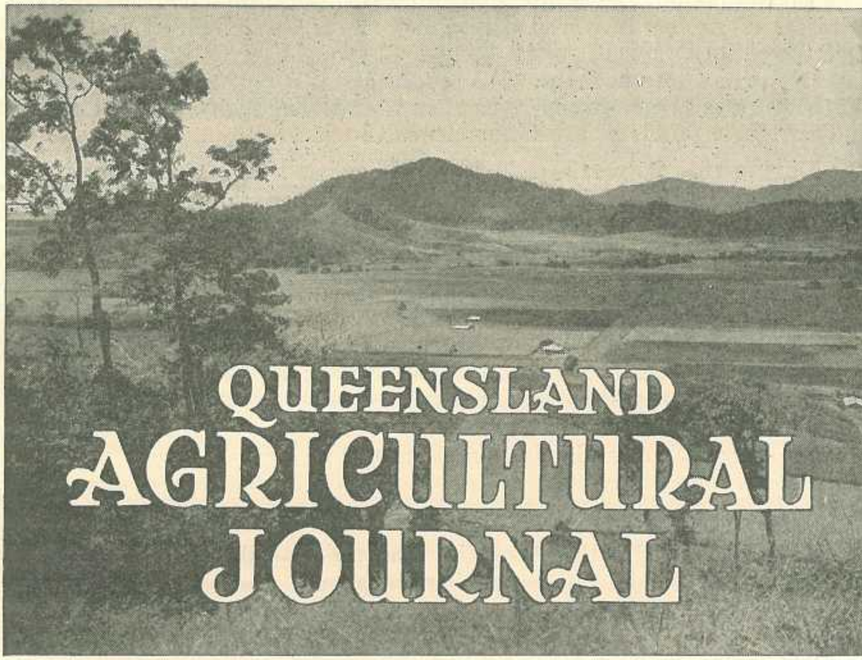
ANNUAL RATES OF SUBSCRIPTION.—Farmers, Graziers, Horticulturists, and Schools of Arts, **One Shilling,** members of Agricultural Societies, **Five Shillings,** including postage. General Public, **Ten Shillings,** including postage.



Vol. LIII. 1 MARCH, 1940 Part 3

The Australian Council of Agriculture.

UNTIL 1933 it was customary for State Ministers of Agriculture to confer annually on agricultural problems of general Commonwealth interest. This Council of Ministers did a great service to the land industries of Australia, for, among other things, it paved the way for a united approach to matters of Commonwealth-wide concern. However, as time went on the Ministers' Conference was burdened by the intrusion of economic factors which were particularly under the control of the Federal Government. Then followed the establishment of the Council for Scientific and Industrial Research, and its activities made direct contact with the representatives of every State desirable. Ultimately this was achieved by the formation of the Australian Council of Agriculture, which consists of the State Ministers of Agriculture, the Federal Minister of Commerce, and a representative of the new Commonwealth Ministry of Supply and Development. In addition, there is a standing committee consisting of the permanent heads of the State Departments and the executive of the Council for Scientific and Industrial Research.

It will be seen, therefore, that the Australian Council of Agriculture as constituted is capable of surveying cultural, economic, scientific, and research problems, and of making decisions acceptable by the Governments concerned. The Commonwealth maintains a permanent secretariat so that, as necessity arises, continuous consultations are possible between the components of the Council.

In discussing the scope and work of the Council recently, the Minister of Agriculture and Stock, Hon. Frank W. Bulcock, remarked that the deliberations of such a body tend to make agriculture a national rather than a State activity. It brought about a recognition of the fact that Australia is essentially agricultural and that many of its scientific and economic problems are Commonwealth-wide.

During the six years he had been associated with the Council Mr. Bulcock said he had found a real desire on the part of the Council to co-ordinate all forms of agricultural activity, and at the same time to conserve the specific field of every individual State.

As the Commonwealth has no Department of Agriculture—and in this it differs from many other federations, the United States of America being an outstanding example—but controls bounties and Customs, and, through the Federal research organisation, exercises a wide influence on the scientific factors of production, it will be readily apparent that a body that represents the three phases of agriculture is essential to prevent overlapping and misunderstandings.

Agricultural Co-ordination.

CONTINUING, Mr. Bulcock said that the co-ordination of agricultural experiment and research programmes was by no means easy of accomplishment, for it was found that personal factors and State considerations were frequently a bar to the pooling of the sum total of knowledge available.

As a result, each State tended to make its work a partial secret. This led to duplication of effort and a considerable wastage of the time of highly trained and skilled workers. So one of the first matters tackled by the newly constituted Council of Agriculture was the preparation of statements showing the work each State was engaged upon, and from this arose a co-ordinated policy that allows for and requires the free exchange of information and results as between the States. From time to time, too, technical officers drawn from each State meet to discuss matters relating to their particular activity.

Happily, the Council for Scientific and Industrial Research is fundamentally co-operative. One achievement of outstanding importance to Queensland was the work of the Council in relation to the export of chilled beef.

Mr. Bulcock went on to say that there were, of course, some people who were impatient for results, but it had to be remembered that the Council for Scientific and Industrial Research had inherited the accumulated problems of agriculture which emerged during the first century of our history. Routine problems were, of course, solved by States as they arose, but the major legacies which fell to the lot of the Council were those difficult problems which had defied or resisted routine investigation. He referred to the dissipation of earlier effort in relation to scientific investigation.

In regard to some important stock diseases particularly, each State was doing some work, but no State was financially able to launch a full-time investigation.

Eventually—in pursuit of the principle laid down by the Council of Agriculture in relation to co-operation—Victoria was financed to specialise in the study of mastitis, and New South Wales undertook investigational and research work in respect of contagious abortion. Thus, for an expenditure of only a few hundred pounds a year, Queensland gets a research service costing from £8,000 to £10,000 a year.

By these means, the problems associated with these and other stock diseases will probably be solved for the benefit of the Commonwealth as a whole.

During its relatively brief life, continued Mr. Bulcock, the Australian Council of Agriculture had been confronted by some difficult problems, but none more difficult than that of the application of quotas to primary exports. During those difficult days we lived in a state of uncertainty, hesitant about agricultural expansion and apprehensive about the security of our existing markets. There were people in those days who advocated restriction of production. The view of the Council of Agriculture was that restriction should be resisted all the way.

In the light of its achievements, he claimed modestly that the Council had fully justified its existence and had done its part in the stabilisation of the economics of primary production.

During recent months members of the Council had been required to give close attention to the marketing problems arising out of the war, said the Minister. Of course, the basis of sales transactions was always just what the purchaser was prepared to give, but it was to the credit of Australia that no sales agreement had been entered into on a profiteering basis. So far as he knew, Australia, in relation to sales, did not propose any basis which could have been so construed. A review of the course of these agreements showed how difficult they were to complete.

Post-war planning was certainly the biggest question listed at the Hobart Conference in February. All States spoke on the matters involved. There was a general feeling among members that the matter was urgent, but the query was: How is it to be approached?

The conference was, however, in agreement on two matters—that the volume of primary export during the war should constitute the minimum basis for post-war exports in the event of quotas being reimposed; and that the Commonwealth should immediately investigate all the circumstances surrounding crops which at present do not yield sufficient to satisfy Australian requirements.

Such an adjustment might, and possibly did, mean an alteration in bounties, excise, and Customs, but with the inevitable contraction in exports during the post-war period, such a course was clearly indicated as necessary for stability in domestic agriculture, and would, to a degree—however small—make for stabilisation during what promised to be an exceedingly difficult period.

Concluding, Mr. Bulcock affirmed his belief in the soundness of the principles underlying a planned agriculture. It would be impossible, he said, for the leading agriculturists of the Commonwealth—cultural, scientific, and economic—to meet and not achieve something of lasting worth to the nation. The Council was, of course, subject to Federal and State Governments, but it had already become the logical clearing house for Australian agriculture.

Pineapple Culture in Queensland.

H. K. LEWCOCK, M.Sc., B.Sc.Agr., Senior Research Officer.

(*Continued from page 44, January, 1940.*)

CHAPTER V.—SOIL REQUIREMENTS OF THE PINEAPPLE.

BECAUSE of its epiphytic relationships (vide Chapter II., p. 618, Vol. LII., Part 6, December, 1939), the pineapple is extremely sensitive to conditions which impede the respiratory activity or breathing of its roots. Such conditions occur in compacted, shallow, or wet soils. The suitability of a soil for pineapple culture is, therefore, determined chiefly by those properties which control soil aeration and the movement and retention of soil moisture. An adequate supply of the mineral nutrients required by plants and freedom from adverse chemical conditions, such as an unfavourable soil reaction, are also essential, but it is usually much easier to remedy nutritional deficiencies in soils used for pineapple culture than it is to modify the conditions which determine their aeration and moisture relationships. This is because the moisture relationships in the zone of root penetration are greatly influenced by the structure and composition of the soil layers which lie below the level at which cultivation is practicable and which, in consequence, have to be taken very much as they are found. From the practical point of view it is accordingly important to give attention to the factors influencing the movement and retention of air and water in soils before considering questions of soil fertility and management.

SOIL PROPERTIES INFLUENCING THE SUITABILITY OF SOILS FOR PINEAPPLE CULTURE.

Soils consist principally of the mineral particles which result from the disintegration and decomposition of rocks. In addition, most soils contain some organic material derived from decaying plant and animal remains. Organic matter which has decayed to the extent that its original cellular structure has been lost is known as *humus*.

The proportions in which different-sized particles occur in the various layers of a soil, the manner in which these soil particles are aggregated, and the amount and nature of the organic matter which is present determine those properties of a soil on which its aeration and moisture relationships depend. The most important of these properties, and the ways in which they influence the suitability of soils for pineapple culture, are as follows:—

Soil Texture.

According to size, soil particles are classed as clay, silt, sand, or gravel, clay consisting of the smallest particles and gravel the largest. Most soils contain clay, silt, and sand, and it is the proportions in which these various sized particles are present in a soil which determine its texture or "feel." Fine-textured soils consist largely of clay, and coarse-textured soils of sand. Intermediate between these extremes come the loams, that is, soils in which the various sized particles are mixed in such proportions that they do not especially reflect the characteristics of any one.

Though frequently rich in mineral plant foods, fine-textured soils become sticky when wet and generally tend to form clods and surface crusts when drying out. For this reason they are difficult to cultivate. While they are highly retentive of moisture, movement of water in fine-textured soils is notably slow, so that they neither moisten readily nor drain freely. When exposed to heavy and continuous rainfall, therefore, they tend to become water-logged, with the consequent exclusion of air. Only when their structure is particularly open can fine-textured soils be regarded as suitable for pineapple culture. In contrast, coarse-textured soils are loose and friable, extremely porous, and very easy to cultivate. For pineapple culture, however, they suffer from the disadvantage that their extreme permeability to water causes the surface layers to dry out very rapidly unless they contain a high content of organic matter. Moreover, coarse-textured soils are frequently extremely deficient in available mineral plant foods. Though actually heavier in weight than those of finer texture, sandy soils are often spoken of as "light" soils because of the ease with which they may be tilled; similarly, soils which are difficult to cultivate are frequently referred to as "heavy" soils. In moderation, stones and gravel have a beneficial effect on the texture of heavy soils since they offset to some extent the undesirable properties of clay.

Medium-textured soils comprise the loams, and these are generally the most suitable for pineapple culture because their aeration and moisture-retaining properties are intermediate between the extremes presented by the clays and sands. However, the value of loams as pineapple soils may be greatly modified by the textural and structural properties of the subsoils which underlie them. For example, in subtropical regions, such as southern Queensland, a relatively impervious layer of fine cemented material may sometimes occur a few inches below the surface of loams and sandy loams which greatly impedes drainage. Formations such as this should be avoided for pineapple culture, irrespective of the nature of the top soil.

Since soil texture is determined by the size of the soil particles which compose it, this property can be altered only through the addition of soil of another texture. Occasionally, it is possible to effect an improvement in the texture of a shallow sandy soil by gradually increasing the depth to which it is ploughed, as in this way fine material which has been washed down and deposited below the normal level of cultivation is brought to the surface again. Apart from this, there is nothing that can be done in a practical way to change the texture of a soil, but the influence of texture on the aeration of a soil and its moisture relationships may be considerably modified by changes in its structure.

Soil Structure.

In contrast to texture, which is dependent on the size of the particles making up a soil, structure is determined by the manner in which these particles are arranged with reference to one another. They may exist either as single particles or clustered together in groups. A soil in which the particles adhere together in clumps is said to possess a *crumb* structure, and on the extent to which this is developed largely depends the permeability of a soil to air and water, and its capacity to retain moisture and release it to growing plants. A favourable structure in both the surface and subsoil layers is an essential requirement for a pineapple soil. In southern Queensland the presence of a closely-compacted, impervious sub-surface layer in the soils of sloping lands may result not only in poor drainage but also in greater susceptibility to erosion.

The structure of a soil is shown by the way in which it behaves under cultivation. Clay particles possess a natural tendency to cling together while coarser particles lack this tendency. Thus a good loam falls apart easily to reveal a characteristic crumb-like structure, while a clay loam may need additional cultivation to make it crumble, and the resulting crumbs will be larger than in a loam proper. On the other hand, sandy soils, and especially those with a low content of organic matter, have a tendency to fall apart into such a fine state of division that the component particles may be individually recognised. Such soils are said to possess a *single grain* structure.

Apart from the proportions of clay or sand which a soil may contain, *i.e.*, its textural properties, the structure of a soil is greatly influenced by (*a*) its humus content and (*b*) cultivation practices. Soils of all kinds tend to develop a desirable crumb structure under the influence of humus, because humus promotes the binding together of both fine and coarse textured particles into aggregates or clumps which are looser and more spongy in character, and more variable in size, than those formed when clay is the cementing agent. It follows, therefore, that maintenance of a soil structure favourable for pineapple growth is dependent on keeping the soil well supplied with organic matter. The problem of renovating old pineapple land in Southern Queensland is largely a matter or re-establishing a favourable soil structure; hence the marked improvement which results from the ploughing under of trash and bulky cover crops, such as maize and crotalaria. A similar effect is produced on old banana land by a few years' growth of lantana, due to infiltration of humus formed from decaying leaves and roots.

Cultivation may exert either beneficial or harmful effects on soil structure, depending on the type of soil and the conditions under which it is carried out. The ploughing of heavy soils when either too moist or too dry results in the formation of clods, which are difficult to work down into a suitable tilth. On the other hand, repeated cultivation of a heavy soil after it has lost all trace of stickiness is beneficial, because at this moisture content the formation of a desirable crumb structure is promoted by exposing the soil to air. Under warm, humid conditions, however, excessive cultivation or exposure leads to a rapid depletion in the humus content of a soil and may thus adversely affect its structure. This is particularly true of the medium and coarse textured soils which are chiefly used for pineapple culture in the coastal districts of Southern Queensland.

However, the principal cause of loss of structure in these and other soils used for pineapple culture in Queensland is erosion. Crumb structure in a soil is generally most highly developed near the surface, because of the relatively greater amounts of organic matter which are contained there. By washing away the surface layer, erosion not only leads to rapid deterioration in the structure of a soil, but may also change its texture. Changes in soil structure due to erosion ordinarily do not take place until land has been brought under cultivation. Consequently, the extent to which a cultivated soil has retained its original structural properties—as exemplified in the soil of adjacent timbered country—is a good indication of the degree of efficiency which has been employed in its management. Loss of soil structure brought about by erosion or too rapid decomposition of humus, or both, is chiefly responsible for the rapid deterioration in productivity which occurs all too commonly in pineapple soils in southern Queensland.

Pore Space.

The particles making up a soil do not fit snugly together, but are separated by cavities which, collectively, form the pore space. The proportion of pore space in a soil is determined both by its texture and by its structure. In very sandy soils—that is, soils in which the particles are not aggregated into crumbs—it may not exceed 30 per cent. of the total volume, while it may account for 50 per cent. of the volume of a fine-textured soil with a well-developed crumb structure, such as a clay loam. Conditions which favour the development of a crumb structure in a soil increase the pore space, while a loss of humus or the compacting of the soil particles reduce it. In cultivated soils, pore space is at a maximum after ploughing, and gradually diminishes as the soil settles down under the impact of rain. Trampling on a soil also reduces its pore space.

The pore space of a soil is filled with air and water. In a friable loam, the most favourable conditions for the development of pineapple roots occur when air and water are present in the pore space in approximately equal proportions—that is, a cubic yard of soil should contain about 6 cubic feet of air. Where the drainage is good, this condition is attained within a day or two following saturation of the soil with rain. As a general rule, the pore space in a soil decreases from the surface downwards, due to the lower humus content and the consequent deterioration in structure. The development of pineapple roots in a soil is confined to those layers in which there is a free circulation of air. Anything which leads to a diminution in the pore space of the cultivated layer of a soil reduces the amount of air it can hold, and may thus adversely affect the supply of air to the roots. Consequently, to maintain the pore space of a soil in a condition which will favour root growth, it is important to prevent it both from losing its structure and from becoming compacted. Covering the soil with a protective layer of mulch is a particularly effective means of preserving its porosity.

MOISTURE RELATIONSHIPS.

The moisture relationships of a soil refer to the manner in which texture, structure, and other soil properties influence the supply of air and water to plant roots. Aeration and the supply of water are intimately related because an increase in the moisture content of a soil reduces the amount of air which is present in the pore spaces, and *vice versa*. In addition, the moisture relationships of a soil largely determine the intake of nutrients by a plant, partly because roots can absorb only substances which are in solution, and partly because the chemical changes by which minerals are rendered available to plants can take place only in the presence of air and water.

Soils differ greatly in their moisture relationships, even under similar climatic conditions, and it is these differences which chiefly determine their suitability for pineapple culture. If the moisture relationships of a soil are favourable for the production of this crop, it will invariably repay generous fertilizer treatment, while if they are unsatisfactory, application of fertilizer alone will not materially increase its productivity.

The moisture relationships of a soil are determined chiefly by (1) its permeability and (2) its capacity to hold water.

After soaking rain, air is forced out of the surface layers of a soil because the pore spaces become filled with water. Since fresh rainwater contains appreciable quantities of dissolved oxygen, however, plant roots are affected only if the period of saturation is prolonged—that is, if the excess water is unable to drain away freely. In a well-drained soil, much of the water which enters at the surface in the form of rain quickly percolates downwards to lower levels, thus permitting the re-entry of air into the pore spaces of the root zone.

Permeability.

The downward movement of excess water in a soil takes place under the influence of gravity, and its rate of flow depends on the permeability of the soil, which is determined by the relative size or diameter of the soil pores. Thus permeability depends partly on soil texture and partly on soil structure. For example, percolation through a fine-textured soil (i.e., a clay) which lacks a crumb structure is much slower than it is through a coarse-textured sand, even though the former has the greater total pore space, because the channels between the clay particles are much narrower than they are in sand. If a fine-textured soil possesses a well-developed crumb structure, however, the pore spaces will be larger and downward movement of water will be facilitated. From this it follows that heavy soils can be regarded as suitable for pineapple culture only when they exhibit an open structure—that is, when their humus content is high. It is essential also that the structure of the subsoil layers is such as will permit the ready escape downwards of excess water; this applies not only to heavy soils but to coarse-textured soils as well.

Water Table.

Unless it is lost by evaporation, moisture which gravitates downwards ultimately reaches a level at which the soil is permanently saturated with water. This is known as the *water table*. In any given soil, the depth at which the water table lies varies somewhat with the season and the year, but, in the absence of impervious layers, it generally follows the contour of the land. The water table has little effect on the moisture relationships in the cultivated layers of a soil unless it lies within a few feet of the surface.

Field Moisture Capacity.

Above the level of the water table, the amount of moisture which is present in a soil depends chiefly on (1) the rate at which water is entering the soil in the form of rainfall, and (2) the rate at which it is being lost by transpiration through plants and by evaporation into the air. The maximum amount of moisture which a soil can hold after it has been thoroughly wetted and all free or excess water has drained away is known as its *field moisture capacity*. The field moisture capacity is of practical importance because it represents approximately the upper limit at which a soil can supply water to plants. Prolonged retention in a soil of moisture above this limit is a certain indication of defective drainage and inadequate aeration—i.e., waterlogging. The field moisture capacity of a soil is greatly influenced by its content of clay and organic matter, particularly the latter. Both of these soil constituents retain water in a manner similar to that in which it is held by a jelly. This results in a swelling of the particles. While clay takes up only a little more than its own volume of water, however, humus can adsorb from four to five times as much. Sand particles do not possess the capacity of adsorption and swelling, and they are unable to hold water except as thin films on their surfaces. For this reason, fine-textured soils usually possess a higher field moisture capacity than coarse-textured soils, while a similar, but proportionately greater, difference exists between soils which are well supplied with organic matter and those which are deficient in this constituent.

Wilting Point.

Plants cannot extract all of the water which remains in a soil when the moisture content is at field moisture capacity. As a soil dries, the pull of the soil particles on the moisture present becomes stronger until finally plant roots are unable to get water quickly enough to make good that lost by transpiration from the leaves, and growth comes to a standstill. At this stage, the moisture content of the soil is said to have been reduced to the *wilting point,* because plants whose leaves are not structurally adapted to withstanding severe drought conditions will droop and die as soon as it is reached. Anatomically, pineapple leaves are so constructed that the rate of transpiration is greatly reduced whenever there is a falling-off in the intake of water by the roots (*vide* Chapter II.). Consequently, drooping of the foliage does not immediately occur in this plant when the moisture content of the soil reaches the wilting point; in fact, development of wilt symptoms in the pineapple may be arrested by a renewal of the water supply even after a period of several weeks unless the roots themselves have suffered injury or decay. For this reason, the occurrence of the collapsed condition known as "pineapple wilt" is almost always indicative of partial or complete failure of the root system; it is therefore more often related to an excessive rather than a deficient supply of soil moisture, since an excessive amount of moisture in the soil implies inadequate aeration, and in the absence of air roots cannot live.

Available Moisture Capacity.

Though pineapples may live for a long time without much water intake they do not grow. It is of practical importance to know, therefore, how much water a soil is capable of supplying to crops which are grown on it—that is, its *available moisture capacity.* This is represented by the difference between the wilting point and the field moisture capacity, since the former is the point at which moisture becomes unavailable to plants and the latter is the maximum amount it can hold after all excess water has drained away. While the wilting point for any given soil remains constant, it varies widely for different soils, depending on their texture and capacity for water retention. Fine-textured soils have relatively high wilting points and sandy soils low ones. Consequently, sandy soils can supply water to plants down to a much lower moisture content than clays. In practice, this means that after a prolonged dry spell, during which the moisture content of a soil has been reduced below its wilting point, much less rain will be required to make water again available for plants on a sandy soil than on a heavy one. On the other hand, heavy soils can hold much greater amounts of water than sandy ones because of the adsorptive properties of the clay which they contain. In view of the pronounced alternation of wet and dry seasons which occurs along the entire Queensland coast, it is evident that the soils which are best adapted for pineapple-growing in this State are those which combine a low wilting point with a relatively high field capacity—that is, soils which are able not only to retain a large amount of usable water, but which respond quickly to rain after drying out. These requirements are best met by sandy loams, particularly those which are well supplied with humus.

The relation which exists between field moisture capacity, wilting point, and moisture-availability in several soils representative of those used for pineapple-growing in southern Queensland is illustrated in the following table:—

Type of Soil and Location.*	Wilting Point.	Field Moisture Capacity.	Available Moisture Capacity.
	Per cent.	Per cent.	Per cent.
Sand (Nambour district)	3·4	4·1	0·7
Fine sand (Beerburrum district)	3·6	5·1	1·5
Sandy loam (Glass House Mountains district) ..	4·5	9·4	4·9
Sandy loam (Nambour district)	5·9	10·4	4·5
Clay loam (Nambour district)	24·0	32·6	8·6

* All samples taken to a depth of nine inches.

Of these soils, the two sandy loams may be regarded as typical of the best pineapple soils in southern Queensland. Analyses show that the proven superiority of soils of this type, when properly managed, lies almost entirely in their moisture relationships since their content of available plant foods is uniformly low. By comparison, it will be evident that a sandy soil is less suitable than one of a loamy texture: in consequence of its lower capacity for retaining moisture in a form available to plants, the moisture content of a sandy soil is quickly reduced below the wilting point whenever a dry period occurs. On the other hand, while soils which contain appreciable quantities of clay possess much greater field moisture capacities than sands, or even loams—unless the latter are very rich in humus—crops grown on them may suffer from acute water shortage at certain times of the year, due to the fact that a considerable fall of rain may be required to raise the moisture content of a dried-out, clayey soil above the wilting point. For example, addition of water equivalent to a fall of approximately 150 points of rain are required to bring the moisture content of the top 6 inches of the clay loam (Nambour district) up to the wilting point after it has become thoroughly dry. Allowing for losses due to evaporation and run-off, it will be seen that, following a prolonged dry period, anything less than a fall of 2 inches on a soil of this type has little value as far as a shallow-rooting crop, such as the pineapple, is concerned. However, in the sandy loam (Nambour district), under similar conditions, water again becomes available for shallow-rooting crops after a fall of 50 points, and a lesser amount is required in the case of the sandy loam (Glass House Mountains district). Quite apart from considerations of drainage and aeration, therefore, clayey soils are likely to prove inferior to sandy loams for pineapple culture in regions where there is marked irregularity in the seasonal distribution of the rainfall. To a greater or lesser degree, this applies to the whole of the Queensland coast.

Movement of Moisture in the Soil.

For the bulk of its water supply, the pineapple depends on the moisture which is contained in the first foot of soil; few roots penetrate below this depth and those which do are relatively inefficient in the absorption of water owing to the sparse development of root hairs on them, consequent on an inadequate circulation of air at deeper levels.

As previously explained, water in excess of the field moisture capacity of the root zone normally drains away to deeper levels under the influence of gravity. All except a very small fraction of that which remains is either absorbed by the roots of plants or evaporated into the atmosphere. Replenishment of the moisture supply in the root zone is effected almost entirely by water which enters the soil from above. Soils in which the moisture relationships of the surface layers are appreciably influenced by the rise of subsoil moisture are generally quite unsuited for pineapple culture, because such a condition is indicative either of a high water table or of very fine pore cavities and a consequent lack of aeration. At one time the view was held that water could rise from a considerable depth to make up the losses which occurred from the surface layers, but it is now known that upward movement of water in soils is confined to relatively short distances. Even in heavy loams the lift does not exceed 2 or 3 feet, while in light sandy soils it may not be more than a few inches. Lateral or sideways movement of water in a soil also takes place very much more slowly than was formerly thought to be the case. In the absence of water percolating down slopes, soil protected from rainfall remains dry for a considerable period even when it is surrounded by soil which is maintained in a thoroughly moistened condition. For example, it has been found that, in a sandy loam, a period of from five to six weeks elapses following heavy rain before soil under the middle of a 3-feet wide strip of paper mulch shows any appreciable rise in its moisture content. Obviously, therefore, the moisture content of a soil should be at or near its field capacity before paper mulch is laid on it.

Downward movement of water in a soil occurs only when its moisture content approximates to its field capacity; until this point is reached, the attraction of the soil particles for water is stronger than the pull of gravity. Thus the rate at which rain penetrates a dry soil provides a very good indication of its field moisture capacity; e.g., a sandy soil which is deficient in humus wets much more quickly than one which contains an appreciable quantity of leaf mould or other decaying plant remains. Consequently, in a soil which possesses a high field moisture capacity, the wetting effect of light showers does not extend for more than a few inches below the surface. Plants can make use of this water provided their roots lie within the zone of moisture penetration. However, roots develop near the surface of a soil only when the moisture content of the surface layers is habitually in excess of the wilting point. In the case of the pineapple, some of the water which collects almost daily in the leaves in the form of dew eventually finds its way to the soil at the base of the stem, and root development is largely confined to this region because of the favourable moisture conditions which exist there (vide Plate 262; Chapter II.). For this reason, the pineapple plant is able to obtain a considerable proportion of its water requirements, not only from dews, but also from falls of rain so light in character that they do not appreciably affect the moisture content of the soil as a whole. This explains the disparity between the size of the aerial organs of the pineapple plant (stem, leaves, and fruit) and that the root system which nourishes them. Among growers it is a frequent cause of amazement that so small a root system can support such a large and vigorously-growing plant structure. Because the spread of the root system is so restricted, however, the maintenance of soil conditions favourable to its efficient functioning is a matter of the greatest practical importance. Particularly, it is necessary to insure that as little as possible of the moisture collected by the leaves is lost from the soil by evaporation into the air.

