days with a spell period of 20 days. The animals did well but there was no way of determining just how much each pasture contributed to this gain. During 1947 a duplicate set of the pasture mixture treatments was established, making nine paddocks totalling 18 acres.

These paddocks were ready for grazing by the winter of that year and in order to cope with the increased pasturage the herd number was raised to 16. The grazing period of each paddock was maintained at five days, thus subjecting the pastures to more intensive treatment, but a much longer recovery period of 40 days also resulted from this arrangement. In July, 1948, the first mob of Herefords was sold for slaughter and replaced by 16 Shorthorn steers from Spring Creek Station.

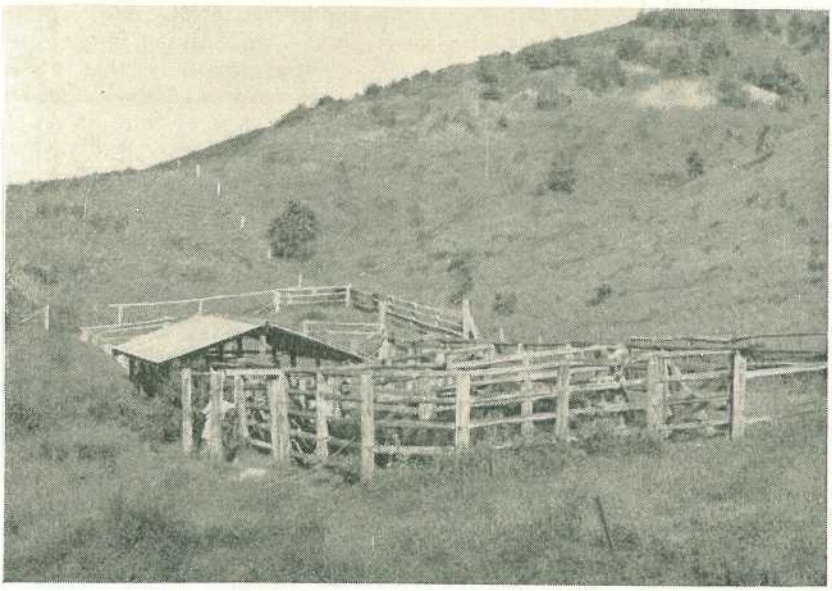


Plate 167.

Stock Yards and Weighbridge at Bureau of Tropical Agriculture.

In August, 1948, a weighbridge was installed in order to obtain liveweight gains of the animals at regular intervals. It was found that, to fit in with other routine activities on the Bureau, weighing the animals on the same days each week would be necessary. This involved a recasting of the grazing schedule of the plots, whereby the two paddocks of like treatment were grazed in conjunction for a period of seven successive days with a spell period of 28 days. To provide for the latter it was necessary to bring in another two-acre paddock of molasses grass, which was thereafter grazed in conjunction with the palatability trial in rotation with the four pasture mixtures. Even with this reduced recovery period the stock were unable to cope with pasture growth during the seasons of heavy growth in February and March.

After two years of grazing with this high rate of stocking some of the pasture mixtures showed signs of overstocking. The mixture most affected in this way was molasses grass and puero. For the first year this mixture gave the best results, but by 1950 purple top Guinea grass and centro was the more impressive pasture. At present plots of the latter appear better than at any time since their establishment.

From these trials it would appear that stylo is unable to grow in association with Guinea grass. The grass by its vigorous nature completely outstrips the legume in growth and the latter, not being shade tolerant, is quickly choked out of the pasture. Centro, on the other hand, twines around the stools, can grow in partial shade, and is sufficiently vigorous to be able to compete with Guinea grass. It promises, therefore, to be a very useful component of Guinea grass pastures. Both puero and stylo will combine with molasses grass

In the trials at the Bureau, puero has done well with molasses grass, but molasses grass has not the carrying capacity of Guinea grass and has shown signs of weakening under the very heavy stocking rate being used. Calopo grows quite well with molasses grass but the legume is not very acceptable to stock and is consequently not grazed. Thus the paddock often has the appearance of a pure legume stand rather than a legume-grass mixture. Calopo has, however, an apparent use in the rejuvenating process of run-down pastures and for this reason cannot be entirely ruled out. There is evidence, too, of cattle eating this legume and doing quite well on it, but from Bureau experience this cannot be wholeheartedly supported.

GRAZING MANAGEMENT OF PLOTS.

The general technique of grazing has been to allow the cattle as much freedom of movement as possible. There is a central water trough and woodlot connected to each paddock by a laneway. The procedure is to open the paddock that is to be grazed, place the animals in this paddock after weighing, and thereafter allow them to seek water and shade at will, except on weighing days. Usually the bullocks leave the paddocks of their own accord about 8 o'clock every morning, drink at the trough and proceed to the woodlot. They do not return for grazing until 5 p.m. On the other hand, on dull showery days they have to be driven from the paddocks. Water and shade are not provided in the paddocks because much of the efficiency of the grazing plots would be lost in camping and trampling if this were done.

MANAGEMENT OF THE STOCK.

Ear tags have been found to be the quickest and most accurate method of identifying stock, but cheek branding is also used in case the tags are pulled out. When weighing commenced it was decided to dehorn the station stock, which were unaccustomed to frequent handling and were difficult to draft in small yards and weigh. However, the first dehorning caused considerable loss in condition, and the animals still remained difficult to handle for a considerable time. As a consequence the next mob was tipped rather than dehorned and this proved very successful. Little weight was lost, the stock worked freely in the yards and they have shown little inclination to horn each other.

Plate 168.

Shorthorn Steers Grazing on Guinea Grass and Stylo, Bureau of Tropical Agriculture.

The first step in the introduction of beef stock into grassland experiments is to see that all paddocks are securely fenced. It is important to ensure that reasonable facilities in the way of saddle horses exist for the handling of cattle, and that strongly constructed yards, sufficiently high to dispel any desire on the part of the animals to attempt an escape, are available on the property. Low yards or widely spaced rails in a yard are dangerous and do not assist in the quietening of beasts.

Station cattle are not accustomed to being yarded very frequently. They usually associate it with some drastic treatment such as branding or dipping, and their recollection of the severe nature of most of these experiences makes them nervous and somewhat difficult to handle. As a result of repeated handling from which no harm befalls the animals, they become very quiet and can, after six months, be worked on foot if the attendant takes them quietly. Before this stage is reached, however, all handling of the animals must be done on horseback.

NOTES ON THE PASTURE MIXTURES TESTED.

Purple Top Guinea Grass and Centro.

Paddocks of this pasture have been most impressive because of the even dark green colour and perfect cover. There is a preponderance of centro in the stand, but over the past year the legume does not appear to have increased appreciably. It is believed that centro would maintain a better balance if planted with the more vigorous common Guinea (*Panicum maximum* var. *typica*). *Glycine javanica* or stylo might prove more suitable with the less vigorous but more palatable purple top Guinea grass. Green panic or fine stem Guinea grass (*Panicum maximum* var. *trichoglume*) might also provide a good balance with either of these two legumes.

Plate 169.

Purple-top Guinea Grass and Centro Pasture, Bureau of Tropical Agriculture.

Molasses Grass and Calopo.

A dense cover has been maintained in one of these paddocks; the other, on poorer ground, is less satisfactory. At times the cover has varied from what appears to be a pure legume stand to a really good grass-legume mixture. It is considered that as calopo is not as readily acceptable to animals as the grass, it tends to dominate the stand. From observations at the Bureau to date it cannot yet be determined whether it is a useful species in a molasses grass pasture or whether it should be abandoned as an unsuitable species. Whatever may be the outcome of future observations, it certainly looks at present as if calopo could play an important role in rejuvenating deteriorated pastures because of its vigorous growth and weed choking potentiality.

Guinea Grass and Stylo.

Evidence is now fairly definite that in good Guinea grass stands stylo has not the capacity to maintain itself under tropical coastal conditions. Where the Guinea grass stand is scattered, in one paddock of this mixture, there is a fairly liberal amount of stylo uniformly distributed throughout the area. In the other paddock, where Guinea has made really good growth and the population of the grass is dense, stylo has almost completely disappeared.

Observations indicate that stylo may combine satisfactorily with the less vigorous varieties of *Panicum maximum* such as purple top Guinea grass and green panic. This legume has much to commend it. Features such as its adaptability, persistence, ability to spread and availability of seed all combine to render it a potentially important pasture legume.

Plate 170.
Guinea Grass and Stylo Pasture, Bureau of Tropical Agriculture.

As a result of rotational grazing, centro has been introduced into this paddock and has taken possession of a small area at one end. This is a really conspicuous section of the paddock, for not only does the grass look greener but it possesses a much softer and quicker flush. Moreover, the grazing animals tend to concentrate on this area as soon as they find their way into the paddock. From this and other observations it seems certain that common Guinea grass and centro would prove ideal in combination. This also furnishes evidence of the ability of centro to colonise—an important character in pasture species—and its superiority over stylo under conditions obtaining at the Bureau of Tropical Agriculture.

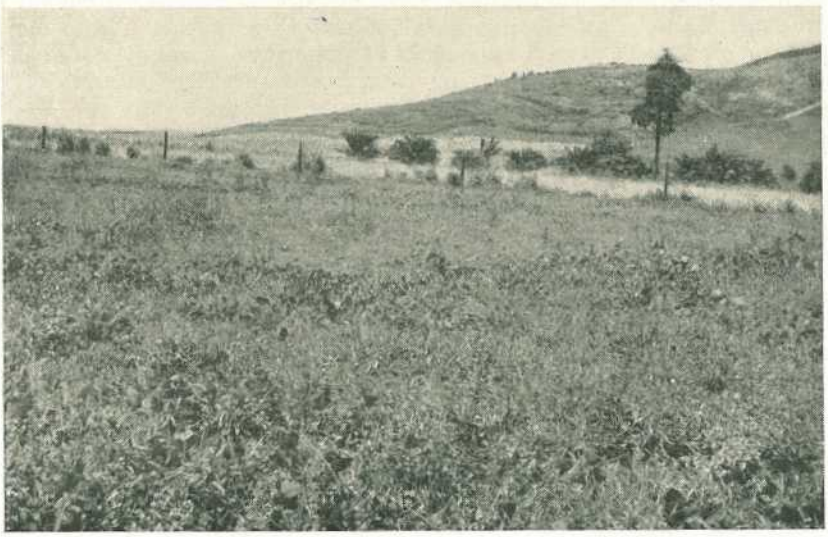


Plate 171.
Molasses Grass and Puero Pasture, Bureau of Tropical Agriculture.

Molasses Grass and Puero.

This combination has developed into a very good mixture in one of the paddocks at the Bureau. In the other, the effects of overstocking have been marked and the mixture is being overwhelmed by blady grass (*Imperata cylindrica*), para grass and blue top (*Ageratum conyzoides*). From observations to date, it would appear that under the present system of seven days grazing and 28 days spell, the stocking rate, which is equivalent to one beast per 1¼ acres, is too heavy for molasses grass even under a rotational system of grazing. In this mixture, however, there is evidence of an increase in the puero cover. Unlike calopo, puero is taken by cattle quite well, and there is no tendency on the part of the grazing animals to concentrate on the grass and neglect the legume.

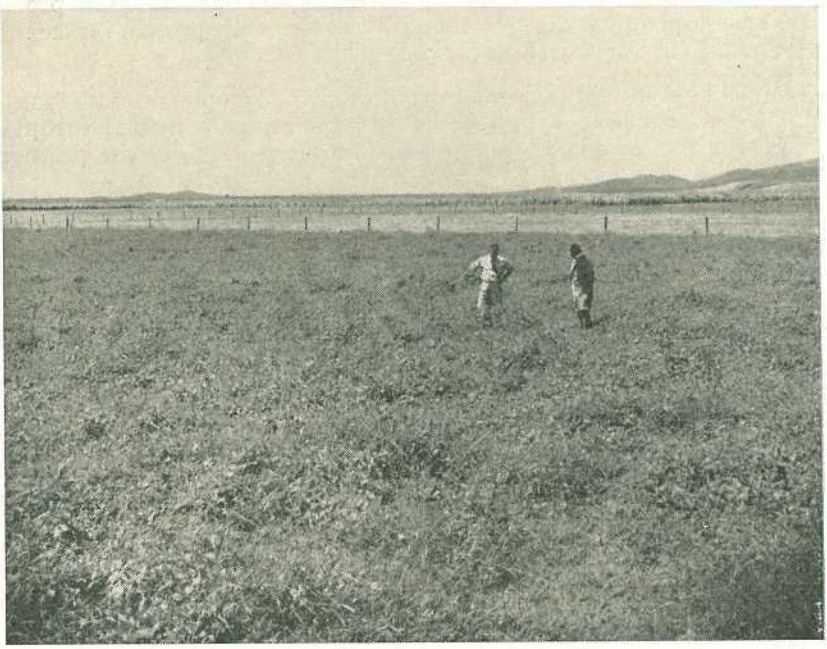


Plate 172.
Molasses Grass and Calopo Pasture, Bureau of Tropical Agriculture.

CHEMICAL COMPOSITION OF THE GRASSES AND LEGUMES.

The variations found in the chemical composition of some of these grasses and legumes, as well as para grass, are shown in the following table.

Range in Chemical Composition of Eight Tropical Pasture Species Expressed as Percentage of Water Free Material.

Species.	Crude Protein.	Crude Fat.	Carbo-hydrate.	Crude Fibre.	Ash.	Ca O.	P_2O_5.
Para grass..	18·6–9·9	2·0–1·4	49·6–40·5	33·0–28·2	18·8–6·8	1·488–·341	·917–·388
Molasses grass ..	14·9–8·4	2·6–1·3	52·5–45·4	35·1–29·3	10·1–6·2	·513–·315	·940–·415
Guinea grass	16·2–6·8	1·7–1·0	46·9–41·7	36·4–32·0	15·6–7·4	1·00 –·413	·644–·276
Purple top guinea grass ..	15·7–3·0	1·7–0·7	49·4–37·2	45·0–26·3	16·1–10·9	1·63–·543	1·38–·593
Stylo ..	18·05–10·55	..	..	..	..	2·70–1·27	·75–·49
Centro ..	23·8–15·8	3·0*	38·4*	30·3*	9·6*	3·61–1·44	·84–·49
Puero ..	19·5*	1·2*	38·6*	34·3*	6·5*	2·63–1·047	·607–·42
Calopo ..	19·5*	1·2*	40·2*	31·1*	8·0*	2·117*	·584*

* Only one determination.

In the light of the detailed analyses carried out by him, Mr. W. J. Cartmill in a report in 1944 concluded that:—"Para grass pasture may be regarded as having an adequate protein content throughout the year. Similarly molasses grass, which has a crude protein content of 10% to 11% throughout the year, may be accepted as satisfactory as a supplier of protein. In both cases the protein levels are highest during the late wet season (February-March) and lowest during the pre-wet season (December-January). Moreover, the fibre content of these two grasses is not high, so that, provided the stock always have access to succulent leaf, the intake of the growth and energy producing constituents should be adequate. Guinea grass probably has an adequate crude protein content during the wet season, but the analyses indicate that in dry periods the fibre content of this grass is fairly high and the protein content correspondingly low, so that at these times the protein intake may not be sufficient for fattening purposes."

It will be seen that the protein values for the legumes are satisfactory and it could be expected that the use of these legumes with the tropical grasses would considerably improve the nutritive value of the pastures.

NOTES ON INTRODUCTIONS OF PASTURE SPECIES.

A small plant introduction area has been maintained at the Bureau of Tropical Agriculture ever since pasture work commenced there.

Of the more recent introductions, *Glycine javanica* is the most outstanding legume. Its apparent wide range of adaptability suggests that it might be useful for trial in areas further south. It may combine well with molasses grass, purple top Guinea grass and fine stem Guinea grass (commonly referred to as green panic in the Burnett and coastal areas south of Rockhampton). It has all the characteristics of a good pasture species, since it makes good growth, is palatable according to Southern Rhodesian experience, and seeds prolifically. Already it has shown more promise on the Atherton Tableland than any other legume yet established there. It is intended to establish a fine stem Guinea grass and *Glycine javanica* pasture mixture at the Bureau of Tropical Agriculture in the near future to examine further the usefulness of this legume.

Desmodium canum is a legume which has persisted in spite of severe competition. It is perhaps not vigorous enough for grasses such as common Guinea grass and molasses grass but may prove suitable with fine stem Guinea grass and other species which do not make rank tall growth.

Desmodium scorpiurus favours less fertile land than most of the other legumes, and may prove a useful species in the poorer areas of the wet belt, just as Townsville lucerne (*Stylosanthes sundaica*) does in the drier areas.

The most outstanding grass introduction is *Andropogon gayanus*, a native of tropical Africa. It has outyielded common Guinea grass in monthly cuttings and appears soft and palatable but, as yet, has not been tested under grazing conditions.

Another promising species is *Brachiaria decumbens*, which also needs to be studied under grazing conditions. It has the capacity to remain green under adverse weather conditions.

Plate 173.

Andropogon gayanus, a Grass Introduced from Tropical Africa, Growing at the Bureau of Tropical Agriculture.

Dichanthium caricosum has not lived up to the high reputation it has gained in the wet Navau Valley of Fiji, and its value for the tropical coastal areas is in doubt.

UTCHEE CREEK RESERVE.

