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ANNUAL RATES OF SUBSCRIPTION.—Queensland Farmers, Graziers, Horticulturists, and Schools of Arts, **One Shilling,** members of Agricultural Societies, **Five Shillings,** including postage. General Public, **Ten Shillings,** including postage.

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Event and Comment.

Queensland Pastures.

QUEENSLAND'S prosperity depends very largely on its livestock products; it is highly desirable, therefore, that the community in general should be impressed with the necessity for pasture conservation, and that landholders in particular should take an active interest in pasture improvement.

For many years past, Dr. E. Hirschfeld has been devoting time and energy in informing Queenslanders of the importance of pastures in the economy of their State and urging the extension of pasture investigational work. Dr. Hirschfeld is not just a preacher; he is a landholder who takes a very lively interest in his pastures, present and future. On his Bybera property in the Inglewood District, Dr. Hirschfeld and his son, Mr. R. S. Hirschfeld, have practised pasture improvement for a number of years and have assiduously attempted to get to the root of the problem of improving pastures on country with an average annual rainfall of 25 to 26 inches and which in its natural state is not grassland. The information they have gained has been freely given to all who sought it.

Recently, the Premier of Queensland (Hon. F. A. Cooper, M.L.A.), invited Dr. Hirschfeld to address the Queensland Cabinet, Members of the Legislative Assembly, representatives of the pastoral industry and senior Government officers on the subject of the development and improvement of Queensland pastures. In his address, Dr. Hirschfeld analysed the causes of pasture deterioration, including overstocking, selective grazing, and the removal of mineral substances from the soil, and discussed the application of various control and reclamation measures, especially in the brigalow-belah country of the South-West. Particular emphasis was given to the loss of mineral substances, which is so gradual that it is rarely realised even by those directly interested

in pasture management. Every beast that leaves the paddock for the saleyards takes with it many pounds of mineral matter, formerly the property of the soil, which is not replaced although essential to the pasturage. Having diagnosed the disease, Dr. Hirschfeld proceeded to discuss the remedies. It was obvious, he said, that good native grasses should be preserved, that promising grasses from other parts of Australia and from countries with a similar climate should be introduced for trial, and that the steady drain of mineral substances from the soil should be compensated for in some way. The loss of minerals, it was considered, imperils the health and fertility of the pasture, the health and fertility of the stock and, not unlikely, the health and fertility of our own people.

On Bybera, as a trial area, 10 acres were fenced and stumped in cleared brigalow-belah country, of which 5 acres were laid out in various-sized plots. In October, 1933, in collaboration with the Department of Agriculture and Stock, 63 different grasses and pasture plants were sown. This was not a botanical investigation of what would grow, but a search for what would prosper, hold their own without being pampered, and above all be acceptable to the stock—the animals themselves to be the judges. Since then, out of the 63 varieties 3 proved to be winners, Flinders and Mitchell grasses being the best in that order. Flinders grass is now a permanent inhabitant of Bybera, but the experiments with Mitchell grass are not complete. In these Bybera experiments it was found that ploughing is necessary for the reclamation of pasture.

The influence of mineral trace elements on grasses gave surprising results. By the addition of minute doses of copper, zinc, manganese and boron, the health of the plants increased and added drought resistance induced them to seed earlier. This applied not only to grasses, but to grain crops such as wheat, barley and oats. During all the years the experiments were continued, weather conditions were recorded daily.

Among the grasses tried was the woolly-finger grass, introduced from South Africa where it was said to thrive on poor, low-rainfall country. Plants were sown in various parts of the selection, but did not do at all well in the rich soil of the brigalow-belah country, but throve in poor sandy soil, remaining green all the year round and eagerly sought by stock. As the grass did not seed, suckering seemed the only way in which the sward could be extended, but slowly; yet it pushed out the useless wire grass. It is suggested that the absence of certain trace elements in the soil in which it is under trial may make this grass incapable of forming seed, and that line of investigation is being followed up.

In pasture management, the importance of giving the grasses a chance to seed has been observed on Bybera on the principle that a close season for grasses during seeding time would help materially in the maintenance of good established pasture.

Passing from pastures, a variety of subjects ranging from bore-sinking and earth-tank construction to the use of minerals in increasing the fertility of stock was touched on by Dr. Hirschfeld in the course of his very interesting address. By direction of the Premier, the address has been published in brochure form for distribution to organisations associated with the land industries; in his preface Mr. Cooper commended the work of Dr. Hirschfeld who, he said, deserves well of the people of Queensland.

Lucerne.*

C. W. WINDERS, Agrostologist.

LUCERNE is a native of the temperate parts of western Asia which for very many years has been cultivated extensively for fodder purposes in most warm-temperate and temperate countries, with some extension into sub-tropical and tropical areas. Extremely large areas of lucerne are grown in the Argentine, the United States of America, Canada, and southern European States. The immense scale on which the crop is produced in the Argentine is indicated by the fact that about 15,000,000 acres are devoted to it in that country. Until a few years ago lucerne was sown in Australia mainly for hay purposes, and it necessarily was restricted largely to areas experiencing a reliable rainfall. Since it was demonstrated that stands suitable for grazing purposes could be established and maintained in areas of relatively low and erratic rainfall, there has been a pronounced increase in the acreage sown to the crop. In addition, lucerne is sown as a minor component of pasture mixtures in many districts.

VARIETIES.

As might be expected of a crop plant with a long agricultural history and a wide geographical distribution, lucerne comprises many types of different appearance and growth habits. There is apparently, however, marked uniformity in the strains grown throughout Australia, these being perennial in habit, possessing a deep tap-root with an extensive system of branches, and bearing a large number of erect, leafy, sparsely-branched stems arising from a crown at or above ground level. The flowers are typically violet in colour.

Although the Australian lucerne is an eminently satisfactory type for hay purposes in most of the agricultural areas of the Commonwealth, and also has a high value for grazing purposes, imported varieties are constantly being tested. The cultivated lucernes of the world are of two main classes, comprising the non-variegated or common varieties, with violet flowers, and the variegated varieties, of hybrid origin, possessing flowers of various colours.

The variegated varieties of lucerne are capable of withstanding extremely low temperatures, hence the designation "hardy" which is often applied to them; they are used extensively in Canada, the northern portion of the United States of America, and Europe, but under Aus-

* Reprinted from *"The Queensland Agricultural and Pastoral Handbook,"* Vol. I.

tralian conditions are less productive than the common varieties. They have certain characteristics, such as buried crowns and, in some cases, rootstocks, which render them more suited to grazing than the Australian and similar lucernes, and attempts are being made to use these hybrid forms in producing good pasture types by breeding. The chief variegated lucerne varieties are Grimm and Canadian Variegated, neither of which is grown in Queensland.

The common or "non-hardy" lucernes include the Australian variety, the Argentine lucernes, the Peruvian lucernes, and the strains grown in the southern United States of America. The chief strains within the Australian variety which are recognised in the seed trade are Hunter River, Tamworth, and Mudgee. Whilst there is little apparent difference between the various regional strains, it is desirable for lucerne growers to purchase seed secured from stands grown under climatic and other conditions resembling those to which the crop is to be subjected.

DISTRICTS AND SOILS.

The bulk of the commercial lucerne hay crop of the State is produced on the Darling Downs and in the Logan, Fassifern, Lockyer, Brisbane, and Burnett Valleys, which lie between the coastal ranges and the Great Dividing Range south of the Tropic of Capricorn. In these districts, large areas of suitable soils are available, rainfall in a normal year is sufficient to ensure several cuttings, and haymaking is not unduly interfered with by inclement weather conditions. Furthermore, water suitable for irrigation often can be obtained from streams or wells. In the coastal districts, where the average annual rainfall generally is in excess of 45 inches, lucerne is not grown extensively, due mainly to difficulties of establishment, connected with soil conditions and weed development, and to hazards of haymaking. West of the Darling Downs, in areas with an average annual rainfall of 20 to 25 inches, lucerne is grown only on a small scale and mainly for grazing purposes, the maintenance of good hay stands being possible only in favoured situations. In semi-arid areas, where the rainfall is low and erratic, lucerne cannot be grown successfully except under irrigation.

The soils best suited to lucerne are fertile, deep, well-drained loams and clay-loam soils, but the crop can be grown successfully on a wide range of soil types, varying from light, sandy loams to moderately heavy clays. The chief soil requirements for permanent hay stands are moderate to high fertility, ample depth and good drainage, constant available moisture, a good lime supply, and proper bacterial content. Most of these features are characteristic of alluvial soils and black and red volcanic soils in the southern and central agricultural areas experiencing an average annual rainfall of between 25 and 45 inches, but there is at times a deficiency of available soil moisture in many areas and it is then necessary, if growth is to be maintained, to apply irrigation water. The suitability of soils of the tropical coast to lucerne growing has not yet been ascertained, but it appears probable that liming, fertilizing, and soil inoculation would be necessary to effect establishment on some of the soil types.

A well-drained site is essential. Lucerne will tolerate standing surface water for only a short time, two days of partial submersion being sufficient to cause extensive permanent damage to a growing crop, although during the winter months a somewhat longer period can be

withstood. Even if land is not liable to flooding, its water-table may rise to a high level during wet weather and remain there sufficiently long to damage the lucerne stand by interfering with the functioning of the roots. Land subject to water-logging often is indicated by the presence of yellow or grey mottlings in the uppermost couple of feet, and this land should not be used for lucerne cultivation unless adequate artificial drainage is provided.

Some soils which would otherwise be quite satisfactory for lucerne lack sufficient lime for the crop. This deficiency can be overcome only by applying a soil amendment, such as one of the various forms of agricultural lime, prior to the sowing of the lucerne. The quantity necessary to apply varies with the extent of the deficiency and with the soil type. If a sample of the soil is submitted to the Department of Agriculture and Stock an examination can be carried out and recommendations made regarding liming. Land other than naturally very fertile alluvial country may be lacking in phosphates and require the application of phosphatic fertilizers. These are best applied at the time of sowing and during the cultivation of the crop.

PREPARATION OF LAND.

Unlike certain of the annual crops, lucerne cannot be planted on newly broken-up land with any great prospect of success. Virgin soils require a lengthy period of preparation for lucerne, not only to improve soil conditions but also to reduce or eliminate weeds and weed seeds. The best method of preparing virgin land is to crop with annuals for at least one season and preferably for two or even three seasons. On intensively-farmed areas, inter-tilled crops, such as maize and potatoes, are useful crops to precede lucerne, much of the weed growth being eliminated by the cultivation afforded the annual crop. Where it is intended to lay down large areas to lucerne in dry areas, cereal crops, such as wheat and oats, usually are employed as preparatory crops. Land which has been devoted to lucerne for a period of years, and which it is proposed to resow with lucerne, should be cropped with annual fodder, grain, or root crops for several seasons before resowing to lucerne is attempted.

The last preceding crop should be removed from the land, and the residues ploughed under, well in advance of the sowing of the lucerne. The first ploughing should be carried out in January or earlier, permitting of approximately two months or more of fallow, during which summer rainfall may be conserved and weeds eliminated by cultivation. At least two ploughings should be given. The depth of ploughing varies according to soil type and district. In the main lucerne-growing districts, loams usually are ploughed to a depth of 6 to 8 inches, but in dry districts of the south-west scarification to a depth of about 3 inches often replaces ploughing. Harrowing with disc or tine cultivators—preferably with the latter towards the end of the fallow period—should be carried out when necessary and a compacted seed-bed with a light surface mulch prepared by the end of March.

ESTABLISHING THE CROP.

The grower who intends to sow lucerne has to give consideration to the following points when preparing to establish the crop:—Time of sowing, selection of seed, inoculation of seed, and rate and methods of sowing.

Time to Sow.

Lucerne is usually sown in Queensland during April or May. At this time, provided the land has been fallowed sufficiently long, the soil contains a good deal of moisture and rains sufficient to permit of germination of the seed may be expected. Weed growth during the winter months generally is not vigorous enough to hinder the development of the young lucerne. Spring planting is favoured by some farmers, particularly when irrigation facilities are available, but has the disadvantages that rainfall in spring usually is unreliable and that weed growth during the early summer will check the young lucerne plants.

Selection of Seed.

"*The Seeds Act of* 1937" requires that lucerne seed offered for sale in Queensland shall have a germination capacity of at least 75 per cent. and be entirely free of dodder* and certain other weed seeds. If purchasers of lucerne seed find the seed on delivery to be pinched or shrivelled, dull in colour, apparently unsound, or contaminated with seeds of various weeds samples, with full particulars regarding dates of purchase and delivery, name of supplier, amount of seed purchased, and date on which the sample was drawn, endorsed on the container, should be sent to the Department of Agriculture and Stock, Brisbane, for free examination.

Seed Inoculation.

For lucerne to make its maximum development it is necessary for certain bacteria to be present in the soil. These bacteria invade the roots of the crop, forming the well-known nodules, and build up for the use of the lucerne plant a supply of nitrogen which otherwise would be unavailable to the lucerne. In areas where burr medic† and other close relatives of lucerne are not naturalised, there is often a deficiency of the requisite bacteria in the soil, and this deficiency must be remedied if lucerne is to flourish.

A method commonly employed in the past but not always very effective is to obtain a quantity of soil from a field where lucerne is grown successfully and scatter it over the new field, prior to sowing, at the rate of 1 cwt. or more to the acre. Alternatively the seed may be mixed with the appropriate bacteria just prior to sowing. At one time this was done by standing a quantity of soil from a good lucerne paddock in a barrel of water, and after a few days sprinkling the liquid over the seed, which was sown immediately on drying. This method has been superseded by the use of pure cultures of the bacteria, supplied, growing on a jelly-like substance, in tubes or bottles. The culture is mixed with skimmed milk and a chemical and the seed is thoroughly wetted with the mixture and dried prior to sowing. If stored as directed by the makers, these bacterial cultures will retain their vitality for several weeks. Application for cultures should be made to the Department of Agriculture and Stock, Brisbane.

Rate of Sowing.

Under extremely favourable conditions, namely, a well-prepared seed-bed and suitable weather conditions prior to and subsequent to sowing, an excellent stand of lucerne for hay purposes can be secured

* *Cuscuta* spp.

† *Medicago denticulata.*

by drilling as little as 5 lb. of high-quality seed to the acre. However, in order to allow for the vagaries of the weather, for possible seed destruction by ants and other animals, and for irregularities in the seed-bed it is advisable to sow approximately twice this quantity on alluvial soils in the main hay-growing districts to ensure a stand which will produce the slender stems desired in lucerne hay. If broadcasting by hand is practised, the amount may be increased to 14 lb. to the acre to avoid thin patches. Seeding rates at least half as heavy again as those recommended frequently are employed, but experience has shown that, under normal circumstances, these higher sowing rates are not justified.

On soils in which the amount of moisture in the subsoil tends, owing to frequent dry weather periods, to be low for a considerable time, dense stands of lucerne cannot be maintained without irrigation and it is, therefore, advisable to make relatively light sowings in such areas where irrigation facilities are not available. On the western Darling Downs and in the Maranoa, provided the seed is drilled in, sowing rates varying from 2 lb. to 6 lb. to the acre are ample. Broadcast sowings should be made at a somewhat heavier rate. In dry districts, the crop may be sown in rows 2 to 3 feet apart to permit of inter-cultivation, which destroys weeds and encourages absorption of rains. The seeding rate is decreased to correspond with the actual planted area. Alternatively, the lucerne may be sown in strips 3 to 4 feet wide, the unplanted strips of the same width being kept cultivated.

Methods of Sowing.

Even though abundant subsoil moisture is present, lucerne should not be planted during dry weather, but should be sown immediately after a good fall of rain, when quick germination is assured. A light ploughing or a harrowing should precede planting, in order to make seed-bed conditions as favourable as possible.

Small areas usually are sown by hand or with a hand-operated broadcasting machine. When broadcasting by hand it is advisable to mix the seed with sand or dry soil to facilitate even distribution. It is also desirable to sow half the seed in one direction and the balance at right angles to the direction in which the first sowing was made. By doing so, there is little danger of missed strips occurring as is frequently the case when the seed is sown in one direction only. Owing to the light nature of the seed it is impossible to get an even distribution if it is sown under windy conditions and broadcasting should therefore be carried out in the morning or only on calm days. If a whirling type of broadcasting machine is used, an even spreading of small quantities of seed may be achieved by turning the handle in the reverse direction to normal. The seed should be covered to a depth of about ½ to 1 inch immediately after distribution. A light rolling with an ordinary roller or with a cultipacker presses the seed into the soil, but it is advisable to follow rolling with a light harrowing in order to obviate caking of the surface. Where the roller is not used, the seed may be covered by means of a light harrowing alone. In some instances a mob of sheep can be effectively used to cover broadcast seed.

When large areas are to be sown, the wheat drill or the combine may be used. The seed may be sown from the grain seed-box if mixed with a bulky carrier, such as bran, but this method of sowing cannot be recommended. Either the fertilizer-box or a special grass seed

attachment should be used. When sown through the fertilizer-box, the lucerne seed should be mixed immediately prior to sowing, with superphosphate, sand, or fine, dry soil, the carrier being used at the rate of about 56 lb. to the acre. If difficulty in sowing the proper quantity of seed to the acre is anticipated, it is advisable to jack up the machine with the fertilizer distributor in gear, and then rotate the wheel through a noted number of turns and weigh the mixture which has dropped. This is the amount which would be sown on an area equal to the width of the drill multiplied by the circumference of the wheel multiplied by the number of turns of the wheel, and with this knowledge the machine can readily be adjusted to sow at any desired rate. In some cases, adjustments may be made to the drill to permit the seed to be drilled into the soil at a shallow depth, but, usually, if sown through the feet of the hoes or discs, the seed will be buried too deeply and it is advisable, therefore, to drop the seed on to the surface of the soil by removing the distributing tubes from the feet of the machine. A brush harrow attached to the footboard of the drill may be used to cover the seed, or a light spike harrow may be run over the sown area. The ordinary dropper type of fertilizer distributor can also be used for sowing lucerne seed.

It is important that lucerne seed be covered by only a shallow layer of soil, since, if it is buried deeply, the seedlings will have difficulty in pushing through to the surface. In heavy soils, the seed should be buried not more than 1 inch, and preferably only ½ inch, in the compact soil of the seed-bed, but in sandy soils a slightly deeper sowing is permissible.

The practice of sowing a cereal or other crop with lucerne with the object of protecting the young lucerne plants from frosts is unnecessary in Queensland and is not employed to any extent. In the grazing districts of the western Darling Downs and Maranoa, where it is usual to sow large acreages of lucerne, the cost of establishment would be partly recouped if wheat could be grown for a season as a companion crop to lucerne without detriment to the establishment of the latter. Little information is available regarding the practicability of securing a grain crop from a mixed sowing of lucerne and wheat without damaging the lucerne stand, but in many seasons in Queensland rainfall is insufficient to permit of this practice.

EARLY TREATMENT OF HAY STANDS.

In the early stages of the lucerne crop, which normally is sown in the autumn, little attention to the stand is necessary. Any patches on which only a few seedlings become established should be resown as early as possible, since it is generally impracticable to establish lucerne on bare patches within the main crop once the surrounding lucerne has made good development. Bare patches in a newly-established stand are frequently due to cutworm attack and cutworm bran bait should be broadcast over and around the bare or thinned-out areas before resowing whenever the presence of cutworms is suspected.

