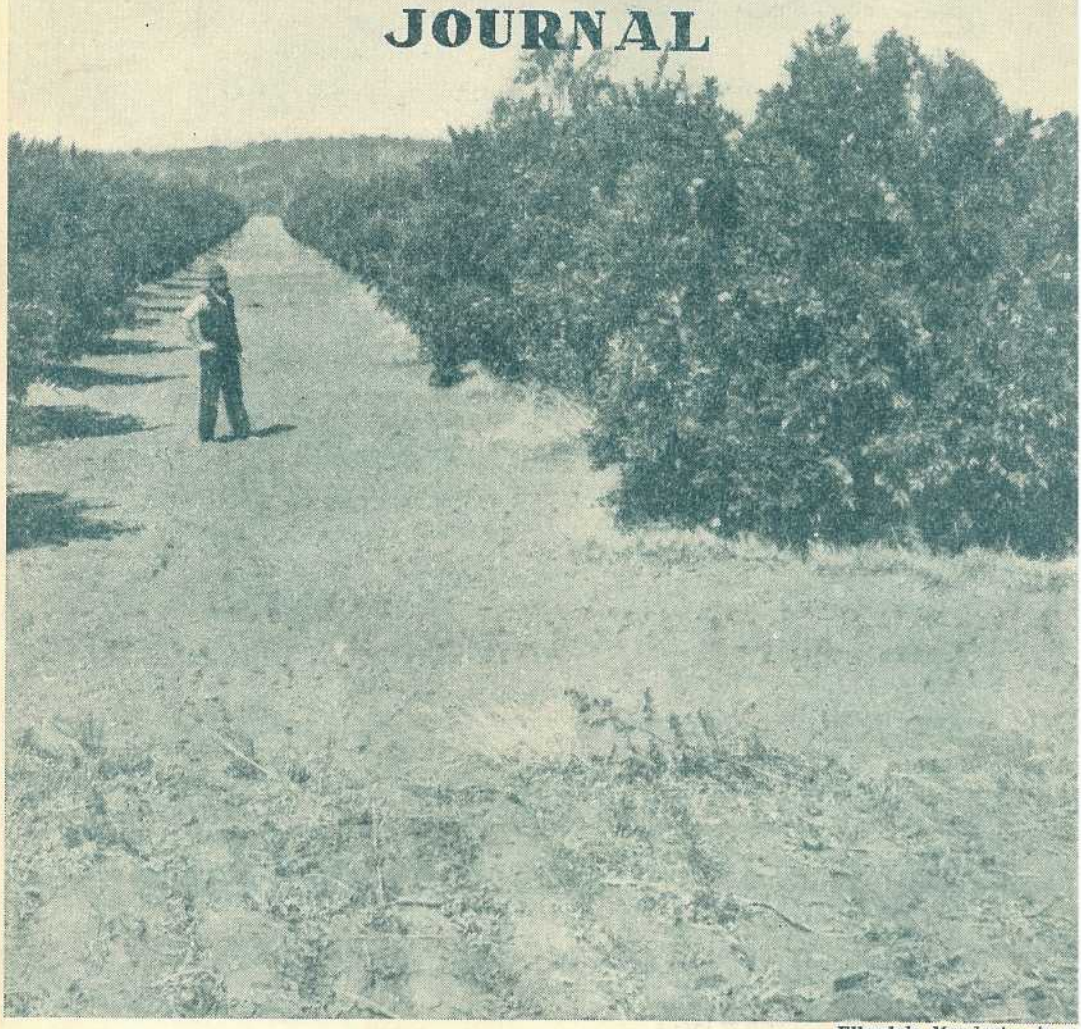
VOL. 73. PART 4 OCTOBER, 1951

DEPARTMENT OF AGRICULTURE

QUEENSLAND AGRICULTURAL JOURNAL



Ellendale Mandarins in a Gayndah Orchard.

LEADING FEATURES

Cotton Varieties

Potato Tuber Moth Control

The Papaw

Elevated Milking Bails

Liver Fluke of Sheep

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

Volume 73 Part 4

QUEENSLAND AGRICULTURAL JOURNAL

Edited by
C. W. WINDERS, B.Sc.Agr.

OCTOBER, 1951

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

GOVERNMENT PRINTER, BRISBANE

Contents

The Cotton Varietal Position In Queensland.

R. W. PETERS, Plant Breeder, Agriculture Branch.

COTTON has been grown commercially in Queensland at intervals since 1860, but it was not until 1920 that the present phase of cotton growing originated under a system of Federal and State guaranteed prices. The type of cotton seed available for planting purposes at that time was of very mixed origin, embracing such divergent types as Sea Island, Egyptian, and various American upland varieties. This seed was distributed to farmers and in succeeding years became hopelessly mixed both in the ginning operations and through cross-pollination in the field.

INTRODUCTION OF NEW VARIETIES.

The urgent need for introducing pure seed of suitable varieties was recognised by the Queensland Department of Agriculture and Stock. At the same time it was realised that the greatest precautions were necessary to prevent the introduction of pests and diseases with the imported seed. It was decided, therefore, to import only small quantities and to grow them under strict quarantine conditions before releasing them into the main cotton growing areas of the State.

The climatic and soil conditions over most of the Queensland cotton belt are similar to those ruling in many parts of the cotton growing areas of the United States of America where the bulk of the American upland cottons are grown. These cottons, with their large bolls and heavy bodied fibres, can be picked and ginned much more economically than the smaller bolled, finer fibred cottons of Sea Island and Egyptian types, for which there is only a limited market. The varieties of cotton introduced and grown in Queensland are therefore all of the American upland type, and are grouped botanically under *Gossypium hirsutum*. Since 1923 numerous varieties of this type of cotton have been introduced and tested over the main cotton growing areas of Queensland. Many gave little promise of being suitable for local conditions, while others, though promising in the first few years,

later exhibited serious faults and were eliminated from further consideration. However, several varieties showing suitability for each of the main soil types on which cotton is grown in Queensland were available in the wide range of material introduced.

PLANT BREEDING AND PURE SEED SUPPLIES.

An upland cotton variety is not necessarily a fixed entity, but usually comprises a number of closely similar lines or strains. When such a variety is taken from one environment to another, for example, from the United States to Australia, the differences between many of these component strains may be accentuated. Thus there is a tendency for a newly introduced variety to separate into various types some of which may be superior (and others inferior) to the average type for that variety.

Careful selection work made within the variety after the breaking-up into a number of types has taken place may produce a strain well adapted to the new regions in which it is being grown. This improvement in cotton by selection has been carried out in Queensland by officers of the Department of Agriculture and Stock on all promising imported varieties, with the result that improved types have been evolved in most of the commercial varieties grown, and more are still being developed.

Cotton is cross-pollinated easily and strict precautions have to be taken to prevent contamination between varieties. It is advisable, therefore, to isolate a variety being grown for pure seed purposes by at least half a mile from other cotton, and also to plant it on land not sown to cotton the previous year unless the previous variety was the same.

Care is likewise necessary at the ginneries to prevent an admixture of seed in the operations connected with the supply of pure seed. It is obviously desirable, therefore, to limit the number of commercial cotton varieties within a district to the lowest possible minimum. The ideal set-up would be to have one variety for each district, but soil variations usually make this impracticable in Queensland.

Even though isolation may be satisfactory and every care be taken at the ginneries, seed purity of cotton varieties tends to deteriorate. To meet this problem a systematic programme of plant selection is necessary in order to maintain a regular supply of good seed within each variety.

MECHANICAL HARVESTING.

The acute shortage of rural labour that has existed in Queensland in the last decade has been chiefly responsible for increasing interest in mechanical pickers for harvesting cotton, and this has necessitated some changes in plant selection objectives. Rank growth is undesirable because of the development of numerous vegetative branches, too many of which prevent the spindles of the picker engaging all the open bolls of seed cotton as they pass through the plant.

The ideal plant type for mechanical harvesting is one not exceeding five feet in height, which has an open habit of growth with the bolls arranged symmetrically over the plant (Plate 111). While specialized methods of cultivation can influence the production of this type of plant, more can be done by careful selection. Already some progress has been made in improving the varieties now being grown commercially, and in testing new varieties that were introduced recently for their potential suitability for machine harvesting.

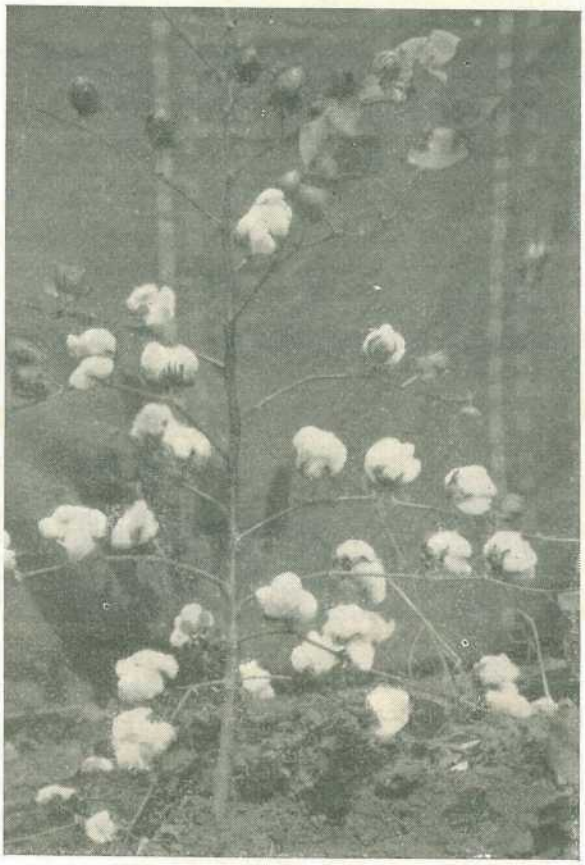


Plate 111.

A Cotton Plant with Foliage Removed to Show Open Type of Branch Structure Suitable for Mechanical Harvesting.

SOILS.

The different types of soil that occur in Queensland and the climatic variations between seasons and between districts make it difficult to recommend the most suitable variety of cotton to grow. However, by a series of varietal tests carried out over a long range of years in the main cotton growing areas, it is now possible to indicate with some confidence the varieties which are likely to give good results on each of the major soil types on which cotton is grown.

It would appear that for rain-grown cotton the clay loams overlying a clay subsoil at a depth of 12 to 36 inches approach nearest to the ideal cotton soil. Grouped under this soil type may be classed the slopes originally timbered with ironbark (in some districts the broadleaf and in others the narrowleaf ironbark being used as the indicator), the lower slopes and flats associated with large box trees, and the well drained soils of the brigalow and brigalow-belah scrubs.

Other types of soil which will produce good yields of cotton, but are more subject to crop fluctuations caused by climatic variations, are the fertile loams and clay loams of the alluvial flats. Of these soils, the

heavier clay loams appear to be the most reliable though excellent yields of good cotton can be obtained on all if the recommended Rhodes grass—cotton rotation system is followed (Plate 112).

Plate 112.

Deteriorated Rhodes Grass Pasture on Brigalow-Belah Scrub Land. Breaking-up for cotton and later replanting with Rhodes grass is essential to maintain the productivity of such land.

The most unsuitable soils appear to be the deep red loams of the softwood scrubs and the deep sandy loams of the river and creek alluvials. Under irrigation the latter soils yield well, but under dry farming conditions are seriously affected by dry conditions and high temperatures.

Plate 113.

A Crop of Miller Cotton, Callide Valley.

COMMERCIAL VARIETIES.

Miller.

The Miller variety (Plate 113) is a big bolled, medium stapled American upland cotton which has been grown for many years in the United States of America. A new strain of it evolved in 1926 was introduced to Queensland in 1930.

The yielding ability, size of boll, ease of picking and the tendency of the variety to produce high grade cotton of a type required by the Australian spinners have made Miller popular wherever conditions are suitable for it. The average Miller plant is of medium size, with one to three basal vegetative branches, one or two of which may be fairly large. The foliage is medium to large in size, and dark green in colour. The main stem is usually erect and fairly tall and sturdy. The fruiting branches are numerous but only of medium length. The fruiting arrangement is fairly open, which allows of good spacing of the bolls. Bolls are large, 60 to 65 to the pound, with a preponderance of five-locks which open well and are moderately stormproof. The fibres, which are of medium to full body, have a staple length of 1 inch and are very strong. The colour of the fibre is white. The lint percentage ranges from 34 to 37.

Since its introduction to Queensland, considerable improvement in Miller has been effected, particularly in one selected strain, Miller (MIB.43.9.0), in which the lint percentage has been increased to approximately 37 per cent. as compared with 34 per cent. when the variety was introduced. In addition this strain is earlier maturing than the original stock and is more open in plant structure.

The Miller variety has always shown partial resistance to jassid, a leaf sucking insect which can cause serious loss of crop. A breeding programme to evolve jassid resistant strains of this variety has been carried out at Biloela Regional Experiment Station. Miller 41J was produced entirely by selection and is fairly resistant, but some recently evolved backcross Millers have proved to be entirely resistant, with all the good characteristics of Miller retained. Some of these are now available for distribution. The variety is recommended for the following soil types in the districts indicated hereunder.

Northern Darling Downs and Maranoa.—The loamy soils of the rising lands and foothills of the Main Dividing Range, originally timbered mostly with open box forests; the more fertile clay loams of the belah flats; some portions of the fertile red loams originally under either open forest or scrub, where moisture retention is better than average for this soil type.

Southern District.—The loams and clay loams of the slopes originally under scrub or open forest; the less fertile alluvial clay loams.

South Burnett.—The black and the brown loams and clay loams of the lower slopes originally under silverleaf ironbark forests; the less fertile grey loams and clay loams of the lower slopes originally under large box trees; the fertile brown and red-brown loams and clay loams of the scrubs.

Central and Coastal Burnett.—The more fertile soils of the gentle open forest slopes, the clay loam alluvials and the decomposed granite soils in the Mount Perry-Boolboonda area.

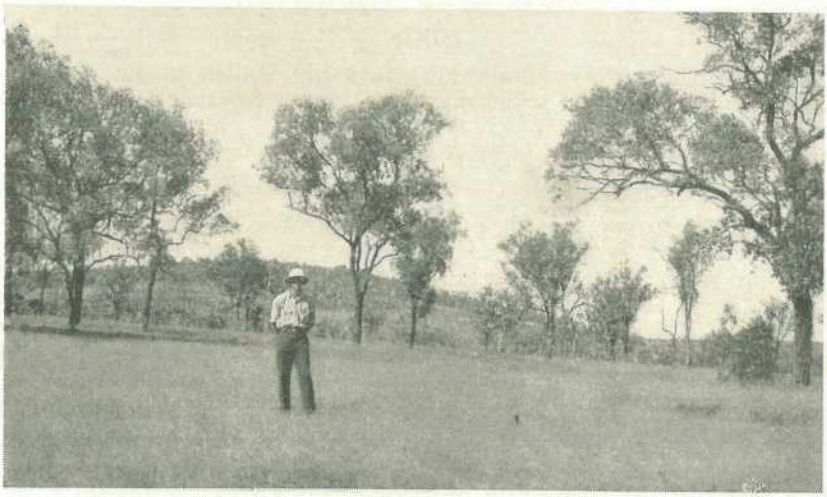


Plate 114.

Typical Silverleaf Ironbark Country, Callide Valley, Which is Suitable for the Miller Variety.

Plate 115.

Bluegum Alluvial Flats in the Callide Valley, Which are Suitable for the Miller and New Mexico Acala Varieties.

Upper Burnett.—The soils of the slopes originally under box or ironbark forests; the loams and clay loams of the scrubs.

Central District.—The soils of alluvial flats and slopes originally timbered with open forest (the very fertile deep loams or sandy loams adjacent to creeks should be avoided); the loams and clay loams of the softwood and brigalow scrubs.

Plate 116.

Softwood Scrub Land in the Callide Valley, Which is Suitable for the Miller Variety.

New Mexico Acala.

This strain of Acala was introduced to Queensland in 1934 from the Field Station of the United States Department of Agriculture at State College, New Mexico. Commencing from the first year of testing, the variety has been remarkable for its uniformity of plant and fibre characters and the high standard which it has maintained under Queensland conditions. In fibre characters it is one of the outstanding varieties grown in Queensland, such characters as drag, body, lint percentage and lint index all being of a very high standard.

The plant is of medium height with a strong erect main stem. Basal vegetative branches usually vary from one to three, one usually being considerably more vigorous than the others. Fruiting branches are long at the base of the plant but become shorter towards the apex of the plant. Leaves are medium-large in size and dark green in colour, the lobes being mostly long and pointed. Bolls are medium-large size, ovoid to ovoid-oblong in shape, with a slightly blunt point, and weigh from 50 to 60 to the pound. The bracts are rather small for an American upland type. The bolls are often pendant, open wide and have good stormproof qualities. Lint has an average length of $1\frac{1}{16}$ inch, with excellent drag and good strength, and is usually heavy bodied and clear white in colour. The lint percentage averages 37.

The symmetrical shape of the plant, the type of boll and the quality of the lint distinguish New Mexico Acala from all other varieties grown in Queensland. It matures earlier than other big bolled cottons and has the capacity to mature much of its crop at the same period. The variety, however, is extremely susceptible to attacks from jassids, which limits its sphere of usefulness in areas where this pest occurs. It does not appear to have the drought resistance of Miller or Lone-star but is very suited to irrigation. Work on the production of a jassid resistant back-cross New Mexico Acala hybrid is in hand at present.

The variety is recommended for the following soil types in the districts indicated hereunder.

Northern Darling Downs and Maranoa.—The better types of the dark brown clay loams of the open forest areas; the alluvial clay loams where irrigation facilities are available.

Southern District.—Results obtained so far in trials indicate that the variety has only limited possibilities in this district.

South Burnett.—The dark-brown clay loams of the lower slopes originally timbered with silverleaf ironbark; the less fertile heavy clay loams of lower slopes and alluvials originally under box trees, more particularly in the first three seasons after the breaking up of grassland.

Central and Coastal Burnett.—Not recommended for these districts.

Upper Burnett.—The loams and clay loams of the alluvials in the southern section of the district. It is not recommended for the northern half of the area, where the soils are too fertile and jassid attacks are frequently experienced.

Central District.—The fertile loams and sandy alluvial loams of the open forests adjacent to creeks in all but the coastal section of this district. The variety appears to be particularly suitable for growing with supplementary irrigation.

Lonestar.