In order to test the experimental pasture mixtures which were being developed at the Bureau of Tropical Agriculture, three blocks of land comprising 660 acres were selected some years ago at Utchee Creek and were gazetted as an experimental reserve. Utchee Creek is situated some 20 miles from the Bureau and most of the area consists of steeply sloping land covered with dense rain forest, which is not suitable for cultivation.

A trial to examine the establishment of grasses and legumes following a scrub burn was commenced on a plot of 10 acres in 1941. The grasses—para, Guinea and molasses—all germinated well and good establishments resulted. Puero, centro, and calopo, the three legumes tried, all gave indications of ready establishment in a scrub burn.

Nothing further was done at Utchee Creek during the war years, but stock from neighbouring farms eventually found their way to the area where pasture species had been established. The stocking rate for the next few years was very heavy, and by the end of 1943, at least half the area had the appearance of a dense legume stand. The legume was the relatively unpalatable calopo, which had spread very vigorously following the suppression of grasses by the grazing stock. Puero had almost entirely disappeared, and centro had confined itself to the scrub margin, where it had climbed to a height of 30 feet. Calopo had also climbed the trees on the fringe of the clearing and it was not uncommon to find both calopo and centro together on the same support.

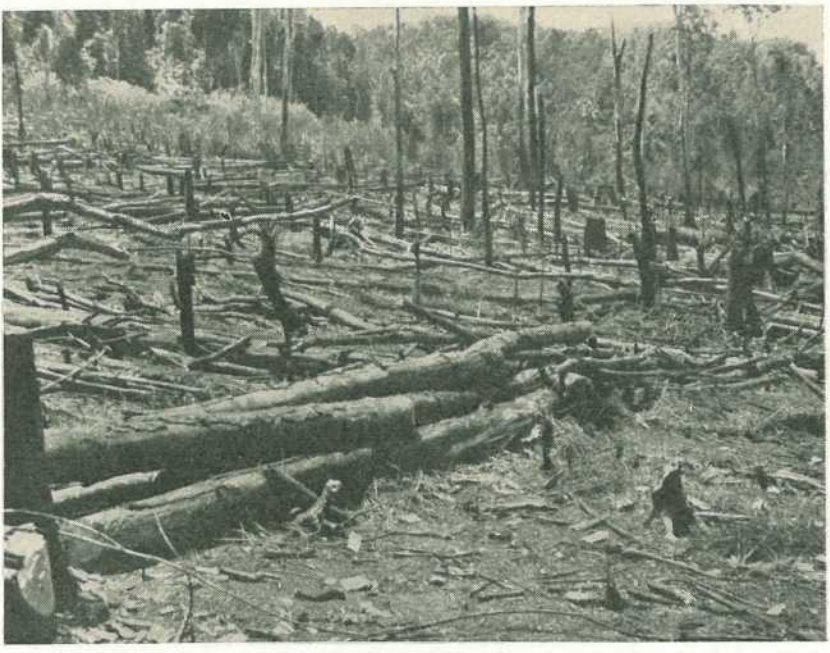


Plate 174.

A New Burn in Fallen Scrub, Utchee Creek, South Johnstone.

Plate 175.

Para Grass with Molasses Grass in Background, Utchee Creek, South Johnstone.

Plate 176.

Burnt-over Molasses Grass Showing Initial Weed Invasion, Utchee Creek, South Johnstone.

Plate 177.

Regeneration of Molasses Grass Following a Burn. The stylo seen in foreground was oversown. Utchee Creek, South Johnstone.

Plate 178.

Puero Dominating Molasses Grass when Oversown Following a Burn. No grazing has been allowed. Utchee Creek, South Johnstone.

Plate 179.

Shorthorn Steers (2½ years old) after 12 Months Grazing at the Bureau of Tropical Agriculture.

The area was fenced in 1944 with the object of keeping stock off the pastures. Within six months of fencing a complete change took place. Guinea grass, which seemed to have disappeared, reappeared vigorously and competed strongly with calopo. This was by far the most important observation made from this preliminary trial apart from the information gained in the initial establishment. It indicated that calopo is a legume which might prove useful in rejuvenating the deteriorated Palmerston areas. The ease with which it can be established, its capacity to burn well, and its ultimate failure to compete with Guinea grass under controlled grazing, suggested its use for reclaiming these areas. Of the other grasses, para grass survived in the area originally planted, while molasses grass was largely replaced by Guinea grass.

In 1946 a second area of 10 acres was felled and seeded to molasses grass. A very quick grass cover resulted. The object of this trial was to determine whether tropical legumes could be introduced into an already established pasture. The paddock was fired in 1948. Stylo was broadcast over half the burnt area and puero over the other half. Both the legumes germinated well and good mixtures of molasses grass and stylo and molasses grass and puero have been obtained. Puero, however, has been outstanding and a first class mixture has resulted. In addition, this vigorous creeper is in process of smothering all sucker growth. The stylo section may improve when the area is stocked at a later period.

By 1948 the work at the Bureau had reached a sufficiently advanced stage to indicate definite lines along which future work might continue at Utchee Creek. An area of 40 acres was cleared at the latter centre with the object of establishing grazing trials. Clearing began in August, and by late December the area was fired and seeded. The area was divided into 10 paddocks each of four acres. All the combinations considered worthy of trial at Utchee Creek could not be tested in one experiment. Seed of puero was in very light supply at that time and the choice of legumes was therefore restricted to stylo and centro. The treatments were as follows:—Molasses grass and stylo, molasses grass and centro, para grass and stylo, para grass and centro, Guinea grass and stylo, Guinea grass and centro, molasses grass, Guinea grass, para grass, and Guinea grass with molasses grass. Each of these grasses and grass-legume mixtures germinated well, and excellent establishments were recorded by April 1949. It is hoped to complete the fencing of these small paddocks and the erection of the yards and weighbridge shortly.

It is intended that each of these four-acre paddocks will be grazed continuously by three bullocks. Every three weeks the animals will be removed for spraying and weighing, and then returned to their respective paddocks. The response of the pastures to this type of management will be closely studied.

CONCLUSION.

The results obtained at the Bureau of Tropical Agriculture and the experience of successful graziers on the tropical coast would indicate that approximately 30,000 head of 2-year-old stores could be fattened in this area annually, on the 50,000 acres estimated to be suitable and available for tropical pastures, if a suitable reliable pasture mixture can be developed.

This would mean that 30,000 head of young stores could be taken annually from the pastoral holdings of the Peninsula, north of a line from Cairns to Normanton. The removal of these 2-year-old beasts would considerably lessen the number of 3-and-4-year-old stores carried on these breeding properties, and this would favour a considerable increase in the number of breeders.

The importance of this exploratory work is therefore considerable, but much remains to be done in connection with the actual pasture mixtures and their relative values. The problems associated with the animal husbandry aspects of this work, such as the maximum production rate of beef, the type of breed best suited for coastal fattening, and the optimum age of beast at which such fattening should begin are matters which still require investigation.

DAIRY PASTURE INVESTIGATIONS.

The Agriculture Branch now has 83 pasture trials, with a total area of about 200 acres, established on dairy farms in Queensland.

This information is given by the Director of Agriculture (Mr. D. O. Atherton) in the Annual Report of the Department for 1950-51.

Sixteen large-scale farm grazing trials are in progress, but it will be some time before definite results can be reported from them.

Based on marked responses to fertilizers in preliminary trials at Gympie, Conondale, Peachester, Eungella Range and Chilverton, six new trials combining fertilizer treatment with sown pastures have been planned.

On the Blackall Range, marked increases in milk yields were recorded following renovation and topdressing of paspalum-white clover pastures. The individual treatments are now being studied separately to determine their contribution to the increased yields.

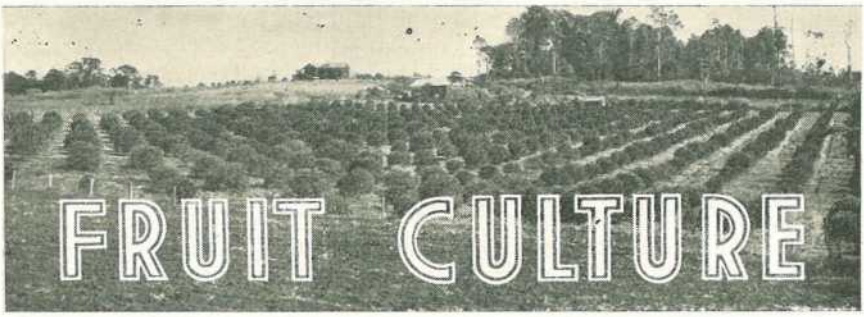
Minor element trials have been laid down in various districts, and a large trial is being conducted with other branches of the Department in an endeavour to find some means of remedying copper deficiency of pasture areas on the Near North Coast.

Approximately 64 acres of hillside pastures have been contour furrowed in the Gympie, Beaudesert and Brisbane Valley districts, with marked response. The method involves ploughing contour furrows at vertical intervals of two to three feet.

Motor mowers are being used in the Moreton and Atherton Tableland districts for investigating the value of regular mowing of blady grass on steep slopes as a means of encouraging better grasses. Results obtained at Pimpama and Peachester suggest that on arable land blady grass can be controlled by ploughing, cropping and resowing to pasture. Discing and resowing may also be effective in some areas.

Seven trials are directly concerned with mat grass control. They suggest that the practice of cultivating infested areas and resowing to pasture is most likely to be effective in preventing the reintrusion of mat grass if a tall-growing pasture species is used.

Twenty-one small pilot plots are maintained with the object of determining the suitability of various pasture species for each dairying district. An introduced fine-stemmed Guinea grass is among the most promising of the newer grasses and it is hoped to build up seed supplies of this grass in due course.



Strawberry Culture.

C. N. MORGAN, Senior Adviser in Horticulture.

THE strawberry is grown in Queensland from the New South Wales border to the far north, but the main producing districts lie within 150 miles north and 50 miles south of Brisbane. The mild winter in this area ensures a long picking period, which frequently extends from June to the end of December. Crops in the northern portion of the State have a much shorter cropping season.

Plate 180.

A Well Grown Strawberry Patch.

During the early part of the harvesting period, the fruit sells readily on the fresh fruit market in Queensland, and many growers also consign to the southern States, where the crop cannot be produced locally during the winter months. By using air transport, the fruit reaches the Sydney and Melbourne markets in first class condition. Late in the season, when market returns do not justify the expense of packing for the fresh fruit trade, the fruit is consigned to local canneries for jam making. The requirements of processors are increasing rapidly and large plantings are made especially to satisfy this demand.

Strawberry growing has some features which make it attractive to many farmers. Firstly, the crop is easily established and returns come in within three months; secondly, the outlay for planting material and equipment to work even a large area is not excessive; and thirdly, the crop fits into the normal farm programme satisfactorily. However, careful attention must be given to the selection of a suitable area for the crop and efficient cultivation in the field is essential for success.

VARIETIES.

The cultivated strawberry is a hybrid of two American species, *Fragaria virginiana* and *F. chiloensis*. The plant is a squat herbaceous perennial with dark green, serrated leaves and bears fleshy fruits with small seeds embedded in the surface. The fruits mature to a brilliant red colour. During the summer months, runners develop on the parent plant and root at the nodes. The runner material is used for propagation, each portion of a runner with an independent root system being capable of forming a new plant.

Two locally selected varieties, Phenomenal and Aurie (Plates 181 and 182) have proved satisfactory for Queensland conditions. They have plenty of vigour and produce medium sized, highly coloured, firm textured fruit which carries well and is suitable for the fresh fruit market and the processing trade. Both varieties bear self-fertile flowers

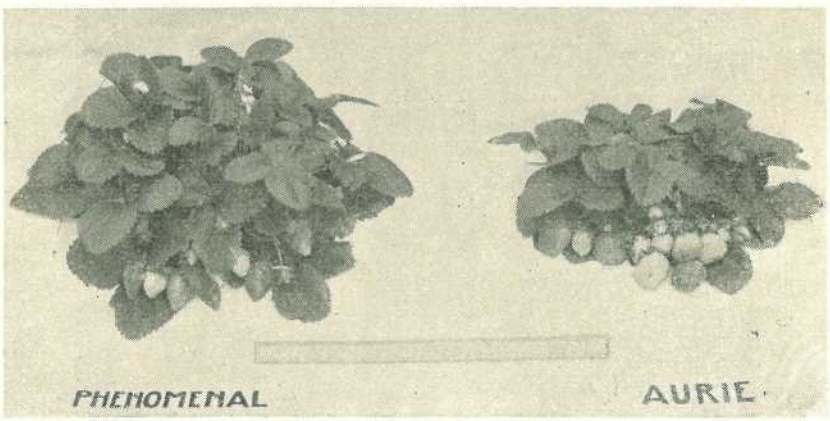


Plate 181.

Strawberry Varieties.

Left—Phenomenal with a rounded bush and pointed berries which are well protected by the leaves.

Right—Aurie with a flattish bush and wedge shaped berries which are somewhat exposed.

and produce good crops without having to be interplanted with a second variety for pollination. Phenomenal is grown more extensively than Aurie. The latter fruits a little earlier and may stand up to dry conditions better than Phenomenal, but the plants suffer rather severely at times from leaf diseases and the quality of the fruit is not so good.

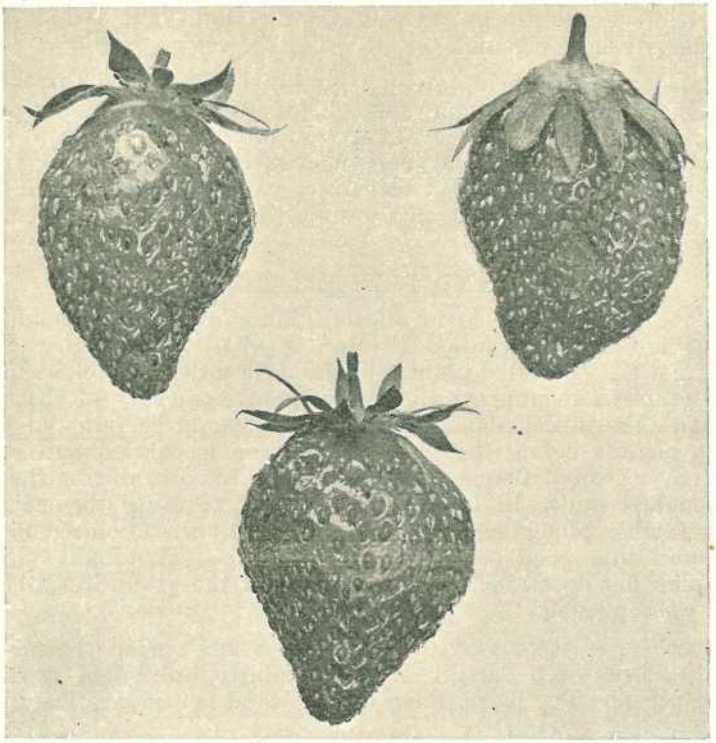


Plate 182.

Fruit of the Variety Phenomenal—Typical Mid-season Berries. Early in the season, the fruit is much larger and usually irregular in shape.

None of the many varieties introduced to and tested in Queensland compares favourably with the local types in either yield or fruit quality.

Virus diseases such as yellow edge and crinkle are a constant threat to the industry and production therefore depends largely on the use of disease-free runners from vigorous, true-to-type plants. An approved runner scheme, whereby strawberry areas are inspected during the growing season, was inaugurated some years ago. If these areas comply with certain standards for plant type and freedom from disease, they are listed as approved sources of planting material. Growers requiring plants should, where possible, obtain them from such approved sources.

LOCATION AND SOILS.

The strawberry crop should be grown in a district with ready access to markets, suitable climatic conditions for the plant and usually a reliable supply of water for irrigation. Irrigation is particularly important in crops grown on some light-textured soils which dry out quickly during the winter and spring months.

Under favourable conditions strawberries do well on almost any type of soil, but well-drained, sandy loams with a good water-holding capacity are generally preferred for the crop. Irrigated areas on red-brown basaltic loams yield particularly well. Where the drainage is good, heavy loams may be planted, especially if water for irrigation is limited or unavailable. On badly drained soils, weed growth is difficult to control, root rots are apt to thin out the stand, and the strawberry plants usually lack vigour.

In the main producing areas, land which is too cold for the more frost-susceptible crops during winter can often be planted profitably to strawberries. New land has many advantages for the crop, not the least of these being the small amount of weed growth during the first year of cultivation. Old land will grow good fruit provided it is well prepared for the crop, adequately supplied with organic matter and fertilized correctly.

LAND PREPARATION.

As the crop is planted in autumn, land preparation should begin in spring in order to get the soil into a good tilth. Though the strawberry is not a deep-rooted plant, ploughing to a depth of eight inches is usually required to improve the water-holding capacity of the average soil. After the initial ploughing, new land should be fallowed for two to three months before the second ploughing is carried out. On old land, a cover crop of Poona pea or maize can be sown during the spring and ploughed under in late summer before planting the strawberry crop; a further ploughing and the subsequent cultivation should bring the ground into good condition for planting. Thorough cultivation before planting does much to firm and level the ground as well as to control weed growth.

Strawberries frequently do well after a late spring vegetable crop which has been well fertilized and regularly cultivated during the growing period. The preparation of such land is comparatively easy.

On shallow or badly drained soils, it may be necessary to plant on raised beds.

