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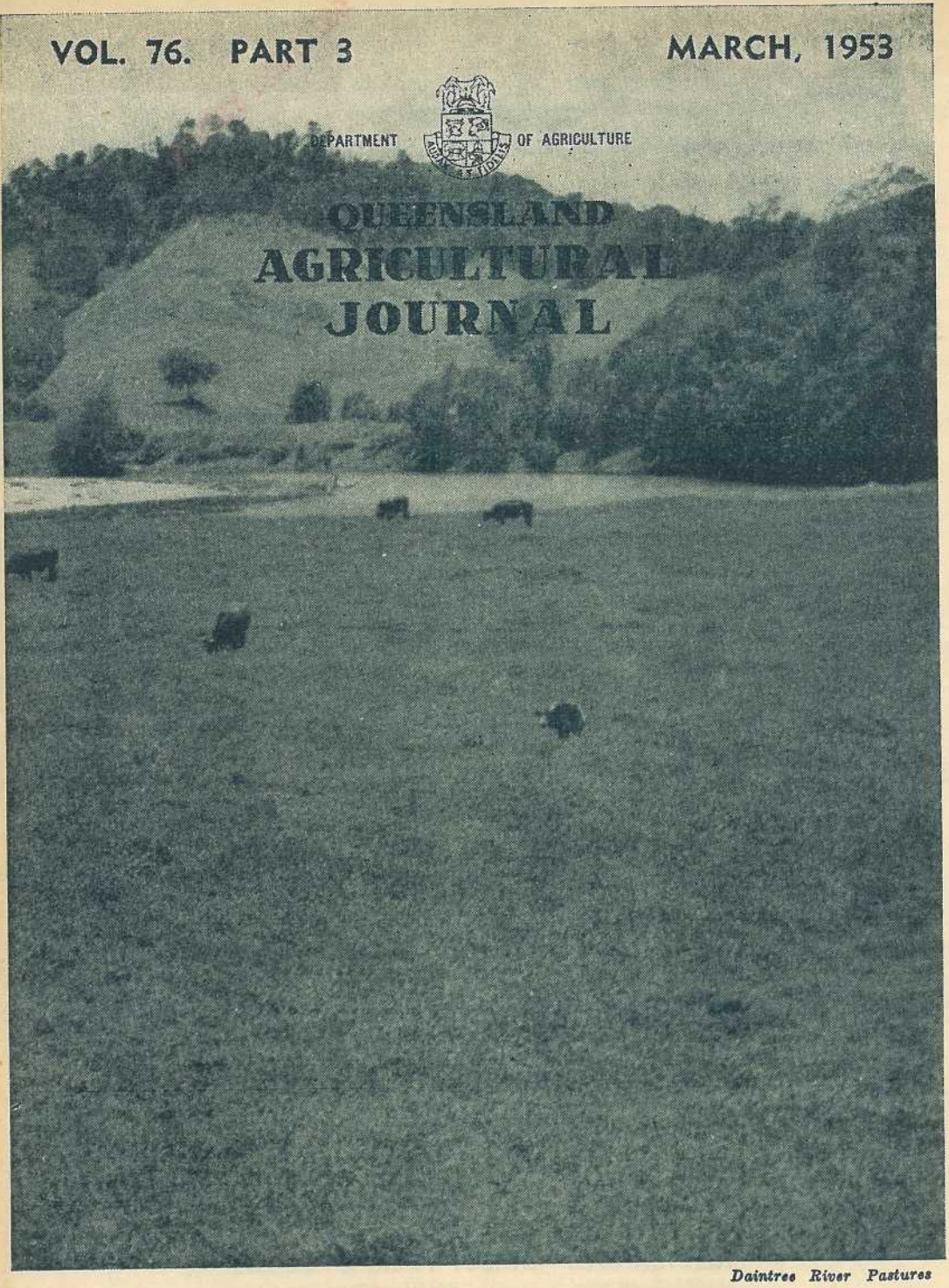

Daintree River Pastures

LEADING FEATURES

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Contents

Upland Rice Growing in Queensland.

T. G. GRAHAM (Agrostologist) and J. W. LITTLER (Assistant Agronomist), Agriculture Branch.

RICE is probably the most important of the cereals—it is the grain staple in the diet of more than half the people of the world. Owing to the diversity of types and strains found in the various countries, it is not certain whether the original home of rice was in South-eastern Asia, India, China or Indo-China.

The wide range of varieties makes it possible to produce good crops under various soil and climatic conditions, ranging from stiff clays to sandy loams, from swamps to well-drained soils and from moist tropical heat at sea level to elevations of 7,000 feet within the tropics. Although it is a tropical cereal found growing luxuriantly in its native environment of high temperatures and high atmospheric humidity, rice has been found to grow with great success under irrigation in some temperate regions such as the Murrumbidgee Irrigation Area of Australia and the southern States of the United States of America.

The world's cultivated varieties of rice fall into two main groups, the swamp or lowland types and the upland types. Swamp rice, as the name suggests, thrives best with a very high level of soil moisture. It is customary to maintain water to a depth of several inches over fields of swamp rice from the early growth stage until the crop commences to mature. Upland rice is synonymous with hill paddy, dryland rice, and mountain rice, and for many years has been cultivated outside the flooded delta regions and terraced irrigated areas for which the Far East is famous. Normally it is not irrigated.

From a nutritional point of view, upland rice is reported to be superior to swamp rice. Analyses of samples carried out in different countries reveal that while average upland rice contains 11.27 per cent. protein and 1.8 per cent. total nitrogen, average swamp rice contains 9.84 per cent. protein and 1.5 per cent. total nitrogen. Upland rice is claimed to be richer in protein compounds and starchy matter, but not in minerals, though some varieties have outstanding individual qualities.

HISTORY OF RICE GROWING IN QUEENSLAND.

Rice growing in Queensland dates back to the second half of the last century. Mr. A. J. Boyd introduced the crop to areas along the Logan, Albert and Pimpama Rivers, by planting a Japanese variety on "Ormeau" Sugar Plantation in 1869. Eventually a small rice mill was established in this area.

In North Queensland in the early days, the Chinese grew rice along the river banks, especially in the Innisfail-Cairns area, and a rice mill is known to have been in operation at Cairns about 1909. Later, in 1917, rice was grown successfully in the Cairns hinterland in the Mareeba and Tolga areas. On the coast north of Cairns, rice was grown in small areas around Bailey's Creek.

Records show that in 1898, 860 acres were planted to rice in Queensland, but the area steadily declined until a revival of interest in rice growing was brought about by a shortage in 1917. However, no real progress was made in developing the industry. A similar shortage followed World War 2 and interest in rice production in Queensland was renewed again.

In order to assess the possibilities of rice growing in North Queensland and with the intention of determining the most suitable varieties for the conditions, the Department began investigations at its Bureau of Tropical Agriculture at South Johnstone in 1946. Testing of varieties has continued since that date, and up to the present several useful varieties have been found. Both swamp and upland varieties have been tested side by side under non-irrigated or upland conditions.

Rice growing during recent years in North Queensland has not been confined solely to the work being carried out by the Bureau of Tropical Agriculture. Some years ago Mason Bros., of Cape Tribulation, collected seed of a variety of rice which had persisted on the creek banks north of the Daintree River since the early days of rice growing in that district. Seed supplies were increased over several years at Cape Tribulation until sufficient was available to establish a large area.

The first large-scale planting with this seed took place at Bailey's Creek, some 10 miles south of Cape Tribulation. An area of 57 acres was planted during the summer of 1949-50, but despite a promising beginning armyworms subsequently caused much damage. In 1950-51 the area sown was increased to 70 acres, but unfavourable weather depressed yields. The 30 acres sown in 1951-52 gave only fair results.

EXPERIMENTAL WORK AT THE BUREAU OF TROPICAL AGRICULTURE.

Early in 1946 a number of varieties were imported from India and Ceylon. As many of these varieties were of the swamp type, it was decided to sow multiplication plots in flood basins, where a level of water could be maintained as required. Accordingly, late-maturing swamp varieties were sown in December 1946, and the early-maturing swamp varieties in a different basin in March 1947. The upland varieties were sown in the field without recourse to flooding.

However, efforts to maintain a level of water in the basins met no success, as the alluvial gray-brown silt loam used proved to be too porous. Thus all the rice plots were actually grown under what might be termed ideal upland conditions. All the varieties except two yielded grain; the highest yield was at the rate of 21.7 cwt. of paddy per acre.

Seven varieties in this initial planting appeared promising, and in November 1947, seed-increase plots of these varieties were planted. As a result of experience with the earlier rice plots, no attempts were made to grow the rice in flood basins, but spray irrigation was used during dry spells in the early summer months.

Land around Tully was also inspected and was considered suitable for rice growing. Subsequently an area of land at Lower Tully was selected for a varietal trial. In February 1948, 1½ acres of this land were sown. The varietal trial consisted of 12 varieties, while in addition, the variety Mekeo and three Californian varieties were sown in seed-multiplication plots. The trial commenced under good conditions, but before harvest troubles were encountered, the chief being dry weather in April, infestation of lightly-sown plots with weeds, lodging of some varieties with weak straw, and loss of grain due to the presence of finches. Only six varieties were harvested, the highest yielding variety being a Ceylon swamp type, Pachchaiperumal, which yielded at the rate of 11.65 cwt. of paddy per acre.

Early in 1949 two varietal trials were laid down. One was again planted at Lower Tully, while the other was established at the Bureau of Tropical Agriculture. The trials consisted of 15 varieties, including Caluso, a New South Wales variety. Three varieties received from the Rice Branch Experiment Station of the University of Arkansas—Fortuna, Early Niro and Prelude—were also included.

The Tully trial was planted in January 1949, while the trial at the Bureau of Tropical Agriculture was delayed until the beginning of February.

Very wet weather followed the planting at Tully, and in some cases, where submergence caused a thinning-out of the stand, weeds obtained the upper hand and choked out the rice. As before, finches were responsible for considerable losses of grain. The highest yield recorded was at the rate of 11.65 cwt. of paddy per acre from the variety Mahadi. There were three complete failures; the variety Kulpi failed to germinate, complete sterility occurred in Satarsal, and Caluso was choked out by weeds.

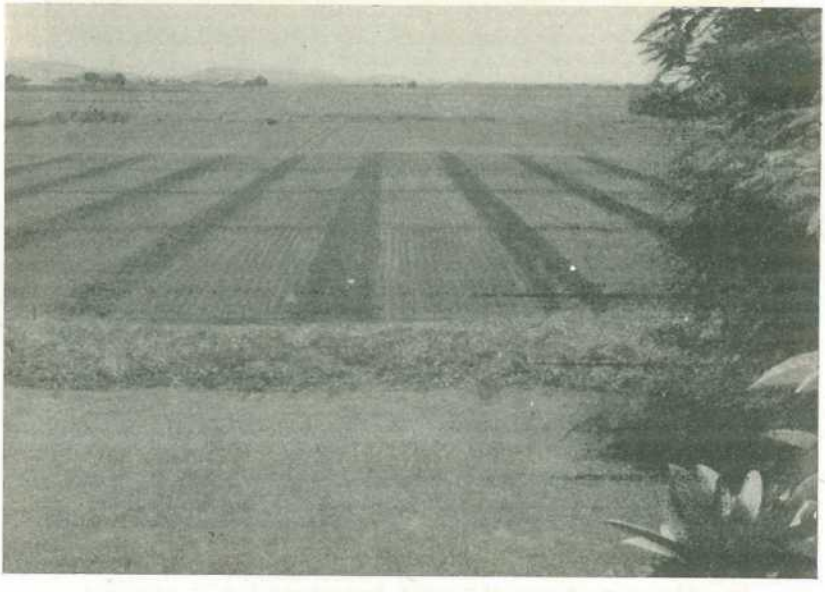


Plate 1.

Rice Seedling Growth in a Varietal Trial at the Bureau of Tropical Agriculture.

Plate 2.

Rice Varietal Trial at the Bureau of Tropical Agriculture. Left, Tribulation. Right, Prelude.

Plate 3.

Rice Trial at the Bureau of Tropical Agriculture. Left, Kalukeenati. Right, Tribulation.

Plate 4.

Harvesting Rice with the Header-Harvester at the Bureau of Tropical Agriculture.

Plate 5.

Seed-Increase Plot of the Rice Variety Speculation at the Bureau of Investigation's Irrigation Research Station at Gatton.

The trial at South Johnstone was located on an alluvial brown silty loam soil which had a tendency to set after rain and had a low moisture-holding capacity. All varieties germinated satisfactorily, except Kulpi, which again failed. On account of the late sowing and the very cold weather experienced in June, the later-maturing varieties such as Mekeo and Fortuna failed to set much seed. Finches were responsible for some loss of grain in this trial also. The best yield was given by the variety Pachchaiperumal, at the rate of 22.5 cwt. of paddy per acre.

Experience up to this time indicated the necessity of eliminating many of the varieties from further trials because of the undesirable field characters of breaking off and lodging. Hence, the next varietal trial, planted at the Bureau of Tropical Agriculture in January 1950, contained only eight varieties. This trial included a new variety, Tribulation, which was made available by the Bailey's Creek growers, Mason Bros. The trial germinated well, but towards the end of January a plague of armyworms invaded the plots, necessitating resowing.

A second trial was established in February 1950. Prior to sowing the land was fertilized with a 5-14-5 fertilizer mixture at the rate of 300 lb. per acre. During the growing period the rice had to compete with an invasion of the tropical legumes calopo and centro. Spraying with an 0.1 per cent. solution of 2,4-D checked these plants without apparently harming the rice.

Only four of the seven varieties in the trial gave appreciable yields. The weather was too dry and cool around flowering time for the longer-maturing varieties (Mekeo, Early Niro and Fortuna) to set grain. Of the others, Pachchaiperumal recorded the highest yield, at the rate of 18.08 cwt. of paddy per acre. Caluso was stunted in growth and was overgrown with weeds, but matured rapidly, taking only 85 days. Because of its unsatisfactory performance it was considered unsuitable for further trial under North Queensland conditions. The variety Kalukeenati lodged very badly, and in addition shed its grain readily. It was considered unworthy of further trial and was also discarded. Fortuna again failed to develop any grain and it too was discarded.

Of the varieties in bulk seed increase plots, Kalukeenati lodged very badly and was harvested by the header-harvester only with difficulty. Pachchaiperumal also lodged, but not so badly as Kalukeenati; it gave the highest yield of 6.83 cwt. of paddy per acre. The variety Tribulation grew well and attained a height in excess of five feet, but rain and wind which were experienced after the crop had flowered caused one-third of the plot to lodge. Prelude exhibited rather stout straw and very little lodging occurred; moreover, the grain did not shed. The other two varieties in the bulk plots, Mekeo and Fortuna, remained erect. The former yielded 4.82 cwt. of paddy per acre, while Fortuna did not yield at all as the grain failed to develop.

Samples of paddy of a number of varieties were given milling tests. The tests showed that the grain of three varieties, Mekeo, Prelude and Early Niro, was suitable for milling.

During the 1950-51 season a varietal trial of six varieties (Pachchaiperumal, Mekeo, Early Niro, Prelude, Tribulation and Speculation), a rate-of-sowing trial, and a bulk plot of Mekeo were grown.

Prior to planting, all three areas received a broadcast application of a 5-14-5 fertilizer mixture at the rate of 200 lb. per acre. When the rice was five weeks old, an application of sulphate of ammonia at the rate of 100 lb. per acre was given.

The season was a dry one, and in the varietal trial only the two earlier-maturing varieties, Pachchaiperumal and Prelude, gave appreciable yields, 10.83 cwt. and 7.63 cwt. of paddy per acre respectively. Although Pachchaiperumal has outyielded the other varieties on several occasions, it possesses three undesirable features: the grain sheds easily, the straw is weak and lodging is common, and the grain is difficult to polish. Hence, despite its yielding ability, it has been necessary to discard this variety also. The variety Mekeo flowered irregularly under the prevailing dry conditions.

The results of the rate-of-sowing trial, using the variety Prelude, indicated that a planting rate of about 75 lb. per acre provided the optimum stand where drills were spaced seven inches apart.

Meteorological data for the Bureau of Tropical Agriculture for the seasons during which the rice experiments described above were carried out are shown in Table 1.

TABLE 1.

METEOROLOGICAL DATA—BUREAU OF TROPICAL AGRICULTURE.

Year.	Jan.	Feb.	Mar.	April.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Total.
Average Daily Maximum Temperature (°F).													
1946 ..	87·6	88·0	88·8	84·2	79·9	74·9	75·5	78·9	82·4	84·8	87·8	87·8	..
1947 ..	93·0	87·1	85·0	83·2	77·6	75·4	76·0	76·5	79·0	81·3	85·6	87·8	..
1948 ..	86·1	85·8	86·2	82·1	79·0	74·2	73·8	74·6	80·4	86·0	87·6	89·1	..
1949 ..	88·2	86·8	82·9	78·0	76·5	72·9	71·8	74·0	77·4	85·7	88·3	89·1	..
1950 ..	88·0	87·0	87·6	80·1	80·0	75·2	75·2	75·1	78·0	83·2	86·0	82·8	..
1951 ..	87·0	86·0	85·5	85·0	78·0	77·7	74·3	77·0	77·0	83·3	85·7	89·2	..
Average Daily Minimum Temperature (°F).													
1946 ..	73·1	72·3	69·6	64·6	62·3	53·2	55·4	55·6	57·2	60·2	66·8	69·4	..
1947 ..	72·0	72·4	72·6	65·3	65·7	61·6	58·0	62·0	62·7	64·5	66·8	69·4	..
1948 ..	70·3	70·9	71·0	67·3	62·9	59·6	60·3	56·0	55·2	63·0	67·4	69·5	..
1949 ..	71·3	72·1	72·8	64·9	58·7	56·3	56·6	59·6	60·6	67·2	66·1	70·6	..
1950 ..	69·6	72·3	71·9	68·7	61·6	56·0	63·7	59·5	61·9	66·3	69·0	70·8	..
1951 ..	73·0	70·0	69·0	64·0	63·0	57·2	58·2	59·1	62·2	64·2	67·7	68·4	..
Average Daily Evaporation (Inches).													
1946 ..	·145	·152	·179	·169	·141	·109	·086	·130	·199	·215	·210	·230	..
1947 ..	·229	·132	·155	·158	·138	·094	·111	·114	·123	·180	·158	·187	..
1948 ..	·160	·144	·131	·127	·104	·108	·094	·136	·179	·203	·192	·213	..
1949 ..	·165	·162	·149	·128	·097	·086	·089	·117	·119	·161	·225	·158	..
1950 ..	·169	·175	·176	·119	·107	·092	·090	·097	·102	·157	·138	·084	..
1951 ..	·078	·109	·138	·147	·103	·093	·092	·122	·303	·154	·124	·121	..
Monthly Rainfall (Inches).													
1946 ..	24·84	35·53	16·26	4·53	7·03	1·30	1·33	0·38	0·09	0·60	1·36	5·01	98·26
1947 ..	0·47	30·14	26·53	4·68	10·15	6·62	2·48	7·28	6·04	4·05	2·66	2·07	103·17
1948 ..	39·49	10·67	18·49	11·14	2·71	8·13	5·46	4·39	0·03	0·72	0·78	6·11	108·12
1949 ..	17·42	23·40	44·28	22·19	7·49	2·27	3·59	3·11	2·96	0·76	1·65	2·30	131·42
1950 ..	17·08	16·84	34·21	31·84	2·02	7·45	7·74	1·18	4·31	2·99	16·51	33·61	175·78
1951 ..	17·55	16·23	9·79	1·81	4·65	4·03	3·61	1·02	7·11	3·22	5·58	7·38	81·98

SOIL AND CLIMATIC REQUIREMENTS FOR UPLAND RICE.

Generally, the rice crop appears to be more exacting in regard to water requirements than to soil type, although soil fertility is important. A well-distributed rainfall of over 60 inches during the growing period is essential for the successful cultivation of upland rice. All varieties thrive on rich soils well provided with organic matter. When the water-table is not high, it is desirable to have a clay subsoil that will retain soil moisture. For optimum results, rice requires about

half an inch of water daily over the growing period, with a maximum of 10 days between falls of rain. There is only one period of the year when rainfall occurs in sufficient quantities for the successful growth of upland rice on soils of low moisture-holding capacity in the wet tropical belt of Queensland, and this period extends from the end of December to the middle of April.

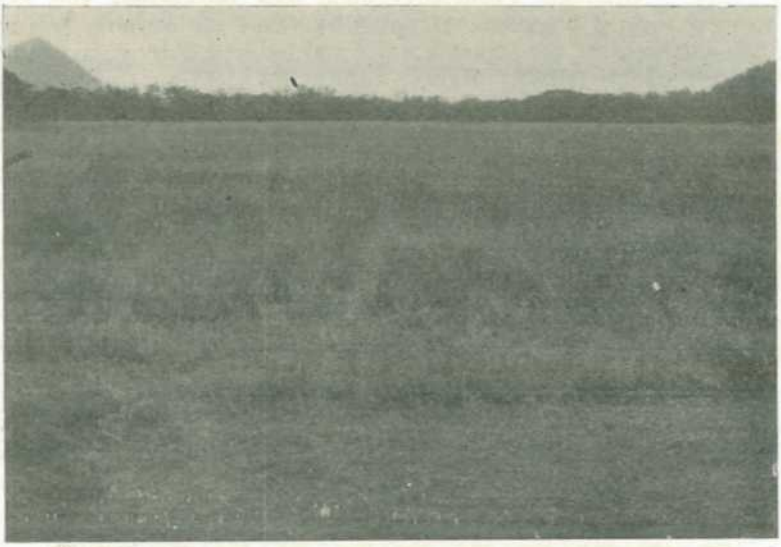


Plate 6.