This variety was introduced in 1923, but for a number of years it showed little evidence of being suitable for conditions in Queensland and it was not until 1930, when tested at Mundubbera on an ironbark slope with interspersed patches of brigalow, that the variety showed promise. Suitable strains were then developed in the Central Burnett, where the variety became very popular. In recent years, however, the variety has been less favoured and has been superseded to a great extent by Miller.

The introduced strain of Lonestar was vigorous in its habit of growth, usually with four strong basal vegetative branches, and the foliage was very coarse. Repeated selection has resulted in the development of a different type of plant, as the following description of a typical Lonestar plant shows:—

Plant growth is vigorous and of medium height, with two to four basal vegetative branches, two of which are usually large but fruit well. The internodal distance between the joints on the main stem is somewhat short. The fruiting branches are numerous, with a well-defined alternation of the internodes giving the branch a zig-zag type of growth. The lower fruiting branches are horizontal but the upper ones, which are normally shorter, are slightly angled from the horizontal, giving the plant an open habit which allows of good ventilation and sunlight penetration. Foliage is medium to large and very dark-green in colour. The bolls are well spaced on the fruiting branches and are large to very large with five-locks predominating. In shape they are broadly ovoid, with short, blunt points. They usually open well, are decidedly stormproof, and have a staple length of approximately 1 inch.

Strains of Lonestar are being grown successfully under a wide range of soil and climatic conditions, which may be summarised for the districts south of Mackay as follows:—

Northern Darling Downs and Maranoa.—The loams, clay loams and clay soils of the plains originally under open box forests; clay loams of the rising lands and foothills of the Dividing Range, which originally carried box trees as the predominating timber; decomposed sandstone areas originally timbered with cypress pine, bull-oak, spotted gum, and ironbark; the heavier types of the clay loam soils of the brigalow scrubs; the clay loams of the flats, originally covered with belah; the red loams and clay loams originally covered with a range of flora varying from open forest to scrub; alluvial clay loams on creek flats and in the folds and valley of the Main Dividing Range.

Southern District.—The brown to black clay loams of the open box forests; the brown to red-brown clay loams of the open forest slopes originally timbered mainly with both broadleaf and narrowleaf ironbark.

South Burnett.—The brown and red-brown clay loams originally timbered with broadleaf and narrowleaf ironbark, and the open gum-top box forests.

Central Burnett.—The brown and red-brown clay loams, as in the South Burnett; the grey and grey-brown clay loams originally timbered with open box forests; the loams overlying a clay subsoil, such as occur, for example, in the open forests chiefly carrying Moreton Bay ash and box; the brown and grey-black heavy clay loams of the brigalow scrubs.

Triumph.

This variety, which was originally known as Oklahoma Triumph in the United States of America, was introduced from that country in 1933. When first planted in Queensland the seed was clearly impure, as a wide range of plant types was observed. Fortunately, the variety responded well to individual plant selection and in a few years improved strains were released for commercial distribution. Continued work in this variety has produced strains which, because of earliness and high yielding ability, are suitable for the more fertile alluvial soils.

The following is an average description of the main Triumph strains now being grown:—

The main stem is erect and of medium height but inclined to bend over when bearing a heavy top crop. There are generally one to three vegetative branches, but usually they do not develop vigorously. The fruiting branches are numerous, horizontal, and long on the lower part of the main stem but shorten slightly higher up. The foliage is of medium size and dark green. Bolls are of medium size and occur roughly in equal proportions of five- and four-locks. Storm resistance of the open bolls is not good. The fibres average $\frac{15}{16}$ inch in length, are of medium body, fairly good strength and of medium drag, while the percentage of lint ranges from 35 to 36·5.

In a season when the planting rains do not occur until it is too late to plant the big bolled, later maturing varieties, Triumph can be planted as late as December on all soils that are moderately fertile with good chances of obtaining a profitable yield. Triumph is also the only reliable variety of cotton to plant on the most fertile alluvial loams in

the wetter districts. It has been demonstrated that in areas which are regularly subject to jassid attack, early plantings of this variety can produce a satisfactory crop before the jassid population is sufficiently large to affect the growth of the plants. Another important characteristic of Triumph is its ability to recover from a setback, caused either by insect activity or adverse climatic conditions, and form a good crop.

Triumph can be grown over a wide range of soils and climatic conditions. In fact, it is grown regularly in all the cotton districts except the main sections of the Central District. The following soil types are recommended for the variety in the main cotton-growing districts south of Mackay.

Northern Darling Downs and the Maranoa.—The heavy black clays and clay loams of the plains. Early autumn ploughing is especially advisable for these soils so as to build up subsoil moisture. It is also necessary to cultivate frequently to minimise the moisture loss caused by severe cracking which may occur on these soils. The fertile loams and clay loams of the softwood scrubs are suitable as well as the fertile loams of the alluvial areas along the main creeks and in the folds and valleys of the Main Dividing Range.

Southern District.—The fertile loams of the alluvials of the main valleys—especially if irrigation facilities are available; the fertile loams and clay loams of the lower levels of either open forest or scrub soils in the narrow side valleys entering the main valleys; the more fertile of the loams of the softwood scrubs.

South Burnett.—The more fertile loams and clay loams of the alluvials—especially if irrigation facilities are available; the fertile loams and clay loams of the softwood scrubs.

Central Burnett.—The fertile loams of the alluvials, especially if irrigation facilities are available; the fertile loams and clay loams of the softwood scrubs; the fertile loams and clay loams of both the open forests and scrubs on the slopes in the Dallarnil and Biggenden districts.

Coastal Burnett.—The fertile alluvial loams of the coastal plain; the more fertile loams of the scrubs and open forests on both the slopes and the alluvials in the inland sections of the district.

Upper Burnett.—On soils similar to those recommended for the South Burnett and the variety is recommended especially for fertile alluvials where irrigation facilities are available.

Central District.—Not recommended for this area.

Other Varieties being Tested in Queensland.

In addition to the main commercial varieties which have been described, the Department of Agriculture and Stock has under investigation a number of other varieties which have been imported more recently. Amongst these are several that have been imported for their potential suitability for machine harvesting. Newer varieties which show superiority in the district tests will be multiplied to provide limited tests on a commercial basis. If the general results obtained in these large scale trials indicate that one or more of the newer varieties are superior to the varieties now commonly grown, seed stocks will be increased as rapidly as possible for general distribution to cotton growers.

The Papaw.

G. W. J. AGNEW, Senior Experimentalist, Horticulture Branch.

THE papaw (*Carica papaya*) is a small herbaceous tree which is grown commercially in Queensland for its fruit. The tree is believed to be indigenous to Central America; it reaches a height of 15 to 20 feet and bears a crown of large, light-green, palmate leaves. The plant grows particularly well in the wet tropics of Queensland, where high temperatures and rainfall permit more or less continuous growth during most of the year.

Plate 117.

Papaw Plantation in Southern Queensland. Older plants are 15 months old and bearing fruit. Young plants in the foreground.

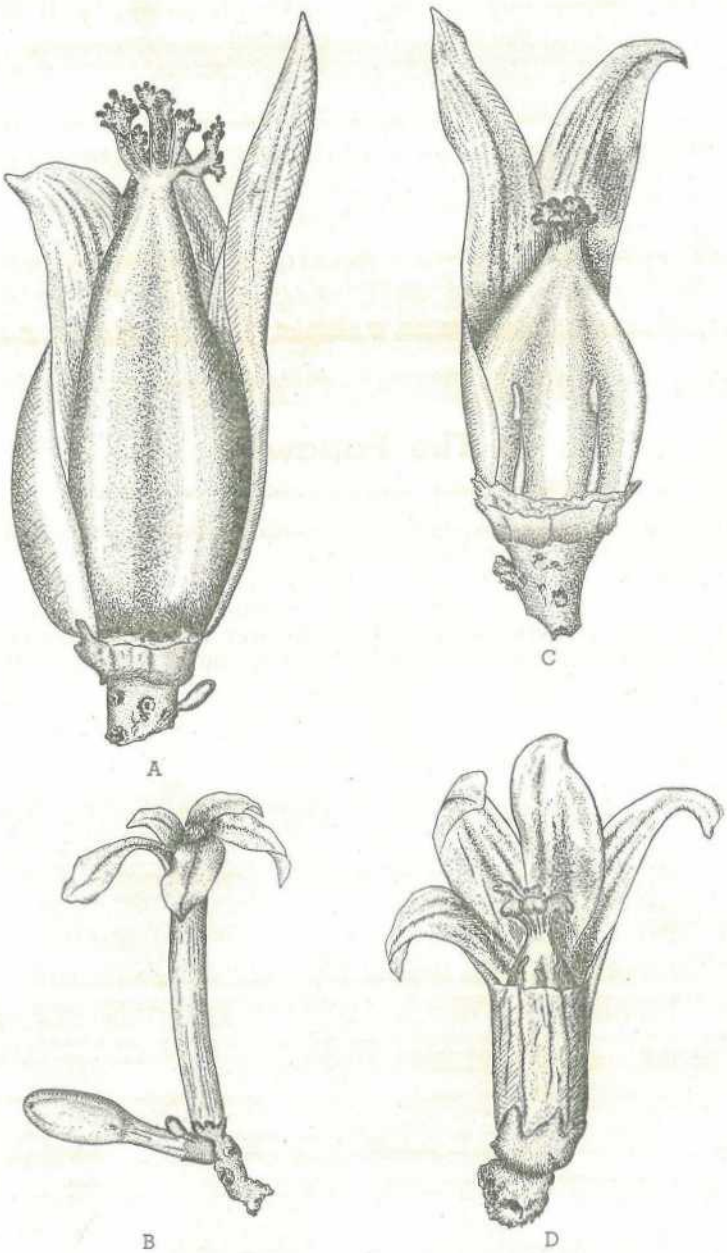


Plate 118.

Flower Types in the Papaw. A, Pistillate. B, Staminate. C, Pentandria. D, Elongata.

Optimum conditions for the papaw are not encountered in southern Queensland, where winter temperatures from June to September are often sufficiently low to affect adversely the development of the plant or the maturation of the fruit. Occasional severe frosts cause widespread damage among papaw plantations in low situations. In North Queensland, plantations are not subject to frost but cyclonic winds occasionally destroy crops in exposed parts of the tropical coast.

In spite of these hazards, many excellent plantations are to be found along almost the whole Queensland coast. The main centres of production are Redlands, Sunnybank, Brookfield and Aspley in the Metropolitan district, the Mary Valley and Gunalda in the North Coast district, Yarwun and Mackay in the Central district and Cairns in North Queensland.

FLOWER TYPES.

In the papaw plant there are three primary flower types—namely, pistillate, staminate and hermaphrodite. Individual trees may bear one, two, or very rarely, all three of these, but generally where more than one flower type occurs in a single plant, their co-existence is for brief periods only.

The five petals of the white pistillate or female flower (Plate 118A) are free for their entire length and surround the flask-shaped pistil in the centre. The stigma opens its five crinkled lobes at full bloom as receptive surfaces for pollen. The lower bulbous part of the pistil is the ovary in which the seeds develop.

In staminate or male flowers (Plate 118B), the comparatively small petals are fused together for slightly over half their length and form a slender tube which bears 10 stamens. Each of these has a yellow lobed anther from which pollen is liberated just prior to the opening of the flower. Staminate flowers cannot produce fruit.

Hermaphrodite flowers of the papaw are classified into three forms—pentandria, intermediate and elongata—according to the nature of their structural modifications. The *pentandria* form (Plate 118C) is somewhat similar to the pistillate flower except that a large stamen occurs near the base of each petal and lies along a groove on the outer surface of the ovary. Pentandria flowers produce a typically squat fruit with deep grooves and well-defined basal petal scars. The *intermediate* form comprises an indefinite group of freakish and distorted flowers in which stamens and the pistil occur in grotesque associations. Fruits produced by intermediate flowers are extremely irregular in structure and of little commercial value. The *elongata* (Plate 118D) is the commonest hermaphrodite flower. It has an elongate pistil partly enveloped by the petals which form a collar around the ovary. Elongata flowers give rise to long fruits with a small seed cavity often characterised by deep fissures.

TREE TYPES.

When pistillate and staminate flowers are borne on different plants, the species is said to be dioecious (Plate 119). Colloquially, trees bearing pistillate flowers are termed "females" while those which normally bear staminate flowers are referred to as "males."

The flowers of a female papaw tree are produced in the leaf axils on single or but simply-branched stalks varying from one to several inches in length, according to the characteristics of the strain. The

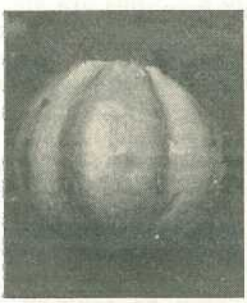
Plate 119.

Tree Types in the Papaw. Female to left and male to right in a dioecious variety. Note the pendulous hermaphrodite fruit on the male tree.

principal flower is borne at the apex of the flower stalk and small subsidiary flowers are situated nearer the base. The size and number of the subsidiary flowers vary considerably on the one tree during the flowering season as well as between trees of dissimilar strains. Fruits produced by the pistillate flowers (Plate 120A) of female trees are usually rounded or oval in general outline, but common irregularities occur in the form of beaked fruits or fruits which taper at the stalk end.

The flowers of a male tree are produced in large numbers on profusely branched stalks, which attain a length of from three to five feet. Some male trees bear a number of reduced hermaphrodite flowers at the terminals of these stalks, particularly during the cool spring and autumn months. These hermaphrodite flowers may produce fruit which is extremely variable in quality (Plate 120 B, C and D) and is often of little market value.

A



B

C

D

Plate 120.

Fruit Types in the Papaw. Derived from—A, pistillate flower; B, pentandria flower; C, elongata flower; and D, intermediate flower.

In hermaphrodite trees, the flowers are normal, with both stamens and pistil. They are produced on short stalks in the axils of the leaves and the subsidiary flowers near the base of the stalk are in many instances either functionally staminate or abnormal hermaphrodites. During the cool months, staminate flowers may be almost exclusively produced, and the tree then becomes virtually a male tree for a limited period. *Pentandria, elongata* and *intermediate* flower forms frequently occur on the same hermaphrodite tree, with the first two predominating from time to time during the flowering season. In some trees, however, one of these, usually *elongata*, predominates throughout the life of the plant. In Queensland, trees which bear practically all *elongata* flowers characteristically produce long, narrow fruit popularly called "Long Toms." At one time the term may have signified a distinct strain but at present it is applied indiscriminately to any long-fruited type of hermaphrodite papaw.

INHERITANCE OF SEX.

Queensland papaw plantations chiefly consist of trees in the dioecious group interspersed with a few hermaphrodites. The distribution of sex types in the progenies of the different possible matings is, therefore, of economic interest.

The segregations for the several possible crosses are:—

Parentage.	*Progeny Ratios.*
Female x Male	Females and Males .. .. 1 : 1
Female x Hermaphrodite	Females and Hermaphrodites 1 : 1
Hermaphrodite x Male	Females, Males and Hermaphrodites .. .. .. 1 : 1 : 1
Hermaphrodite x Hermaphrodite ..	Females and Hermaphrodites 1 : 2

The progeny of the female-hermaphrodite cross will all bear fruit though different shaped fruits will be produced. Observations in plantations with female and hermaphrodite trees indicate that no male trees are needed for pollination if about two-thirds of the stand are hermaphrodites.

SEED-BEDS.

The usual procedure is to raise papaw plants in seed boxes filled with a free, sandy loam. The seed may be sown in drills about two inches apart at a depth of half an inch. When the young seedlings are about two inches high, they are pricked out and transferred to large seed-beds with a four-inch spacing between plants. Alternatively, the seed is broadcast over large seed-beds and raked out to give an approximate spacing of about three inches. The seed-bed is then covered with about half an inch of sandy soil and pressed or rolled. A third method is to plant the seed in individual containers, three seeds to the container, the containers being placed in the seed-bed area where they receive the necessary care and attention. Liberal waterings are necessary to ensure a good germination and the seed-beds or boxes should be protected from the sun by a partial shade such as forest oak or pine tree branches. Heavy shading is unnecessary and the cover should be reduced in overcast weather, otherwise the young seedlings may become spindly.

Planting the seed direct in the field is sometimes practised and has the advantage that plant development is continuous and the risks associated with transplanting are reduced. However, a great deal of care and attention is necessary in watering, weeding and protecting the plants from pests, particularly cutworms, until they are well established, and success is contingent on favourable weather conditions.

Germination under summer conditions should occur in from 14 to 20 days.

The quantity of seed sown depends on the spacing distance in the proposed planting. If an 8 feet x 8 feet spacing is adopted and the trees are planted on the standard square, there will be 680 trees to the acre. Four seedlings are required for each tree position to allow for the culling out of surplus male trees. Seed weights vary considerably with the variety but a seed-bed sowing of four ounces of air-dried seed will usually provide sufficient plants for a one-acre plantation. Such a sowing gives an adequate margin for seed-bed and transplanting losses resulting from unsuitable weather or other causes. A heavier seed rate per acre is necessary when field sowing is practised, for 10 or more seeds are placed in each tree position.

Papaw seed may be sown at any time during the summer. Plants from early summer sowings grow vigorously in the juvenile stage of development and the fruits borne in the following summer are set high on the stem. Autumn planting in the field following seed sowing in December is, however, the best practice in southern Queensland, for the weather is usually favourable for transplanting from late February to early April and the plants attain a height of about two feet or so before cold weather retards growth. The first crop of fruit is then set relatively low on the stem and this makes harvesting simpler.

TRANSPLANTING.

Prior to transplanting, the seed-beds are heavily watered. Seedlings are ready for transplanting when from four to six inches in height but only as many should be lifted as can be planted conveniently before wilting occurs. The importance of having the seed-beds close to the plantation site is, therefore, evident. The danger of losses at transplanting is less if the seedlings are grown in individual containers, for the root system is virtually undamaged when the plants are set out.

Seedlings should be planted with a trowel at the same depth as they were growing in the seed-bed and the roots should be well spaced before the soil is finally pressed into position. It is also advisable to trim the leaves when transplanting. If two or three showery, cloudy days follow transplanting, shading in the field should not be necessary. Potted seedlings also do not need shading. Seed-bed lifted plants require shading on the northern side, either with a small four-inch board pushed in the soil at the side and leaning towards the plant or with small leafy tree branches. Four seedlings are usually planted at each "hill."

FIELD POSITIONS.