FERTILIZING.

Fertilizing practices depend largely on the cropping history of the land. On a soil which is rich in organic matter and has previously grown a heavily fertilized crop, only a light basal dressing is necessary. Where practicable, however, a heavy dressing of farmyard manure should be applied to the soil a few weeks prior to planting. Farmyard manures should be supplemented by a preplanting dressing of a complete fertilizer mixture approximating 5:13:5.

When farmyard manure is not available, commercial fertilizers may be used as a preplanting dressing on well-prepared ground containing a reasonable amount of organic matter. A heavy basal dressing is necessary and amounts of from 15 cwt. to 1 ton per acre are not excessive. A 5:13:5 mixture containing a fair proportion of blood and bone is suitable for most soils. Strawberries may also respond well to basal fertilizer dressings rich in potash. On the red-brown loams which rapidly "fix" a large part of the phosphoric acid and thus make it unavailable to the plants, the fertilizer should be spread in a narrow band about one foot wide along the row which is to be planted and cultivated into the soil about 10 days prior to planting.

Topdressings of fertilizer are usually needed during the growing period. The first topdressing is applied when flowering begins and this is followed by further dressings, the number of which depends on the appearance of the plants and the size of the fruit. About 1-1½ cwt. per acre of a water soluble fertilizer such as a 5:14:5 mixture is needed at each top dressing. Topdressings rich in potash frequently improve the quality of the berries, particularly in soils in which this element is low in supply; a 4:13.5:12 mixture is suitable for this purpose. Straight nitrogen fertilizers such as sulphate of ammonia should be used with caution as they may cause excessive leaf growth, delay in the maturing of early fruit, and lack of firmness in the fruit. Topdressings are applied at the sides of the plant row in such a way that no fertilizer comes in contact with the fruit or leaves. In order to avoid any risk of burning, the plants should be irrigated after each topdressing whenever practicable.

ESTABLISHING THE CROP.

Strawberries are grown in Queensland as an annual crop and it is only on rare occasions that the parent plant remains in the ground for a second year. This practice is largely brought about by the difficulty of controlling weeds during the wet summer months but quite apart from this, the fruit from a ratoon crop does not compare either in size or quality with that from a plant crop. Annual planting is, therefore, sound practice.

Planting Material.

Planting material is usually obtained from a selected area reserved from the previous crop for runner production. Provided they are well looked after, about 1,500 plants yield enough runners to plant one acre. It is particularly important that the plants should be vigorous, true to type and free from disease, for runners from undesirable mother plants produce a most unsatisfactory crop. Severe rogueing should therefore be carried out in the runner bed. Diseased and backward plants must be destroyed as soon as they are detected in the field. Off-type plants which are bearing fruit can be clearly marked and then chipped out as soon as picking is finished.

To encourage the production of sturdy, well-rooted planting material (Plate 183), the runner bed must be regularly cultivated and, if necessary, watered. A light topdressing of fertilizer when the runners first appear in December is required. Weeds grow rapidly at this time of the year and they should be controlled before the runners spread out between the rows. Runners growing in competition with weeds and shaded by them are weak and frequently wilt when they are transplanted. Furthermore, runners from a weed infested bed may carry weed seeds to the new area and offset the work carried out in preparing the ground.

Prior to removing the runners, the beds should be well watered to facilitate digging. In order to avoid injuring the plants, it is best to commence digging the runners at some given point and work through the area on a face. The runners are lifted carefully and separated from each other with a small trowel or a strong-bladed knife, the roots being trimmed to about three inches and all broken and dead leaves removed (Plates 184 and 185). A few of the older leaves also may be removed to lessen transpiration after planting, but excessive leaf pruning is undesirable as the plants may take a long time to become established. After trimming, the runners should be placed either in a bucket containing a little water or between wet bags, and protected from both wind and sun. As far as practicable, no more runners should be dug than can be replanted on the same day.

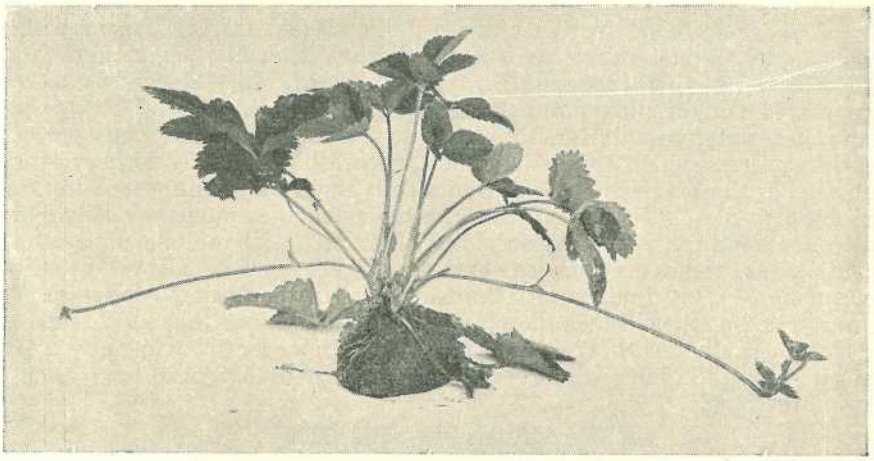


Plate 183.

Strawberry Plant with New Runners. Runners first appear in December and each plant may provide 10 to 15 suitable runners.

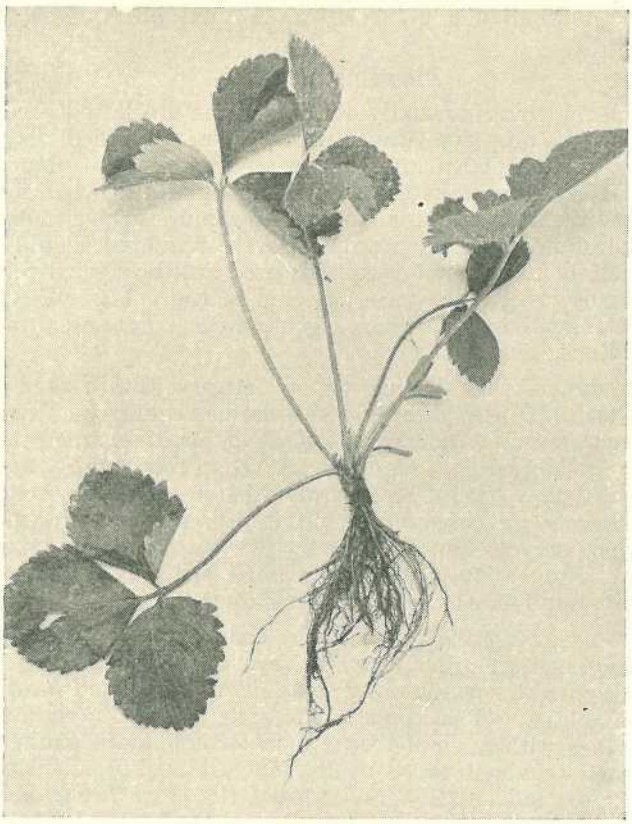


Plate 184.

A Strong Healthy Runner Suitable for Planting, before Trimming.

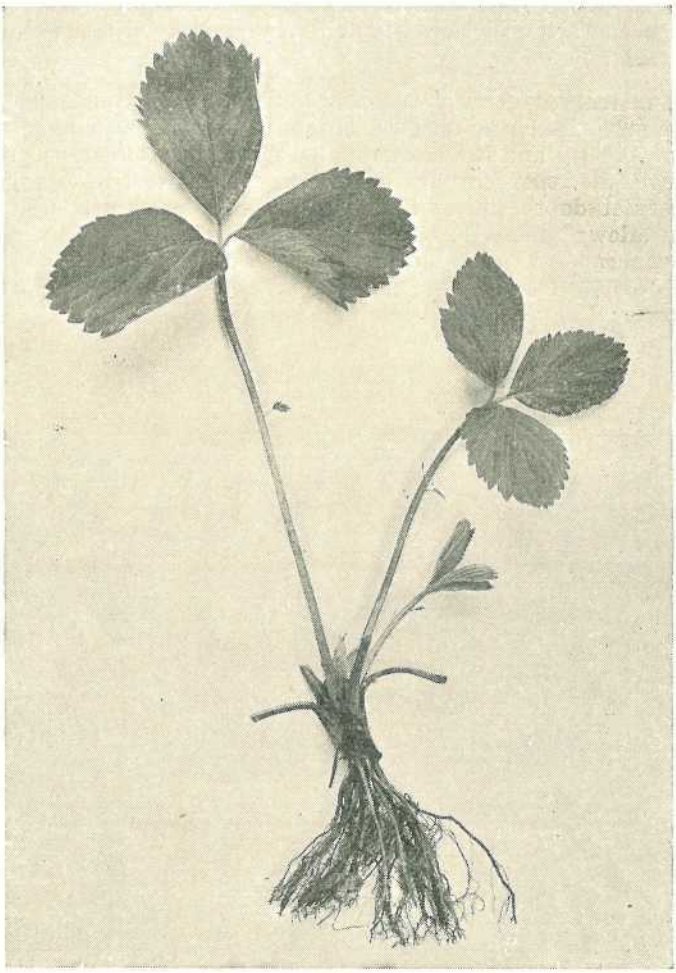


Plate 185.

Runner Trimmed for Planting. The roots are shortened where necessary and broken and damaged leaves removed.

Only healthy runners with a good root system and a well-developed crown should be planted. The older plants—that is, the first and second on each runner—are often preferred as planting material but it is a difficult and tedious job to sort them out. In any case, the crop grown from such plants seldom bears earlier than a crop grown from sturdy plants roughly graded for size prior to planting.

Planting.

The strawberry crop is planted in March, but in a mild autumn planting may continue until early April without affecting the bearing period to any great extent. Planting in February for a very early

harvest is hazardous as the crop is difficult to establish in hot weather, particularly where irrigation is lacking or water is improperly used. Furthermore, crops which are planted very early tend to make excessive leaf growth.

Care in transplanting is essential and the runners must be set with the crown just above ground level (Plate 186). If they are set too low, the crowns silt up and the plants die or make unsatisfactory growth; if set too high, the roots may dry out. It is difficult to transplant runners at the correct depth unless the land has been well prepared for the crop and allowed to settle before the surface is levelled by raking or some other means. When planting, a wire is stretched along the row and the plants are set alongside it; the straight rows obtained in this way are easy to cultivate by tractor, horse and hand implements.

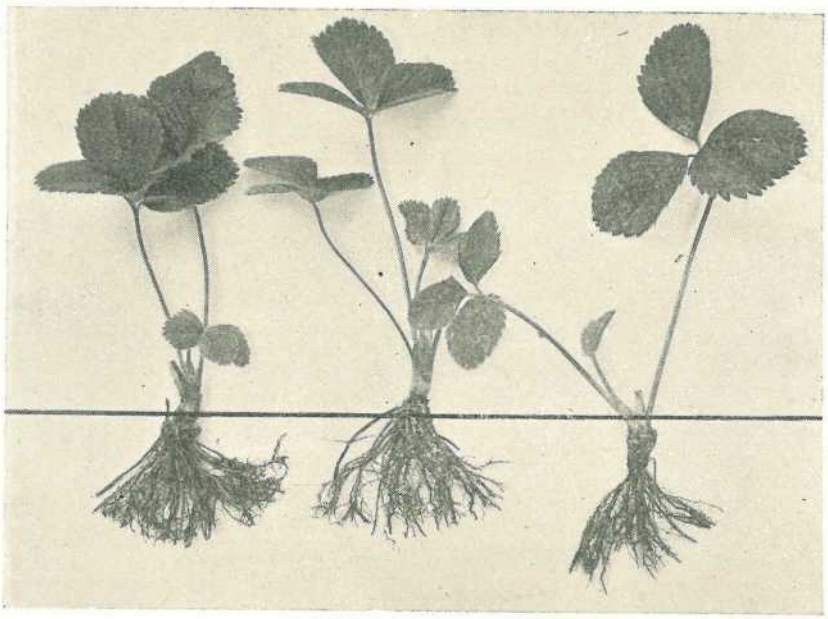


Plate 186.

Depth of Planting. Left—correct; centre—too shallow; right—too deep.

Each planting hole is made by hand or trowel and should be large enough to take the plants, which are set at the correct depth with the roots well spread out. The soil is then firmed around the roots, care being taken to prevent dirt getting into the crowns. As soon as possible after transplanting, the crop should be irrigated or watered in by hand. Planting out is best done in the afternoon.

Strawberry runners may be planted in single or double rows. Single row planting is practised on most farms owing to the ease of cultivating the crop and harvesting the fruit (Plate 187). The number of plants per acre in a single row crop is less than in a double row crop, but this

is not an important consideration on most commercial areas. Double row plantings take approximately 40 per cent. more runners than the same area planted in single rows, but tractor and horse implements cannot be used and all cultivation must be done by hand hoe.

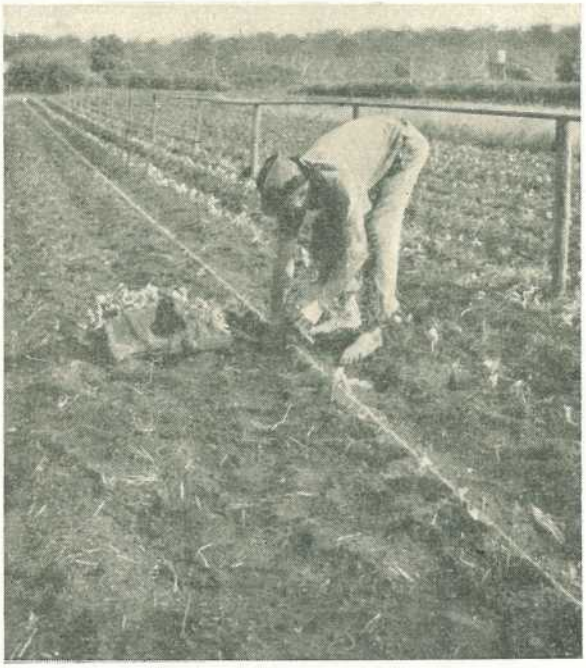


Plate 187.

Planting Strawberries. Note young plants covered with wet bagging and set out along straight planting line.

Planting distances vary according to the implements in use but common spacings for single row plantings are 2½ feet between rows and 15 inches between plants in the row. For double row plantings the best spacings appear to be 3½ feet between the centres of adjacent pairs of rows with 15 inches between the two rows in each pair and 15 inches between plants in the row. The numbers of plants required per acre are shown in Table 1.

TABLE 1.

STRAWBERRY PLANTS PER ACRE.

Single Row Planting.

Distance between Rows.	Distance between Plants.	Number of Plants.
	Inches.	
2 ft. 6 in.	12	17,424
	15	13,939

Double Row Planting.

From Centres of Double Rows.	Distance between Rows.	Distance between Plants.	Approximate Number of Plants.
	Inches.	Inches.	
3 ft. 6 in. ..	15	12	25,000
		15	20,000

MANAGEMENT IN THE FIELD.

Cultivation between and in the rows is necessary to control weed growth. As the strawberry is not a deeply rooted plant, only shallow implements can be used. A dutch or flat hoe is suitable for close work between the plants and small hand cultivators fitted with hoe attachments are generally used in the rows (Plates 188 and 189). Tractor and horse cultivators should be fitted with duck-foot tynes to ensure shallow working. When chipping by hoe, care must be taken not to pull soil away from the plants, and conversely not to lift soil into the crowns.

Plate 188.

Small Hand Cultivator, Fitted with Sweep Type Hoe Attachment.

Plate 189.

Hand Cultivator in Use.

Irrigation.

Irrigation is highly desirable for the strawberry crop as the plants quickly react to dry weather, particularly during the cropping period. Lack of soil moisture is soon followed by a reduction in both fruit size and quality.

On the red-brown loams and some other open types of soil, it is difficult to grow strawberries without irrigation. Water is usually applied by an overhead system such as the Skinner system, which appears to be the most suitable for the crop. Occasional heavy waterings should keep the plants growing satisfactorily until harvesting begins. From then on, about 30 to 50 points is applied at intervals of three or four days. The amount required varies with the soil type but sufficient should be used to keep the plants in full production. Some splashing of the fruit is unavoidable, but the fruit can be washed in the picking trays when it is harvested and allowed to drain in the packing shed.

Mulching.

Mulching is useful in controlling weed growth, conserving moisture in the soil and keeping the fruit free from dirt, including that which is splashed up from the surface of the ground by rain or irrigation water. On the other hand, a mulch may aggravate damage to the fruit from certain ground-frequenting insect pests. Materials used for mulching are oak-leaves, blady grass and tan bark. All of these, if spread around the plants to a depth of an inch for about six to eight inches on each side of the row, soon settle down to a good firm mulch. The mulch does not interfere with topdressings, as the soluble fertilizer used for this purpose quickly passes into the soil.

Sawdust is unsuitable as a mulching material for strawberries as it sticks to the ripe fruit and is difficult to remove when the crop is harvested.

HARVESTING.

Strawberries should be picked for the fresh fruit market when they are about three-quarters coloured. Factory fruit may be allowed to develop full colour, as at this stage the stems are easily removed. To handle the crop successfuly, daily picking during the main part of the season is often necessary and rarely is it possible to allow picking to extend further than every second day.