Weeds generally make their appearance in the young stand, but their removal by means of cultivating implements should not be attempted, owing to the danger of damaging the lucerne plants. In the spring, before the weeds have set ripe seed, the mower should be run over the field in order to cut the weeds. If the cutter bar be raised a few inches, most of the annual weeds can be dealt with, without the

young lucerne plants being damaged by premature close cutting. The first cutting of the young lucerne stand, apart from the partial clipping incidental to weed removal, should not be made until the second lot of buds appears from the crowns, generally when the first growth is in flower. Grazing of young lucerne stands intended for hay purposes should be avoided.

CARE OF THE ESTABLISHED CROP.

It is necessary throughout the life of the stand to adopt methods of management which will ensure the least possible decline in production due to shortage of available moisture, decrease in soil fertility, intrusion of weeds, and incidence of pests and diseases.

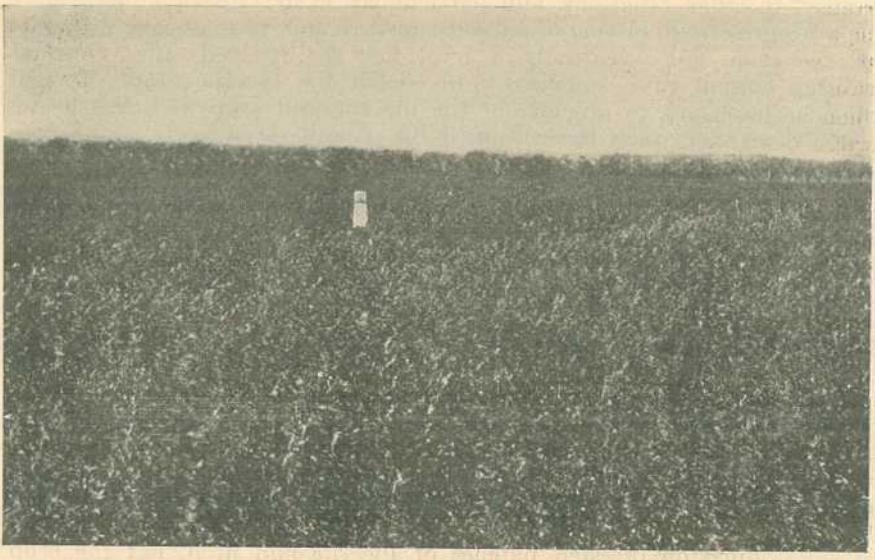

Plate 128.
A CROP OF LUCERNE IN THE HAY STAGE.

Periodic harrowing or cultivation has been proved beneficial in most districts, the main effects being to aerate the soil, to permit of better penetration of rains and to destroy weeds. The rigid tine type of cultivator, and the rotary type of pick implement, do very satisfactory work. Cultivation should be carried out whenever the soil requires loosening. This may be several times a year on the heavier soils on which the crop is grown, but only two or three times on sandy soils. The best time to cultivate is usually shortly after the stand has been cut for hay or grazed off by stock.

Lucerne makes heavy demands upon plant nutrients in the soil and in some cases decrease in yields is attributable to depletion of soil phosphates. In such cases, top-dressing with superphosphate or other phosphatic fertilizer is indicated, the annual rate of application being 2 cwt. of superphosphate or its equivalent to the acre. The fertilizer should be applied immediately after mowing and should be harrowed in. Spring is usually considered the best time to apply fertilizer to lucerne.

Although productive stands of lucerne fifteen years old or even older have been observed in the important haygrowing districts, the average life of stands producing first-class hay crops is considerably less. Indeed, many market suppliers regard it as being sound practice to plough non-irrigated lucerne paddocks at the end of three or four years and grow maize and other annuals of a non-leguminous type for two years before bringing lucerne back into the rotation for a further three or four years.

The productive life of a lucerne stand may be shortened by failure of the water supply, by weed invasion, by disease, and by improper management. On creek and river alluvial soils, the occasional shortages of available soil moisture which occur are usually restored following rains. In other situations, and particularly in dry districts, there may be a progressive depletion of subsoil moisture, due to the heavy demands of the crop, and eventually a level may be reached which normal rainfall cannot raise sufficiently to benefit the lucerne crop. It will then be necessary to plough out the lucerne and crop with less heavy water-demanders than lucerne until the subsoil moisture is restored to a satisfactory level.

Intrusion of weeds into lucerne fields is extremely common. Many of these weeds are controllable by mowing and cultivation, but certain grasses and fishweeds* are very persistent and difficult to suppress. Grasses usually make their appearance when the lucerne commences to decline after three or four years of high production, or they may invade the field and establish themselves during dry periods when there is very little penetration of rains to the lucerne roots. When woolly-top Rhodes grass† invades a lucerne stand, the market value of the hay crop is lowered considerably, since the grass is very evident in both the hay and the chaff. Dodder‡ is often found in lucerne crops, at times causing severe damage to the stand. In its young stages the dodder plant severs its connection with the ground and lives entirely on the host plant. The weed can best be eliminated by burning or scorching. Sometimes straw is piled on infested patches of lucerne and fired, but the crop may be cut and burnt when dry. An effective method of destroying dodder is to scorch the infested patches with a flamethrower, care being taken to treat the stand down to ground level.

The most important disease of lucerne in Queensland is witches' broom, a virus disease which is common in many districts. Infected plants are dwarfed in stature and give rise to an extremely large number of shortened stems with small leaves. The disease spreads relatively slowly, but stands are often rendered unprofitable within a year or two of the first appearance of the trouble. The disease usually does not appear in a crop until the stand is well established, in most cases the second year or later. No remedial measures have so far been worked out. Infected stands should be ploughed out when the disease becomes severe.

Improper methods of cutting and grazing management are responsible for deterioration in many cases. Frequent cutting or close grazing is harmful to the stand and this effect appears to be bound up with the

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* *Chenopodium* spp.

† *Chloris virgata.*

‡ *Cuscuta* spp.

storage and depletion of reserve foods in the roots. It is necessary for the lucerne plant to store up in its roots between cuttings or grazing sufficient reserve foods to promote rapid regrowth. The most important storage period is that following the last summer cutting, during which food is built up and stored away to serve for the early spring growth. It is advisable, therefore, to provide for an ample top-growth to be present during the autumn months so that sufficient leafage is available to manufacture the necessary food materials to be stored. The early growth draws upon the food reserves, but, when it reaches approximately the early flowering stage, it commences to replenish the depleted reserves. If cut or grazed before the root reserves have been restored, the lucerne will be weakened and this effect will persist. Cutting or grazing at any period of the year should be postponed until about nine inches of top-growth have been made.

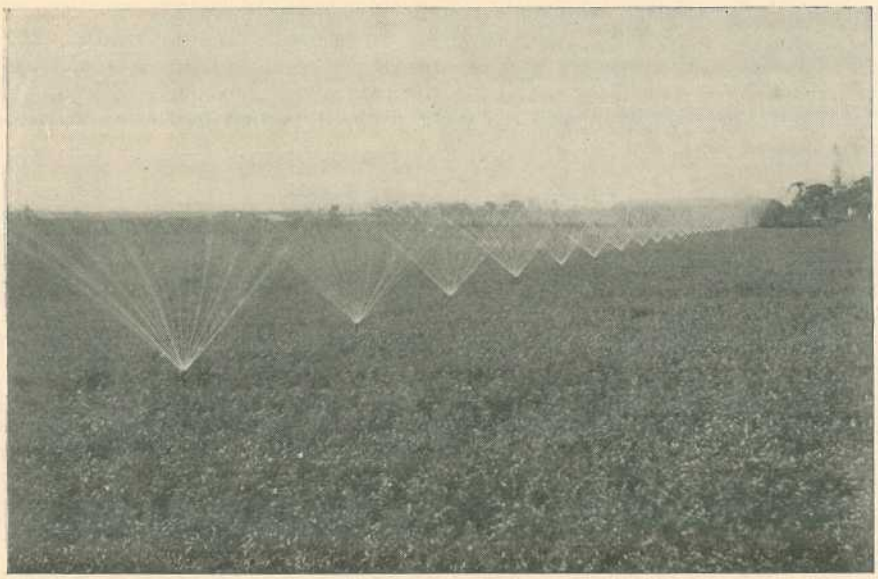

Plate 129.
A LUCERNE CROP BEING IRRIGATED BY A SPRAY SYSTEM.

IRRIGATION OF LUCERNE.

Hay producers in increasing numbers are finding it profitable to irrigate lucerne stands. In many instances, lucerne is only one of a number of cash crops produced on the farm and the spray system of irrigation (Plate 129) is usually adopted because of its flexibility and suitability to a wide range of agricultural and vegetable crops. The flooding system is employed on some farms, but is less economical of water than is overhead irrigation, and this is a serious drawback where water has to be pumped.

Most farmers who irrigate lucerne in Queensland pump from running streams, dams behind weirs, or wells. In all cases it is advisable to have the water supply analysed in order to ascertain its suitability for irrigation purposes. This is especially important where clay loam

soils are irrigated, since the deposition of harmful salts in the surface layers of the soil is more likely to occur in that type of soil than in freely-drained, sandy loams.

Land on which it is intended to grow lucerne with the assistance of spray irrigation should be levelled or given only a slight slope. On the other hand, if flood irrigation by gravitation is to be practised, a more pronounced slope is advisable, otherwise the water will not spread quickly and evenly over the field. Where an irrigation project is in operation and water for flooding is available, delivered on the farm, at a reasonable cost, the land may be levelled and graded and a series of beds prepared by the construction of check banks.

The frequency of watering and the amount of water necessary at each application vary with seasonal conditions and with soil type. At times, the rainfall between cuttings is ample to produce a heavy yield in about four weeks, whereas on some occasions it may be necessary to irrigate two or three times in order to secure a similar result. In normal seasons, an average of one watering to each cutting seldom will be exceeded. Little information on the rate of application is available, but 3 to 4 acre-inches at each watering probably would be the minimum requirement for good returns.

LUCERNE HAYMAKING.

Lucerne hay of good quality must have a high percentage of leaves and the foliage should not be brittle or shattered. The hay should be free of impurities, such as weeds and stubbles, and should not be affected by moulds. A green colour is desirable, since it indicates not only soundness, but also richness in carotene, which gives rise to vitamin A. The quality of the hay is influenced very largely by haymaking operations, and it is necessary to give close attention to all phases of haymaking if a product of high quality is to be made.

Stage of Cutting.

The best quality lucerne hay is provided by a clean crop cut just prior to budding, but because frequent cutting at this stage of growth results in a lower seasonal tonnage of hay and also lessens the longevity of the stand it is usual to cut at a slightly later stage, namely, when the crop is one-tenth to one-fifth in bloom. When the plants are in this stage the shoots of the new growth generally are showing from the crown. In protracted dry weather and in the early spring flowering may be delayed, and the time for cutting should be decided by the appearance of the basal shoots; if the crop commences to yellow it should be cut irrespective of flower or shoot development. If cutting is delayed beyond the early flowering stage the stems harden, leaves are shed, and the quality of the hay is lowered.

Mowing and Raking.

Haymaking should not be commenced until a succession of fine days is probable. Cutting of the crop usually is commenced as early as possible in the morning after heavy dew has disappeared, the ordinary horse-drawn mower being almost universally employed. Subsequent operations should aim at the production of a leafy hay of good colour and aroma and containing about 25 per cent. of moisture prior to stacking. Rapid reduction of moisture is effected by permitting

the crop to wilt in the swath, but bleaching and loss of leaves will occur if the lucerne remains in the swath for more than a few hours on a sunny day. Raking should be commenced when the material in the swath has been well wilted and before the leaf is likely to shatter on handling. It is not advisable to cock a crop which has been wet by rain after cutting in an endeavour to avoid loss.

The usual practice in Queensland is to cure lucerne hay mainly in cocks, the crop being raked from the swath into windrows chiefly to facilitate cocking. The ordinary dump rake is generally used to make the windrows, the side-delivery rake (Plate 130), which prepares a somewhat better type of windrow, not yet being used to any great extent in Queensland. Lucerne may be permitted to cure in the windrow, but the curing process must be continued in the stack if an attractive, high-quality hay is to be made.

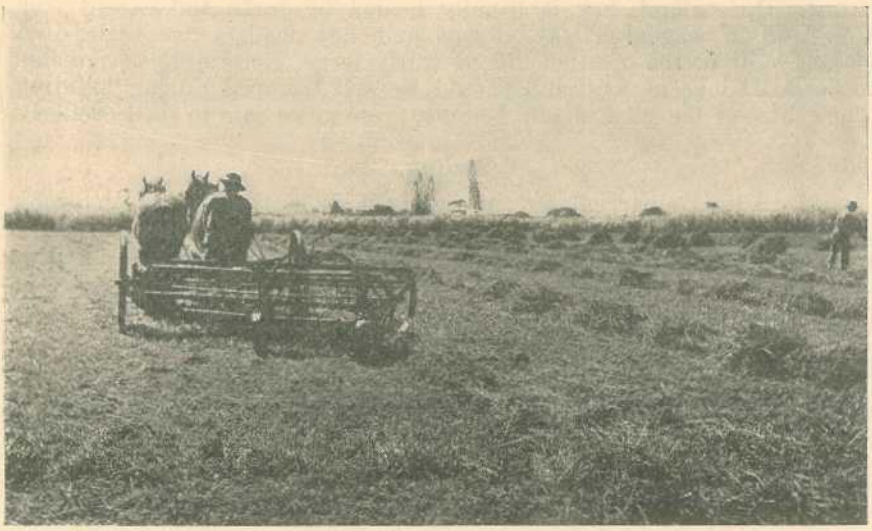

Plate 130.
WINDROWING WITH THE SIDE-DELIVERY RAKE.

Cocking.

Curing and partial sweating of the hay in cocks in the field usually results in a product with good aroma, colour, and leafiness. Prior to cocking, the hay should remain in the windrow for a few hours to assist further evaporation, but excessive drying should be avoided. The dump rake may be used to bunch the material in the windrows ready for cocking, or cocking may be done straight from the windrow. In either case, the building of the cocks should not be commenced until surface moisture due to rain or dew has disappeared.

The cocks should be constructed with the hay fork and made rather tall and narrow with sloping sides to divert rain water. Lucerne left in cocks of this type for from two to four days, the length of time depending upon weather conditions, will cure in a satisfactory condition, only the outside layer being bleached. If cocked while fairly damp, an occasional gentle opening-up to allow air to enter will be necessary.

Stacking.

It is usual to stack lucerne hay before baling, although baling may be done in the field direct from the cocks. Care must be taken that the hay is not stacked or baled when too moist, otherwise spoilage is likely to occur and a risk of spontaneous combustion is created. Hay may be regarded as ready for stacking when a wisp does not exude moisture upon twisting in the hands. Other rough tests include holding the hay against the cheek, a cool feeling indicating excessive moisture content, and scratching the skin of the stem, hay ready for stacking having skin that is difficult to peel off. Loose lucerne hay is preferably stored in barns or sheds, the wastage in such protected stacks being considerably less than in stacks built in the open. Galvanised-iron roofing may be used to afford some measure of protection to the latter.

In Queensland, hay is usually loaded by forks and carted from the field on wagons. Hay sweeps and hay loaders are little used. Stacks built in the open should be fairly large, containing, if possible, at least 20 tons of hay, and should be well tramped during building. The centre of the stack should be built up to allow rain to shed properly.

Baling.

If baling is carried out in the field from the cocks, a portable press is used, but care must be taken that the hay does not contain sufficient moisture to cause mould development in the bale. Baling from the stack is preferable, since with a fully-cured, stacked hay there is no danger of spoilage. Any bunches of weeds or spoiled hay which are noticed during baling should be discarded, so that the bales contain only good-quality hay, which commands the highest market price. By baling in the early morning or in the cool of the evening it is possible to preserve the leafiness of the loose hay. The bales should be neatly made and firmly tied and conform to the size required by the market.

Lucerne Chaff.

A good deal of the lucerne hay produced in Queensland is marketed as chaff. As in the case of bales, uniformity of the product is a very desirable feature.

LUCERNE SILAGE.

The making of silage from leguminous crops, such as lucerne, except in admixture with maize and similar crops, has been practised to only a slight extent in Queensland. Lucerne converted into silage in the normal way is likely to yield a worthless product. An essential part of ordinary silage-making is the formation of certain acids which preserve the material. In lucerne there is often too small a proportion of starches and sugars for the acids to be formed, and the lucerne is decomposed by bacteria, yielding an evil-smelling and unpalatable product.

Within recent years it has been shown that a good silage can be made from lucerne by adding molasses, which is rich in sugar, during the filling of the silo. This system of silage making, however, has not yet been adopted in Queensland because of the number of other highly satisfactory crops that are available in this State for silage making.

GRAZING LUCERNE.

Throughout the dairying and fat-lamb raising districts of the State, it is a common practice to use lucerne stands solely for hay purposes during the warmer months of the year and to make occasional grazings during the winter, when only small hay yields could be expected. Provided grazing is not continuous, but intermittent, and stock are not allowed on the crop when the ground is wet, little permanent damage to the stand results, although there is a tendency for lucerne grazed occasionally to become invaded by weedy grasses more quickly than is the case in crops reserved for hay purposes.

In some of the southern pastoral districts, lucerne is sown to a certain extent mainly for grazing purposes, although one or two hay crops may be taken off during the summer months. As indicated in an earlier paragraph, relatively light sowings of the crop are made in the grazing districts, sowing rates of from 2 lb. to 6 lb. to the acre being commonly employed. In grazing lucerne, it must be kept in mind that continuous close grazing of the crop will weaken the stand and permit the intrusion of weeds of various types. A lucerne paddock should not be grazed until shortly before flowering is commenced, or a little later. The stock should be crowded on to a small area, which is quickly eaten down—say, within a week or ten days—and the stock is then removed to another area. Rapid grazing results in a much faster recovery of the lucerne than if the field is grazed for several weeks, as new shoots which appear under the latter conditions will be damaged or destroyed by the stock. In order to effect rapid, intermittent grazings of large areas of lucerne, it is necessary to have the areas subdivided into relatively small paddocks on which the available stock, or a sufficient number of them, can be concentrated.

On some occasions it may be found necessary to put stock on to lucerne less than 9 inches high. Provided this is not practised regularly, little or no harm will be done to the stand, but it must be emphasised that severe grazing of the early spring growth of lucerne is undesirable. In common with other perennial pasture plants, lucerne stores up in its roots during the summer and autumn months reserve foods to enable it to make vigorous growth in the spring. Should this growth be eaten off in its young stages and insufficient leaf development permitted to enable the plants to restore the root reserves, weakening of the plants will result. The first spring grazing should, therefore, be delayed until the crop has made a top-growth of 9 inches or more. If convenient, the first crop of the season is best cut for hay.

Many soils set hard when trampled by stock, and it is advisable to loosen the surface of such soils by means of a tined renovating implement after the paddock has been grazed.

Certain precautions must be observed if losses in stock grazing on lucerne are to be avoided. Cattle and sheep, being ruminants, are liable to develop hoven, or bloat, if depastured on succulent or wet lucerne. Stock should be accustomed to the crop by putting them on it for only a few minutes on the first day of grazing, and by thereafter gradually increasing the time of grazing. During this introductory period, the stock should have their appetites partly appeased before they are allowed to graze the lucerne. Dairy cattle should be kept under observation whenever they are on lucerne and appropriate measures

applied should bloating occur. Sheep and lambs grazed regularly on lucerne are seldom affected by bloat. The potential ill-effects of lucerne may be minimised by making grass or dry feed available to the stock. In many cases grass is sown with the lucerne, or allowed to come in naturally, with the main object of minimising the danger of bloating.