Loss of Soil Moisture by Evaporation.

Loss of soil water by direct evaporation into the atmosphere is greatest at the surface and decreases with increasing depth. This is due not only to the freer circulation of air which occurs in the surface layers, but also to the heating effects of the sun's rays, since the amount of moisture which air can hold in a vaporised or gaseous form is determined by its temperature. In providing optimum soil conditions for pineapples, therefore, the grower is faced with the problem of minimising water loss in that part of the soil from which evaporation is greatest. Free circulation of air around the roots is just as essential for pineapples as an adequate supply of moisture: in the absence of one, the other is of no value. While evaporation of water from a well-aerated soil cannot be entirely prevented, it can be greatly reduced by protecting the surface from the drying influence of wind and from exposure to the sun's rays, i.e., by shading. Investigations carried out in Europe have shown that, on bare exposed soil, 30 per cent. of the total rainfall is lost from the soil by direct evaporation into the atmosphere, while only 7 per cent. is lost under natural beech forest. Although no figures are available, it is reasonable to suppose that in humid tropical and sub-tropical regions, the difference in the rate of evaporation from bare and shaded soil would be considerably greater, due both to the denser nature of the vegetation on virgin soil and the higher temperatures in the surface layers of bare soil. A stand of vegetation or other surface cover not only shades the soil from the sun's rays, but also affords it some protection against the drying influence of winds. By removing moisture-laden air from the soil surface wind greatly accelerates the rate of water loss, particularly when the atmospheric humidity is low. The westerlies which sweep across Queensland during the late winter and early spring often dry out the cultivated soils of the coastal districts to such an extent that shallow-rooting crops such as the pineapple experience difficulty in meeting their water requirements in the months that follow. Evaporational water loss at this and other times of the year may be greatly reduced by the employment of mulches of various kinds and by spacing the plants so that their leaves form a protective covering over the whole of the soil surface. Within the limits that are defined in the chapter dealing with planting, it may be laid down as a general principle that the drier the locality the closer should the plants be spaced. The most effective form of mulching for the reduction of water loss by evaporation is the use of bitumenized paper, because it is impervious to both moisture and air. This material, known as paper mulch, is particularly valuable on soils with low available moisture capacities, since, if unprotected, soils of this type rapidly dry out below their wilting points. The water which collects in the leaves of plants set out in paper mulch reaches the soil under the mulch by way of the openings through which the plants were inserted, but since these openings are almost entirely occupied by the stems of the plants, subsequent escape of this water in the form of vapour is greatly reduced. The commonly held view that maintaining the surface layers of the soil in a fine state of tilth effectively reduces evaporation of soil moisture into the atmosphere has little foundation in fact because, as already pointed out, it has been established that there are very definite limitations on the extent to which the water film covering the soil particles can move *upwards* in a soil. Cultivation helps to conserve the supply of soil moisture which is available to crops only in so far as it destroys competing weed growth. Further than this, cultivation accelerates evaporation of water from the soil down to the depth at which it is carried out, due to the fact that it provides conditions which permit a freer circulation of air. Therefore, in soils possessing an open structure nothing is gained by deep cultivation once the crop has been planted, though a great deal may be lost, not only through increasing the rate of evaporation of moisture from the surface layers, but also by actual destruction of the roots. From the time of planting in the spring until late in the autumn, when hilling up may become desirable, cultivation in pineapple plantations is necessary only for the purpose of destroying weeds, and it should not be carried out to any depth greater than is required to achieve this objective. In this connection, however, it should be pointed out that, under certain conditions, growth of weeds along the inter-row spaces of a pineapple plantation may have a beneficial effect by preventing the soil from becoming excessively wet. Such conditions sometimes obtain during the summer months in the case of the fine-textured, moisture-retentive loams of the Blackall Range. Following soaking rains, adjustments in the moisture relationships of soils of this type occur relatively slowly, with the result that their water content may exceed the field moisture capacity for dangerously long periods unless something is done to accelerate the removal of excess water from the root zone. Increasing the rate of evaporation by deep cultivation is undesirable, even if it were practicable, not only because of the injury to roots which ensues, but also because of the damage which would result from erosion if further heavy rain should fall. Provided weeds are not permitted to encroach within a foot of the pineapple plants, and provided also that they are scythed down at intervals to prevent them from shading the crop, their roots will materially assist in draining soil under the conditions specified while at the same time binding it against the eroding effects of further downpours. On coarser-textured soils, however, pineapple fields should be kept free of weeds at all times and under all circumstances. The occurrence of waterlogged conditions in such soils is indicative of impenetrable substrata or other factors impeding the removal of surplus moisture.

Waterlogging of Soils.

Waterlogging of soils results from one or more of the following conditions:—(1) accumulation of surface water in hollows or depressions, (2) a shallow watertable, and (3) impervious subsoil formations. The harmful effects of waterlogging on plant growth are due to water filling the pore spaces and thus forcing air out of the soil. Under such conditions, roots are literally suffocated as soon as they have used up any oxygen which may have been dissolved in the water. At field capacity, about 50 per cent. of the pore space of a friable loam is filled with water, the remainder containing air; in a clay loam, the proportion of air is usually somewhat less, though much depends on the degree to which a crumb structure has been developed. Since the intolerance of the pineapple for compact clay soils is due to their deficient aeration, especial attention should be given to the drainage of even moderately heavy soils before planting them with this crop. It should be clearly understood, however, that drainage cannot lower the moisture content of a soil below its field capacity, so that in the case of fine-textured soils which lack a crumb structure, aeration may still be deficient even after they have been drained. Temporary waterlogging of relatively coarse textured soils is not uncommon in the pineapple districts of southern Queensland during rainy periods, due to the presence, at a shallow depth, of impervious subsoil formations. It is best to avoid soils of this kind for pineapple culture, but where they must be utilised, great care should be exercised in preparing the land for planting and in laying out the rows. These matters are dealt with in a subsequent chapter.

Water Requirements of the Pineapple.

In the pineapple, as in other green plants, water is taken in through the root system in a continuous stream and given off through the leaves. Any interruption in this flow of water from roots to leaves results in an immediate cessation of growth. Unless a soil is capable of supplying fully the moisture requirements of crops which are grown on it throughout their entire life cycle, maximum yields cannot be obtained. In none of the pineapple districts along the Queensland coast is the rainfall so distributed that the needs of the crop for moisture are fully met at all times of the year. During the rainy season there is a considerable loss of water as run-off, while in the spring and early summer the soil may dry out to such an extent that the supply of moisture becomes the limiting factor for the growth of the crop.

Weather conditions greatly influence the rate at which plants take water from the soil. In the case of the pineapple, growth slows up very rapidly as soon as the mean daily temperature falls below 70 degrees F., so that, in southern Queensland, the water requirements of this crop during the winter months are very much lower than they are during the spring and summer. Other climatic factors which influence the rate at which water is used by plants are rainfall, wind, amount of sunshine, and the humidity of the atmosphere. The amount and distribution of the rainfall chiefly determines the quantity of water which is available for use by the crop at any given time. Irrespective of other factors, pineapples use more water when the moisture content of the soil is near field capacity than when it approaches the wilting point. Wind increases the rate of evaporation of moisture from leaves in the same way as it does from any other damp object.

The amount of water required to produce a given quantity of dry plant material may vary considerably at different times of the year. Most crop plants transpire from 200 to 600 pounds of water for each pound of dry matter produced. At the time the first fruit matures, pineapple plants of the Smooth Cayenne variety contain an average of 84 per cent. of water and 16 per cent. of dry matter, the moisture content of the ripe fruit being approximately the same as that of the plant as a whole. Assuming that pineapple plants transpire an average of 300 pounds of water for each pound of dry matter produced, approximately 1,000 tons of water per acre (equivalent to 10 inches of rain) would be required to produce a 20-ton crop of fruit, excluding that used in the development of roots, stems, and leaves. Allowing for losses due to run-off, evaporation, and percolation, the rainfall in practically all of the pineapple districts along the Queensland coast would be more than adequate to meet this demand were it not for the irregular manner in which it is distributed. As it is, there are few seasons in which the potential yield is not reduced because of an insufficient supply of water during some period of growth. It is evident, therefore, that the moisture relationships of a soil are of the utmost importance in determining its productivity. A high available moisture capacity lengthens the period over which growth may take place and vice versa. Irrespective of the water-holding capacity of a soil, however, maximum utilisation of the available moisture which it contains is achieved only when every possible precaution is taken to prevent loss by evaporation.

SUPPLY OF PLANT NUTRIENTS.

In addition to permitting free circulation of air and the storage of adequate quantities of available moisture, an additional requirement of a soil for pineapple culture is that it shall contain a supply of mineral nutrients sufficient to meet the needs of the crop throughout the whole of its period of growth. Unlike those relating to soil moisture relationships, however, most deficiencies in respect of plant nutrients may be readily corrected by the use of appropriate fertilizing materials. For this reason, a chemically poor soil is not necessarily unsuited for pineapple-growing; in fact, an unfertile soil may sometimes prove a better economic proposition than a fertile one, provided its moisture relationships are satisfactory. For example, most of the soils used for pineapple culture in southern Queensland are deficient in available mineral plant foods as compared with the alluvial soils of the Don and Burdekin deltas in the northern part of the State, but, under existing conditions, they are generally more profitable because of their proximity to canneries and urban fruit markets. Other things being equal, however, the additional cost of fertilizing a poor soil places it at a considerable disadvantage in comparison with a fertile one.

FREEDOM FROM ADVERSE CHEMICAL CONDITIONS.

The third essential requirement of a soil for pineapple culture is that its chemical constitution shall not adversely affect either the growth or the yield of the crop. This implies not only the absence of harmful concentrations of salts, but also a favourable soil reaction. An excessive concentration of soluble salts, such as alkalies, is rarely encountered in soils of regions which are climatically suited to the culture of the pineapple because of the leaching which has taken place in their surface layers. With the exception of the alluvial soils of the Don and Burdekin deltas, all of the soils which are employed for pineapple culture in Queensland have been subjected to a considerable amount of leaching. None of these soils, either leached or alluvial, have been found to contain injurious concentrations of alkali salts, though, in a few, manganese compounds are present in excessive amounts. However, in the case of reaction—that is, the condition of acidity or alkalinity which exists in a soil—a very different position exists. Investigation has shown that, unlike most crop plants, the pineapple thrives best in an acid soil, and that a neutral or alkaline reaction has a depressing effect on growth. In most of the pineapple districts along the Queensland coast the soils are insufficiently acid for the production of satisfactory yields when they are first brought under cultivation and, with a few exceptions, it is necessary to apply corrective treatment prior to planting them with pineapples. Because of the profound influence which soil reaction exerts on the nutrition of the pineapple, particularly with respect to the availability of iron and phosphorus, it is discussed again in greater detail in a subsequent chapter.

[TO BE CONTINUED.]

Fused Needle Disease and its Relation to the Nutrition of Pinus.

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(*Continued from p. 177, February, 1940.*)

IN order to investigate the effects of the presence and absence of organic matter in *Pinus tæda* and *P. caribæa* a series of experiments were designed in 1934 and laid out at Beerwah. The treatment involved the use of organic matter on diseased and healthy trees and, as a comparison, the removal of organic matter from them. The experiments included pot experiments, transplanting experiments, and soil treatments in the field, and will be individually discussed under these headings.

(a) Pot Experiments.

A number of pot experiments were commenced at Beerwah at the forest nursery. For these the plants used were ten-months-old nursery seedlings, averaging 12 to 15 inches in height. The plants were selected from the nursery beds and were chosen as representatives of a diseased and of a healthy series. The treatments applied in the case of *Pinus tæda* were as follows:—

(A) Healthy plants in nursery soil.

(B) Healthy plants in soil from beneath *P. tæda* trees affected with fused needle.

(C) Diseased plants in soil from beneath *P. tæda* trees affected with fused needle.

(D) Diseased plants in soil from beneath *P. tæda* trees affected with fused needle, mixed with one part of cow dung.

(E) Healthy plants in washed white sand (three parts) and cow dung (one part).

(F) Diseased plants in washed white sand (three parts) and cow dung (one part).

(G) Healthy plants in washed white sand.

(H) Diseased plants in washed white sand.

(J) Diseased plants (from the plantations) in own soil (three parts) and cow dung (one part).

(K) Diseased plants (from the plantations) in own soil.

(L) Diseased plants in soil from beneath diseased *P. caribæa.*

(M) Diseased plants in soil from beneath diseased *P. caribæa* and cow dung (one part).

(N) Diseased plants in cow dung.

(O) Healthy plants in cow dung.

The experiment was then repeated using seedlings of *Pinus caribæa* instead of *Pinus tæda.*

Cow dung was used for supplying organic matter owing to its known richness as a mulch for this purpose and the convenience in mixing. The plants used were lifted from the soil and had their roots washed clean with water and were replanted in the appropriate soil treatment. Six plants of each species were used for each treatment, and in this way eighty-four plants of each species were used.

In treatment (N), involving the planting of each species in cow dung alone, only four plants of each were used owing to the fact that no larger number of diseased plants of the requisite age was available.

The results obtained from the experiment were as follows:—

(A) In the first season there was no change, but in the second there was a tendency to twisting and fusion in the second growth period which occurs in the latter half of the summer.

(B) Early and continuous fusion resulted.

(C) No change in the condition of the plants was effected.

(D) There was recovery in the first season, followed by a relapse to the fused condition in the second season.

(E) Good healthy growth occurred in the first season, followed by the onset of disease in the second season.

(F) The plants recovered in the first season but returned to the diseased condition in the second season.

(G) The plants became spindly and chlorotic, with a typical aspect of malnutrition. Little or no growth was made.

(H) Little or no growth occurred. Chlorosis was present.

(J) The plants recovered in the first season but relapsed to fusion in the second.

(K) Continuous production of diseased growth occurred.

(L) No change in the condition of the plants was noted.

(M) The plants recovered in the first season but relapsed during the second.

(N) The plants recovered and made very vigorous growth but reverted to the fused needle condition at the end of the second growing season.

(O) The plants remained healthy and grew vigorously but tended to become fused at the end of the second season.

Similar tendencies as regards response to the various treatments were displayed by *Pinus tæda* and *Pinus caribæa.*

In January, 1937, the trees in each respective pot were given a dressing of half an ounce of equal parts of potassium sulphate, ammonium sulphate, and calcium superphosphate. All plants at that time were virtually in a diseased condition. No responses to the fertilizer were made by any of the plants. This is significant in connexion with the response noted from similar fertilizer trials in the field and will be referred to again in discussing the rôle played by phosphorus.

From this pot experiment it was found that the amount of organic matter when supplied in the form of cow dung was apparently the limiting factor in deciding the condition of the plants in each pot, and that as this organic food supply became exhausted the condition of fused needle appeared. The response of individual trees in each particular experiment varied slightly, but the general direction of the reaction of all the plants in any one treatment was similar. The relapse to the diseased condition shown by the cow-dung-treated plants in the second season after treatment pointed to the fact that a deficiency of fresh organic matter rather than of organic matter *per se*, as there was old material still remaining in the soil, might possibly be the factor causing the change.

(b) Transplanting Experiment.

As a means of investigating the local environmental effect on individual trees it was decided to commence an experiment involving the placing of healthy trees on sites which had produced diseased ones and *vice versa*. Accordingly, a number of three-year-old plantation trees of *Pinus tæda* at Beerwah which were affected with fused needle disease were dug out of the ground and replanted in the holes from which healthy trees had been removed. The healthy trees were not discarded but were planted in the holes from which the diseased trees had been taken. The experiment was initiated in May, 1935, and fifty-four trees, twenty-seven of which were healthy and twenty-seven diseased, were dealt with. The height of the trees varied from 4 to 7 feet. The results obtained from observations made on the trees are shown in Table VII.

TABLE VII.

THE PERCENTAGE OF TRANSPLANTED TREES BECOMING HEALTHY OR DISEASED.

Date.	Healthy, becoming Diseased.	Diseased, becoming Healthy.
21-4-35	..	..
10-2-37	23·0	34·6
20-7-37	20·0	34·5
28-8-38	26·8	26·8
10-7-39	26·8	33·0

It will be seen that a proportion of the previously healthy trees became affected and that some of the formerly affected trees regained their health. The number of healthy trees becoming affected is in excess of the normal plantation increase in the incidence of the disease in the area on which the plot was situated (Table I., Block B). It is infrequently, in the age class to which these trees belonged, that an affected tree regains vigour and retains it. It is, therefore, presumed that the change of site was instrumental in causing at least a proportion of the trees to change their state of health. There is evidence that the site difference is organic rather than mineral in nature.

The fact that all the trees did not change may be explained by means of a possible inherent genetic factor as postulated earlier. In this case the most susceptible trees would be likely to change to the diseased condition, and the fact that there are numerous healthy trees on sites where diseased trees occur points to the fact that all trees are not susceptible to the same degree. If this inherent factor is present it would also explain the comparatively low proportion of diseased trees recovering when planted in the holes where healthy trees had been growing. Only those plants with a relatively low susceptibility, but enough to induce fused needle disease on the site originally occupied, would then be expected to recover.

(c) Soil Treatment in the Field.

Observations made in conjunction with the experiments just described and also in connexion with plantation conditions in general indicated that there was an apparent soil poverty in plant remains suitable for the support of healthy mycorhiza-forming fungi. Normal healthy mycorhizas are found on diseased trees quite frequently, but only in localized patches where there are accumulations of organic matter such as in a decaying piece of wood or around an old stump. It is evident, however, that these few healthy mycorhizas on diseased trees are not present in large enough numbers to appreciably benefit the health of the plant.

In order to test this organic food-supply aspect of the problem still further, a number of soil treatments were carried out. The first experiment (Block K) was laid out in a stand of *Pinus tæda* in the bluegum logging area at Beerwah as a Latin square of five treatments, the respective treatments being as follows:—

(A)—*Clean Chip.*—The soil surface of the plots in this treatment was chipped clear of all vegetation with a hoe and all the chippings were removed, leaving a clean soil surface. The plots were tended whenever necessary in order to maintain the bare condition of the soil, all falling needles and new vegetation being removed.

(B)—*Cover Crop.*—In this treatment the plots were cultivated by digging to a depth of 6 inches with a mattock after removing the cover of vegetation from the surface. The plots were then sown with seed of New Zealand blue lupin (*Lupinus varius*), which was inoculated with an appropriate nitrogen-fixing bacterium, followed by a summer sowing with *Crotalaria goreensis.* Neither crop, however, was a success on this area, probably because of the root competition supplied by the pine trees. Owing to the failure of the legumes in this plot the treatment was then used as an additional replication of (A).

(C)—*Cultivated.*—In this treatment the plots were dug over to a depth of 6 inches and were thereafter kept clean as in (A). The plots were recultivated three times during the ensuing two years, when, following a further advancement in the investigations resulting from another series of experiments, the treatment was used for the purpose of a clean chipped superphosphate trial using a dressing of superphosphate at the rate of 3 cwt. per acre. These plots had become unnecessary for the purpose of the initial experiments, as they had proved by their reaction that they were a duplication of the clean chipped treatments.

(D)—*Control.*—This treatment received routine plantation tending, which in that locality consists of an annual brushing (up to the time when the pines suppress the other vegetation), by means of a brush hook, of all eucalypt and other coppice growth, together with any other vegetation which has in the meantime appeared. The brushed vegetation is left on the ground.

(E)—*Litter Treatment.*—In this case the plots were cleared by grubbing all living vegetation other than the pine trees and then the ground surface was covered with litter. The litter was spread over the surface of the plots, completely covering them to a depth of 5 inches. The litter consisted of leaves and twigs obtained from beneath standing mixed eucalypt forest, together with chipped fresh blady grass (*Imperata* *cylindrica* var. *koenigii*) material obtained from a heavily grassed area on a nearby creek bank. These plots were treated with another dressing amounting to a 3-inch layer over the plot surfaces twelve months after the initial treatment.

The area included in the experiment was 2·5 acres, thus allowing 1 square chain for each plot, including an isolation strip of one row of trees around the border of each plot. The trees had been planted with a spacing of 8 feet by 8 feet and were five years old at the time of treatment. At the age of ten years the trees in the control plots had a mean height of 12 feet as compared with 40 feet on a similar site which supports healthy growth of the same age. There were a number of spaces from which the trees were missing in some of the plots, due to death at some time previous to the initiation of the experiment. This reduced the number of trees in each unit plot to an average of twenty.

The soil is of a poor sandy character which, however, had, before clearing, carried a good vegetational cover in which *Eucalyptus pilularis, E. acmenioides* and *Syncarpia laurifolia* were the dominant species. The individual trees of these species had reached quite a large size. The soil surface had many small bare patches, but there were small shrubs and grassy tussocks growing on it. There was little or no accumulation of a humus layer, the dropped leaves being disposed of rapidly in the prevailing sub-tropical open conditions. The soil type approximates the Glasshouse sands as described by Vallance (1938), but overlies a white marine sand. The age is regarded as being Triassic, and as such the series is thought to belong to the Ipswich Coal Measures.

The location of a plantation on this particular spot was chosen on account of the excellent development of the original eucalypt vegetation, and also because of its good drainage, mechanical character, accessibility, and favourable chemical analysis in comparison with other neighbouring sites. However, the trees planted there became fused and the area proved the worst in the reserve.

In the same year two further but similar plots were initiated, one (Block L) in one-year-old *Pinus caribæa* in the Mellum logging area at Beerwah and the other (Block M) with newly-planted *Pinus tæda* and *Pinus caribæa* at Glasshouse Mountains. In the former case four treatments were used, the cover crop treatment as described in the first experiment being omitted. In the latter case, however, the initial experiment as laid down in Compartment 1, Bluegum, was duplicated. In this block each individual treatment consisted of two rows of *Pinus tæda* and three rows of *Pinus caribæa.*

In the case of the litter treatments, one further application in addition to the previous two was made in the second year in the case of Blocks L and M.

In the case of both blocks, the individual plots consisted of a unit of five rows of five trees each, with an isolation strip of two rows between any two contiguous treatments.

The experiments in Blocks L and M involved young, still healthy trees, and were commenced in order to gain data concerning the effect of the various treatments on the prevention or cause of fused needle disease, and were located on sites which it was thought, by reason of their relative poverty, would be as likely as any to produce a fair proportion of fused-needle-affected stems later.

The soil in the Mellum experiment at Beerwah was of the type described by Vallance (1938) as the Beerwah Sand, and that at Glasshouse Mountains as the Glasshouse Sand. The Mellum plot was located on undulating country, consisting of gentle ridges interspersed by swamps similar to the type described for the Bluegum plot. The Glasshouse plot was placed on a high ridge on soil which overlies a mesozoic sandstone which, in fact, outcrops in places in the experimental area. A considerable amount of fossilized wood is found lying on the surface. The actual citric acid soluble phosphate present in the soil in this Glasshouse plot is the lowest of any of the determinations made on various sites in the vicinity, the reaction being nil as compared with an average of six parts per million for the remainder of the plantation area. It was also noted that the phosphate values for the ridge tops in this locality were consistently less than those determined for the corresponding slopes and gullies.

Both ridges and slopes originally carried a good stand of eucalyptus forest. The Mellum plot, however, did not carry such good original timber as either the Bluegum or Glasshouse areas. It is comparatively low-lying and the swamp vegetation merged into the eucalyptus forest in that neighbourhood.

At the commencement of the experiment in 1935 observations were carried out in the plots, established as described, and thereafter at midsummer and midwinter, when the height and any change in the appearance of the individual trees was recorded. Girth measurements were commenced in 1939, but, owing to the small errors of high significance which are liable to occur in these observations, it is considered that the height measurements are of the greatest importance.

The progress in growth and disease in the three blocks is shown in Tables VIII. to XVII., and is illustrated graphically in Plates 85, 91, 92, and 93, and by photographs in Plates 86-90.

The results of the Bluegum block are typical of those obtained in all three, and will be considered in detail, while those of the Mellum and Glasshouse blocks (L and M) will be referred to only when outstanding differences occur.

In the Bluegum block (Plate 85, Tables VIII., IX., and X.), the height increment in the litter and control plots was similar and the greatest during the first year, the clean chipped treatment was next, whilst the two cultivated plots were the lowest. In the next year the litter treatment gained a decided ascendency over all the other treatments, whilst the control had been reduced to second place and the clean chipped treatment had now descended to fourth place. At this stage a broadcast dressing of superphosphate at the rate of 3 cwt. per acre was applied to treatment (C), which had been cultivated but which was thenceforth only clean chipped. The results for the succeeding year were still in favour of the litter treatment, whilst the fertilizer dressing caused the treated plots to advance to second place, followed very closely by the control (D). The clean chipped treatment had now become definitely last. In the next year, however (1938-39), the fertilizer treatment proved the best, whilst the litter was now similar to the control, which was still significantly superior to the remainder. In total increment from the beginning of the experiment the litter, control, and fertilized treatments were superior to the clean chipped and cultivated, in that order. The actual figures for these observations are to be seen in Table IX.