Type of Land being used for Rice Growing at Bailey's Creek.

Rainfall data show that in most years it would be risky to plant upland rice in the Innisfail district before late December, as rainfall in the spring and early summer months may be low. Sowing of the crop, therefore, must be completed in January, preferably early January, before the onset of continuous wet weather, which might last for weeks. However, spells of very dry weather occur occasionally, even in January; for instance, the rainfall for January 1947 totalled only 47 points.

For best results, high soil moisture should prevail until the grain has developed. As such conditions usually occur only between January and the middle of April, it appears that a variety of the early-maturing class, such as Prelude, which flowers in 85 days, is required. A longer-maturing variety such as Mekeo would, if sown in January, flower in May, when rainfall may be inadequate to maintain moisture in soils of low moisture-holding capacity. Thus there would be a distinct possibility of a crop failure. A review of the summer and autumn rainfall data for the period 1940 to 1951 at the Bureau of Tropical Agriculture reveals that four out of the 12 years would probably have yielded poor crops of the earlier maturing varieties on the soil types available, and six out of the 12 years would probably have yielded poor crops of the later-maturing varieties. Only two years, 1941 and 1945, were considered ideal as regards rainfall for rice growing.

FERTILIZER.

Like most crops in tropical areas, rice responds to liberal applications of fertilizer. A complete fertilizer mixture of the type 5-14-5 at the rate of 2 cwt. per acre has given satisfactory results at the Bureau. Fertilizer trials with rice on an extensive scale have not been conducted in North Queensland, but it is considered that higher applications of fertilizer would achieve even better results.

Suitable crop rotations with upland rice have not been studied at the Bureau of Tropical Agriculture, but the use of leguminous cover crops appears to be very desirable before planting rice.

LAND PREPARATION.

Preparation of the seedbed for upland rice is similar to that adopted for wheat. Deep ploughing is not necessary, but the creation of a firm, moist, weed-free seedbed is most desirable for good germination and vigorous early growth of the rice seedlings. Under tropical conditions, however, where weed growth is a severe problem, deeper and more frequent cultivations are essential.

Where cover crops are used, or where there is a heavy growth of weeds, ploughing to a depth of nine inches is required. Sufficient time must be allowed for the plant remains to rot adequately, otherwise undecomposed organic matter may cause a temporary shortage of available soil nitrogen, which if not rectified by the application of sulphate of ammonia will result in crop stunting, ultimately adversely affecting yield. Cover crops should be ploughed under not later than six weeks before planting operations are due to commence. Under dry conditions, particularly with non-leguminous cover crops and weed growth, the period of decomposition would be longer.

Subsequent cultivations should aim at maintaining a clean fallow. This can be accomplished in most soils with disc cultivators and harrows. If rain falls after ploughing, however, a shallow cross-ploughing may also be necessary. The aim should be to have a weed-free, consolidated seedbed at planting time.

VARIETIES.

The number of rice varieties in existence is very large. Characters such as yield, maturation period, thickness of straw, ease of breaking, and milling qualities are all very important in selecting varieties. Trials have shown that the varieties offering best prospects of success in North Queensland under upland conditions are the short-term or early-maturing varieties. These varieties are able to make the best use of the main rain period. A disadvantage is that, in seasons when persistent heavy rainfall continues into April, harvesting difficulties will be encountered. For this reason it is essential that varieties have the capacity of retaining the grain in the panicle for a lengthy period without shattering.

Brief descriptions of the most promising varieties so far tested at the Bureau of Tropical Agriculture are set out hereunder and they are illustrated in Plates 7-12.

Speculation.

This variety is believed to have originated from seed brought into Queensland from New Guinea in 1949. It is a stout-strawed, mid-season variety taking approximately 150 days from planting to maturity. Its loose, drooping panicles yield yellow-coloured paddy. The grain is medium-round and colourless.

Mekeo.

This variety also came from New Guinea and was introduced into Queensland during World War 2. It is a late-maturing variety, taking approximately 170 days to mature its grain. The panicles are large, drooping and open, and contain yellow paddy. The grain is large and colourless. The straw is stout and slight lodging has been recorded in only one instance. Having a long growing season, it requires to be planted early for best results. Under favourable conditions it has given fair yields, but in late plantings yields have been negligible, due to faulty setting with the onset of cooler weather in the autumn.

Tribulation.

This variety was obtained from Mason Bros. in the Bailey's Creek area near Cape Tribulation. It was probably introduced into Queensland in the early days, and has become naturalized on swampy areas in the Cape Tribulation area. It is a mid-season variety, taking approximately 150 days to come to maturity. It possesses loose, drooping panicles containing yellow paddy. The grain is thin and rather long and is amber in colour. This variety yields well, but is apt to lodge.

Prelude.

This variety was introduced from the United States of America. It is an early variety, maturing in 125 days. Its loose, drooping panicles contain yellow paddy. The grain is medium-round and colourless. This stout-strawed variety resists lodging. It holds its grain well and has been the most outstanding variety tested to date.

Early Niro.

This variety was introduced from the United States of America. In North Queensland it is a late-maturing variety, taking 160 days to develop the grain. It has loose, drooping panicles possessing creamy-coloured paddy. The grain is long-round and colourless. The straw is stout and does not lodge.

SOWING.

Sowing in drills about seven inches apart to a depth of approximately one inch in the soil is desirable. The standard grain drills for wheat would be ideal for sowing rice. Broadcasting is practised on small areas, but a heavier seeding rate is required to combat weed growth. Drilling enables the seed to be placed in moist soil with ample covering to protect it from loss of moisture and the ravages of birds. Two types of drills at present in general use in wheat areas could be used for sowing rice—the disc drill, which is useful on cloddy ground, and the "combine" or cultivator-drill. These drills are fitted with fertilizer boxes so that seeding and fertilizing can be carried out in one operation. At the Bureau of Tropical Agriculture a seeding rate of

Plate 7.
Seed Panicle of Speculation.

Plate 8.
Seed Panicle of Mekeo.

Plate 9.
Seed Panicle of Tribulation.

Plate 10.
Seed Panicle of Prelude.

Plate 11.
Seed Panicle of Early Niro.

75 lb. per acre with Prelude has given the best results. With all varieties used in tests to date, rates of sowing lower than 70 lb. per acre appear unsatisfactory.

In Eastern countries, the general practice is to transplant seedlings of swamp rice when about six inches high, because of the greatly increased yields attributed to this method. Transplanting for commercial crops in North Queensland, however, would be uneconomic.

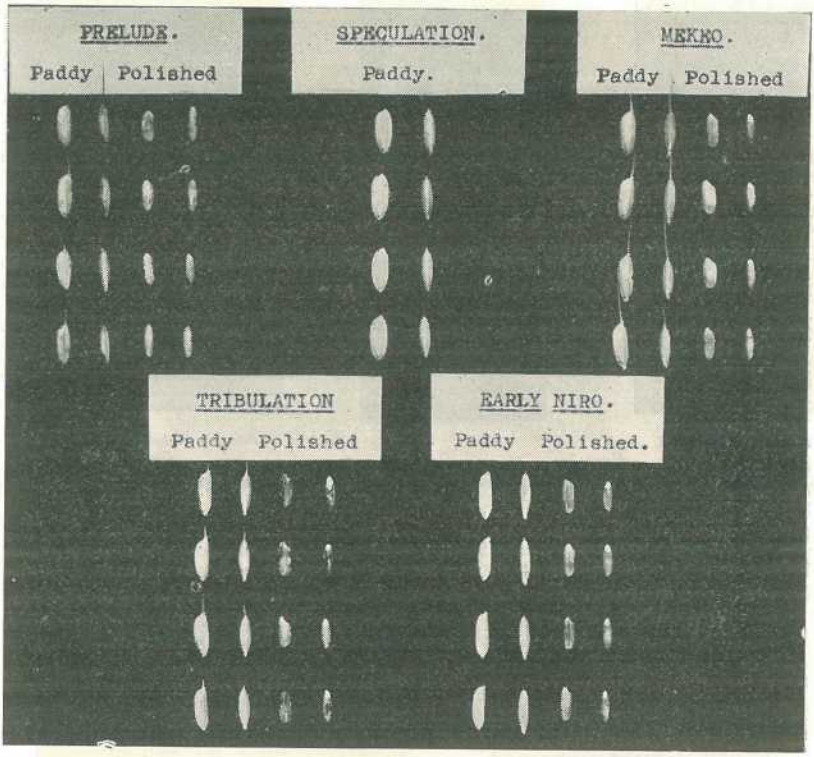


Plate 12.

Grain Types of the Five Most Promising Rice Varieties Grown at the Bureau of Tropical Agriculture.

CULTIVATION.

In rice-growing areas of the Eastern countries, where manual labour is cheap, hand-weeding is the rule. Such a method would be quite impracticable in North Queensland. However, where a good stand of seedlings has been obtained in a clean, well-prepared seedbed following drill sowing, no further cultivation should be necessary provided the field is harrowed to destroy young weed growth when the plants are about six inches high. If this harrowing is given when the crop is about one month old, the operation will not only check young weeds but will also help to thin out crowded areas and encourage tillering. Harrowing should be carried out at right-angles to the drills, preferably during the hotter part of the day, using lever harrows with the tines tilted back. If lever harrows are not available, care should be exercised to keep the harrow teeth free from soil and weeds, otherwise clumps of seedlings will be dragged out and the stand spoiled.

DEVELOPMENT OF THE RICE PLANT.

Tillering commences about five weeks from the time of sowing. The varieties under test at the Bureau of Tropical Agriculture have not tillered freely, the average number per plant in most cases being less than two; most plants have been single-stemmed. The closeness of the stand, and cultivation under non-irrigated conditions, apparently retard tillering. Following tillering, elongation of the internodes progresses and reaches a maximum when the plants are flowering. Where weather conditions are favourable, general flowering soon follows after the emergence of the first panicles from the leaf sheaths.

Flowering of the individual panicle proceeds from the tip downwards, and is completed in about seven days. The success of flowering depends largely on the weather conditions prevailing at the time. Light showers are an advantage, as the setting appears to be more even. Normally, the grain sets and passes through the milk, soft-dough and hard-dough stages to maturity some four to six weeks after flowering.

HARVESTING.

The crop is ready for harvesting when the lower spikelets throughout most of the crop show yellowing of the stem four inches to six inches below the panicles.

If the crop is harvested too early, the milling quality is lowered and the yields are reduced by the presence of immature, chalky kernels. If harvested at the dead-ripe stage, loss may be occasioned by shattering during the operation and also by a lowering of milling quality due to the fact that the kernels fracture readily.

Unlike wheat, rice matures when the greater portion of the plant is still green. Thus lodged crops are extremely difficult to harvest with a header-harvester, as the spirals have a tendency to choke readily.

The general method adopted in harvesting rice mechanically is by header-harvester direct in the field. The harvesting machinery used for wheat has been modified to prevent cracking of the rice grains by inserting rubber-lined threshing drums. Even with this modification, care must be exercised in order to ensure that the grain is not too ripe, otherwise the threshing process is likely to damage the grain. When the kernels in the lower portion of the heads are in the hard-dough stage, the kernels in the upper portion of the head are fully developed and ripe.

Overseas experience indicates that the grain should be harvested when the moisture content ranges from 20% to 27%. If harvested with less than 20% moisture there may be loss from shattering. Rice cannot be stored satisfactorily with this high moisture content, and after harvesting the rice is taken to dryers, where the moisture is gradually reduced to 14-16%.

HULLING.

When the rice comes from the harvesting machine it has two parts of the seed wrapping (the lemma and palea) closely adhering to the grain. In this form it is known as paddy or seed rice. Before rice can be consumed for human food, this seed covering or hull has to be removed. Small de-hullers readily remove the outer covering and the product is unpolished rice. Polished rice is obtained by passing unpolished rice through emery rollers, which polish off the outer coat and reduce the grains to a uniform size and colour.

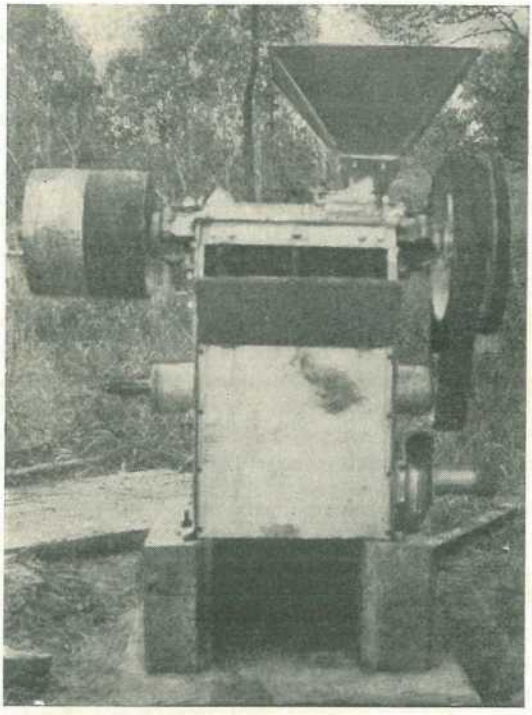


Plate 13.

Rice De-hulling Machine in use at Bailey's Creek.

In commercial rice-growing areas of New South Wales, the crop is sold as paddy by rice farmers and the husk is removed at the mills in the milling process.

THE POSSIBILITIES OF DEVELOPING UPLAND RICE-GROWING IN QUEENSLAND.

Queensland, with its vast range of climatic conditions and soil types, has land suitable for the production of rice. Seasonal conditions, however, are so variable as to render any large-scale production of this crop under non-irrigated conditions a rather risky venture. Fairly large areas would be required because of the heavy capital cost of machinery and the relatively low return per acre and to allow for the introduction of a suitable system of crop rotation. At present, in the absence of local milling facilities, transport costs would be heavy.

Under conditions similar to those at the Bureau of Tropical Agriculture, average yields of 15 cwt. of paddy per acre are unlikely to be exceeded without irrigation. Even with present prices for paddy, it would appear that upland rice growing in Queensland would not be very profitable. Individual growers who are prepared to mill their own rice may find an outlet for unpolished rice on the consumer market, but the heavy initial capital outlay on machinery and suitable land, served by good transport facilities, would be a serious obstacle.

If swamp types of rice could be grown under irrigation on soils with a high moisture-retaining capacity, and milling facilities were established within easy reach, the production of rice in Queensland could be a much more attractive proposition. Large areas of suitable soils occur in the Lower Burdekin.

Some Agricultural Features of the Central Highlands Region of Queensland.

P. J. SKERMAN, Agricultural Resources Officer, Bureau of Investigation, Department of Public Lands.

THE Central Highlands (Plate 1) comprises all of the land contained within the shires of Belyando, Peak Downs, Emerald, Bauhinia and Jericho. The total area is 37,280 square miles, or 23,859,200 acres. The Tropic of Capricorn passes through this region, and the town of Emerald, which lies more or less centrally, is 165 miles due west from the coast at Rockhampton.

The region is made up of forest ranges, lateritic red soil forest and sandy semi-desert country in the western half, and a large area of black soil open downs, dense brigalow and yellowwood scrub country, with some forest ranges and sandy soils, in the eastern half. The open downs black-soil areas are the most important, followed by the brigalow scrub country. It is estimated that there are some 2,716,240 acres of open downs country, of which 1,901,368 acres are potential arable land. In addition, some 4,577,600 acres of brigalow (*Acacia harpophylla*) and yellowwood (*Terminalia oblongata*) scrub occur; it is estimated that some 3,204,320 acres of this land would be suitable for cultivation after clearing.

Beef cattle and sheep raising have been and are still the main occupations. Beef cattle numbers total some 479,000 and sheep numbers 413,000. There has been a tendency to shift from sheep raising to cattle raising following the invasion by white spear grass (*Aristida leptopoda*) of much of the downs area.

EARLY AGRICULTURAL ACTIVITIES.

Practically all agricultural activity within the area in the past has been carried out on open downs country, the exception being a little wheat growing for green feed and hay purposes. The Department of Agriculture and Stock established the Gindie State Farm in the 1897-98 financial year and it was operated continuously until 1932. Annual reports of the activities of the farm were published, and a good deal of information has been collated from these reports.

The farm had a beef Shorthorn stud and cropping was undertaken on the open downs, using horse teams for the farming operations. Crops more or less regularly planted included wheat, barley, oats, maize, panicum, cowpeas, millet, lucerne, pumpkins, field peas, sorghums and cotton. With the limited land preparation given by using horse teams, the results of cropping varied, but the following general findings emerge from a study of the reports:—

(1) Wheat growing for hay should be successful on well-prepared fallowed land in at least two out of every three years, especially as fallowing methods with heavy machinery are an improvement on early efforts with horses.

(2) Maize growing for grain is hazardous, but for ensilage should be successful at least once in two years.

(3) Sorghum growing when tried was successful twice in every three years.

(4) Locust attack may be serious, having been reported nine times during a period of 34 years.

AGRICULTURAL SOILS OF THE AREA.

The soils so far used for agriculture have been the open downs black earths. These are self-mulching, rolling downs soils of high fertility and of good moisture-holding capacity. The soils are mostly residual in nature and derived from basalt. A "rendzina" (black soil overlying amorphous limestone) occurs at the "Chinaman" in the Angle Paddock at Peak Downs. This amorphous limestone has the following chemical analysis:—

Moisture	7·7%	CaO	23·2%
Loss on ignition	34·1%	MgO	9·9%
Fe_2O_3, &c. ..	8·2%	K_2O	0·1%
Na_2O	0·4%	Insoluble in HCl	15·9%

Neutralising Value—65·5%.

There is occasional contamination of the black earths by material derived from the rhyolites, granites and paleozoic metamorphic rocks adjoining the basalt, in which cases the soil analyses show up some possible deficiencies.

Topography influences the depth of the soil profile and it is usual to find some shallow soils of 12-18 inches in depth overlying the basalt at the crest of the ridges, deepening to 3-6 feet or more as one goes down the slopes. Fairly deep alluvial black earths occur on the creek flats—for example, of Capella, Magenta, Abor, Wolfang, Springsure, Minerva, and other creeks.

In texture classification, the black and brown soils fall in the heavy clay group, but the structure is in general excellent and the moisture-holding capacity of the subsoil would enable very effective moisture conservation during fallowing.

Chemically, the soils are generally well supplied with available phosphate, the usual figures indicating a range of 200-500 p.p.m. (below 50 p.p.m. is taken as deficient for agricultural crops). Replaceable potash is generally fair to good in all samples and calcium and magnesium are available in good quantity. Nitrogen figures are generally low but these can be greatly improved by fallowing. Successive crops of sorghum tend to reduce the nitrates fairly rapidly, and fallowing should be an integral part of the rotation.

Typical profiles from the open downs areas are as follows:—

(1) *Residual black soil—One Mile Paddock, Peak Downs—*

0– 9 in. Dark-brown clay.

9–15 in. Dark-brown clay, with limestone nodules.

15–20 in. Light-brown, mottled, dark-grey clay (rotten basalt inclusions).

(2) *Deeper residual soil—Upper Home Paddock, Peak Downs—*

0–60 in. Dark-grey to black clay.

60–72 in. Dark-brown clay.

Full chemical and mechanical analyses of typical soils are given in Table 1.

These friable black and brown soils on undulating topography are liable to erosion by storm waters and this aspect must be kept in mind in handling the soil.