LUCERNE SEED PRODUCTION.

The production of commercial lucerne seed is a very small industry in Queensland and is confined to the eastern part of the Darling Downs. The general practice is to allow an occasional hay crop to go past the usual stage of cutting, in the hope that a payable seed crop will result, and no special sowings for seed production purposes are made. A special combination of soil and weather conditions is essential to the production of a good crop of seed, and under the conditions experienced in Queensland payable seed crops are not commonly secured.

A dense, vigorous hay stand cannot be expected to yield a heavy seed crop, since flowering is largely confined to the tops of the plants. A thin stand flowers profusely, and it is probable that grazing stands, such as those used in the Maranoa, or lucerne sown thinly in widely-spaced rows, would provide the best seed yields. It appears necessary for seed formation that the cutting reserved for seed production make its early growth slowly. The available moisture should be just sufficient to keep the crop growing, but there should be no marked deficiency of water after budding has commenced. Areas with a low relative humidity usually produce better seed crops than humid districts.

In Queensland, no definite procedure is followed in regard to which cutting to leave to mature for seed. In some areas, the early season cuttings provide the best hay crops, owing to the absence of weeds at this time, and seed production is most conveniently reserved until January or February.

The seed crop should be harvested when about two-thirds of the pods are black or dark-brown in colour. The importance of the seed crop on the farm usually does not warrant the purchase of special harvesting machinery. Though wasteful of seed, harvesting and curing as for a hay crop with subsequent threshing from the stack is the procedure usually employed. The least possible handling of the crop, consistent with proper curing, is necessary to prevent shedding of seed.

Cotton Varieties Recommended for the 1945-46 Season.

R. W. PETERS, Plant Breeder.

IRREGULAR climatic conditions ruling throughout the cotton growing districts south of Mackay during the 1944-45 season caused a severe reduction in both acreage harvested and average yield of cotton compared with the previous season. The results obtained, however, added further information regarding the merits of the main cotton varieties being grown in these areas, and allow of sound recommendations being made for their distribution in the 1945-46 season.

The following recommendations of varieties are therefore made for guidance of growers ordering seed that will be distributed from the Glenmore and Whinstanes ginneries, respectively.

Seed Distribution from Glenmore Ginnery.

The Miller variety has once again shown its general suitability for the districts which receive their planting seed from the Glenmore ginnery. Broadly speaking, the strain lot 41S of this variety appears to be well suited for the heavier soils of these areas under either rain grown or supplementary irrigation conditions. On the very fertile heavier alluvials lot 39, which is a slightly more open type, may yield better than lot 41S. Where there is danger of attacks of the leaf sucking jassid, it is advisable to plant lot 1, which is a new jassid-resistant strain especially evolved out of Miller for such areas. Its staple length is slightly shorter than both lots 41S and 39 but its ability to produce appreciably heavier than either of these strains under conditions of severe jassid infestation makes it a valuable cotton for districts where jassids occur in most seasons.

The New Mexico Acala variety has again demonstrated that it is a good cotton for the alluvial loams and sandy loams, particularly when grown with supplementary irrigation. Under the very dry late summer and autumn conditions, the strength of some consignments of this cotton grown without irrigation on the lighter soils indicated, however, that it is highly desirable to have ample supplies of subsoil moisture in such soils at the time of planting this variety to ensure good sound fibre of

1 to $1\frac{1}{16}$ inches in length. New Mexico Acala should not be planted where there is any likelihood of jassid occurring in serious numbers, as it is one of the varieties most susceptible to attack by this insect.

No other variety appears to be required in the districts south of Mackay which receive their planting seed from the Glenmore ginnery, other than on the fertile alluvial soils of the coastal strip from North Bundaberg to Mackay. A quicker-maturing cotton than either Miller or New Mexico Acala is required on such soils and Triumph 39-1 is recommended for such conditions.

Seed Distribution from Whinstanes Ginnery.

The weather experienced in the districts supplied with planting seed from the Whinstanes ginnery provided an excellent test of the ability of the varieties generally grown in these areas to produce satisfactorily under conditions of late-November planting and mostly fairly irregular and sub-normal rainfall. As would be expected under such conditions, the quick maturing Triumph variety yielded well where it had ample subsoil moisture and was given good cultural attention. The lot 39-1 strain of this variety produced particularly well in several districts and it would appear that this cotton is well suited for the lower fertile slopes of both forest and scrub country in the Upper, Central and South Burnett districts and on similar soils in the West Moreton. It is not suitable, however, for the poorer soils and the very fertile alluvials in these districts. Triumph lot 39-7 has given indications of being well suited to the fertile alluvials of the Central Burnett and growers with such soils in this district should order it for both rain grown and supplementary irrigation conditions. Lot 39-4 is a very open type of Triumph and is the quickest producing variety grown in the State. It requires very favourable soil and moisture conditions, however, to yield the best results. It is particularly recommended for growing under both rain grown and supplementary irrigation conditions on the very fertile alluvial soils in the abovementioned sections of the districts receiving seed from Whinstanes.

The Lone Star variety has once again demonstrated that it is the outstanding cotton for growing on the harder, less fertile soils of the forest slopes in these districts and also on all but the softwood scrub soils of the Northern Darling Downs and Maranoa districts. In the former districts lot 34 should be ordered, while in the last two areas lot 33S—a very hardy type—has yielded well over several years.

Miller lot 41 appears to be the most suitable variety for the fertile soils of the upper slopes of the forest and scrub country in all of the districts supplied from the Whinstanes ginnery; except where jassid may be anticipated, when lot 41J, a partially jassid-resistant strain, should be ordered as it has substantially out-yielded lot 41 under even moderate jassid attacks.

New Mexico Acala has again yielded well on the lower forest slopes of the South Burnett and West Moreton districts. It has shown a tendency, however, to produce rather soft cotton where unfavourable conditions have been encountered. This appears to be a weakness of this variety and in conjunction with its extreme susceptibility to attacks by jassids makes it advisable for farmers who usually grow this cotton on forest slopes to try either Miller 41 for the less fertile soils or Triumph 39-1 for the fertile soils.

Qualla is a big-boll, hardy variety that has yielded very satisfactorily in recent years when planted on the poorer sandy loams and sandy clay loams of the forest slopes in the West Moreton district. This appears to be about the most suitable cotton for these soils that has been tested and it is recommended that farmers with such types of soil give it a trial during the coming season. It is not suited to the fertile alluvial or scrub soils, however, where it makes vigorous growth under all but extremely droughty conditions.

Grow Only One Variety.

The Queensland Cotton Board has advised that in order to simplify the receival and identification of cotton arriving at the ginneries, seed of only one variety will be distributed to a grower. Each season a percentage of the growers plant more than one variety in order to have the most suitable cottons for their different soil types. This procedure not only complicates arrangements for districts to produce pure planting seed but also increases the operations connected with receiving and ginning a grower's cotton. Most farmers can undoubtedly benefit by selecting only one variety to grow on their most suitable soils for cotton and, if reasonably satisfactory returns are obtained from it at first, repeatedly growing it. In this way a farmer can determine the full possibilities of a variety for his soil—particularly if efficient cultural practices and correct row and planting spacings are carefully ascertained.

It is therefore recommended that, where a grower has obtained reasonably satisfactory results with a variety, he order seed of it for the coming season, making sure to specify the same lot number of the variety, such as Miller 41S and not just Miller, of which there are several strains. In some instances the Field Officer of the district may desire a new strain of the same variety to be grown in order to increase the seed for general distribution in subsequent seasons. Growers should assist in this work, for only well tested strains are so released.

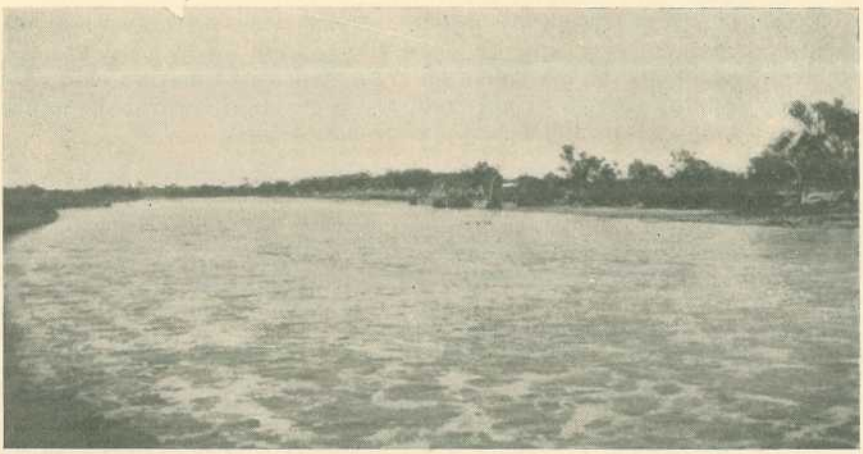

Plate 131.

WHEN THE RIVER RUNS.—The Flinders at Hughenden.

The Queensland Nut.

J. M. WILLS, Fruit Branch.

THE Queensland Nut (*Macadamia ternifolia*), one of the best of the edible nuts, is indigenous to the coastal rain forests of southern Queensland and northern New South Wales. The regional limit of successful cultivation of the nut is given as the tract of coastal country between Camden Haven, New South Wales, in the south, and Maryborough, Queensland, in the north; but a few trees are under observation as far south as Sydney. The most widely spread species is *M. ternifolia*, known commonly as "Australian nut, "Queensland nut," "bush nut," "Bopple nut," or "macadamia nut."

Hitherto, the excessive hardness of shell of some of the more widely distributed types precluded their common use. However, trees have been located which bear nuts with shells thin enough to be cracked with an ordinary nutcracker, and the cultivation of this type is extending in Australia, particularly in the coastal districts of southern Queensland, where conditions are naturally suitable for commercial production.

This native nut is highly nutritious and is one of the richest oil-yielding nuts known, producing about 76 per cent. oil in many respects equal in quality to the best olive oil. An undoubted market exists for the nut, and the success of the industry is assured provided quality, uniformity, and continuity of supply are maintained.

Description.

When growing naturally in rain forests, the nut tree attains a height of from 50 to 60 feet, and branches out when it surmounts the surrounding jungle. Under cultivation, or when growing out in the open, the tree (Plates 132 and 133) is a robust, handsome, evergreen with rounded top and branches clothed closely with glossy, light-green to dark olive-green foliage. The young leaves, which are greenish-yellow, yellow, pink, or red in colour according to type, are produced from terminal buds at the base of the leaf axils. The tree is not deciduous, but a definite resting period during the colder months is observed, the time varying according to climatic conditions. The stalked flowers are borne in pairs along a long axis and form a long, narrow inflorescence (Plate 134). The blooms are very attractive to bees and other useful

Plate 132.
QUEENSLAND NUT TREE IN BEARING.—A close examination will show the clusters of nuts.

insects; consequently, pollination is largely unrestricted. As pointed out later, however, the proportion of nuts set on each inflorescence varies considerably.

The kernels are encased in a brown shell (Plate 135) varying from the common, thick, hard type to one thin enough to be cracked easily with an ordinary nutcracker. Some of the thin-shelled types, however, crack open prematurely on the trees and the planting of these should be avoided. The nut kernel is creamy-white in colour, rich in flavour and oils, and possesses excellent keeping qualities. The whole nut, which is enclosed in a green, rounded pericarp or husk, matures in about six months after setting. A sure sign of maturity is the opening of the husk, which allows the nut to fall to the ground. Sometimes the

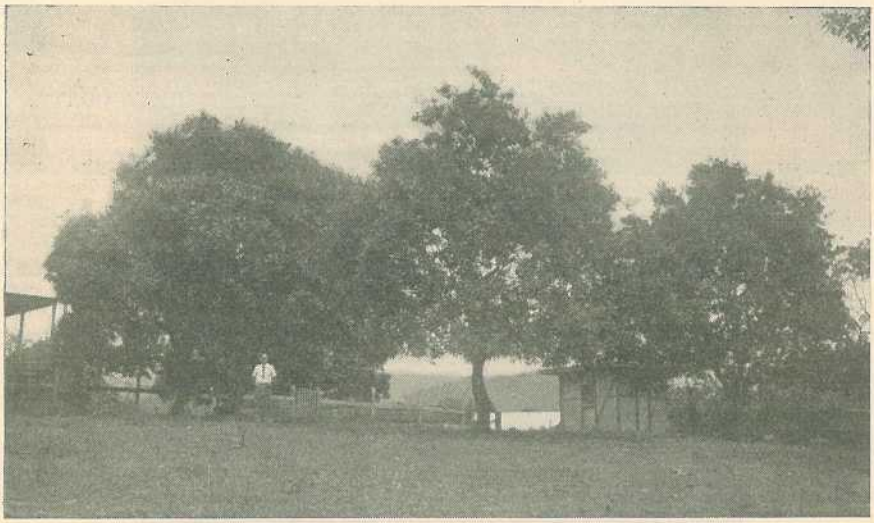

Plate 133.
THE QUEENSLAND NUT IS A WELL-SHAPED SHADE TREE AND, WHEN GROWN AS A GROVE, PROVIDES A PICTURESQUE SETTING FOR A FARM HOMESTEAD.

partially opened husk, with the nut still enclosed, will fall to the ground, but this is not indicative of false maturity, and these nuts may be safely included with others which have fallen clear of the husk.

Root production in *M. ternifolia* is vigorous, the primary root at an early age being almost twice the length of the seedling's aerial growth. Secondary roots are rapidly developed; they are well spaced and travel deep down into the soil, anchoring the tree firmly in its position, and giving a wide spread of feeding rootlets. In the variety *integrifolia*

Plate 134.
BLOSSOMS OF THE QUEENSLAND NUT.

there is always a tendency for the secondary roots to be rather shallow, and they travel for great distances just a few inches below the soil surface; consequently, great care should be taken during cultivation, otherwise many roots will be cut and the hold of the tree in the ground weakened to the extent that it may be blown down by a strong wind.

A remarkable thing about the Queensland nut tree is that, although it is found growing naturally where there is a good average rainfall, when grown under cultivation it is fairly drought-resistant after it has become firmly established. Under suitable conditions, the trees may be expected to bear commercial crops for at least 50 years, and examples of trees 45-60 years old which are still bearing large crops of nuts can be cited. It is quite probable that the life of individual trees may extend to upwards of 100 years.

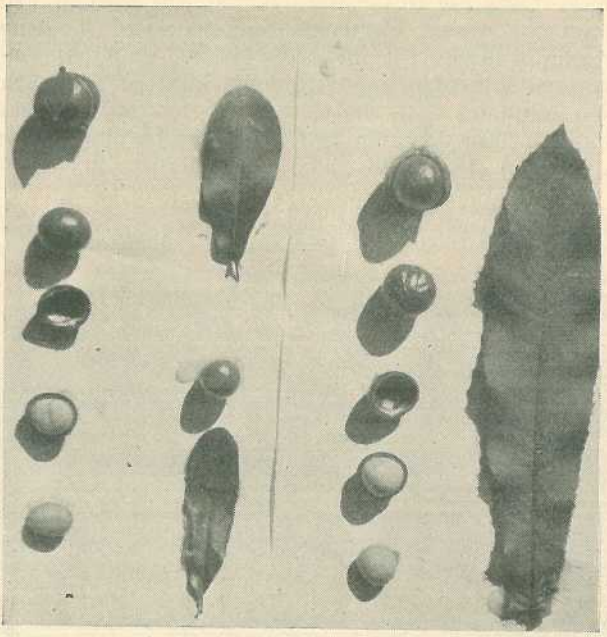

Plate 135.

LEAVES, NUTS IN HUSKS, NUTS WHOLE AND CRACKED, AND KERNELS.

The Queensland nut has been grown in Hawaii in small groves since its introduction from Australia in 1892. It is known there as Macadamia nut.

In 1939 the plantings in Queensland aggregated about 800 acres containing 60,000 trees, most of which were less than fifteen years old. The plantings consisted entirely of seedling trees, the seed having been selected from old trees noted for high yields of nuts of good quality. Both types—*ternifolia* and var. *integrifolia*—were grown and and their marked differences in vegetative and nut characteristics have been noted.

Location and Soil.

The Queensland nut tree thrives in competition with all types of trees which make up coastal rain-forest country, and is also readily

established under cultivation in a very wide variety of soils, ranging from open eucalypt forest soils to fertile alluvial flats. Unsatisfactory growth on poor coastal sands has, however, been noted. Seedlings planted in these poor sands appear to stand still or else develop into scantily-foliaged, stunted trees. Under natural conditions, the tree will be found growing along watercourses in association with hoop pine, where the clay is but a few inches beneath the surface, and its vigour will favourably compare with that of other nut trees growing in association with cedar, carrabin, and similar soft woods indicative of the richness of the loams supporting the heavy rain forests wherein they are found. Mild frosts do little harm, except to young growth.

The general recommendations in selecting an orchard site apply to a nut plantation, except, perhaps, that soil requirements need not be so exacting if the trees are to be planted with the idea of growing small crops between the rows. Furthermore, because of the length of time which must elapse before the nut trees become profitable, consideration may be given to interplanting with some kind of fruit, the economic life of which coincides with the time taken by the nut trees to attain full development. For example, nut trees may be planted between rows of bananas, papaws (Plate 136), and passion fruit. By the time planta-

Plate 136.

QUEENSLAND NUT TREES INTERPLANTED WITH PAPAWS.

tions of those fruits have become commercially unprofitable, the nut trees will have become firmly established without affecting to any noticeable extent the productivity of fruit trees or vines with which they have been interplanted.

Situations exposed to high cold winds should be avoided, as shelter is necessary for the protection of young nuts. They are easily broken off by impact with limbs and rough edges of leaves, and by the force of strong winds. Cold also delays the ripening of pollen, and adversely affects fertilization of the flowers, resulting in irregular setting and scanty filling of the nut clusters. Good drainage is essential for the

satisfactory development of an adequate root system, and where it is lacking it should be provided. Waterlogged situations are quite unsuitable, for, even if they do not perish, the trees will not thrive there.

From observations in districts which are regarded as the natural habitat of the Queensland nut, it appears that altitudes above 1,500 feet are unsuitable for its vigorous development; few trees are found in higher rain-forest country. Attempts to establish Queensland nut groves at altitudes of 2,000 feet and over on rich soil have been mostly disappointing. The young trees definitely lack natural vigour in comparison with trees of similar age planted at lower altitudes. In brief, the Queensland nut thrives best under conditions commonly required for growing bananas and papaws.

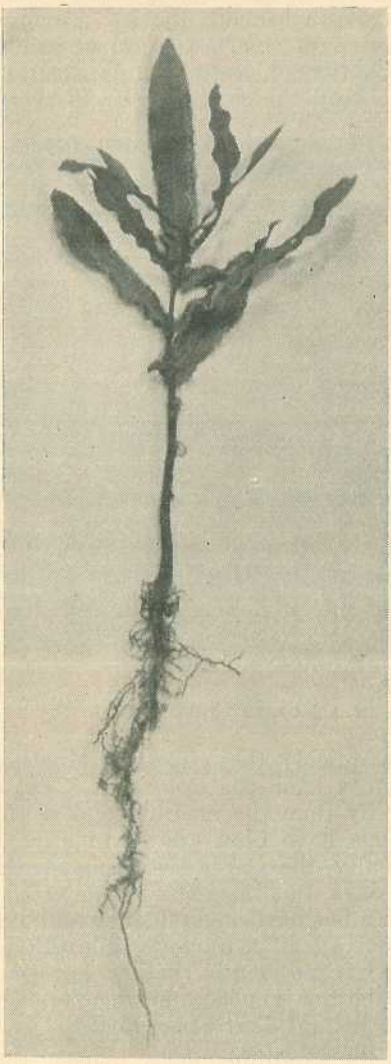

Plate 137.
A SEEDLING QUEENSLAND NUT TREE.—Note the length of root.

