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 MAY, 1940 Part 5

Event and Comment.

Anzac.

ANZAC Day this year was commemorated throughout Australia with greater solemnity than on any previous occasion since "cease fire" sounded in 1918. To-day, young men—many of them the sons of old Diggers, including Gallipoli veterans—are going forth with magnificent courage and self-sacrifice to face an enemy who has blown to bits all the dreams of a better world, the hoped-for outcome of the last "war to end war." So Anzacs are again in Egypt and Palestine to continue the conflict against ruthless aggression which it was thought had ended with the armistice, an armistice which, as events have proved, lasted until September, 1939, when, again, the "lights went out all over Europe." There is no half-way house in a fight against the forces of evil, and we have come to one of those times in history when compromise is useless. To the new Digger, then, the old Digger has handed the torch in the knowledge that modern warfare is no gay adventure, yet with unfaltering faith in ultimate victory for the cause of human freedom, a cause which inspired the Anzac tradition than which the new A.I.F. could have no nobler heritage.

The Realities of War.

IN the course of a recent address, the Premier, Hon. W. Forgan Smith, LL.D., said that from the viewpoint of our citizenship, we are just as much concerned individually as the people who live in the British Isles or in any other part of the British Commonwealth of Nations. We

are all concerned in the war and we must all give our support in order to be victorious. We must free the world from aggression or from the danger of aggression. We must prize justice and reason and have those principles enthroned, rather than that of force. Reason and justice prevail and can live always. There is nothing permanent about force. What is won by force to-day can be taken by a superior force tomorrow, and only those things live and become part of the national character which are brought about by the common consent of the minds and souls of the nation to which we belong.

He personally had no doubt of the result, but he did not underestimate the road we must travel before victory is ours. "We must win the war. We must conquer Germany, otherwise Germany will conquer us, and we will be forced to live under a form of social order other than the one we know and love so well," continued the Premier. "We must not only win the war, but we must win the peace so that the children who are growing up to-day and their children, and their children's children, shall not be torn with the grief, the suffering, and the sorrow of this generation. All of these things must come to pass. They will come to pass if we are strong enough, and if we work hard enough to achieve them. Nothing in life is worth while that is not obtained by honest effort. All wealth is the result of the application of human effort intelligently applied to the resources that Divine Providence has bestowed upon us. That is the basis of all wealth.

"There are some patent medicine vendors in the community to-day who think they have a substitute for work. There is no such substitute, and I personally have never looked for one. I do not regard work as being the curse of Adam. Work is God's greatest gift to mankind. Society can be so organised that men and women will have happiness and enjoyment in their work and shall be protected in the enjoyment of the fruits of their industry so that they shall grow bearing those blossoms of grand characters that delight the hearts of God and man. All those things can be brought about. The best of men and women have always worked towards those ends.

"We require idealism, harnessed to strong resolution. Idealism shines like the star in the heavens by which the mariners set their course. So, therefore, let us all have our ideals. Ideals of themselves, however, are valueless unless they are accompanied by strong resolve.

"You must have the resolution to work and struggle towards the objectives you seek to obtain. I repeat, there is no substitute for work. Very comfortable, if all those things could be written on a piece of paper or be done by a prescription. It might be all right for a while, but my experience in life, and I have no doubt the experience of all, is that everything must be paid for. Sometimes you pay for it in money; sometimes you pay for it in blood and tears; but whatever the price may be, you pay somewhere, somehow, some day.

"It is a great privilege to be connected with the Government of a State," the Premier added. "It is a splendid thing to be associated with others in the development of almost virgin lands. Developing a country, seeing farms, industries, and buildings growing up, population expanding and growing during your own lifetime, is a wonderful privilege and a tremendously great and grave responsibility."

Queensland's Progress.

CONTINUING, the Premier said that Queensland is a State the value of which cannot be overstated. The white population is 1,020,000, and as the population increases we will likely overtake the population of New Zealand at no distant date.

The State of Queensland is expanding very rapidly. Those things are not happening by accident. They are happening because of long-range planning and the continued effort of the citizens of the State. A great majority of the people are highly intelligent. A very good basis to start on. They are also very industrious and have a habit of work very well developed. So with that intelligence and industry, we are bound to prosper.

Queensland's Rural Wealth.

QUEENSLAND'S primary industries in 1939-40 will be worth more to the State than ever before in its history. It is estimated that the four chief products—sugar, wool, butter, and meat—will have a combined value of £44,000,000, about £4,600,000 more than in 1938-39.

Distribution of this huge sum throughout the State has been the main factor in maintaining record prosperity. Aggregate cheques for the four main products compare as follows:—

	1938-39.	1939-40.
	£	£
Sugar	11,750,000 ..	13,800,000
Wool	8,000,000 ..	10,700,000
Butter	9,650,000 ..	9,000,000
Meat	10,000,000 ..	10,500,000
	£39,400,000	£44,000,000

The cheque to sugar interests sets a new record with an increase of £2,000,000. Sugar maintains its position as the State's most valuable product. This year wool has replaced butter in the size of cheques. Returns from wool will total about £10,700,000, an increase of £2,700,000.

The butter cheque may be from £9,000,000 to £9,500,000, depending on weather conditions in the next few weeks. At the lower estimate, this is a fall of £650,000 on last season's record distribution.

Reliable estimates for meat are not available, but the favourable conditions in this trade have been well maintained.

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

H. E. YOUNG, M.Sc.Agr., Assistant Research Officer.

(*Continued from p. 392, April, 1940.*)

(V.) A CARBOHYDRATE HYPOTHESIS FOR THE SIGNIFICANCE OF MYCORHIZAS AND THE CAUSE OF FUSED NEEDLE DISEASE.

Discussion of Physiological Basis.

IT was early considered by the author that the effect of litter dressings in promoting vigorous growth of *Pinus* and in this way causing a recovery from fused needle disease might possibly be due to the provision of carbohydrates by the fungus in a state assimilable by the higher plant. It has been known for a considerable time that, in the asymbiotic culture of orchids, a supply of carbohydrates in a form suitable to the plants must be made available in the substratum for satisfactory growth to take place (Knudson 1922, Wynd 1933). It was also made evident that orchids could grow in the absence of sunlight when supplied with the necessary sugars in the substratum. The nonchlorophyllous plants, cited previously, also obtain their carbohydrates from the mycorhizal systems of their roots.

Calletet (1911), Maquenne (1911), Molliard (1912), Polacci (1917-1920), Breazeale (1923), Banal (1926, *cf.* Miller, 1931), and Falck (1923, *cf.* Melin, 1925) have obtained evidence that plants are able to absorb and utilize carbon dioxide from the soil. Polacci grew plants in a carbon dioxide-free atmosphere, but with their roots in humus rich soil or in nutrient solutions containing carbon dioxide, and observed that plants of *Zea mays, Acer pseudoplatanus* and *Quercus æsculus* lived under these conditions and were able to store starch. It is noteworthy that all these plants have been observed to form mycorhizas. Falck in 1923 demonstrated by culture experiments with young pines that the plants could grow satisfactorily in carbon dioxide-free air when supplied with mycorhiza and raw humus. Plants free from mycorhiza or lacking organic substrates would not grow.

In 1889 Acton (*cf.* Miller, 1931) supplied various carbohydrates and glycerin to a number of plants growing in water cultures, including *Acer pseudolplatanus, Phaseolus vulgaris, Quercus robur,* and *Euphorbia hirsuta,* and found that glucose, saccharose, and glycerin were absorbed and utilized in the dark by these plants in the formation of starch, but that glycogen, dextrin, and soluble starch were not used. Similarly, Laurent in 1904 showed that corn, beans, and other plants could absorb glucose through their roots and use it. This was indicated by the formation of starch in their leaves. The same results were also obtained by Mazé and Perrier in 1904 for corn grown in water cultures.

Knudson (1916) investigated the influence of carbohydrates on plant growth by growing plants in an agar medium to which Pfeffer's nutrient solution and a sugar solution varying in concentration from 1 to 2 per cent. had been added. He measured the effect of the sugars by the dry weights of the treated plants, and found that corn was able to absorb glucose, fructose, saccharose, and maltose through its roots and

to utilize these substances. The relative beneficial effects were in the order quoted. Field peas, timothy, vetch, and radish were also benefited by the addition of sugar to the cultures.

Robbins in 1918 grew the moss plant *Ceratodon purpureus* on a sterile culture medium, and found that carbohydrates, in the form of lævulose, glucose, galactose, lactose, sucrose, and maltose, were absorbed and used, as was evidenced by starch formation in the plant in the dark. Mannite, glycerin, and starch, however, could not be used. With lævulose a greater amount of growth occurred in the dark than in the light; with glucose the reverse was the case.

Brannon (1923, *cf.* Miller, 1931) obtained evidence to show that different species of plants differ as to the kind of sugar they are able to use most efficiently. Lucerne grew best in glucose solutions, whilst timothy fared better with fructose. Radish used both equally well. It seems that all the plants experimented with can use glucose and sucrose to some extent, whilst galactose, mannose, and fructose have been shown to be toxic to some plants.

The evidence that green plants are able to absorb and use carbohydrates by means of their roots is based in many cases upon their behaviour in the dark. Albino plants, which occur as sports in numerous species, form excellent material, and Knudson and Lindstrom (1919) studied the effect of sugars on the duration and growth of albino corn plants. With sucrose present in the culture medium, the plants showed an appreciable gain in weight during a fifty-five day experiment, whilst those grown in a sugar-free solution showed a loss and died twenty-five days sooner.

The Significance of Carbohydrate Assimilation in Mycotrophy and its Application in Connexion with Fused Needle Disease.

From the results obtained by the workers mentioned above there appears to be good evidence that a green plant may absorb carbon compounds from the soil and thus supplement the supply obtained from the air. This being so, there appears to be no reason for not drawing the conclusion that the response of the trees to the litter application in the experiments at Beerwah is due to the reaction resulting from an increased carbohydrate supply made available.

Ludbrook (1937) and the author have both noted the more frequent appearance of starch in healthy trees than in trees suffering from fused needle disease. The author has also noted this comparative absence of starch in trees of poor growth on poor sites which come within the broader conception of fused needle. This fact can perhaps be correlated with the classification of mycotrophic plants into sugar plants and non-mycotrophic into starch plants, as was done by Stahl in 1900. Stahl found that mycotrophic plants were characterized by the relative absence of starch from the leaves, and non-mycotrophic ones by its presence. In the fused needle condition the absence of starch from the needles of diseased trees is thought to be due to the absence of the accessory carbohydrate supply which would be produced by healthy mycorhizas. In healthy plants, where both roots and foliage are working efficiently, enough carbohydrate would be elaborated to make its appearance in the leaves as the storage product starch; the phosphate supply, which is also essential for normal growth, would aid in the translocation of the carbohydrate and promote active fungal growth. It is considered that the

carbohydrate supplied by the mycorhiza is obtained from cellulose. Sugar is the first breakdown product of cellulose (Thaysen and Bunker, 1927), and the cellulose is present in the leaf litter. In this also may lie one of the factors making a supply of fresh litter necessary for healthy growth, as a continual supply of undecomposed cellulose would then be available.

The concept of the higher plant obtaining carbohydrate from its fungus symbiont is in direct contradiction to the unsupported but generally assumed theory that the mycorhizal fungi obtain carbohydrate from the tree roots as their share of the symbiotic relationship. The hymenomycetous fungi which form the mycorhizas are, however, quite capable of obtaining their own carbohydrate supply from the breakdown of organic matter. This is evidenced by their vigorous growth on raw organic substrata and is supported by the experimentally proved fact that one of the major functions of the fungi associated with orchid roots is to supply carbohydrate to the higher plant.

It must not be understood that it is here contended that the only significance of mycorhiza is carbohydrate transference. Inorganic salts and perhaps nitrogen compounds are probably also supplied to the plant, but it is thought that the carbohydrate factor is the limiting one in so far as fused needle disease is concerned. During the course of these experiments further evidence supporting this theory was obtained.

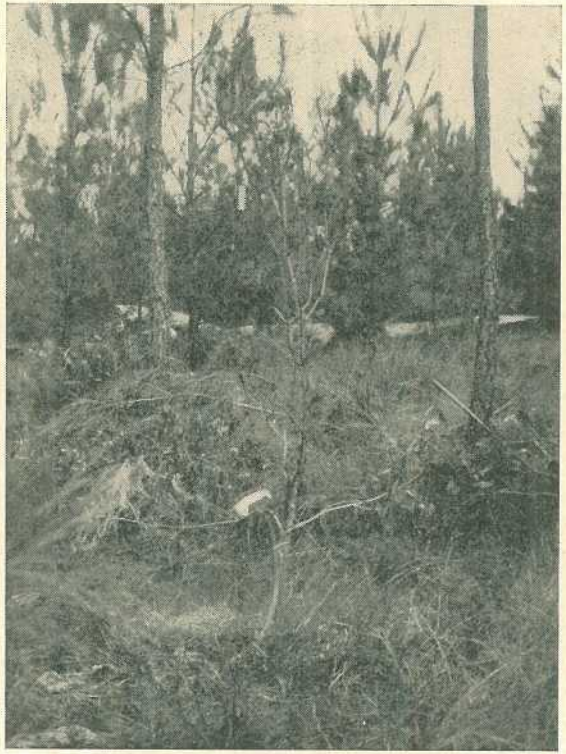
Experimental Evidence Bearing on the Carbohydrate Hypothesis.

(a) Carbohydrate Treatment Experiments.

In order to gain evidence concerning the carbohydrate deficiency theory, it was decided to conduct a series of experiments involving the injection of diseased pine trees with carbohydrates. The experiments were carried out during the 1937-38 growing season at Beerwah.

The method of injection used was by medium of the roots. A suitable severely affected fused needle tree was selected for each trial. The symptoms in all cases were those of the typical form of the disease. The trees were *Pinus caribæa* and *P. tæda* and varied from 5 to 7 feet in height and were not suffering from the effects of suppression by neighbouring trees. For injection purposes a root one-half to three-quarters of an inch in diameter at a distance of about 1 foot from the base of the tree was carefully dissected from the soil. The root was then cut so as to leave a stump approximately 1 foot long attached to the butt of the tree. A piece of rubber tubing about 3 feet long was then fitted over the end of the root stub and secured by twitching a piece of wire around the junction. A filter funnel was fitted into the free end of the tube and secured in an upright position to the trunk of the tree. The funnel was covered by a petri dish closely fitting over it. The petri dish was lined with paper so as to act as a shade from the sun. In all, twelve trees were thus fitted up in the plantation.

The carbohydrates used were lævulose, dextrose, saccharose, and mannite. It has been shown by Wynd (1933) that only dextro-rotary sugars are acceptable to orchid plants as a source of carbohydrate in pure culture experiment. On this account both dextro and lævo-rotary sugars were included in the treatments in this experiment, as well as mannite, which was used as an example of another organic carbon source which is found widely distributed in plant tissue.



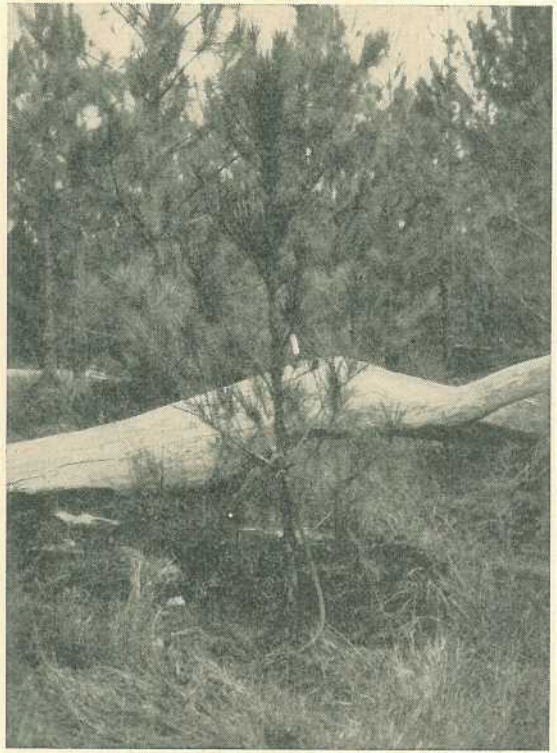


Plate 127.

THE EFFECT OF CARBOHYDRATE INJECTIONS ON FUSED NEEDLE AFFECTED *Pinus tæda*.—Left: Mannite injection with no effect. Right: Saccharose injection causing recovery.

The carbohydrates were used in the form of 2 per cent. solutions in distilled water. It was found that the glass funnels and rubber tubes used in the injection apparatus had to be attended to every other day. At the time of each refilling the tubes and funnels were rinsed in distilled water and fresh solution was added. On the average, each tree absorbed 100 cubic centimetres of 2 per cent. carbohydrate solution in each two-day period. At intervals the ends of the cut roots were trimmed back in order to expose a fresh absorbing surface so as to facilitate the uptake of the solutions. The treatments were carried out over a period of three months during which the trees were making active growth. The average amount of carbohydrate absorbed per tree during this period was eighty-four grammes. Photographic and written records of the condition of the trees used in the experiment were made at intervals until the end of the growing season, when the injections were stopped.

In the case of saccharose a definite response was obtained from all three of the injected trees (Plates 127 and 128). The new growth commenced earlier than in the case of the controls and was of the normal type and length. Previous to the treatment all the needles on the trees were badly twisted together and shortened and much resinosis and dieback of the leading shoots was present. The growth after treatment showed an absence of resinosis with a normal length of needle and no malformations. A less marked but observable response was made by the dextrose-treated trees. In this case the new needles were longer than the old ones; there was little fusion present, but some twisting. Resinosis ceased. The amount of growth during the period was good. No response was obtained from the lævulose and mannite treatments, all the trees involved in these two injection experiments continuing in a badly diseased state. No change was noted in the condition of the trees used as controls during the period of the experiment.

The failure of the trees to produce a reaction to the lævulose treatment is in agreement with Wynd's findings in the case of orchids where lævo-rotary sugars were found to be unavailable to the plant. In 1918 Robbins showed that mannite could not be used by the plants which he treated with that substance, and the present instance is comparable with this.

Twelve months after the commencement of the experiment the trees involved in the treatments were again examined and it was found that all of the trees were then in as bad a state as before the injections were carried out. This was particularly noticeable in the case of the saccharose-treated trees, which had made a marked recovery during the period of treatment. It would appear from this that the response obtained is one which requires the constant presence of the sugar rather than one which is due to a single stimulation.

A series of needle-fused plants were cultivated in sand in earthenware pots and were used for experimental purposes with carbohydrate. In this experiment the plants were watered twice each week with a 2 per cent. cane-sugar solution. The watering was continued over a period of two months. There was no response to this treatment on the part of the plants. Unsatisfactory soil conditions developed owing to the rapid fermentation of the sugar supplied, and it is probable that little of the sugar as such would find its way into the plants.

The result of the injection experiments provides a considerable amount of support for the carbohydrate-deficiency hypothesis for the

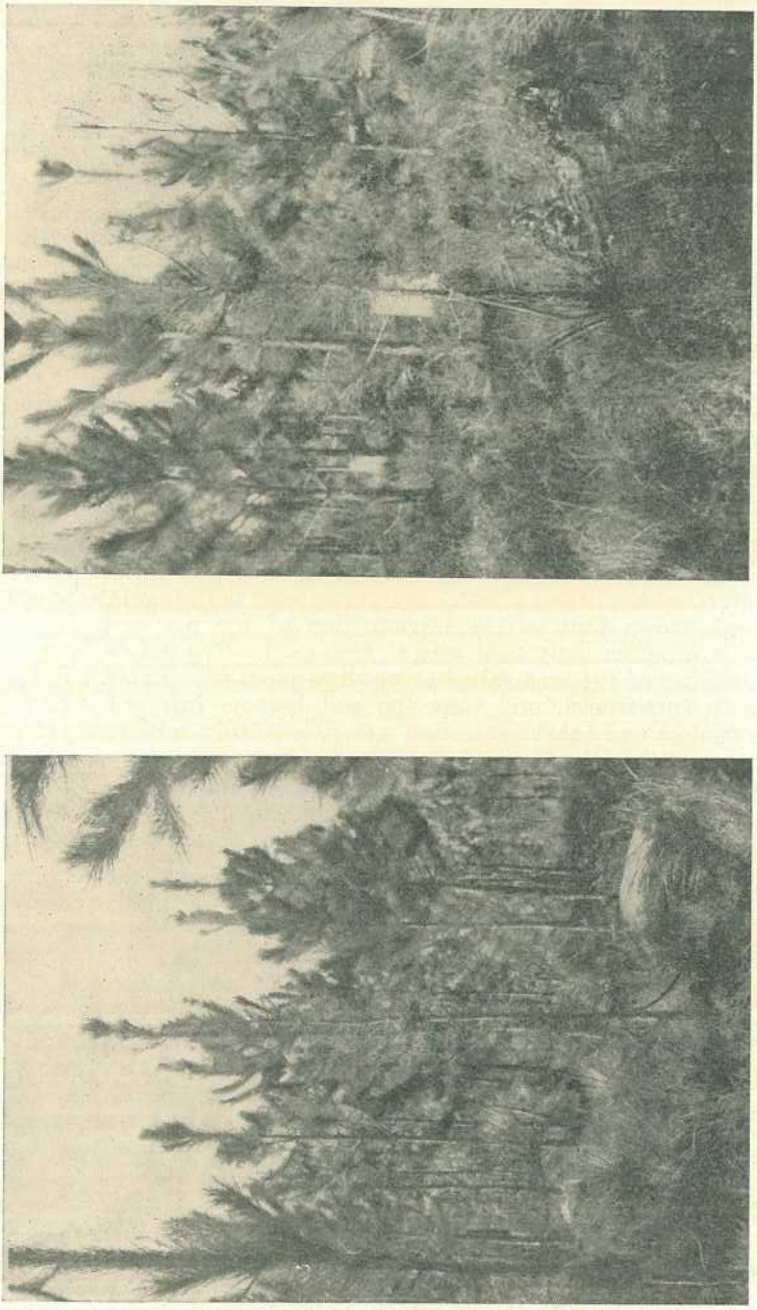


Plate 128.

THE EFFECT OF CARBOHYDRATE INJECTIONS ON FUSED NEEDLE AFFECTED *Pinus caribæa*.—Left: Lævulose injection with no effect. Right: Saccharose injection causing recovery.

primary cause of fused needle disease and also for the carbohydrate theory regarding the significance of the mycorhizal relationship in relation to the tree.

The negative results obtained by Ludbrook (1938) from sugar injections may be attributed to the technique employed. In these experiments all the solution used was introduced at the one time over a period of two days. It is thought such a substance as a sugar would have little effect under these circumstances, as the present experiments have shown that the response is one which only occurs during the period of treatment. Besides this, sugar is such a readily utilizable substance, and any excess supply, such as would be introduced by the bulk treatment method, would be speedily converted by the plant. The provision of a continuous supply of carbohydrate, even if small, over a long period would be the only method of testing such a deficiency, since by this means alone could it be ensured that the carbohydrate as such was being made available to the plant involved over any long time interval.

It has been shown by Constantin and Magrou, in connexion with carbohydrate storage, that tuber formation in potatoes and in certain other plants is a response to fungus infection. Potatoes grown from seed when of a wild strain do not produce tubers in the absence of infection by the mycorhizal symbiont of the potato, which is the fungus *Rhizoctonia solani* (Magrou, 1914, 1921, 1924; *cf.* Kelley, 1937). Many improved strains, however, have developed the habit of forming tubers under cultivated conditions without the presence of the fungal endophyte. It has been shown that on the introduction of the potato to Europe from South America, only seed was at first used. The plants resulting from the sowing of the seed failed to produce potatoes. Later, however, tubers were introduced, and thus the soil became infected with the requisite fungus and tuber formation was successfully achieved. It has also been found that the placing of potato or tomato stems in cane sugar is followed by the production of tubers on these stems.

From the work of Constantin and Magrou it appears that, in the potato and certain other tuberous perennial plants, the effect of mycorhizal development is the production of reserve carbohydrate which is stored in the tubers. Other workers have made similar observations, and it has been stated that tuber formation is, in a number of species investigated, a response to fungus infection. These facts support the carbohydrate hypothesis of the significance of mycorhiza.

The investigations being carried out in connexion with starch elimination in timber in order to reduce the susceptibility of the timber to *Lyctus* borer injury is additional evidence. The theory underlying these experiments is that by girdling the trees just below the first branch so that the main trunk has the food supplies which are obtained from the leaves interrupted, the deposition of starch in the trunk will be stopped. It was hoped that the starch reserves of the trunk would gradually become depleted by the using-up of the carbohydrate stores in the process of cell metabolism. The practically starch-free timber would then not be susceptible to borer attack. In actual practice, however, ringbarking experiments with the oak tree (*Quercus robur*) in England have shown that the starch content of ringbarked trunks has remained unexpectedly high (Parkin, 1938). It is significant here to note that Acton in 1889 demonstrated the absorption of sugar by the roots of *Quercus robur*. The supplementary starch supply to the trunks which is evident after ringing has probably originated in the mycorhizas

of the tree concerned, which is known to be mycotrophic. By this means it is seen that the carbohydrate would be supplied both by leaves and roots, and that on elimination of the leaf supply by ringbarking the roots would be able to provide sufficient for the needs of the trunk for some time. The system of double ringbarking as used by Parkin (1938) in his first experiment, where one girdle was cut at the base of the trunk and one at the top, should have no effect on the supply obtained from the roots, since the sugars would travel up through the xylem with the sapstream. Parkin's results so far support this contention.

(b) Pruning Experiment.

When the mycorhizal theory of the cause of fused needle disease was first postulated in 1934 it was thought that one of the means of investigating the supposed inefficiency of the root systems of diseased trees would be to remove by pruning a considerable portion of the crown and thus alter the root-crown balance. It was thought that by this means the insufficiency of any substance supplied either directly or indirectly by the roots would be offset by the removal of part of the crown, and that there would then be a tendency towards a restoration of balance which would be manifested by the subsequent healthy growth of the foliage.

In order that this aspect of the investigations might be examined, a block at Beerwah of thirteen rows containing a total of 150 five-year-old *Pinus tæda* trees planted in 1929 was marked out for pruning treatment. The trees averaged approximately 7 feet in height and showed a high proportion of fused needle disease and thin crown. They were growing on the site which carried the greatest amount of the disease in the plantation area. All the branches of the trees were pruned cleanly from the main stems up to the second whorl from the terminal bud. The effect of this treatment on the health of the trees is shown in Table XXX. The pruning was carried out on 21st June, 1934. A number of trees were left unpruned throughout the plot in order to provide a comparison.