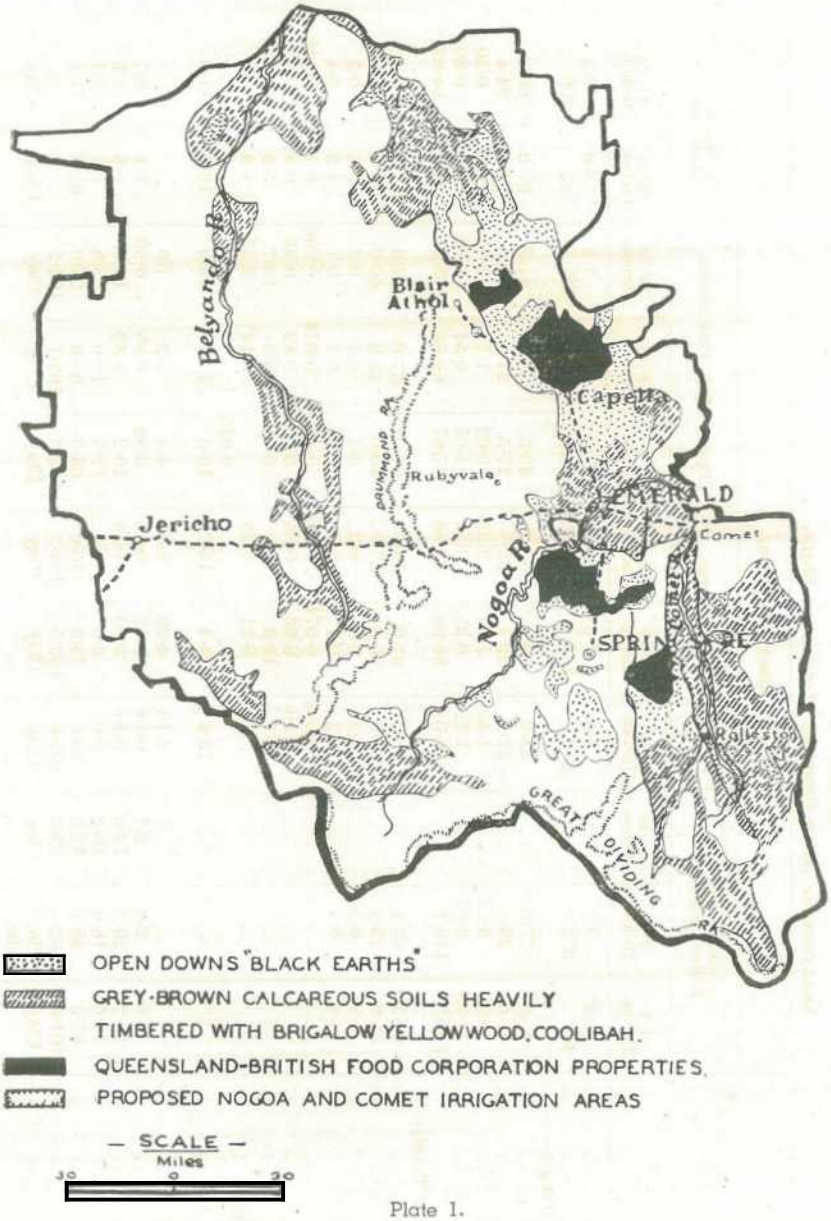


Plate 1.

Sketch Map of the Central Highlands Region, Showing Agricultural Soils.

The other soils in the Central Highlands include podsolic types in the open forest ridges, residual sand ridges, lateritic red earths, alluvials of the Nogoa River, Theresa and Retreat Creeks, and an extensive area of grey and brown calcareous soils carrying a dense stand of brigalow and yellowwood scrub. Of the above, the grey and brown calcareous soils and the alluvials offer great scope for agricultural development, the former being more important because of their extent. The residual sand ridges are utilised to a small extent for citrus growing.

TABLE 1.

ANALYSES OF SOME CENTRAL HIGHLANDS SOILS.

—	Black Earth Group.										
	Gindie (near Railway Station.)			Western 3, Peak Downs.			Upper Valley, Peak Downs.			Peak Downs Homestead.	
	0–2 Inches.	2–12 Inches	12–24 Inches.	0–2 Inches.	2–15 Inches.	15–36 Inches	0–1 Inches.	1–18 Inches.	18–24 Inches.	0–12 Inches.	12–24 Inches.
pH (H_2O)	7·2	7·2	..	7·5	7·6	7·7	7·4	7·4	7·8	6·6	6·5
Available P_2O_5 (p.p.m.)	477	372	..	212	218	206	62	61	167	385	200
Replaceable Bases (m.e. per 100 g.)—											
Ca++	75·9	77·0	..	53·9	53·4	51·9	35·5	39·6	41·5	67·0	69·0
Mg++	41·6	39·4	..	32·9	32·1	32·9	27·5	27·6	29·4	25·1	24·4
Na+	0·98	0·91	..	1·49	1·57	2·55	0·62	1·11	1·65	0·37	0·30
K+	0·98	0·87	..	1·72	0·95	0·51	1·05	0·54	0·69	1·10	0·30
Total	119·5	118·2	..	90·01	88·02	87·86	67·67	68·85	73·24	92·57	94·03
Replaceable Bases (per cent. of Total)—											
Ca	63·5	65·1	..	60·0	61·0	59·0	57·0	57·0	57·0	71·6	73·4
Mg	34·9	33·3	..	36·0	36·0	37·0	40·0	40·0	40·0	26·8	26·0
Na	0·8	0·8	..	0·2	0·2	0·3	0·1	0·2	0·2	0·4	0·3
K	0·8	0·8	..	0·2	0·1	0·1	0·2	0·1	0·1	1·2	0·4
Total Nitrogen (%)	..	..	..	0·092	0·074	0·070	0·084	0·078	0·056	0·157	0·118
Organic Carbon (%)	..	..	..	0·89	0·95	0·84	0·78	0·82	0·95	0·87	0·77
C/N	..	..	..	9·6	12·8	12·0	9·3	10·5	10·7	5·5	6·5
Free Carbonates as $CaCO_3$ (%)	..	..	..	..	0·21	0·36	..	0·14	2·55	1·5	1·6
Total P_2O_5 (%)	..	..	..	..	..	..	0·025	..	..	..	..
Moisture (%)	..	..	..	13·6	14·4	15·2	10·5	11·1	10·9	12·5	11·8
Mechanical Analysis—											
Loss on Acid Treatment	..	..	..	4·10	4·20	4·4	4·4	4·3	7·6	..	..
Coarse Sand (%)	2·0	2·0	2·1	0·16	0·12	0·16	0·88	0·88	0·56	2·1	0·7
Fine Sand (%)	10·2	20·2	12·5	3·88	3·80	1·56	10·2	8·32	10·6	6·3	6·9
Silt (%)	14·6	18·6	16·2	5·0	5·0	5·0	12·5	10·0	2·5	5·1	6·1
Clay (%)	67·5	35·8	62·6	75·0	75·0	75·0	63·5	68·3	61·0	67·6	71·1
Total (%)	101·0	102·5	99·8	101·6	102·5	101·3	102·0	103·1	102·2	..	..
Texture	Clay	Clay-clay loam	Clay	Clay	Clay	Clay	Clay	Clay	Clay	Clay	Clay

—	Brigalow Soils.					Brigalow-Yellowwood Scrub Soil.			Alluvial Soil.			Red Sandy Soil.	
	Weemah.			Minerva.		Emerald.			Codenwarra.			Yamala.	
	0–12 Inches.	12–24 Inches.	24–36 Inches.	0–12 Inches.	12 Inches. +	0–1½ Inches.	1½–15 Inches.	15 Inches. +	0–9 Inches.	9–14 Inches.	14 Inches. +	0–6 Inches.	6–48 Inches.
pH (H_2O)	7·0	..	..	8·1	..	7·6	8·2	..	6·5	..	..	7·1	..
Available P_2O_5 (p.p.m.)	46	..	..	168	..	28	11	..	169	..	..	56	..
Replaceable Bases (m.e. per 100 g.)—													
Ca++	20·6	..	..	21·3	..	40·1	32·1	..	12·5	..	..	4·8	..
Mg++	9·3	..	..	14·3	..	21·5	22·7	..	2·1	..	..	0·2	..
Na+	3·2	..	..	3·7	..	0·77	0·54	..	1·6	..	..	0·64	..
K+	0·42	..	..	0·31	..	0·37	0·21	..	0·92	..	..	0·48	..
Total	33·5	..	..	39·6	..	62·2	55·5	..	17·1	..	..	6·1	..
Replaceable Bases (per cent. of total)—													
Ca	61·5	..	..	53·8	..	64·4	57·7	..	73·1	..	..	78·7	..
Mg	27·8	..	..	36·1	..	34·4	40·9	..	12·3	..	..	3·3	..
Na	9·6	..	..	9·3	..	1·2	1·0	..	9·3	..	..	9·8	..
K	1·2	..	..	0·8	..	0·6	0·4	..	5·3	..	..	8·2	..
Total Nitrogen (%)	0·123	..	..	0·074	..	0·106	0·074	..	0·071	..	..	0·057	..
Free Carbonates as $CaCO_3$ (%)	..	..	..	3·3	..	0·15	0·68	..	..	..	..	..	..
Mechanical Analysis—													
Loss on Acid Treatment	4·0	4·1	3·9	7·7	7·1	1·8	2·8	6·2	2·4	4·0	3·2	1·0	1·3
Coarse Sand (%)	31·2	28·6	30·9	3·4	4·8	3·8	4·2	4·0	8·1	4·8	2·9	63·7	54·7
Fine Sand (%)	16·0	18·1	15·0	20·2	19·3	22·5	16·5	15·4	40·3	24·5	26·8	17·0	22·7
Silt (%)	11·5	10·1	10·4	14·7	14·5	11·9	12·7	11·9	22·5	19·1	19·1	3·0	3·6
Clay (%)	38·8	39·8	41·0	56·0	56·6	58·5	61·8	60·5	25·8	38·8	48·0	16·5	18·5
Texture	Clay loam	Clay loam	Clay loam	Medium clay	Medium clay	Medium clay	Heavy clay	Heavy clay	Loam	Light clay	Light clay	Sandy loam	Sandy loam

The alluvials are limited in extent, but those on the Nogoa River are likely to be more fully developed by irrigation. The surface soil is a grey-brown loam, overlying a grey-brown light clay at nine inches in depth.

The belt of brigalow and brigalow-yellowwood scrub grows on heavy calcareous clays which vary somewhat in their profile development. Where the yellowwood scrub dominates the vegetation, the soil surface is more friable and the soil tends towards a "brown chernosem" type. Where the brigalow dominates, the surface soil is less friable and the grey-brown, heavier-textured soil predominates. Typical profiles are as follows:—

Under Yellowwood Scrub.

Inches.	
0–1½	Brown clay mulch
1½–15	Brown heavy clay, friable
15–	Brown heavy clay, plastic

Brigalow Scrub—Weemah.

Inches.	
0–12	Dark-grey to black clay
12–36	Black clay with lime
36–48	Grey-black clay, with abundant lime
48–69	Mottled grey red-brown clay
69–	Red clay.

The chemical analyses of these soils are shown in Table 1. It will be noted that there is commonly a deficiency of phosphate in the brigalow soils, except where they are flooded, but, apart from that, they are of good fertility and of high moisture-holding capacity. The only drawback at present to their fuller utilisation is the necessity of clearing for cultivation purposes. It has been estimated that some 4,577,600 acres of this country exists in the Central Highlands alone. Throughout Queensland, some 23,000,000 acres of similar soil exists, of which 16,000,000 acres consist of dense timber untouched by the axe.

SORGHUM GROWING IN THE CENTRAL HIGHLANDS.

The present paper relates mainly to sorghum production. The climatic requirements of a grain sorghum crop are warm, moist conditions for germination and growth, with cool and relatively dry conditions for ripening and harvesting. Factors likely to be limiting in the Central Highlands area are:—

(*a*) Heat wave in January, combined with drought.
(*b*) Drought.
(*c*) Heavy midge attack in some years.
(*d*) Heavy smut infestation unless the seed is treated before planting.
(*e*) Early frosts in occasional years.

To this list might be added other factors affecting yields, such as poor germination and locust and mice plagues.

CLIMATOLOGY AND SORGHUM GROWING.

In introducing a discussion of meteorological data in relation to sorghum growing in the Central Highlands area, it must be stressed that records are not adequate to provide completely reliable information on growing seasons, daily rainfall, evaporation, frost incidence,

etc. The main deficiencies are in number of recording stations, evaporation data and figures with which a relationship between ground and screen minimum temperatures could be established.

The summary of climatological data for three towns in the Central Highlands area, shown as Table 2, has been prepared by the Commonwealth Meteorological Bureau.

TABLE 2.

SUMMARY OF CLIMATOLOGICAL DATA FOR CLERMONT, EMERALD, AND SPRINGSURE.

Factor.	Clermont.	Emerald.	Springsure.
Height above sea level (feet)	870	588	1,057
Mean maximum temperature (°F.)—			
January	93·6	94·3	93·1
July	73·0	72·9	70·9
Annual	85·2	85·6	83·8
Mean minimum temperature (°F.)—			
January	70·2	70·3	69·3
July	42·7	44·2	43·0
Annual	57·9	58·5	57·5
Mean relative humidity (9 a.m.)—			
January	61	62	60
July	66	65	58
Annual	60	61	56
Mean annual rainfall (inches)	26·7	24·5	26·0
Number of wet days annually	52	55	60

Rainfall and Sorghum Growing.

The average monthly distribution of rainfall at five centres to 1950 is as shown in Table 3.

TABLE 3.

MONTHLY DISTRIBUTION OF RAINFALL (INCHES).

Station.	Jan.	Feb.	Mar.	April.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Total.
Rolleston	4·08	3·38	2·58	1·56	1·20	1·80	1·31	1·03	1·16	1·60	2·56	3·20	25·62
Springsure ..	4·21	3·78	2·97	1·56	1·36	1·76	1·18	0·99	1·32	1·62	2·39	3·28	26·19
Emerald	4·12	3·40	2·97	1·42	1·07	1·35	1·11	0·85	1·01	1·42	2·19	3·33	24·61
Capella ..	3·89	3·13	2·61	1·26	0·89	1·52	0·90	0·55	0·81	1·26	2·23	3·40	22·45
Clermont	5·02	4·27	3·16	1·64	1·29	1·68	1·06	0·70	0·95	1·28	2·15	3·77	26·97

Years' Records—Rolleston 62, Springsure 82, Emerald 68, Capella 52, Clermont 80.

Seasonal distribution and reliability of summer rainfall are as shown in Table 4.

TABLE 4.

RAINFALL DISTRIBUTION AND RELIABILITY.

Station.	Average Distribution of Seasonal Rainfall.		Reliability of Summer Rainfall.		
	Summer Total.	Winter Total.	Chances of Receiving Less Than—		Range of Summer Rainfall.
			10 In.	15 In.	
	In.	In.	%	%	In.
Rolleston	16	8	14	42	10 to 20
Springsure	16	7	14	40	9 to 24
Emerald	16	6½	20	50	8 to 20
Capella	15	5½	25	50	6 to 20
Clermont	16	5½	14	37	8 to 24

The summer rains are made up usually of heavy storms and general rains. The storm rains are patchy. If properties are scattered throughout the region, therefore, there is a better chance of receiving a storm on at least one property than there is from having interests in one particular locality.

Plate 2.

Open Black-Soil Downs in the Gindie District. The grasses are Yabila grass (*Panicum queenslandicum*) and white spear grass (*Aristida leptopoda*).

Planting Rains.

It is assumed in the absence of actual soil moisture measurements that a minimum of 1.50 inches of rain within a week is required for sorghum or wheat planting. An examination of rainfall incidence during the 10 years, 1942-1951, showed the distribution of planting rains for Clermont, Emerald, Springsure and Rolleston to be as in Table 5.

TABLE 5.

DISTRIBUTION OF PLANTING RAINS, 1942–1951.

	10-Year Period.	Sorghum Planting, Oct. 1–Feb. 14.	Wheat Planting, Mar.-July.
	Times.	Times.	Times.
Planting rains at all 4 centres	25	12	9
Planting rains at 3 centres only	15	7	7
Planting rains at 2 centres only	18	8	6
Planting rains at 1 centre only	24	18	4

Thus only about one-quarter of the scattered planting rains which fall throughout the area actually fall on any one property or in one locality. The figures for each of the four centres for the 10-year period are as follows:—

	10–year Period.	Sorghum Planting.	Wheat Planting.
Clermont	50	29	16
Emerald	49	26	18
Springsure	56	31	19
Rolleston	53	23	20

An analysis of planting rains at Clermont during the period 1914-1949 is shown in Table 6.

TABLE 6.

PLANTING AND GROWING SEASONS FOR SORGHUM AT CLERMONT, 1914–1949.

Week.	Average Weekly Rainfall.	Percentage of Years in which Weekly Rainfall exceeds 150 Points.	Percentage of Years in which Weekly Rainfall exceeds 200 Points.	Average Rainfall during Growing Period if Planted this Week.
	Points.			Points.
Oct. 1– 8	21	3	3	1,132
9–10	33	3	Nil	1,303
17–24	42	9	6	1,357
25–31	21	6	3	1,439
Nov. 1– 8	74	20	12	1,465
9–16	52	9	6	1,490
17–24	57	9	11	1,524
25– 2 Dec.	74	20	14	1,498
Dec. 3–10	104	26	11	1,469
11–18	77	17	14	1,385
19–26	88	23	11	1,341
27– 3 Jan.	151	26	23	1,259
Jan. 4–11	103	20	14	1,123
12–19	103	29	20	1,037
20–27	132	26	26	970
28– 4 Feb.	192	31	29	878
Feb. 5–12	87	23	20	728
13–20	124	17	17	687

It is seen that for Clermont the main break in the season comes in the last week of November, with the best rainfall period during late December and January. Planting rains may occur at any time, but the greatest chance occurs in the December-February period, when most of the planting rains are heavy falls of over two inches for the week.

Moisture for Production.

Though some general ideas regarding the amount of moisture required to produce a sorghum crop in the Central Highlands are held, the only figures available are those for soil moisture and yield compiled by J. Hart (District Agriculturist of the Queensland-British Food Corporation). After two seasons' (1951 and 1952) measurements, he showed that a minimum of 7·50 inches of rain absorbed and held by the soil was required to produce a 27-bushel crop of Kalo grain sorghum. In both seasons the crop was planted late, and the moisture required would be somewhat less than that needed by a crop growing throughout the summer months. The evaporation figure was 1·9 inches during the growing period, giving a total of 9·4 inches of rainfall absorbed. If an average runoff of 5% is added, the total rain required approximates 10 inches under the conditions which obtained.

The actual amount of rain will depend on the condition of the land surface and the intensity of the falls of rain. From the table of seasonal distribution of rains for Central Highlands centres, it will be seen that the average summer rainfall is 15 or 16 inches, so there should be a good chance of retaining 7·50 inches if the land is reasonably receptive of rain. For a higher yield than 27 bushels, more rain would of course be required. In the Land Use Map of Queensland published

in the Annual Report of the Bureau of Investigation (1949) the 20-inch isohyet was adopted as a tentative limit below which cropping would be hazardous.

The chances of receiving less than 10 inches of rainfall during the summer are given as 25% for Capella, 20% for Emerald, and 14% for Rolleston, Springsure and Clermont. Fallowing in a rotation will assist in ensuring adequate moisture for the crop, but the fallow would need to be of about 14 months' duration to enable the conservation of summer rains from one summer to the next.

Plate 3.

Partly Ring-barked Brigalow (*Acacia harpophylla*) **and Yellowwood** (*Terminalia oblongata*) **Scrub Country near Weemah.** The tussocks are tufted brigalow grass (*Paspalidium caespitosum*).

The question of what constitutes an effective fall of rain during the growing period is one which requires further consideration in the Central Highlands area. In Queensland, the application of a Precipitation/Evaporation ratio established in southern Australia is not likely to give full satisfaction in view of the fact that high precipitation and high evaporation coincide in the summer months in northern Australia. Hart, working at Springsure, is endeavouring to establish a correlation between soil moisture, plant growth and yield. The Department of Agriculture and Stock has made a number of measurements at Biloela, just south-east of the Central Highlands area, and has reported a mean yield of 45 bushels from seven varieties of sorghum on a rainfall of 1.39 in. from planting to flowering when the soil was wet to 54 in. at planting, 32 bushels on a rainfall of 4.47 in. when the soil was wet to 30 in., and 75 bushels on 9.06 in. of rainfall, with the soil wet to 45 in. at planting.

In the absence of a reliable measure of effective rainfall for sorghum in the Central Highlands area, it is not possible to make a satisfactory estimate of the reliability of effective rainfall. Department of Agriculture and Stock workers, using criteria which they considered satisfactory for the growth of native pastures, set out the percentages of reliability of effective rainfall for various localities shown in Table 7. Though they are of doubtful value in sorghum-growing studies, they suggest that the Central Highlands centres have a greater affinity with

the western Darling Downs centres (Miles, Goondiwindi) than with the Darling Downs proper (Dalby, Pittsworth, Warwick) and that cropping results would not be so good as on the Darling Downs proper. However, if land use in the Central Highlands is based on agriculture plus grazing with sheep, cattle or pigs, meteorological conditions should be sufficient to provide stability.

TABLE 7.

PERCENTAGE RELIABILITY OF EFFECTIVE RAINFALL.

Station.	4 Wet Summer Months.	4 Consecutive Wet Summer Months.	4 Wet Summer plus 2 Wet Winter Months.	2 Wet Summer plus 2 Wet Winter Months.	2 Wet Summer plus 4 Wet Winter Months.
Clermont	79	76	62	78	34
Emerald	84	79	63	72	35
Springsure	82	77	59	68	33
Dalby	93	86	87	93	63
Miles	84	79	79	89	54
Pittsworth	97	93	93	96	71
Goondiwindi	75	63	70	91	66
Warwick	99	94	96	98	80

[TO BE CONTINUED.]

Triplet Calves.

