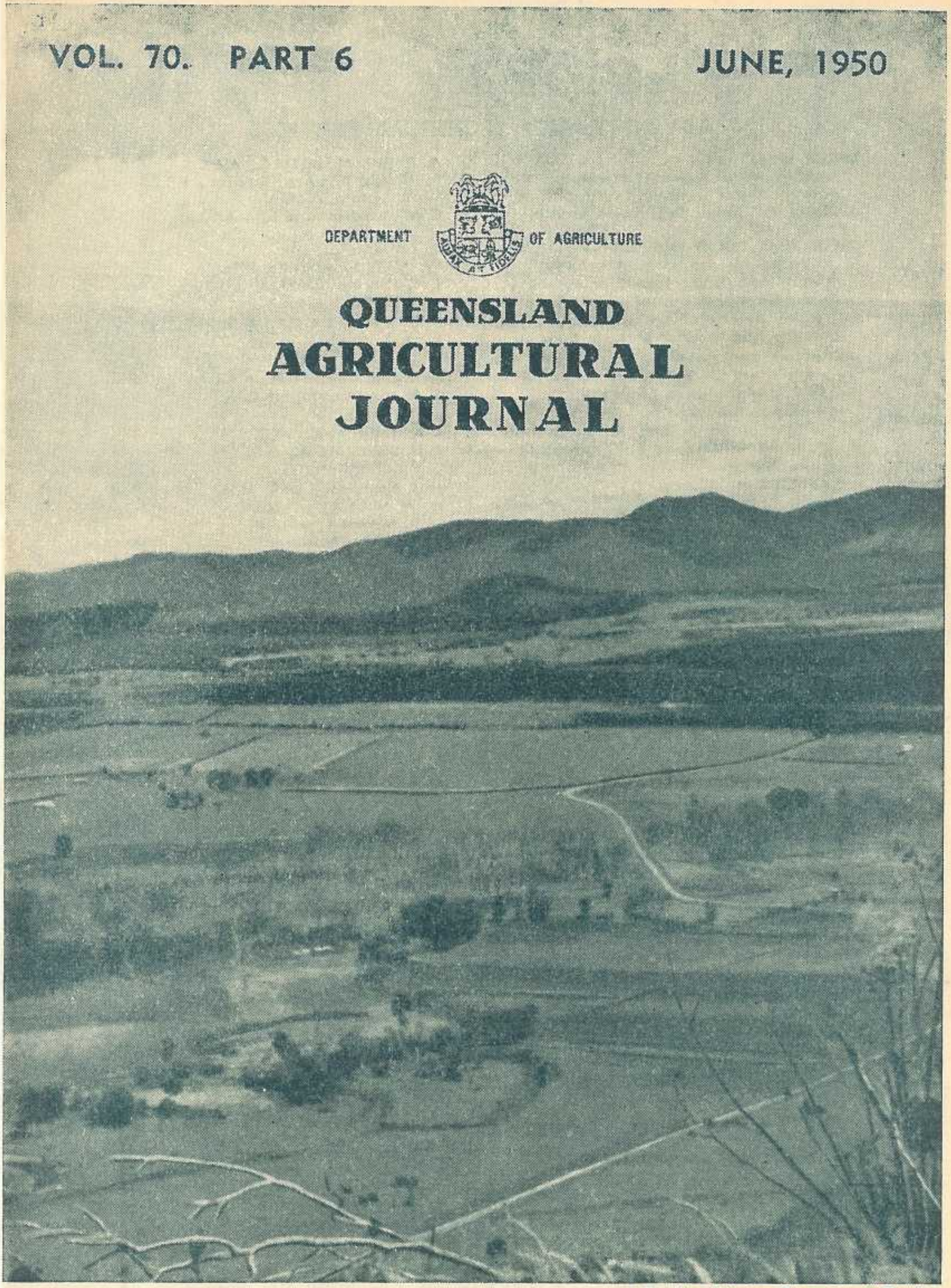
VOL. 70. PART 6 JUNE, 1950

DEPARTMENT OF AGRICULTURE

QUEENSLAND AGRICULTURAL JOURNAL



On the Atherton-Yungaburra Road.

LEADING FEATURES

Wheat Growing

Farm Cooling of Milk and Cream

Whiptail in Cauliflowers

Crop Planting Tables

Registered at the General Post Office, Brisbane, for transmission by Post as a Newspaper.

Volume 70 Part 6

QUEENSLAND AGRICULTURAL JOURNAL

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JUNE, 1950

Issued by Direction of
THE HONOURABLE H. H. COLLINS
MINISTER FOR AGRICULTURE AND STOCK

GOVERNMENT PRINTER, BRISBANE

Contents

Wheat Growing in Queensland

C. S. CLYDESDALE (Senior Adviser in Agriculture) and L. G. MILES (Senior Plant Breeder).

THE story of wheat must be as old as that of civilised man. The crop is certainly known to have existed in a highly developed state amongst some of the earliest civilisations known to us today. It has even invaded, with conspicuous success, the formerly undisputed territory of maize in North and South America, and is the pre-eminent human food crop in the world. Two main reasons for its wide popularity are (i) its general superiority over other cereals for bread making, and (ii) its great adaptability to differing climates and soil types.

On account of the peculiar chemical and physical properties of the gluten within its flour, wheat is specially suited for the making of the soft bread with spongy cellular structure which is so popular amongst the more highly civilised races. Rye flour is also capable of making a fairly open-textured loaf; this, however, is regarded with much less favour than that of wheat. Most of the other cereal grains are incapable of producing a raised loaf of the texture of wheaten bread.

As regards its regional adaptability, wheat is now successfully and widely grown in each of the inhabited continents. While most of the major wheat areas of the world lie within latitudes 30 deg.-60 deg. North and 27 deg.- 40 deg. South, the crop has been successfully grown from the equator to the Arctic Circle. Moreover, it has been recorded from sea level to elevations of over 10,000 feet. Soil types on which the crop is commercially grown also vary widely, but the major world development has been on heavy black prairie soils such as abound in North America, Russia and the Argentine. On account of its wide distribution, this crop is being harvested in one country or another all the year round.

The two main broad groups which are commercially grown are (i) the bread wheats and (ii) of much lesser importance, the durum or macaroni wheats. The bread wheats also fall into two principal groups depending upon the season at which they are planted in the northern hemisphere. The "spring" wheats are normally used in countries in which the winter temperatures are so severe as to prevent cropping during the winter months. These wheats are planted during the spring and harvested in the late summer. Where winter temperatures are less severe and where a sheltering layer of snow may be expected, "winter" wheats are usually sown. These are planted in late autumn, and the young plants at an early stage of development lie dormant through the winter, coming away again with the spring and maturing in midsummer or late summer. Normally the winter wheat group are higher yielding than the spring group because of their longer growing period and the opportunities for better development of their root system. In Australia, "spring" type wheats are universally grown, but owing to the relative mildness of our winter conditions, they are actually grown during the winter and spring months rather than the spring and summer months.

In Table 1, the approximate annual wheat production for the world's ten major producing countries is shown, first for the 1935-39 period and second for the year 1947.

TABLE 1.*

WHEAT PRODUCTION IN SELECTED COUNTRIES.

Producing Country.	Approximate Annual Yield. (millions of bushels.)	
	1935-39.	1947.
United States of America ..	760	1,400
China	750	900
Russia	1,250	900
Canada	310	350
India and Pakistan..	400	300
Australia	150	220
Italy ..	280	200
Argentina	220	170
France	300	150
Turkey	140	130

* Source: F.A.O. Commodity Series No. 10, Jan., 1949.

While Australia ranks somewhat low in production amongst the first ten wheat producing countries, it normally exports a comparatively high percentage of its total yield, thus making it one of the world's leading exporters of wheat. Exports in 1947-48 totalled 60 million bushels of wheat and 780,000 tons of flour; the bulk of the wheat went to England and India, while the principal importers of Australian flour were Ceylon and Malaya.

WHEAT IN QUEENSLAND.

Although Queensland ranks only fifth amongst the Australian States in its wheat production, this crop has developed to the stage at which it is second only to sugar cane among the cultivated crops in annual value to the State. Up till about 1938, Queensland's production was insufficient to meet local requirements, and grain was imported every year from southern States. With expanding production in post-war years imports have been considerably reduced, and in 1949 Queensland joined New South Wales, Victoria, South Australia and Western Australia in entering the export field.

The factors restricting the growth of the industry in Queensland (as compared with southern States) have been mainly climatic. A considerable belt of southern Australia receives the bulk of its rainfall during the winter and spring months and enjoys warm dry weather in midsummer—ideal conditions for the growth and maturity of a winter-planted crop. In Queensland the reverse normally holds; the winter and early spring months are normally the driest in the year, while the harvest months of October-December are frequently characterised by violent storms. With such weather hazards early development was sporadic and subject to frequent set-backs. The comparative success which the industry has subsequently attained has been due largely to (i.) the perfection of the summer fallowing technique, (ii.) the breeding of varieties suited to the environment, and (iii.) the development of power farming methods.

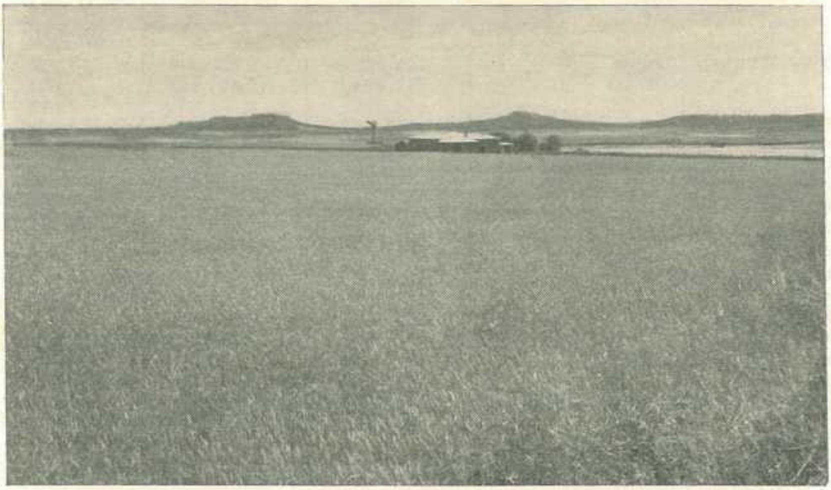


Plate 140.

A Field of Puora Wheat on the Darling Downs.

The purpose of the summer fallow is to entrap as efficiently as possible the heavy summer rains and to retain the moisture within the soil for the benefit of the succeeding winter crop. With ample subsoil moisture stored, all that is required is a useful planting rain during the May-July period to enable the crop to be established with a good chance of success. Crops of over 30 bushels per acre have been obtained on well fallowed land, even in Central Queensland, with no effective rainfall subsequent to planting.

The early selection of varieties for the State was somewhat fortunate in that it included varieties of early maturing habit, relatively low water requirements, and very satisfactory grain quality. The quick ripening of such varieties enabled them to escape many of the hazards of the early summer thunderstorm period, including that of loss through rust. A breeding programme extending over some fifty years has kept these objectives in view and has contributed very materially to the expansion of the industry in this State.

The development of power farming methods has enabled individual farmers to handle considerably larger areas. In addition, by speeding up the operations of land preparation, planting and harvesting, it has greatly increased the safety factor in districts in which the weather conditions are normally unpredictable and often decidedly unfavourable.

The sound progress made by the industry in Queensland is reflected in the fact that, despite occasional seasons in which the crop is almost a total failure, the average grain yield per acre is higher than that in any of the four major wheat producing States, and the grain quality is acknowledged to be well above Australian average. Some idea of the development which has occurred during the last 30 years is provided by Table 2, giving areas sown, total yields of grain, and mean yields in bushels per acre.

TABLE 2.

ANNUAL WHEAT PRODUCTION IN QUEENSLAND.

Year.	Area.	Production.	Yield per Acre.
	Acres.	Bushels.	Bushels.
5-year average, 1920–24	145,555	2,326,904	15·99
1925–29	172,068	2,577,427	14·98
1930–34	244,986	3,980,630	16·25
1935	239,631	2,690,316	11·23
1936	283,648	2,016,236	7·11
1937	372,935	3,749,443	10·05
1938	442,017	8,583,736	19·42
1939	362,044	6,794,906	18·77
1940	322,081	5,687,350	17·66
1941	290,801	3,079,898	10·59
1942	334,785	5,005,065	14·95
1943	281,302	5,084,292	18·07
1944	332,365	6,980,766	21·00
1945	392,502	8,187,687	20·86
1946	247,996	704,835	2·84
1947	462,239	10,684,563	23·11
1948	607,750	14,317,422	23·56
1949	670,000*	11,500,000*	17·16*

* Preliminary estimate only.

For further details of the development of the wheat growing industry in Queensland, reference should be made to the *Queensland Agricultural Journal* for June, 1949 (pp. 364-370) and July, 1949 (pp. 39-55).

QUEENSLAND WHEAT-GROWING DISTRICTS.

The Darling Downs division has always provided the bulk of the State's wheat grain crop. During the 1948 season this division was responsible for 95 per cent. of the total Queensland production. Details of areas and yields for the wheat growing districts of the State for the 1948 season are listed in Table 3.

TABLE 3.

WHEAT PRODUCTION BY DISTRICTS.

District.	Area.	Production.	Yield per Acre.
	Acres.	Bushels.	Bushels.
Darling Downs	563,257	13,593,270	24·13
Maranoa	21,076	303,570	14·40
Port Curtis	9,610	172,698	17·97
Wide Bay and Burnett	9,342	170,727	18·28
Moreton	3,585	76,485	21·33
Central and Far West	880	672	0·76
Total	607,750	14,317,422	23·56

On the Darling Downs the chief producing centres are Dalby, Pittsworth, Jondaryan, Clifton, Millmerran, Warwick, Allora and Cambooya. The older centres are those on the eastern Downs served by the main railway line from Toowoomba to Warwick. During the past 30 years there has been a steady westward trend of the centre of production to the vast open plains country stretching from Pittsworth through Cecil Plains to Dalby and the Jimbour Plains. The Darling Downs division embraces what is certainly the safest area for the further expansion of the industry.

In the Maranoa, wheat has been grown with varying success since 1882. For many years the acreage devoted to this crop fluctuated very little, but of recent years there has been a slight but steady increase. This district was served from 1906 to 1935 by the Roma State Farm, where Mr. R. E. Soutter's wheat breeding programme was centred.

Plate 141.
A Field of Seafoam Wheat at Allora, Darling Downs.

In the Port Curtis division wheat is grown on farms of medium size as an adjunct to dairying and pig raising. While rainfall recordings in this division are similar to those at Darling Downs centres, the evaporation rate is markedly higher and the risks attending crop production are correspondingly greater. In favourable years, however, excellent yields of good quality grain have been recorded, and the area devoted to wheat has more than doubled in the past eleven years. While this district contains a large additional area of potential wheat land and probably will expand its production considerably, it cannot be regarded as a safe area for grain production alone.

In the other districts listed, wheat growing is normally a minor sideline on dairy farms or mixed crop farms of relatively small size, and cannot be expected to expand to any major extent.

SOIL TYPES SUITABLE FOR WHEAT GROWING.

Where satisfactory moisture is available, wheat can be grown successfully in Queensland on most types of soil, ranging from light loams to the red scrub soils of the South Burnett and the heavy black clay soils typical of the western Darling Downs. While the lighter textured soils may have definite advantages in certain seasons, it is on heavy clay soils that the bulk of the State's crop is produced.

The heavy black soils of the Darling Downs possess a high clay content which endows them with an excellent moisture holding capacity and renders them ideally suited for fallowing. Since wheat growing in Queensland depends very largely upon the success of the summer fallow, the heavier soils are generally regarded as the safer soils in areas in which an ample summer rainfall can be conserved.

Where crops have to depend mainly on the rainfall received during the growing period, lighter soils may well give better results. Winter rains in this State are often in the form of light showers which could benefit a sandy loam soil but have little effect upon a heavy clay soil. During seasons of light but frequent winter rains at the Roma State Farm, yields were invariably higher on the lighter soils than on the heavy clay loams. As seasons cannot be forecast, however, little advantage can be taken of this knowledge. Since the whole of Queensland experiences a predominantly summer rainfall, it is logical to assume that any further expansion in wheat growing will be based upon the summer fallow, and will therefore be associated with the heavier types of soil.

Up to the present, there have been virtually no responses to standard fertilizers on the bulk of the Queensland wheat soils. Unlike the soils of much of the wheat belt in southern Australia, the soils of the Darling Downs were well supplied initially with phosphorus and other plant foods. There are recent indications, however, of phosphate deficiency in some of the lighter textured soils fringing the Downs proper and on some of the eroded slopes on the eastern Downs; such soils will respond to regular applications of superphosphate. Moreover, with repeated years of cultivation, even the most fertile of the wheat soils may eventually be denuded of some of the essential plant foods and will then require fertilizing to produce good yields of high quality wheat.

MACHINERY REQUIRED.

There is no crop which can show greater and more revolutionary changes in the machinery and implements used for its production during recent times than wheat. For instance, about 40 years ago, a farmer with 80 acres of suitable land on the eastern Downs, possessing three horses, their harness, a single furrow plough, a set of harrows, and a reaper-and-binder was considered sufficiently well equipped to take up wheat growing. Today, the position is very different, and a heavy outlay is required to purchase an up-to-date plant such as is essential to successful wheat culture. The fact that the chances of success have been much enhanced by the use of modern machinery is, however, an important compensating factor.

The machinery required for wheat production will, of necessity, include the following equipment, the size and number of the various implements depending on the area under crop:—tractor; sundercut; scarifier; harrows; combine; header-harvester; roller (for some areas); and a medium size motor truck. In addition to these items it is also desirable to have a well equipped farm workshop so that repairs can be rapidly effected during the critical planting and harvesting periods.

The estimated cost of a single unit plant containing the above implements would in 1950 be in the vicinity of £3,000, and accordingly it is imperative that these implements receive the best of care. If possible, all machinery should be kept under cover when not in use, and implements should be painted and repainted as required, especially the wooden parts.

On the completion of harvesting or of any other major operation, all machinery before being housed should be thoroughly overhauled for worn, cracked or broken parts, and the required duplicates ordered so that they can be used to replace those defective parts when a slack or wet period occurs. By adopting this procedure, delays occasioned by breakdowns can be reduced to a minimum.

CULTURAL METHODS.

Throughout the main wheat growing areas of the Darling Downs, the universal practice is to grow a crop of wheat each season. It has proved economically sound, where modern machinery and high powered tractors are available, to carry out cultural operations in a manner that will conserve the summer rainfall for use by the following winter crop.

While the surface soil is important in providing the plant nutrients, the subsoil is of particular importance to the wheat grower as a moisture reservoir to carry the crop through the winter months. Moisture and not soil fertility has been the factor limiting the successful growing of wheat throughout the greater part of the wheat growing area. Adequate subsoil moisture can usually be stored during the summer by means of the short clean fallow.

On the western Darling Downs and in the Maranoa, where the rainfall is less, the adoption of the long fallow in conjunction with the short fallow is considered advisable. The value of the long fallow in these two districts was demonstrated by an experiment in which a yield of 24 bushels to the acre was obtained from a 30-acre field worked thus, on a rainfall of under 2 inches during the growing period of nearly six months, whereas that secured on the short-fallow section was only 17 bushels to the acre.

These yields were obviously not produced solely on the rain experienced during the growing period, but were obtained through the moisture and plant foods that had been conserved previously in the soil. Investigations have demonstrated that, under natural conditions, 7½ inches of water are required to pass through a wheat crop to produce 25 bushels of grain per acre. Hence, even supposing the whole quantity which fell as rain were available for the use of the crop, it was necessary for the moisture reserves of the soil to provide the equivalent of approximately a further 5½ inches of rainfall for the 24-bushel crop to be realised.

No hard and fast rule can be laid down regarding the conservation of the necessary soil moisture, for the controlling factors are many. The individual grower must, therefore, decide as to the most desirable course to pursue to meet the requirements of his own particular case.

Fallowing.

The difference between a long and a short fallow is that with the former the land is cropped every second year with wheat, and during the interim is worked with the object of conserving the maximum amount of moisture in the soil from the rains that occur. The short fallow, on the other hand, is sown to a winter cereal every year, the first cultural operation following immediately harvesting has been completed in November or December. With the adoption of a system embracing the long and short fallow, it is advisable to apportion the area to be cropped into three equal sections, two of which will be sown during the first season on a short fallow, the third being worked but not sown until the following year, thereby constituting the first cropped long-fallow area. In the second year one of the two previously planted sections will again be sown, constituting the short-fallow portion of the crop; whereas the balance will constitute next season's long-fallow block. As a result of this procedure, two-thirds of the area devoted to wheat will be cropped every year, half of which, after the first year, will be on long fallow and half on short fallow.

The long-fallow practice in Queensland might be objected to on the grounds of the cost of maintenance of a clean fallow through two summers as well as one winter. However, sheep raising as an adjunct to wheat growing provides a means of controlling weed growth during periods of the long fallow. Wild oats and other winter weeds can also be controlled under such a system.

Treatment of Stubble.

The burning of stubble subsequent to harvesting has been widely practised throughout the Darling Downs. While this practice is known by farmers to be contrary to the soundest agricultural principles, its wide use is based upon ease of subsequent cultivation and upon the absence of evidence of any resultant falling off in yield. In areas in which crops have been tall and a heavy stubble has been left,

Plate 142.