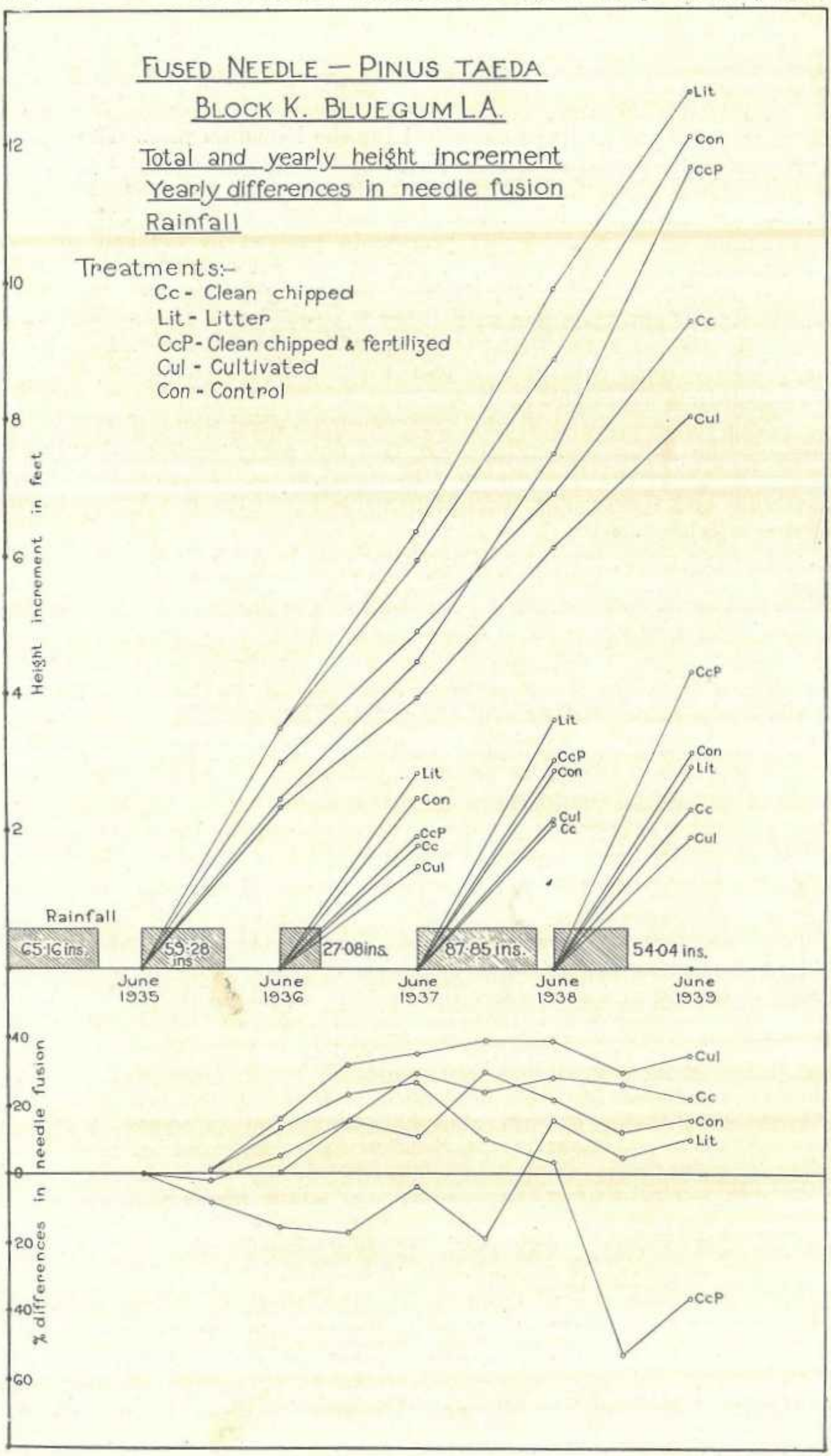
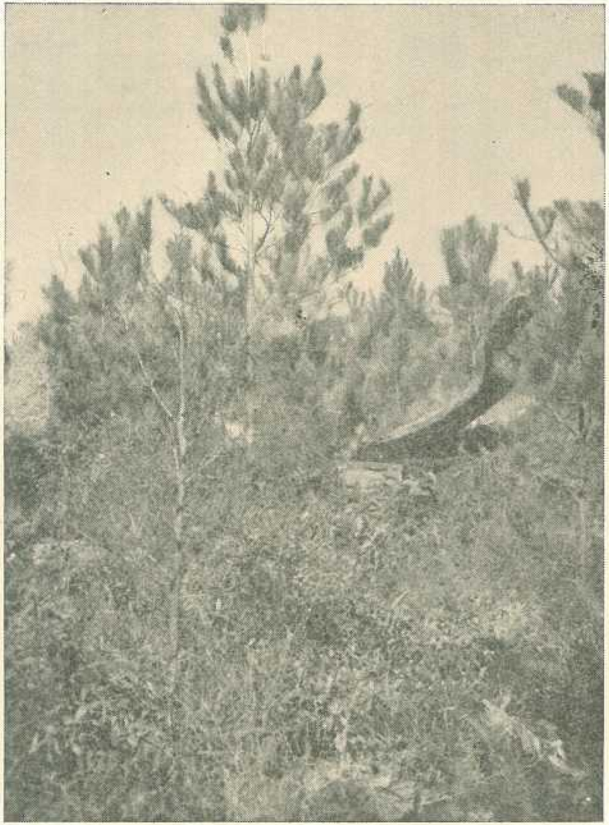
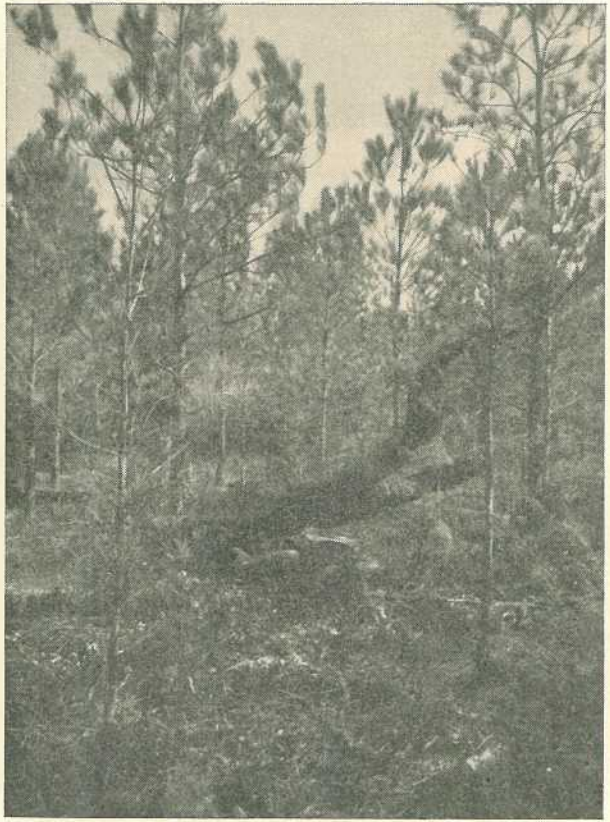


Plate 85.

SOIL ORGANIC MATTER EXPERIMENT, BLOCK K (*Pinus tæda*).—The superphosphate was applied to Plots CcP in June, 1937.



A



B

Plate 86.

LITTER AND FERTILIZER EXPERIMENTS, BLOCK K (*Pinus tæda*).—Control, untreated plot—Left, 1936; Right, same 1939.

TABLE VIII.

OCCURRENCE OF FUSED NEEDLE IN SOIL TREATMENT EXPERIMENT AT BLUEGUM (BLOCK K).

Treatment.	Percentage Trees Affected with Fused Needle each Season.					
	1934-35.	1935-36.	1936-37.	1937-38.	1939.	1938-39.
(A) Clean chipped	66·0	69·4	96·4	95·4	94·6	92·0
(B) Litter	60·0	42·1	56·8	78·4	69·7	66·3
(C) Cultivated, then clean chipped and fertilized (1937)	67·7	82·3	93·7	63·5	14·5	31·2
(D) Cultivated	57·7	75·0	94·8	97·9	88·5	94·5
(E) Control	62·0	62·0	73·0	88·0	70·0	76·5

TABLE IX.

THE HEIGHT INCREMENT OF *Pinus tæda* IN THE SOIL TREATMENT EXPERIMENT AT BLUEGUM (BLOCK K).

Treatment.	Seasonal Increment, in Feet.						
	1935-36.	1936-37.	1937-38.	1938-39.	Total 1935-37.	Total 1935-38.	Total 1935-39.
(A) Clean chipped ..	1·50	0·94	1·07	1·18	2·44	3·50	4·7
(B) Litter	1·75	1·41	1·80	1·48	3·16	4·96	6·4
(C) Cultivated, then clean chipped and fertilized (1937)	1·24	0·97	1·51	2·14	2·21	3·72	5·86
(D) Cultivated ..	1·21	0·77	1·09	0·94	1·98	3·07	4·0
(E) Control	1·76	1·25	1·45	1·6	3·01	4·46	6·06
Standard error ..	±0·187	±0·198	±0·121	±0·177	±0·253	±0·246	±0·314
Significant difference	0·52	0·55	0·34	0·49	0·70	0·68	0·87
Significant Results ..				C>A,B, D,E C>D			C,B,E> A,D
Results approaching Significance	B, E>D B>C	B>D	B>A, D,E C,E>A,D	B>A,D	B>A,C,D E>D	B>A,C,D E>A,C,D C>D	

TABLE X.

MEAN GIRTH BREAST HIGH IN INCHES IN BLOCK K, AT JUNE, 1939.

Treatment.	Mean Girth.	Girth-Height Relationship. (Height in feet ÷ Girth Breast High in Inches.)
Clean chipped	7·29	7·29 : 12·12 = 1 : 1·6
Cultivated	6·77	6·77 : 11·66 = 1 : 1·7
Cultivated, then clean chipped and fertilized (1937)	8·28	8·28 : 13·35 = 1 : 1·6
Control	8·06	8·06 : 14·1 = 1 : 1·7
Litter	8·89	8·89 : 15·2 = 1 : 1·7

The results obtained in relation to fused needle occurrence are shown in Table VIII. From this table it will be observed that in all plots involving the removal of surface vegetable matter (A, C, and D) there was a steady increase in fused needle disease up to the end of the

Plate 87.

LITTER AND FERTILIZER EXPERIMENTS, BLOCK K (*Pinus tæda*).—Fertilized and clean chipped plot 1936, before fertilizing.

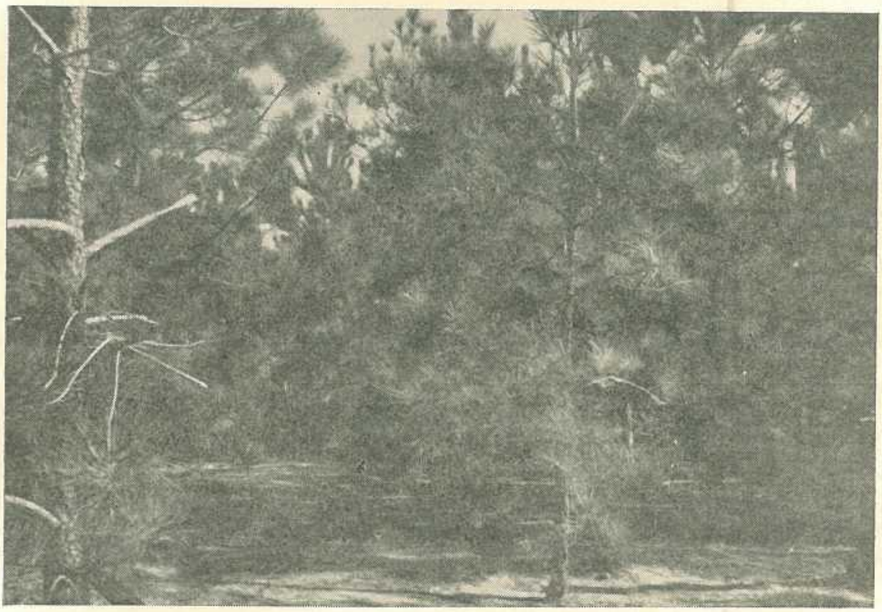
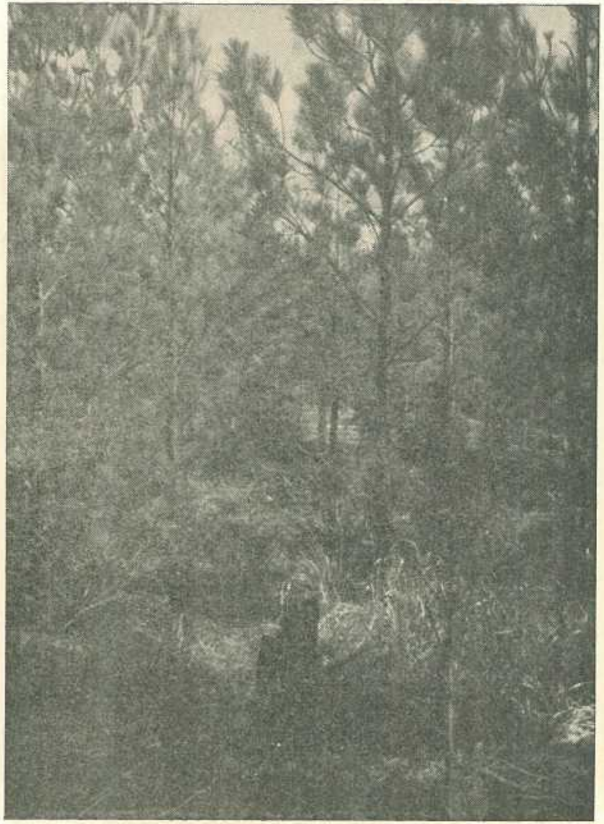


Plate 88.

LITTER AND FERTILIZER EXPERIMENTS, BLOCK K (*Pinus tæda*).—Fertilized and clean chipped plot, 1939. Same as Plate 87, after fertilizing in 1937.

A



B

Plate 89.

LITTER AND FERTILIZER EXPERIMENTS, BLOCK K (*Pinus tæda*).—Litter treatment—Left, 1936; Right, same 1939.

A B

Plate 90.

LITTER AND FERTILIZER EXPERIMENTS, BLOCK K (*Pinus tæda*).—Clean chipped plot—Left, 1936; Right, same 1939.

1937-38 season, except in the case of C, which was fertilized and in which a recovery from the typical symptoms was experienced during the growing season following the addition of superphosphate in 1937. The plot treated with litter improved considerably during the first two seasons after initiation, but began to regress towards the condition of the control treatments after that period. The control treatments showed a steady increase in the incidence of the disease, but, as has been illustrated in other plots, began to recover with the gradual formation of a ground cover.

In girth (Table X.) the plots treated with litter are superior to all the others. There is little difference between the control and fertilized plots, which are both superior to the cultivated, which is better than the clean chipped treatment. The girth-height relationship is similar for all plots.

In the case of the Mellum plot (Block L), which was laid out in one-year-old *Pinus caribæa*, the results of the various treatments can conveniently be seen in Plate 91 and Tables XI., XII., and XIII. In this plot the fertilized trees are shorter but stockier than the litter-treated stems. The results from this plot are similar to those from Block K.

TABLE XI.

THE PERCENTAGE OF *Pinus caribæa* TREES AFFECTED WITH FUSED NEEDLE DISEASE EACH SEASON IN BLOCK L, MELLUM.

Treatment.	Season.				
	1934-35.	1935-36.	1936-37.	1937-38.	1938-39.
Clean chipped	..	4·8	14·3	10·0	17·4
Control	..	..	5·5	3·6	9·2
Cultivated, then clean chipped and fertilized (1937)	0·9	2·7	4·5	2·7	2·7
Litter	0·9	1·8	..	2·7	9·0

TABLE XII.

THE HEIGHT INCREMENT IN FEET OF *Pinus caribæa* IN BLOCK L, MELLUM.

Treatment.	Season.				Total Increment, to 30-6-37.	Total Increment, to 30-6-38.	Total Increment, to 30-6-39.
	1935-36.	1936-37.	1937-38.	1938-39.			
(A) Clean chipped ..	0·82	1·35	2·87	3·02	2·17	5·04	8·05
(B) Litter	1·06	1·81	4·13	3·78	2·87	7·00	10·75
(C) Clean chipped and fertilized (1937)	0·75	1·60	4·01	3·95	2·34	6·36	10·28
(D) Control	1·11	1·42	3·06	3·18	2·54	5·60	8·78
Standard Error ±	0·164	0·13	0·12	0·089	0·228	0·335	0·38
Significant Difference (20 : 1)	0·52	0·41	0·38	0·28	0·73	1·06	1·21
Significant Results ..		B > A	C, B > A, D	C, B > A, D		B > A, D C > A	C,B > A,D
Results Approaching Significance ..		B > D			B > A		

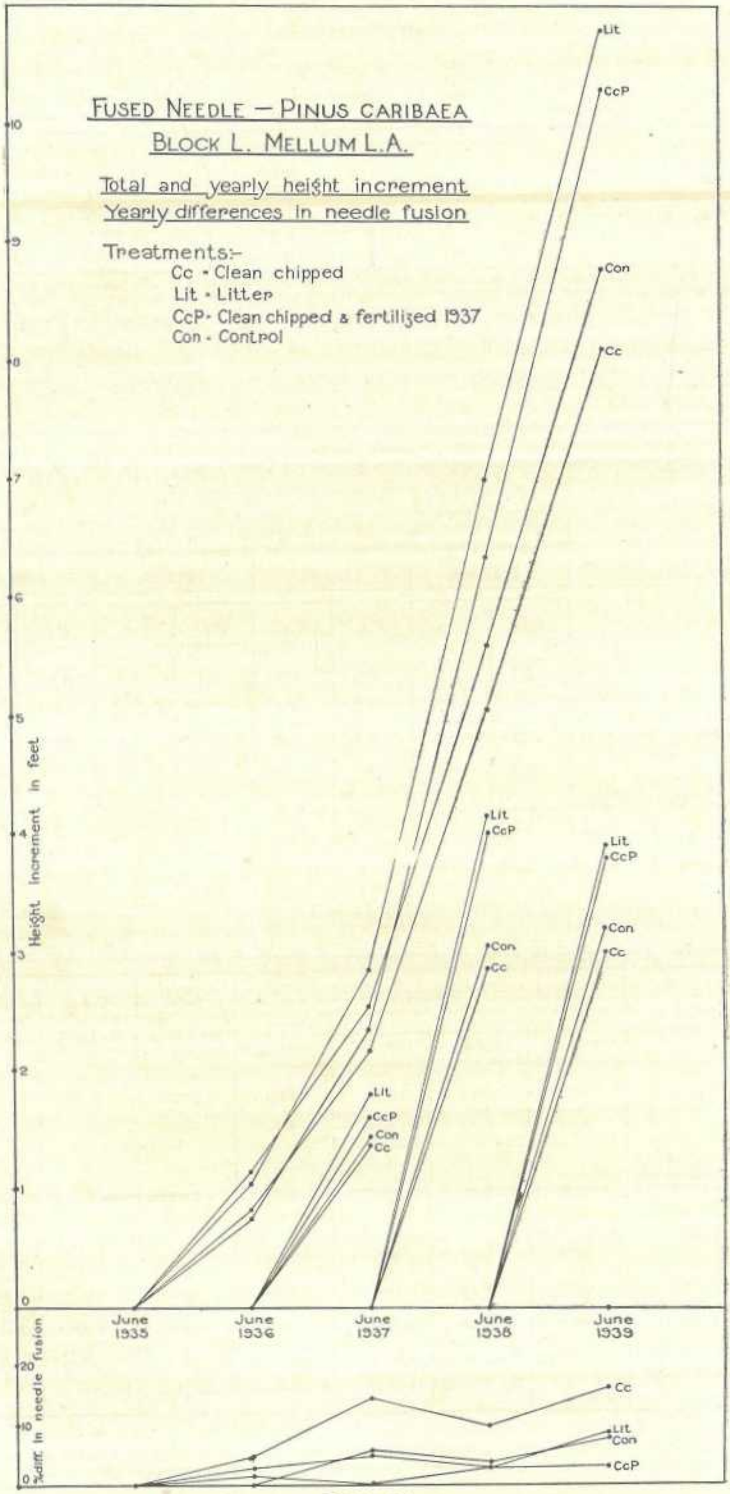


Plate 91.

SOIL ORGANIC MATTER EXPERIMENT, BLOCK L (*Pinus caribæa*).

TABLE XIII.

MEAN GIRTH BREAST HIGH IN INCHES IN BLOCK L, AT JUNE, 1939.

Treatment.	Mean Girth.	Girth-Height Relationship.
Clean chipped	6·05	6·05 : 9·5 = 1 : 1·57
Control	5·76	5·76 : 10·1 = 1 : 1·75
Clean chipped and fertilized (1937) ..	7·81	7·81 : 11·8 = 1 : 1·51
Litter	7·23	7·23 : 12·1 = 1 : 1·67

The results obtained from the Glasshouse Mountains Block (M) are illustrated, in so far as *Pinus tæda* is concerned, in Plates 92 and 93, whilst the actual figures for both species are shown in Tables XIV., XV., XVI., and XVII.

TABLE XIV.

THE PERCENTAGE OF TREES AFFECTED WITH FUSED NEEDLE DISEASE IN *Pinus tæda* AND *P. caribæa* AT GLASSHOUSE MOUNTAINS (BLOCK M).

Treatment.	Season.							
	1935-36.		1936-37.		1937-38.		1938-39.	
	P.t.	*P.c.*	*P.t.*	*P.c.*	*P.t.*	*P.c.*	*P.t.*	*P.c.*
Cover crop	2·0	4·3	8·3	2·9	6·1	3·7	10·6	3·2
Control	8·3	1·3	2·0	2·1	6·25	1·0	4·1	1·2
Clean chipped	4·2	5·5	8·3	2·8	28·5	7·1	22·4	4·2
Litter	4·2	1·4	4·2	1·4	4·2	2·9	6·1	5·8
Clean chipped and fertilized (1937)	9·0	6·6	6·6	2·1	11·0	3·9	2·2	1·2

TABLE XV.

THE HEIGHT INCREMENT IN FEET OF *Pinus tæda* IN BLOCK M AT GLASSHOUSE MOUNTAINS.

Treatment.	Season.				Total Increment, to 1937.	Total Increment, to 1938.	Total Increment, to 1939.
	1935-36.	1936-37.	1937-38.	1938-39.			
(A) Clean chip ..	0·94	1·44	3·81	3·08	2·38	6·19	9·24
(B) Litter	0·83	2·79	5·00	3·38	3·61	8·61	11·66
(C) Cultivated, then clean chipped and fertilized (1937)	0·92	1·91	4·93	3·60	2·83	7·75	11·36
(D) Cover crop ..	0·91	1·94	4·53	3·76	2·86	7·38	11·14
(E) Control	0·74	1·02	3·59	3·36	1·76	5·35	8·72
Standard Error ± ..	0·075	0·301	0·336	0·132	0·378	0·53	0·623
Significant Results ..	0·21	0·84	0·93	0·37	1·04	1·47	1·75
Results Approaching Significance ..		B > E, A D, C > E	B, C > A, E D > E	D > A,B,E C > A	B > A, E C > E	C, B > E, A D > E	A, B, C > A, E

TABLE XVI.

THE HEIGHT INCREMENT OF *Pinus caribæa* IN BLOCK M AT GLASSHOUSE MOUNTAINS.

Treatment.	Season.				Total Increment, to 1937.	Total Increment, to 1938.	Total Increment, to 1939.
	1935-36.	1936-37.	1937-38.	1938-39.			
(A) Clean chip ..	0·79	1·04	3·49	3·24	1·83	5·32	8·56
(B) Litter	0·80	1·73	4·16	3·44	2·53	6·69	10·12
(C) Cultivated, then clean chipped and fertilized (1937)	0·88	1·61	4·61	3·56	2·49	7·09	10·66
(D) Cover crop ..	0·77	1·53	4·13	3·48	2·30	6·43	9·92
(E) Control	0·72	0·77	3·17	3·24	1·49	4·66	7·88
Standard Error ± ..	0·04	0·081	0·180	0·082	0·109	0·267	0·323
Significant Difference	0·11	0·22	0·50	0·23	0·30	0·74	0·90
Significant Results..	C > D, E	B,C,D > E, A A > D	C > E, A D,B > A,E	D,B,C > A,E	D,B,C > E, A A > D	B,D,C > E, A	D,B,C > A,E
Results Approaching Significance ..			C > D				

TABLE XVII.

THE GIRTH AT BREAST HEIGHT OF THE TREES IN BLOCK M (1939) GLASSHOUSE MOUNTAINS.

Treatment.	Girth Breast High.		Girth-Height Relation.	
	P. caribæa.	*P. tæda.*	*P. caribæa.*	*P. tæda.*
(A) Clean chipped	5·55	5·31	1 : 1·7	1 : 1·9
(B) Litter	7·18	7·17	1 : 1·5	1 : 1·7
(C) Cultivated, then clean chipped and fertilized (1937)	6·89	6·89	1 : 1·7	1 : 1·8
(D) Cover crop	6·73	6·72	1 : 1·6	1 : 1·8
(E) Control	4·93	4·71	1 : 1·8	1 : 2·0
Standard Error	0·44	0·508		
Significant Difference ..	1·22	1·41		
Significant Results	B,C > A,E D > E	B,C,D > A,E		

In the case of Block M, the harmful effect of clean chipping is not, from the fused-needle aspect, so evident in the case of *Pinus caribæa* as with *P. tæda.* The percentage of fused needle disease, however, is comparatively low in all plots and the exact relationship, therefore, less evident.

The general direction of the reaction obtained from the various treatments at Mellum and Glasshouse Mountains was the same as that shown by the block at Bluegum. Considering all the blocks together, the litter treatment gave the best results in the early stages regarding the incidence of fused needle disease. As the litter aged, there was a tendency towards an increase of the disease in these plots, and for their place to be taken either by the superphosphate treated plots or by the control plots in which the natural accumulation of litter had begun to play a part. As regards height growth, the litter treatments were outstanding, although in annual increment they tended to be replaced by the superphosphate treated plots in the later years.

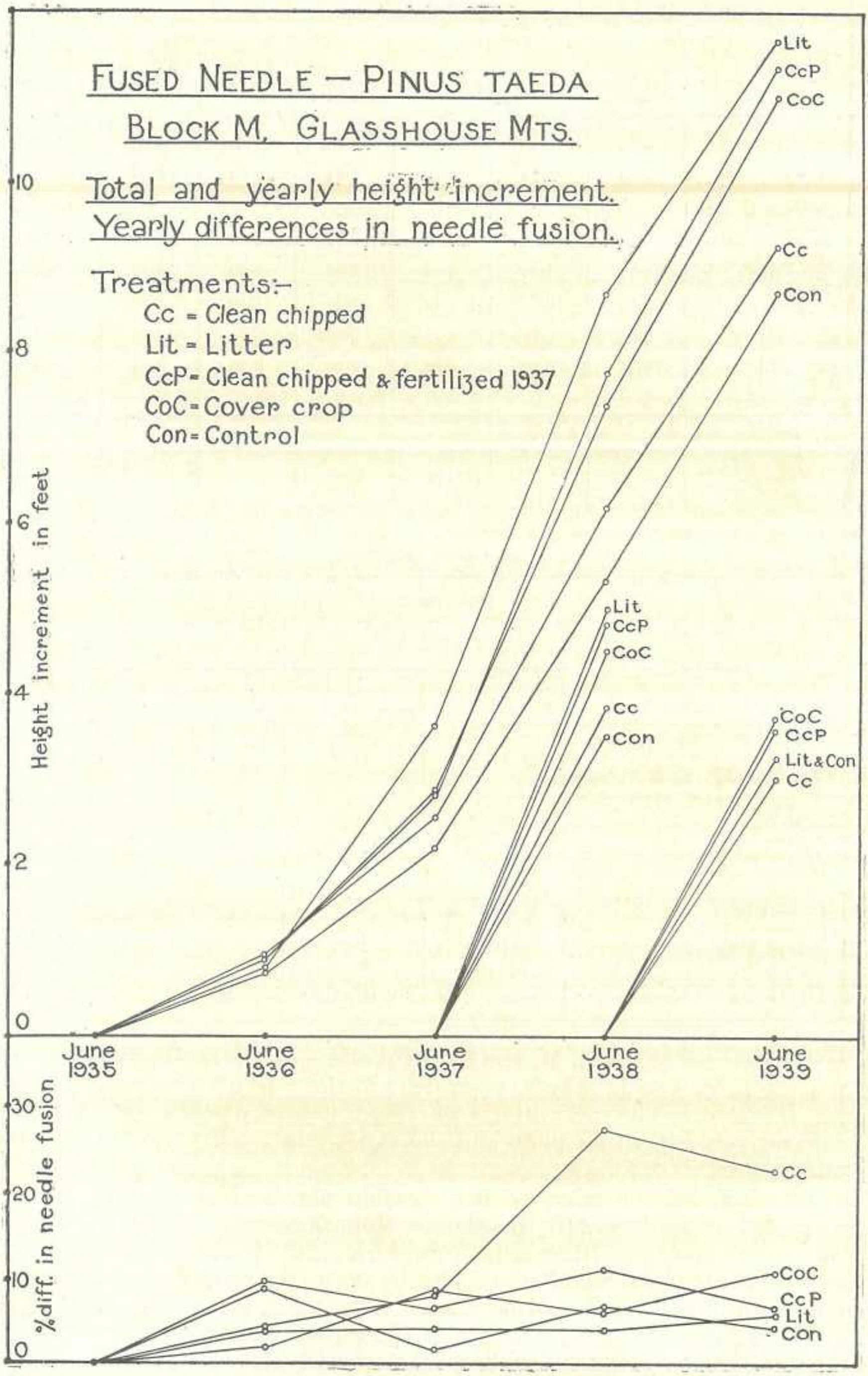


Plate 92

SOIL ORGANIC MATTER EXPERIMENT, BLOCK M (*Pinus tæda*).