TABLE XXX.

THE EFFECT OF PRUNING ON FUSED NEEDLE DISEASE.

Date.	Percentage of Pruned Trees Affected.	Percentage of Unpruned Trees Affected.
21–6–34	50·0	48·8
3–1–35	33·5	46·3
6–6–35	22·4	53·5
4–2–36	35·0	52·0
3–7–36	33·0	56·0
9–2–37	44·8	56·2

It will be noted that there was an immediate response to the pruning in that the percentage of needle fusion in the pruned trees immediately exhibited a decrease. This reduction in the number of trees affected continued for twelve months, after which there was again an upward trend towards the initial amount of infection. This upward trend synchronized with the regrowth of the crowns.

The experiment showed that there was a connexion between fused needle disease and root-crown balance. That is, it appeared that there was some factor connected with the root system which in fused needle

areas was supplied in insufficient quantities to satisfy adequately the normal crown needs, but which, on the occasion of radical crown reduction by pruning, was sufficient. On the recovery of the crown, however, this again became inadequate, due to the consequent tendency to the upset of the balance again.

If it is assumed as a result of the sugar injection experiments that a carbohydrate supply is deficient in fused needle areas, then the pruning is an additional argument in favour of the theory of carbohydrate intake by the roots, since a reduction in leaf area would immediately reduce the crown to such an extent that the supply from the deficient mycorhizal system would be sufficient for the plant's needs, even though part of the photosynthetic system was removed.

(c) The Effect of Different Species of Mycorhiza-forming Fungi.

In another series of experiments carried out at Beerwah (Young, 1940) it was shown that different mycorhiza-forming fungi have different effects on the growth of *Pinus caribœa*. Considering it possible that the disease might be due to the presence of an unsuitable fungus symbiont, experiments were designed to obtain some information on this matter. Large boxes were constructed at Beerwah and placed on a rack above the ground and filled with nursery soil. The boxes and soil were sterilized with formalin. After sterilization the containers were sown with sterilized seed of *Pinus caribœa*. Each container, except that reserved for a control, was inoculated with a pure culture of a different mycorhizal fungus. The cultures were prepared on sterilized unhusked oats, and the resulting inoculum introduced to the boxes in drills alongside the seed drills when the seed had germinated. The fungi used were: *Boletus granulatus, B. elegans, B. bovinus, B. scaber, B. viscidus, B. luteus,* and *Russula* sp. The control box was inoculated with mycorhizas obtained from beneath a healthy stand of *Pinus caribœa*. These mycorhizas contained *Boletus granulatus* and *Rhizopogon roseolus*. After germination the number of seedlings in each box was adjusted by removing the excess plants so that an even number remained in each box.

At the end of the first growing season ten months later, when the plants were dormant and ready for planting in the field, all the seedlings were measured for height and every tenth plant sampled and the mean dry weight for each treatment determined. The measurements showed that the different fungi had different effects on the seedling growth. *Boletus viscidus* gave the best growth and was significantly superior to *B. elegans, Russula* sp. and *B. granulatus*. The actual results obtained are shown in Table XXXI.

TABLE XXXI.

THE MEAN HEIGHTS AND WEIGHTS OF *Pinus caribœa* SEEDLINGS INOCULATED WITH DIFFERENT MYCORHIZAL FUNGI.

Species of Fungus.	Number of Seedlings.	Mean Height in Inches.	Standard Error.	Mean Weight in Grammes.
Boletus viscidus	202	15·23	0·17	14·63
Boletus scaber	213	14·99	0·17	12·95
Boletus luteus	202	14·84	0·16	11·21
Boletus bovinus	200	14·82	0·16	14·19
Boletus elegans	223	14·55	0·15	10·79
Russula sp.	228	13·51	0·14	9·78
Boletus granulatus	190	13·21	0·15	12·92
Control (*B. granulatus-Rhizopogon roseolus*)	194	13·07	0·15	9·31

The results obtained indicate that different fungi have a definite bearing on the capacity of the one soil to support the growth of *Pinus caribœa*. It is possible that the fungi which produced the best growth were better able to use the available nutrients than the others, and from this point of view would be more desirable symbionts for the pine trees under the conditions of a poor soil. This factor could be turned to practical advantage by inoculating nursery soils with the most desirable fungus. It is noteworthy that the naturally occurring mycorhizal complex on the pine trees at Beerwah gave the poorest results.

In culture on ordinary media *Boletus viscidus* has proved to be the most vigorous growing species of those enumerated, and this capacity for vigorous growth may be the reason for the superiority of this fungus.

This fungus also proved to be the best for biologically indicating phosphate deficiency in soils, as was described earlier.

(d) Summer Fluctuation in Percentage of Fused Needle Disease.

It has been previously noted that there is a fluctuation in the percentage of fused needle disease during any one summer. Under normal conditions the number of trees affected in any one area tends to decrease in the first half of the summer from that recorded during the previous dormant winter period. After midsummer, however, there is a return to the fused condition of the majority of the trees which had improved. Also in plantations in the actively susceptible stage there is a further increase in percentage infection, accounted for by the number of previously healthy trees which then become diseased. In the light of the organic matter hypothesis in connection with the disease it is considered that this fluctuation can be directly correlated with the raw organic matter supplies.

During the winter months there is a considerable amount of leaf-casting carried out by the indigenous vegetation in the pine plantations as well as by the pine trees themselves. Owing to the cooler and normally drier weather this dropped foliage accumulates to a much greater extent than during the period in the moister and hotter summer months when oxidation and decay go on more actively. In the latter portion of the summer there is less leaf fall and the winter accumulation of plant detritus becomes exhausted under open conditions such as exist in a young pine plantation where the soil surface is relatively unprotected from the sun. In this way there are more suitable conditions present for healthy mycorhizal development in the first half of the summer than in the latter half. This means that the pine trees will be better supplied with nutrients, inorganic and organic, during the first half of the growing season than in the second half, and this is reflected in the appearance of the trees as described above. The phosphorus contained in the litter will, of course, after liberation, be fixed in the soil, but the concentration of this element in the soil will be much less and therefore less effective than when it was combined in the relatively smaller amount of litter.

When the pine stand has reached the closed stage, however, there is a greater accumulation of litter due both to the protective action of shading and also to the greater quantity of plant detritus thrown down. This factor results in the gradual elimination of the fused needle condition, for, instead of an increase in the percentage of diseased trees during late summer, there is a tendency for the early summer decrease to continue until ultimately a healthy stand results.

The Relationship between Phosphate Status and the Carbohydrate Hypothesis.

The stimulation effected by phosphorus applications, which has previously been described, can be attributed to four possible reactions. In the first place phosphate treatment causes an increased growth of the natural vegetation and a consequent increase in the amount of litter supplied to the ground surface. The importance of this action is evident when the delayed response of the pine trees to phosphate additions is considered. It is thought that the delay is due to the time which must elapse before the natural vegetation, as a result of increased vigour due to the manuring, has grown to such a stage that it produces the increased litter supply which is thus built up on the ground. The pine trees then are able, by means of their mycorhizas, to avail themselves of this extra food supply, which contains the necessary carbohydrate and phosphatic substances. According to this hypothesis the action of the phosphorus is of an indirect nature. The truth of this view is supported by results obtained from pot experiments. In this case a number of plants of *Pinus tæda* and *P. caribæa* (twenty of each) were grown in humus deficient soils, and after a period of two years had developed the typical symptoms of malnutrition, including chlorosis, thin crown, and fused needle. A phosphatic fertilizer was applied to the plants in the form of superphosphate at the rate of one-sixth of an ounce to each eight-inch pot. The plants in the pots gave no response to the treatment. The experiment was repeated in soil similarly deficient in organic matter but with plants produced from seed obtained from diseased *P. tæda* trees with similar results. If the phosphate effect was a direct one a response would be expected. The absence of suitable organic matter was apparently the reason for this negative effect.

The response which was shown by the clean-chipped plots which were treated with superphosphate, as is described in part "A" of this paper, may be explained by the increased availability of the residual organic matter in the soil due to the action of micro-organisms. It has been shown (Sing Chen Chang 1939) that the addition of phosphorus compounds to vegetable débris markedly increases the decomposition of the latter. In this way, on the phosphate-treated plots there was made available a greater amount of organic material for the stimulation of fungus and tree development. The residual supplies of the soil organic matter, owing to the absence of replenishment on these plots, must, however, ultimately reach a point of unavailability again. There is an indication at present that this is becoming the case, as is evidenced in the graph (Plate 85) showing the progress of fused needle disease in block K. Here, at the last observation period, an increase of the condition in these phosphate-treated plots was recorded (see also footnote, page 311). Analyses for humus bore out this hypothesis, as is shown in Table XXXII. The phosphate was added in 1937.

TABLE XXXII.

THE AMOUNT OF HUMUS IN CLEAN CHIPPED PLOTS WITH AND WITHOUT PHOSPHATE ADDITIONS IN BLOCK K (1939).

Treatment.	Mean Percentage Humus.	Number of Plots.
Clean chipped, without phosphate	1·61	5
Clean chipped, with phosphate	1·40	5
Control (unchipped, with natural ground cover)	1·84	5
Sig. Diff.	0·69	.. .

It will be noted that the phosphate-treated soil has, in comparison with the other clean-chipped soil, lost a considerable amount of its humus. The difference is not statistically significant but is constant from plot to plot. The amount of humus contained in the untreated soil is greater than in either of the clean-chipped treatments, and illustrates the deleterious effects of clean-chipping on soils of this nature.

The second factor concerned in the stimulation received after the application of superphosphate is in connection with the production of phosphatides by the higher plant. It has been shown conclusively by Melin (1925) that the phosphatides which are excreted by all parts of living plants are essential to the normal metabolism of the mycorhiza-forming fungi. The phosphatides appear to act not as direct nutrients to the fungi but as catalysts in metabolic processes and are not themselves sources of nutrient. Melin carried out a considerable number of experiments with various species of mycorhiza-forming fungi, and without exception all the fungi showed very large growth responses in the presence of these substances. He showed experimentally that enzyme formation in the fungi was promoted by phosphatides. For the successful functioning of the fungi as a means of nutrient absorption for the tree it would appear that the tree must first be able to supply the fungus with suitable quantities of phosphatide. In order to do this there must be present in the soil enough phosphorus for the manufacture of phosphatide in the tree. In this way the addition of phosphorus may indirectly promote the activity of the mycorhiza-forming fungi. The fact that the fungi need the phosphatide for the formation of enzymes is of considerable significance when the breakdown of cellulose to simple carbohydrates by the action of the mycorhizal fungi is considered. By excreting phosphatides the tree enables the fungus to supply it with carbohydrate.

The phosphorus applications may also cause a third reaction. This is a direct effect on the mycorhizal fungi. It is well known that this mineral is above all others essential for fungus growth. In fact, the elements considered essential for the higher plant are, with the exception of phosphorus, thought to be of minor importance in fungus nutrition. This characteristic of the fungi has been availed of for the formulation of biological tests for the availability of phosphorus in soil (Mehlich, Fred and Truog 1938). In devising this method the authors demonstrated that the addition of any of the essential elements other than phosphorus in reasonable quantities had no influence on fungus growth. They were able to correlate the growth of *Cunninghamella* spp. when grown on soil plaques with the amount of phosphate present in the soil.

In an experiment carried out by the author, soil samples in which the amount of total phosphate present was determined were obtained from the plots concerned in the fertilizer trials at Beerwah. The samples were placed in petri dishes and moistened with distilled water. Each sample was then inoculated with a piece of culture medium from an actively growing culture of *Boletus viscidus*, which is a known mycorhiza-forming fungus (Melin, 1925), and which has proved to be superior to all the other species experimented with in promoting the growth of seedlings of *Pinus caribæa* (Young, 1940). In the case of all the plots which were treated with phosphate the fungus grew rapidly through the sample, and covered the soil with hyphæ in forty-eight hours. In the case of untreated and phosphorus-deficient soils no growth was apparent. The only differences in the soils was the amount of total P_2O_5 present, which was determined by analysis previous to inoculation.

This experiment serves to stress the importance of phosphorus in the metabolism of a typical mycorhiza-forming fungus. With the presence of adequate phosphorus for fungus growth and the availability of a phosphatide supply, the fungus is enabled to carry out the breakdown of raw organic matter and transfer the products to the higher plant.

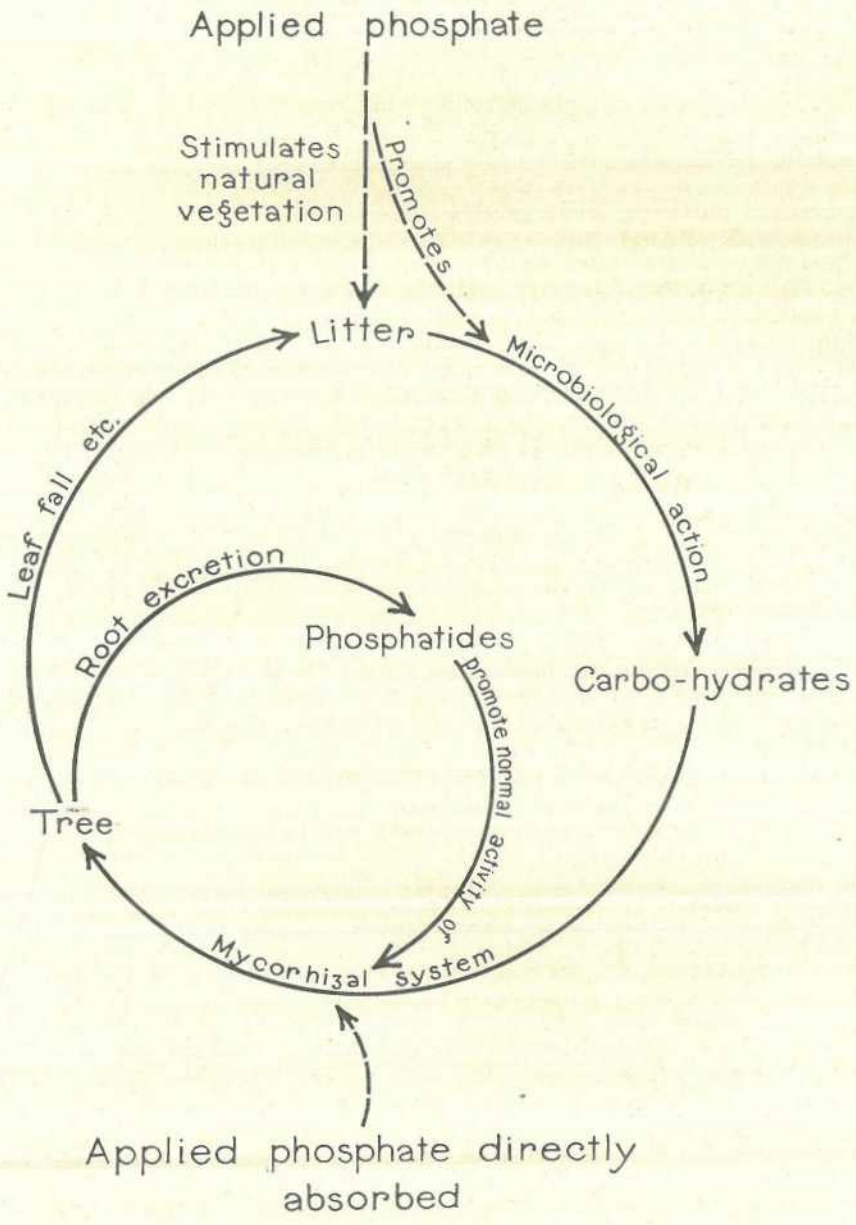


Plate 129.

DIAGRAMMATIC REPRESENTATION OF THE EFFECT OF PHOSPHATE APPLICATIONS ON THE NUTRITIONAL CYCLE OF THE PINE TREE.

The fourth aspect of phosphorus stimulation on the pine tree is the direct manurial effect. This, however, from the results obtained from the pot experiments, appears to be of little significance. The fact that the quantities of other nutrients present in the poor plantation soils where malnutrition occurs are also extremely low indicates that the application of any one of these deficient elements alone could not be the direct cause of vigorous growth. This aspect of the question has also been noted by Perry (1939) in Western Australia. In pot experiments carried out at Beerwah the application of an N.P.K. fertilizer, in the absence of organic matter, to plants suffering from malnutrition had no effect. It has been shown (Miller, 1931) that phosphorus in the plant plays an essential part in the translocation of carbohydrate. If, however, the carbohydrate supply is deficient, as is thought to be the case in soils deficient in organic matter, the phosphorus would not in this case be able to carry out its functions.

The effect of phosphate applications on the nutritional cycle of the mycorhizal fungus and the pine tree is illustrated diagrammatically in Plate 129.

In drier localities, such as at Pechey, on the brow of the Great Dividing Range, fused needle disease occurs on a soil with relatively high phosphate values averaging over 2,000 p.p.m. That the pine trees are able to absorb this phosphate is shown by needle analyses, which show a mean content in young green needles of *Pinus radiata* of 2,400 p.p.m. of phosphate in both diseased and healthy trees, with similar figures for *P. tæda* and *P. coulteri*. In this locality, however, the rainfall is limited to 30 inches per annum. There is, therefore, during the greater part of the year a deficiency in soil moisture as compared with the coastal soils, and a consequent poor development of leaf mould on the soil surface. The leaves falling to the ground do not rot in the usual way, but crumble to dust. This leads to a poor development of the moist organic horizon, so important in the nutrition of *Pinus*, and a consequent deficiency in health. In this occurrence of fused needle, the disease, although the same, is seen to be primarily due to a moisture rather than a phosphate deficiency. However, the primary cause is the same—that is, there is a deficiency in suitable organic matter brought about in each case by the respective factors just mentioned, which results in a badly balanced mycorhizal association. The treatment of the condition occurring at Pechey is much more difficult than in the case of a simple phosphate deficiency. It would consist in the conservation of a greater amount of moisture in the surface soil than is normal in the young plantations, and this, under present conditions, is not economically possible. This effect, however, is brought about naturally as the plantation develops. The ground surface then becomes sheltered from the hot drying sun and winds, and a favourable type of litter is then formed. The beneficial effect of this is evidenced by the increasing vigour of the trees after crown closure and the increase in moisture in the soil surface.

There is evidence that the depressing effect of ammonium sulphate is also due to a reaction on the mycorhizal fungus rather than the tree itself. This was further investigated by means of a somewhat similar type of experiment to that carried out to demonstrate the effect of varying quantities of soil phosphate on the growth of a mycorhizal fungus. Pure cultures of *Rhizopogon roseolus, Boletus granulatus*, and *Boletus viscidus* were used as indicators. All three of these organisms are proved mycorhiza formers of *Pinus tæda* and *P. caribæa* (Young,

1937). The fungi were grown on plates in petri dishes at 26 deg. C. The medium was Coon's synthetic medium, but the formula was varied so that four media were prepared differing only in the source of nitrogen, which was supplied as equivalent quantities of asparagin, sodium nitrate, ammonium sulphate, and sodium nitrite. The rate of growth of the three fungi on the different media was measured by the radius of spread over the surface of the plates in the same time. The results obtained from this experiment are shown in Table XXXIII., and represent the mean results obtained from ten cultures of each fungus on each medium.

TABLE XXXIII.

THE EFFECT OF DIFFERENT NITROGEN SOURCES ON THE GROWTH OF THREE MYCORHIZAL FUNGI.

Nitrogen Source.	Radial Growth in Millimetres.		
	R. roseolus.	*B. granulatus.*	*B. viscidus.*
Asparagin	Nil	9·5	40·0
Sodium nitrate	3	16·0	52·0
Ammonium sulphate	Nil	4·0	15·0
Sodium nitrite	Nil	11·5	40·0

It will be noted that *Rhizopogon roseolus* showed very little growth on any of the media used. This fungus is a difficult one to culture on ordinary media. Good results, however, were obtained with both *Boletus granulatus* and *B. viscidus,* the latter fungus in particular being a very vigorously growing type. The best growth was obtained on the sodium nitrate medium. The asparagin and sodium nitrite media produced approximately similar results, and the ammonium sulphate gave significantly bad results.

From this it will be seen that there is an evident correlation between the depressed growth on the ammonium sulphate-treated plots of pine trees and the retarding effect of this substance on the activity of the mycorhizal fungi. The increase in fused needle disease on these plots was also very noticeable. See Tables XXI. and XXII. and Plates 95, 96, and 97 in Part A of this paper.

The stimulation of the production of chlorophyll, and hence extra carbohydrate, by the use of certain minor elements, notably zinc, as described in Sovietski Sub-tropiki (1938) would effectively explain the results obtained in Western Australia by the treatment of pine trees with these elements and accords well with the present hypothesis.

(VI.) GENERAL CONCLUSION.

The present paper seeks to show that the cause of fused needle disease and the related manifestations of malnutrition which occur on the poorer forest soils is intimately bound up with the mycorhizal complex. The deficiency of raw organic matter brought about by the clearing and burning of the natural forest, followed by general forest management methods, tends to produce a maximum effect on the trees from the fourth to the sixth year of normal plantation growth. In some cases this maximum is retained for a long period and is liable to result in plantation failure. The deficiency in the raw litter causes development of an unhealthy mycorhizal condition, which results directly in the malnutrition of the tree. In poor soils, owing to the low concentrations of

plant nutrients, the large absorptive surface provided by a well-developed active mycorhizal system is essential for a balanced tree nutrition. In addition, the provision of a carbohydrate supply by the root complexes of the trees in question seems to be intimately bound up with the health of the trees, and for this purpose the presence of an available and continuous supply of raw organic matter, from which the hymenomycetous fungi concerned in mycorhiza formation can produce this carbohydrate, is essential. From injection experiments it is indicated that the carbohydrate supplied is in the form of a sugar.

The application of phosphatic fertilizers to poor plantation soils capable of retaining phosphorus results in the healthy growth of *Pinus tæda* and *Pinus caribœa* which have been affected by fused needle and other symptoms of malnutrition. The effect of phosphorus is mainly an indirect one and is considered to be due to four reactions: (*a*) the resulting increase in litter due to the stimulation of the natural vegetation; (*b*) the stimulation of fungus growth which thus makes more organic food supplies available; (*c*) the stimulation of the phosphatide excretion of the roots of the pine tree, which results in better mycorhizal development; (*d*) the direct nutrient effect on the pine tree. The last effect is thought to be relatively unimportant. The litter obtained from the increased ground cover favours the desired mycorhizal development and provides a source of carbohydrates as well as phosphates and other substances. The ground cover protects the feeding roots of the trees to some extent from heat effects.

The provision of a higher proportion of phosphorus than is normally present in the plantation soil at Beerwah before litter formation has begun seems essential for the satisfactory growth and fructification of *Boletus granulatus* and *Rhizopogon roseolus*. The favourable growth reaction is probably due to a direct nutritional effect and to the stimulation of phosphatide excretion of the higher plant. It is possible that this is not wholly a direct effect, but is due to the result of a change in the biological direction of the humus breakdown in the soil. The phosphate dressings bring about a healthy condition of the mycorhizal relationship so that, in areas which were formerly diseased and carried trees which possessed a large proportion of abnormal mycorhizas, the nature of the root fungus relationship becomes more favourable. Before treatment the fungi exhibit a parasitic tendency and actively attack the cells of the root cortex. After treatment the fungus becomes non-parasitic and is able to be digested by the root cells. This conception taken of the significance of the mycorhiza is an extension of that adopted by Frank and elaborated by Melin, Stahl, Rayner, and Hatch.

It is thought that as well as providing a more efficient absorptive system on the tree roots so that mineral salts and nitrogen compounds are more readily available, the mycorhizas also furnish a means of augmenting the carbohydrate supply. In this connexion it is pointed out that the fungi concerned are known saprophytes, and the roots of the higher plants are known to be efficient organs for salt absorption. If this is accepted the view usually taken of the root fungus association in which the fungus is thought to obtain carbohydrate from the higher plant and the higher plant to receive mineral salts from the fungus is one which postulates an evolution in direct opposition to the normal physiological forces operating. In the author's conception the fungus manufactures its own carbohydrate supply from the available soil organic matter, and a portion of this is transferred to the higher

plant by means of the intimate association existing in the mycorhizal structures. Nitrogenous compounds probably come within this category, though in the case of the pine there is no evidence that they are a limiting factor. Mineral salts are also obtained per medium of the fungus hyphae. It is thought in this case that elaboration on the part of the fungus is not of such a complicated nature. It is difficult to understand how the fungus can obtain comparable benefit from the symbiotic relationship, other than its dependence on the plant host for an essential supply of phosphatide or other phosphorus compounds. In this way one can obtain a satisfactory explanation and also an understanding of how the evolution of the root fungus partnership originated.

In normal plantation practice, except in dry areas, it is considered that a convenient indicator of what sites are liable to be affected by any of the troubles discussed, other than the using of the pine trees themselves for this purpose, would be the results of analyses for total phosphate. Consideration has been given to this matter and work at present being carried on indicates that for *Pinus tæda* the limiting figure is close to one hundred and thirty-five parts per million. *Pinus caribæa* demands a minimum total phosphate value of 110 p.p.m. However, whenever indications of the troubles discussed are found the condition is readily and economically remedied by applying a broadcast dressing of calcium superphosphate. In the case of soils with a low phosphate fixing capacity the dressing should consist of ground rock phosphate. Under normal conditions the cost of labour and materials for a three-hundred weight dressing of superphosphate does not exceed 17s. per acre.

In dry areas with fertile soils, fused needle disease appears to be due to a moisture deficiency which results in the deficiency of a litter formation suitable for mycorhizal activity.

Applications of nitrogen, calcium, potassium, zinc, and other elements have had negligible effects in reducing the incidence of the disease. Ammonium sulphate, in fact, actually causes an accentuation of the condition when applied alone. When used in combination with other fertilizers it depresses their beneficial effects.