Discing of Heavy Stubble Without Burning.—This is being undertaken on sloping land as a measure to protect the soil from erosion.

considerable difficulty may be encountered, with the machinery available, in preparing a fallow with satisfactory moisture conserving mulch. Under such conditions particularly, the temptation to burn the stubble has been very great.

The principal arguments against stubble burning are (i.) that it robs the soil of a potential annual source of organic matter which would help to maintain a good soil structure; and (ii.) that it destroys the surface cover and renders the soil more subject to erosion during the heavy rains of the summer period. The burning of the crop residues is a particularly unwise procedure on unprotected slopes. If stubbles cannot be retained and satisfactorily worked upon such slopes, the land should not be used for wheat or any other winter crop which requires the soil to lie bare during the wet season.

The principle of stubble-mulching has recently been developed in America, and may find a useful application in Queensland, particularly on slopes which are subject to erosion. The practice involves the use of special cultivating equipment which stirs up the subsurface soil but leaves the straw on the surface as a soil-protecting mulch (Plate 142). Certain difficulties may arise in the application of such methods—for example, in the complete control of weeds during the stubble-mulch period, and in planting (should residues of straw still remain on the surface at planting time). For these reasons, stubble-mulching, while regarded as being very sound in principle, cannot be universally recommended until the technique of its operation has been worked out in Queensland and until satisfactory results to both soil and crop have been demonstrated.

Land Preparation.

While a multiple disc or mouldboard plough (more frequently the latter) is required to bring virgin land into condition for wheat growing, the subsequent use of the plough is seldom necessary on established Downs wheat farms. A disc cultivator, scarifier, combine drill and harrows are the implements normally used in preparation of land for wheat. Implements are selected for size and width of cut in accordance with the horse-power of the tractor employed. Where wheat is grown in rotation with other crops on mixed farms or dairy farms, the initial cultural operation will almost certainly require to be a ploughing to dispose of row crop residues, grass, weeds, etc. Ploughing may also be a necessity upon soils of poorer structure than the typical wheat soils of the Darling Downs, in order to open up the land for satisfactory penetration of summer rains. Such ploughing is frequently carried out by means of multiple-disc cultivator-ploughs of the "sundercut" type (Plate 143).

As cultural operations are carried out during the summer months when heavy rains are frequently experienced, soil erosion is an important factor to be considered, particularly on sloping or undulating country. Fortunately, most of the open plain country, on which a high percentage of Queensland's wheat is produced, is very flat and relatively safe from erosion. Where erosion is likely to occur, cultivation should follow the level contours of the field in order to minimise loss of soil and increase moisture-trapping capacity.

Once harvesting is completed, it is essential to work the land as soon as possible to make it receptive of summer rains. The condition of the soil will of course determine the period at which this first cultivation can be carried out, but conditions are usually favourable as soon

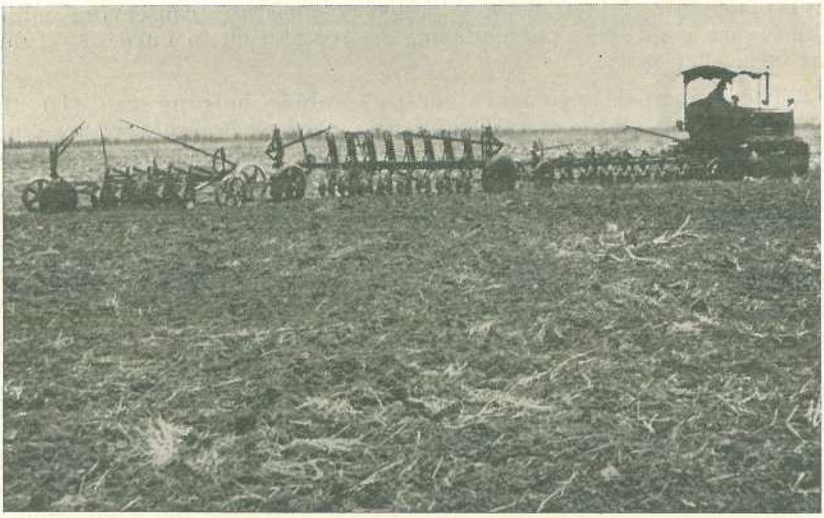


Plate 143.

Initial Preparation of Land.—A heavy tractor is pulling three disc-cultivator-ploughs of the "Sundercut" type.

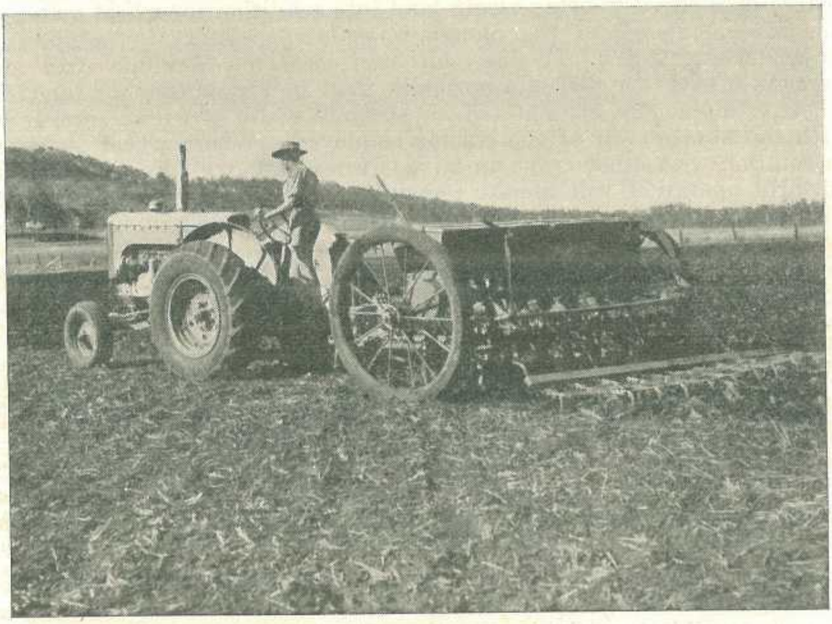


Plate 144.

Working the Fallow on a Mixed Farm by Means of a Light Tractor and "Combine."

as the land will carry a tractor satisfactorily after rain. It is then necessary to complete the operation as rapidly as possible before the land becomes too hard for working. Deep cultivation is generally regarded as unnecessary and even undesirable for wheat. The initial cultivation need not exceed 5 inches, with later operations aiming at the establishment of a firm seed-bed at 2 to 3 inches from the surface. After the first cultivation the surface is allowed to lie in a rough state until rain has fallen, when harrowing will normally reduce the soil to a favourable tilth

All tillage operations are then directed towards moisture conservation by the elimination of weeds and the provision of a loose surface mulch. The breaking of the surface crust leaves the soil in a condition which is receptive of rainfall, and so promotes maximum penetration. The mulch also provides insulation for the moist subsurface soil, and minimises evaporation. This protection is particularly important in clay soils which tend to crack during hot dry periods, and hence lose further moisture from the deeper layers.

The implements used to create and maintain a surface mulch will depend largely on soil conditions and weed incidence. It is not wise to use a disc cultivator when a tine implement (Plate 144) will do the job. Tined implements have the advantage of disturbing the surface soil without unnecessary inversion and undue loss of moisture, and at the same time creating an even seed-bed. It is, however, self-evident that where weeds have become firmly established, such as following a continued wet period, the disc cultivator is the logical implement to use. The use of the harrows soon after rain, while weeds are small, frequently saves the use of more expensive modes of cultivating.

The number of times it is necessary to work a field will vary considerably with the season. While it is necessary that a high percentage of all summer rains should be held, this is especially so in the case of the normal heavy rains of February and March.

Surface Mulch.

Observations made over a lengthy period on a wide range of soils in different parts of Queensland indicate that 2½ to 3 inches is the ideal depth of mulch. Shallower depths are not as effective and a deep mulch is not only a waste of time but is harmful in a season of low rainfall.

The recommended depth provides a firm moist seed-bed just under the seed at planting and this encourages a quick even germination which is desired by wheat growers. The black earth soils of the Darling Downs fortunately have a "self mulching" tendency which facilitates working and the preparation of a satisfactory seed-bed.

VARIETIES.

A steady and continuous change has occurred in the list of varieties holding premier place in the State's wheat culture. Many hundreds of varieties from many parts of the world have been tried by farmers under field conditions during the history of the industry here. It gradually became evident, however, that the varieties offering best prospects of a successful grain crop were early maturing varieties, and preferably those with a light foliage and stemmy rather than leafy appearance. The early maturing habit conferred a certain drought resistance, since varieties of this type required less moisture per unit of grain yield than did later maturing types. This characteristic was especially important in the earlier days of the industry before the short or summer fallow was as efficiently practised as it is today. Another major advantage of the early maturing varieties was that they were in most seasons able to mature their crop before rusts became prevalent enough to seriously threaten yields. Such varieties, while certainly not rust-resisting, were frequently rust-escaping.

The breeding programme, commenced by Mr. R. E. Soutter before the beginning of the century and continued by him until his retirement in 1948, had as its major objectives (i.) drought resistance, (ii.) high bread-making quality, (iii.) rust resistance, and (iv.) general adaptation to local conditions. Considerable success was achieved in objectives (i.), (ii.) and (iv.) within a period of 25 years, and the important westward movement towards Dalby of the centre of wheat production has been attributed by farmers themselves to be largely the result of the liberation of Soutter wheats. Rust resistance was not successfully introduced into commercial wheats until quite recently, mainly because no suitable rust-resisting parents were available in the earlier years of the century. The liberation of Three Seas represented a distinct advance in rust resistance at that time, but a high degree of field resistance has not been achieved until the last decade. It is intended that all new varieties made available to farmers in Queensland shall now possess rust resistance (particularly stem-rust resistance) in addition to yielding ability, high quality and general adaptability.

In the late 1920's the three leading varieties in the State were Pusa-4 (from India), Florence and Clarendon (both from New South Wales); these three held pride of place until 1932. In 1933 and 1934 Florence, Flora and Three Seas were the leading varieties, and Queensland-bred wheats were beginning to play an important part; these three wheats dominated the scene until 1939, when Florence's popularity began to wane and Puora reached a prominent position. Puora became the most popular variety in 1941 and has retained this position up till the present time. In Table 4 are listed the 12 most popular varieties during the 1948 season together with their acreages both for that season and for the preceding season.

TABLE 4.

ORDER OF IMPORTANCE OF MAIN VARIETIES.

Variety.	1947 Area.		1948 Area.	
	Acres.	Per cent.	Acres.	Per cent.
Puora*	128,501	26·5	104,857	16·7
Three Seas †*	55,820	11·5	72,070	11·5
Puseas*	49,561	10·2	69,724	11·1
Gabo	8,517	1·8	58,106	9·2
Charter	10,183	2·1	53,000	8·4
Puglu*	45,477	9·4	52,070	8·3
"Fedweb-5"	20,754	4·3	49,230	7·8
Puno*	51,759	10·7	38,459	6·1
Warput*	16,095	3·3	22,339	3·5
Kendee	1,541	0·3	21,799	3·5
Ford	17,343	3·6	9,205	1·5
Florence x College*	881	0·2	8,205	1·3

* Queensland bred variety.

† Including Seafoam.

While in recent years over 80 per cent, of the State's wheat acreage has been occupied by Queensland-bred varieties, there is a marked present trend towards rapid increase of New South Wales stem-rust resistant varieties such as Gabo and Charter. As new rust resistant varieties from the Queensland breeding programme are made available for general distribution, it is anticipated that such rust resistant types will eventually dominate the field.

Brief descriptions and actual-size illustrations of the more important varieties grown in Queensland follow, the varieties being listed alphabetically. The majority of these varieties are either widely used or recommended at the present time; a few, such as Florence, Flora and Pusa-4, while little grown today, have been included for reasons of historical interest.

Plate 145.
Celebration.

Plate 146.
Charter.

Celebration.

This is a stem-rust resistant variety developed by the New South Wales Department of Agriculture at Glen Innes. It is little grown in Queensland as yet, and being late maturing like Ford, cannot be generally recommended for main-season planting. Ears (Plate 145) are loose and tapering, with a medium tip awn and smooth brown chaff. The variety is fairly tall, like Ford, and susceptible to leaf-rust, but is highly resistant to stem-rust. Grain is of fairly high gluten quality. Its main use will be as a stem-rust resistant variety for early planting, and possibly also as a hay or grazing wheat.

Charter.

Another new rust resistant wheat from Glen Innes, N.S.W., this is a fairly tall variety with attractive straw and slightly tapering, well filled ears (Plate 146) which are white chaffed and prominently tip-awned. Charter is mid-early to midseason in maturity, highly resistant to stem-rust and moderately susceptible to leaf-rust. When ripened under favourable conditions the grain is very attractive, smooth and vitreous, with high gluten quality. When carrying a heavy grain crop the straw is apt to lodge from the base, but since there is no tendency to break or tangle, no difficulty is normally experienced in harvesting. Charter has shown itself well adapted to hot ripening conditions, and produces a well finished grain even in Central Queensland, where southern varieties frequently pinch rather badly. This characteristic, together with its rust resistance, suggests its usefulness for spring planting in years in which the winter planting rains have been unsatisfactory. It is also being sown quite generally as a main-season variety on the Darling Downs. Evidence from northern New South Wales in the 1949 season suggests the appearance of a new form of stem-rust to which Charter is quite susceptible. The future rust resistance of this variety is therefore in some doubt, and will require to be carefully checked during the next few seasons.

"Fedweb—5."

This variety is another of the rust resistant group which has spread into Queensland from New South Wales. Unfortunately, it has, in passing through farmers' hands, acquired an incorrect name. It has recently been ascertained that the variety known in Queensland as Fedweb-5 is not truly a Fedweb at all, but is almost certainly a strain of similar parentage to Gabo. The wheat is very similar in all its field characteristics (including rust reaction) to Gabo. The only distinguishing features are the usually taller growth (by 3 to 6 inches) and later maturity (by 4 or 5 days) of "Fedweb-5." The variety, like Gabo, is capable of very good yields under favourable conditions, but Gabo has generally proved somewhat the better of the two, and would certainly be preferred for medium-late or late sowing. Another variety known as "Fedweb-7" is easily distinguished from "Fedweb-5" by its brown chaff; though grown to some extent on the Darling Downs, it has proved less popular than "Febweb-5."

Flora.

This variety is now little grown in Queensland, having been superseded largely by Puora. At the time of its liberation, however, it represented a distinct advance in breeding for Queensland conditions. A wheat of good grain quality, it won international prizes, and was very prominent in Queensland wheat culture for 20 years. The variety is early maturing, erect, with medium-tall straw; ears (Plate 147) are of medium size, lax, completely bald, with smooth white chaff. The grain is very distinctive, being small, shotty and very vitreous. Flora is very susceptible to both leaf-rust and stem-rust, and has in occasional bad rust years produced very pinched grain.

Florence.

One of Farrer's wheats, this has played a prominent part in Queensland from the early years of the century right up to 1938, about which time it was superseded as leading variety by Flora. Florence is an early maturing variety with medium-tall straw and ears having white chaff and tip awns. The variety has always been free-shelling, resulting sometimes in shattering in the field and sometimes in excessive weathering of the grain. Though this variety has been a very reliable one for many years, there is little to recommend it now in preference to a number of more recent varieties. Florence, like Pusa-4, has played a very important part in the breeding of modern varieties and strains.

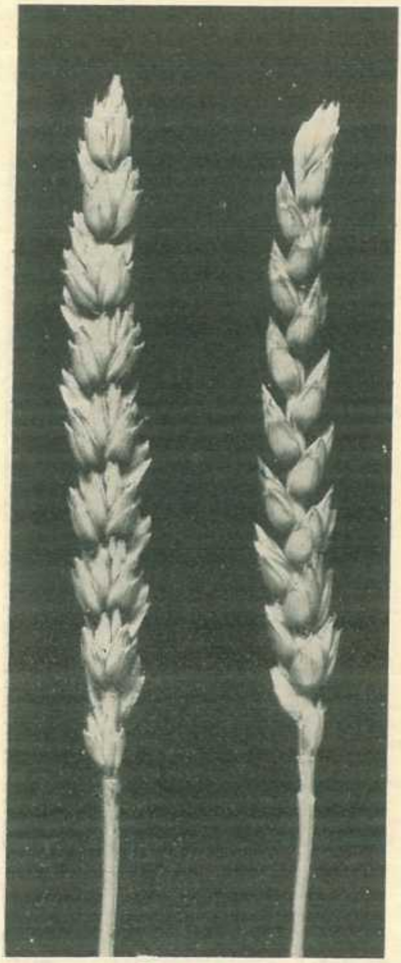


Plate 147.
Flora.

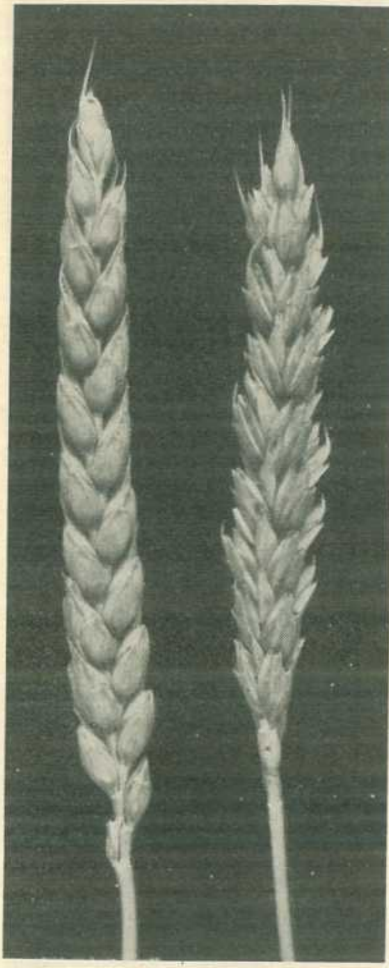


Plate 148.
Florence x College.

Florence x College.

This crossbred selection, which it is hoped to liberate under the name of Lawrence, was derived from a cross between Florence and a highly rust resistant variety known at the time as "College," but almost certainly the North American variety Hope. This selection, made in

1938, has been widely tested and has proved to date the most rust resistant wheat in Queensland under field conditions. The variety is moderately tall, with fairly fine attractive straw of good strength. It is mid-late to late in maturity, averaging perhaps a little earlier than Ford. Ears (Plate 148) are of small to medium size, tapering and slightly inclined, with small tip-awns seldom exceeding ¼ in.; chaff is smooth and creamy white. The grain is of medium size and light colour, and is semi-translucent, yielding a flour of very satisfactory gluten quality. This variety is highly resistant in the field to both stem-rust and leaf-rust; it has also shown better cold resistance than most Queensland varieties and has proved itself a useful grazing wheat. When planted

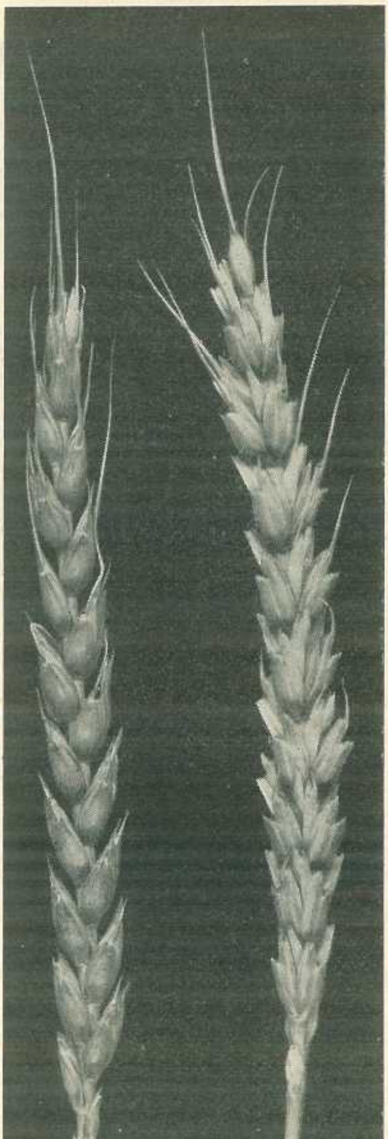


Plate 149.
Ford.

Plate 150.
Gabo.

as a main-season variety it is capable of useful yields, but would not be expected to compete successfully with a number of the standard early-maturing varieties. It is recommended chiefly as a substitute for Ford for early planting; its rust resistance and cold resistance give it an advantage over Ford and its palatability makes it ideal for feeding off. The variety is also recommended for trial in coastal districts as a hay or grazing wheat.

Ford.

This South Australian wheat has been grown to a moderate extent for over 20 years, and attained its maximum popularity between 1937 and 1943. It is a late-maturing variety which proved suitable in most years for early planting for green feed, hay or grain. It was used considerably as a dual purpose wheat capable of producing useful grain yields after feeding off. In this class it has largely been superseded by Warput, and now rust-resistant wheats such as Florence x College and Celebration are available to take its place. Ford is a tall, yellow-strawed variety with a particularly long, loose, tapering ear (Plate 149) with prominent tip-awns. Its grain is large, yellowish and of medium gluten strength.

Gabo.