THE triplet calves shown (two heifers and a bull) were born last year on the farm of Mr. A. A. Boag (Three Moon, Monto), which is managed by Mr. W. T. Morris as a share farmer. The dam was a fairly large A.I.S. grade cow and the sire a registered A.I.S. bull. The calves were normal and healthy and are pictured below at about a week old. The heifers weighed about 55 lb. at birth and the bull about 60 lb. The cow gave birth to twin calves at her previous calving. Two other sets of twins were born on the farm during the previous few months.

TUBERCULOSIS-FREE CATTLE HERDS.
(AS AT 28th FEBRUARY, 1953.)

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," Benair, *via* Kingaroy Sullivan Bros. " Valera " Stud, Pittsworth Reushle Bros., " Reubydale " Stud, Ravensbourne H. F. Marquardt, " Chelmer " Stud, Wondai W. G. Marquardt, " Springlands," Wondai A. C. and C. R. Marquardt, " Cedar Valley," Wondai A. H. Sokoll, " Sunny Crest " Stud, Wondai W. and A. G. Scott, " Welena," A.I.S. Stud, Blackbutt G. Sperling, " Kooravale " Stud, Kooralgin, *via* Cooyar C. J. Schloss, " Shady Glen," Rocky Creek, Yarraman W. H. Thompson, " Alfa Vale," Nanango
Ayrshire	L. Holmes, " Benbecula," Yarranlea J. N. Scott, " Auchen Eden," Camp Mountain " St. Christopher's and Iona " Studs, Brookfield road, Brisbane E. Mathie and Son, " Ainslie " Aryshire Stud, Maleny
Friesian	C. H. Naumann, " Yarrabine Stud," Yarraman
Guernsey	C. D. Holmes, " Springview," Yarraman A. B. Fletcher, Cossart Vale, Boonah W. H. Doss, Degilbo, *via* Biggenden
Jersey	Queensland Agricultural High School and College, Lawes J. S. McCarthy, " Glen Erin Jersey Stud," Greenmount J. F. Lau, " Rosallen Jersey Stud," Goombungee G. Harley, Hopewell, Kingaroy 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 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 W. S. Conochie and Sons, " Brookland " Stud, Sherwood road, Sherwood Estate of J. A. Scott, " Kiaora," Manumbar road, Nanango F. W. Verrall, " Coleburn," Walloon
Polled Hereford ..	W. Maller, " Boreview," Pickanjinnie

ANIMAL HEALTH

Bloat in Dairy Cattle.

G. I. ALEXANDER, Cattle Husbandry Officer.

BLOAT or tympany is due to the sudden accumulation of large quantities of gas in the paunch. The accumulated gas causes pressure on the diaphragm, difficulty in breathing, and obstruction of the circulation; rupture of the diaphragm or rumen may occur.

Dairy cattle appear to be more susceptible to bloat than beef animals or sheep. However, all are susceptible. There are two chief kinds of bloat, acute and chronic. Acute bloat is closely related to the feeding of the animal, young legumes being most frequently the cause. It has occurred on lucerne, burr medic, red and white clovers, and field peas. Moisture on the pasture is an important predisposing cause. Non-leguminous feeds (including rapidly growing ryegrasses, cabbage leaves, potatoes, rape, beets and grain alone) have also been incriminated as causing bloat. Acute bloat has even been recorded in calves fed on milk as the sole ration.

Chronic bloat is not necessarily dependent on feed conditions and the gas formation is more moderate and continuous. It is often due to weakness in the digestive organs, such as may be caused by tuberculosis. A swallowed nail or piece of wire may penetrate the wall of the stomach and the ensuing irritation and infection may cause chronic bloat.

Symptoms and Cause of Bloat.

The symptoms of bloat vary. Acute bloat is usually indicated by the following symptoms. There develops a prominent swelling and ballooning of the left flank, which rebounds and gives a dull sound when thumped. The cow is uneasy and nervous and she no longer chews her cud. As the pressure increases, the breathing becomes laboured; the nostrils are dilated and the mouth open; and the cow moans.

The feeds which cause bloat (such as green lucerne, rape and clover) actually do not produce as much gas as do dry hay and concentrates. Gas formation is a natural process in the paunch of the cow and is due to fermentation and bacterial action. The cause of the excessive accumulation of gas which produces bloat is associated with the absence of belching by the cow. This involuntary act serves as a safety valve to permit the escape of excess gases, the stimulus for this being provided by irritation of the stomach lining. After stimulation of the stomach lining, the opening of the oesophagus into the stomach relaxes at the next contraction of the stomach and permits a quantity of gas to escape from the paunch. Hay and mature grasses contain a great deal of fibre, while green legumes and young grass have little, and it is the high fibre content of the mature grass which provides the stimulus to the

stomach lining. For this reason hungry or greedy animals are most susceptible, as they quickly consume a large quantity of the bloat-producing feed and so the gas forms much more quickly than normally and the stimulus to the stomach wall is not sufficient to produce belching.

Frequently, acute bloat is associated with the formation of a frothy mass in the paunch. This is attributed to rapid fermentation in the paunch in the presence of a substance called saponin (found in lucerne), which lowers the surface tension of the fluids in the paunch. This foamy consistency of the material in the paunch is thought to be responsible for difficulty in belching.

Preventive Measures.

Hungry stock should not be put directly onto lucerne or other leguminous pasture unless it is mature. It is a good plan to graze cattle on a grass pasture or on Sudan grass before putting them on the legume. Sudan grass is especially effective in this respect. As an alternative to grazing on grass, the cattle may be fed some hay; maize silage is also claimed to be effective. It often happens, however, that the practice of feeding stock on roughage before putting them onto a legume breaks down, as after the routine has been established the cattle will wait until they are placed on the legume and then feed greedily. Under these circumstances, it is advisable to allow only short periods of grazing on the legume at first, especially if the legume is in a young stage, and gradually increase the grazing period as the stock become used to the legume.

Cattle provided with mixed grass and legume pasture are much less likely to bloat than those on legume alone. A good mixed pasture containing approximately equal parts of legume and grass prevents bloating, but it is difficult to maintain the desired balance throughout the year, and the grazing animal cannot be forced to consume equal amounts of grass and legume.

It is claimed in connection with beef cattle that gorging on lucerne is prevented by permitting the stock free access to a paddock of grass at the same time as the lucerne is being grazed. The cattle are claimed to soon overcome their craving for the lucerne and develop a pattern of grazing grass for a period, then lucerne for a period. However, this procedure is dangerous with dairy cattle.

A useful method of preventing bloat is to place a hay rack in the middle of the lucerne pasture. The rack should be placed so that the animals have to reach up to get the hay. The paddock should not be too large, and preferably strip grazing should be carried out, the rack being moved to each strip as it is grazed.

Lucerne and other legumes should not be fed while they are moist from dew or rain; this is especially important when the crop is in the young, actively growing stage.

None of the procedures mentioned above will guarantee freedom from bloat, but they all considerably lessen the risk of its occurrence.

Treatment.

When a cow becomes bloated, she should be treated promptly. In mild cases, keeping the mouth open with a gag or piece of wood until the beast has belched most of the gas through the mouth is often useful (Plate 1).

The cow may be drenched with a mixture of 2 tablespoonfuls of turpentine and 1-1½ pints of raw linseed oil (Plate 2). This is often effective in milder cases. It is sometimes advisable to follow this treatment the following day with a laxative such as Epsom salts (1 lb. dissolved in about 2 pints of water).

Plate 1.

A Small Wooden Gag is Sometimes Used in Treating Mild Cases of Bloat.

Plate 2.

Drenching with Turpentine and Raw Linseed Oil for a Mild Case of Bloat.

A new treatment which has been found to be very effective is the use of an antifoaming agent such as "Antifoamol." Turpentine has a similar action, but has the disadvantage of destroying the micro-organisms in the paunch with which it comes in contact. The newer anti-foaming agents, which act by raising the surface tension, do not have this side-effect. "Antifoamol" may be given as a drench, 100 c.c. being diluted in a pint of water. It is more effective when injected into the paunch, but this should only be done by a veterinary surgeon (Plate 3).

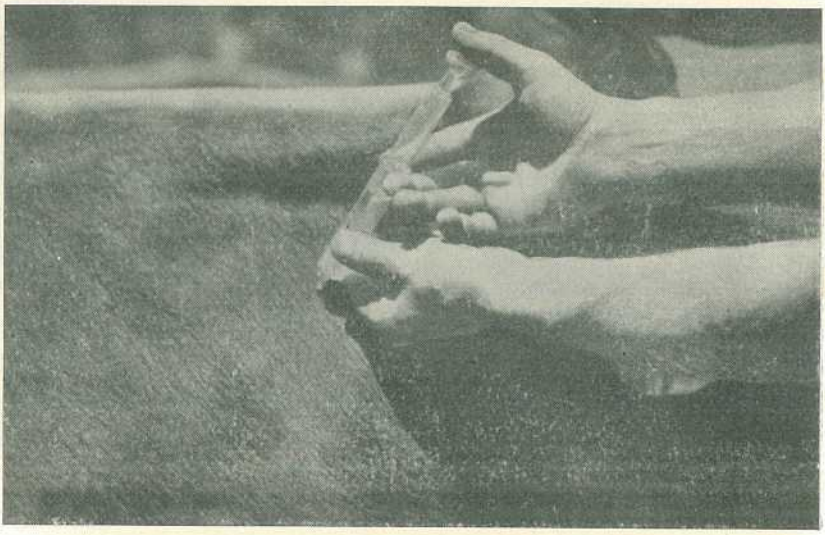


Plate 3.

An Anti-foaming Agent may be Injected into the Paunch in the Same Position as Puncturing with the Trocar and Cannula is Performed.

Plate 4.

In Case of Mild Bloat, a Length of Hose May be Passed Down the Paunch to Relieve the Distension. At the same time, the forequarters of the animal should be raised by walking it onto a step.

It may be possible to relieve the distention of the paunch by getting the cow to swallow one end of a short piece of garden hose, thus permitting gas to escape through it (Plate 4). The cow's mouth may be held open by means of a wedge or piece of wood, and the forequarters raised by leading the animal onto a step.

In extreme cases the paunch may be punctured by means of a trocar and cannula. The puncture is made on the left side of the flank midway between the last rib and the point of the hip bone, and about three or four inches below the edge of the loin bones (Plate 5). The

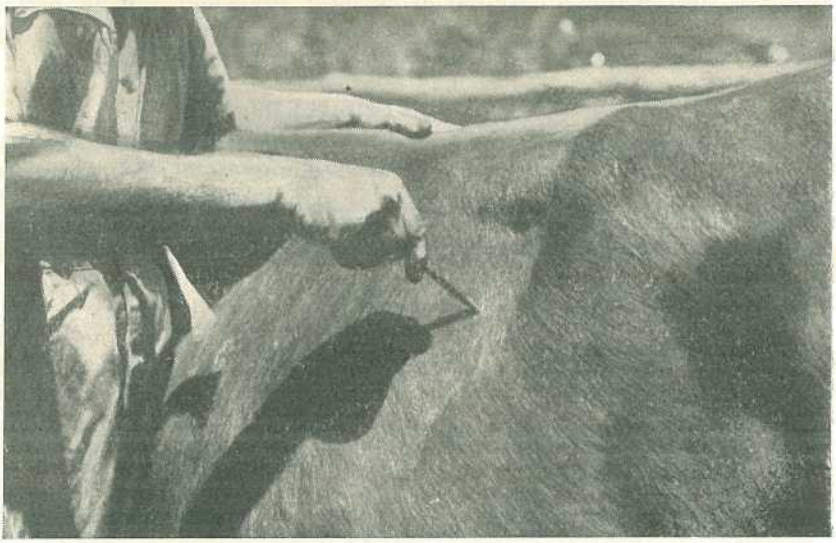


Plate 5.

In Severe Cases of Bloat, the Paunch may be Punctured by a Trocar and Cannula.

trocar is inserted downwards, forwards and inwards, and then withdrawn gradually so as not to allow too sudden an escape of gas through the cannula. The cannula should be held firmly against the skin. When withdrawing the cannula the trocar should be re-inserted and the skin should be pushed inwards away from the cannula as it is withdrawn to prevent as much as possible the escape of fluid from the paunch. Peritonitis is sometimes a sequel to this operation and it should be attempted only in case of emergency. The wound should be treated with sulphanilamide powder to control the infection which has occurred.

A veterinary surgeon should be consulted in cases of chronic bloat, as these require specialised attention due to the difficulty in deciding the cause and the special treatments required.

Blackleg.

C. R. MULHEARN, Director of Veterinary Services.

BLACKLEG, or black quarter, is an infectious disease of calves and young cattle and to a lesser extent of sheep. It is very common in Queensland and occurs practically every year in the coastal and sub-coastal country from the New South Wales border to Townsville.

The incidence varies from year to year, and in some years only a small number of cases are detected, whilst in others the outbreaks are very extensive and widespread and occur almost in epidemic form. The disease is also seasonal, in that it is most prevalent during certain periods of the year, such as summer and autumn in southern Queensland and autumn and winter in North Queensland.

ANIMALS AFFECTED.

Calves from about 4 to 18 months old are chiefly affected with the disease, but cases also occasionally occur in young cattle up to two years old and sometimes even in older animals. All classes of animals may be affected, but the biggest and strongest calves appear to be more susceptible. Often well-grown bulls are the first animals to die. As the disease usually follows beneficial seasonal conditions, most animals are in good condition when outbreaks occur.

The disease has been reported from sheep in Queensland, and young rams appear to be most susceptible. The symptoms assume a slightly different form in sheep, and the changes are chiefly confined to the head and neck.

The disease is caused by bacteria, but it is not directly contagious from animal to animal. When a beast becomes affected the organisms multiply in certain parts of the body, and when the animal dies, as most usually do when affected with this disease, the bacteria which are present in millions through the carcase become scattered over the surrounding areas as the carcase decomposes or is broken up. The bacteria, on being exposed, form spores—that is, they become enclosed in a protective covering—and in this condition they remain highly resistant to outside agencies, such as sunlight and cold, and they continue to be infective for years. They remain in the soil, and at some subsequent period may be carried upon blades of grass or through some other agency gain entrance to an animal's body, and cause a fresh case of the disease. It is therefore easily understood how a pasture becomes contaminated and why outbreaks of blackleg regularly occur in certain paddocks. The more cases that occur, particularly if the carcases are not adequately disposed of, the greater will be the risk of infection in these areas in subsequent years.

SYMPTOMS.

The bacteria must gain entrance to the calf's body before the disease can develop, and it is thought that this may happen through injuries in the legs or lower extremities or through small abrasions in the mouth, stomach, or intestines. It is considered that the wounds on rams' heads resulting from fighting are a common means by which they gain entrance to the system in these animals.

When the causal organism enters the body it becomes established in one of the large muscle groups, such as the hindquarters, forequarters, or neck, and produces the changes which give rise to the disease.

As the disease is very sudden in onset and may kill the animal in less than 24 hours, it frequently happens that no symptoms are detected; an animal which is apparently healthy one day may be found dead the next. However, some animals may last up to 48 hours between onset of sickness and death and an occasional animal may even recover.

Fever is usually present in some degree before any change is noticeable in the animal. Dullness and depression become obvious, and if the temperature is then taken it will be found to be several degrees above normal and may be from 104° to 106° F. Muscular tremors may also be noticeable, and when the animal is moved, pronounced lameness in either the hind or forelimbs will be evident. On closer examination a swelling will be detected in one of the groups of muscles, usually in the hindquarters, but sometimes along the belly or about the forequarters. This swelling may at first be small, but within a matter of hours it becomes enlarged and extensive and is very painful. At a later stage, and usually just before death, the skin over the swelling becomes dark and dry with a parchment-like consistency. If the swelling is manipulated it will "crackle," due to the presence of gas and fluid in the underlying tissues. On being opened (an unwise procedure) a dark, frothy, sour-smelling liquid will drain away.

Following the early symptoms the animal discontinues feeding, shows dullness, rapid breathing followed by exhaustion, loss of consciousness, and death, with little or no signs of struggling. Death is actually caused by the circulation through the system of poisonous substances (toxins) produced by the bacteria within the swelling described above.

POST-MORTEM FINDINGS.

The post-mortem findings are important in connection with the diagnosis, as it frequently happens that the animals are found dead without showing symptoms, and an immediate diagnosis is desirable in order that the necessary preventive measures can be undertaken. As the disease usually occurs when putrefaction sets in rapidly, one finds the affected carcase to be badly "blown" within a few hours of death, due to the formation of gas under the skin. This causes the legs on the upper side of the carcase to extend straight out. However, if the body is closely examined it is possible to find the seat of the trouble in the form of a swelling which "crackles" under pressure of the hand. This crackling is quite distinctive and is not found in other parts of the body. If this area is opened it will be found to contain a dirty blackish, frothy fluid mixed through the tissues. The muscles are also much darker than normal, and the whole area is not unlike a bad bruise. There is a distinctive smell in this lesion which is quite different from the smell of an ordinary decomposing carcase and which has been described as resembling rancid butter. The presence of these changes in the carcase of an animal under two years is sufficient to warrant a diagnosis of blackleg and the immediate institution of preventive measures. It is not wise to open up the carcase, as the body discharges become scattered, and with them the organisms, which may give rise to outbreaks of the disease in later years. However, should the body of a recently dead animal be opened up, one usually finds up to half a gallon of bloodstained fluid in the abdominal cavity and the liver and kidneys are congested and swollen.

TREATMENT.

It is rarely possible to treat animals affected with blackleg because of the rapid course of the disease, but where possible, treatment with

penicillin by subcutaneous (under the skin) or intra-muscular (into a muscle) injection may be of value. The sick animal should be held in the shade and given ample supplies of water.

Prevention of the disease is the only effective way of controlling it and this is aimed at by (*a*) protecting the animal from being exposed to infection, and (*b*) protecting the animal by building up its resistance to the disease.

Prevention of Exposure to Infection.

The bacteria responsible for blackleg multiply in enormous numbers within the diseased animal's body, and are scattered when the carcase is opened up. The organisms form spores, which may live for very many years in the soil and still be responsible for fresh outbreaks of the disease. Unless the carcases of animals dying of the disease are properly disposed of, the soil and pastures in the vicinity become grossly contaminated with the infection, outbreaks of the disease regularly occur, and the area becomes more heavily charged with infection each year until it becomes recognised as a "hotbed" of the disease.

Whenever possible, carcases should be destroyed by burning. The carcase should be moved as little as possible and it should not be opened, as the body discharges will scatter the germs. If burning is not possible, deep burial and thorough disinfection are recommended.

Prevention by Inoculation.

This is the best method of control, and in areas where the disease regularly occurs, preventive inoculation of all young cattle should be undertaken each year.

Time to Inoculate.

Although cases of blackleg may occur at any time of the year, the disease is usually more active during the autumn and winter months; in southern Queensland this period of activity is usually reached earlier than in the north. Inoculation should be designed to give protection over this important period. The decision as to whether regular yearly or intermittent inoculations are carried out will depend on the history of the disease in the individual area.

Age to Inoculate and Duration of Immunity.

The development of immunity depends upon the reaction of a special system in the body to the products of bacterial activity introduced into the tissues by inoculation. It is considered that to achieve a full immunity, a calf should be six months old at the time of inoculation. However, it may be necessary to inoculate before this age; in this case the duration of immunity may be shorter, and it is desirable to re-inoculate if another wave of the disease appears. The immunity is achieved about two weeks after inoculation and persists for about 18 months to two years. It gradually wanes, so an animal inoculated at six months may have lost its immunity by two years. However, by this time the animal is in an age group which is not usually susceptible to the disease, though in some outbreaks older animals are affected. In such a case, it may be necessary to inoculate again at this time.

It is usually thought that inoculation gives immunity for life, but this is not the case.

Types of Vaccine.

Muscle vaccine—This is of historical interest only, but consisted of affected muscle tissue sterilized and dried, then ground into powder, suspended in water and injected.

Aggressins.—These are a refinement on the above procedure and are prepared by growing the bacteria in a culture in the laboratory. The bacteria are filtered out, leaving a clear, sterile liquid which contains the poisonous substance which the bacteria generate in the process of growth. This is called an exotoxin, and is the most powerful factor in causing death in blackleg. The aggressins may be liquid or solidified by evaporation. By introducing this substance in small quantities, the mechanism of the body which combats the poison is brought into action, and is in a state of readiness against natural infection.

Whole culture vaccines.—These are prepared in the same way as the aggressins except that the bacteria are allowed to remain in the solution and are killed by sterilization. Thus a whole culture vaccine consists of an aggressin plus the dead bacteria, and should give a more complete immunity in that a reaction is set up in the body against the poison actually contained in the bacteria, the endotoxin. This is less important than the exotoxin, but nevertheless plays some part.

Alum-precipitated whole culture vaccines.—These are whole culture vaccines to which alum has been added, and they are milky in appearance due to precipitation. This vaccine is absorbed slowly from the site of injection, and therefore should give a more lasting immunity. This is the type of vaccine prepared by the Commonwealth Serum Laboratories.

Factors causing a Breakdown in Immunity.

Age of inoculation—Inoculation of the calf when too young, before the protective mechanism is properly developed. If a calf is inoculated at three to four months of age, it may need re-inoculation in four to six months.