In the light of the foregoing hypothesis the sequence of events in fused needle affected areas on poor coastal soils may be summarized as follows:—The preparation of a plantation site under normal conditions involves the removal of marketable timber and the cutting-down of the remainder of the naturally occurring forest trees, followed, after the lapse of a suitable period to allow for the drying-out of the felled trees, by the burning of the area. The burn results in the destruction of all effective surface organic matter and the liberation of the contained inorganic salts. At the time of planting on the poor soils usually used for plantations of *Pinus* spp. in Australia there are few weeds or coppice growths yet present in quantity sufficient to provide any appreciable litter formation. The inorganic salts contained in the original litter, including the phosphates, are then washed into the soil where the concentration is less than in the litter. During the first two years, however, there usually appears to be enough suitable organic matter left in the soil for the satisfactory nutrition of the pine trees. During the first twelve months after planting, the roots of the plants do not find their way to the surface from the planting holes, and the normal surface feeding system is not developed until towards the end of the second

year. During this period the residual organic matter supplies, of the type necessary for pine nutrition under the local conditions, gradually becomes depleted owing to the action of the soil fauna and flora and oxidative processes, and the insufficient replenishment provided from above the soil surface. It is considered that the diseased condition is manifested when these organic matter supplies reach the minimum requisite for healthy growth, and that, when the ecological development of the plantation advances to forested conditions again, involving the adequate provision of organic matter with its included phosphorus compounds and healthy mycorhizal development, the disease eventually disappears. The direct surface application of phosphatic manures, at a comparatively small cost, stimulates plant and fungal growth and eliminates the necessity for this delay.

The emphasis placed upon certain aspects of the nutrition of the pine tree in the course of the investigations resulting in the above conclusions may have more far-reaching effects in that the hypothesis established may lead to a better understanding of plantation problems not directly included in the scope of the present work.

BIBLIOGRAPHY.

ALLISON, R. V. (1932).—Importance of the Use of Copper, Manganese, and Zinc Salts in the Agricultural Development of the Low Moor Soils of the Florida Everglades. Second Internat. Cong. Soil Sci. Proc., VI., pp. 257-275.

ADDOMS, RUTH M. (1937).—Nutritional Studies on Loblolly Pine. Plant Physiology, XII., pp. 199-205.

BIRMINGHAM, W. A. (1922).—Disease of *Pinus insignis* at Strickland State Forest, Narara. Australian Forestry Journ., V., pp. 206-211.

BOHN, GEORGES, and ANNA DRZEWINA (1932).—Accélération et Inhibition de la Croissance des Plantes par l'Argent Metallique. Soc. Biol. Compt. Rend., CIX., pp. 638-641.

BURGES, A. (1936).—On the Significance of Mycorhiza. New Phytologist, XXXV., pp. 117-131.

HATCH, A. B., and K. D. DOAK (1933).—Mycorhizal and other Features of the Root Systems of Pinus. Jour. Arnold Arboretum 14, pp. 85-99.

HATCH, A. B. (1937).—The physical Basis of Mycotrophy in Pinus. The Black Rock Forest Bull. No. 6.

HEYWARD, F., and R. M. BARNETTE (1934).—The Effect of Frequent Fires on the Chemical Composition of Forest Soils in the Longleaf Pine Region. Univ. Florida, Agr. Exp. Stn., Bull. 265.

JONES, W. NEILSON (1938).—On the occurrence of Needle Fusion in Pines in the South of England. Empire Forestry Jour. XVII., 2, 244-246.

KELLEY, A. P. (1937).—The Literature of Mycorrhizae. The Landenberg Laboratory, Landenberg, Pennsylvania.

KELLEY, A. P. (1937).—Additions to the Literature of Mycorrhizae. The Landenberg Laboratory, Landenberg, Pennsylvania.

KELLEY, A. P. (1938).—Additions to the Literature of Mycorrhizae. The Landenberg Laboratory, Landenberg, Pennsylvania.

KESSELL, S. L., and T. N. STOATE (1936).—Plant Nutrients and Pine Growth, Australian Forestry, I., 1, 1-13.

KESSELL, S. L., and T. N. STOATE (1938).—Pine Nutrition. Forests Department of Western Australia, Bull. 50.

KNUDSON, L. (1916).—Influence of Certain Carbohydrates on green Plants. Cornell Univ. Agr. Expt. Stn. Mem. 106.

KNUDSON, L. (1922).—Nonsymbiotic Germination of Orchid Seeds. Bot. Gaz. LXXIII., pp. 1-25.

LIPMAN, J. G., H. C. MCLEAN, and H. C. LINT (1916).—The Oxidation of Sulfur in Soils as a Means of Increasing the Availability of Mineral Phosphates. Soil Sci. I., 6, 499.

LUDBROOK, W. V. (1937).—Needle Fusion of Pinus in Southern New South Wales. Counc. Sci. Ind. Res., Australia. Pamph. 72.

LUDBROOK, W. V. (1939).—Needle Fusion of Pinus in Southern New South Wales. Counc. Sci. Ind. Res., Australia. Pamph. 89.

MCDOUGALL, W. B. (1914).—On the Mycorhizas of Forest Trees. Amer. Jour. Bot., I., pp. 51-74.

MCDOUGALL, W. B. (1922).—Mycorhizas of Coniferous Trees. Jour. of Forestry, XX., pp. 255-260.

MASUI, KOKI (1926).—A Study of the Mycorhiza of *Abies firma* S. with special reference to its Mycorrhizal Fungus, *Cantharellus floccosus* Schio. Mem. Coll., II., 1, 15-84. Sci., Kyoto Imp. Univ. Ser. B.

MEHLICH, A., FRED E. B. and E. TRUOG (1938).—The Cunninghamella Plaque Method of measuring available Phosphorus in Soil. Soil Science, XXXVIII., 6, 445-460.

MELIN ELIAS (1925).—Untersuchungen uber die Bedeutung der Baummykorrhiza. Eine okologische-physiologische Studie, VI. G. Fischer Jena.

MILLER, E. C. (1931).—Plant Physiology. New York and London, The McGraw-Hill Book Co. Inc. Second edition.

MITCHELL, H. L., R. F. FINN, and R. O. ROSENDAHL (1937).—The relation between Mycorrhizae and the Growth and Nutrient Absorption of Coniferous Seedlings in Nursery Beds. Black Rock Forest Papers, I., p. 10.

MITCHELL, H. L. (1939).—The Growth and Nutrition of White Pine Seedlings in Cultures with Varying Nitrogen, Phosphorus, Potassium, and Calcium. The Black Rock Forest Bull. No. 9.

PARKIN, E. A. (1938).—The Depletion of Starch from Timber in Relation to Attack by Lyctus Beetles, III. Forestry XII., 2, 117-124.

PERRY, D. H. (1939).—The Effect of Superphosphate on *Pinus pinaster*. Australian Forestry, IV., 1, 12-64.

RAMAGE, H. (1930).—Mushrooms—Mineral Content. Nature, CXXVI., p. 279.

RAYNER, M. C. (1927).—Mycorrhiza. London. Wheldon and Wesley.

RAYNER, M. C. (1933).—Mycorrhiza in the Genus Citrus. Nature, CXXXI., p. 399.

RAYNER, M. C. (1934).—Mycorrhiza in Relation to Forestry, I. Forestry, VII., pp. 96-125.

RAYNER, M. C. (1936).—The Mycorrhizal Habit in Relation to Forestry, II. Forestry, X., pp. 1-22.

RAYNER, M. C. (1938).—The Use of Soil or Humus Inocula in Nurseries and Plantations. Empire For. Jour., XVII., 2, 236-243.

REED, H. S., and TH. FRÉMONT (1934).—Sur les Réactions des Cellules des Racines de Citrus à l'Infection par les Mycorhizas. Compt. Rend. Acad. Sci. Paris, XCCIX., pp. 84-87.

REED, H. S., and TH. FRÉMONT (1935).—Étude physiologique de la Cellule à Mycorhizas dans les Racines de Citrus. Rev. Cytol et de Cytophys. Veg., 1, 4, 327-348.

ROBBINS, W. J. (1918).—Direct assimilation of Organic Carbon by *Ceratodon purpureus*. Bot. Gaz., LXV., pp. 543-551.

ROBBINS, W. J. (1922).—Cultivation of Excised Root Tips and Stem Tips under Sterile Conditions. Bot. Gaz., LXXIII., pp. 376-390.

ROGER, G. J. (1931).—Report to the New South Wales Forestry Commission (unpublished).

RUSSELL, E. J. (1932).—Soil Conditions and Plant Growth. London. Longmans, Green, and Co.

SAMUEL, G. (1922).—Notes on Forest Pathology from South Australia. Australian Forestry Jour., V. pp. 223-226.

SHERRY, S. P. (1938).—The Rate of Growth and Health of the Southern Pines in the Midland Conservancy. Jour. South African For. Assoc., I., pp. 30-40.

SIDERIS, C. P., and B. A. KRAUSS (1934).—The Effect of Sulphur and Phosphorus on the Availability of Iron to Pineapple and Maize Plants. Soil. Sci., CCCLXXII., p. 85.

SING CHEN CHANG (1939).—The Transformation of Phosphorus during the Decomposition of Plant Materials. Soil Science, XLVIII., 2, 85-101.

SOVIETSKI SUBTROPIKI No. 4 (1938).—The Influence of Manuring on the Chlorophyll Accumulation. Abs. in Imp. Bur. Soil Sci., XI., 2, 1939.

THAYSEN, A. C., and H. J. BUNKER (1927).—The Microbiology of Cellulose, Hemicellulose, Pectin, and Gums. Oxford University Press, London; Humphrey Milford.

VALLANCE, L. G. (1938).—A Soil Survey of the Beerburrum, Glasshouse Mountains, and Beerwah Pineapple District. Queensland Agric. Jour., XLIX., 6.

VON STIEGLITZ, C. R. (1938).—Soil Sampling Methods. Jour. Australian Inst. Agric. Sci., IV., 4, 232.

WOODROFF, N. C. (1933).—Pecan Mycorrhizas. Agr. Expt. Stn., Georgia, Bull. 178.

WYND., F. L. (1933).—Sources of Carbohydrate for Germination and Growth of Orchid Seedlings. Ann. Miss. Bot. Gard., XX., pp. 569-581.

YOUNG, R. S. (1935).—Certain Rarer Elements in Soils and Fertilisers and Their Rôle in Plant Growth. Cornell Univ. Agric. Expt. Stn. Memoir 174.

YOUNG, H. E. (1935).—Fused Needle of Species of Pinus. Queensland Agric. Jour., XLIV., 3, 11.

YOUNG, H. E. (1936).—A Mycorrhiza Forming Fungus of Pinus. Jour. Australian Inst. Agric. Sci., II., 1, 32-34.

YOUNG, H. E. (1937).—*Rhizopogon luteolus*, a Mycorrhizal Fungus of Pinus. Forestry, XI., I. 30-31.

YOUNG, H. E. (1938).—The Acidification of Alkaline Nursery Soils for the Production of Exotic Pines, Queensland Agric. Jour., L., 5, 16.

YOUNG, H. E. (1940).—The Influence of Different Species of Mycorhiza forming Fungi on Pinus and Araucaria. Jour. Australian Inst. Agric. Sci., VI., 1, 21-25.

WAKSMAN, S. A. (1927).—Principles of Soil Microbiology. London. Bailliére, Tindall, and Cox.

WAKSMAN, S. A. (1938).—Humus. London. Bailliére, Tindall, and Cox.

FODDER CONSERVATION ON THE DOWNS.

Fodder conservation on a large scale is an extending practice on the Darling Downs, and results are proving beneficial to all concerned.

Around one centre, practically no silage was made a few years ago; and now more than fifty dairy farmers have pit silos filled with sorghum.

The cost of digging the pit, harvesting the crop, filling, and covering the pit ranges from three shillings to five shillings a ton of silage made.

One farmer in the Pittsworth district has now had six years' experience with this form of fodder conservation. He began with a stack, but abandoned it because of excessive waste. His estimated cost of digging the pit, harvesting the crop, and covering the pit works out at three shillings and sixpence a ton. The cost, of course, is reduced when the pit is used several times. He now has 400 tons of silage in four pits. Some of the pits have been filled four times, and silage down for three or four years has opened up in perfect order.

And this is how fodder conservation has worked out recently in actual practice—

A dry spell was followed by a grasshopper invasion which destroyed young crops of Sudan grass, making it necessary to begin hand feeding the dairy herd with silage. About 2 tons of silage a day was fed to fifty cows, the only other feed being a green pick from grass.

On the second day after starting to hand feed the silage to the dairy herd, the milk supply began to improve and very soon equalled the quantity given when the cows were grazing on green stuff.

Two tons of silage a day would be worth seven to eight shillings, plus labour. On the credit side, the milk yield increased, and continued to increase, about three-quarters of a gallon per cow per day.

Some Agricultural Problems of the Mackay District.

By H. W. KERR.*

Introduction.

DURING the 1939 harvesting season the seven mills of the Mackay district contributed some 210,000 tons of sugar to the record Queensland production of 890,000 tons. It may therefore well justify its claim to distinction as the major sugar-producing area of the State. Moreover, a study of production figures over the past five years shows that the expansion in yields in this area has progressed at a more rapid rate than that for Queensland as a whole. One might therefore infer that the Mackay district standards of agriculture are progressing rapidly to a high level of production efficiency, in a manner comparable with that of other areas south of Townsville. If we should take out the average production per acre figures for Mackay and the rest of Queensland for the past twelve years we find—

Year.	Mackay. Tons per acre.	Rest of Queensland.
1928	13·2	18·2
1929	11·5	17·8
1930	12·2	16·6
1931	11·7	18·7
1932	12·1	18·7
1933	16.5	21.8
1934	14·7	21·2
1935	14.9	19.6
1936	17.4	22.5
1937	14·2	22·6
1938	16·4	23·0
1939	18·5†	23·2†
Average	**14.4**	**20.3**

†Estimated.

These data will doubtless come as a surprise to many farmers. Certainly they show that average cane yields per acre in Mackay have improved materially in recent seasons over what they were even ten years ago; but they are so markedly below those for other areas, that it would appear worthwhile pausing to enquire whether there is some insurmountable obstacle to the attainment of a more flattering figure.

To some growers it may seem that with the Bureau the "crop yield per acre" factor has become an obsession, to the exclusion of all other considerations. While not admitting the truth of such a charge, it will be confessed that we have been forced to regard the intensity of production as one of the most reliable yardsticks of comparative prosperity as

* In an address to Q.S.S.C. Technologists at Mackay Conference, 1940, and reprinted from *The Cane Growers' Quarterly Bulletin* (Department of Agriculture and Stock) for April.

between one area and another. The reason is to be found in the fact that, in a country which boasts a high standard of living comfort for its people, the relatively high rate of wages earned by its inhabitants demands a correspondingly high standard of production efficiency, if the real benefits of such a system are to be enjoyed. If we should analyse the cane production costs from farm by farm we would find, in general, that the largest single contributing factor is that of labour charges. We therefore recognise that any attempt to reduce costs must be closely associated with improved efficiency in the utilization of man power.

This may best be illustrated by a simple example: If the sum total of a farmer's efforts for a year be the production of a cane crop of 250 tons, and the value of his wages be placed at £250, the contribution of labour costs to the total production costs is £1 per ton of cane. Suppose that by the adoption of improved methods, the production per unit of labour could be increased to 500 tons of cane, the labour cost per ton is automatically reduced to 10s. It is generally safe to assume that the means employed for increasing efficiency of labour utilization would not absorb anything like the amount of saving in labour costs effected, and the net result is a decidedly improved financial position for the individual.

If we should seek appropriate means for bringing about this hypothetical advance in status, we should almost certainly not find that it could be effected by an expansion in the area cultivated. Though some temporary advantage might be gained if new land could be brought into production, this in itself would never be permanent. There is clearly a definite limit to the area which one man can effectively till, unaided, and we must seek the answer in improved tonnages of crop per acre. While one man may take care of a farm producing 600 tons of cane at an average yield of 40 tons per acre, it is certain he could not attempt to care for 50 acres each of which averaged but 12 tons of cane per acre.

It is appreciated that many growers in the Mackay district have assigned areas which could not permit of the farmer making a success of his business from cane growing alone; but that is a question which lies beyond the scope of this discussion. On the other hand, there are many farmers who cannot offer this as an excuse for the relatively low production efficiency they have been able to accomplish. It is the purpose of this address to discuss briefly the major factors responsible for the conditions indicated, and to suggest means whereby they may be overcome.

In the first place, it should not be inferred, from the example presented above, that we consider for one moment that much of the Mackay land is capable of a sustained production average of 40 tons of cane per acre. On the contrary, it is recognised that standards of efficiency are not rigid and can only be established after a careful assessment of all relevant factors: and, briefly, while an average production of 25 tons per acre would be regarded as a high accomplishment under one set of conditions, a level of 30 tons might in other circumstances be considered decidedly mediocre. This aspect of the question will not be overlooked in any comments which are now offered.

Mackay Cane Soils and Climate.

The lands of the Mackay district vary in quality from rather poor, shallow, inadequately-drained soils to the high quality silty alluvials which constitute the best of our Queensland cane lands. The major

portion of the cultivated area consists, however, of a medium quality alluvial loam, of reasonable depth, but often of low water-holding capacity, and presenting substantial tillage difficulties due to the unfavourable condition of the moderate quantity of clay which they carry: in common with most canelands of Queensland which have been under cultivation for fifty years or more, the humus content of the land is at a low level.

What the quality and production capacity of such lands were in their virgin state we can only guess. Certainly they were cultivated for many years before the accumulating knowledge of the soil's requirements in respect to plantfoods, and the true value of artificial manures in the maintenance of fertility, were widely appreciated or applied. The present-day farmer on these older lands is therefore faced with a problem which does not enter into the calculations of the grower who is able to commence the business of cane growing on virgin land. This problem is thus one not of maintaining fertility, but of creating and building up the productive power of an impoverished soil.

As regards the rainfall which the district normally experiences, it must be conceded that it is no better than that of most cane areas south of Townsville. Though it exceeds in the aggregate the average annual precipitation of practically all other cane districts within these confines, the excessive downfalls of the wet season are frequently a disadvantage, following very often an unduly dry spring and early summer season which has seriously checked crop growth. This is notably true for the indifferently drained lands of the district.

Summed up, the Mackay farmer's problem is one of producing satisfactory crops on a soil very often deficient in plantfoods, and of which the moisture-retentive capacity does not permit of sustained crop growth during the protracted drought periods, which so frequently follow beneficial falls of rain. How are these defects to be overcome?

Discussion of Problem and Remedies.

It is a well-recognised agricultural principle that, other things being equal, a crop feeding on a fertile soil will utilize the available moisture in the land much more efficiently than one which is deficient in respect of one or more plantfoods. Increasing the humus or organic matter content of the soil will, as we have repeatedly stressed, improve both soil plantfood supply and moisture holding capacity. Judicious fallowing of the fields under grass cover also enables the land to recover something of its former fertility, because its plantfood reserves are being conserved and not removed from the farm in cane crops; this policy also leads to a general improvement in the physical condition and hence the tillage qualities of the land. But it will be found in practice that before such means can be invoked to an effective degree, the interminable drain on the already depleted plantfood supply of the soil must be stopped. The judicious use of the correct kinds of artificial manure alone can bring about an immediate and measurable improvement in the magnitude of the cane crops harvested. Without this, any plans for the conservation of any cane crop residues or even the growth of satisfactory grass or other fallow land crops cannot be adopted successfully. However, the farmer must not conclude that such a policy will inevitably necessitate the purchase of the high-priced mixtures which the fertilizer representative may urge. On the contrary, it will frequently be found that judicious buying will enable a marked improvement in crop yields to be effected at relatively low cost.

Firstly, the true nature of the plantfood deficiencies must be determined. The well-planned fertility trial offers most in this regard: but as everybody cannot be catered for in this respect, the next best thing is an analysis of the soil. This service is offered free to all cane-growers, and the Bureau officers will even sample the soil on request and attend to its despatch to our laboratories. The farmer will thus learn whether the phosphate or potash requirements of the soil are most acute, and plan his purchases of manures accordingly, as will be recommended. Phosphate is a relatively cheap material to buy, and more often than not it is the one most urgently needed. As regards nitrogen—the most expensive (per unit) of all fertilizer constituents—the Mackay grower may be assured that soil deficiencies in respect of this nutrient are probably the most important single fertility factor contributing to deflated cane tonnages. This is notably true with ratoons. Moreover, it is the one plantfood the supply of which can be effected, at least in part, through the efforts of the farmer himself.

Fallowing with Green Manuring.

We have on many occasions urged the value of green manuring with legumes as the soundest policy to be followed for the effective treatment of fallow cane lands. By virtue of the co-operative enterprise which pea and bean crops exhibit towards the interesting root-nodule organisms which exist in the soil, the crop is able to accumulate large amounts of nitrogen which represents a net gain to the soil when the crop is turned under and rotted. This nitrogen becomes readily available for the nutrition of the cane crop which is next planted in the field, and provided the leguminous crop has made successful growth it is almost certain that the full nitrogen requirements of a heavy cane crop will be met from this source.

Unfortunately, the ratoons which follow will derive little residual effects from this treatment a year later; and it will be necessary to apply at least a modest dressing of sulphate of ammonia, in addition to the appropriate mixture of phosphates and potash, to assure a satisfactory cane yield.

The better utilization of mill by-products is a matter which might well engage the attention of farmers favourably located in respect of the mill. Both muds and molasses can be employed to build up the plantfood reserves of the land, and these are generally much cheaper than the equivalent materials in the form of artificial manure. If the molasses is used as stockfeed on the farm the plantfoods which it contains are ultimately returned to the land.

The farmer who embarks on such a plan of soil fertility building, with limited means at his disposal for the purchase of even the bare essential needs of fertilizers, will usually discover that it is a good plan to throw in a year (or even more) of fallow in order that the process he has initiated will progress most speedily. This recommendation presupposes, of course, that the farmer has ample assigned land available to enable this to be done. We are, indeed, attempting to demonstrate the wisdom of such a scheme on one of the poorer blocks of the Mackay Experiment Station. Though it will be some years before the benefits can be adequately demonstrated, it is of interest to record that yields to date have been very satisfactory for both plant and first ratoon crops: and it is an essential feature of the plan that second ratoon crops of cane will not be grown for some years to come, despite the fact that first

ratoon crops are of a standard which suggests that at least a third cutting would give a fair return. The object is, of course, not only to raise the fertility to a reasonable level, but to hold and improve upon this level as the rotation progresses.

The need for a satisfactory long-fallow leguminous crop is fully appreciated, and much effort is being devoted to the realisation of this ambition. Already a number of newly-introduced species have been tested, and one or two of these possess decided promise. Trials are being made at the present time in all areas with Gambia pea, while a "first cousin" which has a shrubby growth habit and is known as Giant Crotalaria is also of interest. A crop of the latter has been growing on the Bundaberg Station for the past 16 months, and has produced a very heavy growth. If such species could be utilized for grazing purposes, the land would still derive the major benefits from leguminous crops, and the necessity for frequent seeding during a long fallow would be avoided.

For short fallows, Poona pea still appears to possess greatest merit; one important feature in its favour is the low cost of seeding an acre. It is a good drought resister, but naturally thrives only when the soil

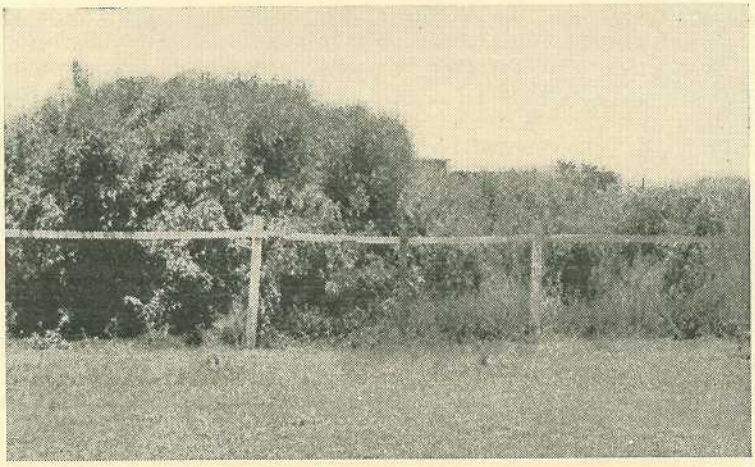


Plate 130.

ILLUSTRATING THE GROWTH HABIT OF GIANT CROTALARIA.—Crop on the left, 15 months old; on the right, ratoon crop 8 months old. The original growth of the latter half had been cut down in May, 1939.

moisture supply is adequate; on waterlogged land it is liable to be killed out by wilt, so that attention to land drainage will benefit both cane and green manure crops.

Trash Conservation.

Trash conservation is generally frowned upon by Mackay growers. Almost without exception ratoon crops are burnt before harvesting, and where such crops are light, there would seem to be no alternative. But this is merely side-stepping the issue; we would repeat that the practice of trash conservation offers by far the best means available for restoring soil humus and fertility. Our trials to date at the Bundaberg Station confirm the wisdom of the policy, which has also been incorporated in the rotational trial field at Mackay which was discussed earlier.

Obviously the first essential is to bring the land to such a state of fertility that a first ratoon may be produced which can be harvested economically in the leaf. Again, moderate fertilizer treatments combined with long fallowing and green manuring would appear to offer most in this regard.

Soil Acidity and Drainage.

There are two further important factors which do not appear to have received the full attention which their importance demands, in any attempt to eliminate unfavourable growth factors from much of the Mackay area. The first is the use of lime, to correct harmful acidity which exists in many old soils. The Bureau officers can carry out a rapid soil test on the farm and inform the grower immediately if his land is in this condition, and this service should also be more fully availed of by farmers. The second factor is that of soil drainage. This subject has been fully discussed at past Conferences of the Society held in Mackay, and it is safe to state that as much potential cane growth is lost by waterlogging of land in the wet season as is forfeited due to dry weather in a normal spring. Admittedly the solution of the problem is not simple, and where large expanses of low level land exist, much ingenuity is called for in correcting such troubles. But it has been done effectively by certain well known growers of the district, and the improvement in crop growth which has followed has in some cases been extraordinary.

Irrigation.

To overcome losses from drought, the obvious direct remedy is irrigation. The resources of the area in this regard are doubtless inferior to those of the neighbouring Burdekin district; but again, all too little importance has frequently been attached to the desirability of the practice. Available water exists in the drifts underlying many farms of the area, while much of the water running to waste in the coastal streams could be put to good use if handled intelligently. It is sincerely hoped that closer attention will be paid to this important phase of cane production in the near future.

Cultivation Methods.