For some reason, certain sections of "scrub," in districts where the trees grow naturally, are bare of Queensland nut trees. For instance, through the lower Little Nerang Valley, from Talai Mountain, in the north-east, to Wunburra, in the south-east, they are not to be found. Searches made through "scrubs" from the junction of the Little Nerang with the Big Nerang at Gilston up to Wunburra Mountain at the north-east of Springbrook have failed to reveal a single nut tree. On the western side of the range, in the Nerang Valley, the eastern side in the Mudgeeraba Valley, and below the junction of the two creeks at Gilston, the trees grow and flourish naturally.

Two small groves planted on the western side of Talai Mountain are producing nuts of moderate quality, but the trees have developed a spindly growth under cultivation, in contrast with the sturdy, stocky growth common in more favourable situations in other parts of the district.

Propagation.

Propagation at present is confined chiefly to the raising of seedlings (Plate 137). Grafting young seedlings with scions from trees possessing desirable characteristics is engaging the attention of experimentalists, who are hopeful of overcoming a natural difficulty which is in the way of the complete success of this work.

Until they reach bearing stage, trees raised from seed must be

regarded as an unknown quantity, because of the effect of cross pollination. No information is yet available as to the percentage of seedlings which will bear true to type and possess the characteristics of the parent tree. As a general recommendation, seed should be obtained from trees which have been selected for their vigour, productivity, desirable habit, freedom from disease, and earliness in reaching commercial bearing, and, in regard to the nuts, the shape, thinness of shell, size of kernel, flavour, and oil content.

Most satisfactory germination is obtained by planting the nuts immediately after they fall from the tree, when at least a 70 per cent. strike may be expected. Although the nut keeps well, good results have not been attained by the planting of old and indifferent quality nuts. The nuts should be removed from the husk (but not from the shell) and planted on their sides about their own depth beneath the surface in a well-prepared seed-bed, or in boxes filled with river-bed sand or sandy loam. Seed boxes should be placed in a sheltered, warm, handy position where they can be watered regularly to keep the sand moist. Without

Plate 138.
QUEENSLAND NUT SEEDLINGS IN A NURSERY BED.

frequent watering the young seedlings quickly die. The germination period varies considerably, even with nuts from the same tree. Thin-shelled nuts germinate much more quickly than the medium and thick-shelled types; some thin-shelled seedlings have been known to appear within two weeks from planting. Normally, the young seedlings should appear above ground at from 30 to 90 days, but instances of up to 150 days are known. When the young growth has hardened off, the seedlings should be lifted and planted about 1 foot apart in nursery beds (Plate 138) and well watered. If seedlings are left too long in shallow germination boxes the primary root reaches the bottom and becomes malformed, and the growth and development of the young plant are retarded.

Another successful method of raising seedlings is to inspect the nuts in the sand boxes at intervals of a few days after the first two or three weeks of sowing, and to remove any which are showing signs of

cracking and plant them at intervals of 12 inches in a nursery bed, or in 12-inch pots, where they should remain until the young seedlings have developed sufficiently for planting in their permanent positions in the field. They must, however, be handled carefully, so as not to damage the young root tip.

It will be found that, irrespective of which of the abovementioned germination methods is adopted, the young plants will grow better if transplanted into nursery rows from the seed box or seed bed. Root development is then more vigorous and the young trees have more room to grow. By the following spring, or when the seedlings are about six months old, they should be from 6 to 9 inches high, and, provided weather conditions are suitable, will be far enough advanced for transplanting permanently. If the weather is dry they may be left until autumn.

Planting nuts in empty 2-lb. jam or fruit tins, the bottoms of which have been perforated all round the edge with a nail, is also recommended. After perforation the tins are filled with sand or sandy loam, then well soaked to settle down the loam. Afterwards the nuts are planted as already described and the tins treated in the same manner as seed boxes. The principal advantage of this method is that the seedlings need not be planted out into a nursery bed but may remain in the tins until large enough to transplant. When planting out, the bottoms of the tins are easily removed by breaking away at the line of nail holes, and the whole planted without disturbance to the root system of the seedling; consequently losses—particularly in the dry spring—are greatly reduced. The sides of the tin rust away before having any detrimental effect on the growth of the tree.

The germination of individual nuts is so uncertain that it is inadvisable to plant them direct into the field. Warmth and moisture and attention are essential for rapid germination, and these are best provided by following the procedures outlined.

Planting.

In digging the trees from the nursery rows, they should be removed as carefully as possible to avoid excessive injury to the roots. If the tap root is broken during digging, the injured portion should be cleanly cut off above the point of mutilation. The tap root normally is long, and may be pruned back in young seedlings to about 12 inches. It is advisable to soak the bed thoroughly a few hours before lifting the young trees. They will then be easier to extract from the ground without injury to the roots. The digging of a trench 15 to 18 inches deep alongside the rows and about 8 or 9 inches from the plants will simplify digging; alternatively, a spade may be pushed down about 8 or 9 inches from the young seedlings a week or so before lifting to sever the long secondary roots and so facilitate lifting.

The last growth should be allowed to harden off before the young trees are transplanted, otherwise many failures will result. Seedlings planted out during the rainy season—February to April—quickly establish themselves, and fewer losses will follow transplanting. There is then plenty of moisture in the soil, while frequent showers and high humidity assist the young trees to rapidly recover from the shock of disturbance.

Where different varieties are to be grown in the same grove, they should be kept apart, each variety being planted in a block or row by itself. By so doing, the nuts from each variety can be kept separate during harvesting; this is most important, because thin-shelled nuts should be marketed separately. Furthermore, if everbearing trees are mixed with other varieties, nuts in different stages of maturity will often be included in the same parcel, causing dissatisfaction to buyers and disappointing returns to the grower.

If the seedlings are planted with other fruits, planting distances will be more or less governed by the fruit tree rows, but experience has shown that a minimum of 20 feet and a maximum of 30 feet between trees will give satisfactory results. The square system of planting is most popular because of the ease with which cultivation can be carried on. In the hexagonal system, the tree rows are staggered, and 15 per cent. more trees may be planted to the acre. Another method of planting, which has much to commend it, is to plant 15 feet apart on the square and, after the trees are ten years old—or sooner, if the branches become interlocked—to cut out every second tree, leaving a final spacing of 30 feet by 30 feet. This method is very successful where a grove is planted with the idea of dispensing with interplanting of small crops after the third year. Under the lastmentioned method a much larger acreage return is naturally obtained during the first years of bearing, helping to offset the cost of maintaining the grove from time of planting to time of coming into profit; furthermore, the close planting for that period does not appear to affect adversely the growth or bearing capacity of the trees, while it has been suggested that pollination is improved.

To calculate the number of trees to the acre when planted on the square, multiply the distances apart in feet and divide the result into 43,560, the number of square feet in 1 acre. The following table gives the approximate number of trees to the acre when planted at the distance shown:—

Distance Apart.	Number of Trees per Acre.	
	Square.	Hexagonal.
15 feet	190	220
20 feet	109	125
25 feet	70	80
26 feet	64	75
27 feet	60	69
28 feet	55	63
29 feet	51	58
30 feet	48	53

One of the first essentials in successfully establishing a grove is to thoroughly prepare the land before planting by ploughing and harrowing until the soil has been worked to a satisfactory tilth. Where it is impracticable to plough the land, then the work must be done by hand, a forked hoe being the most suitable implement for the purpose.

Having decided the distances apart the trees are to be planted, the next thing to do is to measure the land and peg the positions the trees are to occupy.

When digging the holes, the surface soil should be taken out first and placed on one side. The subsoil should then be well broken up deeply enough to allow the tree to be planted to a similar depth to that occupied in the nursery bed. The holes need only be wide enough to allow the roots to be properly spaced without cramping. A small mound of top soil should be placed in the bottom of the hole and the roots evenly spaced outward and downwards at an angle of about 45 degrees, the spaces between the roots being filled in with fine soil and pressed firmly. Before the hole is completely refilled, water should be applied and allowed to soak well in.

Should the weather be hot or the position be exposed to high winds, shade and supports should be provided. For shade, a piece of hessian or brush placed over stakes supporting the young trees is sufficient. A satisfactory way of providing supports is to drive three or four stakes well into the ground around each tree, and to these it is held firmly by tying with strips of hessian or galvanised iron wire slipped through pieces of rubber hosing or similar material to prevent the trunk from being injured at point of contact. The stakes also help to protect the young trees during cultivation and also from grazing cattle, when they are planted in open grazing paddocks. Apart from cattle eating the young shoots, the continued breaking of tender growth results in the development of stunted and malformed trees.

In hare-infested districts, it is necessary to provide protection either by netting fences or by wrapping the young trunks in protective material to prevent their being girdled. Hares have a liking for the recently hardened bark, and considerable losses have resulted from their activities.

[TO BE CONTINUED.]

TOMATO SEED-BEDS—A CORRECTION.

The concluding paragraph of Mr. C. N. Morgan's article on Tomato Seed-beds, which appeared in the last number of the Journal, should read:—

"There are approximately 10,000 seeds to an ounce, and although good seed has a very high germination percentage it is always advisable to plant sufficient to make allowance for non-fertile seed and unsuitable plants. It is recommended that at least 1½ oz. of seed be sown for each acre of field—i.e., 2,000 plants."

APPLIED BOTANY

Chicory—A Weed Pest Often Confused with Skeleton Weed.

C. T. WHITE, Government Botanist.

DURING the past few months several farmers on the Darling Downs, who had become alarmed over the appearance on their properties of a plant they thought was the notorious skeleton weed, submitted specimens of the suspected plant. In all cases it proved to be chicory. Chicory root is a well known adulterant of coffee, and cultivated types produce a thick, carrot-like tap root suitable for drying and grinding. In its wild state, however, the tap root becomes long and fibrous and of no value commercially. It is easy to see how the plant may be mistaken for skeleton weed by people who have never seen that pest, for the numerous, twiggy, leafless stems would immediately suggest a plant bearing a common name like skeleton weed or skeleton plant.

True skeleton weed has not yet been found in Queensland but the two plants should easily be distinguished by the accompanying illustrations, taken from the Flora of France by the Rev. H. Coste. Chicory is a much branched plant, the flowers blue and borne in the axils of bracts or small leaves all the way up the stem. The bottom leaves are much lobed. The seeds are crowned by a ring of very small scales. In addition to its cultivation for the root, chicory is grown in continental Europe as a salad and cooking green. Endive is a closely allied plant.

Skeleton weed is also a branching plant of similar growth but the flowers are yellow. The seeds are very different from those of chicory. They bear at the top a long slender stalk carrying a tuft of hairs. By means of this parachute-like attachment the seeds may be carried for considerable distances.

Plate 139.
CHICORY.

Plate 140.
SKELETON WEED.

PLANT PROTECTION

Carrot Root Aphid.

HUBERT JARVIS, Research Officer.

TWO aphids have been found attacking carrots in Queensland but only one of them, the carrot root aphid*, is a pest of any consequence. This insect has been recorded from many parts of the State on the carrot—its most important cultivated host plant—on the parsnip, and on a number of weeds.

The damage caused by the aphid is not spectacular, for this pest normally occurs on the root of the plant where it is more or less concealed. However, it can usually be found on plants surrounded by the mounds of small brown ants, for these insects frequently live in association with the aphids. When such carrots are examined, colonies of small, whitish-grey aphids are seen along the root. In dull, cloudy weather, the aphids may emerge from the ground and shelter in the crown of the plant or even migrate to the leaves (Plate 141). Yellowing of the young leaves may follow, and this is accompanied by a certain amount of stunting in plant growth. The damage to the crop is not conspicuous. Yields may be affected by an overall reduction in the size of the roots, and malformations in the shape of the carrots are sometimes attributable to the presence of this insect, particularly if the attack begins when the plants are young.

Life History.

The adult aphid is about one-sixteenth of an inch in length, elongate-oval in shape, and covered with a whitish bloom which masks its light olive-brown colour. Both immature and full-grown insects occur in the one colony. Like many other aphids, the females produce living young and these reach maturity in twelve to fourteen days. Under suitable conditions, therefore, the aphid population may increase very rapidly. In spring, winged adults appear and odd specimens may then be seen on the leaves of the plants. Winged males are very rarely encountered, but they can be distinguished from the females by the presence of distinct, black spots on the abdomen. In temperate countries, the winged aphids migrate from summer to winter hosts but this phase of their activities is unimportant in Queensland. Like other aphids, the pest has sucking mouth parts which enable the insect to pierce the root or the leaf and suck the sap from it. The ants which

* *Anuraphis tulipae* Boy.

tend aphid colonies collect sweet secretions from the latter insect. The association is probably mutually advantageous; the ants garner food supplies very easily and the aphids are carried from plant to plant and thus well distributed through the cultivated area. The carrot aphid

Plate 141.
CARROT ROOT APHID.—Note the dense colonies in the crown of the plant and on the leaves.

has been recorded from carrots, parsnips, and some related plants. However, these are probably much less important in maintaining the insect from season to season than the common dock, the roots of which are almost always infested by the pest during the period of the year when carrots are not grown. Overseas, the carrot aphid injures the bulbs of some ornamental plants if they are stored for any length of time under semi-shade conditions, which are very favourable for the insect.

Control.

The importance of the carrot aphid in the crop depends on the time when the attack is initiated, the abundance of ants in the soil, and the weather conditions during the growing period. If the attack begins late and growing conditions are good, any ill effects are slight. Should the attack begin early in the growing period, however, and the weather continue cloudy for some weeks, the aphids may become very abundant and may congregate in the crowns of the plants where the damage can be most serious. Under these circumstances, control measures may have to be applied. A nicotine dust containing 3 per cent. of nicotine will, if used at weekly intervals, keep the crowns of the plants free from this pest. Treatment is, in practice, restricted to crops in which the crowns of the plants have been invaded and the condition of these crowns is perhaps the best index of the need or otherwise for treatment.

Beet Webworm.

HUBERT JARVIS, Research Officer.

BEETROOT is grown extensively in Queensland during the autumn, winter and spring months in most market-gardening areas. Though the crop is usually free from serious insect pests, the beet webworm* is sometimes responsible for considerable damage to the foliage.

Of the several beetroot plantings made during the season, only the first is likely to encounter a major outbreak of the webworm. This is accounted for by the fact that, in summer, this insect commonly feeds on black pigweed which is widely distributed in cultivated areas throughout the State. Hence, by the end of summer, webworm moths are usually very numerous and when the pigweed dies down during autumn, these moths may attack any cultivated beet which is growing rapidly. The larval stages of the insect feed on the lower surface of the leaf and, at first, the upper surface remains intact as a thin, colourless membrane pierced here and there by unevenly shaped holes. Within two or three weeks, the whole of the foliage of the plant may be more or less completely destroyed, each leaf consisting of a network of veins linked by an irregular membrane which is often twisted into grotesque shapes by silken strands spun by the older larvae (Plate 142). If the larvae on the plant have not reached maturity when defoliation is complete, they may actually gouge out holes in the exposed surface of the "root."

Life History and Habits.

The larvae responsible for the damage are the immature stages of a very common moth which is about three-quarters of an inch across the outstretched wings. The forewings are dark-brown in colour and are divided into two parts by an oblique, white band. These moths lay their small, bluish, oval, scale-like eggs singly or in pairs on the under surface of the leaves, usually alongside a vein. The larvae emerge from the eggs within four or five days and commence to feed. At first they are creamy-white in colour but greyish-green and black marks subsequently appear on the body which is also characterized by a distinct, black line down the middle of the back. The full-grown larvae are about one inch in length, somewhat spindle-shaped and usually stretched out so that the two prolegs on the last abdominal segment are distinctly visible. In severe outbreaks, one hundred or more larvae may be found on a single plant, some of them being sheltered within the folded parts of a leaf held together by silk spun by the insect. On completing their development, the larvae leave the plant and enter the soil where they spin cocoons near the "root" of the plant and often attached to it (Plate 143). The cocoons are about

* *Hymenia recurvalis* Zell.

Plate 142.
PART OF LEAF SHOWING BEET WEBWORM INJURY AND LARVAE.

half an inch in length and are usually covered with particles of soil but they can be distinguished from small clods by their characteristic oval shape. Inside the cocoons, the larvae change into the pupal stage which lasts approximately one week. The adult moths then emerge from the pupae, escape from the soil and take to the wing. The whole life cycle may thus be completed in approximately four weeks.

Control.

Control measures for this insect have not been studied in detail but there is some field evidence that an arsenate of lead dust applied in the early stages of an outbreak will do much to check the ravages of the pest. Two or more treatments at weekly intervals may be necessary if moths are entering the crop from outside areas and laying their eggs on the leaves continually. A suitable dust contains equal parts of arsenate of lead and an inert carrier such as kaolin or talc. As arsenate of lead is poisonous to human beings, applications of this insecticide must cease at least six weeks before the crop is harvested;

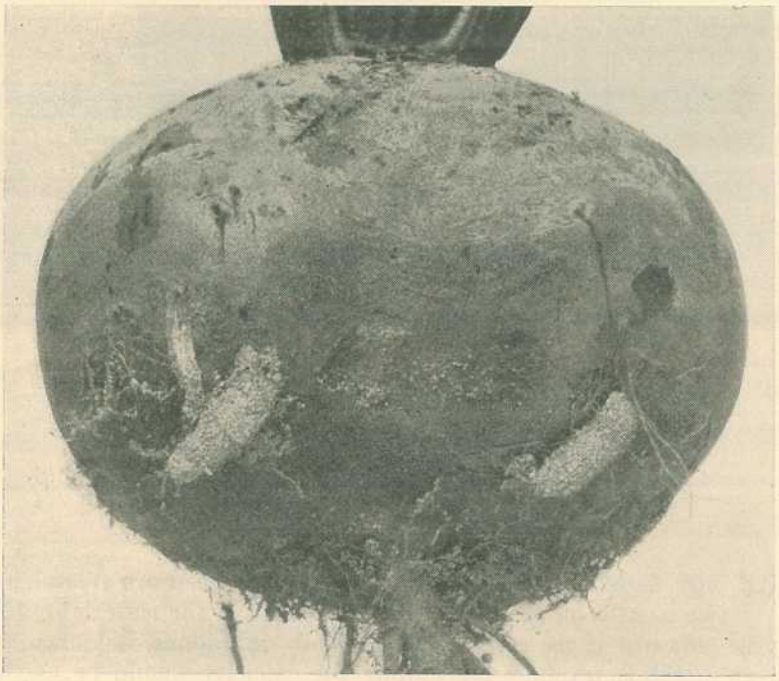

Plate 143.
BEETROOT WITH COCOONS OF THE BEET WEBWORM ATTACHED.

otherwise toxic residues may be present when the beet is marketed. Derris dust, however, may be substituted for arsenate of lead during the latter half of the growing period, but this dust should contain at least one per cent. of rotenone as the toxic constituent. Any insecticide used should be applied by means of a suitable dust gun with the nozzle near the ground and directed horizontally so that the dust surges up through the plants.

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Enquiries for advisory literature on other subjects would be welcomed.