(*b*) *Type of vaccine.*—Any of the vaccines mentioned above should be quite effective in controlling the disease. However, the vaccine should preferably be prepared from a strain or strains of the organism similar to that which is causing losses in the area concerned.

(*c*) *Waning of immunity.*—The immunity will not last indefinitely and where an outbreak is affecting older cattle, re-inoculation of 2-year-old stock may be required.

(*d*) *Inoculation.*—The vaccine must not be too old. Information is given on the package regarding the date up to which the vaccine may be used, and this should be strictly adhered to. Care should be taken to administer the correct dose to each animal, otherwise consistent results cannot be expected.

Green Cestrum—A Plant Poisonous to Stock.

D. W. LAVERS, Veterinary Officer, Division of Animal Industry.

GREEN cestrum (*Cestrum parqui*), a shrub introduced from South America, has become a common naturalised alien in south-eastern Queensland, especially in vacant allotments around towns; it is sometimes cultivated as a hedge plant. The plant is responsible for some deaths of livestock every year and stock-owners are advised to be able to recognise it and take the necessary steps to prevent stock from eating it.

The shrub stands 4-5 ft. high and suckering occurs very freely from the base. The leaves, which have a rather offensive odour when crushed, are 2-4 in. long and on a leaf stalk of about a quarter of an inch. They are arranged alternately on the stem. The flowers are in bunches and are yellowish green, or sometimes somewhat brownish in colour. The fruits are black, shiny, and egg-shaped, about $\frac{1}{3}$ in. long, with seeds embedded in a juicy, dark-purple pulp.

Animals require only a small quantity of the plant to show some toxic effects. Horses, as a rule very selective grazers, seldom touch the plant and only a few cases of poisoning in horses have occurred Cattle and sheep, however, will eat it if fresh feed is scarce, even if they are fed on chaff. It is taken particularly in the late winter and during frosty weather. In addition, cases of poisoning have occurred in pigs and fowls.

Symptoms of Poisoning.

Affected animals are feverish and have poor appetite and increased thirst. Severe irritation to the bowel causes intense abdominal pain and a bloodstained scour, particularly in the more prolonged cases. Excitement with charging sometimes occurs, and death is preceded by a general paralysis. The rapidity of onset of these symptoms is dependent on the quantity consumed and the individual susceptibility of the animal. Usually death occurs only a few hours after the first signs of sickness appear; thus animals are often found dead without any symptoms having been seen.

Bloodstained fluid is often seen at the nostrils and the anus after death, and the carcase usually "blows up" quickly. Post-mortem examination reveals a severe gastro-enteritis, a large quantity of free blood mingling with the bowel contents. Haemorrhages occur throughout the body tissues, particularly on the outer membrane of the bowel.

Treatment of Affected Animals.

No treatment is particularly effective for poisoning by green cestrum. On general grounds, however, the use of Condy's crystals can be recommended. As much of the crystals as can be placed on a half-penny piece is dissolved in 1½-2 pints of water and given as a drench. Immediate action should be taken, of course, to prevent access to the suspected plants by other stock either by removing them to another paddock or by erecting a temporary fence around the plants.

Eradication of Plant.

The plant is seldom particularly abundant and eradication by hand is the most effective means of control. Many types of sprays, including the non-poisonous hormone group, have been tried, but on the whole

Plate 1.

Fruiting and Flowering Stems of Green Cestrum.

have been unsatisfactory. The parent plant should be pulled out or cut off below soil level. Numerous suckers will come up from the old roots and these will have to be chipped or hand-pulled regularly until the roots become exhausted. It may take as long as five years before the plant is finally destroyed.

In south-eastern Queensland, where green cestrum grows most abundantly, stock-owners should take the greatest care to prevent trouble occurring. Paddocks, particularly vacant allotments around towns, should be carefully inspected before stock are allowed in to graze. With a little care, serious losses and expense can be avoided.

A Preliminary Survey of Dairy Sires.

S. E. PEGG, Chief Adviser, Herd Recording Section.

THE survey of sires which was first reported in the report on pure-bred herd recording for the year 1949-50 is still in its preliminary stages, and the data up to June 1952 are reported here in the same manner as in the two previous reports.

With a view to providing a means of comparing the various sires, the average production of all recorded daughters is given, together with the average "maturity equivalent" butterfat production. The "maturity equivalent" factors used are those published in the 1950-51 report. As mentioned in that report, no factors were then available for the Ayrshire, Guernsey or Friesian breeds. This year, in response to appeals by a number of breeders and in order to give some degree of comparison, the Ayrshire bulls have been compared by the use of A.I.S. factors and the Guernseys by means of the Jersey factors. It is realised that the use of these factors is arbitrary, as there is no evidence to show that they are correct for the breeds mentioned; but, as previously mentioned, they have been used in response to appeals by breeders.

The factors used are:—

	A.I.S.	Jersey.
2-year-olds	1.40	1.35
3-year-olds	1.20	1.15
4-year-olds	1.10	1.05

It should be realised that the use of "maturity equivalent" factors will favour early-maturing animals and penalise late-maturing animals, but at present it offers a means of comparing productions at various ages.

In order to draw attention to those sires whose daughters have a "maturity equivalent" average production of 400 lb. butterfat or over, the name of the sire is printed in heavy black letters.

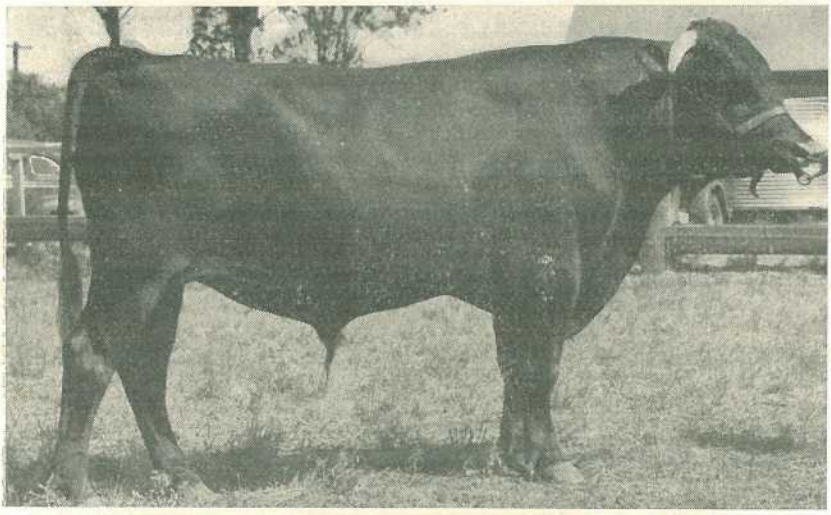


Plate 1.

"Valera Monarch," owned by Messrs. Sullivan Bros., "Valera," Pittsworth. This bull appears in the list of sires for the first time. Ten 2-year-old daughters have averaged 286 lb. butterfat, with a maturity equivalent of 400 lb. butterfat.

[Photo. by "Queensland Country Life."

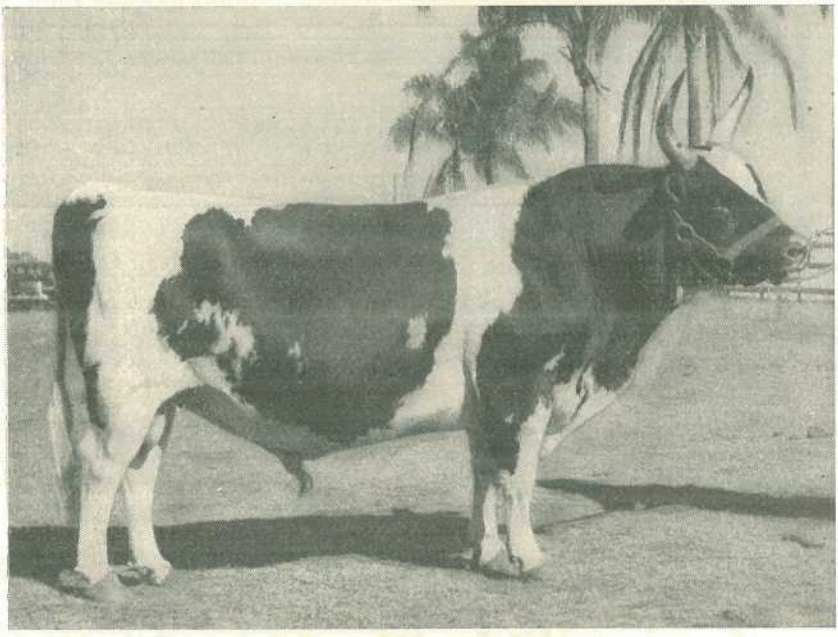


Plate 2.

"Oatlands Duke," owned by Mr. J. N. Scott, "Auchen Eden," Camp Mountain. Sixteen of his daughters have averaged 314 lb. butterfat and the "maturity equivalent" is 426 lb.

[Photo. by "Queensland Country Life."

AVERAGE PRODUCTION OF DAUGHTERS OF SIRES.

Sire.	Herd Book. No.	Average Production of Daughters in Various Age Groups.												Average of All Recorded Daughters.					
		2-Year-Olds.			3-Year-Olds.			4-Year-Olds.			Mature.								
		Lactations.	Milk.	B.Fat.	Lactations.	Milk.	B.Fat.	Lactations.	Milk.	B.Fat.	Lactations.	Milk.	B.Fat.	No.	Lactations.	Milk.	Test.	B.Fat.	Ma. Eq. B.Fat.
			Lb.	Lb.		Lb.	Lb.		Lb.	Lb.		Lb.	Lb.			Lb.	%	Lb.	Lb.
A.I.S.																			
Alfa Vale Nigel	6,439	9	7,176	291	7	7,450	302	2	8,137	307	1	11,674	445	16	19	7,410	3·99	296	378
Alfa Vale Plumber	1,345	3	7,185	294	5	6,917	287	4	8,135	345	9	8,005	317	16	21	7,742	3·95	306	358
Alfa Vale Pride 2nd	5,441	38	7,424	312	8	8,507	362	8	8,062	328	4	11,726	505	45	58	7,717	4·22	326	428
Alfa Vale Pride 3rd	4,515	14	6,398	268	6	6,400	267	4	6,978	308	1	7,976	309	22	25	6,495	4·17	271	354
Alfa Vale Re-Nell	384	12	6,945	272	10	8,022	317	5	7,690	302	3	10,692	434	24	30	7,495	3·96	297	369
Arolla Limerick	6,474	22	5,649	236	2	6,433	253	1	9,553	321	..	..	..	23	25	5,783	4·13	239	328
Bingleigh Jean's Monarch	6,579	6	7,831	365	7	9,809	409	1	5,962	217	3	11,610	445	11	17	8,635	4·31	372	468
Bingleigh Royal	6,582	3	6,574	268	3	8,321	322	5	7,252	282	1	10,583	448	10	12	7,213	3·91	282	340
Blacklands Count	3,724	17	7,266	293	9	8,624	339	2	10,047	398	3	12,496	512	26	31	8,144	4·01	327	417
Blacklands Czar	3,045	5	6,327	266	5	7,711	315	4	8,930	344	3	9,466	362	16	17	7,993	4·13	330	380
Blacklands Emblem	4,592	11	8,021	332	1	9,797	388	1	6,372	229	2	7,774	295	15	15	8,063	4·02	324	428
Blacklands Jean's Victory	5,528	12	7,344	309	3	7,646	301	..	..	..	2	9,046	374	15	17	7,507	4·17	313	414
Blacklands Prospector	37	30	7,743	302	12	8,325	317	1	7,005	277	9	11,302	466	45	53	8,238	3·91	322	416
Burradale Byron	1,258	10	10,161	389	2	14,041	514	1	9,025	367	1	10,980	403	14	14	10,693	3·45	369	540
Corunna Supreme	3,118	20	7,004	275	6	8,620	334	4	9,911	414	6	9,585	396	27	36	7,869	4·08	321	404
Dnalwon Count	2,016	7	6,026	225	3	7,847	282	2	8,342	311	2	8,917	312	13	14	7,095	3·66	260	325
Dnalwon Felix	5,639	9	6,670	237	4	7,836	276	1	8,967	284	3	10,184	367	14	17	7,361	3·61	266	334
Dulcamah Disraeli	3,150	9	5,514	231	1	8,003	326	3	7,281	321	4	8,824	354	13	17	6,501	4·20	273	333
Fairholme Lewis	6,825	9	6,355	287	2	6,257	294	..	..	..	..	..	..	11	11	6,337	4·54	288	393
Fairthorn Rainbows Prince	6,834	22	6,307	238	2	7,495	265	..	..	..	..	..	..	23	24	6,237	3·77	235	326
Fairvale Ensign	5,716	3	6,564	258	3	9,606	365	2	9,078	347	7	9,129	363	13	15	8,547	3·88	332	374
Fairvale Jellicoe	8,082	16	6,929	304	1	8,109	403	1	9,563	390	..	..	..	17	18	7,153	4·40	315	420
Fairvale Jeweller	9,324	19	5,803	239	3	6,148	269	2	7,760	335	..	..	..	20	24	6,089	3·98	243	333
Fairvale Major	4,816	8	7,106	300	6	7,758	311	6	7,519	322	13	9,571	416	23	33	7,960	4·25	338	389
Fairvale Reward	6,837	2	6,307	281	7	6,566	277	6	6,812	292	6	6,339	260	13	21	6,734	4·22	284	332
Glengallen Major	1,551	6	6,848	280	4	6,674	272	2	7,607	319	2	7,557	308	13	14	7,017	4·13	290	359
Glengarry Gems Royal	4,854	2	7,437	320	5	7,342	345	1	6,613	305	18	8,150	389	25	26	7,870	4·73	372	397
Greyleigh Eros	2,193	18	6,878	271	9	9,347	326	7	10,542	398	9	11,981	445	27	47	8,638	3·86	333	407
Greyleigh Honorarium	321	3	8,824	275	1	10,246	370	5	9,911	335	10	10,948	383	12	19	9,903	3·31	328	368
Greyleigh Valiant	666(I.)	5	9,054	341	9	10,480	403	3	10,035	400	5	9,288	359	19	22	9,676	3·88	375	448
Hillview Premier 2nd	1,653(I.)	4	6,797	270	7	7,819	314	1	9,131	343	..	..	..	10	12	7,494	3·98	298	372
Jamberoo Banner	8,299	12	5,733	235	1	7,185	306	2	5,512	206	..	..	..	13	15	5,778	4·07	235	318
Kilburnie Royalist	3,306	8	6,500	265	5	8,404	292	1	7,072	279	1	7,976	321	13	15	7,372	3·80	280	358
Kyabram Masterpiece	7,094	1	6,657	257	2	7,228	282	3	8,377	314	1	10,579	333	12	17	7,050	3·77	266	346
Midget's Sheik of Westbrook	1,511(I.)	27	6,972	281	9	8,117	337	1	6,944	319	8	7,853	309	37	45	7,167	4·07	292	368
Mountain Camp Joker	5,979	17	5,292	210	2	6,159	240	..	..	..	..	..	..	17	19	5,362	3·97	213	295
Murray Bridge Florrie's Prince	7,210	4	6,671	273	4	7,631	318	6	9,339	353	3	8,786	361	12	17	8,039	3·95	318	372

Navillus Prince Henry	6,013	5	6,480	320	8	7,304	288	6	8,417	336	7	10,248	393	18	26	7,814	3·93	307	356
Newstead Musician	8,476	6	6,755	281	3	7,930	300	..	..	..	1	8,724	333	10	10	7,304	4·00	292	378
Newstead Reliance	5,080	10	7,164	309	9	7,600	319	3	9,021	383	1	9,386	357	20	23	7,578	4·24	321	408
North Glen Emblem	2,522	14	7,491	295	7	8,168	338	5	8,978	354	2	14,604	542	17	28	8,077	4·04	326	414
Parkview Highbrow	6,077	6	6,531	266	2	7,946	328	2	7,861	324	1	10,411	382	10	11	7,161	4·07	292	372
Parkview Limerick	5,110	24	6,861	270	6	9,026	366	3	10,759	401	2	9,658	395	27	35	7,495	3·95	296	388
Patrol of Cosy Camp ..	1,258(L.)	3	7,218	284	2	6,789	256	3	9,076	355	6	9,954	384	11	14	8,559	3·89	333	376
Penrhos Blossom's Prince ..	2,577	5	8,265	322	3	6,217	265	2	8,569	334	3	8,207	390	11	13	7,634	4·07	311	374
Penrhos Pansy's Pride	4,265	7	9,809	425	10	11,543	500	3	11,307	492	4	13,994	578	21	24	11,364	4·27	485	578
Penrhos Pansy's Prince	3,455	15	6,693	260	8	5,683	238	..	..	..	6	7,894	325	24	29	6,599	4·00	264	337
Reward of Fairfield	1,769	27	9,270	380	18	11,093	464	12	13,077	552	32	14,188	585	45	89	11,197	4·12	461	535
Rocklea Comet	8,627	12	5,803	213	..	..	..	1	4,463	180	..	..	..	12	13	5,807	3·67	213	296
Ronnoc Emblem	7,409	5	7,099	307	4	6,619	271	5	6,441	264	7	8,545	339	20	21	7,272	4·11	299	347
Rosenthal Lilac 4th's Emblem ..	7,426	7	6,752	282	1	6,150	274	2	7,720	303	1	7,590	319	11	11	6,949	4·14	288	371
Rosenthal McArthur	8,461	14	6,125	241	5	5,818	231	2	4,823	191	..	..	..	19	21	5,960	3·93	234	319
Rosenthal Musketeer	5,214	11	6,764	267	3	7,269	297	1	11,981	503	3	8,726	362	14	18	7,555	4·06	307	387
Rosenthal Pendant's Prince ..	564	18	5,655	225	7	6,540	261	5	7,323	288	8	9,553	410	36	38	6,953	4·07	283	340
Rosenthal Perfection	5,216	7	6,525	261	3	7,519	305	4	8,996	336	7	7,975	347	15	21	7,678	3·97	305	357
Rosenthal Surplus 2nd	683	6	5,990	245	9	8,332	334	4	9,682	394	3	9,661	389	16	22	7,765	4·02	312	376
Rosenthal Surprise	5,222	7	5,893	241	3	7,412	304	..	..	..	1	6,643	342	10	11	6,442	4·02	259	343
Sunlit Farm King Billy	4,376	12	6,480	271	1	7,519	298	1	7,402	289	1	9,903	364	15	15	6,972	4·02	280	373
Sunlit Farm Madam's Victory ..	8,686	12	6,596	258	..	..	..	1	9,324	366	..	..	..	12	13	6,823	3·91	267	356
Sunnyview Artist	3,535	19	5,841	242	2	8,024	333	3	7,667	335	1	8,729	389	22	25	6,278	4·19	263	349
Sunnyview Commodore	2,752	6	9,245	372	4	13,045	557	..	..	..	3	9,408	401	13	13	10,452	4·16	435	538
Sunnyview Kitchener	7,488	5	9,020	418	3	8,701	355	1	9,652	366	1	12,572	519	10	10	9,793	4·12	404	522
Sunnyview Royal National ..	7,493	8	6,890	273	5	7,988	347	4	7,993	331	1	9,185	386	16	18	7,210	4·09	295	375
Sunnyview Spearvale	8,704	10	7,064	276	8	8,453	332	4	7,771	321	..	..	..	22	22	7,698	3·96	305	385
Tabbagong Victory	8,729	33	6,654	265	8	8,938	308	..	..	..	..	..	..	29	41	6,741	4·11	277	368
Tara Governor	6,297	9	7,046	263	2	9,282	332	1	11,013	378	3	10,570	384	12	15	8,183	3·65	299	379
Treviac General	2,889	14	6,513	253	5	6,286	297	2	8,602	367	..	..	..	20	21	6,535	4·04	265	350
Trevor Hill Bosca	5,351	27	7,332	299	7	8,307	335	9	8,315	338	9	10,182	419	39	52	7,619	4·04	308	393
Trevor Hill Progress	5,353	12	6,386	264	1	7,494	308	..	..	..	..	..	..	12	13	6,479	4·14	268	374
Trevor Hill Reflection	3,583	19	6,844	290	15	7,498	307	8	9,326	320	8	7,987	350	41	51	7,593	4·20	319	393
Valera Daphne's Prince 2nd ..	7,588	6	4,926	188	3	6,106	227	4	6,308	231	1	6,503	251	12	14	5,494	3·77	207	258
Valera Monarch	10,054	10	6,806	286	..	..	..	..	..	..	..	..	..	10	10	6,806	4·20	286	400
White Park Ronald	3,607	7	5,898	236	3	5,702	236	2	8,770	373	3	9,118	369	11	15	7,053	4·04	285	339
AYRSHIRE.																			
Benbecula Marquis	11,670	9	4,912	197	4	7,078	278	4	8,304	320	2	8,658	340	15	19	6,041	3·95	239	302
Benbecula Bonnie Willie ..	9,479	4	9,193	347	9	9,176	354	1	6,535	292	3	10,021	360	13	17	8,975	3·84	345	420
Crescent Farm Bell Boy ..	12,557	11	6,739	268	..	..	..	..	..	..	..	..	..	10	11	6,739	3·99	268	340
Myola Bessemer	11,224	10	5,447	214	6	7,278	282	3	5,949	237	5	6,966	285	18	24	6,082	4·01	244	294
Myola Jellicoe	10,568	15	6,107	249	17	6,647	265	8	7,217	394	13	7,027	283	44	53	6,670	4·05	270	326
Myola Perfection	11,936	9	5,665	230	2	5,895	289	1	6,788	253	..	..	..	11	12	5,835	4·16	243	327
Oatlands (Q.) Dan	11,941	7	6,483	274	3	7,412	331	3	8,188	357	..	..	..	10	13	6,928	4·27	296	388
Oatlands (Q.) Duke	11,230	13	7,059	308	5	6,033	249	..	..	..	..	..	..	16	17	7,257	4·33	314	426
GUERNSEY.																			
Fairfield Winner	4,857	10	5,151	241	10	6,291	288	10	6,175	298	4	6,547	302	28	34	5,929	4·69	278	318
Laureldale Pluto	4,211	1	5,928	285	3	6,001	282	3	5,206	272	9	6,051	310	12	16	5,833	4·51	263	313
Laureldale President	1,944	5	6,094	282	2	5,859	317	1	12,125	550	5	8,216	407	10	13	7,060	4·83	341	392
Laureldale Pride	8,832	27	4,906	228	4	5,158	226	..	..	..	..	..	..	29	31	4,968	4·61	229	306
Linwood Hurricane	8,845	17	5,353	247	1	5,344	261	2	6,410	293	..	..	..	16	19	5,398	4·63	250	329
Minnamurra Topsey's Sequel 2nd ..	5,095	12	6,400	324	9	6,719	348	4	9,285	435	9	8,047	409	22	34	6,733	5·03	339	402
Warrawong Winter	4,535	16	6,432	306	11	6,428	314	4	7,784	345	6	6,196	279	28	37	6,483	4·78	310	382

AVERAGE PRODUCTION OF DAUGHTERS OF SIRES.