In a district where the rainfall distribution is erratic and uncertain, the value of timely cultivation cannot be over-estimated. Though it will be admitted that the land preparation for, and tillage of, the plant cane is reasonably good, ratoons are too often allowed to take their chance. Such a policy inevitably spells disaster, for a ratoon crop is no more able to get along without assistance than could plant cane. It would seem that this experience is, in many cases, a direct consequence of an attempt to make up by extensive cultivation what the farmer is not able to achieve on per acre production; but as was discussed the basis of such a policy is unsound and the farmer would be well advised to recast his plans, and seek to intensify production on an area which he can adequately manage.

Finally, one must stress once again what is doubtless in the minds of all Mackay growers—that the future of agriculture in the potentially rich Mackay district must lie in the ability of its farmers to develop their lands for the production of crops other than cane. Much has been written and stated regarding the possibilities of some form of stock raising, which would dove-tail admirably with cane production, on farms where land is available for the purpose. The question cannot be dealt with in

detail at this juncture; but suffice it to say that it offers a means of deriving income from land while in fallow, and the net effect is to improve both the financial position of the farmer and the productivity of the land for cultivated crops.

Conclusion.

This presentation of certain Mackay problems has necessarily been sketchy in nature and incomplete in its treatment; but it is hoped that the points raised will serve to bring out some profitable discussion on this subject, which is certainly the most important one to Mackay growers generally. Though no attempt will be made to forecast the ultimate attainment of the district, in so far as cane production is concerned, it is safe to assert that an objective of 3 tons of sugar per acre as an average standard of production for the entire area is definitely modest. We feel that in the course of a few years the average production per acre on the Mackay Experiment Station will be 25 tons of cane, and it must be admitted that this farm is not above the average quality of the Mackay lands. The forecast result will be achieved by employing the methods which have been recommended above for Mackay growers generally.

QUEENSLAND SHOW DATES FOR 1940.

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

MAY.

Millmerran Rodeo	6th
Longreach	6th to 8th
Mundubbera	8th and 9th
Beaudesert Show	8th and 9th
Nanango	9th to 11th
Beaudesert Campdraft	10th and 11th
St. George Show	10th and 11th
Blackall	13th and 14th
Roma	14th to 16th
Gayndah	15th and 16th
Mitchell	15th and 16th
Murgon	16th to 18th
Warrill View	18th
Barcaldine Show	21st and 22nd
Ipswich	21st to 24th
Goomeri	23rd and 24th
Biggenden	23rd and 24th
Baralaba	23rd and 24th
Baralaba Rodeo	25th
Kalbar	25th
Charleville Show	28th to 30th
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
Nambour	11th and 13th
Ayr	12th and 13th
Rosewood	12th and 13th
Cleveland	12th and 13th
Townsville	16th to 18th
Maleny	18th and 19th
Charters Towers	29th to 31st
Gatton	23rd to 25th
Innisfail	25th, 26th, and 27th
Caboolture	26th and 27th
Atherton Show	30th and 31st
Crow's Nest	31st and 1st August
Maleny Show	abandoned for 1940

AUGUST.

Home Hill	2nd and 3rd
Pine Rivers	2nd and 3rd
Royal National, Brisbane	12th to 17th

SEPTEMBER.

Imbil	6th and 7th
Canungra	7th
Pomona	13th and 14th
Rocklea	14th
Malanda Show	18th and 19th
Beenleigh	20th and 21st
Ithaca	28th

OCTOBER.

Warwick Rodeo	5th and 7th

A Cane Hoist Operated by a Motor Cycle Engine.

By E. V. HUMPHRY.*

AS many farmers know, hauling up a load of cane by hand is not an easy job, and the winch is still worked by hand in most districts. Now that the motor lorry is used for carting, everything has been speeded up, and the transfer of cane to railway wagons also deserves attention.

Two farmers in the Giru district decided to arrange some form of power to operate the winch, and they did so, using an old motor cycle engine as the source of the power. The outfit was fitted up quite successfully on the farm with a little assistance from the mill workshop.

The essential features of the engine are illustrated in Plates 131, 132, 133: the unit has been in use for a number of seasons, proving most economical and a very valuable time and labour saver. The whole process of lifting the load from the wagon or lorry and crossing it to the cane truck is done by one man (the carter) in a few minutes. Before the engine was mounted, at least two men were required and the time taken to haul up the load was about four-fold that taken by the engine. The petrol consumption amounts to about one bottle to every 35 tons, which, in the circumstances, is negligible. It is designed to operate a 5-ton winch and has lifted to within a few hundredweight of that amount.

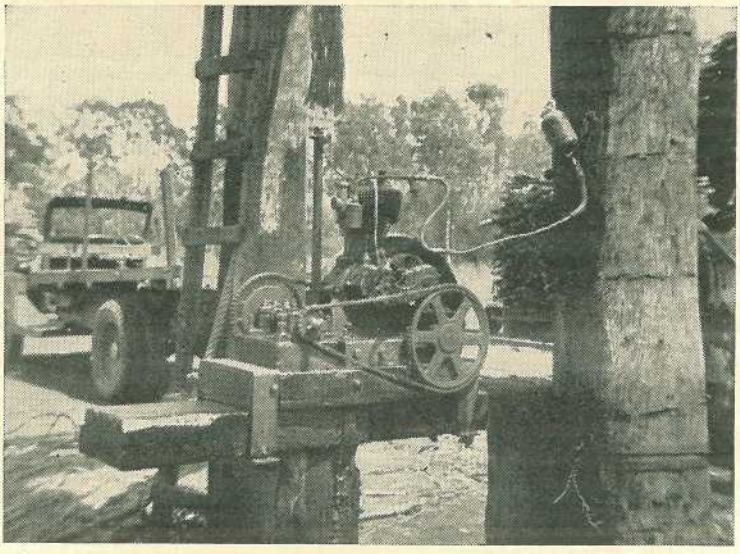


Plate 131.
CLOSE-UP VIEW OF MOTOR CYCLE ENGINE ADAPTED FOR USE IN CANE HOISTING.

The following paragraphs, studied in conjunction with the photographs of the outfit and an elevation and plan drawing, should give a fairly detailed and clear picture of the manner in which this simple outfit can be constructed.

* In *The Cane Growers' Quarterly Bulletin* (Department of Agriculture and Stock) for April, 1940.

The engine is a single cylinder A.J.S. motor cycle engine stripped from the frame, together with pinion and chain and chain wheel. It is mounted inside two pieces of timber (A1 and A2), 11 in. x 3 in. x 3 in. These pieces are bolted to the main frame timber (B), which is 32 in. x 9 in. x 4 in.

A drive is taken from the crankshaft chain pinion (C) to a $1\frac{1}{4}$ in. shaft (D), 12 in. long, carried in two brassed-lined plummer blocks (E) raised on 3 in. timber (F). This drive consists of the pinions, sprocket wheel, and chain taken from the motor cycle. The chain wheel (G) is at one end of this $1\frac{1}{4}$ in. shaft, while the other end is turned down to 1 in. diameter and carries the pinion (H) of the second chain drive.

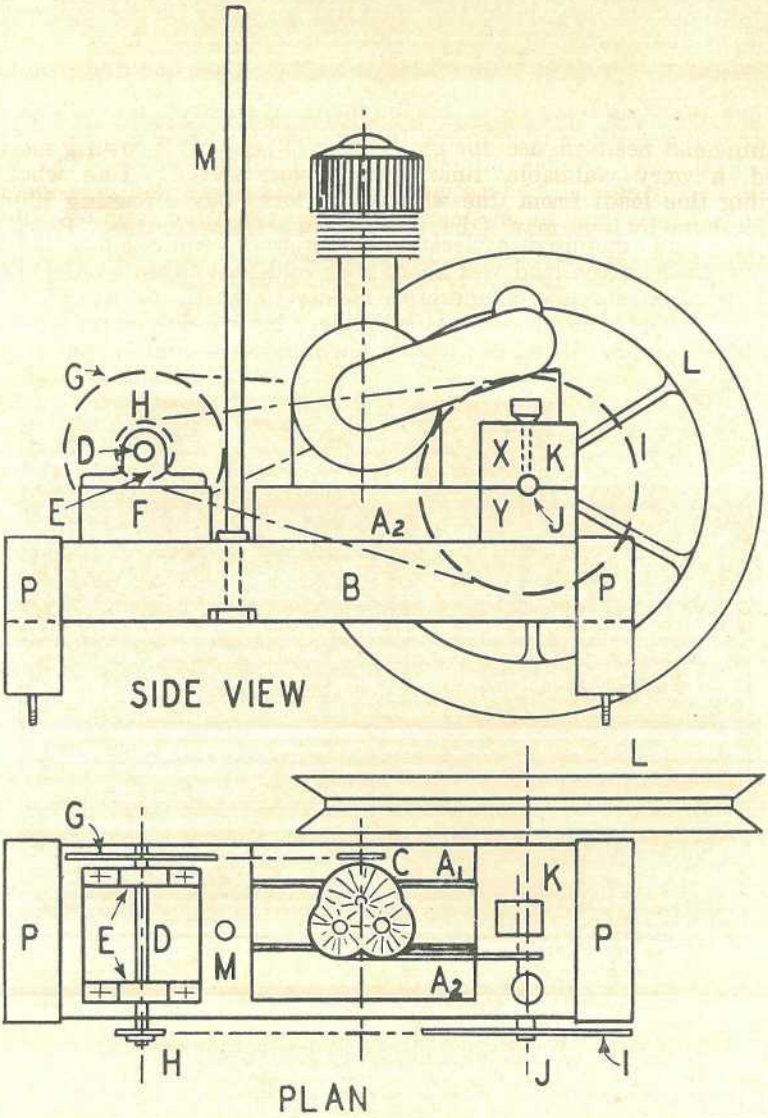


Plate 132.

PLAN AND SIDE VIEW OF THE ARRANGEMENT USED.—*See* text for explanatory notes.

This second chain drive is a Renold chain reduction with the 19-tooth pinion (H) driving a 76-tooth wheel (I) by a ½-inch pitch chain. The 76-tooth wheel is mounted on one end of a 1½-inch diameter shaft (J), 15 in. long. Actually, this shaft is carried in a long wooden bearing (K) formed by boring out pieces of timber 5 in. wide by 3 in. deep, two pieces (X and Y) being bolted together and carrying the shaft midway between them. Two grease cups are provided for the lubrication of the bearing.

At the other end of the shaft is mounted a V-groove chain pulley (L), 24 in. outside diameter. This chain pulley takes the ordinary endless hand chain of the winch and drives the large V-groove chain wheel on the winch. A piece of ¾-in. diameter pipe (M) is mounted vertically on the base timbers, being secured with lock nuts on either side of the timbers. This pipe serves to carry the throttle controls. The petrol container is hung from a nearby post (*see* illustration) and connected to the carburettor by means of copper and some flexible metallic piping.

Plate 133.

CANE LOAD WHICH HAD JUST BEEN LIFTED BY THE SMALL ENGINE.

The base timbers have U-shaped pieces (P) of 3 in. x 1¼ in. mild steel bolted to the ends. These U-shaped pieces have short bolt ends welded on, provided with wing nuts. They fit over the 9 in. x 4 in. horizontal timber used to support the outfit and the bolt ends pass through two 3 in. wide steel plates. By this means the outfit is clamped to the support in a suitable position to give proper tension on the winch chain, and it can also be loosened to slide the engine on the mounting blocks to take the chain off to allow the load to cross over to the truck and be let

down. It is advisable to pour some old sump oil on the mounting block to enable the engine to slide freely when unclamped. The mounting block should be very firm and, in turn, mounted on two posts set well into the ground.

The engine is started by a removable handle from the rear shaft (D), or it may be started by pulling on the winch chain while the slings are still loose.

If the preceding paragraphs have been followed carefully, with reference to the drawings, there should be no difficulty in constructing a similar outfit. There is no reason why an engine other than an A.J.S. should not be used as the principle would be the same for most power units.

MOLASSES FOR POTASH DEFICIENT SOILS.

While recent reports received from representatives of the fertilizer trade regarding future supplies are more reassuring, it is nevertheless desirable that efforts be made to utilize existing Australian resources to the best advantage.

In relationship to potash, all of which is at present imported, this would call for better supervision in the rationing and distribution of molasses which is extensively employed in several areas as a means of building up depleted soils. For obvious reasons this by-product is most effective when applied to soils which are potash-deficient, and as far as practicable molasses utilization might be confined to areas of such lands.

In the Cane Growers' Handbook it is stated that difficulty would be experienced in spreading molasses evenly in amounts of less than 5 tons per acre. This would provide, of course, much more potash than the heaviest cane crops would need. In conversation recently, a northern cane grower pointed out that molasses applications of 2 or 3 tons per acre may be made satisfactorily, with a little care and assistance on the part of the farmer. We would definitely recommend, then, that the by-product be applied in dressings of these dimensions, where molasses is regarded largely as a source of potash to the ensuing crop. On average composition, 2 tons will provide the equivalent of 2½ cwt. of muriate of potash per acre, or as much potash as is contained in 5 cwt. of Sugar Bureau No. 3 planting mixture—the richest mixture available for such soils. In addition, it will provide organic nitrogen equivalent to about 2 cwt. of sulphate of ammonia.

It is certainly more economical to apply 2 tons per acre to each of two successive ratoon crops of cane, than to apply 5 tons per acre to first ratoons only. This is particularly true in regions of high summer rainfall, where losses of potash, due to leaching, are of a high order.

We would also stress—although it should be obvious—that after applying molasses the farmer does not require any potash in the artificial manure subsequently employed. It might be advantageous to apply superphosphate or meatworks manure in moderate amounts and a top dressing of sulphate of ammonia will be of value, especially on older ratoons.

H.W.K.

(*The Cane Growers' Quarterly Bulletin* for April.)

Control of Rats in Queensland Cane Fields.

By W. A. McDOUGALL.*

LOSSES in the canefields of Queensland, as in many other countries, are caused by rats biting into the sticks of standing cane crops; the losses vary considerably from year to year and at times are considered to be severe. It is a difficult matter to calculate, with any degree of accuracy, the loss incurred by rat attacks in any field or on a particular farm and counts, weighings, and the consequent comparisons of clean and bitten sticks give irregular and unreliable results. Varietal factors and crop type are of some considerable importance and these tend to upset most of the apparently accurate methods devised. It would seem that the best indication of the aggregate amount of cane lost is the difference between an estimate (made by a competent man) of the cane which should be harvested from particular fields or farms and that which ultimately could be actually delivered to the mill. In the computation of total loss from rat damage, extra harvesting costs (if any) should be added to cane lost and an allowance should be made for depressed C.C.S. In regard to the latter, it is seldom, if ever, that severe rat damage results in a loss of more than one unit of commercial cane sugar in cane delivered to a mill in Queensland.

From an economic viewpoint, the control of rats in canefields means the reducing of such losses to as low a figure as possible by a reasonable expenditure of money. There are two avenues of approach to this problem—viz., (1) attempts to protect the crop, despite the presence of rats, and (2) attacking and interfering with the rat population. It is considered that, under all conditions, best results will be obtained from a judicious combination of both methods, rather than from trusting completely to either one of them.

To date, the only known economic method of direct protection of cane is associated with the selection of more suitable varieties. It is known that, although under certain conditions *all* varieties may be damaged by rats, there are certain varietal characteristics which offer some degree of protection. A "rat resistant" variety should be thick barrelled, moderate to hard rinded, and not prone to lodging.

In the matter of "attacking and interfering with the rat population," the three methods usually available are clearing of harbourage, trapping, and poisoning. Trapping is expensive, and has no advantages whatsoever over poisoning, in attempts to reduce rat populations. Its chief uses in the field are in checking up on any controls, research work, and in providing useful information for the general guidance of those supervising rat control.

Of the six herbivorous or omnivorous rat species with which cane workers might come into contact, only two have any intimate relationship with close ground cover, such as grass, weeds, shrubs, &c., which is the usual conception of harbourage. These two rats are the Field Rat (*Rattus conatus* Thomas) and the Smaller Khaki Rat (*Melomys littoralis* Lonn.); the latter also inhabits, in comparatively large numbers, "palm tree" swamps where the Field Rat seldom exists unless a close floor covering is present. The harbourage of the Larger Khaki Rat (*Melomys cervinipes* Gould) and the Scrub Rat (*Rattus assimilis* Gould) is rain forest or scrub. The native habitat of *Rattus culmorum* T. & D.

* In *The Cane Growers' Quarterly Bulletin* for April, 1940.

is very restricted and, as it seldom comes in contact with cane, this rat is of minor importance in the problem of controlling rat damage to sugar cane. The House Rat (*Rattus rattus* L.) is often present in canefields, but it also nests in scrub, trees, buildings, and in many places where the native rats are seldom found. The House Rat will be found in greatest numbers in cane situated near and in mill townships, or near farm buildings; they seldom inflict economic damage to these crops. When all cane is harvested it is these field-living *house rats* which enter buildings or dwellings; the Field Rat will not enter houses. Occasionally a Smaller Khaki Rat may be seen in a farm house and *M. cervinipes* sometimes becomes a nuisance in scrub camps. However, these intrusions are more accidental than consistent.

The species of rats damaging cane in any district will depend upon the amount of cane coming into contact with the native habitats of the different species; for example, if there is a large amount of "scrub" cane the Larger Khaki Rat will make its presence felt. The two "grass rats"—i.e., the Field Rat and the Smaller Khaki Rat—are present in all areas.

It is often stated that when and where there are a large number of rats there is extensive and intensive harbourage. This is true, of course, but it sometimes is forgotten that there is often a large amount of harbourage in known rat country but few rats. The association of harbourage with rats is much more obvious in the case of "grass rats" than it is with those connected with scrub, but both types exhibit somewhat parallel population fluctuations.

Another favourable factor of Field Rat environment is damp, friable soil. In a year of large rat populations this factor usually spreads and coincides with large areas where only harbourage (including cane) existed for any length of time during seasons of small rat populations. Nevertheless, it does not follow that this creation of large areas suitable for rat habitation will in turn produce large rat populations (e.g., heavy and prolonged wet seasons are not always followed by rat plagues); there are still other factors, which react on the rats themselves, for the production of excessive populations.

To sum up the status of harbourage destruction as an aid in the control of cane rats: Fundamentally the subjects are not sufficiently closely related to warrant any undue emphasis being placed on this point. In years of light rat infestation large scale destruction is unnecessary, and during seasons of heavy infestation, when every little help is desired, the project, carried out on a scale sufficiently large to be of any use whatsoever, would probably be both uneconomic and impracticable.

Many investigators have encountered difficulties when attempting to poison house rats. To a certain extent these difficulties do not exist when dealing with our indigenous cane rats in Queensland. Individually it is comparatively easy to poison them with a suitable bait. Also, once it has been established that a certain bait can give satisfactory results it may be used indefinitely; there is no reason to assume that a periodic change of bait will improve attempts to reduce rat populations under any of differing circumstances which may be encountered.

Under Queensland conditions baits with arsenic, red squills, barium carbonate, strychnine, and glycerol monochlorohydrin do not provide or promise the same degree of efficiency as those containing yellow

phosphorus or thallium sulphate. The successful administration of thallium sulphate to rats depends upon the consumption of considerable amounts of a desired rat food and, as a bait base, wholewheat has been found to be the most suitable. Thallium sulphate treated wheat at a strength of 1 : 300 is recommended as the most suitable bait of this type for Queensland canefield conditions.

Yellow phosphorus paste on bread has been used as a rat bait in houses for many years. Queensland canefield rats are far from partial to bread (either fresh or stale) as a food, and the paste itself is not very palatable to these rats. Nevertheless, this very cheap bait, containing the most deadly of all known rat poisons, may be highly successful in canefields as its remarkably high toxicity carries it through. With this bait it is not necessary for a large "take" to be experienced to obtain good results. The idea of "take," mass consumption, and palatability is one which, unfortunately, has become too closely associated with the efficiency of a bait. It is submitted that a better criterion is the effect of a particular bait in reducing rat populations. In this regard phosphorus paste on bread and 1 : 300 thallium sulphate treated wheat are, under suitable conditions, both good despite their different palatabilities.

The thallium treated wheat bait can be weather-proofed, if desired, by packeting in weather-proof material. Phosphorus baits are commonly supposed to lose their toxicity after a few nights in the field. However, it has been found that these baits are quite toxic over a considerable period, and it is the palatability which decreases suddenly after the laying of the baits.

The addition of such materials as linseed oil or corn oil to baits does not improve or otherwise interfere with the efficiency of the baits.

In different cane areas of Queensland different methods of placing baits and times of baiting are employed. Some centres believe in continuous all-the-year-round poisoning both in harbourage and (mostly from May to November or December) in cane. Others concentrate on poisoning in grass harbourage and along headlands and partially neglect to place baits in cane. Whilst not attempting to decry the first-mentioned method, it is considered that it is unnecessarily costly: also its effect in controlling total rat populations in areas as large as cane districts is negligible compared with that exerted by weather conditions. Where rats are present, the placing of baits on ten-yard grids has been found most efficient. Smaller spacing seems unnecessary and larger distances do not cover the average wanderings of the individual rat during a reasonably short period of time.

In the past, attempts to control rats in cane by the use of baits have given mixed results. When failures occur the type of bait and/or method of laying baits and/or times of baiting are blamed. Variations in these factors are then tried. It is considered that the only steps which should be taken are to increase the amount of bait and shorten time lapses between baiting periods. Often these failures are not the fault of the particular bait being used; they are more fundamental.

On the other hand, there are occasions when rat population size and movement are such that economic poisoning ceases to provide any appreciable degree of control.

Briefly crystallizing the above discussions in the form of specific recommendations for rat control in canefields:—

1. Plant more rat resistant varieties in rat infested country and on places in farms (such as near well-grassed creeks and scrub) where past experience has shown that rats may be expected to attack cane.
2. Poison with phosphorus on bread or 1:300 thallium sulphate treated wheat; the cheaper phosphorus is quite suitable for most purposes. Place the baits on the ground on small areas (which have been cleared with a hoe or the boot) every 10 yards, along every seventh row of damaged cane. Baits should also be placed in patches of damaged cane, and in harbourage near rat-eaten cane. Baiting should commence immediately the presence of rats is noticed in the canefields. Further baits should be put out whenever and where fresh rat bites are seen in the cane.

The provision of rat baits or poison is a matter which is best carried out by the local Cane Pests Board or other central organisation.

APPLY FERTILIZERS EARLY!

We have always advocated that applications of mixed manures to plant cane should be placed in the drill—for preference, just below the cane setts. This assures the earliest possible supply of phosphate and potash to the young cane, and is especially important on lands highly deficient in these plantfoods.

If Sugar Bureau mixtures are employed, the amount of nitrogen added is insignificant. This is planned deliberately, for if the farmer has green manured the land during the fallow, ample nitrogen should subsequently be available for the full needs of the plant cane.

There are, however, certain circumstances in which these planting mixtures might be improved upon: (1) on land which is known to be highly deficient in nitrogen (that is, where sulphate of ammonia gives good results even with plant cane), and where no green crop has been grown; or (2) in every case where, for one reason or another, the farmer finds it necessary to "plough-out and replant." An early nitrogen deficiency may be so acute in these circumstances that the development of the plant cane may be seriously retarded, unless more nitrogen is applied in the planting drill.

Under such conditions, the use of Sugar Bureau *ratooning*, rather than *planting*, mixtures is advised; or, alternatively, the application of a mixture rich in meatworks manure may be substituted. Such treatments have proven particularly valuable in the Lower Burdekin district, where the application of nitrogenous fertilizers is the only plantfood treatment which gives consistently beneficial results.

H.W.K.

(*The Cane Growers' Quarterly Bulletin* for April.)

The Veterinary Medicines Acts, 1933 to 1938.

Veterinary Medicines Registered for the period January, 1939, to December, 1941.

List No. 2 (supplementary to List No. 1 issued July, 1939).* Published on 31st December, 1939, in accordance with section 6 (7) of the Acts.

F. B. COLEMAN, Registrar of Veterinary Medicines.

	Reg. No.
Animal Health Station, Yeerongpilly—	
First and Second Blackleg Vaccines	333
Bazley, C.B., Dalby—	
Bazley's Specific	1393
Buzacotts (Queensland) Limited, Brisbane—	
Bio Fowl Pox Vaccin	273
Captain Products (Queensland), Brisbane—	
Sterelin	1772
Vetrelin	2508
Pronto	2509
The Committee of Direction of Fruit Marketing, Brisbane—	
Waratah Nicotine Sulphate	1665A
Covington, Misses L. and M., Toowoomba—	
Magic Mange Cure	1928
Cramsie Dwyer and Company, Wallangarra—	
Pleuro Vaccine (Pure Culture)	1914
Blackleg Vaccine	1941
Stoctone (Concentrated) Drench	2178
G.T.S. Tetrachloride Double Strength Worm and Fluke Drench	2024
David, F. D., Brisbane—	
Happidog Vitone	2336
Denhams Proprietary Limited, Brisbane—	
"Poultry's" Canker Paint	252
Wondertone	319
Chickhealth	440
"Poultry's" Eye Roup Cure	441
"Poultry's" Great Bronchial Remedy	442
"Poultry's" Iron Tonic Mixture	443
"Poultry's" Scaley Leg Ointment	444
"Poultry's" Special Roup Cure	445
"Anticocid"	2338
Wart Ointment	2494
Duffin, C. J., Innisfail—	
Mourilyan Alterative Worm and Condition Powders	2042
Duffin's Dog Condition Powders	2319
Finney, L. W., Brisbane—	
Telson Fluke Drench	88
Telson General Purpose Drench	89
Telson Poultry Powder	234
Telson Salve	2493

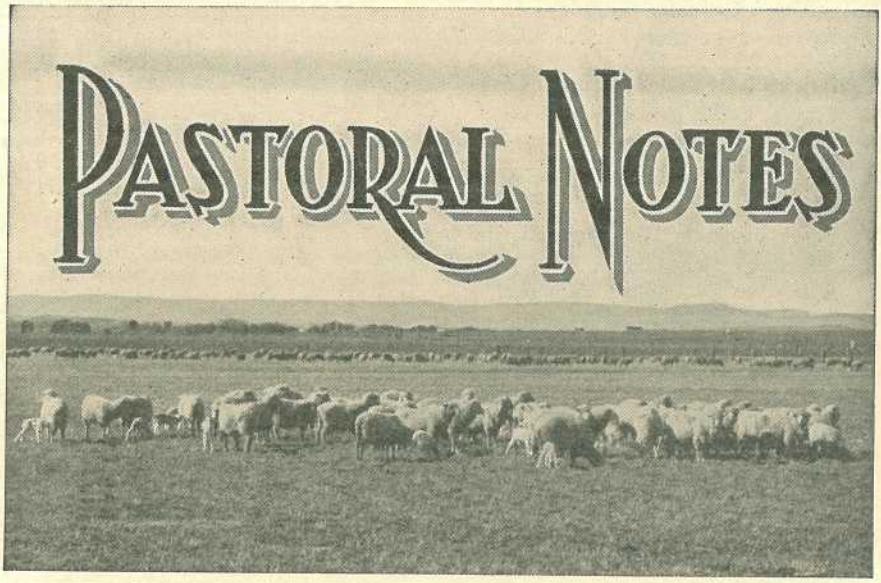
* List No. 1 was published in the "Queensland Agricultural Journal," July, 1939, page 91, together with details relating to the requirements of the Acts.