The fruit is picked into trays and sorted into first class and factory grades in the field during harvesting. Sizing is carried out in the shed, where the strawberries are packed into 8 in. x 4 in. x 1¼ in. boxes in single layers of threes, fours or fives for the fresh fruit market. Special containers holding approximately 14 lb. are used for factory consignments.

INTERSTATE TRADE IN FRUIT AND VEGETABLES.

Statistics of interstate movements of horticultural products during 1950-51 show that exports from Queensland included 426,991 cases of pineapples, 103,435 cases of bananas, 31,305 cases of mangoes, 262,397 bags of pumpkins, 114,645 cases of beans, 66,500 cases of cucumbers, 479,697 cases of tomatoes, and many thousands of packages of other produce.

TUBERCULOSIS-FREE CATTLE HERDS.
(AS AT 19th NOVEMBER, 1951.)

Breed.	Owner's Name and Address of Stud.
Aberdeen Angus ..	The Scottish Australian Company Ltd., Texas Station, Texas F. H. Hutton, " Bingegang," Dingo
A.I.S.	F. B. Sullivan, " Fermanagh," Pittsworth D. Sullivan, " Bantry " Stud, Rossvale, *via* Pittsworth W. Henschell, " Yarranvale," Yarranlea Con. O'Sullivan, " Navillus Stud," Greenmount H. V. Littleton, " Wongalea Stud," Hillview, Crow's Nest J. Phillips and Sons, " Sunny View," Kingaroy Sullivan Bros., " Valera " Stud, Pittsworth Reushle Bros., " Reubydale " Stud, Ravensbourne H. F. Marquardt, " Chelmer," Wondai W. G. Marquardt, " Springlands," Wondai A. C. and C. R. Marquardt, " Cedar Valley," Wondai A. H. Sokoll, " Chelmsford," Wondai
Ayrshire	L. Holmes, " Benbecula," Yarranlea J. N. Scott, " Auchen Eden," Camp Mountain " St. Christopher's and Iona " Studs, Brookfield Road, Brisbane
Friesian	C. H. Naumann, " Yarrabine Stud," Yarraman J. F. Dudley, " Pasadena," Maleny
Guernsey	C. D. Holmes, "Springview," Yarraman
Jersey	W. E. O. Meier, " Kingsford Stud," Rosevale, *via* Rosewood J. S. McCarthy, " Glen Erin Jersey Stud," Greenmount J. F. Lau, " Rosallen Jersey Stud," Goombungee G. Harley, Hopewell, Childers Toowoomba Mental Hospital, Willowburn Farm Home for Boys, Westbrook F. J. Cox and Sons, " Rosel " Stud, Crawford, Kingaroy Line R. J. Browne, Hill 60, Yangan P. J. L. Bygrave, " The Craigan Farm," Aspley A. Verrall and Sons, " Coleburn Stud," Walloon R. J. Crawford, " Inverlaw Jersey Stud," Inverlaw, Kingaroy P. H. F. Gregory, " Carlton," Rosevale, via Rosewood E. A. Matthews, " Yarradale," Yarraman A. L. Semgreen, " Tecoma," Coolabunia G. & V. Beattie, " Beauvern," Antigua, Maryborough L. E. Meier, " Ardath " Stud, Boonah A. M. and L. J. Noone, " Winbirra " Stud, Mt. Esk Pocket, Esk

PLANT PROTECTION

Phoma Rot of Tomatoes.

J. C. JOHNSON, Assistant Pathologist, Science Branch.

THIS disease was first recorded in Queensland in 1926, and though usually regarded as being of minor importance, it may become a serious problem to tomato growers during seasons of high rainfall. Under such conditions it may prove to be the most serious cause of fruit wastage, both in the field and during transit to the market. The causal agent is the fungus *Phoma destructiva* Plowr., which is a wound parasite gaining entry through injuries present on the surface of the fruit.

Symptoms.

On the fruit, infection occurs frequently at the stem end, where it causes sunken lesions not unlike those caused by target spot (Plate 190). In this case the fungus enters through the stem scar. Fruit showing ring or star cracking is particularly susceptible, while roughly handled or hail damaged fruit may become infected on all surfaces (Plates 191 and 192). It is this last type of infection which causes the greatest amount of transit loss, since the others are more often encountered at the time of harvesting, when they are rejected.

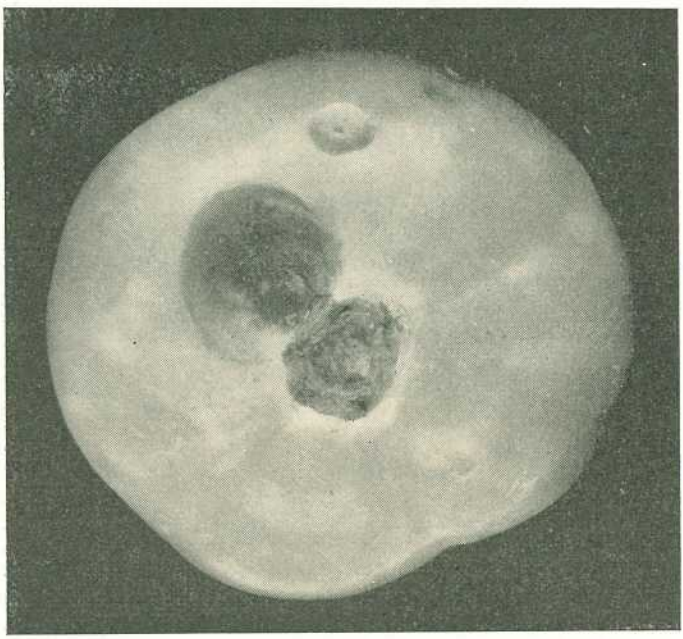


Plate 190.

Phoma Rot of Tomato. Stem end infection.

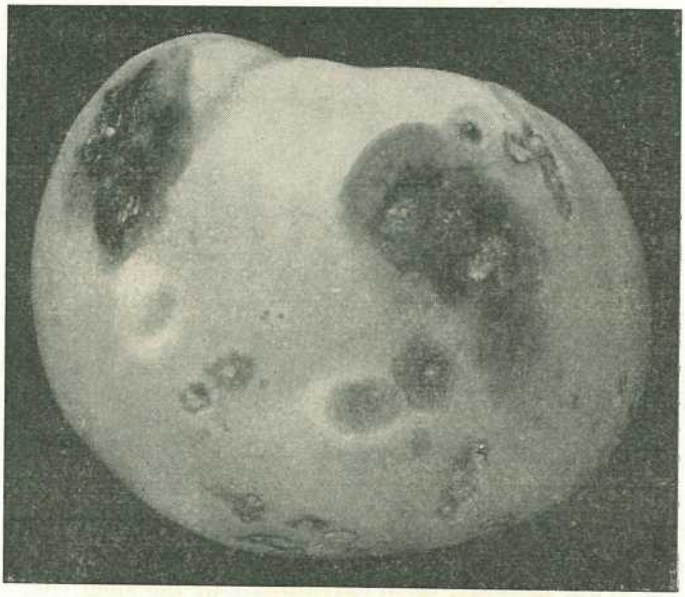


Plate 191.

Phoma Rot of Tomato. Transit rot produced by careless harvesting or packing. Note damaged skin of fruit.

Plate 192.

Phoma Rot of Tomato. Infection following hail damage.

The small circular spots as they first appear on the ripening fruit are usually somewhat depressed and show little discolouration of the underlying tissue. A close examination of the larger lesions, especially when held towards the light, will reveal the presence of numerous minute erupting spore-producing bodies in the centre of the diseased area. The pimpled appearance which this gives to the lesions is a

distinguishing feature and one from which the older name of pimply rot was derived. The infected tissue usually later becomes dark and sunken, but this is not always the case, for under certain conditions large infected areas may occur and be neither sunken nor dark. The pimply appearance is, however, a constant feature of the disease. The invaded tissues remain quite firm unless invaded by other soft rot organisms.

The fungus is able to grow and produce an abundance of spores on dead tomato leaves which often accumulate under older plants. In periods of exceptionally high rainfall, the leaves, leaf stalks and stems of the growing plants may also be attacked, and large dark lesions showing concentric ring markings are produced. These symptoms are again very similar to those produced by target spot.

Control Measures.

The amount of fruit wastage in the crop depends largely upon what precautions are taken right through the growing period. Residues from previous crops should be destroyed by raking and burning, or by some other means. Seed-beds should not be located near packing sheds or where diseased and discarded fruit from previous crops have been allowed to accumulate. The regular application of copper dusts or sprays, both in the seed-bed and in the field, will also serve as a form of protection. Where dead leaves accumulate under the plants, the fungus is able to build up a reservoir of infection from which the spores are conveyed to the fruit, and these should therefore be removed where possible. This practice should not prove difficult in staked or trellised crops.

Since infection takes place through skin wounds on the fruit, care should be taken to ensure minimum injury during harvesting and packing operations. This should include regular inspection of picking tins, packing benches and graders for likely causes of fruit injury, and the use of protective felt or soft sacking surfaces wherever possible. After harvesting, fruit should be kept in a dry place until it can be marketed.

Dairy Building and Equipment Competition, 1951.

R. A. PAUL, Director of Field Services, Division of Dairying.

THE above competition was designed and conducted by officers of the Dairying Division and financed from the Commonwealth Dairy Industry Efficiency Grant.

A total of 400 points was allotted for the competition, divided into two main sections and various sub-sections as follows:—

Section 1.	Points.
1. Dairy Buildings	100
2. Site of Premises	30
3. Water supply at Premises	30
4. Yards	30
5. General overall design	10
	200

Section 2.	
1. Cow preparation and milking facilities	80
2. Straining, Separating and Cooling	60
3. Cleansing, Sterilizing and Storage	60
	200
Total	400

The dairying districts of the State were divided into eight zones and prize money amounted to £50 in each zone, with a proviso for any or all of the prize money to be withheld if the judges considered the entries to be of insufficient merit to warrant award.

Prizes were—

First	£30
Second	£12
Third	£8

A total of 76 entries was received and competition was keen in all zones with the exception of the Warwick zone, where one entry was received and a second prize only was awarded.

It is the intention in this article and another in a subsequent issue, by illustrations and descriptive matter of some of the winning entries, to bring to the notice of dairymen the most up to date developments in dairy building and equipment design and operation, as a means of encouraging more efficient milking management.

ZONE 1 PRIZE WINNERS.

Zone 1 (judge, Senior Dairy Adviser C. L. Moran) included the districts of Dairying Division officers stationed at Ipswich, Esk, Beaudesert, Laidley and Boonah. Six entries were received and the prize winners were:—

1st—A. McDougall, Veresdale, with a total of 364 points out of a possible 400 points.

2nd—T. & E. Vayro, Helidon, with a total of 338 points out of a possible 395 points.

3rd—Mrs. Hilda A. Raabe, Gatton, with a total of 325 points out of a possible 395 points.

The building owned by Mr. McDougall is situated on the crest of a hill with three-way drainage, and faces north to gain the advantage of the prevailing cool breezes in summer and the maximum amount of sunlight in winter. The exterior of the shed is weatherboard, painted white, constructed on an 18-inch high concrete wall. Bails are lined with tongued and grooved hardwood enamelled pale blue, which makes for easy cleaning and gives a very cool appearance. The shed is ceiled to eliminate dust and the cobweb nuisance.

From the ground plan (Plate 193) and Plate 194 the general layout of the premises can be seen. The area directly in front of the shed is laid out in bananas, papaws, &c., while the back and eastern side is in lawn, the whole giving a large stock-free area away from the milk storage section.

The bails are of tubular steel and a four-unit milking machine is installed. The engine room also houses the sterilizer. The separator and wash-up rooms are lined with masonite enamelled white, and provided with louvred windows for ventilation and light.

The milk is cooled over a surface cooler and stored in a refrigerator. Plate 195 shows this equipment and also the hoist used to place the cans in and out of the refrigerator and on to the trolley for conveyance to the milk lorry shown in Plate 196. The slope of the land is such that the milk cans slide from the trolley to the table of the truck, thus obviating any lifting.

Ample rain water is available from four 1,000 gallon tanks, while dam water is also laid on for washing of floors, &c., and to provide stock water at the yards. As the plan shows, the spraying crush, isolation yard and feeding stalls are conveniently placed. Drainage from the shed and yards is excellent and taken well away from the shed area.

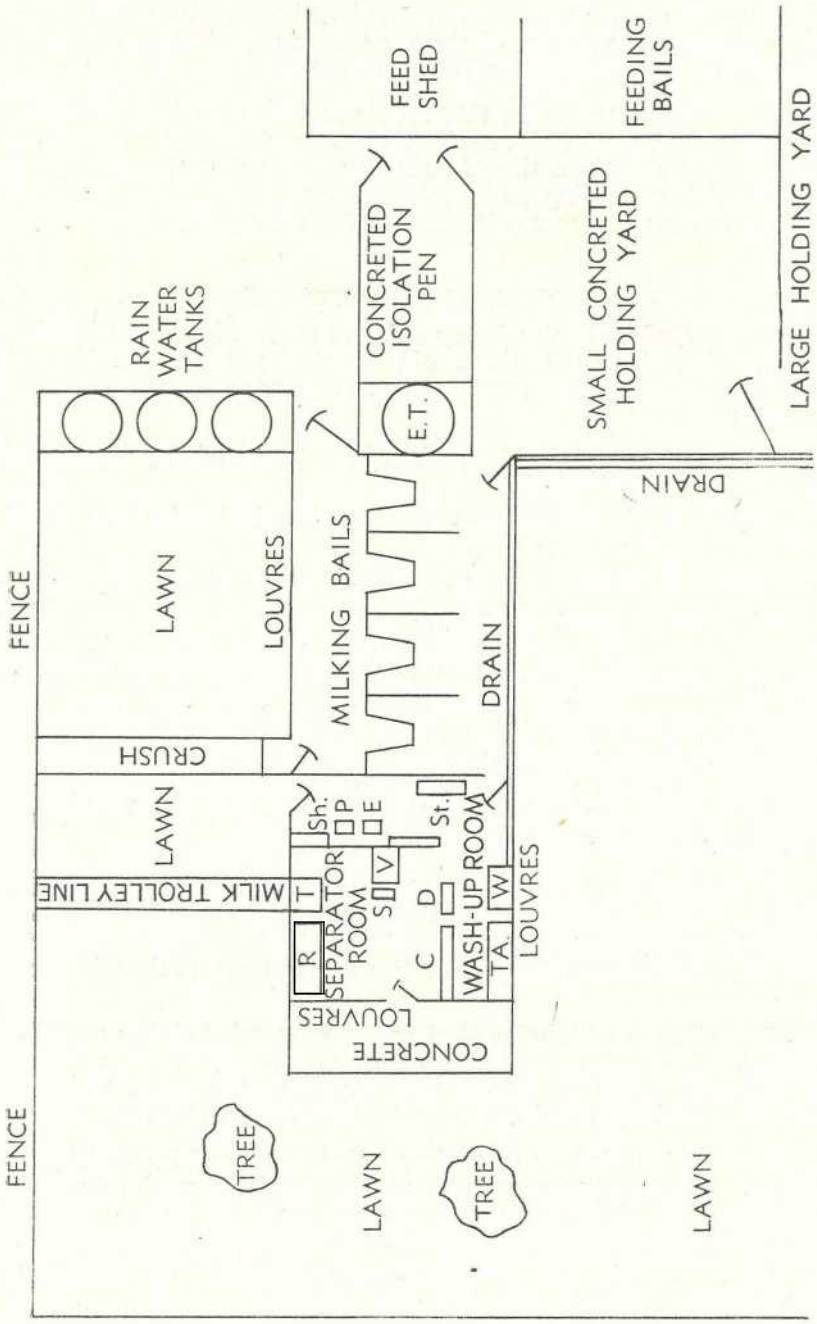


Plate 193.

Ground Plan of Premises and Surroundings—Mr. A. McDougall, Veresdale.
C, can rack; D, draining rack; E, engine; E.T. elevated tank; P, pump; R, refrigerator; S, separator; Sh., shelf; St., sterilizer; T, trolley; TA, table; V, milk vat; W, wash-up trough.

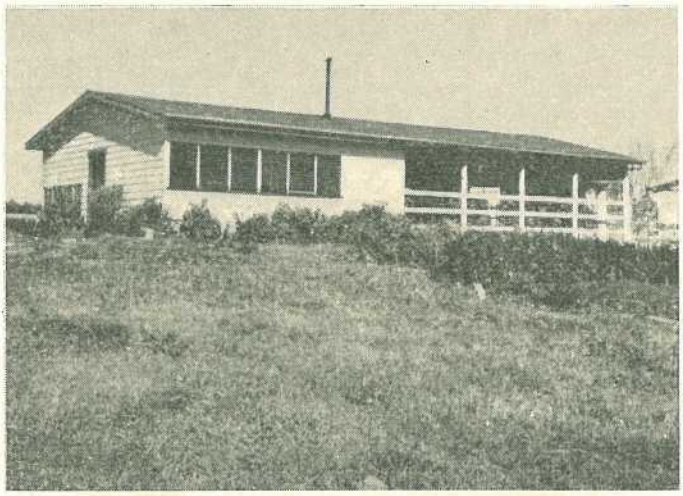


Plate 194.
View of Building—Mr. A. McDougall, Veresdale.