One of the outstanding modern Australian wheat varieties, this wheat, which was bred by Sydney University, combines high yielding ability with good quality, good field characteristics and stem-rust resistance. It is short, well stooled, strong strawed and early maturing, with fairly short ears (Plate 150) having light coloured chaff and strong tip-awns. While it is very highly susceptible to leaf-rust, it has shown itself capable of high yields in spite of heavy infestation by this disease. Its grain is of low bushel weight, but, while frequently of poor appearance owing to a dull and wrinkled bran, has proved itself capable of producing a bread flour of high quality and good balance. In recent tests, Gabo has proved its outstanding yielding ability at a number of centres on the Darling Downs, particularly in the eastern and central sections. It cannot be recommended for general planting in hotter districts, where it often finishes badly, or in coastal areas, where it has proved highly susceptible to scab. It is recommended for June or July sowings throughout the eastern and central Downs. On account of the recent appearance of new races of stem-rust, Gabo's resistance to this disease is now in question. In the 1949 season, Gabo on the eastern Downs was still highly resistant to stem-rust, but reports from northern New South Wales and the western Downs claimed that the variety had on occasions been seriously rusted.

Kendee.

This is another of the rust resisting wheats developed recently by Sydney University plant breeders. It is a wheat of medium height and strong straw; heavy crops have, however, been known to lodge severely like those of Charter. Ears (Plate 151) are fairly compact, with yellow chaff, and tip-awns up to 1 inch in length. In Queensland it is mid-early to midseason in maturity, and capable of high yields, particularly under good conditions. Its grain is large, slightly wrinkled and dull, but mainly vitreous, and yielding a flour of medium-strong class. Kendee, like Gabo, is highly susceptible to local forms of leaf-rust, but has in the past proved to be fairly resistant to stem-rust, being in this respect somewhat inferior to Gabo and Charter. The variety appears to be well suited to midseason planting on the Darling Downs, but would not be generally recommended for planting further north or west.

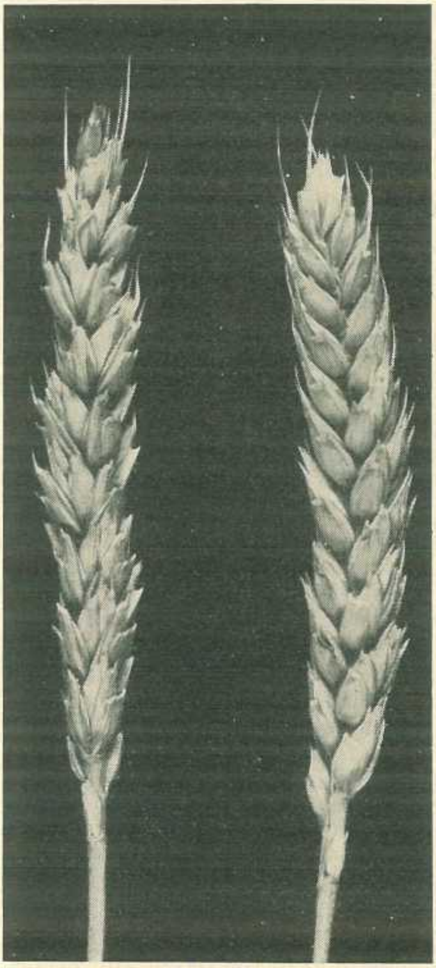


Plate 151.
Kendee.

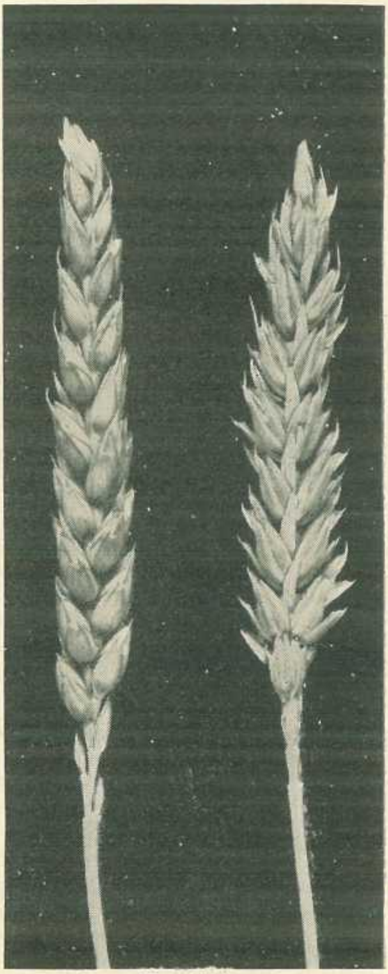


Plate 152.
Puno.

Puno.

This Queensland-bred variety has the parentage Pusa-4 x Novo. Puno is very similar in its general growth to the more widely grown variety Puora, but on ripening develops a brighter, yellower colour in the straw and chaff. Puno is an ever-maturing variety with sparse foliage and moderately tall straw; in most seasons it averages 3 inches taller than Puora. Straw is reasonably strong, but the variety frequently lodges seriously from the base. Ears (Plate 152) are medium-small, tapering and slightly open, characterised by smooth creamy chaff and very short (often hook-shaped) tip-awns. Puno is susceptible to both leaf-rust and stem-rust, but even under conditions of fairly general attack is able to mature a plump grain sample. The grain is normally of medium size, smooth, amber coloured, vitreous, and of high bushel weight and pleasing appearance. Its high gluten quality places it in the strong flour class. Puno has yielded well under a variety of conditions, and should be a useful variety for midseason or late planting in any of the inland wheat districts.

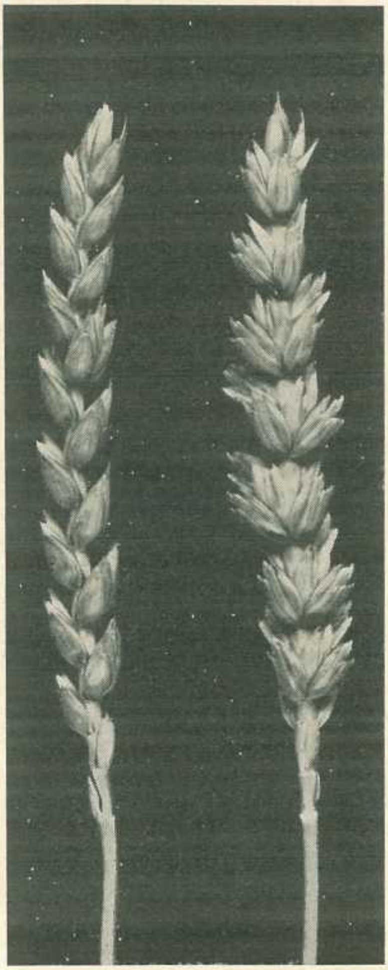


Plate 153.
Puora.

Plate 154.
Puseas.

Puora.

The present standard Queensland variety, Puora occupied 105,000 acres in 1948, and has been in first position since 1941. The variety is derived from a Pusa-4 x Flora cross made at Roma State Farm in 1926; the selection from which the variety was derived was made in 1932 and named in 1936. Puora, like most Queensland-bred wheats, is early-maturing and carries a very light foliage (Plate 140). Height is medium to medium-tall, and straw and glumes are a dull creamy white. Straw is of moderate strength, and though the variety lodges occasionally, it is no worse than average in this respect. Ears (Plate 153) are of small to medium size, tapering, and very open when viewed from the side; the chaff is smooth and tip-awns are absent, making this one of the few common varieties which are completely bald. Grain is medium-small to medium in size, shorter and broader than that of Puno and closer to white in its colour; its texture is normally vitreous, and it yields a flour of strong gluten quality. While Puora is fairly susceptible to both stem-rust and leaf-rust, it is able in most seasons to escape serious injury. Puora is a very reliable "main-crop" variety for general sowing, both on the Downs and in outlying districts. It appears to be better adapted to the central and western Downs than to the eastern fringe.

Pusa-4.

Pusa-4 is an early importation from India, which has generally been regarded in Australia as the standard of highest (or premium) gluten quality. Like Florence it was prominent in Queensland wheat culture for over 20 years and is still grown on some thousands of acres today. It is an early maturing, medium-tall variety with a somewhat open, bald, tapering ear with densely pubescent glumes (velvet chaff). It is very susceptible to rust, but otherwise is well suited to Queensland conditions even as far north as the Tropic. It has been widely used as a parent of many of the State's highest quality wheats.

Puseas.

Derived from a cross between Pusa-4 and Three Seas, Puseas was distributed in 1936 and named in 1939; since 1942 it has been one of the five leading varieties in the State. It is early to mid-early, being normally a few days later than Puora. Straw is medium-tall (usually 2 to 3 inches taller than Puora) and of medium strength. Ears (Plate 154) are tapering, slightly inclined and moderately dense, with smooth white chaff and tip-awns, one or two of which are prominent and up to ½ inch in length, the remainder short and hooked. The grain is large and plump, semi-translucent, often with slightly wrinkled bran; its flour quality places it in the strong to medium-strong class. Puseas is moderately susceptible to leaf-rust but possesses good field resistance to stem-rust, though by no means immune to this disease. Puseas has yielded well, particularly on the central Downs, and should be a useful main-crop variety for that district.

Seafoam and Three Seas.

These two varieties, which are virtually indistinguishable in field characteristics, are both selections from the same cross, Comeback x Cretan x Comeback. Major purpose of this cross was to combine the high quality of Comeback with the rust resistance of Cretan. Both varieties are of short to medium height (Plate 141), with fine straw of medium strength, and white, prominently bearded ears (Plate 155); this latter characteristic readily identifies them as they are virtually the only bearded varieties grown commercially in Australia. Both are very early in maturity, and though not highly resistant to leaf-rust and stem-rust, show a useful tolerance in the field to these diseases. The grain is somewhat opaque and fairly soft, providing a medium-strong flour of very useful baking quality. The combined acreage of these two sister varieties has placed them in either first, second or third position in the State since 1934. They have provided a useful standby for late main-season planting and have proved very reliable grain producers in the Maranoa, Burnett and Central Queensland districts. One of their main disadvantages is their liability to shatter if harvesting is delayed.

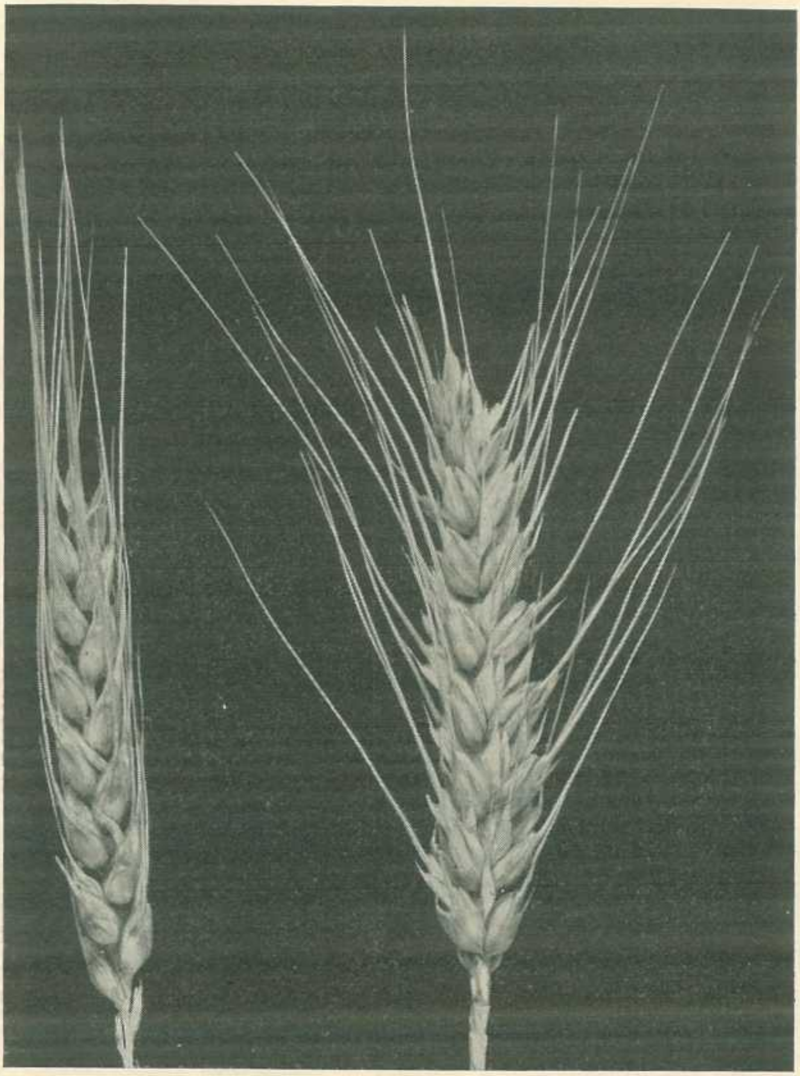


Plate 155.
Seafoam.

Warput.

This was bred from the cross Pusa-4 x Warren with the purpose of providing a good general purpose wheat suitable for green feed, hay or grain. It is a mid-late variety with fairly tall weak straw, and a long, curved, tapering ear (Plate 156) which is smooth chaffed and completely bald. Grain is fairly large, opaque to semi-translucent, and of satisfactory baking quality. While the variety is not highly resistant to rusts, it usually shows quite good field resistance, being superior to most of the older Queensland varieties in this respect. This variety was intended to displace Currawa as an early-sown dual purpose wheat. Currawa's main disadvantage was its poor flour quality, and in this respect, as in rust resistance, Warput is definitely superior. Regularly occupying approximately 5 per cent. of the State's wheat acreage since 1938, Warput has given some excellent performances in terms of grain yields following one or more grazings during growth.

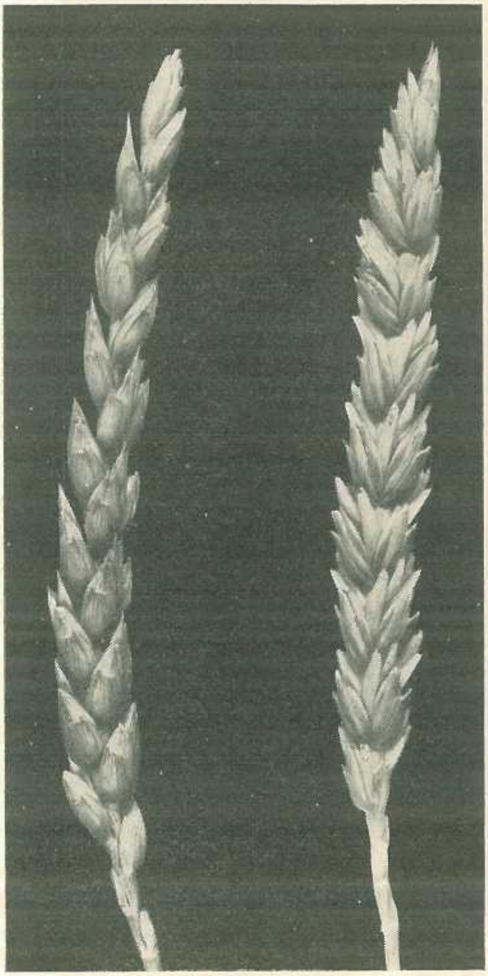


Plate 156.
Warput.

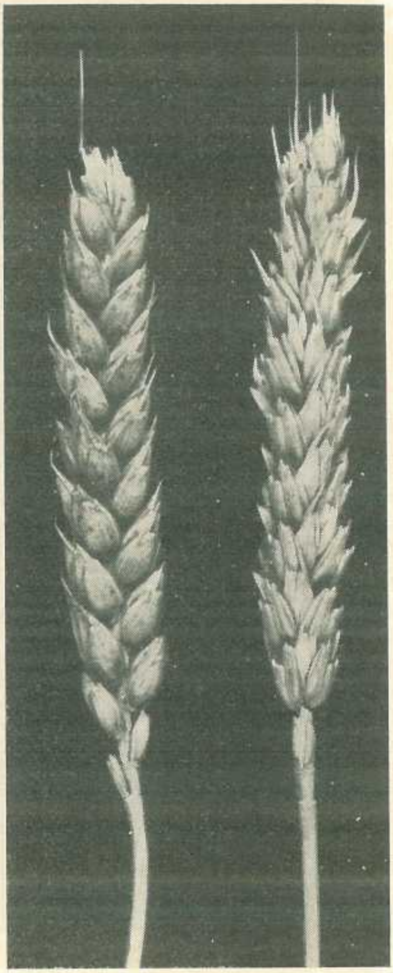


Plate 157.
Yalta.

Yalta.

This is another of the newer varieties bred for rust resistance at the Glen Innes Station of the New South Wales Department of Agriculture. It is a mid-season wheat with medium-tall, strong, coarse straw. Ears (Plate 157) are somewhat compact and of the squarehead type, with velvet chaff and one or two prominent tip-awns. The grain is medium-small, broad and plump, and a dark amber colour; the flour is of strong or premium quality. Yalta, while appearing a most attractive variety under reasonable growing conditions, has not been prominent in grain yield in Queensland. Moreover, the recent occurrence of a new form of stem-rust has reduced Yalta to the status of a highly susceptible variety. There is little therefore to recommend its use in preference to a number of the standard varieties for main-season planting.

SEED.

Seed wheat supplies are available through the Queensland State Wheat Board, Margaret Street, Toowoomba.

Having decided upon the variety or varieties to sow, the farmer can procure his seed from this source with the guarantee that it is true to variety, of the required standard of germination, free from disease, and graded. As with other crops, the use of sound and reliable seed free from contamination with weed seeds cannot be too strongly recommended.

A grower should never lightly discard a variety which has served him well over a period of years. Varieties which have been recommended to him by other farmers, or about which he has read glowing accounts, should not be widely adopted until they have been thoroughly tested under local conditions. New varieties released by the Department of Agriculture and Stock will have been subjected to field testing before release, and will be described from time to time in the *Queensland Agricultural Journal.*

A grower using his own seed should be sure that it comes up to standard and that it is free from disease and foreign seed. Varietal purity is another important matter, and in this connection the grower is reminded that the main sources of contamination are the complicated machines used for harvesting, grading and sowing. Of these machines, the harvester in particular is almost impossible to clean thoroughly without being taken completely apart. In actual field practice the best procedure to adopt when changing from one variety to another is to clean out the more accessible parts of the harvester before commencing on the new variety and then to reserve the required seed from the last harvested material of the second variety.

Seed Treatment.

Treatment of the seed with a fungicide for the control of bunt or ball smut is strongly advised. The presence of bunt in a field of wheat immediately rules it out for bread flour production, and the cost of the treatment at the rate of a few pence per bushel represents a very small premium to pay for insurance against the condemnation of a crop.

Dry powder treatment, or dry pickling, as it is often called, has for many years been universally applied for this purpose. The chemical used is copper carbonate, copper oxychloride, or one of the organic mercurial compounds, and the rate of application is 2 oz. per bushel of seed. The powder to be effective must come into intimate contact with all seeds in the mass to be treated. It may be applied by thorough mixing with the grain in a home-made pickler of the type illustrated in Plate 158 or in specially made machines which are available at reasonable price. In addition, picklers are frequently attached to the larger seed graders, and travelling outfits of this type will grade and treat the seed in the one operation on farms in the major wheat growing districts.

As the treatment with copper carbonate does not impair the vitality of the seed, even when stored for 12 months, it should be done as soon after harvesting as is practicable. This is particularly desirable if the grain is weathered or is of softer varieties such as Three Seas, for such grain is susceptible to weevil infestation. Prolonged keeping of seed treated with mercury dusts, however, should be avoided, as some reduction in germination may occur if storage extends over several months. Though the dusts will not destroy weevils actually in the grain, they will afford it some protection if not already infested.

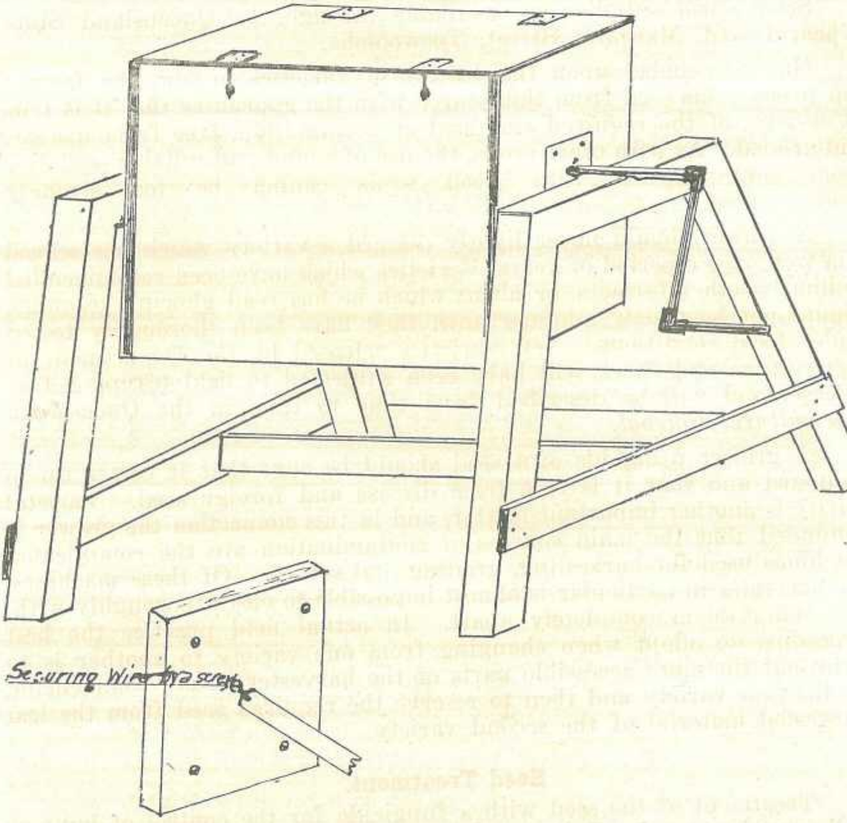


Plate 158.
Diagram of a Seed Pickler Made from a Petrol Case.