	Reg. No.
Flynn Bros., Brisbane—	
Osmond's Worm Drench and Fluke Kill	431
Osmond's "Vermiline" (Lamb Worm Drench and Tonic)	2548
Goldsbrough and Company Limited, Brisbane—	
Harton Veto-Cide	394
"Harton" Arsenical Sheep Drench	1377
Hall and Company, F., Brisbane—	
Hall Mark Blowfly and Worm Exterminator in Sheep	2489
Happidog Stores Proprietary Limited, Brisbane—	
Happidog Worm Syrup	2488
Hayes Veterinary Company, Brisbane—	
Gonadin Serum	1919
Mactaggarts Primary Producers' Co-operative Association, Limited, Brisbane—	
"Max-Tar" Dehorning Dressing	2449
McDonald and Company, A. H., Brisbane—	
Vetamac Sheep Drench	2185
Vetamac Germicide and Antiseptic	2375
Vetamac Bluestone Nicotine Worm Drench	2591
New Zealand Loan and Mercantile Agency Company Limited, Brisbane—	
Cooper's Sheep Worm Drench	2503
Cooper's Liquid Worm Remedy for Puppies and Dogs	2504
Cooper's N.C. Sheep Worm Drench	2600
Nobles Proprietary Limited, Brisbane—	
Sykes's Animal Colic Remedy	37
Norris Agencies Proprietary Limited, Brisbane—	
Sidolia Stock Drench	2498
Nyal Company, Brisbane—	
Krect Dog Ointment	2500
Parke Davis and Company, Brisbane—	
Parke Davis C.A. Worm Capsules R.B. (No. 196)	2506
Aloin Cathartic Ball (Compressed)	2522
Kamala	2592
Poultry Farmer's Co-operative Society Limited, Brisbane—	
Merval	1122
Queensland Pastoral Supplies Proprietary Limited, Brisbane—	
Stockaid Nikos	1867
Salmond and Spraggon (Australia) Proprietary Limited, Brisbane—	
Bob Martin's Tasteless Distemper Powders	422
Sharkey, S. B., Mackay—	
Sharkey's Hobble Chafe Lotion	2440
Steggall, P. M., Toowoomba—	
King's Worm Capsules	2171
King's Greyhound Tonic	2172
King's Pad Paint	2173
Stewart, S. H., Sandgate, Brisbane—	
Bot Capsule	1482
Worm Capsules	1483
Chemco Dog Condition Powder	1484

	Reg. No.
Tatnell and Graham, Gympie—	
Spedosol Powder	26
Taylors Elliotts and Australian Drug Proprietary Limited, Brisbane—	
Row's Embrocation	130
Doyle's Laryngine	168
Reducine	170
Rainbow Famous Mixture for Dogs of All Breeds	2374
Vitaforce Products (Queensland), Brisbane—	
Vitaforce Dog Soap	2556
Vitaforce Distemper Capsules	2557
Vitaforce Blue Lotion	2558
Vitaforce Puppy Worm Syrup	2559
Vitaforce Worm Capsules	2560
Webster Bros., Proprietary Limited, Brisbane—	
Pro-Vet Anti Toxic Drench	185
Pro-Vet Salve	201

Index of Brands that are not indicated in the foregoing list by the Primary Dealer's Name.

Brand.	Primary Dealer.
Bio	Buzacotts (Qld.) Ltd.
Bob Martin's	Salmond & Spraggon (Aust.) Ltd.
Chemco	Stewart, S. H.
Cooper's	New Zealand Loan & Mercantile Agency Co. Ltd.
Doyle's	Taylors Elliotts & Australian Drug Pty. Ltd.
G.T.S.	Cramsie Dwyer & Co.
Happidog	David, F. W.
Harton	Goldsbrough Mort & Co. Ltd.
King's	Steggall, P. M.
Krect	Nyal Co.
Magic	Covington, L. & M.
Max-Tar	Mactaggarts Primary Producers Co-op. Assn. Ltd.
Mourilyan	Duffin, C. J.
Osmond's	Flynn Bros.
Poultry's	Denhams Pty. Ltd.
Pro-Vet	Webster Bros. Pty. Ltd.
Rainbow	Taylors Elliotts & Australian Drug Pty. Ltd.
Row's	Taylors Elliotts & Australian Drug Pty. Ltd.
Sidolia	Norris Agencies Ltd.
Spedosol	Tatnell & Graham.
Stockaid	Queensland Pastoral Supplies Ltd.
Stoctone	Cramsie Dwyer & Co.
Sykes's	Nobles Pty. Ltd.
Telson	Finney, L. W.
Vetamac	McDonald & Co., A. H.
Waratah	Committee of Direction of Fruit Marketing.



Strangles.

THIS is an acute, contagious, febrile, catarrhal disease affecting horses, mules and asses. Young animals are usually attacked, and acquire an immunity which may be lifelong, although aged animals are sometimes affected, the disease following a mild course.

Strangles is caused by a streptococcus, which is found in the lymph glands and nasal discharges of affected animals.

There are two forms of the disease—simple strangles, which runs a relatively mild course of from three to four weeks, and a much more serious form in which the catarrh leads to broncho pneumonia and, at times, an abscess may burst internally and set up gangrenous pneumonia, or the organism infects the blood stream and sets up abscesses in the lungs, liver, spleen, and kidneys, causing death within a few days.

Simple strangles is characterised by inflammation of the upper air passages, evidenced by a cough with a nasal discharge, at first clear and watery, and later thick and yellowish with fever, and abscess formation in the lymph glands situated in the angle of the jaws (submaxillary).

The eyes become reddened and discharge, respiration is increased, and the pulse later becomes rapid and weak. The animal is listless, with staring coat and refuses food.

Treatment.—The patient should be made comfortable in an airy shed or box, and, if cover is not available, should be rugged and allowed to remain untied in an open yard, but in strict isolation from other young animals.

Feed should be offered in a box on the ground, and the appetite tempted with green stuff, bran mashes, &c., in small quantities at a time, with water constantly available, to which may be added nitrate of potash—one ounce to three gallons of water which has had the chill taken off it in cold weather.

Discharges from the eyes and nose should be removed daily with cotton wool soaked in a mild disinfectant—such as peroxide of hydrogen, permanganate of potash, or boracic, in weak solution—after which the nostrils may be moistened with olive oil, which prevents discharges from drying around the parts.

Feed boxes and buckets should be kept disinfected and free from discharges.

The development of the abscess may be hastened by the application of hot fomentations, mustard poultices, or of weak biniodide blister, when it will usually burst spontaneously. If this does not happen the abscess should be opened with a sharp disinfected knife, selecting as a site for the incision a soft spot which will be found in the swelling. Too early surgical interference is not desirable. The contents of the abscess should then be squeezed out and the wound disinfected, and kept open until the discharge ceases.

With careful nursing and good feed, recovery in most cases is rapid.

Preventive treatment consists of three inoculations with Commonwealth Strangles Vaccine at intervals of four days. Treatment of infected animals with this vaccine is valuable, but the services of a veterinary surgeon are necessary, as the dosage must be carefully watched and altered as indicated by the reaction of the patient.

"LUMPY JAW" OF CATTLE.

Actinomycosis—"lumpy jaw" or "wooden tongue"—is a common disease of cattle. There are two forms of the disease, indicated by the foregoing terms, one of which attacks the bones of the jaw and the other the tongue. Strangely enough, each form is caused by a different type of organism.

These organisms are found on the grass, and infection probably takes place through a small injury to the gums. From there they penetrate the tongue or the jawbone, as the case may be.

Advanced cases are easily recognised by the stockowner. In one form, the tongue is increased in size and may be so large as to project out of the mouth. It is very hard to the touch—hence the term "wooden." When the jaw is attacked there is often considerable swelling and pus formation. The pus works its way to the exterior, and openings are produced through which the pus flows. Extension of the process leads to the formation of several openings and the jaw may, as a result of the formation of new bone tissue and inflammatory swelling, grow to an enormous size.

Bad cases, whether of the tongue or jaw form, lead to emaciation of the animal because of the difficulty in taking food. Owners are not advised to attempt treatment of bad cases. It is better to destroy the animals, as they may cause infection of other stock.

In the case of valuable animals, if the disease is not too far advanced, treatment may be possible, and owners are asked accordingly to get in touch with the Animal Health Station, Yeerongpilly.

RESTING STOCK BEFORE SLAUGHTER.

The importance of resting stock before slaughter cannot be stressed too strongly.

Considerable loss is incurred annually through partial and total condemnation of carcases at slaughter-houses and bacon factories for bruised and fevered conditions resulting from the slaughter of animals immediately on their arrival.

Sometimes in the yarding of pigs whips or sticks are used, and a troublesome pig may receive quite a few hits before it is actually penned. Pigs are usually fat and soft and are, therefore, easily bruised. Very severe bruising, too, may be caused behind the jaws of pigs as a result of their having their heads jammed when they are being drafted into various pens. In such cases as these, where the pigs are slaughtered almost immediately upon arrival the slaughtering inspector may find it necessary to remove large areas of bruised flesh from the carcase, and may have to remove the head and, perhaps, cut up high into the neck, almost to the shoulder.

Practically all such partial condemnations of pigs would be avoided if the owners of slaughter-yards made provision for spelling the animals a few days before slaughter, so that any bruising which may have occurred shall have time to vanish.

With cattle, it is also important not to have the animals slaughtered as soon as they have been delivered, more particularly if they have travelled long distances either by rail or road.

When cattle are trucked they may be bruised, either by the horns of other beasts or by bumping against the sides of the truck while the train is in motion. Likewise, when cattle travel by road they may arrive at their destination in a condition of semi-exhaustion, because of weather conditions and the distances they have been required to travel on the hoof. When these cattle are slaughtered immediately on delivery, the inspector has almost invariably to condemn a certain amount of meat, and sometimes a whole carcase, for fever or bruising.

These condemnations would, in most cases, be avoided if the cattle were rested for a few days after their journey in order that they may recover from an injury or exhaustion before they are slaughtered.

HORSES EARN THEIR SALT.

A good farm horse is well worth his feed. Most farmers realise this, but all too frequently plough horses may be seen licking the dried sweat from each other.

Working horses are incapable of sustained effort without a liberal supply of salt, and when the food is low in this mineral they try to remedy the deficiency by licking the saline deposit from evaporated sweat round the collar, saddle, and other gear of a team mate.

It is, therefore, sound practice to keep rock salt in a convenient place for working horses.

USE OF DIPPING FLUIDS.

Dipping is a routine practice throughout the heavily tick-infested areas of the State, and all solutions used contain arsenic as their base. No other substance has been found to equal arsenic in the treatment of ticky cattle.

The dipping solutions, which are used under Government control, and are applied to cattle moving from ticky to clean country, must, by law, contain 8 lb. of arsenic per 400 gallons of solution. It has been shown, however, that this solution has a reasonably wide margin of safety and that for all ordinary purposes a solution containing 6 lb. of arsenic is effective in the treatment of ticks. It is of interest to note that the South African authorities require a solution to contain just over 6 lb. per 400 gallons.

A cheap and effective dipping solution can be made up by using arsenic and caustic soda. Six lb. of arsenic require somewhere about 2 lb. of caustic soda to dissolve it. If the two ingredients are placed in the bottom of a drum, one on each side, and water added slowly as by a cup or pannikin, and the two substances slowly mixed together with a stick, it will be found that the water commences to boil and bubble. This is due to a chemical action taking place between the arsenic and the soda, and the former is soon dissolved. Water may then be added up to 400 gallons. A dipping solution such as this is very efficient and cheap.

If washing soda is used, it is necessary to boil the solution before the arsenic goes into solution. This, however, is a disadvantage, as it takes time.

Where owners use caustic soda it is very necessary to keep the container closed very tightly, so that air does not enter. If exposed to air, the caustic soda is changed chemically by the absorption of moisture and sodium carbonate or washing soda is produced. Properly sealed containers prevent this.

MERINO EWES FOR FAT LAMB RAISING.

Fat lamb raisers may be handicapped in their industry by the scarcity of the right type of ewe. This disability applies not only in Queensland, but, to a lesser degree perhaps, in all the other States.

In Queensland, 98 per cent. of the sheep are merinos. It becomes necessary in nearly all cases, therefore, to start breeding for fat lambs with ewes of this breed.

The grazier could help the fat lamb industry and, at the same time, obtain a profitable price for ewes culled for strength of fibre on his property by supplying suitable ewes to the fat lamb raiser. This applies especially where very strong-woolled merinos are bred. There is nearly always a line of strong wool running to roughness when the type indicated is used.

The fat lamb industry can stand this roughness in the ewes, provided size and constitution are there, and both the grazier and fat lamb raiser would be well served—the grazier as to price and the lamb raiser as to type—if they could come to a business relationship.

The ewes described are really valuable to the farmer, but, unfortunately, are often slaughtered because of lack of realisation of their usefulness in the fat lamb industry.

BOTFLIES IN HORSES.

About this time of the year consideration should be given to drenching horses for bots. In determining the period of the year when drenching for these parasites will give best results, their life history must be considered.

The adult flies occur throughout the late spring and summer. During this time they lay their eggs upon the hairs of certain parts of the horse's body. These eggs hatch in time and the young larvae or bots enter the mouth of the horse. Here they remain for a certain period in the tissue of the tongue and cheeks. They eventually reach the stomach where they are to be found throughout the winter. During the late winter and spring they leave the stomach and are passed out with the dung. After a resting stage in the ground, the larvæ are gradually transformed into adult flies which eventually emerge and commence to lay eggs.

If the horse is drenched during the spring and summer, it may therefore readily become reinfested. Adult flies may still be prevalent and many eggs are yet to hatch; and there may be larvæ in the tissues of the cheeks and tongue which are protected from the drug. In the late autumn, however, all larvæ are in the stomach and are easily killed and removed by treatment.

To be most effective, all horses not only on the one farm, but on every farm in a district, should be treated during late autumn.

The most effective drug is carbondisulphide. The animals are starved for 24 hours before and for 4 hours after treatment. The drug is enclosed in a gelatine capsule and given as a ball at the rate of 6 cubic centimetres for every 250 lb. weight. Care should be taken not to allow this ball to break in the mouth as its effects may end fatally for the horse. If such an accident should happen, wash the mouth out at once with clean rain water.

COUNTING SHEEP.

It may be taken as a fact that unless one is born with or has developed an aptitude for this work he will never make a first-class sheep counter. There are many methods of counting. The novice will try and count them singly as they come—one, two, three, four, and so on. This is a very slow process, and the gate has to be very narrow if an accurate tally is to be obtained.

Some count in twos—two, four, six, eight, and so on. This again is slow where big flocks have to be dealt with, and the sheep would be better on grass than in the break.

A successful method is to count in groups of three, one up to thirty-three, and let a single sheep go and tally 100.

It is astonishing to observe the speed and correctness of two good counters, one giving delivery and the other taking delivery.

It is a rare thing when two good men are engaged to see a check count, and this applies where thousands of sheep have to be correctly tallied. Constant practice is necessary to keep in form. To this cause may be attributed the fact that many drovers excel in counting sheep.

Care of Milking Machines.

MILKING machines, although they have revolutionised dairying methods, may, if mishandled or neglected, constitute one of the biggest menaces to milk and cream quality that the dairy farmer has to face. Many people hold the opinion that clean milk of good keeping quality and choice grade cream cannot be produced with a machine, but this has been investigated fully and both research work and practical experience have proved that it is wrong. As good a quality of milk can be produced by machine as by hand, provided the correct procedure is followed in care and cleaning.

Another objection often brought forward is that the machine tends to increase udder trouble. This is, of course, true if the farmer fails to notice cases of infection as soon as they occur and allows diseased cows to be milked by the machine. The great importance of inspecting the foremilk for any abnormal appearance should be realised, and any cow showing signs of mastitis in the first-drawn streams should be milked out by hand and the milk isolated from that used for human consumption. Cows with sore teats should also be milked by hand, although the machine may safely be used if they are left until last. A machine is very unlikely to cause teat sores—in fact, one Queensland dairy farmer with a large herd has experienced complete freedom from them over six months since he started machine milking—but it is liable to transfer the infection if used subsequently, without sterilization, on other cows.

The solution of most milking machine troubles lies in proper cleaning and sterilizing after each milking. It is essential that cleaning should be done promptly after milking is completed before the milk solids have time to dry on the rubber parts, for once dry they are far more difficult to remove completely. The first machines were crude inventions made with ordinary rubber parts which were easily cracked and pitted by the action of fat and hot water, making them excellent breeding places for contaminating bacteria. Nowadays, the modern machines are solidly built and the rubbers are of the very best quality

resistant to high temperatures, so that they can safely be boiled and even sterilized regularly by steam, without injury.

The method of dealing with milking machines using a weak solution of caustic soda in boiling water is well adapted to Australian conditions and has proved economical, rapid, and successful. This method is as follows:—

(1) One gallon of clean *cold* water is drawn through each set of teat cups by suction, lifting the unit up and down in a bucket of water to allow air to mix with it.

(2) The outsides of teat cups and rubber tubing are then washed and brushed in *warm* water and caustic soda.

(3) At least one gallon of *boiling* caustic soda solution is drawn through each separate set of teat cups, holding them so that all receive equal treatment.

(4) The solution is removed completely by drawing at least 2 gallons of *boiling* water through each set of cups.

(5) If steam is available this is applied for five minutes to complete the sterilization.

Strength of Solution.—One full teaspoonful of caustic soda added to every 4 gallons of boiling water is the correct amount and, provided this strength is not exceeded, no damage will be done to the machine, and satisfactory results will be obtained. Used carelessly, however, caustic soda is dangerous in its action, and care is needed in handling it and in making up the solution. The water used must be really boiling to achieve proper cleansing and sterilization, and by this treatment the resistance of the rubber parts to cracking is actually increased.

The vacuum line is often a source of trouble, and should receive a complete flushing once each day with boiling water, care being taken not to flood the pump. All taps should be left open when the machine is not in use, and the teat cups should be hung up in a cool dust-free place. The use of chemicals other than in the washing process has been found to be unsatisfactory, and there is great danger of traces of them finding their way into the milk and cream and causing taints.

FEEDING OF CONCENTRATES.

Farmers are often adverse from feeding concentrates which impart a flavour or "taint" to the butterfat. Peanut products are a typical example. In many cases the difficulty may be overcome by feeding the material immediately after milking. The animal then is assured of sufficient time, before the next milking, in which it can utilise the constituents liable to give the off flavours.

A COW'S AGE AND ITS EFFECT ON MILK.

How does the age of a cow influence the composition of milk? This is a question often asked. From the dairyman's point of view the fat is the most important constituent, and much experimental work has been carried out to determine how the fat test varies with the age of the cow. It has been shown that, with advancing years, cows produce milk containing a diminishing percentage of fat. The variation observed is not of any serious consequence, but it is nevertheless noticeable when average figures are taken. A cow of a high testing breed which shows an average test of 5 per cent. of fat as a young animal will decline to about 4·5 per cent. if she continues to produce to fourteen years of age.

It is sometimes thought that a heifer showing a low test as a two-year-old may improve as she matures. There are no grounds for such a belief, and any farmer building up hopes of this nature is likely to be very disappointed. The richness of milk is a matter of inheritance, and so far as is known nothing can be done to change it in an individual animal.

An interesting feature with this work is that mathematicians have taken an interest in it, and one man has actually worked out a formula for calculating the fat test for any specified age, provided that the average test for the first milking period is known.

The effect of age on the other constituents of milk has also been studied, and there is a decrease, with age, in all constituents except albumen, which increases slightly from year to year.

The effect of age on the fat test (richness) of milk should not be confused with the effect of age on milk production. There is a gradual increase in the quantity of milk produced from year to year until a maximum period is reached, after which the production figures show a slow decline. The age of maximum milk production for most breeds has been shown to be eight or nine years.

MARGINAL CREAM.

Modern methods of manufacture and factory equipment have done much to enable the utilisation of cream, which a few years ago would have been discarded. Nevertheless, the dairying industry still offers no exemption to the general rule that the quality of raw materials directly influences the character of the manufactured product. The addition of a few faulty cans of cream to a vat may thus cause the spoilage of otherwise choice quality butter. Only a thorough knowledge of the origin and nature of a given defect can help in determining the fate of doubtful cream.

There is a limit to the capability of machinery and manufacturing technique to offset defects in cream quality, and no factory can afford to slur over defects in the cream received. Any laxity in this respect is really doing the farmer a disservice, for he may remain unaware that better-quality cream is required, and takes less instead of more care on the farm.

First-quality butter can only be obtained when the farmer realises that the remedy for cream defects is essentially his responsibility.

Pig-feeding.

GRAIN enters largely into successful pig-raising. The price of maize often makes feeding problems difficult for the pig farmer. On the mixed farm, every effort should be made to conserve the carbohydrate-rich crops—Swede turnips, arrowroot, and pumpkins—for the pigs. Molasses can be substituted for half the maize in a ration, but great care must be exercised in getting the pigs accustomed to this quantity. It should be done gradually.

Open grazing should be practised as extensively as possible; and, when porkers show a lean unthrifty appearance, it will probably pay to carry them on to bacon weight. The farmer with a good stock of feed should be wary of buying more weaners than he can feed. If the separated milk supply is not sufficient, producers are strongly advised to use the meat meal now on the market. It is an excellent substitute.

While curdled separated milk has a slightly higher feeding value than fresh milk in pig-feeding, the use of the former is not recommended as a general practice.

The usual method of souring milk on the farm is by holding it for a period in a vat or drum, which usually has an inside lining of decaying milk. This decomposing milk may contain not only the bacteria which cause normal souring of the milk, but also bacteria which are capable of decomposing the milk and turning it into a condition which is harmful to the pig. Further, when souring is practised under uncontrolled conditions, the feeding value of the milk may be greatly reduced by excessive souring.

Considering the very slight advantage of good soured milk over good fresh milk and the grave risk of an injurious decomposition of the milk when it is soured under the usual farm conditions, it is better to feed the milk fresh from the separator after the froth has been removed.

Milk should not be allowed to remain in the trough after pigs have had their meal. Any milk held over between one separating and the next should be kept in clean drums or cans, which are washed and scalded daily.

The sudden changing from sour milk to sweet milk, or from sweet milk to sour milk, in a pig's diet, may readily cause digestive disorder.

PIG-BREEDING RECORDS.

On every farm where the farmer breeds his own pigs some form of breeding record should be kept, for a record of the productivity of each sow, as well as a herd average, will contain information of much value to the observant breeder. Such records are not difficult to set out, and but a few minutes would be required each week to keep the book up to date. Therefore, a very small expenditure of time and money will ensure a supply of information which may be the means of adding materially to the income from the piggery.

A simple record may be prepared in the following way:—Take an ordinary exercise book or card, and across the top of two facing pages, or the card, rule two lines, between which the breed, name, and date of birth of the sow may be written. Then rule vertical lines to the bottom, and in the spaces between these lines there should be written such information as date of service, date of farrowing, number born, number weaned, pigs sold or killed for meat, gross returns, and remarks. In the remarks column, a note should be made of any pigs born dead, the causes of losses up to weaning, and deaths after weaning, as well as remarks concerning the type of growth rate of the litter.

When a complete breeding record is kept for each sow on the farm, the owner can, by studying the individual records, note the sows which have had small litters, or have not reared litters well, and so on. Therefore, if a sow's performance is not good, she should be replaced. By doing this, the average for the herd is raised, to the ultimate benefit of the owner.

Another use for records is to compare the results obtained from different foods. By feeding different rations to groups of pigs, and keeping a record of the amount of food eaten and the weight increases made on different rations, the farmer can determine for himself the foods which will give the greatest gain in weight for the least cost or labour.

The useful information to be gained from breeding records does more than merely compensate for the brief time and light expense involved.