The typical site for a papaw plantation is on sloping ground, and provision must be made for any necessary surface drains. The tree positions are then pegged out. Each tree position is forked or mattocked about four weeks prior to planting. If available, compost should be dug into each "hill," and in the less fertile soils, it is advantageous to add four ounces of a complete fertilizer high in phosphoric acid at the same time. Two weeks after planting out, a 2 oz. dressing of sulphate of ammonia per hill will promote vigorous growth.

Spacing distances for papaw plants (Plate 121) in the field range from 6 x 6 feet to 12 x 12 feet. Trees on virgin rain forest land grow very tall if they are planted close and much of the crop must be harvested by ladder (Plate 122). A spacing of 8 x 12 feet or 10 x 10 feet is satisfactory in these circumstances. An 8 x 8 feet spacing is, however, preferred under average plantation conditions.

SOIL AND FERTILIZER REQUIREMENTS.

In Queensland, papaw plantations are placed either on virgin land recently cleared of rain forest or hardwood forest, or on land which has grown pineapples, bananas or some other crop for several years. These soils vary considerably in both structure and fertility. Many plantations are necessarily placed on hillsides to avoid frost injury and are thus frequently associated with rocky and gravelly soils. Good drainage is essential, for waterlogging stunts the plant and is frequently associated with disease outbreaks.

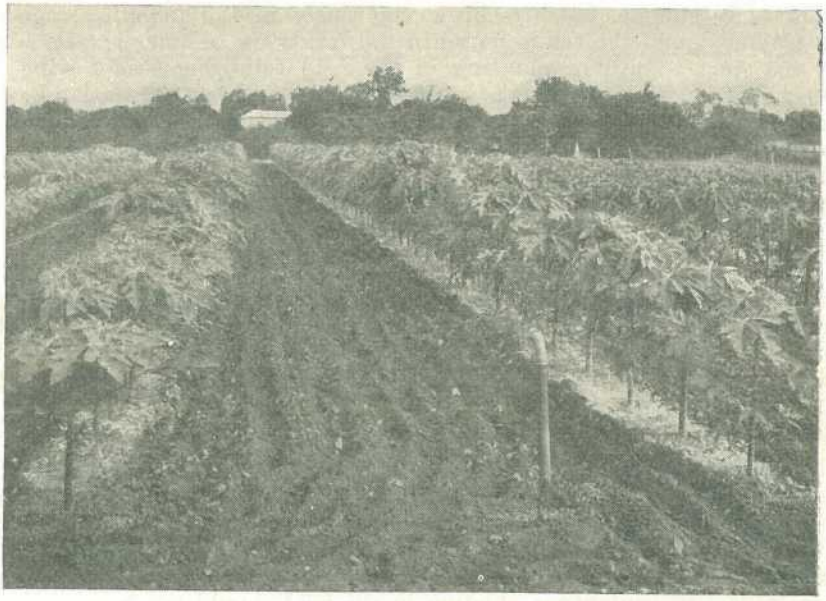


Plate 121.

Young Papaw Plantation at Sunnybank. The plants will later be thinned to an 8-feet spacing in the row.

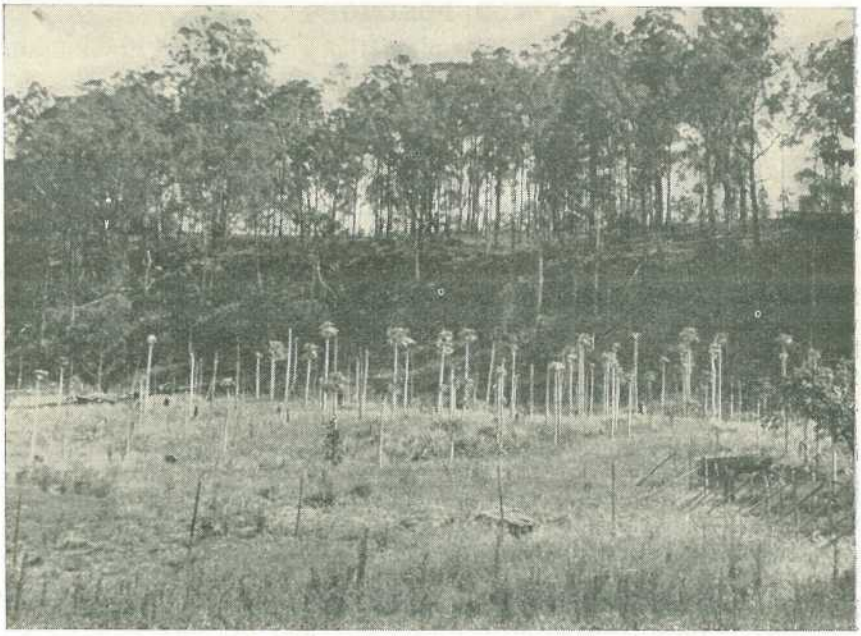


Plate 122.

Old Papaw Plantation. Note the great height and the small crown of leaves.

Where soil fertility is high, excellent yields of good quality fruit have been obtained without the use of fertilizers. Most typically, however, plantation sites occur on soils of low or medium fertility in which plant nutrients have been lost by continuous cropping, erosion and leaching. The papaw tree draws heavily on the available water and plant foods in the soil for at least eight months of the year and efficient plantation management is, therefore, essential.

Though much information remains to be obtained on fertilizer usage in papaw plantations, good results can be obtained on most soils from the use of an 8:10.5:5 or similar mixture applied at the following rates:—4 oz. for trees up to three months old; 12 oz. for trees up to six months old; 2 to 3 lb. for trees one year old and upwards. Three full applications should be made during the growing and blossoming period in September, November and February, with a light application in April.

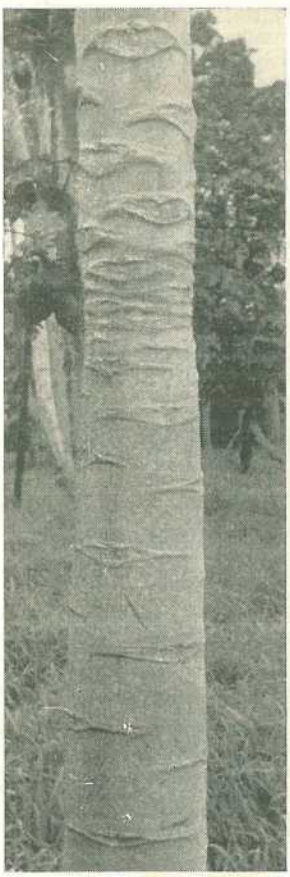


Plate 123.

Papaw Stem Showing Constriction. This is the result of slow growth during the cold winter months or in a dry period.

PLANTATION MANAGEMENT.

Cultivation practices in papaw plantations vary considerably with the type of plantation. Many of these are so steep and rocky that anything other than hand cultivation is precluded. The plant spacing adopted will also influence the method of cultivation employed. Owing to the shallow rooting habit of the plant, only skim cultivation is permissible, but weeds must be suppressed, particularly during the dry spring and early summer months when stress conditions occur (Plate 123). Papaws respond well to heavy mulching with dry grass or other litter. The mulch cover retards surface evaporation, helps to suppress weed growth and provides a constant supply of decomposing organic matter.

Thinning.

The four plants in each tree position are retained until flowering takes place. They are then thinned out so that the final stand contains one male tree to every nine female trees. Instead of removing the surplus plants, it is good practice to lop off male trees one foot above ground level, and female trees two feet above the ground. Should the selected tree collapse a sucker from one of the lopped trees can then be trained to replace it. Should the selected tree make normal growth and bear a satisfactory plant crop, the adjacent lopped trees are then cut back to the ground.

Flower Production and Fruit Set.

During the principal flowering period from November to late January, each tree produces approximately four flowers per

week and the average setting is about 60 per cent. A much lower percentage setting can be expected from February to April, when protracted wet weather may prevent natural pollination.

The time taken for complete fruit development varies from four to nine months, the fruit from early summer flowers reaching maturity more quickly than that from late summer flowers. The early winter crop maturing in May and June is produced by flowers borne in November and December, whereas the spring crop in August and September is produced by late summer flowers.

Average tree production in a plant crop from the main flowering period (November to January) is about 30 fruits per tree with an average weight of approximately three pounds. A crop yield of this kind is equivalent to slightly more than three bushels per tree.

Branching.

Branching (Plate 124) commonly occurs in papaws as a result of injury to the growing tip. Some strains, however, branch more than others and will do so even in the absence of any injury. Most branched

Plate 124.

Branched Papaw Plant. Branching takes place when the primary growing point is injured.

trees produce smaller fruit than single stemmed trees, and except in very vigorous trees, branching is an undesirable character. High branches tend to collapse when they are carrying fruit and must be either propped or tied back to avoid this trouble.

Cutting Back.

Aged trees in a healthy condition can be rejuvenated by cutting them back to about two feet above the ground where the stems are solid. This can also be done with younger trees that have grown too tall for convenient harvesting. After cutting, buds develop from the stump and two or three of the most vigorous shoots are allowed to grow. Cutting should be done during the early spring and it is good practice to cover the cut surface of the stem with a tin to prevent cracking and subsequent decay.

HARVESTING.

In southern Queensland, fruit ripens throughout most of the year, but there are two important harvest periods—April to June and September to November. In northern Queensland the main harvesting periods are longer.

For local markets, fruit is harvested in the firm-ripe stage when the first colour is showing at the base, and the fruit becomes fully ripe in from four to five days. For export to southern States fruit should be picked at a stage which allows about eight days to the full ripe condition. The stage of maturity as gauged by external colouring of fruit will vary according to seasonal conditions, the variety grown and the requirements of the buyer, but generally the fruit should be harvested at an earlier stage in the summer than in the winter.

Great care must be exercised in harvesting papaws in the firm-ripe stage, as they bruise easily. The fruit should be cut and not pulled from the tree, as pulling often results in damage at the basal end. Fruit stalks should be cut close to the tree stem in order to prevent the immature fruit on the tree from rubbing on the protruding stub. The stalk on the fruit should be trimmed before packing.

The milky latex which exudes from the broken rind of immature papaws irritates the skin and an operator handling the fruit for a lengthy period should wear rubber gloves and an apron.

PAPAW VARIETIES.

Though many distinct papaw varieties, such as Cowleyii, Long Tom, New Guinea Red, Singapore Red and Solo, have been introduced into Queensland, nearly all commercial plantings are still grown from open pollinated seed and the identity of any variety has been lost. Two pure varieties recently released in Queensland are Bettina and Improved Petersen.

Bettina has been derived from an introduction from Florida (the "Betty") and a local selection. It is a vigorous, squat, umbrella-like tree, carrying smooth rounded-oval fruits of 3 to 5 lb. weight and with attractive external and internal colour. The flesh is comparatively thick (1 to 1½ inches), of firm consistency and attractive flavour, and is particularly suitable for canning.

Improved Petersen is derived from a reasonably pure strain grown in isolation for some years. It produces a tall tree which bears a single fruit in each leaf axil. The fruit has an attractive flavour and its

small size (2 to 3 lb.) is an asset on the fresh fruit market. In general, fruit quality is good but the skin colour could be better and its carrying qualities are scarcely adequate for distant markets.

FRUIT CHARACTERS.

The following features which influence fruit quality have been dominant in selection work in Queensland.

Size and Shape of Fruit: Smooth-surfaced, oval or rounded-oval fruits weighing 3 to 4 lb. are the most readily saleable either as fresh fruit or for canning.

Skin Colour: Differences in depth of colour are apparent in fruits of dissimilar varieties but a uniform rind colour is desirable. Partially seeded fruits colour more intensely at the apical end than the stalk end, which is often poorly seeded. Summer ripened fruits usually have a more even colour and fewer blemishes than those which mature in the cooler months.

Fruit Flavour: Flavour is a distinctive character which is difficult to specify, varies with the season at which the fruit matures and to most tastes is governed by the sweetness of the flesh. Broadly there appear to be two distinct flavours, the musk and the nasturtium or cress flavours, and the former is preferred by Queensland consumers.

Flesh Quality: Flesh thickness, which is of particular importance to the canning industry, varies considerably with the variety and the amount of seed in each fruit. A firm but not hard flesh is desirable for both the fresh fruit and canning trades. Fruit which lacks firmness of flesh at maturity usually carries badly.

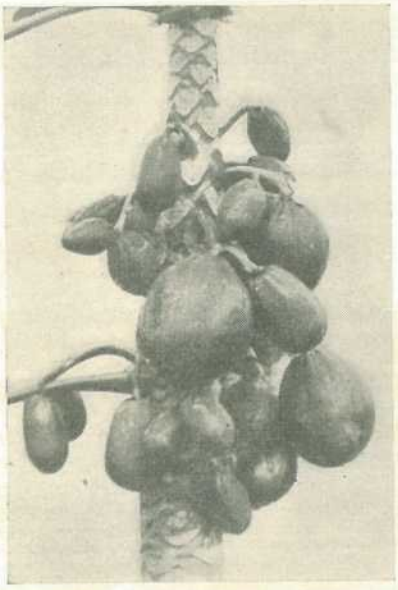
HAND POLLINATION.

The operation of hand pollination in the dioecious group of papaws can be used to maintain an elite line of papaws or, if natural pollination is insufficiently effective, to produce a commercial crop of fully developed and well-seeded fruits.

To Improve Fruit Setting.

In central and southern Queensland, the effects of defective pollination are commonly seen in trees with an irregular setting of fruit or carrying undersized, seedless, misshapen fruits (Plates 125 and 126). These are the results of unfavourable climatic conditions, such as prolonged wet weather, for pollination during the flowering period from November to May.

Male trees shed their pollen during the late bud stage before the petals open. For hand pollination, it is therefore necessary to test the late-stage buds for free pollen by folding back the petals and tapping the bud with the finger. The operator collects a sufficient number of suitable late-stage male flower buds to complete the pollinations in hand. Where male trees are plentiful, whole branches of flowers may be broken off and the buds plucked as required. The unfurled petals of the flower bud are broken off and the remaining portion is used as a brush to dust pollen lightly over the stigma lobes of the female flower. Within about three days the stigma lobes begin to wither and turn brown and further pollination is of no value.



A

B

C

Plate 125.

Papaw Pollination—A, Light crop of uneven shaped fruit in a plant which received insufficient pollen. B, An even crop in a plant subjected to good natural pollination. C, Large rounded fruit in hand pollinated papaws of the variety Bettina.

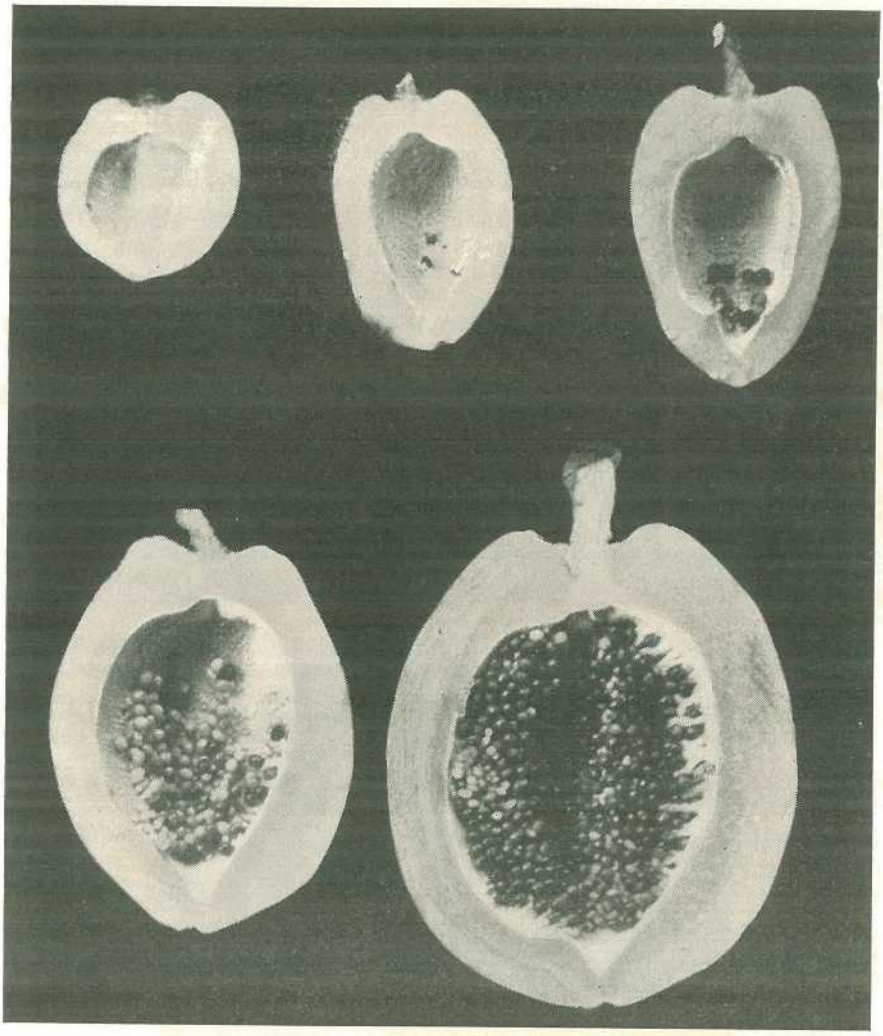


Plate 126.

Fruit Size and Pollination. The amount of seed indicates the degree of effective pollination and is correlated with both the size and shape of the fruit.

In commercial plantations, hand pollination in the first flowering season should be done at intervals of about three to four days. With semi-dwarf varieties the operation can be continued through the second flowering.

Controlled Hand Pollination.

In order to maintain a pure variety in the dioecious group of papaws, flower pollination must be carried out in selected female plants under controlled conditions. Flower buds of the female tree are, therefore, covered with 4 x 3 inch paper bags a day or two prior to their opening. All subsidiary flowers on the principal flower stalk are first removed, the bag being slipped over the large apical bud and clipped

tightly on to the flower stalk with a paper clip or fastener so as to exclude foreign pollen. When the flower opens, the bag is temporarily removed, pollen from late-stage buds of the selected male tree is dusted on to the stigma of the female flower, and the bag is again placed in position to cover the flower. The transfer of pollen is made as quickly as possible.

The pollinated flower is appropriately labelled, with the male and female parentage recorded on the label. Commercial cardboard tags dipped in hot paraffin wax after marking with waterproof ink have been found useful for this purpose. The loop of the tag is slipped over the pollinated flower and held on the flower stalk. Seven days after pollination, the paper bag is removed.