All dusts are harmful if inhaled in quantity; therefore, the precaution of covering the mouth and nostrils should be taken when pickling seed. A damp cloth or handkerchief may be used, though a cheap dust-mask or respirator is more effective and can be worn without discomfort. Surplus dusted grain should not be fed to stock or fowls, because of the poisonous properties of the pickling dust; the mercurial dusts are, of course, particularly poisonous.

Seed Storage.

Wheat seed is generally stored in bags either in a closed barn or outside on a raised platform, but wherever it is stored, the utmost care should be taken to make it secure from the attacks of rats, mice and other vermin, and to see that it is not directly exposed to the weather; otherwise, when required, it may be found to be worthless. In the event of weevils making their appearance, which is quite probable if the harvest is a wet one, it will be necessary to fumigate the seed with carbon bisulphide. For further details relating to insect control in stored grain, reference should be made to Departmental Pamphlet No. 114, entitled "Stored Products Pests."

SOWING.

Wheat in Queensland is almost universally drilled in at 7-inch row spacing by means of the standard grain drills of varying size. Broadcasting is seldom seen anywhere in the State, its limited use being restricted to small farms and usually for providing a small patch of green feed. Even in districts as far from the centre of the wheat belt as the Upper Burnett and the Dawson and Callide Valleys, grain drills (Plate 159) are standard farm equipment, their versatility enabling them to be used for sorghums, linseed, cowpeas and a variety of other crops in addition to wheat and oats. Drilling enables the seed to be placed in contact with moist soil at the desired depth, with ample covering to protect it from loss of moisture and from attack by birds and animals. Where the soil is in favourable condition for sowing, drilling will ensure an excellent germination and result in a very considerable saving in seed as compared with broadcasting.

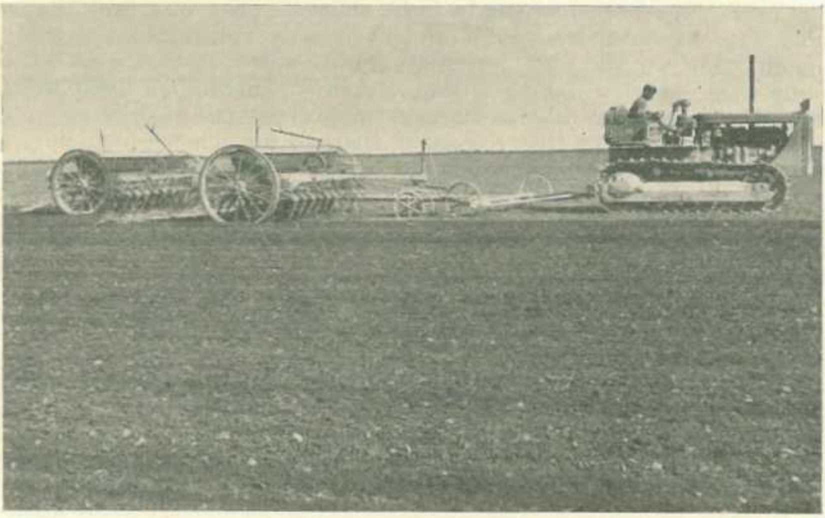


Plate 159.
Planting Wheat on a Large Grain Farm.—A heavy tractor and two combine drills in echelon are being used.

Two types of drill are at present in general use, the disc drill and the "combine" or cultivator-drill. The disc drill is the older type and was once in general use, but it has now been largely superseded by the combine. The latter type is a dual-purpose machine which enables the farmer in one operation to give the land its last working and to sow the seed, with the soil in the best possible condition to ensure germination. The combine drill has been a great boon to wheatgrowers, especially on soils which are inclined to run together after rain. On weedy soils, the use of this implement obviates the necessity for two separate operations of final cultivation and sowing. Such final cultivation would be vitally necessary to destroy newly germinated weeds after rain and to restore the surface mulch. If planting then had to be carried out as a separate operation, the area capable of being handled by each individual would be considerably reduced, and much of the seed would be placed less favourably with respect to moisture than where the two operations are combined in one. Once a good stand of young wheat plants is well established they can normally compete successfully with weeds germinating on any subsequent rains.

With the removal of the grain tubes and attachments, the combine can be used continually as a spring-tooth or rigid-tine cultivator for the summer working of fallows. Both disc and cultivator drills are normally fitted with a fertilizer attachment capable of distributing any kind of commercial fertilizer.

Dry planting, though not advocated as a general practice, is sometimes advisable; this is particularly so where a large acreage has been prepared for sowing and the main sowing period has passed without planting rains. If portion of such an area is planted dry, it has a good chance of shooting away quickly with the first rain, and no delay will be occasioned if such rain should prove to set in for some days or even weeks. One of the main risks with dry-planted wheat is that, if the first rains experienced are only light showers, they may wet the seed sufficiently to cause it to malt and eventually rot, without providing enough moisture for full germination and safe establishment of the young crop. Another danger is that, if heavy rain follows dry-planting, the soil surface may cake so hard as to prevent the emergence of the young seedlings. For this reason, if there is any choice available, the areas chosen for dry-planting should be those with the lighter textured soils or the better self-mulching soils. Finally, when this practice is used, care should be taken that the seed is not buried too deeply, and particularly that it does not come in contact with soil which is damp enough to cause malting or premature shooting.

A word of warning is offered at this juncture. Grain left in drills overnight or during periods of drizzle is liable to consolidate, particularly if it has been treated with dust for disease control. When the machine is started up again after such an occurrence, so much strain is thrown upon the gears that a serious breakdown may result. Such a contingency can best be avoided by always giving the grain shaft a turn or two backwards and forwards before starting the machine again after a spell.

Rates of Sowing.

The most satisfactory planting rate varies somewhat from one district to another and from one variety to another. The overall variation in the seeding rate, however, is not great and the rate would generally lie between two-thirds of a bushel and one bushel per acre. For April-May plantings on the Darling Downs, 40-50 lb. of seed per acre will give an ample stand; for later plantings, in which stooling is likely to be less pronounced, it is customary to increase the seeding rate to 50-60 lb. per acre. In the drier district of the Maranoa, lighter stands are often more successful, and these rates can profitably be reduced to 30-35 lb. for early planting and 40-45 lb. for later planting. Of the minor wheat-growing districts, the areas with better rainfall should follow the recommendations for the Darling Downs, and the drier, hotter districts should follow those for the Maranoa.

Weathered grain and dry-pickled grain will not run as freely through the drill as a bright sample of untreated seed. It is advisable therefore, before commencing sowing operations, to check the calibration of the drill by making trial sowings with a few pounds of each variety to be used. A calculation based on a weighed quantity of seed and the area covered by the time the grain box has emptied will soon provide the actual sowing rate for the particular gearing used. Such work is best carried out well ahead of actual planting time, the seed being run out on to a piece of spare ground. Where grain has been stored for some time or has been subjected to weathering or to insect attack, its germination should be checked before planting. Where the germination percentage falls below 90 per cent., the planting rate should be increased to compensate for the faulty seed.

HARROWING THE CROP.

The harrowing of the growing crop can generally be carried out with safety as soon as the young plants are about 6 inches high and have become firmly established.

Harrowing certainly drags out a percentage of the wheat plants, but when the stand is not already too thin, no damage results. It destroys weed seedlings, induces deeper rooting and possibly increases tillering, which advantages will under most conditions more than make up for any damage done. Many farmers are not in favour, however, of harrowing the young wheat crops and the practice is not recommended for soils which are inclined to bake and run together. Should stubble conservation be adopted by farmers in Queensland in order to combat soil erosion, then, in such cases, harrowing of the crop should not be attempted.

Where harrowing can be done, the operation should be across the drilling in order to secure the best results and to reduce plant injury to a minimum. Harrowing across the drills is, of course, not wholly practicable for fields which have been planted by the common method of "round and round" drilling. In such instances, it is advisable to harrow across the direction of the longest rows. Close examination should always be made of the effect of the operation to decide whether more damage than good is being done. It is imperative to keep the harrow teeth free of soil.

[TO BE CONTINUED.]

PENICILLIN EMULSION MUST BE KEPT COOL.

Veterinary officers of the Department of Agriculture and Stock point out to retailers and dairy farmers the need to hold penicillin emulsions at a fairly low temperature.

These products have been used extensively and successfully for the treatment of the common form of contagious mastitis of dairy cows during the past two years. However, it must be realised that they will degenerate and lose their curative effect if stored carelessly.

All manufacturers mark clearly on the packages or tubes in which the substance is marketed that it must always be kept in a cool place. Some state the temperature at which the product should be stored; others merely state that refrigeration is unnecessary if it is kept in a cool place.

The Department considers that during most of the year it should be possible to store penicillin products without refrigeration if care is exercised in choosing the storage place, but it suggests that during the hotter months it is probably necessary to hold penicillin emulsions in a refrigerator, as the storage temperature should not be higher than 60 degrees.

Whiptail in Cauliflowers

C. N. MORGAN (Senior Adviser in Horticulture) and A. F. C. HENDERSON (Assistant Soils Technologist).

THE cauliflower crop is grown extensively during the late summer, autumn and winter months in the metropolitan area for the Brisbane market. The crop is not an easy one to handle, for it requires a fertile soil and ample supplies of moisture during the whole of the growing period. Until a few years ago, production was more or less restricted to districts characterised by soils of the "peaty" type, and most growers were specialists whose long experience had made them familiar with the crop and the methods required for its successful production. The demand for good quality cauliflowers has increased and many new growers have entered the industry. The soils used for the crop differ in both their chemical and physical properties, and a disorder known as whiptail has been recorded from most of the intensively farmed market garden areas in southern Queensland where cauliflowers are grown. It is due to a molybdenum deficiency in the soil.

Symptoms.

The symptoms of whiptail vary with the age of the crop and the severity of the outbreak. However the name whiptail comes from a characteristic feature of affected plants in which the normal broad, open leaf is reduced to a midrib with a narrow, uneven band of green tissue on each side. The whiptail leaf is usually twisted and the deformed tissue on each side of the midrib is usually corrugated. The reduction in leaf area associated with the disorder upsets the nutrition of the plant. An affected crop is shown in Plate 160.

Several symptoms both precede and follow the development of whiptail leaves in the cauliflower plant. A recognition of the early symptoms is useful in determining the need or otherwise for remedial measures, which become urgent when the disorder appears in the seed bed or the field.

In cases of extreme molybdenum deficiency, seedlings may be affected. The leaves become pale, the outer edges tend to curl downwards and areas of dead tissue appear along the margins of the leaves. The young leaves lose their turgidity, growth ceases and the plant finally dies. If the seed-bed is lost, the planting schedule for the year is upset and this may be costly to farmers who grow cauliflowers for a special market and time their seed-bed plantings with precision. Spectacular losses of this kind are not common.

If healthy seedlings are transplanted, whiptail symptoms may appear in the field four to six weeks later. The first symptom is then an interveinal chlorosis in which the tissue between the veins becomes yellowish-green in colour and takes on a somewhat marbled appearance. All the outer leaves may be affected and the chlorosis remains until the plant is fully grown. The younger leaves usually retain the normal green colour but the tissue at their edges breaks down. This edge-burn in the young leaves is the beginning of the severe malformation recognised in the typical whiptail leaf.

Plate 160.

A Cauliflower Crop (Early March Variety) Affected by Whiptail.

Crops affected by whiptail seldom bear well, but the actual loss in any particular outbreak depends on the time at which the disorder appears in the field and the severity of the symptoms. If the disease appears early, few flowers may be harvested; if it appears late, some flowers will be small and many will be inferior in quality, as whiptail affected plants give little leaf protection to the developing curd.

Varietal Susceptibility.

In other States it appears that the incidence of whiptail in the cauliflower crop, although mainly determined by the molybdenum status of the soil, is also influenced by the variety grown. The influence of the variety on the severity of whiptail symptoms in the field would depend mainly on its molybdenum requirements during the growing period.

Recent trials at the Redlands Experiment Station showed marked differences in the varietal reaction to a molybdenum deficiency on the red loams typical of this district. Whiptail occurred in two varietal trials at the Station during 1949. The first of these was designed to compare varieties which might be suitable for the early crop planted in the field during March. Of the seven varieties grown, three—White Queen, Snowball X and Snowball Y—completed their development normally. Early November showed mild symptoms of the disorder, but the other three varieties—Snowball A, January 68 and Early March—were all severely affected. Early March was a total loss, no flowers being harvested. In another trial which was field planted in May, all of the eight varieties grown showed whiptail symptoms. However, the two least affected were Model White and Rumsey's Snow. No heads were harvested from Early March.

So many factors are obviously involved in varietal behaviour in whiptail susceptible soils that trials over a period of years would be needed to make accurate comparisons. The foregoing differences are therefore, of general interest rather than a guide to the use of varieties by farmers in the metropolitan and near-metropolitan district.

Soils in Relation to Whiptail.

Trace elements such as molybdenum and boron are needed in only very small quantities by cultivated plants. A recognition of their importance in horticultural practice is comparatively recent, but there are indications that these deficiencies are becoming more acute in the intensively farmed market garden areas of southern Queensland. This could perhaps be expected, for two or three crops may be grown annually on the same soil and each removes its quota of the elements concerned. As supplies are limited in the first place, the reserves in the soil must sooner or later become depleted. Many intensively farmed soils near Brisbane are apparently reaching this stage.

Whiptail has been known for many years and reasonable control of the disorder can frequently be obtained by liberal applications of either dolomite or lime. Indeed, it has often been assumed that whiptail is characteristic of highly acid soils. Much of the land planted to cauliflowers in southern Queensland is naturally acid and liming would, therefore, bring pH value closer to 6·5, which is generally considered the most suitable for the plant. Liming apparently makes more of molybdenum reserves in the soil available to the plant. However, if these reserves are very low, liming does not always correct the disorder.

Control.

In areas where whiptail is known to occur, farmers should regard the disorder as a threat to cauliflower crops each year, and take the necessary precautions to prevent or control it. If liming is practised, but does not give complete control of whiptail, or if the condition of the soil does not warrant an application of lime or dolomite, then the use of ammonium molybdate is recommended. The following control measures are based on experimental work carried out in other States, and confirmed in practice at the Redlands Experiment Station:—

(1) Seed-beds should be treated with ammonium molybdate at the rate of one-tenth of an ounce per square yard, applied one to two weeks before transplanting. It is convenient to dissolve one ounce of this substance in 10 gallons of water, applying the solution at the rate of one gallon per square yard of seed-bed. Contact between the solution and the plant leaves has no harmful effect, although the leaves may become temporarily tinged with a bluish colour.

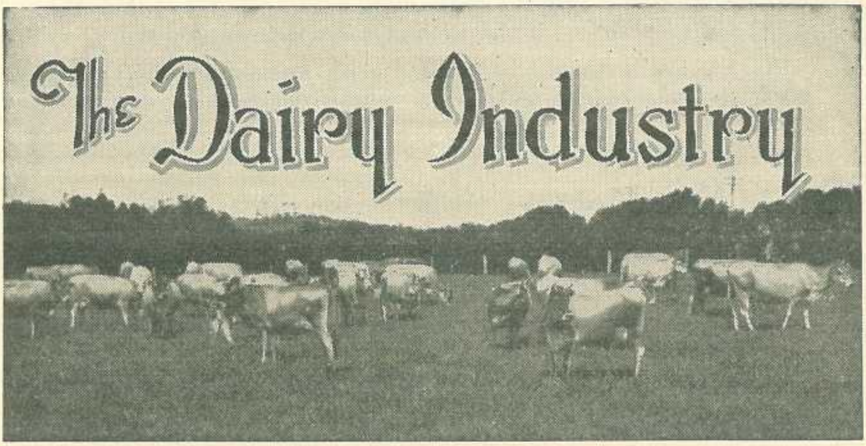
(2) If, after transplanting, plants from a treated or untreated seed-bed begin to show symptoms of whiptail, then ammonium molybdate should be applied at the rate of one pound per acre. One pound can be dissolved in 40 gallons of water, and the solution applied as a spray, or watered on to the plants with a watering can.

(3) If symptoms appear in the cauliflower seed-bed, ammonium molybdate should be applied promptly at the rate of one-tenth of an ounce per square yard. This application should be repeated one week before transplanting.

Ammonium molybdate is usually sold in a lumpy condition. It will dissolve readily in hot water, but should be ground to a fine powder before dissolving in cold water.

TUBERCULOSIS-FREE CATTLE HERDS (AS AT 25th MAY, 1950).

Breed.	Owner's Name and Address of Stud.
Aberdeen Angus	The Scottish Australian Company Ltd., Texas Station, Texas.
Jersey	W. E. O. Meier, "Kingsford" Stud, Rosevale, via Rosewood.
A.I.S.	F. B. Sullivan, "Fermagh," Pittsworth.
Ayrshire ..	L. Holmes, "Bencecula," Yarranlea.
A.I.S.	D. Sullivan, Rossvale, via Pittsworth.
A.I.S.	W. Henschell, Yarranlea.
A.I.S.	Con O'Sullivan, "Navillus Stud," Greenmount.
Jersey	J. S. McCarthy, "Glen Erin Jersey Stud," Greenmount.
Jersey	J. F. Lau, "Rosallen Jersey Stud," Goombungee.
A.I.S.	H. V. Littleton, "Wongalee" Stud, Hillview, Crow's Nest.



The Cooling and Holding of Milk and Cream on the Farm

F. G. FEW, Dairy Technologist, Division of Dairying.

INTRODUCTION.

IT is generally recognised that three major factors enter into the production of a good quality milk or cream on the farm. Briefly, these are a healthy herd, clean production methods and the prompt and efficient cooling of the product. All are problems in themselves and require particular consideration. This article is confined to the cooling problem and only so far as production on the farm is concerned.

Why Prompt Cooling is Necessary.

Milk from the udder of a healthy cow is practically free from bacteria likely to cause a rapid decline in quality. Despite all precautions, however, a degree of contamination from external sources is inevitable by the time the milk reaches the cans. If the milk has been properly cooled during this period, the rate of reproduction of the bacteria present is considerably checked, and with a limited population, little or no harm is likely to result.

Freshly drawn milk also contains inhibiting substances which restrain bacterial growth for a certain time. This period of protection is extended by prompt cooling, but if cooling is delayed, the effect soon becomes lost. A technique of prompt and efficient milk and cream cooling on the farm is thus invaluable, both to restrain the activity of any bacteria that may be introduced and to prolong the natural protective power of the product itself.

Degree of Cooling Necessary.

The temperature to which milk and cream should be cooled on the farm depends, to some extent at least, on the form of consumption intended for the product and on the holding time before despatch to the depot or factory. Milk, and especially that produced for the whole-milk trade, should, if possible, be promptly cooled to a temperature around 40 deg. F., this practice being essential for the night's milk marketed the following morning. Milk is one of the most perishable of foods and, in all cases, requires prompt cooling if quality is to be maintained.

For cream used for butter manufacture by Australian manufacturing methods a temperature around 70 deg. F. allows of a desirable degree of ripening in a cleanly produced product. This temperature would therefore suffice if the cream was despatched to the factory within a short time. Under Queensland conditions, however, the holding time on a farm supplying cream is often considerable and to offset this fact a lower temperature should be the objective. Cream hygienically produced and promptly cooled to and maintained at 50 deg. F. will keep for relatively long periods. As deliveries to Queensland factories are usually not more frequent than three or four times per week, cooling to 50 deg. F. or less is thus the objective to be achieved wherever possible.

Holding Temperatures for Milk and Cream.

It appears axiomatic that it is of little use cooling milk or cream to avoid rapid deterioration unless the product can be kept cooled. A means of storage is thus necessary in all cases where milk or cream is to be kept for any time on the farm. The temperature of the cool storage accommodation provided should at least equal that to which the product is cooled, a temperature not exceeding 40 deg. F. being required for milk and approximately 50 deg. F. in the case of cream.

Requirements of Cooling Systems.

Milk and cream when freshly produced on the farm will be found to have a temperature around 90 deg. F. Any cooling system in use will thus be required to reduce this temperature quickly and the ideal system will enable a temperature drop of about 40 deg. F. to take place.

Heat will only pass from one object to another if the latter is at a lower temperature. The first requirement for milk or cream cooling is thus a suitable medium at a temperature below that to which the product is to be cooled. In practice, air and water are the only natural media available.

When heat can be transferred, the rate of cooling is proportional to each of two factors—the surface area of contact and the temperature difference. Either factor can alter the rate of cooling to the same extent—for example, by doubling one factor the amount of heat removed in the same time is doubled.

Consider a can of milk or cream freshly produced on the farm and allowed to stand in air or water. The temperature will be around 90 deg. F., which is likely to be about 20 deg. F. above both the atmospheric temperature and that of water normally available on the farm. Due to the temperature difference, the milk or cream will start to cool, and eventually the air or water temperature will be reached. Experience shows, however, that this technique is not satisfactory, as the cooling rate is so slow as to be useless for safeguarding quality. It is true that the rate of cooling is somewhat faster when water is used instead of air, but even so the product is still at a high temperature for too long a period. Bacteria which multiply rapidly between 70 deg. F. and 90 deg. F. are likely to spoil the milk or cream in the time required to effect cooling by standing the cans in either air or water at atmospheric temperature.