Name and Address.	Name of Hatchery.	Breeds Kept.
G. Adler, Tinana	Nevertire ..	White Leghorns, Australorps, Rhode Island Reds, and Langshans
F. J. Akers, Eight Mile Plains ..	Elmsdale ..	Australorps
E. J. Blake, Rosewood	Sunnyville ..	White Leghorns, Australorps, White Wyandottes, and Rhode Island Reds
A. F. Buchler, Milman	Pincrow ..	White Leghorns
J. Cameron, Oxley Central ..	Cameron's ..	White Leghorns and Australorps
M. H. Campbell, Albany Creek, Aspley	Mahaca ..	White Leghorns and Australorps
J. E. Caspaney, Kalamia Estate, Ayr	Evlington ..	White Leghorns
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
T. G. Crawford, Stratford, via Cairns	Rho-Isled ..	Rhode Island Reds
Dr. W. Crosse, Musgrave road, Sunnybank	Brundholme ..	Australorps, White Leghorns, and Rhode Island Reds
O. M. Dart, Upper Brookfield ..	Woodville ..	Australorps, White Leghorns, Langshans, and Rhode Island Reds,
Dixon Bros., Wondecla ..	Dixon Bros. ..	White Leghorns
F. G. Ellis, Old Stanthorpe road, Warwick	Sunny Corner ..	Australorps
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
G. Grice, Loch Lomond, via Warwick	Kiama ..	White Leghorns
J. W. Grice, Loch Lomond, via Warwick	Quarrington ..	White Leghorns
Mrs. M. Grillmeier, Mount View, Milman	Mountain View	Australorps, Minorcas, and Rhode Island Reds
C. and C. E. Gustafson, Tannymorel	Bellevue ..	Australorps, White Leghorns, and Rhode Island Reds
P. Haseman, Stanley terrace, Taringa	Black and White	Australorps and White Leghorns
C. Hodges, Kuraby	Kuraby ..	White Leghorns and Anconas
H. Hufschmid, Ellison road, Geebung	Meadowbank ..	White Leghorns, Brown Leghorns, Minorcas, Australorps, and Rhode Island Reds

Name and Address.	Name of Hatchery.	Breeds Kept.
J. McCulloch, White's road, Manly	Hindes Stud Poultry Farm	White Leghorns, Brown Leghorns, and Australorps
F. McNamara, Vogel road, Brassall, Ipswich	Frammara ..	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 Electric	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, Beaudesert rd., Cooper's Plains	Norups ..	White Leghorns and Australorps
H. W. and C. E. E. Olsen, Marmor	Squaredeal ..	White Leghorns, Black Leghorns, Australorps, Brown Leghorns, and Anconas
A. C. Pearce, Marlborough ..	Marlborough Stud Poultry Farm	Australorps, Langshans, 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 Poultry Breeding Farm	White Leghorns, Brown Leghorns, Australorps, Langshans, White Wyandottes, Rhode Island Reds
G. R. Rawson, Mains road, Sunnybank	Rawson's ..	Australorps
J. Richards, Atherton	Mount View ..	White Leghorns and Australorps
H. K. Roach, Wyandra ..	Lum Burra ..	Australorps and White Leghorns
C. L. Schlencker, Handford road, Zillmere	Windyridge ..	White Leghorns
S. E. Searle, New Cleveland road, Tingalpa	Tingalpa ..	White Leghorns and Australorps
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	Cosy Nook ..	White Leghorns and Australorps
A. G. Teitzel, West street, Aitkenvale, Townsville	Crescent ..	White Leghorns
W. J. B. Tonkin, Parkhurst, North Rockhampton	Tonkins' ..	White Leghorns and Australorps
W. A. Watson, Box 365, P.O., Cairns	Hillview ..	White Leghorns
G. A. C. Weaver, Atherton ..	Weaver's ..	Australorps, White Leghorns, Buff Leghorns, Wyandottes, Anconas, Indian Game, Rhode Island Reds, Barred Rocks, Buff and Black Orpingtons
H. M. Witty, Kuraby ..	..	White Leghorns and Australorps
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 applications received up to the 20th March, 1940:—

Name and Address.	Name of Hatchery.	Breeds Kept.
W. Brown, Waterworks road, Ashgrove	Strathleven ..	White Leghorns
B. Cross, Apple Tree Creek, Childers	Spring Hill ..	White Leghorns, Australorps, and Langshans
W. Easson, Formosa road, Tingalpa	Grassdale ..	White Leghorns and Anconas
B. E. W. Frederich, Oxley road, Corinda	Glen Albyn ..	Australorps
S. W. Kay, Cemetary road, Mackay	Kay's	White Wyandottes, Light Sussex, Rhode Island Reds, Australorps, White and Brown Leghorn
C. Mengel, New Lindum road, Wynnum West	Mengels ..	Australorps
P. and K. Walsh, Cleveland ..	Pinklands ..	White Leghorns

MAN AND ANIMAL—SYMPATHY, NOT SENTIMENT.

Country life is never successful when divorced from consideration of the animals which make it prosperous. Starving sheep, miserable cows, and sore-backed horses are generally owned by hard people, except when emergencies, such as drought, occur.

As care for the welfare of our stock increases, so also does our satisfaction with the job we have taken on. Money does not come into the question at all. This satisfaction is worth something far more than cash, and cannot be bought. After all, livestock must never be compared with machines. There is only one standard to use for animal comfort and that is a personal one. We have to put ourselves in the animal's place under each set of conditions and consider whether they would be comfortable to us, too. If not coming up to this standard it is not fair to expect too much from the animals under conditions less than comfortable.

Most stockowners are sincerely anxious to do everything possible, or practicable at the time, for the comfort of their flocks and herds. Some of us, however, are inclined not to think too hard about such matters as salt in the paddocks for the sheep or rugs for dairy cows and horses in cold weather.

Apart from making stock comfortable in the paddock or in the yard, there is a return worth having in the shape of the increased confidence animals develop in the man who looks after them. Any horse trainer will tell us that. There must always be a sympathetic bond—not a sentimental one—between man and animal before either reaches his best in the partnership of animal husbandry. Probably nothing puts right a man's attitude to his animals more easily than to develop his own understanding of the extent of the dependence of his stock on his efforts. This is very important, because, little as he imagines it, almost everything the stock gets comes from his own doings. Take paddocks, for example—when fenced we say with a flourish of the sweat rag: "Thank goodness, the stock are secure now." So they are, but secure from what? It is all too easy to forget that when we let stock go into a paddock from that moment we completely control their existence. No longer can they look for a belt of thick scrub to shelter from the hot summer sun or camp in on frosty winter nights, unless we have been wise enough to provide for them beforehand. It is surely up to us to provide for all emergencies so that our stock can have the most comfortable conditions of living possible in all the circumstances.

Trees for shade and shelter should be provided on every farm.

—From "The New Zealand Farmer Weekly."

Fodder Conservation in Central Queensland.

THE importance of fodder conservation in Central Queensland cannot be too strongly emphasised, as the transition from an extensive to an intensive use of land has become not only desirable but necessary from an economic point of view. The irregularity of the summer, and, more particularly, the winter rainfall makes it imperative to practise fodder conservation.

Adequate supplies of conserved fodder are essential to ensure continuous production of butter and other farm products. The following suggestions may assist in achieving the desired objective:—

Rotational grazing of both native and artificial grasses ensures the most profitable use of the pasture and requires the subdivision of the grazing area into small paddocks. By grazing each paddock in rotation, the grass is fed in its most nutritious form. The young green grass—continuously available when rotational grazing is practised—possesses a high protein content and little fibre, and the nutritive ingredients are very palatable and readily assimilated by stock. Under good seasonal conditions, the stock will be unable to cope with the rapidly growing grass. The surplus should be cut when the seed head has just formed, and stored as reserve fodder.

Rhodes grass, so plentiful in the scrub or rain forest areas, as well as ordinary forest grasses, can conveniently be conserved, either as hay or ensilage. While the conservation of fodder as hay is very convenient, it is interesting to note that well-made ensilage is highly nutritive, and can be held for long periods without deterioration.

Hundreds of tons of valuable green feed, which could be converted easily into nutritious fodder, are allowed to waste away annually. During the present season, enormous quantities of pasture have been allowed to seed, and the nutritive value of the herbage lost. The value of this to the farmer, had it been conserved, would have been considerable.

Lucerne stands supreme as the most useful of all fodders. Unfortunately, the crop needs rather special soil conditions, but when these are favourable, at least a small area should be sown. It is particularly

adaptable to grazing and hay-making, but the first cut or two from a new lucerne patch are often used in combination with some other form of fodder for ensilage.

The dry seasons which occur sometimes in Central Queensland demand quick-growing crops which recover rapidly after light rains. Sudan grass is better suited to these conditions than the millets. It gives heavy yields over a season's growth; it can stand repeated cutting, and provides feed well into the winter; it produces fine quality green feed, especially after the first cutting, and may be used for either hay or ensilage; and it will grow on comparatively poor soils.

Sorghums generally are especially valuable, as they provide both a bulky and nutritious fodder. Sorghum withstands dry conditions better than maize. It also thrives on poor as well as fertile soils, and provides green, succulent feed well into the winter. When grown for use with Sudan grass and cowpea, an excellent combination of crops for ensilage is provided. Sorghum should be harvested for ensilage when the seed is in the dough stage, and is best chaffed before the silos are filled.

The rainfall during the summer months is usually sufficient to produce summer fodder crops, but, unfortunately, winter rains are rather unreliable. In the more favoured areas sufficient rains occur to ensure at least good fodder crops of wheat and oats.

The benefits to be derived from conserving fodders are being gradually appreciated by farmers. Excellent crops are at present being grown in some places in Western Queensland, where the bore water is suitable. Farmers in these favoured localities should utilise the available bore water for the production of fodder crops, to some extent, at least.

NEW QUEENSLAND-BRED SEEDLING CANES.

From time to time progress reports are presented on the early performances of new and promising seedlings raised by the Bureau. Eventually certain of these are propagated for distribution, and they duly appear in the list of approved varieties for areas where they may be tried by growers generally.

It would appear from comments which we sometimes hear that, because canes are "approved" in this manner, our action is regarded as a specific recommendation for all farmers to plant them. This is certainly not correct. Farmers should appreciate that, unless a cane is listed as approved, they are not permitted to plant it, except by special prearrangement with the Bureau. When any new cane is added to a list, we mean to convey that we consider it worthy of trial, and we usually give an indication of the general conditions under which it might have value. In no circumstances is it suggested that a grower should plant more than one or two acres of any new variety which has not been tested extensively, and its true worth established.

H.W.K.

(The Cane Growers' Quarterly Bulletin.)

CROP ROTATION.

Rotation of crops is generally necessary in most systems of farming, if the fertility and physical condition of the soil are to be maintained. Apparently, every crop requires some particular combination of plant foods, and by growing the same crop season after season on the same soil, a depletion of the main plant foods required by that crop results. Hence, after continuous cropping for some years, yields may become unprofitable. By growing different crops in rotation, the productivity of the soil may be maintained or even improved in the case of naturally inferior types of soil.

Rotational systems vary with the climatic conditions and the range of profitable crops.

Crops used in rotational systems in various parts of the world are frequently grazed off by stock, or harvested for fodder. Any accumulated manure is thus returned to the land. Where such systems are practised, the organic matter ploughed in as dung assists in maintaining the soil in a satisfactory physical condition. Where stock-raising is less important, a green manure must be included in rotations, which include nitrogen-requiring crops, to obviate any excessive depletion of nitrogen and organic matter. If climatic conditions are suitable, crops such as cowpea, soy-bean, clovers, and other legumes can be grown and ploughed under as green manure. Such green manuring usually increases the yields of the following crops.

In dry areas, green manuring has not proved so beneficial, as the organic matter decomposes rather slowly. Long fallows have therefore been developed, particularly in wheat-growing districts. When the crop is harvested, the land is ploughed as early as possible and left in a rough state to trap all subsequent rains. If the crop is stripped, the standing straw should be burned before ploughing, otherwise it may be difficult to obtain a compact seed-bed, and there is some risk of the following crop being deprived of nitrogen.

Crop rotation has received little attention in Queensland, because of the natural fertility of soils which have only been cultivated for a comparatively short period. Climatic conditions have also favoured the cultivation of a particular crop within a well-defined area. As a result, crops such as wheat, cotton, peanuts, and arrowroot are more or less confined to districts which have proved suitable for their successful production.

The need for a more diversified farming system, using a variety of crops in rotation, is clearly necessary in some old cultivations where specialisation in one crop has both decreased fertility and impaired the physical condition of the soil.

Properly devised rotational systems can be expected to yield larger crops, to ensure economy in the use of manures, and generally result in the more profitable working of the available land.

HEAVIER SEEDING FOR POONA PEAS.

Reference has been made previously to the fact that Poona pea is grown less on the alluvial soils of Bundaberg than on any other soil type in the area. It was pointed out that with their naturally high moisture supply large crops could be grown on the river lands almost independently of the season, and that it is on these lands that an increased nitrogen supply is generally most needed.

Growers on the alluvial country have frequently pointed out that the grassy and weedy nature of their farms is the principal reason that Poona pea crops are not grown. They claim that the pea crop will not prevent the development of grass and weeds—which seed during the growth of the peas—and thus a further supply of unwanted seeds is ploughed into the ground when the peas are turned under. It is preferable—they argue—to keep the land in bare fallow, and cultivate to kill weeds until ready for planting.

There is much in the above arguments on these particular soils, but a recent experiment of a Bundaberg river farmer throws a new light on the subject. The normal seeding of Poona pea in Bundaberg is 15 lb. per acre. This is ample in most soils to give a good cover, though sometimes a little grass may be seen surviving amongst the crop. The farmer referred to above sowed his river land with 40 lb. of Poona pea seed per acre. After germination the young plants were so thick that they rapidly covered all the ground surface, developed into a tall heavy crop, and at time of ploughing in no weeds or grass could be found in the field. Such weed and grass seed as germinated was shaded out and died—thus giving the same effect as cultivation on bare fallow. At the same time the grower obtained a crop which cannot fail to improve the subsequent cane crop. Another benefit accruing from the heavy seeding—and this time an unexpected one—was the fact that the Poona pea main stems were thinner and less woody than is usual in more thinly planted crops; this made ploughing in easier.

During the same season a grower on the red forest sandy soil near Bundaberg reported identical results with a 40 lb. per acre seeding. Weeds and grass were again smothered, a thin-stemmed crop of peas of more than normal height was obtained, and a distinct improvement was noted in the ease with which they were cut by the disc and turned into the soil.

N.J.K.

(The Cane Growers' Quarterly Bulletin.)

THE FARMERS OF THE FUTURE.

No educational movement of recent years has made greater progress than the junior farmer club movement, as represented by the school project clubs in Queensland and the junior farmers' clubs in the other States.

In New South Wales the number of junior farmers' clubs is now over 350, with a membership of nearly 9,000, of whom over 3,000 are boys and girls who have left school. The girls and boys themselves actually held just over 100 club and district shows last year. The quality of the exhibits prepared by the young farmers has everywhere improved in both stock and produce. Many juniors are now members of the registered stock societies. Many boys win in open competitions, some have quite large dairy herds, and some fathers have followed their sons' advice in the improvement of pastures, in the growing of lucerne, and in farm management generally.

These are only a few indications of what the junior farm club movement means to the youth of our land, to the primary industries, and to the country generally.

How to Plant a Deciduous Fruit Tree.

FROM the time trees leave the nursery until they are permanently planted, they should never be left exposd to sun, wind, or air, when it possibly can be avoided.

Trees waiting for planting should be heeled-in with moist earth about the roots, and only taken out of the ground when actually needed for setting. The hole dug for a tree should be large enough to permit the roots to spread out naturally in all directions. It is unnecessary to dig wide holes if the trees are heavy-rooted, for the roots must be trimmed back at transplanting time.

All broken, torn, and dead roots should be cut back to fresh living wood. When the clean cut surfaces come in contact with moist soil. new roots are formed very readily.

Filling in the holes is most important in planting the tree. To get the best results, moist soil must be placed closely around the roots, preferably by hand, so that no air holes or crevices are left.

When the trees are placed in position, the roots are spread out and a shovelful or two of fine earth thrown in upon them. The soil should be carefully worked in between the crevices and, when the hole is about one-third full, the soil about the roots of the tree should be tramped down firmly. Moving the tree up and down, while the earth is being filled in, will assist materially in eliminating air holes and in bringing the soil into close contact with the roots. There is little danger of the earth being over-packed, but trees often die for lack of tramping.

After the roots are all covered and packed in tightly, the hole may be filled in with loose soil. Tramping the top of the ground after completely filling the hole is undesirable.

When planting the tree allowance must be made for the looseness of the ground in deciduous fruit areas in the Stanthorpe district. If the tree is set only as deep as the collar, it will be well out of the ground

twelve months later, when the land has settled down. Hence, to ensure the best results, the collar of the young tree should be from 4 to 6 inches below the surface of the ground. In twelve months' time the collar will be at the proper depth—namely, level with or just under ground level.

If possible, trees should be planted not later than the end of July. The root system will then be established before the buds start to shoot. Later planting is apt to be too great a tax on the tree's resources.

Since the roots have been cut back prior to planting, it is necessary to cut back the top of the tree proportionately in order to maintain a balance between the top and the root. If this is not done, the tree, when it comes into leaf, will lose moisture faster than the reduced root system can supply it, and death may result.

A tree should be headed low—the best height being 18 inches to 2 feet. The most uniform orchards are made by setting whipsticks in preference to headed trees. With whipsticks, the grower can form any desired type of head, whereas trees headed in the nursery often possess badly formed heads which have to be cut off and re-formed in the orchard.

Three, or at most four, main limbs at the start are enough for any fruit tree. If properly placed on the trunk, it will never be necessary to cut out a large limb—a step which is undesirable except in the most extreme cases.

The main limbs should not all start out at the same height from the trunk, for if all the weight of limbs and of fruit is directed at a single point, the tree is liable to split. Opposite crotches should be avoided.

The after-cultivation of freshly-planted trees, as well as all other trees, is most important. It is a loss of both time and money to plant trees unless the orchardist is prepared to look after them. Young trees left to struggle against weeds, drought, and a poverty-stricken soil suffer severely. If, by chance, they do survive, they become stunted, and are never of much value. Great care is necessary in cultivating an orchard, for the careless use of horses and implements can do very great harm to the trees.

CABBAGE-GROWING FOR MARKET.

The cabbage is one of the most important vegetables for the market gardener. It grows best in the cooler districts, but by carefully selecting varieties the crop may be grown in most parts of Queensland.

The seed should be sown in beds of well-drained, deeply and thoroughly worked soil. The soil, if heavy, should be improved by the addition of sand or decayed vegetable matter; if poor and sandy, the addition of a loamy soil or well-rotted manure will be beneficial.

The surface of the bed should be fertilized and firmed, and the seed sown thinly in shallow drills about 4 inches apart. After sowing, mulch the bed with well-rotted leaf mould to prevent excessive evaporation of moisture.

The seed-bed must be watered regularly, for a check on the growth of young seedlings is often followed by unsatisfactory results.

When large enough to handle, the seedlings should be thinned to an inch apart, for if grown too thickly they develop into long, spindly, weak plants.

Shading during the hottest part of the day is often necessary, but this shade should be removed as soon as the plants are strong enough to withstand the heat. Overshading also produces spindly plants. Approximately 1 lb. of seed will provide sufficient plants for an acre of cabbage.

In about six weeks the young plants should be large enough for transplanting. They may then be hardened off by restricting water supplies for a day or two before their removal to the field. Transplanting should be done in cloudy or showery weather, but if weather conditions are unfavourable the young seedlings should be watered in, and, as a further precaution, the top half of the leaves may be trimmed off to lessen transpiration until the root system is established.

Loosening of the soil in the seed-bed with a fork before lifting the plants helps to save many of the small roots. If the bed has been well soaked previously, the plants will lift with a ball of soil adhering to the roots, which will help to keep them moist.

The roots of the young plants should be kept damp after removal from the bed, and this may be done by standing them in a bucket containing a puddle of soil and water.

In planting, a hole is first made in the ground with a dibble—an old spade or digging fork handle is suitable. The hole should be only deep enough to allow the roots of the seedling to reach the bottom of the hole. Turn in a little earth, and then draw the plant slightly upwards before pressing the soil firmly around it. This ensures that the main root will not be doubled up.

The plants should be in rows 3 feet apart; in the rows the smaller varieties should be spaced 2½ feet and the larger varieties 3 feet apart. The growth of cabbages should on no acocunt be checked. Regular cultivation and watering are, therefore, essential.

The right varieties should be selected for different times of the year. Winter-planting types should be early and quick maturing.

In the cooler areas, seed of the early varieties is sown during autumn. Main crop varieties are sown between August and December. The coastal districts are best suited to the winter crop.

Cabbage should be marketed as soon as possible after cutting, and only good, firm-hearted vegetables should be sent for sale. Care in handling is essential, and when placed in bags for railing they should be packed as firmly as possible.

Recommended varieties are:—

Early.—Early Allhead and Early Drumhead, both of which are large, early, and quick growers.

Main Crop.—Succession is the most popular variety, and may be grown almost any time. It is a good large Drumhead type.

Surehead is slightly larger than Succession. It is hardy, and, may be planted closer in the rows, as it has fewer outside leaves.

HANDLING CITRUS FRUITS.

The harvesting of citrus fruits will soon be in progress, and for several weeks to come growers will be chiefly concerned in the marketing of their crops.

Care in the handling of citrus fruits pays the grower handsomely. Rough handling contributes towards wastage losses in export fruit and in fruit being held by local markets, because, chiefly, of green and blue moulds, which are familiar to every citrus-grower.

These moulds are fungal parasites disseminated by means of spores which chiefly gain entrance to the fruit through bruises and skin abrasions.

The healthy unbroken skin of the orange is proof against almost all decays.

Abrasions may be caused during picking operations by the finger nails of careless pickers, or by allowing the clippers to cut into or prick the rind of the fruit when cutting the stem.

By the use of clippers with cup-shaped blades and rounded points, there is no excuse for the fruit being clipper-cut whilst the gloves on the hands will prevent finger-nail injury.

All stems should be cut off short and smooth; otherwise they are likely to puncture the skin of other oranges during handling.

Another source of damage is protruding nails on the inside of the picking boxes, the points pricking into perfectly good oranges, causing punctures through which spores may enter.

The picking boxes should be well made; the internal surfaces of the boxes should be finished smooth to avoid friction during transit of the fruit from the orchard and the packing shed.

It is not only necessary for the orchardist himself to be careful, but he must also see that his employees are not negligent.

In the packing shed most growers make some provision to ensure cleanliness; nevertheless, there are some who do not appreciate the obvious necessity for hygiene. Occasionally uncovered buckets and tins are observed containing mouldy fruits in various stages of breakdown which are allowed to accumulate from day to day. Where this occurs, those responsible for the cleanliness of the shed fail, apparently, to realise the enormous number of spores produced from mouldy fruit which are dispersed in the form of "mould dust" capable of reproducing the same decay in all punctured and bruised fruit with which it comes in contact. It is essential that all waste and reject fruit which accumulates during each day's work should be effectually destroyed daily by burning. Moreover, a frequent washing of the floors of the packing shed with a ½ per cent. caustic soda solution, or other suitable fungicide, will reduce mould contamination within the shed.

The Fruit Market.

JAS. H. GREGORY, Instructor in Fruit Packing.

WITH winter approaching, growers should allow their fruit to advance further in colour and ripeness. This applies particularly to pineapples and papaws for Sydney and Melbourne markets. Complaints have already been received from the South as to the immaturity of some consignments. With colder weather the risk of overripe deliveries is greatly lessened. For that reason, too, it takes longer for immature fruit to ripen, hence the wisdom of allowing fruit for winter disposal to show more evidence of ripening than is usual with summer consignments. Notice should be taken of complaints about unripeness, otherwise prohibitive action may become necessary in the interests of consignors as a whole. It is hardly fair to allow a market to be spoilt by a few growers who ought to know better than to send unripe fruit to the South.

Water blister in pineapples and "squirter" in bananas have been troublesome. More care in handling would help to reduce loss from these causes.

Grapes generally have been of excellent quality, but later deliveries were evidently affected by adverse weather. Citrus fruits are selling at nearly normal values. Complaints of unripeness of citrus fruits have also been rife. It is just as well to understand clearly that the buyer does not want green fruit, and if some growers persist in sending it the inevitable result will be a lessened demand, and so, again, the majority may have to suffer for the thoughtless or careless few.

Prices for the last week of April:—

TROPICAL FRUITS.

Bananas.

Brisbane.—Smalls, 11s. 6d. to 15s.; sixes, 12s. to 18s.; sevens, 14s. to 20s.; eights and nines, 17s. to 22s.

Bunch bananas.—

Cavendish, 2d. to 7d. dozen.

Lady Fingers, 2½d. to 9d. dozen.

Sugars, 2d. to 6d. dozen.

Sydney.—Sixes, 14s. to 18s.; sevens, 16s. to 21s.; eights and nines, 18s. to 24s.

Melbourne.—Sixes, 12s. to 17s.; sevens, 14s. to 19s.; eights and nines, 16s. to 21s.

Adelaide.—To 24s. tropical case.

Pineapples.

Brisbane.—Smoothleaf: 3s. to 7s. 6d. case; specials higher. Loose: 2s. to 3s. dozen. Roughs: 6s. to 9s. case; 2s. to 6s. dozen.

Sydney.—7s. to 12s.; few higher.

Melbourne.—Smoothleaf: 7s. to 13s. per tropical case.

Water blister prevalent.

Papaws.

Brisbane.—Yarwun, 5s. to 8s. 6d. tropical case; Locals, 2s. to 5s. bushel case.

Sydney.—7s. 6d. to 14s. tropical case.

Melbourne.—14s. to 18s. tropical case.

Custard Apples.

Brisbane.—2s. 6d. to 4s. half-bushel case.

Sydney.—4s. to 6s. half-bushel.

Melbourne.—4s. to 6s. half-bushel.

Monstera Deliciosa.

Brisbane.—2s. 6d. to 3s. 6d. per dozen.

CITRUS FRUITS.

Oranges.

Brisbane.—Navels: 7s. to 12s. case. Commons: 5s. to 8s. case.

Sydney.—Queensland, 8s. to 12s.

Brisbane.—Locals, 7s. to 12s.; Gayndah, 8s. to 16s.

Mandarins.

Brisbane.—Emperor: 7s. 6d. to 12s. Fewtrells: 6s. to 9s.

Sydney.—Emperor: 10s. to 14s. Fewtrells: 8s. to 11s.

Melbourne.—Emperor: 14s. to 16s. Fewtrells: 8s. to 12s.

Grapefruit.

Brisbane.—4s. to 9s.

Sydney.—Queensland, 8s. to 12s.

Melbourne.—9s. to 13s.

Lemons.

Brisbane.—Locals, 7s. to 12s; Gayndah, 8s. to 16s.

Sydney.—Queensland, 9s. to 16s.

Melbourne.—9s. to 14s.

OTHER FRUITS.

Passion Fruit.

Brisbane.—Firsts, 16s. to 20s.; seconds, 10s. to 15s.

Rosellas.

Brisbane.—2s. 6d. to 3s. 6d. sugar-bag.

Grapes.

Brisbane.—Waltham Cross, 10s. to 13s. case; Purple Cornichon, 10s. to 14s.; Muscatels, 7s. to 11s.

DECIDUOUS FRUITS.

Apples.

Brisbane.—Granny Smith, 11s. to 13s.; Duke Clarence, 7s. to 8s.; Jonathan, 7s. to 10s.; Cleopatra, 8s. to 10s.; Alfristan, 7s.; French Crab, 6s. to 10s.; Delicious, 8s. to 11s.; Scarlets, 7s. to 9s.; Ribston Pippin, 5s. to 6s; Cox's Orange, 5s. to 6s.

Pears.

Brisbane.—Beune de Capimont, 9s. to 10s.; Beune Anjou, 9s. to 11s.; Winter Cole, 10s. to 14s.; Packham's Triumph, 9s. to 12s.

Tomatoes.

Brisbane.—Ripe, 1s. 6d. to 5s.; Coloured, 4s. to 8s.; Green, 4s. to 6s.

MISCELLANEOUS, VEGETABLES, &c.

Cabbages.—Local, 4s. to 8s.; Stanthorpe, 8s. to 12s.

Cauliflowers.—4s. to 16s. dozen.

Beans.—Brisbane, 3s. to 8s. bag; Sydney, 6s. to 14s. bushel; Melbourne, 5d. to 6d. lb.