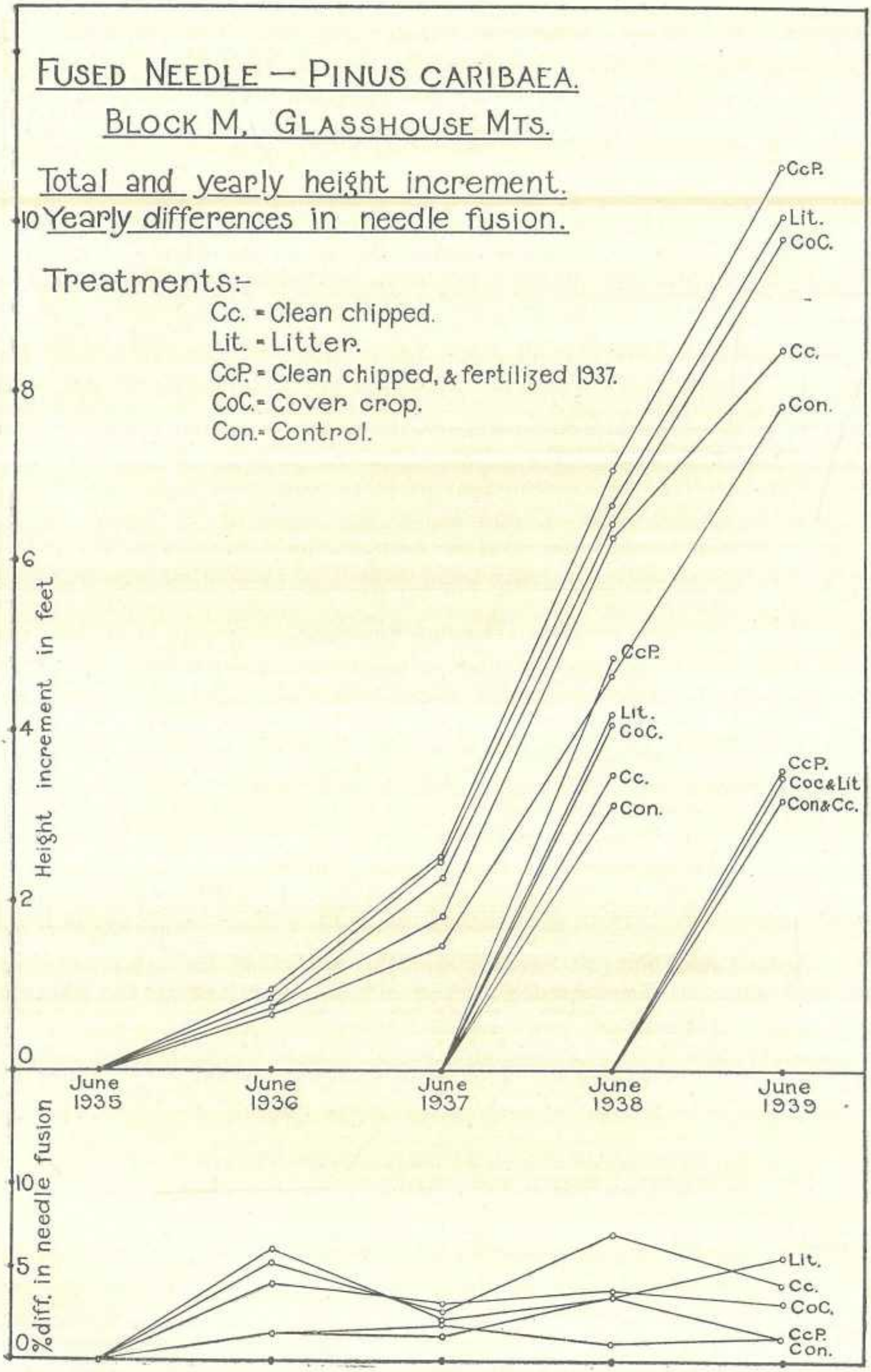


Plate 93.
SOIL ORGANIC MATTER EXPERIMENT, BLOCK M (*Pinus caribæa*).

The cover crop treatment in Block M was sown with the legume *Crotalaria goreensis,* which became satisfactorily established and reproduced itself by self-sowing of seed each year. However, it did not produce any superior reaction to that given by the litter dressing.

The clean chipped plots were consistently the worst as regards fused needle disease, and resembled the control plots in their poor height increments.

Except in the case of Block K, the control plots showed poor height growth throughout. In the case of Block K, the increase in height growth shown by these plots as compared with similar plots in the other experiments is considered to be due to the greater age of the plantation in which Block K is established. This is responsible for a greater natural litter accumulation, with its consequent beneficial effect on the pine growth. The control plots as a whole, however, followed the normal trend in fused needle development in their locality, which usually showed an increase in the early stages and then a decrease as natural litter accumulated.

The result of the application of superphosphate was remarkable. After the initial delay of one season the incidence of fused needle disease rapidly diminished and the annual height increment increased, with the result that the plots thus treated were outstanding in their final appearance.

(d) Delayed Planting.

An experiment was designed at Glasshouse Mountains in order to investigate the effect of natural regeneration of organic litter on pine growth. In the usual course of events in that district the natural forest is felled and burned approximately six months before planting takes place in July. The experimental block was laid out as a Latin square, in which the treatments consisted of planting trees in each respective plot at one, two, three, and four years after the normal planting would have taken place. During the period elapsing between burning and planting, the experimental area was tended in the routine fashion by brushing all vigorous growth and leaving the litter on the ground.

It is hoped by this process that the period of normal plantation susceptibility to fused needle disease will be minimized by the natural recovery evidenced in older plantations. This experiment, however, will not be finalized for some years, and no results of significance are yet available for publication. The area involved in the experiment is 5 acres.

V. SOIL MANURING EXPERIMENTS, WITH SPECIAL REFERENCE TO PHOSPHATE STATUS.

In 1935 it was decided to initiate investigations involving the alteration of the pH value of the soil in which was growing a selected stand of *Pinus tæda.* At the time it was thought that the actual reaction of the soil might be having an adverse effect on the mycorhizal complex of the pine trees, and in this way was perhaps instrumental in bringing about the fused-needle condition. An experiment was, therefore, designed so that some evidence on this aspect of the trouble might be gained, and this, in turn, led to further work on soil treatment.

(a) Broadcast Dressings.

Experiment 1, *Block NA*.—The treatments which it was decided to use were ground limestone, to induce a more alkaline condition, and ground sulphur, to induce a more acid reaction (Young, 1938). An N.P.K. mixture was decided upon for a third treatment, in order to provide a general stimulant for comparison purposes, whilst an untreated control formed the fourth treatment. The experiment was laid out as a randomized block in October, 1935, and was located in Compartment 7, Beerwah, on a site similar to that of the Bluegum experiment described previously.

The dressings which were applied to the respective plots were as follows:—

(1) Ground limestone at the rate of 2 tons per acre.

(2) Control.

(3) N.P.K. at the rate of 5 cwt. per acre.

(4) Ground sulphur at the rate of 6 cwt. per acre.

The mixed fertilizer used consisted of superphosphate 75 lb., ammonium sulphate 25 lb., and potassium sulphate 25 lb. All treatments were applied as broadcast dressings on one-tenth-acre plots, with a two-row isolation strip between the various plots. The annual and progressive increments are shown in the accompanying graph (Plate 94), together with the progress of needle fusion in the various treatments. The actual figures relating to the experiment are to be seen in Tables XVIII., XIX., and XX. Before treatment the pH of the soil was even over the site and ranged from 5·6 to 5·8.

TABLE XVIII.

BLOCK NA—THE INCREMENT IN FEET OF TREES TREATED WITH THE VARIOUS CHEMICALS.

Treatment.	Seasonal Increment.				Total Increment to each Season.		
	1935-36.	1936-37.	1937-38.	1938-39.	30-6-37.	30-6-38.	30-6-39.
(1) Ground limestone	2·7	2·3	4·1	3·3	5·0	9·1	12·4
(2) Control	2·7	2·2	3·9	2·8	4·9	8·8	11·6
(3) N.P.K.	3·1	2·7	5·2	3·9	5·8	11·0	14·9
(4) Ground sulphur	2·9	2·3	4·2	3·3	5·2	9·4	12·7

TABLE XIX.

SUMMARY OF PERIODIC OBSERVATIONS ON FUSED NEEDLE DISEASE IN BLOCK NA, BLUEGUM.

Treatment.	Total No. of Trees.	Percentage of Trees Affected each Year.					pH 1938.
		1935.	1936.	1937.	1938.	1939.	
(1) Ground limestone	116	21·6	35·4	49·25	55·1	44·8	6·1
(2) Control	123	23·5	37·4	46·4	48·75	40·6	5·7
(3) N.P.K.	121	14·9	24·8	18·2	Nil	Nil	5·4
(4) Ground sulphur	123	23·5	38·25	56·9	51·25	56·1	5·0

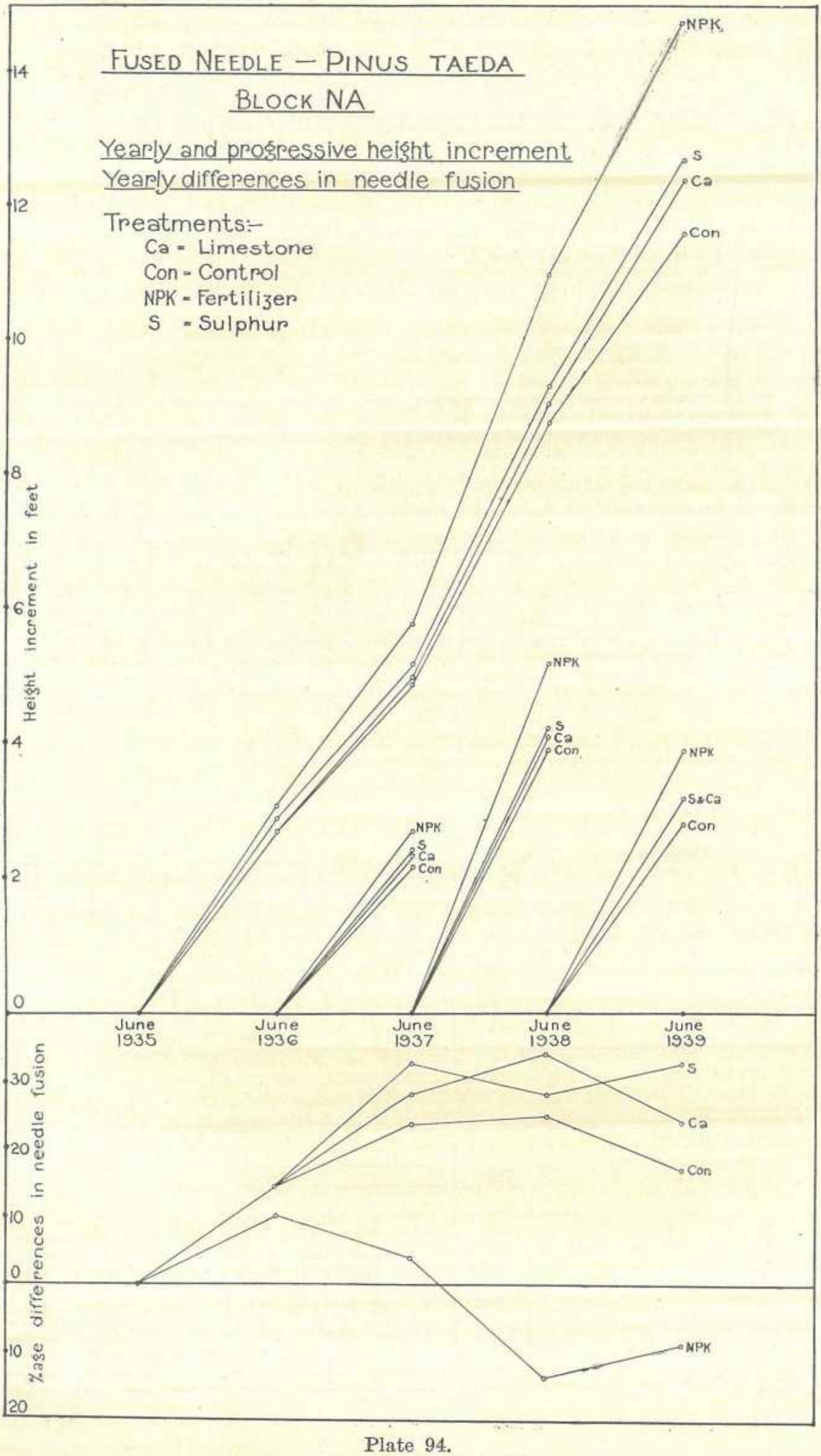


Plate 94.

SOIL MANURING EXPERIMENT, BLOCK NA (*Pinus tæda*).

TABLE XX.

MEAN GIRTH BREAST HIGH OF TREATMENTS IN BLOCK NA, BLUEGUM (1939).

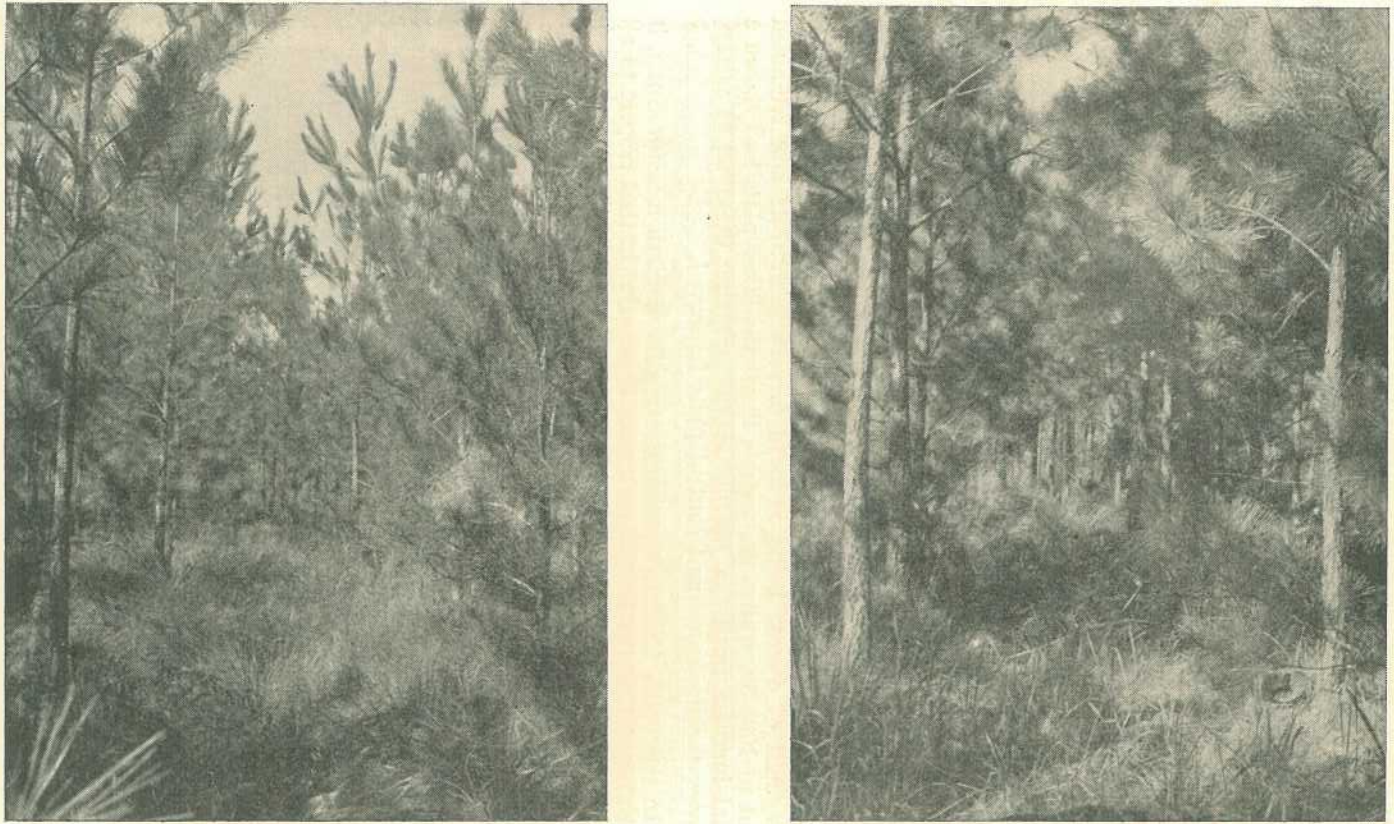
Treatment.	Girth in Inches.	Girth-Height Relationship.	
		Mean Height.	Relationship to Girth.
(1) Ground limestone	10·83	19·4	1 : 1·8
(2) Control	10·46	18·6	1 : 1·8
(3) N.P.K.	12·58	22·0	1 : 1·8
(4) Ground sulphur	10·88	20·1	1 : 1·86

From the results given it will be seen that during the first two years after the initiation of the experiment there was no marked difference in height growth between any of the treatments. A uniformity examination before treatment also showed that the plots were directly comparable. In the seasons 1937-38 and 1938-39 the N.P.K. treated plots made outstanding progress, the appearance of the trees also considerably improved, the crowns becoming heavily covered with dark-green healthy foliage. In all the other treated plots there was a parallel development to that shown by the controls except during the last season, when the limestone and sulphur plots improved. The N.P.K. plots were also outstanding when the incidence of fused needle disease was considered, the amount of disease being reduced to zero in 1937-38 and remained absent in 1938-39, whilst the trouble in all the other plots had shown a normal increase until the 1937-38 season. During the 1938-39 season, however, the limestone and control plots improved.

In the Table (XX.), showing the results of girth measurements, it will be noted that the N.P.K. treatment is superior in that respect to all the others. The limestone and sulphur treatment results are approximately equal and the results for the control are the worst. The girth-height relationship is similar for all the treatments.

A very notable feature of the response provided by the plots treated with the N.P.K. mixture was the remarkable reaction experienced by the natural vegetational ground cover, which consisted of grass, heaths, and eucalypt coppice. At the time of application of the fertilizer the ground had numerous bare patches of soil surface interspersed with tussocks of grass and with shrubs. The description supplied for the soil treatment site at Bluegum (Block K) fits this area admirably. In the first season after fertilizing the grasses began to spread, and in the second a complete luxuriant ground cover was established and has persisted except where it is now being killed out by the formation of a canopy by the pine trees and where a needle litter is now taking its place. The other treatments produced no observable effects on the ground cover or the trees. The effect of superphosphate treatment is illustrated photographically in Plate 95.

In the N.P.K. treatment it is considered that the stimulation of the ground cover was largely responsible for the beneficial effects on pine growth. This conclusion was arrived at, firstly, because direct application of litter, as was done in previously described experiments, has been followed by a similar response, and, secondly, because the fertilizer effect was produced after a distinct time lag (almost two



A B

Plate 95.

FERTILIZER EXPERIMENTS, BLOCK NA (*Pinus tæda*), 1939.—Left, untreated control plot; Right, fertilized plot (N.P.K.).

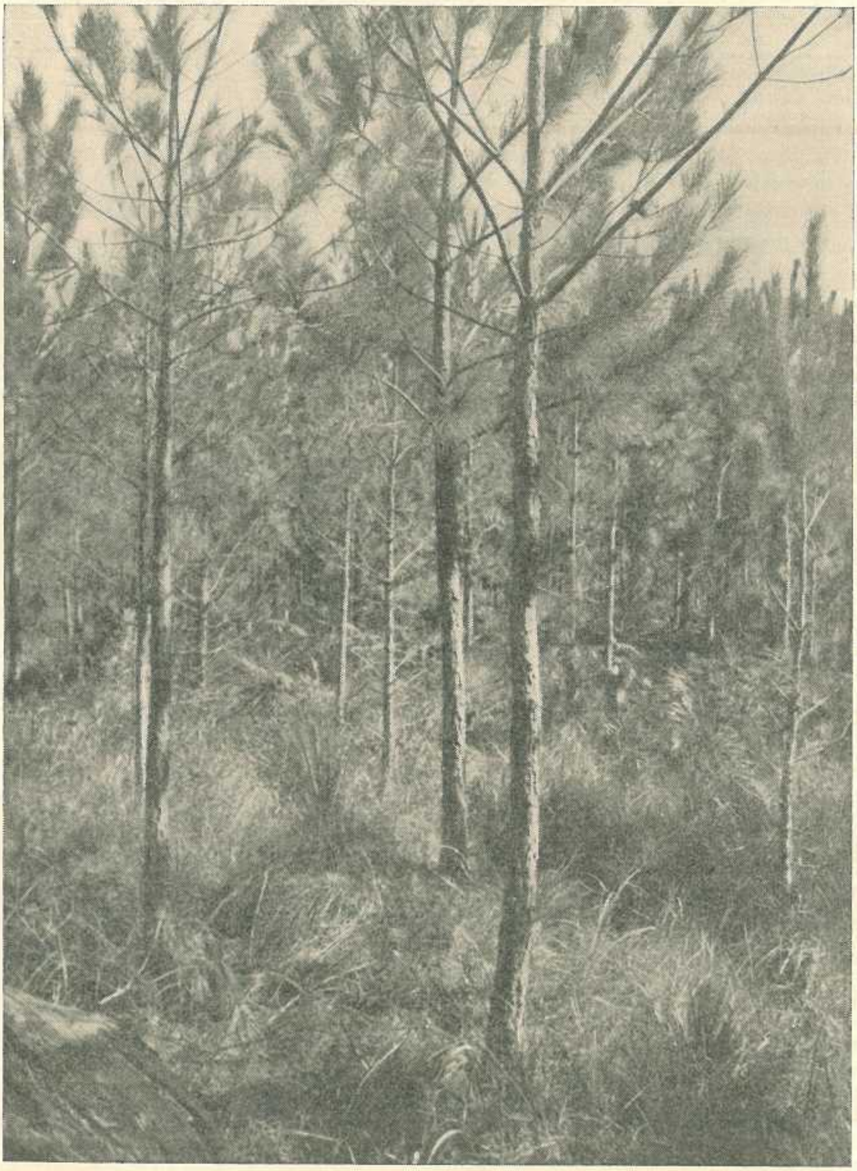


Plate 96.
FERTILIZER EXPERIMENTS, BLOCK NB (*Pinus tæda*), 1939.—Ammonium sulphate treated plot.

years) and made its appearance with the production of an efficient ground cover. It was also considered that the effect was most probably due to the superphosphate contained in the mixture on account of the fact that the phosphorus was the most likely constituent to be bound in the soil over the period in question and also because analyses had demonstrated the presence of adequate supplies of nitrogen and potassium in the soils. For this reason superphosphate alone was applied to the cultivated plots in the previously discussed experiments at Bluegum, Mellum, and Glasshouse Mountains, while further experiments using all the N.P.K mixture ingredients were initiated on fresh sites. The unsatisfactory results obtained from single-tree soil treatments with superphosphate (Young, 1935; Ludbrook, 1939) is also considered to be due to this effect. With single-tree treatment there is not enough soil area involved to be able to bring about any effective change in the tree-root environment by the stimulation of litter formation.

Experiment 2, *Block NB.*—In order to verify the results obtained from the first experiment, it was duplicated in 1935 on adjacent ground one year after the initiation of the first trial. Two additional treatments were added to the layout—namely, ammonium sulphate and potassium sulphate used at the same rate as in the N.P.K. mixture. The results obtained from this experiment (Block NB) are shown in Tables XXI. and XXII., and Plates 96 and 97.

TABLE XXI.

THE INCREMENT IN FEET AND THE FUSED NEEDLE POSITION IN BLOCK NB.

Treatment.	Inc. for 1937-38.	Inc. for 1938-39.	No. of Trees.	Percentage of Trees Diseased.			
				1935-36.	1936-37.	1937-38.	1938-3.9
(1) Ground limestone	4·15	3·35	116	10·35	29·4	39·75	23·7
(2) Control	4·15	3·2	108	20·4	34·25	34·25	35·5
(3) N.P.K.	4·9	3·9	113	20·3	15·9	15·9	1·0
(4) Ground sulphur	4·7	3·15	111	9·0	27·0	37·0	36·9
(5) Ammonium sulphate	4·11	2·7	108	..	32·4	43·6	67·6
(6) Potassium sulphate	4·2	3·66	119	..	26·8	37·8	30·25

TABLE XXII.

THE MEAN GIRTH AT BREAST HEIGHT OF THE TREES IN EXPERIMENT NB, AT JUNE, 1939.

Treatment.	Girth Breast High in Inches.	Mean Height.	Girth-Height Relationship.
(1) Ground limestone	11·39	20·3	1·78
(2) Control	11·63	20·8	1·79
(3) N.P.K.	12·44	21·6	1·74
(4) Ground sulphur	12·07	21·6	1·78
(5) Ammonium sulphate	10·54	18·75	1·78
(6) Potassium sulphate	11·74	22·3	1·9

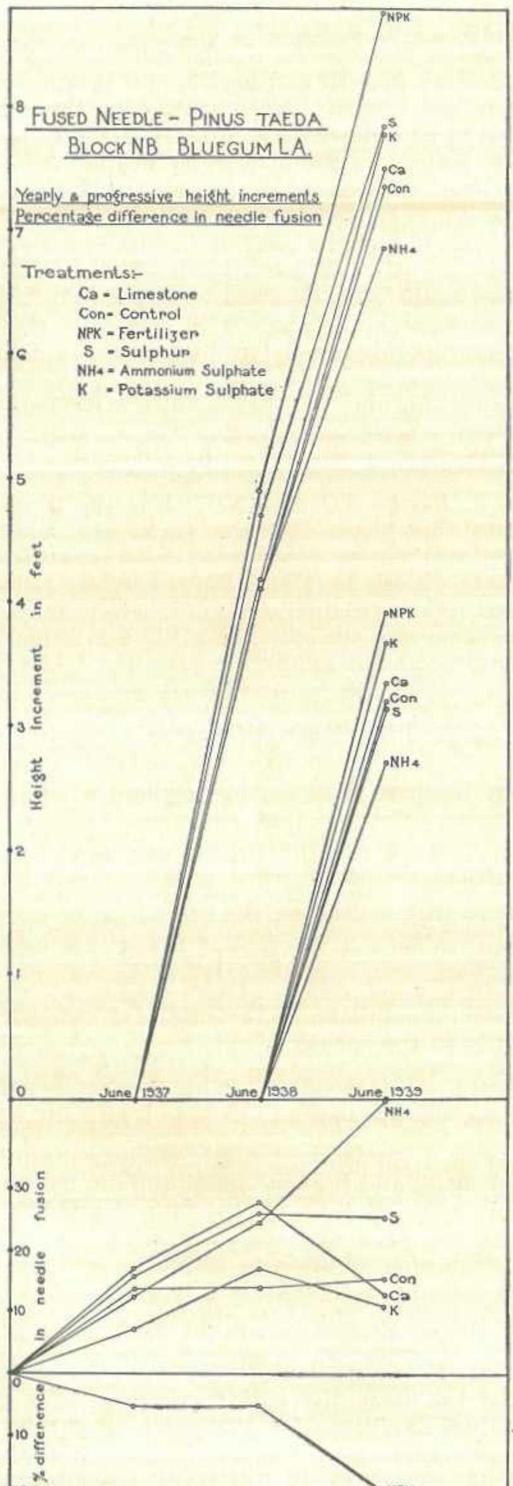


Plate 97.

SOIL MANURING EXPERIMENT, BLOCK NB (*Pinus tæda*).