Sire.	Herd Book. No.	Average Production of Daughters in Various Age Groups.												Average of All Recorded Daughters.					
		2-Year-Olds.			3-Year-Olds.			4-Year-Olds.			Mature.								
		Lactations.	Milk.	B.Fat.	Lactations.	Milk.	B.Fat.	Lactations.	Milk.	B.Fat.	Lactations.	Milk.	B.Fat.	No.	Lactations.	Milk.	Test.	B.Fat.	Ma. Eq. B.Fat.
			Lb.	Lb.		Lb.	Lb.		Lb.	Lb.		Lb.	Lb.			Lb.	%	Lb.	Lb.
JERSEY.																			
Aerofoyle of Banyule	3,181	3	5,794	293	3	6,505	352	2	7,616	402	4	8,516	496	10	12	7,003	5·49	385	431
Austral Park Double Blue	15,633	18	5,362	281	3	7,621	405	2	3,682	214	1	6,361	326	20	24	5,632	5·26	296	390
Avon Real Star (Imp.)	16,488	12	4,950	263	4	6,330	319	1	6,566	332	..	..	..	13	17	5,219	5·27	275	357
Belgonia Flashlight	15,354	15	4,739	246	3	4,757	249	..	..	..	..	..	..	17	18	4,741	5·19	246	344
Belgonia Lady's Duke 2nd ..	9,513	16	5,580	277	1	5,453	262	3	5,549	293	3	8,170	413	20	23	5,963	5·03	300	374
Belgonia Peggy 9th's Duke ..	7,429	14	5,114	258	3	6,465	339	1	3,910	207	..	..	..	14	18	5,118	5·10	261	343
Bellgarth Stylish	10,878	13	5,861	328	8	6,081	343	11	6,300	347	23	7,033	396	18	55	6,237	5·56	347	400
Belmont Royal Peer	15,243	22	4,064	201	1	4,594	224	..	..	..	..	..	..	22	23	4,062	4·97	202	271
Brampton Daffodil's Peer ..	11,760	13	4,599	249	2	5,150	283	2	5,878	299	5	6,509	346	15	23	4,970	5·45	270	337
Brooklands Merry Monarch ..	13,940	12	5,427	283	2	5,443	279	1	8,393	452	..	..	..	11	15	5,603	5·05	283	337
Brooklands Regalia	14,490	16	5,280	292	3	6,171	343	2	6,811	364	1	6,338	319	16	22	5,570	5·49	306	394
Bulby Maria Keepsake	16,366 (J.S.B.A.)	14	5,868	303	9	5,407	292	5	7,091	398	5	7,567	399	18	33	5,773	5·21	301	370
Bulby Oxford Gamboge	12,025 (J.S.B.A.)	5	6,601	336	5	7,578	374	3	7,572	387	3	5,982	299	11	16	6,996	4·92	344	411
Burnlea Aviator 4th	8,317	1	5,105	256	7	5,329	258	3	5,870	287	1	6,589	314	10	12	5,523	4·83	267	304
Calton Lothean	9,615	6	6,547	320	4	7,187	377	4	7,328	365	6	7,791	393	14	20	7,088	4·98	353	406
Devon Park Maderia's Victorious	15,744	33	5,224	303	4	6,601	414	..	..	..	1	7,599	387	38	38	5,432	5·84	317	416
Glenside Lone Star	9,721	5	6,131	312	1	6,579	327	1	7,860	451	8	8,466	392	12	15	7,338	4·93	362	408
Glenview Royal Chief	13,956	12	4,941	241	3	5,697	301	5	6,825	348	2	3,952	239	17	22	5,293	5·03	266	326
Hunstrete Emperor's Volunteer (Imp.)	6,457	..	..	..	..	..	..	..	..	..	11	7,955	455	11	13	7,955	5·72	455	455
Inverlaw Observer	15,436	17	5,043	255	2	6,465	321	..	..	..	..	..	..	18	19	5,106	5·05	258	343
Jersey Lea Golden Duke	13,831 (J.S.B.A.)	21	4,793	267	15	5,455	316	5	5,903	315	23	5,992	323	27	64	5,196	5·60	291	337
Lawn View Teddie	16,460	12	4,620	223	2	5,407	256	..	..	..	..	..	..	14	14	4,733	4·82	228	293
Lermont Volunteer	8,658	17	4,077	211	3	5,108	283	3	5,794	353	1	4,954	249	18	24	4,315	5·40	233	294
Masterpiece Yerribee of Bruceville	3,292	7	5,299	277	5	5,728	305	4	6,428	344	9	7,793	426	17	25	6,491	5·28	343	382
Maurfield Larkspur's Gift	9,632	9	6,195	330	5	7,579	377	1	6,942	349	8	8,192	405	16	23	7,207	5·06	365	427
Mornmoot Clementines Valour ..	12,092	10	6,192	295	4	5,977	288	3	6,913	347	2	9,373	488	18	19	6,494	4·86	316	382
Navua Ladoras Ruler	10,249	6	5,880	349	4	6,472	373	6	5,687	363	4	5,975	335	18	20	6,097	5·95	363	421
Navua Victorious Samaritan ..	13,167	6	4,591	244	5	4,842	265	3	5,801	314	1	6,553	353	12	15	4,960	5·36	266	321
Oxford Ajax	11,553	7	6,243	312	3	6,524	351	..	..	..	2	7,550	432	10	12	6,354	5·19	330	410
Oxford Asters Lad	8,129	5	4,927	301	5	7,537	354	2	6,496	314	7	7,275	360	18	19	6,612	5·13	339	384
Oxford Brown Victory	6,162	8	5,650	290	2	5,022	292	2	5,495	339	6	4,778	251	13	18	5,128	5·30	272	328
Oxford Daffodil's Victor	11,016	10	6,188	347	4	8,141	467	2	8,539	459	5	6,386	399	20	21	6,668	5·74	383	409
Oxford Fawn's Noble	14,530	15	5,775	321	4	6,633	375	4	5,733	321	..	..	..	16	23	6,015	5·50	331	428
Oxford Fawn's Victor	12 605	17	5,415	282	3	4,927	313	4	6,008	298	1	6,669	364	18	25	5,313	5·14	273	345

Oxford Flying Fox	15,501	8	4,634	243	5	5,807	315	2	7,146	403	..	..	..	13	15	5,324	5·37	286	350
Oxford Franklyn	16,005	12	5,926	293	1	5,808	300	..	..	..	..	..	..	13	13	5,916	4·95	293	391
Oxford King Peter	15,273	9	4,768	259	1	3,651	177	1	4,978	246	..	..	..	10	11	4,635	5·33	247	332
Oxford Noble Peer	9,124	8	4,912	282	4	5,709	330	1	7,321	436	5	6,475	364	11	18	5,296	5·64	299	366
Oxford Peer	7,361	17	5,717	313	4	6,167	332	..	..	..	1	7,315	385	19	22	5,829	5·51	321	420
Oxford Pixie's Victor	10,837	16	5,422	287	3	5,941	302	3	6,637	336	4	6,578	320	19	26	5,564	5·19	289	368
Oxford Royal Lad	8,001	27	5,888	315	8	6,849	362	7	7,341	389	2	7,209	338	37	44	6,106	5·26	321	399
Palm Ridges Golden Victory	14,704	8	4,932	277	2	5,269	319	1	4,017	274	1	7,115	385	11	12	5,158	5·78	298	382
Retford Earl Victor	3,655	11	7,349	380	3	6,931	392	6	7,261	374	8	8,101	392	18	29	7,205	5·14	370	430
Retford King's Thorn	5,115	12	6,170	325	5	7,286	411	3	8,319	464	8	8,168	449	26	28	7,246	5·44	394	455
Retford May's Victor	5,286	9	6,141	336	2	6,051	345	2	8,373	503	8	7,745	411	12	21	6,682	5·31	355	418
Retford Royal Atavist	7,066 (J.S.B.A.)	28	4,607	254	2	5,377	307	1	10,115	590	10	8,927	492	37	41	5,614	5·54	311	377
Rosel Solid Gold	11,813	1	5,525	309	3	4,169	234	7	4,584	262	8	6,219	328	17	19	5,237	5·50	288	293
Samares Cute Prince 3rd (Imp.)	8,876	8	6,423	345	3	8,615	427	3	8,134	416	3	7,657	416	13	17	7,023	5·24	368	437
Selseys Royal Standard	12,093	3	6,117	332	7	6,040	312	2	5,579	291	3	7,032	329	12	15	6,195	5·18	321	369
Selseys Samares Hallmark	11,722	27	5,419	288	2	6,320	363	2	6,320	363	2	6,298	364	26	32	5,423	5·38	292	384
Trecarne Butter Queen's Officer	10,218	10	4,263	239	2	5,377	311	2	4,852	270	6	5,307	298	10	20	4,508	5·61	253	311
Trecarne Golden King 2nd	11,233	14	5,422	335	4	6,641	404	2	6,136	400	3	6,422	399	18	24	5,718	6·17	353	436
Trecarne Golden Lad 2nd	14,944	7	5,590	284	7	5,330	271	2	7,538	414	..	..	..	13	16	5,641	4·49	253	345
Trecarne Renown 2nd	5,546	24	4,947	264	10	6,639	357	4	6,546	343	3	7,173	379	27	41	5,361	5·47	293	363
Trecarne Royal Officer	12,999	18	3,770	212	3	5,074	290	1	6,528	315	..	..	..	18	22	3,974	5·53	220	288
Trecarne Some Duke	11,850	25	4,937	266	17	5,286	284	10	6,062	316	16	6,358	335	37	68	5,631	5·31	299	353
Trecarne Some Tots Duke 2nd	14,241	19	4,854	264	4	5,453	304	1	7,061	379	..	..	..	14	24	4,871	5·48	267	349
Trecarne Some Victor 4th	12,781	9	4,931	269	5	5,188	287	..	..	..	2	5,252	289	14	16	4,943	5·52	273	336
Trecarne Victor 4th	11,492	31	4,986	253	12	6,078	309	9	6,293	328	6	7,275	376	30	58	5,717	4·76	272	326
Trinity Ambassador	2,834	18	5,793	325	8	7,169	428	5	6,546	367	7	6,903	375	24	38	6,058	5·56	337	403
Trinity Crowning Effort (Imp.)	12,311	24	5,177	273	7	7,252	383	8	7,591	384	13	7,422	370	36	52	6,091	5·15	314	372
Trinity Cute Commodore	11,101	8	7,490	369	7	7,735	391	3	8,013	394	3	6,881	345	19	21	7,589	4·97	377	462
Trinity Daffodil's Effort	13,747	24	6,675	315	3	7,195	372	4	8,424	372	1	7,523	356	26	32	6,922	4·75	329	421
Trinity Gleaming Effort	15,002	14	5,572	298	3	6,320	353	..	..	..	..	..	..	11	17	5,609	5·40	303	399
Trinity Golden Royal	10,760	17	4,906	268	8	6,150	337	3	6,460	347	11	6,248	339	25	39	5,642	5·44	307	371
Trinity Governor's Hope	5,730	43	5,684	292	19	7,537	382	6	7,357	398	22	8,189	417	55	90	6,334	5·13	325	395
Trinity Graceful Duke	14,575	20	4,697	257	2	5,319	308	..	..	..	..	..	..	18	22	4,787	5·45	261	370
Trinity Irondele's Effort	14,240	7	4,353	210	3	6,320	235	..	..	..	..	..	..	10	10	4,350	5·01	218	280
Trinity Mighty Prince	13,678	18	4,908	264	2	6,212	323	3	6,319	323	4	5,818	299	22	24	5,316	5·25	279	344
Trinity National Victory	12,309	9	5,261	282	5	6,822	348	1	8,263	390	2	7,051	313	16	17	6,292	4·94	311	386
Trinity Noble Effort 2nd	13,323	24	4,478	245	8	5,660	308	3	6,033	367	..	..	..	24	35	5,276	5·36	283	348
Trinity Popcorn 2nd's Pioneer	6,952	4	5,814	299	1	5,503	343	4	5,564	280	3	6,013	311	10	12	5,753	5·16	297	343
Trinity Royal Prince	10,756	6	5,251	259	4	5,999	304	1	5,172	263	1	6,567	349	12	12	5,603	5·03	282	343
Trinity Royal Sovereign	8,180	7	5,587	276	2	6,238	299	1	4,073	238	6	6,751	348	15	16	5,961	5·00	298	354
Trinity Some Officer	6,798	7	5,428	314	9	6,666	390	8	7,443	439	22	6,625	379	21	46	6,403	5·79	371	410
Vinchelez Golden Victory (Imp.)	4,943	15	4,395	256	6	5,025	304	..	..	..	6	5,279	279	18	27	4,749	5·69	270	335
Westbrook Aster's Lad 39th	11,654	4	4,077	216	6	4,891	250	..	..	..	..	..	..	10	10	4,565	5·17	236	295
Westbrook Aster's Lad 44th	11,865	1	2,396	98	1	3,176	163	4	4,288	212	14	4,347	226	20	20	4,179	5·12	214	219
Wheatlands Jester (Imp.)	6,950 (J.S.B.A.)	2	5,544	268	3	7,364	387	1	10,379	615	7	7,526	411	11	13	7,077	5·28	374	403
Woodside Golden Volunteer	6,366	65	5,118	269	16	6,335	337	6	6,346	344	12	7,183	383	66	99	5,407	5·25	284	363
Woodview Officer	14,025	12	3,765	205	2	5,604	309	..	..	..	..	..	..	12	14	4,015	5·38	216	290

When examining production records, it is essential to consider the conditions under which the records are made. It must be realised that the standard of herd management and the plane of feeding play a very important part in determining the production of animals. When selecting animals for the herd, the farmer should endeavour to select animals with production records produced under conditions similar to those existing on his own farm. In the past much disappointment has been experienced because the animals were selected on account of high production records which were made under artificial or extremely favourable conditions, totally dissimilar from those existing on the property on which they were subsequently used.

Plate 3.

"Tabbagong Victory," with Ten of His Daughters, all owned by Mr. M. C. Lester, "St. Andrews," Glengallan, Warwick. Twenty-nine of this bull's daughters have averaged 277 lb. butterfat ("maturity equivalent" 368 lb.).

[Photo. by "Queensland Country Life."

The Bacteriological Content of Dairy Farm Utensils Cleansed with Approved Detergents.

W. F. SCHUBERT, Biochemist, Dairy Research Branch.

AN investigation designed to obtain information on the bacteriological condition of dairy farm utensils cleaned with approved detergents was carried out during 1951 on selected farms in the Caboolture district and on the Darling Downs. The water supplies on the Caboolture farms were relatively soft, whilst those on the Darling Downs farms were chemically hard. One milk-supply farm (Farm A) and three cream-supply farms were selected for the trials.

The equipment used on the milk-supply farm comprised a 4-unit milking machine, a 40-gallon milk vat, a milk strainer, a beehive cooler, four 8-gallon cans, and sundry buckets.

The equipment in use on the cream farms consisted of a 4-unit milking-machine, a 40-gallon milk vat, a cream separator, 8-gallon cans, and sundry buckets.

On all farms the equipment was in good physical condition.

Cleaning Techniques.

The cleaning routines used were as follows:—

Farms A, C, D.

(1) A cold (atmospheric temperature) water rinse of all equipment immediately after milking.

(2) Treatment with a detergent solution at a temperature of 160-180°F.

(3) Treatment with hot water at 200°F.

(4) A hypochlorite (200 p.p.m.) pre-rinse of all equipment before the commencement of the next milking.

Farm B.

The general routine was the same as on farm A with the following exceptions:—

(1) A warm (110°F.) water rinse was used immediately after milking in place of the cold water rinse.

(2) A warm (110°F.) water pre-rinse was substituted for the hypochlorite pre-rinse.

On farms C and D the routine was similar to Farm A.

Sufficient detergent to last four weeks was made up and the farmers concerned instructed in its use by a practical demonstration. Weekly visits were then paid to the farm and the following samples taken:—(1) rinses of all utensils except the cream separator; (2) teat rinses of the first eight cows to be milked; (3) samples of the first milk to pass over the utensils.

Methods of Rinsing.

(1) *Milking machine.*—The cluster was disconnected from the end unit and the rinse water sucked directly through the machine. The rinse was collected at the releaser.

(2) *Clusters.*—The clusters were rinsed five times with the same rinse water.

(3) *Milk vat.*—The rinse solution was poured into the vat and the vat then rotated so that the rinse water made contact with the whole surface. The rinse solution was collected through the tap.

(4) *Milk strainer.*—The rinse water was poured directly through and collected from beneath.

(5) *Milk cooler.*—The rinse water was poured onto the top of the cooler and collected at the outlet.

(6) *Milk can.*—The rinse water was poured into the can, the lid replaced and the can placed on its side on the ground. The can was then rolled forward six turns and then back six turns. It was restored to the vertical position and the rinse solution poured into the lid and then into a sterile container.

(7) *Milk bucket.*—As for milk vat.

(8) *Teats.*—The udders of cows on the milk-supply farm were first washed with a hypochlorite solution (1,000 p.p.m.); in the case of cows on the cream-supply farm, warm water was used. Each teat was then allowed to dip into the rinse solution for an instant.

(9) *First milk over utensils.*—Samples of the first milk through the machine, in the milk vat, through the milk strainer, over the milk cooler and in the can, were collected in sterile containers.

Detergents Used.

The following detergents were used:—

Farm A.

(1) Soda ash + wetting agent (3:1 mixture)—2 oz. per 4 gallons of water.

(2) Detergent-Sanitiser—1½ fl. oz. solution A + 1½ fl. oz. solution B per gallon.

(3) Caustic soda—½ oz. per 4 gallons of water.

(4) Washing soda + wetting agent (3:1 mixture)—4 oz. per 4 gallons of water.

(5) Sodium metasilicate—2 oz. per 4 gallons of water.

Farm B.

(1) Trisodium phosphate + cationic surface active agent (9:1 mixture)—2 oz. per 4 gallons of water.

(2) Washing soda—4 oz. per 4 gallons of water.

(3) Trisodium phosphate—2 oz. per 4 gallons of water.

(4) Sodium metasilicate—2 oz. per 4 gallons of water.

(5) Proprietary wetting agent—½ oz. per 4 gallons of water.

(6) Hot water (180°F.).

Farm C.

A mixture of—

Soda ash	19	lb.
Sodium metasilicate	5½	lb.
Trisodium phosphate	7	lb.
Teepol	8	lb.
Water	40	gallons

One and a-half pints of the mixture was used to 4 gallons of hot water.

Farm D.

A mixture of—

Soda ash	25	lb.
Trisodium phosphate	7	lb.
Teepol	8	lb.
Water	40	gallons

One pint of the mixture was used per 2 gallons of hot water.

It will be noted that in a few cases the detergents have been duplicated. This was done because the detergents gave what was considered to be either very good or very bad results on the first trial. Of the detergent-sanitisers used, one was a proprietary line and the other was prepared in the laboratory. The mixtures of alkalies and wetting agents used were those recommended by the manufacturers of the wetting agents. One trial was run with hot water (180°F.) in order to test the efficiency of this agent alone. No build-up of soil was observed on the equipment during this trial.

Discussion of Results.