Peas.—7s. to 14s. bag.

English Potatoes.—5s. to 7s. sugar-bag.

Sweet Potatoes.—2s. to 3s. bag.

Parsnips.—6d. to 1s. 6d. bundle.

Carrots.—4d. to 1s. 3d. bundle.

Beetroot.—6d. to 2s. bundle.

Lettuce.—9d. to 3s. dozen.

Chokos.—4d. to 9d. dozen.

Pumpkins.—Brisbane, 4s. 6d. to 6s. bag; Sydney, 6s. to 10s. cwt.

Marrows.—1s. 6d. to 5s. case.

Cucumbers.—Brisbane, 5s. to 7s. bushel; Sydney, 6s. to 10s. bushel.

SPORTSMANSHIP IN THE SHOW RING.

To be successful, every show exhibitor has to be a sport. Stockowners who have given many years to breeding and exhibiting show stock are usually good winners and good losers. The compliment of being a good winner or a good loser is even better than that of being a good breeder or a good exhibitor of live stock. To be a good winner or loser is a virtue which all exhibitors at our shows should possess, and it is a virtue that builds friendship. To be one who can gracefully win or lose in sporting acceptance of the judge's verdict—or, in the language of the day, one who "can take it"—is to have every real sportsman's respect.

The world admires a good winner, but it admires a good loser even more.

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 Friesian Cattle Society, production charts for which were compiled during the month of March, 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.).				
Rhodesview Strawberry 2nd	W. Gierke and Sons, Rhodesview, Helidon ..	10,884·27	400·255	Rhodesview Red Knight
Junior, 4 Years (Standard, 310 lb.).				
College Gold 3rd	Q.A.H. School and College, Lawes	10,190·69	405·278	Trevlac General
Senior, 3 Years (Standard, 290 lb.).				
Glen Idol Daphne	Estate P. Doherty, Box 31, Gympie	9,100·35	364·485	Excellency of Blacklands
Glen Idol Daphne 2nd	Estate P. Doherty, Box 31, Gympie	9,059·75	338·754	Excellency of Blacklands
Alfa Vale Gladys 3rd	J. E. Heath, Springlea, Merlwood, Murgon ..	7,678·7	308·369	Reward of Fairfield
Senior, 2 Years (Standard, 250 lb.).				
Rhodesview Nancy 22nd	W. Gierke and Sons, Rhodesview, Helidon ..	7,638·71	338·385	Rhodesview Red Knight
College Raceme	Q.A.H.S. and College, Lawes	8,294·28	330·663	College Sergeant
Glengarry Heatherbell	G. Waugh, Glengarry, Peeramon..	7,369·35	309·417	Blacklands Patron
Junior, 2 Years (Standard, 230 lb.).				
Trevlac Hazel	W. V. Lubke, Glamorganvale	7,917·5	304·27	Trevlac Hinkler
Glen Idol Primrose	Estate P. Doherty, Box 31, Gympie	9,424·4	372·807	Excellency of Blacklands
Happy Valley Artdene	R. R. Radel, Happy Valley, Coalstoun Lakes ..	6,146·00	278·231	Sunnyview Artist
Boah Peak Ruby 2nd (265 days)	Mrs. E. E. Bruggemann, Boah Peak, Silverleigh	7,130·25	263·222	Glenroy Admiral

JERSEY.

MATURE COW (STANDARD, 350 LB.).

Kensington Fairy Queen	Miss J. Nowlan, Lindum	6,761·2	369·464	Trinity Recompense
Lyndhurst Pussy	J. Sigley, Millaa Millaa	7,249·00	353·226	Lyndhurst Butter King

JUNIOR, 4 YEARS (STANDARD, 310 LB.).

Keystone Mintie	E. J. Keys, Proston	8,364·75	431·862	Trinity Bright Royal
Oxford Rosary	E. J. Keys, Proston	6,302·45	345·836	Oxford Rivoli

SENIOR, 3 YEARS (STANDARD, 290 LB.).

Bellefaire Pride's Exaltation	J. Richardson, Oakwood	5,529·11	341·436	Design's Soeurette Pride
Keystone Claribelle	E. J. Keys, Proston	5,932·8	305·002	Gunawah Gamboge Prince
Bellgarth Opal 2nd	K. W. Gadsby, Bonathorne, Jandowae	5,742·76	296·529	Trecarne Renown 2nd

SENIOR, 2 YEARS (STANDARD 250 LB.).

Hocknell Golden Girl	N. C. Webb, Beaudesert	8,050·77	428·56	Bremerside Zilla's Boy
Hopewell Mavoureen	Geo. Hurley, Childers	5,647·96	353·575	Carnation's Queen Golden
Inverlaw Lady Myrtle	R. J. Crawford, Inverlaw, Kingaroy	5,650·78	339·462	Little Jack of Inverlaw
Tecoma Bunnie	W. J. Semgreen, Tecoma, Coolabunia	5,090·9	305·418	Bruce of Inverlaw

JUNIOR, 2 YEARS (STANDARD, 230 LB.).

Inverlaw Phyllis	R. J. Crawford, Inverlaw, Kingaroy	9,756·3	543·939	Oxford Royal Lad

FRIESIAN.

SENIOR, 2 YEARS (STANDARD, 250 LB.).

Tent Hill Stella	W. H. Grams, Upper Tent Hill, Gatton ..	9,876·12	336·74	Tent Hill Starlings Actuary

General Notes

Staff Changes and Appointments.

Mr. K. L. Coates, Macnade Sugar Mill, Halifax, has been appointed mill-owners' representative on the Macknade Local Sugar Cane Prices Board in place of Mr. N. S. Beatty.

Constables J. S. Toohill and H. N. Smith, Chinchilla, have also been appointed inspectors under the Brands Acts and the Slaughtering Act; and Constable P. B. Guymer, Warra, also has been appointed an inspector under the Brands Acts.

Mr. E. T. Lewin, inspector of stock, Department of Agriculture and Stock, Brisbane, will be transferred to Boonah.

Messrs. A. L. Gabriel, Merrimac, Mudgeeraba, and A. Turner, Homebush, via Mackay, have been appointed honorary protectors under "*The Fauna Protection Act of* 1937."

The appointment of Mr. N. G. Monroe as an inspector under the Stock, Slaughtering, and Dairy Produce Acts, Department of Agriculture and Stock, has been cancelled, and Mr. D. S. Robertson has been appointed to the vacancy.

Mr. A. G. Colyer, Tidalmaree, Benaraby, has been appointed an honorary protector under "*The Fauna Protection Act of* 1937."

The following have been appointed honorary protectors under the Fauna Protection Act:—Messrs. C. F. Schultz (Woodhouse Station, Ayr), W. Gunn (Kildonan, Goondiwindi), D. W. O. McIntyre (Strathmore, Toobeah), H. P. McIntyre (Gradna, Talwood), and S. O. D. Arthur (Keetah, via Yelarbon).

Central Coast Stallion District.

A Proclamation has been issued under the Stallions Registration Acts amending the description of the Central Coast Stallion District to include the petty sessions districts of Clermont, Emerald, and Springsure. The Central Coast district formerly comprised the petty sessions districts of Gladstone, Mount Morgan, Banana, Rockhampton, and St. Lawrence.

Canary Seed—Surplus Production.

The Minister for Agriculture and Stock (Hon. F. W. Bulcock), in a recent statement on the canary seed position, said he wished to bring to the notice of farmers on the Darling Downs the fact that the statistical position in relation to supplies of canary seed was such that no justification existed for continued production of this crop on the scale which had been reached in recent years. It was disturbing to the market, continued the Minister, that the record canary seed crop, garnered after the bounteous season of 1938-39, should have coincided with increasing production of canary seed in the Southern States, and with a reported decline in the popularity of keeping caged birds as a hobby.

As a result of these factors, trade channels are well stocked with canary seed, and the condition of the industry would be safeguarded and improved if growers refrained from growing the crop for the production of seed this season.

In the past two seasons, the Canary Seed Board had been able to obtain bank finance for the payment of advances to growers, only with the assistance of a Government guarantee. The guarantee was given in respect of the past season's crop to give the industry breathing time in which to set its house in order. The guarantee was made available on condition that the Canary Seed Board prevailed on growers to reduce production substantially during the coming season.

The canary seed plant is a valuable fodder crop, and where plantings have already been made they should be fed off or converted into hay for feeding to animals, and so be eventually marketed in the form of meat or milk for a better return than appears to be obtainable for the sale of seed from the crop.

The Minister added that with the facts and figures at his disposal it was clear that neglect on the part of the growers to respond to this suggestion could only result in a state of chaos and disorganisation from which the industry may not recover for many years.

Canary Seed Board.

An Order in Council has been issued under the Primary Producers' Organisation and Marketing Acts, amending the constitution of the Canary Seed Board to provide that elections of growers' representatives on such Board shall be held triennially, and that such representatives shall hold office for a period of three years.

Answers to Correspondents

BOTANY.

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

A Native Panic Grass.

T.W.K. (Feluga, N.Q.)—

The specimen is *Brachiaria miliiformis*, a native panic grass, for which we have not heard a local name. It is fairly widely spread in Queensland, but is mostly found in old cultivation areas or where ground has been disturbed. When found as a member of the ordinary pasture, it generally appreciates loose, sandy soil. The grass is generally regarded as of high feeding value, as palatable to stock, and is worth fostering.

Johnson Grass.

N.C.L. (Texas)—

Your specimen is Johnson grass (*Sorghum halepense*). This grass, like other members of the Sorghum family, contains a prussic-acid-yielding glucoside, and there is always a certain risk in feeding it to cattle. Cattle should never be allowed on to it on an empty stomach.

Blue Grass. Pitted Blue Grass.

R.K.B.M. (Wondai)—

1. *Dichanthium sericeum*, Blue Grass. Generally regarded as one of the best and most palatable of our native grasses.
2. *Bothriochloa decipiens*, Red Leg, Bitter or Pitted Blue Grass. A very inferior species that frequently overruns eaten-out country.

Spiny Burr Grass.

R.B.M. (Toowoomba)—

The specimen forwarded is *Cenchrus pauciflorus*, commonly known as Spiny Burr Grass in New South Wales. It is a native of America, and has probably been in Australia for many years. In Queensland it is, so far, only met with on the Darling Downs, where it seems to be spreading. Elsewhere it is usually regarded as a pest, mainly of sheep, as it catches in the wool and is extremely difficult to remove, as well as causing irritation when it penetrates as far as the skin. In America, it is reputed to be one of the most difficult burrs to remove from wool. Where possible, its spread should be prevented, although it has not yet become a serious pest in this State.

Bean Vine. Silk Cotton Tree.

C.J.G. (Brisbane)—

The plant with the pods and large black seeds is *Mucuna gigantea*, sometimes known as black bean or bean vine. It has a wide distribution in coastal Queensland and is not known to possess any economic properties. The pods are covered with short hairs, which are very irritating if they get between the fingers.

The silky material is from the silk cotton tree *Bombax malabaricum*, a tree with a wide distribution through India, the Malayan region, New Guinea, and Northern Australia. The silky cotton surrounding the seeds can be used as a substitute for kapok, but is very inferior to true kapok, and the demand for it is very limited. We do not know of any market for it in Australia.

A Native Sorghum.

R.C.B. (Chinchilla)—

The specimen is *Sorghum leiocladum*, a native Sorghum with a fairly wide distribution in Queensland, and especially common in some parts of the Darling Downs. It is a fairly useful fodder of a rather coarse sort for cattle.

"Cape Cotton."

H.C. (Crow's Nest)—

The specimen is *Gomphocarpus fruticosus*, variously known as "Cape cotton," "wild cotton," "milky cotton," and "white cotton." It is a very common weed in parts of Queensland, particularly on scrub areas, where it is very common as secondary growth. Cattle usually avoid it. It belongs to a dangerous family (Asclepiadaceae) which contains many poisonous plants, and it has always been regarded as definitely harmful to stock. Feeding tests carried out at Yeerongpilly have mostly yielded negative results, except in one case, when a sheep died, exhibiting post-mortem symptoms as follows:—"Slight congested areas along the alimentary tract, some hæmorrhages under pleura, congestion in vessel of heart. Trachea and bronchi slight congestion. Parenchymatous organs slight congestion."

"Wild Gooseberry."

M.D.O'D. (Lowood)—

The specimen is a species of North American Ground Cherry or Wild Gooseberry, *Physalis subglabrata*. This is a perennial species of gooseberry, propagated not only by seed but also by underground stems, which, when broken up, are capable of forming fresh plants. The plant has been established in Queensland for some years, but does not seem to have spread very rapidly. It is, however, possible that it may become a bad weed pest if not checked, and eradication should be attempted wherever possible. Constantly cutting off the new green shoots in order to starve the underground portions will eventually exhaust the plant in a small area. This would have to be done probably at least once every fortnight at the least for some little time. Plants like this are usually susceptible to poisoning by weak arsenical solutions, which, however, are difficult to use where stock are depastured.

"Coolibah Grass."

A.B.H. (Noondoo)—

The specimen is Coolibah Grass, *Thellungra advena*. This grass is sometimes called Coolibah Mitchell, although we do not like this local name, as the grass is not related to the Mitchell grass proper. It is also sometimes called "never-fail," a name applied, however, to a number of grasses in Western Queensland. We were very interested in your remarks on it, as reports on its fodder value in Queensland are rather conflicting. The grass has rather an interesting botanical history, and was first named from refuse from a dump outside woollen mills in Switzerland, and was not recognised in Australia until comparatively recently, having been confused with a much inferior sort.

Bamboo.

C.R.A. (Jambin)—

If you want a big bamboo, the common bamboo of Queensland is *Bambusa arundinacea*. You may probably obtain offshoots suitable for planting of this from Mr. H. G. Simmons, Curator, Botanic Gardens, Rockhampton. It would be as well to obtain the price from him before ordering. If you only want a smaller bamboo, such as the one used for fishing rods, the Black Bamboo, *Phyllostachys nigra*, would be satisfactory. A plant sometimes called Bamboo in Western Queensland is *Arundo donax*, the Spanish Reed. This grows well from cuttings or clumps, and is very useful as a windbreak, about 10 to 12 ft. high. It is sometimes planted with good effect around earth tanks.

White Passion Vine.

J.M.D. (Yeppoon)—

The specimen is the White Passion Vine (*Passiflora alba*), a native of Brazil, but now naturalised in Queensland. It is abundant in some parts of South-eastern Queensland, especially at Tamborine Mountain and around Beaudesert. Feeding tests show that it is poisonous to stock, but cattle have to eat great quantities of it before ill-effects are noticed. The fruits are not known to contain any poisonous or harmful properties, but have rather an unpleasant flavour, if we remember rightly.

Plants from Oakey District Named.

K.E.V. (Crosshill, via Oakey)—

1. *Chenopodium triangulare?* Fish Weed, a very common plant in Queensland. Stock eat it readily enough, particularly when it's dying off, but it gives an objectionable fishy flavour to milk and cream, hence the local name.
2. *Erigeron linifolius,* Horse Weed.
3. *Solanum ellipticum,* Potato Bush.
4. *Myoporum debile,* a procumbent plant fairly common, but for which we have not heard a local name.
5. *Helichrysum apiculatum,* Small Everlasting.
6. *Indigofera* sp., a species of indigo. This plant should be distinguished from the common Darling Pea, of the Darling Downs and parts of New South Wales, which also is frequently called Indigo.
7. *Ruellia australis,* a plant for which we have not heard a local name.
8. *Calotis lappulacea.* The seed-heads form nasty burrs, and are one of the common "bindy-eyes" of Queensland. We have also heard the plant called "Bogan Flea." The seeds get into clothing, blankets, and are rather a nuisance.
9. *Ajuga australis,* Australian Bugle.
10. *Oxalis corniculata,* Wood Sorrel. This plant is very common in Queensland and is distributed from the coast to the interior. It is very abundant frequently in brigalow country, and is sometimes mistaken for a clover. It does not belong to the Clover family, however.
11. *Evolvulus alsinoides,* a plant of the Convolvulus or Morning Glory family.
12. *Verbascum virgatum,* Twiggy Mullein, a native of the Mediterranean region, probably introduced as a garden plant, now quite common in Queensland, but not a particularly bad weed.
13. *Gnaphalium japonicum,* Cud Weed.
14. *Chenopodium carinatum,* a little plant of the Saltbush family, for which we have not heard a local name.
15. *Boerhaavia diffusa,* Tar Vine.
16. *Zornea diphylla,* a legume for which we have not heard a common name. It is very common in Queensland pastures, and is generally regarded as being good fodder.

You did not say whether you kept duplicates, so the specimens are being returned to you under separate cover. The usual plan is to number each specimen, retain duplicates similarly numbered, when names corresponding to numbers will be returned.

Glycine Pea, Sweet Melilot—Two Useful Plants.

(E.W.B. (Atherton)—

1. *Glycine tabacina,* Glycine Pea, a native plant with a wide distribution in Queensland. It is a legume, and is generally looked upon as rather a useful plant in the mixed native pasture.
2. *Melilotus alba,* Sweet Melilot or White Melilot. This plant has been spoken highly of as a fodder at different times, but never seems to have taken on much in Australia. Two forms occur—an annual and a biennial form. It is looked on as a good honey-producing plant. We have had reports that it has withstood fairly dry conditions in Northern Queensland.

A "Wild Lucerne."

W.H.S. (Quilpie)—

The specimen is *Psoralea patens,* a native plant for which we have not heard a common name, other than "wild lucerne"—a name applied, however, to several leguminous plants in Queensland. The genus Psoralea contains about a dozen species, some of which are regarded as excellent fodder for stock. One of them is known as Urvine or Herb-vine in the Northern Territory. It is not a vine, but grows exactly like your species. Mr. A. J. Cotton once wrote us that this Northern Territory one was abundant on the flooded country from which the best bullocks come. We should say that Psoraleas are good fodder, but both the one you sent and the Northern Territory one referred to we have seen very frequently in quantities and left quite untouched by stock. It may be that stock have to acquire a liking for the plants.

Rural Topics

Meat for the Troops—How the Army Ration Originated.

The modern ration for soldiers only dates from the eighteenth century. The originator of the army ration was Frederick the Great, who realised the importance of proper feeding of the men who had to do the fighting. He organised a corps of foragers—known in the A.I.F. as "scroungers"—and their job was to go around the country gathering all available provisions. They also had to arrange for a "balanced ration"—that is the actual giving out of definite portions of various kinds of food to each soldier, either on a daily or weekly scale.

Much of Frederick's success as a general was because of his careful organisation for feeding his troops. Likewise, Wellington won many of his victories because he paid attention to the food supplies of his army. In fact, it was a boast of Wellington that many could lead troops, but that he alone could feed them.

Napoleon was, as everyone knows, the author of the famous phrase: "An army marches on its stomach." As a matter of fact, it was the experience gained in the Napoleonic wars which formed the basis of the modern system of meat packing and distribution.

The development of modern industrialism had not gone far, however, when Napoleon astounded the world by his ability not only to move troops with remarkable speed from one field of action to another, but also to obtain the necessary supplies even when far away from his base.

Washington had the same ideas in the American War of Independence. Nevertheless, organised supply of food to soldiers in the field was not on a really satisfactory basis in the United States until the World War. In the Civil War, the armies lived on the country around where they were fighting.

The development of freezing and canning and other forms of preservation—especially of meat—as was so near perfection in the last war, has made all the difference to the fighting soldier and those whose job it is to "keep the tucker up to him."

To feed the modern army—especially when a million men may be mobilised at the one time—requires tremendous organisation. The British Army authorities have had long experience in army equipment and supply, and that was why, no doubt, we only seemed to go short in the last war when the ration carrier was "knocked."

Meat has always been the foundation of the soldier's diet, but it has been provided by various means at different periods. In the old days—back to the time of Alexander the Great and Julius Caesar—farmers had to feed invading troops as well as fight them, but to-day meat for the troops comes out of a tin or a modern refrigerator. The great problem is to keep supplies up to them and that is how the producers of Queensland, as well as those of the rest of the Empire, will bring victory to the arms of the Allies.

Britain's War Time Agricultural Policy.

In all walks of life, war time conditions must differ from those of peace, although in various degrees and directions. It is inevitable that some must bend their energies to the more strenuous endeavour, and some may endure the greater sacrifices. That is what the farmers of the Old Country are already finding out after not much more than eight months of war.

But both strenuous endeavour and greater sacrifices are being accepted with characteristic cheerfulness by the British farmer who realises the futility of speculating on what might have been.

Britain's war time agricultural policy is based on a programme of ploughing up grass land, the sole aim of which is to reduce the Old Country's dependence on imported supplies of foods for both man and animal. The immediate object underlying this is to free shipping for other war time services. In all branches of farming, and particularly in regard to livestock, the British farmer is using his knowledge and experience to meet abnormal conditions. He has been asked for an effort and he is responding. Some have cheerfully adopted farming practice more or less strange to them. They are doing their utmost, forgetting any opinions about what might have been, and thinking only of what is.

Another Shearing Achievement.

Here is another remarkable shearing achievement, this time from New Zealand. On Waipari Station recently, a Maori shearer averaged 315 sheep a day for a six-day tally. This is claimed as a Hawkes Bay record for a six days' shearing tally. The same shearer also put up a Hawkes Bay record two seasons ago. His peak day's tally this season was 330 sheep.

A very fine effort, but we have seen no details as to the condition of the sheep or their fleeces and other circumstances in which it was accomplished.

Producer Gas Units on the Farm.

Because of the rise in the price of motor spirit, and a possible war time restriction, much interest is being taken by the man on the land in the possibilities of producer gas units for farm work. Here is some information of especial usefulness to all concerned.

Savings of more than 70 per cent. in fuel costs have been reported by New South Wales farmers who harvested wheat last season with producer gas-driven units.

This information has been given by the Producer Gas Committee appointed by the New South Wales Government. The committee visited the Parkes district recently and interviewed wheat farmers who are using tractors equipped with producer gas plants.

Evidence obtained shows that operating on full load a saving of over 70 per cent. in the fuel costs is made by using producer gas. This saving is usually sufficient to pay for the cost of installation within a period of one year.

On an average yield of about twelve bushels of wheat to the acre, it was found that the cost of tractors operating on liquid fuel was approximately fivepence a bushel; operating on charcoal the cost was a penny-ha'penny.

The number of tractors in New South Wales is about 13,000, approximately 100 of which are operated on producer gas. It is believed that there will be many conversions when the savings possible thereby are realised.

It is regarded as essential, however, that adequate supplies of fuel should be readily available and that producer units should be of an approved type. Furthermore, it is important, as with all other mechanical equipment, that there should be proper maintenance. Provided that the plant is efficient and proper care is given, engine wear would be less than is the case when other fuels are used.

A decided advantage of charcoal gas was that because of the low cost of power per acre, farmers were willing to give the workings to their soil necessary to ensure the highest yields.

It has been found during periods of low prices that many farmers using tractors try to reduce costs by neglecting to cultivate, with the result that yields do not come up to expectations. It is evident, therefore, that a cheap fuel results in more efficient farming.

As a matter of fact, charcoal and producer gas equipment for farming purposes should not be regarded either as experimental or for emergency purposes, but rather as a means worth adopting permanently in the interests of economical working of the farm.

An Outsize in Churns.

A giant butter churn which makes nearly 6,000 lb. of butter in one churning was an outstanding exhibit in the engineering court at the New Zealand Exhibition. The churn was made in New Zealand of kauri pine. Its capacity is 2½ tons of butter in a single churning of less than two hours.

"Breeding Standards."

Dr. John Hammond, of the animal breeding station at the Cambridge University School of Agriculture—he is remembered as a distinguished visitor to Queensland last year—describing his work recently, said that he had succeeded in breeding a "standard" rabbit which, no matter how it is mated within its breed, will produce the same sized litter with the same coloured eyes and fur, and with always the same proportion of males, and which show the same weight increases in the same length of time—if not troubled by disease. Now he hopes to supply the same principles to pig breeding for the purpose of trying to evolve a "standard" pig.

That would be "rationalising" the pig industry with a vengeance.

New Sheep-Blowfly Dressing.

Graziers troubled with the blowfly problem will welcome a report of tests carried out at the McMaster Laboratory (New South Wales) which have given very satisfactory results.

The dressing known as C.B.E. contains boracic acid and camphor oil, and kills both maggots and flies which come in contact with it.

After trial under laboratory conditions, the dressing was subjected to a series of practical field tests under conditions favourable to fly-strike, especially crutch-strike, which covers about 90 per cent. of the affected ewes.

So that the tests might be of the utmost practical value, they were carried out on a number of properties in North-western New South Wales, not far below the Queensland border, and Southern and Central Queensland, covering a line running north and south for 600 miles where fly-strike is usually prevalent. The tests, which lasted from the autumn of 1938 to the autumn of last year, were made by graziers in collaboration with the science men.

Results, as a whole, are regarded as satisfactory. Of 140 sheep treated in one trial, only nine were restruck within fourteen days, most of these being on one property where an exceptionally severe fly attack was experienced.

Observations on the incidence of crutch-strike in the course of other field trials suggest that the restruck sheep might be of a highly susceptible type and very difficult to protect from restrike. To check this, a special trial was carried out at Walgett on sheep whose fly-strike record for the previous eighteen months was known. The results of this trial were similar to those on the property where nine sheep were restruck in a fortnight. All were very wrinkly sheep, the crutches of which were always damp, even when the wool was closely shorn, and the restrikes occurred on what was virtually bare, damp skin. In all these cases, the struck area outside the damp portion healed cleanly and quickly.

The new dressing was very easy to apply. It was found that all full-grown flies coming in contact with the dressing died instantly. Strike wounds were found to heal rapidly, and there was no evidence that the dressing had any harmful effect on either the skin or the wound. The wool remained free and did not become matted after treatment.

The dressing has not yet been available to graziers for large-scale tests under everyday conditions, as the war has held up imports of camphor oil. However, early shipments are due very soon. The dressing will then be manufactured locally, so that all sheepmen who are interested will be able to test it for themselves.

Thinking Out New Ideas for British Farmers.

The world is governed by ideas, and it is a very short-sighted farmer who is afraid of a new notion. A new war-time development in Britain is a sort of agricultural "C.I.D."—a "Clever Ideas Department," and it has the blessing of the British Minister for Agriculture. Its official title is "Special Inquiries," and it has a staff of four. Its business is to think of ideas which can be used to promote the food production campaign and to follow up any suggestions which may come from official sources and from unofficial sources.