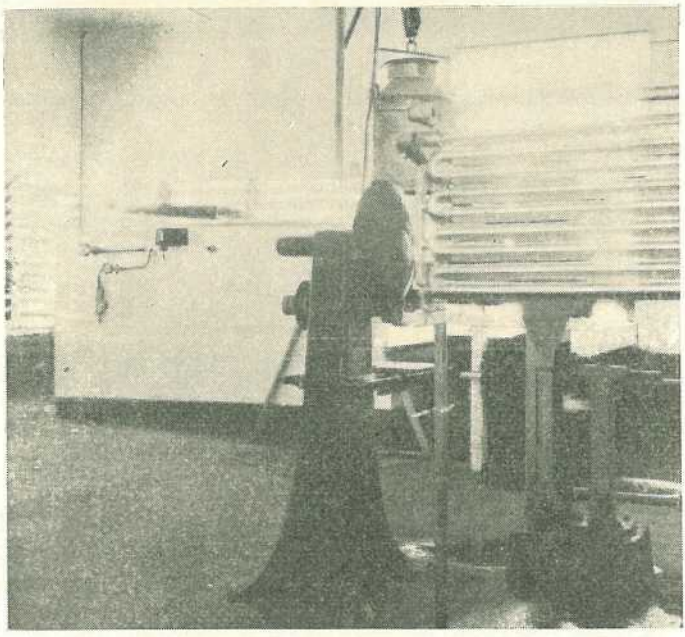


Plate 195.
Cooling and Refrigeration Equipment—Mr. A. McDougall, Veresdale.

The building of the second prize winners, T. and E. Vayro, has been erected a little over 12 months. It is the combined dairy building type with walk-through bails and is substantially constructed. It is painted and houses a four-unit milking machine, engine, sterilizer, wash-up troughs, racks and benches.

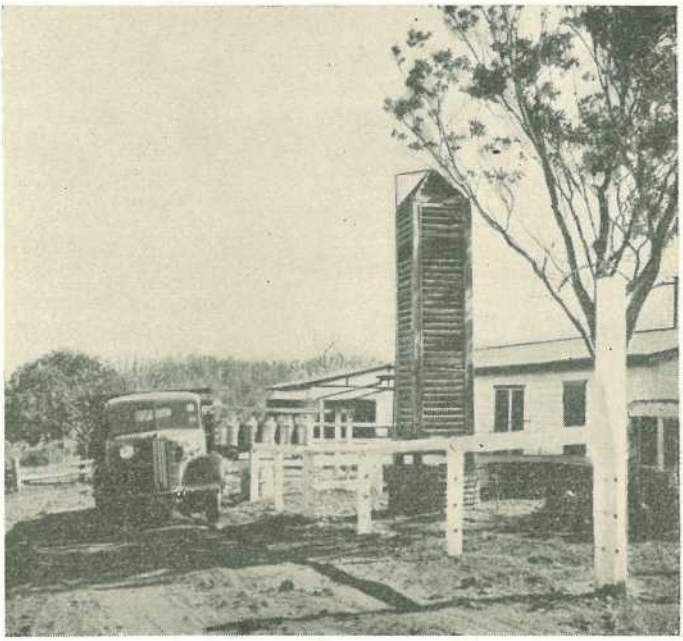


Plate 196.
Milk Being Loaded at the Farm of Mr. A. McDougall, Veresdale.

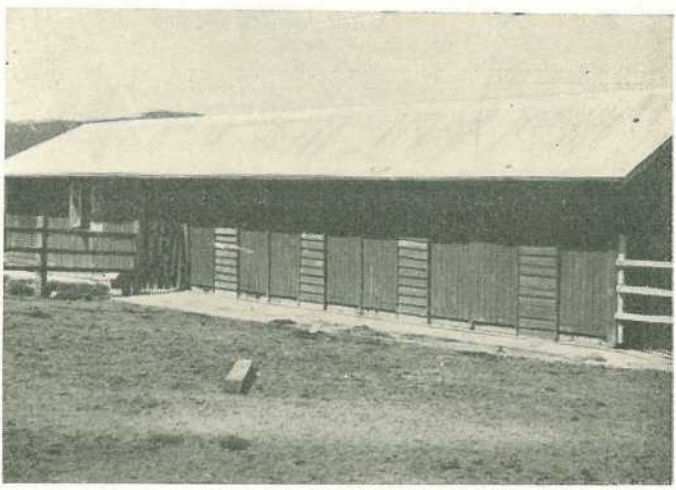


Plate 197.
Premises of T. and E. Vayro, Helidon.

The bails and yards are very well drained and water supply is adequate, but no provision has been made for a stock-free area or for shade and water for stock at the yards.

Plate 197 gives a general view of the buildings.

ZONE 2 WINNERS.

Twenty-five entries were received in Zone 2, which embraced the districts of Dairying Division officers stationed at Brisbane, Caboolture and Southport, and these were judged by Senior Dairy Adviser V. J. Brimblecombe. Due to the keen competition and merit of the top entries, the judge made the recommendation that extra prizes be awarded. This was agreed to and the following prizes were awarded:—

—	Judging Points.	Points Scored.	Percentage.
1st—Mrs. J. Robinson, Southport	380	335	88·16
Equal 2nd—C. W. Pope, Samford	395	347	88
Equal 2nd—A. W. Houghton, Samford	395	347	88
Equal 3rd—Webb Bros., Woodford	400	344	86
Equal 3rd—Misses H. and D. Storey, Logan Village ..	395	339	86

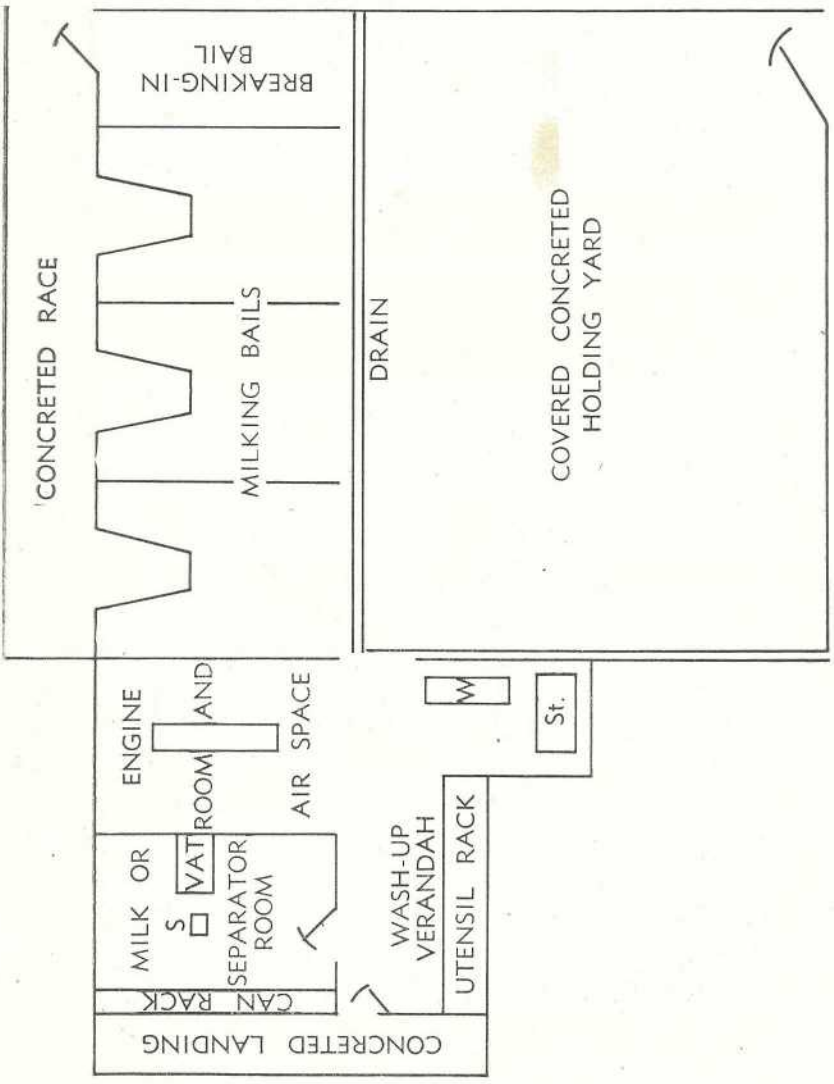


Plate 198.

Ground Plan of Premises—Mrs. Juila Robinson, Southport.

S, separator; St., sterilizer; W. wash-up trough.

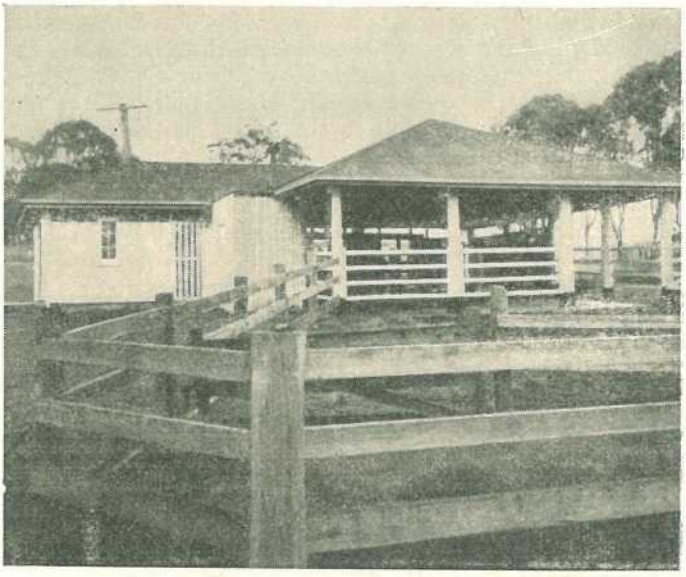


Plate 199.
General View of Buildings and Yards—Mrs. Julia Robinson, Southport.

Plate 200.
Rear View of Shed—Mrs. Julia Robinson, Southport.

The general layout of the buildings and yards of the first prize winner is shown by the ground plan in Plate 198.

The bails are of the walk-through type with side gates leading to a fenced concrete race which takes the cows away from the treatment and storage end of the buildings. A feature of this shed is a special breaking-in bail for heifers, which can also be used for hand milking if desired.

The whole structure is on concrete curbings, and is well ventilated and painted white inside and out. An extension of the wash-up room houses the sterilizer and an outside concrete strip runs the full length of the end of the milk room.

In Plate 199 can be seen the high gable roof covering the concreted holding yard, while Plate 200 gives a view of the rear of the shed with the exit gates and race.

The building and yards are located on a well drained slope with a north-easterly aspect. An adequate stock-free area is provided, water supply for cleansing and stock purposes is drawn from the town main, good open concrete drains are provided and a belt of natural trees at the site provides shade and shelter.

The buildings of the equal second prize winners are very similar in design and the ground plan in Plate 201 gives the layout on the property of Mr. C. W. Pope.

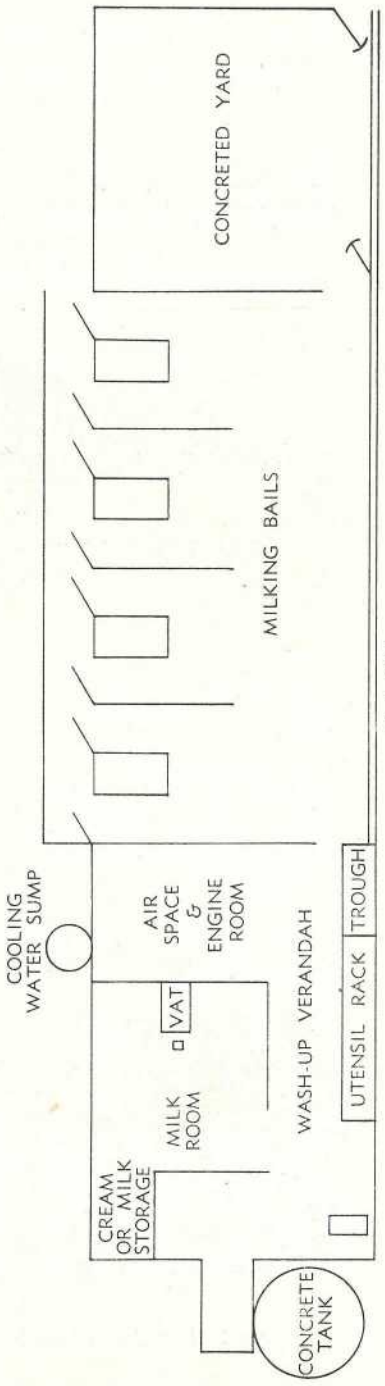


Plate 201.

Ground Plan of Shed—Mr. C. W. Pope, Samford.

The walls of this building are on concrete curbings, but the internal posts are in the cement. The dummy bails are suspended, thus making for ease in cleaning.

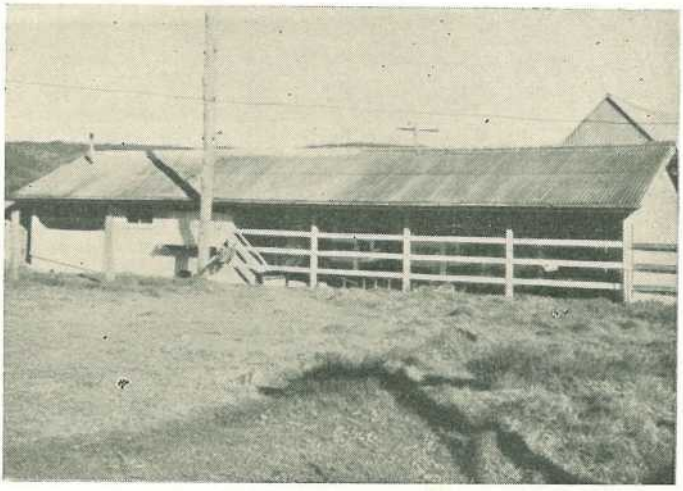


Plate 202.

General View of Building—Mr. C. W. Pope, Samford.

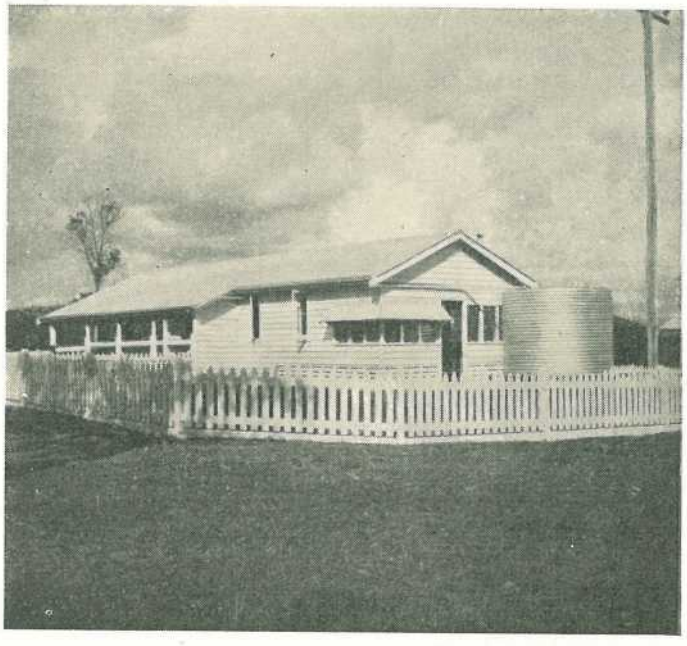


Plate 203.

General View of Building—Messrs. Webb Bros., Woodford.

The separator room is lined and the whole building painted white inside and out, giving a very attractive appearance. Provision of a stock-free area would be an improvement.

Plate 204.

View of Building—Messrs. Webb Bros., Woodford.

Plate 202 gives a general view of the building from the front looking into the bails. The buildings and yards are well positioned on sloping ground with an E.N.E. aspect. Drainage is excellent and ample water is available, from rain water tanks and an elevated tank supplied from a creek, for cleaning and stock purposes.

Plates 203 and 204 give general views of the buildings of Messrs. Webb Bros., showing a well constructed, attractively painted, gable-roofed crush type shed. The low white picket fence keeps the stock well away from the treatment end of the building, which features bottom ventilation on two sides and glass louvres shaded over to prevent the sun's rays from entering the room.

[TO BE CONTINUED.]

CHANGE OF ADDRESS.

Journal subscribers notifying change of address should state their full Christian names and surname as well as their full former and new addresses.

Address all communications to the Under Secretary, Department of Agriculture and Stock, Brisbane.

ANIMAL HEALTH

Parasitic Worm Diseases of Cattle.

P. J. O'SULLIVAN (Parasitologist, Animal Health Station, Yeerongpilly.)

(*Continued from page 304 of the November issue.*)

NEMATODES OR ROUND WORMS.

These are elongate rounded worms and include some of the most serious parasites infesting livestock. They vary tremendously in size. In our cattle the largest species measure up to four inches in length and the smallest is less than a quarter of an inch long.

The sexes are usually separate—that is, there are male and female worms, the male being smaller. Some kinds of roundworms require an intermediate host to complete their life cycle, as with the tapeworms and flukes, but the majority reproduce in the manner explained below.