Each hand pollinated flower should produce a fruit with from 500 to 1,000 seeds. It is advisable to treat three or four times the number of flowers estimated to give sufficient seeds for current requirements after allowing for incidental losses.

Aiding the Pineapple Industry.

In a report on the operations of the Horticulture Branch of the Department of Agriculture and Stock during 1950-51, the Director of Horticulture (Dr. S. A. Trout) states that pineapple plant selection was the main theme of the Branch advisory campaign during the year, as elimination of inferior planting material is essential if the industry is to develop on sound lines.

On the pineapple investigational side, attention was given to weed control, fertilizer requirements, regulation of flowering and fruiting, and other aspects.

Firm recommendations for the use of sodium pentachlorphenate for the control of weeds were issued to growers, and attention is now being given to PCP-diesel oil emulsions, which are more suitable against summer weeds.

Fertilizer trials have been established on distinct soil types at Beerwah, Nambour, Flaxton and Dagun.

Hormone treatment of pineapple plants, which can be used for regulating flowering and ripening and increasing fruit size, is being further investigated in an endeavour to devise cheaper methods of application.

The transport of factory pineapples in crates containing 12 cases was shown to reduce handling costs without affecting factory yield.

Progress was made in investigations into the utilisation of cannery wastes.

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

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

Plant Poisoning of Stock.

In a survey of losses from plant poisoning during the past year, the Director of Veterinary Services (Mr. C. R. Mulhearn) lists the following plants as incriminated or suspected:—Noogoora burr, poison peach, yellow daisy, lantana, bracken fern, yellow-wood, wild tobacco, caustic vine, green cestrum, wild cottons, native indigo, Crofton weed and Gomphrena weed.

PLANT PROTECTION

Potato Tuber Moth Control In South Queensland.

A. W. S. MAY, Entomologist, Science Branch.

THE potato tuber moth (*Gnorimoschema operculella* Zell.) is a serious pest of potatoes in Queensland. Though it is more usually considered a pest of the tubers both prior to harvest and in storage, larval damage in the tops interferes with normal plant development and can materially reduce yields. In the southern part of the State, this pest is more prevalent in the spring crop and the adoption of a regular schedule of control measures should be considered a necessary feature of potato production.

SEASONAL HISTORY.

Overwintering moths deposit eggs on the leaves soon after the plants appear above ground, and the resulting larvae skeletonise the leaf tissues or burrow into the growing point of the stem. Larval damage in the tops increases as new generations of the pest develop and often attains serious proportions in hot, dry seasons. Complete plant defoliation may then occur before tubers are formed.

As the crop approaches maturity the moths lay eggs on the tubers should these become exposed, or accessible through cracks in the soil. When the tops wilt or dry out the larvae will also migrate to unprotected tubers.

The insect may remain active in the field during summer in volunteer potato plants and in alternate hosts such as tobacco and some native related plants, and in stored tubers. Numbers wane, however, with the approach of cooler weather and this pest is rarely of major importance in autumn crops.

CONTROL MEASURES IN THE FIELD.

Every effort should be made to prevent the pest attaining populations that may cause irreparable damage to the plants. Cultural and chemical methods can be combined to achieve this end.

Pre-planting.

Farm hygiene, including the destruction of all residues from earlier potato crops, and other moth harbourage, should be given attention.

Pre-flowering.

Once the crop has germinated and until flowering commences, the plants should be given good conditions for development. Uninterrupted top growth during this period will ensure maximum tuber formation.

DDT, in either spray or dust form, should be applied to prevent larval damage to the tops and to check infestations of aphis, jassids, the 28-spotted ladybird and the other potato foliage pests.

Post-flowering.

Top protection is also essential during this period as it ensures tuber development.

Insecticidal application may not entirely prevent tuber attack as the crop approaches maturity; therefore, as an added precaution the plants should be hilled.

Early hilling can interfere with tuber formation, so this operation should commence after the majority of tubers are formed, but before they develop sufficiently to crack the soil. Hills should be maintained until harvest, particularly when the soil is prone to cracking.

Rate of DDT Application.

DDT, preferably in spray form, should be applied at the rate of one pound per acre at each application.

As many types of spray machinery are used by potato growers the method of achieving this rate of application can be calculated from the following. Two-fifths of a gallon of 25 per cent. DDT emulsion, half a gallon of 20 per cent. DDT emulsion, two pounds of 50 per cent. DDT dispersible powder and 50 pounds of 2 per cent. DDT dust, all contain one pound of DDT. Any one of these quantities may be used to obtain the required dosage per acre, the spray forms by diluting the particular quantity of concentrate with an amount of water equal to the output per acre of the spray machine.

Timing of DDT Applications.

DDT applications should commence soon after moths are first noticed in the field, and should be continued while moths are present.

Two treatments, and possibly a third, spaced 2 to 3 weeks apart will be sufficient to prevent damage in the tops, and to reduce the likelihood of a population developing before harvest.

Harvesting.

Harvesting should not be delayed after the tubers have reached maturity. If this is unavoidable during dry weather, hilling should be continued, or light spray irrigation used to prevent serious ground cracking.

As the tubers are bagged in the field they should be treated with a 2 per cent. DDT dust at the rate of half a pound per bag.

A convenient method of dusting the tubers is to place a small amount of dust in the bottom of the tin used for picking up each time before it is filled.

As larvae quickly migrate from the rapidly wilting tops and moths lay eggs on exposed tubers, the sequence of digging, dusting and bagging should be a quick and continuous operation.

CONTROL MEASURES IN STORAGE.

Stored potatoes, including seed set aside for the next crop, can be protected from tuber moth attack by thorough treatment with 2 per cent. DDT dust at the rate of half a pound per bag.

An alternative and equally effective method entails the storing of tubers in bags that have dried after being dipped in a 2 per cent. DDT emulsion.

To reduce the likelihood of rots developing during storage, only reasonably sound potatoes should be placed in the bags.

Surface Treatments Against Two Common Timber Borers.

A. R. BRIMBLECOMBE, Entomologist, Science Branch.

THE powder post beetle (*Lyctus brunneus* Steph.) and the Queensland pine beetle (*Calymmaderus incisus* Lea) are frequently responsible for serious damage to timbers in Queensland (Plates 127 and 128). The former attacks the sapwood of a variety of timbers while the latter attacks only certain pine timbers.

The treatments described below to deal with these borers are not approved preventive treatments satisfying the requirements of "The Timber User's Protection Act"* but are recommended for application in buildings, to furniture and other manufactured articles where infestations have occurred in non-immunised timbers and when thoroughly carried out should be effective in arresting attacks and preventing further infestations.

Materials.

A mixture of equal parts of K55 standard Creosote and kerosene is good for borer control generally, but it leaves an oily brown stain which is difficult to obliterate and subsequent painting is not practicable without the use of special priming coats. Where staining is of no consequence this mixture is recommended.

The following solutions are suitable if staining is to be avoided, and where it is desired to paint the treated surface. A month should elapse between the last application and painting.

Pentachlorphenol.

"Caltex Wood Preserving Oil."
"Vacuum Wood Preserving Oil."
"Pent-o-leen."

Zinc naphthenate.

"Hardiproof Clear."

Copper naphthenate.

"Hardiproof Green."
"Coponol."

Methods of Application.

On rough or unpainted surfaces applications may be made by brushing, spraying or injecting, but on painted or finished surfaces the injection method is most suitable.

Treatments for powder post beetle attacks need be applied to the sapwood only, if this can be readily distinguished. General applications are desirable for attacks by the Queensland pine beetle, particularly on the underside of floors.

Brushing:—The preservative solution should be brushed liberally on all accessible surfaces, at the rate of one gallon to 100 to 150 square feet where a large area is involved.

* This Act applies to the use of timbers susceptible to the powder post beetle.

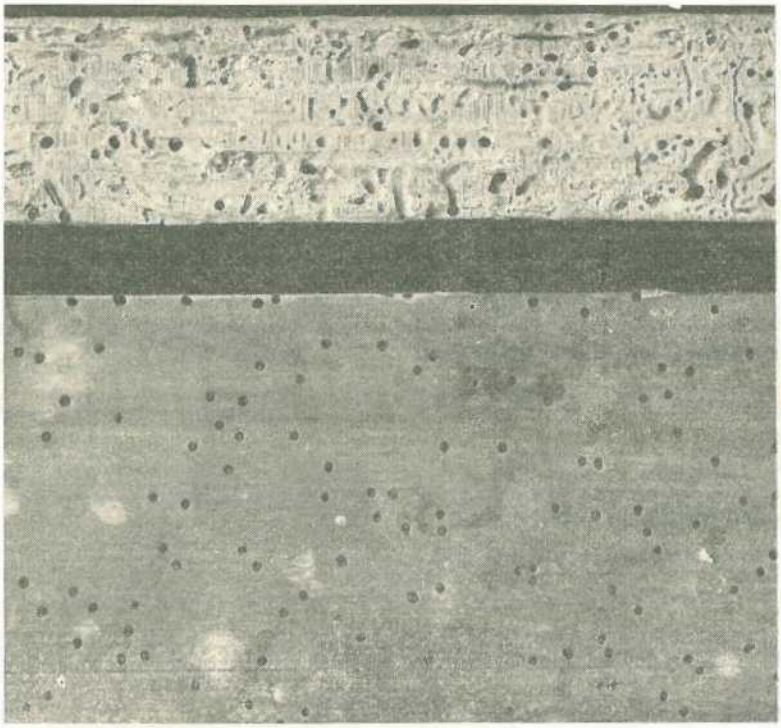


Plate 127.

Queensland Pine Beetle Damage. Hoop pine timber showing internal damage and emergence holes.

Plate 128.

Powder Post Beetle Damage. Tulip oak timber showing internal damage and emergence holes.

Spraying:—As a substitute for the brush treatment a low pressure spray such as given by a stirrup pump or knapsack pump may be used. This method should be of advantage in difficult places on the underside of floors.

Injecting:—Preservative solution may be injected, by means of a syringe, into the emergence holes until the tunnelling is saturated. The holes should then be plugged with putty or plastic wood filler. This treatment is recommended primarily for the Queensland pine beetle and on unpainted surfaces it should be followed by a brush application.

Timing of Applications.

Against the Powder Post Beetle:—Four single applications at intervals of three months, one application being given particularly in late August.

Against the Queensland Pine Beetle:—Four single applications at yearly intervals, in late August.

CAUTION.

With each of the chemicals listed above there is a risk of skin irritation and operators are cautioned against splashing on tender parts of the body. When splashing is unavoidable suitable "barrier creams" should be used, "Innoxa Q.B.5" is particularly suitable when using pentachlorphenol. The use of goggles and a nose mask is recommended when spraying in cupboards and other difficult places where inhalation of fumes is likely. If the skin has been splashed soap and warm water should be used as soon as possible.

INOCULATION OF LEGUME SEEDS.

★ ★

The Department of Agriculture and Stock supplies cultures of bacteria for the inoculation of seeds of legumes such as Poona pea, blue lupins, lucerne and clovers.

Seed inoculation is often necessary where the legume intended for planting has not previously been grown successfully, as it provides the plants with bacteria which are necessary for their full development.

Cultures are supplied free and post free. They are in bottles and have to be mixed with skim milk for sprinkling on the seed.

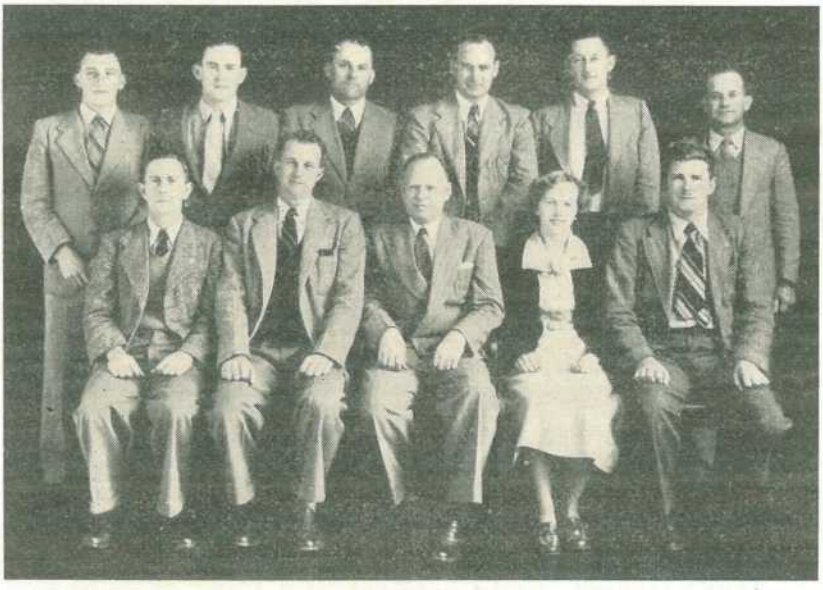
Order from the Under Secretary, Department of Agriculture and Stock, Brisbane, at least 10 days before sowing. State amount and type of seed to be treated.

Pig Officers' School.

IN accordance with the Department's policy of providing refresher courses for field officers of various branches, members of the Pig Branch attended a school conducted by the Department in Brisbane during August.

The officers were given the latest information on selection of stock, breeding, feeding, housing, management, and disease control. Visits were paid to factories and institutions to secure additional information. An interchange of views and ideas between officers from various districts also proved beneficial.

Those participating in the school included the Officer-in-Charge of the Pig Branch (Mr. F. Bostock), Senior Adviser E. L. Melville, Advisers T. Abell, J. Christensen, C. R. Grieve, J. Liddell and C. Porter, Assistant Husbandry Officer K. Hutchinson, and Cadets J. Aitken and J. Hunter.



Front Row:—T. Abell, E. L. Melville, F. Bostock, Miss B. Barralet (Typist), K. Hutchinson.

Back Row:—J. Hunter, J. Aitken, C. R. Grieve, J. Liddell, C. Porter, J. Christensen.

An Elevated Milking Bails.

P. McCALLUM and O. H. HEINER, Division of Dairying.

THE principle of the elevated milking bails—that is, having the cows at a higher level than the milker to reduce stooping—is not new to Queensland. Several dairies in the State have had semi-elevated milking bails for over 20 years, but the idea went out of favour until the visit to Australia about two years ago of Professor Petersen of U.S.A., when interest was again aroused.

Though the idea is not new to Queensland, the Americans were the first to fully develop and carry it to its logical conclusion by raising the cow well up in the air so that the milker has no need to bend his back at all. The latest design of elevated milking shed in the United States has the floor on which the cow stands raised 30 inches above the floor of the milker's alley. This eliminates stooping of the operative during milking. Stooping was not entirely avoided during milking in the elevated bails known as echelon or race bails (Plate 129), which were at one time fairly popular in Queensland and New South Wales. In these bails the difference in the levels of the floors was about 12 to 15 inches.

In the latest American bails each cow stall, which is of all-metal construction, is made to completely enclose the cow (Plate 130). In the echelon bails which were popular here some years ago the cows mostly entered at ground level and the milker's alley was below ground level with steps down at each end. A serious disadvantage of this type was the lack of drainage from the milker's alley. Where this type of shed was built on sloping ground, the floor where the cows entered was built up a little, allowing this end of the centre alley to be at ground level with steps leading down from the separator room end. A further disadvantage of these sheds was the dust which was created by the cows coming out and around both sides of the separator room. The combined dairy building now usually built in Queensland provides for the cows to enter at the end farthest from the separator room, and leave the bails by means of a concrete race (four feet wide) which takes them to the end of the bails again and thus away from the separator room. This allows a 30 ft. stock-free area around the separator room and so reduces dust and contamination.

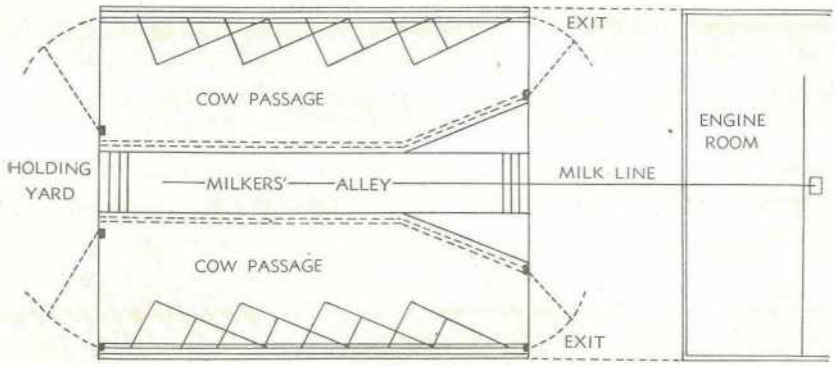


Plate 129.

Sketch of Layout of Echelon Type Elevated Bails Once Popular in Queensland.

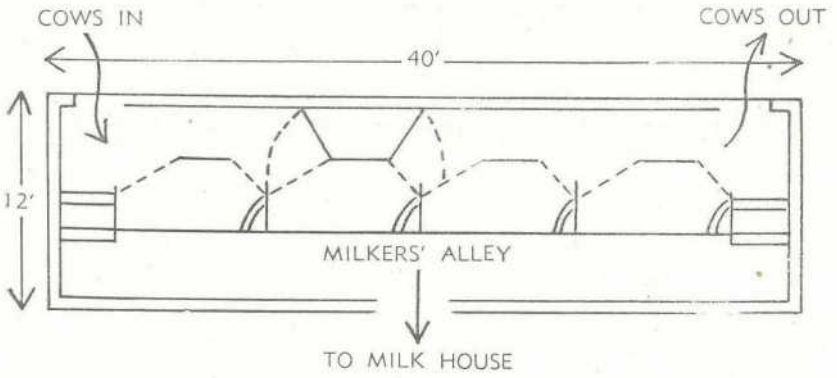


Plate 130.

Sketch of American-type Elevated Bails, in which the Cows are Completely Enclosed.

A New Zealand farmer who made a close study of the Petersen Elevated Milking Bails compromised by raising the cows 15 inches above the ground and having the centre alley or well 15 inches below the ground. The cows entered and left the milking race by long sloping ramps.

The American type elevated bails are not well adapted to Queensland conditions for several reasons. Firstly, it is unnecessary to keep cows indoors in Queensland. Secondly, in America, where the releaser type of milking machine is not used, the vacuum line for the bucket-type which is in general use runs at floor level along the edge of the elevated floor, and the milk is carried in the buckets to the milk room. Concentrates are fed to the cows while being milked.