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All applications for departmental publications should be addressed to **The Under Secretary, Department of Agriculture and Stock, Brisbane.**

Points for the Sheep-raiser.

J. L. HODGE, Senior Adviser in Sheep and Wool.

DIPPING SHEEP.

THE most satisfactory results are obtained if sheep are treated up to two months off shears. Correct strength of the material used can only be obtained if the capacity of the bath, in gallons, is known. The following simple formulæ for finding the capacity should be useful:—

Add together the length of the dip line and the length of the bottom in inches, and divide by two. This gives the average length. Obtain the average width in a similar manner, and multiply the average length by the average width in inches, and the product by the depth. Divide this by 231, and the result will be approximately number of gallons in the bath.

If liquid dips are to be used it is necessary only to add the prescribed quantity of the liquid in the proportion indicated. This should be done slowly and the bath content constantly stirred.

More care is necessary in the case of powder dips. Having ascertained the gallon contents of the bath, the powder should be apportioned as recommended on the packets. To mix thoroughly, take only a small portion of the powder and in convenient vessels add water and stir to the consistency of mustard. When the necessary amount of powder has been thus treated, add to the bath, constantly stirring from the bottom.

Never dip sheep in a heated condition. It is well to yard the previous night. Choose fine weather for the operation. Avoid if possible, extremes of heat and cold. Drain thoroughly. If practicable, dry in the shade. Do not drive sheep in such a manner as to cause overheating after dipping. If there are lambs at foot see that they do not suck for some two or three hours after their mothers have been immersed.

Any of the proprietary dips of known repute is recommended.

UNIFORMITY IN FAT LAMBS.

The time has arrived in Queensland when the question of uniformity in fat lambs should receive more attention at the hands of the producer. Knowledge gleaned from the experiments carried out by the Department of Agriculture and Stock points to certain definite conclusions. It should now be accepted as a fact that crossbred ewes are absolutely necessary for the production of first-class, early-maturing sucker lambs. It is estimated that the crossbred ewe beats the Merino by as much as a month. Apart from Corriedales, which are excellent for the purpose, the most favoured cross is got by the use of one of the long-woolled English rams on the biggest, boldest Merinos available. Romney Marsh and Border Leicester lend themselves spendidly for the purpose. In addition to the excellence of the lambs they produce, these ewes are valuable from a wool production point of view. With changed conditions crossbred wool is bringing its value, and this fact should no longer be neglected by fat lamb growers.

On the crossbred ewes as described South Downs and Dorset Horns have done best. Success, too, has been achieved, where necessity makes the use of Merino ewes compulsory, by the joining of Border Leicester rams. For coastal areas the Romney Marsh still holds pride of place.

This question of uniformity in fat lambs is an important one and growers should strive for the best, which throughout the past few years have always brought excellent prices despite market fluctuations that have hit owners of indifferent lambs so hard on occasion.

INCREASING POPULARITY OF CORRIEDALES IN QUEENSLAND.

As in the other States, this general utility sheep is deservedly taking its place amongst the flocks of Queensland. Evolved some seventy years ago, mainly to provide farmers with a good carcase animal, and at the same time a profitable wool producer, the breed has well fulfilled the position on farms intended for it.

The Corriedale was originated by crossing the pure-bred Merino with the Lincoln, the progeny being inbred to type. The length of time of the Corriedales existence, some seventy years, may, in the world of breeding, be regarded as a comparatively short space of time. This lack of longevity in the breed necessitates the greatest care in the maintenance of type. Generally speaking, the older the breed the greater certainty of animals reproducing to type. Hence, with the Corriedale, the necessity for heavy culling.

In Queensland there is a tendency to breed too fine a sheep. This defeats the object for which this breed was introduced. With too fine a fleece there goes a definite loss in size and constitution. Although a strong covering is advocated, there is no excuse for lack of quality.

A true Corriedale wool should be of comparatively great length, bright, and above all truly crimped for the whole length of the staple.

Deep culling is advised in Corriedale flocks, and the rejected animals should come from both ends as it were. Sheep showing lack of quality, and too much Lincoln, should be discarded, whilst those lacking in size and leaning towards Merino characteristics should be just as rigorously thrown out.

Well bred Corriedale wool is bringing a good price.

INCREASED LAMBING PERCENTAGES.

With a view to increased lambing percentages, graziers would be well advised to adopt a practice too little known and adopted in this State. This is the taking out of all dry ewes after the flock has lambed, with the idea of rejoining rams with that portion of the flock which is not suckling a lamb. The practice is not advised unless seasonal conditions are in its favour.

The handiest time to undertake this work is at lamb-marking time. The flock must be yarded for this operation, and it is no great trouble to run the flock through the race and draft three ways—wet ewes, dry ewes, and lambs to be operated upon. It has been found practicable to have a man squatting somewhere in the forcing pen in such a position as not to impede the movement of the sheep, but in such a position as to be able to indicate to the man at the gate the coming of a dry ewe. Where the flock is small ewes may be individually examined and the dry ones slightly raddled on the top of the head. It is then an easy matter to take them off at the drafting gate.

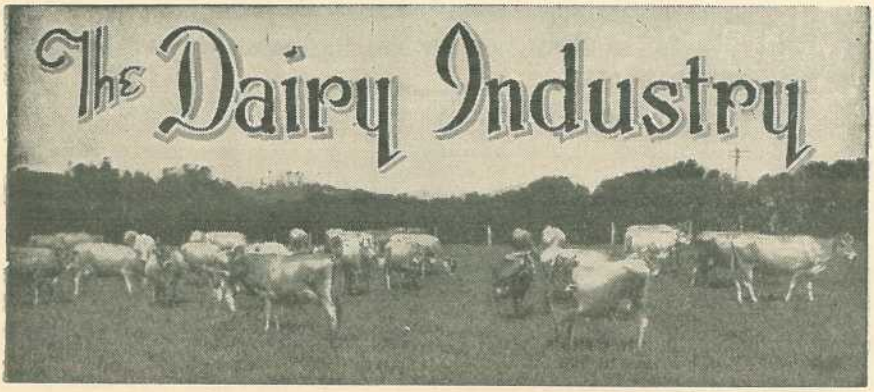
Where numbers permit it is advisable to join fresh rams.

The practice advised is useful also as indicating barren ewes in a flock. Given two chances without result, those ewes still dry should be joined with a flock destined for the market as fats.

WOOL CLASSING AND APPRAISEMENT.

Small growers, especially, would be well advised to give more attention to the proper classing of their clips. It is now the practice, in the case of badly prepared wool, for the appraisers to refuse to value such lines. The brokers handling the wool are ordered to have same reclassed, with consequential additional expense to the grower. The delay entailed in payment, too, is a consideration. Length of staple, quality, and type should be the chief guiding factors to the small producer. Generally speaking, the larger clips are prepared for market satisfactorily, but even here, in some cases, there is room for improvement. Scarcity of shed hands is sometimes reflected in the treatment of the lower lines especially. The difference in broken and pieces could be better indicated. Stains are apt to creep into the pieces lines.

Farmers incapable of properly preparing their wool for market should avail themselves of the service rendered by the Department of Agriculture and Stock. Under the Farmers' Wool Scheme farmers' wools are scientifically prepared for market at small cost. The monetary gain to the small man is undoubted.



Bacteria and Their Relation to Dairying.

E. B. RICE and O. St. J. KENT.

BACTERIA, popularly called microbes or germs, were first discovered in 1675 by a Dutchman named Leeuwenhoek; but it was not until about eighty years ago, when Pasteur made his wonderful discoveries in the field of applied bacteriology, that very much was found out about them. Louis Pasteur's discoveries brought improvement in surgical practice, introduced inoculation as a preventive measure against disease, and overcame defects in the fermentation industries of his day.

Milk and cream are of such high nutritive value that their spoilage by bacteria is very rapid unless every care is exercised in their production and handling. The most frequent cause of their deterioration is, in fact, from the activities of these most lowly of living organisms. Thus an elementary knowledge of bacteria and their activities is necessary for one to appreciate the importance of dairy hygiene.

Application to Industry.

At the outset it is advisable to correct the erroneous impression, so frequently held, that all bacteria are harmful. Because a few species are well known as the cause of certain diseases which take a heavy toll of life, bacteria have gained a reputation which is not wholly deserved. Of the numerous species known, those which are detrimental to animal and plant life, or are objectionable in industrial processes, are relatively few indeed; and, were it not for the activities of some types, several important industries might not be in existence to-day. The fermentation industries, such as brewing, winemaking, and vinegar manufacture, depend upon the specific functions of certain bacteria. The dairy industry itself must be regarded as one of the major fermentation industries; cheese, especially, could not be made without the aid of bacteria. The making of silage, a valuable food for dairy stock, depends on the development of certain bacteria, which produce acid in the green fodder and so prevent putrefaction and decay.

Shape and Arrangement of Bacteria.

Bacteria occur in three fundamental forms, which are illustrated in Plate 144—

A, Spherical or rounded form (coccus);
B, Rod-shaped form (bacillus);
C, Bent, curved or spiral form (spirillum).

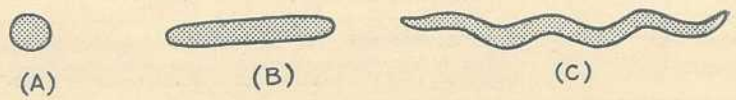


Plate 144.

ILLUSTRATING THREE DIFFERENT FORMS OF BACTERIA.—(*a*) Coccus; (*b*) Bacillus; (*c*) Spirillum.

Bacteria do not always occur singly. Certain types of bacteria are characterised by the manner in which they arrange their individual cells. Thus we have the following well-known arrangements (Plate 145) and their names:—

(i) *Streptococcus:* This is the name given to a bacterium, spherical in shape, which is capable of existing in chains.

(ii.) *Streptobacterium:* A rod-shaped bacterium, capable of existing in chains.

(iii.) *Micrococcus:* A spherical-shaped bacterium, existing either singly or in groups of four (tetrads).

(iv.) *Diplococcus:* A spherical-shaped bacterium existing in pairs. The common milk-souring organism belongs to this group. This is a sub-group of the Streptococci.

(v.) *Sarcina:* Bacteria existing in bundles of regular appearance, similar to apples packed in a case.

(vi.) *Staphylococcus:* Spherical-shaped bacteria existing in irregular or grape-like bundles.

Whilst the three shapes illustrated in Plate 144 broadly indicate the appearance of bacteria, it should be understood that there are bacteria which assume shapes which occupy an intermediate position between the well-defined coccus and the well-defined bacillus—e.g., a short rod with rounded ends and a coccus, oval in shape, are sometimes difficult to distinguish under a microscope.

Size and Growth.

Bacteria can only be observed by the aid of a powerful microscope. Some idea of their extreme minuteness may be gathered from the popular illustration that 25,000 bacteria of average size, when placed end to end in a row, would just stretch across a halfpenny, which is exactly 1 inch in diameter. They consist essentially of the substance protoplasm, which is the foundation of all living matter, surrounded by a membrane called the cell wall. The jellyfish, or common sea blubber, is made up almost entirely of protoplasmic material. The rapid growth of bacteria, coupled with the undesirable changes in milk constituents as a result of the activities of certain species, renders them of much account in dairying.

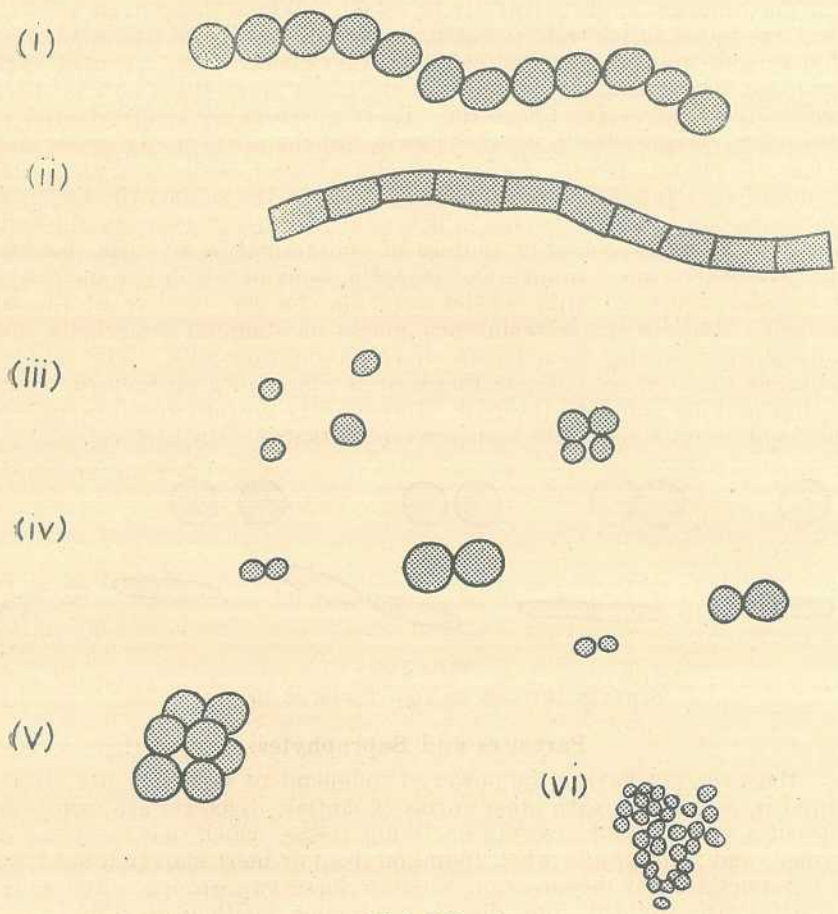


Plate 145.

SHOWING VARIOUS ARRANGEMENTS OF BACTERIAL CELLS.—(i.) Streptococcus; (ii.) Streptobacterium; (iii.) Micrococcus; (iv.) Diplococcus; (v.) Sarcina; (vi.) Staphylococcus.

The rapidity of development is bound up with their method of reproduction, which is extremely simple; the bacterium simply divides into two by a process known as fission (see Plate 146), and the new cells are known as daughter cells. Under suitable conditions, a single bacterium is able to divide into two within a period of thirty minutes; in the succeeding thirty minutes these two become four, and increase to eight after the next interval of thirty minutes. So rapid is their multiplication that in less than twenty-four hours the progeny of the original single bacterium would number millions. Fortunately, under natural conditions the by-products resulting from the activities of the bacteria on the nutritive substances upon which they are subsisting, exert a retarding influence on their rate of growth, so that the actual numbers fall short of what they would be were ideal conditions possible.

Where Bacteria Exist.

The question might naturally be asked, "Where do bacteria exist?" They are found in the soil, in water, in the air, and in the digestive tract of man and animals—in fact, almost everywhere. The air over high mountain peaks and over the sea some miles from the shore is often sterile—that is, free from bacteria. Their numbers are relatively few in the open air, especially in rural districts, but the air of a city street may be heavily contaminated. Unless the cow's udder is diseased there are normally very few bacteria in milk as it leaves the udder, the bacterial contamination arising *after* the milk is drawn. Dust and flies in the bails and dairy may be potential sources of contamination of milk, because they always transport numbers of bacteria, some of which are the causes of serious defects of milk. Flies may also be the carriers of disease bacteria. Impure water from such places as stagnant waterholes and dams sometimes may be a means of contaminating milk. The udders, flanks, and tails of the cows wading in such places pick up bacteria which during milking fall into the pail. Imperfectly cleaned utensils are the chief source by which milk becomes contaminated with bacteria.

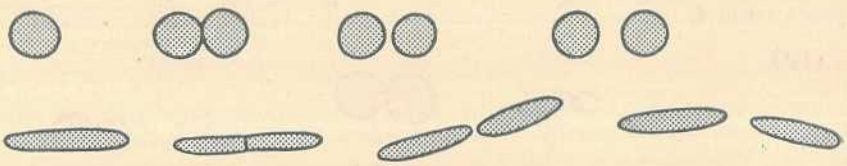


Plate 146.
SHOWING DIVISION OF TWO TYPES OF BACTERIA.

Parasites and Saprophytes.

Bacteria, not having the power of independent existence, are always found in association with other forms of matter. Bacteria are said to be *parasites* when found growing on living tissue, which may be plant or animal, and *saprophytes* when found on dead or inert material, but there is no strict line of demarcation between these two groups. Again, the parasites are divided into disease-producing (pathogenic) and non-disease producing (non-pathogenic) bacteria. An organism may be pathogenic for animals, yet non-pathogenic for man.

The Food of Bacteria.

As with all other forms of life, moisture is essential for bacterial development. Similarly food is required, but obviously in exceedingly small quantities; even "pure" water will support some bacterial growth. Altogether about twelve different chemical elements are required for the nutrition of bacteria, but the most important of these are nitrogen, carbon, and oxygen. Of these, nitrogen is found in the casein and albumen of milk, whilst the carbon and oxygen exist in the milk-sugar and fat. A teaspoonful of milky solution left in a cream can or other utensil after cleaning is capable of sustaining the growth of millions of bacteria, which would immediately seed any fresh milk or cream introduced into the vessel, and so quickly cause deterioration. The reason why the proper cleansing and thorough drying of dairy utensils is always stressed is thus apparent, because so long as there is a complete absence of moisture any few bacteria which may remain behind after washing the vessel will be prevented from increasing in numbers.

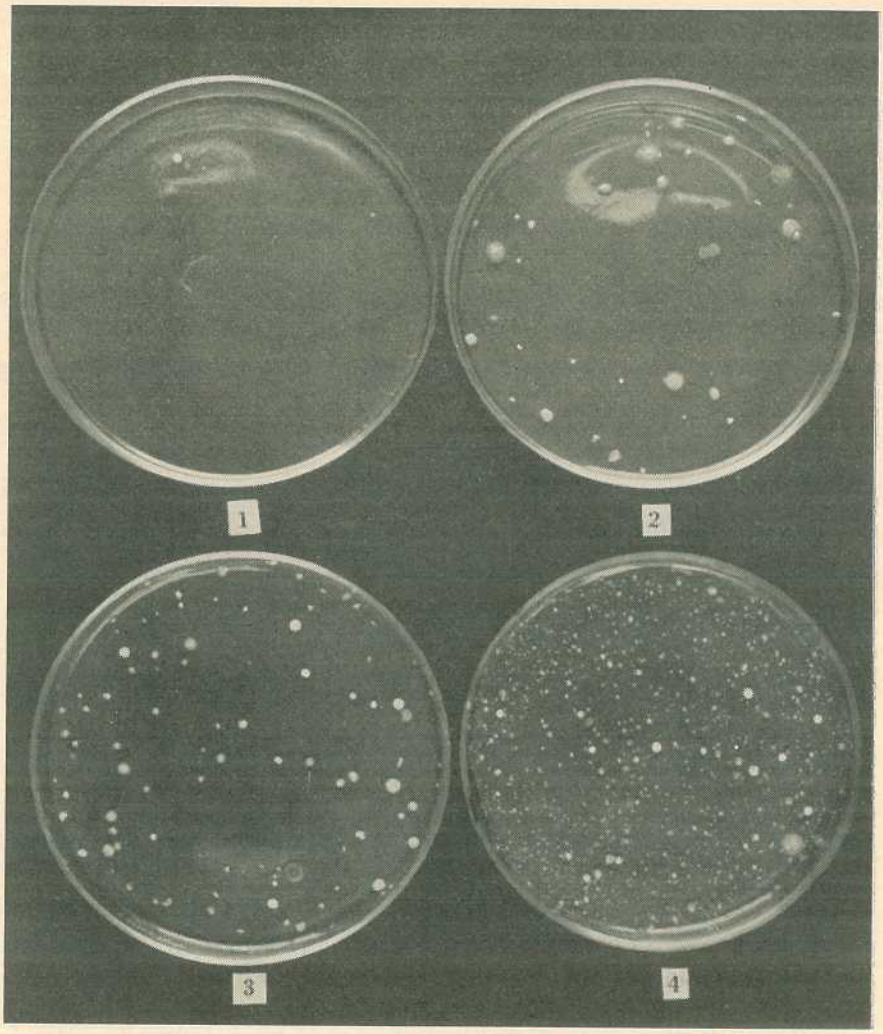


Plate 147.