Assuming that the cooling must still be effected in the can, it is obvious that the surface area through which the heat is withdrawn remains the same. Thus the only way of accelerating cooling is to increase the temperature difference. If a cooling medium is available at 50 deg. F. instead of 70 deg. F., it follows that with a 90 deg. F. milk or cream the initial rate of cooling will be doubled, since $(90 - 50) = 2 \times (90 - 70)$. Practical results have again shown that satisfactory results can be obtained by bulk cooling in cans with a chilled water or brine at considerably below 50 deg. F. The farm refrigerator system for milk cooling utilises this method with the addition of certain refinements to still further increase the cooling rate. The bulk cooling of milk or cream in cans by standing in air cooled to even 50 deg. F. or below is still unsatisfactory due to the much lower rate of heat transfer to cold air as compared with chilled water or brine.

The requirements for efficient cooling can now be considered in a different light by fundamentally altering the technique employed. Reviewing the two factors affecting the rate of cooling, it will be seen that the surface area provided has not as yet received attention. It so happens that it is a matter of little difficulty to enormously increase the contact cooling area, and the most efficient cooling systems largely exploit this fact.

The milk or cream can be made to expose a large area to the cooling medium by merely allowing it to gravitate in a thin stream over a suitable device. Quite a number of such have been devised, the most satisfactory for farm use being the tubular surface cooler. The cooling medium—water, brine, or refrigerant—is contained within the pipes of the cooler and the milk or cream gravitates slowly from the top to the bottom in a continuous stream. At any given instant a small quantity of milk or cream exposes a large surface area to the cooling medium. This results in rapid cooling, and, with proper design, a temperature approximately the same as the medium is reached by the time the milk or cream leaves the cooler. The essential requirements are, of course, a suitable tubular cooler and a supply of cool water, brine or refrigerant. Where water is used it is important to ensure that its temperature does not rise after prolonged use, and a means of recooling is generally advisable. A supply of brine or refrigerant obviously requires a refrigerator unit designed according to the cooling requirements to be met.

Types of Cooling and Holding Systems.

It is convenient to consider farm cooling under separate headings, depending on whether milk or cream is the product in question. This is not due to any fundamental difference in the principles involved, but merely because of practical requirements. The volume of milk produced is roughly ten times that of its cream content, and ten times as much cooling is involved. Cream is also usually held for much longer periods and storage is of great importance for this product. Milk is never held on the farms for periods longer than overnight, and as a result immediate initial cooling is generally more significant in this case.

The most satisfactory methods of cooling and holding milk and cream on the farm are as follow:—

Milk.

(1) Farm refrigerator units in conjunction with initial water cooling using the tower re-circulating system.

(2) Water-cooling alone using recirculated water from a tower system with overnight storage in a pit extension.

Cream.

(1) Farm refrigerator units.

(2) Water-cooling of the cream followed by storage in a charcoal cooler.

The methods listed above employ one or more of the following—farm refrigerator units, water-cooling tower, and charcoal cooler. Details regarding each will be considered separately and in the order given.

FARM REFRIGERATOR UNITS.

For some years past two Dairy Associations in Queensland have sponsored the use of refrigerator units on the farms of their suppliers. The good results obtained were responsible to at least some degree for the move by the Queensland Co-operative Dairy Companies' Association for a universal scheme for the State. The outcome of discussions held

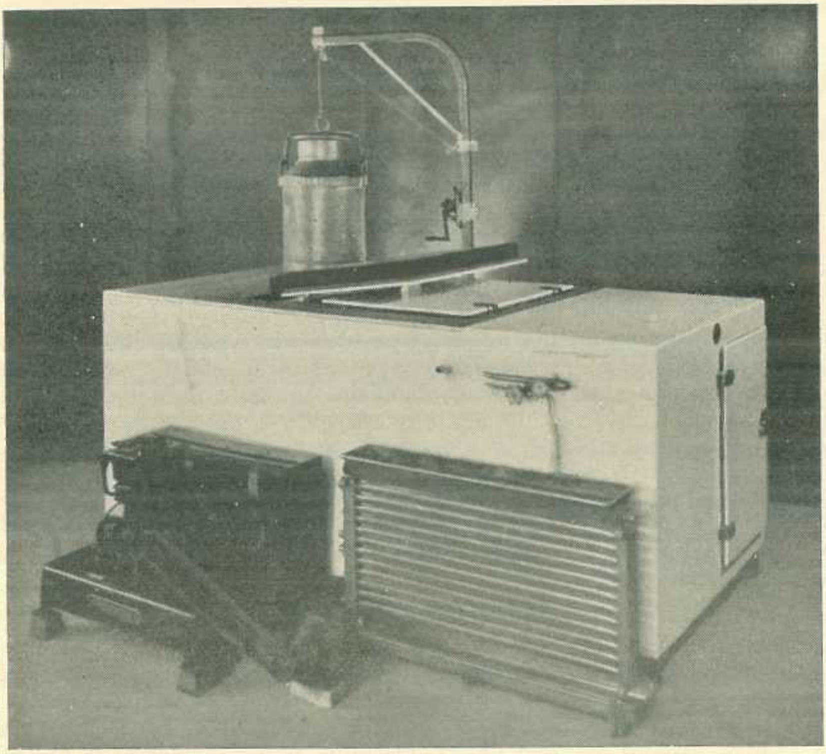


Plate 161.

Immersion-type Farm Refrigeration Unit for Milk.

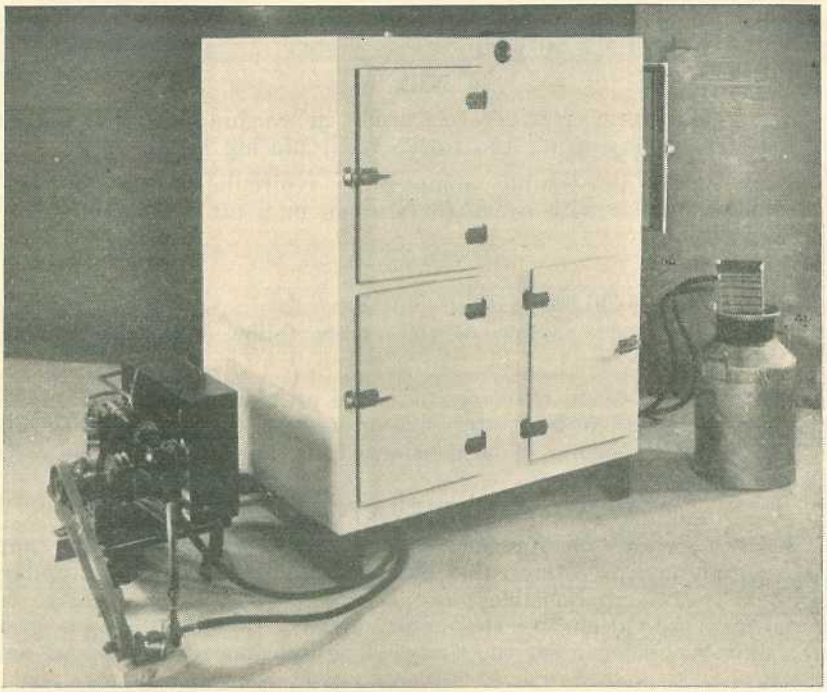


Plate 162.

Air-cooled Type Farm Refrigeration Unit for Cream.

was the present scheme for provision of farm refrigerator units by the Queensland Butter Marketing Board, whereby any farmer in the State can purchase one to suit his requirements. Several different types (two are shown in Plates 161 and 162) are available to meet the various needs on the farm, with or without certain refinements as desired by the farmer himself. Three different sized units are available for milk supplying farms, capacities being 40, 60 and 80 gallons—using 10 gallon cans—per day, respectively. In each size two different models can be supplied, depending on the necessity or otherwise for the shock cooling of milk on the farm. Again, two types of each model are available, one with and one without storage facilities for household foods. Four models in each size are thus actually assembled, though as far as the method of cooling utilised is concerned, there are simply two models in each size. The degree of cooling on which the capacity is based is from 72 deg. F. to 40 deg. F. for the two smaller models and from 90 deg. F. to 40 deg. F. (equal to 110 gallons from 72 deg. F. to 40 deg. F.) for the largest size, with the machine operating 6 hours per day in each case.

Methods of Cooling.

The cooling is effected in one or two ways, both of which, as indicated earlier, have been shown to be satisfactory. These methods are—

(1) Cooling in cans with chilled water at an initial temperature around 34 deg. F. The milk is first cooled to around 70 deg. F. by an independent method to be considered at a

later stage. The refrigerator unit utilising this method is decribed as an "immersion" unit, as the cans of milk are immersed to shoulder height in the cooling medium contained within a tank in the refrigerator cabinet. Accelerated milk cooling is achieved by the use of sprays which effect agitation and materially improve the heat transfer rate.

(2) Shock-cooling using a double cooler, the top section of which employs cooling by an outside water supply, with chilled water cooling in the bottom cooler section. A small pump circulates the chilled water from the tank within the refrigerator cabinet. This system ensures that the milk is cooled to approximately 40 deg. F. within a short time of its leaving the milking machine.

Farm milk refrigerators of the immersion type are used where the time interval between milking and despatch to the factory or depot is sufficient for the milk to fall in temperature to 40 deg. F. Generally speaking, this is only true where the night's milk is to be held over until the following morning, though in some cases the waiting time in the morning may be sufficient.

Refrigerators of the immersion type are thus designed to suit any milk supplier desiring to market the night's milk the following morning. The morning's milk is, of course, also most likely to be marketed in addition, but cooling by the refrigerator unit should not be relied upon in this case.

The shock-cooling units are employed where it is imperative to cool the milk to 40 deg. F. in the short time between milking and despatch from the farm. Their use is particularly valuable in the case of milk from the morning's milking being supplied for consumption in the whole milk trade. The immersion tank within these units is used for the cooling and storage of the night's milk as previously explained.

Units Available.

All farm milk refrigerators consist of a cabinet containing the immersion tank and with or without the special food storage compartment. The condensing units are situated external to but adjacent to the cabinet and are normally driven indirectly from the engine operating the milking machine. The surface, tubular shock-cooler is conveniently placed to allow the milk to gravitate directly to the receiving can after leaving the cooler.

Farm refrigerator units suitable for the cooling and holding of cream are available in three sizes, holding 4, 6 or 8 cans (8 gallon size), respectively. In all models the cream is shock-cooled, using a small surface cooler and an anti-freezing (sweet-brine) solution from a copper tank within the cabinet unit. The largest unit can be fitted with a larger compressor unit if so desired, thus cutting down the necessary running time each day. For the hotter districts of the State the larger compressor unit is also a definite advantage. After the cream is shock-cooled to 50 deg. F., the cans are merely stored in an air-cooled compartment until despatched to the factory. The storage temperature is between 40 deg. F. and 45 deg. F., to which the cream would slowly cool during storage. Household compartments are standard on all cream-cooling farm refrigerators, but this space can be used alternatively for additional can storage if so desired.

All units for milk or cream can be fitted as automatic, thermostatically controlled units provided electric power from an outside reticulating system is available on the farm. Additional requirements are an electric motor and a thermostat, and the extra expense is fully justified if power is available. With such fittings the machine can operate at will to suit the daily loading instead of depending on the relatively fixed hours during which the farm engine is normally in use.

Prevention of Corrosion.

Little if any attention should be normally required by farm refrigerators and maintenance is similar to that required by domestic or other refrigeration units. Generally speaking, the services of a qualified refrigeration serviceman are required, as the work is outside that possible on the average farm. Immersion units should, however, be given attention as far as the chilled water in the immersion tank is concerned. Without attention some degree of corrosion of the mild steel strips used for strengthening the copper tank is likely to occur. The milk cans may also suffer unless the external tinning is in very good condition. The following recommendations are given with respect to the avoidance of undue corrosion in such immersion tanks:—

(1) Only the best quality water available should be used, and if tank water cannot be obtained the softest supply on hand is to be preferred. Rain water should be used if at all possible.

(2) The chilled water in the refrigerator unit can be rendered relatively non-corrosive by maintaining it slightly alkaline in reaction. This is best accomplished by adding caustic soda, soda ash, or, if both are unobtainable, freshly slaked lime. Household washing soda is also effective, as it contains the same chemical as soda ash, but it is much weaker because of the large proportion of combined water normally present. Using the first mentioned chemicals, a tablespoonful of one or the other will quite likely prove sufficient, particularly if rain water is used in the chilling tank. A larger dosage may be required if washing soda is used, but care must be taken to avoid making the water too alkaline.

The correct degree of alkalinity can be easily checked by adding one drop of ordinary phenolphthalein solution—as used at butter factories for cream neutralisation—to a tablespoonful of the water in an ordinary white china cup. A faint but definite pink colouration indicates a degree of alkalinity consistent with a minimum corrosive effect both on the immersed cans and the mild steel strips on which they rest.

(3) With care in the external cleanliness of cans and avoidance of milk spillage, the charge of chilled water should last some time. A certain amount of topping up with fresh water is likely to be required but, unless excessive, only an occasional test on the degree of alkalinity (with correction if required) should be necessary.

(4) When it is evident that contamination of the water has taken place, the chilling tank should be emptied completely and thoroughly cleaned. When dry, the mild steel bars should be painted with an aluminium paint, and after drying the tank can be recharged and treated once again to ensure alkalinity of the water.

Costs.

The cost of farm refrigerator units varies with the model and from time to time with the actual cost of manufacture and assembly. At present prices vary from £209 to £330, with £15 extra for fully electric machines. Full particulars regarding latest prices and recommendation for specific farm needs can be obtained at any time by writing to the Manager, the Queensland Butter Marketing Board, P.O. Box 1020 N, G.P.O., Brisbane.

WATER COOLING TOWER.

When milk or cream is cooled by a liquid medium, either directly in the can or through the tubes of a surface cooler, the liquid temperature must rise, as the heat is merely transferred and not eliminated. Provision to cool the medium itself is thus imperative if the process is to be continuous, unless the supply of cool liquid is relatively inexhaustible. In farm refrigerator units, employing either chilled water or sweet brine, this necessary cooling is effected by the compressor, which is designed accordingly. The initial chilling, to approximately 70 deg. F. under summer conditions in the case of milk units, is accomplished by using water, and means for its continued cooling is thus generally an additional requirement. Even in cases where the water supply is unlimited, it is also advantageous to recirculate only a limited quantity if such can be cooled below the mean temperature of the main supply.

Many methods of cooling re-circulated water by natural means have been tried with varying degrees of success. The principle employed is that of self-cooling whereby a portion of the water evaporates and in so doing cools that left for recirculation. Some direct heat transfer to the air is also possible, but only if the water temperature is above that of the air itself. The amount of evaporation possible, however, depends on the percentage saturation of the air with water vapour; the lower this value the greater the degree of evaporation and thus the greater the degree of self-cooling possible. Any effective water-cooling system must thus make possible the greatest degree of cooling compatible with existing atmospheric conditions, and the efficiency of such systems is determined on this basis. As the lowest temperature to which water can be cooled by natural, evaporative means is the so-called wet-bulb temperature existing at the time, this figure is used to evaluate farm cooling efficiencies. Although this temperature varies considerably, both from day to day and throughout any particular day, it does not, even under Queensland summer conditions, exceed 70 deg. F. over quite a proportion of the dairying areas of this State. The natural cooling of water by self-evaporation to this temperature is thus quite practicable in these areas and can be used effectively for reducing milk or cream from its initial temperature of around 90 deg. F. During most months of the year the wet-bulb temperature is much lower than 70 deg. F., thus making a greater degree of initial milk or cream cooling quite within reach.

Of many different methods tried for cooling water to the lowest possible temperature, the most satisfactory is considered to be a water cooling tower system. This is not a new method and most farmers will be familiar with the technique which is exemplified by the cooling of recirculated vacreator water at butter factories and is often used for cooling engine jacket water at factories or local power houses.

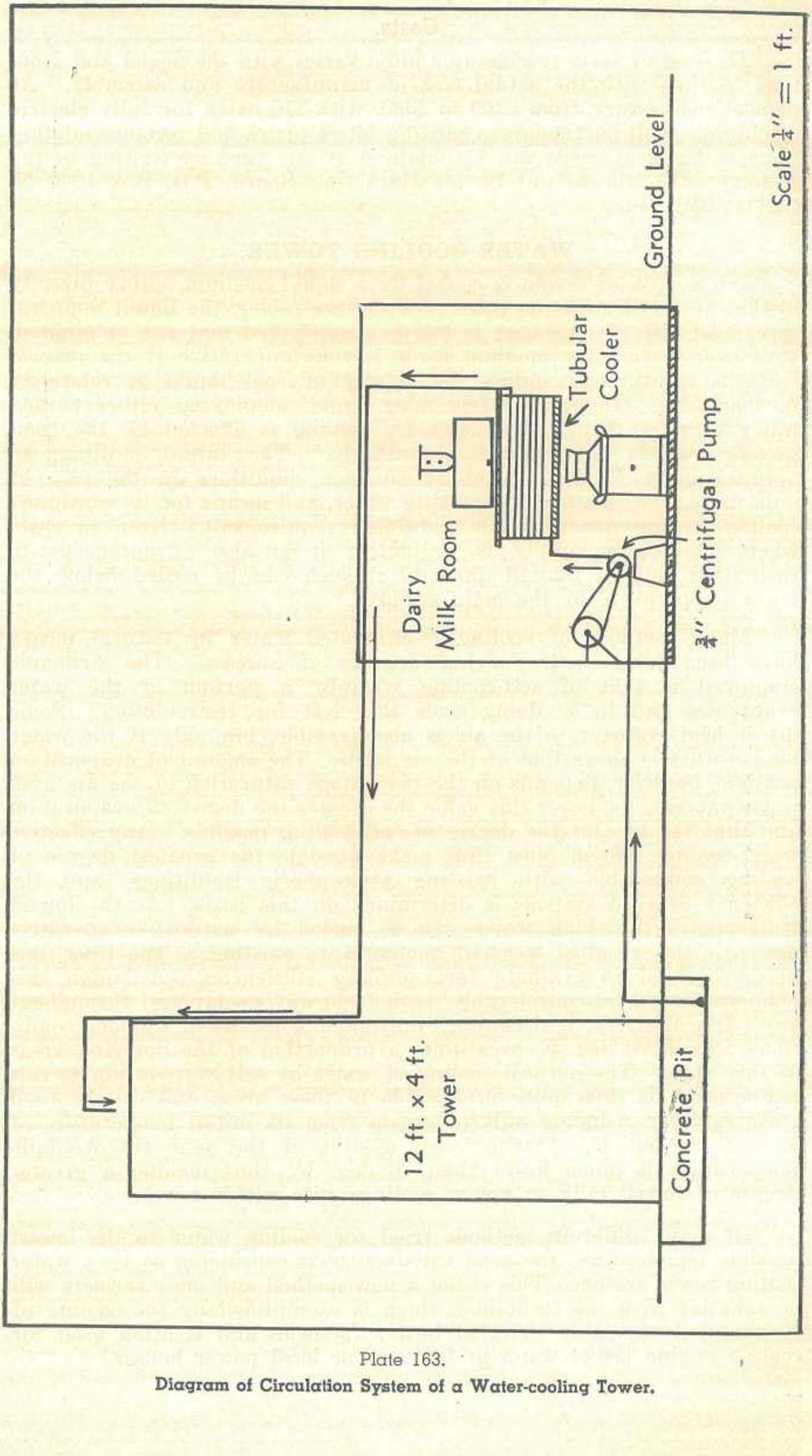


Plate 163.

Diagram of Circulation System of a Water-cooling Tower.

Some years ago experimental work was carried out to decide on a type and size of cooling tower suitable for farm requirements. Since that time observations have been made on many towers installed, and, in addition alternative methods suggested have been carefully tested. Results have shown that the most efficient cooling has always been associated with the water-cooling tower. In some cases large reserves of water have been used without provision for re-cooling, but the results obtained were not comparably satisfactory. The details of the water-cooling tower system recommended for farm use are as under.

Description of Water Cooling System.

Plate 163 shows the general arrangement of the tower-recirculated water cooling system. The water is drawn from the 1 ft. deep concrete pit below the tower by means of a ¾-in. centrifugal pump driven from the dairy house mainshaft as shown. The water is pumped through the tubular surface cooler and finally delivered for recooling at the top of the tower. The tubular water coolers which are familiar to most farmers are the only type suitable for milk or cream cooling using tower-cooled recirculated water. The tower is placed away from the dairy building to ensure the proper ventilation essential for water-cooling. It should be located on the side of the building exposed to the prevailing winds during the summer months, but need not be far away provided free air access on its four sides is assured. The amount of water needed for recirculation is not large and the pit shown on the tower drawings will hold ample water (approximately 200 gallons). A deep pit is not advisable. Tests have shown that water leaving the tower is generally cooler than a large volume of water in a deep pit, and hence, on mixing, the water leaving the cooler is higher in temperature than need be. Only sufficient water to properly cover the foot valve is required. The other advantages of a shallow pit are ease of cleaning, safety where children are present, and a greater rate of circulation due to the much smaller suction lift, unless (as is rarely the case) a deep pit is filled to the same water level. The cost of constructing a deep pit is also an item of importance, especially if it is made throughout of concrete, and results have shown that it is of no advantage from the viewpoint of efficient cooling.

Materials for Tower Construction.