It will be noted that a similar progression to that shown by the initial plot has taken place. The N.P.K. mixture again gave the best results as regards both growth and health, and it will be noted that the disease incidence had almost been removed in the plots so treated. There is also seen to be a decrease in disease in the limestone treatment during the last season and a slight decrease in the potassium treatment. The ammonium sulphate treatment showed a definite repressive effect on tree growth, and also caused a large incidence of fused needle disease. The control plot showed a slight increase in fused needle, but no relative decrease in height growth. In mean girth (Table XXII.), the N.P.K. treated plots were again best, followed by the sulphur, potash, control, limestone, and ammonium sulphate treatments in that order. The ammonium sulphate in this connexion also showed a definite repressive effect. The results obtained with the superphosphate dressings with removal of litter by chipping and raking in the Bluegum, Mellum, and Glasshouse Mountains plots indicate that the response to the fertilizer was bound up with this constituent of the mixture.

Experiment 3, *Blocks NC and ND.*—For the purpose of further investigations into this phase of the experiments, another and third series of fertilizer trials were commenced in August, 1937. The plots were in *Pinus tæda* (Block NC) and *Pinus caribæa* (Block ND). The site used for Block NC was comparable to the two previous ones, and the trees were of the same age, whereas Block ND was situated on a swamp with a fine sandy soil and this appears to have had a definite influence on the results.

In the case of the *Pinus tæda* (Block NC), the treatments applied were:—

(1) Litter, together with superphosphate at the rate of 3 cwt. per acre. The litter application was to a depth of 3 inches.

(2) N.P.K. at the rate of 5 cwt. per acre, mixed in similar proportions as in the previous experiments (NA and NB).

(3) Litter, 3 inches deep on the soil surface.

(4) Superphosphate at the rate of 3 cwt. per acre.

(5) Control.

(6) Ammonium sulphate, at the rate of 1 cwt. per acre, treated annually in the spring.

The experiment commenced in *Pinus caribæa* (Block ND) was similar; in this case the ammonium sulphate treatment was omitted.

The layout was a randomized block with two replications as in the previous experiment, and the individual units in the two experiments were arranged as one-tenth-acre blocks with isolation strips between them. The treatments applied were designed to compare the results of the various favourable treatments already given, and it was also decided to again include an inorganic nitrogenous fertilizer in Block NC for comparison with the litter treatment and the mixed fertilizer. In this case ammonium sulphate was used again. Good results had been achieved in previous tests with both litter, superphosphate, and N.P.K. dressings. In the last case, the indications were that the phosphate alone was the active ingredient for the purpose of this investigation. In the experiment under consideration litter, superphosphate, and N.P.K. were directly compared with each other, whilst the application of litter and superphosphate together, to the same plot, was also carried out in order to see if the effects of the two dressings were complementary.

Observations made at the conclusion of the first year after treatment showed that there was no significant difference in the height increment of any of the treatments, although the general appearance of the plots which included superphosphate in their dressings was superior to that of those which did not receive this ingredient. The ground cover of the phosphate treated plots and the density of foliage on the trees had improved very noticeably during the first season and was very satisfactory during the second season. The results illustrating the effects of the different treatments on the incidence of fused needle disease are shown in Tables XXIII. to XXVI. and Plates 98 and 99.

TABLE XXIII.

THE HEIGHT INCREMENT IN FEET AND FUSED NEEDLE PERCENTAGE IN BLOCK NC IN *Pinus tæda*.

Treatment.	No. of Trees per Plot.	Percentage of Trees Affected.			Height Increment, 1937-38.	Height Increment, 1938-39.
		1936-37.	1937-38.	1938-39.		
(1) Litter and superphosphate ..	125	52·0	16·8	2·4	4·39	4·3
(2) N.P.K.	127	44·9	36·25	7·0	4·92	3·9
(3) Litter	121	44·75	36·4	18·1	4·43	3·55
(4) Superphosphate	127	43·3	26·75	2·4	4·64	4·0
(5) Control	124	33·9	42·75	40·3	4·15	3·0
(6) Ammonium sulphate ..	120	40·0	62·5	62·4	..	2·75

No results were obtained for the height increment of treatment No. 6 in Block NC in 1938 owing to the fact that growth had already commenced in the trees receiving this dressing at the time of measuring, and consequently no authentic measurements could be taken for that season's initial height.

TABLE XXIV.

THE MEAN GIRTH BREAST HIGH IN INCHES OF THE TREES IN BLOCK NC, IN *Pinus tæda*.

Treatment.	Girth Breast High.	Mean Height, in Feet.	Girth-Height Relationship.
(1) Litter and superphosphate ..	11·41	21·2	1 : 8
(2) N.P.K.	11·83	21·8	1 : 8
(3) Litter	11·90	22·7	1 : 9
(4) Superphosphate	12·15	22·0	1 : 8
(5) Control	10·64	19·6	1 : 8
(6) Ammonium sulphate	10·53	20·3	1 : 9

The figures given for height increment illustrate the fact that the response expected from superphosphate dressings was given to some extent by all the trees so treated during the first season and was more marked in 1939. There was also a response to the litter treatment

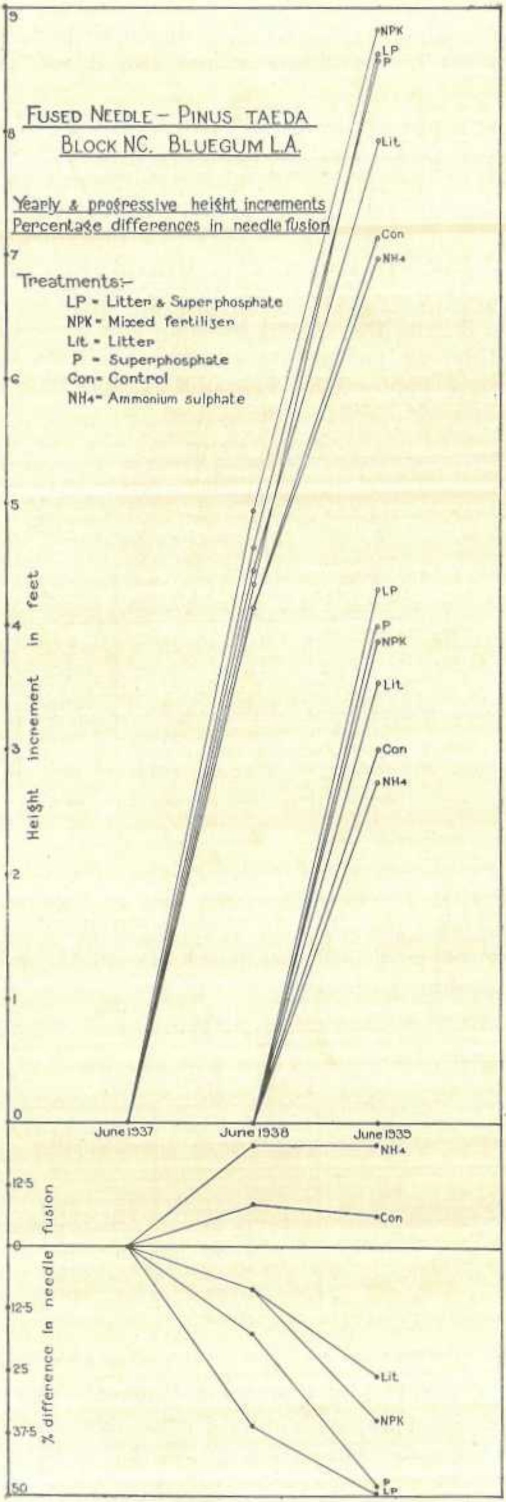


Plate 98.

SOIL MANURING EXPERIMENT, BLOCK NC (*Pinus tæda*).

alone. The most significant reaction was the decline of fused needle disease in some of the treatments, and at midsummer in the current season (1938-39) the results were very marked. The only trees showing little difference were those in the control. The ammonium sulphate treatments again produced a decreased height growth and increased fused needle disease. Both the combination litter-superphosphate treatment and the superphosphate dressing alone had reduced the disease incidence remarkably, and the reduction in the two cases was similar. The litter-superphosphate mixture, however, produced the best growth in both plots. A reduction in the number of diseased trees was also experienced by the plots treated with N.P.K., with and without litter, though in Block NC by no means to the same extent as in the two previously noted treatments. In Block ND the litter application increased the amount of fused needle disease. This is no doubt due to the abnormal soil conditions in the swampy site, and will be discussed more fully in Part B.

The great and abnormal increase in disease in the ammonium sulphate treated plot, as compared with the control, is remarkable. There was no noticeable increase in ground cover on this treatment, and a somewhat similar effect, though to a lesser extent, was noted with the same treatment in Block NB, as discussed previously. It is considered that the ammonium sulphate in the N.P.K. mixture is responsible for the superiority of the superphosphate alone, as compared with the mixture. Equal quantities of phosphate were applied in all cases. It is possible that the bad effect of the ammonium sulphate is due to the quicker disappearance of the organic matter resulting from increased activity of cellulose-destroying organisms.

The mean girths breast-high of the trees in the various treatments approximately follow the trends in height increment and health, with the ammonium sulphate treatment the worst and the superphosphate the best. The girth-height ratio is approximately equal for all plots.

TABLE XXV.

THE HEIGHT INCREMENT IN FEET AND THE AMOUNT OF FUSED NEEDLE DISEASE IN BLOCK ND IN *Pinus caribæa*.

Treatment.	No. of Trees per Plot.	Percentage of Trees Affected.			Height Increment, 1937-38.	Height Increment, 1938-39.
		1936-37.	1937-38.	1938-39.		
(1) Litter and superphosphate ..	104	18·35	19·28	1·0	4·04	4·21
(2) N.P.K.	116	16·4	18·95	4·3	4·24	4·08
(3) Litter	98	7·14	37·8	52·0	3·86	3·76
(4) Superphosphate	113	13·28	18·6	2·6	4·34	4·46
(5) Control	120	8·7	30·0	41·6	3·84	3·59

It will be seen that *Pinus caribæa* has behaved in a similar fashion to *Pinus tæda* in that a marked fused needle and height growth response was provided by all the areas treated with superphosphate in any form.

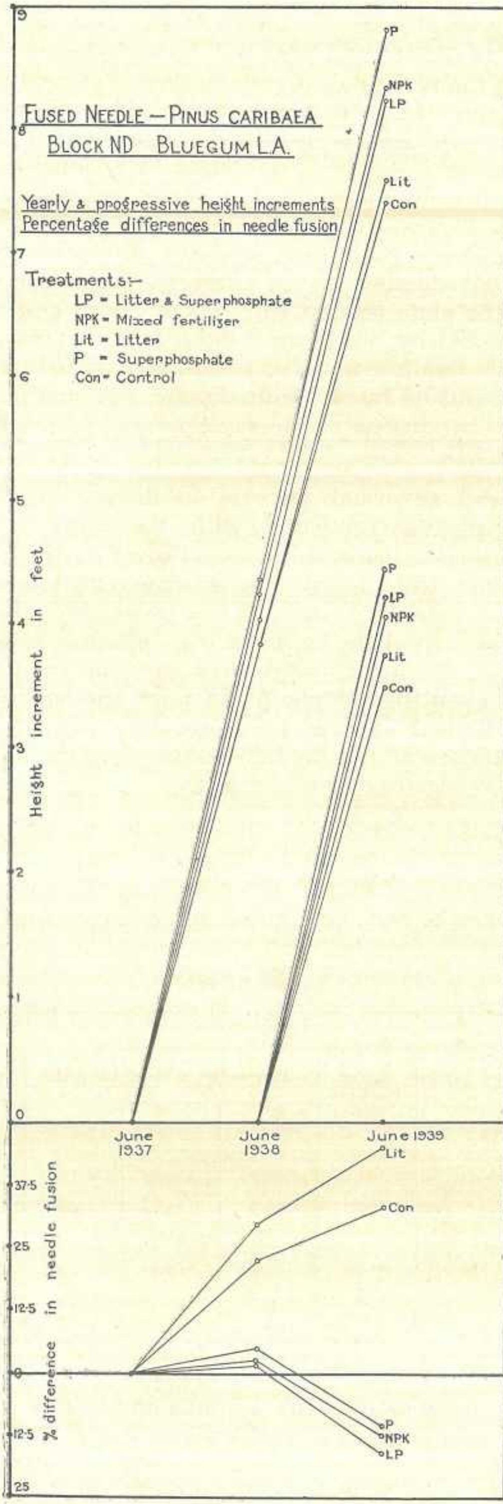


Plate 99.
SOIL MANURING EXPERIMENT, BLOCK ND (*Pinus caribæa*).

TABLE XXVI.

THE GIRTH AT BREAST HEIGHT IN PLOT ND (1939) IN *P. caribæa*.

Treatment.	Girth Breast High.	Mean Height.	Girth-Height Relationship.
(1) Litter and superphosphate ..	8·88	16·0	1·8
(2) N.P.K.	9·32	16·4	1·8
(3) Litter	8·62	16·1	1·8
(4) Superphosphate	9·51	17·2	1·8
(5) Control	9·24	16·7	1·8

(b) Total Phosphate Requirements.

Following the results obtained by measurements and observations carried out on the various experimental plots, analyses for phosphate content were made on samples collected (June, 1939) from each unit plot of each treatment. The analyses were carried out by the Agricultural Chemist. In all 111 such analyses were made. It was found that in nearly every case all the phosphate applied as superphosphate had become fixed in the soil and that there was no phosphate available as shown by the citric acid soluble method. The sampling over the plots was carried out to a depth of 4 inches. By another series of analyses it was shown that all the phosphate added, which in each case was 3 cwt. per acre, was fixed in the top 2 inches of the soil. The mean amount of phosphate in the top 4 inches of soil in all the untreated plots was 83 parts per million. In the treated plots it was 190 p.p.m. In the latter cases all plots were showing healthy growth and in the former abnormal growth. Where phosphate had been applied and the soil undisturbed, as in the experimental plots, the phosphate was normal for the area (83 p.p.m.) below the 4-inch level in which the fertilizer was concentrated. The effect of cultivation on such a site would be to distribute the phosphate through the disturbed area and thus lower its concentration. In the top 8 inches of soil to which 3 cwt. of superphosphate per acre had been applied, the actual phosphate content was 120 p.p.m., although in the top 4 inches it was 190 p.p.m. and in the top 2 inches 330 p.p.m. A simple calculation shows that all the phosphate was apparently fixed in this latter region. On the site of an old pineapple farm, where fused needle disease does occur, but very infrequently, there is total phosphate present to the extent of 135 p.p.m. This was in the same concentration throughout the top 8 inches of soil, where it had probably been well distributed by ploughing operations. In areas receiving superphosphate as a surface dressing, fused needle disease has entirely disappeared, as is illustrated in the foregoing experiments, whereas, where cultivation and consequent dilution of the phosphate has occurred, there is still fusion present, although the actual phosphate content, to a depth of 8 inches, is greater. The surface feeding habit of the root system of the pine trees is important in this regard. The mycorhizal roots are concentrated in the top few inches of soil, and it seems that the actual concentration of phosphate in that region alone, rather than to a lower depth, is the limiting factor involved.

Analyses were also made of the needles from each of the plots. In all cases only the newest needles were used so as to ensure that they were the same age. From untreated soil where the mean phosphate content was 83 p.p.m. the mean needle content (dry weight) was 1,300 p.p.m. From fertilized soils with a phosphate content of 190 p.p.m. in the top 4 inches. the needle content on the average was 2,400 p.p.m. It will therefore be seen that the amount present in the soil is directly reflected by the content of the new needles when there is a deficiency. In areas where there is abundant phosphate present, however, the needle content does not exceed the amount quoted, which appears to be the maximum amount of phosphate absorbed.

The phosphate content of the litter cast by the natural vegetation on unfertilized poor sites at Beerwah has a mean value of 350 p.p.m., on fertilized sites the mean value is 730 p.p.m. Similar values were obtained from analyses made of freshly cast needles of pine trees on the same sites. The fact that the amount of phosphate in the normal litter is considerably higher than that in the normal soil (83 p.p.m.) in part explains the beneficial effect of litter applications but does not explain why litter treated trees tend to become badly diseased again as the litter ages. If it were a simple phosphate effect this would not happen, since the phosphate, except that retained in the wood, is being returned to the soil surface.

The experiments described, which involved the treatment of some plots with litter as well as phosphate, indicated that this treatment. except on swamp (raw humus) sites, gave a better response than the phosphate alone. The function of the litter is more fully discussed in Part B, but in brief it is considered that in its raw state it provides a source of carbon and other organic materials essential for both the mycorhizas and the pine tree itself. After ageing it loses a great deal of value in this regard. The satisfactory functioning of the mycorhizas, however, is apparently intimately bound up with the amount of total phosphate present in the soil also.

The little response obtained from superphosphate application at the rate of 3 cwt. per acre on swamp sites (Block ND) is explainable because of their abnormally low initial phosphate value. On these sites the soil is a fine grey sand with total phosphate values of from 10 to 27 p.p.m. Such sites as these would require considerably greater additions of fertilizer to bring them up to a value greater than the minimum requirement for healthy pine growth.

(c) Conclusion.

In many respects the results of the soil treatment experiments have been outstanding. The retrogression shown by the pine trees growing in soil which was kept clean chipped and raked, throughout the period of the experiments was noteworthy. When superphosphate was added to such plots the treatment caused a decrease in the amount of fused needle disease present during the second season and also a considerable and significant height increment as compared with similar plots when unfertilized. The effect of superphosphate treatment was confirmed in a striking manner in subsequent field experiments illustrated by blocks NA, NB, NC, and ND. Ammonium sulphate in all cases causes a depression in growth and increases the severity of fused needle disease.

The reaction initiated by the superphosphate was apparently due to the increased amount of raw organic matter, formed by the resulting vigorous growth of plants forming the ground cover, together with the stimulated activity of the mycorhizal fungi. The effect of direct applications of organic litter was also beneficial, but was not prolonged as in the case of superphosphate, possibly on account of the effects of ageing on the litter and the fact that supplies of fresh matter were not added. In this regard it is noteworthy that, in the pot experiments used in connection with humus applications, the addition of N.P.K. fertilizer had no effect on plants after the effect of the humus application had worn off. In this case there was also no effect experienced by plants growing in humus free soil when given this fertilizer treatment. This would also support the contention that the superphosphate has little direct nutrient effect when applied to the conifers in question. The effect of adding superphosphate to the litter dressing was to increase the benefits which are caused by either alone.

An improvement in all plots save the unfertilized clean chipped ones was noticeable as the trees aged, and was conceivably due to the gradual development of an adequate litter horizon. In the case of the superphosphate treated clean chipped plots, the response shown may be expected to cease with time and the diseased condition to return to that of the simple clean chipped plots (see footnote).* This theory is postulated for the reason that the superphosphate may make organic matter already present in the soil of the clean stripped plots available; but with the absence of litter to replace that used, these plots should eventually return to the fused needle condition. This is borne out by the absence of response obtained from the pot experiments already described when soil lacking organic matter was treated with the same N.P.K. fertilizer mixture, and by the tendency towards fusion of the superphosphate treated trees in Block K.

* It is of interest to note that the postulation concerning the eventual onset of fused needle conditions in the superphosphate treated clean chipped plots has been confirmed by results just obtained from the midsummer observations carried out in January, 1940. In the case of all the blocks (K, L, and M) containing this treatment there has been a definite increase in fused needle disease, whilst in the case of treatments involving the application of superphosphate to plots on which the natural ground cover was allowed to accumulate, with in some cases litter additions, the percentage of diseased trees has continued to decrease. The results are summarized in the following table :—

THE PERCENTAGE OF FUSED NEEDLE DISEASE IN 1939 AND 1940 IN THE VARIOUS FERTILIZER BLOCKS REFERRED TO IN THE TEXT.

Block.	Clean Chipped.		Superphosphate + Clean Chipped.		Litter.		Control. (Natural Cover.)	
	1939.	1940.	1939.	1940.	1939.	1940.	1939.	1940.
K	89·0	88·0	26·3	30·8	51·5	52·1	70·4	64·6
L	18·0	41·8	3·8	10·5	9·8	27·4	9·7	20·9
M	12·8	18·9	1·3	13·7	6·0	12·6	3·7	5·2

Block.	Superphosphate + Litter.		Superphosphate + Natural Cover.		Litter.		Control. (Natural Cover.)	
	1939.	1940.	1939.	1940.	1939.	1940.	1939.	1940.
NC	3·2	0·8	7·0	0·7	18·1	18·1	39·5	39·5
ND	1·0	1·0	4·3	3·4	52·0	59·1	41·6	44·8

TABLE XXVII.

SUMMARY OF RESULTS OF SOIL TREATMENTS.

Block.	Period.	Results of Treatments.													
		Superphosphate.		Litter.		N.P.K.		Litter and Superphosphate.		Clean Chipped.		Control.		Ammonium Sulphate.	
		G.	H.	G.	H.	G.	H.	G.	H.	G.	H.	G.	H.	G.	H.
K	1935-39	++++	++++	+++	++					−−−−	−−−−	++	+		
L	1935-39	++++	++++	++++	+++					−−	−−	+	+		
M (*P. taeda*)	1935-39	++++	++	++++	++					−	−	+	++		
NA	1935-39					++++	++++					+	+		
NB	1936-39					++++	++++					+	+		
NC	1937-39	++++	++++	++	++	+++	+++	++++	++++			−	−	−−−−	−−−−
ND	1937-39	++++	+++	−−	−−	+++	++	+++	+++			−−	−−	−−−	−−−

G = growth. H = freedom from fused needle disease.

For the purpose of summarizing, the results of the various major treatments used in the experiments have been grouped in table XXVII. The various treatments have been given units according to the relative effects produced at the time of the final examination. The range extends four units in the positive directon (+ + + +) towards health and vigour and a similar number of units (— — — —) in the negative direction towards the diseased state and the lowest growth rate. Two columns are given to each treatment. The first records the results as affecting growth and the second deals with the amount of disease present.

The pine trees in all superphosphate treated plots in any of the experiments gained a healthy dark-green colour with a dense foliage, and it was noted that the mycorhizal fungi, *Rhizopogon roseolus* and *Boletus granulatus* (Young 1936, 1937) began fruiting freely on these plots although no fructifications were visible elsewhere save in healthy pine stands. The presence of *Rhizopogon roseolus* was particularly noticeable on account of the burrows dug by the bandicoots (*Isoodon obesulus* Shaw.), in search of the subterranean sporophores, of which they appear particularly fond. It was also noted that, in the case of all the superphosphate treated plots, the trees retained their needles for two or more years instead of one as is the case in a badly affected area.

Soil analyses demonstrated that the amount of available phosphate (citric acid extract) present cannot be correlated with the incidence of fused needle disease, but that the quantity of total phosphate (20 per cent. hydrochloric acid extract) present in the surface horizons was directly connected with it.

A total phosphate content of over 135 p.p.m. in the top 4 inches of the soil was found to be essential for the satisfactory development of *Pinus taeda* on the Beerwah soils. Somewhat less is sufficient for *P. caribaea*.

Chemical analyses of pine needles and leaves of other vegetation growing on these soils show that their phosphate contents are related to the amount present in the soil when there is a deficiency in this substance, but that when there is enough present for healthy growth the foliage content tends to be constant.

THE PRACTICAL APPLICATION OF TREATMENTS IN PLANTATION MANAGEMENT.

The first responses to treatment of the fused needle condition were given by trees to which an addition of litter had been supplied. The carrying out of such a treatment in routine plantation work would be impossible on account of the prohibitive costs involved when considered in relation to the value of the product. The formation of a litter was, however, found to be greatly encouraged by an alteration in the system of tending. The old system consisted in cutting all extraneous vegetation by means of a brush-hook down to a height of about two feet above the ground. It was found that if the brushing were carried out as near to the ground surface as possible all the cut vegetation then lay on the surface instead of being suspended by sticks and stumps as was the case with high brushing. In this way a mulch was formed on the soil surface by a lowering of the cutting height, whereas with a high cutting level the material which could have formed the mulch was largely kept out of reach of the plant roots. The cost of the low brushing was in excess of that for the high brushing but not enough to warrant its non-adoption. This technique has now been uniformly applied to fused needle susceptible areas and a marked improvement of the mulch on the soil surface has resulted.

The superphosphate fertilizer dressing has also been followed up in general practice and it has now been found practicable and advantageous to provide all areas at Beerwah and Glasshouse Mountains which show signs of typical malnutrition with a broadcast dressing of superphosphate at the rate of 3 cwt. per acre. This rate of application is, for the soils in question, adequate for the production of vigorous pine growth, but until experimental results, dealing with the actual rate of dressing which is most economical as well as satisfactory, have been concluded it is considered advisable to administer a safely excessive broadcasting. The cost of dressing an acre of the type of country in which the disease usually occurs is from 15s. to 17s., depending on the accessibility of the site, and as this will save a number of years of those which otherwise would pass before the stand reached maturity, if ever, under untreated conditions, it will be seen that the treatment is not expensive. The fact that many untreated trees would, if they eventually recovered by natural processes, be of such poor form as to be unmarketable is also worth considering. The areas so far treated with the fertilizer have made a very satisfactory recovery, and besides producing a normal growth rate and gaining a healthy, well-clothed crown, have now commenced to set normal seed for the first time. In the diseased state fertile seed is seldom produced.

As was the case in experimental treatments, fertilizer broadcasts did not visibly affect the treated trees greatly until the second season after the dressing, when a count made in a treated area of known history returned a 100 per cent. recovery of affected trees. This area had previously been affected to the extent of 70 per cent. of the stems.

It is possible that the introduction of the superphosphate treatment to forest plantations may be of great value in converting land hitherto considered to be of too poor a type for planting, from a nutrient standpoint, into such a condition as would provide satisfactory coniferous plantation areas. When applied to areas considered as failures it is thought that in many cases results similar to those obtained at Beerwah will occur, and areas which were disappointing may in all probability become equal to the best. It is not claimed, however, that fertilizing with superphosphate will cause satisfactory plantations to develop on poorly drained sites or sites which are characterised by soils with a mechanical structure unsuited to pine growth. The fertilizer also cannot be expected to make a tree planted out of its climatic environment grow as well as it would in a more suitable location.

It is hoped that, by means of a simple chemical analysis to determine the total phosphate content of the soil, each plantation site may be graded as to phospate requirement. It is considered from the evidence available that a phosphate value of over 150 p.p.m. in the top 4 inches of soil is desirable for vigorous growth of *Pinus tæda* and of over 110 p.p.m. for *P. caribœa*. The amount of fertilizer necessary to bring any particular soil to this value is a matter for calculation and experiment.

With sandy soils with low phosphate fixing capacity on account of their paucity in iron and alumina it is considered that soluble phosphate such as superphosphate should not be used as it would be quickly leached out. Ground rock phosphate in this case would be more suitable, as it is applied in an already insoluble condition. The amount of each fertilizer to be added should of course be estimated from their relative phosphate contents. The treatment of soils of low phosphate value but with abnormally high acidities such as obtains in a case at Beerwah on an organic sandy swamp with a pH value of 3·6 is being investigated, and will probably consist of a combination dressing of lime and either rock or superphosphate.

The use of phosphate fertilizers on such soils as those described above opens up great possibilities for the successful exploitation of the large areas of this type of country, available in Queensland and elsewhere, for the production of exotic conifers.

[TO BE CONTINUED.]

PREVENT BUSH FIRES.

Carelessness Costs Lives and Money.