Though there has been a good deal of interest shown in this State with regard to elevated bails, the main difficulty has been to determine a suitable adaptation to Queensland conditions. Through the ingenuity of Mr. J. J. Schabe, of Thangool, the first all-metal elevated milking bail in Queensland has been constructed (Plates 131 and 132).

Being an entirely new idea, many unthought of problems arose during the course of its construction, but all these were satisfactorily ironed out. With the view to helping other dairymen who may be interested in this new labour-saving shed, some of the details concerning its dimensions are outlined.

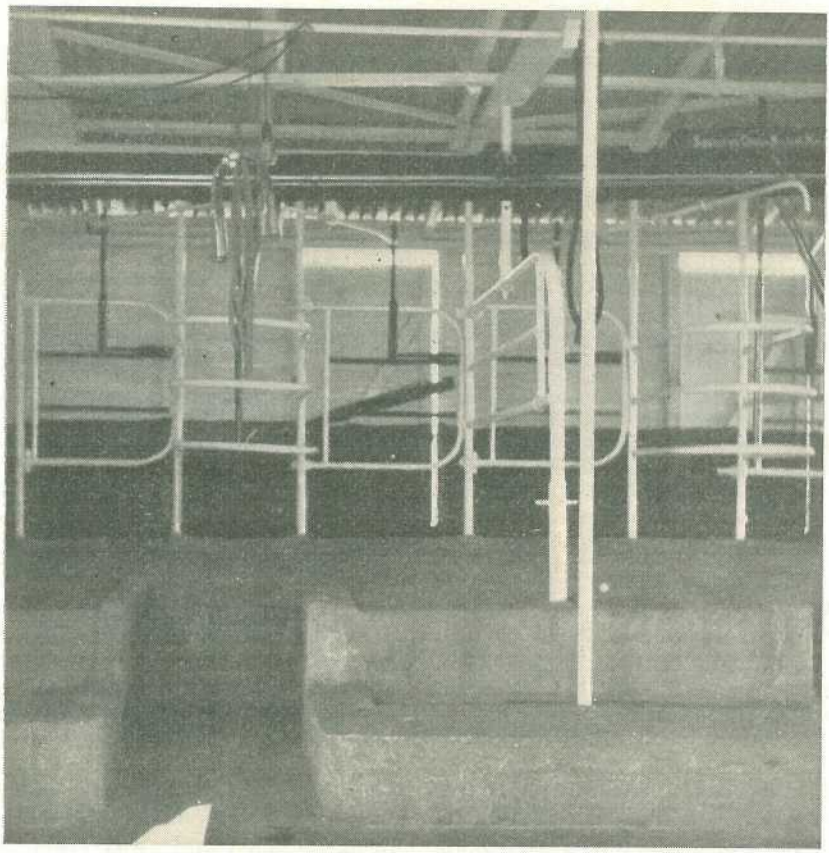


Plate 131.

General View of Elevated Bails Built by Mr. J. J. Schabe, of Thangool.

The layout and dimensions follow very closely those of the combined dairy building plan of the Division of Dairying of the Department of Agriculture and Stock. The dairy building, 41 feet long, is made up of a cream room 6 feet by 8 feet to house the dairy refrigerator, a separator room 8 feet by 8 feet, an engine room (or air space) 6 feet wide, and a 21 feet long three-unit milking shed of six bails with the all metal "dummies" suspended from the roof. The width of the shed is 18 feet. At the entrance to the shed is a small holding yard, 12 feet wide, covered by a lean-to roof.

The concrete foundations of the shed were laid before any timber work was done. A foundation sketch of the layout is shown in Plate 133. "Dwarf" concrete walls 18 inches high, above the finished floor level, keep all woodwork well above waterline, protect it from white ants, increase its life and make for easy cleaning and hosing down. The

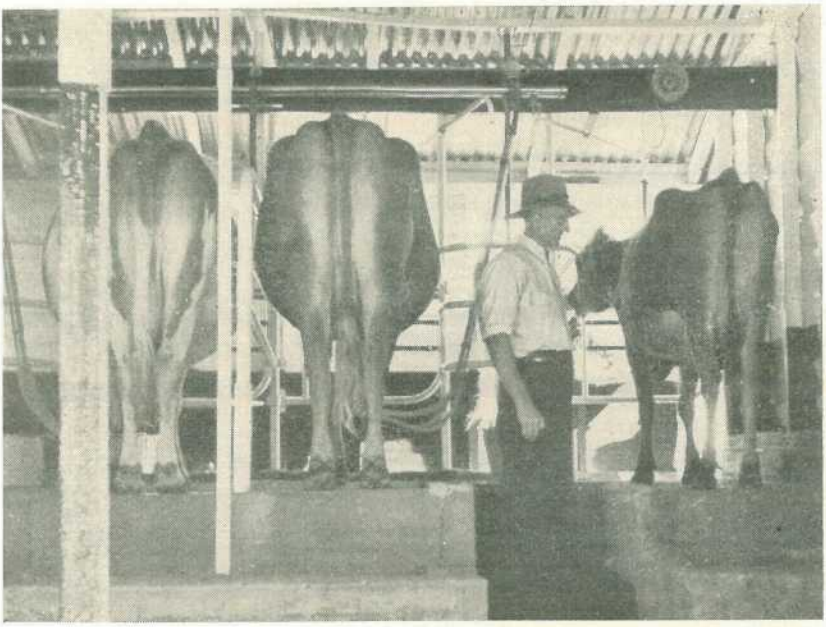


Plate 132.

View of Cows Being Milked in Elevated Bails.

dwarf walls could be advantageously increased up to a height of 3 feet on both ends of the milking bails—that is, between the engine room and first bail and the bail farthest from the separator room. Bolts set in the concrete when it is being laid allow all bottom plates to be firmly bolted to the concrete foundations. All drainage is effectively graded from the separator room end to the farthest bail. A heavy metal wash-up trough, a steam sterilizer and an hygienic metal draining rack are provided in the separator room section. A 3 feet 6 inch wide concrete race is provided in front of the bails. The cows pass into this race on leaving the bails and are thus taken to the end of the shed and away from the separator room. The roof of the shed is extended to cover the exit

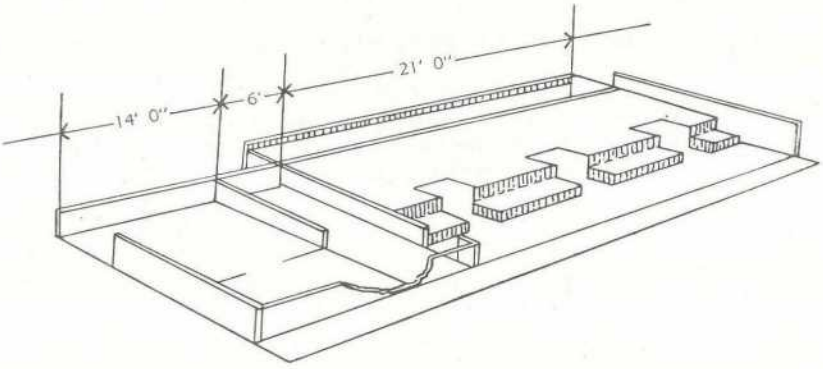


Plate 133.

Foundation Sketch of Dairy Shed with Three-unit Elevated Bails.

race, which is also walled in for protection from the weather. This exit race, together with the concrete entrance to the bails, practically eliminates the dust and mud menace. An added feature of Mr. Schabe's layout is a concrete foot-bath about 10 feet long and 3 feet wide which extends from the main cowyard to the small concrete holding yard. This foot-bath has proved a boon during the wet season, as practically no mud is carried into the bails.

The all-metal bails were designed for the cow's head to be held in a metal yoke during milking, but this tended to slow up milking operations and was eliminated. Metal dummy bails were not provided by the firm supplying the metal bails and had to be made on the job. One metal gate was provided in the centre of each bail unit and leading to the exit race, but this idea was also discarded in favour of a metal gate in front of each cow, allowing her to walk straight into the race. All metal gates open the one way, turning the cows down the race. The elevated bail does not lend itself to one gate in the centre of the unit, as cows are likely to slip down into the milker's alley. The metal "dummy" bails tend to keep the cow straight on the platform. Another advantage of the metal dummy is that it provides a convenient place on which to hang the teat-cup assembly, when necessary, between milking cows. However, these dummies should not be right back to the edge of the milker's alley, but sufficient space should be left to place a milking machine test bucket on the platform for the carrying out of herd recording.

A small dwarf wall an inch or two high is placed around the U of the milker's alley to prevent any water or urine running into this section. In the milker's alley a small recess six inches deep and six inches high is let into the wall of the cow platform at floor level to make room for the operator's feet and thus allow him to stand close to the cow. The small dwarf wall can be seen in Plate 132.

Mr. Schabe's elevated bail is only 20 inches high, whereas the American bail is 30 inches above the floor of the milker's alley. The height of 20 inches is suitable under Mr. Schabe's conditions, as he is small in stature and he finds it a suitable working height with his Guernsey herd. A tall person would require the elevated bail about six inches higher.

No difficulty is experienced in getting the cows to walk up the two 10-inch high concrete steps on to the ramp. So as to allay any fears in this regard it might be as well to mention that the first step was originally only 15 inches wide and the cows very often did not bother to step on this step but stepped up the 20 inches in one stride. To prevent this the first step has been widened to 30 inches so that the cows must take two steps to reach the platform.

Heifers take to the new idea equally as well as the older cows. Mr. Schabe usually puts his heifers through the bails for a week or so before they calve to accustom them to the surroundings, but on one occasion five heifers came into production without having been through the bails before and no trouble was experienced in breaking them into the elevated bail. Four of them walked straight up into the bail, while one had to be coaxed for a couple of milkings. It might be as well to mention that Mr. Schabe's Guernsey cows are all quiet and are treated with kindness so as to get the best out of them. His opinion of the elevated bail is that it makes quiet cows quieter.

It might also be thought that the milker is at a great disadvantage as far as manure splash is concerned, but this is not a problem in Mr. Schabe's case as his cows very seldom do any droppings in the bails and if they do it is caught on a shovel and put into the wheelbarrow, while any urine is caught in a tin. There was a lush growth of grass in the summer of 1950 which had a very laxative effect on the cows, but manure splash caused no discomfort.

With the cows so elevated it might be thought that the milk line and milk vat would be very high up in the air, but this is another thing which has worked out satisfactorily. The milk line in the bail farthest from the separator room is 5 feet 6 inches from the platform floor, and the stand on which the milk vat is placed is only 4 feet from the floor of the separator room. The releaser is higher than usual and a concrete step on which to stand when dismantling the releaser has been built into the separator room floor.

The metal division between each unit is 4 feet high above the floor. No metal rail has been found necessary on the outside of the cow above the edge of the milker's alley to prevent her from falling into the alley or well.

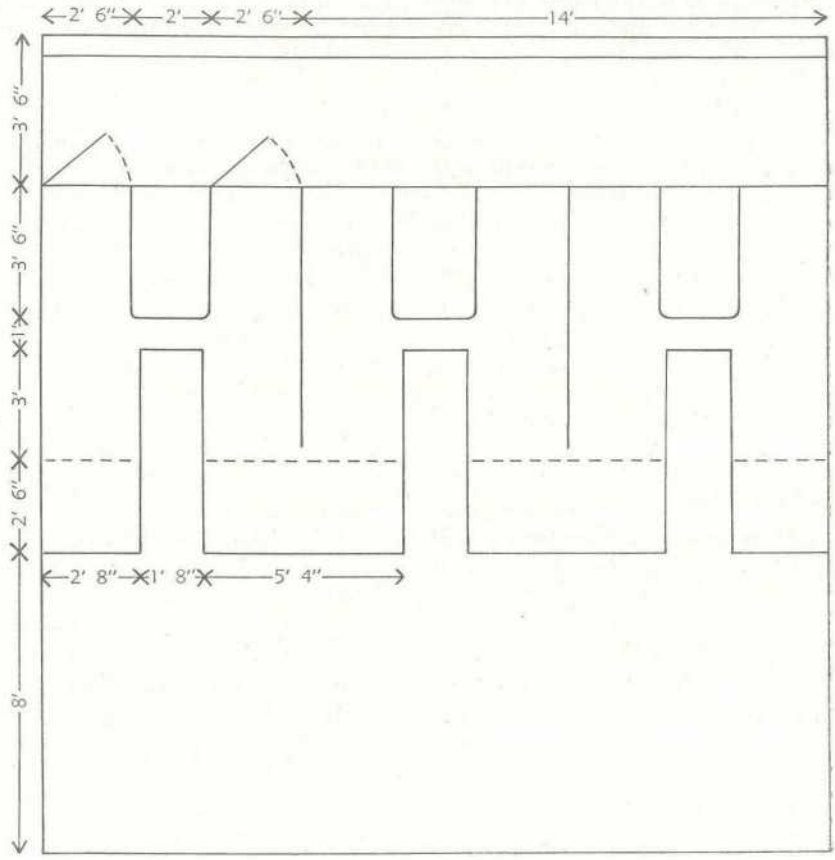


Plate 134.

Sketch of General Layout of 21 ft. x 18 ft. Milking Shed With Three-unit Elevated Bails.

In the erection of any milking shed an item that usually concerns the farmer most is the matter of expense. The only higher cost in the erection of the elevated bail is for extra cement. Mr. Schabe estimates that it took one ton more cement than the ordinary type of milking shed. Extra sand and rock were used to fill in the elevated portion of the bails and this was covered with a cement floor from three to four inches thick.

The general layout of the 21 feet by 18 feet milking shed and 3 feet 6 inch race is depicted in Plate 134.

After 12 months' trial Mr. Schabe has no desire to go back to the conventional type of milking shed. After a hard day in the field he finds the milking of his 45 to 50 cows an easy operation and he is as fresh at the finish of milking as he was at the start.

It is rather difficult to convey a complete picture of the elevated bail and give all its dimensions in an article. In order that it may be more clearly understood the dimensions are shown in Plate 135.

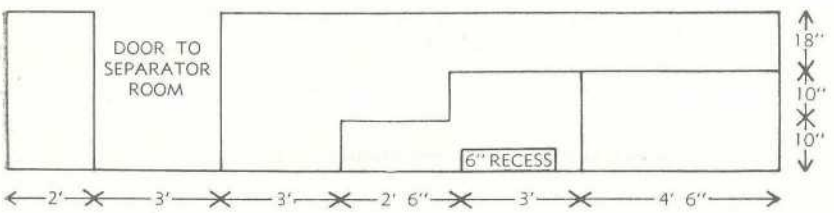


Plate 135.

Section Through First Bail, Showing Dimensions of Platform.

After having worked in his present milking shed for 12 months Mr. Schabe offers the following suggestions for improvements. Instead of having the engine room-separator room-refrigerator room section 18 feet wide as at present, he would extend it to bring it in line with the race in front of the bails. This extra space would allow the refrigerator to be moved back a couple of feet, and still be about 2 feet from the wall, thus allowing better circulation of air around the refrigerator and ease in sweeping and cleaning.

The extra width would allow more room around the wash-up section and this area could be better arranged.

Extra width in the separator room would be an advantage and make more room for the compressor of the refrigerator when housed in this section.

In the engine room (or air space) extra space would prove convenient for dairymen with home lighting plants where a generator and batteries are stored in this section. An auxiliary engine could also be included in the case of a breakdown.

The first step up to the platform is a little too wide and could conveniently be reduced from 2 feet 6 inches to 2 feet.

Herd Improvement Through Herd Recording.

S. E. PEGG, Division of Dairying.

IN general, in the first few years of production recording the main use made of the information received by the farmer is limited to attempting to improve production by the culling of low-producing cows and the rearing of calves from the higher producers, but experience in other countries has shown that the increased production gained by this means is very limited and the only manner in which any substantial increase can be achieved is by the selection of suitable herd sires.

One of the laws of breeding is that "the sire and dam play an equal part in the determination of the offspring." It is thus apparent that as the sire has a 50 per cent. representation in each of the offspring, he is the main factor in determining the productive ability of the future herd. For this reason it is necessary to give considerable thought to the buying of a bull for use in the herd.

What are the desirable characteristics in the daughters of a bull? Briefly, these are:—

(1) A high level of milk and butterfat production.

(2) Resistance to disease (good constitution).

(3) Fertility (ability to calve regularly each year).

(4) A long working life.

(5) A good milking temperament.

In order to obtain these qualities it is necessary, when purchasing a bull, to go to those purebred herds where they are most likely to be found in the stock. The level of milk and butterfat production may be readily ascertained by an examination of the factory returns and the testing records of the herd.

Resistance to disease is very important, and investigations carried out by the New Zealand Dairy Board's staff show that susceptibility and resistance to mastitis are definitely influenced by breeding, in the same manner that breeding influences the level of milk and butterfat production.

In connection with fertility, scientific investigations substantiate the claim that breeding plays a part.

A long working life is an essential, as most cows reach their maximum production at the age of five or six years, and will continue to produce a slightly declining yield each year from then on. It will be readily appreciated that it is unprofitable to rear an animal only to find that it becomes unproductive after two or three calves. As breeding affects the first three of the abovementioned qualities, it is obvious that it must also affect the length of the working life of an animal. The best evidence of a long working life is provided by test records of individual cows year after year. *Therefore, if possible, select a sire from animals which have continuous test records.*

A good milking temperament is becoming increasingly important in efficient utilisation of labour on dairy farms. Professor Petersen of U.S.A. emphasises that he obtained a very good correlation between daughters and dams in milking times.

Where is one most likely to find strains of dairy cattle likely to transmit these qualities?

If the breeder can demonstrate success in his own herd in breeding good lifetime qualities, then that herd is certainly a source of bulls likely to transmit those qualities in commercial herds.

If a bull is bought from a cow on appearance, but without any production records, then all one has is the inherent value of type, which is problematical. If she has a single high record of production, then nothing is known of her ability to stand up to sustained production.

If she has a good lifetime record, then at least a check can be made on one side of the pedigree for one generation of the qualities required. But even this is not good enough, as good breeding lines for commercial qualities are not built up in one generation.

If one can get progeny tests for the male ancestors and several generations of lifetime records for the female ancestors, the gamble on the bull transmitting suitable commercial dairy qualities is greatly reduced.

Breeders can assist in providing the abovementioned information by—

(*a*) testing every cow every year so that lifetime records of cows can be compiled and the qualities of the sire assessed;

(*b*) making available to the purchaser factory returns and testing records for the herd when discussing the sale of bulls;

(*c*) indicating the feeding policy in the herd, as it is essential to know under what conditions the records are produced.