A summary of the results of the trials is given in Tables 1 and 2. In most instances the number of colonies of bacteria per unit volume of rinse is of the same order for each utensil. This indicates that the results are more a reflection of technique than of the merit of the individual detergents used. Hence it is not possible to compare the relative bacteriological efficiencies of the detergents.

From Table 3, in which are set out the average values, it will be noted that the milk vat, the milk cooler, and the milk can for farms A and B gave relatively high results. On farms C and D, where hard water supplies were used in conjunction with mixed detergents, the principal sources of contamination were located in the milking machines and milk vat. This suggests that these utensils are the least efficiently cleaned on the farm.

The results indicate that if the udders are efficiently washed, there is only a small contribution of bacteria from this source, and then only to the first milk.

The conclusion is reached that if proper methods are employed, it should be possible to produce milk on Queensland farms with a colony count of less than 50,000 per millilitre.

TABLE 1.

SUMMARY OF RESULTS OF INDIVIDUAL DETERGENTS*.

	Farm A—Milk Farm.					Farm B—Cream Farm.						
——	Soda Ash + Wetting Agent.	Detergent Sanitiser.	Caustic Soda.	Washing Soda + Wetting Agent.	Sodium Metasilicate.	Trisod. Phosphate + Cationic Surface Active Agent.	Washing Soda.	Tri-Sodium Phosphate.	Sodium Metasilicate.	Wetting Agent.	Hot Water.	Means.
Clusters	377	60	561	TNC	TNC	164	80	216	154	278	1,740	241
Milking Machine	17,700	2,570	4,980	TNC	TNC	1,080	1,050	537	1,440	206	907	1,490
Vat	18,700	7,080	2,110	33,300	TNC	902	1,470	2,300	4,050	4,170	17,800	3,990
Strainer	516	1,810	149	266	490	..	..	..	..	..	..	518
Cooler	2,530	2,580	7,990	TNC	TNC	..	..	..	..	..	..	3,710
Can	13,000	171,000	41,200	TNC	5,720	7,760	9,720	2,360	2,600	1,060	3,040	8,020
Bucket	69	202	48	109	241	105	28	254	219	186	225	118
Teat Rinses	11,300	12,400	10,100	TNC	TNC	5,630	6,330	9,440	6,820	8,360	27,600	9,640
First Milk through Machines ..	56,600	26,900	59,200	45,200	41,400	3,630	3,160	6,560	6,680	3,870	16,300	11,400
Milk in Vat	41,900	35,800	48,100	36,900	27,200	1,880	4,120	14,400	10,200	4,900	19,600	12,200
Milk through Strainers	61,300	33,900	42,900	26,900	43,400	..	..	..	..	..	..	44,700
Milk over Cooler	52,200	32,200	56,600	28,300	43,400	..	..	..	..	..	..	45,600
Milk in Can	47,900	28,500	44,900	27,400	26,200	..	..	..	..	..	..	38,800

* Geometric Means.

NOTES.—TNC = No. geometric mean determined because colonies were too numerous to count in the majority of determinations.

.. = No determinations were made.

In the washing soda + wetting agent and sodium metasilicate trials on Farm A (milk farm) hot water was not used at the evening wash-up owing to a technical fault in the hot water system.

TABLE 2.

SUMMARY OF RESULTS OF MIXED DETERGENTS.

	Farm C.	Farm D.	Geometric Mean.
Bucket	1,134	5,181	2,262
Vat	19,920	19,860	19,890
Milking Machines	60,290	8,702	25,010
Separator	940	5,255	2,055
Milk Can	372	1,054	526

TABLE 3.

GEOMETRIC MEANS OF ALL RESULTS.

Utensils.	Colony count per ml. of rinse.	
	Average Farms A and B.	Average Farms A, B, C and D.
Clusters	241	..
Milking Machine	1,490	2,300
Milk Vat	3,990	5,108
Milk Strainer	518	..
Milk Cooler	3,710	..
Milk Can	8,020	5,274
Milk Bucket	118	186
Teat Rinses	9,640	..
First Milk	..	..
Through Machine	11,400	..
In Vat	12,200	..
Through Strainer	44,700	..
Over Cooler	45,600	..
In Can	38,800	..

Technical Data.

Volumes of Rinses Used.

The rinse water used was the buffered distilled water recommended by "The Standard Methods for the Examination of Dairy Products" of the American Public Health Association (ninth edition).

In cases where hypochlorite solutions were used on the farm, the thiosulphate inactivator was added to the rinse water.

The volumes of rinse water used for the individual farm utensils were as follows:—

Utensil.	Volume of Sterile Buffered Distilled Water Used.
Milking machine	1,000 ml.
Clusters (each)	500 ml.
Milk vat	200 ml.
Milk strainer	100 ml.
Milk cooler	200 ml.
Milk can	200 ml.
Milk bucket	100 ml.

Media.

Colony counts on the rinses were made on tryptone-glucose-meat extract agar with incubation at 30 °C. for 48 ± 3 hours.

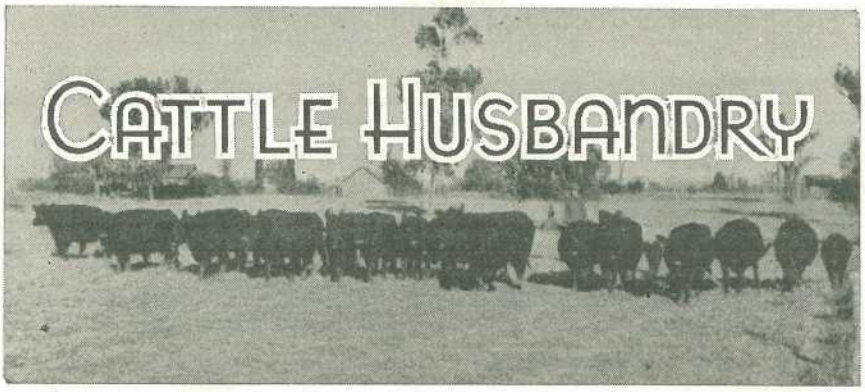
Colony counts on the milk were made on tryptone-glucose-meat extract-skim milk agar with incubation at 30°C. for 48 ± 3 hours.

References.

American Public Health Association. Standard Methods for the Examination of Dairy Products. Ninth Edition.

Acknowledgment.

The investigations outlined above were conducted on demonstration farms from funds provided by the Commonwealth Dairy Industry Efficiency Grant and the assistance of field officers employed under the grant is acknowledged.



A Calf-Branding Crush and Cradle.

J. J. SULLIVAN (Senior Adviser) and J. G. YOUNG (Husbandry Officer),
Cattle Husbandry Branch.

THE management of a cattle property is efficient or otherwise according to the method of handling the cattle. Where cattle are concerned, the most efficient operations are those which are carried out as quickly and as quietly as possible with the greatest economy of labour and with the least possible distress to the cattle.

The old methods of calf branding adopted on many Queensland properties entailed a considerable amount of excitement, noise and wasted energy on the part of both the stockman and the calf, but these old methods of scruffing and man-handling or bronchoing are rapidly being replaced by more efficient methods.

Today, efficient station managers in southern and central Queensland will not tolerate the waste of energy and unnecessary ill-usage of young cattle, and the branding cradle has been installed on many properties. Its advantages are such that in an emergency, not uncommon in these days of labour shortage, the entire branding operation can be carried out quite promptly, and without undue effort, by a man and a boy. It is without doubt one of the most valuable labour-saving devices available to the industry. Any design of a new yard for handling mixed cattle should not be considered complete without this unit, and it can usually be added as an appendage to an already constructed yard in such a way that no drastic alterations are needed to the original. However, in all circumstances it is important to remember that the yard used to hold the calves after branding should be used for this purpose only, so that a clean, dust-free enclosure is available to the calves at a critical time.

CALF CRUSH.

The calf crush and branding cradle described here is a convenient type. From the pound a gate opens into a V-shaped calf-pen, which, as shown in Plate 1, is provided with a gate which can close at three positions so as to keep the calves well packed up. At the entrance to the calf crush is a slide gate, and at the other end another slide, through which the calf passes to the waiting pen, and then into the cradle.

The following specifications may be adopted for the crush:— 8 ft. panels from centre to centre of posts; 8 in. posts, 6 ft. 9 in. long, 3 ft. in ground, 3 ft. 9 in. out; 4 in. rails; top rail morticed in flush with the top of the post; 2nd rail 15 in. from top of post; 3rd rail 27 in.

from top of post, all morticed flush with post; width of crush 14 in. at ground level, 17 in. at top of top rail; length of waiting pen 4 ft. 9 in.; space allowed for installation of the branding cradle at the end of the waiting pen 5 ft. 6 in.

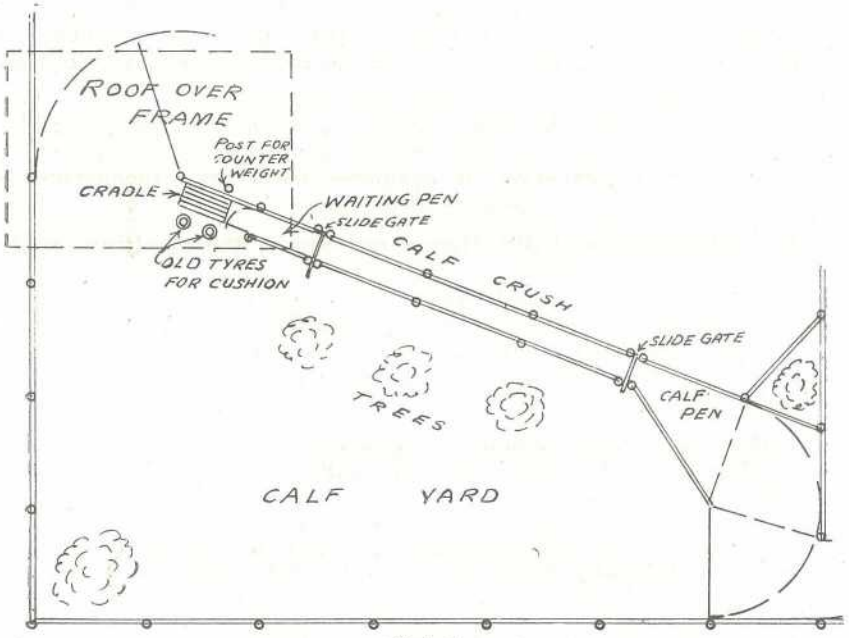


Plate 1.

Plan of a Calf-Branding Crush with Cradle.

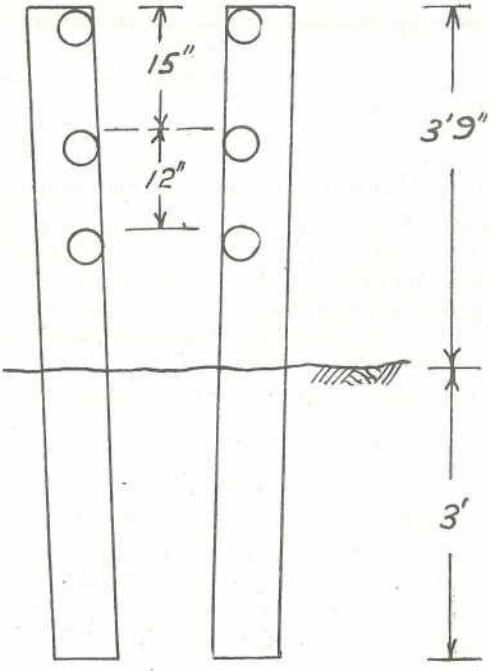


Plate 2.

Section Through Calf-Branding Crush.

A STURDY CALF-BRANDING CRADLE.

The cradle described and illustrated in Plates 3-9 was constructed by Mr. V. M. Hayes of "Kerry Downs," near Emerald, from materials which he had available on his property. The machine was built in his own workshop, using carpentry and blacksmithing tools and facilities usually found in the average station or property workshop. The electric welding on the trigger-release mechanism was the only work done outside the home shop.

The machine embodies some novel features of construction which make for speed and ease of handling, and although metal is used considerably in its construction, it compares more than favourably in weight with the more common wooden types.

A notable feature of Mr. Hayes' machine is the pivotting on the central hinge, providing such balance that even the largest calves, 12 months of age or more, can be thrown off their feet with a minimum of effort when caught properly in the cradle. The machine is extremely sturdy and well braced against the thrust of the calf and the jarring caused when calf and cradle are thrown over.

With care in the selection of timber and materials and proper maintenance, this cradle would be reasonably expected to "last a lifetime." The only maintenance needed would be the withdrawal of the central hinge after use and the storage of the two halves of the machine under cover. The assembly process takes no more than one or two minutes. A cause of much damage to many machines, particularly types with an all-wooden frame, is the weight of the calf stamping on the lower frame when being released.

The machine drawn and described is for branding on the near side. However, it should be readily possible to construct a similar cradle for off-side work from the illustrations.

The timber used in the construction of the cradle is spotted gum (*Eucalyptus maculata*), a useful hardwood for tool handles and other purposes where resistance to jarring and shocks is needed. The four "bows" were originally 4 in. x 2 in. x 40 in. long; they were dressed down to the required shape with saw, chisel and plane and finally rounded on the inside faces and edges with a spokeshave. The four "bows" are all approximately the same size and shape.

The larger half of the cradle (Plate 3), upon which the calf lies when thrown to the ground, is a solid piece of metal about an eighth of an inch thick. Actually, in the machine described a section of discarded cattle water-troughing was used; it was curved slightly to fit the shape of the bows with an approximate 1 in. camber at the extreme top and 1½ in. at the extreme bottom.

A length of half-inch angle iron is rivetted to the rear edge of the metal sheet for added strength and to present a blunt edge to the approaching calf.

The section is solidly braced with a flat iron bar (1 in. x ¼ in.) from the bottom of the rear "bow" to the top of the front "bow."

The metal sheet continues for about 2 in. below the bottom of the "bows" and is in close proximity to the central hinge bolt. In the model described the space between sheet and hinge bolt is only about half an inch. Calves have on occasions sustained leg fractures in models

where this gap has been wide enough to allow the animal to place a leg between the bottom edge of the frame and the hinge. If unnoticed by the operator, the leg is invariably broken when calf and machine are thrown to the ground.

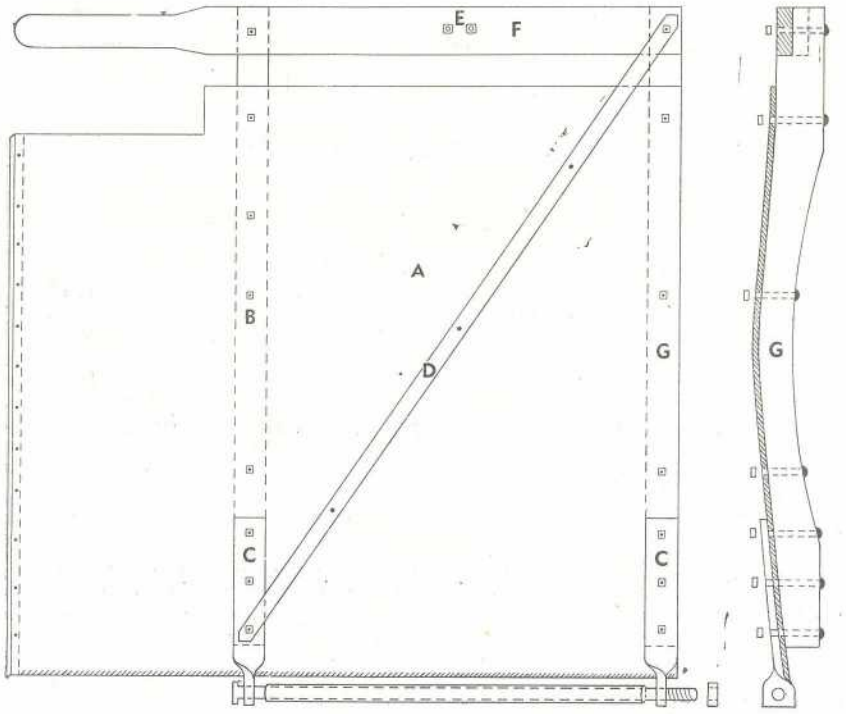


Plate 3.

Lower Section of Cradle—Underneath View. A. Metal base 42" × 37" with one corner cut out and rear edge strengthened with half-inch angle iron rivetted on. B. Rear bow. C. Steel strip 2" × ½" shaped at end to hold hinge pin. D. Iron or steel brace 1" × ¼" held by ¼" tank bolts. E. Metal D. F. 3" × 2" spotted gum cross-piece. G. Front bow, shaped from a 40" length of 4" × 2" spotted gum. The metal base of the cradle and the steel strip connecting the hinge pin are shown in the view at the right.

The smaller or top half of the cradle (Plate 4) is an open frame consisting of two "bows" similar to those on the other half, and opposing them when the machine is assembled. Three cross-pieces, morticed into the "bows" and fixed with countersunk ⅜ in. bolts, run horizontally between the "bows." In the case of the two 3 in. x 2 in. cross-pieces at the top of each half of the cradle, the mortice is halved or shared between the "bow" and cross-piece for added strength and rigidity, whilst the other cross-pieces are simply morticed 1-1½ in. into the "bows."

The machine pivots on a ¾ in. hinge bolt approximately 30 in. long, with a ¾ in. spacer bar (piping) used to counteract any movement of one half of the frame relative to the other. The "hooks" attaching the frames to the hinge pin are of 2 in. x ½ in. metal and were turned and shaped as illustrated. Each is secured to the bottom of the "bow" by three ⅜ in. bolts.

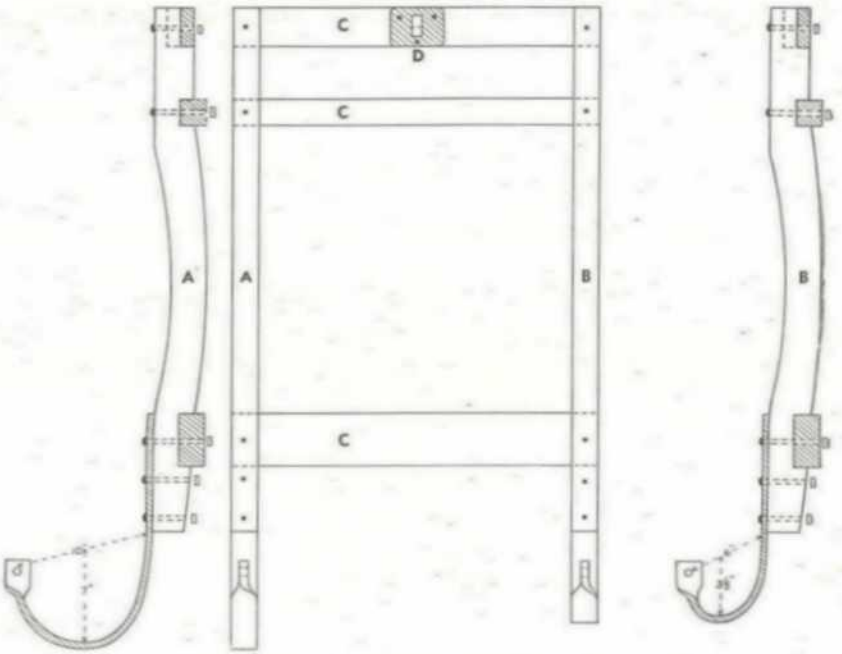


Plate 4.

Upper Section of Cradle. The cradle, which is 28" wide, is shown from underneath in the centre, and the rear and front bows are shown at left and right, respectively. A. Rear bow. B. Front Bow. C. Cross-pieces 3" × 2", 2" × 2" and 4" × 2". D. Metal plate 4" × 3" with keyway 1¼" × ⅜" for ratchet or sword.

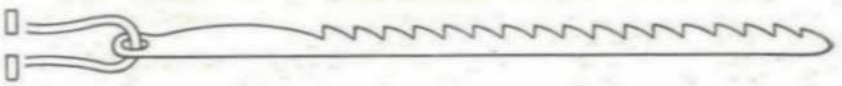


Plate 5.

Ratchet or Sword. This is a 24" piece of 1" × ½" steel with 18 teeth.

Plate 6.

Individual Teeth of Ratchet or Sword. Each tooth is ⅜" deep and has a ⅛" flat area on the top and a ¼" flat area in the well.

The ratchet (Plate 5) was made from a piece of steel 1 in. x ½ in. and approximately 2 ft. long. The serrations were cut as shown in Plate 6. The features are an ⅛ in. "flat" on the top of the teeth to minimise the wear which occurs if these teeth are pointed and a ¼ in. flat area in the well of the serration in which the pawl snugly fits. The pawl utilizes, thus, the full depth of the serration, and wear, especially in the middle section of the ratchet, is kept to a minimum.