The female worm lays her eggs, which are passed out in the manure. Under suitable conditions of temperature and moisture, the egg hatches to give rise to a tiny larval worm. This larval worm leads a free living existence, feeding on organic matter, bacteria, etc., in the dung and pasture. As development proceeds the larva moults twice, but during the second moult it retains its old larval skin as a protective sheath. This sheath gives the larva added protection against the effects of low temperature and dryness. The larva is now capable of infecting cattle. This "infective larva," as it is called, crawls up the grasses when they are wet with dew or rain and is thus available to the grazing animal.

Large Stomach Worm or Barber's Pole Worm (Haemonchus contortus).

This species (Plate 205) is found in the fourth stomach and is easily seen swimming free in the semi-fluid contents or adhering to the stomach wall when the contents are poured off. The female worm measures up to 1¼ inches in length and is red and white spirally striped; hence the name barber's pole worm. The spiralling is due to the white ovaries being wound round the straight red intestine. The male is smaller than the female and is uniformly pink in colour.

Life History.—The pre-parasitic phase of the life cycle of this worm follows the general pattern outlined above. When the infective larvae enter the host they cast their protective sheaths and burrow into the lining of the stomach and lie under a small blood clot. After a period of development they moult again and then leave the lining and enter the lumen of the gut and develop into adults by sucking blood from the walls. Eighteen to 20 days after ingestion the worms are mature and start laying eggs.

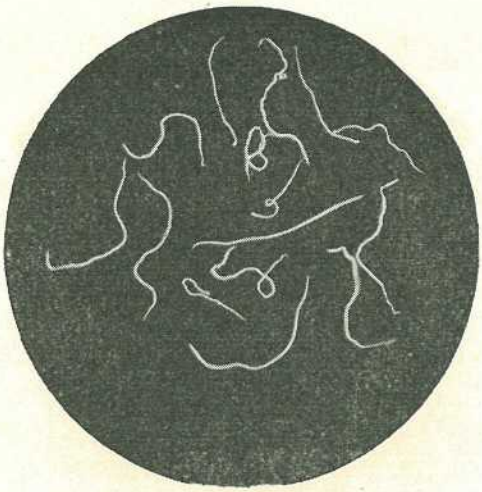


Plate 205.

Large Stomach Worm or Barber's Pole Worm (Haemonchus contortus).
Natural size.

Effect on Cattle.—The large stomach worm is the most serious parasite with which the cattle owner has to contend. Animals under 18 months old are chiefly affected and it is only rarely that adult animals are heavily parasitised by this species.

The worm is an active blood sucker and the effects of an infestation are principally those associated with loss of blood. The blood becomes thin and watery and the membranes of the eyes and mouth lose their healthy pink colour and become nearly white. The coat is dry and rough and a dropsical swelling develops under the jaw. Heavily infested animals rapidly lose condition and become weak. They show a disinclination to move about and stand in a dejected manner. The appetite usually remains good until shortly before death. Sometimes diarrhoea is profuse, particularly when many immature worms are present, but constipation may occur with mature infestations.

Brown Stomach Worm or Lesser Stomach Worm (Ostertagia ostertagi).

These are slender brownish worms (Plate 206), about half an inch long, which are found lying against the wall of the fourth stomach. Owing to their small size they can be easily overlooked. If the contents of the stomach are poured off and the walls washed lightly, the worms can be seen as fine brown streaks on the surface. They are generally most numerous near the opening of the stomach into the small intestine. A better method is to scrape the walls of the stomach and examine the scrapings in a glass dish held over a dark background.

Life History.—The pre-parasitic stages of the life cycle follow the general roundworm pattern. Following ingestion the larvae burrow into the walls of the stomach and lie coiled up in small, elevated, nodular areas. The lining of the stomach becomes inflamed and shows small pin-point haemorrhages. The larvae soon leave the nodules and continue their development on the mucosa.

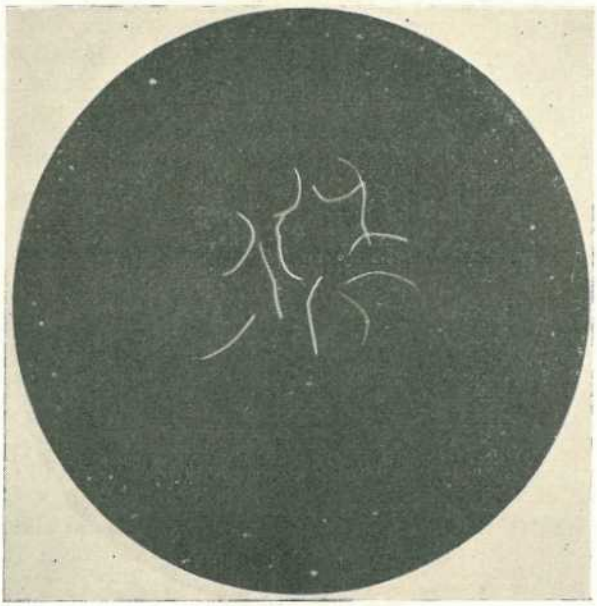


Plate 206.

Brown Stomach Worm or Lesser Stomach Worm (Ostertagia ostertagi). Natural size.

Effect on Cattle.—In many parts of the world the brown stomach worm is a serious parasite of cattle and may cause marked loss of condition, anaemia and diarrhoea. It is essentially a parasite of the cooler areas but is very common in southern Queensland. It may be sufficiently numerous on the Darling Downs to be pathogenic, or at least a contributing factor in outbreaks caused by other worms. Wet periods during the winter and early spring may lead to heavy infestation with these worms.

Plate 207.

Stomach Hair Worm (Trichostrongylus axei). Natural size.

Stomach Hair Worm (Trichostrongylus axei).

This is an extremely slender, reddish, hairlike worm (Plate 207) which rarely attains a length of more than a quarter of an inch. It is found in the fourth stomach in the same situations as the brown stomach worm. These worms are very fine and should be looked for in light scrapings from the walls of the stomach.

The life history differs only in small details from that of the larger stomach worm.

Though it is an important parasite of cattle in temperate countries such as England, it rarely becomes sufficiently numerous to be serious in Queensland. It is seen chiefly in the south-eastern areas and like the brown stomach worm may become important during wet winters.

Hookworm (Bunostomum phlebotomum).

This is a stout whitish worm (Plate 208) up to about an inch in length which occurs in the first few feet of the small intestine. The mouth of this worm is large and globular and has a number of teeth, by which it adheres firmly to the intestinal wall.

Plate 208.

Hookworm (Bunostomum phlebotomum). Natural size.

Life History.—The early part of the life history of the hookworm up to the development of the infective larvae in the pastures is similar to that of the stomach worms. Though some infection by the hookworm can occur when the larvae are swallowed, it most usually takes place by the larvae boring through the animal's skin. This can happen when any part of the animal's body comes in contact with soil or faeces containing hookworm larvae. Having penetrated the skin, the larvae reach the blood vessels and are carried to the lungs, where they undergo a period of development and then travel up the windpipe to the mouth and are swallowed. In the intestine they grow to maturity and start producing eggs about two months after first entering the animal.

Effect on Cattle.—The mouth structure of the hookworm makes it a serious blood sucker. A piece of the intestinal lining is drawn into the large globular mouth capsule and the teeth at the base of the capsule lacerate the tissues and the worm feeds on tissue and blood.

The effects of the hookworm are very similar to those of the large stomach worm. There is rapid loss of condition, anaemia and bottle jaw develop, and the animal may suffer from a diarrhoea in which the excreta is dark in colour.

Hookworm infestations are very serious in calves and relatively few worms can cause well marked symptoms, particularly when there are large stomach worms and large bowel worms also present.

Treatment and Control.—Hookworms in cattle are resistant to the majority of the drenches commonly used. Phenothiazine, even in heavy doses, may not remove the hookworms from every animal. Tetrachlorethylene is useful provided the drench goes direct to the fourth stomach. Unfortunately, there is no guarantee that pre-drenching with copper or sodium salts will bring this about by closing the oesophageal groove (see note on anthelmintics in a later section).

Hookworm infestation in young calves is generally associated with crowding of animals in small muddy calf pens and yards. The mixture of mud and faeces makes a good medium for the development of the infective larvae and the adhering qualities of this mixture allows easy entry of the larvae through the skin of the calves. Low-lying swampy areas have the same effect as muddy yards and lead to heavy hookworm infestation in older animals or in beef herds.

At present the control of hookworms must be based on preventive measures. Calf pastures and pens should be on high ground away from damp, swampy or muddy areas. In these circumstances, calves run on an extensive system acquire only a very light infestation, which is actually beneficial. A calf is able to throw it off by natural means and develops a fairly strong immunity as a result. Once this occurs, the calf very rarely acquires a pathogenic hookworm infestation at a later date.

Heavily parasitised animals should be drenched with phenothiazine twice at an interval of 14 days, placed on a clean pasture and given good supplementary food. The drenching will remove the other pathogenic species present and possibly some of the hookworms. The prevention of re-infestation coupled with a high plane of nutrition gives the calves a chance to throw off the infestation by natural means. A third drench in another 14 days may be desirable, for hookworms take about two months to mature in the calf and immature stages of all worms are more resistant to drenches than adults.

Small Intestinal Worm (Cooperia spp.).

These are small pinkish worms (Plate 209) up to a third of an inch in length which infest the first part of the small intestine. They are somewhat stouter than the stomach hair worms and if scrapings are taken from the intestinal wall and examined in a glass dish held over a dark background, these small intestinal worms may be readily seen.

Life History.—Their life history is similar to that of the stomach worms, cattle becoming infested when they swallow the infective larvae.

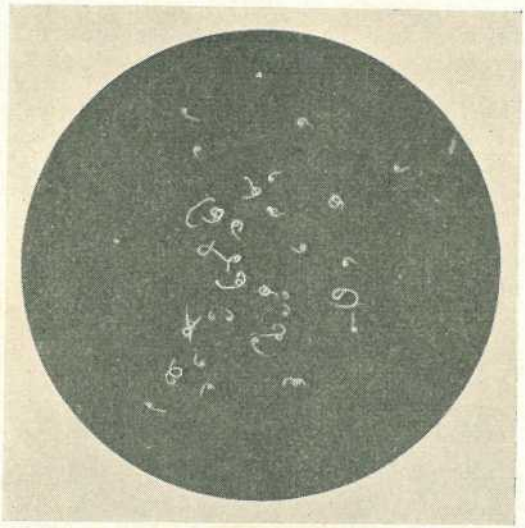


Plate 209.

Small Intestinal Worm (Cooperia spp.). Natural size.

Effect on Cattle.—Young calves are chiefly affected and may carry heavy infestation by the time they are three to four months old. However, the infestation is only temporary and is largely thrown off in two to three months.

In general, the worms are not considered pathogenic unless present in very large numbers. Anaemia is not a pronounced symptom nor is there any development of bottle jaw. Very heavy infestations have been associated with marked loss of condition and diarrhoea but it is suspected that many of these cases have some other complicating factor also present.

Treatment and Control.—These worms are resistant to phenothiazine, but treatment is rarely required. In cases of heavy infestation the calves should be drenched twice with phenothiazine at an interval of 14 days to remove other species of worms, allowing the calves to combat the small intestinal worms by natural means. Good supplementary feed and a change of pasture should also be provided. If the preventive measures outlined on page 362 are put into practice the animals are able to throw off their initial infestation without any symptoms developing.

Large Bowel Worm (Bosicola radiatus).

This is a stout, whitish worm (Plate 210) up to three-quarters of an inch in length which occurs in the first portion of the large bowel. The worms lie close against the bowel wall, sometimes burying their anterior ends into it and causing a conspicuous pitting.

Life History.—Larvae hatch from the eggs and develop in the manure in the usual way and then on being swallowed by cattle burrow deep into the intestinal wall, particularly of the large bowel or colon.

Later the worms return to the lumen of the large bowel, where they grow to maturity. Generally they reach maturity in five to six weeks after being swallowed, but the period may be considerably lengthened by the larvae being trapped in the bowel wall.

Effects on Cattle.—This worm is an extremely common parasite in Queensland, particularly in the coastal areas. When present in numbers in young stock, it causes anaemia, loss of condition and diarrhoea. The diarrhoea is a characteristic symptom, the dung being very watery and

Plate 210.

Large Bowel Worm (Bosicola radiatus). Natural size.

containing quantities of mucus. In very heavy infestations this mucus may be blood-flecked and may contain some worms. Large bowel worm infestations are generally complicated by concurrent large stomach worm and hookworm infestations.

The larvae when they burrow into the walls cause the formation of nodules. These are more conspicuous in older cattle and when in numbers may interfere with the movement of the bowel and so contribute to the general ill effects of an infestation. However, the nodule development is not so great as that caused by a similar type of worm in sheep.

In young stock heavy infestations with this parasite can be fatal, but should recovery occur the animal may remain stunted and unthrifty.

Whipworm (Trichuris spp.).

These worms resemble a whip (Plate 211); the anterior portion is long and slender like a lash and the posterior portion is short and stout like a whip handle. They are found in the caecum or blind gut, but occasionally, when a heavy infestation is present, extend a short distance into the large bowel.

The life cycle of this worm differs somewhat from that of the other roundworms. The eggs are passed out in the manure, and under favourable conditions a tiny larva develops inside the egg. However, the egg does not hatch until swallowed by an animal. The released larva then makes its way to the caecum, where it grows to maturity.

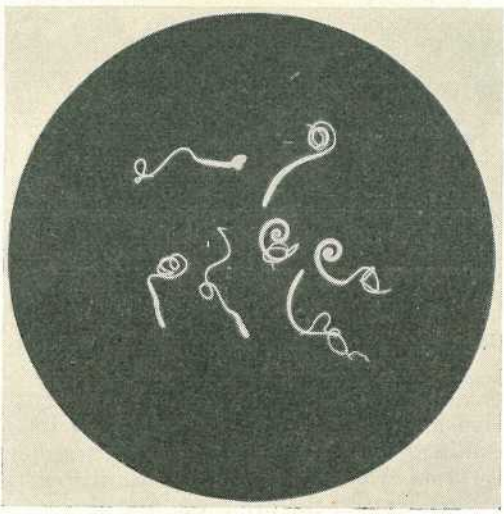


Plate 211.
Whipworm (Trichuris spp.) Natural size.

Though a common parasite of cattle, the whipworm is not considered harmful unless present in very large numbers. In Queensland this is a very rare occurrence.

No effective treatment is known and control rests entirely on preventive measures.

Lungworm (Dictyocaulus viviparus).

This is an elongate, slender, whitish worm (Plate 212) which grows up to three inches and more in length and is found in the small air tubes of the lungs.

Life History.—The eggs laid by the female in the lungs are coughed up and swallowed. On their way through the alimentary canal they hatch and the tiny larvae pass out with the droppings. Some eggs may be coughed out of the mouth in the sputum and saliva and hatch without passing through the animal.

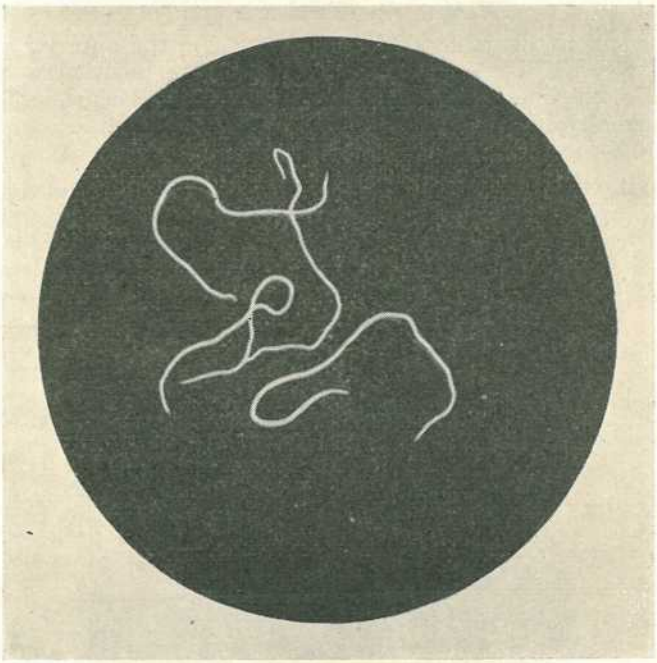


Plate 212.
Lungworm (Dictyocaulus viviparus). Natural size.

After the usual period of development on the pasture they arrive at the infective stage and reach the host by way of its food and water. Once inside the animal they bore through the intestinal wall and reach the lymph nodes from which they are eventually carried to the lung. Here they make their way to the air tubes and grow to the adult stage.

Effects on Cattle.—Lungworms can be serious in young calves. A few worms do little harm but when present in numbers they cause frequent coughing and difficulty in breathing. The animal becomes weak and listless and frequently suffers from diarrhoea. Bunches of worms are frequently coughed up in a quantity of bloodstained frothy material. Eventually the breathing rate becomes very rapid and the animal may die.

The main effects of lungworms are a mechanical blocking of the air tubes and an irritation that may lead to pneumonia.

Treatment and Control.—Lungworm disease of cattle is usually associated with two factors—poor nutrition and a heavy infestation of other worms. The following treatment is therefore indicated:—

(1) Remove affected animals from the pasture in which they have been running and provide them with warm quarters and nutritious feed.

(2) Drench twice with phenothiazine at an interval of 14 days. This drench has no direct effect on the lungworm but removes most of the other pathogenic species in the alimentary tract and enables the animal's resistance against the lungworms to be increased.

In most cases if these two measures are put into practice, outbreaks can be controlled.