Milking Machines—A Correction.

In some copies of the September issue of the Journal, Plate 99 was printed upside down. The longer of the teat-cup assemblies illustrated is the Ridd.

Tuberculin Testing of Dairy Herds.

Figures for tuberculin testing of milk supply herds by the Department of Agriculture and Stock show that during 1950-51, over 86,000 tests were made in 1,378 herds. The number of cattle which reacted to the test was 1,129, giving an average percentage of 1.31 reactors. Darling Downs and Beaudesert herds had very few reactors, their average being less than 3 in 1,000. Areas with less than 10 in 1,000 included Southport, North Brisbane and Petrie, Dayboro-Mt. Mee, Ipswich, Rockhampton and Kingaroy.

The figures indicate that continuous testing of herds for tuberculosis, with elimination of reactors, can reduce the incidence of the disease to a very low figure.

Dairy Building Competition Results.

THE 1951 Dairy Building and Equipment Competition conducted by the Department of Agriculture and Stock has been completed and the results have been announced by the Minister for Agriculture and Stock (Hon. H. H. Collins), who said that 76 entries were judged in the eight zones.

The judges reported that entries generally were of a high standard and some were of exceptional merit. Descriptions and photographs of the winning sheds will be used by the Department's Division of Dairying to stimulate interest in modern buildings and equipment throughout the dairying districts.

Mr. Collins said that farmers co-operating with the Department under the Commonwealth Dairy Efficiency Grant were ineligible for the competition, but their milking sheds are open for inspection by interested dairy farmers when field days are held from time to time on the farms concerend.

The prizewinners, who will share prize money of £387 from the Commonwealth Dairy Industry Efficiency Grant, are as follows:—

Zone 1.

1st Mr. A. McDougall, Veresdale.
2nd Mr. and Mrs. T. and E. Vayro, Flagstone Creek.
3rd Mr. E. Raabe, Forest Hill.

Zone 2.

1st Mrs. Julia Robinson, High street, Southport.
2nd Mr. C. W. Pope, Samford; and Mr. A. W. Houghton, Samford (equal).
3rd Messrs. Webb Bros., Woodford; and Misses Hannah and Daisy Storey, Logan Village (equal).

Zone 3.

1st Mr. L. C. Iseppi, Bowenville.
2nd Mr. I. B. Skerman, Kaimkillenbun.
3rd Mr. G. H. Lawrence, Taylor Road Mail Service.

Zone 4.

1st Messrs. Allen and Sons, Chatsworth.
2nd Mr. F. J. Fleiter, Conondale.
3rd Estate A. A. Alcorn, Witta road, Maleny.

Zone 5.

1st Messrs. Stollznow Bros., Bundaberg.
2nd Mrs. E. Powell, Box 37, Gin Gin.
3rd Mr. C. G. Luthje, Monto.
Special Mr. R. R. Jarvis, Mundubbera.

Zone 6.

1st Mr. N. D. Hill, Nagoorin.
2nd Messrs. W. Menkens and Son, Box 76, Home Hill.
3rd Mr. R. M. Bell, Dalrymple Heights.

Zone 7.

Only award Mr. T. B. Wright, Goomburra.

Zone 8.

1st Mr. J. F. Evans, Mongallon, via Malanda.
2nd Mr. R. S. Griffiths, Moregatta, via Millaa Millaa.
3rd Mr. D. E. Beattie, Malanda.

The Liver Fluke and Black Disease of Sheep.

S. J. MILLER, Husbandry Officer, Sheep and Wool Branch.

LIVER fluke infestation of sheep is not commonly found in Queensland, though a number of cases were reported from areas adjacent to the southern Darling Downs during the wet period of 1950. Where it occurs commonly, liver fluke may be of considerable economic importance, because, in addition to causing ill health and actually killing sheep on its own account, it renders affected animals susceptible to a serious disease known as black disease. This name comes from the black appearance of the under surface of the skin resulting from the filling of the blood vessels with dark blood.

LIFE CYCLE OF THE FLUKE.

It is necessary for the sheep owner to know something of the various stages in the complicated life history of the fluke in order to appreciate fully the measures that are necessary for its control.

The liver fluke is a flat worm, shaped somewhat like a leaf and about an inch long. Each fluke contains both male and female reproductive organs and is admirably adapted for the production of enormous numbers of eggs, each worm laying up to about 45,000. These eggs pass down the bile ducts of the infected animal into the bowel and thence to the exterior in the droppings. Under suitable moist conditions, such as in a slow flowing stream or in wet ground, the eggs hatch in a fortnight or longer to a minute embryo which is the intermediate stage between the egg and the adult fluke.

This intermediate stage must find a special fresh-water snail in which to develop further. It dies if unable to locate the particular snail within a day or so. Once established in the snail, various changes take place and within a few months very young flukes which are capable of infecting sheep emerge and attach themselves to blades of grass or water weeds. Here each young fluke encloses itself in a protective casing, and is said to be encysted.

After it has been swallowed by a sheep drinking or eating in an infested area, the young fluke penetrates the wall of the bowel and eventually bores its way into the liver. It wanders about in the liver tissue for about 10 weeks, causing a considerable amount of damage, and finally enters the bile tubes, where it grows to maturity.

Under favourable conditions the fluke completes its life cycle from the egg stage to the mature adult in five or six months.

It will be seen that conditions necessary for the propagation of the fluke in any area are:—

(1) The presence of a particular species of snail.

(2) The presence of the eggs of the fluke.

(3) The presence of slow flowing streams, springs, swamps or marshy ground.

(4) The presence of sheep.

DISTRIBUTION.

Liver fluke is most commonly found in sheep raising districts of the Commonwealth that are well watered by springs and creeks and have a heavier effective rainfall than that of the semi-arid districts of Queensland in which the great majority of our sheep are run. In this State, it has been recorded only from the Warwick-Stanthorpe area.

EFFECTS OF FLUKE INFESTATION.

Three different pictures may be seen in areas where fluke is present. These are referred to as acute fluke infestation, chronic fluke infestation and black disease.

Acute Fluke Infestation.

Acute fluke infestation is a condition resulting from liver damage caused by a large number of young wandering flukes. The sheep eat young flukes which have developed from eggs hatched about the spring of the year, and the effects of infestation are consequently seen from midsummer to late summer. Affected sheep are usually found dead without having shown symptoms. The principal post-mortem changes are enlargement and darkening of the liver, which may be covered with greyish shreds of clotted blood, and often the presence of bloodstained fluid in the body cavity.

Chronic Fluke Infestation.

In this form, the sheep begin to pick up young flukes about December and the infestation increases in the late summer and early autumn. Provided the infestation is not massive, the flukes will develop to maturity without the sheep succumbing. However, as it takes over two months for the flukes to mature, it follows that the sheep will not show marked symptoms of chronic fluke infestation until the winter. The main symptoms are anaemia (shown by paleness of membranes), bottlejaw, loss of condition and weakness. Post-mortem examination reveals emaciation, the liver is small and hard, the bile tubes are thickened, standing out like white pipes in the liver and containing adult flukes, and there is often much fluid in the body cavity.

Black Disease.

Black disease is an infectious disease. It is caused by bacteria which live in the soil, from which they reach the sheep's intestine and then the liver. They may stay in the liver for a long period in a harmless resting stage, known as the spore stage. The spores are stimulated into active growth through liver injury by young flukes, and when this happens the bacteria produce a poison which kills the sheep. The disease occurs only when both the bacteria and the fluke are present.

Unlike acute fluke infestation, which requires heavy infestation with young flukes, black disease can occur following even light infestations. Hence, though ordinary control measures may eliminate acute and chronic fluke disease, black disease can still occur as long as odd flukes are present in the sheep.

Sheep usually die quickly without showing symptoms. The post-mortem findings, which are fairly characteristic, include the following:—

(*a*) The blood vessels under the skin are engorged with dark blood, giving the impression of a black under-surface to the skin.

(*b*) The surface of the liver shows sharply defined yellowish-white areas from $\frac{1}{4}$ to $1\frac{1}{2}$ inches in diameter.

(*c*) The heart sac contains straw-coloured fluid which may have formed a clot.

Mature flukes are seldom seen in cases of this disease.

Diagnosis.

The following table may be used to differentiate between the three forms of fluke disease.

Points to Consider.	Acute Fluke Disease.	Chronic Fluke Disease.	Black Disease.
Usual seasonal incidence	Midsummer to late summer	Late autumn and winter	Midsummer to late summer (checked by frost)
Condition of sheep..	Fat	Poor	Fat
Age of sheep ..	Adult	Adult	Adult
Symptoms	Sudden death	1. Weakness .. .. 2. Bottle jaw .. .. 3. Pale membranes .. 4. Pot belly .. .. 5. Loss of condition ..	1. May lag behind when driven 2. Die quickly
Post-mortem findings	1. Liver enlarged .. 2. Liver dark .. .. 3. Body cavity contains blood and stained fluid 4. *No mature flukes* .. 5. No necrotic areas ..	1. *Mature flukes* in bile tubes 2. Bile tubes like thick white pipes 3. Liver small and hard	1. No mature flukes 2. *Necrotic areas* on surface of liver 3. Fluid in heart sac

Although these diseases usually have the seasonal occurrence mentioned, it should be remembered that the young flukes encysted on the grass may remain alive for many months, especially in wet, swampy places. If sheep do not graze in these places until forced to do so by dry conditions, the flukes may not be picked up until some months after reaching the encysted stage. Acute fluke infestation and black disease in these circumstances may be seen even in late winter instead of summer.

CONTROL.

From what has been said of the life history of the fluke, it will be seen that the easiest ways in which the life history may be interrupted are by getting rid of adult flukes and by eliminating the snails concerned. Treatment of sheep and the adoption of measures for snail destruction will usually bring both acute and chronic fluke infestation under control, but it may not be possible to eliminate snails from a property, in which case the incidence of fluke may remain high enough to start an outbreak of black disease.

Treatment for Fluke Infestation.

Chronic fluke infestation can be controlled by drenching the sheep with carbon tetrachloride.

In badly infested areas, drenching should be carried out at the end of April, in the middle of June and at the end of July. In moderately infested areas, drenching in the middle of May and at the end of July should suffice, while in slightly infested areas a single drenching in the middle of June should prove adequate.

A dosage of 1 c.c. of carbon tetrachloride in 4 c.c. of liquid paraffin is effective against adult flukes in the bile tubes. This dose will overcome chronic fluke infestation but not acute infestations where young flukes are wandering in the liver tissue. If the dose of carbon tetrachloride is increased to 4 or 5 c.c. (that is, 10-12·5 c.c. of "double strength" or 20-25 c.c. of "single strength" drenches) the young fluke will be killed. However, there is some risk attached to giving large doses of carbon tetrachloride and they should not be used until the necessity for them has been definitely established by a veterinarian or field officer of the Division of Animal Industry.

Decreasing the Snail Population.

As was mentioned earlier, a special fluke-carrying snail is necessary for the completion of the life cycle of the liver fluke. The snail concerned is a quarter of an inch long and about one-sixth of an inch in diameter. It has a brownish, horn-coloured shell, and if placed on the hand with its opening down and the point facing towards the person holding it, the direction of the spiral is seen to be clockwise.

Snail destruction may be brought about either by draining swampy areas to eliminate breeding grounds, or by distributing bluestone. The method of approach will vary with the property, but three measures that can be taken are:—

(*a*) Broadcast bluestone powder at the rate of 20 lb. per acre, mixing with fine sand to facilitate even distribution.

(*b*) Spray a solution of bluestone (1 lb. in 5 gallons of water) around swamps, gullies, &c.

(*c*) Treat larger pools by dragging a bag of bluestone through them.

The time at which to use bluestone depends to a large extent on the life cycle of the snail and will vary slightly according to seasonal conditions. Used in September, it will kill the snails before the young flukes emerge; snails missed at this time may be killed by bluestone in January or February, before they start to breed. If the swampy areas are very large at these times because of heavy rains, it is advisable to wait until the areas have dried out somewhat before using bluestone.

Treatment of Black Disease.

The liver fluke control methods given above should be supplemented by vaccination against black disease. A vaccine is available which, injected in spring or early summer, enables the sheep to develop immunity before the disease is likely to make its appearance. Though the liver may still be damaged by young wandering flukes, and the bacteria which cause black disease may be present, the vaccination renders the sheep immune to the effects of the poison liberated by the black disease bacteria. Sheep vaccinated in two successive years are usually resistant to black disease for the rest of their lives.

SUMMARY OF CONTROL MEASURES.

Month.	Disease.	Control Measures.
January	Acute fluke and black disease	Use bluestone
February	ditto ..	..
March	ditto ..	..
April	ditto ..	..
May	ditto ..	..
June	Chronic fluke ..	Drench with carbon tetrachloride once, twice or three times as required
July	ditto ..	
August	ditto ..	
September	ditto ..	Vaccinate against black disease. Use bluestone
October	ditto ..	..
November	ditto ..	..
December	ditto ..	..

INFERTILITY IN DAIRY CATTLE.

As the first step in a co-ordinated plan aimed at solving the problem of infertility in dairy cattle, the States are to be asked to explore means of carrying out a survey of their dairy herds to determine the nature of the infertility being experienced.

This decision, the Minister for Agriculture and Stock (Honourable H. H. Collins) said recently, had been made at the initial meeting in Sydney of the technical committee appointed to investigate the problem. The Australian Agricultural Council, comprising Federal and State Ministers of Agriculture, at its meeting in Brisbane earlier this year, had agreed that the committee, comprised of representatives of each of the State Departments of Agriculture and the Commonwealth Scientific and Industrial Research Organization, should be appointed.

Mr. Collins said that the Queensland representative on the committee, Mr. A. L. Clay (Assistant Director of the Division of Animal Industry), had reported that the representatives of the various States had agreed that, while it was not possible at present to form a reliable estimate of the economic loss to the dairying industry through infertility, it was certain the loss was very considerable.

The committee felt that there was not enough factual information on the problem available at present to embark on any large-scale programme of research. Therefore, the first essential in a planned attack was a survey of the herds. It was realised, in this respect, that records now kept by dairy farmers were in most cases not as complete as desired, but this difficulty could be overcome initially by confining the survey to selected farms. It would be necessary to encourage more farmers to keep breeding records to ensure the ultimate success of the survey.

The Minister added that the committee felt its appointment represented the first stage of a positive approach to the problem, and members were hopeful that a solution would ultimately be provided.

School for Sheep and Wool Extension Officers.

(Brisbane, September 10-14, 1951.)

[*Opening Address by Mr. A. F. Bell, Chairman of the Queensland State Committee of C.S.I.R.O. and Under Secretary, Queensland Department of Agriculture and Stock.*]

THE holding of this school is a very important advance in the integration of science and practice.

The Executive and the Advisory Council of C.S.I.R.O. have, in the post-war years, given a great deal of thought to devising means for the more rapid translation of research findings into practice and last year it became possible to establish an Agricultural Research Liaison Section. This new section has been placed under the capable control of Mr. R. R. Pennefather who has had some years of very successful experience in the leading of a field extension unit in the Murrumbidgee Irrigation Areas.

The present school is the first of the Research-Extension Schools which will be instituted for the purpose of transmitting and discussing research findings in the various divisions of Agricultural Science. We in Queensland are very gratified that our invitation to hold the first school here was so readily accepted by C.S.I.R.O.

The cost of the school is being borne by the Wool Fund, and I am sure that the members of the wool industry will be pleased at the representative group attending. Twenty-eight interstate representatives of the Commonwealth and all mainland States are present, together with sixteen members of the Sheep and Wool staff in Queensland.

The large Queensland representation is due to the fact that the Director of Sheep Husbandry (Mr. G. R. Moule) has been conducting one of the periodic schools for his field staff and arrangements have been made for them to attend this school also.

Naturally it is not possible to cover the whole field of sheep and wool research in one school and future schools will take up other avenues. On this occasion emphasis will be placed on sheep numbers, breeding problems, and the methods and findings of the research workers which may be adopted by sheep breeders. In a country in which the flocks are periodically decimated by the effects of drought the rate at which the flocks may be built up again is quite as important as the improvement of the breed. Sessions will also be devoted to nutrition and drought feeding.

Lectures will be given by five research workers from the C.S.I.R.O., assisted by one from each of the Departments of Agriculture in New South Wales and Queensland, and the New South Wales University of Technology. Each lecture will be followed by a full discussion of the subject. The various State representatives attending the school are not only invited to enter into these discussions, they are expected to do so. Research and extension must be regarded as complementary and the best results will be obtainable only through close team work.

In the final analysis the research worker and the extension worker are paid from the same purse and mutual encouragement, understanding, and criticism will alone give good team work. If the extension worker feels that a particular piece of research is inadequate, or that

the findings are unlikely to be applicable under his particular conditions, then it is his duty to say so. Research workers, on the other hand, can greatly benefit by the contacts with the men who have their fingers so closely upon the pulse of the industry. This type of school affords an excellent opportunity to develop those close contacts.

So far I have referred only to the type of research which is known as "applied research" but we should never lose sight of the necessity for the conduct of a large proportion of "pure research" by organisations such as C.S.I.R.O.

To draw an analogy: The merchant marine has performed a very complex and most beneficial service to mankind but it must necessarily work along routes already charted. But if there had been no altruistic souls to support the idea of ships setting out on voyages of discovery, without hope of immediate practical gain, then the great discoveries of the Americas, Australia, and all the New World would never have been made.

If we are to advance the frontiers of our knowledge, and to provide the framework for the carrying out of applied research, then we must make provision for pure research on a generous scale. In this age, when the results of applied research are so apparent, people are prone to overlook the fact that the basis was laid by past workers in the field of pure research.

C.S.I.R.O. is charged with the responsibility of carrying out both these types of research and I hope it will always receive the necessary funds and encouragement to maintain an adequate proportion of pure reserach.

Finally, may I say that this school is valuable as indicating the complementary fields of responsibility of C.S.I.R.O. and the State Departments of Agriculture. Anyone with experience of successful extension activities knows that it is essential to speak to the producer with one voice; anything otherwise leads to confusion. At the same time an organisation such as C.S.I.R.O. is bettter equipped to conduct fundamental and long term researches than are the States. Both, however, necessarily carry out applied research and this is the common ground on which they meet. The conduct of schools such as this will ensure the ready interchange of ideas and knowledge.