BACTERIA FROM MILK.—Photograph of bacterial colonies growing on petri-dishes (or plates). Each colony has developed from a single bacterium, fixed in position on a jelly-like food (agar medium). The four plates show milks of varying degrees of bacterial cleanliness.

How Bacteria Feed.

All microbes have a cell wall or "skin" through which all solid matter must pass before it may be used as food. Most food decomposed by bacteria is solid, and it is perhaps difficult to imagine just how this solid material is able to pass through the cell wall. What happens is this: The bacteria secrete substances called "enzymes" which act on the solid or insoluble food and make it soluble, so that it is then able to pass through the cell wall as food. It may be mentioned here that enzymes find practical application in the dairy industry. Cheese-making depends on the action of the enzyme called rennin, which is found in rennet used for coagulation of the milk. The defect known as sweet curdling is brought about by the secretion of an enzyme by certain bacteria.

Oxygen Supply.

Oxygen is necessary for the growth of all bacteria. Those which use oxygen from the air or water are called *aerobic*, and those which do not or cannot use free oxygen are called *anaerobic* bacteria. They obtain their oxygen from such solid food as milk-sugar and fats. Those bacteria which can utilise oxygen from both sources are called *facultative* bacteria.

Influence of Temperature.

Each bacterium has a temperature which is most favourable to its growth. This is called its *optimum* temperature. Each kind has a *minimum* temperature below which growth is impossible and also a *maximum* temperature above which no reproduction occurs. The range between these two points may be a few degrees or many; for instance, bacteria, which cause tuberculosis grow close to body heat, 96 deg.—105 deg. F., whilst the common lactic acid bacteria grow from 50 deg.—100 deg. F. The minimum temperature for some bacteria is below freezing point; the maximum for others is above 150 deg. F. Freezing prevents development of bacteria, but does not necessarily kill them; they remain dormant. Freezing cannot therefore be used to destroy bacteria in butter, which is generally stored well below freezing point. When the temperature is raised above its maximum, the bacterium is soon destroyed. Moist heat has a greater effect than dry heat. A temperature of 130-140 deg. F. for ten minutes in water will kill most bacteria found in dairy products. Some bacteria produce what is known as a spore, which may be likened to the seed of a plant. Spores are naturally more resistant than the bacteria in their ordinary vegetative or growing condition. Boiling water and steam are very effective in the treatment of dairy equipment and utensils. The process of pasteurising is an application of heat to kill bacteria, and the cooling process which follows the heating prevents any bacteria which may survive from developing. The warm temperature of the Queensland summer proves ideal for the development of most bacteria commonly found in milk, but bacterial growth is practically suspended at cold temperatures, such as are found on our winter nights. At temperatures of 50 deg. F. or lower growth is almost checked. The importance of cooling milk, cream, and other dairy products, and keeping them cool, is thus very obvious.

The following table, abstracted from Orla Jensen's "Dairy Bacteriology," illustrates nicely the influence of temperature on rate of growth:—

	Bacteria per millilitre.
Milk immediately after milking	1,480
Same milk, after standing eighteen hours—	
At deg. Fahr. 48	2,100
54	5,600
59	156,000
64	550,000
70	6,750,000

Temperature also has an important bearing upon the types of bacteria found in milk and cream. If cream can be maintained at 60 to 70 deg. F., which corresponds roughly with spring conditions in this State, the lactic acid bacteria which cause the familiar souring of milk will gain almost complete control in the cream and produce a desirable

fermentation in it. These bacteria may be regarded as friends of the butter and cheese manufacturer, for the acid produced by them, combined with the rapid growth at their optimum temperature, will assist in suppressing other species which bring about injurious fermentations. Milk intended for the liquid milk trade should contain as few bacteria as possible, as none can be designated "friendly" in such milk. At temperatures around 80-90 deg. F., which approximate Queensland summer conditions, many bacteria which are very objectionable in dairy produce become dominant. Although it is recognised that in the summer in many of the dairying districts of this State there are difficulties in the way of cooling cream or milk to an extent sufficient to prevent any increase in the numbers of bacteria, farmers would go a long way towards reducing considerably the high proportion of inferior cream which is delivered to factories in the summer if they were able to cool to and keep their cream at 60-70 deg. F. In cleanly produced cream held at 70 deg. F. the lactic acid bacteria will predominate and the cream will make up into choice butter under the Australian methods of butter manufacture.

Pasteurisation and Sterilization.

The word *pasteurisation* is used to commemorate the work of Pasteur, the distinguished French bacteriologist. The process consists in heating milk to a temperature high enough and for sufficient time to ensure the destruction of all disease-producing bacteria. The heating is followed by rapid cooling. Besides destroying all pathogens, most other bacteria are also destroyed. Pasteurisation was first used commercially by Louis Pasteur to preserve wines, and was later introduced into the dairying industry by Professor Storch, of Denmark. In the dairying industry in Australia practically all butter is made from pasteurised cream; most of the cheese is manufactured from pasteurised milk, and city milk supplies are being increasingly marketed in the pasteurised condition. Milk pasteurisation methods include a "short time-high temperature" system, which employs a temperature of 162 deg. F. for fifteen seconds, and a "holding" or "batch" system, employing a lower temperature of 145 deg. F. for thirty minutes. Both systems are efficient, and usually destroy 99 per cent. or more of the original vegetative bacterial forms in cleanly produced milk or cream; only spores and heat-tolerant vegetative forms will survive.

Pasteurisation not only destroys the tuberculosis and other disease germs, but is also industrially important in improving the keeping quality of milk, butter, and other dairy products. Butter could not otherwise be successfully made in Australia for export to the United Kingdom. In pasteurising cream for butter manufacture, continuous high temperature-short time machines are now entirely used in Queensland. Higher temperatures are used for cream than for milk pasteurisation, at least 180 deg. F. being employed.

Sterilization is a word which is sometimes confused with pasteurisation. It means that milk or any other substance has been heated so often or to such a high temperature that all living micro-organisms are destroyed. In order to sterilize milk without heating under pressure, it is essential that it be heated to boiling point for thirty minutes on each of three or more successive days. In the cleansing of dairy utensils it is not sufficient to have them physically clean, but they must also be near-sterilized either by immersion in boiling water or by subjecting them to steam sterilization.

Influence of Darkness and Sunlight.

Bacteria prefer darkness. Strong sunlight kills them. Well-lighted and ventilated bails and dairy buildings will assist to keep them in control. To obtain the maximum benefit from the natural light the bails should, other factors permitting, face north. Dairy farmers should bear in mind that sunlight is the cheapest germicide, but the subjection of improperly cleansed utensils to too much sunlight will result in a tallowy flavour being developed which will be imparted to milk or cream.

Effect of Chemicals.

Many chemicals are utilised either for destroying bacteria (disinfectants) or for preventing their growth (preservatives). In preserving samples for analysis, formalin, corrosive sublimate, and potassium dichromate are used. Boric acid is sometimes used as a preservative in dairy products, but is now prohibited in Queensland and most other countries. Chlorine compounds, such as hypochlorites and chloramines, are becoming the most popular disinfectants for dairy work.

Effect of Drying (Desiccation).

It has already been pointed out that all bacteria require water to enable them to grow and reproduce. If access to water is prevented by drying, then bacteria are either killed or rendered inert. Certain types are able to resist desiccation for considerable periods, becoming active again on receiving a water supply. For example, certain lactic acid bacteria are dried under vacuum and used in this dry powder form for distribution as cheese-starters. Dry milks or milk powders keep so long simply because they contain so little water.

Drying is an important factor in the control of bacterial activity. All utensils on the farm and in the factory should be cleaned carefully and then drained and allowed to dry thoroughly; this prevents bacteria from growing. Factory operatives should remember particularly those cans from the can-washer and allow them to dry properly before putting on the lids. It is important not to use cloths for drying utensils, as they are often a source of serious recontamination. Udder wash cloths should be cleaned and hung to dry between milkings, and when used again they should be dipped in a chlorine disinfectant solution.

Bactericidal Action of Blood.

It may be of interest to refer to the absence of bacteria in the blood-stream of a healthy animal or person. This is attributed to the ability of certain cells (white corpuscles) in the blood to digest bacteria which invade the blood stream. Not until this resistance is broken down, through ill-health or other cause, are bacteria able to survive and bring about disease.

Resistance to Unfavourable Environment.

A factor which renders the control of bacteria a difficult problem is their resistance to unfavourable conditions, such as lack of food, unsuitable temperatures, dryness, and so on. Mention has already been made of their ability to withstand unusual degrees of cold and heat. Certain bacteria—usually those the natural habitat of which is the soil—are able to form what is known as a spore, which may be compared with the seed of a plant. Like the seed, which is hardier than the plant itself, the bacterial spore is able to withstand adverse circumstances much better than the living cell. The hardihood of a spore may be indicated by

pointing out that boiling water is unable to destroy it, unless allowed to remain in contact for some time, and there is a record of spores of the anthrax bacillus which, after having been kept in a dried state for ten years, germinated when transferred to a suitable environment. Fortunately, few of the bacteria encountered in dairy products, unless they are produced and handled under conditions which can only be regarded as hygienically unsatisfactory, belong to the spore-forming group. Sporing organisms found in milk generally originate from soil.

Control of Bacterial Contamination.

Care in all stages of production and treatment on the farm and in conveyance to the factory is essential to produce and keep milk and cream free from excessive bacterial contamination. Strict observance of the few points enumerated hereunder would go far towards checking the activities of undesirable bacteria, and, incidentally, deriving the monetary reward which is now provided in the Dairy Produce Acts for cream of choice quality:—

(*a*) Examine cows regularly for indication of udder disorders.

(*b*) Clean flanks and udders with a cloth moistened in weak Condy's fluid or chlorine solution.

(*c*) Wash the hands before milking each animal.

(*d*) Thoroughly clean and dry utensils after use—

(i.) Rinse in lukewarm water.

(ii.) Scrub in a warm soda solution, or other approved cleanser, and rinse with plain boiling water.

(iii.) Immerse in boiling water, or steriilze with steam.

(iv.) Allow to drain and dry on a dust-free rack.

(*e*) Rinse all utensils just before milking with water sterilized with a chlorine compound.

(*f*) Cool milk and cream immediately and keep them cool.

(*g*) Exercise additional care in the summer months, when conditions are ideal for bacterial multiplication.

LOOK FOR THE WHITE JOURNAL WRAPPER.

It is not possible to notify subscribers by letter when their subscriptions expire. For some time it was the practice, when a new payment became due, to send the last paid-for Journal in a yellow wrapper. Yellow paper cannot now be obtained for this purpose, and in future a white wrapper will be used to remind subscribers that renewal is necessary.

Look for the white wrapper, as it may not be possible to supply copies missed by not renewing early.

ANIMAL HEALTH

Substitutes for the Bluestone and Nicotine Sulphate Worm Drench for Sheep.

F. H. S. ROBERTS, Animal Health Station, Yeerongpilly.

THE following table gives the drenches recommended for worm diseases in sheep in Queensland and their respective efficiencies against the various harmful species of worms:—

Drench.	Species of Worms Controlled.
Bluestone and arsenic	Large stomach worm (*Haemonchus contortus*)
Carbontetrachloride	Large stomach worm (*Haemonchus contortus*)
Bluestone	Large stomach worm (*Haemonchus contortus*)
Bluestone and nicotine sulphate ..	Large stomach worm (*Haemonchus contortus*) and hair worms (*Trichostrongylus* spp.)
Bluestone and tetrachlorethylene ..	Large stomach worm (*Haemonchus contortus*) and hair worms (*Trichostrongylus* spp.)
Phenothiazine	Large stomach worm (*Haemonchus contortus*), hair worms (*Trichostrongylus* spp.) and nodule worm (*Oesophagostomum columbianum*)

Conditions in most of the sheep country have been very dry during the past few months. This means that sheep are now going into the winter in very poor condition. Once the weather breaks, it is certain that outbreaks of disease due to hair worms will occur, particularly among the younger sheep, their low condition making them very susceptible to infestation.

An examination of the above table shows that there are three drenches which may be relied on to control trichostrongylosis or hair worm disease, namely, bluestone and nicotine sulphate, bluestone and tetrachlorethylene, and phenothiazine.

Stocks of nicotine sulphate in this country have been gradually diminishing and *to-day supplies are exhausted;* it is impossible to say when further supplies can be expected. There are, however, adequate supplies of tetrachlorethylene and phenothiazine. Both of these are more efficient against hair worms than nicotine sulphate. The advantages and disadvantages of these two drenches warrant some discussion.

Bluestone and Tetrachlorethylene.

(1) This drench is considered more effective against hair worms than nicotine sulphate, but not as efficient as phenothiazine.

(2) It is cheaper than phenothiazine but costs $\frac{4}{5}$d. per adult sheep.

(3) Tetrachlorethylene must be preceded by bluestone to be efficient, as it is one of those drenches which must be swallowed directly into the fourth stomach to give results. Any double operation of this nature,

drenching firstly with bluestone and then following up with tetrachlorethylene, is tedious and laborious. However, there are now available drenching guns which considerably simplify tetrachlorethylene administration and the two drugs can be given in the necessary sequence in a single operation. The Bacchus gun is sold by Elliotts and Australian Drug Pty. Ltd.; and a similar type of gun will shortly be marketed by Wilcox Mofflin Ltd.

(4) Like all drenches which depend on bluestone closing the oesophageal groove and being swallowed directly into the fourth stomach, bluestone and tetrachlorethylene will fail in about 10 per cent. of sheep.

(5) Tetrachlorethylene causes alarming symptoms in some sheep immediately following administration, but these are only temporary.

Phenothiazine.

(1) This, in the doses recommended is the most efficient drench available. It removes not only large and small stomach worms and hair worms, but is the only drench which has a high efficiency against nodule worm.

(2) Phenothiazine does not depend for its efficiency on being swallowed into the fourth stomach, thus it is effective in all sheep. It can be used to advantage on those sheep which fail to respond to the bluestone drenches.

(3) Through careless administration and subsequent handling of the flock, some damage may be caused to the fleece through staining, but with adequate care this can be avoided.

(4) Being insoluble in water, phenothiazine is administered as a suspension. Administration is, admittedly, not as easy as with soluble drenches, like bluestone and nicotine; but with modern preparations and suitable drenching guns, this does not present any real difficulty.

(5) The cost of phenothiazine is high—namely, 3½d. per adult sheep. To offset this, one must take into consideration its high efficiency. This means that fewer treatments would be required for a complete clean-up and indirectly a rapid and considerable reduction in the contamination of the pastures could be expected.

Before deciding which drench to use, it is necessary to make sure which species of worm is responsible for the outbreak. Considering efficiency, availability of supplies and costs, the following treatments are recommended:—

(*a*) *For large stomach worms* use bluestone alone, bluestone and arsenic, or carbontetrachloride. If the bluestone drenches are employed, the "tail" that fails to respond could be treated with carbontetrachloride or phenothiazine. Carbontetrachloride, like phenothiazine, is effective in all sheep. It should be used carefully, however, as it is sometimes responsible for serious mortalities.

(*b*) *For hair worms* use bluestone and tetrachlorethylene or phenothiazine. If bluestone and tetrachlorethylene is used, phenothiazine will be required for the "tail."

(*c*) *For nodule worm* use phenothiazine only.

Faults Observed in Performance of the Mules Operation.

G. R. MOULE, Government Veterinary Officer.

FIELD experience has shown that the Mules operation can give a remarkable degree of protection to sheep from blow fly attack provided that the operation is performed correctly. In last issue of the Journal the correct method of "Mulesing" sheep was described and the object of this article is to point out the main faults that appear to have been made by men performing the operation.

In the course of the last four years, hundreds of thousands of sheep have been treated and careful observations of treated sheep under fly wave conditions have been made to determine any faulty methods which have left the sheep still predisposed to fly attack.

This "follow-up" work has indicated that it is the sheep which have been incorrectly treated which have been struck under practical field conditions and it is thus incumbent on graziers who wish to protect their sheep by applying the Mules operation to watch for these faults and prevent their occurrence.

Common Faults.

When operating it is advisable to watch for the following:—

(i.) *Removal of Insufficient Skin.*—It is a major fault to take off too little skin. When operating on lambs at marking time as much skin as possible should be removed and when treating ewes and weaners the piece of skin removed from more heavily developed animals should be a good deal wider than that removed from the plain breached sheep. The same standard crescent-shaped cuts should, in general, be made on all animals irrespective of their development. Plate 148 shows the breech of a sheep whose breech has not been subjected to very radical treatment. This picture, which was taken only 24 hours after treatment, shows how the wrinkles only had been followed. A large fold has been left at (1) and the cuts have not come into the edge of the bare area at (2). As the operation has not been carried far enough down the breech a fold, that could cause trouble, is left at (3).

(ii.) *Uneven Stretching of "Bare Area."*—It is desirable to stretch the "bare area" evenly and to do this the two cuts should be about the same width for any one sheep. Plate 149 shows a sheep (24 hours after operation) which has not been treated in that way. The cut on the left side of the sheep commences with a nice sharp point and is wide enough opposite the bare area, but unfortunately it has not been carried down the inside of the crutch far enough. The cut on the other side is the same width all the way and while it may have removed any wrinkle that may have been present it would not have the desired effect of evenly stretching the bare area to its maximum size.

Plate 148.
INSUFFICIENT SKIN HAS BEEN REMOVED FROM THIS SHEEP.

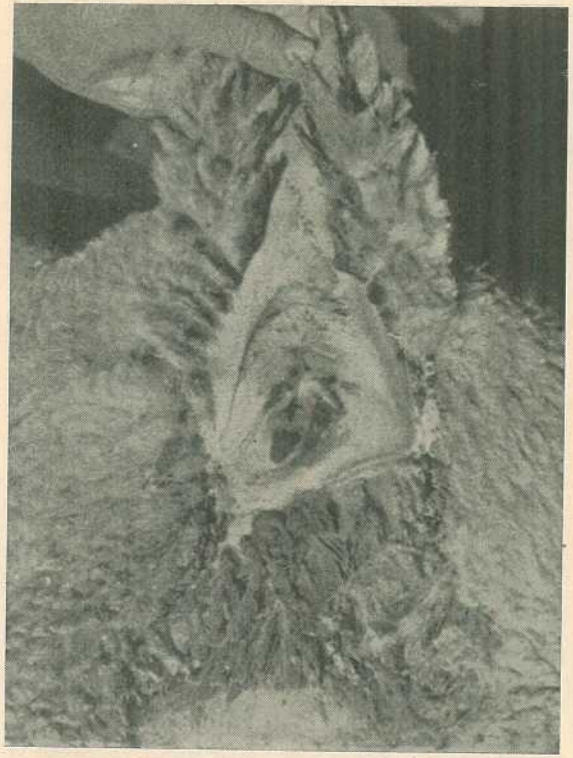


Plate 149.
"BARE AREA" NOT EVENLY STRETCHED.