The only other treatment available is an injection of drugs into the windpipe by means of a sterilized hypodermic syringe. However, this treatment is not always successful and is not recommended. The operation is not an easy one and should be carried out under the supervision of a Stock Inspector or some other experienced person. A formula employed is as follows:—

Turpentine	1 drachm
Glycerine	1 drachm
Chloroform	1½ drachms
Carbolic acid	10 minims

The general preventive measures outlined on page 362 if put into practice will do much to control lungworm. Special attention should be given to the avoidance of damp pastures for calves, as these favour the development and survival of lungworm larvae.

Beef Nodule Worm (Onchocerca gibsoni).

This is an extremely common parasite of cattle in Queensland. It is found in nodules, chiefly in the brisket and stifle regions. The nodules vary from the size of a pea up to something of the order of five inches in diameter. Each nodule contains a female and one or more male worms and if cut open these may be seen inside intricately tangled up in the tissues (Plate 213). The worms themselves are slender and very fragile. The female may measure up to 20 inches and more in length and the male up to four inches.

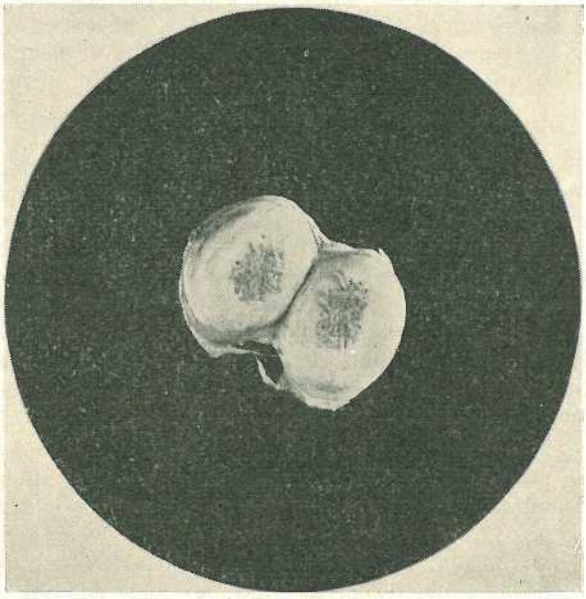


Plate 213.

Beef Nodule Cut Open to Show the Intricately Coiled Worm Inside.

Life History.—The life history has not been worked out in this country but studies in Malaya show that it is spread by certain species of sandflies. The eggs which hatch in the nodule give rise to tiny larvae known as microfilariae. These leave the nodule and are found in the lymph spaces in the skin. When these sandflies attack cattle they ingest the microfilariae, which then undergo a necessary part of their development in the sandfly. When an infected fly bites another bovine the larvae are liberated and eventually penetrate the host's skin. After moving around for some time they settle down in the brisket and stifle, and as a result of their presence here the tissues around them gradually form a nodule.

Effects on Cattle.—The beef nodule worm does not appear to be harmful in any way to cattle. The presence of nodules in the brisket is, however, not desirable and this portion of the carcase has to be boned and examined for nodules before being exported.

Control.—It is impossible to remove the adult worms from an animal and any control measures must be directed against the sandflies that spread the parasite. These tiny flies breed in a variety of situations, such as mud, rotting vegetation, manure heaps, etc., and under the conditions present in the areas where cattle become infested control of these flies does not appear at the present time to be feasible.

CONTROL OF PARASITIC DISEASES.

Under normal conditions it is impossible to maintain animals completely free from worms. Much can be done, however, to prevent these parasites from becoming sufficiently numerous to endanger the animal's health. Even when medicinal treatment is efficient it should never be relied upon as the sole means of keeping the infestation at a low level. This applies particularly to cattle, for unfortunately little is known of the efficiency of many of the drugs that have been used on them for the removal of worm parasites. The cattle owner should endeavour to use preventive measures as a means of keeping his stock healthy and to use medicinal treatment only as an adjunct to these measures.

Preventive Measures.

Preventive measures are designed to reduce the chances of the animals becoming infested. They are based upon a knowledge of the life histories of the worms and of the conditions in a pasture which favour the development and survival of worm eggs and larvae. The period spent outside the host is a "weak link" in the life cycle of a parasite and it is against this "link" that preventive measures are applied.

Everything possible should be done to reduce the chance of an animal picking up large numbers of infective larvae and thus becoming heavily parasitised.

Adult cattle are reasonably resistant to worms, while calves and yearlings are most susceptible. The younger animals should be given primary consideration when putting preventive measures into operation.

Calf Pen Hygiene.—Small calf pens, often used during the first few weeks of an animal's life, must be kept as clean and dry as possible, for they are often a source of heavy worm infestation, as well as other common calfhood diseases. The mixture of mud and faeces makes an ideal medium for the development of hookworm larvae, and as it adheres

very well to the feet and body of the calf, ingress of larvae through the skin is made easy. A mixture of mud and faeces from swampy areas may lead to hookworm infestation of older animals.

Rate of Stocking.—The stocking rate of young stock should be as light as possible. The more animals there are on a pasture the more the pasture becomes contaminated with larvae and the greater are the chances of an animal becoming heavily infested. In dairying districts a high stocking rate cannot always be avoided, but this can be compensated for by improved pasture to raise the standard of nutrition and by efficient management so that adequate spelling is possible.

In beef herds, local overcrowding of animals on creek frontages, gullies or damp areas has the same effect as overstocking, even though the overall stocking rate of the paddock may be low. Many outbreaks amongst beef weaners run on the extensive system have been associated with local overcrowding in the situations mentioned.

Calf Pastures.—Permanent calf pastures for calves and young stock should be avoided. The retention of animals for long periods in a small calf paddock leads to heavy contamination of the area with droppings and a resultant increase in the number of infective larvae available to the animal. These permanent calf pastures become eaten out and the animals are forced to graze closer to the ground and then the rate of intake of infective larvae is greatly increased. This applies even when supplementary feeding is practised. The animals are continually becoming infested but may not show clinical symptoms of parasitism until they receive some check later in life.

Any system of rotational grazing whereby a pasture can be used for 1-2 weeks and then spelled for 4-6 weeks is beneficial in preventing outbreaks of parasitism. The pasture can be grazed by horses while spelling, for the worms of horses do not affect cattle and vice versa.

Damp, low-lying and swampy areas should not be grazed by young stock for the moisture favours the survival of infective larvae. Swampy areas are an important source of food in dry times but the heavy faecal contamination these areas receive greatly increases the chances of gross parasitism. If these areas must be used it is advisable to carry out anthelmintic treatments at regular and frequent intervals before the young stock show symptoms of parasitism.

Nutrition.—Nutrition plays an important part in the prevention and control of worm parasites. Animals in good condition and receiving adequate feed are often able to throw off an infestation by natural means. This factor is used in the treatment of lungworms and hookworms, where drenching is not always successful. Animals on a high plane of nutrition are able to stand a moderate worm burden, but as soon as the nutritional plane is lowered they start to show the effects of worms. Outbreaks of parasitism are relatively few during a normal summer in Queensland when pastures are at their best, but during the winter, when the pastures are falling off, outbreaks are common and widespread. When anthelmintic treatment is given to heavily infested animals they often fail to show the improvement expected, because, though most of the worms may have been removed, the animals are unable to obtain sufficient nourishment from a poor pasture to repair the damage caused by the worms.

Supplementary feeding can play an important part in controlling parasitism if applied during periods of the year when pastures are poor and animals have been treated for worms.

There is evidence that mineral and trace element deficiencies may be associated with increased parasitism in cattle. The significance of this is not known at present but is suspected in several areas in Queensland. When any mineral deficiency is known to occur in an area it is advisable that the young stock be given access to licks containing the deficient elements.

Anthelmintic Treatment of Roundworms.

The aim of anthelmintic treatment should be preventive rather than curative. Parasitism in calves can be very slow in its onset and if treatment is delayed until the animals are visibly wormy disappointing results are often obtained.

In areas when parasitism can be expected it is advisable to drench early—that is, before the worm burden, coupled with a falling plane of nutrition, leads to symptoms of parasitism. Under Queensland conditions the bulk of the worm infestation is picked up during the summer and early autumn so that three treatments are required—namely, during February-March, June-July and September-October. The first treatment is to remove principally the large stomach worms picked up during the summer. The second is designed to remove the bulk of the worms picked up during the rainy season and the adult large bowel worms which have left the bowel wall since the last drenching. These two treatments are very important, for it is desirable that the calves go into the winter as free as possible from worms. The third treatment in the spring is directed mainly against the large bowel worm. In areas which receive heavy spring rains a further treatment will be desirable before the February-March period.

In beef herds it may not be necessary to give more than two treatments while the calves are with their mothers—the first in February-March and the second at the time of weaning. If weaning is delayed till late in the year the June-July treatment is desirable. The setback associated with weaning often produces very susceptible animals and outbreaks of parasitism are likely to occur a few months after weaning. For this reason the calves should be drenched when they are taken from their mothers and before being placed in the weaning paddock.

Beef weaners are still susceptible to worm infestations during the summer and autumn following weaning and must be watched carefully and treated at the first signs of parasitism.

Every calf in a herd should be treated and not only those that appear wormy. Untreated calves, though they appear healthy, may be carrying a moderate worm burden. If these are placed on a clean pasture with the treated animals they act as a source of contamination of the pasture with larvae. These apparently healthy animals may show symptoms of parasitism at a later date.

Drenched calves must be placed immediately on a pasture that has not been grazed by cattle for some time. Drenching may remove the majority of the worms present in the animals but the calves are still susceptible to worms. If they are returned to the old pasture they will quickly acquire a new infestation. This is particularly important with animals that have shown clinical symptoms before drenching. These animals are very susceptible to reinfestation and will not improve unless reinfestation is prevented and they are given nutritious food to repair the damage caused by the worms.

Animals showing marked clinical symptoms of parasitism should be drenched twice at 14-day intervals with a change of pasture after each drenching. The majority of the drenches used are not particularly effective against immature stages, so the second treatment is required to remove the worms that were immature at the time of the first treatment.

Anthelmintics in Use.—Very little critical work has been done in the study of anthelmintics for cattle. The majority of the drenches used have their recommendations based on their efficiency against sheep roundworms.

Phenothiazine is the best drug for cattle roundworms. It is very efficient against the large stomach worm (*Haemonchus contortus*) and the large bowel worm (*Bosicola radiatus*) and moderately efficient against the smaller stomach worms (*Ostertagia* spp. and *Trichostrongylus axei*). It is not always efficient against the hookworm (*Bonostomum phlebotomum*) and the small intestinal worm (*Cooperia* spp.).

Copper sulphate, alone or in combination with arsenic or nicotine sulphate, has been used for stomach worms, and tetrachlorethylene, preceded by copper sulphate or baking soda, for stomach worms and hookworms. For these drenches to be effective they must go direct to the fourth stomach. If they are swallowed into the rumen or paunch they become so diluted that by the time they reach the fourth stomach they are not effective in removing worms.

Phenothiazine.—Phenothiazine is not soluble in water but is available as a wettable powder that can be suspended in water or as an already prepared suspension. The powder can be given in the feed of stall-fed animals but it is more conveniently given as a drench. The dose rate of the powder form is as follows:—

Animals 2 to 4 months	½ oz. phenothiazine
4 to 6 months	¾ oz. ,,
6 to 12 months	1 oz. ,,
12 to 18 months	1½ oz. ,,
over 18 months	2 oz. ,,

To prepare a drench, weigh out the total amount of phenothiazine required to treat all the animals in the herd. Pass the powder through a sieve to remove all lumps (a kitchen sifter is very suitable for this purpose). Measure out 12 fluid ozs. of water for each pound of phenothiazine. Pour the water on to the powder gradually, stirring vigorously to form a thin paste. When used in this form the amounts to be given are as follows:—

Animals 2 to 4 months	¾ fluid oz.
4 to 6 months	1⅛ fluid oz.
6 to 12 months	1½ fluid oz.
12 to 18 months	2¼ fluid oz.
over 18 months	3 fluid oz.

The above suspension is in some quarters considered to be too thick to use without some difficulty. A thinner suspension may be made by weighing out the quantity of phenothiazine required to treat the animals and placing it in a container graduated in fluid ounces. A little water is added to form a paste and finally more water is added until there are twice as many fluid ounces of suspension in the container

as ounces (weight) of powder used. Each fluid ounce of this suspension will contain half an ounce (weight) of the powder. The dose rate will then be as follows:—

Animals 2 to 4 months	.. ..	1 fluid oz.
4 to 6 months	.. ..	1½ fluid oz.
6 to 12 months	.. ..	2 fluid oz.
12 to 18 months	.. ..	3 fluid oz.
over 18 months	.. ..	4 fluid oz.

The above method is suitable when small numbers of animals are to be treated and odd fractions of a pound of the powder are to be used.

The mixture, particularly the thin type, must be kept well stirred during drenching or the phenothiazine will sink to the bottom. The drench may be given with a drenching gun or drenching funnel. There are drenching guns specially designed for phenothiazine. These may clog after some use but this can be avoided by frequent washing with water and keeping the plunger well lubricated with liquid paraffin.

Phenothiazine is a very safe drug to use on cattle. Starvation before or after treatment is not required. The urine may be stained red for some days but this is of no importance as it is due only to an oxidation product of the drench and not to the presence of blood pigments.

An eye condition resembling blight often follows the use of phenothiazine but this effect soon disappears. The condition is due to the action of bright sunlight on a phenothiazine derivative present in the eye 12 to 36 hours after drenching. The condition can be prevented entirely if the animals are kept in complete shade the day after drenching. Small numbers of calves on dairy farms may be enclosed in barns and sheds and beef calves confined in heavily shaded paddocks.

Tetrachlorethylene.—This drug is available commercially as a mixture of equal parts of tetrachlorethylene and liquid paraffin or as an emulsion. The drench is given immediately after 4 oz. (half a cup) of a 5 per cent. solution of baking soda (half a pound of baking soda in one gallon of water). The baking soda is to close the oesophageal groove and allow the drench to go direct to the fourth stomach. This is based on recommendations of workers in South Africa. There is some doubt, however, as to the efficiency of sodium or copper salts in closing the groove. If the groove does not close the drench will pass into the paunch and be ineffective. Tetrachlorethylene treatment should only be attempted in cases of hookworm infestations that do not respond to phenothiazine. (See notes on hookworms given earlier).

The dose rate of a 50 per cent. mixture of tetrachlorethylene and liquid paraffin is as follows:—

Animals 2 to 4 months ..	.. 20 to 30 c.c. of the mixture
4 to 8 months ..	.. 30 to 40 c.c. „ „ „
8 to 12 months	.. 40 to 50 c.c. „ „ „
12 to 18 months	.. 50 to 60 c.c. „ „ „

Tetrachlorethylene has a low toxicity for cattle but some animals immediately after drenching develop a staggering gait, become giddy and may even fall down. This intoxication is only temporary and the calves are back to normal in a few minutes.

Repairing a Galvanised Iron Tank.

F. MANUELL, Agriculture Branch.

THE writer has successfully repaired badly-holed 1,000-gallon galvanised iron water tanks by the method given here.

First check your tank stumps and stand. Be sure your stumps are not rotten at the bottom and that your stand is level and firm.

Materials and Tools Required.

Five bags of cement and half a yard of plaster sand will cement a 1,000-gallon tank (two coats), including the cement creaming.

A large whitewash brush or an old paint brush.

A wire brush.

A large hand trowel (about 9 inches).

A small hand trowel (4 inches).

A short-handled shovel for mixing material.

Several buckets.

A steel or wooden float is handy, but not essential.

Two high ladders and a long plank, or similar scaffolding, are a great help when cementing inside the tank.

Arrange the ladders and plank so that the plank is about one inch above the outer edge of the opening on top. You can then use a short ladder resting on the inside bottom of the tank and leaning against the edge of the top plank to enable you to climb into the tank without disturbing the cement work. Another ladder from the ground and leaning against the outer edge of the plank will be necessary to climb up to the plank, if the tank is on high stumps.

The cementing material can be mixed outside the tank and carried up, or taken into the tank in the dry state and mixed on the bottom of the tank (the latter method is the better).

A large tarpaulin to put right over the tank (excluding the opening at the top) is a great advantage. It keeps the sun off the side of the tank and keeps the inside cool while working.

Cleaning the Tank.

Empty the tank, and shut off any water which might run into it from the roof. To facilitate working inside the tank, it is advisable to open the top crimped edge or cut a large semi-circular opening on the top of the tank (with tinsnips) and bend this cut portion back, instead of climbing in and out through the opening where the water normally runs into the tank. (This cut opening can be closed and soldered up when the cementing is finished.)

Clean out the tank thoroughly, removing all scale rust with a scraper and a wire brush. If there are any large holes in the sides of the tank, patch them with bird wire. Disregard any small holes (the cement will fill these up) and put a cork or wooden plug into the pipe at the bottom of the tank to prevent any cement getting into it. If there is any buckling on the inside bottom of the tank (and there usually is), drive some large-headed clouts through the bottom of the tank into the stand to make the bottom firm.

The First Coat.

Commence by putting a creamy coat of cement and water (creaming to be about as thick as pea soup), all over the inside walls of the tank. This first coat of creaming will dry very quickly.