At the present time this new department is working on a "waste not want not" programme, which has two objects—to see that nothing is wasted that could be profitably used on farms, and to see that the fullest possible use is made of the by-products of the farms on the farms.

Hundreds of suggestions which have been sent to the British Ministry of Agriculture since the war began have been referred to the new department. Few, however, have come from farmers.

"For the present," said one of the staff recently, "we are not anxious to get any more ideas from the general public. We have had one or two useful suggestions, but the rest have been either impracticable or just bunk. Ideas from practical farmers will always be welcomed, however." Some people, the official added, had offered to sell inventions.

Working in close touch with the new department is the Salvage Department of the Ministry of Supply. Between them they are investigating such matters as the conversion of town refuse into farm manure, the utilisation of factory wastes and by-products, and the disposal of "swill" from army camps for pig feeding.

Farm Notes

JUNE.

THE wheat planting season normally extends from April to July, with the main Darling Downs sowing during June. Well-prepared fallows should contain enough moisture to permit of sowings after light showers only, but on recently ploughed lands it will be necessary to await substantial rains or commence sowing dry when the surface soil has dried out sufficiently to avoid the malting of grain. Farmers unfamiliar with the characteristics of the different varieties of wheat should remember that, in general, early-maturing varieties should be sown late, and slow-maturing varieties sown early.

Of the varieties in general cultivation at present, Florence, Novo, and Seaspray are early maturing, while Currawa and Cleveland are slow maturing.

All others are classified as medium, early, or mid-season, with little difference in the number of days taken to mature under identical conditions.

All seed wheat should be treated for the prevention of ball smut, using copper carbonate or either of the mercury dusts "agrosan" or "ceresan."

Where dry conditions have prevented the earlier seasonal sowings of oats, barley, wheat, field peas, and other field crops, there is still time to profit by so doing, choosing early-maturing varieties which will make satisfactory growth before the normal warm, dry spring conditions commence.

With all fodder crops for grazing, greater value is obtained from a number of small paddocks which may be fed off in rotation.

Land intended for maize should now be ploughed to a depth of at least 9 inches, and allowed to lie in the rough until early spring, the action of frost and rain having a mellowing effect on the soil.

Paddocks set aside for the July and August planting of potatoes should also receive attention, as adequate preparation of land is one of the most important factors in successful agriculture.

Farmers desirous of destroying useless green timber or undergrowth with arsenic pentoxide are reminded that the April to July period is probably the most effective time for carrying out this work. Frill ringing and poisoning of trees with a 20 per cent. solution of arsenic pentoxide has proved very satisfactory, combined with the felling and swabbing of butts to destroy suckers and undergrowth. Shelter belts and shade trees should always be reserved when planning poisoning or ring-barking operations.

The winter is generally the best time to undertake the laborious work of ringbarking, clearing, fencing, and roadmaking.

Recently harvested maize grain should be allowed to dry out completely before being shelled, otherwise heating in the bags may occur.

Grain not required for immediate use or sale can be stored indefinitely at no great cost, other than the initial purchase of tanks and occasional fumigation to destroy weevils.

EASY SCRUB-FEEDING.

Only people without thought cut down useful fodder trees; others merely lop off the top branches. Both way are wasteful, and regrowth is a matter of months, or even years. The most economical method is to flail the leaves off. By stripping the foliage in this way, the twigs remain to make new growth within a few weeks, when the process can be repeated.

Orchard Notes

JUNE.

THE COASTAL DISTRICTS.

IF the weather is dry, citrus orchards should be kept in a good state of tilth and winter green manure crops turned under. Old worn-out trees may be dug out and burnt. Custard apples will be ripening more slowly as the nights get colder. If the weather becomes very cold, or if immature fruit is sent South, the fruit is apt to turn black and become valueless. Grade custard apples carefully, and pack in cases holding a single layer of fruit only for the Southern markets.

The pineapple plantation should be shallow worked and kept free from weeds. The fruit takes longer to mature at this time of the year, consequently it may remain on the plant until partly coloured before gathering for the Southern markets.

Banana plantations also should be kept worked and free from weeds, especially if the weather is dry, as a severe check to the plants now may mean small fruit later on. Bananas should be allowed to become full before the fruit is cut. The necessity of proper handling, grading, and packing of the fruit should be kept in mind. Land intended for planting with bananas or pineapples during the spring should be prepared now.

Strawberries require constant attention, and unless there is a regular and abundant rainfall, they should be watered regularly. Where not already done, vineyards should be cleaned up ready for pruning. It is, however, too early to prune or to plant out new vineyards.

THE GRANITE BELT, SOUTHERN AND CENTRAL TABLELANDS.

ALL kinds of deciduous fruit trees are now ready for pruning, and this is the principal work of the month in the orchards of the Granite Belt. Thin out young trees properly, and cut them back hard. Many good trees are spoilt by insufficient or wrong pruning during the first three years. If in doubt as to the correct method of pruning consult the district instructor in fruit culture. In old orchards, do not have too much bearing wood; cut out severely, especially in the case of peaches. Planting may be commenced where the land is ready, as early-planted trees become well established before spring, and thus get a good start. When land is intended for planting this season, see that it is well prepared and well sweetened before the trees are put in, as young trees seldom make a good start when planted in sour or badly prepared land.

Slowly acting manures—such as bonedust, meatworks manure, or phosphates—may be applied now, as they are not liable to be washed out of the soil, and will be available for the use of the trees when they start growth in spring. Lime may also be applied where required. Badly drained land should be attended to, as no fruit trees will thrive with stagnant water lying round their roots.

On the Downs and Tableland all kinds of fruit trees may be pruned now, and vines also may be pruned in any district where there is no risk of late frosts. Prunings should be gathered and burnt, and the vineyards ploughed up and well worked to reduce the soil to a good state of tilth, so that should rain come it will absorb all that falls. The moisture can be kept in the soil by cultivation afterwards.

Citrus fruits will be at their best in the western districts. The trees should be watered if they show signs of distress; otherwise all that is necessary is to keep the surface of the land well worked. All main-crop lemons should have been picked by this time.

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.

CLOTHING BABY.

OUR talk this month is to be about baby's clothing, because in our work of keeping baby happy and comfortable and well, the manner in which he is clothed plays quite a big part, and one to which too little attention has been paid. We do not nowadays find babies clad in the long, heavily-trimmed robes and layers of tight binders beloved of our grandmothers, but there are still many mothers and mothers to be who need to learn what clothing baby should wear and why.

Purpose.

The real purpose of clothing is to protect the body from injury, heat, and cold, and baby should only wear enough clothes to keep him nicely warm. To pile layer after layer of superfluous clothing on a child is still a common fault amongst over-anxious mothers, who are afraid of the new baby "taking cold." The amount of clothing a baby should wear depends not on the season of the year, but on the temperature of the air, and the general condition of the child. It is sometimes possible to leave off some of baby's clothing on a particularly warm day in autumn or spring, and a cool change in summer may make it necessary to add a woolly. On the very hot days of our Queensland summer baby is often happiest clothed only in a singlet and napkin. A robust, vigorous child will require less clothing than one who is inactive, wasted, or ill. A premature or underweight baby requires special care in order to maintain his body temperature.

Comfort.

Baby's clothes, then, should be warm and light, and what weight there is should hang from the shoulders. Heavy clothing will tend to limit the child's movements and make him easily tired, and if too closely woven, will not allow free circulation of air. A baby may develop a skin rash from wearing too heavy or too many clothes. It is possible for loss of weight to occur, especially in small or weakly babies, from wearing garments that do not keep them warm. Coldness or blueness of the hands and feet and blueness of the lips indicate that the child is insufficiently clad. All garments should fit loosely. Tight elastics and strings should not be used. Plenty of room should be allowed at the armholes so that baby may use his arms freely and all seams should be well finished off to prevent chafing of the delicate skin. Too much material between the thighs should be avoided and waterproof material should not be used as it prevents evaporation of sweat and keeps the skin too moist. Lace edgings, especially round the neck, and too many bows and ribbons can very easily cause irritation and discomfort. For a number of reasons the best place to display pretty lace or embroidery is at the hem of babys frock, not on the bodice.

Economy.

The baby of to-day, especially in a climate like that of Queensland, needs but few garments. If these are made of good materials that wear and wash well, replacement becomes unnecessary. The most economical way of arranging a baby's wardrobe is to have the garments made in such a way that they can be easily adapted to fit either the new baby or the child of ten or twelve months. This is easily done by the addition of a few hand-made tucks in the shoulders, because the difference in the size is usually only in the width of the body and the length of the sleeves. As a baby gets older he needs shorter clothes, and the ones he wore at three weeks will probably be the right length at nine months. Hand-knitted garments cost very little and a number of books can be obtained which will help a mother with her knitting. Light wool or wool and cotton mixtures are more economical than flannelette which is made from cotton and ceases to be warm when the fleecy pile wears off. In addition, it is heavy and does not dry quickly. Of the summer materials fine linen or cotton voile wash and wear well and are cool, and silk is useful, but, of course, cannot be boiled, and is liable to discolour. The rayon materials are suitable, as they can be boiled, but they are inclined to crush easily, and do not usually wear as well as cottons.

Making and Laundering.

Although some washing has to be done every day with a baby in the home, we must aim at making the laundry work as light as possible. How many women when the day's work is finished have to spend the evening ironing little garments which crease almost as soon as they are put on again. Simple magyar patterns, easy to wash and quickly dried and ironed, are the best foundation for baby's layette. Even the mother unused to sewing can make them with very little trouble and with a few simple directions to follow can keep them looking "good as new" after washing. The first year of motherhood should be a joy not a time of unnecessary work and worry.

In our article next month we shall describe baby's outfit in detail.

You may obtain information on all matters concerning infant and child welfare by visiting the nearest Maternal and Child Welfare Centre (Baby Clinic), or by writing to the Sister in Charge, or by communicating direct with the Maternal and Child Welfare Centre (Baby Clinic), Alfred street, Fortitude Valley, N.1., Brisbane.

IN THE FARM KITCHEN.

CITRUS FRUIT JAMS.

Grapefruit Marmalade (1).

Grapefruit as required, to each pound allow 1½ pints of water and 1½ lb. of sugar.

Wipe and weigh the grapefruit and put it into a preserving pan with the water. Cover with plates so as to keep them under the water, bring to the boil, and boil gently for about one and a-quarter hours, until rinds are tender. Then leave until the next day. Unless using an enamel pan, it is advisable to turn the fruit and water into a basin when cool, as, if left in an aluminium pan for any length of time, it will discolour it. Take out the fruit and drain it, then cut into quarters and scrape out the pulp and soft pith. Rub this through a sieve; it will nearly all rub through with the exception of the pips. Measure the water in which the fruit was boiled, and, if it has been reduced to less than half, make up to half with water. Return it to the pan with the pulp and sugar, also the peel sliced thinly. Boil the pips in just a little water for about half an hour, then strain and add. Cook slowly until the sugar has dissolved, then bring to the boil and boil until it will jelly when tested, keeping it stirred and skimmed as required. It will probably take about one and a-half hours.

Grapefruit Marmalade (2).

Take 1 grapefruit, 1 lemon, 1 bitter orange, 1 sweet orange.

Wash and dry the grapefruit, oranges, and lemon. Peel as thinly as possible. Remove and throw away all white pith. Slice the fruit thinly, gathering up all pips into a small muslin bag, and catching any juice that happens to fall in the slicing. Put the pulp and finely-shredded peel into a basin, after measuring. Cover with three times the quantity of cold water and stand till next morning, covering with a cloth. Next morning put peel, pulp, water, and bag of pips into a preserving pan. Bring to the boil and boil two minutes. Return to the basin and cover. Repeat this process three days in succession, then throw out the bag of pips. Measure, add an equal quantity of sugar, and boil till the marmalade jellies when tested. Pot and cover.

Grapefruit Marmalade (3).

To 1 grapefruit, add 1 lemon and 1 orange, slice all very finely.

To every pint of pulp add 3 pints of water, soak all night, next day boil for fifteen minutes, then take off, leave again till next day; then add 1 lb. of sugar to each pint of pulp. Boil till syrup jells when tested.

Old English Style Marmalade.

Take 2 lb. Seville oranges, 4 pints water, 6 lb. sugar, juice 2 lemons.

Remove orange pips and place in a muslin bag. Tie with string. Squeeze juice from oranges and lemons into a saucepan. Shred and put orange-peel into the saucepan with the juice. Add water and bag of pips. Now add sugar. When sugar is dissolved, boil till a little sets when tested on a cold saucer. Leave standing in the saucepan for five minutes. Put into dry, warm jars and cover.

Seville Orange Marmalade.

Seville oranges as required. Allow 1 lemon to 9 oranges, allow 2 pints of water to 1 lb. of fruit.

Remove the peel from the oranges and lemons and cut it into fine shreds. Slice the fruit thinly, removing the pips. Cut the slices into four and put them into a basin with the peel and water to soak overnight. Next day turn the fruit into a preserving pan and boil until it is tender. Leave it until it is cold, then weigh it and allow an equal quantity of sugar. Let the sugar dissolve slowly, then bring the marmalade to the boil and boil it until it will jell when tested.

NOTE.—If the preserving pan is weighed before any cooking is done, the weight of the cooked fruit and water can be obtained quite easily.

Seville, Orange, and Lemon Marmalade.

Take 6 Seville oranges, 2 lemons, 2 sweet oranges; weigh them and allow 2 lb. sugar and 2 pints water to 1 lb. fruit.

Wipe the oranges and lemons and weigh them. Cut them into quarters and remove the pips. Put the pips into a basin with half a pint of cold water, and leave them to soak for a few hours; then strain off the water, and add it to the oranges and lemons. Slice the orange and lemon quarters very thinly, cutting pulp and rind together. Put them into a large pan and add water in proportion, less the half pint added from the pips. Leave the fruit to soak for about twenty-four hours, then boil it gently until the rinds are quite tender. Leave it soaking again until the next day, then add the sugar in proportion. Bring the marmalade slowly to the boil, and boil for about one hour and a-half or until it will jelly.

Orange Ginger Marmalade.

Take 6 lb. sweet oranges, 6 pints water, 6 lb. sugar, ¼ lb. lump ginger.

Wipe the oranges, peel them, and divide them into quarters, removing the pips, as you do so. Put the peel through the mincer, then put it into a preserving pan with the water and orange quarters. Bruise the ginger, tie it in muslin, and add it. Bring it to the boil, add the sugar and, when dissolved, boil the marmalade until it will jelly when cold, keeping it stirred and skimmed as required.

Orange and Rhubarb Marmalade.

Take 4 lb. of rhubarb (when cut up), 2 lb. sweet oranges, 1 lemon, 5 lb. sugar, 1 pint water.

Wipe the oranges and peel them. Put the peel in a pan with sufficient water to cover it well, and boil it gently until it is tender, adding more water if it is required. When the peel is ready, drain off the water and save it. Shred the peel finely. Remove the green leaves from the rhubarb, wipe the sticks and cut them into even-sized pieces. Cut up the oranges and remove the pips. Put the orange pulp into a preserving pan with the prepared rhubarb, the shredded peel, sugar, lemon juice, and grated lemon-rind, and a pint of the water in which the orange-peel was boiled. Cook the marmalade slowly until the sugar is dissolved, then bring it to the boil and boil it till it will jelly when cold. Pot and cover in the usual way.

Sweet Orange Jam.

Take 3 oranges, 3 lb. sugar, 3 pints water (boiling).

Cut the oranges very thinly, pour the boiling water over. Allow to stand till next day. Put the orange and liquid into a preserving pan and boil until the rind is tender, add the sugar, and boil again till it jells when tested.

Lemon Marmalade.

Take 12 lemons (3 lb. in weight), 7½ pints water, allow 1 lb. sugar to 1 lb. pulp.

Wipe the lemons and cut them in quarters.

Take out the pips and put them into a basin with 1 pint of the water and leave to soak for a few hours. Slice the lemon quarters very thinly. Put them into a preserving pan with the remainder of the water. Add also the strained water from the pips. Let this stand for about twenty-four hours. Then boil it gently for about one to one and a-half hours until the rinds are quite tender. Leave it to stand until next day, then weigh it and add the sugar in proportion. Bring to the boil, and boil for about one hour, or until it will jelly.

Lemon Jelly.

Take 12 lemons, 4 oranges, water, sugar.

Wash dry, and cut up the fruit roughly. Remove all the pips. Cover with ten pints of water (cold) and stand for twenty-four hours. Boil for two hours. Strain. Add sugar, allowing one pound of sugar to each pint of juice. Boil rapidly for ten minutes. Soak the pips in some of the water, and add the water to juice. Strain through muslin. Boil till the jelly sets when tested on a cold plate. Pot and cover at once.

Mandarin Cheese.

Take 2 lb. mandarins, 3 pints water, 3 lb. sugar, juice 2 lemons.

Wipe the mandarins and grate the skins lightly, then put the mandarins into a pan with the water, and boil them gently until tender. Drain them and cut them up in quarters and scrape out the pulp. Mince the pith in a mincer, then rub it through a sieve with the pulp. Boil the pips in about half a pint of water until it is reduced to a quarter of a pint. Strain this water into the water in which the mandarins were boiled, adding also the sieved pulp and pith, grated rinds, sugar, and lemon juice. Cook the mixture slowly until the sugar is dissolved, then bring it to the boil and boil it till it will jelly when cold.

RAINFALL IN THE AGRICULTURAL DISTRICTS.

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

Divisions and Stations.	Average Rainfall.		Total Rainfall.		Divisions and Stations.	Average Rainfall.		Total Rainfall.	
	Mar.	No. of years' records.	Mar., 1940.	Mar., 1939.		Mar.	No. of years' records.	Mar., 1940.	Mar., 1939.
North Coast.	In.		In.	In.	*South Coast—contd.*	In.		In.	In.
Atherton	8·82	39	29·09	19·79	Gatton College ..	3·27	41	4·26	12·73
Cairns	17·98	58	41·22	27·81	Gayndah	3·02	69	4·32	4·08
Cardwell	15·74	68	22·42	21·76	Gympie	6·20	70	6·81	7·14
Cooktown ..	15·31	64	25·68	28·99	Kilkivan	3·85	61	5·26	4·00
Herberton ..	7·86	54	13·70	21·65	Maryborough ..	5·95	69	8·88	9·19
Ingham	16·10	48	25·62	27·55	Nambour	9·53	44	11·74	18·36
Innisfail	26·70	59	44·06	40·42	Nanango	3·35	58	4·63	2·87
Mossman Mill ..	18·16	27	38·97	35·43	Rockhampton ..	4·42	69	5·68	8·31
Townsville ..	5·71	23	5·27	6·50	Woodford ..	7·79	53	10·38	11·25
Central Coast.					*Central Highlands.*				
Ayr	6·37	53	3·13	5·31	Clermont ..	3·05	69	5·41	2·75
Bowen	5·79	69	4·08	3·60	Gindie	2·61	41	..	3·65
Charters Towers ..	3·75	58	3·80	2·94	Springsure ..	2·93	71	4·77	4·76
Mackay P.O. ..	12·21	69	16·28	14·08	*Darling Downs.*				
Mackay Sugar Experiment Station	11·24	43	14·94	10·34	Dalby	2·72	70	3·25	4·58
Proserpine ..	12·48	37	12·65	9·82	Emu Vale ..	2·38	44	2·69	7·28
St. Lawrence ..	5·27	69	15·55	4·83	Hermitage ..	2·08	33	..	..
South Coast.					Jimbour	2·58	52	3·32	2·91
					Miles	2·70	55	3·73	3·80
Biggenden ..	3·99	41	6·17	3·12	Stanthorpe ..	2·62	67	2·57	5·00
Bundaberg ..	5·30	57	7·70	8·40	Toowoomba ..	3·77	68	4·44	7·14
Brisbane	5·72	88	8·72	15·72	Warwick	2·53	75	3·60	8·61
Caboolture ..	7·70	53	9·90	17·79	*Maranoa.*				
Childers	4·84	45	8·23	9·00					
Crohamhurst ..	11·00	47	17·15	18·50	Bungeworgorai ..	1·81	26	..	2·74
Esk	4·71	53	5·36	6·90	Roma	2·68	66	3·04	6·62

A. S. RICHARDS, Divisional Meteorologist.

CLIMATOLOGICAL TABLE—MARCH, 1940.

COMPILED FROM TELEGRAHHIC REPORTS.

Districts and Stations.	Atmospheric Pressure, Mean 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	29·83	86	73	93	17, 18, 19	68	7, 8	2,568	23
Herberton	..	76	64	85	17, 18, 20	56	15, 16	1,370	24
Rockhampton	29·98	85	71	93	19	66	1	568	15
Brisbane	30·08	81	67	94	20	61	28, 30	872	14
Darling Downs.									
Dalby	30·09	82	60	89	20, 29, 30	52	1, 28	325	8
Stanthorpe	..	76	56	87	28	44	27	257	6
Toowoomba	..	77	62	85	20	55	1, 9	444	8
Mid-Interior.									
Georgetown	29·87	89	69	98	20	60	8, 31	652	10
Longreach	29·97	89	66	96	20	55	1	18	3
Mitchell	30·06	83	61	88	6, 7	51	28	319	4
Western.									
Burketown	29·87	90	74	99	3	65	1	850	8
Boulia	..	93	69	100	19	57	1	..	..
Thargomindah ..	30·01	96	68	101	6, 7, 8	57	22	..	..

ASTRONOMICAL DATA FOR QUEENSLAND.

TIMES COMPUTED BY A. C. EGLINTON.

TIMES OF SUNRISE, SUNSET, AND MOONRISE.

AT WARWICK.

	May, 1940.		June, 1940.		MOONRISE. May, 1940.	June. 1940.
	Rises.	Sets.	Rises.	Sets.	Rises.	Rises.
					a.m.	a.m.
1	6·18	5·20	6·37	5·3	12·40	1·53
2	6·18	5·19	6·37	5·3	1·31	2·47
3	6·19	5·19	6·38	5·3	2·21	3·39
4	6·19	5·18	6·38	5·3	3·11	4·32
5	6·20	5·17	6·38	5 3	4·3	5·27
6	6·21	5·17	6·39	5·3	4·53	6·22
7	6·21	5·16	6·39	5·3	5·48	7·17
8	6·22	5·15	6·39	5·3	6·41	8·9
9	6·22	5·15	6·40	5·2	7·34	8·59
10	6·23	5·14	6·40	5·2	8·28	9·47
11	6·23	5·13	6·40	5·2	9·22	10·32
12	6·24	5·13	6·41	5·2	10·13	11·15
13	6·25	5·12	6·41	5·2	11·1	11·56
						p.m.
14	6·25	5·11	6·41	5·2	11·48	12·39
					p.m.	
15	6·26	5·10	6·42	5·2	12·32	1·21
16	6·26	5·10	6·42	5·3	1·15	2·5
17	6·27	5·9	6 42	5 3	1·58	2 53
18	6·28	5·9	6.42	5·3	2·40	3·43
19	6·28	5·8	6·43	5·3	3·24	4·36
20	6·29	5·8	6·43	5·4	4·11	5 32
21	6·30	5·7	6·43	5·4	5·2	6·27
22	6·30	5·7	6·43	5·4	5·53	7·24
23	6·31	5·6	6·44	5·4	6·48	8 20
24	6·32	5·6	6·44	5·5	7·45	9·13
25	6·32	5·6	6·44	5·5	8·42	10 5
26	6·33	5·5	6·44	5·5	9·38	10·56
27	6·33	5·5	6·44	5·5	10·31	11·54
28	6·34	5·5	6·45	5·6	11·20	..
						a.m,
29	6·35	5·4	6·45	5·6	..	12·45
					a.m.	
30	6·35	5·4	6·45	5·6	12·12	1·31
31	6·36	5·3	..	..	1·3	..

Phases of the Moon, Occultations, &c.

7th	May.	● New Moon	10 7	p.m.
15th	,,	☽ First Quarter	6 51	a.m.
21st	,,	○ Full Moon	11 33	p.m.
29th	,,	☾ Last Quarter	10 40	a.m.

Apogee, 3rd May, at 9.0 a.m.
Perigee, 19th May, at 5.0 a.m.

On the 5th the greatest and the smallest of the planets will be nearest each other, Jupiter rising at 5 o'clock and Mercury half an hour later. By the 10th, the latter will pass Saturn below the western horizon. All three planets will be near the position where the Vernal Equinox occurred in the Northern Hemisphere, 550 B.C., still called "The First Point of Aries," although it is now westward of this point, in Pisces.

At nightfall on the 10th Mars, the crescent Moon and Venus will form an attractive sight above the western horizon. Mars, the lowest, will set at 8 p.m., the Moon about 8.30, and Venus nearly 10 minutes later.

Venus, ever the fairest and most effulgent among the planets, will on the 20th attain its greatest brilliancy—this on account of being in that half of its elongated orbit where it is nearest the Earth, between us and the Sun. When it arrives at, or very near, the point where it is exactly in line with Sun and Earth its dark half is turned towards us but on either side it is more or less illumined. At this time we see it as a beautiful crescent, with a telescope.

Mercury rises at 4.43 a.m., 1 hr. 35 mins. before the Sun, and sets at 4.25 p.m., 55 min. before it on the 1st; on the 15th it rises at 5.48 p.m., 1 hr. 38 min. before the Sun, and sets at 4.44 p.m., 26 min. before it.

Venus rises at 9.51 a.m., 3 hrs. 33 min. after the Sun, and sets at 8.1 p.m., 2 hrs. 41 min. after it on the 1st; on the 15th it rises at 9.42 a.m., 3 hrs. 16 min. before the Sun, and sets at 7.52 p.m., 2 hrs. 42 min. before it.

Mars rises at 9.18 a.m. and sets at 7.42 p.m. on the 1st; on the 15th it rises at 9.4 a.m. and sets at 7.24 p.m.

Jupiter rises at 5.14 a.m. and sets at 4.40 p.m. on the 1st; on the 15th it rises at 5.5 a.m. and sets at 4.19 p.m.

Saturn rises at 5.53 a.m. and sets at 5.11 p.m. on the 1st; on the 15th it rises at 5.5 a.m. and sets at 4.19 p.m.

6th June	●	New Moon	11 5	a.m.
13th	,,	☽ First Quarter	11 59	a.m.
20th	,,	○ Full Moon	9 2	a.m.
28th	,,	☾ Last Quarter	4 13	a.m.

Perigee, 15th June, at 1.0 a.m.
Apogee, 27th June, at 9.0 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.