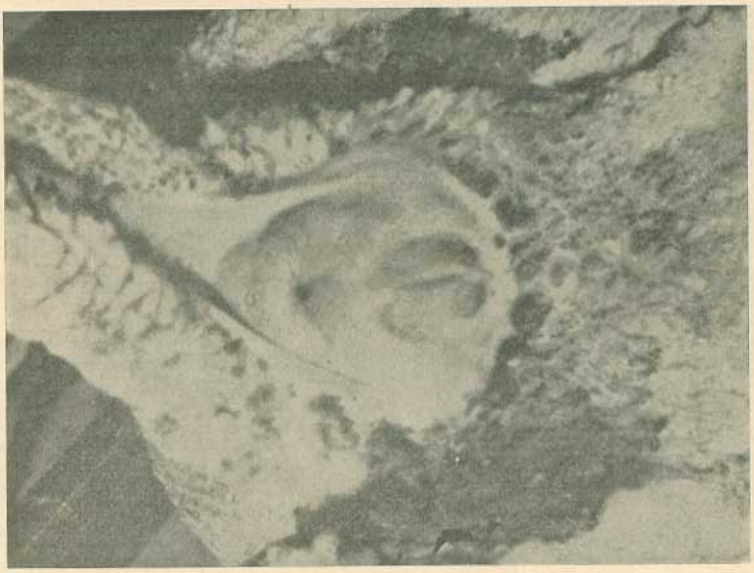


Plate 151.
THE RESULT OF CUTTING INTO THE "BARE AREA."

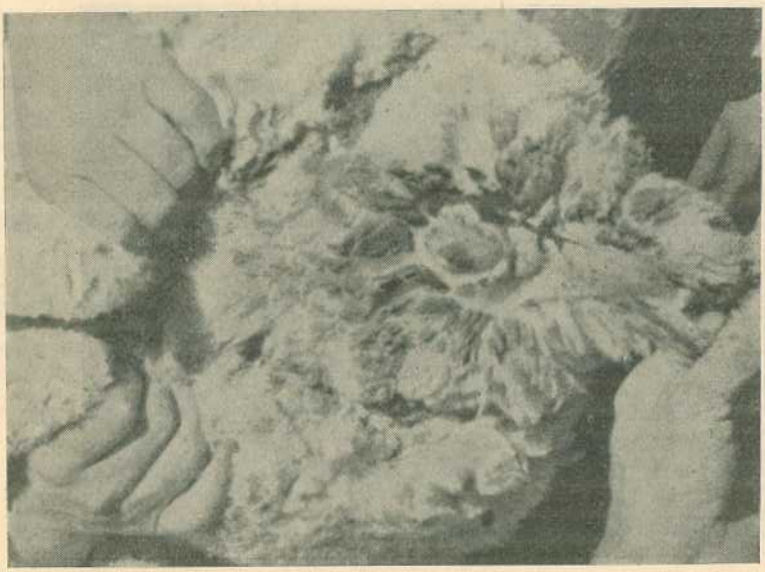


Plate 150.
"BARE AREA" INADEQUATELY STRETCHED.

(iii.) *Inadequate Stretching of "Bare Area."*—In order to stretch the "bare area" it is important that the cuts should come just to the edge of the bare skin. Plate 150 shows a lamb, one month after treatment, in which the operation has been radical enough but the cuts have been made too far away from the edge of the bare area. The result has not been satisfactory as the bare area is practically unaffected by this treatment.

(iv.) *Cutting into "Bare Area."*—One of the worst mistakes that can be made is to cut into the bare area. The result of doing this is shown in Plate 151. It will be noticed that the skin is stretched unevenly and the wool-growing skin is brought in close to the vulva. Thus in performing the operation the shear blades should just run to the edge of the bare area, but should not cut into it.

(v.) *Commencement of Cuts not Level.*—It is also important that the cuts should start at about the same distance from the midline of the back. If the two cuts do not start at the same level, uneven stretching of the bare area may result. It has been observed that it is a good plan for operators to watch treated sheep as they run away after being tipped out of the cradles. Variations in the level at which the cuts are commenced are readily noticed at that time.

Graziers performing the operation would be well advised to keep a close eye on the treated sheep after they have healed up to see the results of faulty operations and to remember that it is faulty initial treatment that leaves sheep predisposed to fly attack.

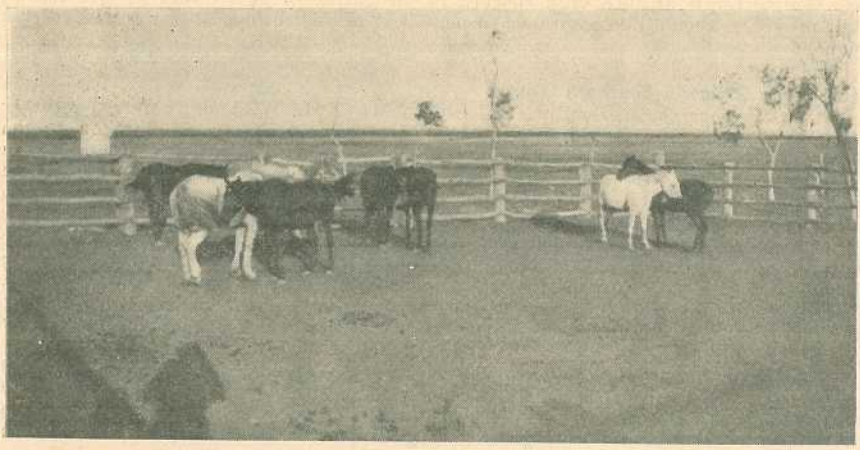


Plate 152.
HEAD TO TAIL.—Station Horses in the Stockyard, Eulolo, near Mackinlay, N.W. Queensland.

GENERAL NOTES

Maintenance of Soil Fertility.

Much more could be done to restore to the soil the plant food removed by crops and stock, remarked the Minister for Agriculture and Stock (Mr. T. L. Williams) in the course of a recent announcement. Continuing, he said that the decline in soil fertility was serious, and not only affected farmers and graziers, but also the prosperity of the State. Many farmers had not yet fully realised, apparently, the real cause of reduced returns, and seem to think that it is up to the Government and not themselves to do something about it.

The Department of Agriculture and Stock is in a position to offer practical advice on the maintenance of soil fertility, but in the last analysis, the remedy lies mainly in the hands of the primary producers.

It is clear that sowing the same crop on land year after year and overstocking of grazing areas are the principal causes of loss of fertility, and the obvious correctives are the practice of crop rotation, the sowing of fodder-crops for grazing, pasture improvement and renovation; also to avoid stocking so heavily that the most nutritious and palatable grasses eventually disappear.

The introduction of protein-rich legumes in crop rotations helps to maintain soil fertility, besides providing a better balanced ration for stock. The proper use of animal manure helps greatly in building up soil fertility. Unfortunately, animal manure is often wasted by allowing it to lie where dropped until most of its valuable constituents are lost by the action of the wind, sun, and rain. Much also can be done in restoring and maintaining the fertility of the soil by the judicious application of suitable fertilizers, and the sowing of green manure crops.

At present, there is a world-wide food shortage as the direct result of war, and in Australia, largely because of drought and shortage of efficient farm labour, the prospects are that the food situation may not materially improve for some time after the war. Millions of people in war-torn Europe and Asia will depend on increasing food production to the maximum possible to save them from slow starvation. Quite apart from the humanitarian aspect of relieving this distress and consequent chaos and possible desperate revolutionary action, it is obviously sound policy to preserve the fertility of our arable and grazing lands.

"I fully realise," Mr. Williams added, "that with the present manpower and material shortage, primary producers are hard beset to prevent farm deterioration, but the matter is of such vital concern to the future of agriculture in Queensland that producers should be encouraged to include it in their own post-war reconstruction plans."

Veterinary Officer's Southern Tour.

The Minister for Agriculture and Stock (Mr. T. L. Williams) referred recently to an official visit paid by Mr. G. R. Moule, Government Veterinary Surgeon, to the Southern States for the purpose of contacting research workers interested in animal production, to note recent developments in experimental technique in veterinary science, and to obtain first-hand information on work conducted into problems specific to Queensland.

Mr. Moule met research officers at the McMaster Laboratory, Glenfield Research Station, the Veterinary School, and the McGarvie-Smith Farm in New South Wales; the C.S.I.R. Animal Health Laboratories, the Veterinary Research Laboratory, Commonwealth Serum Laboratories, and the Werribee Research Farm in Victoria; and the C.S.I.R. Nutrition Laboratory, Waite Institute, and Roseworthy College in South Australia.

In the course of his visit to the McMaster Laboratory he closely observed the analytical methods employed by the Wool Biology Department in that Laboratory to determine how the cut of clean scoured wool might be increased. In a visit to the Gordon Institute at Geelong he also gave particular attenion to the various aspects of wool fibre fineness and related characters which are likely to revolutionise present methods of sheep husbandry.

At the McGarvie-Smith Farm, controlled by the Sydney University Veterinary School, an economic method of feeding dairy cattle was noted.

Particular attention was also given to certain work carried out in Southern laboratories in regard to animal nutrition, including experiments on minor element deficiencies and the influence of toxic substances such as flourine.

An experiment just completed in Adelaide dealt with the capacity of various strains of Australian Merinos in respect of different planes of nutrition.

Altogether, the Minister added, results of Mr. Moule's visit should be of considerable benefit in his work as a veterinary officer in this State.

A Poisonous Plant.

"It is necessary to issue a further warning about the *Cestrum Parqui* plant which is poisonous to livestock, in view of the heavy loss of cows recently suffered by a dairyman in the Brisbane area," said the Minister for Agriculture and Stock (Mr. T. L. Williams) recently. It provides an example of the deadly nature of this plant when livestock have access to land where it is growing. These cattle apparently made straight for the cestrum and ate the young shoots when put in a small holding paddock.

The cestrum is a shrub 4 to 5 feet high, suckering very freely from the base, and the dark leaves when crushed have a rather offensive odour. It bears yellowish-green flowers in bunches at the end of the branches. The fruit is black, shining, and egg-shaped, containing angular seeds embedded in a juicy dark purple pulp.

Complete eradication is difficult, because after the plants have been cut off below the soil level, or pulled out, numerous suckers will come up from the old roots. These must be chipped or hand-pulled regularly until the old roots become exhausted. This may have to be persisted in for as many as five seasons before the plants are finally destroyed.

Fodder Transport Permits.

The Minister for Agriculture and Stock (Mr. T. L. Williams) in commenting recently on a statement that fodder was held up by a rail ban on grain, hay, and chaff consigned to centres south of Warwick, stated that this was not in accordance with fact.

The ban was only imposed on fodder intended for export from the State, but in no instance has there been any delay in the issue of permits for the transport of any grain, hay, or chaff south of Warwick, provided the departmental committee dealing with this matter had been convinced the fodder would be used for the feeding of stock in Queensland.

Mr. Williams also stated that the Railway Department had co-operated fully with his Department in expediting the issue of these permits. He added that, in view of the erroneous idea existent in some quarters that it was necessary to obtain a permit before feed could be purchased, he desired to advise producers and traders that there was no restriction on normal trading in respect to maize or any chaff or hay, other than oaten.

Red Cross Work Overseas.

It must never be forgotten that the international character of Red Cross, which is an essence of its nature and the main-spring of its effectiveness in war-time, implies an international responsibility. The Australian Red Cross Society has accepted the privileges of internationalism: it is prepared, when called upon, to accept its responsibilities. Plans have been made to co-operate with U.N.R.R.A., and Red Cross has two units, trained in medicine, nutrition, and general hygiene, waiting to work in Greece. In its relief for civilians, the Society works with the Australian Government's Council for U.N.R.R.A., which is comprised of representatives of voluntary organisations throughout Australia.

Red Cross Social Service.

At the request of Army, Red Cross in Australia has undertaken to provide Social Service workers in all base and intermediate base hospitals for men and women of the Services throughout Australia on the basis of one trained worker to every 400 beds. The Social Service Department of the Society already numbers in its personnel 30 trained workers, three of whom are in England receiving specialised psychiatric training. In order to meet the demands of the Army, and since trained Social Service workers are few, the Society has inaugurated a system of scholarships to ensure University training in this work for men and women throughout Australia. At present 48 are training. Each Division has its Social Service Department, under the direction of a trained social worker, to advise and help members and medically discharged ex-members of the Services and their families with their domestic and employment problems.

Rural Topics

The Menace of Mastitis.

It is difficult to estimate the monetary loss due to mastitis which causes not only a loss in production of milk and butterfat, but also serious reduction in the number of dairy cows. There is no doubt that effective control of mastitis will result in a marked improvement in quality and a very significant increase in quantity of milk from our dairy herds. In spite of intense research in many countries, however, a positive cure for many of the types of the disease has not yet been discovered; although it is known, that hygiene is all-important in the control and prevention of mastitis and that the spread of the disease may be limited by the high standards of sanitation in the milking shed and by observing simple precautionary measures during milking.

Clearing Land with Power Machinery.

Landholders who have seen bulldozers in operation during the past three years in the clearing of timbered land for airfield and other purposes have been impressed with the potentialities of this equipment for peace-time development of agricultural lands. The Canadian Department of Agriculture recently published the results of a survey of the use of power equipment in the improvement of bush lands in Alberta. This type of country carries only light timber and bushes, and the power machinery used consists of four main pieces of equipment, viz., a crawler tractor, a V-shaped brush cutter, a brush piler, and a breaking plough. The crawler tractors used are of 60-75 h.p. The V-shaped cutting blade is attached to the front of the tractor, and it and the operator are protected from falling trees by an overhanging framework. The blade cuts with a forward shearing action on both sides at ground level and cuts a swath about 12 feet wide. The piler is used to push the fallen timber and bushes into piles for burning, and it consists of a breastwork attached to the front of the tractor, and carrying prongs that jut out at right angles to its base. The breaking plough is used to break land through the roots and operates to a depth of about 10 inches.

The bulldozer is not favoured for the clearing of lighter stands, for the following reasons:—(1) It is slower than the brush cutter and therefore more costly; (2) it removes the topsoil to a large extent; (3) soil clings to the roots and stumps of uprooted trees, making burning difficult; (4) the bulldozer pushes the trees forward, and they have to be pushed aside before further clearing is possible.

Money in Pigs.

"A profitable consignment" was how Mr. W. F. H. Cislowski, of Kolan River South, Bundaberg, described the trucking of nineteen bacon pigs recently from his piggery. The pigs were of a somewhat old English Berkshire type but were otherwise of good quality. They were born on 20th August, 1944, and were marketed on 28th February, 1945, with the following result:—

14 sold at 9d. per lb. (dressed weights ranging from 142 lb. to 187 lb.); one leg rejected on account of bruising.
3 sold at 8½d. per lb. (dressed weights, 160, 166, and 182 lb.).
2 sold at 6½d. per lb. (dressed weights, 182 and 184 lb.).
Total receipts, £114 17s. Railage, £3 1s. 9d.
Net return per pig, £5 17s. 8d.

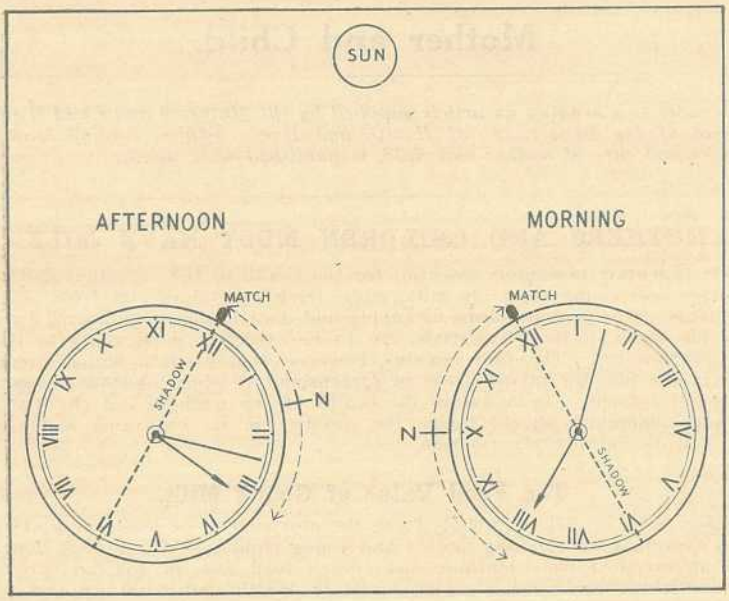
Commenting on these, Mr. E. J. Shelton, of the Pig Branch, Department of Agriculture and Stock, remarked that the only fault he had to find with the pigs was, as the owner realised, that they were too short-bodied and thick and when finished carried more than the desired amount of fat, although they graded very well.

Mr. Cislowski has now purchased a well-grown Large White boar to replace the original Berkshire, and hopes to be able to steadily improve on former efforts at producing quality pigs.

GADGETS AND WRINKLES

WATCH USED AS COMPASS.

Here, for some who may not already know it, is a very handy wrinkle for easily converting a watch into quite a useful compass. The only essential is that there is enough sunlight to cast a clearly defined shadow.



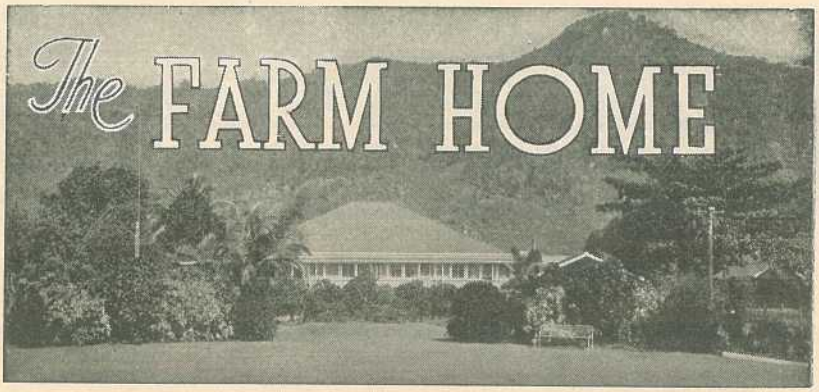
Hold the watch horizontally, yourself facing the sun, or, better still, place the watch on a flat stone or table face upwards. Then hold a match or other thin piece of stick vertically against the edge of the watch opposite the 12 o'clock mark. Swing the watch round gently until the shadow from the match cuts across the watch face forming a thin line passing exactly through both the 12 and 6 o'clock marks. Now carefully note precise position of the small or hour hand. The north point will then lie exactly midway between the hour hand and 12 o'clock.

For satisfactory results it is of course necessary that the watch is showing correct standard time. In other respects, the actual amount of error is, for all ordinary purposes, negligible. The sketch makes the method easy to follow.

TO MAKE A BELT GRIP.

Most belts give trouble because they are not tight enough on their surface and that of the pulley is too smooth to give the necessary grip. Then, naturally, belt dressing has to be used. In some instances honey has been used quite effectively. The advantage of this dressing is that it can be easily washed off the pulley and belt if too much accumulates through constant use.

The most effective and cheapest dressing to be found is common inner tube rubber. This is melted and poured on the belt while it is in motion. You will find this a very lasting dressing.



Mother and Child.

Under this heading an article supplied by the Maternal and Child Welfare Service of the Department of Health and Home Affairs, dealing with the welfare and care of mother and child, is published each month.