The Vegetation of South-Eastern Queensland.*

D. A. HERBERT, D.Sc., Professor of Botany, University of Queensland.

THE pattern of the vegetation of Queensland is complex and slowly changing. There are three distinct elements in the flora—the Malaysian, represented in part by the rain forests, the sub-Antarctic, represented by the beech forests, and the Australian, represented by the eucalyptus forests and the drier communities of the interior. This does not imply that the two former elements are recent invasions or any less entitled to consideration as Australian vegetation than the eucalypts. They were well established here in the early Tertiary period as the types of vegetation that were suited to special climates, not only in the continent which at present has the familiar australioid shape, but in other land masses with which exchange of populations was geographically possible. From this point of view the rain forests are the Australian aspect of a great flora characteristic of tropical and sub-tropical high rainfall areas from south-eastern Asia to Polynesia. The beech forests are representative of the sub-Antarctic areas which extend from New Guinea to South America. The eucalyptus forests remain as characteristically Australian because, except for some areas in New Guinea, Timor and other islands to the north, there has not been the climatic scope for their extension, or if there has, it no longer exists.

Climatic changes from the early Tertiary onwards have redistributed the vegetation, enforcing large-scale retreats and favouring extensions of territory of types adapted to drier conditions. Beech forests, originally of much wider extent, now occupy a very limited area near the southern border of the State. The alpine vegetation has gone, as there are no suitable habitats in the Queensland area of the present, although the occurrence of southern Australian high moor types in New Guinea, and of Dracophyllum on Bellenden Ker in North Queensland, suggests its former occurrence. Rain forests occupy high rainfall strips along the coast, but dry scrubs further inland suggest stragglers in the retreat. The distribution of Eucalypts, characteristically best developed as a marginal strip and losing their dominance with increasing aridity towards the interior, indicates the catastrophe that overtook a former flora of very different distribution.

Changes in the vegetation pattern are still going on in Queensland. There are oscillations between the inland blue grass and Mitchell grass communities, and between Mitchell grass and saltbush. In some cases, and these are very obvious, the change appears to be unidirectional. Rain forests are encroaching on eucalyptus forests, tidal flats are colonized by mangroves, and mangroves may give way through various stages to land forests. Grassland and eucalyptus forest alike may be overwhelmed by brigalow (*Acacia harpophylla*), and brigalow may be succeeded by a dry type of rain forest. Some curious mixtures, inevitable where entirely different communities, usually mutually exclusive, are changing their boundaries, may sometimes be seen, as for example on Widgee Mountain in the McPherson Range, where rain forest epiphytes are growing on *Xanthorrhoea arborea*, the grass tree, in an area where the beech forest is encroaching on the territory of the Eucalypts.

* Reprinted from "Handbook of Queensland," prepared for the 1951 Meeting of the Australian and New Zealand Association for the Advancement of Science.

Important though climate is in the distribution of vegetation types, from the cool mountainous habitats of southern Queensland to the tropical lowlands, and from the comparatively well watered coast to the desert of the western border, the pattern is greatly modified by soil types. In the subsequent generalized account of the plant communities of the south-eastern corner of the State, some outstanding examples will be mentioned. The communities will be grouped under the headings of Rain Forest, Mangroves, Strand Vegetation and Eucalyptus Forests, with some notes on freshwater swamps. The inland communities—grassland, saltbush, forests, scrubs and deserts—are beyond the scope of this paper.

Rain Forest.

Rain forest, the most luxuriant development of Queensland vegetation, reaches its peak where good soil and a heavy rainfall of about 60 inches or more per annum, well distributed throughout the year, give the right conditions for its exuberant growth. Such areas are discontinuous along the coast and adjacent highlands. They are most extensive from the Daintree River to the Tully River and west to the Atherton Tableland, from Mackay to Proserpine and west to the Eungella Range, in the district to the east of Gympie and south through the Blackall Range, and on the McPherson Range on the southern border of the State. In New South Wales it extends from the McPherson Range to the Richmond River, and recurs further south, notably in the Dorrigo area. These are all regions of high rainfall, but elsewhere there are rain forests of varying extent, occurrence tending to be determined by local favourable conditions of water supply, soil or shelter. Around Brisbane, for example, they occur along streams, in sheltered valleys, on southern slopes where insolation is reduced, and on rich retentive soils such as those derived from basalt. Examples may be seen along the road from Ashgrove to Mount Glorious. The influence of soil is often very marked. In the McPherson Range and on Tamborine Mountain the rain forest characteristic of the basalts and andesites often stops sharp at the rhyolite and trachyte, or perhaps continues as an attenuated "bastard scrub," a mixture of rain forest and open forest trees. Adequate water supply along stream courses may create favourable conditions for rain forest where the surrounding country supports only eucalyptus forests, but in such cases the development of epiphytes characteristic of forests of the high rainfall areas is comparatively scanty. Although it is customary to refer to the rain forests of Queensland and Northern New South Wales as tropical, this must not be taken to imply that the temperature conditions are those of the tropical lowlands. In the tropics there are pronounced differences between the plant associations of lowland and montane rain forests though in general appearance they have much in common. The rain forests of tropical lowlands, tropical mountains, and of extra-tropical Queensland, because of the general similarity in type and the possession of a great deal of floristic detail in common, may be grouped together as a Malaysian type because the affinities are predominantly with those of Malaysia.

Rain forests in their best development are dense forests of trees mostly from 90 to 120 feet high, standing close together with their roots interlaced and their tops forming a continuous canopy so that there is a twilight gloom at midday stabbed by occasional shafts of sunlight. The low light intensity, often less than one two-hundredth of that in a

clearing, is responsible for the comparative dearth of small plants, but where there is a little extra light filtering through a gap in the canopy, thickets of seedlings—wild raspberries, nettles, lawyer vines (*Calamus*), and a host of tree seedlings—form dense tangles. When finally one fills the gap, the others, starved for light, either die or hang on to a life of light-poverty. A characteristic of rain forest trees is a suppression period in the early years; they may persist under heavy shade for many years, little more than a few inches in height, and shoot up when an opportunity finally presents itself. Eucalypts, intolerant of shade, cannot enter the rain forest, though on its margin they may attain a great size. Rain forest, on the other hand, may invade Eucalyptus forest provided moisture conditions are suitable.

The deep shade of rain forests causes death and self pruning of the lower branches of the trees and the trunks are characteristically straight and clean. The difficulty of distinguishing the foliage makes it necessary to recognize species by other characters such as bark texture, colour, scent, fluting and buttressing. Buttressing is particularly striking; many species flare out at the base into broad plank-like triangles between the horizontal roots and the trunk. In the carrabin (*Sloanea woollsii*) the buttresses may be twelve feet or more high and convex on the outer edge. In the booyong (*Tarrietia argyrodendron*) they are smaller and concave. The lignum vitae (*Vitex lignum-vitae*) has an angular fluted trunk. Conspicuous in the rain forests are the strangling figs or banyans, such as the green-leaved Moreton Bay fig (*Ficus watkinsiana*). The seed germinates on the branches of other trees, forming a seedling with a lignotuber. A long root drops down to the ground; others follow and anastomose to form a root-cage round the host trunk, finally strangling it and leaving the canopy of fig branches perched high on a convoluted trunk of fused roots. *Quintinia sieberi,* the possum wood, germinates on tree ferns and behaves in a similar way.

Woody lianas are another feature. *Calamus muelleri,* the lawyer vine, is a climbing vine notorious because of its barbed whips. Some of the woody lianas, notably species of *Vitis,* are known as water vines because when cut into billets they yield considerable quantities of water. *Pothos loureiri,* a soft-stemmed araceous climber that often clothes the tree trunks with dense masses of foliage, is easily recognised by the fact that the winged petiole is larger than the lamina. Epiphytes vary considerably in their occurrence. Some trees support heavy aerial gardens of ferns, orchids, mosses and lichens, while others are comparatively free. From the point of view of size the species of *Platycerium* (elkhorns and staghorns), the bird's nest fern (*Asplenium nidus*) and the king orchid (*Dendrobium speciosum*) are of special interest. The peat-tanks of the Platyceriums are a root-hold for numerous small plants and even tree seedlings with feeble epiphytic powers.

The fern flora of the rain forest is very rich. Hymenophyllaceae (filmy ferns) are characteristic of the dampest parts. Epiphytic species of *Polypodium, Asplenium,* and other genera clothe tree trunks. The prickly tree-fern (*Alsophila leichhardtiana*) is common. A maiden hair fern (*Adiantum formosum*) with fronds up to four feet in height forms dense masses in more open situations. Marestails (*Asplenium adiantoides*) hang from the bird's nest ferns and elkhorns, along with the haresfoot (*Davallia pyxidata*) or very occasional ribbon fern (*Ophioglossum pendulum*).

Rain forests have a wealth of tree species. The best guide is "Australian Rain Forest Trees," by W. D. Francis. Important genera are *Agathis* (kauri pine), *Araucaria* (*A. cunninghamii*, the hoop pine), *Castanospermum*, *Cedrela* (*C. toona* var. *australis*, red cedar), *Cinnamomum*, *Cryptocarya*, *Dysoxylum*, *Elaeocarpus*, *Endiandra*, *Eugenia*, *Ficus*, *Flindersia*, *Grevillea*, *Litsea*, *Sloanea*, *Tarrietia*, and *Weinmannia*. These, however, are only a few of the genera, and familiarity comes only with long experience. There is one genus, however, that the visitor should learn to recognize on first sight. It is *Laportea*. *Laportea gigas*, the stinging tree, ultimately attains a height of 120 feet, with a soft wooded, fluted and buttressed trunk. It has large heart-shaped leaves up to a foot long and nine inches wide, covered with stinging hairs. *L. moroides*, a shrub, has similar leaves and is probably even more irritating. The shining leaved stinging tree, *L. photiniphylla*, has glossy leaves rather like those of a white mulberry and is less easily recognised. Herbaceous nettles (*Urtica* species) are also common, but their sting, though annoying, is not as violent as that of *Laportea*.

In the McPherson Range, mostly at elevations over 3,000 feet, and where the moist south-easterly winds bring mists and heavy rain to the mountains, the Malaysian rain forest grades into forests of antarctic beech (*Nothofagus moorei*). These trees are for the most part old and gnarled, and heavily invested with moss and lichen. The old trunks tend to decay and to be replaced by coppice growth. *Callicoma serratifolia*, a common rain forest tree, is found with the beeches and in this foggy habitat has the same habit of growth. These forests are the equivalent of the moss forests that replace the montane rain forests of the extra-Australian tropics in the cloud belts, though here they are strongly sub-Antarctic in their general floristic composition.

At the other end of the series from beech and the wet type of rain forest is what is often known as dry scrub, scrub being the unfortunate name usually applied to rain forest in Queensland. In areas with a rainfall down to about 35 inches per annum, the rain forest becomes attenuated. Lianas and epiphytes become increasingly rare and the trees become smaller. Many of the species and genera disappear. Crows ash (*Flindersia australis*), lignum vitae (*Vitex lignum-vitae*), booyong (*Tarrietia argyrodendron*) and silky oak (*Grevillea robusta*) are amongst the survivors, but they are smaller than in the coastal rain forests. There is a tendency for such dry scrubs to succeed brigalow (*Acacia harpophylla*) scrubs, their tree species being able to survive the dense shade of this community. It is a peculiar fact that the dry scrub often grows where eucalyptus forest might be just as successful. It seems that we have here two different types, the eucalyptus forest developing in response to the climatic conditions, and the dry scrub representing the residue of more resistant rain forest types, both being quite well suited to the same environment.

Typically rain forest stops quite sharply and there is a narrow ecotone perhaps only a few yards wide between it and the entirely different open eucalyptus forest. There are considerable areas, however, of so-called bastard scrub—eucalyptus forest that is gradually proceeding to a rain forest climax by infiltration of rain forest types. The stage is ultimately reached where the shade swings the balance in favour of rain forest. This may be observed in the coastal area at the foot of the Blackall Range, where the blackbutt (*E. pilularis*) forest may be seen along the road in various stages of evolution towards rain forest.

Mangroves.

These forests of the sea are found along the coast on muddy, tidal flats and banks, especially where large slow rivers flow into quiet bays. Their roots are submerged at high tide and young plants may be entirely covered. River mangroves extend upstream to the tidal limits, but not into fresh water. The greatest mangrove development is in the tropics, adjacent to areas where rainfall favours rain forest. There the trees range in size according to species, age and position from 6 feet to 70 feet or more in height. The number of species and the size of individual trees are markedly reduced beyond the tropics and along dry tropical coasts, but mangrove forests are still well developed and aggressive in south Queensland. Their members are an ecological and not a taxonomic group; *Rhizophoraceae* predominates in the number of species, but the trees include members of other widely separated families. The peculiar ecological conditions of the habitat include the initial difficulties of establishment where tides rise and fall, a marked fluctuation in salinity of the soil (about 3 per cent. at high tide, rising to 8 per cent. or more at low tide), deficient aeration in the mud, direct and reflected light, and winds.

In Moreton Bay, which may be taken as typical of south Queensland, there are seven tree species of mangrove—*Aegiceras corniculatum*, *Avicennia marina* var. *resinifera*, *Bruguiera gymnorrhiza*, *Ceriops tagal* var. *australis*, *Excœcaria agallocha*, *Lumnitzera racemosa* and *Rhizophora mucronata*. The commonest is *Avicennia*, the white mangrove, which is usually the first colonist of mud banks and may form forests over 40 feet in height. Its shallow horizontal roots are lined with erect pneumatophores which project several inches above the mud. *Avicennia* and *Aegiceras* also grow densely along the tidal reaches of the rivers, where in places *Crinum pedunculatum* and a fern (*Acrostichum speciosum*) occur with them. Both absorb considerable amounts of salt, and *Aegiceras*, which is a shrub up to 15 feet high, secretes it from the leaves, which are characteristically frosted with small crystals. *Bruguiera*, the black mangrove, is usually on the landward side of the mangrove forest, and is not a pioneer; its shallow roots loop out of the mud at intervals, forming "knees." *Ceriops*, without pneumatophores, grows in sandier situations; the trees attain 15 feet in height, but are often only half that stature, and they are buttressed at the base. *Excœcaria* (Euphorbiaceae), the milky mangrove, occurs on the landward side, sometimes on dry land; its latex has the reputation of being poisonous and of causing temporary blindness if splashed in the eyes. *Rhizophora*, the red mangrove, is recognised by the prop roots which curve outwards from the trunks or drop from the branches. *Rhizophora* and *Bruguiera* are used for tanbark by fishermen.

These mangroves, with the exception of *Excœcaria*, are viviparous, i.e., the seed germinates while the fruit is still on the tree. In *Avicennia* and *Aegiceras* the seedling remains in the capsule until after the fruit has fallen. In *Rhizophora*, *Bruguiera* and *Ceriops*, the seedlings burst from the fruit and may be a foot long before they fall; in *Rhizophora* they may occasionally reach 3 feet in length. These developed seedlings are a common feature of drift along the beaches. Their advanced growth considerably reduces the hazards of establishment on newly formed mud banks, the formation and colonization of which often synchronize.

The successional series in Moreton Bay usually starts with *Avicennia*, sometimes with *Rhizophora*. *Aegiceras* and *Ceriops* come later. Along rivers *Aegiceras* appears on the landward side of *Avicennia*. *Ceriops* comes in mainly in more sandy flats. *Bruguiera* is a fairly late arrival and often abuts on the strand forest. *Excœcaria* usually occurs at high tide mark, or even beyond. It is not viviparous, and although found on drier ground, it is still a mangrove as it can cope with the osmotic fluctuations of the mangrove habitat.

Though the immediate utility of mangroves is the holding of banks and the maintenance of watercourses, they have the added function of slowly paving the way for dry land forest. This may take place in two directions. The first is the establishment of strand forest including *Casuarina equisetifolia* var. *incana*, *Hibiscus tiliaceus* and *Thespesia populnea* after the *Excœcaria* or *Bruguiera* stage when the soil is no longer subjected to the tides; and the second is through the development of salt marsh and salt meadow. Salt marsh is on flat country, which tends to dry out and crack in between flood tides and develop a high salinity. Here the Avicennias fail, and their dead stumps are left amongst *Salicornia australis* and other succulents such as *Suaeda*, *Arthrocnemum* and *Sesuvium* taking part in the sere. The tendency is for the salt marsh to give way to salt meadow, which is essentially a sward of the saltwater couch, *Sporobolus virginicus*. There are fringing zones of *Fimbristylis polytrichoides* on the salt marsh side, and on the landward side various other sedges such as *Cyperus polystachyus*. After the salt meadow stage comes *Casuarina glauca*, the swamp oak, ushering in the land forest.

Strand Vegetation.

The common sand binders of the coastal dunes are *Ipomoea pes-caprae*, the goat's foot convolvulus, with purple flowers and runners that reach high tide mark, *Vigna lutea*, a yellow-flowered legume, and *Canavalia obtusifolia*, a purple flowered sword bean. *Acacia longifolia* var. *sophorae*, with prostrate stems up to about 12 feet long, is common in places. Amongst the grasses are *Spinifex hirsutus*, the round inflorescences of which often blow along the beach, *Zoysia pungens* (the coastal couch), *Ischaemum triticeum*, *Lepturus repens*, and *Stenotaphrum subulatum*. Succulent plants include *Mesembryanthemum aequilaterale* (pigsface), *Cakile maritima*, *Scaevola suaveolens*, *Euphorbia atoto* and *Euphorbia eremophila*. Trees of the dunes that occur on the more stable soils include the coastal sheoak, *Casuarina equisetifolia* var. *incana*, and the two screw pines, *Pandanus odoratissimus* and *Pandanus pedunculatus*. The screw pines, locally known as bread fruit, are remarkable for their stout prop roots with large root caps like corky egg cups. *Banksia integrifolia* is found on the more stabilized dunes. Behind them the sand cypress or Bribie cypress (*Callitris columellaris*), often wind-shorn at the top, is common in places.

Elsewhere on the more stabilized parts of the coast the land forest may abut directly on a narrow fringe of strand trees including *Hibiscus tiliaceus* (the cotton tree), *Casuarina equisetifolia* var. *incana*, *Thespesia populnea* and *Pandanus*. Occasionally in this strip may be found *Sophora tomentosa*, a leguminous tree conspicuous for its constricted pods. In heavy rainfall areas, rain forest may start immediately behind the sheoak and cotton tree fringe with or without dwarfing and wind-shearing and with the incidence of epiphytes varying according to the amount of shelter.

Eucalyptus Forests.