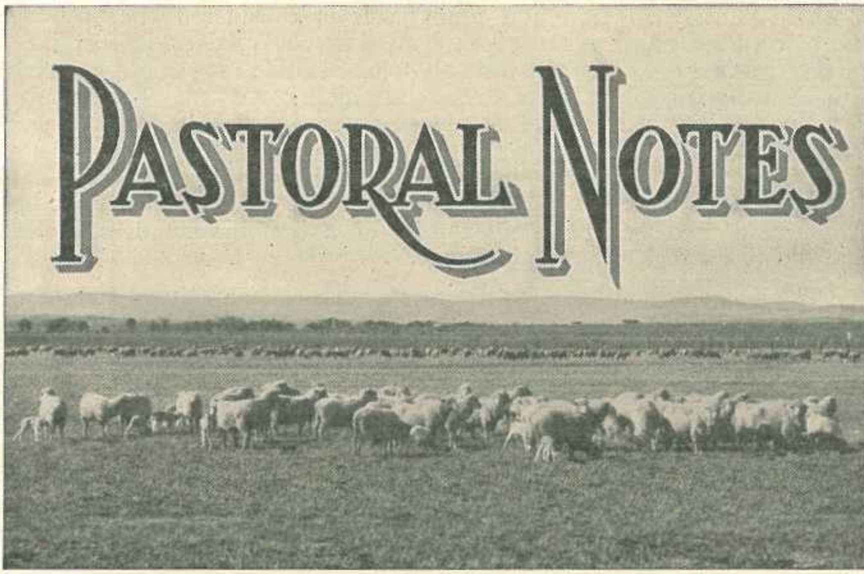
The following points are worthy of careful consideration by the various committees controlling bush fire brigade operations, in order that such suggestions, where found practicable, may be circulated among those concerned:—

1. Publicity.
2. Educational activities.
3. Enforcement of regulations and ordinances in respect of fire breaks and removal of any bush and scrub which may be a menace to adjoining property.

The following rules are suggested for the prevention of fire in bush and scrub country:—

1. Matches.—Be sure that your match is out. Break it in two before you throw it away.
2. Tobacco.—Be sure that pipe ashes and cigar or cigarette ends are dead before throwing them away. Never throw them into scrub, leaves, or litter.
3. Making Camp.—Before building a fire, scrape away all inflammable material from a spot 5 feet in diameter. Dig a small hole in the centre of the cleared area and in it build your fire. Keep your fire small. Never build it against trees or logs or near scrub.
4. Breaking Camp.—Never break camp before your fire is out.
5. How to put out a camp fire.—Stir the embers while soaking them with water. Turn small sticks and drench both sides. Wet the ground around the fire. If you cannot get water stir in earth and tread it down until packed tight over and around the fire. Be sure the last spark is extinguished.
6. Burning Scrub.—Never burn bush or scrub in windy weather nor while there is the slightest danger of the fire getting away. Burning, however, must be restricted to those periods during which it is legal to burn.

Most bush fires are man made.



"Pink-Eye" in Sheep.

"PINK-EYE," or infectious ophthalmia, has been known for many years in Australia, and though the mortality is very slight, deaths may and do occur in drought or semi-drought areas where, because of blindness, sheep are unable to get to water.

A great deal of trouble follows outbreaks in travelling mobs of sheep or during mustering for shearing and other purposes, for the disease is then very difficult to check.

Material from the infected eye of a sheep transferred to the healthy eye of another sheep reproduces the disease, and healthy sheep grazing on tall pasture (for instance, most seeding grasses, &c.) and running with infected sheep may also suffer. If, however, the grass is kept well cropped down, the liability to infection is considerably reduced. It is presumed, therefore, that in the field, "pink-eye" is not transmitted from sheep to sheep by direct contact, but by the material from the infected eyes being brushed off by grass or herbage, and thus conveyed to the eyes of healthy sheep. Flies also may spread the disease.

An attack of the disease appears to convey an immunity, but if only one eye of the sheep is affected, this is the only eye which possesses the immunity.

It is also known that exudate from the eye becomes non-infective after drying for a short period. Thus, in fine weather, healthy sheep can be turned into previously infected paddocks or driven over stock routes without risk twenty-four to forty-eight hours after infected sheep have been moved out of these places. There is also some evidence to show that any injury to the eyes through dust, grass seeds, or anything else increases the liability to infection.

The symptoms can be divided into three stages which ordinarily follow one another, although it is quite common for the trouble to clear up at the second stage and not proceed to the final stage of ulceration.

The first stage is characterised by a discharge from one or both eyes, and on examination the membrane surrounding the eye is found to be inflamed and the eyelids swollen. These symptoms are followed by the second stage, in which the front of the eyeball becomes smoky or opaque. A scum is gradually formed through which small branching blood vessels may be seen and a varying amount of pus is present in the corner of the eye.

By this time the sheep is quite blind in the affected eye, and shows signs of acute pain, while the least sound will disturb the animal, causing it to rush blindly in any direction with its head held high, progress being stopped only by violent contact with a fence or some such object.

The third stage, which is not seen in all affected sheep, is one of ulcer formation in the front of the eye. Sometimes the ulcers appear to burst, and the eye becomes practically covered in pus.

Many cases, however, do not go as far as this, and even if left untreated the animal may recover with little or no loss of sight, although complete recovery probably takes a month or even longer.

As in many other diseases of sheep, treatment depends on the facilities for handling the sick animals. All affected sheep should be at once isolated and cut up into small hospital mobs held in small shady paddocks, handy to water, where they can be supervised easily.

A few drops of a 2½ per cent. solution of zinc sulphate in water, made by dissolving 1 oz. zinc sulphate in 1 quart of water, should be dropped into the affected eyes by means of a shearer's oilcan. All pus and other matter is wiped from the eyes with cotton wool soaked in this same solution.

This treatment should be carried out as frequently as possible, and usually the disease will clear up after about a week.

RIGHT TYPE OF EWES FOR LAMB-RAISING.

No matter what ram is fancied, if merino ewes form the mother flock, the fat lamb-raiser is handicapped in the matter of profitable weights at an early age, or, in other words, early maturity.

The ewe most suitable for the production of early maturing sucker lambs for export is got by the use of rams of one of the long-woolled breeds—such as the Romney Marsh, Border Leicester, or Lincoln—on the strongest, boldest type of merino ewe procurable. The ewe lambs from the resultant drop should be retained as the future breeding flock.

Purebred Corriedale ewes also are recommended as dams in a fat lamb-raising flock.

On either type of ewe a Downs ram—such as the Southdown or Dorset Horn—should be used.

The ewe flock should be maintained in good, strong, store condition until lambing time. After lambing, no feed is too good for the ewe and lamb.

Under favourable conditions, fat lambs should be marketed at four months of age.

REDWATER IN CATTLE.

There are two kinds of redwater in Queensland. Both are caused by minute blood parasites and are carried by the tick. The differences between these two organisms are so small that they can only be recognised under the microscope. It is impossible to determine which type of redwater is present by an examination of an animal in the field. Fortunately, this is not necessary.

During the last few years intensive efforts have been made to find a suitable drug which would be effective in treatment and yet easy to apply. For many years piroblue held favour. This is effective in the treatment of one kind of redwater, but is ineffective against the other. Unfortunately, the common form in Queensland is unaffected by piroblue. Moreover, piroblue has a great disadvantage in that it requires to be used intravenously—i.e., it must be inoculated into the jugular vein.

Acaprin is now used largely in the treatment of redwater outbreaks, and is known to be effective against both forms of the disease. It is easily applied because the dose is small and it can be injected subcutaneously—under the skin. Supplies of the drug are kept on hand at the Department of Agriculture and Stock and by leading chemists. It is put up in the form of a solution and in single doses.

In areas where redwater is common, owners should keep a few doses of the drug on hand, together with a small hypodermic syringe.

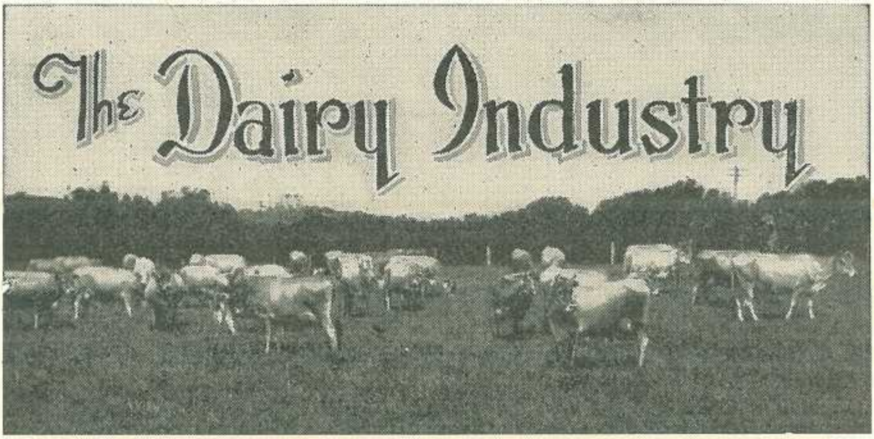
Cases should, of course, be treated as early as possible, but even those which look hopeless at the start will, within an hour or two, show improvement, and so go on to recovery. A second injection can also be given without harming the animal in any way.

PASTURE MANAGEMENT.

If seasonal rains occur, many of the pastoral areas in Queensland may soon be well covered with grass and herbage. If widely distributed summer rains do fall, a good autumn crop of long grass should be assured. The effect of autumn long grass is to supplement the organic constituents of the soil. This augmented organic content will tend to maintain the fertility of the pastures. In ordinary circumstances, pastures should not be burnt off. This applies especially to sown pastures, such as paspalum and Rhodes grasses. The effect of a severe grass fire is to reduce greatly the potential supply of the organic constituents of the soil. If persisted in, the practice of burning off may result in sterility of the soil. It is possible that bush fires recurring annually form one of the principal factors in the reduction of the fertility of much open forest country to far below that of rain-forest country.

In burnt-over areas, an invasion of non-nutritious grasses may always be looked for. In particular, the farmer with paspalum pastures can watch for the entrance of carpet grasses and rat's-tail grass. The prompt eradication of these almost worthless intruders may mean the saving of many weeks of labour in two or three years' time, when, otherwise, these invading grasses shall have spread and seeded.

In paspalum pastures, ordinary white clover should be fostered. A good pasture of this kind can often be established by broadcasting a few ounces of white clover seed to the acre in a paspalum paddock. This can be done during autumn. Generally, white clover prefers a sandy soil.



What is a Fair Over-run?

THE over-run paid out by butter factories is a much-discussed subject among dairy farmers. A question frequently asked is: "What is the maximum over-run obtainable by a factory where all weighings, tests, and other operations are carried out correctly." Here is the answer:—

Over-run in Queensland is the excess butter actually manufactured over the amount of commercial butter (estimated from the approved chart) obtainable from all cream received at the factory. Butter of legal composition must contain at least 82 per cent. of fat, and to obtain the maximum over-run a factory must, therefore, convert every ounce of fat which it receives in the cream into butter containing exactly 82·0 per cent. of fat. Under commercial conditions this is impossible, as there is a proportion of the fat lost in various ways. There is a certain amount of cream spilt, or lost in other ways, during sampling, tipping, and processing; a further quantity of fat is lost in the buttermilk and, finally, there is a loss of butter in the packing process. The percentage of the total fat lost in these ways is approximately 0·2 per cent. in spillage, &c., 1 per cent. in the buttermilk, and 0·25 per cent. in packing—making a total fat loss of approximately 1·45 per cent. The effect of this loss is best illustrated by an example.

One thousand lb. of cream with a fat test of 40 would be paid for as 489 lb. of commercial butter. The actual quantity of fat in this weight of cream is 417 lb. A loss of 1·45 per cent. of this fat means that 6 lb. of fat is lost during handling and manufacture, leaving 411 lb. of fat which can be manufactured into butter. The maximum weight of butter of legal composition which can be manufactured from this quantity of fat is 500 lb., and the maximum over-run is therefore 11 lb. of butter on the estimated quantity of 489 lb.—equivalent to 2·25 per cent. It is not possible for a factory working under commercial conditions to consistently obtain this over-run, and it can be taken for granted that the over-run obtainable should be no higher than 2 per cent. A factory can only consistently exceed this figure by one or more of the following practices:—

(*a*) Cutting the weights of the cream.

(*b*) Cutting the fat tests.

(*c*) Manufacturing butter of illegal composition.

In the manufacture of unsalted butter, the over-run obtainable is considerably less than the figure given above. The maximum over-run obtainable on unsalted butter is 1 per cent., but under commercial conditions it is doubtful whether it could exceed 0·75 per cent. A factory which manufactures both salted and unsalted butter should, therefore, have a lower over-run than one which makes salted butter exclusively.

CALF-FEEDING.

About 87 per cent. of cows' milk is water. Of the remainder, nearly one-third is fat, and a good separator, if properly operated, will remove about 95 per cent. of this fat. Very little protein is removed. It follows that, if the separated milk is to be made equal in feeding value to the original milk, either the fat or its equivalent must be replaced. There is no need to place protein, and for this reason it is not good practice to feed such protein-rich materials as linseed meal in conjunction with skim milk to very young calves.

Dripping obtained from a reputable meatworks, or cod liver oil, may be incorporated in the milk, but they are rather expensive and difficult to mix properly. A better system is to use finely-ground maize. Maize meal from good-quality grain contains as much as 5 per cent. high-grade oil and 70 per cent. of easily digested carbohydrate, which, to some extent, serves the same purpose as fat.

The new-born calf should get whole milk for a fortnight if it is to be given a good start in life. For the first few days it may be fed three times daily; after that, twice daily is enough. A safe level to feed is 1 gallon to each 100 lb liveweight. At the end of the second week a little maize meal is stirred into the milk and the change to separated milk begun. By the end of the third week the maize meal may be built up to a handful, and the change to separated milk completed. By the end of a month the calf begins to nibble grass, and can consume about ½ lb. of meal.

From then on to the eighth week the milk can be replaced progressively by water and a meal mixture. By the eighth week the calf will be able to eat up to 2 lb. daily of a suitable meal mixture.

Such a mixture may contain 35 lb. of linseed meal and 65 lb. of a cereal meal. Pollard and bran should not constitute more than one-half of the cereal meal. The remainder may be crushed oats, barley, or maize. About ½ lb. of salt and 2 lb. of sterilised bone meal should be included in the mixture.

As the animals takes more grass or hay, the supply of the meal mixture is restricted. At six months, unless an adverse period is encountered, the calf should be able to fend for itself.

Before Winter Comes.

BEFORE winter comes, some preparations should be made to ensure comfortable quarters for the pigs on the farm. Although in Queensland the stock may not use the shelters for a long period, when they do have need of cover it should be ready for them.

First of all, the drainage from the piggery should be inspected. After the wet season the drains are often silted up, and pools may have been turned into deep, foul wallows. The drains should be cleared, and the wallows drained and filled in. This will prevent water from lying in the yards after winter rains. Wet, sloppy yards in the winter time make the pigs uncomfortable, and consequently more or less unthrifty. In addition, the discomfort to the men who have to carry on routine feeding, &c., in the piggery is of some importance.

Where the sheds and feeding troughs are movable, they should be shifted to a fresh site. If the sheds and troughs are fixed, any holes or wallows against them should be filled. Then the sheds themselves should be inspected for cracks in the lower walls and floor. Any such cracks should be closed to prevent draughts, which are liable to cause rheumatic and muscular disorders in the pigs. Guard rails should be examined in the farrowing sheds, and all troughs cleaned and examined for necessary repairs.

At the end of summer there is usually a quantity of rank grass growing. If cut and stacked, this will be useful as bedding for winter litters.

Fences in a piggery generally need some attention during the year, and while the other work is being carried out it is advisable to inspect the fences for loose wires and posts, and to fill in holes made by pigs trying to root under the fence lines.

Where foods are boiled for pigs, it is a good plan to examine the fireplace and boiler and ensure that it will not be necessary to make repairs during the winter months when the boiler will be in daily use.

Although much of this labour may appear unnecessary, the farmer who understands animal management will realise that, apart from the fact that equipment is receiving an overhaul, the work is being done with one main object—to ensure the comfort of the stock. Where pigs are kept under comfortable conditions, they generally prove more economical growers than those which are neglected, for the contented pig is a quicker grower and usually requires less feed per 1 lb. gain in live weight. Thus, for his own benefit, the pig-raiser should make sound preparations for the winter months.

THE FARROWING SOW.

While "in pig" the sow should be given as much freedom as possible, for activity promotes health and good digestion, to the advantage of the sow and her prospective litter.

Her food should not be stinted, but she should be kept in moderate condition. Sows which are too fat at farrowing will probably have trouble in delivery, and may also suffer from many other troubles, of which milk fever is only one. On the other hand, if the sow is kept too short of food, she cannot nourish the young pigs properly while carrying them, nor can she suckle them properly when born.

At the time of farrowing a close watch should be kept by the usual attendant—strangers upset the sow—who should not interfere unless there is evidence of trouble in parturition or the sow attempts to bite her young. This sometimes happens when some of the pigs remain to be born and one of those already dropped tries to get to the teats; especially if it squeals, the sow—usually a young one—will seize the piglet in her mouth and quickly squeeze the life out of it. Should she break the skin and taste blood, she may turn on the rest of the litter and eat them. The attendant can prevent this by taking each piglet as it is dropped and putting it aside in a straw-lined box until all are born, when they may be put on to the teats and all will be well.

For the first two weeks after farrowing the sow does not require more food than she received during the last two weeks of pregnancy, but after this the supply should be gradually increased as she requires it.

There is nothing commoner than deficiency diseases in young pigs caused by the absence of the requisite amount of mineral matter in the food. Mineral matter is contained in fish meal, while cod liver oil, with its essential vitamins, stands pre-eminent as a constituent in the food of young pigs. One teaspoonful of cod liver oil twice a day is sufficient for pigs up to ten weeks old.

Draughts, dampness, and uncleanliness, as well as unsuitable food for the mother, will cause scouring, which may lead to death.

Given reasonable care and attention, no trouble should arise, and this little extra care means the difference between a strong, healthy litter and a few stunted, unthrifty runts.

Name and Address.	Name of Hatchery.	Breeds Kept.
G. Adler, Tinana	Nevertire ..	White Leghorns, Australorps, and White Wyandottes
F. J. Akers, Eight Mile Plains ..	Elmsdale ..	Australorps
E. J. Blake, Rosewood	Sunnyville ..	White Leghorns, Australorps, White Wyandottes, and Rhode Island Reds
R. H. and W. J. Bowles, Glenmore road, North Rockhampton	Glen	White Leghorns and Australorps
J. Cameron, Oxley Central ..	Cameron's ..	White Leghorns and Australorps
M. H. Campbell, Albany Creek, Aspley	Mahaca ..	White Leghorns and Australorps
J. L. Carrick and Son, Manly road, Tingalpa	Craigard ..	White Leghorns and Australorps
N. Cooper, Zillmere road, Zillmere	Graceville ..	White Leghorns
R. B. Corbett, Woombye ..	Labrena ..	White Leghorns and Australorps
Dr. W. Crosse, Musgrave road, Sunnybank	Brundholme ..	Australorps, White Leghorns, Rhode Island Reds, and Rhode Island Whites
T. G. Crawford, Stratford, via Cairns	Rho-Isled ..	Rhode Island Reds
Dixon Bros., Wondecla ..	Dixon Bros. ..	White Leghorns
Elks and Sudlow, Beerwah ..	Woodlands ..	White Leghorns and Australorps
W. H. Gibson, Manly road, Tingalpa	Gibson's ..	Australorps and White Leghorns
Gisler Bros., Wynnum ..	Gisler Bros. ..	White Leghorns and Australorps
G. Grice, Loch Lomond, via Warwick	Kiama ..	White Leghorns and Australorps
J. W. Grice, Loch Lomond, via Warwick	Quarrington ..	White Leghorns
Mrs. M. Grillmeier, Milman ..	Mountain View	Australorps, Minorcas, and Rhode Island Reds
C. and C. E. Gustafson, Box 24, Tannymorel	Bellevue ..	Australorps, White Leghorns, Langshans, and Rhode Island Reds
P. Haseman, Stanley terrace, Taringa	Black and White	Australorps and White Leghorns
C. Hodges, Kuraby	Kuraby ..	White Leghorns and Anconas

Name and Address.	Name of Hatchery.	Breeds Kept.
J. McCulloch, Whites road, Manly	Hindes Stud Poultry Farm	White Leghorns, Brown Leghorns, and Australorps
F. McNamara, Vogel road, Brassall, Ipswich	Fammara ..	White Leghorns and Australorps
A. Malvine, junr., The Gap, Ashgrove	Alva	Australorps and White Leghorns
H. L. Marshall, Kenmore ..	Stonehenge ..	Australorps and White Leghorns
W. J. Martin, Pullenvale ..	Pennington ..	Australorps, White Leghorns, and Langshans
J. A. Miller, Racecourse road, Charters Towers	Hillview ..	White Leghorns
F. S. Morrison, Kenmore ..	Dunglass ..	Australorps, White Leghorns, and Brown Leghorns
Mrs. H. I. Mottram, Ibis avenue, Deagon	Kenwood ..	White Leghorns
J. W. Moule, Kureen	Kureen ..	Australorps and White Leghorns
D. J. Murphy, Marmor ..	Ferndale ..	White Leghorns, Brown Leghorns, Australorps, Light Sussex, and Silver Campines
S. V. Norup, Cooper's Plains ..	Lilybank ..	White Leghorns and Australorps
H. W. and C. E. E. Olsen, Marmor	Squaredeal ..	White Leghorns, Black Leghorns, Australorps, Anconas, Langshans
A. C. Pearce, Marlborough ..	Marlborough ..	Australorps, White Leghorns, Rhode Island Reds, Light Sussex, White Wyandottes, Khaki Campbell Ducks, Indian Runner Ducks, and Bronze Turkeys
E. K. Pennefather, Douglas street, Oxley Central ..	Pennefathers ..	White Leghorns and Australorps
G. Pitt, Box 132, Bundaberg ..	Pitt's	White Leghorns, Brown Leghorns, Australorps, Langshans, Light Sussex, White Wyandottes, Rhode Island Reds
G. R. Rawson, Mains road, Sunnybank	Rawson's ..	Australorps
J. Richards, Atherton	Mountain View	White Leghorns and Australorps
H. K. Roach, Wyandra ..	Lum Burra ..	Australorps and White Leghorns
C. L. Schlencker, Handford road, Zillmere	Wyndyridge ..	White Leghorns
A. Smith, Beerwah	Endcliffe ..	White Leghorns and Australorps
A. T. Smith, Waterworks road, Ashgrove	Smith's ..	Australorps and White Leghorns
T. Smith, Isis Junction	Fairview ..	White Leghorns and Langshans
H. A. Springall, Progress street, Tingalpa	Springfield ..	White Leghorns
J. Steckelbruck, The Gap, Ashgrove	..	White Leghorns and Australorps
W. J. B. Tonkin, Parkhurst, North Rockhampton	Tonkins' ..	White Leghorns and Australorps
W. A. Watson, Mulgrave road, Cairns	Hillview ..	White Leghorns
G. A. C. Weaver, Atherton ..	Weaver's ..	Australorps, White Leghorns, Buff Leghorns, White Wyandottes, Minorcas, Anconas, Indian Game, Rhode Island Reds, Barred Rocks
H. M. Witty, Kuraby ..	Witty's ..	White Leghorns and Anconas
P. A. Wright, Laidley ..	Chillowdeane ..	White Leghorns, Brown Leghorns, and Australorps
R. H. Young, Box 18, Babinda	Reg. Young's ..	White Leghorns, Australorps, and Brown Leghorns

Following is a list of new registrations received up to the 20th February, 1940:—

Name and Address.	Name of Hatchery.	Breeds Kept.
A. F. Buchler, Milman	Pincrow ..	White Leghorns
J. E. Caspaney, Ayr ..	Evlington ..	White Leghorns
T. Duval, Athalie Estate, Home Hill	..	White Leghorns
F. G. Ellis, Old Stanthorpe road, Warwick	Sunny Corner ..	Australorps
H. Hufschmid, Ellison road, Geebung	Meadowbank ..	White Leghorns, Brown Leghorns, Minorcas, Australorps, and Rhode Island Reds
C. Mengel, New Lindum road, Wynnum West	Mengels ..	Australorps
S. E. Searle, New Cleveland road, Tingalpa	Tingalpa ..	White Leghorns
V. White, Cleveland	Pinklands ..	White Leghorns

EFFECT OF CLIMATIC CONDITIONS ON DIFFERENT CLASSES OF POULTRY.

Two classes of birds are generally used by commercial farmers—light breeds, such as Leghorns, Anconas, and Minorcas; and heavy or dual-purpose breeds, such as Australorps, Wyandottes, and Rhode Island Reds.

Light breeds, as a rule, are of a "highly strung" nature, and very susceptible to climatic changes, particularly during the early periods of production. Rains and cold snaps will invariably check production with this type of bird. This is particularly noticeable if the birds are not housed under the intensive system. If false moults are to be avoided, the highly strung nature of the birds also makes it inadvisable to alter their location until they have settled well into production and until spring approaches.

If, for any reason, light breeds have to be handled before the middle of, say, July, go about the work quietly and, if at all possible, work only in the afternoon, for most of the birds to lay on that day will have done so by then.

The dual-purpose breeds, on the other hand, are more docile and quiet. They are not so easily disturbed by climatic changes during the early laying stages, but are more susceptible to heat, as many dual-purpose birds lay on fat. In selecting breeders, select against this characteristic and choose the most active, alert birds. Greater liberties can be taken with dual-purpose breeds in relation to change of quarters, but do not worry them or shift them during early winter, as they are not immune from false moults.

Dodder in Lucerne Seed.

LUCERNE is grown from seed and is usually sown with the object of providing a stand for several years. With this in mind, only the best seed should be bought with an assurance that it is free from dodder.

Dodder is an annual parasitical plant found in the warmer parts of the world. Its seed germinates in the soil, sends up a stem and attaches itself to the host plant which, in Queensland, is mostly lucerne. It is leafless, with twining thread-like stems, which attach themselves to the host plant by means of tubercles; from then onwards the parasite draws its nourishment from this source and severs its connection with the soil. The immediate effect is that the host plant is called on to support not only itself but also the dodder until ultimately the exhausted plant dies, in most cases smotheerd in a tangled mass of light-brown threads. Dodder produces seed quickly, so that it can run the full life cycle (seed to seed) before the host plant dies from starvation. Dodder seeds are borne in a globular capsule with four seeds in each. These seeds are pressed together, giving them their characteristic flattened surfaces.

Unfortunately, this parasitical growth is common in lucerne fields. Experience shows that the dodder seeds cannot be removed satisfactorily from lucerne seed with cleaning machinery, or by sieving; this statement is based on many unsuccessful attempts to make saleable dodder-infested lucerne seed.

Growers of lucerne seed, in fairness to themselves as well as to those who may buy their seed, should never harvest seed from a dodder-infested field.

It should be borne in mind that any seed for sowing, or any material found to be dodder-infested, is subject to immediate seizure, and the person offering infested seed for sale is liable to prosecution. A £50 fine is provided for the sale of lucerne seed containing dodder. No excuse can be accepted for the presence in seed or feed of such a destructive parasite which can well be considered as lucerne's worse enemy.

Buyers should always insist on an assurance that the seed they are purchasing is dodder-free.

Samples of lucerne seed representing seeds purchased by farmers for their own sowing are examined free of charge, at the Seed Testing Station, Department of Agriculture and Stock, Brisbane. Samples should be of not less weight than 4 oz., and marked as follows:—

Sample of seed drawn from
bags representing a total of bags marked
Purchased from of on
Name and address of sender, and date.

It is better to send a sample for examination as soon as it is purchased, rather than wait until the crop has grown, and then find it contains injurious weeds.

WINTER AND SPRING FEED.

For winter and spring feed in coastal areas which usually have a fair winter rainfall, the winter cereals, wheat, oats, barley, and rye, are strongly recommended. If these crops are combined with a legume, such as field peas or vetches, the nutritive value of the fodder is greatly enhanced.

Sowings of these crops may be continued during May. If seasonal rains are delayed, sowings may be extended until early in July, but with such late sowings the crops will only be available for a short period.

In the absence of seed drills, broadcasting is usually adopted, sowing the legume first, and discing or ploughing it under, following with the cereals, which are broadcast and harrowed in.