Then mix 2 parts of plaster sand (or other very fine, clean sand) with 1 part of cement. An ordinary household bucket makes a good measure for this work. Mix the sand and cement thoroughly in the dry state before adding any water. When thoroughly mixed, add only sufficient water to make the mixture workable (not sloppy).

The first coat of creaming on the walls will be dry, so give a small section on the top inside another coat of creaming, and start putting on the cement mixture. The surface of the wall you are working on *must* be wet with the creaming mixture to allow the cement mixture to stick properly, so keep about half a bucket of creaming handy to wet each section as you apply the mixture (stir the creaming in the bucket frequently). A good method is to work around the inside top, putting a circle about 12 inches wide right round, then another circle right round just below the first circle, and so on down to the bottom.

When putting the cement mixture on, be *sure* and press it firmly into the corrugations of the tank and the bird wire, if the tank has been patched.

When the sides are finished, start on the bottom. A good method is to cream and cement about one-third of the bottom in one section, then one-third again on the opposite side, leaving a strip about 2 feet wide down the centre bottom. Let those two strips dry until hard enough to stand on (say about 12 hours) then cream and cement the centre strip (a wide board is useful to put on top of the cemented portion to stand on). Make this cemented bottom no less than one inch thick, and both the walls and bottom should be left with a rough surface, so that the second coat will stick well on to the first coat.

The Second Coat and Sealer.

Allow the first coat to harden (any time after about two days) then apply the second coat. Just before applying the second coat, wet the surface of the first coat with clean water (this will dry quickly).

For the second coat use 1 part of sand to 1 part of cement. Mix the sand and cement thoroughly in the dry state, then add the water. Mix thoroughly again, then start at the top again. Give the first coat a creaming of the cement and water, and put on the second coat right round the top (about 12 inches wide), covering the inside corrugations with about half an inch of cement mixture, then another circle below the first, and continue in circles down to the bottom. Press the second coat on to the first coat, and smooth off the surface as it becomes dry enough to smooth.

Don't forget to give each section a creaming just before you put on the cement mixture.

When the inside walls are finished, give the bottom a creaming coat and put the second coat on the bottom, about half an inch thick, in three sections of one-third each. When the second coat has been smoothed off and has set (about two days), give the sides and bottom two coats of creaming and follow this with two coats of alum water sealer at 24-hour intervals between the applications. (Use 1 lb. alum to 4 gallons of water. Dissolve alum in very hot water and apply while hot.)

When the cemented tank is filled with water after rain, the water is hard, owing to the alum wash. However, this hardness will disappear after the tank has been emptied and refilled with rain water.

Another method which can be used to seal the finished job is to incorporate the sealing material with the sand and cement when the second coat is being mixed. Waterglass (sodium silicate) can be added to the water in the mixing (1 part of waterglass to 12 parts of water).

Brucellosis Testing of Swine.

The Department of Agriculture and Stock is operating a scheme whereby pig herds are tested at intervals for the occurrence of swine brucellosis (contagious abortion).

A herd listed by the Department as "brucellosis tested" is one in which all such animals as may be determined by the Director of the Department's Division of Animal Industry have been subjected to two successive tests for brucellosis, at intervals determined by him, without any positive reactors being found.

In order for a herd to be retained on the list of Tested Herds, a semi-annual or annual re-test of the herd, as determined by the Director, is required. If at a re-test any animal gives a positive reaction to the test the herd is removed from the list; it is not listed again until subsequent tests, as determined by the Director, have been carried out.

Full particulars of the Brucellosis Testing of Swine and application forms may be obtained from the Under Secretary, Department of Agriculture and Stock, William Street, Brisbane.

TESTED HERDS.

(AS AT 23rd NOVEMBER, 1951.)

Breed.	Owner's Name and Address of Stud.
Berkshire	S. S. Ashton, " Scotia " Stud, Pittsworth
	J. J. Bailey, " Lucydale " Stud, East Greenmount
	S. Cochrane, " Stanroy " Stud, Felton
	Garrawin Stud Farm Pty. Ltd., 657 Sandgate road, Clayfield
	G. Handley, " Handleigh " Stud, Murphy's Creek
	J. L. Handley, " Meadow Vale " Stud, Lockyer
	R. G. Koplick, " Melan Terez " Stud, Rochedale
	H. V. Littleton, " Wongalea " Stud, Crow's Nest
	O'Brien and Hickey, " Kildurham " Stud, Jandowae East
	E. Pukallus, " Plainby " Stud, Crow's Nest
	G. C. Traves, " Wynwood " Stud, Oakey
	E. Tumbridge, " Bidwell " Stud, Oakey
	Westbrook Farm Home for Boys, Westbrook
	H. W. Wyatte, Rocky Creek, Yarraman
	H.M. State Farm, " Palen Creek," Palen Creek
	A. R. Ludwig and Sons, " Cryna " Stud, Beaudesert
	H. H. Sellars, " Tabooba " Stud, Beaudesert
	F. Thomas, " Rosevale " Stud, Beaudesert
	Bowkett and Meacle, " Myola Vale " Stud Piggery, Burra Burri, Jandowae
	D. T. Law, Trouts Road, Aspley
	R. J. McCullough, " Maxholm " Berkshire Stud, Gatton
	C. F. W. and B. A. Schellback, " Redvilla " Stud, Kingaroy
	R. H. Crawley, " Rockthorpe " Stud, via Pittsworth
Large White	H. J. Franke and Sons, " Delvue " Stud, Cawdor
	Garrawin Stud Farm Pty. Ltd., 657 Sandgate road, Clayfield
	F. L. Hayward, " Curyo," Jandowae
	J. A. Heading, " Highfields," Murgon
	K. B. Jones, " Cefn " Stud, Pilton
	R. G. Koplick, " Melan Terez " Stud, Rochedale
	R. Postle, " Yarralla " Stud, Pittsworth
	E. C. Smith, " Smithfield " Stud, Coomera
	E. J. Bell, " Dorne " Stud, Chinchilla
	A. G. Fry, " Birubi " Stud, Dalby
	N. E. Meyers, Halpine Plantation, Kallangur
	L. C. Lobegeiger, " Bremer Valley " Stud, Moorang, via Rosewood
	J. H. G. Blakeney, " Talgai " Stud, Clifton
	V. P. McGoldrick, " Fairymeadow " Stud, Cooroy
	N. Woltmann and Sons, Wooroolin
	R. S. Powell, Kybong, via Gympie

TESTED HERDS—continued.

Breed.	Owners Name and Address of Stud.
Tamworth	S. Kanowski, " Miecho " Stud, Pinelands N. R. Potter, " Actonvale " Stud, Wellcamp D. F. L. Skerman, " Waverley " Stud, Kaimkillenbun A. C. Fletcher, " Myola " Stud, Jimbour L. C. Lobegeiger, " Bremer Valley " Stud, Moorang, via Rosewood Salvation Army Home for Boys, Riverview F. Thomas, " Rosevale " Stud, Beaudesert A. J. Surman, Noble Road, Goodna P. V. McKewin, "Wattleglen" Stud, Goombungee Department of Agriculture and Stock, Regional Experiment Station, Kairi
Wessex Saddleback ..	W. S. Douglas, " Greylight " Stud, Goombungee K. Day and P. Hunting, " Kazan " Stud, Goodna E. Sirrett, " Iona Vale " Stud, Kuraby C. R. Smith, " Belton Park " Stud, Nara H. H. Sellars, " Tabooba " Stud, Beaudesert H. Thomas, " Eurara " Stud, Beaudesert D. T. Law, Trouts Road, Aspley G. J. Wilson, " Glenbella " Stud, Silverleigh G. J. Cooper, "Cedar Glen", Yarraman J. B. Dunlop, Acacia Road, Kuraby

ASTRONOMICAL DATA FOR QUEENSLAND.

JANUARY.

Supplied by W. J. NEWELL, Hon. Secretary of the Astronomical Society of Queensland.

TIMES OF SUNRISE AND SUNSET.

At Brisbane.			MINUTES LATER THAN BRISBANE AT OTHER PLACES.					
Day.	Rise.	Set.	Place.	Rise.	Set.	Place.	Rise.	Set.
	a.m.	p.m.						
1	4·56	6·46	Cairns ..	48	9	Longreach	43	27
6	5·0	6·47	Charleville ..	29	25	Quilpie	33	37
11	5·04	6·47	Cloncurry	63	36	Rockhampton ..	18	2
16	5·08	5·47	Cunnamulla ..	28	31	Roma	19	15
21	5·12	6·46	Dirranbandi ..	16	22	Townsville ..	40	9
26	5·16	6·45	Emerald	27	12	Winton	51	30
31	5·20	6·43	Hughenden ..	48	22	Warwick	2	6

TIMES OF MOONRISE AND MOONSET.

At Brisbane.		
Day.	Rise.	Set.
	a.m.	p.m.
1	8·44	9·55
2	9·49	10·29
3	10·50	11·01
4	11·50	11·32
	p.m.	
5	12·48	..
		a.m.
6	1·46	12·05
7	2·44	12.40
8	3·42	1·19
9	4·38	2·02
10	5·31	2·50
11	6·19	3·43
12	7·02	4·37
13	7·40	5·34
14	8·14	6·29
15	8·44	7·24
16	9·13	8·18
17	9·41	9·11
18	10·09	10·05
19	10·40	11·00
20	11·14	11·58
		p.m.
21	11·53	1·00
22	..	2·06
	a.m.	
23	12·41	3·14
24	1·37	4·21
25	2·42	5·24
26	3·54	6·19
27	5·07	7·07
28	6·20	7·48
29	7·28	8·25
30	8·34	8·58
31	9·37	9·31

MINUTES LATER THAN BRISBANE (SOUTHERN DISTRICTS).

Charleville 27 ; Cunnamulla 29 ; Dirranbandi 19 ;
Quilpie 35 ; Roma 17 ; Warwick 4.

MINUTES LATER THAN BRISBANE (CENTRAL DISTRICTS).

Day.	Emerald.		Longreach.		Rockhampton.		Winton.	
	Rise.	Set.	Rise.	Set.	Rise.	Set.	Rise.	Set.
1	24	15	40	31	15	7	46	35
6	13	25	28	41	2	16	31	48
11	9	30	25	45	0	21	26	54
16	17	23	32	39	8	14	37	44
21	28	12	44	27	19	2	51	30
26	30	11	45	25	20	0	53	28
31	17	22	33	38	8	13	37	44

MINUTES LATER THAN BRISBANE (NORTHERN DISTRICTS).

Day.	Cairns.		Cloncurry.		Hughenden.		Townsville.	
	Rise.	Set.	Rise.	Set.	Rise.	Set.	Rise.	Set.
1	41	21	57	44	42	29	34	18
3	28	32	50	53	34	38	24	28
5	18	43	42	59	27	45	16	36
7	8	48	36	62	21	48	8	40
9	2	55	33	67	17	52	3	45
11	3	56	34	67	18	53	4	46
13	10	50	37	63	22	49	9	42
15	19	42	42	59	27	44	17	36
17	29	32	50	53	35	38	25	28
19	39	21	56	44	41	29	33	18
21	50	10	64	37	48	23	41	10
23	54	3	67	32	51	18	44	4
25	56	3	68	32	52	18	46	4
27	50	11	64	38	48	23	41	11
29	37	24	55	46	40	31	31	21
31	25	36	47	55	32	40	21	31

Phases of the Moon.—First Quarter, January 4th, 2.42 p.m.; Full Moon, January 12th, 2.55 p.m.; Last Quarter, January 20th, 4.09 p.m.; New Moon, January 27th, 8.26 a.m.

On January 4th the sun will be at its nearest approach to earth (91,400,000 miles). On the 15th it will rise and set 23 degrees south of true east and true west respectively. The moon will rise and set at true east and true west respectively on 3rd, 17th and 30th.

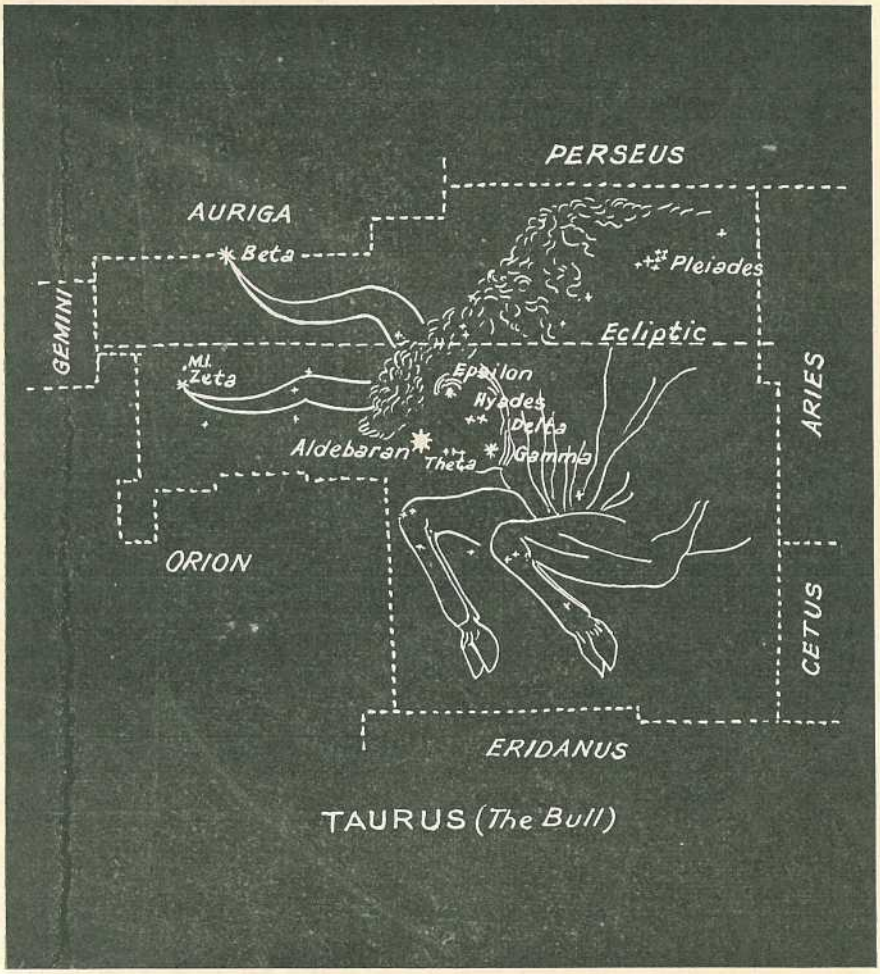
Mercury.—A morning object all this month. At the beginning, in the constellation of Ophiuchus, it will rise about 1¾ hours before sunrise and at the end of January, in the constellation of Sagittarius, it will rise 1 hour 11 minutes before sunrise.

Venus.—This month will rise about 2¾ hours before the sun. At the beginning of the month it will be situated in the constellation of Libra and after passing through the constellations of Scorpio and Ophiuchus will be placed in the constellation of Sagittarius at the close of the month.

Mars.—In the constellation of Virgo, will rise near midnight at the beginning of the month, when it will be situated near Spica. At the end of the month it will rise about 1 hour before midnight.

Jupiter.—At the beginning of the month will set near midnight but at the end of the month it will set between 9.45 p.m. and 11 p.m. On the 3rd and 31st the moon will be situated near this planet.

Saturn.—Situated in the constellation of Virgo, it will rise near midnight at the beginning of the month, not far from Mars; but at the end of January it will rise between 10 p.m. and 11.15 p.m.



THE CONSTELLATIONS.

TAURUS—THE BULL.

This is one of the constellations of the Zodiac and is sometimes said to represent the bull of mythology which swam away from Europa, but the form of a bull was probably given to the group by the Babylonians. The constellation possesses two magnificent clusters in the Hyades and the Pleiades. The Hyades cluster looks like a huge A lying obliquely across the sky with gamma Tauri at the apex, Epsilon Tauri at the left foot and Aldebaran (Alpha Tauri) at the right foot. Aldebaran a bright reddish 1st magnitude star, has a faint 11th magnitude companion about 120 seconds away. Between Aldebaran and Gamma are Theta 1 and 2, easily seen as a pair with the naked eye. On the other leg, between Epsilon and Gamma, are the Deltas 1, 2 and 3.

To really appreciate this group it should be examined with field glasses or a wide field telescope. The Pleiades, known to most people as the Seven Sisters, is a fine compact group that immediately catches the eye. Most people can see 6 stars in the group with the unaided eye but some with acute vision have claimed to see as many as 9. Actually the Pleiades are immersed in nebulous matter which is very evident on long exposure photographs of the group. Seven of the bright stars of the group are named Alcyone (Eta) Celeone, Electra, Maia, Merope, Asterope, and Taygeta, after the daughters of Atlas and the nymph Pleione. Two others in the group are named after Atlas (27 Tauri) and Pleione (28 Tauri). Many doubles will be seen in this group when examined with a telescope. Old star maps show the Hyades as the head of the bull, with Aldebaran as the eye. A line from Gamma through Aldebaran produced 5 times brings the eye to Zeta at the tip of one horn and a line from Gamma through Epsilon points to Beta on the other horn. About one degree north of Zeta will be found M1, "The Crab Nebula". It is a faint gaseous nebula, the outline being visible only in large telescopes. It was discovered in 1731 but was forgotten and rediscovered by Messier in 1758, which led him to make his catalogue of 103 clusters and nebulae, hence its designation in his list as M1.