All timber is of undressed hardwood; the concrete is made of 4:2:1 mixture. The water distribution tray as shown is preferably of plain galvanised iron with 3 in. sides and perforated over its whole base area, although it can be made of boards (6 in. by ½ in.) closely butted together and with ½ in. holes bored along the centre of each board. The timber required is as follows:—

Tower Uprights: Four 3 in. by 3 in., 15 ft. long.

Louvres: Start 2 ft. from ground level and spaced 5 in. apart vertically; 25 are required for each side, or 100 for the complete tower. They are of 6 in. by ½ in. hardwood and are 3 ft. 4¾ in. in length. Each louvre extends across the 3 in. face of the holding 3 in. by ⅝ in. batten strip, resulting in a vertical overlap of ⅝ in. and 1½ in. measured along the louvre. Eight lengths of battening each 10 ft. long are required to hold the louvres.

Tower Bracing: Of 3 in. by ⅝ in. battening. Eight pieces each 7 ft. long are required.

Baffles: Made of 6 in. by ½ in. hardwood. Five are required for each complete baffle, each board being 3 ft. 4 in. long. For the four sets of baffles, 20 such boards are thus required.

The baffle boards are nailed to cross supports, two of 3 in. by 1½ in. hardwood and 3 ft. 6 in. long being required for each complete baffle. Similarly these are flushed into the two 3 in. by 1½ in. supports, each 4 ft. long, bolted to the tower uprights.

Summary of Materials Required—

Timber—

3 in. by 3 in. hardwood—four lengths of 15 ft. each.

6 in. by ½ in. hardwood—100 lengths of 3 ft. 4¾ in. each; 20 lengths of 3 ft. 4 in. each.

3 in. by 1½ in. hardwood—8 lengths of 3 ft. 6 in. each; 8 lengths of 4 ft. each.

3 in. by ⅝ in. hardwood—8 lengths of 10 ft. each; 8 lengths of 7 ft. each.

Concrete: Materials for approximately 20 cubic feet, allowing for concreting in of tower uprights. This requires about two-thirds of a yard of sand-gravel mixture and four bags of cement.

Piping: ¾ in. galvanised of a length determined by position of tower relative to dairy building. Clips to hold piping tower also required.

Bolts and Nails: 16 bolts each ⅜ in. by 6 in. long. Nails—supply of 2 in.

Water Distributing Tray: Plain galvanised iron sheet 3 ft. 6 in. square with 3 in. sides soldered.

Circulating Pump: ¾ in. centrifugal pump, belt-driven from shaft in dairy.

Cooler: Standard tubular cooler for either milk or cream as the case may be.

Construction of Tower.

The four tower uprights are erected on the chosen site after first excavating the necessary pit below the ground level. The posts are concreted in the ground up to the level of the bottom concrete of the pit—that is, up to 1 ft. 3 in. from the ground level. The baffles and distributing tray are assembled and placed in position as shown in Plates 164-167. Sections of battening from the 10 ft. lengths are cut to fit between the supports (B) bolted to the uprights and the appropriate numbers of louvres are fixed to the battens by nailing through from the outside of the battens into the louvres themselves. The assembled sections are then nailed to the tower uprights, the nails passing through the battens in the reverse direction to those holding the louvres. The tower bracing is then finally secured, and the piping, &c., arranged as required. Construction of the concrete pit is carried out, and any light iron or steel reinforcements available can be advantageously added when laying down. Similarly, a concrete path drip 2 ft. wide all round the tower prevents mud, &c., from easily entering the pit during wet weather or following excessive drift loss from the tower due to high winds. The path should slope away from the tower across its width tc prevent water entering the pit during wet weather.

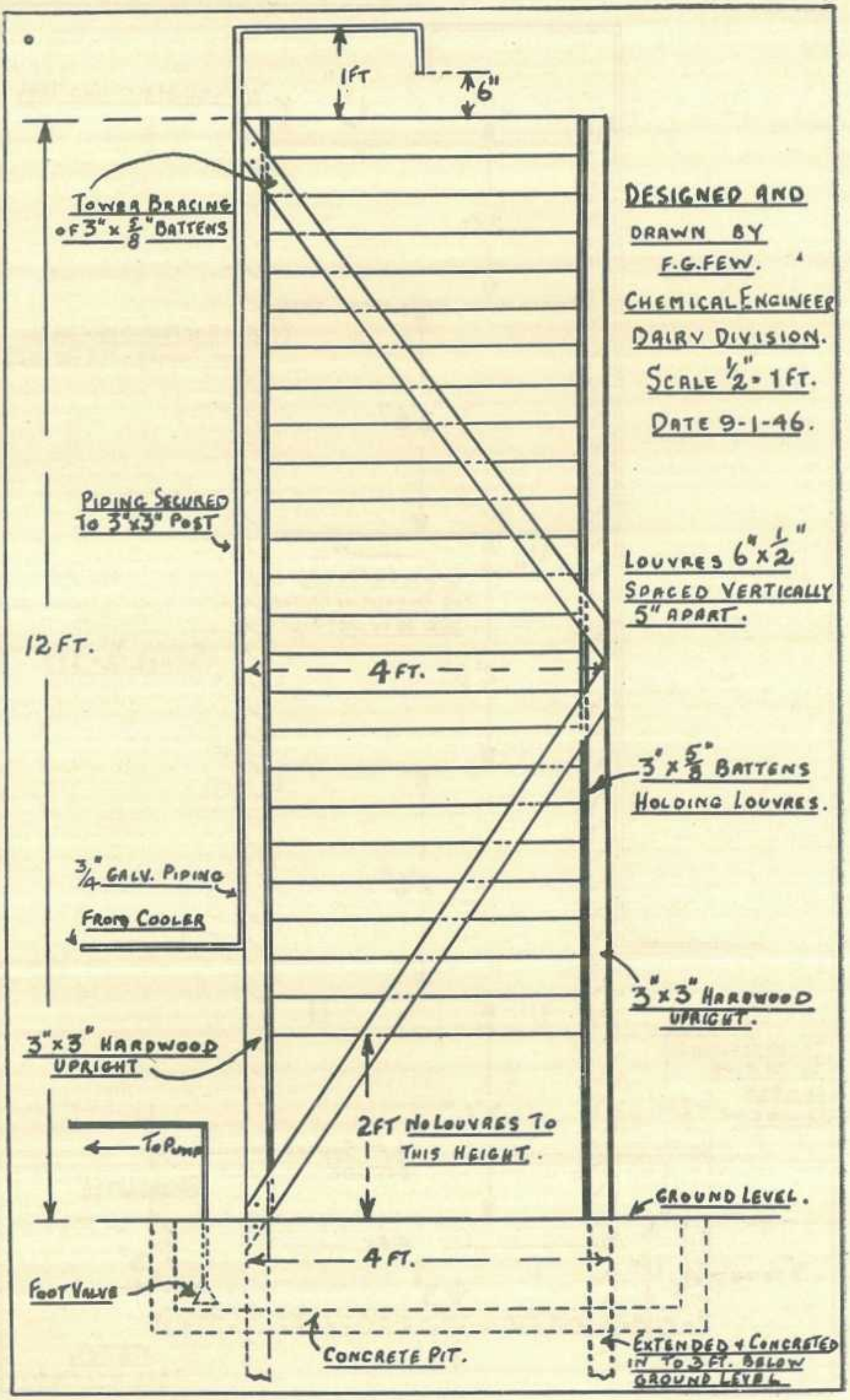


Plate 164.
Elevation of a 4-ft. Square Water-cooling Tower.

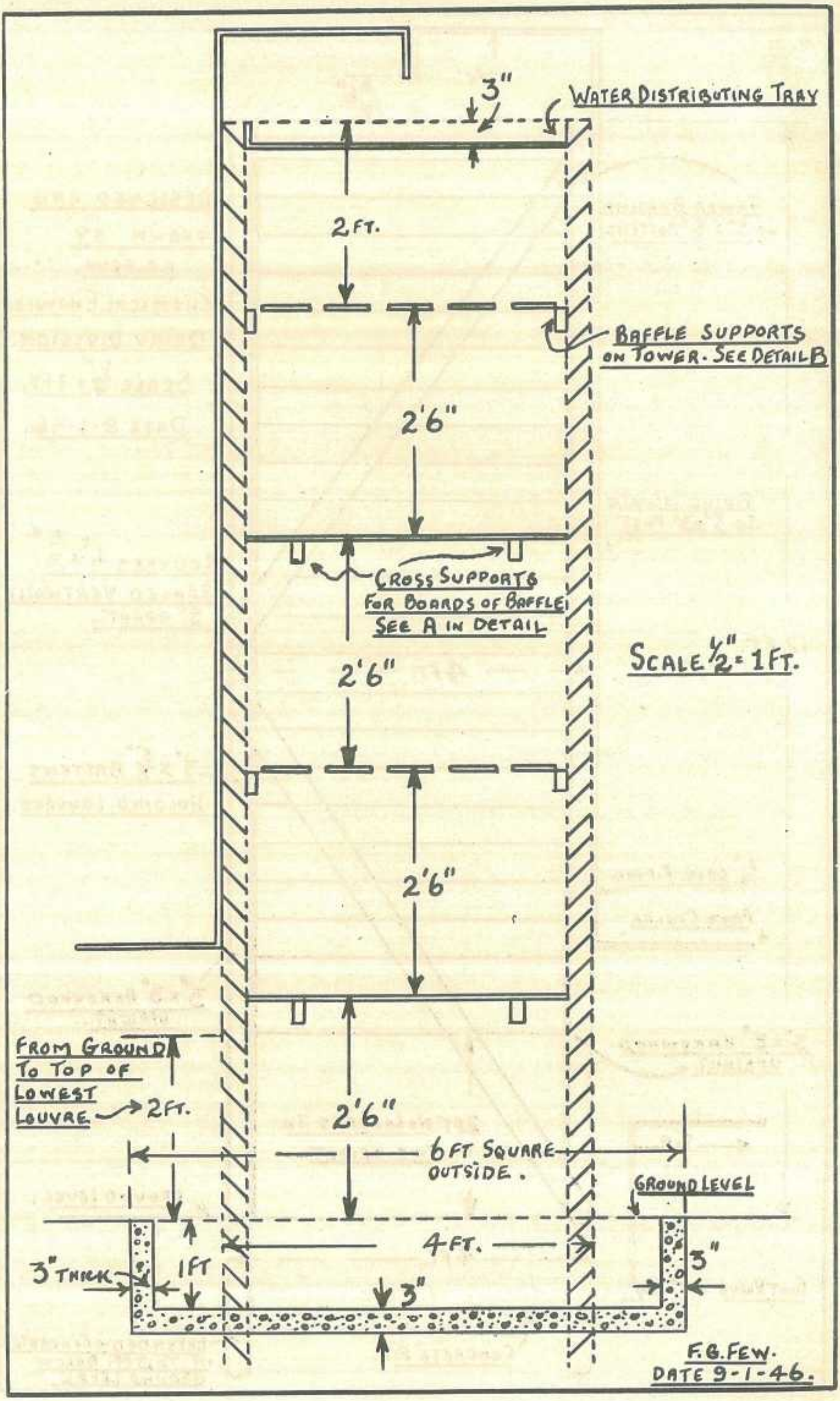


Plate 165.

Sectional Elevation Showing Number and Disposition of Baffles and Concrete Pit.

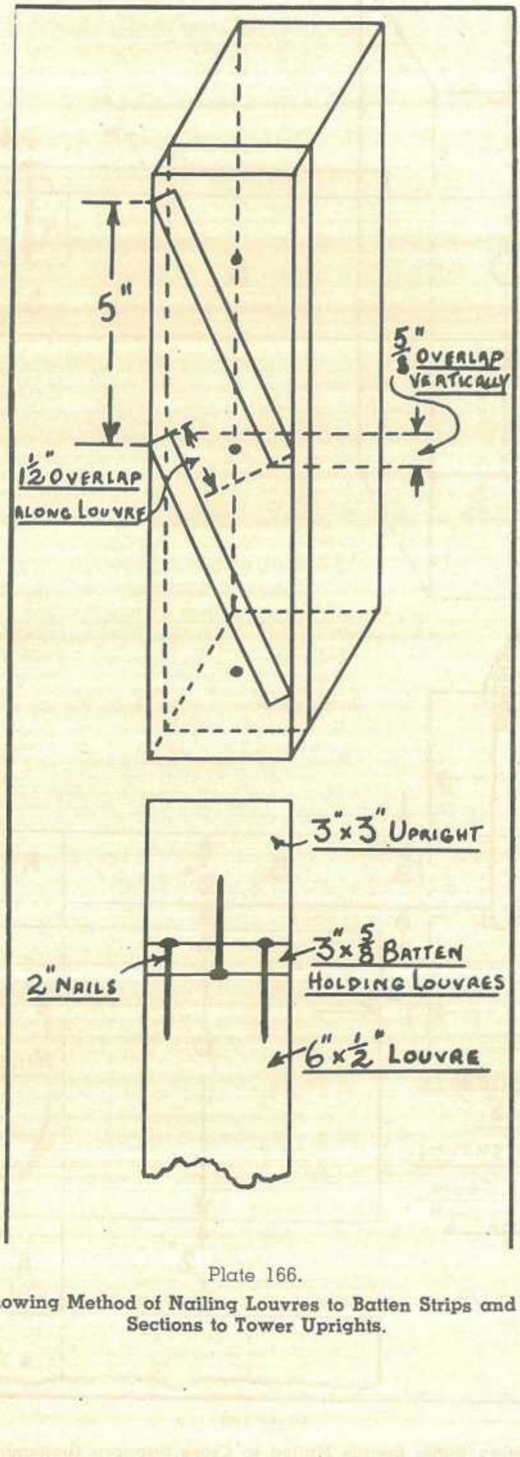


Plate 166.

Diagram Showing Method of Nailing Louvres to Batten Strips and Assembled Sections to Tower Uprights.

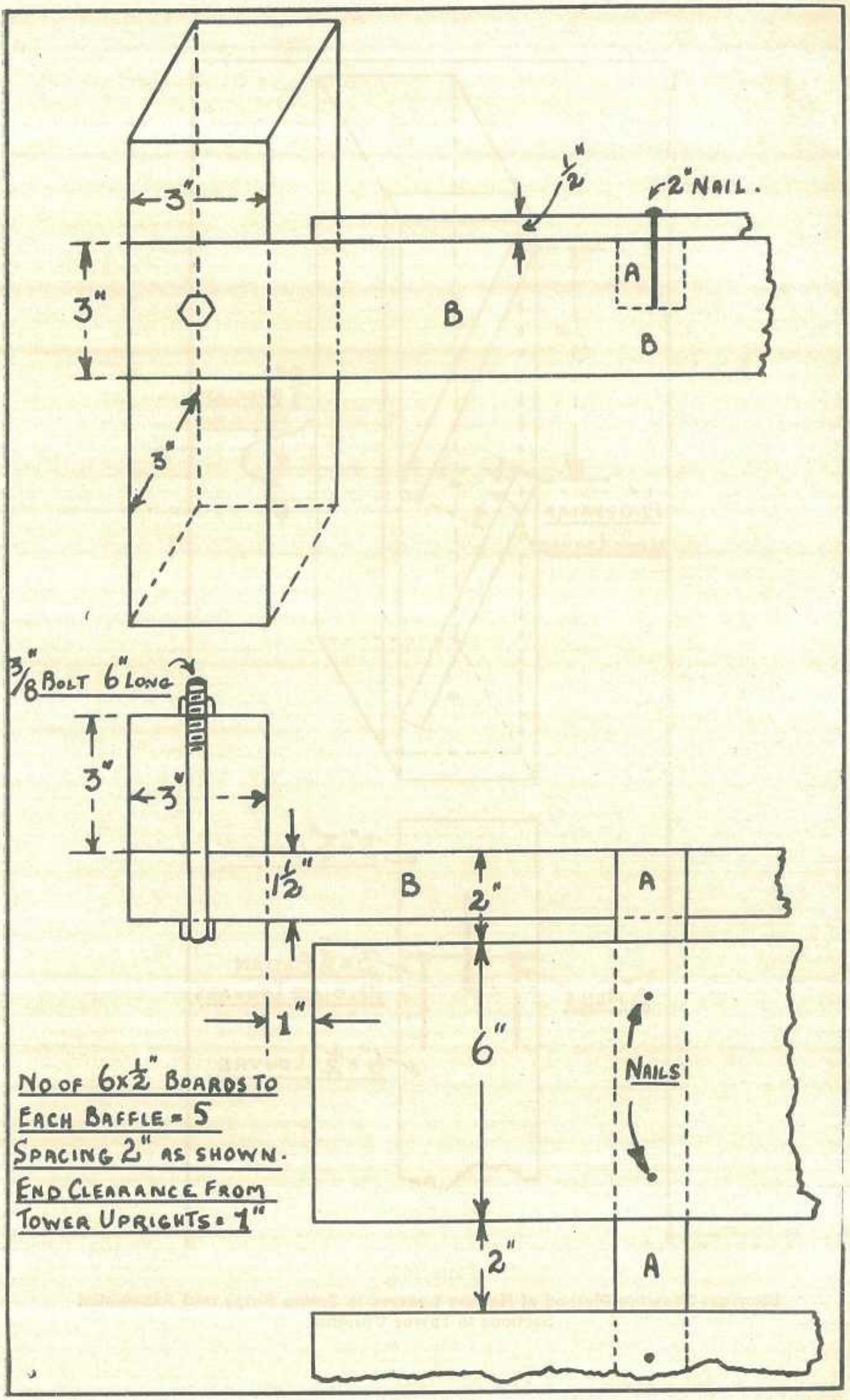


Plate 167.

Diagram Showing Baffle Boards Nailed to Cross Supports (bottom); and Support for Completed Baffles Bolted to Tower Uprights (top).

Variations in Design.

It is quite obvious that any person building a water-cooling tower may be prompted to depart from the standard design submitted. (See Plates 168 and 169.) There is no harm in this provided the fundamentals are preserved. The number of baffles and their disposition must be adhered to as they are inherent in the design of the unit. Of many modifications seen and suggested as the result of experience two are worthy of consideration in this article. The upright posts may be supported on horizontal cross members supported by the concrete sides of the water pit. This avoids any deterioration in the timber at or below the water line and also a leakage loss of water due to the concrete shrinking away from the posts after ageing. Unless rigidly constructed, however, the tower is likely to be less stable, and proper reinforcing of the concrete sides of the pit and secure holding down bolts for the cross timbers are essential. This variation is, however, not necessary if occasional attention is given to the uprights the preservation of which is not a matter of particular difficulty.

On some farms, unequipped with refrigerators, the problem of can storage is often one of difficulty. A type of cool storage cabinet especially designed for this need will be considered later and is the recommendation given if the farmer is not prepared to install a farm refrigerator unit. Storage for a relatively short time can, however, be provided by extending the pit of the water-cooling tower and increasing the depth in the extension to approximately 18 inches. The cans of milk or cream can be placed in this extension and will be kept at approximately the same temperature as that achieved during cooling while awaiting despatch from the farm. The size of the extension required can be determined by the farmer and will obviously be sufficient to suit the number of cans to be held. The required water level throughout should be sufficient to just fill the pit with the cans in place, and the equivalent depth without the cans should be indicated by a permanent mark to facilitate replenishing when necessary. A cover should be provided over the pit extension to keep off direct sun and any water spray from the cans during the storage period.

Plate 168.

Water-cooling Tower (at left), Showing Situation in Relation to Bails and Milk Stand.

Plate 169.
Close View of the Tower Shown in Plate 168.

Use of Water-cooling Tower.

The water-cooling tower is recommended for use in all cases where water is used solely for milk or cream cooling or if water is complementary to refrigeration in the case of milk. For the farm chilling of milk for the liquid whole milk trade, where farm refrigerators are recommended, initial cooling with tower-recirculated water is very desirable. The result is that approximately half the heat that must be eliminated from the milk can be removed without the expenditure of refrigeration. The capacity of the machine installed is thus, in effect, doubled; alternatively, the cost of refrigeration for the same milk handled is halved. If a farmer is not prepared to install a refrigerator unit the milk can be cooled to approximately 70 deg. F. even under summer conditions by the use of the tower system. While this is not a temperature sufficiently low to adequately safeguard initial milk quality, it is very much superior to no provision for cooling and results have been quite satisfactory in most cases. This is particularly true where the morning's milk is despatched from the farm without undue delay.

For cheese milk suppliers the tower cooling system has been shown to give very good results. Most farms producing milk for this purpose are either without cooling facilities of any kind or at most employ rather primitive and inefficient methods. The use of refrigerators on farms supplying milk for cheese manufacture will, of course, prove satisfactory, at least as far as the cooling requirements are concerned. If their use is not contemplated, however, the tower system is recommended, with storage of the evening's milk in the pit extension previously described. Generally very good results can be expected from the evaporative cooling of water on the Darling Downs—the chief cheese-producing area in the State—due to low relative humidities usually experienced. No better system for the cooling of milk by natural means has been devised, and efficiencies achieved are quite high even when based on a somewhat difficult provisional standard. A consideration of the standards on which cooling is evaluated will be given at a later stage.

For farms producing cream the use of refrigerator units is recommended without exception. Although initial water cooling can be combined with refrigeration, it is not really justified with the relatively small cooling load to be accommodated. All farm refrigerator units are designed to allow for shock cooling of the cream throughout the whole range of temperature necessary, and with such provision water-cooling is not required.