Suitable varieties are:—Wheat—Florence, Warren, or Warchief; oats—Sunrise, Belah, or Algerian; barley—Skinless. Florence wheat, 30 lb., combined with Dun field peas at the rate of 20 lb. per acre, has proved a suitable mixture, as both are early maturing. Algerian oats, 30 lb., combined with vetches at the rate of 20 lb. per acre, make also a suitable combination, particularly for early sowing, as this mixture is considerably slower in maturing than the former. The early maturing varieties of oats, such as Belah and Sunrise, may also be sown with field peas if desired.

If individual crops are sown, the following rates of seeding per acre are recommended:—Wheat 60 lb., barley 50 lb., oats 50 lb., rye 50 lb., field peas, 40 lb., vetches 30 lb.

The crop should be cut and fed direct to stock as, where grazing is practised, wastage occurs through tramping.

Rape may also be grown now and during the winter months to provide an abundance of succulent feed for both sheep and pigs. Rape is not so suitable for dairy cattle, because of the taint which it may impart to milk, and to its tendency to induce bloat.

Rape may be sown early in May, drilling in 4 to 5 lb. of seed per acre. Broadleaf Dwarf Essex is the best variety.

The root crops, mangels, sugar beet, Swede turnips, and kohl-rabi may also be sown on land which has been well prepared.

A "Planet Junior" cultivator and seeder is a useful implement for this work, the seed being sown in rows 2½ feet apart, and the plants being thinned out to 1 foot intervals. Sow mangels and sugar beet at the rate of 5 to 7 lb. per acre, Swede turnips 2 to 3 lb., and kohl-rabi 2 lb.

ONION-GROWING.

As onion sowings are usually made in April and May, the incidence of the rainfall received during the winter months is of the utmost importance, and, when deficient, has to be supplemented by irrigation. Because of its deep-rooting habit, the onion can withstand limited dry spells, but the best results are obtained where the growing period is fairly moist, with drier conditions towards maturity and during harvest.

Rich, well-drained, sandy loams, friable and easy to work, have proved the most suitable, producing onions of good appearance and better keeping qualities than those grown on heavier soil types. Sandy soils tend to produce bulbs of good size but low-keeping quality, while heavy soils will induce thickened or bull-necked plants.

The preparation of land intended for onion cultivation will now be nearing completion, and it must be remembered that deep cultivation should be avoided as the sowing period approaches.

The seed may be broadcast in seed-beds from which the plants are transplanted to their permanent positions in the field. Alternatively the seed may be sown in the permanent drills. The latter method is usually adopted in Queensland, utilising the "Planet Junior" type of hand seeder, and placing the seed in drills 12 inches to 15 inches apart, which will be found to call for 2 lb. to 3 lb. per acre. The seed should only be lightly covered with not more than ½ inch of soil, as deeper sowings germinate very poorly.

When the young plants are 4 inches to 5 inches high they are thinned out to a distance of 4 inches to 6 inches in between plants, a practice usually carried out with the aid of a 2-inch chipping hoe.

In the southern districts sowings may be commenced soon and continued until May, while in the central and northern districts the period can be extended to July. If sown too early, losses may result from flowering, while if too late the bulbs may be small owing to insufficient time in which to mature before the hot weather causes scalding. Sow late-maturing varieties early and early-maturing varieties late. Only freshly-grown tested seed should be utilised, as onion seed deteriorates rapidly, and it is therefore preferable to buy seed from reliable sources.

The Brown Spanish type, including "Early Hunter River Brown Spanish," is the most popular, the onions being of good appearance and flavour and possessing good keeping qualities.

The hand cultivators of the "Planet Junior" type are useful for inter-row cultivation, as all weed growth must be kept in check. The soil should not be thrown up against the bulbs, the object being to draw the soil away rather than towards the plants, thus inducing the formation of bulbs. If the soil is not drawn away, bending over the tops with a twisting motion will assist in the formation of bulbs. When the seed-bed has been thoroughly prepared it will be found that very little hand weeding is necessary. Further information may be obtained on application to the Department of Agriculture and Stock, Brisbane.

WHEN TO POISON GREEN TIMBER.

The autumn is the best time to poison green timber wtih arsenic pentoxide or sodium arsenite. If the job is done when the sap flow in the tree is ceasing, suckering will be reduced to a minimum.

The Spraying of Early Beans.

BECAUSE of the high prices recently obtained for vegetables, bean growers on the North Coast are planting exceptionally early this season, and, with the use of the nicotine sulphate-white oil spray, they hope to control the bean fly sufficiently to ensure the production of satisfactory crops. Prior to the use of this spray, plantings right up to May in other years often succumbed or the yields were markedly affected because of bean fly attack.

In using the spray at present, growers must not overlook the fact, that the life cycle of the bean fly is shortened somewhat in this warmer weather. Consequently, instead of the two sprayings earlier suggested —that is, the first to be applied when the plants are four days old and the second four days later—it would be advisable to make the first spraying three days after the first beans have appeared and the second four days later, followed by at least two extra sprayings at four-day intervals. This procedure should be adopted for crops planted while the warm weather continues, that is, until the cooler weather retards bean fly activity.

Up to five and six sprayings have been applied in some cases, but recommendations involving this number of sprayings cannot at present be made, pending the completion of experimental work. Growers, therefore, will have to be guided by the number of flies apparent on the plants and the growing conditions. If warmth and moisture are plentiful the plants may survive a certain amount of bean fly attack and still produce good crops. If conditions are dry, however, the plants usually show the effects of the fly very quickly. The spraying programme will, therefore, probably need to be adjusted to the general conditions.

The formula of the spray is as follows:—One fluid ounce of nicotine sulphate, 8 fluid ounces of white oil, 5 gallons of water. For growers with large areas a larger quantity of spray may be prepared from the following ingredients:—Half pint nicotine sulphate, 4 pints white oil, 50 gallons water.

BANANAS IN AUTUMN.

During autumn trashing is an important job in the plantation, for it both minimises black end and anthracnose trouble, and allows the free access of air and sunshine, the latter being of the greatest value during cold weather.

Trashing stimulates the rate of sucker growth, and some growers, even though their areas are on unprotected windy slopes, claim that autumn trashing is preferable to treatment at the end of the winter.

In young plantations where growth has been slow, and in which the plants are now carrying their first bunch, an application of fertilizer would be helpful. A suitable dressing would be 1½ lb. of superphosphate, 1 lb. of sulphate of ammonia, and from ½ to 1 lb. of muriate of potash, applied per stool and well incorporated with the soil. Such a dressing should have been applied during March, but growers who neglected to treat their plantations, or whose area has suffered a setback through weather conditions, will find an application later on very beneficial. Without some such assistance, it is quite possible that fruit thrown during April will take six months to mature. Very slow maturing fruit is, of course, undesirable.

In the older plantations, heavy fertilizer applications may be unprofitable. Areas which are not remunerative should, therefore, be eradicated if the financial prospects do not warrant their further maintenance.

It is well worth while tagging a few bunches throughout the whole of the plantation, these tags carrying the date on which the bunch is thrown. When the bunch is cut the period of development can very easily be calculated. In this way the grower can find out which section of the plantation produces most rapidly. These areas will, of course, be the most profitable.

The marketing of immature fruit is undesirable. If necessary, during winter, the top hand on the bunch should show traces of colour.

Growers with exposed plantations should, as cooler weather advances, bag their bunches to protect them from the cold. The fruit from bagged bunches matures fairly rapidly, and is very much better in quality than unprotected fruit. Second-hand bags may be used for the purpose, but any cost involved is amply repaid by increased returns to the grower.

PARSLEY.

Parsley will grow almost anywhere and on any kind of soil which is not of too stiff a nature, although a partially shaded position and a rich, moist soil suit it best. Being a biennial, it must be sown each year in order to provide a continuous supply. It should be sown twice a year —in March and April for use in winter and spring, and again in August and September for use in summer. Seeds may be sown in shallow drills in the open ground, and the seedlings thinned out to about 6 inches apart. It frequently happens that parsley is sown too thickly and early thinning is neglected, with the result that the plants run to seed prematurely. Instead of sowing a continuous row, drop a few seeds along the drill at 6-inch intervals, and when the seedlings have developed several leaves remove all but the strongest plant in each group.

The Fruit Market.

J. H. GREGORY, Instructor in Fruit Packing.

THE apple season has brought the usual crop of troubles associated with sending in varieties such as Granny Smith before they have reached the right stage of ripeness. It certainly is hard to understand why growers, season after season, persist in trying to sell to consumers and maintain sales of fruit which they would not eat themselves. The excuse that they are sold as "cookers" is not sound, as the Granny Smith, because of its late season popularity, will always retain its favour with the retailers.

The same applies to Stanthorpe tomatoes. Many lines have arrived on the market with too high a percentage of immature fruit. This fruit will not ripen satisfactorily and if humidity is high a large percentage develop blight and soft rots before colouring. Many lines sold by agents have been returned by the buyers. Drastic action has had to be taken to remove fruit of this class from the market.

Intense heat at the end of January caused considerable damage to most fruits, pineapples particularly. Quantities of sunburned pineapples have been taken by factories. It is stressed again that the mixing of sunburned fruit with sound factory fruit will cause confusion and rejection of the affected fruit. Sunburned pineapples taken by the factory must be kept separate and branded with a large "S" on both ends of the case with one fruit on the top layer wrapper in paper.

Mango prices dropped in consequence of the large crop of common types around Brisbane.

Stone fruits eased off. Grapes have been selling well.

TROPICAL FRUITS.

Bananas.

Brisbane.—Cavendish: Small, 5s. 6d. to 8s.; sixes, 6s. 6d. to 11s.; sevens, 7s. 6d. to 13s. 6d.; eights and nines, 8s. to 14s. 6d.

Sydney.—Cavendish: Sixes, 12s. to 16s.; sevens, 13s. to 15s.; eights and nines, 19s. to 22s.

Melbourne.—Cavendish: Sixes, 11s. to 13s.; sevens, 13s. to 15s.; eights and nines, 14s. to 16s.

Adelaide.—Cavendish: 18s. to 20s.

Lady's Finger.—2d. to 9½d. per dozen.

Pineapples.

Brisbane.—Smoothleaf: 1s. 6d. to 5s. per dozen; 3s. 6d. to 6s. per case. Ripley: 6d. to 4s. 6d. per dozen; 4s. to 8s. per case

Sydney.—Smoothleaf: 5s. to 8s.

Melbourne.—Smoothleaf: 7s. to 9s.

Papaws.

Brisbane.—Yarwun, 5s. to 7s. tropical case; Local, 1s. to 3s. bushel.

Monstera Deliciosa.

3s. 6d. dozen.

Mangoes.

Brisbane.—Commons, 1s. to 5s.; fancy varieties, 5s. to 7s. bushel.

Sydney.—2s. to 3s. half-bushel.

Passion Fruit.

Brisbane.—First Grade, 5s. to 8s.; Second Grade, 4s. to 5s.

Melbourne.—10s. to 12s.

CITRUS FRUITS.

Oranges.

Brisbane.—New South Wales Packing House, 18s. to 24s. bushel.

Grapefruit.

Brisbane.—Palestine, 35s. per export citrus case.

Lemons.

Brisbane.—Locals, 6s. to 13s.; Gayndah, 15s. to 20s.

DECIDUOUS FRUITS.

Apples.

Brisbane.—Jonathan, 6s. to 8s. (some lower); Granny Smith, 5s. to 8s.; Delicious, choice, 7s. to 8s., poorly coloured, 5s. to 6s.; Other varieties, 4s. to 7s. Cookers, 3s. to 5s.

Pears.

Brisbane.—W.B.C., 9s. to 11s. Others, 4s. to 8s.

Peaches.

Brisbane.—3s. to 8s.

Plums.

Brisbane.—President, 7s. to 8s. Grand Duke, 7s. to 8s. Giant Prune, 7s. to 10s. Ponds, 9s. to 10s.

OTHER FRUITS.

Grapes.

Brisbane.—Roma, 4s. to 6s. Waltham Cross, 8s. to 9s. Muscatels, 5s. to 7s.

Tomatoes.

Brisbane.—Ripe, 1s. to 2s. 6d.; Green, 1s. 6d. to 2s. 6d.; Coloured, 2s. to 3s. 6d.

Too much green unsaleable fruit is being marketed by the Stanthorpe district.

Figs.

8d. to 9d. box; 2s. 6d. to 3s. tray.

MISCELLANEOUS, VEGETABLES, &c.

Watermelons.—2s. to 10s. per dozen.

Rockmelons.—4s. to 8s. per case.

Cucumbers.—1s. to 3s. bushel.

Pumpkins.—Brisbane: 5s. to 7s. bag. Melbourne: £10 to £12 per ton.

Marrows.—Brisbane: 1s. to 3s. dozen.

Lettuce.—2s. 6d. to 5s. 6d. bundle.

Cabbages.—Local: 1s. to 5s. dozen. Stanthorpe: 7s. to 9s. bag.

Beans.—Brisbane: Prime, 7s. to 10s.; Old, 3s. to 4s. bag.

Peas.—Brisbane: First Quality, 5s. to 7s. bag; old, 3s. to 4s. New South Wales: 8s. to 16s. 56 lb. bag.

Parsnips.—6d. to 1s. bundle.

Carrots.—3d. to 9d. bundle.

Beetroot.—3d. to 1s. bundle; prime quality higher; supplies short.

Rhubarb.—6d. to 1s. 3d. bundle.

South Australian Celery.—28s. to 30s. crate.

PUBLICATIONS.

A pamphlet is available on the transport of pineapples to factory. Copies can be obtained free on application to the Under Secretary, Department of Agriculture and Stock, William street, Brisbane, or Committee of Direction, Turbot street, Brisbane.

BANANA SUCKERING.

A flush growth of young suckers may appear in most banana areas after heavy summer rains.

Before they form their own root system, these suckers rely solely on the parent plant for their subsistence, and where a number are present they retard the parent plant's growth and the development of its bunch of fruit.

Most growers have a definite time for suckering in their working plan, but others fit in at any time, if at all, with the result that four, six, eight, and up to a dozen suckers, ranging in size from "peepers" to fully-grown plants, are seen, all of which have robbed the parent plant of some of its vigour.

Even in the most fertile soils the number of suckers left to bear the grower's next bunch should seldom be more than two, and sometimes three. It is desirable, therefore—particularly if a fertilizing programme is carried out—to destroy all the suckers which are not required as soon as they peep above the ground. At this stage they are easy to disconnect with little damage to the plant, and the fertilizer applied goes only to those suckers which will eventually produce the next cutting of bananas.

PRODUCTION RECORDING.

List of cows and heifers officially tested by officers of the Department of Agriculture and Stock which have qualified for entry into the Advanced Register of the Herd Books of the Australian Illawarra Shorthorn Society, the Jersey Cattle Society, and the Guernsey Cattle Society, production charts for which were compiled during the month of January, 1940 (273 days unless otherwise stated).

Name of Cow.	Owner.	Milk Production.	Butter Fat.	Sire.
		Lb.	Lb.	
	AUSTRALIAN ILLAWARRA SHORTHORNS.			
	MATURE COW (STANDARD, 350 LB.).			
Model 4th of Alfa Vale	W. H. Thompson, Alfa Vale, Nanango	14,275·1	598·454	Reward of Fairfield
Happy Valley Bluebell 4th	R. R. Radel, Coalstoun Lakes	8,869·56	379·306	Burradale Emperor
Burradale Silky 18th (197 days)	W. F. Kajewski, Glenroy, Glencoe	9,423·35	379·217	Burradale Eclipse
Glenroy Isabel (204 days)	W. F. Kajewski, Glenroy, Glencoe	8,955·75	358·626	Burradale Earl
Rosenthal Maggie 13th	S. J. H. Mitchell, Rosenthal, Warwick	8,756·83	354·571	Rosenthal Handsome Boy
	SENIOR, 3 YEARS (STANDARD, 290 LB.).			
Gem 7th of Alfa Vale	W. H. Thompson, Alfa Vale, Nanango	11,497·6	559·181	Alfa Vale Red Prince
Kyabram Mab	C. W. Black, Kumbia	11,764·63	529·323	Ledger of Greyleigh
	JUNIOR, 3 YEARS (STANDARD, 270 LB.).			
Model 11th of Alfa Vale	W. H. Thompson, Alfa Vale, Nanango	12,982·9	600·289	Reward of Fairfield
Rhodesview Strawberry 5th	W. Gierke and Sons, Rhodesview, Helidon	9,521·61	354·982	Blacklands Prospector
Penrhos Stella 5th	A. Sandilands, Penrhos, Wildash	6,576·6	276·131	Penrhos Monarch
	SENIOR, 2 YEARS (STANDARD, 250 LB.).			
Rhodesview Daisy	W. Gierke and Sons, Rhodesview, Helidon	8,468·45	332·994	Blacklands Prospector
	JUNIOR, 2 YEARS (STANDARD, 230 LB.).			
Glenroy Empress	W. F. Kajewski, Glenroy, Glencoe	10,680·25	440·944	Park View Glider
Happy Valley Pride (257 days)	R. R. Radel, Coalstoun Lakes	6,304·32	300·164	Sunnyview Artist
Glen Idol Daphne 3rd	P. Doherty, Box 31, Gympie	7,349·25	298·951	Excellency of Blacklands
Rhodesview Nancy 24th	W. Gierke and Sons, Rhodesview, Helidon	7,899·83	292·55	Blacklands Prospector
Rhodesview Fancy 7th	W. Gierke and Sons, Rhodesview, Helidon	5,975·58	238·505	Blacklands Prospector

JERSEY.

Mature Cow (Standard, 350 Lb.).

Dawn of Southport	C. Huey, Ashview, Sabine	6,508·4	361·883	Werribee Twylish Starbright King

Senior, 4 Years (Standard, 330 Lb.).

Woodlands Fashion	D. R. Hutton, Bellgarth, Cunningham	8,181·98	416·665	Kenmore Victor
Bellgarth Lucky Girl 2nd	D. R. Hutton, Bellgarth, Cunningham	5,572·96	334·047	Bellgarth Lucky Boy

Senior, 3 Years (Standard, 290 Lb.).

Glenview Flower	F. P. Fowler and Son, Glenview, Coalstoun Lakes	8,054·15	438·392	Trinity Governor's Hope
Bellgarth Claire de Lune 2nd	D. R. Hutton, Bellgarth, Cunningham	7,067·51	396·325	Trecarne Renown 2nd
Bellgarth Birthday 4th	D. R. Hutton, Bellgarth, Cunningham	7,459·02	381·258	Trecarne Renown 2nd
Oxford Remus Butterfly	E. Keys, Proston	7,845·6	375·389	Overlook Nancy's Remus

Junior, 3 Years (Standard, 270 Lb.).

Bellgarth Gallatea	D. R. Hutton, Bellgarth, Cunningham	6,487·9	329·203	Bellgarth Bellboy 2nd

Senior, 2 Years (Standard, 250 Lb.).

Bellgarth Butter Queen 2nd	D. R. Hutton, Bellgarth, Cunningham	5,725·65	328·665	Trecarne Renown 2nd
Broadview Harmony	W. S. Kirby, Byrnestown	5,213·88	264·257	Glenview Mason

Junior, 2 Years (Standard, 230 Lb.).

Keystone Lavender	E. Keys, Proston	5,942·8	316·156	Gunawah Gamboge Prince
Broadview May	W. S. Kirby, Byrnestown	4,884·63	271·065	Glenview Mason
Bellgarth Mabel	D. R. Hutton, Bellgarth, Cunningham	4,722·79	269·149	Trecarne Renown 2nd
Carnation Bonny Locket	D. R. Hutton, Bellgarth, Cunningham	6,173·42	267·722	Carnation Locket's Victory
Broadview Lavender	W. S. Kirby, Broadview, Byrnestown	4,445·3	240·663	Glenview Lynda's Noble
Broadview Cherry Blossom	W. S. Kirby, Byrnestown	4,265·08	237·098	Glenview Mason

GUERNSEY.

Junior, 2 Years (Standard, 230 Lb.).

Laureldale Chimes	W. A. Cooke, Laureldale, Witta	6,802·1	275·355	Laureldale President

General Notes

Staff Changes and Appointments.

Mr. L. C. Home, Department of Agriculture and Stock, has been appointed laboratory assistant in the Bureau of Sugar Experiment Stations.

Messrs. John Harrison, Stewartdale, Ripley, and F. C. Limpus, North Rockhampton, have been appointed honorary protectors under the Fauna Protection Act.

Constable J. T. Johnston, Biggenden, has been appointed also an inspector under the Brands Acts.

Mr. A. R. White, border gatekeeper for the New South Wales Department of Agriculture at Stanthorpe, has been appointed also an inspector under the Diseases in Plants Acts.

Mr. D. Walsh, Horseshoe Bay, Bowen, has been appointed an honorary protector of fauna in respect of the sanctuary embracing the pasturage reserve at Cape Edgecumbe, Bowen.

The undermentioned have been appointed honorary fauna protectors and honorary rangers in respect of native plants—

Messrs. L. Larsen (North Tamborine); Rev. W. A. Hardie (Woolloongabba); L. G. O'Keefe (Thompson Estate); C. F. Schroder (Normanby); A. C. Taylor (Annerley); J. Cuthbertson (One Mile Estate, Ipswich); W. C. Horner and E. W. Bell (Springbrook).

Mr. M. L. Cameron, Chief Clerk of the Department of Agriculture and Stock, has been appointed deputy for the Under Secretary, Mr. R. P. M. Short, as a member of the Rural Development Board during the latter's absence from Brisbane on official business.

The appointment of Mr. J. Pedelty, Burrum, as an inspector under the Diseases in Plants Acts has been cancelled, and Mr. I. L. Andersson, loader for the Committee of Direction of Fruit Marketing at Burrum, has been appointed an inspector in his stead.

Mr. W. F. Snewin (Indooroopilly) has been appointed an inspector under the Diseases in Stock Acts, the Slaughtering Act, and the Dairy Produce Acts, Department of Agriculture and Stock.

Mr. D. R. L. Steindl, assistant pathologist, Bureau of Sugar Experiment Stations, Department of Agriculture and Stock, has been transferred from Bundaberg to Brisbane.

Mr. T. K. Kelly, inspector under the Stock, Slaughtering, and Dairy Produce Acts, has been transferred from Ravensbourne to Ramsay.

Mr. W. C. Wilson, night officer, Wacol, has been appointed an honorary protector under the Fauna Protection Act.

Mr. W. H. Schacht, of the Forests Office, Brooweena, has been appointed an honorary fauna protector.

Constable T. A. McNaught, Kajabbi, has been appointed also an inspector under the Slaughtering Act.

Mr. Hunter Freeman, until recently chief cane inspector, Macknade Mill, Herbert River, has been appointed millowners' representative on the Central Sugar Cane Prices Board in succession to Mr. E. S. Smith, resigned.

Mr. J. E. Ladewig, Inspector of Dairies, has been transferred from Biloela to Toowoomba.

Mr. H. W. Miller, jun. (Woolloongabba) has been appointed an honorary protector of fauna and honorary ranger under the Native Plants Protection Act.

Other appointments of honorary protectors under the Fauna Protection Act are:—Messrs. E. G. C. Eardley (North Gooburrum), J. E. Pashley (Gooburrum), G. E. Unkles and P. J. Mittelheuser (Burnett Heads road), F. G. Bettiens (Tirroan), W. Manderson (Gin Gin), and W. R. Douglas (Maryborough road, Bundaberg).

Egg Board.

An Order in Council has been issued under the Primary Producers' Organisation and Marketing Acts amending the constitution of the Egg Board to provide that registration of growers' premises shall be effected not later than 30th April in each year from and after the year 1940, instead of from the 1st August in each year.

Answers to Correspondents

BOTANY.

Replies selected from the outgoing mail of Mr. C. T. White, Government Botanist.

Forest Blue Grass. Early Spring Grass.

J.K., Kalbar—

1. Forest Blue Grass, *Bothriochloa intermedia.* This grass is very common in Queensland, and is generally regarded as a very good cattle grass in the mixed native pasture.
2. Early Spring Grass, *Eriochloa procera.* This grass responds fairly readily to spring and early summer rains, hence the local name, though it is perhaps no more applicable to it than to several other native sorts. It is generally regarded as a very good stock grass, palatable, and nutritious.

Caustic Vine or Milky Vine.

J.R.L., Jericho—

The specimen is the Caustic Vine or Milky Vine, *Sarcostemma australe,* a plant with a very wide distribution in Queensland. Feeding tests have definitely proved the plant poisonous to stock. On the other hand, it has been reported in South Australia as quite a good fodder. It belongs to a dangerous family of plants (the Asclepiadaceae), and there is no doubt it is unwholesome. Like many succulents, including prickly-pear, it has the power of living on its own stores of food for quite a long time.

Brazilian Wax Palm.

M. Bros., Sydney—

I have not seen the Brazilian Wax Palm or Carnauba Wax Palm (*Copernicia cerifera*) growing in Queensland. It is a native of the hotter parts of Brazil, but might thrive in north-eastern Queensland, particularly about Cairns and the Daintree River. It is doubtful if it would pay to grow the palm for the collection of the wax, as it would take some time for trees to attain marketable size, and the collection of the wax is apparently a tedious business. The wax is borne on the young leaves which are shaken, and the wax then melted for local use and for export. The tree is cultivated in some tropical countries, including India, but purely as an ornamental palm, and so far as I know, has never been considered as a commercial crop in these countries.

Trees for a Windbreak—Swamp Couch.

J.D. (Toowoomba)—

1. For the purpose of a windbreak so that the branches will touch Lambertiana pines should be planted about 30 feet apart.
2. Bottle trees will probably be best planted in August or early September, after the late frosts and before the weather gets too hot.
3. The best time to plant plane trees is July or August.
5. Lambertiana pines and Arazonica pines may be head pruned if desired. This, however, is purely a matter of individual taste.
6. Swamp couch or water couch is a very bad pest in cultivation once it gets a hold. Under ordinary garden conditions continual digging out is probably the best means of eradicating it, but if you want to spray it as you suggest you would probably find the best system would be to expose the roots and spray with some weak arsenical solution or other weedicide. If the standing plants are sprayed, it would have to be done several times before it would take effect. Spraying of plants, such as water couch and nut grass only burns off the tops and leaves the underground parts unaffected, unless, of course, they are growing on a place such as a tennic court where fairly strong solutions can be applied several times.

Rural Topics

Sales Tax on Farm Equipment.

The following information on Sales Tax exemptions has been supplied by the Federal Taxation Department:—

1. In the Sales Tax law, extensive provision is made to permit exemption from sales tax in respect of certain machinery, implements, apparatus, equipment, and materials for use in the agricultural industry.

2. The term ''agricultural'' is defined to mean ''of or pertaining to agriculture, and for the purposes of this definition 'agriculture' includes viticulture, horticulture, pasturage, apiculture, poultry farming, dairy farming, and other operations connected with the cultivation of the soil, the gathering in of crops, and the rearing of livestock.''

3. The term ''agricultural industry'' includes fresh fruit packing sheds of individual fruit growers, and also co-operative fresh fruit packing sheds of fruit growers. Packing sheds owned by persons not engaged in fruit growing, or packing sheds owned by cool storage companies are not within the ''agricultural industry.''

4. Many persons engaged in the agricultural industry are under the impression that exemption from payment of sales tax applies in respect of *all* goods purchased by them. That impression is not a correct one. Exemption applies only to those goods which are actually covered by the schedule of exemptions.

5. The schedule referred to includes certain goods which are exempt no matter for what purpose they are purchased, while other goods are exempt only subject to the condition that they are for use in the agricultural industry. The former type of exemption is termed ''unconditional,'' and the latter is known as ''conditional.''

6. In the schedule of exemptions, provision also has been made for exemption to be granted in respect of machinery, implements, and apparatus not elsewhere included (and parts therefor) used in the agricultural industry, if, in the opinion of the Commissioner of Taxation, they are goods of a kind used exclusively or primarily and principally in that industry.