The limits of the range of eucalyptus forests are determined by aridity in the west, and by the competition of the dense rain forests in high rainfall areas along the coast. Within this range they may be suppressed by brigalow (*Acacia harpophylla*) or by the type of rain forest usually known as dry scrub, both of which form a canopy with lighting conditions unfavourable to eucalypt establishment. The trends of the eucalyptus forests between the rain forest and the mulga scrub, or from the southern border to the tropical north, are complicated by the influence of soil types which may produce amazing variation in a very small area.

In the vicinity of Brisbane, common species are *E. maculata* (spotted gum), *E. tessellaris* (Moreton Bay ash), *E. micrantha* (scribbly gum), *E. tereticornis* (blue gum), *E. propinqua* (grey gum), *E. hemiphloia* (gum-topped box), *E. resinifera* (red stringybark), *E. acmenioides* and its allies *E. carnea* and *E. umbra* (yellow stringybarks), *E. microcorys* (tallow wood), *E. crebra* (narrow-leaved ironbark), *E. paniculata* (grey ironbark), *E. gummifera* (red bloodwood), and *E. trachyphloia* (white bloodwood). With them occur two allied genera, *Tristania* and *Angophora*. *T. conferta* (Brisbane box) and *T. suaveolens* (swamp mahogany, which also extends up the hillsides) are found in very diverse situations, and are two of the commonest trees of the area. *Angophora lanceolata* (rusty gum, sometimes called red gum) of the hillsides is a rather different tree from that seen further south in New South Wales; on the flats *A. woodsiana* (apple) often mingles with *E. tereticornis*. These two genera are regarded as normal constituents of the coastal Eucalyptus forests, because of their ubiquity and general habit of growth.

Tristania conferta varies from a shrub in such localities as the less exposed dunes on Moreton Island to an average tree of the eucalyptus forests around Brisbane, and finally a forest giant of 150 feet or more on rain forest edges. It grows in the McPherson Range at an altitude of over 2,500 feet, at sea level in tropical North Queensland, and enters into the most diverse associations. In a list of plants from any area, its recording by name only does not suggest the plasticity of habit of this species in harmonizing with its associate trees. Other common trees of the eucalyptus forests are *Casuarina torulosa* (forest oak), *Alphitonia excelsa* (red ash), *Acacia cunninghamii* (Brisbane black wattle), and *A. aulacocarpa* (hickory wattle). Amongst the more sporadic Australian types are *Exocarpus, Lomatia, Hakea, Jacksonia* and *Persoonia*. The orchids *Cymbidium suave* and *C. iridifolium* are fairly common in the hollows of broken branches of eucalypts, their roots often extending for yards in the decayed material of the trunk.

The characteristic trees of the watercourses in eucalyptus forests in south-eastern Queensland include *Eucalyptus tereticornis* (blue gum), *Casuarina cunninghamiana, Eugenia ventenatii* (weeping myrtle or water gum), *Callistemon viminalis* (red bottlebrush), *Melaleuca bracteata* (river tea tree) and *Castanospermum australe* (black bean). Where the streams rise in rain forest country there is a tendency for a considerable number of rain forest tree species to join the more usual assemblage. All gradations from the typical creek trees of the eucalyptus forests to fringing rain forest may occur along the same watercourse.

On the margins of true rain forest, tall eucalypts including *E. resinifera, E. microcorys, E. paniculata,* and *E. grandis* mixed with *Tristania conferta* and *Casuarina torulosa* have a characteristic undergrowth of ferns such as *Davallia dubia* and *Doodia aspera,* wild ginger (*Alpinia caerulea*), yams (*Dioscorea transversa*), *Smilax australis, Duboisia myoporoides, Alyxia ruscifolia, Homalanthus populifolius* and many others. It is in this shaded habitat, the ecotone between the two types of forest, that many rain forest trees find a foothold, so that slowly the rain forest extends its territory. The eucalypts, on the other hand, are unable to penetrate the rain forest because of their intolerance of shade. To the north of Brisbane this tendency for the supplanting of the eucalypts is seen in the blackbutt (*E. pilulifera*) country. The undergrowth paves the way for *Rhodamnia trinervia* (scrub stringybark), *Diploglottis cunninghamii* (native tamarind), *Elaeocarpus cyaneus* (blue quandong), and other trees, and finally a rain forest climax is established. The whole series may be traced along the highway between Caloundra and Nambour.

In the Stanthorpe area, the cold spot of Queensland, which is an extension of the New England tableland, there is a distinct southern representation, including *E. macrorrhyncha, E. andrewsii, E. melliodora, E. obliqua, E. stuartiana,* and *E. rubida.* Most of these fail in the McPherson Range, where the rain forest is occupying comparable altitudes. On the trachytic and rhyolitic soils, however, some such as *E. andrewsii* and *E. oreades* attain giant proportions with no danger of being overwhelmed.

In the Dave's Creek country of the McPherson Range there is a remarkable development of mallee heath under high rainfall conditions. It is within a mile of beech forest. Here partly surrounded by a mixed community of eucalypts and rain forest trees, there is an area of hungry soil derived from a volcanic glass. The dominant Eucalypts are two mallees, *E. condonocarpa* and a form of *E. resinifera,* the latter a large tree on rhyolitic and trachytic soils. With them are dwarf shrubs of the genera *Casuarina, Callitris, Callistemon,* and characteristic heathland Epacrids, Rutaceae and hardy ferns. Over considerable areas of this volcanic glass the collection is reduced by absence of the mallees and larger shrubs to heathland. This mallee heath is a curiosity because of its limited occurrence in an area otherwise dominated by heavy forest.

Along the coast there is another type of country where soil conditions result in a different modification of the eucalyptus forests. This is the wallum. The term is applied in a general way to the sandy coastal belt from the border to the tropic of Capricorn. The wallum (*Banksia aemula*) is the characteristic tree. The area is one of extensive treeless flats, interspersed with peat swamps (occasionally with *Sphagnum*) drained by slow creeks, and rolling sandy ridges. The flats are covered by a heath with species of *Leptospermum* (including *L. scoparium* and the lemon scented *L. liversidgei*), *Boronia, Eriostemon, Epacris, Sprengelia, Conospermum,* etc. The true wallum is a little higher in ground level and continues up the sand ridges. *Banksia aemula* is characteristic, but stunted eucalypts including *E. gummifera, E. micrantha,* and *E. seeana* are common; here, too, occur many of the showy spring wild flowers, including *Aotus villosa, Ricinocarpus pinifolius, Sowerbœa juncea* and *Hibbertia linearis.* Along the streams *Eucalyptus robusta* and *Melaleuca viridiflora* (paper-bark tea tree) are usually common with a close ground cover of *Gleichenia, Halorrhagis,*

Comesperma, and other small plants. Not infrequently the parasitic vines of *Cassytha* make a dense and almost impenetrable tangle; where the area has been fired this plant is much less troublesome. Wallum is essentially a poor-country type of vegetation. There is a marked response to applications of phosphates, zinc and copper, but it is comparatively useless for cultivation. Gradations from wallum to better type soils occur in places. Along the north coast the better class sandy ridge soils with the addition of phosphatic fertilizer are used for the growth of exotic pines, mainly *Pinus caribaea* and *P. taeda*. In the Glasshouse Mountains area, the sandy ridges are capped with a red sandy loam of considerable depth normally carrying a fairly heavy eucalyptus forest. These loams, which are a gradation from the barren sandy soils, are used for pineapple growing. With increasing fertility wallum may grade into blackbutt forest, from which the trend is towards rain forest.

Freshwater Swamps.

Tea tree swamps are of such common occurrence close to the shore in southern Queensland that they deserve special brief outline. They are in their typical form dominated by paper bark tea tree, mostly *Melaleuca viridiflora*, and the swampy floor is carpeted with *Blechnum serrulatum* (bungwall fern). In the deeper water there are *Nymphaea* spp. (the yellow flowered *N. flava* being a naturalized alien from Florida), *Limnanthemum indicum* (fringed water lily) with *Sparganium angustifolium* (burr reed), sedges and Restiaceae towards the margins. The introduced water hyacinth (*Eichhornia crassipes*) may form a dense cover. Bordering the swamps such grasses as *Paspalum distichum* (water couch), *Leersia hexandra* (rice grass) and *Phragmites communis* (common reed) mix with the water peppers (*Polygonum* spp.). These swamps are, of course, developmental communities, and the gradation is from *Melaleuca* through *Tristania suaveolens* (swamp mahogany) and perhaps *Casuarina glauca* to the local climax.

WHALE SOLUBLES IN STOCK FEEDING.

A product of the Australian whaling industry, known as "whale solubles," may prove of use in reducing the amount of protein-rich concentrates of animal origin now required for stock feeding in Australia.

The Minister for Agriculture and Stock (Hon. H. H. Collins) said recently that feeding trials with both pigs and chickens were being conducted at Yeerongpilly Animal Health Station to determine whether whale solubles in conjunction with vegetable proteins such as peanut meal and linseed meal can be effectively and economically used to replace most of the animal protein now being fed in rations for these animals.

Mr. Collins explained that hitherto fairly large proportions of animal proteins had been considered necessary to supply essential food materials, including one of the most recently discovered vitamins. Fish solubles in small quantities are being used overseas to replace much of the animal protein concentrate in stock rations, and the work now in progress is designed to show whether the feeding of whale solubles can be applied here. The use of fish meal in Australia is limited by the amount available. There is no large fishing industry and the amount of by-products at centres of distribution is usually too small and of unsuitable quality.

If the whale product proves suitable and can be produced in sufficient quantity, it will relieve the animal protein shortage which now exists.

Brucellosis Testing of Swine.

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

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

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

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

TESTED HERDS.

(AS AT 19th SEPTEMBER, 1951.)

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

TESTED HERDS—continued.

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

ASTRONOMICAL DATA FOR QUEENSLAND.

NOVEMBER.

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

TIMES OF SUNRISE AND SUNSET.

At Brisbane.			MINUTES LATER THAN BRISBANE AT OTHER PLACES.					
Day.	Rise.	Set.	Place.	Rise.	Set.	Place.	Rise.	Set.
	a.m.	p.m.						
1	4·59	6·05	Cairns	45	12	Longreach	42	28
6	4·55	6·09	Charleville ..	29	25	Quilpie	33	37
11	4·52	6·12	Cloncurry	61	38	Rockhampton ..	17	3
16	4·50	6·16	Cunnamulla ..	28	31	Roma	18	15
21	4·48	6·20	Dirranbandi ..	17	21	Townsville ..	37	12
26	4·47	6·24	Emerald	26	13	Winton	49	31
30	4·46	6·27	Hughenden ..	46	24	Warwick	3	6

TIMES OF MOONRISE AND MOONSET.

At Brisbane.		
Day.	Rise.	Set.
	a.m.	p.m.
1	5·41	8·05
2	6·34	9·14
3	7·34	10·19
4	8·40	11·16
5	9·49	..
		a.m.
6	10·57	12·05
	p.m.	
7	12·02	12·46
8	1·04	1·22
9	2·04	1·55
10	3·03	2·26
11	4·01	2·57
12	5·00	3·29
13	5·58	4·03
14	6·58	4·41
15	7·56	5·23
16	8·50	6·10
17	9·40	7·01
18	10·25	7·56
19	11·05	8·51
20	11·40	9·47
21	..	10·42
	a.m.	
22	12·12	11·37
	p.m.	
23	12·42	12·32
24	1·11	1·28
25	1·40	2·26
26	2·12	3·27
27	2·48	4·32
28	3·30	5·42
29	4·19	6·54
30	5·17	8·02

MINUTES LATER THAN BRISBANE (SOUTHERN DISTRICTS).

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

MINUTES LATER THAN BRISBANE (CENTRAL DISTRICTS).

Day.	Emerald.		Longreach.		Rockhampton.		Winton.	
	Rise.	Set.	Rise.	Set.	Rise.	Set.	Rise.	Set.
1	29	10	44	24	19	0	52	27
6	27	12	43	26	18	1	50	29
11	15	22	30	38	6	13	35	44
16	9	30	25	45	0	21	26	54
21	14	25	29	41	4	16	33	48
26	23	14	39	30	14	5	45	34
30	30	9	46	23	21	0	54	26

MINUTES LATER THAN BRISBANE (NORTHERN DISTRICTS).

Day.	Cairns.		Cloncurry.		Hughenden.		Townsville.	
	Rise.	Set.	Rise.	Set.	Rise.	Set.	Rise.	Set.
1	54	4	67	33	51	19	44	5
3	56	2	68	32	52	17	46	3
5	53	8	67	36	50	21	44	8
7	43	13	59	39	44	24	36	13
9	31	24	51	46	35	32	25	21
11	20	36	43	55	28	40	17	31
13	10	46	37	61	22	47	9	38
15	3	53	34	66	18	51	4	44
17	2	56	33	67	17	53	3	46
19	8	51	36	64	21	50	8	43
21	17	43	41	59	26	45	15	36
23	22	33	45	54	30	38	19	29
25	33	23	52	45	37	30	27	20
27	43	11	60	38	45	23	36	11
29	53	3	67	32	50	18	44	4
30	56	2	68	32	52	17	46	3

Phases of the Moon.—First Quarter, 6th November, 4.59 p.m.; Full Moon, 14th November, 1.52 a.m.; Last Quarter, 22nd November, 6.1 a.m.; New Moon, 29th November, 11 a.m.

On the 15th the sun will rise and set about 20 degrees south of true east and true west respectively, and on the 10th the moon will set at true west and will rise near true east on the 24th.

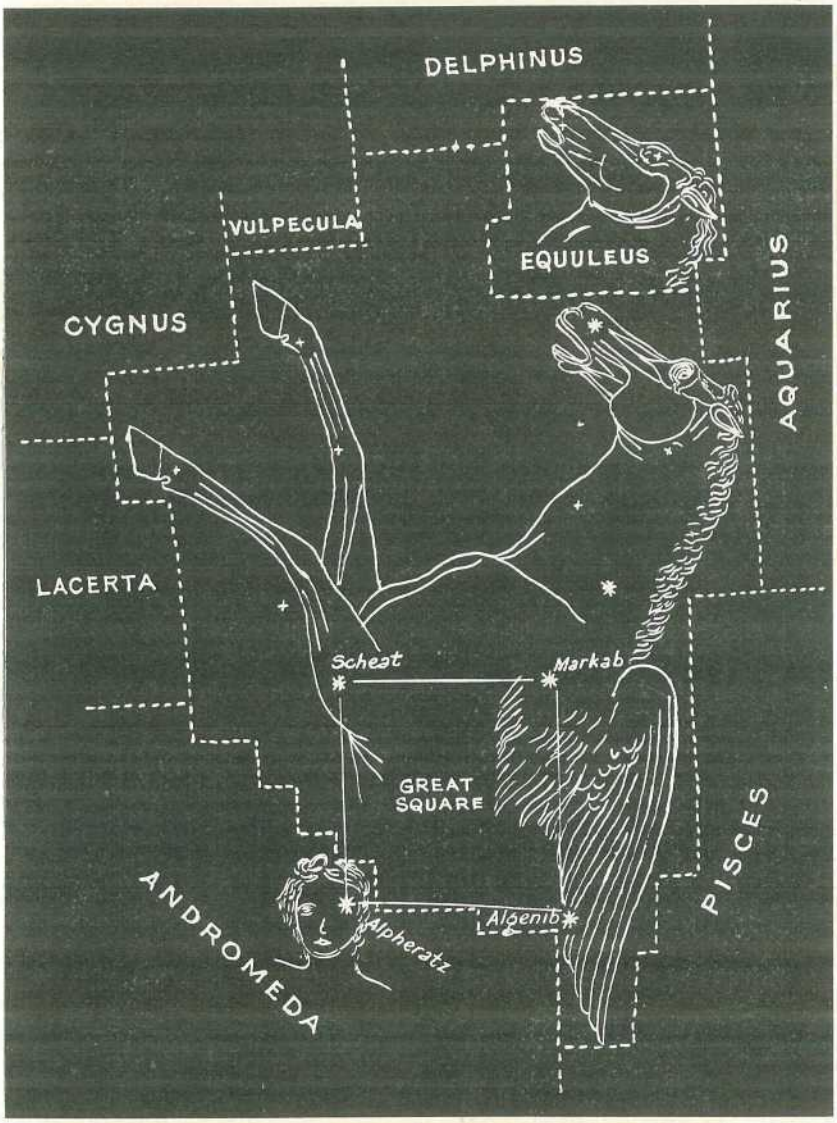
Mercury.—An evening object all this month. On the 1st, in the constellation of Libra, it will set about 1 hour after the sun and will reach greatest angle east of the sun on the 28th, when in the constellation of Ophiuchus it will set about 1¾ hours after sunset.

Venus.—Now rising about 2¼ hours before the sun and is situated in the constellation of Leo at the beginning of November and in the constellation of Virgo at the end of the month. On the 21st it will pass close to Saturn.

Mars.—Also a morning object in the constellation of Leo and is situated farther from the sun than Venus or Saturn. On the 1st it will rise about 2½ hours before the sun and at the end of the month will rise 3¼ hours before sunrise.

Jupiter.—A brilliant evening object, situated in the constellation of Pisces. At the beginning of the month it will set between 3.32 a.m. and 4.45 a.m. and at the end of November will set soon after midnight.

Saturn.—Placed near Mars and Venus, in the early morning eastern sky. On the 1st it will rise 1¼ hours before the sun and will then be situated nearest the horizon. At the end of the month it will rise about 2 hours before the sun and will be placed between Mars and Venus.



THE CONSTELLATIONS.

An easily identified constellation, now appearing in the northern sky during early evening, is Pegasus—the Winged Horse. It is recognised by the four bright stars which form a square from which it also gets the name "The Great Square of Pegasus." However, only 3 stars of the square belong to Pegasus—Markab (Alpha), Scheat (Beta) and Algenib (Gamma). The fourth, Alpheratz, is now known as Alpha Andromedal but in some ancient star maps it was marked as delta Pegasi. The group is said by some to be named after the immortal steed of Perseus; another legend says that Pegasus was made by Neptune from the drop of blood which dripped into the sea from the Gorgon Medusa's severed head. Scheat (Beta) is a giant star about 87 times the diameter of our sun and is an irregular variable.

Between Pegasus and Aquila (described last month) are the constellations of Equuleus and Delphinus. Equuleus—the Little Horse—is a small inconspicuous group, but Delphinus —the Dolphin—is a small but beautiful group which is somewhat similar to the Pleiades to the naked eye, though not so bright. It is also known by the unromantic name of Job's Coffin.