Where farmers are not prepared to install refrigerators, the water tower system can be advantageously used to cool the cream as much as possible. Due to the high water/cream ratio possible, the latter can be cooled practically to the existing wet-bulb temperature. Storage overnight can be provided using a pit extension, but as some cream has also to be kept during the daytime in most cases, the charcoal cool cabinet is generally required for cream storage. The pit extension is thus more generally useful in the case of a cheese milk farm where the installation of a farm refrigerator unit is not contemplated.

Costs.

It is not possible to give exact costs because of the many variable and local factors involved. When the initial field investigation on a water cooling tower was made about five years ago, the complete installation cost was around £20 if the farmer erected the tower himself. The equipment included in this cost was a suitable tubular cooler (24 inch by 13 inch), ¾ inch centrifugal pump with wooden driving pulley, timber and cement.

Costs have risen considerably in the interim and an expenditure of at least £30 can be expected if none of the equipment required is already on hand. If labour has to be hired for any of the work the cost will, of course, be additional.

[TO BE CONTINUED.]

FREE SEED-TESTING SERVICE.

The Department of Agriculture and Stock is prepared to examine for purity and germination seeds purchased by farmers for their own sowing. Inquiries regarding this free service should be addressed to the Standards Officer, Department of Agriculture and Stock, Brisbane.

Crop Planting Tables—Northern and Central Districts.

Showing Times of Planting and Rates of Sowing for Field Crops.

BY OFFICERS OF THE AGRICULTURAL BRANCH.

QUEENSLAND is a large State covering a wide range of climatic conditions, and in a crop planting summary it is impossible to define accurately planting and harvesting times for each and every area. The tables which have been compiled for the various agricultural areas are intended to be a general guide with reference to the season generally experienced, and in determining sowing times attention has been paid to the seasonal conditions under which it is expected harvesting would be carried out.

Zones.

For the purposes of the tables, Queensland has been divided into three main zones as follows:—

Southern Districts.—Included in this zone is the area south of latitude 25° (approximately Bundaberg) to the southern border of Queensland.

Central Districts.—This zone lies between latitude 20° (approximately Bowen) and latitude 25°.

Northern Districts.—All districts north of latitude 20° are grouped in this zone.

The Coastal Districts within each zone refer, for the most part, to the land between the main coastal ranges and the seashore—approximately a 30-mile strip. In some areas, where the influence of coastal rainfall extends further inland, this strip may be wider. The Inland Districts are defined as beyond that limit to the outer edge of the 25-inch annual rainfall belt. Tableland Districts refer to elevated areas within about 100 miles of the coast.

Generally speaking the bulk of the annual rainfall in Queensland is received during the summer months. In areas with an annual rainfall lower than 25 inches and with a high rate of evaporation of soil moisture, crop production is hazardous without supplementary irrigation.

Explanation of Terms.

The meaning of most terms used in the tables is obvious, and the only ones in which confusion in interpretation may arise are "green feed" and "food."

The term *green feed* is used where the crop can be cut and fed immediately in the green state to farm animals. The term *food* is used where the crop can be harvested and fed immediately to farm animals, or held in good condition for some time in the field without harvesting if required, or harvested and then stored in farm structures.

It is recognised that individual farmers may use some crops in other ways than indicated in the tables, but the intention here is to name the *main purposes* for which various crops are used.

NORTHERN DISTRICTS.

SOWING AND PLANTING TABLE FOR FIELD CROPS.

(This table requires to be adapted to suit individual circumstances).

Crop.	Main Purpose for Which Grown.	When to Sow or Plant.			How Sown or Planted.				Approximate Period of Growth of Crop in Months.	Remarks.
		Coastal Districts.	Tableland Districts.	Inland Districts.	Distance Rows Apart.	Distance Between Plants.	Quantity of Seed per acre if Drilled.	Quantity of Seed per acre if Broadcast.		
					Ft. In.	Ft. In.				
Arrowroot	Flour and pig food..	Aug. to Nov.	Sep. to Dec.	Sep. to Dec.	5 0	2 0	10 to 12 cwt. of bulbs	..	8 to 10 ..	Suited best to coastal districts
Artichoke	Pig food	July to Aug.	Aug. to Oct.	Aug. to Oct.	3 6	1 6	4 to 5 cwt. of tubers	..	4 to 5 ..	Difficult to store; will keep better in soil
Barley (Cape and Skinless)	Grazing and green feed	Apr. to June	Feb. to June	Mar. to June	Drilled	..	1 bus. ..	1½ bus. ..	2 to 4 ..	..
Beans, Lima ..	Seed	Mar. to May	Nov. to Jan.	Nov. to Jan.	2 6	0 9	20 to 25 lb.	..	3½ to 4 ..	..
Beans, Navy or Canning	Seed	Mar. to May	Dec. to Jan.	Dec. to Jan.	2 4	0 4	15 to 24 lb. ..	..	3 to 3½ ..	Wider rows for fertile soils
Beet, Silver	Green feed for poultry	Mar. to June	Feb. to June	Feb. to June	2 6	1 0	4 lb. ..	..	3 to 4 ..	..
Broom Millet ..	Brushware	Mar. to July	Nov. to Jan.	Nov. to Jan.	3 6	0 9	3 to 4 lb. ..	..	4½ to 5 ..	..
Buckwheat	Nectar for bees; grain for poultry	Mar. to July	Dec. to Apr.	Dec. to Apr.	2 0	0 3	25 to 30 lb. ..	40 to 45 lb. ..	1½ to 2½ ..	Produces a valuable nectar crop within 6 weeks of planting
Carrot, Field ..	Stock food	Apr. to June	Mar. to June	Apr. to June	1 9	..	2 to 3 lb. ..	..	4 to 5 ..	..
Cassava	Pig food	Aug. to Dec.	Sep. to Jan.	Oct. to Jan.	5 0	2 0	Cuttings used	..	8 to 10 ..	Boil tubers before using; discard water
Cotton	Fibre..	Mar. to Apr.	Oct. to Nov.	Oct. to Nov.	3 6	1 0	15 to 20 lb. delinted seed	..	5 to 7 ..	..
Cow Cane	Green feed	Apr. to Sep.	Oct. to Jan.	Oct. to Jan.	5 0	1 6	2 or 3-eyed setts used	..	7 to 9 ..	Suitable for several ratoons
Cowpea*	Seed, grazing and hay	Mar. to Apr.	Nov. to Jan.	Nov. to Jan.	3 0	0 6	6 to 10 lb. ..	15 to 20 lb. ..	3½ to 4½ ..	For green manure purposes, *see* under "Leguminous cover crops," page 362
Garlic	Market	Mar. to May	Apr. to May	Apr. to May	1 6	0 6	..	..	6	
Grasses (*see* Pastures)										

* The use of bacterial inoculum with most leguminous plants is recommended. Supplies are obtainable from the Department of Agriculture and Stock, Brisbane

NORTHERN DISTRICTS—*continued.*

SOWING AND PLANTING TABLE FOR FIELD CROPS.

(This table requires to be adapted to suit individual circumstances).

Crop.	Main Purpose for Which Grown.	When to Sow or Plant.			How Sown or Planted.				Approximate Period of Growth of Crop in Months.	Remarks.
		Coastal Districts.	Tableland Districts.	Inland Districts.	Distance Rows Apart.	Distance Between Plants.	Quantity of Seed per acre if Drilled.	Quantity of Seed per acre if Broadcast.		
					Ft. In.	Ft. In.				
Leguminous Cover Crops*—										
Blue Lupin	Green manure	Autumn	Autumn	Autumn	Drilled	..	1 bus.	1½ bus.	5	Erect growth
Calopo	Green manure	Summer	Summer	Summer	..	..	..	3 lb.	18 or more	Long-term cover; creeping growth
Centro	Green manure	Summer	Summer	Summer	..	..	..	3 lb.	18 or more	Long-term cover; creeping growth
Cowpeas	Green manure	Summer	Summer	Summer	Drilled	..	20 to 25 lb.	25 to 30 lb.	3½ to 5	Creeping growth
Cusara Pea	Green manure	Summer	Summer	Summer	Drilled	..	5 lb.	10 lb.	5 to 6	Erect growth
Field Pea	Green manure	Autumn	Autumn	Autumn	Drilled	..	1 to 1½ bus.	1½ to 2 bus.	3 to 4	Creeping growth
Gambier Pea	Green manure	Summer	Summer	Summer	Drilled	..	5 lb.	10 lb.	5 to 6	Erect growth
Mauritius (Velvet Bean)	Green manure	Summer	Summer	Summer	3 0	2 0	20 lb.	40 to 60 lb.	3 to 4	Creeping growth
Poona Pea	Green manure	Summer	Summer	Summer	Drilled	..	20 to 25 lb.	20 to 30 lb.	3½ to 4	Semi-erect growth
Puero	Green manure	Summer	Summer	Summer	..	..	..	3 lb.	18 or more	Long-term cover; creeping growth
Rice Bean	Green manure	Summer	Summer	Summer	Drilled	..	15 to 20 lb.	20 to 25 lb.	4 to 5	Creeping growth
Soybean	Green manure	Summer	Summer	Summer	Drilled	..	20 to 30 lb.	25 to 35 lb.	3 to 4	Semi-erect growth
Tangier Pea	Green manure	Autumn	Autumn	Autumn	Drilled	..	10 lb.	12 lb.	5	Creeping growth
Vetches or Tares	Green manure	Autumn	Autumn	Autumn	Drilled	..	¾ to 1 bus.	1 to 1½ bus.	3½ to 4½	Creeping growth
Linseed (Flax)	Seed for oil	Apr. to June	Apr. to June	Apr. to June	Drilled	..	20 to 25 lb.	..	4½ to 5	..
Lucerne*	Hay and grazing	Apr. to May	Apr. to May	Apr. to May	Drilled	..	10 to 12 lb.	14 to 18 lb.	3	For grazing in drier arears 4 to 6 lb.; in grass mixtures 1 to 3 lb.
Maize	Grain and stock	Mar. to Aug.	Nov. to Jan.	Nov. to Jan.	4 0	1 3	8 to 10 lb.	56 lb. for stock food	4 to 5	For stock food closer row and plant spacing with increased seed rate

* *See* footnote on page 361.

Pop Corn	Grain	Mar. to Sep.	Nov. to Jan.	Nov. to Jan.	3 6	1 0	5 to 7 lb. ..	..	4	..
Sweet Corn ..	Market	Mar. to Sep.	Nov. to Jan.	Nov. to Jan.	3 6	1 0	6 to 8 lb. ..	..	3	..
Mangel and Sugar Beet	Stock food	Mar. to May	Mar. to May	Mar. to May	2 6	1 0	4 to 6 lb. ..	..	6 to 7 ..	..
Millet (French) ..	Grain	Mar. to Aug.	Nov. to Feb.	Nov. to Feb.	Drilled	..	10 to 14 lb. ..	20 lb. ..	2 to 2½ ..	..
Millet (Giant and Dwarf Setaria)	Grain, hay and grazing	Mar. to Dec.	Nov. to Feb.	Nov. to Feb.	Drilled	..	10 to 14 lb. ..	20 lb. ..	2½ to 3 ..	Can be grazed earlier if required
Millet (Japanese) ..	Hay and grazing ..	Mar. to Dec.	Nov. to Feb.	Nov. to Feb.	Drilled	..	10 to 14 lb. ..	20 lb. ..	2 to 3 ..	Can be grazed earlier if required
Millet (White Panicum)	Grain, hay and grazing	Mar. to Dec.	Nov. to Feb.	Nov. to Feb.	Drilled	..	10 to 14 lb. ..	20 lb. ..	2½ to 3 ..	Can be grazed earlier if required
Oats	Grazing and hay ..	Mar. to June	Feb. to June	Feb. to June	Drilled	..	1½ bus. ..	1½ to 2 bus.	3 to 5 ..	..
Onion	Market	Apr. to May	Apr. to May	Apr. to May	1 2	3 to 6 in.	1½ to 3 lb. ..	..	5 to 6 ..	..
Panicum (*see* "Millet")										
Pasture Grasses—										
Buffel	Pasture	..	..	Spring and summer	..	..	..	2 to 3 lb. ..	Perennial; summer grower	Suitable for sandy soils in dry areas
Elephant	Pasture and green feed	Sep. to Jan.	Oct. to Jan.	Oct. to Jan.	5 0	2 6	Root and stem cuttings used	..	Perennial; summer grower	Graze or cut frequently to prevent woody stems developing; ratoons vigorously
Guinea (Common, Purple Top and Green Panic)	Pasture	Aug. to May	Oct. to Feb.	Oct. to Feb.	4 0	3 0	Root cuttings used for Common Guinea only	4 to 5 lb. ..	Perennial; summer grower	Provides best pasture if excessive stem development is prevented
Kikuyu	Pasture	Aug. to May	Oct. to Feb.	Oct. to Feb.	3 0	3 0	Runner cuttings used, or plough or disc in chopped runners	..	Perennial; summer grower	..
Mitchell	Pasture	..	..	Spring and early summer	..	..	..	2 to 3 lb. ..	Perennial; summer grower	..
Molasses	Pasture	Aug. to May	Oct. to Feb.	Oct. to Feb.	..	..	..	2 to 4 lb. ..	Perennial; summer grower	Used on scrub burns; needs careful management
Para	Pasture	Aug. to May	Oct. to Feb.	Oct. to Feb.	6 0	6 0	Runner cuttings used; or plough or disc in chopped runners	3 to 4 lb. ..	Perennial; summer grower	..

NORTHERN DISTRICTS—*continued.*

SOWING AND PLANTING TABLE FOR FIELD CROPS.

(This table requires to be adapted to suit individual circumstances).

Crop.	Main Purpose for Which Grown.	When to Sow or Plant.			How Sown or Planted.				Approximate Period of Growth of Crop in Months.	Remarks.
		Coastal Districts.	Tableland Districts.	Inland Districts.	Distance Rows Apart.	Distance Between Plants.	Quantity of Seed per acre if Drilled.	Quantity of Seed per acre if Broadcast.		
					Ft. In.	Ft. In.				
Paspalum	Pasture	Sep. to Mar.	Oct. to Feb.	Oct. to Feb.	..	..	..	8 to 12 lb. ..	Perennial; summer grower	Does not thrive in extreme dry heat; best results from sowing in prolonged showery weather
Prairie	Pasture	Mar. to May	Mar. to May	Mar. to May	..	..	..	20 to 25 lb. ..	Annual; winter and spring grower	..
Rhodes	Pasture	Sep. to Mar.	Oct. to Feb.	Oct. to Feb.	..	..	..	8 to 12 lb. ..	Perennial; summer grower	Best results from sowing in prolonged showery weather
Pasture Legumes—										
Calopo	Pasture mixtures ..	Sep. to Dec.	..	..	..	..	..	3 lb. in mixtures	Perennial; summer grower	Less palatable than other tropical legumes
Centro	Pasture mixtures ..	Sep. to Dec.	..	..	..	..	..	4 lb. in mixtures	Perennial; summer grower	Stock must acquire a taste for this legume
Puero	Pasture mixtures ..	Sep. to Dec.	..	..	12 0	6 0	..	3 lb. in mixtures	Perennial; summer grower	Very palatable
Stylo	Pasture mixtures ..	Sep. to Dec.	..	..	..	..	..	2 lb. in mixtures	Perennial; summer grower	Palatability uncertain; stock must acquire a taste
Townsville Lucerne	Pasture mixtures ..	Sep. to Mar.	Sep. to Mar.	Sep. to Mar.	..	..	..	3 to 4 lb. ..	Perennial; summer grower	..
White Clover ..	Pasture mixtures ..	..	Mar. to May	..	..	..	..	2 lb. in mixtures	Perennial; winter and spring grower	..
Pea, Field*	Stock food and grazing	Apr. to June	Feb. to June	Feb. to June	Drilled		1 to 1¼ bus.	1½ to 2 bus.	3 to 4 ..	When sown in combination with a cereal, ½ to ¾ bus. per acre. For green manure purposes, *see* under "Leguminous cover crops," page 362

* *See* footnote on page 361.

Peanut	Kernels	Mar. to Aug.	Nov. to Jan.	Nov. to Jan.	3 0	1 3	25 to 30 lb. of kernels	..	4 to 5 ..	..
Potato	Market	Apr. to May	July and Jan	July and Jan	3 6	1 0	6 to 8 cwt. of tubers	..	3 to 4 ..	..
Pumpkin	Market and stock food	Mar. to Aug.	Nov. to Jan.	Nov. to Jan.	8 to 12 feet	3 to 4 feet	2 to 3 lb. ..	..	5 to 6 ..	..
Rape	Stock feed	Mar. to June	Mar. to June	Mar. to June	Drilled	..	5 to 6 lb. ..	6 to 8 lb. ..	$2\frac{1}{2}$ to 4 ..	..
Rice, Swamp ..	Grain	Nov. to Jan.	Nov. to Jan.	Nov. to Jan.	Drilled	..	80 to 120 lb.	..	4 to 5 ..	Requires constant flooding during growing period
Rice, Upland ..	Grain	Nov. to Jan.	Nov. to Jan.	Nov. to Jan.	Drilled	..	60 to 90 lb. ..	..	4 to 5 ..	..
Rye	Grain and grazing ..	Mar. to June	Feb. to June	Feb. to June	Drilled	..	$\frac{3}{4}$ to 1 bus.	1 to $1\frac{1}{4}$ bus.	3 to 5 ..	..
Sorghum, Grain ..	Grain; stubble grazing	Mar. to Aug.	Nov. to Jan.	Nov. to Jan.	14 to 42 in.	..	4 to 12 lb. ..	12 to 20 lb. ..	$3\frac{1}{2}$ to 5	Immature growth of any member of this group may contain poisonous properties; care should be exercised in grazing
Sorghum, Sweet ..	Stock fodder ..	Mar. to Aug.	Nov. to Jan.	Nov. to Jan.	3 6	0 4	5 to 6 lb. ..	12 to 15 lb. ..	$3\frac{1}{2}$ to 5	
Sudan Grass ..	Grazing and hay ..	Aug. to Dec.	Nov. to Feb.	Nov. to Feb.	Drilled	..	8 to 10 lb. ..	10 to 14 lb. ..	2 to 4	
Soybean*	Seed, grazing and hay	Apr. to Sep.	Nov. to Jan.	Nov. to Jan.	2 6	4 to 6 in.	15 to 20 lb. ..	25 to 35 lb. ..	$3\frac{1}{2}$ to $4\frac{1}{2}$ ..	Unsuitable for very wet coastal areas
Sunflowers	Seed for oil and bird seed	Apr. to Sep.	Nov. to Jan.	Nov. to Jan.	3 0 or 3 6	1 0	4 to 6 lb. ..	..	4 to 5 ..	Unsuitable for very wet coastal areas; wider spacing and less seed per acre where hand harvesting adopted
Potato, Sweet ..	Market and stock fodder	All seasons	Oct. to Feb.	Oct. to Feb.	4 0	2 0	Cuttings used	..	4 to 5 ..	Plants in wet coastal areas usually after wet season; useful for pig raising
Tobacco	Leaf	Mid-May and June	July to Oct.	July to Oct.	4 0	1 6 to 2 0	$^{1}/_{5}$ oz. in seedbeds	..	3 to 4 ..	Plants must be reared in specially prepared seed-beds and transplanted when strong enough
Turnip (including Swede)	Market and stock food	Apr. to Aug.	Mar. to June	Mar. to June	2 0	1 0	$1\frac{1}{2}$ to 2 lb. ..	3 to 4 lb. ..	4 to 5 ..	..
Vetches or Tares ..	Grazing	Apr. to June	Mar. to June	Mar. to June	Drilled	..	30 to 40 lb. ..	40 to 60 lb. ..	3 to 4 ..	For green manure purposes, *see* under "Leguminous cover crops," page 362
Wheat	Grazing and hay ..	Apr. to June	Mar. to June	Mar. to June	Drilled	..	$^{2}/_{3}$ to 1 bus.	1 to $1\frac{1}{2}$ bus.	3 to 4 ..	Fodder purposes only; rust-resistant varieties recommended

CENTRAL DISTRICTS.

SOWING AND PLANTING TABLE FOR FIELD CROPS.

(This table requires to be adapted to suit individual circumstances).