7. Before conditionally exempt goods can be regarded as exempt, it is necessary for the essential condition to be fulfilled, viz., to satisfy the Commissioner of Taxation that at the time of purchase the use to which the particular article is to be put is exclusively or predominantly in the agricultural industry. In this respect it should be noted that goods or equipment such as tractors, engines, tanks, &c., cannot be regarded as being exempt goods unless the condition for exemption in each case is fulfilled, viz., that they are for use in the agricultural industry, such as for, say, drawing ploughs, working pumps to raise water for irrigation purposes, or containing water for watering livestock, respectively.

8. When an agriculturist purchases goods which may be conditionally exempt if used by him for the specific purposes mentioned in the schedule of exemptions, he is entitled to obtain such goods or equipment free of sales tax, provided he furnishes a certificate to the vendor in the following terms:—

''*Sales Tax Exemptions Act*, 1935-1939.''

To the Commissioner of Taxation and the
Commonwealth of Australia.

I hereby certify that the (engine) purchased by me from (John Smith and Co.) on is for use exclusively in (state the exempt purpose, *e.g.*, pumping water for irrigation purposes) .

(Signature).''

9. Notwithstanding the production of certificates given by purchasers that goods or equipment are to be used for an exempt purpose, responsibility is placed upon vendors to ensure that the goods or equipment in question can be used for the exempt purposes stated, and that they are covered by the Department's interpretation of the terms of the particular exemption. Persons engaged in the agricultural industry can greatly assist vendors, the Department, and themselves by observing the procedure abovementioned. In any case of doubt, advice should be sought from the Deputy Federal Commissioner of Taxation, Commonwealth Government Offices, Adelaide street, Brisbane.

10. The giving of fraudulent certificates by a person in order to obtain exemptions to which he is not entitled is an offence under section 29 (*b*) of the *Crimes Act*, 1914-1928, the penalty for which is imprisonment for two years.

Judging a Dairy Heifer.

When selecting a dairy heifer, the form and general character will, to a large extent, indicate whether she will develop into a good producer. When a heifer is quite young, the trained eye of the judge can see its dairy value and can discern the dairy type as distinct from the beef type. The production records of her ancestral dams on both sides are important factors in determining her future dairy value, while constitution also is important. The form of the heifer with a future as a profitable producer is, in miniature, that of a good type, fully-developed dairy cow.

Something New in Butter Churns.

The largest churn in the United States has just been installed in a butter factory in California. It was made from two sand-cast aluminium shells which, together, weigh 1,500 lb. In tests, this unit has churned 660 gallons of cream into 2,580 lb. of butter in from thirty to forty-five minutes. Because of the cubical design, the churn is said to be capable of churning butter in half the time necessary for the conventional roll-type churn. Aluminium was used in the construction of this churn in order to obtain the advantages of the lightness of the metal and its non-contaminating properties.

Infra-red Rays and Seed Germination.

Infra-red ray tests by science workers in New York State (U.S.A.) indicated a very noticeable stimulation as well as an increase in seed germination. In these tests, seeds were subjected to infra-red rays. The lamp used is attached to any 110-volt electric circuit, and is moved slowly and carefully at a set distance above the surface of the seeds. Ten seconds has been found to be the most effective time for keeping the lamp in any one position. The success of these tests indicate possibilities for improving market garden production by ensuring better germination.

A New Milk Process.

"De-aired" milk is the latest development in America. It is claimed that this new process improves the flavour and nutrition of the milk, and makes a more concentrated food.

Possibly with "de-aired" and "de-watered" milk we would have just "condensed" milk in another form. Anyhow, new ideas are always welcome.

Rough on Rats.

Because of the serious depredations on food stocks by rats, the British Government has declared another war—a war on rats and other vermin. Periodical "rat weeks" are to be held during which every farmer is asked to make a special effort to destroy any rats on his own land and premises, and to do everything necessary towards obtaining concerted action in these regular rat drives.

Meat Meal for Cows.

Now that Queensland dairy farmers are out to improve every branch of dairy practice, they will be interested in an experiment with meat meal, which was conducted recently at the Victorian State Research farm at Werribee, near Melbourne. The experiment was designed to find out the value of meat meal as a supplementary source of protein for milking cows on pasture. As a result of the experiment, the fat content of the milk of the cows fed on meat meal increased substantially, and the meal did not impart any taint to the milk.

Revival in Horse Breeding—War Influences.

Horse breeders in Great Britain, as well as in Australia, see a distinct gleam of hopefulness for their industry.

Apart from military purposes, both light and heavy horses are wanted for riding, transport and farm work.

For some time before the outbreak of war, trade for horses in the United Kingdom had lapsed considerably. The ploughing-up of grassland, with its accompanying subsidy of £2 an acre, has raised hopes for a better demand for good draught animals, although it is recognised that for the increased cultivation scheme, tractors will continue in extensive use. But against that is the increased demand for tractors for other purposes apart from farm work.

At a recent four-days sale of Clydesdales in Scotland, every class was cleared at a very much higher average than at the corresponding sale last year. Recent sales in England also have disclosed a distinct strengthening of trade, and, altogether, a strong revival in horsebreeding is evident.

Farm Notes

APRIL.

SUMMER fallowed wheat lands should now be in good condition, and may be maintained in good tilth by a light surface working after all rainfalls of over half an inch.

Seed wheat may be prepared and held in readiness for immediate sowing by grading and treating with an approved bunticidal dust for the prevention of smut. Copper carbonate, or the mercury dusts agrosan and ceresan, will be found effective for this purpose, using from 1 to 2 oz. to a bushel, according to the efficiency of the mixing apparatus employed.

Seed barley and oats should be treated with a mercury dust, or with formalin in preference to copper carbonate.

The main sowings of winter cereals and legumes required for winter and spring feed may be made during the month; and growers are advised to include field peas or tares at the rate of 20 lb. seed per acre, thereby increasing the nutritive value of the fodder obtained. Algerian oats predominate in present sowings, but the barleys, Cape and Skinless, in addition to the slower maturing varieties of wheat are also of value.

April and May are good months for the sowing of lucerne. The area under this valuable crop should be extended whenever and wherever possible. By sowing when weed growth is at a minimum, the young plants have a better chance to become strongly established, and there is less likelihood of the surface soil drying out and affecting germination, than if early summer sowings are made.

From 10 to 12 lb. of seed to the acre is ample on the best lucerne lands, but where sown largely for grazing purposes in the drier districts 3 to 4 lb. to the acre should be sufficient.

Root crops sown during March will be making fair growth, and should be thinned out to permit of full development. Further sowings of mangolds, swede turnips, sugar beet, field carrots, kohl rabi, and rape may be made where soil moisture is sufficient.

Information on fumigation of maize with carbon bisulphide may be obtained from the Department of Agriculture and Stock, Brisbane.

Sorghums, together with other summer fodder crops, which are approaching maturity, and are not required for green fodder, should be conserved as silage wherever possible.

Pumpkins required for storage should be allowed to ripen in the field, gathering with the short stalk attached, and storing in a dry airy shed, preferably on slatted shelves to permit of rapid inspection for possible decay.

Winter grasses and clovers may be sown during April in districts suitable for their growth, but sowings must be made on thoroughly prepared cultivation.

ONE WAY OF GETTING THE PLOUGHING DONE.

Here is a good story, suggested by the intense cultivation campaign in the Old Country—

The farmer's wife to the farmer—"Bill, isn't it time to get the early ploughing done?"

And the farmer's reply—"Don't need to, Mary. When all these machinery agents get through demonstrating their new tractors they'll have everything ploughed up except the concrete cow-bails."

Orchard Notes

APRIL.

FOR overseas or interstate markets only the best fruit should be selected, and it should be graded for size, colour, and quality, and properly packed, only one grade of fruit being packed in a case.

All orchards, vineyards, and plantations not thoroughly clean should receive early attention, for from now until the next rainy season the ground must be kept in a thorough state of tilth and free from weeds in order, firstly, to retain moisture in the soil; and, secondly, to enable birds, ants, and predacious insects to get at and destroy the pupæ of fruit flies and other pests harbouring in the soil.

Banana and pineapple plantations should be put into good order, and kept free from weed growth.

Land to be planted with fruit trees should be prepared now. It is always advisable to allow newly cleared land time to sweeten before planting.

QUEENSLAND SHOW DATES FOR 1940.

The Queensland Chamber of Agricultural Societies has issued the following list of show dates for 1940:—

APRIL.

Pittsworth	2nd and 3rd
Millmerran	5th
Toowoomba	15th to 18th
Dalby	22nd and 23rd
Chinchilla	26th and 27th
Kingaroy	30th April and 1st and 2nd May
Tara	30th April and 1st May

MAY.

Miles	1st
Monto	1st and 2nd
Yarraman	3rd, 4th, and 6th
Millmerran Rodeo	6th
Longreach	6th to 8th
Mundubbera	8th and 9th
Beaudesert Show	8th and 9th
Beaudesert Campdraft	10th and 11th
Nanango	9th to 11th
Blackall	13th and 14th
Roma	14th to 16th
Gayndah	15th and 16th
Mitchell	15th and 16th
Murgon	16th to 18th
Warrill View	18th
Ipswich	21st to 24th
Goomeri	23rd and 24th
Biggenden	23rd and 24th
Baralaba	23rd and 24th
Baralaba Rodeo	25th
Kalbar	25th
Gympie	30th and 31st and 1st June
Lowood	31st May and 1st June

JUNE.

Wowan	6th and 7th
Maryborough	6th to 8th
Blackbutt	7th and 8th
Childers	10th and 11th
Boonah	12th and 13th
Bundaberg	13th to 15th
Gin Gin	17th and 18th
Gladstone	19th and 20th
Kilcoy	21st and 22nd
Rockhampton	25th to 29th
Toogoolawah	28th and 29th

JULY.

Mackay	1st to 4th
Esk Show and Campdraft	5th and 6th
Proserpine	5th and 6th
Bowen	10th and 11th
Ayr	12th and 13th
Rosewood	12th and 13th
Cleveland	12th and 13th
Townsville	16th to 18th
Maleny	18th and 19th
Charters Towers	23rd to 25th
Gatton	23rd to 25th
Innisfail	25th, 26th, and 27th

AUGUST.

Home Hill	2nd and 3rd
Pine Rivers	2nd and 3rd
Atherton	6th and 7th
Caboolture	8th and 9th
Royal National, Brisbane	12th to 17th

SEPTEMBER.

Imbil	6th and 7th
Rocklea	14th
Ithaca	28th

OCTOBER.

Warwick Rodeo	5th and 7th

Maternal and Child Welfare.

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

MEAN WHAT YOU SAY.

IT is most important that parents should mean what they say in dealing with their children, and that the children should know this. It is worse than useless to allow a child to do something one day and punish him for doing the very same thing next day. How is he to know what to expect? Last week mother did not allow him to play out on the street, but one day the week before she did. Naturally, being a clever, reasonable child, he thinks he will risk it again. Mother may not punish him.

Bribes and threats are wrong means of teaching a child to obey. If you tell a child that you will give him something nice if he does what you ask you are bribing him, and before long you will find he will do nothing unless he gets something out of it.

Very few of the parents who threaten their children mean what they say. A mother may say to her naughty child: "I will ask the policeman to come and take you to gaol." She knows it is not true. At first her threat frightens the child; then he learns that it is not true, and before long he takes no notice. Threats may turn him into a coward; every mother who wants her child to be brave should avoid them. On the other hand, if the threats are never carried out the child may grow indifferent. It is best never to threaten.

Children do not obey people whom they cannot trust, and parents who break promises to their children cannot expect to be trusted or obeyed by their children.

Speak Quietly.

Here is another point. When your child is not obedient do you become angry and raise your voice? That excites the child, and some children like such excitement very much. They will even do things they know are naughty just for the sake of seeing mother lose her temper. If parents can manage not to get angry they will find it much easier to teach their children to be obedient. Loud talking is a strain to listen to, and is bad both for children and for grown-ups. It makes the home noisy; noise makes everyone in the home nervous and irritable. Parents who always speak quietly find that their children will listen to them more willingly.

Be Reasonable.

A toddler's doings, which seem so trivial to many grown-ups, are really very important indeed to him; and the things that grown-ups think so very important mean nothing at all to him. He does not think, for example, it is important to give up his play and come to dinner as soon as he is called.

It is a good plan to allow the child a few minutes to finish what he is doing before you expect him to obey a command. Let him have five minutes' grace before mealtime and before bedtime, for instance. There are some things little children really cannot do, and yet they are often asked to do them—for instance, to sit still for a long time, to keep from making a noise for a long time. It is not fair to expect little children to do these things, which adults can, of course, do quite easily. The child's muscles are too busy growing to allow him to sit still for a long time. They need constant exercise—by wriggling and other means which sometimes annoy tired mothers—in order to grow. Only an adult, whose muscles have reached their final stage of growth, can discipline his muscles so that he can sit still for a long time. And making a noise is a part of the business of growing. The toddler's chattering and shouting are just as important to healthy growth as is the lusty crying of the healthy infant.

It is not really hard to teach a child to obey the first time you speak if you always speak quietly, never angrily; if you let the child find by experience that everything is pleasant when he takes notice quickly but not so pleasant if he does not obey. When the little child is good and obedient it is right for mother to show that she is pleased to allow some little treat.

Teach Children to Think for Themselves.

If people are to be happy when they grow up they must have learned to obey certain rules when they were children; but they must have learned to think for themselves. Children must be taught to think for themselves what is right for them to do. There are children who never do anything by themselves. They never think for themselves. They have to wait until someone tells them what to do. When they grow up they are very unhappy because they cannot be independent.

Let us teach our children to think for themselves, encourage them when they plan to do things without help, when they attempt to fasten their own shoes, to put on their own socks, to do up their buttons, to wash their faces. They may seem to be getting on very slowly. It takes time to let them make the effort to help themselves, but try to be patient while they accomplish what they are trying to do. Praise them for trying to help themselves. It will be all the better for them if they learn to be independent, and in the long run all the better for mother.

IN THE FARM KITCHEN.

BOTTLING THE GARDEN.

Here are some well-known jams made from improved recipes, and also some new recipes well worth trying.

Green Tomato Jam.

Take 7 lb. green tomatoes, 6 lb. loaf sugar, 6 lemons, 6 oz. glace ginger.

Scald the tomatoes, a few at a time, and peel. Wash and dry lemons and grate off rinds, then halve and extract the juice. Place tomatoes and lemon rind and juice in a preserving pan. Add sugar. Stir over a slow heat until sugar is dissolved, then bring to the boil. Add chopped ginger. Boil until jam jells when tested on a cold plate. Pot and seal.

Loveapple Jam.

Take 2 lb. tomatoes, 2 lemons, 2 lb. sugar, 4 oz. glace ginger.

Scald, peel, and slice tomatoes. Cover with sugar, Stand overnight. Drain syrup into a preserving pan. Bring to boil. Boil until clear and quite thick. Skim. Add chopped ginger, grated lemon rind, and strained juice of lemon. Simmer until fruit is clear.

Beetroot Marmalade.

Take 4 lb. beetroot, 3 lemons, 3 oz. glace ginger, cold water, 3 lb. granulated sugar, 4 oz. almonds, pinch of salt.

Choose young beets. Wash carefully, and remove skins. Put through a mincer. Place in a preserving pan. Cover with cold water. Bring to boil. Simmer until tender. Add sugar, salt, chopped ginger, and the grated rinds and strained juice of the lemons. Bring to simmering point and simmer until clear and thick—about an hour. When nearly ready, blanch and put almonds through mincer and add. Pot and seal up securely.

Rhubarb Jam.

Take 3 cupfuls sliced rhubarb, 3 oranges, ½ lb. blanched almonds, 3 cupfuls granulated sugar, 1 lemon.

Place the rhubarb, sugar, grated lemon rind, and strained juice of the oranges and lemon in a preserving pan. Bring to the boil. Simmer for half an hour. Chop and add almonds. Simmer for five minutes longer.

Quince Jelly.

Take 3 lb. quinces, 6 cupfuls water, 3 lb. tart apples, sugar.

Choose quinces that are not quite ripe. Rub off down with a rough cloth. Core and chop quinces and place in a preserving pan. Add water. Wipe and quarter apples and throw into pan. Bring to boil, and stew gently till soft, but do not mash the fruit. Pour into a jelly bag and allow to drip into a basin underneath. Measure liquid, and to each pint allow 1 lb. sugar. Add sugar. Stir till dissolved, then bring to the boil and boil very slowly until the jelly stage is reached. Pot and seal when cold.

Apricot Butter.

Take ½ lb. dried apricots, ¼ lb. butter, 1 lemon, 4 eggs, 1¼ lb. sugar, cold water.

Wash, halve, and quarter apricots. Place in a saucepan and barely cover with cold water. Stew very slowly till tender, then rub fruit and any remaining liquid through a fine sieve. Cool the puree. Place in the top of a double saucepan. Add sugar, butter, well-beaten eggs, and grated rind and strained juice of lemon. Stir constantly over boiling water till creamy. Pot and seal. Use in place of jam with bread or as a filling for layer cakes or tartlets.

Amber Marmalade.

Take 1 pineapple, 1 lemon, sugar, 1 grapefruit.

Pare and shred the pineapple. Wash and dry the grapefruit and lemon, then slice thinly. Measure the fruit and cover with water, allowing three pints of water to one pint of fruit. Stand covered with a cloth till next day. Boil three or more hours till the rind is tender. Set aside again till next day. Measure and add an equal amount of sugar. Boil till the jelly stage is reached. Then pot and seal.

RAINFALL IN THE AGRICULTURAL DISTRICTS.

TABLE SHOWING THE AVERAGE RAINFALL FOR THE MONTH OF JANUARY IN THE AGRICULTURAL DISTRICTS, TOGETHER WITH TOTAL RAINFALL DURING 1940 AND 1939, FOR COMPARISON.

Divisions and Stations.	Average Rainfall.		Total Rainfall.	
	Jan.	No. of years' re-cords.	Jan., 1940.	Jan., 1939.
North Coast.	In.		In.	In.
Atherton	11·78	39	7·15	10·92
Cairns	16·72	58	13·19	26·25
Cardwell	17·07	68	10·45	19·94
Cooktown ..	14·34	64	22·24	14·27
Herberton ..	9·46	54	7·10	5·85
Ingham	15·81	48	16·29	8·80
Innisfail	20·30	59	25·42	26·32
Mossman Mill ..	18·11	27	27·07	24·98
Townsville ..	11·06	23	8·09	3·94
Central Coast.				
Ayr	11·08	53	4·23	2·88
Bowen	9·65	69	2·91	1·24
Charters Towers ..	5·35	58	4·68	2·01
Mackay P.O. ..	13·65	69	10·48	4·04
Mackay Sugar Experiment Station	13·37	43	10·17	5·07
Proserpine ..	15·04	37	15·56	6·09
St. Lawrence ..	9·06	69	2·67	5·39
South Coast.				
Biggenden ..	5·25	41	1·85	9·94
Bundaberg ..	8·57	57	2·36	8·97
Brisbane	6·34	88	7·47	1·93
Caboolture ..	7·47	53	4·78	4·20
Childers	7·26	45	1·01	6·55
Crohamhurst ..	12·04	47	6·88	4·24
Esk	5·65	53	4·79	3·01

Divisions and Stations.	Average Rainfall.		Total Rainfall.	
	Jan.	No. of years' re-cords.	Jan., 1940.	Jan., 1939.
South Coast—contd.	In.		In.	In.
Gatton College ..	4·30	41	3·69	6·56
Gayndah	4·58	69	5·84	5·13
Gympie	6·56	70	4·48	4·88
Kilkivan	5·45	61	3·00	6·72
Maryborough ..	7·06	69	2·90	8·73
Nambour	9·54	44	4·83	4·04
Nanango	4·61	58	4·45	4·35
Rockhampton ..	7·49	69	3.15	4·75
Woodford ..	7·67	53	9·61	2·75
Central Highlands.				
Clermont ..	5·05	69	0·51	4·96
Gindie	3·73	41	..	8·33
Springsure ..	4·20	71	0·91	6·82
Darling Downs.				
Dalby	3·39	70	5·28	7·97
Emu Vale ..	3·20	44	2·53	2·81
Hermitage ..	..	..	..	..
Jimbour	3·58	52	1·48	8·96
Miles	3·68	55	1·83	6·90
Stanthorpe ..	3·64	67	3·07	4·23
Toowoomba ..	5·08	68	5·72	6·78
Warwick	3·56	75	3·28	3·51
Maranoa.				
Bungeworgorai ..	2·17	26	..	6·12
Roma	3·11	66	0·80	5·19

A. S. RICHARDS, Divisional Meteorologist.

CLIMATOLOGICAL TABLE—JANUARY, 1940.

COMPILED FROM TELEGRAPHIC REPORTS.

Districts and Stations.	Mean Atmospheric Pressure, at 9 a.m.	Shade Temperature.						Rainfall.	
		Means.		Extremes.				Total.	Wet Days.
		Max.	Min.	Max.	Date.	Min.	Date.		
Coastal.	In.	Deg.	Deg.	Deg.		Deg.		Points.	
Cooktown	29·76	88	76	95	21, 29	73	11, 12	2,224	13
Herberton	..	81	64	94	26	56	16, 28	710	20
Rockhampton	29·82	94	73	107	26	65	3	315	13
Brisbane	29·86	88	71	110	26	65	3	747	9
Darling Downs.									
Dalby	29·84	94	67	108	26	57	24	528	8
Stanthorpe	..	88	61	104	26	48	23, 24	307	6
Toowoomba	..	88	64	103	26	54	2, 23, 24	572	12
Mid-Interior.									
Georgetown	29·79	90	72	98	25, 26	67	14	766	13
Longreach	29·77	103	76	117	26	65	9	205	8
Mitchell	29·79	100	72	113	26	55	24	133	6
Western.									
Burketown	29·76	89	77	99	22, 23	72	8, 11	1,021	17
Boulia	29·70	101	79	113	20, 25	72	8, 9	114	4
Thargomindah ..	29·74	104	77	117	25	60	23	2	1

ASTRONOMICAL DATA FOR QUEENSLAND.

TIMES COMPUTED BY A. C. EGLINTON.

TIMES OF SUNRISE, SUNSET, AND MOONRISE.

AT WARWICK.

	March, 1940.		April. 1940.		MOONRISE. March, 1940.	MOONRISE. April. 1940.
	Rises.	Sets.	Rises.	Sets.	Rises.	Rises.
					p.m.	a.m.
1	5·46	6·24	6·2	5·50	11·36	12·9
2	5·46	6·23	6·3	5·49	a.m.	1·3
3	5·47	6·22	6·3	5·48	12·29	1·54
4	5·47	6·21	6·4	5·47	1·22	2·42
5	5·48	6·20	6·4	5·46	2·15	3·34
6	5·48	6·19	6·5	5·45	3·8	4·27
7	5·49	6·18	6·5	5·43	3·58	5·14
8	5·49	6·17	6·6	5·42	4·49	6·9
9	5·50	6·16	6·7	5·41	5·41	7·2
10	5·51	6·15	6·7	5·40	6·38	7·53
11	5·51	6·13	6·8	5·39	7·19	8·46
12	5·52	6·12	6·8	5·38	8·11	9·40
13	5·53	6·11	6·9	5·37	9·6	10·33
14	5·53	6·10	6·9	5·36	9·57	11·24
						p.m.
15	5·54	6·8	6·10	5·35	10·53	12·17
16	5·54	6·7	6·10	5·34	11·44	1·3
					p.m.	
17	5·55	6·6	6·11	5·33	12·39	1·50
18	5·55	6·5	6.11	5·32	1·30	2·34
19	5·56	6·4	6·12	5·31	2·21	3·17
20	5·56	6·3	6·12	5·30	3·8	4·3
21	5·57	6·2	6·13	5·29	3·56	4·49
22	5·57	6·1	6·13	5·28	4·44	5·34
23	5·58	6·0	6·14	5·27	5·31	6·23
24	5·58	5·59	6·14	5·26	6·15	7·15
25	5·59	5·58	6·15	5·25	7·1	8·9
26	5·59	5·57	6·15	5·24	7·48	9·4
27	6·0	5·56	6·16	5·24	8·37	10·0
28	6·0	5·55	6·16	5·23	9·29	10·54
29	6·0	5·54	6·17	5·22	10·22	11·49
30	6·1	5·53	6·17	5·21	11·15	..
31	6·1	5·52	..	..	..	..

Phases of the Moon, Occultations, &c.

1st Mar.	☾ Last Quarter	12	35 p.m.
9th „	● New Moon	12	23 p.m.
17th „	☽ First Quarter	1	25 p.m.
24th „	○ Full Moon	5	33 a.m.

Apogee, 9th March, at 3.0 p.m.
Perigee, 23rd March, at 10 p.m.

On the 14th the invisible Neptune will be in opposition to the Sun, rising as the Sun sets. The first to see the planet was Dr. Galle, of Berlin, in 1846, marvellously near the position calculated by Leverrier in France. Since the far-distant body takes 164.8 days to complete one revolution around the Sun, it has only accomplished somewhat more than half of its aerial journey through six of the twelve zodiacal constellations, which vary in width. It has now crossed the border from Leo into Virgo.

On the 16th Mars will be only about 1 deg. north of Uranus. Since it takes eighty-four years for Uranus to complete one revolution, it has been nearly twice around the Zodiac since its discovery, in the constellation Gemini, by Sir W. Herschel, in March, 1782. It is now in Aries, very near the border of Taurus.

Precisely at 4 o'clock in the morning of 20th March the Sun will cross the celestial equator from south to north, and our Autumnal Equinox, with a welcome change in temperature, will arrive. Day and night are of equal length, according to Sun-dial time, on that day, and as the Sun rises due east and sets due west, it would be useful to note those points along the horizon.

Mercury rises at 7.7 a.m., 1 hr. 21 min. after the Sun, and sets at 7.9 p.m., 45 min. after it, on the 1st; on the 15th it rises at 6.52 a.m., 58 min. after the Sun, and sets at 6.50 p.m., 42 min. after it.

Venus rises at 8.51 a.m., 3 hrs. 5 min. after the Sun, and sets at 8.19 p.m., 1 hr. 55 min. after it, on the 1st; on the 15th it rises at 9.10 a.m., 3 hrs. 16 min. after the Sun, and sets at 8.10 p.m., 2 hrs. 2 min. after it.

Mars rises at 10.15 a.m., and sets at 9.11 p.m. on the 1st; on the 15th it rises at 10.2 a.m., and sets at 8.46 p.m.

Jupiter rises at 8.10 a.m., and sets at 8.0 p.m. on the 1st; on the 15th it rises at 7.28 a.m., and sets at 7.12 p.m.

Saturn rises at 9.21 a.m., and sets at 8.49 p.m. on the 1st; on the 15th it rises at 8.31 a.m., and sets at 7.57 p.m.

8th April	○ Full Moon	6	18 a.m.
15th „	● New Moon	11	46 p.m.
22nd „	☽ First Quarter	2	37 p.m.
29th „	☾ Last Quarter	5	49 p.m.

Apogee, 5th April, at 7.0 p.m.
Perigee, 21st April, at 5.0 a.m.

For places west of Warwick and nearly in the same latitude, 28 degrees 12 minutes S., add 4 minutes for each degree of longitude. For example, at Inglewood, add 4 minutes to the times given above for Warwick; at Goondiwindi, add 8 minutes; at St. George, 14 minutes; at Cunnamulla, 25 minutes; at Thargomindah, 33 minutes; and at Oontoo, 43 minutes.

The moonlight nights for each month can best be ascertained by noticing the dates when the moon will be in the first quarter and when full. In the latter case the moon will rise somewhat about the time the sun sets, and the moonlight then extends all through the night; when at the first quarter the moon rises somewhat about six hours before the sun sets, and it is moonlight only till about midnight. After full moon it will be later each evening before it rises, and when in the last quarter it will not generally rise till after midnight.

It must be remembered that the times referred to are only roughly approximate, as the relative positions of the sun and moon vary considerably.