MOTHERS AND CHILDREN MUST HAVE MILK.

FOODS which are absolutely essential for the health of the expectant and nursing mother and young child are milk, eggs, fresh vegetables and fruit and whole grain cereals. War time problems of supply and distribution, complicated by serious drought shortages of these essentials, are to be expected, particularly in the more isolated settlements. The fact remains, however, that even in normal times it is difficult in the hot dry inland areas of Queensland to obtain adequate supplies of these essential foods. To maintain the health of the mothers and children of the West each community should tackle the problem in its own area and see what can be done to improve the position.

The Food Value of Goat's Milk.

Because milk is such a valuable food, the provision of at least one pint per day for each expectant and nursing mother and young child is of the utmost importance. Milk is an excellent body building and energy food and, in addition, provides in large quantities the materials which maintain health and build up and preserve the bones and teeth. In dry areas fresh cow's milk becomes almost unobtainable in the summer, because there is insufficient feed for the cattle, and at present the stocks of dried milk are less than usual. Let it be remembered at this stage that Australia is not the only place having large stretches of barren country. Africa, Spain, and other countries solved the milk supply problem hundreds of years ago with the aid of a very valuable and much maligned little animal—the goat. In Spain and Malta it is no unusual sight to see the milkman driving his herd of well-tended goats and milking them at the customer's door. The fresh milk supply for mothers and babies is dealt with in a very practical way. There seems no good reason why the milkman in the West should not supply goats' milk when cows' milk may be difficult to obtain.

Goat's milk is just as good as cow's milk and the family who owns a goat or two has three great advantages—the milk is clean, it is fresh, and it contains no added water. Can that always be said of the cows' milk supply?

Uses of Goat's Milk.

Mothers can do anything with goat's milk which can be done with cow's milk, from making baby's food to delicious junkets and milk puddings to other dishes for the whole family. Fresh butter can be made from it, which although less yellow than our usual butter, is just as good. In many countries cheese made from goat's milk is a common food. Why cannot Western Queensland communities try to have a fresh milk supply all the year round? A good Nanny (the crossbred Saanan—

cost about £2—does well in Queensland) deprived of her kid, well fed and milked twice a day will give milk for nine or twelve months. In places like Charleville and Cunnamulla where gardens can be watered with bore or river water, some kind of green feed for the goats can be grown. Even for full hand feeding, which would hardly ever be necessary, only about 10 cwt. of lucerne chaff, bran or maize is required in the course of a year. Six to eight goats can be fed on the amount of feed required for one cow. In some districts during dry spells, the goats can be fed by cutting down and bringing in mulga. We do not expect a cow to give good milk if she is not properly fed; therefore, families owing goats must expect to hand feed them when pasture is scarce or non-existent. During very hot dry weather, if milk is not obtainable and the fowls lay no eggs, Western children may become poorly nourished and fall easy victims to sandy blight and other infections. Each place has its own difficulties and problems which must be tackled by the man on the spot with a first thought for the mothers and children. If this service can help call at or write to *The Maternal and Child Welfare Information Bureau*, 184 *St. Paul's Terrace, Brisbane*. These letters may be addressed "*Baby Clinic, Brisbane,*" and need not be stamped.

IN THE FARM KITCHEN.

Vegetable Soups.

Cauliflower Soup.

Ingredients: One cauliflower, 1 oz. ham, 1½ pints water or stock, ½ pint milk, 2 small onions, blade of mace, 2 oz. butter, 2 oz. flour.

Cook together in a lined pan the cauliflower, onions, seasoning, chopped ham and water. When cauliflower is cooked, remove some nice sprigs for serving in the soup, and continue boiling till all is tender. Rub through a hair sieve. Melt the butter, add the flour, then add the milk gradually. Add the sieved soup and boil up, stirring all the time. Reheat the cauliflower sprigs in the soup for a moment or two, then serve at once. For a vegetarian soup, substitute for 1 oz. ham 2 sticks celery, and use water instead of stock.

Green peas, sprouts, marrow, lettuce, beetroot or celery may be used in the same way as cauliflower.

Cabbage Soup.

Ingredients: Small head of cabbage, shredded finely, 2 slices bacon, 2 sliced onions, 4 small carrots diced, 1 quart water and 4 teaspoons meat paste for stock, salt, pepper, 3 tablespoons grated cheese, 4-5 slices toast, cut in squares.

Fry the bacon. Add onions and carrots. Add water and meat paste. Put in cabbage and salt and allow to simmer half an hour. Don't allow to boil. Add 3 more cups stock, more salt, pepper. Add cheese and toast and serve immediately.

Potato Soup.

Ingredients: Six good-sized potatoes, celery leaves, 1 pint milk, 1 oz. to 2 oz. butter, 1 tablespoon chopped parsley, salt and pepper.

Quarter and boil potatoes, drain and mash well, adding butter and celery leaves, finely chopped. Add the milk and 1 pint of the potato water, stir well, boil up again and season. Sprinkle in the parsley before serving.

Carrot Soup.

Scrape and slice 4 carrots, 1 small onion, and a small stick of celery. Cook them in 1 oz. butter without allowing them to brown. Add ½ pint of milk and ½ oz. flour, and stir until the whole boils. Then add 1 pint of milk and simmer for 15 minutes. Press the whole through a sieve, return to the saucepan and reheat.

Haricot Bean Soup.

Half a pound of haricot beans, 1 stick celery, 1 oz. dripping, 3 pints cold water, 1 small beetroot, 4 tomatoes, 1 peeled onion, salt and pepper to taste, 1 meaty bone.

Rinse beans. Place in a basin. Cover with cold water. Soak for 12 hours. Drain and rinse. Wash and slice tomatoes, or substitute tinned. Halve beetroot. Slice celery and onion. Melt dripping in a saucepan. Add prepared vegetables and drained beans. Toss in fat till dripping is absorbed, then add water, salt and pepper and bone, then heat to simmering point. Cover. Simmer gently from 3 to 4 hours. Remove beetroot. Rub remainder through a sieve. Reheat. Enough for four or five persons.

ASTRONOMICAL DATA FOR QUEENSLAND.

JULY.

Supplied by the Astronomical Society of Queensland.

TIMES OF SUNRISE AND SUNSET.

At Brisbane.			MINUTES LATER THAN BRISBANE AT OTHER PLACES.					
Date.	Rise.	Set.	Place.	Rise.	Set.	Place.	Rise.	Set.
	a.m.	p.m.						
1	6.39	5.03	Cairns	9	48	Longreach	27	43
6	6.39	5.05	Charleville	25	29	Quilpie	37	33
11	6.39	5.07	Cloncurry	37	62	Rockhampton ..	2	18
16	6.38	5.10	Cunnamulla ..	30	28	Roma	15	19
21	6.36	5.12	Dirranbandi ..	21	17	Townsville	9	40
26	6.34	5.15	Emerald	12	27	Winton	30	51
31	6.31	5.17	Hughenden ..	22	48	Warwick	4	4

TIMES OF MOONRISE AND MOONSET.

At Brisbane.		
Date.	Rise.	Set.
	p.m.	a.m.
1	10.39	10.50
2	11.41	11.28
		p.m.
3	..	12.06
	a.m.	12.44
4	12.44	
5	1.47	1.25
6	2.52	2.08
7	3.57	2.56
8	5.02	3.48
9	6.04	4.45
10	7.01	5.44
11	7.53	6.45
12	8.39	7.44
13	9.19	8.41
14	9.55	9.35
15	10.28	10.28
16	11.00	11.19
17	11.30	..
	p.m.	a.m.
18	12.01	12.11
19	12.35	1.03
20	1.10	1.56
21	1.51	2.51
22	2.35	3.46
23	3.25	4.42
24	4.21	5.38
25	5.21	6.32
26	6.24	7.21
27	7.27	8.07
28	8.31	8.49
29	9.34	9.29
30	10.38	10.07
31	11.41	10.44

MINUTES LATER THAN BRISBANE (SOUTHERN DISTRICTS).

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

MINUTES LATER THAN BRISBANE (CENTRAL DISTRICTS).

Date.	Emerald.		Longreach.		Rockhampton.		Winton.	
	Rise.	Set.	Rise.	Set.	Rise.	Set.	Rise.	Set.
1	22	15	38	31	13	6	43	35
6	14	25	29	41	4	17	33	49
11	12	27	27	42	2	18	30	50
16	19	19	35	35	10	10	40	39
21	27	13	43	28	18	3	50	31
26	26	12	42	27	17	2	49	30
31	16	21	31	37	7	12	36	43

MINUTES LATER THAN BRISBANE (NORTHERN DISTRICTS).

Date.	Cairns.		Cloncurry.		Hughenden.		Townsville.	
	Rise.	Set.	Rise.	Set.	Rise.	Set.	Rise.	Set.
1	35	19	54	44	39	29	29	18
3	25	30	47	50	32	35	22	25
5	19	40	44	57	29	42	18	46
7	11	47	38	62	23	47	11	39
9	8	50	37	63	21	49	8	42
11	9	47	37	62	22	47	9	39
13	14	41	41	58	26	43	14	34
15	23	33	46	53	31	38	21	28
17	31	23	52	46	36	31	26	21
19	41	18	57	43	42	28	34	17
21	48	11	63	38	47	24	39	12
23	51	6	65	35	49	21	42	8
25	49	7	63	36	48	21	40	8
27	42	13	58	40	43	25	35	14
29	31	23	52	46	36	31	26	21
31	21	34	45	54	31	38	19	29

PHASES OF THE MOON.

Last Quarter 3rd July, 4.13 a.m.; New Moon, 9th July, 11.35 p.m.; First Quarter, 17th July, 5.01 p.m.; Full Moon, 25th July, 12.25 p.m.

DISCUSSION.

The maximum northern declination of the Sun having been reached last month, it will now begin to be noticeable how the declination of the Sun is again on the southward move. At the end of the month the Sun will rise and set approximately 20 degrees north of true east and west respectively.

On 16th July the Moon will rise and set almost true east and true west.

Venus.—At the beginning of the month this planet in the constellation of Taurus will rise, in Queensland, between 3 a.m. and 4 a.m., about 16 degrees north of true east. By the end of the month it will rise between 3.30 a.m. and 3.45 a.m., about 23 degrees north of true east.

Mars.—At the beginning of the month Mars will rise between 2.30 a.m. and 3.15 a.m., about 16 degrees north of true east, and by the end of the month will rise between 2 a.m. and 2.45 a.m., about 23 degrees north of true east.

Jupiter.—Jupiter will still be a conspicuous object in the western evening sky. At the beginning of the month, in the constellation of Leo, it will set between 10.30 p.m. and 11.30 p.m., about 5 degrees north of true west. At the end of the month, in the constellation of Virgo, it will set between 9 p.m. and 10 p.m., about 3 degrees north of true west.

Saturn.—Saturn is still too close in line with the Sun for observation. On the 16th it will be exactly in line with the Sun.

TOTAL ECLIPSE OF THE SUN.

The third eclipse of this year, which occurs on 9th July (Greenwich date) will not be visible in Australia; but from within a path approximately 60 miles wide, stretching from Boise in the west of the United States, across Hudson Bay, Greenland, Sweden, and Finland to east of the Caspian Sea in Asia, the interesting sight of a total eclipse will be witnessed. The accompanying diagram (not to scale) illustrates the conditions of this eclipse. The paths of the Moon and Earth are indicated and arrows show the direction of movement. The heavy arrow across the Earth indicates the direction of the Earth's spin. The dark cone, tapering to a point as it approaches the Earth, represents the umbra or dense shadow of the Moon. From anywhere inside of this cone the Sun is totally obscured by the Moon. The shaded cone, increasing in diameter as it approaches the Earth, represents the penumbra or half shadow. From inside of this cone only a part of the Sun is blocked from view by the Moon. Neither the Earth nor the Moon move in exactly circular orbits, and thus the distances of the Sun, Moon, and Earth from each other are not constant. Sometimes, then, the cone of the umbra is not quite long enough to reach the Earth. When this is the case the disc of the Moon, as seen from the Earth, is not large enough to completely cover the disc of the Sun, and from a path across the Earth up to 230 miles wide observers see a ring of sunlight round the Moon. This is known as an annular eclipse. When, however, the distance between the Moon and Earth is less than the length of the umbra, observers on a small area of the Earth (up to 180 miles diameter) come within this cone of dense shadow and see the disc of the Moon completely obscure the disc of the Sun. This is what is known as a total eclipse. For a considerable distance from the area of total eclipse a partial eclipse is seen, and as the Moon moves in its orbit and the Earth spins on its axis, the eclipse areas move across the Earth from west to east. The path on the Earth over which the umbra passes on 9th July is shown by the heavy line, and the broken line shows the southern limit of the path of the penumbra or cone of partial eclipse.

QUEENSLAND WEATHER IN MAY.

Thunderstorms with variable rain results were recorded in the south-eastern divisions, and local heavy far north coast falls resulted from prevailing south-easterlies. The most useful rain distribution, however, commenced on the 27th as the result of late monsoonal influences. A series of daily falls, still variable in amount, lasted till the 3rd June, benefiting districts from the north-west Carpentaria south and south-east through the Central and Central Highlands areas and across most of the south-eastern quarter of the State. The end of the month central rains gave many aggregate totals of approximately two to four inches over a belt of country between Stamford and Tambo, and in south-eastern divisions early June amounts supplemented the sparse and under-average aggregate monthly district totals of May. As rains were accompanied by mild temperatures, a fairly general benefit and improved winter outlook should follow in many pastoral areas. A general rain is still needed in the central-west, south-west, and Warrego to overcome the effects of protracted dry conditions, and agricultural and pastoral areas in the Port Curtis, Central Coast, and adjacent highlands would appreciate further soaking rain to supplement the present partial improvement. The Downs and most of the Moreton farming areas, especially the former, are now experiencing good growing conditions, especially for early sown wheat.

Temperature.—Average maximum readings, mostly normal or slightly below, ranging from approximately 1.4 deg. below at Georgetown to 0.7 deg. above at Thargomindah, where minimum temperatures were 3.2 deg. above normal. Minimum figures in other districts varied from approximately 1 deg. above to 1 deg. below, with Georgetown 3.3 deg. below.

Frosts fairly prevalent, especially the first three weeks; Stanthorpe, eleven days, with minimum readings 28 deg./23 deg. (10th); Mitchell, four days; Tambo, ten days, 33 deg./25 deg. (17th). Herberton frosts, 16th/17th (33 deg./27 deg. latter date).

The rain position is summarised below:—

Division.	Normal Mean.	Mean May, 1945.	Departure from Normal.
	Points.	Points.	Per cent.
Peninsula North	137	276	101 above
Peninsula South	50	37	26 below
Lower Carpentaria	38	33	13 ,,
Upper Carpentaria	58	64	10 above
North Coast, Barron	300	487	62 ,,
North Coast, Herbert	434	398	8 below
Central Coast, East	165	143	13 ,,
Central Coast, West	81	19	77 ,,
Central Highlands	127	138	9 above
Central Lowlands	87	214	146 ,,
Upper Western	51	79	55 ,,
Lower Western	69	60	13 below
South Coast, Port Curtis	203	149	27 ,,
South Coast, Moreton	349	307	12 ,,
Darling Downs East	156	164	5 above
Darling Downs West	143	101	29 below
Maranoa	137	52	62 ,,
Warrego	112	97	13 ,,
Far South-West	97	87	10 ,,

Commonwealth of Australia Meteorological Bureau, Brisbane.

RAINFALL IN THE AGRICULTURAL DISTRICTS.

APRIL RAINFALL.

(Compiled from Telegraphic Reports).

Divisions and Stations.	Average Rainfall.		Total Rainfall.		Divisions and Stations.	Average Rainfall.		Total Rainfall.	
	April.	No. of years' records.	April, 1944.	April, 1945.		April.	No. of years' records.	April, 1944.	April, 1945.
North Coast.	In.		In.	In.	*South Coast—contd.*	In.		In.	In.
Atherton	4·42	42	1·93	23·93	Gatton College ..	1·86	44	0·26	1·29
Cairns	11·23	61	3·46	6·05	Gayndah	1·46	72	0·81	0·96
Cardwell	8·78	71	4·10	4·20	Gympie	3·43	73	1·29	1·67
Cooktown	8·69	67	0·57	4·31	Kilkivan	2·20	62	0·48	0·43
Herberton	3·73	57	2·10	2·81	Maryborough ..	3·81	72	0·65	1·95
Ingham	7·64	51	3·67	4·38	Nambour	6·13	47	0·18	6·39
Innisfail	20·21	62	6·19	15·73	Nanango	1·93	61	0·36	1·41
Mossman	7·41	19	2·24	4·63	Rockhampton ..	2·53	72	0·67	0·19
Townsville	3·29	72	1·51	1·60	Woodford	4·52	55	0·25	3·44
Central Coast.					*Central Highlands.*				
Ayr	2·77	56	0·53	1·35	Clermont	1·64	72	0·69	..
Bowen	2·91	72	1·96	0·70	Springsure	1·56	74	1·54	0·62
Charters Towers ..	1·54	61	0·45	0·93					
Mackay	6·31	72	1·25	2·81	*Darling Downs.*				
Proserpine	6·11	40	3·18	5·38	Dalby	1·39	73	0·44	2·06
St. Lawrence ..	2·73	72	0·08	0·87	Emu Vale	1·32	47	0·25	1·53
					Jimbour	1·42	64	0·30	1·91
South Coast.					Miles	1·43	58	0·17	2·83
Biggenden	2·15	44	0·04	0·99	Stanthorpe	1·70	70	0·64	2·08
Bundaberg	3·25	60	1·11	0·65	Toowoomba	2·56	71	0·42	3.61
Brisbane Bureau ..	3·65	93	0·04	4·32	Warwick	1·60	78	0·34	2·11
Caboolture	4·48	67	0·12	3·52					
Childers	2·85	48	1·70	2·52	*Maranoa.*				
Crohamhurst	6·68	50	0·32	6·83	Roma	1·28	69	0·64	3·10
Esk	2·89	56	0·24	1·09	St. George	1·29	62	0·09	0·62

CLIMATOLOGICAL TABLE FOR APRIL.

(Compiled from Telegraphic Reports.)

Divisions and Stations.	Atmospheric Pressure. Mean at 9 a.m.	Shade Temperature.		Extremes of Shade Temperature.				Rainfall.	
		Mean Max.	Mean Min.	Max.	Date.	Min.	Date.	Total.	Wet Days.
Coastal.	In.	Deg.	Deg.	Deg.		Deg.		Points.	
Cairns	..	84	70	88	6	58	12	605	21
Herberton	..	74	59	81	7	44	11	281	20
Townsville	..	84	67	88	13	55	10, 11	160	9
Brisbane	30·11	78	61	90	6	56	9	432	15
Darling Downs.									
Dalby	..	79	54	88	6	44	11	206	6
Stanthorpe	..	69	49	80	7	35	5	208	8
Toowoomba	..	73	53	85	6	42	11	361	7
Mid-Interior.									
Georgetown	29·94	90	65	95	2	51	11, 12	17	1
Longreach	30·10	89	64	99	6	48	10	22	2
Mitchell	30·11	80	50	89	6	40	9, 10	176	4
Western.									
Burketown	..	92	68	96	22	55	10, 11	25	2
Boulia	30·10	88	61	97	6	46	10	..	..
Thargomindah	30·11	80	60	92	6	50	10	9	2

A. S. RICHARDS, Divisional Meteorologist.

Commonwealth of Australia,
Meteorological Bureau, Brisbane.