Crop.	Main Purpose for Which Grown.	When to Sow or Plant.		How Sown or Planted.				Approximate Period of Growth of Crop in Months.	Remarks.
		Coastal Districts.	Tableland and Inland Districts.	Distance Rows Apart.	Distance Between Plants.	Quantity of Seed per Acre if Drilled.	Quantity of Seed per Acre if Broadcast.		
				Ft. in.	Ft. in.				
Arrowroot	Flour and pig food ..	Aug. to Nov.	Sep. to Oct...	5 0	2 0	10 to 12 cwt. of bulbs	..	8 to 10 ..	Suited best to coastal districts
Artichoke	Pig food	Aug. to Nov.	Sep. to Nov.	3 6	1 6	4 to 5 cwt. of tubers	..	4 to 5 ..	Difficult to store; will keep better in soil
Barley (Cape and Skinless)	Grazing and green feed	Mar. to June	Mar. to June	Drilled	..	1 bus. ..	1½ bus. ..	2 to 4 ..	..
Beans, Lima	Seed	July to Jan...	Sep. to Dec...	2 6	0 9	20 to 25 lb. ..	..	3 to 4 ..	..
Beans, Navy or Canning	Seed	Sep. to Jan...	Sep. to Jan...	2 4	0 4	15 to 24 lb. ..	..	3 to 3½ ..	Wider rows for fertile soils
Beet, Silver	Green feed for poultry	Mar. to June	Mar. to June	2 6	1 0	4 lb.	..	3 to 4 ..	..
Broom Millet ..	Brushware	Sep. to Dec...	Sep. to Dec...	3 6	0 9	3 to 4 lb. ..	..	4½ to 5 ..	..
Buckwheat	Nectar for bees; grain for poultry	Aug. to Mar.	Aug. to Mar.	2 0	0 3	25 to 30 lb. ..	40 to 45 lb. ..	1½ to 2½ ..	Produces a valuable nectar crop within 6 weeks of planting
Canary Seed	Hay, green feed and grain	Mar. to June	Mar. to June	Drilled	..	10 to 15 lb. ..	20 to 25 lb. ..	4½ to 5 ..	Not recommended for grain in this zone
Carrot, Field	Stock food	Mar. to June	Apr. to May	1 9	..	2 to 3 lb. ..	..	4 to 5 ..	..
Cassava	Pig food	Aug. to Oct.	Sep. to Oct...	5 0	2 0	Cuttings used ..	..	8 to 10 ..	Boil tubers before using; discard water
Cotton	Fibre..	Sep. to Nov.	Sep. to Nov.	3 6	1 0	15 to 20 lb. delinted seed	..	5 to 7 ..	..
Cow Cane	Stock food	July to Dec.	Sep. to Dec...	5 0	2 0	2 or 3-eyed setts used	..	7 to 9 ..	Suitable for several ratoons
Cowpea*	Seed, grazing and hay	Sep. to Jan...	Oct. to Jan...	3 0	0 6	6 to 10 lb. ..	15 to 20 lb. ..	3½ to 4½ ..	For green manure purposes, *see* "Under Leguminous cover crops," page 367

* *See* footnote on page 361.

Garlic	Market	Mar. to May	Mar. to May	1 6	0 6	..	..	6	..
Grasses (*see* Pasture)									
Leguminous Cover Crops*—									
Blue Lupin ..	Green manure ..	Autumn ..	Autumn ..	Drilled	..	1 bus. ..	1½ bus. ..	5	Erect growth
Cowpeas	Green manure ..	Summer ..	Summer ..	Drilled	..	20 to 25 lb. ..	25 to 30 lb. ..	3½ to 4 ..	Creeping growth
Cusara Pea ..	Green manure ..	Summer ..	Summer ..	Drilled	..	5 lb.	10 lb.	5 to 6 ..	Erect growth
Field Pea	Green manure ..	Autumn ..	Autumn ..	Drilled	..	1 to 1½ bus. ..	1½ to 2 bus. ..	3 to 4 ..	Creeping growth
Gambia Pea ..	Green manure ..	Summer ..	Summer ..	Drilled	..	5 lb.	10 lb.	5 to 6 ..	Erect growth
Mauritius (Velvet) Bean	Green manure ..	Summer ..	Summer ..	3 0	2 0	20 lb.	40 to 60 lb. ..	5	Creeping growth
Poona Pea	Green manure ..	Summer ..	Summer ..	Drilled	..	20 to 25 lb. ..	20 to 30 lb. ..	3½ to 4 ..	Semi-erect growth
Rice Bean	Green manure ..	Summer ..	Summer ..	Drilled	..	15 to 20 lb. ..	20 to 25 lb. ..	4 to 5 ..	Creeping growth
Soybean	Green manure ..	Summer ..	Summer ..	Drilled	..	20 to 30 lb. ..	25 to 35 lb. ..	3½ to 4 ..	Semi-erect growth
Tangier Pea ..	Green manure ..	Autumn ..	Autumn ..	Drilled	..	10 lb.	12 lb.	5	Creeping growth
Vetches or Tares ..	Green manure ..	Autumn ..	Autumn ..	Drilled	..	¾ to 1 bus. ..	1 to 1½ bus. ..	3½ to 4½ ..	Creeping Growth
Linseed (Flax) ..	Seed for oil	Apr. to June	Apr. to June	Drilled	..	20 to 25 lb. ..	..	4½ to 5 ..	..
Lucerne*	Hay and grazing ..	Apr. to May	Apr. to May..	Drilled	..	10 to 12 lb. ..	14 to 18 lb. ..	3	For grazing in drier areas, 4 to 6 lb.; in grass mixtures, 1 to 3 lb.
Maize	Grain and stock food	Aug. to Dec.	Sep. to Dec...	4 0	1 3	8 to 10 lb. ..	56 lb. for stock food	4 to 5; for stock food 3 to 4	For stock food closer row and plant spacing with increased seed rate
Pop corn	Grain	Sep. to Jan...	Oct. to Jan...	3 6	1 0	5 to 7 lb. ..	..	4	..
Sweet Corn ..	Market	Sep. to Jan...	Oct. to Jan...	3 6	1 0	6 to 8 lb. ..	..	3	..
Mangel and Sugar Beet	Stock food	Feb. to May..	Mar. to May	2 6	1 0	4 to 6 lb. ..	..	6 to 7 ..	..
Millet (French) ..	Grain	Sep. to Jan.	Oct. to Jan...	Drilled	..	10 to 14 lb. ..	20 lb.	2 to 2½ ..	..
Millet (Giant and Dwarf Setaria)	Grain, hay & grazing	Aug. to Feb.	Sep. to Feb...	Drilled	..	10 to 14 lb. ..	20 lb.	2½ to 3 ..	Can be grazed earlier, required
Millet (Japanese) ..	Hay and grazing ..	Aug. to Feb.	Sep. to Feb...	Drilled	..	10 to 14 lb. ..	20 lb.	2 to 3 ..	Can be grazed earlier, required

* *See* footnote on page 361.

CENTRAL DISTRICTS—*continued.*

SOWING AND PLANTING TABLE FOR FIELD CROPS.

(This table requires to be adapted to suit individual circumstances).

Crop.	Main Purpose for Which Grown.	When to Sow or Plant.		How Sown or Planted.				Approximate Period of Growth of Crop in Months.	Remarks.
		Coastal Districts.	Tableland and Inland Districts.	Distance Rows Apart.	Distance Between Plants.	Quantity of Seed per Acre if Drilled.	Quantity of Seed per Acre if Broadcast.		
				Ft. in.	Ft. in.				
Millet (White Panicum)	Hay and grazing ..	Aug. to Feb.	Sep. to Feb...	Drilled	..	10 to 14 lb. ..	20 lb.	2½ to 3 ..	Can be grazed earlier, if required
Oats	Grazing, hay and grain	Mar. to June	Mar. to June	Drilled	..	1½ bus. ..	1½ to 2 bus. ..	3 to 5 ..	..
Onion	Market	Apr. to May..	Apr. to May..	1 2	3 to 6 in.	1½ to 3 lb. ..	..	5 to 6 ..	..
Panicums (*see* Millets)									
Pasture Grasses—									
Blue Panic ..	Pasture	Sep. to Mar...	Sep. to Feb...	..	..	..	4 lb.	Perennial; summer grower	Graze heavily and intermittently once established
Buffel	Pasture	Sep. to Mar...	Sep. to Mar...	..	..	..	4 to 5 lb. ..	Perennial; summer grower	Sandy or deep soils best; lighter sowing rate in the west on sandy country
Elephant	Pasture and green feed	Sep. to Feb...	Oct. to Jan...	5 0	2 6	Root and stem cuttings used	..	Perennial; summer grower	Graze or cut frequently to prevent woody stems developing; ratoons vigorously
Guinea (Common Guinea and Green Panic)	Pasture	Sep. to Mar...	Oct. to Feb...	2 0	2 0	Root cuttings used for Common Guinea	4 to 5 lb. ..	Perennial; summer grower	Graze to maintain young growth, but allow resting period
Kikuyu	Pasture	Sep. to Feb...	Oct. to Feb...	3 0	3 0	Runner cuttings used; or plough or disc in chopped runners	..	Perennial; summer grower	Only Tableland areas in northern part of Central district
Mitchell	Pasture	..	Spring and early summer	..	..	..	2 to 3 lb. ..	Perennial; summer grower	Trample in seed with sheep

Molasses	Pasture	Sep. to Mar...	Oct. to Feb...	..	..	..	2 to 4 lb. ..	Perennial; summer grower	Used on scrub burns; needs careful grazing; suitable only in limited areas; frost susceptible
Para	Pasture	Sep. to Feb...	..	6 0	6 0	Runner cuttings used, or plough or disc in chopped runners	3 to 4 lb. ..	Perennial; summer grower	Used in swamps or where water supply ample or ground always damp
Paspalum	Pasture	Sep. to Mar...	..	..	..	..	8 to 12 lb. ..	Perennial; summer grower	Best growth where rainfall exceeds 40″
Prairie	Pasture	Mar. to May	Mar. to May	..	..	..	20 to 25 lb. ..	Annual; winter and spring grower	May regenerate if allowed to seed
Rhodes	Pasture	Sep. to Mar...	Oct. to Mar...	..	..	..	8 to 12 lb. ..	Perennial; summer grower	Sown on summer burns; best results from sowing in prolonged showery weather
Pasture Legumes—									
Black Medic ..	Pasture mixtures ..	Autumn ..	Autumn ..	..	..	..	2 to 3 lb. in mixtures	Annual or biennial	Growth extends into summer; may regenerate
Phasemy Bean ..	Pasture mixtures ..	Spring and summer	Spring and summer	..	..	..	5 to 7 lb. in mixtures	Annual; summer grower	Regenerates; may be useful in Rhodes grass country
Townsville Lucerne	Pasture mixtures ..	Spring ..	..	..	..	..	5 to 6 lb. in mixtures	Annual; summer grower	Regenerates
Stylo	Pasture mixtures ..	Spring ..	..	..	..	..	5 lb. in mixtures	Perennial; summer grower	..
White Clover ..	Pasture mixtures ..	Early autumn	Early autumn	..	..	..	2 lb. in mixtures	Perennial; winter and spring grower	Best suited to high Tableland areas, *e.g.*, Eungella
Pea, Field*	Stock food and grazing	Mar. to June	Apr. to June	Drilled	..	1 to 1¼ bus. ..	1½ to 2 bus. ..	3 to 4 ..	When sown in combination with a cereal, ½ to ¾ bus. per acre; for green manure purposes, *see* under "Leguminous cover crops," page 367
Peanut	Kernels	Sep. to Dec...	Sep. to Dec...	3 0	1 3	25 to 30 lb. of kernels	..	4 to 5 ..	..
Potato	Market	June and Jan.	June and Jan.	2 6	1 0	6 to 8 cwt. of tubers	..	3 to 4 ..	..
Pumpkin	Market and stock food	Sep. to Jan...	Sep. to Jan...	8 to 12 feet	3 to 4 feet	2 to 3 lb. ..	..	5 to 6 ..	Plantings in the Mackay-Bowen area are made usually after the summer wet season

* *See* footnote on page 361.

CENTRAL DISTRICTS—*continued.*

SOWING AND PLANTING TABLE FOR FIELD CROPS.

(This table requires to be adapted to suit individual circumstances).

Crop.	Main Purpose for Which Grown.	When to Sow or Plant.		How Sown or Planted.				Approximate Period of Growth of Crop in Months.	Remarks.
		Coastal Districts.	Tableland and Inland Districts.	Distance Rows Apart.	Distance Between Plants.	Quantity of Seed per Acre if Drilled.	Quantity of Seed per Acre if Broadcast.		
				Ft. in.	Ft. in.				
Rape	Stock food	Mar. to May	Mar. to May	Drilled	..	5 to 6 lb. ..	6 to 8 lb. ..	2½ to 4 ..	..
Rice, Swamp	Grain	Oct. to Jan...	Oct. to Jan...	Drilled	..	80 to 120 lb. ..	..	4 to 5 ..	Requires constant flooding during growing period
Rice, Upland ..	Grain	Oct. to Jan...	..	Drilled	..	60 to 90 lb. ..	..	4 to 5 ..	..
Rye	Grain and grazing ..	Mar. to June	Apr. to June	Drilled	..	¾ to 1 bus. ..	1 to 1¼ bus. ..	3 to 5 ..	..
Sorghum, Grain ..	Grain; stubble grazing	Sep. to Feb...	Sep. to Jan...	14 to 42 in.	..	4 to 12 lb. ..	10 to 20 lb. ..	3½ to 5	
Sorghum, Sweet ..	Stock food	Sep. to Feb...	Sep. to Feb...	3 6	0 4	5 to 6 lb. ..	12 to 15 lb. ..	3½ to 5	Immature growth of this group may contain poisonous properties: care should be exercised in grazing
Sudan Grass	Grazing and hay ..	Sep. to Feb...	Sep. to Jan...	Drilled	..	8 to 10 lb. ..	10 to 14 lb. ..	2 to 4	
Soybean*	Seed, grazing and hay	Sep. to Jan...	Oct. to Jan...	2 6	4 to 6 in.	15 to 20 lb. ..	25 to 35 lb. ..	3½ to 4½ ..	For green manure purposes, *see* under "Leguminous cover crops," page 367
Sunflowers	Seed for oil and bird seed	Sep. to Jan...	Sep. to Jan...	28 or 35 in.	1 0	4 to 6 lb. ..	..	4 to 5 ..	Wider spacings and less seed per acre where hand harvesting adopted
Sweet Potato ..	Market and stock food	Sep. to Feb...	Sep. to Dec...	4 0	2 0	Cuttings used ..	..	4 to 5 ..	Plantings in the Mackay-Bowen area are made usually after the summer wet season; useful for pig grazing
Tobacco	Leaf	Sep. to Dec...	Sep. to Dec...	4 0	18 to 24 in.	1/5 oz. in seed-beds	..	3 to 4 from transplanting	Plants must be raised in specially prepared seed-beds, and transplanted to permanent positions when strong enough
Turnip (including Swede)	Market and stock food	Feb. to May..	Feb. to May..	2 0	1 0	1½ to 2 lb. ..	3 to 4 lb. ..	4 to 5 ..	..
Vetches or Tares* ..	Grazing	Mar. to June	Mar. to June	Drilled	..	30 to 40 lb. ..	40 to 60 lb. ..	3 to 4 ..	For green manure purposes, *see* under "Leguminous cover crops," page 367
Wheat	Grain, grazing and hay	Apr. to June	Apr. to July	Drilled	..	⅔ bus. ..	1 to 1⅓ bus. ..	3 to 6 ..	Fodder purposes only on coast where rust resistant varieties are recommended

* *See* footnote on page 361.

The Baby's Need for Mothering.

HOW many mothers "enjoy" their first babies—or for that matter any subsequent babies they may have? Has all the instruction issued by the various authorities concerned with the very important task of reducing the numbers of deaths and the amount of ill-health in babies served to make conscientious parents feel that it is their duty to bring their babies up according to a strict plan which must not be departed from and in which it is wrong for a baby to be cuddled, rocked, or talked to at any time?

Smaller families, the greater participation of mothers in social and other activities outside the home, and lack of home help may be contributory causes, but the fact remains that many babies are "mothered" only at feed times and not always then if they are bottle fed.

This is entirely wrong. Every human being needs to feel loved and wanted, and nowhere is this more evident than in the response of the young baby to cuddling and caressing. It is not uncommon to see bonny little babies, left for long periods to the care of more or less indifferent strangers by mother's social activities or outside employment, become in time pale, flabby, and uninterested in what is going on around them.

Doctors and nurses who work in large institutions where children remain for any length of time know how easy it is for small babies to become retarded mentally and physically because they cannot have the intimate personal care and individual attention which they receive in a happy family circle and to which they can respond. Such institutional babies adopted into private homes often bloom so quickly in response to love and mothering that even the most inexperienced person can see the change. From this it will be realised that loving handling and mothering of a baby are absolutely necessary for this growth and development, both physical and mental. Babies who are allowed to lie all day passively in cots will quickly become languid and wasted. This does not say that baby should be nursed all the time he is awake and played with until he becomes excited and over-stimulated, but he certainly should not be left for too long unnoticed or in the same position. He should be turned from side to side or propped up with pillows so that he can watch what is going on around him. A change of position is a relief and rest for baby just as it is for older people. With careful planning of household duties every mother should find some times in each day when she can talk to and play with her baby for a few minutes in a calm and happy way so that he does not become over-excited.

A baby who is fed by his mother is always "mothered" at feed times, and equally so an artificially fed baby should never be allowed to lie in his cot while taking his bottle. He should be cuddled and held in a position as nearly as possible like that of the baby being fed at his mother's breast. An outing each day is good for mother and baby alike. If it could be made practicable for every girl to receive advice and instruction in the handling of little babies as part of her education we should have more families able to "enjoy" their children even from their early baby days.

Any further information on this and other matters connected with children may be obtained by communicating personally with the Maternal and Child Welfare Information Bureau, 184 St. Paul's terrace, Brisbane, or by addressing letters, "Baby Clinic, Brisbane." These letters need not be stamped.

ASTRONOMICAL DATA FOR QUEENSLAND.

JULY, 1950.

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

TIMES OF SUNRISE AND SUNSET.

At Brisbane.

Date.	Rise.	Set.
	a.m.	p.m.
1	6·39	5.03
6	6·39	5.05
11	6·39	5.07
16	6·38	5.10
21	6·36	5.12
26	6·34	5.15
31	6·31	5.17

MINUTES LATER THAN BRISBANE AT OTHER PLACES.

Place.	Rise.	Set.	Place.	Rise.	Set.
Cairns	9	49	Longreach ..	27	43
Charleville	25	29	Quilpie	37	33
Cloncurry	37	63	Rockhampton ..	1	19
Cunnamulla ..	32	27	Roma	15	19
Dirranbandi ..	22	16	Townsville ..	8	41
Emerald	12	28	Winton	29	51
Hughenden ..	21	49	Warwick	5	4

TIMES OF MOONRISE AND MOONSET.

At Brisbane.

Date.	Rise.	Set.
	p.m.	a.m.
1	6.28	7.56
2	7.35	8.44
3	8.38	9.24
4	9.38	9.58
5	10.34	10.29
6	11.27	10.57
7	..	11.25
	a.m.	
8	12.20	11.53
		p.m.
9	1.14	12.23
10	2.08	12.56
11	3.04	1.34
12	4.01	2.18
13	4.57	3.07
14	5.51	4.02
15	6.41	5.01
16	7.26	6.03
17	8·06	7.04
18	8.42	8.05
19	9.16	9.05
20	9.47	10.05
21	10.19	11.07
22	10.52	a.m.
23	11.29	12.11
	p.m.	
24	12.11	1.18
25	12.59	2.27
26	1.56	3.36
27	3.00	4.43
28	4.08	5.42
29	5.16	6.34
30	6.21	7.18
31	7.23	7.55

MINUTES LATER THAN BRISBANE (SOUTHERN DISTRICTS).

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

MINUTES LATER THAN BRISBANE (CENTRAL DISTRICTS).

Date.	Emerald.		Longreach.		Rockhampton.		Winton.	
	Rise.	Set.	Rise.	Set.	Rise.	Set.	Rise.	Set.
1	29	10	45	24	20	0	52	27
6	18	19	34	35	9	10	38	41
11	11	29	26	44	0	20	7	52
16	11	28	26	43	0	19	7	52
21	20	16	37	31	11	7	42	36
26	30	9	46	23	21	0	54	26
31	23	14	39	29	14	4	45	33

MINUTES LATER THAN BRISBANE (NORTHERN DISTRICTS).

Date.	Cairns.		Cloncurry.		Hughenden.		Townsville.	
	Rise.	Set.	Rise.	Set.	Rise.	Set.	Rise.	Set.
1	53	4	67	33	50	19	44	5
3	43	13	59	39	44	24	36	13
5	31	24	51	46	35	31	25	21
7	21	34	44	54	29	39	18	29
9	16	39	41	57	26	42	14	34
11	7	52	36	65	20	50	7	44
13	2	56	33	67	17	53	3	46
15	3	53	34	66	18	51	4	44
17	11	45	38	60	23	46	10	37
19	21	34	44	54	29	39	18	29
21	33	22	52	45	37	30	27	19
23	44	16	61	41	45	26	37	15
25	54	5	67	34	51	20	44	6
27	56	2	68	32	52	17	46	3
29	50	6	64	34	48	20	41	7
31	39	16	56	41	41	26	33	15

Phases of the Moon.—Last Quarter, July 7, 12.53 p.m.; New Moon, July 15, 3.05 p.m.; First Quarter, July 22, 8.50 p.m.; Full Moon, July 29, 2.17 p.m.

On 15th July, the Sun will rise and set 25 degrees north of true east and true west respectively, and on the 6th and 20th the Moon will rise and set at true east and true west respectively. On the 5th the Sun will be at its furthest distance from the Earth—94,600,000 miles.

Mercury.—At the beginning of the month, in the constellation of Taurus, will rise about 1 hour before the Sun, and on the 11th will be in line with the Sun, after which it will pass into the evening sky. By the end of July, in the constellation of Leo, it will set about 1½ hours after the Sun.

Venus.—In the constellation of Taurus at the beginning of the month, when it will rise 2½ hours before sunrise, but by the end of the month, in the constellation of Gemini, will rise 1¾ hours before the Sun.

Mars.—Still in the constellation of Virgo on the 1st, it will set about midnight, while on the 31st it will set about 1 hour before midnight.

Jupiter.—In the constellation of Aquarius, in the eastern evening sky, at the beginning of the month will rise between 9.15 p.m. and 10.30 p.m. At the end of the month it will rise between 7.20 p.m. and 8.45 p.m.

Saturn.—In the constellation of Leo, will set between 10 p.m. and 11.30 p.m. at the beginning of July and between 8.15 p.m. and 9.30 p.m. at the end of July.