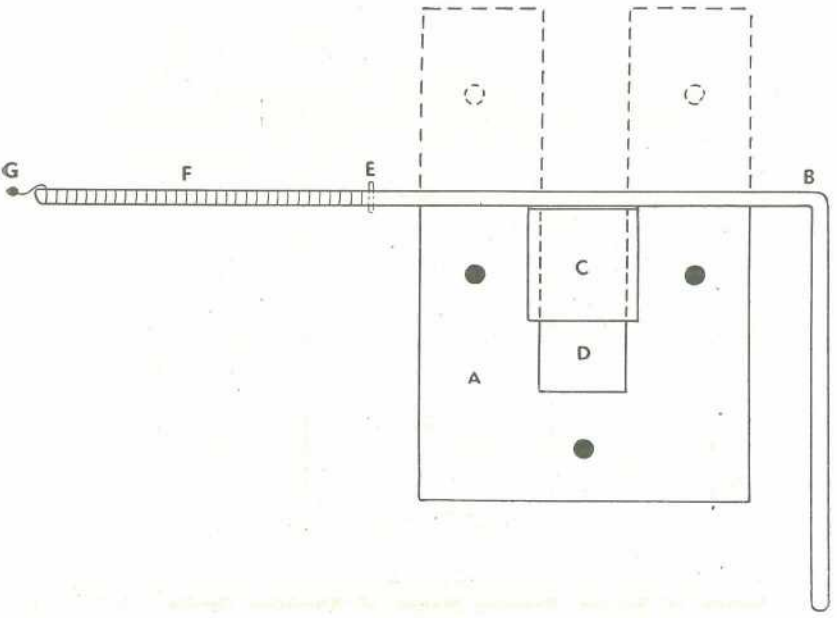


Plate 7.

Trigger Release Mechanism. A. Metal plate bolted to cross-piece. The dotted portions at the top are bent back over the rod B. B. Metal rod (½"). C. Spring steel pawl welded to metal rod. D. Keyway. E. Pin through rod. F. Steel spring. G. Pin to cross-piece.

The pawl itself is a piece of spring steel measuring 1 in. x 1 in. x ¼ in. and is welded to the metal rod, forming, together with a strong spring, the trigger release mechanism (Plate 7). The trigger release can be activated by the index finger, allowing both hands to be used on the top frame when releasing the branded calf. The 18-gauge steel spring has a fairly high tension and measures 3 in. in length and ½ in. in diameter.

The metal cut from the plates to make the keyway for the ratchet was not completely removed but was bent into and used to line the keyway in the cross-piece, to prevent wear of the timber by the moving ratchet. The ratchet swings on a metal D of ½-in. rod.

The bed-log, 6 in. x 6 in., is morticed to its full width into two round anchor posts which are buried 3 feet into the ground (Plate 8). Two strong steel pins (in the model described, sections of an old sulky axle were used) pass through the bed-log and are bent on themselves at the top to form a bolt hole with a neat ¾ in. clearance. The spacing of these pins is the same as that between the "hooks" of the frame.

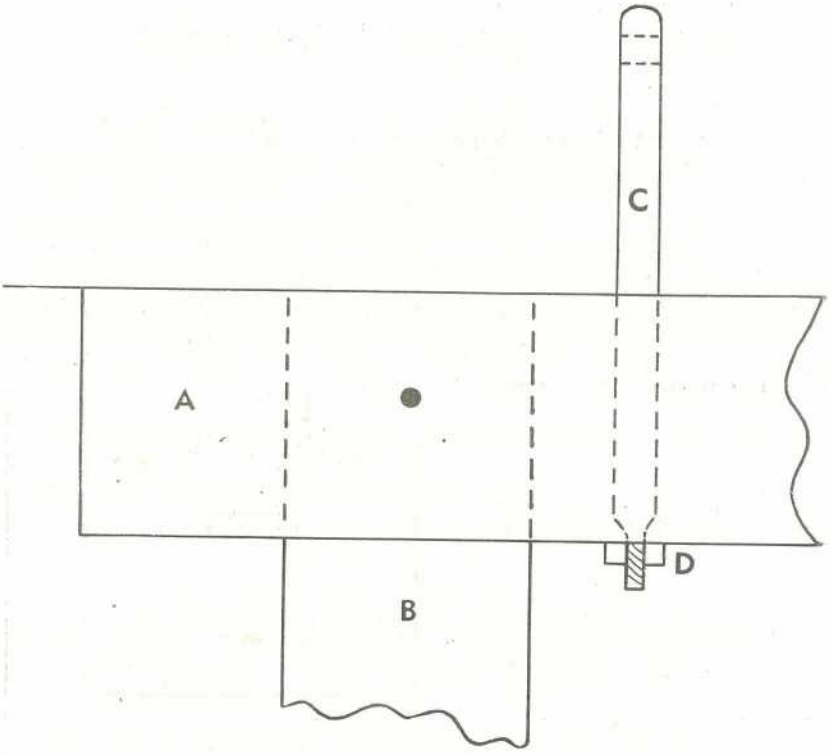


Plate 8.

Portion of Bed-log, Showing Means of Attaching Cradle. A. Bed-log 6" × 6" morticed into anchor post. B. Anchor post of round timber 3 ft. in ground. C. Steel pin 1" × 1" bent at top to form a $\frac{3}{4}$" bolt hole. D. Lock nut.

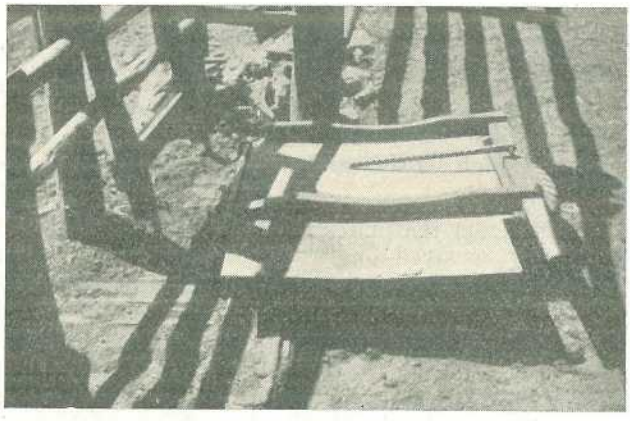


Plate 9.

Cradle Opened and Showing the Construction of the Lower Portion.

Plate 10.
Cradle Closed on Calf.

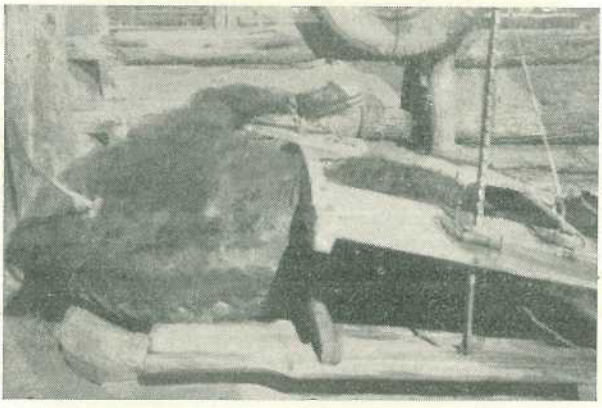


Plate 11.
Branding a Calf. The leg is chained to prevent struggling.

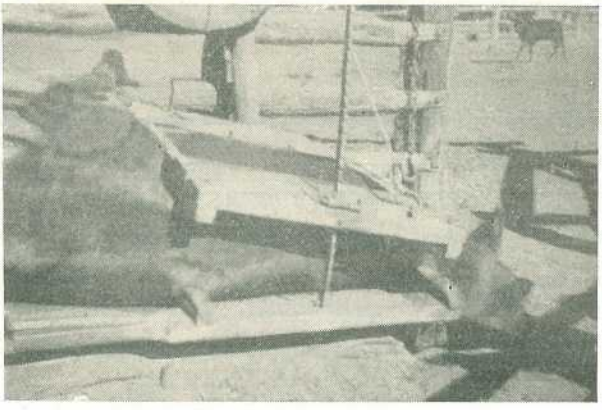


Plate 12.
Calf Branded and Ready to be Released.

The height of the pins above ground level is such that, when assembled, the rear "hook" just touches the ground, whilst the front "hook" clears the ground by several inches. In this case, a pin height of 7 in. was needed to achieve this clearance.

A counter-weight attached to the cradle by means of a rope passing over a pulley set in a high post makes for ease of operation, and the use of old tyres to give a cushion effect will prolong the life of the cradle.

The position of the calf in Plates 10-12 indicates the ease and efficiency with which the operations of castration and branding may be carried out in a suitable cradle. The cradle shown in these illustrations differs in detail of construction but not in principle from that illustrated in Plates 3-9.

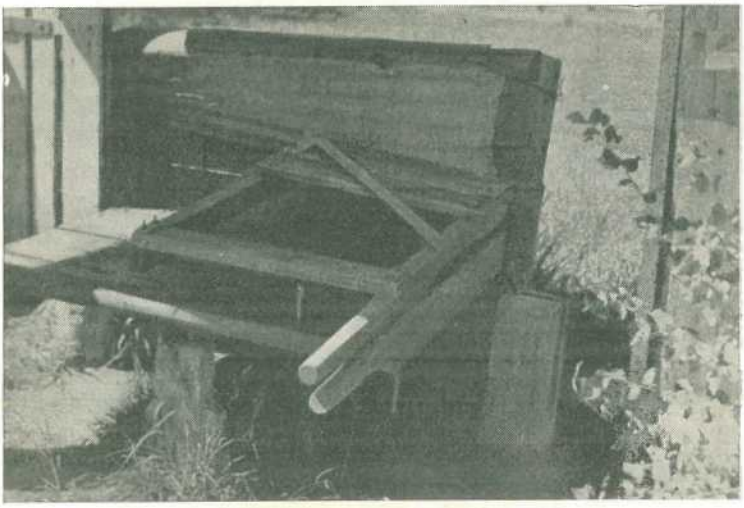


Plate 13.

A Branding Cradle in Which the Calf is Held 18 Inches Clear of the Ground. Some cattlemen consider that this makes the work easier and reduces the risk of infection from dust and dirt.

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 28th FEBRUARY, 1953.)

Breed.	Owner's Name and Address of Stud.
Berkshire	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
	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, M.S. 373, Beaudesert
	D. T. Law, Trouts road, Aspley
	C. F. W. and B. A. Schellback, " Redvilla " Stud, Kingaroy
	R. H. Crawley, " Rockthorpe " Stud, via Pittsworth
	F. R. J. Cook, " Alstonvilla," Woolvi, *via* Gympie
	D. E. and E. C. Apelt, " Thelmur," Oakey
	Mrs. I. M. James, " Kenmore " Stud, Cambooya
	H. L. Stark, " Florida," Kalbar
	J. H. N. Stoodley, " Stoodville," Ormiston
	H.M. State Farm, Numinbah
	V. G. M. and A. G. Brown, " Bardell," Goovigen
	R. E. Paulsen, " Hillcrest " Stud, Binjour Plateau, M.S. 670, Gayndah
	M. G. and R. H. Atkins, " Diamond Valley " Stud, Mooloolah
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. J. Bell, " Dorne " Stud, Chinchilla
	L. C. Lobegeiger, " Bremer Valley " Stud, Moorang, *via* Rosewood
	J. H. G. Blakeney, " Talgai " Stud, Clifton
	H. R. Gibson, " Thistleton " Stud, Maleny
	H.M. State Farm, Numinbah
	K. A. Hancock, " Laurestonvale " Stud, Murgon

TESTED HERDS—continued.

Breed.	Owner's Name and Address of Stud.
	O. H. Horton, Mannuem, Kingaroy
	V. P. McGoldrick, " Fairymeadow " Stud, Cooroy
	N. Woltmann and Sons, Wooroolin
	R. S. Powell, Kybong, *via* Gympie
	E. B. Horne, " Kalringal," Wooroolin
	S. T. Fowler, " Kenstan " Stud, Pittsworth
	J. A. and J. McNicol, " Camden," Canning Vale, Warwick
	H. L. Larsen, " Oakway," Kingaroy
	C. Allison, " Colrene " Stud, Lake and Reserve roads, Slacks Creek
	E. G. Evans, Box 22, Maleny
Tamworth	S. Kanowski, " Miecho " Stud, Pinelands
	N. R. Potter, " Actonvale " Stud, Wellcamp
	D. F. L. Sherman, " Waverley " Stud, Kaimkillenbun
	A. C. Fletcher, " Myola " Stud, Jimbour
	Salvation Army Home for Boys, Riverview
	F. Thomas, M.S. 373, Beaudesert
	A. J. Surman, Noble road, Goodna
	P. V. McKewin, " Wattleglen " Stud, Goombungee
	Department of Agriculture and Stock, Regional Experiment Station, Kairi
	P. V. Campbell, Lawn Hill, Lamington
	E. C. Phillips, " Sunny View," M.S. 90, Kingaroy
	T. A. Stephen, " Withcott," Helidon
	W. F. Kajewski, " Glenroy " Stud, Glencoe
	A. A. Herbst, Bahr Scrub, *via* Beenleigh
	R. G. Koplick, " Melan Terez " Stud, Rochdale
	H.M. State Farm, Numinbah
Wessex Saddleback ..	W. S. Douglas, " Greylight " Stud, Goombungee
	D. Kay 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
	A. Curd, Box 35, Jandowae
	C. Allison, " Colrene " Stud, Lake and Reserve roads, Slacks Creek

ASTRONOMICAL DATA FOR QUEENSLAND.

MAY

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	6.13	5.17	Cairns	12	46	Longreach	28	42
6	6.16	5.13	Charleville	25	29	Quilpie	37	33
11	6.19	5.09	Cloncurry	38	61	Rockhampton ..	2	18
16	6.21	5.06	Cunnamulla ..	31	27	Roma	15	19
21	6.24	5.04	Dirranbandi ..	22	16	Townsville	11	38
26	6.27	5.02	Emerald	13	26	Winton	31	50
31	6.29	5.00	Hughenden ..	23	47	Warwick	5	4

TIMES OF MOONRISE AND MOONSET.

At Brisbane.		
Day.	Rise.	Set.
	p.m.	a.m.
1	6.29	7.59
2	7.23	8.58
3	8.21	9.56
4	9.24	10.48
5	10.29	11.36
		p.m.
6	11.34	12.19
7	..	12.58
	a.m.	
8	12.38	1.34
9	1.42	2.09
10	2.47	2.45
11	3.52	3.23
12	4.59	4.04
13	6.06	4.51
14	7.13	5.43
15	8.17	6.39
16	9.14	7.38
17	10.05	8.38
18	10.49	9.37
19	11.26	10.33
20	11.59	11.27
	p.m.	
21	12.29	..
		a.m.
22	12.58	12.20
23	1.26	1.11
24	1.55	2.03
25	2.25	2.56
26	2.59	3.51
27	3.38	4.48
28	4.23	5.48
29	5.15	6.49
30	6.13	7.48
31	7.16	8.43

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	30	10	45	25	20	0	53	28
6	25	13	41	28	16	3	47	31
11	15	24	30	40	6	16	35	47
16	10	30	25	44	0	20	27	53
21	16	21	31	38	7	12	36	43
26	26	13	42	29	17	3	49	32
31	29	10	45	25	20	0	52	28

MINUTES LATER THAN BRISBANE (NORTHERN DISTRICTS).

Day.	Cairns.		Cloncurry.		Hughenden.		Townsville.	
	Rise.	Set.	Rise.	Set.	Rise.	Set.	Rise.	Set.
1	54	5	67	34	51	20	44	6
3	54	3	67	32	51	18	44	4
5	56	8	68	36	52	21	46	8
7	43	18	59	43	44	27	36	17
9	31	30	51	50	35	35	25	25
11	20	41	43	58	28	44	17	35
13	9	50	37	63	21	49	8	42
15	3	55	34	67	18	52	4	45
17	6	51	35	64	20	50	6	43
19	13	43	39	59	24	45	12	36
21	22	34	45	54	30	39	19	29
23	32	29	52	50	36	35	26	25
25	41	19	57	43	42	28	34	17
27	50	6	64	34	48	20	41	7
29	54	4	67	33	51	19	44	5
31	53	4	67	33	50	19	44	5

Phases of the Moon.—Last Quarter, May 6, 10.21 p.m.; New Moon, May 13, 3.06 p.m.; First Quarter, May 21, 4.20 a.m.; Full Moon, May 29, 3.03 a.m.

On May 15 the sun will rise and set about 20 degrees north of true east and true west respectively.

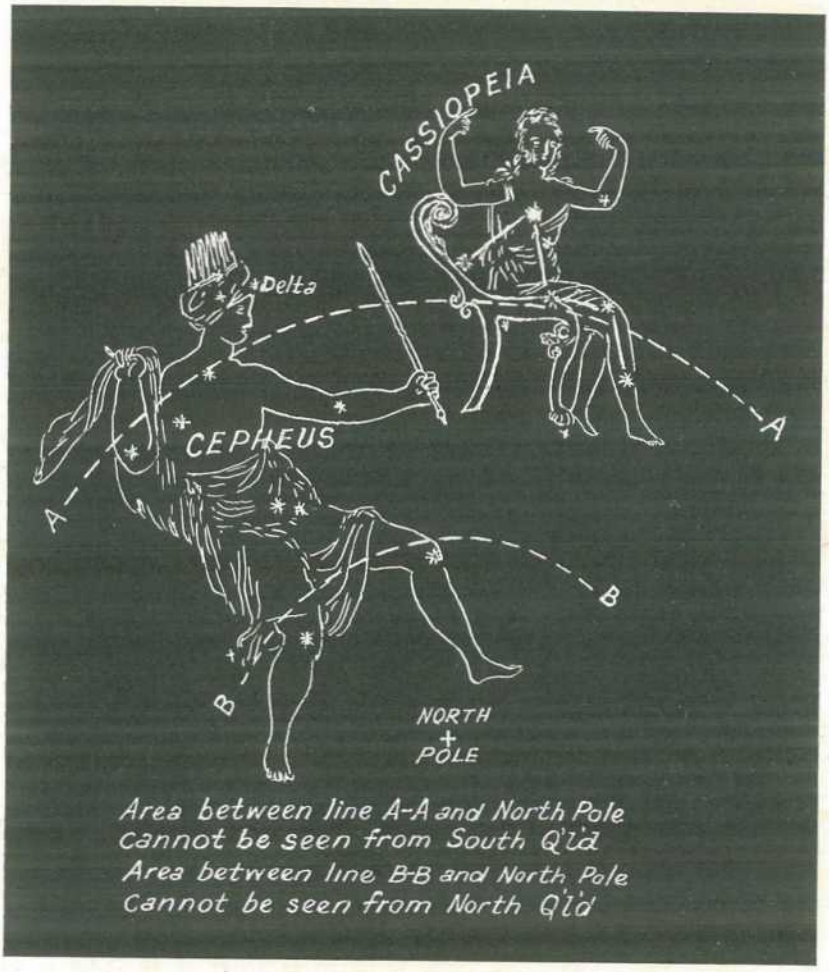
Mercury.—At the beginning of the month, in the constellation of Pisces, will rise 1 hour 44 minutes before the sun and will be in line with the sun on 24th, after which it will pass into the evening sky, and at the end of the month in the constellation of Taurus, will set 28 minutes after the sun.

Venus.—In the constellation of Pisces, at the beginning of the month will rise 1 hour 47 minutes before the sun and will reach greatest brilliancy on the 19th. By the end of the month it will rise 3 hours 20 minutes before the sun.

Mars.—Too close in line with the sun for observation.

Jupiter.—Also too close in line with the sun for observation.

Saturn.—In the constellation of Virgo, will rise just before sunset at the beginning of the month. On the 24th it will be about 5 degrees from Spica and on the 25th the moon will be near the planet. By the end of May it will set between 2.50 a.m. and 4.00 a.m.



THE CONSTELLATIONS.

CASSIOPEIA.

Though from southern Queensland it is not difficult to observe Cassiopeia, from North Queensland this constellation may be seen from 15 to 20 degrees above the northern horizon on the meridian. The constellation is well known in the northern hemisphere and is referred to as the "M" or "W" because of the shape of the brightest stars of the group. According to Greek legend, Cepheus and Cassiopeia were King and Queen of Ethiopia. The constellation contains many doubles, nebulae and clusters, and also the famous nova discovered by Tycho Brahe in 1572, the brightest nova recorded. When first observed by Tycho on November 11, 1572, it was brighter than Jupiter and Venus and at its brightest could be seen in broad daylight. At the end of the month it faded, gradually changing in colour from white to yellow ruddy, and finally by March, 1574, it had faded from view. Though Tycho fixed the position of this nova in relation to the surrounding stars as well as he could with the means then available, the star cannot now be located even with the most powerful telescopes. Cassiopeia is on the opposite side of the North Pole to Ursa Major and is best seen from Queensland in the evening during November and in the early morning during July.

CEPHEUS.

This group adjoins Cassiopeia but is closer to the North Pole, only the extreme southern tip being visible low on the horizon from North Queensland. This constellation also contains a number of double stars, variables and clusters. Delta Cephei is important as a typical star of the regular short-period variables. It was detected by John Goodricke in 1784. Its magnitude varies from a minimum of about 4.3 to a maximum of about 3.6 in one and a-half days, the decline, however, taking about 4 days. A cluster type Cepherd variable has a still shorter period—less than 24 hours. The study of Cepherd variables is of great importance in the determination of a star's distance, the distance having a definite relation to the period and magnitude.